ZR350
Installation Manual

Part No. 025-9375C

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WARRANTY

Zetron's warranty is published in the current Zetron *United States Price Book*.

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DECLARATION OF CONFORMITY

CE

Manufacturer Name and Address:
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European Union Representative:
Zetron, Inc.
28 Campbell Court,
Campbell Road,
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Declares that the Product: **Model ZR350 Europatch**

In Application of Council Directives: EU EMC Directive 89/336/EEC
EU Low Voltage Directive 73/23/EEC

Compliance was demonstrated to the following specifications:

Radiated Emissions	CISPR 22: 1994, EN 55022 Class B
Conducted Emissions	CISPR 22: 1994, EN 55022 Class B
Electrostatic Discharge (ESD) Immunity	IEC 1000-4-2:1995, EN 50082-1, 3KV CD, 8KV AD
Radiated RF Immunity	IEC 1000-4-3:1995, EN 50082-1, 3V/m
Electrical Fast Transient/Burst Immunity	IEC 1000-4-4:1995, EN 50082-1, 0.5 kV Signal Lines 1.0 kV Power Lines
Low Voltage Directive	EN 60950: +A1 +A2

Redmond, WA, USA
November, 96

Kathryn North
Quality Manager

Kathryn North

072-0086C

FOREWORD

SCOPE

This manual is intended for use by experienced technicians familiar with similar types of equipment. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause interference with radio communications. The installation of the ZR350 should only be attempted by qualified radio service personnel. All of the information contained in this manual is current as of the date it was printed.

RELATED MANUALS

There are several manuals that are related to the equipment used in a ZR350, which might be helpful during the installation. They are:

GR300/GR500 Repeater Stations (Motorola # 6880903Z42)

Radius GR300 and GR500 Repeater Stations (Motorola # 6880903Z43)
(Supplement to GM300 RSS Manual - 6880902Z36)

GM300 Service Manual (Motorola # 6880902Z32)

GM300 RSS Manual (Motorola # 6880902Z36)

TECHNICAL SUPPORT

To obtain technical support on the ZR350 you can call Motorola and ask for “ZR350 technical support”.

In order to aid the technical support personnel in helping you, we ask that you have the serial number of the ZR350 available in case they need to track the file of the order it was sold under. You should also have as much information as possible on the type of installation, how far along it has gotten, what sort of programming or operating problems you are having, etc. It is also helpful if the person making the call to Motorola is the technician doing the installation or programming of the system. Technical support is almost never facilitated by passing information back and forth through a third person.

SERVICE

If a malfunction occurs with the ZR350, during or after the warranty period, that cannot be resolved over the phone with technical support personnel, then that unit should be returned to Motorola for servicing. You must obtain authorization from the technical support person that you work with in order to return a unit to Motorola.

Make sure that the unit is shipped in its original packaging or use careful packing procedures, to eliminate the possibility of damage while en route.

During the warranty period, Motorola will either repair or replace the unit as required. If the unit is out of warranty, then you must pay a service fee.

ORDERING PARTS

The manual lists all of the parts used in the ZR350 in the Maintenance section. In addition to showing the Zetron part number, a description of the component and its manufacturer's part number will be listed. If you need a component that is not readily available in your area, you may order it from Zetron by calling for technical support on the ZR350 and giving the parts information to the technician.

Parts may also be ordered by FAX. Address the FAX to "Zetron - Business & Industrial Division - Technical Support". Be sure to identify the model for which you are ordering parts and the parts themselves as completely as possible. Send the FAX to (206) 820-7031.

1. INTRODUCTION

1. INTRODUCTION

OVERVIEW

The ZR350 is designed to provide any size of business with a convenient way to keep in touch with their employees anywhere on the business site, even when the very nature of the business requires that those employees be in motion about the site.

In order to simplify both the installation of the ZR350 and the planning of the entire system, the ZR350 is designed specifically to interface to the Motorola GR300 or GR500 Repeater Station, or in simplex situations to a single GM300 radio. The ZR350 interfaces directly to the Auxiliary connectors on the radios and ready-made cables for this installation are available from Motorola.

The ZR350 supports both Tone Only and Tone+Voice paging using the Two-tone and Five-tone sequential selective calling formats. It also supports both two-way Radio and Talkback operation for radio users.

The ZR350 supports up to three dedicated telephone desksets for local control of the system. Depending on telephone wiring and the specific telephone instruments used, the desksets may be located as much as 700 meters away from the ZR350. The operator of the Local phone can use it not only to make pages and talk to radio users, but also to monitor phone calls and repeater operations on the station. In an emergency situation, the Local phone operator can take priority control of the ZR350 with only a hook flash and cancel any operations in progress so that emergency pages can be made without delay.

The ZR350 telephone input can be used to connect to either the PSTN “Central Office” or a company PBX switch. This not only allows knowledgeable users to make calls and pages from any phone on the site or from public telephones, it also allows DTMF equipped radios to originate calls whenever the need arises. The PSTN/PBX line can also be programmed to automatically call a single preselected user when the line rings so that this input can be used to provide after-hours contact with night shift or security personnel, or an emergency line for fire or medical teams.

Note

If the PBX/CO port (J1) of the ZR350 is connected to the Public Switched Telephone Network (PSTN), the installer should use a telephone coupler that is approved in the jurisdiction where the connection is being made. If no coupler is used, it is the installer’s responsibility to determine whether or not local regulation allow this connection to be made.

The ZR350 can be programmed using a straightforward set of DTMF commands from either of the phone inputs or from the radio channel. Programmable items include all of the access and disconnect codes, the Program mode access code, the station Morse code identifier, the

Radio Activity and Call Limit timers, and many additional parameters, giving the installing technician considerable control in defining the final operation of the paging system.

STANDARD FEATURES

The following is a short list of the more significant features that come standard in every ZR350.

- Dial-access paging from any PBX extension or PSTN subscriber line.
- Priority paging and supervisory control from up to three dedicated telephone desksets.
- Interconnect circuitry allows radio users to initiate calls to the PBX or outside line, or to make calls to other radios or pagers on the system. With the optional Local Phone Ringer, radio users may initiate calls to the dedicated telephone desksets.
- Quick interfacing to Motorola Radius GM300 radios (up to 40 watts) using purpose made cables. Designed to fit into the accessory slot in the Motorola Radius GR300 or GR500 Repeater Station cabinets (see Figure 1-1).
- Can use existing telephone wiring at the customer site for ease of installation.
- Includes a 100-user database, with individual user validation and support for group call paging.
- Supports Radios, Tone-Only, Tone & Voice, and Talkback paging using Motorola Quick Call II, and Five-tone sequential (Select V).
- Comes standard with a built-in Dial Click decoder circuit to support callers overdialing the user number of the pager they wish to call from pulse or rotary telephone instruments.

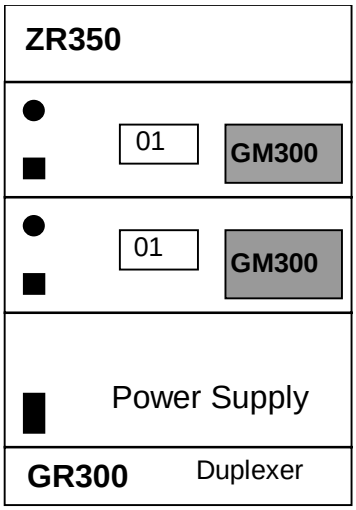


Figure 1-1 ZR350 Installed in GR300 Repeater Station

SPECIFICATIONS

Telephone Interface

Line type	Subscriber line, PBX extension.
Connector	RJ11 modular jack.
Incoming call	Ring detection on tip-ring pair, selectable number of rings to answer.
Call answer	Off-hook, tip-ring current draw.
Call disconnect	Busy tone, call limit, radio activity time-out, “#0” from phone, or local override.
Overdial decode	DTMF and rotary dial click decode.
Ringer Equivalence	0.4B

Local Telephone Interface

Number of desksets	0-3. Typical phone draws 13-20 mA. Depending on system, distances of 700 meters from ZR350 may be achieved.
Line type	Loop start, 12V battery feed.
Connector	RJ11 modular jack.

Radio Interface

Connector	Standard GM300 16 pin plugs.
Connections	Flat RX audio, Mic audio, Flat TX audio, CSQ detect, PTT, PL/DPL detect, +12 VDC, Ground.

Selective Calling

Two tone	Motorola Quick Call II, tone groups 1-6 supported.
Five tone	CCIR1, CCIR2, EEA, EIA, ZVEI1, ZVEI2, DZVEI, PZVEI, ZVEI3
Equipment types	5-tone radio, 5-tone talkback, 5-tone tone-only pager, 5-tone Tone+Voice pager, QCII group call radio, QCII radio, QCII talkback, QCII tone only pager, QCII Tone+Voice pager.

General

Size	220 x 177 x 34 mm. Fits in GR300 and GR500 enclosures.
Weight	700 g
Power	10.5 - 16 VDC, 200 mA (powered by GM300 radio), up to 280 mA may be drawn if all three local desksets are off-hook.
Operating Temperature	-30° to +70° Celsius.
Adjustments	Audio level, Encode level, VOX, and Dial Click.
Indicators	Power, Transmit, Receive, Phone, and VOX.
Controls	Connect/Disconnect.
Prompt tones	Progress tones, error tones and warning tones sent to radio or phone.
Programming	Via DTMF phone or DTMF radio.
Data retention	EEPROM.

2. INSTALLATION

2. INSTALLATION

INSTALLATION WARNING

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the manual, it may cause interference to radio communications. Installation of the ZR350 should only be attempted by qualified radio service personnel.

OVERVIEW

This section explains how to install the ZR350 EuroPatch into a system using either one or two of the Motorola Radius radios, specifically the GM300 radios. There will be two separate wiring diagrams, depending on whether or not the system will be using a single radio for simplex operation or two radios for half-duplex operation. Refer to the GM300 Service Manual (6880902Z32) for details on the radio and the GM300 RSS Manual (6880902Z36) for information on using the Motorola Radio Service Software to program the radio(s). Refer to the GR300/GR500 Repeater Station manual (6880903Z42) and the repeater programming supplement to the RSS manual (6880903Z43) when using a GR300 repeater.

A complete telephone interconnect system requires;

1. A ZR350 EuroPatch Telephone Interconnect.
2. A fixed radio or duplex base station comprised of one or two Motorola GM300 radios.
3. An interface cable between the ZR350 EuroPatch and Motorola radio(s). One cable per radio is required; one for simplex, two for duplex.
4. A 12 volt DC power supply for the radio(s) and EuroPatch.
5. A duplexer (if two radios are used) and antenna.
6. A Digital Voice Delay module for the EuroPatch if a single Motorola simplex radio is being used.
7. Up to 3 local telephone units if direct connect dispatch is desired.
8. Field units e.g. handheld radios, radios, and/or pagers.

Quick-cabling is provided for the connection between the ZR350 EuroPatch and the radio(s). Power is provided by the connection to the receive radio. The mounting holes (one on each side) are aligned to match the holes on the Motorola repeater cabinet. Interface cables are typically provided with the GR300 and GR500 cabinets, or may be optionally ordered from Motorola.

The ZR350 is typically located in or near the telephone room and usually occupies a PBX extension. Additionally, up to three telephone desksets may be directly connected. These desksets are connected using normal two-wire cabling and thus may be placed nearly anywhere in the building and take advantage of existing runs of telephone cable.

Simple DTMF programming commands allow the system manager to enable/disable users, define the calling restrictions and otherwise exercise control over operation of the system.

EQUIPMENT REQUIRED FOR INSTALLATION

The following equipment is required for proper installation of the ZR350 to either one or two Radius GM300 radios:

- A radio communications service analyzer
- An oscilloscope (or at least a VOM capable of reading Volts AC on an RMS scale) for setting audio levels
- A hand-held radio with DTMF encode capability programmed for the same channels as the new system
- A DTMF telephone to use in the Local Telephone input
- Several sizes of cross-head screw driver to remove the top cover for configuration

You may include any other equipment and hand tools that your experience indicates might be useful, but this is considered to be the minimum equipment necessary to perform a normal installation without difficulty.

RADIO CONFIGURATION AND PROGRAMMING FOR SIMPLEX SYSTEMS

This section explains how to configure a single GM300 radio for operation with the EuroPatch. The single radio will operate as a transceiver, providing the receive function, transmit function, PL/DPL decoder, and Select V (five-tone) decoder.

CAUTION

The radio auxiliary connector must be programmed properly or damage may occur to the radio or ZR350 EuroPatch!

A single PL/DPL decode may be programmed in the GM300 radio to provide protection against co-channel interference or added system security. If a PL/DPL decode is programmed, all units accessing the ZR350 must transmit this same PL/DPL.

The radio may also include a Select V (five-tone) decode address. This decoder may be used to provide radio to phone access, and optional emergency number autodial. If this feature is desired, pin 4 of the auxiliary connector should be programmed as "External Alarm" (as shown in the following example). If the feature is not desired, either Pin 4 should be programmed as NULL 2, or no Select V decode configured. In the programming example, a Select V decode is enabled for CCIR address 12345.

The receiver section may be programmed for either "Local" or "Distant" sensitivity. The installer should consider the application and select the appropriate mode.

Since the system will only operate on a single channel, only one "MODE" should be installed. This will ensure the station does not end up on the wrong frequency.

Example Simplex GM300 Radio Setup: Configure hardware jumpers in GM300 radio as shown in Table 2-1.

Table 2-1 Motorola GM300 Jumper Settings: Simplex

Jumper	Setting	Function
JU551	B	RX audio = de-emp and muted
JU651	A	Mic sensitivity = 80 mV
JU701	A	Flat TX audio through limiter

Example Simplex Radio Setup (continued):

MOTOROLA Radio Service Software
Radius GM300 Model:M44GMC29C3__

CHANGE/VIEW:RADIO WIDE

Use UP / DOWN Arrows To Enable.

RADIO WIDE CONFIGURATION

MODEL INFORMATION
M44GMC29C3__.....40 WATT
UHF Band .....438.0-470.0 MHz
Squelch.....Coded
Conventional Modes.....1
Serial Number.....159TSS0376

ACCESSORY INFORMATION
ACC. Internal.....None
ACC. External.....General I/O
ACC. Custom.....Y

OPTIONS
TOT Rekey Time (s).....Off
Forced Monitor.....Off
Handset.....N

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT SCREEN		SCAN OPTIONS		OTHER ACCESSORY	EXIT

MOTOROLA Radio Service Software
Radius GM300 Model:M44GMC29C3__

CHANGE/VIEW:RADIO WIDE:ACCESSORY

Use UP / DOWN Arrows To Enable.

ACCESSORY CONNECTOR CONFIG

INT Accessory: None EXT Accessory: General I/O Custom: Y

PIN#	DESCRIPTION	DATA DIR	DEBOUNCE	ACT LEVEL
4	External Alarm	Output	No	High
6	NULL 1	Input	No	Low
8	PL/DPL & CSQ Det	Output	No	Low
9	NULL 1	Input	No	High
12	CSQ Detect	Output	No	Low
14	NULL 1	Input	No	Low

Power-Up Delay (sec) : 0.204

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP		PREVIOUS ACC. EXT	NEXT ACC. EXT	PRINT SCREEN				RESET DEFAULT	EXIT

Example Simplex Radio Setup (continued):

MOTOROLA Radio Service Software Radius GM300 Model:M44GMC29C3__ CHANGE/VIEW:MODE	Enter Value.

Model 001 Name...01
Type.....Conventional

Rx Frequency.....464.50000
Tx Frequency.....464.50000

Rx Squelch Type.....TPL
Rx Squelch Code.....110.9 2Z

Tx Squelch Type.....CSQ

Rx Signaling System.....01
Rx Signaling Name.....SELECT V

Tx Signaling System.....00
Tx Signaling Name.....NONE

Busy Channel Lockout.....N
Local/Distance.....DX
Time Out Timer (s).....255

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP	GOTO MODE	PREVIOUS MODE	NEXT MODE	PRINT SCREEN	SCAN LIST		MODE UTILITY		EXIT

MOTOROLA Radio Service Software Radius GM300 Model:M44GMC29C3__ CHANGE/VIEW:SIG:RAD WIDE	Use UP / DOWN Arrows To Enable.

SIGNALING RADIO WIDE

Voice Selcall Encode.....N
Call Alert Encode.....N
Radio Check Encode.....N
Low Battery.....N
Emergency Alarm.....None

Auto Reset Timer (s).....Off
PTT Repeat Timer (s).....Off
Tx Hold Time (s).....Off
Call List Time Out (s).....Off
Select V Sidetones.....Disabled

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT SCREEN					EXIT

Example Simplex Radio Setup (continued):

```
MOTOROLA Radio Service Software                 Use UP / DOWN Arrows To Adjust Value.
Radius GM300   Model:M44GMC29C3__

CHANGE/VIEW:SIG:DECODE

      EFT        DECODE        GROUP   GROUP   GROUP          ALERT    CALL
 ID   TIME     SEQUENCE  DIGIT      TYPE POSITIONS         TONES  LIGHT
  A   0.00       12345--              -      -  -------          Y    Y

F1        F2        F3        F4        F5        F6        F7        F8        F9        F10
HELP   GOTO      PREVIOUS  NEXT      PRINT               DELETE    ADD                 EXIT
       SEQUENCE  SEQUENCE  SEQUENCE  SCREEN              SEQUENCE  SEQUENCE
```

```
MOTOROLA Radio Service Software                 Use UP / DOWN Arrows To Select Type.
Radius GM300   Model:M44GMC29C3__

CHANGE/VIEW:SIG:SIGNAL

 System.....................01                  Signaling Std.............100ms CCIR
 Type.....................SELECT V
 Call Type.....................Call Alert
 Alert Tone Reset.....Automatic

                                                 Horn/Lights.....Permanent
                                                 Horn/Lights Delay.....0.0

 PTT ID.....................No      Pretime (s).....0.5 PL/DPL Required.....N
 PTT Sidetone.....Y                Signaling Squelch.....N
 PTT Short Sidetone.....Y          DOS Hold off.....0.0

 Primary Decode..... A             Base Call Encode.....--  --  --
 Secondary Decode.....--           PTT Encode.....--  --  --
                                   Ext Call Encode.....--  --  --

F1        F2        F3        F4        F5        F6        F7        F8        F9        F10
HELP      PREVIOUS  NEXT      PRINT               DELETE    ADD                 EXIT
          SYSTEM    SYSTEM    SCREEN              SYSTEM    SYSTEM
```

Simplex Assembly

1. Complete the connection of the radio to the power supply and the antenna cable. The radio should be programmed for its channel assignment and the Auxiliary connector pin functions before being connected to the ZR350.

2. If the ZR350 is still in the factory default configuration and no Digital Voice Delay board is to be used, proceed directly to step 4, otherwise, remove the top cover from the ZR350. Working from the rear of the unit, the radio connectors will be on the right and the telephone connectors on the left. See Figure 2-1.

3. Locate the jumpers JP3, JP4, and JP5 (just behind P2), and verify that they are installed (factory default). These jumpers pass signals from the Transmit connector P2 over to the Receive connector P1. In the simplex application all signals enter and leave the unit via the Receive connector.

   If a Digital Voice Delay board is to be used, remove the installed jumper JP9, and install the Digital Voice Delay board.

   Once you have set/verified the positions of these jumpers, proceed with the assembly.

4. Connect the cable from the radio to the Receive connector, P1, on the far right of the ZR350 chassis.

5. Connect the DTMF telephone set to the Local telephone jack, J2, on the far left of the unit. This will be used to enter the programming mode on the ZR350, for adjustments and configuring the unit.

This completes the initial assembly of the equipment. Final assembly will be done after the tests and adjustments are complete. Proceed now to the Initial Turn-on.

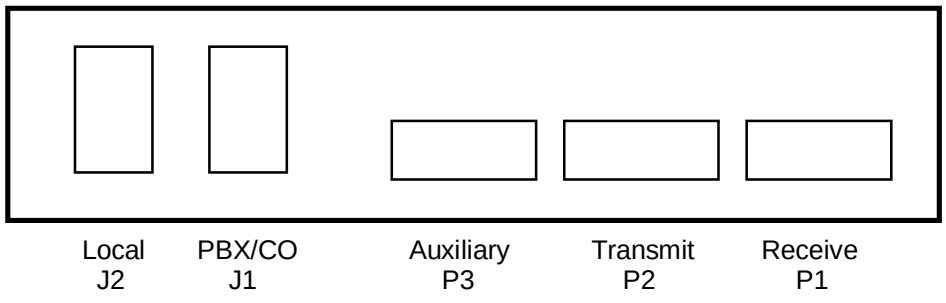


Figure 2-1 Rear of the ZR350

RADIO CONFIGURATION AND PROGRAMMING FOR DUPLEX SYSTEMS

This section explains how to configure a pair of GM300 radios for duplex operation. It is broken up into two parts: one for the receive radio and one for the transmit radio.

Duplex Receive GM300 Radio

This radio will be used by the ZR350 EuroPatch to perform as a receiver, PL/DPL decoder, and Select V (five-tone) decoder. It does not require any transmit capability.

CAUTION

The radio auxiliary connector must be programmed properly or damage may occur to the radio or ZR350 EuroPatch!

A single PL/DPL decode may be programmed in the receive radio to provide protection against co-channel interference or added system security. If a PL/DPL decode is programmed in the receive radio, all units accessing the EuroPatch must transmit this same PL/DPL.

The receive radio may also include a Select V (five-tone) decode address. This decoder may be used to provide radio to phone access, and optional emergency number autodial. If this feature is desired, pin 4 of the auxiliary connector should be programmed as "External Alarm" (as shown in the following example). If the feature is not desired, either Pin 4 should be programmed as NULL 2, or no Select V decode configured. In the programming example, a Select V decode is enabled for CCIR address 12345.

The receive radio may be programmed for either "Local" or "Distant" sensitivity. The installer should consider the application and select the appropriate mode.

Since the system will only operate on a single channel, only one "MODE" should be installed. This will ensure the station does not end up on the wrong frequency.

Example Duplex Receive Radio Setup: Configure the hardware jumpers in the GM300 radio used for a receiver as shown in Table 2-2.

Table 2-2 Motorola GM300 Radio Jumper Settings: RX

Jumper	Setting	Function
JU551	B	Rx audio = de-emp and muted
JU651	A	Mic sensitivity = 80 mV
JU701	A	Flat Tx audio through limiter

Example Duplex Receive Radio Setup (continued):

MOTOROLA Radio Service Software
Radius GM300 Model:M44GMC29C3__

CHANGE/VIEW:RADIO WIDE

Use UP / DOWN Arrows To Enable.

RADIO WIDE CONFIGURATION

MODEL INFORMATION
M44GMC29C3__.....40 WATT
UHF Band .....438.0-470.0 MHz
Squelch.....Coded
Conventional Modes.....1
Serial Number.....159TSS0376

OPTIONS
TOT Rekey Time (s).....Off
Forced Monitor.....Off
Handset.....N

ACCESSORY INFORMATION
ACC. Internal.....None
ACC. External.....General I/O
ACC. Custom.....Y

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT SCREEN		SCAN OPTIONS		OTHER ACCESSORY	EXIT

MOTOROLA Radio Service Software
Radius GM300 Model:M44GMC29C3__

CHANGE/VIEW:RADIO WIDE:ACCESSORY

Use UP / DOWN Arrows To Enable.

ACCESSORY CONNECTOR CONFIG

INT Accessory: None EXT Accessory: General I/O Custom: Y

PIN#	DESCRIPTION	DATA DIR	DEBOUNCE	ACT LEVEL
4	External Alarm	Output	No	High
6	NULL 1	Input	No	Low
8	PL/DPL & CSQ Det	Output	No	Low
9	NULL 1	Input	No	High
12	CSQ Detect	Output	No	Low
14	NULL 1	Input	No	Low

Power-Up Delay (sec) : 0.204

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP	PREVIOUS ACC. EXT	NEXT ACC. EXT	PRINT SCREEN				RESET DEFAULT	EXIT	

Example Duplex Receive Radio Setup (continued):

MOTOROLA Radio Service Software Radius GM300 Model:M44GMC29C3__ CHANGE/VIEW:MODE	Enter Value.

Model 001 Name.....01
Type.....Conventional

Rx Frequency.....469.50000
Tx Frequency.....Blank

Rx Squelch Type.....TPL
Rx Squelch Code.....110.9 2Z

Rx Signaling System.....01
Rx Signaling Name.....SELECT V

Busy Channel Lockout.....N
Local/Distance.....Local
Time Out Timer (s).....255

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP	GOTO MODE	PREVIOUS MODE	NEXT MODE	PRINT SCREEN	SCAN LIST		MODE UTILITY		EXIT

MOTOROLA Radio Service Software Radius GM300 Model:M44GMC29C3__ CHANGE/VIEW:SIG:RAD WIDE	Use UP / DOWN Arrows To Enable.

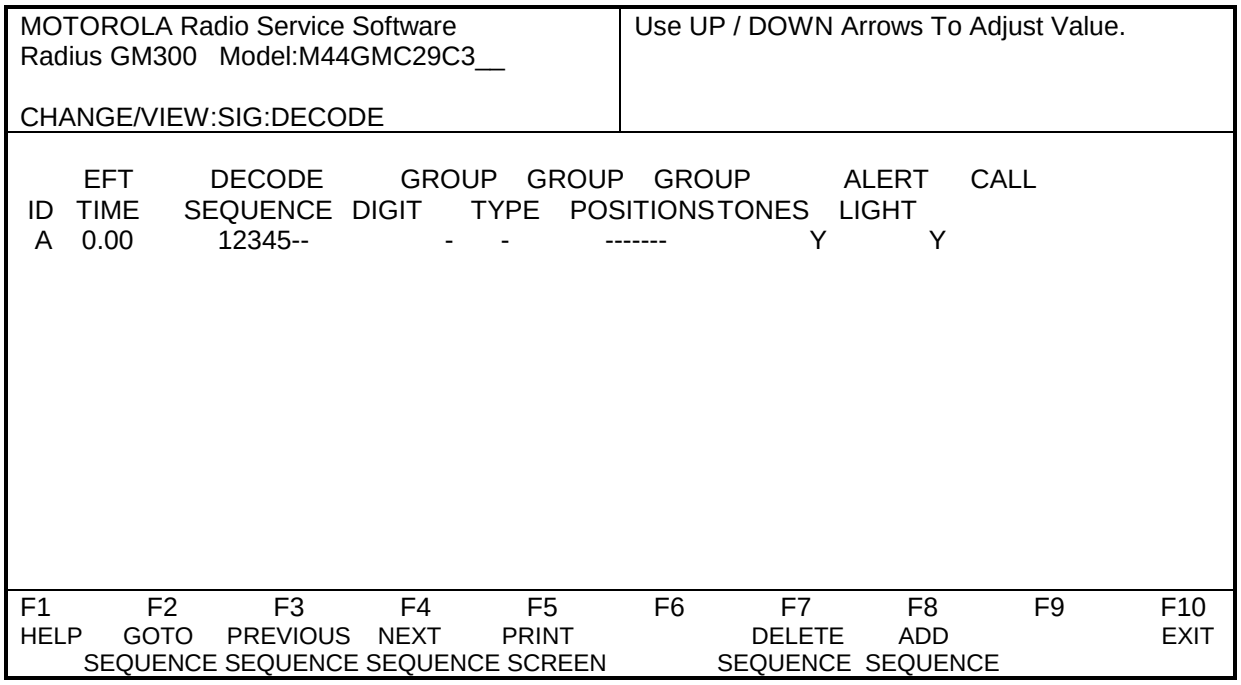
SIGNALING RADIO WIDE

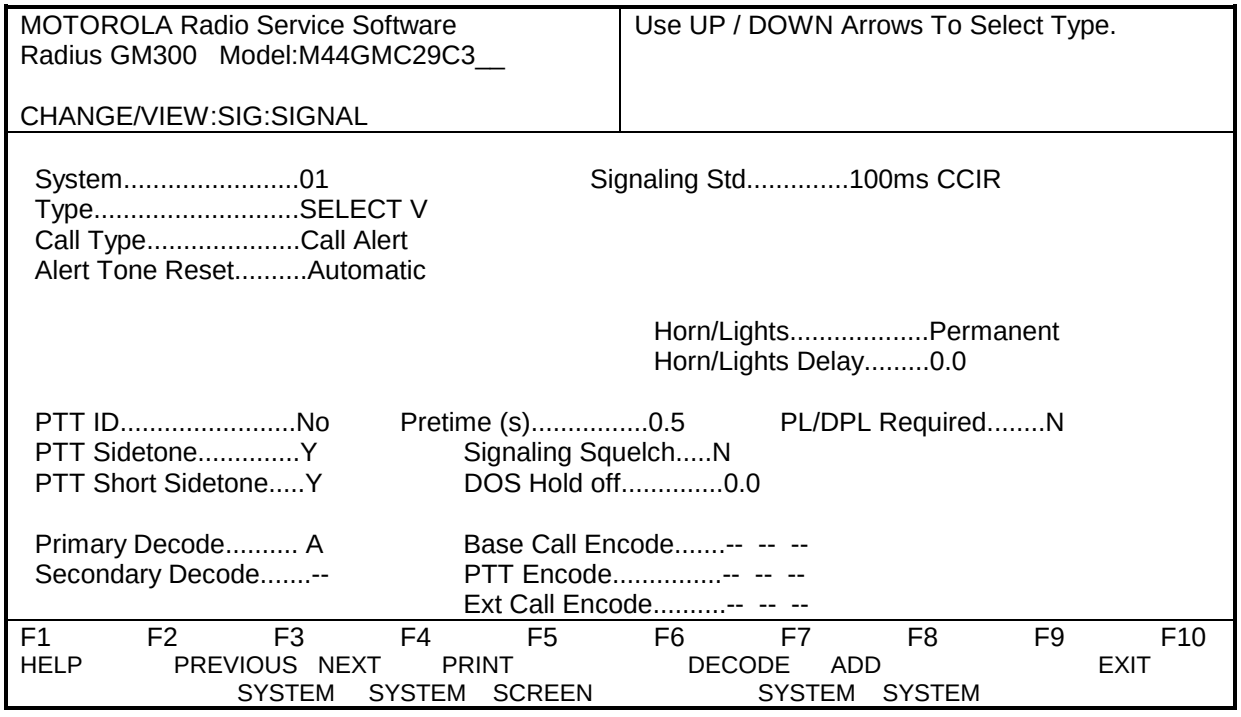
Voice Selcall Encode.....N
Call Alert Encode.....N
Radio Check Encode.....N
Low Battery.....N
Emergency Alarm.....None

Auto Reset Timer (s).....Off
PTT Repeat Timer (s).....Off
Tx Hold Time (s).....Off
Call List Time Out (s).....Off
Select V Sidetones.....Disabled

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP				PRINT SCREEN					EXIT

Example Duplex Receive Radio Setup (continued):





Duplex Transmit GM300 Radio

This radio will be used by the ZR350 EuroPatch to perform as a transmitter. It may also be used to provide transmit channel busy detection and lockout.

CAUTION

The radio auxiliary connector must be programmed properly or damage may occur to the radio or ZR350 EuroPatch!

The transmit radio should not be programmed for any PL/DPL or Select V encode or decode.

If using the transmit radio to detect transmit channel busy and lockout, the receiver section may be programmed for either "Local" or "Distant" sensitivity. The installer should consider the application and select the appropriate mode.

Since the system will only operate on a single channel, only one "MODE" should be installed. This will ensure the station does not end up on the wrong frequency.

Example Duplex Transmit Radio Setup: Configure the hardware jumpers in the GM300 radio used for a transmitter as shown in Table 2-3.

Table 2-3 Motorola GM300 Jumper Settings: TX

Jumper	Setting	Function
JU551	B	Rx audio = de-emp and muted
JU651	A	Mic sensitivity = 80 mV
JU701	A	Flat Tx audio through limiter

Example Duplex Transmit Radio Setup (continued):

MOTOROLA Radio Service Software
Radius GM300 Model:M44GMC29C3__

CHANGE/VIEW:RADIO WIDE

Use UP / DOWN Arrows To Enable.

RADIO WIDE CONFIGURATION

MODEL INFORMATION
M44GMC29C3__.....40 WATT
UHF Band .....438.0-470.0 MHz
Squelch.....Coded
Conventional Modes.....1
Serial Number.....159TSS0375

ACCESSORY INFORMATION
ACC. Internal.....None
ACC. External.....General I/O
ACC. Custom.....Y

OPTIONS
TOT Rekey Time (s).....Off
Forced Monitor.....Off
Handset.....N

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP			PRINT SCREEN		SCAN OPTIONS		OTHER ACCESSORY	EXIT	

MOTOROLA Radio Service Software
Radius GM300 Model:M44GMC29C3__

CHANGE/VIEW:RADIO WIDE:ACCESSORY

Use UP / DOWN Arrows To Enable.

ACCESSORY CONNECTOR CONFIG

INT Accessory: None EXT Accessory: General I/O Custom: Y

PIN#	DESCRIPTION	DATA DIR	DEBOUNCE	ACT LEVEL
4	NULL 2	Output	No	High
6	NULL 1	Input	No	Low
8	CSQ Detect	Output	No	Low
9	NULL 1	Input	No	Low
12	NULL 1	Input	No	Low
14	NULL 1	Input	No	Low

Power-Up Delay (sec) : 0.187

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP	PREVIOUS ACC. EXT	NEXT ACC. EXT	PRINT SCREEN				RESET DEFAULT	EXIT	

Example Duplex Transmit Radio Setup (continued):

MOTOROLA Radio Service Software Radius GM300 Model:M44GMC29C3__ CHANGE/VIEW:MODE	Enter Value.

Model 001 Name.....01
Type.....Conventional

Rx Frequency.....464.50000
Tx Frequency.....464.50000

Rx Squelch Type.....CSQ

Tx Squelch Type.....CSQ

Busy Channel Lockout.....N
Local/Distance.....DX
Time Out Timer (s).....250

Phone Signaling System.....00
Phone Signaling Name.....NONE

Rx Signaling System.....00
Rx Signaling Name.....NONE

Tx Signaling System.....00
Tx Signaling Name.....NONE

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
HELP	GOTO MODE	PREVIOUS MODE	NEXT MODE	PRINT SCREEN	SCAN LIST		MODE UTILITY		EXIT

Duplex Assembly

1. Complete the connection of the two radios to their power supply and the appropriate antenna cables. The radios should be programmed for their transmit and receive channel assignments and their Auxiliary connector pin functions before being connected to the ZR350.

2. Remove the top cover from the ZR350, working from the rear of the unit the radio connectors will be on the right and the telephone connectors on the left. See Figure 2-2.

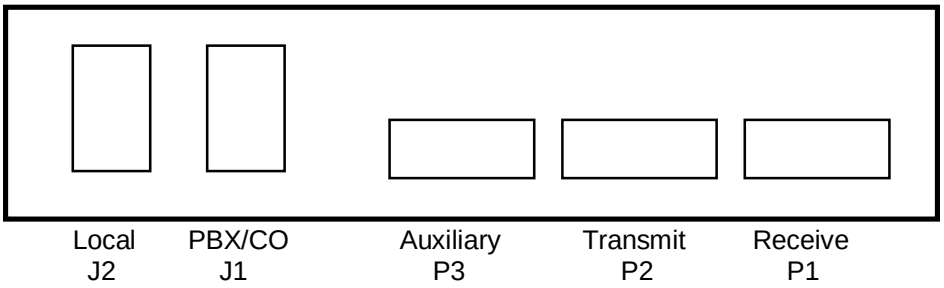


Figure 2-2 Rear of the ZR350

3. Locate jumpers JP3, JP4, and JP5 inside the unit and remove the installed jumpers from these positions. (Stow the jumpers in a safe place for possible, future simplex installations.)

4. Connect the cable from the Receive radio to the Receive connector, P1, on the far right of the ZR350 chassis.

5. Connect the cable from the Transmit radio to the Transmit connector, P2, on the right in between the Auxiliary and the Receive connectors.

6. Connect the DTMF telephone set to the Local telephone jack, J2, on the far left of the unit. This will be used to enter the programming mode on the ZR350, for adjustments and configuring the unit.

7. This completes the initial assembly of the equipment. Final assembly will be done after the tests and adjustments are complete. Proceed now to the Initial Turn-on.

MOTOROLA GM350 AND GM950 CONNECTION NOTES

The following subsections cover interfacing the ZR350 to several popular models of Motorola radios.

ZR350 Connections

The ZR350 uses the same style connectors for interfacing to the radios the Motorola has utilized for its GM-series radios. Table 2-4 shows which signals are available on the pins of each separate port. Some of the pins have no signal connected, or only have signal if jumpers have been set correctly inside the unit.

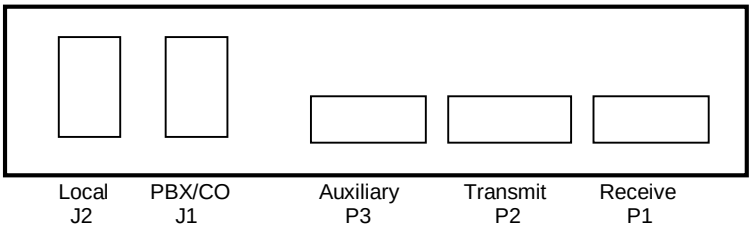


Figure 2-3. Rear Panel of the ZR350

Table 2-4. Pinout of the ZR350 Connectors

PIN	Description	P3 ACC	P2 TX	P1 RX
1	SPKR-	Yes	NC	Yes
2	MIC	Yes	Yes	Yes*
3	PTT	Yes	Yes	Yes*
4	EXT ALARM	NC	NC	Yes
5	FLAT TX AUDIO	Yes	Yes	Yes*
6	I/O	Yes*	Yes*	Yes*
7	GND	Yes	Yes	Yes
8	COR/TX Busy	Yes	Yes	Yes
9	EM SW	NC	Yes	Yes
10	IGN	Yes	NC	Yes
11	RX AUDIO	Yes	NC	Yes
12	/16 CH COR	Yes	NC	Yes
13	+12Vdc	Yes	NC	Yes
14	MIC OFF HOOK	Yes	NC	Yes
15	INT SP+	NC	Yes	Yes
16	EXT SP +	Yes	Yes	Yes

* Jumper selectable
For Simplex installations use P1. Install JP3 JP4 JP5
For Duplex installations use P1 & P2. Remove JP3 JP4 JP5

P1 pin 4 is used to trigger a predefined Autodial in the ZR350. If no autodial is programmed the ZR350 will go off hook and allow freedial when activated.

GM350 Radio Programming

To connect the ZR350 to the GM350 use direct pin to pin 16 way interface cables (supplied with ELN4055 — available from Motorola), and program the GM350 I/O as shown in Figure 2-4.

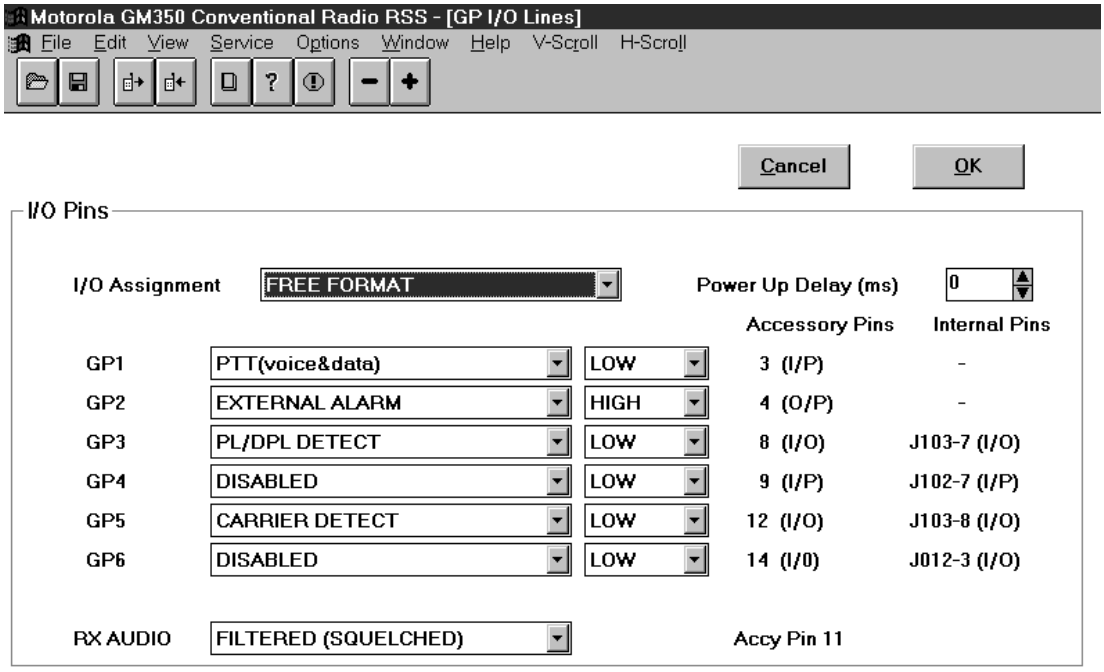


Figure 2-4. GM350 Programming Parameters

NOTE: Connect pin 10 (Ignition Sense) of the GM350 to +12V_{DC} so that the Radio powers-on in the "on" state.

GM950 Radio Programming

To connect the ZR350 to the GM950 use direct pin to pin 16 way interface cables (supplied with ELN4055 — available from Motorola), and program the GM950 I/O as shown in Figure 2-5.

NOTE: Connect pin 10 (Ignition Sense) of the GM950 to +12V_{DC} so that the Radio powers-on in the "on" state.

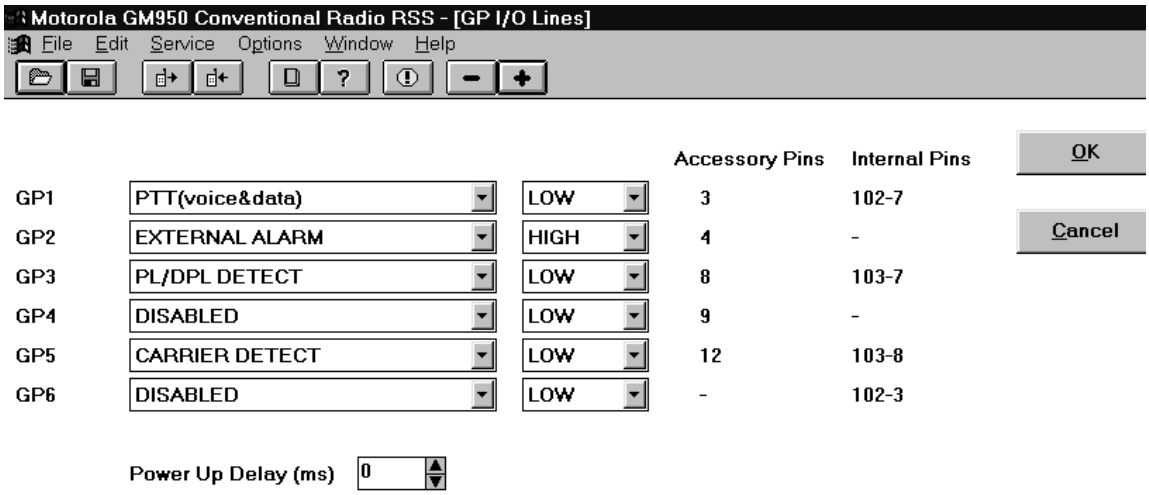


Figure 2-5. GM950 Programming Parameters

Additional Radio Notes

Motorola Software Release Note for Rapid PTT Patch (GM350) R01.00.00

Purpose for release

This utility updates adds a patch to codeplug patch space to address a problem that occurs when the PTT is activated in rapid succession (less that 150 ms between PTTs). In this situation the second PTT is ignored. This problem only occurs when PL is set on the channel and really on has an impact on radio operating in a base station environment. This utility was developed by Graeme Johnson in Feb 1997. This is a re-release of this tool.

Product:	Rapid PTT Patch DOS Utility
Version:	R01.00.00
Kit Number:	ENVN4023A
Date:	13/10/99
Contact:	Cathal Gallagher-c20373@email.mot.com Phone: EIRE 3531-7970337
Related Codeplugs:	Patch added to codeplug patch space.
Related Firmware:	No changes to existing firmware

Utility Code Information

Kit number for release ENVN4023A. Stored under Clearcase at:

/vobs/rss/ariane_conv/utility/rapid_PTT_Patch

This is a self extracting utility which runs on DOS.

INITIAL TURN-ON

1. Connect the power cable from the AC/DC power supply to an appropriate AC power source.
2. Switch the power supply on.
3. Turn on the radio(s) by turning the volume controls clockwise.
4. Verify that the ZR350's green **Power** LED is illuminated, and that the display windows on the radios are illuminated.

ADJUSTMENTS

The following steps explain how to set the receive audio level, the (signaling) encode level, and the dial click decode level. When it is necessary to enter the program mode during these adjustments, you will do so from the Local phone, or a DTMF equipped radio or portable radio. To enter the program mode, lift the handset on the Local phone instrument and enter the program mode access code at the prompt. The default access code is 12350#. When you have finished the setting the desired levels, press 99# to exit the program mode.

NOTE

At any time, while in the program mode, if no DTMF key is pressed for 60 seconds, the ZR350 will exit the program mode automatically. To get back into the program mode, hang up the Local phone, then just lift the handset and enter the program mode access code again.

Setting the Receive Level

This adjustment is necessary to ensure an adequate level of receive audio for reliable DTMF decode from the radio and a good level of voice to the phone.

1. Using a service monitor, generate a 1 kHz tone at 60% of full deviation on the receive channel of the ZR350 system.
2. Using an oscilloscope or DVM, adjust the RX control (R88) until a reading of 470 mV rms (or 1.33V p-p) is present at pin 1 of the ZR350 programming connector, J2, on the front of the unit, or on either pin of JP10 on the Controller Board inside. See Figure 2-6 for the location of J2-pin 1.

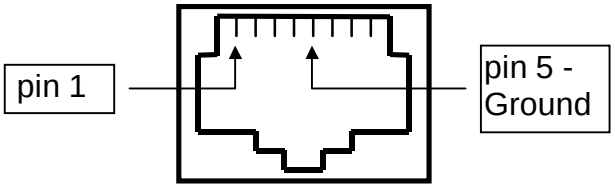


Figure 2-6 Programming Connector J2, Front View

Setting the Transmit Tone Level

This step is necessary to set the audible tone deviation levels transmitted from the interconnect. If the optional encode is used, then this step will set both audible and subaudible tone levels simultaneously.

1. Enter the program mode by lifting the handset on the Local phone and entering the DTMF program mode access code (the default is 12350#). The unit should respond with five quick beeps to indicate successful entry into the program mode.
2. Set the service monitor to measure the signal deviation on the transmit channel of the ZR350 system.
3. Enter the command 92# from the phone to start the tone generation. The ZR350 will generate a 1 kHz tone which can be observed on the transmit channel with the service monitor.
4. Adjust the ENCODE control (R89) on the ZR350 to produce a reading of 60% of maximum channel deviation on the service monitor (for example, set it to 3 kHz deviation for 25 kHz channel spacing systems, or 1.5 kHz deviation on 12.5 kHz systems).
5. Press a DTMF '#' on the phone to end the Encode test. Enter the command 99# to exit the program mode.

Setting the Dial Click Decode Level

If the ZR350 is to be used in situations where some of the callers will be trying to over-dial user numbers from rotary phones, the following steps will ensure the best possible decoding of the dial clicks from rotary or pulse telephones. To perform this test, a call has to be made to the PSTN line or PBX extension to which the ZR350 is connected from a separate line or extension so that the dial click sensitivity can be set while decoding clicks that have actually come through the switch. This is what happens on live calls. The test will use DTMF and both rotary or pulse dialing so both kinds of phone instruments will need to be connected to the line from where the call is being made from, or you may use a single telephone instrument that is capable of being switched between the two modes of dialing.

1. Once the ZR350 has been connected to the phone line or PBX extension that it will be using, and you have set up the DTMF and rotary phones on a separate line or extension, call the ZR350 using the DTMF phone. When the ZR350 answers the ringing line, after the first ring is default, enter the program mode access code (12350# is default) and listen for the five beeps to confirm entry into the program mode.
2. Still using DTMF, enter the command 96# to start the dial click decode test. At this point, pick up the rotary/pulse phone and hang up the DTMF phone (or switch modes on the phone if it is capable of both styles of dialing).
3. Dial the digits one through zero on the rotary/pulse phone and listen after each digit for the beeps coming back from the ZR350. The ZR350 should return a string of beeps that is equal to the digit dialed.

4. If the ZR350 does not return the correct number of beeps for some or all of the digits dialed, then adjust the CLICK control (R90) and try the missed digits again, continue this procedure until all of the digits are decoded correctly.
5. Switch back to the DTMF phone and enter a DTMF "#" to end the test. Enter 99# to exit the program mode.

Setting the VOX Level

The VOX detector in the ZR350 is used to operate the PTT when the unit is operating in the simplex mode and to detect a Busy signal from the phone while operating in any mode. The VOX is initially adjusted during production and in many cases should be adequate as it is. However, checking that it operates correctly could save time in the future. This test can be conducted from either the Local phone or the PBX/PSTN line. It should be done on whichever line is getting a poor response from the VOX circuit.

1. Go off hook on the Local phone or dial the ZR350's phone number, when the unit answers and prompts you enter the program mode access code (12350# is default) and listen for the five beeps.

2. Speak into the phone in a normal tone of voice while watching the VOX LED. The LED should illuminate when speaking into the phone and turn off during quiescent periods. If the output of the VOX detector is not switching on and off as it should, then adjust the VOX control (R87), until the detector responds correctly to the presence and absence of voice audio on the phone line.

3. Press the DTMF command 99# to exit the programming mode and hang up the phone.

FINAL ASSEMBLY

The final assembly consists of replacing the top cover on the unit and installing it into whatever equipment rack arrangement is being used on site. If the ZR350 is being used with the Motorola GR300 or GR500 Repeater system, the top cover of the ZR350 is put on with the beveled edge of the cover towards the rear of the unit, so that it can be slid all the way forward in the top position of the GM300 chassis. If the ZR350 is being used with a single radio or some other sort of rack arrangement, then fit the top cover with the beveled edge facing towards the front of the unit.

PROGRAMMING

The programming of the ZR350 to customize it for a particular application is covered in detail in Section 5. It is highly recommended that time be taken to review the next section on the operation of the ZR350 before going on to programming the unit.

3. OPERATION

3. OPERATION

OVERVIEW

This section of the manual explains how the ZR350 EuroPatch works in all of its various modes. A thorough understanding of how the unit operates will make it simpler to plan the unit's programming.

NB: Throughout this section the word "radio" is used in its most basic sense describing a radio user as anyone with a two-way radio that can both receive and make calls. This will include persons carrying portables as well as people in vehicles.

MULTI-USER INTERCONNECT

The ZR350 EuroPatch is capable of supporting interconnect operations in two modes (multi-user and single user) on its PSTN/PBX line. This portion of the Operations section will deal with how the ZR350 operates in the multi-user mode, which is the default mode.

Simplex Operation

The ZR350 defaults to operating in the simplex mode. It actually has two push-to-talk modes, plain *Simplex VOX* and *Simplex VOX with prekey*. The difference between the two modes lies in how the interconnect behaves after the radio unkeys each time.

In *Simplex VOX*, the interconnect will mute the receive audio path when the radio unkeys and then just sit there and wait to see if the telephone VOX goes active or the Carrier detect goes active in order to determine what the interconnect does next.

In *Simplex VOX with Prekey*, when the radio unkeys the interconnect mutes the receive audio path and automatically keys the transmitter and opens the phone-to-radio audio path in anticipation of the telephone party answering the radio right away. If the VOX does not detect audio from the phone within the programmed VOX Hold Time (one second by default), then the interconnect will unkey the transmitter and wait to see what happens, just as it does in the Simplex VOX mode.

Most of the operations are altered in obvious ways when operating in the simplex mode. When a phone-to-radio call is placed, the interconnect will unkey in between rings in order to check for the radio answering the call. When a radio-to-phone access is made, the interconnect will unkey after letting the radio hear two seconds of dial tone so that it can receive the phone number the radio wants to dial.

Duplex Operation

The ZR350 is also capable of operating in the half-duplex mode. This means that the ZR350 itself is interfaced to a full duplex radio station and can support both repeater operations and radio-to-radio calling.

Phone-to-Radio Calls

When a caller wants to place a page or talk to a radio, the caller dials the phone/extension number of the ZR350 and it starts to ring. The ZR350 starts counting the number of rings on the phone line and it checks the status of the receiver to see if the channel is currently in use. If the channel is busy, then the ZR350 will not answer the phone line until the carrier detect input has been idle for at least three seconds. If the channel is idle, then the unit will answer the phone line after it has counted the number of rings it is programmed for.

When the necessary conditions have been satisfied (i.e. channel is idle and the proper number of rings have been counted), then the ZR350 answers the phone and sends the caller a single beep. This beep is a prompt to the phone caller to go ahead and enter the user number of the radio to which they wish to speak. If the number entered by the caller is a valid user, the unit will key the transmitter and selectively call the radio. After it has called the radio the ZR350 will send out a ringing sound until the radio answers the call. As an alternative, the interconnect can be programmed to ring out just once and then wait silently for the radio to answer the page. Regardless of which ring out mode is being used, the interconnect will only wait for the programmed Radio Answer Time, which defaults to 30 seconds, before it either terminates the call or forwards it on to another user. If the user number entered by the caller is not valid, then the interconnect returns an error tone to the caller and hangs up.

In the event that the caller does not respond to the prompt from the ZR350 and makes no user number entry, the ZR350 will wait for four seconds to hear the first digit of the overdial, and if it does not hear anything, then the interconnect will try to call the user programmed in the Auto-Call User field. If there is no Auto-Call User then the ZR350 will return an error tone to the caller and hang up the line.

If the ZR350 answers the phone and then, while the caller is entering the user number, the channel becomes busy with dispatch traffic, the ZR350 will send a double ring sound to the phone caller while it is waiting for the channel to become idle again, for up to 30 seconds. The caller can wait on the line for the channel to clear at which time the interconnect will place the call.

Phone-to-Radio Call Example

USER	Dials extension number of ZR350.
ZR350	Waits for programmed number of rings, then answers with a **BEEP**.
USER	Enters the two digit user number of the equipment they want to call from their phone.
ZR350	Checks for authorized user and calls the appropriate user.

Communication Equipment

The following list explains how the ZR350 behaves when calling equipment of different types.

TONE ONLY PAGER

The interconnect checks for an idle channel and then keys up and makes the Two-tone or Five-tone page. When the page is finished, the interconnect unkeys, sends a five-beep prompt to the phone line to indicate that the page is finished, and then it hangs up the phone.

TONE & VOICE PAGER

The interconnect checks for an idle channel and then keys up and makes the Two-tone or Five-tone page. When the page is finished, the interconnect sends a single beep to the phone caller to prompt them to start speaking their message. As long as the interconnect detects voice activity from the phone, it will continue to allow the phone party to speak until the pager Talk Time is reached (by default Talk Time is 10 seconds). When the limit is reached the ZR350 will unkey the transmitter, send a five-beep prompt back to the phone caller, and hang up the phone. If the VOX circuit does not indicate any audio coming from the phone for more than two seconds, then the interconnect will end the call early regardless of how much time is left in the Talk Timer.

TALKBACK PAGER

When a user is programmed as a Talkback user, the ZR350 sends a double beep prompt to the phone caller after the page is done, as a go- ahead prompt to speak their voice message, and will pass the caller’s voice to the transmitter for 30 seconds. If the radio user decides to answer the caller, the user need only key up his or her radio during the first thirty seconds of the call and the ZR350 will consider the presence of carrier (with the proper PL/DPL) as an acknowledgment. Once the user answers, the call proceeds the same way that a call to a radio equipment type would and is subject to the same timers. If the ZR350 does not detect carrier during the first 30 seconds of the call, then it terminates the call.

QCII RADIO

For the two-tone radio equipment type, after the paging tones are sent, the interconnect transmits a ringout sound while waiting for the called radio to answer. The answer sequence consists of the Connect Prefix, and depending upon the programmed sign-on mode of the interconnect, may be followed by the two-digit user number of the called radio. Only the called radio may answer the call. The QCII format supports group call using extended single tone, accessed by double-digit entries when the first and second tone groups are the same.

FIVE-TONE RADIO

Calls to five-tone radios are the same as QCII radios, except that the calls are answered with carrier. The appropriate PL/DPL must accompany the carrier if programmed in the receive radio. It is assumed that the five-tone radios are programmed with busy channel lockout, and may not all have keypads. Group call is supported through a group substitution digit (see the programming section).

QCII GROUP-CALL RADIO

The difference between this equipment type and the regular Radio equipment type is that the ZR350 will accept the interconnect's Connect Prefix to answer the call without any user number being sent. The reason for this is that a number of radios are going to unsquelch and this allows any unit to answer the call. When it comes time to terminate the call, the users can send the Disconnect Prefix alone to hang the ZR350 up. This equipment type supports the Quick Call II format only. In Short Sign-on mode, this equipment type is identical to the regular QCII Radio Type.

CALL FORWARD

Strictly speaking, this isn't a separate equipment type, however, it needs to be explained while on the subject of how the ZR350 behaves while trying to signal out to users. When a call is made to a user and they do not answer within the allowed time, the interconnect checks the user database to see if that user has a Call Forward user assigned. If there is none, the interconnect simply terminates the call and hangs up. If there is a Call Forward user assigned, then the interconnect places a new call out to the Call Forward user and waits for it to answer. If there is no answer to the original call, and the forwarded call, the interconnect will continue until the call has been forwarded three times and then it will terminate the call. While a call can be forwarded to a Tone Only or a Tone & Voice pager, users with these two equipment types cannot have calls forwarded from them. The reason for this is that no response is ever expected from pagers so there is no reason to ever forward their calls.

The Quick Call II and Select V code sent to the radio users is determined by both the particular radio equipment type command used for that individual user and the user's number. There is more discussion of this topic in "User Commands" in Section 5.

Answering a Call

In general, a radio answers a selcall by using DTMF to send the interconnect's Connect Prefix. The exact digits that make up the Connect Prefix will be determined by how the ZR350 was programmed when it was installed. The prefix can be from one to eight digits long and can contain any combination of the numbers zero to nine and the "*" character. If the ZR350 is programmed in full sign-on mode, a QCII radio is required to follow the Connect Prefix with that user's individual user number. The user number sent will always be a two-digit entry (users one to nine will put a leading zero ahead of their number). When a call to a Talkback or Five-tone radio is made, the interconnect considers the call to be connected if it sees any carrier activity on the channel. There is no answer sequence for either

of the pager equipment types since the ZR350 never expects to get any response back from Tone Only or Tone & Voice pagers.

Terminating a Call

When it comes time to end a call in progress, there are a number of ways by which it can be terminated. Some of these involve voluntary actions on the part the persons involved in the call, and some of these are automatic actions taken by the ZR350 itself when certain conditions are met. The following list explains all of the ways in which calls are normally terminated.

DTMF TERMINATION

Short Sign-on Mode: At any point in a conversation the radio user can terminate the call by sending the DTMF Disconnect Prefix.

Full Sign-on Mode: In this mode, a user is required to follow the Disconnect Prefix with appropriate user number to terminate the call. As an example, the default Disconnect Prefix is a "#" and the call in progress involves user number 5, so to disconnect the call the radio would send "#05". The ZR350 will not accept a disconnect request from any radio other than the one involved in the call. The exception to this is when the call was initiated as a QCII Group-Call Radio, in which case it will always allow anyone to terminate the call with just the Disconnect Prefix and no user number.

PHONE TERMINATION

The phone caller can terminate the call in progress by entering a "#0" on a DTMF phone, or terminate a call while it is still ringing out to the radio by entering just a "#". Callers who dialed in from a pulse or rotary phone are not able to disconnect the call. Calls initiated from the Local Phone require only hanging up the phone instrument to terminate the call.

AUTO CLEARDOWN

It is possible that a phone caller would hang up without disconnecting a call and that the radio user involved (for a number of reasons) would not be able to disconnect it either. The ZR350 deals with this possibility by using a Radio Activity timer. While a call is in progress, this timer is reset every time carrier is detected from the radio. If the timer ever makes it all the way down to zero before seeing carrier from the radio again, then the interconnect will end the call in progress automatically.

The interconnect will start transmitting a single-beep prompt, every three seconds, starting 12 seconds before the end of the call. All the radio needs to do to reset the timer when the beeps start is to key up momentarily. The Radio Activity timer's duration is programmable to 30 seconds, 45 seconds, or one minute (the default is 30 seconds).

CALL LIMIT

The ZR350 can be programmed to limit the overall duration of a call and to disconnect it automatically when the Call Limit timer expires. This timer can be disabled in programming or set to three, five, or ten minute durations. The Call Limit timer can also be programmed to allow the radio to reset the timer when it is about to expire by entering a "*". When the ZR350 receives this "*", it will reset the timer and extend the length of the call by whatever period the timer is currently set to. The default programming for the Call Limit timer is for a three minute limit without the radio being able to reset it. The ZR350 will indicate that the Call Limit timer is running out by sending the radio a double-beep prompt every three seconds starting fifteen seconds before the end of the call.

LOCAL CONTROLLED

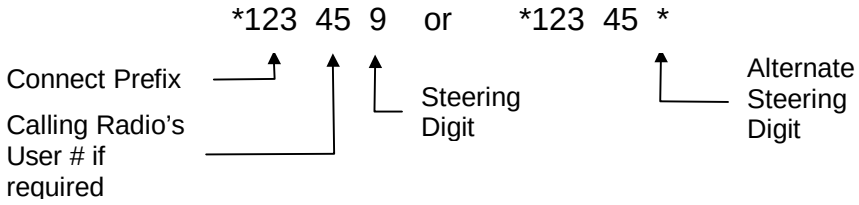
The ZR350 is capable of supporting from one to three telephone instruments connected directly to its Local phone port. The operators of these Local phones can gain access to the ZR350 at any time by picking up the handsets of their phones. If the system is idle, then the interconnect will give the operator a beep prompt and handle the call just as it would a caller on the PSTN/PBX line. The Local Phone can terminate a call at any time by going back on hook. If there is a call already in progress, then the Local operator can monitor it and speak to both parties if necessary. If the Local operator needs to take over the channel for a priority call, it is possible to terminate the call in progress simply by doing a hook-flash. That is, by pressing the hook switch on the Local phone instrument for approximately a half a second and letting it up again.

If the ZR350 has been fitted with the optional Local Phone Ringer box then the radio user may also originate calls to the Local Phone.

When a call is terminated normally (i.e. other than by a hook-flash on the Local phone), the ZR350 will send a five-beep prompt to the phone party and to the radio. If the call is terminated by the Local operator doing a hook-flash on the Local phone, then both parties will hear a "Bee-Doo" error tone. The phone will be hung up right away. If there is a Morse Code Station ID programmed and enabled, and the timer for the ID has expired, then the ZR350 will transmit the ID before unkeying the transmitter.

Radio-to-Phone Calls

The ZR350 will allow radio users to originate calls to the PSTN/PBX line. The users do this by using the interconnect's Connect Prefix and a single "Steering Digit" to indicate the type of call they want to make (if the interconnect is operating in the Full Sign-on mode instead of the default Short Sign-on mode, then the user number will be required as well). The steering digit is necessary because the interconnect will also allow radio-to-Local Phone and radio-to-radio calls to be made. Phone calls can be initiated with either of two steering digits, a "9" or a "*". As an example, if a radio whose user number was 45 wanted to make a phone call on a ZR350 system with a Connect Prefix of "*123", and the interconnect was configured for Full Sign-on mode, then the user would send either one of the following DTMF strings:



In response to receiving the proper Connect Prefix and steering digit along with a valid user number, the ZR350 will take the PSTN/PBX line off hook, key the transmitter, and pass the dial tone back to the radio. When the radio keys up and starts to dial the phone number, the ZR350 checks the first and second digits received from the radio against the first and second digit toll restrict groups, if any have been programmed. If a match is found to any of the toll restricts, then the call is canceled and the interconnect hangs up the line. If no match is found, then the interconnect lets all of the digits pass straight through to the phone line. If the interconnect has been programmed to pulse dial on radio-to-phone calls, then the ZR350 will keep the radio-to-phone audio path muted during the dialing and will convert the incoming digits from the radio into pulse dialing to the phone line. There is no limit as to how many digits the radio can dial, however, if pulse dialing is being used the ZR350 will stop converting the incoming digits and unmute the receive audio path to the phone as soon as it sees a gap of more than five seconds since the last digit was received from the radio. Once the interconnect quits the pulse dialing routine, any further DTMF digits received will be passed straight through to the phone just like voice audio.

At the beginning of the previous paragraph, the phrase "a valid user number" was used. For the purposes of making a radio-to-phone call a valid user is any one whose equipment type has been programmed. User numbers that have been programmed as pagers can initiate calls and are treated as radio users for the duration of the call.

Select V Decode Initiated Calls

The Select V decode will cause the ZR350 to access the phone line and dial a programmable telephone number. This is a single phone number of up to 16 digits. When the autodial takes place, the EuroPatch will take the phone line off hook, wait 2 seconds, then begin dialing. If no autodial phone number is programmed, the phone line will be taken off-hook, just as if a

valid DTMF Connect Code had been received. Dial tone will be passed to the radio user, and the radio user may dial just as in a regular radio-to-phone call. Call disconnect may be accomplished by sending the DTMF Disconnect Prefix, call limit time-out, radio activity time-out, or “#0” from the phone side.

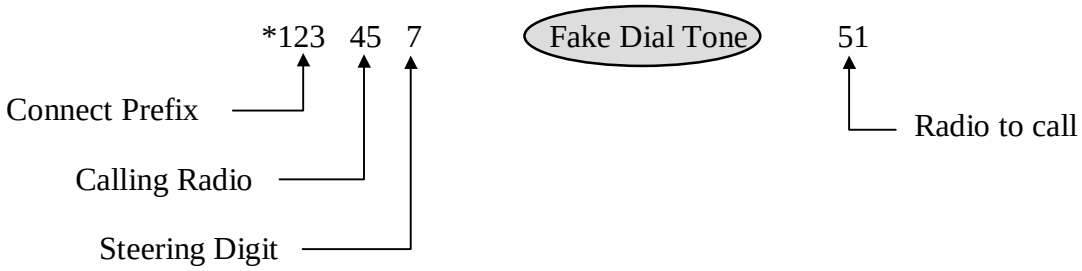
Radio to Local Phone Calls (Option)

If the Local Phone Ringer option is connected to the ZR350, then it is possible to make calls from a radio to the Local Phone. Calls are initiated in the same way as calls to the PSTN/PBX line, with the exception that a steering digit of “4” must be used. After entering the connect code followed by a “4”, the radio will hear a series of double rings as the Local Phone is rung. If the Local Phone is not answered within one minute, the call is automatically terminated.

Once a radio-to-phone call is in progress, it will proceed under all the same rules and timers that a phone-to-radio call would, and can be terminated in the same ways. If the Courtesy Tone is enabled the interconnect will send it to the phone every time the radio unkeys. If the Privacy Mask is enabled, then the interconnect will break the repeat audio path and send a masking tone to the transmitter whenever it is receiving a signal from the radio.

Radio-to-Radio Calls

The sign on sequence for a radio-to-radio call is similar to the one for a radio-to-phone call except for the steering digit. The radio will use a “7” as the steering digit for a radio-to-radio call. When the interconnect receives its Connect Prefix followed by a valid user number and the steering digit “7” (no user number is entered in the Short Sign-on mode), it will key the transmitter and generate a fake dial tone to prompt the radio user to enter the user number of the radio or pager that they wish to call. As an example, if a radio whose user number is 45 wants to call user 51 on a ZR350 system with a Connect Prefix of “*123”, and the interconnect is configured for Full Sign-on mode, then the user would send the following DTMF string:



The following list explains how the call proceeds depending upon the equipment type of the user requested.

RADIOS (FIVE-TONE, QCII, QCII GROUP-CALL)

The proper selective signaling for that user is sent over the channel, followed by ringing for the rest of the Radio Answer time. If the called user does not answer this call within the Radio Answer time, then the ZR350 either forwards the call or terminates it. If the called user does answer, then the call proceeds in the same way that a telephone call would and either one of the radios involved can terminate the call by sending the Disconnect Prefix along with their user number. All of the phone call timers, including Call Limit resetting if enabled, are still used. The one item from phone calls that is not used in a radio-to-radio call is the Courtesy tone.

TONE ONLY PAGERS

The interconnect will transmit the appropriate paging tones followed by the five-beep prompt back to the originating radio. Then it unkeys and return to its idle state.

TONE & VOICE PAGERS

The interconnect will transmit the appropriate paging tones, follow by a single “Talk” beep prompt back to the originating radio. The radio keys up and begins sending his voice message at this point. The interconnect will terminate the page and return to idle when either the Talk Time limit is reached or the carrier detect from the radio drops for more than two seconds.

TALKBACK USERS

The interconnect will transmit the appropriate selective call and then send the double-beep "talk" prompt to the originating radio to let him or her know that they can now start speaking to the called user.

Radio Access Code Summary

Equipment Type	Operation	Radio Response (Short Sign-on Mode)	Radio Response (Full Sign-on Mode)
Five-tone Radio Five-tone Talkback QCII Talkback	Answer a call	Carrier	Carrier
QCII Radio	Answer a call	Connect Prefix	Connect Prefix + user #
QCII Group-call Radio	Answer a call	Connect Prefix	Connect Prefix
All types	Initiate a Radio-to-Phone call	Connect Prefix + 9, or Connect Prefix + *	Connect Prefix + User # + 9 or Connect Prefix + User # + *
All types	Initiate a Radio-to-Radio call	Connect Prefix + 7 wait for Fake Dial Tone, enter User # to call	Connect Prefix + User # + 7 wait for Fake Dial Tone, enter User # to call
All types	Initiate a Radio-to-Local Phone call (with Local Phone Ringer option)	Connect Prefix + 4	Connect Prefix + User # + 4
Five-tone Radio Five-tone Talkback QCII Radio QCII Talkback	Terminate a call	Disconnect Prefix	Disconnect Prefix + User #
QCII Group-call Radio	Terminate a call	Disconnect Prefix	Disconnect Prefix

Private Tones (PL/DPL + CSQ)

Up to now, the operation of the ZR350 has been discussed in terms of looking for carrier activity only on the receive frequency of the system. The ZR350 interconnect has no PL tone or DPL code decoding capability of its own, however, it can make use it the single tone or code decoding capability of the GM300 radio that it is using as a receiver. By programming the receive radio to provide a PL/DPL + CSQ Output signal on pin 8 of its Auxiliary (Accessory) connector, you can provide the ZR350 with the means of telling the difference between general channel activity and a transmission from one of the radios belonging to the

ZR350 system. The ZR350 will always look at both the CSQ and the PL/DPL + CSQ inputs on its Receive radio connector and check for a valid indication. If you decide to use this feature, then all of radios being carried by users on this system must be programmed to transmit the same PL tone or DPL code.

SINGLE USER INTERCONNECT

The Single User mode of operation does not affect operations initiated from the Local phone or from the radios. It only affects how the ZR350 handles calls that come in on the PSTN/PBX phone line.

When the phone line rings the necessary number of times, the ZR350 will look in the Auto-Call User memory slot and immediately call that user. If the Auto-Call User's equipment type is defined as a radio then the interconnect will not answer the phone line until that user responds to the call. The interconnect will either ring out continuously to the radio or ring out once and then wait depending on how it is programmed. If the radio being called does not respond within the Radio Answer time, then the interconnect will check to see if there is a Call Forward User programmed. If there isn't one then the interconnect stops right then and returns to its idle state. If there is a Call-Forward User programmed then the interconnect places a call to that user according to its equipment type.

If the equipment type of a user is programmed to anything other than radio, then the ZR350 will answer the phone line right away so that the caller can hear any prompt tones that the interconnect makes concerning the progress of the call to the Auto-Call User.

If one of the Local phones is lifted to make call, the operator can still dial for any valid user in the ZR350 database, just as in the Multi-user mode. Radio and Talkback users can still sign on using the radio-to-radio steering digit (7) and make calls and pages to any other valid user in the database.

NOTE

Placing the ZR350 in the Single-User mode of operation not only forces it to perform a certain action whenever the telephone rings, it prevents the interconnect from being able to support the initiating of any other sort of operation from the PSTN/PBX input. This means that you will no longer be able to call in and enter into the Program mode from the PSTN/PBX line once you program the interconnect for Single-User operation if the Auto-Call User is anything other than a mobile. In most cases this will probably not matter, but you should be aware that you will need to use the Local phone or the radio to program the ZR350 after you configure it in this manner.

USER PROGRAMMING

The purpose of this subsection is not to explain in detail every command for programming the ZR350 (that will be covered in Section 5), but rather to explain how the programming of individual users is organized. This explanation should make it easier to find the necessary information in the correct tables when the time comes to start programming an interconnect for use by the end users.

The ZR350 has the capacity for 100 individual users, which are numbered 00 to 99 for the purposes of the database, programming, and selecting them for calls. The programmable items for any given user are its equipment type, its selective signaling format, and its Call Forward user.

Of the three items, the Call Forward user is the simplest with which to work. When the programming command is entered for assigning a Call Forward user (50#), the interconnect will prompt for the number of the user who originally received the call and then for the number of the user to which the call is to be forwarded (if the original user does not answer). The call forward entry for a user can be cleared by not entering any digits for the second user number.

The commands for assigning user equipment types actually serve three functions. The first is that they enable the user entered. Users without an equipment type assigned are by definition disabled, which is the default condition of all users. The second thing that these commands do is to define a user's equipment type which determines how the interconnect will behave when a call is placed to that user. The last thing that these commands do is to assign one of the signaling formats supported by the ZR350 to that user's equipment.

There is no command to allow the installer to program a particular tone, code, or page to an individual user, the ZR350 will assign these automatically to users when their equipment type are programmed based on the users' numbers. What this means is that the user equipment will have to be programmed to that particular tone, code or page. This will be described in a little more detail in "User Commands" in Section 5. The tables in "Five-Tone Encode" and "Two-Tone Paging" in Appendix A show the relationship between user numbers and paging codes.

4. MAINTENANCE

4. MAINTENANCE

OVERVIEW

This section of the manual contains the information necessary to work on the ZR350 down to the component level. For more technical information and assistance you can call Motorola and ask for technical support on the ZR350.

DISASSEMBLY

While it is unlikely that you will need take your ZR350 apart in the field, if the need does arise, there are a few tips that will make process of disassembling and reassembling the unit proceed smoothly and calmly. The ZR350 has a single main circuit board and the Digital Voice Delay board (if installed) will be mounted on stand-offs on top of it. The following steps are the easiest way to accomplish this.

1. Remove the top cover by removing the four #440 screws located on the sides of the unit near the corners and sliding the cover off.

2. If there is a Digital Voice Delay Board mounted in the unit on top of the Control Board, remove the #440 screw holding it on and carefully remove the Digital Voice Delay Board by pulling it straight up. Then remove the standoff in the middle of the Control Board.

3. Remove the remaining #440 screws that are holding the Control Board in bottom chassis of the unit.

4. Now comes the step that requires a little finesse. Slide the circuit board towards the rear of the chassis as far as it will go, until the Connect switch, modular jack, and leads are all clear of the sheet metal and then carefully raise the front end of the circuit board out of the chassis. When the front end of the circuit cards is high enough to clear the top of the chassis, pull the board forward until the rear connectors come out.

When removing the Control Board, be careful not to put too much stress on the Connect button or it could be damaged.

To reassemble the unit, start out by inserting the rear connectors into the rear of the bottom chassis and then work your way backwards through all the previous steps.

PARTS LISTS

This subsection contains the parts lists for the Control Board used in the ZR350 terminal and also the optional Digital Voice Delay and Local Phone Ringer boards. These parts lists describe the characteristics of each part, list its Zetron part number, and, where applicable, list its original manufacturer's part number as well.

In order of appearance the parts lists are for:

1. The ZR350 Control Board.

2. The Digital Voice Delay Board.

3. The Local Phone Ringer Board.

If you are having difficulty in locating a part on the list, check to be sure that are looking on the correct parts list for the assembly you are working with.

Parts List - 702-9805C ZR350 Control Board

LEGEND:
+ = OPTION, INSTALL PER CUSTOMER ORDER
# = NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
= = SUBSTITUTE PART

ZETRON ZR350 CONTROL BOARD PARTS LIST: 702-9805C

Item	Qty	Reference	Part No.	Description	Part Value
1	1	R72	101-0010	1.0 OHM 1/4W 5%CARBON FILM	
2	1	R4	101-0025	10 OHM 1/4W 5% CARBON FILM	
3	3	R5,R31,R57	101-0033	22 OHM 1/4W 5% CARBON FILM	
4	1	R23	101-0047	47 OHM 1/4W 5% CARBON FILM	
5	3	R16,R69,R82	101-0067	560 OHM 1/4W 5% CARBON FILM	
6	1	R8	101-0068	620 OHM 1/4W 5% CARBON FILM	
7	2	R22,R32	101-0069	680 OHM 1/4W 5% CARBON FILM	
8	11	R17,R19,R29,R30,R37, R51,R59,R62,R64,R70, R73	101-0073	1.0K 1/4W 5%CARBON FILM	
9	1	R83	101-0078	1.8K 1/4W 5% CARBON FILM	
10	1	R61	101-0080	2.0K 1/4W 5% CARBON FILM	
11	3	R7,R18,R84	101-0081	2.2K 1/4W 5% CARBON FILM	
12	1	R20	101-0086	3.6K 1/4W 5% CARBON FILM	
13	3	R35,R38,R63	101-0089	4.7K 1/4W 5% CARBON FILM	
14	1	R25	101-0092	6.2K 1/4W 5% CARBON FILM	
15	1	R71	101-0094	7.5K 1/4W 5% CARBON FILM	
16	14	R10,R15,R36,R50,R52, R53,R54,R55,R56,R58, R66,R67,R76,R80,R81#	101-0097	10K 1/4W 5% CARBON FILM	
17	1	R33	101-0099	12K 1/4W 5% CARBON FILM	
18	1	R78	101-0100	13K 1/4W 5% CARBON FILM	
19	1	R65	101-0101	15K 1/4W 5% CARBON FILM	
20	1	R49	101-0104	20K 1/4W 5% CARBON FILM	
21	1	R27	101-0105	22K 1/4W 5% CARBON FILM	
22	3	R11,R12,R13	101-0106	24K 1/4W 5% CARBON FILM	
23	1	R28	101-0109	33K 1/4W 5% CARBON FILM	
24	2	R44,R41	101-0111	39K 1/4W 5% CARBON FILM	
25	1	R43	101-0114	51K 1/4W 5% CARBON FILM	
26	5	R26,R39,R42,R47,R48	101-0117	68K 1/4W 5% CARBON FILM	
27	6	R24,R40,R68,R74,R75, R79	101-0121	100K 1/4W 5% CARBON FILM	
28	5	R6,R45,R46,R85,R86	101-0123	120K 1/4W 5% CARBON FILM	
29	1	R60	101-0128	200K 1/4W 5% CARBON FILM	
30	1	R34	101-0133	330K 1/4W 5% CARBON FILM	
31	2	R77,R21	101-0145	1.0M 1/4W 5% CARBON FILM	
32	1	R3	102-0471	470 OHM 1/2W 5% CARBOM FILM	
33	1	R14	103-0049	RESISTOR, 47 OHM 2W 5% CARBON FILM	
34	1	RV1	105-0001	VARISTOR 250V AC	
35	0	R1#,R2#	106-0047	4.7 OHM 1/2W 5% FUSIBLE	
36	1	R9	106-2231	RESISTOR, 22K 1/2W 5% FLAME RESISTANT	
37	1	R87	107-0003	2K POT 1 TURN R/A	
38	2	R88,R89	107-0010	10K POT 1 TURN R/A	
39	1	R90	107-0203	200K 1 TURN R/A	
40	1	RP5	119-0008	10K x 7 BUSSED 8-PIN SIP	
41	1	RP6	119-0017	220 X 8 ISOLATED 16-PIN DIP	
42	2	RP4,RP3	119-0021	R/2R 100K/200K 10 PIN SIP	
43	2	RP7,RP1	119-0025	10K X 4 ISOLATED 8-PIN SIP	
44	1	RP2	119-1040	100K X 4 ISOLATED 8-PIN SIP	
45	2	C12,C13	150-0096	1000 PF 1KV +-10% CERAMIC DISC YSP	
46	2	C2,C1	150-0471	470 PF 3KV +-10% CERAMIC DISC YSP	
47	2	C34,C35	151-0022	22PF 100V/200V +-10%/5% CERAMIC NPO	

Parts List - 702-9805C ZR350 Control Board (Continued)

Item	Qty	Reference	Part No.	Description	Part Value
48	2	C51,C45	151-0028	270PF 100V/200V +-5% CERAMIC NPO	
49	1	C46	151-0047	470PF 100V/200V +-10%/5% CERAMIC NPO	
50	1	C44	151-0091	.0033UF 100V +-5% CERAMIC NPO	
51	22	C3,C4,C8,C17,C20, C21,C22,C23,C25,C27, C29,C33,C36,C37,C38, C40,C41,C43,C53,C58, C59,C61	151-0180	.1UF 50V +-20% CERAMIC Z5U	
52	4	C39,C48,C54,C60	151-0199	.47UF 50V +-5%, POLYESTER	
53	7	C30,C49,C50,C62,C63, C64,C70	152-0012	.1 UF 50V +-5% POLYESTER	
54	2	C56,C55	152-0015	.015 UF 50V +-5% POLYESTER	
55	1	C10	152-0021	.47 UF 250V +-10% POLYESTER	
56	1	C67	152-0050	10 UF 100V 20% NON-POLAR ELECTROLYTIC, RADIAL	
57	3	C32,C65,C69	152-0085	.01 UF 50V +- 5% POLYESTER	
58	1	C68	152-0089	.001 UF 50V +-5%POLYESTER	
59	1	C47	152-0152	.0015 UF 50V 5% POLYESTER	
60	1	C11	152-0224	.22 UF 630VDC +/10% POLYESTER	
61	4	C15,C31,C57,C66	154-0025	1 UF 35V TANTALUM +- 10%	
62	1	C6	154-0035	2.2UF 25V TANTALUM +-10%	
63	8	C5,C16,C18,C19,C24, C26,C28,C52	154-0100	10 UF 16V TANTALUM +-10%	
64	2	C42,C7	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	
65	1	C9	155-0084	470 UF 25V 20% RADIAL ALUMINUM ELECTROLYTIC	
66	1	C14	155-0090	1000 UF 25V +-20% RADIAL ALUMINUM ELECTROLYTIC	
67	3	E1,E14,E15	305-0001	FERRITE BEADS W/ LEADS	
68	2	T1,T2	305-0018	PHONE HYBRID XFMR	
69	14	E2,E3,E4,E5,E6,E7, E8,E9,E10,E11,E12,E13, E16,E17	305-0306	EMI SUPPRESSION FILTER	
70	5	DS2,DS3,DS4,DS5,DS6	311-0011	LED RED FLUSH	
71	1	DS1	311-0012	LED GREEN FLUSH	
72	1	U1	311-1001	OPTO ISOLATOR, BI-POLAR H11AA1	
73	5	U9,U10,U13,U16,U17	316-3074	QUAD HF OP-AMP EXT. TEMP 33074	
74	1	VR1	316-4780	REGULATOR, +5V, 1A EXT. TEMP7805	
75	1	U3	321-0204	DTMF RECEIVER75T204	
76	0	U5^	321-0451	EXP CMOS MICRO, -40 +85C, PLCC, 3.5 TO 12 MHZASIC 002	
77	0	U4 ^	322-7257	32K X 8 EPROM EXT TEMP32KX8 EPROM	
78	1	U11	322-9366	4K EEPROM EXT. TEMP93C66	
79	2	U14,U15	323-4053	ANALOG SWITCH, TRIPLE SPDT 4053	
80	1	U6	324-4373	OCTAL LATCH 74HC373	
81	2	U7,U8	324-4374	OCTAL DFF REG74HC374	
82	2	U2,U12	324-7414	IC, HEX SCHMIDT, MOTOROLA THRESHOLDS 74HC14	
83	8	Q1,Q3,Q5,Q6,Q10,Q11, Q12,Q13	340-3904	NPN 40V/200MA, TO92 2N3904	
84	3	Q4,Q14,Q15	340-3906	PNP 40V/200MA, TO92 2N3906	
85	5	Q2,Q7,Q8,Q9#,Q16,Q17	340-7000	XSTR, MOSFET, N-CHANNEL TO-92 60V/0.2A, 5 OHMS2N7000	
86	1	CR2	342-0001	DIODE, SILICON 1A 100V 1N4002	
87	1	CR12	342-0103	SCHOTTKY, 0.37V @ 1MA TYP SD103A	
88	7	CR8,CR9,CR10,CR11, CR13,CR14,CR15	342-3009	DIODE, SILICON 100V 250MW 1N4148	
89	4	CR5,CR6,CR7,CR16	343-3035	ZENER, 12V 1W +-5%1N4742A	
90	3	CR1,CR3,CR4	343-3100	ZENER, 8.2V 1W +-5% 1N4738A	
91	1	SW1	371-0024	SPST RA PWB MNT MOM PB	
92	1	Y1 **NOTE 1**	376-0358	XTAL, 3.579545MHZ HC-49 CL=18PF	3.58MHZ
93	1	Y2 **NOTE 1**	376-1106	XTAL, 11.0592MHZ HC-49 CL=18PF	11.0592MHZ
94	1	K1	380-0030	RELAY, DPDT MINI-DIP, 12 V COIL	
95	2	J1,J2	401-0080	6-PIN LO PRO R/A TELCO	
96	1	J4	401-0194	8 PIN TELCO CON RA	
97	3	P1,P2,P3	401-0254	ZR300 DOUBLE ROW HEADER	
98	1	J3	401-6006	6-POS MALE	

Parts List - 702-9805C ZR350 Control Board (Continued)

Item	Qty	Reference	Part No.	Description	Part Value
99	0	TP1#,TP2#,TP3#,TP4#, TP5#	403-0001	1 OF 401-0052	
100	4	JP1#,JP2#,JP3,JP4, JP5,JP6#,JP9,JP10#	403-0002	2 OF 401-0052	
101	0	JP7#,JP8#	403-0003	3 OF 401-0052	
102	2	FX1,FX2 **NOTE 2**	416-1303	FUSE,3/4 AMP,SLO-BLO,SUBMINIATURE,AXIAL	0.75 AMP
103	1	XVR1	210-0001	4-40 KEP NUT ZINC	
104	1	XVR1	221-0108	4-40 x 1/4 PAN HD PHIL, SEM, EXTERNAL TOOTH	
105	4	XFX1-2 **(2 EA) NOTE 2**	305-0090	BEAD, 4S2 FERRITE, 0.394 SLEEVE, NO LEADS	
106	4	XJP3,4,5,9 **(IN**)	402-3040	MINI JUMPER	
107	1	XU1	407-0006	SKT, 06 PIN DIP	
108	1	XU11	407-0008	SKT, 08 PIN DIP	
109	1	XU4	407-0028	SKT, 28 PIN DIP	
110	1	XU5	407-0068	SKT, 68 PIN PLCC	
111	5	XDS1-5	417-0010	LED MOUNT RA	
112	1	PCB	410-9805A	ZR350 CONTROL BOARD	

NOTES: (Notes are for production use only.)

Parts List - 702-0023B Digital Voice Delay Board

LEGEND:
+ = OPTION, INSTALL PER CUSTOMER ORDER
# = NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
= = SUBSTITUTE PART

ZETRON DIGITAL VOICE DELAY BOARD PARTS LIST: 702-0023B

Item	Qty	Reference	Part No.	Description	Part Value
1	3	R1,R2,R6	101-0097	RESISTOR,10K OHM,1/4W,5%,CARBON FILM	10K
2	2	R3,R4	101-0113	RESISTOR,47K OHM,1/4W,5%,CARBON FILM	47K
3	1	R5	101-0145	RESISTOR,1.0M OHM,1/4W,5%,CARBON FILM	1.0M
4	1	RP1	119-0008	R-NETWORK,10K OHM x 7,BUSSED,SIP-08	10K
5	2	C19,C18	151-0028	CAP,270pF,100V,5%,CERAMIC,NPO	270pF 100V
6	1	C7 NOTE 5	151-0180	CAP,.1uF,50V,20%,CERAMIC Z5U	.1 50V
7	10	C1,C2,C8,C9,C11,C12, C13,C14,C15,C17 NOTE 5	151-0181	CAP,.1uF,50V,10%,CERAMIC X7R	.1 50V
8	1	C16	152-1474	CAP,.47uF,100V,5%,POLYESTER	.47uF 100V
9	1	C3 NOTE 5	154-0025	CAP,1uF,35V,10%,TANTALUM	1 TANT
10	4	C4,C5,C6,C10 NOTE 5	154-0100	CAP,10uF,16V,10%,TANTALUM	10 TANT 16V
11	1	U1	321-5481	CODEC,5V PCM U/A LAW,SERIAL I/O,5V,SOG-20	145480
12	1	U3 NOTE 3	321-7257	SRAM,256K(32K x 8),85nS,40uA,0-70 C	32K x 8 RAM
13	0	U4= NOTE 1	322-5032	CPLD,32 MACROCELL,10nS,PLCC-44	PZ5032
14	1	U6	323-4049	INVERTER,UNBUFFER GATES,HEX,DIP-16	4049
15	1	U5	324-4373	LATCH,HC,3-STATE,NON-INVERTING,OCTAL	74HC373
16	1	SW1	371-0023	SWITCH,ROTARY,16 POS,TOP ADJUSTED	
17	1	Y1	376-0512	RESONATOR,CERAMIC,512KHZ	512KHZ
18	0	P1#	401-0181	CONN,HDR,.025SQRA,10POS[5x2],.100CTR,.230/.120	
19	1	J1 NOTE 2	401-6005	6-POS FEMALE	
20	0	JP1#	403-0003	03 OF 401-0052	
21	0	U2# NOTE 4	N/A	SRAM\EXPANSION\ENABLER	
22	0		061-0383	PRODUCT COMPATIBILITY SHEET	
23	1	U4 NOTE 1	395-0025A	PROGRAMMED DIGITAL VOICE DELAY CPLD	
24	1	PCB	410-0023B	DIGITAL VOICE DELAY	

NOTES: (Notes are for production use only.)

Parts List - 702-9807A Local Phone Ringer

LEGEND:
= NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY
+ = OPTION (INSTALLED PER CUSTOMER ORDER)

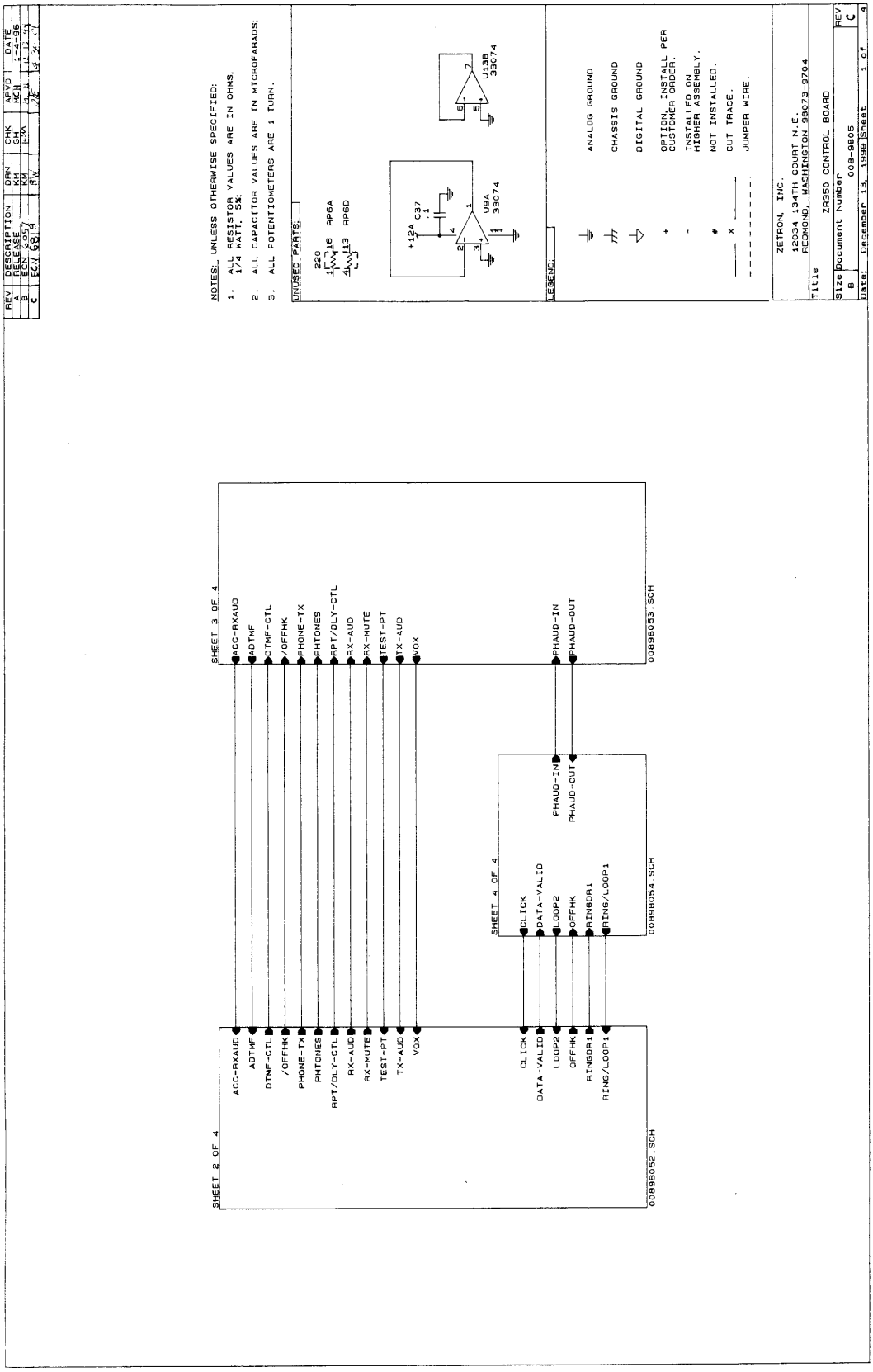
Item	Qty	Reference	Part No.	Description	Part Reference
1	2	R12,R11	101-0073	1.0K 1/4W 5% CARBON FILM	
2	1	R4	101-0074	1.2K 1/4W 5% CARBON FILM	
3	1	R3	101-0082	2.4K 1/4W 5% CARBON FILM	
4	2	R8,R5	101-0097	10K 1/4W 5% CARBON FILM	
5	1	R6	101-0109	33K 1/4W 5% CARBON FILM	
6	1	R2	101-0121	100K 1/4W 5% CARBON FILM	
7	1	R9	101-0129	220K 1/4W 5% CARBON FILM	
8	2	R7,R1	101-0135	390K 1/4W 5% CARBON FILM	
9	1	R10	101-0150	2.7M 1/4W 5% CARBON FILM	
10	4	C3,C4,C5,C6	150-0096	1000 PF 1KV +-10% CERAMIC DISC YSP	
11	3	C2,C10,C12	151-0180	.1UF 50V +-20% CERAMIC Z5U	
12	2	C14,C15	152-0010	.1 UF 250V +-10% POLYESTER	
13	3	C9,C11,C13	152-0012	.1 UF 50V +-5% POLYESTER	
14	1	C8	152-0021	.47 UF 250V +-10% POLYESTER	
15	1	C7	154-0100	10 UF 16V TANTALUM +-10%	
16	1	C1	155-0140	3300 UF 25V +50%-10% AXIAL ALUMINUM ELECTROLYTIC	
17	4	E2,E3,E4,E5	305-0001	FERRITE BEADS W/ LEADS	
18	2	E1,E6	305-0306	EMI SUPPRESSION FILTER	
19	1	T1	305-1635	16V 6VA SPLIT BOBBIN XFMR	
20	1	DS2	311-0011	LED RED FLUSH	
21	1	DS1	311-0012	LED GREEN FLUSH	
22	1	U2	323-4049	HEX INVERTER, UNBUFFER GATES	4049
23	1	U1	323-4098	DUAL MONOSTABLE	4098
24	2	Q5,Q7 **NOTE 1**	340-0172	PNP 3A 80V, 12.5W	MJE172
25	2	Q4,Q6 **NOTE 1**	340-0182	NPN 3A 80V, 12.5W, GAIN OVER 50	MJE182
26	3	Q1,Q2,Q3	340-3904	NPN 40V/200MA, TO92	2N3904
27	1	CR2	342-0001	DIODE, SIL 1A 100Y	1N4002
28	1	CR3	342-3009	DIODE, SILICON 100V 250MW	1N4148
29	1	CR1	342-5400	DIODE, SIL 3A 50V	1N5400
30	1	SW1	371-0024	SPST RA PWB MNT MOM PB	
31	1	K1	380-0030	DPDT 12V COIL MINI RELAY 360 OHM	
32	2	J1,J2	401-0080	6-PIN LO PRO R/A TELCO	
33	1	F1	416-1202	FUSE AGC 2A FAST-BLOW	2A
34	2	XU1,XU2	407-0016	SKT, 16 PIN DIP	
35	1	PCB	410-9807A	LOCAL PHONE RINGER BOARD	
36	2	XF1	416-3040	FUSE CLIP	
37	2	XDS1,XDS2	417-0010	LED MOUNT RA	

NOTES: (Notes are for production use only.)

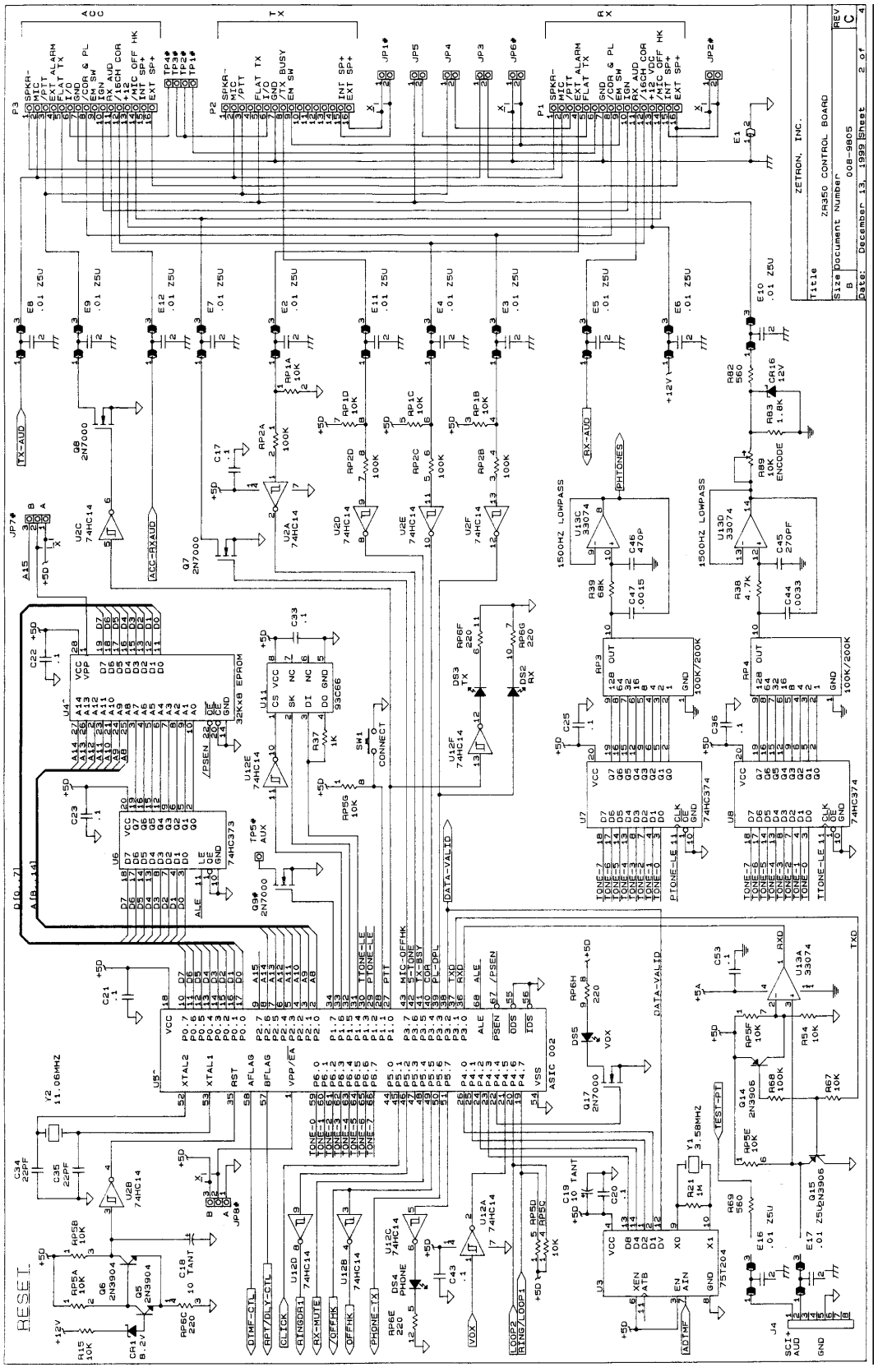
SCHEMATICS

The remainder of this section contains the schematics of the three printed circuit boards used in the ZR350.

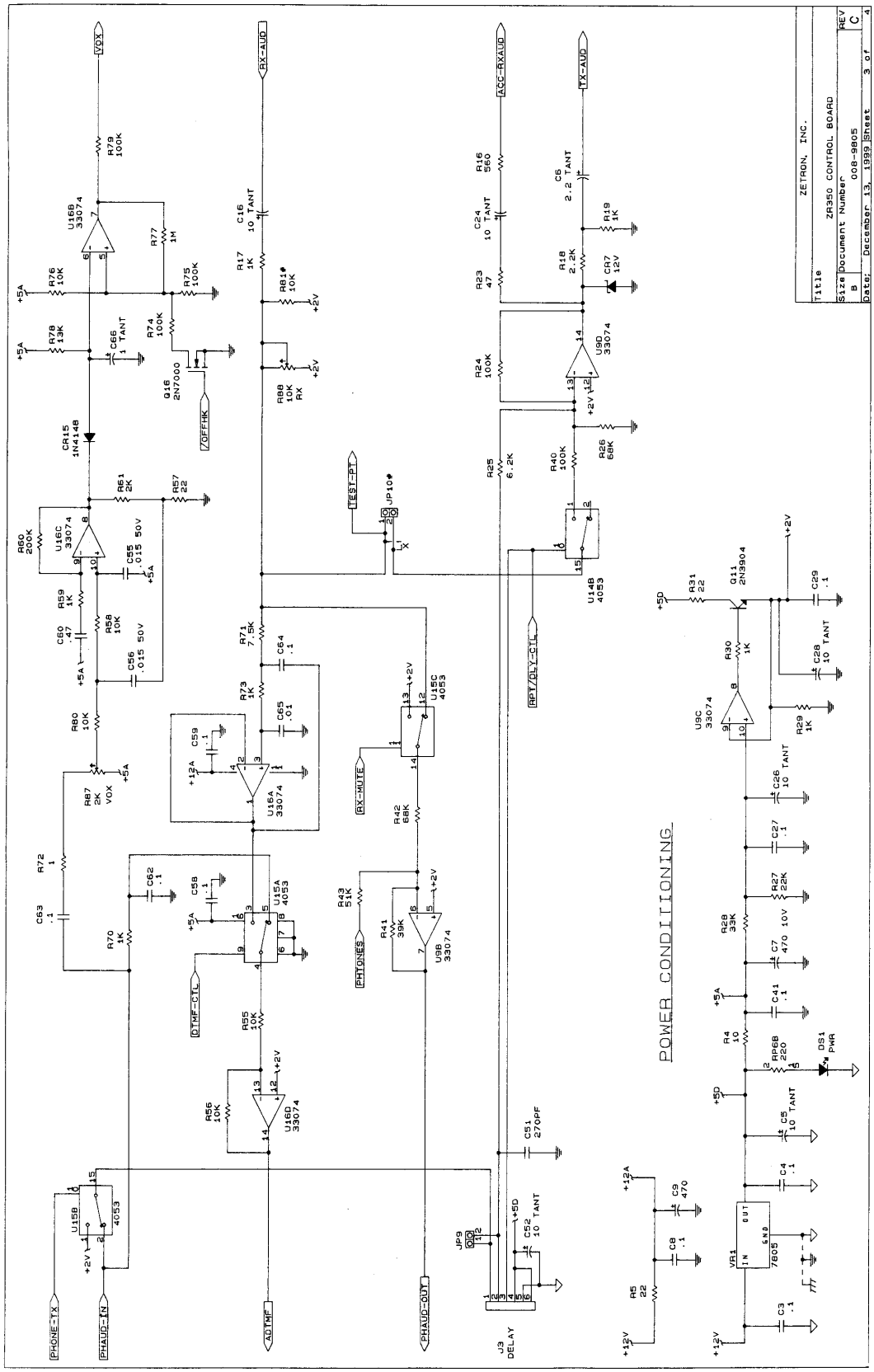
Schematic - 008-9805C ZR350 Control Board



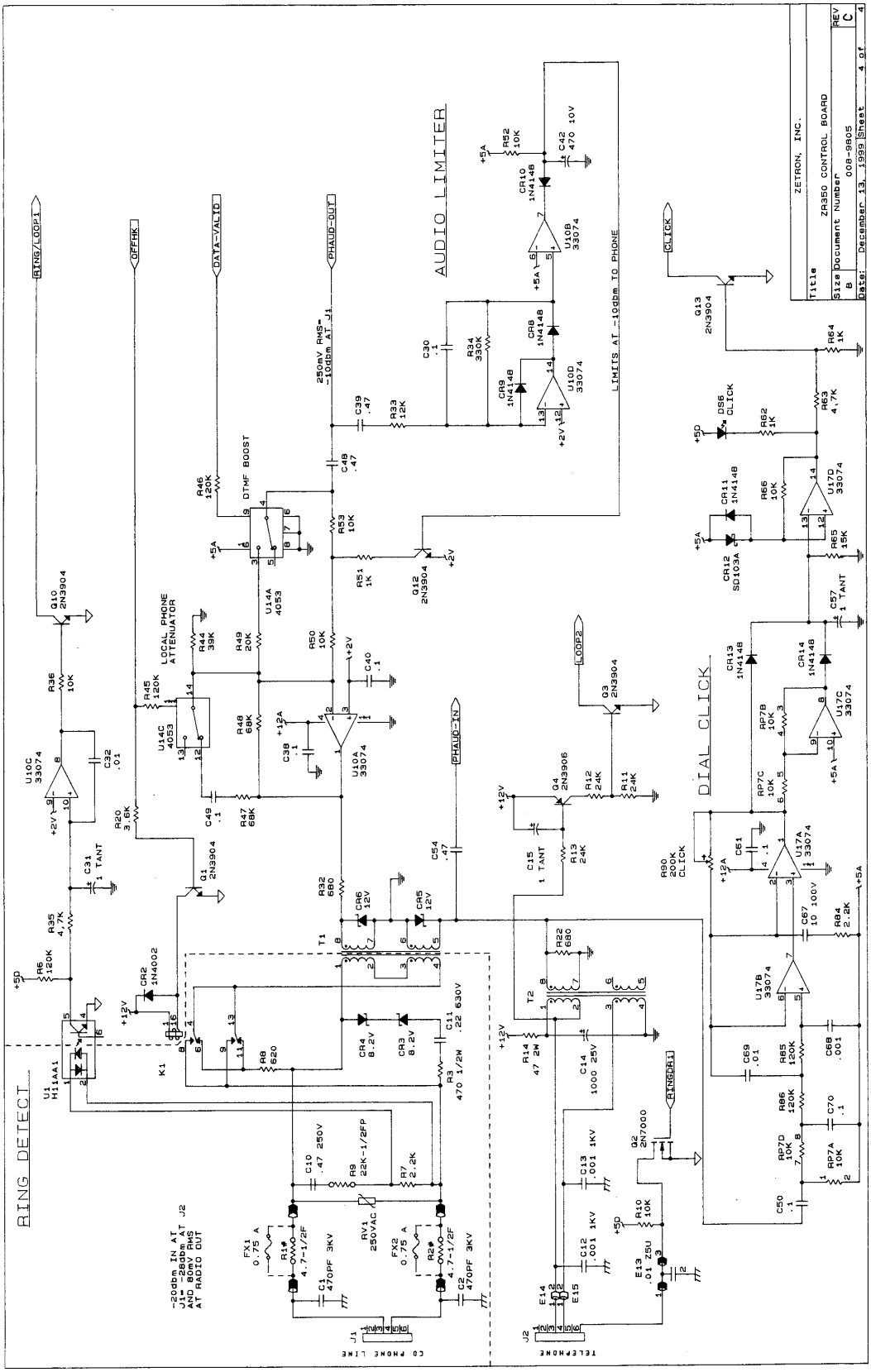
Schematic - 008-9805C ZR350 Control Board (Sheet 2 of 4)



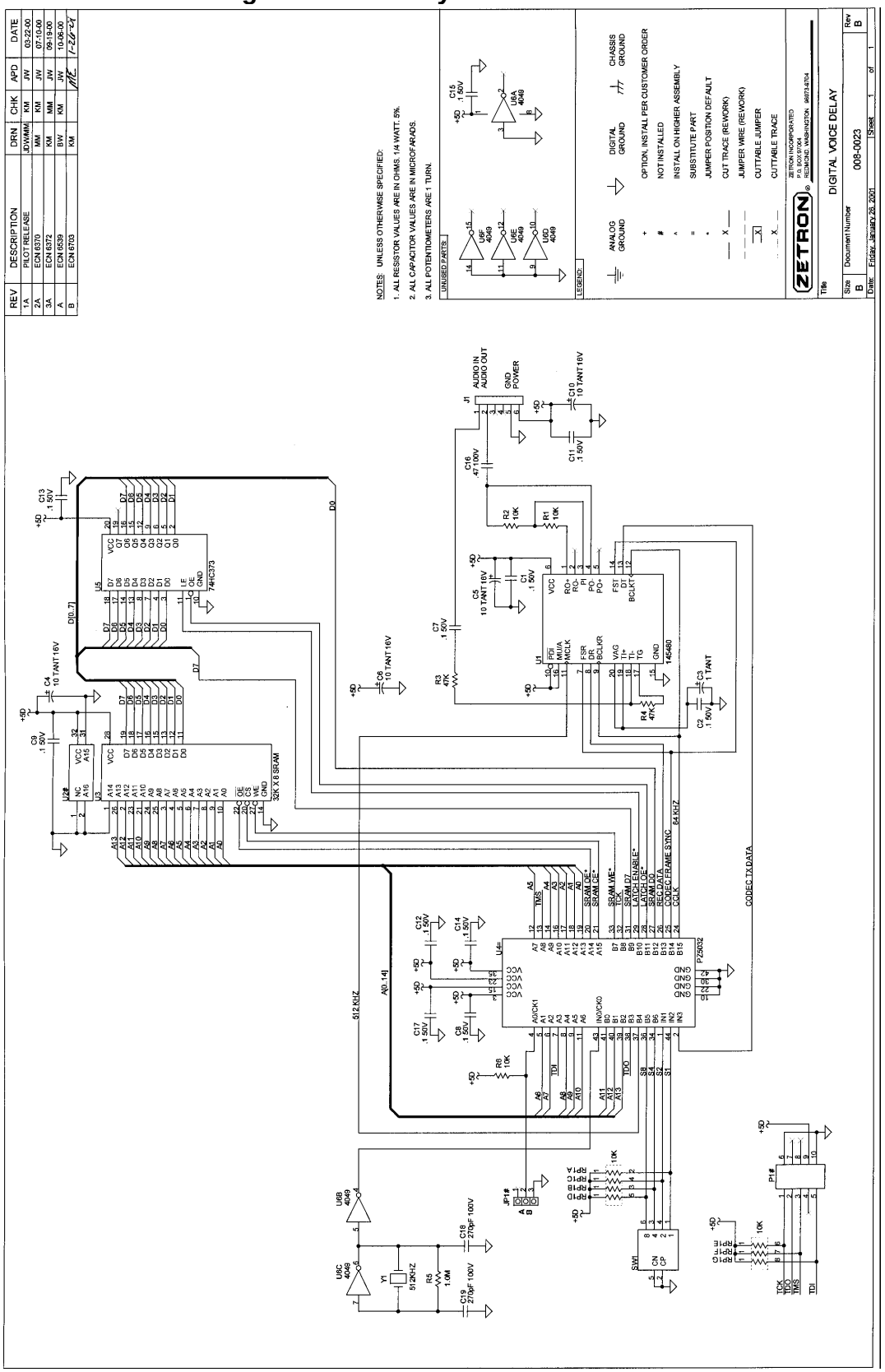
Schematic - 008-9805C ZR350 Control Board (Sheet 3 of 4)



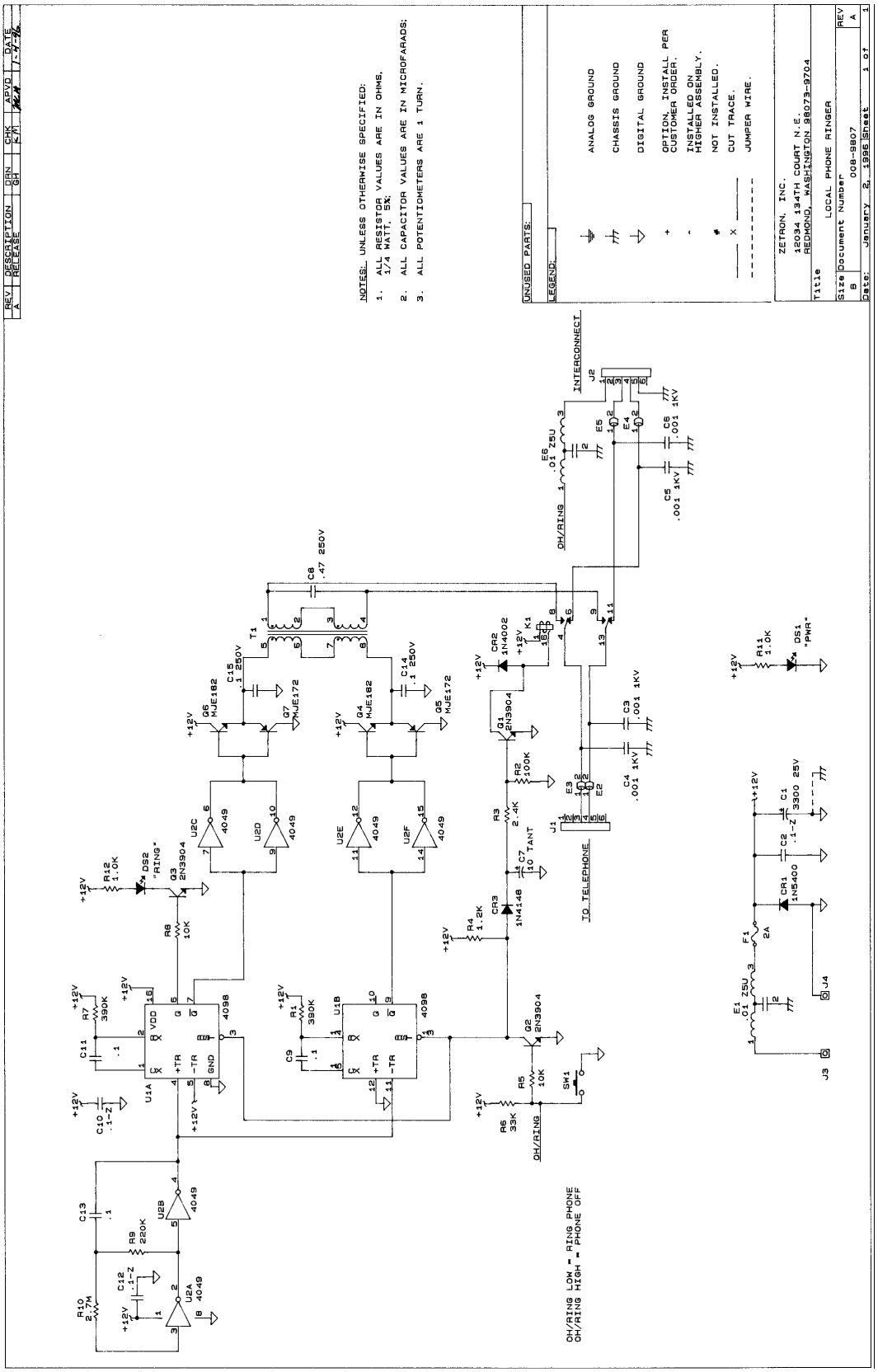
Schematic - 008-9805C ZR350 Control Board (Sheet 4 of 4)



Schematic - 008-0023B Digital Voice Delay Board



Schematic - 008-9807A Local Phone Ringer



5. PROGRAMMING

5. PROGRAMMING

OVERVIEW

This section of the manual contains information and procedures that will be used by the technician to program the ZR350 to match the particular needs of the end user. There is a brief review of the various equipment types to aid the technician in choosing the correct user programming commands for the application. The remainder of the section is devoted to explaining the use and functions of the DTMF programming commands used to set up the ZR350 itself.

USER EQUIPMENT TYPE

The ZR350 has a 100-user database, identified as users 00 through 99. In addition to being able to individually define the type of selective call used to reach any one of these users, the ZR350 also allows you to define what type of equipment that user is carrying. The equipment type tells the ZR350 how to proceed once it has finished the selective call. That is, whether or not it should ring on the channel or cut the telephone audio through immediately and what, if any, kind of response the interconnect should expect to get back from the radio user. The ZR350 supports nine types of equipment that you may already be familiar with. They are:

5-tone radio
: Ring-outs follow paging tones, radio answers with PTT, terminates call via DTMF disconnect code or phone party #0.

5-tone talkback
: Call initiator voice hails, radio may talk-back via PTT, terminates call via DTMF disconnect code or phone party #0.

5-tone tone-only pager
: Caller hears alert beeps after paging tones are sent.

5-tone tone+voice pager
: Call initiator may speak voice message after the prompt.

QCII group call radio
: Ring-outs follow paging tones, radio answers with DTMF connect prefix, terminates call via DTMF disconnect prefix or phone party #0.

QCII radio
: Ring-outs follow paging tones, radio answers with DTMF connect code, terminates call via DTMF disconnect code or phone party #0.

QCII talkback
: Call initiator voice hails, radio may talk-back via PTT, terminates call via DTMF disconnect code or phone party #0.

QCII tone only pager
Caller hears alert beeps after paging tones are sent.

QCII tone+voice pager
Call initiator may speak voice message after the prompt.

PROGRAMMING THE ZR350

The ZR350 cannot be programmed using the Motorola RSS system the way the radios are programmed. All of the programming of the ZR350 is done using DTMF commands, either from the radio or from one of the phone inputs. The simplest way for the installer to program the interconnect is by plugging a regular DTMF telephone set into the Local port on the back. This method also provides the installer with a good way to control the installation tests and alignments.

While the DTMF programming method is convenient, it does not provide any way to interrogate the ZR350 about what its programming currently is. The only thing that you can do when you are unsure of what value is in memory for a certain command is to reprogram that command to the value you want it to be. For this reason, a record should always be kept for the initial programming of the unit, and of any changes that are made over time.

Program Mode Access Code

The Program mode can be accessed from either of the telephone inputs or from over the radio using the same five digit DTMF code. The default code is 12350. Whenever the code is entered, it is followed by a # just like any other programming command. There is a command provided to allow the system operator to change this access code to a number of his or her own choosing. The command is 90#.

WARNING:

If you change the Program mode access code to another number, BE SURE TO RECORD THE NEW NUMBER IN A SECURE PLACE! If you forget what the new access code is, then the only way to get back into the programming mode on the ZR350 will be to use the CONNECT button on the front of the unit to force a reset of all programmable memory to factory defaults. This move will also destroy all other programming in the unit and force you to reprogram everything from scratch.

Entering the Program Mode

How to access the Program mode of the ZR350 from the phone will be covered first, and then from the radio. When programming the interconnect from the radio, it is a good idea to have a second radio, or a scanner, tuned to the transmit frequency of the interconnect to ensure that the audible prompts and responses of the interconnect are heard while programming it. This is recommended because of the DTMF keypad PTT delay that many portables and DTMF microphones have, which would prevent them from returning to the receive mode soon enough for the operator to hear the responses of the ZR350.

From the phone

1. Call the number of the phone line going into the interconnect or lift the handset on the Local phone.

2. When the ZR350 answers the phone input that you called in on it will issue a beep as a prompt for you to enter the Program mode access code. If the interconnect is in Single User Mode, wait for the ringing to stop after the Radio Answer Time expires, and listen for a double beep prompt.

3. From the DTMF keypad on your phone, enter the Program mode access code, followed by a #. The default entry is 12350#. NOTE: Programming can only be done from a DTMF phone, never from a Pulse or Rotary phone.

4. The ZR350 will respond with five quick beeps to confirm that you are now in the Program mode. If the access code is incorrect, or was improperly entered, the interconnect will respond with an error tone (commonly called a “bee-doo” tone because of what it sounds like) and hang up. To be considered a valid entry, each digit in the access code must be entered within one second of the preceding digit.

From the radio

1. Key the radio you are using and send the DTMF Program mode access code followed by a #. The default is 12350#.

2. Unkey the radio and listen for the five quick beeps that indicate successful entry into the Program mode. If the code sent is incorrect or is improperly entered, the ZR350 will ignore it and not respond at all. In order to be considered a valid entry, each digit in the access code must be entered within one second of the preceding digit.

Entering a Command

In order to execute a programming command, use DTMF to send the number of the command followed by a #. Each time that a command is finished, the interconnect will return the five quick beeps as a “go-ahead” prompt, to indicate that you were successful and that the interconnect is waiting for the next programming command entry. If an error is detected, the interconnect will return an error signal, a “bee-doo” sound.

As an example of how to enter a simple command, in order to program the ZR350 to convert the phone numbers dialed by radio users into pulse dialing before sending them to the phone, enter the DTMF command “05#” and the interconnect will return five beeps.

NOTE

While entering commands, the DTMF “*” digit can be used as a “clear entry” key, to cancel a command or data that was entered in error.

Some commands, such as the station Morse code ID or changing the Program mode access code, will require the entry of additional digits in order to complete the command. When entering a command of this type, the ZR350 will return a two beep prompt to indicate that it is waiting for more data. After it receives all the information that it needs to complete the command, the interconnect will return the regular five beep "go-ahead" prompt. When entering additional numbers, most cashes will not require leading zeros. The interconnect will interpret 0001#, 001#, 01#, and 1# all to be the value one. However, there is one exception to this rule. When using the command 25# to enter the station Morse code ID string, then the ZR350 will require that all of the numbers that follow this command be two digit numbers. This will be explained in more detail under command 25#.

IMPORTANT

At any time while programming the interconnect, if no DTMF digits are received for a period of more than 60 seconds, then the interconnect will exit the programming mode automatically and return to the normal idle state.

Programming Example

The following example shows the DTMF sequences entered for a short programming session.

12350#	Enter the DTMF Program Access Code
91#	Reset the ZR350 to Default Settings
53# 1#	Enable User 01 as 5-tone Radio
99#	Exit the Program Mode

Exiting the Program Mode

The command code to exit the Program mode is 99#. After completing a command entry, while the ZR350 is waiting for the next command, use the 99# to exit the Program mode. If, in the middle of a command that requires the entry of additional data, or using one of the test commands to set levels during installation, then the command or test must be finished before using the 99# to exit. The ZR350 will return a ringing sound as confirmation that it is exiting the Program mode and then drop the transmitter or hang up the phone.

DTMF Command Descriptions

The following two subsections will provide a brief description of the purpose of each command, and, when necessary for clarity, an example of how the command is used. The commands have been divided into two groups, System and User, based on whether or not the command acts on the system as a whole, or only changes the operation of a single user at a time. The System commands include the test modes used during the installation for making level adjustments.

SYSTEM COMMANDS

Access and Disconnect Prefixes

In order to initiate and terminate a phone call, a radio must key in a DTMF access or disconnect prefix followed by his or her user number.

01# xx..xx# - CONNECT PREFIX (default = *1)

This command sets the Connect Prefix, which is used to initiate and answer calls from a radio. The connect prefix code is entered before the user number and steering digit to sign-on to the ZR350. The connect prefix may consist of the digits 0-9 and "*", and may be from one to eight digits in length. The default is "*1". The steering digit allows the user to place radio to phone calls and radio to radio calls.

02# xx..xx# - DISCONNECT PREFIX (default = #1)

The disconnect prefix code is entered before the user number to disconnect a call in progress. It may consist of the digits 0-9 and "#", and may be from one to eight digits in length. To enter a DTMF "#" in the sequence, enter it as a "*" since "#" is used to terminate the command. When the ZR350 writes the string to the EEPROM, it will convert all of the "*"s to "#"s. The default is "#1". For example, to set the Disconnect prefix to "#123", you would enter the following DTMF tones:

02# [beep-beep] * 1 2 3 # [beep-beep-beep-beep-beep]

03# xx..xx# - TOLL RESTRICT BYPASS PREFIX (default = 99)

The toll restrict bypass prefix code operates in the same fashion as the connect prefix code, but allows the user to bypass all toll restrictions. The prefix may be from one to eight digits in length. DTMF "#"s may not be entered although DTMF "*"s may. The default is "99".

Radio-to-Phone, Pulse or DTMF Dialing

These commands select the dialing method that will be used for radio-to-phone calls. The default mode is to pass the radio's DTMF digits along to the phone line. The ZR350 can be programmed to regenerate the radio's telephone number as pulse dialing to accommodate older phone systems. The radio audio to the phone is muted while this regeneration is going on.

04# - DTMF DIAL RADIO ORIGINATED CALLS (default)
05# - PULSE DIAL RADIO ORIGINATED CALLS

This command causes the ZR350 to dial into the PSTN using rotary pulses at 10 pps.

Pulse Dial Make / Break Ratio

These commands are used to set the make/break ratio for pulse dialed mobile originated calls. The default is to use the 39/61 ratio.

204# - SET MAKE/BREAK RATIO to 39/61 (default)
205# - SET MAKE/BREAK RATIO to 33/67

Rings-to-Answer

These commands set the number of rings required from the phone line before the ZR350 will answer the call. If the interconnect is set to the Single-User mode of operation, this command sets the number of rings before the interconnect calls the Auto-Call user. The default is one ring.

06# - WAIT 1 RING BEFORE ANSWERING (default)
07# - WAIT 3 RINGS BEFORE ANSWERING
08# - WAIT 5 RINGS BEFORE ANSWERING

Radio Answer Time

The radio answer time is the amount of time (10-60 seconds) allowed for a radio to answer the call before the call is forwarded to the Call Forward User, if one has been programmed for the radio originally called. Calls may be forwarded three times before the call is terminated. The default setting for this timer is 30 seconds.

10# xx# - RADIO ANSWER TIME (default = 30 seconds, range 10 to 60)

Disable Interconnect Operation

This command is used to disable all of the ZR350's operations without changing any of its programming. Once this command has been executed, the only thing that the ZR350 will allow a caller or radio user to do is to enter the Program mode. To place the interconnect back into normal operation, just enter into the Program mode, from the phone or the radio, and then exit again. Once out of the Program mode, all normal ZR350 operations will return.

12# - DISABLE INTERCONNECT OPERATION

Toll Restrict Digits

These commands allow the system operator to define which digits, if any, are used for toll restricting radio originated calls. The toll restrict routine checks the first and second digits of the telephone number dialed against the digits entered with these two commands. If it finds a match for either digit within the two groups defined here, then the interconnect aborts the phone call. Each one of the groups can have up to four digits in it. The default condition for each group is no digits entered.

14# xxxx# - FIRST DIGIT TOLL RESTRICT DIGITS (default = none)
15# xxxx# - SECOND DIGIT TOLL RESTRICT DIGITS (default = none)

To clear a group out that has previously had numbers entered in it, use the appropriate command and enter the second # without putting any digits ahead of it. For example, to clear out the First Digit Toll Restricts, enter the following:

14# [beep-beep] # [beep-beep-beep-beep-beep]

Radio Ring-out Method

This command determines how the ZR350 behaves on a phone-to-radio call. It can either ring-out on the channel until the user who was called answers, or it can ring-out once and then just wait for the user to answer. In either case, the ZR350 will only wait the Radio Answer time to get a response from the user that was called. If the ZR350 does not get a response from the user within that time, it either terminates the call or starts a call to the Call Forward User if there is one programmed. The default mode for this is to ring on the channel until the radio answers. When using the Call Forward feature, the ring-until-answer mode (17#) should be used to ensure proper operation.

16# - RING ONCE ON AIR AND WAIT FOR RADIO ANSWER
17# - RING ON CHANNEL UNTIL RADIO ANSWERS (default)

Repeater Enable/Disable

This command enables the carrier repeat function of the Model 350. If a CTCSS tone or DCS code has been programmed on the receive radio, only carrier with the correct tone or code will be repeated. The default is disabled.

18# - ENABLE CARRIER REPEAT
19# - DISABLE CARRIER REPEAT (default)

Repeater Hold Time

These commands determine the delay before the ZR350 unkeys its transmitter after the radio user unkeys in the Carrier Repeat mode. The default is for a three second hold time.

21# - NO REPEAT HOLD TIME
22# - 1 SECOND REPEAT HOLD TIME
23# - 3 SECOND REPEAT HOLD TIME (default)
24# - 5 SECOND REPEAT HOLD TIME

Repeater Transmitter Time-out

These commands enable or disable the three minute Transmitter Time-out timer that operates during the Carrier Repeat mode (see command 18#). If the dispatch conversation lasts for longer than three minutes, then the ZR350 will unkey the transmitter and wait for the radio users to unkey before returning to service. The time-out is fixed at three minutes and may only be enabled and disabled. The default condition is enabled.

51# - TRANSMITTER TIME-OUT TIMER ENABLED (default)
52# - TRANSMITTER TIME-OUT TIMER DISABLED

Morse Code Station Identification

If enabled, the ZR350 will transmit the call sign of the interconnected transmitter as determined by the commands 60#, 61#, or 62#. The command 25# is used to program the code string used for the station's Morse code ID. When transmitted, the ID routine will use a tone of 1000 Hz., at 30% deviation, and at a speed of 20 words per minute. In order to enter the letters in the station call sign, they must first be converted into numbers. These letter-to-number conversions are listed in Table 5-1. In order to avoid confusion, all of the digits in the station's call sign are entered as two-digit numbers with leading zeros. As a convenient memory aid, all of the letter-to-number conversions are based on the key assignments used on a DTMF telephone keypad. Looking at the tone pad picture in Table 5-1, notice that the first digit of a letter code is selected from the top row of digits (1, 2 or 3). This is a "shift" key. Now notice the letters above each key. By using the "shift" key plus a letter key, the code is complete. The only letters not represented are Q and Z. Numbers are entered directly (i.e. 01, 02, etc.). Enter all digits and end with a "#" key.

25# xxxxxxxx# - MORSE CODE STATION IDENTIFICATION (default = none)

The following is an example of how to enter the station ID into the ZR350 using command 25#.

To set the ID to	WNCR-414								
Enter DTMF ⇒	25#	19	26	32	27	04	01	04	#
Comments ⇒	ID#	W	N	C	R	4	1	4	done

In order to clear the station ID memory location, enter the second # without any digits ahead of it, that is: 25# #.

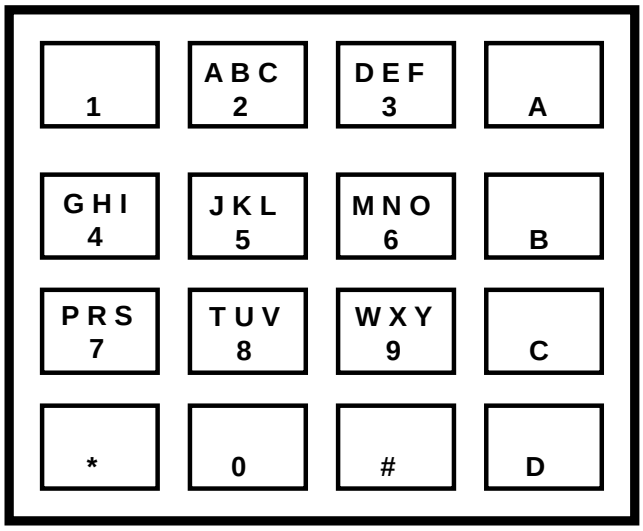
Enable Station Identification

These commands are used to disable or enable the Morse Code Station ID, and to set the requirements for transmitting the ID if enabled. The time limit between ID transmissions is always ten minutes, however, command 61# requires that there be some activity on the channel, within the timer period or after it expires, in order to make the ZR350 ID, and command 62# will always ID after the timer times out. The default is to ID upon activity.

60# - DISABLE STATION IDENTIFICATION
61# - ENABLE STATION ID / 10 MINUTE INTERVAL / WITH ACTIVITY (default)
62# - ENABLE STATION ID / 10 MINUTE INTERVAL / NO ACTIVITY NEEDED

Table 5-1 Morse Code ID Key-Code Chart

Digits	#	Code	Digits	Letter	Code	Digits	Letter	Code
00	0	– – – – –	12	A	• –	26	N	– •
01	1	• – – – –	22	B	– • • •	36	O	– – –
02	2	• • – – –	32	C	– • – •	17	P	• – – •
03	3	• • • – –	13	D	– • •	10	Q	– – • –
04	4	• • • • –	23	E	•	27	R	• – •
05	5	• • • • •	33	F	• • – •	37	S	• • •
06	6	– • • • •	14	G	– – •	18	T	–
07	7	– – • • •	24	H	• • • •	28	U	• • –
08	8	– – – • •	34	I	• •	38	V	• • • –
09	9	– – – – •	15	J	• – – –	19	W	• – –
			25	K	– • –	29	X	– • • –
30	/	– • • – •	35	L	• – • •	39	Y	– • – –
#	END		16	M	– –	20	Z	– – • •



Courtesy Tone

When enabled, this feature sends a 1000 Hz beep tone to the telephone, every time the radio unkeys during a phone-to-radio or a radio-to-phone call. This tone is provided to give the phone party a positive indication that it is his or her turn to talk. This beep is not available during radio-to-radio calls. The default condition for this feature is disabled.

26# - COURTESY TONE ENABLED
27# - COURTESY TONE DISABLED (default)

Half-duplex Privacy Mask

This feature is used to provide a limited degree of privacy during telephone conversations with radio users. This feature is only available on systems that are set up for half-duplex operation since it depends on the receive audio to the ZR350 coming in on a different carrier frequency than the transmit uses. When this feature is enabled, the ZR350 will mute the repeat audio path while the radio user is speaking and transmit an annoying cover tone in its place to discourage idle monitoring of the channel. When the radio user unkeys and the phone party starts to speak, the cover tone is dropped and the phone audio is transmitted in the clear. The default condition for this feature is disabled.

28# - PRIVACY MASK ENABLED
29# - PRIVACY MASK DISABLED (default)

Call Limit Timer

The ZR350 has a Call Limit timer that may be used to restrict the length of telephone calls. The timer may be enabled or disabled, and may be programmed to allow the radio user to extend the time by sending a DTMF "*". Starting 15 seconds before the call is to be terminated, the ZR350 will transmit double warning beeps every 3 seconds to let the user know that he or she is about to time out. Commands 30#, 31#, and 32# are used to enable/disable the timer, and commands 33#, 34#, and 35# are used to set the limit of the timer if enabled. The default is 3 minutes without the ability to reset it (command 30# then 33#).

30# - ENABLE CALL LIMIT TIMER (default)
31# - ENABLE CALL LIMIT TIMER/ALLOW RADIO TO RESET WITH "*"
32# - NO CALL LIMIT
33# - 3 MINUTES (default)
34# - 5 MINUTES
35# - 10 MINUTES

Radio Activity Timer

During a phone call, the radio user is expected to be in control of and responsible for the use of the radio channel. In order to ensure that the radio user is still in range and available to do this, the ZR350 requires that it receive some carrier from the radio user (it is enough just to key up momentarily) at least every 30 seconds, or it will terminate the call in progress. These commands are used to set the maximum time the interconnect will go without seeing a

transmission from the radio user without terminating the call. When there are only 15 second left to the timer, the interconnect starts sending single beep warning tone, every three seconds, until the radio user either keys up or the call is terminated. The default value for this timer is 30 seconds.

36# - 30 SECOND RADIO ACTIVITY (default)
37# - 45 SECOND RADIO ACTIVITY
38# - 1 MINUTE RADIO ACTIVITY

Operating Mode

These commands are used to set the operating mode of the ZR350 to match the kind of base station radio it is interfaced with. The default mode is Simplex VOX. The difference between Simplex VOX and VOX with pre-key is that, when set to “pre-key”, whenever the carrier detect signal goes away the ZR350 will go ahead and key the transmitter right away, in anticipation of the phone caller starting to speak. In the Simplex VOX mode, the interconnect will not key until it detects VOX activity from the phone.

40# - HALF DUPLEX MODE
42# - SIMPLEX VOX (default)
43# - SIMPLEX VOX with PRE-KEY

VOX Hold Time

When the ZR350 is operating in the Simplex VOX or Simplex VOX w/pre-key mode, a VOX hold timer is used to smooth out the operation of the interconnect. The VOX hold time will keep the transmitter keyed during small gaps or pauses in the telephone party’s speech, by requiring the VOX output to go false for longer than the hold time before it will unkey the transmitter. The default value for this timer is 1 second.

44# - VOX HOLD TIME .5 SECONDS
45# - VOX HOLD TIME .8 SECONDS
46# - VOX HOLD TIME 1 SECOND (default)
47# - VOX HOLD TIME 1.3 SECONDS
48# - VOX HOLD TIME 1.5 SECONDS

Carrier Detect Hold Time

These commands are used to set the value of the COR Hold Timer. This timer is used to de-sensitize the carrier detect input (COR) during simplex operation when the radio is fading or picket-fencing. The ZR350 will not shift from radio-to-phone over to phone-to-radio until the COR input has been false for longer than the time period programmed here. The default value for this feature is no hold time.

83# - NO COR HOLD TIME (default)
84# - 100 MSEC COR HOLD TIME
85# - 300 MSEC COR HOLD TIME
86# - 500 MSEC COR HOLD TIME

Tone+Voice Paging Talk Time

When calling a Tone+Voice pager, the Talk Time determines the maximum amount of time that the phone caller has to speak his or her voice message on the channel. If a gap of 2 seconds is detected in the caller's voice (using the VOX circuit) then the call is terminated, even if there is Talk Time remaining. The default setting is 10 seconds. Range is ten to thirty seconds.

67# xx# - TALK TIME (default = 10 seconds, range 10 to 30)

Auto-Call User

The Auto-Call User is used for two purposes. The first one is as the default user, to be called in the event that a phone caller does not enter a user number after the access prompt when the ZR350 is operating in the multi-user mode. The Auto-Call User is also used to specify which user gets called when the ZR350 is operating in single user mode and the phone rings. The default setting is "00" and the range is 00 to 99. If you wish to disable the Auto-Call feature, you must either disable the user to whom the Auto-Call assigned, or reassign the Auto-Call to a user who is currently disabled.

68# xx# - AUTO-CALL USER NUMBER (default = 00)

Single/Multi-User Operation

These two commands determine what the ZR350 will do when the phone line rings. If set to Multi-User, then the interconnect will answer the phone and wait for the caller to enter the user number of the person they wish to call. If it does not receive a number from the caller, then the interconnect will call the Auto-Call user (if there is one). If set to Single User, then the interconnect will immediately call the user number programmed into the Auto-Call user slot. The default setting is for Multi-User.

81# - SINGLE USER OPERATION
82# - MULTI-USER OPERATION (default)

Busy Tone Disconnect

The ZR350 can use the VOX detector to detect a busy signal from the phone and terminate a radio originated call without any further action on the part of the radio user. The ZR350 can be programmed to only react to a busy tone during the first 20 seconds of the call, to ignore busy tone altogether, or to react to busy tone at any time throughout the whole call. The default for this feature is to only look for a busy tone during the first 20 seconds.

87# - DISCONNECT ON BUSY FOR FIRST 20 SECONDS (default)
88# - DISABLE BUSY DETECT
89# - DISCONNECT ON BUSY FOR DURATION OF CALL

Program Mode Access Code

This command allows the installer or system operator to change the access code used to enter into the Program mode. The default entry is 12350.

90# xxxxx# - PROGRAM ACCESS CODE (default = 12350)

The following are DTMF commands for initial setup and test:

Reset Memory to Defaults

This command resets all programmable items to the factory defaults and clears all of the user database and call forwarding database.

91# - RESET MEMORY TO DEFAULTS

The ZR350 may be reset manually by holding in the “CONNECT” button while cycling power. The button must be held in until the “PHONE” LED begins flashing. Release the button to place the ZR350 into its normal operating mode.

Tests and Adjustments

These commands are used to perform various test and level adjustments when the ZR350 is installed. They are explained completely in the installation procedure in Section 2.

92# - TX LEVEL TEST
96# - DIAL CLICK TEST

Exit Program Mode

This command will make the ZR350 exit the Program mode and return to the normal idle state. In order to use this command, you must have finished all entries associated with any other command or test and be at the point that the ZR350 is waiting for a new programming command.

99# - EXIT PROGRAM MODE

Sign-on Mode

This command selects whether mobiles are required to enter their user number following the Connect or Disconnect Prefix. In the Short Sign-on mode, mobiles never need to follow the prefix with their user number. In the Full Sign-on mode, the requirement is dependent upon the equipment type. The default mode is Short Sign-on.

100# - Short Sign-on Mode (default)
101# - Full Sign-on Mode

Local Phone Ringer Option

If the Local Phone Ringer option is installed with the ZR350, it must be enabled with this command. This option allows mobiles to ring the Local Phone instrument by using a steering digit of “4”. The default condition is disabled.

102# - Local Phone Ringer Enabled
103# - Local Phone Ringer Disable (default)

Call Forward Gap

These commands are used to enable or disable a one second gap between call forwards. When the transmitter is dropped, there is a slight chance that another user may acquire the channel. The ZR350 does not check carrier again before proceeding with the call forwarding, therefore, the ZR350 can interfere with other users on the channel if a gap is used. Default is no gap.

201# - ENABLE GAP BETWEEN CALL FORWARDS
202# - DISABLE GAP BETWEEN CALL FORWARDS (default)

USER COMMANDS

The following commands are used to assign specific attributes to individual users. Any user programming done with these commands is cleared back to the default settings whenever the memory of the ZR350 is reset.

Assigning Call Forward Users

This command is used to assign the call forward user number for any user. After the command has been entered, the ZR350 will give two beeps to indicate that it is waiting for the user number of the user who has been called. After that number is entered, the ZR350 will issue two more beeps indicating that it is ready for the user number to forward the call to. Remember that the second user number is the user who will be called in the event that the first user does not answer. If you wish to disable call forwarding on a particular user, simply press the "#" key when the ZR350 is asking for the second user number. Because calls to pagers are not expected to be answered, call forwarding is not used on Tone Only or Tone+Voice pagers.

Examples: 50# 22# 46# (if user 22 doesn't answer, call user 46)
50# 30# # (clear any call forward for user 30)

50# uu# xx# - ASSIGN CALL FORWARD USER NUMBER

User Equipment Types

The following commands serve two purposes. They enable users and they specify what equipment type each user has. The equipment type tells the ZR350 how to operate when it is asked to call a particular user. The default condition of all users is that they are disabled.

There are 100 slots numbered from 00 to 99. When one of the commands is entered, two beeps are sent indicating that the ZR350 is ready for a user number. The user number and equipment type determine the method of selectively signaling the user.

70# xx# - USER DISABLED (default condition for all users)
53# xx# - FIVE-TONE RADIO
54# xx# - FIVE-TONE TALKBACK PAGER
55# xx# - FIVE-TONE TONE-ONLY PAGER
56# xx# - FIVE-TONE TONE+VOICE PAGER
69# xx# - QCII GROUP-CALL RADIO
73# xx# - QCII RADIO
74# xx# - QCII TONE-ONLY PAGER
75# xx# - QCII TONE+VOICE PAGER
78# xx# - QCII TALKBACK PAGER

Two-tone encode parameters

These two commands are used to set which Quick Call II paging tone groups are used by the ZR350 to make up the QCII pages it transmits. When a call is placed to a user that is assigned

QCII as their paging format, then the interconnect uses the two digits of the user number to select tones from the two tone groups specified with these commands. The first digit of the user number selects a tone from the group specified by the command 65#, and the second digit of the user number selects a tone from the group specified by the command 66#. If both the first and the second tones end up being the same, then the interconnect will make a Group Call page (one tone, 8 seconds long) instead of making a regular page (1 second 1st tone, zero gap, 3 second 2nd tone). The default is Motorola Tone Group 1 for command 65# and Tone Group 2 for command 66#. The allowable range is Motorola Tone Groups 1 through 6.

65# x# - QCII GROUP 1 (default = 1)
66# x# - QCII GROUP 2 (default = 2)

MOTOROLA TONE GROUPS:

The ZR350 supports paging tones from the first six Motorola Quick Call II tone groups. Table 5-2 shows the tones of those groups for convenient reference. The table does not show the usual diagonal tones for these tone groups because the ZR350 does not allow the assignment of diagonal tone. If the first and second tones of the page are the same, the ZR350 will send an extended single tone group call page.

Table 5-2. Two-Tone Group Frequencies

	MOTOROLA TONE GROUP NUMBER					
TONE #	1	2	3	4	5	6
0	330.5	569.1	1092.4	321.7	553.9	1122.5
1	349.0	600.9	288.5	339.6	584.8	1153.4
2	368.5	634.5	296.5	358.6	617.4	1185.2
3	389.0	669.9	304.7	378.6	651.9	1217.8
4	410.8	707.3	313.0	399.8	688.3	1251.4
5	433.7	746.8	953.7	422.1	726.8	1285.8
6	457.9	788.5	979.9	445.7	767.4	1321.2
7	483.5	832.5	1006.9	470.5	810.2	1357.6
8	510.5	879.0	1034.7	496.8	855.5	1395.0
9	539.0	928.1	1063.2	524.6	903.2	1433.4

Five-tone encode parameters

These commands are used to configure the five-tone encode functions in the ZR350. A description of each parameter follows;

a) 5-tone tone series and timing. Nine selections are supported. Use Table 5-3 to select the proper tone series and tone timing.

Table 5-3. Five-Tone Group Frequencies

Tone set	CCIR1	CCIR2	EEA	EIA	ZVEI1	ZVEI2	DZVEI	PZVEI	ZVEI3
Selection #	1	2	3	4	5	6	7	8	9
Tone #									
0	1981	1981	1981	600	2400	2400	2200	2400	2400
1	1124	1124	1124	741	1060	1060	970	1060	1060
2	1197	1197	1197	882	1160	1160	1060	1160	1160
3	1275	1275	1275	1023	1270	1270	1160	1270	1270
4	1358	1358	1358	1164	1400	1400	1270	1400	1400
5	1446	1446	1446	1305	1530	1530	1400	1530	1530
6	1540	1540	1540	1446	1670	1670	1530	1670	1670
7	1640	1640	1640	1587	1830	1830	1670	1830	1830
8	1747	1747	1747	1728	2000	2000	1830	2000	2000
9	1860	1860	1860	1869	2200	2200	2000	2200	2200
A Group	2400	2400	1055	2151	2800	885	825	970	885
B	930	930	930	2433	810	810	740	810	810
C Reset	2247	2247	2400	2010	970	740	2800	2800	2800
D	991	991	991	2292	885	680	885	885	680
E Repeat	2110	2110	2110	459	2600	970	2400	2600	970
F	1055	1055	2247	1091	680	2600	680	680	2600
Tone Period	70ms	100ms	40ms	33ms	70ms	70ms	70ms	70ms	70ms

b) 5-tone leading digit straps. The 5-tone selcall sent is three preset leading digits, followed by two “user” digits.

First digit strap ___ (0-9)
Second digit strap ___ (0-9)
Third digit strap ___ (0-9)
Fourth digit _x_ (from user input)
Fifth digit _x_ (from user input)

c) Group translation digit. This selectable digit provides the user a mechanism to send a five-tone group call. If a user enters a match to this digit, the EuroPatch will substitute the Group tone. For Example: Leading straps = 123, Group digit = 9, users = 5-tone radio

User enters 45, EuroPatch sends 12345 = individual call
User enters 91, EuroPatch sends 123G1 = group of 10
User enters 99, EuroPatch sends 123GR = group of 100

d) Extended First Tone. The ZR350 may be configured to extend the first selcall tone of all outbound selcalls to the transmitter. When Scanning Radios are being used on a system, the radios monitor each channel in their scan list for RF Carrier, CTCSS, and a Selcall Tone. When all three are detected the radio stops scanning and waits for the remainder of the call sequence to see if the call is for itself or not. If it is, the radio opens up its squelch and remains stopped on that channel for the duration of the call. If not, the radio remains squelched/muted and resumes scanning. To allow all radios to collect on to the channel and reliably decode the selcall, the first tone in the selcall sequence must be extended.

The Extended First Tone duration is programmed as the number of "tone periods" to extend the first tone, 0 to 99. When set to zero, the first tone duration is not extended and is the same as all subsequent tones. When set to 1, the first tone duration is doubled. Some example settings are:

Tone Set	EFT Setting	1st Tone Duration	Standard Duration
CCIR 100ms	0	100ms	100ms
CCIR 100ms	1	200ms	100ms
EEA 40ms	24	1 second	40ms
ZVEI 1 70ms	35	2.52 seconds	70ms

e) Select V decode access mode. The EuroPatch is typically accessed using DTMF ANIs, but may also be accessed using Motorola Select V (5-tone) decode. This feature (when enabled) requires the installer to program a Select V Call Alert in the GM300 receive radio as;

Call Type = Call Alert
Alert Tone Reset = Automatic
Horn / Lights = Permanent
Horn / Lights Delay = 0 sec
Pin 4 on the auxiliary connector = External alarm, output high
Select V decode capcode and tone series as required

The Select V decode will cause the ZR350 to access the phone line and dial a programmable telephone number. This is a single phone number of up to 16 digits. When the autodial takes place, the EuroPatch will take the phone line off hook, wait 2 seconds, then begin dialing. If no autodial phone number is programmed, the phone line will be taken off-hook, just as if a valid DTMF Connect Code had been received. Dial tone will be passed to the radio user, and the radio user may dial just as in a regular radio-to-phone call. Call disconnect may be accomplished by sending the DTMF Disconnect Prefix, call limit time-out, radio activity time-out, or "#0" from the phone side. A two second pause may be inserted in the dialing string by entering a DTMF "*" (multiple delays may be used).

Five tone selective calling parameters;

11# n# - FIVE-TONE TONE SERIES / TIMING (1-9)
13# n# - FIVE-TONE GROUP TRANSLATION DIGIT (0-9, OR # = NONE)
39# n# - EXTENDED FIRST TONE (0 - 99, Default = 0)
49# n# - FIVE-TONE DECODE EMERGENCY AUTODIAL PHONE NUMBER
(up to 16 digits)
57# n# - FIVE-TONE ENCODE FIRST DIGIT STRAP (0-9)
58# n# - FIVE-TONE ENCODE SECOND DIGIT STRAP (0-9)
59# n# - FIVE-TONE ENCODE THIRD DIGIT STRAP (0-9)

FACTORY TEST SOFTWARE

The commands that follow are used for factory testing of the telephone interface, however, they are still accessible from the basic Program mode so that they can be used whenever it would be helpful. For the purposes of giving an example, it is assumed that the interconnect's programming is still at defaults.

1. Call the ZR350 on the PSTN/PBX line, or pick up the Local Phone. If using the Local Phone, a hook flash may be performed instead of pushing the CONNECT button in the following steps.

2. When the interconnect answers and prompts you for a number, enter 12350# from the phone's DTMF keypad. You will get a quick five-beep acknowledgment that you have entered the Program mode.

3. Enter the DTMF command 203# to leave the normal Program mode and enter into the telephone test mode. The interconnect will respond with a double-beep prompt.

4. At this point, the phone line is "off-hook", the PHONE LED is lit, and the interconnect is idling (which it will continue to do indefinitely if it receive no further input), waiting for you to push the CONNECT button on the front of the unit to start the telephone tests.

5. Push the CONNECT button on the front of the interconnect. The ZR350 will respond with a quick five-beep prompt to indicate that it is now waiting for telephone test commands. As with normal Program mode commands, all telephone test commands end with a #.

The following is a list of the commands available in the telephone test mode and what they will do.

1# This command causes the ZR350 to dial the number sequence 9-8-7-6-5-4-3-2-1-0 using pulse mode dialing, and then it returns to idle, waiting for another test command.

2# This command opens up the audio path from the radio input to the telephone. It remains open until the CONNECT button is pushed.

3# This command sends one sequence of the “End-of-Programming” tone to the telephone and then returns to idle, waiting for another command.

4# This command sends one sequence of the “Programming Error” tone to the telephone and then returns to idle, waiting for another test command.

5# This command will continuously send a tone in a two seconds on, four second off pattern, until the CONNECT button is pressed, at which time the interconnect returns to idle, waiting for another command.

6# This command will continuously send the “Busy Ring” tone sequence to the telephone until the CONNECT button is pushed, at which time the interconnect returns to idle, waiting for another command.

7# This command will continuously send the “Normal Ring” tone sequence to the telephone in a two seconds on, four seconds off pattern until the CONNECT button is pressed, at which time the interconnect will return to idle, waiting for another command.

8# This command continuously sends the “Normal Ring” tones to the telephone without any break, until the CONNECT button is pressed, at which time the interconnect returns to idle, waiting for another command.

9# This command sends a continuous tone to the telephone, until the CONNECT button is pressed, at which time the interconnect returns to idle, waiting for another command.

10# This command sends a continuous “Programming Error” tone sequence to the telephone, until the CONNECT button is pressed, at which time the interconnect returns to idle, waiting for another command.

11# This command will send the “End-of-Program-Mode” tones to the telephone continuously, until the CONNECT button is pressed, at which time the interconnect returns to idle, waiting for another command.

12# This command will send a continuous “beep” tone (1 kHz) to the telephone until the CONNECT button is pressed, at which time the interconnect returns to idle and waits for another command.

13# This command will make the interconnect repeatedly pulse dial the digit “0” until the CONNECT button is pressed, at which time the interconnect returns to idle and waits for another command.

203# This command is used to exit the Telephone Test mode as well as to enter it. When this command is entered, from within the Telephone Test mode, the ZR350 will return an “Error” tone and then return to the normal Program mode.

Once you return to the normal Program mode, you can either work with the commands in that mode, or exit back to the Normal operating mode by entering a 99#. The ZR350 will return

an “End-of-Program-Mode” tone (ringing) and the return to its normal idle state, waiting for a call to come in.

APPENDIX A. QUICK REFERENCE

APPENDIX A. QUICK REFERENCE

SYSTEM PROGRAMMING COMMANDS

01# _ _ _ _ _ _ _ _ # Connect Prefix (default = *1)
02# _ _ _ _ _ _ _ _ # Disconnect Prefix (default = #1)
03# _ _ _ _ _ _ _ _ # Toll Restrict Bypass Prefix (default = 99)

04# DTMF Dial Radio Originated Calls (default)
05# Pulse Dial Radio Originated Calls

204# - Set Make/Break Ratio to 39/61 (default)
205# - Set Make/Break Ratio to 33/67

06# Wait 1 ring before answering (default)
07# Wait 3 rings before answering
08# Wait 5 rings before answering

10# _ _ # Radio Answer Time (default = 30 seconds, 10-60)

12# Disable Interconnect

14# _ _ _ _ # First Digit Toll Restrict digits (default = none)
15# _ _ _ _ # Second Digit Toll Restrict digits (default = none)

16# Ring once on air and wait for radio answer
17# Ring on channel until radio answers (default)

201# Enable gap between call forwards
202# Disable gap between call forwards (default)

18# Enable single user (CSQ, PL, DPL) repeat
19# Disable carrier repeat (default)
21# No repeat hold time
22# 1 second repeat hold time
23# 3 second repeat hold time (default)
24# 5 second repeat hold time
51# Time-out timer enabled, 3 minute (default)
52# Time-out timer disabled

25# _ _ _ _ _ _ _ _ # Morse code station identification (default = none)
60# Disable station identification
61# Station id / 10 minute interval / with activity (default)
62# Station id / 10 minute interval / no activity

26# Courtesy tone enabled
27# Courtesy tone disabled (default)

28# Privacy mask enabled
29# Privacy mask disabled (default)

30# Enable call limit timer (default)
31# Enable call limit timer w/ "*" reset
32# No call limit
33# 3 minutes (default)
34# 5 minutes
35# 10 minutes

36# 30 second radio activity (default)
37# 45 second radio activity
38# 1 minute radio activity

40# Half duplex mode
42# Simplex vox (default)
43# Simplex vox with pre-key

44# Vox hold time .5 seconds
45# Vox hold time .8 seconds
46# Vox hold time 1 second (default)
47# Vox hold time 1.3 seconds
48# Vox hold time 1.5 seconds
83# No COR hold time (default)
84# 100 msec carrier hold time
85# 300 msec carrier hold time
86# 500 msec carrier hold time

49# _ _ _ _ _ _ _ _ _ _ ... # Select V decode autodial number (16 digits)

67# _ _ # Talk time (default = 10 seconds, range 10 to 30)
68# _ _ # Auto-call user number (default = 0)

81# - Single User Operation
82# - Multi-User Operation (default)

87# Disconnect on busy for first 20 seconds (default)
88# Disable busy detect
89# Disconnect on busy for duration of call

99# Exit program mode

100# - Short Sign-on Mode (default)
101# - Full Sign-on Mode

102# - Local Phone Ringer Enabled
103# - Local Phone Ringer Disable (default)

USER PROGRAMMING COMMANDS

50# _ _ # _ _ #	Assign call forward user number
70# _ _ #	User disabled (default condition for all users)
53# _ _ #	5-tone radio (answer via COR, disconnect via DTMF)
54# _ _ #	5-tone talkback (voice hail, COR answer, DTMF disconnect)
55# _ _ #	5-tone tone only pager
56# _ _ #	5-tone tone + voice pager
69# _ _ #	QCII group-call radio equipment type
73# _ _ #	QCII radio equipment type
74# _ _ #	QCII tone only pager equipment type
75# _ _ #	QCII tone & voice pager equipment type
78# _ _ #	QCII talkback pager equipment type

99# Exit program mode

SELECTIVE CALLING COMMANDS

11# _ #	5-tone tone series / timing (1-9, default = 1)
13# _ #	5-tone group translation digit (none or 0-9, default = none)
39# _ _#	Extended First Tone (0-99, default = 0)
57# _ #	5-tone encode first digit strap (0-9, default = 1)
58# _ #	5-tone encode second digit strap (0-9, default = 2)
59# _ #	5-tone encode third digit strap (0-9, default = 3)
65# _ #	QCII group 1 (1-6, default = 1)
66# _ #	QCII group 2 (1-6, default = 2)

99# Exit program mode

INSTALLATION COMMANDS

90# _ _ _ _ _ #	Program access code (default = 12350)
91#	Reset memory to defaults
92#	Tx level test
96#	Dial click test

FIVE-TONE ENCODE (Tone Group/Timing Table)

Tone set	CCIR1	CCIR2	EEA	EIA	ZVEI1	ZVEI2	DZVEI	PZVEI	ZVEI3
Selection #	1	2	3	4	5	6	7	8	9
Tone #									
0	1981	1981	1981	600	2400	2400	2200	2400	2400
1	1124	1124	1124	741	1060	1060	970	1060	1060
2	1197	1197	1197	882	1160	1160	1060	1160	1160
3	1275	1275	1275	1023	1270	1270	1160	1270	1270
4	1358	1358	1358	1164	1400	1400	1270	1400	1400
5	1446	1446	1446	1305	1530	1530	1400	1530	1530
6	1540	1540	1540	1446	1670	1670	1530	1670	1670
7	1640	1640	1640	1587	1830	1830	1670	1830	1830
8	1747	1747	1747	1728	2000	2000	1830	2000	2000
9	1860	1860	1860	1869	2200	2200	2000	2200	2200
A Group	2400	2400	1055	2151	2800	885	825	970	885
B	930	930	930	2433	810	810	740	810	810
C Reset	2247	2247	2400	2010	970	740	2800	2800	2800
D	991	991	991	2292	885	680	885	885	680
E Repeat	2110	2110	2110	459	2600	970	2400	2600	970
F	1055	1055	2247	1091	680	2600	680	680	2600
Tone Period	70ms	100ms	40ms	33ms	70ms	70ms	70ms	70ms	70ms

TWO-TONE PAGING (Tone Group/Tone Number/Frequency Table)

	TONE GROUP NUMBER					
TONE #	1	2	3	4	5	6
0	330.5	569.1	1092.4	321.7	553.9	1122.5
1	349.0	600.9	288.5	339.6	584.8	1153.4
2	368.5	634.5	296.5	358.6	617.4	1185.2
3	389.0	669.9	304.7	378.6	651.9	1217.8
4	410.8	707.3	313.0	399.8	688.3	1251.4
5	433.7	746.8	953.7	422.1	726.8	1285.8
6	457.9	788.5	979.9	445.7	767.4	1321.2
7	483.5	832.5	1006.9	470.5	810.2	1357.6
8	510.5	879.0	1034.7	496.8	855.5	1395.0
9	539.0	928.1	1063.2	524.6	903.2	1433.4