MOTOROLA

QUANTAR™

Digital–Capable Station

For Conventional, *SECURENET*, *ASTRO*, 6809 Trunking, and *IntelliRepeater* Systems

VHF — 25W & 125W
UHF — 25W, 100W, & 110W
800 MHz — 20W & 100W
900 MHz — 100W

Instruction Manual

68P81095E05–B

COMMERCIAL WARRANTY
(STANDARD)

Motorola radio communications products are warranted to be free from defects in material and workmanship for a period of ONE (1) YEAR, (except for crystals and channel elements which are warranted for a period of ten (10) years) from the date of shipment. Parts, including crystals and channel elements, will be replaced and labor will be provided free of charge for the full warranty period. Thereafter purchaser must pay for the labor involved in repairing the product or replacing the parts at the prevailing rates together with any transportation charges to or from the place where warranty service is provided. This express warranty is extended by Motorola Communications and Electronics, Inc., 1301 E. Algonquin Road, Schaumburg, Illinois 60196, to the original purchaser only, and only to those purchasing for purpose of leasing or solely for commercial, industrial, or governmental use.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED WHICH ARE SPECIFICALLY EXCLUDED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

In the event of a defect, malfunction or failure to conform to specifications established be seller, or if appropriate, to specifications accepted by Seller in writing, during the period shown, Motorola, at its option, will either repair or replace the product or refund the purchase price thereof, and such action on the part of Motorola shall be the full extent of Motorola's liability hereunder.

This warranty is void if:

a. the product is used in other than its normal and customary manner;

b. the product has been subject to misuse, accident, neglect or damage;

c. unauthorized alterations or repairs have been made, or unapproved parts used in the equipment.

This warranty extends only to individual products, batteries are excluded. Because each radio system is unique, Motorola disclaims liability for range, coverage, or operation of the system as a whole under this warranty except by a separate written agreement signed by an officer of Motorola.

LICENSED PROGRAMS — Motorola software provided in connection with this order is warranted to be free from reproducible defects for a period of one (1) year. All material and labor to repair any such defects will be provided free of charge for the full warranty period, and SUBJECT TO THE DISCLAIMER IN BOLD FACE TYPE.

Non–Motorola manufactured products are excluded from this warranty, but subject to the warranty provided by their manufacturers, a copy of which will be supplied to you on specific written request.

In order to obtain performance of this warranty, purchaser must contact its Motorola salesperson or Motorola at the address first above shown, attention Quality Assurance Department.

This warranty applies only within the United States.

EPS–48759–O

FCC INTERFERENCE WARNING

The FCC Requires that manuals pertaining to Class A and Class B computing devices must contain warnings about possible interference with local residential radio and TV reception. This warning reads as follows:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial or residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

MOTOROLA

Commercial Government and
Industrial Solutions Sector

QUANTAR ™

Digital – Capable Station

for Conventional, *SECURENET*, *ASTRO*, 6809 Trunking, and *IntelliRepeater* Systems

VHF — 25W & 125W
UHF — 25W, 100W, & 110W
800 MHz — 20W & 100W
900 MHz — 100W

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1301 E. Algonquin Road, Schaumburg, IL 60196

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MODEL AND OPTION SELECTION PROCEDURE (INCLUDES MODEL/OPTION COMPLEMENTS)

The following equipment ordering scenario is used by the sales representative to equip a *Quantar* station with the proper hardware and firmware for specific system types and customer-defined options and features. The scenario is described here to explain the process and to show the structure and contents of the various options and models.

1

The sales model is T5365A (as translated from C99ED/001C).

NOTE: *The Sales Model includes only a TRN7795A Base Station Nameplate. Equipping the station with the proper modules is accomplished by ordering additional options, as described in the following steps.*

2

A System Family Option must be selected as follows:

System Type	Family Option	VHF	UHF	800 MHZ	900 MHZ
Conventional Analog	X597	✓	✓	✓	✓
Conventional Analog *SECURENET*	X598	✓	✓	✓	
Conventional *ASTRO* VSELP	X599	✓	✓	✓	
Conventional *ASTRO* CAI	X806	✓	✓	✓	
6809 Trunking Analog	X997	✓	✓	✓	✓
6809 Trunking *SECURENET*	X996	✓	✓	✓	
6809 Trunking *ASTRO* VSELP	X992	✓	✓	✓	
6809 Trunking *ASTRO* CAI	X900	✓	✓	✓	
SMARTZONE 6809 Trunking *ASTRO* VSELP	X989	✓	✓	✓	
SMARTZONE 6809 Trunking *ASTRO* CAI	X897	✓	✓	✓	
SMARTZONE *IntelliRepeater* Trunking	X999	✓	✓	✓	✓
SMARTZONE *IntelliRepeater* Trunking SECURENET	X998	✓	✓	✓	
SMARTZONE *IntelliRepeater ASTRO* VSELP	X990	✓	✓	✓	
SMARTZONE *IntelliRepeater ASTRO* CAI	X898	✓	✓	✓	

(Continued)

3 The following tables show the available power and band options.

VHF

Frequency Range \ Output Power	25W	125W
VHF High Band Range 1 (132–154 MHz)	Option X330AA	Option X530AA
VHF High Band Range 2 (150–174 MHz)		Option X530AB

NOTE: *Customer–specified frequencies which are in the 150–154 MHz range are automatically assigned to Range 2 by Order Processing* ***unless*** *one of the following options is ordered:*

X325 (125W only) *— Specifies Range 1 Exciter (overrides automatic assignment to Range 2) where the transmit frequency is between 150 and 154 MHz.*
X326 *— Specifies Range 1 Receiver (overrides automatic assignment to Range 2) where the receive frequency is between 150 and 154 MHz.*

These options are typically used to ensure that the transmit and receive frequencies are in the required customer range; this is required for use with a duplexer module.

UHF

Frequency Range \ Output Power	25W	100W	110W
UHF Range 1 (403–433 MHz)	Option X240AA	Not Available	Option X640AA
UHF Range 2 (438–470 MHz)	Option X240AB	Not Available	Option X640AB
UHF Range 3 (470–494 MHz)	Not Available	Not Available	Option X640AC
UHF Range 4 (494–520 MHz)	Not Available	Option X640AD	Not Available

800/900 MHz

Frequency Range \ Output Power	20W	100W
800 MHz	Option X250AA	Option X750AA
900 MHz	Not Available	Option X660AA

(Continued)

4

If no other options are selected, Motorola's Order Processing appends the appropriate standard options (based on power and frequency band) to complete the station equipment list. The tables below show the completed equipment lists for the available options.
If additional options are desired, they must be added to the initial order form. Step 5 lists the available options and the impact each has on the standard equipment configuration.

VHF

OPTION X330AA SELECTED IN STEP 3 (VHF Range 1; 25W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X330AA**	**VHF High Band Ranges 1 & 2; 25W Transmitter**
	TLD3110B	25 W Power Amplifier Module (VHF R1 & R2)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X131AA**	**Exciter Module (VHF High-Band Range 1)**
	CLD1270A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X333AA	**Receiver Module (VHF High-Band Range 1)**
	CLD1250A	Receiver Module (Board, Preselector, Hardware)
	CLN7334A	Receiver Module Front Panel
	TRN7799A	VHF/UHF Tuning Kit
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AB	**Power Supply Assembly**
	CPN1049B	265W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12")
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AD	**Blank Panels**
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12" Cabinet**
	THN6700A	12" x 20" Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12" Cabinet
	X436AA	**Instruction Manual**
	68P81095E05	*Quantar* Station Functional Manual

OPTION X330AA SELECTED IN STEP 3 (VHF Range 2; 25W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X330AA**	**VHF High Band Ranges 1 & 2; 25W Transmitter**
	TLD3110B	25 W Power Amplifier Module (VHF R1 & R2)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X131AB**	**Exciter Module (VHF High-Band Range 2)**
	CLD1280A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X333AB	**Receiver Module (VHF High-Band Range 2)**
	CLD1260A	Receiver Module (Board, Preselector, Hardware)
	CLN7334A	Receiver Module Front Panel
	TRN7799A	VHF/UHF Tuning Kit
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AB	**Power Supply Assembly**
	CPN1049B	265W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12")
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AD	**Blank Panels**
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12" Cabinet**
	THN6700A	12" x 20" Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12" Cabinet
	X436AA	**Instruction Manual**
	68P81095E05	*Quantar* Station Functional Manual

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VHF

OPTION X530AA SELECTED IN STEP 3
(VHF Range 1; 125W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X530AA** TLD3101F TKN8699A TRN7480A TRN7708A CHN6100A	**VHF High Band Range 1; 125W Transmitter** 125 W Power Amplifier Module (VHF R1) PA−to−Exciter RF Cable Station Interconnect Board (Backplane) PA Module Front Panel Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X131AA** CLD1270A CHN6100A	**Exciter Module (VHF High-Band Range 1)** Exciter Module (Board and Hardware) Anti-Vibration/EFI Screws (2)
	X333AA CLD1250A CLN7334A TRN7799A CHN6100A	**Receiver Module (VHF High-Band Range 1)** Receiver Module (Board, Preselector, Hardware) Receiver Module Front Panel VHF/UHF Tuning Kit Anti-Vibration/EFI Screws (2)
	X43AA CPN1047A CLN7261A CPN6086A CHN6100A	**Power Supply Assembly** 625W Power Supply (AC input; w/o battery chrg) Ferrite RFI Suppressor Front Panel, Dummy Charger Connector Anti-Vibration/EFI Screws (2)
	X621AY CLN1614A TRN7476A TKN8751A	**Station Control Module (SCM); Standard EPIC III** Station Control Module SCM Internal Speaker Internal Speaker Cable
	X222AB CGN6157A CHN6100A	**Front Panel (Station Control Module**) Station Control Module Front Panel Anti-Vibration/EFI Screws (2)
	X216AA CLN6955A TKN8731A CLN6816A	**Wireline Interface Module (WIM) (4−wire)** Wireline Interface Board WIM Cable RFI Suppressor
	C831AA TRN7479A	**Card Cage** Card Cage Assembly (12”)
	X142AA TRN7494A	**Duplex Interface Assembly** Duplex Interface (includes ant. connector bracket)
	X249AW TKN8753A TKN9126A	**RF Cabling** Receiver mini−UHF to N−type coax cable Transmitter N−type to N−type coax cable
	X187AA TRN7663A	**Domestic Power Cable** AC Line Cord
	X163AD TRN7696A CHN6100A	**Blank Panels** Dual Slot Wide Blank Panel Anti-Vibration/EFI Screws (2)
	X842AB CLN6885A	**Ethernet Termination Kit** Ethernet Termination Hardware
	X430AA THN6700A TTN5040A	**12” Cabinet** 12” x 20” Cabinet Grommet
	X362AA TBN6625A	**Packing** Packing for 12” Cabinet
	X436AA 68P81095E05	**Instruction Manual** *Quantar* Station Functional Manual

OPTION X530AB SELECTED IN STEP 3
(VHF Range 2; 125W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X530AB** TLD3102F TKN8699A TRN7480A TRN7708A CHN6100A	**VHF High Band Range 2; 125W Transmitter** 125 W Power Amplifier Module (VHF R2) PA−to−Exciter RF Cable Station Interconnect Board (Backplane) PA Module Front Panel Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X131AB** CLD1280A CHN6100A	**Exciter Module (VHF High-Band Range 2)** Exciter Module (Board and Hardware) Anti-Vibration/EFI Screws (2)
	X333AB CLD1260A CLN7334A TRN7799A CHN6100A	**Receiver Module (VHF High-Band Range 2)** Receiver Module (Board, Preselector, Hardware) Receiver Module Front Panel VHF/UHF Tuning Kit Anti-Vibration/EFI Screws (2)
	X43AA CPN1047A CLN7261A CPN6086A CHN6100A	**Power Supply Assembly** 625W Power Supply (AC input; w/o battery chrg) Ferrite RFI Suppressor Front Panel, Dummy Charger Connector Anti-Vibration/EFI Screws (2)
	X621AY CLN1614A TRN7476A TKN8751A	**Station Control Module (SCM); Standard EPIC III** Station Control Module SCM Internal Speaker Internal Speaker Cable
	X222AB CGN6157A CHN6100A	**Front Panel (Station Control Module**) Station Control Module Front Panel Anti-Vibration/EFI Screws (2)
	X216AA CLN6955A TKN8731A CLN6816A	**Wireline Interface Module (WIM) (4−wire)** Wireline Interface Board WIM Cable RFI Suppressor
	C831AA TRN7479A	**Card Cage** Card Cage Assembly (12”)
	X142AA TRN7494A	**Duplex Interface Assembly** Duplex Interface (includes ant. connector bracket)
	X249AW TKN8753A TKN9126A	**RF Cabling** Receiver mini−UHF to N−type coax cable Transmitter N−type to N−type coax cable
	X187AA TRN7663A	**Domestic Power Cable** AC Line Cord
	X163AD TRN7696A CHN6100A	**Blank Panels** Dual Slot Wide Blank Panel Anti-Vibration/EFI Screws (2)
	X842AB CLN6885A	**Ethernet Termination Kit** Ethernet Termination Hardware
	X430AA THN6700A TTN5040A	**12” Cabinet** 12” x 20” Cabinet Grommet
	X362AA TBN6625A	**Packing** Packing for 12” Cabinet
	X436AA 68P81095E05	**Instruction Manual** *Quantar* Station Functional Manual

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UHF

OPTION X240AA SELECTED IN STEP 3 (*Quantar* UHF; Range 1, 25W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X240AA** TLE2731A TKN8699A TRN7480A TRN7708A CHN6100A	***Quantar* UHF R1; 25W Transmitter** 25 W Power Amplifier Module (UHF R1) PA−to−Exciter RF Cable Station Interconnect Board (Backplane) PA Module Front Panel Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X132AA** CLE1230A CHN6100A	**Exciter Module (UHF, R1)** Exciter Module (Board and Hardware) Anti-Vibration/EFI Screws (2)
	X334AA CLE1190A CLN7334A TRN7799A CHN6100A	**Receiver Module (UHF, R1)** Receiver Module (Board, Preselector, Hardware) Receiver Module Front Panel VHF/UHF Tuning Kit Anti-Vibration/EFI Screws (2)
	X43AB CPN1049B CLN7261A CPN6086A CHN6100A	**Power Supply Assembly** 265W Power Supply (AC input; w/o battery chrg) Ferrite RFI Suppressor Front Panel, Dummy Charger Connector Anti-Vibration/EFI Screws (2)
	X621AY CLN1614A TRN7476A TKN8751A	**Station Control Module (SCM); Standard EPIC III** Station Control Module SCM Internal Speaker Internal Speaker Cable
	X222AB CGN6157A CHN6100A	**Front Panel (Station Control Module)** Station Control Module Front Panel Anti-Vibration/EFI Screws (2)
	X216AA CLN6955A TKN8731A CLN6816A	**Wireline Interface Module (WIM) (4−wire)** Wireline Interface Board WIM Cable RFI Suppressor
	C831AA TRN7479A	**Card Cage** Card Cage Assembly (12”)
	X142AA TRN7494A	**Duplex Interface Assembly** Duplex Interface (includes ant. connector bracket)
	X249AW TKN8753A TKN9126A	**RF Cabling** Receiver mini−UHF to N−type coax cable Transmitter N−type to N−type coax cable
	X187AA TRN7663A	**Domestic Power Cable** AC Line Cord
	X163AD TRN7696A CHN6100A	**Blank Panels** Dual Slot Wide Blank Panel Anti-Vibration/EFI Screws (2)
	X842AB CLN6885A	**Ethernet Termination Kit** Ethernet Termination Hardware
	X430AA THN6700A TTN5040A	**12” Cabinet** 12” x 20” Cabinet Grommet
	X362AA TBN6625A	**Packing** Packing for 12” Cabinet
	X436AJ 68P81095E05	**Instruction Manual** *Quantar* Station Functional Manual

OPTION X640AA SELECTED IN STEP 3 (*Quantar* UHF; Range 1, 110W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X640AA** TTE2061A TKN8699A TRN7480A TRN7708A CHN6100A	***Quantar* UHF R1; 110W Transmitter** 110 W Power Amplifier Module (UHF R1) PA−to−Exciter RF Cable Station Interconnect Board (Backplane) PA Module Front Panel Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X132AA** CLE1230A CHN6100A	**Exciter Module (UHF, R1)** Exciter Module (Board and Hardware) Anti-Vibration/EFI Screws (2)
	X334AA CLE1190A CLN7334A TRN7799A CHN6100A	**Receiver Module (UHF, R1)** Receiver Module (Board, Preselector, Hardware) Receiver Module Front Panel VHF/UHF Tuning Kit Anti-Vibration/EFI Screws (2)
	X43AA CPN1047A CLN7261A CPN6086A CHN6100A	**Power Supply Assembly** 625W Power Supply (AC input; w/o battery chrg) Ferrite RFI Suppressor Front Panel, Dummy Charger Connector Anti-Vibration/EFI Screws (2)
	X621AY CLN1614A TRN7476A TKN8751A	**Station Control Module (SCM); Standard EPIC III** Station Control Module SCM Internal Speaker Internal Speaker Cable
	X222AB CGN6157A CHN6100A	**Front Panel (Station Control Module)** Station Control Module Front Panel Anti-Vibration/EFI Screws (2)
	X216AA CLN6955A TKN8731A CLN6816A	**Wireline Interface Module (WIM) (4−wire)** Wireline Interface Board WIM Cable RFI Suppressor
	C831AA TRN7479A	**Card Cage** Card Cage Assembly (12”)
	X142AA TRN7494A	**Duplex Interface Assembly** Duplex Interface (includes ant. connector bracket)
	X249AW TKN8753A TKN9126A	**RF Cabling** Receiver mini−UHF to N−type coax cable Transmitter N−type to N−type coax cable
	X187AA TRN7663A	**Domestic Power Cable** AC Line Cord
	X163AD TRN7696A CHN6100A	**Blank Panels** Dual Slot Wide Blank Panel Anti-Vibration/EFI Screws (2)
	X842AB CLN6885A	**Ethernet Termination Kit** Ethernet Termination Hardware
	X430AA THN6700A TTN5040A	**12” Cabinet** 12” x 20” Cabinet Grommet
	X362AA TBN6625A	**Packing** Packing for 12” Cabinet
	X436AJ 68P81095E05	**Instruction Manual** *Quantar* Station Functional Manual

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UHF

OPTION X240AB SELECTED IN STEP 3
(*Quantar* UHF; Range 2, 25W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X240AB**	***Quantar* UHF R2; 25W Transmitter**
	TLE2732A	25 W Power Amplifier Module (UHF R2)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X132AB**	**Exciter Module (UHF, R2)**
	CLE1240A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X334AB	**Receiver Module (UHF, R2)**
	CLE1200A	Receiver Module (Board, Preselector, Hardware)
	CLN7334A	Receiver Module Front Panel
	TRN7799A	VHF/UHF Tuning Kit
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AB	**Power Supply Assembly**
	CPN1049B	265W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12”)
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AD	**Blank Panels**
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12” Cabinet**
	THN6700A	12” x 20” Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12” Cabinet
	X436AJ	**Instruction Manual**
	68P81095E05	*Quantar* Station Functional Manual

OPTION X640AB SELECTED IN STEP 3
(*Quantar* UHF; Range 2, 110W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X640AB**	***Quantar* UHF R2; 110W Transmitter**
	TTE2062A	110 W Power Amplifier Module (UHF R2)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X132AB**	**Exciter Module (UHF, R2)**
	CLE1240A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X334AB	**Receiver Module (UHF, R2)**
	CLE1200A	Receiver Module (Board, Preselector, Hardware)
	CLN7334A	Receiver Module Front Panel
	TRN7799A	VHF/UHF Tuning Kit
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AA	**Power Supply Assembly**
	CPN1047A	625W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12”)
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AD	**Blank Panels**
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12” Cabinet**
	THN6700A	12” x 20” Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12” Cabinet
	X436AJ	**Instruction Manual**
	68P81095E05	*Quantar* Station Functional Manual

(Continued)

UHF

OPTION X640AC SELECTED IN STEP 3
(*Quantar* UHF; Range 3, 110W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X640AC**	***Quantar* UHF R3; 110W Transmitter**
	TTE2063A	110 W Power Amplifier Module (UHF R3)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X132AC**	**Exciter Module (UHF, R3)**
	CLE1250A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X334AC	**Receiver Module (UHF, R3)**
	CLE1210A	Receiver Module (Board, Preselector, Hardware)
	CLN7334A	Receiver Module Front Panel
	TRN7799A	VHF/UHF Tuning Kit
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AA	**Power Supply Assembly**
	CPN1047A	625W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12”)
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AD	**Blank Panels**
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12” Cabinet**
	THN6700A	12” x 20” Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12” Cabinet
	X436AJ	**Instruction Manual**
	68P81095E05	*Quantar* Station Functional Manual

OPTION X640AD SELECTED IN STEP 3
(*Quantar* UHF; Range 4, 100W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X640AD**	***Quantar* UHF R4; 100W Transmitter**
	TTE2064A	100 W Power Amplifier Module (UHF R4)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X132AD**	**Exciter Module (UHF, R4)**
	CLE1260A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X334AD	**Receiver Module (UHF, R4)**
	CLE1220A	Receiver Module (Board, Preselector, Hardware)
	CLN7334A	Receiver Module Front Panel
	TRN7799A	VHF/UHF Tuning Kit
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AA	**Power Supply Assembly**
	CPN1047A	625W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12”)
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AD	**Blank Panels**
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12” Cabinet**
	THN6700A	12” x 20” Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12” Cabinet
	X436AJ	**Instruction Manual**
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800 MHz

OPTION X250AA SELECTED IN STEP 3 (800 MHz *Quantar*; 20W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X250AA**	***Quantar* 800 MHz; 20W Transmitter**
	TLF1940A	20 W Power Amplifier Module (800 MHz)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X133AA**	**Exciter Module (800 MHz)**
	CLF1510A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X335AA	**Receiver Module (800 MHz)**
	CLF1530A	Receiver Module (Board, Front Panel, Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AB	**Power Supply Assembly**
	CPN1049B	265W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12”)
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AL	**Blank Panels**
	TRN7695A	Single Slot Wide Blank Panel
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12” Cabinet**
	THN6700A	12” x 20” Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12” Cabinet
	X436AH	**Instruction Manual**
	68P81095E05	*Quantar* Station Functional Manual

OPTION X750AA SELECTED IN STEP 3 (800 MHz *Quantar*; 100W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X750AA**	***Quantar* 800 MHz; 100W Transmitter**
	TLF1930C	100 W Power Amplifier Module (800 MHz)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X133AA**	**Exciter Module (800 MHz)**
	CLF1510A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X335AA	**Receiver Module (800 MHz)**
	CLF1530A	Receiver Module (Board, Front Panel, Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AA	**Power Supply Assembly**
	CPN1047A	625W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module)**
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12”)
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AL	**Blank Panels**
	TRN7695A	Single Slot Wide Blank Panel
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12” Cabinet**
	THN6700A	12” x 20” Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12” Cabinet
	X436AH	**Instruction Manual**
	68P81095E05	*Quantar* Station Functional Manual

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900 MHz

OPTION X660AA SELECTED IN STEP 3
(900 MHz; 100W Transmitter)

Source	Option/ Kit	Description
Option from Initial Sales Order	**X660AA**	***Quantar* 900 MHz; 100W Transmitter**
	TLF1800B	100 W Power Amplifier Module (900 MHz)
	TKN8699A	PA–to–Exciter RF Cable
	TRN7480A	Station Interconnect Board (Backplane)
	TRN7708A	PA Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
Options/Kits Internally Added by Motorola Order Processing	**X134AA**	**Exciter Module (900 MHz)**
	CLF1520A	Exciter Module (Board and Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X336AA	**Receiver Module (900 MHz)**
	CLF1540A	Receiver Module (Board, Front Panel, Hardware)
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X43AA	**Power Supply Assembly**
	CPN1047A	625W Power Supply (AC input; w/o battery chrg)
	CLN7261A	Ferrite RFI Suppressor
	CPN6086A	Front Panel, Dummy Charger Connector
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X621AY	**Station Control Module (SCM); Standard EPIC III**
	CLN1614A	Station Control Module
	TRN7476A	SCM Internal Speaker
	TKN8751A	Internal Speaker Cable
	X222AB	**Front Panel (Station Control Module**)
	CGN6157A	Station Control Module Front Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X216AA	**Wireline Interface Module (WIM) (4–wire)**
	CLN6955A	Wireline Interface Board
	TKN8731A	WIM Cable
	CLN6816A	RFI Suppressor
	C831AA	**Card Cage**
	TRN7479A	Card Cage Assembly (12”)
	X142AA	**Duplex Interface Assembly**
	TRN7494A	Duplex Interface (includes ant. connector bracket)
	X249AW	**RF Cabling**
	TKN8753A	Receiver mini–UHF to N–type coax cable
	TKN9126A	Transmitter N–type to N–type coax cable
	X187AA	**Domestic Power Cable**
	TRN7663A	AC Line Cord
	X163AL	**Blank Panels**
	TRN7695A	Single Slot Wide Blank Panel
	TRN7696A	Dual Slot Wide Blank Panel
	CHN6100A	Anti-Vibration/EFI Screws (2)
	X842AB	**Ethernet Termination Kit**
	CLN6885A	Ethernet Termination Hardware
	X430AA	**12” Cabinet**
	THN6700A	12” x 20” Cabinet
	TTN5040A	Grommet
	X362AA	**Packing**
	TBN6625A	Packing for 12” Cabinet
	X436AD	**Instruction Manual**
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5 The following lists available options that may be selected in addition to the standard model and options (described in Steps 1 thru 4).

AVAILABLE HARDWARE OPTIONS FOR *QUANTAR* STATION

Option Category	Option and Complement	
Power Supply	**AC Input Supplies** **X30AA 625W Power Supply with Battery Charger** CPN1048C 625W Power Supply Assembly w/ Battery Charger TKN8732A Battery Charger Cable Kit TKN8786A Battery Temperature Sensor TRN5155A 10' Extension Cable w/connectors and fuse block CHN6100A Anti-Vibration/EFI Screws (2) CLN7261A AC Line Cord Ferrite RFI Suppressor CLN7419A Power Supply Front Panel w/Screws **X30AB 265W Power Supply with Battery Charger** CPN1050E 265W Power Supply Assembly w/ Battery Charger TKN8732A Battery Charger Cable Kit TKN8786A Battery Temperature Sensor TRN5155A 10' Extension Cable w/connectors and fuse block CHN6100A Anti-Vibration/EFI Screws (2) CLN7261A AC Line Cord Ferrite RFI Suppressor CPN6086A Power Supply Front Panel w/Screws	**DC Input Supplies** **X121AA 210W Power Supply (12/24V DC Input)** TRN7802A 210W Power Supply Assembly (12/24 V DC Input) TKN8732A Battery Charger Cable Kit TRN5155A 10' Extension Cable w/connectors and fuse block CHN6100A Anti-Vibration/EFI Screws (2) **X112AA 600W Power Supply (24V DC Input)** TRN7801A 600W Power Supply Assembly (24 V DC Input) TKN8732A Battery Charger Cable Kit TRN5155A 10' Extension Cable w/connectors and fuse block CHN6100A Anti-Vibration/EFI Screws (2) **X113AA 210W Power Supply (48/60 V DC Input)** TRN7803A 210W Power Supply Assembly (48/60 V DC Input) TKN8732A Battery Charger Cable Kit TRN5155A 10' Extension Cable w/connectors and fuse block CHN6100A Anti-Vibration/EFI Screws (2) **X113AB 600W Power Supply (48/60 V DC Input)** CPN1031B 600W Power Supply Assembly (48/60 V DC Input) TKN8732A Battery Charger Cable Kit TRN5155A 10' Extension Cable w/connectors and fuse block TTN4068A Power Supply Front Panel and Screws CHN6100A Anti-Vibration/EFI Screws (2)
Wireline Interface Module	**X84AA Omit Standard Wireline Interface Module (WIM)** **X144AA Add 8−Wire Wireline Interface Module (WIM)** CLN6956A 8−Wire Wireline Interface Board (WIB) TKN8731A WIM Cable Kit CLN6816A RFI Suppressor	
Antenna Relay	**X371AA Add Antenna Relay** TRN7664A Antenna Relay, Cables, and Mounting Hardware	
Duplexer	**X182AC Add Duplexer Module (UHF R1)** 0185417U04 Duplexer (UHF R1) TTN5008A Duplexer Mtg Hdwr **X182AD Add Duplexer Module (UHF R2)** 0185417U05 Duplexer (UHF R2) TTN5008A Duplexer Mtg Hdwr **X182AE Add Duplexer Module (UHF R3)** 0185417U06 Duplexer (UHF R3) TTN5008A Duplexer Mtg Hdwr **X182AF Add Duplexer Module (UHF R4)** 0185417U07 Duplexer (UHF R4) TTN5008A Duplexer Mtg Hdwr	**X182AA Add Duplexer Module (132−146 MHz)** 0185417U01 Duplexer (132−146 MHz) TTN5008A Duplexer Mtg Hdwr **X182AB Add Duplexer Module (144−160MHz)** 0185417U02 Duplexer (144−160 MHz) TTN5008A Duplexer Mtg Hdwr **X182AJ Add Duplexer Module (158−174 MHz)** 0185417U03 Duplexer (158−174 MHz) TTN5008A Duplexer Mtg Hdwr **X182AG Add Duplexer Module (800 MHz)** TDF6980A Duplexer (800 MHz) TTN5008A Duplexer Hardware (4 screws) **X182AH Add Duplexer Module (900 MHz)** TDF6542A Duplexer (900 MHz) TTN5008A Duplexer Hardware (4 screws)
Modem	**X437AA Add *ASTRO* Modem** TRN7668A *ASTRO* Modem Card	

Option Category	Option and Complement	
Circulator	**X676AN** **Add Triple Circulator (UHF, R1 and R2)** TLE9120A Dual Circulator TLN3391A 50 Ohm Load with Heat Sink TLE9140A Low Pass Filter TRN7796A Fan, Peripheral Tray **X676AA** **Add Triple Circulator (132–146 MHz)** TYD4001A Dual Circulator TLN3391A 50 Ohm Load with Heat Sink TYD4010A Low Pass Filter TRN7796A Cooling Fan **X676AB** **Add Triple Circulator (144–160 MHz)** Same as X676AA except substitute TYD4002A Dual Circulator **X676AC** **Add Triple Circulator (158–174 MHz)** Same as X676AA except substitute TYD4003A Dual Circulator	**X676AP** **Add Triple Circulator (UHF, R3 and R4)** TLE9130A Dual Circulator TLN3391A 50 Ohm Load with Heat Sink TLE9140A Low Pass Filter TRN7796A Fan, Peripheral Tray **X676AQ** **Add Triple Circulator (800 MHz)** TLF7320A Dual Circulator TLN3391A 50 Ohm Load with Heat Sink TLF7340A Low Pass Filter TRN7796A Fan, Peripheral Tray **X676AR** **Add Triple Circulator (900 MHz)** TLF7330A Dual Circulator TLN3391A 50 Ohm Load with Heat Sink TLF7340A Low Pass Filter TRN7796A Fan, Peripheral Tray
UHSO	**X873AA** **Add Internal Ultra High Stability Oscillator** CLN7012A BNC Terminator CHN6100A Anti-Vibration/EFI Screws (2) CLN1477A UHSO Module TTN5070C UHSO Board TTN5071A UHSO Housing and Front Panel TTN5072A UHSO 5 PPB Ovenized Element	
Peripheral Tray	**X696AA** **Add Peripheral Tray** TRN7751A *Quantar* Peripheral Shelf	
Miscellaneous	HSN1000 External Speaker TRN7738A External Speaker Hardware (bracket and cable) HMN1001A Microphone *Note that the external speaker and microphone are not options and must be ordered as line items on the STIC–1 order form.*	

FOREWORD

Product Maintenance Philosophy

Due to the high percentage of surface-mount components and multi–layer circuit boards, the maintenance philosophy for this product is one of Field Replaceable Unit (FRU) substitution. The station is comprised of self-contained modules (FRUs) which, when determined to be faulty, may be quickly and easily replaced with a known good module to bring the equipment back to normal operation. The faulty module must then be shipped to the Motorola System Support Center for further troubleshooting and repair to the component level.

Scope of Manual

This manual is intended for use by experienced technicians familiar with similar types of equipment. In keeping with the maintenance philosophy of Field Replaceable Units (FRU), this manual contains functional information sufficient to give service personnel an operational understanding of all FRU modules, allowing faulty FRU modules to be identified and replaced with known good FRU replacements.

The information in this manual is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMRs are added to the manuals as the engineering changes are incorporated into the equipment.

Service and Replacement Modules

Motorola System Support Center
1311 E. Algonquin Road
Schaumburg, IL 60196

1−800−221−7144
Int'l 1−847−576−7300
FAX 1−847−576−2172

For complete information on ordering FRU replacement modules, or instructions on how to return faulty modules for repair, contact the System Support Center (see sidebar).

The following FRU replacement modules are available:

Receiver Module (VHF Range 1)	TLN3250A
Receiver Module (VHF Range 2)	TLN3251A
Receiver Module (UHF, Range 1)	TLN3313A
Receiver Module (UHF, Range 2)	TLN3314A
Receiver Module (UHF, Range 3)	TLN3373A
Receiver Module (UHF, Range 4)	TLN3374A
Receiver Module (800 MHz)	TLN3315A
Receiver Module (900 MHz)	TLN3316A
Exciter Module (VHF Range 1)	TLN3252A
Exciter Module (VHF Range 2)	TLN3253A
Exciter Module (UHF, Range 1)	TLN3305A
Exciter Module (UHF, Range 2)	TLN3306A
Exciter Module (UHF, Range 3)	TLN3375A
Exciter Module (UHF, Range 4)	TLN3376A
Exciter Module (800 MHz)	TLN3307A
Exciter Module (900 MHz)	TLN3308A
Power Amplifier Module (VHF 25W, R1 & R2)	TLN3255A
Power Amplifier Module (VHF 125W, R1)	TLN3379A
Power Amplifier Module (VHF 125W, R2)	TLN3254A
Power Amplifier Module (UHF R1; 25W)	TLN3443A
Power Amplifier Module (UHF R2; 110W)	TLN3446A
Power Amplifier Module (UHF R4; 100W)	TLN3450A
Power Amplifier Module (800 MHz 20W)	TLN3441A
Power Amplifier Module (800 MHz 100W)	TLN3442A
Power Amplifier Module (900 MHz 100W)	TLN3299A
Station Control Module (Conventional/6809)	CLN1293A
Station Control Module (Conventional/6809 *EPIC III*)	CLN1621A
Station Control Module (*IntelliRepeater*)	CLN1294A
4−Wire Wireline Interface Module	CLN1295A
8−Wire Wireline Interface Module	CLN1296A
Power Supply Module (625W AC)	TLN3259A
Power Supply Module (625W AC w/charger)	TLN3260A
Power Supply Module (265W AC)	TLN3261A
Power Supply Module (265W AC w/charger)	TLN3262A
Power Supply Module (210W 12/24 V DC)	TLN3264A
Power Supply Module (210W 48/60 V DC)	TLN3378A
Power Supply Module (600W 24 V DC)	TLN3263A
Power Supply Module (600W 48/60 V DC)	TLN3377A
ASTRO Modem Card	TLN3265A

GENERAL SAFETY INFORMATION

The following general safety precautions must be observed during all phases of operation, service, and repair of the equipment described in this manual. The safety precautions listed below represent warnings of certain dangers of which we are aware. You should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

General Safety Precautions

- ▶ Read and follow all warning notices and instructions marked on the product or included in this manual before installing, servicing or operating the equipment. Retain these safety instructions for future reference. Also, all applicable safety procedures, such as Occupational, Safety, and Health Administration (OSHA) requirements, National Electrical Code (NEC) requirements, local code requirements, safe working practices, and good judgement must be used by personnel.
- ▶ Refer to appropriate section of the product service manual for additional pertinent safety information.
- ▶ Because of danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modifications of equipment.
- ▶ Identify maintenance actions that require two people to perform the repair. Two people are required when:
  - – A repair has the risk of injury that would require one person to perform first aid or call for emergency support. An example would be work around high voltage sources. A second person may be required to remove power and call for emergency aid if an accident occurs to the first person.
    Note *Use the National Institute of Occupational Safety and Health (NIOSH) lifting equation to determine whether a one or two person lift is required when a system component must be removed and replaced in its rack.*
- ▶ If troubleshooting the equipment while power is applied, be aware of the live circuits.
- ▶ DO NOT operate the transmitter of any radio unless all RF connectors are secure and all connectors are properly terminated.
- ▶ All equipment must be properly grounded in accordance with Motorola Standards and Guideline for Communications Sites “R56” 68P81089E50 and specified installation instructions for safe operation.
- ▶ Slots and openings in the cabinet are provided for ventilation. To ensure reliable operation of the product and to protect if from overheating, these slots and openings must not be blocked or covered.
- ▶ Only a qualified technician familiar with similar electronic equipment should service equipment.
- ▶ Some equipment components can become extremely hot during operation. Turn off all power to the equipment and wait until sufficiently cool before touching.

Human Exposure Compliance

This equipment is designed to generate and radiate radio frequency (RF) energy by means of an external antenna. When terminated into a non–radiating RF load, the base station equipment is certified to comply with Federal Communications Commission (FCC) regulations pertaining to human exposure to RF radiation in accordance with the FCC Rules Part 1 section 1.1310 as published in title 47 code of federal regulations and procedures established in TIA/EIA TSB92, Report On EME Evaluation for RF Cabinet Emissions Under FCC MPE Guidelines. Compliance to FCC regulations of the final installation should be assessed and take into account site specific characteristics such as type and location of antennas, as well as site accessibility of occupational personnel (controlled environment) and the general public (uncontrolled environment). This equipment should only be installed and maintained by trained technicians. Licensees of the FCC using this equipment are responsible for insuring that its installation and operation comply with FCC regulations Part 1 section 1.1310 as published in title 47 code of federal regulations.

Whether a given installation meets FCC limits for human exposure to radio frequency radiation may depend not only on this equipment but also on whether the "environments" being assessed are being affected by radio frequency fields from other equipment, the effects of which may add to the level of exposure. Accordingly, the overall exposure may be affected by radio frequency generating facilities that exist at the time the licensee's equipment is being installed or even by equipment installed later. Therefore, the effects of any such facilities must be considered in site selection and in determining whether a particular installation meets the FCC requirements.

FCC OET Bulletin 65 provides materials to assist in making determinations if a given facility is compliant with the human exposure to RF radiation limits. Determining the compliance of transmitter sites of various complexities may be accomplished by means of computational methods. For more complex sites direct measurement of the power density may be more expedient. Additional information on the topic of electromagnetic exposure is contained in the Motorola Standards and Guideline for Communications Sites publication. Persons responsible for installation of this equipment are urged to consult the listed reference material to assist in determining whether a given installation complies with the applicable limits.

In general the following guidelines should be observed when working in or around radio transmitter sites:

- All personnel should have electromagnetic energy awareness training
- All personnel entering the site must be authorized
- Obey all posted signs
- Assume all antennas are active
- Before working on antennas, notify owners and disable appropriate transmitters
- Maintain minimum 3 feet clearance from all antennas
- Do not stop in front of antennas
- Use personal RF monitors while working near antennas
- Never operate transmitters without shields during normal operation
- Do not operate base station antennas in equipment rooms

For installations outside of the U.S., consult with the applicable governing body and standards for RF energy human exposure requirements and take the necessary steps for compliance with local regulations.

References

TIA/EIA TSB92 "Report On EME Evaluation for RF Cabinet Emissions Under FCC MPE Guidelines," Global Engineering Documents: http://global.ihs.com/

FCC OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields": http://www.fcc.gov/oet/rfsafety/.

Motorola Standards and Guideline for Communications Sites, Motorola manual 68P81089E50.

IEEE Recommended Practice for the Measure of Potentially Hazardous Electromagnetic Fields – RF and Microwave, IEEE Std C95.3–1991, Publication Sales, 445 Hoes Lane, P.O. Box 1331, Piscattaway, NJ 08855–1331

IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE C95.1–1991, Publication Sales, 445 Hoes Lane, P.O. Box 1331, Piscattaway, NJ 08855–1331.

PERFORMANCE SPECIFICATIONS

General

TX Sub–Band Range	**VHF** 132–154 MHz (R1) 150–174 MHz (R2) **UHF** 403–433 MHz (R1) 438–470 MHz (R2) 470–494 MHz (R3) 494–520 MHz (R4) **800** 851–870 MHz **900** 935–941 MHz
RX Sub–Band Range	**VHF** 132–154 MHz (R1) 150–174 MHz (R2) **UHF** 403–433 MHz (R1) 438–470 MHz (R2) 470–494 MHz (R3) 494–520 MHz (R4) **800** 806–825 MHz **900** 896–902 MHz
Number of Channels	16
Channel Spacing	VHF: 30, 25, 12.5 kHz UHF/800: 12.5, 25 kHz 900: 12.5 kHz
Frequency Generation	Synthesized
Power Supply Type	Switching
Power Supply Input Voltage	90–280 V ac
Power Supply Input Frequency	47–63 Hz
Battery Revert	12V (25W radios) 24V (100W, 110W, and 125W radios)
T/R Separation (with duplexer option)	VHF: $\geq$1.5 MHz UHF/800:45 MHz 900: 39 MHz
Temperature Range (ambient)	—30° C to +60° C

PERFORMANCE SPECIFICATIONS (Cont'd)

Receiver

I−F Frequencies	**VHF** 21.45 MHz (1st) 450 kHz (2nd) **UHF** 73.35 MHz (1st) 450 kHz (2nd) **800** 73.35 MHz (1st) 450 kHz (2nd) **900** 73.35 MHz (1st) 450 kHz (2nd)
Preselector Bandwidth	VHF/UHF: 4 MHz 800: 19 MHz 900: 6 MHz
Sensitivity (12 dB SINAD)	VHF: 0.25 μV UHF: 0.35 μV 800/900: 0.30 μV
Sensitivity (20 dB Quieting)	VHF: 0.35 μV UHF: 0.5 μV 800/900: 0.42 μV
Adjacent Channel Rejection	**VHF** 90 dB (25/30 kHz) 80 dB (23.5 kHz) **UHF** 75 dB (12.5 kHz) 85 dB (25 kHz) **800** 70 dB (12.5 kHz) 80 db (25 kHz) **900** 70dB
Intermodulation Rejection	**VHF** 85 dB (25/30 kHz) 80 dB (30 kHz) **UHF** 85 dB **800** 85 dB **900** 70 dB
Spurious and Image Rejection	100 dB
Wireline Output	−20 dBm to 0 dBm @ 60% Rated System Deviation, 1 kHz
Audio Response (Analog Mode)	+1, −3 dB from 6 dB per octave de−emphasis; 300−3000 Hz referenced to 1000 Hz at line input
Audio Distortion	Less than 3% @ 1000 Hz
FM Hum and Noise (300 to 3000 kHz bandwidth)	**VHF** 50 dB (25/30 kHz) 45 dB (12.5 kHz) **UHF** 45 dB (12.5 kHz) 50 dB (25 kHz) **800** 45 dB (12.5 kHz) 50 dB (25 kHz) **900** 45 db
Frequency Stability	1 ppm
RF Input Impedance	50 Ω
FCC Designation (FCC Rule Part 15)	VHF: ABZ89FR3776 UHF: ABZ89FR4796 800: ABZ89FR5757 900: ABZ89FR5768

PERFORMANCE SPECIFICATIONS (Cont'd)

Transmitter

Power Output	**VHF** 6–25W, 25–125W **UHF** 5–25W, 25–110W **800** 5–20W, 20–100W **900** 6–25W
Electronic Bandwidth	Full sub–band
Intermodulation Attenuation	**VHF:** 20 dB (single circulator; standard on all PAs) 65 dB (triple circulator – requires triple circulator option) **UHF:** 50 dB (single circulator; standard on all PAs) **800:** 50 dB (single circulator; standard on all PAs) **900:** 20 dB (single circulator; standard on all PAs) 70 dB (triple circulator – requires triple circulator option)
Spurious and Harmonic Emissions Attenuation	90 dB
Deviation	**VHF, UHF, and 800** ±5 kHz (25 kHz) ±2.5 kHz (12.5 kHz) ±4 kHz (*SECURENET* coded) ±2.4 kHz (*SECURENET* coded) **900** ±2.5 kHz
Audio Sensitivity	–35 dBm to 0 dBm (variable)
Audio Response (Analog Mode)	+1, –3 dB from 6 dB per octave pre–emphasis; 300–3000 Hz referenced to 1000 Hz at line input
Audio Distortion	Less than 2% @ 1000 Hz @ 60% rated system deviation
FM Hum and Noise (300 to 3000 Hz bandwidth)	45 dB nominal (12.5 kHz) 50 dB nominal (25/30 kHz)
Frequency Stability	VHF, UHF, 800: 1 ppm 900: 0.1ppm
RF Output Impedance	50 Ω
FCC Designation (FCC Rule Parts 22, 74, 80, 90)	**VHF** 25W: ABZ89FC3774 125W: ABZ89FC3773 **UHF** 25W: ABZ89FC4797 110W: ABZ89FC4798 **800** 20W: ABZ89FC5775 100W: ABZ89FC5776 **900** 100W: ABZ89FC5767

Measurement Methods per TIA/EIA–603
Specifications subject to change without notice

MOTOROLA

DESCRIPTION

Figure 1. *Quantar* Station in 12” Cabinet (UHF Shown)

1 INTRODUCTION

The Motorola *Quantar* Station (available in VHF, UHF, 800 MHz and 900 MHz) provides conventional analog, *ASTRO*, *ASTRO CAI*, *SECURENET*, 6809 Trunking, and *IntelliRepeater* capabilities in a compact, software−controlled design. The station architecture and microprocessor−controlled Station Control Module allow for fast and reliable expansion and upgrading. FLASH memory in the Station Control Module allows software downloads to be performed locally (using serial or Ethernet port) or remotely via modem.

Compact Mechanical Design

The entire *Quantar* station is housed in a 5 rack−unit−high card cage weighing only 55 lbs. A single cage may be mounted in a 12” cabinet (shown in Figure 1) or multiple cages may be mounted in standard telephone−style equipment racks or various sizes of Motorola cabinets.

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State–of–the–Art Electrical Design

Transmitter Circuitry

The station transmitter circuitry is designed for continuous duty operation and may be operated at full–rated power. Output power is continually monitored by an internal calibrated wattmeter. The wattmeter output feeds a power control loop which continually adjusts and maintains the desired output power. All adjustments are electronic, including deviation and output power.

Receiver Circuitry

The station receive circuitry features multiple bandwidth capability (12.5, 25, or 30 kHz, depending on band), as well as *ASTRO* digital operation. Injection signals for the 1st and 2nd mixers are generated by frequency synthesizer circuitry electronically controlled by the Station Control Module. All receive signals (analog, *SECURENET*, *ASTRO,* and *ASTRO CAI*) are detected and digitized before being sent to the Station Control Module, providing improved audio quality consistency throughout the coverage area.

Station Control Module

The *Quantar* Station Control Module is microprocessor–based and features extensive use of ASIC and digital signal processing technology. The module serves as the main controller for the station, providing signal processing and operational control for the station modules.

Wireline Circuitry

The station wireline circuitry provides a wide variety of telephone interfaces, including analog, *ASTRO*, *ASTRO CAI*, *SECURENET*, Tone Remote Control, DC Remote Control, and WildCard I/O connections. Telephone line connections are easily made to the wireline circuitry via connectors on the rear of the station.

Switching Power Supply

The *Quantar* station features a switching–type power supply which accepts a wide range of ac inputs (90–280 V ac, 47–63 Hz) and generates the necessary dc operating voltages for the station modules. The power supply continually monitors and adjusts the output voltages, and requires no external adjustments or calibration.

Summary of Operating Features

Standard Features

The following are a few of the standard *Quantar* features:

- Compact, single cage design
- Extensive Self-Test Diagnostics and Alarm Reporting
- FRU maintenance philosophy (reduces down time)
- Easily programmed via Radio Service Software
- Local or Remote Software downloading to FLASH memory
- Expansion and upgrades performed by module replacement and/or software upgrade
- Highly reliable and accurate continuous duty transmitter circuitry
- Operates as *IntelliRepeater* trunking station
- Compatible (with appropriate options) with analog, *SECURENET*, *ASTRO* and *ASTRO CAI* digital signaling
- Versatile and reliable switching−type power supply
- Wide operating temperature range: −30° C to +60° C (−22° F to +140° F)

Optional Hardware Features

The following are a few of the *Quantar* station optional hardware features:

- Battery Revert — charges co-located storage batteries and automatically reverts to battery backup operation in the event of ac power failure
- Triple Circulator Option — provides additional isolation and intermodulation protection for rf-congested transmitter sites
- Duplexer Option — allows a single antenna to serve for both transmitter and receiver circuitry in repeater applications
- Antenna Relay Option — allows a single antenna to be switched between transmitter and receiver circuitry for base station applications
- UHSO Option — ultra−high stability oscillator provides improved station frequency accuracy required for some system types
- *ASTRO* Modem — allows connection (for *ASTRO* digital signaling) to a console through a Digital Interface Unit (DIU) in an *ASTRO* system
- Station Access Module (SAM) — allows station to decode MDC Repeater Access (e.g., Select5, DTMF, etc.)
- Wide Space Receiver — provides 8 MHz receiver bandwidth for VHF and UHF stations

Multiple System Capability

In addition to conventional capabilities, the *Quantar* station can be programmed to operate in 6809 Trunking and *IntelliRepeater* Trunking systems.

6809 Trunking

When programmed for 6809 Trunking capability, the station can operate in a *SMARTNET* trunking system under control of a 6809 Trunking Controller.

IntelliRepeater *Trunking*

When programmed for *IntelliRepeater* capability, the *Quantar* station can operate in Motorola's most advanced wide-area trunking systems — *SMARTZONE*. The station can operate both as a remote voice channel and, if necessary, perform all call processing and channel assignment tasks normally requiring a trunking controller.

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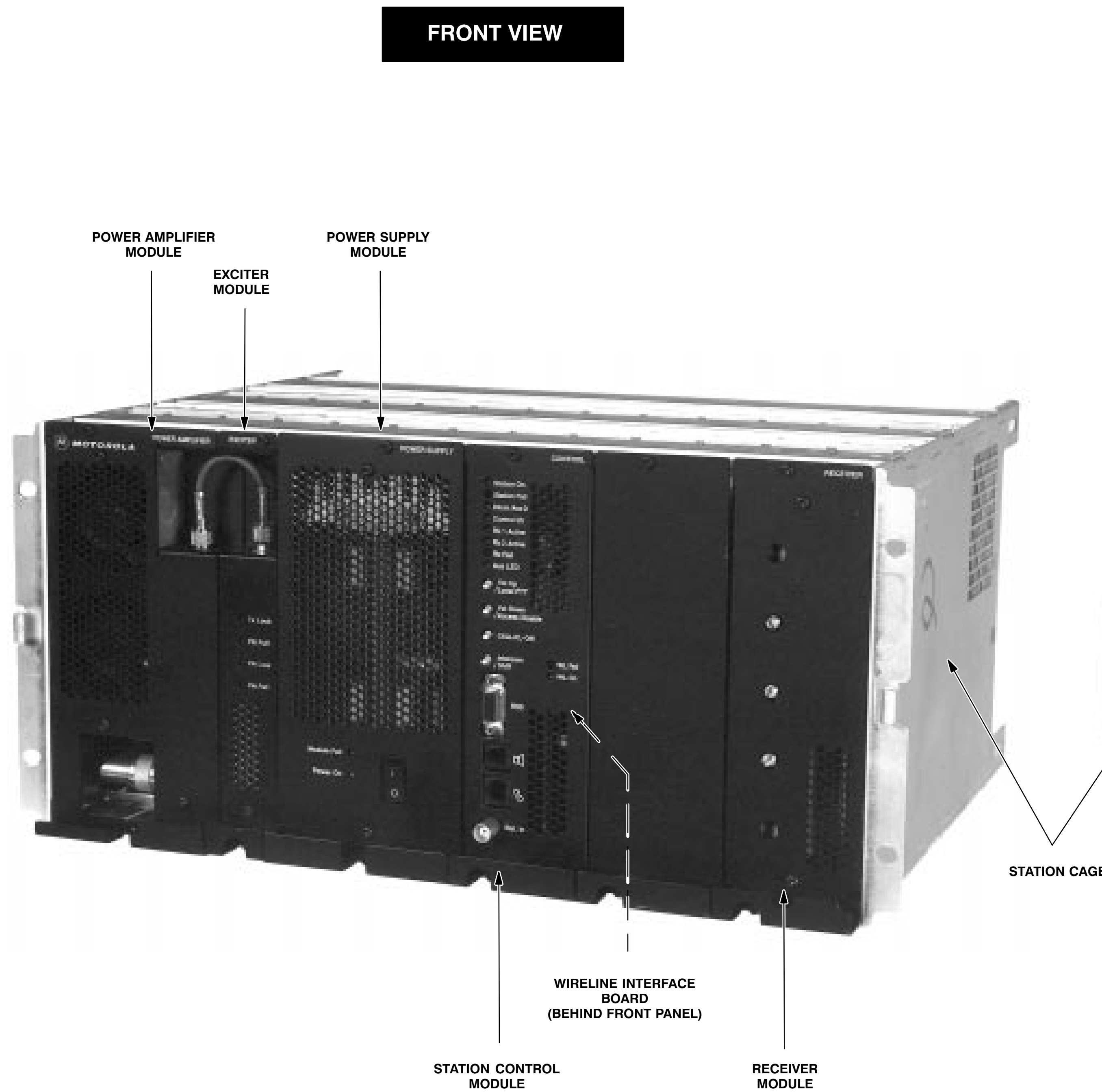
2 STATION COMPONENTS

Figure 2 shows the *Quantar* station modules and components (UHF shown).



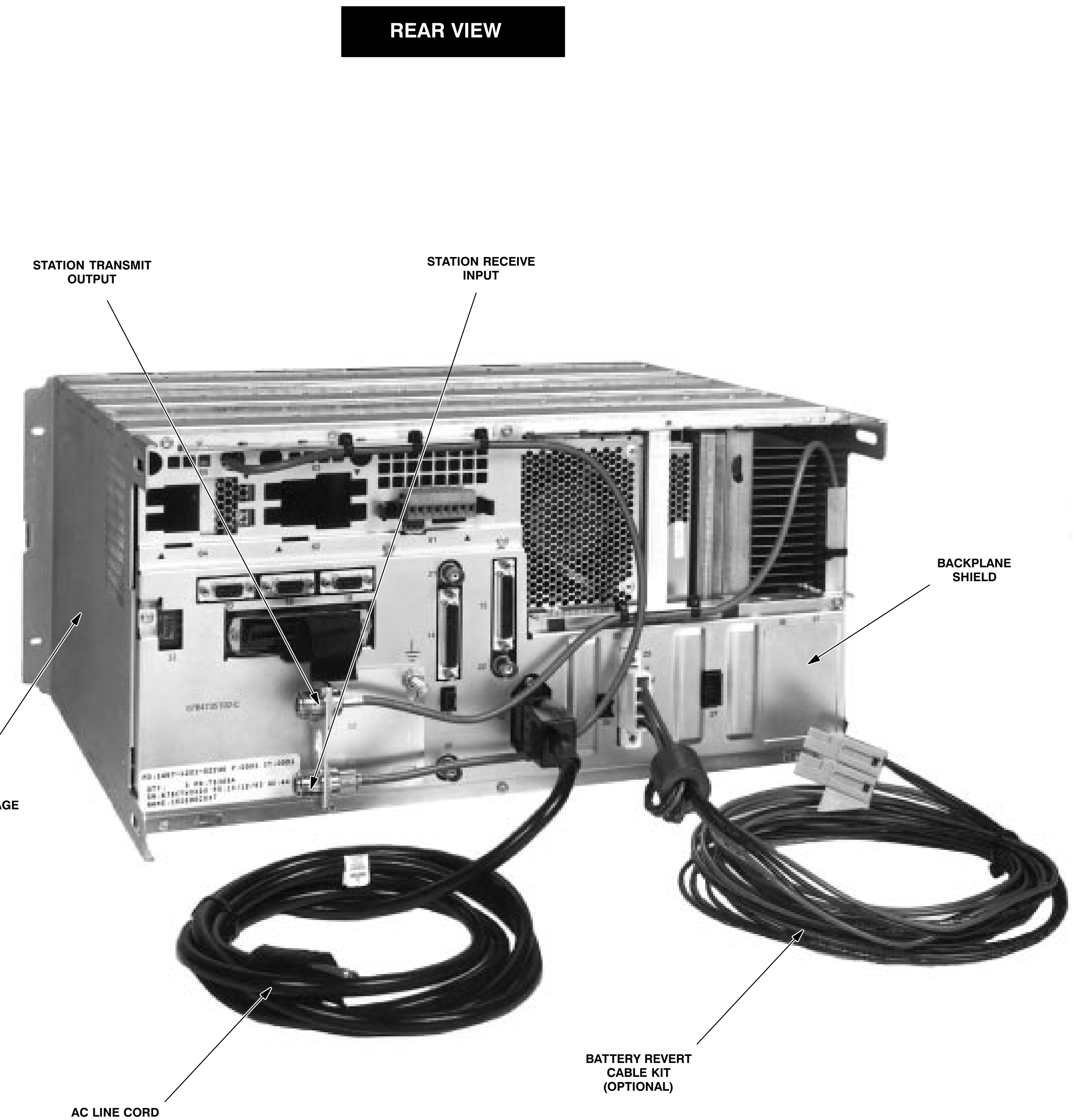


***Figure 2**. Quantar* Station Components (Front and Rear Views; UHF Shown)

3 FUNCTIONAL THEORY OF OPERATION

The following functional theory of operation provides an overview of the station circuitry. For a more thorough functional description of a particular module, refer to the functional sections located behind the tab **STATION MODULES**. Refer to the block diagram in Figure 3 for the following functional theory of operation.

Transmitter Circuitry Operation

Introduction

The Transmitter Circuitry is comprised of the Exciter Module and the Power Amplifier (PA) Module. These modules combine to produce the modulated, amplified rf signal which is transmitted via the site transmit antenna.

Exciter Module Operation

The Exciter Module is a microprocessor-controlled module which generates a modulated rf signal at the desired transmit frequency and sends this signal to the PA for amplification. The circuitry operates as follows.

The synthesizer/VCO accepts frequency programming data from the Station Control Module (via the SPI bus) and generates an rf carrier signal at the specified frequency. The modulation audio signal (from the SCM) modulates the carrier, resulting in a modulated rf signal at approximately +13 dBm which is fed to the PA.

The TX Power Control Circuitry accepts an output power detect voltage from the PA and compares this signal to a reference voltage representing the desired output power. Based on the comparison, a power control voltage is generated to control the output power from the PA. This feedback and control loop continually monitors the output power and adjusts the control voltage to maintain the proper output power from the PA.

Power Amplifier Module Operation

The modulated rf signal from the Exciter Module is input to the Intermediate Power Amplifier (IPA) in the PA. After amplification to approximately 0–10 W (depending on power control voltage from Exciter Module), the signal is fed to a Driver or a Final module (depending on station's maximum output power). The gain of the IPA stage is controlled by the power control voltage from the Exciter Module.

The modulated rf signal is amplified by the Driver and/or Final and is output to the site transmit antenna via a circulator and a harmonic filter/coupler. The coupler consists of a calibrated wattmeter which feeds a dc voltage proportional to the output power to the TX Power Control Circuitry in the Exciter Module to serve as the feedback signal in the power control loop.

Receiver Circuitry Operation

Introduction

The Receiver Circuitry accepts receive rf signals from the site receive antenna, performs filtering and dual conversion, and outputs a digitized receive signal to the Station Control Module.

Receiver Module Operation

The receive signal is input from the site receive antenna to a multi-pole preselector filter which provides highly selective bandpass filtering. The filtered signal is then amplified and fed to the rf input of the 1st mixer, which mixes the signal with an injection signal generated by the synthesizer/VCO, resulting in a 21.45 MHz (VHF) or a 73.35 MHz (UHF, 800, 900) 1st i−f (intermediate frequency) signal. (The injection signal frequency is determined by frequency programming data from the Station Control Module via the SPI bus.)

The 21.45 MHz or 73.35 MHz 1st i−f signal is filtered and input to a custom receiver IC. This component contains circuitry for 2nd injection and mixing, amplification, and A/D (analog to digital) conversion, resulting in a digitized receive signal. This signal is fed as differential data to the Station Control Module.

Station Control Module Operation

Introduction

The Station Control Module (SCM) is the microprocessor−based controller for the station. Major components include an MC68360 microprocessor, a 56002 Digital Signal Processor (DSP), and two ASIC devices (host and DSP). The SCM operates as follows.

Station Control Module Operation

The Host Microprocessor (μP) serves as the controller for the SCM, operating from the station software stored in FLASH memory. This software determines the system capabilities of the station (analog, *ASTRO*, *SECURENET*, etc.) The Host μP communicates with the station modules and the SCM circuitry via address and data buses, an HDLC bus, and a SPI bus. External communications ports include a serial port SCM front panel and backplane) and an Ethernet port (backplane).

The DSP and DSP ASIC perform the necessary digital processing for the station audio and data signals. The DSP circuitry interfaces with the Receiver Module (receive audio), the Exciter Module (modulation signal), the Wireline Interface Board (wireline audio), and external audio devices (microphone, handset, external speaker, and station local speaker).

The 2.1 MHz Reference Oscillator generates the reference signal used by the Receiver and Exciter Modules.

Wireline Interface Board Operation

Introduction

The Wireline Interface Board (WIB) serves as the interface between the customer telephone lines and the station. In general, the WIB processes and routes all wireline audio signals between the station and the landline equipment (such as consoles, modems, etc.). Landline-to-station and station-to-landline audio signals are connected to the WIB via copper pairs at the rear of the station.

Wireline Interface Board Operation

Note: *The WIB is offered in 4−wire and 8−wire models. The WIB shown in the block diagram is a simplified 4−wire model. Refer to the functional sections located behind tab WIRELINE CIRCUITRY for details on both models.*

The WIB contains a microprocessor, two FLASH memory ICs (which contain the WIB operating software downloaded by the SCM), and an ASIC device to process and route the various audio signals. Analog, *SECURENET*, and *ASTRO* signals are processed as follows.

- Analog signals are converted to digital signals and routed to the SCM via the TDM (time division multiplex) bus.
- *ASTRO* and *ASTRO CAI* data signals are processed by an *ASTRO* modem card (daughter board plugged into the WIB) and sent to/from the SCM via the HDLC bus. (The station operates in *transparent* mode only, and **does not** perform encryption or decryption of the *ASTRO* or *ASTRO CAI* signal.)
- *SECURENET* encoded signals are processed by the ASIC, sent to/from the microprocessor via the data bus, and sent to/from the Station Control Module microprocessor via the HDLC bus. (The station operates in *transparent* mode only, and **does not** perform encryption or decryption of the *SECURENET* signal.)

The WIB also contains the I/O circuitry used with the WildCard Option. Refer to the *Quantar*/*Quantro* RSS User's Guide (68P81085E35) for more information on the WildCard Option.

Power Supply Module Operation

The Power Supply Module is a switching−type power supply which accepts an ac input (90−280 V ac, 47−63 Hz) and generates the necessary dc operating voltages for the station modules. Stations rated at 20/25 W output power are equipped with Power Supply Modules which generate +5 and +14.2 V dc. Stations rated at 100/110/125 W output power are equipped with Power Supply Modules which generate +5, +14.2 V, and +28 V dc.

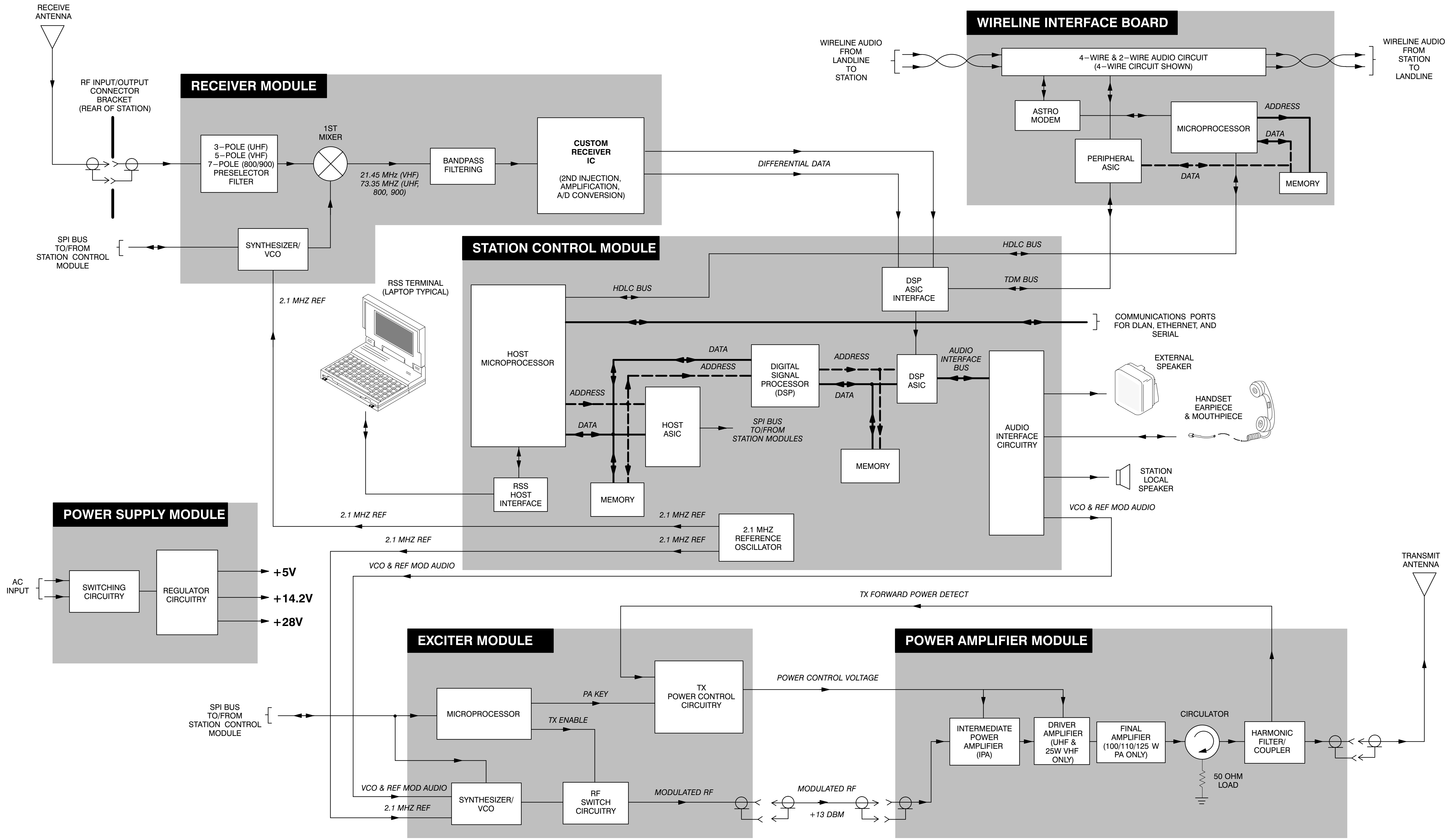


Figure 3. *Quantar* Station Functional Block Diagram

MOTOROLA

INSTALLATION

For *Quantar* Stations and Ancillary Equipment (VHF, UHF, 800 MHz, and 900 MHz)

Contents

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68P81096E57–A
11/15/99–UP

1 PRE–INSTALLATION CONSIDERATIONS

A good installation is important to ensure the best possible performance and reliability of the station equipment. Vital to a good installation is pre–installation planning. Planning the installation includes considering the mounting location of the equipment in relation to input power, antenna(s), and telephone interfaces. Also to be considered are site environmental conditions, the particular mounting method (several available), and required tools and equipment. The following paragraphs provide additional details on these and other pre–installation considerations.

Important— If this is your first time installing this type of equipment, it is highly recommended that you completely read the entire Installation section before beginning the actual installation.

Installation Overview

The following information is intended to serve as an overview for installing the *Quantar* station and ancillary equipment. Step–by–step procedures for each of the major tasks are then provided beginning in paragraph 2.

- Plan the installation, paying particular attention to environmental conditions at the site, ventilation requirements, and grounding and lightning protection.
- Unpack and inspect the equipment
- Mechanically install the equipment at the site
- Make necessary electrical and cabling connections, including the following:
    - AC input cabling
    - Coaxial cables to transmit and receive antennas
    - Phone line connections
    - System cables
- Perform a post–installation functional checkout test of the equipment to verify proper installation
- Proceed to the Optimization procedures (located behind the OPTIMIZATION tab) to customize the station parameters per customer specifications (e.g., operating frequency, PL codes, etc.)

Environmental Conditions at Intended Installation Site

Important — If the station is to be installed in an environment which is unusually dusty or dirty (and thus does not meet the air quality requirements), the air used to cool the station modules must be treated using appropriate filtering devices. Dust or dirt accumulating on the internal circuit boards and modules is not easily removed, and can cause such malfunctions as overheating and intermittent electrical connections.

The *Quantar* station may be installed in any location suitable for electronic communications equipment, provided that the environmental conditions do not exceed the equipment specifications for temperature, humidity, and air quality. These are:

Operating Temperature Range — −30°C to +60°C

Humidity — not to exceed 95% relative humidity @ 50°C

Air Quality — For equipment operating in an environmentally controlled environment with the station cage(s) rack mounted, the airborne particulates level must not exceed 25 µg/m³.

For equipment operating in an area which is not environmentally controlled (station cage(s) cabinet mounted), the airborne particulates level must not exceed 90 µg/m³.

Important! Rack−mounted stations must be protected from dripping water from overhead pipes, air conditioning equipment, etc. Serious damage to station components could occur if proper protection is not provided.

Equipment Ventilation

Two of the station modules (the power amplifier and power supply modules) are equipped with cooling fans (thermostatically controlled) that are used to provide forced convection cooling. The air flow is front to back, allowing several station cages to be stacked within a rack or cabinet. When planning the installation, observe the following ventilation guidelines:

- Customer−supplied cabinets must be equipped with ventilation slots or openings in the front (for air entry) and back or side panels (for air to exit). If several station cages are installed in a single cabinet, be sure ventilation openings surround **each** cage to allow for adequate cooling.
- All cabinets must have at least 6 inches of open space between the air vents and any walls or other cabinets. This allows adequate air flow.
- When multiple cabinets (each equipped with several station cages) are installed in an enclosed area, make sure the ambient temperature of the room does not exceed the recommended maximum operating temperature (+60°C). It may be necessary to have air conditioning or other climate control equipment installed to satisfy the environmental requirements.

AC Input Power Requirements

The *Quantar* station is equipped with a multiple−output dc power supply module (various models available) that operates from 90Vrms to 280Vrms, 50 or 60 Hz ac input power (automatic range and line frequency selection). A standard 3−prong line cord is supplied to connect the power supply (rear of station) to the ac source.

Note: *If you wish to connect the station to a 220 VAC outlet, you must obtain a line cord employing "HAR" flexible cord with fittings approved by a safety testing agency in the end use country.*

It is recommended that a standard 3−wire grounded electrical outlet be used as the ac source. The outlet must be connected to an ac source capable of supplying a maximum of 766 Watts. For a nominal 110V ac input, the ac source must supply 8.5 amperes and should be protected by a circuit breaker rated at 15 amperes. For a nominal 220V ac input, the ac source must supply approximately 4.25 amperes.

Equipment Mounting Methods

The *Quantar* station equipment may be mounted in a variety of racks and cabinets (available as options), as follows:

No Rack or Cabinet

- Station shipped without rack or cabinet (Option X87AA) — customer may install station in rack or cabinet of choice; station is designed to fit standard EIA 19" rack configuration

Standard Open Racks

- 7' (Model TRN7342), 7½' (Model TRN7343), or 8' (Model TRN7344) racks— open frame racks accept multiple *Quantar* stations and ancillary equipment; EIA 19" rack configuration. Note that rack mounting hardware (Option X153AA) is required for each *Quantar* cage to be rack mounted.

Modular Racks

- 30" (Option X741AA), 45" (Option X742AA), or 60" (Option X743AA) modular racks — accept multiple *Quantar* stations and ancillary equipment; EIA 19" rack configuration. These racks are designed to be stacked (see page 26).

Cabinets

Note: *Although cabinets can physically house multiple stations, thermal limitations may reduce the maximum number of stations for a given cabinet size. Consult Motorola System Engineering or the Product System Planner if you anticipate possible thermal limitations.*

- Shipped in 12" x 20" cabinet (Option X430AA) — roll−formed cabinet with front and rear vented doors holds a single *Quantar* station
- Shipped in 30" x 20" cabinet (Option X52AA) — roll−formed cabinet with front and rear vented doors holds up to three (3) *Quantar* stations
- Shipped in 46" x 20" cabinet (Option X308AA) — roll−formed cabinet with front and rear vented doors holds up to four (4) *Quantar* stations
- Shipped in 60" x 20" cabinet (Option X180AA) — roll−formed cabinet with front and rear vented doors holds up to six (6) *Quantar* stations

Site Grounding and Lightning Protection

CAUTION

Proper site grounding and lightning protection are vitally important considerations. Failure to provide proper lightning protection may result in permanent damage to the radio equipment.

Site Grounding and Lightning Protection Recommendations

One of the most important considerations when designing a communications site is the ground and lightning protection system. While proper grounding techniques and lightning protection are closely related, the general category of site grounding may be divided as follows:

Electrical Ground — Ground wires carrying electrical current from circuitry or equipment at the site is included in the category of electrical ground. Examples include the ac or dc electrical power used to source equipment located at the site, telephone lines, and wires or cables connected to alarms or sensors located at the site.

RF Ground — This type of ground is related to the transmission of radio−frequency energy to earth ground. An example of rf grounding is the use of shielding to prevent (or at least minimize) the leakage of unwanted rf transmissions from communications equipment and cables.

Lightning Ground — Providing adequate lightning protection is critical to a safe and reliable communications site. Telephone lines, rf transmission cables, and ac and dc power lines must all be protected to prevent lightning energy from entering the site building.

Although a comprehensive coverage of site grounding techniques and lightning protection is not within the scope of this instruction manual, there are several excellent industry sources for rules and guidelines on grounding and lightning protection at communications sites. Motorola recommends the following reference source:

Quality Standards FNE Installation Manual *68P81089E50*

Quantar *Equipment Grounding Guidelines*

The *Quantar* station cage is equipped with a single ground lug located on the rear panel of the cage. Use this lug to connect the cage to the site ground point. It is assumed that all telephone lines, antenna cables, and ac or dc power cabling has been properly grounded and lightning protected by following the rules and guidelines provided in the previously mentioned reference source.

Recommended Tools and Equipment

In addition to the typical complement of hand tools, the following tools and equipment are recommended for proper installation of the station equipment.

- A six to eight foot wooden step ladder (used to access the top of the 7’, 7½’, and 8’ racks, if applicable)
- A block–and–tackle or suitable hoist is recommended to lift cabinets equipped with multiple stations, and to stack cabinets or modular racks. (Each fully equipped station cage weighs approximately 55 lbs.)
- Tarpaulin or plastic drop cloth to cover surrounding equipment while drilling concrete anchor holes (for installations where cabinet or rack is being anchored to concrete flooring)
- Vacuum cleaner for removing concrete dust (for installations where cabinet or rack is being anchored to concrete flooring)

Equipment Unpacking and Inspection

The *Quantar* station equipment may be shipped either by air freight or electronic van (as specified by customer). The packing methods are as follows:

- If no cabinet or rack is selected, the station cage is shipped in a cardboard container with styrofoam interior corner braces.
- If the 12” x 20” cabinet is selected, the station cage is shipped installed in the cabinet, all contained within a cardboard container with corrugated interior corner braces.
- All other available cabinets are shipped with the *Quantar* station cage(s) installed in the cabinet, with the cabinet bolted to a wooden skid and covered with a cardboard box with corrugated interior corner braces
- Stations ordered for use in open frame racks (7’, 7½’, or 8’ available) are shipped with the cage(s) in a cardboard container with corrugated interior corner braces. The rack is shipped separately wrapped in insulating foam.
- Stations ordered for use in a modular rack (30”, 45”, or 52” available) are shipped installed in the rack. The rack is then covered in an anti–static bag.

Thoroughly inspect the equipment as soon as possible after delivery. If any part of the equipment has been damaged in transit, immediately report the extent of the damage to the transportation company.

Physical Dimensions and Clearances

Quantar *Cage without Cabinet*

Figure 1 shows the dimensions and recommended clearances for a single *Quantar* station cage.

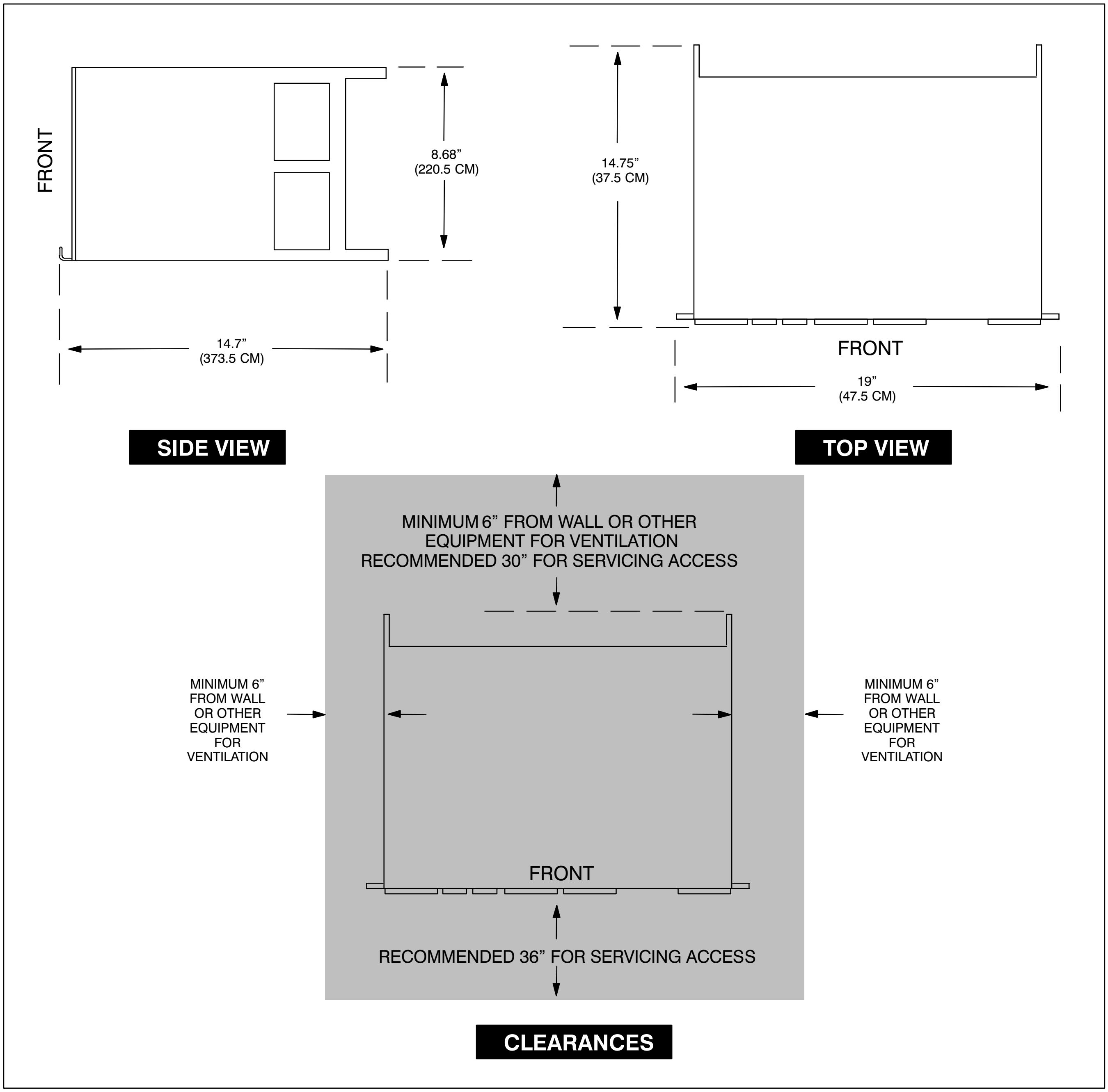


Figure 1. *Quantar* Station Cage Dimensions and Clearances

Physical Dimensions and Clearances (Continued)

Model numbers for the three rack sizes are:

7' TRN7342
7½' TRN7343
8' TRN7344

Quantar *Cages Installed in 7', 7½', and 8' Racks*

Three sizes of racks are available for mounting *Quantar* station cages and ancillary equipment. Figure 2 shows the physical dimensions for all three rack sizes (shown is 8' rack with ten (maximum) *Quantar* cages installed; 7' and 7½' racks each hold nine maximum). Recommended clearance front and rear is 36" minimum for servicing access. Refer to Equipment Ventilation on Page 3 for recommended ventilation clearances.

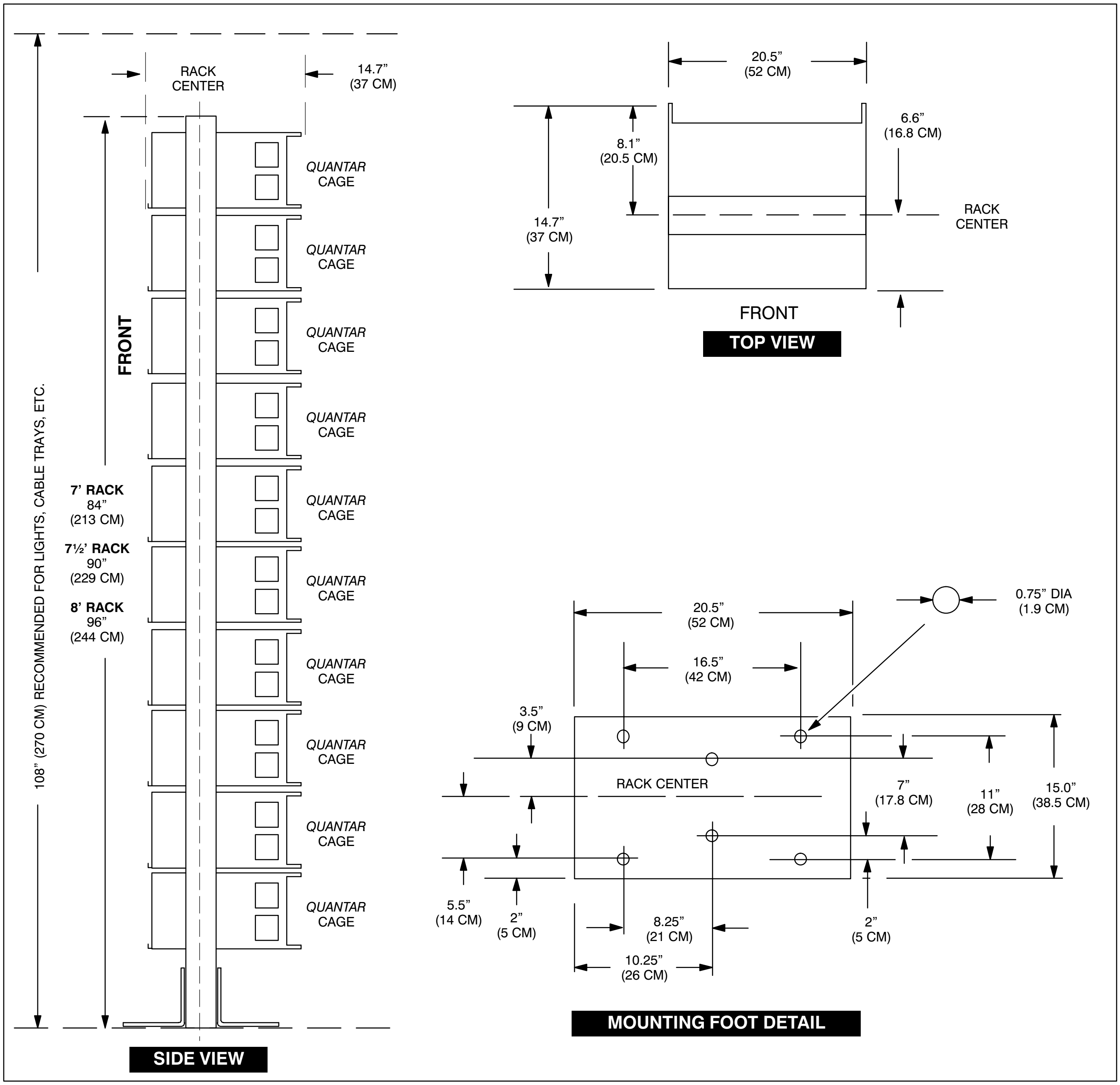


Figure 2. Dimensions and Clearances for 7', 7½', and 8' Racks

Physical Dimensions and Clearances (Continued)

Option numbers for the three modular rack sizes for ***Quantar*** *stations are:*

30”	*X741AA*
45”	*X742AA*
52”	*X743AA*

Quantar *Cages Installed in Modular Racks*

Three sizes of modular racks are available for mounting *Quantar* station cages and ancillary equipment. Figure 3 shows the physical dimensions for all three rack sizes (shown is 52” modular rack with five (maximum) *Quantar* cages installed; 30” racks hold 3 cages and 45” racks hold 4 cages maximum). Recommended clearance front and rear is 36” minimum for servicing access. Refer to Equipment Ventilation on Page 3 for recommended ventilation clearances.

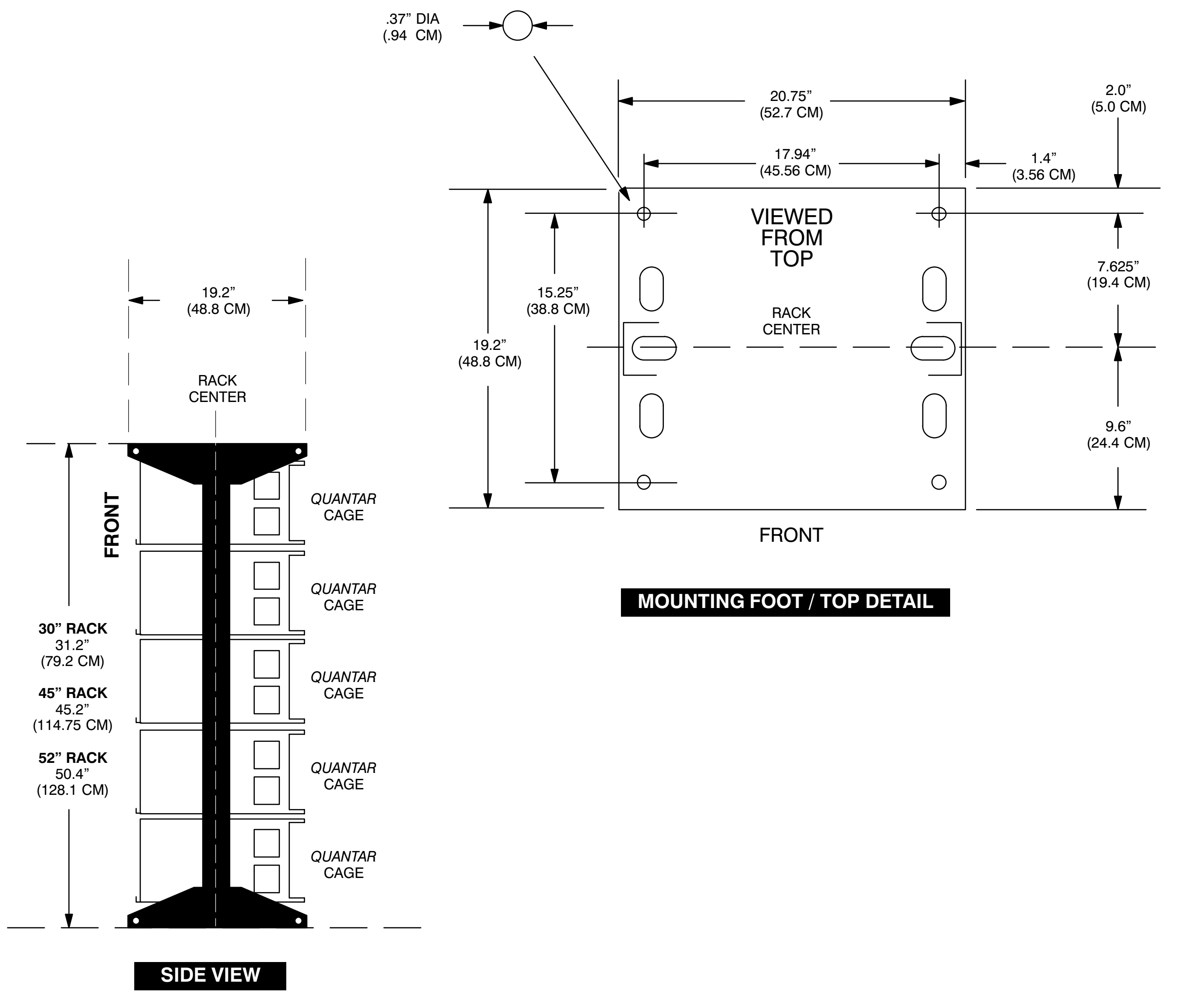


Figure 3. Dimensions and Clearances for 30”, 45”, and 52” Modular Racks

Physical Dimensions and Clearances (Continued)

12" x 20" Cabinet

Figure 4 shows the physical dimensions for a 12" x 20" cabinet (Option X430AA). Minimum recommended clearances are 30"(front) and 36" (rear) for installation access. Refer to Equipment Ventilation on Page 3 for recommended ventilation clearances.

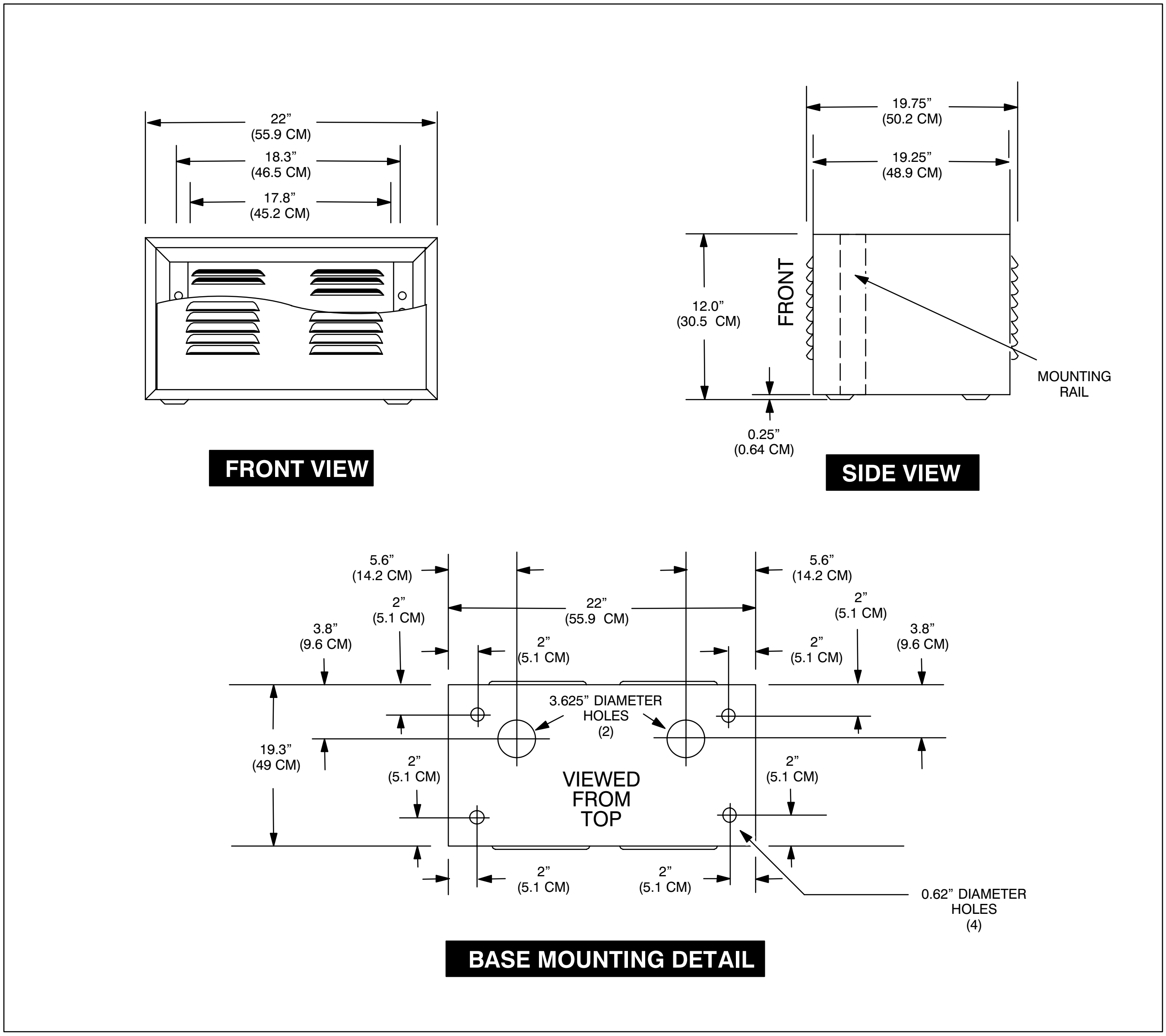


Figure 4. 12" x 20" Cabinet Dimensions

Physical Dimensions and Clearances (Continued)

30” x 20” Cabinet

Figure 5 shows the physical dimensions for a 30” x 20” cabinet (Option X52AA). Minimum recommended clearances are 30”(front) and 36” (rear) for installation access. Refer to Equipment Ventilation on Page 3 for recommended ventilation clearances.

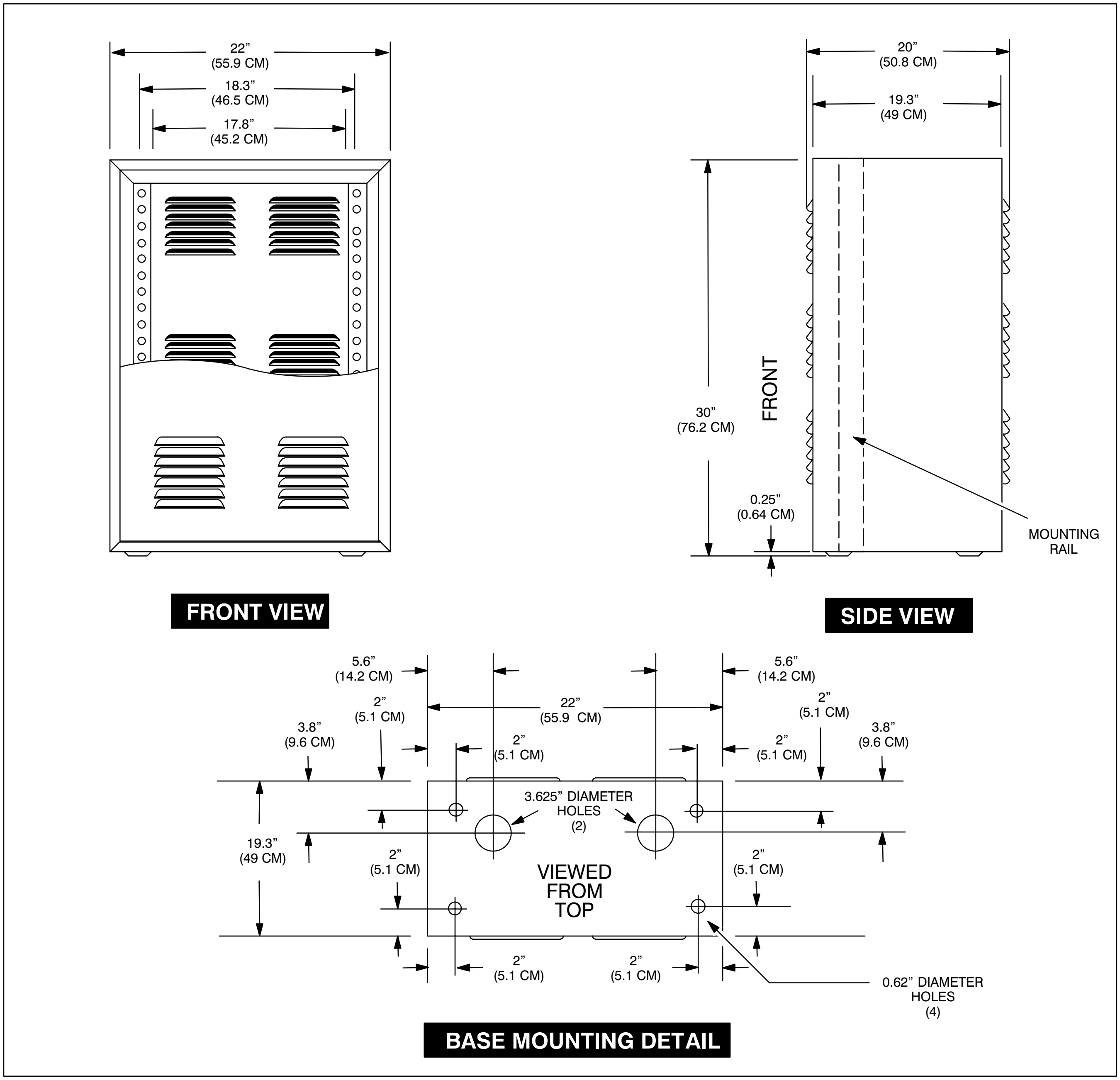


Figure 5. 30” x 20” Cabinet Dimensions

Physical Dimensions and Clearances (Continued)

46” x 20” Cabinet

Figure 6 shows the physical dimensions for a 46” x 20” cabinet (Option X308AA). Minimum recommended clearances are 30”(front) and 36” (rear) for installation access. Refer to Equipment Ventilation on Page 3 for recommended ventilation clearances.

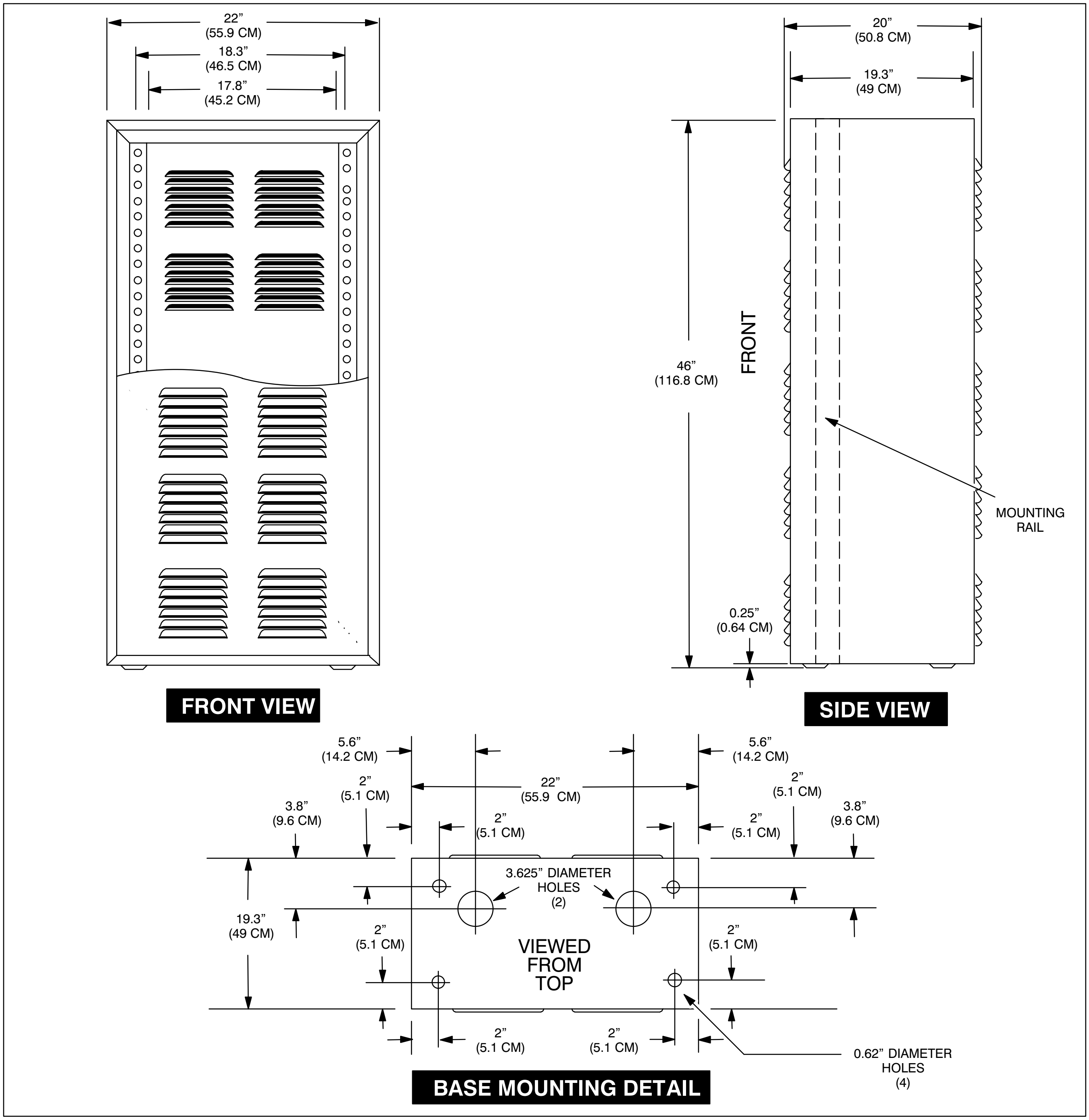


Figure 6. 46” x 20” Cabinet Dimensions

Physical Dimensions and Clearances (Continued)

60” Indoor Cabinet

Figure 7 shows the dimensions for a 60” indoor cabinet (Option X180AA). Minimum recommended clearances are 30”(front) and 36” (rear) for installation access. Refer to Equipment Ventilation on Page 3 for recommended ventilation clearances.

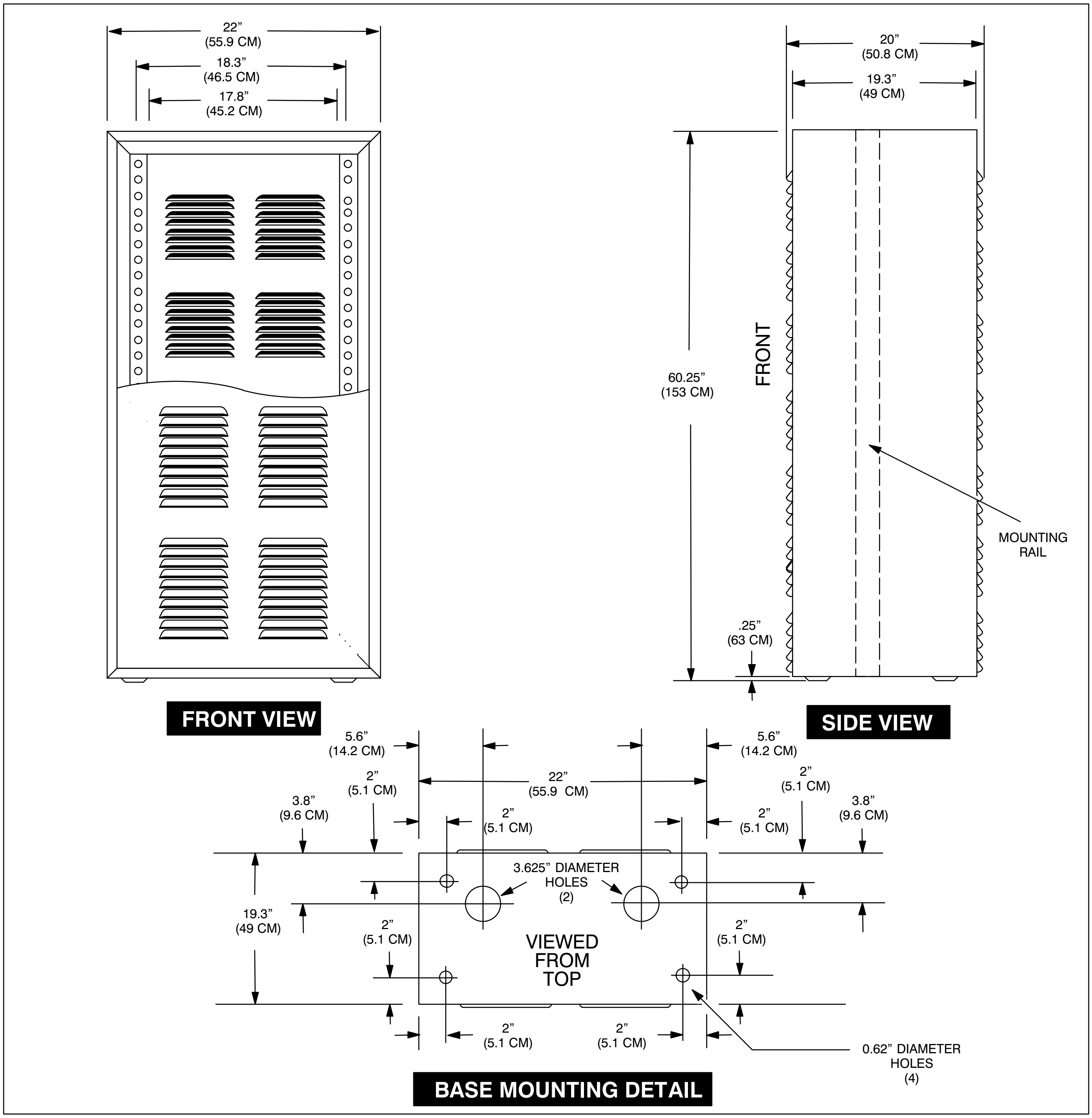


Figure 7. 60” Indoor Cabinet Dimensions

2 MECHANICAL INSTALLATION

This section describes the procedures necessary to unpack and mechanically install the *Quantar* station equipment. A variety of mounting methods are possible, depending on such factors as which type of cabinet or rack (if any) has been selected to house the station cage(s), whether stacking of cabinets is desired, etc. Procedures are provided for each of the cabinet/rack types.

If it becomes necessary to remove any of the modules, refer to the *Module Replacement Procedures* located in the **Troubleshooting** section of this manual for removal instructions. Be sure to observe proper electro–static discharge precautions if modules must be removed from the cage.

Unpacking the Equipment

Important: *Regardless of the packing method, immediately inspect the equipment for damage after unpacking and report the extent of any damage to the transportation company.*

Introduction

Quantar station equipment packing methods vary depending upon the type of optional rack or cabinet selected by the customer. *Quantar* station cages may also be packed and shipped as standalone units with no cabinet or cage. Unpacking procedures for these various methods are provided in the following paragraphs.

Unpacking Standalone Quantar *Station Cage*

Standalone cages (ordered with Option X87AA, omit cabinet) are packed in a cardboard box with styrofoam interior spacers and cardboard stiffeners. Unpack as described in Figure 8.

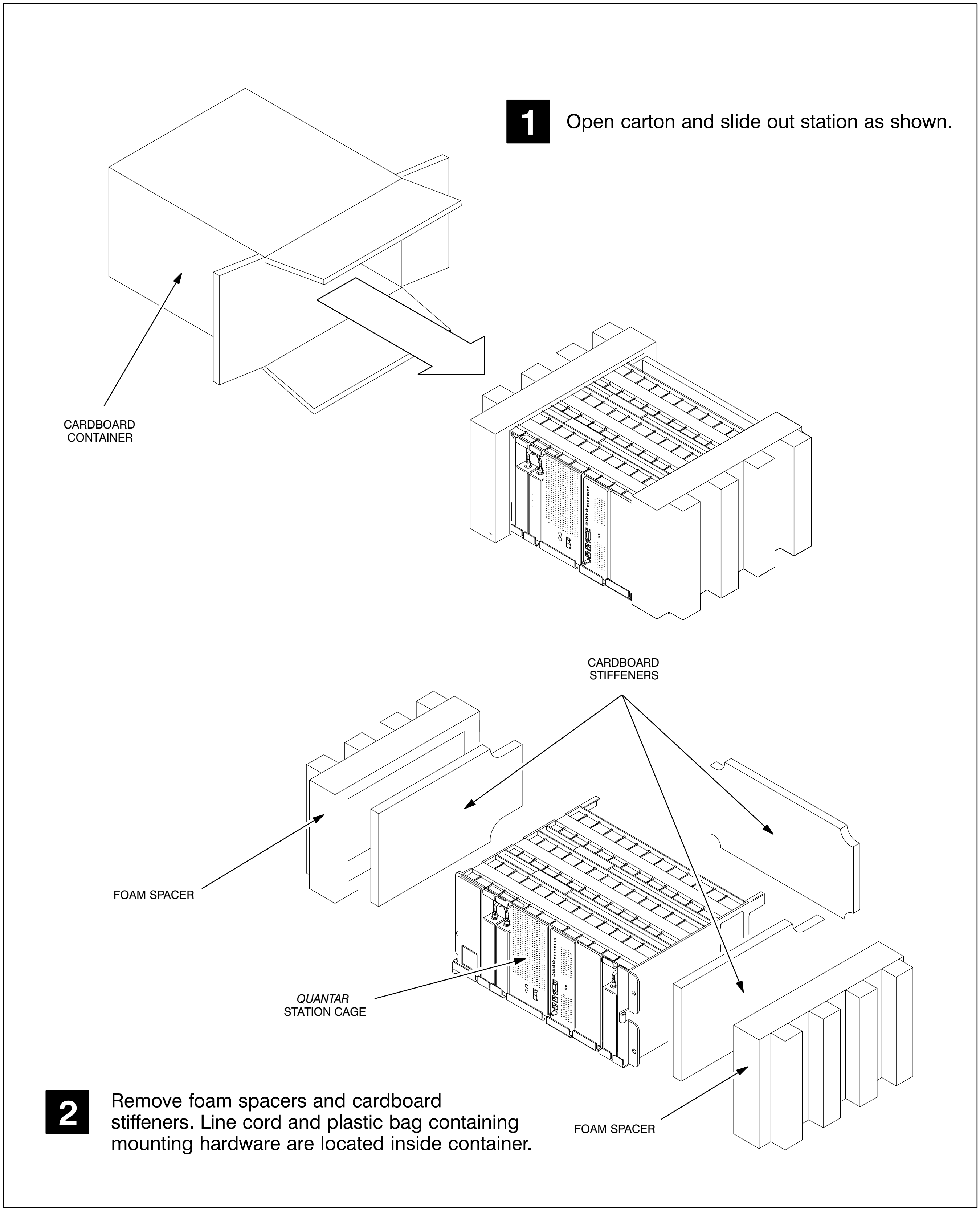


Figure 8. Unpacking Procedures for *Quantar* Station Cages

Unpacking the Equipment (Continued)

Unpacking 12” x 20” Cabinet

Quantar stations ordered with the 12” x 20” cabinet option are shipped installed in the cabinet and packed in a cardboard container with corrugated corner braces and a cardboard pallet. Unpack as described in Figure 9.

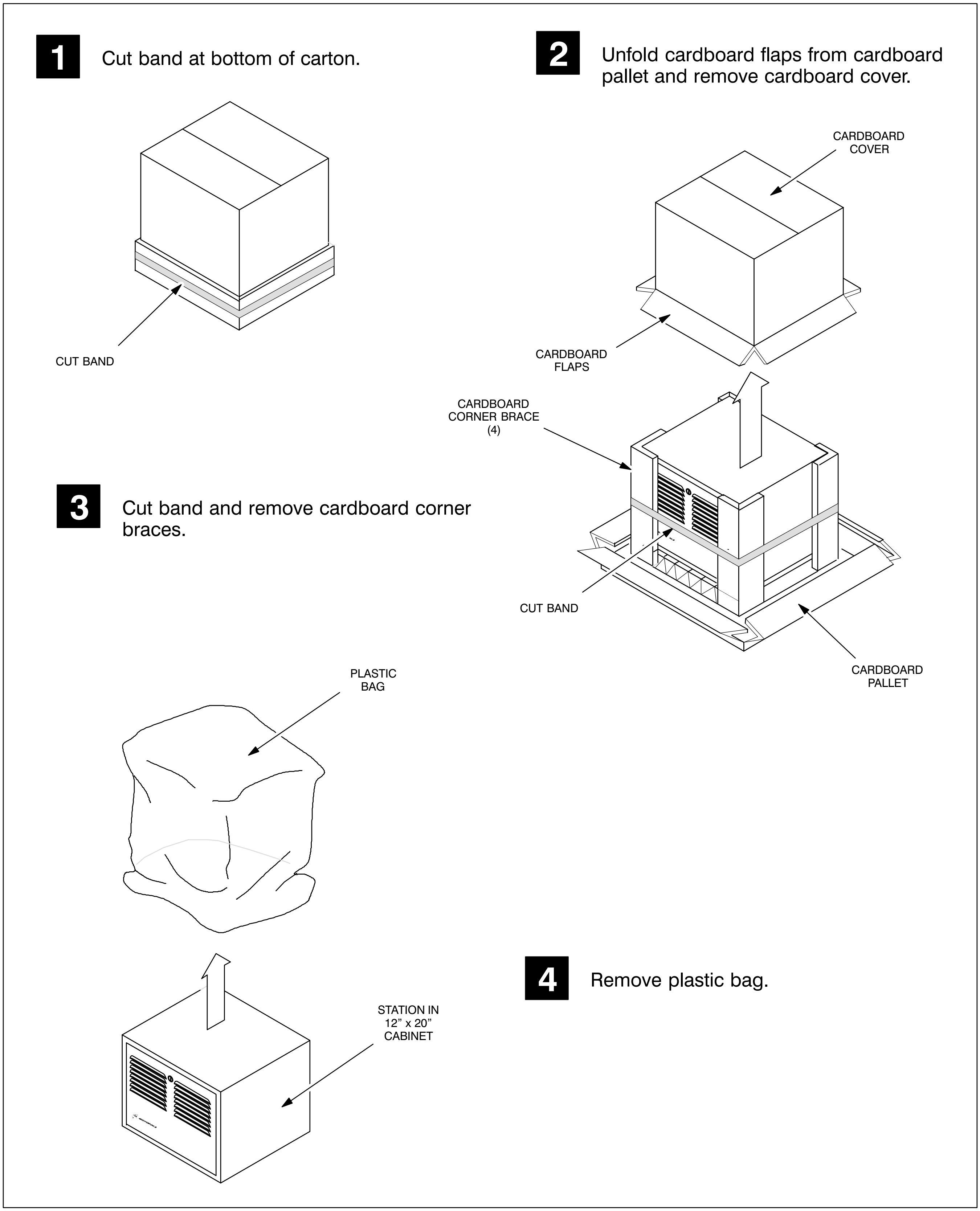


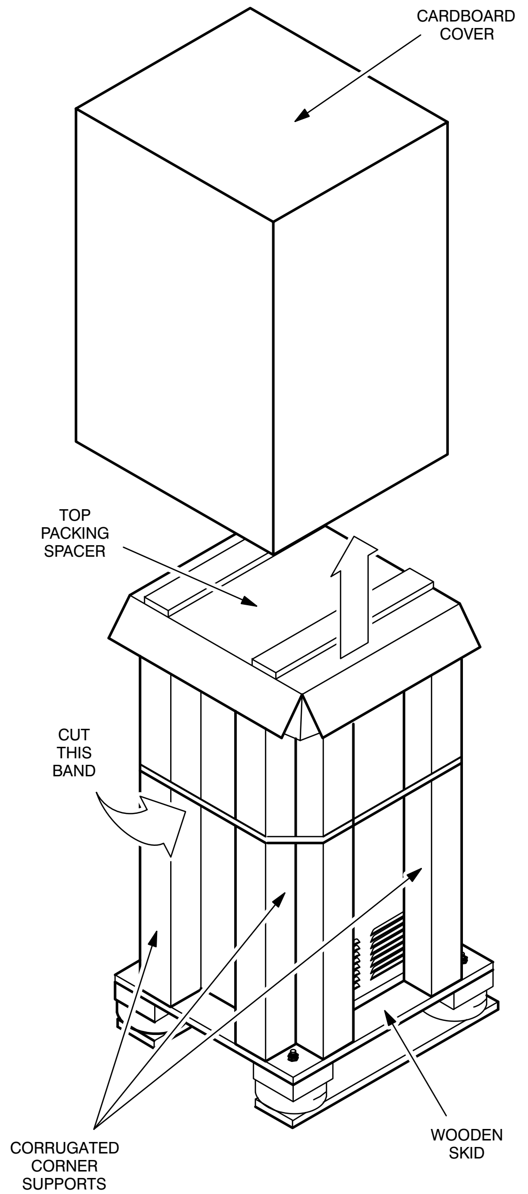
Figure 9. Unpacking Procedures for *Quantar* Station Cages Shipped in 12” x 20” Cabinets

Unpacking the Equipment (Continued)

Unpacking 30” x 20” Cabinet, 46” x 20” Cabinet, and 60” Indoor Cabinet

These cabinet styles are shipped mounted to a wooden skid, secured with corrugated corner braces held by a plastic strap, and covered with a cardboard cover. Unpack the equipment as described in Figure 10.

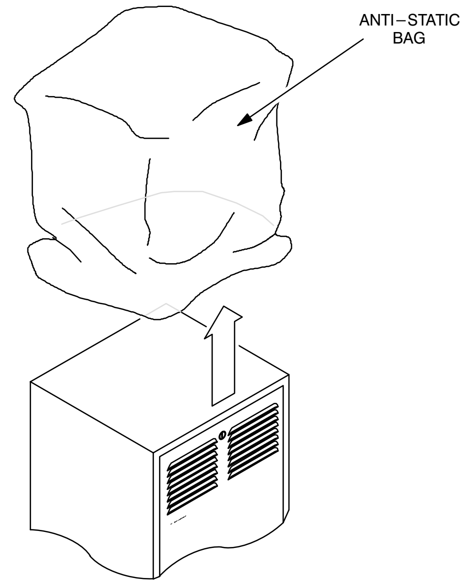
1 Remove cardboard cover from station.



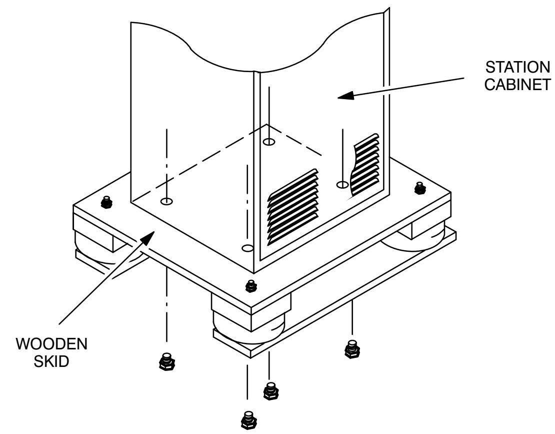
2 Cut band as shown.

3 Remove top packing spacer and corrugated corner supports.

4 Remove anti–static bag. **Do not** discard bag. It will be re–installed to protect equipment during installation.



5 Depending on cabinet type, either open or remove front and rear doors to gain access to the four (4) bolts securing the station to the wooden skid. Remove the bolts and nuts as shown.



6 Use hoist to lift the station from the skid. Remove skid and return station to floor.

7 Replace anti–static bag over station to provide protection during installation.

Figure 10. Unpacking Procedures for 30", 46" (shown), and 60" Indoor *Quantar* Cabinets

Mounting Procedures

Introduction

Perform the following procedures to mechanically install the *Quantar* station equipment cages, racks, or cabinets. Note that racks and cabinets may house multiple *Quantar* station cages, and some cabinets may be stacked one atop the other to maximize use of space.

Mounting Quantar *Station Cage(s) in Customer−Supplied Cabinet*

The *Quantar* station cage is designed to fit in a standard EIA 19" enclosure. Mounting screws (M6 x 1.0 tapping) are provided to secure the cage flanges to the customer−supplied cabinet. Mount the cage(s) as follows:

Note: *Installing multiple cages one above the other is permitted as long as proper ventilation is maintained. Refer to Equipment Ventilation on page 3 for details.*

Step 1. Determine the location in the cabinet into which to mount the cage. Note that when installing multiple cages, it is recommended that you mount the first cage in the lowest possible position in the cabinet, making sure the modules clear the bottom frame of the cabinet, then continue towards the top with additional cages.

Step 2. Thread two of the supplied mounting screws into the lowest mounting holes of the cabinet mounting rails. Now insert the cage into the cabinet, resting the cage on the two screws.

Step 3. Insert the remaining two mounting screws through the bottom two mounting holes in the cage mounting flanges (left and right sides) and secure the cage to the cabinet mounting rails.

Step 4. Remove the two lower mounting screws and insert them through the upper two mounting holes in the cage mounting flanges.

Step 5. Tighten all four mounting screws securely.

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Mounting Procedures (Continued)

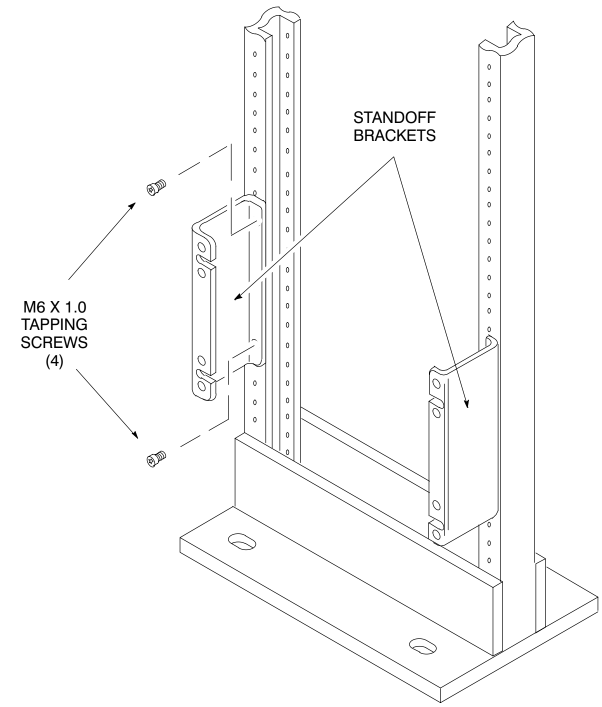
Mounting Quantar *Station Cage(s) in Customer–Supplied Rack*

Note: *Option X153AA provides two (2) standoff brackets and four (4) self–tapping screws.*

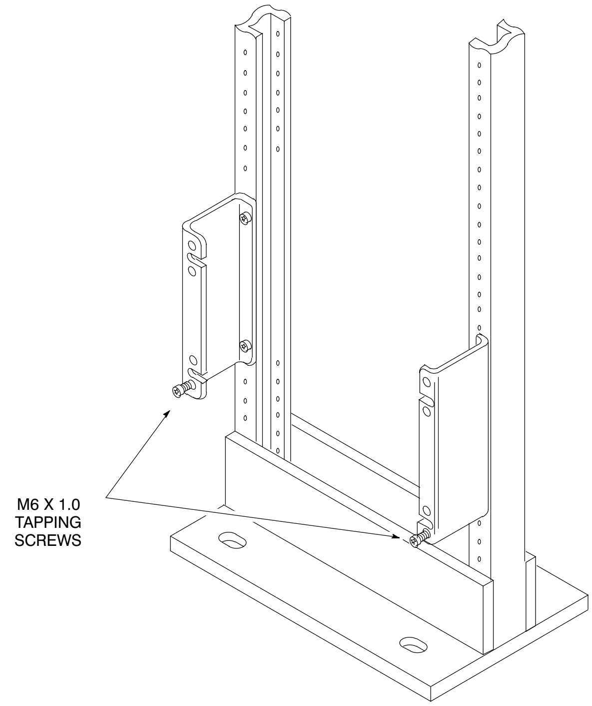
Quantar station cages intended for field mounting in a customer–supplied rack require standoff brackets to center the cage within the rack mounting rails. Mount the cage(s) as described in Figure 11.

Note: *Installing multiple cages one above the other is permitted as long as proper ventilation is maintained. Refer to Equipment Ventilation on page 3 for details.*

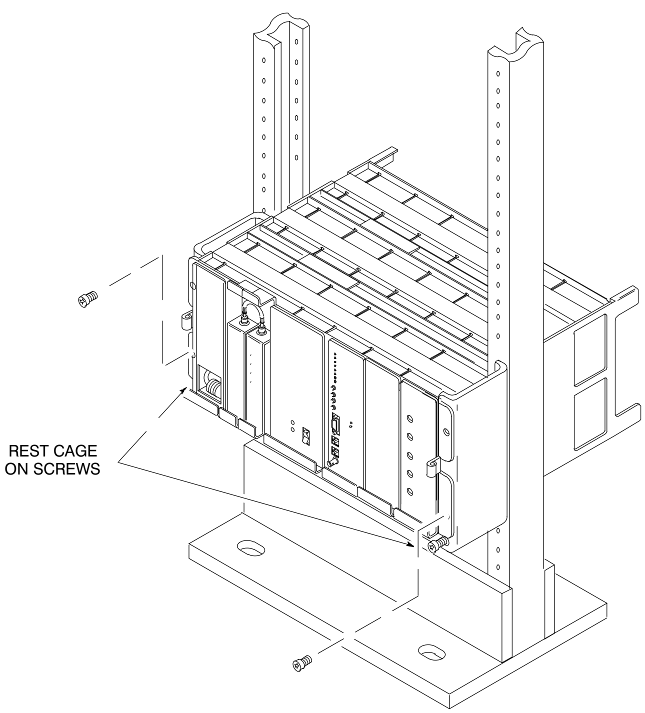
Note that when installing multiple cages, it is recommended that you mount the first cage in the lowest possible position in the rack, then continue building towards the top with additional cages. Mounting screws (M6 x 1.0 tapping) are provided with each cage to secure the cage flanges to the standoff brackets.



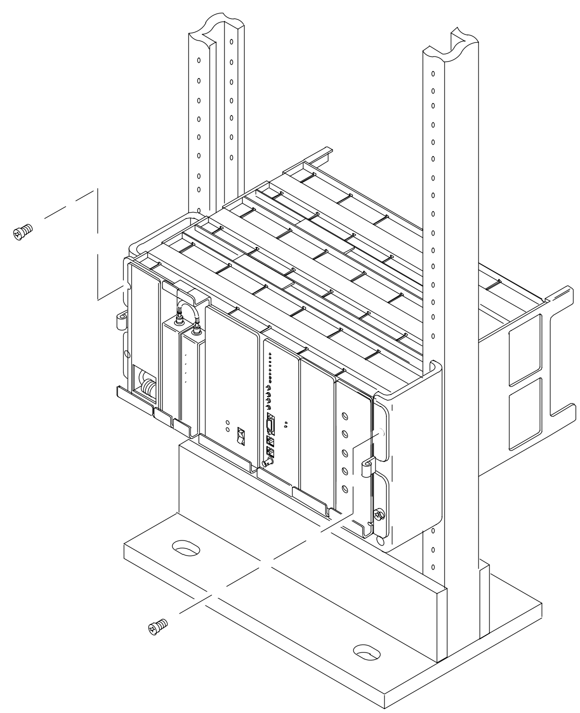
1 Position standoff brackets at desired position on rack (as shown). Secure to rack using M6 x 1.0 tapping screws.



2 Partially install M6 x 1.0 tapping screws in bottom holes in brackets, as shown.



3 Rest cage on lower two screws and install two M6 x 1.0 tapping screws in holes as shown. Tighten securely.



4 Remove two screws used to support cage and install in the upper two holes of the brackets. Tighten securely.

Figure 11. Installation Procedure for Rack Standoff Brackets

Mounting Procedures (Continued)

WARNING

A fully equipped 8' rack (ten *Quantar* cages) weighs approximately 650 lbs (245 kg). Handle with extreme caution to avoid tipping.

CAUTION

Cement dust from concrete flooring is harmful to electronic equipment and wiring. Make sure that the rack and any co–located equipment are protected prior to drilling holes in the concrete floor. Use a tarpaulin, cloth, or plastic sheeting to cover exposed equipment. (The rack should be already covered with an anti–static bag; do not remove the bag at this time.) Use a vacuum while drilling the holes to minimize the spread of concrete dust. Carefully clean up any accumulated dust and debris from the anchor installation before uncovering the equipment.

Installing 7', 7½', and 8' Open Racks and 30", 45", and 52" Modular Racks

In a typical installation, the rack is bolted to a concrete floor to provide stability. The following procedure describes the steps necessary to bolt the rack to a concrete floor. Be sure to check with local authorities to verify that the following procedure conforms to local building codes and regulations ***before permanently installing the rack***.

Step 1. Carefully align the rack at the desired anchoring location.

Step 2. Use the rack mounting foot as a template and mark the location of the six (open racks) ¾" (1.9 cm) or four (modular racks) .37" (.94 cm) diameter mounting holes. All four or six anchoring positions must be used.

Step 3. Move the rack aside, drill holes in the concrete floor, and install the mounting anchors (RAM RD–56 anchors recommended) per instructions provided with the anchors. Make sure that none of the anchors comes in contact with the reinforcing wire mesh buried in the concrete; the rack must be electrically isolated from any other equipment or materials at the site.

Step 4. Align the rack with the installed anchors and lightly secure the rack to the floor using the proper mounting hardware. **Do not tighten the mounting hardware at this time.**

Step 5. Check the vertical plumb of the rack. Also check that the top is level. Use shims (flat washers or flat aluminum plates) as necessary under the rack mounting foot to achieve vertical plumb and horizontal level.

Step 6. Tightly secure the rack to the floor anchors making sure that it remains vertically plumb and horizontally level.

Step 7. After all debris is removed and cement dust is cleared away, remove whatever protective covering has been placed on the equipment, including the anti–static bag.

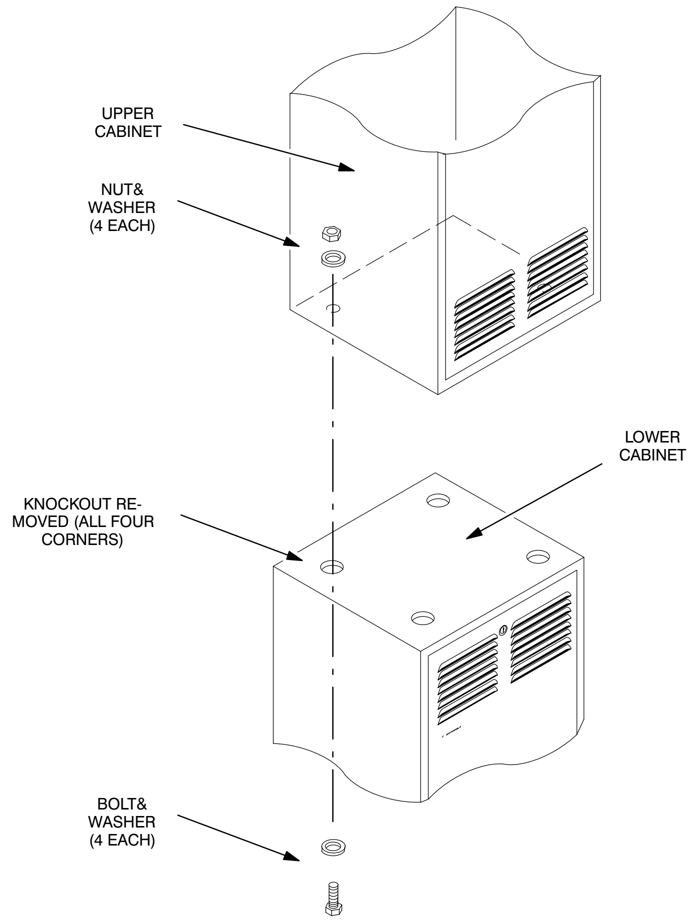
Mounting 30" x 20", 46" x 20", and 60" Indoor Cabinets

Each cabinet bottom is pre–drilled with four (4) mounting holes to allow attachment to the site floor. If installing on a concrete floor, use the cabinet as a template, mark the hole locations, and follow the procedures given for anchoring equipment racks (page 24). If installing on a wooden floor, use lag bolts and washers (customer supplied) to secure the cabinet to the floor.

Stacking Cabinets

The 12”, 30”, 46”, and 60” cabinets may be stacked on atop another to maximize use of site space. Stacking kit TRN7750A contains the necessary bolts, nuts, and washers to stack one cabinet on another. Remove the knockouts on the top of the lower cabinet and use the hardware as shown below to attach the upper cabinet.

Note: It is recommended that if different sizes of cabinets are being stacked (e.g., if a 30” cabinet is being stacked on top of a 46” cabinet), the larger size cabinet should be placed on the bottom.



The table below lists the stacking limits for the available cabinet sizes.

Cabinet Stacking Limits

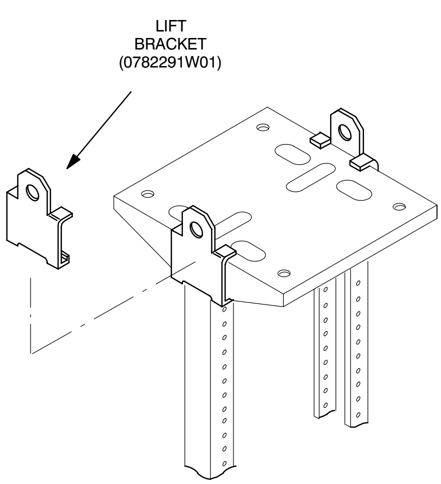
Cabinet Size	Maximum Stacking Number
12” x 20”	6 (72” max height)
30” x 20”	3 (90” max height)
46” x 20”	2 (92” max height)
60” Indoor	Not Stackable

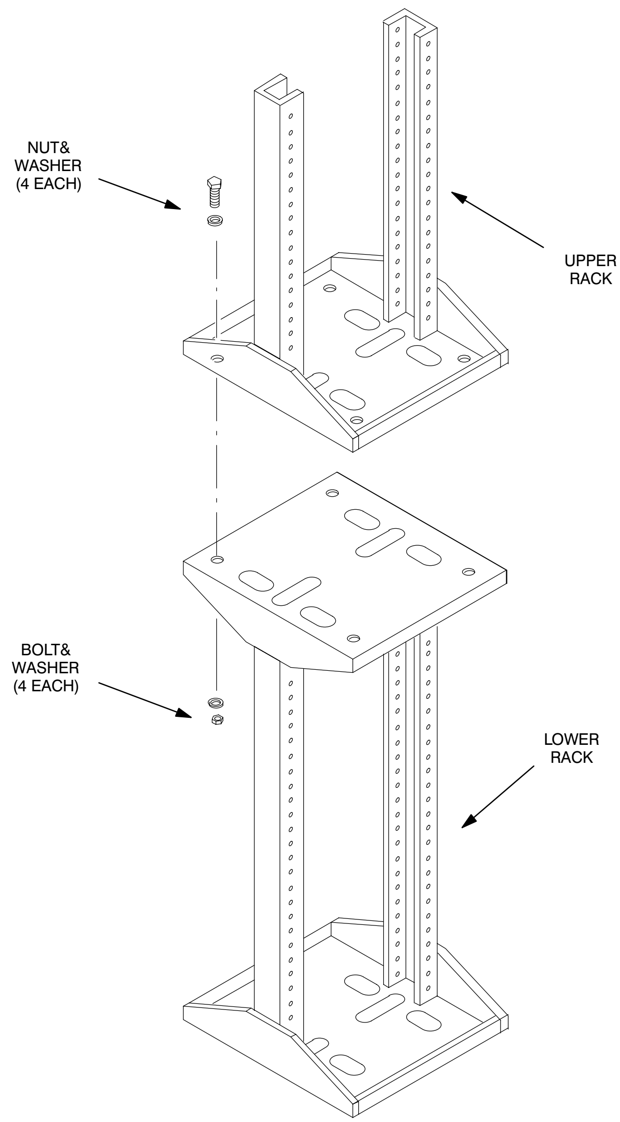
Stacking Modular Racks

The 30”, 45”, and 52” modular racks may be stacked one atop another to maximize use of site space. Stacking kit TRN7750A contains the necessary bolts, nuts, and washers to stack one rack on another. Use the hardware as shown below to attach the upper rack.

Note: *It is recommended that if different sizes of racks are being stacked (e.g., if a 30” rack and a 45” rack are being stacked), the larger rack should be placed on the bottom.*

Note: *Lift Brackets are available from WASPD to aid in lifting the racks. Install the brackets as shown below, and attach a lift bar or chain thru the bracket holes. A hoist may then be used to lift the rack.*



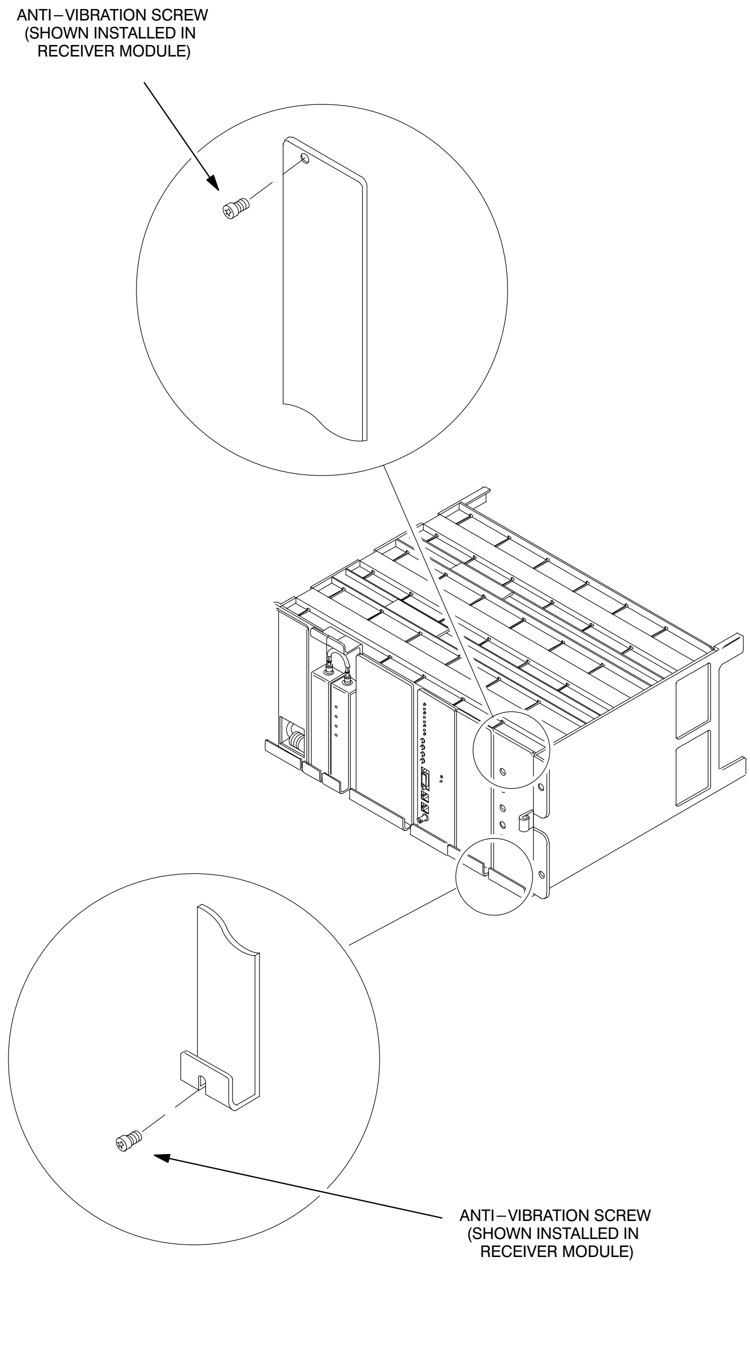


Modular Rack Stacking Limits

Stacking Combinations
Three 30” Modular Racks
One 45” and One 30” Modular Rack
One 30” and One 52” Modular Rack
Two 45” Modular Racks
One 45” and One 52” Modular Rack

Anti-Vibration/EMI Screws

Stations are shipped with Torx–head tapping screws installed at the top and bottom of each of the module front panels. These screws help reduce EMI emissions from the station modules, as well as provide additional mechanical stability for installations where a high amount of vibration (such as from nearby heavy machinery) is encountered.



3 ELECTRICAL CONNECTIONS

After the station equipment has been mechanically installed, electrical connections must be made. These include making power supply connections, connecting antenna coax cables, system cables, and telephone lines.

Power Supply Connections

CAUTION

Do not apply ac power to the station at this time. Make sure that the ac power switch (located on the front panel of the Power Supply Module is turned to OFF and that the circuit breaker associated with the ac outlet is also turned to OFF.

AC Input Power Connection

Each station cage is shipped with an eight foot 3−conductor line cord. Attach the receptacle end of the cord to the ac input plug located on the rear of the power supply module (as shown in Figure 12). Plug the 3−prong plug into a 110 V ac grounded outlet. (If you wish to connect the station to a 220 V ac outlet, you must obtain a line cord employing “HAR” flexible cord with fittings approved by a safety testing agency in the end use country.)

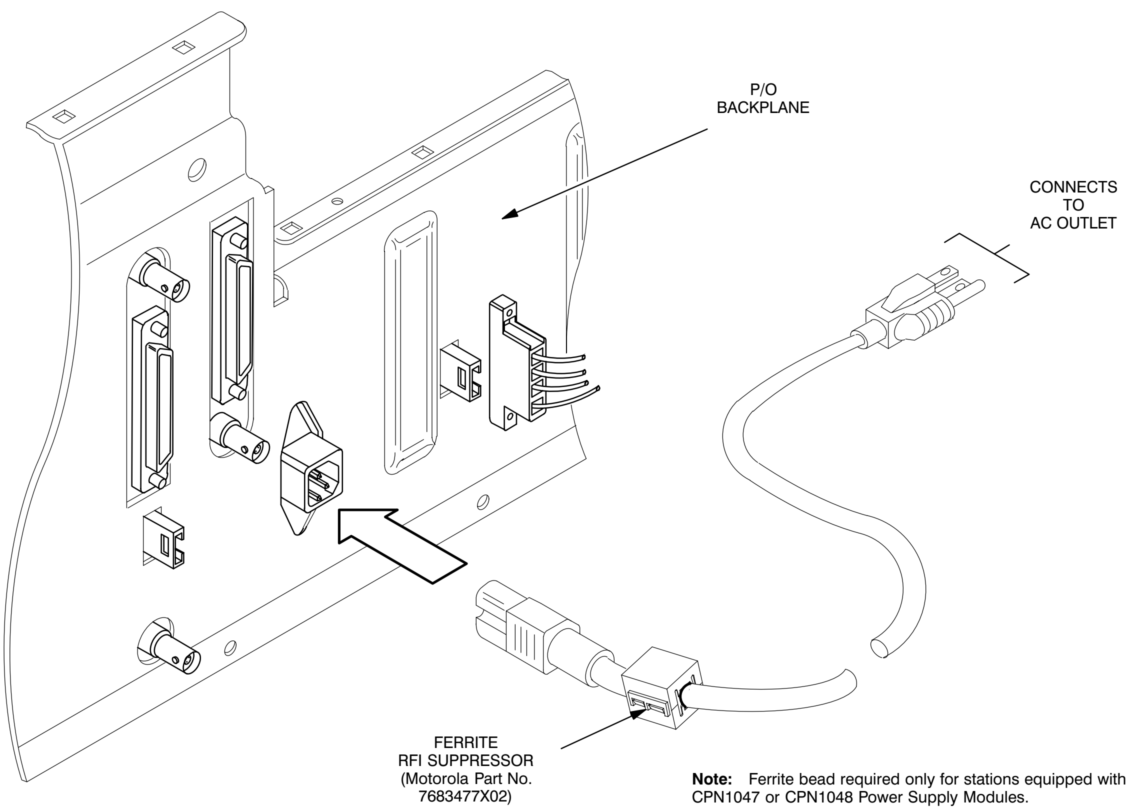


Figure 12. Connecting AC Line Cord

Power Supply Connections (Continued)

DC Input Power Connections

Stations shipped with the optional dc input power supply module accept a dc input from either a 12/24 V dc or 48/60 V dc source (e.g., a bank of storage batteries). Connections to the dc source are made via a 10’ battery charger cable kit shipped with the station, as shown in Figure 13.

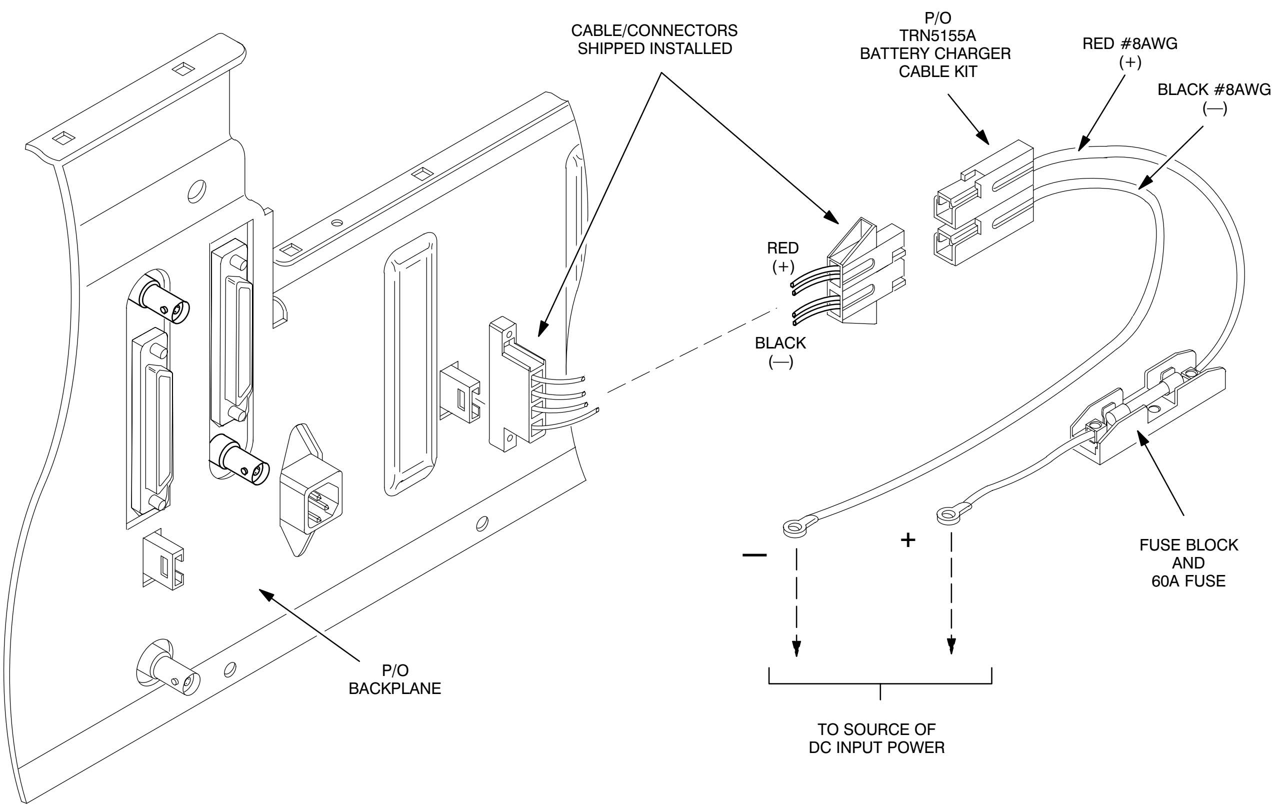


Figure 13. Making Connections to DC Power Source

Power Supply Connections (Continued)

Ground Connection

The *Quantar* station cage is equipped with a single ground lug located on the rear panel of the cage. Connect this lug to the site ground point as shown in Figure 14.

Refer to *Quality Standards — FNE Installation Manual (68P81089E50)* for complete information regarding lightning protection.

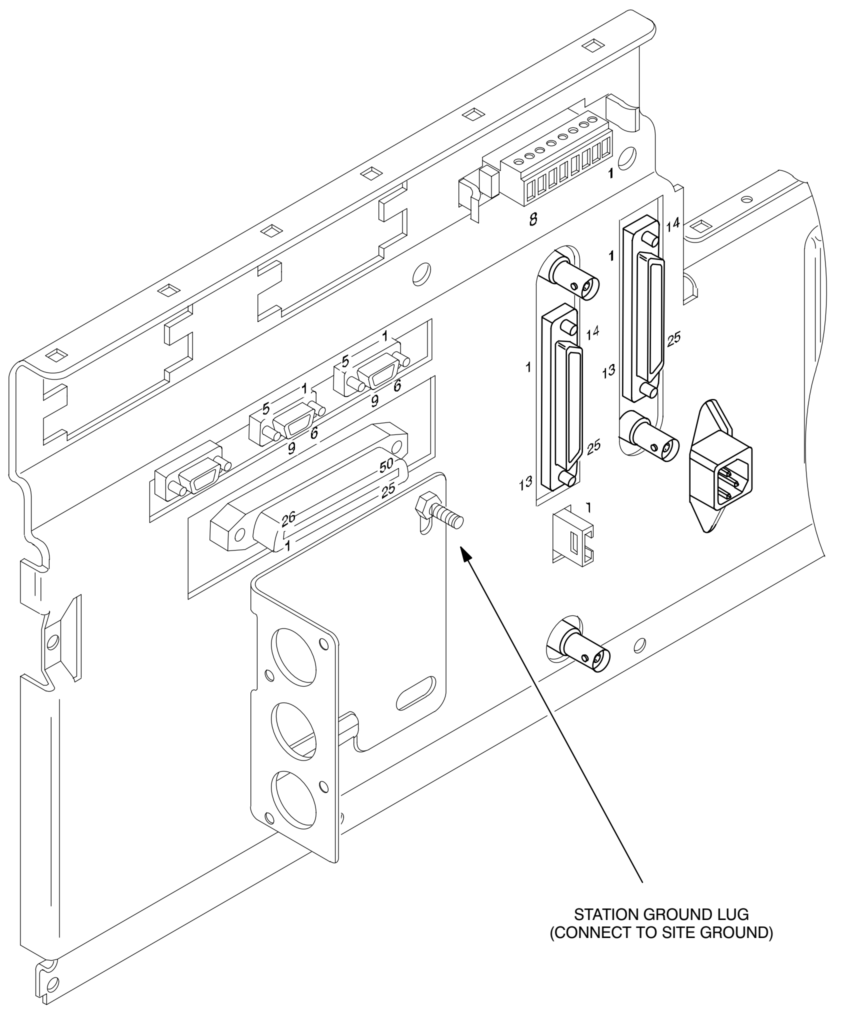


Figure 14. Connecting Station Ground Lug to Site Ground

Power Supply Connections (Continued)

Important! *Connect the charged battery to the station* ***before*** *applying AC power. Failure to do so may prevent the Power Supply Module from reverting to battery power upon AC failure.*

Important! *For Motorola Power Supply Modules with battery charging capability, the card edge connector used to connect to an external battery (located on the backplane)* ***may not*** *be used as a secondary source of dc output power. In order to prevent charging a battery with one or more dead cells, the supply is designed to provide charging current only if the battery is above +21.5 V (High Power Supplies) or +10.5 V (Low Power Supplies).*

Important! *Be sure to connect the battery cables* ***exactly*** *as shown in the illustration below, making certain to observe wire colors and polarities.*

Storage Battery Connections

Stations with a power supply module equipped with the battery charger/revert option offer the capability of reverting to battery backup power in the event of an ac power failure. Connections associated with the battery charger/revert feature are:

- Charger/Revert Cable — the station is shipped with a 4−wire cable terminated in a heavy duty 2−position connector; cable kit TRN5155A (shipped with station) contains mating connector, two 10’ lengths of red and black #8 AWG gauge wires, a fuse block and 60A fuse, and crimp−on ring lugs. Make connections to the storage battery as shown in Figure 15.
- Battery Temperature Cable — thermistor (TKN8786A) and cable (TKN8732A) are shipped with charger−style power supply); cable with three wires carries a variable resistance signal from the thermistor which is mounted in close proximity to storage battery; resistance is proportional to battery temperature and is used by diagnostic circuitry in power supply module. Make thermistor connections as shown in Figure 15.

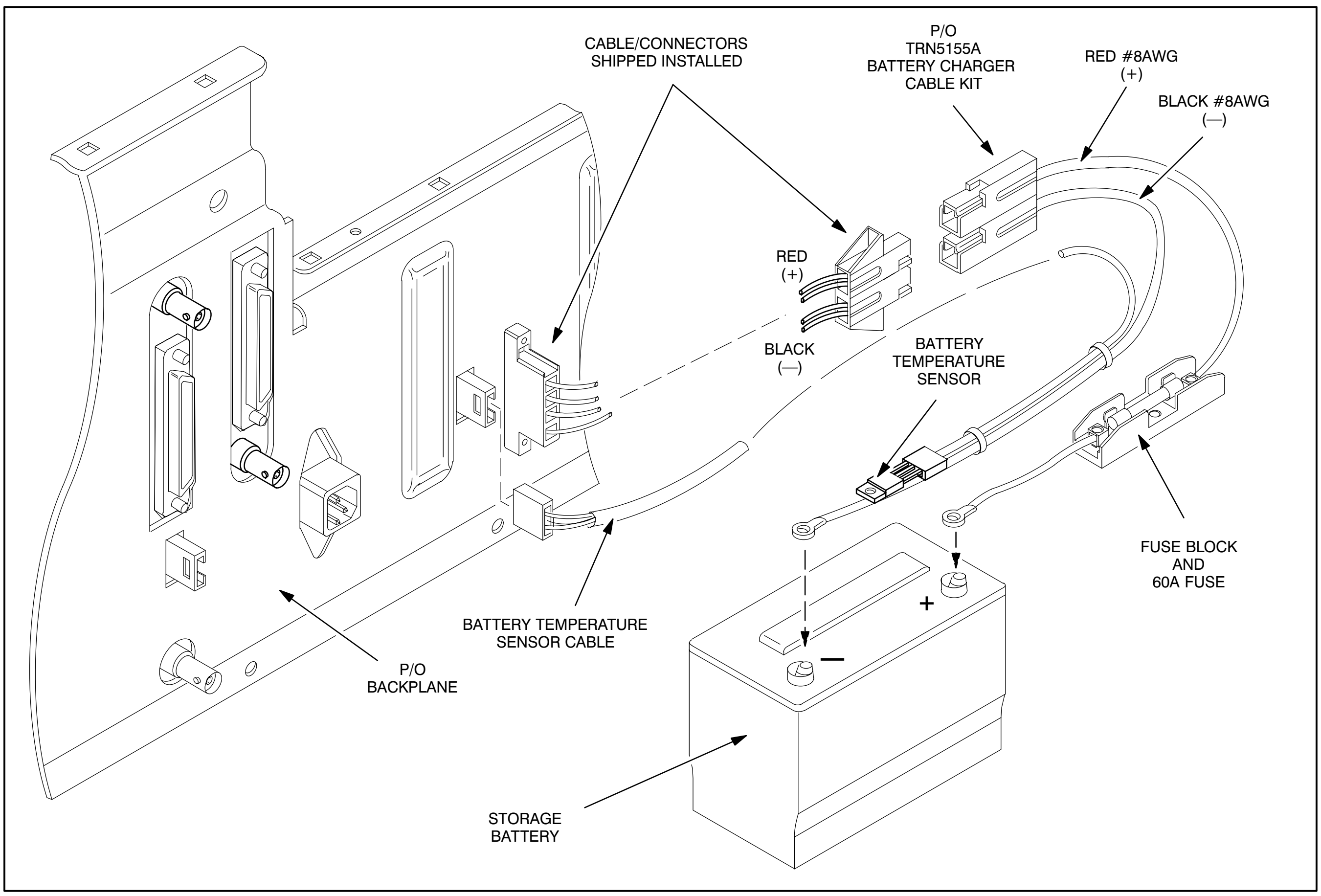


Figure 15. Making Connections to Storage Battery

RF Cabling Connections

Introduction

The transmit and receive antenna rf connections may be made in one of three fashions, depending on the options ordered with the station and system application.

- **Separate TX and RX Connectors** — A bracket located on the rear of the station holds two N−type connectors, one for RX and one for TX. Coax cables from the receive and transmit antennas must be connected to these N−type connectors.
- **Single Antenna with Antenna Relay Option**— An antenna relay module is mounted on the rear of the station. Coax cables from the station Receiver and Power Amplifier Modules are connected to the antenna relay module. A single N−type connector is provided for connection to a single RX/TX antenna. The relay module is controlled by a signal from the Station Control Module via a 3−wire cable connected between the antenna relay module and a 3−pin connector located on the backplane.
- **Duplexer Option** — The duplexer option equips the station with a Duplexer Module which is typically mounted in the same rack or cabinet as the station. Coax cables from the station Receiver and Power Amplifier Modules are connected to the Duplexer Module. A single N−type connector is provided for connection to a single RX/TX antenna.

RF Cabling Connections (Continued)

Separate RX and TX Connectors

Stations intended for separate transmit and receive antennas are shipped with the coax cables from the Power Amplifier and Receiver Modules connected to the bracket on the backplane, as shown below (Figure 16).

Connect the rf cables from the transmit and receive antennas to the station as shown below.

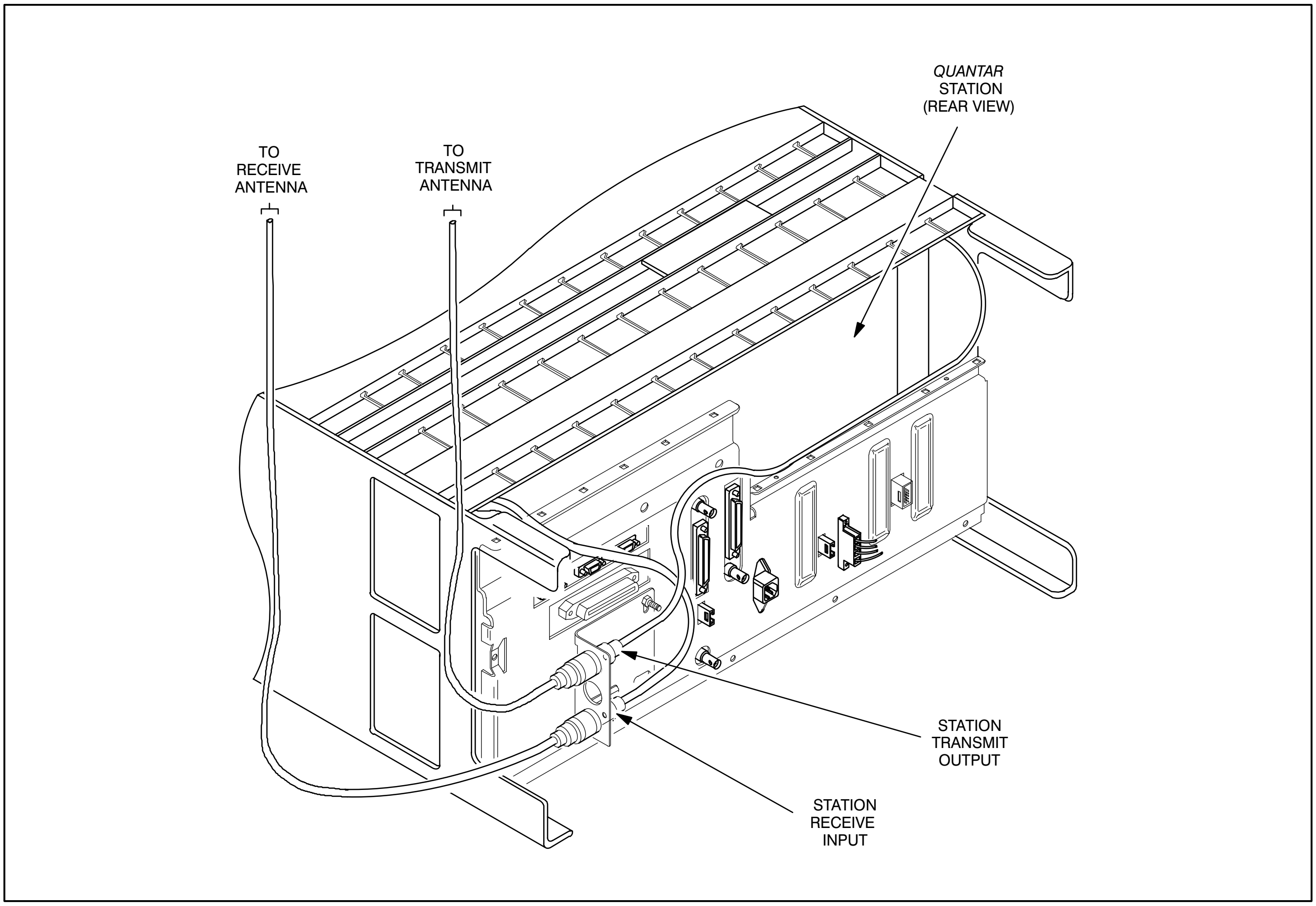


Figure 16. Separate RX and TX Antenna Connections

RF Cabling Connections (Continued)

Antenna Relay Option

Stations equipped with the antenna relay option are shipped with the antenna relay module installed in the bracket on the backplane, with the rf cables from the Power Amplifier and Receiver Modules connected as shown below (Figure 17). Note that the 3–wire control cable from the antenna relay to connector #23 located on the backplane has been installed.

Connect the single transmit/receive antenna rf cable to the center N–type connector on the antenna relay module.

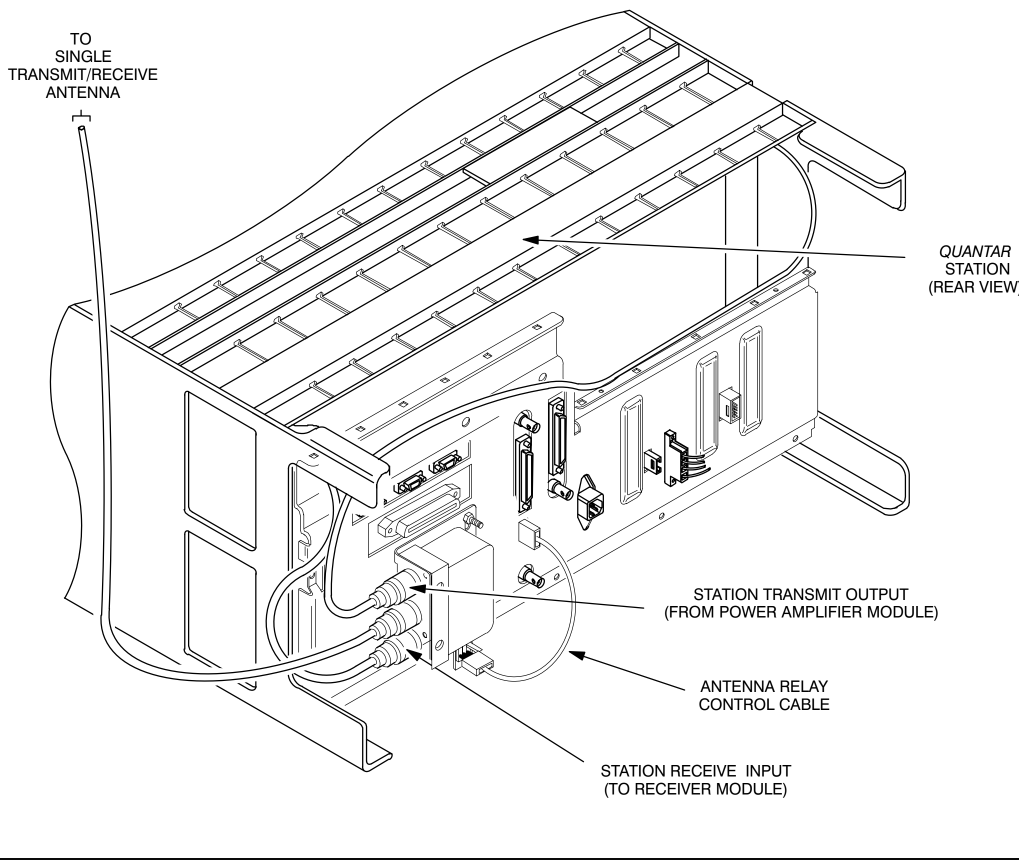


Figure 17. RF and Control Cable Connections for Station Equipped with Antenna Relay

RF Cabling Connections (Continued)

Duplexer Option

The Duplexer Option may be installed with or without the Triple Circulator Option. In either configuration, connect the rf cable to/from the single TX/RX antenna to the Duplexer Module as shown in Figure 18 (for VHF). Figure 19 (for UHF), or Figure 20 (for 800/900 MHz).

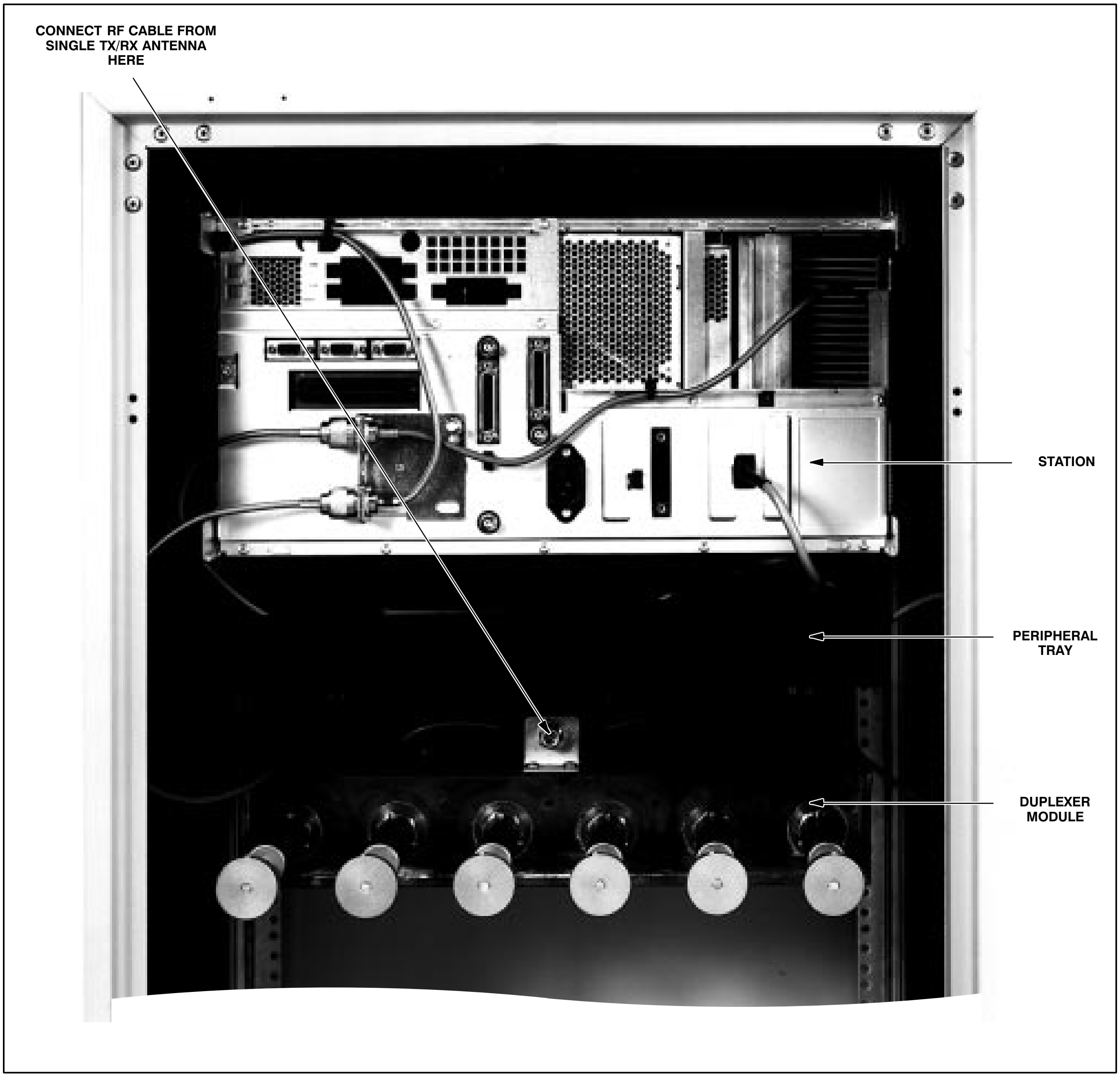


Figure 18. TX/RX Antenna Cable Connection to Duplexer Module (VHF; Triple Circulator Configuration Shown)

RF Cabling Connections (Continued)

Duplexer Option (continued)

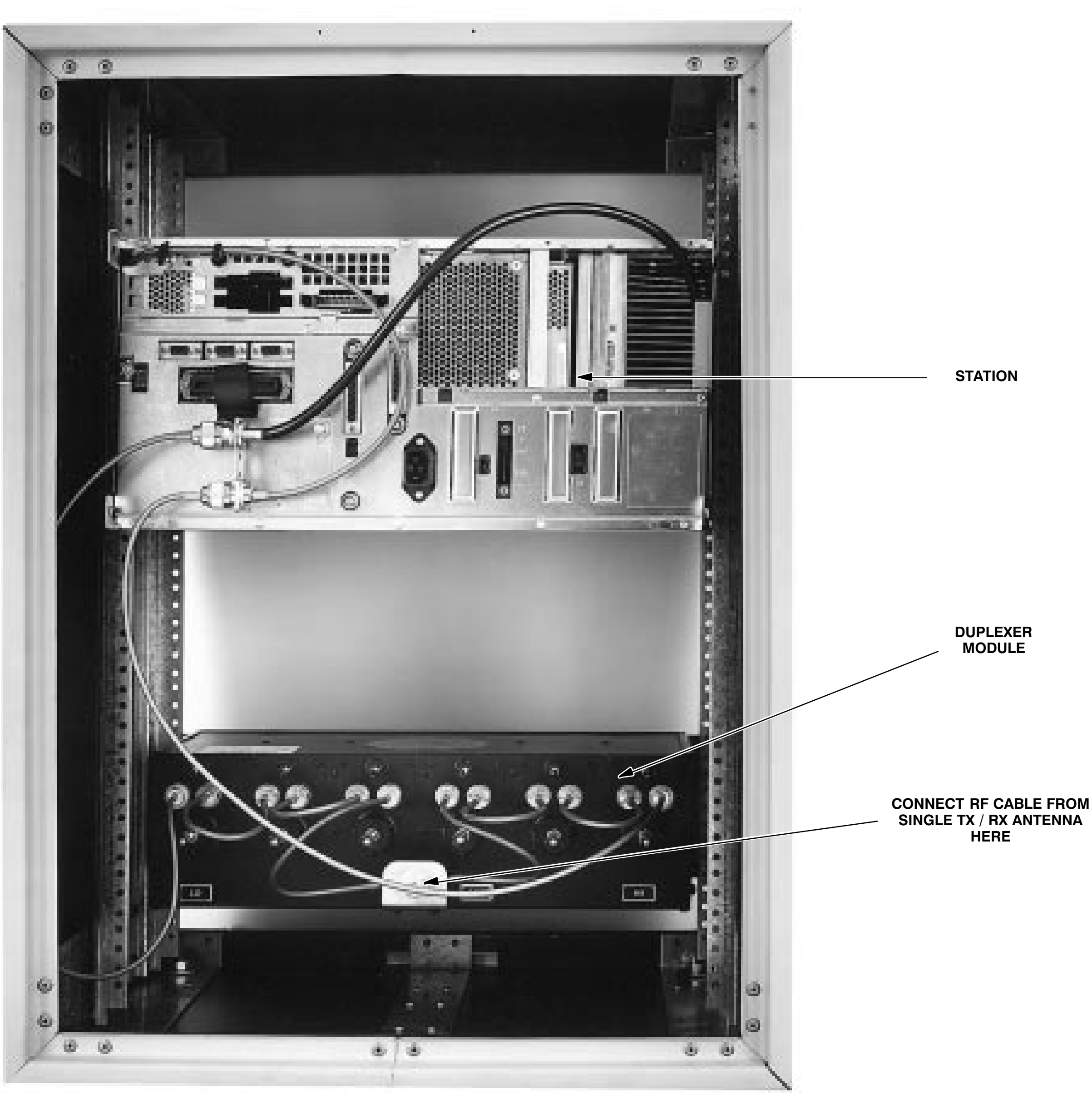


Figure 19. TX/RX Antenna Cable Connection to Duplexer Module (UHF)

RF Cabling Connections (Continued)

Duplexer Option (continued)

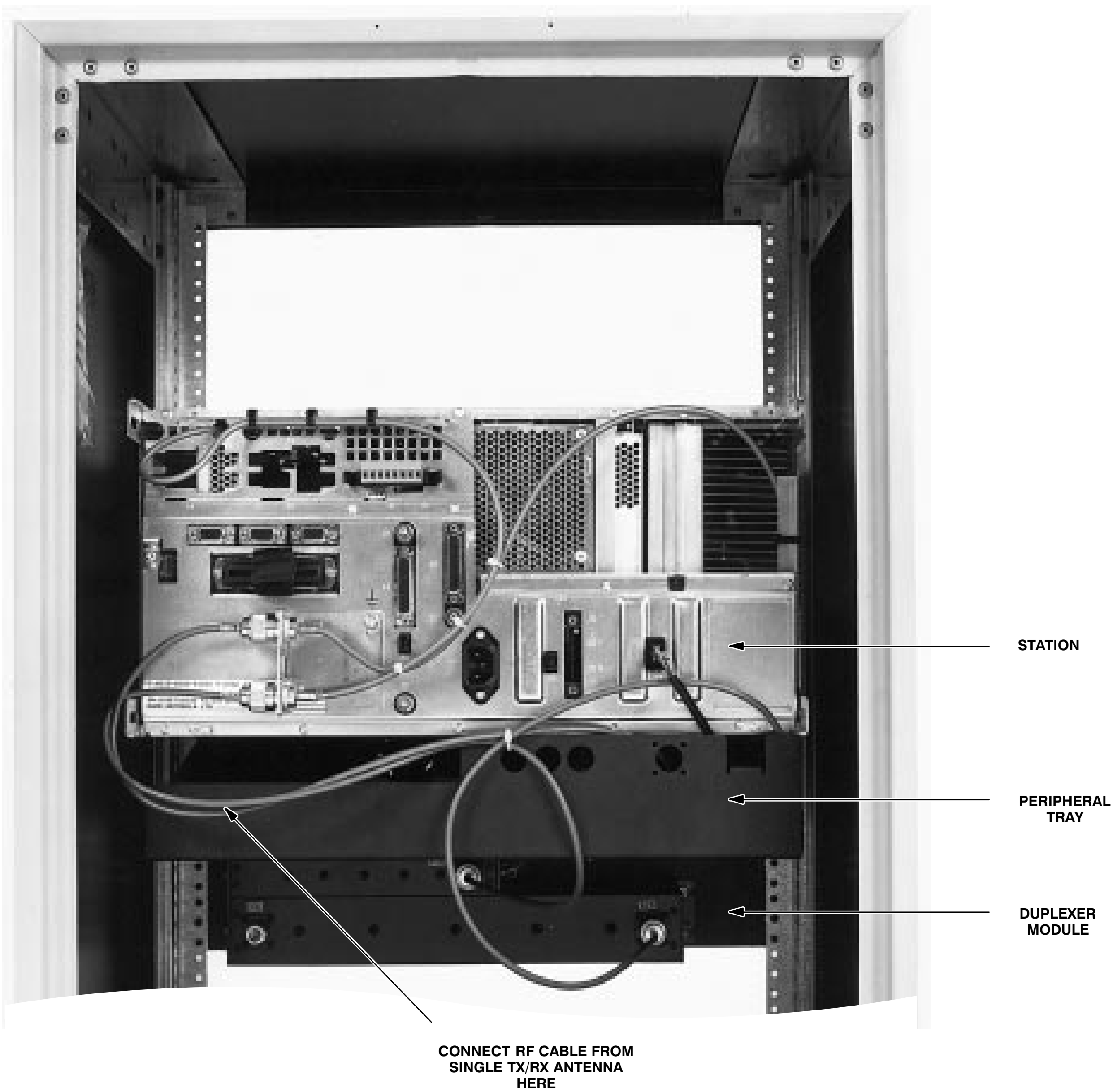


Figure 20. TX/RX Antenna Cable Connection to Duplexer Module (800/900 MHz; Triple Circulator Configuration Shown)

Connecting System Cables

Introduction

Depending on the type of communications system and options, various system cables must be connected to the station backplane. Make the connections as described in the following paragraphs.

IntelliRepeater *D-LAN Cabling Connections*

Note: ***IntelliRepeater*** *networks may be either D–LAN or Ethernet. Refer to page 40 for instructions on connecting the stations in an Ethernet network.*

A typical Motorola *IntelliRepeater* trunking site is comprised of multiple *IntelliRepeater*–capable stations connected together in a local area network. One of the stations is assigned to act as the current active master and is responsible for all call processing and channel assignments within the site. The other stations act as voice channel repeaters under control of the current active master.

Note: *Options X148AA–X150AA provide an* ***IntelliRepeater*** *LAN cable kit which includes a PhoneNet interface box, an RJ–11 terminator, and a length (10', 25', or 50') of telephone cable with RJ–11 connectors on each end.*

Cabling for an *IntelliRepeater* trunking site using a D-LAN network consists of making the LAN connections between each of the stations. Make the cabling connections as follows.

Step 1. Select a station to be at one end of the network. Note that the station need not be the station selected to serve as the current active master.

Step 2. Connect the 9–pin D–type connector (part of the *PhoneNet* interface box) to connector DLAN1 (located on the station backplane, as shown in Figure 21).

Step 3. Install an RJ–11 terminator in one of the RJ–11 ports on the *PhoneNet* interface box. (The empty RJ–11 port at each end of the network must be terminated with an RJ–11 terminator.)

Step 4. Select the end of the telephone cable with a ground wire and spade terminal attached. Connect the RJ–11 connector into the empty port of the *PhoneNet* interface box; connect the spade lug to the station chassis screw, as shown in Figure 21.

Step 5. Install a *PhoneNet* interface box to the remaining stations in the *IntelliRepeater* network.

Step 6. Connect the stations together in a “daisy chain” fashion, as shown in Figure 21. Remember to connect the ground wire and spade terminal to the station chassis screw on each station.

Step 7. Install an RJ–11 terminator in the empty RJ–11 port in the *PhoneNet* interface box on the last station in the network.

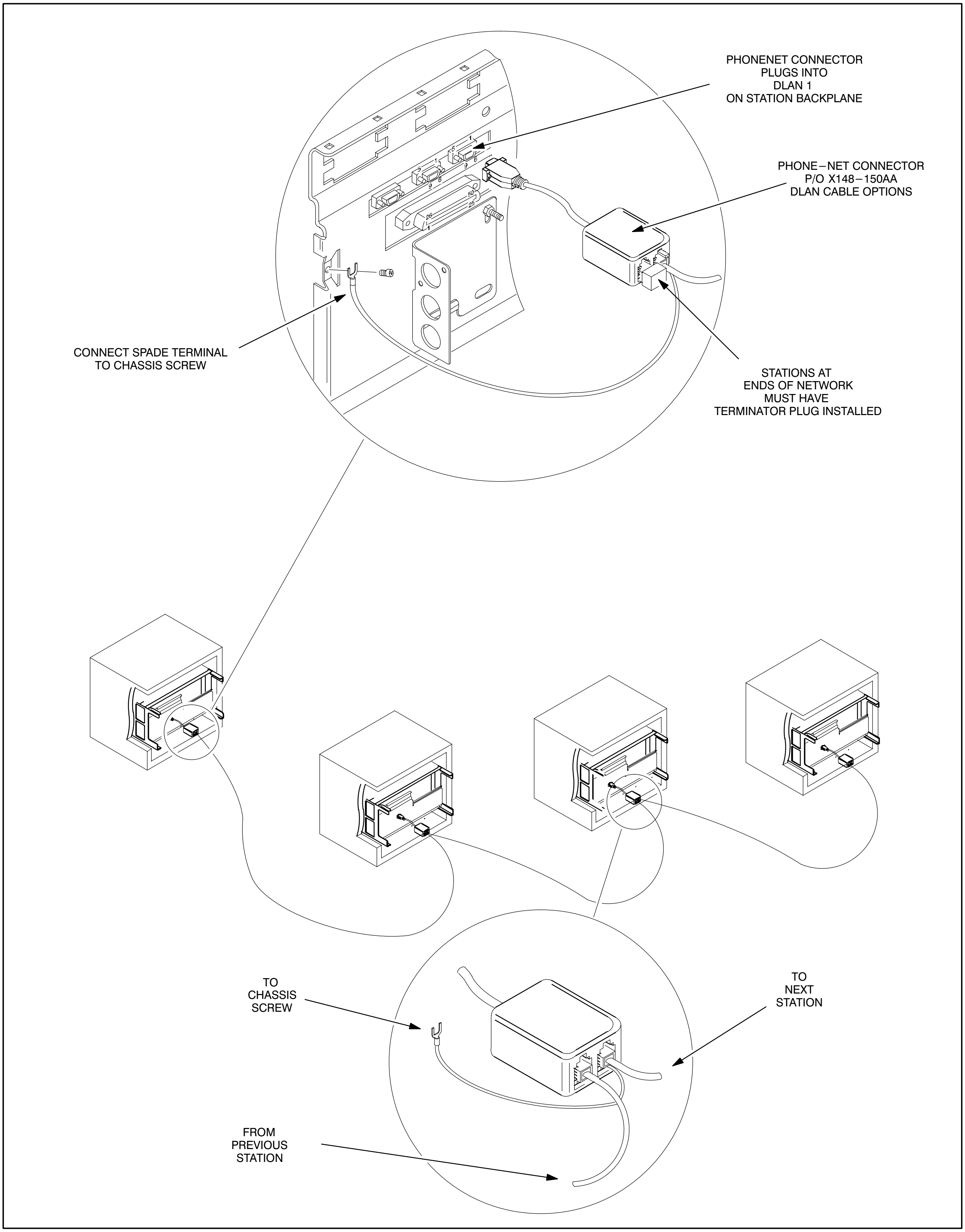


Figure 21. *IntelliRepeater* Trunking Site D–LAN Network Cabling Detail

Connecting System Cables (Continued)

IntelliRepeater *Ethernet Cabling Connections*

*Note: **IntelliRepeater** networks may be either D−LAN or Ethernet. Refer to page 38 for instructions on connecting the stations in a D−LAN network.*

Cabling for an *IntelliRepeater* trunking site using an Ethernet network consists of making the 10BASE−2 (coaxial) cabling connections between each of the stations. Make the cabling connections as follows.

Step 1. Connect a T-connector to BNC connector #22 on the backplane of each station in the network.

Step 2. Select two stations, one at each end of the network. One will be the terminated end of the Ethernet network, the other will be the access point of the Ethernet network.

Step 3. Place a terminator on one end of the T-connector on the station selected to be at the terminated end of the network, as shown in Figure 22.

*Note: A coaxial cable and a T-connector is provided with each **IntelliRepeater** station shipped from the factory. A site termination kit (Option X843AB) provides two terminators, a T-connector to serve as the network access point, and a circular insulating pad.*

Step 4. Using the supplied 10BASE−2 coaxial cables, connect the stations together in a “daisy chain” fashion, as shown in Figure 22.

Step 5. Create a network access point by connecting the last station to a T-connector and terminating the other end. This T-connector serves as the access point for the Ethernet network. This T-connector may be used to connect a PC to the network to download station software to the FLASH memory in each of the *IntelliRepeater* stations.

Step 6. Insulate each T-connector by folding the circular insulating pad around the connector and pressing it together until it sticks to itself, holding it in place.

Important! Ethernet networks utilize a floating ground. In order to eliminate possible data corruption resulting from multiple ground points in the network, the network should be grounded at **only one point**. This is typically accomplished at the terminated end of the network by using a terminator with an attached ground wire. Attach the ground wire to the station chassis. Make sure that the other T-connectors and cables in the network are not grounded to any station, either intentionally or accidentally, by using the circular insulating pads on every T-connector.

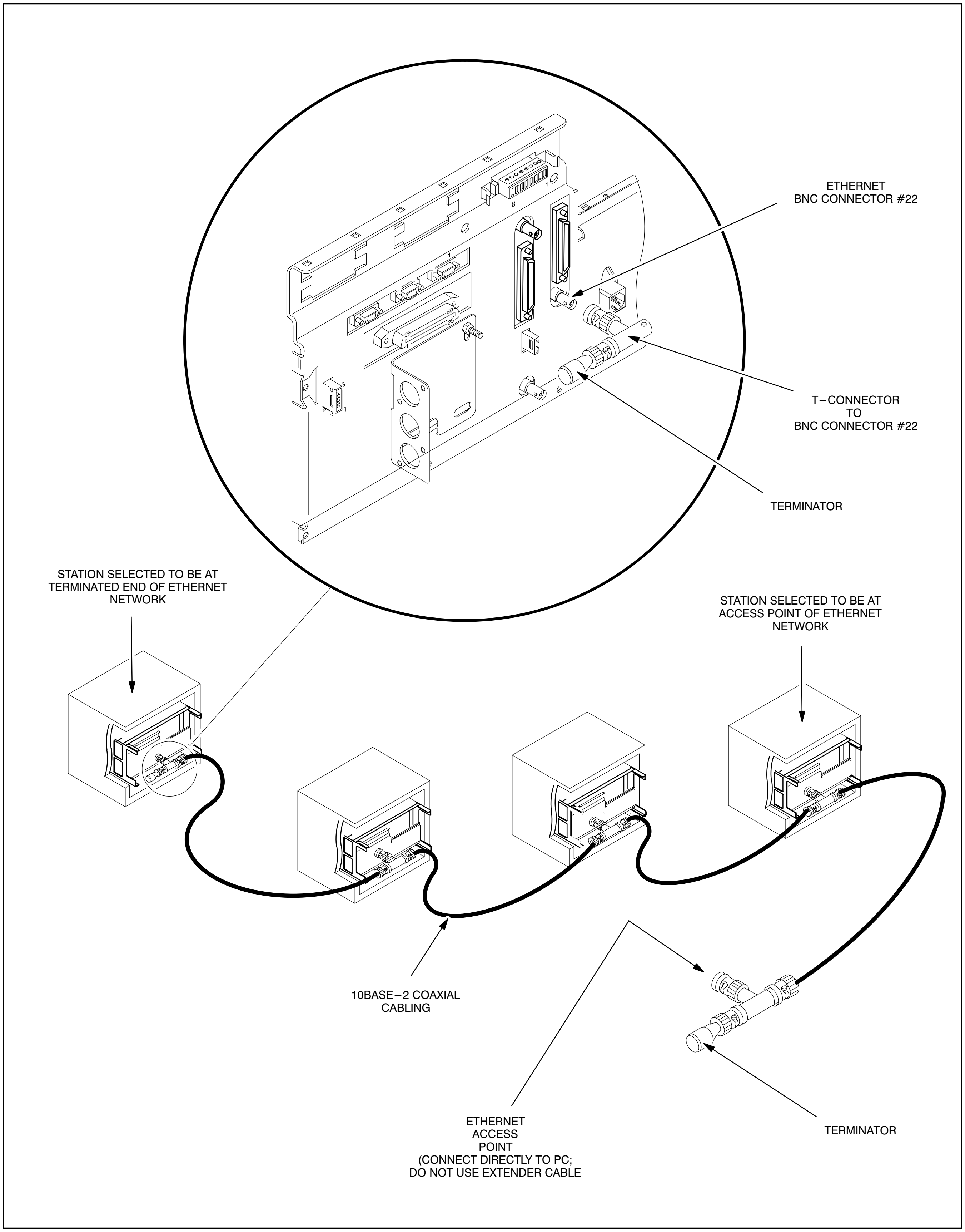


Figure 22. *IntelliRepeater* Trunking Site Ethernet Network Cabling Detail

Connecting System Cables (Continued)

6809 Trunking Cabling Connections

Connect the control cable from the 6809 Trunking Controller to the station backplane as shown in Figure 23 below.

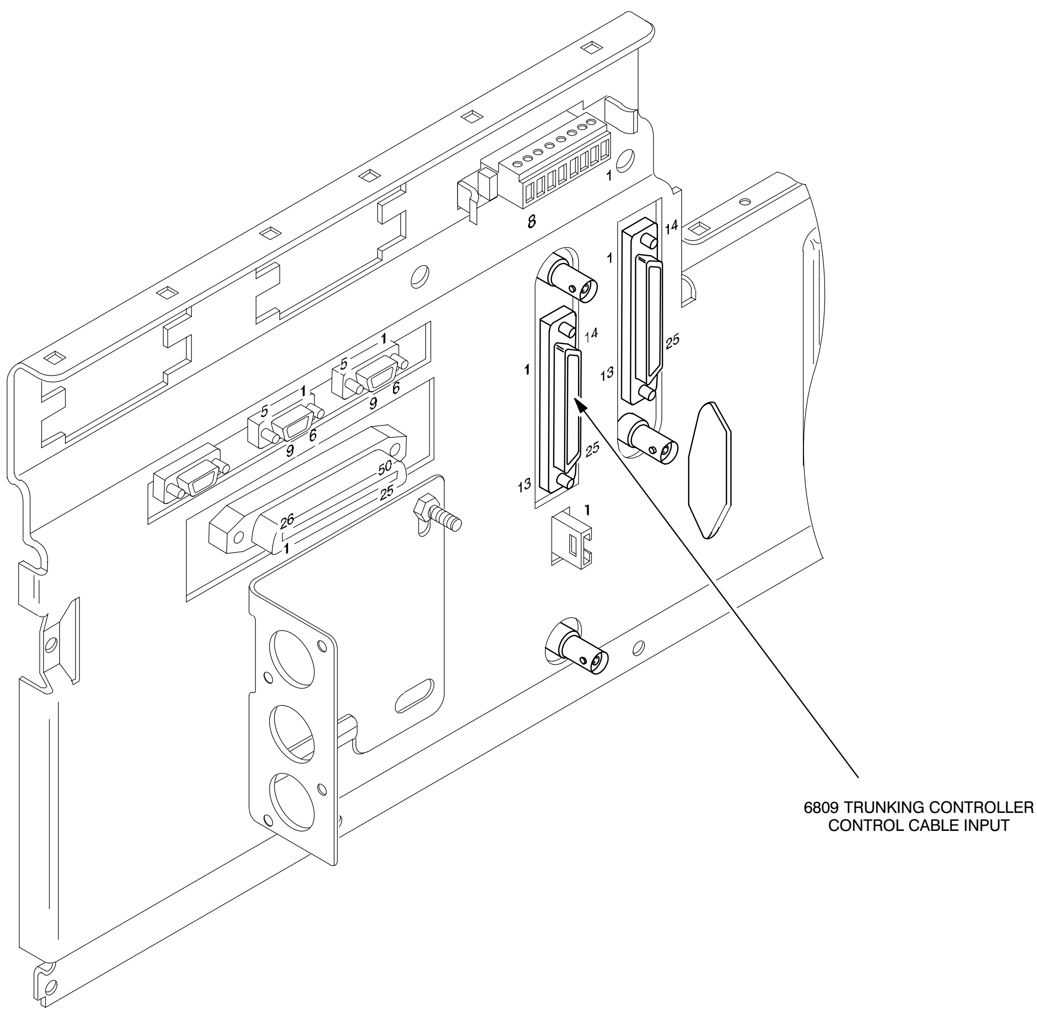


Figure 23. Connecting 6809 Trunking Controller Cable

Connecting System Cables (Continued)

Zone Controller Cabling Connections

Connect the control cable from the Zone Controller to the station backplane as shown in Figure 24 below.

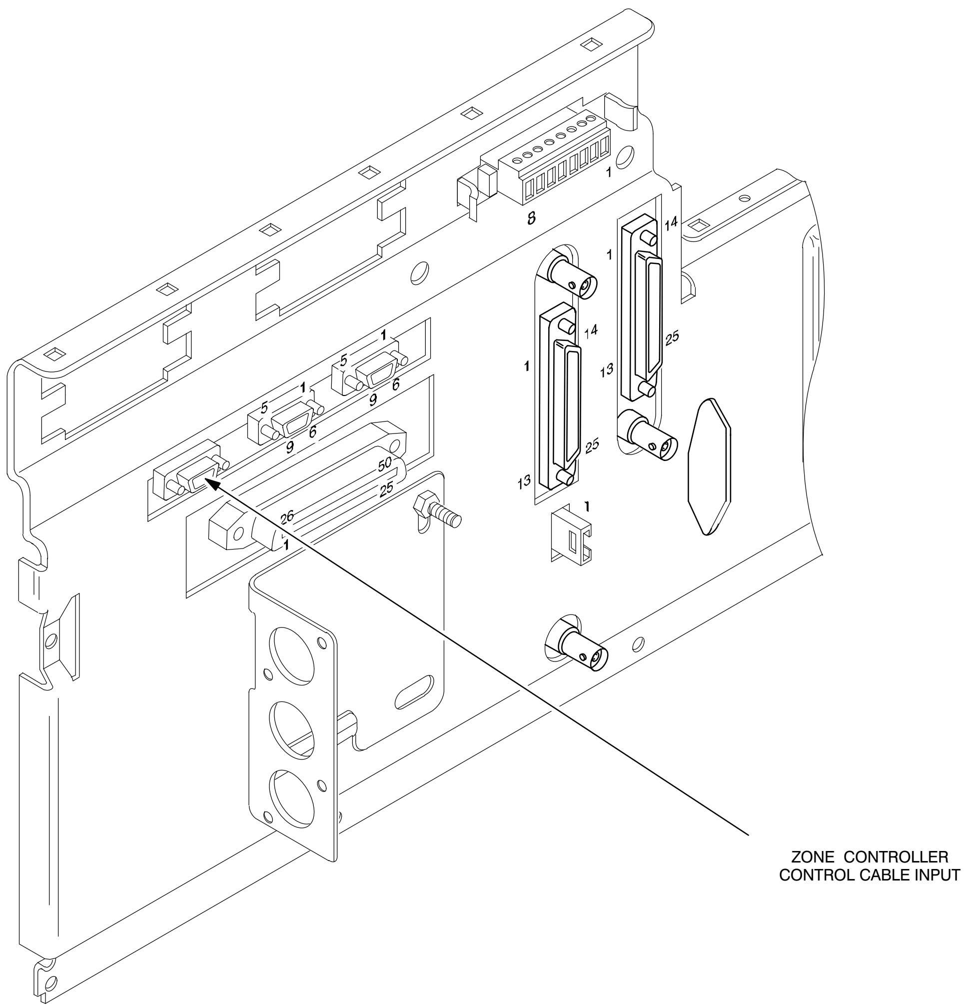


Figure 24. Connecting Zone Controller Cable

Connecting System Cables (Continued)

6809 Controller TSC/CSC Link Cabling Connections

Connect the TSC/CSC link cable (broadcast box) from the 6809 Controller to the station backplane as shown in Figure 25 below.

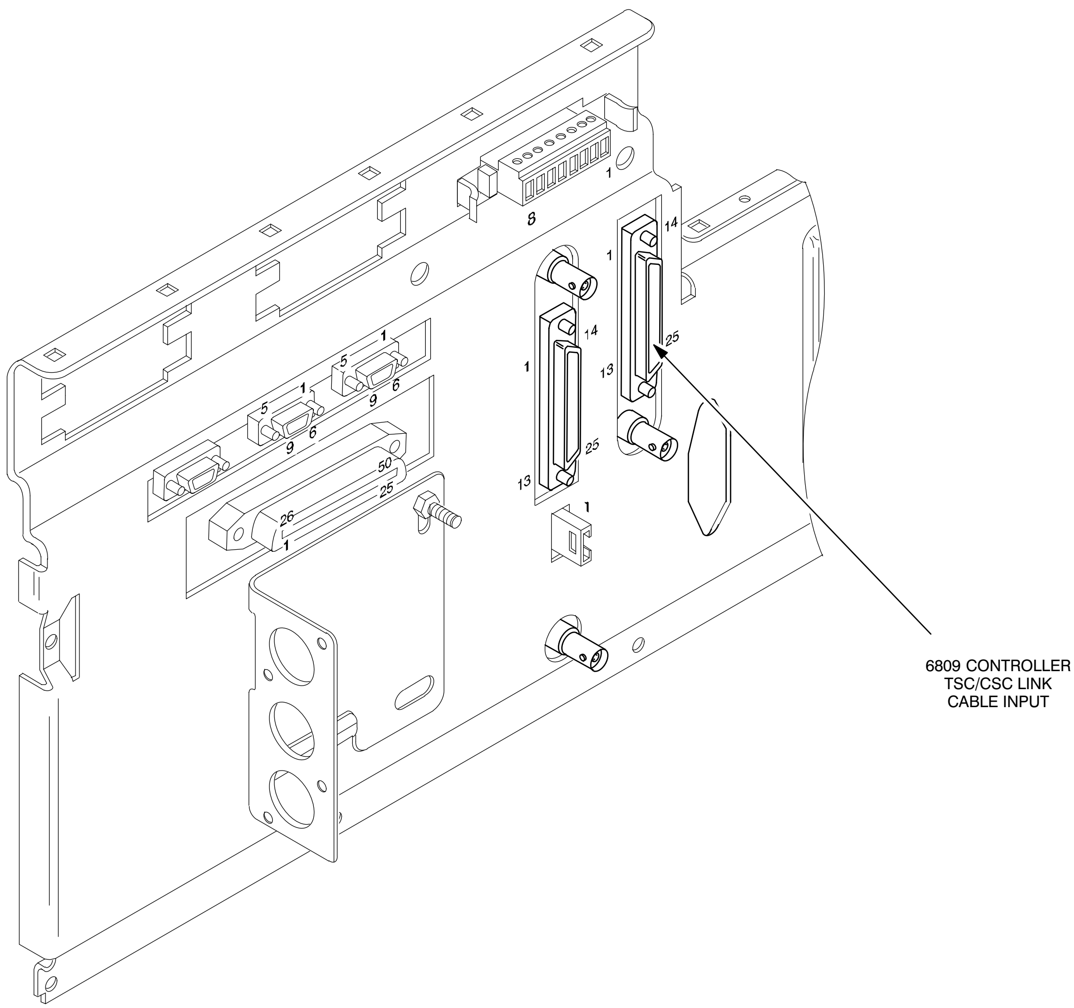


Figure 25. Connecting Zone Controller Cable

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Connecting Telephone Lines

Introduction

In conventional systems where the station is controlled by a remote console, or in wide area systems utilizing comparators, phone lines must be connected between the station and the remote equipment. The phone lines may carry analog voice, *SECURENET*–encoded voice, and/or *ASTRO*–encoded voice. Also carried on the phone lines is one of two types of remote control signaling (Tone Remote Control or *ASTRO* digital packets). The following information defines the specifications for the phone lines, the location on the station backplane for phone line connections, and which of the four (4) wireline circuits to use for various system types.

Telephone Line Specifications

Most telephone companies recognize either "3002" or "Type 5" as designations to define phone line types and associated electrical specifications. Telephone lines meeting the specifications for either of these types are acceptable for use with the *Quantar* station. The following table shows the specifications for "3002" and "Type 5" phone line types.

Type 5 and "3002" Phone Line Specifications

Parameter	Type 5 Specification	3002 Specification
Loss Deviation	±4.0 dB	±4.0 dB
C–Notched Noise	51 dBrnCO	51 dBrnCO
Attenuation Distortion: 504 to 2504 Hz 404 to 2804 Hz 304 to 3004 Hz	 −2.0 to +8.0 dB −2.0 to +10.0 dB −3.0 to +12.0 dB	 −2.0 to +8.0 dB spec not available −3.0 to +12.0 dB
Signal to C–Notched Noise Ratio	≥ 24 dB	≥ 24 dB
Envelope Delay Distortion: 804 to 2604 Hz	1750 μsec	1750 μsec
Impulse Noise Threshold	71 dBrnCO	
Intermodulation Distortion: R2 R3	 ≥ 27 dB ≥ 32 dB	≥ 25 dB ≥ 30
Phase Jitter: 20–300 Hz 4–300 Hz	 ≥ 10 Degrees ≥ 15 Degrees	≥ 25 Degrees ≥ 30 Degrees
Frequency Shift	± 3 Hz	± 5 Hz

Connecting Telephone Lines (Continued)

Location of Telephone Line Connections

For added convenience, telephone line connections may be made in one of two locations on the station rear panel.

- 50–pin Telco Systems Connector
- Orange 8–Position Screw Terminal Connector

The location of the telephone line connections is shown in Figure 26. Note that these connections are **not** surge or transient protected. Refer to *Quality Standards — FNE Installation Manual (68P81089E50)* for details.

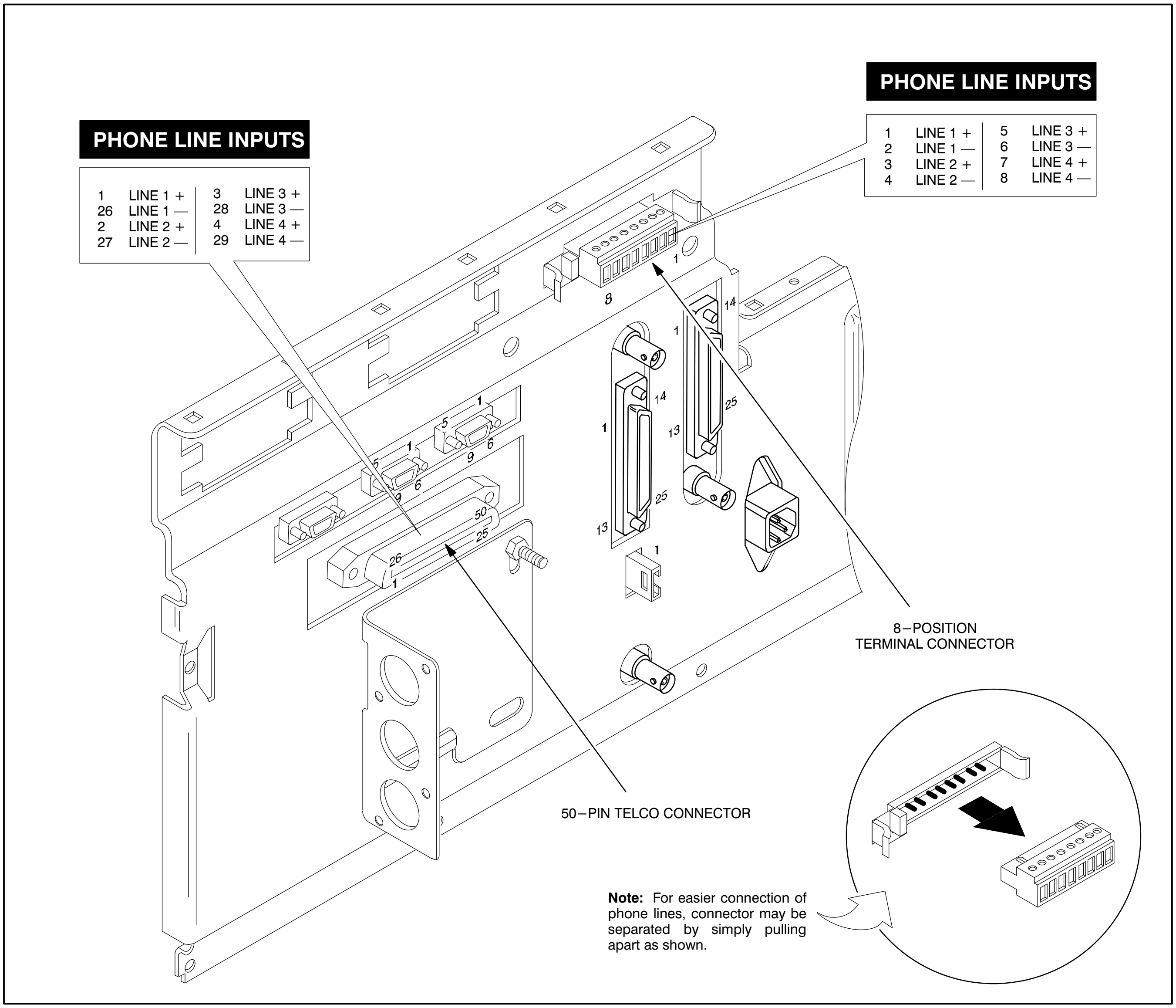


Figure 26. Two Locations for Telephone Line Connections

Connecting Telephone Lines (Continued)

Note: *Stations equipped with a 4–wire Wireline Interface Board (Model CLN6955) can support a single 4–wire or a single 2–wire telephone line connection.*
Stations equipped with an 8–wire Wireline Interface Board (Model CLN6956) can support two 4–wire or a single 2–wire telephone line connection. Refer to the Wireline Interface Board section in this manual for details.

2–Wire / 4–Wire Jumper Setting

Wireline Interface Boards are shipped with the 2–wire/4–wire jumper (JU1010) installed in the 4–wire position. If required for your installation, move the jumper to the 2–wire position. Refer to the appropriate (per model) Wireline Interface Board section in this manual for jumper details.

Input/Output Impedance Matching Jumper Settings

Wireline Interface Boards are shipped with the input/output impedance matching jumpers installed in the 600 Ω positions. If required for your installation, move the jumpers to the desired positions. Refer to the appropriate model Wireline Interface Board section in this manual for jumper details.

System Type vs Wireline Circuit Matrix

The following table shows which of the four (4) wireline circuits to use for various system types.

Connecting Telephone Lines (Continued)

System Type vs Wireline Circuit Matrix Table

System Type	Line 1 (Note 1)	Line 2 (Note 1)	Line 3 (Note 3)	Line 4 (Note 3)
Conventional Local Area Analog	Console	Console	Not Used	Not Used
Conventional Local Area Analog with Repeater Access	Console	Console	Not Used	Not Used
Conventional Wide Area Analog	Comparator	Comparator	Not Used	Not Used
Conventional Simulcast Wide Area Analog	(Note 2)	Comparator	Not Used	Not Used
Conventional Local Area *SECURENET*	DVM or CIU	DVM or CIU	Not Used	Not Used
Conventional Local Area *SECURENET* w/Repeater Access	DVM or CIU	DVM or CIU	Not Used	Not Used
Conventional Wide Area *SECURENET*	DVM or *DIGITAC*	DVM or *DIGITAC*	Not Used	Not Used
Conventional Simulcast Wide Area *SECURENET*	(Note 2)	DVM or *DIGITAC*	Not Used	Not Used
Conventional Local Area *ASTRO*	DIU	DIU	Not Used	Not Used
Conventional Local Area *ASTRO* w/Repeater Access	DIU	DIU	Not Used	Not Used
IntelliRepeater Trunking Wide Area Analog	*SMARTZONE* Audio Switch	*SMARTZONE* Audio Switch	Not Used	Not Used
IntelliRepeater Trunking Wide Area *SECURENET*	*SMARTZONE* Audio Switch	*SMARTZONE* Audio Switch	Not Used	Not Used
6809 Trunking Single Site Analog	Interconnect	Interconnect	Not Used	Not Used
6809 Trunking Single Site *SECURENET*	DVM or CIU	DVM or CIU	Not Used	Not Used
6809 Trunking Single Site Analog w/Console Priority Interface	Console	Console	Interconnect (8–Wire WIB Req'd)	Interconnect (8–Wire WIB Req'd)
6809 Trunking Wide Area Analog	Comparator	Comparator	Not Used	Not Used
6809 Trunking Simulcast Wide Area Analog	(Note 2)	Comparator	Not Used	Not Used
6809 Trunking Wide Area *SECURENET*	DVM or *DIGITAC*	DVM or *DIGITAC*	Not Used	Not Used
6809 Trunking Simulcast Wide Area *SECURENET*	(Note 2)	DVM or *DIGITAC*	Not Used	Not Used

Notes:

1. For 4–wire systems, Line 1 is transmit audio (landline to station), and Line 2 is receive audio (station to landline). For 2–wire systems, Line 2 is transmit and receive audio (conventional local area analog only).
2. For Simulcast stations, transmit audio is connected from RDM (or equivalent) to GEN TX DATA+ and – on backplane.
3. Lines 3 and 4 can be used with the Enhanced WildCard Option for customer-specific applications (in analog stations only). The optional 8-wire Wireline Interface Module is required.

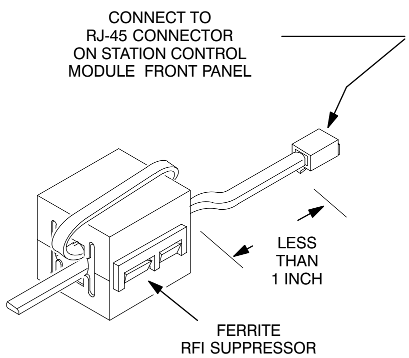
Connecting V.24 Board

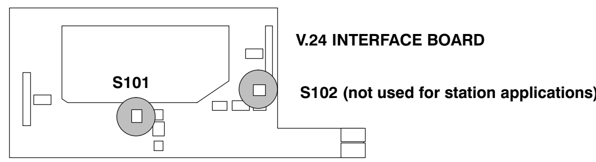
Note *Connecting to a local DIU or ASTRO-TAC Comparator requires a null modem cable and programming the station for Internal Clock Generation (refer to the RSS User's Guide for details).*

For *Quantar*/*Quantro* Conventional stations (hybrid links) and *SMARTZONE* Trunking stations (V.24 required), connections to/from the station are made using a V.24 Interface Board (installed on the Wireline Interface Board). This board (Option X889AC) allows connections to be made between external V.24 modem equipment and the station via an RJ-45 connector accessible on the front panel (as shown below).

Make the connections and DIP Switch settings as shown in Figure 27.

Note *The cable connected to the V.24 RJ-45 connector must have a ferrite RFI suppressor installed. This suppressor is supplied by Motorola with each station and must be installed as shown below.*



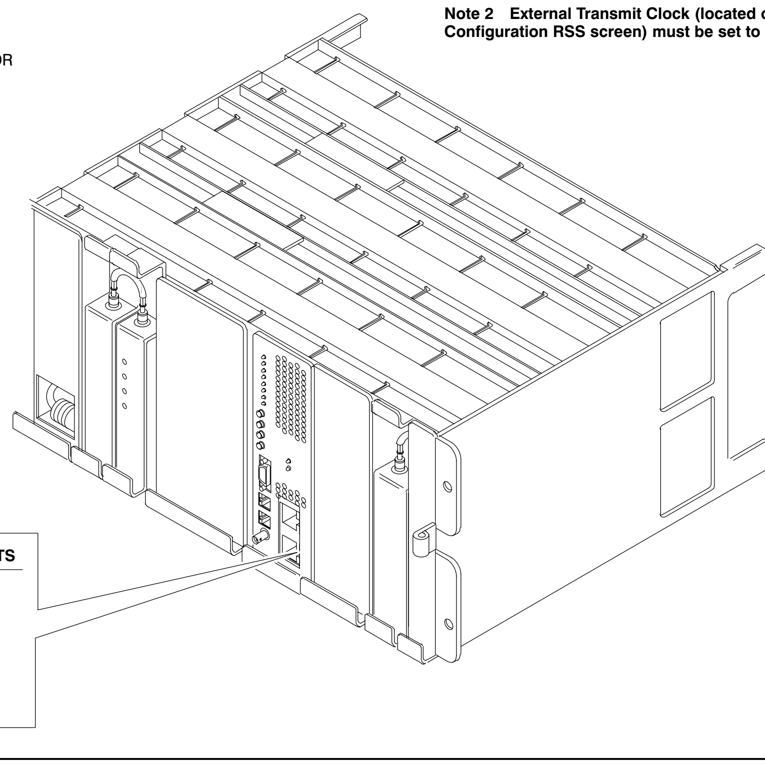


S101 DIP Switch Settings

Position	Local Connection to Comparator (Note 1)	Connection to Microwave System (Note 2)
1	OFF	ON
2	ON	OFF
3	n/a	n/a
4	n/a	n/a

Note 1 External Transmit Clock (located on the Wireline Configuration RSS screen) must be set to DISABLED.

Note 2 External Transmit Clock (located on the Wireline Configuration RSS screen) must be set to ENABLED.

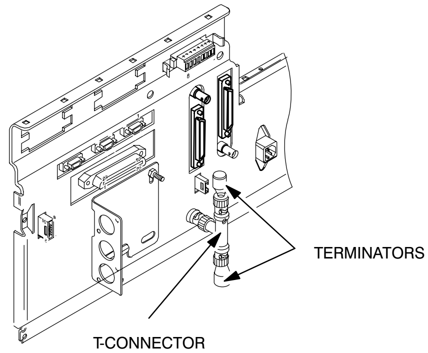


RJ-45 PIN-OUTS	
1	RCLK
2	CD
3	TCLK
4	GND
5	RXD
6	TXD
7	CTS
8	RTS

Figure 27. Making V.24 Board Connections

Connecting External Reference

Note *For standalone stations equipped with an internal UHSO module, make sure the BNC connector #30 (located on the backplane) is terminated as shown below.*



Overview

In some cases (e.g., Simulcast, 900 MHz, etc.), the use of a frequency reference other than the internal reference oscillator (located on the Station Control Board) is required. In these cases, either an internal Ultra High Stability Oscillator (UHSO, available as an option) or an external 5 MHz or 10 MHz source (typically from a rubidium–based standard) must be employed. Without one of these sources connected, the station synthesizers will not maintain the required stability.

Single Station Connections

For stations without the internal UHSO option, connect the output of an external 5 MHz or 10 MHz reference source to one of two station connectors, as shown in Figure 28. (The external source must remain connected and powered at all times during station operation; otherwise, the synthesizers will fail to lock and the station will not transmit or receive.)

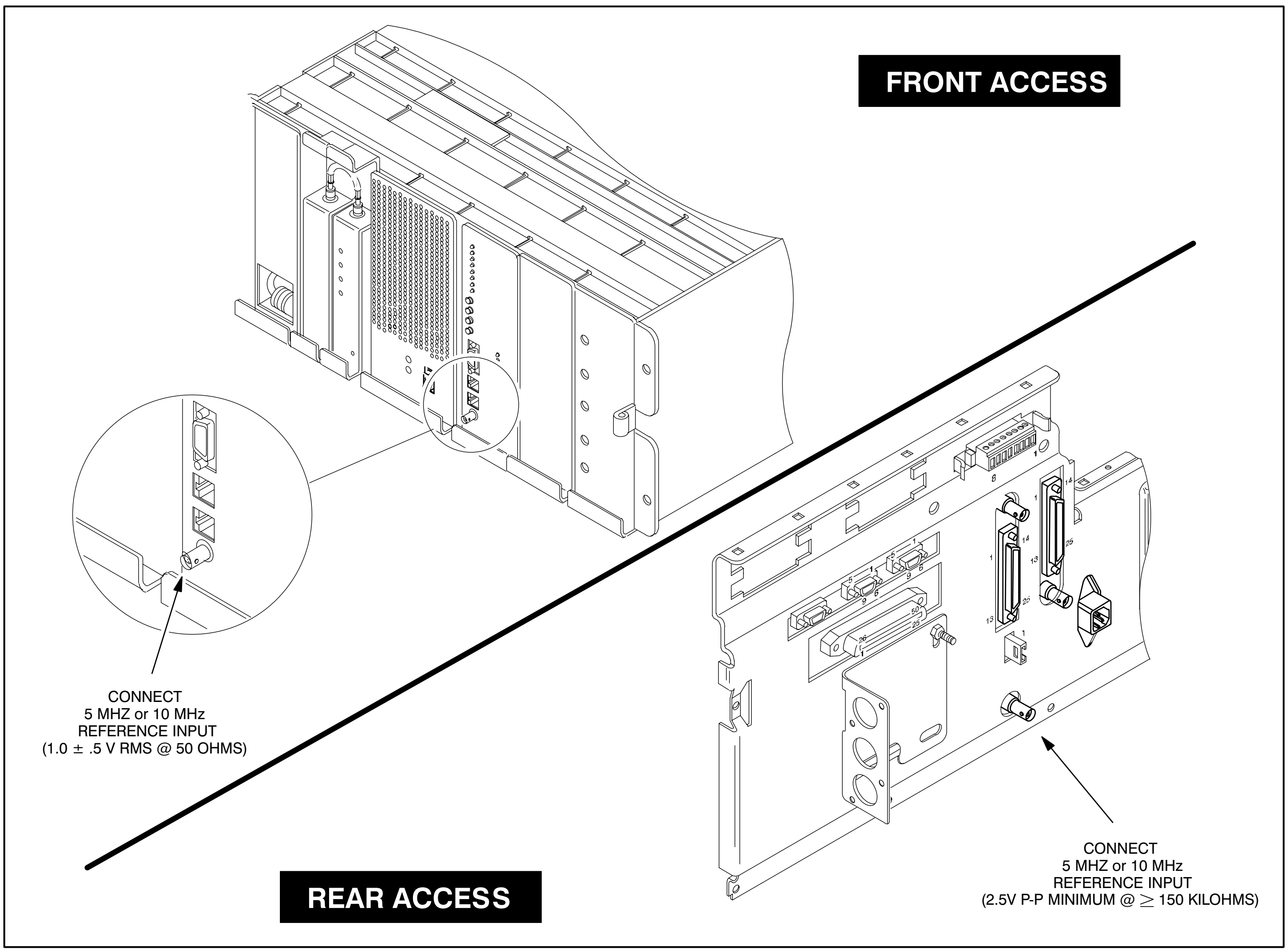


Figure 28. Connecting External 5 MHz or 10 MHz Reference Source to Single Station

Connecting External Reference (continued)

Multi-Drop Connections

For sites with multiple stations that require a high-stability reference signal, a multi-drop configuration may be used. In this configuration, a single source (either an external signal source or a station equipped with a UHSO module) provides the reference signal to all stations at the site. Make the connections as shown in Figure 29.

Note the following guidelines and requirements:

- A maximum of six (6) *Quantar* stations (mounted in same rack) can be connected in a multi-drop configuration.
- An Ultra High Stability Oscillator module (UHSO) must be installed in the bottom station only.
- RSS programming for bottom station must be set for **INTERNAL — HIGH STABILITY** (*Freq Ref:* field on the *Hardware Configuration* screen). All other stations must be set for EXTERNAL — 5 MHz. Refer to the *Radio Service Software User's Guide 68P81085E35* for details on RSS programming.

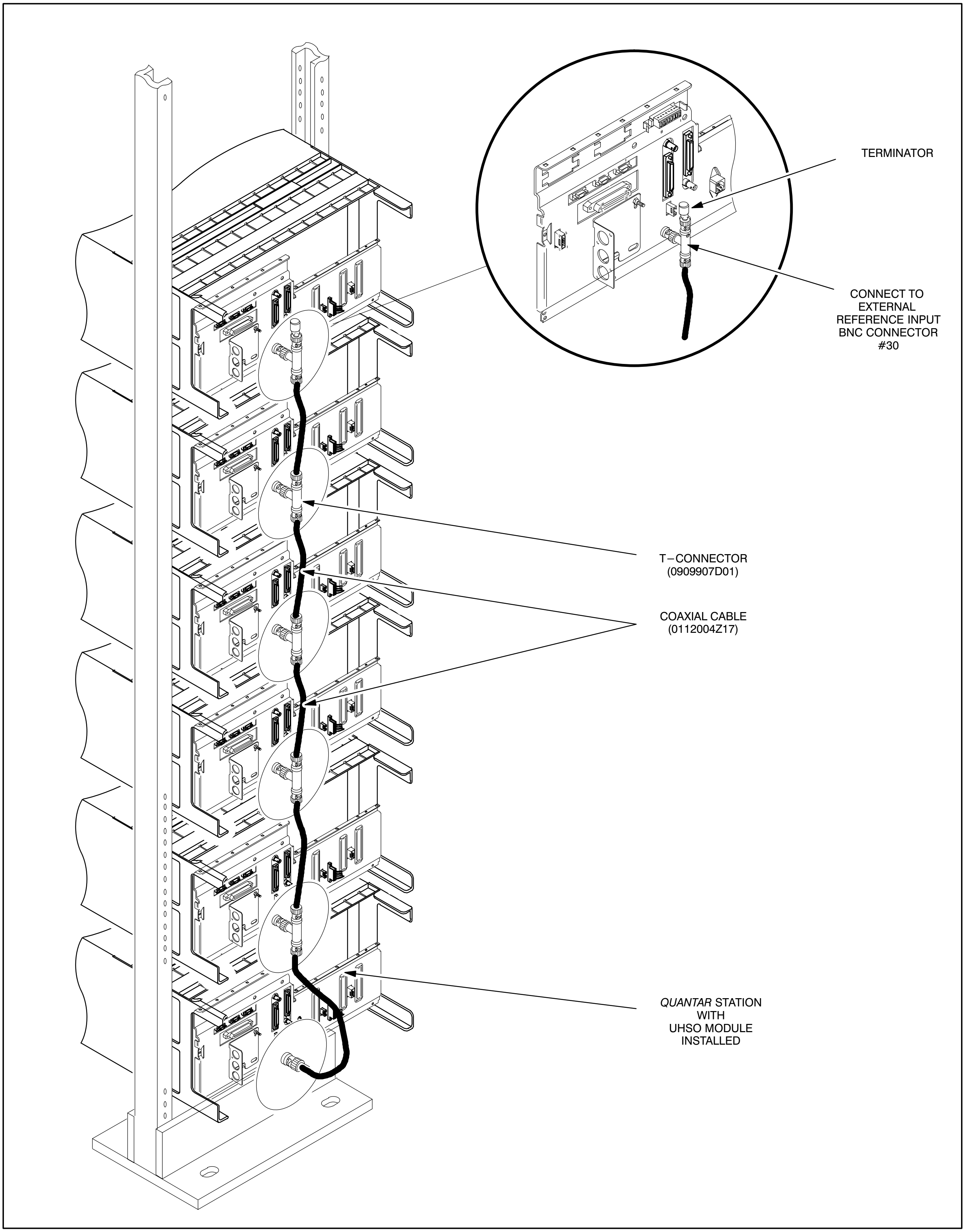


Figure 29. Multi-Drop Connections of Reference Source to Multiple Stations

4 POST–INSTALLATION CHECKOUT

After the station equipment has been mechanically installed and all electrical connections have been made, you may now apply power and check for proper operation prior to optimizing the station.

Applying Power

Before applying power to the station, make sure all modules and boards are securely seated in the appropriate connectors on the back-plane and that all rf cables are securely connected.

Step 1. Turn ON the circuit breaker controlling the ac outlet that is supplying power to the station Power Supply Module.

Step 2. Turn the station power ON using the rocker switch located on the Power Supply Module front panel.

Verifying Proper Operation

Introduction

Upon turning the station power ON, a start–up sequence begins which performs certain tests and initialization before entering normal station operation. The station LEDs provide a visual indication of the progress of the start–up sequence, and may be decoded to determine which test (if any) has failed.

The following describes the behavior of the LEDs upon powering up the station, as well as how to decode the LEDs to isolate potential hardware and software malfunctions.

Station Control Module LEDs Power Up Sequence

Step 1. The **Station Fail** LED momentarily lights, followed by all eight LEDs turning on.

Step 2. The start–up sequence tests now run, and the LEDs go out (top to bottom) as each test is completed.

Step 3. After **Aux LED** is turned off, the **Station Fail** LED is turned on and (for Conventional/6809 stations only) the **Intercom** LED flashes while the station software and hardware are initialized.

Step 4. Once initialized, the **Station Fail** and **Intercom** LEDs are turned off and the **Station On** LED (green) is turned on. This indicates that the module has passed all the start–up tests and is now operational.

continued on next page

Verifying Proper Operation (Continued)

Station Control Module Failures

- If the **Station Fail** lights and stays on (Step 1), check to see if the Station Control Module and Power Supply Module are seated properly in the backplane. Also check to make sure that the EPROMs (two 40–pin socket–mounted ICs located on Station Control Board) are seated properly and installed with pin 1 of each IC closest to the center of the board. Otherwise, replace Station Control Module.
- If LEDs #6 and #7 (**Rx 2 Active** and **Rx Fail**, respectively) alternately blink, one of the start–up tests has failed, as indicated by one of the first three LEDs being turned on.

  — If LED #1 is turned on, reseat the FLASH SIMM in its socket; otherwise, replace the FLASH SIMM.

  — If LED #2 or #3 is turned on, check to make sure DRAM SIMMs are correct size for system application (*IntelliRepeater* stations require one 8 Mbyte DRAM SIMM). If correct size, reseat the DRAM SIMMs in sockets. Otherwise, replace DRAM SIMMs.
- If start–up tests are run successfully (all LEDs light and go off one by one) and the **Station Fail** lights and stays on (Step 3), replace Station Control Module.
- If start-up tests are run successfully (all LEDs light and go out one by one) and the **Station Fail** lights momentarily followed by all LEDs blinking, perform a software download to FLASH memory as described in the *Quantar/Quantro* RSS User's Guide (68P81085E35).

Exciter Module LEDs Power Up Sequence

Step 1. After Station Control Module passes all start–up tests and becomes operational, all four Exciter LEDs momentarily light.

Step 2. The start-up sequence tests now run, and the LEDs go out (top to bottom) as each test is completed.

Step 3. Once **PA FAIL** is turned off, the **TX Lock** LED is turned on. This indicates that the module has passed all of the start–up tests and is now operational.

Exciter Module Failures

- If LEDs #1 and #2 (**TX Lock** and **PA Full**, respectively) alternately blink, one of the start–up tests has failed. Check to make sure that the EPROM (40-pin socket-mounted IC located on Exciter Board) is seated properly and installed with pin 1 of the IC closest to the center of the board. Otherwise, replace Exciter Module.

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Verifying Proper Operation (Continued)

Wireline Module LEDs Power Up Sequence

Step 1. After Station Control Module passes all start–up tests and becomes operational, the Wireline start–up tests now run.

Step 2. If all tests are passed, the **WL On** LED is turned on (green).

Wireline Module Failures

- If the two LEDs alternately flash slowly (in any one of several possible flashing patterns), replace the Wireline Interface Board.

Proceeding to Optimization

If all LEDs sequence properly, the station may be considered electrically functional and is ready for optimizing and alignment. Proceed to the *Optimization* section in this manual.

MOTOROLA

OPTIMIZATION

For *Quantar* and *Quantro*
Station and Ancillary Equipment

1 DESCRIPTION

After the station and ancillary equipment have been mechanically installed, properly cabled, and power applied (as described in the *Installation* section of this manual), the equipment must then be optimized before placing into operation.

An overview of the optimization tasks is as follows:

- Customize the station codeplug and saving the data to the station
- Perform the following alignment tasks:
  - — Rx Wireline
  - — Tx Wireline
  - — Receiver RSSI calibration
  - — Receiver Squelch Adjust
  - — Battery Equalization
  - — Reference Oscillator
  - — Simulcast/ASTRO Launch Time Offset (required for *ASTRO* Simulcast systems only)
- Perform post−optimization checkout procedures, such as verifying power output, deviation, etc.

For detailed instructions to perform these optimization tasks, follow the procedures provided in *Optimizing a New Installation*, located in the RSS User's Guide (68P81085E35).

Commercial Government and
Industrial Solutions Sector
1301 E. Algonquin Road, Schaumburg, IL 60196

1 DESCRIPTION

This section describes the switches, pushbuttons, connectors and LED indicators provided on the *Quantar* station used during local operation of the station and servicing.

Summary of Switches, Pushbuttons, and Connectors

The following switches, pushbuttons, and connectors are provided to allow the station to be operated and/or serviced locally. The location and function of these controls and connectors is shown in Figure 1.

Switches, Pushbuttons, and Connectors

Station Control Module	Power Supply Module
Volume Up Pushbutton Volume Down Pushbutton CSQ/PL/OFF Pushbutton (squelch mode) Intercom Pushbutton Handset/Microphone Connector External Speaker Connector RSS Port Connector External 5 MHz Input BNC Connector	Main Power On/Off Switch

Summary of LED Indicators

Note: *Refer to the Troubleshooting section of this manual for detailed descriptions and interpretation of the LED indicators.*

The following LED indicators are provided to indicate operating status of the station. The location of these controls and connectors is shown in Figure 1.

Summary of LED Indicators

Station Control Module	Power Supply Module	Exciter Module	Wireline Interface Module
Station On Station Fail Intcm/Acc D Control Ch Rx 1 Active Rx 2 Active Rx Fail Aux LED	Module Fail Power On	TX Lock PA Full PA Low PA Fail	WL On* WL Fail* ******LEDs visible on Station Control Module front panel*

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STATION ON LED

STATION FAIL LED

INTCM/ACC D

CONTROL CH

RX1 ACTIVE LED

RX2 ACTIVE LED

RX FAIL LED

AUX LED

NOTE: FUNCTION OF LED INDICATORS IS DESCRIBED IN THE TROUBLESHOOTING SECTION IN THIS MANUAL.

POWER AMPLIFIER MODULE

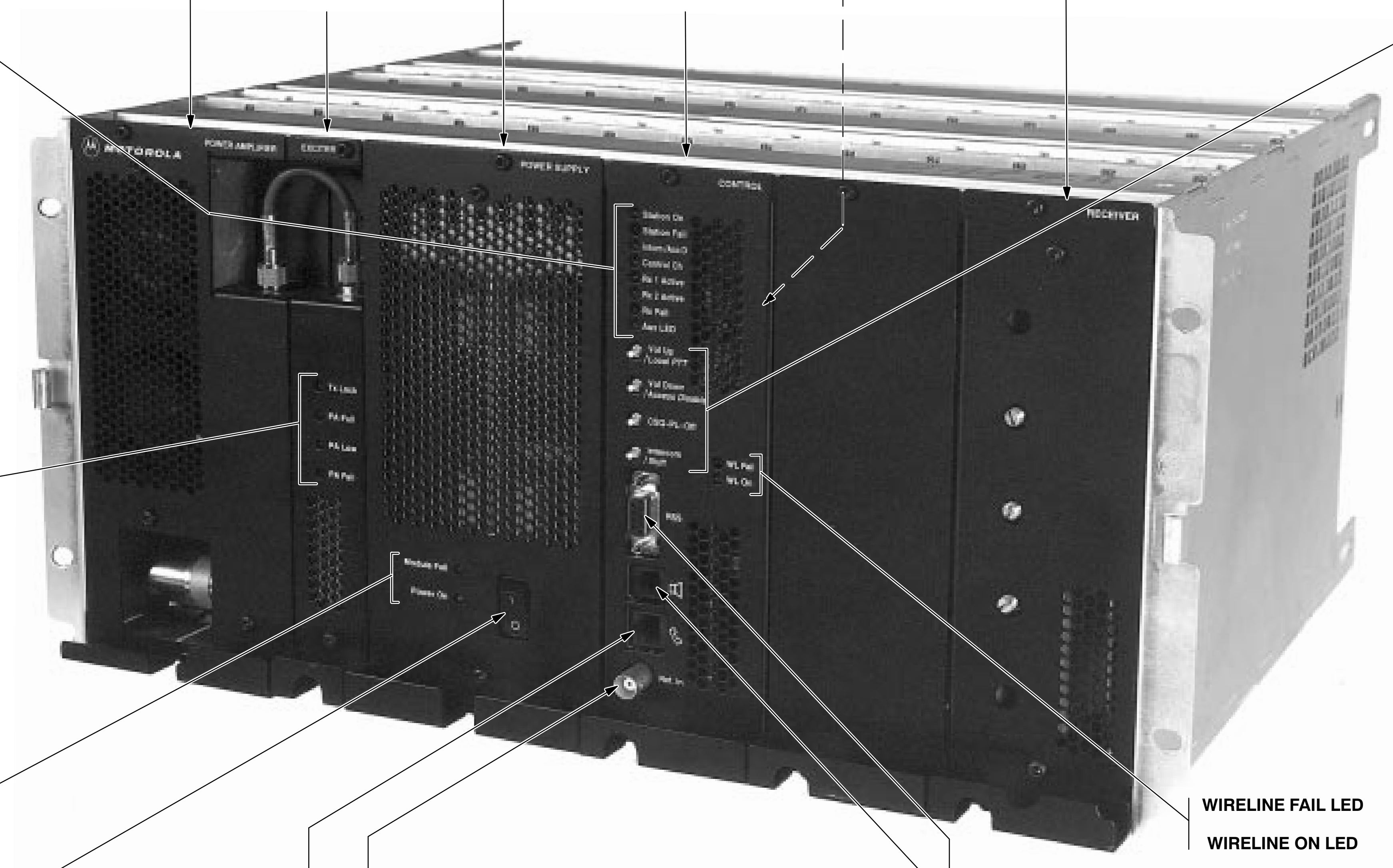
POWER SUPPLY MODULE

WIRELINE INTERFACE BOARD (BEHIND FRONT PANEL)

EXCITER MODULE

STATION CONTROL MODULE

RECEIVER MODULE #1



TX LOCK LED

PA FULL LED

PA LOW LED

PA FAIL LED

NOTE: FUNCTION OF LED INDICATORS IS DESCRIBED IN THE TROUBLESHOOTING SECTION IN THIS MANUAL.

POWER SUPPLY MODULE FAIL LED

POWER ON/OFF LED

POWER ON/OFF SWITCH

NOTE: FUNCTION OF LED INDICATORS IS DESCRIBED IN THE TROUBLESHOOTING SECTION IN THIS MANUAL.

WIRELINE FAIL LED

WIRELINE ON LED

EXTERNAL REFERENCE INPUT

- USED TO CONNECT AN EXTERNAL SOURCE OF 5/10 MHZ FOR CALIBRATION OF STATION REFERENCE OSCILLATOR

HANDSET/MICROPHONE CONNECTOR (RJ-11)

- USED TO CONNECT TELEPHONE−STYLE HANDSET WITH PTT BUTTON (TMN6164 OR EQUIVALENT)
  OR
  MICROPHONE WITH PTT BUTTON (HMN1001A OR EQUIVALENT)

EIA−232 RSS PORT CONNECTOR

- USED TO CONNECT AN *IBM* PC (OR COMPATIBLE) PC RUNNING RSS SOFTWARE TO PERFORM STATION ALIGNMENT, OPTIMIZATION, AND DIAGNOSTICS
- REQUIRES NULL MODEM CABLE (MOTOROLA PART NO. 30−80369E31)

EXTERNAL SPEAKER CONNECTOR (RJ-11)

- USED TO CONNECT 6W EXTERNAL SPEAKER (HSN1000)

VOLUME UP PUSHBUTTON

- USED TO INCREASE THE VOLUME OF THE LOCAL SPEAKER, EXTERNAL SPEAKER, AND HANDSET EARPIECE
- IF LOCAL SPEAKER ON, EACH DEPRESSION RAISES VOLUME LEVEL ONE OF 16 STEPS; STOPS AT STEP 16
- IF LOCAL SPEAKER OFF, DEPRESS ONCE TO RAISE VOLUME LEVEL ONE STEP AND TURN ON LOCAL SPEAKER

VOLUME DOWN PUSHBUTTON

- USED TO DECREASE THE VOLUME OF THE LOCAL SPEAKER, EXTERNAL SPEAKER, AND HANDSET EARPIECE
- EACH DEPRESSION LOWERS VOLUME LEVEL ONE OF 16 STEPS; STOPS AT STEP 0
- IF LOCAL SPEAKER ON, HOLD BUTTON IN FOR 2 SECONDS AND RELEASE TO LOWER VOLUME LEVEL ONE STEP AND TURN OFF LOCAL SPEAKER

SQUELCH SELECT PUSHBUTTON

- USED TO SELECT BETWEEN PL, CARRIER, OR SQUELCH OFF
- WITH SQUELCH OFF, EACH DEPRESSION OF PUSHBUTTON SELECTS SQUELCH IN FOLLOWING SEQUENCE:

OFF>CARRIER>PL

INTERCOM PUSHBUTTON

- USED TO TOGGLE INTERCOM MODE
- WHEN INTERCOM MODE ENABLED, TECHNICIAN AT SITE AND REMOTE CONSOLE OPERATOR MAY COMMUNICATE IN AN INTERCOM FASHION (USING MICROPHONE/HANDSET WITH PTT BUTTON); NEITHER PARTY'S AUDIO IS TRANSMITTED OVER THE AIR

DESCRIPTION OF SPECIAL FUNCTIONS

PUSHBUTTON COMBINATION	FUNCTION
VOLUME UP, VOLUME DOWN, & INTERCOM	STATION RESET — PERFORMS A "WARM" STATION RESET; TAKES APPROXIMATELY 10−20 SECONDS
INTERCOM & VOLUME UP (NOTE)	TOGGLE TX KEY — KEYS/DEKEYS STATION TRANSMITTER WITHOUT PL NOTE THAT TX KEY TIMES OUT AFTER APPROXIMATELY 2 MINUTES.
INTERCOM & VOLUME DOWN (NOTE)	ACCESS DISABLE SELECT —TOGGLES ACCESS DISABLE MODE; WHEN IN ACCESS DISABLE, STATION MAY BE KEYED ONLY BY LOCAL MICROPHONE/HANDSET, INTERCOM & VOLUME UP BUTTONS, OR BY APPROPRIATE FUNCTION KEY FROM RSS.

NOTE: USE THE INTERCOM BUTTON AS A "SHIFT" KEY TO PERFORM MULTIPLE PUSHBUTTON FUNCTIONS. FOR EXAMPLE, PRESS AND HOLD INTERCOM, THEN PRESS VOLUME UP TO TOGGLE TX KEY FUNCTION.

Figure 1. Switches, Pushbuttons, Connectors, and LED Indicators for *Quantar* Station (UHF Shown)

MOTOROLA

ROUTINE MAINTENANCE

For *Quantar* and *Quantro*
Station and Ancillary Equipment

1 INTRODUCTION

This section provides routine maintenance recommendations for the *Quantar* and *Quantro* station and associated ancillary equipment.

Routine Maintenance Overview

The *Quantar* and *Quantro* station and ancillary equipment have been designed with state–of–the–art technology and operate under software control, thus requiring minimal routine maintenance. Virtually all station operating parameters are monitored and self–corrected by the Station Control Module, making virtually all periodic adjustments and tuning unnecessary.

Providing that the equipment is installed in an area which meets the specified environmental requirements (see Pre–Installation planning for environmental specifications), the only routine maintenance task required is the calibration of the station reference oscillator circuit (and the optional UHSO, if installed). The calibration procedure is provided in the RSS User's Guide (68P81085E35).

Note: If the station equipment is installed in a particularly dusty environment, precautions must be taken to filter the air used for forced cooling of the station. Excessive dust drawn across and into the station circuit modules by the cooling fans can adversely affect heat dissipation and circuit operation. In such installations, be sure to clean or replace external filtering devices periodically. Refer to Pre–Installation Planning in the Installation section of this manual for recommended filtering techniques.

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68P81086E39–D
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2 RECOMMENDED SCHEDULE

The circuit device(s) responsible for determining the station reference frequency exhibit slight variations in their operating characteristics over time (“infant aging”). Approximately 90% of the component aging process occurs during the first year of operation. After the initial one year period, the device(s) remain stable for a substantially longer period of time. Therefore, it is recommended that the station reference oscillator be calibrated after one year of operation, and thereafter less often as prescribed in a recommended schedule of periodic calibration.

Station Reference Calibration Schedule

After performing the initial one year calibration procedure, periodic calibration is required according to the schedule shown below. Note that the intervals are affected by the accuracy (in PPM) required either for FCC compliance or by the system requirements, whichever is more stringent.

Table 1. *Recommended Intervals for Calibrating Station Reference Oscillator (After Initial One–Year Calibration)*

Accuracy Desired/Required	***Recommended Interval***
±5 PPM	Every 4 years
±2.5 PPM	Every 2 years
±1.5 PPM	Once yearly
±1.0 PPM (821–824 MHz Public Safety Band)	Once yearly
±0.1 PPM (see note)	Once yearly

Note: ±0.1 PPM accuracy requires the use of either the UHSO Option X873AA or an external 5 MHz source. The UHSO option requires both the internal station reference oscillator **and** the UHSO to be calibrated once yearly using the RSS. When using an external 5 MHz source, the internal station reference oscillator must be calibrated once yearly using the RSS, and the external source must be calibrated once yearly using the manufacturer’s recommended procedure.

MOTOROLA

TROUBLESHOOTING

For *Quantar* Station and Ancillary Equipment (VHF, UHF, 800 MHz, and 900 MHz)

1 INTRODUCTION

This section provides troubleshooting recommendations and procedures for the *Quantar* station and associated ancillary equipment.

Troubleshooting Overview

The troubleshooting procedures and supporting diagrams provided in this section allow the service technician to isolate station faults to the module/assembly level. Defective modules are then replaced with known good modules to restore the station to proper operation.

Troubleshooting information includes:

- Table defining the function of the various alarm LED indicators
- Troubleshooting flow charts
- Module replacement procedures
- Post-repair procedures for performing alignment following replacement of defective modules

2 RECOMMENDED TEST EQUIPMENT

The following list of test equipment is recommended to perform troubleshooting procedures on the *Quantar* station and ancillary equipment.

List of Test Equipment

- Motorola R2001 or R2600 Series Communications Analyzer (or equivalent)
- PC with RSS program
- 9-pin female to 9-pin male Null Modem Cable (30−80399E31)
- In-Line Wattmeter (Motorola S-1350 or equivalent)
- Dummy Load (50Ω, station wattage or higher)
- Handset/Microphone with PTT switch (TMN6164 or equivalent)
- Torx driver with #15 bit (for removal of module front panels)
- IC Extraction Tool (01−80386A04)

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3 TROUBLESHOOTING PROCEDURES

The troubleshooting and repair philosophy for the *Quantar* station and ancillary equipment is one of Field Replaceable Unit (FRU) substitution. The station is comprised of self-contained modules (FRUs) which, when determined to be faulty, may be replaced with a known good module to quickly bring the station back to normal operation. The faulty module must then be shipped to a Motorola repair depot for further troubleshooting and repair to the component level.

Because the *Quantar* station is computer-controlled and employs state-of-the-art digital signal processing techniques, many of the troubleshooting procedures require the use of the Motorola-supplied Radio Service Software (RSS). The RSS is run on a PC (or compatible) with RS-232 communication port capability. The RSS allows the technician to access alarm log files, run diagnostics, and set up the equipment for various audio and rf tests. Complete details on the operation of the RSS are provided in the RSS User's Guide (68P81085E35).

Troubleshooting Overview

Introduction

Two procedures are provided for troubleshooting the *Quantar* station and ancillary equipment. Each procedure is designed to quickly identify faulty modules, which may then be replaced with known good modules to restore proper station operation.

Procedure 1 — Routine Site Visit Functional Checkout

Procedure 1 consists of a series of non-intrusive tests that can be quickly run during a routine site visit. This procedure allows the technician to verify the proper station operation without taking the station out of service. An overview of the procedure is shown in the flow chart (Figure 1) on page 3.

Procedure 2 — Troubleshooting A Reported/Suspected Problem

Procedure 2 should be used when an equipment problem has been either reported or is suspected. This procedure is comprised of both non-intrusive (equipment not taken out of service) and intrusive (requiring the equipment be temporarily taken out of service) tests that allow the technician to troubleshoot reported or suspected equipment malfunctions. An overview of the procedure is shown in the flow chart (Figure 2) on page 4.

How to Use These Troubleshooting Procedures

Perform the following basic steps in order to efficiently troubleshoot the *Quantar* station equipment.

Step 1. Select the appropriate troubleshooting procedure flow chart (Procedure 1 or Procedure 2).

Step 2. Perform the tasks given in the selected flow chart. Tasks requiring additional explanation are marked with page references. Locate the additional information, perform the tasks (if any), and return to the flow chart.

Step 3. Once the faulty module has been identified, proceed to *Module Replacement Procedures*, beginning on page 19.

PROCEDURE 1

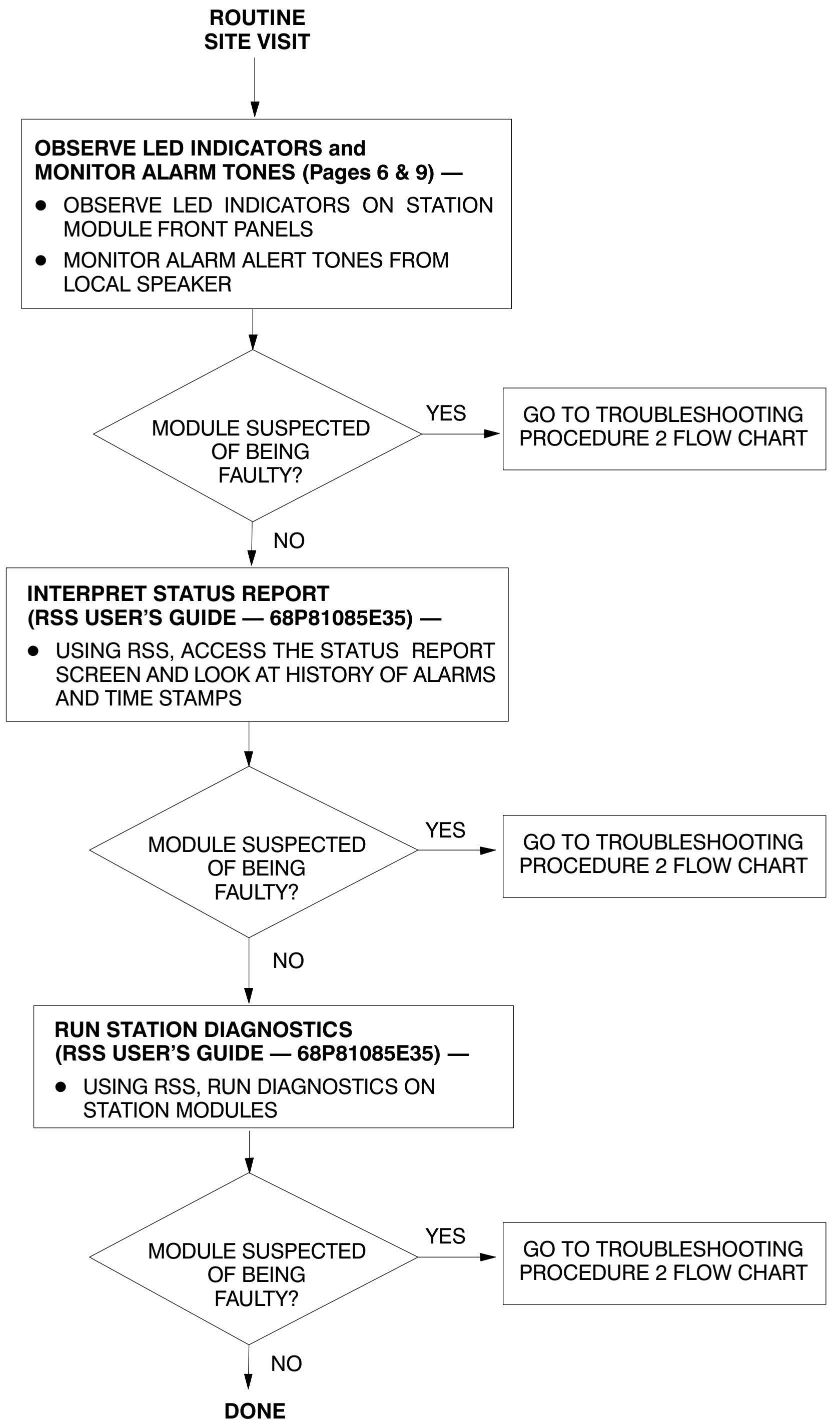


Figure 1. *Quantar* Station Troubleshooting Overview (Procedure 1 — Routine Site Visit)

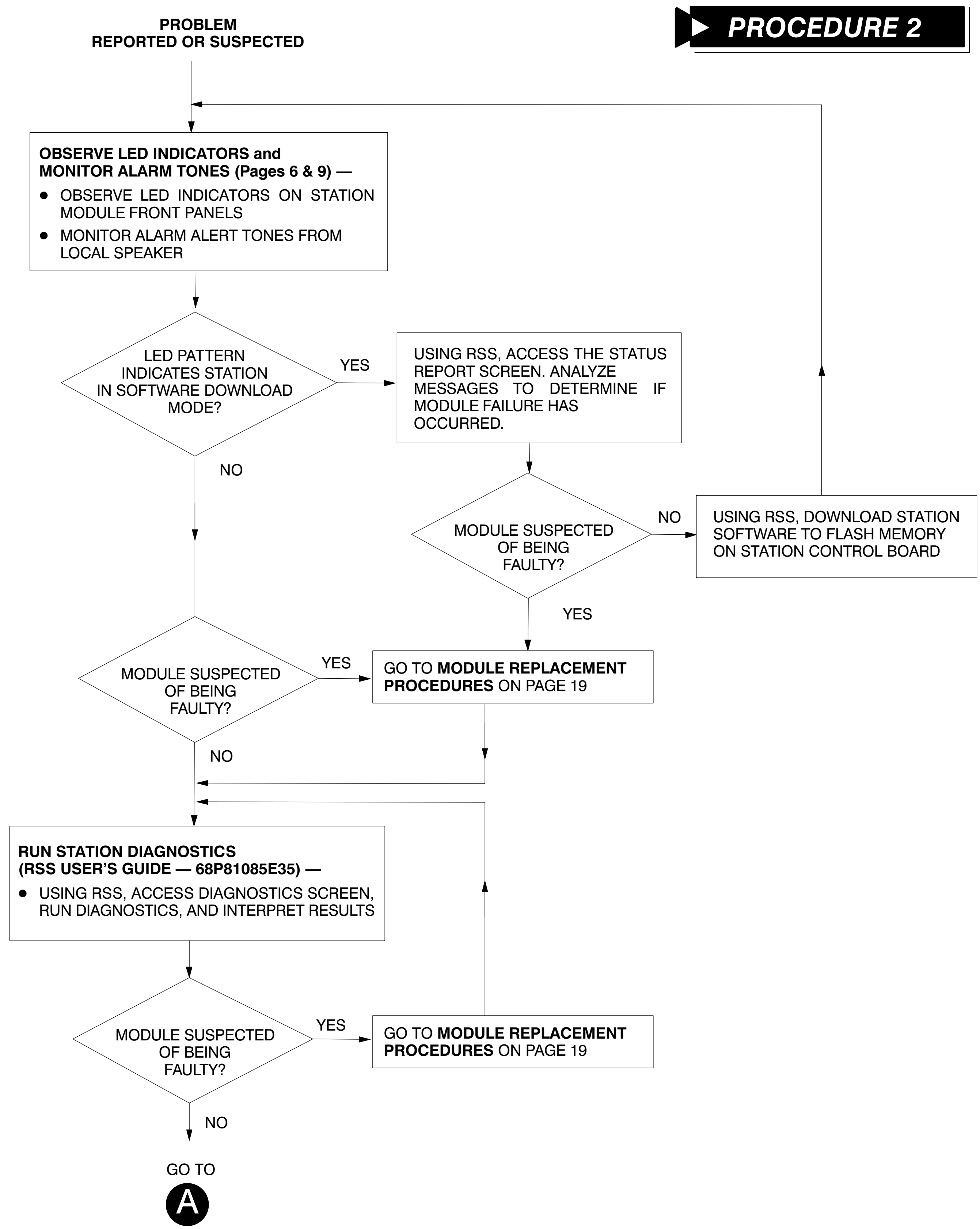


Figure 2. *Quantar* Station Troubleshooting Overview (Procedure 2 — Reported or Suspected Problem)

PROCEDURE 2 (Cont'd)

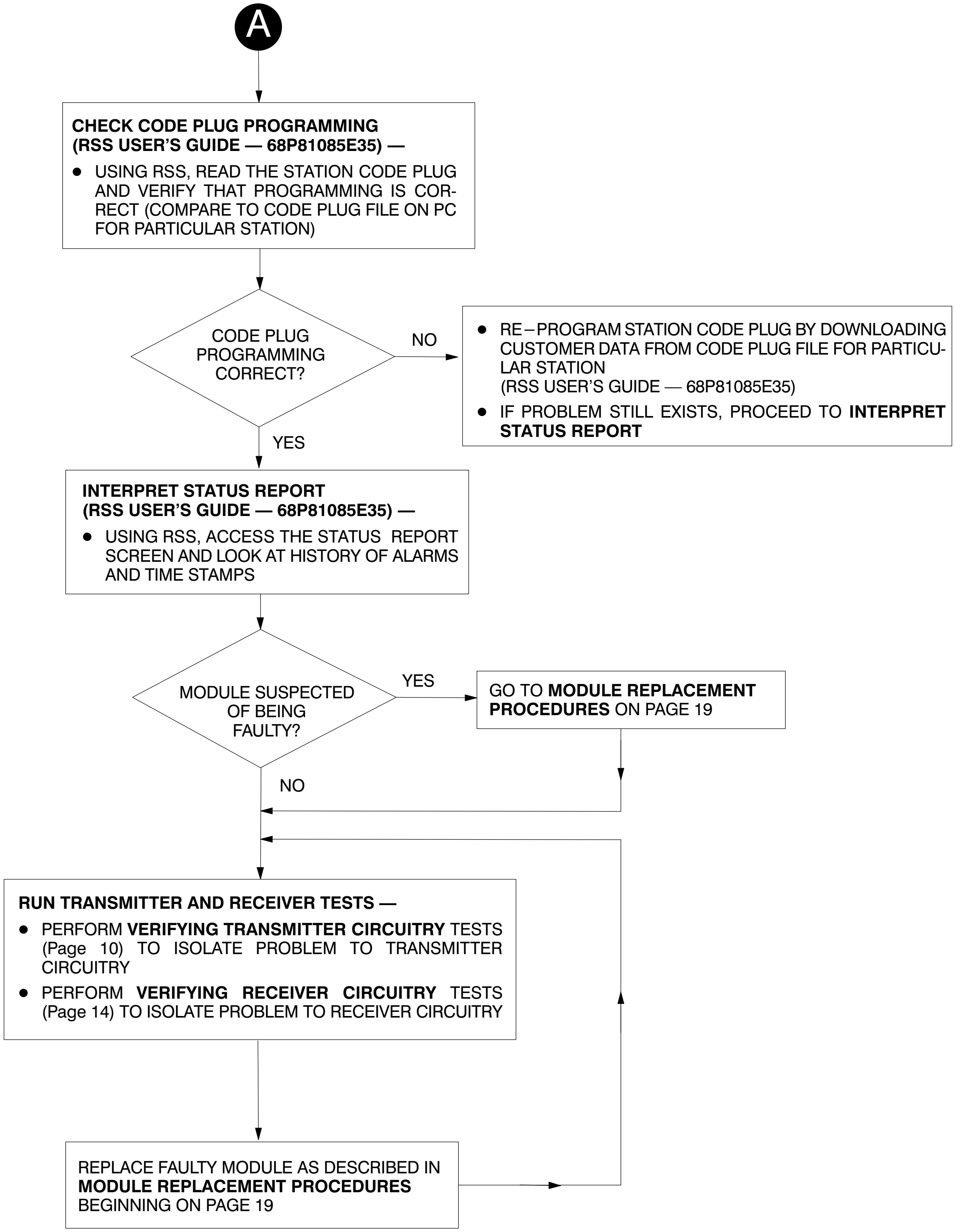


Figure 2. Troubleshooting Procedure 2 (Continued)

Interpreting LED Indicators

Several LED indicators are provided on the front panels of the modules that indicate specific operating conditions. The service technician may observe these LEDs to obtain a quick status indication of the station equipment.

Figure 3 shows the location of all LED indicators provided on the station equipment. Table 1 lists each LED indicator along with a description of the status indicated by each LED.

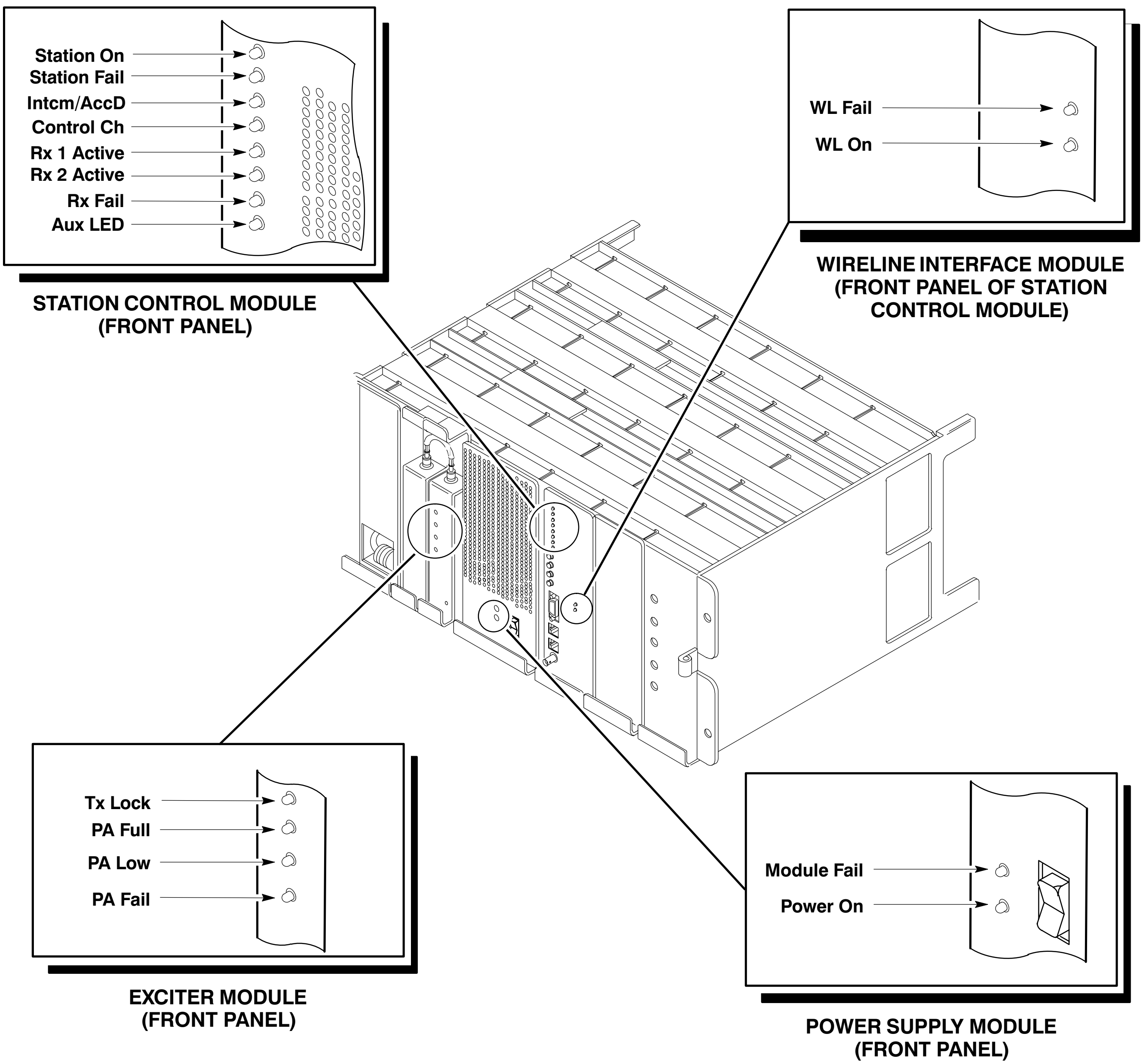


Figure 3. *Quantar* Station LED Indicators (UHF Shown)

Table 1. Quantar Station *LED Indicator Functions*

LED Location	LED Name	Status Definition
EXCITER MODULE	**TX Lock**	– GREEN when Exciter synthesizer is locked; module fully functional. – OFF when: synthesizer is out of lock **or** +5V, +14.2V, or both are absent
	PA Full	– GREEN when transmitter is keyed and PA output power is at expected power level (as set by technician via RSS during station alignment) – OFF when: PA not keyed **or** PA keyed but PA output power is **not** at expected power level (as set by technician via RSS during station alignment)
	PA Low	– YELLOW when transmitter is keyed and PA output power is less than expected power level (as set by technician via RSS during station alignment) but not shut down (for example, during power cutback mode) – OFF when: PA not keyed **or** PA keyed and PA output power is at expected power level (as set by technician via RSS during station alignment)
	PA Fail	– RED when: No PA output power (for example, during PA shutdown mode); LED status is latched, thereby indicating status during current key or for previous key **or** (High power models only) Overdrive alarm is generated by Driver PA **Note:** Any component associated with the PA could cause LED to light. These include the +5V/IPA Module, the Driver PA Module, the Final PA Module, and rf peripherals (such as the circulator, low pass filter, etc.) – FLASHING when PA is in Test Mode (activated by technician via RSS; when in Test Mode, power cutback, VSWR protection, and open power loop protection are disabled) – OFF when PA output power is either at expected level or at specific cutback levels (any level other than shutdown); LED status is latched, thereby indicating status during current key or for previous key
POWER SUPPLY MODULE	**Module Fail**	– OFF during normal operation. – Lights RED when module malfunction occurs, such as shorted output, current limit exceeded, loss of communication with Station Control Module, etc.
	Power On	– GREEN with ac input power present and switch turned ON – OFF when ac input power absent or switch turned OFF

Table 1. Quantar Station *LED Indicator Functions (continued)*

LED Location	LED Name	Status Definition
STATION CONTROL MODULE (SCM)	**Station On**	– GREEN when SCM fully functional – FLASHING when front panel switch press detected – OFF for SCM failure
	Station Fail	– RED for SCM failure – OFF when SCM fully functional (no failure)
	Intcm/Acc D	– YELLOW when station is in Intercom mode – FLASHING once per second when station is in Access Disable Mode – FLASHING twice per second when station is TX Inhibited – OFF when station is not in Intercom mode
	Control Ch	– GREEN when station is control channel (trunking systems only) – FLASHES each time station decodes ISW (*IntelliRepeater* systems only) – OFF when station is not control channel (trunking systems only)
	RX 1 Active	– GREEN when Station Control Board is passing audio/data (receive path unmuted) from Receiver #1; The following conditions must be met: Carrier at proper frequency being received Carrier signal level is above threshold set in codeplug Squelch criteria met (carrier, PL, DPL, ASTRO, secure, etc.) (Note that squelch criteria can be manually altered via RSS for testing purposes) – OFF when above conditions are not met for Receiver #1
	RX 2 Active	– Indicates condition of Receiver #2; Same status definitions as RX 1 ACTIVE
	RX Fail	– RED when Receiver #1 and #2 are both non–functional ⋆ – BLINKING ONCE PER SECOND when Receiver #1 is non–functional ⋆ – BLINKING TWICE PER SECOND when Receiver #2 is non–functional ⋆ or when SAM Module or UHSO Module is non–functional – OFF when both Receiver #1 and #2 are functional ⋆ (or no receiver modules installed) ⋆ A receiver module is considered non–functional if a failure is detected during diagnostics run at time of power–up or during normal operation.
	Aux LED	– GREEN LED available for special application function
	All LEDs Flashing On and Off in Unison	– Station is in Software Download mode, either initiated by the RSS or due to software failure.
	LEDs Flashing Up and Down in Sequential Pattern	– Stationhas received software files from RSS and is in process of downloading the software to FLASH memory in the Station Control Module
WIRELINE INTERFACE BOARD (WIB)	**WL On**	– GREEN when WIB fully functional – OFF for WIB failure
	WL On	– GREEN when WIB fully functional – OFF for WIB failure
	Both LEDs Blinking Rapidly	– WIB is in Software Download mode (operating software is being downloaded into the FLASH memory on WIB from Station Control Module)

Notes:

1. All LEDs momentarily light following station reset (Volume Up, Volume Down, and Intercom buttons on SCM front panel pressed simultaneously) or upon station power up.
2. If no LED indicators are on, make sure that ac power to the station power supply is present. Check the circuit breaker at the ac source. Check the ac line cord. If no problem found, suspect Power Supply Module.

Interpreting Alarm Alert Tones

Note: *The alarm tones may also be routed to the console (via the wireline) and transmitted over the air. Refer to the* ***RSS User's Guide 68P81085E35*** *for details on enabling/disabling these two alarm routing options.*

Introduction

Four station alarm conditions are reported with audio alert tones which are routed to the local speaker. The alarms are also entered into the alarm log which can be accessed using the RSS (*refer to RSS User's Guide 68P81085E35*).

The four alarm conditions are represented by a series of alarm tones, from a single beep to four beeps. Each beep is a 1200 Hz tone lasting 125 msec. The alarm tones occur during a repeating 10 second window, with 2 seconds between successive alarms (when more than one alarm are active). The following two examples illustrate the timing of the alarm tones.

Example 1: Single Alarm (#3)

beep . . . beep . . . . beep . . . . [repeats]

Alarm #3

10 Second Window

Example 2: Multiple Alarms (#1 and #4)

beep . . . . beep . . . . beep . . . . beep . . . . beep . . . . [repeats]

2 seconds

Alarm #1 **Alarm #4**

10 Second Window

The alarm tone definitions are as follows:

Number of Beeps	Alarm Condition Name	Alarm Condition Description
1	Battery Revert	Alarm is reported when station loses ac line power and reverts to battery backup. Alarm is cleared when station receives ac power.
2	PA Fail	Alarm is reported when PA fails to key up to full output power. Alarm is cleared upon successful keyup to full power.
3	Synthesizer	Alarm is reported when either TX or RX synthesizers fail to lock. Alarm is cleared when both synthesizers lock.
4	Overvoltage	Alarm is reported when battery charging voltage is above +34.5 V (100 W stations) or +17.25 V (20 W stations). Alarm is cleared when voltage returns to normal range.

Verifying Transmitter Circuitry

IMPORTANT

Performing this procedure requires that the station be taken out of service. It is recommended that, unless the station is already out of service due to an equipment malfunction, this procedure be performed during off-peak hours so as to minimize the disruption of service to the system subscribers. To take the equipment out of service, use the **Access Disable** function described in the *Operation* section of this manual.

Introduction

While most module faults can be detected by running the station diagnostics provided by the RSS, the following procedure provides a more traditional method of troubleshooting the transmitter circuitry. This procedure is useful in the event that the RSS is not at hand or for some reason cannot be utilized (PC malfunction, etc.).

This procedure allows the service technician to make minor adjustments and verify proper operation of the station transmit circuitry, including:

- Exciter Module
- Power Amplifier Module
- Power Supply Module
- 2.1 MHz reference oscillator circuitry
- Transmitter-related circuitry on the Station Control Board (SCM)

In general, the transmitter circuitry is exercised by injecting and measuring signals using a Motorola R2001 Communications Analyzer (or equivalent). Incorrect measurement values indicate a faulty module(s); measurement values within the acceptable range verify proper operation of the above listed modules and circuitry.

Required Test Equipment

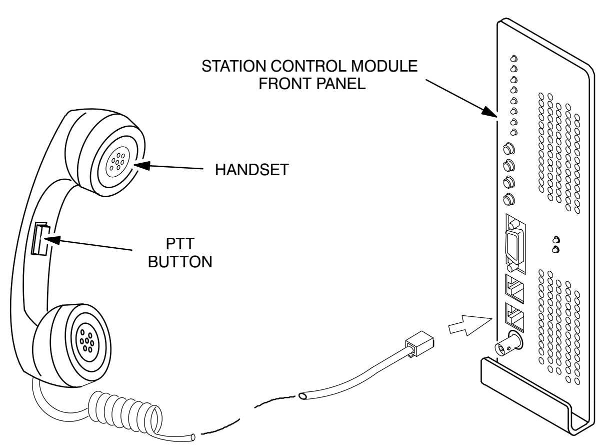
The following test equipment is required to perform the procedure:

- Motorola R2001 Communications Analyzer (or equivalent)
- Telephone-style handset with PTT switch (TMN6164 or equiv.)
- In-Line Wattmeter (Motorola Model S-1350 or equivalent)
- Dummy Load (50Ω, station wattage or higher)

Verifying Transmitter Circuitry Procedure

Step 1. Connect test equipment by performing Steps 1–3 shown in Figure 4.

Step 2. Connect handset to RJ-11 connector on SCM front panel as shown.



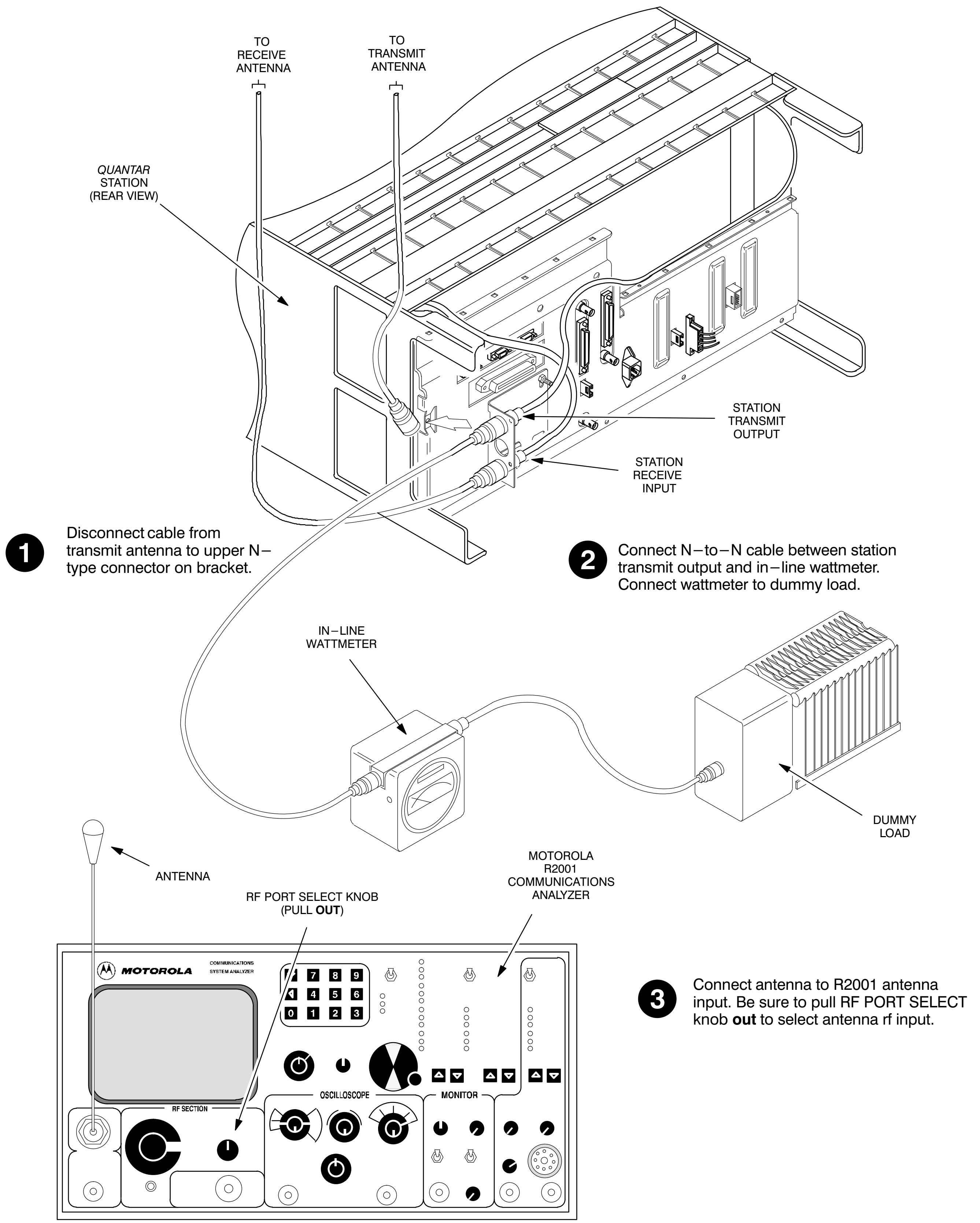


Figure 4. Test Equipment Setup for Verifying Transmitter Circuitry

Verifying Transmitter Circuitry (Continued)

Note: *Suspected faulty modules are shown ranked in order of most to least likelihood.*

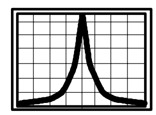
Step 3. Press the PTT button and observe LED indicators on Exciter Module front panel.

- If **PA Low** or **PA Fail** LED is lit, suspect the following:
  Power Amplifier Module failure
  Exciter Module failure
  Loose or bad Exciter-to-PA rf cable
  Loose or bad PA-to-antenna rf output cable
  PA rf output cable not properly terminated
- If **TX Lock** LED is off, suspect the following:
  Faulty Station Control Module
  Faulty Exciter Module
  Faulty backplane

Step 4. Measure output power by pressing the PTT button and observing reading on in-line wattmeter.

- If PA output not at proper power (as set for particular site), adjust the output power as described in the RSS User's Guide (68P81085E35).

Step 5. If PA output power OK, set up R2001 for spectrum analyzer display. Press the PTT button and observe the display. The display should look similar to:



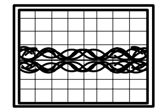
Note: *Suspected faulty modules are shown ranked in order of most to least likelihood.*

- If the display shows multiple carriers evenly spaced about the carrier, suspect a faulty PA module or +5V/IPA Module
- If the display shows a solid carrier but off frequency, suspect the following:
  Faulty Exciter or Station Control Module
  Faulty external 5 MHz reference source
- If the display shows a single carrier moving erratically, suspect:
  Faulty Station Control Module
  Faulty Exciter Module
  Faulty PA Module

(continued on page 13)

Verifying Transmitter Circuitry (Continued)

Step 6. If display OK, set up R2001 to display modulation. Using the handset, push the PTT button and speak into the mouthpiece. Verify that the display shows:



- If proper display is not obtained, suspect faulty SCM or Exciter Module.

Step 7. Set the R2001 for GEN/MON MTR. Press the PTT button and speak loudly in the mouthpiece to cause maximum deviation. Display should read ±5 kHz maximum.

- If proper display is not obtained, suspect faulty SCM or Exciter Module.

Step 8. This completes the **Verifying Transmitter Circuitry** test procedure. If all displays and measurements are correct, the transmitter circuitry may be considered to be operating properly. Remove test equipment, restore the station to normal service, and return to the troubleshooting flow chart to resume troubleshooting sequence.

Verifying Receiver Circuitry (Analog Capable Stations)

IMPORTANT

Performing this procedure requires that the station be taken out of service. It is recommended that, unless the station is already out of service due to an equipment malfunction, this procedure be performed during off-peak hours so as to minimize the disruption of service to the system subscribers. To take the equipment out of service, use the **Access Disable** function described in the *Operation* section of this manual.

IMPORTANT

Note that if station operates as a repeater the transmit output from the station must be connected to a dummy load to prevent over-the-air broadcast during receiver testing.

Introduction

While most module faults can be detected by running the station diagnostics provided by the RSS, the following procedure provides a more traditional method of troubleshooting the receiver circuitry. This procedure is useful in the event that the RSS is not at hand or for some reason cannot be utilized (PC malfunction, etc.).

This procedure allows the service technician to make minor adjustments and verify proper operation of the station receive circuitry, including:

- Receiver Module
- Power Supply Module
- 2.1 MHz reference oscillator circuitry
- Receiver-related circuitry in the Station Control Module (SCM)

In general, the receiver circuitry is exercised by injecting and measuring signals using a Motorola R2001 Communications Analyzer (or equivalent). Incorrect measurement values indicate a faulty module(s); measurement values within the acceptable range verify proper operation of the above listed modules and circuitry.

Required Test Equipment

The following test equipment is required to perform the procedure:

- Motorola R2001 Communications Analyzer (or equivalent)
- Telephone-style handset with PTT switch (TMN6164 or similar)
- Female N-type to Female N-type coaxial cable
- RJ-11 to BNC cable
- Dummy Load (50Ω, station wattage or higher) required for repeater stations only

Verifying Receiver Circuitry Procedure

Step 1. Connect test equipment by performing Steps 1−3 shown in Figure 5.

Step 2. Disable PL and carrier squelch by repeatedly pressing the **PL/CSQ/Off** button until receiver noise is heard thru the handset (or external or internal speaker). If no audio is heard, suspect the following:

- Faulty Receiver Module
- Faulty Station Control Module
- R2001 is outputting a carrier signal

Step 3. Set R2001 to generate a .5 μV (−113 dBm) FM signal at the *Quantar* receiver frequency, modulated by a 1 kHz tone at 3 kHz deviation. The 1 kHz tone should be audible thru the handset (or internal or external speaker). If no audio is heard, suspect the following:

- Faulty Station Control Module (2.1 MHz reference)
- Faulty Receiver Module
- Faulty antenna-to-Receiver preselector rf cable
- Faulty R2001-to-station rf cable

(continued on page 16)

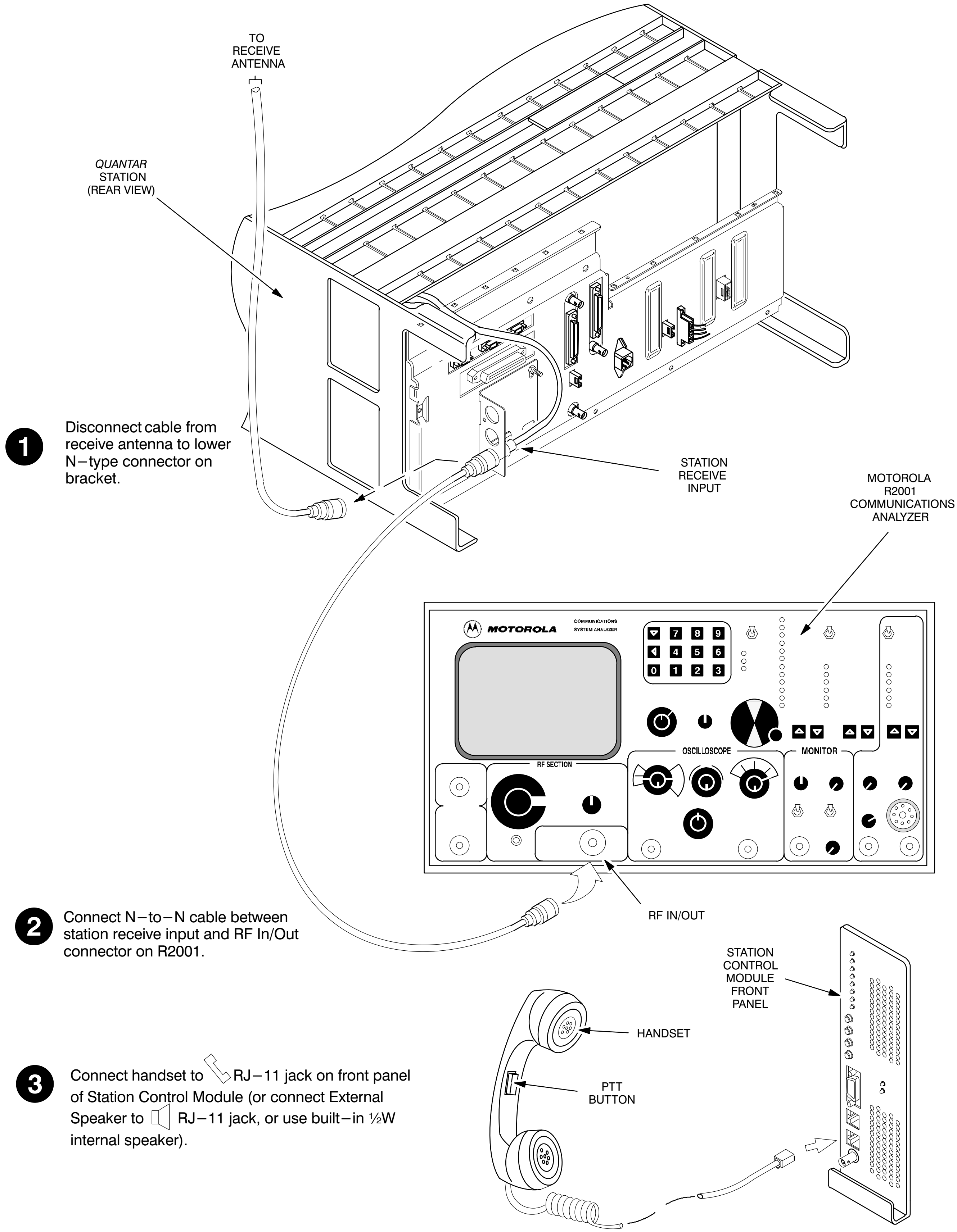
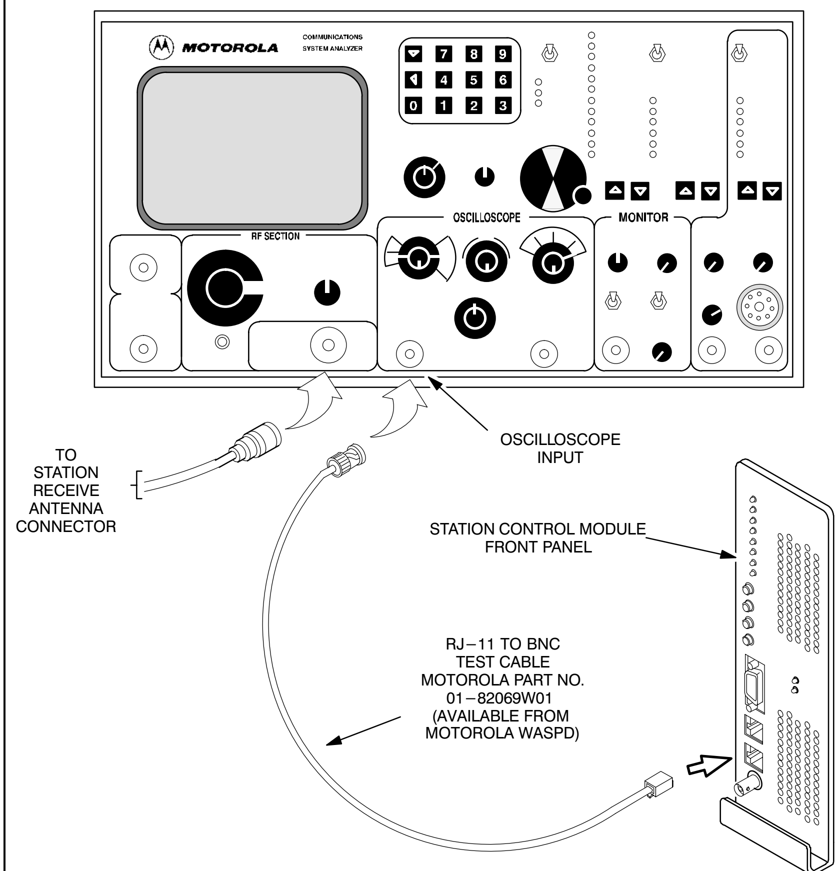


Figure 5. Test Equipment Setup for Verifying Receiver Circuitry

Verifying Receiver Circuitry (Continued)

Step 4. If audio is heard, connect the HANDSET RJ−11 jack to the Oscilloscope input BNC connector, as shown below:



Step 5. Use **Volume Up** button to increase volume to maximum. Measure the audio level using the R2001.

- Audio level should measure approximately .75 to 1.5 V p−p. If not, suspect faulty SCM.

Step 6. Change R2001 injection signal level to:

VHF: .25 µV (−119 dBm)
UHF: .35 µV (−116 dBm)
800, 900: .30 µV (−117.5 dBm)

Note: *To measure SINAD, the station must be programmed for mixed mode Analog/Digital operation. Incorrect reading will result if programmed for Digital Only operation.*

Step 7. Measure the receiver SINAD. The value should read 12 dB or greater. If not, tune the preselector (VHF and UHF only) and recheck SINAD. If 12 dB SINAD cannot be achieved, replace the Receiver Module.

Note: *For VHF and UHF stations only, refer to* ***5. Preselector Field tuning Procedure*** *in this section for procedures to tune the receiver preselector.*

Step 8. This completes the **Verifying Receiver Circuitry** test procedure. If all displays and measurements are correct, the receiver circuitry may be considered to be operating properly. Remove test equipment, restore the station to normal service, and return to the troubleshooting flow chart to resume troubleshooting sequence.

Verifying Receiver Circuitry (Digital Only Stations)

IMPORTANT

Performing this procedure requires that the station be taken out of service. It is recommended that, unless the station is already out of service due to an equipment malfunction, this procedure be performed during off-peak hours so as to minimize the disruption of service to the system subscribers. To take the equipment out of service, use the **Access Disable** function described in the *Operation* section of this manual.

IMPORTANT

Note that if station operates as a repeater the transmit output from the station must be connected to a dummy load to prevent over-the-air broadcast during receiver testing.

Introduction

While most module faults can be detected by running the station diagnostics provided by the RSS, the following procedure provides a more traditional method of troubleshooting the receiver circuitry.

This procedure allows the service technician to make minor adjustments and verify proper operation of the station receive circuitry, including:

- Receiver Module
- Power Supply Module
- 2.1 MHz reference oscillator circuitry
- Receiver-related circuitry in the Station Control Module (SCM)

In general, the receiver circuitry is exercised by injecting and measuring test pattern signals using a Motorola R2670 Communications Analyzer (or equivalent) and analyzing the Bit Error Rate using the RSS. Incorrect measurement values indicate a faulty module(s); measurement values within the acceptable range verify proper operation of the above listed modules and circuitry.

Required Test Equipment

The following test equipment is required to perform the procedure:

- Motorola R2670 Communications Analyzer with *ASTRO* CAI Option (or equivalent)
- PC running Radio Service Software (RSS) program
- Female N-type to Female N-type coaxial cable
- Dummy Load (50Ω, station wattage or higher) required for repeater stations only

Verifying Receiver Circuitry Procedure

Step 1. Proceed to the procedure *ASTRO Bit Error Rates Reports* (located in Chapter 4 of the *RSS User's Guide 68P81085E35*). Follow the instructions for setting up the test equipment and initiating a BER report using the RSS.

Step 2. If the BER reading is above 5%, suspect the following:

- Faulty Station Control Module (2.1 MHz reference)
- Faulty Receiver Module
- Faulty antenna-to-Receiver preselector rf cable
- Faulty R2670-to-station rf cable

Step 3. Change R2670 injection signal level to:

VHF: .25 µV (−119 dBm)
UHF: .35 µV (−116 dBm)
800, 900: .30 µV (−117.5 dBm)

(continued on page 18)

Verifying Receiver Circuitry (Analog Capable Stations) (Continued)

Note: *For VHF and UHF stations only, refer to* ***5. Preselector Field tuning Procedure*** *in this section for procedures to tune the receiver preselector.*

Step 4. Note the receiver BER reading. The BER reading should be 5% or less. If not, tune the preselector (VHF and UHF only) and recheck the BER reading. If a reading of 5% or less cannot be achieved, replace the Receiver Module.

Step 5. This completes the **Verifying Receiver Circuitry** test procedure. If all displays and measurements are correct, the receiver circuitry may be considered to be operating properly. Remove test equipment, restore the station to normal service, and return to the troubleshooting flow chart to resume troubleshooting sequence.

4 MODULE REPLACEMENT PROCEDURES

Station modules suspected of being faulty must be replaced with known good modules to restore the station to proper operation. The following procedures provide instructions for replacing each of the station modules and performing any required post-replacement adjustments or programming.

General Replacement Information

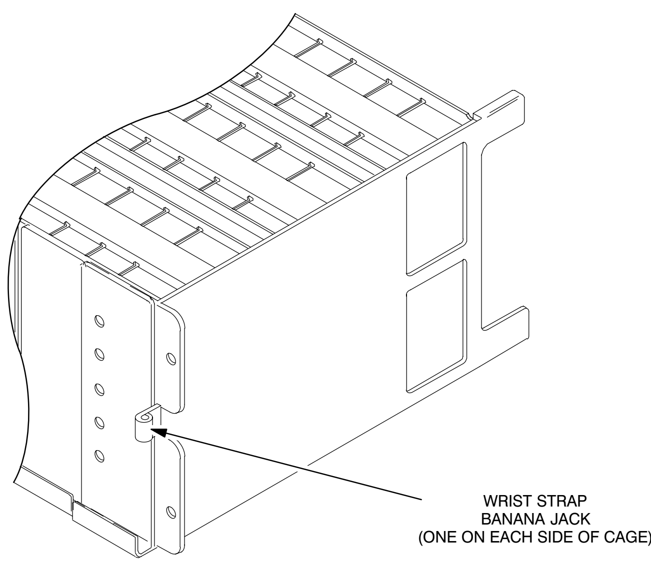
Anti−Static Precaution

The station circuitry contains many C-MOS and other static-sensitive devices. When servicing the equipment, you must take precautionary steps to prevent damage to the modules from static discharge. Complete information on prevention of static protection is provided in Motorola publication 68P81106E84, available through Motorola National Parts. Some additional precautions are as follows:

- A wrist strap (Motorola Part No. RSX4015A, or equivalent) should be worn while servicing to minimize static buildup. Banana jacks are built into the station cage for connection of the wrist strap.

WARNING

When wearing Conductive Wrist Strap, be careful near sources of high voltage. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentally touching high voltage sources.



CAUTION

DO NOT insert or remove station modules with power applied. This may result in damage to the modules.

- **Do not** insert or remove modules with power applied. Always turn off the station using the On/Off switch located on the front of the Power Supply Module before inserting or removing modules.
- All spare modules should be kept in a conductive bag for storage and transporting. When shipping modules to the repair depot, always pack in conductive material.

General Replacement Information (Continued)

Care of Gold–Plated Connector Contacts

The connections between the modules and the station backplane board are made with gold-plated card edge connector contacts to provide maximum reliability. Gold-plated materials do not form a non-conductive oxide layer, and therefore should not require cleaning under normal conditions.

When the modules have been subjected to many extraction/insertion cycles, or if the station is operated in a dusty environment, the contacts may require cleaning. **Do not** use an eraser or any type of abrasive substance to clean either the module card-edge connectors or the backplane connector contacts. Any type of abrasive cleaning (typically employed for cleaning non gold-plated contacts) can result in the removal of the gold plating or bending of the connector contacts.

If cleaning of the gold-plated contacts is required, use a soft cloth dampened with alcohol to lightly wipe the contacts. Be sure not to touch the contact surfaces with your fingers, as finger oils and salts can contaminate the contact surfaces.

Cleaning Module Rails

After a few module extraction/insertion cycles, wipe the module rails with a soft cloth to remove any oxidation or foreign material. This ensures a good ground connection between the module and the cage.

Power Down Station Before Removing/Inserting Modules

Before removing or inserting a module into the station cage and engaging the backplane connector, be sure to turn off the station power using the Power Supply Module On/Off switch.

Important! If the station is equipped with battery backup, turning the On/Off switch to OFF **will not** turn the station off. You must also disconnect the battery revert cable from the station backplane. Remember to reconnect the battery cable before restoring the station to operation.

Validating Repairs

After replacing a faulty module with a known good module, perform one of the following tests to validate the repair before leaving the site.

- If the faulty module was detected as the result of running station diagnostics via the RSS, run the diagnostics again after the repair is made to ensure that the replacement module passes all diagnostic tests.
- If the faulty module was detected by an operational failure, perform the operation to ensure that the repair corrected the reported/detected failure.

Replacing Power Amplifier Module

Replacement Procedure

Step 1. Turn off station power (refer to page 20).

Step 2. Using a Torx #15 driver, remove anti-vibration screw(s) (if installed) from top and/or bottom of module front panel.

Step 3. Disconnect mini–UHF connector on rf cable connecting Exciter Module to Power Amplifier Module.

Step 4. Slide the module out to the first stop. Disconnect the N-type connector (rf output from the module) from the lower left side of module.

Step 5. Remove faulty module from cage.

Step 6. Install replacement Power Amplifier Module by sliding module into cage (about 2 inches from full insertion). Connect the rf output cable to the N-type connector at the lower left side of the module.

Step 7. Slide the module in completely and firmly seat the module connector into the backplane. (**Do not** slam the module against the backplane or push any harder than necessary to seat the connectors.) Now reconnect the rf cable from the Exciter Module.

Step 8. Restore power to the station.

Post-Replacement Optimization Procedure

Perform the *Power Output* alignment procedure located in the RSS User’s Guide (68P81085E35).

Replacing Exciter Module

Replacement Procedure

Step 1. Turn off station power (refer to page 20).

Step 2. Using a Torx #15 driver, remove anti-vibration screw(s) (if installed) from top and/or bottom of module front panel.

Note *The replacement board must have the same model number as the faulty board (e.g., TLF6920). If it does not, contact the System Support Center at 1-800-221-7144 for instructions on how to proceed.*

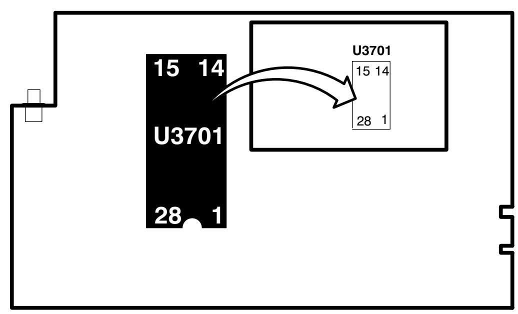
Step 3. Disconnect mini-UHF connector on rf cable connecting Power Amplifier Module to Exciter Module.

Step 4. Remove faulty module from cage.

Step 5. The Exciter Board software must now be removed from the old board and installed onto the replacement board. The software is contained on a single EPROM. You must remove the EPROM from the replacement board and replace it with the EPROM from the old board. The following illustration shows the location of the EPROM.

Note *If the existing EPROM is faulty, contact the System Support Center at 1-800-221-7144 to obtain replacement part. The version of software contained in the replacement device must match that of the faulty device.*

Note *Use an IC Extraction Tool (Motoorla Part No. 01−80386A04) to remove the firmware devices.*



Step 6. Install replacement Exciter Module by sliding module into cage and firmly seating the module connector into the backplane. (**Do not** slam the module against the backplane or push any harder than necessary to seat the connectors.) Now reconnect the rf cable from the Power Amplifier Module.

Step 7. Restore power to the station.

Post-Replacement Optimization Procedure

Step 1. Perform the *TX Deviation Gain Adjust* alignment procedure located in the RSS User’s Guide (68P81085E35).

Step 2. Perform the *Reference Modulation* alignment procedure located in the RSS User’s Guide (68P81085E35).

Step 3. For *ASTRO* Simulcast systems only, perform the *ASTRO/Simulcast Launch Time Offset* alignment procedure located in the RSS User’s Guide (68P81085E35).

Replacing Power Supply Module

Replacement Procedure

Step 1. Turn off station power (refer to page 20).

Step 2. Using a Torx #15 driver, remove anti-vibration screw(s) (if installed) from top and/or bottom of module front panel.

Step 3. Remove faulty module from cage.

Step 4. Install replacement Power Supply Module by sliding module into cage and firmly seating the module connector into the backplane. (**Do not** slam the module against the backplane or push any harder than necessary to seat the connectors.)

Step 5. Restore power to the station.

Post-Replacement Optimization Procedure

Replacement Power Supply Modules are factory aligned. Therefore, no post-replacement optimization is required for this module.

Replacing Station Control Module (all except modules in *IntelliRepeater* Ethernet Networks)

Note *The replacement board must have the same model number as the faulty board (e.g., CLN6961). If it does not, contact the System Support Center at 1-800-221-7144 for instructions on how to proceed.*

Note *If the existing EPROM or FLASH SIMM is faulty, contact the System Support Center at 1-800-221-7144 to obtain replacement parts. The version of software contained in the replacement devices must match that of the faulty devices.*

Note *Use an IC Extraction Tool (Motorola Part No. 01−80386A04) to remove the firmware devices.*

Replacement Procedure

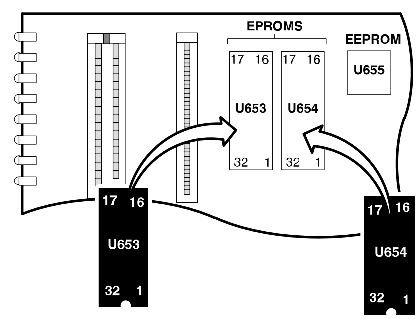
Step 1. If the module is capable of communicating with the RSS, connect the PC to the RSS port, start the RSS program, and save the codeplug from the station to a file on the PC hard disk. This will allow the codeplug information to be downloaded to the codeplug located on the replacement Station Control Board. If the module cannot communicate with the RSS, an archive file (if available) of the particular station codeplug may be downloaded. If no archive codeplug file exists, you must program the codeplug as described in the RSS User's Guide (68P81085E35).

Step 2. Turn off station power (refer to page 20).

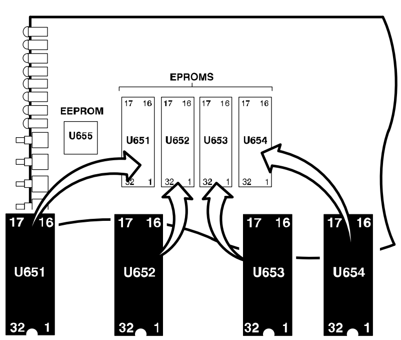
Step 3. Using a Torx #15 driver, remove front panel and Station Control Board as described in Figure 6.

Step 4. The Station Control Board software must now be removed from the old board and installed onto the replacement board. The software is contained on either two or four EPROMS (earlier version boards) or a single FLASH SIMM (later version boards). You must remove the EPROMs or FLASH SIMM from the replacement board and install the EPROMs or FLASH SIMM from the old board. The following illustrations show the locations of the EPROMs and FLASH SIMM.

Software on Two EPROMs



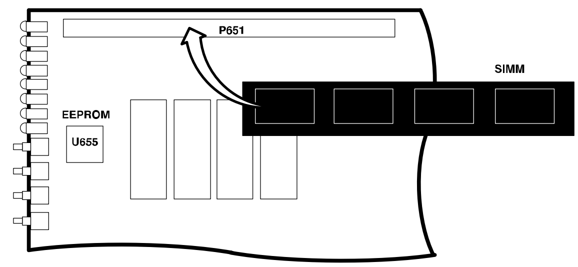
Software on Four EPROMs



Replacing Station Control Module (Conventional/6809) (Continued)

Replacement Procedure (continued)

Software on Single FLASH SIMM



Note: *When inserting Station Control Board into cage, place your thumbs on the BNC and D-type connectors and firmly push the board into the backplane connector.*

Step 5. Install replacement Station Control Board by sliding board into cage and firmly seating the board card-edge connectors into the backplane. (**Do not** slam the board against the backplane or push any harder than necessary to seat the connectors.)

Step 6. Replace the front panel by pressing it into place and replacing the two screws. Be sure the 2-wire cable from the local speaker is connected to the 3-pin connector at the bottom front of the Station Control Board. If the connector is not keyed (earlier models), you may connect the 3-pin connector in either polarity.

Step 7. Restore power to the station.

Alignment Procedures
- RX Wireline
- TX Wireline
- Squelch Adjust
- Battery Equalization (if required)
- Power Output
- Tx Deviation Gain Adjust
- Reference Modulation

For *ASTRO* stations, also perform RSSI and Simulcast/ASTRO Launch Time Offset alignment.

For 6809 Trunking stations, also perform TDATA alignment.

Post-Replacement Optimization Procedure

Step 1. Replacement Station Control Modules are shipped with default data programmed into the codeplug (EEPROM located on board). After replacing a Station Control Board, you must download codeplug data (unique to the particular station) to the replacement board codeplug. Simply retrieve the file from your archive and follow the instructions in the RSS User's Guide (68P81085E35) for saving data to the codeplug. Note that if no archive codeplug file exists, you may create a new codeplug by copying the ***training.cp*** codeplug file (supplied with the RSS) and then program it as necessary to meet the particular station's requirements.

Step 2. Calibrate the reference oscillator (station reference) by performing the procedure in the Routine Maintenance section of this manual.

Step 3. Perform the alignment procedures listed in the sidebar as described in the RSS User's Guide (68P81085E35).

Replacing Station Control Module (for modules in *IntelliRepeater* Ethernet Networks)

Replacement Procedure

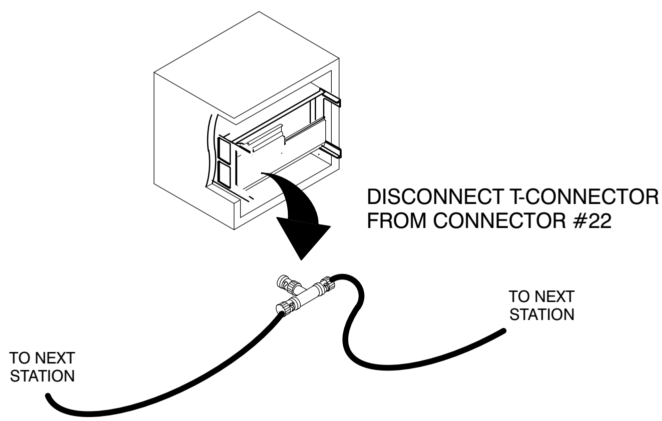
Step 1. If the module is capable of communicating with the RSS, connect the PC to the RSS port, start the RSS program, and save the codeplug from the station to a file on the PC hard disk. This will allow the codeplug information to be downloaded to the codeplug located on the replacement Station Control Board. If the module cannot communicate with the RSS, an archive file (if available) of the particular station codeplug may be downloaded. If no archive codeplug file exists, you must program the codeplug as described in the RSS User's Guide (68P81085E35).

Note *If the Physical Address and/or the IP Address cannot be read, contact the System Support Center at 1-800-221-7144.*

Step 2. Using the RSS, read the *IP Address* and *Physical Address* assigned to the station and jot them down. (From the RSS **Main Menu**, go to **Service:Ethernet Parameters** to read the *IP Address* and the *Physical Address*.)

Step 3. Turn off station power (refer to page 20).

Step 4. Disconnect the station from the Ethernet LAN as described below.



Step 5. Using a Torx #15 driver, remove front panel and Station Control Board as described in Figure 6.

Note *Use an IC Extraction Tool (Motorola Part No. 01–80386A04) to remove the firmware devices.*

Step 6. The Station Control Board software must now be removed from the old board and installed onto the replacement board. The software is contained on a single FLASH SIMM. You must remove the FLASH SIMM from the replacement board and install the FLASH SIMM from the old board. The following illustration shows the location of the FLASH SIMM.

Replacing Station Control Module (for modules in *IntelliRepeater* Ethernet Networks) (Continued)

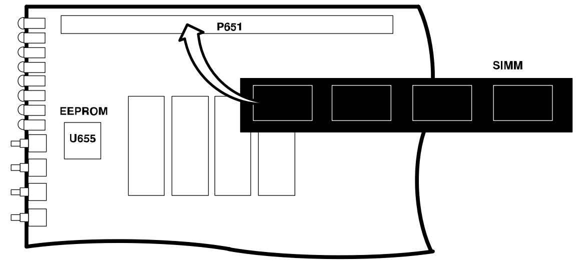
Note *If the existing FLASH SIMM is faulty, contact the System Support Center at 1-800-221-7144 to obtain a replacement part.*

Note *The replacement board must have the same model number as the faulty board (e.g., CLN6960). If it does not, contact the System Support Center at 1-800-221-7144 for instructions on how to proceed.*

Note: *When inserting Station Control Board into cage, place your thumbs on the BNC and D−type connectors and firmly push the board into the backplane connector.*

Replacement Procedure (continued)

Software on Single FLASH SIMM



Step 7. Install replacement Station Control Board by sliding board into cage and firmly seating the board card-edge connectors into the backplane. (**Do not** slam the board against the backplane or push any harder than necessary to seat the connectors.)

Step 8. Replace the front panel by pressing it into place and replacing the two screws. Be sure the 2-wire cable from the local speaker is connected to the 3-pin connector at the bottom front of the Station Control Board. If the connector is not keyed (earlier models), you may connect the 3-pin connector in either polarity.

Step 9. Restore power to the station.

Post-Replacement Optimization Procedure

Step 1. Replacement Station Control Modules are shipped with default data programmed into the codeplug (EEPROM located on board). After replacing a Station Control Board, you must download codeplug data (unique to the particular station) to the replacement board codeplug. Simply retrieve the file from your archive and follow the instructions in the RSS User's Guide (68P81085E35) for saving data to the codeplug. Note that if no archive codeplug file exists, you may copy a codeplug from another station at the site and save it to this station.
Important! When the RSS prompts you to "Crossload" the other stations at the site, answer **NO**.

Step 2. Using the RSS, navigate to **Service:Ethernet Parameters** and change the *IP Address* and *Physical Address* to the addresses you read in Step 2 on page 26.

Step 3. Calibrate the reference oscillator (station reference) by performing the procedure in the Routine Maintenance section of this manual.

Step 4. Perform the alignment procedures listed in the sidebar as described in the RSS User's Guide (68P81085E35).

Step 5. Turn off station power (refer to page 20).

Step 6. Reconnect the T-connector from the Ethernet LAN.

Step 7. Restore power to the station.

Alignment Procedures
- RX Wireline
- TX Wireline
- Squelch Adjust
- Battery Equalization (if required)
- Power Output
- Tx Deviation Gain Adjust
- Reference Modulation

For *ASTRO* stations, also perform RSSI and Simulcast/ASTRO Launch Time Offset alignment.

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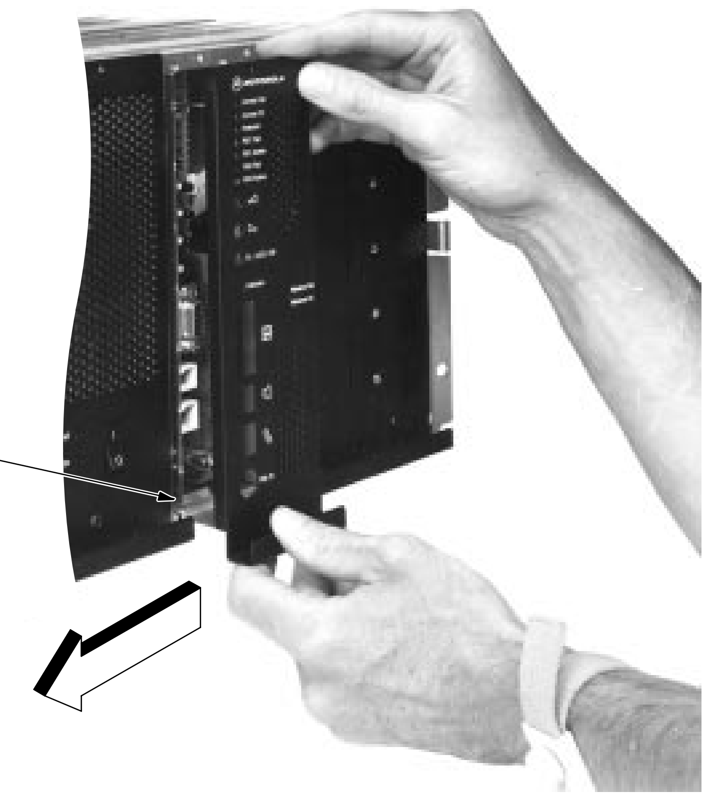
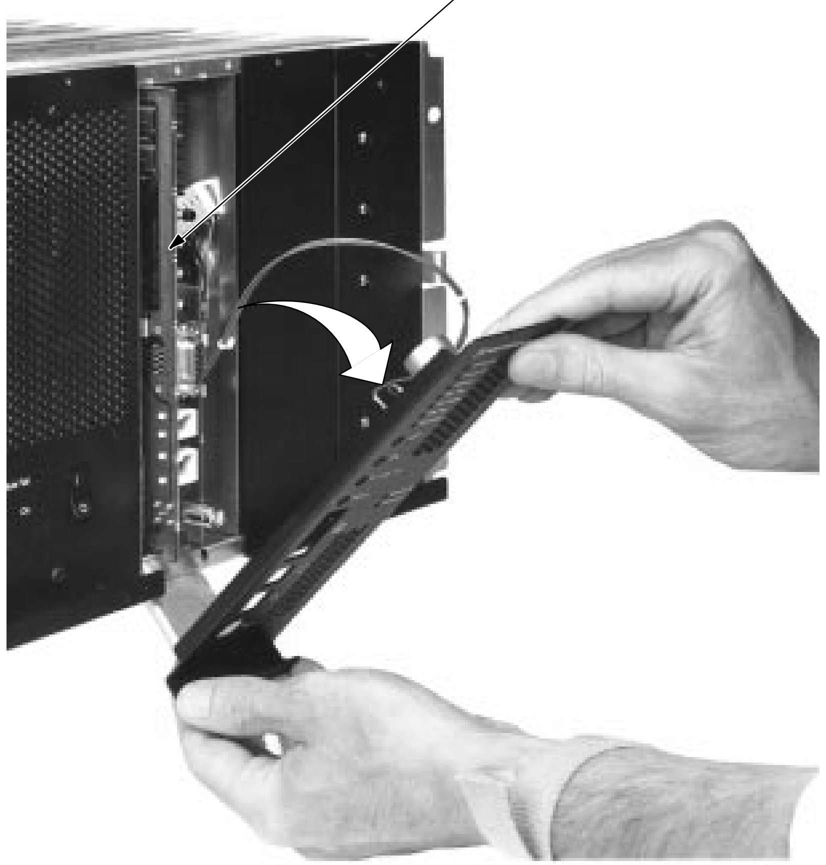
1

Remove the two screws from top and bottom of Station Control Module front panel.

2

Partially remove front panel and position the board extraction tab on the bottom rail of the cage and slide the panel to the left until the lip of the tab is positioned behind the cutout in the Station Control Board.





3

Tip back on the panel to pry the Station Control Board out of the backplane connectors.

4

Remove Station Control Board from cage.

Figure 6. Removal Procedure for Station Control Board (*Quantar* VHF Station Shown)

Replacing Wireline Interface Board

Note *A later model board (CLNxxxx) can be used to replace both later model boards and earlier model boards (TRNxxxx). However, earlier model boards cannot be used to replace later model boards. (Later model boards support either EPROMs or FLASH; earlier model boards support only EPROMs.)*

Note *If the existing EPROM or FLASH SIMM is faulty, contact the System Support Center at 1-800-221-7144 to obtain replacement parts. The version of software contained in the replacement devices must match that of the faulty devices.*

Note *Use an IC Extraction Tool (Motorola Part No. 01−80386A04) to remove the firmware devices.*

Replacement Procedure

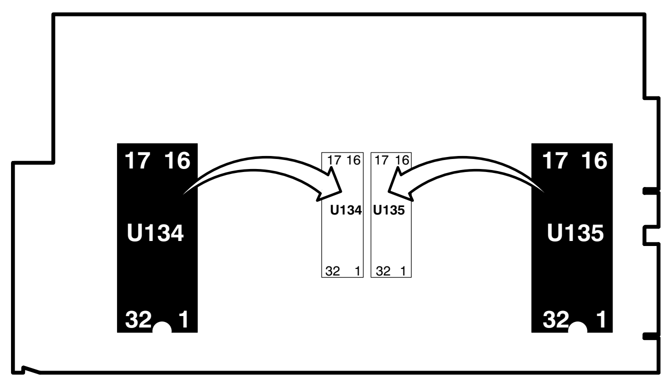
Step 1. Turn off station power (refer to page 20).

Step 2. Using a Torx #15 driver, remove anti-vibration screw(s) (if installed) from top and/or bottom of module front panel.

Step 3. Remove Station Control Module front panel and Wireline Interface Board as described in Figure 6.

Step 4. Set all jumpers on replacement board to match those on the faulty board. These include input/output impedance matching jumpers, 2-wire/4-wire select jumper, and dc remote control selection jumpers.

Step 5. The Wireline Board software must now be removed from the old board and installed onto the replacement board. The software is contained on either two EPROMS (earlier version boards) or two FLASH ICs (later version boards). You must remove the EPROMs or FLASH ICs from the replacement board and install the EPROMs or FLASH ICs from the old board. The following illustration shows the locations of the EPROMs and FLASH ICs.



Step 6. Install replacement Wireline Interface Board by sliding board into cage and firmly seating the board card-edge connectors into the backplane. (**Do not** slam the board against the backplane or push any harder than necessary to seat the connectors.)

Step 7. Replace the front panel by pressing it into place and replacing the two screws. Be sure the 2-wire cable from the local speaker is connected to the 3-pin connector at the bottom front of the Station Control Board. If the connector is not keyed (earlier models), you may connect the 3-pin connector in either polarity.

Step 8. Restore power to the station.

Post-Replacement Optimization Procedure

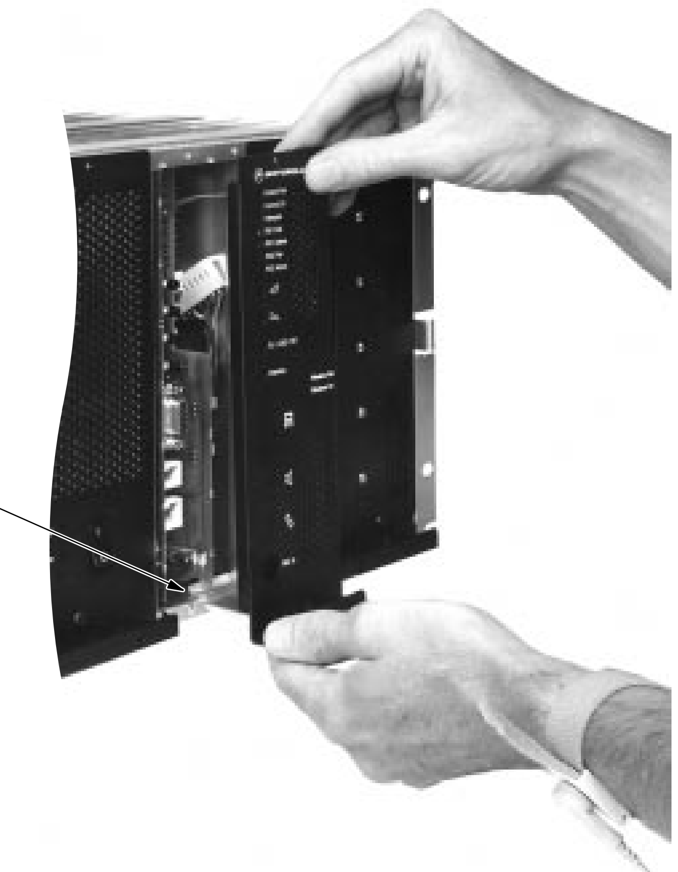
Perform the *Rx Wireline* and *Tx Wireline* adjustment procedures located in the RSS User's Guide (68P81085E35).

1

Remove the two screws from top and bottom of Station Control Module front panel.

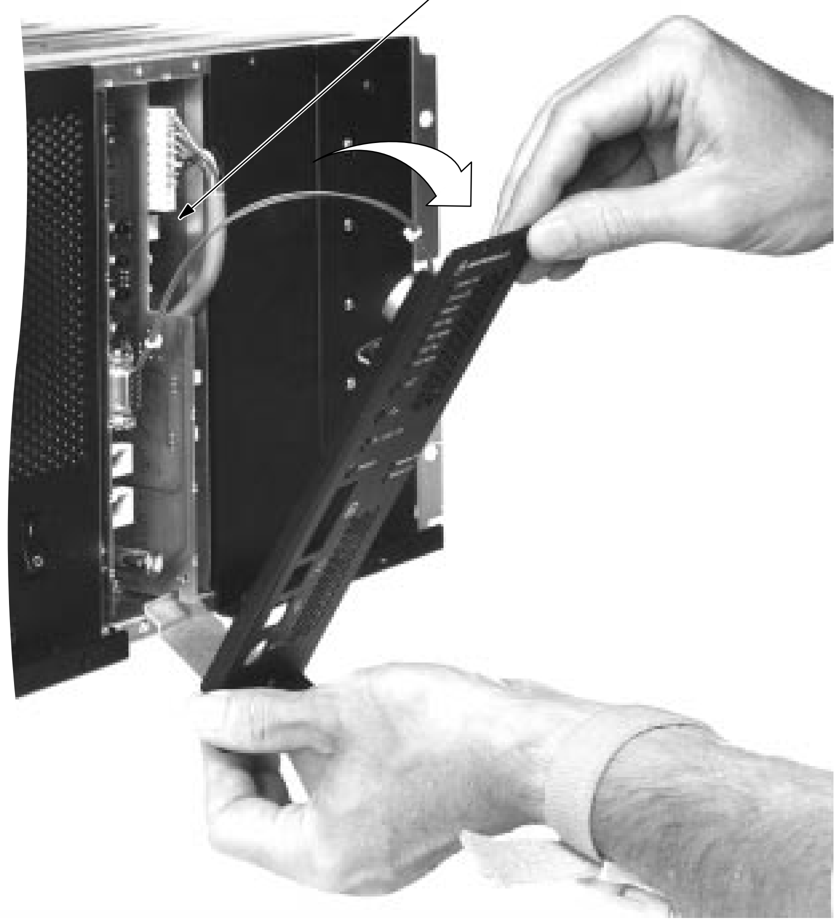
2

Partially remove front panel and position the board extraction tab on the bottom rail of the cage and slide the panel to the left until the lip of the tab is positioned behind the cutout in the Wireline Interface Board.



3

Tip back on the panel to pry the Wireline Interface Board out of the backplane connectors.



4

Disconnect the 8-position connector as shown and remove Wireline Interface Board from cage.

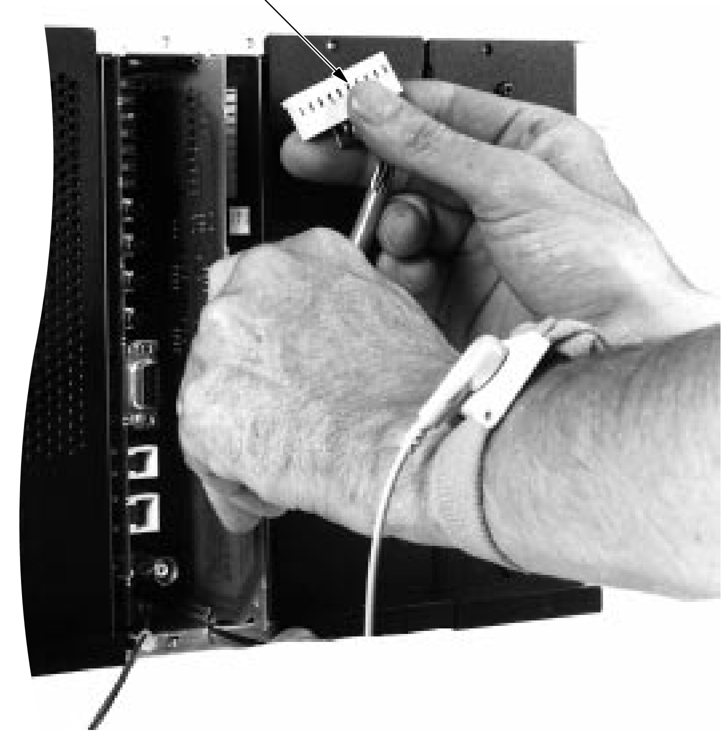


Figure 7. Removal Procedure for Wireline Interface Board (*Quantar* VHF Station Shown)

Replacing Receiver Module and/or Preselector Assembly (VHF and UHF)

Note: *On VHF and UHF models, the Receiver Module is comprised of a Preselector Assembly and a Receiver Board attached to a module housing. The Preselector Assembly and the Receiver Board are each considered to be a field replaceable unit (FRU). Replacement procedures are given for each FRU. If you choose to replace the entire module (including receiver board and preselector), you must perform the preselector tuning procedure.*

Replacement Procedure

Step 1. Turn off station power (refer to page 20).

Step 2. Using a Torx #15 driver, remove anti-vibration screws (if installed) from top and/or bottom of module front panel.

Step 3. Slide the module out to the first stop. Disconnect mini-UHF connector on rf cable (rf input to the module) connected to the preselector assembly.

Step 4. Remove faulty module from cage.

Step 5. If **Receiver Board** is being replaced:

- Disconnect cable (mini-UHF connector) connected to Receiver Board.
- Remove nine (9) Torx−head screws securing Receiver Board to module housing. Note location of foam insulating pad beneath VCO portion of Receiver Board.
- Remove faulty board and replace with known good board. Be sure to position the foam insulating pad (noted in previous step) behind the VCO.
- Secure board using Torx-head screws removed previously. Reconnect rf cable to mini-UHF connector on board.

Step 6. If **Preselector Assembly** is being replaced:

- Disconnect cables (mini-UHF connectors) from assembly.
- Remove faulty Preselector Assembly by removing two(2) Torx-head screws securing assembly to module housing.
- Install known good assembly and secure using Torx−head screws removed previously. Reconnect rf cables to mini-UHF connectors.

(continued on next page)

Replacing Receiver Module and/or Preselector Assembly (VHF and UHF) (Continued)

Replacement Procedure (Continued)

Step 7. Install repaired Receiver Module by sliding module into cage (about 2 inches from full insertion). Connect the rf input cable to the mini-UHF connector on the Preselector Assembly.

Step 8. Slide the module in completely and firmly seat the module connector into the backplane. (**Do not** slam the module against the backplane or push any harder than necessary to seat the connectors.)

Step 9. Restore power to the station.

Post-Replacement Optimization Procedure

Step 1. If you replaced the **Receiver Board** — Perform the *Squelch Adjust* and the *RSSI* alignment procedures located in the RSS User's Guide (68P81085E35).

Step 2. If you replaced the **Preselector Assembly** — Perform the preselector field tuning procedure beginning on page 36.

Replacing Receiver Module (800 MHz and 900 MHz)

Replacement Procedure

Step 1. Turn off station power (refer to page 20).

Step 2. Remove anti-vibration screws (if installed) from top and/or bottom of module front panel.

Step 3. Slide the module out to the first stop. Disconnect mini-UHF connector on rf cable (rf input to the module) connected to the preselector assembly.

Step 4. Remove faulty module from cage.

Step 5. Install replacement Receiver Module by sliding module into cage and firmly seating the module connector into the backplane. (**Do not** slam the module against the backplane or push any harder than necessary to seat the connectors.) Connect the rf cable to the mini-UHF connector at the top of the module.

Step 6. Restore power to the station.

Post-Replacement Optimization Procedure

Perform the *Squelch Adjust* and the *RSSI* alignment procedures located in the RSS User's Guide (68P81085E35).

Replacing ASTRO Modem Card

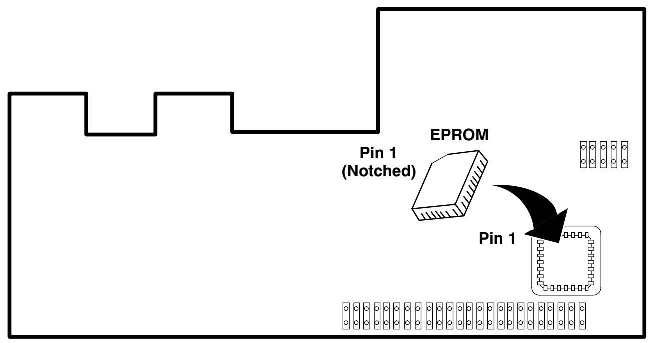
Replacement Procedure

Step 1. Turn off station power (refer to page 20).

Step 2. Remove the Wireline Interface Board as described on page 30.

Step 3. Unplug faulty ASTRO Modem Card from Wireline Interface Board.

Step 4. Inspect the label on the EPROM (shown below). If the date is **8-16-93**, remove the EPROM and install it on the replacement board. For all other dates, the EPROM on the replacement board is compatible and need not be replaced.



Step 5. Install replacement modem card.

Step 6. Install Wireline Interface Board as described on page 30.

Step 7. Restore power to the station.

Post-Replacement Optimization Procedure

The ASTRO Modem Card requires no settings or adjustments. The card is configured by the Station Control Module on station power up.

Replacing Backplane Board

Replacement Procedure

Step 1. Turn off station power (refer to page 20).

Step 2. Remove all modules/boards from the station cage as described on the previous pages. Make sure that all modules/boards are placed on properly grounded anti-static surface.

Step 3. Label all cables connected to the rear of the Backplane Board. Disconnect all cables from the backplane.

Step 4. Remove the eleven (11) Torx-head screws which secure the metal shield and backplane board to the cage.

Step 5. Remove the metal shield from the backplane, sliding the two guide pins located at each end at the bottom of the shield from the backplane board. Remove the backplane board.

Step 6. Install the replacement Backplane Board and metal shield using the 11 Torx-head screws removed previously, reconnect all cables, and reinstall all modules/boards.

Step 7. Restore power to the station.

Post-Replacement Optimization Procedure

Using the RSS, run a complete battery of diagnostics to exercise all boards and modules.

5 PRESELECTOR FIELD TUNING PROCEDURE

The VHF and UHF Receiver Modules are comprised of a circuit board and a preselector assembly, both secured in a slide−in module housing. The preselector assembly is a 3-pole (UHF) or a 5-pole (VHF) bandpass filter equipped with tuning slugs to adjust the passband corresponding to the operating frequency(s) of the station. The preselector assembly must be field tuned if replaced in the field or if the station operating frequency(s) are modified. The tuning procedure follows.

Required Test Equipment

The following test equipment is required to properly tune the preselector assembly:

- RF Signal Generator — Motorola R2600 Communications Analyzer, R2001 Communications Analyzer (see note), or HP8656A signal generator (or equivalent)
- Dip/Peak Monitor — HP435B Power Meter (or equivalent) with HP8484A sensitive power head, Boonton Model 92E with BNC input, or R2001/R2600 using the spectrum analyzer function
- Torque driver capable of delivering 12 in−lbs of torque and 10 mm deep well socket
- Tuning probe — Motorola Part No. 0180763D22, p/o TRN7799A tuning kit
- Flat−blade screwdriver

Note: *The R2600 Communications Analyzer can both generate and measure simultaneously. The R2001 may be used for either the generator or the monitor function, but not both simultaneously. When using R2001 as the signal generator, rf signal* ***must*** *be taken from the Antenna port.*

IMPORTANT

Tuning for best SINAD response **DOES NOT** result in optimum tuning of the preselector assembly. You must use this field tuning procedure to obtain optimum preselector performance.

VHF Tuning Procedure

Calculating Proper Alignment Frequency

Use one of the following two methods to calculate the alignment frequency to be generated by the signal generator.

For stations with a **single receive frequency**, calculate the frequency of the alignment signal as follows:

Step 1. From the site documentation or the RSS, determine the station receive frequency.

Step 2. If the frequency is $\leq$ 148 MHz (Range 1), or $\leq$ 156 MHz (Range 2), subtract 250 kHz. Otherwise, note actual frequency.

Example: If station receive frequency is 134.575 MHz, subtract 250 kHz since frequency is less than 143 MHz.

134.575 MHz — 250 kHz = 134.325 MHz

Step 3. If Receiver Module is **Range 1**, determine the alignment frequency as follows:

If frequency (from Step 2) is < 134 MHz, then alignment frequency = 133.75 MHz.

If frequency (from Step 2) is > 152 MHz, then alignment frequency = 152 MHz.

Otherwise, use actual frequency from Step 2.

Step 4. If Receiver Module is **Range 2**, determine the alignment frequency as follows:

If frequency (from Step 2) is < 152 MHz, then alignment frequency = 151.75 MHz.

If frequency (from Step 2) is > 172 MHz, then alignment frequency = 172 MHz.

Otherwise, use actual frequency from Step 2.

For stations with **multiple receive frequencies**, calculate the frequency of the alignment signal as follows:

Step 1. From the site documentation or the RSS, note the receive frequency for each channel supported by the station.

Step 2. Calculate a midpoint frequency as follows:

$$F_{mid} = (F_{highest} + F_{lowest}) \div 2$$

Step 3. Using F_{mid} in place of the station receive frequency, perform Step 2 thru Step 4 from above.

VHF Tuning Procedure (Continued)

Preparing Equipment

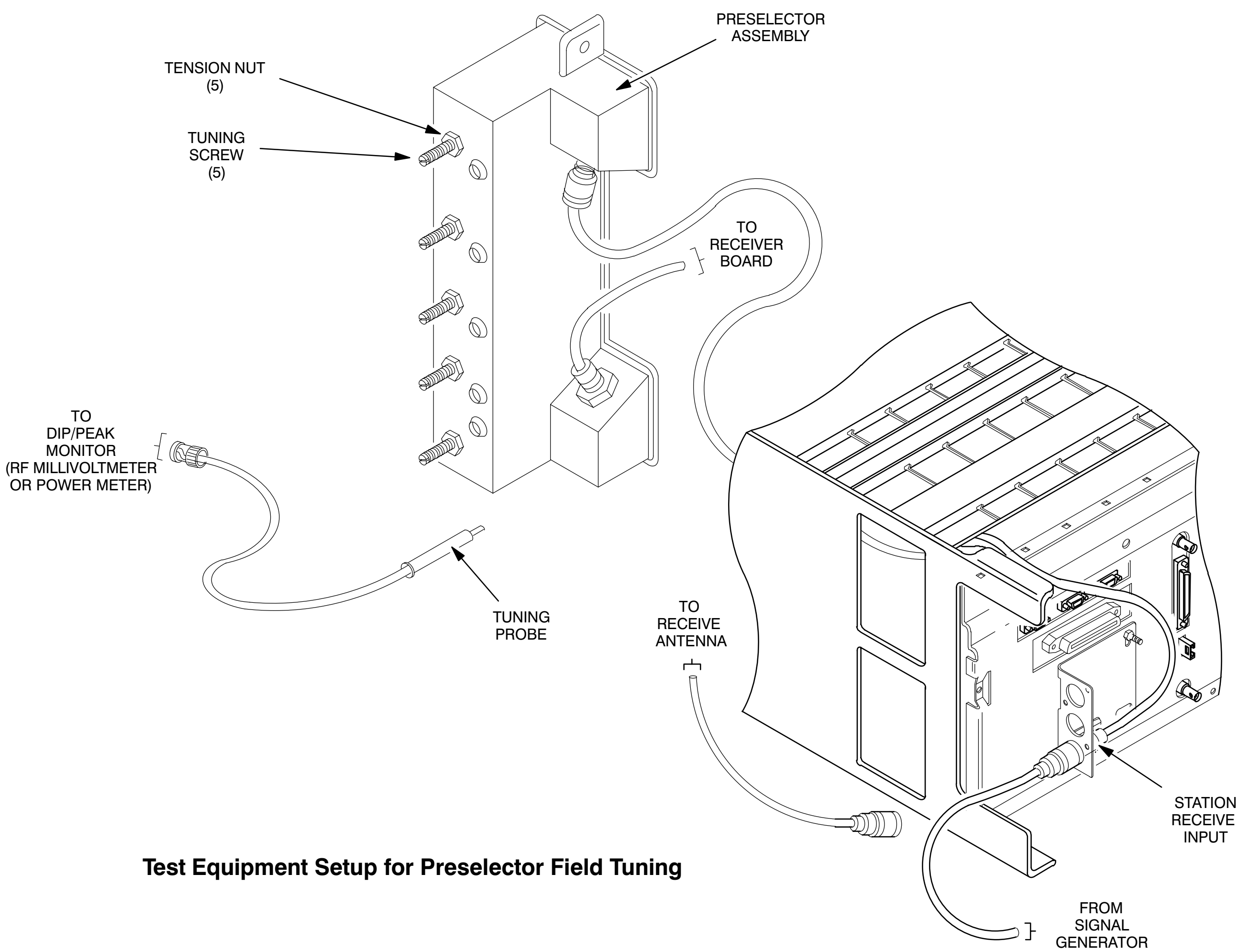
Step 1. Make sure Receiver Module (with Preselector Assembly) is installed in a functional station cage equipped with a Power Supply Module.

Step 2. Remove the two Torx−head screws from the Receiver Module front panel and remove the panel.

Step 3. Detune the preselector as follows.
If the alignment frequency (calculated on the previous page) is greater than 148 MHz (Range 1) or 156 MHz (Range 2), turn the five tuning screws in (CW) until 1/8" protrudes past each of the tension nuts. If the alignment frequency is less than or equal to 148 MHz (Range 1) or 156 MHz (Range 2), back out (CCW) the five tuning screws until ¾" protrudes past each of the tension nuts.

Step 4. Using the torque driver and deep well socket, tighten the five tension nuts on the adjustment screws to 6 in−lbs.

Step 5. Connect the test equipment as shown below:



Test Equipment Setup for Preselector Field Tuning

VHF Tuning Procedure (Continued)

IMPORTANT

When tuning for peak or dip, turn the tuning screw ½ turn past the peak or dip to verify that you have obtained a true peak or dip. After ensuring you have found true peak or dip, turn the screw back to the location of the original peak or dip.

Tuning Procedure

Step 1. Turn the station power supply ON (to provide the active 50Ω termination).

Step 2. Adjust the signal generator to the frequency calculated on page 40. Set the level to +5 dBm.

Step 3. Insert tuning probe into cavity H1 and adjust tuning screw 1 for a **PEAK**.

Step 4. Leave tuning probe in cavity H1 and adjust tuning screw 2 for a **DIP**.

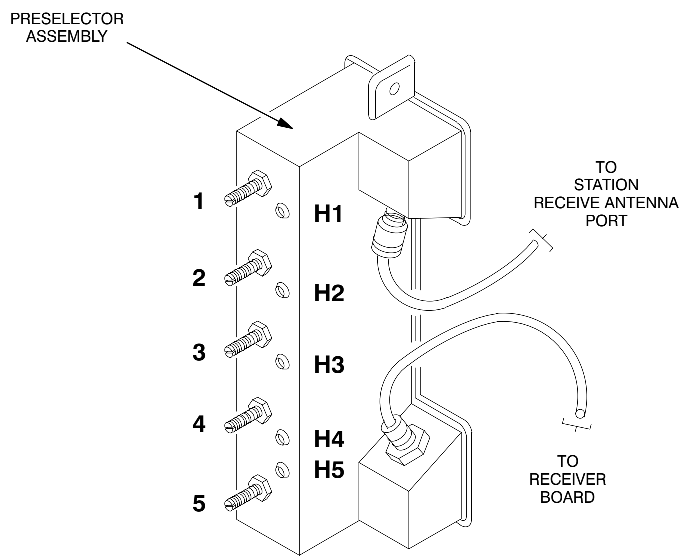
Step 5. Insert tuning probe into cavity H2 and adjust tuning screw 3 for a **DIP**.

Step 6. Insert tuning probe into cavity H3 and adjust tuning screw 4 for a **DIP**.

Step 7. Insert tuning probe into cavity H4. Decrease output from signal generator to −5 dBm.

Step 8. Adjust tuning screw 5 for a **DIP**. Then turn tuning screw 5

¼ turn CCW. (Note that dip will not be as sharp for screw 5 as it was for screws 2 thru 4.)



Location of Tuning Screws and Cavity Probe Holes

UHF Tuning Procedure

Calculating Proper Alignment Frequency

Use one of the following two methods to calculate the alignment frequency to be generated by the signal generator.

For stations with a **single receive frequency**, calculate the frequency of the alignment signal as follows:

Step 1. From the site documentation or the RSS, determine the station receive frequency. **Add 200 kHz.**

Step 2. If Receiver Module is **Range 1**, determine the alignment frequency as follows:

If frequency (from Step 1) is > 431 MHz, then alignment frequency = 431 MHz.

If frequency (from Step 1) is < 405 MHz, then alignment frequency = 405 MHz.

Otherwise, use actual frequency from Step 1.

Step 3. If Receiver Module is **Range 2**, determine the alignment frequency as follows:

If frequency (from Step 1) is > 468 MHz, then alignment frequency = 468 MHz.

If frequency (from Step 1) is < 440 MHz, then alignment frequency = 440 MHz.

Otherwise, use actual frequency from Step 1.

Step 4. If Receiver Module is **Range 3 or 4**, determine the alignment frequency as follows:

If frequency (from Step 1) is > 518 MHz, then alignment frequency = 518 MHz.

If frequency (from Step 1) is < 472 MHz, then alignment frequency = 472 MHz.

Otherwise, use actual frequency from Step 1.

For stations with **multiple receive frequencies**, calculate the frequency of the alignment signal as follows:

Step 1. From the site documentation or the RSS, note the receive frequency for each channel supported by the station.

Step 2. Calculate a midpoint frequency as follows:

$$F_{mid} = (F_{highest} + F_{lowest}) \div 2$$

Step 3. Using F_{mid} in place of the station receive frequency, perform Step 1 thru Step 4 from above.

UHF Tuning Procedure (Continued)

Preparing Equipment

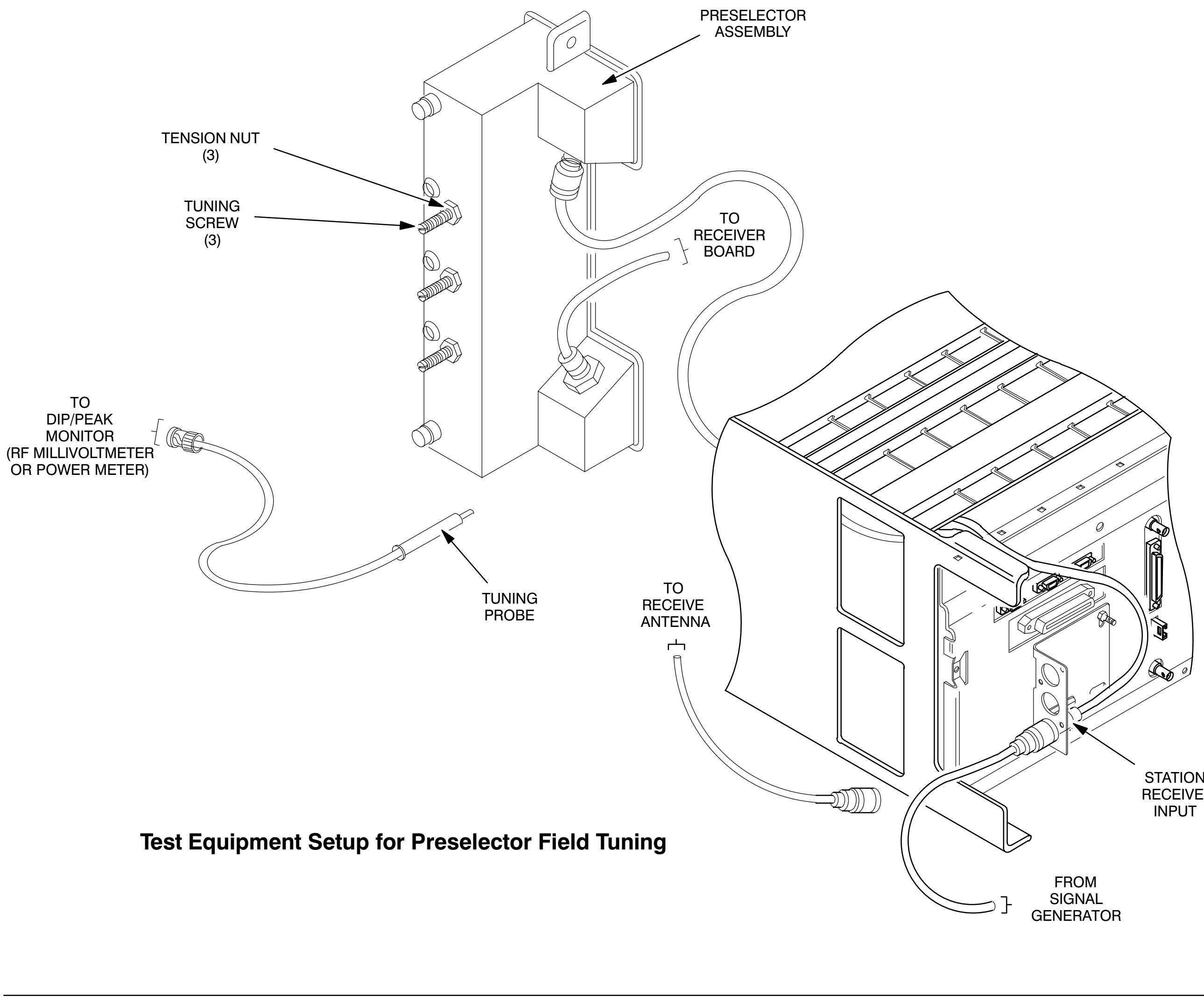
Step 1. Make sure Receiver Module (with Preselector Assembly) is installed in a functional station cage equipped with a Power Supply Module.

Step 2. Remove the two Torx−head screws from the Receiver Module front panel and remove the panel.

Step 3. Using the torque driver and deep well socket, loosen the three tension nuts on the adjustment screws.

Step 4. Detune the preselector as follows.
Turn tuning screws **3** and **4** clockwise until they bottom out. Be careful not to apply more than 3 in−lbs of torque to prevent warping preselector cover and housing.

Step 5. Connect the test equipment as shown below:



Test Equipment Setup for Preselector Field Tuning

Tuning Procedure (Continued)

IMPORTANT

When tuning for peak or dip, turn the tuning screw ½ turn past the peak or dip to verify that you have obtained a true peak or dip. After ensuring you have found true peak or dip, turn the screw back to the location of the original peak or dip.

Tuning Procedure

Step 1. Turn the station power supply ON (to provide the active 50Ω termination).

Step 2. Adjust the signal generator to the frequency calculated on page 40. Set the level to +5 dBm.

Step 3. Insert tuning probe into cavity U2 and adjust tuning screw 2 for a **PEAK**.

Step 4. Tighten tension nut on tuning screw 2 to at least 12 in–lb and fine tune tuning screw 2 for a **PEAK**.

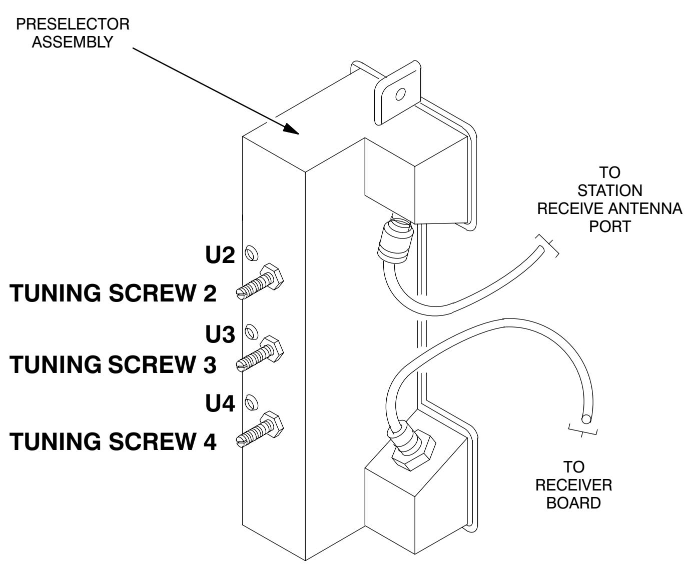
Step 5. Keep tuning probe in cavity U2 and adjust tuning screw 3 for a **DIP**.

Step 6. Tighten tension nut on tuning screw 3 to at least 12 in–lb and fine tune tuning screw 2 for a **DIP**.

Step 7. Insert tuning probe into cavity U3. Decrease output from signal generator to –5 dBm.

Step 8. Adjust tuning screw 4 for a **DIP**.

Step 9. Tighten tension nut on tuning screw 4 to at least 12 in–lb and fine tune tuning screw 4 for a **DIP**.



Location of Tuning Screws and Cavity Probe Holes

MOTOROLA

RECEIVER MODULE

INCLUDES MODELS:
TRD6361A-F Receiver Board(132–154 MHZ)
TFD6511A Preselector Filter (132–154 MHZ)
TRD6362A-F Receiver Board (150–174 MHZ)
TFD6512A Preselector Filter (150–174 MHZ)

1 DESCRIPTION

The *Quantar*/*Quantro* VHF High Band Receiver Modules are described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Receiver Module provides the receiver functions for the *Quantar* VHF station. Each receiver module is comprised of a Preselector Filter Assembly and a Receiver Board, all contained within a slide–in module housing. The receiver module performs highly selective bandpass filtering and dual down conversion of the station receive rf signal. A custom receiver IC then performs an analog to digital conversion of the received signal and outputs a differential data signal to the Station Control Module.

The Models TFD6511/TFD6512 Preselector Filter Assemblies and the TRD6361/TRD6362 Receiver Boards differ only in the range of operation. Models TFD6511/TRD6361 operate in VHF Range 1 (132–154MHz); Models TFD6512/TRD6362 operate in VHF Range 2 (150–174MHz). Unless otherwise noted, the information provided in this section applies to all models.

Overview of Circuitry

The receiver module contains the following circuitry:

- Frequency Synthesizer Circuitry— consisting of a phase–locked loop and VCO, generates the 1st LO injection signal
- Preselector Filter Assembly — provides 5–pole bandpass filtering of the station receive rf input
- Receiver Front End Circuitry — performs filtering, amplification, and the 1st down conversion of the receive rf signal
- Custom Receiver IC Circuitry — consists of a custom IC which performs the 2nd down conversion, filtering, amplification, and analog to digital conversion of the receive signal
- Address Decode & A/D Converter Circuitry — performs address decoding to provide board and chip select signals; also converts analog status signals to digital format for transfer to Station Control Module
- Local Power Supply Regulation — accepts +14.2V dc input and outputs +10V and +5V dc operating voltages

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the receiver module controls, indicators, and all input and output external connections.

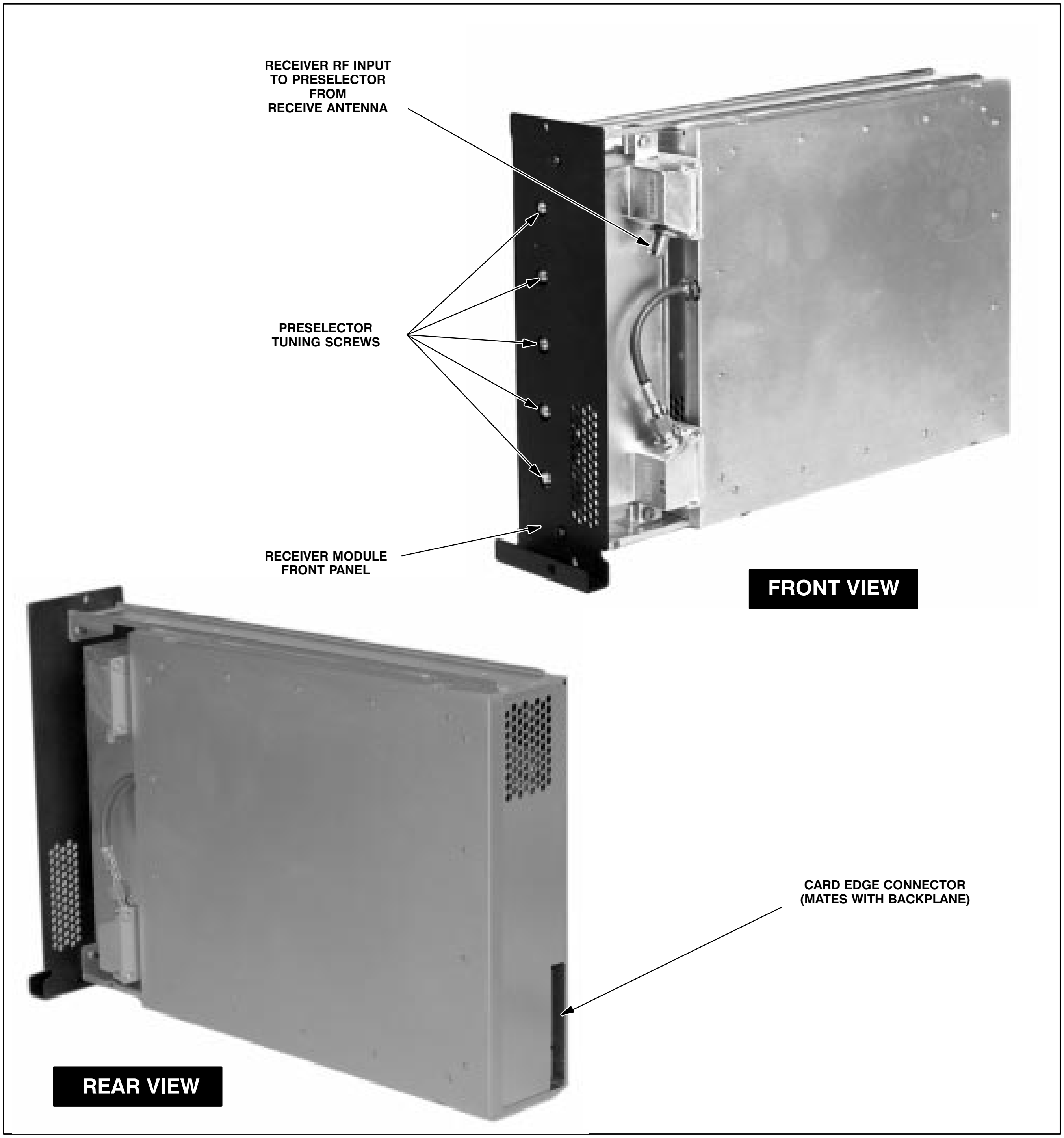

Figure 1. *Quantar/Quantro* VHF Receiver Module Controls, Indicators, and Inputs/Outputs

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the receiver circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the receiver module.

Synthesizer and VCO Circuitry

Introduction

The synthesizer and VCO circuitry generate the 1st LO injection signal for the 1st mixer in the receiver front end circuitry. Functional operation of these circuits is as follows.

Phase–Locked Loop

The phase–locked loop (PLL) IC receives frequency selection data from the Station Control Module microprocessor. Once programmed, the PLL IC compares a 2.1 MHz reference signal (from the Station Control Module) with a feedback sample of the VCO output. Depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference, correction pulses are generated. (The width of these correction pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.)

The up/down pulses from the PLL IC are fed to a charge pump which outputs a dc voltage proportional to the pulse widths. This dc voltage is then low–pass filtered and fed to the VCO as the *CONTROL VOLTAGE*. (Note that if a frequency change is requested by the microprocessor, the low–pass loop filter is momentarily bypassed to accelerate the frequency change.)

VCO

The dc control voltage from the synthesizer is fed to dual VCOs which generate the 1st LO injection signal. Within each band (Range 1 and Range 2), one VCO generates signals in the upper half of the band, while the other VCO generates signals in the lower half of the band. Only one VCO is active at a time. Selection of the active VCO is provided by a *BANDSHIFT* signal from the PLL IC.

The active VCO responds to the dc control voltage and generates the appropriate rf signal. This signal is fed through a buffer ampifier and impedance matching and output to the 1st LO injection amplifier in the receiver front end circuitry. A sample of the injection signal is returned to the PLL IC (via a feedback buffer) to serve as a VCO feedback signal.

Preselector Filter Assembly

The preselector filter assembly provides 5 poles of bandpass filtering for the station receive rf input signal. The filter assembly is mounted to the front of the receiver module housing and provides mini–UHF connectors for input from the receive antenna and output to the receiver board. Tuning screws are provided for filter tuning. (Refer to the *Troubleshooting* section in this manual for instructions on tuning the preselector assembly.)

Receiver Front End Circuitry

The receive rf input is fed from the antenna through the 5–pole preselector assembly to the receiver board. The signal is low–pass filtered, amplified, image filtered, and fed to one input of the 1st mixer. The signal is mixed with the 1st LO injection signal (generated by the synthesizer/VCO circuitry) to produce a 21.45 MHz 1st i–f signal.

The 1st i–f signal is 2–pole bandpass filtered and fed to an amplifier. The amplifier gain (high or low) is determined by an AGC switch circuit that is controlled by an AGC select signal from the Station Control Board. The amplified 1st i–f signal is then 4–pole bandpass filtered and fed to the rf input of the custom receiver IC.

Custom Receiver IC Circuitry

The custom receiver IC provides additional amplification, filtering, a second down conversion, and finally analog to digital conversion of the 2nd i–f signal. The digital receive signal is then output via differential driver circuitry to the Station Control Board. This data signal contains the necessary I and Q quadrature information, AGC information, and other data transfer information required by the Station Control Board to process the receive signal. (Note that the recovered audio signal is in digital format throughout the station circuitry, resulting in a more noise–free, linear receiver. Analog audio is present only in the external speaker driver circuitry on the Station Control Board and on the Wireline Interface Board at the phone line connections to and from the station.)

The remainder of the custom receiver IC circuitry consists of timing and tank circuits to support the internal oscillator, 2nd LO synthesizer circuitry, and 2nd i–f circuitry.

A serial bus allows data communications between the custom receiver IC and the DSP ASIC located on the Station Control Board. This bus allows the DSP ASIC to control various current and gain settings, establish the data bus clock rate, program the 2nd LO, and perform other control functions.

Address Decode and A/D Converter Circuitry

Address Decode Circuitry

The address decode circuitry allows the Station Control Board to use the address bus to select a specific device on a specific station board for control or data communications purposes (via the SPI bus). If the board select circuitry decodes address lines A2 thru A5 as the receiver module address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 and generates chip select signals for the PLL and A/D converter and the *SYNTH ADAPT* signal to control the loop filter bypass switch in the synthesizer circuitry.

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the receiver board are fed to the A/D converter, which converts them to a digital signal and, upon request by the Station Control Board, outputs the signal to the Station Control Board via the SPI bus.

Voltage Regulator Circuitry

The voltage regulator circuitry consists of +10V and two +5V regulators. The +10V regulator accepts a +14.2V dc input and generates a +10V dc operating voltage for the receiver board circuitry.

The +10V regulator output also feeds two +5V regulators which output Custom Analog +5V and Custom Digital +5V dc operating voltages to supply the custom receiver IC. In addition, a +5V dc operating voltage is input at the backplane (from the station power supply) to supply Digital +5V to the remainder of the receiver board circuitry.

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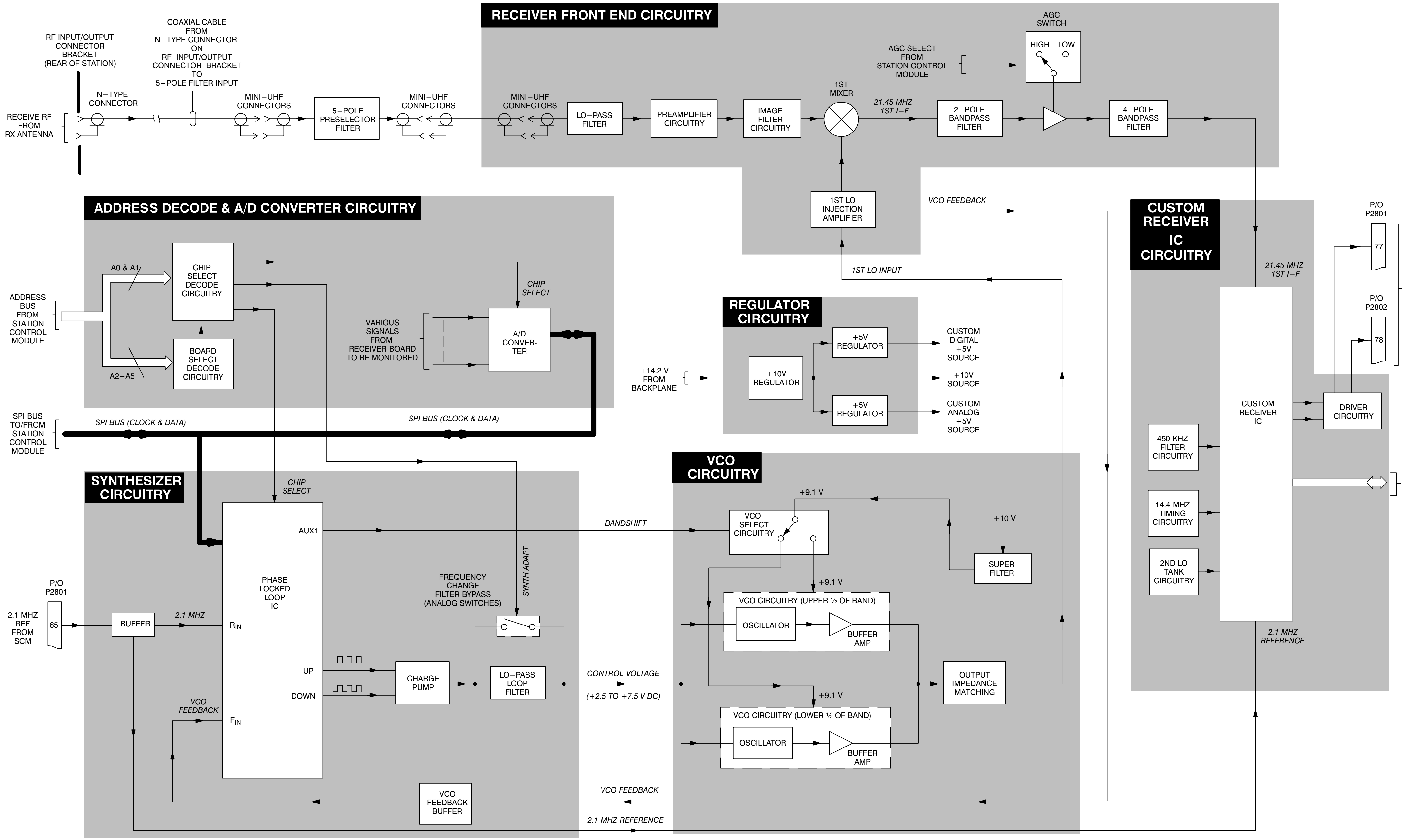

Figure 2. VHF Ranges 1 and 2 Receiver Module Functional Block Diagram

MOTOROLA

RECEIVER MODULE

INCLUDES MODELS:

TRE6281A−E Receiver Board/TLE5991A Preselector (403−433 MHZ)
TRE6282A−E Receiver Board/TLE5992A Preselector (438−470 MHZ)
TRE6283A−E Receiver Board/TLE5993A Preselector (470−494 MHZ)
TRE6284A−E Receiver Board/TLE5993A Preselector (494−520 MHZ)

1 DESCRIPTION

The *Quantar/Quantro* UHF Receiver Modules (ranges 1 thru 4) are described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all equipment modules.)

General Description

The Receiver Module provides the receiver functions for the *Quantar/Quantro* communications equipment. Each receiver module is comprised of a Preselector Filter Assembly and a Receiver Board, all contained within a slide−in module housing. The receiver module performs highly selective bandpass filtering and dual down conversion of the receive rf signal. A custom receiver IC then performs an analog to digital conversion of the received signal and outputs a differential data signal to the Station Control Module.

The preselector and receiver board models differ only in the range of operation. Unless otherwise noted, the information provided in this section applies to all models.

Overview of Circuitry

The receiver module contains the following circuitry:

- Frequency Synthesizer Circuitry— consisting of a phase−locked loop and VCO, generates the 1st LO injection signal
- Preselector Filter Assembly — provides 3−pole bandpass filtering of the receive rf input
- Receiver Front End Circuitry — performs filtering, amplification, and the 1st down conversion of the receive rf signal
- Custom Receiver IC Circuitry — consists of a custom IC which performs the 2nd down conversion, filtering, amplification, and analog to digital conversion of the receive signal
- Address Decode & A/D Converter Circuitry — performs address decoding to provide board and chip select signals; also converts analog status signals to digital format for transfer to Station Control Module
- Local Power Supply Regulation — accepts +14.2 V dc input and outputs +10V and +5V dc operating voltages

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the receiver module controls, indicators, and all input and output external connections.

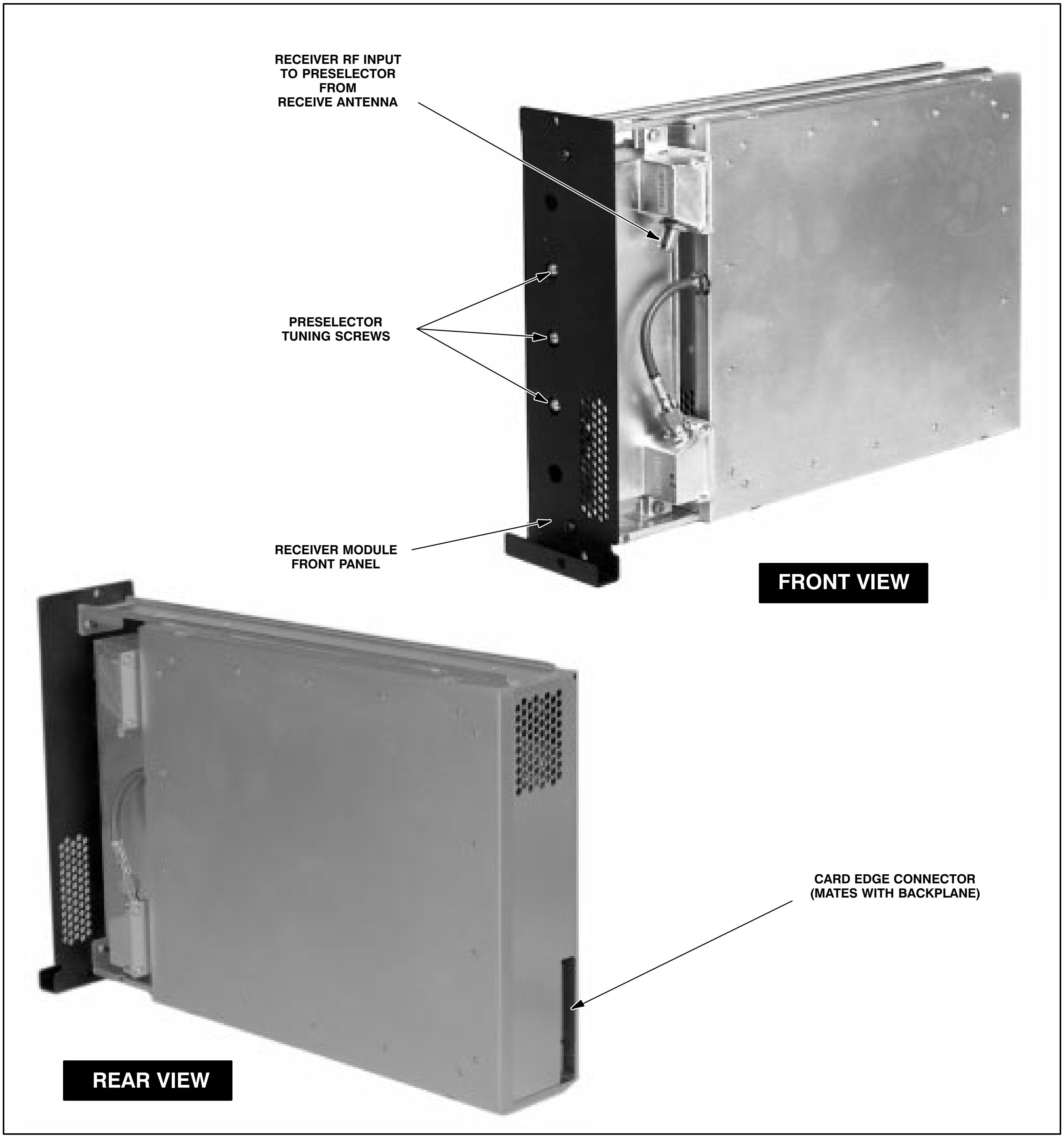

Figure 1. UHF Receiver Module Controls, Indicators, and Inputs/Outputs

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the receiver circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the receiver module.

Synthesizer and VCO Circuitry

Introduction

The synthesizer and VCO circuitry generate the 1st LO injection signal for the 1st mixer in the receiver front end circuitry. Functional operation of these circuits is as follows.

Phase−Locked Loop

The phase−locked loop (PLL) IC receives frequency selection data from the Station Control Module microprocessor. Once programmed, the PLL IC compares a 2.1 MHz reference signal (from the Station Control Module) with a feedback sample of the VCO output. Depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference, correction pulses are generated. (The width of these correction pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.)

The up/down pulses from the PLL IC are fed to a charge pump which outputs a dc voltage proportional to the pulse widths. This dc voltage is then low−pass filtered and fed to the VCO as the *CONTROL VOLTAGE*. (Note that if a frequency change is requested by the microprocessor, the low−pass loop filter is momentarily bypassed to accelerate the frequency change.)

VCO

The dc control voltage from the synthesizer is fed to dual VCOs which generate the 1st LO injection signal. Within each band (Ranges 1 thru 4), one VCO generates signals in the upper half of the band, while the other VCO generates signals in the lower half of the band. Only one VCO is active at a time. Selection of the active VCO is provided by a *BANDSHIFT* signal from the PLL IC.

The active VCO responds to the dc control voltage and generates the appropriate rf signal. This signal is fed through a buffer amplifier and impedance matching and output to the 1st LO injection amplifier in the receiver front end circuitry. A sample of the injection signal is returned to the PLL IC (via a feedback buffer) to serve as a VCO feedback signal.

Preselector Filter Assembly

The preselector filter assembly provides 3 poles of bandpass filtering for the receive rf input signal. The filter assembly is mounted to the front of the receiver module housing and provides mini–UHF connectors for input from the receive antenna and output to the receiver board. Tuning screws are provided for filter tuning. (Refer to the *Troubleshooting* section in this manual for instructions on tuning the preselector assembly.)

Receiver Front End Circuitry

The receive rf input is fed from the antenna through the 3–pole preselector assembly to the receiver board. The signal is low–pass filtered, amplified, image filtered, and fed to one input of the 1st mixer. The signal is mixed with the 1st LO injection signal (generated by the synthesizer/VCO circuitry) to produce a 73.35 MHz 1st i–f signal.

The 1st i–f signal is 2–pole bandpass filtered and fed to an amplifier. The amplifier gain (high or low) is determined by an AGC switch circuit that is controlled by an AGC select signal from the Station Control Module. The amplified 1st i–f signal is then 4–pole bandpass filtered and fed to the rf input of the custom receiver IC.

Custom Receiver IC Circuitry

The custom receiver IC provides additional amplification, filtering, a second down conversion, and finally analog to digital conversion of the 2nd i–f signal. The digital receive signal is then output via differential driver circuitry to the Station Control Board. This data signal contains the necessary I and Q quadrature information, AGC information, and other data transfer information required by the Station Control Module to process the receive signal. (Note that the recovered audio signal is in digital format throughout the equipment circuitry, resulting in a more noise–free, linear receiver. Analog audio is present only in the external speaker driver circuitry on the Station Control Board and on the Wireline Interface Board at the phone line connections to and from the equipment.)

The remainder of the custom receiver IC circuitry consists of 2nd LO VCO circuitry and timing and tank circuits to support internal circuitry.

A serial bus allows data communications between the custom receiver IC and the DSP ASIC located on the Station Control Board. This bus allows the DSP ASIC to control various current and gain settings, establish the data bus clock rate, program the 2nd LO, and perform other control functions.

Address Decode and A/D Converter Circuitry

Address Decode Circuitry

The address decode circuitry allows the Station Control Board to use the address bus to select a specific device on a specific station board for control or data communications purposes (via the SPI bus). If the board select circuitry decodes address lines A2 thru A5 as the receiver module address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 and generates chip select signals for the PLL and A/D converter and the *SYNTH ADAPT* signal to control the loop filter bypass switch in the synthesizer circuitry.

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the receiver board are fed to the A/D converter, which converts them to a digital signal and, upon request by the Station Control Module, outputs the signal to the Station Control Module via the SPI bus.

Voltage Regulator Circuitry

The voltage regulator circuitry consists of +10V and three +5V regulators. The +10V regulator accepts a +14.2V dc input and generates a +10V dc operating voltage for the receiver board circuitry.

The +10V regulator output also feeds three +5V regulators. Two of the regulators provide Custom Analog +5V and Custom Digital +5V dc operating voltages to supply the custom receiver IC. The third regulator provides Synth +5V to supply the synthesizer circuitry.

In addition, a +5V dc operating voltage is input at the backplane (from the station power supply) to supply Digital +5V to the remainder of the receiver board circuitry.

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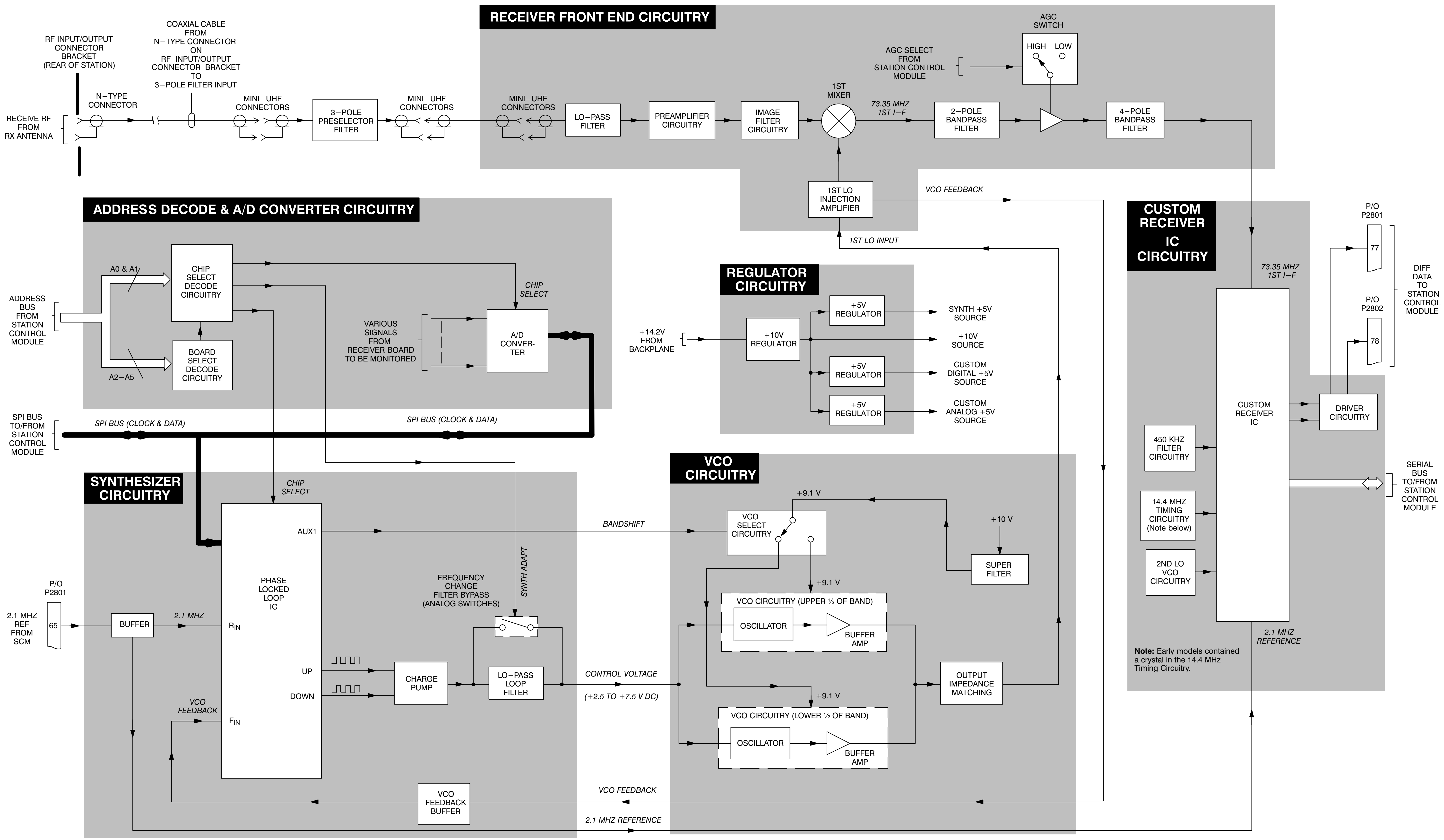

Figure 2. *Quantar/Quantro* UHF (Ranges 1 thru 4) Receiver Module Functional Block Diagram

MOTOROLA

RECEIVER MODULE

Includes TRF6551G Receiver Board

1 DESCRIPTION

The *Quantro*/*Quantar* 800 MHz Receiver Module is described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Receiver Module provides the receiver functions for the *Quantro*/*Quantar* 800 MHz station. The receiver module is comprised of a Receiver Board and a ceramic preselector (mounted on board), all contained within a slide−in module housing. The receiver module performs highly selective bandpass filtering and dual down conversion of the station receive rf signal. A custom receiver IC then performs an analog to digital conversion of the received signal and outputs a differential data signal to the Station Control Module.

Overview of Circuitry

The receiver module contains the following circuitry:

- Frequency Synthesizer Circuitry— consisting of a phase−locked loop and VCO, generates the 1st LO injection signal
- Ceramic Preselector Filter — provides 7−pole bandpass filtering of the station receive rf input
- Receiver Front End Circuitry — performs filtering, amplification, and the 1st down conversion of the receive rf signal
- Custom Receiver IC Circuitry — consists of a custom IC which performs the 2nd down conversion, filtering, amplification, and analog to digital conversion of the receive signal
- Address Decode & A/D Converter Circuitry — performs address decoding to provide board and chip select signals; also converts analog status signals to digital format for transfer to Station Control Module
- Local Power Supply Regulation — accepts +14.2V dc input and outputs +10V and +5V dc operating voltages

2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the receiver module controls, indicators, and all input and output external connections.

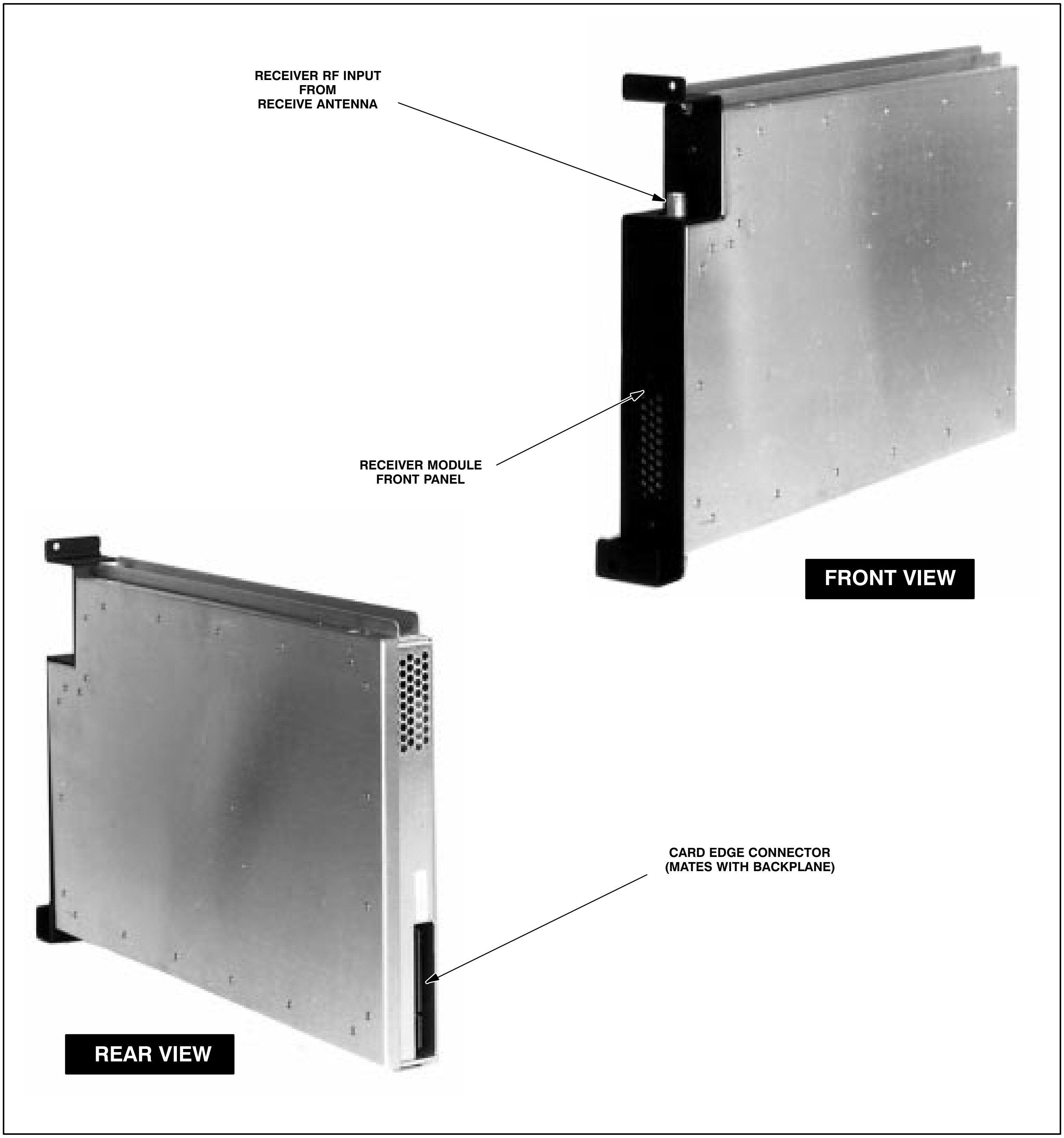

Figure 1. *Quantro*/*Quantar* 800 MHz Receiver Module Controls, Indicators, and Inputs/Outputs

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the receiver circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the receiver module.

Synthesizer and VCO Circuitry

Introduction

The synthesizer and VCO circuitry generate the 1st LO injection signal for the 1st mixer in the receiver front end circuitry. Functional operation of these circuits is as follows.

Phase–Locked Loop

The phase–locked loop (PLL) IC receives frequency selection data from the Station Control Module microprocessor. Once programmed, the PLL IC compares a 2.1 MHz reference signal (from the Station Control Module) with a feedback sample of the VCO output. Depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference, correction pulses are generated. (The width of these correction pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.)

The up/down pulses from the PLL IC are fed to a charge pump which outputs a dc voltage proportional to the pulse widths. This dc voltage is then low–pass filtered and fed to the VCO as the *CONTROL VOLTAGE*. (Note that if a frequency change is requested by the microprocessor, the low–pass loop filter is momentarily bypassed to accelerate the frequency change.)

VCO

The dc control voltage from the synthesizer is fed to a VCO which generates the 1st LO injection signal. The VCO responds to the dc control voltage and generates the appropriate rf signal. This signal is fed through a buffer amplifier and impedance matching and output to the 1st LO injection amplifier in the receiver front end circuitry. A sample of the injection signal is returned to the PLL IC (via a feedback buffer) to serve as a VCO feedback signal.

Receiver Front End Circuitry

The receive rf input is fed from the antenna through a low−pass filter to a 7−pole ceramic preselector filter which provides highly selective bandpass filtering. The output of the preselector filter is then amplified, image filtered, and fed to one input of the 1st mixer. The signal is mixed with the 1st LO injection signal (generated by the synthesizer/VCO circuitry) to produce a 73.35 MHz 1st i−f signal.

The 1st i−f signal is 2−pole bandpass filtered and fed to an amplifier. The amplifier gain (high or low) is determined by an AGC switch circuit that is controlled by an AGC select signal from the Station Control Module. The amplified 1st i−f signal is then 4−pole bandpass filtered and fed to the rf input of the custom receiver IC.

Custom Receiver IC Circuitry

The custom receiver IC provides additional amplification, filtering, a second down conversion, and finally analog to digital conversion of the 2nd i−f signal. The digital receive signal is then sent via differential driver circuitry to the Station Control Board. This data signal contains the necessary I and Q quadrature information, AGC information, and other data transfer information required by the Station Control Module to process the receive signal. (Note that the recovered audio signal is in digital format throughout the station circuitry, resulting in a more noise−free, linear receiver. Analog audio is present only in the external speaker driver circuitry on the Station Control Board and on the Wireline Interface Board at the phone line connections to and from the station.)

The remainder of the custom receiver IC circuitry consists of timing and tank circuits to support the internal oscillator, 2nd LO synthesizer circuitry, and 2nd i−f circuitry.

A serial bus allows data communications between the custom receiver IC and the DSP ASIC located on the Station Control Board. This bus allows the DSP ASIC to control various current and gain settings, establish the data bus clock rate, program the 2nd LO, and perform other control functions.

Address Decode and A/D Converter Circuitry

Address Decode Circuitry

The address decode circuitry allows the Station Control Board to use the address bus to select a specific device on a specific station board for control or data communications purposes (via the SPI bus). If the board select circuitry decodes address lines A2 thru A5 as the receiver module address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 and generates chip select signals for the PLL and A/D converter and the *SYNTH ADAPT* signal to control the loop filter bypass switch in the synthesizer circuitry.

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the receiver board are fed to the A/D converter, which converts them to a digital signal and, upon request by the Station Control Module, outputs the signal to the Station Control Module via the SPI bus.

Voltage Regulator Circuitry

The voltage regulator circuitry consists of +10V and two +5V regulators. The +10V regulator accepts a +14.2V dc input and generates a +10V dc operating voltage for the receiver board circuitry.

The +10V regulator output also feeds two +5V regulators which output Custom Analog +5V and Custom Digital +5V dc operating voltages to supply the custom receiver IC and Synthesizer IC. In addition, a +5V dc operating voltage is input at the backplane (from the station power supply) to supply Digital +5V to the remainder of the receiver board circuitry.

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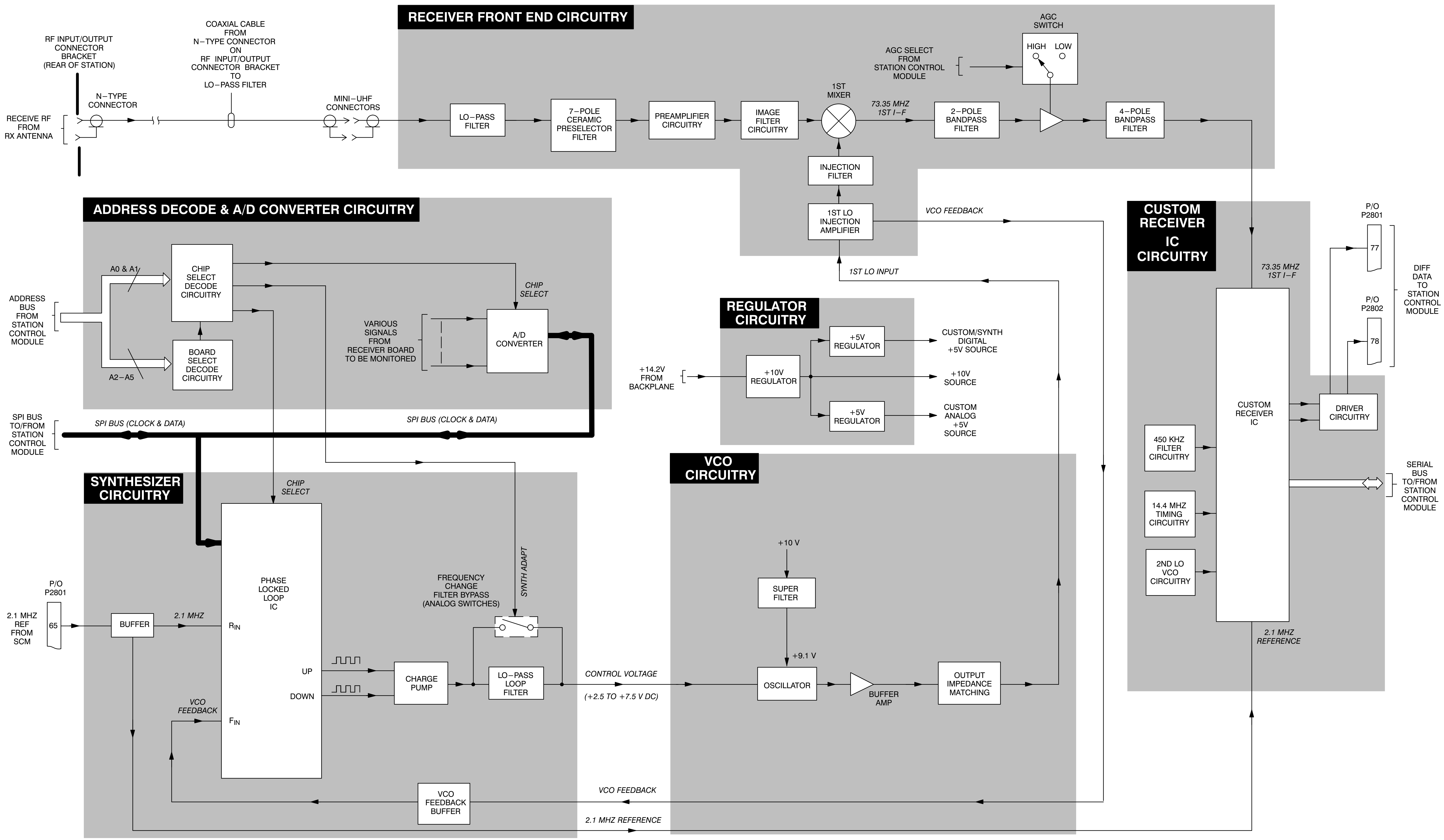

Figure 2. *Quantro/Quantar* 800 MHz Receiver Module Functional Block Diagram

MOTOROLA

RECEIVER MODULE

Includes TRF6552G Receiver Board

1 DESCRIPTION

The *Quantar/Quantro* 900 MHz Receiver Module is described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Receiver Module provides the receiver functions for the *Quantar/ Quantro* 900 MHz station. The receiver module is comprised of a Receiver Board and a ceramic preselector (mounted on board), all contained within a slide−in module housing. The receiver module performs highly selective bandpass filtering and dual down conversion of the station receive rf signal. A custom receiver IC then performs an analog to digital conversion of the received signal and outputs a differential data signal to the Station Control Module.

Overview of Circuitry

The receiver module contains the following circuitry:

- Frequency Synthesizer Circuitry— consisting of a phase−locked loop and VCO, generates the 1st LO injection signal
- Ceramic Preselector Filter — provides 7−pole bandpass filtering of the station receive rf input
- Receiver Front End Circuitry — performs filtering, amplification, and the 1st down conversion of the receive rf signal
- Custom Receiver IC Circuitry — consists of a custom IC which performs the 2nd down conversion, filtering, amplification, and analog to digital conversion of the receive signal
- Address Decode & A/D Converter Circuitry — performs address decoding to provide board and chip select signals; also converts analog status signals to digital format for transfer to Station Control Module
- Local Power Supply Regulation — accepts +14.2V dc input and outputs +10V and +5V dc operating voltages

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the receiver module controls, indicators, and all input and output external connections.

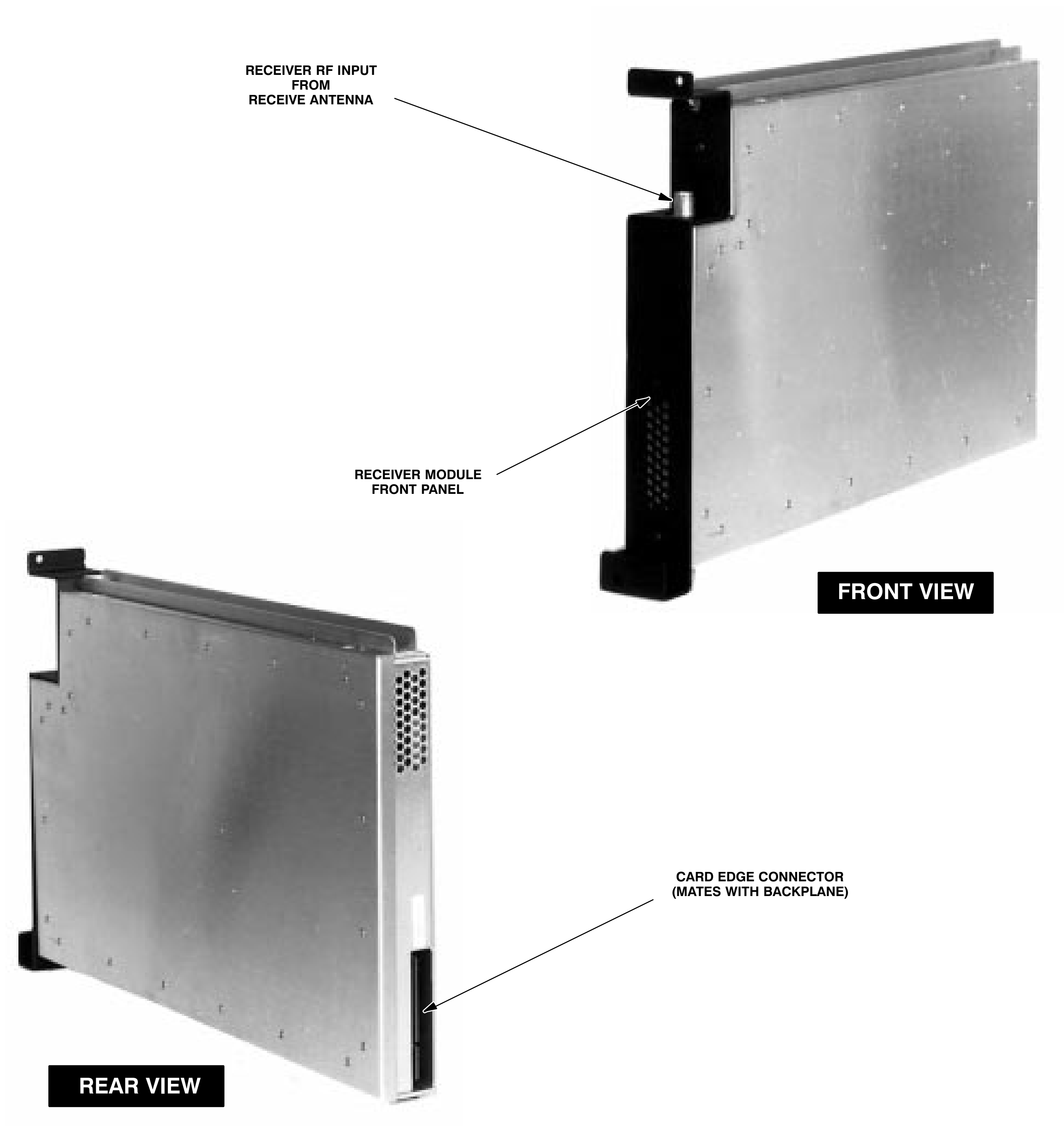

Figure 1. *Quantar/Quantro* 900 MHz Receiver Module Controls, Indicators, and Inputs/Outputs

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the receiver circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the receiver module.

Synthesizer and VCO Circuitry

Introduction

The synthesizer and VCO circuitry generate the 1st LO injection signal for the 1st mixer in the receiver front end circuitry. Functional operation of these circuits is as follows.

Phase–Locked Loop

The phase–locked loop (PLL) IC receives frequency selection data from the Station Control Module microprocessor. Once programmed, the PLL IC compares a 2.1 MHz reference signal (from the Station Control Module) with a feedback sample of the VCO output. Depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference, correction pulses are generated. (The width of these correction pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.)

The up/down pulses from the PLL IC are fed to a charge pump which outputs a dc voltage proportional to the pulse widths. This dc voltage is then low–pass filtered and fed to the VCO as the *CONTROL VOLTAGE*. (Note that if a frequency change is requested by the microprocessor, the low–pass loop filter is momentarily bypassed to accelerate the frequency change.)

VCO

The dc control voltage from the synthesizer is fed to a VCO which generates the 1st LO injection signal. The VCO responds to the dc control voltage and generates the appropriate rf signal. This signal is fed through a buffer amplifier and impedance matching and output to the 1st LO injection amplifier in the receiver front end circuitry. A sample of the injection signal is returned to the PLL IC (via a feedback buffer) to serve as a VCO feedback signal.

Receiver Front End Circuitry

The receive rf input is fed from the antenna through a low−pass filter to a 7−pole ceramic preselector filter which provides highly selective bandpass filtering. The output of the preselector filter is then amplified, image filtered, and fed to one input of the 1st mixer. The signal is mixed with the 1st LO injection signal (generated by the synthesizer/VCO circuitry) to produce a 73.35 MHz 1st i−f signal.

The 1st i−f signal is 2−pole bandpass filtered and fed to an amplifier. The amplifier gain (high or low) is determined by an AGC switch circuit that is controlled by an AGC select signal from the Station Control Module. The amplified 1st i−f signal is then 4−pole bandpass filtered and fed to the rf input of the custom receiver IC.

Custom Receiver IC Circuitry

The custom receiver IC provides additional amplification, filtering, a second down conversion, and finally analog to digital conversion of the 2nd i−f signal. The digital receive signal is then sent via differential driver circuitry to the Station Control Board. This data signal contains the necessary I and Q quadrature information, AGC information, and other data transfer information required by the Station Control Module to process the receive signal. (Note that the recovered audio signal is in digital format throughout the station circuitry, resulting in a more noise−free, linear receiver. Analog audio is present only in the external speaker driver circuitry on the Station Control Board and on the Wireline Interface Board at the phone line connections to and from the station.)

The remainder of the custom receiver IC circuitry consists of timing and tank circuits to support the internal oscillator, 2nd LO synthesizer circuitry, and 2nd i−f circuitry.

A serial bus allows data communications between the custom receiver IC and the DSP ASIC located on the Station Control Board. This bus allows the DSP ASIC to control various current and gain settings, establish the data bus clock rate, program the 2nd LO, and perform other control functions.

Address Decode and A/D Converter Circuitry

Address Decode Circuitry

The address decode circuitry allows the Station Control Board to use the address bus to select a specific device on a specific station board for control or data communications purposes (via the SPI bus). If the board select circuitry decodes address lines A2 thru A5 as the receiver module address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 and generates chip select signals for the PLL and A/D converter and the *SYNTH ADAPT* signal to control the loop filter bypass switch in the synthesizer circuitry.

A/D Converter Circuitry

Analog signals from various strategic operating points throughout the receiver board are fed to the A/D converter, which converts them to a digital signal and, upon request by the Station Control Module, outputs the signal to the Station Control Module via the SPI bus.

Voltage Regulator Circuitry

The voltage regulator circuitry consists of +10V and two +5V regulators. The +10V regulator accepts a +14.2V dc input and generates a +10V dc operating voltage for the receiver board circuitry.

The +10V regulator output also feeds two +5V regulators which output Custom Analog +5V and Custom Digital +5V dc operating voltages to supply the custom receiver IC and Synthesizer IC. In addition, a +5V dc operating voltage is input at the backplane (from the station power supply) to supply Digital +5V to the remainder of the receiver board circuitry.

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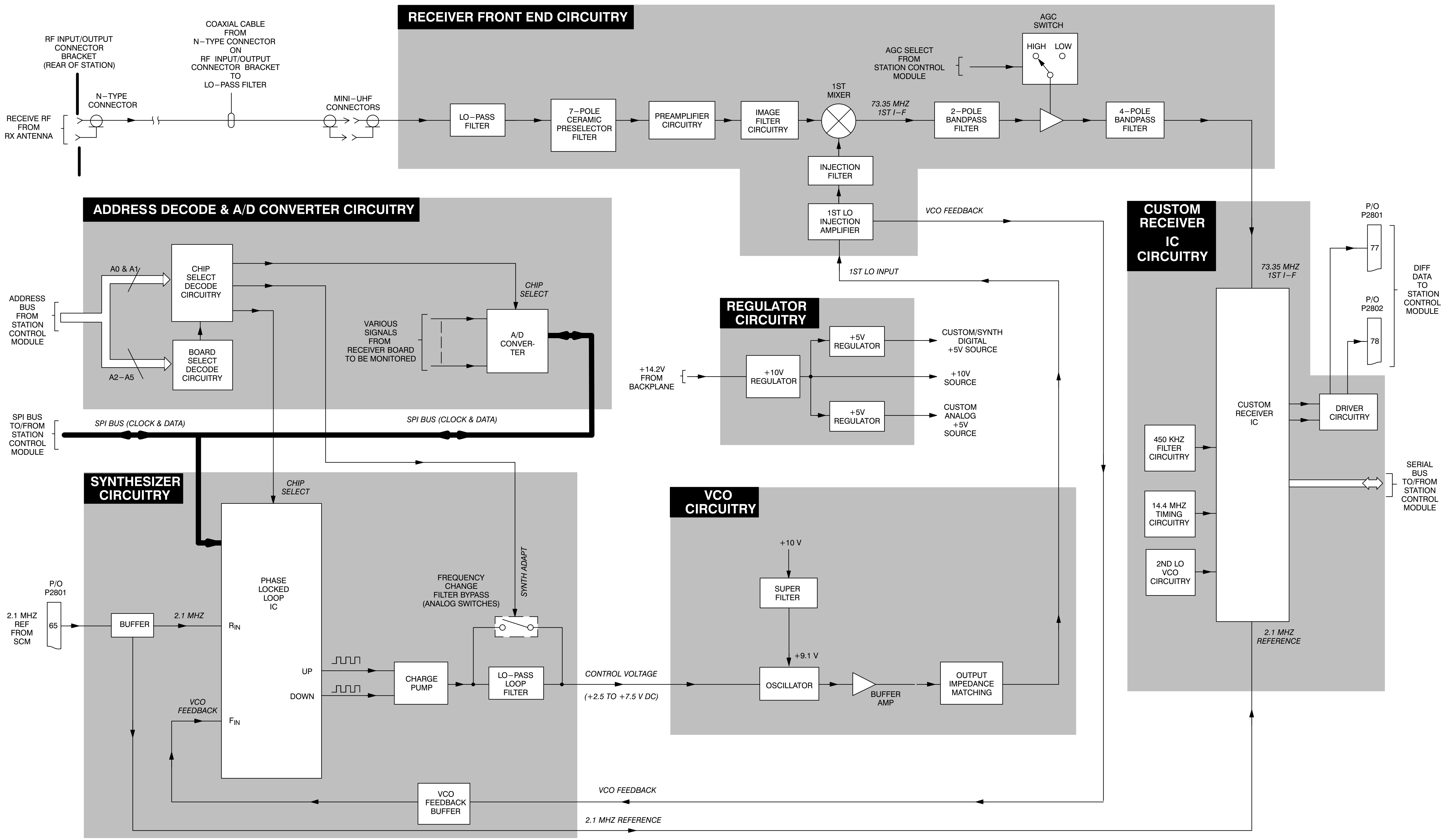

Figure 2. *Quantar/Quantro* 900 MHz Receiver Module Functional Block Diagram

MOTOROLA

EXCITER BOARD

MODELS TLD9831A-D (132–154 MHZ)
TLD9832A-D (150–174 MHZ)
TLE5971A-F (403–433 MHZ)
TLE5972A-F (438–470 MHZ)
TLE5973A-F (470–494 MHz)
TLE5974A-F (494–520 MHz)
TLF6920A-G (850–870 MHZ)
TLF6930A-G (935–941 MHz)

1 DESCRIPTION

The TLD9831A/32, TLE5971 thru 74, TLF6920, and TLF6930 Exciter Boards are described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Exciter Board (in conjunction with the Power Amplifier Module) provides the transmitter functions for the *Quantar* and *Quantro* stations. Contained within a slide–in module housing, the exciter board generates a low–level modulated rf signal which is input to the power amplifier module for further amplification and output to the transmit antenna.

These Exciter Boards differ only in the range of operation, as shown in the title of this section. Unless otherwise noted, the information provided in this section applies to all models.

Overview of Circuitry

The exciter board contains the following circuitry:

- Microprocessor — serves as the main controller for the exciter board; provides control, monitoring of signals, and interfaces with the Station Control Module microprocessor over a serial bus
- Frequency Synthesizer Circuitry— consisting of a phase–locked loop and VCO, generates a modulated rf signal at the transmitter carrier frequency
- Transmitter Power Control — generates a dc control voltage which controls the output power of the power amplifier module
- RF Switch — allows the microprocessor to turn on/off the exciter output signal to the power amplifier module

2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the exciter module controls, indicators, and all input and output external connections.

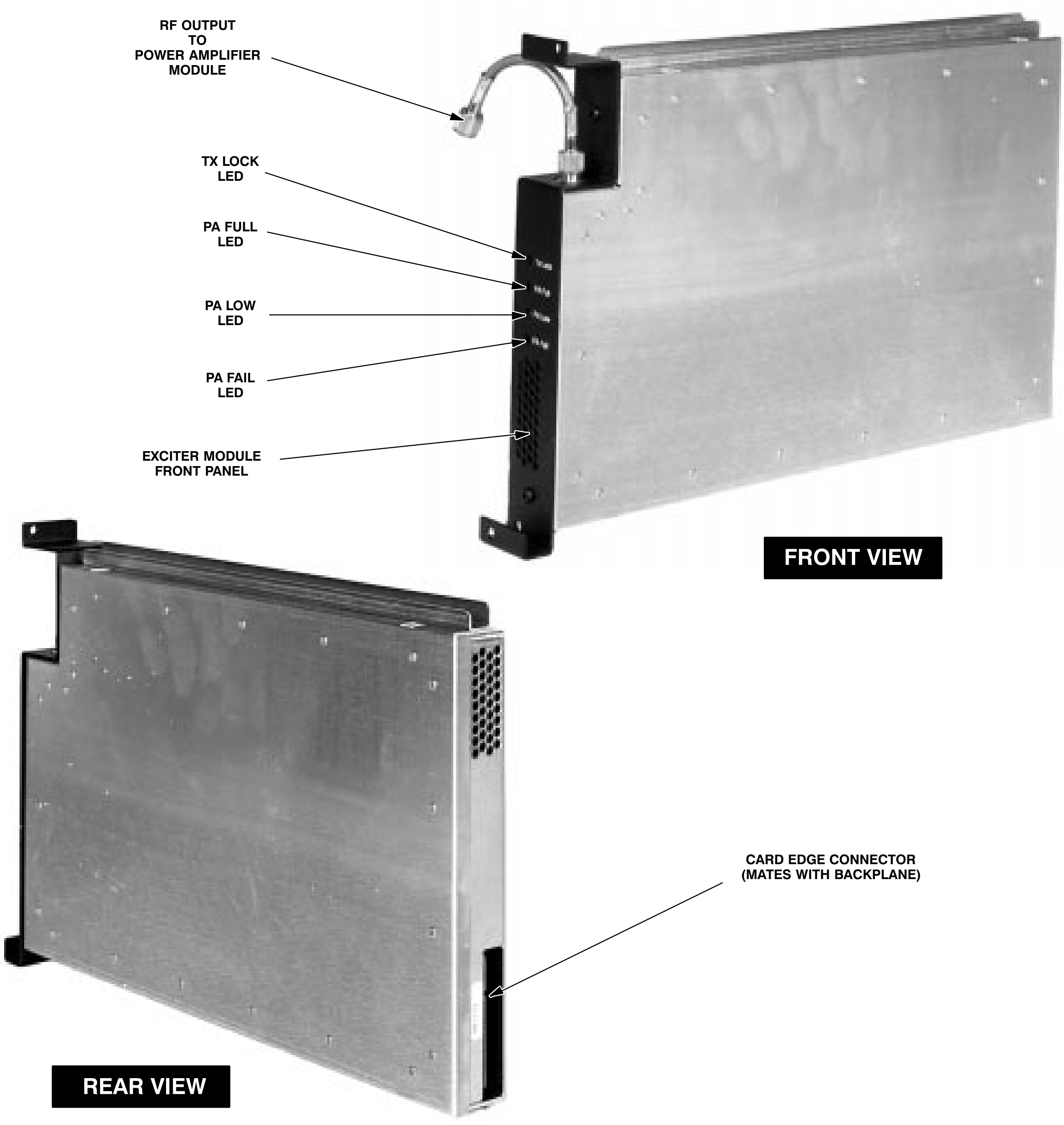

Figure 1. Exciter Module Controls, Indicators, and Inputs/Outputs

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the exciter circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the exciter module.

Synthesizer and VCO Circuitry

Introduction

As mentioned previously, the exciter module generates a low–level modulated rf signal which is input to the power amplifier module. The rf carrier is generated by a frequency synthesizer consisting of synthesizer circuitry and VCO circuitry. Functional operation of these circuits is as follows.

Phase–Locked Loop

The phase–locked loop (PLL) IC receives frequency selection data from the microprocessor. Once programmed, the PLL IC compares a 2.1 MHz reference signal (from the Station Control Module) with a feedback sample of the VCO output. Depending on whether the feedback signal is higher or lower in frequency than the 2.1 MHz reference, correction pulses are generated. (The width of these correction pulses is dependent on the amount of difference between the 2.1 MHz reference and the VCO feedback.)

The up/down pulses from the PLL IC are fed to a charge pump which outputs a dc voltage proportional to the pulse widths. This dc voltage is then low–pass filtered and fed to the VCO as the *CONTROL VOLTAGE*. (Note that if a frequency change is requested by the microprocessor, the low–pass loop filter is momentarily bypassed to accelerate the frequency change.)

VCO

The dc control voltage from the synthesizer is fed to dual VCOs which generate the rf carrier signal. Within each band (VHF–R1, R2, UHF–R1, R2, R3, R4, and 800 MHz), one VCO generates signals in the upper half of the band, while the other VCO generates signals in the lower half of the band. Only one VCO is active at a time. Selection of the active VCO is provided by a *BANDSHIFT* signal from the PLL IC.

Note: *800 MHz and 900 MHz Exciter Modules have only one VCO which operates over the entire 900 MHz range.*

The active VCO responds to the dc control voltage and generates the appropriate rf signal. This signal is fed through impedance matching, amplification, and filtering and is output to the RF Switch Circuitry. A sample of the output is returned to the PLL IC to serve as a VCO feedback signal.

Synthesizer and VCO Circuitry (Continued)

Modulation

The active VCO receives an audio/data modulation signal from the Station Control Module via two low–pass filters. This modulation signal modulates the active VCO to produce a modulated low–level rf carrier signal.

Low–frequency modulation signals (below the loop filter corner) tend to be interpreted by the PLL as VCO frequency error. A modulation compensation signal is added to the PLL control voltage to cancel out this effect and allow for low frequency modulation.

RF Switch Circuitry

The modulated rf signal from the VCO is fed through an attenuator to an rf switch circuit. Signal *TX ENABLE* from the microprocessor controls the switch. The rf signal is output to a mini–UHF connector mounted in a recess in the module front cover. An rf cable connects the exciter output to the power amplifier module.

Microprocessor Circuitry

Introduction

The microprocessor (μP) serves as the main controller for the exciter module circuitry. The μP provides the following functions.

Communications with Station Control Module

Data communications between the exciter μP and the Station Control Module μP is performed via a serial peripheral interface (SPI) bus. This bus allows the SCM μP to interrogate the exciter μP (to obtain status and alarm information) and to issue commands to the exciter μP (to select frequency and output power). The SPI bus is also used to allow the exciter μP to send data to the synthesizer PLL IC (to select frequency) and the D/A Converter IC (to control output power).

Monitoring External Signals

The exciter μP accepts input signals from various sources, including portions of the exciter circuitry and from the power amplifier module. These signals are input to the μP through analog multiplexers where they are monitored. The levels on these status lines are used by the μP to control the operation of the exciter circuitry and to report to the SCM μP.

EPROM

The μP operating program and various algorithms for frequency and output power control are stored in an EPROM. The μP accesses the EPROM via an address bus and a data bus.

Microprocessor Circuitry (Continued)

Output Control Signals

Various output control signals from the μP are fed to latches via the data bus. These signals include *PA KEY*, *TX ENABLE*, and the control signals for the front panel LEDs. Other control signals are provided to portions of the exciter module circuitry, as well as to the Power Amplifier Module.

Exciter ID Resistor ROM

A resistor network ROM provides exciter ID information to the μP. This information defines in which band and range (e.g., VHF–Range 1, UHF, 900 MHz, etc.) the particular exciter is designed to operate.

Oscillator Circuitry

The clock signal for the μP is generated by internal circuitry and an external 8.0000 MHz crystal circuit.

TX Power Control Circuitry

A/D Converter

The TX Power Control Circuitry consists of an D/A converter and a custom Power Control IC. Upon station power–up, the exciter μP sends data to the D/A converter (via the SPI bus) to select the desired output power (in Watts) from the power amplifier. The D/A converter outputs a dc reference voltage proportional to the selected output power.

Power Control IC

The Power Control IC generates a dc power control voltage (V_CONT) which is fed to the power amplifier module to control the output power. A forward power detect (TX_VF) signal (dc voltage proportional to the output power from the power amplifier) is fed back to the Power Control IC. The Power Control IC compares the TX_VF signal with the POWER SELECT voltages from the A/D converter and adjusts V_CONT accordingly to obtain the selected output power. This “feedback and control loop” continually monitors the TX_VF signal and adjusts V_CONT to maintain a constant output power at the selected level.

Monitoring of Loop Status

A sample of the dc power control voltage (V_CONT) is fed back to the μP via the analog multiplexer to allow the μP to monitor the status of the power control loop. Inability of the power amplifier to output the selected power (as indicated by V_CONT going to the maximum level) results in the μP re–programming the A/D converter to select a lower output power level. If after two reductions in selected power the power amplifier still cannot output the selected power, the μP initiates “shut down” mode by selecting 0 Watts and turning the rf switch OFF.

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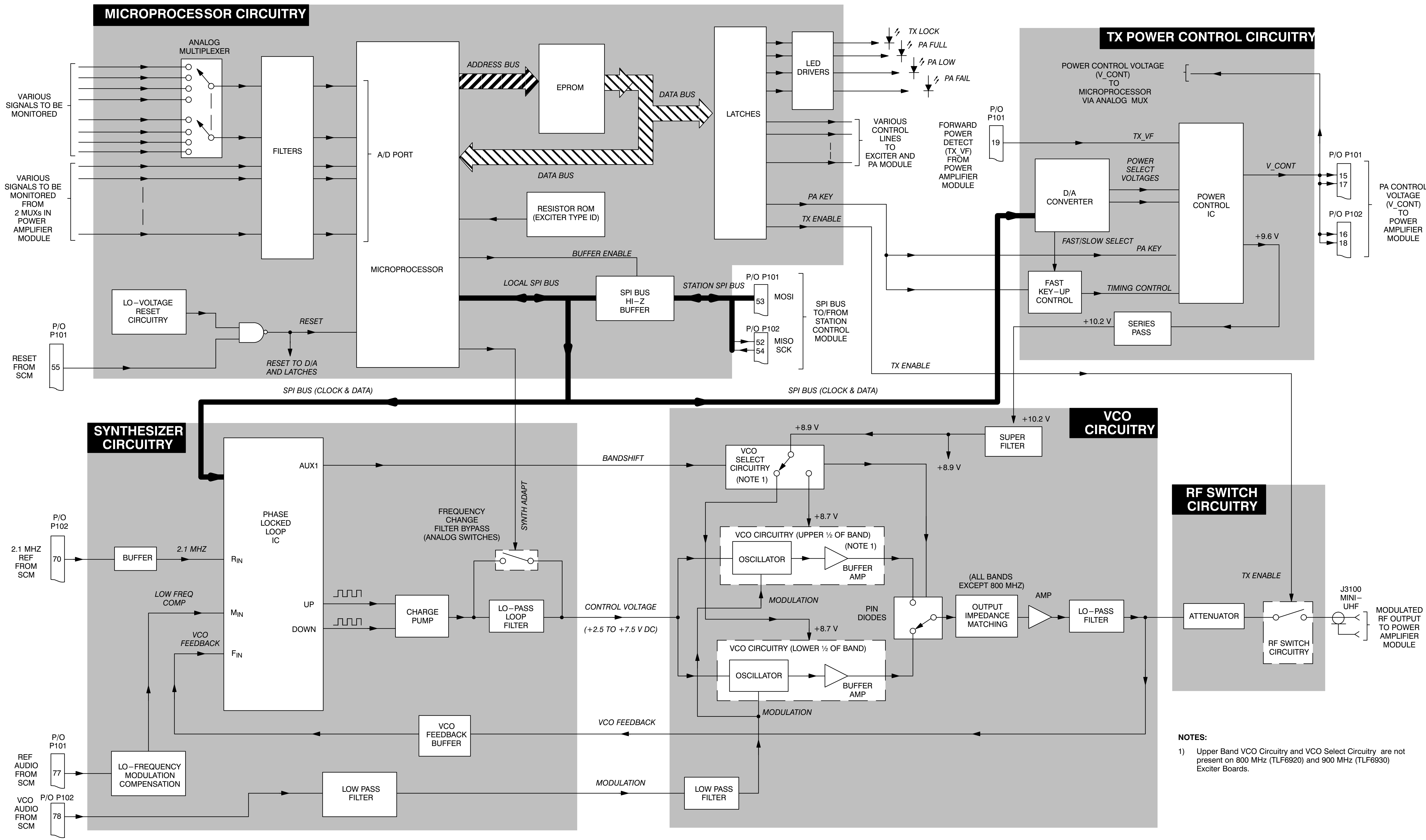

Figure 2. VHF, UHF, 800 MHz, and 900 MHz Exciter Modules Functional Block Diagram

POWER AMPLIFIER MODULE

MODELS: TLD3110A (25W, 132–174 MHz)
TLD3101A (125W, 132–154 MHz)
TLD3102A (125W, 150–174 MHz)

1 DESCRIPTION

The Models TLD3110 and TLD3101/TLD3102 Power Amplifier Modules are described in this section. A general description, identification of controls, indicators, and inputs/outputs, functional block diagrams, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Power Amplifier Module (PA) accepts a low–level modulated rf signal from the Exciter Module and amplifies the signal for transmission via the site transmit antenna. The output power is continually monitored and regulated by a feedback and control loop, with a power output control voltage being generated by the transmitter control circuitry located in the Exciter Module.

The Models TLD3110 and TLD3101/TLD3102 PA Modules are very similar in design and function, with the major differences being the output power capabilities and operating frequency range. Unless otherwise noted, the information provided in this section applies to all three models.

Overview of Circuitry

The PA contains the following circuitry:

- Intermediate Power Amplifier (IPA) — low–level amplifier stage which is controlled by the transmitter control voltage from the Exciter Module; provides an output of approximately 0 to 10W
- Driver Power Amplifier (DPA) — contained in 25W PA only, provides final amplification of the IPA output; provides an output of 35W maximum
- Final Power Amplifier (FPA) — contained in 125W PA only, provides final amplification of the IPA output; provides an output of 160W maximum
- Circulator — provides PA module output isolation
- Harmonic Filter/Coupler — suppresses harmonic radiation and couples the PA output to the transmit antenna connector; also serves as a power meter
- Sense and Detect Circuitry — provides sense and detect signals for critical signal points throughout the circuitry; signals are monitored by the Exciter Module

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the PA controls, indicators, and all input and output external connections.

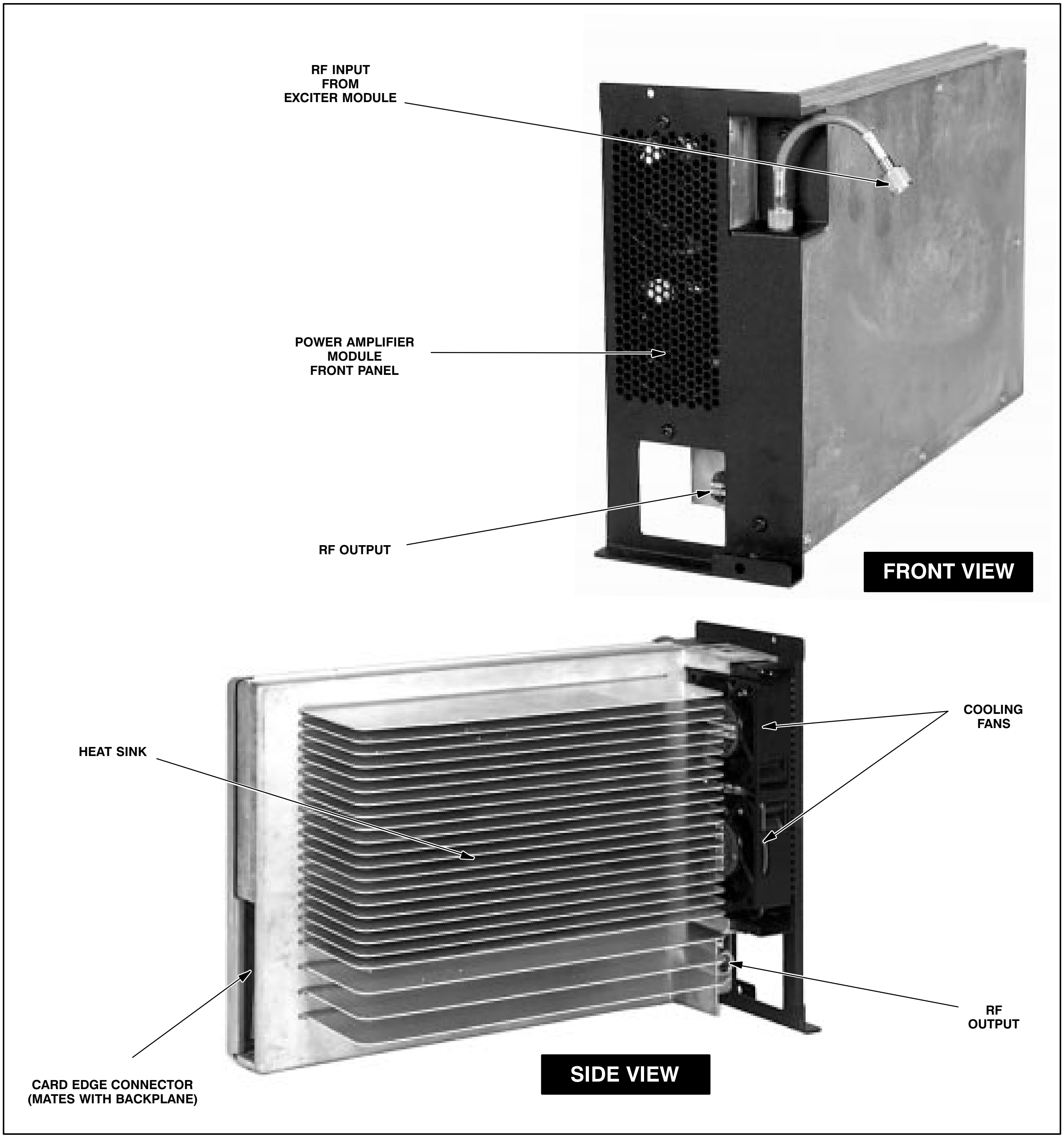

Figure 1. Power Amplifier Module Controls, Indicators, and Inputs/Outputs (125 W Model Shown)

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the PA circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Functional block diagrams are provided in Figure 2 (TLD3110, 25 W) and Figure 3 (TLD3101/TLD3102, 125 W). As mentioned previously, the four PA modules are similar in design and function. The following theory of operation applies to all four modules except where noted.

RF Signal Path

A low−level modulated rf signal (approximately +13 dBm) from the Exciter module is input to the PA module via a coax cable. The signal is input to the IPA and amplified to approximately 0 to 10W [depending on the dc power control voltage (V_CONT) from the Exciter Module].

The IPA output is fed to a DPA (25W) or an FPA (125W), where final amplification occurs. The output of the DPA (35W maximum) or FPA (160W maximum) is fed to a circulator, which passes the transmit signal to the harmonic filter/coupler, while routing all reflected power to a 50Ω load.

The output of the circulator is fed to the harmonic filter/coupler. This circuit provides highly selective bandpass filtering and couples the signal to an N−type connector mounted to the module casting. A coax cable routes the signal to an N−type connector mounted on an rf input/output connector bracket located on the rear of the station.

Output Power Control

A feedback and control loop configuration is used to regulate the PA output power. The Harmonic Filter/Coupler generates a dc voltage proportional to the PA Module output power. This voltage (TX_VF) is fed to the TX Power Control Circuitry in the Exciter Module. The TX_VF voltage is compared to reference voltages to generate a dc power control voltage (V_CONT).

Note that V_OMNI does not control the output level of the DPA directly but serves as on/off control for the DPA stage.

The dc power control voltage (V_CONT) is output from the Exciter Module and fed through filtering circuitry in the PA to a voltage translation and current limiting circuit. The output of this circuitry is V_OMNI, a dc voltage which controls the output power of the IPA.

Summary of Power Control Operation — By controlling the output level of the IPA (range of 0 to 10W), the output power of the PA module is established. The feedback and control loop (TX_VF fed back to Exciter Module resulting in V_CONT to control IPA output) continually monitors and maintains the proper output power from the PA.

Sense and Detect Circuitry

Introduction

The PA is equipped with several sense and detect circuits to provide status signals to the Exciter Module. In most cases, the Exciter Module microprocessor uses these signals to determine PA operating conditions and, in response, varies certain control signals to correct output power, turn on cooling fans, etc. The sense and detect circuits are described in the following paragraphs.

Current Sensing Circuitry (25W)

IPA and DPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the IPA and the DPA and outputs two dc signals directly proportional to the IPA and DPA currents. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltage (IPA_I or DPA_I) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the IPA or DPA.

Current Sensing Circuitry (125W)

IPA current sense circuitry (comprised of a differential amplifier and a sensing resistor) meters the current being drawn by the IPA and outputs a dc signal directly proportional to the IPA current. Circuit operation is described in the following paragraph.

The differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the IPA current. The dc voltage (IPA_I) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the IPA.

FPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the FPA (side A and side B) and outputs two dc signals directly proportional to the currents for side A and side B. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltages (FPA_I1_A and FPA_I1_B) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the FPA (side A or side B).

Sense and Detect Circuitry (Continued)

PA Temperature Sense

A thermistor and buffer circuit provides a dc voltage proportional to the PA temperature. This signal (PA_TEMP) is fed to the Exciter Module, which monitors the signal and reduces the PA output power [by reducing the dc power control voltage (V_CONT)] if the PA temperature exceeds set limits.

IPA, DPA, and FPA Detect Circuitry

Detection circuits provide a dc voltage approximately proportional to the rf outputs of the IPA, DPA (25W), and FPA (125W) stages. These dc signals (IPA_VF, DPA_VF, and FPA_VF, used for diagnostic purposes only) are fed to the Exciter Module via an analog multiplexer and filter circuitry.

Reflected Power Detect Circuitry

The Harmonic Filter/Coupler provides a dc voltage approximately proportional to the reflected power at the output of the stage. This dc signal (TX_VR) is fed to the Exciter Module via an analog multiplexer and filter circuitry. The signal indicates the amount of potentially harmful reflected power at the PA output. If the reflected power exceeds a set limit, the Exciter Module will shut down the PA.

V_OMNI Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the V_OMNI control voltage from the Voltage Translator & Current Limiter circuit. This dc signal (V_OMNI*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+14V Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the +14 V dc input voltage from the station Power Supply Module. This dc signal (14.2V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+28V Detect Circuitry (125W Only)

A voltage divider circuit provides a dc voltage approximately proportional to the +28 V dc input voltage from the station Power Supply Module. This dc signal (28V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Cooling Fans Control Circuitry (125 W Models Only)

WARNING

The cooling fans in the PA Module are thermostatically controlled and may come on at any time during station operation. Keep fingers clear of fan blades.

The PA is equipped with a dual fan module to provide forced air cooling of the PA. The fan module is controlled by a FAN ON signal from the Exciter Module, which is fed to a driver circuit in the PA Module. The Fan Driver/Detect Circuitry controls the power to the fans via two feed−thru pins in the PA chassis which mate with the power connector on the slide−in fan module. The fans are turned on only when the temperature in the PA exceeds a set limit. It is normal for the fans to cycle on and off during station operation.

The Fan Driver/Detect Circuitry also monitors the current to the fans and feeds a dc detect voltage to the Fan Status Circuitry, which outputs a status signal indicating whether the fan current is above or below a predetermined range. The status signal (FAN_ALARM) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Power Amplifier ID Resistor ROM

A resistor network "ROM" provides power amplifier ID information to the Exciter Module via an analog multiplexer and filter circuits. This information includes the band and range in which the PA is designed to operate (e.g., VHF−Range 1, UHF, 900 MHz, etc.) and the maximum output power (e.g., 25 W, 125 W, etc.).

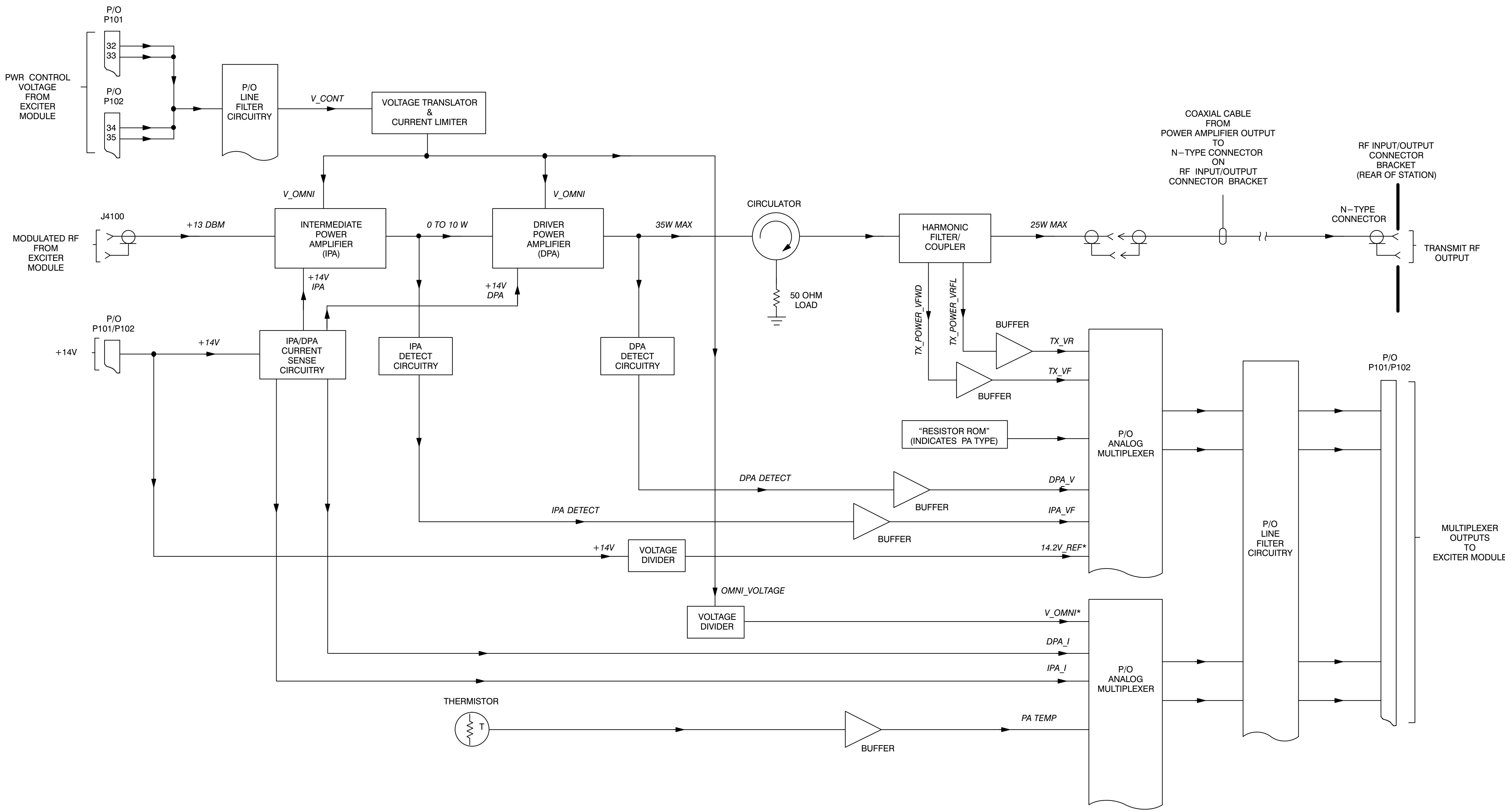

Figure 2. TLD3110 25W Power Amplifier Module Functional Block Diagram

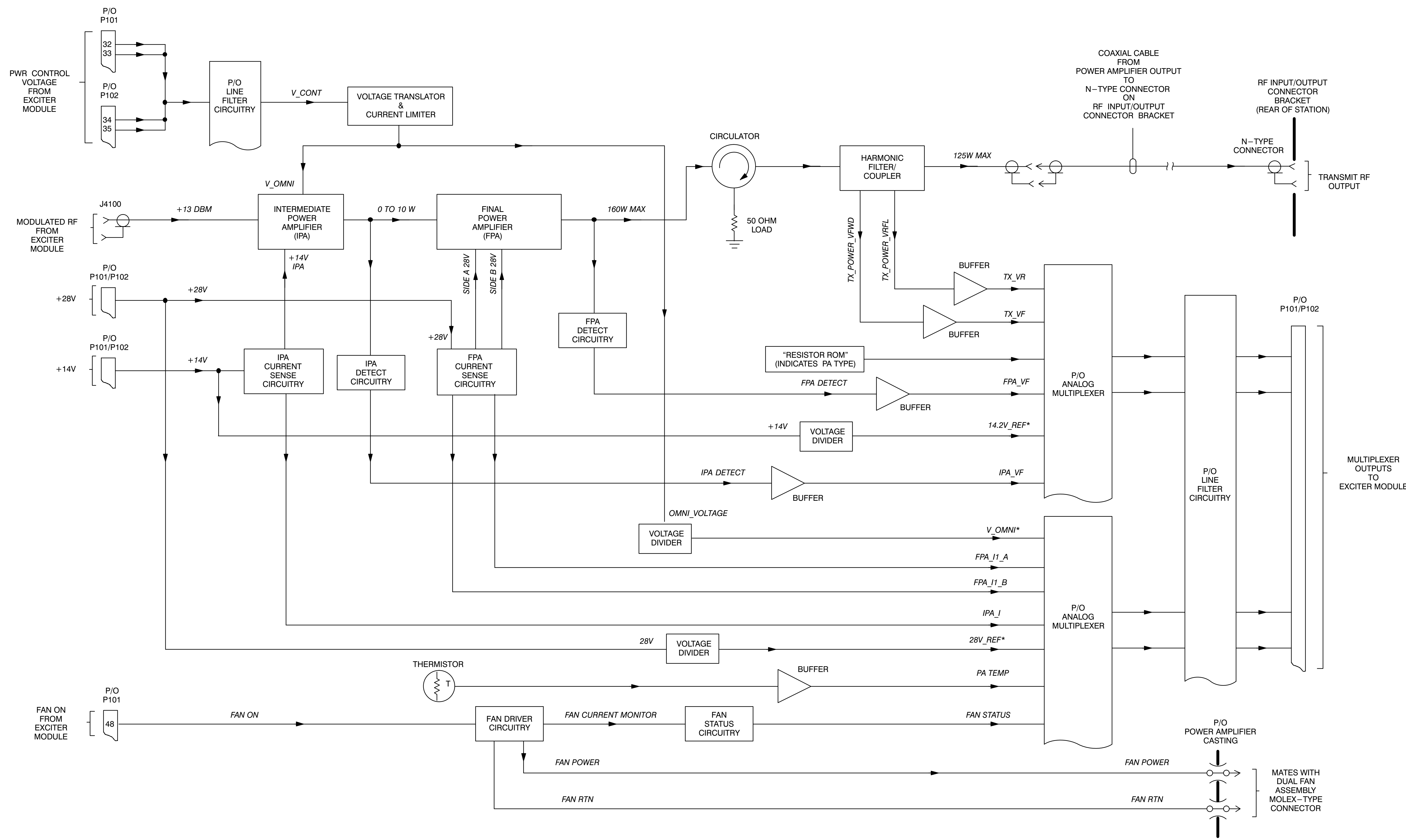

Figure 3. *TLD3101/TLD3102 125W Power Amplifier Module Functional Block Diagram*

MOTOROLA

POWER AMPLIFIER MODULE

MODELS: TLE2731A (25W, UHF Range 1)
TLE2732A (25W, UHF Range 2)
TTE2061A (110W, UHF Range 1
TTE2062A (110W, UHF Range 2)
TTE2063A (110W, UHF Range 3)
TTE2064A (100W, UHF Range 4)

1 DESCRIPTION

The Models TLE2731A, TLE2732A, TTE2061A, TTE2062A, TTE2063A, and TTE2064A Power Amplifier Modules are described in this section. A general description, identification of controls, indicators, and inputs/outputs, functional block diagrams, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Power Amplifier Module (PA) accepts a low−level modulated rf signal from the Exciter Module and amplifies the signal for transmission via the site transmit antenna. The output power is continually monitored and regulated by a feedback and control loop, with a power output control voltage being generated by the transmitter control circuitry located in the Exciter Module.

These PA Modules are very similar in design and function, with the major differences being the output power capabilities and operating frequency range. Unless otherwise noted, the information provided in this section applies to all three models.

Overview of Circuitry

The PA contains the following circuitry:

- Intermediate Power Amplifier (IPA) — low−level amplifier stage which is controlled by the transmitter control voltage from the Exciter Module; provides an output of approximately 0 to 15W
- Driver Power Amplifier (DPA) — contained in 25W PA only, provides final amplification of the IPA output; provides an output of 35W max.
- Final Power Amplifier (FPA) — contained in 100/110W PAs only, provides final amplification of the IPA output; provides an output of 180W maximum
- Circulator — provides PA module output isolation
- Harmonic Filter/Coupler — suppresses harmonic radiation and couples the PA output to the transmit antenna connector; also serves as a power meter
- Sense and Detect Circuitry — provides sense and detect signals for critical signal points throughout the circuitry; signals are monitored by the Exciter Module

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the PA controls, indicators, and all input and output external connections.

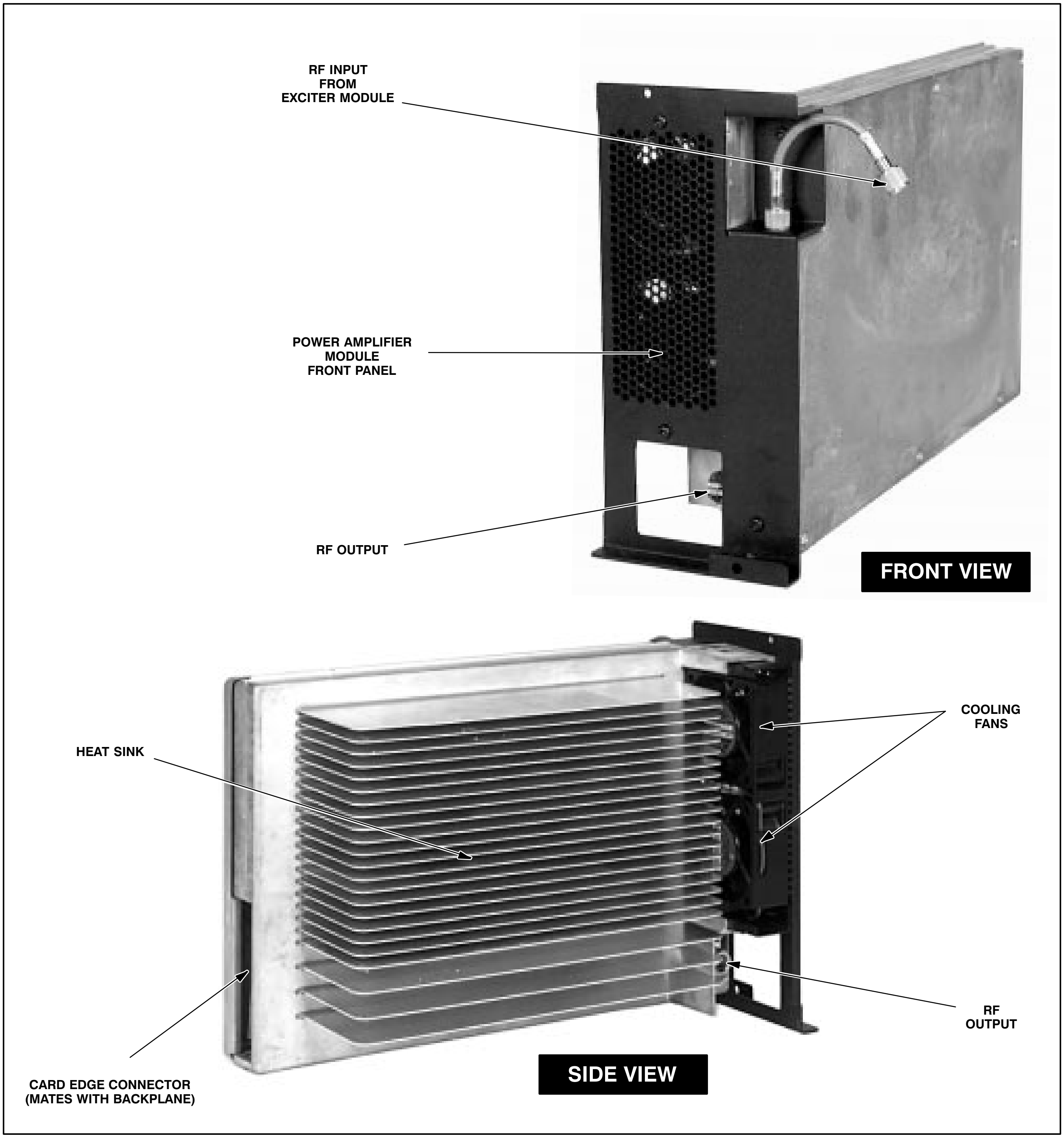

Figure 1. Power Amplifier Module Controls, Indicators, and Inputs/Outputs (110 W Model Shown)

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the PA circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Functional block diagrams are provided in Figure 2 (TLE2731A and TLE2732A, 25 W) and Figure 3 (TTE2061A−63A, 110 W and TTE2064A, 100W). As mentioned previously, the five PA modules are similar in design and function. The following theory of operation applies to all four modules except where noted.

RF Signal Path

A low−level modulated rf signal (approximately +13 dBm) from the Exciter module is input to the PA module via a coax cable. The signal is input to the IPA and amplified to approximately 0 to 15W [depending on the dc power control voltage (V_CONT) from the Exciter Module].

The IPA output is fed to a DPA (25W) or an FPA (100/110W), where final amplification occurs. The output of the DPA (35W maximum) or FPA (180W maximum) is fed to a circulator, which passes the transmit signal to the harmonic filter/coupler, while routing all reflected power to a 50Ω load.

The output of the circulator is fed to the harmonic filter/coupler. This circuit provides highly selective bandpass filtering and couples the signal to an N−type connector mounted to the module casting. A coax cable routes the signal to an N−type connector mounted on an rf input/output connector bracket located on the rear of the station.

Output Power Control

A feedback and control loop configuration is used to regulate the PA output power. The Harmonic Filter/Coupler generates a dc voltage proportional to the PA Module output power. This voltage (TX_VF) is fed to the TX Power Control Circuitry in the Exciter Module. The TX_VF voltage is compared to reference voltages to generate a dc power control voltage (V_CONT).

Note that V_OMNI does not control the output level of the DPA directly but serves as on/off control for the DPA stage.

The dc power control voltage (V_CONT) is output from the Exciter Module and fed through filtering circuitry in the PA to a voltage translation and current limiting circuit. The output of this circuitry is V_OMNI, a dc voltage which controls the output power of the IPA.

Summary of Power Control Operation — By controlling the output level of the IPA (range of 0 to 15W), the output power of the PA module is established. The feedback and control loop (TX_VF fed back to Exciter Module resulting in V_CONT to control IPA output) continually monitors and maintains the proper output power from the PA.

Sense and Detect Circuitry

Introduction

The PA is equipped with several sense and detect circuits to provide status signals to the Exciter Module. In most cases, the Exciter Module microprocessor uses these signals to determine PA operating conditions and, in response, varies certain control signals to correct output power, turn on cooling fans, etc. The sense and detect circuits are described in the following paragraphs.

Current Sensing Circuitry (25W)

IPA and DPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the IPA and the DPA and outputs two dc signals directly proportional to the IPA and DPA currents. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltage (IPA_I or DPA_I) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the IPA or DPA.

Current Sensing Circuitry (100/110W)

IPA current sense circuitry (comprised of a differential amplifier and a sensing resistor) meters the current being drawn by the IPA and outputs a dc signal directly proportional to the IPA current. Circuit operation is described in the following paragraph.

The differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the IPA current. The dc voltage (IPA_I) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the IPA.

FPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the FPA (side A and side B) and outputs two dc signals directly proportional to the currents for side A and side B. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltages (FPA_I1_A and FPA_I1_B) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the FPA (side A or side B).

Sense and Detect Circuitry (Continued)

PA Temperature Sense

A thermistor and buffer circuit provides a dc voltage proportional to the PA temperature. This signal (PA_TEMP) is fed to the Exciter Module, which monitors the signal and reduces the PA output power [by reducing the dc power control voltage (V_CONT)] if the PA temperature exceeds set limits.

IPA, DPA, and FPA Detect Circuitry

Detection circuits provide a dc voltage approximately proportional to the rf outputs of the IPA (15W), DPA (25W), and FPA (100/110W) stages. These dc signals (IPA_VF, DPA_VF, and FPA_VF, used for diagnostic purposes only) are fed to the Exciter Module via an analog multiplexer and filter circuitry.

Reflected Power Detect Circuitry

The Harmonic Filter/Coupler provides a dc voltage approximately proportional to the reflected power at the output of the stage. This dc signal (TX_VR) is fed to the Exciter Module via an analog multiplexer and filter circuitry. The signal indicates the amount of potentially harmful reflected power at the PA output. If the reflected power exceeds a set limit, the Exciter Module will shut down the PA.

V_OMNI Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the V_OMNI control voltage from the Voltage Translator & Current Limiter circuit. This dc signal (V_OMNI*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+14V Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the +14 V dc input voltage from the station Power Supply Module. This dc signal (14.2V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+28V Detect Circuitry (100/110W Only)

A voltage divider circuit provides a dc voltage approximately proportional to the +28 V dc input voltage from the station Power Supply Module. This dc signal (28V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Cooling Fans Control Circuitry (100/110 W Models Only)

WARNING

The cooling fans in the PA Module are thermostatically controlled and may come on at any time during station operation. Keep fingers clear of fan blades.

The PA is equipped with a dual fan module to provide forced air cooling of the PA. The fan module is controlled by a FAN ON signal from the Exciter Module, which is fed to a driver circuit in the PA Module. The Fan Driver/Detect Circuitry controls the power to the fans via two feed−thru pins in the PA chassis which mate with the power connector on the slide−in fan module. The fans are turned on only when the temperature in the PA exceeds a set limit. It is normal for the fans to cycle on and off during station operation.

The Fan Driver/Detect Circuitry also monitors the current to the fans and feeds a dc detect voltage to the Fan Status Circuitry, which outputs a status signal indicating whether the fan current is above or below a predetermined range. The status signal (FAN_ALARM) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Power Amplifier ID Resistor ROM

A resistor network “ROM” provides power amplifier ID information to the Exciter Module via an analog multiplexer and filter circuits. This information includes the band and range in which the PA is designed to operate (e.g., UHF, 800 MHz, etc.) and the maximum output power (e.g., 25 W, 110 W, etc.).

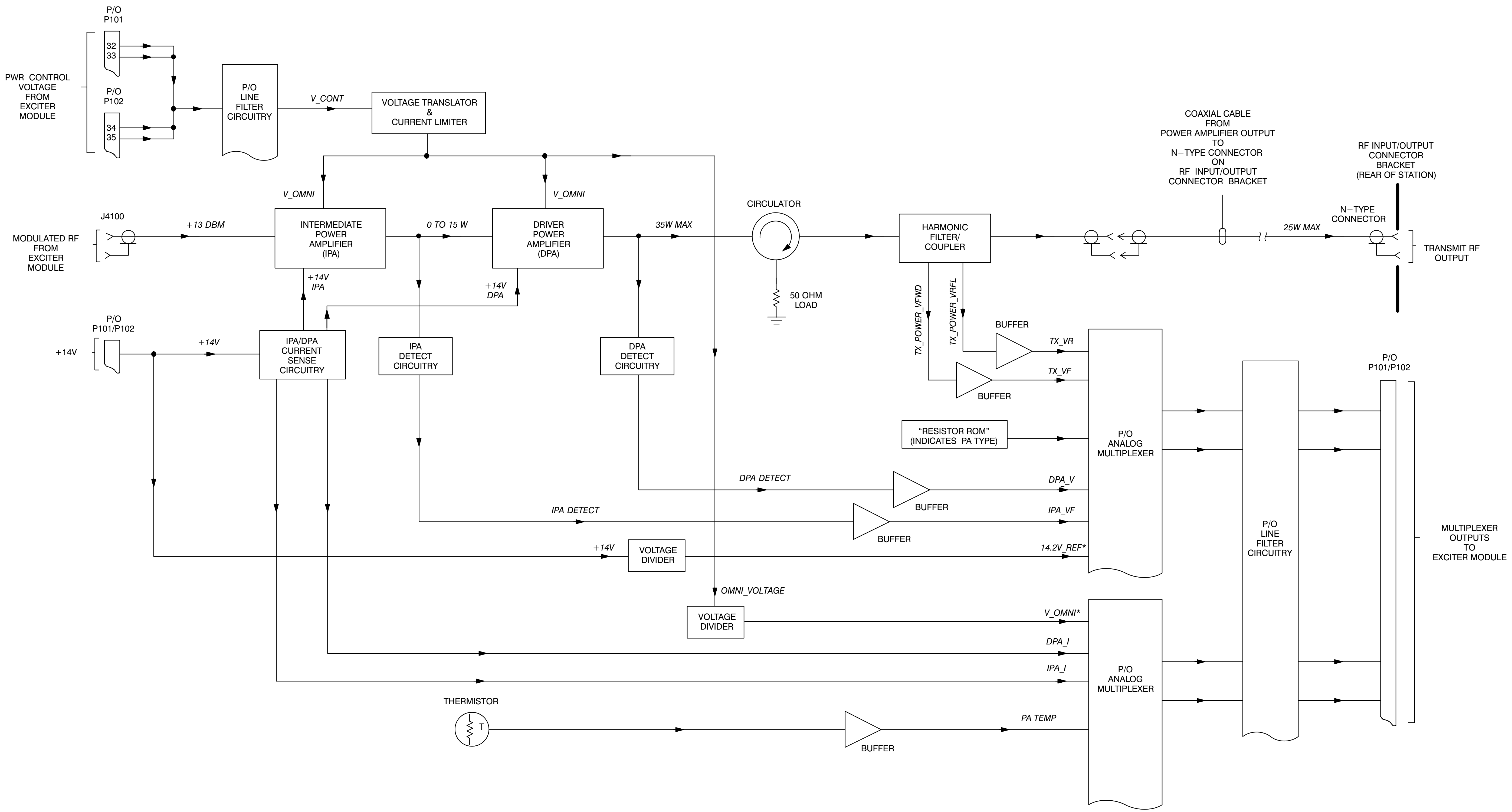

Figure 2. TLE2731A/TLE2732A 25W UHF Power Amplifier Module Functional Block Diagram

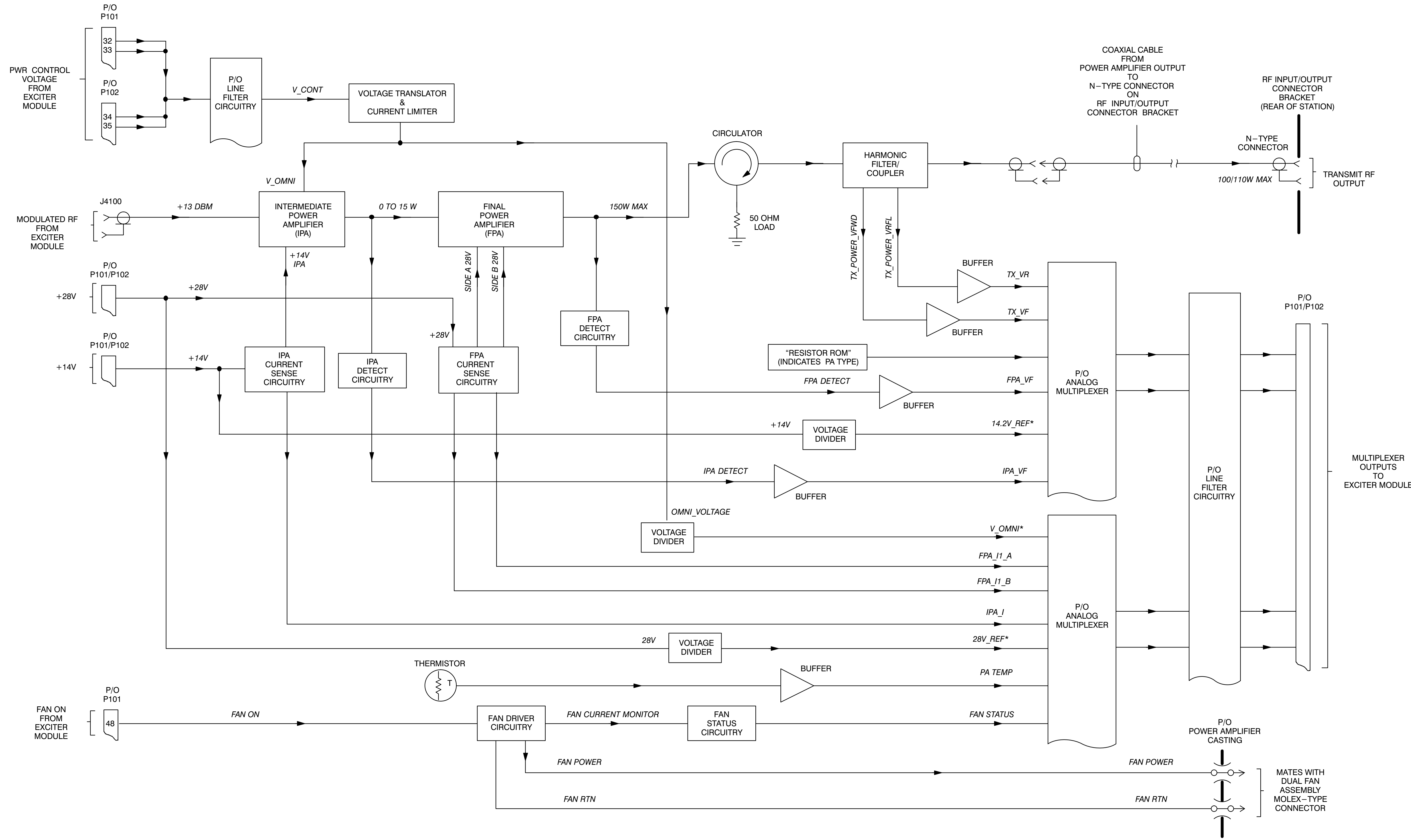

Figure 3. TTE2061A−63A 110W UHF and TTE2064A 100W UHF Power Amplifier Module Functional Block Diagram

MOTOROLA

POWER AMPLIFIER MODULE

MODELS: TLF1940A (20W, 850−870 MHz)
TLF1930A (100W, 850−870 MHz
TLF1800A (100W, 935−941 MHz)

1 DESCRIPTION

The Models TLF1940A/TLF1930A 800 MHz and TLF1800A 900 MHz Power Amplifier Modules are described in this section. A general description, identification of controls, indicators, and inputs/outputs, functional block diagrams, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Power Amplifier Module (PA) accepts a low−level modulated rf signal from the Exciter Module and amplifies the signal for transmission via the site transmit antenna. The output power is continually monitored and regulated by a feedback and control loop, with a power output control voltage being generated by the transmitter control circuitry located in the Exciter Module.

The PA Modules described in this section are very similar in design and function, with the major differences being the output power capabilities and operating frequency. Unless otherwise noted, the information provided in this section applies to all four models.

Overview of Circuitry

The PA contains the following circuitry:

- Intermediate Power Amplifier (IPA) — low−level amplifier stage which is controlled by the transmitter control voltage from the Exciter Module; provides an output of approximately 0 to 10W
- Driver Power Amplifier (DPA) — provides amplification (35W maximum) of the IPA output
- Final Power Amplifier (FPA) — contained in 100W PA only, provides final amplification of the IPA output; provides an output of 160W maximum
- Circulator — provides PA module output isolation
- Harmonic Filter/Coupler — suppresses harmonic radiation and couples the PA output to the transmit antenna connector; also serves as a power meter
- Sense and Detect Circuitry — provides sense and detect signals for critical signal points throughout the circuitry; signals are monitored by the Exciter Module

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the PA controls, indicators, and all input and output external connections.

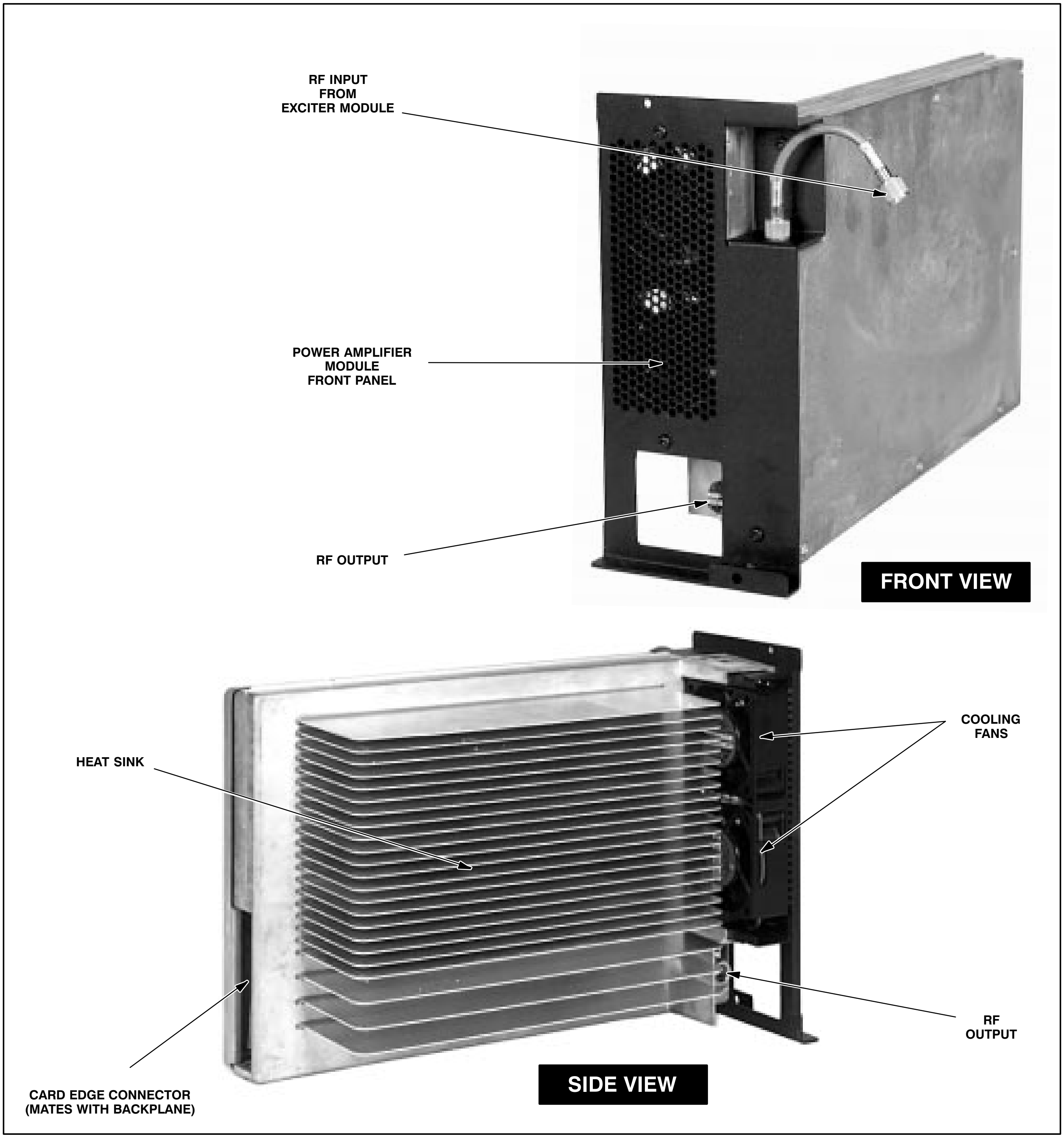

Figure 1. Power Amplifier Module Controls, Indicators, and Inputs/Outputs (100W Model Shown)

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the PA circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Functional block diagrams are provided in Figure 2 (TLF1940A, 20 W) and Figure 3 (TLF1800A and TLF1930A, 100 W). As mentioned previously, the four PA modules are similar in design and function. The following theory of operation applies to all four modules except where noted.

RF Signal Path

A low−level modulated rf signal (approximately +13 dBm) from the Exciter module is input to the PA module via a coax cable. The signal is input to the IPA and amplified to approximately 0 to 10W [depending on the dc power control voltage (V_CONT) from the Exciter Module].

On the 20W model, the IPA output is fed to a DPA which provides final amplification. On the 100W model, the IPA output is fed to a DPA and then to an FPA which provides final amplification. The output of the DPA (35W maximum) or FPA (160W maximum) is fed to a circulator, which passes the transmit signal to the harmonic filter/coupler, while routing all reflected power to a 50Ω load.

The output of the circulator is fed to the harmonic filter/coupler. This circuit provides highly selective bandpass filtering and couples the signal to an N−type connector mounted to the module casting. A coax cable routes the signal to an N−type connector mounted on an rf input/output connector bracket located on the rear of the station.

Output Power Control

A feedback and control loop configuration is used to regulate the PA output power. The Harmonic Filter/Coupler generates a dc voltage proportional to the PA Module output power. This voltage (TX_VF) is fed to the TX Power Control Circuitry in the Exciter Module. The TX_VF voltage is compared to reference voltages to generate a dc power control voltage (V_CONT).

Note that V_OMNI does not control the output level of the DPA directly but serves as on/off control for the DPA stage.

The dc power control voltage (V_CONT) is output from the Exciter Module and fed through filtering circuitry in the PA to a voltage translation and current limiting circuit. The output of this circuitry is V_OMNI, a dc voltage which controls the output power of the IPA.

Summary of Power Control Operation — By controlling the output level of the IPA (range of 0 to 10W), the output power of the PA module is established. The feedback and control loop (TX_VF fed back to Exciter Module resulting in V_CONT to control IPA output) continually monitors and maintains the proper output power from the PA.

Sense and Detect Circuitry

Introduction

The PA is equipped with several sense and detect circuits to provide status signals to the Exciter Module. In most cases, the Exciter Module microprocessor uses these signals to determine PA operating conditions and, in response, varies certain control signals to correct output power, turn on cooling fans, etc. The sense and detect circuits are described in the following paragraphs.

Current Sensing Circuitry (20W)

IPA and DPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the IPA and the DPA and outputs two dc signals directly proportional to the IPA and DPA currents. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltage (IPA_I or DPA_I) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the IPA or DPA.

Current Sensing Circuitry (100W)

IPA and DPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the IPA and the DPA and outputs two dc signals directly proportional to the IPA and DPA currents. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltage (IPA_I or DPA_I) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the IPA or DPA.

FPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the FPA (side A and side B) and outputs two dc signals directly proportional to the currents for side A and side B. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltages (FPA_I1_A and FPA_I1_B) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the FPA (side A or side B).

Sense and Detect Circuitry (Continued)

PA Temperature Sense

A thermistor and buffer circuit provides a dc voltage proportional to the PA temperature. This signal (PA_TEMP) is fed to the Exciter Module, which monitors the signal and reduces the PA output power [by reducing the dc power control voltage (V_CONT)] if the PA temperature exceeds set limits.

IPA, DPA, and FPA Detect Circuitry

Detection circuits provide a dc voltage approximately proportional to the rf outputs of the IPA, DPA, and FPA (100W only) stages. These dc signals (IPA_VF, DPA_VF, and FPA_VF, used for diagnostic purposes only) are fed to the Exciter Module via an analog multiplexer and filter circuitry.

Reflected Power Detect Circuitry

The Harmonic Filter/Coupler provides a dc voltage approximately proportional to the reflected power at the output of the stage. This dc signal (TX_VR) is fed to the Exciter Module via an analog multiplexer and filter circuitry. The signal indicates the amount of potentially harmful reflected power at the PA output. If the reflected power exceeds a set limit, the Exciter Module will shut down the PA.

V_OMNI Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the V_OMNI control voltage from the Voltage Translator & Current Limiter circuit. This dc signal (V_OMNI*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+14V Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the +14 V dc input voltage from the station Power Supply Module. This dc signal (14.2V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+28V Detect Circuitry (100W Only)

A voltage divider circuit provides a dc voltage approximately proportional to the +28 V dc input voltage from the station Power Supply Module. This dc signal (28V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Cooling Fans Control Circuitry (100 W Models Only)

WARNING

The cooling fans in the PA Module are thermostatically controlled and may come on at any time during station operation. Keep fingers clear of fan blades.

The PA is equipped with a dual fan module to provide forced air cooling of the PA. The fan module is controlled by a FAN ON signal from the Exciter Module, which is fed to a driver circuit in the PA Module. The Fan Driver/Detect Circuitry controls the power to the fans via two feed−thru pins in the PA chassis which mate with the power connector on the slide−in fan module. The fans are turned on only when the temperature in the PA exceeds a set limit. It is normal for the fans to cycle on and off during station operation.

The Fan Driver/Detect Circuitry also monitors the current to the fans and feeds a dc detect voltage to the Fan Status Circuitry, which outputs a status signal indicating whether the fan current is above or below a predetermined range. The status signal (FAN_ALARM) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Power Amplifier ID Resistor ROM

A resistor network “ROM” provides power amplifier ID information to the Exciter Module via an analog multiplexer and filter circuits. This information includes the band and range in which the PA is designed to operate (e.g., VHF−Range 1, UHF, 900 MHz, etc.) and the maximum output power (e.g., 25 W, 125 W, etc.).

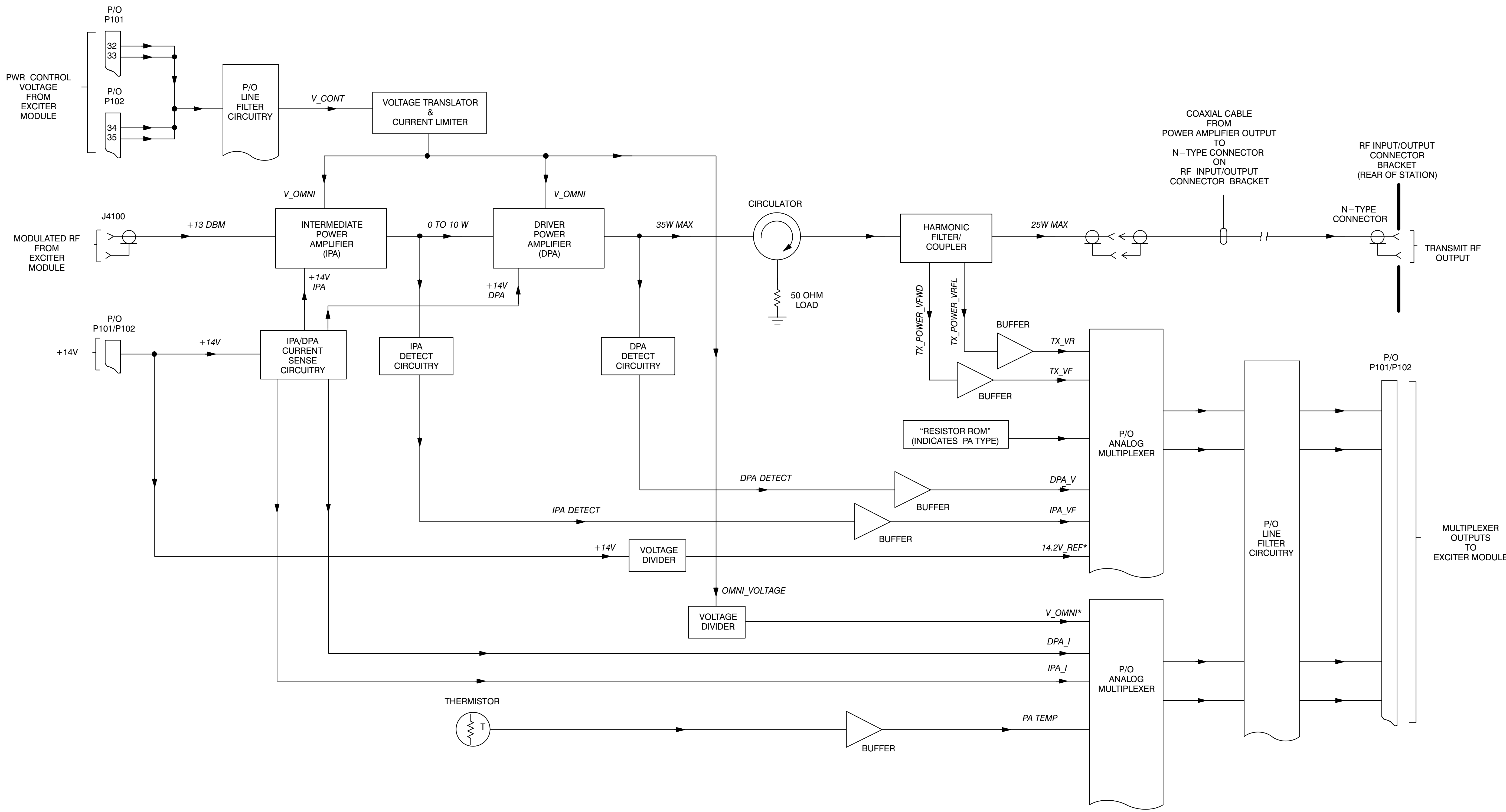

Figure 2. TLF1940A (800 MHz) 20W Power Amplifier Module Functional Block Diagram

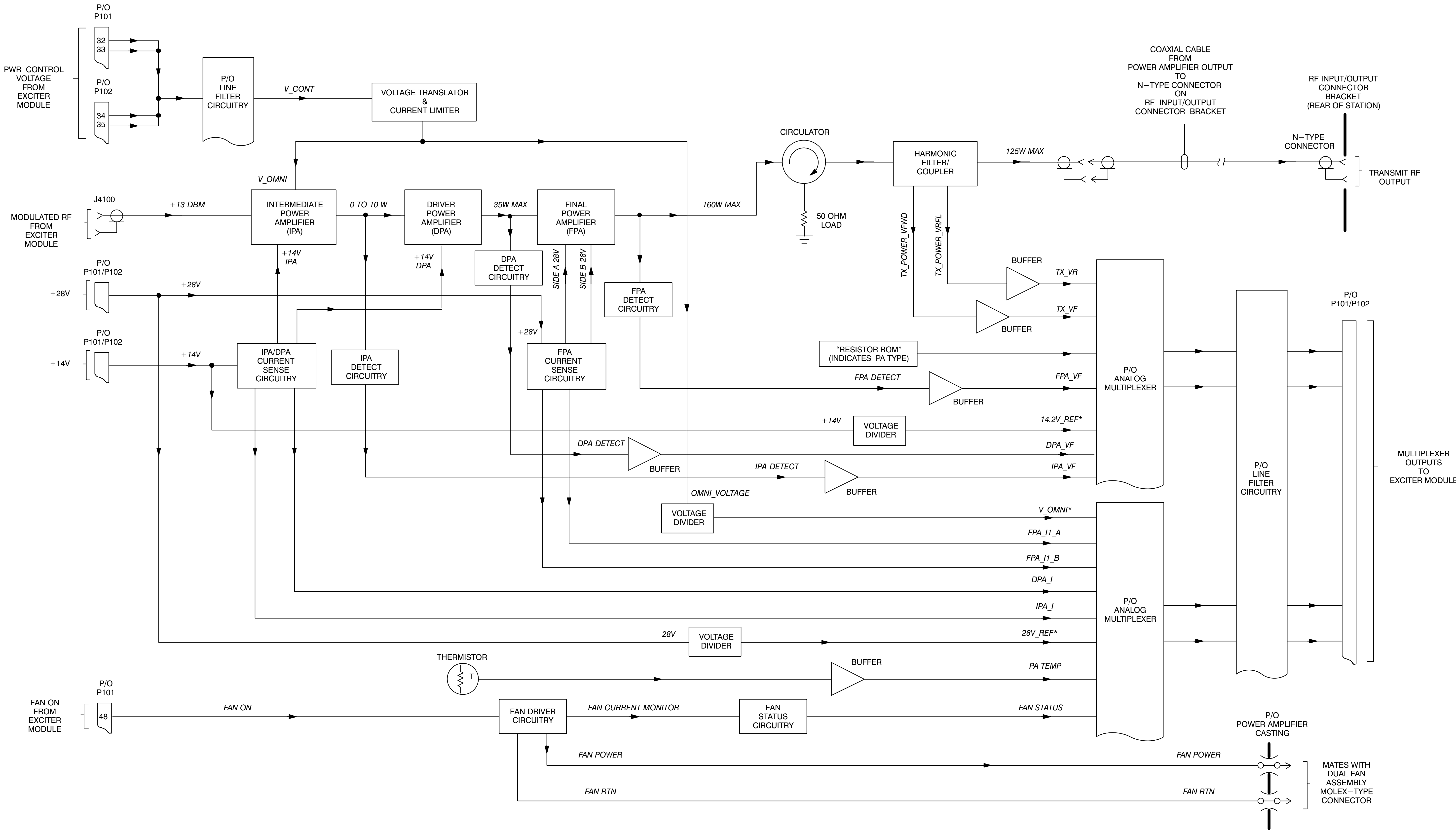

Figure 3. TLF1930A (800 MHz) and TLF1800A (900 MHz) 100W Power Amplifier Module Functional Block Diagram

MOTOROLA

STATION CONTROL MODULE

MODELS CLN6960A CLN6961A

1 DESCRIPTION

The Models CLN6960A and CLN6961A Station Control Modules (SCM) are described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The SCM serves as the main controller for the station. The SCM board contains a 68EN360 microprocessor, a 56002 Digital Signal Processor, and support circuitry which combine to provide signal processing and operational control over the other station modules. The SCM also contains the station operating software (stored in FLASH memory) and codeplug which define the personality of the station, including system capabilities (*ASTRO*, *SECURENET*, *IntelliRepeater*, etc.) and operating parameters such as output power and operating frequency.

The CLN6961A provides conventional operation along with MRTI and 6809 trunking capabilities. The CLN6960A is a full−featured model and is required for use in *IntelliRepeater* applications. Specific differences between the two models are shown throughout the functional block diagram (Figure 2).

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Overview of Circuitry

The SCM contains the following circuitry:

- **Host Microprocessor** — 68EN360 µP which comprises the central controller of the SCM and station
- **Non−Volatile Memory** — consists of a FLASH SIMM module that contains the station operating software and data, and an EEPROM that contains the station codeplug data
- **DRAM Memory** — Dynamic RAM into which station software is downloaded and executed
- **External Line Interface Circuitry** — provides interface between the SCM and external devices such as *IntelliRepeater* DLAN ports, RSS port, an Ethernet port, and miscellaneous backplane connectors
- **Digital Signal Processor (DSP) and DSP ASIC Circuitry**— performs high−speed processing of audio and signaling data signals
- **Station Reference Circuitry** — generates the 2.1 MHz reference signal used throughout the station
- **HDLC Bus Control Circuitry** — provides bus control to allow Host Microprocessor communications port SCC1 to communicate with the Wireline Interface Board and other optional modules via the HDLC interprocessor communications bus
- **Audio Interface Circuitry** — routes the various audio input signals (such as microphone, wireline, and receiver audio) to output devices (such as external speaker, built−in local speaker, and exciter modulation inputs)
- **Input / Output Ports Circuitry** — two 32−line output buses allow miscellaneous control signals to be sent to various circuits throughout the station; two 32−line input buses allow miscellaneous inputs to be received from throughout the station
- **Front Panel LEDs and Switches** — general purpose input/output ports control eight status LEDs and accept inputs from four momentary switches, all located on the SCM front panel
- **Supply Voltages Circuitry** — contains filtering and regulator circuitry which accepts +14.2 V and +5 V from backplane and generates the operating voltages required by the SCM circuitry

2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the SCM controls, indicators, and all input and output external connections.

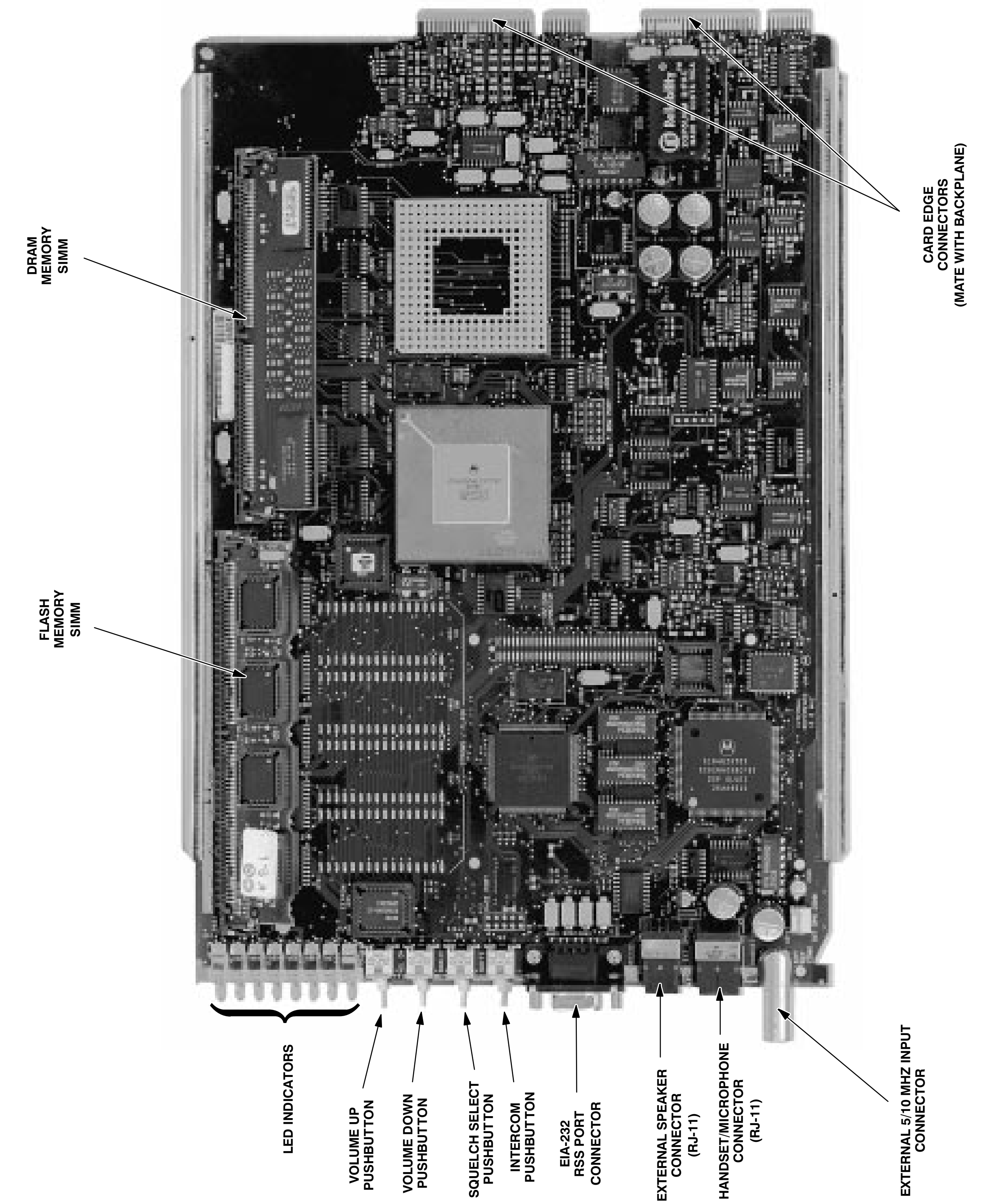

Figure 1. Station Control Module Controls, Indicators, and Inputs/Outputs (CLN6960A shown)

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the SCM circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the SCM.

Host Microprocessor

Overview

The Host Microprocessor (µP) serves as the main controller for the SCM (and station). The µP, an MC68EN360 running at a clock speed of 25 MHz, controls the operation of the station as determined by the station software (contained in a FLASH SIMM module) and the station codeplug (EEPROM).

Communications Buses

The Host µP provides six general−purpose serial communications buses, as follows:

- **SCC1** — Used as Ethernet port for high-speed communications, either to connect to the Ethernet local network of an *IntelliRepeater* trunking site or to allow station software to be downloaded from a local PC into the FLASH memory
- **SCC2** — Used as communications port to allow the station to connect into the local network of an *IntelliRepeater* trunking site; external connections are provided by a 9−pin D−type connector (#19) located on backplane
- **SCC3** — Used as the Interprocessor Communications Bus (HDLC protocol) to allow the Host µP to communicate with the Wireline Interface Board and other optional modules
- **SCC4** — Used as RS−232 port for connections to external equipment, such as a modem
- **SMC1** — Used as RS−232 port for RSS communications (9-pin D-type connector #20 on backplane)
- **SMC2** — Used as RS−232 port for RSS communications (9-pin D-type connector located on SCM front panel)

Address and Data Buses

The µP is equipped with a 28−line address bus used to access the non−volatile memory, DRAM memory, and provide control (via memory mapping) for other circuitry in the SCM. A 32−line data bus (buffered for the non−volatile memory) is used to transfer data to/from the SCM memory, as well as other SCM circuitry.

SPI Bus

The Host µP also controls the SPI bus, a general−purpose communications bus that allows the Host µP to communicate with other modules in the station.

(continued)

Host Microprocessor (Continued)

DRAM Controller

The Host μP provides signals necessary to access and refresh the DRAM memory.

25 MHz Clock Circuitry

A crystal−controlled 25 MHz clock circuit and buffer provide the 25 MHz clock signal to the Host μP.

Non−Volatile Memory

Station Software FLASH Memory

The station software resides in a FLASH SIMM module (1M x 32 for CLN6960A, 512k x 32 for CLN6961A). The FLASH SIMM is accessed by the Host μP via the 28−line Host Buffered Address Bus and the 32−line Host Buffered Data Bus.

Codeplug EEPROM

The data which determines the station personality resides in an 8K x 8 codeplug EEPROM. Stations are shipped from the factory with generic default data programmed into the codeplug EEPROM. Field programming is performed during installation using the Radio Service Software (RSS) program to enter additional customer−specific data, such as site output power, time−out timer settings, etc.

DRAM Memory

Note:
Model CLN6961A contains a 512k x 32 DRAM SIMM. Model CLN6960A contains a 2M x 32 DRAM SIMM (for use in ***IntelliRepeater*** *applications).*

Each SCM contains a DRAM SIMM into which the station software code is downloaded and run. The DRAM also provides short−term storage for data generated/required during normal operation. Read and write operations are performed using the Host Buffered Address and Host Buffered Data buses.

The DRAM memory locations are sequentially refreshed by the column and row signals from the Host μP.

External Line Interface Circuitry

IntelliRepeater *DLAN Network Port*

A DLAN port is provided on the station backplane to allow the station to connect into the local network of an *IntelliRepeater* trunking site. This DLAN port is provided by Host μP serial communication bus SCC2.

SCC2 communicates with an RS−485 bus transceiver, which provides DLAN+ and DLAN− signals. These signals are connected to a 9−pin D−type connector (#19) located on the station backplane, which typically mates with a *PhoneNET* adapter module connected into the *IntelliRepeater* local network.

Ethernet Port

An Ethernet port is provided via a BNC connector on the station backplane which allows the station to connect into the Ethernet local network of an *IntelliRepeater* trunking site. The Ethernet port may also be used to allow station software to be downloaded from a local PC into the FLASH SIMM module. This Ethernet port is provided by Host μP serial communication bus SCC1.

General Purpose RS232 Serial Port

A general purpose RS−232 communications port is provided by Host μP serial communication bus SCC4. This port is available at a DB-25 connector (#15) located on the station backplane, and may be used to connect external equipment (e.g., an external modem).

RSS Port (Backplane)

A 9−pin D−type connector (#20) is provided on the station backplane to allow service personnel to connect a PC loaded with the Radio Service Software (RSS) and perform programming and maintenance tasks. The RSS port may also be used to allow station software to be downloaded from a local PC into the FLASH SIMM module. This RSS port is provided by Host μP serial communication bus SMC1 which communicates with the RSS terminal via EIA−232 Bus Receivers/Drivers.

RSS Port (Front Panel)

A 9−pin D−type connector is provided on the SCM front panel to allow service personnel to connect a PC loaded with the Radio Service Software (RSS) and perform programming and maintenance tasks. The RSS port may also be used to allow station software to be downloaded from a local PC into the FLASH SIMM module. This RSS port is provided by Host μP serial communication bus SMC2 which communicates with the RSS terminal via EIA−232 Bus Receivers/Drivers.

Digital Signal Processor (DSP) and DSP ASIC Circuitry

General

All station transmit and receive audio/data is processed by the DSP and related circuitry. This circuitry includes the DSP IC, the DSP ASIC, and the DSP ASIC Interface Circuitry. All audio signals input to or output from the DSP are in digitized format.

Inputs to the DSP circuitry are:

- Digitized receive signals from the Receiver Module
- Audio from handset or microphone connected to appropriate SCM front panel connector; signal is digitized by CODEC IC (p/o Audio Interface Circuitry) before being sent to DSP via Audio Interface Bus
- Digitized voice audio/data from Wireline Interface Board and other optional modules via TDM bus
- ASTRO modem data from Wireline Interface Board via HDLC bus
- *SECURENET* modem data from Wireline Interface Board via HDLC bus
- 6809/MRTI transmit audio

Outputs from the DSP circuitry are:

- Digitized voice audio/data from DSP to Wireline Interface Board and other optional modules via TDM bus
- Digitized voice audio from DSP to external speaker, built−in speaker, or handset earpiece via Audio Interface Bus and Audio Interface Circuitry
- Digitized voice audio/data from DSP to Exciter Module (modulation signals) via Audio Interface Bus and Audio Interface Circuitry
- 6809/MRTI transmit audio

Digital Signal Processor (DSP)

The DSP, a 56002 operating at an internal clock speed of 60 MHz, accepts and transmits digitized audio to/from the various modules in the station. The DSP provides address and data buses to receive/transmit digitized audio (via the DSP ASIC) and to access the DSP program and signal processing algorithms contained in three 32K x 8 SRAM ICs. Three additional 32K x 8 SRAM ICs are provided for data storage.

DSP ASIC

The DSP ASIC operates under control of the DSP to provide a number of functions, as follows:

- Interfaces with the DSP via the DSP address and data buses
- Accepts 16.8 MHz signal from Station Reference Circuitry and outputs a 2.1 MHz reference signal used throughout the station
- Provides interfaces for the HDLC bus, TDM bus, and serial bus used to communicate with the Receiver Module,
- Accepts digitized data from Receiver Module via DSP ASIC Interface Circuitry
- Provides interfaces for several A/D and D/A converters

Station Reference Circuitry

The Station Reference Circuitry consists of a phase−locked loop comprised of a high−stability VCO and a PLL IC. The output of the VCO is a 16.8 MHz signal which is fed to the DSP ASIC. The ASIC divides the signal by 8 and outputs a 2.1 MHz signal which is separated and buffered by a splitter and output to the Exciter Module and Receiver Module as 2.1 MHz REF.

The Station Reference Circuitry may operate in one of three modes:

- **Normal Mode** — In this mode, the control voltage is turned off (via control voltage enable switch) and the high−stability VCO operates in an open loop mode; stability of the VCO in this mode is 1 PPM per year.
- **Manual Netting Mode** — Periodically, an external 5/10 MHz source is required to fine tune, or “net”, the 16.8 MHz reference signal. In this mode, the PLL compares the 5/10 MHz reference and a sample of the 16.8 MHz VCO output and generates up/down pulses. The Host µP reads the pulses (via SPI bus) and sends correction signals (via SPI bus) to the VCO to adjust the output frequency to 16.8 Mhz ±0.3 ppm.
- **High−Stability Mode** — For some systems (e.g., Simulcast systems), the free−running stability of the VCO is unacceptable for optimum system performance. Therefore, an external 5/10 MHz source is connected permanently to one of the BNC connectors. In this mode, the PLL compares the 5/10 MHz reference and a sample of the 16.8 MHz VCO output and generates a dc correction voltage. The control voltage enable switch is closed, allowing the control voltage from the PLL to adjust the high−stability VCO frequency to 16.8 Mhz ±0.3 ppm. The VCO operates in this closed loop mode and is continually being frequency controlled by the control voltage from the PLL.

Note:
Two BNC connectors (one 50 Ω input located on SCM front panel, one high impedance input located on the station backplane) are provided to allow an external 5/10 MHz source to be input to the OSC_{in} input to the PLL to perform frequency netting. Refer to the Maintenance section in this manual for recommended intervals and procedures for netting the station reference.

HDLC Bus Control Circuitry

The HDLC Bus Control Circuitry provides high−impedance buffering and data routing for the Interprocessor Communications Bus (a serial data bus implementing HDLC protocol). This bus allows the Host µP to communicate with the microprocessor located on the Wireline Interface Board and other optional modules via an interprocessor communications bus.

Audio Interface Circuitry

General

The Audio Interface Circuitry interfaces external analog audio inputs and outputs with the DSP circuitry.

External Audio Sources

A multiplexer, under control of the Host μP, is used to select one of eight possible external audio input sources (four for diagnostic loopback signals, two for future use, one for 6809/MRTI transmit audio, and one for handset or microphone audio). The selected audio source signal is converted to a digital signal by the A/D portion of the CODEC IC and sent to the DSP ASIC via the Audio Interface Bus. The DSP circuitry processes the signal and routes it to the desired destination.

External Audio Destinations

Digitized audio from the DSP circuitry is input to the D/A portion of the CODEC IC and is output to one of four external devices:

- External Speaker — connects to RJ−11 jack ( ) located on SCM front panel
- Handset Earpiece/Microphone — connects to RJ−11 jack ( ) located on SCM front panel
- Local Built−In Speaker — internal speaker and ½ W audio amplifier; may be switched on/off and volume controlled by using volume up ( ) and down ( ) buttons on SCM front panel
- J14 on Station Backplane — 6809/MRTI receive audio output to external MRTI Module

Exciter Modulation Signals

Digitized audio/data intended to be transmitted from the station is output from the DSP circuitry to a D/A converter via the TX/Voice Audio signal (p/o the Serial Synchronous Interface bus, connected between the DSP and the DSP ASIC). The digitized signal is converted to analog, level shifted and amplified, and fed to a 0−6 kHz filter. The output of the filter is then fed to one of the inputs of a multiplexer. The output of the multiplexer is fed to two individual digitally controlled potentiometers (each of which is adjusted by the Host μP via the SPI Bus) and output to the Exciter Module as modulation signals VCO MOD AUDIO and REF MOD AUDIO.

Input/Output Ports

Input Ports

Two general–purpose 32–line input ports are provided to allow various input signals from the SCM and station circuitry to be accepted and sent to the Host µP. The two ports (I/O Port P0 In and I/O Port P1 In) are each comprised of 32 lines which come from circuitry in the SCM as well as other modules in the station via the backplane. The buses are input to buffers which make the data available to the Host µP via the Host Buffered Data Bus. Typical inputs include the pushbutton switches located on the SCM front panel and the MIC PTT signal from the handset/microphone.

Output Ports

Two general–purpose 32–line output ports are provided to allow various control signals from the Host µP to be output to the SCM and station circuitry via the backplane. The two ports (I/O Port P0 Out and I/O Port P1 Out) are each comprised of 32 lines which come from the Host Buffered Data Bus via latches. Typical output control signals include the control lines for the eight LEDs located on the SCM front panel and the local speaker enable signal.

6809/MRTI Interface Circuitry

6809 Trunking Interface

TX DATA from the 6809 Trunking Controller is input to the station via J14 on the station backplane. The signal is routed thru nominal filtering on the 6809/MRTI Interface Circuitry and fed to the Audio Interface Circuitry. The T DATA signal is then waveshaped/filtered and fed to an A/D converter, which outputs a digital signal to the DSP via the Audio Interface Bus.

6809 RX AUDIO is output from the DSP to the Local Audio Circuitry via the Audio Interface Bus. The signal is amplified, filtered, buffered, and output thru nominal filtering on the 6809/MRTI Interface Circuitry to the 6809 Trunking Controller via J14 on the station backplane.

MRTI Interface

MRTI AUDIO from an external MRTI module is input to the station via J14 on the station backplane. The signal is routed thru the 6809/MRTI Interface Circuitry and fed to one input of an 8–to–1 multiplexer. If selected, the MRTI TX AUDIO signal is converted to a digital signal by the A/D portion of the CODEC IC and sent to the DSP ASIC via the Audio Interface Bus.

MRTI RX AUDIO is output from the DSP to the Local Audio Circuitry via the Audio Interface Bus. The signal is amplified, filtered, buffered, and output thru the 6809/MRTI Interface Circuitry to the external MRTI Module via J14 on the station backplane.

Front Panel LEDs and Switches

Note:
Refer to the Troubleshooting section of this manual for complete details on the interpretation of the LEDs.

Note:
Refer to the Operation section of this manual for complete details on the use of the pushbutton switches.

LEDs

Eight status LEDs are provided on the SCM front panel to provide visual indications of various station operating conditions.The LEDs are controlled by eight lines from I/O Port P0 Out.

Switches

Four momentary contact pushbutton switches are provided on the SCM front panel to allow various station functions to be selected. Depressing a pushbutton causes a high to be sent to the Host µP via I/O Port P0 In.

Supply Voltages Circuitry

The SCM contains on−board regulator and filtering circuitry to generate the various operating voltages required by the SCM circuitry. +14.2 V and +5V from the backplane are used as sources for the following supply voltage circuits:

- **+10V Regulator Circuitry** — provides +10 V dc and a +5 V reference voltage (½ of +10V) for the Audio Interface Circuitry in the SCM.
- **VCCA Supply Circuitry** — provides VCCA (+5V) and a +2.5 V reference voltage (½ of VCCA) for the Audio Interface Circuitry in the SCM.
- **Filtering Circuitry** — filters the +14.2 V and +5V from the backplane to provide A+ and VCC, respectively, for the SCM digital circuitry.

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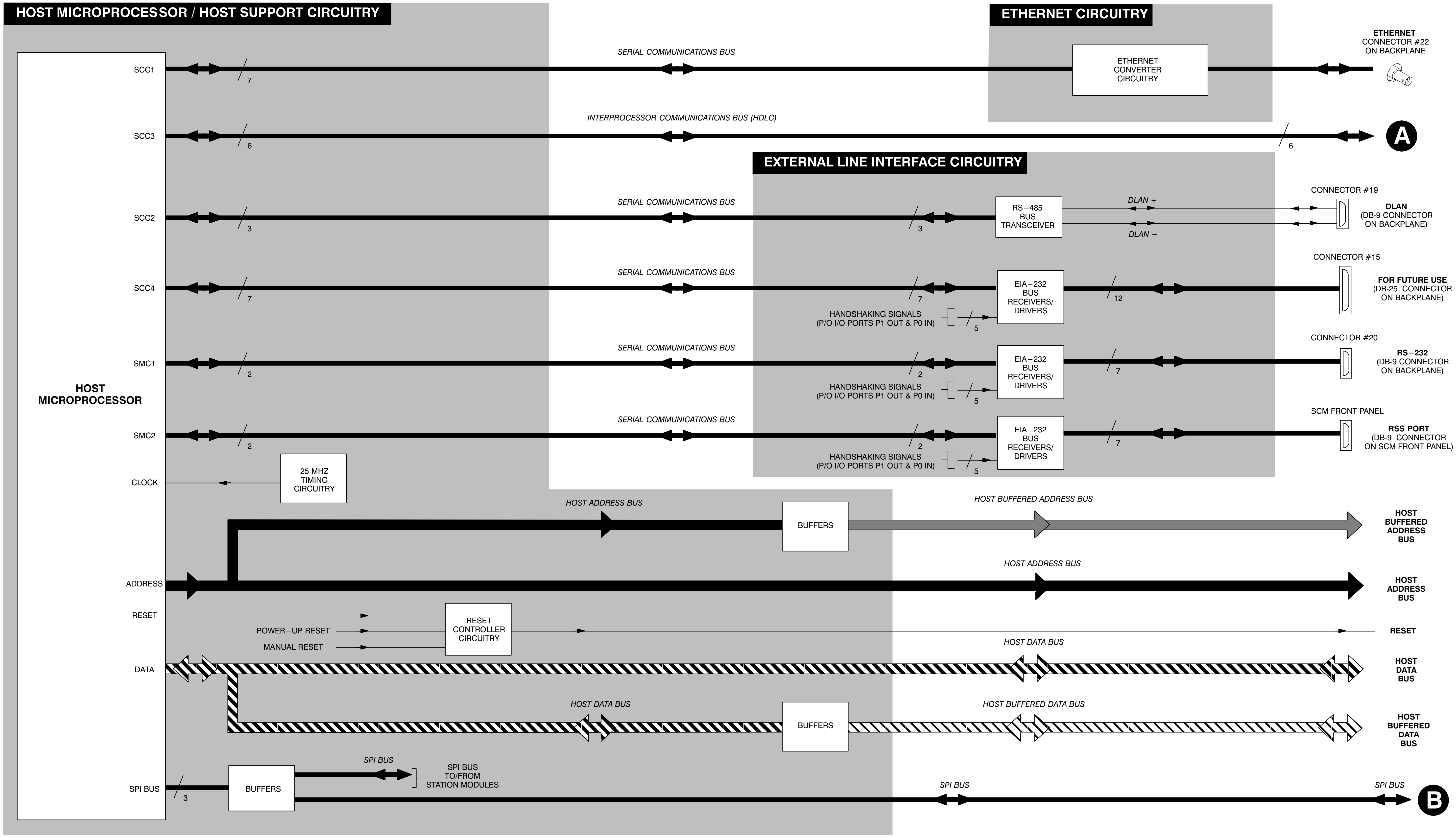


Figure 2. CLN6960A and CLN6961A Station Control Module Functional Block Diagram (1 of 5)

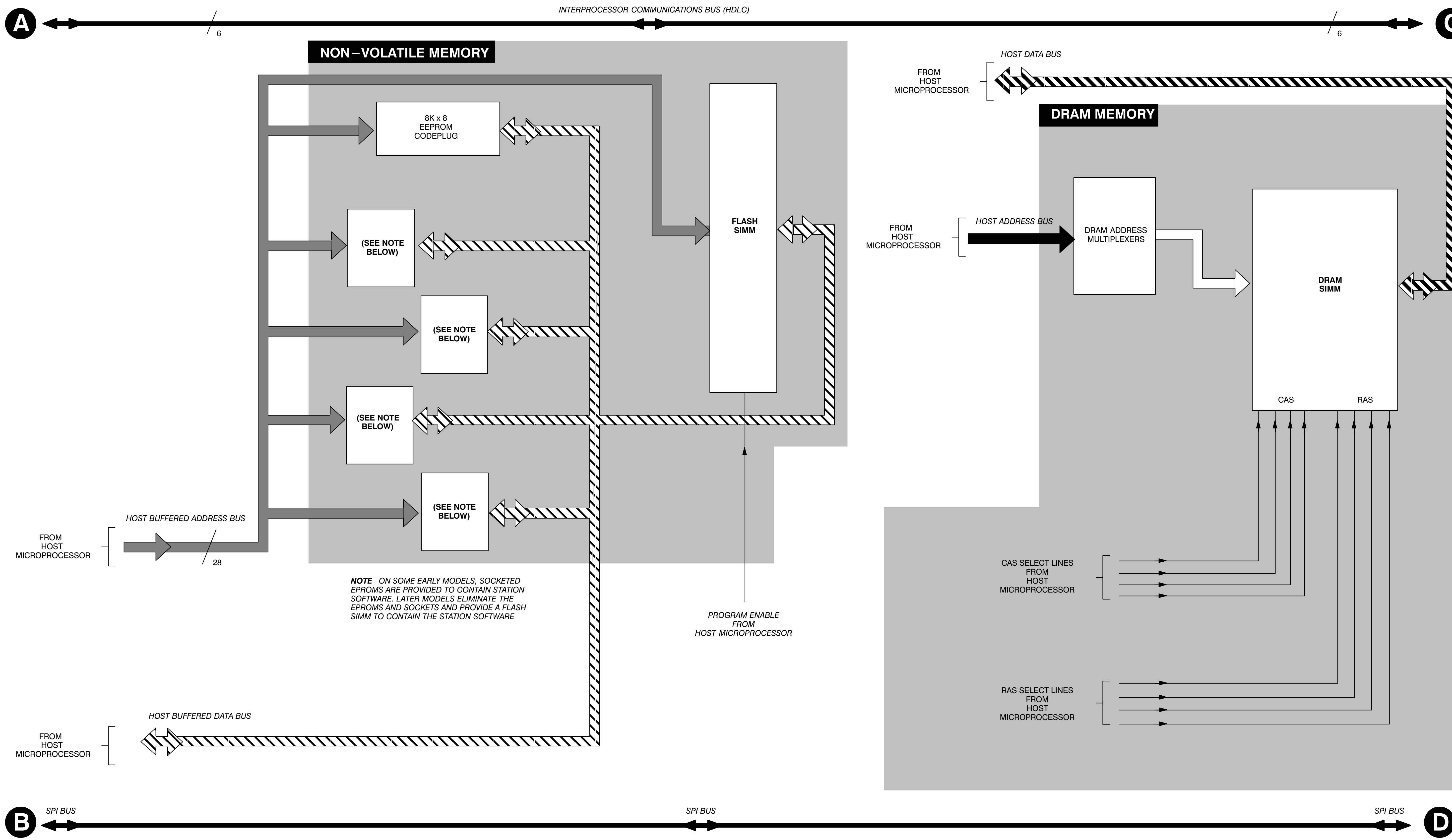


Figure 2. CLN6960A and CLN6961A Station Control Module Functional Block Diagram (2 of 5)

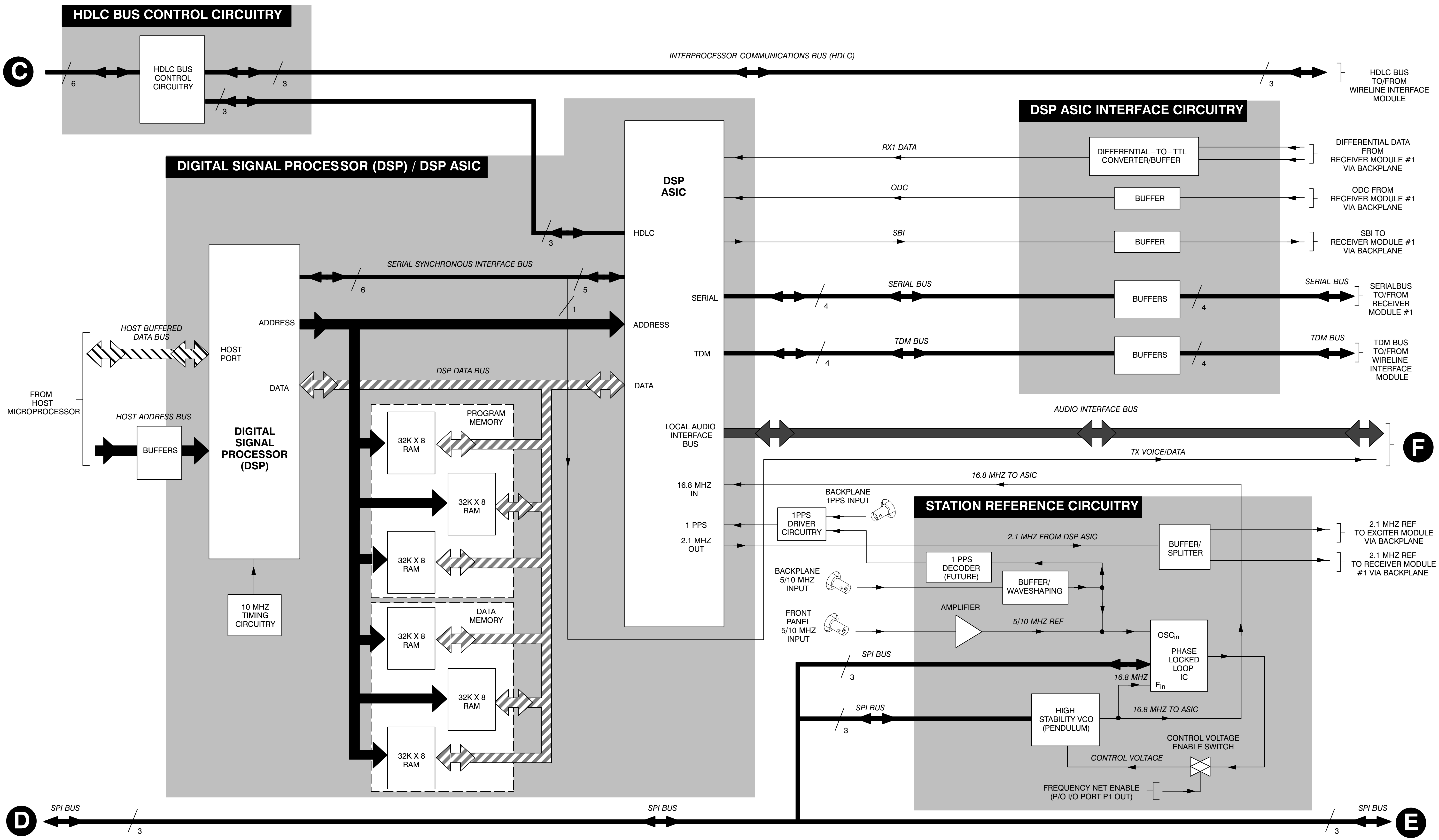


Figure 2. CLN6960A and CLN6961A Station Control Module Functional Block Diagram (3 of 5)

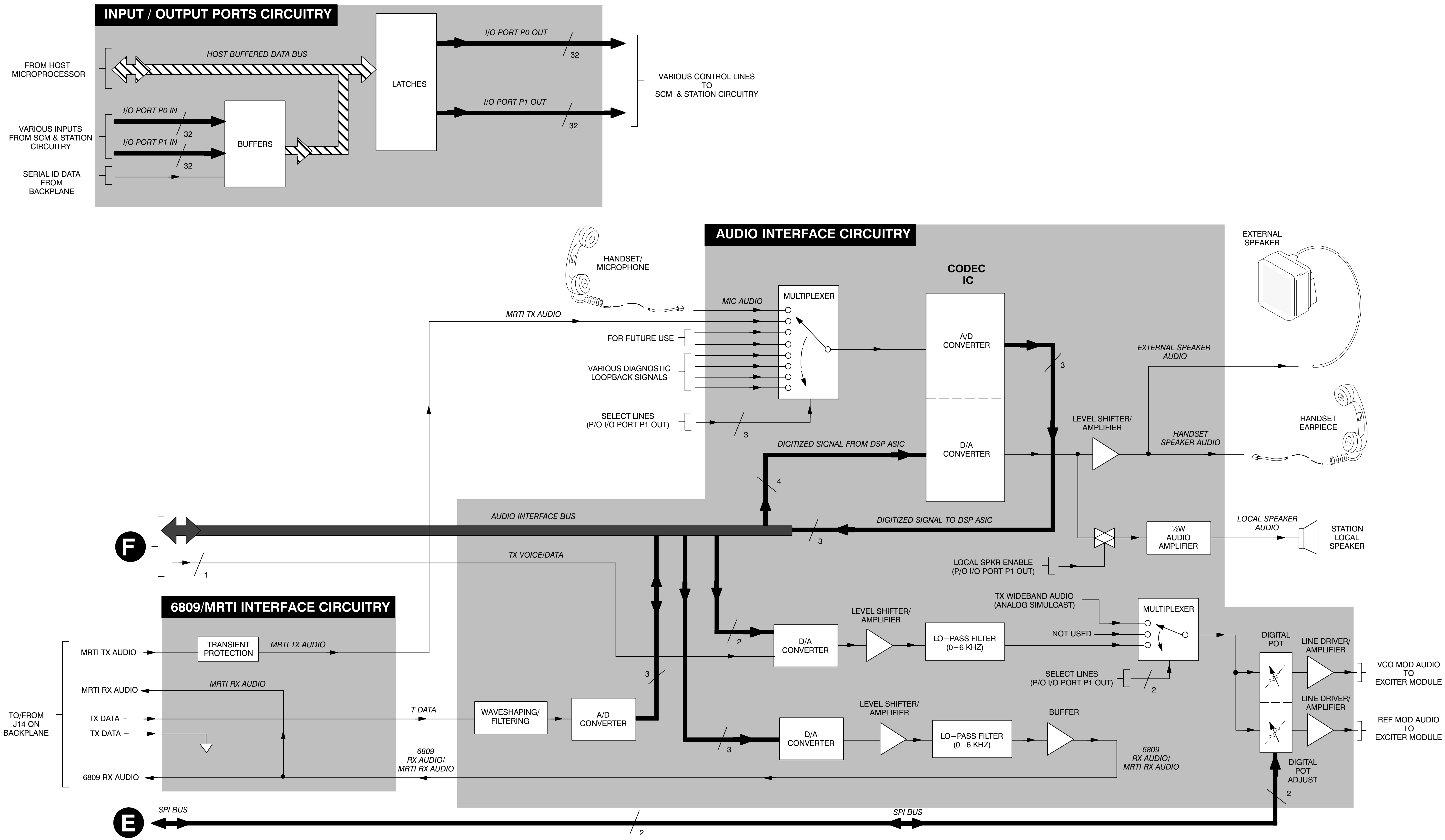
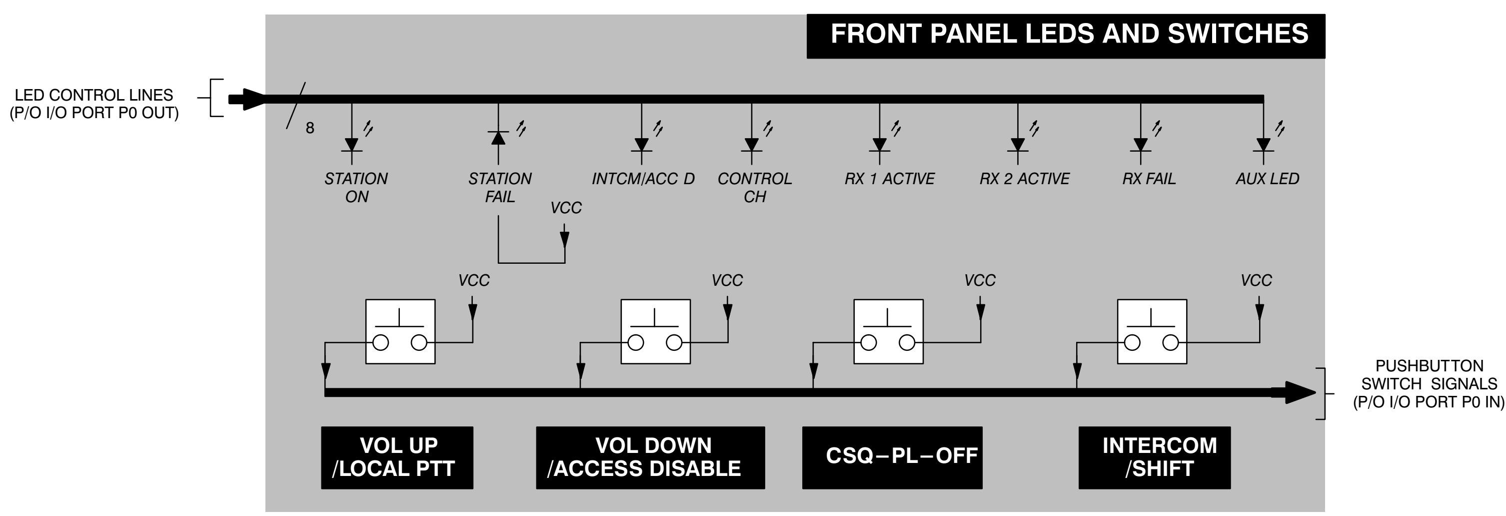


Figure 2. CLN6960A and CLN6961A Station Control Module Functional Block Diagram (4 of 5)



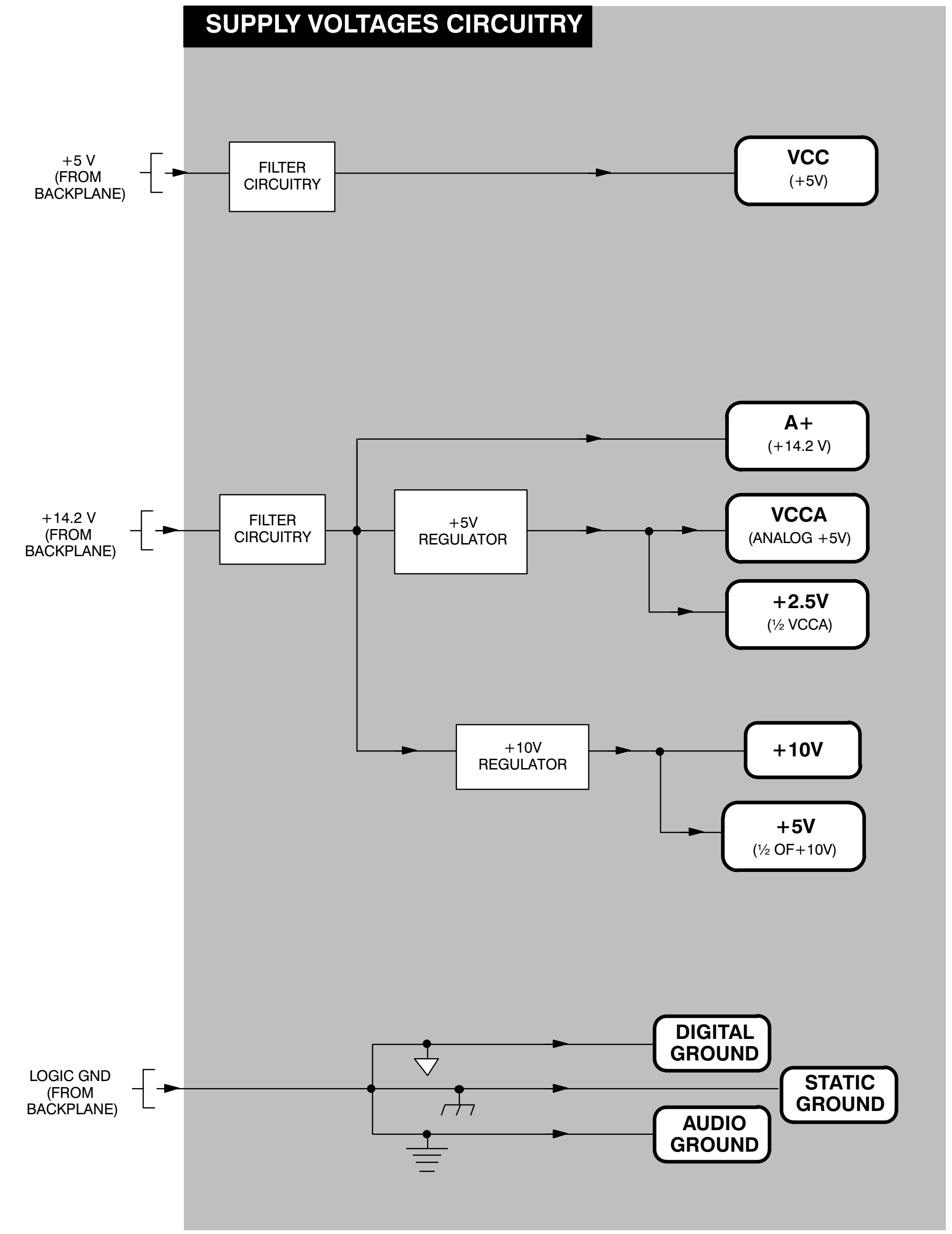


Figure 2. CLN6960A and CLN6961A Station Control Module Functional Block Diagram (5 of 5)

MOTOROLA

STATION CONTROL MODULE

MODEL CLN1614A

1 DESCRIPTION

The Model CLN1614A Station Control Module (SCM) is described in this section. A general description, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The SCM serves as the main controller for the station. Each SCM is comprised of two circuit boards (Control Board and LED Board), contained in a single slide-in housing. The two boards are connected via a multi-conductor ribbon cable.

The Control Board contains a 68EN360 microprocessor, a 56002 Digital Signal Processor, and support circuitry which combine to provide signal processing and operational control over the other station modules. The SCM also contains the station operating software (stored in FLASH memory) and codeplug which define the personality of the station, including system capabilities (*ASTRO*, *SECURENET*, etc.) and operating parameters such as output power and operating frequency.

The CLN1614A SCM provides conventional operation along with MRTI and 6809 trunking capabilities for use in *Quantar* and *Quantro* stations.

Commercial Government and Industrial Solutions Sector
1301 E. Algonquin Road, Schaumburg, IL 60196

Overview of Circuitry

The SCM is comprised of two circuit boards, connected together via a multi-conductor ribbon cable. These boards contain circuitry as follows:

Control Board (CLN7060A)

- **Host Microprocessor** — 68EN360 µP which comprises the central controller of the SCM and station
- **Non−Volatile Memory** — consists of a FLASH SIMM module that contains the station operating software and data, and an EEPROM that contains the station codeplug data
- **DRAM Memory** — Dynamic RAM into which station software is downloaded and executed
- **External Line Interface Circuitry** — provides interface between the SCM and external devices such as the RSS port, an Ethernet port, and miscellaneous backplane connectors
- **Digital Signal Processor (DSP) and DSP ASIC Circuitry**— performs high-speed processing of audio and signaling data signals
- **Station Reference Circuitry** — generates the 2.1 MHz reference signal used throughout the station
- **HDLC Bus Control Circuitry** — provides bus control to allow Host Microprocessor communications port SCC1 to communicate with the Wireline Interface Board and other optional modules via the HDLC interprocessor communications bus
- **Audio Interface Circuitry** — Comprised of a Local Audio ASIC that routes the various audio input signals (such as microphone, wireline, and receiver audio) to output devices (such as external speaker, built−in local speaker, and exciter modulation inputs)
- **Input / Output Ports Circuitry** — two multi−line output buses allow miscellaneous control signals to be sent to various circuits throughout the station; two multi−line input buses allow miscellaneous inputs to be received from throughout the station
- **Supply Voltages Circuitry** — contains filtering and regulator circuitry which accepts +14.2 V and +5 V from backplane and generates the operating voltages required by the SCM circuitry

LED Board (CLN7098A)

- **Front Panel LEDs and Switches** — general purpose input/output ports control eight status LEDs and accept inputs from four momentary switches, all located on the SCM front panel
- **Front Panel Connectors** — four connectors (RSS Port DB-9, External Speaker RJ-11, Handset/Microphone RJ-11, and 5/10 MHz External Input BNC) are mounted on the front panel for interface with external equipment

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 and Figure 2 show the SCM controls, indicators, and all input and output external connections.

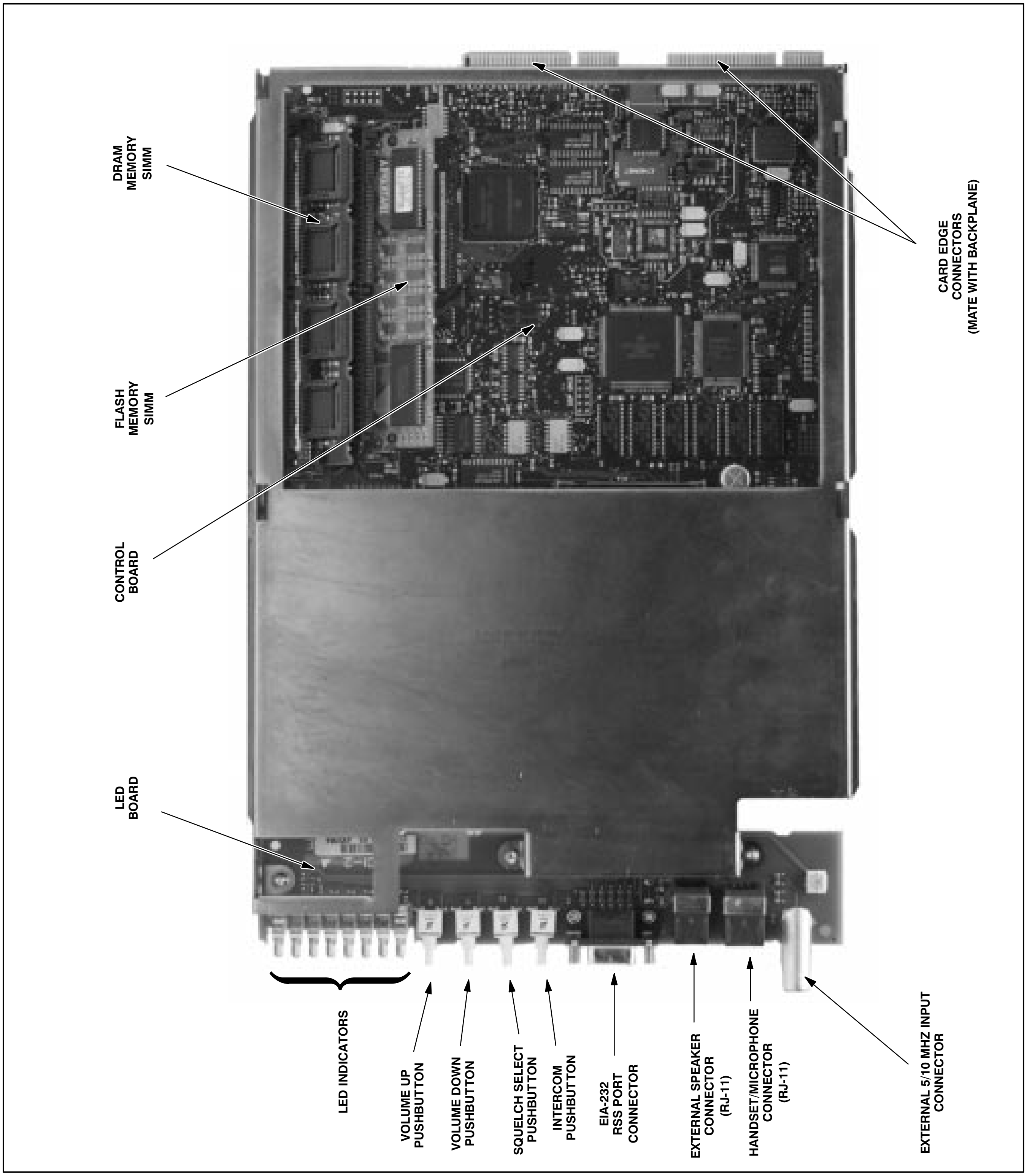

Figure 1. Station Control Module Controls, Indicators, and Inputs/Outputs (Front View)

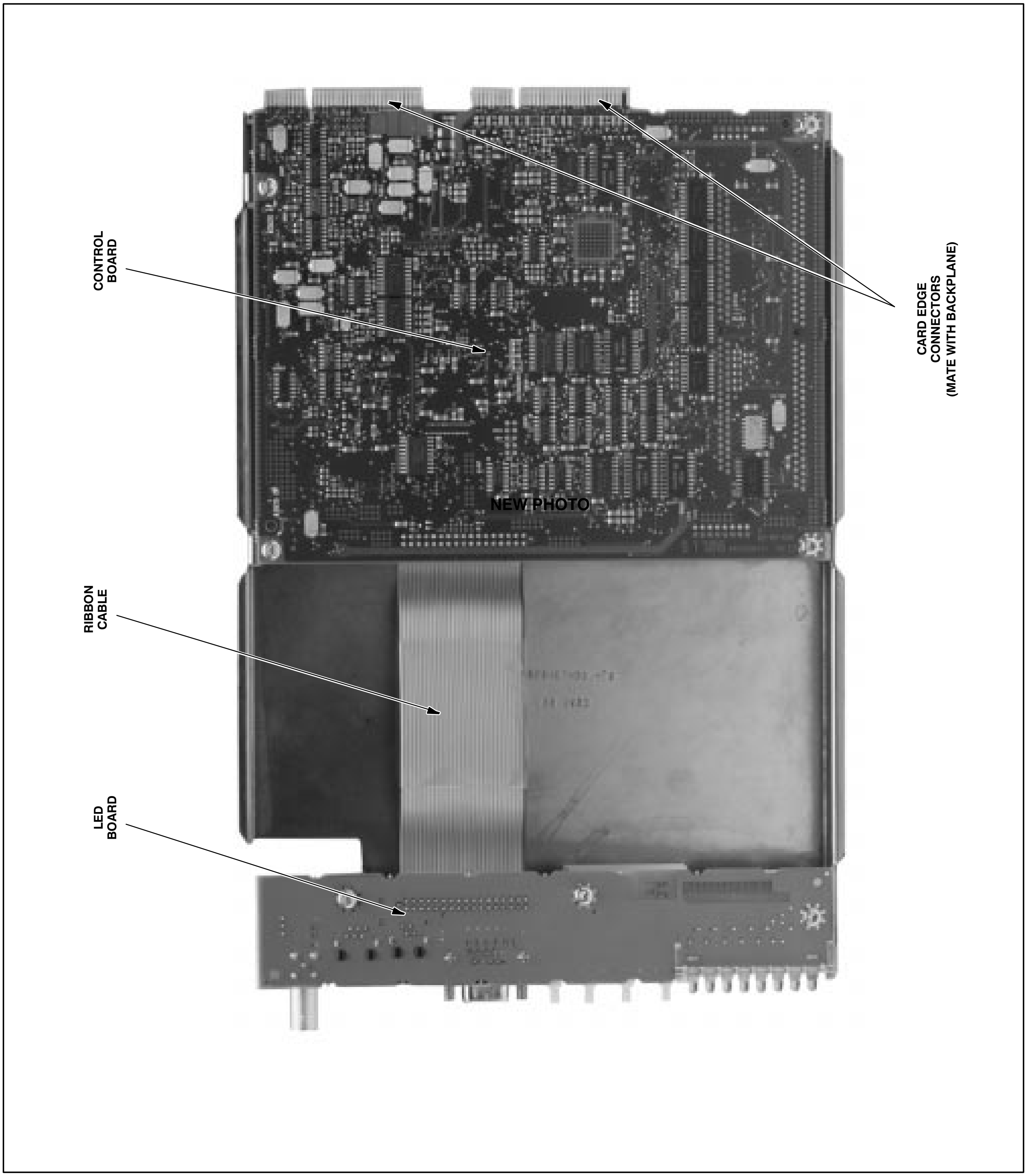

Figure 2. Station Control Module Controls, Indicators, and Inputs/Outputs (Rear View)

3 FUNCTIONAL THEORY OF OPERATION (CLN7060A Control Board)

The following theory of operation describes the operation of the CLN7060A Control Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 3 for a block diagram of the CLN7060A Control Board.

Host Microprocessor

Overview

The Host Microprocessor (μP) serves as the main controller for the SCM (and station). The μP, an MC68EN360 running at a clock speed of 25 MHz, controls the operation of the station as determined by the station software (contained in a FLASH SIMM module) and the station codeplug (EEPROM).

Communications Buses

The Host μP provides five general−purpose serial communications buses, as follows:

- **SCC1** — Used as Ethernet port for high-speed communications, either to allow station software to be downloaded from a local PC into the FLASH memory
- **SCC3** — Used as the Interprocessor Communications Bus (HDLC protocol) to allow the Host μP to communicate with the Wireline Interface Board and other optional modules
- **SCC4** — Used as RS−232 port for connections to external equipment, such as a modem
- **SMC1** — Used as RS−232 port for RSS communications (9-pin D-type connector #20 on backplane)
- **SMC2** — Used as RS−232 port for RSS communications (9-pin D-type connector located on SCM front panel)

Address and Data Buses

The μP is equipped with a 28−line address bus used to access the non−volatile memory, DRAM memory, and provide control (via memory mapping) for other circuitry in the SCM. A 32−line data bus (buffered for the non−volatile memory) is used to transfer data to/from the SCM memory, as well as other SCM circuitry.

SPI Bus

The Host μP also controls the SPI bus, a general−purpose communications bus that allows the Host μP to communicate with other modules in the station.

(continued)

Host Microprocessor (Continued)

DRAM Controller

The Host µP provides signals necessary to access and refresh the DRAM memory.

25 MHz Clock Circuitry

A crystal−controlled 25 MHz clock circuit and buffer provide the 25 MHz clock signal to the Host µP.

Non−Volatile Memory

Station Software FLASH Memory

The station software resides in a 512k x 32 FLASH SIMM module. The FLASH SIMM is accessed by the Host µP via the 28−line Host Buffered Address Bus and the 32−line Host Buffered Data Bus.

Codeplug EEPROM

The data which determines the station personality resides in an 8K x 8 codeplug EEPROM. Stations are shipped from the factory with generic default data programmed into the codeplug EEPROM. Field programming is performed during installation using the Radio Service Software (RSS) program to enter additional customer−specific data, such as site output power, time−out timer settings, etc.

DRAM Memory

Each SCM contains a 512k x 32 DRAM SIMM into which the station software code is downloaded and run. The DRAM also provides short−term storage for data generated/required during normal operation. Read and write operations are performed using the Host Buffered Address and Host Buffered Data buses.

The DRAM memory locations are sequentially refreshed by the column and row signals from the Host µP.

External Line Interface Circuitry

Ethernet Port

An Ethernet port is provided via a BNC connector on the station backplane which allows the station to connect into the Ethernet local network of an *IntelliRepeater* trunking site. The Ethernet port may also be used to allow station software to be downloaded from a local PC into the FLASH SIMM module. This Ethernet port is provided by Host μP serial communication bus SCC1.

General Purpose RS232 Serial Port

A general purpose RS−232 communications port is provided by Host μP serial communication bus SCC4. This port is available at a DB-25 connector (#15) located on the station backplane, and may be used to connect external equipment (e.g., an external modem).

RSS Port (Backplane)

A 9−pin D−type connector (#20) is provided on the station backplane to allow service personnel to connect a PC loaded with the Radio Service Software (RSS) and perform programming and maintenance tasks. The RSS port may also be used to allow station software to be downloaded from a local PC into the FLASH SIMM module. This RSS port is provided by Host μP serial communication bus SMC1 which communicates with the RSS terminal via EIA−232 Bus Receivers/Drivers.

RSS Port (Front Panel)

A 9−pin D−type connector is provided on the SCM front panel to allow service personnel to connect a PC loaded with the Radio Service Software (RSS) and perform programming and maintenance tasks. The RSS port may also be used to allow station software to be downloaded from a local PC into the FLASH SIMM module. This RSS port is provided by Host μP serial communication bus SMC2 which communicates with the RSS terminal via EIA−232 Bus Receivers/Drivers.

Digital Signal Processor (DSP) and DSP ASIC Circuitry

General

All station transmit and receive audio/data is processed by the DSP and related circuitry. This circuitry includes the DSP IC, the DSP ASIC, and the DSP ASIC Interface Circuitry. All audio signals input to or output from the DSP are in digitized format.

Inputs to the DSP circuitry are:

- Digitized receive signals from the Receiver Module
- Audio from handset or microphone connected to appropriate SCM front panel connector; signal is digitized by CODEC IC (p/o Audio Interface Circuitry) before being sent to DSP via Audio Interface Bus
- Digitized voice audio/data from Wireline Interface Board and other optional modules via TDM bus
- ASTRO modem data from Wireline Interface Board via HDLC bus
- *SECURENET* modem data from Wireline Interface Board via HDLC bus
- 6809/MRTI transmit audio

Outputs from the DSP circuitry are:

- Digitized voice audio/data from DSP to Wireline Interface Board and other optional modules via TDM bus
- Digitized voice audio from DSP to external speaker, built−in speaker, or handset earpiece via Audio Interface Bus and Audio Interface Circuitry
- Digitized voice audio/data from DSP to Exciter Module (modulation signals) via Audio Interface Bus and Audio Interface Circuitry
- 6809/MRTI transmit audio

Digital Signal Processor (DSP)

The DSP, a 56002 operating at an internal clock speed of 60 MHz, accepts and transmits digitized audio to/from the various modules in the station. The DSP provides address and data buses to receive/transmit digitized audio (via the DSP ASIC) and to access the DSP program and signal processing algorithms contained in three 32K x 8 SRAM ICs. Three additional 32K x 8 SRAM ICs are provided for data storage.

DSP ASIC

The DSP ASIC operates under control of the DSP to provide a number of functions, as follows:

- Interfaces with the DSP via the DSP address and data buses
- Accepts 16.8 MHz signal from Station Reference Circuitry and outputs a 2.1 MHz reference signal used throughout the station
- Provides interfaces for the HDLC bus, TDM bus, and serial bus used to communicate with the Receiver Module,
- Accepts digitized data from Receiver Module via DSP ASIC Interface Circuitry
- Provides interfaces for several A/D and D/A converters

Station Reference Circuitry

The Station Reference Circuitry consists of a phase−locked loop comprised of a high−stability VCO and a PLL IC. The output of the VCO is a 16.8 MHz signal which is fed to the DSP ASIC. The ASIC divides the signal by 8 and outputs a 2.1 MHz signal which is separated and buffered by a splitter and output to the Exciter Module and Receiver Module as 2.1 MHz REF.

The Station Reference Circuitry may operate in one of three modes:

- **Normal Mode** — In this mode, the control voltage is turned off (via control voltage enable switch) and the high−stability VCO operates in an open loop mode; stability of the VCO in this mode is 1 PPM per year.
- **Manual Netting Mode** — Periodically, an external 5/10 MHz source is required to fine tune, or "net", the 16.8 MHz reference signal. In this mode, the PLL compares the 5/10 MHz reference and a sample of the 16.8 MHz VCO output and generates up/down pulses. The Host μP reads the pulses (via SPI bus) and sends correction signals (via SPI bus) to the VCO to adjust the output frequency to 16.8 Mhz ±0.3 ppm.
- **High−Stability Mode** — For some systems (e.g., Simulcast systems), the free−running stability of the VCO is unacceptable for optimum system performance. Therefore, an external 5/10 MHz source is connected permanently to one of the BNC connectors. In this mode, the PLL compares the 5/10 MHz reference and a sample of the 16.8 MHz VCO output and generates a dc correction voltage. The control voltage enable switch is closed, allowing the control voltage from the PLL to adjust the high−stability VCO frequency to 16.8 Mhz ±0.3 ppm. The VCO operates in this closed loop mode and is continually being frequency controlled by the control voltage from the PLL.

Note:
Two BNC connectors (one 50 Ω input located on SCM front panel, one high impedance input located on the station backplane) are provided to allow an external 5/10 MHz source to be input to the OSC_{in} input to the PLL to perform frequency netting. Refer to the Maintenance section in this manual for recommended intervals and procedures for netting the station reference.

HDLC Bus Control Circuitry

The HDLC Bus Control Circuitry provides high−impedance buffering and data routing for the Interprocessor Communications Bus (a serial data bus implementing HDLC protocol). This bus allows the Host μP to communicate with the microprocessor located on the Wireline Interface Board and other optional modules via an interprocessor communications bus.

Audio Interface Circuitry

General

The Audio Interface Circuitry interfaces external analog audio inputs and outputs with the DSP circuitry. Most of the local audio processing is performed by a custom Local Audio ASIC.

External Audio Sources

A multiplexer, under control of the Host µP, is used to select one of six possible external audio input sources (four for diagnostic loopback signals, one for 6809/MRTI transmit audio, and one for handset or microphone audio). The selected audio source signal is converted to a digital signal by the A/D portion of the CODEC circuit and sent to the DSP ASIC via the Audio Interface Bus. The DSP circuitry processes the signal and routes it to the desired destination.

External Audio Destinations

Digitized audio from the DSP circuitry is input to the D/A portion of the CODEC IC and is output to one of four external devices:

- External Speaker — connects to RJ−11 jack ( ) located on SCM front panel
- Handset Earpiece/Microphone — connects to RJ−11 jack ( ) located on SCM front panel
- Local Built−In Speaker — internal speaker and ½ W audio amplifier; may be switched on/off and volume controlled by using volume up ( ) and down ( ) buttons on SCM front panel
- J14 on Station Backplane — 6809/MRTI receive audio output to external MRTI Module

Exciter Modulation Signals

Digitized audio/data intended to be transmitted from the station is output from the DSP circuitry to a D/A converter via the TX/Voice Audio signal (p/o the Serial Synchronous Interface bus, connected between the DSP and the DSP ASIC). The digitized signal is converted to analog, level shifted and amplified, and fed to a 0−6 kHz filter. The output of the filter is then fed to one of the inputs of a multiplexer. The output of the multiplexer is fed to two individual digitally controlled potentiometers (each of which is adjusted by the Host µP via the SPI Bus) and output to the Exciter Module as modulation signals VCO MOD AUDIO and REF MOD AUDIO.

Input/Output Ports

Input Ports

Two general−purpose multi−line input ports are provided to allow various input signals from the SCM and station circuitry to be accepted and sent to the Host μP. The two ports (I/O Port P0 In and I/O Port P1 In) are comprised of 32 and 24 lines, respectively, which come from circuitry in the SCM as well as other modules in the station via the backplane. The buses are input to buffers which make the data available to the Host μP via the Host Buffered Data Bus. Typical inputs include the pushbutton switches located on the SCM front panel and the MIC PTT signal from the handset/microphone.

Output Ports

Two general−purpose multi−line output ports are provided to allow various control signals from the Host μP to be output to the SCM and station circuitry via the backplane. The two ports (I/O Port P0 Out and I/O Port P1 Out) are comprised of 32 and 8 lines, respectively, which come from the Host Buffered Data Bus via latches. Typical output control signals include the control lines for the eight LEDs located on the SCM front panel and the local speaker enable signal.

6809/MRTI Interface Circuitry

6809 Trunking Interface

TX DATA from the 6809 Trunking Controller is input to the station via J14 on the station backplane. The signal is routed thru nominal filtering on the 6809/MRTI Interface Circuitry and fed to the Audio Interface Circuitry. The T DATA signal is then waveshaped/filtered and fed to an A/D converter, which outputs a digital signal to the DSP via the Audio Interface Bus.

6809 RX AUDIO is output from the DSP to the Local Audio Circuitry via the Audio Interface Bus. The signal is amplified, filtered, buffered, and output thru nominal filtering on the 6809/MRTI Interface Circuitry to the 6809 Trunking Controller via J14 on the station backplane.

MRTI Interface

MRTI TX AUDIO from an external MRTI module is input to the station via J14 on the station backplane. The signal is routed thru the 6809/MRTI Interface Circuitry and fed to one input of an 6−to−1 multiplexer. If selected, the MRTI TX AUDIO signal is converted to a digital signal by the A/D portion of the CODEC IC and sent to the DSP ASIC via the Audio Interface Bus.

MRTI RX AUDIO is output from the DSP to the Local Audio Circuitry via the Audio Interface Bus. The signal is amplified, filtered, buffered, and output thru the 6809/MRTI Interface Circuitry to the external MRTI Module via J14 on the station backplane.

Supply Voltages Circuitry

The SCM contains on−board regulator and filtering circuitry to generate the various operating voltages required by the SCM circuitry. +14.2 V and +5V from the backplane are used as sources for the following supply voltage circuits:

- **VCCA Supply Circuitry** — provides VCCA (+5V) for the Audio Interface Circuitry in the SCM.
- **Filtering Circuitry** — filters the +14.2 V and +5V from the backplane to provide A+ and VCC, respectively, for the SCM digital circuitry.

4 FUNCTIONAL THEORY OF OPERATION (CLN7098A LED Board)

The following theory of operation describes the operation of the CLN7098A LED Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 4 for a block diagram of the CLN7098A LED Board.

Front Panel LEDs and Switches

Note:
Refer to the Troubleshooting section of this manual for complete details on the interpretation of the LEDs.

Note:
Refer to the Operation section of this manual for complete details on the use of the pushbutton switches.

LEDs

Eight status LEDs are provided on the SCM front panel to provide visual indications of various station operating conditions.The LEDs are controlled by eight lines from I/O Port P0 Out.

Switches

Four momentary contact pushbutton switches are provided on the SCM front panel to allow various station functions to be selected. Depressing a pushbutton causes a high to be sent to the Host μP via I/O Port P0 In.

Front Panel Connectors

Four connectors are provided on the SCM front panel to interface with external equipment:

- **RSS Port** — DB-9 connector used for connection to a PC loaded with Radio Service Software (RSS) for configuring/servicing the station
- **External Speaker Connector** — RJ-11 connector used for connection to an external speaker (Model HSN1000)
- **External Handset/Microphone** — RJ-11 connector used for connection to an external handset (Model TMN6164) or microphone (Model HMN1001)
- **5/10 MHz Input** — BNC connector used for connection to an external source of 5 or 10 MHz to be used as a station reference

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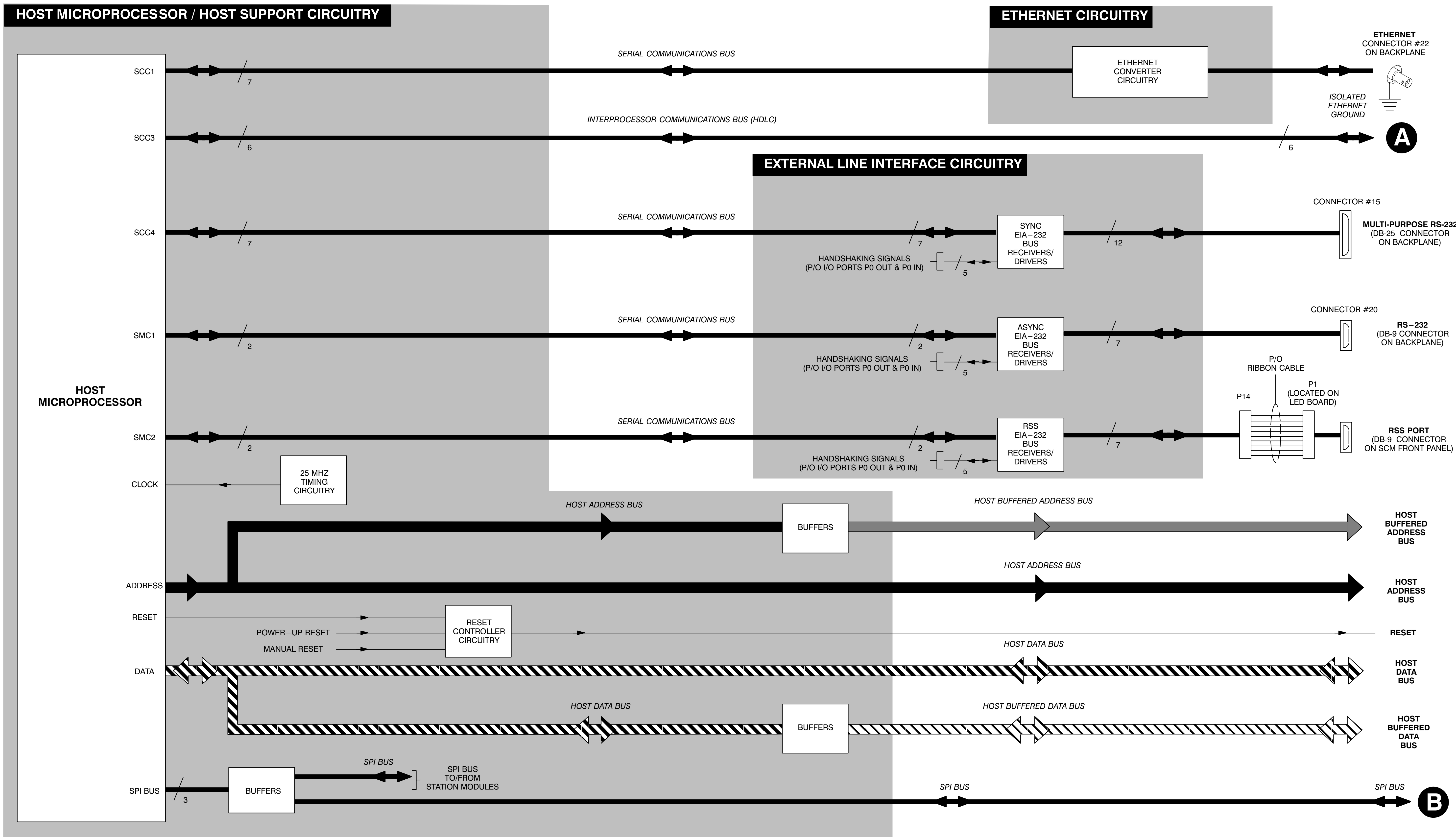


Figure 3. CLN7060A Station Control Board Functional Block Diagram (1 of 5)

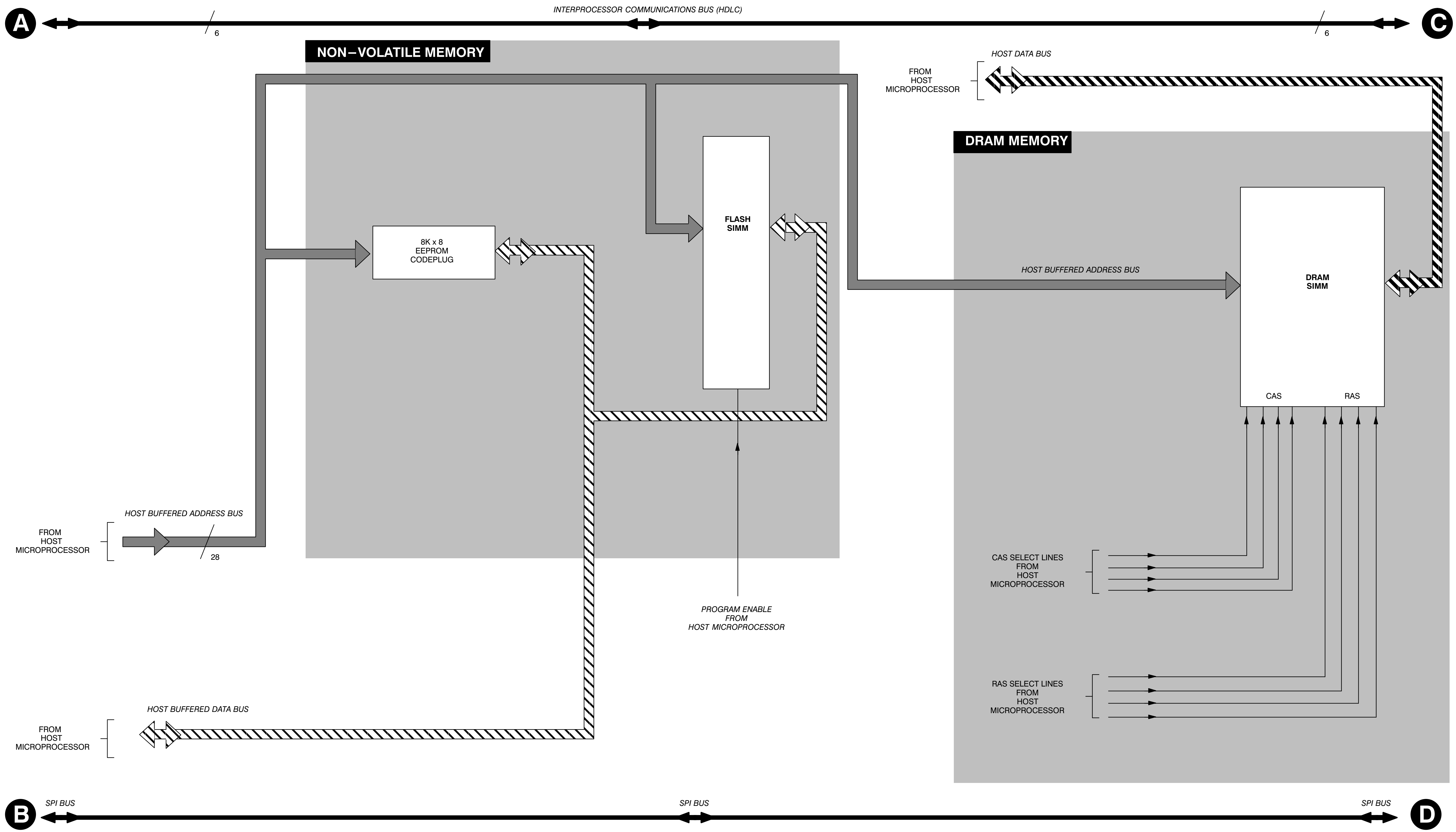


Figure 3. CLN7060A Station Control Board Functional Block Diagram (2 of 5)

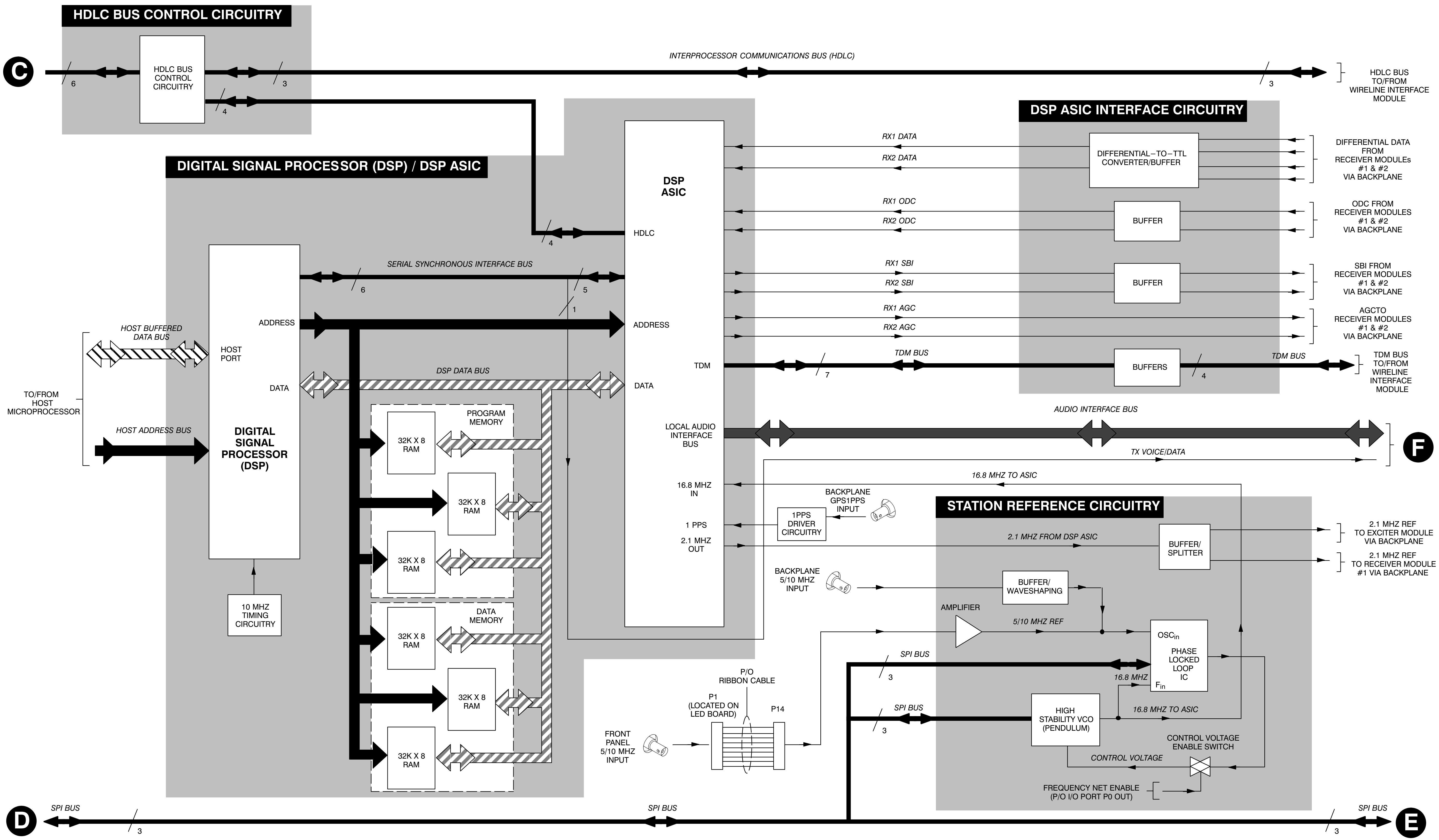


Figure 3. CLN7060A Station Control Board Functional Block Diagram (3 of 5)

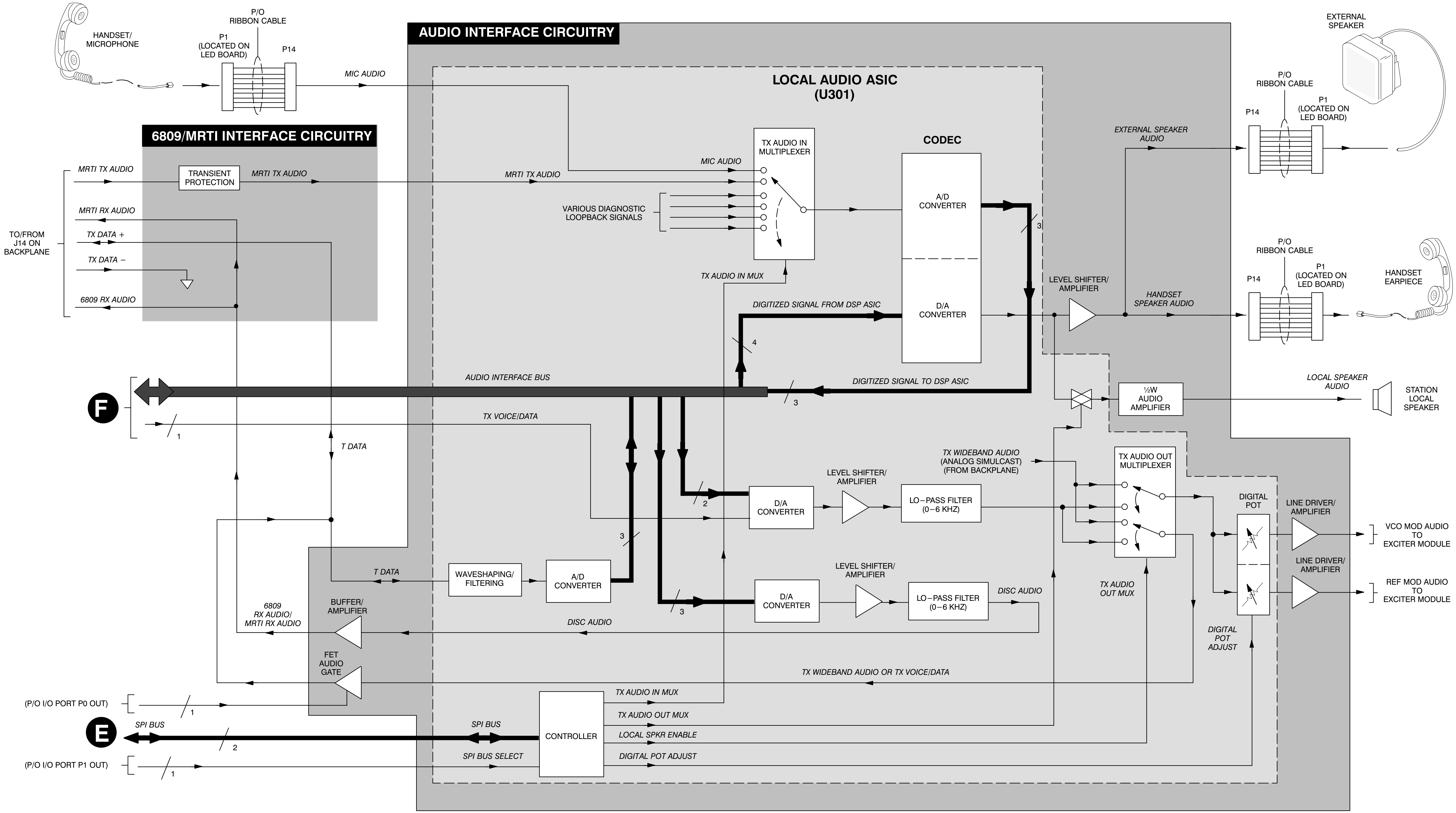
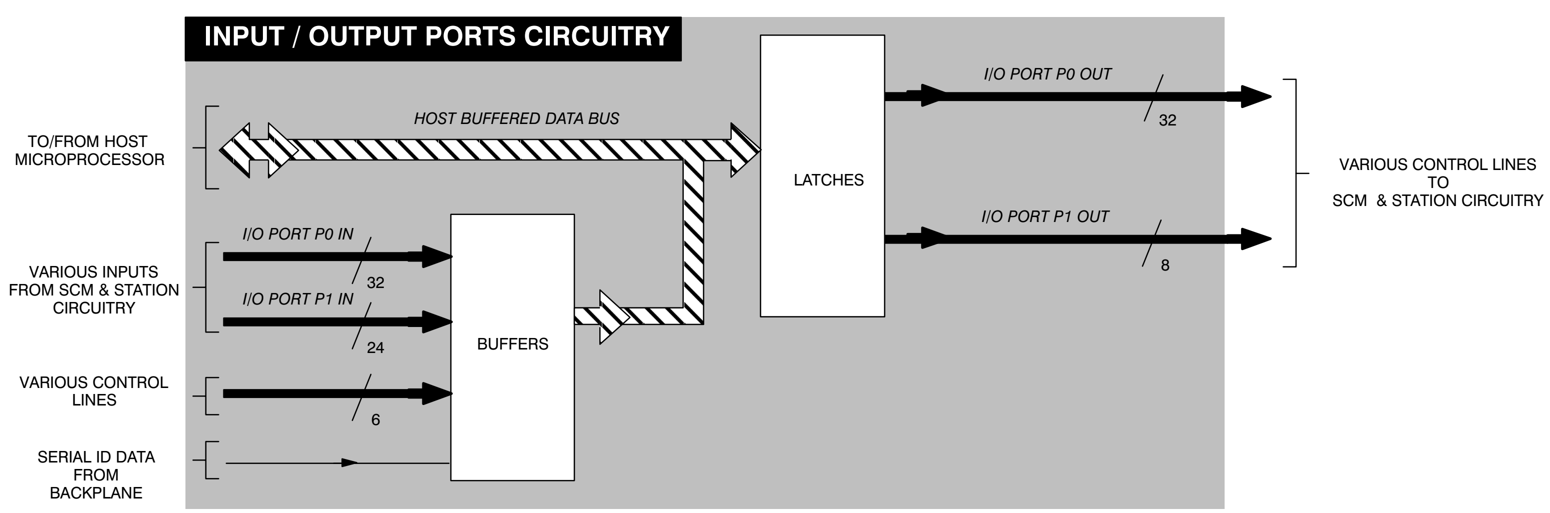


Figure 3. CLN7060A Station Control Board Functional Block Diagram (4 of 5)



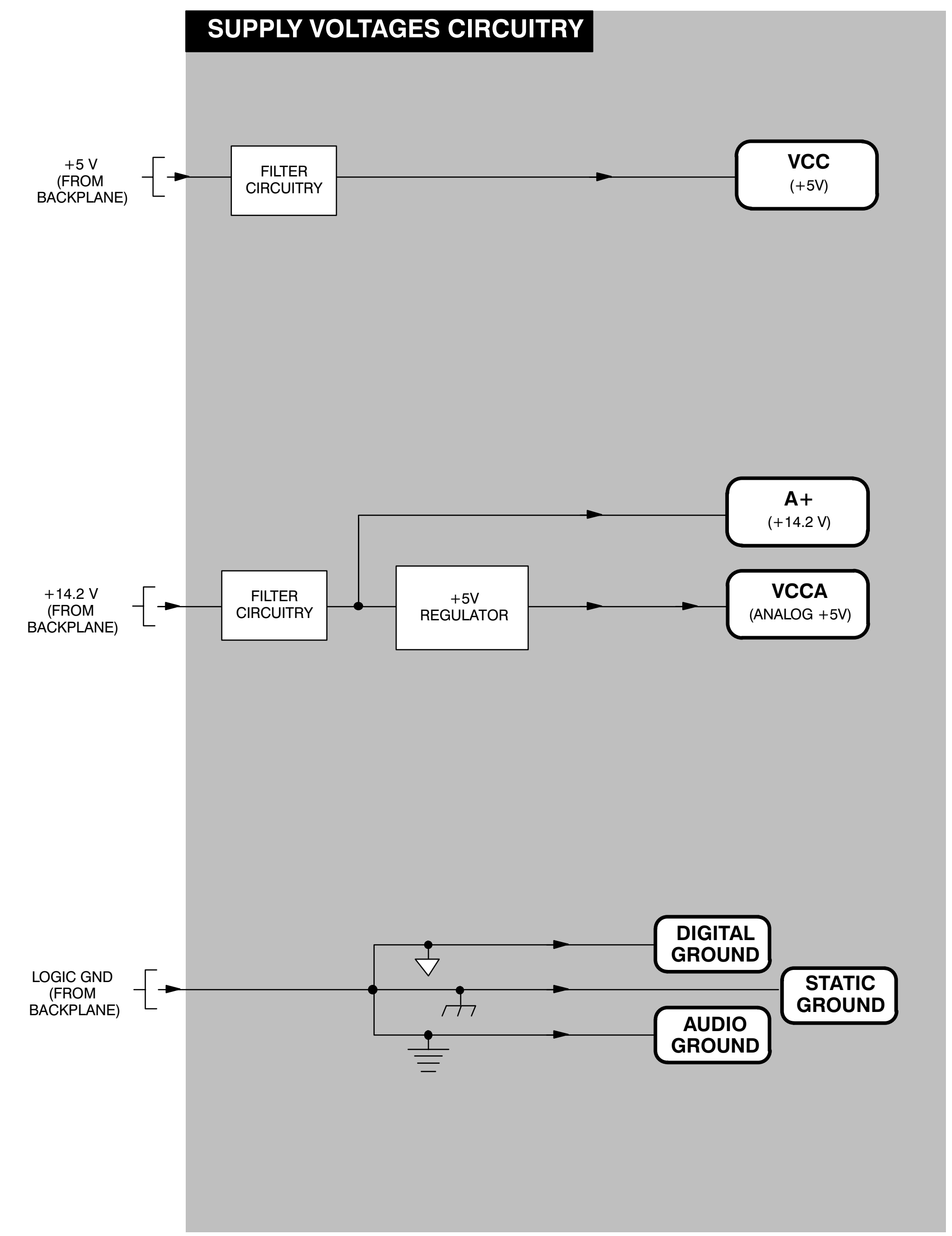


Figure 3. CLN7060A Station Control Board Functional Block Diagram (5 of 5)

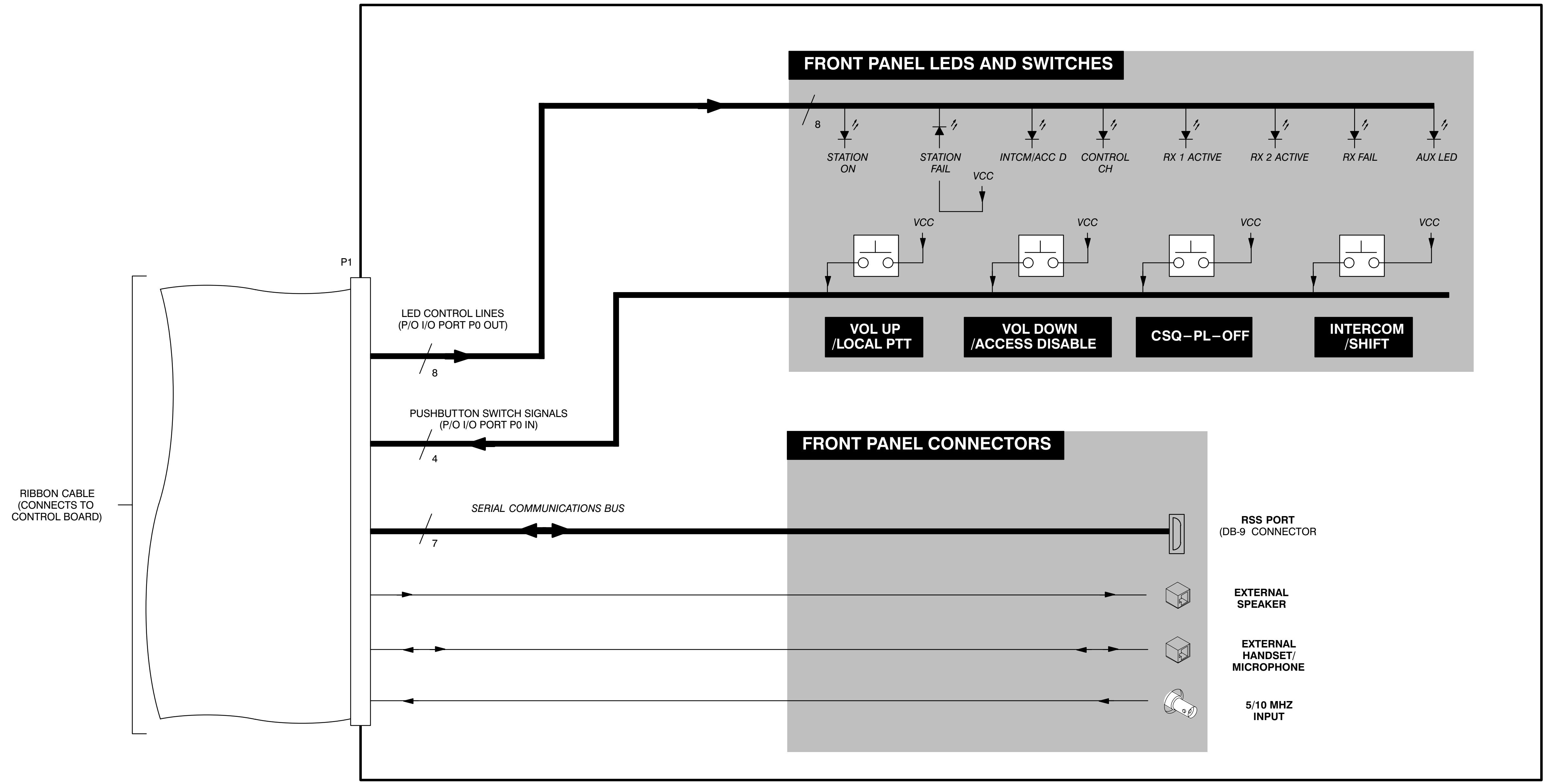


Figure 4. CLN7098A LED Board Functional Block Diagram

MOTOROLA

WIRELINE INTERFACE BOARD

MODELS CLN6955A
CLN6957A

1 DESCRIPTION

The Models CLN6955A and CLN6957A Wireline Interface Boards are described in this section. A general description, identification of jumpers, indicators, and inputs/outputs, functional block diagrams, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

Note: *Model CLN6955 WIB is designed for use in stations installed in locations where local codes permit phone line connections to either the 50−pin Telco connector or the orange screw terminal connector. Model CLN6957 allows only connections to the orange screw terminal connector.*

The Wireline Interface Board (WIB) serves as the interface between the customer telephone lines and the station equipment. Each WIB contains circuitry to interface with a variety of telephone line configurations and signal types. In addition, the board contains a connector to accept one modem card. This card is required to interface with a 9.6kbps (ASTRO) input.

The WIB is installed behind the Station Control Module front panel and connects to the station backplane. Phone line connections may be made either to a 50−pin Telco connector and/or an orange screw terminal connector (see sidebar).

Overview of Circuitry

The WIB contains the following circuitry:

- Audio and Data Circuits — the WIB provides a number of voice and data circuits which interface with the customer phone lines
- Microprocessor — serves as the main controller for the WIB; communicates with the Station Control Module microprocessor, interfaces with the ASTRO and *SECURENET* data signals, and provides monitoring and control for a variety of on−board I/O circuits
- Peripheral Application Specific IC (PASIC) — primarily responsible for injecting and retrieving PCM voice signals into/from the TDM (time division multiplex) bus that connects from the WIB to the Station Control Module
- DC Remote Detection — circuitry provides current sensing and detection for dc remote control of station
- Simulcast Processing Circuitry — circuitry is provided for summing and control of Simulcast PL and reverse burst tones

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the WIB jumpers, indicators, and all input and output external connections.

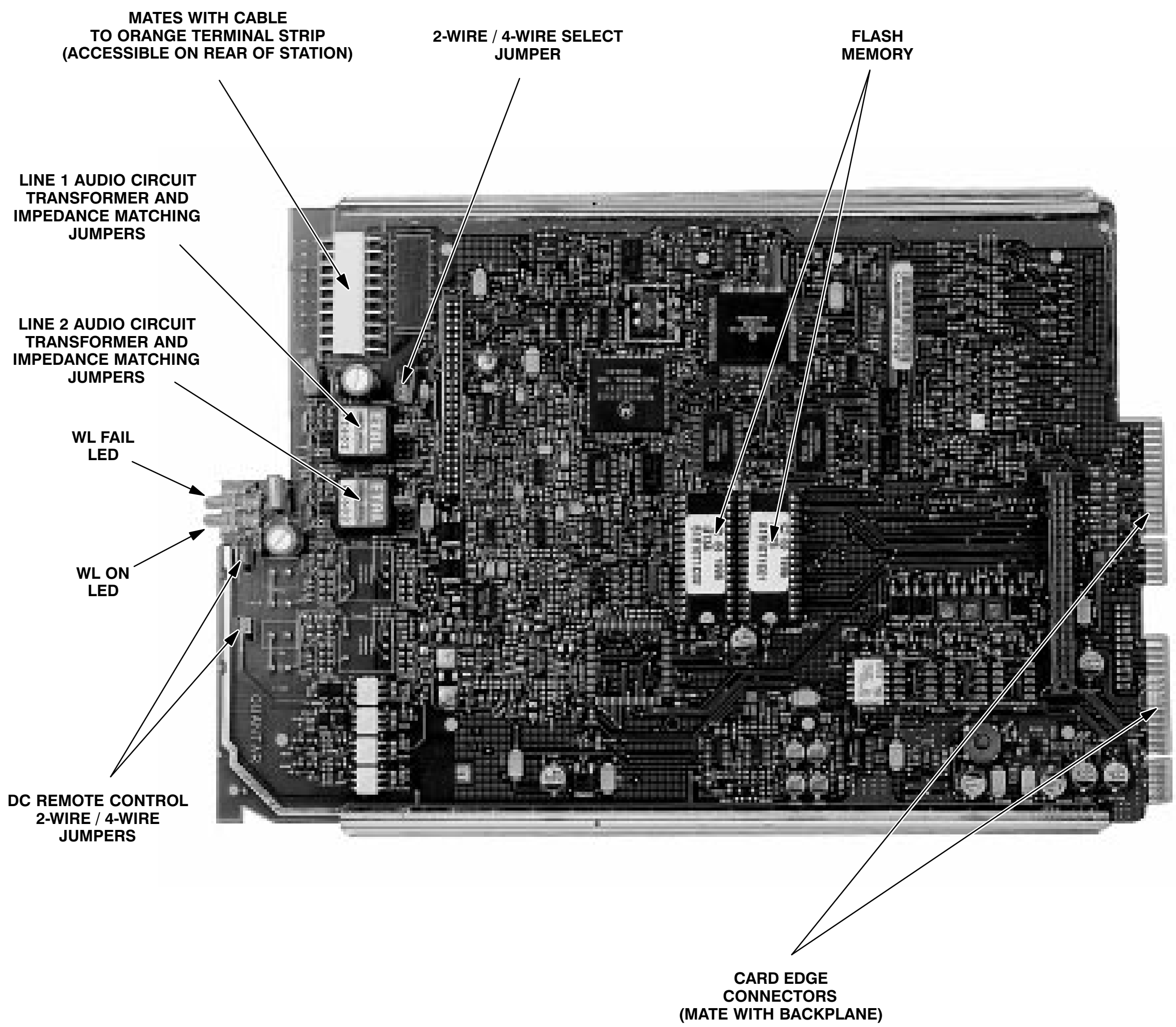

Figure 1. Wireline Interface Board Jumpers, Indicators, and Inputs/Outputs (CLN6955A Shown)

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the WIB circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for an overall block diagram of the WIB, and Figure 3 thru Figure 6 for block diagrams for 2–wire voice, 4–wire voice, 9.6kbps (ASTRO), and 12kbps *SECURENET* signal paths.

Functional Overview (Refer to Figure 2)

Introduction

As mentioned previously, the WIB serves as the interface between the customer telephone lines and the station equipment. In general, the WIB processes and routes all voice and/or data signals between the station equipment and the landline equipment (e.g., a control center, modem, etc.).

As shown in the block diagram in Figure 2, the WIB contains a microprocessor with RAM and EPROM, a Peripheral Application Specific IC (PASIC), one 4–wire audio circuit, and one 2–wire audio circuit. Also provided are a dc remote decoding circuit, Simulcast processing circuitry, and miscellaneous I/O circuits. All of these circuits are described in the following paragraphs.

Microprocessor Circuitry

The WIB microprocessor (μP) provides overall control of the WIB operation, provides two serial bus links, and communicates with the microprocessor in the Station Control Module.

The WIB operating code and other parameters are stored in two 256k x 8 FLASH ICs. Short term storage is provided by two 128k x 8 RAM ICs.

The μP data bus is connected to each of the PASICs to provide control and to input and output 12kbps *SECURENET* data.

Two serial bus links are provided and managed by the μP. One of these is dedicated to interfacing with a plug–in modem card for 9.6kbps (ASTRO) applications. The other serial link is used to interface with the microprocessor in the Station Control Module using HDLC protocol.

Peripheral Application Specific IC (PASIC)

One PASIC is provided on the WIB to interface with the various audio/data circuits. In general, the PASIC is responsible for accepting either PCM voice information (for 4–wire or 2–wire operation) or 12kbps secure data (12kbps *SECURENET* operation) and routing the information to the proper destination (i.e., from landline to station, and from station to landline). Details of the signal paths are provided in **Description of Audio/Data Signal Paths** later in this section.

Functional Overview (Cont'd) (Refer to Figure 2)

Audio/Data Circuits

Each WIB contains circuitry for one 4−wire audio/data circuit, one 2−wire audio/data circuit, one 9.6kbps (ASTRO) data circuit, and one 12kbps *SECURENET* data circuit. As shown in the block diagram, the PASIC and its associated circuitry function to provide the following signal paths:

- 4−wire voice audio from landline to station, and from station to landline
- 2−wire voice audio from landline to station, and from station to landline
- 9.6kbps (ASTRO) modem data from landline to station, and from station to landline
- 12kbps *SECURENET* modem data from landline to station, and from station to landline

Description of Audio/Data Signal Paths provided later in this section contains block diagrams of each of the major signal paths with an explanation of the signal flows.

DC Remote Detection

The WIB contains circuitry to monitor the Line 1 Audio and Line 2 Audio input lines and detect dc control currents. The detection outputs (±12.5mA, ±5.5 mA, +2.5 mA, and −2.5 mA) are dc voltages (nominally either +.7V or +5V) which are fed to an A/D converter. The converter serves as a comparator and interprets the inputs as highs and lows. The data is then sent serially to the microprocessor.

Miscellaneous Inputs/Outputs

The following inputs and outputs are provided on the WIB. These lines may be assigned various functions according to customer specifications.

- One (1) optically−coupled inputs
- Seven (7) transistor−coupled inputs
- One (1) relay closure outputs (normally open contacts)
- Three (3) transistor−coupled outputs

Simulcast Processing Circuitry

Summing and gating circuitry is provided on the WIB to allow PL tones, reverse burst, and TX audio (GEN TX DATA) to be combined and output to the VCO in the Exciter Module (after signal processing by the SCM) to directly modulate the rf carrier. The simulcast circuitry is controlled by the Station Control Board microprocessor via the WIB microprocessor and the PASIC on the WIB.

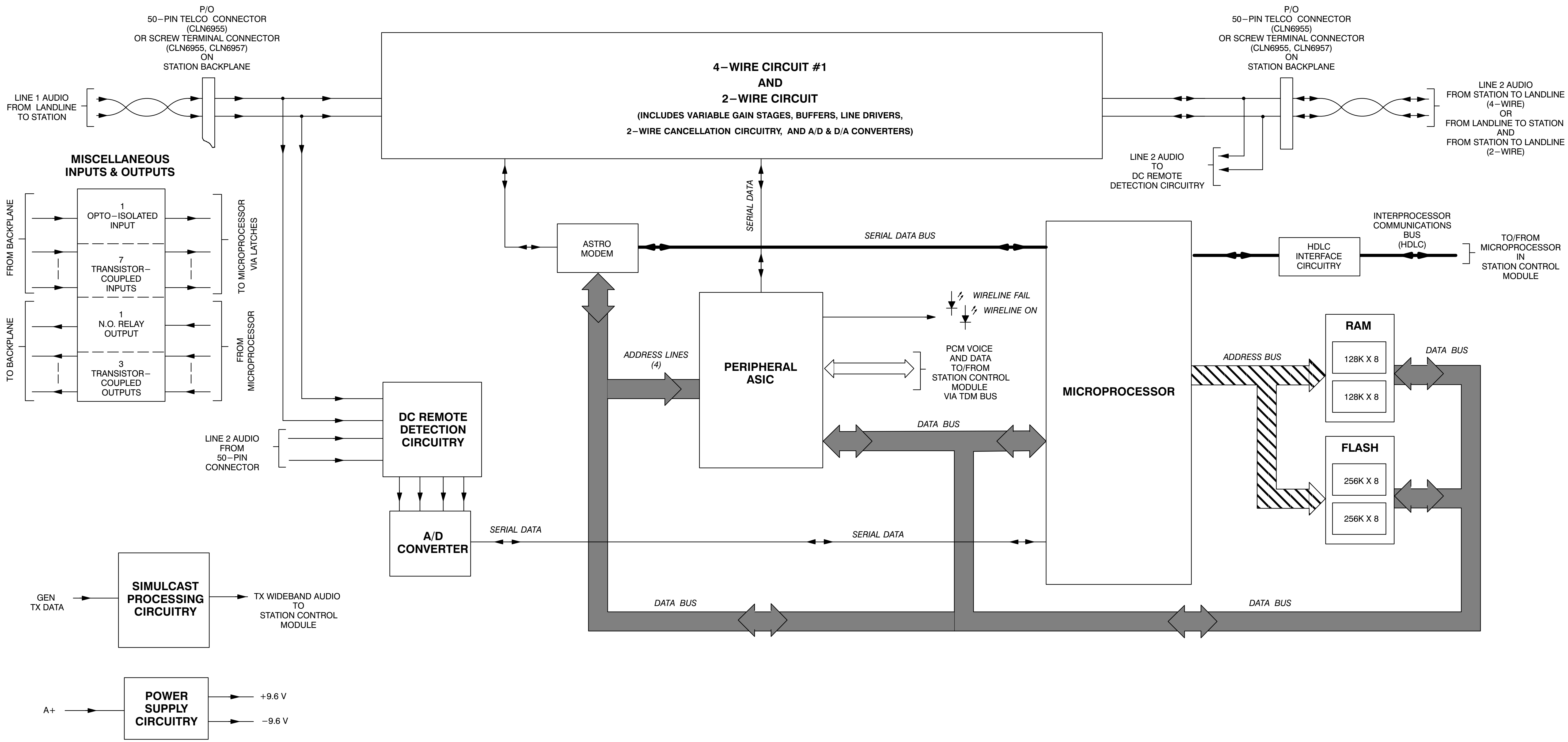

Figure 2. CLN6955A / CLN6957A Wireline Interface Board Functional Block Diagram

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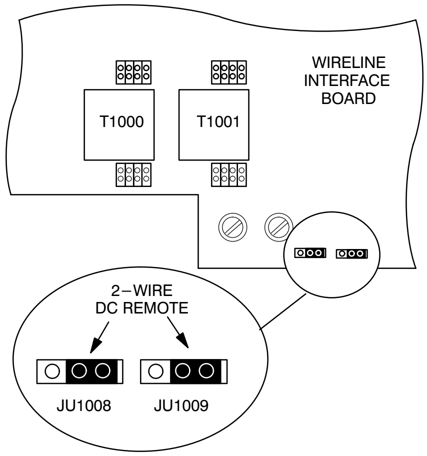
Description of Audio/Data Signal Paths

Note:

Depending on local codes and/or customer preference, phone line connections may be made at either the 50−pin Telco connector or the screw terminal connector on the station backplane. 2−wire audio connections are made at Line 2 Audio.

For systems using dc remote control, set jumpers JU1008 and JU1009 as shown below for 2−wire applications:



Four levels of gain adjustment are provided by circuitry on the WIB for Landline−to−Station and Station−to−Landline audio paths. Additional fine level adjustments are performed in software in the Station Control Module.

(Note that a sample of the outbound signal is fed from one of the output transistors to the cancellation amplifier in the landline to station circuitry. This signal is used to cancel the outbound signal and allow the inbound signal to pass through the landline to station circuitry.)

2−Wire Voice Audio Path (Refer to Figure 3)

Voice audio signals sent to/from the station via 2−wire copper pair are processed by the 2−wire audio circuit on the WIB (Line 2 Audio). The audio transformer in this circuit may have both inbound and outbound audio signals present simultaneously, and therefore employs circuitry to pass audio in each direction while cancelling the alternate signal. The 2−wire audio circuit operates as follows:

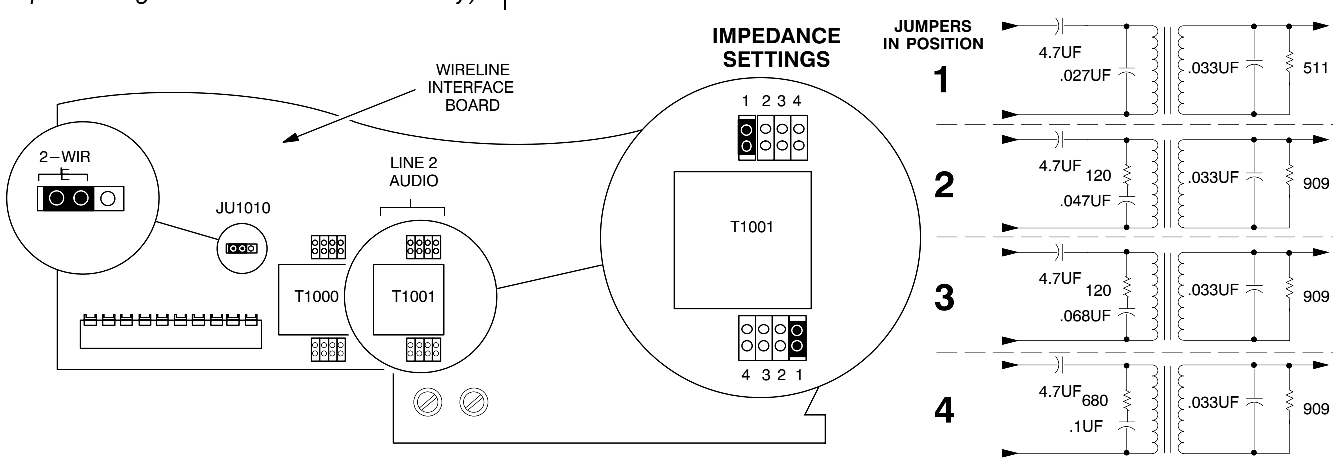
Landline to Station balanced audio is input to the primary of an audio transformer. The signal is induced into the transformer secondary and fed to an amplifier. [Note that jumper fields in parallel with both the primary and secondary coils provide for selectable impedance matching. Refer to the illustration below for impedance setting information.]

The amplifier sums the inbound and outbound signals and feeds one input to the cancellation amplifier. The other input to this amplifier is the output signal only. A cancellation of the outbound signal results, and the output from this amplifier is the inbound signal only. The signal is fed to a buffer (through jumper JU1010 placed in the 2−wire position, as shown below) which feeds the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides eight levels of gain adjust (5, 10, 15, 20, 25, 30, 35, and 40 dB).

The output of the gain adjust circuitry is fed to an A/D converter, which digitizes the audio signal into a PCM output. This output is fed serially to the PASIC, which places the data in the proper TDM timeslot (as instructed by the microprocessor in the SCM) and output to the SCM on the TDM Bus.

Station to Landline audio is input to the PASIC in the form of PCM data on the TDM bus. The PASIC extracts the data and feeds it to a D/A converter, which takes the PCM data and converts it to an analog audio signal. The audio signal is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, −6dB, −12dB, and −18dB).

The output of the gain adjust circuitry is fed thru a 2−pole low−pass filter and into the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push−pull configuration to drive the primary of an audio transformer. The audio signal is induced into the secondary and output to the landline system (via either the 50−pin Telco connector or screw terminal connector) as balanced audio.



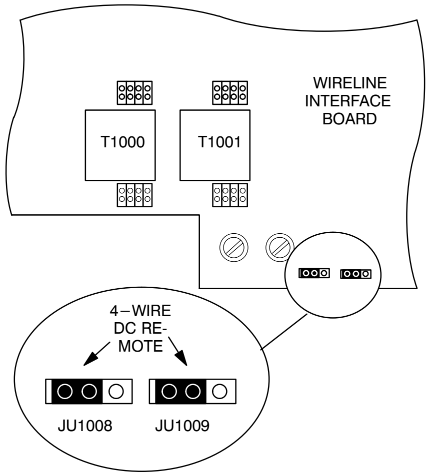
Note: All jumpers removed for high impedance input/output.

Description of Audio/Data Signal Paths (Continued)

Note:

Depending on local codes and/or customer preference, phone line connections may be made at either the 50−pin Telco connector or the screw terminal connector on the station backplane. Landline to Station signals are connected at Line 1 Audio. Station to Landline signals are connected at Line 2 Audio.

For systems using dc remote control, set jumpers JU1008 and JU1009 as shown below for 4−wire applications:



Four levels of gain adjustment are provided by circuitry on the WIB for Landline−to−Station and Station−to−Landline audio paths. Additional fine level adjustments are performed in software in the Station Control Module.

4−Wire Voice Audio Path (Refer to Figure 4)

Voice audio signals sent to/from the station via 4−wire copper pairs are processed by the 4−wire audio circuit on the WIB (Line 1 Audio & Line 2 Audio). The 4−wire circuit operates as follows:

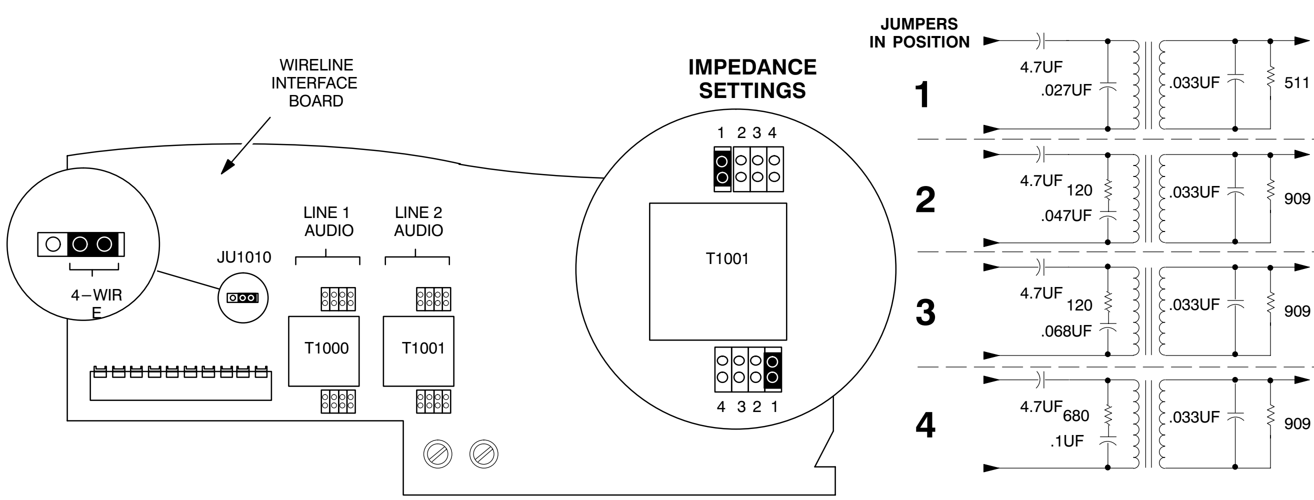
Landline to Station balanced audio is input to the primary of an audio transformer. The signal is induced into the transformer secondary and fed to a buffer (through jumper JU1010 placed in the 4−wire position, as shown below). [Note that jumper fields in parallel with both the primary and secondary coils provide for selectable impedance matching. Refer to the illustration below for impedance setting information.]

The buffer output is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides eight levels of gain adjust (5, 10, 15, 20, 25, 30, 35, and 40 dB).

The output of the gain adjust circuitry is fed to an A/D converter, which digitizes the audio signal into a PCM output. This output is fed serially to the PASIC, which places the data in the proper TDM timeslot (as instructed by the microprocessor in the Station Control Module) and output to the SCM on the TDM Bus.

Station to Landline audio is input to the PASIC in the form of PCM data on the TDM bus. The PASIC extracts the data and feeds it to a D/A converter, which takes the PCM data and converts it to an analog audio signal. The audio signal is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, −6dB, −12dB, and −18dB).

The output of the gain adjust circuitry is fed thru a 2−pole low−pass filter and into the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push−pull configuration to drive the primary of an audio transformer. The audio signal is induced into the secondary and output to the landline system (via either the 50−pin Telco connector or screw terminal connector) as balanced audio.



Note: All jumpers removed for high impedance input/output.

Description of Audio/Data Signal Paths (Continued)

9.6KBPS (ASTRO) Modem Data Path (Refer to Figure 5)

9.6kbps (ASTRO) modem data signals are sent to/from the station via 4−wire copper pairs and are processed by the 4−wire audio circuit on the WIB (Line 1 Audio & Line 2 Audio). The 4−wire circuit operates as follows:

Note:
Depending on local codes and/or customer preference, phone line connections may be made at either the 50−pin Telco connector or the screw terminal connector on the station backplane. Landline to Station signals are connected at Line 1 Audio. Station to Landline signals are connected at Line 2 Audio.

Landline to Station modem data is input to the primary of an audio transformer as balanced audio. The signal is induced into the transformer secondary and fed to a buffer (through jumper JU1010 placed in the 4−wire position, as shown at the bottom of page 8). [Note that jumper fields in parallel with both the primary and secondary coils provide for selectable impedance matching. Refer to the illustration at the bottom of page 8 for impedance setting information.]

The WIB is equipped with a connector to accept a plug−in ASTRO modem card.

The buffer output is fed to a modem (a separate card which plugs into the WIB) which converts the modem signal to detected data. The data signal is then fed to the microprocessor over a serial bus. The microprocessor sends the data to the microprocessor in the Station Control Module over an interprocessor communications bus (HDLC protocol).

Station to Landline modem data is input to the microprocessor from the Station Control Module microprocessor via the interprocessor communications bus (HDLC protocol). The microprocessor feeds the data to the modem which converts the data to a modem signal.

The output of the modem is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, −6dB, −12dB, and −18dB).

The output of the gain adjust circuitry is fed thru a 2−pole low−pass filter and into the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push−pull configuration to drive the primary of an audio transformer. The modem data signal is induced into the secondary and output to the landline system (via either the 50−pin Telco connector or screw terminal connector) as balanced audio.

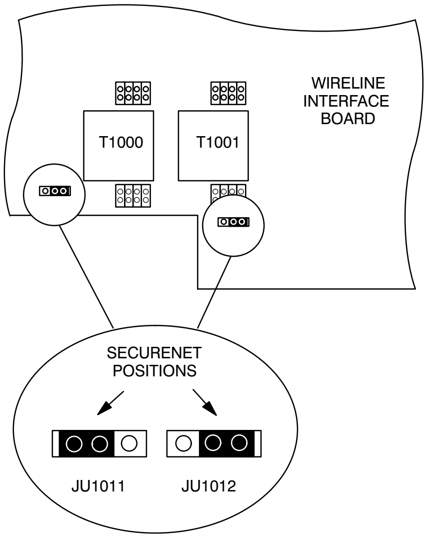
Description of Audio/Data Signal Paths (Continued)

The Quantar station supports SECURENET transparent mode only.

Note:

Depending on customer preference, phone line connections may be made at either the 50−pin Telco connector or the screw terminal connector on the station backplane. Landline to Station signals are connected at Line 1 Audio. Station to Landline signals are connected at Line 2 Audio.

*For **SECURENET** systems, make sure jumpers JU1011 and JU1012 are placed as shown below.*



12KBPS* SECURENET *Modem Data Path (Refer to Figure 6)

12kbps *SECURENET* modem data signals are sent to/from the station via 4−wire copper pairs and are processed by the 4−wire audio circuit on the WIB (Line 1 Audio & Line 2 Audio). The 4−wire circuit operates as follows:

Landline to Station 12kbps modem data is input to the primary of an audio transformer as balanced audio. The signal is induced into the transformer secondary and fed to a buffer (through jumper JU1010 placed in the 4−wire position, as shown at the bottom of page 8). [Note that jumper fields in parallel with both the primary and secondary coils provide for selectable impedance matching. For *SECURENET* systems, place both jumpers in position 1, as shown in the illustration at the bottom of page 8.]

The buffer output is fed through a 3−pole low−pass filter to a limiter, which converts the modem signal to a data signal. The output of the limiter is fed to the PASIC as serial data.

The PASIC sends the data to the microprocessor as 8−bit parallel data over the data bus.The microprocessor sends the data to the microprocessor in the Station Control Module over an interprocessor communications bus (HDLC protocol).

Station to Landline 12kbps modem data is input to the microprocessor from the Station Control Module microprocessor via the interprocessor communications bus (HDLC protocol). The microprocessor feeds the data to the PASIC as 8−bit parallel data over the data bus.

The PASIC outputs the data serially through a 3−pole low−pass filter to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, −6dB, −12dB, and −18dB).

The output of the gain adjust circuitry is fed to the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push−pull configuration to drive the primary of an audio transformer. The modem data signal is induced into the secondary and output to the landline system (via either the 50−pin Telco connector or screw terminal connector) as balanced audio.

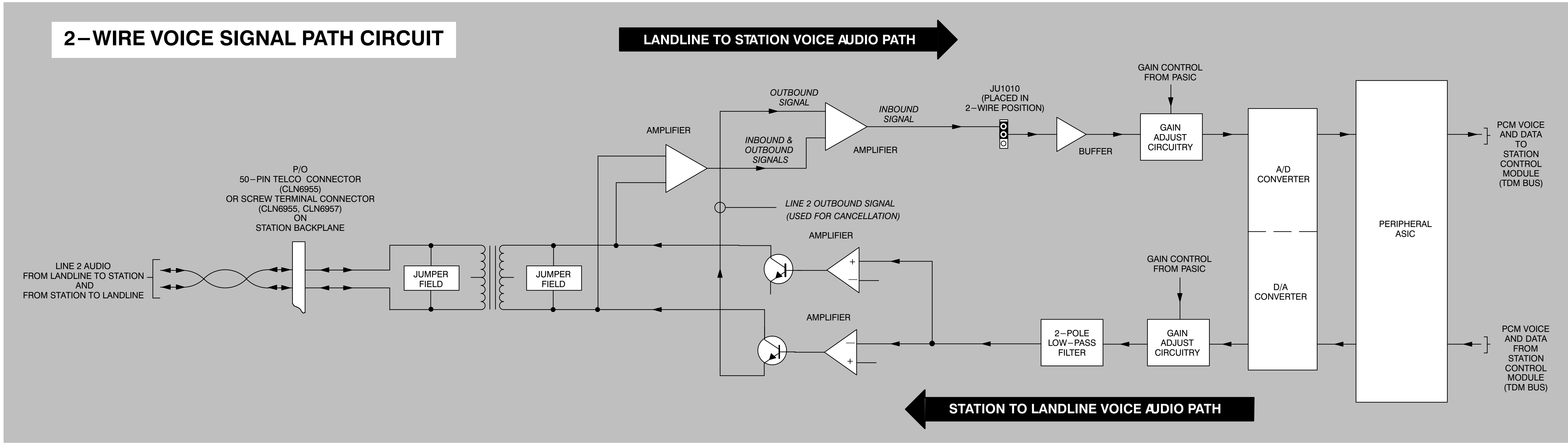


Figure 3. 2–Wire Voice Audio Path Functional Block Diagram

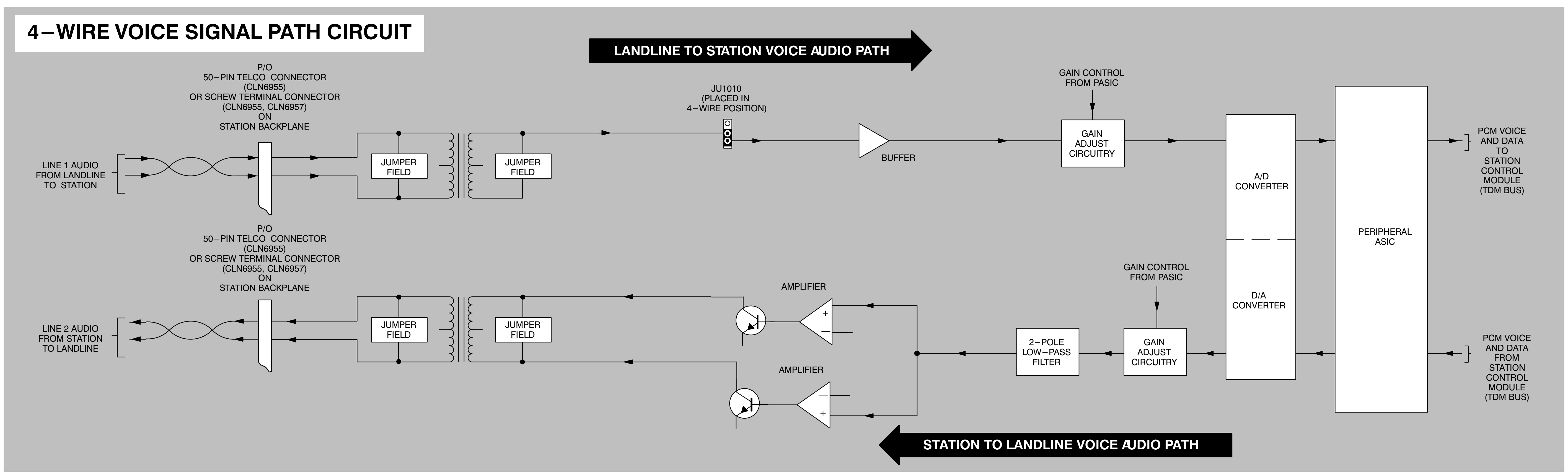


Figure 4. 4–Wire Voice Audio Path Functional Block Diagram

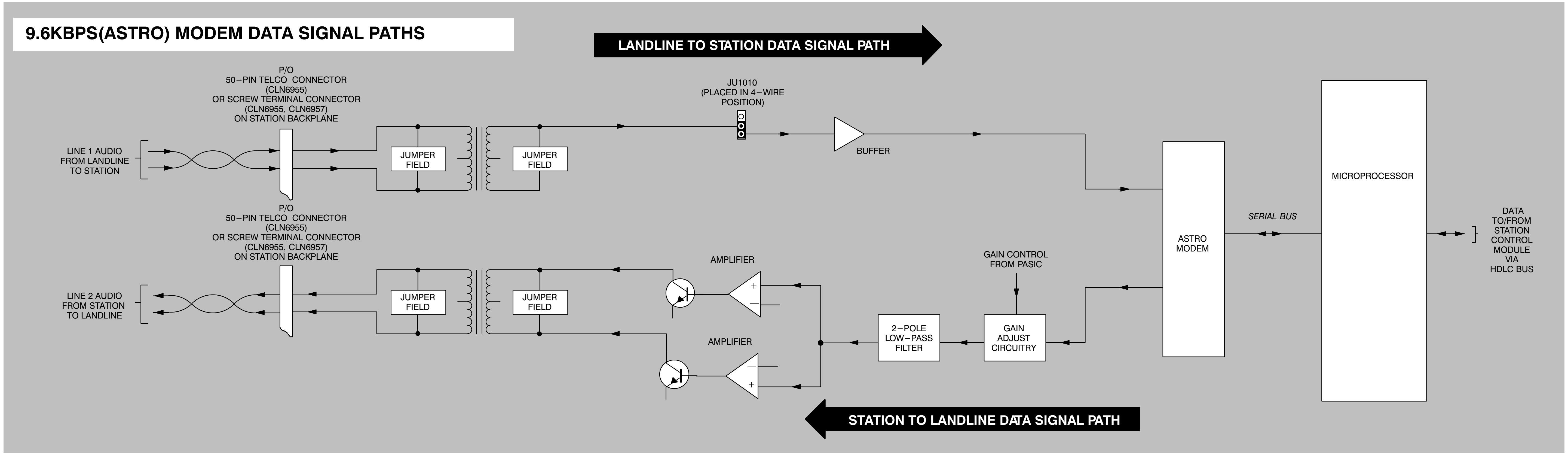


Figure 5. 9.6kbps (ASTRO) Modem Data Signal Path Functional Block Diagram

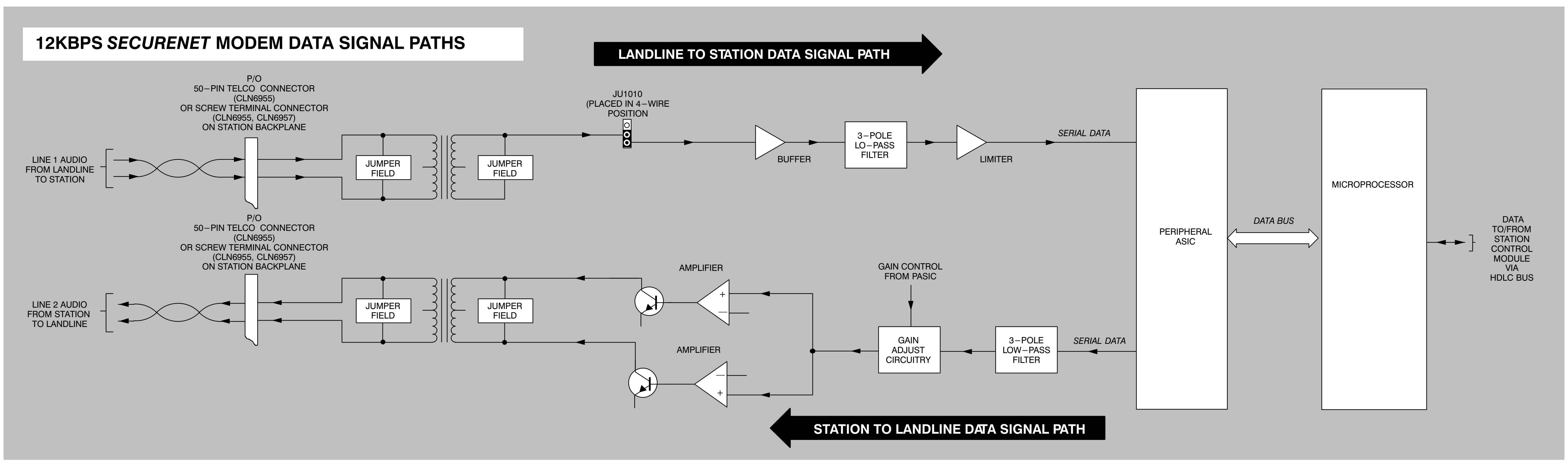


Figure 6. 12kbps *SECURENET* Modem Data Signal Path Functional Block Diagram

WIRELINE INTERFACE BOARD

MODELS CLN6956A CLN6958A

1 DESCRIPTION

The Models CLN6956A and CLN6958A Wireline Interface Boards are described in this section. A general description, identification of jumpers, indicators, and inputs/outputs, functional block diagrams, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

Note: *Model CLN6956 WIB is designed for use in stations installed in locations where local codes permit phone line connections to either the 50−pin Telco connector or the orange screw terminal connector. Model CLN6958 allows only connections to the orange screw terminal connector.*

The Wireline Interface Board (WIB) serves as the interface between the customer telephone lines and the station equipment. Each WIB contains circuitry to interface with a variety of telephone line configurations and signal types. In addition, the board contains connectors to accept two modem cards. These cards are required to interface with up to two 9.6kbps (ASTRO) inputs.

The WIB is installed behind the Station Control Module front panel and connects to the station backplane. Phone line connections may be made either to a 50−pin Telco connector and/or an orange screw terminal connector (see sidebar).

Overview of Circuitry

The WIB contains the following circuitry:

- Audio and Data Circuits — the WIB provides a number of voice and data circuits which interface with the customer phone lines
- Microprocessor — serves as the main controller for the WIB; communicates with the Station Control Module microprocessor, interfaces with the ASTRO and *SECURENET* data signals, and provides monitoring and control for a variety of on−board I/O circuits
- Peripheral Application Specific IC (PASIC) — primarily responsible for injecting and retrieving PCM voice signals into/from the TDM (time division multiplex) bus that connects from the WIB to the Station Control Module
- DC Remote Detection — circuitry provides current sensing and detection for dc remote control of station
- Simulcast Processing Circuitry — circuitry is provided for summing and control of Simulcast PL and reverse burst tones

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2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the WIB jumpers, indicators, and all input and output external connections.

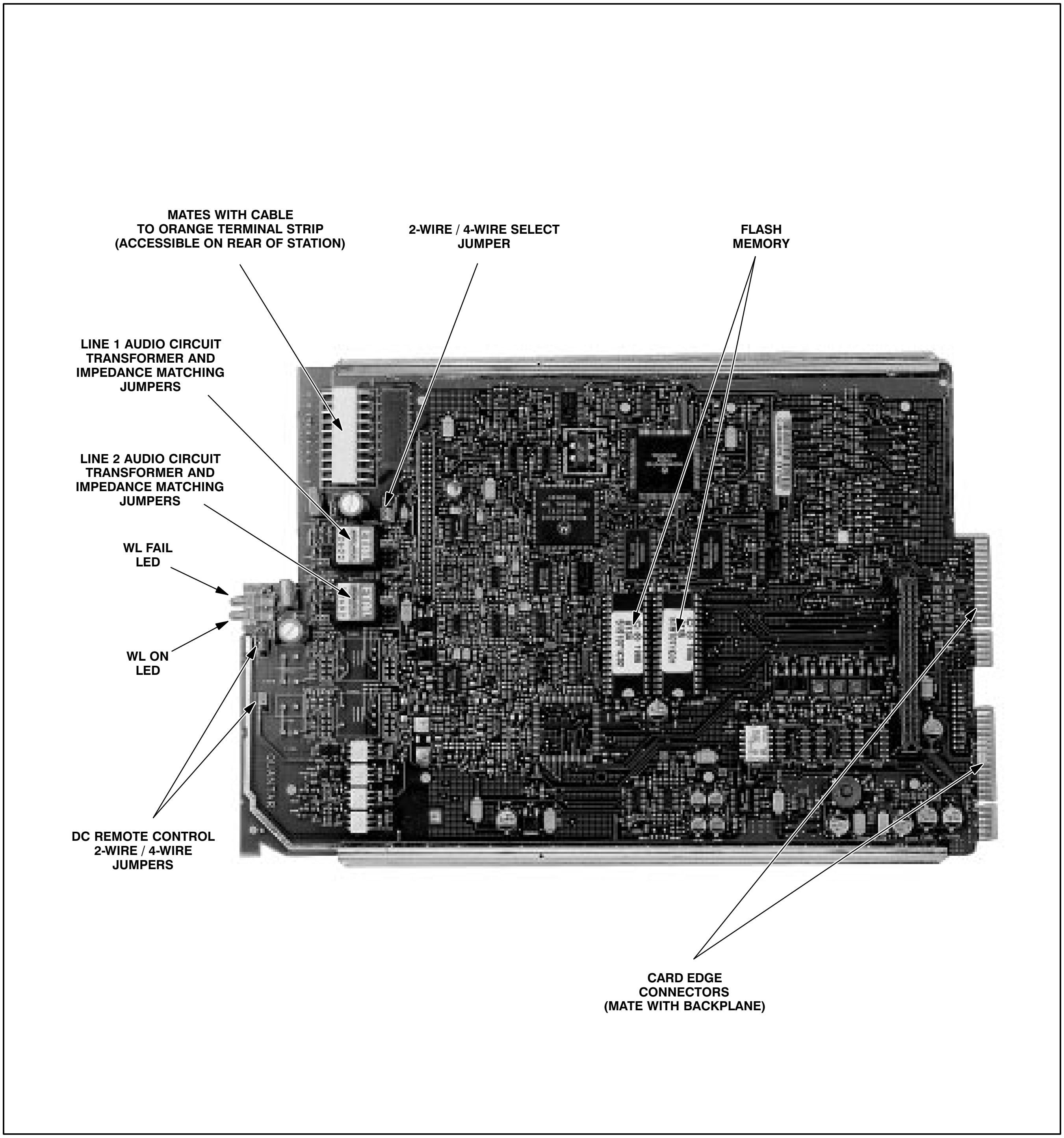

Figure 1. Wireline Interface Board Jumpers, Indicators, and Inputs/Outputs (CLN6956A Shown)

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the WIB circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for an overall block diagram of the WIB, and Figure 3 thru Figure 6 for block diagrams for 2−wire voice, 4−wire voice, 9.6kbps (ASTRO), and 12kbps *SECURENET* signal paths.

Functional Overview
(Refer to Figure 2)

Introduction

As mentioned previously, the WIB serves as the interface between the customer telephone lines and the station equipment. In general, the WIB processes and routes all voice and/or data signals between the station equipment and the landline equipment (e.g., a control center, modem, etc.).

As shown in the block diagram in Figure xx, the WIB contains a microprocessor with RAM and EPROM, two Peripheral Application Specific ICs (PASIC), two 4−wire audio circuits, and one 2−wire audio circuit. Also provided are a dc remote decoding circuit, Simulcast processing circuitry, and miscellaneous I/O circuits. All of these circuits are described in the following paragraphs.

Microprocessor Circuitry

The WIB microprocessor (μP) provides overall control of the WIB operation, provides three serial bus links, and communicates with the microprocessor in the Station Control Module.

The WIB operating code and other parameters are stored in two 256k x 8 FLASH ICs. Short term storage is provided by two 128k x 8 RAM ICs.

The μP data bus is connected to each of the PASICs to provide control and to input and output 12kbps *SECURENET* data.

Three serial bus links are provided and managed by the μP. Two of these are dedicated to interfacing with two plug−in modem cards for 9.6kbps (ASTRO) applications. The other serial link is used to interface with the microprocessor in the Station Control Module using HDLC protocol.

Peripheral Application Specific IC (PASIC)

Two PASICs are provided on the WIB to interface with the various audio/data circuits. One PASIC interfaces with the 4−wire/2−wire circuitry, and the other PASIC interfaces with the second 4−wire circuit. In general, each PASIC is responsible for accepting either PCM voice information (for 4−wire or 2−wire operation) or 12kbps secure data (12kbps *SECURENET* operation) and routing the information to the proper destination (i.e., from landline to station, and from station to landline). Details of the signal paths are provided in **Description of Audio/Data Signal Paths** later in this section.

Functional Overview (Cont'd) (Refer to Figure 2)

Audio/Data Circuits

Each WIB contains circuitry for two 4−wire audio/data circuits, one 2−wire audio/data circuit, two 9.6kbps (ASTRO) data circuits, and two 12kbps *SECURENET* data circuits. As shown in the block diagram, the upper PASIC interfaces with the 2−wire/4−wire circuitry, and the lower PASIC interfaces with the second 4−wire circuit.

Each PASIC and its associated circuitry function to provide the following signal paths:

- 4−wire voice audio from landline to station, and from station to landline
- 2−wire voice audio (upper PASIC only) from landline to station, and from station to landline
- 9.6kbps (ASTRO) modem data from landline to station, and from station to landline
- 12kbps *SECURENET* modem data from landline to station, and from station to landline

Description of Audio/Data Signal Paths provided later in this section contains block diagrams of each of the major signal paths along with an explanation of the signal flows.

DC Remote Detection

The WIB contains circuitry to monitor the Line 1 Audio and Line 2 Audio input lines and detect dc control currents. The detection outputs (±12.5mA, ±5.5 mA, +2.5 mA, and −2.5 mA) are dc voltages (nominally either +.7V or +5V) which are fed to an A/D converter. The converter serves as a comparator and interprets the inputs as highs and lows. The data is then sent serially to the microprocessor.

Miscellaneous Inputs/Outputs

The following inputs and outputs are provided on the WIB. These lines may be assigned various functions according to customer specifications.

- Four (4) optically−coupled inputs
- Eight (8) transistor−coupled inputs
- Four (4) relay closure outputs (normally open contacts)
- Six (6) transistor−coupled outputs

Simulcast Processing Circuitry

Summing and gating circuitry is provided on the WIB to allow PL tones, reverse burst, and TX audio (GEN TX DATA) to be combined and output to the VCO in the Exciter Module (after signal processing by the SCM) to direclty modulate the rf carrier. The simulcast circuitry is controlled by the Station Control Board microprocessor via the WIB microprocessor and upper PASIC on the WIB.

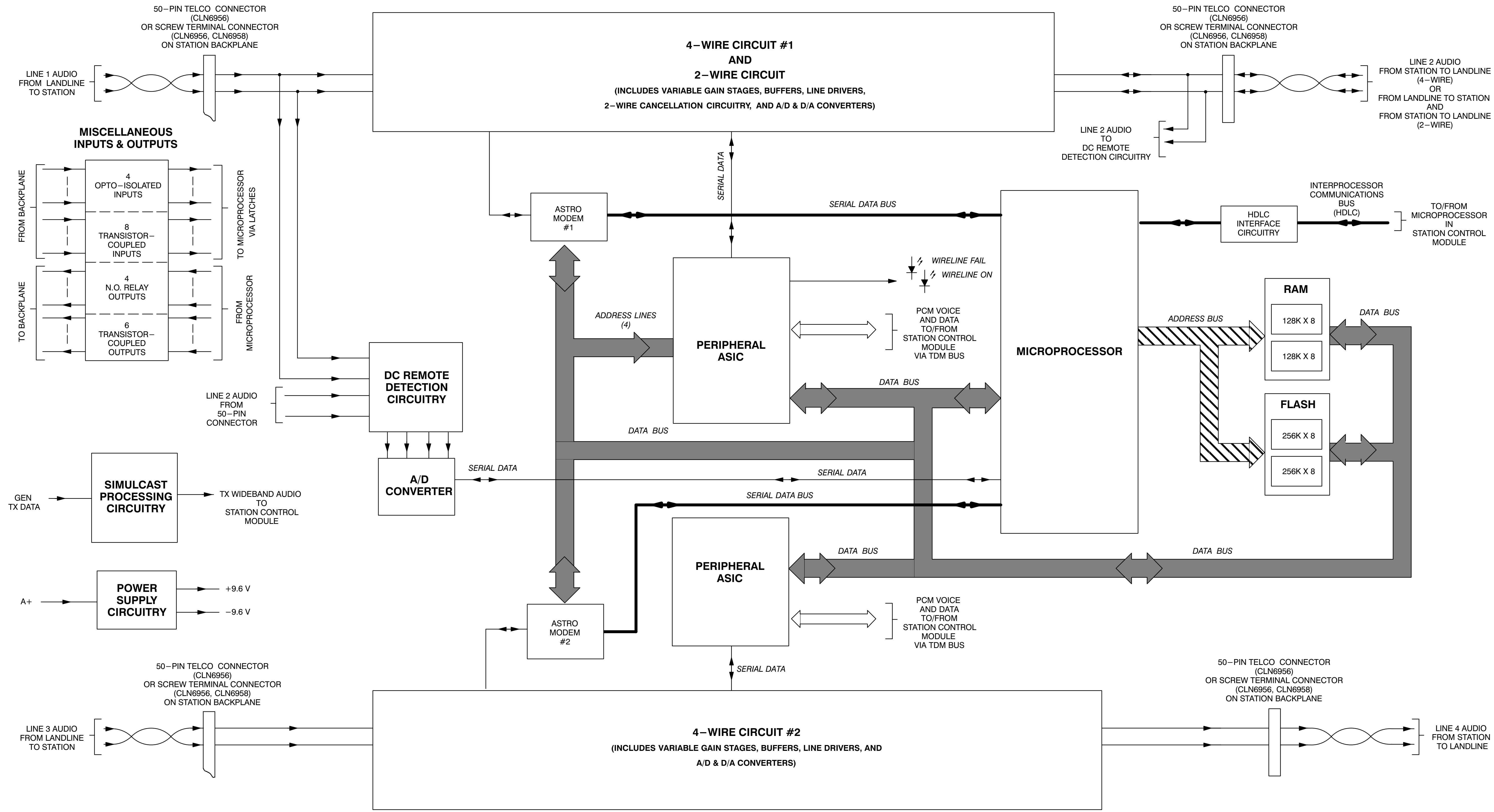

Figure 2. CLN6956A / CLN6958A Wireline Interface Board Functional Block Diagram

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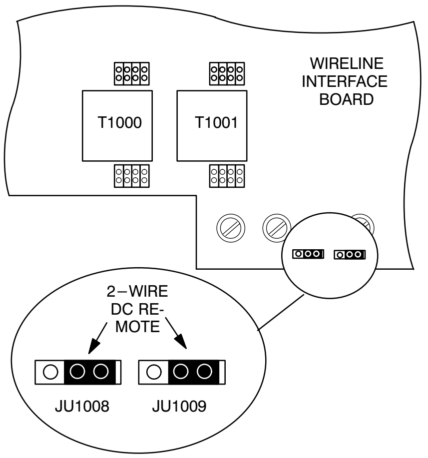
Description of Audio/Data Signal Paths

Note:

Depending on local codes and/or customer preference, phone line connections may be made at either the 50–pin Telco connector or the screw terminal connector on the station backplane. 2–wire audio connections are made at Line 2 Audio.

For systems using dc remote control, set jumpers JU1008 and JU1009 as shown below for 2–wire applications:



Four levels of gain adjustment are provided by circuitry on the WIB for Landline–to–Station and Station–to–Landline audio paths. Additional fine level adjustments are performed in software in the Station Control Module.

(Note that a sample of the outbound signal is fed from one of the output transistors to the cancellation amplifier in the landline to station circuitry. This signal is used to cancel the outbound signal and allow the inbound signal to pass through the landline to station circuitry.)

2–Wire Voice Audio Path (Refer to Figure 3)

Voice audio signals sent to/from the station via 2–wire copper pair are processed by the 2–wire audio circuit on the WIB (Line 2 Audio). The audio transformer in this circuit may have both inbound and outbound audio signals present simultaneously, and therefore employs circuitry to pass audio in each direction while cancelling the alternate signal. The 2–wire audio circuit operates as follows:

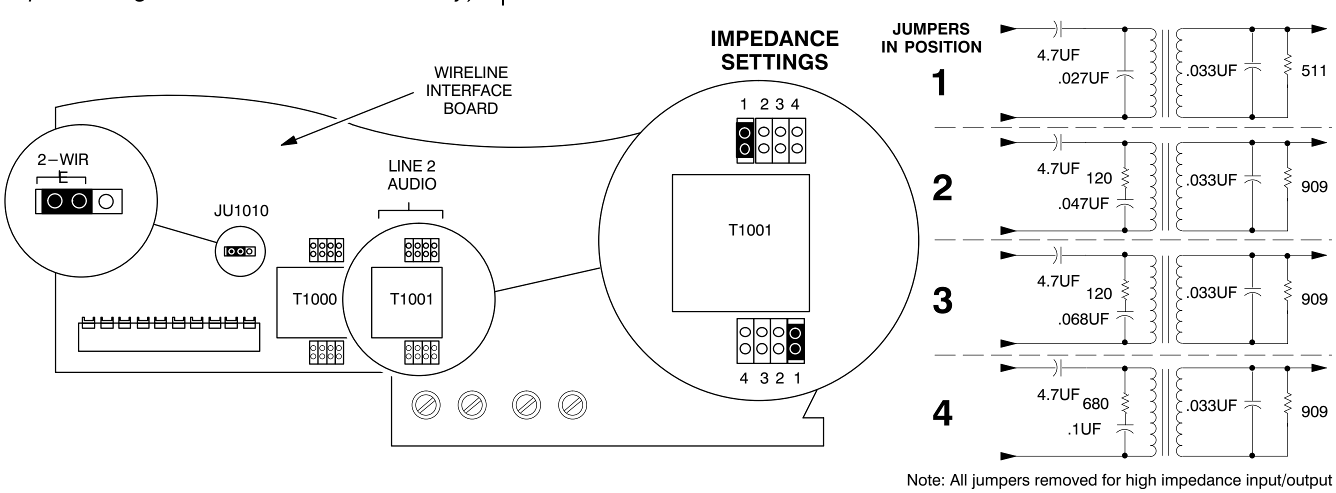
Landline to Station balanced audio is input to the primary of an audio transformer. The signal is induced into the transformer secondary and fed to an amplifier. [Note that jumper fields in parallel with both the primary and secondary coils provide for selectable impedance matching. Refer to the illustration below for impedance setting information.]

The amplifier sums the inbound and outbound signals and feeds one input to the cancellation amplifier. The other input to this amplifier is the output signal only. A cancellation of the outbound signal results, and the output from this amplifier is the inbound signal only. The signal is fed to a buffer (through jumper JU1010 placed in the 2–wire position, as shown below) which feeds the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides eight levels of gain adjust (5, 10, 15, 20, 25, 30, 35, and 40dB).

The output of the gain adjust circuitry is fed to an A/D converter, which digitizes the audio signal into a PCM output. This output is fed serially to the PASIC, which places the data in the proper TDM timeslot (as instructed by the microprocessor in the SCM) and output to the SCM on the TDM Bus.

Station to Landline audio is input to the PASIC in the form of PCM data on the TDM bus. The PASIC extracts the data and feeds it to a D/A converter, which takes the PCM data and converts it to an analog audio signal. The audio signal is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, –6dB, –12dB, and –18dB).

The output of the gain adjust circuitry is fed thru a 2–pole low–pass filter and into the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push–pull configuration to drive the primary of an audio transformer. The audio signal is induced into the secondary and output to the landline system (via either the 50–pin Telco connector or screw terminal connector) as balanced audio.

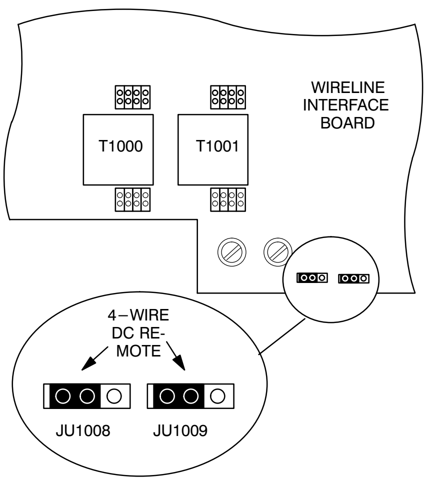


Note: All jumpers removed for high impedance input/output

Description of Audio/Data Signal Paths (Continued)

Note:
Depending on local codes and/or customer preference, phone line connections may be made at either the 50–pin Telco connector or the screw terminal connector on the station backplane. Landline to Station signals are connected at Line 1 Audio or Line 3 Audio. Station to Landline signals are connected at Line 2 Audio or Line 4 Audio.

For systems using dc remote control, set jumpers JU1008 and JU1009 as shown below for 4–wire applications:



Four levels of gain adjustment are provided by circuitry on the WIB for Landline–to–Station and Station–to–Landline audio paths. Additional fine level adjustments are performed in software in the Station Control Module.

4–Wire Voice Audio Path (Refer to Figure 4)

Voice audio signals sent to/from the station via 4–wire copper pairs are processed by one of two 4–wire audio circuits on the WIB:

- Line 1 Audio & Line 2 Audio
- Line 3 Audio & Line 4 Audio

Both 4–wire circuits operate identically as follows:

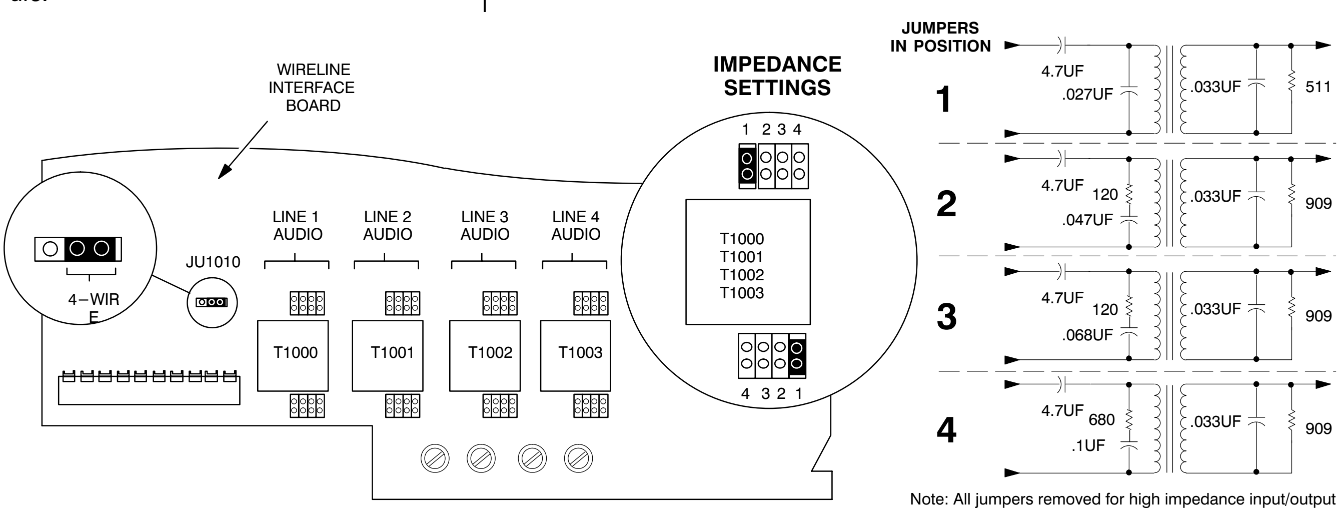
Landline to Station balanced audio is input to the primary of an audio transformer. The signal is induced into the transformer secondary and fed to a buffer (through jumper JU1010 placed in the 4–wire position, as shown below). [Note that jumper fields in parallel with both the primary and secondary coils provides for selectable impedance matching. Refer to the illustration below for impedance setting information.]

The buffer output is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides eight levels of gain adjust (5, 10, 15, 20, 25, 30, 35, and 40dB).

The output of the gain adjust circuitry is fed to an A/D converter, which digitizes the audio signal into a PCM output. This output is fed serially to the PASIC, which places the data in the proper TDM timeslot (as instructed by the microprocessor in the Station Control Module) and output to the SCM on the TDM Bus.

Station to Landline audio is input to the PASIC in the form of PCM data on the TDM bus. The PASIC extracts the data and feeds it to a D/A converter, which takes the PCM data and converts it to an analog audio signal. The audio signal is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, –6dB, –12dB, and –18dB).

The output of the gain adjust circuitry is fed thru a 2–pole low–pass filter and into the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push–pull configuration to drive the primary of an audio transformer. The audio signal is induced into the secondary and output to the landline system (via either the 50–pin Telco connector or screw terminal connector) as balanced audio.



Description of Audio/Data Signal Paths (Continued)

9.6KBPS (ASTRO) Modem Data Path (Refer to Figure 5)

9.6kbps (ASTRO) modem data signals are sent to/from the station via 4–wire copper pairs and are processed by one of two 4–wire audio circuits on the WIB:

- Line 1 Audio & Line 2 Audio
- Line 3 Audio & Line 4 Audio

Both 4–wire circuits operate identically as follows:

Note:
Depending on local codes and/or customer preference, phone line connections may be made at either the 50–pin Telco connector or the screw terminal connector on the station backplane. Landline to Station signals are connected at Line 1 Audio or Line 3 Audio. Station to Landline signals are connected at Line 2 Audio or Line 4 Audio.

Landline to Station modem data is input to the primary of an audio transformer as balanced audio. The signal is induced into the transformer secondary and fed to a buffer (through jumper JU1010 placed in the 4–wire position, as shown at the bottom of page 8). [Note that jumper fields in parallel with both the primary and secondary coils provide for selectable impedance matching. Refer to the illustration at the bottom of page NO TAG for impedance setting information.]

The buffer output is fed to a modem (a separate card which plugs into the WIB) which converts the modem signal to detected data. The data signal is then fed to the microprocessor over a serial bus. The microprocessor sends the data to the microprocessor in the Station Control Module over an interprocessor communications bus (HDLC protocol).

The WIB is equipped with two connectors to accept two plug–in ASTRO modem cards, one for each 4–wire modem data circuit.

Station to Landline modem data is input to the microprocessor from the Station Control Module microprocessor via the interprocessor communications bus (HDLC protocol). The microprocessor feeds the data to the modem which converts the data to a modem signal.

The output of the modem is fed to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, –6dB, –12dB, and –18dB).

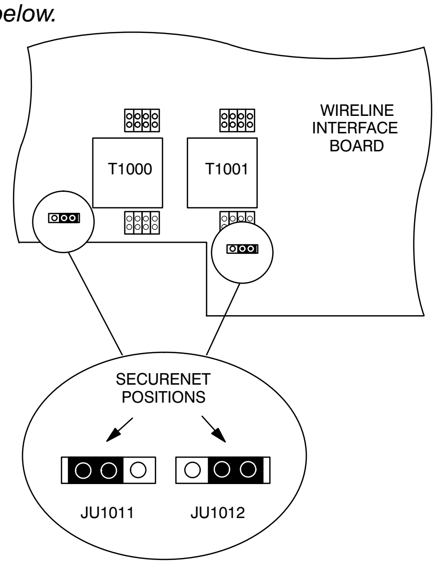
The output of the gain adjust circuitry is fed thru a 2–pole low–pass filter and into the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push–pull configuration to drive the primary of an audio transformer. The modem data signal is induced into the secondary and output to the landline system (via either the 50–pin Telco connector or screw terminal connector) as balanced audio.

Description of Audio/Data Signal Paths (Continued)

The Quantar *station supports* SECURENET <u>*transparent*</u> *mode only.*

Note:
Depending on customer preference, phone line connections may be made at either the 50–pin Telco connector or the screw terminal connector on the station backplane. Landline to Station signals are connected at Line 1 Audio or Line3 Audio. Station to Landline signals are connected at Line 2 Audio or Line 4 Audio.

For ***SECURENET*** *systems, make sure jumpers JU1011 and JU1012 are placed as shown below.*



12KBPS SECURENET *Modem Data Path (Refer to Figure 6)*

12kbps *SECURENET* modem data signals are sent to/from the station via 4–wire copper pairs and are processed by one of two 4–wire audio circuits on the WIB:

- Line 1 Audio & Line 2 Audio
- Line 3 Audio & Line 4 Audio

Both 4–wire circuits operate identically as follows:

Landline to Station 12kbps modem data is input to the primary of an audio transformer as balanced audio. The signal is induced into the transformer secondary and fed to a buffer (through jumper JU1010 placed in the 4–wire position, as shown at the bottom of page 8). [Note that jumper fields in parallel with both the primary and secondary coils provide for selectable impedance matching. For *SECURENET* systems, place both jumpers in position 1, as shown in the illustration at the bottom of page 8.]

The buffer output is fed through a 3–pole low–pass filter to a limiter, which converts the modem signal to a data signal. The output of the limiter is fed to the PASIC as serial data.

The PASIC sends the data to the microprocessor as 8–bit parallel data over the data bus.The microprocessor sends the data to the microprocessor in the Station Control Module over an interprocessor communications bus (HDLC protocol).

Station to Landline 12kbps modem data is input to the microprocessor from the Station Control Module microprocessor via the interprocessor communications bus (HDLC protocol). The microprocessor feeds the data to the PASIC as 8–bit parallel data over the data bus.

The PASIC outputs the data serially through a 3–pole low–pass filter to the gain adjust circuitry. Under control of the PASIC, the gain control circuitry provides four levels of gain adjust (0dB, –6dB, –12dB, and –18dB).

The output of the gain adjust circuitry is fed to the inputs of two amplifiers. The outputs of the amplifiers are fed to two transistors which are connected in a push–pull configuration to drive the primary of an audio transformer. The modem data signal is induced into the secondary and output to the landline system (via either the 50–pin Telco connector or screw terminal connector) as balanced audio.

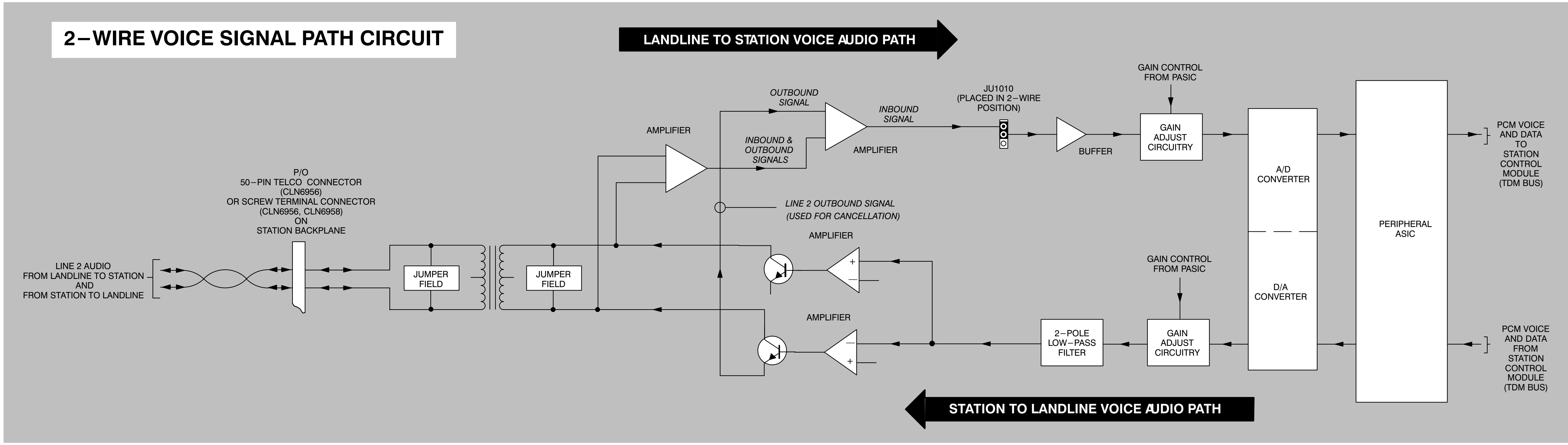


Figure 3. 2–Wire Voice Audio Path Functional Block Diagram

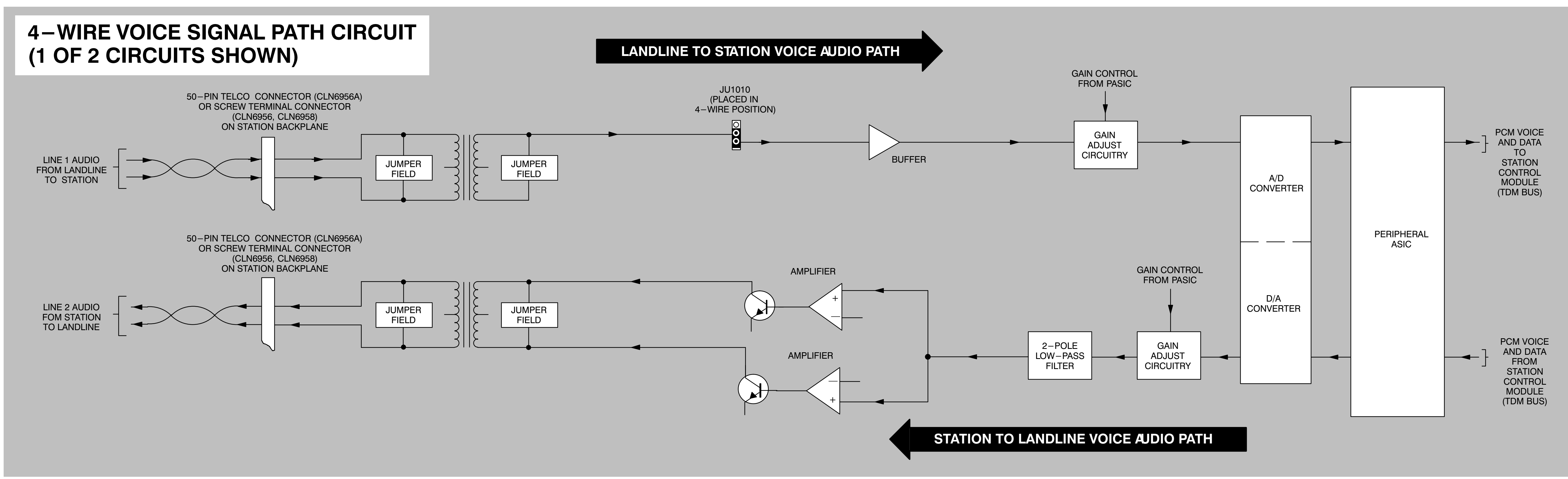


Figure 4. 4–Wire Voice Audio Path Functional Block Diagram

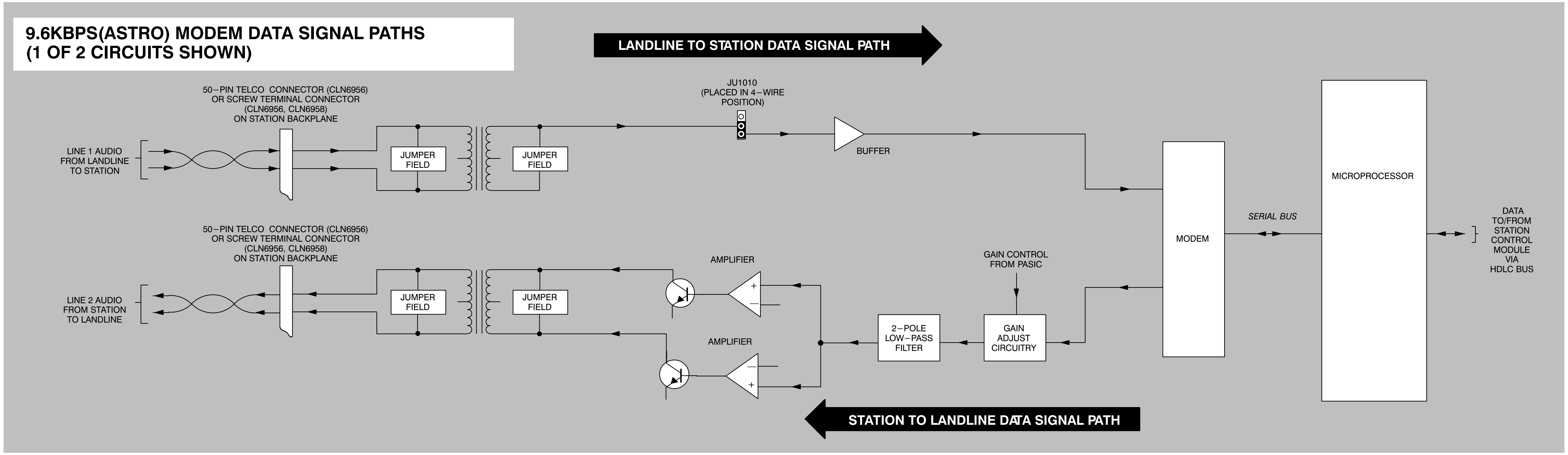


Figure 5. 9.6kbps (ASTRO) Modem Data Signal Path Functional Block Diagram

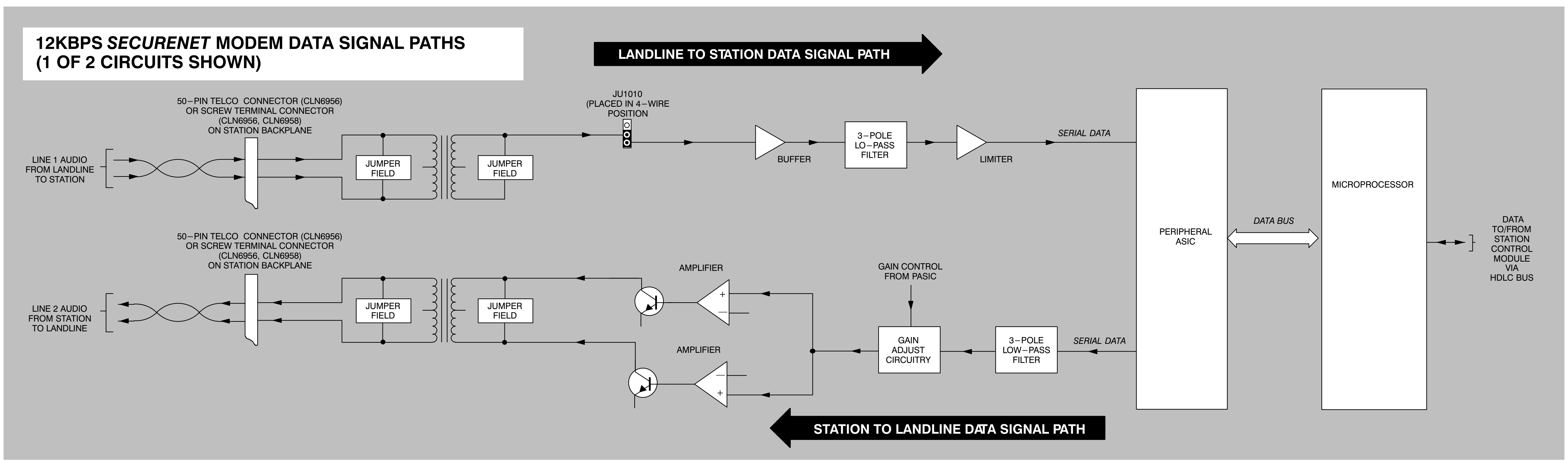


Figure 6. 12kbps *SECURENET* Modem Data Signal Path Functional Block Diagram

MOTOROLA

POWER SUPPLY MODULE

INCLUDES MODELS:
CPN1049A (265W w/o Battery Charger; AC Input)
CPN1050B (265W with Battery Charger; AC Input)

1 DESCRIPTION

The Models CPN1049A/CPN1050B Power Supply Modules are described in this section. A general description, performance specifications, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Models CPN1049A/CPN1050B Power Supply Modules each accept an ac input (90−264 V ac, 47−63 Hz) and generate +14.2V dc and +5.1V dc operating voltages to power the station modules. Each power supply module is comprised of three circuit boards which provide several switching-type power supply circuits, power factor correction circuitry, battery charger/revert circuitry (CPN1050B only), and diagnostics and monitoring circuitry, all contained within a slide-in module housing.

The power supply module provides the following features:

- **Auto-ranging for input voltage and frequency** — circuitry automatically adjusts for input ranges of 90−264 V ac and 47−63 Hz; no jumpers, switches, or other settings are required
- **Input transient and EMI protection** — MOV, gas discharge, and filter devices protect the power supply circuitry from ac line voltage transients and electro-magnetic interference
- **Internal voltage and current limiting** — circuitry continually monitors critical voltages and currents and shuts supply down if preset thresholds are exceeded
- **Temperature protection** — module contains built-in cooling fan; supply shuts down if temperature exceeds preset threshold
- **Diagnostic monitoring** — critical internal parameters are continually monitored and reported to the Station Control Module, which can automatically provide correction for certain operating conditions

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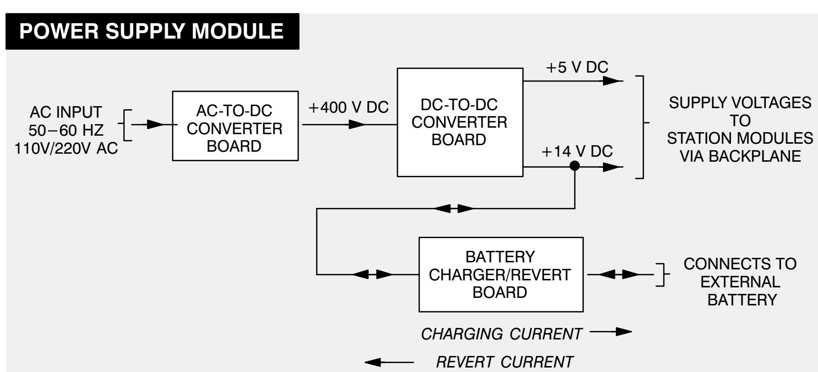
General Description (continued)

- **Fan Failure Protection** — Power Supply enters shutdown mode in event of cooling fan failure
- **Battery Reverse Polarity Protection** — Charger circuitry is protected against connecting the external battery in reverse polarity (CPN1050 only)
- **Auto Switchover to/from Battery** — If AC input fails, station is automatically switched over to battery operation; when AC input is restored, station is automatically switched back to power supply operation (CPN1050 only)
- **Auto Recovery from Shutdown** — Power Supply automatically recovers from shutdown mode if the cause of the shutdown no longer exists
- **Software-Controlled Battery Charging Voltage** — The battery charging voltage and current is controlled based on the ambient temperature (CPN1050 only)
- **Limited In-Rush Current** — Circuitry limits in-rush current to less than 30 A in all conditions

The Models CPN1049A and CPN1050B differ only in the inclusion of battery charger/revert board (CPN1050B only). Unless otherwise noted, the information provided in this section applies to both models.

Power Supply Module Simplified Block Diagram

The illustration below provides a simplified block diagram of a Power Supply Module (with battery charger) showing how the three circuit boards interconnect. A detailed block diagram and functional theory of operation for each board is provided later in this section (beginning on page 8).



Overview of Circuitry

The power supply module is comprised of three circuit boards, connected together via cables. These boards contain circuitry as follows:

AC-to-DC Converter Board (CPN6065B)

- **Input Conditioning Circuitry** — consists of ac line transient protection, EMI filtering, front panel on/off switch, startup-delayed relay, and a full-wave rectifier.
- **Startup Delay Circuitry** — provides a delay of approximately 1.5 seconds from time on/off switch is turned on until the power supply becomes functional (allows pre-charge of high-capacity filter capacitors to limit in-rush current on power up).
- **Boost/Power Factor Correction Circuitry** — consists of switching-type power supply that generates +400V dc for use by DC-to-DC Converter Board, as well as providing power factor correction.
- **Battery Revert Trigger Circuitry** — Monitors +400 V dc and generates a signal to the Battery Charger/Revert Board to activate battery revert if the +400 V dc fails or drops below approximately +350 V dc.
- **VCC Supply Circuitry** — consists of switching-type power supply that generates the VCC supply voltage (approximately +13V dc) for use by circuitry on AC-to-DC Converter Board and DC-to-DC Converter Board.

DC-to-DC Converter Board (CPN6079B)

- **+14 V Supply Circuitry** — consists of switching-type power supply that generates the +14 V dc supply voltage and provides primary/secondary isolation.
- **+5 V Supply Circuitry** — consists of switching-type power supply that generates the +5 V dc supply voltage (from +14 V dc supply voltage).
- **Battery Charger Control Circuitry** — Provides buffering for signals related to battery charging/revert operation.
- **Reference Voltage Circuitry** — Generates +10V_SEC and +2.5V_SEC supply voltages for use by local circuitry.
- **Diagnostics Circuitry** — converts analog status signals to digital format for transfer to Station Control Module.
- **Address Decode Circuitry** — performs address decoding to provide chip select signal for the A/D converter.
- **Startup/Shutdown Control Circuitry** — Provides delay intervals for startup and shutdown of entire power supply module.

— continued on next page —

Overview of Circuitry (Continued)

Battery Charger/Revert Board (CPN6074A)

- **Charger Supply Circuitry** — consists of switching-type power supply that generates charging current for the external storage battery.
- **Pulse Width Modulator Circuitry** — consists of pulse-width modulator, boost switch timer, and driver circuitry to provide variable-width pulses for the FET switches in the Charger Supply Circuitry.
- **Battery Revert Circuitry** — consists of signal monitoring circuitry which turns on the Battery Revert FET Switches for certain input signal conditions (such as AC Fail).
- **Current Mode Controller Circuitry** — consists of current and voltage feedback signal monitoring circuitry which controls the Pulse Width Modulator Circuitry to maintain the desired charger output current and voltage.
- **SPI Bus Interface Circuitry** — consists of a D/A converter which accepts charger control digital signals from the Station Control Module and converts these signals to analog dc voltages to control various operating characteristics of the battery charger circuitry.
- **Shutdown Circuitry** — consists of signal monitoring circuitry which shuts down the battery charger for certain input signal conditions (such as loss of BATT_WATCHDOG signal from the Station Control Module).
- **Local Supplies Circuitry** — Accepts +14V_RAW (from DC-to-DC Converter Board) and generates VCC (+10V) and +5V supply voltages for use by local circuitry.

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2 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the Models CPN1049A and CPN1050B Power Supply Modules.

Performance Specifications

Table 1. CPN1049A/CPN1050B Power Supply Modules Performance Specifications

Parameter	Specification
Weight	6.5 kg (14.3 lbs)
Operating Temperature Range	−30 to +60° C (no derating)
Input Voltage Range	90 to 264 V ac
Input Frequency Range	47 to 63 Hz
Maximum Input Current	8.5 A
Steady State Output Voltages	+14.2 V dc ±5% +5.0 V dc ±5%
Output Current Ratings	+14.2 12.5 A +5.1 9 A
Total Output Power Rating	265W* * *including 100W for battery charger*
Output Ripple	All outputs 150 mV p−p (measured with 20 MHz BW oscilloscope at 25°C).

3 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the power supply module controls, indicators, and all input and output external connections.

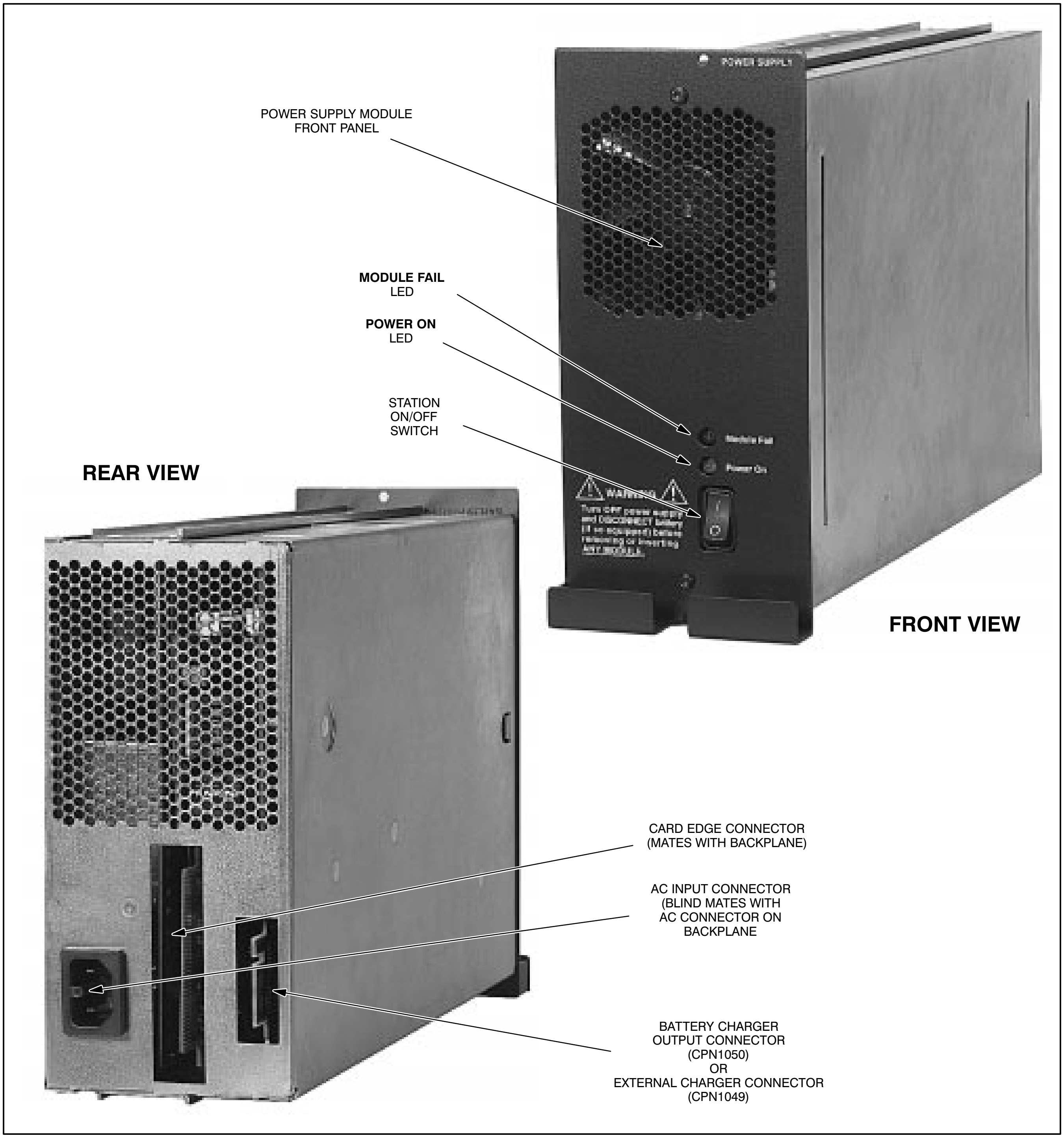

Figure 1. CPN1049A/CPN1050B Power Supply Module Controls, Indicators, and Inputs/Outputs

4 FUNCTIONAL THEORY OF OPERATION (AC-to-DC Converter Board)

The following theory of operation describes the operation of the CPN6065B AC-to-DC Converter Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the AC-to-DC Converter Board.

Input Conditioning Circuitry

Introduction

The AC-to-DC Converter Board accepts ac power from an external source, typically a 110V or 220/240V ac wall receptacle. AC power is connected to the board via a 3-wire line cord plugged into an ac receptacle mounted on the station backplane, into which the entire power supply module slides (blind mate connection).

Transient and EMI Protection

The ac line input is fed to the AC-to-DC Converter Board circuitry via transient protection and EMI filter circuits. The transient protection devices provide protection against voltage spikes by providing an effective short to ground under high voltage transient conditions. The EMI filter prevents electrical noise generated by the power supply module from interfering with other equipment connected to the same ac line circuit.

Front Panel On–Off Switch / Relay Circuitry

A rocker-type switch located on the power supply module front panel allows the power supply (and station) to be turned on and off. Note that the switch allows the filter circuitry (p/o Boost/Power Factor Correction Circuitry) to slowly charge (for approximately 1.5 seconds after switch is turned on) through two diodes and resistors. After the 1.5 second delay, the relay turns on and provides an ac input to the bridge rectifier. This 1.5 second pre-charge delay period limits in-rush current through the filter capacitors upon power up.

Rectifier Circuitry

The ac line voltage (via the relay) is rectified by a full-wave bridge rectifier and fed to the Boost/Power Factor Correction Circuitry.

Startup Delay Circuitry

This circuitry monitors the ac input (from the on/off switch) and provides a 1.5 second delay when switch is turn on before energizing the relay to turn on the power supply.

If the AC input is below approximately 85 V rms, the relay will not be turned on and the power supply outputs will be disabled. The red **Module Fail** LED on the front panel will light.

Boost/Power Factor Correction Circuitry

Overview

The Boost/Power Factor Correction Circuitry is comprised of a switching-type power supply which generates a +400 V dc voltage. This voltage is fed to the DC-to-DC Converter Board to be used as the source for the +14V and +5V Supply Circuits.

Switching Power Supply Operation

The switching power supply consists of a pulse width modulator (PWM) running at 67 kHz. The PWM output pulses are fed through driver transistors to control three power FETs which rapidly switch the Toroid Power Coil to ground. The result is a high induced current which charges the filter capacitors to approximately 400 V dc.

Note that the PWM output pulses are also controlled by voltage and current feedback signals. These feedback signals allow the average ac line current over switching cycles to be sinusoidal and in-phase with the ac input voltage (i.e., power factor corrected).

Battery Revert Trigger Circuitry

A comparator monitors the +400 V dc from the output of the Boost/ Power Factor Correction Circuitry and a +5V reference signal. If the +400 V dc voltage should drop below approximately +350 V dc (considered an ac input failure), a BOOST_LOW signal is sent to the Battery Charger/Revert Board (via the DC-to-DC Converter Board) to activate battery revert mode.

VCC Supply Circuitry

This circuitry consists of a switching-type power supply which generates a +13 V dc supply voltage used as VCC by the local circuitry and the primary side of the DC-to-DC Converter Board.

The circuitry consists of a pulse width modulator (PWM) running at 67 kHz (from DC-to-DC Converter Board). The PWM output repetitively gates the +400 V dc (from the Boost/Power Factor Correction Circuitry) to the primary of the housekeeping transformer. The result is an induced voltage in the secondary winding which feeds a half-wave rectifier circuit. The output is a +13 V dc VCC supply voltage.

LED Status Indicators

Two LEDs located on the power supply module front panel indicate module status as follows:

- **AC On—** lights GREEN when On/Off switch is On and the AC input voltage is within operating range; LED turns off when module is turned off, ac power is removed, or AC input voltage is below approximately 85 V rms.
- **Module Fail—** lights RED when initially turning on or off the Power Supply (this is normal and does not indicate a failure) or when the DC-to-DC Converter Board is not functioning properly; LED turns off when module is functioning properly

Note *When in Battery Revert Mode (CPN1050 only), neither LED is lit. The cooling fan will continue to run.*

5 FUNCTIONAL THEORY OF OPERATION (DC-to-DC Converter Board)

The following theory of operation describes the operation of the CPN6079B DC-to-DC Converter Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 3 for a block diagram of the DC-to-DC Converter Board.

+14V Main Supply Circuitry

Overview

The +14V Main Supply Circuitry is comprised of two mirrored switching-type power supplies which generate the +14 V supply voltage. This voltage is used as the source for the +5V supply circuit, as well as the +14V supply voltage for the station modules (via the backplane) and

Switching Power Supply Operation

The +14V Main Supply Circuitry consists of two identical switching-type power supplies operating in parallel. Both supplies operate identically, as follows. A 133 kHz clock signal from the Sync Generator Circuitry is fed through a buffer to a Pulse Width Modulator (PWM). The PWM output pulses control a pair of power FETS (via a driver) to gate the +400 V dc (from the AC-to-DC Converter Board) to the primary of a power transformer. The induced voltage in the transformer secondary is half-wave rectified to charge the output filter circuitry, resulting in an output voltage of +14 V dc.

Since each supply receives a 133 kHz clock signal that is 180° out of phase with the other, each switching power supply alternately charges the output filter circuitry, resulting in an effective charging rate of 266 kHz.

Protection Circuitry

Peak/Average Current Limiting Circuitry — The peak current limiting circuitry accepts an output current feedback signal and a scaled +14V_RAW reference signal to control the PWMs. This effectively maintains a constant output voltage for varying output current demands.
The average current limiting circuitry monitors the +14 V dc output and generates a shutdown signal (MAIN_SD_PRI) if the average output current reaches a predetermined limit.

Overvoltage Protection Circuitry — This circuitry monitors the +14V output voltage and generates a shutdown signal (MAIN_SD_SEC) to shut down the entire power supply module if the +14 V output voltage exceeds a preset threshold.

+5 V Supply Circuitry

Overview

The +5 V Supply Circuitry is comprised of a switching-type power supply which generates a +5 V dc supply voltage. This voltage is used as the +5 V supply voltage for the station modules (via the backplane).

Switching Power Supply Operation

The +5 V switching power supply consists of a pulse width modulator (PWM) running at 133 kHz. The PWM output pulses are fed through a driver to control a power FET which repetitively gates the +14V_RAW (from the +14V Main Supply Circuitry) to a power coil. The result is a high induced voltage which charges the filter capacitors to approximately +5 V dc. A current sense comparator provides a feedback signal to the PWM to maintain a constant output voltage.

Protection Circuitry

An overvoltage detect circuit monitors the output voltage and, if preset thresholds are exceeded, turns on a FET crowbar circuit which immediately discharges the output to protect other modules in the station.

An overcurrent detect circuit monitors the current draw from the +5V Supply Circuitry and, if a preset threshold is exceeded, generates a MAIN_SD_SEC signal which shuts down the entire power supply module.

Battery Charger Control Circuitry

The AC_FAIL signal (from the AC-to-DC Converter Board) is buffered and fed to 1) the diagnostics circuitry as AC_GOOD_DIAG, and 2) the Battery Charger/Revert Board as BATTERY_REVERT. This signal activates battery revert mode.

Reference Voltage Circuitry

This circuitry accepts +14V_RAW (from the +14V Main Supply Circuitry) and generates +10V_SEC and +2.5V_SEC supply voltages for use by local circuitry.

Diagnostics Circuitry

Overview

The diagnostics circuitry consists of an 11-channel A/D converter which converts analog status signals from critical points in the power supply module to digital format for transfer to the Station Control Module via the SPI bus. Most of the status signals are generated by detect circuits to indicate the status of dc supply voltages and references.

Temperature Monitor and Control Circuitry

A thermistor mounted on the power supply module heatsink provides a varying resistance input to the Heatsink Temp Detect Circuitry. If the heatsink temperature exceeds a preset limit, the circuitry generates a MAIN_SD_SEC shutdown signal which shuts down the entire power supply module. A HEATSINK_DIAG signal is also sent to the Station Control Module via the A/D converter and SPI bus.

Fan Monitor and Control Circuitry

The cooling fan in the power supply module is powered from the +14V Supply Circuitry and runs continuously. If the fan fails, the Fan Fault Detect circuit generates a fail signal (FAN_FAIL_DIAG) which is fed to the A/D converter. The fail signal also triggers a 50 second delay circuit which (after 50 seconds) generates a MAIN_SD_SEC signal which shuts down the entire power supply.

Address Decode Circuitry

The address decode circuitry allows the Station Control Module to use the address bus to select either the D/A converter (Battery Charger/Revert Board) or the A/D converter (Diagnostics Circuitry) for communications via the SPI bus. Typical communications include reading status signals from the Diagnostics Circuitry and providing charger output control signals to the Battery Charger/Revert Board.

Startup/Shutdown Control Circuitry

Shutdown Delay Circuitry

Upon receiving a shutdown signal (MAIN_SD_PRI) from the +14V Main Supply Circuitry, this circuit passes the signal through the Soft Start Circuitry for a 1 second interval to allow the entire power supply module to shutdown. The module then restarts (if the on/off switch is in **On** position). If the MAIN_SD_PRI signal is still active, the shutdown process will repeat.

Startup/Shutdown Delay Circuitry

When the power supply module is first turned on, the RELAY_ON signal is low and the output of the Startup/Shutdown Delay Circuitry keeps the supply in shutdown mode. After about 1.5 seconds RELAY_ON goes high, and the Startup/Shutdown Delay Circuitry provides a 1 second delay before releasing the shutdown signal and allowing the power supply to operate.

When the power supply module is turned off, the RELAY_ON signal goes low and the Startup/Shutdown Delay Circuitry keeps the supply in operating mode for 1 second to allow Battery Revert Mode to activate.

Soft Start Circuitry

Each time the Soft Start Circuitry receives a startup signal (i.e., MAIN_SD_PRI is inactive and the output of the Startup/Shutdown Delay Circuitry is high), the Soft Start Circuitry provides a gradually increasing output signal to “soft start” the Pulse Width Modulators (p/o +14V Main Supply Circuitry). This action minimizes the surge current when charging the output filter capacitors.

6 FUNCTIONAL THEORY OF OPERATION (Battery Charger/Revert Board)

The following theory of operation describes the operation of the CPN6074A Battery Charger/Revert Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 4 for a block diagram of the Battery Charger/Revert Board.

Note *Model CPN1049A Power Supply Modules (without battery charging capabilities) are equipped with a CPN6078A External Charger Connect Board in place of the CPN6074A Battery Charger/Revert Board. The External Charger Connect Board provides a direct electrical path from the +14V Main Supply Circuitry (p/o the DC-to-DC Converter Board) to the card edge connector used to connect to an external charger and battery. The external charger is responsible for 1) charging the external battery and 2) detecting an AC power fail condition and initiating battery revert mode.*

Charger Supply Circuitry

Overview

The Charger Supply Circuitry is comprised of a switching-type power supply which generates the charging current necessary to charge an external storage battery.

Switching Power Supply Operation

The charger switching power supply accepts +14V (from the DC-to-DC Converter Board) which is fed through a filter and a Buck FET Switch to a Power Coil. This coil is controlled by the Buck FET Switch and a Boost FET Switch to produce an induced output voltage of approximately +12 to +16 V dc. This charging voltage is filtered and fed through a pair of Reverse Battery FET Switches to the output terminals (card edge connector that extends from the rear of the Power Supply Module). Connections to an external storage battery are made to this card edge connector.

Protection against connecting the battery in reverse polarity is provided by the Charger Output Control Circuitry and the Reverse Battery FET Switches.

A thermistor mounted near the battery and connected to the station via a backplane connector provides an input to a comparator. The comparator output (BATT_T_DIAG) provides a dc voltage proportional to the battery temperature. This signal is sent to the Station Control Module via the Diagnostics Circuitry on the DC-to-DC Converter Board.

Pulse Width Modulator Circuitry

A 133 kHz clock signal (from the DC-to-DC Converter Board) is fed through a buffer/driver to a Pulse Width Modulator (PWM). The 133 kHz PWM output pulses are fed 1) directly to the Buck FET Switch via a driver, and 2) to the Boost FET Switch via a Boost Switch Timer and Driver. The two signals control the respective FET switches to control the Power Coil in the Charger Supply Circuitry so that it produces an approximately +12 to +16 V dc output to be filtered and charge the external battery.

Battery Revert Circuitry

Overview

The Battery Revert Circuitry accepts various inputs and determines when to activate battery revert mode by turning on the Battery Revert FET Switches. Battery Revert Mode will be activated or deactivated in the following conditions:

- If the AC_FAIL signal (from the DC-to-DC Converter Board) goes low (indicating that AC power has failed), the Battery Revert FET Switches will be turned on (via the FET Driver).
- If the battery voltage is too low, the Undervoltage Detect circuit detects the condition and disables the battery revert circuitry.
- If the battery voltage is too high, the Overvoltage Detect circuit detects the condition and disables the battery charger and the battery revert circuitry.
- If a fault condition exists (e.g., +5V Overcurrent), the shutdown detect circuitry detects the condition and disables the battery charger and the battery revert circuitry.

Current Mode Controller Circuitry

Overview

The Current Mode Controller Circuitry performs two major functions:

- The PWR_CUT signal (from the DC-to-DC Converter Board) is fed through a Voltage Scaling Circuit and reduces the battery charger output current during periods of heavy current draw by the station.
- The Voltage Scaling Circuitry accepts V_BC_RAW (voltage feedback signal from battery) and BATT_VOLT_RANGE and BATT_VOLT_SELECT signals (from the Station Control Module via the D/A Converter) which combine to set the charger output voltage (in a range of +12 V dc to +16 V dc).

SPI Bus Interface Circuitry

This circuitry consists of a D/A Converter that accepts digital signals from the Station Control Module and converts them to analog signals which control the operation of the Battery Charger/Revert Board. These signals:

- Control the charger voltage to the battery (BATT_VOLT_RANGE and BATT_VOLT_SELECT)
- Disable the Undervoltage Detect Circuitry (UVLO_DISABLE) to allow the station to continue operation even though the battery voltage is below the desired level
- Provide a watchdog signal to refresh the Watchdog Timer Circuitry (BATT_WATCHDOG)

Shutdown Circuitry

This circuitry accepts four input signals and generates a shutdown signal to shut down the battery charger for certain input signal conditions, A shutdown signal will be generated for any of the following conditions:

- The BATT_WATCHDOG signal (from the Station Control Module) is not present (indicating that the Station Control Module has failed, or the station's *Battery Type* field has been programmed (via RSS) for “NONE”
- The OVLO_LCKOUT signal is high (indicating that the battery voltage is too high)
- The MAIN_SD_SEC signal is low (indicating that one of the various monitoring points indicates a fault, such as overcurrent condition for +14V or +5 V supplies, overcurrent condition for entire Power Supply Module, etc.
- The AC_FAIL signal is high (indicating that the AC power to the Power Supply Module has been interrupted)

Local Supplies Circuitry

This circuitry contains two voltage regulators which accept +14V_RAW (from the +14V Main Supply Circuitry) and generate VCC (+10 V dc) and +5 V supply voltages for use by local circuitry.

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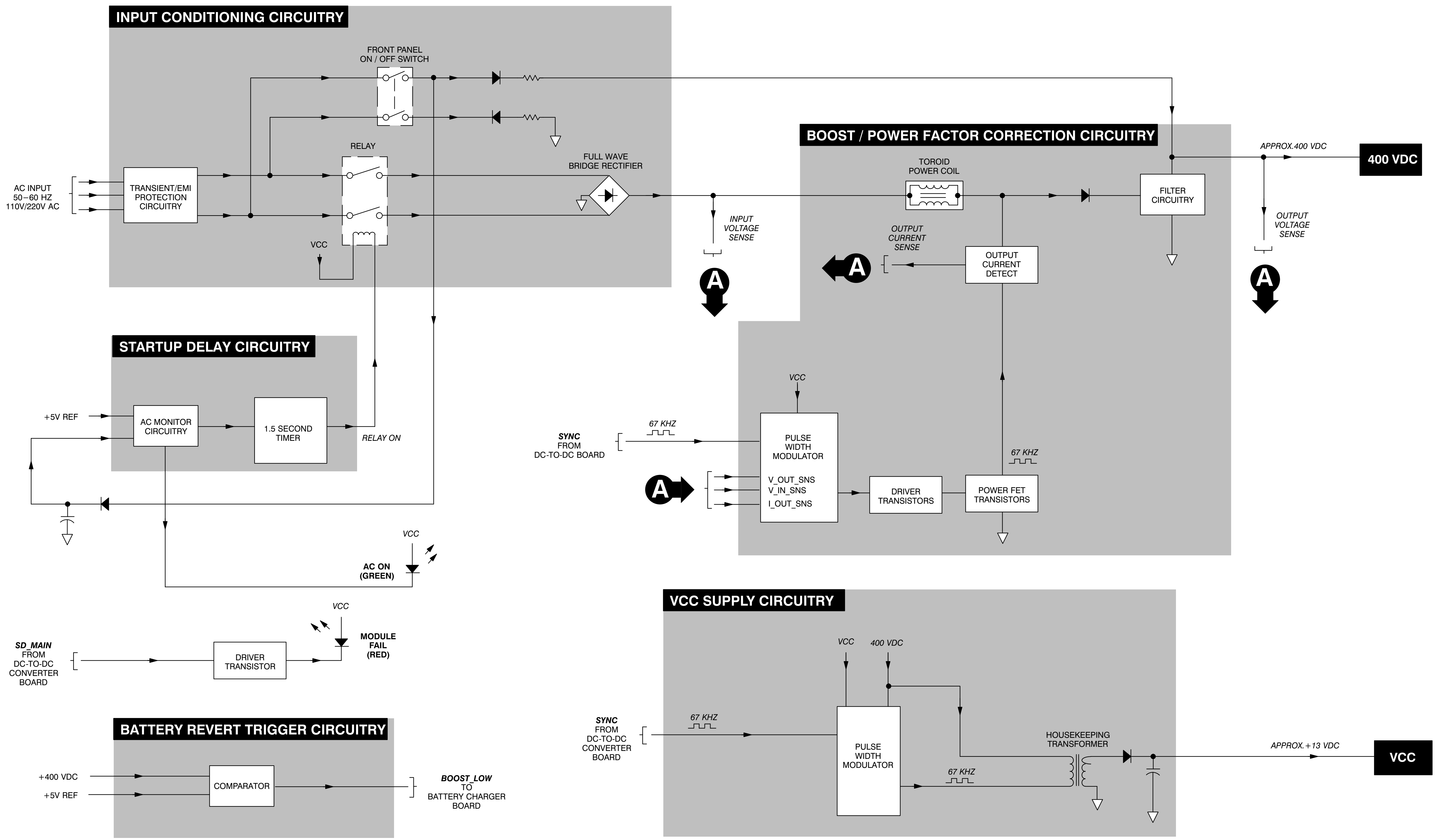

Figure 2. CPN6065B AC-to-DC Converter Board Functional Block Diagram

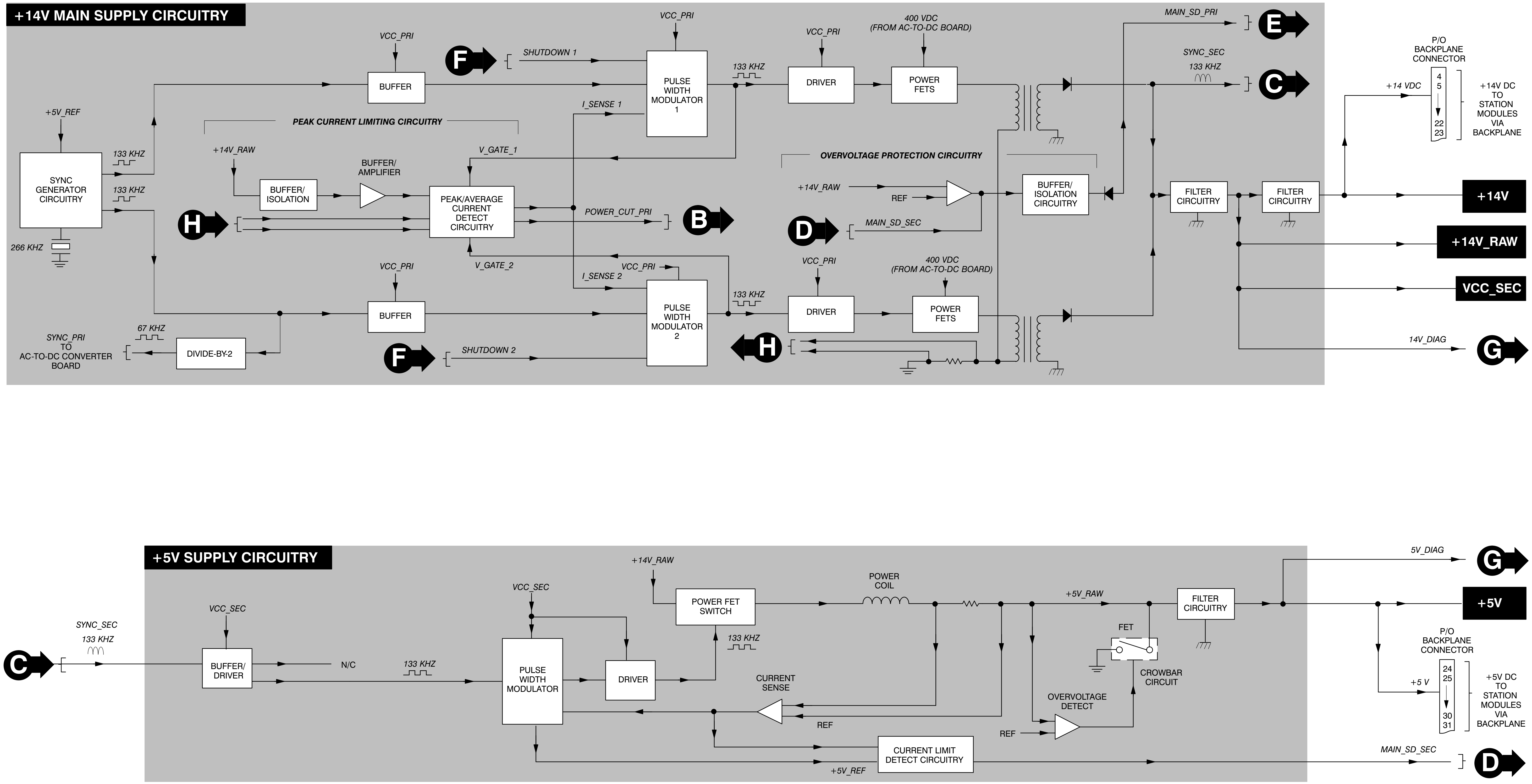

Figure 3. CPN6079B DC-to-DC Converter Board Functional Block Diagram (1 of 2)

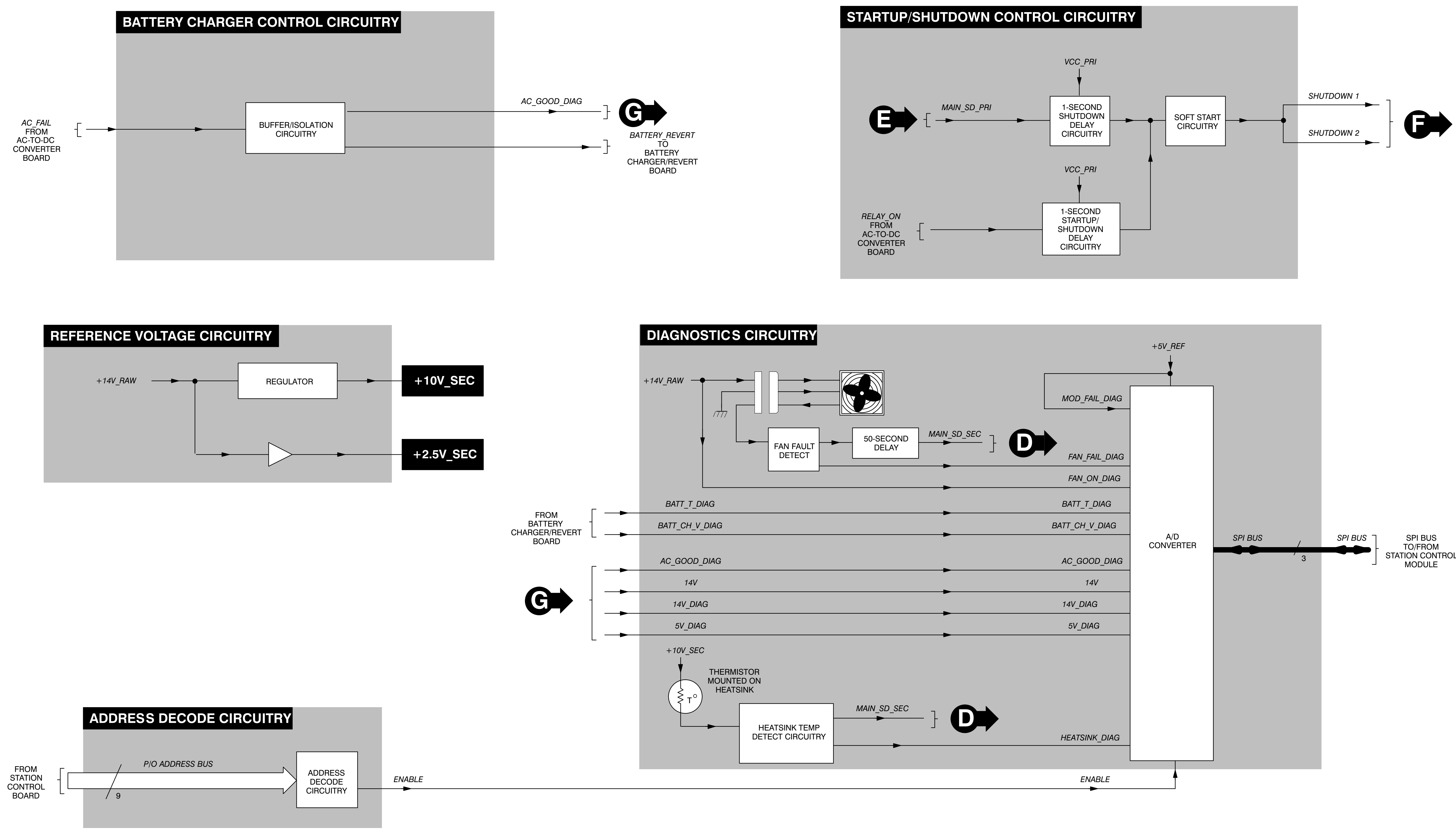

Figure 3. CPN6079B DC-to-DC Converter Board Functional Block Diagram (2 of 2)

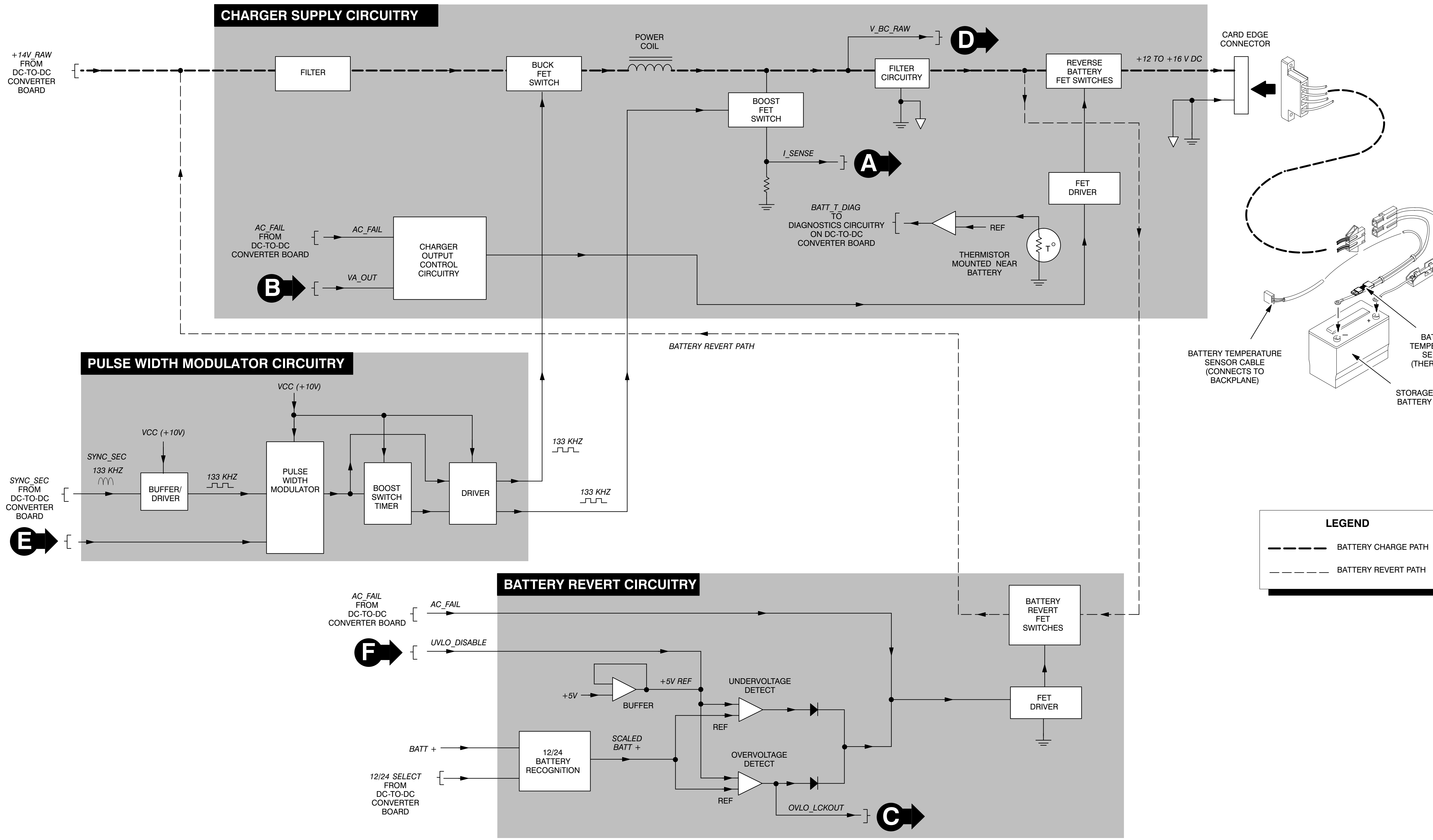

Figure 4. CPN6074A Battery Charger/Revert Board Functional Block Diagram (1 of 2)

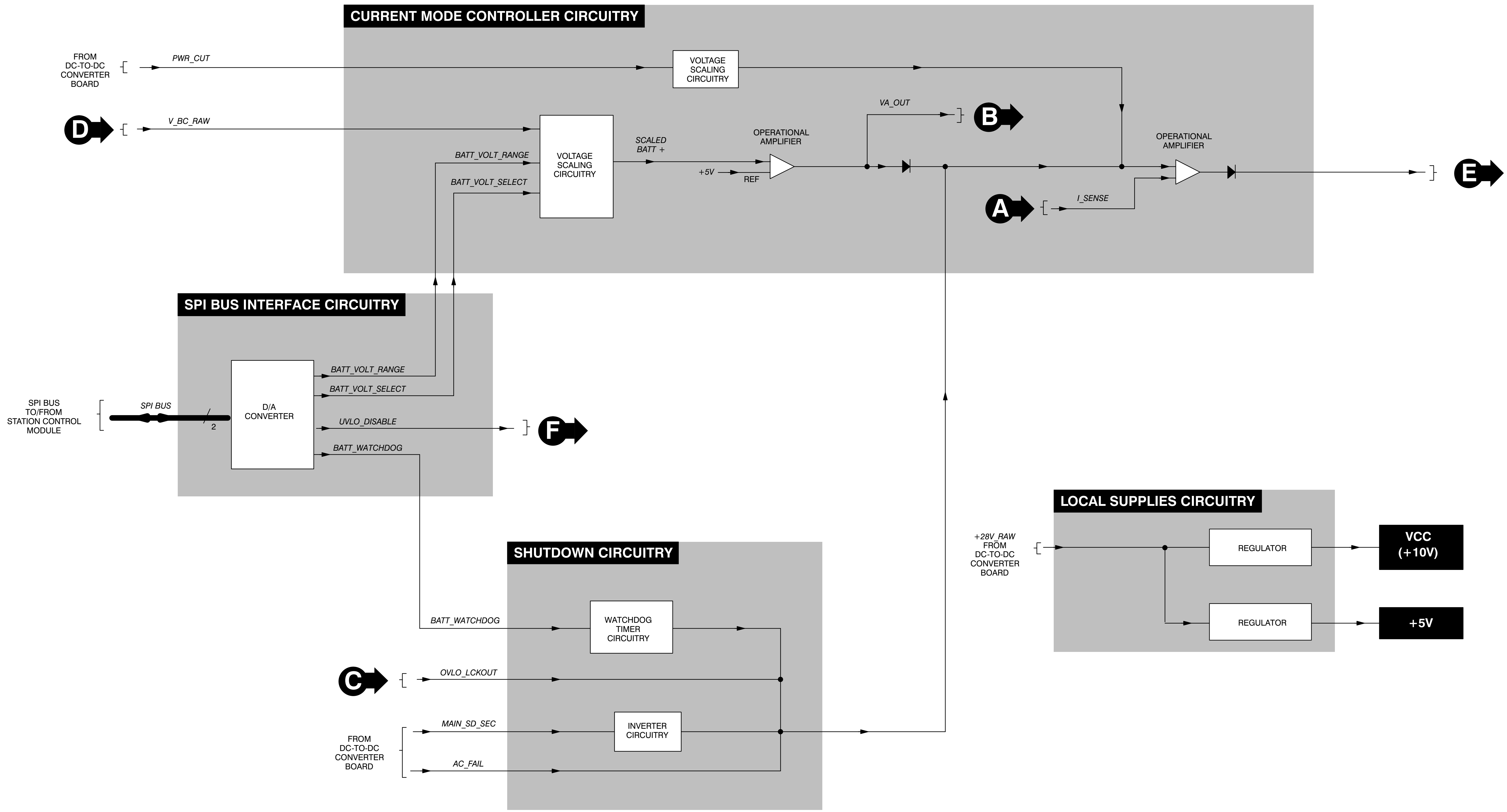

Figure 4. CPN6074A Battery Charger/Revert Board Functional Block Diagram (2 of 2)

POWER SUPPLY MODULE

INCLUDES MODELS:
CPN1047A (625W w/o Battery Charger; AC Input)
CPN1048A (625W with Battery Charger; AC Input)

1 DESCRIPTION

The Models CPN1047A/CPN1048A Power Supply Modules are described in this section. A general description, performance specifications, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Models CPN1047A/CPN1048A Power Supply Modules each accept an ac input (90−264 V ac, 47−63 Hz) and generate +28.6V dc, +14.2V dc, and +5.1V dc operating voltages to power the station modules. Each power supply module is comprised of three circuit boards which provide several switching-type power supply circuits, power factor correction circuitry, battery charger/revert circuitry (CPN1048A only), and diagnostics and monitoring circuitry, all contained within a slide-in module housing.

The power supply module provides the following features:

- **Auto-ranging for input voltage and frequency** — circuitry automatically adjusts for input ranges of 90−264 V ac and 47−63 Hz; no jumpers, switches, or other settings are required
- **Input transient and EMI protection** — MOV, gas discharge, and filter devices protect the power supply circuitry from ac line voltage transients and electro-magnetic interference
- **Internal voltage and current limiting** — circuitry continually monitors critical voltages and currents and shuts supply down if preset thresholds are exceeded
- **Temperature protection** — module contains built-in cooling fan; supply shuts down if temperature exceeds preset threshold
- **Diagnostic monitoring** — critical internal parameters are continually monitored and reported to the Station Control Module, which can automatically provide correction for certain operating conditions

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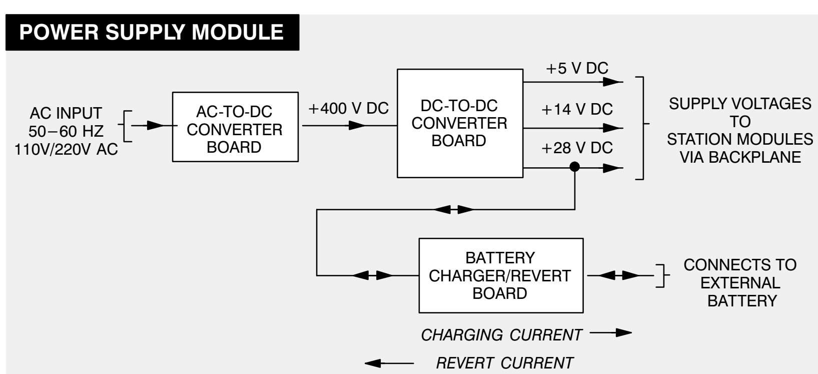
General Description (continued)

- **Fan Failure Protection** — Power Supply enters shutdown mode in event of cooling fan failure
- **Battery Reverse Polarity Protection** — Charger circuitry is protected against connecting the external battery in reverse polarity (CPN1048 only)
- **Auto Switchover to/from Battery** — If AC input fails, station is automatically switched over to battery operation; when AC input is restored, station is automatically switched back to power supply operation (CPN1048 only)
- **Auto Recovery from Shutdown** — Power Supply automatically recovers from shutdown mode if the cause of the shutdown no longer exists
- **Software-Controlled Battery Charging Voltage** — The battery charging voltage and current is controlled based on the ambient temperature (CPN1048 only)
- **Limited In-Rush Current** — Circuitry limits in-rush current to less than 30 A in all conditions

The Models CPN1047A and CPN1048A differ only in the inclusion of battery charger/revert board (CPN1048A only). Unless otherwise noted, the information provided in this section applies to both models.

Power Supply Module Simplified Block Diagram

The illustration below provides a simplified block diagram of a Power Supply Module (with battery charger) showing how the three circuit boards interconnect. A detailed block diagram and functional theory of operation for each board is provided later in this section (beginning on page 8).



Overview of Circuitry

The power supply module is comprised of three circuit boards, connected together via cables. These boards contain circuitry as follows:

AC-to-DC Converter Board (CPN6065B)

- **Input Conditioning Circuitry** — consists of ac line transient protection, EMI filtering, front panel on/off switch, startup-delayed relay, and a full-wave rectifier.
- **Startup Delay Circuitry** — provides a delay of approximately 1.5 seconds from time on/off switch is turned on until the power supply becomes functional (allows pre-charge of high-capacity filter capacitors to limit in-rush current on power up).
- **Boost/Power Factor Correction Circuitry** — consists of switching-type power supply that generates +400V dc for use by DC-to-DC Converter Board, as well as providing power factor correction.
- **Battery Revert Trigger Circuitry** — Monitors +400 V dc and generates a signal to the Battery Charger/Revert Board to activate battery revert if the +400 V dc fails or drops below approximately +350 V dc.
- **VCC Supply Circuitry** — consists of switching-type power supply that generates the VCC supply voltage (approximately +13V dc) for use by circuitry on AC-to-DC Converter Board and DC-to-DC Converter Board.

DC-to-DC Converter Board (CPN6067A)

- **+28 V Main Supply Circuitry** — consists of switching-type power supply that generates the +28 V dc supply voltage and provides primary/secondary isolation.
- **+14 V Supply Circuitry** — consists of switching-type power supply that generates the +14 V dc supply voltage (from +28 V dc supply voltage).
- **+5 V Supply Circuitry** — consists of switching-type power supply that generates the +5 V dc supply voltage (from +28 V dc supply voltage).
- **Battery Charger Control Circuitry** — Provides buffering for signals related to battery charging/revert operation.
- **Reference Voltage Circuitry** — Generates +10V_SEC and +2.5V_SEC supply voltages for use by local circuitry.
- **Diagnostics Circuitry** — converts analog status signals to digital format for transfer to Station Control Module.
- **Address Decode Circuitry** — performs address decoding to provide chip select signal for the A/D converter.
- **Startup/Shutdown Control Circuitry** — Provides delay intervals for startup and shutdown of entire power supply module.

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Overview of Circuitry (Continued)

Battery Charger/Revert Board (CPN6074B)

- **Charger Supply Circuitry** — consists of switching-type power supply that generates charging current for the external storage battery.
- **Pulse Width Modulator Circuitry** — consists of pulse-width modulator, boost switch timer, and driver circuitry to provide variable-width pulses for the FET switches in the Charger Supply Circuitry.
- **Battery Revert Circuitry** — consists of signal monitoring circuitry which turns on the Battery Revert FET Switches for certain input signal conditions (such as AC Fail).
- **Current Mode Controller Circuitry** — consists of current and voltage feedback signal monitoring circuitry which controls the Pulse Width Modulator Circuitry to maintain the desired charger output current and voltage.
- **SPI Bus Interface Circuitry** — consists of a D/A converter which accepts charger control digital signals from the Station Control Module and converts these signals to analog dc voltages to control various operating characteristics of the battery charger circuitry.
- **Shutdown Circuitry** — consists of signal monitoring circuitry which shuts down the battery charger for certain input signal conditions (such as loss of BATT_WATCHDOG signal from the Station Control Module).
- **Local Supplies Circuitry** — Accepts +28V_RAW (from DC-to-DC Converter Board) and generates VCC (+10V) and +5V supply voltages for use by local circuitry.

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2 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the Models CPN1047A and CPN1048A Power Supply Modules.

Performance Specifications

Table 1. CPN1047A/CPN1048A Power Supply Modules Performance Specifications

Parameter	Specification
Weight	6.5 kg (14.3 lbs)
Operating Temperature Range	−30 to +60° C (no derating)
Input Voltage Range	90 to 264 V ac
Input Frequency Range	47 to 63 Hz
Maximum Input Current	8.5 A
Steady State Output Voltages	+28.6 V dc ±5% +14.2 V dc ±5% +5.0 V dc ±5%
Output Current Ratings	+28.6 12.5 A +14.2 8 A +5.1 3 A
Total Output Power Rating	625W* * *including 100W for battery charger*
Output Ripple	All outputs 150 mV p−p (measured with 20 MHz BW oscilloscope at 25°C).

3 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the power supply module controls, indicators, and all input and output external connections.

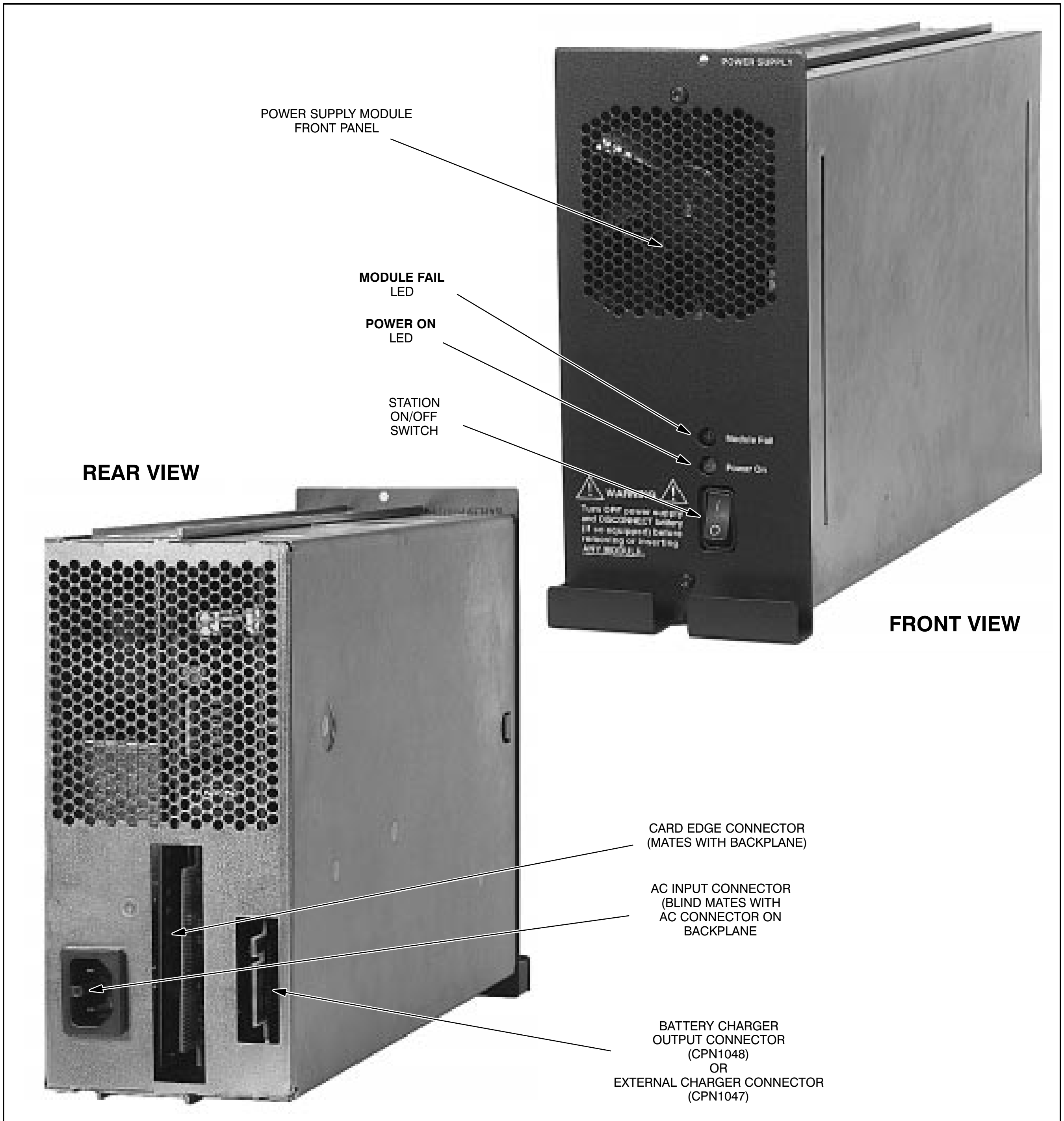

Figure 1. CPN1047A/CPN1048A Power Supply Module Controls, Indicators, and Inputs/Outputs

4 FUNCTIONAL THEORY OF OPERATION (AC-to-DC Converter Board)

The following theory of operation describes the operation of the CPN6065B AC-to-DC Converter Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the AC-to-DC Converter Board.

Input Conditioning Circuitry

Introduction

The AC-to-DC Converter Board accepts ac power from an external source, typically a 110V or 220/240V ac wall receptacle. AC power is connected to the board via a 3-wire line cord plugged into an ac receptacle mounted on the station backplane, into which the entire power supply module slides (blind mate connection).

Transient and EMI Protection

The ac line input is fed to the AC-to-DC Converter Board circuitry via transient protection and EMI filter circuits. The transient protection devices provide protection against voltage spikes by providing an effective short to ground under high voltage transient conditions. The EMI filter prevents electrical noise generated by the power supply module from interfering with other equipment connected to the same ac line circuit.

Front Panel On–Off Switch / Relay Circuitry

A rocker-type switch located on the power supply module front panel allows the power supply (and station) to be turned on and off. Note that the switch allows the filter circuitry (p/o Boost/Power Factor Correction Circuitry) to slowly charge (for approximately 1.5 seconds after switch is turned on) through two diodes and resistors. After the 1.5 second delay, the relay turns on and provides an ac input to the bridge rectifier. This 1.5 second pre-charge delay period limits in-rush current through the filter capacitors upon power up.

Rectifier Circuitry

The ac line voltage (via the relay) is rectified by a full-wave bridge rectifier and fed to the Boost/Power Factor Correction Circuitry.

Startup Delay Circuitry

This circuitry monitors the ac input (from the on/off switch) and provides a 1.5 second delay when switch is turn on before energizing the relay to turn on the power supply.

If the AC input is below approximately 85 V rms, the relay will not be turned on and the power supply outputs will be disabled. The red **Module Fail** LED on the front panel will light.

Boost/Power Factor Correction Circuitry

Overview

The Boost/Power Factor Correction Circuitry is comprised of a switching-type power supply which generates a +400 V dc voltage. This voltage is fed to the DC-to-DC Converter Board to be used as the source for the +28V, +14V, and +5V Supply Circuits.

Switching Power Supply Operation

The switching power supply consists of a pulse width modulator (PWM) running at 67 kHz. The PWM output pulses are fed through driver transistors to control three power FETs which rapidly switch the Toroid Power Coil to ground. The result is a high induced current which charges the filter capacitors to approximately 400 V dc.

Note that the PWM output pulses are also controlled by voltage and current feedback signals. These feedback signals allow the average ac line current over switching cycles to be sinusoidal and in-phase with the ac input voltage (i.e., power factor corrected).

Battery Revert Trigger Circuitry

A comparator monitors the +400 V dc from the output of the Boost/Power Factor Correction Circuitry and a +5V reference signal. If the +400 V dc voltage should drop below approximately +350 V dc (considered an ac input failure), a BOOST_LOW signal is sent to the Battery Charger/Revert Board (via the DC-to-DC Converter Board) to activate battery revert mode.

VCC Supply Circuitry

This circuitry consists of a switching-type power supply which generates a +13 V dc supply voltage used as VCC by the local circuitry and the primary side of the DC-to-DC Converter Board.

The circuitry consists of a pulse width modulator (PWM) running at 67 kHz (from DC-to-DC Converter Board). The PWM output repetitively gates the +400 V dc (from the Boost/Power Factor Correction Circuitry) to the primary of the housekeeping transformer. The result is an induced voltage in the secondary winding which feeds a half-wave rectifier circuit. The output is a +13 V dc VCC supply voltage.

LED Status Indicators

Two LEDs located on the power supply module front panel indicate module status as follows:

- **AC On—** lights GREEN when On/Off switch is On and the AC input voltage is within operating range; LED turns off when module is turned off, ac power is removed, or AC input voltage is below approximately 85 V rms.
- **Module Fail—** lights RED when initially turning on or off the Power Supply (this is normal and does not indicate a failure) or when the DC-to-DC Converter Board is not functioning properly; LED turns off when module is functioning properly

Note *When in Battery Revert Mode (CPN1048 only), neither LED is lit. The cooling fan will continue to run.*

5 FUNCTIONAL THEORY OF OPERATION (DC-to-DC Converter Board)

The following theory of operation describes the operation of the CPN6067A DC-to-DC Converter Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 3 for a block diagram of the DC-to-DC Converter Board.

+28V Main Supply Circuitry

Overview

The +28V Main Supply Circuitry is comprised of two mirrored switching-type power supplies which generate the +28 V supply voltage. This voltage is used as the source for the +14V and +5V supply circuits, as well as the +28V supply voltage for the station modules (via the backplane) and

Switching Power Supply Operation

The +28V Main Supply Circuitry consists of two identical switching-type power supplies operating in parallel. Both supplies operate identically, as follows. A 133 kHz clock signal from the Sync Generator Circuitry is fed through a buffer to a Pulse Width Modulator (PWM). The PWM output pulses control a pair of power FETS (via a driver) to gate the +400 V dc (from the AC-to-DC Converter Board) to the primary of a power transformer. The induced voltage in the transformer secondary is half-wave rectified to charge the output filter circuitry, resulting in an output voltage of +28 V dc.

Since each supply receives a 133 kHz clock signal that is 180° out of phase with the other, each switching power supply alternately charges the output filter circuitry, resulting in an effective charging rate of 266 kHz.

Protection Circuitry

Peak/Average Current Limiting Circuitry — The peak current limiting circuitry accepts an output current feedback signal and a scaled +28V_RAW reference signal to control the PWMs. This effectively maintains a constant output voltage for varying output current demands.
The average current limiting circuitry monitors the +28 V dc output and generates a shutdown signal (MAIN_SD_PRI) if the average output current reaches a predetermined limit.

Overvoltage Protection Circuitry — This circuitry monitors the +28V output voltage and generates a shutdown signal (MAIN_SD_SEC) to shut down the entire power supply module if the +28 V output voltage exceeds a preset threshold.

+14 V Supply Circuitry

Overview

The +14 V Supply Circuitry is comprised of a switching-type power supply which generates a +14.2 V dc supply voltage. This voltage is used as the +14.2 V supply voltage for the station modules (via the backplane).

Switching Power Supply Operation

The +14 V switching power supply consists of a pulse width modulator (PWM) running at 133 kHz. The PWM output pulses are fed through a driver to control a power FET which repetitively gates the +28V_RAW (from the +28V Main Supply Circuitry) to a power coil. The result is a high induced voltage which charges the filter capacitors to approximately +14.2 V dc. A current sense comparator provides a feedback signal to the PWM to maintain a constant output voltage.

Protection Circuitry

An overvoltage detect circuit monitors the output voltage and, if preset thresholds are exceeded, turns on a FET crowbar circuit which immediately discharges the output to protect other modules in the station.

An overcurrent detect circuit monitors the current draw from the +14V Supply Circuitry and, if a preset threshold is exceeded, generates a MAIN_SD_SEC signal which shuts down the entire power supply module.

+5 V Supply Circuitry

The +5 V Supply Circuitry operates identically to the +14 V Supply Circuitry (described above) to generate a +5.1 V dc supply voltage. This voltage is used as the +5 V supply voltage for the station modules (via the backplane).

Battery Charger Control Circuitry

The POWER_CUT_PRI signal (from the Peak/Average Current Detect Circuitry) is buffered and fed to the Battery Charger/Revert Board as POWER_CUT_SEC. This signal reduces the current supplied by the battery charger circuitry to divert maximum power to the power supply outputs (+28V, +14V, and +5V) during times of heavy current draw.

The AC_FAIL signal (from the AC-to-DC Converter Board) is buffered and fed to 1) the diagnostics circuitry as AC_GOOD_DIAG, and 2) the Battery Charger/Revert Board as BATTERY_REVERT. This signal activates battery revert mode.

Reference Voltage Circuitry

This circuitry accepts +28V_RAW (from the +28V Main Supply Circuitry) and generates +10V_SEC and +2.5V_SEC supply voltages for use by local circuitry.

Diagnostics Circuitry

Overview

The diagnostics circuitry consists of an 11-channel A/D converter which converts analog status signals from critical points in the power supply module to digital format for transfer to the Station Control Module via the SPI bus. Most of the status signals are generated by detect circuits to indicate the status of dc supply voltages and references.

Temperature Monitor and Control Circuitry

A thermistor mounted on the power supply module heatsink provides a varying resistance input to the Heatsink Temp Detect Circuitry. If the heatsink temperature exceeds a preset limit, the circuitry generates a MAIN_SD_SEC shutdown signal which shuts down the entire power supply module. A HEATSINK_DIAG signal is also sent to the Station Control Module via the A/D converter and SPI bus.

Fan Monitor and Control Circuitry

The cooling fan in the power supply module is powered from the +14V Supply Circuitry and runs continuously. If the fan fails, the Fan Fault Detect circuit generates a fail signal (FAN_FAIL_DIAG) which is fed to the A/D converter. The fail signal also triggers a 50 second delay circuit which (after 50 seconds) generates a MAIN_SD_SEC signal which shuts down the entire power supply.

Address Decode Circuitry

The address decode circuitry allows the Station Control Module to use the address bus to select either the D/A converter (Battery Charger/Revert Board) or the A/D converter (Diagnostics Circuitry) for communications via the SPI bus. Typical communications include reading status signals from the Diagnostics Circuitry and providing charger output control signals to the Battery Charger/Revert Board.

Startup/Shutdown Control Circuitry

Shutdown Delay Circuitry

Upon receiving a shutdown signal (MAIN_SD_PRI) from the +28V Main Supply Circuitry, this circuit passes the signal through the Soft Start Circuitry for a 1 second interval to allow the entire power supply module to shutdown. The module then restarts (if the on/off switch is in **On** position). If the MAIN_SD_PRI signal is still active, the shutdown process will repeat.

Startup/Shutdown Delay Circuitry

When the power supply module is first turned on, the RELAY_ON signal is low and the output of the Startup/Shutdown Delay Circuitry keeps the supply in shutdown mode. After about 1.5 seconds RELAY_ON goes high, and the Startup/Shutdown Delay Circuitry provides a 1 second delay before releasing the shutdown signal and allowing the power supply to operate.

When the power supply module is turned off, the RELAY_ON signal goes low and the Startup/Shutdown Delay Circuitry keeps the supply in operating mode for 1 second to allow Battery Revert Mode to activate.

Soft Start Circuitry

Each time the Soft Start Circuitry receives a startup signal (i.e., MAIN_SD_PRI is inactive and the output of the Startup/Shutdown Delay Circuitry is high), the Soft Start Circuitry provides a gradually increasing output signal to “soft start” the Pulse Width Modulators (p/o +28V Main Supply Circuitry). This action minimizes the surge current when charging the output filter capacitors.

6 FUNCTIONAL THEORY OF OPERATION (Battery Charger/Revert Board)

The following theory of operation describes the operation of the CPN6074B Battery Charger/Revert Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 4 for a block diagram of the Battery Charger/Revert Board.

Note *Model CPN1047A Power Supply Modules (without battery charging capabilities) are equipped with a CPN6078A External Charger Connect Board in place of the CPN6074B Battery Charger/Revert Board. The External Charger Connect Board provides a direct electrical path from the +28V Main Supply Circuitry (p/o the DC-to-DC Converter Board) to the card edge connector used to connect to an external charger and battery. The external charger is responsible for 1) charging the external battery and 2) detecting an AC power fail condition and initiating battery revert mode.*

Charger Supply Circuitry

Overview

The Charger Supply Circuitry is comprised of a switching-type power supply which generates the charging current necessary to charge an external storage battery.

Switching Power Supply Operation

The charger switching power supply accepts +28V (from the DC-to-DC Converter Board) which is fed through a filter and a Buck FET Switch to a Power Coil. This coil is controlled by the Buck FET Switch and a Boost FET Switch to produce an induced output voltage of approximately +21 to +31 V dc. This charging voltage is filtered and fed through a pair of Reverse Battery FET Switches to the output terminals (card edge connector that extends from the rear of the Power Supply Module). Connections to an external storage battery are made to this card edge connector.

Protection against connecting the battery in reverse polarity is provided by the Charger Output Control Circuitry and the Reverse Battery FET Switches.

A thermistor mounted near the battery and connected to the station via a backplane connector provides an input to a comparator. The comparator output (BATT_T_DIAG) provides a dc voltage proportional to the battery temperature. This signal is sent to the Station Control Module via the Diagnostics Circuitry on the DC-to-DC Converter Board.

Pulse Width Modulator Circuitry

A 133 kHz clock signal (from the DC-to-DC Converter Board) is fed through a buffer/driver to a Pulse Width Modulator (PWM). The 133 kHz PWM output pulses are fed 1) directly to the Buck FET Switch via a driver, and 2) to the Boost FET Switch via a Boost Switch Timer and Driver. The two signals control the respective FET switches to control the Power Coil in the Charger Supply Circuitry so that it produces an approximately +21 to +31 V dc output to be filtered and charge the external battery.

Battery Revert Circuitry

Overview

The Battery Revert Circuitry accepts various inputs and determines when to activate battery revert mode by turning on the Battery Revert FET Switches. Battery Revert Mode will be activated or deactivated in the following conditions:

- If the AC_FAIL signal (from the DC-to-DC Converter Board) goes low (indicating that AC power has failed), the Battery Revert FET Switches will be turned on (via the FET Driver).
- If the battery voltage is too low, the Undervoltage Detect circuit detects the condition and disables the battery revert circuitry.
- If the battery voltage is too high, the Overvoltage Detect circuit detects the condition and disables the battery charger and the battery revert circuitry.
- If a fault condition exists (e.g., +5V Overvurrent), the shutdown detect circuitry detects the condition and disables the battery charger and the battery revert circuitry.

Current Mode Controller Circuitry

Overview

The Current Mode Controller Circuitry performs two major functions:

- The PWR_CUT signal (from the DC-to-DC Converter Board) is fed through a Voltage Scaling Circuit and reduces the battery charger output current during periods of heavy current draw by the station.
- The Voltage Scaling Circuitry accepts V_BC_RAW (voltage feedback signal from battery) and BATT_VOLT_RANGE and BATT_VOLT_SELECT signals (from the Station Control Module via the D/A Converter) which combine to set the charger output voltage (in a range of +21 V dc to +31 V dc).

SPI Bus Interface Circuitry

This circuitry consists of a D/A Converter that accepts digital signals from the Station Control Module and converts them to analog signals which control the operation of the Battery Charger/Revert Board. These signals:

- Control the charger voltage to the battery (BATT_VOLT_RANGE and BATT_VOLT_SELECT)
- Disable the Undervoltage Detect Circuitry (UVLO_DISABLE) to allow the station to continue operation even though the battery voltage is below the desired level
- Provide a watchdog signal to refresh the Watchdog Timer Circuitry (BATT_WATCHDOG)

Shutdown Circuitry

This circuitry accepts four input signals and generates a shutdown signal to shut down the battery charger for certain input signal conditions, A shutdown signal will be generated for any of the following conditions:

- The BATT_WATCHDOG signal (from the Station Control Module) is not present (indicating that the Station Control Module has failed, or the station's *Battery Type* field has been programmed (via RSS) for "NONE"
- The OVLO_LCKOUT signal is high (indicating that the battery voltage is too high)
- The MAIN_SD_SEC signal is low (indicating that one of the various monitoring points indicates a fault, such as overcurrent condition for +14V or +5 V supplies, overcurrent condition for entire Power Supply Module, etc.
- The AC_FAIL signal is high (indicating that the AC power to the Power Supply Module has been interrupted)

Local Supplies Circuitry

This circuitry contains two voltage regulators which accept +28V_RAW (from the +28V Main Supply Circuitry) and generate VCC (+10 V dc) and +5 V supply voltages for use by local circuitry.

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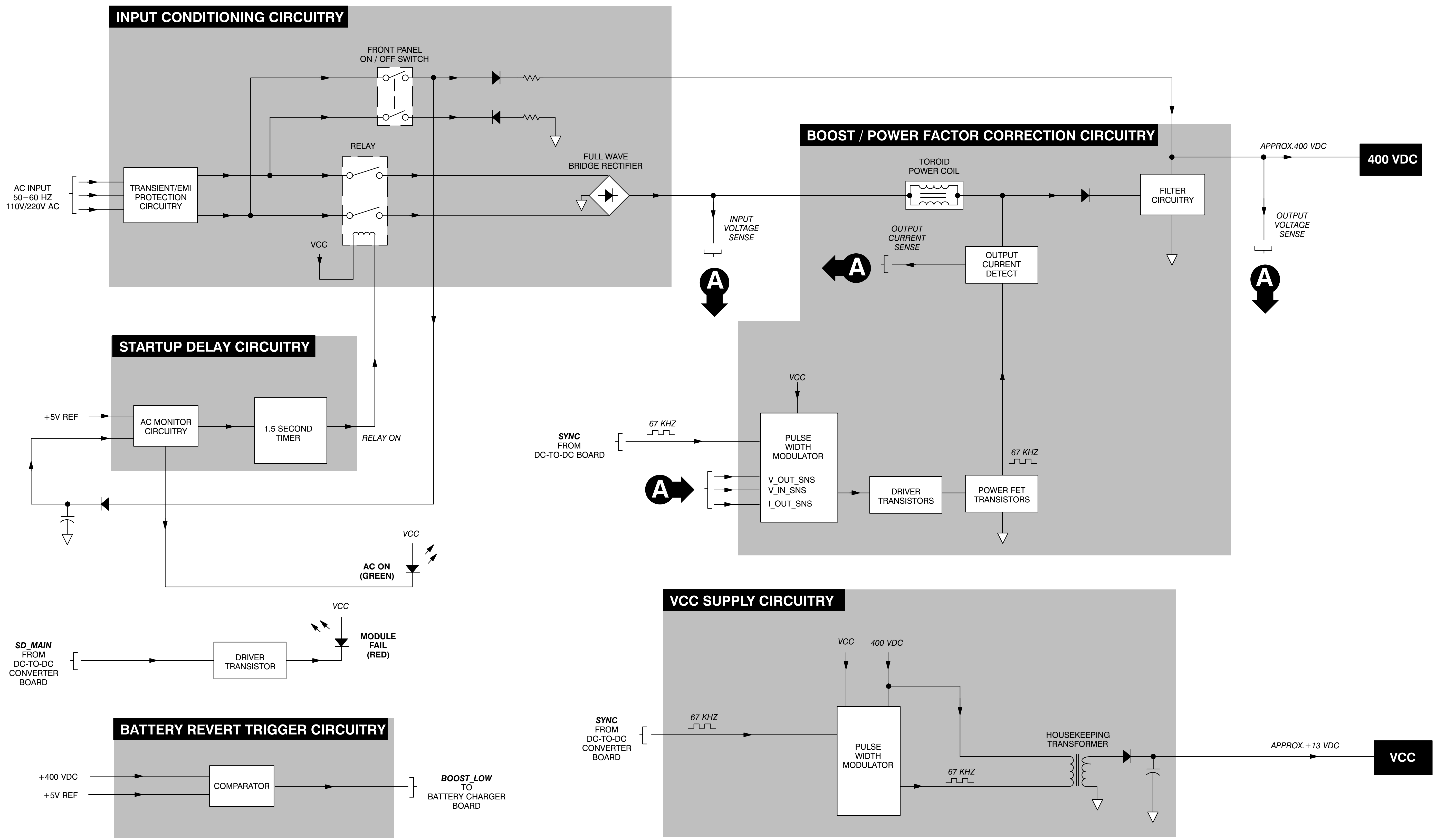

Figure 2. CPN6065B AC-to-DC Converter Board Functional Block Diagram

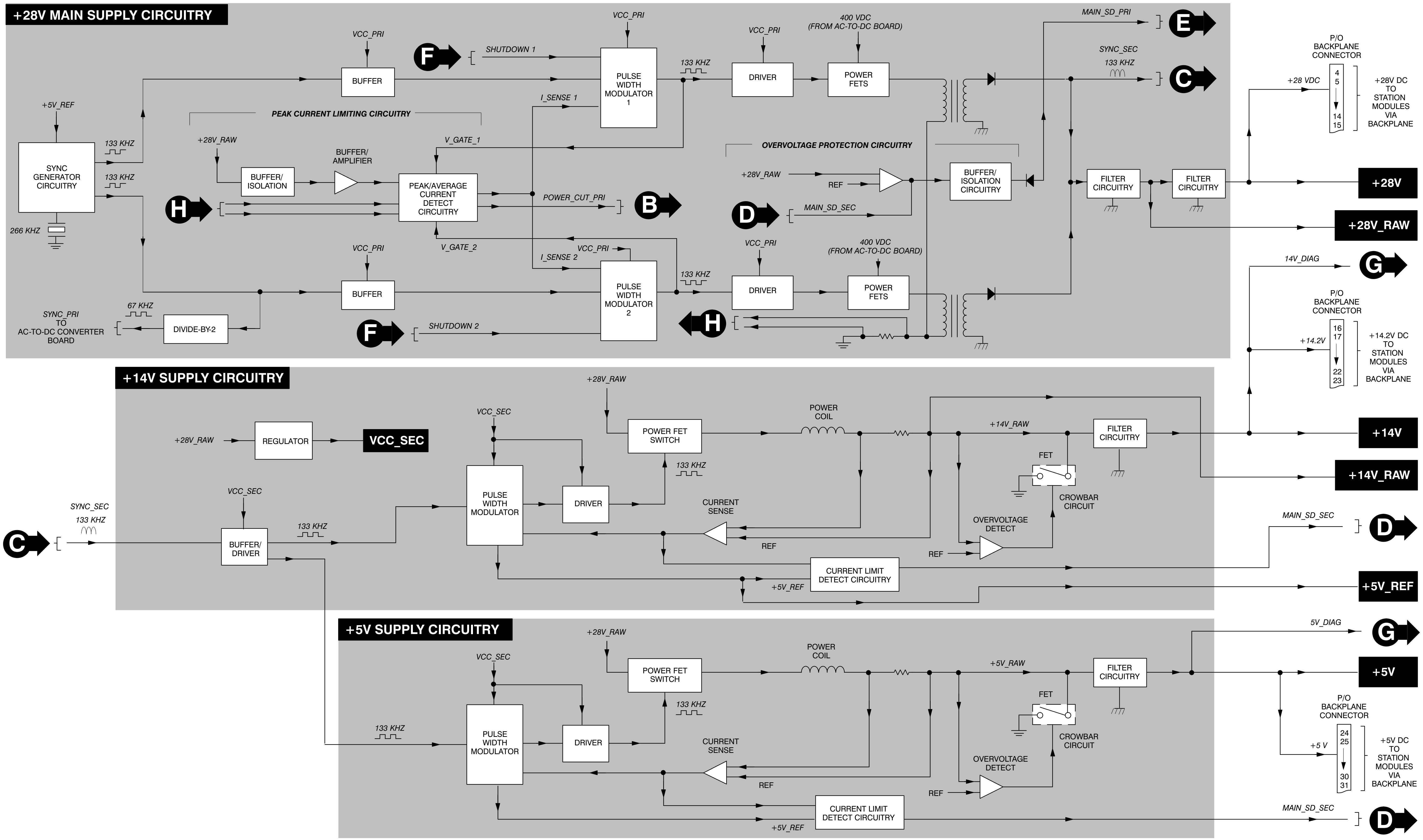

Figure 3. CPN6067A DC-to-DC Converter Board Functional Block Diagram (1 of 2)

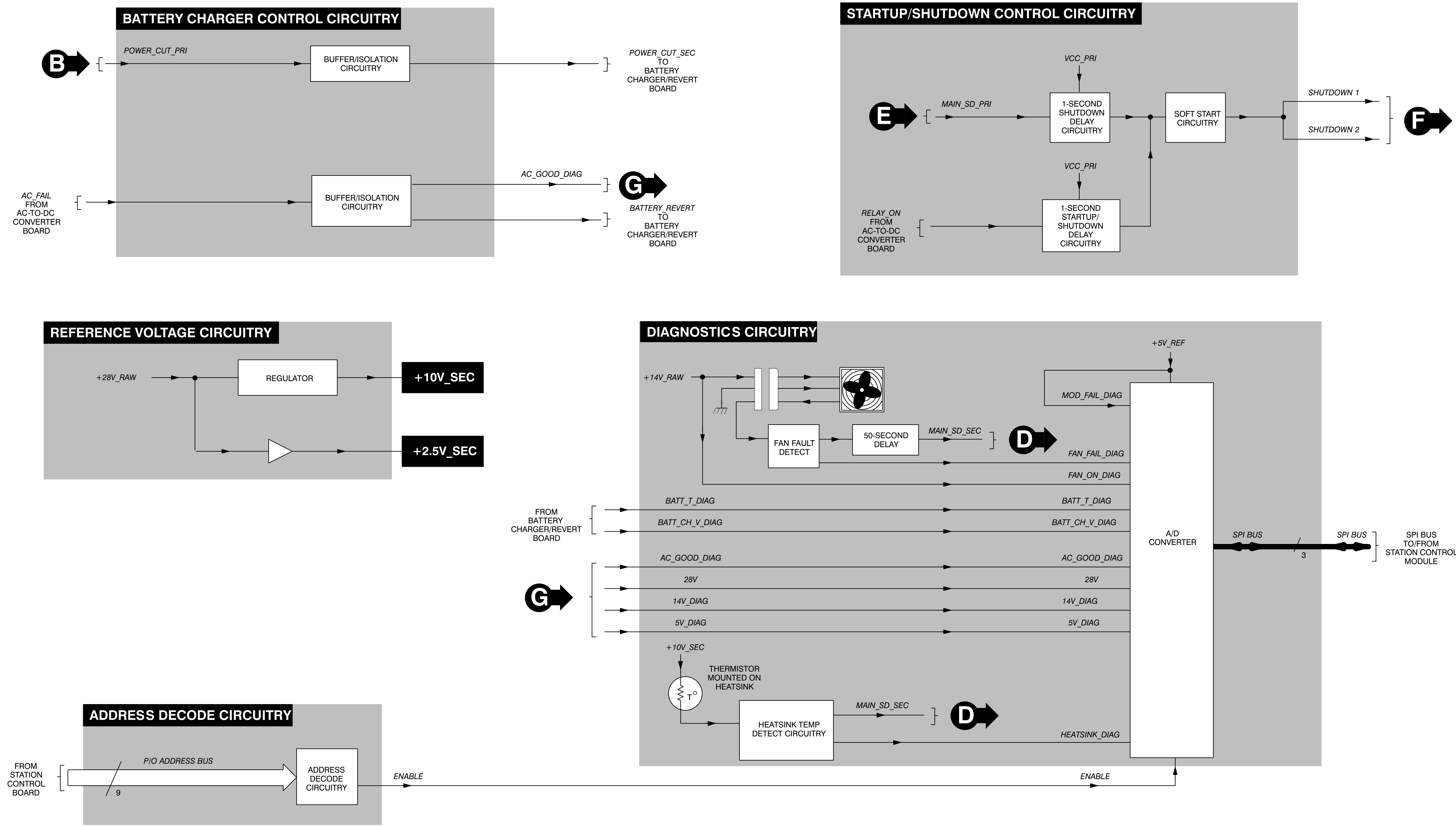

Figure 3. CPN6067A DC-to-DC Converter Board Functional Block Diagram (2 of 2)

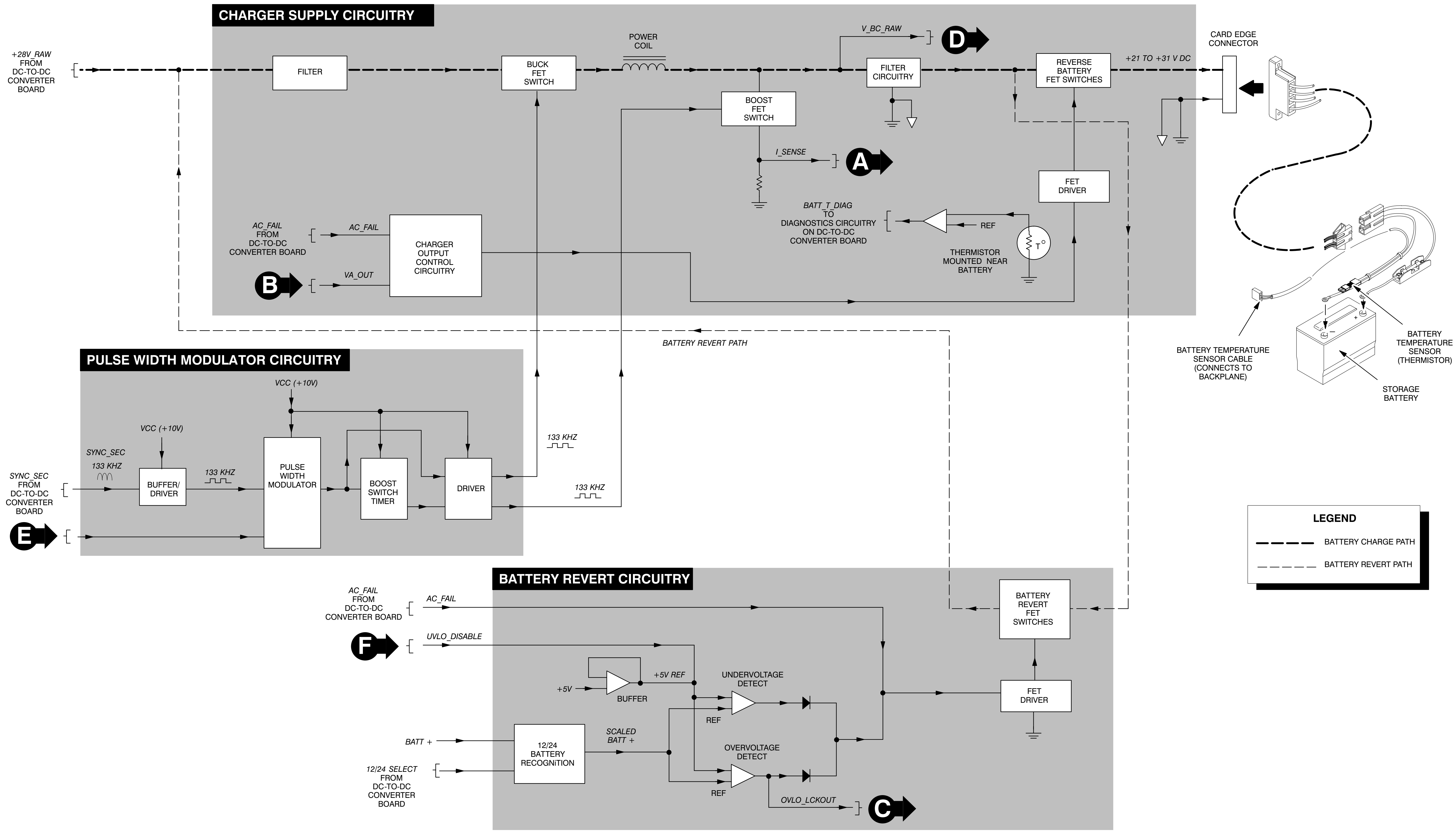

Figure 4. CPN6074B Battery Charger/Revert Board Functional Block Diagram (1 of 2)

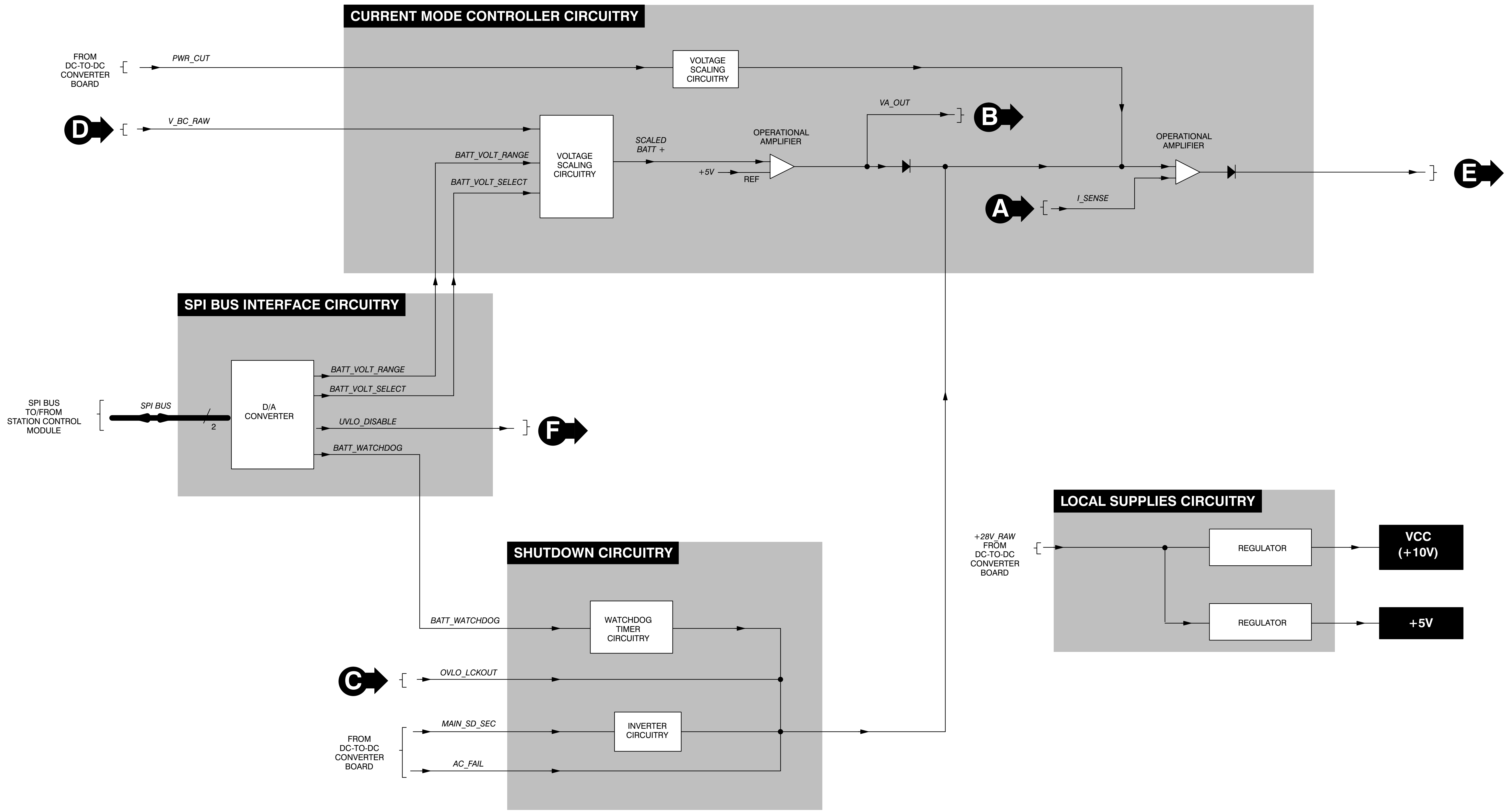

Figure 4. CPN6074B Battery Charger/Revert Board Functional Block Diagram (2 of 2)

MOTOROLA

POWER SUPPLY MODULE

INCLUDES MODELS:
TRN7802A (210W; 12/24V DC Input)
TRN7803A (210W; 48/60V DC Input)

1 DESCRIPTION

The Models TRN7802A/TRN7803A Power Supply Modules are described in this section. A general description, performance specifications, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the satellite receiver or station.)

General Description

The Model TRN7802A Power Supply Module accepts an input of either 12 V dc or 24 V dc, while the Model TRN7803A Power Supply Module accepts an input of either 48 V dc or 60 V dc. Each module generates +5V dc and +14.2V dc operating voltages to power the satellite receiver or station modules. Each power supply module is comprised of several switching−type power supply circuits and diagnostics and monitoring circuitry, all contained within a slide−in module housing.

The power supply module provides the following features:

- Internal voltage and current limiting — circuitry continually monitors critical voltages and currents and shuts supply down if preset thresholds are exceeded
- Temperature protection — module contains built−in cooling fan which is thermostatically controlled; supply shuts down if temperature exceeds preset threshold
- Diagnostic monitoring — critical internal parameters are continually monitored and reported to the Station Control Module, which can automatically provide correction for certain operating conditions
- Front panel On/Off switch with built−in circuit breaker (30A for TRN7802A, 10A for TRN7803A)

The Models TRN7802A and TRN7803A differ only in the required dc input voltage. Unless otherwise noted, the information provided in this section applies to both models.

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1 DESCRIPTION (Continued)

Overview of Circuitry

The power supply module contains the following circuitry:

- Startup Inverter Circuitry — provides VCC for power supply circuitry during initial power−up
- Main Inverter Circuitry — consists of switching−type power supply that generates the +14.2V dc supply voltage
- +5 V Inverter Circuitry — consists of switching−type power supply that generates the +5 dc supply voltage
- Clock Generator Circuitry — generates 267 kHz and 133 kHz clock signals used by pulse width modulators in the three inverter circuits
- Diagnostics Circuitry — converts analog status signals to digital format for transfer to Station Control Module
- Address Decode Circuitry — performs address decoding to provide chip select signals for the A/D and D/A converters

2 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the Models TRN7802A and TRN7803A Power Supply Modules.

Performance Specifications

Table 1. TRN7802A/TRN7803A Power Supply Modules Performance Specifications

Parameter	Specification
Weight	6.5 kg (14.3 lbs)
Operating Temperature Range	−30 to +60° C
Input Voltage Range	TRN7802A 10.5 − 34.5 V dc TRN7803A 41 − 72 V dc
Maximum Input Current	8.5 A
Steady State Output Voltages	+14.2 V dc ±5% +5.1 V dc ±5%
Output Current Ratings	+14.2 12.5 A +5.1 9 A
Total Output Power Rating	no derating 225 W
Output Ripple	All outputs 50 mV p−p (measured with 20 MHz BW oscilloscope at 25°C). High Frequency individual harmonic voltage limits in 10 kHz−100 MHz frequency band: 14.2 V 1.5 mV p−p 5V 5 mV p−p
Short Circuit Current	0.5 A avg. max

3 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the power supply module controls, indicators, and all input and output external connections.

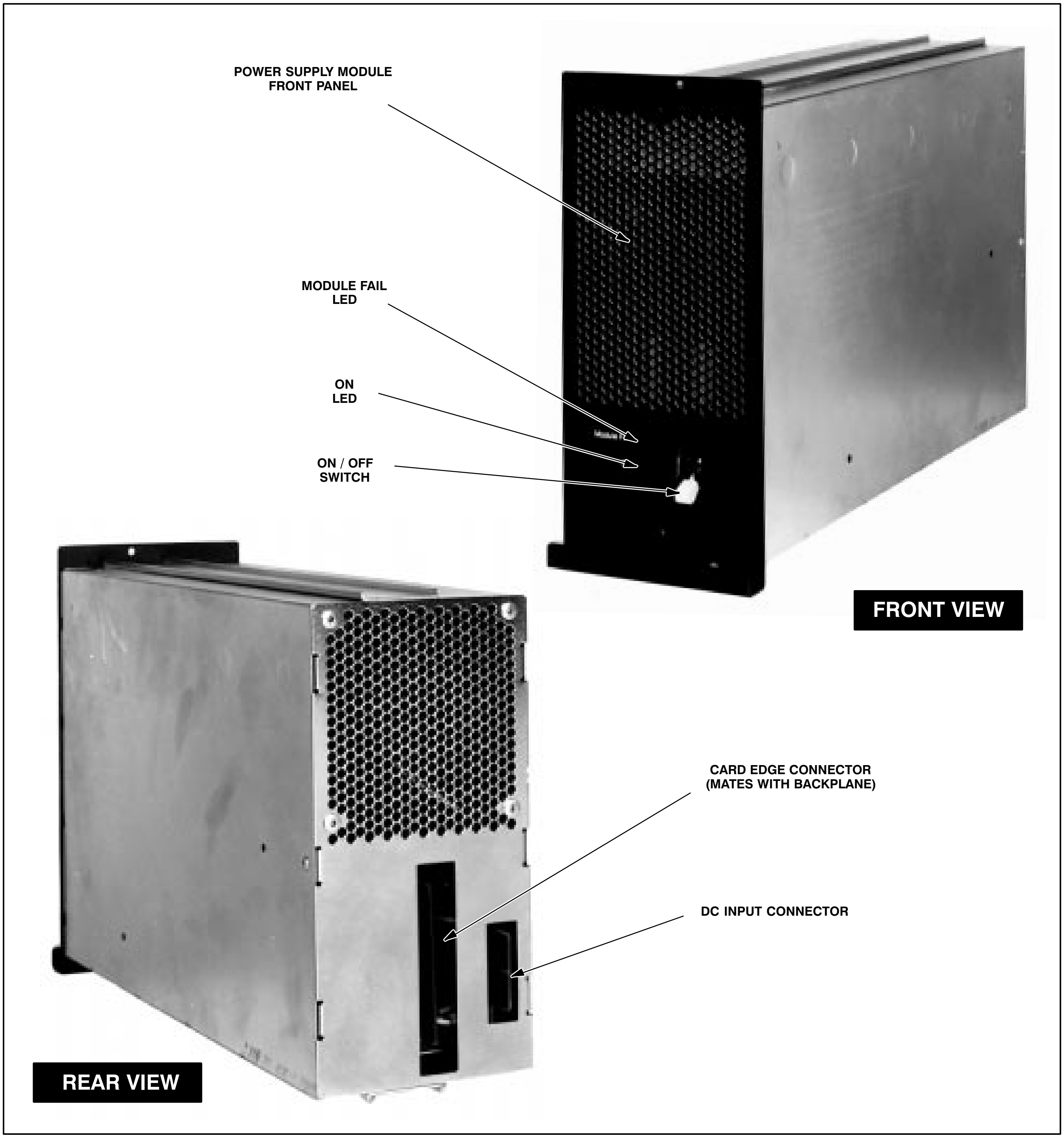

Figure 1. Power Supply Module Controls, Indicators, and Inputs/Outputs

4 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the power supply circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the power supply module.

Input Conditioning Circuitry

Introduction

The power supply module accepts dc power from an external source, typically a bank of storage batteries. DC power is connected to the module via a 4–wire dc input cable mounted on the satellite receiver or station backplane.

Transient and EMI Protection

The dc input is fed to the power supply module circuitry via transient protection and EMI filter circuits. The transient protection devices provide protection against voltage spikes by providing an effective short to ground under high voltage transient conditions. The EMI filter prevents electrical noise generated by the power supply module from interfering with other equipment connected to the same dc source.

Front Panel On–Off Switch and Breaker

A toggle–type switch located on the power supply module front panel allows the power supply (and satellite receiver or station) to be turned off by removing the dc input voltage. The switch controls a built–in circuit breaker (rated at 30A for TRN7802A, 10A for TRN7803A) to provide overload protection for the power supply and satellite receiver or station circuitry.

Startup Inverter Circuitry

This circuitry consists of a switching–type power supply which generates a +12 V dc supply voltage used by the power supply module circuitry as VCC at the time of initial power up. When all supply voltages have stabilized, this circuit is overridden by +14.2 V BULK which continues to supply VCC to the module circuitry.

The circuitry consists of a pulse width modulator (PWM) running at 133 kHz (internal circuitry provides clock signal during initial power up). The PWM output pulses control a transistor switch which repetitively gates voltage (divided down 400 V dc from the Input Conditioning Circuitry) to the primary of the startup isolation transformer. The result is an induced voltage in the secondary winding which feeds two half–wave rectifier circuits. One circuit provides the +12 V dc Startup Bias voltage (used by the module circuitry as initial VCC), and the other provides a BULK DETECT signal used by the Diagnostics Circuitry to generate the DC FAIL signal.

Main Inverter Circuitry

Overview

The main inverter circuitry is comprised of a switching−type power supply which generates a +14.2 V dc supply voltage. This voltage is used as the source for the +5 V inverter circuit in the power supply module, as well as the +14.2 V supply voltage for the satellite receiver or station modules (via the backplane).

Switching Power Supply Operation

The main inverter switching power supply consists of a pulse width modulator (PWM) running at 67 kHz. The PWM output pulses control a power FET bridge which alternately gate the input dc voltage (from the Input Conditioning Circuitry) to the primary of the main isolation transformer. The result is an induced voltage in the secondary windings of the transformer at 133 kHz rate.

Transformer Secondary Voltages

The main isolation transformer has two secondary windings, as follows:

- **Module Fail Winding —** operates in conjunction with a half−wave rectifier circuit to provide a dc signal (Mod Fail) to the A/D converter (p/o Diagnostics Circuitry); indicates that the main inverter circuitry is functioning properly.
- **+14.2 V Winding —** operates in conjunction with a full−wave rectifier circuit to generate a +14.2 V dc supply voltage. Overcurrent and overvoltage detect circuits monitor the circuit operation and, if preset thresholds are exceeded, generate a shutdown signal which is fed to the softstart circuitry to shutdown the main inverter.

+5 V Inverter Circuitry

Overview

The +5 V inverter circuitry is comprised of a switching−type power supply which generates a +5 V dc supply voltage. This voltage is used as the +5 V supply voltage for the satellite receiver or station modules (via the backplane).

Switching Power Supply Operation

The +5 V inverter switching power supply consists of a pulse width modulator (PWM) running at 133 kHz. The PWM output pulses control a power FET which repetitively gates the +14.2 V dc (from the Main Inverter Circuitry) to the filtering circuitry. The result is a +5 V dc supply voltage.

Protection Circuitry

An overvoltage detect circuit monitors the output voltage and, if preset thresholds are exceeded, generates a shutdown signal which is fed to the softstart circuitry to shutdown the main inverter. Upon an overvoltage detection, a FET crowbar circuit immediately discharges the output to protect other modules in the satellite receiver or station.

An overcurrent detect circuit monitors the current draw from the +5 V inverter circuit and, if a preset threshold is exceeded, shuts down the +5 V inverter. If the overcurrent condition lasts for a preset length (approx. 50 msec), the surge current delay circuit generates a shutdown signal which is fed to the softstart circuitry to shutdown the main inverter.

Diagnostics Circuitry

Overview

The diagnostics circuitry consists of a 11–channel A/D converter which converts analog status signals from critical points in the module to digital format for transfer to the Station Control Module via the SPI bus. Most of the status signals are generated by detect circuits to indicate the status of dc supply voltages and references.

Temperature Monitor and Control Circuitry

A thermistor mounted on the power supply module heatsink provides a varying resistance input to several detect and control circuits, as follows:

- **Heatsink Status Detect —** compares signal from thermistor to reference voltage to generate an output proportional to heatsink temperature; signal is sent to Station Control Board via A/D converter and SPI bus.
- **Hi–Temp Detect —** compares signal from thermistor to reference voltage to generate a high temperature signal if preset threshold is exceeded; signal is sent to softstart circuitry to shut down main inverter if overtemperature condition is detected.
- **Fan Control Circuitry—** compares signal from thermistor to reference voltage to generate a fan control signal to turn on cooling fan mounted in power supply module; also generated is a FAN ON status signal which is sent to Station Control Board via A/D converter and SPI bus.

  Note that a Fan Fault Detect circuit accepts a pulsed feedback signal from the cooling fan to indicate whether the fan is functioning (when turned on by Fan Control Circuitry); a FAN FAIL status signal is sent to Station Control Board via A/D converter and SPI bus

Note: *The cooling fan in the Power Supply Module is thermostatically controlled and may come on at any time during satellite receiver or station operation. Failure of the fan to rotate continuously does not indicate a failure of the module.*

Status LED Indicators

Two LEDs located on the power supply module front panel indicate module status as follows:

- **On—** lights GREEN when power supply module is turned on and functioning properly; LED turns off when module is turned off, input power is removed, or module startup circuitry is in fail mode
- **Module Fail—** lights RED when power supply module is in fail mode, or when a failure in another station module causes excessive current drain on any of the power supply output voltages; LED turns off when module is functioning properly

Address Decode Circuitry

The address decode circuitry allows the Station Control Board to use the address bus to select the A/D converter (Diagnostics Circuitry) for communications via the SPI bus. Typical communications include reading status signals from the Diagnostics Circuitry.

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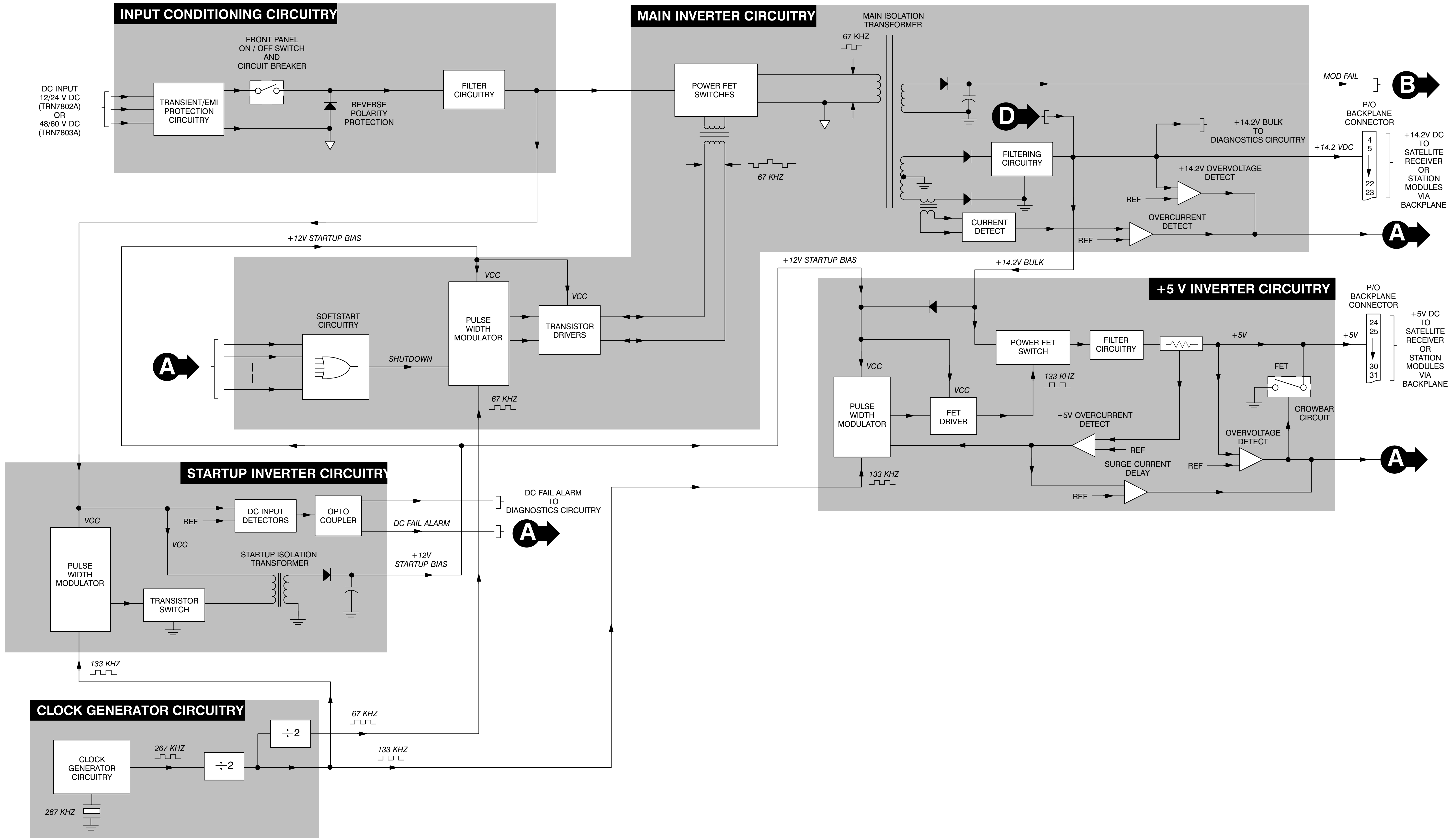

Figure 2. 210W DC/DC Power Supply Module Functional Block Diagram (Sheet 1 of 2)

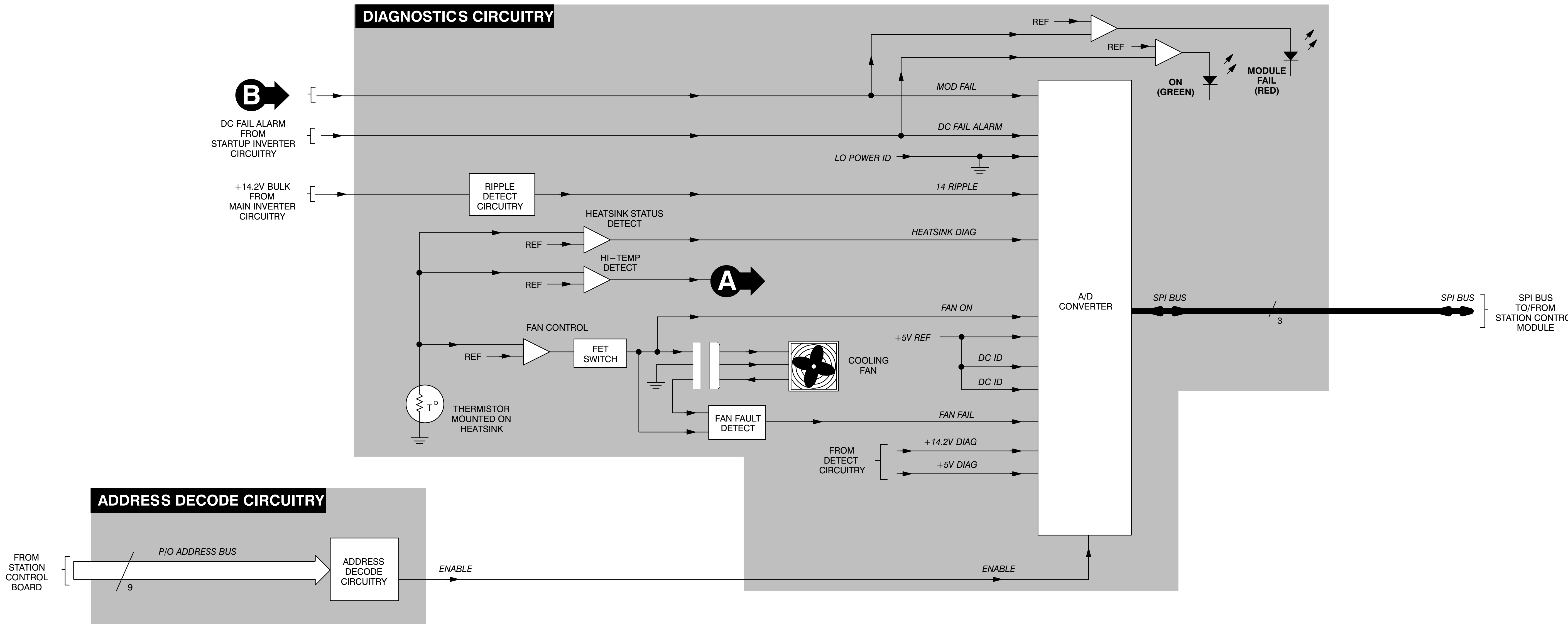

Figure 2. 210W DC/DC Power Supply Module Functional Block Diagram (Sheet 2 of 2)

MOTOROLA

POWER SUPPLY MODULE

Model TRN7801A (600W; 24 V DC Input)

1 DESCRIPTION

The Model TRN7801A Power Supply Module is described in this section. A general description, performance specifications, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Model TRN7801A Power Supply Module accepts an input of 24 V dc and generates +28.6V dc, +5V dc, and +14.2V dc operating voltages to power the station modules. The power supply module is comprised of several switching-type power supply circuits and diagnostics and monitoring circuitry, all contained within a slide-in module housing.

The power supply module provides the following features:

- **Internal voltage and current limiting** — circuitry continually monitors critical voltages and currents and shuts supply down if preset thresholds are exceeded
- **Temperature protection** — module contains built−in cooling fan which is thermostatically controlled; supply shuts down if temperature exceeds preset threshold
- **Diagnostic monitoring** — critical internal parameters are continually monitored and reported to the Station Control Module, which can automatically provide correction for certain operating conditions
- Front panel On/Off switch with built-in 50A circuit breaker

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1 DESCRIPTION (Continued)

Overview of Circuitry

The power supply module contains the following circuitry:

- Startup Inverter Circuitry — provides VCC for power supply circuitry during initial power−up
- Main Inverter Circuitry — consists of switching−type power supply that generates the +28V dc supply voltage
- +14.2 V Inverter Circuitry — consists of switching−type power supply that generates the +14.2V dc supply voltage
- +5 V Inverter Circuitry — consists of switching−type power supply that generates the +5 dc supply voltage
- Clock Generator Circuitry — generates 67 kHz and 133 kHz clock signals used by pulse width modulators in the four inverter circuits
- Diagnostics Circuitry — converts analog status signals to digital format for transfer to Station Control Module
- Address Decode Circuitry — performs address decoding to provide chip select signals for the A/D and D/A converters

2 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the Model TRN7801A Power Supply Module.

Performance Specifications

Table 1. TRN7801A Power Supply Module Performance Specifications

Parameter	Specification
Weight	6.5 kg (14.3 lbs)
Operating Temperature Range	−30 to +45° C (no derating) −30 to +60° C (derated)
Input Voltage Range	21.0− 34.5 V dc
Maximum Input Current	40A
Steady State Output Voltages	+28.6 V dc ±5% @ 16A +28.6 V dc ±5% @ 12.8A (derated) +14.2 V dc ±5% @ 9A +5.1 V dc ±5% @ 9A
Output Current Ratings	+28.6 16A +14.2 9A +5.0 9A
Total Output Power Rating	no derating 630 W derated 540 W
Output Ripple	All outputs 50 mV p−p (measured with 20 MHz BW oscilloscope at 25°C). High Frequency individual harmonic voltage limits in 10 kHz−100 MHz frequency band: 28.6V 1.5 mV p−p 14.2 V 3.0 mV p−p 5V 5.0 mV p−p
Short Circuit Current	0.5 A avg. max

3 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the power supply module controls, indicators, and all input and output external connections.

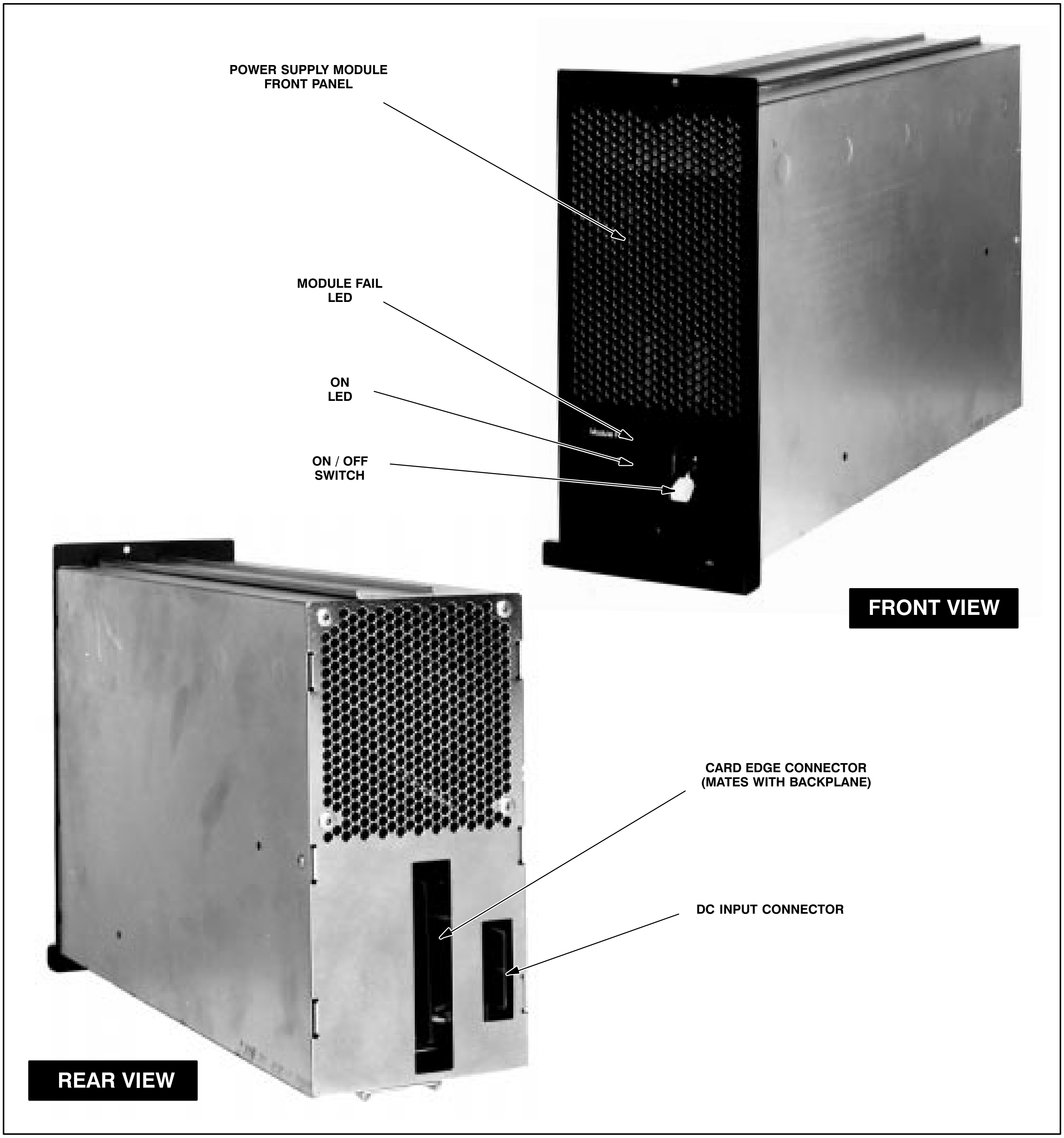

Figure 1. Power Supply Module Controls, Indicators, and Inputs/Outputs

4 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the power supply circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the power supply module.

Input Conditioning Circuitry

Introduction

The power supply module accepts dc power from an external source, typically a bank of storage batteries. DC power is connected to the module via a 4–wire dc input cable mounted on the station backplane.

Transient and EMI Protection

The dc input is fed to the power supply module circuitry via transient protection and EMI filter circuits. The transient protection devices provide protection against voltage spikes by providing an effective short to ground under high voltage transient conditions. The EMI filter prevents electrical noise generated by the power supply module from interfering with other equipment connected to the same dc source.

Front Panel On–Off Switch

A toggle–type switch located on the power supply module front panel allows the power supply (and satellite receiver) to be turned off by removing the dc input voltage. The switch controls a built-in circuit breaker (rated at 50A) to provide overload protection for the power supply and station circuitry.

Startup Inverter Circuitry

This circuitry consists of a switching–type power supply which generates a +12 V dc supply voltage used by the power supply module circuitry as VCC at the time of initial power up. When all supply voltages have stabilized, this circuit is overridden by +14.2 V BULK which continues to supply VCC to the module circuitry.

The circuitry consists of a pulse width modulator (PWM) running at 133 kHz (internal circuitry provides clock signal during initial power up). The PWM output pulses control a transistor switch which repetitively gates voltage to the primary of the startup isolation transformer. The result is an induced voltage in the secondary winding which feeds two half–wave rectifier circuits. One circuit provides the +12 V dc Startup Bias voltage (used by the module circuitry as initial VCC), and the other provides a BULK DETECT signal used by the Diagnostics Circuitry to generate the AC FAIL signal.

Main Inverter Circuitry

Overview

The main inverter circuitry is comprised of a switching−type power supply which generates a +28.6 V dc supply voltage. This voltage is used as the source for the +14.2 V and +5 V inverter circuits in the power supply module, as well as the +28 V supply voltage for the station modules (via the backplane).

Switching Power Supply Operation

The main inverter switching power supply consists of a pulse width modulator (PWM) running at 67 kHz. The PWM output pulses control a power FET bridge which alternately gate the input dc voltage (from the Input Conditioning Circuitry) to the primary of the main isolation transformer. The result is an induced voltage in the secondary windings of the transformer at 133 kHz rate.

Transformer Secondary Voltages

The main isolation transformer has two secondary windings, as follows:

- **Module Fail Winding —** operates in conjunction with a half−wave rectifier circuit to provide a dc signal (Mod Fail) to the A/D converter (p/o Diagnostics Circuitry); indicates that the main inverter circuitry is functioning properly.
- **+28 V Winding —** operates in conjunction with a full−wave rectifier circuit to generate a +28 V dc supply voltage. Overcurrent and overvoltage detect circuits monitor the circuit operation and, if preset thresholds are exceeded, generate a shutdown signal which is fed to the softstart circuitry to shutdown the main inverter.

+14.2 V Inverter Circuitry

Overview

The +14.2 V inverter circuitry is comprised of a switching−type power supply which generates a +14.2 V dc supply voltage. This voltage is used as the +14.2 V supply voltage for the station modules (via the backplane).

Switching Power Supply Operation

The +14.2 V inverter switching power supply consists of a pulse width modulator (PWM) running at 133 kHz. The PWM output pulses control a power FET which repetitively gates the +28.6 V dc (from the Main Inverter Circuitry) to the filtering circuitry. The result is a +14.2 V dc supply voltage.

Protection Circuitry

An overvoltage detect circuit monitors the output voltage and, if preset thresholds are exceeded, generates a shutdown signal which is fed to the softstart circuitry to shutdown the main inverter. Upon an overvoltage detection, a FET crowbar circuit immediately discharges the output to protect other modules in the station.

An overcurrent detect circuit monitors the current draw from the +14.2 V inverter circuit and, if a preset threshold is exceeded, shuts down the +14.2 V inverter. If the overcurrent condition lasts for a preset length (approx. 50 msec), the surge current delay circuit generates a shutdown signal which is fed to the softstart circuitry to shutdown the main inverter.

+5 V Inverter Circuitry

Overview

The +5 V inverter circuitry operates identically to the +14.2 V inverter circuitry (described above) to generate a +5 V dc supply voltage. This voltage is used as the +5 V supply voltage for the station modules (via the backplane).

Diagnostics Circuitry

Overview

The diagnostics circuitry consists of an 11−channel A/D converter which converts analog status signals from critical points in the module to digital format for transfer to the Station Control Module via the SPI bus. Most of the status signals are generated by detect circuits to indicate the status of dc supply voltages and references.

Temperature Monitor and Control Circuitry

A thermistor mounted on the power supply module heatsink provides a varying resistance input to several detect and control circuits, as follows:

- **Heatsink Status Detect —** compares signal from thermistor to reference voltage to generate an output proportional to heatsink temperature; signal is sent to Station Control Board via A/D converter and SPI bus.
- **Hi−Temp Detect —** compares signal from thermistor to reference voltage to generate a high temperature signal if preset threshold is exceeded; signal is sent to softstart circuitry to shut down main inverter if overtemperature condition is detected.
- **Fan Control Circuitry—** compares signal from thermistor to reference voltage to generate a fan control signal to turn on cooling fan mounted in power supply module; also generated is a FAN ON status signal which is sent to Station Control Board via A/D converter and SPI bus.

  Note that a Fan Fault Detect circuit accepts a pulsed feedback signal from the cooling fan to indicate whether the fan is functioning (when turned on by Fan Control Circuitry); a FAN FAIL status signal is sent to Station Control Board via A/D converter and SPI bus

Note: *The cooling fan in the Power Supply Module is thermostatically controlled and may come on at any time during station operation. Failure of the fan to rotate continuously does not indicate a failure of the module.*

Status LED Indicators

Two LEDs located on the power supply module front panel indicate module status as follows:

- **Power On—** lights GREEN when power supply module is turned on and functioning properly; LED turns off when module is turned off, input power is removed, or module startup circuitry is in fail mode
- **Module Fail—** lights RED when power supply module is in fail mode, or if a failure in another station module causes excessive current drain on any of the power supply output voltages; LED turns off when module is functioning properly

Address Decode Circuitry

The address decode circuitry allows the Station Control Board to use the address bus to select the A/D converter (Diagnostics Circuitry) for communications via the SPI bus. Typical communications include reading status signals from the Diagnostics Circuitry.

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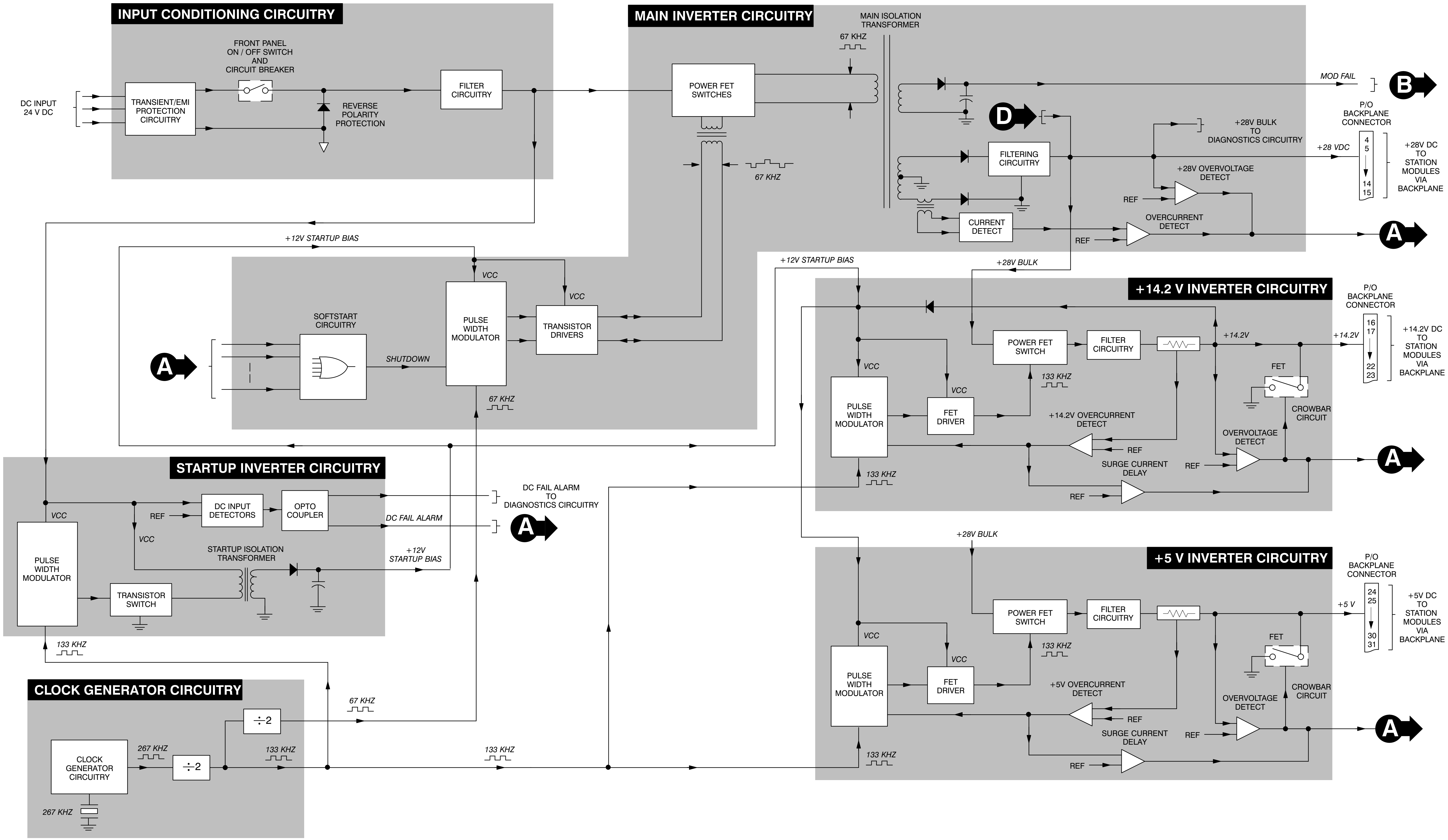

Figure 2. 600W DC/DC Power Supply Module Functional Block Diagram (Sheet 1 of 2)

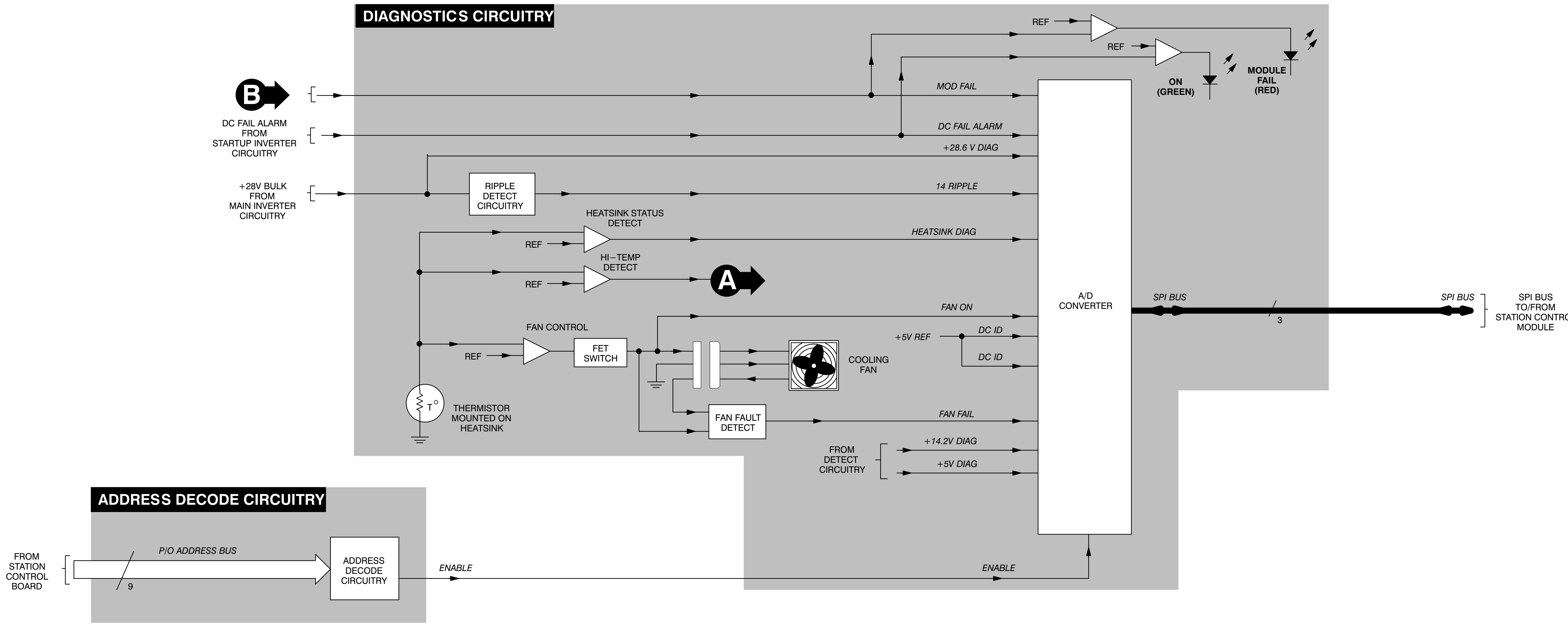

Figure 2. 600W DC/DC Power Supply Module Functional Block Diagram (Sheet 2 of 2)

MOTOROLA

POWER SUPPLY MODULE

CPN1031B (600W; 48/60V DC Input)

1 DESCRIPTION

The Model CPN1031B Power Supply Module is described in this section. A general description, performance specifications, identification of controls, indicators, and inputs/outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Models CPN1031B Power Supply Module accepts a dc input of either 48 V dc or 60 V dc and generates +28.6V dc, +14.2V dc, and +5.1V dc operating voltages to power the station modules. The power supply module is comprised of two circuit boards which provide several switching-type power supply circuits and diagnostics and monitoring circuitry, all contained within a slide-in module housing.

The power supply module provides the following features:

- **Internal voltage and current limiting** — circuitry continually monitors critical voltages and currents and shuts supply down if preset thresholds are exceeded
- **Temperature protection** — module contains built-in cooling fan; supply shuts down if temperature exceeds preset threshold
- **Diagnostic monitoring** — critical internal parameters are continually monitored and reported to the Station Control Module, which can automatically provide correction for certain operating conditions
- **Fan Failure Protection** — Power Supply enters shutdown mode in event of cooling fan failure
- **Auto Recovery from Shutdown** — Power Supply automatically recovers from shutdown mode if the cause of the shutdown no longer exists
- **Limited In-Rush Current** — Circuitry limits in-rush current to less than 30 A in all conditions

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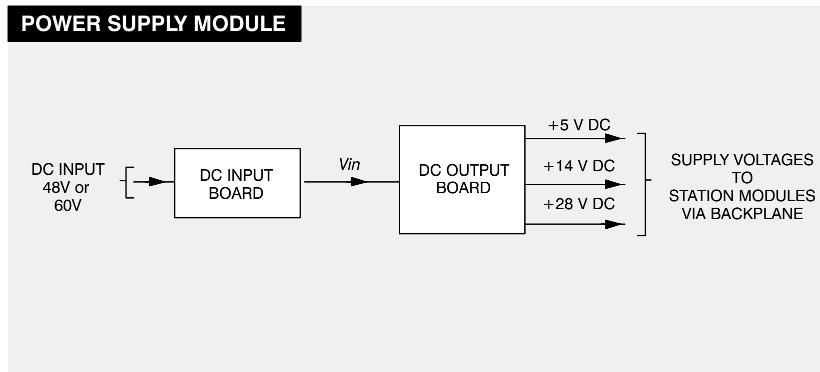
Power Supply Module Simplified Block Diagram

The illustration below provides a simplified block diagram of a Power Supply Module showing how the two circuit boards interconnect. A detailed block diagram and functional theory of operation for each board is provided later in this section (beginning on page 6).



Overview of Circuitry

The power supply module is comprised of two circuit boards, connected together via cables. These boards contain circuitry as follows:

DC Input Board (CPN6064B)

- **Input Conditioning Circuitry** — consists of: dc filtering components, reverse polarity circuitry to protect power supply circuitry from reverse polarity connection to external DC source, Startup Delay Circuitry
  - — Filter Circuitry to provide filtering of DC input voltage
  - — Reverse Polarity Circuitry to protect power supply circuitry from reverse polarity connection to external DC source
  - — Startup Delay Circuitry to provide a delay of approximately 1.5 seconds from time on/off switch is turned on until the power supply becomes functional (allows pre-charge of high-capacity filter capacitors to limit in-rush current on power up)
  - — Filter Circuitry to provide filtering of DC output voltage
- **Inverter Circuitry A and B** — consists of two inverter circuits that accept gating signals from the *Inverters A/B Control Circuitry* (on DC Output Board) to provide 133 kHz signal to *Output Filter Circuitry* and to the *+5V and +14V Power Supply Circuits* (on DC Output Board)
- **Output Filter Circuitry** — consists of dc filtering components to filter the +28 V dc output voltage supplied to the station modules

DC Output Board (CPN6068A)

- **Inverters A/B Control Circuitry** — consists of switching-type circuitry that generates the 133 kHz *V_GATE_1* and *V_GATE_2* signals to the *Inverter A* and *Inverter B* circuitry on the DC Input Board; also contains *Peak Current Limiting Circuitry* and *Overvoltage Protection Circuitry*.
- **+14 V Supply Circuitry** — consists of switching-type power supply that generates the +14 V dc supply voltage.
- **+5 V Supply Circuitry** — consists of switching-type power supply that generates the +5 V dc supply voltage.
- **Reference Voltage Circuitry** — Generates +10V_SEC and +2.5V_SEC supply voltages for use by local circuitry.
- **Diagnostics Circuitry** — converts analog status signals to digital format for transfer to Station Control Module.
- **Address Decode Circuitry** — performs address decoding to provide chip select signal for the A/D converter.
- **Startup/Shutdown Control Circuitry** — Provides delay interval for shutdown of entire power supply module.

2 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the Model CPN1031B Power Supply Module.

Performance Specifications

Table 1. CPN1031B Power Supply Module Performance Specifications

Parameter	Specification
Weight	6.5 kg (14.3 lbs)
Operating Temperature Range	−30 to +60° C (no derating)
Input Voltage Range	+43.2 V dc to +62.4 V dc
Maximum Input Current	22 A
Steady State Output Voltages	+28.6 V dc ±5% +14.2 V dc ±5% +5.0 V dc ±5%
Output Current Ratings	+28.6 12.5 A +14.2 8 A +5.1 3 A
Total Output Power Rating	No Derating 600 W
Output Ripple	All outputs 50 mV p−p (measured with 20 MHz BW oscilloscope at 25°C). High Frequency individual harmonic voltage limits in 10 kHz−100 MHz frequency band: 28.6V 1.5 mV p−p 14.2 V 3.0 mV p−p 5V 5.0 mV p−p
Short Circuit Current	25.5 A ± 3 A

3 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the power supply module controls, indicators, and all input and output external connections.

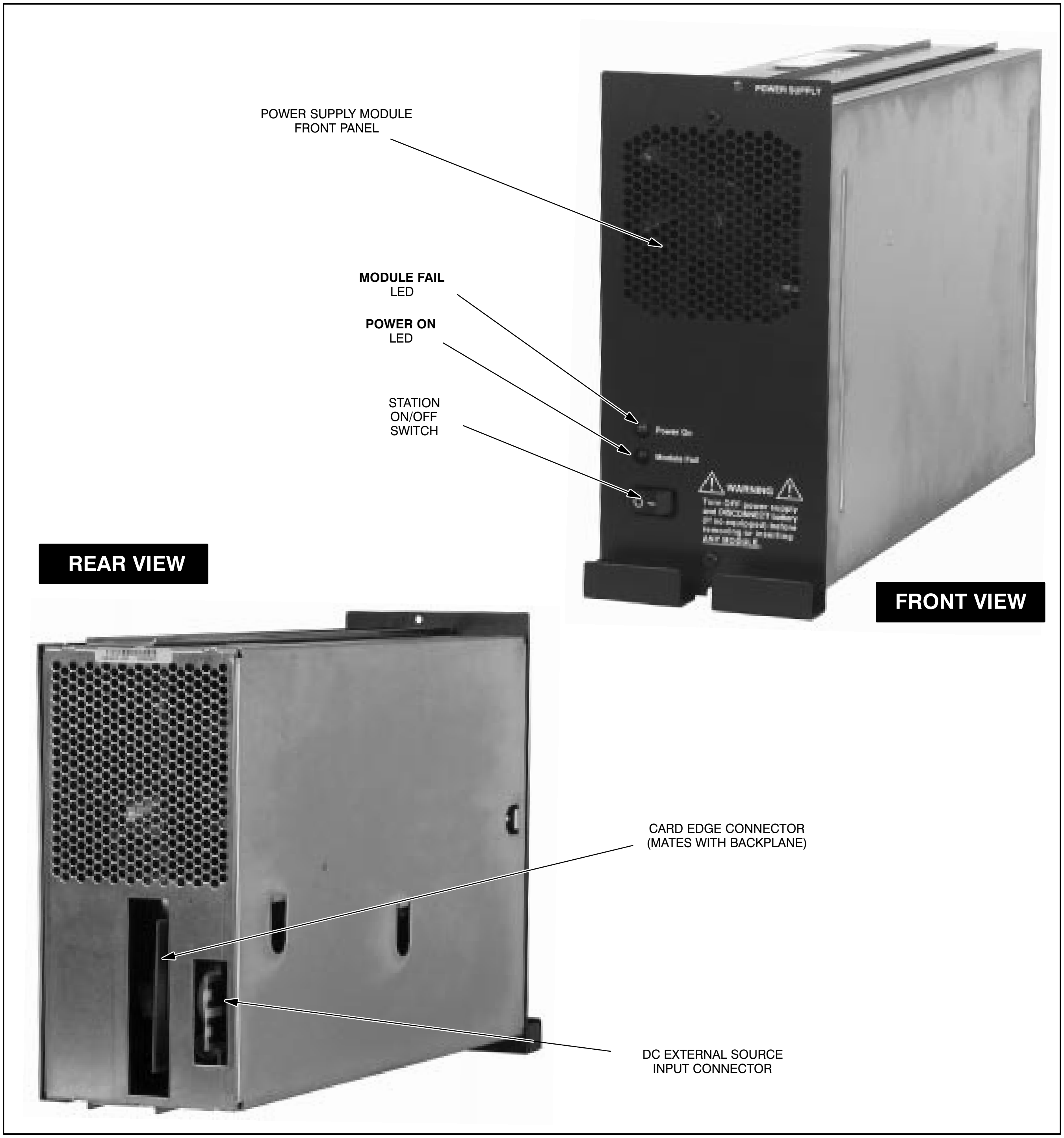


Figure 1. CPN1031B Power Supply Module Controls, Indicators, and Inputs/Outputs

4 FUNCTIONAL THEORY OF OPERATION (DC Input Board)

The following theory of operation describes the operation of the CPN6064B DC Input Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the DC Input Board.

Input Conditioning Circuitry

Introduction

The DC Input Board accepts dc power from an external source, typically a bank of storage batteries. DC power is connected to the board via a 4-wire dc input cable mounted on the station backplane.

Input Filter Circuitry

The DC input voltage is fed to filtering circuitry. This circuitry consists of filter capacitors that remove any ripple and/or transients from the input dc signal.

Front Panel On–Off Switch / Startup Delay Circuitry

A rocker-type switch located on the power supply module front panel allows the power supply (and station) to be turned on and off. Note that the switch allows the output filter circuitry to slowly charge (for approximately 1.5 seconds after switch is turned on) through two diodes and resistors. After the 1.5 second delay, the relay turns on and provides the full dc input voltage to the output filter circuitry. This 1.5 second precharge delay period limits in-rush current through the filter capacitors upon power up.

If the DC input is below approximately 43.2 V, the relay will not be turned on and the power supply outputs will be disabled. The red **Module Fail** LED on the front panel will light.

Output Filter Circuitry

The DC input voltage is fed to filtering circuitry. This circuitry consists of filter capacitors that remove any ripple or noise from the switching circuitry from the +28 V dc output.

Inverter Circuitry A and B

Inverter Circuitry A and Inverter Circuitry B are identical switching-type circuits that accept the gating signals (V_GATE_1 and V_GATE_2) from the DC Output Board and generate a 133 kHz output signal. This signal is fed to the Output Filter Circuitry (which provides a +28 V dc supply voltage to the station) and to the +5V and +14V Supply Circuits on the DC Output Board.

Output Filter Circuitry

This circuitry consists of a series of filter capacitors that filter the 133 kHz signal from Inverter Circuits A and B to provide a +28 V dc supply voltage for use by the station modules (via the backplane).

5 FUNCTIONAL THEORY OF OPERATION (DC Output Board)

The following theory of operation describes the operation of the CPN6068A DC Output Board circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 3 for a block diagram of the DC Output Board.

Inverters A/B Control Circuitry

Overview

The Inverters A/B Control Circuitry is comprised of two mirrored switching-type circuits which generate the V_GATE_1 and V_GATE_2 signals used by the Inverter Circuitry A and Inverter Circuitry B (located on the DC Input Board).

Switching Circuitry Operation

The switching circuitry consists of two identical switching-type circuits operating in parallel. Both circuits operate identically, as follows. A 67 kHz clock signal from the Sync Generator Circuitry is fed through a buffer to a Pulse Width Modulator (PWM). The PWM outputs a 133 kHz signal (V_GATE_1 or V_GATE_2) which is fed to Inverter Circuitry A (or Inverter Circuitry B) located on the DC Input Board.

Since Inverter Circuitry A and Inverter Circuitry B each receives a 133 kHz V_GATE signal that is 180° out of phase with the other, each circuit alternately charges the output filter circuitry, resulting in an effective charging rate of 133 kHz.

Protection Circuitry

Peak/Average Current Limiting Circuitry — The peak current limiting circuitry accepts an output current feedback signal and a scaled +28V_RAW reference signal to control the PWMs. This effectively maintains a constant output voltage for varying output current demands.
The average current limiting circuitry monitors the +28 V dc output and generates a shutdown signal (PRI_SHUTDOWN) if the average output current reaches a predetermined limit.

Overvoltage Protection Circuitry — This circuitry monitors the +28V_RAW voltage and generates a shutdown signal (PRI_SHUT_SEC) to shut down the entire power supply module if the +28 V output voltage exceeds a preset threshold.

+14 V Supply Circuitry

Overview

The +14 V Supply Circuitry is comprised of a switching-type power supply which generates a +14.2 V dc supply voltage. This voltage is used as the +14.2 V supply voltage for the station modules (via the backplane).

Switching Power Supply Operation

The +14 V switching power supply consists of a pulse width modulator (PWM) running at 133 kHz. The PWM output pulses are fed through a driver to control a power FET which repetitively gates the +28V_RAW (from the Output Filter Circuitry on the DC Input Board) to a power coil. The result is a high induced voltage which charges the filter capacitors to approximately +14.2 V dc. A current sense comparator provides a feedback signal to the PWM to maintain a constant output voltage.

Protection Circuitry

An overvoltage detect circuit monitors the output voltage and, if preset thresholds are exceeded, turns on a FET crowbar circuit which immediately discharges the output to protect other modules in the station.

An overcurrent detect circuit monitors the current draw from the +14V Supply Circuitry and, if a preset threshold is exceeded, generates a PRI_SHUT_SEC signal which shuts down the entire power supply module.

+5 V Supply Circuitry

The +5 V Supply Circuitry operates identically to the +14 V Supply Circuitry (described above) to generate a +5.1 V dc supply voltage. This voltage is used as the +5 V supply voltage for the station modules (via the backplane).

Reference Voltage Circuitry

This circuitry accepts +28V_RAW (from the +28V Main Supply Circuitry) and generates +10V_SEC and +2.5V_SEC supply voltages for use by local circuitry.

Diagnostics Circuitry

Overview

The diagnostics circuitry consists of an 11-channel A/D converter which converts analog status signals from critical points in the power supply module to digital format for transfer to the Station Control Module via the SPI bus. Most of the status signals are generated by detect circuits to indicate the status of dc supply voltages and references.

Temperature Monitor and Control Circuitry

A thermistor mounted on the power supply module heatsink provides a varying resistance input to the Heatsink Temp Detect Circuitry. If the heatsink temperature exceeds a preset limit, the circuitry generates a PRI_SHUT_SEC shutdown signal which shuts down the entire power supply module. A HEATSINK_DIAG signal is also sent to the Station Control Module via the A/D converter and SPI bus.

Overvoltage/Undervoltage Detect Circuitry

This circuitry monitors the VIN__FLTRD signal from the DC Input Board and generates a DC_GOOD_DIAG signal as long as the VIN__FLTRD signal remains within predetermined limits. The circuitry also drives the LED indicators (described below).

LED Status Indicators

Two LEDs located on the power supply module front panel indicate module status as follows:

- **Power On—** lights GREEN when On/Off switch is On and the AC input voltage is within operating range; LED turns off when module is turned off, ac power is removed, or AC input voltage is below approximately 85 V rms.
- **Module Fail—** lights RED when initially turning on or off the Power Supply (this is normal and does not indicate a failure) or when the DC-to-DC Converter Board is not functioning properly; LED turns off when module is functioning properly

Address Decode Circuitry

The address decode circuitry allows the Station Control Module to use the address bus to select either the D/A converter (Battery Charger/Revert Board) or the A/D converter (Diagnostics Circuitry) for communications via the SPI bus. Typical communications include reading status signals from the Diagnostics Circuitry.

Startup/Shutdown Control Circuitry

Shutdown Delay Circuitry

Upon receiving a shutdown signal (PRI_SHUTDOWN) from the +28V Main Supply Circuitry, this circuit passes the signal through the Soft Start Circuitry for a 1 second interval to allow the entire power supply module to shutdown. The module then restarts (if the on/off switch is in **On** position). If the PRI_SHUTDOWN signal is still active, the shutdown process will repeat.

Soft Start Circuitry

Each time the Soft Start Circuitry receives a startup signal (i.e., PRI_SHUTDOWN is inactive), the Soft Start Circuitry provides a gradually increasing output signal to "soft start" the Pulse Width Modulators (p/o +28V Main Supply Circuitry). This action minimizes the surge current when charging the output filter capacitors.

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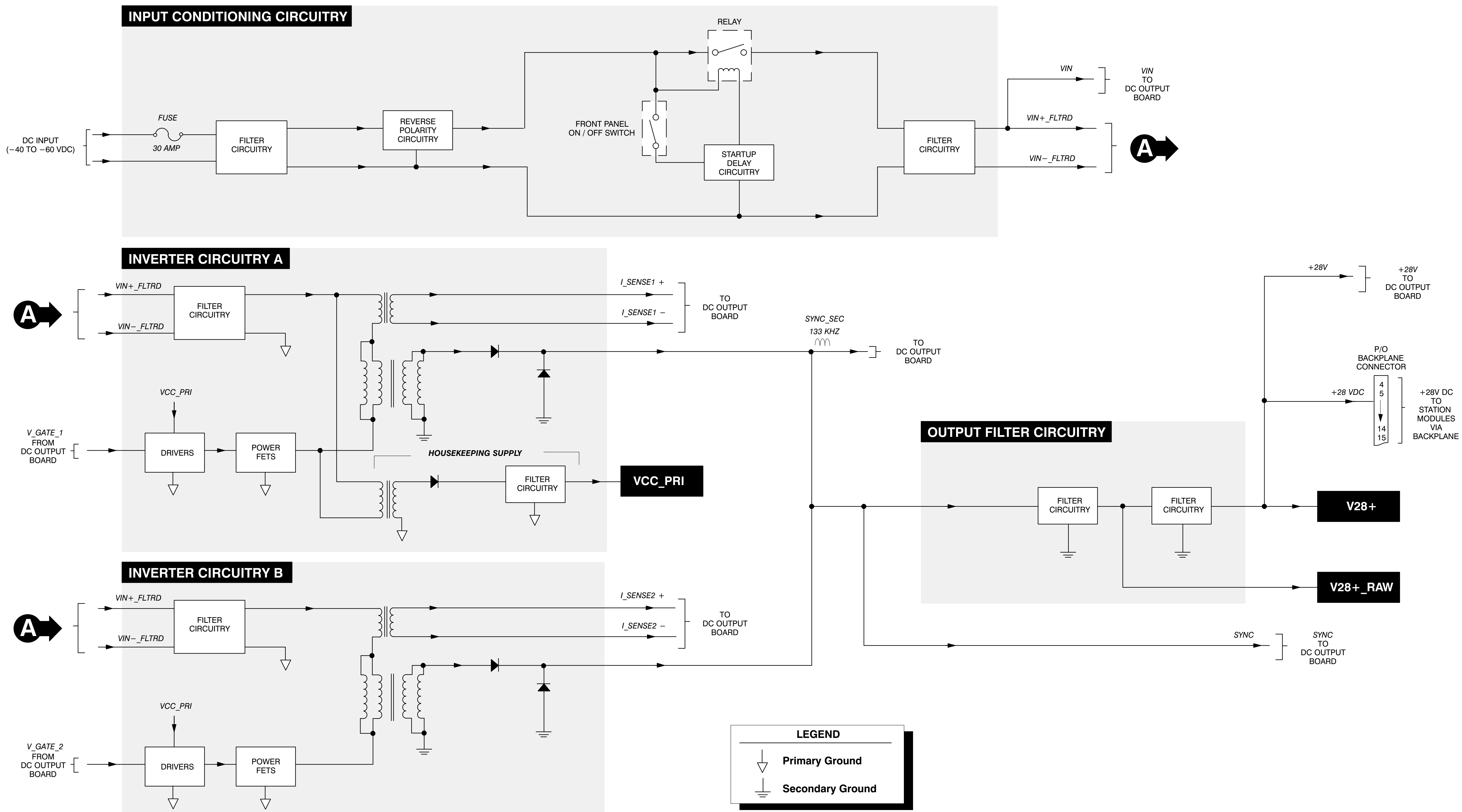

Figure 2. CPN6064B DC Input Board Functional Block Diagram

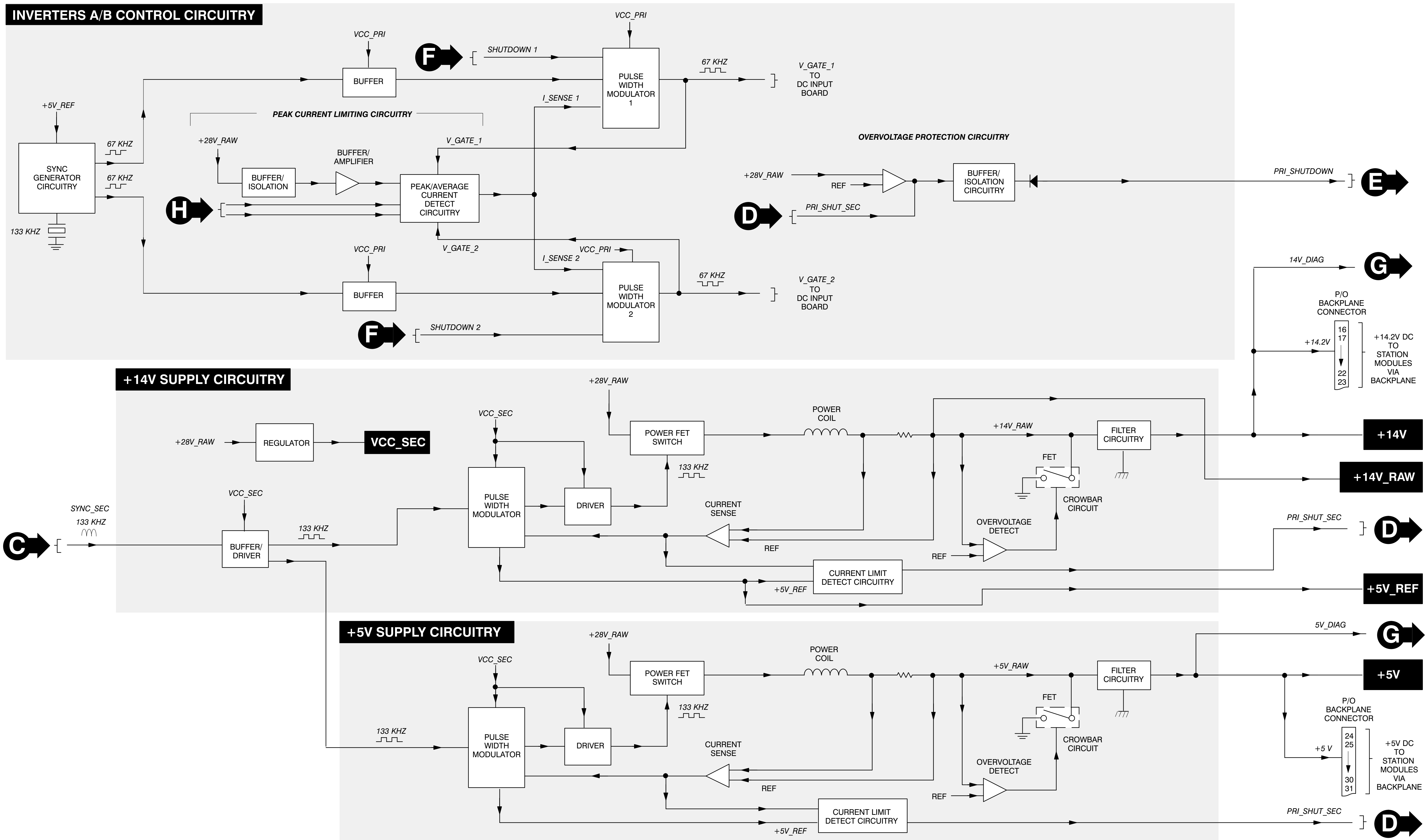

Figure 3. CPN6068A DC Output Board Functional Block Diagram (1 of 2)

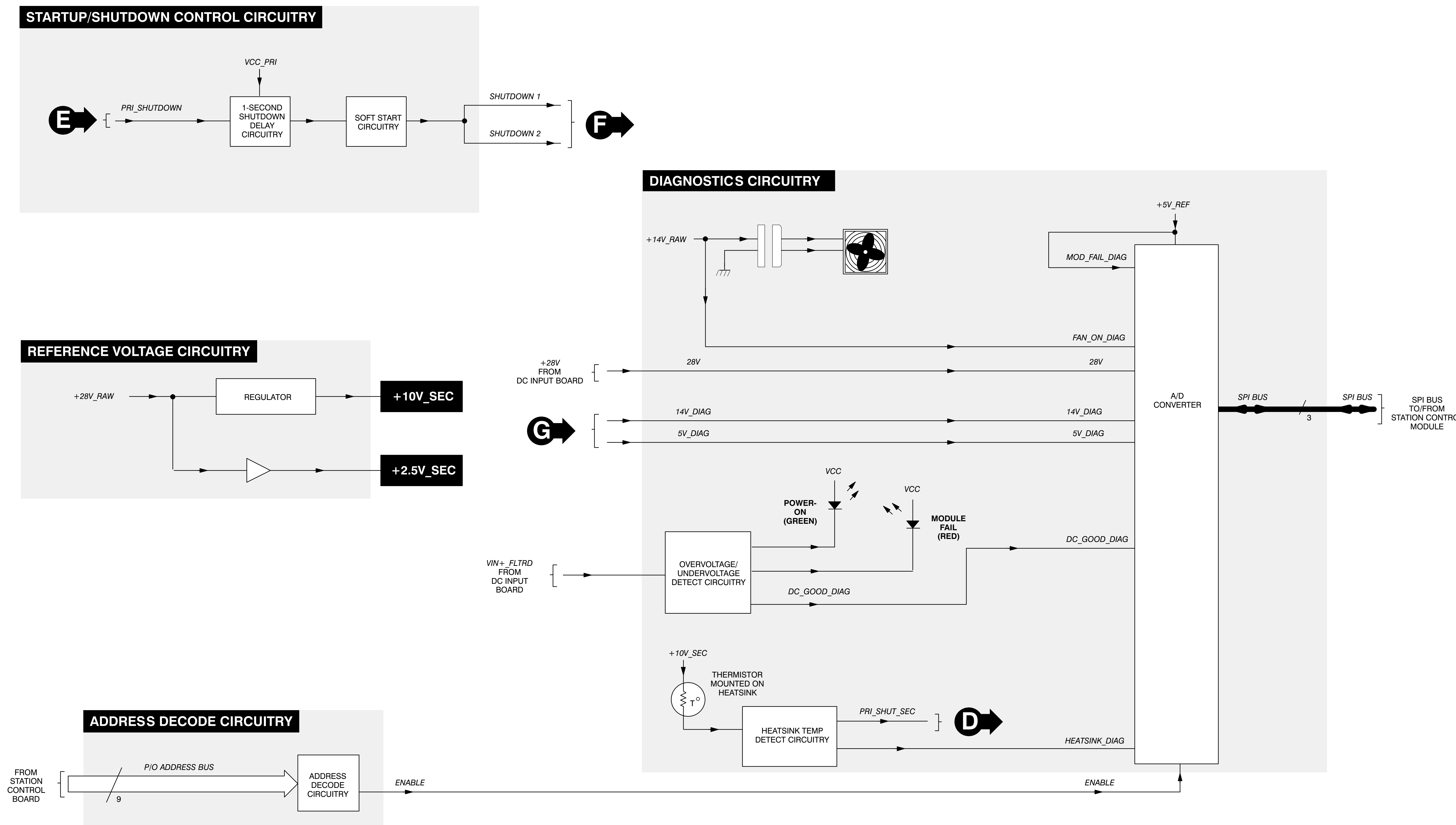

Figure 3. CPN6068A DC Output Board Functional Block Diagram (2 of 2)

MOTOROLA

STATION BACKPLANE BOARD

MODEL TRN7480A

1 DESCRIPTION

The TRN7480A Station Backplane Board provides the electrical interconnections for the plug−in modules of a *Quantar* station. The board also provides the connectors necessary to interface the station to phone lines, peripheral rf equipment, and other communications and maintenance equipment. This section provides a general description, identification of inputs/outputs, and a pin−out listing for all interface connectors, including information on signal names, functions, and levels.

General Description

The station backplane board (mounted across the rear of the *Quantar* station card cage) is constructed with connectors on both sides. The connectors on one side mate with the various station plug−in modules; the connectors on the other side allow interface connections between the station and the phone lines, peripheral rf equipment, and other communications and maintenance equipment.

A metal shield mounts over the rear of the backplane board to provide protection for the circuit board runners and connector solder pads, ESD protection, and EMI/RFI shielding, as shown in Figure 1. This shield also provides a mounting location for the antenna connector bracket and the station grounding lug.

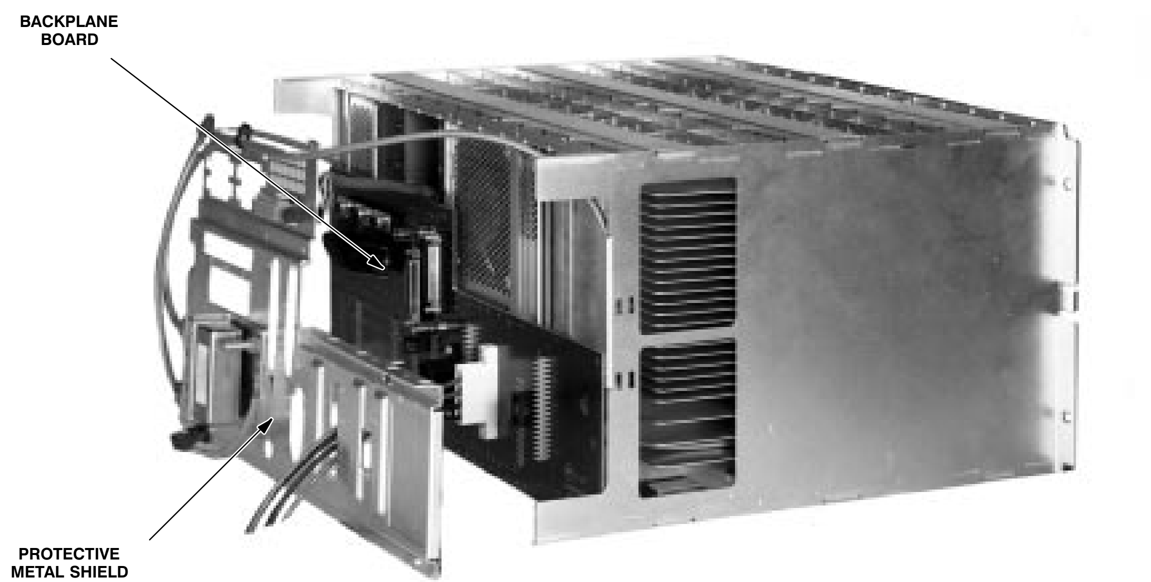

Figure 1. Backplane (Shown with Protective Metal Shield Removed)

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2 LOCATION OF BACKPLANE CONNECTORS

Figure 1 shows the location of the connectors on each side of the station backplane board.

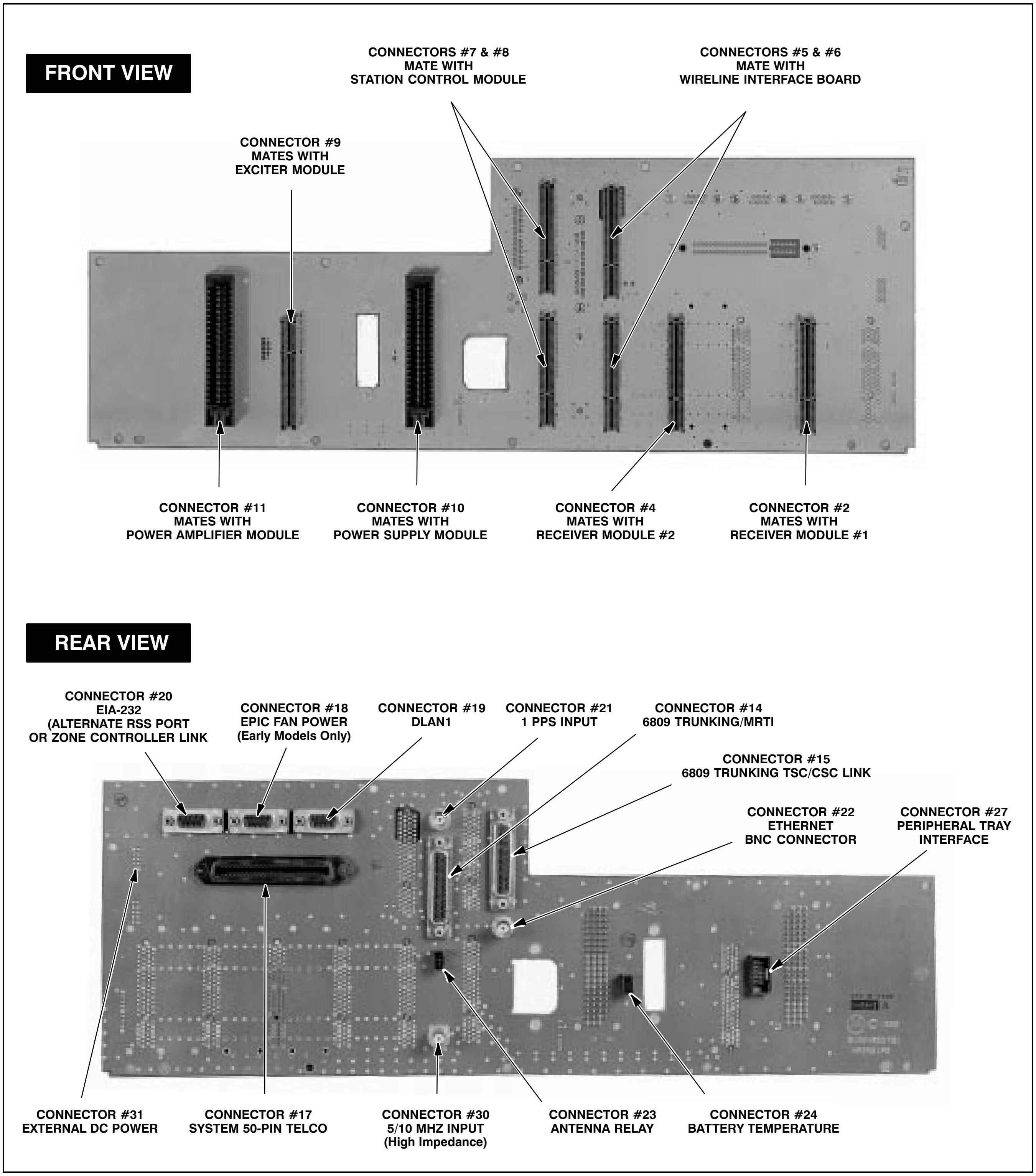

Figure 1. *Quantar* Station Backplane (TRN7480A) Connector Locations (Front and Rear Views)

3 BACKPLANE CONNECTORS INFORMATION

Each connector on the backplane has been assigned a connector number. In some cases, the connector number is stamped into the metal shield covering the rear of the backplane board. The connectors which accept the plug−in modules are not marked. Table 1 lists each connector and its assigned number.

Figure 2 provides pin−out information for all connectors located on the rear of the backplane board. As shown, each connector pin is defined by signal name, input or output (with reference to connector), to/from location, and a brief description of the signal function. Note that pin−out information for any connectors intended for future applications is not shown. Also, note that in the "To/From" column the source or destination of the signal is given as a connector number followed by a pin number. The first number (preceded by a "#") represents the assigned connector number, followed by the specific connector pin number.

Table 1. Assigned Connector Number vs Function/Location Information

Connector #	Function/Location
1	Not used
2	Accepts plug−in Receiver Module #1
3	Not used
4	Accepts plug−in Receiver Module #2
5	Accepts bottom card−edge connector of plug−in Wireline Interface Board
6	Accepts top card−edge connector of plug−in Wireline Interface Board
7	Accepts bottom card−edge connector of plug−in Station Control Module
8	Accepts top card−edge connector of plug−in Station Control Module
9	Accepts plug−in Exciter Module
10	Accepts plug−in Power Supply Module
11	Accepts plug−in Power Amplifier Module
12	Not used
13	Not used
14	Provides interface for 6809 Trunking Controller and (future) MRTI Interface
15	Accepts TSC/CSC Link cable from 6809 Trunking Controller
16	Not used
17	50−pin Telco System Connector (accepts customer phone line connections, access to customer−defined inputs/outputs, Simulcast inputs, etc.; connector located on backplane at rear of station)
18	Provides dc power to external fan module for early model EPIC Station Control Modules (limited production)
19	DLAN1 DB−9 connector (used in *IntelliRepeater* applications to form network between multiple stations; connector located on backplane at rear of station; mates with DB−9−to−dual RJ11 *PhoneNET* adapter module; see note above)
20	EIA−232 asynchronous port (used for connection to *SMARTZONE* controller in wide−area *IntelliRepeater* trunking system or for alternate RSS port in a non−*IntelliRepeater* trunking system)
21	1 PPS input from GPS Receiver for *ASTRO* Simulcast systems
22	BNC connector which allows connection to an *IntelliRepeater* Ethernet network via a 10BASE−2 coaxial T-connector. Also may be used to locally connect PC running RSS to download software to FLASH memory in Station Control Module.
23	Antenna Relay 3−pin AMP−type connector (used to supply control signal to antenna relay module; connector located on backplane at rear of station)
24	Battery Temperature 3−pin AMP−type connector (used to accept variable resistance proportional to temperature of co−located storage batteries; connector located on backplane at rear of station)
25	Not used
26	Not used
27	RF Peripheral Tray 10−pin AMP−type connector (used to transfer signals to/from components housed in externally−mounted RF Peripheral Tray; connector located on backplane at rear of station)
28	Not used
29	Not used
30	BNC input connector (used to accept 5/10 MHz reference signal from external frequency standard for calibrating reference oscillator in Station Control Module; connector located on backplane at rear of station; electrically isolated from BNC connector on front panel of Station Control Module to allow for multi-drop configuration)
31	Provides external +5V and +14.2 V dc power (e.g., MRTI, Modem, etc.)

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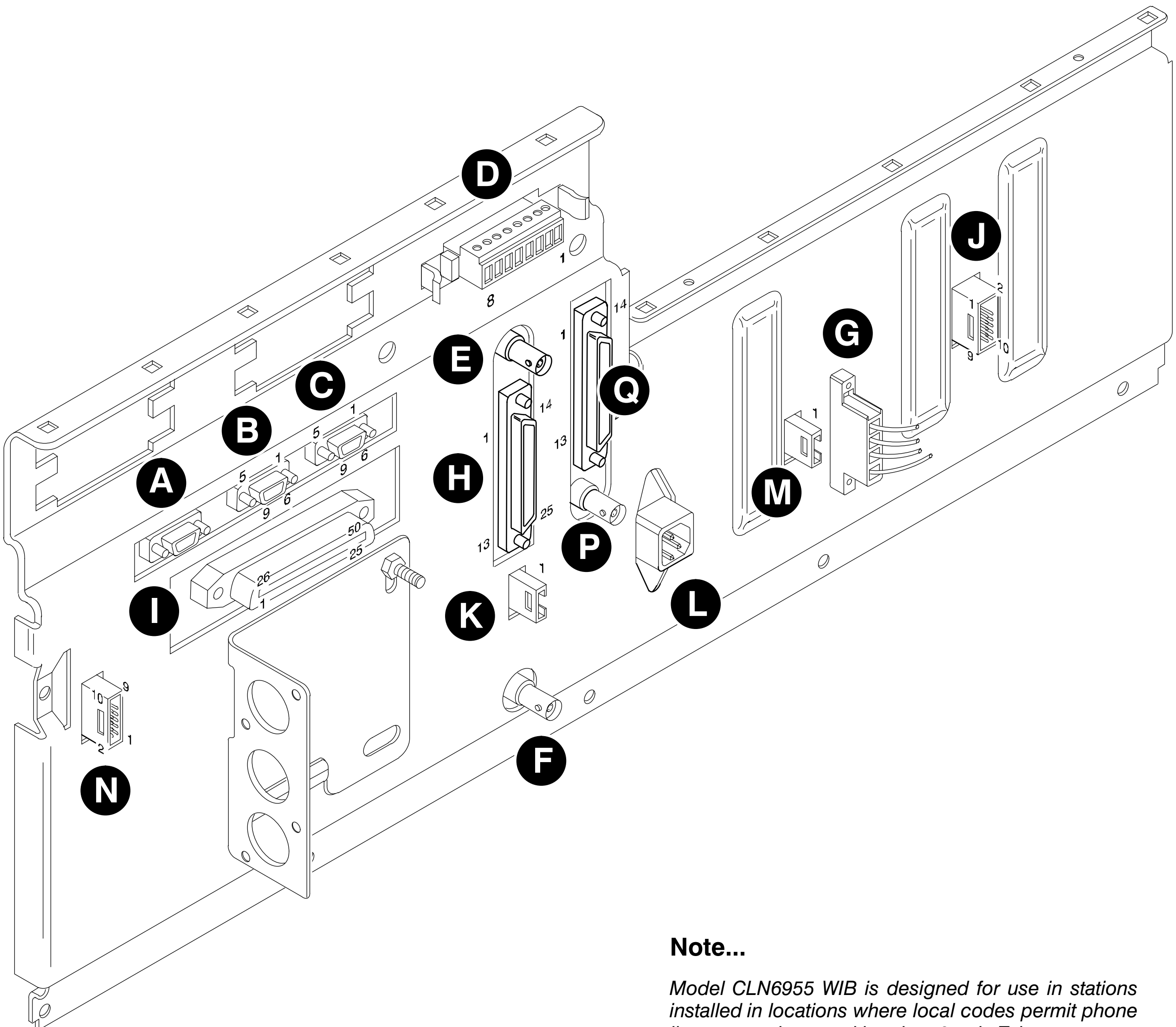


Note...

Model CLN6955 WIB is designed for use in stations installed in locations where local codes permit phone line connections to either the 50–pin Telco connector (I) or the orange screw terminal connector (D). Model CLN6957 allows only connections to the orange screw terminal connector (D).

Figure 2. TRN7480A Backplane Rear Connectors Pin–Out Information (Sheet 1 of 3)

A

CONNECTOR #20	EIA–232 (Alternate RSS Port)			
Pin #	**Signal**	**Input**	**Output**	**Function**
1	DCD1	✓		Data Carrier Detect
2	RXD1	✓		Receive Data
3	TXD1		✓	Transmit Data
4	DTR		✓	Data Terminal Ready
5	SIGNAL GND			Station Ground
6	DSR	✓		Data Set Ready
7	RTS1		✓	Request to Send
8	CTS1	✓		Clear to Send
9	Ring Indicator			Not used

B

CONNECTOR #18	EPIC Fan Control (Early Models Only)			
Pin #	**Signal**	**Input**	**Output**	**Function**
1	FAN GND			Ground for external fan
2				
3				
4				
5				
6				
7				
8	FAN +		✓	+14.2 V dc for external fan
9				

C

CONNECTOR #19	DLAN1			
Pin #	**Signal**	**Input**	**Output**	**Function**
1	Shield Gnd			Station Ground
2	WFI+			Future use
3	WFI —			Future use
4	DLAN1+	✓	✓	Differential Data (+)
5	DLAN1 —	✓	✓	Differential Data (—)
6	WFI+			Future use
7	WFI —			Future use
8	DLAN1+	✓	✓	Differential Data (+)
9	DLAN1 —	✓	✓	Differential Data (—)

D

PHONE LINE INPUTS

1	LINE 1 +	5	LINE 3 +
2	LINE 1 —	6	LINE 3 —
3	LINE 2 +	7	LINE 4 +
4	LINE 2 —	8	LINE 4 —

E

CONNECTOR #21

1 PPS

1 PPS clock signal from GPS Receiver for *ASTRO* Simulcast application. TTL levels @ 50 ohms.

F

CONNECTOR #30

5/10 MHZ INPUT

Accepts external 5 or 10 MHz Frequency Standard for Calibrating Station Reference Oscillator (located in Station Control Module);
5 MHz injection level = 1.0 ± .5 V RMS;
High Impedance Input

G

CONNECTOR #25

BATTERY CHARGER OUTPUT

Two RED (top) and two BLACK (bottom) wires to battery revert connector mounted on station cage.

H

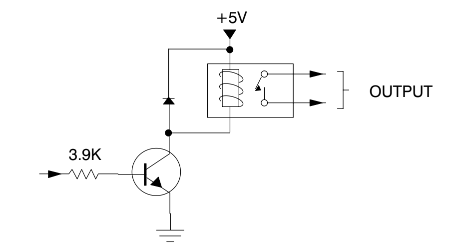
CONNECTOR #14	6809 TRUNKING/MRTI			
Pin #	**Signal**	**Input**	**Output**	**Function**
1	MRTI TX Audio			MRTI
2	MRTI PTT			MRTI
3	Open			MRTI
4	Monitor			MRTI
5	PL Strip			MRTI
6	Open			MRTI
7	MRTI RX Audio			MRTI
8	Patch INH			MRTI
9	Gnd			MRTI
10	AUX Indicate			Future use
11	TPTT	✓		Control signal to key transmitter (active low) (6809)
12	TSTAT		✓	Indicates transmitter status (active high) (6809)
13	Tx Data +	✓		Modulation input from 6809 Controller (6809)
14	Open			
15	Rx Carrier			MRTI
16	Gnd			Station Ground (6809)
17	Gnd			Station Ground (6809)
18	Gnd			Station Ground (6809)
19	Gnd			Station Ground (6809)
20	Gnd			Station Ground (6809)
21	Tx Data –	✓		Modulation input from 6809 Controller (6809)
22	Rx Wideband Aud		✓	Receive output to 6809 Controller (6809)
23	MUTE	✓		Mutes station signals (active low) (6809)
24	CCI	✓		Indicates Control Channel status (active low) (6809)
25	RSTAT			Indicates receiver status (active high) (6809)

I

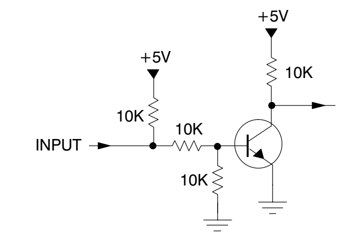
CONNECTOR #17	SYSTEM 50–PIN TELCO			
Pin #	**Signal**	**Input**	**Output**	**Function**
1	Line 1+	✓		Customer 4–wire Phone Line Input (Line 1+)
2	Line 2+	✓	✓	Customer 2–wire Phone Line Input/Output (Line 2+)
3	Line 3+	✓		Customer 4–wire Phone Line Input (Line 3+)
4	Line 4+		✓	Customer 4–wire Phone Line Output (Line 4+)
5	Aux TX Audio	✓		Input from external device
6	Open			Open
7	GND			Station Ground
8	5 VDC Out		✓	+5V dc from Power Supply (1 Amp Max.)
9	Gen TX Data —			Modulation signal from Simulcast equipment (Note 1)
10	PL (+) In	✓		Future Use
11	Aux In 1 (Ext Failsoft)	✓		Customer–defined transistor buffered Input (Note 1)
12	Aux In 2 (TX Inhibit)	✓		Customer–defined transistor buffered Input (Note 1)
13	Aux In 3 (Ext TX Code Det)	✓		Customer–defined transistor buffered Input (Note 1)
14	Aux In 4 (RX WL Inhibit)	✓		Customer–defined transistor buffered Input (Note 1)
15	Aux In 5 (Duplex Enable)	✓		Customer–defined transistor buffered Input (Note 1)
16	Aux In 6 (In Cabinet Repeat)	✓		Customer–defined transistor buffered Inpu (Note 1)
17	Aux In 7 (Channel 4)	✓		Customer–defined transistor buffered Input (Note 1)
18	Aux Out 7 (RD Stat +)		✓	N.O. contact of Relay A (Note 1)
19	Aux Out 8		✓	N.O. contact of Relay B
20	Aux Out 9		✓	N.O. contact of Relay C
21	Aux Out 10		✓	N.O. contact of Relay D
22	Aux In 9 (Ext PTT+)	✓		Opto–isolated customer–defined input (Opto A+)
23	Aux In 10 (Channel 1 +)	✓		Opto–isolated customer–defined input (Opto B+)
24	Aux In 11 (Chanel 2 +)	✓		Opto–isolated customer–defined input (Opto C+)
25	Aux In 12 (Channel 3 +)	✓		Opto–isolated customer–defined input (Opto D+)
26	Line 1 —	✓		Customer 4–wire Phone Line Input (Line 1—)
27	Line 2 —	✓	✓	Customer 2–wire Phone Line Input/Output (Line 2—)
28	Line 3 —	✓		Customer 4–wire Phone Line Input (Line 3 —)
29	Line 4 —		✓	Customer 4–wire Phone Line Output (Line 4—)
30	Aux RX Audio		✓	Output to external device
31	Open			Open
32	GND			Station Ground
33	14.2 VDC Out		✓	+14.2 V dc from Power Supply (1 Amp Max.)
34	Gen TX Data +			Modulation signal from Simulcast equipment
35	PL (—) In	✓		Future Use
36	Aux Out 1 (Failsoft Ind)		✓	Customer–defined transistor buffered output (Note 1)
37	Aux Out 2 (RX Code Det)		✓	Customer–defined transistor buffered output (Note 1)
38	Aux Out 3		✓	Customer–defined transistor buffered output
39	Aux Out 4		✓	Customer–defined transistor buffered output
40	Aux Out 5		✓	Customer–defined transistor buffered output
41	Aux Out 6		✓	Customer–defined transistor buffered output
42	Aux In 8	✓		Customer–defined transistor buffered input
43	Aux Out 7 (RD Stat –)		✓	N.O. contact of Relay A (Note 1)
44	Aux Out 8		✓	N.O. contact of Relay B
45	Aux Out 9		✓	N.O. contact of Relay C
46	Aux Out 10		✓	N.O. contact of Relay D
47	Aux In 9 (Ext PTT—)	✓		Opto–isolated customer–defined input (Opto A—)
48	Aux In 10 (Channel 1 –)	✓		Opto–isolated customer–defined input (Opto B—)
49	Aux In 11 (Channel 2 –)	✓		Opto–isolated customer–defined input (Opto C—)
50	Aux In 12 (Channel 3 –)	✓		Opto–isolated customer–defined input Opto D—)

Notes:

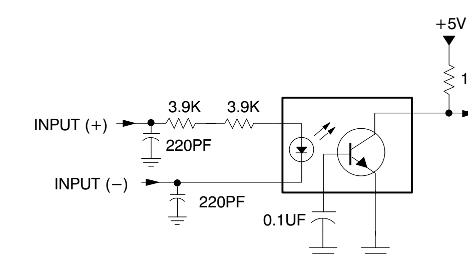
1. Many of the customer–defined inputs and outputs have been preassigned wtih signal names and functions usually required in typical Trunking, *SECURENET*, and other systems. These default preassignments have been made for customer convenience only, and may be re–assigned as necessary. The preassigned signal names are shown in parentheses in the SIGNAL column. (Reassignment requires the use of the Wildcard Option.)



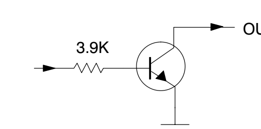
Typical Relay Closure Output Circuit



Typical Transistor-Coupled Input Circuit



Typical Opto-Coupled Input Circuit



Typical Transistor-Coupled Output Circuit

Figure 2. TRN7480A Backplane Rear Connectors Pin–Out Information (Sheet 2 of 3)

J

CONNECTOR #27				PERIPHERAL TRAY INTERFACE
Pin #	**Signal**	**Input**	**Output**	**Function**
1	14.2 V		✓	+14.2 V dc from Power Supply (1 Amp Max.)
2	GND			Station Ground
3	ANT RLY KEYED A+		✓	Switched +14.2 V to energize antenna relay (if located in Peripheral Tray)
4	EXT I/O 2			Future Use
5	EXT I/O 1		✓	Switched +14.2 V to energize Main/Standby relay
6	EXT Circ Temp	✓		DC voltage proportional to temperature from sensor mounted on Dual Circulator Module
7	EXT WM Ref			Ground reference for External Wattmeter
8	EXT WM Vr	✓		DC voltage proportional to External Wattmeter reflected power
9	EXT WM Vf	✓		DC voltage proportional to External Wattmeter forward power
10	GND			Station Ground

N

CONNECTOR #31				EXTERNAL DC POWER
Pin #	**Signal**	**Input**	**Output**	**Function**
1	GND		✓	Station Ground
2	Spare			Not Used
3	Spare			Not Used
4	Spare			Not Used
5	Spare			Not Used
6	+14.2 V		✓	+14.2 V dc @ 1 Amp (if no connection to Connector #17–pin 33)
7	Spare			Spare
8	+5 V		✓	+5 V dc @ 1 Amp (if no connection to Connector #17–pin 8)
9	Spare			Not Used
10	GND		✓	Station Ground

K

CONNECTOR #23				ANTENNA RELAY
Pin #	**Signal**	**Input**	**Output**	**Function**
1	GND			Station GND
2	ANT RLY KEYED A+		✓	Switched +14.2 V to energize antenna relay
3	GND			Station Gnd

P

CONNECTOR #22

ETHERNET PORT

Accepts 10BASE–2 coaxial cable (via T-connector) for connections to an *IntelliRepeater* Ethernet network or to download software via a locally connected PC running RSS.

L

CONNECTOR #50

AC INPUT

Connects to 110V/220V AC source via 3–wire line cord.

Q

CONNECTOR #15				MULTI-PURPOSE RS-232
Pin #	**Signal**	**Input**	**Output**	**Function**
1	Shield Gnd			Station Ground
2	TxD3		✓	Transmit Data
3	RxD3	✓		Receive Data
4	RTS3		✓	Request to Send
5	CTS3	✓		Clear to Send
6	DSR3	✓		Data Set Ready
7	Signal Ground			Station Ground
8	DCD3	✓		Data Carrier Detect
9	OPEN			
10	OPEN			
11	OPEN			
12	OPEN			
13	Local Loopback 3		✓	Not Used
14	OPEN			
15	TCLK3		✓	Transmit Clock
16	OPEN			
17	RCLK	✓		Receive Clock
18	OPEN			
19	OPEN			
20	DTR3		✓	Data Terminal Ready
21	OPEN			
22	OPEN			
23	OPEN			
24	OPEN			
25	Remote Loopback 3		✓	Not Used

M

CONNECTOR #24				BATTERY TEMPERATURE
Pin #	**Signal**	**Input**	**Output**	**Function**
1	GND			Station Ground
2	BATT TEMP	✓		Variable resistance proportional to battery temperature from sensor near storage batteries
3	GND			Station Ground

Figure 2. TRN7480A Backplane Rear Connectors Pin–Out Information (Sheet 3 of 3)

MOTOROLA

ANTENNA RELAY MODULE

Option X371AA

1 DESCRIPTION

Option X371AA provides an antenna relay module for use with *Quantar* and *Quantro* station products. This section provides a general description, option complement, identification of inputs/outputs, and functional theory of operation. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

This antenna relay module allows a single antenna to be used for both transmit and receive functions (base station applications only). The antenna relay is controlled by a signal from the Station Control Module to connect the antenna to either the Power Amplifier Module (transmit) or Receiver Module (receive). The antenna relay module is mounted on an angle bracket provided on the rear of the station card cage.

Figure 1. Typical Antenna Relay Module

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2 INPUT AND OUTPUT CONNECTIONS

Figure 2 shows the antenna relay module input and output external connections.

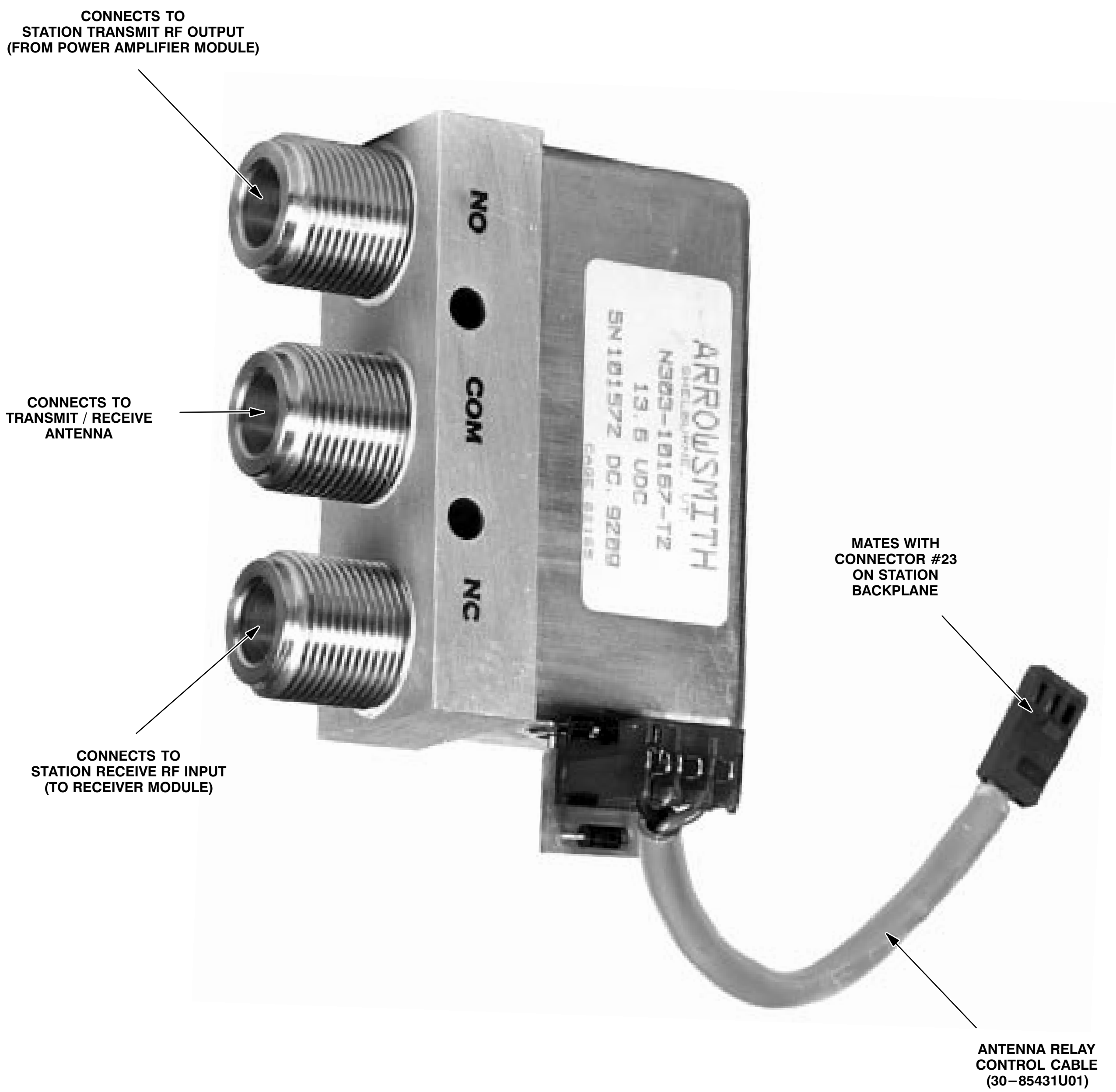

Figure 2. Antenna Relay Module Inputs/Outputs

3 OPTION COMPLEMENT

Table 1 shows the contents for the Option X371AA antenna relay module.

Option Complement Chart

Table 1. Antenna Relay Option X371AA Complement

Model	Description
TRN7664A	Includes miscellaneous hardware and antenna relay module (Motorola Part No. 80−84033T02)

4 PERFORMANCE SPECIFICATIONS

Table 2 shows the electrical performance specifications for the antenna relay used in Options X371AA−AC.

Performance Specifications

Table 2. Performance Specifications for Antenna Relay

Parameter	Specification
Operating Frequency	DC − 4 GHz
Maximum Input Power	500W
Coil Specifications: Pull−in voltage Drop−out voltage Resistance	 9.5V dc 2V dc 100Ω ±10% @ 20°C
Contacts Specifications: Type Actuation Pull−in time Drop−out time	 SPDT Failsafe 20 msec max. 10 msec max.
Insertion Loss	0.30dB max
Isolation	70dB min
VSWR Maximum	1.3 : 1
Temperature Range	−30°C to +80°C
Terminations	Female N−Type
Input and Output Impedance	50 Ohms

5 MOUNTING LOCATIONS

In order to provide alternative routing for the antenna rf cable, the Antenna Relay Module may be installed in two positions on the rf input/output bracket. Stations equipped with the antenna relay module option are shipped with the antenna relay module installed as shown in Figure 3, allowing the rf cable to be routed out the side of the cabinet or rack. If desired, the bracket may be turned 90° counterclockwise to allow the cable to be routed toward the bottom of the cabinet or rack, as shown in Figure 4.

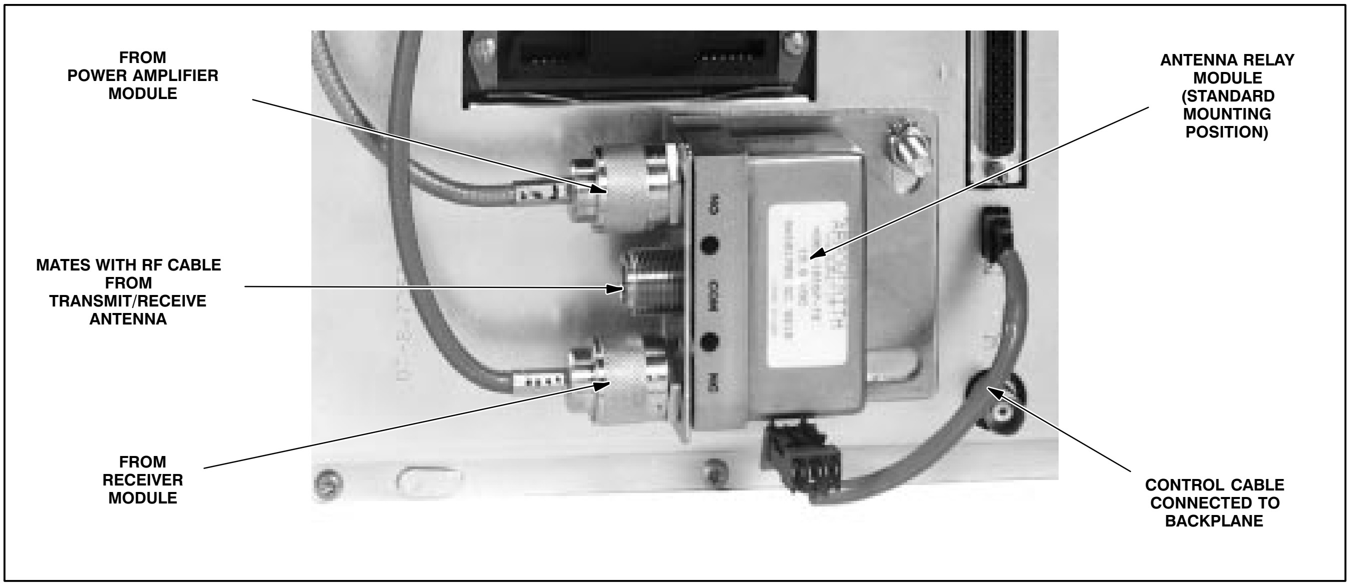

Figure 3. Standard Mounting Position for Antenna Relay Module

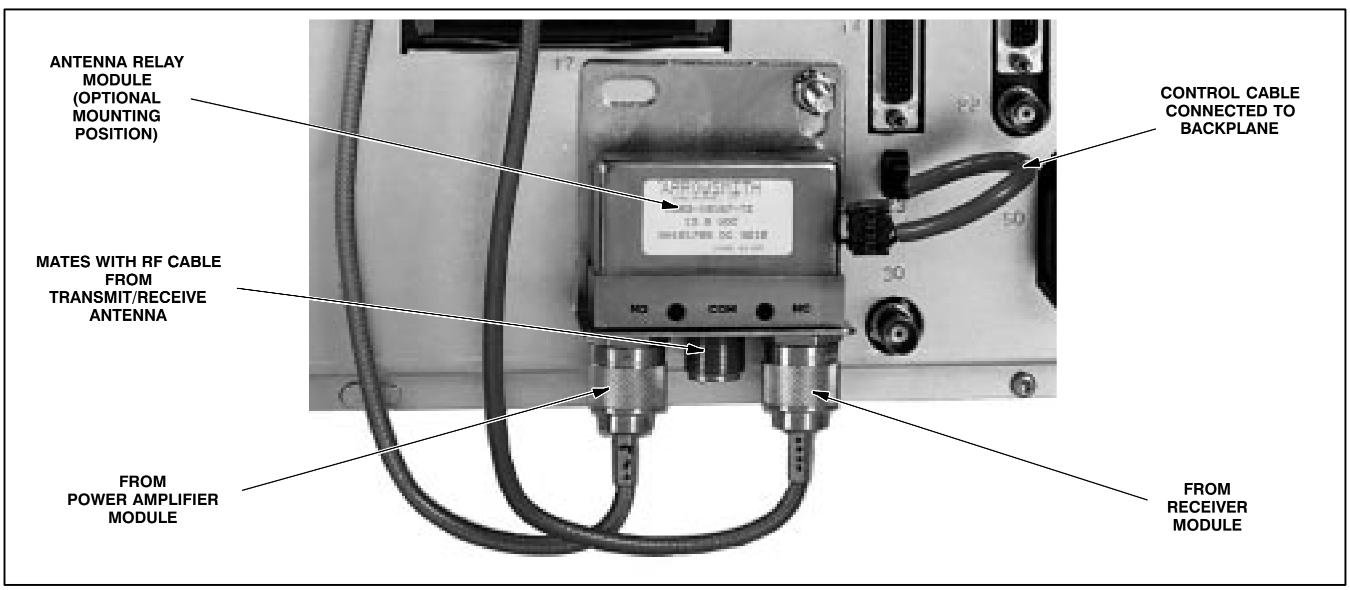

Figure 4. Optional Mounting Position for Antenna Relay Module

6 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the Antenna Relay Module at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 5 for a block and interconnect diagram of the Antenna Relay Module.

Functional Operation

Note that with the relay de−energized the antenna is connected to the Receiver Module. To connect the antenna to the Power Amplifier Module, the Station Control Module must energize the relay.

The Antenna Relay Module contains a relay with a set of normally open and normally closed contacts. The relay coil is controlled by a signal from the Station Control Module to connect either the Receiver Module or the Power Amplifier Module to a single transmit/receive antenna. Refer to the block diagram shown in Figure 2.

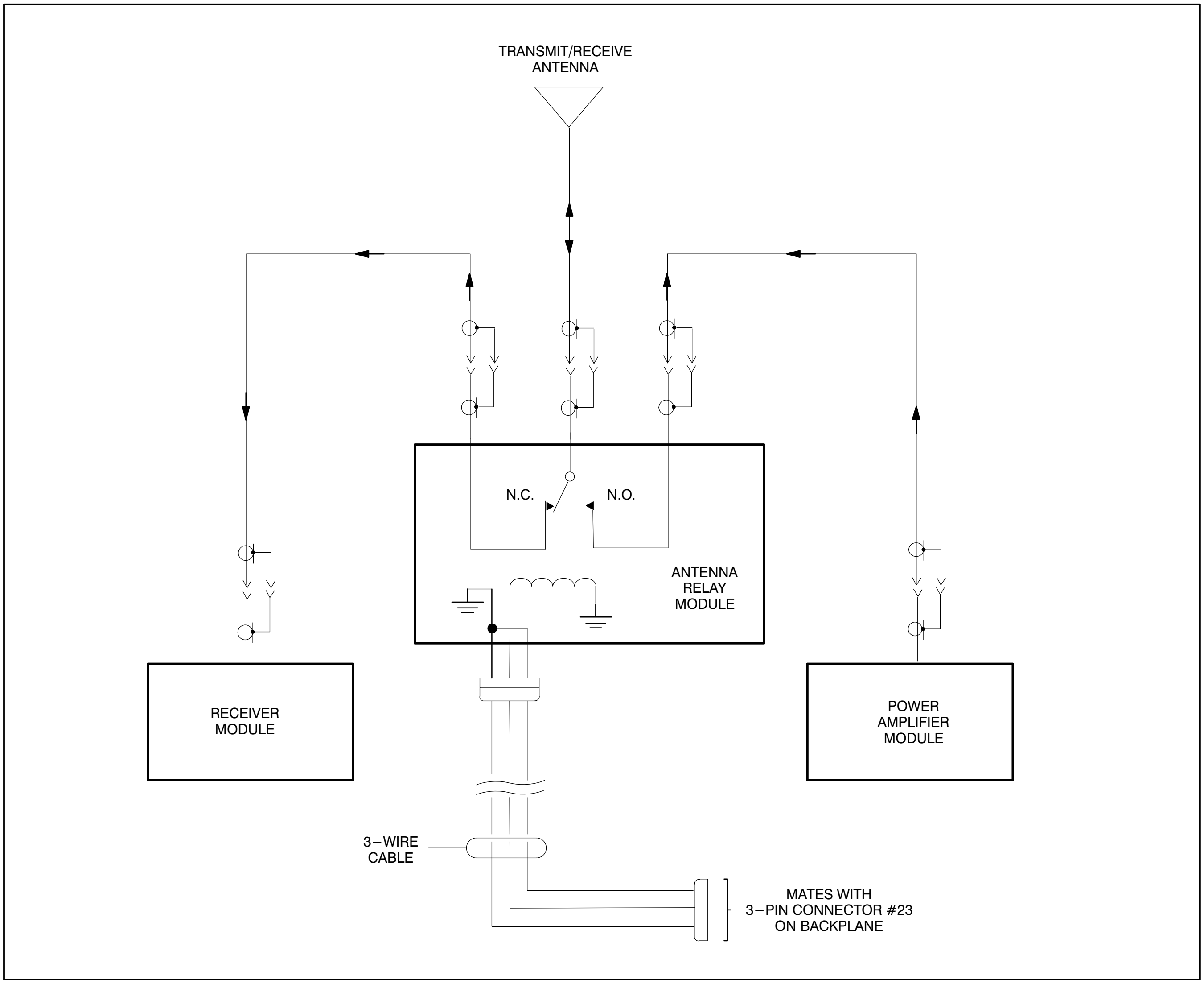

Figure 5. Functional Block and Interconnect Diagram for Antenna Relay Module

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MOTOROLA

TRIPLE CIRCULATOR OPTION

(Options X676AA–AC)

1 DESCRIPTION

Options X676AA–AC provide band–specific dual circulator assemblies and low pass filters for use with *Quantar* VHF station. The triple circulator option is comprised of the dual circulator assembly combined with the single circulator located in the station power amplifier module. This combination provides 65 dB (min) of isolation between the Power Amplifier Module and the transmit antenna. A low pass filter connects between the dual circulator output and the transmit antenna.

This section provides a general description, option matrix chart, identification of inputs/outputs, and functional theory of operation. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The dual circulator assembly consists of two rf circulators and a 50 Ω load with heat sink, all mounted on a 3/16 ” aluminum plate which is housed in the Peripheral Tray. The tray is equipped with a cooling fan which directs air across the fins of the heat sink. The rf output from the Power Amplifier Module connects to the input of the assembly, while the output connects to an external low pass filter. The output of the filter connects to the transmit antenna (directly, via antenna relay module, or via duplexer).

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2 OPTIONS COMPLEMENT

Table 1 shows the applications and contents for the available triple circulator options for *Quantar* VHF station.

Option Complement Chart

Table 1. Triple Circulator Options Complement

Option	Application	Option Contents	
X676AA	*Quantar* VHF High Band (132–146 MHz)	TYD4001A TLN3391A TYD4010A TRN7796A	Dual Circulator 50Ω Load w/ heatsink Low Pass Filter Cooling Fan
X676AB	*Quantar* VHF High Band (144–160 MHz)	TYD4002A TLN3391A TYD4010A TRN7796A	Dual Circulator 50Ω Load w/ heatsink Low Pass Filter Cooling Fan
X676AC	*Quantar* VHF High Band (158–174 MHz)	TYD4003A TLN3391A TYD4010A TRN7796A	Dual Circulator 50Ω Load w/ heatsink Low Pass Filter Cooling Fan

3 PERFORMANCE SPECIFICATIONS

Table 2 shows the electrical performance specifications for the dual circulator assembly used for Options X676AA–AC.

Table 3 shows the electrical performance specifications for the low pass filter used in Options X676AA–AC.

Performance Specifications

Table 2. Performance Specifications for Dual Circulator Assembly

Parameter	Specification
Operating Frequency X676AA X676AB X676AC	 132–146 MHz 144–160 MHz 158–174 MHz
Maximum RF Input Power	400W
Insertion Loss	1.25dB max (with low pass filter)
Isolation	45 dB min *(total of 65 dB when combined with circulator built into power amplifier module)*
Operating Temperature Range	–20°C to +70°C
Input/Output Return Loss	19.1 dB min
Terminations	Female N–Type
Input and Output Impedance	50 Ohms
50Ω Load Maximum Power	25W without cooling fan on 90W with cooling fan on
Thermistor Output	50 kΩ @ 25°C 1.7 k Ω @ 125°C

Table 3. Performance Specifications for Low Pass Filter

Parameter	Specification
Operating Frequency	132–174 MHz
Insertion Loss	0.25 dB
Maximum RF Input Power	350W
Rejection	55 dB min (264–600 MHz)

4 INPUTS/OUTPUTS

Figure 1 shows the dual circulator assembly input and output external connections.

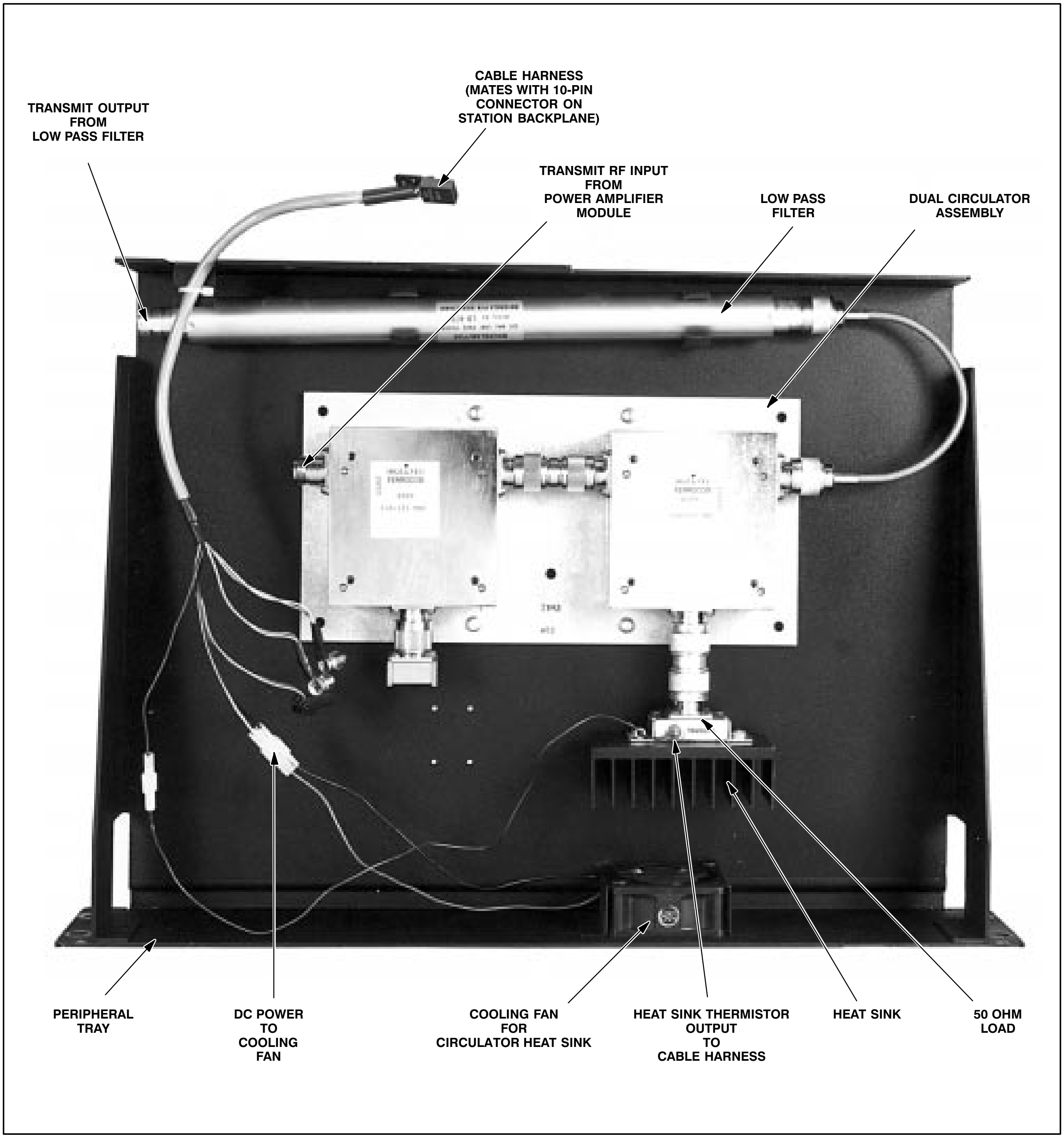

Figure 1. Dual Circulator Assembly and Low Pass Filter (Mounted in Peripheral Tray) Inputs and Outputs

5 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the Dual Circulator Assembly and Low Pass Filter at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block and interconnect diagram of the Dual Circulator Assembly and Low Pass Filter.

Functional Operation

Note: *The Triple Circulator Option is typically used in high density radio site applications where other co–located transmitters near the frequency of the station can cause I.M. products. The addition of the dual circulator improves I.M. from >30dB$_I$ to >75 dB$_I$. The low pass filter reduces spurious emissions to 90 dBc.*

The Dual Circulator Assembly accepts transmit rf output power from the power amplifier module and provides 45 dB (minimum) of isolation between the power amplifier module and the transmit antenna. The assembly consists of two circulators, each with a 50Ω load. Each circulator allows forward rf energy to pass through to the output, while routing any reflected rf energy to the corresponding 50Ω load. Refer to the block diagram shown in Figure 2.

Most of the reflected energy is absorbed by the 50Ω load (heat sink mounted) connected to the second circulator. A thermistor mounted on the heat sink provides a variable resistance signal proportional to the heat sink temperature. This signal is routed to the Station Control Module via the Peripheral Tray cabling harness. If the heat sink temperature exceeds a preset threshold, the Station Control Module enables PA cutback mode. If the overtemperature condition persists, the power amplifier is shut down completely.

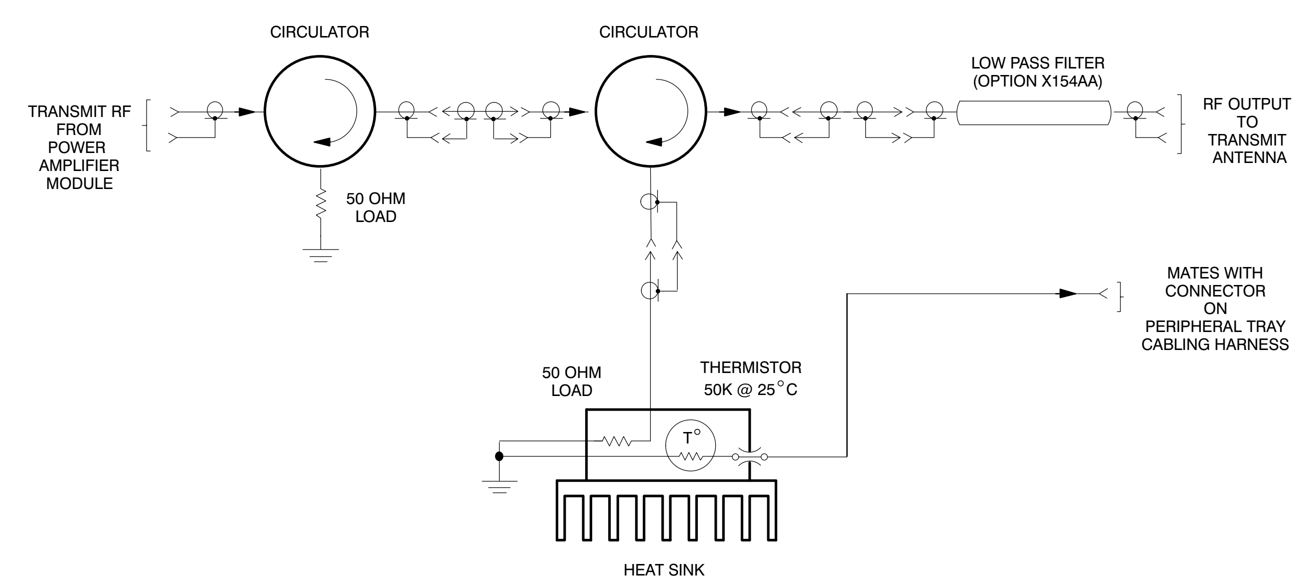

Figure 2. Functional Block and Interconnect Diagram for Dual Circulator Assembly

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TRIPLE CIRCULATOR OPTION

Options X676AN (UHF R1/R2)
X676AP (UHF R3/R4)

1 DESCRIPTION

Options X676AN and X676AP provide a dual circulator assembly and low pass filter for use with the *Quantar* UHF station. The triple circulator option is comprised of the dual circulator assembly combined with the single circulator located in the station power amplifier module. This combination provides 65 dB (min) of isolation between the Power Amplifier Module and the transmit antenna. A low pass filter connects between the dual circulator output and the transmit antenna.

This section provides a general description, option matrix chart, identification of inputs/outputs, and functional theory of operation. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The dual circulator assembly consists of a double rf circulator and a 50 Ω load with heat sink, all mounted on a 3/16 " aluminum plate which is housed in the Peripheral Tray. The tray is equipped with a cooling fan which directs air across the fins of the heat sink. The rf output from the Power Amplifier Module connects to the input of the assembly, while the output connects to an external low pass filter. The output of the filter connects to the transmit antenna (directly, via antenna relay module, or via duplexer).

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2 OPTION COMPLEMENT

Table 1 and Table 2 show the contents of the X676AN and X676AP Triple Circulator Options.

Option Complement Charts

Table 1. X676AN Triple Circulator Option Complement

Option	Option Contents	
X676AN	TLE9120A	Dual Circulator
	TLN3391A	50Ω Load w/ heatsink
	TRN7796A	Cooling Fan
	TLE9140A	Low Pass Filter

Table 2. X676AP Triple Circulator Option Complement

Option	Option Contents	
X676AP	TLE9130A	Dual Circulator
	TLN3391A	50Ω Load w/ heatsink
	TRN7796A	Cooling Fan
	TLE9140A	Low Pass Filter

3 PERFORMANCE SPECIFICATIONS

Table 3 shows the electrical performance specifications for the dual circulator assemblies used in Options X676AN (UHF R1/R2) and X676AP (UHF R3/R4). Table 4 shows the electrical performance specifications for the low pass filter used in Options X676AN and X676AP.

Performance Specifications

Table 3. Performance Specifications for Dual Circulator Assemblies

Parameter	Specification
Operating Frequency	X676AN 403–475 MHz X676AP 475–520 MHz
Maximum RF Input Power	400W
Insertion Loss (with low pass filter and cables)	1.15dB typ 1.6dB max
Isolation	45 dB min *(total of 60 dB when combined with circulator built into power amplifier module)*
Operating Temperature Range	−20°C to +70°C
Input/Output Return Loss	19.1 dB min
Terminations	Female N–Type
Input and Output Impedance	50 Ohms
50Ω Load Maximum Power	25W without cooling fan on 90W with cooling fan on
Thermistor Output	22 kΩ @ 25°C 1.7 k Ω @ 125°C

Table 4. Performance Specifications for Low Pass Filter

Parameter	Specification
Operating Frequency	403–520 MHz
Insertion Loss	0.2 dB
Maximum RF Input Power	500W

4 INPUTS/OUTPUTS

Figure 1 shows the dual circulator assembly input and output external connections.

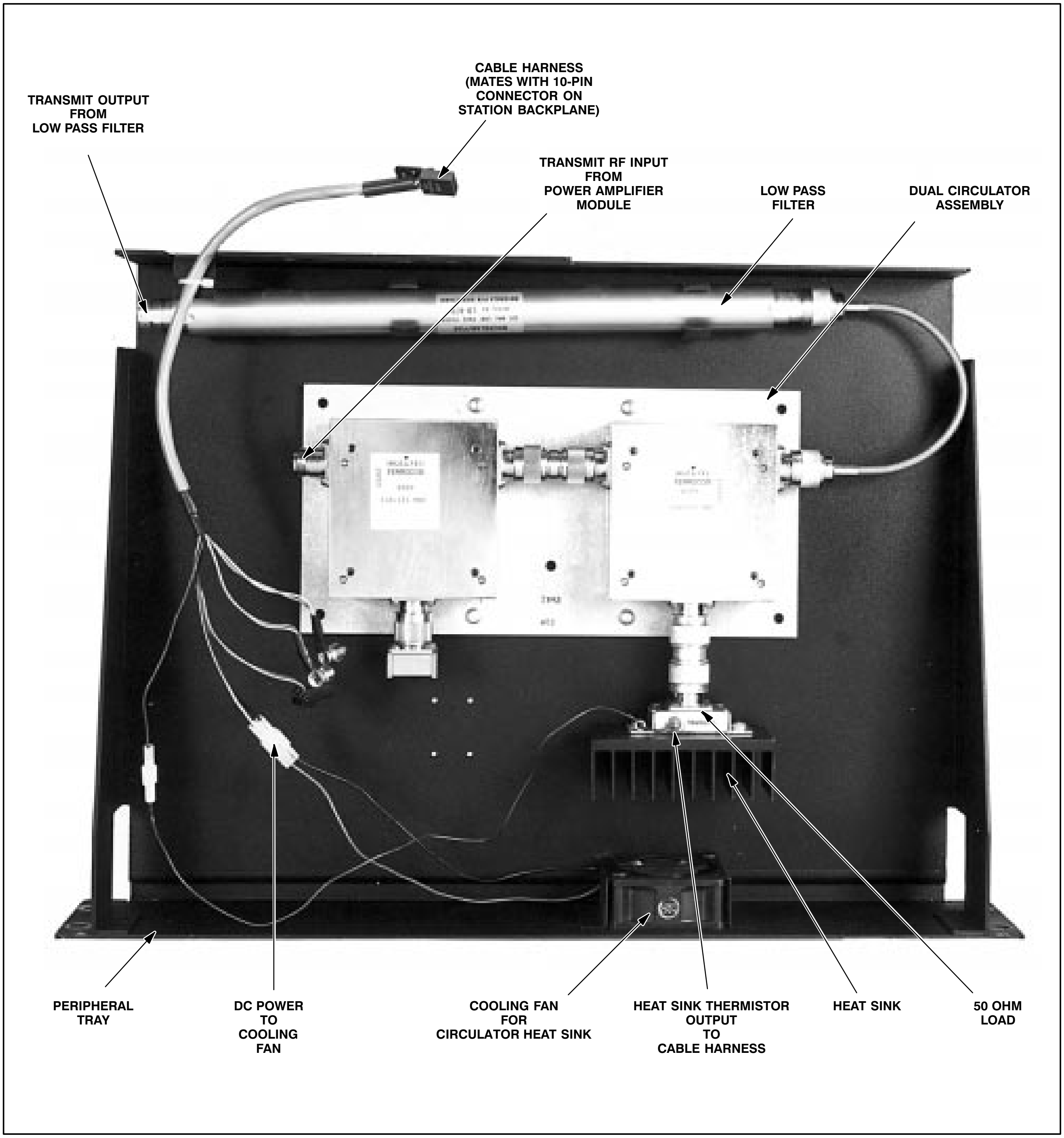

Figure 1. Dual Circulator Assembly and Low Pass Filter (Mounted in Peripheral Tray) Inputs and Outputs

5 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the Dual Circulator Assembly and Low Pass Filter at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block and interconnect diagram of the Dual Circulator Assembly and Low Pass Filter.

Functional Operation

Note: *The Triple Circulator Option is typically used in high density radio site applications where other co–located transmitters near the frequency of the station can cause I.M. products. The addition of the dual circulator improves I.M. from >20dB$_I$ to >50 dB$_I$. The low pass filter reduces spurious emissions to 90 dBc.*

The Dual Circulator Assembly accepts transmit rf output power from the power amplifier module and provides 45 dB (minimum) of isolation between the power amplifier module and the transmit antenna. The assembly consists of two circulators, each with a 50Ω load. Each circulator allows forward rf energy to pass through to the output, while routing any reflected rf energy to the corresponding 50Ω load. Refer to the block diagram shown in Figure 2.

Most of the reflected energy is absorbed by the 50Ω load (heat sink mounted) connected to the second circulator. A thermistor mounted on the heat sink provides a variable resistance signal proportional to the heat sink temperature. This signal is routed to the Station Control Module via the Peripheral Tray cabling harness. If the heat sink temperature exceeds a preset threshold, the Station Control Module enables PA cutback mode. If the overtemperature condition persists, the power amplifier is shut down completely.

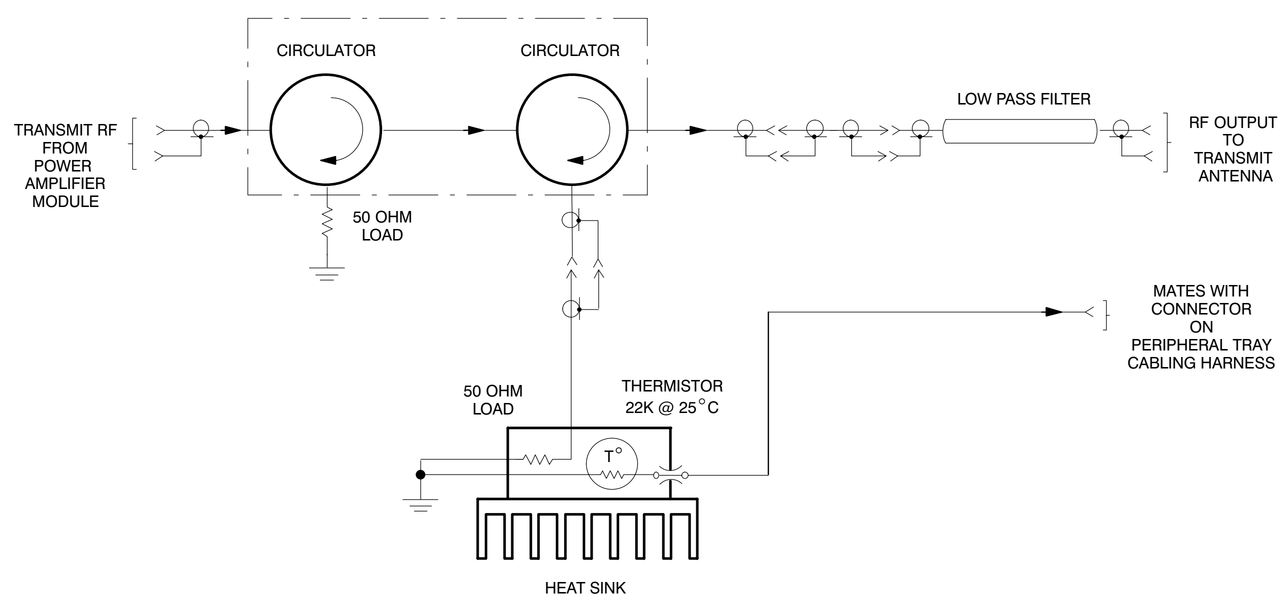

Figure 2. Functional Block and Interconnect Diagram for Triple Circulator Option

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TRIPLE CIRCULATOR OPTION

Options X676AQ (800 MHz)
X676AR (900 MHz)

1 DESCRIPTION

Options X676AQ and X676AR provide a dual circulator assembly and low pass filter for use with the *Quantar* 800 MHz and 900 MHz stations, respectively. The triple circulator option is comprised of the dual circulator assembly combined with the single circulator located in the station power amplifier module. This combination provides 65 dB (min) of isolation between the Power Amplifier Module and the transmit antenna. A low pass filter connects between the dual circulator output and the transmit antenna.

This section provides a general description, option matrix chart, identification of inputs/outputs, and functional theory of operation. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The dual circulator assembly consists of a double rf circulator and a 50 Ω load with heat sink, all mounted on a 3/16 ” aluminum plate which is housed in the Peripheral Tray. The tray is equipped with a cooling fan which directs air across the fins of the heat sink. The rf output from the Power Amplifier Module connects to the input of the assembly, while the output connects to an external low pass filter. The output of the filter connects to the transmit antenna (directly, via antenna relay module, or via duplexer).

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2 OPTION COMPLEMENT

Table 1 and Table 2 show the contents of the X676AQ and X676AR Triple Circulator Options.

Option Complement Charts

Table 1. X676AQ Triple Circulator Option Complement

Option	Option Contents	
X676AQ	TLF7320A	Dual Circulator
	TLN3391A	50Ω Load w/ heatsink
	TRN7796A	Cooling Fan
	TLF7340A	Low Pass Filter

Table 2. X676AR Triple Circulator Option Complement

Option	Option Contents	
X676AR	TLF7330A	Dual Circulator
	TLN3391A	50Ω Load w/ heatsink
	TRN7796A	Cooling Fan
	TLF7340A	Low Pass Filter

3 PERFORMANCE SPECIFICATIONS

Table 3 shows the electrical performance specifications for the dual circulator assemblies used in Options X676AQ (800 MHz) and X676AR (900 MHz). Table 4 shows the electrical performance specifications for the low pass filter used in Options X676AQ and X676AR.

Performance Specifications

Table 3. Performance Specifications for 800 MHz and 900 MHz Dual Circulator Assemblies

Parameter	Specification
Operating Frequency	X676AQ 850–870 MHz X676AR 935–941 MHz
Maximum RF Input Power	400W
Insertion Loss (with low pass filter and cables)	1.15dB typ 1.6dB max
Isolation	45 dB min *(total of 60 dB when combined with circulator built into power amplifier module)*
Operating Temperature Range	−20°C to +70°C
Input/Output Return Loss	19.1 dB min
Terminations	Female N–Type
Input and Output Impedance	50 Ohms
50Ω Load Maximum Power	25W without cooling fan on 90W with cooling fan on
Thermistor Output	22 kΩ @ 25°C 1.7 k Ω @ 125°C

Table 4. Performance Specifications for Low Pass Filter

Parameter	Specification
Operating Frequency	840–960 MHz
Insertion Loss	0.2 dB
Maximum RF Input Power	500W

4 INPUTS/OUTPUTS

Figure 1 shows the dual circulator assembly input and output external connections.

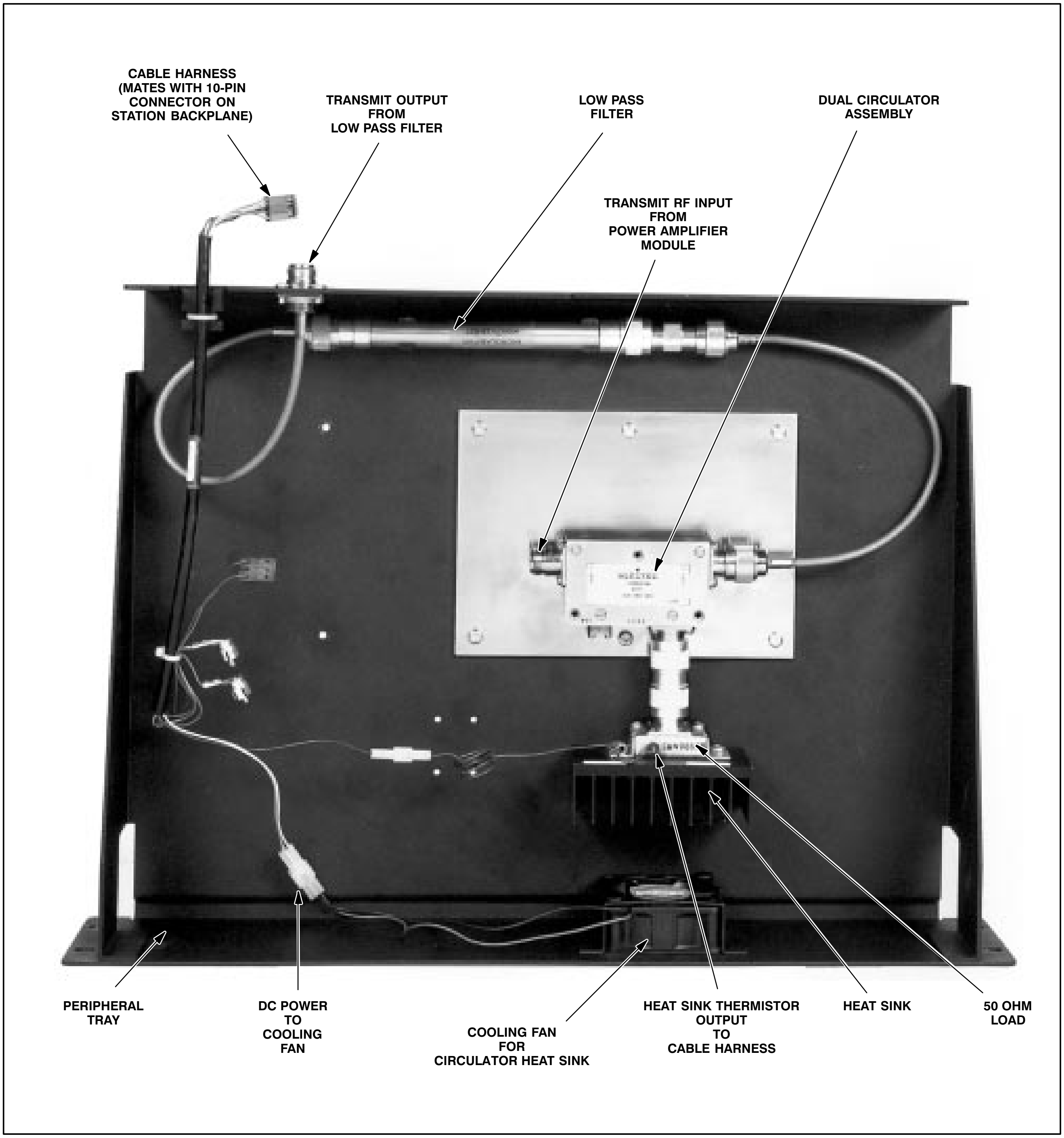

Figure 1. Dual Circulator Assembly and Low Pass Filter (Mounted in Peripheral Tray) Inputs and Outputs

5 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the Dual Circulator Assembly and Low Pass Filter at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block and interconnect diagram of the Dual Circulator Assembly and Low Pass Filter.

Functional Operation

Note: *The Triple Circulator Option is typically used in high density radio site applications where other co–located transmitters near the frequency of the station can cause I.M. products. The addition of the dual circulator improves I.M. from >20dB$_I$ to >50 dB$_I$. The low pass filter reduces spurious emissions to 90 dBc.*

The Dual Circulator Assembly accepts transmit rf output power from the power amplifier module and provides 45 dB (minimum) of isolation between the power amplifier module and the transmit antenna. The assembly consists of two circulators, each with a 50Ω load. Each circulator allows forward rf energy to pass through to the output, while routing any reflected rf energy to the corresponding 50Ω load. Refer to the block diagram shown in Figure 2.

Most of the reflected energy is absorbed by the 50Ω load (heat sink mounted) connected to the second circulator. A thermistor mounted on the heat sink provides a variable resistance signal proportional to the heat sink temperature. This signal is routed to the Station Control Module via the Peripheral Tray cabling harness. If the heat sink temperature exceeds a preset threshold, the Station Control Module enables PA cutback mode. If the overtemperature condition persists, the power amplifier is shut down completely.

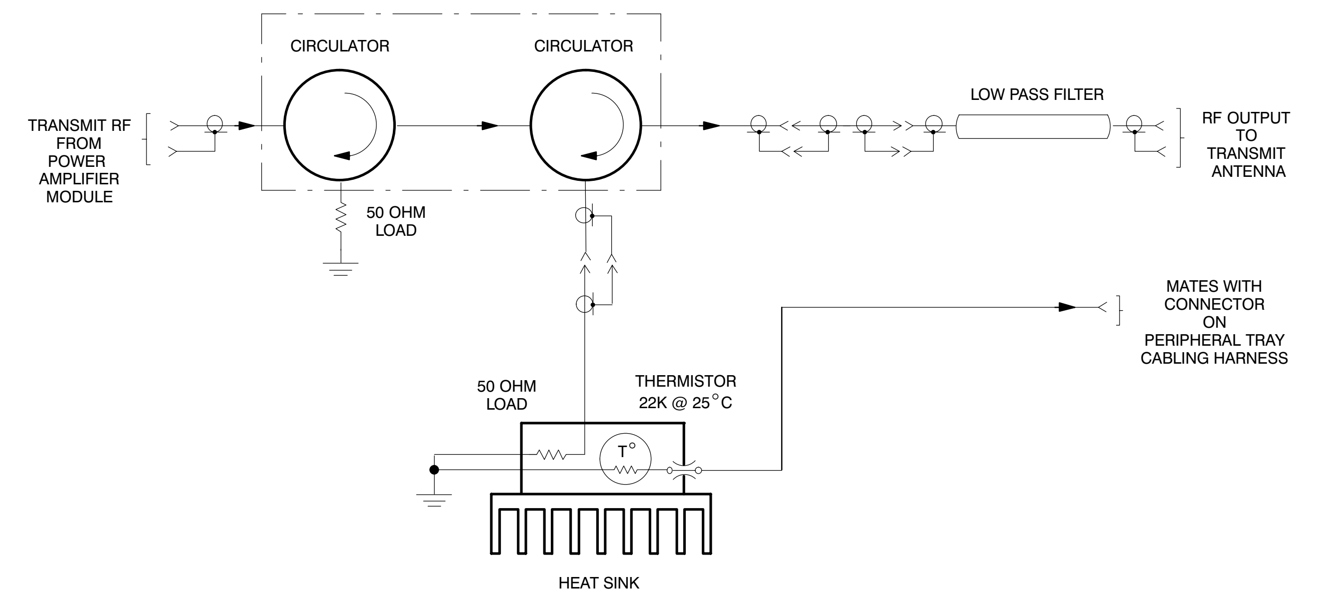

Figure 2. Functional Block and Interconnect Diagram for Triple Circulator Option

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DUPLEXER MODULE

Options X182AA (132–146 MHz)
X182AB (144–160 MHz)
X182AJ (158–174 MHz)

1 DESCRIPTION

Options 182AA/AB/AJ provide band–dependent duplexer modules for use with *Quantar* VHF stations. This section provides a general description, identification of adjustments and inputs/outputs, performance specifications, and a typical mounting location detail. While the duplexer module is considered non–repairable, tuning screws are provided for field tuning should replacement become necessary due to module failure, or if retuning is necessary due to a change in operating channels. A single channel field tuning procedure is provided in this section.

General Description

The duplexer module (shown in Figure 1) allows a transmit and receive channel pair to share a common TX/RX antenna. Each duplexer module consists of six resonant cavities (three for transmit and three for receive) contained in a temperature–compensated copper enclosure designed to mount in a standard EIA 19" equipment rack.

Each set of three cavities is designed and tuned to pass the respective transmit or receive channel frequency (or bandwidths) while providing maximum TX noise suppression at the RX frequency and maximum RX isolation at the TX frequency.

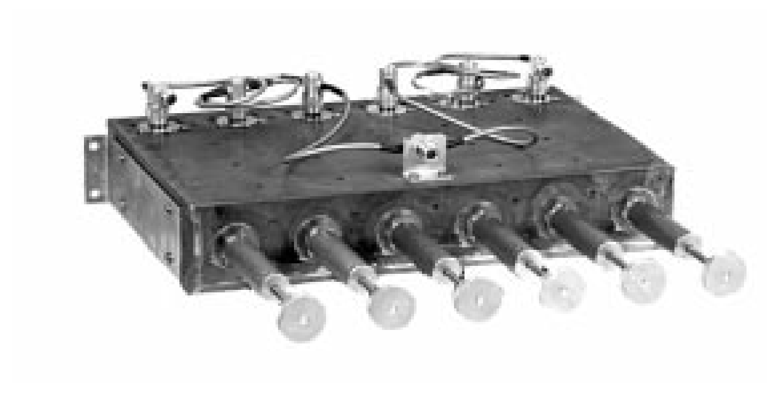

Figure 1. Typical Duplexer Module

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2 ADJUSTMENTS AND INPUTS/OUTPUTS

Figure 2 shows the location of the adjustment screws and input and output rf connectors for the duplexer module.

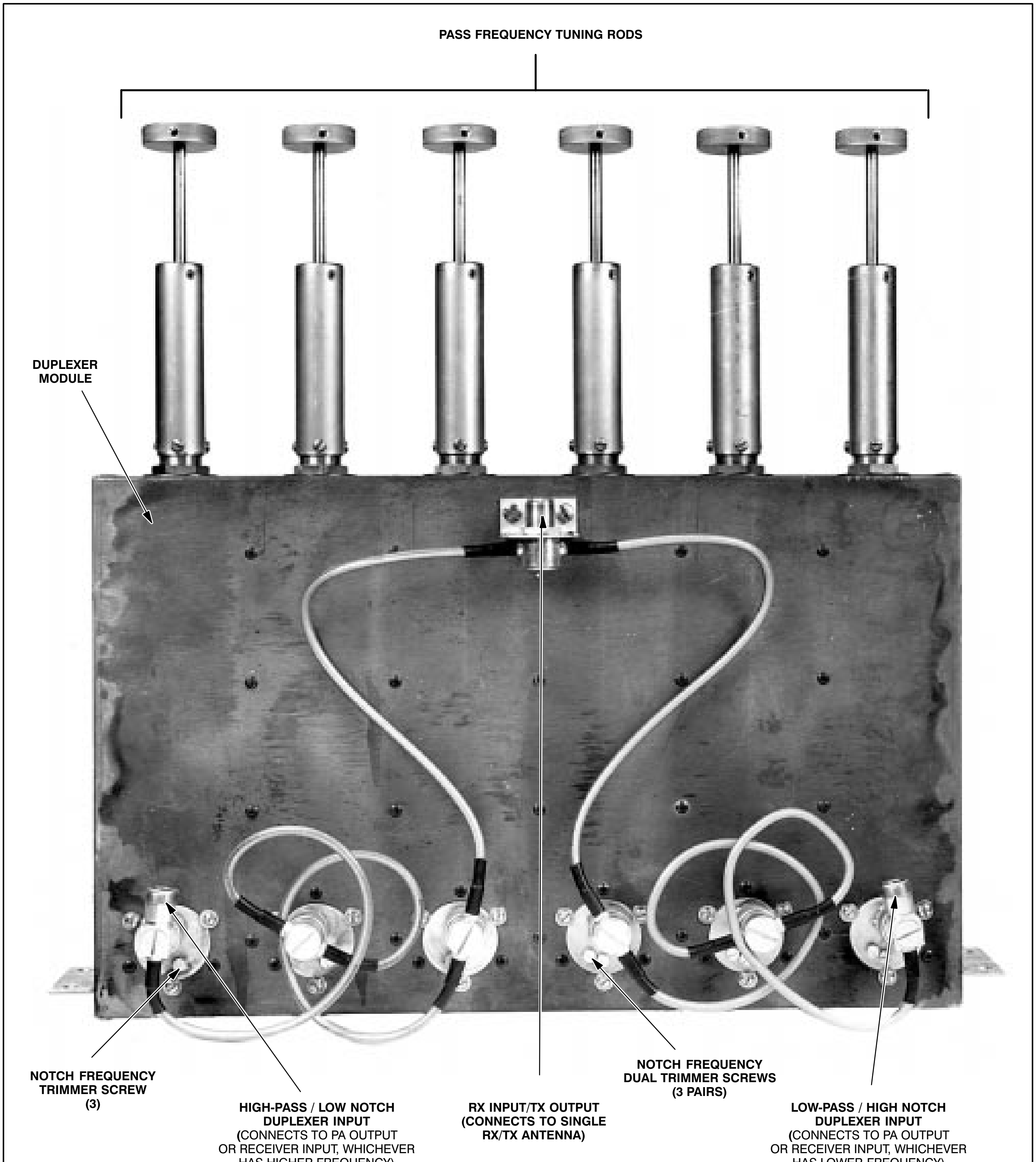


Figure 2. *Quantar* VHF Duplexer Module Adjustment Screws and Input/Output Connections

3 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the duplexer module.

Performance Specifications

Table 1. Duplexer Performance Specifications (Options X182AA/AB/AJ)

Parameter	Specification	
Operating Frequency Model X182AA Model X182AB Model X182AJ	 132–146 MHz 144–160 MHz 158–174 MHz	
Insertion Loss (Transmitter to Antenna)	1.3 dB max	
Insertion Loss (Antenna to Receiver)	1.3 dB max	
Frequency Bandwidth vs Frequency Separation	**Tx–to–RX Spacing** 1.5 MHz 2.5 MHz 3.5 MHz 4.5 MHz and above	**Bandwidth (maximum)** 200 kHz 600 kHz 800 kHz 1000 kHz
TX Noise Suppression at RX Freq.	75 dB min	
RX Isolation at TX Freq.	75 dB min	
Frequency Separation (Min.)	1.5 MHz	
Return Loss	14 dB minimum	
Maximum Input Power	150 W	
Temperature Range	–30°C to +60°C	
Size	3” (H) x 21.5” (D) x 17” (W) EIA Rack Mountable	
Weight	22 lbs.	
Terminations	Female N–Type	
Input and Output Impedance	50 Ohms	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

4 TYPICAL MOUNTING CONFIGURATION

The duplexer module is typically mounted in the same rack or cabinet as the station and peripheral tray (if equipped). Figure 3 shows front and rear views of a typical repeater configuration in which a station, triple circulator option, and duplexer option are installed in a single cabinet. Also shown is a simplified interconnect diagram showing the receiver and transmitter paths to a single RX/TX antenna.

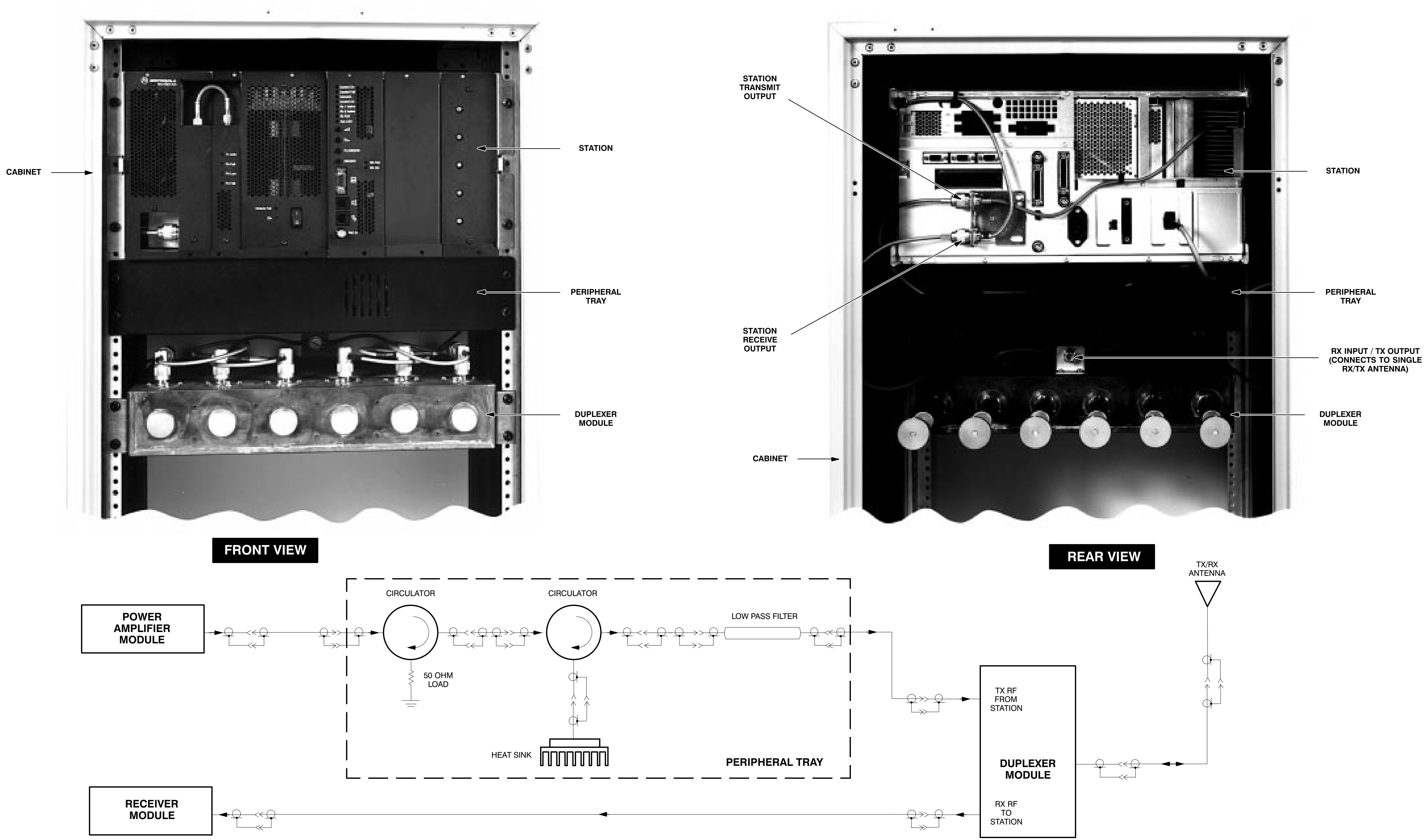


Figure 3. Typical Duplexer Mounting Configuration and Interconnect Diagram

5 FIELD TUNING PROCEDURE

Duplexer modules shipped with stations are tuned at the factory. If a duplexer must be replaced in the field, the unit must be installed and tuned specifically to the transmit and receive frequency pair for the particular station.

Field Tuning Overview

The duplexer module is comprised of three low–pass/high–notch cavities and three high–pass/low–notch cavities. Each set of three cavities provides bandpass filtering for either the transmit rf signal or the receive rf signal. In general, the duplexer must be tuned so that the transmit cavity set passes the transmit signal and rejects the receive signal; concurrently, the receive cavity set must be tuned to pass the receive signal and reject the transmit signal.

Note: *This tuning procedure is valid for channels with a bandwidth of 200 kHz or less. If bandwidth is more than 200 kHz, the duplexer must be tuned by the service depot.*

Tuning is performed by injecting rf signals and making tuning adjustments (using the tuning rods and trimmer screws) while monitoring for maximum or minimum readings on the rf millivoltmeter. Field tuning the duplexer module requires the following general adjustments:

- Tune high–pass/low–notch cavities for maximum pass and reject response
- Tune low–pass/high–notch cavities for maximum pass and reject response
- Check high–pass/low–notch and low–pass/high–notch cavities for insertion loss
- Check high–pass/low–notch and low–pass/high–notch cavities for isolation

Required Test Equipment

Field tuning of the duplexer module requires the following test equipment:

- Motorola R2001 Communications Analyzer (or equivalent)
- RF Millivoltmeter (Boonton 92E or equivalent)
- RF Signal Generator (HP8565 or equivalent)
- 50Ω N–type terminator
- Male–to–Females N–Type “T” connector (UG–107B/U or equiv.)
- Slotted screwdriver
- 3/32” allen wrench
- Tuning tool (thin blade)
- N–to–N bullet connector (UG29A/U or equivalent)
- N–to–BNC Adapter (UG349A/U)
- N–to–N Connector (UG57B/U)

Setting Up for Tuning Duplexer

Perform the preliminary tasks shown in Figure 4 to prepare for tuning the duplexer module.

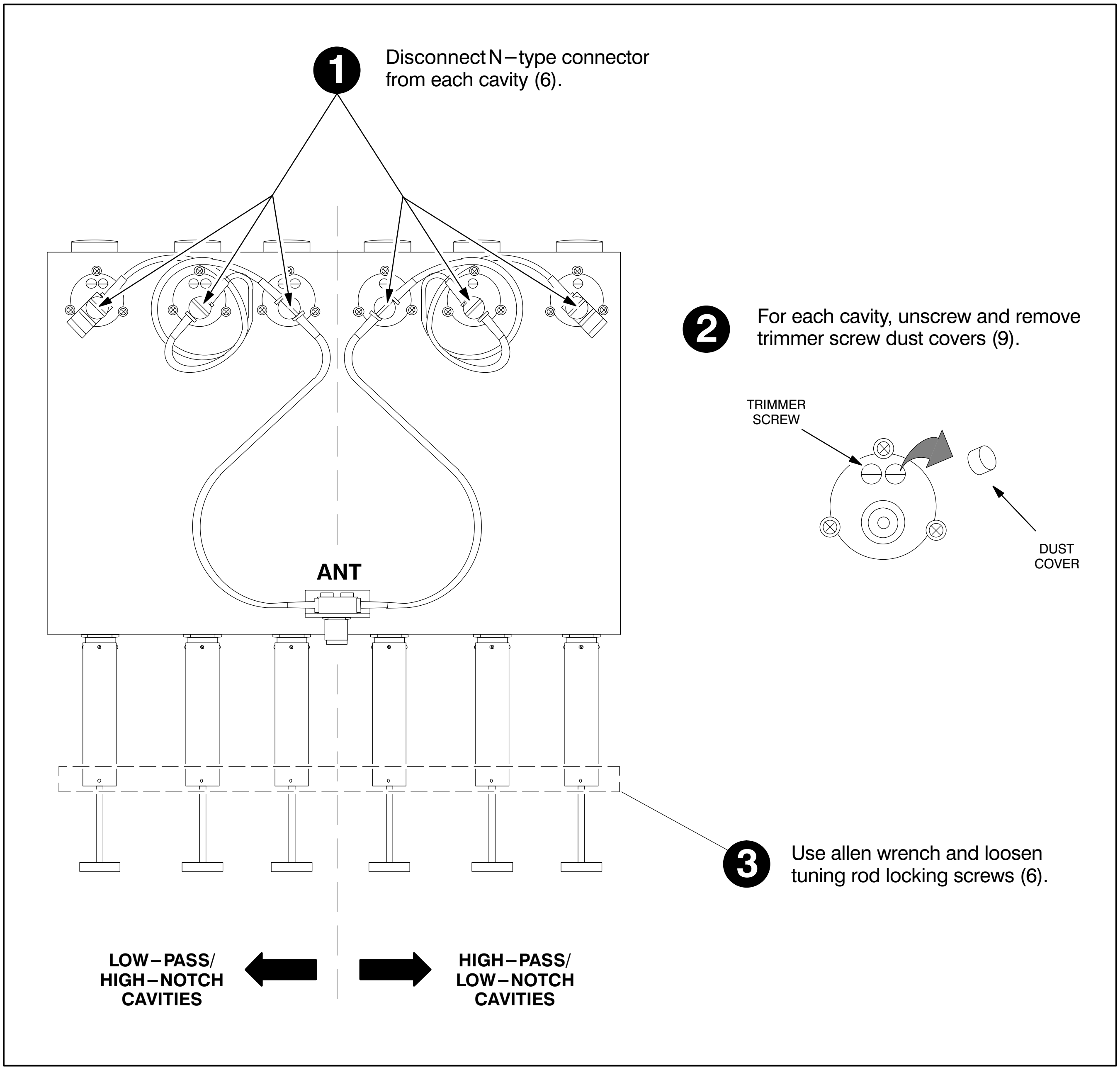


Figure 4. Preliminary Tasks Prior to Tuning Duplexer

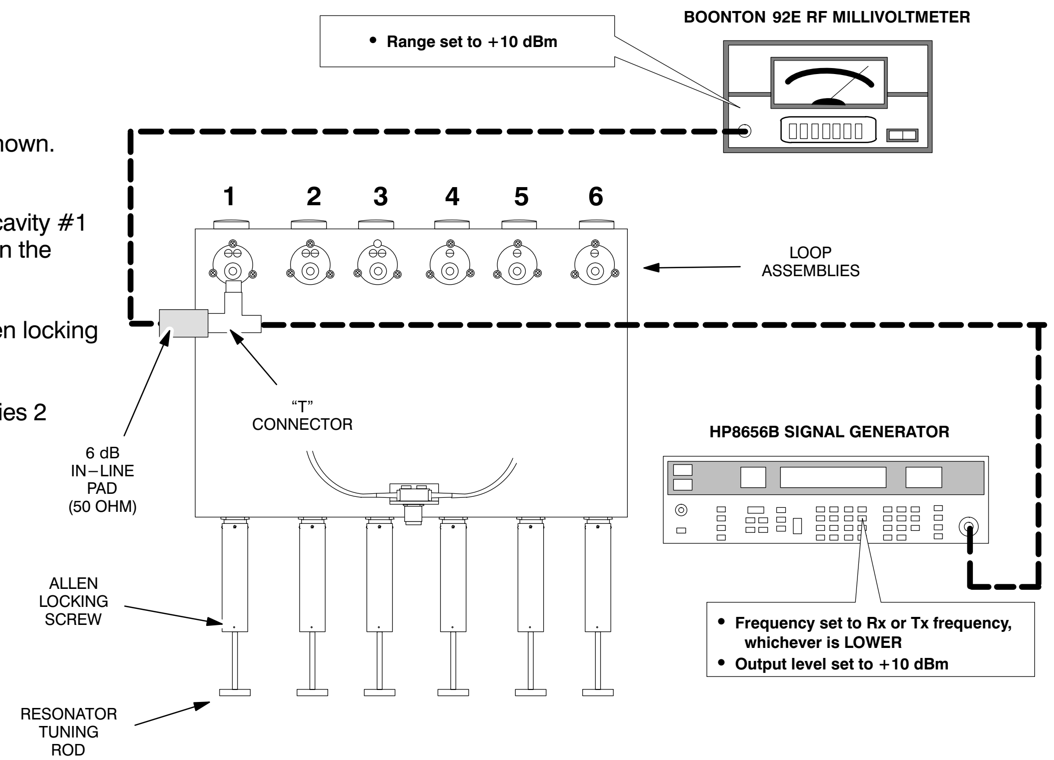
Duplexer Tuning Procedure

The duplexer field tuning procedures are provided in Figure 5. The procedures are most easily performed with the duplexer module removed from the station rack or cabinet. Be sure to make note of the transmit and receive frequencies for the particular station before beginning.

If the duplexer module is tuned according to instructions and does not meet specifications for return loss, insertion loss, and/or isolation, you must return the duplexer for repair.

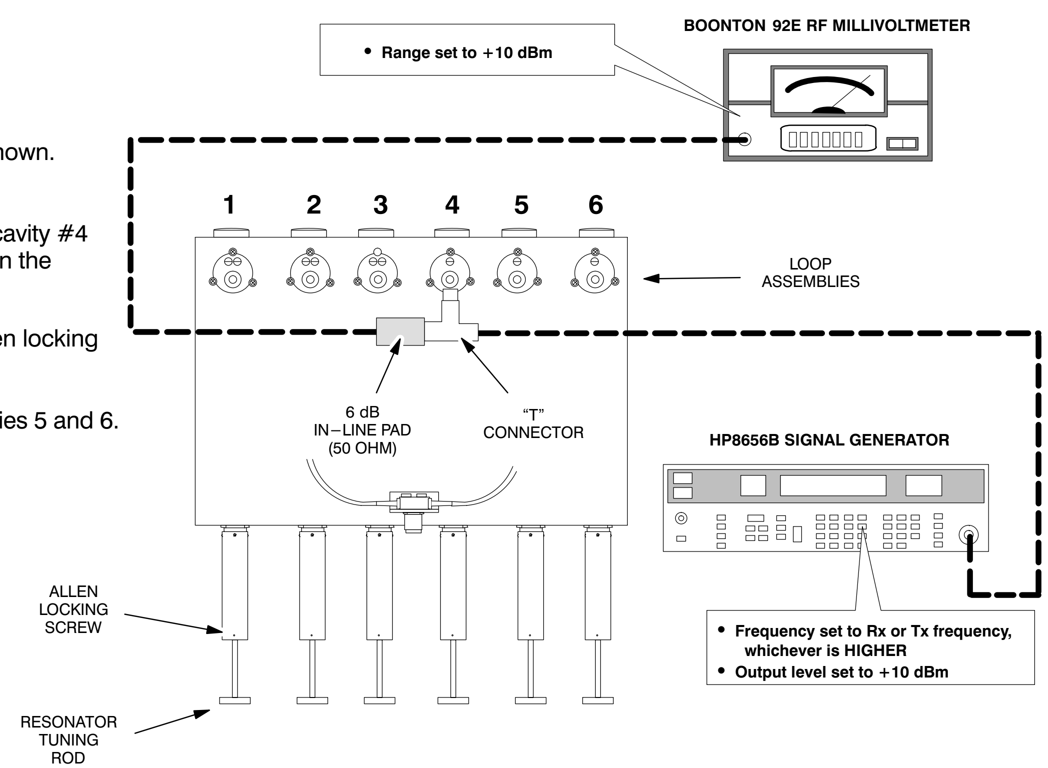
1 TUNING LOW PASS RESONATORS

1. Set up test equipment as shown.
2. Push or pull tuning rod for cavity #1 to obtain a **PEAK** reading on the millivoltmeter.
3. Use allen wrench and tighten locking screw.
4. Repeat steps 2 & 3 for cavities 2 and 3.



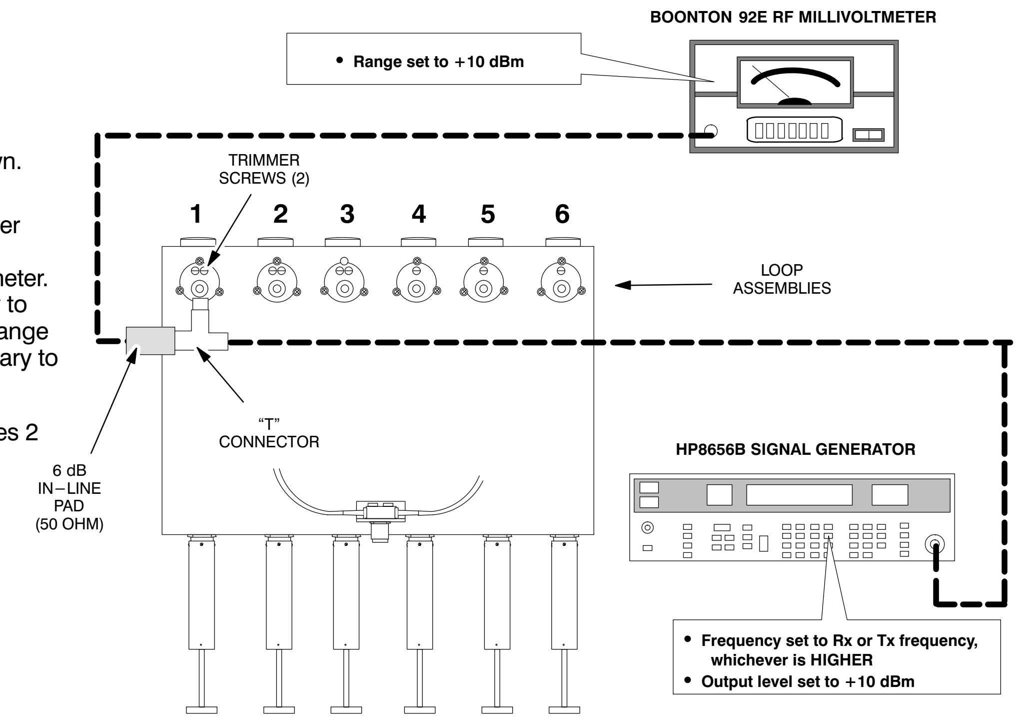
2 TUNING HIGH PASS RESONATORS

1. Set up test equipment as shown.
2. Push or pull tuning rod for cavity #4 to obtaina **PEAK** reading on the millivoltmeter.
3. Use allen wrench and tighten locking screw.
4. Repeat steps 2 & 3 for cavities 5 and 6.



3 TUNING HIGH NOTCH LOOP ASSEMBLIES

1. Set up test equipment as shown.
2. Use tuning tool to adjust trimmer screws for cavity #1 to obtain **minimum** reading on millivoltmeter. (Adjust trimmer screws equally to obtain minimum. Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Repeat steps 1 and 2 for cavities 2 and 3.



4 TUNING LOW NOTCH LOOP ASSEMBLIES

1. Set up test equipment as shown.
2. Use tuning tool to adjust trimmer screw for cavity #4 to obtain **minimum** reading on millivoltmeter. (Adjust trimmer screw to obtain minimum. Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Repeat steps 1 and 2 for cavities 5 and 6.

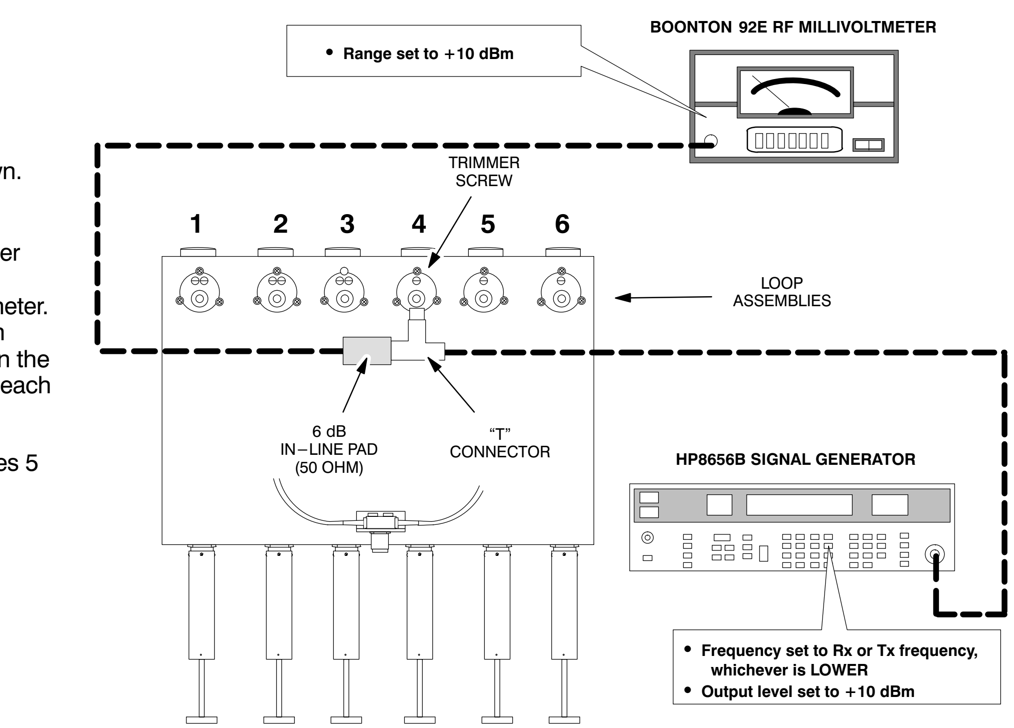
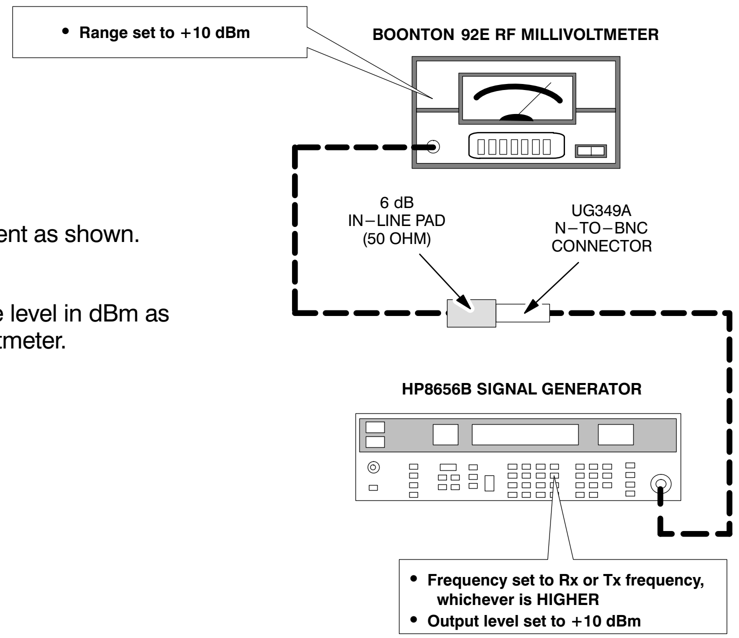
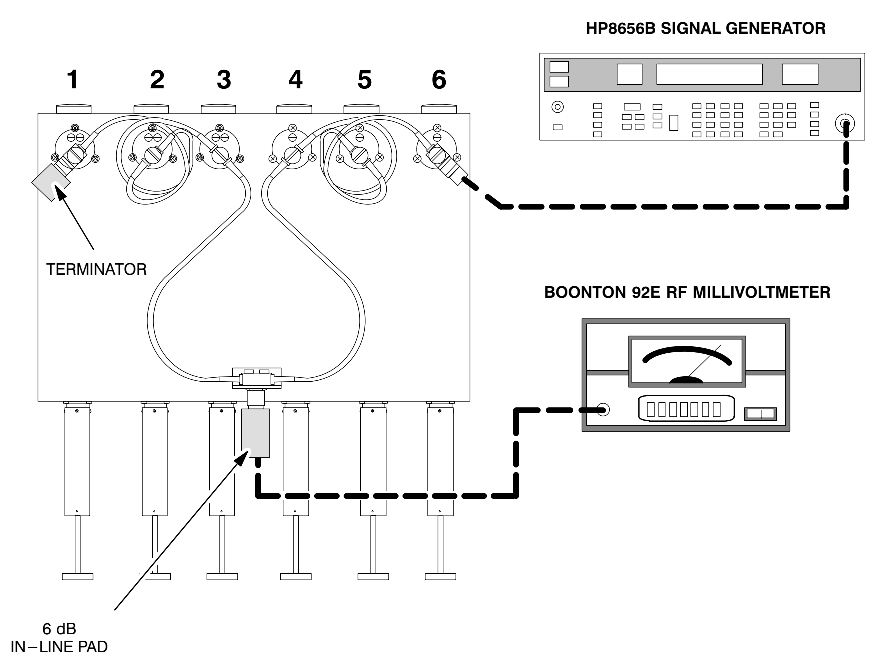


Figure 5. *Quantar* VHF Duplexer Field Tuning Procedure (Sheet 1 of 3)

5 VERIFYING INSERTION LOSS



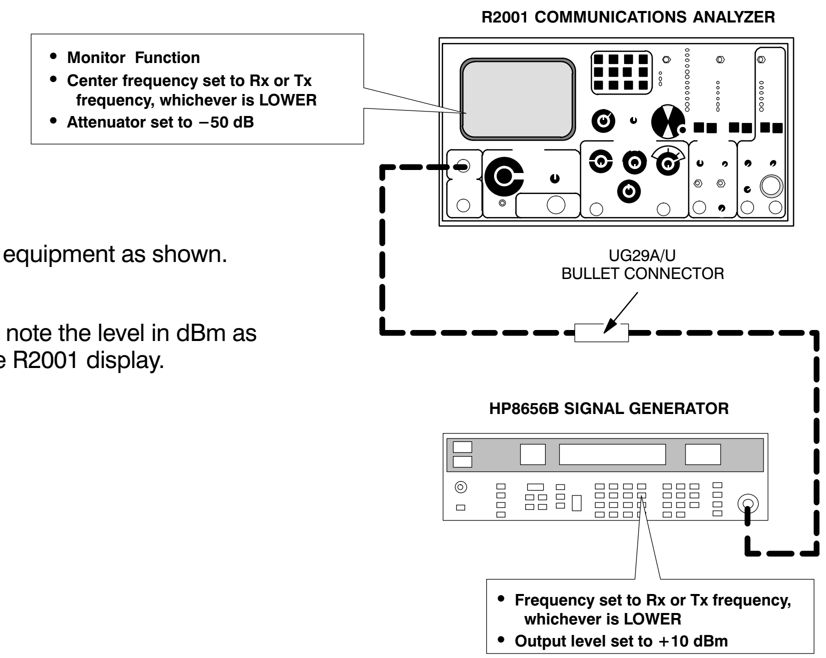
1. Connect test equipment as shown.
2. Observe and note the level in dBm as shown on the millivoltmeter.



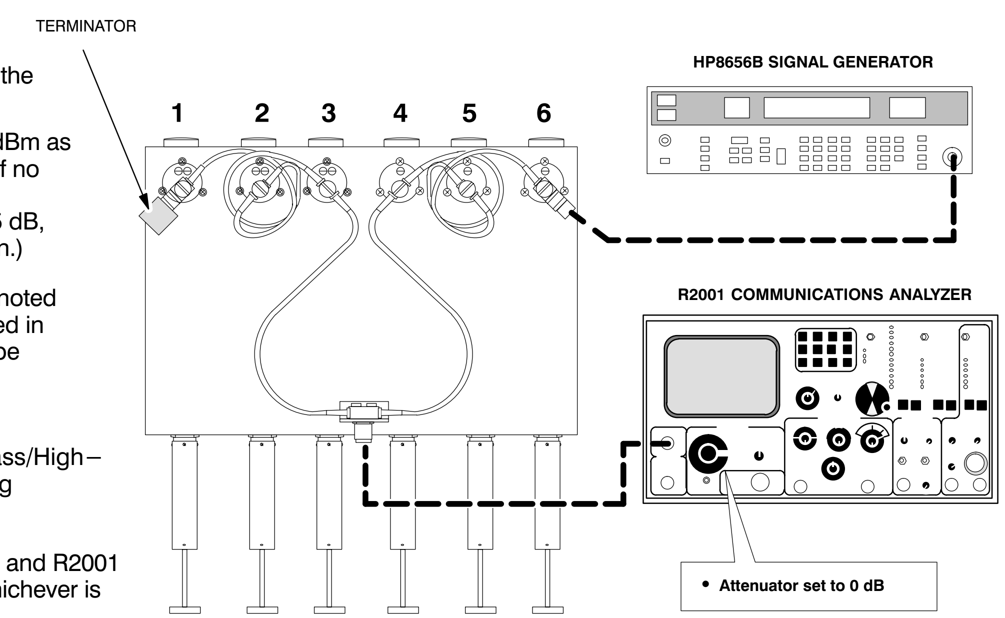
3. Connect the duplexer cable assembly and test equipment to the duplexer as shown.
4. Observe and note the level in dBm as shown on the millivoltmeter.
5. Subtract the absolute number noted in Step 2 from the number noted in Step 4. The difference should be less than 1.3 dB to meet specification for Insertion Loss.
6. Repeat Steps 1–5 for Low–Pass/High–Notch cavities with the following exceptions:

   1) Set Frequency Generator for Rx or Tx frequency, whichever is **LOWER**
   2) Connect Signal Generator to Low Pass duplexer input (cavity #1)
   3) Connect terminator to cavity #6.

6 VERIFYING ISOLATION



1. Connect test equipment as shown.
2. Observe and note the level in dBm as shown on the R2001 display.



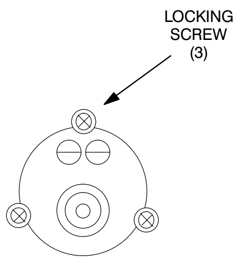
3. Connect the test equipment to the duplexer as shown.
4. Observe and note the level in dBm as shown on the R2001 display. (If no number is displayed, consider isolation to be greater than 105 dB, which exceeds the specification.)
5. Subtract the absolute number noted in Step 4 from the number noted in Step 2. The difference should be higher than 75 dB to meet specification for Isolation.
6. Repeat Steps 1–5 for Low–Pass/High–Notch cavities with the following exceptions:

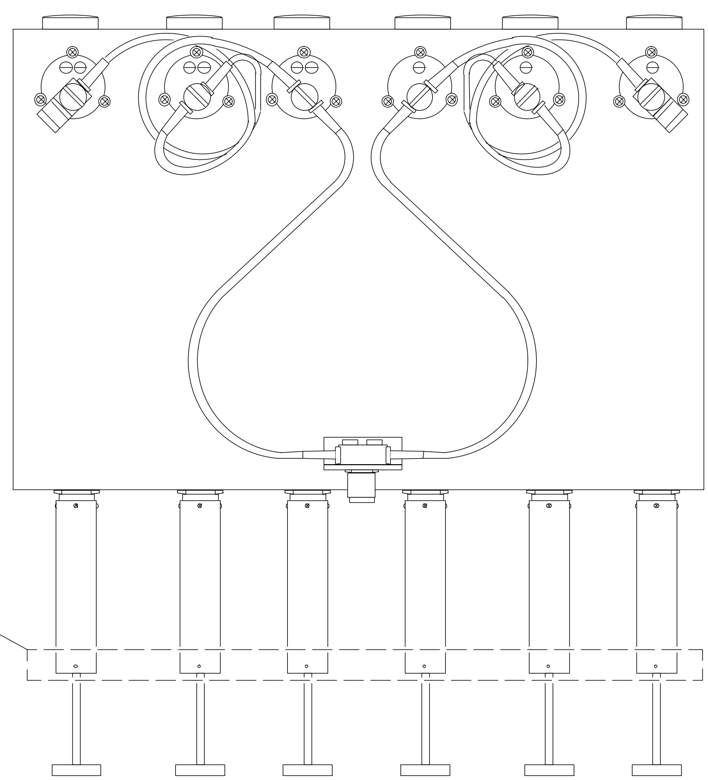
   1) Set Frequency Generator and R2001 for Rx or Tx frequency, whichever is **HIGHER**
   2) Connect Signal Generator to Low Pass duplexer input (cavity #1)
   3) Connect terminator to cavity #6.

Figure 5. *Quantar* VHF Duplexer Field Tuning Procedure (Sheet 2 of 3)

7 POST–TUNING CHECKS

1. Make sure all locking screws are tight. Re–install dust covers on all trimmer capacitors.





2. Make sure all tuning rod locking screws (6) are tight.

Figure 5. *Quantar* VHF Duplexer Field Tuning Procedure (Sheet 4 of 4)

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UHF DUPLEXER MODULE

Options X182AC (403–435 MHz)
X182AD (435–470 MHz)
X182AE (470–490 MHz)
X182AF (490–520 MHz)

1 DESCRIPTION

Options X182AC–AF provide band–dependent duplexer modules for use with *Quantar* and *Quantro* UHF stations. This section provides a general description, identification of adjustments and inputs/outputs, performance specifications, and a typical mounting location detail. While the duplexer module is considered non–repairable, tuning screws are provided for field tuning should replacement become necessary due to module failure, or if re-tuning is necessary due to a change in operating channels. A single channel field tuning procedure is provided in this section.

General Description

The duplexer module (shown in Figure 1) allows a transmit and receive channel pair to share a common TX/RX antenna. Each duplexer module consists of six resonant cavities (three for transmit and three for receive) contained in a temperature–compensated copper enclosure designed to mount in a standard EIA 19” equipment rack.

Each set of three cavities is designed and tuned to pass the respective transmit or receive channel frequency (or bandwidths) while providing maximum TX noise suppression at the RX frequency and maximum RX isolation at the TX frequency.

Figure 1. Typical UHF Duplexer Module

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2 ADJUSTMENTS AND INPUTS/OUTPUTS

Figure 2 shows the location of the adjustment screws and rf input and output connectors for the duplexer module.

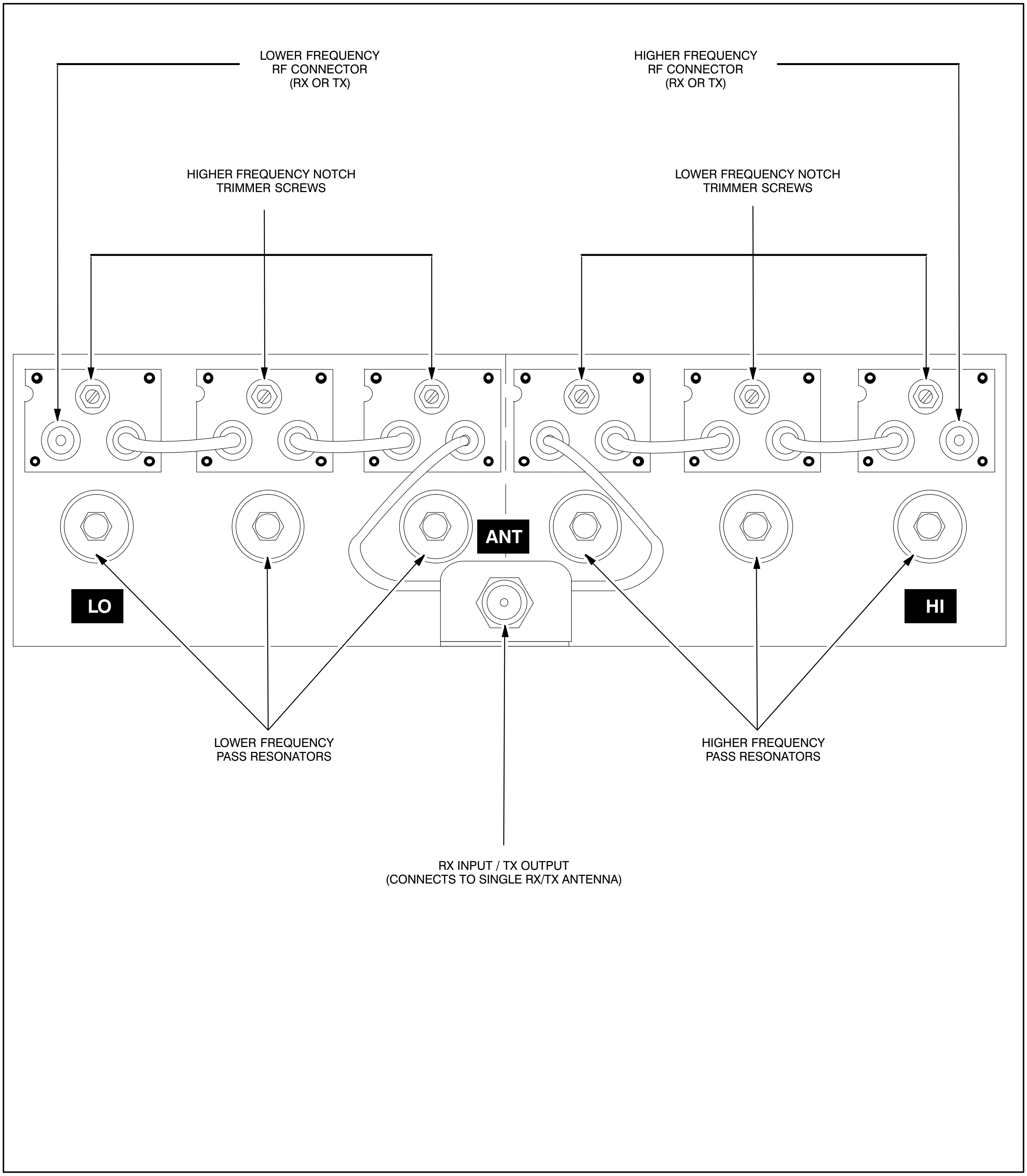


Figure 2. *Quantar* / *Quantro* UHF Duplexer Module Adjustment Screws and Input/Output Connections

3 PERFORMANCE SPECIFICATIONS

Table 1 shows the electrical performance specifications for the duplexer module.

Performance Specifications

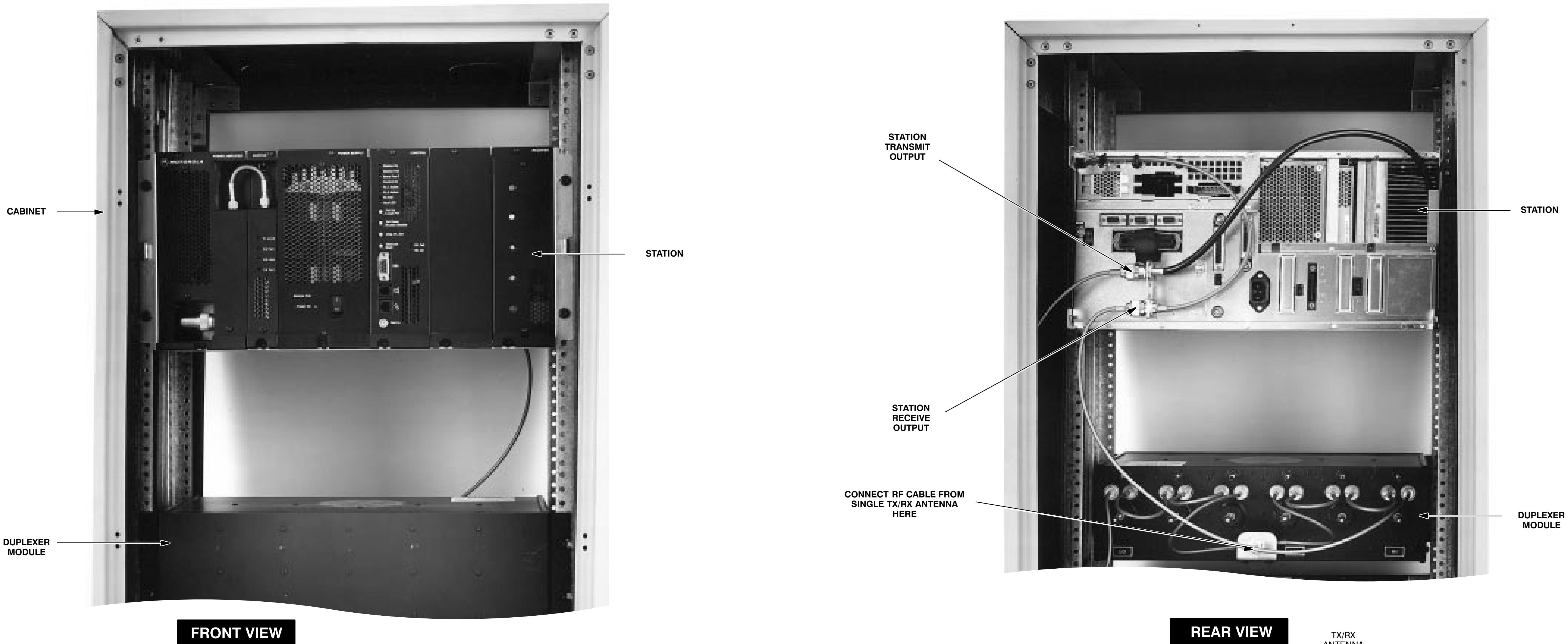
Table 1. Duplexer Performance Specifications (Options X182AC–AF)

Parameter	Specification
Operating Frequency Model X182AC Model X182AD Model X182AE Model X182AF	 403–435 MHz 435–470 MHz 470–490 MHz 490–520 MHz
Insertion Loss (Transmitter to Antenna)	1.3 dB max
Insertion Loss (Antenna to Receiver)	1.3 dB max
TX–to–RX Frequency Separation (Min.)	5 MHz (X182AC, AD) 3 MHz (X182AE, AF)
TX Noise Suppression at RX Freq.	120 dB min (X182AC, AD) 100 dB min (X182AE, AF)
RX Isolation at TX Freq.	120 dB min (X182AC, AD) 100 dB min (X182AE, AF)
Return Loss	17 dB minimum
Maximum Input Power	250 W
Temperature Range	−30°C to +60°C
Size	5¼" (H) x 14" (D) x 19" (W) EIA Rack Mountable
Weight	23 lbs.
Terminations	Female N–Type
Input and Output Impedance	50 Ohms

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

4 TYPICAL MOUNTING CONFIGURATION

The duplexer module is typically mounted in the same rack or cabinet as the station and peripheral tray (if equipped). Figure 3 shows front and rear views of a typical repeater configuration in which a station, triple circulator option, and duplexer option are installed in a single cabinet. Also shown is a simplified interconnect diagram showing the receiver and transmitter paths to a single RX/TX antenna.



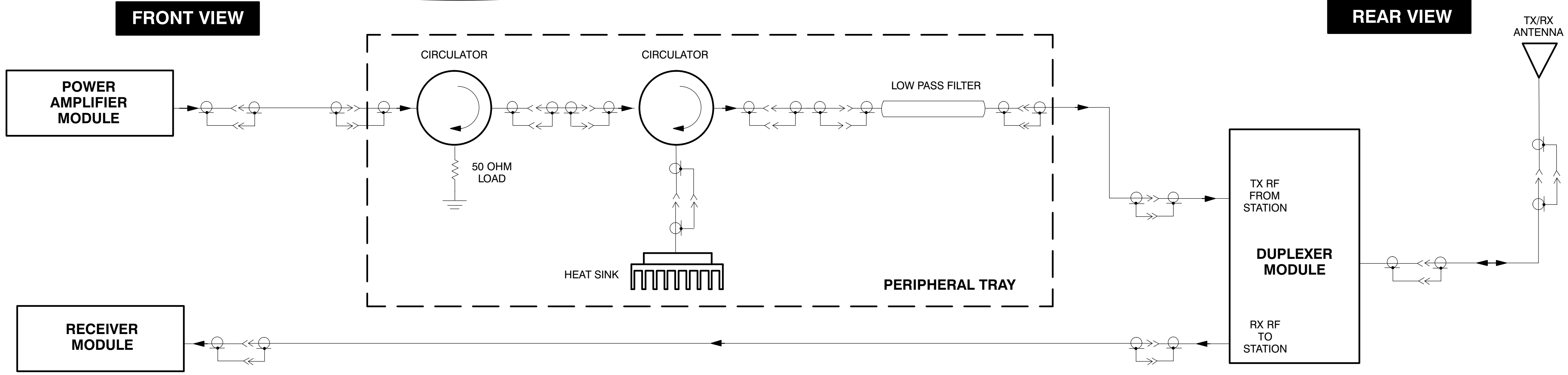


Figure 3. Typical Duplexer Mounting Configuration and Interconnect Diagram

5 FIELD TUNING PROCEDURE

Duplexer modules shipped with stations are tuned at the factory. If a duplexer must be replaced in the field, the unit must be installed and tuned specifically to the transmit and receive frequency pair for the particular station.

Field Tuning Overview

The duplexer module is comprised of three low–pass/high–notch cavities and three high–pass/low–notch cavities. Each set of three cavities provides bandpass filtering for either the transmit rf signal or the receive rf signal. In general, the duplexer must be tuned so that the transmit cavity set passes the transmit signal and rejects the receive signal; concurrently, the receive cavity set must be tuned to pass the receive signal and reject the transmit signal.

Note: *This tuning procedure is valid for channels with a bandwidth of 200 kHz or less. If bandwidth is more than 200 kHz, the duplexer must be tuned by the service depot.*

Tuning is performed by injecting rf signals and making tuning adjustments (using the resonator and notch adjusting screws) while monitoring for maximum or minimum readings on the rf millivoltmeter. Field tuning the duplexer module requires the following general adjustments:

- Tune high–pass/low–notch cavities for maximum pass and reject response
- Tune low–pass/high–notch cavities for maximum pass and reject response
- Check high–pass/low–notch and low–pass/high–notch cavities for insertion loss
- Check high–pass/low–notch and low–pass/high–notch cavities for isolation

Required Test Equipment

Field tuning of the duplexer module requires the following test equipment:

- Motorola R2001 Communications Analyzer (or equivalent)
- RF Millivoltmeter (Boonton 92E or equivalent)
- RF Signal Generator (HP8656B or equivalent)
- 50Ω N–type terminator
- Tuning tool (5/32” x 4” screwdriver)
- N–to–N bullet connector (UG29A/U or equivalent)
- 7/16” Nutdriver
- 7/16” Open End Wrench
- N–to–BNC Adapter (UG349A/U)
- N–to–N Connector (UG57B/U)

Setting Up for Tuning Duplexer

Perform the preliminary tasks shown in Figure 4 to prepare for tuning the duplexer module.

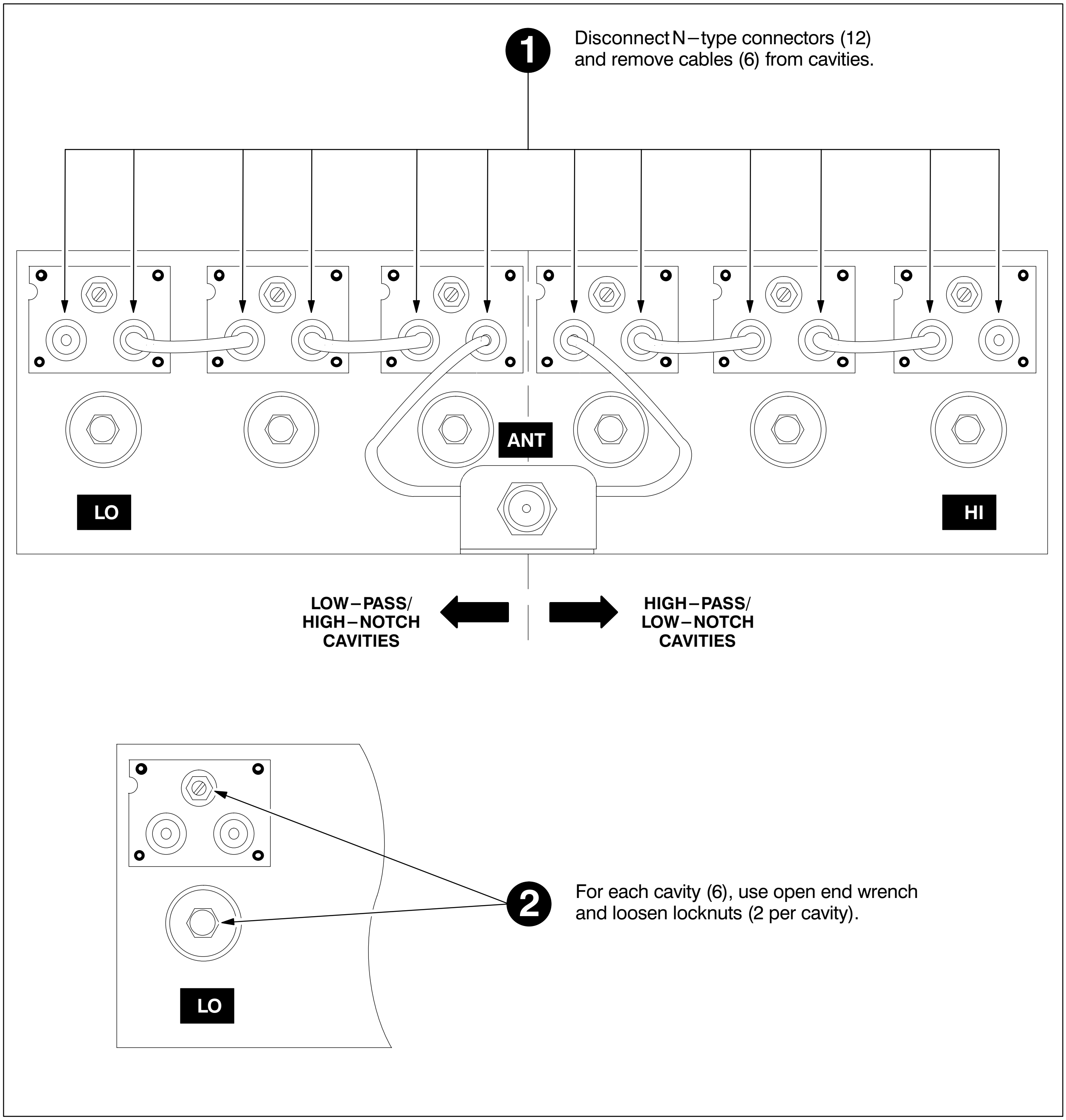


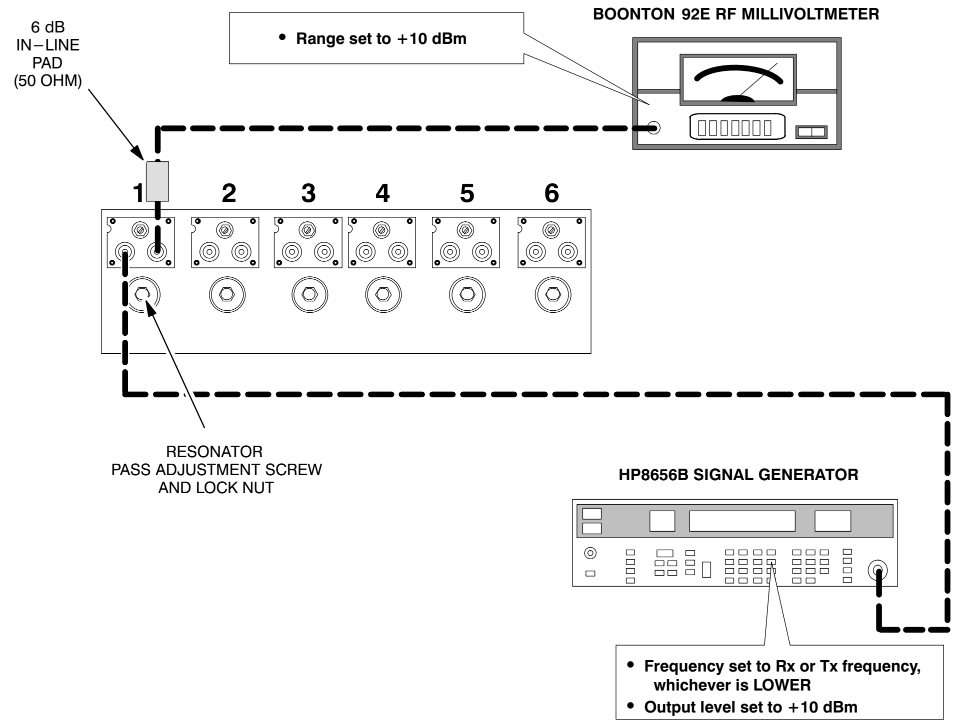
Figure 4. Preliminary Tasks Prior to Tuning Duplexer

Duplexer Tuning Procedure

The duplexer field tuning procedures are provided in Figure 5. The procedures are most easily performed with the duplexer module removed from the station rack or cabinet. Be sure to make note of the transmit and receive frequencies for the particular station before beginning.

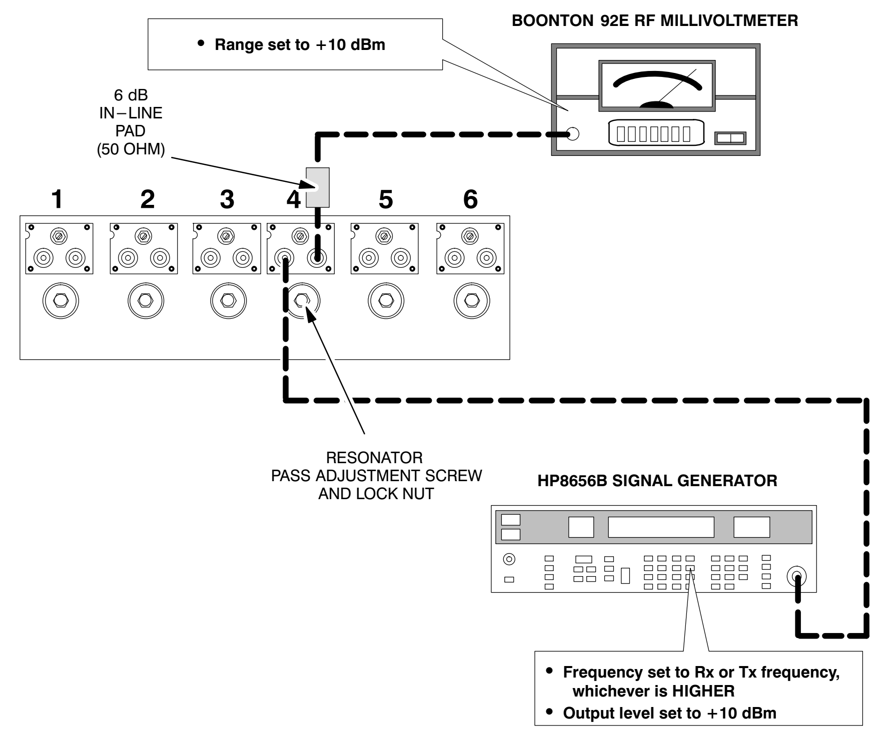
If the duplexer module is tuned according to instructions and does not meet specifications for return loss, insertion loss, and/or isolation, you must return the duplexer for repair.

1 TUNING LOW PASS RESONATORS



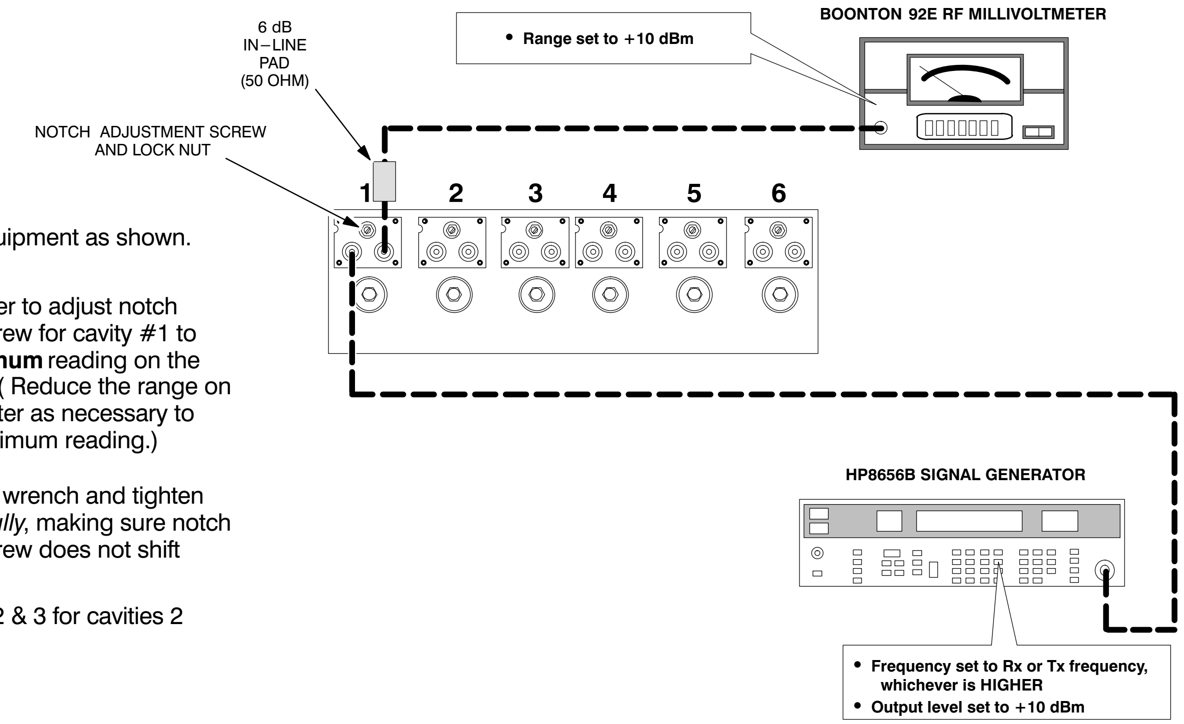
1. Set up test equipment as shown.
2. Use nut driver to adjust pass adjustment screw for cavity #1 to obtain a **PEAK** reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut *carefully*, making sure pass adjustment screw does not shift position.
4. Repeat steps 2 & 3 for cavities 2 and 3.

2 TUNING HIGH PASS RESONATORS



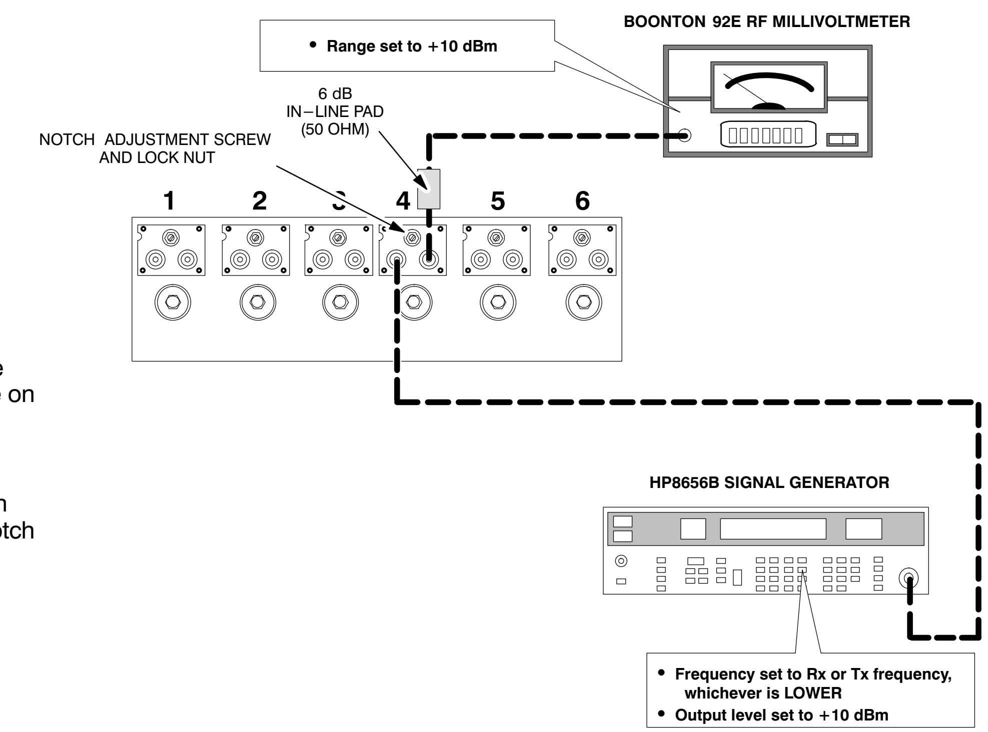
1. Set up test equipment as shown.
2. Use nut driver to adjust pass adjustment screw for cavity #4 to obtain a **PEAK** reading on the millivoltmeter.
3. Use open end wrench and tighten lock nut *carefully*, making sure pass adjustment screw does not shift position.
4. Repeat steps 2 & 3 for cavities 5 and 6.

3 TUNING HIGH NOTCH LOOP ASSEMBLIES



1. Set up test equipment as shown.
2. Use screwdriver to adjust notch adjustment screw for cavity #1 to obtain a **minimum** reading on the millivoltmeter. (Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Use open end wrench and tighten lock nut *carefully*, making sure notch adjustment screw does not shift position.
4. Repeat steps 2 & 3 for cavities 2 and 3.

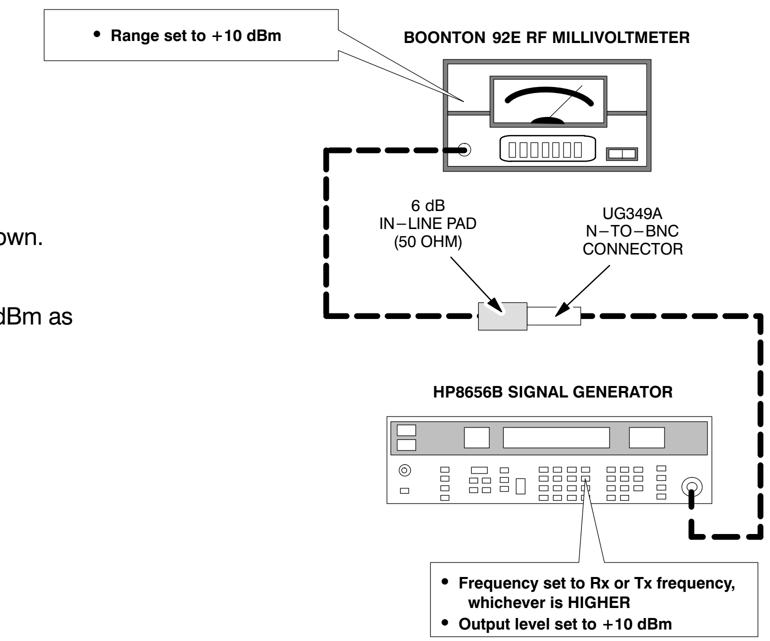
4 TUNING LOW NOTCH LOOP ASSEMBLIES



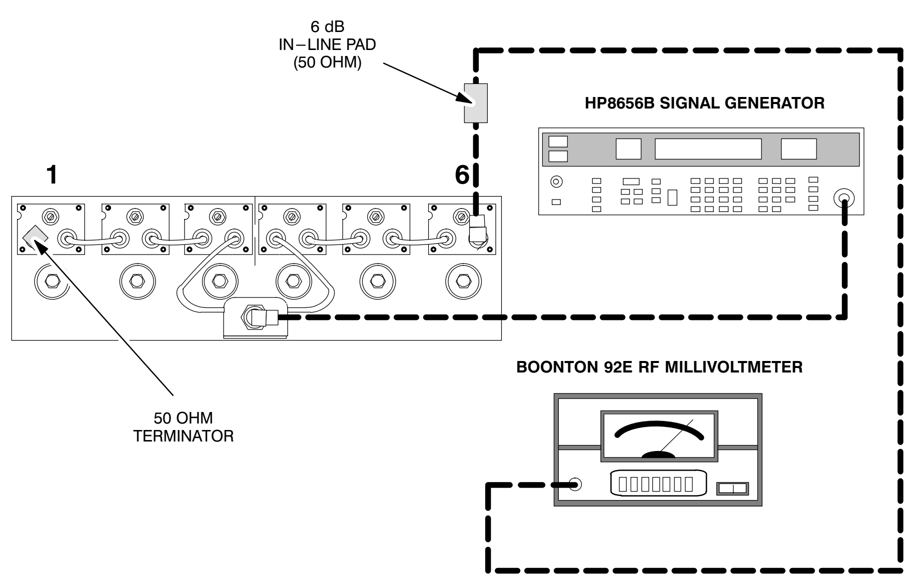
1. Set up test equipment as shown.
2. Use screwdriver to adjust notch adjustment screw for cavity #4 to obtain a **minimum** reading on the millivoltmeter. (Reduce the range on the millivoltmeter as necessary to reach true minimum reading.)
3. Use open end wrench and tighten lock nut *carefully*, making sure notch adjustment screw does not shift position.
4. Repeat steps 2 & 3 for cavities 5 and 6.

Figure 5. *Quantar* / *Quantro* UHF Duplexer Field Tuning Procedure (Sheet 1 of 3)

5 VERIFYING INSERTION LOSS



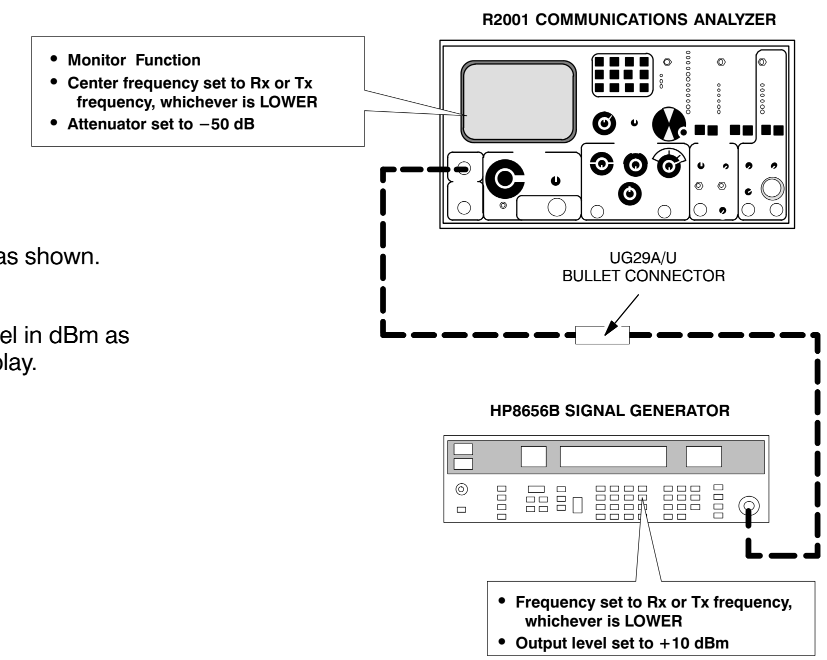
1. Connect test equipment as shown.
2. Observe and note the level in dBm as shown on the millivoltmeter.



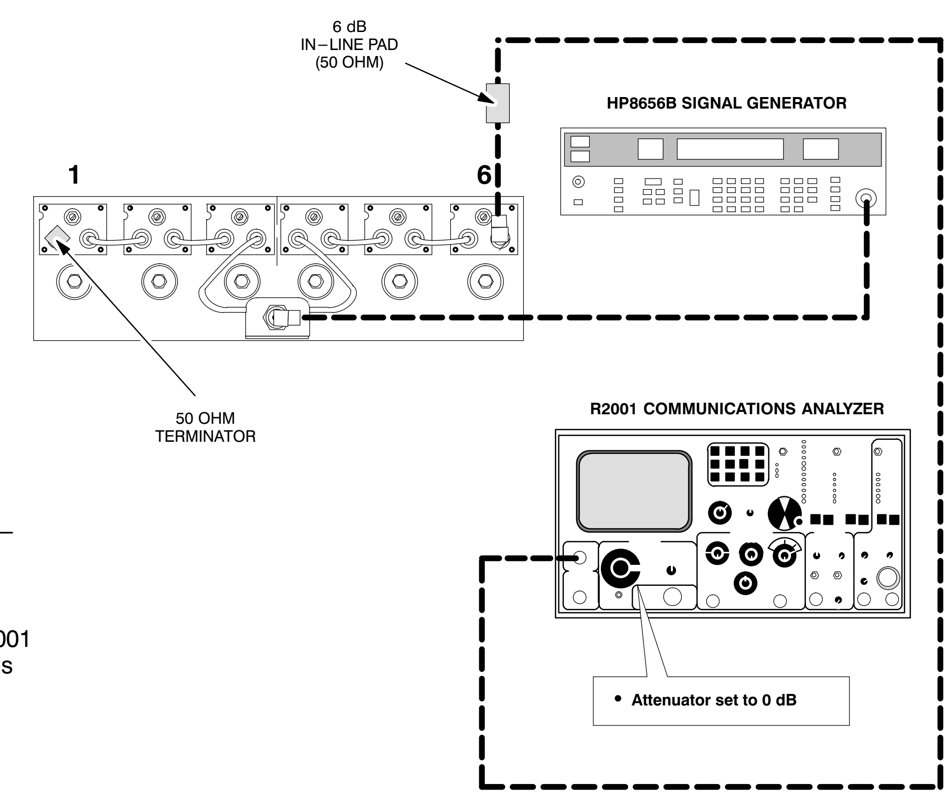
3. Connect the duplexer cables and test equipment to the duplexer as shown.
4. Observe and note the level in dBm as shown on the millivoltmeter.
5. Subtract the absolute number noted in Step 2 from the number noted in Step 4. The difference should be less than 1.3 dB to meet specification for Insertion Loss.
6. Repeat Steps 1−5 for Low−Pass/High−Notch cavities with the following exceptions:

    1) Set Frequency Generator for Rx or Tx frequency, whichever is **LOWER**
    2) Connect Millivoltmeter to Low Pass duplexer input (cavity #1)
    3) Connect terminator to cavity #6.

6 VERIFYING ISOLATION



1. Connect test equipment as shown.
2. Observe and note the level in dBm as shown on the R2001 display.



3. Connect the test equipment to the duplexer as shown.
4. Observe and note the level in dBm as shown on the R2001 display. (If no number is displayed, consider isolation to be greater than 105 dB, which exceeds the specification.)
5. Subtract the absolute number noted in Step 4 from the number noted in Step 2. The difference should be higher than 100 dB to meet specification for Isolation.
6. Repeat Steps 1−5 for Low−Pass/High−Notch cavities with the following exceptions:

    1) Set Frequency Generator and R2001 for Rx or Tx frequency, whichever is **HIGHER**
    2) Connect R2001 to Low Pass duplexer input (cavity #1)
    3) Connect terminator to cavity #6.

Figure 5. *Quantar* / *Quantro* UHF Duplexer Field Tuning Procedure (Sheet 2 of 3)

7 POST–TUNING CHECKS

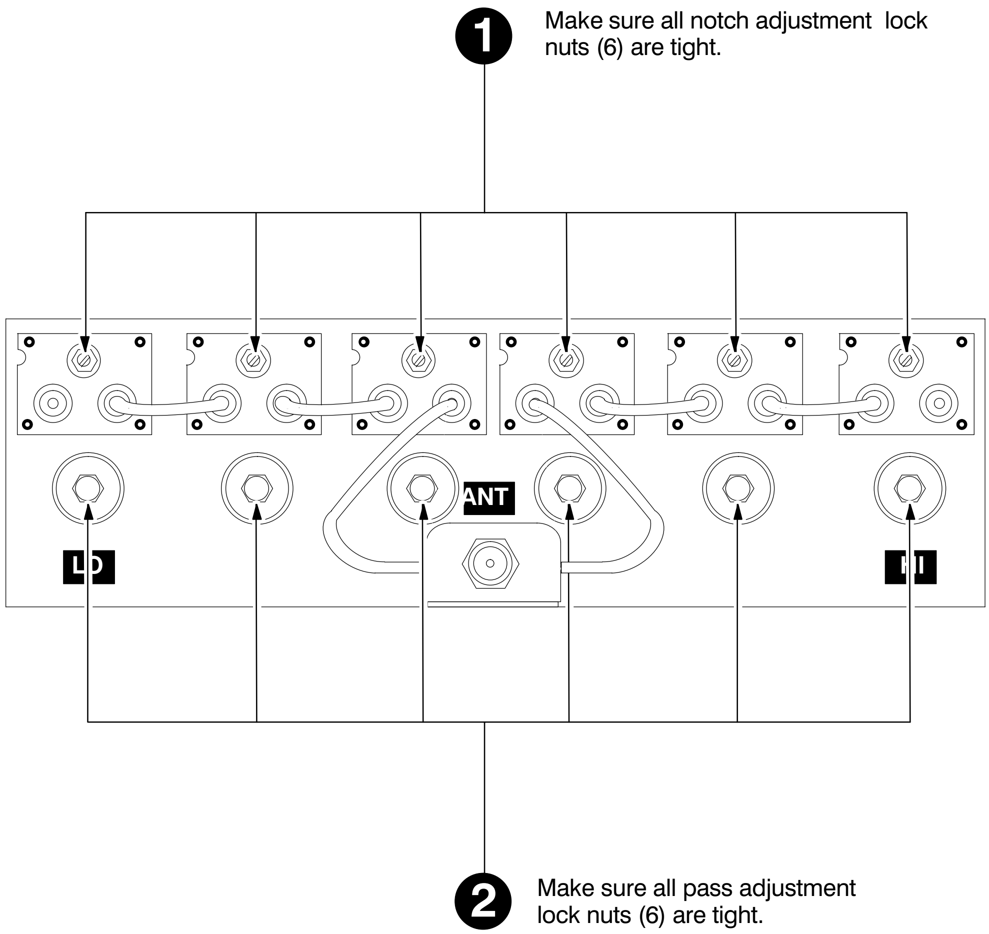


Figure 5. *Quantar/Quantro* UHF Duplexer Field Tuning Procedure (Sheet 3 of 3)

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MOTOROLA

DUPLEXER MODULE

Options X182AG
RX (806–824 MHz)
TX (851–869 MHz)
X182AH
RX (896–902 MHz)
TX (935–941 MHz)

1 DESCRIPTION

Options X182AG and X182AH provide a duplexer module for use with *Quantar* 800 MHz and 900 MHz stations, respectively. This section provides a general description, identification of inputs/outputs, performance specifications, and a typical mounting location detail. The duplexer module is considered non–repairable and requires no field tuning.

General Description

The duplexer module (shown in Figure 1) allows a transmit and receive channel pair to share a common TX/RX antenna. Each duplexer module consists of ten resonant cavities (five for transmit and five for receive) contained in a temperature–compensated copper enclosure designed to mount in a standard EIA 19" equipment rack.

Each set of five cavities is designed and tuned to pass the respective transmit or receive channel frequency (or bandwidths) while providing maximum TX noise suppression at the RX frequency and maximum RX isolation at the TX frequency.

Figure 1. Typical 900 MHz Duplexer Module

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2 INPUTS/OUTPUTS

Figure 2 shows the input and output rf connectors for the duplexer module.

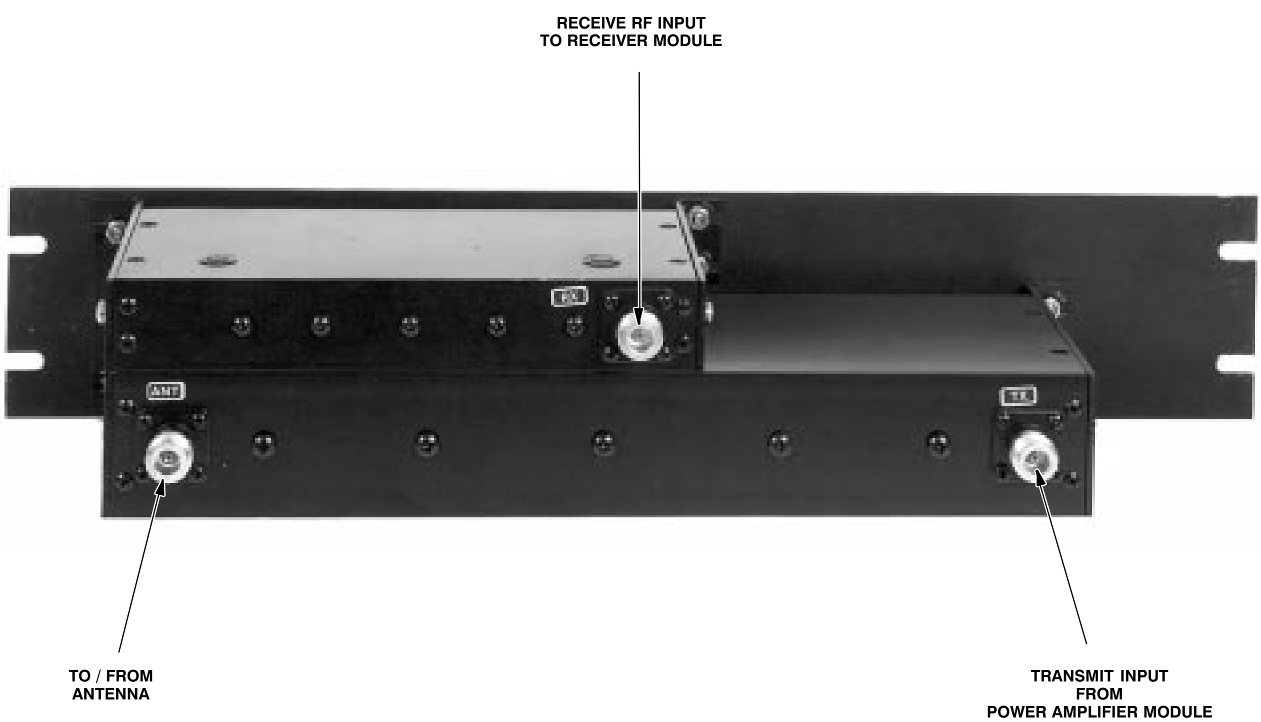


Figure 2. *Quantar* 800 MHz/900 MHz Duplexer Module Input/Output Connections

3 PERFORMANCE SPECIFICATIONS

Table 1 and Table 2 show the electrical performance specifications for the 800 MHz and 900 MHz duplexer modules.

Table 1. Duplexer Performance Specifications (Option X182AG)

Parameter	Specification
Operating Frequency	806–869 MHz
Insertion Loss (Transmitter to Antenna)	1.0 dB max
Insertion Loss (Antenna to Receiver)	1.0 dB max
Frequency Passband	RX 806–824 MHz TX 851–869 MHz
TX Noise Suppression at RX Freq.	80 dB min
RX Isolation at TX Freq.	80 dB min
Frequency Separation	45 MHz
Return Loss	14 dB minimum
Maximum Input Power	500 W
Temperature Range	−30°C to +60°C
Size with rack mounting panel	3½” (H) x 5¾” (D) x 19” (W) EIA Rack Mountable
Weight with rack mounting panel	7.5 lbs.
Terminations	Female N–Type
Input and Output Impedance	50 Ohms

Table 2. Duplexer Performance Specifications (Option X182AH)

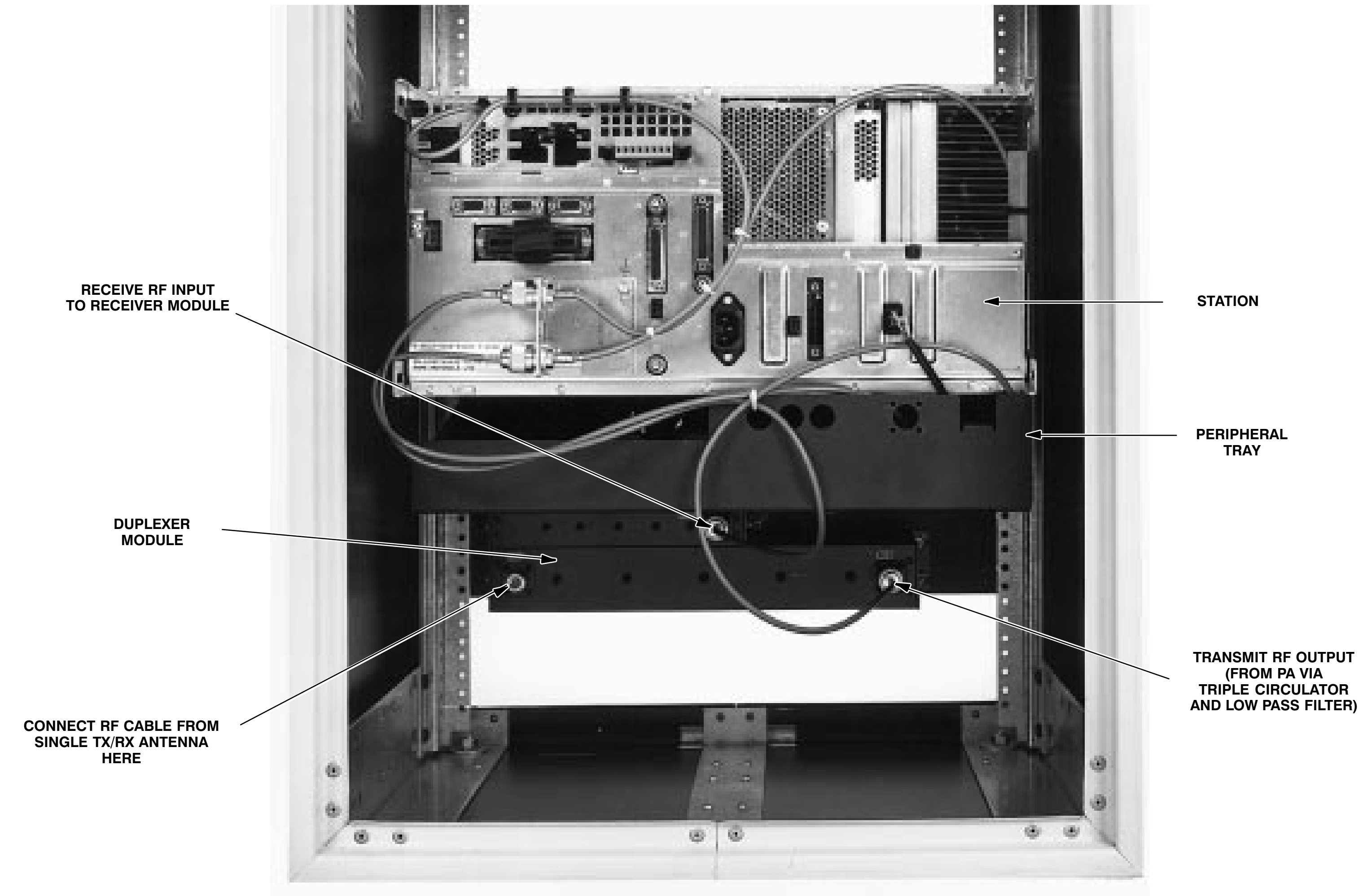
Parameter	Specification
Operating Frequency	896–941 MHz
Insertion Loss (Transmitter to Antenna)	1.0 dB max
Insertion Loss (Antenna to Receiver)	1.0 dB max
Frequency Passband	RX 896–902 MHz TX 935–941 MHz
TX Noise Suppression at RX Freq.	75 dB min
RX Isolation at TX Freq.	75 dB min
Frequency Separation	39 MHz
Return Loss	15 dB minimum
Maximum Input Power	500 W
Temperature Range	−30°C to +60°C
Size with rack mounting panel	3½” (H) x 5¾” (D) x 19” (W) EIA Rack Mountable
Weight with rack mounting panel	7.5 lbs.
Terminations	Female N–Type
Input and Output Impedance	50 Ohms

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

4 TYPICAL MOUNTING CONFIGURATION

The duplexer module is typically mounted in the same rack or cabinet as the station and peripheral tray (if equipped). Figure 3 shows front and rear views of a typical repeater configuration in which a station, triple circulator option, and duplexer option are installed in a single cabinet. Also shown is a simplified interconnect diagram showing the receiver and transmitter paths to a single RX/TX antenna.

FRONT VIEW



REAR VIEW

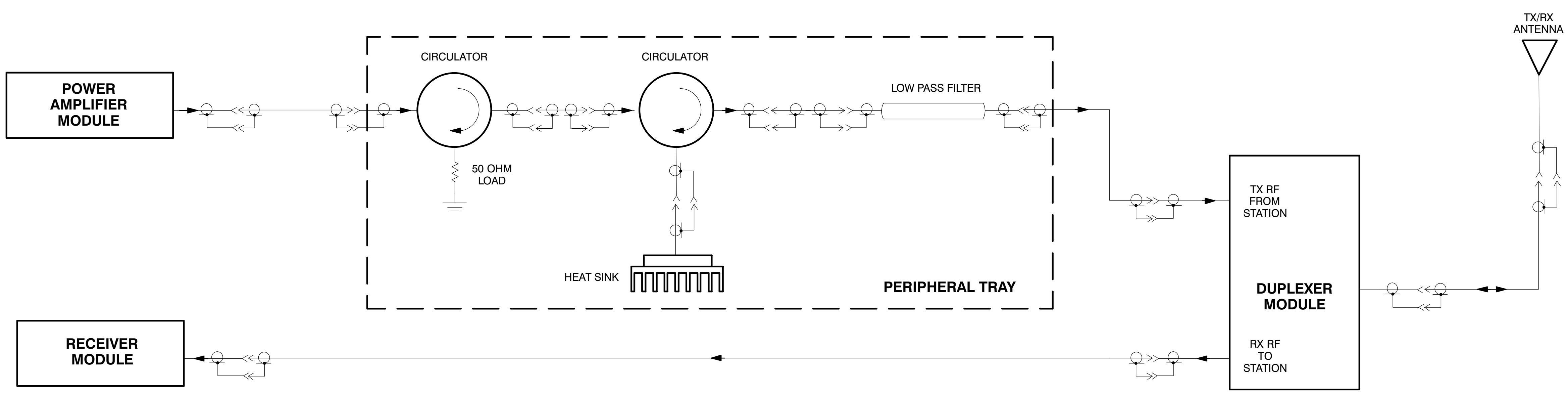


Figure 3. Typical Duplexer Mounting Configuration and Interconnect Diagram

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MOTOROLA

ASTRO MODEM CARD

(Option X437AA)

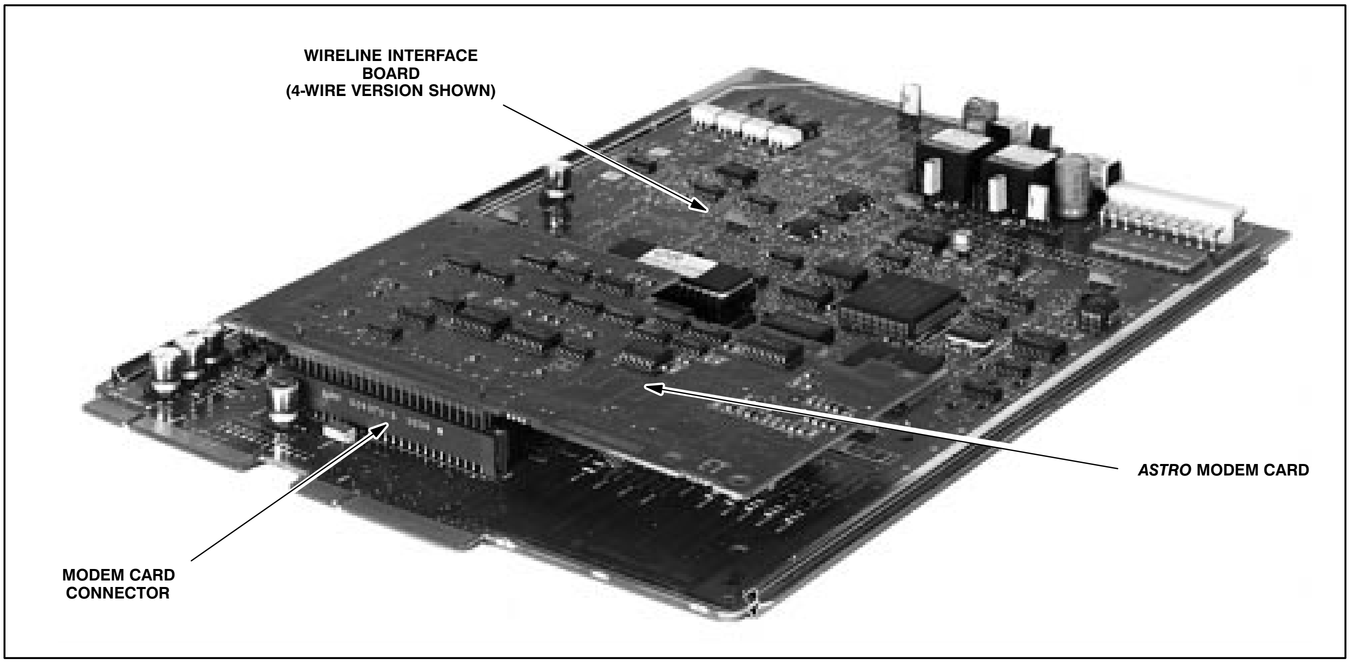

Figure 1. *ASTRO* Modem Card Installed on Wireline Interface Board

1 DESCRIPTION

Option X437AA provides a single *ASTRO* Modem Card for use with *Quantar* station products. The *ASTRO* Modem Card provides the interface between the station and the wireline in systems using *ASTRO* 9.6 kbps signaling. The card connects to the Wireline Interface Board, as shown in Figure 1. Note that 8-wire Wireline Interface Boards are equipped with connectors for two *ASTRO* modem cards.

General Description

Note: *The* ASTRO *modem card contains no jumpers or switches and requires no adjustments. The card is auto-configured upon station power-up.*

The modem card accepts *ASTRO* modem signaling from the wireline and converts the signal to detected data, which is then fed to the Station Control Module for further processing. Data from the Station Control Module is fed to the modem card, which converts the signal to an *ASTRO* modem signal and outputs the signal to the wireline. (Refer to the Wireline Interface Board sections in this manual for block diagrams showing the interface between the *ASTRO* modem card and the wireline/station.)

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PERIPHERAL TRAY

(Option X696AA)

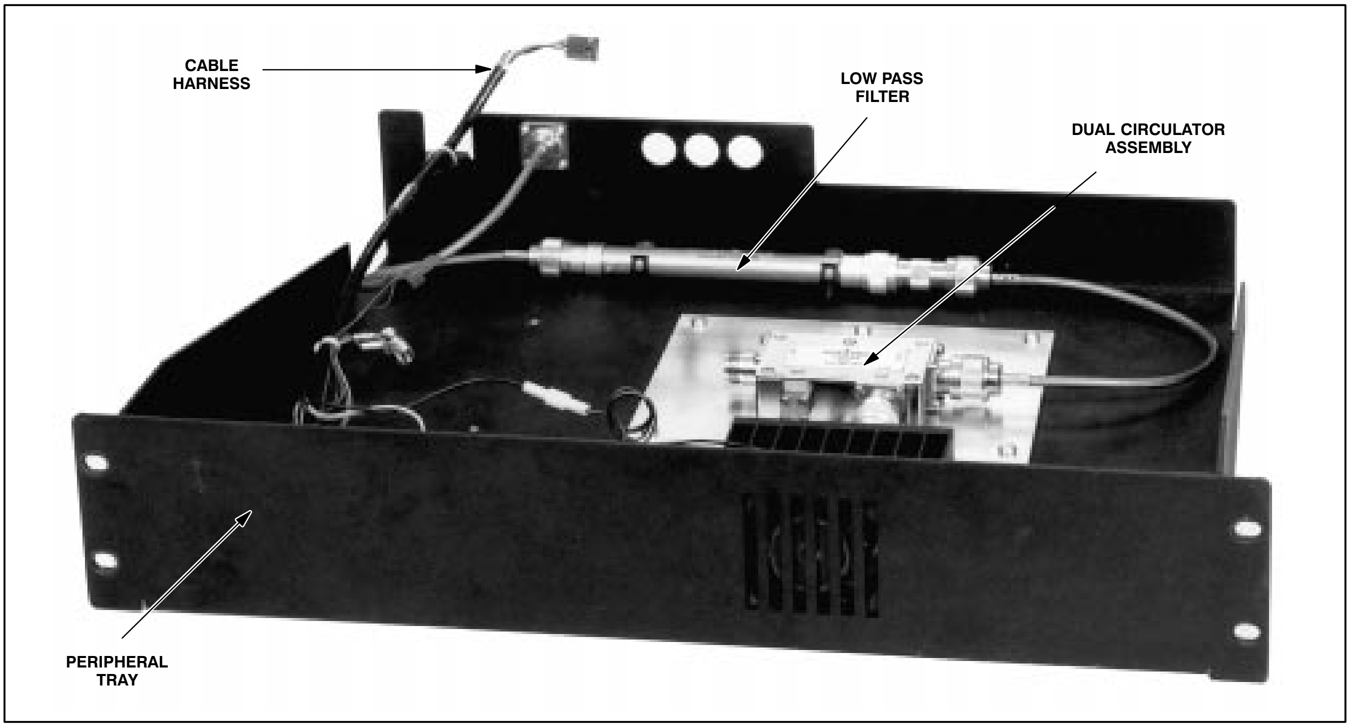

Figure 1. Peripheral Tray with Internal Components (900 MHz Components Shown)

1 DESCRIPTION

Option X696AA provides a peripheral tray and cable harness for use with *Quantar* station products. This section provides a general description, option complement, and identification of inputs/outputs. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The peripheral tray is comprised of a rack–mount tray. The tray (shown in Figure 1) allows various ancillary equipment (circulators, filters, etc.) to be housed and electrically connected to the station.

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2 OPTIONS COMPLEMENT

Table 1 shows the contents for the Option X696AA Peripheral Tray option.

Option Complement Chart

Table 1. Peripheral Tray Option X696AA Complement

Model/Part No.	Description
TRN7751A	Peripheral Tray Assembly
0383498N08	Self−tapping screws (4)
2785203U01	Peripheral Tray Shelf

3 PERIPHERAL TRAY CONTENTS AND INPUTS/OUTPUTS

Figure 2 shows the Peripheral Tray equipped with dual circulator assembly and low pass filter.

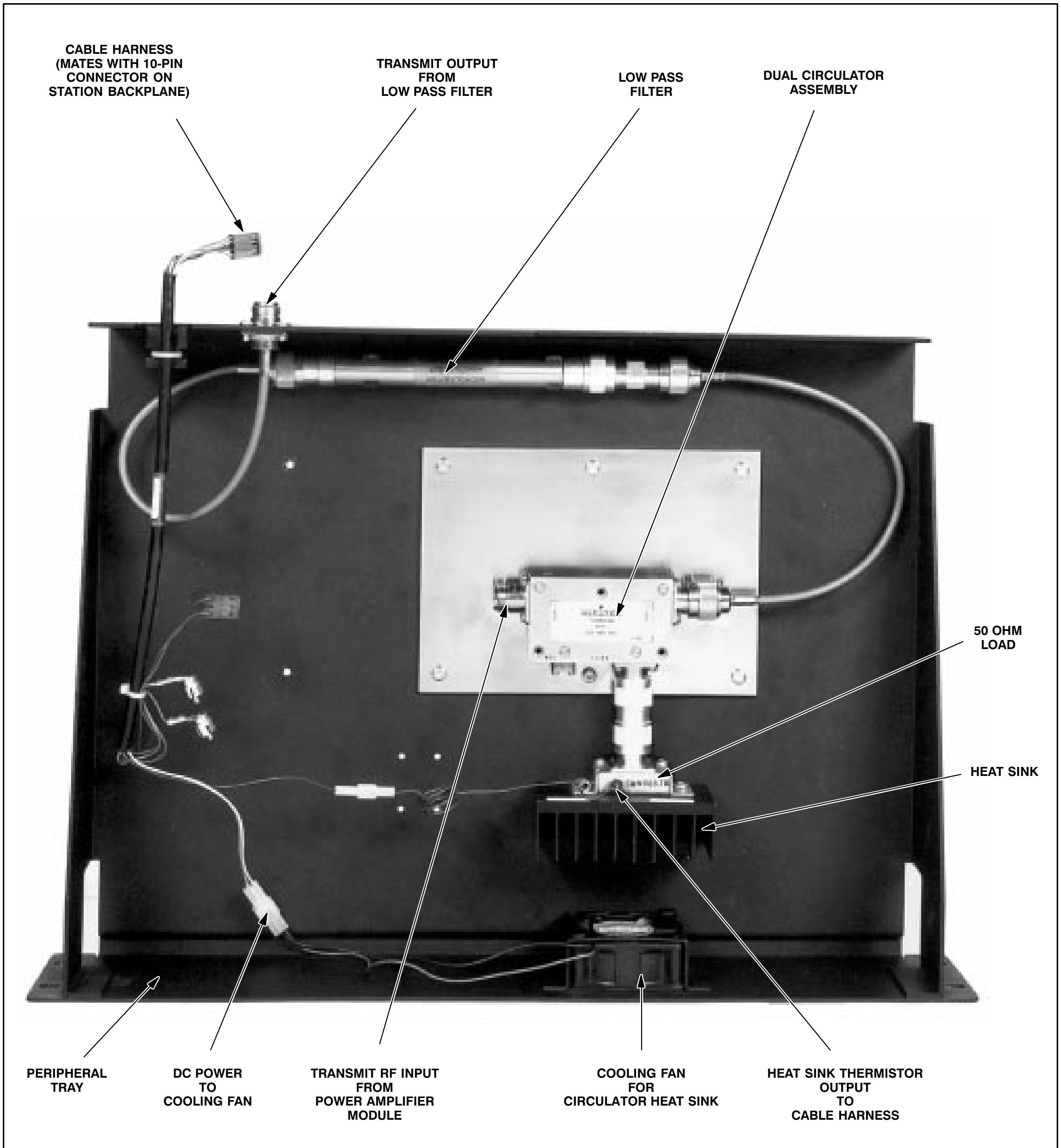

Figure 2. Peripheral Tray Contents and Inputs and Outputs (900 MHz Circulator and Low Pass Filter Shown)

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MOTOROLA

ULTRA HIGH STABILITY OSCILLATOR (UHSO) MODULE (Internal)

Option X873AA

1 DESCRIPTION

The Option X873AA UHSO Module is described in this section. A general description, identification of inputs/outputs, functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The X873AA Option provides an Ultra−High Stability Oscillator Module which significantly increases the frequency accuracy of the station's internal frequency reference circuitry (located on the Station Control Module). The UHSO module is designed to slide into the 2nd receiver slot of the station card cage and is powered by the station power supply (via the backplane).

The module consists of a sealed ovenized element, voltage regulator circuitry, and control and diagnostics circuitry.

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2 IDENTIFICATION OF INPUTS/OUTPUTS

Figure 1 shows the UHSO Module input and output external connections.

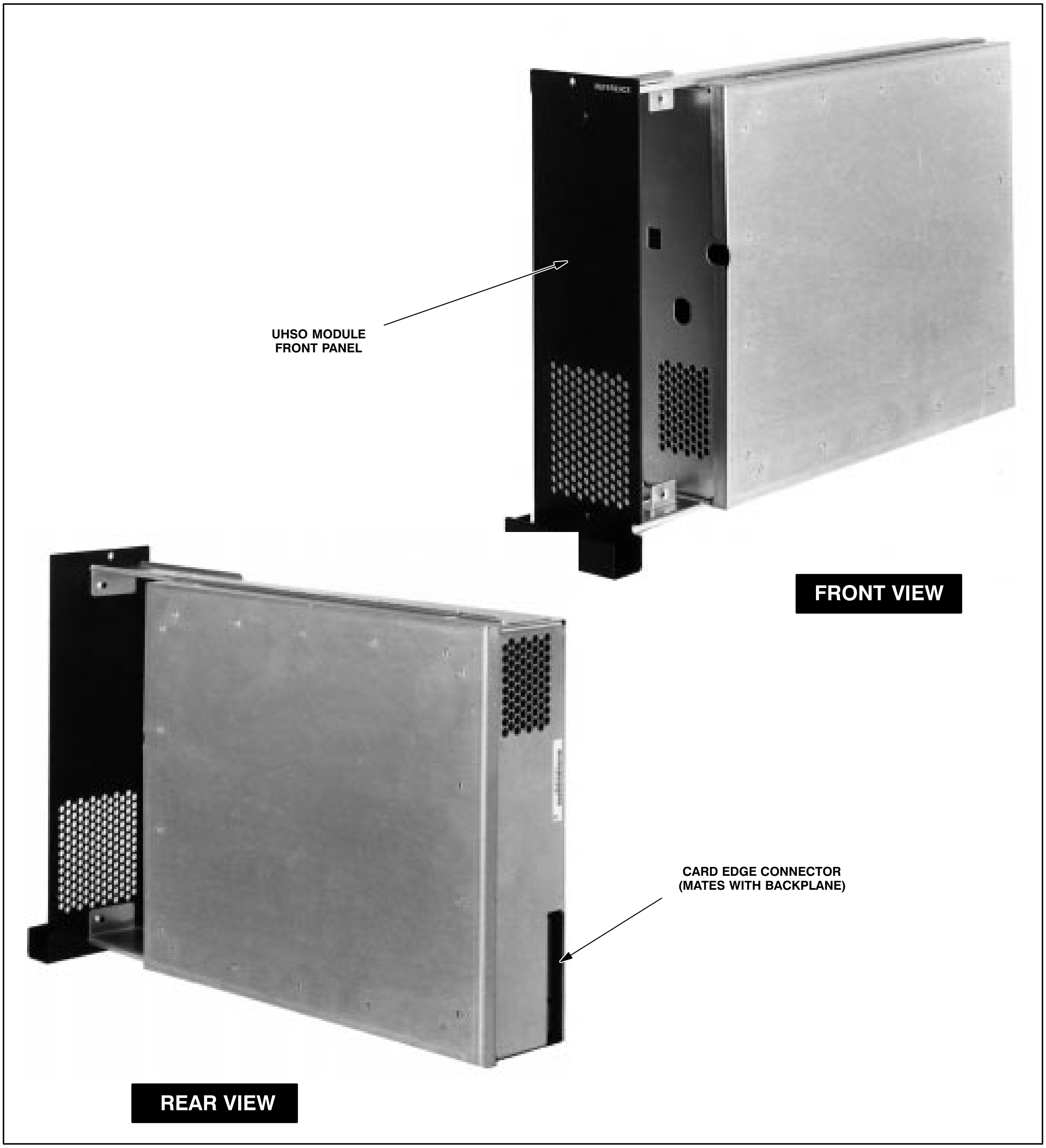

Figure 1. UHSO Module Inputs and Outputs

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the UHSO Module circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to the block diagram shown in Figure 2.

+10V Regulator Circuitry

A series pass regulator circuit accepts +14.2 V from the backplane and generates a +10 V dc supply voltage. This +10 V is used to power the ovenized 5 MHz element as well as other circuitry on the UHSO board.

5 MHz Oscillator Circuitry

A sealed ovenized 5 MHz element provides a highly stable 5 MHz reference output. This output is fed to the Station Control Module (via the backplane) and is used to control the reference oscillator circuitry (located on the SCM board) to maintain improved frequency accuracy. A sample of the 5 MHz signal is fed to one of the A/D converter inputs (p/o Diagnostics Circuitry).

The ovenized element also generates a +8V dc voltage. This +8V is used to power the buffers associated with the steering voltage, and allows the steering voltage and ovenized element to “track”, eliminating the need for additional temperature compensation. The + 8V dc voltage is also scaled and buffered to provide a +8V sample which is fed to one of the A/D converter inputs (p/o Diagnostics Circuitry).

Control Circuitry

The control circuitry accepts 12 bits of data from the Station Control Module (via the SPI bus) and outputs a corresponding dc voltage. This voltage is scaled and buffered and output as a dc steering voltage which controls the frequency output of the 5 MHz oscillator. [Note that this is not a closed feedback loop system. The 12 bits are sent only during station power up and when performing the reference oscillator calibration procedure (using the RSS).]

The dc steering voltage is also scaled and buffered to provide a steering voltage sample which is fed to one of the A/D converter inputs (p/o Diagnostics Circuitry).

Address Decode Circuitry

The address decode circuitry allows the Station Control Board to use the address bus to select a specific device on a specific station board for control or data communications purposes (via the SPI bus). If the board select circuitry decodes address lines A2 thru A5 as the UHSO module address, it enables the chip select circuitry. The chip select circuitry then decodes address lines A0 and A1 and generates chip select signals for the D/A and A/D converters.

Diagnostics Circuitry

Various dc voltages and sample signals are input to an A/D converter which converts the signals to a binary representation. The data is then sent to the Station Control Module (via the SPI bus) for monitoring and diagnostics purposes.

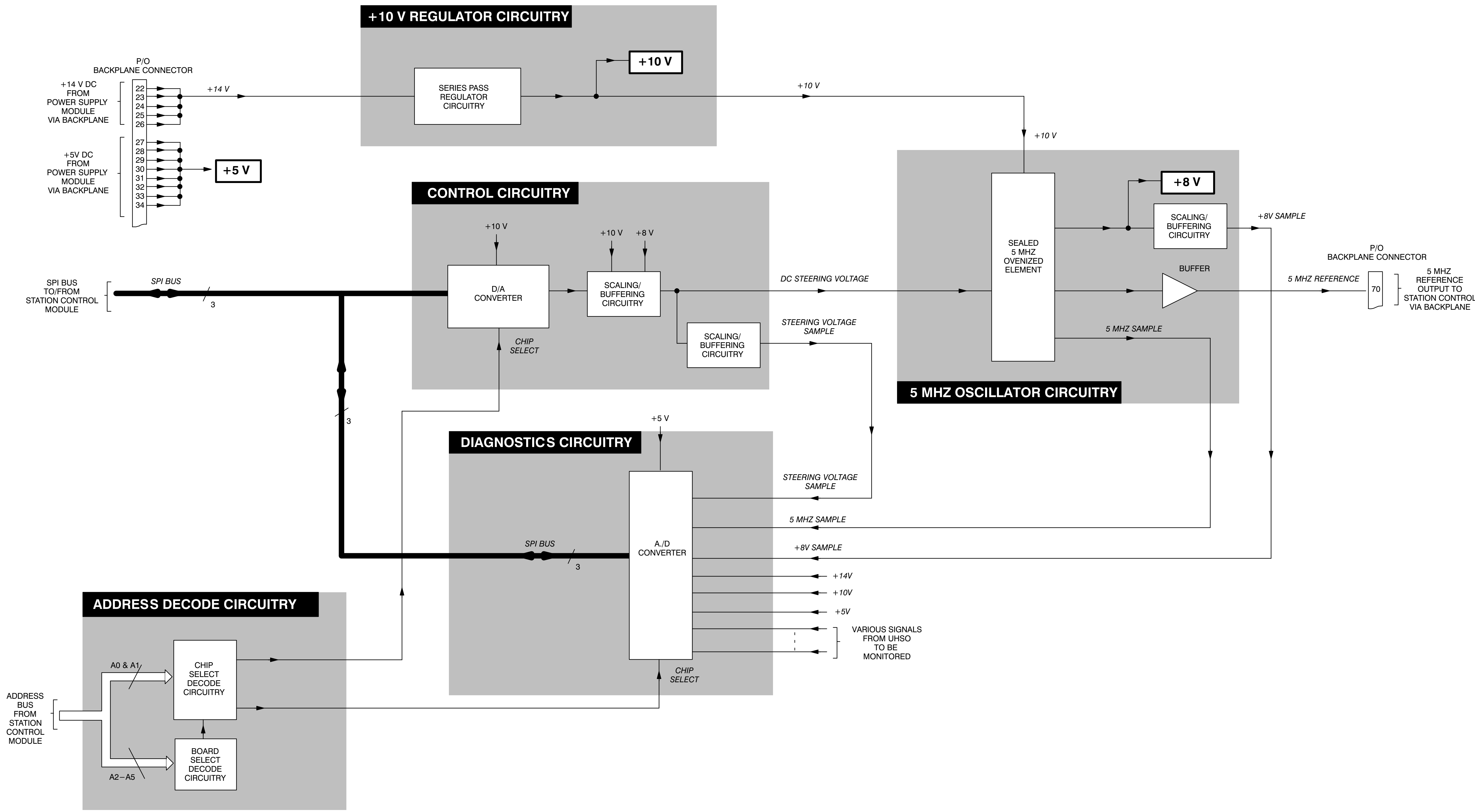

Figure 2. Internal UHSO Module Functional Block Diagram

MOTOROLA

RA/RT CONFIGURATION (E & M KEYING)

For *Quantar* and *Quantro* Stations

1 OVERVIEW

The RA/RT (E & M keying) configuration allows a *Quantar*/*Quantro* station to be controlled by a remote console using either a radio link or a microwave link in place of the usual wireline link. This configuration is typically used in cases where the station is located in a relatively inaccessible location (such as a mountain top) where running phone lines is either impractical or impossible.

As shown in Figure 1A, a pair of stations (called station 1 and station 2) is used to substitute for the normal wireline connections between the repeater station and the console. Figure 1B shows a microwave RA/RT link.

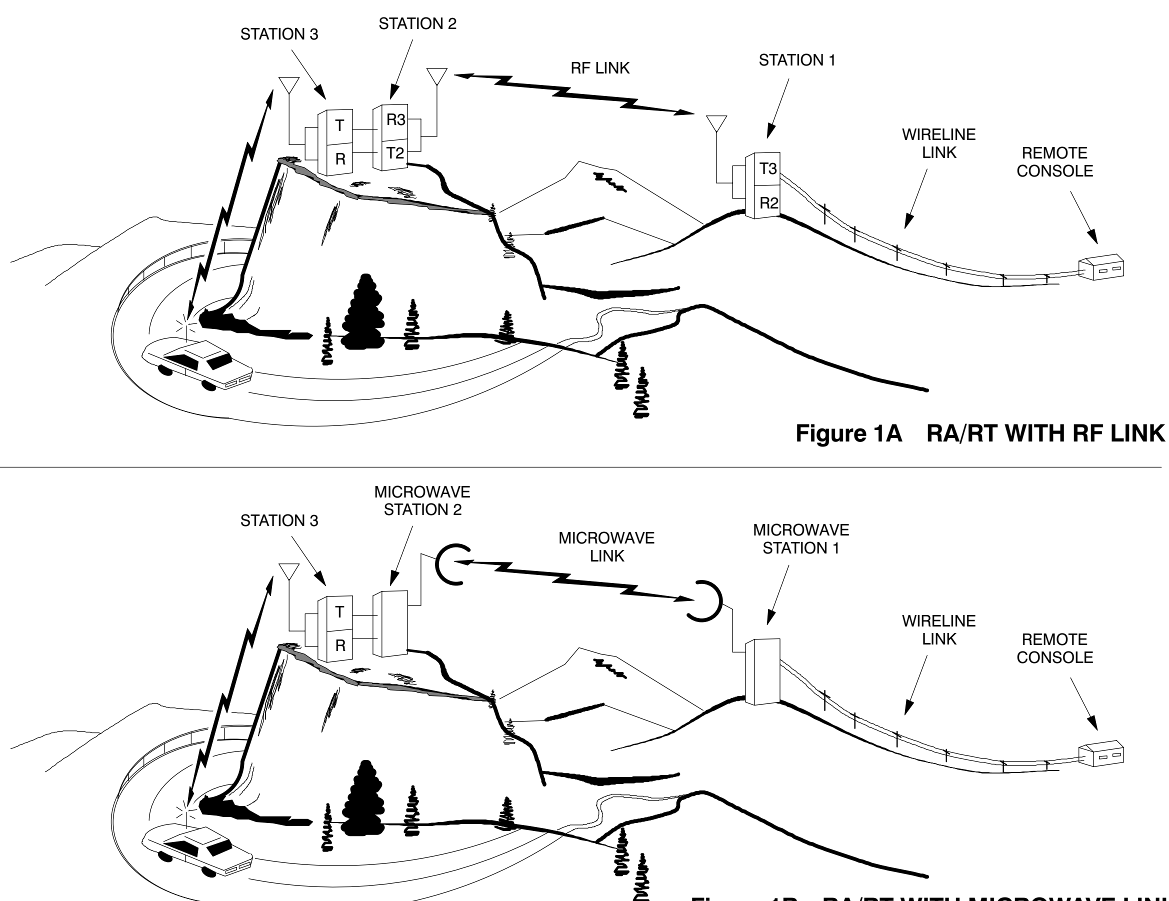

Figure 1A RA/RT WITH RF LINK

Figure 1B RA/RT WITH MICROWAVE LINK

Figure 1. Typical RA/RT Systems (E & M Keying)

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2 ELECTRICAL CONNECTIONS (RF LINK)

Install stations 1, 2, and 3 as described in the appropriate functional base station manual. Figure 2 shows the connections between the stations necessary to allow RA/RT (E & M keying) operation. Perform the following procedures to make the wiring connections between the console and Station 1 and between Stations 2 and 3.

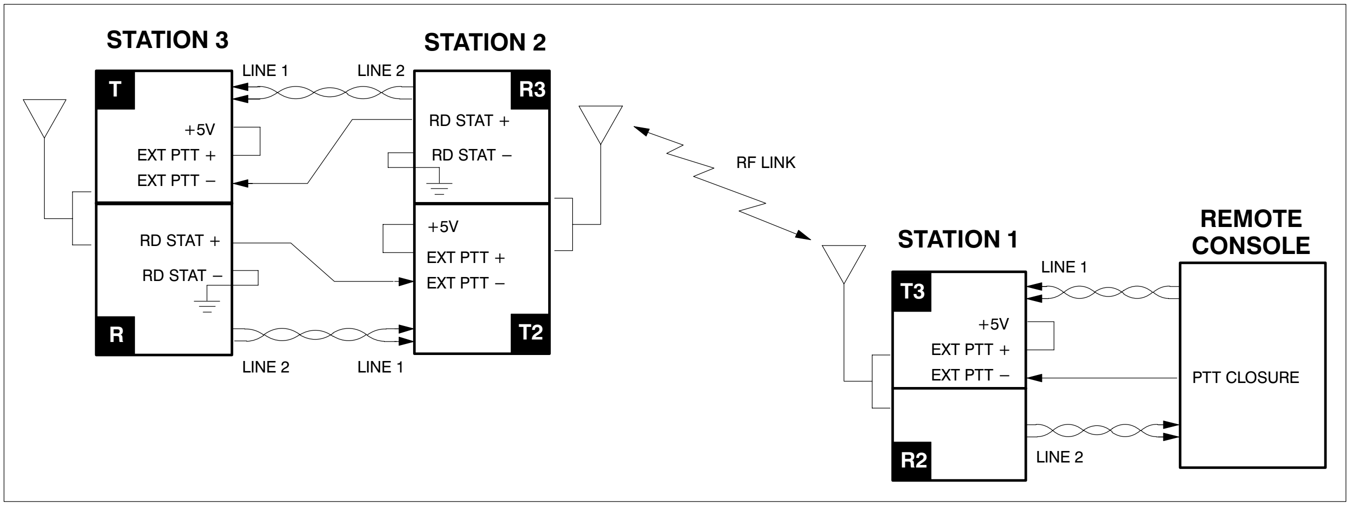
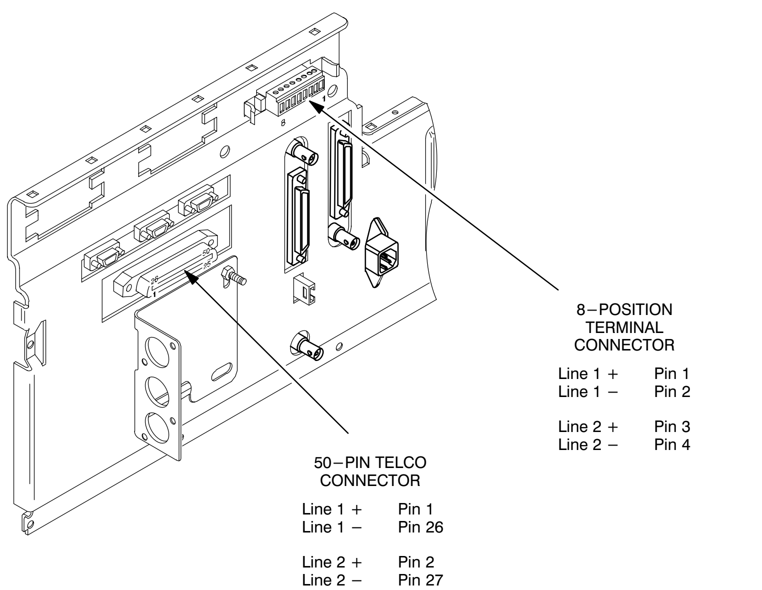


Figure 2. RA/RT (E & M Keying) Wiring Connections (RF Link)

Console to Station 1 Wiring Connections

Step 1. Connect the landline–to–station audio (from the console) to the Line 1 connections on the backplane of Station 1 as shown below.

Step 2. Connect the station–to–landline audio (to the console) to the Line 2 connections on the backplane of Station 1, as shown below.



Note *Phone line connections may be made at either the 50-pin Telco connector or the 8-position terminal connector. Refer to the* ***Installation*** *section of the appropriate station functional manual for more details on phone line connections.*

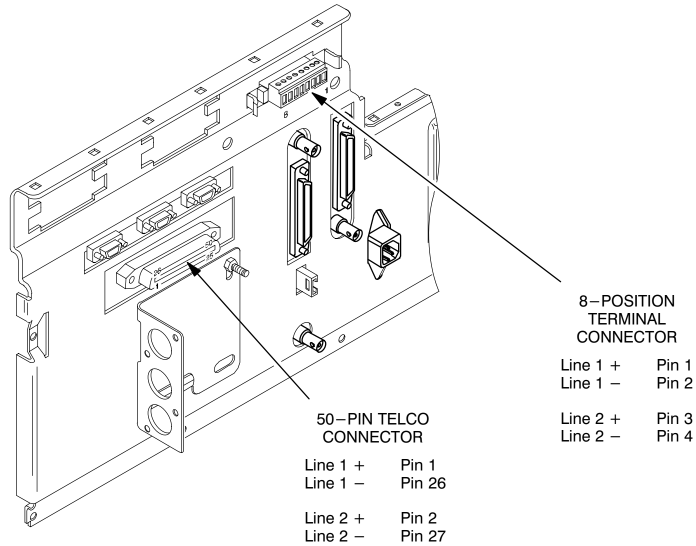
Station 2 to Station 3 Wiring Connections

Wireline Connections

Step 1. Connect the Line 1 audio from Station 2 to the Line 2 connections on Station 3 as shown below.

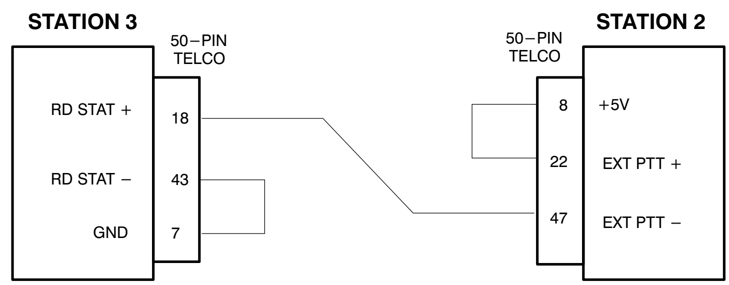
Step 2. Connect the Line 2 audio from Station 2 to the Line 1 connections on Station 3 as shown below.

Note *Phone line connections may be made at either the 50-pin Telco connector or the 8-position terminal connector. Refer to the* ***Installation*** *section of the appropriate station functional manual for more details on phone line connections.*

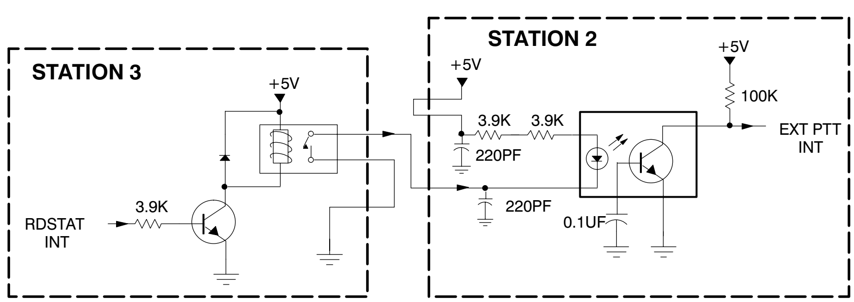


RDSTAT to EXT PTT Connection (Station 3 to Station 2)

Step 1. Connect the RD STAT + and – signals from Station 3 to the EXT PTT + and – signals on Station 2 as shown below. An equivalent schematic circuit for the RD STAT and EXT PTT signals is also shown.



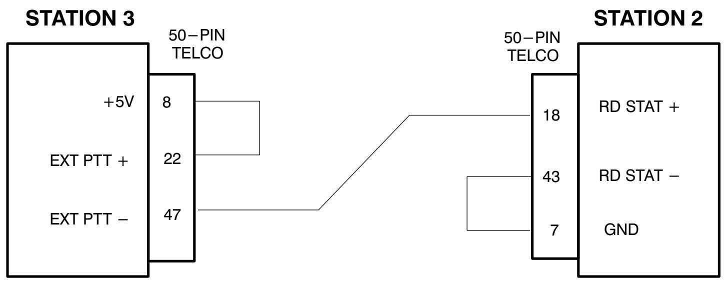
Note ***RDSTAT INT*** *signal goes high when Station 3 detects receive signal (according to RX Activation parameter setting via RSS). This energizes relay, turns on LED in opto-coupler, and pulls* ***EXT PTT INT*** *low. This causes Station 2 transmitter to key up and routes Line 1 audio to the transmitter.*

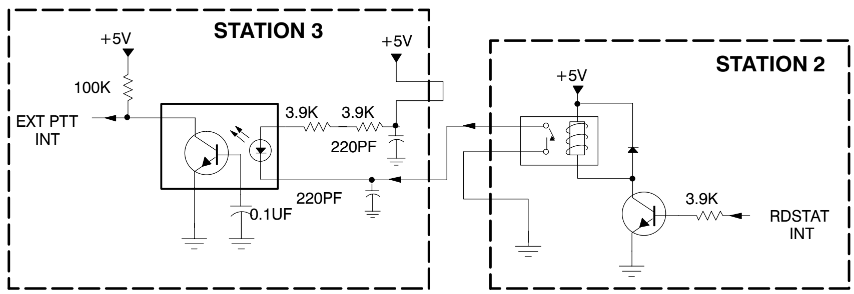


Station 2 to Station 3 Wiring Connections (Cont'd)

RDSTAT to EXT PTT Connection (Station 2 to Station 3)

Step 1. Connect the RD STAT + and – signals from Station 2 to the EXT PTT + and – signals on Station 3 as shown below. An equivalent schematic circuit for the RD STAT and EXT PTT signals is also shown.





Note ***RDSTAT INT*** *signal goes high when Station 2 detects receive signal (according to RX Activation parameter setting via RSS). This energizes relay, turns on LED in opto-coupler, and pulls* ***EXT PTT INT*** *low. This causes Station 3 transmitter to key up and routes Line 1 audio to the transmitter.*

3 ELECTRICAL CONNECTIONS (MICROWAVE LINK)

Install the station as described in the appropriate functional base station manual. Figure 2 shows the connections between the station, microwave equipment, and console necessary to allow RA/RT (E & M keying) operation. Perform the following procedures to make the wiring connections between the console and the Microwave Station 1 and between Microwave Station 2 and Station 3.

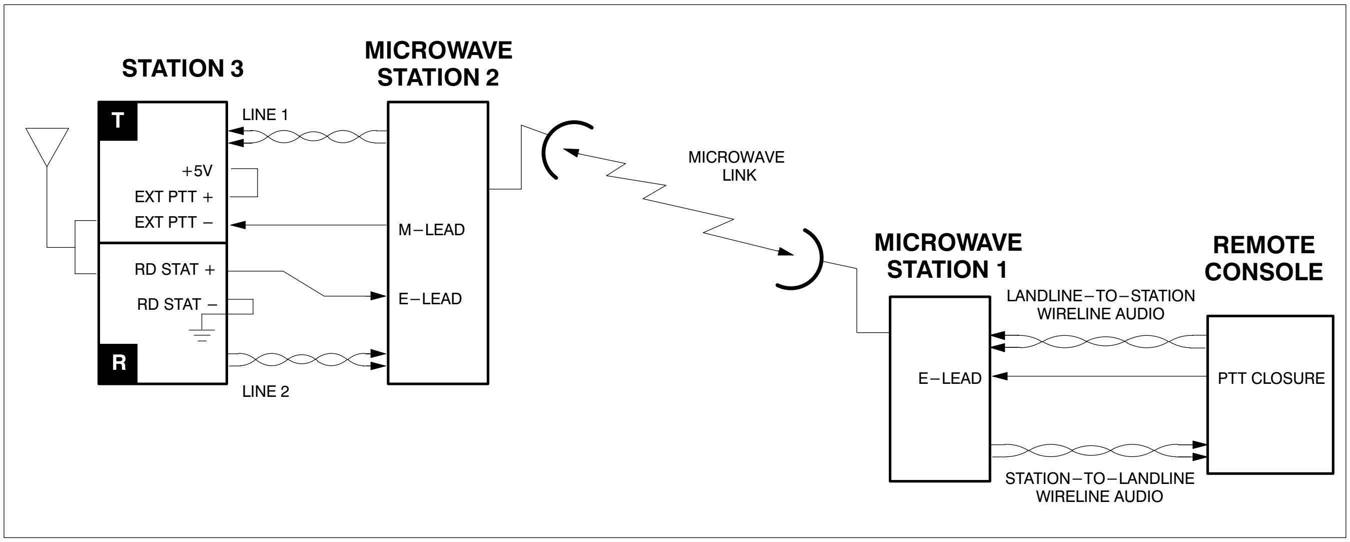


Figure 3. RA/RT (E & M Keying) Wiring Connections (Microwave Link)

Console to Microwave Station 1 Wiring Connections

Note *Refer to the Microwave Station manual for details of making wireline connections.*

Step 1. Connect the landline−to−station audio (from the console) to Microwave Station 1.

Step 2. Connect the station−to−landline audio (to the console) to the Microwave Station.

Microwave Station 2 to Station 3 Wiring Connections

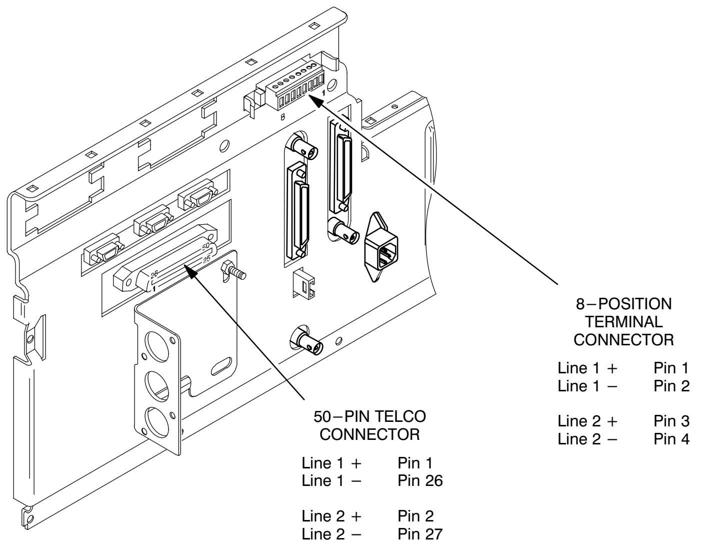
Note *Refer to the Microwave Station manual for details of making wireline connections.*

Wireline Connections

Step 1. Connect the station–to–landline audio from Microwave Station 2 to the Line 1 connections on Station 3 as shown below.

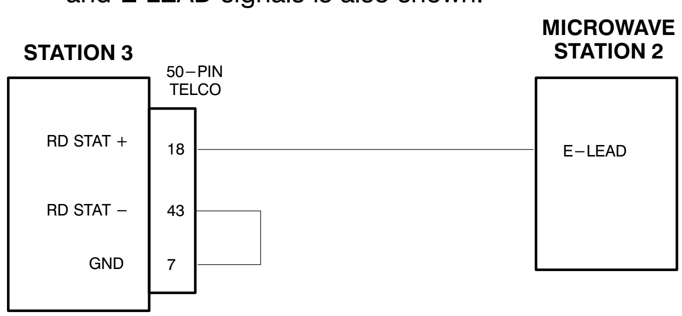
Step 2. Connect the landline–to–station audio to Microwave Station 2 to the Line 2 connections on Station 3 as shown below.

Note *Phone line connections may be made at either the 50-pin Telco connector or the 8-position terminal connector. Refer to the* ***Installation*** *section of the appropriate station functional manual for more details on phone line connections.*

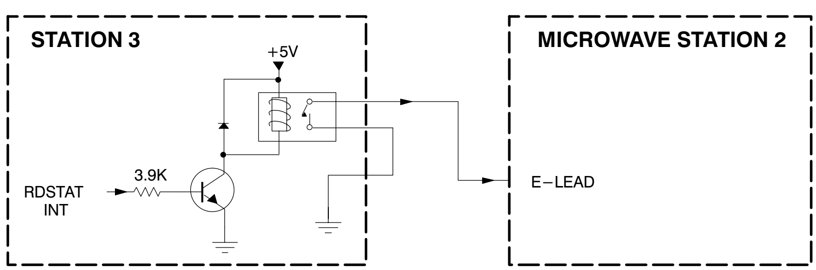


RDSTAT to E–Lead Connection (Station 3 to Station 2)

Step 1. Connect the RD STAT + and – signals from Station 3 to the E–Lead signal on Microwave Station 2 as shown below. An equivalent schematic circuit for the RD STAT and E LEAD signals is also shown.



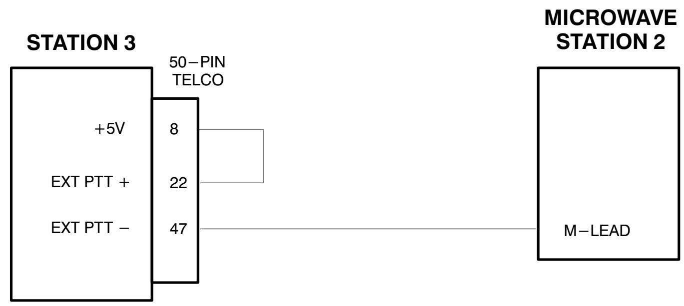
Note ***RDSTAT INT*** *signal goes high when Station 3 detects receive signal (according to RX Activation parameter setting via RSS). This energizes relay and provides ground signal to* ***E LEAD*** *input on Microwave Station 2.*

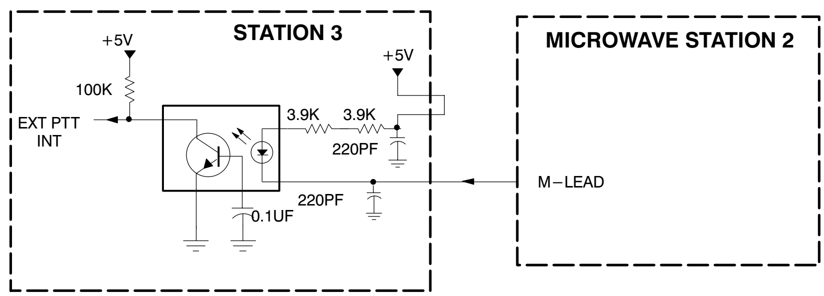


Microwave Station 2 to Station 3 Wiring Connections (Cont'd)

M−Lead to EXT PTT Connection (Station 2 to Station 3)

Step 1. Connect the M−Lead on the Microwave Station 2 to the EXT PTT + signal on Station 3 as shown below. An equivalent schematic circuit for the EXT PTT and M LEAD signals is also shown.





__Note__ __MLEAD__ output from Microwave Station 2 goes low when transmitting signal on wireline. This causes __EXT PTT__ to activate and key Station 3 transmitter.

4 RSS PROGRAMMING

Using the *Quantar/Quantro* Radio Service Software (RSS) program, make the following codeplug data changes to allow proper RA/RT operation. (Refer to the *RSS User's Guide 68P81085E35* for details on making codeplug programming changes.)

Table 1. Codeplug Data Changes for RA/RT Operation (RF Link Configuration)

Equipment	Codeplug Data Parameter	RSS User's Guide Location
Station 1	**Disable** TX Notch Filter	Programming the Wireline Configuration Data (p/o Chapter 4)
Station 3	**Disable** TX Notch Filter	Programming the Wireline Configuration Data (p/o Chapter 4)

Table 2. Codeplug Data Changes for RA/RT Operation (Microwave Link Configuration)

Equipment	Codeplug Data Parameter	RSS User's Guide Location
Station 3	**Disable** TX Notch Filter	Programming the Wireline Configuration Data (p/o Chapter 4)

5 TX WIRELINE ALIGNMENT

You may align the TX Wireline levels as described in the *RSS User's Guide 68P81085E35* (which requires the use of an external signal generator), or you may use the station to generate the alignment tone. This method is described as follows.

Note — *Make sure the Automatic Line Control parameter is disabled for Stations 1,2, and 3.*

Station 1 TX Wireline Alignment

Perform standard TX Wireline alignment procedure located in *RSS User's Guide 68P81085E35*.

Station 2 TX Wireline Alignment

Step 1. Connect the RSS to Station 3 and access the RX Wireline Alignment screen.

Step 2. Set the RX wireline level and **Save** it. (Note that the wireline level is typically set to −6 dBm.)

Step 3. Press **F2** to turn on the 1 kHz tone. **Do not** exit this screen.

Step 4. With the RSS program still running, disconnect the RSS cable from Station 3 and connect it to Station 2. Now exit the RX Alignment screen.

Step 5. Access the TX Wireline Alignment screen and press **F8** to save the alignment value. (Station 3 is providing the 1 kHz alignment tone.)

Step 6. Exit the TX Wireline Alignment screen.

Step 7. With the RSS program still running, disconnect the RSS cable from Station 2 and connect it to Station 3.

Step 8. Access the RX Wireline Alignment screen and turn off the 1 kHz tone.

Station 3 TX Wireline Alignment

Step 1. Connect the RSS to Station 2 and access the RX Wireline Alignment screen.

Step 2. Set the RX wireline level and **Save** it. (Note that the wireline level is typically set to −6 dBm.)

Step 3. Press **F2** to turn on the 1 kHz tone. **Do not** exit this screen.

Step 4. With the RSS program still running, disconnect the RSS cable from Station 2 and connect it to Station 3. Now exit the RX Alignment screen.

Step 5. Access the TX Wireline Alignment screen and press **F8** to save the alignment value. (Station 2 is providing the 1 kHz alignment tone.)

Step 6. Exit the TX Wireline Alignment screen.

Step 7. With the RSS program still running, disconnect the RSS cable from Station 3 and connect it to Station 2.

Step 8. Access the RX Wireline Alignment screen and turn off the 1 kHz tone.

MOTOROLA

RA/RT CONFIGURATION (TRC CONTROL)

For *Quantar* and *Quantro* Stations

1 OVERVIEW

The RA/RT (TRC control) configuration allows a *Quantar*/*Quantro* station to be TRC controlled by a remote console using either a radio link or a microwave link in place of the usual wireline link. This configuration is typically used in cases where the station is located in a relatively inaccessible location (such as a mountain top) where running phone lines is either impractical or impossible.

As shown in Figure 1A, a pair of stations (called station 1 and station 2) is used to substitute for the normal wireline connections between the repeater station and the console. Figure 1B shows a microwave RA/RT link.

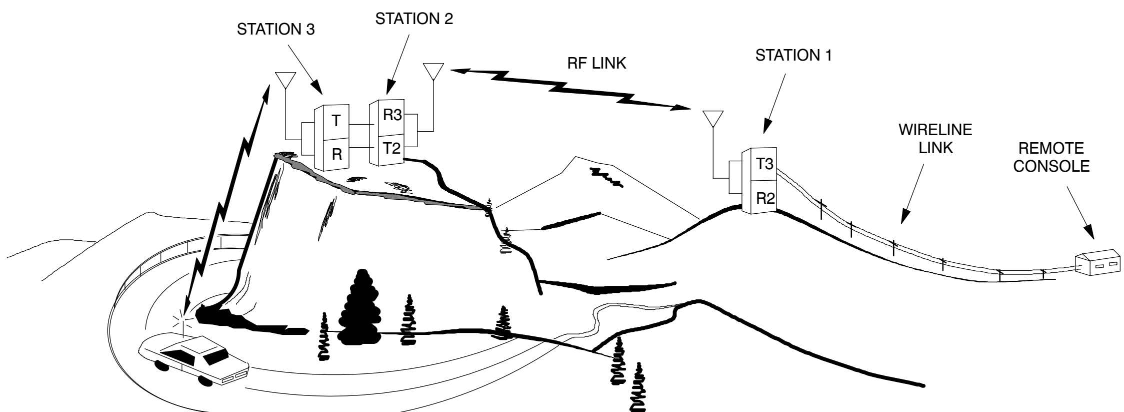


Figure 1A RA/RT WITH RF LINK

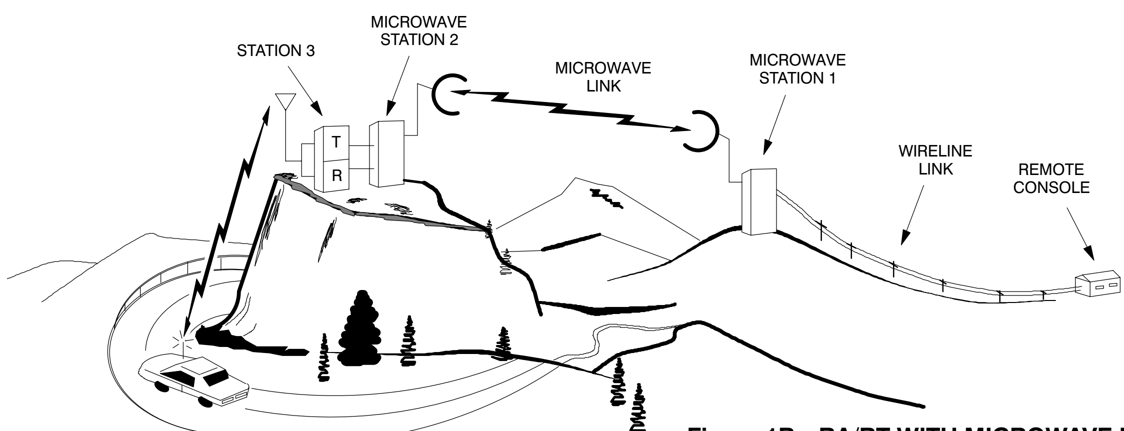


Figure 1B RA/RT WITH MICROWAVE LINK

Figure 1. Typical RA/RT Systems (TRC Control)

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2 ELECTRICAL CONNECTIONS (RF LINK)

Install stations 1, 2, and 3 as described in the appropriate functional base station manual. Figure 2 shows the connections between the stations necessary to allow RA/RT (TRC control) operation. Perform the following procedures to make the wiring connections between the console and Station 1 and between Stations 2 and 3.

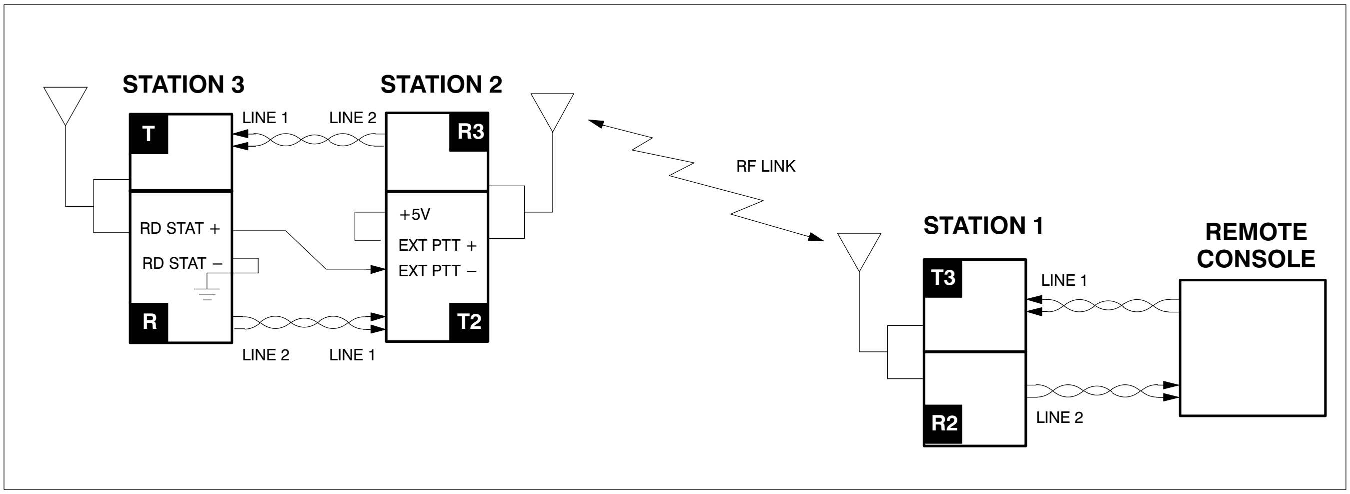


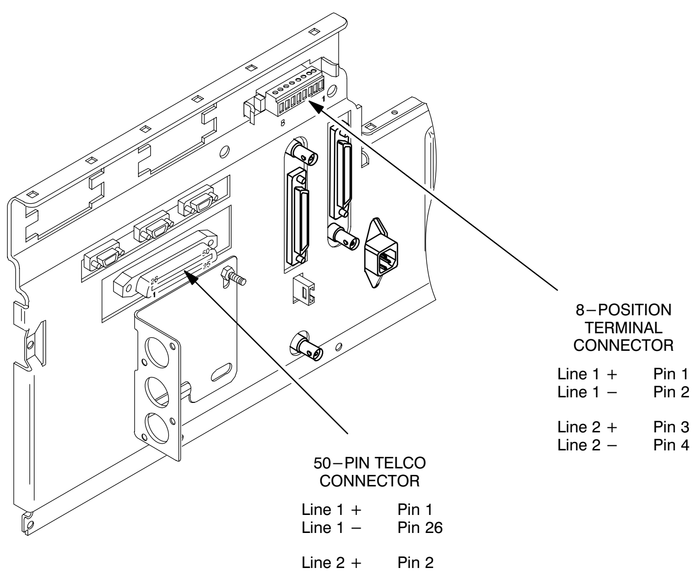
Figure 2. RA/RT (TRC Control) Wiring Connections (RF Link)

Console to Station 1 Wiring Connections

Note *Phone line connections may be made at either the 50-pin Telco connector or the 8-position terminal connector. Refer to the* ***Installation*** *section of the appropriate station functional manual for more details on phone line connections.*

Step 9. Connect the landline−to−station audio (from the console) to the Line 1 connections on the backplane of Station 1 as shown below.

Step 10. Connect the station−to−landline audio (to the console) to the Line 2 connections on the backplane of Station 1, as shown below.



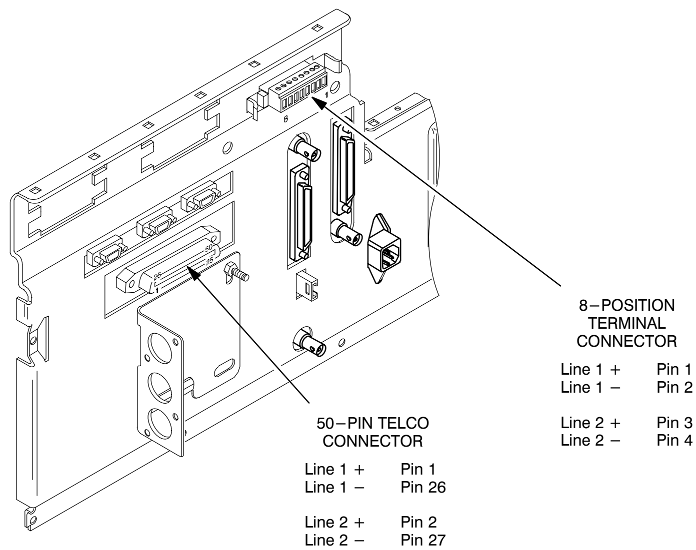
Station 2 to Station 3 Wiring Connections

Wireline Connections

Step 1. Connect the Line 1 audio from Station 2 to the Line 2 connections on Station 3 as shown below.

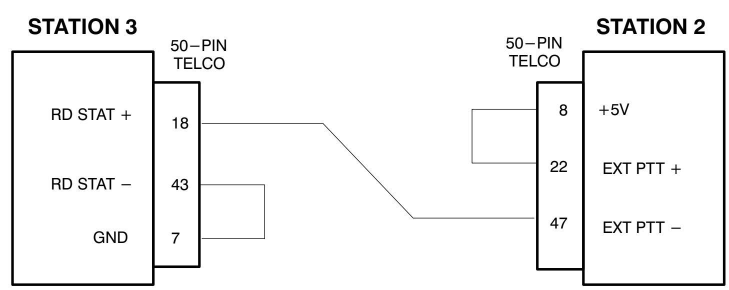
Step 2. Connect the Line 2 audio from Station 2 to the Line 1 connections on Station 3 as shown below.

Note *Phone line connections may be made at either the 50-pin Telco connector or the 8-position terminal connector. Refer to the* ***Installation*** *section of the appropriate station functional manual for more details on phone line connections.*

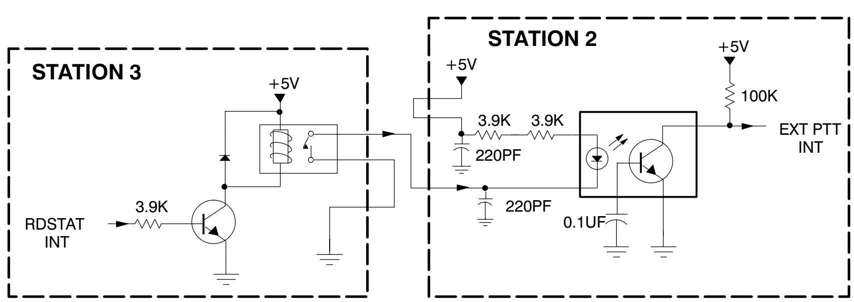


RDSTAT to EXT PTT Connection

Step 1. Connect the RD STAT + and – signals from Station 3 to the EXT PTT + and – signals on Station 2 as shown below. An equivalent schematic circuit for the RD STAT and EXT PTT signals is also shown.



Note ***RDSTAT INT*** *signal goes high when Station 3 detects receive signal (according to RX Activation parameter setting via RSS). This energizes relay, turns on LED in optocoupler, and pulls* ***EXT PTT INT*** *low. This causes Station 2 transmitter to key up and routes Line 1 audio to the transmitter.*



3 ELECTRICAL CONNECTIONS (MICROWAVE LINK)

Install the station as described in the appropriate functional base station manual. Figure 2 shows the connections between the station, microwave equipment, and console necessary to allow RA/RT (TRC control) operation. Perform the following procedures to make the wiring connections between the console and the Microwave Station 1 and between Microwave Station 2 and Station 3.

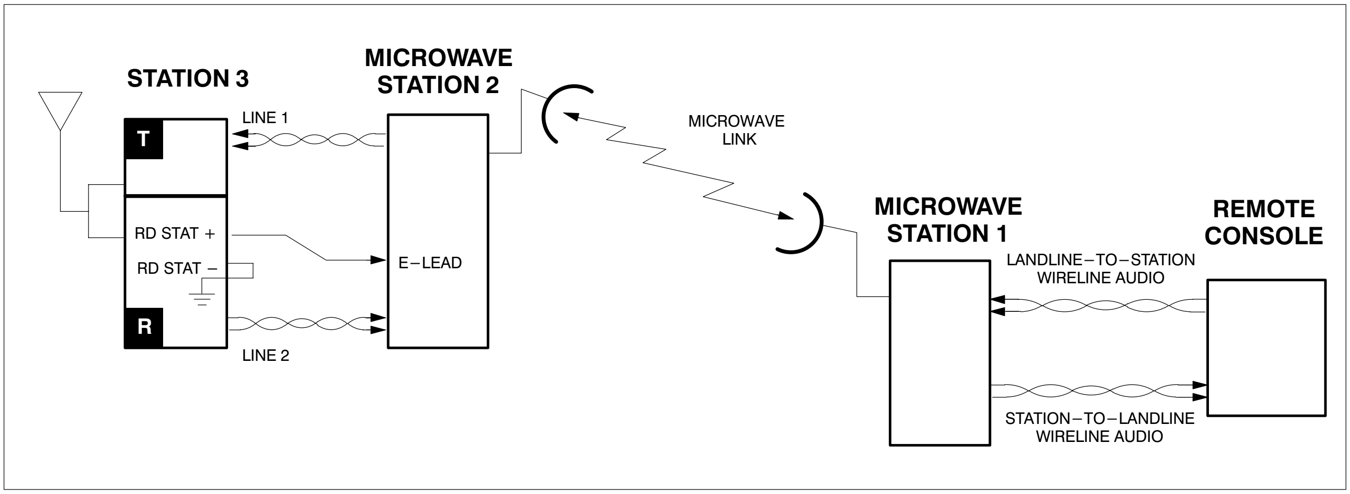


Figure 3. RA/RT (TRC Control) Wiring Connections (Microwave Link)

Console to Microwave Station 1 Wiring Connections

Note *Refer to the Microwave Station manual for details of making wireline connections.*

Step 1. Connect the landline−to−station audio (from the console) to Microwave Station 1.

Step 2. Connect the station−to−landline audio (to the console) to the Microwave Station.

Microwave Station 2 to Station 3 Wiring Connections

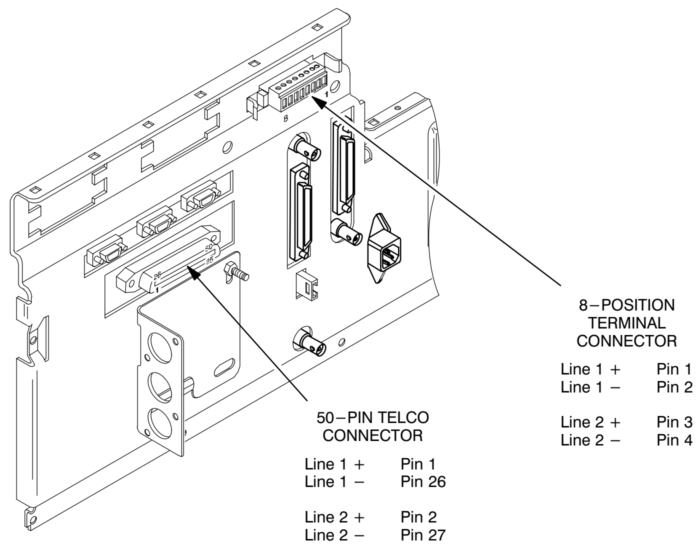
Note Refer to the Microwave Station manual for details of making wireline connections.

Wireline Connections

Step 1. Connect the station–to–landline audio from Microwave Station 2 to the Line 1 connections on Station 3 as shown below.

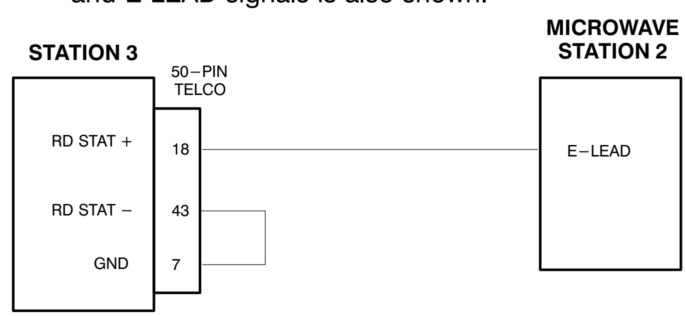
Step 2. Connect the landline–to–station audio to Microwave Station 2 to the Line 2 connections on Station 3 as shown below.

*Note Phone line connections may be made at either the 50-pin Telco connector or the 8-position terminal connector. Refer to the **Installation** section of the appropriate station functional manual for more details on phone line connections.*

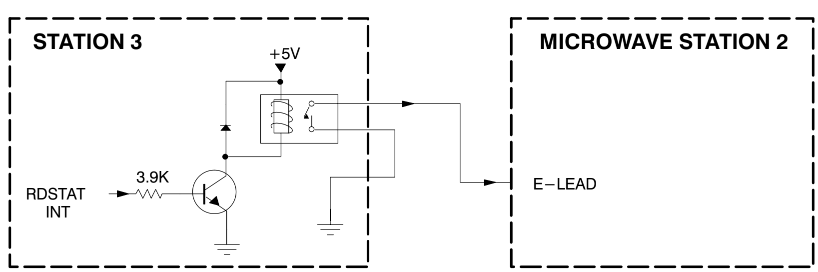


RDSTAT to E–Lead Connection

Step 1. Connect the RD STAT + and – signals from Station 3 to the E–Lead signal on Microwave Station 2 as shown below. An equivalent schematic circuit for the RD STAT and E LEAD signals is also shown.



*Note **RDSTAT INT** signal goes high when Station 3 detects receive signal (according to RX Activation parameter setting via RSS). This energizes relay and provides ground signal to **E LEAD** input on Microwave Station 2.*



4 RSS PROGRAMMING

Using the *Quantar/Quantro* Radio Service Software (RSS) program, make the following codeplug data changes to allow proper RA/RT operation. (Refer to the *RSS User's Guide 68P81085E35* for details on making codeplug programming changes.)

Table 1. Codeplug Data Changes for RA/RT Operation (RF Link Configuration)

Equipment	Codeplug Data Parameter	RSS User's Guide Location
Station 1	Change command for Guard Tone from (typically) MORE to **KEY**. Leave all other commands empty.	Programming the TRC Commands Data (p/o Chapter 4)
	Disable TX Notch Filter	Programming the Wireline Configuration Data (p/o Chapter 4)
Station 3	**Enable** TX Notch Filter	Programming the Wireline Configuration Data (p/o Chapter 4)

Note — *Make sure console is programmed for 240 msec HLGT. On SECURENET systems, increase to 360 msec.*

Table 2. Codeplug Data Changes for RA/RT Operation (Microwave Link Configuration)

Equipment	Codeplug Data Parameter	RSS User's Guide Location
Station 3	**Enable** TX Notch Filter	Programming the Wireline Configuration Data (p/o Chapter 4)

Note — *Make sure console is programmed for 240 msec HLGT. On SECURENET systems, increase to 360 msec.*

5 TX WIRELINE ALIGNMENT

You may align the TX Wireline levels as described in the *RSS User's Guide 68P81085E35* (which requires the use of an external signal generator), or you may use the station to generate the alignment tone. This method is described as follows.

Note — *Make sure the Automatic Line Control parameter is disabled for Stations 1, 2, and 3.*

Station 1 TX Wireline Alignment

Perform standard TX Wireline alignment procedure located in *RSS User's Guide 68P81085E35*.

Station 2 TX Wireline Alignment

Step 1. Connect the RSS to Station 3 and access the RX Wireline Alignment screen.

Step 2. Set the RX wireline level and **Save** it. (Note that the wireline level is typically set to −6 dBm.)

Step 3. Press **F2** to turn on the 1 kHz tone. **Do not** exit this screen.

Step 4. With the RSS program still running, disconnect the RSS cable from Station 3 and connect it to Station 2. Now exit the RX Alignment screen.

Step 5. Access the TX Wireline Alignment screen and press **F8** to save the alignment value. (Station 3 is providing the 1 kHz alignment tone.)

Step 6. Exit the TX Wireline Alignment screen.

Step 7. With the RSS program still running, disconnect the RSS cable from Station 2 and connect it to Station 3.

Step 8. Access the RX Wireline Alignment screen and turn off the 1 kHz tone.

Station 3 TX Wireline Alignment

Step 1. Connect the RSS to Station 2 and access the RX Wireline Alignment screen.

Step 2. Set the RX wireline level and **Save** it. (Note that the wireline level is typically set to −6 dBm.)

Step 3. Press **F2** to turn on the 1 kHz tone. **Do not** exit this screen.

Step 4. With the RSS program still running, disconnect the RSS cable from Station 2 and connect it to Station 3. Now exit the RX Alignment screen.

Step 5. Access the TX Wireline Alignment screen and press **F8** to save the alignment value. (Station 2 is providing the 1 kHz alignment tone.)

Step 6. Exit the TX Wireline Alignment screen.

Step 7. With the RSS program still running, disconnect the RSS cable from Station 3 and connect it to Station 2.

Step 8. Access the RX Wireline Alignment screen and turn off the 1 kHz tone.

MOTOROLA

FALL BACK IN-CABINET REPEAT FEATURE

For *Quantar* and *Quantro* Stations

1 OVERVIEW

Feature Description

The Fall Back In-Cabinet Repeat (FBICR) feature provides limited backup communications capabilities in Simulcast (Option U764) and Non-Simulcast Voting (Option X269) systems in which the link to the Comparator has been lost (phone line disruption, cable disconnection, etc.). Figure 1 and Figure 2 illustrate typical scenarios in which the FBICR mode is activated. (Note that in these examples automatic FBICR mode is assumed; refer to *Automatic and External Modes* below for details.)

Note *The FBICR feature is supported only for Station/RSS Release R10.03.00 and later.*

Automatic and External Modes

The FBICR feature may be configured for either automatic or external modes (depending on system types, as explained later). Automatic mode is configured by programming certain station parameters using the Radio Service Software (RSS). External mode requires (in addition to RSS settings) that electrical connections be made to certain pins on the System Connector (Connector #17) located on the station backplane; external equipment (customer-provided) is used to ground one or more of these lines to force the station into FBICR mode.

The FBICR feature can be configured for the following system types in Automatic or External Modes:

Automatic Mode

- Conventional Analog (both Simulcast and Non-Simulcast Voting Systems)
- Conventional *ASTRO* (CAI) (both Simulcast and Non-Simulcast Voting Systems)
- Trunked *ASTRO* (SMARTZONE or SMARTNET) (CAI, VSELP) (Simulcast only)

External Mode

- Conventional Analog (both Simulcast and Non-Simulcast Voting Systems)
- Conventional *ASTRO* (CAI) (both Simulcast and Non-Simulcast Voting Systems)
- Trunked Analog (SMARTZONE or SMARTNET) (both Simulcast and Non-Simulcast Voting Systems)
- Trunked *ASTRO* (SMARTZONE or SMARTNET) (CAI, VSELP) (Simulcast only)

— *continued on page 3* —

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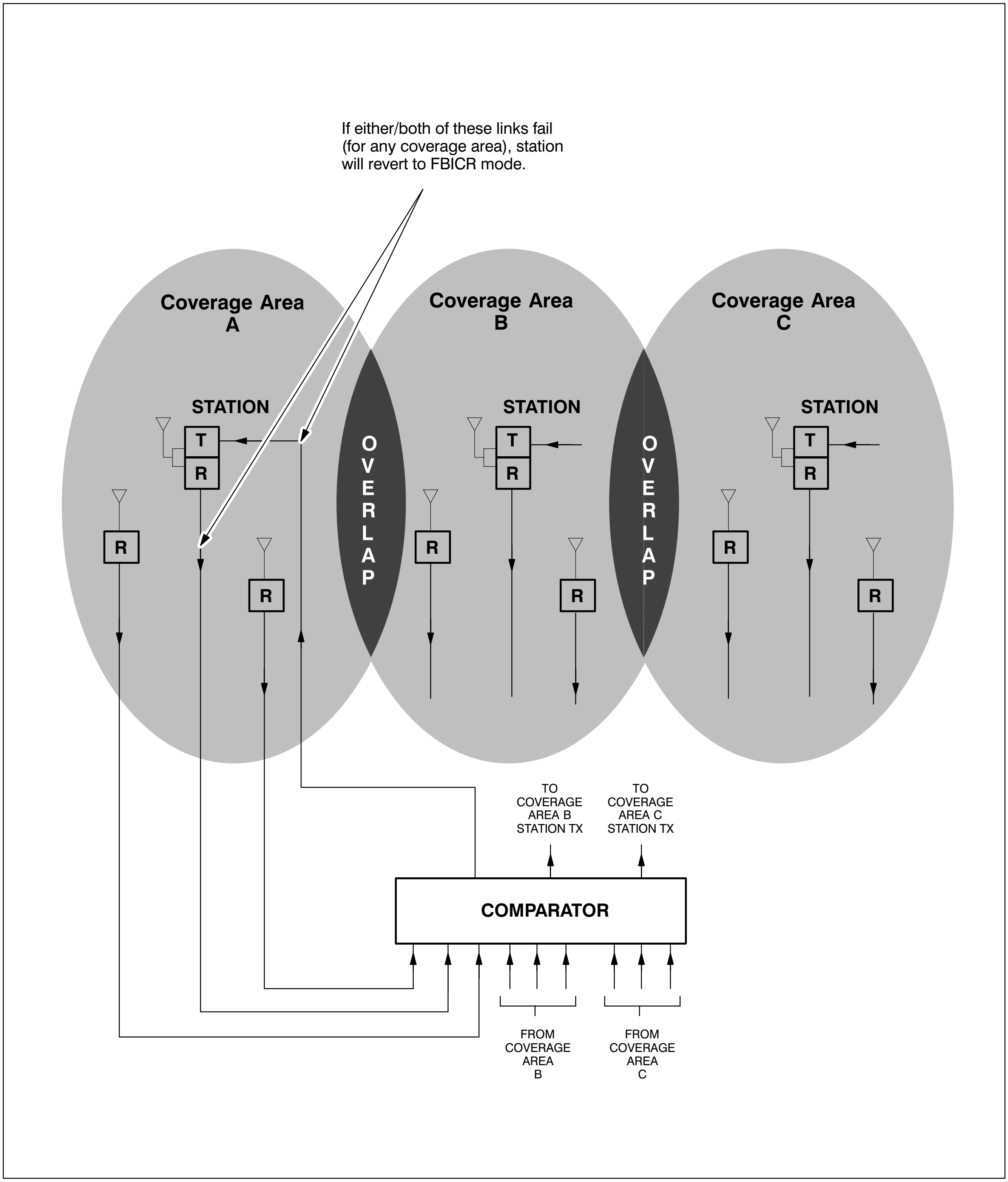


Figure 1. FBICR Feature in Simulcast Voting System (Automatic FBICR Mode Shown)

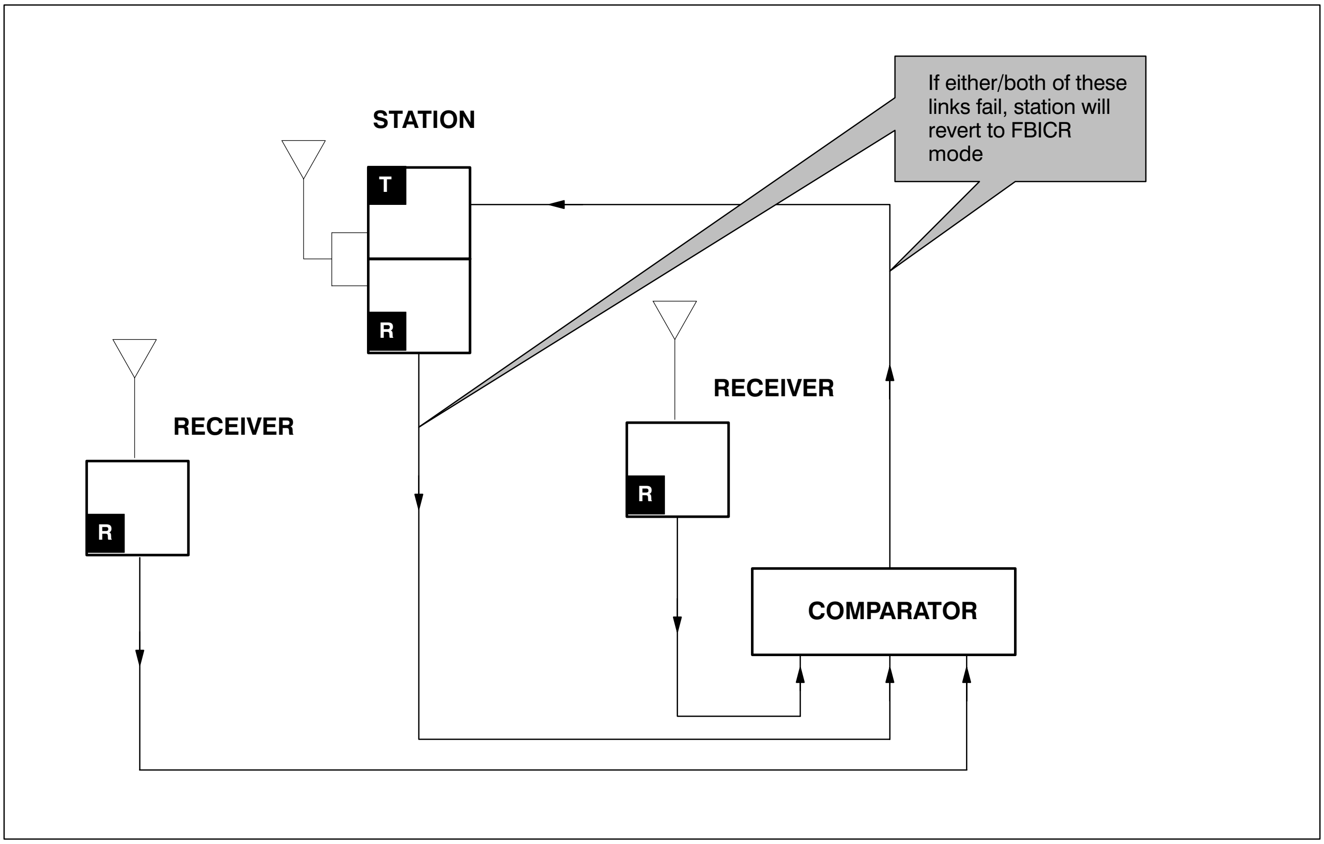


Figure 2. FBICR Feature in Non-Simulcast Voting System (Automatic FBICR Mode Shown)

Link Failure Detection Requirements

Before automatically enabling FBICR mode, a link failure detection must occur, defined as follows:

For Digital Systems

- Protocol Failure
- Carrier Detect Loss

Note *In a V.24 Hybrid Configuration, the loss of the analog link **will not** cause the station to enter FBICR mode. Only the failure of the digital link will cause the station to enter FBICR mode.*

For Analog Systems

- Loss of External PTT (Simulcast)
- No TRC Keyup (Voting)

Other Things to Know

- It is important to note that a station operating in FBICR mode is independent of other stations/receivers in the particular system. This is especially important in a Simulcast system, because simulcast transmission timing will be lost for the overlap coverage area between an active Simulcast station and a FBICR station. In a typical Simulcast scenario, the station responsible for the major coverage area is set for FBICR, and any adjacent stations are subsequently disabled.
- Automatic and External modes are mutually exclusive (i.e., a station may not be configured for both modes).

2 CONFIGURING THE FBICR FEATURE

Depending on the system type and whether you wish to configure for automatic or external operation, the FBICR feature must be configured by using the RSS only, or a combination of RSS programming and external wiring connections. Each configuration scenario is described on the following pages.

Automatic Mode

Conventional Analog or Conventional ASTRO (CAI) (Simulcast or Non-Simulcast Voting Systems)

Step 1. Access the *Wireline Configuration Screen*.

Step 2. Set the *Fall Back In-Cabinet Repeat* field to **ENABLED**.

Step 3. Enter the desired delay time (in msecs) in the *Fall Back Timer* field.

MOTOROLA RADIO SERVICE SOFTWARE
BASE STATION PRODUCTS
Page 1 of 2 VER:XX.XX.XX
:CHANGE/VIEW:WIRELINE CONFIGURATION

Use Up/Down Arrow Keys to Select Wireline Operation

Wireline Operation	4 WIRE FULL DUPLEX	
Console Priority	DISABLED	OPTION
Remote Control Type	ASTRO	
TRC Input	Line 1	
Outbound Analog Link Timer	120 sec	
Comparator	NONE	OPTION
Fall Back In−Cabinet Repeat	ENABLED	
Fall Back Timer	xxx msec	
Status Tone	ENABLED	
Status Tone Frequency	2175 kHz	
Wireline Squelch	DISABLED	
Rx Securenet/ASTRO To Wireline	ENABLED	
Equalization	DISABLED	

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP									EXIT

◆ **End of Procedure** ◆

Automatic Mode (continued)

Note *While in FBICR mode, the station will transmit Failsoft beeps and the subscriber will give the Failsoft indication.*

Trunked (SMARTZONE or SMARTNET) ASTRO (CAI, VSELP) (Simulcast Systems Only)

Step 1. Access the *Wireline Configuration Screen*.

Step 2. Set the *Fall Back In-Cabinet Repeat* field to **ENABLED**. (No *Fall Back Timer* setting is required.)

```
MOTOROLA RADIO SERVICE SOFTWARE                 Use Up/Down Arrow Keys to Select
BASE STATION PRODUCTS                           Wireline Operation
Page 1 of 2            VER:XX.XX.XX
:CHANGE/VIEW:WIRELINE CONFIGURATION

Wireline Operation                 4 WIRE FULL DUPLEX
Console Priority                   DISABLED              OPTION
Remote Control Type                ASTRO
  TRC Input                        Line 1
Outbound Analog Link Timer         120 sec
Comparator                         NONE                  OPTION
  Fall Back In-Cabinet Repeat      ENABLED

Status Tone                        ENABLED
  Status Tone Frequency            2175  kHz
Wireline Squelch                   DISABLED

Rx Securenet/ASTRO To Wireline     ENABLED
Equalization                       DISABLED

F1    F2    F3    F4    F5    F6    F7    F8    F9    F10
HELP                                                  EXIT
```

Step 3. Access the *6809 Trunking Interface Screen*.

Step 4. Make sure the *Failsoft* field is set to **ENABLED**, and set the *Modulation Type* to **ASTRO** or **ANALOG**.

```
MOTOROLA RADIO SERVICE SOFTWARE                 Use Up/Dn Arrow Keys To Select
BASE STATION PRODUCTS                           RSTAT Mode
          VER:XX.XX.XX
:CHANGE/VIEW:6809 TRUNKING

RSTAT Mode                         Normal

Failsoft                           ENABLED
  Line TRC Encode                  DISABLED
  Failsoft Carrier Squelch         DISABLED
  Dual CT Failsoft Only            DISABLED
  Modulation Type                  ASTRO

Trunking Tickle Source             TX DATA LINE
Trunking Tickle Source TOT         1        sec
CSC Logical Channel Number         1
Rx Discriminator Type              QUANTAR/MICOR

F1    F2    F3    F4    F5    F6    F7    F8    F9    F10
HELP                                                  EXIT
```

◆ **End of Procedure** ◆

External Mode

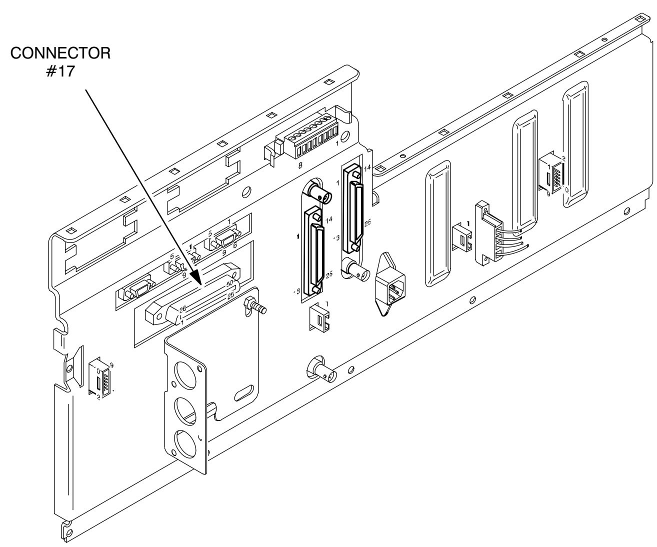
Conventional Analog or Conventional ASTRO (CAI) (Simulcast or Non-Simulcast Voting Systems)

Step 1. Access the *Wireline Configuration Screen*.

Step 2. Set the *Fall Back In-Cabinet Repeat* field to **DISABLED**.

```
MOTOROLA RADIO SERVICE SOFTWARE              Use Up/Down Arrow Keys to Select
BASE STATION PRODUCTS                        Wireline Operation
Page 1 of 2          VER:XX.XX.XX
:CHANGE/VIEW:WIRELINE CONFIGURATION

Wireline Operation                 4 WIRE FULL DUPLEX
Console Priority                   DISABLED              OPTION
Remote Control Type                ASTRO
   TRC Input                       Line 1
Outbound Analog Link Timer         120  sec
Comparator                         NONE                  OPTION
   Fall Back In–Cabinet Repeat     DISABLED
   Fall Back Timer                 0      msec

Status Tone                        ENABLED
   Status Tone Frequency           2175   kHz
Wireline Squelch                   DISABLED

Rx Securenet/ASTRO To Wireline     ENABLED
Equalization                       DISABLED

F1     F2   F3   F4   F5   F6   F7   F8   F9   F10
HELP                                           EXIT
```

Step 3. Connect a wire to pin 16 of System Connector #17 (located on the station backplane). To activate FBICR mode, an external circuit (customer-provided) must ground this pin.



◆ **End of Procedure** ◆

External Mode (continued)

Trunked (SMARTZONE or SMARTNET) Analog (Simulcast or Non-Simulcast Voting Systems)

Step 1. Access the *Wireline Configuration Screen*.

Step 2. Set the *Fall Back In-Cabinet Repeat* field to **ENABLED**.
Set the *Fall Back In-Cabinet Repeat* field to **0 msec**.

MOTOROLA RADIO SERVICE SOFTWARE
BASE STATION PRODUCTS
Page 1 of 2 VER:XX.XX.XX
:CHANGE/VIEW:WIRELINE CONFIGURATION

Use Up/Down Arrow Keys to Select Wireline Operation

Wireline Operation	4 WIRE FULL DUPLEX	
Console Priority	DISABLED	OPTION
Remote Control Type	ASTRO	
TRC Input	Line 1	
Outbound Analog Link Timer	120 sec	
Comparator	NONE	OPTION
Fall Back In−Cabinet Repeat	ENABLED	
Fall Back Timer	0 msec	
Status Tone	ENABLED	
Status Tone Frequency	2175 kHz	
Wireline Squelch	DISABLED	
Rx Securenet/ASTRO To Wireline	ENABLED	
Equalization	DISABLED	

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP									EXIT

Step 3. Access the *6809 Trunking Interface Screen*.

Step 4. Set the *Modulation Type* to **ANALOG**.

MOTOROLA RADIO SERVICE SOFTWARE
BASE STATION PRODUCTS
VER:XX.XX.XX
:CHANGE/VIEW:6809 TRUNKING

Use Up/Dn Arrow Keys To Select RSTAT Mode

RSTAT Mode	Normal
Failsoft	DISABLED
Line TRC Encode	DISABLED
Failsoft Carrier Squelch	DISABLED
Dual CT Failsoft Only	DISABLED
Modulation Type	ANALOG
Trunking Tickle Source	TX DATA LINE
Trunking Tickle Source TOT	1 sec
CSC Logical Channel Number	1
Rx Discriminator Type	QUANTAR/MICOR

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP									EXIT

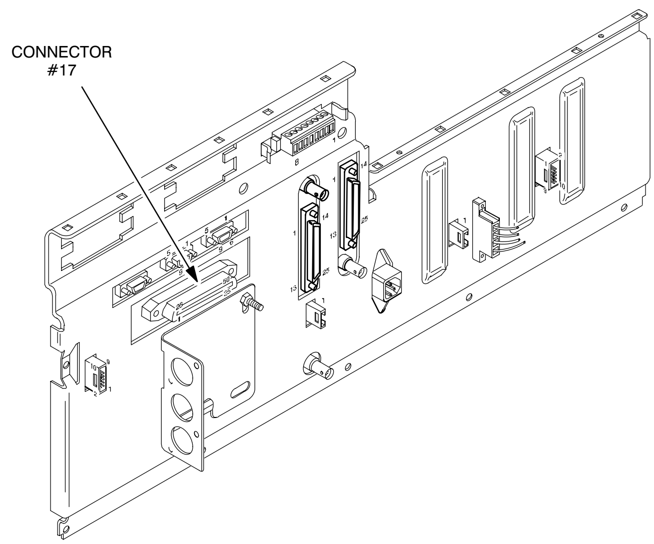
— *continued on next page* —

External Mode (continued)

Trunked (SMARTZONE or SMARTNET) Analog (continued)

Step 5. Connect a wire to pin 11 and pin 16 of System Connector #17 (located on the station backplane). To activate FBICR mode, an external circuit (customer-provided) must ground these pins.

Note *When pins 11 and 16 are grounded, the station will enter FBICR operation. The station will ignore any wireline transmit activity, ignore the EXT PTT line, and assert the TSTAT line. While in FBICR mode, the station will transmit Failsoft beeps and the subscriber will give the Failsoft indication.*



◆ **End of Procedure** ◆

External Mode (continued)

Trunked (SMARTZONE or SMARTNET) ASTRO (CAI, VSELP) (Simulcast Systems Only)

Step 1. Access the *Wireline Configuration Screen*.

Step 2. Set the *Fall Back In-Cabinet Repeat* field to **DISABLED**. (No *Fall Back Timer* setting is required.)

MOTOROLA RADIO SERVICE SOFTWARE BASE STATION PRODUCTS Page 1 of 2 VER:XX.XX.XX :CHANGE/VIEW:WIRELINE CONFIGURATION	Use Up/Down Arrow Keys to Select Wireline Operation

Wireline Operation	4 WIRE FULL DUPLEX	
Console Priority	DISABLED	OPTION
Remote Control Type	ASTRO	
TRC Input	Line 1	
Outbound Analog Link Timer	120 sec	
Comparator	NONE	OPTION
Fall Back In−Cabinet Repeat	DISABLED	
Status Tone	ENABLED	
Status Tone Frequency	2175 kHz	
Wireline Squelch	DISABLED	
Rx Securenet/ASTRO To Wireline	ENABLED	
Equalization	DISABLED	

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP									EXIT

Step 3. Access the *6809 Trunking Interface Screen*.

Step 4. Set the *Modulation Type* to **ASTRO** or **ANALOG**.

MOTOROLA RADIO SERVICE SOFTWARE BASE STATION PRODUCTS VER:XX.XX.XX :CHANGE/VIEW:6809 TRUNKING	Use Up/Dn Arrow Keys To Select RSTAT Mode

RSTAT Mode	Normal
Failsoft	DISABLED
Line TRC Encode	DISABLED
Failsoft Carrier Squelch	DISABLED
Dual CT Failsoft Only	DISABLED
Modulation Type	ASTRO
Trunking Tickle Source	TX DATA LINE
Trunking Tickle Source TOT	1 sec
CSC Logical Channel Number	1
Rx Discriminator Type	QUANTAR/MICOR

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP									EXIT

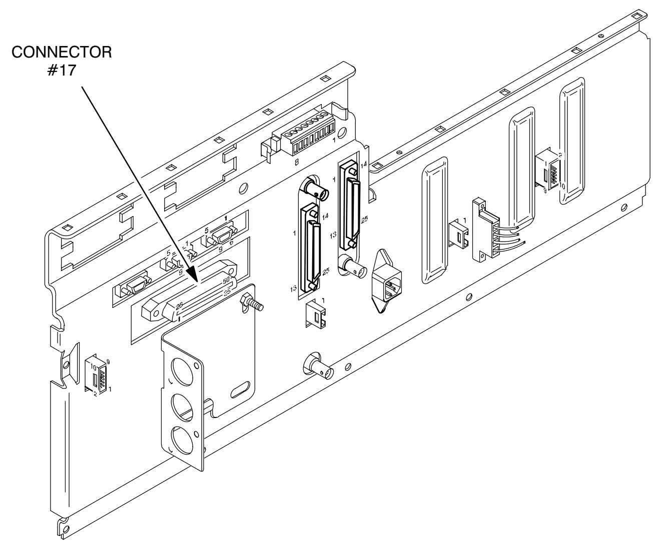
— *continued on next page* —

External Mode (continued)

Trunked (SMARTZONE or SMARTNET) ASTRO (CAI, VSELP) (continued)

Note *When pins 11 and 16 are grounded, the station will enter FBICR operation. The station will ignore any wireline transmit activity, ignore the EXT PTT line, and assert the TSTAT line. While in FBICR mode, the station will transmit Failsoft beeps and the subscriber will give the Failsoft indication.*

Step 5. Connect a wire to pin 11 and pin 16 of System Connector #17 (located on the station backplane). To activate FBICR mode, an external circuit (customer-provided) must ground these pins.



◆ **End of Procedure** ◆

MOTOROLA

MAIN/STANDBY CONFIGURATION

For *Quantar* and *Quantro* Stations

1 OVERVIEW

The Main/Standby configuration allows two *Quantar*/*Quantro* stations to operate as a redundant pair. If the Main station should fail (due to hardware or software malfunction), the Standby station will immediately take over and provide service. Each station's operating mode (Main or Standby) is determined by a setting made using the Radio Service Software (RSS).

Please note the following requirements/restrictions that are applicable to the Main/Standby feature:

- Main/Standby feature is compatible with stations in **Conventional** systems only
- Main/Standby feature **is not** compatible with *ASTRO* signaling
- The station must be equipped with an 8−wire Wireline Interface Module and the Enhanced Wildcard Option

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2 ELECTRICAL CONNECTIONS

Install both stations (designating one as A and the other as B) as described in the appropriate functional base station manual. Make the wiring connections as shown in Figure 2 to allow Main/Standby operation.

Hint *Wiring connections between the two stations and with external equipment will be facilitated by using a standard telephone punch block. Figure 1 shows how to connect the stations and punch block.*

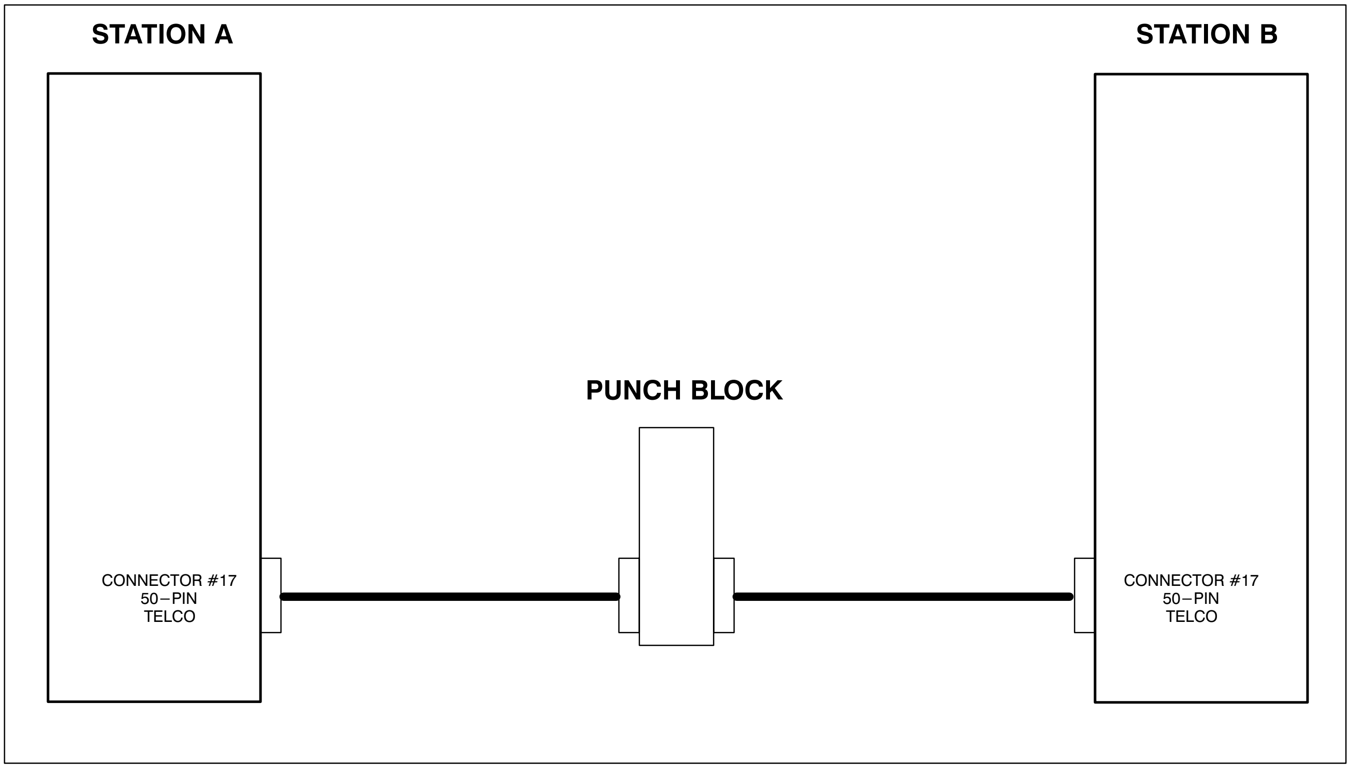

Figure 1. Using Punch Block to Facilitate Wiring Connections

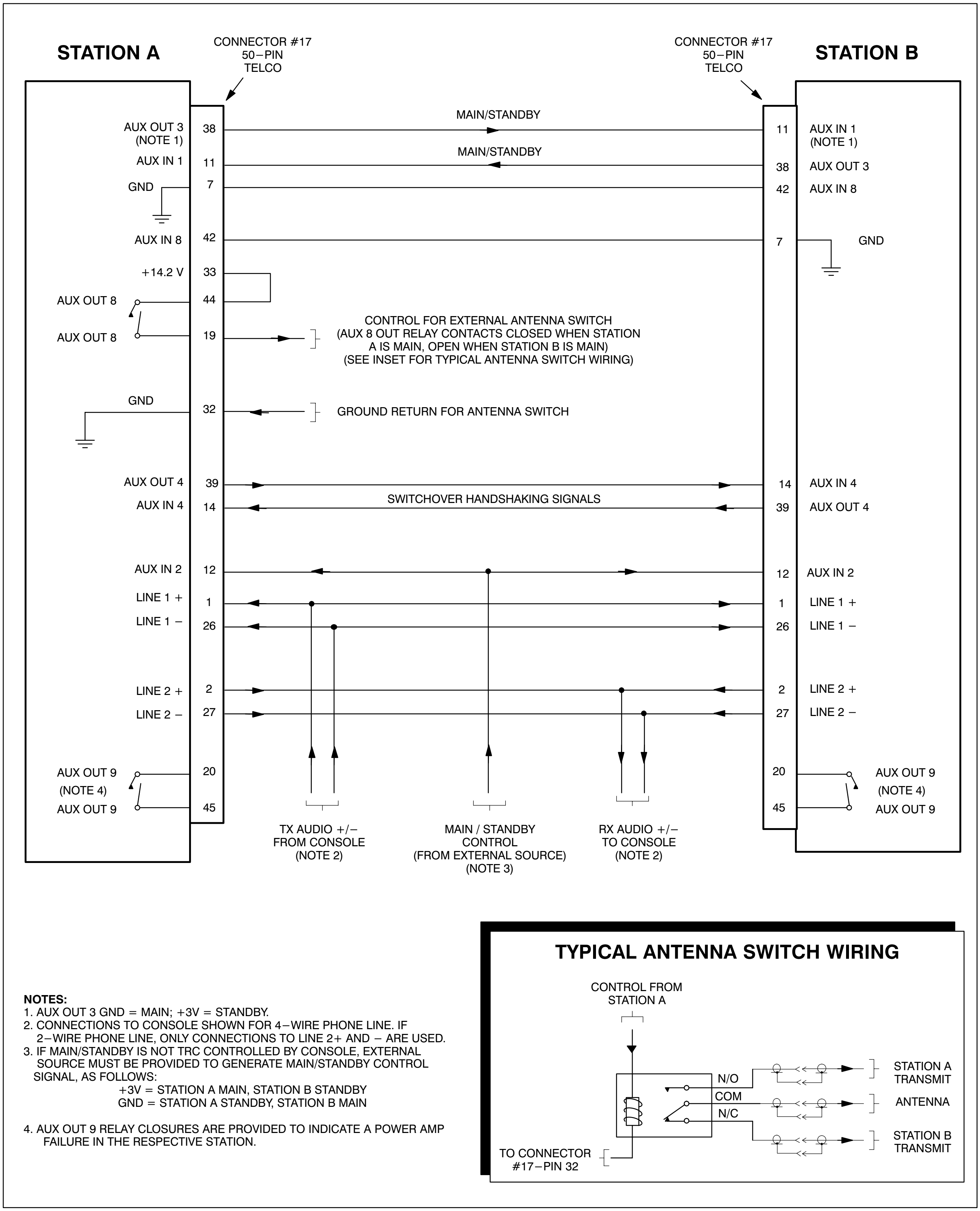

Figure 2. Wiring Connections for Main/Standby Configuration

3 SETTING WIRELINE IMPEDANCE JUMPERS

Set the impedance jumpers on the Wireline Interface Modules in Stations A and B as described in Table 1. Figure 3 shows the location of the jumpers.

Table 1. Wireline Impedance Jumpering for Main/Standby Operation

STATION A		STATION B	
2–Wire Connection to Console	**4–Wire Connection to Console**	**2–Wire Connection to Console**	**4–Wire Connection to Console**
Jumpers in position 1 on T1001	Jumpers in position 1 on T1000 and T1001	All jumpers removed (high impedance) on T1001	All jumpers removed (high impedance) on T1000 and T1001
Jumper JU1010 in 2-wire position	Jumper JU1010 in 4-wire position	Jumper JU1010 in 2-wire position	Jumper JU1010 in 4-wire position

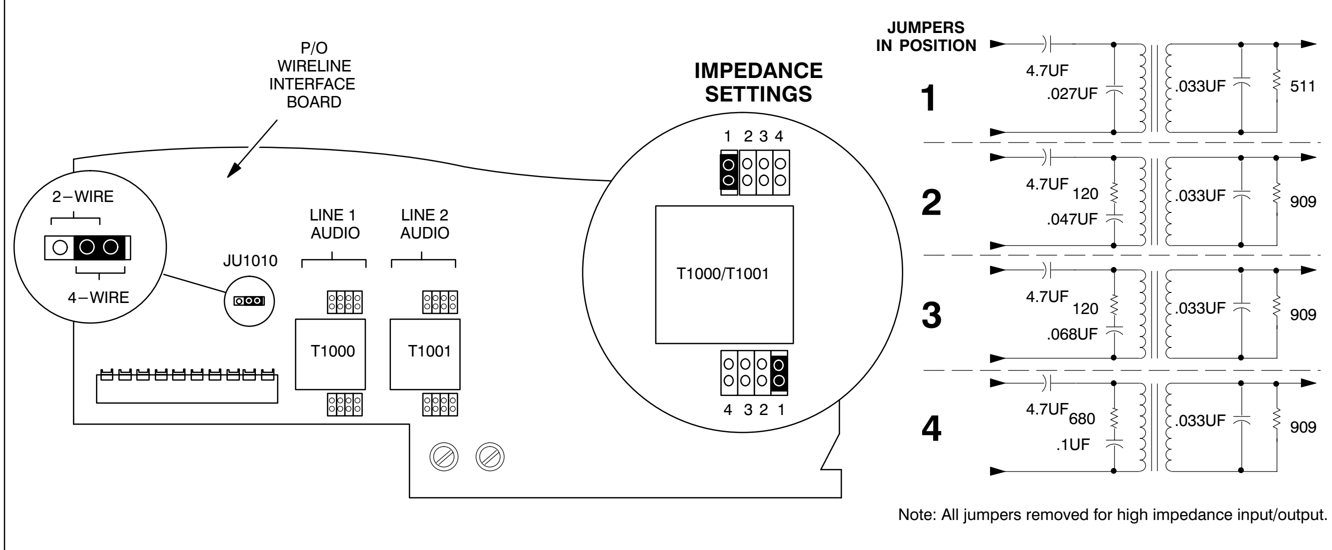

Figure 3. Wiring Connections for Main/Standby Configuration

4 RSS PROGRAMMING

In order to enable the Main/Standby Feature, the following two tasks must be performed using the *Quantar*/*Quantro* Radio Service Software (RSS) program. (Refer to the *RSS User's Guide 68P81085E35* for details on performing the following tasks.)

Step 1. Connect a PC running the RSS program to one of the two stations and read the station codeplug.

Step 2. Access the *Hardware Configuration* screen and set the Main/Standby field for **MAIN** (for station designated as Main) or **STANDBY** (for station designated as standby) as shown in Figure 4.

Step 3. Perform all other RSS programming tasks to configure the station (as described in the *RSS User's Guide 68P81085E35*).

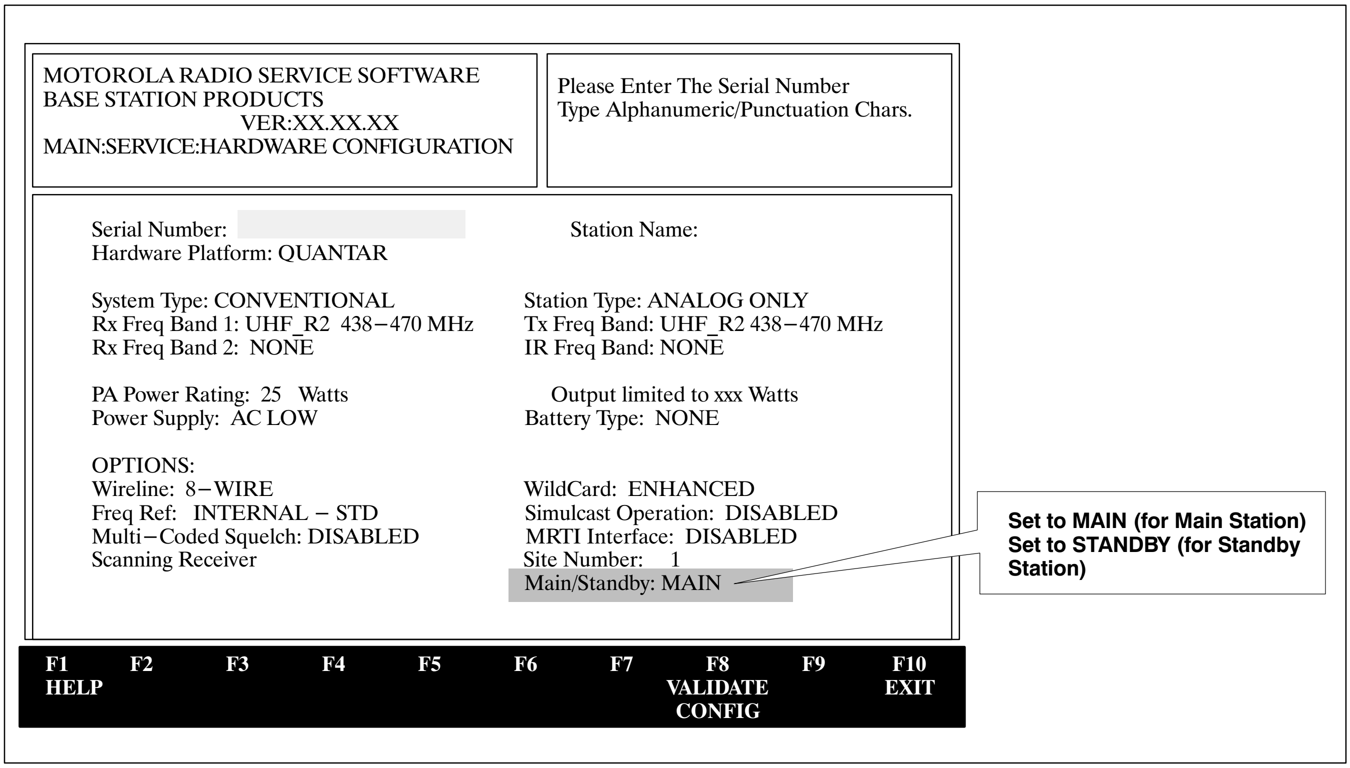

Figure 4. Making Main/Standby RSS Setting

Step 4. Access the *Wildcard Configuration* menu screen and select *State/Action Configuration*. Press **F4** to set the WildCard Tables to their default values. This ensures that the tables for the Main/Standby Feature are programmed with the factory values. Note that any WildCard Tables that have been custom created by the customer will be deleted, and that any customization of the default tables will be returned to the factory default values. Re-enter these if the functions are still required for this installation.

Step 5. Save the codeplug to the station.

Step 6. Repeat Steps 1 thru 4 for the other station.

5 MAIN/STANDBY OPERATION

Three Modes of Main/Standby Operation

The Main/Standby Feature offers three modes of switching from MAIN to STANDBY and from STANDBY to MAIN:

- **Automatic (or "Hot") Switchover** — Whenever one of the modules fails in the MAIN station, the MAIN station will automatically set itself to STANDBY and will signal its companion station to set itself to MAIN. The MAIN station will not automatically switch to STANDBY unless it is connected to its companion station and the companion station has not indicated a failure mode. (To disable automatic switchover mode, refer to page 8.)
- **Tone Remote Control Switchover** — Sending function tone 4 to the stations will force the MAIN station to STANDBY mode and the STANDBY station to MAIN mode. Sending function tone 5 to the stations will force the MAIN station back to MAIN mode and the STANDBY station back to STANDBY mode. If either station has detected a module failure, neither switchover will occur. (To change the particular function tones that trigger these events, refer to 9.)
- **External Control Switchover** — An external control device may be connected to Input 2 on Connector #17 (located on backplane of both stations) to initiate a Main-to-Standby or a Standby-to-Main switchover to occur. Grounding this signal causes the MAIN station to go to STANDBY mode and the STANDBY station to go to MAIN mode. Pulling this signal high causes the STANDBY station to go to MAIN mode and the MAIN station to go to STANDBY mode.

Additional Functions Provided by the Main/Standby Feature

- **Antenna Relay Control** – When the MAIN station is operating in MAIN mode, the relay driven output 8 is energized. The use of this closure is left up to the user. Typically a user will use this closure to drive an external relay which connects the antenna to whichever station is operating in MAIN mode.
- **Status Request** – Utilizing TRC function tone 14, the console operator can request which station is in MAIN mode. One beep will be returned if the MAIN station is in MAIN mode and two beeps if the STANDBY station is in MAIN mode.
- **Reset** – Utilizing TRC function tone 15, both stations will reset.

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6 CUSTOMIZING MAIN/STANDBY OPERATION

Default Operation

The Main/Standby Feature is implemented using the Radio Service Software (RSS) WildCard Feature. As shipped from the factory, the RSS contains 21 WildCard Tables for the Main station and 20 WildCard Tables for the Standby station. These tables contain default settings that define the basic operation of the Main/Standby Feature (i.e., control of Main and Standby status of two interconnected stations via pre-defined Tone Remote Control function tones to provide backup redundancy in the event of a station failure).

Customizing Main/Standby Operation

Although all of the Main/Standby WildCard Tables are user configurable (via the RSS), it is recommended that only the following functions be customized by the user. Follow the instructions in Chapter 11 of the *RSS User's Guide 68P81085E35* for details on modifying the WildCard Tables.

- **Disable Automatic (Hot) Switchover** — Delete WildCard Table 8 in both stations

```
                          TABLE 8 OF 20
 STATE CONDITION
           Description:    MAIN/STANDBY 8
State               Cond    State                Cond    State
EVENT FLAG 6        AND     INPUT 8
---------------------------------------------------------------------------
     ACTION:                            INACTION:
 –          STANDBY                              – NULL
 –          MRTI DISABLE                         –
 –          RX WL MUTE                           –
 –          WAIT             30                  –
 –          CLR OUTPUT       3                   –
 –          CLR OUTPUT       8                   –
 –                                               –
 –                                               –
```

- **Select Alternate Function Tones to Activate Main/Standby Switchover (default is FT4 to switch, FT5 to switch back)** — To modify the Function Tone that initiates the initial switch from Main to Standby, modify the TRC TONE entry in WildCard Table 19 in the MAIN station and WildCard Table 17 in the STANDBY station.
  To modify the Function Tone that initiates the switch back from Standby to Main, modify the TRC TONE entry in WildCard Table 18 in the MAIN station and WildCard Table 18 in the STANDBY station.

Main

```
                              TABLE 19 OF 31
 STATE CONDITION
           Description:    MAIN/STANDBY 19
State                 Cond    State                 Cond    State
TRC TONE          4   AND NOT  EVENT FLAG 12
---------------------------------------------------------------------------
     ACTION:                              INACTION:
 -          STANDBY                               - NULL
 -          MRTI DISABLE                          -
 -          RX WL MUTE                            -
 -          WAIT                30                -
 -          CLR OUTPUT          3                 -
 -          CLR OUTPUT          8                 -
 -                                                -
 -                                                -
```

Modify TRC Tone field to change Main-to-Standby Switchover

Standby

```
                              TABLE 17 OF 30
 STATE CONDITION
           Description:    MAIN/STANDBY 17
State                 Cond    State                 Cond    State
TRC TONE          4   AND NOT  EVENT FLAG 12
---------------------------------------------------------------------------
     ACTION:                              INACTION:
 -          SET OUTPUT          3                 - NULL
 -          SET OUTPUT          8                 -
 -          WAIT                30                -
 -          RX WL ENABLE                          -
 -          MRTI ENABLE                           -
 -          MAIN                                  -
 -                                                -
 -                                                -
```

Main

```
                              TABLE 18 OF 31
 STATE CONDITION
           Description:    MAIN/STANDBY 18
State                 Cond    State                 Cond    State
TRC TONE          5   AND NOT  EVENT FLAG 12

---------------------------------------------------------------------------
     ACTION:                              INACTION:
 -          SET OUTPUT          3                 - NULL
 -          SET OUTPUT          8                 -
 -          WAIT                30                -
 -          RX WL ENABLE                          -
 -          MRTI ENABLE                           -
 -          MAIN                                  -
 -          SET EVENT FLAG   8                    -
 -                                                -
```

Modify TRC Tone field to change Standby-to-Main Switchover

Standby

```
                              TABLE 18 OF 30
 STATE CONDITION
           Description:    MAIN/STANDBY 18
State                 Cond    State                 Cond    State
TRC TONE          5   AND NOT  EVENT FLAG 12
---------------------------------------------------------------------------
     ACTION:                              INACTION:
 -          STANDBY                               - NULL
 -          MRTI DISABLE                          -
 -          RX WL MUTE                            -
 -          WAIT                30                -
 -          CLR OUTPUT          3                 -
 -          CLR OUTPUT          8                 -
 -                                                -
 -                                                -
```

- **Select Alternate Function Tone to Initiate a Status Request (default is FT14)**

Main

```
                              TABLE 12 OF 31
     STATE CONDITION
               Description:    MAIN/STANDBY 12
    State                 Cond    State                Cond    State
    TRC TONE         14  AND NOT  STN KEYED            AND NOTRX QUAL MET
-----------------------------------------------------------------------------
         ACTION:                              INACTION:
     -         ABORT TIMER 1                           - NULL
     -         SET EVENT FLAG   8                      -
     -                                                 -
     -                                                 -
     -                                                 -
     -                                                 -
     -                                                 -
     -                                                 -
```

Modify TRC Tone field to change which function tone initiates a Status Request

Standby

```
                              TABLE 11 OF 30
     STATE CONDITION
               Description:    MAIN/STANDBY 11
    State                 Cond    State                Cond    State
    TRC TONE         14  AND NOT  STN KEYED            AND NOTRX QUAL MET
-----------------------------------------------------------------------------
         ACTION:                              INACTION:
     -         ABORT TIMER 1                           - NULL
     -         SET EVENT FLAG   7                      -
     -                                                 -
     -                                                 -
     -                                                 -
     -                                                 -
     -                                                 -
     -                                                 -
```

- **Select Alternate Function Tone to Initiate a Reset to Both Stations (default is FT15)**

Main

```
                          TABLE 21 OF 31
 STATE CONDITION
          Description:    MAIN/STANDBY 21
State                 Cond    State               Cond    State
TRC TONE       15
---------------------------------------------------------------------------
     ACTION:                             INACTION:
 -           RESET                                 - NULL
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
```

Modify TRC Tone field to change which function tone initiates a Status Reset

Standby

```
                          TABLE 20 OF 30
 STATE CONDITION
          Description:    MAIN/STANDBY 20
State                 Cond    State               Cond    State
TRC TONE       15
---------------------------------------------------------------------------
     ACTION:                             INACTION:
 -           RESET                                 - NULL
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
 -                                                 -
```

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MOTOROLA

FAST KEYUP FEATURE

For *Quantar* and *Quantro* Stations

1 OVERVIEW

The Fast Keyup Feature allows *Quantar* and *Quantro* stations to be keyed up by an external device (such as a Data Controller) in approximately 12 milliseconds (*Quantar* VHF and *Quantro* UHF) or 10 milliseconds (all other stations). Note that normal keyup time using the station's PTT input is approximately 50 msecs.

In order to implement this feature, three signals (TX Audio, RX Audio, and PTT) must be connected between the station and the external device. Also, an RSS parameter setting must be made to properly configure the feature's operation. This manual provides step-by-step instructions for performing these tasks.

***Note —** The Fast Keyup Feature applies only to non-Simulcast, Analog Conventional stations.*

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68P80800A02–A
9/1/00–UP

2 ELECTRICAL CONNECTIONS

As shown in Figure 1, the following signals must be connected properly between the station and the external device:

- PTT
- TX Audio
- RX Audio

Additionally, there are two possible connection configurations — **Direct Connection** and **Splatter Filter Connection**. The Direct Connection configuration is chosen when the external device provides the required splatter filtering of the TX Audio signal. The Splatter Filter Connection configuration is chosen when the station's internal splatter filter is to be utilized (no splatter filtering provided by the external device).

The following procedures describe how to make the signal connections for each type of connection configuration.

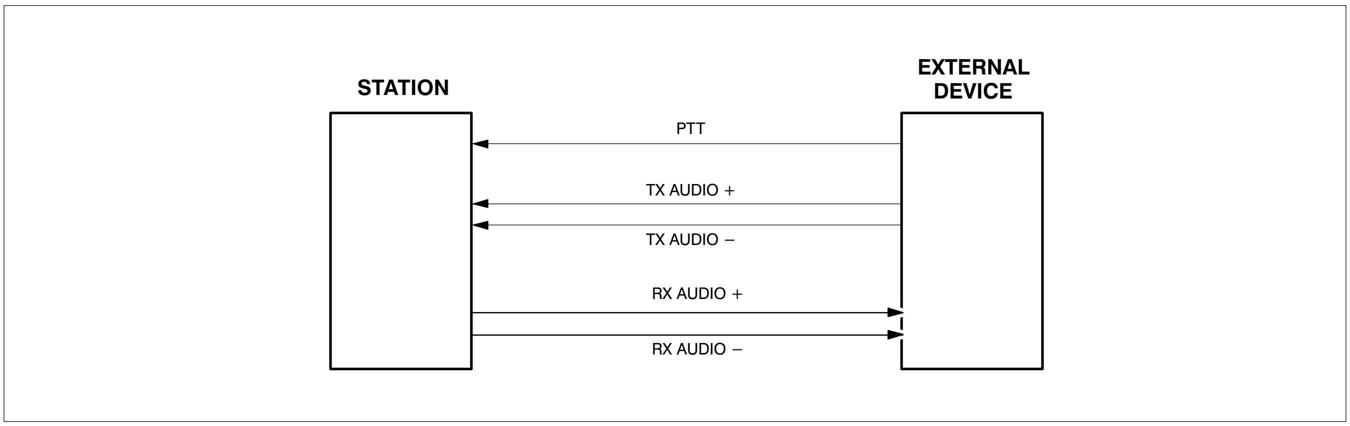


Figure 1. Fast Keyup Feature Wiring Diagram

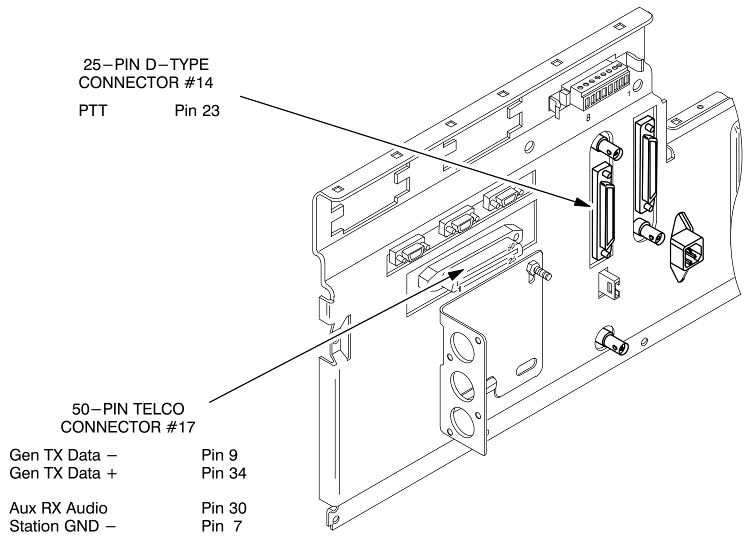
Wiring Details for Direct Connection and Splatter Filter Configurations

Step 1. Connect the PTT signal from the external device to Connector #14 on the station backplane as shown below.

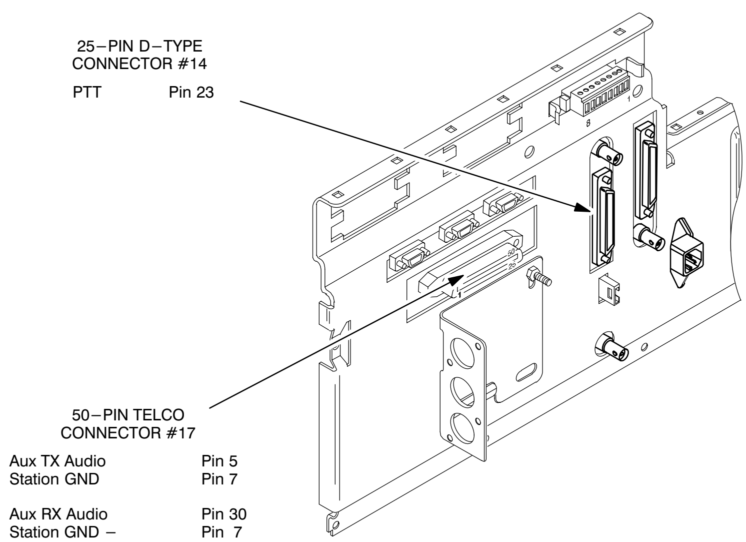
Step 2. Connect TX Audio (+) and (–) from the external device to Connector #17 on the station backplane as shown below.

Step 3. Connect Aux RX Audio and GND from the station backplane Connector #17 to the external device as shown below.

Direct Connection Configuration



Splatter Filter Connection Configuration



3 RSS PROGRAMMING

Using the *Quantar/Quantro* Radio Service Software (RSS) program (Version R09.05.00 or higher), make the following codeplug data changes to allow proper Fast Keyup operation. (Refer to the *RSS User's Guide 68P81085E35* for details on making codeplug programming changes.)

Table 1. Codeplug Data Changes for Fast Keyup Operation

Codeplug Data Parameter	RSS User's Guide Location
Set the **Fast Key–Up** parameter to *WIDEBAND* for Direct Connection configurations, or to *AUX TX* for Splatter Filter Connection configurations. ***Note*** *AUX TX selection is not compatible with MRTI.*	Programming the RF Configuration Data (p/o Chapter 4)

4 FAST KEYUP PERFORMANCE CHARACTERISTICS

Figure 2 shows the performance characteristics of the station after implementing the Fast Keyup Feature.

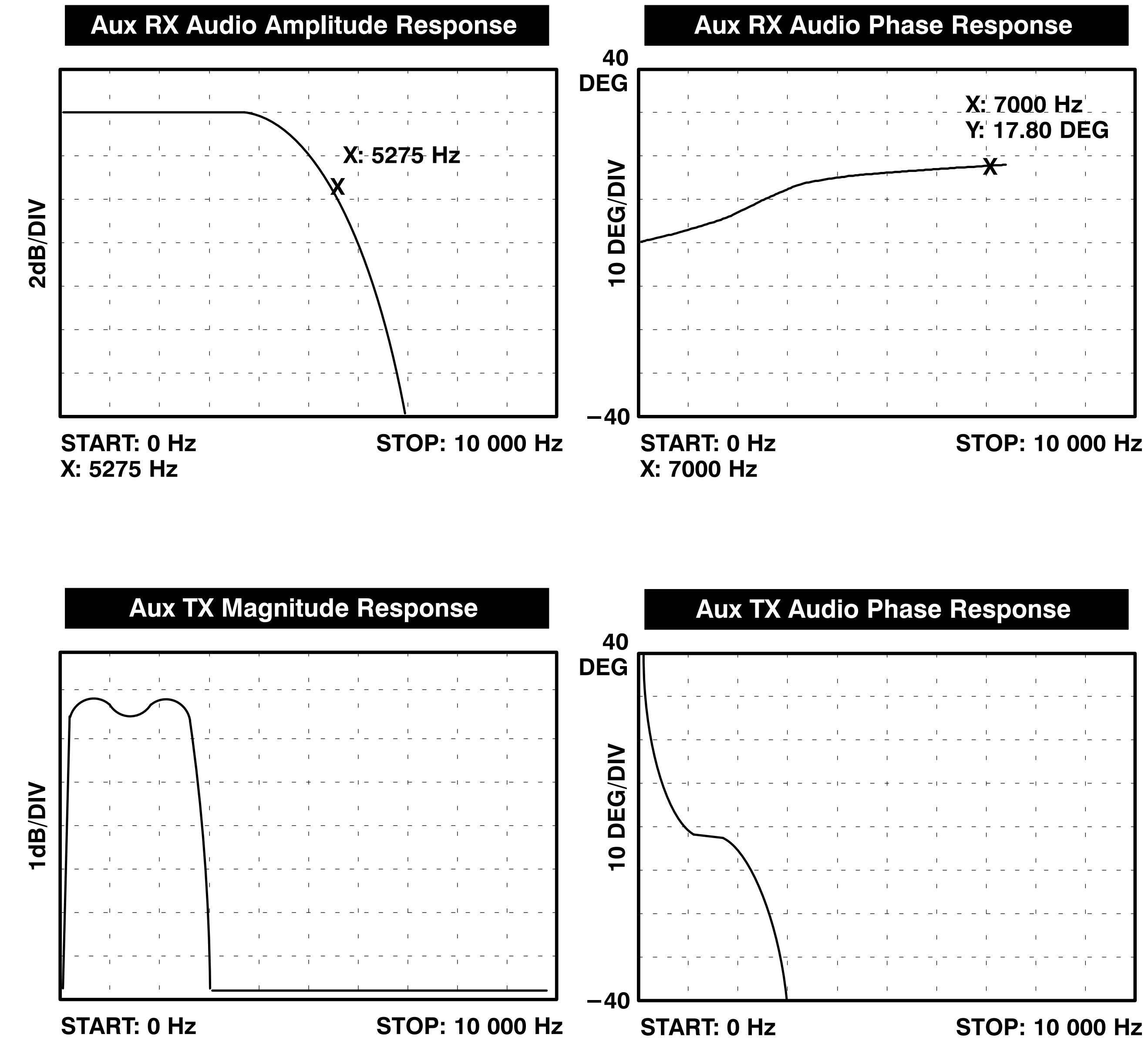


Figure 2. Fast Keyup Performance Characteristics

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MOTOROLA

DUAL CONTROL OF GATED ACCESS VIA TRC AND SAM

For *Quantar* and *Quantro* Stations Servicing MCS Users

1 OVERVIEW

This section describes how to program the station (*Quantar* or *Quantro*) and the Station Access Module (SAM) to allow two functions (repeater setup/knockdown and "gated access" to be controlled (toggled on and off) by both of the following methods:

- Console Operator using TRC tones
- Subscriber Unit using DTMF or MDC 1200 signaling transmitted over the air

By utilizing the MCS Feature and controlling the repeater setup/knockdown and "gated access" functions, an effective "Mutual Aid" talk group configuration can be created. In this configuration, subscribers within a specific coverage area (local subscribers) are assigned a "primary" PL and have their MCS User Access field set to ENABLED. These subscribers will repeat as normal (assuming station is toggled to "repeater setup" mode). Should emergency conditions require other subscribers outside of the local area to enter the communications area, these subscribers will be able to communicate with each other (as well as local users) via the same local repeater if they have been assigned with a "secondary" PL and have their MCS User Access set to GATED. Additionally, the repeat mode (setup or knocked down) and gated access mode (enabled or disabled) may be controlled by both a console operator or a subscriber unit. (Note that Gated User Access is disabled upon station reset. Gated Access must be enabled via over-the-air transmissions to the SAM module, or via TRC tones from the console.)

The following table shows how the repeater access and "gated access" functions may be controlled to provide access to local and visiting subscribers. Refer also to Figure 1 (showing a typical repeater access call flow chart ***before*** Gated Access is employed), and Figure 2 (showing a repeater access call flow chart ***after*** Gated Access is incorporated).

Gated Access	Repeater Up/Down	Subscriber Operation
Enabled	Up	• Local subscribers (primary PL) will repeat. • Emergency subscribers (secondary PL and MCS User Access set to GATED) will repeat.
Enabled	Down	• No subscribers will repeat.
Disabled	Up	• Only local subscribers (primary PL) will repeat.
Disabled	Down	• No subscribers will repeat.

In order to perform the procedures in this section, you must program certain parameters in the *Quantar* or *Quantro* station and the Station Access Module (SAM). In order to do this, you will need the following software programs:

- RVN5002 *Quantar*/*Quantro* Radio Service Software (RSS) Version R09.05.00 or higher)
- RVN4110 Station Access Module (SAM) Radio Service Software (RSS) Version R01.01 or higher)

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68P81096E11–O
12/15/99–UP

Call Flow Prerequisites

- MCS User Access is Enabled (but not Gated)
- Analog Rptr Activation RSS Parameter set to SC
- Local Subscribers are using “Primary” PL

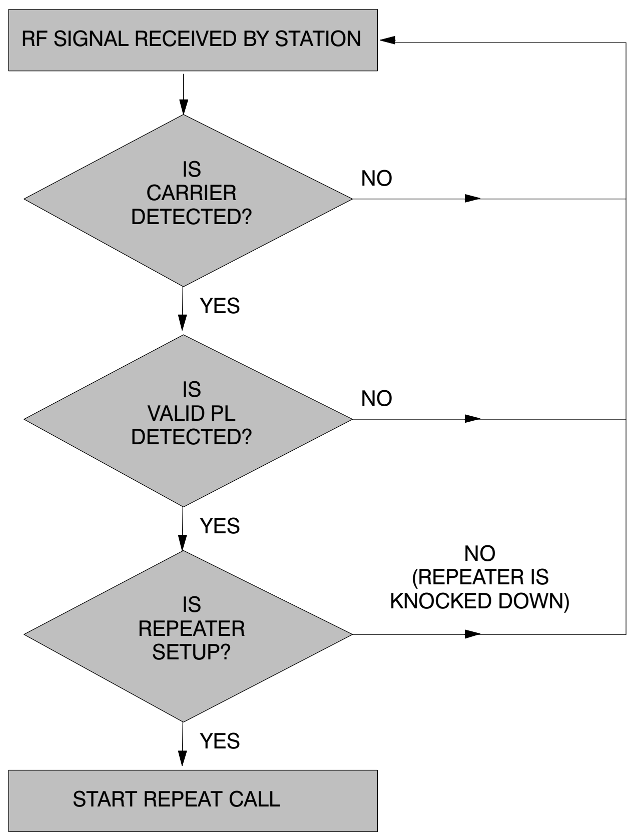

Figure 1. Typical Call Flow Chart Without Gated Access Incorporated

Call Flow Prerequisites

- MCS User Access is set to "Gated"
- Analog Rptr Activation RSS Parameter set to SC
- Emergency conditions exist, in which non-Local Subscribers are using "Secondary" PL

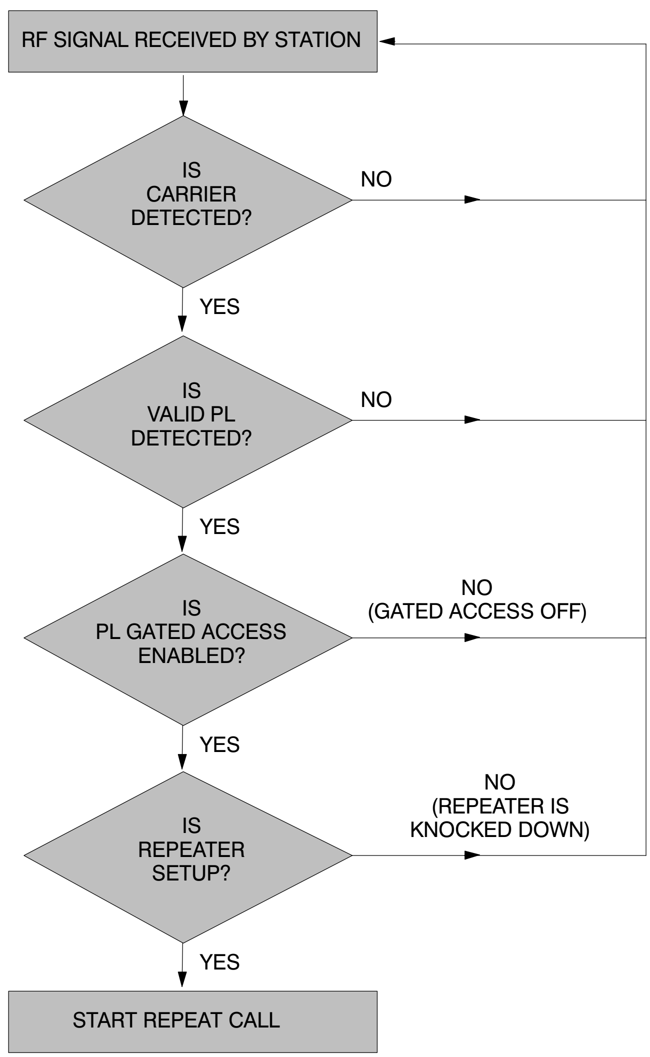

Figure 2. Typical Call Flow Chart With Gated Access Incorporated

2 STATION RSS PROGRAMMING

In order to support dual control of gated access by TRC and SAM, certain station parameters must be programmed using the *Quantar*/*Quantro* Radio Service Software (RSS) program (Version R09.05.00 or higher). (Refer to the *RSS User's Guide 68P81085E35* for details on making these settings.)

Step 1. Connect a PC running the Station RSS program to one of the two stations and read the station codeplug.

Step 2. Access the *Hardware Configuration* screen and set the *Multi-Coded Squelch* field to **MULTI−PL ONLY** to enable the Multi-Coded Squelch feature (as shown in Figure 3).

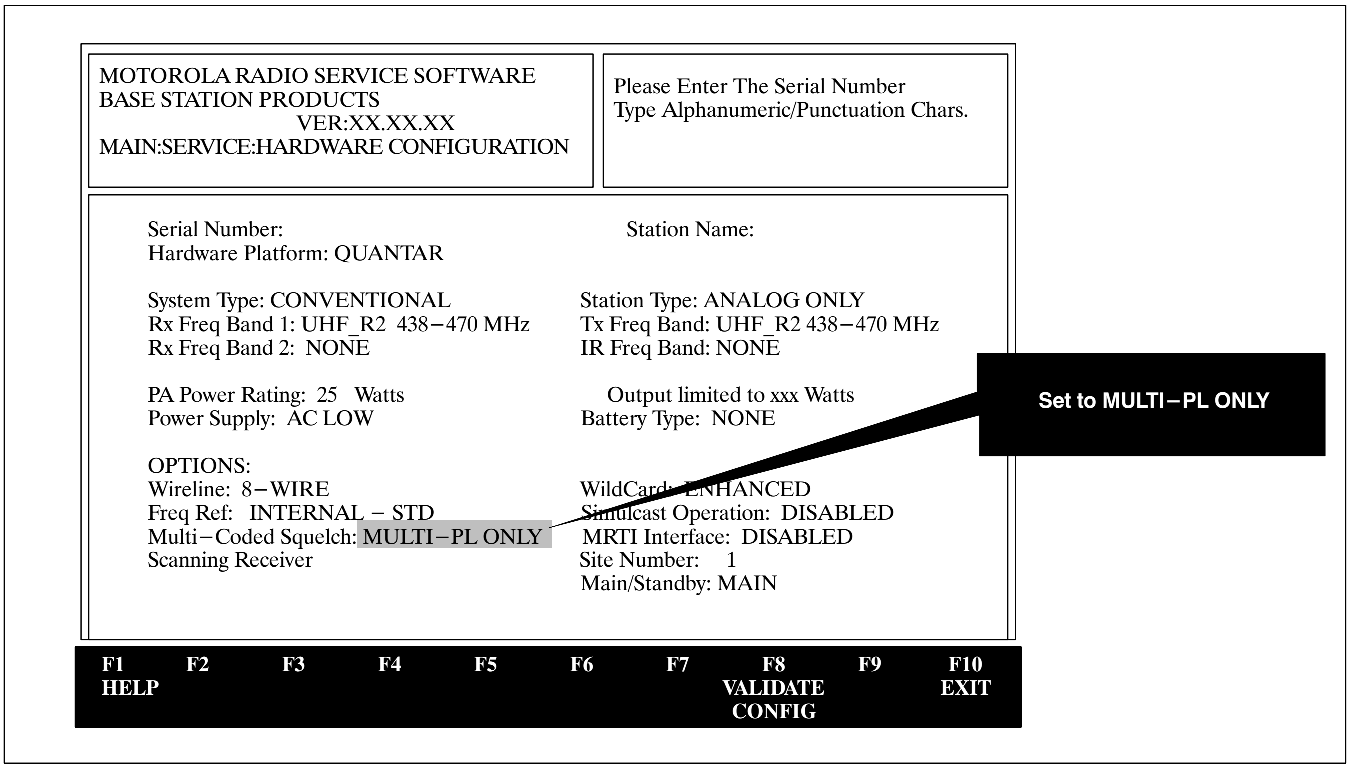

Figure 3. Making *Multi-Coded Squelch* RSS Setting

continued on next page ☞

Step 3. Access Page 1 of the *Channel Information* screen and set the *Analog Rptr Access* field to **MDC/TONE** (as shown in Figure 4) to enable the Station Access Module (SAM).

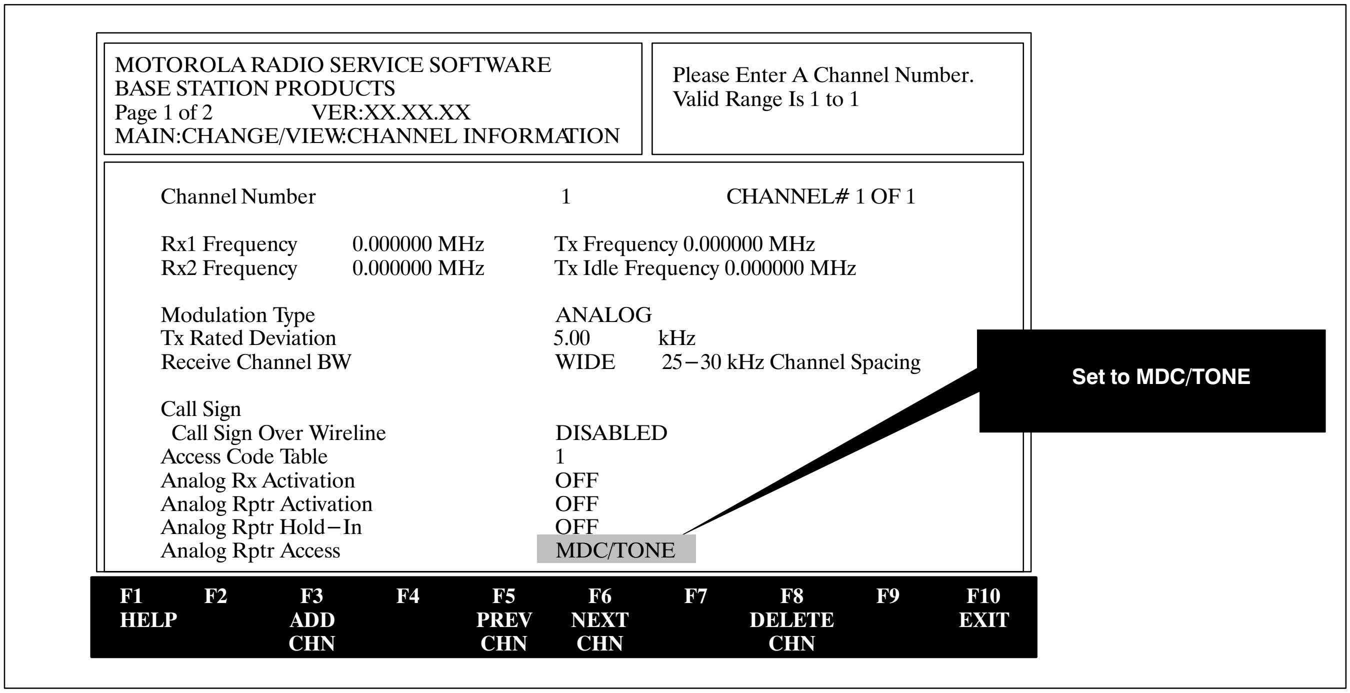

Figure 4. Making *Analog Rptr Access* RSS Setting

Step 4. Access the *RF Configuration Data* screen and set the *Repeater Operation* field for **REPEATER** (as shown in Figure 5).

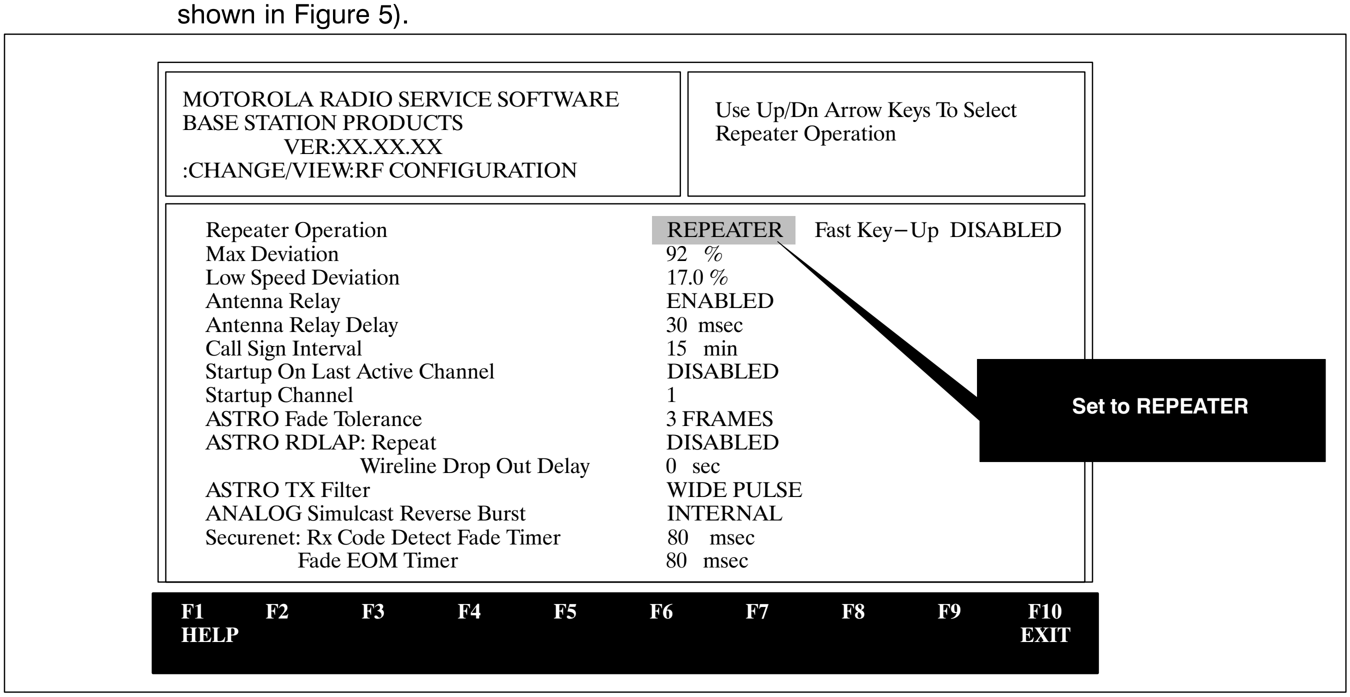

Figure 5. Making *Repeater Operation* RSS Setting

continued on next page ☞

Step 5. Access the *Multi-Coded Squelch* screen, enter the desired number of users, then set the "secondary" PL's *User Access* field to **GATED** (as shown in Figure 6). Refer to the *RSS User's Guide 68P81085E35* for details on setting up users in the *Multi-Coded Squelch* screen.

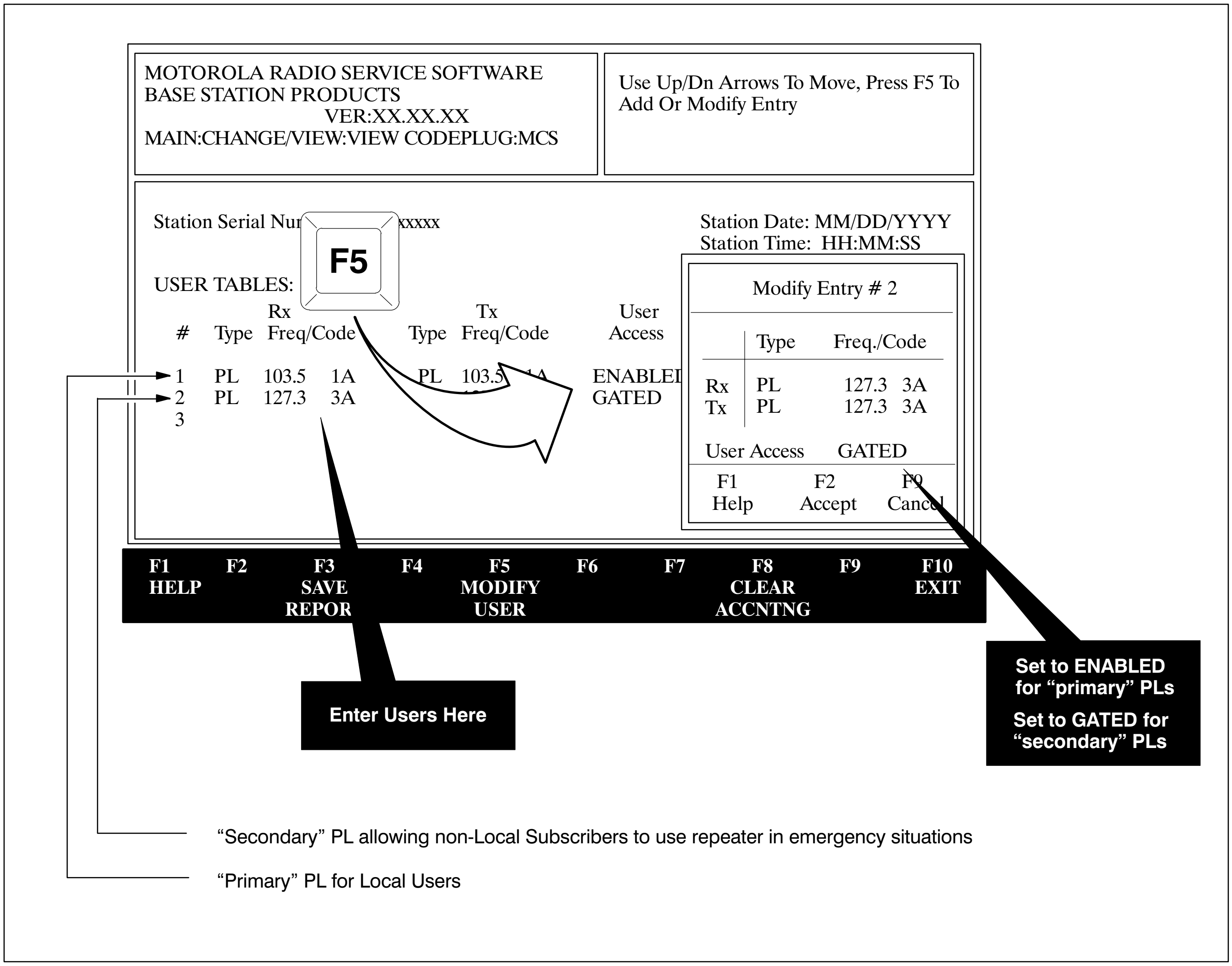

Figure 6. Entering Users and Setting to *Gated*

Step 6. Access the *TRC Commands* screen and program tones FT3–FT6 (as shown in Figure 7). Refer to the *RSS User's Guide 68P81085E35* for details on programming the tones.

MOTOROLA RADIO SERVICE SOFTWARE
BASE STATION PRODUCTS
Page 1 of 3 VER:XX.XX.XX
MAIN:CHANGE/VIEW:TRC COMMANDS

Enter Command or Use Tab/Shift Tab
and Enter To Move Between Fields

Guard Tone 2175 Hz	MORE
FT1 — 2050 Hz	MONITOR
FT2 — 1950 Hz	CHN 001 KEY
FT3 — 1850 Hz	RPT ON
FT4 — 1750 Hz	RPT OFF
FT5 — 1650 Hz	GATEACC ON

F1 HELP	F2	F3	F4	F5	F6	F7	F8	F9	F10 EXIT

MOTOROLA RADIO SERVICE SOFTWARE
BASE STATION PRODUCTS
Page 2 of 3 VER:XX.XX.XX
MAIN:CHANGE/VIEW:TRC COMMANDS

Enter Command or Use Tab/Shift Tab
and Enter To Move Between Fields

FT6 — 1550 Hz	GATEACC OFF
FT7 — 1450 Hz	
FT8 — 1350 Hz	
FT9 — 1250 Hz	
FT10 — 1150 Hz	

F1 HELP	F2	F3	F4	F5	F6	F7	F8	F9	F10 EXIT

Figure 7. Programming TRC Tones FT3–FT6

◆ End of This Procedure ◆

3 SAM RSS PROGRAMMING

In order to support dual control of repeater access by TRC and SAM, certain SAM parameters must be programmed using the Station Access Module (SAM) Radio Service Software (RSS) program. (Refer to the *SAM RSS User's Guide 68P80309E35* for details on performing the following tasks.)

Step 1. Connect a PC running the RSS program to the RSS port on the front panel of the SAM module and read the SAM codeplug.

Step 2. **For DTMF operation**, access *Page 03* of the *SAM Decoder Selection* screen and program the *TARGET* and *ACT TBL* settings as shown in Figure 1. These settings establish the keypad sequences and corresponding Action Tables for Repeater Setup, Repeater Knockdown, Gated Access Enable and Gated Access Disable. Note that if there is default data already entered when opening the screen, overwrite the data with the data shown below.

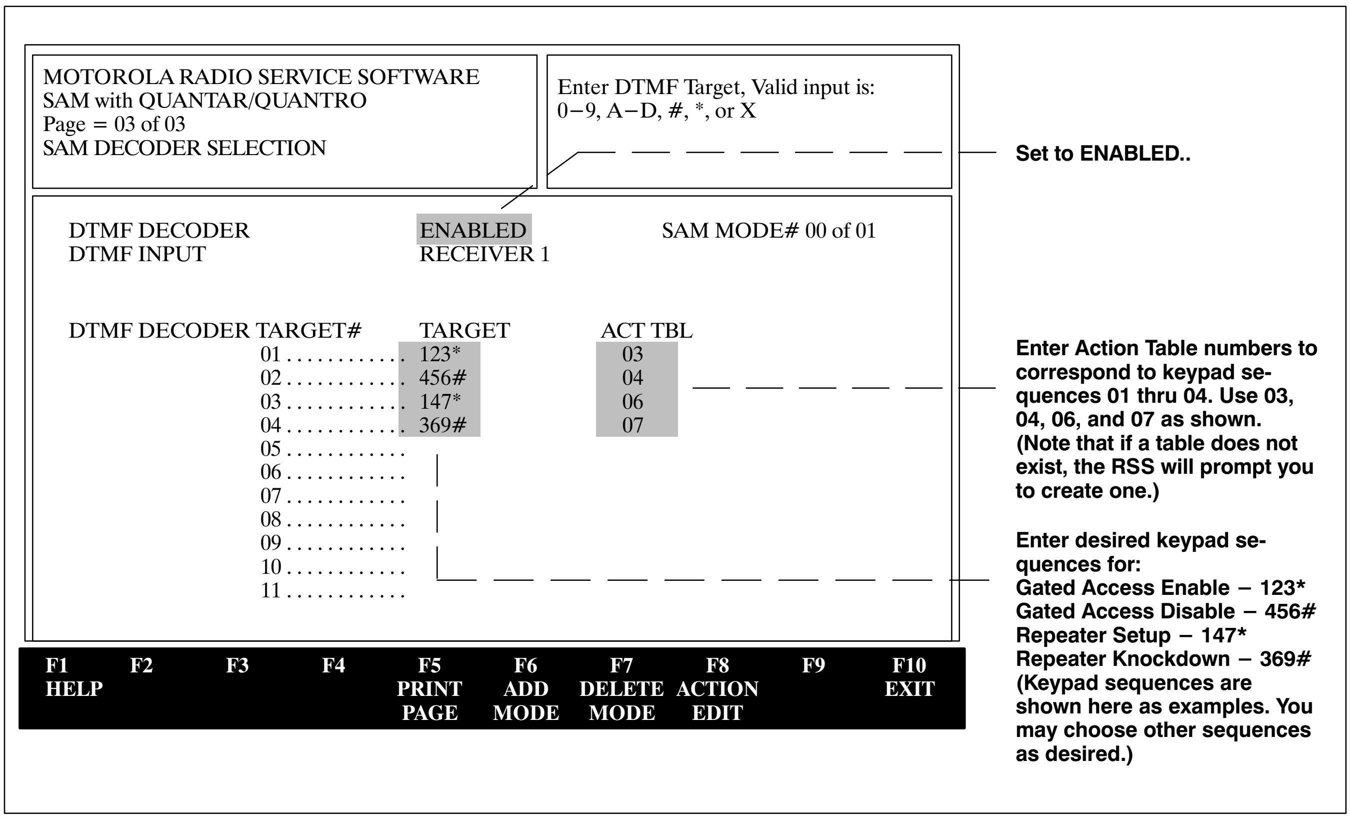

Figure 1. Making DTMF *SAM Decoder Selection* RSS Settings

continued on next page ☞

For MDC 1200 operation, access *Page 02* of the *SAM Decoder Selection* screen and program the *OPCODE*, *ID*, and *ACT TBL* settings as shown in Figure 2. These settings establish the IDs and corresponding Action Tables for Repeater Setup, Repeater Knockdown, Gated Access Enable and Gated Access Disable. Note that if there is default data already entered when opening the screen, overwrite the data with the data shown below.

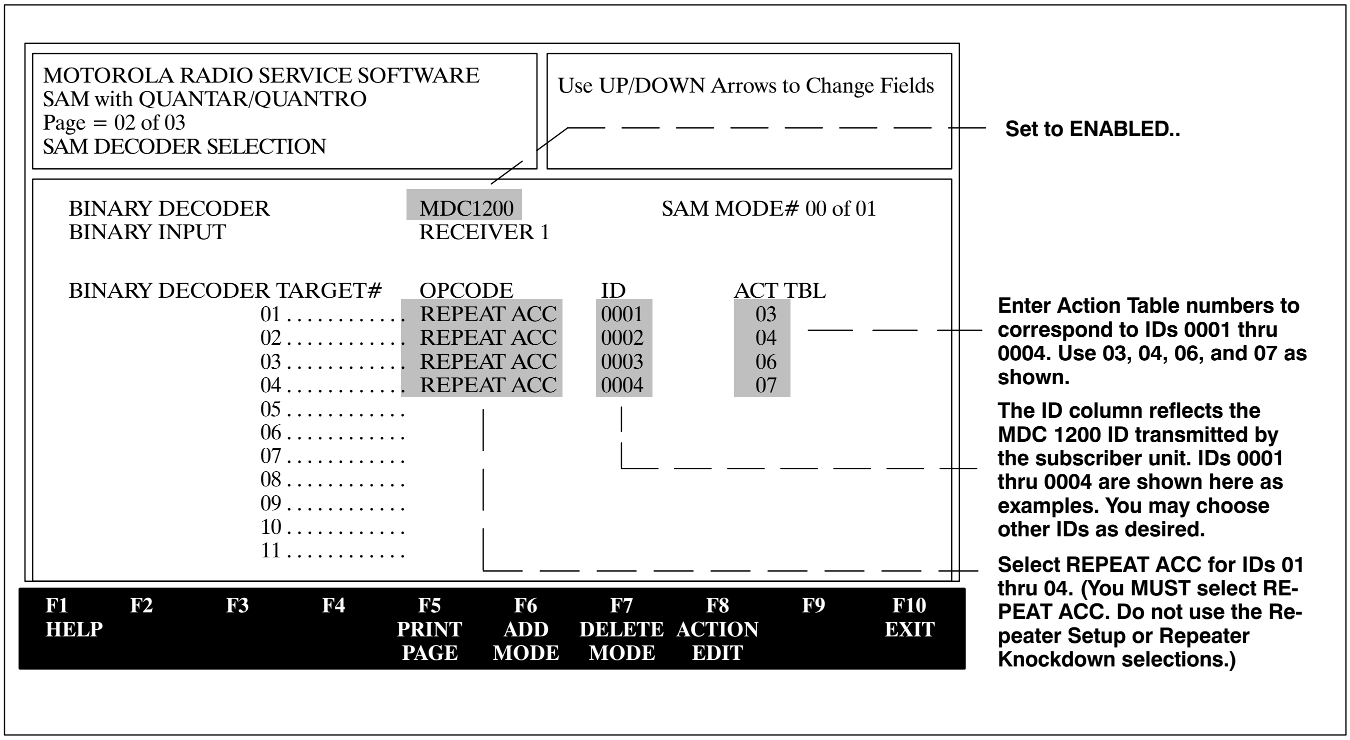

Figure 2. Making MDC 1200 *SAM Decoder Selection* RSS Settings

continued on next page ☞

Step 3. Access the *SAM Action Tables* screen and program Tables 03 and 04 as shown in Figure 3. These Action Tables control the Gated Access functions (enabled and disabled). Note that if there is default data already entered when opening the tables, overwrite the data with the data shown on the facing page.

continued on next page ☞

Setting Action Table 03 (Enable Gated Access)

MOTOROLA RADIO SERVICE SOFTWARE
SAM with QUANTAR/QUANTRO
Page = 01 of 04
ACTION TABLES

Use UP/DOWN Arrows to Change Fields

Use arrow keys to toggle to 03.

ACTION TABLE 03 ACTION TABLE# 03 of xx

#	ACTION			
#	ACTION	ADDRESS	TARG BIT	POLARITY
01	MANIBIT	004C	1	DISABLED
#	ACTION	WAIT TIME		
02	WAIT	100		
#	ACTION	ADDRESS	TARG BIT	POLARITY
03	MANIBIT	004C	1	ENABLED
#	ACTION			
04				
#	ACTION			
04				

Program Actions 01 – 03 as shown.

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT PAGE		CLEAR TABLE			EXIT

Setting Action Table 04 (Disable Gated Access)

MOTOROLA RADIO SERVICE SOFTWARE
SAM with QUANTAR/QUANTRO
Page = 01 of 04
ACTION TABLES

Use UP/DOWN Arrows to Change Fields

Use arrow keys to toggle to 04.

ACTION TABLE 04 ACTION TABLE# 04 of xx

#	ACTION			
#	ACTION	ADDRESS	TARG BIT	POLARITY
01	MANIBIT	004C	1	ENABLED
#	ACTION	ADDRESS	TARG BIT	POLARITY
02	MANIBIT	004C	0	DISABLED
#	ACTION	WAIT TIME		
03	WAIT	100		
#	ACTION	ADDRESS	TARG BIT	POLARITY
04	MANIBIT	004C	1	DISABLED
#	ACTION			
05				

Program Actions 01 – 04 as shown.

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT PAGE		CLEAR TABLE			EXIT

Figure 3. Programming the Action Tables for Gated Access Enable/Disable

Step 4. Access the *SAM Action Tables* screen and program Tables 06 and 07 as shown in Figure 4. These Action Tables control the Repeater Setup and Knockdown functions. Note that if there is default data already entered when opening the tables, overwrite the data with the data shown on the facing page.

◆ End of This Procedure ◆

Setting Action Table 06 (Repeater Setup)

MOTOROLA RADIO SERVICE SOFTWARE
SAM with QUANTAR/QUANTRO
Page = 01 of 04
ACTION TABLES

Use UP/DOWN Arrows to Change Fields

Use arrow keys to toggle to 06.

ACTION TABLE 06 ACTION TABLE# 06 of xx

#	ACTION	ADDRESS	TARG BIT	POLARITY
01	MANIBIT	004C	3	ENABLED

#	ACTION	WAIT TIME
02	WAIT	100

#	ACTION	ADDRESS	TARG BIT	POLARITY
03	MANIBIT	004C	3	DISABLED

Program Actions 01 – 03 as shown.

\# ACTION
04

\# ACTION
04

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT PAGE		CLEAR TABLE			EXIT

Setting Action Table 07 (Repeater Knockdown)

MOTOROLA RADIO SERVICE SOFTWARE
SAM with QUANTAR/QUANTRO
Page = 01 of 04
ACTION TABLES

Use UP/DOWN Arrows to Change Fields

Use arrow keys to toggle to 07.

ACTION TABLE 07 ACTION TABLE# 07 of xx

#	ACTION	ADDRESS	TARG BIT	POLARITY
01	MANIBIT	004C	3	DISABLED

#	ACTION	WAIT TIME
02	WAIT	100

#	ACTION	ADDRESS	TARG BIT	POLARITY
03	MANIBIT	004C	3	ENABLED

Program Actions 01 – 03 as shown.

\# ACTION
04

\# ACTION
04

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT PAGE		CLEAR TABLE			EXIT

Figure 4. Programming the Action Tables for Repeater Setup/Knockdown

Notes...

INPUT/OUTPUT SPECIFICATIONS FOR EXTERNAL CONTROLLERS

For *Quantar* and *Quantro* Stations

1 OVERVIEW

The *Quantar* and *Quantro* stations can be connected to external third-party controllers to accommodate various system applications. Connections between the station and the external controller equipment typically involve the following primary interface signals (available on the station backplane System Connector #17):

- Line 1 + and Line 1 —
- Aux TX Audio (or Aux PL Audio)
- Aux RX Audio
- Carrier Indication + and Carrier Indication —
- PTT + and PTT —

To facilitate making connections between the station and external controller, this section provides electrical characteristics, frequency response curves, and other interface details for the primary interface signals.

Note *When the WildCard option is purchased (required to configure inputs/outputs for connection to an external controllers) and is then enabled (via the RSS), the pre-defined functionality of the signals on System Connector J17 as shown in the Backplane section of this manual (e.g., J17-Pin 22 is Ext PTT +, J17-Pin 11 is Ext Failsoft, etc.) is lost.*
In order to restore the pre-defined signals, you must press ***F4*** *(SET TO DEFAULT) on any of the WildCard RSS screens. Doing so automatically creates a set of WildCard Tables that now determine J17's signal functionality. The* ***Editing WildCard Tables*** *section (page 8) may now be used to change the signal functionality, as desired.*

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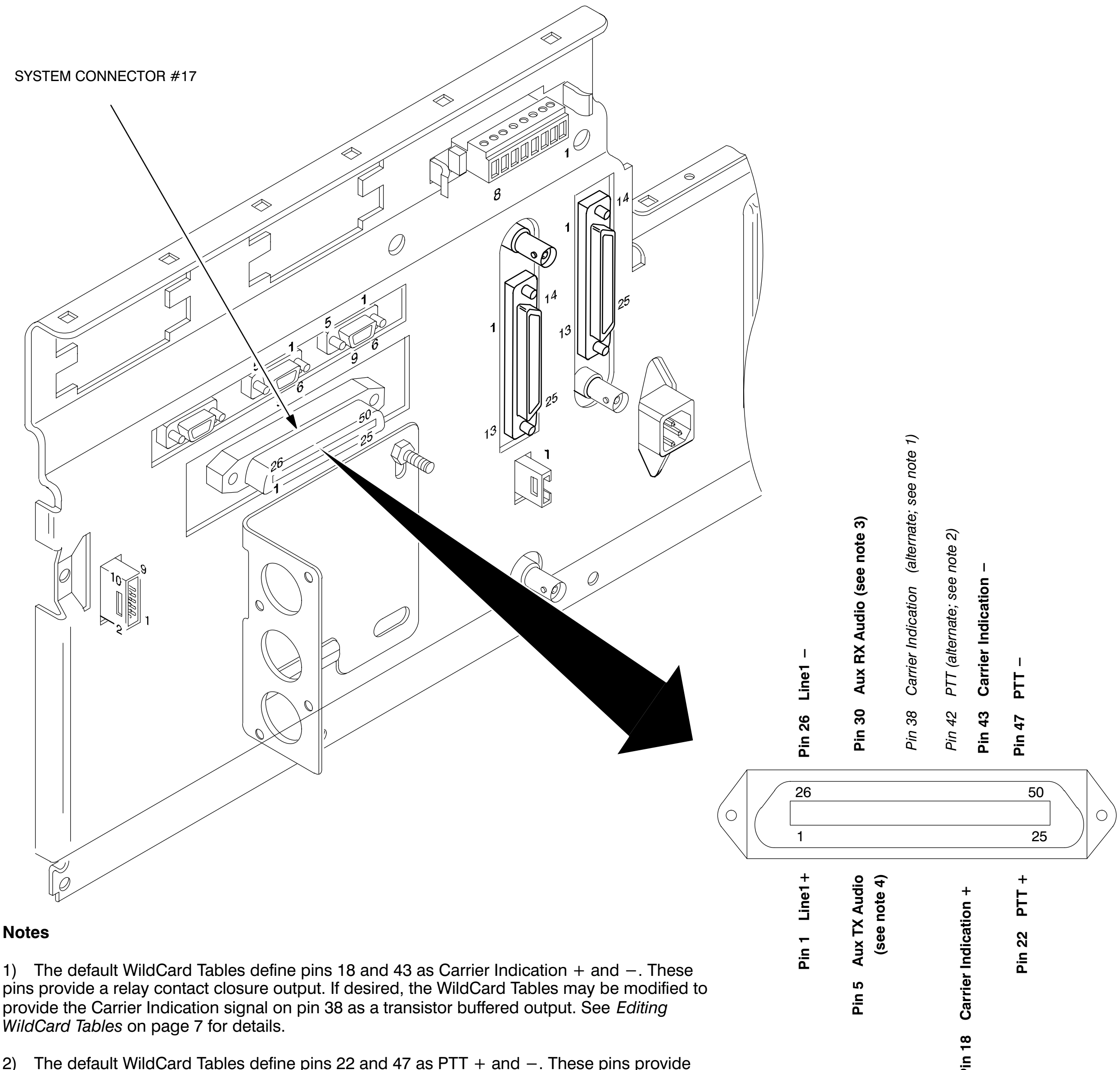
2 ELECTRICAL CONNECTIONS

Figure 1 shows the pin-out locations of the primary interface signals available on System Connector #17.



Notes

1) The default WildCard Tables define pins 18 and 43 as Carrier Indication + and –. These pins provide a relay contact closure output. If desired, the WildCard Tables may be modified to provide the Carrier Indication signal on pin 38 as a transistor buffered output. See *Editing WildCard Tables* on page 7 for details.

2) The default WildCard Tables define pins 22 and 47 as PTT + and –. These pins provide an opto-coupled input. If desired, the WildCard Tables may be modified to provide the PTT signal on pin 42 as a transistor buffered input. See *Editing WildCard Tables* on page 7 for details.

3) Stations shipped from the factory are programmed with no signal at pin 30. In order to program this pin for Aux RX Audio, refer to *Editing WildCard Tables* on page 7.

4) Stations shipped from the factory are programmed with no signal at pin 5. Depending on the application, this pin may be programmed for AUXPL Audio or Aux TX Audio In order to program this pin for AUXPL Audio or Aux TX Audio, refer to *Editing WildCard Tables* on page 7.

Figure 1. Signal Locations on System Connector #17

3 ELECTRICAL CHARACTERISTICS

This section provides the electrical characteristics, frequency response curves, and other interface details for the primary interface signals.

Line 1 + and Line 1 — (J17−Pins 1 and 26)

General Characteristics

Line 1 + and Line 1 − provide a balanced phone line input for incoming audio signals to the station. The input impedance is set by jumpers located on the Wireline Interface Board. The jumpers are set at the factory for 600Ω impedance. You may change the impedance (if desired) by changing the jumpers as described in the appropriate (4-wire or 8-wire) Wireline Interface Board section in this manual.

Phone Line Specifications

Most telephone companies recognize either “3002” or “Type 5” as designations to define phone line types and associated electrical specifications. Telephone lines meeting the specifications for either of these types are acceptable for use with the *Quantar* station. The following table shows the specifications for “3002” and “Type 5” phone line types.

Type 5 and “3002” Phone Line Specifications

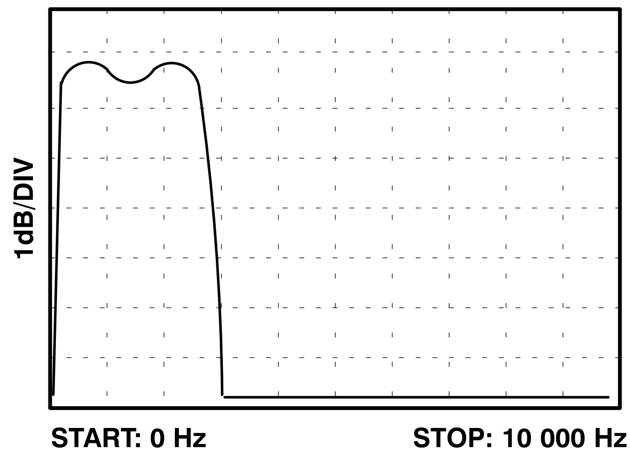
Parameter	Type 5 Specification	3002 Specification
Loss Deviation	±4.0 dB	±4.0 dB
C−Notched Noise	51 dBrnCO	51 dBrnCO
Attenuation Distortion: 504 to 2504 Hz 404 to 2804 Hz 304 to 3004 Hz	 −2.0 to +8.0 dB −2.0 to +10.0 dB −3.0 to +12.0 dB	 −2.0 to +8.0 dB spec not available −3.0 to +12.0 dB
Signal to C−Notched Noise Ratio	≥ 24 dB	≥ 24 dB
Envelope Delay Distortion: 804 to 2604 Hz	1750 μsec	1750 μsec
Impulse Noise Threshold	71 dBrnCO	
Intermodulation Distortion: R2 R3	 ≥ 27 dB ≥ 32 dB	≥ 25 dB ≥ 30
Phase Jitter: 20−300 Hz 4−300 Hz	 ≥ 10 Degrees ≥ 15 Degrees	≥ 25 Degrees ≥ 30 Degrees
Frequency Shift	± 3 Hz	± 5 Hz

Aux TX Audio (J17–Pin 5)

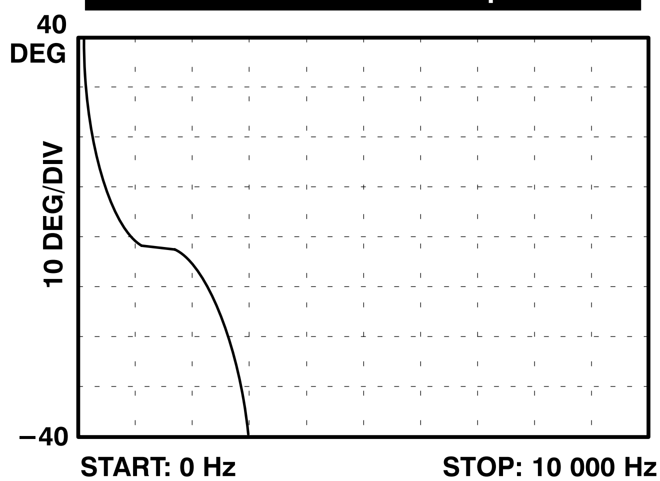
Note ***In order for J17-Pin 5 to support the Aux TX Audio signal, you must edit the Wildcard Table as shown on page 11.***

The **Aux TX Audio** signal is an unbalanced, 470Ω impedance input to the station. The input voltage range is −4.1 V to +4.1 V at 250 Hz to 3 kHz. The response curves for this signal are shown below.

Aux Tx Audio Magnitude Response



Aux Tx Audio Phase Response

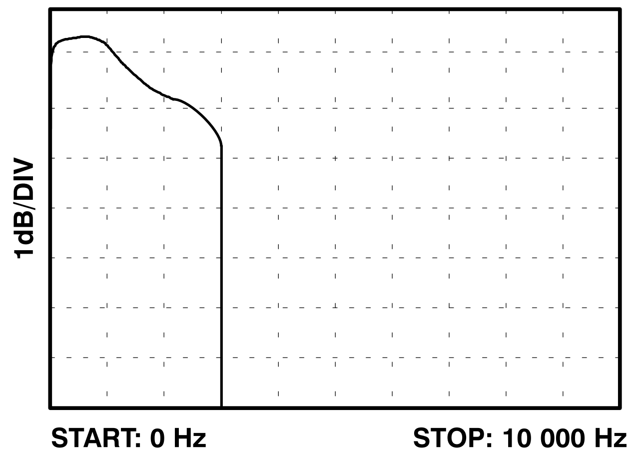


Aux PL Audio (J17–Pin 5)

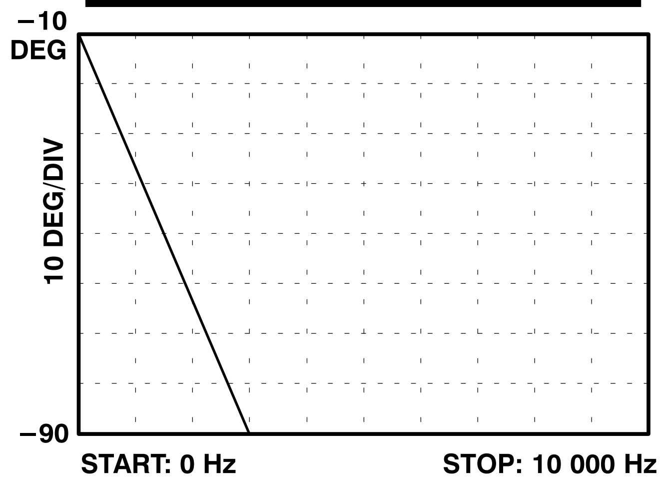
***Note** In order for J17-Pin 5 to support the Aux PL Audio signal, you must edit the Wildcard Table as shown on page 12.*

The **Aux PL Audio** signal is an unbalanced, 470Ω impedance input to the station. The input voltage range is −4.1 V to +4.1 V at 5 Hz to 3 kHz. The response curves for this signal are shown below.

Aux PL Audio Magnitude Response

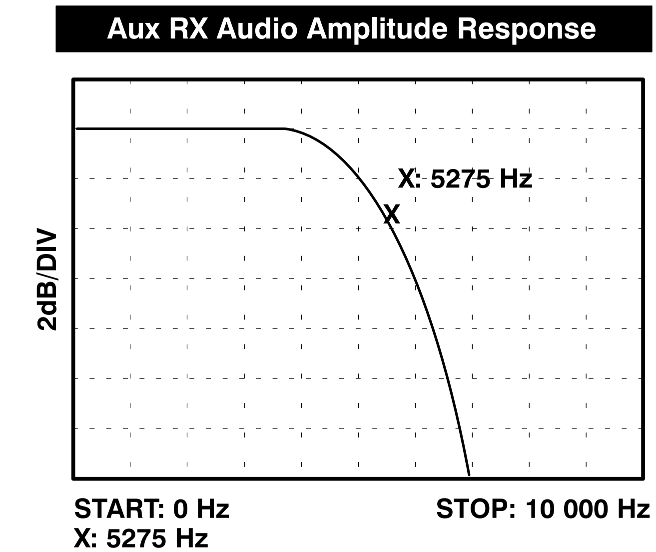


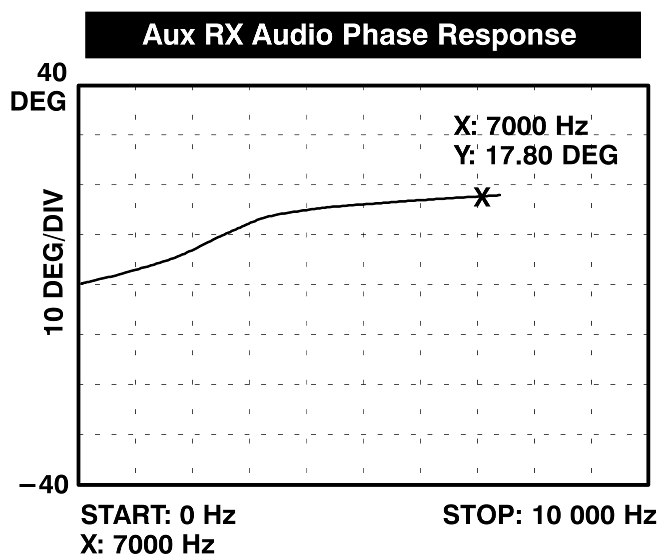
Aux PL Audio Phase Response



Aux RX Audio (J17−Pin 30)

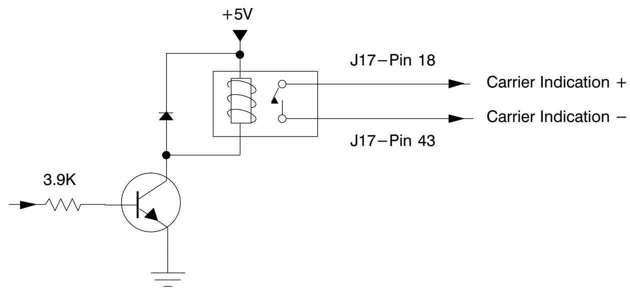
The Aux RX Audio signal is an unbalanced output from an operational amplifier with an output impedance of less than 5Ω. The output voltage range is 0 to 6.6V P-P at 0 to 6 kHz. The response curves for this signal are shown below.





Carrier Indication +/− (J17−Pins 18 and 43)

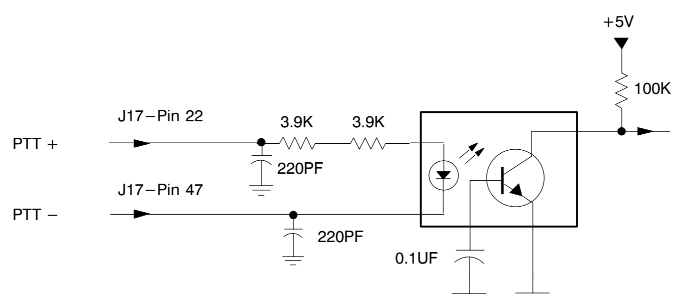
The Carrier Indication + and Carrier Indication − signal provides a relay closure output, as shown below. (If desired, the WildCard Tables may be edited to provide the Carrier Indication signal on J17−Pin 38 as a transistor-buffered output. Refer to *Editing WildCard Tables* on page 7 for details.)



Typical Relay Closure Output Circuit

PTT +/− (J17−Pins 22 and 47)

The PTT + and PTT − signal provides an opto-isolated input, as shown below. (If desired, the WildCard Tables may be edited to provide the PTT signal on J17−Pin 42 as a transistor-buffered input. Refer to *Editing WildCard Tables* on page 7 for details.)



Typical Opto−Coupled Input Circuit

4 EDITING WILDCARD TABLES

You must edit certain WildCard Tables in order to cause certain signals to appear on specific pins on the System Connector J17. Instructions for modifying these WildCard Tables are provided in this section.

The WildCard Tables are programmed in the factory to provide:

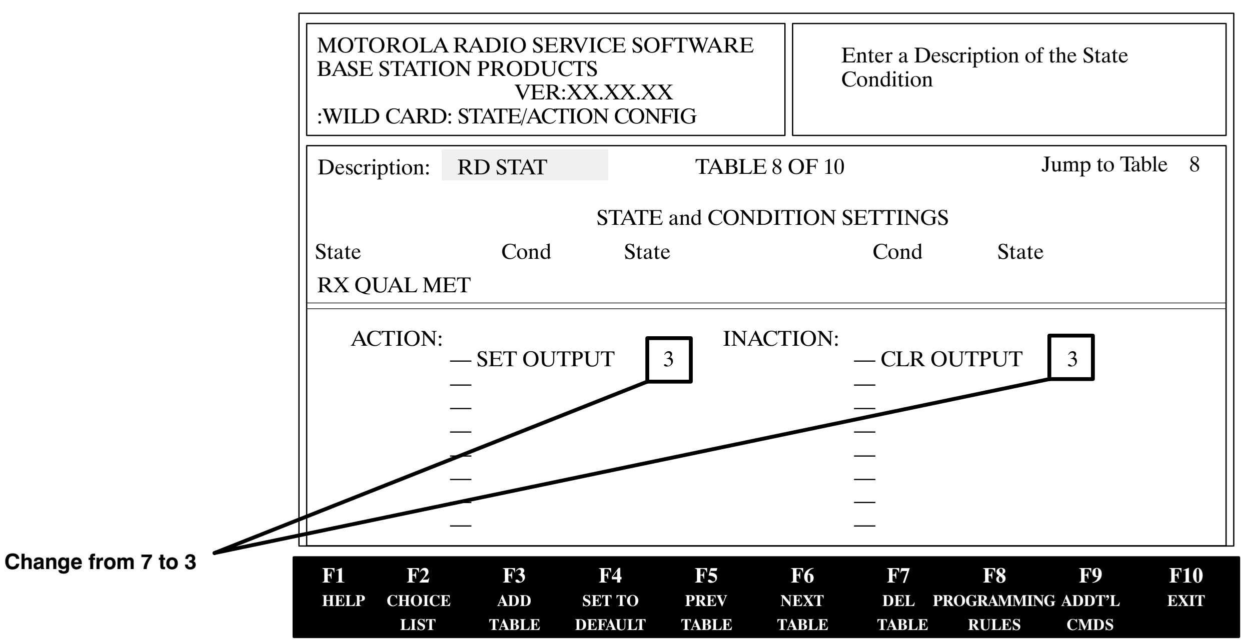
- Carrier Indication + and − on J17−Pins 18 and 43 as a relay contact closure output
- PTT + and − on J17−Pins 22 and 47 as an opto-isolated input

If desired, the WildCard Tables may be modified to change the connector pin number and signal interface as follows:

- Carrier Indication on J17−Pin 38 as a transistor buffered output
- PTT on J17−Pin 42 as a transistor buffered input

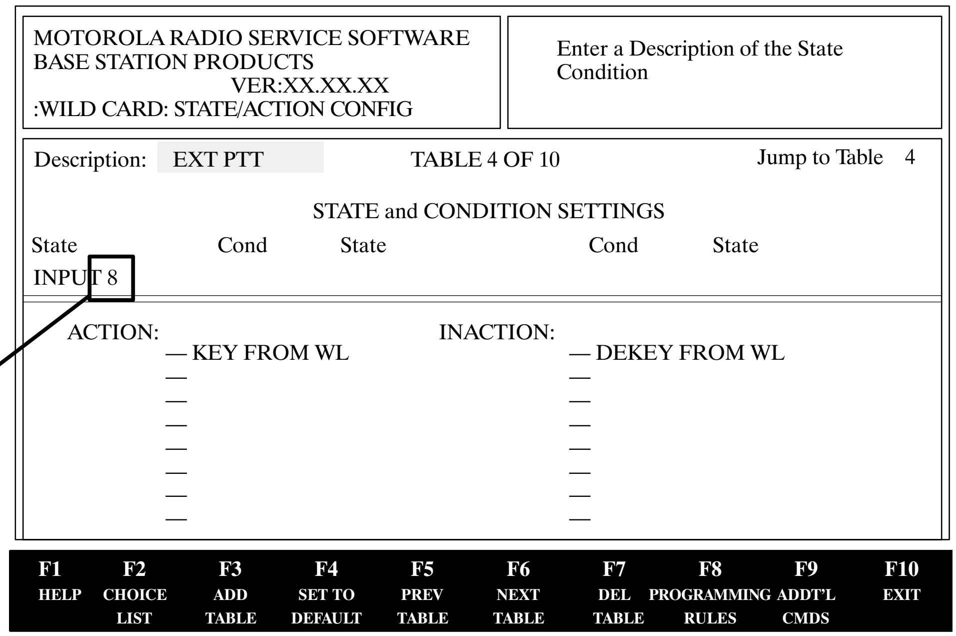
Changing Carrier Indication Signal to J17−Pin 38

The WildCard Tables are programmed in the factory to provide Carrier Indication + and − on J17−Pins 18 and 43 as a relay contact closure output. Modify WildCard Table 8 as shown below to move the Carrier Indication signal to J17-Pin 38 as a transistor buffered output.



Changing PTT to J17–Pin 42

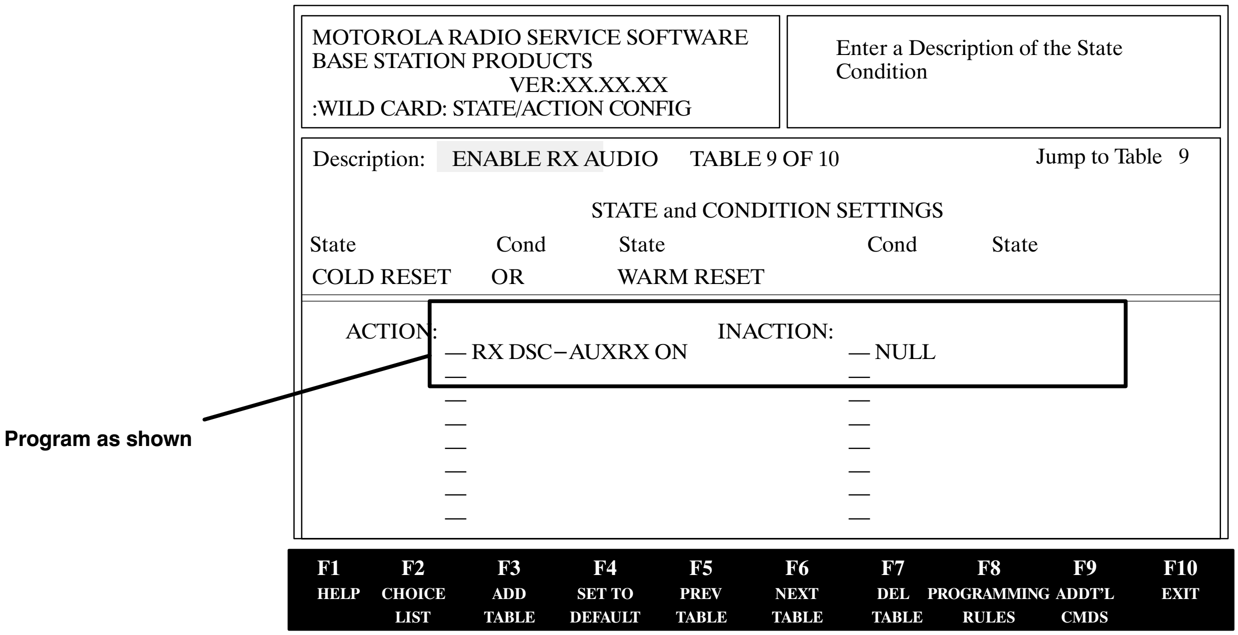
The WildCard Tables are programmed in the factory to provide PTT + and – on J17–Pins 22 and 47 as an opto-isolated input. Modify WildCard Table 4 as shown below to move PTT to J17–Pin 42 as a transistor buffered input. When PTT is asserted, the station will gate audio from Line 1 to the transmitter. Follow the alignment instructions for the Wireline to set proper deviation level.



Change from 9 to 8

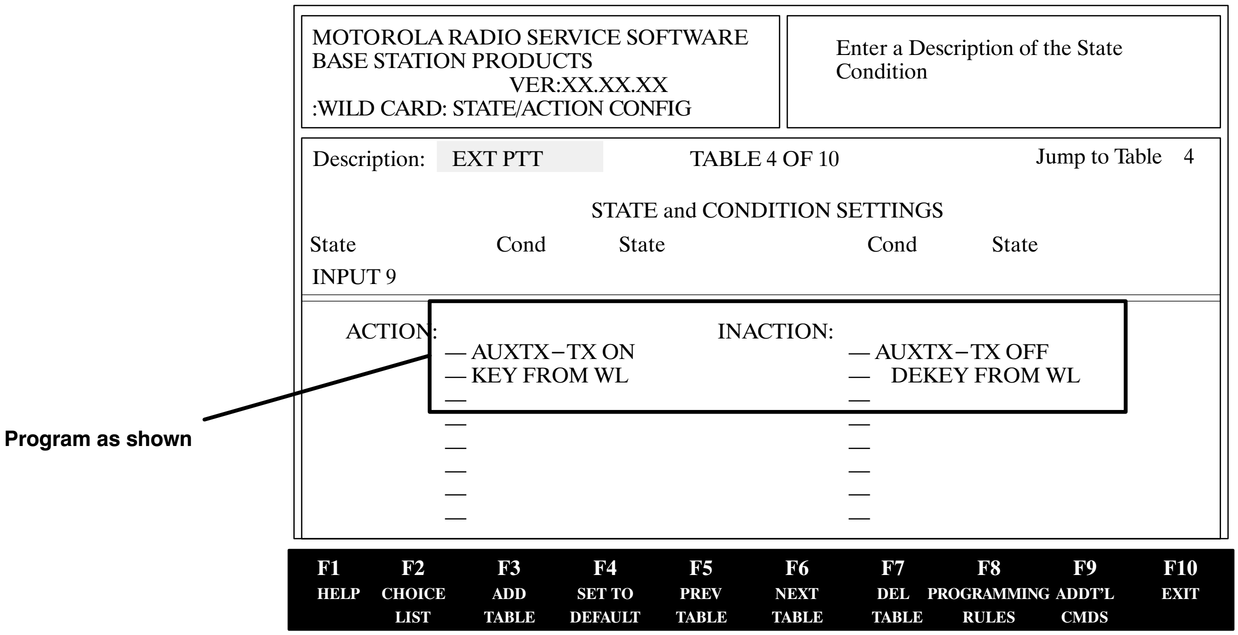
Routing Aux RX Audio to J17-Pin 30

Edit (or add) WildCard Table 9 in order to route the Aux RX Audio signal to J17-Pin 30.



Routing Aux TX Audio to J17-Pin 5

Edit WildCard Table 4 in order to route the Aux TX Audio signal from J17-Pin 5 to the transmitter. Alignment is fixed so that a 1 kHz tone at −10 dBm at the input provides 60% deviation. (For example, on a 25 kHz channel with 5 kHz maximum deviation, a −10 dBm input results in 3 kHz deviation.)



Routing Aux PL Audio to J17-Pin 5

Edit WildCard Table 4 as shown below in order to sum the signal at Aux TX Audio with the audio signal at Line 1. The signal input to the Aux TX Port can be either a PL signal, a DPL signal, or some other low speed digital signal. The port is scaled so that an amplitude of −10 dBm provides a 20% deviation of the transmitted rf signal. (For example, on a 25 kHz channel with 5 kHz maximum deviation, the low speed signal input at − 10 dBm results in 1 kHz deviation.) Note that the audio input at Line 1 must be aligned following the wireline alignment procedure located in the Radio Service Software (RSS) User's Guide.