CE-5

COMMUNICATIONS MONITOR

CUSHMAN
ELECTRONICS, INC.

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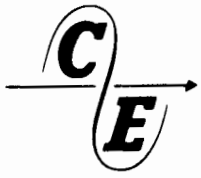

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5601••0034

DECEMBER 1973

WARRANTY

CUSHMAN ELECTRONICS, INC. WARRANTS EACH OF THE INSTRUMENTS OF THEIR MANUFACTURE TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE YEAR FROM THE DATE OF ORIGINAL PURCHASE. THE FOREGOING IS IN LIEU OF ANY OTHER WARRANTY, EXPRESS, IMPLIED OR STATUTORY. THE COMPANY, UNDER THEIR LIBERAL WARRANTY, WILL REPAIR OR REPLACE ANY INSTRUMENT FOUND DEFECTIVE.

THIS WARRANTY MAY NOT APPLY TO INSTRUMENTS WHICH, IN THE OPINION OF THE COMPANY, HAVE BEEN ALTERED OR MISUSED.

This manual is intended to give the user a comprehensive knowledge of the instrument and its operation or repair. In the event of trouble, study the manual carefully. Most instrument malfunctions can be corrected by the user with a minimum of lost usage time.

For assistance or information of any kind, contact the factory. Give full details of the nature of your problem and include the model and serial number of the instrument.

Should it appear that the instrument needs to be returned to the factory for service or recalibration, let us know. Shipping instructions will be promptly given to you. There will be no charge for repair on instruments within the one year warranty other than transportation costs after 90 days of ownership. Estimates of charges for non-warranty or any other service will be supplied by the factory upon request before work is begun and such work will be done on an actual cost basis only.

CLAIM FOR DAMAGE IN SHIPMENT

Your instrument should be inspected and tested as soon as it is received. The instrument is insured for safe delivery. If the instrument is damaged in any way or fails to operate properly, file a claim with the carrier or, if insured separately, with the insurance company.

. . . . . .

We sincerely pledge our immediate and fullest cooperation
to all users of our precision electronic instruments.

PLEASE ADVISE US IF WE CAN ASSIST YOU IN ANY MANNER

CUSHMAN ELECTRONICS, INC.
830 Stewart Dr. ☐ Sunnyvale, Cal. 94086 ☐ 408—739-6760

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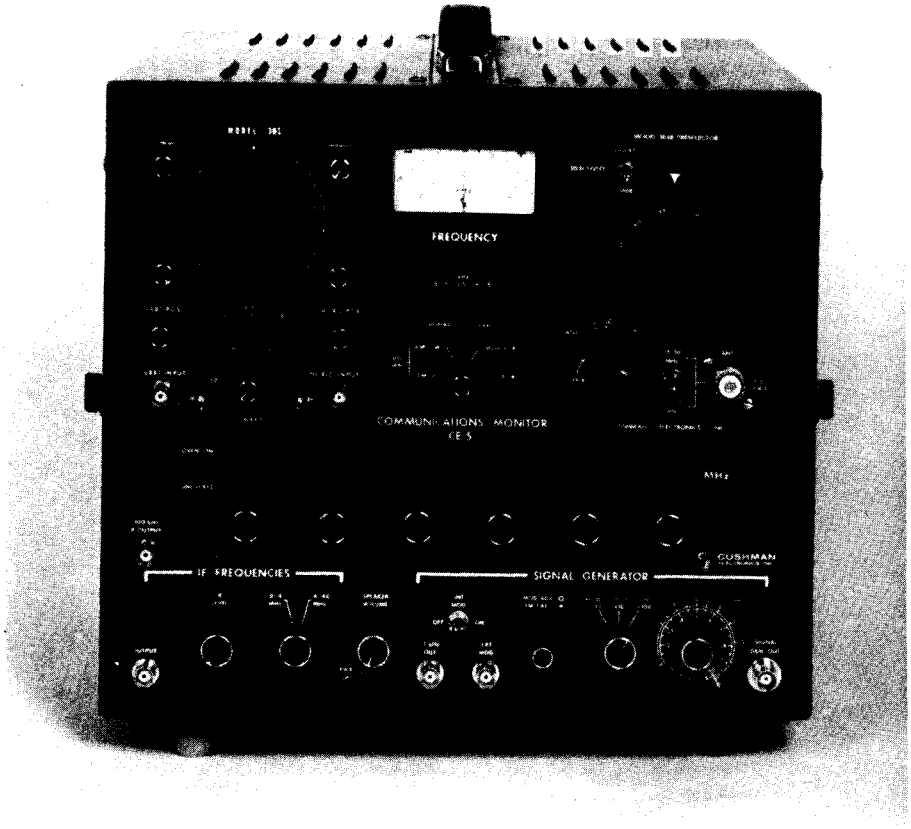


Figure 1-1. CE-5 Communications Monitor

SECTION 1
GENERAL DESCRIPTION

INTRODUCTION

1.01 The Cushman CE-5 Communications monitor accurately measures the frequency of the output of FM or AM transmitters. The range of measurement is from 20 MHz to 519.999 MHz. It also measures the frequency deviation of the modulated output of these transmitters, and using the Model 313 plug-in the percentage of AM may be measured.

1.02 The CE-5 functions as a signal generator covering the same range of 20 MHz to 519.999 MHz with the same accuracy as in the Monitor mode. The output level is calibrated from 0.1 to 100 microvolts. The output may be either FM, AM or CW and the modulation and level are both adjustable. Modulation, both FM and AM, is from an internal 1 kHz source. Modulation from an external source, 60 Hz to 20 kHz, may also be used for both AM and FM. In addition both internal and external modulation may be applied simultaneously.

1.03 In the IF Frequencies mode signals from 1 kHz to 40 MHz are available at a separate output, with the same accuracy as the generator. Level is adjustable but not calibrated. These IF Frequencies may be used for alignment and troubleshooting of receiver IF and audio circuits.

1.04 In the generator mode the CE-5 may be used to align and check the sensitivity of receivers. Since both internal and external modulation may be used simultaneously or several external modulating frequencies may be summed and used to modulate the output, the instrument may be used for testing and aligning of tone operated receivers.

1.05 When a measurement of the received frequency with greater resolution is required a counter may be connected to the 100 kHz IF OUTPUT connector. This output is 100 kHz ± the error of the signal with reference to the dialed in frequency. The accuracy now will be the accuracy of the CE-5 Master Oscillator crystal frequency ± the accuracy of the counter.

GENERAL DESCRIPTION

1.06 The CE-5 is a specialized VHF/UHF superheterodyne receiver. With it a transmitter can be monitored for correct carrier frequency and amount of modulation deviation. The assigned transmitter carrier frequency is "dialed in" and the actual carrier frequency of the received signal is compared with an internally generated standard. This standard is the local-oscillator (LO) frequency.

1.07 When the incoming signal is of sufficient amplitude, a frequency error detector is activated and a meter shows the difference between the assigned carrier frequency and the actual carrier frequency. Discriminator circuits are also turned on which provide an indication (on a Deviation Meter or Oscilloscope) of frequency deviation.

1.08 The CE-5 must be operated with either a Cushman Model 301 Oscilloscope or a Model 302 Deviation Meter inserted into the left-hand plug-in compartment, and the broadband mixer, one of the RF Preselectors or one of the other available plug-ins in the right hand compartment.

1.09 The incoming signal is received at the antenna connector of whatever RF plug-in is used and a first intermediate frequency (IF) signal is produced with a frequency that is 10 MHz ± carrier frequency error. LO frequency = dialed in frequency ±10 MHz. Dialed in frequency = assigned carrier frequency, therefore the difference between the LO frequency and the actual carrier frequency is 10 MHz ± the carrier frequency error. The LO frequency may be either 10 MHz above or below the dialed in frequency.

1.10 The first IF signal is mixed with a stable 9.9 MHz signal from the Master Oscillator (MO) to produce a second IF signal with a frequency of 100 kHz ± carrier frequency error. The error is detected and displayed on the FREQUENCY meter.

1.11 The second IF signal is also demodulated and the resultant audio frequency signal is amplified in the Deviation Meter or in the Oscilloscope to give an indication of the amount of FM deviation present due to the modulation on the received carrier.

1.12 In the Signal Generator mode the LO is used for the output signal, but is shifted ±10 MHz so that the output frequency will be the same as the dialed in frequency. This 10 MHz shift is automatically taken care of by mixing an internally generated 10 MHz signal with the LO. This 10 MHz signal can be modulated, either FM or AM, or left unmodulated for CW output. Modulation is by an internally generated 1 kHz signal or may be from an external source, or both may be used together.

1.13 The level of FM, AM or CW signals generated by the CE-5 is controlled by attenuators which are calibrated to give an output of between 0.1 and 100 microvolts through a 20 dB fixed attenuator which is supplied with the instrument. This fixed attenuator should be used for protection, but approximately 10 times more signal is available

without the pad. A fuse is included in the signal generator and in the 20 dB pad to protect the signal generator mixer from accidental overload.

1.14 IF Frequencies are also available for external use. This output is a signal variable throughout the audio range and throughout the range of frequencies that are usually found in the intermediate frequency stages of commercial radio receivers (that is, a range of from 1 kHz to 40 MHz). The IF frequency output level is not calibrated. From 0 to 3.9999 MHz the frequencies are fundamentals, from 4 to 39.999 MHz the harmonic content is enhanced and the 10th harmonic of the fundamentals is used. Other harmonics are also present in this signal and are available for use. Connection to the output is made at the IF output connector. The first dial digit must be placed in the IF position to obtain these frequencies.

1.15 The numbers that indicate the dialed-in frequency are operative in all modes of the CE-5, monitoring as well as signal generating. The numbers are lighted for easy reading. If a frequency that is not within the operating range of the CE-5 is selected, the display will flash on and off to indicate this. Table 1-1 lists the specifications for the CE-5 as well as the pertinent characteristics of the available plug-in accessories.

ACCESSORIES

1.16 Two types of accessories are available for use with the CE-5. Units that plug into the Monitor and obtain operating power from it, and items furnished with the Monitor but not integral parts of it.

1.17 Plug-In Units

1.18 An opening in the left-hand part of the Monitor front panel, accepts either the Model 301 Oscilloscope or the Model 302 FM Deviation Meter. One or the other of these must be used to provide FM deviation measurements. A similar opening in the right-hand part of the front panel accepts a Model 303 Broadband Mixer, a Model 313 AM Monitor, or one of the presently available RF Preselectors.

1.19 The Model 303 Broadband Mixer is used in the measurement of frequency and FM deviation of local transmitters over the whole range of 20-520 MHz. The RF Preselectors are used over the ranges of the most used bands in the same way for monitoring transmitters many miles distant. The Preselectors are also equipped with broadband mixers. The Model 312 Frequency Extender covers the range of 50 kHz to 20 MHz for both FM measuring and the Signal Generating functions. The Model 313 has all the capabilities of the Model 303 and in addition it can monitor AM signals. It displays the percentage of AM (0-100%) in either the Monitor or Signal Generator modes.

1.20 The Model 301 Oscilloscope permits visual examination of the exact modulation of the transmitter carrier. Unbalanced modulation, power supply pulses, unusual clipping, and other problems are immediately apparent so that appropriate repairs can be made. The Model 301 has an automatic sync circuit similar to that found in laboratory instruments. The scope graticule is calibrated to show deviation on any one of three ranges: ±1.5, ±5, and ±15 kHz. Switches on the front panel permit use of external vertical inputs while using the internal sweep. External signals may also be connected to the horizontal input. This permits use of the Model 301 independently of the monitoring function, for routine testing, troubleshooting, displaying Lissajous patterns, etc. The Oscilloscope can also be used for receiver IF bandwidth measurement and discriminator alignment, as described in the Model 301 manual.

1.21 The Model 302 FM Deviation Meter provides three ranges: 0 to 2.5, 0 to 6, and 0 to 25 kHz. An instantaneous peak indicator light flashes when the absolute peak deviation of the incoming carrier exceeds an amount preset by means of the SET control. Operation and accuracy of the flasher are not affected by modulation frequency, repetition rate, or waveform. A switch permits selection and measurement of either plus (+) or minus (-) deviation peaks. A scope jack is provided for simultaneous meter indications and oscilloscope observations of deviation (a separate oscilloscope, not a Model 301, must be used).

1.22 Auxiliary Items

1.23 Two major auxiliary items are supplied with the instrument: a telescoping antenna, extendable from 9.5 to 39 inches, and a 20 dB fixed attenuator with cable for use with the CE-5 when a generated signal is being fed into a receiver. (See Table 2-1 for a complete list of auxiliary items). Both the attenuator and the cable are stored inside the front cover of the instrument. Installation of the antenna is described in Section 3.10a, the use of the 20 dB fixed attenuator in Section 3.11d.

Table 1-1. CE-5 Communications Monitor, Specifications

ITEM	CHARACTERISTICS
RF SIGNAL GENERATION	
FREQUENCY	
Range	20-519.999 MHz
Resolution	1000 Hz
Accuracy	0.00002% ± Time Base
LEVEL	
Range	0.1μV to 100μV RMS, after external 20 dB attenuator
Accuracy	±3 dB at 100μV RMS output from external 20 dB attenuator
Dial Attenuator	±2 dB
Step Attenuator	±2 dB
OUTPUT IMPEDANCE	50Ω Nominal
MODULATION	
FM	
Internal	
Frequency	1000 Hz
Deviation	0 to 25 kHz min.
Distortion, Deviation in the range of 3.3 to 15.0 kHz	2% max.
External	
Frequency (For optimum performance the sum of the modulating frequency and deviation, in kHz, should not exceed 45)	100 Hz to 20 kHz
Input Impedance	600Ω nominal
Simultaneous	
Frequency	External tone 100 Hz to 20 kHz, and internal tone 1000 Hz
AM	
Internal	
Frequency	1000 Hz
Range	0 to 80% min.
Distortion	
30% modulation	5% max.
80% modulation	10% max.
External	
Frequency	100 Hz to 20 kHz
MONITOR	
Frequency	
Range	20-519.999 MHz
Resolution	
Meter	50 Hz
Accuracy	0.00002% ± Time Base
Sensitivity	See plug-in specifications
IF SIGNAL GENERATION	
Frequency	
Range	1 kHz-3.9999 MHz 4 MHz-39.999 MHz (on harmonics)
Accuracy	0.00002% ± Time Base

Table 1-1 Specifications (Continued)

ITEM	CHARACTERISTICS
Level	0 to 1 volt nominal into 600Ω in 0-4 MHz mode 5 volt nominal into 600Ω in 4-40 MHz mode
100 kHz I.F. Output	
Level	100mV RMS min. into 10kΩ min. load impedance
1 kHz Output	
Level	1V p-p nominal into 600Ω
TIME BASE	
Aging	5×10^{-8}/Month max. (3 month average) 6×10^{-7}/Year max.
Oven Warm-up Time	Less than 25 min. from 25°C to 1×10^{-7} Less than 45 min. from 0°C to 1×10^{-7}
POWER REQUIREMENTS	115V ±10% AC, 50-400 Hz, 75 Watts max. (Factory option available for 230V ±10% AC, 50-400 Hz.)
DIMENSIONS	12 1/4" High x 13" Wide x 18 1/2" Deep
WEIGHT	
Less Plug-ins	31 lbs. (Approx.)
With Plug-ins	38 lbs. (Approx.)
ENVIRONMENTAL	
Temperature, operating	0°C to 55°C
Temperature, storage	-40°C to +75°C
Humidity	95% RH, +40°C
Vibration	10-55 CPS, .01" p-p amplitude
Shock	4" Bench drop
Altitude	25,000 Ft. Non-operative 15,000 Ft. Operative
Model 301 Oscilloscope Plug-in	
Deviation Measurement Accuracy	±5% full scale in three ranges: 1.5 kHz, 5.0 kHz, 15.0 kHz
External Inputs	Vertical and Horizontal
External Vertical Sensitivity	300mV for full scale
External Frequency Response (3 dB)	30 kHz
Model 302 Deviation Meter Plug-in	
Accuracy of Measurements	±4% full scale in three ranges: 0-2.5, 0-6, 0-25 kHz
Model 303 Broadband Mixer Plug-in	
Carrier Frequency Coverage	20-520 MHz 520-1030 MHz using harmonics
Sensitivity	Less than 10mV below 520 MHz
Input Impedance	50 ohms (nominal)
Receiver Bandwidth (3 dB)	
Broad	80 kHz
Narrow	13.5 kHz

Table 1-1 Specifications (Continued)

ITEM	CHARACTERISTICS	
RF Preselector Plug-ins	Model 304B	Model 305B
Frequency Coverage	25-50 MHz	140-175 MHz
Nominal Input Impedance	50 ohms	50 ohms
Bandwidth (3 dB)		
Broad	65 kHz	65 kHz
Narrow	20 kHz	20 kHz
Sensitivity: Less than	20 microvolts	20 microvolts
	Model 306D	Model 307B
Frequency Coverage	450-520 MHz	120-139.9999 MHz
Nominal Input Impedance	50 ohms	50 ohms
Bandwidth (3 dB)		
Broad	65 kHz	65 kHz
Narrow	20 kHz	20 kHz
Sensitivity: Less than	20 microvolts	20 microvolts
Mod 312 Frequency Extender	50 kHz to 20 MHz	
Freq. Dev. Measurement: Sensitivity	Less than 10mV	
Input/Output	50Ω	
RF Generation: Output voltage	100mV RMS ±1.0 dB into 50Ω load	
Step Attenuator	0.1, 1.0, and 10.0 mV RMS	
Model 313 AM Monitor	20 MHz to 1 GHz	
Input Sensitivity	Less than 10mV	
AM Modulation (meter) Range	0-100%	

SECTION 2
INSTALLATION

UNPACKING AND INSPECTION

2.01 When unpacking the Model CE-5 Communications Monitor inspect the packing box and the instrument for signs of possible shipping damage and see if the auxiliary items, listed in Table 2-1 and shown in Figure 2-1, are present. Verify satisfactory performance as outlined in the Operating Instructions (Section 3). If the instrument is damaged or fails to operate properly, or if any of the auxiliary items are missing, file a claim with the transportation agency or, if insured separately, with the insurance company.

ENVIRONMENTAL REQUIREMENTS

2.02 Temperature

2.03 The CE-5 is designed to operate between 0°C and +55°C (ambient). Especially in the field, these temperatures can easily be exceeded; for instance, the internal temperature of a closed automobile trunk may exceed 150°C during summer daylight hours.

Do not block the cabinet ventilating louvers. Exceeding the upper or lower temperature limits for extended periods may not result in noticeable damage to the instrument, but may cause poor performance or actual malfunctioning.

2.04 RF Fields

2.05 Where extremely high RF radiation fields exist (such as when the CE-5 is used near a transmitter), the telescoping antenna should be pushed down to reduce pickup. Where many high-power transmitters are in use adjacent-channel interference may be experienced if the transmitters are operating within 90 kHz of each other. In such cases, the SELECTIVITY switch on the Model 303 Broadband Mixer should be placed in the SHARP position. If satisfactory measurements can still not be made, direct connection between the transmitter to be monitored and the CE-5 via an RF attenuator may be required; contact Cushman Electronics for further information. (Note: In the SHARP position the bandwidth is narrowed so that deviation readings may be degraded unless the sum of the modulation frequency plus the frequency deviation, in kHz, is less than 11. In the WIDE position this sum may be as much as 33.)

POWER REQUIREMENTS

2.06 The CE-5 operates from a 115 volt (±10%) 50 to 400 Hz AC source. Power consumption is 75 watts. If 230V AC operation is desired this must be specified in the original order. A 115 volt instrument may be converted to 230V AC by returning to the factory for the installation of a 230 volt crystal oven and the necessary wiring changes.

WARM-UP REQUIREMENTS

2.07 The accuracy of CE-5 measurements depends on maintaining the master-oscillator crystal at a constant temperature. This is done by a thermostatically controlled oven which requires a 25 minute warm-up period prior to use. (When stored at temperatures down to 0°C, up to 45 minutes is required for warm-up. Proportionately more time is required for lower temperatures.) Oven operation is independent of the on-off power control and it is recommended that the instrument be installed so that it can be kept connected to its power source. Thus, the CE-5 will be ready to make precise measurements within seconds after the instrument is turned on.

PREPARATION FOR RESHIPMENT

2.08 It is recommended that the shipping box and foam packaging be kept in case it becomes necessary to ship the instrument to the service point or factory for service or repair. (Contact Cushman Electronics Customer Service Department before returning an instrument.)

2.09 The following is a general guide for repackaging the instrument for shipment.

NOTE

If the instrument is to be shipped, attach a tag to the instrument identifying the owner and showing the return address. Indicate the service or repair to be accomplished. Include the model number and full serial number on the instrument. In any correspondence, always identify the instrument by model number and serial number.

2.10 If the original container is to be used, proceed as follows:

(1) Place the instrument in the original container. (If the original container is not available, one can be purchased from Cushman Electronics.)

(2) Make sure that the container is well sealed with strong tape.

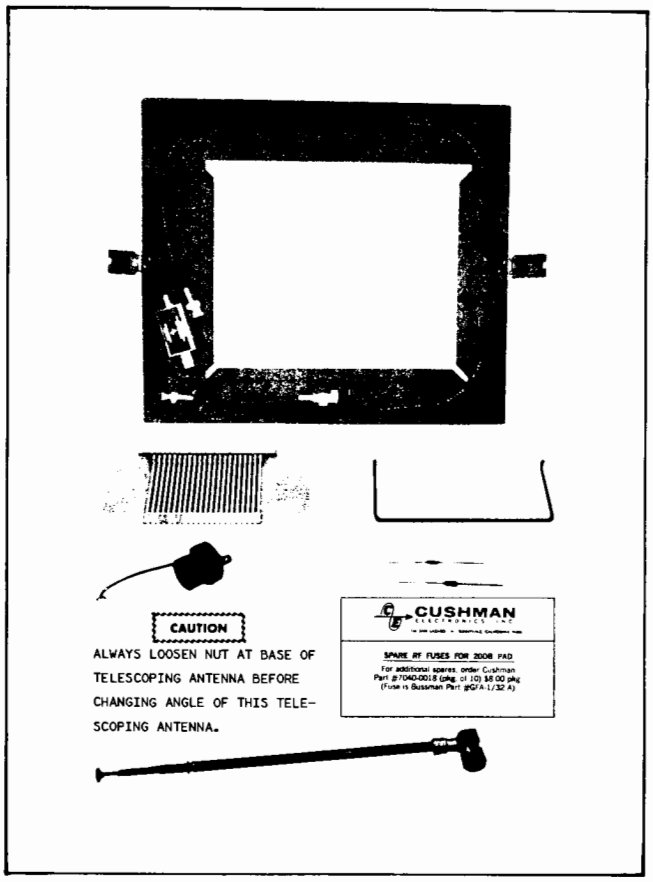


Figure 2-1. Auxiliary Items Furnished With CE-5

Table 2-1. Auxiliary Items Furnished with CE-5

ITEM	DESCRIPTION	CUSHMAN STOCK NO.	QUANTITY
1	Fuse, RF, 1/32 Amp	1955-0005	2
2	Three prong/two prong AC Plug Adapter	2535-0001	1
3	Extractor, P. C. Board	3875-0036	1
4	Extender Board	7001-0024	1
5	20-dB Fixed Attenuator Adapter Cable Assembly	7040-0032	1
6	RF Cable Assembly	7032-5001-01	1
7	Antenna Assembly	7040-0019	1
8	Manual, CE-5	5601-0034	1
9	Front Cover	7005-0029	1

2.11 If the original container is not used, proceed as follows:

(1) Wrap the instrument in plastic or heavy paper before placing in an inner container.

(2) Place packing material around all sides of the instrument.

(3) Place the instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

(4) Mark the shipping container: "DELICATE ELECTRONIC INSTRUMENT", "FRAGILE".

SERVICE OR REPAIR

2.12 In the event that factory service or repair seems to be required, contact the Cushman Electronics Customer Service Department for further service information or to make arrangements for shipment to the factory or to a Service Center. The factory address is:

Cushman Electronics, Inc.
Customer Service Department
830 Stewart Drive
Sunnyvale, California 94086
Telephone: (408) 739-6760

2.13 Other service centers for Cushman Electronics instruments are:

BCS Associates, Inc.
940 North Fern Avenue
Orlando, Florida 32803
Telephone: (305) 896-4881

Reshal Associates
219 West University Drive
Arlington Heights, Ill. 60004
Telephone (312) 398-7660

SECTION 3
OPERATION

GENERAL INFORMATION

3.01 The Model CE-5 may be operated in one of three modes: Monitor (frequency and deviation measurement), AM/CW or FM Signal Generation, IF and Audio frequency generation. The first two modes are selected by the Function switch, located in the center of the panel. The third mode is selected by the most significant digit switch (farthest left) of the Frequency Selector switches, when it is in the IF position.

3.02 In the MONITOR position of the function switch, the incoming signal is applied through the ANT. connector, either from an outside antenna or from the telescoping antenna. The signal frequency is measured by dialing in the assigned frequency of the transmitter with the six frequency selectors and reading the frequency error on the FREQUENCY meter. Modulation deviation is indicated simultaneously by the FM DEVIATION meter of the Model 302 Deviation Meter or on the screen of the Model 301 Oscilloscope, whichever is used. A built-in speaker makes the modulation on the incoming carrier audible. Level is adjusted by the SPEAKER VOLUME control.

3.03 In the SIG. GEN. positions of the function switch, the desired frequency is also dialed in with the six Frequency Selector knobs. The generated signal (AM/CW or FM) is available at the SIGNAL GEN. OUT connector. A precision attenuator provides calibrated outputs of 0 to 1, 0 to 10, 0 to 100 microvolts. When SIG. GEN./FM has been selected (instead of AM/CW) the modulation deviation can be varied from zero to 25 kHz. An internally generated 1 kHz modulating signal is available or, an external modulating signal can be used, or both internal and external modulation may be used simultaneously. The amount of deviation of the modulation on this generated signal can be read on the FM DEVIATION meter or on the Oscilloscope screen. Level is adjusted with the MOD ADJ control.

3.04 In the AM/CW position the output is CW, if no modulating tone is applied. The internal 1 kHz source may be used to modulate the output or an external signal connected to the EXT MOD connector. Both internal and external modulation may be used simultaneously if desired. Level is adjusted with the MOD ADJ control.

3.05 When audio or IF signal generation is desired, the first and second (from the left) frequency selectors must be used. Turning the first knob brings into view the numbers 0-5, or the letters IF. To prepare the instrument for audio or IF frequency signal generation, the first knob is turned until IF shows. Unless the second knob is turned to 0, 1, 2, or 3, the light which illuminates the six windows will flash on and off, indicating that the frequency dialed is not within the capability of the CE-5 to generate. If the first knob has been set to show IF and the IF FREQUENCIES switch is in the 0-4 MHz position, output frequencies from 1 kHz to 3.9999 MHz can be generated in 100 Hz increments and are selected by dialing the desired number. In the 4-40 MHz position of the IF FREQUENCIES switch, the decimal point appears between the third and fourth digits and harmonic frequencies up to 39.999 MHz are available in 1 kHz increments. The generated signal is available at the IF FREQUENCIES OUTPUT connector and the level is adjusted with the adjacent IF LEVEL control.

FRONT PANEL CONTROLS

3.06 The front panel controls, displays, and connectors shown in Figure 1-1 are listed in Table 3-1. The knob below the FREQUENCY meter, which is used to switch from signal measurement to signal generation is called the Function Switch in the table and throughout the text. The six knobs in a row just below the frequency display window are used to dial in a frequency. They are referred to as the Frequency Selectors. Operating controls for the plug-in units are described in the instruction books for those units.

TURN ON AND WARM UP

3.07 Plug the power cord into an AC power outlet (117 volts ±10%, 50 to 400 Hz) and turn on the power by means of the on/off switch on the SPEAKER VOLUME control.

3.08 Allow the CE-5 to warm up for approximately 15 minutes. (If the instrument has been stored at a temperature below +32°F, additional warm-up time to bring instrument up to operating temperature is required).

FREQUENCY DEVIATION MEASUREMENT

3.09 In the following procedure it is assumed that the RF plug-in is either a Model 303 Broadband Mixer or one of the Preselectors operating in the Broadband mode. In the Preselector mode, the procedure is the same except that the Preselector dial must be set to the frequency dialed in on the CE-5. The Model 301 Oscilloscope or the Model 302 Deviation Meter must be plugged into the left hand opening of the CE-5.

Table 3-1. Operating Controls and Connectors

CONTROL OR CONNECTOR	FUNCTION
FREQUENCY Meter	Indicates received signal error, above or below the dialed in frequency, in kHz.
kHz 1.5, 5, 15	Range switch for FREQUENCY meter. Indicates full scale ranges in MONITOR mode only. In SIG GEN FM range is ±5 kHz only. In CAL or SIG GEN AM/CW RANGE IS ±1.5 kHz only.
SIGNAL LEVEL Indicator Light	Lights when a received signal is strong enough for reliable measurements, in MONITOR mode. In other Function switch positions has no significance with regard to signal level.
Function Switch	
CAL	The FREQUENCY meter is zeroed with the inner knob of the Function switch. FREQUENCY meter range is automatically ±1.5 kHz.
MONITOR	Receive-Monitor operation. Both carrier frequency and FM deviation may be measured. With Model 313 plug-in AM percentage of modulation may be measured.
SIG GEN AM/CW	Signal Generator operation. Output frequency is the same as the dialed in frequency. CW when neither internal nor external modulation is applied. AM with either internal or external modulating tones.
SIG GEN FM	Signal Generator operation. Output frequency the same as the dialed in frequency ± the FREQUENCY meter reading on ±5 kHz scale. Meter centered by FM CAL control.
OVEN ON Indicator Light	On whenever power is applied to the instrument.
UNLOCKED Indicator Light	Indicates an unlocked condition in the Frequency Synthesizer when lighted.
MHz, Frequency Selectors	Each frequency selector knob is associated with a lighted number indicating the dialed in frequency. Numbers will flash off and on if a frequency is dialed that is not within the range of the instrument.
100 kHz IF OUTPUT connector	100 kHz ± error of signal being received or generated. For connection to a Frequency Counter to give greater resolution.
IF FREQUENCIES	First (left side) Frequency Selector dial must be set to IF to obtain these frequencies.
IF LEVEL	Adjusts IF output level. Uncalibrated.
0-4 MHz	Frequencies in the range of 1 kHz to 3.9999 MHz may be generated when the Frequency Selector switches (other than the first) are set to the desired frequency. Decimal point automatically positioned.

Table 3-1. Operating Controls and Connectors (continued)

CONTROL OR CONNECTOR	FUNCTION
4-40 MHz	Frequencies in the range of 4-39.999 MHz may be generated when the Frequency Selector switches (other than the first) are set to the desired frequency. Decimal point automatically positioned. These are the tenth harmonic amplified output of the fundamentals of the lower range. Other harmonics are present and may be used.
OUTPUT connector	IF Frequencies available at this connector.
SPEAKER VOLUME/PWR OFF switch	Controls signal level to the internally mounted speaker. Controls AC power to the instrument. When in the OFF position the crystal oven only is supplied with power.
SIGNAL GENERATOR INT MOD/OFF ON	In the ON position 1 kHz modulating tone is supplied for internal FM or AM, when instrument is in SIG GEN mode.
EXT MOD Connector	External modulating signals, 60 Hz to 20 kHz, modulate the output whenever they are applied to this connector in the SIG GEN mode.
1 kHz OUT Connector	The internally generated 1 kHz modulating tone always available at this connector.
MOD ADJ	Adjusts Frequency Deviation in FM mode or percentage of modulation in AM mode. Frequency deviation is measured on the Deviation Meter or Oscilloscope plug-ins. AM percentage of modulation is measured with Model 313 plug-in.
FM CAL	Adjusts center frequency of generated FM signal, as indicated on the FREQUENCY meter ±5 kHz range. 100 kHz output may be used for greater resolution. Center frequency may be offset up to ±5 kHz for test purposes.
-40 dB, X1, -20 dB, X10, 0 dB, X100	Adjusts output level in 20 dB steps. Multiplier for microvolt settings of Variable Attenuator.
-20 to 0 dB, .1-1.0 Microvolts	Variable attenuator control. Output level is the sum of the dB readings of the step attenuator and the variable attenuator. Microvolt output is the variable control setting multiplied by the step attenuator setting. Readings are correct only when 20 dB pad is used on the SIGNAL GEN OUT connector.
SIGNAL GEN OUT	Output of Signal Generator available at this connector at approximately 10 times the level indicated by the attenuator.

3.10 Make the following connections and settings:

a) Connect an external antenna or the telescoping antenna supplied with the instrument to the ANT. connector. If the telescoping antenna is used, extend it to its full length for low band measurements, to approximately 18 inches for high band measurements, and use minimum length for UHF measurements.

b) Turn the function switch to CAL.

c) Adjust the inner knob (part of the function switch) for a zero (mid-scale) reading on the FREQUENCY meter.

d) If the Model 301 Oscilloscope is being used, set the toggle switches for horizontal and vertical inputs to the INT. position and adjust the VERT. POS. control so that the trace is on the zero reference line while the deviation range switch is in the ±1.5 position. Adjust the scope INTENSITY, FOCUS, and ASTIGMATISM controls for a sharp trace on the screen.

e) Change the function switch to the MONITOR position.

f) Dial in the assigned frequency of the transmitter with the six frequency selectors.

g) Key the transmitter. The SIGNAL LEVEL light should come on. If it does not, move the CE-5 closer to the transmitter until the received signal is strong enough to turn on the light. Normally, measurements can be made easily when the CE-5 is between 25 and 50 feet from the radiating antenna. When a plug-in Preselector is being used, measurements can be made at distances of many miles from the transmitter, assuming the use of an adequate external antenna.

h) Read the difference between transmitter's assigned frequency and actual, transmitted carrier frequency on the Frequency Meter. Select the appropriate, lowest meter range (with the lever switch just below the meter) for greatest resolution. Or connect a counter to the 100 kHz IF OUTPUT and read 100 kHz ± the frequency error.

i) Modulate the transmitter and read the FM deviation on the FM DEVIATION meter or the Oscilloscope. Select the appropriate meter or scope range with the range switch (kHz knob on Deviation Meter, kHz lever switch on Oscilloscope). On the oscilloscope screen, peaks appear above and below the horizontal centerline of the display; the Deviation Meter indicates either positive or negative peaks, depending on the setting of the FM DEV PEAKS switch. If the DEVIATION PEAKS indicator level on the Deviation Meter plug-in has been set (see Model 302 Instruction Manual), all modulation peaks that exceed this level will cause the indicator to light.

j) If the Model 313 AM Monitor is plugged into the right hand compartment, connect the antenna to the connector on the Model 313, and perform the preceding steps (b) through (h). Modulate the transmitter (AM) and read the percentage of modulation on the Model 313 meter. Meter range is 0-100 % modulation.

AM/CW, FM SIGNAL GENERATION

3.11 CW Signal Generation

a. Set the six frequency selector switches to the desired frequency.

b. Place the function switch in the AM/CW position.

c. Set INT MOD switch to OFF.

d. Connect the coaxial cable and the 20-dB fixed attenuator (stored inside the front cover) between the panel connector, SIGNAL GEN. OUT, and the receiver to be tested. The variable attenuators will not read correctly unless the fixed attenuator is used.

e. Adjust the output level with the SIGNAL GENERATOR coarse and fine attenuator controls.

CAUTION

Whenever a direct connection is made between the CE-5 and a transceiver, keying the transceiver will damage the 20 dB fixed attenuator and possibly the CE-5. A fuse is mounted in the 20 dB attenuator as a protective measure. A fuse is also installed in the output of the signal mixer in the CE-5.

3.12 AM Signal Generation

a. Install a Model 313 AM Monitor in the right hand compartment of the CE-5. (AM signals may be generated without the Model 313 but percentage of modulation cannot be

monitored.)

b. Make settings as in paragraph 3.11.

c. For internal 1 kHz modulation only set the INT MOD switch to ON. (No signal should be connected to the EXT MOD connector.) Adjust percentage of modulation with the MOD ADJ control.

d. For external modulation only set INT MOD switch to OFF. Connect external modulation source (60 Hz to 20 kHz) to EXT MOD connector. The external modulation signal may be a single tone or several tones summed together. Adjust modulation percentage with MOD ADJ control.

e. For simultaneous internal and external modulation set INT MOD switch to ON and connect the external modulating signal to the EXT MOD connector. Adjust modulation level with the MOD ADJ control.

3.13 FM Signal Generation

a. Set the frequency selector dials to the desired frequency.

b. Place the function switch in the FM position.

c. Set INT MOD switch to ON if internal 1 kHz modulation is desired. Adjust deviation with MOD ADJ control.

d. If modulation from an external source is desired, connect source to EXT MOD. If simultaneous internal and external modulation is not desired set INT MOD switch to OFF. Adjust level with MOD ADJ control.

e. In either c. or d. set the Frequency meter to 0 using the FM CAL control. The output frequency will now correspond to the frequency dialed in on the Frequency Selectors. The deviation may now be read on the Deviation meter or oscilloscope.

f. Steps 3.11d, e and CAUTION note apply also to FM signal generation.

NOTE

The FM CAL control varies the center frequency of the FM signal and permits testing the alignment and maximum sensitivity of receivers. The FREQUENCY meter is automatically on the ±5 kHz range when in the FM position regardless of the position of the range switch.

AUDIO AND IF SIGNAL GENERATION

3.14 To generate these frequencies set the controls as follows:

a. Rotate the first frequency selector (on left side) to the extreme clockwise position so that IF shows in the display window. If the frequency display window light flashes on and off, this indicates a dialed in frequency which the CE-5 cannot generate. Only if the second frequency selector is turned to 0, 1, 2, or 3, will the light remain steady.

b. Set the IF FREQUENCIES range switch to either 0-4 or 4-40 MHz, as desired.

c. Dial in the desired IF or audio frequency. (Audio frequencies below 1 kHz can be generated; however, the output frequencies will have slight amounts of residual FM.)

d. The generated signal is available at the front panel IF FREQUENCIES OUTPUT connector. Its level can be varied with the IF LEVEL control.

e. The basic output frequency range is always 0-3.9999 MHz, variable in 100 Hz steps. When the switch is placed in the 4-40 MHz position, the 10th harmonic of the fundamental frequencies is used. Other harmonics are present also and can be used.

OUT OF BAND OPERATION

3.15 When using the Broadband Mixer plug-in or the Wideband mode in a Preselector, most of the frequencies between 520 MHz and 1030 MHz may be measured using the second harmonics of the CE-5 LO.

3.16 The frequencies that cannot be measured when using harmonic operation are: 590-610, 690-710, 790-810, 890-910 MHz. When making out of band measurements the measurement sensitivity will be less than in the normal 20-520 MHz band.

3.17 The required LO (f_4) for second harmonic operation is the desired frequency ±10 MHz divided by 2. This frequency must fall within one of the LO (f_4) bands. See Table 3-2. The frequency that must be dialed in on the Monitor is the required LO (f_4) frequency ±10 MHz. 10 MHz is subtracted if mixing is on the high side (Table 3-2) or 10 MHz is added if mixing is on the low side.

3.18 For example, to measure a frequency of 610 MHz, add 10 MHz to obtain 620 MHz and divide by 2 to get 310 MHz, the required LO frequency. (If 10 had been subtracted from 610 to

get 600 and divided by 2 to obtain 300, that frequency does not appear in Table 3-2 and so could not be used.) 310 MHz falls at the bottom of the 310-329.999 LO (f_4) which mixes on the high side. The dialed in frequency then will be 310-10 = 300 MHz.

3.19 Another example, for a frequency of 589 MHz. 589-10 = 579, divided by 2 equals 289.5 MHz. This falls at the top of the 260-289.999 band which mixes on the low side. The dialed in frequency will be 289.5+10 = 299.5 MHz.

These examples were chosen to illustrate the fact that there is no L.O. frequency available for frequencies between 589.999 and 610 MHz which would require an L.O. between 289.999 and 310 MHz.

3.20 To generate second harmonic signals the dialed in frequency will be the desired frequency divided by 2. Since the output being used is the second harmonic of the generated frequency the attenuator calibration will not apply.

Table 3-2. Synthesizer Frequency Relationships

DIAL SETTING	VARIABLE FREQUENCY F1	FIXED FREQUENCY F2	FIXED FREQUENCY F3	LO FREQUENCY TO PLUG-IN OR M3 F4	MIXING SIDE
20 - 39.999	460 - 479.999	0	-430	30 - 49.999	HIGH
40 - 79.999	460 - 499.999	0	-430	30 - 69.999	LOW
80 - 99.999	460 - 479.999	+60	-430	90 - 109.999	HIGH
100 - 119.999	460 - 479.999	+60	-430	90 - 109.999	LOW
120 - 139.999	460 - 479.999	+100	-430	130 - 149.999	HIGH
140 - 179.999	460 - 499.999	+100	-430	130 - 169.999	LOW
180 - 199.999	460 - 479.999	+160	-430	190 - 209.999	HIGH
200 - 219.999	460 - 479.999	+160	-430	190 - 209.999	LOW
220 - 249.999	460 - 489.999	+200	-430	230 - 259.999	HIGH
250 - 269.999	460 - 479.999	-200	0	260 - 279.999	HIGH
270 - 299.999	460 - 489.999	-200	0	260 - 289.999	LOW
300 - 319.999	470 - 489.999	-160	0	310 - 329.999	HIGH
320 - 349.999	470 - 499.999	-160	0	310 - 339.999	LOW
350 - 369.999	460 - 479.999	-100	0	360 - 379.999	HIGH
370 - 399.999	460 - 489.999	-100	0	360 - 389.999	LOW
400 - 419.999	470 - 489.999	-60	0	410 - 429.999	HIGH
420 - 449.999	470 - 499.999	-60	0	410 - 439.999	LOW
450 - 469.999	460 - 479.999	0	0	460 - 479.999	HIGH
470 - 519.999	460 - 509.999	0	0	460 - 509.999	LOW

NOTES: 1. ALL FREQUENCIES ARE IN MHZ.
2. THE LAST 4 DIGITS OF THE VCO, THE BALANCED MIXER, AND THE OUTPUT MIXER FREQUENCIES ARE THE SAME AS THE LAST 4 DIGITS OF THE DIALED IN FREQUENCY.

DIAL INDICATOR LIGHT REPLACEMENT

3.21 To change the Frequency Selector indicator lights or the decimal point lights, proceed as follows:

a. Remove the plug-in units.

b. Remove the side covers of the CE-5.

c. Remove one or both plug-in trays. If the burned out light is not in the center only the tray on one side needs to be removed. (The right hand tray is held by four flat head screws. The left hand tray has, in addition, a spacer mounted to the center plate. Remove the screw from the center plate end of the spacer.)

d. Very carefully unsolder the two light connecting leads from the terminals. (Use a shield between the adjacent wires and the soldering iron to prevent burning the insulation.) Remove the light.

e. Insert a new light, with sleeving on the connecting leads, and solder to the proper terminals.

f. Replace the trays, side covers and plug-in units.

SECTION 4
THEORY OF OPERATION

INTRODUCTION

4.01 This section begins with a description of the circuit reference series of identifying numbers assigned to the different circuit boards. A general description of the overall operation of the Monitor is followed by a description of the frequency synthesizer. The section concludes with a description of the operation of the individual circuits.

4.02 The circuits of the instrument are referred to by the Circuit Reference Series A1-A25. A20, A21 are not used. A22, A23, A24, A25 refer to the circuits mounted directly on the Front Panel, Rear Panel, Main Chassis and Center Plate assemblies respectively. A board number is etched on each circuit board. The Circuit Reference Series, the Assembly number and the Figure numbers are cross referenced to the board number in Table 6-1. A9, A10 are mounted within a container assembly because these circuits must be specially shielded. The Circuit Reference Series, the assembly number and the jack number are screened on the chassis next to the jack connectors

4.03 The components on each circuit board are numbered in sequence on that board. The complete identification of a component combines the Circuit Reference Series number and the board component number. For example, the first numbered resistor on the Sample and Hold board will be A2R1 and the third transistor A2Q3 etc. In describing the individual boards only the board sequence will be used, and only when reference is made to a component outside that board will the complete identification be given.

FUNCTIONAL DESCRIPTION

4.04 The CE-5 Communications Monitor is essentially a VHF/UHF superheterodyne receiver with front end Preselectors covering different frequency bands. Each Preselector operates in a Tuneable Mode over a selected band with high input sensitivity and in the Wideband mode (Preselector untuned) over the full range to which the Monitor may be tuned, with a reduced sensitivity. See Overall Block Diagram Figure 4-6.

4.05 The major portion of the circuitry in the Monitor is for the purpose of generating, synthesizing and controlling the Local Oscillator frequency. In the Receive Mode the Local Oscillator frequency is either 10 MHz above or 10 MHz below the frequency dialed up on the Monitor so as to produce a 10 MHz Preselector IF output.

4.06 In the Signal Generator mode the L.O. output signal is shifted 10 MHz so that it corresponds to the frequency dialed up and is then used as the output frequency. This frequency shift is accomplished by mixing the L.O. with a 10 MHz signal. In the AM/CW mode this signal comes from the synthesizer and may be amplitude modulated. In the FM mode this 10 MHz signal is supplied by a 10 MHz VCO which is frequency modulated by either the internal 1 kHz or external modulating signal, or both. The center frequency is adjusted to the synthesizer frequency by the front panel FM CAL adjustment.

4.07 Frequency synthesis begins with a stable 3 MHz crystal oscillator mounted in a temperature controlled oven. All frequencies used are derived from or compared to this source. Signals are produced either by harmonic generation or mixing. Accuracy is maintained by phase locking the outputs to the master oscillator. In this way the accuracy of this very stable Master oscillator is maintained throughout the whole instrument. Thus the Local Oscillator signal becomes a standard frequency to which an incoming signal is compared. In the signal generating mode this same accuracy is maintained.

4.08 Signals in the range of 1 kHz to 40 MHz are available at the IF Output connector when the first frequency digit switch is placed in the IF position. These frequencies also come from the frequency synthesizer.

4.09 Input signals are mixed with the L.O. in the preselector to produce a 10 MHz I.F. output. This signal is mixed with a 9.9 MHz L.O. output from the synthesizer to produce a second IF of 100 kHz. Since both L.O signals are the standards generated by the synthesizer, the frequency error of the input signal, if any, will appear on the signal in the second IF. Frequency error detector circuits display this error on the FREQUENCY meter which is calibrated directly in kHz.

4.10 The modulation (FM) is also recovered by these circuits and displayed either on the oscilloscope or deviation meter plug-in. AM is detected and displayed by the Model 313 plug-in. Audio output is amplified and reproduced in the speaker.

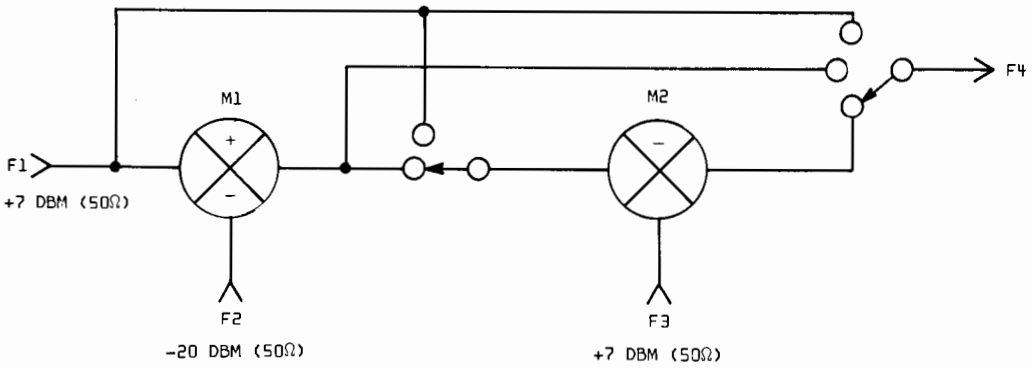
4.11 Frequency Synthesizer

4.12 The Frequency Synthesizer consists of a crystal controlled Master Oscillator (M.O.), a phase locked loop made up of a voltage controlled oscillator (VCO), a Divide-by-N Counter (÷N) with a phase detector and associated circuits, harmonic generators, multipliers and various mixers.

4.13 The basic frequency is generated by the crystal controlled M.O. The M.O. output is divided and multiplied to provide most of the fixed frequencies required. It is used for reference in the phase locked loops of the Programmable Phase Locked Loop which supplies the remainder of the fixed frequencies and in the VCO which provides the variable frequency required for the complete coverage of the band of Local Oscillator (L.O.) frequencies.

4.14 The VCO operates at frequencies from 6 to 10 MHz. Either 40 or 42 MHz is added to this output in the Balanced mixer, then the output is multiplied by ten to produce the variable part of the L.O. frequency. As the case requires either none, one or two fixed frequencies are added or subtracted to or from the variable output to produce the required L.O. frequency. This L.O. will be either 10 MHz lower or 10 MHz higher than the frequency that is dialed in on the monitor in the Receive mode. In the Signal Generator mode 10 MHz is either added or subtracted to the L.O. and the result is then used as the output. The output frequency now is the same as the frequency dialed in on the monitor. Table 4-1 shows the relationships between these

Table 4-1. Synthesizer Frequency Relationships and Mixer Plan



DIAL SETTING	VARIABLE FREQUENCY F1	FIXED FREQUENCY F2	FIXED FREQUENCY F3	LO FREQUENCY TO PLUG-IN OR M3 F4	MIXING SIDE
20 - 39.999	460 - 479.999	0	-430	30 - 49.999	HIGH
40 - 79.999	460 - 499.999	0	-430	30 - 69.999	LOW
80 - 99.999	460 - 479.999	+60	-430	90 - 109.999	HIGH
100 - 119.999	460 - 479.999	+60	-430	90 - 109.999	LOW
120 - 139.999	460 - 479.999	+100	-430	130 - 149.999	HIGH
140 - 179.999	460 - 499.999	+100	-430	130 - 169.999	LOW
180 - 199.999	460 - 479.999	+160	-430	190 - 209.999	HIGH
200 - 219.999	460 - 479.999	+160	-430	190 - 209.999	LOW
220 - 249.999	460 - 489.999	+200	-430	230 - 259.999	HIGH
250 - 269.999	460 - 479.999	-200	0	260 - 279.999	HIGH
270 - 299.999	460 - 489.999	-200	0	260 - 289.999	LOW
300 - 319.999	470 - 489.999	-160	0	310 - 329.999	HIGH
320 - 349.999	470 - 499.999	-160	0	310 - 339.999	LOW
350 - 369.999	460 - 479.999	-100	0	360 - 379.999	HIGH
370 - 399.999	460 - 489.999	-100	0	360 - 389.999	LOW
400 - 419.999	470 - 489.999	-60	0	410 - 429.999	HIGH
420 - 449.999	470 - 499.999	-60	0	410 - 439.999	LOW
450 - 469.999	460 - 479.999	0	0	460 - 479.999	HIGH
470 - 519.999	460 - 509.999	0	0	460 - 509.999	LOW

NOTES: 1. ALL FREQUENCIES ARE IN MHZ.
2. THE LAST 4 DIGITS OF THE VCO, THE BALANCED MIXER, AND THE OUTPUT MIXER FREQUENCIES ARE THE SAME AS THE LAST 4 DIGITS OF THE DIALED IN FREQUENCY.

frequencies.

4.15 For instance, if the number "123.456" is dialed in, the VCO oscillates at 6.3456 MHz; adding 40 MHz gives 46.3456 MHz; multiplying by ten brings the frequency to 463.456 MHz; adding 100 MHz and subtracting 430 MHz gives an L.O. of 133.456 MHz, 10 MHz higher than the 123.456 MHz that was dialed in.

4.16 When a frequency is dialed in, the VCO is adjusted to within 100 kHz of the frequency it must produce by the settings of the first, second, and third frequency selectors. For the values used in the example (123.456/6.3456) this is between 6.3000 and 6.4000 MHz. The setting of all six frequency selectors program the ÷N Counter to the exact VCO frequency associated with this setting. At first the frequency at which the VCO oscillates is not exact to the last three digits and it "hunts" for a few cycles. When the frequency is exactly right, but not until then, the ÷N counter produces a 100 Hz output signal.

4.17 Figure 4-1 is a simplified block diagram of the frequency synthesizer. The loop is shown in the phase-locked condition and therefore the ÷N output is represented as being 100 Hz.

4.18 For the VCO to produce a signal with a frequency of 6.3456 MHz or, 6,345,600 Hz, the input to the ÷N counter must be 6,345,600 pulses per second. The counter divides this input by "N", which stands for the variable quantity for which it can be programmed. In the example N=63,456 and 6,345,600 ÷ 63,456 = 100. Thus, except for the very short time during which the VCO "hunts" for the correct frequency, the ÷N counter output is always 100 pulses per second or 100 Hz.

4.19 The 100-Hz output of the ÷N counter is phase-compared with a stable 100 Hz signal from the M.O. When the signals have the proper phase relationship, this condition is represented by a pulse of a certain duration from the Phase Detector. Each pulse is transformed into a ramp voltage by the Ramp Generator with a duration that is proportional to the width of the pulse. Each ramp is sampled by the 100 Hz from the ÷N counter and a capacitor is charged to the amplitude of the sample.

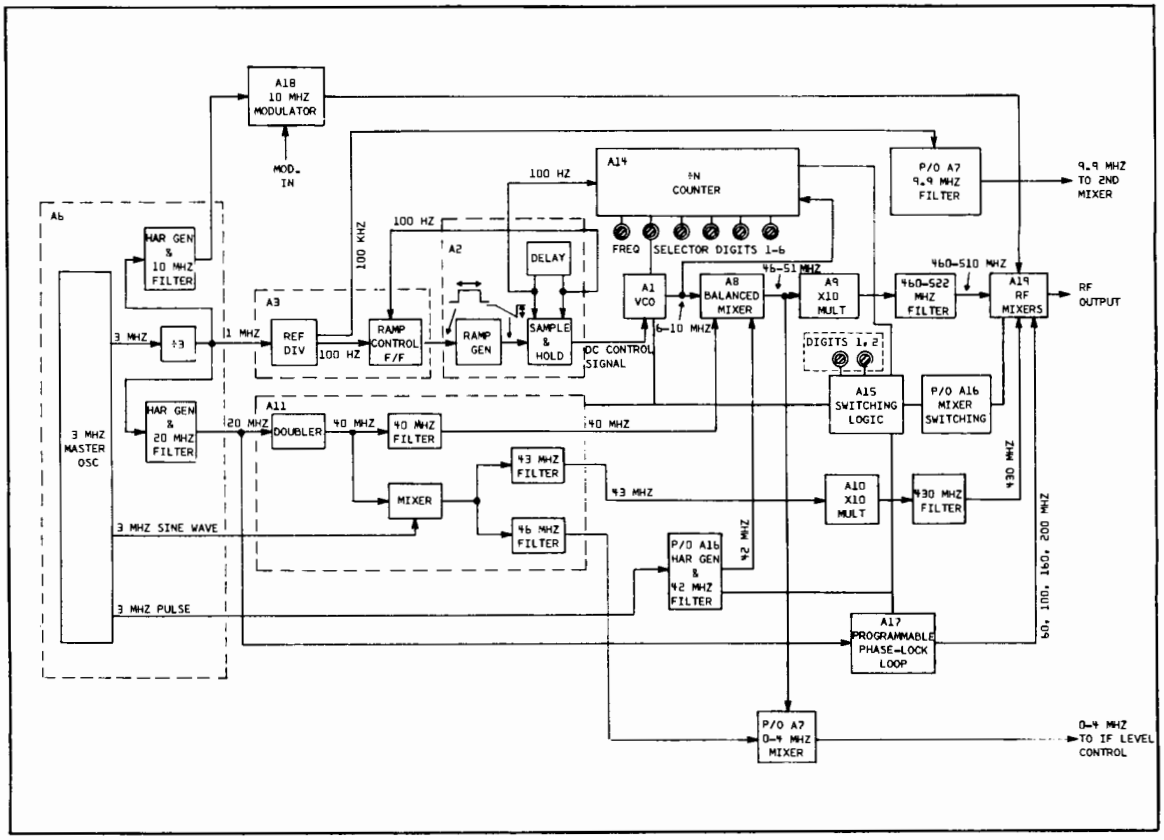


Figure 4-1. Frequency Synthesizer, Simplified Block Diagram

The capacitor retains a certain portion of its charge and after a suitable delay a second sampling takes place. A second capacitor charges to a potential corresponding to the charge that is retained by the first capacitor and the second capacitor retains this exact charge for as long as the two 100 Hz signals have the proper phase relationship. The potential to which the second capacitor charges is used as a control voltage on a Varicap in the VCO circuit. Since it is a Varicap characteristic to change capacitance according to a control voltage, it acts as a fine-tuning device to adjust the VCO to precisely the frequency required.

4.20 The VCO output is combined with either a 40 or a 42 MHz signal in the Balanced Mixer and multiplied by ten in the X10 Multiplier. The signal is then filtered by the 460 to 512 MHz Filter and finally a fixed frequency is added or subtracted. The fixed frequency may be zero, 60, 100, 160, 200, 430 MHz or one of the other four frequencies combined with 430 MHz in the RF mixer. See Table 4-1.

4.21 The output of the RF Mixer (which consists of the multiplied and filtered Balanced Mixer output and the fixed frequency) is passed through a pin diode switch to the mixer in the RF plug-in unit. See Overall Block Diagram Figure 4-6. In the RF plug-in the local oscillator input and the incoming RF signal are mixed to produce the 10 MHz I. F.

4.22 When the CE-5 is used as a signal generator, (FM or AM/CW) the output is switched to the Signal Generator Mixer where, in addition to mixing the Balanced Mixer output with the fixed frequency, 10 MHz is added or subtracted to make the SIGNAL GEN OUT signal coincide with the dialed-in frequency.

4.23 When the CE-5 is used to generate signals in the audio or I. F. range, signal processing is as has been described for the Receive mode, but only up to the point where the signal has passed through the Balanced Mixer. The balanced mixer output is fed to the 0-4 MHz Mixer, which is turned on to generate audio and I. F. signals. Table 4-2

Table 4-2. Frequency Relationships, Audio and I. F. Signal Generation

Frequency Selector Setting	VCO Frequency (MHz)	Balanced Mixer Output (MHz)	To 0-4 MHz Mixer (MHz)	0-4 MHz Mixer Output (MHz)
0.0000 - 0.9999	6.0000 - 6.9999	46.0000 - 46.9999	46.0000	0.0000 - 0.9999
1.0000 - 1.9999	7.0000 - 7.9999	47.0000 - 47.9999	46.0000	1.0000 - 1.9999
2.0000 - 2.9999	8.0000 - 8.9999	48.0000 - 48.9999	46.0000	2.0000 - 2.9999
3.0000 - 3.9999	9.0000 - 9.9999	49.0000 - 49.9999	46.0000	3.0000 - 3.9999

NOTES: 1. First Digit Frequency Selector Knob set to I. F.
2. Fixed frequency input to Balanced Mixer is 40 MHz

shows the frequency relationships in the Frequency Synthesizer in this case.

4.24 A 40 MHz fixed frequency is added to the VCO output in the Balanced Mixer when generating audio and I. F. signals. The Balanced Mixer output is mixed with a 46 MHz fixed frequency in the 0-4 MHz Mixer to produce signals that vary between 1 kHz and 4 MHz according to the setting of the frequency selectors. (Frequencies between 0 and 1 kHz are present but not recommended for use) When the IF FREQUENCIES selector is moved to the 4-40 MHz position the harmonics of signals from 0.4 MHz to 4 MHz are enhanced and can be used.

4.25 The Frequency Synthesizer also provides a 10 MHz and a 9.9 MHz output. The 10 MHz signal is used for calibration and AM/CW generation. The 9.9 MHz signal is mixed with the output of the RF plug-in to produce the 100 kHz second IF frequency.

CIRCUIT DESCRIPTION

4.26 Master Oscillator, Divider and Filters. A6

4.27 This circuit provides the following outputs:

a. A 1 MHz signal for the Reference Divider.

b. A 3 MHz sine wave for the 43 MHz and 46 MHz mixer and filters.

c. A 3 MHz pulse output for the 42-MHz harmonic generator and filter.

d. A 10 MHz signal for discriminator calibration and AM/CW generation.

e. A 20 MHz signal for the 40 MHz mixer and the programmable phase locked loop.

4.28 As shown in the schematic, Figure 6-6, transistor Q1 is part of a modified Pierce oscillator circuit. The 3 MHz crystal is electrically in the base circuit of Q1 but physically in a separate Crystal Oven. The 3 MHz sine wave output of the oscillator is fed through untuned isolation amplifier Q2 to IC2 and also to board pin 4. Integrated Circuit, IC2, is a pulse shaper which changes the 3 MHz sine wave to a square wave. This 3 MHz pulse output is fed to the 42 MHz Filter via board pin 7 and also to IC1 which is connected as a ÷3 counter. Pulse-shaper, IC2, accepts the 1 MHz signal and provides an output, rich in harmonics, to the 10 MHz and 20 MHz filters on the board itself and via board pin 13 to the Reference Divider.

4.29 The 10 MHz and 20 MHz filters are amplifiers in which the output of each stage is tuned to the desired frequency, Q4, Q6, for 10 MHz and Q3, Q5, Q7, Q8, Q9 for 20 MHz. The 10th or 20th harmonic of the input, 1 MHz, signal is selected and amplified to provide the desired frequency output at the proper level. The 10 MHz output, through board pin 9, goes to the 10 MHz Modulator and the 20 MHz output, through board pin 17, goes to the 40 MHz

Mixer and the Programmable Phase Lock Loop.

4.30 Reference Divider. A3

4.31 The Reference Divider circuit is shown in the upper part of Figure 6-3. The 1 MHz signal from the M.O. is divided by decade counters IC1, IC5, IC7, and IC8, and buffered by IC3, IC9, and IC10, to produce a 100 kHz, a 1 kHz, and a 100 Hz output. The first two outputs are available at board pins 4 and 9. The third output is fed to IC2 of the Phase Detector which is shown in the lower part of the schematic.

4.32 Integrated circuit IC2 contains a flip-flop which is set through pin 6 and reset through pin 5. The 100 Hz signal from the Reference Divider turns this flip-flop on and the 100 Hz signal from the ÷N Counter, which comes through the delay circuit on the Sample and Hold board and board pin 20, turns the flip-flop off. The length of the ramp in the ramp generator on the Sample and Hold board is determined by the duration of this pulse.

4.33 Part of IC4 is used as an inverter through which the phase detector output is passed before it goes through board pin 11 to the Sample and Hold circuit. The other part of IC4 is a frequency discriminator which operates in conjunction with the phase detector, IC2. An output of this portion of IC4 triggers the one-shot multivibrator, IC6, which gates a bias voltage to the Lamp Driver, switching transistor Q1.

4.34 When the phase relationship between the input signals does not change, and therefore, when the VCO frequency is correct, the output of IC6 is low and Q1 is off. When the opposite condition prevails, that is, when the loop is unlocked, the output of IC6 is high and Q1 conducts. This lights the UNLOCKED indicator by providing its lamp with a ground return.

4.35 Voltage-Controlled Oscillator. A1

4.36 The circuits on this printed circuit board, generate a signal with a frequency in the range of from 6 to 10 MHz. The frequency that is generated depends on the setting of the front panel frequency selector switches.

4.37 As shown in Figure 6-1, the oscillator circuit includes transistor Q1 and four separate tank circuits. The resonant frequency of each tank can be varied by applying one of ten capacitances in parallel with it. The oscillator is then fine tuned by a Varicap, CR2, which is always in the circuit but the capacitance of which is varied by a control voltage developed in the Sample and Hold circuits.

4.38 The appropriate tank circuit is selected with the first and second frequency selectors. Table 4-3 shows the selector settings that connect one of the sets of the dual diodes, CR1A/B, CR3A/B-CR5A/B, to ground to select that tank circuit.

Table 4-3. VCO Tank Circuits Selected by First and Second Frequency Selectors

First \ Second	0	1	2	3	4	5	6	7	8	9
0, 1	I	II	I	II	I	II	III	IV	I	II
2	I	II	I	II	III	I	II	I	II	III
3, 4, 5	II	III	II	III	IV	I	II	I	II	III
IF	I	II	III	IV	-	-	-	-	-	-

I represents 6 to 7 MHz Tank Circuit
II represents 7 to 8 MHz Tank Circuit
III represents 8 to 9 MHz Tank Circuit
IV represents 9 to 10 MHz Tank Circuit

4.39 Also indicated in Figure 6-1 is the mechanical coupling (shaft) by which the third most significant digit of the frequency selector is coupled to a rotary switch in the VCO assembly. Thus, depending on the setting of this switch the correct capacitance is switched in parallel with the selected tank circuit.

4.40 The fine adjustment to bring the VCO output to the correct frequency is accomplished with the varicap, CR2. The DC output from the sample and hold circuit adjusts the capacity of CR2 until the VCO frequency is correct.

4.41 Divide-by-N Counter. A14

4.42 The function of the ÷N circuit is to divide the VCO output frequency by a number (N) determined by the setting of the Frequency Selector switches, which will cause the output to be 100 Hz when the VCO frequency is correct.

4.43 As has been stated, the VCO must produce a signal with a frequency of 6.3456 MHz for a dialed-in frequency of 123.456 MHz. The VCO sinewave output is connected to the clock pulse-forming network, IC7 (Figures 4-2 and 6-14) In the example, the ÷N Counter must count 6,345,600 pulses per second and produce a signal of 100 pulses per second (100 Hz). This means that for every 63,456 input (clock) pulses, the counter must produce one output pulse. ÷N, in this case, is 63,456.

4.44 When mention is made of the "count" of a decade, this is a reference to the combination of binary states of the four flip-flops that are contained in the decade counter IC's (IC1, IC2, IC3, IC4, IC6, IC9). Each flip-flop is either on or off, it is either in binary state 1 or binary state 0. When counting the decades succesively assume binary coded decimal (BCD) counts 0 through 9. The correlation between the binary state of a flip-flop and the decimal count of the decade is as shown in Table 4-4.

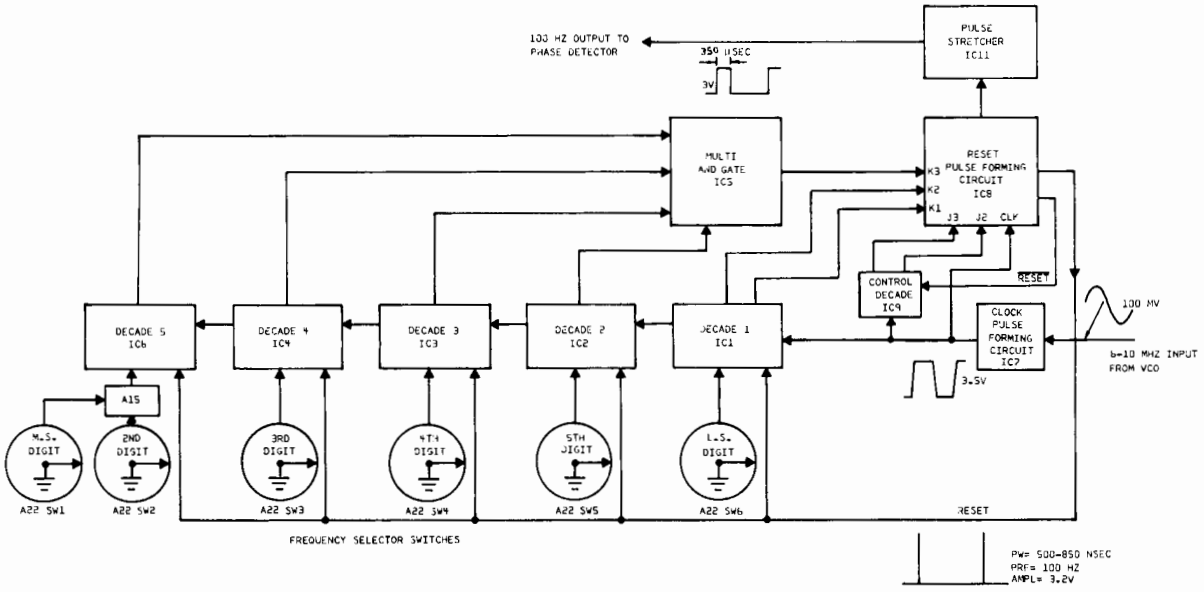


Figure 4-2. Divide-by-N Counter, Simplified Block Diagram

4.45 The ÷N Counter consists mainly of decade counters and gating circuits. There are five *counting* decades, IC1, IC2, IC3, IC4, IC6, and one control decade, IC9, all identical and each capable of counting to ten (a decade). For each ten-count a decade produces one output pulse. Thus, if the first decade counts to ten and produces an output pulse and the second decade counts the output pulses of the first decade to produce its one output pulse, the second decade produces one pulse for every one hundred pulses counted by the first decade. With a third, fourth and fifth decade, the counter as a whole will count 100,000 before the last (fifth) decade can produce its first output pulse.

Table 4-4. Decimal Count of a Decade and the Binary States of its Flip-Flops

Decimal Count	FF-1	FF-2	FF-3	FF-4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

4.46 The decades count continuously, but they can only count to ten. Further, since zero is considered a count, the decades count from 0 to 9. When there is an input signal the five decades cannot return to zero together until they have counted the full count of 100,000 or, from 0 to 99,999.

4.47 To reach a count other than a full count of 99,999, for instance the 63,456 count of the example, each decade must be preset. This is done with the frequency selectors on the CE-5 front panel.

4.48 When the least significant digit of the frequency selector is turned to 6 (63,456) IC1 is preset to 3 (9-6=3). The other four decades are preset or programmed for 4 (9-5=4), 5(9-4=5), 6(9-3=6), and 3(9-6=3). When N=63,456 the decades are preset to 36,543, so that they need to count only 63,456 pulses to reach their first full count of 99,999.

4.49 During the last ten-count by the first decade all other decades will already have reached 9. During this last ten-count a sixth, control decade, senses that the five counting decades are nearing a full count. Specifically,

when IC2, IC3, IC4, IC6 are at count 9 and the first decade reaches count 4 (five more counts to 99,999), the last five pulses are not fed to the first decade but are used in the reset pulse forming network to produce the reset pulse.

4.50 At this count of 4 in the first decade, IC1, IC8 changes state to generate the N output pulse. The beginning of this pulse transfers the input clock signal to IC9 and also resets the dividers IC1, 2, 3, 4, 6 to the preset number determined by the dial settings. When IC9 reaches the count of 9, from its preset count of 5, IC8 again changes state to terminate the ÷N output pulse and transfer the input clock signal back to IC1 so that at the 0 count the dividers may again start counting from the preset number.

4.51 Thus, there is one reset pulse for each 63,456 input or clock pulses. And, since (in this example) the VCO signal consists of 6,345,600 pulses per second (6.3456 MHz), there will be 100 reset pulses per second or, a signal with a pulse repetition frequency of 100 Hz. This signal, made up of reset pulses is the output of the ÷N circuit which is compared with the M.O. signal in the Phase Detector.

4.52 In a signal that consists of between 6,000,000 pulses per second and 10,000,000 per second (the VCO range of 6 to 10 MHz) each clock pulse has a duration of between 100 and 170 nanoseconds. Since it takes the duration of five clock pulses to form the reset pulse, this reset pulse will be between 500 and 850 nanoseconds duration.

4.53 Pulses of this short a duration, even if they occur at the correct frequency, cannot be used as the signal that is to be compared with the 100-Hz signal from the M.O. A pulse stretching circuit, IC11, is used to lengthen the duration of each individual pulse to 350 microseconds.

4.54 The pre-setting of the decades is performed with the frequency selectors and consists of grounding or not grounding the preset input to each flip-flop in the correct combination when the desired number is dialed. Each frequency selector (except the first and the second) is associated with a binary-coded rotary switch which is constructed so that there is one terminal connection to the preset input of each flip-flop. Thus, when a digit is selected, the four flip-flops in each decade are grounded or not grounded as is appropriate for the required preset count of the decade.

4.55 The first and second frequency selectors are both associated with the fifth decade, through IC10. Because of the frequency relationship between the dialed in frequencies and the VCO frequencies (Table 4-1) the numbers dialed in have no direct numerical relationship with the associated preset state of the fifth decade. In the example for instance, the third digit dialed in and displayed is a 3 (123,456 MHz), the second digit of the associated VCO frequency is also 3 (6.3456 MHz). The numerical relationship between the 3 and the preset state of the decade is simply 9-3=6. The first and second digits of the dialed-in frequency are 1 and 2 (123,456). The VCO has no digit corresponding to the first dialed in digit; and the first VCO digit, corresponding to the second dialed in digit, is 6 (6.3456) not 2. Thus, there is no simple numerical relationship; instead, since the first digit of the VCO frequency is arbitrarily 6, 7, 8, or 9; the state of the fifth decade is 3, 2, 1, or 0. Table 4-5 shows which fifth decade state results from which combination of positions of the first and second frequency selectors.

Table 4-5. Fifth Decade Count Preset by First and Second Frequency Selectors

First \ Second	0	1	2	3	4	5	6	7	8	9
0, 1	3	2	3	2	3	2	1	0	3	2
2	3	2	3	2	1	3	2	3	2	1
3, 4, 5	2	1	2	1	0	3	2	3	2	1
IF	3	2	1	0	-	-	-	-	-	-

4.56 Sample and Hold Circuits. A2

The Sample and Hold circuits develop a DC control voltage for the Varicap in the VCO circuit that is proportional to the phase relation between the 100 Hz output of the ÷N Counter and the 100 Hz signal that is derived from the M.O. output. Figure 4-3 is a block diagram of the sample-and-hold circuits.

4.57 The Ramp Generator consists of an inverter, Q1, a reset switch, Q2, and the current amplifiers, Q3, Q4. Its output is a negative going ramp. An undelayed pulse from the ÷N counter turns on FET, Q5, for the duration of the pulse. This causes a small section of the ramp voltage to be passed by Q5 and stored on C9. C9 charges to the most negative level of this ramp section. This charge is proportional to the phase difference between the 100 Hz ÷N output and the 100 Hz derived from the Master Oscillator. Because of the very high input impedance of the MOS FET source follower, Q8, the charge is retained on C9. Q8 drives the operational amplifier IC1 which approximately doubles the voltage difference between IC1-3 and test point 3.

4.58 The voltage on C9 is not suitable as a control voltage for the VCO Varicap because of the sampling ripple that is present, shown on the waveforms in Figure 4-3. The delayed ÷N pulse therefore activates a second sampling circuit so that a sample can be taken of the charge on C9 between un-delayed ÷N pulses.

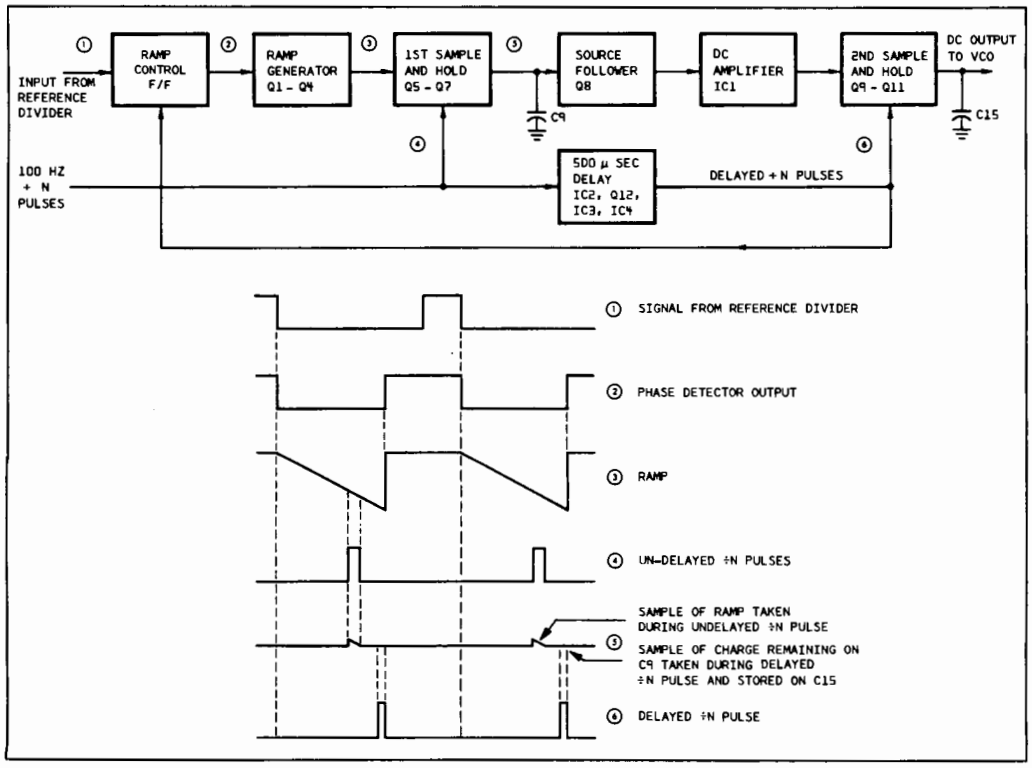


Figure 4-3. Sample and Hold Circuits, Simplified Block Diagram

4.59 The second sample and hold circuit (Q9, Q10, Q11) is virtually identical to the first and its action is the same. It samples the output of IC1 and applies this sample across C15. The result is a control voltage, available at board pin 21 that is suitable for fine tuning the VCO.

4.60 The 500 microsecond delay circuit is shown in the lower part of Figure 6-2. Integrated circuit, IC2, is connected as a one-shot multivibrator which is triggered by the leading edge of the undelayed N pulse and puts out a voltage pulse of approximately 500 microseconds duration. This pulse is inverted by Q12 and the lagging edge of the inverted pulse is used to trigger a second one-shot multivibrator, IC3. The output of IC3 is a pulse approximately 250 microseconds wide, delayed by 500 microseconds. In the foregoing discussion this has been referred to as the delayed ÷N pulse. Integrated circuit IC4 acts as a buffer with two outputs. One output drives Q11 of the second sample and hold circuit and the other goes to the reference divider board, A3.

4.61 40 MHz, 43 MHz and 46 MHz Filters. A11

4.62 The circuits on this board convert 20 MHz and 3 MHz Master Oscillator outputs to signals with frequencies of 40, 43, and 46 MHz.

4.63 The 20 MHz signal from the Master Oscillator is doubled by Q1, Figure 6-11. Isolation amplifier Q7 feeds this 40 MHz signal to the Balanced Mixer, through board pin 15, only when +20 VDC is applied to pin 13. This DC voltage is applied when the first frequency selector is in the 1, 2, 3, 4, IF position, but not when it is in the 5 position.

4.64 In addition, the 40-MHz output of Q1 is fed through amplifier, Q2, to mixer, CR2/CR3, where it is combined with a 3 MHz signal from the Master Oscillator. The output of this mixer contains both 40 MHz +3 MHz = 43 MHz and 40 MHz + 2nd harmonic of 3 MHz = 46 MHz. The output containing the two frequencies is filtered by the harmonic amplifier filter, Q3-Q6 providing a 43 MHz signal at board pin 22. A similar filter, consisting of Q8, Q9 and Q10, makes a 46 MHz signal available at board pin 2. 43 MHz output is switched on when frequencies between 20-249,999 MHz are dialed up. 46 MHz output is used only when the first digit dial is in the IF position.

4.65 42 MHz Filter, Audio Amplifier, Mixer and IF Switching. A16

4.66 Three different functions are performed on this board. See Figure 6-16. There is

a harmonic generator for 42 MHz, an audio amplifier and the switching control for the RF mixers and the IF signals used in mixing for the L.O. output.

4.67 Audio output from the Discriminator circuit is amplified by IC1 and connected to the speaker at pin 7.

4.68 3 MHz pulses from the Master Oscillator/Divider are shaped into narrow pulses by IC3 and passed through harmonic amplifier filter Q5, Q8, Q13, Q21. These stages amplify the 42 MHz component of the input pulse to the level required for mixing.

4.69 The switching circuits on this board control the 43 MHz filter, the 43 MHz X10 multiplier and the RF Mixers. The first two digits (100 MHz and 10 MHz frequency selector switches) through the Switching Logic, A15, control an input to pin 21. This input enables the 43 MHz Filter and the 43 MHz X10 Multiplier through Q9, Q14, Q18, to switch in the 430 MHz fixed frequency when necessary. See Table 4-1.

4.70 Input from the first two digits through pins 18 and 21 control the switch made up of Q1, Q2, Q3, and IC2 which selects one of the four transistor switches connected to the outputs of IC2. Outputs from these switches through pins 13, 14, 15, 17 control the RF mixers. In this way the RF mixers are programmed to accept the output of the programmable Phase Lock Loop or the 430 MHz output of the 43 MHz X10 multiplier or both as required. See Table 4-1.

4.71 Balanced Mixer. A8

4.72 The circuits on this board add either a 40 MHz or a 42 MHz signal to an input from the VCO. The 40 MHz signal comes from the 40 MHz Filter (A11), and the 42 MHz signal comes from the 42 MHz Filter (A16). Both inputs are applied to board pin 2 but only one of the sources is ever activated at a time. The frequency selectors have been wired, to apply +20V to the selected filter to turn it on.

4.73 Buffer Amplifier, Q1, Figure 6-8, provides amplification of whichever input is received and its output is applied to the double balanced mixer through the primary of mixer transformer, T1. The input from the VCO enters the board at pin 11 and is amplified by IC1. The gain is automatically controlled by a DC signal from a level detector on the 46 to 50.99 MHz Multiplier board, A9. This Automatic Level Control (ALC) signal enters the board at board pin 14 and is amplified by IC2 before being applied to IC1. The controlled VCO output of IC1 is then fed to the center tap of transformer T2 through emitter follower, Q4 and band pass filter L12-14, C34-40. This transformer together with T1, CR1, CR2, CR3, and CR4 form the double balanced mixer. The output of T2 is fed to a Bandpass Amplifier which passes and amplifies only the frequencies between 46 and 50.99 MHz. The Bandpass Amplifier provides two outputs, a normal output at pin 21 and an attenuated output at pin 18.

4.74 46-50.99 MHz X10 Multiplier. A9

4.75 The input signal from the Balanced Mixer is connected through J1 to CR1, R1 and T1. Figure 6-9. Part of the input signal is rectified by CR1 and fed back to the Balanced Mixer as the Automatic Level control voltage. T1 with CR2, CR3 doubles the frequency and it is amplified by the tuned amplifiers Q1-Q3 and applied to snap diode CR4. The fast turn-off characteristics of this diode produces a signal very rich in harmonics. The fifth harmonic of the doubled signal is selected by the 460-522 MHz filter FIL-1 to provide the required 460-510 MHz output.

4.76 43 MHz X10 Multiplier. A10

4.77 Input to this circuit from the 43 MHz filter through J1 is amplified by Q1. Figure 6-10. The second harmonic of this signal is amplified by Q2, Q3 and applied to the Snap Diode, CR2, to provide an output rich in harmonics. The 430 MHz filter, FIL-1 selects the fifth harmonic of the doubled frequency to provide the 430 MHz required in the RF Mixer.

4.78 Programmable Phase Lock Loop and Amplifier. A17

4.79 The main components of this circuit are the Voltage Controlled Oscillator (VCO) and the Phase Detector. The VCO is programmed by switching inductances in the oscillator tank circuit and capacitances in the feedback circuit. Figure 6-17.

4.80 Switching in the RF circuits is accomplished with PIN diodes. These very low capacitance diodes are isolated from the control circuits or power supply by RF chokes and resistors. When forward biased they offer a low impedance path to RF signals and when reverse biased they are effectively an open circuit.

4.81 The VCO, Q8, is in a common base configuration. The variable capacitance is furnished by Varicap, CR11, and the variable inductance by L4, L5, L8. Feedback capacitors are C1, C6, C10 and the residual capacitance of the PIN diodes CR9, CR10 when they are nonconducting. Since these capacitances are in series the smallest value in the circuit is dominant. Additional Varicap bias is added when 200 MHz is selected.

4.82 The inductors and capacitors that are selected for the four frequencies when a positive voltage is applied to one of the input pin connectors are shown in Table 4-6. The four inputs from the Frequency Selector switching logic program the diodes CR1-CR8 to control the transistors which in turn control the PIN diode switches.

C10 is switched in by CR9, Q1; C6 by CR10, Q2; L5 by CR12, Q3, Q6, Q11; and L8 by CR15, Q4, Q7, Q12. Additional Varicap bias is switched into the loop amplifier, IC1, by Q13. R58 adjusts the level of this additional bias. Q5, Q9, Q10 form the amplifier on-off control switch, supplying -12V to the amplifiers Q15-Q18 and to some of the transistor switches. CR14 prevents undesireable DC feedback when the VCO is off.

Table 4-6. Programmable Phase Lock Loop Switching

Input Pin	Output Frequency	Inductance	Feedback Capacitor	Additional Varicap Bias
20,X	60 MHz	L4	C10	No
18,V	100 MHz	L4, L5	C10	No
19,W	160 MHz	L4, L5, L8	C6	No
21,Y	200 MHz	L4, L5, L8	Diode Residual	Yes
All control inputs low		Oscillator/Amplifier OFF (Q9 Off)		

4.83 Oscillator output is amplified by the wide-band feedback pair Q15, Q16, and goes to the RF Mixers through board pin 9.

4.84 Phase lock is accomplished by comparing the VCO output frequency with a 20 MHz output from the Master Oscillator in a phase detector, the DC output of which is applied to the Varicap through the loop amplifier, IC1, to bring the VCO into a phase locked relationship to the 20 MHz.

4.85 A portion of the VCO oscillator output is taken through C26 and amplified by the feedback pair Q17, Q18. This is applied to one side of the phase detector through auto transformer T4. The phase detector is made up of T2, T3, and the diodes CR16-CR19. 20 MHz input is amplified by Q23, Q24 and applied to the phase detector transformer T2. L14 aids in impedance matching. DC output from the center tap of T2 passes through loop amplifier, IC1, to the varicap, CR11.

4.86 If the loop goes out of lock, as when frequencies are switched, the loop gain drops to zero. This allows IC1 to operate as a low frequency Wien bridge oscillator. The frequency determining components are R59, C17 and R60, C28. The output of IC1, operating as an oscillator, applied to varicap CR11 causes the VCO to move through its range of frequencies. As it passes through the lock frequency, the loop closes, the high loop gain overrides the Wien bridge oscillator action and IC1 returns to its function as a loop amplifier.

4.87 RF Mixers and IF Amplifiers. A19

4.88 The fixed 430 MHz and the variable 460 to 510 MHz from the frequency synthesizer and the selected 60, 100, 160 or 200 MHz from the programmable phaselock loop VCO are mixed together, as required (see Table 4-1), in the two RF Mixers BM1 and BM2. The Sig Gen Mixer is used only in the Signal Generator mode where it is necessary to shift the L.O. by 10 MHz to produce the dialed in output frequency. Figure 6-19.

4.89 The IF Amplifier, Q2-Q5, is made up of two wide band feedback pairs, and covers the LO range of 30 MHz to 260 MHz. The band pass filter, 500 MHz to 700 MHz, in the RF input of BM2 and the Low Pass filter, 300 MHz, in the output are used to suppress spurious signals and mixing products that would otherwise show up in the output.

4.90 For the LO range of 260 MHz to 440 MHz a 260 MHz to 450 MHz band pass filter is used. The IF amplifier is IC1, which has an Automatic Level Control loop around it. IC2 is the loop amplifier. Feedback level is adjusted with R20. The LO range of 440 MHz to 510 MHz is not amplified, but is fed through directly to the Preselector Plug-in or to the Sig. Gen. Mixer.

4.91 Switching is accomplished by the use of PIN diodes, which direct the signals into and out of the mixers and IF amplifier. Switching is controlled by the first two digits of the Frequency Selector switches through the Switching Logic, A15, A16. The PIN diode switches are off when the diodes are back biased and on when they are forward biased. The ground path for the DC control of the PIN diodes is completed through RF chokes and they are isolated from the control circuit by series resistors. The RF is thus confined to the proper path through the PIN diodes. Either a positive or a negative voltage is applied to the PIN diodes and the way the diodes are connected determines whether the diodes are forward or back biased. Q1 controls the diode switches to the LO output and the Sig. Gen. Mixer.

4.92 The control lines into the board are connected to terminals 1-7. Table 4-7 indicates the polarity of the voltage on the control lines + (positive) -(negative) and which mixers and amplifiers are turned on for the different ranges.

Table 4-7. Mixer and IF Amplifier Switching

Dial Fcy. Range	Control Input TP No.							ALC	MIXERS			IF AMPL		LO/S.G.
MHz	1	2	3	4	5	6	7	IC1	M1	M2	M3	Q1-Q6	Q7-Q13	Q9
20-80	+	-	+	-	+	-	-	OFF	OFF	ON	OFF	OFF	ON	OFF
80-250	+	+	-	+	+	-	-	ON	ON	ON	OFF	OFF	ON	OFF
250-450	+	+	-	-	-	+	-	ON	ON	OFF	OFF	ON	OFF	OFF
450-520	-	+	+	-	+	+	-	OFF	OFF	OFF	OFF	OFF	OFF	OFF
In Signal Generator mode settings are as above except: (See note paragraph 4.97)														
All Bands							+				ON			ON

4.93 In the Signal Generator mode the Sig. Gen. Mixer is switched in and 10 MHz from the modulator, through the attenuator switch A22S12, either modulated or CW, is mixed with the LO signal to generate the proper output frequency. Output from the Sig. Gen. Mixer is connected to the front panel SIGNAL GEN. OUT connector, A22J5. F1 protects the mixer from external overloads

applied to the output connector.

NOTE

If the Model 312 Frequency Extender (50 kHz to 20 MHz) is installed in the CE-5, -12 VDC is applied to the base of Q1 and the Sig. Gen. Mixer is never activated.

4.94 Switching Logic. A15

4.95 The circuits associated with the first and second digits of the Frequency Selector switches are controlled by this logic. This logic performs the following functions:

(a) Selects tank circuit of VCO, pins V, 19, 20, 21.

(b) Selects 430 MHz fixed L.O. frequency, pin L.

(c) Selects one of the Programmable Phase Lock loop VCO frequencies, pins 2, 9, F, 4.

(d) Controls meter reversing relay according to whether mixing takes place on high side or low side, pin 18.

(e) Selects 40 MHz mixing frequency instead of 42 MHz when dial frequency is set below 500 MHz, pin P.

(f) Selects 42 MHz mixing frequency instead of 40 MHz when dial frequency is set to 500 MHz or above, pin R.

(g) Selects 46 MHz for mixing in the 0-40 MHz generator and enables the audio and IF output when required, pin M.

(h) Sets fifth decade count Preset on ÷N board, pins V, 19, 20.

4.96 When a first or second digit is dialed the connection labelled with that digit in Figure 6-15 is connected to ground (logic low). This is indicated by the complement bar over the numbers. The hundred MHz numbers are indicated by primed (2') digits.

4.97 VCO tank circuits are selected by a logic low output (ground closure) according to the pattern of Table 4-3. The meter relay control output, pin 18, is a ground closure when mixing is on the high side. Outputs are approximately +5V for the selection of a Programmable Phase Lock Loop frequency through pins 2, 9, F, 4, and for selection of 430 MHz (43 MHz enable) through pin L. Outputs are +20V through pins R (42 MHz), P (40 MHz) or M (I.F.) when any one of these is selected by the 100 MHz frequency dial setting.

4.98 1 kHz to 4 MHz Mixer and 9.9 MHz Filter. A7

4.99 These circuits accept a 46 to 50.99 MHz signal from the Balanced Mixer, pin 4, and a 46 MHz signal from the 46 MHz filter, pin 2. The two inputs are mixed to produce signals with frequencies in the 0 to 4 MHz range. As shown in Figure 6-7, the 46 MHz signal is amplified by Q1 before being applied to the mixer, T1, CR1, CR2. The 46-50.99 MHz signal is not amplified but applied directly to the center-tap of mixer transformer, T1.

4.100 The frequency that results from mixing is in the 0 to 4 MHz range. The signal is amplified by Q2, Q3, and delivered through emitter follower, Q4, to pin 10. When the front panel IF FREQUENCIES switch is placed in the 4 to 40 MHz position, a feedback path between Q3 and Q2 through R37 and R18 is removed by grounding the junction of the two resistors via pin 8. This increases the gain of the amplifier making the output approximately a square wave and, consequently, the 4 to 40 MHz harmonic content of the output signal is raised to a usable level.

4.101 100 kHz from the Reference Divider is connected to the input of the 9.9 MHz filter via pin 21. The first four harmonic amplifiers, Q5-Q8, are tuned to 3.3 MHz to select this frequency from the harmonics of the input 100 kHz square wave. The last harmonic amplifier, Q9, is tuned to 9.9 MHz to produce the required output at the proper level.

4.102 Second IF/Discriminator and Frequency Error Meter. A5, A4

4.103 These circuits are all on A5 except the meter which is on A4. For ease of discussion they have been divided in functional elements as follows:

1. Second Mixer, which includes an amplifier for the 10 MHz signal from the Preselector, an amplifier for the 9.9 MHz filter, and the mixer which produces a second IF which is nominally 100 kHz.

2. Discriminator/Frequency Error Detector, which delivers a voltage to the FREQUENCY meter when the second IF is not exactly 100 kHz.

3. Audio circuits, which demodulate the 100 kHz signal and deliver the AF signal to the audio amplifier on A16 and to either a Deviation Meter or an Oscilloscope plug-in.

4. Signal Level Detector which produces a disabling voltage to keep the Frequency Error Detector turned off until a sufficiently strong signal is received by the CE-5, and then enables the Frequency Error Detector and lights the SIGNAL LEVEL indicator when the

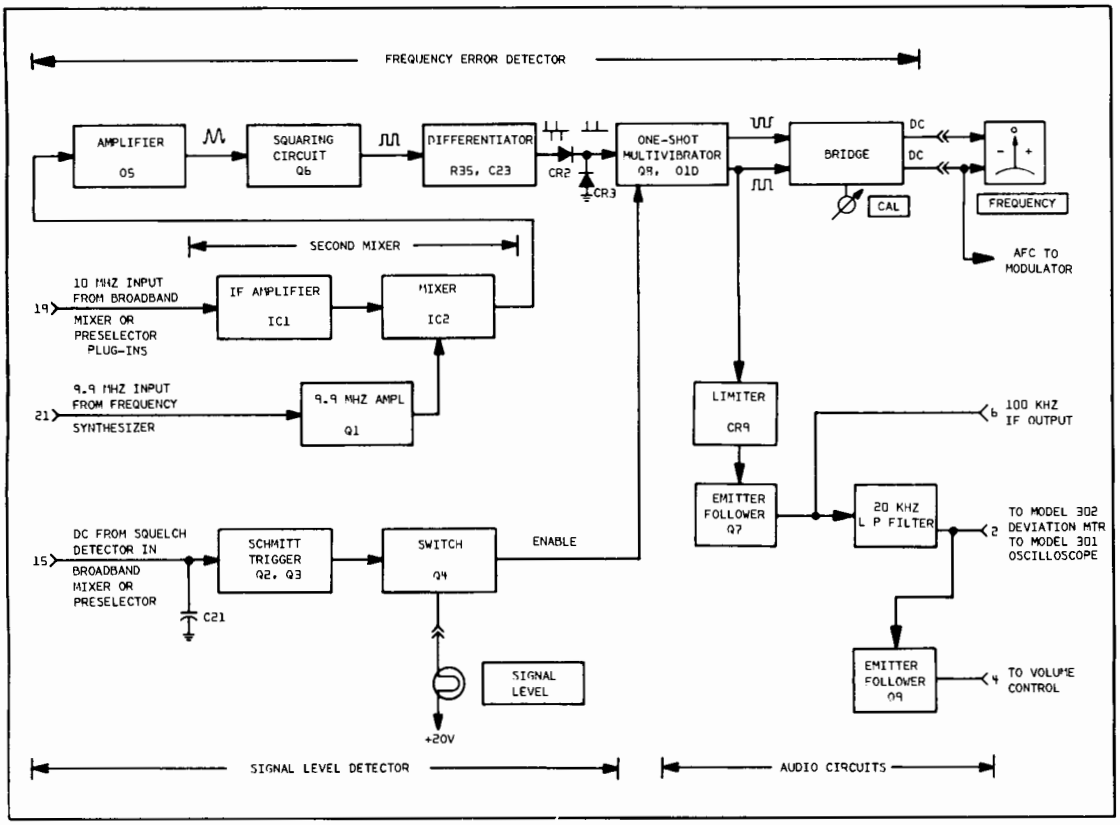


Figure 4-4. Second IF and Discriminator Circuits, Simplified Block Diagram

signal level is high enough for satisfactory measurement.

4.104 Figure 4-4 is a block diagram of the Second IF and Discriminator circuits and Figure 6-5 is the schematic.

4.105 Second Mixer

4.106 The 10 MHz signal from the RF plug-in Preselector is amplified by tuned amplifier IC1 and applied to IC2. The 9.9 MHz signal from the Frequency Synthesizer is amplified by tuned amplifier Q1 and also applied to IC2. IC2 is connected as a mixer and its output is fed through a low pass filter to Q5 in the Frequency Error Detector.

4.107 Frequency Error Detector

4.108 The 100 kHz signal from IC2 is amplified by Q5 and applied to a squaring circuit Q6. The resulting 100 kHz square wave is differentiated, R35/C23, and the positive pulses are passed by CR1 to trigger a one-shot multivibrator, Q8, Q10. The multivibrator can operate only when the received signal is strong enough for the Signal Level Detector to furnish an enabling ground through Q4. The multivibrator output is a pulse with a width that is one-half the period of a 100 kHz square wave (5 microseconds) at the collector of Q10. This pulse width remains at 5 microseconds regardless of meter reading. The width between pulses, however, depends on the interval between input pulses (pulse frequency) and therefore will be longer for a lower frequency and shorter for a higher frequency. The duty cycle will therefore vary with frequency, and will be 50% only at 100 kHz. The outputs from the collectors of Q8 and Q10 are fed to a meter bridge circuit.

4.109 The bridge circuit includes the FREQUENCY meter on the front panel. A simplified schematic of the metering bridge circuit is shown in Figure 4-5. In this figure transistors Q8 and Q10 are shown as switches, one of which is always off when the other one is on.

4.110 For more than half the frequencies that can be selected, the LO frequency is 10 MHz below the dialed in frequency, Table 4-1. When this is true, relay A4K1 on the Frequency Meter board, Figure 6-4, is de-energized and the input from the Q10 side of the Frequency-Error

Detector is applied to the positive side of the meter.

4.111 For the remainder of the frequencies A4K1 is energized and the input from the Q8 side of the Frequency Error Detector is applied to the positive terminal of the meter. Regardless of whether the relay is energized or de-energized, the action of the circuit is the same.

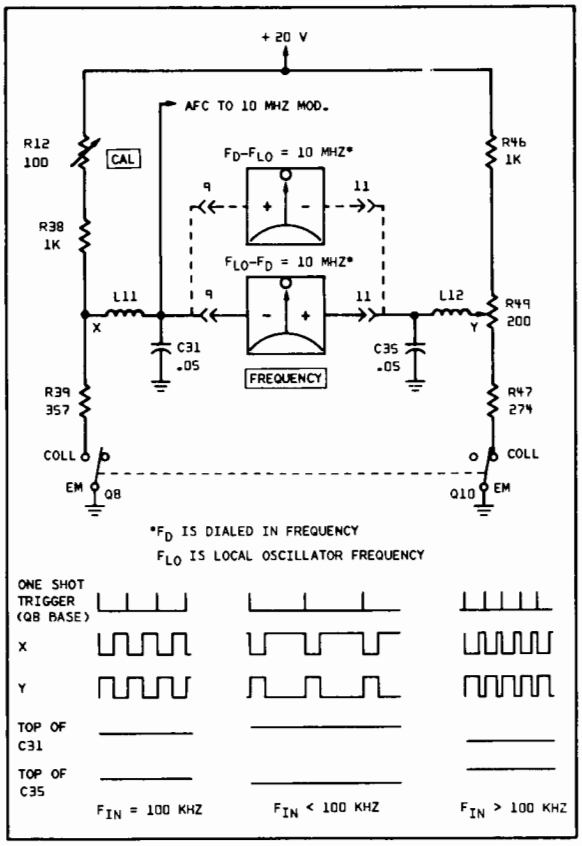


Figure 4-5. Frequency Meter Bridge Circuit

4.112 For the conditions shown in Figure 4-5, the switch that is on, Q10, causes the voltage at point Y to drop to a minimum (about .6 volts) and the switch that is off permits the voltage at point X to rise to a maximum (about 20 volts). The lower part of Figure 4-5 shows the waveforms at points X and Y. The time a switch is on equals the time it is off only when the input frequency is exactly 100 kHz; that is, when the pulse durations equal the times between pulses and represent a 50% duty cycle.

4.113 When the pulsed signals at X and Y have a 50% duty cycle, the L/C combinations L11/C31 and L12/C35, which are averaging networks, apply the same potential to both sides of the meter.

4.114 When the input signal frequency is not exactly 100 kHz, but higher or lower, one of the switches is on a shorter time than it is off. Therefore, the other switch is on longer than it is off. Neither the duty cycle of the waveform at X, nor the one at Y is 50% and, as a result, the average voltages at these points are not equal. A difference of potential exists across the meter and the meter needle deflects. Since needle deflection is proportional to the difference in potential across the meter and since this potential is proportional to the difference between 100 kHz and the frequency of the input signal, the meter dial is calibrated directly in kHz.

4.115 Adjustment has been provided by R49 which centers the range of the front panel CAL control A22R12. In addition, each of the three meter ranges, 0 to 1.5 kHz, 0 to 5 kHz, and 0 to 15 kHz, can be separately adjusted by one of three potentiometers A4R4, A4R5, A4R6.

4.116 The three meter ranges are selected by means of the lever switch directly under the FREQUENCY meter on the front panel. A pair of diodes A4CR1, A4CR2 provide overload protection for the meter.

4.117 Meter-range selection is possible only when the function switch is in the MONITOR position and the CE-5 is being used as a Communications Monitor. When the function switch is in FM, AM/CW, or CAL, no range selection is possible. In FM the meter input always indicates in the 0 to 5 kHz range. In AM/CW and in CAL, only the 0 to 1.5 kHz range is effective.

4.118 The voltage at the junction of L12 and C35 is also used as an Automatic Frequency Control (AFC) voltage. For this purpose it is applied via pin 9 and the front-panel function switch A22S8-D10 to the Varicap in the oscillator circuit on the Modulator Board.

4.119 Audio Circuits

4.120 In the explanation of the metering circuit, mention was made of the manner in which the voltages appearing across the averaging network relate to the duty cycles of the pulses signals and cause meter needle deflection. If the incoming signal is frequency-modulated the average voltages at points X and Y also vary at the modulation rate. This variation does not affect the needle deflection because of the filtering action of the averaging circuits (L11/C31, L12/C35).

4.121 The modulation which is still present at the collector of Q10, (100 kHz ± error + modulation) is fed through an isolation diode, CR9, to the audio circuits consisting of emitter follower, Q7, a low pass filter, and another emitter follower, Q9. The audio signal passes to the volume control through pin 4. The audio to the Deviation Meter or Oscilloscope passes through Q7, the low pass filter to pin 2. The output at pin 6 is taken off at a point in the signal path where the 100 kHz component is

still present. This output is made available at the front panel 100 kHz IF output, A22J2. A counter connected to this connector will read 100 kHz ± the frequency error to the accuracy of the counter ± the monitor accuracy.

4.122 Signal Level Detector

4.123 The RF plug-in Preselectors incorporate a squelch circuit which produces a DC voltage that is proportional to received signal strength. This DC voltage is applied to a Schmitt Trigger consisting of Q2 and Q3, which is set to fire when the signal output of the First IF Amplifier in the Preselector is approximately 60 millivolts. When the Schmitt Trigger fires, it turns switching transistor Q4 on, which enables the Frequency Error Detector and also lights the SIGNAL LEVEL indicator to announce that the signal is strong enough for reliable measurement. The Schmitt Trigger remains in the fired state as long as the signal level is above the critical level.

SIGNAL GENERATING CIRCUITS

4.124 Signals in the range of 20 MHz to 520 MHz are generated by mixing a CW or modulated CW 10 MHz signal, with the Frequency Synthesizer output (L.O. Signal). This was noted in paragraphs 4.22 and 4.93. The signal thus generated has the same frequency as is shown by the Frequency Selector dial. The circuits used are the same as in the Receive mode with the exception of the modulator circuit. The generation of IF output frequencies was discussed in paragraphs 4.99 and 4.100.

4.125 10 MHz Modulator. A18

4.126 The purpose of this circuit is to frequency modulate or amplitude modulate the 10 MHz input to the Signal Generator Mixer. This modulation signal is derived from a Frequency Synthesizer 1 kHz source, or from an external source with a frequency between 60 Hz and 20 kHz. Figure 6-18 is the schematic of the 10 MHz Modulator.

4.127 In the FM mode the 10 MHz signal is generated by voltage controlled oscillator Q3. The tuned circuit of the oscillator consists of C10, C12, L2, C14, C15, and Varicap, CR1. The capacitance of the Varicap varies with the voltage across it. The frequency is set to exactly 10 MHz with the FM CAL control. The FREQUENCY meter indicates "0" when the adjustment to this frequency is correct. The FM CAL control adjusts the DC voltage applied to Varicap, CR1, in the frequency determining portion of the oscillator circuit through pin H. The oscillator is kept at 10 MHz by an AFC voltage from the Frequency Error Detector, A5, via the front panel function switch, A22S8-D2 through pin J.

4.128 The modulating signal is applied to CR1 through pin K, R1, C1, L1. This voltage causes the Varicap capacitance to change with the modulation frequency and thus controls the frequency of the oscillator to produce frequency modulation.

4.129 The 1 kHz modulating signal from the Frequency Synthesizer is connected through pin B to IC1A, connected as a 1 kHz bandpass filter. Output from IC1A goes to amplifier, IC1B, through FET transistor switch, Q2. External modulating signals from the front panel EXT MOD connector A22J4 are also connected to the input of IC1B. Either the internal or external modulating signal or both if desired is thus amplified by IC1B and the output goes through pin 4 to MOD ADJ control, A22R5A-1. From there the signal comes back to pin K as the modulating voltage to the Varicap, CR1, or to the amplitude modulator Q10 through amplifier Q13. In this way either internal or external modulation is controlled by the front panel MOD ADJ control.

4.130 The output of IC1A is attenuated and then connected to emitter follower, Q1, from which it is connected to the 1 kHz OUT connector A22J3, making 1 kHz available at the front panel at all times.

4.131 The 10 MHz VCO oscillator, Q3, and amplifier, Q4, are enabled by +20V connected through the FUNCTION switch, A22S8-B2, when it is set to the FM position through pin M.

4.132 Modulated 10 MHz goes through tuned amplifier Q5, through voltage controlled attenuator, R77, CR2, through emitter follower Q8 to tuned output amplifier, Q9. Output from Q9 is tapped off between C39, C40, (for impedance matching) passes through the pad R54-56 to pin T and then to front panel MICROVOLTS control A22R6. An output from Q9 also goes to emitter follower Q14 and from Q14 to the Preselector via pin U. From the Preselector it is connected to the Second IF/ Discriminator A5. FM CAL, A22R5B is used to adjust the VCO to 10 MHz. Another output is coupled out through emitter follower Q15 to average detector CR7, R69, R70. This detector responds to carrier level but not to the modulation on the signal. Detector output is filtered by C41, amplified by IC2 and connected to the voltage controlled attenuator, R77, CR2, to provide automatic level control for the 10 MHz output.

4.133 Internal 1 kHz or external modulating signals are also connected, through pin K, to Q13. When the FUNCTION switch is in the FM position +20V is also connected to CR6 which causes Q13 to be biased off and allows Q10 to act only as a constant current source in the emitter of Q9. When the FUNCTION switch is placed in the AM/CW position, VCO oscillator and amplifier Q3, Q4, is disabled, and Q13 is enabled as a buffer for the modulation signal. At the same time the 10 MHz filter on the Master Oscillator/Divider/Filter circuit, A6, is turned on to supply a 10 MHz signal to the 10 MHz modulator through pin P to the input of Q5.

This signal is connected to Voltage Controlled Attenuator, R77, CR2, through Q8 to Q9 where it is amplitude modulated by Q10 which is driven by the modulating signal through Q13. The Amplitude Modulated 10 MHz signal now goes through pin T to RF Mixer, A19, via the RF attenuator, and thus not only shifts the L.O. signal the required 10 MHz but also amplitude modulates the output signal.

4.134 In CW operation the 10 MHz input through pin P is amplified and passed out to the Signal Generator mixer through pin T. INT MOD must be switched off to prevent 1 kHz modulation. Also all signals must be disconnected from EXT MOD connector, A22J4.

4.135 In the FM and AM/CW signal generating modes, the Modulator output is fed through the signal generator attenuator to the A19 Sig Gen Mixer. The attenuator is calibrated in terms of voltage level at the output of a 20 dB fixed attenuator connected to the SIGNAL GEN OUT connector. Without adjustment, slightly different output voltages would be produced by the Signal Generator Mixer for each of the CE-5 frequency bands, for a given 10-MHz input signal. Therefore, the Modulator output level must be slightly different for each of these bands. To accomplish this a different bias is applied to IC2, depending on which fixed L.O. frequencies are used in the RF mixers.

4.136 Logic switching outputs from the mixer and IF switching circuit, A16 are used to switch in the proper adjustable resistor, R37, R41, R49, R62 through transistor switches Q6, Q7, Q11, Q12. These resistors control the bias on IC2 and thus set the output level for each band of frequencies.

4.137 In the CAL mode of the FUNCTION switch A22S8, the 10 MHz from the Master Oscillator/Divider/Filter passes through the circuit as in the CW mode and goes out pin U to the last IF stages of the Preselector and then to the second IF/Discriminator circuit, A5, where it is used as the standard to which the FREQUENCY meter is calibrated. Front panel CAL control, A22R12, center control on FUNCTION switch, is used to balance the error detector bridge so that the FREQUENCY meter reads zero when this accurately generated 10 MHz frequency is applied.

4.138 Switchable Attenuator. A20

4.139 Level to the output connector, in the Signal Generator mode, is controlled in 20 dB (X10) steps by the switchable attenuator. Two identical 20 dB attenuators are individually switched in or out in proper combination to provide these steps. PIN diode switches CR1-CR8 (Figure 6-26) are controlled by the front panel X1-X10-X100 switch, A22S12. -12V to both attenuators switches both out of the circuit for 0 dB attenuation (X100). -12V to one and +20V to the other switches one in for 20 dB (X10), and +20V to both switches both in for 40 dB attenuation (X1). Fine adjustment, .1-1.0 microvolts, is accomplished by a variable pad, A22R6, which controls the amplitude of the 10 MHz output from the modulator (as noted in paragraph 4.132) to the Sig Gen Mixer.

4.140 POWER SUPPLIES

4.141 The power supply circuits and components are mounted on two circuit boards, the center plate and the rear panel. The transformer and main fuse are mounted on the rear panel, A23. The rectifiers, filter capacitors and DC fuses are mounted on the circuit board, A13, which is attached to the rear panel. The Regulator control circuits are contained in, A12, while the series regulator transistors are mounted on the center plate, A25. See Figures 6-12, 6-13, 6-22, and 6-24.

4.142 Three separate secondary windings on the transformer A23T1 supply AC power to the three bridge rectifiers on A13. Each rectifier output is separately fused and is filtered by a single capacitor. Rectifier outputs go to the regulator A12. A fourth secondary winding supplies power to the dial and decimal point lights.

4.143 The 20 volt regulator is a conventional series regulator type. The differential amplifier is A12IC1 and the reference voltage is set by A12CR2. A12Q1 is a current amplifier which feeds the series regulator, A25Q1, mounted on the center plate. Overcurrent protection is provided by sensing resistor A12R4 and control transistor A12Q2.

4.144 The -12 volt regulator operates in the same manner as the 20 volt regulator except that the positive side is connected to ground.

4.145 In the 5 volt regulator the supply for the zener reference, A12CR4, is taken from the 20 volt output, A12Q5 is the differential amplifier. The remainder of the circuit corresponds to the 20 volt regulator. An additional zener diode, A12CR5, prevents voltage spikes from reaching the Integrated Circuits, which are powered by the 5 volt supply.

4.146 DECIMAL POINT LIGHTS AND FLASHER A22

4.147 The position of the decimal point light is controlled by A22S9 and A22S1E. The decimal point is shifted one place to the left when A22S1 is in the IF position and A22S9 is

in the 0-4 MHz position.

4.148 Switches A22S1 and A22S2, the first and second Frequency digits are wired so that if they are set to a frequency outside the range of the instrument the flasher, A22S13, will be cut in and the dial lights will flash on and off. Also the Unlocked light may come on. Any setting of the RF range below 20.000 MHz or above 519.999 MHz will cause the lights to flash. In the IF range any setting above 3.9999 MHz in the 0-4 MHz range or above 39.999 MHz in the 4-40 MHz range will also cause the lights to flash.

4.149 The input AC from power plug, P1, if filtered by A23L1, L2 and A23C1-4. This filtered power source is then used to drive both the power transformer, A23T1, and the Crystal Oven through jack A25J7.

NOTE

For 230 volt operation jumper wires on A23T1 pins 1-2 and 3-4 must be removed and pins 2-3 jumpered. A different Crystal Oven specified to operate from a 230 volt AC source must also be installed and the Master Oscillator realigned. It is recommended that the unit be returned to Cushman Electronics for this modification. Instructions for packaging and shipment are contained in paragraphs 2.08 through 2.13.

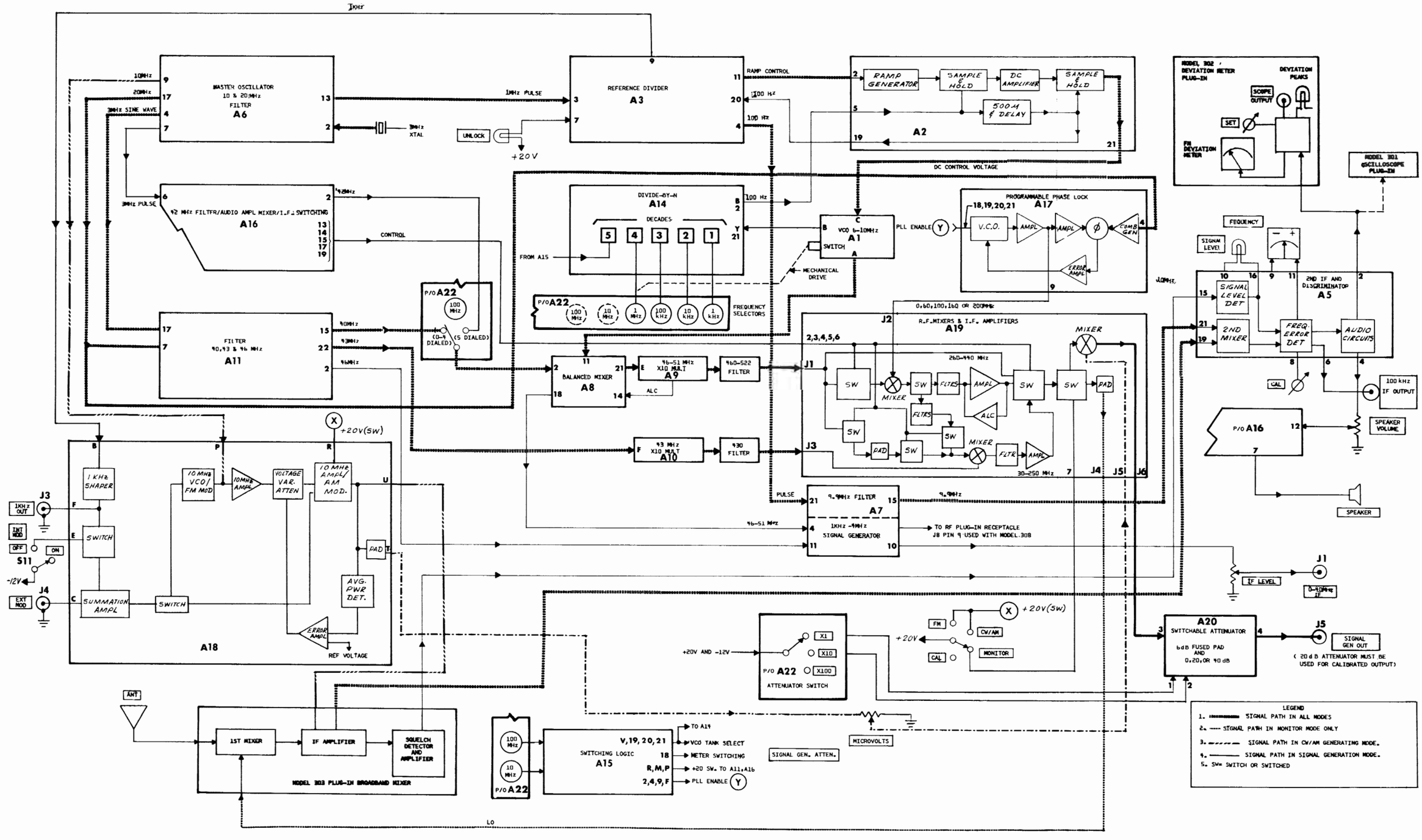


Figure 4-6. Model CE-5 Overall Block Diagram

5601-0034

SECTION 5
MAINTENANCE

GENERAL INFORMATION

5.01 This section is divided into two major subsections: "Adjustments", and Troubleshooting". It is recommended that for adjustments other than those described, the faulty subassembly or the entire instrument be returned to the Cushman Electronics Customer Service Department for calibration and alignment. Refer to paragraph 2.12.

5.02 In the following discussions it is assumed that the operator is familiar with the operating procedures described in Section 3.

5.03 The instrument should be warmed up for a short time before any adjustment is attempted.

ACCESS AND PARTS LOCATION

5.04 Components in the top part of the instrument can be reached by removing the side covers. Each cover is held by six screws; the speaker leads must be disconnected before the right-hand cover can be removed completely. When the instrument is placed on its back the bottom cover can be removed. With this cover off the VCO and the plug-in printed circuit board are accessible.

5.05 Figure 5-1 shows the location of the circuit boards in the bottom of the instrument. The same drawing is screened on the inside of the bottom panel.

5.06 Location of components on the circuit boards is given on the component identification drawings which are placed on the inside sheet of the schematic diagrams to which they apply. The adjustable components may be located from these drawings.

5.07 The fuses of the three regulated power supplies are on the rectifier board which is mounted on the inside of the rear panel near the upper left hand corner. The +20V fuse is nearest the outside, the -12V fuse is in the center and the +5V fuse is nearest to the center plate. The 0.2A slo-blo fuse for the oscilloscope plug-in is mounted above the left hand plug-in jack A24J17. The main fuse is mounted on the rear panel near the power cord and is accessible from the outside of the instrument.

5.08 A board extractor and an extender board are furnished. They are inserted in a compartment in the bottom of the instrument. Before removing or inserting a circuit board, be sure to turn off the power to the instrument.

5.09 All adjustments accessible through the chassis have a label next to the access hole. The assemblies mounted on the center plate have a label affixed. The label for the assembly on the right hand side of the center plate is directly behind the assembly on the left hand side.

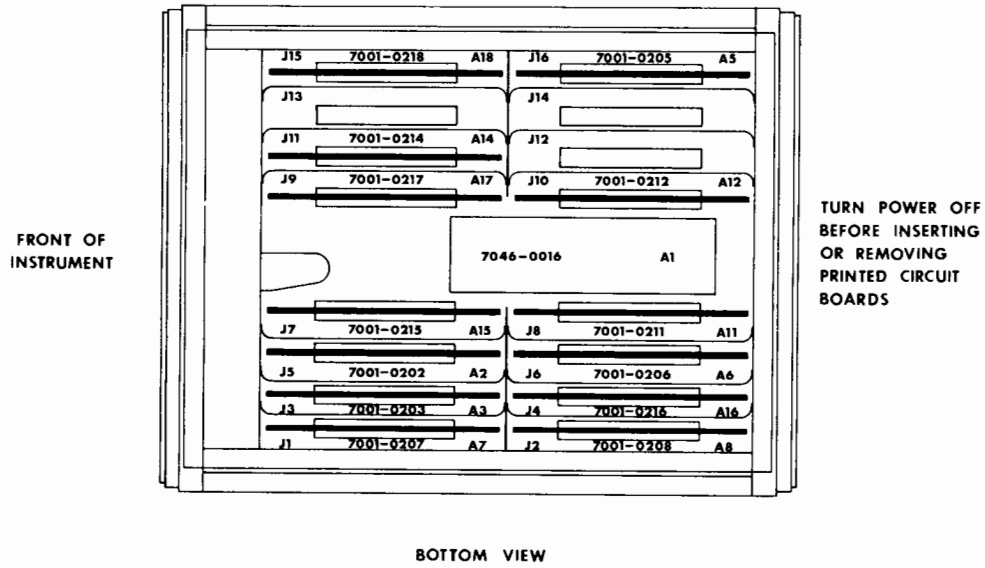


Figure 5-1. Circuit Board Location.

ADJUSTMENTS

5.10 POWER SUPPLY VOLTAGES

5.11 Equipment required:

Digital Multimeter Dana 4300 or equivalent

NOTE

The regulated power supplies are set to within 0.5% of rated output voltage at the factory. They should not be adjusted unless a voltmeter with the specified accuracy is available.

5.12 Stand the instrument on its back and remove the bottom cover. Locate the Power Supply Regulator board, A12, and raise it up on board extender. (Paragraph 5.08). See Figure 6-12.

a. Measure the +20V output at board pin 5. Adjust R7 if necessary.

b. Measure the +5V output at board pin 15. Adjust R14 if necessary. The +20V supply must be checked and adjusted before making any adjustment to the +5V output.

c. Measure the -12V output at board pin 19. Adjust R21 if necessary. Replace circuit board in chassis.

5.13 MASTER OSCILLATOR FREQUENCY

5.14 Equipment required: Counter having a time base accuracy of 1 part in 10^7 or better. Dana 8100 or equivalent.

5.15 Stand the CE-5 on its back, remove the bottom cover and elevate the A16 board on the extender. Turn on the instrument and let the crystal oven warm up for at least 30 minutes.

NOTE

If the CE-5 is left connected to the AC power the crystal oven will be on even though the instrument power is turned off and will be ready for calibration a few seconds after the instrument is turned on.

5.16 After the crystal oven is thoroughly warmed up, turn on the CE-5 and proceed as follows:

a. Turn the 100 MHz dial (first dial on left) of the Frequency Selectors to 5. (This turns on the 42 MHz harmonic amplifier).

b. Connect the counter to board pin 2 on A16. Use a X1 oscilloscope probe connected to the counter to make the connection. Counter should read 42 MHz ±4 Hz. If necessary adjust A25C1 (just below crystal oven on right lower rear of center plate) for this reading. Replace A16.

CAUTION

115V (or 230V) AC is present in this area. Use a long plastic tool to make this adjustment.

5.17 FREQUENCY METER ZERO ADJUST

5.18 Set the Function switch to CAL and proceed as follows:

a. With power off mechanically zero the needle on the FREQUENCY meter. (Adjustment accessible through small hole directly below meter).

b. Center the white line (set straight up) of the CAL CONTROL (inner control concentric with the Function switch).

c. Adjust FREQ. METER COARSE CAL ADJUST (A5R49) until the FREQUENCY meter reads zero. (Adjustment located on right side of chassis toward rear. Use plastic adjusting tool.)

5.19 MODULATOR CENTER FREQUENCY

5.20 After making above adjustment, with meter left setting on zero, proceed as follows:

a. Set Function switch to FM.

b. Set the white line on the FM CAL control (concentric with MOD ADJ control) so that it points straight up.

c. Turn MOD ADJ control fully counterclockwise.

d. Stand CE-5 on its back and locate the A18 board. Adjust L2 for a zero reading on the FREQUENCY meter. See component identification, Figure 6-18. (L2 is accessible without raising board on extender, a little below middle of board.)

5.21 FREQUENCY METER RANGE

5.22 The IF output of the CE-5 may be used to calibrate the FREQUENCY meter. Since the calibration depends on the difference between two synthesizer generated frequencies the calibration is accurate to the degree of the synthesizer accuracy.

a. Use a Broadband plug-in or a Preselector with a Wide Band mixer set to the Wide Band mode.

b. Set Function switch to CAL and zero the meter with the CAL, control concentric with the Function switch.

c. Set the Function switch to MONITOR.

d. Set the IF FREQUENCIES switch to 4-40 MHz.

e. Set the Frequency Selector dial to IF 09.999 MHz.

f. Connect a coaxial cable with an adapter from the IF FREQUENCIES OUTPUT to the ANT. connector on the RF plug-in.

g. Turn the IF LEVEL control fully clockwise.

h. Set the FREQUENCY meter range switch to ±1.5 kHz.

i. The meter should read -1.0 kHz on the lower scale. If not adjust R6 on the printed circuit board mounted on the back of the FREQUENCY meter (upper control). (Access to control through left hand opening with plug-in removed.)

j. Set meter range switch to ±5 kHz and dial in IF 09.995 MHz.

k. Meter should read -5.0 kHz on upper scale. If not adjust R4, middle control on the board mounted on the meter.

l. Set the meter range switch to ±15 kHz and dial in IF 09.985.

m. Meter should read -15 kHz on the lower scale. If not adjust R2, lower control.

n. To verify the positive side of the scale dial in IF 10.001, IF 10.005, IF 10.015 for the ±1.5 kHz, ±5 kHz, ±15 kHz ranges respectively.

5.23 20 dB FIXED ATTENUATOR

5.24 The 20 dB attenuator is used to prevent damage to the CE-5 in case the transmitter of a transceiver to which the CE-5 is connected is accidentally keyed. In case this occurs the fuse will be blown and possibly the input resistor, R3, (Figure 6-25) may be damaged. Before calibrating the CE-5 Signal Generator output level, or in case damage is suspected the attenuator should be checked.

a. Use an RF source calibrated in dB, HP608 or equivalent and an RF Voltmeter with a 50Ω probe, Boonton 91D or equivalent. Measure the attenuation of the attenuator. It should be 20 dB ± 1/2 dB. (If an RF voltmeter is not available use a metered receiver as an indicator and the Signal Generator (HP 608) attenuator to make the measurement. Make certain receiver is not saturated.)

b. If repair is necessary use only the fuses furnished with the instrument or order from Cushman Electronics. (Cushman part number 7040-0018 in packages of 10 fuses.) Use only 5% resistors of values given in Figure 6-25.

5.25 SIGNAL GENERATOR OUTPUT LEVEL

5.26 Test equipment required: RF Signal Generator with 50Ω output, HP 608 or equivalent. Receiver capable of operating at the frequencies to be calibrated, having a signal strength meter. (A receiver without a meter, with an AC VTVM connected to the output of the first or second IF stage may be substituted.) The receiver is used as a transfer device after the level has been set by the signal generator.

a. Check and adjust, if necessary, at the following frequencies:

FREQ RANGE	CALIBRATION FREQUENCY	ADJUSTMENT
20-80 MHz	35 MHz	A18R37
80-250 MHz	165 MHz	A18R41
250-450 MHz	350 MHz	A18R49
450-520 MHz	470 MHz	A18R62

The adjustments are on the 10 MHz modulator board, accessible when bottom cover is removed. Adjustment controls are in order from the inside of the board toward the outer end with R37 being the inner control and R62 the outer.

b. Set the CE-5 to MONITOR and dial in the calibration frequency given in step a. Connect the signal generator to a Broadband mixer plug-in in the CE-5 and very carefully tune the signal generator to the calibration frequency as indicated on the CE-5 FREQUENCY meter. Do not disturb the signal generator frequency setting until after measurement has been made.

c. Connect the signal generator to the receiver through the 20 dB attenuator and set the signal generator for 10μvolts output. The attenuator will reduce this level by 10:1 so there will be 1 μvolt at the input of the receiver. Note the reading on the signal strength meter. (Make certain the receiver is not saturated.)

d. Remove the input end of the 20 dB attenuator from the signal generator and connect it to the SIGNAL GEN OUT on the CE-5.

e. Turn the CE-5 Function switch to SIG GEN AM/CW. Make certain the INT MOD switch is off and nothing is connected to EXT MOD. Set CE-5 step attenuator to X1 and MICROVOLTS to 1.0μvolt.

f. Observe the reading on the signal strength meter of the receiver. This reading must be within ±2 dB of the reading noted in step c. If this reading is not obtained refer to step a. for adjustment control and location. Adjust level until it is within ±2 dB of reading noted in c.

g. If no adjustment is required, or after adjustment is made, repeat procedure of steps b. through f. for the other calibration frequencies listed in step a.

h. After adjustment the signal level should be checked with the Function switch in the FM position (no modulation). Carefully set FM CAL to frequency. Level should be within 1 dB of levels noted for CW operation.

5.27 VCO SUB-ASSEMBLY REMOVAL

5.28 In case it is necessary to remove the VCO sub-assembly for shipment to the factory for repair and calibration, proceed as follows:

a. Stand the CE-5 on its back and remove bottom cover.

b. Loosen the two set screws of the U-joint next to the VCO assembly so that this U-joint will remain with the shaft going to the other U-joint.

c. Remove the three sheet metal screws that fasten the VCO assembly to the chassis.

d. Slide the VCO assembly down until the VCO shaft is clear of the U-joint and lay it on the work surface in front of the CE-3.

e. Remove the cables from the VCO assembly.

5.29 To replace the VCO assembly:

a. Set the 1 MHz Frequency Selector dial (third from left) to "0".

b. Find the small black mark on the shaft on the VCO assembly and set this mark between the capacitors marked .4 and .5.

c. Follow the procedure of paragraph 5.11 in reverse order.

TROUBLESHOOTING

5.30 In all modes of operation the phase lock loop of the main frequency synthesizer circuit is a most important part of the instrument. When this loop is not phase locked the proper frequencies are not synthesized. The UNLOCKED indicator shows the condition of this circuit. The UNLOCKED indicator is OUT when the two 100 Hz signals to the phase detector, A3, are phase locked, or when both signals are absent.

5.31 When the UNLOCKED indicator remains on it indicates trouble somewhere in this circuit. An indication of the area affected may be had by removing the Sample and Hold board, A2.

NOTE

Always turn off power in the instrument when removing or installing circuit boards.

5.32 After removing board A3, turn instrument on again and note condition of UNLOCKED light. If the light does not come on the trouble may be with the crystal oscillator, master oscillator circuit, A6, or Reference Divider Phase Detector, A3. (Both signals absent from phase detector.) If the light remains on the trouble is probably in the loop itself, that is in the Sample and Hold board, A2, the Reference Divider/Phase Detector, A3, the Divide-by-N counter, A14, or the VCO, A1.

5.33 To further narrow down the area of trouble a high frequency oscilloscope such as the HP 180 series or equivalent, or a frequency counter such as the Dana 8100 series or equivalent may be used for signal tracing. The frequencies and voltages into and out of the circuit boards are given in many cases on the schematic diagrams.

5.34 Before extensive checking of circuits the power supply regulated outputs should be checked, paragraph 5.13-5.15. Performing the other adjustments may help to localize the trouble. For instance, in the Signal Generator output adjustment, if the proper level may be obtained in the CW position of the Function switch but not in the FM position the trouble is most likely in the 10 MHz Modulator board, A18.

5.35 If, when the VCO assembly has been removed and replaced, the UNLOCKED indicator remains on, the trouble probably is due to misalignment of the VCO switch on the third Frequency Selector dial shaft. Refer to paragraphs 5.10-5.12.

5.36 In the troubleshooting Table 5-1 some front panel indications of possible troubles are listed with the probable cause and the circuits

or boards that should be checked. In shooting trouble use the Block Diagram, Figure 4-6, to trace signals through the instruments and the frequencies and levels indicated on the schematics.

5.37 If another CE-5 is available the quickest way to locate trouble is by board substitution. When the faulty board is located it may be returned to the factory Customer Service Department for repair (paragraph 2.12, 2.13) if desired.

Table 5-1. TROUBLESHOOTING CHART

TROUBLE	POSSIBLE CAUSE	CHECK
1. CE-3 inoperative	Main fuse	Check and replace if necessary
2. CE-3 inoperative except oven light	Fuse on Power Supply Rectifier Board	Check and replace if necessary.
3. FREQUENCY meter pinned SIGNAL LEVEL light on	No -12 VDC	Check -12V fuse on Rectifier Board
4. No RF signal reception, Signal Generation OK	RF Plug-in	Check for signal through plug-in, check squelch output
5. No Signal Generation, reception OK, CAL OK	20 dB Attenuator fuse Signal Mixer fuse	Check 20 dB attenuator Check fuse A19F1
6. No Signal Generation FM or CW, no CAL, reception OK	10 MHz Modulator	Check 10 MHz outputs from 10 MHz Modulator Board A18
7. No reception, no signal generation, CAL OK	Failed board in path of LO signal	Check all bands following Table 4-1 to see if programmable Phase Lock or 43 MHz x 10 multiplier may be at fault. Check output of other boards in LO path.
8. No CW Signal Generation FM Sig. Gen OK	No 10 MHz output from Master Oscillator	Check 10 MHz output of M.O. board, A6
9. No FM Sig. Gen, CW Sig. Gen OK	VCO on 10 MHz modulator board	Check VCO output at collector of A18Q4
10. No CAL, no Sig. Gen UNLOCKED light on	Master Oscillator board or Crystal Oscillator	Check A6 board for proper outputs
11. FREQUENCY meter pinned in CAL or SIG GEN, Signal Level light on	Second IF and Discriminator	Check 9.9 MHz to board A5 Check A5 board
12. SIGNAL LEVEL light on, no RF in. FREQUENCY METER pinned in MONITOR.	RF Plug-in	Squelch misadjusted
13. UNLOCKED light on but CE-5 appears to work OK	REF.DIVIDER/PHASE DET.	UNLOCKED light control circuits on board A3
14. UNLOCKED light on in some FREQUENCY SELECTOR dial positions	Divide-by-N counter	Check for 100 Hz output from Board A14
15. UNLOCKED light on in all Frequency Selector positions	Frequency Synthesizer loop out of lock	Check outputs of boards A1, A2, A3, A14

SECTION 6
PARTS LISTS AND SCHEMATIC DIAGRAMS

INTRODUCTION

6.01 The following parts lists and schematic diagrams have been arranged in order according to the Circuit Reference Series numbers. Refer to paragraph 4.02. Each schematic diagram and parts list is identified with this number. The circuit boards in the instrument are etched with the Circuit Board Number. See Cross Reference Table 6-1. below.

6.02 Parts list pages are grouped with the schematic diagrams to which they refer. Component identification drawings showing the location of the individual components on the circuit board are placed on the inner sheet of the schematic diagram to which they apply.

Table 6-1. Printed Circuit Board and Circuit Reference Numbers Cross Reference.

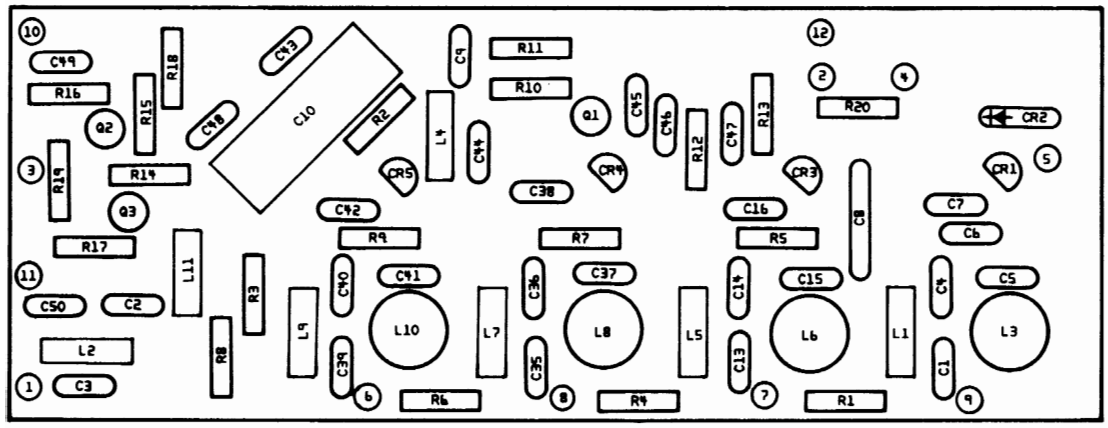
Ckt. Bd. No.	Circuit Title	Ckt. Ref. No.	Assembly No.	Figure No.
1780-0045	Voltage Controlled Oscillator	A1	7001-0201	6-1
1780-0046	Sample and Hold	A2	7001-0202	6-2
1780-0047	Reference Divider	A3	7001-0203	6-3
1780-0052	Frequency Error Meter	A4	7001-0204	6-4
1780-0054	Second IF Discriminator	A5	7001-0205	6-5
1780-0061	Master Oscillator/Divider/Filters	A6	7001-0206	6-6
1780-0062	1 kHz-4 kHz Mixer/9.9 MHz Filter	A7	7001-0207	6-7
1780-0065	46.00-50.99 MHz Balanced Mixer	A8	7001-0208	6-8
1780-0066	46.00-50.99 MHz X10 Multiplier	A9	7001-0209	6-9
1780-0067	43 MHz X10 Multiplier	A10	7001-0210	6-10
1780-0078	40 MHz, 43 MHz, and 46 MHz Filter	A11	7001-0211	6-11
1780-0082	Power Supply Regulator	A12	7001-0212	6-12
1780-0084	Power Supply Rectifier	A13	7001-0213	6-13
1780-0089	Divide-by-N	A14	7001-0214	6-14
1780-0450	Switching Logic	A15	7001-0215	6-15
1780-0451	42 MHz Filter, Audio Amplifier, Mixer and IF Switching	A16	7001-0216	6-16
1780-0452	Programmable Phase Lock Loop and Amplifier	A17	7001-0217	6-17
1780-0453	10 MHz Modulator	A18	7001-0218	6-18
1780-0454	RF Mixers and IF Amplifier	A19	7001-0219	6-19
1780-0459	Switchable Attenuator	A20	7001-0240	6-26
---	20 dB Pad Assembly	-	7040-0032	6-25

VOLTAGE CONTROLLED OSCILLATOR. A1

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A1	VCO Board Assy	7001-0201	Cushman	
	VCO Container Assy	7046-0016	Cushman	
	Printed Circuit Board	1780-0045	Cushman	
	CAPACITORS			
C1	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C2	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C3	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C4	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C5	Mica, 22pF, ±5%, 500V	1002-0023	Elmenco	DM15-C-220J
C6	Mica, 27pF, ±5%, 500V	1002-0008	Elmenco	DM15-E-270J
C7	Mica, 96pF, ±1%, 500V	1002-0049	Elmenco	DM15-F-960F
C8	Poly, .068μF, ±10%, 100V	1008-0036	Sprague	18F2583
C9	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C10	Elect, 100μF, ±10%, 25V	1013-0003	Sprague	TE-1211
C11	Not Used			
C12	Not Used			
C13	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C14	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C15	Mica, 24pF, ±5%, 500V	1002-0051	Elmenco	DM15-C-240J
C16	Mica, 91pF, ±1%, 500V	1002-0048	Elmenco	DM15-F-910F
C17	Mica, 68pF, ±1%, 500V	1002-0084	Elmenco	DM15-E-580-F-0-4CR
C18	Mica, 51pF, ±5%, 500V	1002-0045	Elmenco	DM15-E-510J
C19	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C20	Mica, 431F, ±5%, 500V	1002-0046	Elmenco	DM15-E-430J
C21	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C22	Mica, 36pF, ±5%, 500V	1002-0041	Elmenco	DM15-E-360J
C23	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C24	Mica, 30pF, ±5%, 500V	1002-0043	Elmenco	DM15-E-300J
C25	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C26	Mica, 22pF, ±5%, 500V	1002-0023	Elmenco	DM15-C-220J
C27	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C28	Mica, 15pF, ±5%, 500V	1002-0001	Elmenco	DM15-C-150J
C29	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C30	Mica, 10pF, ±5%, 500V	1002-0016	Elmenco	DM15-C-100J
C31	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C32	Cer, 4.7pF, ±.25pF, 500V	1005-0015	Erie	301-000-C0H0-479C
C33	Var, .5-18pF, 750V	1001-0001	JFD	VCJ2611
C34	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C35	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C36	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C37	Mica, 18pF, ±5%, 500V	1002-0014	Elmenco	DM15-C-180J
C38	Mica, 68pF, ±1%, 500V	1002-0084	Elmenco	DM15-E-680-F-0-4CR
C39	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C40	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C41	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C42	Mica, 39pF, ±2%, 500V	1002-0054	Elmenco	DM15-E-390G
C43	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C44	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C45	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C46	Cer, 100pF, ±5%, 1000V	1005-0046	Sprague	10TCT-T10
C47	Mica, 220pF, ±5%, 500V	1002-0029	Elmenco	DM15-F-221J
C48	Cer, 1.5pF, ±.25pF, 500V	1005-0041	Erie	301-000-C0K0-159C
C49	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C50	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z

VOLTAGE CONTROLLED OSCILLATOR (cont). A1

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	COILS			
L1	RF Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L2	RF Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L3	Var, .83 - 1.6μH	1596-0018	Delevan	4000-10
L4	RF Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L5	RF Choke, 120μH, ±5%	1586-0033	Delevan	1537-80
L6	Var, .83 - 1.6μH	1596-0018	Delevan	4000-10
L7	RF Choke, 180μH, ±5%	1585-0035	Delevan	1537-88
L8	Var, 1.7 - 3.4μH	1596-0019	Delevan	4000-14
L9	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
L10	Var, 1.7 - 3.4μH	1596-0019	Delevan	4000-14
L11	RF Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
	DIODES			
CR1	Dual, Si, MMSD6100	1283-0002	Motorola	MSD-6100
CR2	Var, ±5%	1281-0019	TRW	V947B
CR3	Dual, Si, MMSD6100	1283-0002	Motorola	MSD-6100
CR4	Dual, Si, MMSD6100	1283-0002	Motorola	MSD-6100
CR5	Dual, Si, MMSD6100	1283-0002	Motorola	MSD-6100
	RESISTORS			
R1	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R2	Comp, 220Ω, ±5%, 1/2W	1067-2215	Allen-Bradley	EB2215
R3	Comp, 220Ω, ±5%, 1/2W	1067-2215	Allen-Bradley	EB2215
R4	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R5	Comp, 15k, ±5%, 1/4W	1066-1535	Allen-Bradley	CB1535
R6	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R7	Comp, 8.2k, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R8	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R9	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R10	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R11	Comp, 22k, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R12	Comp, 33k, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R13	Comp, 8.2k, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R14	Comp, 1.2k, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R15	Comp, 27k, ±5%, 1/4W	1066-2735	Allen-Bradley	CB2735
R16	Comp, 2.2k, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R17	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R18	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R19	Comp, 56Ω, ±5%, 1/4W	1066-5605	Allen-Bradley	CB5605
R20	Comp, 22k, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
	TRANSISTORS			
Q1	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q2	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q3	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
	CONNECTORS			
JA	Phone Jack, Rear Mount	2586-0003	Swiftcraft	3505-F
JB	Phone Jack, Rear Mount	2586-0003	Swiftcraft	3505-F
JC	Phone Jack, Rear Mount	2586-0003	Swiftcraft	3505-F
P1	Socket, 7 pin Female	2535-0007	Amphenol	126-198
	SWITCHES			
SW1	Switch, Rotary, 1 pole, 10 pos.	1851-0023	Cushman	


10
C49
R16
R18
C43
C10
R15
C48
R2
C4
R11
R10
L4
C44
Q1
C45
C46
R12
C47
R13
12
2
9
R20
CR2
Q2
3
R19
R14
CR5
CR4
CR3
CR1
5
Q3
C38
C42
R9
R7
C16
R5
C8
C7
C6
R17
11
L11
C40
C41
C36
C37
C14
C15
C4
C5
C50
C2
R3
L9
L10
L7
L8
L5
L6
L1
L3
L2
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R4
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R1
9

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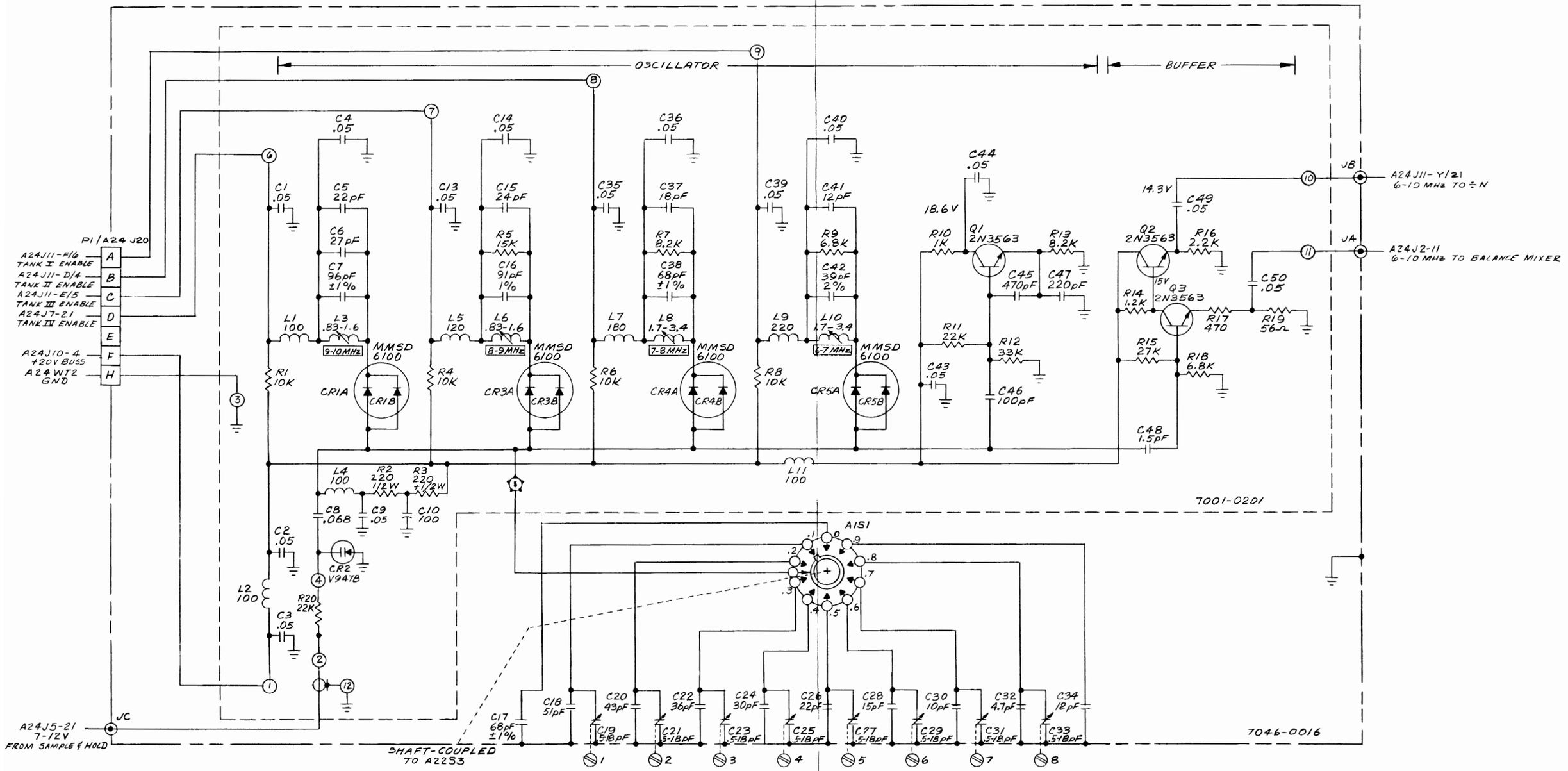


NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

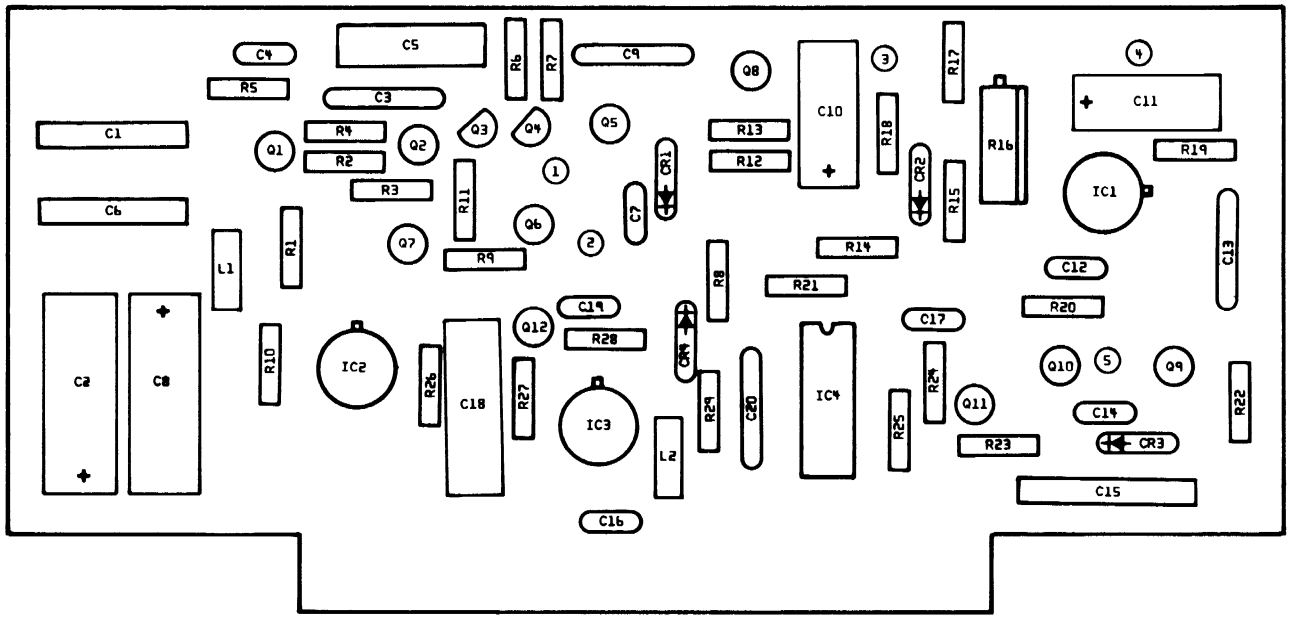
Figure 6-1. Voltage Controlled Oscillator. A1

SAMPLE AND HOLD. A2

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A2	P.C. Board Assy, Sample & Hold	7001-0202	Cushman	
	P.C. Board	1780-0046	Cushman	
	CAPACITORS			
C1	Polyester, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C2	Elect, 100μF, ±10%, 25V	1013-0003	Sprague	TE-1211
C3	Polyester, .022μF, ±10%, 100V	1008-0034	Sprague	225P22391WA3
C4	Mica, 180pF, ±5%, 500V	1002-0005	Elmenco	DM15-F-181J
C5	Poly, .68μF, ±5%, 100V	1008-0039	Electrocube	625BIB684K
C6	Polyester, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C7	Mica, 330pF, ±5%, 500V	1002-0032	Elmenco	DM15-F-331J
C8	Elect, 100μF, ±10%, 25V	1013-0003	Sprague	TE-1211
C9	Polyester, .0082μF, ±10%, 100V	1008-0015	Sprague	225P82291
C10	Elect, 25μF, -10% +25%, 25V	1013-0010	Sprague	TE-1207
C11	Elect, 25μF, -10% +25%, 25V	1013-0010	Sprague	TE-1207
C12	Mica, 200pF, ±5%, 500V	1002-0042	Elmenco	DM15-F-201J
C13	Polyester, .0056μF, ±10%, 100V	1008-0022	Sprague	225P56291WA3
C14	Mica, 330pF, ±5%, 500V	1002-0032	Elmenco	DM15-F-331J
C15	Poly, .39μF, ±10%, 200V	1008-0037	Electrocube	625BIC394K2
C16	Cer, .05μF, -20% +80%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C17	Cer, .05μF, -20% +80%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C18	Polyester, .15μF, ±10%, 200V	1008-0035	Sprague	192P15492
C19	Cer, .05μF, -20% +80%, 25V	1005-0014	Erie	5855/505/Y5U0/503Z
C20	Polyester, .068μF, ±10%, 100V	1008-0036	Sprague	225P68391WA3
	COILS			
L1	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
L2	RF Choke, 120μH, ±5%	1585-0033	Delevan	1537-80
	DIODES			
CR1	Si, 1N3064	1281-0013	Sylvania	1N3064
CR2	Si, 15V, 20%, 1W	1281-0028	Motorola	1N4744
CR3	Si, 1N3064	1281-0013	Sylvania	1N3064
CR4	100V, PIV, 1 Amp.	1281-0023	ITT	1N4002
	INTEGRATED CIRCUITS			
IC1	OP-AMP, SN72709L	2025-0014	T.I.	SN72709L
IC2	Dual 2-input NOR Gate	2025-0010	Fairchild	U8A-9914-28X
IC3	Dual 2-input NOR Gate	2025-0010	Fairchild	U8A-9914-28X
IC4	Quad 2-input Pos NAND Gate	2025-0003	T.I.	SN7400N
	RESISTORS			
R1	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R2	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R3	Comp, 15kΩ, ±5%, 1/4W	1066-1535	Allen-Bradley	CB1535
R4	Comp, 220kΩ, ±5%, 1/4W	1066-2245	Allen-Bradley	CB2245
R5	Comp, 150kΩ, ±5%, 1/4W	1066-1545	Allen-Bradley	CB1545
R6	Comp, 22kΩ, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R7	Comp, 8.2kΩ, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R8	Comp, 5.6kΩ, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R9	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R10	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R11	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R12	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R13	Comp, 47kΩ, ±5%, 1/4W	1066-4735	Allen-Bradley	CB4735
R14	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R15	Comp, 1.8kΩ, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825

SAMPLE AND HOLD (cont). A2

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R16	Pot, 1kΩ, ±10%, 3/4W	1212-0013	Helitrim	89WR
R17	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R18	Comp, 15kΩ, ±5%, 1/4W	1066-1535	Allen-Bradley	CB1535
R19	Comp, 1.5kΩ, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R20	Comp, 33kΩ, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R21	Comp, 5.6kΩ, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R22	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R23	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R24	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R25	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R26	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R27	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R28	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R29	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
	TRANSISTORS			
Q1	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q2	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q3	Si, NPN, 2N5089	1272-0031	Motorola	2N5089
Q4	Si, NPN, 2N5089	1272-0031	Motorola	2N5089
Q5	N-Channel, FET, 2N4092	1272-0025	Teledyne	2N4092
Q6	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q7	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q8	P-Channel MOS FET	1272-0026	General Inst.	MEM511A
Q9	N-Channel, FET, 2N4092	1272-0025	Teledyne	2N4092
Q10	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q11	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q12	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275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C5
R6
R7
C9
Q8
3
R17
4
R5
C3
C11
C1
R4
Q1
Q2
Q3
Q4
Q5
R13
C10
R18
R16
R19
R2
R12
CR1
CR2
C6
R3
R11
1
IC1
R15
C7
Q7
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C8
R10
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R26
C18
R27
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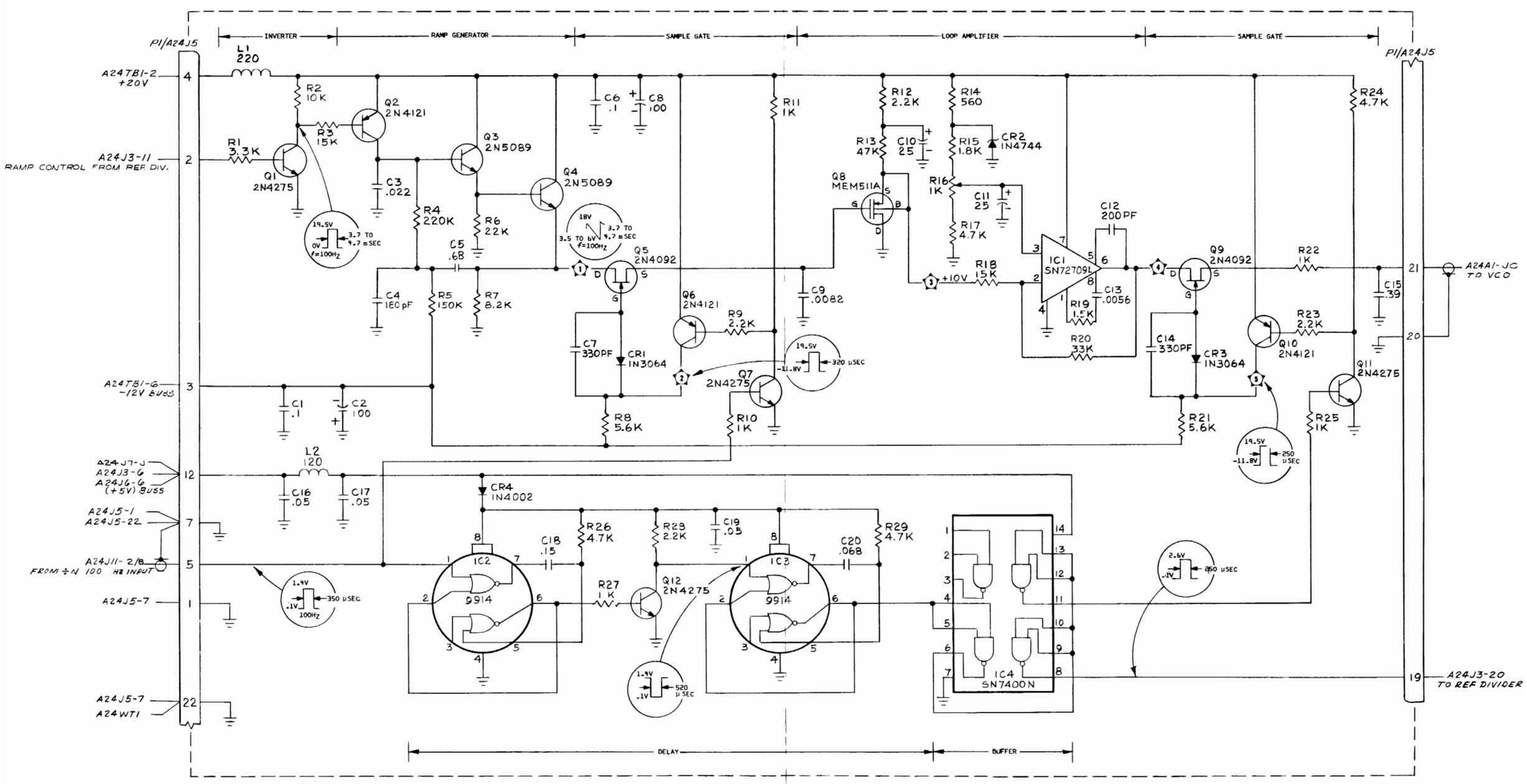
Q11
C14
R22
L2
R23
CR3
C15
C16



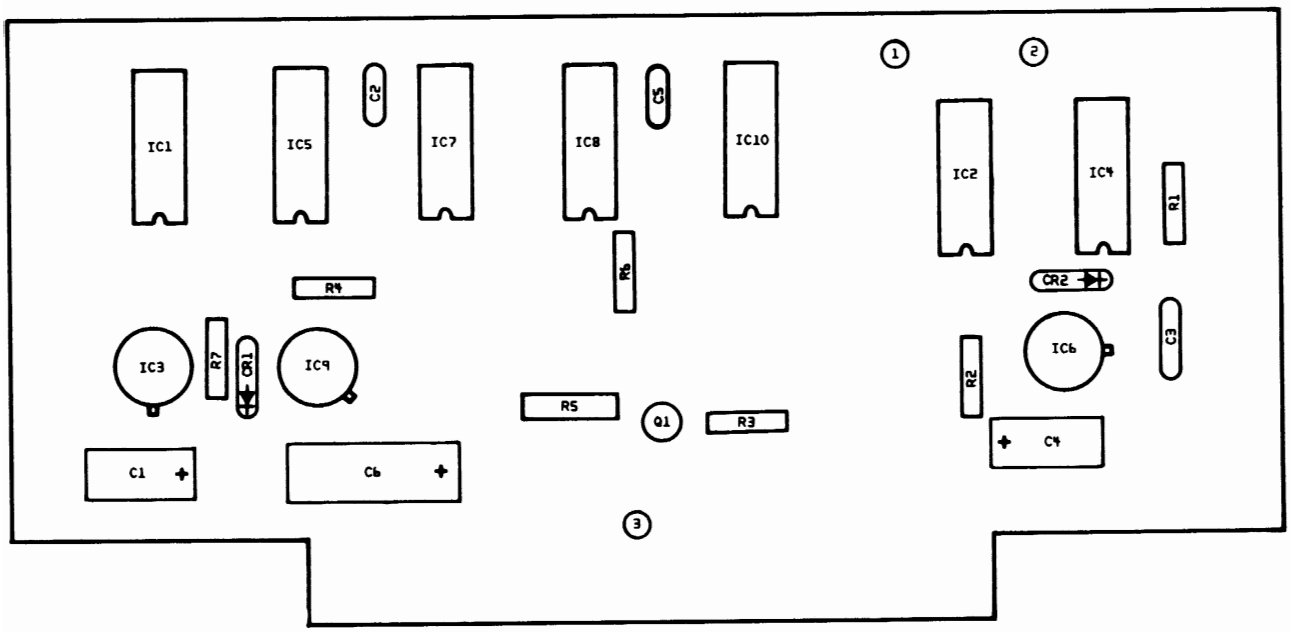
NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN µF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN µH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-2. Sample and Hold. A2

REFERENCE DIVIDER, A3

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A3	Ref. Divider P.C. Board Assy.	7001-0203	Cushman	
	P. C. Board	1780-0047	Cushman	
	CAPACITORS			
C1	Elect, 15μF, +75% -10%, 12V	1013-0015	Sprague	30D156G012BA2
C2	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C3	Mica, 270pF, ±5%, 500V	1002-0031	Elmenco	DM15-F-271J
C4	Elect, 15μF, +75% -10%, 12V	1013-0015	Sprague	30D156G012BA2
C5	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C6	Elect, 100μF, +75% -10%, 12V	1013-0011	Sprague	30D107G012CC5
	DIODES			
CR1	Si, 100V PIV, 1 amp.	1281-0023	ITT	1N4002
CR2	Si, 100V PIV, 1 amp.	1281-0023	ITT	1N4002
	INTEGRATED CIRCUITS			
IC1	Decade Counter	2025-0002	T.I.	SN7490N
IC2	DTL Flip-Flop	2025-0009	T.I.	SN15850N
IC3	Dual 2-input NOR Gate	2025-0010	Fairchild	U8A-9900-28X
IC4	Quad 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N
IC5	Decade Counter	2025-0002	T.I.	SN7490N
IC6	Dual 2-input NOR Gate	2025-0010	Fairchild	U8A-9900-28X
IC7	Decade Counter	2025-0002	T.I.	SN7490N
IC8	Decade Counter	2025-0002	T.I.	SN7490N
IC9	RTL Buffer Ampl.	2025-0011	Fairchild	U8B-9900-28X
IC10	Quad 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N
	RESISTORS			
R1	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R2	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R3	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R4	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R5	Comp, 100Ω, ±5%, 1/2W	1067-1015	Allen-Bradley	EB1015
R6	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R7	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
	TRANSISTORS			
Q1	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275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IC5
C2
IC7
IC8
C5
IC10
1
2
IC2
IC4
R1
R4
R6
CR2
IC3
R7
CR1
IC9
IC6
C3
R2
R5
Q1
R3
C4
C1
C6
3

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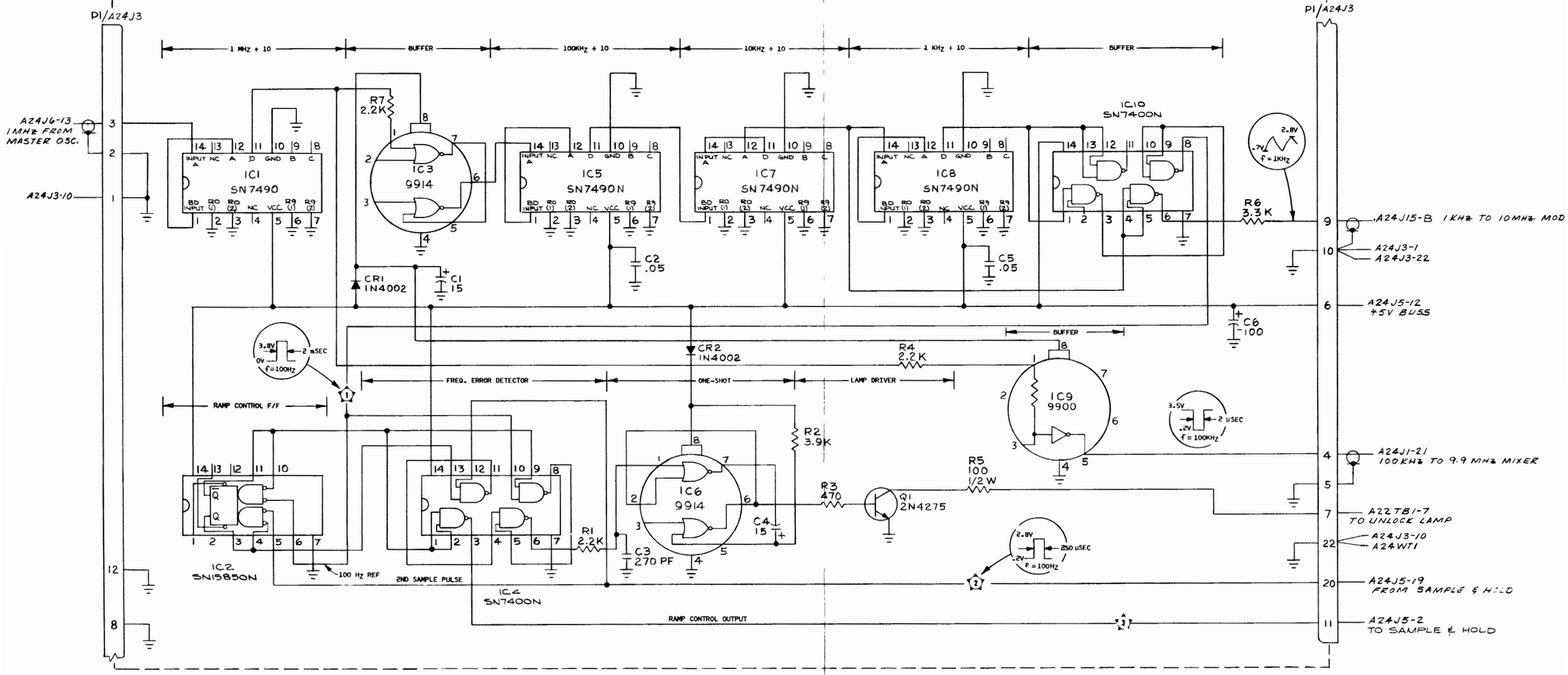


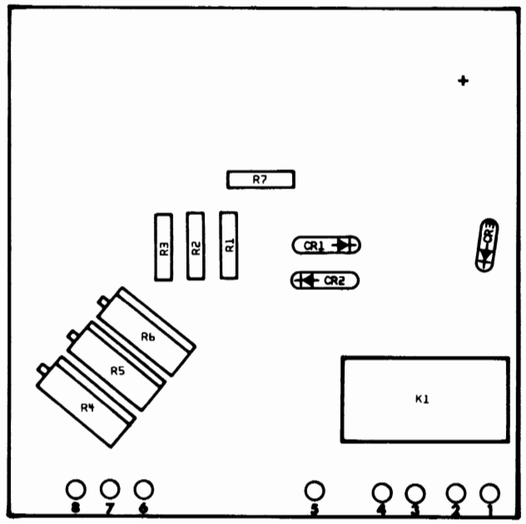
NOTE:

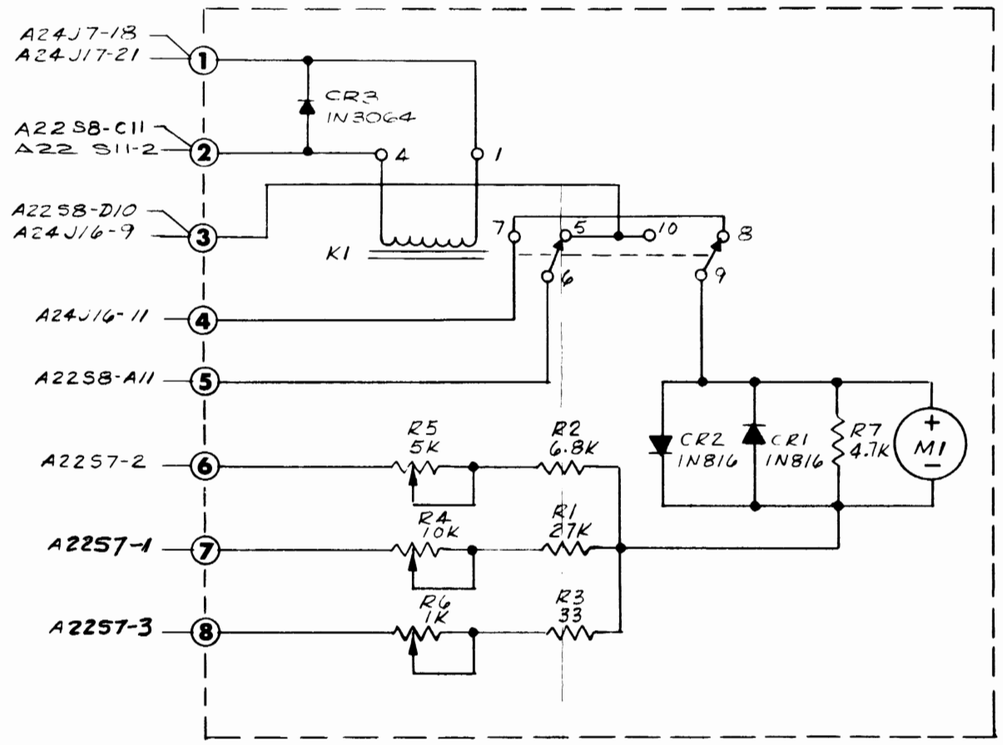
1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN µF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN µH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-3. Reference Divider. A3

FREQUENCY ERROR METER. A4

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A4	Frequency Error Meter Board Assy	7001-0204	Cushman	
	Printed Circuit Board	1780-0456	Cushman	
	DIODES			
CR1	Si, 1N816	1281-0009	Transitron	1N816
CR2	Si, 1N816	1281-0009	Transitron	1N816
CR3	Si, 1N3064	1281-0013	Teledyne	1N3064
	RELAYS			
K1	12V DC, DPDT	1313-0002	Parelco	R102E-Z2-V185
	RESISTORS			
R1	Comp, 27kΩ, ±5%, 1/4W	1066-2735	Allen-Bradley	CB2735
R2	Comp, 6.8kΩ, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R3	Comp, 33Ω, ±5%, 1/4W	1066-3305	Allen-Bradley	CB3305
R4	Pot, 10kΩ, ±10%, 3/4W	1215-0014	Helitrim	89WR
R5	Pot, 5kΩ, ±10%, 3/4W	1215-0012	Helitrim	89WR
R6	Pot, 1kΩ, ±10%, 3/4W	1215-0013	Helitrim	89WR
R7	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725





NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-4. Frequency Error Meter. A4

SECOND IF/DISCRIMINATOR. A5

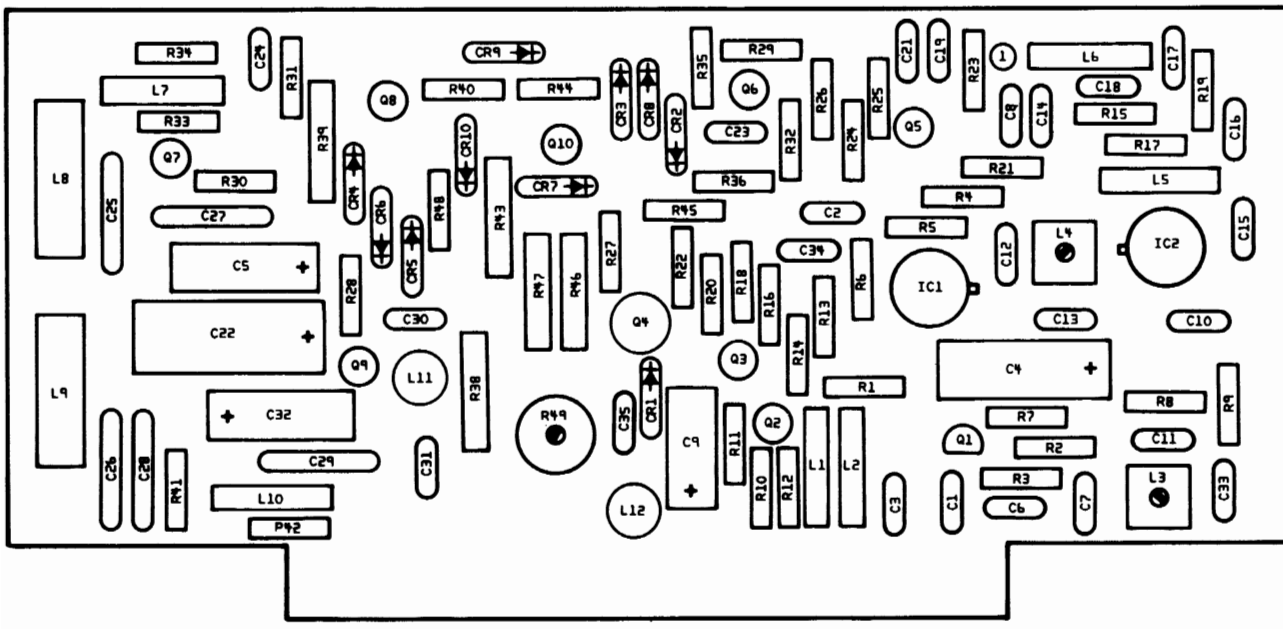
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A5	Second IF and Discriminator Board Assy	7001-0205	Cushman	
	Printed Circuit Board	1780-0054	Cushman	
	CAPACITORS			
C1	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C2	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C3	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C4	Elect, 100μF, +75% -10%, 12V	1013-0011	Sprague	30D107G012CC5
C5	Elect, 15μF, ±10%, 25V	1013-0005	Sprague	30D156G025BB5
C6	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C7	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C8	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5835/505/Y5U0/503Z
C9	Elect, 15μF, +75%, -10%, 12V	1013-0015	Sprague	30D156G012BA5
C10	Cer, 2.2pF, ±.25pF, 500V	1005-0017	Erie	301-000-C0J0-229C
C11	Mica, 430pF, ±5%, 500V	1002-0034	Elmenco	DM15-F-431J
C12	Mica, 430pF, ±5%, 500V	1002-0034	Elmenco	DM15-F-431J
C13	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C14	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5835/505/Y5U0/503Z
C15	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5835/505/Y5U0/503Z
C16	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C17	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C18	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5835/505/Y5U0/503Z
C19	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C20	Not Used			
C21	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5835/505/Y5U0/503Z
C22	Elect, 100μF, ±10%, 25V	1013-0003	Sprague	30D107G025DD5
C23	Mica, 100pF, ±5%, 500V	1002-0011	Elmenco	DM15-F-101J
C24	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C25	Poly, .027μF, ±10%, 100V	1008-0032	Sprague	225P27391
C26	Poly, .027μF, ±10%, 100V	1008-0032	Sprague	225P27391
C27	Mica, 2000pF, ±5%, 500V	1002-0077	Elmenco	DM19-E-202J
C28	Poly, .027μF, ±10%, 100V	1008-0032	Sprague	225P27391
C29	Poly, .027μF, ±10%, 100V	1008-0032	Sprague	225P27391
C30	Mica, 470pF, ±1%, 500V	1002-0044	Elmenco	DM15-F-471F
C31	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5835/505/Y5U0/503Z
C32	Elect, 15μF, ±10%, 25V	1013-0005	Sprague	30D156G025BB5
C33	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C34	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835/512/Y5U/103Z
C35	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5835/505/Y5U0/503Z
	COILS			
L1	RF Choke, 470μH, ±5%	1585-0019	Delevan	2500-12
L2	RF Choke, 470μH, ±5%	1585-0019	Delevan	2500-12
L3	Var. Inductor, 8 turns, 16 MHz	1596-0011	TRW	21024
L4	Var. Inductor, 8 turns, 16 MHz	1596-0011	TRW	21024
L5	RF Choke, 82μH, ±5%	1585-0032	Delevan	1537-72
L6	RF Choke, 82μH, ±5%	1585-0032	Delevan	1537-72
L7	RF Choke, 2.2mH, ±5%	1585-0030	Delevan	2500-44
L8	RF Choke, 4.7mH, ±5%	1585-0006	Delevan	2500-60
L9	RF Choke, 4.7mH, ±5%	1585-0006	Delevan	2500-60
L10	RF Choke, 2.2mH, ±5%	1585-0030	Delevan	2500-44
L11	RF Choke, 22mH, ±15%	1585-0029	Delevan	2534-56
L12	RF Choke, 22mH, ±15%	1585-0029	Delevan	2534-56

SECOND IF/DISCRIMINATOR (cont). A5

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	DIODES			
CR1	Ge, G633	1282-0005	ITT	G633
CR2	Ge, G633	1282-0005	ITT	G633
CR3	Ge, G633	1282-0005	ITT	G633
CR4	Si, 1N3064	1281-0013	Teledyne	1N3064
CR5	Si, 1N3064	1281-0013	Teledyne	1N3064
CR6	Si, 1N3064	1281-0013	Teledyne	1N3064
CR7	Si, 1N3064	1281-0013	Teledyne	1N3064
CR8	Ge, G633	1282-0005	ITT	G633
CR9	Si, 1N3064	1281-0013	Teledyne	1N3064
CR10	Si, 1N3064	1281-0013	Teledyne	1N3064
	INTEGRATED CIRCUITS			
IC1	RF Ampl, CA3028A	2025-0012	RCA	CA3028A
IC2	RF Ampl, CA3028A	2025-0012	RCA	CA3028A
	RESISTORS			
R1	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R2	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R3	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R4	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R5	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R6	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R7	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R8	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R9	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R10	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R11	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R12	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R13	Comp, 22Ω, ±5%, 1/4W	1066-2205	Allen-Bradley	CB2205
R14	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R15	Comp, 1.5kΩ, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R16	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R17	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R18	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R19	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R20	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R21	Comp, 820Ω, ±5%, , 1/2W	1067-8215	Allen-Bradley	EB8215
R22	Comp, 12kΩ, ±5%, 1/4W	1066-1235	Allen-Bradley	CB1235
R23	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R24	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R25	Comp, 22Ω, ±5%, 1/4W	1066-2205	Allen-Bradley	CB2205
R26	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R27	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R28	Comp, 68Ω, ±5%, 1/4W	1066-6805	Allen-Bradley	CB6805
R29	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R30	M Film, 2.21kΩ, ±1%, 1/8W	1075-0010	Dale	MFF1/8T1
R31	M Film, 10kΩ, ±1%, 1/8W	1075-0009	Dale	MFF1/8T1
R32	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R33	M Film, 332Ω, ±1%, 1/8W	1075-0024	Dale	MFF1/8T1
R34	M Film, 2.21kΩ, ±1%, 1/8W	1075-0010	Dale	MFF1/8T1
R35	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R36	Comp, 12kΩ, ±5%, 1/4W	1066-1235	Allen-Bradley	CB1235
R37	Not Used			
R38	M Film, 1kΩ, ±1%, 1/2W	1076-0007	Dale	MFF1/2T1
R39	M Film, 357Ω, ±1%, 1/2W	1076-0012	Dale	MFF1/2T1
R40	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025

SECOND IF/DISCRIMINATOR (cont). A5

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R41	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R42	M Film, 475Ω, ±1%, 1/8W	1075-0023	Dale	MFF 1/8 T1
R43	M Film, 14.7kΩ, ±1%, 1/4W	1077-0002	Dale	MFF 1/4 T1
R44	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R45	Comp, 33kΩ, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R46	M Film, 1kΩ, ±1%, 1/2W	1076-0007	Dale	MFF 1/2 T1
R47	M Film, 274Ω, ±1%, 1/2W	1076-0013	Dale	MFF 1/2 T1
R48	Comp, 1.2kΩ, ±5%, 1/2W	1067-1225	Allen-Bradley	EB1225
R49	Pot, 200Ω, ±10%, 1/4W	1200-0016	Allen-Bradley	F FR201U
	TRANSISTORS			
Q1	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q2	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q3	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q4	Si, NPN, 2N3567	1272-0014	Fairchild	2N3567
Q5	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q6	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q7	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q8	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q9	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q10	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275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C15
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R28
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C34
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C29
R49
R2
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L2
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C33
C31
R10
R12
R3
C1
C6
C7
C3
L10
L12
P42

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SIGNAL LEVEL DETECTOR — AUDIO — SECOND I.F. MIXER — DISCRIMINATOR

P1/A24J16 — P1/A24J16

A24J7B2-2 +20V BUSS — 17 — L1 470

A24J18-3 SQUELCH VOLTAGE — 15 — R10 1K — C9 15 — R11 4.7K

C5 15 — C8 .05

R12 2.2K — R14 3.9K — Q2 2N3565 — R16 1K — R13 22

Q3 2N3565 — R18 2.2K — R20 2.2K — CR1 G633 — Q4 2N3567 — R22 12K

R27 560 — R28 68 — C22 100

R30 2.21K 1% 1/8W — Q7 2N3565 — R31 10K 1% 1/8W — R33 322 1% 1/8W

C27 2000pF — L7 22mH — L8 4.7mH — L9 4.7mH — L10 22mH

R34 2.21K 1% 1/8W — C24 470pF — C25 .027 — C26 .027 — C28 .027 — C29 .027 — R42 475 1% 1/8W

Q9 2N3565 — R41 470 — C32 15

R1 3.9K — R2 3.9K — C6 .01 — R3 3.3K — C7 .01

A24J1-15 9.9 MHz — 21 — C1 .01 — Q1 T1537

R9 3.9K — C33 .01 — R8 1K — L3 — C11 430pF

A24WT2 A24J16-1 — 22

R7 220 — C10 2.2pF

R21 820 1/2W

R4 1.2K — C2 .01 — R5 2.2K — R6 51 — C3 .01

C12 430pF — L4 — C14 .05 — IC1 CA3028A — C13 3.3pF — L5 82

R15 1.5K — R17 1.2K — C16 .01 — R19 2.2K — IC2 CA3028A — C15 .05 — C18 .05 — L6 82 — C17 470pF — C19 470pF

R24 3.3K — R29 2.2K — Q5 2N3565 — R23 3.3K — R25 22 — R26 2.2K — C21 .05

R32 3.3K — C23 100pF — CR2 G633 — Q6 2N4275 — R35 10K

CR3 G633

R48 1.2K 1/2W — CR5 1N3064 — R38 1K 1% 1/2W — CR6 1N3064 — R39 357 1% — R40 1K

R43 14.7K 1% 1/2W — R44 4.7K — R46 1K 1% 1/2W — C35 .05 — L12 22mH — R49 200 — CR9 1N3064 — L11 22mH — C31 .05 — R47 274 1% 1/2W — CR10 1N3064

Q8 2N4275 — CR4 1N3064 — C30 470pF — CR7 1N3064 — Q10 2N4275 — CR8 G633

R36 12K — R45 33K

A24J18-7 10MHz IN FROM PLUG-IN — 19 — C3 .01 — 20

A24J18-5 A24J15-5 -12V BUSS — 18 — L2 470 — C4 100 — C34 .01

P1/A24J16

10 — A22XDS1-A SIGNAL LEVEL

4 — A22R3-1 AUDIO OUTPUT — 5

7 — 6 — A22J2 100 KHz IF OUTPUT

2 — A24J17-11 TO SCOPE PLUG-IN — 3

1 — A24J16-22

8 — A22R12-2 CW CAL

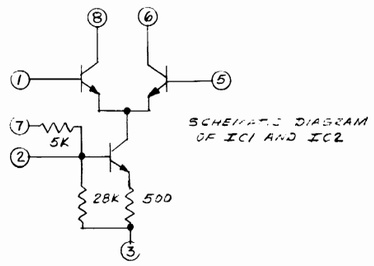
16 — A22R12-3 CW CAL & SIG LEVEL — 12

11 — A22A4-4 TO FREQ ERROR METER

9 — A22A4-3 TO FREQ ERROR METER

NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.



SCHEMATIC DIAGRAM OF IC1 AND IC2

Figure 6-5. Second IF/Discriminator. A5

MASTER OSCILLATOR/DIVIDER/FILTERS. A6

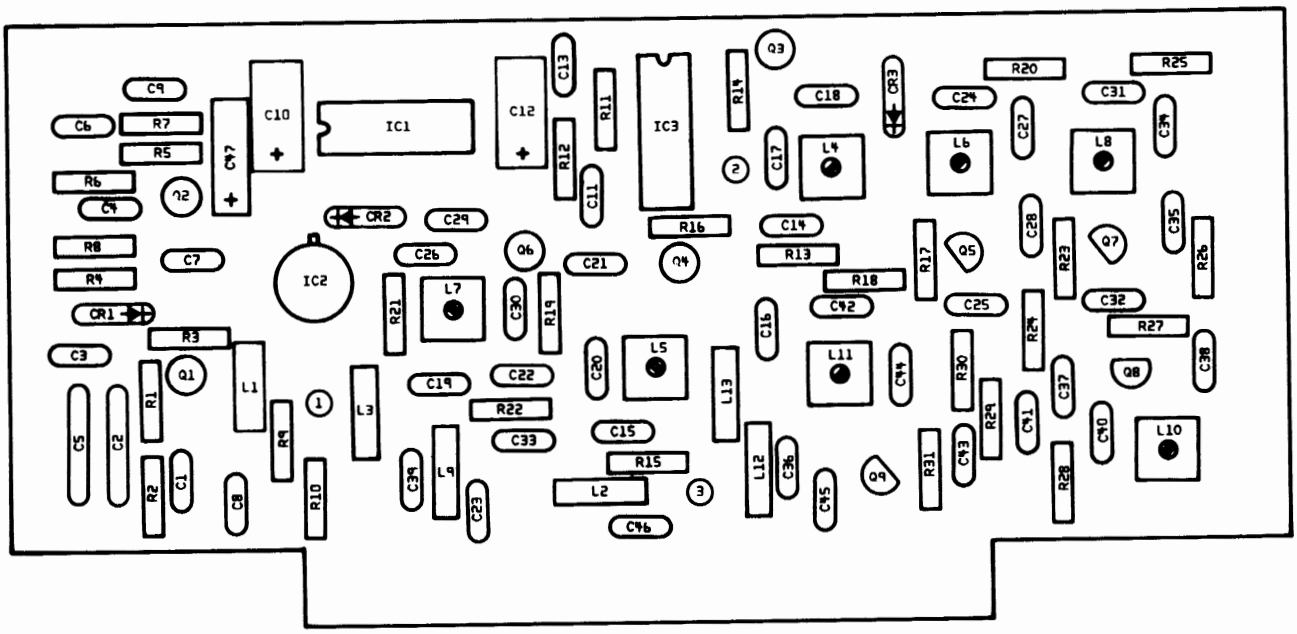
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A6	Master Osc/Divider/Filters P.C. Board Assy	7001-0206	Cushman	
	P.C. Board	1780-0061	Cushman	
	CAPACITORS			
C1	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C2	Poly, .0012μF, ±10%, 100V	1008-0016	Sprague	225P82291WA3
C3	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C4	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C5	Poly, .0027μF, ±10%, 100V	1008-0009	Sprague	225P27291
C6	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C7	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C8	Mica, 180pF, ±5%, 500V	1002-0005	Elmenco	DM15-F-181J
C9	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C10	Elect, 15μF, +75% -10%, 12V	1013-0015	Sprague	30D156G012BA2
C11	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C12	Elect, 15μF, +75% -10%, 12V	1013-0015	Sprague	30D156G012BA2
C13	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C14	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C15	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C16	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C17	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C18	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C19	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C20	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C21	Mica, 10pF, ±5%, 500V	1002-0016	Elmenco	DM15-C-100J
C22	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C23	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C24	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C25	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C26	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C27	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C28	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C29	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C30	Mica, 27pF, ±5%, 500V	1002-0008	Elmenco	DM15-E-270J
C31	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C32	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C33	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C34	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C35	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C36	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C37	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C38	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C39	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C40	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C41	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C42	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C43	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C44	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C45	Mica, 10pF, ±5%, 500V	1002-0016	Elmenco	DM15-C-100J
C46	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-000-Y5U0-503Z
C47	Tant, 10μF, ±10%, 20V	1011-0007	Kemet	K10C20K

MASTER OSCILLATOR/DIVIDER/FILTERS (cont). A6

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	COILS			
L1	RF Choke, 680μH, ±5%	1585-0023	Delevan	1537-08
L2	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
L3	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
L4	Var. Inductor, 4 turns	B1596-0010	Cushman	
L5	Var. Inductor, 8 turns	B1596-0011	Cushman	
L6	Var. Inductor, 4 turns	B1596-0010	Cushman	
L7	Var. Inductor, 8 turns	B1596-0011	Cushman	
L8	Var. Inductor, 4 turns	B1596-0010	Cushman	
L9	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
L10	Var. Inductor, 4 turns	B1596-0010	Cushman	
L11	Var. Inductor, 4 turns	B1596-0010	Cushman	
L12	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
L13	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
	DIODES			
CR1	Si, Zener, 6.8V, ±20%	1281-0007	Motorola	1N957
CR2	Si, 1 amp, 100V PIV	1281-0023	ITT	1N4002
CR3	Si, 1N3064	1281-0013	Transitron	1N3064
	INTEGRATED CIRCUITS			
IC1	TTL Dual Flip-Flop	2025-0005	T.I.	SN7476N
IC2	RTL Buffer	2025-0011	Fairchild	U8A-9900-28X
IC3	Quad 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N
	RESISTORS			
R1	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R2	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R3	Comp, 1.5kΩ, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R4	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R5	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R6	Comp, 27kΩ, ±5%, 1/4W	1066-2735	Allen-Bradley	CB2735
R7	Comp, 680Ω, ±5%, 1/4W	1066-6815	Allen-Bradley	CB6815
R8	Comp, 1.5kΩ, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R9	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R10	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R11	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R12	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R13	Comp, 5.1kΩ, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R14	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R15	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R16	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R17	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R18	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R19	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R20	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R21	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R22	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R23	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R24	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R25	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R26	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R27	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R28	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R29	Comp, 5.6kΩ, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R30	Comp, 5.6kΩ, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R31	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025

MASTER OSCILLATOR/DIVIDER/FILTERS (cont). A6

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	TRANSISTORS			
Q1	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q2	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q3	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q4	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q5	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q6	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q7	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q8	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q9	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37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C6
R7
R5
R6
C4
Q2
C10
C47
IC1
C12
C13
R12
R11
C11
IC3
R14
Q3
C18
CR3
C24
R20
R25
C31
C17
L4
L6
C27
L8
C34
CR2
C29
R16
C14
C28
C35
R8
C7
C26
Q6
C21
Q4
R13
R17
Q5
R23
Q7
R26
R4
IC2
R18
CR1
R21
L7
C30
R19
C42
C25
C32
R24
R27
R3
C16
C3
Q1
L1
C20
L5
L13
L11
C44
R30
C38
Q8
R1
C19
C22
R22
C37
C5
C2
L3
R9
C15
R29
C41
C40
L10
C33
R15
C39
L9
L2
L12
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R31
C43
R28
R2
C1
C8
R10
C23
C46
C45

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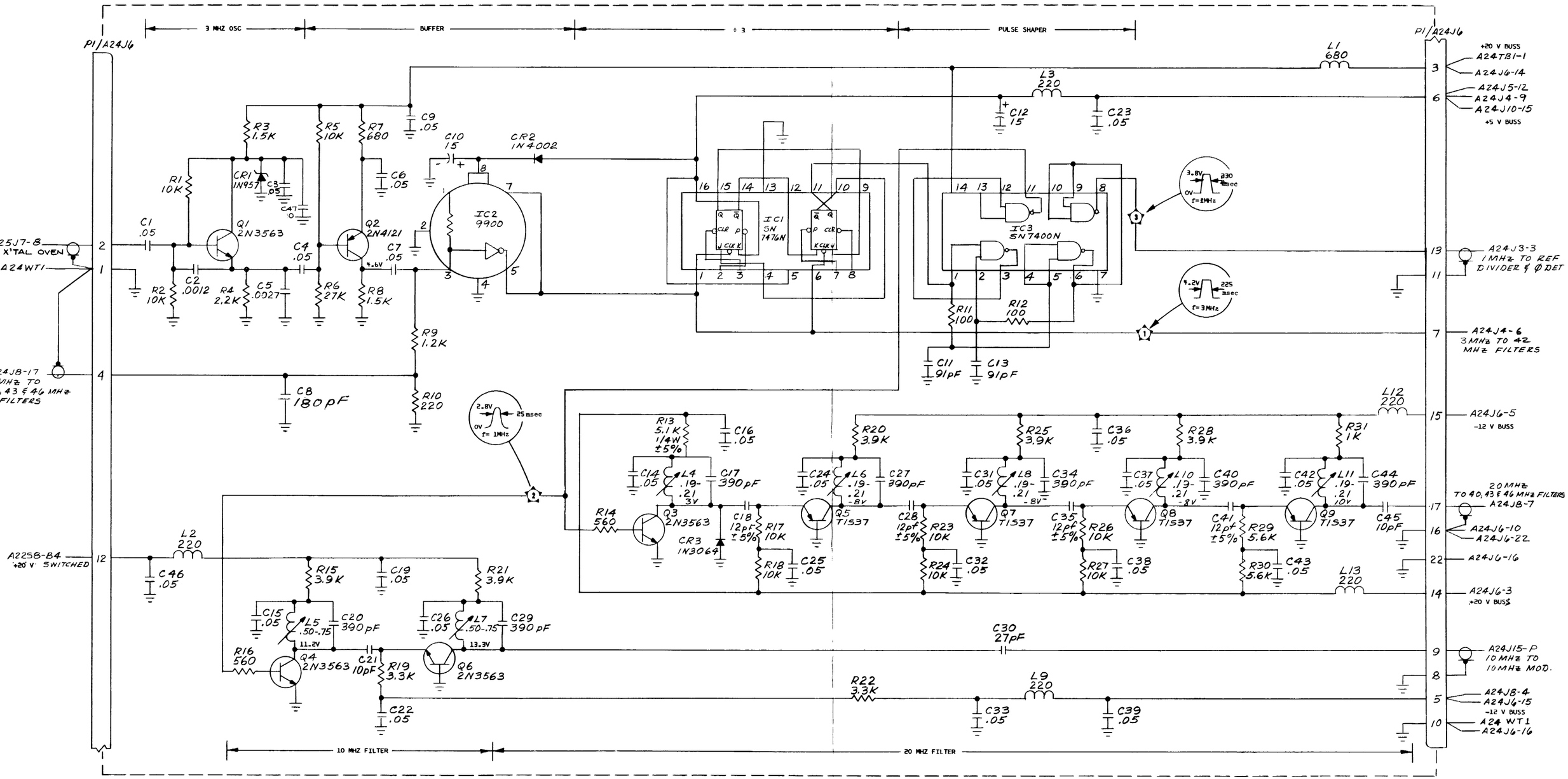


NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

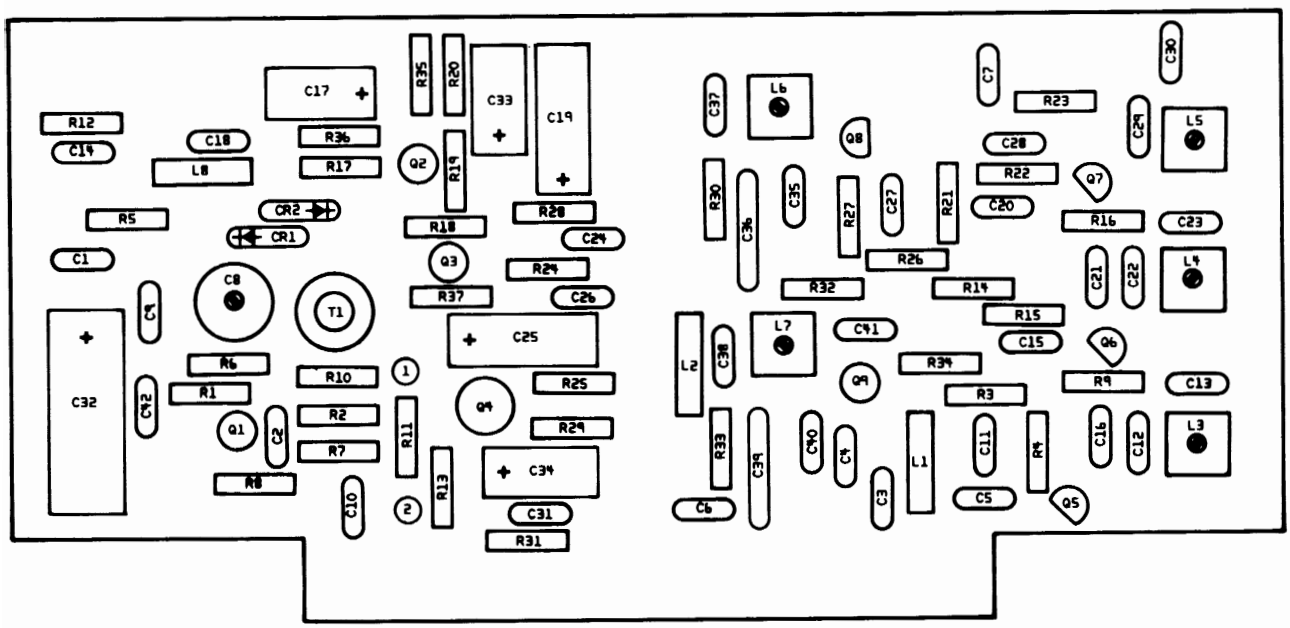
Figure 6-6. Master Oscillator/Divider/Filters. A6

1 kHz-4 kHz MIXER/9.9 MHz FILTER, A7

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A7	1 to 4 MHz and 9.9 MHz Mixers Board Assy	7001-0207	Cushman	
	Printed Circuit Board	1780-0062	Cushman	
	CAPACITORS			
C1	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C2	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C3	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C4	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C5	Mica, 560pF, ±5%, 300V	1002-0037	Elmenco	DM15-F-561J
C6	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C7	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C8	Cer, 9-35pF, 350V	1001-0006	Erie	538-002-94D
C9	Mica, 27pF, ±5%, 500V	1002-0008	Elmenco	DM15-E-270J
C10	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C11	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C12	Mica, 510pF, ±5%, 500V	1002-0036	Elmenco	DM15-F-511J
C13	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C14	Mica, 27pF, ±5%, 500V	1002-0008	Elmenco	DM15-E-270J
C15	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C16	Mica, 15pF, ±5%, 500V	1002-0001	Elmenco	DM15-C-150J
C17	Elect, 1.0μF, ±10%, 25V	1013-0004	Sprague	30D105G025BA5
C18	Mica, 27pF, ±5%, 500V	1002-0008	Elmenco	DM15-E-270J
C19	Elect, 15μF, ±10%, 25V	1013-0005	Sprague	30D156G025BB5
C20	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C21	Mica, 15pF, ±5%, 500V	1002-0001	Elmenco	DM15-C-150J
C22	Mica, 510pF, ±5%, 500V	1002-0036	Elmenco	DM15-F-511J
C23	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C24	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C25	Elect, 15μF, ±10%, 25V	1013-0005	Sprague	30D156G025BB5
C26	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C27	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C28	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C29	Mica, 510pF, ±5%, 500V	1002-0036	Elmenco	DM15-F-511J
C30	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C31	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C32	Elect, 100μF, ±10%, 25V	1013-0003	Sprague	30D107G025DD5
C33	Elect, 1.0μF, ±10%, 25V	1013-0004	Sprague	30D105G025BA5
C34	Elect, 1.0μF, ±10%, 25V	1013-0004	Sprague	30D105G025BA5
C35	Mica, 620pF, ±5%, 300V	1002-0038	Elmenco	DM15-F-621J
C36	Poly, .0082μF, ±10%, 100V	1008-0015	Elmenco	225-P82291
C37	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C38	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C39	Poly, .0082μF, ±10%, 100V	1008-0015	Elmenco	225-P82291
C40	Mica, 430pF, ±5%, 500V	1002-0034	Elmenco	DM15-F-431J
C41	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C42	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
	COILS			
L1	RF Choke, 680μH, ±5%	1585-0023	Delevan	2500-20
L2	RF Choke, 680μH, ±5%,	1585-0023	Delevan	2500-20
L3	Var. Inductor, 2.2-5.1μH	1596-0004	TRW	20211-R2
L4	Var. Inductor, 2.2-5.1μH	1596-0004	TRW	20211-R2
L5	Var. Inductor, 2.2-5.1μH	1596-0004	TRW	20211-R2
L6	Var. Inductor, 2.2-5.1μH	1596-0004	TRW	20211-R2
L7	Var. Inductor, 0.5-0.75μH	1596-0011	TRW	21024
L8	RF Choke, 5.6μH, ±10%	1585-0028	Delevan	1537-30

1 kHz-4 kHz MIXER/9.9 MHz FILTER (cont). A7

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	DIODES			
CR1	Ge, G633	1282-0005	ITT	G633
CR2	Ge, G633	1282-0005	ITT	G633
	RESISTORS			
R1	Comp, 27kΩ, ±5%, 1/4W	1066-2735	Allen-Bradley	CB2735
R2	Comp, 8.2kΩ, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R3	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R4	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R5	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R6	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R7	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R8	Comp, 120Ω, ±5%, 1/4W	1066-1215	Allen-Bradley	CB1215
R9	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R10	Comp, 150Ω, ±5%, 1/4W	1066-1515	Allen-Bradley	CB1515
R11	Comp, FSV, ±5%, 1/4W	1066-xxxx		
R12	Comp, 680Ω, ±5%, 1/4W	1066-6815	Allen-Bradley	CB6815
R13	Comp, 120Ω, ±5%, 1/4W	1066-1215	Allen-Bradley	CB1215
R14	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R15	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R16	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R17	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R18	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R19	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R20	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R21	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R22	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R23	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R24	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R25	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R26	Comp, 6.8kΩ, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R27	Comp, 8.2kΩ, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R28	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R29	Comp, 330Ω, ±5%, 1/4W	1066-3315	Allen-Bradley	CB3315
R30	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R31	Comp, 82Ω, ±5%, 1/4W	1066-8205	Allen-Bradley	CB8205
R32	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R33	Comp, 8.2kΩ, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R34	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R35	Comp, 12kΩ, ±5%, 1/4W	1066-1235	Allen-Bradley	CB1235
R36	Comp, 22kΩ, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R37	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
	TRANSFORMER			
T1	Toroid, 9 turns #26, 4 turns #26	1579-0007	Cushman	
	TRANSISTORS			
Q1	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q2	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q3	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q4	Si, NPN, 2N3642	1272-0018	Fairchild	2N3642
Q5	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q6	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q7	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q8	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q9	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563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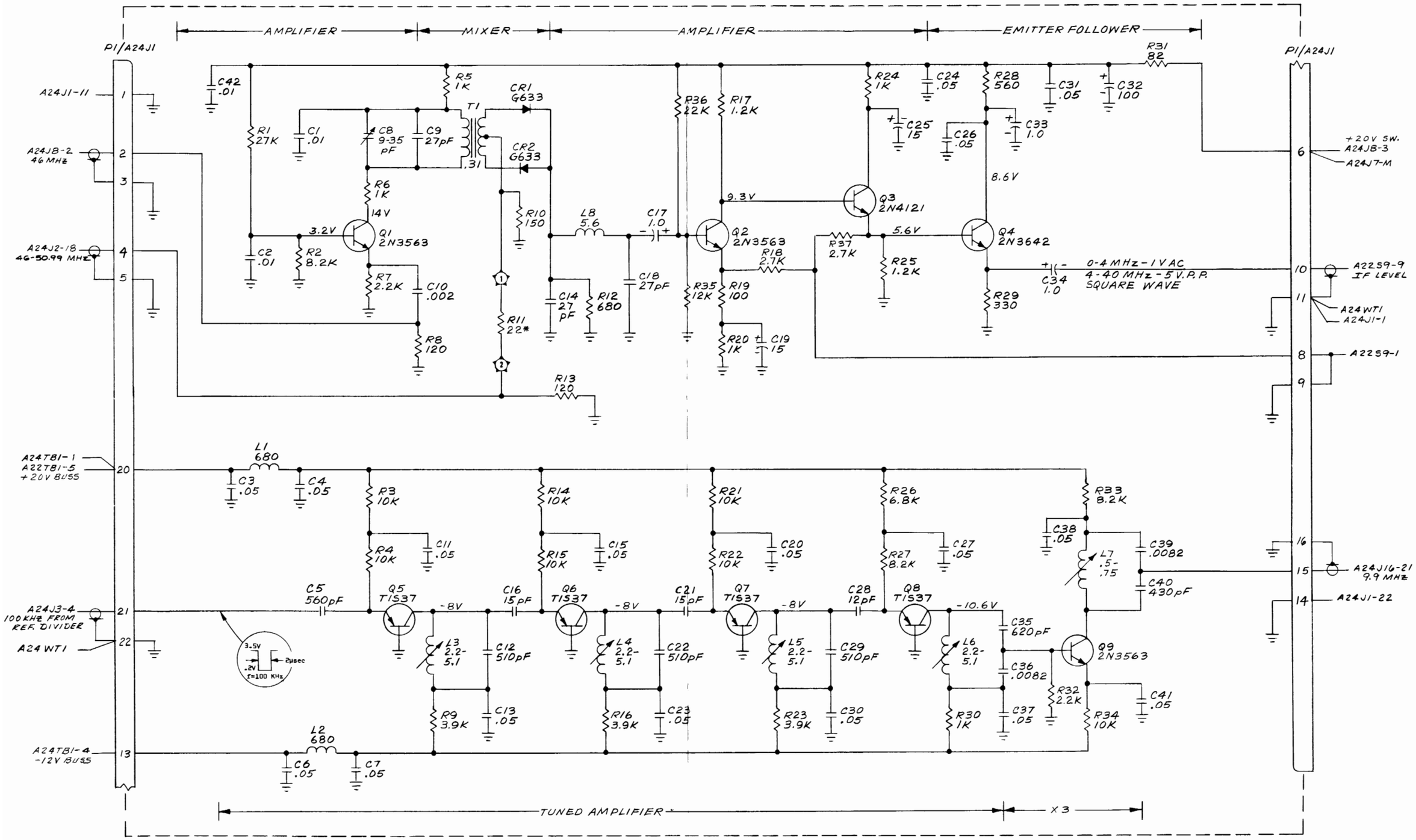
C21
C22
L4
R15
C15
Q6
R9
C13
C16
C12
L3
R4
C11
C5
Q5
L1
C3
C4
C40
R3
R34
Q9
C41
L7
C38
L2
C39
R33
C6
R32
R19
R26
R27
C27
R21
C35
C36
R30
C37
L6
Q8

5601**0034



NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-7. 1 kHz-4 kHz Mixer/9.9 MHz Filter. A7

46.00-50.99 MHz BALANCED MIXER. A8

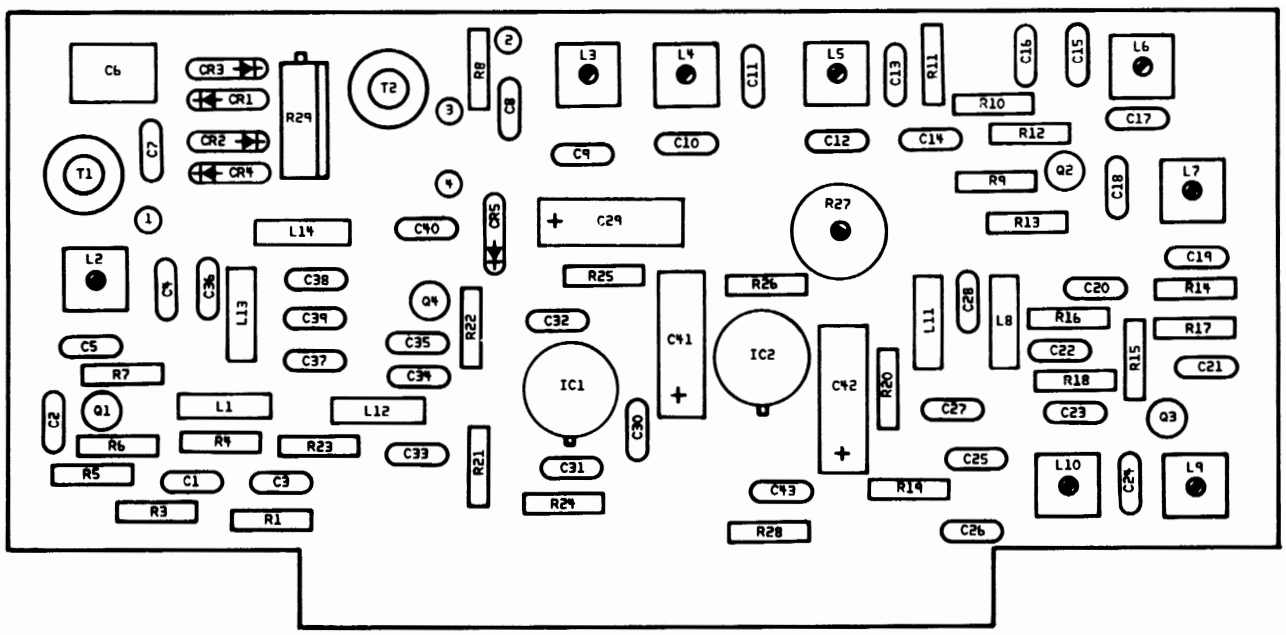
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A8	46.00-50.99 MHz Balanced Mixer, P.C. Board Assy	7001-0208	Cushman	
	Printed Circuit Board	1780-0065	Cushman	
	CAPACITORS			
C1	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C2	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C3	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C4	Mica, 33pF, ±5%, 500V	1002-0024	Elmenco	DM15-E-330J
C5	Mica, 68pF, ±5%, 500V	1002-0013	Elmenco	DM15-E-680J
C6	Cer, 2-8pF, 350V	1001-0010	Erie	538-006A
C7	Mica, 5pF, ±5%, 500V	1002-0028	Elmenco	DM15-C-050D
C8	Mica, 100pF, ±5%, 500V	1002-0011	Elmenco	DM15-F-101J
C9	Mica, 68pF, ±5%, 500V	1002-0013	Elmenco	DM15-E-680J
C10	Cer, 5.6pF, ±.25pF, 500V	1005-0042	Erie	301-C0H-569C
C11	Mica, 33pF, ±5%, 500V	1002-0024	Elmenco	DM15-E-330J
C12	Cer, 5.6pF, ±.25pF, 500V	1005-0042	Erie	301-C0H-569C
C13	Mica, 43pF, ±5%, 500V	1002-0046	Elmenco	DM15-E-430J
C14	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C15	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C16	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C17	Mica, 43pF, ±5%, 500V	1002-0046	Elmenco	DM15-E-430J
C18	Cer, 6.8pF, ±.25pF, 500V	1005-0006	Erie	301-000-C0H0-689C
C19	Mica, 39pF, ±5%, 500V	1002-0018	Elmenco	DM15-E-390J
C20	Mica, 15pF, ±5%, 500V	1002-0001	Elmenco	DM15-C-150J
C21	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C22	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C23	Cer, 8.2pF, ±.25pF, 500V	1005-0043	Erie	301-000-C0H0-829C
C24	Mica, 43pF, ±5%, 500V	1002-0046	Elmenco	DM15-E-430J
C25	Mica, 68pF, ±5%, 500V	1002-0013	Elmenco	DM15-E-680J
C26	Mica, 120pF, ±5%, 500V	1002-0010	Elmenco	DM15-F-121J
C27	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C28	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C29	Elect, 15μF, ±10%, 25V	1013-0005	Sprague	30D156G025BB5
C30	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C31	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C32	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C33	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C34	Mica, 56pF, ±5%, 500V	1002-0019	Elmenco	DM15-E-560J
C35	Mica, 330pF, ±5%, 500V	1002-0032	Elmenco	DM15-F-331J
C36	Mica, 270pF, ±5%, 500V	1002-0031	Elmenco	DM15-F-271J
C37	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C38	Mica, 220pF, ±5%, 500V	1002-0029	Elmenco	DM15-F-221J
C39	Mica, 430pF, ±5%, 500V	1002-0034	Elmenco	DM15-F-431J
C40	Mica, 270pF, ±5%, 500V	1002-0031	Elmenco	DM15-F-271J
C41	Elect, 15μF, ±10%, 25V	1013-0005	Sprague	30D156G025BB5
C42	Elect, 15μF, ±10%, 25V	1013-0005	Sprague	30D156G025BB5
C43	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
	COILS			
L1	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L2	Var. Inductor, 0.19-0.21μH	1596-0010	Cushman	
L3	Var. Inductor, 0.28-0.34μH	7050-0021	Cushman	
L4	Var. Inductor, 0.28-0.34μH	7050-0021	Cushman	
L5	Var. Inductor, 0.28-0.34μH	7050-0021	Cushman	

46.00-50.99 MHz BALANCED MIXER (cont). A8

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
L6	Var. Inductor, 0.28-0.34μH	7050-0021	Cushman	
L7	Var. Inductor, 0.28-0.34μH	7050-0021	Cushman	
L8	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L9	Var. Inductor, 0.28-0.34μH	7050-0021	Cushman	
L10	Var. Inductor, 0.28-0.34μH	7050-0021	Cushman	
L11	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L12	RF Choke, 1μH, ±10%	1585-0027	Delevan	1537-12
L13	RF Choke, .56μH, ±10%	1585-0036	Delevan	1840-07
L14	RF Choke, .68μH, ±10%	1585-0024	Delevan	1537-08
	DIODES			
CR1	HP 2800	1283-0001	HPA	5082-2800
CR2	HP 2800	1283-0001	HPA	5082-2800
CR3	HP 2800	1283-0001	HPA	5082-2800
CR4	HP 2800	1283-0001	HPA	5082-2800
CR5	Zener, 9.1V, ±5%, 1N4739A	1281-0027	IRC	1N4739A
	INTEGRATED CIRCUITS			
IC1	RF Ampl, CA3028A	2025-0012	RCA	CA3028A
IC2	RF Ampl, CA3028A	2025-0012	RCA	CA3028A
	RESISTORS			
R1	Comp, 120Ω, ±5%, 1/4W	1066-1215	Allen-Bradley	CB1215
R2	Not Used			
R3	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R4	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R5	Comp, 5.6kΩ, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R6	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R7	Comp, 270Ω, ±5%, 1/4W	1066-2715	Allen-Bradley	CB2715
R8	Comp, 68Ω, ±5%, 1/4W	1066-6805	Allen-Bradley	CB6805
R9	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R10	Comp, 5.6kΩ, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R11	Comp, 12kΩ, ±5%, 1/4W	1066-1235	Allen-Bradley	CB1235
R12	Comp, 680Ω, ±5%, 1/4W	1066-6815	Allen-Bradley	CB6815
R13	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R14	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R15	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R16	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R17	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R18	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R19	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R20	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R21	Comp, 330Ω, ±5%, 1/4W	1067-3315	Allen-Bradley	EB3315
R22	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R23	Comp, 1.5kΩ, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R24	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R25	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R26	Comp, 8.2kΩ, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R27	Pot, 1kΩ, ±10%, 1/4W	1200-0012	Allen-Bradley	F FR102U
R28	Comp, 1.5kΩ, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R29	Pot, 100Ω, ±10%, 3/4W	1215-0009	Beckman	89 PR 100
	TRANSFORMERS			
T1	Toroid, Trifiliar Coil Assy	C1579-0017	Cushman	
T2	Toroid, Trifiliar Coil Assy	C1579-0017	Cushman	

46.00-50.99 MHz BALANCED MIXER (cont). A8

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	TRANSISTORS			
Q1	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q2	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q3	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q4	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563


C6
CR3
CR1
CR2
CR4
R29
T2
R8
2
3
L3
L4
C11
L5
C13
R11
C16
C15
L6
R10
C17
C7
T1
C8
C9
C10
C12
C14
R12
Q2
R9
C18
L7
4
1
L14
C40
CR5
C29
R27
R13
L2
C4
C36
L13
C38
C39
C37
Q4
C35
C34
R22
C32
R25
R26
C41
IC2
C19
C20
R14
R16
C22
R18
R17
C21
R15
C5
R7
C2
Q1
L1
L12
R6
R4
R23
C33
R5
C1
C3
R3
R1
R21
C31
R24
IC1
C30
C42
R20
L11
C28
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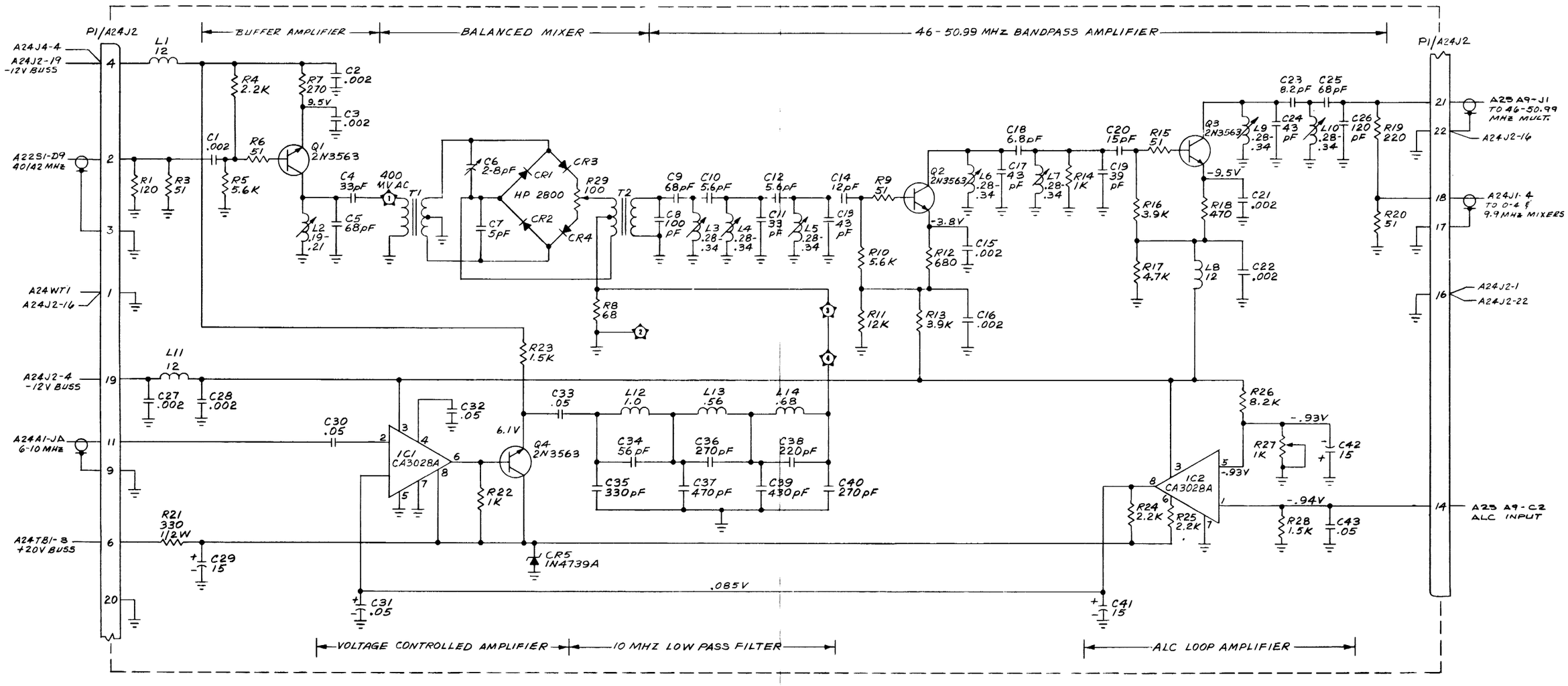
C23
Q3
C25
L10
C24
L9
C43
R19
R28
C26

5601••0034



NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

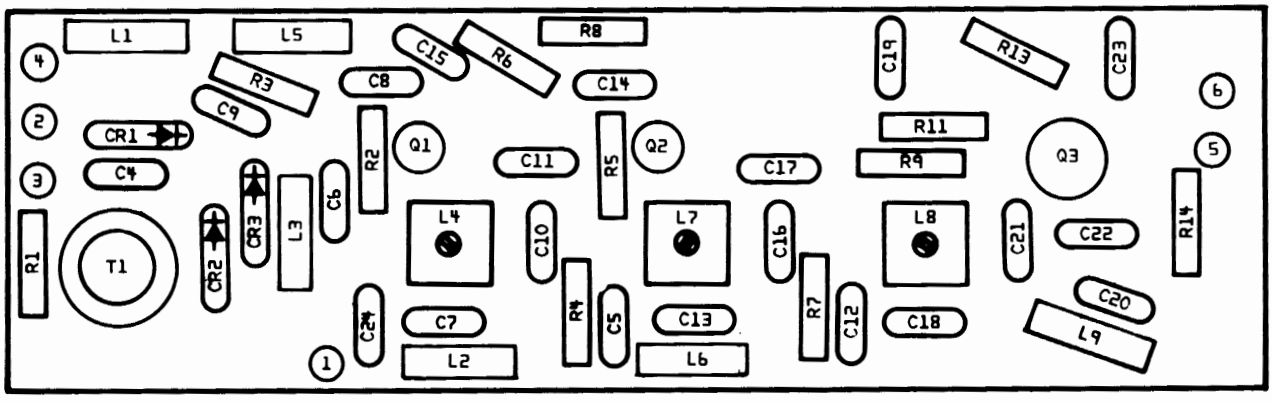
Figure 6-8. 46.00-50.99 MHz Balanced Mixer. A8

46.00-50.99 MHz X10 MULTIPLIER, A9

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A9	46.00-50.99 MHz x 10 Multiplier P.C. Board Assy	7001-0209	Cushman	
	P.C. Board	1780-0066	Cushman	
	CAPACITORS			
C1	Feed Thru, 1000pF, ±20%, 500V	1005-0008	Erie	357-001-X5U0-102M
C2	Feed Thru, 1000pF, ±20%, 500V	1005-0008	Erie	357-001-X5U0-102M
C3	Feed Thru, 1000pF, ±20%, 500V	1005-0008	Erie	357-001-X5U0-102M
C4	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C5	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C6	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C7	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C8	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C9	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C10	Mica, 24pF, ±5%, 500V	1002-0051	Elmenco	DM15-C-240J
C11	Mica, 10pF, ±5%, 500V	1002-0016	Elmenco	DM15-C-100J
C12	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C13	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C14	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C15	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C16	Mica, 36pF, ±5%, 500V	1002-0041	Elmenco	DM15-E-360J
C17	Mica, 22pF, ±5%, 500V	1002-0023	Elmenco	DM15-C-220J
C18	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C19	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C20	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C21	Mica, 5pF, ±5%, 500V	1002-0028	Elmenco	DM15-C-050D
C22	Mica, 560pF, ±5%, 300V	1002-0037	Elmenco	DM15-F-561J
C23	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C24	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C25	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C26	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
	COILS			
L1	RF Choke, 4.7μH, ±10%	1585-0021	Delevan	1537-28
L2	RF Choke, 4.7μH, ±10%	1585-0021	Delevan	1537-28
L3	RF Choke, 4.7μH, ±10%	1585-0021	Delevan	1537-28
L4	#24 Wire, 2 1/2 turns (blk)	7050-0022	Cushman	
L5	RF Choke, 4.7μH, ±10%	1585-0021	Delevan	1537-28
L6	RF Choke, 4.7μH, ±10%	1585-0021	Delevan	1537-28
L7	#24 Wire, 2 1/2 turns (blk)	7050-0022	Cushman	
L8	#24 Wire, 3 1/2 turns (blk) Var.	7050-0030	Cushman	
L9	Choke, 2 1/2 turns, Wide Band	1586-0003	Ferroxcube	VK20020/4B
	CONNECTORS			
J1	Connector, Right Angle BNC	2536-0006	Startronics	UG-1098/U
J2	Connector, BNC	2536-0010	Kings	KC79-35
	DIODES			
CR1	Ge, G633	1282-0005	ITT	G633
CR2	HP 2800	1283-0001	HPA	5082-2800
CR3	HP 2800	1283-0001	HPA	5082-2800
CR4	Step Recovery	1282-0008	HPA	5082-0180
	FILTER			
Fil-1	460-522 MHz Coaxial	1040-0026	Cushman	

46.00-50.99 MHz X10 MULTIPLIER (cont). A9

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	RESISTORS			
R1	Comp, 120Ω, ±5%, 1/4W	1066-1215	Allen-Bradley	CB1215
R2	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R3	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R4	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R5	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R6	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R7	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R8	Comp, 220Ω, ±5%, 1/2W	1067-2215	Allen-Bradley	EB2215
R9	Comp, 68Ω, ±5%, 1/4W	1066-6805	Allen-Bradley	CB6805
R10	Not Used			
R11	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R12	Not Used			
R13	Comp, 180Ω, ±5%, 1/2W	1067-1815	Allen-Bradley	EB1815
R14	Comp, 3.3kΩ, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R15	Comp, 1.5kΩ, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
	TRANSFORMER			
T1	Toroid, #28 Wire, 17 turns Bifilar	1579-0013	Cushman	
	TRANSISTORS			
Q1	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q2	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q3	Si, NPN, 2N3866	1271-0005	RCA	2N3866


L1
L5
R8
C15
R6
C19
R13
C23
R3
C8
C14
C9
R2
Q1
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Q3
CR1
C11
R5
Q2
C17
R9
C4
C6
L4
L7
L8
C21
C22
R14
R1
T1
CR3
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CR2
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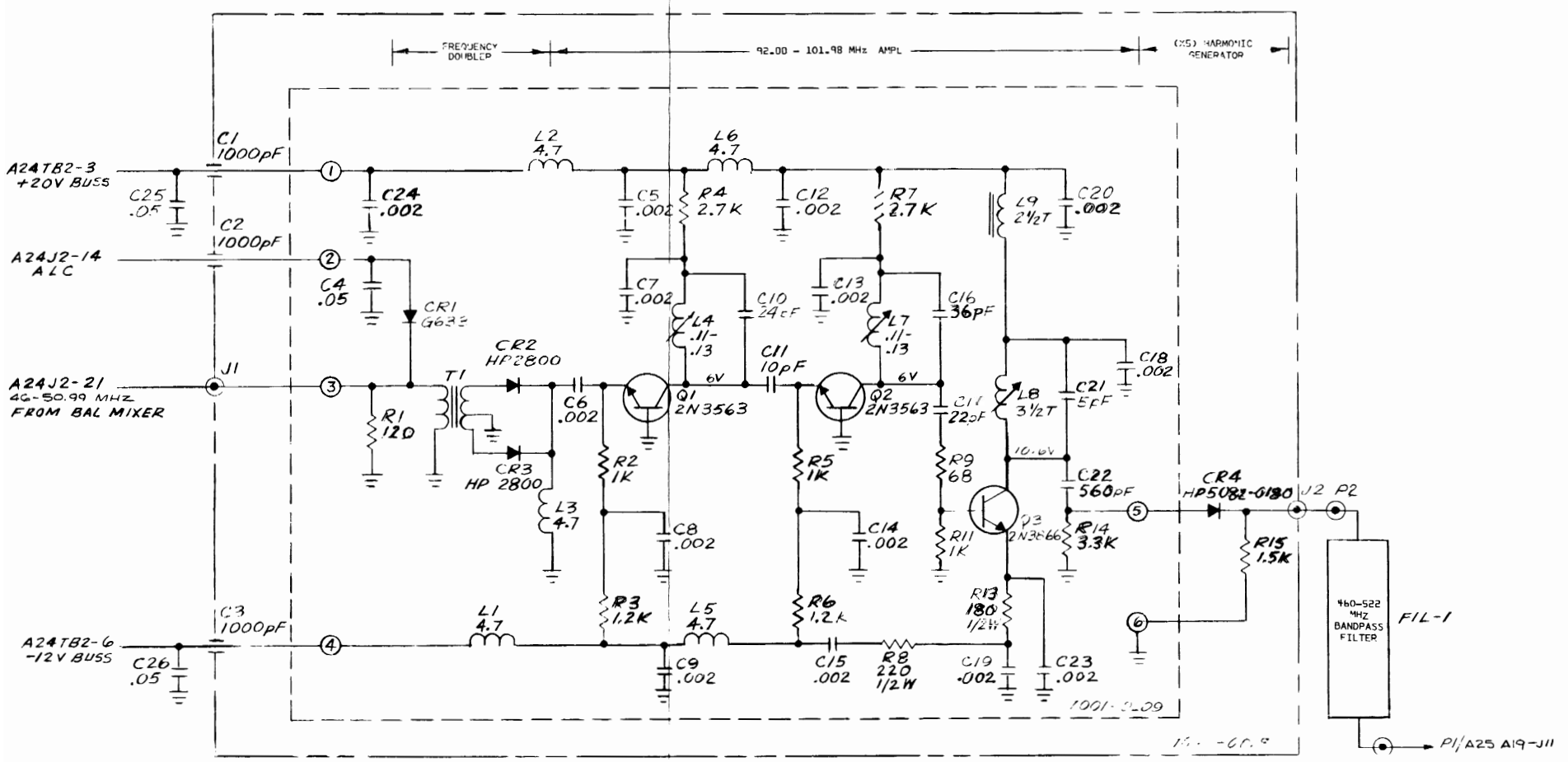


NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

R10 & R12 NOT USED

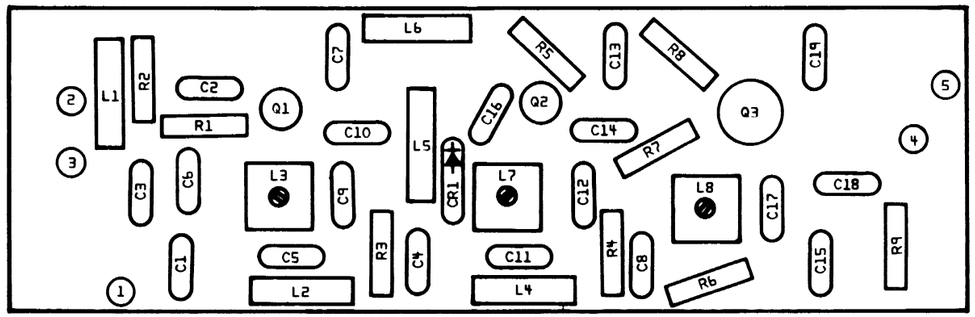
Figure 6-9. 46.00-50.99 MHz X10 Multiplier. A9

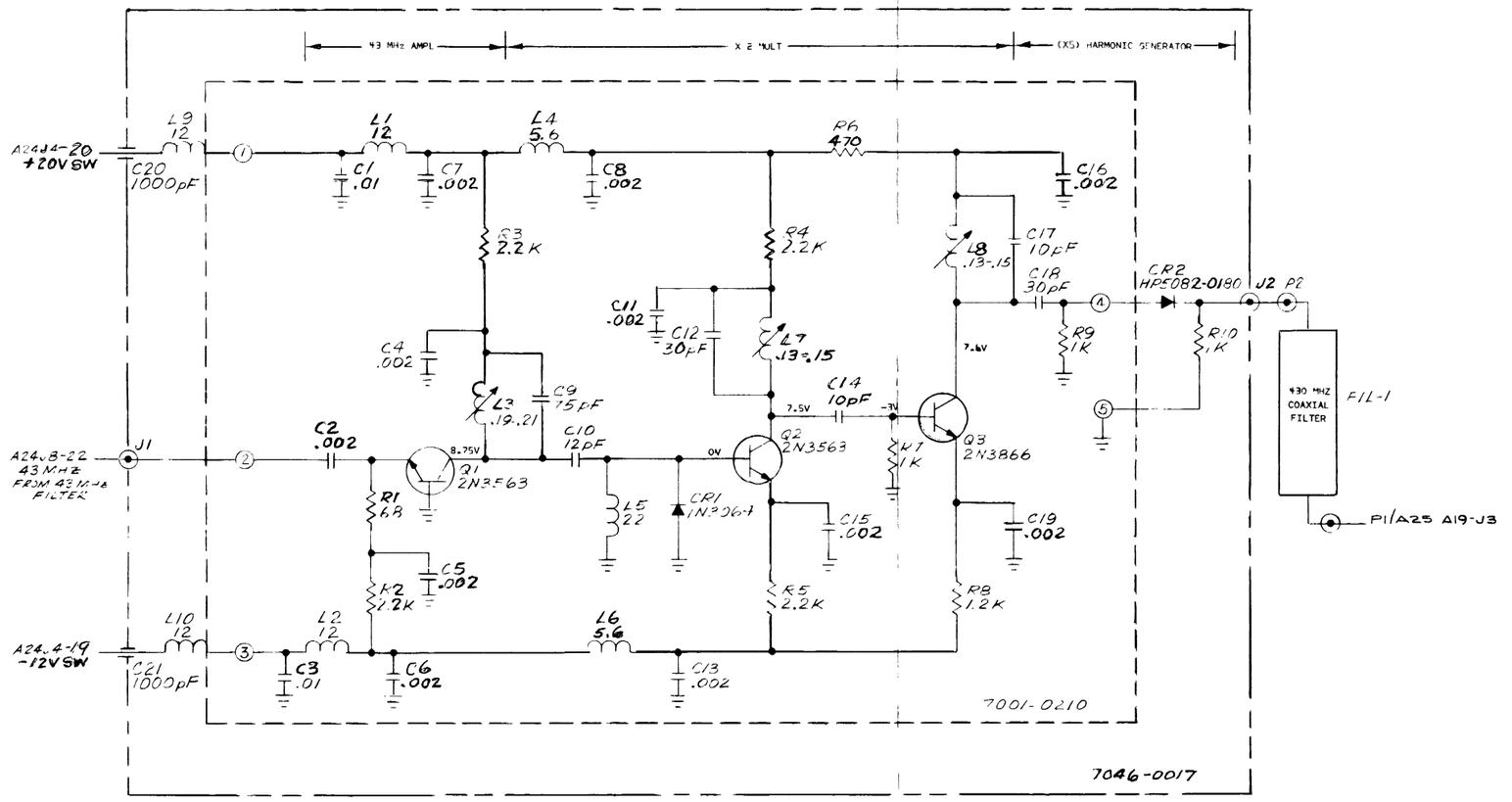
43 MHz X10 MULTIPLIER, A10

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A10	43 MHz x 10 Multiplier P.C. Board Assy	7001-0210	Cushman	
	P.C. Board	1780-0067	Cushman	
	CAPACITORS			
C1	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C2	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C3	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C4	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C5	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C6	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C7	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C8	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C9	Mica, 75pF, ±5%, 500V	1002-0025	Elmenco	DM15-E-750J
C10	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
C11	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C12	Mica, 30pF, ±5%, 500V	1002-0043	Elmenco	DM15-E-300J
C13	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C14	Mica, 10pF, ±5%, 500V	1002-0016	Elmenco	DM15-C-100J
C15	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C16	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C17	Mica, 10pF, ±5%, 500V	1002-0016	Elmenco	DM15-C-100J
C18	Mica, 30pF, ±5%, 500V	1002-0043	Elmenco	DM15-E-300J
C19	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C20	Feed Thru, 1000pF, ±20%, 500V	1005-0008	Erie	857-001-X5U0-503Z
C21	Feed Thru, 1000pF, ±20%, 500V	1005-0008	Erie	857-001-X5U0-503Z
	COILS			
L1	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L2	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L3	Var. Inductor, 0.19-0.21μH	1596-0010	Cushman	
L4	RF Choke, 5.6μH, ±10%	1585-0028	Delevan	1537-30
L5	RF Choke, 22μH, ±10%	1585-0012	Delevan	1537-44
L6	RF Choke, 5.6μH, ±10%	1585-0028	Delevan	1537-30
L7	Var, #22 Wire, 3 turns, (blk)	7050-0005	Cushman	
L8	Var, #22 Wire, 3 turns, (blk)	7050-0005	Cushman	
L9	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L10	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
	CONNECTORS			
J1	Connector, Right Angle BNC	2536-0006	Startronics	UG-1098/U
J2	Connector, BNC	2536-0010	Kings	KC79-35
	DIODES			
CR1	Si, 1N3064	1281-0013	Sylvania	1N3064
CR2	Diode, HP 5082-0180	1282-0008	HP	HP5082-0180
	FILTER			
Fil-1	Filter, 430 MHz, Coaxial	1040-0009	Cushman	
	RESISTORS			
R1	Comp, 68Ω, ±5%, 1/4W	1066-6805	Allen-Bradley	CB6805
R2	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R3	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R4	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R5	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225

43 MHz X10 MULTIPLIER (cont). A10

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R6	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R7	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R8	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R9	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R10	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
	TRANSISTORS			
Q1	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q2	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q3	Si, NPN, 2N3866	1271-0005	RCA	2N3866





NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-10. 43 MHz X10 Multiplier. A10

40 MHz, 43 MHz, AND 46 MHz FILTER. A11

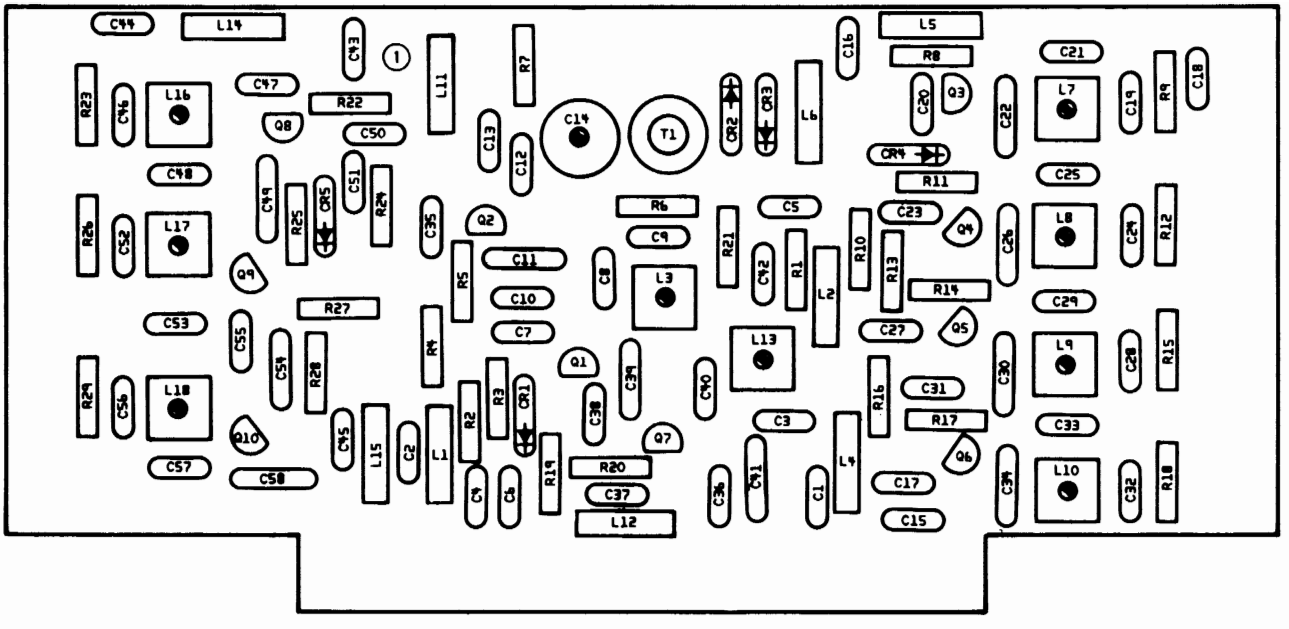
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A11	40 MHz, 43 MHz, and 46 MHz Filter - P.C. Board Assy	7001-0211	Cushman	
	P.C. Board	1780-0078	Cushman	
	CAPACITORS			
C1	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C2	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C3	Mica, 270pF, ±5%, 500V	1002-0031	Elmenco	DM15-F-271J
C4	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C5	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C6	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C7	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C8	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C9	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C10	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C11	Cer, 2.2pF, ±.25pF, 500V	1005-0017	Erie	301-000-C0J0-229C
C12	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C13	Mica, 33pF, ±5%, 500V	1002-0024	Elmenco	DM15-E-330J
C14	Var. Cer, 9-35pF, 35V	1001-0006	Erie	538-002-94D
C15	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C16	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C17	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C18	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C19	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C20	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C21	Mica, 82pF, ±5%, 500V	1002-0020	Elmenco	DM15-E-820J
C22	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C23	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C24	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C25	Mica, 82pF, ±5%, 500V	1002-0020	Elmenco	DM15-E-820J
C26	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C27	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C28	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C29	Mica, 82pF, ±5%, 500V	1002-0020	Elmenco	DM15-E-820J
C30	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C31	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C32	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C33	Mica, 82pF, ±5%, 500V	1002-0020	Elmenco	DM15-E-820J
C34	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C35	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C36	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C37	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C38	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C39	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C40	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C41	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C42	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C43	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C44	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C45	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C46	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C47	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C48	Mica, 68pF, ±5%, 500V	1002-0013	Elmenco	DM15-E-680J
C49	Cer, 5.6pF, ±.25pF, 500V	1005-0042	Erie	301-C0H-569C
C50	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M

40 MHz, 43 MHz, AND 46 MHz FILTER (cont). A11

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
C51	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C52	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C53	Mica, 68pF, ±5%, 500V	1002-0013	Elmenco	DM15-E-680
C54	Cer, 4.7pF, ±.25pF, 500V	1005-0015	Erie	301-C0H-479C
C55	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C56	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C57	Mica, 75pF, ±5%, 500V	1002-0025	Elmenco	DM15-E-750J
C58	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
	COILS			
L1	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L2	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L3	Var, 0.19-0.21μH	1596-0010	TRW	21023
L4	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L5	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L6	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L7	Var, 0.19-0.21μH	1596-0010	TRW	21023
L8	Var, 0.19-0.21μH	1596-0010	TRW	21023
L9	Var, 0.19-0.21μH	1596-0010	TRW	21023
L10	Var, 0.19-0.21μH	1596-0010	TRW	21023
L11	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L12	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L13	Var, 0.19-0.21μH	1596-0010	TRW	21023
L14	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L15	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L16	Var, 0.19-0.21μH	1596-0010	TRW	21023
L17	Var, 0.19-0.21μH	1596-0010	TRW	21023
L18	Var, 0.19-0.21μH	1596-0010	TRW	21023
	DIODES			
CR1	Si, 1N3064	1281-0013	Sylvania	1N3064
CR2	Ge, G633	1282-0005	ITT	G633
CR3	Ge, G633	1282-0005	ITT	G633
CR4	Si, 1N3064	1281-0013	Sylvania	1N3064
CR5	Si, 1N3064	1281-0013	Sylvania	1N3064
	RESISTORS			
R1	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R2	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R3	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R4	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R5	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R6	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R7	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R8	Comp, 22kΩ, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R9	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R10	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R11	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R12	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R13	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R14	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R15	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R16	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R17	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R18	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R19	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R20	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035

40 MHz, 43 MHz, AND 46 MHz FILTER (cont). A11

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R21	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R22	Comp, 22kΩ, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R23	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R24	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R25	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R26	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R27	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R28	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R29	Comp,			
	TRANSFORMERS			
T1	Toroid, 9 turns #26, 4 turns #26	C1579-0007	Cushman	
	TRANSISTORS			
Q1	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q2	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q3	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q4	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q5	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q6	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q7	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q8	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q9	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q10	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37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L14
C43
1
L11
R7
L5
R8
C21
R23
C46
L16
C47
R22
Q8
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C13
C12
C14
T1
CR2
CR3
L6
C16
C20
Q3
C22
L7
C19
R9
C18
C48
CR4
R11
C25
C49
R25
CR5
C51
R24
C35
Q2
R6
C9
C5
C23
Q4
L8
C24
R12
R26
C52
L17
C11
R5
C8
L3
R21
C42
R1
L2
R10
R13
C26
Q9
C10
R14
C29
R27
C7
C27
Q5
C53
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R28
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C39
C40
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C30
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C2
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C9
C6
R19
R20
C37
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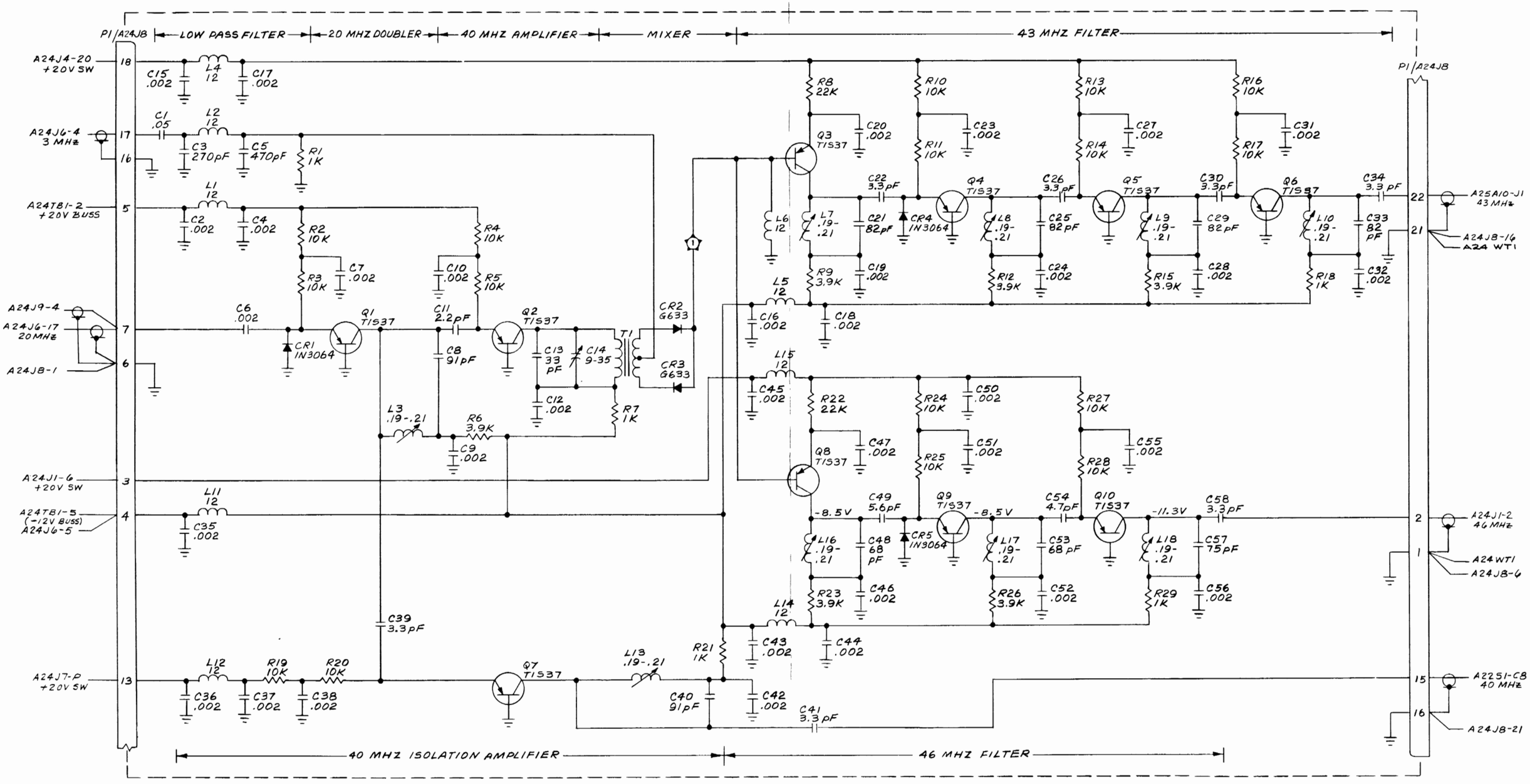
C36
C41
C1
L4
C17
C15
C34
L10
C32
R18
C57
C58



NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

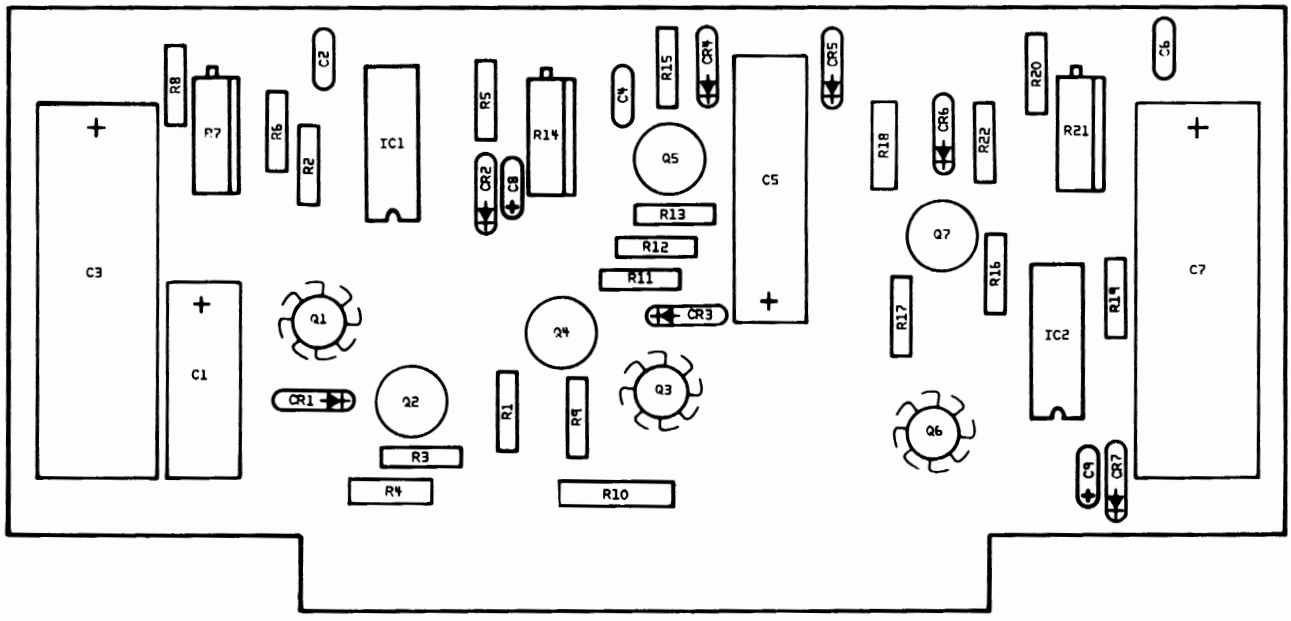
Figure 6-11. 40 MHz, 43 MHz, and 46 MHz Filter. A11

POWER SUPPLY REGULATOR. A12

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A12	Power Supply Regulator P.C. Board Assy	7001-0212	Cushman	
	P.C. Board	1780-0082	Cushman	
	CAPACITORS			
C1	Elect, 100μF, ±10%, 25V	1013-0003	Sprague	30D107G025DD5
C2	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C3	Elect, 500μF, 25V	1014-0002	Ill. Elna	25T500
C4	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C5	Elect, 250μF, +75% -10%, 16V	1013-0016	Sprague	30D257G016DF2
C6	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C7	Elect, 500μF, 25V	1014-0002	Ill. Elna	25T500
C8	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C9	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
	DIODES			
CR1	Si, 1 amp, 100V PIV	1281-0023	ITT	1N4002
CR2	Zener, 6.2V	1281-0038	Transitron	1N827
CR3	Si, 1 amp, 100V PIV	1281-0023	ITT	1N4002
CR4	Si, Zener, 4.3V, ±5%	1281-0025	I.R.	1N4731A
CR5	Si, Zener, 7.5V, ±5%, 1W	1281-0026	I.R.	1N4737A
CR6	Si, 1 amp, 100V PIV	1281-0023	ITT	1N4002
CR7	Zener, 6.2V	1281-0038	Transitron	1N827
	INTEGRATED CIRCUITS			
IC1	Op. Amp. 2N72741N	2025-0022	T.I.	2N72741N
IC2	Op. Amp. 2N72741N	2025-0022	T.I.	2N72741N
	RESISTORS			
R1	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R2	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R3	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R4	WW, 1Ω, ±5%, 3W	1159-0001	Ohmite	4330
R5	Comp, 1.8kΩ, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R6	Metal Film, 887Ω, ±1%, 1/8W	1075-0022	Dale	MFF 1/8 T1
R7	Pot, 500Ω, ±10%, 3/4W	1215-0011	Helitrim	89WR
R8	Metal Film, 2.21kΩ, ±1%, 1/8W	1075-0010	Dale	MFF 1/8 T1
R9	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R10	WW, .5Ω, ±3%, 3W	1159-0002	Dale	RS-2B
R11	Comp, 6.8kΩ, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R12	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R13	Comp, 10Ω, ±5%, 1/4W	1066-1005	Allen-Bradley	CB1005
R14	Pot, 100Ω, ±10%, 3/4W	1215-0010	Helitrim	89WR
R15	Comp, 270Ω, ±5%, 1/4W	1066-2715	Allen-Bradley	CB2715
R16	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R17	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R18	WW, 1Ω, ±5%, 3W	1159-0001	Ohmite	4330
R19	Comp, 820Ω, ±5%, 1/4W	1066-8215	Allen-Bradley	CB8215
R20	Metal Film, 475Ω, ±1%, 1/8W	1075-0023	Dale	MFF 1/8 T1
R21	Pot, 500Ω, ±10%, 3/4W	1215-0011	Helitrim	89WR
R22	Metal Film, 475Ω, ±1%, 1/8W	1075-0023	Dale	MFF 1/8 T1

POWER SUPPLY REGULATOR (cont). A12

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	TRANSISTORS			
Q1	Si, NPN, 2N3053	1272-0011	RCA	2N3053
Q2	Si, NPN, 2N3567	1272-0014	Fairchild	2N3567
Q3	Si, NPN, 2N3053	1272-0011	RCA	2N3053
Q4	Si, NPN, 2N3567	1272-0014	Fairchild	2N3567
Q5	Si, NPN, 2N3567	1272-0014	Fairchild	2N3567
Q6	Si, NPN, 2N3053	1272-0011	RCA	2N3053
Q7	Si, NPN, 2N3567	1272-0014	Fairchild	2N3567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R7
R6
R2
C2
IC1
R5
R14
CR2
C8
C4
R15
CR4
Q5
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R12
R11
CR3
C5
CR5
R18
CR6
R22
R20
R21
C6
C7
Q7
R16
R17
IC2
R19
C9
CR7
C3
C1
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CR1
Q2
R3
R4
Q4
R1
R9
R10
Q3
Q6

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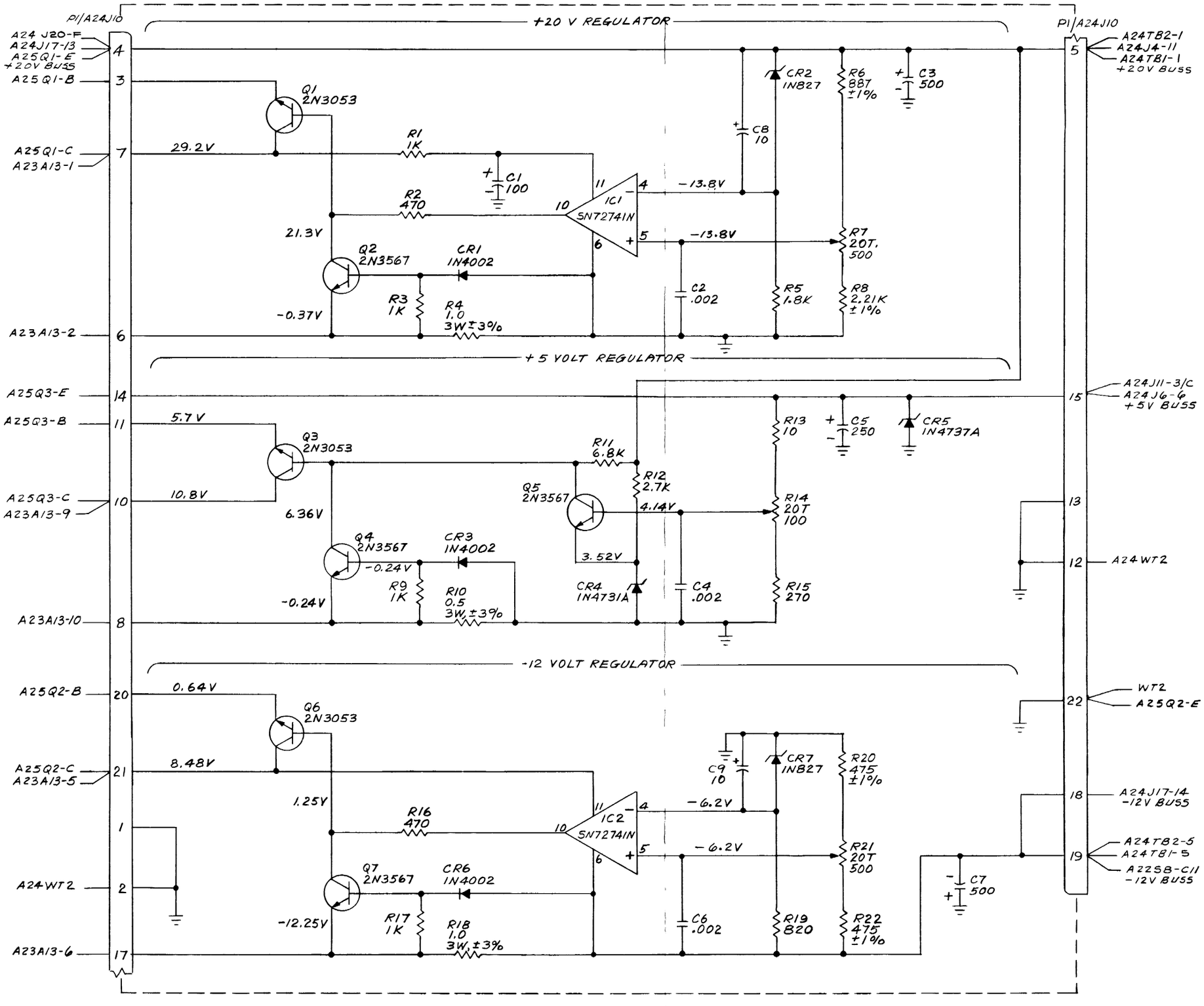


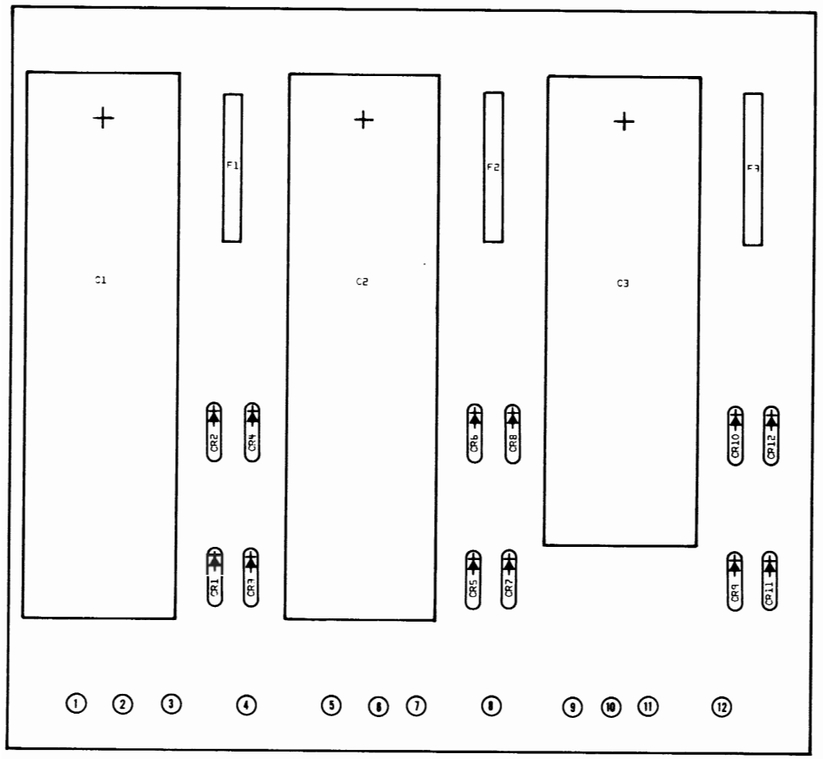
NOTE:

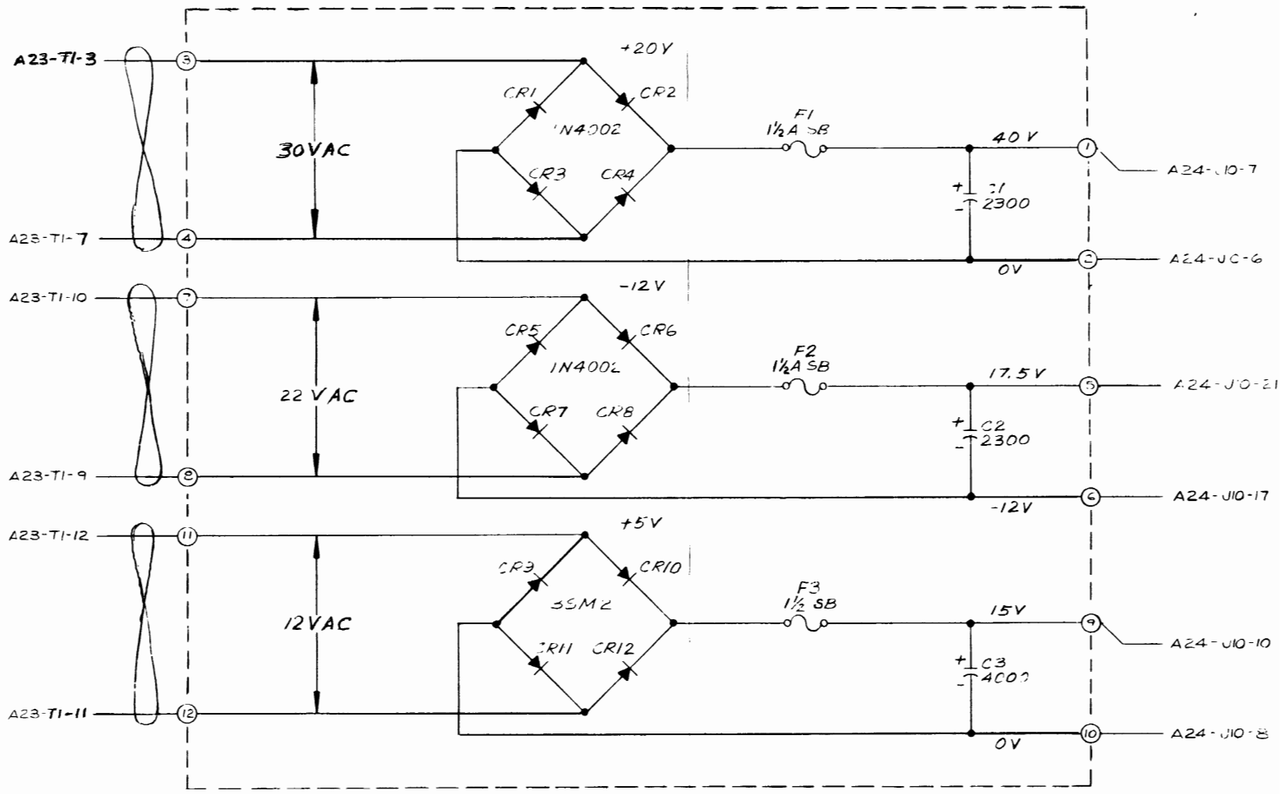
1. RESISTORS – 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS – VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS – VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-12. Power Supply Regulator. A12

POWER SUPPLY RECTIFIER. A13

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A13	Power Supply Rectifier, P.C. Board Assy	7001-0213	Cushman	
	P.C. Board	1780-0084	Cushman	
	CAPACITORS			
C1	Elect, 2300μF, 50V	1014-0004	Sprague	39D-238G050JT5
C2	Elect, 2300μF, 50V	1014-0004	Sprague	39D-238G050JT5
C3	Elect, 4000μF, +75% -10%, 25V	1014-0005	Sprague	39D408G025JS5
	DIODES			
CR1	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR2	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR3	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR4	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR5	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR6	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR7	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR8	Si, 100V PIV, 1 amp	1281-0023	ITT	1N4002
CR9	PIV, 2 amp Rectifier	1281-0024	Semtech	3SM2
CR10	PIV, 2 amp Rectifier	1281-0024	Semtech	3SM2
CR11	PIV, 2 amp Rectifier	1281-0024	Semtech	3SM2
CR12	PIV, 2 amp Rectifier	1281-0024	Semtech	3SM2
	FUSES			
F1	3AG, 1 1/2 amps, Slo-Blo	1955-0018	Bussman	AGC 1-1/2 S/B
F2	3AG, 1 1/2 amps, Slo-Blo	1955-0018	Bussman	AGC 1-1/2 S/B
F3	3AG, 1 1/2 amps, Slo-Blo	1955-0018	Bussman	AGC 1-1/2 S/B





NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN µF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN µH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-13. Power Supply Rectifier. A13

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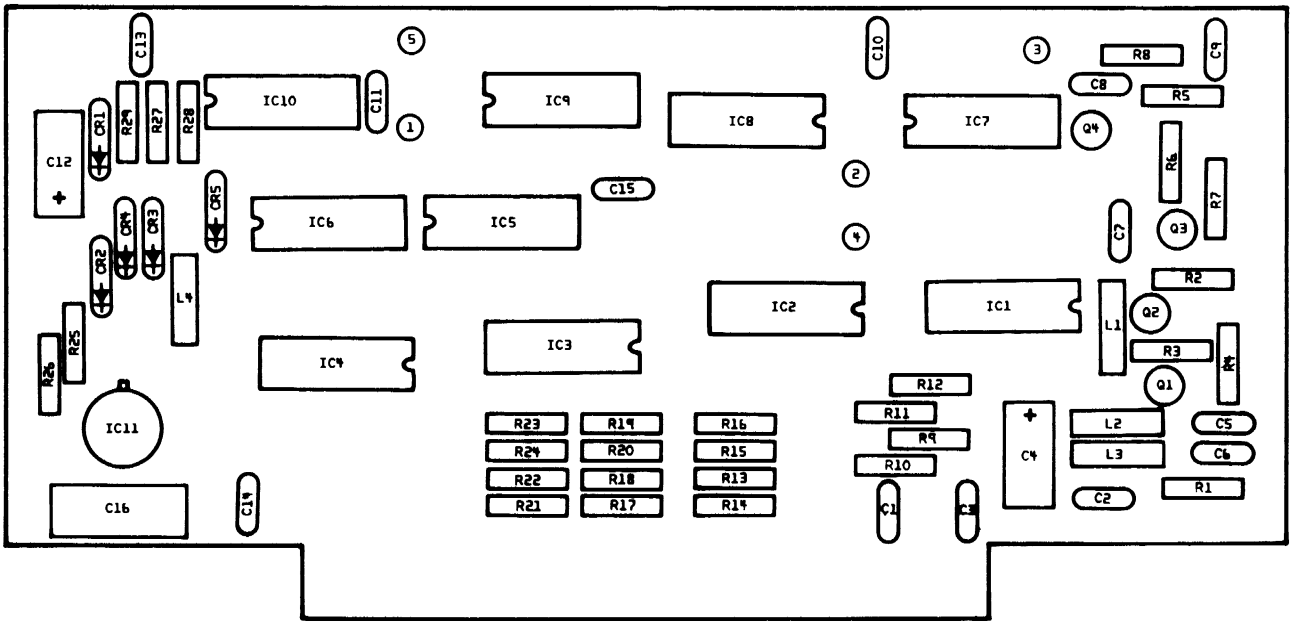
DIVIDE-BY-N. A14

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A14	Divide-By-N P.C. Board Assy	7001-0214	Cushman	
	P.C. Board	1780-0089	Cushman	
	CAPACITORS			
C1	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C2	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C3	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C4	Elect, 15μF, +75% -10%, 12V	1013-0015	Sprague	30D156G012CC5
C5	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C6	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C7	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C8	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C9	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C10	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C11	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C12	Elect, 15μF, +75% -10%, 12V	1013-0015	Sprague	30D156G012CC5
C13	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C14	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C15	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C16	Poly, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
	COILS			
L1	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
L2	RF Choke, 47μH, ±5%	1585-0010	Delevan	1537-60
L3	RF Choke, 47μH, ±5%	1585-0010	Delevan	1537-60
L4	RF Choke, 12μH, ±10%	1585-0011	Delevan	1537-38
	DIODES			
CR1	Si, 1 amp, 100V PIV	1281-0023	ITT	1N4002
CR2	Si, 1 amp, 100V PIV	1281-0023	ITT	1N4002
CR3	Si, 1N3064	1281-0013	Sylvania	1N3064
CR4	Si, 1N3064	1281-0013	Sylvania	1N3064
CR5	Si, 1N3064	1281-0013	Sylvania	1N3064
	INTEGRATED CIRCUITS			
IC1	50 MHz, Presettable Decade	2025-0016	T.I.	SN74196N
IC2	50 MHz, Presettable Decade	2025-0016	T.I.	SN74196N
IC3	50 MHz, Presettable Decade	2025-0016	T.I.	SN74196N
IC4	50 MHz, Presettable Decade	2025-0016	T.I.	SN74196N
IC5	Quad, 8-input Pos. NAND Gate	2025-0004	T.I.	SN7430
IC6	50 MHz, Presettable Decade	2025-0016	T.I.	SN74196N
IC7	Triple 3-input Pos. AND Gate	2025-0017	T.I.	SN74H11N
IC8	TTL Dual Flip-Flop	2025-0007	T.I.	SN7472N
IC9	50 MHz, Presettable Decade	2025-0016	T.I.	SN74196N
IC10	Quad, 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N
IC11	Dual, 2-input, NOR Gate	2025-0010	Fairchild	U8A-9914-28X
	RESISTORS			
R1	Comp, 120Ω, ±5%, 1/4W	1066-1215	Allen-Bradley	CB1215
R2	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R3	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R4	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R5	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215

DIVIDE-BY-N (cont). A14

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R6	Comp, 12Ω, ±5%, 1/4W	1066-1205	Allen-Bradley	CB1205
R7	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R8	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R9	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R10	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R11	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R12	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R13	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R14	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R15	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R16	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R17	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R18	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R19	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R20	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R21	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R22	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R23	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R24	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R25	Comp, 1.2kΩ, ±5%, 1/4W	1066-1225	Allen-Bradley	CB1225
R26	Comp, 4.7kΩ, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R27	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R28	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R29	Comp, 2.7kΩ, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
	TRANSISTORS			
Q1	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q2	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q3	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q4	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275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C11
IC9
IC8
C10
IC7
R8
C9
C8
R5
Q4
R6
R7
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R26
R27
R28
C15
CR5
IC6
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CR4
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CR2
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Q3
R2
L4
IC2
IC1
L1
Q2
R25
IC4
IC3
R3
R4
Q1
R12
IC11
R23
R19
R16
R11
L2
C5
R24
R20
R15
R9
C4
L3
C6
R10
R22
R18
R13
C2
R1
C16
C14
R21
R17
R14
C1
C3

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P1/A24J11

A24J11-3/C +5V BUSS 19 W

A24A1-JB 6-10 MHz 21 Y

A24TB2-4 -12V BUSS 20 X

A2256-C3 U

A24J11-1/A 22 Z

A2256-D6 18 V

A2256-B2 17

A2256-A5 16 T

A2255-C3 13 P

A2255-D6 14

A2255-B2 R

A2255-A5 16 S

A2254-C3 11

A2254-D6 12 N

A2254-B2 10 L

A2254-A5 M

A2253-C3 8

A2253-D6 7 H

A2253-B2 9 K

A2253-A5 J

L1 12 · C4 15 12V · C7 .05 · C8 .05 · C9 .05 · L2 47 · C1 .05 · C5 .05 · C2 .01 · L3 47 · C3 .05 · C6 .05 · R1 120 · R2 560 · R3 1.2K · R4 1.2K · R5 220 · R6 12 · R7 470 · R8 1.2K · Q1 2N3563 · Q2 2N3563 · Q3 2N4121 · Q4 2N4275

30 NS

IC1 SN74196N (TYPICAL) — CLR, RESET, A, B, TA, TBD

IC2 SN74196N

IC3 SN74196N

IC4 SN74196N

IC5 SN7430

IC6 SN74196N

IC7 SN74H11N

IC8 SN7472N — CLEAR, CLOCK, PRESET

IC9 SN74196N

IC10 SN7400N

R9 2.7K · R10 2.7K · R11 2.7K · R12 2.7K · R13 2.7K · R14 2.7K · R15 2.7K · R16 2.7K · R17 2.7K · R18 2.7K · R19 2.7K · R20 2.7K · R21 2.7K · R22 2.7K · R23 2.7K · R24 2.7K

R25 1.2K · C10 .05

P1/A24J11

L4 12 · C11 .05 · C12 15 12V · C13 .05 · C14 .05 · A24J18-15 A24J10-15 A24J11-19/W +5V BUSS 3 C

L4 12 · CR1 IN4002 · CR2 IN4002 · C15 .05 · R26 2.7K · C16 .10 · IC11 9914 · 2 B A24J5-5 100 Hz OUTPUT · 1 A A24W72 A24J11-22/Z

CR3 IN3064 · TANK 3 ENABLE A24J7-20 A24 J20-C · 5 E

R28 2.7K · R27 2.7K

CR4 IN3064 · TANK 2 ENABLE A24J7-19 A24 J20-B · 4 D

R29 2.7K

CR5 IN3064 · TANK 1 ENABLE A24J7-V A24 J20-A · 6 F

NOTE:

1. RESISTORS – 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS – VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS – VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

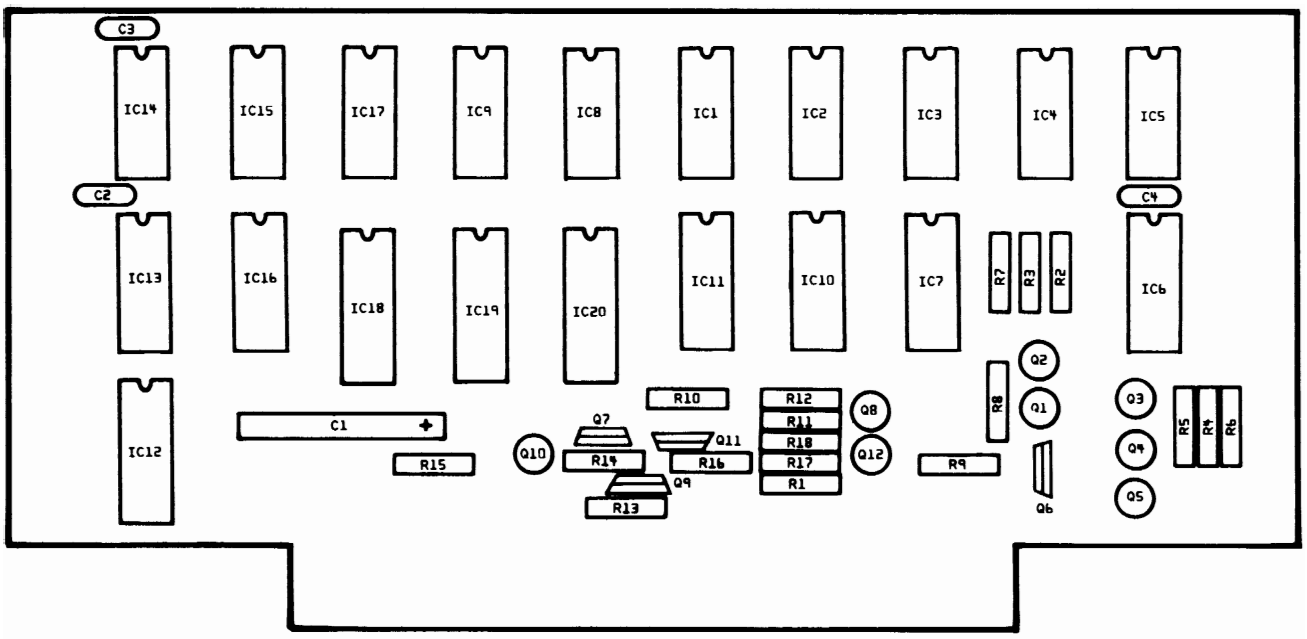
Figure 6-14. Divide-by-N. A14

SWITCHING LOGIC, A15

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A15	Switching Logic, P.C. Board Assy	7001-0215	Cushman	
	P.C. Board	1780-0450	Cushman	
	CAPACITORS			
C1	Elect, 100μF, +75% -10%, 12V	1013-0011	Sprague	30D107G012CC5
C2	Cer, .1μF, ±20%, 25V	1005-0044	Sprague	5C023104X0250B3
C3	Cer, .1μF, ±20%, 25V	1005-0044	Sprague	5C023104X0250B3
C4	Cer, .1μF, ±20%, 25V	1005-0044	Sprague	5C023104X0250B3
	INTEGRATED CIRCUITS			
IC1	4-wide 2-input AND-or-INVERT Gates	2025-0063	T.I.	SN7454N
IC2	4-wide 2-input AND-or-INVERT Gates	2025-0063	T.I.	SN7454N
IC3	4-wide 2-input AND-or-INVERT Gates	2025-0063	T.I.	SN7454N
IC4	4-wide 2-input AND-or-INVERT Gates	2025-0063	T.I.	SN7454N
IC5	4-wide 2-input AND-or-INVERT Gates	2025-0063	T.I.	SN7454N
IC6	Hex Inverter, SN7404N	2025-0048	T.I.	SN7404N
IC7	Hex Inverter, SN7404N	2025-0048	T.I.	SN7404N
IC8	Triple 3-input NAND Gate	2025-0047	T.I.	SN7410N
IC9	Quad, 2-input Pos NAND Gate	2025-0003	T.I.	SN7400N
IC10	Quad, 2-input Pos NAND Gate	2025-0003	T.I.	SN7400N
IC11	Hex Inverter, SN7404N	2025-0048	T.I.	SN7404N
IC12	Hex Inverter, SN7404N	2025-0048	T.I.	SN7404N
IC13	4-wide 2-input AND-or-INVERT Gates	2025-0063	T.I.	SN7454N
IC14	Quad, 2-input Pos NAND Gate	2025-0003	T.I.	SN7400N
IC15	Triple 3-input NAND Gate	2025-0047	T.I.	SN7410N
IC16	Quad, 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N
IC17	Quad, 2-input Pos. NOR Gate	2025-0059	T.I.	SN7402N
IC18	Hex Inverter, SN7404N	2025-0048	T.I.	SN7404N
IC19	Quad, 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N
IC20	Quad, 2-input Pos. NOR Gate	2025-0059	T.I.	SN7402N
	RESISTORS			
R1	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R2	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R3	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R4	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R5	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R6	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R7	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R8	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R9	Comp, 2.2kΩ, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R10	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R11	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R12	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R13	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R14	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R15	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R16	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R17	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R18	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035

SWITCHING LOGIC (cont). A15

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	TRANSISTORS			
Q1	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q2	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q3	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q4	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q5	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q6	Si, PNP, MPS U56	1272-0052	Motorola	MPS U56
Q7	Si, PNP, MPS U56	1272-0052	Motorola	MPS U56
Q8	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q9	Si, PNP, MPS U56	1272-0052	Motorola	MPS U56
Q10	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q11	Si, PNP, MPS U56	1272-0052	Motorola	MPS U56
Q12	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275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IC14
IC15
IC17
IC9
IC8
IC1
IC2
IC3
IC4
IC5
C2
C4
IC13
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IC18
IC19
IC20
IC11
IC10
IC7
R7
R3
R2
IC6
Q2
IC12
C1
R10
R12
R11
R18
R17
R1
Q8
Q12
R8
Q1
Q3
Q4
Q5
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R13
R15
R9
Q6

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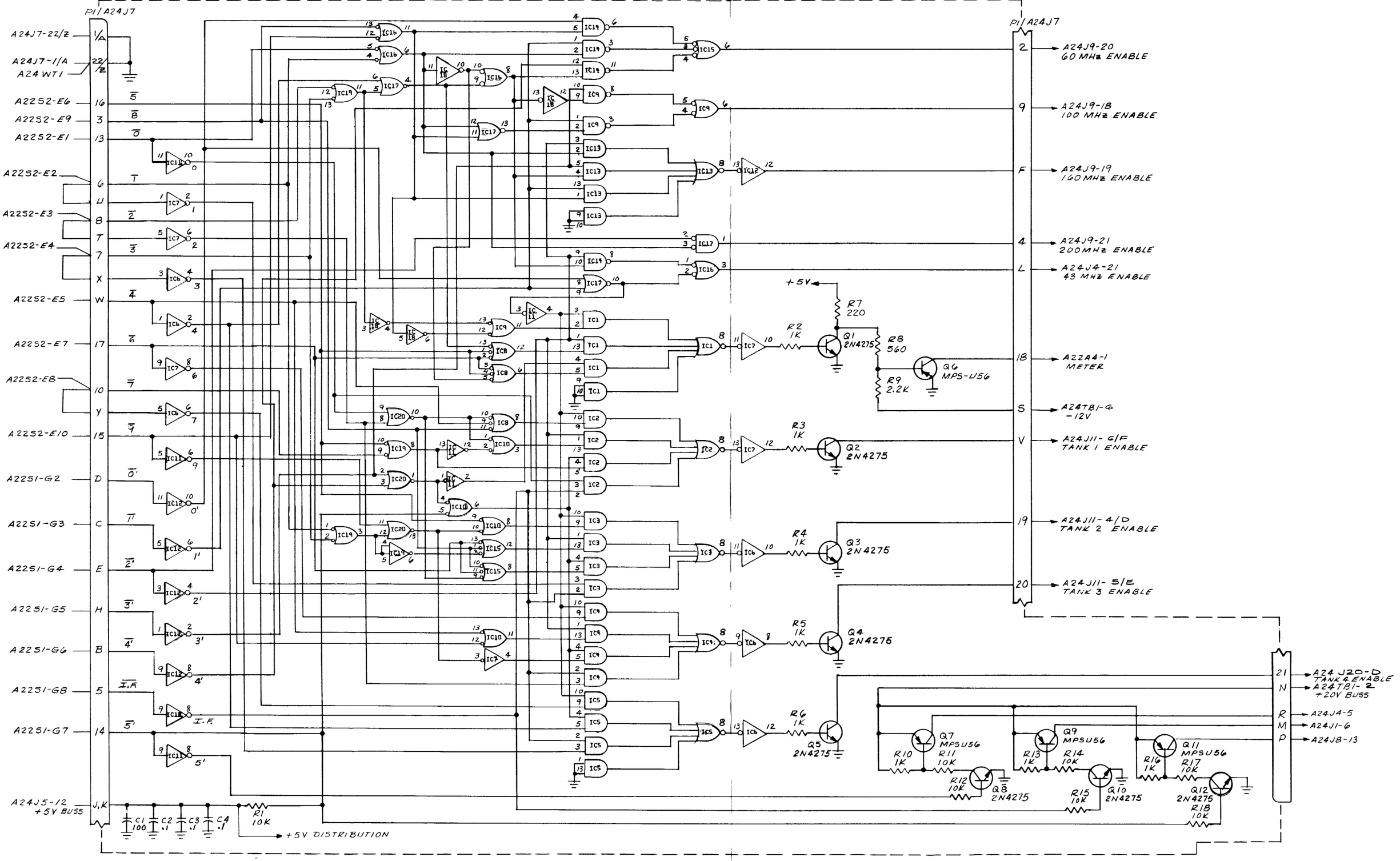


NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

IC NO.	PART NO.
1,2,3,4,5,13	SN7454N
8,15	SN7410N
9,10,14,16,19	SN7400N
17,20	SN7402N
6,7,11,12,18	SN7404N

Figure 6-15. Switching Logic. A15

42 MHz FILTER, AUDIO AMPLIFIER, MIXER AND IF SWITCHING. A16

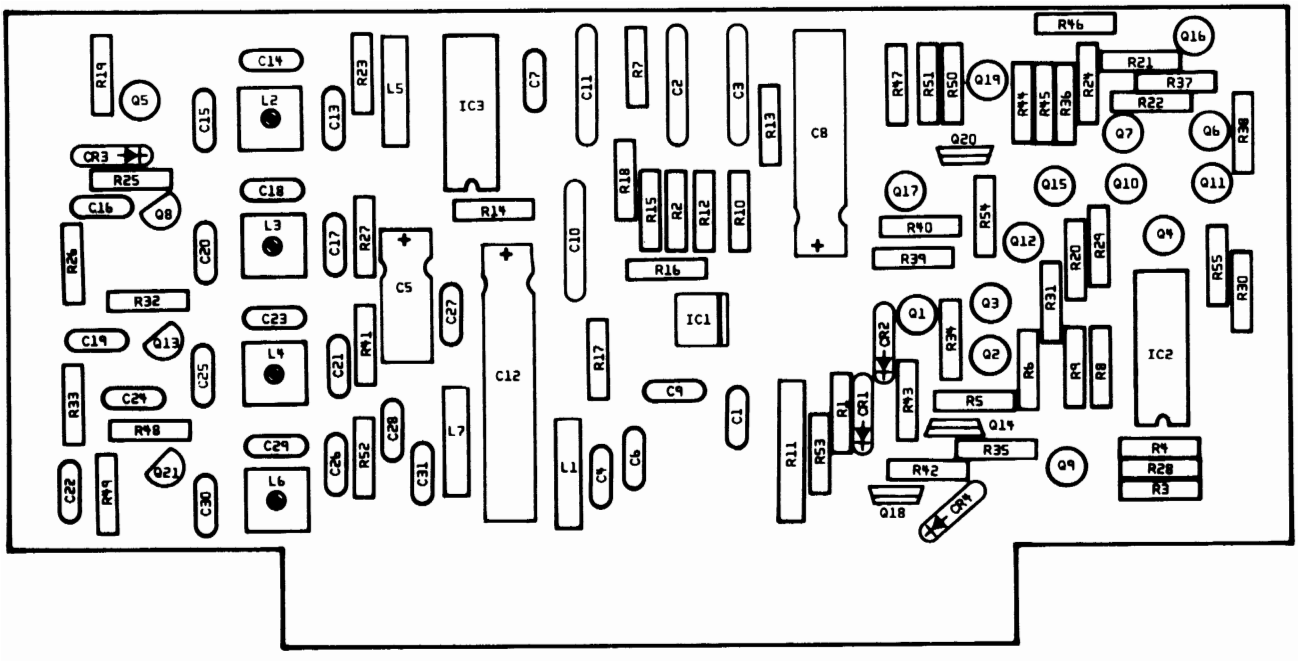
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A16	42 MHz Filter, Audio Ampl, Mixer & IF Switching P.C. Board Assy	7001-0216	Cushman	
	P.C. Board	1780-0451	Cushman	
	CAPACITORS			
C1	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C2	Poly, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C3	Poly, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C4	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C5	Elect, 1.0μF, ±10%, 25V	1013-0004	Sprague	30D105G025BA5
C6	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C7	Mica, 51pF, ±5%, 500V	1002-0045	Elmenco	DM15-E-510J
C8	Elect, 100μF, ±10%, 25V	1013-0003	Sprague	30D107G025DD5
C9	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C10	Poly, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C11	Poly, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C12	Elect, 250μF, +75% -10%, 16V	1013-0016	Sprague	30D257G016DF2
C13	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C14	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C15	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C16	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C17	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C18	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C19	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C20	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C21	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C22	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C23	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C24	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C25	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C26	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C27	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C28	Cer, .05μF, +80% -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C29	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C30	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C31	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
	COILS			
L1	RF Choke, 220μH, ±5%	1585-0018	Delevan	1537-92
L2	Var. Inductor, 4 turns	1596-0010	Cushman	
L3	Var. Inductor, 4 turns	1596-0010	Cushman	
L4	Var. Inductor, 4 turns	1596-0010	Cushman	
L5	RF Choke, 15μH, ±10%	1585-0034	Delevan	1437-40
L6	Var. Inductor, 4 turns	1596-0010	Cushman	
L7	RF Choke, 15μH, ±10%	1585-0034	Delevan	1437-40
	DIODES			
CR1	Ge, G633	1282-0005	ITT	G633
CR2	Si, 1N3064	1281-0013	Sylvania	1N3064
CR3	Si, 1N3064	1281-0013	Sylvania	1N3064
CR4	Ge, G633	1282-0005	ITT	G633
	INTEGRATED CIRCUITS			
IC1	Audio Power Ampl	2025-0060	Motorola	MFC 6070
IC2	Quad, 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N
IC3	Quad, 2-input Pos. NAND Gate	2025-0003	T.I.	SN7400N

42 MHz FILTER, AUDIO AMPLIFIER, MIXER AND IF SWITCHING (cont). A16

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	RESISTORS			
R1	Comp, 33kΩ, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R2	Comp, 1Meg, ±5%, 1/4W	1066-1055	Allen-Bradley	CB1055
R3	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R4	Comp, 5.1kΩ, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R5	Comp, 5.6kΩ, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R6	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R7	Comp, 180kΩ, ±5%, 1/4W	1066-1845	Allen-Bradley	CB1845
R8	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R9	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R10	Comp, 100kΩ, ±5%, 1/4W	1066-1045	Allen-Bradley	CB1045
R11	Comp, 62Ω, ±5%, 1W	1068-6205	Allen-Bradley	GB6205
R12	Comp, 1Meg, ±5%, 1/4W	1066-1055	Allen-Bradley	CB1055
R13	Comp, 820kΩ, ±5%, 1/4W	1066-8245	Allen-Bradley	CB8245
R14	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R15	Comp, 2Meg, ±5%, 1/4W	1066-2055	Allen-Bradley	CB2055
R16	Comp, 6.8kΩ, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R17	Comp, 6.8kΩ, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R18	Comp, 10kΩ, ±5%, 1/4W	1066-1005	Allen-Bradley	CB1005
R19	Comp, 560Ω, ±5%, 1/4W	1066-5615	Allen-Bradley	CB5615
R20	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R21	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R22	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R23	Comp, 5.1kΩ, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R24	Comp, 5.1kΩ, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R25	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R26	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R27	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R28	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R29	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R30	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R31	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R32	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R33	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R34	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R35	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R36	Comp, 33kΩ, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R37	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R38	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R39	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R40	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R41	Comp, 3.9kΩ, ±5%, 1/4W	1066-3925	Allen-Bradley	CB3925
R42	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R43	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R44	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R45	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R46	Comp, 5.1kΩ, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R47	Comp, 5.1kΩ, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R48	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R49	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R50	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R51	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R52	Comp, 1kΩ, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R53	Comp, 56kΩ, ±5%, 1/4W	1066-5635	Allen-Bradley	CB5635
R54	Comp, 5.1kΩ, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5635
R55	Comp, 10kΩ, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035

42 MHz FILTER, AUDIO AMPLIFIER, MIXER AND IF SWITCHING (cont). A16

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	TRANSISTORS			
Q1	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q2	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q3	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q4	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q5	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q6	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q7	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q8	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q9	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q10	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q11	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q12	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q13	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37
Q14	Si, PNP, MPS U56	1272-0052	Motorola	MPS U56
Q15	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q16	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q17	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q18	Si, NPN, MPS U06	1272-0053	Motorola	MPS U06
Q19	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q20	Si, NPN, MPS U06	1272-0053	Motorola	MPS U06
Q21	Si, PNP, TIS 37	1271-0003	T.I.	TIS 37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Q5
C14
L2
C15
C13
R23
L5
IC3
C7
C11
R7
C2
C3
R13
C8
R46
Q16
R47
R51
R50
Q19
R21
R37
R22
R44
R45
R36
R24
Q7
Q6
R38
Q20
CR3
R25
C16
Q8
C18
L3
C17
R27
C5
R14
C10
R18
R15
R2
R12
R10
Q17
R40
R39
R54
Q15
Q10
Q11
Q12
Q4
R20
R29
R55
R30
R26
C20
R32
C23
L4
C19
Q13
C21
R41
C27
C12
R16
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R17
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Q9
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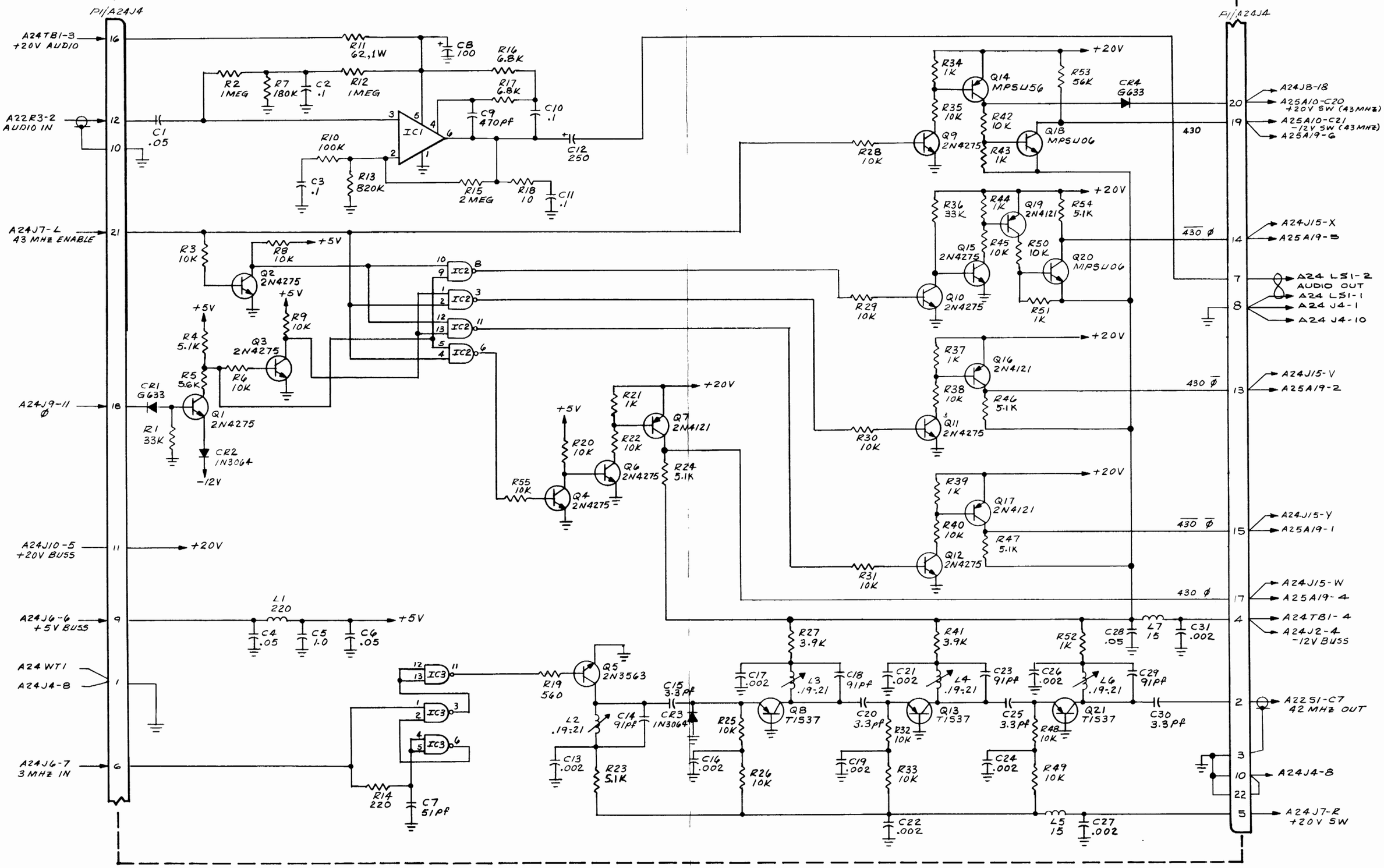
R28
R3
Q18
CR4



NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

IC NO	TYPE
1	MFC6070
2,3	SN7400

Figure 6-16. 42 MHz Filter, Audio Amplifier, Mixer and IF Switching. A16

6-75/6-76

PROGRAMMABLE PHASE LOCK LOOP AND AMPLIFIER. A17

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A17	P.C. Board Assy, Programmable Phase Lock Loop & Ampl	7001-0217	Cushman	
	P.C. Board	1780-0452	Cushman	
	CAPACITORS			
C1	Mica, 220pF, ±5%, 500V	1002-0029	Elmenco	DM15-F-221J
C2	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C3	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C4	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C5	Cer, .01μF, +80% -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C6	Cer, 8.2pF, ±.25pF, 500V			
C7	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C8	Cer, .47pF, ±10%, 50V	1005-0092	Cap Sales	CK06BX474K
C9	Poly, .0056μF, ±10%, 100V	1008-0022	Sprague	225P56291WA3
C10	Mica, 36pF, ±5%, 500V	1004-0007	Cornl Dubilier	CD6ED360J
C11	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C12	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U-503Z
C13	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C14	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C15	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C16	Var. Cer, 5.5-18pF	1001-0008	Erie	538-002A-5.5-18
C17	Cer, .1μF, ±10%, 100V	1005-0064	Aerovox	CK06BX104K
C18	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C19	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C20	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C21	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C22	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C23	Mica, FSV, ±5%, 500V	1002-xxxx		
C24	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C25	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C26	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C27	Mica, 150pF, ±5%, 500V	1002-0021	Elmenco	DM15-F-151J
C28	Elect, 1.5μF, ±10%, 35V	1013-0001	Sprague	150D155X9035B2
C29	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C30	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C31	Not Used			
C32	Mica, 22pF, ±5%, 500V	1002-0023	Elmenco	DM15-C-220J
C33	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C34	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C35	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C36	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C37	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C38	Mica, 91pF, ±5%, 500V	1002-0027	Elmenco	DM15-F-910J
C39	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C40	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C41	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C42	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C43	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
	COILS			
L1	Choke, Molded, 1μH, ±10%	1585-0027	Delevan	1537-12
L2	Choke, Molded, 1μH, ±10%	1585-0027	Delevan	1537-12
L3	Choke, Molded, 1μH, ±10%	1585-0027	Delevan	1537-12
L4	Variable, 5 1/2 turns	1596-0064-03	Cushman	
L5	Variable, 2 1/2 turns	1596-0064-04	Cushman	

PROGRAMMABLE PHASE LOCK LOOP AND AMPLIFIER (cont). A17

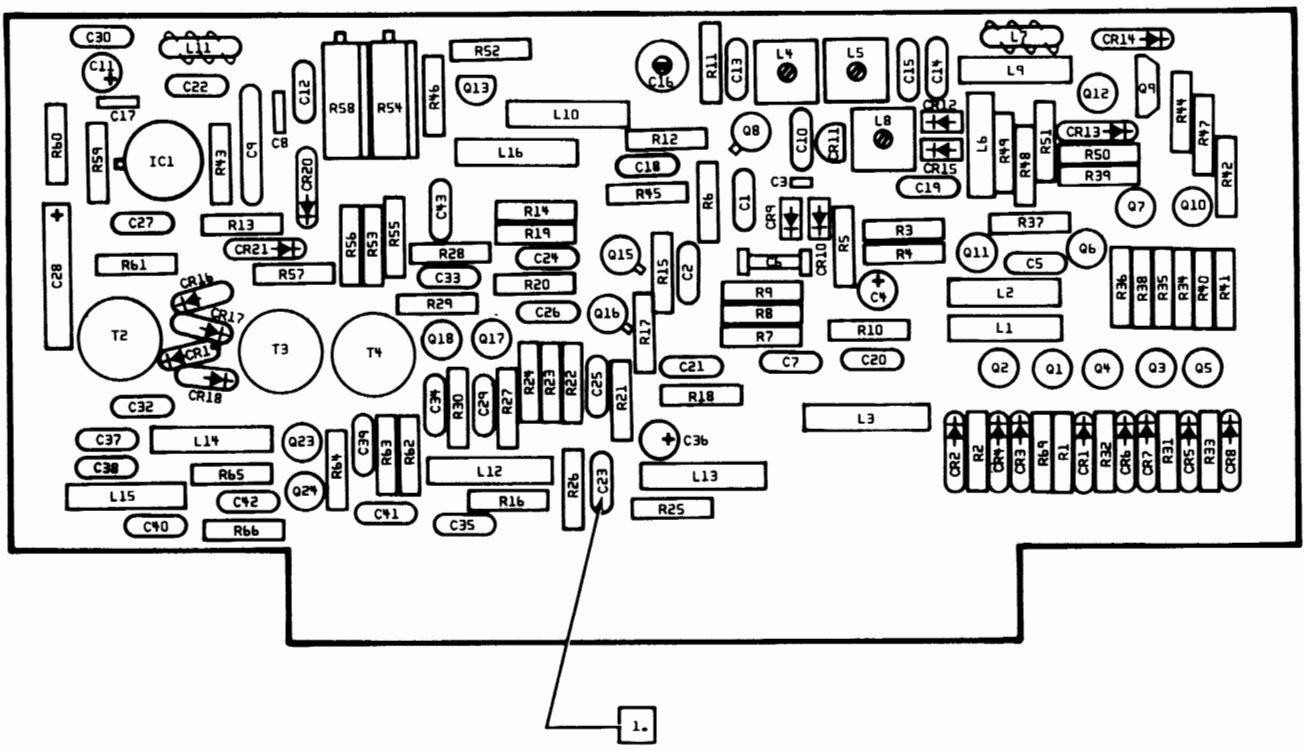
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
L6	Choke, Molded, 1μH, ±10%	1585-0027	Delevan	1537-12
L7	Choke, 2 1/2 turns	1586-0003		VK20020/4B
L8	Variable, 1 turn	1596-0064-05	Cushman	
L9	Choke, Molded, 1μH, ±10%	1585-0027	Delevan	1537-12
L10	Choke, .22μH, ±10%	1585-0039	Delevan	1537-02
L11	Choke, 2 1/2 turns	1586-0003		VK20020/4B
L12	Choke, Molded, 1μH, ±10%	1585-0027	Delevan	1537-12
L13	Choke, .68μH, ±10%	1585-0024	Delevan	1537-08
L14	Choke, 3.3μH, ±10%	1585-0037	Delevan	1537-24
L15	Choke, .68μH, ±10%	1585-0024	Delevan	1537-08
L16	Choke, Molded, 10μH, ±10%	1585-0016	Delevan	1537-36
	DIODES			
CR1	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR2	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR3	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR4	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR5	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR6	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR7	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR8	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR9	Si, Pin Switching	1281-0050	Motorola	MPN3401
CR10	Si, Pin Switching	1281-0050	Motorola	MPN3401
CR11	Si, Dual Voltage Varicap	1281-0058	Motorola	MV104
CR12	Si, Pin Switching	1281-0050	Motorola	MPN3401
CR13	Si, Diodes, 1N3064	1281-0013	Teledyne	1N3064
CR14	Diode, Ge, G633	1282-0005	ITT	G633
CR15	Si, Pin Switching	1281-0050	Motorola	MPN3401
CR16	Diode, HP5982-2800	1283-0001	H.P.	HP5982-2800
CR17	Diode, HP5982-2800	1283-0001	H.P.	HP5982-2800
CR18	Diode, HP5982-2800	1283-0001	H.P.	HP5982-2800
CR19	Diode, HP5982-2800	1283-0001	H.P.	HP5982-2800
CR20	Zener, 4.3V	1281-0025	I.R.	1N4731A
CR21	Zener, 4.3V	1281-0025	I.R.	1N4731A
	INTEGRATED CIRCUITS			
IC1	I.C., Op-Ampl, LM301A	2025-0032	National	LM301A
	RESISTORS			
R1	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R2	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R3	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R4	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R5	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R6	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R7	Comp, 330Ω, ±5%, 1/4W	1066-3315	Allen-Bradley	CB3315
R8	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R9	Comp, 8.2k, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R10	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R11	Comp, 390Ω, ±5%, 1/4W	1066-3915	Allen-Bradley	CB3915
R12	Comp, 1.5k, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R13	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R14	Comp, 33k, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R15	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035

PROGRAMMABLE PHASE LOCK LOOP AND AMPLIFIER (cont). A17

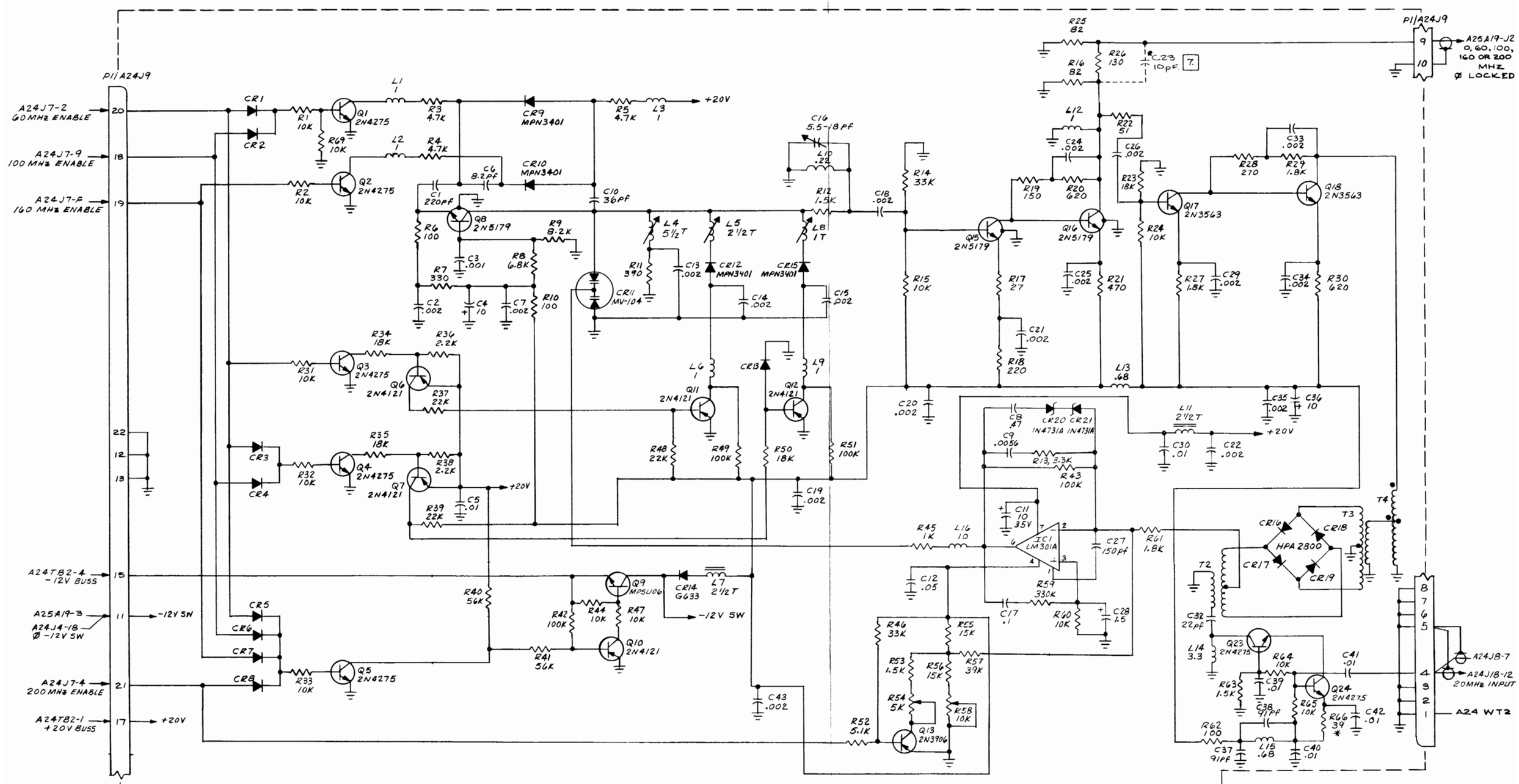
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R16	Comp, 82Ω, ±5%, 1/4W	1066-8205	Allen-Bradley	CB8205
R17	Comp, 27Ω, ±5%, 1/4W	1066-2705	Allen-Bradley	CB2705
R18	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R19	Comp, 150Ω, ±5%, 1/4W	1066-1515	Allen-Bradley	CB1515
R20	Comp, 620Ω, ±5%, 1/4W	1066-6215	Allen-Bradley	CB6215
R21	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R22	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R23	Comp, 18k, ±5%, 1/4W	1066-1835	Allen-Bradley	CB1835
R24	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R25	Comp, 82Ω, ±5%, 1/4W	1066-8205	Allen-Bradley	CB8205
R26	Comp, 130Ω, ±5%, 1/4W	1066-1315	Allen-Bradley	CB1315
R27	Comp, 1.8k, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R28	Comp, 270Ω, ±5%, 1/4W	1066-2715	Allen-Bradley	CB2715
R29	Comp, 1.8k, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R30	Comp, 620Ω, ±5%, 1/4W	1066-6215	Allen-Bradley	CB6215
R31	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R32	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R33	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R34	Comp, 18k, ±5%, 1/4W	1066-1835	Allen-Bradley	CB1835
R35	Comp, 18k, ±5%, 1/4W	1066-1835	Allen-Bradley	CB1835
R36	Comp, 2.2k, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R37	Comp, 22k, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R38	Comp, 2.2k, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R39	Comp, 22k, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R40	Comp, 56k, ±5%, 1/4W	1066-5635	Allen-Bradley	CB5635
R41	Comp, 56k, ±5%, 1/4W	1066-5635	Allen-Bradley	CB5635
R42	Comp, 100k, ±5%, 1/4W	1066-1045	Allen-Bradley	CB1045
R43	Comp, 100k, ±5%, 1/4W	1066-1045	Allen-Bradley	CB1045
R44	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R45	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R46	Comp, 33k, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R47	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R48	Comp, 22k, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R49	Comp, 100k, ±5%, 1/4W	1066-1045	Allen-Bradley	CB1045
R50	Comp, 18k, ±5%, 1/4W	1066-1835	Allen-Bradley	CB1835
R51	Comp, 100k, ±5%, 1/4W	1066-1045	Allen-Bradley	CB1045
R52	Comp, 5.1k, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R53	Comp, 1.5k, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R54	Pot, 5k, ±10%, 3/4W	1215-0012	Helitrim	89 WR
R55	Comp, 15k, ±5%, 1/4W	1066-1535	Allen-Bradley	CB1535
R56	Comp, 15k, ±5%, 1/4W	1066-1535	Allen-Bradley	CB1535
R57	Comp, 39k, ±5%, 1/4W	1066-3935	Allen-Bradley	CB3935
R58	Pot, 10k, ±10%, 3/4W	1215-0014	Helitrim	89 WR
R59	Comp, 330k, ±5%, 1/4W	1066-3345	Allen-Bradley	CB3345
R60	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R61	Comp, 1.8k, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R62	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R63	Comp, 1.5k, ±5%, 1/4W	1066-1525	Allen-Bradley	CB1525
R64	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R65	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R66	Comp, 39Ω, ±5%, 1/4W	1066-3905	Allen-Bradley	CB3905
R67	Not Used			
R68	Not Used			
R69	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035

PROGRAMMABLE PHASE LOCK LOOP AND AMPLIFIER (cont). A17

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	TRANSFORMER			
T1	Not Used			
T2	Toroid, Trifilar Coil Assy	1579-0017	Cushman	
T3	Toroid, Trifilar Coil Assy	1579-0017	Cushman	
T4	Toroid, Trifilar Coil Assy	1579-0017	Cushman	
	TRANSISTORS			
Q1	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q2	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q3	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q4	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q5	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q6	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q7	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q8	Si, NPN, 2N5179	1272-0067	RCA	2N5179
Q9	Si, NPN, MPS-U06	1272-0053	Motorola	MPS-U06
Q10	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q11	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q12	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q13	Si, PNP, 2N3906	1272-0037	Motorola	2N3906
Q14	Not Used			
Q15	Si, NPN, 2N5179	1272-0067	RCA	2N5179
Q16	Si, NPN, 2N5179	1272-0067	RCA	2N5179
Q17	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q18	Si, NPN, 2N3563	1272-0022	Fairchild	2N3563
Q19	Not Used			
Q20	Not Used			
Q21	Not Used			
Q22	Not Used			
Q23	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q24	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275



1. INSTALLED IN SOME UNITS IN FINAL TEST.



NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTFD.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.
6. ALL DIODES ARE IN3064 UNLESS OTHERWISE NOTED.

7. INSTALLED IN SOME UNITS IN FINAL TEST.

NOT USED:
C31
Q14, 19, 20, 21, 22
R67, 68
T1

Figure 6-17. Programmable Phase Lock Loop and Amplifier. A17

10 MHz MODULATOR. A18

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A18	P.C. Board Assy, 10 MHz Modulator	7001-0218	Cushman	
	P.C. Board	1780-0453	Cushman	
	CAPACITORS			
C1	Poly, .027μF, ±10%, 100V	1008-0032	Sprague	225P27391
C2	Tant, 2.2μF, ±10%, 35V	1011-0001	Dickson	D2R2GSB35K
C3	Mylar, .022μF, ±1%, 100V	1008-0082	F-Dyne	PE12-022-100-1
C4	Mica, 330pF, ±5%, 500V	1002-0032	Elmenco	DM15-F-331J
C5	Poly, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C6	Mica, 820pF, ±5%, 300V	1002-0039	Elmenco	DM15-F-821J
C7	Mylar, .022μF, ±1%, 100V	1008-0082	F-Dyne	PE12-022-100-1
C8	Tant, 2.2μF, ±10%, 35V	1011-0001	Dickson	D2R2GSB35K
C9	Mica, 180pF, ±5%, 500V	1002-0005	Elmenco	DM15-F-181J
C10	Mica, 22pF, ±5%, 500V	1002-0023	Elmenco	DM15-C-220J
C11	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C12	Cer, 221F, ±2%, 500V	1005-0007	Erie	301-000-U2J0-220G
C13	Mylar, .022μF, ±1%, 100V	1008-0082	F-Dyne	PE 12-022-100-1
C14	Mica, 470pF, ±5%, 500V	1002-00 5	Elmenco	DM15-F-471J
C15	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C16	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C17	Mica, 15pF, ±5%, 500V	1002-0001	Elmenco	DM15-C-150J
C18	Poly, .1μF, ±10%, 100V	1008-0031	Sprague	225P10491
C19	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C20	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5835-505-Y5U0-503Z
C21	Mica, 390pF, ±5%, 500V	1002-0033	Elmenco	DM15-F-391J
C22	Mica, 2000pF, ±5%, 500V	1002-0077	Elmenco	DM19-E-202J
C23	Mica, 20pF, ±5%, 500V	1002-0060	Elmenco	DM15-200J
C24	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C25	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C26	Tant, 10μF, +50-20%, 35V	1011-0006	ITT	Tag 10/35-20
C27	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5835-505-Y5U0-503Z
C28	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C29	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C30	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C31	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C32	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C33	Tant, 100μF, ±20%, 20V	1011-0010	Kemet	T362D107M020AS
C34	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C35	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C36	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C37	Mica, 430pF, ±5%, 500V	1002-0034	Elmenco	DM15-F-431J
C38	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5835-505-Y5U0-503Z
C39	Poly, .0033μF, ±10%, 100V	1008-0041	Sprague	225P33291WA3
C40	Mica, 470pF, ±5%, 500V	1002-0035	Elmenco	DM15-F-471J
C41	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C42	Cer, 4.7pF, ±.25pF, 500V	1005-0015	Erie	301-000-C0H0-479C
C43	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C44	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C45	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C46	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C47	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C48	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C49	Tant, 10μF, +50 -20%, 35V	1011-0006	ITT	Tag 10/35-20
C50	Tant, 100μF, ±20%, 20V	1011-0010	Kemet	T362D107M020AS

10 MHz MODULATOR (cont). A18

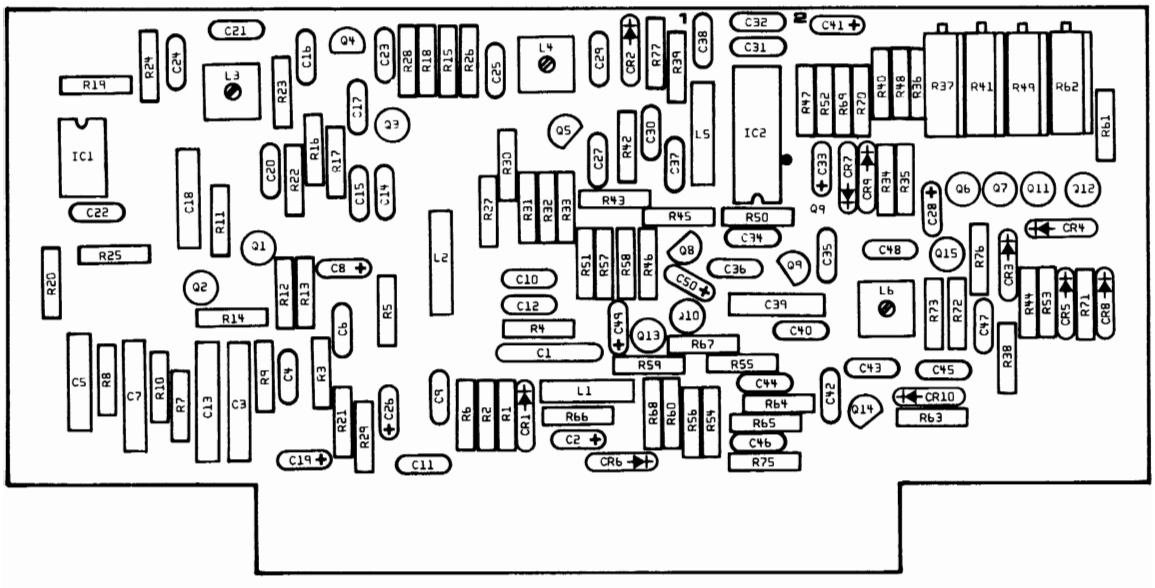
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	COILS			
L1	Choke, ±5%, 82μH	1585-0032	Delevan	1537-72
L2	Variable, 3.8-7.3μH	1596-0025	Delevan	4000-18
L3	Variable, .5-.75μH	1596-0011	Cushman	
L4	Variable, .5-.75μH	1596-0011	Cushman	
L5	Choke, ±10%, .56μH	1585-0036	Delevan	1840-07
L6	Variable, .5-.75μH	1596-0011	Cushman	
	DIODES			
CR1	Si, Varicap	1281-0059	Motorola	MV1638
CR2	Silicon Pin Switching	1281-0050	Motorola	MPN-3401
CR3	Diode, 1N3064	1281-0013	Teledyne	1N3064
CR4	Diode, 1N3064	1281-0013	Teledyne	1N3064
CR5	Diode, 1N3064	1281-0013	Teledyne	1N3064
CR6	Diode, 1N3064	1281-0013	Teledyne	1N3064
CR7	Diode, HP5982-2800	1283-0001	H.P.	HP5982-2800
CR8	Diode, 1N3064	1281-0013	Teledyne	1N3064
CR9	Diode, HP5982-2800	1283-0001	H.P.	HP5982-2800
CR10	Diode, 1N3064	1281-0013	Teledyne	1N3064
	INTEGRATED CIRCUITS			
IC1	I.C., Dual Op Amp	2025-0058	Signetics	N5558V
IC2	I.C., High Performance Op. Amp	2025-0022	T.I.	SN72741N
	RESISTORS			
R1	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R2	Comp, 2Meg, ±5%, 1/4W	1066-2055	Allen-Bradley	CB2055
R3	Metal Film, 294k, ±1%, 1/8W	1075-0028	Dale	MFF 1/8 T1
R4	Comp, 220k, ±5%, 1/4W	1066-2245	Allen-Bradley	CB2245
R5	Comp, 2k, ±5%, 1/4W	1066-2025	Allen-Bradley	CB2025
R6	Comp, 1.2Meg, ±5%, 1/4W	1066-1255	Allen-Bradley	CB1255
R7	Metal Film, 10k, ±1%, 1/8W	1075-0009	Dale	MFF 1/8 T1
R8	Metal Film, 2.49k, ±1%, 1/8W	1075-0027	Dale	MFF 1/8 T1
R9	Metal Film, 137Ω, ±1%, 1/8W	1075-0026	Dale	MFF 1/8 T1
R10	Metal Film, 10k, ±1%, 1/8W	1075-0009	Dale	MFF 1/8 T1
R11	Comp, 5.6k, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R12	Comp, 22k, ±5%, 1/4W	1066-2235	Allen-Bradley	CB2235
R13	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R14	Comp, 1Meg, ±5%, 1/4W	1066-1055	Allen-Bradley	CB1055
R15	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R16	Comp, 8.2k, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R17	Comp, 8.2k, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R18	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R19	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R20	Comp, 1.8k, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R21	Comp, 620Ω, ±5%, 1/4W	1066-6215	Allen-Bradley	CB6215
R22	Comp, 8.2k, ±5%, 1/4W	1066-8225	Allen-Bradley	CB8225
R23	Comp, 10Ω, ±5%, 1/4W	1066-1005	Allen-Bradley	CB1005
R24	Comp, 2.2k, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R25	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R26	Comp, 10Ω, ±5%, 1/4W	1066-1005	Allen-Bradley	CB1005
R27	Comp, 10Ω, ±5%, 1/4W	1066-1005	Allen-Bradley	CB1005
R28	Comp, 120Ω, ±5%, 1/4W	1066-1215	Allen-Bradley	CB1215
R29	Comp, 2.2k, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R30	Comp, 43Ω, ±5%, 1/4W	1066-4305	Allen-Bradley	CB4305

10 MHz MODULATOR (cont). A18

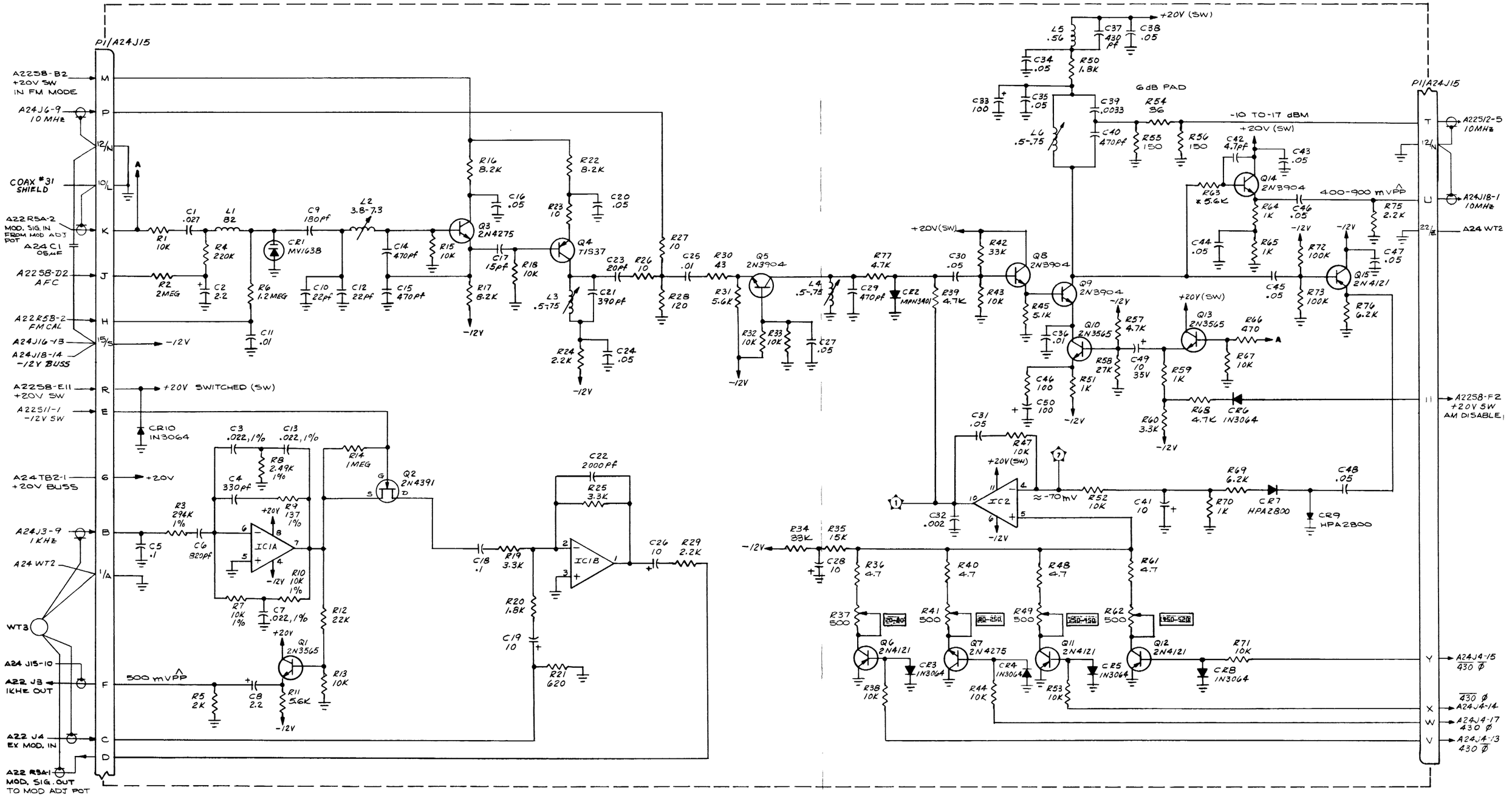
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R31	Comp, 5.6k, ±5%, 1/4W	1066-5625	Allen-Bradley	CB5625
R32	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R33	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R34	Comp, 33k, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R35	Comp, 15k, ±5%, 1/4W	1066-1535	Allen-Bradley	CB1535
R36	Comp, 4.7Ω, ±5%, 1/4W	1066-0001	Ohmite	
R37	Pot, 500Ω, ±10%, 3/4W	1215-0011	Helitrim	89 WR
R38	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R39	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R40	Comp, 4.7Ω, ±5%, 1/4W	1066-0001	Ohmite	
R41	Pot, 500Ω, ±10%, 3/4W	1215-0011	Helitrim	89 WR
R42	Comp, 33k, ±5%, 1/4W	1066-3335	Allen-Bradley	CB3335
R43	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R44	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R45	Comp, 5.1k, ±5%, 1/4W	1066-5125	Allen-Bradley	CB5125
R46	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R47	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R48	Comp, 4.7Ω, ±5%, 1/4W	1066-0001	Ohmite	
R49	Pot, 500Ω, ±10%, 3/4W	1215-0011	Helitrim	89 WR
R50	Comp, 1.8k, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R51	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R52	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R53	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R54	Comp, 36Ω, ±5%, 1/4W	1066-3605	Allen-Bradley	CB3605
R55	Comp, 150Ω, ±5%, 1/4W	1066-1515	Allen-Bradley	CB1515
R56	Comp, 150Ω, ±5%, 1/4W	1066-1515	Allen-Bradley	CB1515
R57	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R58	Comp, 27k, ±5%, 1/4W	1066-2735	Allen-Bradley	CB2735
R59	Comp 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R60	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R61	Comp, 4.7Ω, ±5%, 1/4W	1066-0001	Ohmite	
R62	Pot, 500Ω, ±10%, 3/4W	1215-0011	Helitrim	89 WR
R63	Comp, FSV, ±5%, 1/4W	1066-xxxx		
R64	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R65	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R66	Comp, 470Ω, ±5%, 1/4W	1066-4715	Allen-Bradley	CB4715
R67	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R68	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R69	Comp, 6.2k, ±5%, 1/4W	1066-6225	Allen-Bradley	CB6225
R70	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R71	Comp, 10k, ±5%, 1/4W	1066-1035	Allen-Bradley	CB1035
R72	Comp, 100k, ±5%, 1/4W	1066-1045	Allen-Bradley	CB1045
R73	Comp, 100k, ±5%, 1/4W	1066-1045	Allen-Bradley	CB1045
R74	Not Used			
R75	Comp, 2.2k, ±5%, 1/4W	1066-2225	Allen-Bradley	CB2225
R76	Comp, 6.2k, ±5%, 1/4W	1066-6225	Allen-Bradley	CB6225
R77	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
	TRANSISTORS			
Q1	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q2	FET, N-Channel	1272-0042	Teledyne	2N4391
Q3	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q4	Si, PNP, TIS 37	1271-0003		TIS 37
Q5	Si, NPN, 2N3904	1272-0032	Motorola	2N3904

10 MHz MODULATOR (cont). A18

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
Q6	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q7	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q8	Si, NPN, 2N3904	1272-0032	Motorola	2N3904
Q9	Si, NPN, 2N3904	1272-0032	Motorola	2N3904
Q10	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q11	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q12	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121
Q13	Si, NPN, 2N3565	1272-0017	Fairchild	2N3565
Q14	Si, NPN, 2N3904	1272-0032	Motorola	2N3904
Q15	Si, PNP, 2N4121	1272-0023	Fairchild	2N4121


C21
R24
C24
L3
R19
C16
Q4
C23
R28
R18
R15
R26
C25
L4
C29
CR2
R77
C38
C32
C31
C41
R47
R52
R69
R70
R40
R48
R36
R37
R41
R49
R62
R61
IC1
C22
R23
C17
Q3
C18
R16
R17
C20
R22
C15
C14
Q5
R42
C30
C37
L5
IC2
C33
CR7
CR9
R34
R35
C28
Q6
Q7
Q11
Q12
R30
R27
R31
R32
R33
R43
R45
R50
C34
Q9
C35
C48
Q15
CR4
R76
CR3
R44
R53
CR5
R71
CR8
R11
Q1
R25
R20
Q2
R14
R12
R13
C8
C6
R5
L2
C10
C12
R4
C1
R51
R57
R58
R46
C50
Q8
C36
C49
Q13
Q10
R67
R59
C39
C40
L6
R73
R72
C47
R38
C5
R8
C7
R10
R7
C13
C3
R9
C4
R3
R21
R29
C26
C19
C9
C11
R6
R2
R1
CR1
L1
R66
C2
CR6
R68
R60
R56
R54
R55
C44
R64
R65
C46
R75
C43
C45
C42
Q14
CR10
R63

5601••0034



IC NO	TYPE
1	N5558V
2	SN7274IN

Figure 6-18. 10 MHz Modulator. A18

RF MIXERS AND IF AMPLIFER. A19

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A19	RF Mixers & I.F. Amplifiers Board Assembly	7001-0219	Cushman	
	P.C. Board	1780-0454	Cushman	
	CAPACITORS			
C1	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C2	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C3	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C4	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C5	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C6	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C7	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C8	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C9	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C10	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C11	Cer, 6.8pF, ±.25pF, 500V	1005-0006	Erie	301-000-C0H0-689C
C12	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C13	Cer, 4.7pF, ±.25pF, 500V	1005-0015	Erie	301-000-C0H0-479C
C14	Cer, 6.8pF, ±.25pF, 500V	1005-0006	Erie	301-000-C0H0-689C
C15	Cer, 10pF, ±.25pF, 500V	1005-0093	Erie	301-000-C0H0-100C
C16	Cer, 9.2pF, ±.25pF, 500V	1005-0043	Erie	301-000-C0H0-829C
C17	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C18	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C19	Mica, 820pF, ±5%, 300V	1002-0039	Elmenco	DM15-F-821J
C20	Mica, 220pF, ±5%, 500V	1002-0029	Elmenco	DM15-F-221J
C21	Not Used			
C22	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C23	Mica, 100pF, ±5%, 500V	1002-0011	Elmenco	DM15-F-101J
C24	Cer, 100pF, ±10%, 100V	1005-0082	Erie	8121-100-C0G-101K
C25	Cer, 100pF, ±10%, 100V	1005-0082	Erie	8121-100-C0G-101K
C26	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C27	Cer, .01μF, +80 -20%, 25V	1005-0013	Erie	5835-512-Y5U-103Z
C28	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C29	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C30	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C
C31	Cer, 2.2pF, ±.25pF, 500V	1005-0017	Erie	301-000-C0J0-229C
C32	Cer, 2.2pF, ±.25pF, 500V	1005-0017	Erie	301-000-C0J0-229C
C33	Chip, 6.8pF, ±1/2pF, 50V	1012-0012	Viclan	0805NP06T0D50S
C34	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C35	Chip, 5.6pF, ±1/2pF, 50V	1012-0011	Varadyne	30BN050S5R6C(S)
C36	Cer, 12pF, ±5%, NP0 ±30%, 500V	1005-0076	Erie	301-000-0C0G0-120J
C37	Cer, 10pF, ±.25pF, 500V	1005-0093	Erie	301-000-C0H0-100C
C38	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C39	Cer, 10pF, ±.251F, 500V	1005-0093	Erie	301-000-C0H0-100C
C40	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C41	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C42	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C43	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C44	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C45	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C46	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C47	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C48	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C49	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C50	Mica, 68pF, ±5%, 500V	1002-0013	Elmenco	DM15-E-680J
C51	Cer, 3.3pF, ±.25pF, 500V	1005-0011	Erie	301-000-C0J0-339C

RF MIXERS AND IF AMPLIFIER (cont). A19

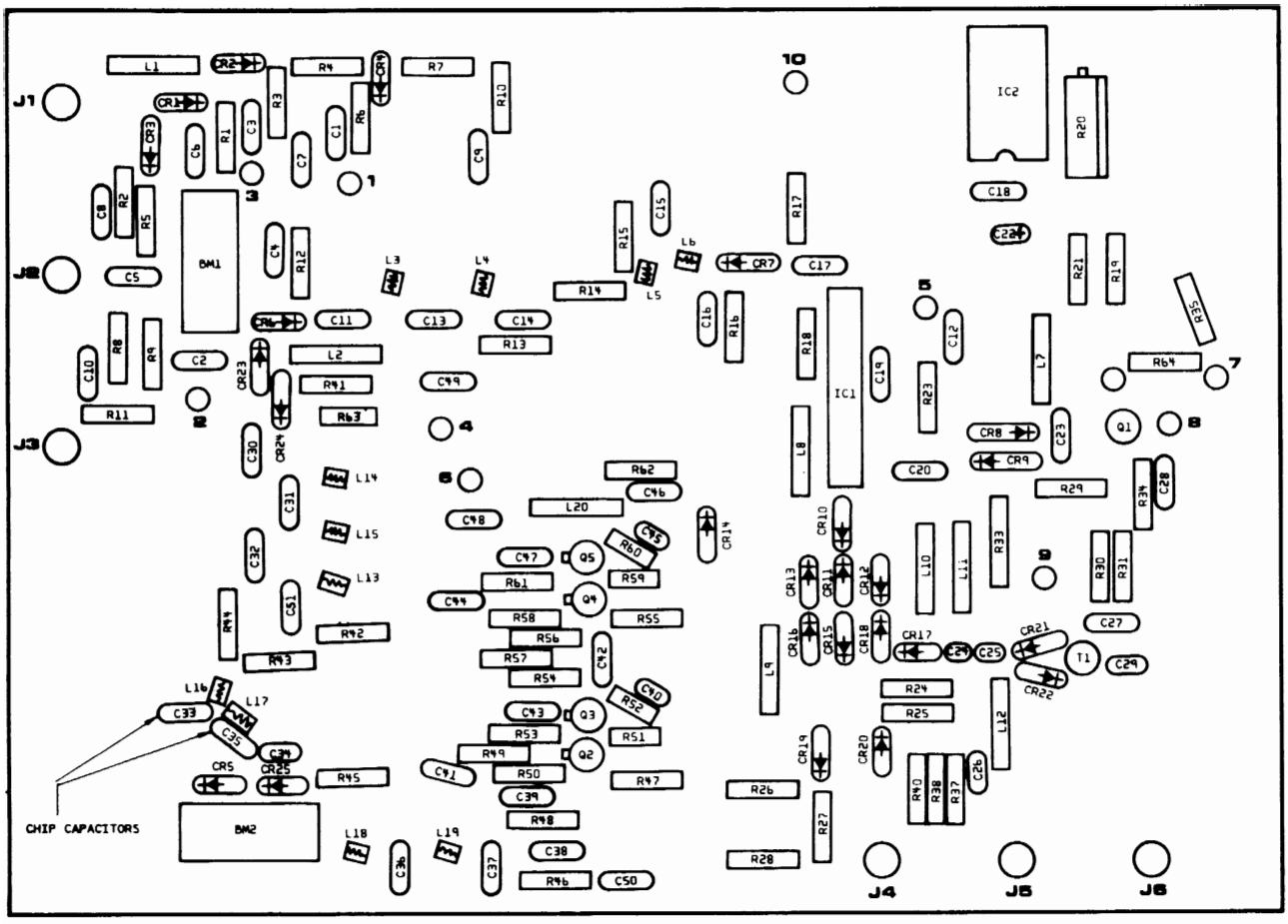
CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	COILS			
L1	Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L2	Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L3	Air Core, 2 1/2 turns	1596-0071	Cushman	
L4	Air Core, 2 1/2 turns	1596-0071	Cushman	
L5	Air Core, 2 turns	1596-0070	Cushman	
L6	Air Core, 1 1/2 turns	1596-0069	Cushman	
L7	Choke, 220μH, ±10%	1585-0018	Delevan	1537-92
L8	Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L9	Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L10	Choke, 100μH, ±5%	1585-0017	Delevan	1537-76
L11	Choke, .22μH, ±20%	1585-0039	Delevan	1537-02
L12	Choke, .56μH, ±10%	1585-0036	Delevan	1840-07
L13	Air Core, 1 turn	1596-0068	Cushman	
L14	Air Core, 1 turn	1596-0068	Cushman	
L15	Air Core, 1 turn	1596-0068	Cushman	
L16	Air Core, 1 turn	1596-0068	Cushman	
L17	Air Core, 1 1/2 turns	1596-0069	Cushman	
L18	Air Core, 2 1/2 turns	1596-0071	Cushman	
L19	Air Core, 4 turns	1596-0072	Cushman	
L20	Choke, 2.2μH, ±10%	1585-0013	Delevan	1537-20
	DIODES			
CR1	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR2	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR3	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR4	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR5	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR6	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR7	Si, HPA3080	1281-0055	H. P.	5082-3080
CR8	Diode, 1N82A	1282-0004	Sarkes Tarzian	1N82A
CR9	Diode, 1N82A	1282-0004	Sarkes Tarzian	1N82A
CR10	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR11	Si, Pin Switch, MPN3401	281-0050	Motorola	MPN 3401
CR12	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR13	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR14	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR15	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR16	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR17	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR18	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR19	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR20	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR21	Diode, HPA-2900	1283-0003	H. P.	5082-2900
CR22	Diode, HPA-2900	1283-0003	H. P.	5082-2900
CR23	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR24	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
CR25	Si, Pin Switch, MPN3401	1281-0050	Motorola	MPN 3401
	INTEGRATED CIRCUITS			
IC1	26 dB Gain, ATF417	2025-0065	Amperex	ATF417
IC2	Op-Amp, High Performance	2025-0022	T.I.	SN72741N

RF MIXERS AND IF AMPLIFIER (cont). A19

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	JACKS			
J1	Connector, BNC Jack, Bulkhead	2536-0034	Kings	KC-79-143
J2	Connector, BNC Jack, Bulkhead	2536-0034	Kings	KC-79-143
J3	Connector, BNC Jack, Bulkhead	2536-0034	Kings	KC-79-143
J4	Connector, BNC Jack, Bulkhead	2536-0034	Kings	KC-79-143
J5	Connector, BNC Jack, Bulkhead	2536-0034	Kings	KC-79-143
J6	Connector, BNC Jack, Bulkhead	2536-0034	Kings	KC-79-143
	MIXERS			
BM1	Mixer, Double Balance	2010-0002	Mini Circuits	SRA-2
BM2	Mixer, Double Balance	2010-0002	Mini Circuits	SRA-2
	RESISTORS			
R1	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R2	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R3	Comp, 56Ω, ±5%, 1/4W	1066-5605	Allen-Bradley	CB5605
R4	Comp, 150Ω, ±5%, 1/4W	1066-1515	Allen-Bradley	CB1515
R5	Comp, 330Ω, ±5%, 1/4W	1066-3315	Allen-Bradley	CB3315
R6	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R7	Comp, FSV, ±5%, 1/4W	1066-xxxx		
R8	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R9	Comp, FSV, ±5%, 1/4W	1066-xxxx		
R10	Comp, 56Ω, ±5%, 1/4W	1066-5605	Allen-Bradley	CB5605
R11	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R12	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R13	Comp, 300Ω, ±5%, 1/4W	1066-3015	Allen-Bradley	CB3015
R14	Comp, 19Ω, ±5%, 1/4W	1066-1805	Allen-Bradley	CB1805
R15	Comp, 300Ω, ±5%, 1/4W	1066-3015	Allen-Bradley	CB3015
R16	Comp, 62Ω, ±5%, 1/4W	1066-6205	Allen-Bradley	CB6205
R17	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R18	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R19	Comp, 27k, ±5%, 1/4W	1066-2735	Allen-Bradley	CB2735
R20	Pot, 100Ω, ±10%, 3/4W	1215-0010	Helitrim	89 WR
R21	Comp, 1Meg, ±5%, 1/4W	1066-1055	Allen-Bradley	CB1055
R22	Not Used			
R23	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R24	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R25	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R26	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R27	Comp, 24Ω, ±5%, 1/4W	1066-2405	Allen-Bradley	CB2405
R28	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R29	Comp, 100Ω, ±5%, 1/4W	1066-1015	Allen-Bradley	CB1015
R30	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R31	Comp, 2.4k, ±5%, 1/4W	1066-2425	Allen-Bradley	CB2425
R32	Not Used			
R33	Comp, 1k, ±5%, 1/2W	1067-1025	Allen-Bradley	CB1025
R34	Comp, 4.3k, ±5%, 1/4W	1066-4325	Allen-Bradley	CB4325
R35	Comp, 4.7k, ±5%, 1/4W	1066-4725	Allen-Bradley	CB4725
R36	Not Used			
R37	Comp, 91Ω, ±5%, 1/4W	1066-9105	Allen-Bradley	CB9105
R38	Comp, 82Ω, ±5%, 1/4W	1066-8205	Allen-Bradley	CB8205
R39	Not Used			
R40	Comp, 91Ω, ±5%, 1/4W	1066-9105	Allen-Bradley	CB9105

RF MIXERS AND IF AMPLIFIER (cont). A19

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
R41	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R42	Comp, 300Ω, ±5%, 1/4W	1066-3015	Allen-Bradley	CB3015
R43	Comp, 19Ω, ±5%, 1/4W	1066-1805	Allen-Bradley	CB1805
R44	Comp, 300Ω, ±5%, 1/4W	1066-3015	Allen-Bradley	CB3015
R45	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R46	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R47	Comp, 20k, ±5%, 1/4W	1066-2035	Allen-Bradley	CB2035
R48	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R49	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R50	Comp, 51Ω, ±5%, 1/4W	1066-5105	Allen-Bradley	CB5105
R51	Comp, 200Ω, ±5%, 1/8W	1065-2015	Allen-Bradley	BB2015
R52	Comp, 1k, ±5%, 1/8W	1065-1025	Allen-Bradley	BB1025
R53	Comp, 750Ω, ±5%, 1/4W	1066-7515	Allen-Bradley	CB7515
R54	Comp, 180Ω, ±5%, 1/4W	1066-1815	Allen-Bradley	CB1815
R55	Comp, 20k, ±5%, 1/4W	1066-2035	Allen-Bradley	CB2035
R56	Comp, 6.8k, ±5%, 1/4W	1066-6825	Allen-Bradley	CB6825
R57	Comp, 1k, ±5%, 1/4W	1066-1025	Allen-Bradley	CB1025
R58				
R59	Comp, 200Ω, ±5%, 1/8W	1065-2015	Allen-Bradley	BB2015
R60	Comp 1k, ±5%, 1/8W	1065-1025	Allen-Bradley	BB1025
R61	Comp, 510Ω, ±5%, 1/4W	1066-5115	Allen-Bradley	CB5115
R62	Comp, 2.7k, ±5%, 1/4W	1066-2725	Allen-Bradley	CB2725
R63	Comp, FSV, ±5%, 1/4W	1066-xxxx		
	TRANSFORMER			
T1	Toroidal Bifilar	1579-0031	Cushman	
	TRANSISTORS			
Q1	Si, NPN, 2N4275	1272-0016	Fairchild	2N4275
Q2	Si, NPN, 2N5179	1272-0060	Motorola	2N5179
Q3	Si, NPN, 2N5179	1272-0060	Motorola	2N5179
Q4	Si, NPN, 2N5179	1272-0060	Motorola	2N5179
Q5	Si, NPN, 2N5179	1272-0060	Motorola	2N5179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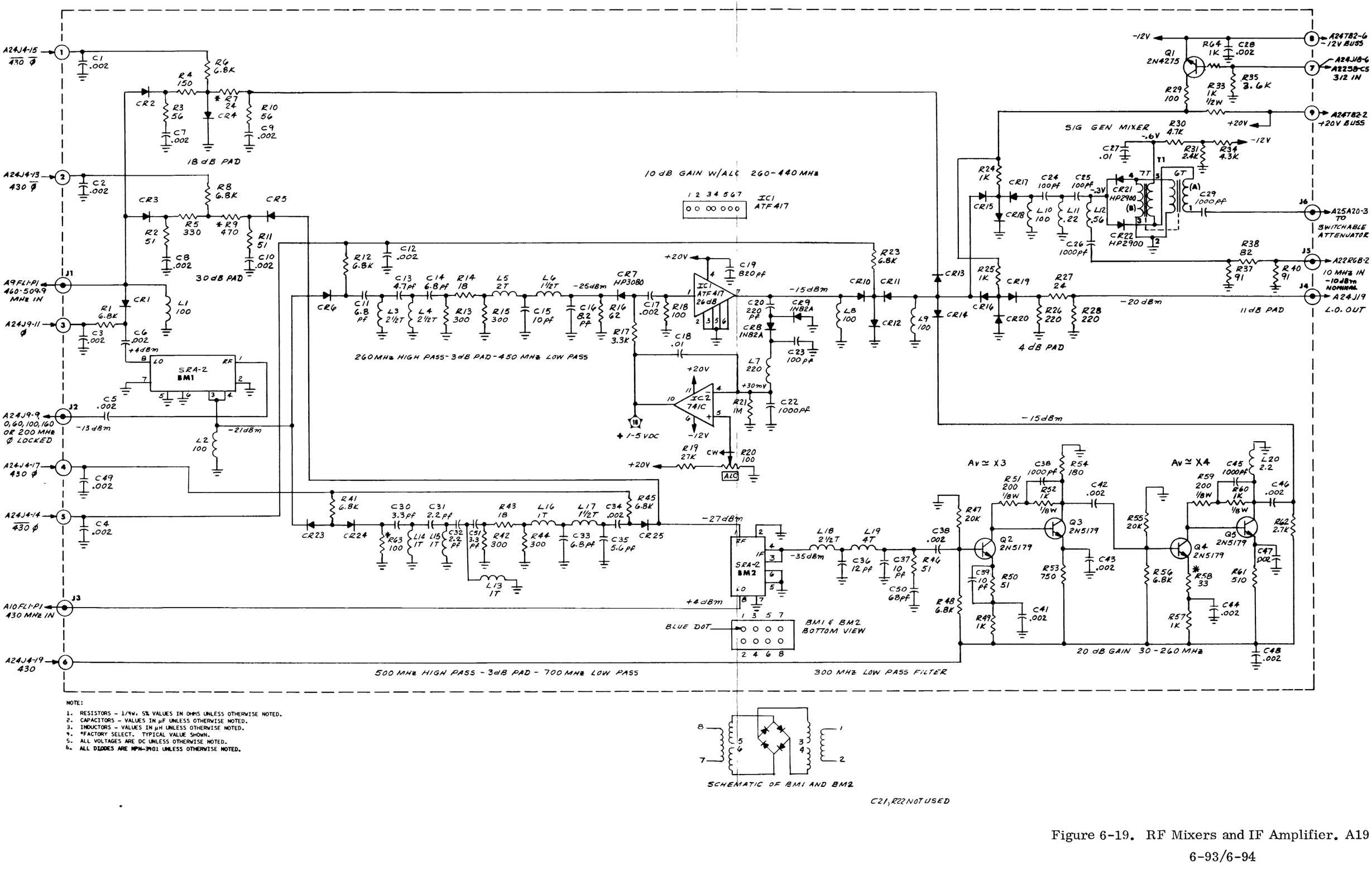
J2
J3
J4
J5
J6
BM1
BM2
IC1
IC2
CHIP CAPACITORS



NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN µF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN µH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.
6. ALL DIODES ARE MPN-3901 UNLESS OTHERWISE NOTED.

Figure 6-19. RF Mixers and IF Amplifier. A19

FRONT PANEL ASSEMBLY. A22

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A22	Front Panel Assy	7003-0063	Cushman	
	CAPACITORS			
C1	Mica, 150pF, ±5%, 500V	1002-0021	Elmenco	DM15-F-151J
C2	Poly, .68pF, ±10%, 100V	1008-0039	Electrocube	625B1C394K2
	COILS			
L1	RF Choke, 10μH, ±10%	1585-0016	Delevan	1537-36
	CONNECTORS			
J1	BNC Type Bulkhead	2536-0010	Kings	KC79-35
J2	BNC Type Bulkhead	2536-0010	Kings	KC79-35
J3	BNC Type Bulkhead	2536-0010	Kings	KC79-35
J4	BNC Type Bulkhead	2536-0010	Kings	KC79-35
J5	Bulkhead Feed Thru	2536-0038	Kings	KC99-54
	LAMPS			
XDS1	Connector	2900-0004	Dialco	515-0050
DS1	Indicator, Red	2870-0010	Dialco	507-3910-1431-600
DS2	Neon Lamp, NE-2 or Equivalent	2871-0001	Chi. Miniature	Ne-2
DS3	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
DS4	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
DS5	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
DS6	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
DS7	Lamp, W/1,5" Leads	2870-0011	Chi. Miniature	7-7382
DS8	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
DS9	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
DS10	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
DS11	Lamp, W/1.5" Leads	2870-0011	Chi. Miniature	7-7382
	METER			
M1	Meter Frequency, w/Bezel	C1402-0018	Cushman	
	RESISTORS			
R1	Comp, 68kΩ, ±5%, 1/4W	1066-6835	Allen-Bradley	CB6835
R2	Pot, 250Ω, ±10%, 2W	1203-0019	Allen-Bradley	JA4N048P251UA
R3/S10	Pot, Var, 10kΩ, w/switch	1203-0018	Allen-Bradley	JS4N048P103UA
R4	Comp, 470kΩ, ±5%, 1/4W	1066-4745	Allen-Bradley	CB4745
R5	Pot, Var, 1k/500k, Dual	1204-0003	Allen-Bradley	JJC91400C
R6	Pot, 50Ω, ±20%, 2W	1204-0004	Allen-Bradley	JJ95204A
R7	Metal Film 100Ω, ±1%, 1/10W	1074-1033	Dale	RN55D1000-F
R8	Not Used			
R9	Not Used			
R10	Not Used			
R11	Not Used			
R12	P/O S8			
	SWITCHES			
S1	Rotary 4 pole, 7 position	1851-0039	Cushman	
S2	Rotary 3 pole, 10 position	1851-0058	Cushman	
S3	Rotary 4 pole, 10 position	1851-0027	Cushman	
S4	Rotary 4 pole, 10 position	1851-0027	Cushman	
S5	Rotary 4 pole, 10 position	1851-0027	Cushman	

FRONT PANEL ASSEMBLY (cont). A22

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
S6	Rotary 4 pole, 10 position	1851-0027	Cushman	
S7	Lever, w/knob	1851-0016	Cushman	
S8/R12	Switch, Function, w/pot	1851-0025	Cushman	
S9	4 pole, 2 position, Shorting	1851-0022	Centralab	PA-1010
S10	Not Used			
S11	Toggle, SPDT, w/mtg hdw	1850-0008	C&K Comp.	7101
S12	Rotary 2 pole, 3 position	1851-0079	Cushman	
S13	Relay, Turn Indicator, .6A, 12V	1313-0006	Signal Stat	175Y1
	TERMINAL BOARD			
TB1	Tiepoint, Miniature, 5 Pin	1760-0012	Smith	1157
TB2	Terminal Board	1760-0014	Cushman	
TB3	Terminal Board	1760-0014	Cushman	
TB4	Terminal Board	1760-0014	Cushman	
TB5	Terminal Board	1760-0014	Cushman	
TB6	Terminal Board	1760-0014	Cushman	

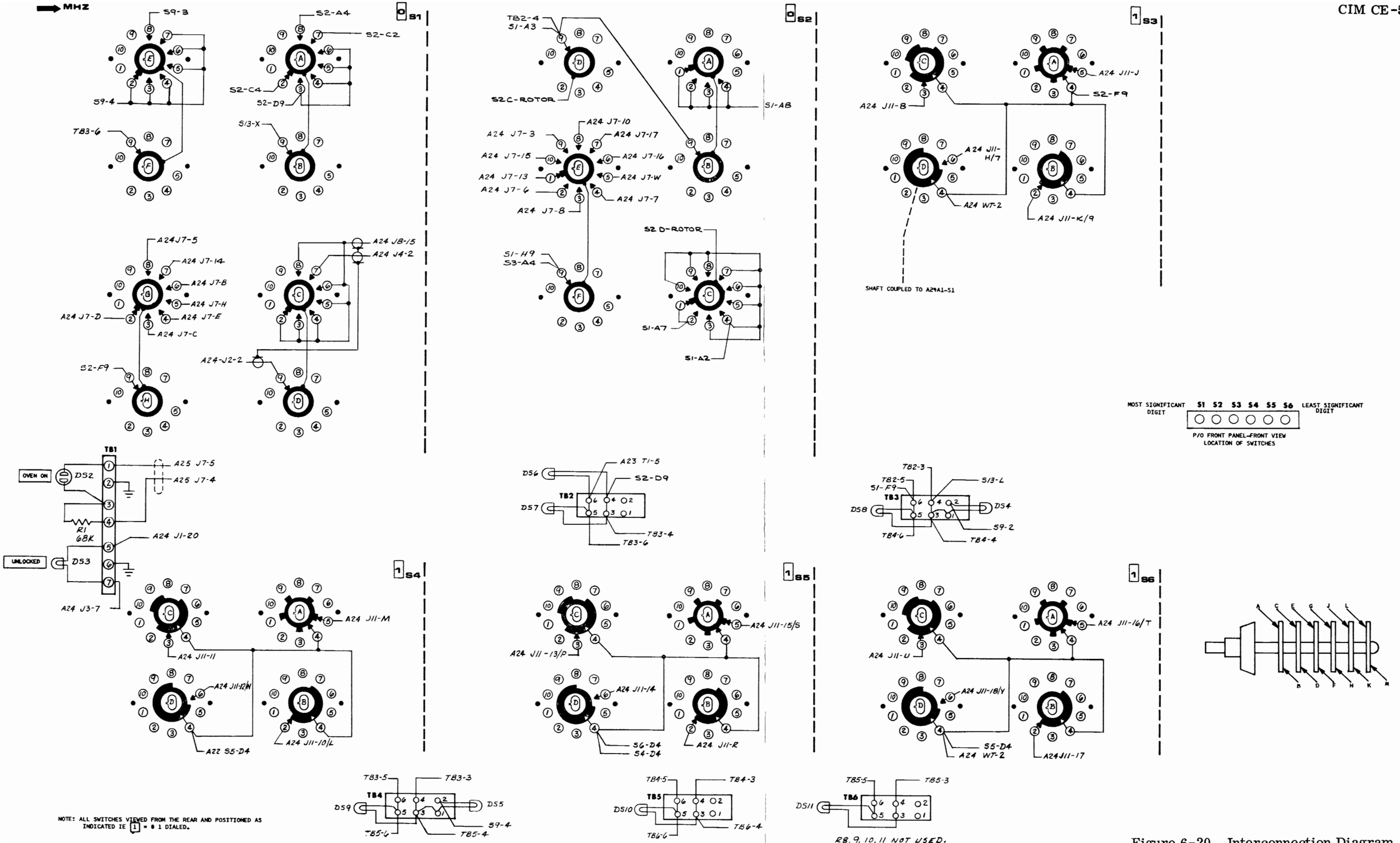


Figure 6-20. Interconnection Diagram, Front Panel, Sheet 1. A22

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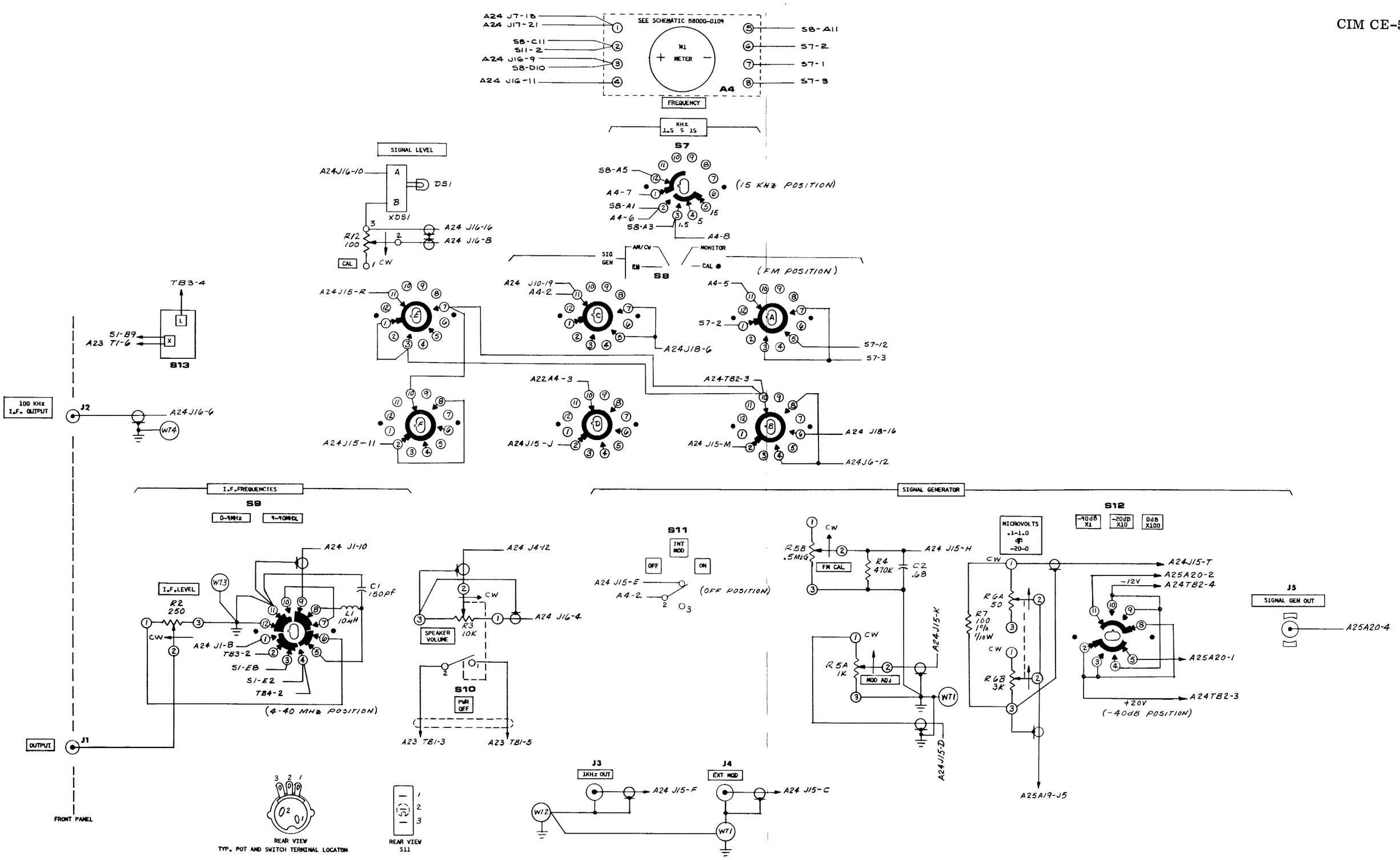

Figure 6-21. Interconnection Diagram, Front Panel, Sheet 2. A22

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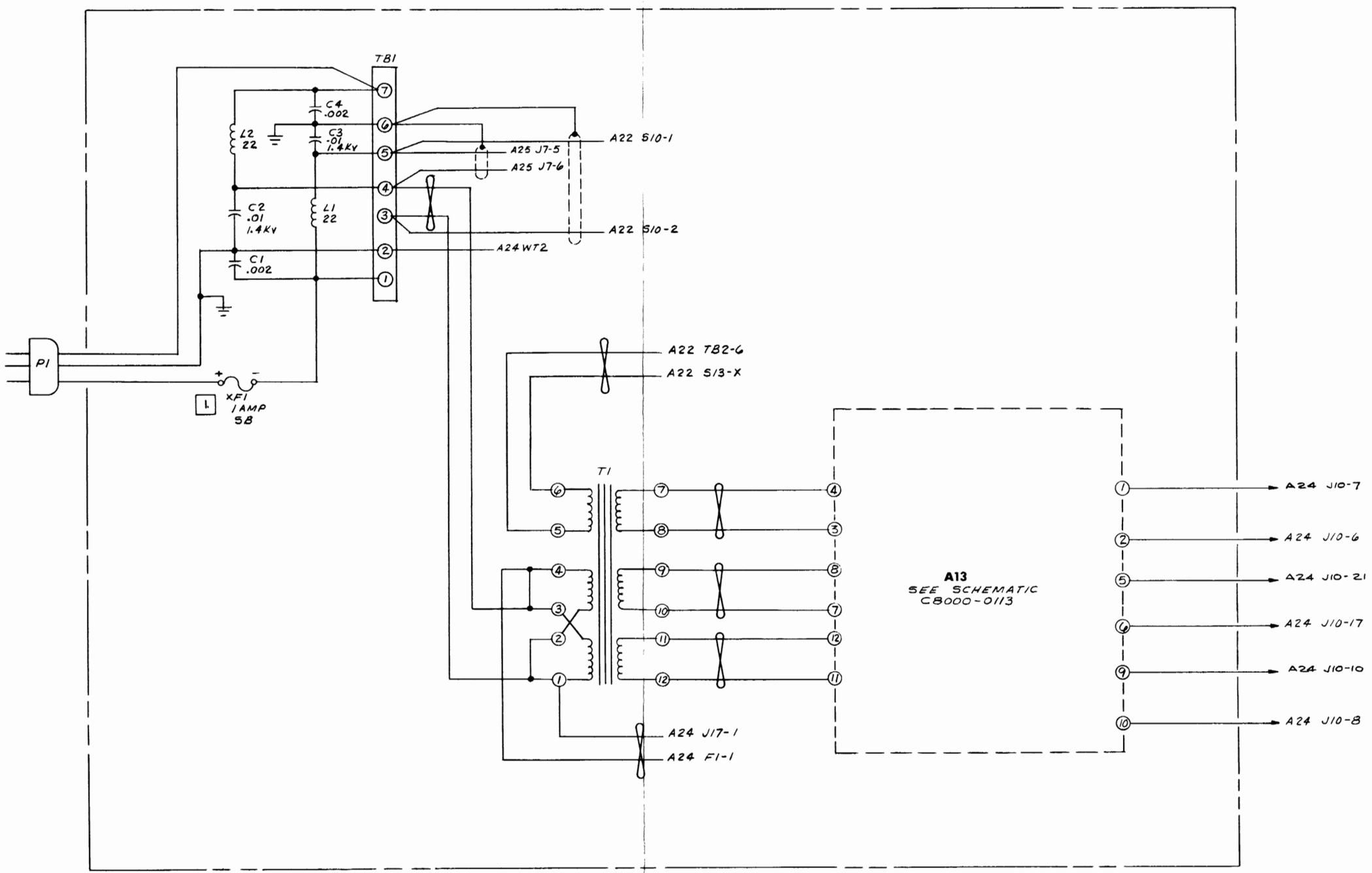
REAR PANEL ASSEMBLY. A23

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A23	Panel Assy, Rear	7003-0064	Cushman	
	CAPACITORS			
C1	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
C2	Cer, .01μF, ±20%, 1.4kV	1005-0051	Sprague	1256-S10
C3	Cer, .01μF, ±20%, 1.4kV	1005-0051	Sprague	1256-S10
C4	Cer, .002μF, ±20%, 500V	1005-0003	Erie	831-596-Z5U-202M
	COILS			
L1	Choke, 100μH, ±20%, 2 amp	1585-0040	Miller	B-6021
L2	Choke, 100μH, ±20%, 2 amp	1585-0040	Miller	B-6021
	FUSES			
F1	1 amp, Slo Blo, 3AG	1955-0006	Littlefuse	3AG-313001
XF1	Holder, Low Profile Fuse	1965-0011	Littlefuse	348-8-9-9
	TERMINAL BOARD			
TB1	Tiepoint, 7 pin, #55C	1760-0013	Cinch Jones	#55C
	TRANSFORMER			
T1	Transformer, Power	1575-0006	Cushman	



NOTES: [1.] POSITIVE AND NEGATIVE SYMBOLS ARE MARKED ON FUSE HOLDER TERMINALS.

Figure 6-22. Wiring Diagram, Rear Panel. A23

MAIN CHASSIS ASSEMBLY. A24

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A24	Main Assembly	7017-0023	Cushman	
	Main Chassis Assembly	7007-0017	Cushman	
	CAPACITOR			
C1	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
C2	Cer, .05μF, +80 -20%, 25V	1005-0014	Erie	5855-505-Y5U0-503Z
	CONNECTORS			
J1	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J2	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J3	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J4	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J5	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J6	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J7	Connector, 22 Contact, 44 pin	2535-0023	Viking	2VK22D/1-1
J8	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J9	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J10	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J11	Connector, 22 Contact, 44 pin	2535-0023	Viking	2VK22D/1-1
J12	Not Used			
J13	Not Used			
J14	Not Used			
J15	Connector, 22 Contact, 44 pin	2535-0023	Viking	2VK22D/1-1
J16	Connector, 22 pin	2535-0018	Viking	2VK22S11-1
J17	Connector, 24 pin female	2535-0020	Amphenol	25-190-24
J18	Connector, 24 pin female	2535-0020	Amphenol	25-190-24
J19	Not Used			
J20	Plug, 7 pin male	2535-0008	Amphenol	126-195
	Extender, P.C. Board Assy	D1780-0085	Cushman	
	CONNECTORS			
	22 Contact, 44 terminal, Double row	2535-0023	Viking	2VK22D/1-1

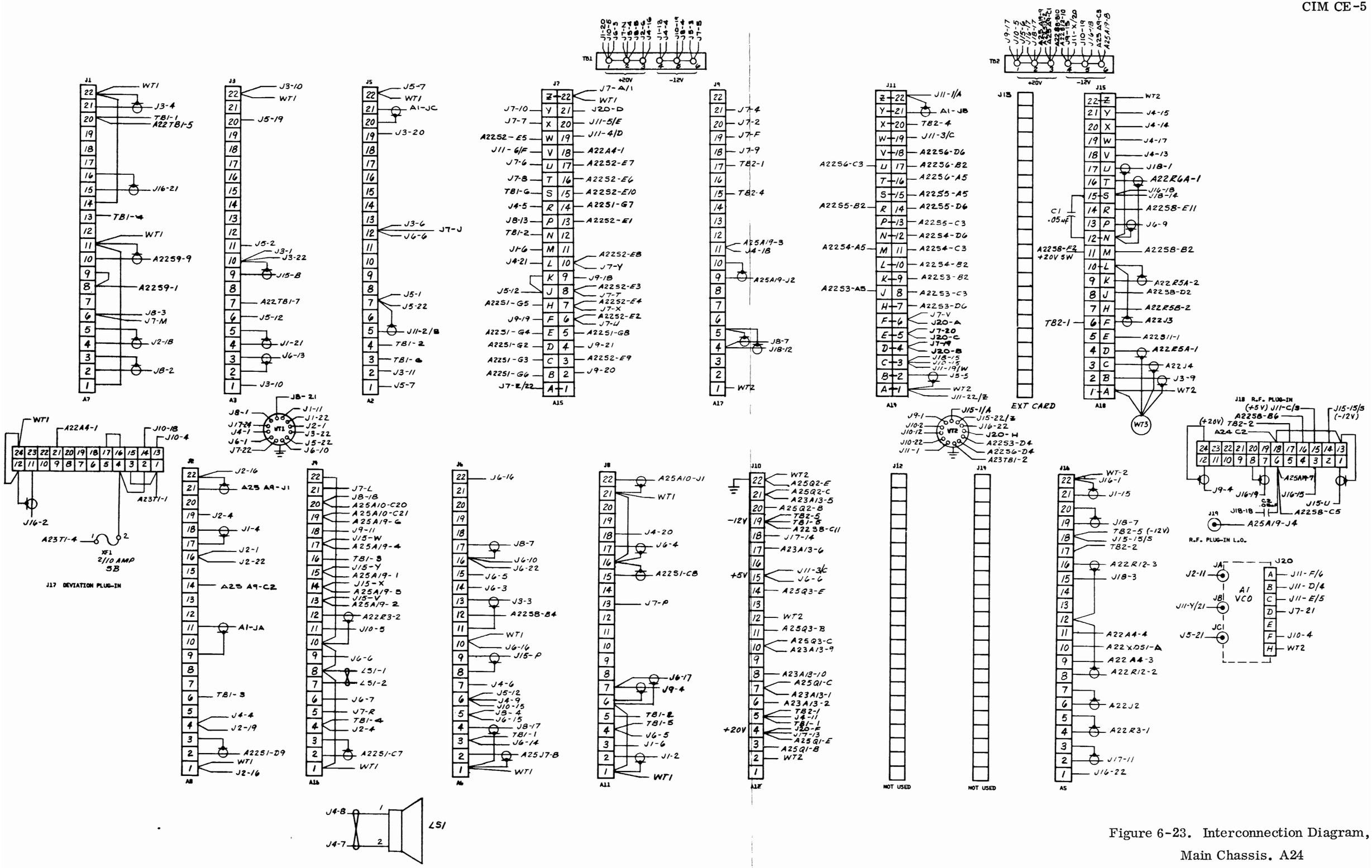


Figure 6-23. Interconnection Diagram, Main Chassis. A24

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CENTER PLATE ASSEMBLY. A25

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A25	Plate Assy, Center	7013-1003	Cushman	
	CAPACITOR			
C1	Var, .5-18pF, 750V	1001-0001		VCJ2611
	CONNECTORS			
J7	Socket, Octal	2605-0001	Cinch Jones	8 EM
	TRANSISTORS			
Q1	Si, NPN, xstr.	1271-0001	RCA	2N3054
Q2	Si, NPN, xstr.	1271-0001	RCA	2N3054
Q3	Si, NPN, xstr.	1271-0001	RCA	2N3054

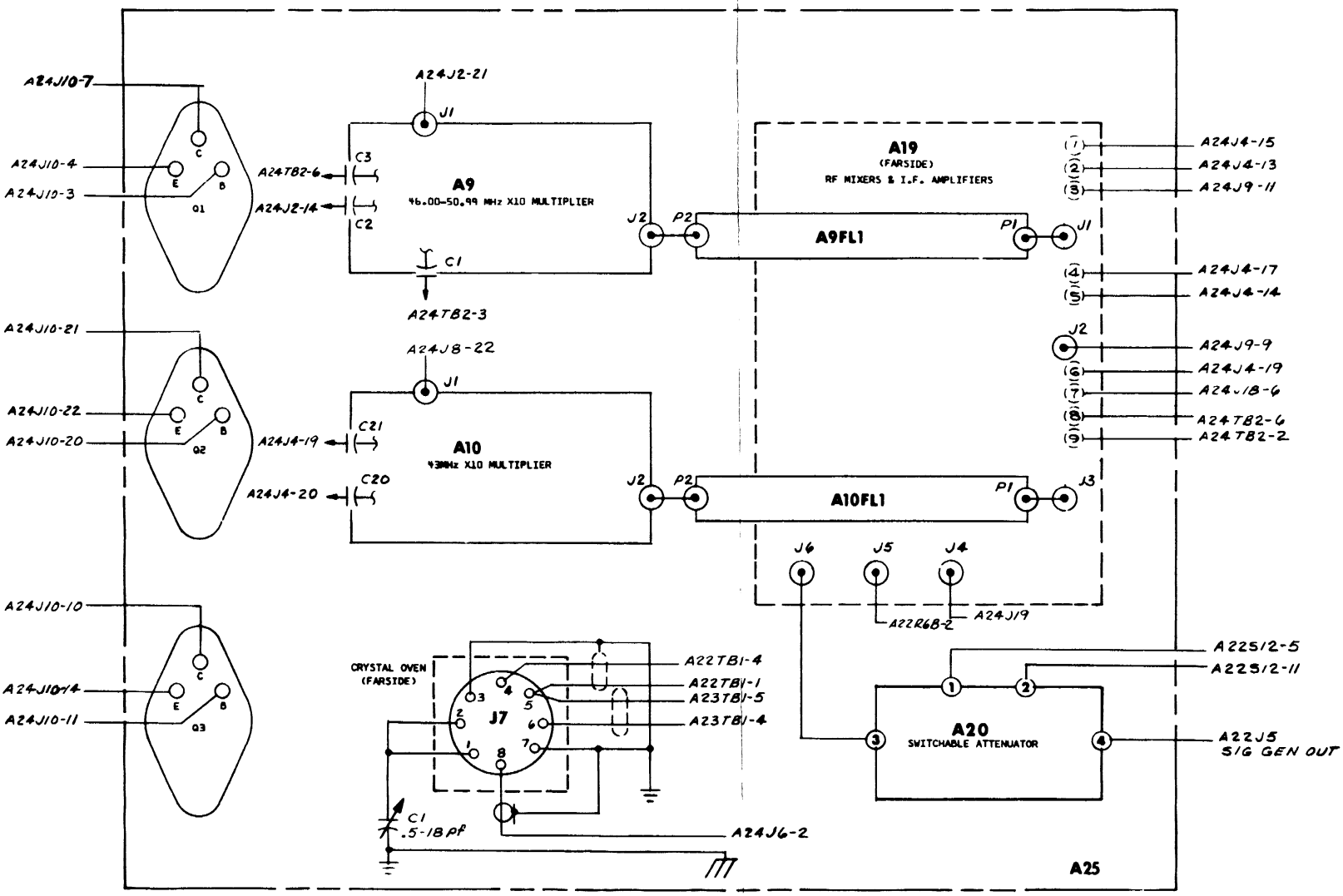

Figure 6-24. Interconnection Diagram, Center Plate. A25

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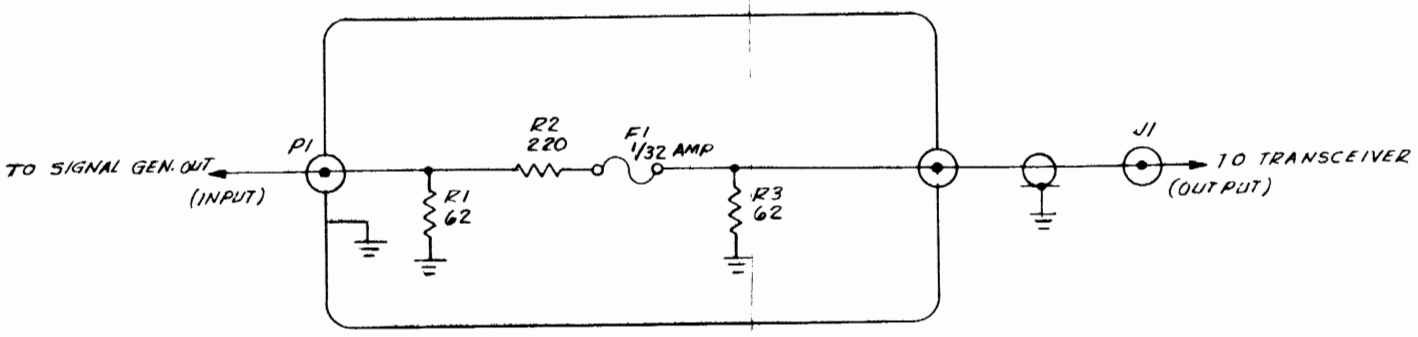
20 dB PAD ASSEMBLY

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
	Pad Assembly - 20dB	7040-0032	Cushman	
	CONNECTORS			
P1	BNC Recp. w/mtg hdw	2536-0010	Kings	KC79-35
	FUSE			
F1	Fuse, 1/32 amp	1955-0005	Buss	GFA 1/32
	RESISTORS			
R1	Comp, 62Ω, ±5%, 1/4W	1066-6205	Allen-Bradley	CB6205
R2	Comp, 220Ω, ±5%, 1/4W	1066-2215	Allen-Bradley	CB2215
R3	Comp, 62Ω, ±5%, 1/4W	1066-6205	Allen-Bradley	CB2215



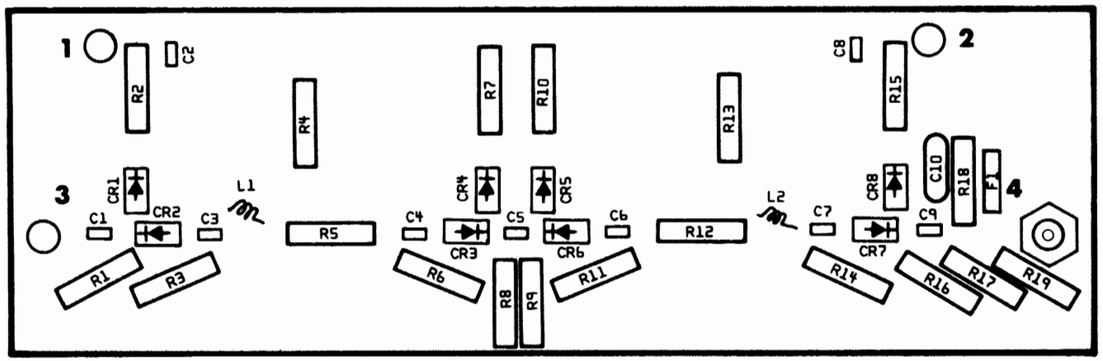
NOTE:

1. RESISTORS - 1/4W, 5% VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS - VALUES IN μF UNLESS OTHERWISE NOTED.
3. INDUCTORS - VALUES IN μH UNLESS OTHERWISE NOTED.
4. *FACTORY SELECT. TYPICAL VALUE SHOWN.
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED.

Figure 6-25. 20 dB Pad Assembly

SWITCHABLE ATTENUATOR, A20

CKT. REF.	DESCRIPTION	CE STOCK NO.	MFR.	MFR. NO.
A20	Switchable Attenuator, P.C. Board Assy	7001-0240	Cushman	
	P.C. Board	1780-0459	Cushman	
	CAPACITORS			
C1	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C2	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C3	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C4	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C5	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C6	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C7	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C8	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C9	Cer, 1000pF, ±10%, 100V	1005-0081	Erie	8121-100-W5R-102K
C10	Mica, 12pF, ±5%, 500V	1002-0017	Elmenco	DM15-C-120J
	COILS			
L1	Air Core, 3 turns	1596-0076	Cushman	
L2	Air Core, 3 turns	1596-0076	Cushman	
	DIODES			
CR1	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
CR2	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
CR3	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
CR4	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
CR5	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
CR6	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
CR7	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
CR8	Si, Pin Switching, MPN3401	1281-0050	Motorola	MPN 3401
	FUSE			
F1	Fuse, 1/32 Amp	1955-0005	Buss	GFA 1/32
	RESISTORS			
R1	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R2	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R3	Metal Film, 61.9Ω, ±1%, 1/10W	1075-0007	Dale	MF 1/10 T1
R4	Comp, 1.8k, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R5	Metal Film, 255Ω, ±1%, 1/8W	1075-0047	Mepco	RN55C2550F
R6	Metal Film, 61.9Ω, ±1%, 1/10W	1075-0007	Dale	MF 1/10 T1
R7	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R8	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R9	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R10	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R11	Metal Film, 61.9Ω, ±1%, 1/10W	1075-0007	Dale	MF 1/10 T1
R12	Metal Film, 255Ω, ±1%, 1/8W	1075-0047	Mepco	RN55C2550F
R13	Comp, 1.8k, ±5%, 1/4W	1066-1825	Allen-Bradley	CB1825
R14	Metal Film, 61.9Ω, ±1%, 1/10W	1075-0007	Dale	MF 1/10 T1
R15	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB3325
R16	Comp, 3.3k, ±5%, 1/4W	1066-3325	Allen-Bradley	CB1825
R17	Comp, 150Ω, ±5%, 1/4W	1066-1515	Allen-Bradley	CB1515
R18	Comp, 24Ω, ±5%, 1/4W	1066-2405	Allen-Bradley	CB2405
R19	Comp, 150Ω, ±5%, 1/4W	1066-1515	Allen-Bradley	CB1515



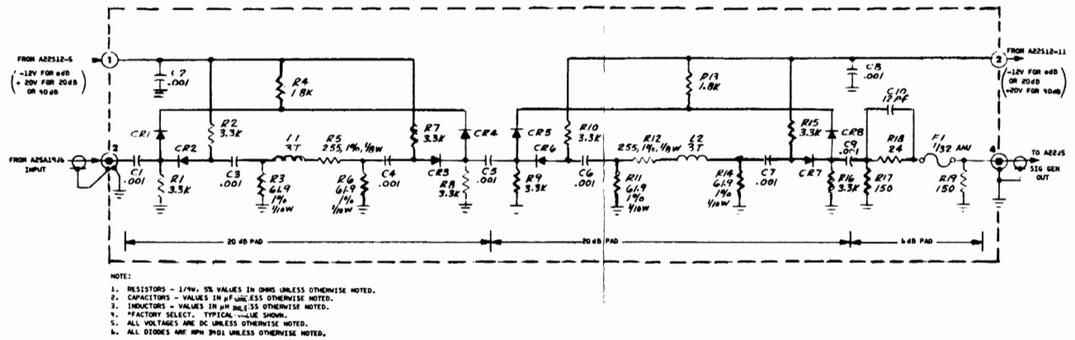


Figure 6-26. Switchable Attenuator. A20

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5601-0034