TM 11-6625-700-25

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

DIGITAL READOUT ELECTRONIC COUNTER AN/USM-207

(NSN 6625-00-911-6368)

This copy is a reprint which includes current pages from Changes 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

OCTOBER 1966

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HEADQUARTERS
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NG: None.
USAR: None.
For explanation of abbreviations wed, see AR 320-50.

SECTION A. GENERAL

1. Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment. Department of the Army Pamphlet No. 310-4 is a current index of technical manuals, technical bulletins, supply manuals, (types 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders available through publication supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes to and revisions of each equipment publication.

2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR *700-58* (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Reporting of Equipment Manual Improvements. The direct reporting of errors, omissions, and recommendations for improving this equipment manual by the individual user is authorized and encouraged. DA Form 2028 will be used for reporting these improvements. This form may be completed by using pencil, pen, or typewriter. DA Form 2028 will be completed by the individual using the manual and forwarded direct to Commanding Officer, U.S. Army Electronics Command, ATTN: AMSEL-MR-NMP-AD, Fort Monmouth, New Jersey 07703.

SECTION 1

GENERAL INFORMATION

1-1. SCOPE.

This Technical Manual is in effect upon receipt. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-2. GENERAL DESCRIPTION.

The AN/USM-207 is a portable, solid-state electronic counter for precisely measuring and displaying on an 8-digit numerical readout the frequency and period of a cyclic electrical signal, the frequency ratio of two signals, the time interval between two points on the same or different signals, and the total number of electrical impulses (totalizing). The counter also provides the following types of output signals:

a. Standard signals from 0.1 cps to 10 mc in decade steps derived from a l-mc frequency standard, frequency dividers, and a frequency multiplier;

b. Input signals divided in frequency by factors from 10 to 10^8 by a frequency divider;

c. Digital data of the measurement in four-line binary-coded-decimal form with decimal point and control signals for operation of printers, data recorders, or control devices; and

d. A l-mc output from a frequency standard.

1-3. DESCRIPTION OF UNIT.

The AN/USM-207 consists of a major counter assembly, two plug-in assemblies which install in recesses on the front and rear panel, and a group of accessory cables and connectors stored in the detachable front cover.

a. DIGITAL READOUT ELECTRONIC COUNTER CP-814/USM-207. - The major assembly Digital Readout Electronic Counter CP-814/USM-207 contains the input amplifiers; gate control; display, reset and transfer control; frequency multipliers; time base dividers; decade and readout boards; numerical display tubes; decimal point and units indicators; power supply and regulator; and controls associated with these circuits.

b. RADIO FREQUENCY OSCILLATOR 0-1267/USM-207. - This plug-in assembly develops a 1-me signal and includes its own power supply. The oscillator includes the l-mc output receptacle which may be used as a source of that frequency when the oscillator is connected to ac power through the basic counter or when connected to the power line independently of the counter. The counter may be operated without the oscillator in totalizing, scaling the input signal, time interval with external clock, and frequency ratio measurements. For other measurements the counter does not require the oscillator when a separate external 100-kc or l-mc signal is connected. In either of those two situations the oscillator may be left in the counter or removed. The oscillator plugs into the right rear of the counter.

c. ELECTRONIC FREQUENCY CONVERTER CV-1921/USM-207. - This plug-in assembly permits measurement of frequencies up to 500 mc using the heterodyne principle. The unit consists of the broadband amplifier, mixer, multiplier, and controls and indicators associated with these circuits. When measurements other than heterodyne frequency measurement are made, the converter is not required, but need not be removed. The converter also permits the measurement of signals from 35 mc to 100 mc with a greater sensitivity than available with the basic counter. The converter plugs into the right front of the counter.

d. COUNTER COVER CW-801/USM-207. - The CW-801/USM-207 protects the front panel of the counter when not in use and provides storage space for the power cable, printed circuit board extender, two rf cables, six adapters, two tee connectors, two plug- in test cables, and the Operating Manual.

1-4. REFERENCE DATA.

The AN/SM-207 is designed for continuous operation in ambient temperatures from –28°C to +65°C with relative humidity to 95 percent, except that performance above 50°C is limited to operation with an external frequency standard. Within this range, the equipment will operate with the performance and accuracy specified below.

a. FREQUENCY MEASUREMENT.-

(1) Range (with converter): 0 cps to 500 mc.

(2) Range (without converter): 0 cps to 100 mc.

(3) Input channel: A (ac coupled), C (ac or dc coupled), or converter (ac coupled).

(4) Input amplitude.

(a) Channel A input: 0.1 to 300 volts rms from 1.0 cps to 10 mc with 6 db/octave roll-off below 10 cps; 0.1 volt rms to 100 volts rms from 10 mc to 100 mc.

(b) Channel C input: 0.1 volt rms to 425 volts rms, from 0.0 cps to 1 mc when dc coupled; ac coupled same as dc coupled except lower limit is 10 Cps.

(c) Converter input: 0.01 volt to 10 volts rms from 35 mc to 500 mc.

(5) Input impedance.

(a) Channel A input: 1 megohm +10% shunted by 30 pf maximum.

(b) Channel C input: 1 megohm +10% shunted by 30 pf maximum.

(c) Converter input: 50 ohms nominal,

(6) Readout units: In direct frequency measurement, readout is in kc and mc with automatically positioned decimal point; with frequency conversion, readout in mc is added to or subtracted from converter mixing frequency selector switch reading in mc.

(7) Gate times: 1µsec, 10 µsec, 100 µsec, 1 ms, 10 ms, 100 ms, 1 second, 10 seconds.

(8) Accuracy: ±1 count ± time-base accuracy.

b. PERIOD MEASUREMENT.-

(1) Input channel: B.

(2) Input range: Dc coupled, 0.0 cps to 1 mc for single period, and 0.0 cps to 300 kc for average of multiple periods; ac coupled, same as dc coupled, except lower limits are 10 cps.

(3) Input amplitude: 0.1 volt rms to 425 volts rms.

(4) Input impedance: 1 megohm ±10% shunted by 30 pf maximum.

(5) Number of periods averaged: 1, 10, 10^2 10^3, 10^4, and 10^5

(6) Frequency counted: 1 cps to 10 mc in decade steps for 1 period and 10 period average measurements; 100 cps to 10 mc in decade steps for 10^2 period average measurement; 1 kc to 10 mc in decade steps for 10^3 period average measurement; 10 kc to 10 mc in decade steps for 10^4 period average measurement; 100 kc to 10 mc in decade steps for 10^5 period average measurement.

(7) Readout units: Time of a single period in microseconds, milliseconds, and seconds with automatically positioned decimal point.

(8) Accuracy:

± Time-base accuracy

$$\pm \frac{\text{trigger error} \pm \frac{\text{frequency (unknown)}}{\text{frequency counted}}}{\text{Number of periods averaged}}.$$

c. FREQUENCY-RATIO MEASUREMENT. -

(1) Numerator input: Same as for frequency input as listed in paragraph a.

(2) Denominator (B) input: Same as for channel B as listed in paragraph b.

(3) Multipliers: 1, 10, 10^2, 10^3, 10^4, 10^5.

(4) Readout: $\frac{\text{Numerator input}}{\text{B}}$ with automatically positioned decimal point (no units).

(5) Accuracy: ±1 count ± trigger error of B.

d. TIME-INTERVAL MEASUREMENT. -

(1) Input channels: B (start) and C(stop) inputs may be switched to common signal or to separate signals to provide time interval between points on one or two waveforms, respectively.

(2) Input signals: Same characteristics as listed for period measurement in paragraph b.

(3) Range: 1 µsec to 10^8 seconds.

(4) Time-base frequency counted: 1 cps to 10 mc in decade steps.

(5) Accuracy: ± 1 count ± time-base accuracy.

(6) Readout units: Microseconds, milliseconds, or seconds with automatically positioned decimal point.

e. TIME INTERVAL MEASUREMENT, EXTERNAL CLOCK (A/B ⇒ C). -

(1) Input channels: A, B, and C. Channel C input may be switched to common signal or to separate signals to provide count of channel A signal pulses between points on one or two waveforms, respectively.

(2) Range:

$$\frac{\text{1 cps to 100 mc}}{\text{Time B} \Rightarrow \text{C} \geq 1\ \mu\text{sec}}$$

(3) Accuracy: ±1 count.

f. TOTAL COUNT. -

(1) Count range: 0 to 99,999,999.

(2) Maximum counting rate: 100 mc.

(3) Input channel: A, C, or converter.

(4) Input signal characteristics: Same as for frequency measurement as listed in paragraph a.

(5) Start and stop: Front panel control.

g. DISPLAY. -

(1) Number of digits: 8 digits with automatically positioned decimal point.

(2) Units displayed: Microseconds, mill - seconds, seconds, megacycles, kilocycles.

(3) Display tubes: In- line biquinary display tubes.

(4) Storage: Power switch selects (a) storage of a displayed count while the next count is being accumulated, and display changes only when new count changes; or (b) continuous display of counting between display periods.

(5) Display time: Adjustable from less than 0.1 second to greater than 5.0 seconds, independent of gate time. Display-time control includes an infinite-display-time position.

h. TIME BASE. -

(1) Source: l-mc internal crystal oscillator.

(2) Stability: ±1 part in 10^9 in 1000 seconds after 2-hours stabilizing time.

(3) Drift: Not more than 1 part in 10^8 per week after 48 hours stabilizing time.

(4) Coarse adjustment: Screwdriver-type control varies l-me output approximately ±5 parts in 10^7.

(5) Fine adjustment: Screwdriver-type control varies l-me output approximately ±500 parts in 10^{10}.

i. REFERENCE FREQUENCY INPUT. -

(1) Frequency: 100 kc or 1 mc.

(2) Amplitude: 0.5 volt rms to 10 volts rms.

(3) Input impedance: 1000 ohms 10% shunted by 30 pf maximum.

j. TRIGGER ERROR. - Not greater than 0.3 percent for sine-wave signals having at least 40 decibels signal-to-noise ratio and 0.l-volt rms amplitude.

k. STANDARD l-MC OUTPUT. - Sinusoidal, l-volt peak-to-peak minimum, 50-ohm output impedance.

1. STANDARD FREQUENCY. -

(1) outputs: 0.1 cps, 1 cps, 10 cps, 100 cps, 1 kc, 10 kc, 100 kc, 1 mc, 10 mc.

(2) Output impedance: 50 ohms nominal.

(3) Minimum peak amplitude for all outputs: 1.5 volts.

(4) Waveshapes: 0.1 cps through 10 kc, positive rectangular pulses; 100 kc, positive, approximately rectangular pulses; 1 mc, positive square wave; 10 mc, sine wave.

m. SCALED OUTPUTS. -

(1) Frequency: Input signal applied to channel A, channel C, or converter, divided by any decade factor from 10 to 10^8 Input signal is as specified in paragraph a.

(2) Output impedance: 50 ohms nominal.

(3) Minimum peak amplitude for all outputs: 1.5 volts.

(4) Waveshapes: Input divided by 10^8 through 10^3, positive rectangular pulses; input divided by 10^2, positive, approximately rectangular pulses; input divided by 10, positive square waves.

n. PRINTER INTERFACE. -

(1) Each of 8 digits has a corresponding 4-line binary-coded decimal (l-2-4-8); "0" false level, more positive than +10.0 volts; "l" true level, more negative than +0.5 volt; source impedance, approximately 10 k each line.

(2) Decimal-point data is represented by a 4-line binary-coded decimal (l-2-4-8), which corresponds to the 7 decimal points (D-0 through D-6) with D-0 at the right; "0" false level, more positive than +10.0 volts; "l" true level, more negative than +0.5 volt; code line 8 is always false; source impedance, approximately 10 k each line.

(3) Print-command signal at end of counting cycle; negative pulse from a voltage more positive than +11.5 volts to 3 voltage less positive than +1.5 volts.

(4) Reset inhibit: Connect to ground.

(5) +12 volts at up to 0.1 ampere for coding of printout.

o. RESET. - Pushbutton switch.

p. OPERATING TEMPERATURE. -

(1) 0°C to 50°C when operating with internal time base.

(2) -28°C to +65°C when operating with external reference frequency input used as time base.

q. STORAGE TEMPERATURE.- 62°C to +75°C.

r. RELATIVE HUMIDITY. -0 to 95 percent.

s. POWER REQUIREMENTS. - 115 vac ± 10%, 50/60 cps ±5%, or 400 cps ±10%, 115 watts maximum.

t. WEIGHT. - 51 pounds.

u. DIMENSIONS. - See table 1-1.

1-5. EQUIPMENT SUPPLIED.

The equipment supplied with AN/USM-207 is listed in table 1-1. In addition to the basic counter, two plug-in units, and the cover, it includes accessory cables. connectors, adapters, two panel protectors, two copies of the Operators' Manual, and two copies of the Technical Manual. As shipped, all accessories and one copy of the Operators' Manual are stowed within the cover.

1-6. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED.

A list of all equipments and publications required but not supplied is provided in table 1-2.

1-7. FACTORY OR FIELD CHANGES.

Digital Readout Electronic Counter AN/USM-207 is a new instrument; no factory or field changes have been made as of date of issue.

1-8. PREPARATION FOR RESHIPMENT.

Electronic equipment must be packed with special care. The package in which the equipment is originally shipped is designed to give the instrument full protection from adverse environments and from the shock and vibration incurred in shipment. It should be preserved and utilized for reshipment wherever possible. When preparing the AN/USM-207 for shipment, stow all accessories within the holders inside the cover of the instrument, and lock the cover in place. If the factory-designed package is not in satisfactory condition, pack in accordance with MIL-P-116 and MIL-E-17555E.

TABLE 1-1. EQUIPMENT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		OVER-ALL DIMENSIONS (IN.)			VOLUME (CU FT)	WEIGHT (LB)
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Counter Cover	CW-801/USM-207	6.20	16.90	4.75	0.28	6.25
1	Digital Readout Electronic Counter	CP-814/USM-207	6.36	16.50 18.86‡	18.50	1.07	36.50 38.75‡
1	Electronic Frequency Converter	CV-1921/USM-207	4.62	4.69	8.00	0,11	3.75
1	Radio Frequency Oscillator	O-1267/USM-207	4.75	4.69	8.00	0.10	5.00
	Digital Readout Electronic Counter	AN/USM-207	6.40	16.90 18. 86*	21.50	1.30	51.50 53.75‡
2*	Connector Adapter	UG-255/U	—	—	—	—	—
2*	Connector Adapter	UG-273/U	—	—	—	—	—
2*	Connector Adapter	UG-274B/U	—	—	—	—	—
2*	Connector Adapter	UG-1035/U	—	—	—	—	—

*Part of Counter Cover CW-801/USM-207.
‡with side panels and handles.

TABLE 1-1 (Continued)

QTY PER EQUIP	NOMENCLATURE		OVER-ALL DIMENSIONS (IN.)			VOLUME (CU FT)	WEIGHT (LB)
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1*	Electrical Power Cable Assy	MP1330065 (8.25 ft)	—	–			–
1*	Printed Circuit Board Extender	MP06-515	4.9	6.0	0.31	—	—
1*	Printed Circuit Board Extractor	MP1250587	1.75	5.8	0.125 rod dia	-	—
1*	Radio Frequency Cable Assy	MP1350003 (15 in.)	--	—			
1*	Radio Frequency Cable Assy	MP1330068 (13.5 in.)	–				–
2*	Radio Frequency Cable Assy	MP1330070 (8.25 ft)	–				-
2	Operators' Manual (Volume 2) for Digital Readout Electronic Counter AN/USM-207	NAVSHIPS 0969-028-4020	11	8.5	0.2	–	–
2	Technical Manual (Volume 1) for Digital Readout Electronic Counter AN/USM-207	NAVSHIPS 0969-028-4010	11	8.5	1.0		–
1	Right-Hand Panel Protector, w/16 Mounting Screws	MP1190064	4.60	18.25	1.18	—	1
1	Left-Hand Panel Protector, w/16 Mounting Screws	MP1190065	4.60	18.25	1.18	--	1

*Part of Counter Cover CW-801/USM-207.

TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
1	Audio Oscillator	TS-382C/U	Trouble shooting of A, B, and C Amplifiers, and external time-base source in reference standards procedures.	Minimum frequency range: 800 cps to 110 kc. Output amplitude: Continuously variable from less than 1 millivolt rms to 10 volts rms.
1	DC Differential Voltmeter	AN/USM-98A	Precision measurement of power-supply output voltages.	Voltages: 0 to ±300 volts. Input impedance: 1 megohm minimum. Accuracy: ±1%.
1	DC Power Supply	Harrison Laboratories Model 6226A	Test and repair of 1-mc oscillator.	Output voltage: Adjustable from 20 volts to 30 volts at 1 ampere minimum. Load regulation: 0.02%.

TABLE 1-2. (Continued)

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
1	Electronic Multimeter	ME-30A/U	Precision measurement of power-supply ripple voltages.	Voltages: 0 to 10 volts rms. Input impedance: 1 megohm minimum. Accuracy: ±5%.
1	Frequency Error Expander	Motorola Model S1061AR	Temperature setting in the 1-mc oscillator.	Frequency error multiplication: 10^3.
1	Frequency Standard	FR-44/URM-18	Radio-frequency-oscillator frequency adjustment.	Frequency: 100 kc or 1 mc. Stability: 5 parts in 10^{10} per day. 1 part in 10^8 per week Amplitude: 0.5 volt rms minimum into 1,000 ohms.
1	Oscilloscope	AN/USM-140B	Waveform analysis of frequencies below 22 mc and low-frequency voltage measurement.	Minimum frequency range of of vertical channel: Dc to 22 mc. Sweep mode: Internal/external. Internal sweep time range: 0.1 microsecond/cm to 0.1 second/cm minimum.
1	Oscilloscope	Tektronix Model 585 with Type 82 Plug-in.	Waveform analysis of frequencies above 22 mc.	Minimum frequency range of vertical channel: Dc to 80 mc. Internal sweep time range: 0.05 microsecond/cm to 10 milliseconds/cm minimum.
1	RF Millivoltmeter	AN/URM-145	Precision voltage measurement over a wide range of frequencies.	Minimum frequency range: 1 mc to 600 mc. Accuracy: 1 mc to 100 mc: ±6%. 100 mc to 600 mc: ±12%.
1	Synthesizer	FR-44/URM-18 FR-45/URM-18	Sensitivity check at precise frequencies.	Frequency standard input: 1 mc, 1 volt peak-to-peak sinusoidal signal from a 50-ohm source impedance. Output frequencies: 1 cps to 1 mc in decade steps; and 10 mc, 20 mc, 50 mc, and 100 mc. Output amplitude: 1 v rms minimum into a 1-megohm load.
1	Variable Transformer	CN-16A/U	Power-supply adjustment.	Current rating: 4 amperes minimum. Input voltage: 115 v rms ±10%.

TABLE 1-2. (Continued)

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
	Variable Transformer (cont)			Output voltage: Adjustable from 0 to 130 v rms. Output receptacle: Three-terminal.
1	VHF Signal Generator	AN/USM-44A	Alignment of electronic frequency converter.	Minimum frequency range: 100 mc to 480 mc. Amplitude: 0 to 0.5 volt rms adjustable in calibrated steps.
1	UHF Signal Generator	AN/URM-49	Alignment of electronic frequency converter.	Minimum frequency range: 450 mc to 650 mc. Amplitude: 0 to 0.5 volt rms adjustable in calibrated steps.
1	Wattmeter	AN/URM-120	Power-supply adjustment.	Power range: 0 to 200 watts minimum. Voltage range: 0 to 150 volts minimum.
1	Attenuator	CN-318	Means of adjusting output level of synthesizer.	Attenuation range: 0 to 60 db minimum, in 1-db steps. Frequency range: Dc to 100 mc. Impedance: 50 to 100 ohms.
1	BNC Probe Adapter	Tektronix Model 013-054	Faciliates probing of signals terminated in a BNC connector.	
2	Connector Adapter	UG-201/U	Faciliates connection between uhf and vhf signal generators and counter.	
1	50-Ohm BNC Termination	DA-223/U	Proper impedance termination for counter output signals.	
1	Instruction Book for Audio Oscillator TS-382C/U	TM11-6625-261-12		
1	Instruction Book for Dc Differential Voltmeter AN/USM-98A	TM11-6625-599-12		
1	Instruction Book for Dc Power Supply 6226A	Harrison Laboratories commercial manual for Model 6226A.		

TABLE 1-2. (Continued)

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
1	Instruction Book for Electronic Multimeter ME-30A/U	TM11-6625-320-12		
1	Instruction Book for Frequency Error Expander S1061AR	Motorola commercial manual for Model S1061AR		
1	Instruction Book for Frequency Standard FR-44/URM-18	TM11-2665		
1	Instruction Book for Oscilloscope AN/USM-140B	TM11-6625-535-15-1		
1	Instruction Book for Oscilloscope Tektronix Model 585	Tektronix commercial manual for Model 585		
1	Instruction Book for RF Millivoltmeter, AN/URM-145	TM11-6625-524-14		
1	Instruction Book for FR-44/URM-18 and FR-45/URM-18	TM 11-2665		
1	Instruction Book for Vhf Signal Generator AN/USM-44A	TM11-6625-508-10		
1	Instruction Book for Uhf Signal Generator AN/URM-49	TM11-6625-280-15		

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

The counter is shipped with the radio frequency oscillator and electronic frequency converter installed. All accessories supplied with the counter are installed within the front cover prior to shipment. Handle the instrument carefully when removing it from the shipping container.

2-2. POWER REQUIREMENTS.

The counter is designed to operate from 115 volts ±10 percent, single-phase ac, at 50 cps ±5 percent, 60 cps ±5 percent, or 400 cps ±10 percent. Operation at frequencies or voltages other than these should not be attempted. Total power demand does not exceed 115 watts.

2-3. SITE SELECTION.

The counter is a portable test instrument designed to operate satisfactorily over a wide range of environments. It will find applications in airborne, shipboard, and land-based electronic maintenance and research facilities.

2-4. INSTALLATION REQUIREMENTS.

Adequate air circulation should be provided to prevent damage to the instrument. Care must be taken to allow a minimum of 6 inches of clear space behind the cabinet to permit proper air flow through the counter. Applications using the PRINTER connector on the rear panel may require more than the 6-inch minimum clearance.

2-5. CABLE ASSEMBLIES.

The only cable required for Installation of the equipment is the power cable that is supplied. All cables and connectors supplied for the operation and maintenance of the counter are stored within the front cover of the cabinet as follows:

a. POWER CABLE. -This is a three-conductor cable, one end of which terminates in a plug that mates with the power connector on the rear panel of the instrument. The other end of the power cable terminates in a polarized three-contact male plug. One contact of the plug is an offset pin which grounds the instrument chassis when the plug is used with a grounded three-terminal receptacle. The plug can be modified for use with a two-terminal receptacle according to the following procedure:

(1) Loosen the screw on the offset pin, and remove the green (ground) lead.

(2) Connect the green lead to ground.

(3) Insert plug directly into the receptacle. The offset pin will fold back automatically.

WARNING

If the green lead on the plug is not attached to ground when a two-terminal receptacle is used, the instrument panel and cabinet may assume an off-ground potential and present a hazard to operating personnel.

b. RF CABLES. - Two rf cables, consisting of 8 feet of type RG-58C/U cable terminated at each end with a BNC connector type UG-88E/U are supplied with the instrument. These cables connect any of the counter inputs directly to a 13 NC-terminated signal source.

c. ADAPTERS AND TEE CONNECTORS. - The following adapters and tee connectors are supplied with the instrument:

(1) One plug-in printed circuit board test extender. The extender allows the plug-in printed circuit boards to be raised to a convenient height for trouble shooting and maintenance.

(2) Two BNC male to UHF female type UG-255/U Adapters for making connections to equipment having UHF connectors.

(3) Two BNC female to UHF male type UG-273/U Adapters for making connections to equipment having UHF connectors.

(4) Two type UG-1035/U Adapters with binding posts connected to BNC male connectors for making connection at the counter inputs to test leads terminated in banana connectors.

(5) Two BNC tee connectors type UG-274B/U for making multiple input connections to equipment having BNC connectors.

(6) One plug-in test cable consisting of type RG-58C/U cable terminated with male and female BNC connectors. This cable is to be connected when operating the electronic frequency converter outside of the instrument during maintenance.

(7) One 12-conductor plug-in test cable terminated at one end with a 15-contact male connector and at the other with a 15-contact female connector. This cable is to be connected when operating the rf oscillator or frequency converter outside of the instrument during maintenance.

d. PRINTER CABLE. - The cable required for connection to the PRINTER connector on the rear of the instrument is not supplied. To use the binary-code-decimal and control data available at the PRINTER connector, a suitable mating cable must be constructed, To construct a mating cable, use a type MS3106R-36-8S connector and 22-gauge, nylon-covered hook-up wire appropriately color-coded. Pin connections are as listed in table 2-1.

"e. CONNECTOR COVERS. - Two internally threaded covers, attached to the rear panel with chains, protect the PRINTER AND POWER connectors when not in use. "

TABLE 2-1. CONNECTIONS TO PRINTER

FUNCTION		PRINTER CONNECTOR PIN NO.
DIGIT	WEIGHT	
10^0 (units) (right-end)	1 2 4 8	O J I G
10^1 (tens)	1 2 4 8	u p n k
10^2 (hundreds)	1 2 4 8	Y U T M
10^3 (thousands)	1 2 4 8	F E D A
10^4 (ten thousands)	1 2 4 8	z w t r
10^5 (hundred thousands)	1 2 4 8	h e d Z
10^6 (millions)	1 2 4 8	P L K H
10^7 (ten millions)	1 2 4 8	j a V R
Decimal Point	1 2 4 8	g c b X
Inhibit signal input: connect to ground through external contacts to prevent counter reset during printout.		s
+12 volts at up to 0.1 ampere: can be used to code printout.		f
Print command output: negative pulse of at least 10 volts amplitude from a voltage more positive than 11.5 volts indicates that completed measurement is ready for printout.		v
Ground.		m

2-6. PRINTED CIRCUIT BOARD EXTRACTOR.

An extractor for removing the plug-in printed circuit boards is supplied with the instrument. The tool is stored under the test extender in the instrument cover.

2-7. INSPECTION AND ADJUSTMENT.

Inspect the counter upon receipt for any damage which may have occurred in transit. Check that there are no loose or broken control knobs, bent or broken connectors, scratches or cracks on the readout window, and dents or scratches on the cabinet and panel surfaces. Inspect the air filter to be sure it is not damaged. Apply power to the counter and check for operation of the fan. Operate the counter in the test function as described in table 3-4. All internal adjustments are initially made at the factory; the instrument is ready for use as received.

2-8. INTERFERENCE REDUCTION.

The counter is designed to meet minimum radio interference requirements only when both the rf oscillator and frequency converter are installed.

2-9. FITTING OF COUNTER COVER.

To adjust the tension latches on the counter cover, proceed as follows:

a. Remove all external connections to the counter.

b. Set counter on work bench with the front panel facing up, so that the counter is resting on the four rubber legs on the rear panel.

c. Place cover on counter and fasten with the four latches.

d. With a screwdriver turn the setscrew on each latch an equal amount clockwise to obtain a snug fit.

2-10. INSTALLING THE FRONT-PANEL PROTECTORS.

The front-panel protectors are shipped in a separate package together with the long pan-head mounting screws, and may be installed in the field according to the following procedure:

a. Remove the 16 short pan-head screws from either side of the counter. Do not remove the four flat-head screws.

b. Install the left-hand protector MP1190065 cm the left side of counter with 16 long pan- head screws.

c. Install the other protector MP1190064 on the right side of the counter with the remaining 16 long pan-head screws.

SECTION 3

OPERATION

Operation, Section 3, is included as Volume 2 of this Technical Manual. Volume 2 is identified as "Operators" Manual for Digital Readout Electronic Counter AN/USM-207," NAVSHIPS 0969-028-4020.

SECTION 4

TROUBLE SHOOTING

4-1. LOGICAL TROUBLE SHOOTING.

This section contains information useful in quickly determining and correcting the cause of equipment malfunction or performance degradation. Trouble shooting is based on the following six logical steps:

a. SYMPTOM RECOGNITION. - This is the first step in the trouble-shooting procedure; it requires a complete knowledge and understanding of equipment operating characteristics. Trouble may arise which is not a direct result of a faulty component. To evaluate such troubles requires considerable experience on the part of the technician. The reference standards procedures of Section 5 point out most "not so apparent" malfunctions.

b. SYMPTOM ELABORATION. - Once an equipment trouble has been recognized, trace it as close as possible to its point of origin. Much information can be gained from operating the counter. Note the normal response of the counter to all control settings. Then, when the readout provides an unusual indication, it serves as a symptom for localizing the trouble.

c. LISTING PROBABLE FAULTY FUNCTION. - A complete understanding of the equipment operating principles is especially important at this phase of the trouble-shooting procedure. With all information about the problem in mind, formulate a number of "logical choices" as to the cause and likely location of the malfunction. Confine each choice to a functional section of the equipment as shown in figure 4-1.

d. LOCALIZING THE FAULTY FUNCTION. - In performing this phase of the trouble- shooting procedure, review the choices of possible equipment faults. Conduct tests to determine the area in which the problem lies in an efficient order. Refer to the functional section trouble-shooting descriptions and servicing block diagrams and isolate the problem to a single functional section.

e. LOCALIZING TROUBLE TO THE CIRCUIT. - Once the problem has been isolated to a single functional section, make additional "logical choices" as to which circuit is at fault. Refer to the signal flow and test information contained on the functional and servicing block diagrams in making these "logical choices." Also, refer to the detailed schematic diagrams in Section 5 to obtain information for help in localizing the faulty circuit.

f. FAILURE ANALYSIS. - When the faulty circuit or part has been isolated, review the procedures followed up to this point to determine why the fault affected the equipment in the manner it did. This review is necessary to make certain that the fault discovered is the cause and not the result of the malfunction.

g. TEST POINTS. - Significant test points throughout the equipment are identified on functional and servicing block diagrams and on parts-location illustrations by use of test-point symbols. Star test-point symbols are assigned to those test points which are used to isolate functional sections or circuit groups in trouble shooting. Circle test-point symbols are assigned to those test points which are helpful in isolating faulty circuits. Circle and star symbols are not marked on the equipment. Standoff-terminal test points have TP reference designators marked on the equipment and on the schematic diagram.

4-2. OVERALL FUNCTIONAL DESCRIPTION.

Figure 4-1 is the overall functional block diagram of the counter. The individual functional sections are constructed on one or more plug-in printed circuit boards. Any of these printed circuit boards may be removed from the counter for purposes of adjustment, trouble shooting, and replacement of parts. Basic operation of the counter is shown in figure 4-2. An overall logic diagram is provided in figure 4-3. To make a measurement, requires two types of information: a count signal, and a gate control signal. These two signals may be generated within the instrument or they may be supplied from outside sources. The type of measurement the counter will make depends upon the relationship of these two signals. However, in any function the instrument counts the count signal for a period of time determined by the gate control signal. Routing of these signals within the instrument is accomplished by logic circuits. These logic circuits are controlled by the operator by means of the front panel FUNCTION, time base, and SENSITIVITY switches. The output of each switch is a select voltage which operates one or more logic circuits in the counter. These voltages are referred to as F, T, and S select terms and are defined in table 4-1.

a. FUNCTIONAL SECTIONS. - The following are the functional sections of the counter:

(1) Radio Frequency Oscillator 0-1267/USM-207.
(2) Electronic Frequency Converter CV-1921/USM-207.
(3) A Amplifier.
(4) B Amplifier.
(5) C Amplifier.
(6) 10 Mc and 1 Mc Multipliers.
(7) Scaler.
(8) Gate Control.
(9) Count Control.
(10) Cycle Control.
(11) Count Decades.
(12) Readout.
(13) Power Supply.

b. RADIO FREQUENCY OSCILLATOR 0-1267/USM-207. - The radio frequency oscillator generates a signal of precise frequency for use throughout the counter. It is a separate plug-in assembly containing its own power supply and may be used to provide a precise l-mc standard signal for use outside the instrument.

c. ELECTRONIC FREQUENCY CONVERTER CV-1921/USM-207. - The electronic frequency converter accepts radio frequencies between 100 mc and

500 mc and converts them to radio frequencies between 5 mc and 100 mc for measurement by the basic counter. It is a separate plug-in assembly and must be installed in or connected to the basic counter for operation.

d. A AMPLIFIER. - The A amplifier amplifies the A input signal or the output of the converter for use throughout the counter.

e. B AMPLIFIER. - The B amplifier amplifies and shapes the B input signal for use throughout the counter.

f. C AMPLIFIER. - The C amplifier amplifies and shapes the C input signal for use throughout the counter.

g. 10 MC AND 1 MC MULTIPLIER. - The 10 mc and 1 mc multiplier multiplies the frequency and shapes the signal generated by the radio frequency oscillator. It provides precise timing signals to the various functional sections of the basic counter and to the frequency converter.

h. SCALER. - The scaler consists of a series of decade dividers and gating systems which provide divided standard frequencies and control signals. These signals are used throughout the counter as either count or control signals depending on the type of measurement the instrument is making.

i. GATE CONTROL. - The gate control generates the gate control signal. This signal determines the length of time that the count decades will count the count signal.

j. COUNT CONTROL. - The count control provides the proper count signal to the count decades, as selected by the setting of the front-panel switches.

k. CYCLE CONTROL. - The cycle control produces all signals necessary to display the measurement results on the readout and to recycle the counter.

l. COUNT DECADES. - The count decades count the count signal when permitted to do so by the gate control. The result of their counting becomes the final reading displayed by the readout at the end of each measurement.

m. READOUT. The readout receives binary-coded-decimal data from the count decades, decodes this data into decimal form and drives the readout indicator tubes. The readout also contains memory circuits which function when the counter is operated in the STORE mode.

n. POWER SUPPLY. - The power supply supplies all dc power required by the basic instrument and the converter.

TABLE 4-1. F, T, AND S SELECT TERM SYMBOLS

F SELECT TERMS	
FUNCTION SWITCH POSITION	F SYMBOL
PERIOD B X 1	F1
PERIOD B X 10	F2
PERIOD B X 10^2	F3
PERIOD B X 10^3	F4
PERIOD B X 10^4	F5
PERIOD B X 10^5	F6
TIME B ⇒ C	F7
FREQ	F8
SCALE A	F9
MANUAL STOP	F10
MANUAL START	F11
T SELECT TERMS	
TIME BASE SWITCH POSTION	T SYMBOL
10^{-1}	T1
1	T2
10	T3
10^2	T4
10^3	T5
10^4	T6
10^5	T7
10^6	T8
10^7	T9
10^8 (RATIO A/B x M)	T10
S SELECT TERMS	
SENSITIVITY SWITCH POSITION	S SYMBOL
.1V	S1
1 V	S1
10 V	S1
100 V	S1
PLUG-IN	S1
TEST	S2
FREQ. C	S3

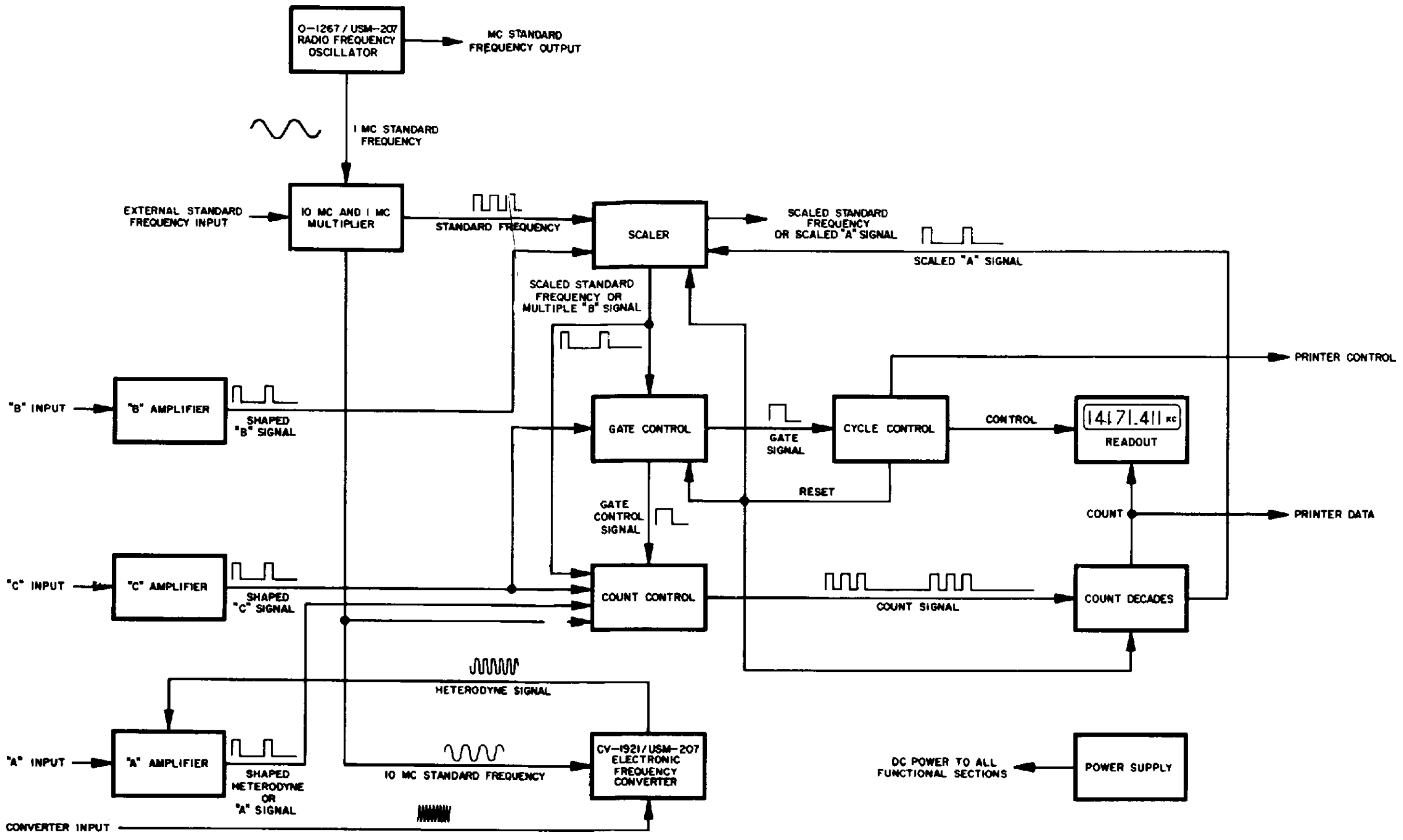


Figure 4-1. Digital Readout Electronic Counter
AN/USM-207 Overall Functional Block Diagram

4-3. OVERALL COUNTER TROUBLE SHOOTING.

Before attempting any trouble-shooting procedure, make an overall preliminary check of the equipment. Look for external defects such as a dirty air filter, broken or loose controls, damaged readout indicators, or damaged input connectors. Remove the top cover per paragraph 5-2; then check for broken or bulging components, loose readout indicators and damaged wiring.

a. TEST EQUIPMENT AND SPECIAL TOOLS. - Test equipment required for trouble shooting is listed in table 4-2. A printed circuit board extractor is supplied with the instrument. Figure 5-1 shows the correct use of this tool.

b. TROUBLE-SHOOTING PROCEDURE. - Procedure for trouble shooting the overall counter is given in table 4-3. This procedure utilizes readout indications in response to particular control settings as a means of localizing trouble to a single or group of functional sections. Where improper presentations are obtained, table 4-3 directs the technician to the probable functional section or sections of the counter which deserve a more detailed check. Further checking can then be performed by referring to the trouble-shooting text and functional and servicing block diagram for the functional section concerned. Test voltages and detailed trouble- shooting tables are provided for each functional section.

c. SERVICING BLOCK DIAGRAM. - A servicing block diagram for the overall counter is shown in figure 4-2. This diagram shows all the signals and select terms supplied to and taken from each functional section, and the development of the select terms by the various control switches.

TABLE 4-2. TEST EQUIPMENT REQUIRED FOR TROUBLE SHOOTING

DESIGNATION	NAME
ME-6A/U	Electronic Multi meter
CCUH-801	Dc Differential Voltmeter
AN/USM-140B	Oscilloscope
Tektronix Model 585 with	Oscilloscope
Type 82	Plug-in
Hewlett Packard Model 608C	Vhf Signal Generator
Hewlett Packard Model 612A	Uhf Signal Generator
TS-382C/U	Audio Oscillator

TABLE 4-3. OVERALL COUNTER TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
1	Connect counter to power source, set POWER switch to TRACK and REF FREQ 100 KC or 1 MC switch to INT.	POWER lamp, OVEN lamp, and all readout indicators, light, and fan operates.	3
		POWER lamp, OVEN lamp, and all readout indicators do not light, and fan does not operate.	2
		If POWER lamp and all readout indicators light, fan operates but OVEN lamp does not light, check radio frequency oscillator functional section.	
		If POWER lamp, OVEN lamp, and all readout indicators light, but fan does not operate. check fan motor.	
		If POWER lamp and OVEN lamp light, fan operates, but no readout indicators light, check power supply functional section.	
		If POWER lamp and OVEN lamp light, fan operates, and some but not all readout indicators light, check readout functional section.	

TABLE 4-3. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
2	Check both fuses behind frequency converter plug-in.	If both fuses are good, check power source and AILFI.	
		If either or both fuses are bad, replace them and check power supply functional section.	
3	Set FUNCTION switch to TIME B ⇒ DC, mode selector switch to COM, and both SLOPE switches to +. Press RESET switch. Turn B TRIGGER VOLTS control clockwise.	GATE lamp lights.	4
		If GATE lamp does not light, check B amplifier and cycle control functional sections.	
4	Rotate time-base switch clockwise from 1 through 10^7, one position at a time. In each position, observe readout indicator which advances from 0 through 9 at a l-cps rate.	All readout indicators advance numerically from 0 through 9.	5
		If none of the readout indicators change display as the time-base switch is rotated, check the radio frequency oscillator, 10-mc and l-me rnultiplier, scaler, count control, and count decade functional sections.	
		If some but not all readout indicators change display in numerical order, check the count decade and readout functional sections.	
		If more than one number lights at a time on any readout indicator, check the readout functional section.	
5	Turn C TRIGGER VOLTS control clockwise.	GATE lamp goes out.	6
		If GATE lamp does not go out, check C amplifier functional section.	
6	Set SENSITIVITY switch to .1 V and the time-base switch to 1. Apply a 100-mv rms sine wave of approximately 1000 cps to the FREQ. A connector.	Frequency of input signal is displayed on the readout.	7
		If frequency of input signal is not displayed on the readout, check A amplifier and count control functional sections.	
7	Set POWER switch to STORE.	Number displayed on readout does not change when GATE lamp is on.	8
		If number displayed on any readout indicator changes when GATE lamp is on, check cycle control and readout functional sections.	
8	Set SENSITIVITY switch to PLUG- IN, and both converter attenuator switches on the frequency converter to the left (. 1 V max) position. Operate the converter in all frequency ranges with 100-mv input signals applied to the INPUT connector.	If readout displays correct indications all major circuits within the counter are operating correctly.	9
		If readout displays incorrect indications, check converter and count functional sections.	

TABLE 4-3. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
Note The remaining steps utilize the self-test function of the counter and may be performed as routine operating procedure at any time			
9	Set FUNCTION switch to FREQ, SENSITIVITY switch to TEST and time-base switch to 10^6.	00000010. MC is displayed on readout and gate lamp cycles on and off.	10
		If 00000010. MC is displayed on readout but gate lamp does not cycle on and off, check cycle control functional section.	
		If wrong number is displayed on the readout but gate lamp cycles on and off, check count control and count decade functional sections.	
10	Set time-base switch to 10^5.	0000010.0 MC is displayed on readout.	11
		If wrong number is displayed on the readout, check count decade functional section.	
11	Set time-base switch to 10^4.	000010.00 MC is displayed on readout.	12
		If wrong number is displayed on readout, check count decade functional section.	
12	Set time-base switch to 10^3	00010000. KC is displayed on readout.	13
		If wrong number is displayed on readout, check count decade functional section.	
13	Set time-base switch to 10^2.	0010000.0 KC is displayed on readout.	14
		If wrong number is displayed on readout, check count decade functional section.	
14	Set time-base switch to 10.	010000.00 KC is displayed on readout.	15
		If wrong number is displayed on readout, check count decade functional section.	
15	Set time-base switch to 10^{-1}.	If 10000000 CPS is displayed on readout, all major circuits within the counter are operating correctly.	
		If wrong number is displayed on readout, check count decade functional section.	

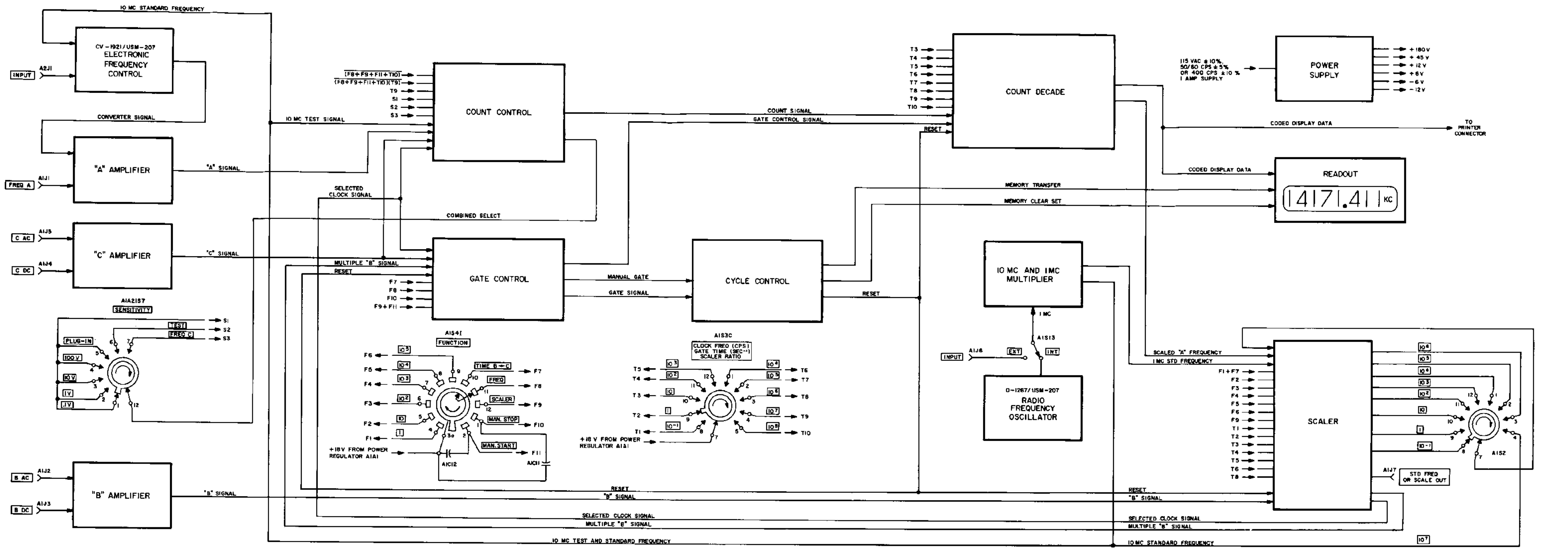


Figure 4-2. Overall Functional and Servicing Block Diagram

NOTES

1. Primary signal paths weighted.
2. ——— — — ——— (heavier weight) indicates functional section boundaries.
3. ——— — — ——— (lighter weight) indicates etched circuit boundaries.
4. When assembly and circuit boundaries coincide, solid lines are used with assembly reference designator shown in lower left-hand corner.
5. Letters and numbers near etched-circuit boundaries designate connector terminals.
6. Select signals S1 through S3, F1 through F11, and T1 through T10 generated by front-panel switches.

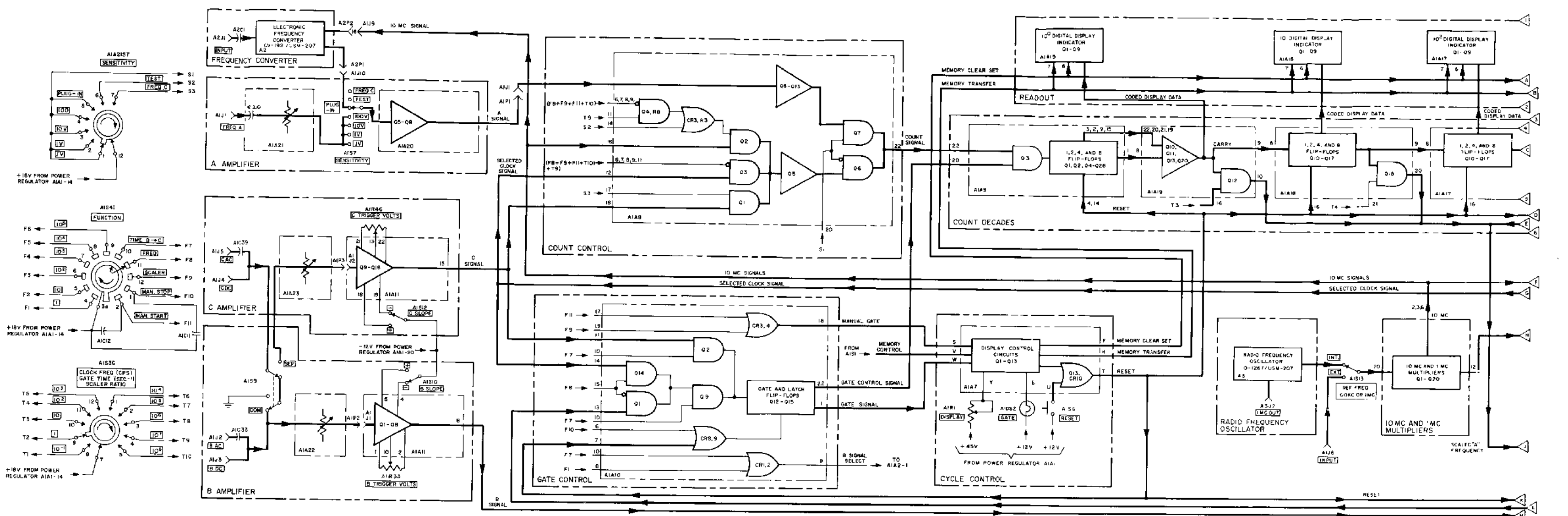
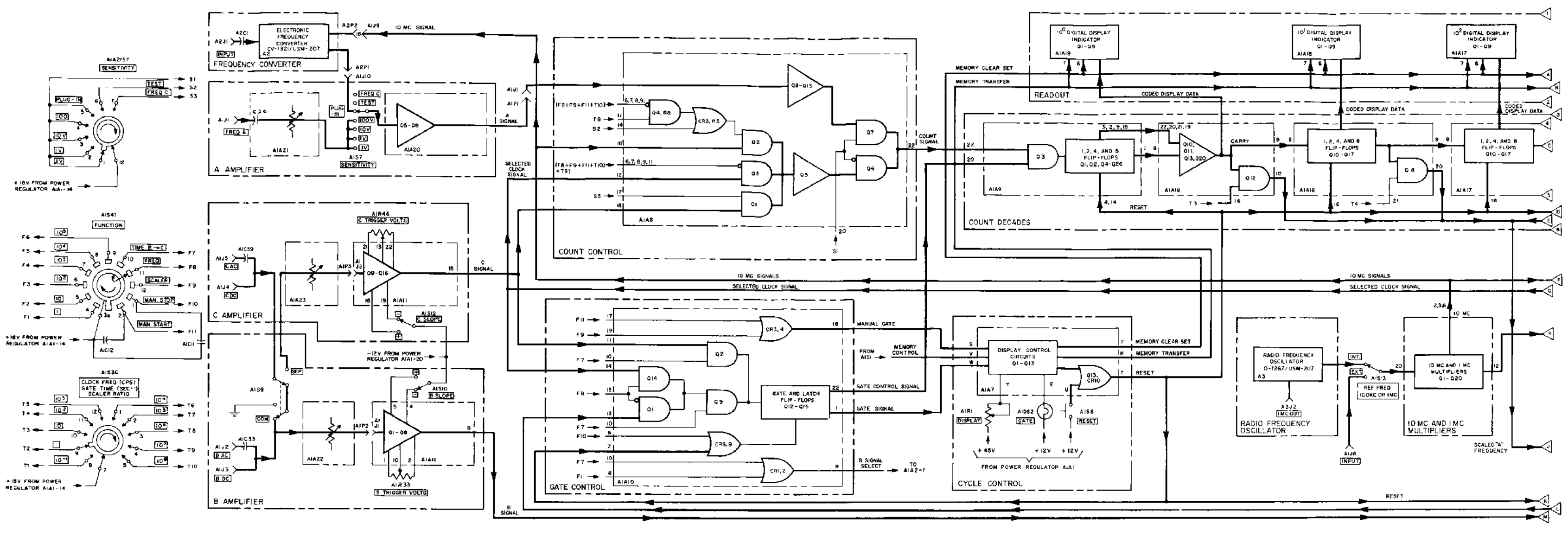


Figure 4-3. Overall Logic Diagram, Sheet 1 of 2



NOTES

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Figure 4-3. Overall Logic Diagram, Sheet 1 of 2

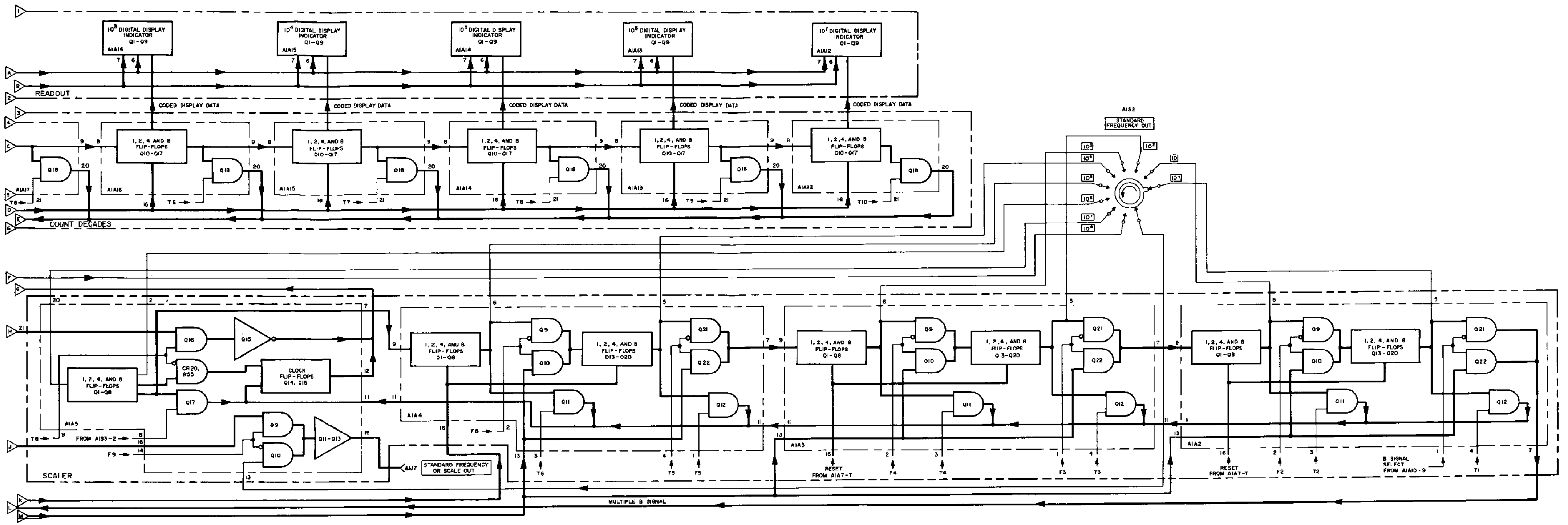


Figure 4-3. Overall Logic Diagram, Sheet 2 of 2

4-4. RADIO FREQUENCY OSCILLATOR O-1267/USM-207.

RADIO FREQUENCY OSCILLATOR 0-1267/ USM-207 FUNCTIONAL DESCRIPTION. - The radio frequency oscillator is a separate assembly consisting of a l-mc oscillator, l-mc amplifiers, and regulated power supply. The amplifier circuits and the major portion of the power supply circuits are mounted on one printed circuit board. The l-mc oscillator, power transformer, series-regulating transistor and one filter capacitor are mounted on the chassis of the unit. Figure 4-4 shows the functional relationship of all circuits in the oscillator and gives test Points and waveforms as an aid in trouble shooting.

The +25 v power supply operates all circuits in the oscillator and is independent of the basic counter chassis. Transformer T1 supplies 30 vac to the bridge rectifier consisting of A3CR1 through A3CR4. The +35-volt output of the bridge rectifier is applied to the input of the regulator consisting of A3Q1, A3Q2, and associated circuits.

The regulator is a series type with A3Q1 acting as a variable resistance in series with the load. Comparison amplifier A3Q2 compares a sample of the regulator output voltage (obtained from the voltage divider consisting of A3R7 and A3R8) against a stable reference voltage (the 11.2-volt drop across A3CR6 and A3CR7). Any dc shift or ac ripple in the output voltage is amplified and applied to the base of the series regulator transistor Q1. This signal has the proper polarity and amplitude to counteract the initial change in the output voltage. The regulated output voltage is supplied to the two l-mc amplifiers A3Q3 and A3Q4 and to l-mc oscillator A3Y1.

The l-mc oscillator is a mechanically enclosed subassembly which includes the following functional circuits: (1) frequency generator; (2) regulator A3Y1Q4, regulator A3Y1CR1 and A3Y1R4, and (3) temperature control. The frequency generator consists of crystal A3Y1Y1, amplifiers A3Y1Q1 through A3Y1Q3, and associated circuits. The crystal resonates at 1 mc and receives its excitation from amplifier A3Y1Q1. Variations in the crystal resonant frequency as a result of aging are compensated for by COARSE and FINE adjustment capacitors A3Y1C3 and A3Y1C2. Regulator A3Y1Q4 provides the necessary operating voltage required by emitter follower A3Y1Q3 and serves as the input source for regulator A3Y1CR1 and A3Y1R4. Regulator A3Y1CR1 and A3Y1R4 provides the necessary operating voltage required by amplifiers A3Y1Q1 and A3Y1Q2, The l-mc signal developed by A3Y1Y1 and A3Y1Q1 is amplified by A3Y1Q2 and applied through A3Y1Q3 to the output circuits of the radio frequency oscillator.

The temperature control maintains a constant temperature inside the crystal oven which houses the crystal and other frequency-generator parts. Thermal resistor A3Y1R15 senses the temperature inside the crystal oven, and causes an output to be which is Proportional to the variation in that temperature. This output IS amplified by amplifiers A3Y1Q5 through A3Y1Q8 and applied as a current variation to the heating element A3Y1R9. In turn, the heating element produces less or more heat, as required, to return the temperature to its regulated value. Reference diodes A3Y1CR4 through A3Y1CR7 supply thermal resistor A3Y1R15 with a constant input voltage. Temperature-setting resistor A3Y1R21 sets the regulated value of the temperature inside the crystal oven.

The output of the 1-mc oscillator is applied to two separate amplifier stages A3Q3 and A3Q4. The load for A3Q3 is the series connection of A3R11 and A3R12. The common Point of these two resistors is connected to ac ground by A3C4. This limits the maximum signal swing at the collector of A3Q3 to approximately 12 volts. The output of Q3 is the l-mc standard frequency used throughout the counter. The load for A3Q4 is a l-mc tuned tank coupled through an adjustable winding on A3T2 to the 1 MC OUT connector A3J2 on the panel of the assembly. The sinusoidal signal at this connector is approximately 1.0 v rms when operating into a 50-ohm load.

b. RADIO FREQUENCY OSCILLATOR 0-1267 USM-207 TROUBLE SHOOTING. - Problems in the radio frequency oscillator fall into three categories: (1) Problems in the +25-volt regulated supply, (2) problems in the l-mc oscillator, and (3) problems in the output circuits. Check the +25-volt regulated supply first, as described in table 4-4; then check the l-mc oscillator.

Note

The l-mc oscillator is a mechanically enclosed subassembly, and cannot be tested in detail while mounted in the radio frequency oscillators. To repair it, requires specialized equipment and materials, not available on board ship. When the fault is isolated to the l-mc oscillator replace it with one which is known to be operating properly, but do not (discard the faulty subassembly. Instead, ship it to a test station which has the proper repair facilities. Refer to paragraph 5-5ac for shipping instructions.

The l-mc oscillator normally produces an output voltage of approximately 1 volt rms after a 20-minute warmup. However, the load circuits will operate properly with an input voltage as low as 0.75 volt rms Consider this before replacing the l-mc oscillator. Finally, check the output circuits using standard signal-tracing techniques. See figure 4-4 for test points and expected waveforms.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-4, 5-24 through 5-32 and 5-55 through 5-58 and 5-6C.

TABLE 4-4. RADIO FREQUENCY OSCILLATOR 0-1267/USM-207 TROUBLE SHOOTING

Note

The radio frequency oscillator is a shore-repairable item. The following procedures are not intended to be performed on board ship.

STEP	ACTION	RESULTS	NEXT STEP
		+25-VOLT REGULATED SUPPLY	
1	Set POWER switch to STBY. Measure dc voltage at test point C after 20-minute warmup.	Voltage is correct (+25 volts ± l0%.	2
		Voltage is near zero.	3
		If voltage IS greater than +27 volts, check A3Q1, A3Q2, A3CR5, A3CR6, and A3CR7.	
2	Measure ac ripple voltage at test point C.	Ripple voltage is 100 mv peak-to-peak or less.	4
		If ripple voltage is greater than 100 mv peak-to-peak, check A3C1 and A3C3.	
3	Check waveform at test point E, and compare with that shown in figure 4-4.	Waveform is correct.	16
		Waveform is incorrect.	4
4	Disassemble the l-mc oscillator according to paragraph z+3. Connect test setup as shown in figure 5-32, and measure dc voltage at test point K.	Voltage IS correct (+20 volts).	5
		If voltage is absent or too low (less than +18 volts), check A3Y1Q4.	
5	Measure dc voltage at test point J.	Voltage is correct (+12 volts ±1 volt).	6
		If voltage is incorrect, check A3Y1CR1.	
		If voltage is absent, check A3Y1R4.	
6	Observe waveform at test point G, and compare with that shown in figure 4-4.	Waveform is correct.	14
		If amplitude is too low (less than 1.4 volts peak-to-peak), check A3Y1R1, A3Y1Q1, and A3Y1Y1.	
		Frequency is incorrect.	7
7	While monitoring the frequency at test point F, turn first A3Y1C3 then A2Y1C2 through its entire adjustment range.	Frequency varies gradually as each adjustment capacitor is turned.	8
		If, when one of the adjustment capacitors is turned, frequency varies abruptly or not at all, check that capacitor.	
8	Remove all external connections from the l-mc oscillator and, while still disassembled, place in an oven preheated to 75°C. Leave it in the oven for a minimum of two hours; then remove it from the oven		

TABLE 4-4. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
		+25-VOLT REGULATED SUPPLY (cont)	
8 (cont)	and reconnect it in the test setup as shown in figure 5-32.		
9	Observe heating element A3Y1R9, and verify that it is energized.	Heating element is energized.	13
		Heating element is not energized.	10
10	Measure dc voltage at test point L.	Voltage is correct (+2.2 volts ±0.1 volt).	11
		If voltage is incorrect, check A3Y1R17.	
11	Measure dc voltage at test point M.	Voltage is correct (0.9 volt ±0.1 volt).	12
		If voltage is incorrect, check A3Y1R15.	
12	Measure dc voltage at test point N.	If voltage is correct (7.5 volts ±0.5 volt), check heating element A3Y1R9.	
		If voltage is incorrect, check A3Y1Q5, A3Y1Q6, A3Y1Q7, and A3Y1Q8.	
13	Calibrate the frequency of the l-mc oscillater according to paragraph 5-4i. Use test setup as described in paragraph 5-4i, but apply +25 volts between terminals E19 and E20 and probe oscillator output at terminal E21. Following calibration, allow two hours for the oscillator to stabilize, then check the frequency again.	If the oscillator cannot be calibrated, check A3Y1Y1.	
		If the oscillator can be calibrated, but, following the two-hour warmup, the frequency is off by more than 1 part in 10^9, perform the temperature adjustment procedure of paragraph 5-5ai.	
14	Check output voltage at test point H.	If output voltage is correct, check A3Y1Q3.	
		If output voltage is incorrect, check A3Y1Q2.	
		OUTPUT CIRCUITS	
15	Observe waveform at test point I and compare with that shown in figure 4-4.	Waveform is correct.	16
		If waveform is incorrect, check A3Q3.	
16	Observe waveform at test point D and compare with that shown in figure 4-4.	Waveform is correct.	17
		If waveform is incorrect, check A3Q4.	
17	Connect 50-ohm load to A3J2. Observe waveform at test point 2 and compare with that shown in figure 4-4.	If waveform is incorrect, perform amplitude alignment procedure described in paragraph 5-4j. Then, if the waveform is still incorrect, check A3T2.	

NOTES

1. Primary signal paths weighted.
2. ——— — — ——— indicates etched circuit boundaries.
3. Dc voltages are preceded by "+" or "-".
4. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5/cm.
   Sweep time: 1 μs/cm.
5. Explanation of symbols placed at waveforms:

   T - Duration of the portion of waveform indicated.
   V - Peak-to-peak voltage.
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
8. Operating control settings:

   POWER switch to STBY.
9. The letters CW, placed adjacent to A3Y1R21, indicate the direction of rotation viewed from the shaft end.

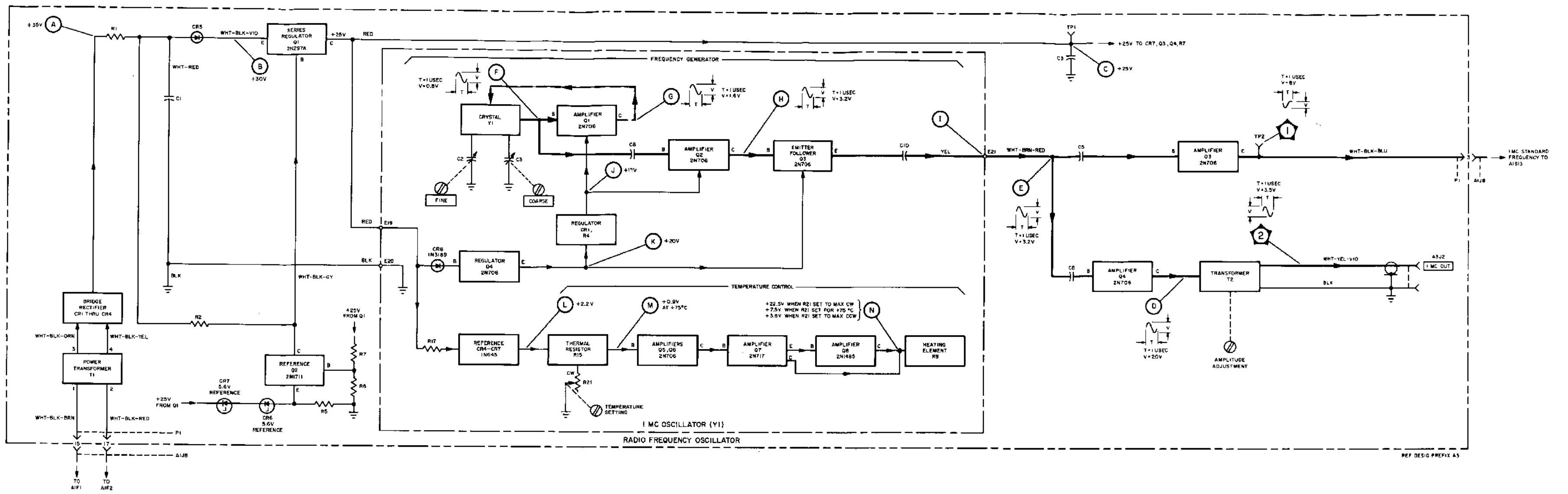


Figure 4-4. Radio Frequency Oscillator O-1267/USM-207, Functional and Servicing Block Diagram

4-5. ELECTRONIC FREQUENCY CONVERTER CV-1921/USM-207.

a. ELECTRONIC FREQUENCY CONVERTER CV-1921/USM-207 FUNCTIONAL DESCRIPTION.- The converter is a separate assembly consisting of all circuits necessary for converting signals in the frequency range of 100 mc to 500 mc to a frequency range within the measurement capabilities of the counter. Figure 4-5 shows the functional relationship of all circuits in the converter and gives test points and waveforms as an aid in trouble shooting.

The converter operates on the heterodyne principle of mixing the unknown frequency with a known frequency to produce a beat frequency which can be measured by the counter. The result of the beat frequency measurement and the frequency of the known mixed signal can then be used to determine the frequency of the original signal.

Nine mixing frequencies (100, 150, 200, 250, 300, 350, 400, 450, and 500 megacycles) are used in the converter, all derived from the 10-mc standard frequency produced by the frequency multiplier A1A6. The 10-mc standard frequency is applied to the 50-mc multiplier A2A1; this assembly supplies a 50-mc signal to the harmonic generator. The harmonic generator produces the nine mixing frequencies. It consists of diode A2CR3 inside a cavity resonator. This diode produces harmonics which excite the cavity at each of the mixing frequencies. The resonant frequency of the cavity may be varied by means of switch A2S4 to produce any of the mixing frequencies at its output.

The remaining circuits of the converter consist of the attenuator, the mixer, and the video amplifier. The arrangement of these circuits is shown in figure 4-5.

When the input signal to the converter is between 35 mc and 100 mc, proper operation will occur when the DIRECT-HETERODYNE switch is in the DIRECT position. In this position the input signal is applied through the attenuator network R16, R17, C35 directly to the video amplifier. This action results in the input signal merely being amplified before it is applied to the counter.

Input frequencies between 100 mc and 500 mc are measured with the DIRECT-HETERODYNE switch set to HETERODYNE. The input signal is applied to the balanced mixer and combined with a mixing frequency to produce a difference frequency between 5 mc and 60 mc. The difference frequency is passed through the low pass filter, amplified in the video amplifier, and applied to the counter. The mixing frequency selected can be either above or below the incoming frequency, as long as it produces a difference frequency in the range of 5 mc and 60 mc. However, in most cases, each measurement is performed twice: First, the mixing frequency selector switch is set to the lower frequency and the resultant readout of the counter is added to the mixing frequency. Next, the mixing frequency selector switch is set to the higher frequency, and the resultant readout of the counter is subtracted from the mixing frequency. The latter serves as a verification for the first measurement. The 500 position of the mixing frequency selector switch is used primarily for this purpose.

The amplified difference frequency of the video amplifier is, in addition, amplified in the meter amplifier and monitored by LEVEL METER A2M1. The LEVEL METER deflects in proportion to the input amplitude, and indicates whether or not this amplitude is sufficient to drive the counter.

b. FREQUENCY CONVERTER CV-1921/USM-207 TROUBLE SHOOTING.-

Note

To trouble shoot the converter requires special test equipment not available on board ship.

The converter operates at relatively high frequencies. As such, it is not suited for a point-by-point trouble-shooting procedure. Instead, the operation of the converter is tested in each position of the mixing frequency selector switch, and the fault isolated to one or more groups of circuits. In general, if the operation is improper in every position of the mixing frequency selector switch, the fault is probably located either in the input attenuator or the video amplifier. If improper operation occurs in only one or two switch positions, the fault can probably be found in a cavity component associated with that switch position. Finally, check the circuits in detail. Check transistors and diodes first, followed by capacitors and inductors.

A point-by-point trouble- shooting procedure is possible for the 50-mc frequency multiplier and video amplifier circuits. These procedures are shown in table 4-5, and are performed once the problem is isolated to either of these circuit groups.

Problems in the 50-mc frequency multiplier can be caused by improper tuning. Before starting the trouble- shooting procedure, check that each stage of the converter is properly tuned. The procedure for tuning each stage is given in paragraph 5-4k.

c. USEFUL ILLUSTRATIONS. — Illustrations useful in maintaining this functional section are: figures 4-5, 5-4, 5-5, 5-6, 5-7, 5-8, 5-9, 5-51, 5-52, 5-53, 5-54, 5-61, and 5-62.

TABLE 4-5. 50 MC FREQUENCY MULTIPLIER AND VIDEO AMPLIFIER TROUBLE SHOOTING

Note

The following procedure is not intended to be performed on board ship.

STEP	ACTION	RESULTS	NEXT STEP
50 MC MULTIPLIER (A2A1)			
1	Observe waveform at test point 2 on A2A1 and compare with that shown in figure 4-5.	Waveform is correct.	2
		If waveform is incorrect, check A2A1Q1, A2A1Q2, A2A1CR1, A2A1CR2, A2A1T1, and A2A1T2. Readjust A2A1T1 and A2A1T2.	
2	Observe waveform at test point B on A2A1 and compare with that shown in figure 4-5.	Waveform is correct.	3
		If waveform is incorrect, check A2A1Q3, A2A1Q4, A2A1Q5, A2A1T3, A2A1T4, and A2A1T5. Readjust A2A1T3, A2A1T4, A2A1T5, and A2R4.	
VIDEO AMPLIFIER			
3	Place mixer frequency selector switch in the 0 position, attenuator switches to the left, and DIRECT-HETERODYNE switch to DIRECT. Apply a 10-mv rms 100-mc sine wave to the INPUT connector. Observe the waveform at test point 1 and compare with that shown in figure 4-5.	Waveform is correct.	4
		If waveform is incorrect, check A2Q3, A2Q4, A2Q5, and A2Q6.	
4	Observe action of level meter A2M1.	If meter reads in green area, check counter operation.	
		If meter does not read in green area, check A2Q7, A2CR7, A2CR8, A2M1, A2R41, A2R42, and A2R43.	

NOTES

1. Primary signal paths weighted.
2. ——— — — — ——— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "−".
5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5 v/cm, 0.1 v/cm
   Sweep time: 1 μs/cm
   Sweep magnifier: X10.
6. Explanation of symbols placed at waveforms:

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. The letters CW, placed adjacent to the appropriate terminals of A2R46 indicate the direction of rotation viewed from the shaft end.
9. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.

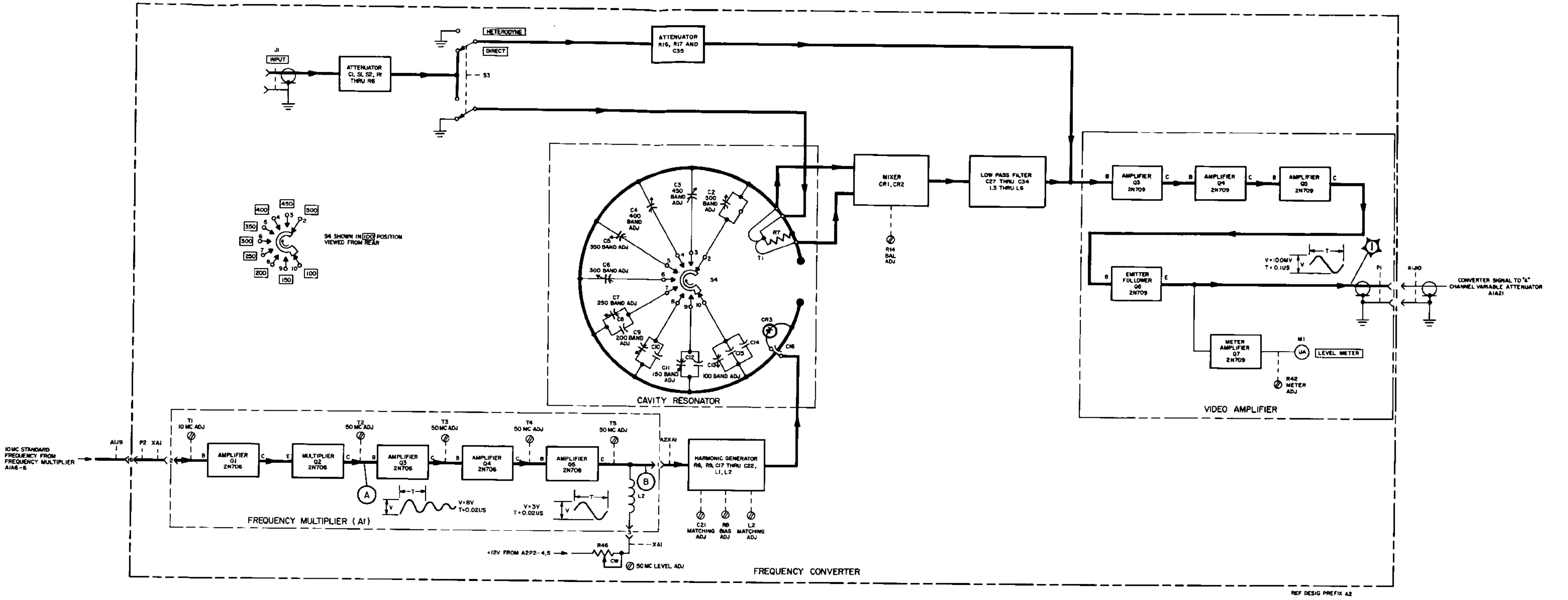


Figure 4-5. Electronic Frequency Converter CV-1921/USM-207, Functional and Servicing Block Diagram

4-6. A AMPLIFIER.

a. A AMPLIFIER FUNCTIONAL DESCRIPTION. -The A amplifier consists of A attenuator A1A21 and af-rf amplifier A1A20. The A attenuator is mounted on the front panel SENSITIVITY switch; the af-rf amplifier is constructed on printed circuit board A1A20. This functional section receives the A input signal from the FREQ. A receptacle and the output signal from the frequency converter, attenuates and/or amplifies these signals, and supplies one, as selected, to count control functional section. The A amplifier functional and servicing block diagram is shown in figure 4-6. The A input signal is capacity-coupled to the A attenuator, and the output of the A attenuator is applied to the af-rf amplifier. Signals appearing at the input of the af-rf amplifier are coupled to the gate terminal of the field-effect transistor A1A20Q6. This transistor operates as a source-follower and presents a high input impedance to low frequency signals. This stage is bypassed by A1A20C18 at higher frequencies. Current to A1A20Q6 is supplied by the constant-current generator A1A20Q5.

The output of the source follower is capacity-coupled to two-stage amplifier A1A20Q7 and A1A20Q8. The output of A1A20Q8 becomes the A signal that is supplied to the count control functional section.

b. A AMPLIFIER TROUBLE SHOOTING.- Problems in the A amplifier fall into two categories: (1) problems in the attenuator assembly, and (2) problems in the amplifier stages.

Problems in the attenuator assembly usually result from opened or shorted parts due to application of excessive voltages to the FREQ. A receptacle. The coupling capacitor at this input is a 600-volt unit, and may be damaged if voltages greater than this are applied. If the amplifier does not produce an output in certain positions of the SENSITIVITY switch check the parts involved in that switch position. To trouble shoot problems in the amplifier stages, first remove left section of the front panel from the front casting, The procedure for removing the panel is given in Section 5. The trouble shooting procedure given in table 4-6 follows a signal through the amplifier on a stage-by- stage basis. When a stage is found where the signal is absent, check the parts associated with that stage.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-6, 4-7, 5-8, 5-9, 5-10, 5-50, and 5-63.

TABLE 4-6. A AMPLIFIER TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
1	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. SENSITIVITY switch to 10 V. Apply a 10-volt rms, 1000-cps sine wave to the FREQ. A connector. Observe the waveform at test point A and compare with that shown in figure 4-6.	Waveform is correct.	2
		If waveform is incorrect or absent, check A1A20Q6, A1A21R6, and A1A21R7.	
2	Change SENSITIVITY switch to 1 V and amplitude of input signal to 1 volt rms. Observe the waveform at test point A and compare with that shown in figure 4-6.	Waveform is correct.	3
		If waveform is incorrect or absent, check A1A21R4 and A1A21R5.	
3	Change SENSITIVITY switch to .1 V and amplitude of input signal to 0.1 volt rms. Observe the waveform at test point A and compare with that shown in figure 4-6.	Waveform is correct.	4
		If waveform is incorrect or absent, check A1A21R2 and A1A21R3.	
4	Observe the waveform at test point B and compare with that shown in figure 4-6.	Waveform is correct.	5
		If waveform is incorrect, check A1A20Q7.	
5	Observe the waveform at test point 1 and compare with that shown in figure 4-6.	If waveform is correct, check count control.	
		If waveform is incorrect, check A1A20Q8.	

NOTES

1. Primary signal paths weighted.
2. ———— — — ———— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "−".
5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 1 v/cm.
   Sweep time: 1 ms/cm.
6. Explanation of symbols placed at waveforms:

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
9. Operating control settings:

   POWER switch to TRACK.
   SENSITIVITY switch to 10 V with 10 v rms applied to FREQ. A connector.
   SENSITIVITY switch to 1 V with 1 v rms applied to FREQ. A connector.
   SENSITIVITY switch to .1 V with 0.1 v rms applied to FREQ. A connector.

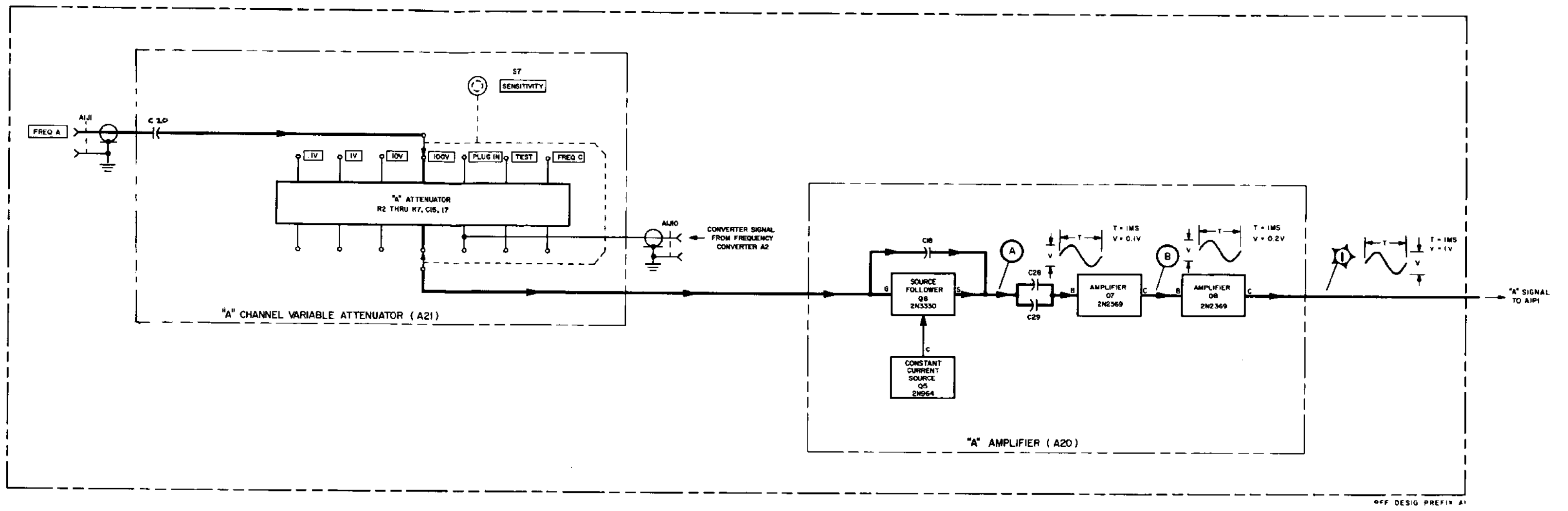


Figure 4-6. "A" Amplifier, Functional and Servicing Block Diagram

4-7. B AMPLIFIER.

a. B AMPLIFIER FUNCTIONAL DESCRIPTION. - The B amplifier consists of the channel B variable attenuator and trigger level control A1A22 and part of af-rf amplifier AlA11, The channel B variable attenuator is mounted on the front-panel B MULTIPLIER switch; the af-rf amplifier is constructed on one-half of printed circuit board assembly AlA11. This functional section receives the input B signal from the B AC and B DC input connectors, attenuates, amplifies, and shapes this signal for use throughout the counter. The B amplifier functional and servicing block diagram is shown in figure 4-8.

The B DC input is direct-coupled through the attenuator to the B coaxial connector J1 on AlAll. The B AC input is capacity-coupled by A1C33 to the same point. The mode selector switch A1S9 permits the input of the B attenuator to be connected to the input of the C attenuator when certain measurements requiring common B and C signals are made. Signals appearing at the B coaxial connector on AlAl1 are coupled to the gate terminal of the field-effect-transistor A1A1lQ1. This stage (AMPL1) presents a high input impedance to low-frequency input signals. The output of this stage is coupled to differential amplifier DA2, consisting of A1A11Q2 and A1A11Q3. The output of A1A11Q2 is applied to dc amplifier AMPL3 consisting of A1A11Q4. A portion of the output of this stage is fed back through A1A11R13 to A1A11Q3. This feedback stabilizes the differential amplifier over changes in temperature and transistor characteristics. The output of A1A11Q4 is also applied to A1A11Q5. This transistor is part of Schmitt-trigger stage ST4 which provides a pulse output to the remainder of the amplifier.

The differential amplifier, dc amplifier, and Schmitt trigger make up the trigger circuits for the B input. The input signal to the Schmitt trigger can be made to vary about a dc level by the dc bias-voltage variations on the base of A1A11Q3. This variable bias voltage is supplied by the B TRIGGER VOLTS control A1R33. Since the trigger points of the Schmitt trigger are fixed, the points on the input signal which cause the Schmitt trigger to change state can be varied by adjusting the B TRIGGER VOLTS control. The range of this control is sufficient to vary the trigger points of the Schmitt trigger over the complete waveform of any signal within the dynamic range of the amplifier.

The output of the Schmitt trigger is applied to AND gate AG7 and to inverter INV5 consisting of A1A11Q7. The output of the inverter is applied to another AND gate, AG6. Both AND gates are controlled by the B SLOPE switch A1S10. When this switch is set to +, the output of the Schmitt trigger is capacity-coupled through AG7 to the output inverter INV8 consisting of AlAl1Q8. When the B SLOPE switch is set to -, the output of INV5 is capacity-coupled through AG6 to INV8. The two AND gates and the B SLOPE switch have the effect of selecting either the positive or negative slope of the input waveform for ultimately triggering the output inverter. Figure 4-7 shows the relationships of a typical sine-wave input signal to the amplifier output for all variations of trigger level polarity and slope selection.

b. B AMPLIFIER TROUBLE SHOOTING. — Problems in the B amplifier fall into three categories: (1) problems in the attenuator assembly, (2) problems in the trigger voltage adjustment stages and, (3) problems in the slope selection stages. Table 4-7 is a trouble-shooting chart for the B amplifier. Some of the problems mentioned can be caused by improper adjustment of the amplifier. Before starting the trouble- shooting procedure, check that the amplifier is properly adjusted. The procedure for adjusting the amplifier is given in paragraph 5-4h.

Problems in the attenuator assembly usually result from opened or shorted parts due to application of excessive voltages to the B AC or B DC inputs. The coupling capacitor at the B AC input is a 600-volt unit and may be damaged if voltages greater than this are applied. If the amplifier does not produce an output in certain positions of the B MULTIPLIER switch, check the parts involved in that switch position.

Problems in the trigger voltage adjustment stages will be in either the field-effect transistor stage AMPL1, differential amplifier DA2, dc amplifier stage AMPL3, or Schmitt trigger ST4. In trouble shooting for problems in these stages it is most efficient to follow the signal through the amplifier until the faulty stage is located. When it is located, check the individual parts in detail.

Problems in the slope selection stages will be in either inverter stages INV5 and INV8, or in AND gates AG6 and AG7. If a part in the amplifier is replaced, readjust the assembly according to the procedure of paragraph 5-4h.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-7, 4-8, 5-8, 5-9, 5-11, 5-46, and 5-64.

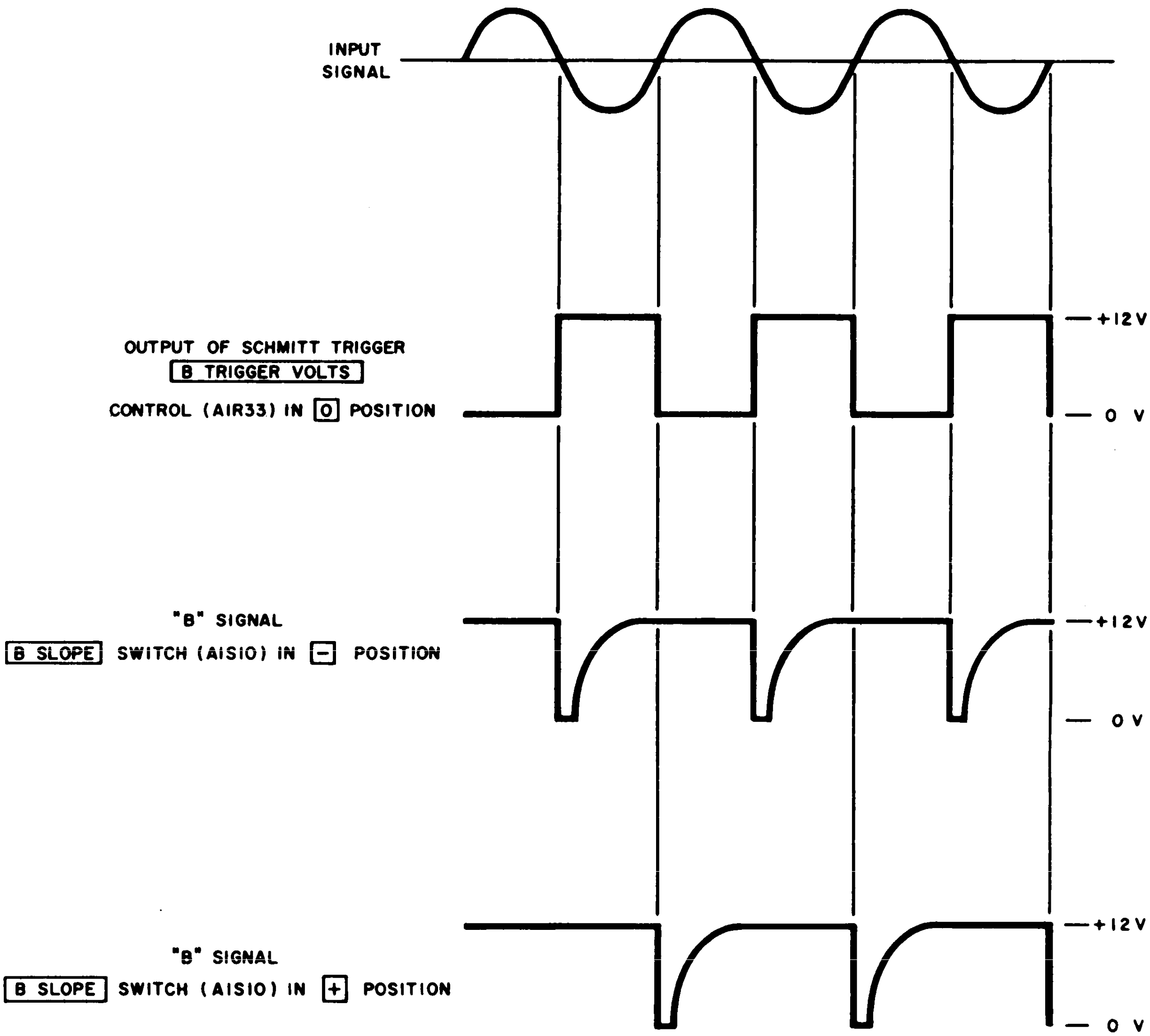


Figure 4-7. "B" Amplifier, Trigger Point Waveforms

TABLE 4-7. B AMPLIFIER TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
1	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. Mode selector switch to SEP. B MULTIPLIER switch to 10. B TRIGGER VOLTS control to 0.	Waveform is correct.	2
		If waveform is incorrect or absent, check A1A1lQ1, A1A22R27, A1A22R28, A1A22C36, and A1C33.	

TABLE 4- (Continued)

STEP	ACTION	RESULTS	NEXT STEP
1 (cont)	Apply a 10-volt rms, 1000-cps sine-wave signal to the B AC connector. Observe the waveform at test point A and compare with that shown in figure 4-8.		
2	Change B MULTIPLIER switch to 3 and amplitude of input signal to 3 volts rms. Observe the waveform at test point A and compare with that shown in figure 4-8.	Waveform is correct.	3
		If waveform is incorrect or absent, check A1A22R25 and A1A22R26.	
3	Change B MULTIPLIER switch to 1 and amplitude of input signal to 1 volt rms. Observe the waveform at test point A and compare with that shown in figure 4-8.	Waveform is correct.	4
		If waveform is incorrect or absent, check A1A22R23, A1A22R24, and A1A22C35.	
4	Change B MULTIPLIER switch to .3 and amplitude of input signal to 0.3 volt rms. Observe the waveform at test point A and compare with that shown in figure 4-8.	Waveform is correct.	5
		If waveform is incorrect or absent, check A1A22R21, A1A22R22, and A1A22C34.	
5	Change B MULTIPLIER switch to .1 and amplitude of input signal to 0.1 volt rms. Observe the waveform at test point A and compare with that shown in figure 4-8.	Waveform is correct.	6
		If waveform is incorrect or absent, check A1A22R50 and A1A22C46.	
6	Rotate B TRIGGER VOLTS control throughout its range, observe the wave-form at test point B and compare with that shown in figure 4-8.	Waveform remains correct as B TRIGGER VOLTS control is rotated.	7
		If waveform is incorrect or disappears when B TRIGGER VOLTS control is rotated, check adjustment of amplifiers A1A11Q2, A1A11Q3, A1A11Q4, A1A1lCR1, A1A11CR2, and A1A11CR3.	
7	Set B TRIGGER VOLTS control to 0, observe the waveform at test point C and compare with that shown in figure 4-8.	Waveform is correct.	8
		If waveform is incorrect check, A1A11Q5, A1A11Q6, and A1A11CR4.	
8	Set B SLOPE switch to +, observe the waveform at test point D and compare with that shown in figure 4-8.	Waveform is correct.	9
		If waveform is incorrect check, A1A11Q7, A1A11CR5, A1A11CR6, and A1A11CR7.	
9	Change B SLOPE switch from + to -, observe the waveform at test point 1 and compare with that shown in figure 4-8.	If waveform remains correct when B SLOPE switch is in either position, check loading of B amplifier.	
		If waveform is incorrect, check A1A1108, A1A11CR8, A1A11CR9, and A1A11CR10.	

NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ——— — — ——— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "−".
5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 2 v/cm.
   Sweep time: 1 ms/cm.

6. Explanation of symbols placed at waveforms:

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.

7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. The letters CCW, placed adjacent to the appropriate terminals of A1A22R33, indicate the direction of rotation viewed from the end shaft.
9. Abbreviations within logic or circuit blocks are as follows:

AG	AND Gate
AMPL	Amplifier
DA	Differential Amplifier
INV	Inverter
ST	Schmitt Trigger

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.

10. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
11. Operating control settings:

    POWER switch to TRACK.
    Mode selector switch to SEP.
    B MULTIPLIER switch to 10 with 10 v rms applied to B AC connector.
    B MULTIPLIER switch to 3 with 3 v rms applied to B AC connector.
    B MULTIPLIER switch to 1 with 1 v rms applied to B AC connector.
    B MULTIPLIER switch to .3 with 0.3 v rms applied to B AC connector.
    B MULTIPLIER switch to .1 with 0.1 v rms applied to B AC connector.
    B TRIGGER VOLTS control to 0.
    B SLOPE switch to + to produce waveform at D.

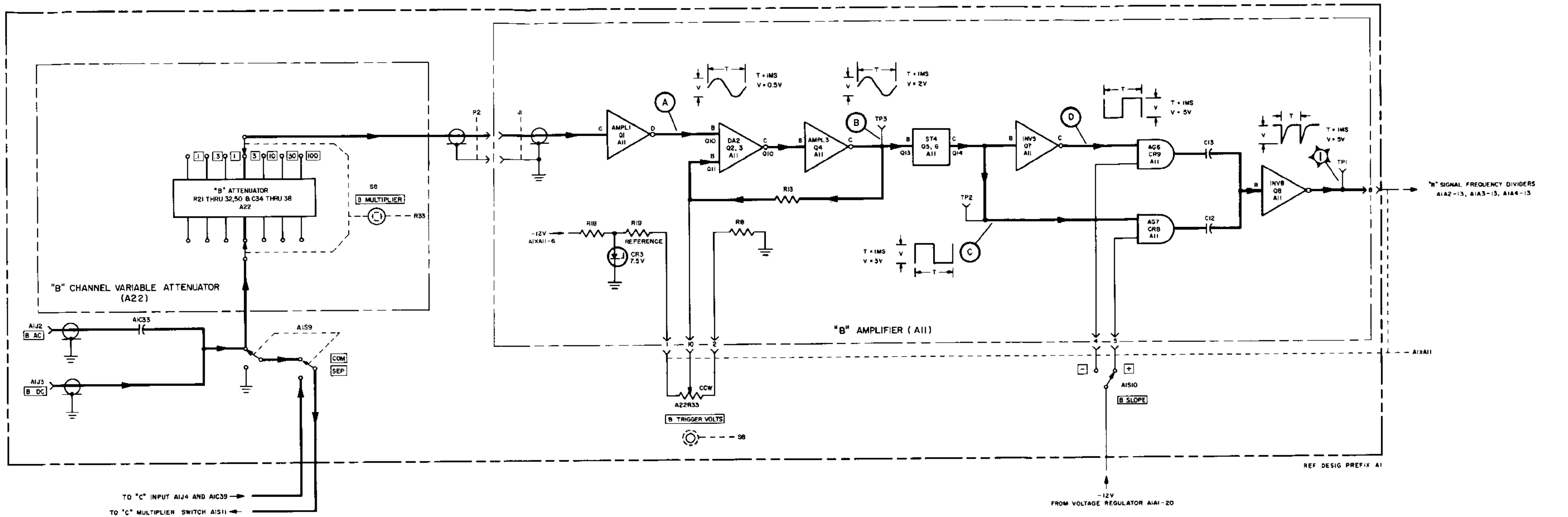


Figure 4-8. "B" Amplifier, Functional and Servicing Block Diagram

4-8. C AMPLIFIER.

a. C AMPLIFIER FUNCTIONAL DESCRIPTION. -The C amplifier consists of the channel C variable attenuator and trigger level control A1A23, and part of af-rf amplifier AlAll. The channel C variable attenuator is mounted on the front-panel C MULTIPLIER switch; the af-rf amplifier is constructed on one-half of printed circuit board assembly Al All. This functional section receives the C input signal from the C AC and C DC input connectors, attenuates, amplifies, and shapes this signal for use throughout the counter. The C amplifier functional and servicing block diagram is shown in figure 4-9.

The C DC input is direct-coupled through the attenuator to the C coaxial connector J2 on AlAll. The C AC input is capacity-coupled by A1C39 to the same point. Signals appearing at the C coaxial connector on Al All are coupled to the gate terminal of field-effect-transistor A1A11Q9. This stage (AMPL9) presents a high input impedance to low frequency input signals. The output of this stage is coupled to differential amplifier DA10 consisting of A1A11Q10 and A1A1lQ1l. The output of A1A11Q10 is applied to dc amplifier AMPL1l consisting of A1A11Q12. A portion of the output of this stage is fed back through A1A11R50 to A1A1lQ1l. This feedback stabilizes the differential amplifier over changes in temperature and transistor characteristics. The output of A1A11Q12 is also applied to A1A11Q13. This transistor is part of Schmitt-trigger stage ST12 which provides a pulse output to the remainder of the amplifier.

The differential amplifier, dc amplifier, and Schmitt trigger make up the trigger circuits for the C input. The input signal to the Schmitt trigger can be made to vary about a dc level by the dc bias voltage variations on the base of A1A1lQ1l. This variable bias voltage is supplied by the C TRIGGER VOLTS control A1R46. Since the trigger points of the Schmitt trigger are fixed, the points on the input signal which cause the Schmitt trigger to change states can be varied by adjusting the C TRIGGER VOLTS control. The range of this control is sufficient to vary the trigger points of the Schmitt trigger over the complete waveform of any signal within the dynamic range of the amplifier.

The output of the Schmitt trigger is applied to AND gate AG15 and to inverter INV13 consisting of A1A11Q15. The output of the inverter is applied to another AND gate, AG14. Both AND gates are controlled by the C SLOPE switch A1S12. When this switch is set to +, the output of the Schmitt trigger is capacity-coupled through AG15 to the output inverter INV8 consisting of A1A11Q16. When the B SLOPE switch is set to -, the output of INV13 is capacity-coupled through AG14 to INV8. The two AND gates and the C SLOPE switch have the effect of selecting either the positive or negative slope of the input waveform for ultimately triggering the output inverter. The relationships of a typical sine-wave input signal to the amplifier output signal for all variations of trigger level polarity and slope selection are identcal to those shown for the B amplifier in figure 4-7.

b. C AMPLIFIER TROUBLE SHOOTING. - Problems in the C amplifier fall into three categories: (1) problems in the attenuator assembly, (2) problems in the trigger voltage adjustment stages, and (3) problems in the slope selection stages. Table 4-8 is a trouble-shouting chart for the C amplifier. Some of the problems mentioned can be caused by improper adjustment of the amplifier. Before starting the trouble-shooting procedure check that the amplifier is properly adjusted. The procedure for adjusting the amplifier is given in paragraph 5-4h.

Problems in the attenuator assembly usually result from opened or shorted parts due to application of excessive voltages to the C AC or C DC inputs. The coupling capacitor at the C AC input is a 600-volt unit, and may be damaged if voltages greater than this are applied. If the amplifier does not produce an output in certain positions of the C MULTIPLIER switch, check the parts involved in that switch position.

Problems in the trigger voltage adjustment stages will be either the field-effect transistor stage AMPL9, differential amplifier DA10, dc amplifier stage AMPL11, or Schmitt trigger ST12. In trouble shooting for problems in these stages it is most efficient to follow the signal through the amplifier until the faulty stage is located. When it is located, check the individual parts in detail.

Problems in the slope selectlon stages will be either in inverter stages INV13 and INV16, or in AND gates AG14 and AG15. If a part in the amplifier is replaced, readjust the assembly according to the procedure of paragraph 5-4h.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-9, 5-8, 5-9, 5-12, 5-46, and 5-65.

TABLE 4-8. C AMPLIFIER TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
1	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. Mode selector switch to SEP. C MULTIPLIER switch to 10. C TRIGGER VOLTS control to 0.	Waveform is correct.	2
		If waveform is incorrect or absent, check A1A11Q9, A1A23R40, A1A23R41, A1A3C39, and A1A23C42.	

TABLE 4-8. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
1 (cont)	Apply a 10 volt rms, 1000-cps sine-wave signal to the C AC connector. Observe the waveform at test point E and compare with that shown in figure 4-9.		
2	Change C MULTIPLIER switch to 3 and amplitude of input signal to 3 volts rms. Observe the waveform at test point E and compare with that shown in figure 4-9.	Waveform is correct.	3
		If waveform is incorrect or absent, check A1A23R38, and A1A23R39.	
3	Change C MULTIPLIER switch to 1 and amplitude of input signal to 1 volt rms. Observe the waveform at test point E and compare with that shown in figure 4-9.	Waveform is correct.	4
		If waveform is incorrect or absent, check A1A23R36, A1A23R37, and A1A23C41.	
4	Change C MULTIPLIER switch to .3 and amplitude of input signal to 0.3 volt rms. Observe the waveform at test point E and compare with that shown in figure 4-9.	Waveform is correct.	5
		If waveform is incorrect or absent, check A1A23R34, A1A23R35, and A1A23C40.	
5	Change C MULTIPLIER switch to .1 and amplitude of input signal to 0.1 volt rms. Observe the waveform at test point E and compare with that shown in figure 4-9.	Waveform is correct.	6
		If waveform is incorrect or absent, check A1A23R51 and A1A23C47.	
6	Rotate C TRIGGER VOLTS control throughout its range, observe the waveform at test point F and compare with that shown in figure 4-9.	Waveform remains correct as C TRIGGER VOLTS control is rotated.	7
		If waveform is incorrect or disappears when C TRIGGER VOLTS control is rotated, check adjustment of amplifiers A1A11Q10, A1A1lQ1l, A1A11Q12, A1A1lCR1l, A1A11CR12, and A1A11CR13.	
7	Set C TRIGGER VOLTS control to 0, observe the waveform at test point G and compare with that shown in figure 4-9.	Waveform is correct.	8
		If waveform is incorrect, check A1A11Q13, A1A11Q14, and A1A11CR14.	
8	Set C SLOPE switch to +, observe the waveform at test point H and compare with that shown in figure 4-9.	Waveform is correct.	9
		If waveform is incorrect, check A1A11Q15, A1A11CR15, A1A11CR16, and A1A11CR17.	
9	Change C SLOPE switch from + to -, observe the waveform at test point 2 and compare with that shown in figure 4-9.	If waveform remains correct when C SLOPE switch is in either position, check loading of C amplifier.	
		If waveform is incorrect, check A1A11Q16, A1A11CR18, A1A11CR19, and A1A11CR20.	

NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ——— — — ——— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "-".
5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 2 v/cm.
   Sweep time: 1 ms/cm.
6. Explanation of symbols placed at waveforms:

   T - Duration of the portion of waveform indicated.
   V - Peak-to-peak voltage.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. The letters CCW, placed adjacent to the appropriate terminals of A1A23R46 potentiometer, indicate the direction of rotation viewed from the shaft end.
9. Abbreviations within logic or circuit blocks are as follows:

   AG — AND Gate
   AMPL — Amplifier
   DA — Differential Amplifier
   INV — Inverter
   ST — Schmitt Trigger

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.
10. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
11. Operating control settings:

    POWER switch to TRACK.
    Mode selector switch to SEP.
    C MULTIPLIER switch to 10 with 10 v rms applied to C AC connector.
    C MULTIPLIER switch to 3 with 3 v rms applied to C AC connector.
    C MULTIPLIER switch to 1 with 1 v rms applied to C AC connector.
    C MULTIPLIER switch to .3 with 0.3 v rms applied to C AC connector.
    C MULTIPLIER switch set to .1 with 0.1 v rms applied to C AC connector.
    C TRIGGER VOLTS control to 0.
    C SLOPE switch to + to produce waveform at H.

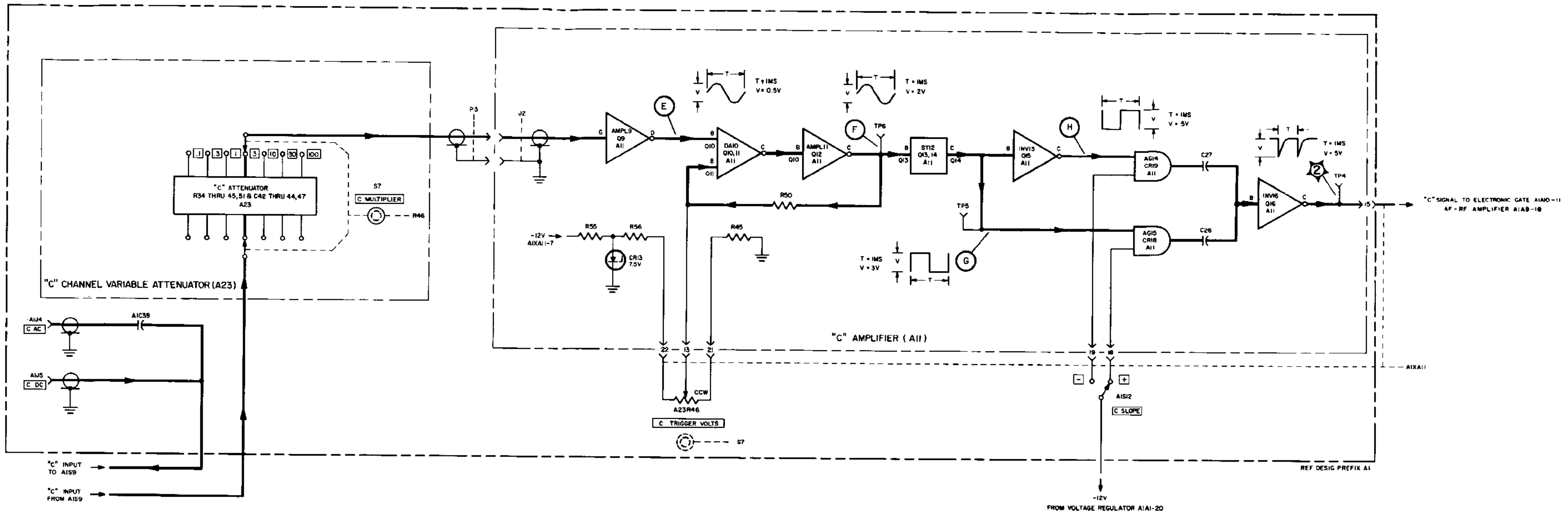


Figure 4-9. "C" Amplifier, Functional and Servicing Block Diagram

4-9. 10 MC AND 1 MC MULTIPLIER.

a. 10 MC AND 1 MC MULTIPLIER FUNCTIONAL DESCRIPTION.- The 10 mc and 1 mc multiplier receives the 1-mc standard frequency produced by the radio frequency oscillator or an external 100-kc or 1-mc standard frequency. The multiplier amplifies, multiplies, and shapes these signals to produce the l-me and 10-mc standard frequencies used throughout the counter. It is a separate assembly constructed entirely on printed circuit board A1A6. Figure 4-10 shows the functional relationship of all circuits in the multiplier and gives test points and waveforms as an aid in trouble shooting.

The input stage of the multiplier accepts either a 100-kc or l-mc input signal. Resistor network A1A6R1 through A1A6R4 at the base of A1A6Q1 prevents damage to this transistor from the application of excessive dc levels (up to 600 v) to the input. The output of this stage is amplified further by A1A6Q2.

These two stages operate in the same way with either 100-kc or l-mc inputs. The third stage, A1A6Q3, operates with a 500-kc tuned tank circuit as its load. When the input is a 100-kc signal, it multiplies that frequency by 5, producing a 500-kc signal at the collector of A1A6Q3. When the input is a l-me signal, it is passed with no multiplication. The output of A1A6Q3 is further amplified by a two-stage amplifier consisting of A1A6Q4 and A1A6Q5.

The following stage, A1A6Q6, is a l-mc tuned amplifier. When the input to this stage is 500 kc, the signal is multiplied by 2 to 1 mc. When the input to this stage is 1 mc, the signal passes without multiplication. The output of A1A6Q6 is further amplified by tuned amplifier stages A1A6Q7 and A1A6Q8, elimating the l-kc and 500-kc components from the l-me signal. The output of A1A6Q8 is amplified in amplifier A1A6Q9, passed through emitter follower A1A6Q10, and applied as the l-mc frequency standard to the frequency dividers.

The output of A1A6Q8 is, in addition, applied to emitter follower A1A6Q11, and serves as the l-me fundamental from which the 10-mc signal is derived. Phase splitter A1A6Q12 provides two l-mc outputs; one output is in-phase with the output of A1A6Q11, and the other is 180 degrees out-of-phase. The two outputs of the phase splitter are full-wave rectified by diodes A1A6CR7 and A1A6CR8, and combined to produce a 2-mc signal. Tuned amplifier A1A6Q13 amplifies this 2-mc signal and removes the l-me component. Clippers A1A6CR7 and A1A6CR8 increase the harmonic content of the 2-mc signal. Multiplier A1A6Q14 increases the 10-mc component of the clipped signal.

The output of A1A6Q14 is further amplified by tuned stages A1A6Q15 and A1A6Q16, eliminating the 2-mc components from the 10-mc signal. The output of A1A6Q16 is applied to two separate branches. In one branch it is passed through emitter followers A1A6Q19 and A1A6Q20 and terminated on pin 6 of XA1A6. This signal serves as the 10-mc input to the frequency converter. In the other branch the signal is amplified by amplifier A1A6Q17, passed through emitter follower A1A6Q18 and terminated on pin 2 and 3 of XA1A6. The signal terminated on pin 2 serves as the 10-mc standard frequency applied to A1S2. The signal terminated on pin 3 serves as the 10-mc test signal applied to the count control.

b. 10 MC AND 1 MC MULTIPLIER TROUBLE SHOOTING.- Problems in the 10-mc and l-mc multiplier fall into four categories: (1) absence of l-mc output; (2) absence of 10-mc output; (3) improper 1-mc output waveform; and (4) improper 10-mc output waveform. Table 4-9 is a trouble-shooting chart for the l-mc and 10-mc multiplier. Separate procedures are given for the l-mc and 10-mc multipliers. All the problems mentioned above can be caused by improper tuning of one or more stages of the multiplier. Before the trouble-shooting procedure is started, check each stage for proper adjustment. The procedure for adjusting the multiplier is given in paragraph 5-4e. The most efficient method for isolating a problem in the multiplier is to follow the signal from stage to stage. When a stage is found where the signal disappears or becomes distorted, check the parts associated with that stage.

The output amplitude of Q1 is approximately the same with either the 100-kc or l-mc input.

Amplifiers A1A6Q2, A1A6Q5, and A1A6Q13 drive multiplier stages, and must have conector wave - forms of the proper repetition rate with negative edges falling in less than 50 nanoseconds.

Table 4-9 is the 10-mc and l-mc multiplier trouble-shooting chart. In this table the specified input frequency is 100 kc. If the l-mc multiplier is adjusted and working properly with this input frequency, it will also work properly with a l-mc input frequency. If any tank circuit is adjusted in the process of trouble shooting or if a component is found to be faulty and is replaced, the entire multiplier must be adjusted. The procedure for adjusting the multiplier is given in paragraph 5-4e.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-10, 5-41, and 5-66.

TABLE 4-9. 10 MC AND 1 MC MULTIPLIER TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
		1 MC MULTIPLIER	
1	Set POWER switch to TRACK and REF FREQ 100 KC OR 1 MC switch to EXT. Apply a 0.5-volt rms, 100-kc signal to time base INPUT connector, observe waveform at test point A and compare with that shown in figure 4-10.	Waveform is correct.	2
		If waveform is incorrect check A1A6Q1.	
2	Observe waveform at test point B and compare with that shown in figure 4-10.	Waveform is correct. (Negative edge falling in less than 50 nanoseconds.)	3
		If waveform is incorrect, check A1A6CR1 and A1A6Q2.	
3	Observe waveform at test point C and compare with that shown in figure 4-10.	Waveform is correct. (Negative edge falling in less than 50 nanoseconds.)	4
		If waveform is incorrect, check A1A6CR2, A1A6CR3, A1A6Q3, A1A6Q4, and A1A6Q5. Readjust A1A6C7.	
4	Observe waveform at test point D and compare with that shown in figure 4-10.	Waveform is correct. (Negative edge falling in less than 50 nanoseconds.)	5
		If waveform is incorrect, check A1A6CR4, A1A6Q6, and A1A6L2, Readjust A1A6L2.	
5	Observe waveform at test point E and compare with that shown in figure 4-10.	Waveform is correct.	6
		If waveform is incorrect, check A1A6Q7, A1A6Q8, A1A6L3, and A1A6L4. Readjust A1A6L3 and A1A6L4.	
6	Observe waveform at test point 1 and compare with that shown in figure 4-10.	Waveform is correct.	7
		If waveform is incorrect, check A1A6CR6, A1A6Q9, and A1A6Q10.	

TABLE 4-9. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
		10 MC MULTIPLIER	
7	Observe waveform at test point F and compare with that shown in figure 4-10.	Waveform is correct. (Negative edge falling in less than 50 nanoseconds.)	8
		If waveform is incorrect, check A1A6CR7, A1A6CR8, A1A6CR9, A1A6CR10, A1A6Q11, A1A6Q12, and A1A6Q13.	
8	Observe waveform at test point G and compare with that shown in figure 4-10.	Waveform is correct. (Negative edge falling in less than 50 nanoseconds.)	9
		If waveform is incorrect, check A1A6L6, A1A6L7, A1A6L8, A1A6Q14, A1A6Q15, and A1A6Q16. Readjust A1A6L6, A1A6L7, and A1A6L8.	
9	Observe waveform at test point 2.	Waveform is correct. (Negative edge falling in less than 50 nanoseconds.)	10
		If waveform is incorrect, check A1A6Q19 and A1A6Q20.	
10	Observe waveform at test point 3.	If waveform is incorrect, check A1A6CR11, A1A6CR12, A1A6Q17, and A1A6Q18.	

NOTES

1. Primary signal paths weighted.
2. ——— — — ——— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "−".
5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5 v/cm.
   Sweep time: 1 μs/cm, 0.1 μs/cm.
6. Explanation of symbols placed at waveforms:

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. Letters outside of circuit blocks indicate transistor or diode elements.
9. Operating control settings:

   POWER switch to TRACK.
   REF FREQ switch to EXT.
10. T = 10 μs when 100-kc input is used.
    T = 1 μs when 1-mc input is used.
11. T = 2 μs when 100-kc input is used.
    T = 1 μs when 1-mc input is used.

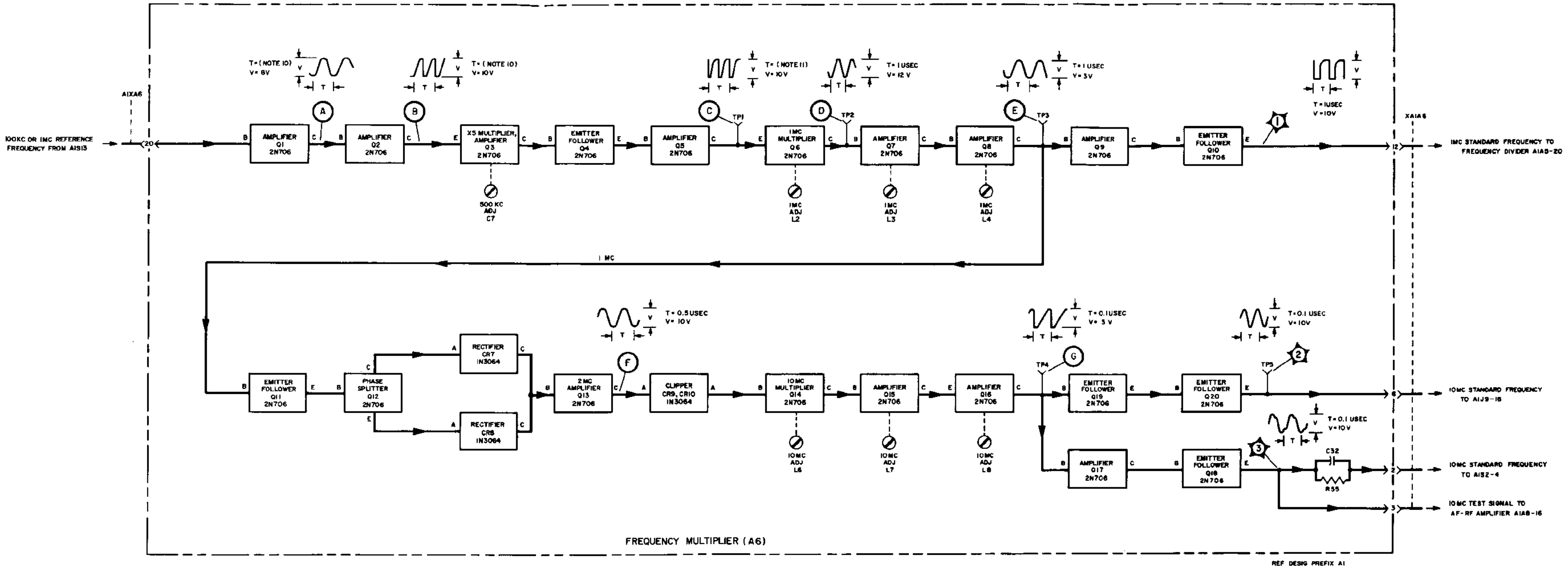


Figure 4-10. 10 Mc and 1 Mc Multiplier, Functional and Servicing Block Diagram

4-10. SCALER.

a. SCALER FUNCTIONAL DESCRIPTION. - The scaler functional section consists of two types of decade frequency dividers. The first type is capable of operating at a l-mc rate; one of this type is included in the counter. It is constructed on printed circuit board A1A5. The second type is capable of operating at a 300-kc rate; six of this type are included in the counter. These six dividers are constructed in pairs on printed circuit boards A1A2, A1A3, and A1A4. Figure 4-15 shows the functional relationship of all circuits in the scaler and gives test points and waveforms as an aid in trouble shooting.

Each frequency divider consists of four hi-stable multi vibrators (flip-flops) coupled together in such a way so as to produce one output pulse for each ten input pulses. Figure 4-11 shows a typical flip-flop.

The input to the flip-flop is applied at the junction of capacitors Cl and C2, and the output is taken at the collector of Q2. Resistors R1 and R2 form steering networks which steer input pulses to the base of the saturated transistor, These pulses cut off the saturated transistor and cause the flip-flop to change state. The resulting output is a train of pulses with half the repetition rate of the input pulses. Diodes CR1 and CR2 are used in some flip-flops to permit a higher counting rate.

Figure 4-12 is a simplified schematic diagram, showing a method of coupling the four flip-flops together to provide one output pulse for each ten input pulses. Figure 4-13 shows the idealized waveforms at the output of each flip-flop. At the count of zero, Ql, Q2, Q3, and Q5 are saturated and their collectors are at approximately zero volts. Diodes CR1 and CR2 form an AND gate at the input to the Q2-side of the "2" flip-flop. This AND gate prevents the "2" flip-flop and "4" flip-flop from. changing state after the eighth input pulse is applied to the frequency divider. Since the Q7 side of the "8" flip-flop is driven directly by the "l" flip-flop, the tenth input pulse causes the "8" flip-flop to change state. This, in effect, causes the "8" flip-flop to change state at the counts of eight and ten. The change of state at the count of ten is used as the divider output. Frequency dividers A1A2 through A1A5 operate in this manner.

The output of each of the six frequency dividers on A1A2 through A1A9 is applied to a gating system. These gating systems are identical, and one is shown

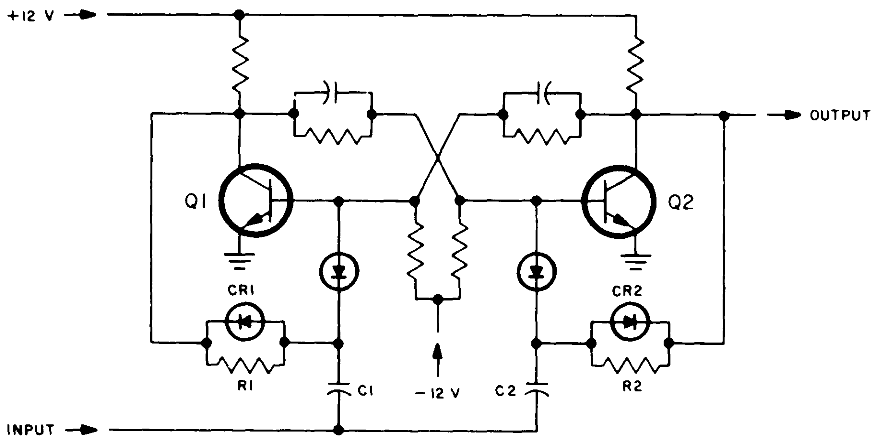


Figure 4-11. Typical Scaler Flip- Flop, Simplified Schematic Diagram

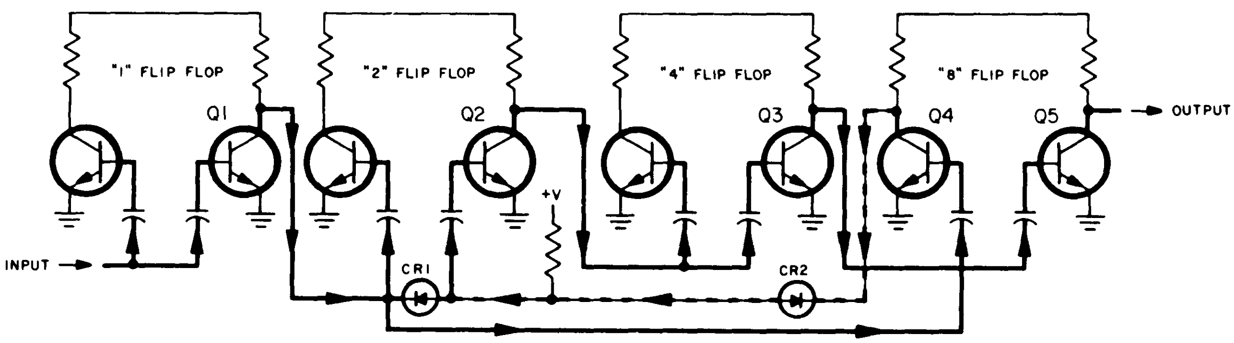


Figure 4-12. Coupled Scaler Flip-Flops, Simplified Schematic Diagram

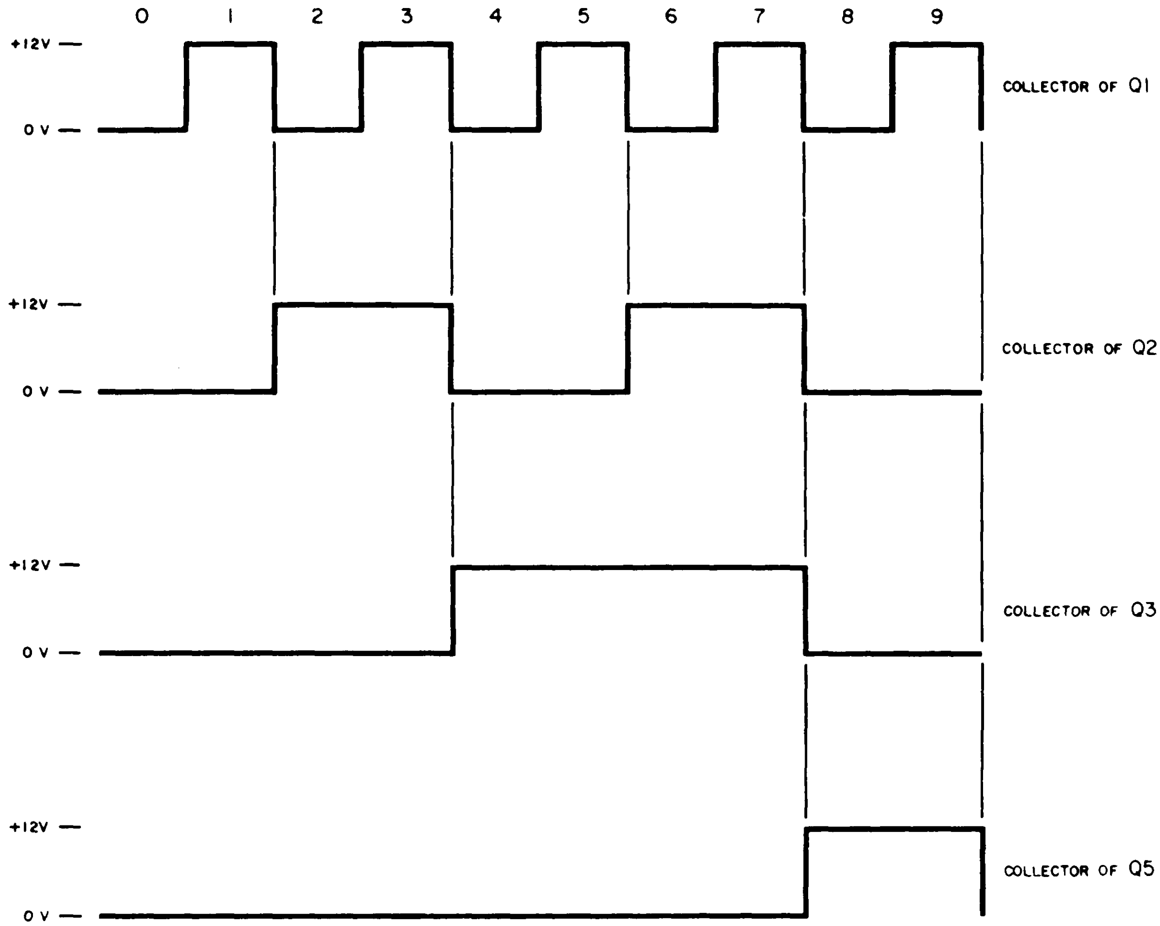


Figure 4-13. Coupled Scaler Flip-Flops, Collector Waveforms

in figure 4-14. The output of the B amplifier is also applied to each gating system. Operation of the gates is as follows: saturation of Q1 causes the output of frequency divider to be applied to the time-base clocking system on frequency divider A1A5, saturation of Q2 causes the divider output to be applied to the input of the following frequency divider; saturation of Q3 causes the output of the B amplifier to be applied to the input of the following frequency divider. These gates allow either the B signal or time-base signals to be routed in the scaler and permit the output of any frequency divider to be sampled for use throughout the counter.

Frequency divider A1A5 divides the l-mc standard frequency. Its output is applied directly to the input of the following frequency divider A1A4. The time-base clocking system is constructed on a portion of printed circuit board A1A5. This system synchronizes the selected time-base output of A1A2, A1A3 or A1A4, with the l-mc time-base signal.

The selected time-base output sets the clock flip-flop (FF13), consisting of A1A5Q14 and A1A5Q15, and the output of the "4" flip-flop (FF3) resets it. Since the clocked time-base output is taken from the reset-side of the clock flip-flop, this time-base pulse is always in synchronization with the change of state of the "4" flip-flop. The clock flip-flop is driven by AG6 when the 1-mc time-base is selected, and by AG14 when the 100-kc time base is selected. The standard frequency and scale A frequency output circuits are also located on printed circuit board A1A5. The selected scaled A frequency from the count decades is applied to AG8 and the selected standard frequency from the frequency dividers is applied to AG9. Either of these AND gates can provide the appropriate scaled output to Schmitt trigger ST10. The output of the Schmitt trigger is applied to inverter INV12. The output of this transistor is coupled to the STD FREQ OR SCALE OUT A1J7 on the rear panel of the counter.

b. SCALER TROUBLE SHOOTING. - Problems in the scaler functional section may occur in any one of the following circuits:

(1) The frequency dividers.

(2) The gating circuits following frequency dividers A1A2, A1A3, and A1A4.

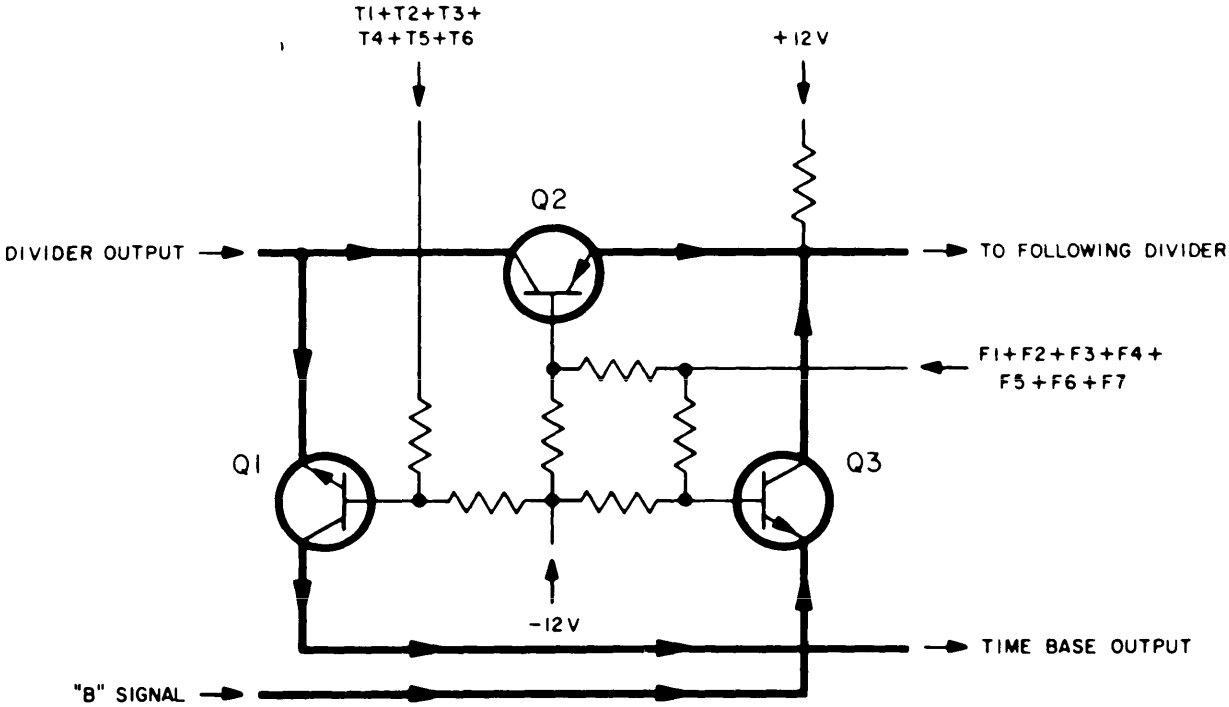


Figure 4-14. Output Gating System, Symplified Schematic Diagram

(3) The time-base clocking circuits.

(4) The scale output circuits.

The trouble-shooting procedures of all the frequency dividers are identical. The first step in trouble shooting these dividers is to check that each flip-flop can be made to change state by shorting the collector of the cutoff transistor to ground. If a flip-flop can be made to change state but does not operate when an input signal is applied, check its triggering circuits. If the divider divides the repetition rate of the input signal by a factor other than ten, check the diodes forming the AND gates at the input to the "2" flip-flop FF2, FF16 or FF24.

problems in the time base clocking system may occur in the clock flip-flop FF13 or in either the l-mc time-base gate AG6 or 100-kc time-base gate AG14. The clock flip-flop FF13 may be checked by shorting the collector of the cutoff transistor to ground. This should cause the flip-flop to change state. If if does change state, check the trigger circuits. If the l-mc and 100-kc time-base gates AG6 and AG14 do not produce a clock signal when they are selected, check transistors A1A5Q16 and A1A5Q17.

Trouble shooting the scale output circults can be accomplished by following the signal through AG8, AG9, ST10, and INV12 until the faulty stage is located. Once the faulty stage is located, check it in detail. Table 4-10 is the scaler trouble-shooting chart.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-11, 4-12, 4-13, 4-14, 4-15, 5-39, and 5-67.

TABLE 4-10. SCALER TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
	FREQUENCY DIVIDERS A1A2, A1A3, A1A4		
	Note Test point designations in this column refer to test points on the applicable frequency divider.	Note Prefix all reference designations in this column by the assembly number of the applicable frequency divider.	
1	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. FUNCTION switch to MAN START. Observe waveform at test point 1 on faulty frequency divider and compare with that shown in figure 4-15.	Waveform is correct.	2
		If waveform is absent, check previous divider.	
2	Observe waveform at test point A and compare with that shown in figure 4-15.	Waveform is correct.	4
		Waveform is absent.	3
3	Monitor voltage at test point A. Determine cutoff transistor in FF15 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR1, CR2, CR3, and CR4.	
		If voltage does not change, check Q1 and Q2.	
		If voltage changes by more than 10 volts but returns to its original level, check Q1 and Q2.	
4.	Observe waveform at test point B and compare with that shown in figure 4-15.	Waveform is correct.	6
		Waveform is absent.	5
5	Monitor voltage at test point B. Determine cutoff transistor in FF16 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR5, CR6, CR7, and CR10.	
		If voltage does not change, check Q3 and Q4.	
		If voltage changes by more than 10 volts but returns to its original level, check Q3 and Q4	
6	Observe waveform at test point C and compare with that shown in figure 4-15.	Waveform is correct.	8
		Waveform is absent.	7
7	Monitor voltage at test point C. Determine cutoff transistor in FF17 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR8 and CR9.	
		If voltage does not change, check Q5 and Q6.	
		If voltage changes by more than 10 volts but returns to its original level, check Q5 and Q6.	

TABLE 4-10. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
		FREQUENCY DIVIDERS A1A2, A1A3, A1A4 (cont)	
8	Ovserve waveform at test point D and compare with that shown in figure 4-15.	Waveform is correct.	10
		Waveform is absent.	9
9	Monitor voltage at test point D. Determine cutoff transistor in FF18 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR10, CR11, and CR12.	
		If voltage does not change, check Q7 and Q8.	
		If voltage changes by more than 10 volts but returns to its original value, check Q7 and Q8.	
10	Observe waveform at test point E and compare with that shown in figure 4-15.	Waveform is correct.	11
		If waveform is incorrect, check Q9.	
11	Observe waveform at test point F and compare with that shown in figure 4-15.	Waveform is correct.	13
		Waveform is absent.	12
12	Monitor voltage at test point F. Determine cutoff transistor in FF23 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR13, CR14, CR15, and CR16.	
		If voltage does not change, check Q13 and Q14.	
		If voltage changes by more than 10 volts but returns to its original level, check Q13 and Q14.	
13	Observe waveform at test point G and compare with that shown in figure 4-15.	Waveform is correct.	15
		Waveform is absent.	14
14	Monitor voltage at test point G. Determine cutoff transistor in FF24 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR17, CR18, CR19, and CR20.	
		If voltage does not change, check Q15 and Q16.	
		If voltage changes by more than 10 volts but returns to its original level, check Q15 and Q16.	
15	Observe waveform at test point H and compare with that shown in figure 4-15.	Waveform is correct.	17
		Waveform is absent.	16
16	Monitor voltage at test point H. Determine cutoff transistor in FF25 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR21 and CR22.	

TABLE 4-10. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
	FREQUENCY DIVIDERS A1A2, A1A3, A1A4 (cont)		
16 (cont)		If voltage does not change, check Q17 and Q18.	
		If voltage changes by more than 10 volts but returns to its original level, check Q17 and Q18.	
17	Observe waveform at test point I and compare with that shown in figure 4-15.	Waveform is correct.	19
		Waveform is absent.	18
18	Monitor voltage at test point I. Determine cutoff transistor in FF26 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check CR20, CR23, and CR24.	
		If voltage does not change, check Q19 and Q20.	
		If voltage changes by more than 10 volts but returns to its original level, check Q15 and Q16.	
19	Observe waveform at test point 3 and compare with that shown in figure 4-15.	Waveform is correct.	20
		If waveform is incorrect, check Q21.	
20	Rotate time-base switch until voltage at test point 4 becomes more positive than +17 volts. Observe waveform at test point 2 and compare with that shown in figure 4-15.	Waveform is correct.	21
		If waveform is incorrect, check Q11.	
21	Rotate time-base switch until voltage at test point 7 becomes greater than +17 volts. Observe waveform at test point 2 and compare with that shown in figure 4-15.	Waveform is correct.	22
		If waveform is incorrect, check Q12.	
22	Set the controls on the front panel of the counter as follows: Mode selector switch to SEP. B MULTIPLIER switch to 1. B TRIGGER VOLTS control to 0. Apply a 1-volt rms 1000-cps, sine wave to the B AC connector. Rotate FUNCTION switch until voltage at test point 6 becomes more positive than +17 volts. Observe waveform at test point 3 and compare with that shown in figure 4-15.	Waveform is correct.	23
		If waveform is incorrect, check Q22.	
23	Rotate FUNCTION switch until voltage at test point 5 becomes more positive than +17 volts. Observe waveform at test point E and compare with that shown in figure 4-15.	If waveform is correct, check loading of time-base output.	
		If waveform is incorrect, check Q10.	

TABLE 4-10. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
		FREQUENCY DIVIDER A1A5	
24	Set FUNCTION switch to MAN START. Observe waveform at test point J and compare with that shown in figure 4-15.	Waveform is correct.	26
		Waveform is absent.	25
25	Monitor voltage at test point J. Determine cutoff transistor in FF1 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check A1A5CR1, A1A5CR2, A1A5CR3, and A1A5CR4.	
		If voltage does not change, check A1A5Q1 and A1A5Q2.	
		If voltage changes by more than 10 volts but returns to its original level, check A1A5Q1 and A1A5Q2.	
26	Observe waveform at test point K and compare with that shown in figure 4-15.	Waveform is correct.	28
		Voltage does not change.	27
27	Monitor voltage at test point K. Determine cutoff transistor in FF2 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check A1A5CR5, A1A5CR6, A1A5CR7, A1A5CR8, A1A5CR9, and A1A5CR10.	
		If voltage does not change, check A1A5Q3 and A1A5Q4.	
		If voltage changes by more than 10 volts but returns to its original level, check A1A5Q3 and A1A5Q4.	
28	Observe waveform at test point L and compare with that shown in figure 4-15.	Waveform is correct.	30
		Voltage does not change.	29
29	Monitor voltage at test point L. Determine cutoff transistor in FF3 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check A1A5CR11, A1A5CR12, A1A5CR13, and A1A5CR14.	
		If voltage does not change, check A1A5Q5 and A1A5Q6.	
		If voltage changes by more than 10 volts but returns to its original level, check A1A5Q5 and A1A5Q6.	
30	Observe waveform at test point 8 and compare with that shown in figure 4-15.	Waveform is correct.	32
		Waveform is absent.	31

TABLE 4-10. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
		FREQUENCY DIVIDER A1A5 (cont)	
31	Monitor voltage at test point 8. Determine cutoff transistor in FF4 and short its collector to ground.	If voltage changes by more than 10 volts and remains at that level, check A1A5CR9, A1A5CR15, A1A5CR16, A1A5CR17, and A1A5CR18.	
		If voltage does not change, check A1A5Q7 and A1A5Q8.	
		If voltage changes by more than 10 volts but returns to its original level, check A1A5Q7 and A1A5Q8.	
32	Set time-base switch to 10^6. Observe waveform at test point 9 and compare with that shown in figure 4-15.	Waveform is correct.	33
		If voltage does not change, check A1A5Q15, A1A5Q16, A1A5CR22, and A1A5CR23.	
33	Set time-base switch to 10^5. Observe waveform at test point 9 and compare with that shown in figure 4-15.	Waveform is correct.	34
		If waveform is absent, check A1A5Q15, A1A5Q17, and A1A5CR22.	
34	Set time-base switch to 10^6. Observe waveform at test point 9 and compare with that shown in figure 4-15.	Waveform is correct.	35
		If waveform is absent, check A1A5Q14, A1A5Q15, A1A5CR20, A1A5CR21, and A1A5CR22.	
35	Set time-base switch to 10^5. Observe waveform at test point M and compare with that shown in figure 4-15.	Waveform is correct.	36
		If waveform is incorrect, check A1A5Q9, A1A5Q10, and A1A5CR19.	
36	Observe waveform at test point 11 and compare with that shown in figure 4-15.	Waveform is correct.	37
		If waveform is incorrect, check A1A5Q11, A1A5Q12, and A1A5Q13.	
37	Set FUNCTION switch to SCALE A, time-base switch to 10^2, and SENSITIVITY switch to TEST. Observe waveform at test point M and compare with that shown in figure 4-15.	If waveform is correct, check loading on STD FREQ OR SCALE OUT receptacle.	
		If waveform is incorrect, check A1A5Q9.	

NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ▬▬ ▬ ▬ ▬▬ indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "-".
5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5 v/cm.
   Sweep time: See Note 11.
6. Explanation of symbols placed at waveforms.

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. Abbreviations within logic or circuit blocks are as follows:

   AG AND Gate
   FF Flip-Flop
   INV Inverter
   OR OR Gate
   ST Schmitt Trigger

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.
9. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
10. Assemblies A1A2, A1A3, and A1A4 are identical. Only A1A4 is shown in detail.
11. Time duration of waveforms is variable.
12. Assembly numbers are as given at bottom of assembly boundaries.
13. Operating control settings:

    POWER switch to TRACK.
    FUNCTION switch to MAN START.
14. F and T select terms are defined in table 4-1.
15. An asterisk (*) indicates that the assembly designator is the same as that listed in the lower left-hand corner of the applicable dashed-line block.

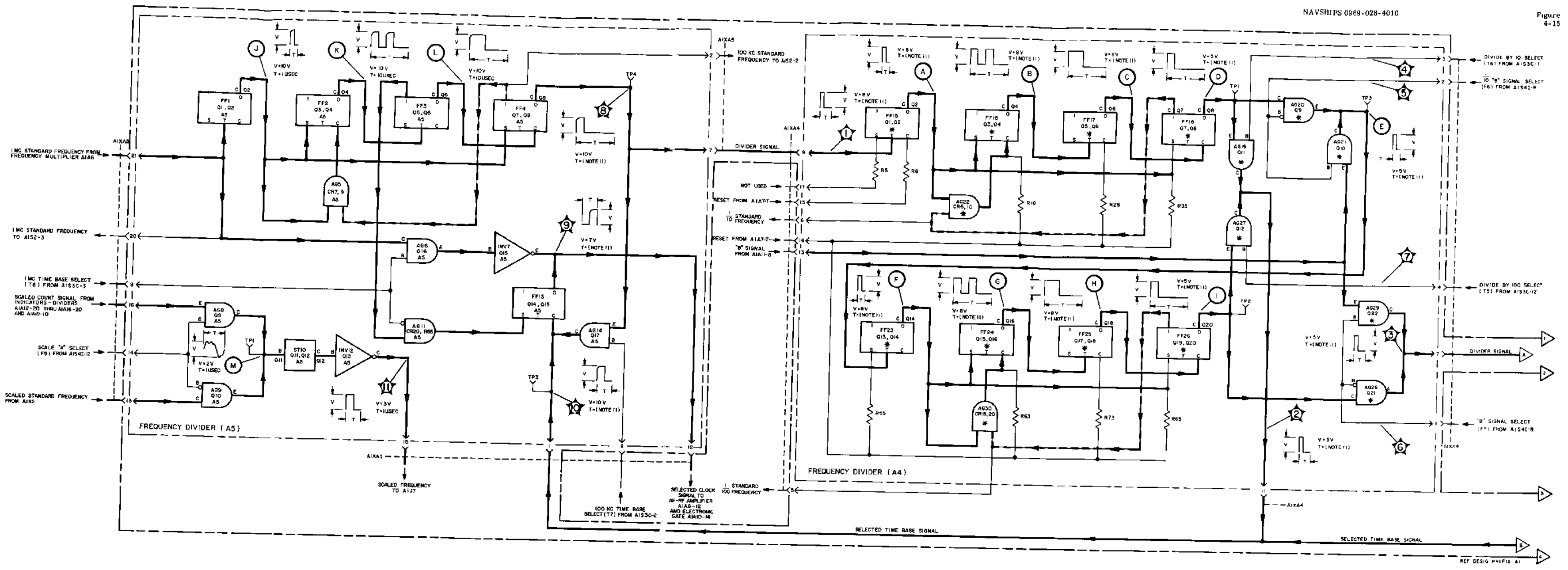
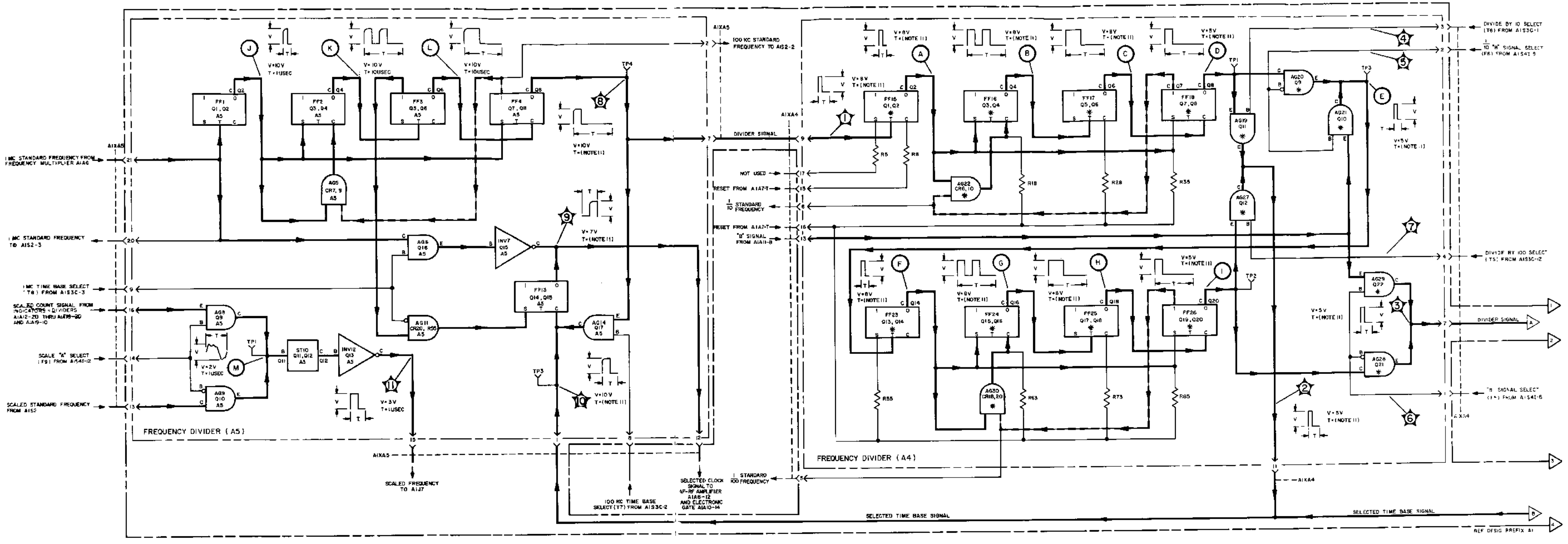


Figure 4-15. Scaler, Functional and Servicing Block Diagram (Sheet 1 of 2)



NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.

2. ——— — — ——— indicates assembly boundaries.

3. Names of panel controls and connectors are enclosed in boxes.

4. Dc voltages are preceded by "+" or "–".

5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5 v/cm.
   Sweep time: See Note 11.

6. Explanation of symbols placed at waveforms.

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.

7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.

8. Abbreviations within logic or circuit blocks are as follows:

   AG AND Gate
   FF Flip-Flop
   INV Inverter
   OR OR Gate
   ST Schmitt Trigger

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.

9. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.

10. Assemblies A1A2, A1A3, and A1A4 are identical. Only A1A4 is shown in detail.

11. Time duration of waveforms is variable.

12. Assembly numbers are as given at bottom of assembly boundaries.

13. Operating control settings:

    POWER switch to TRACK.
    FUNCTION switch to MAN START.

14. F and T select terms are defined in table 4-1.

15. An asterisk (*) indicates that the assembly designator is the same as that listed in the lower left-hand corner of the applicable dashed-line block.

Figure 4-15. Scaler, Functional and Servicing Block Diagram (Sheet 1 of 2)

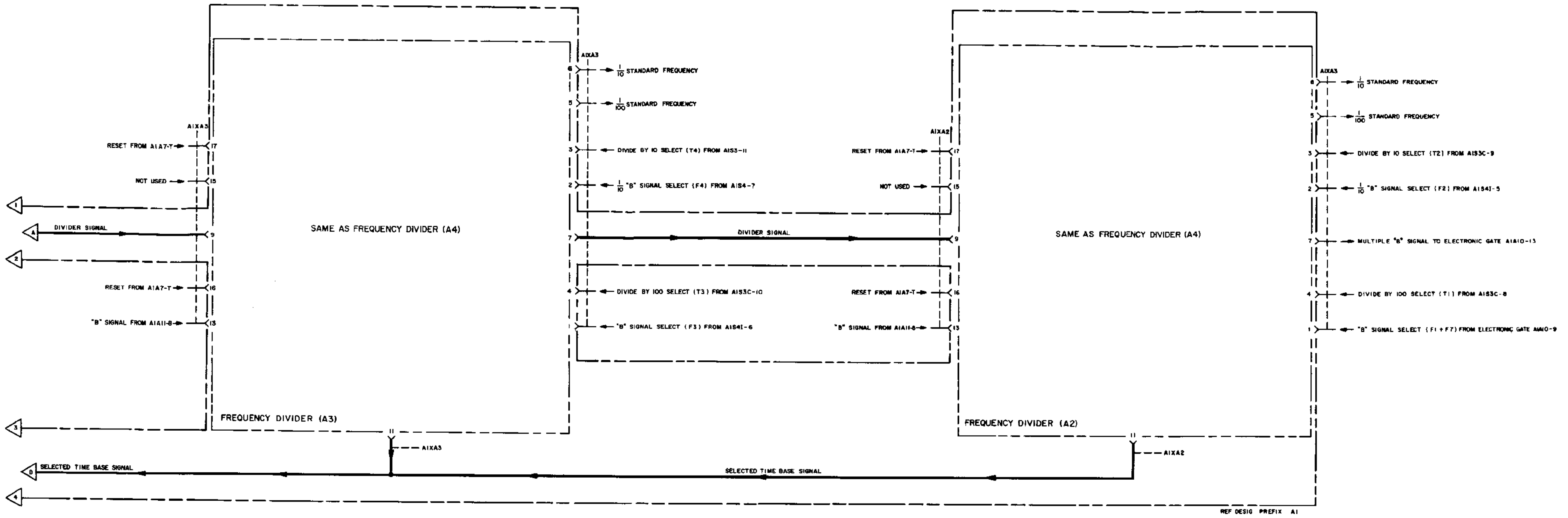


Figure 4-15. Scaler, Functional and Servicing Block Diagram (Sheet 2 of 2)

4-11. GATE CONTROL.

a. GATE CONTROL FUNCTIONAL DESCRIPTION. - The gate control functional section provides the gate control signal to the count decades functional section. This signal determines the length of time count decades count the signal applied to their input. The gate control functional section is constructed on printed circuit board A1Al0. Figure 4-16 is the functional and servicing block diagram for the section

The gate-control signal is produced by the gate flip-flop FF9, consisting of A1A10Q12 and A1A10Q14, and emitter follower EF12, consisting of A1A10Q19. Setting of FF9 causes the gate control signal to become zero volts and the count decades to count. The gate flip-flop can be set by the following signals: the selected clock signal corresponding to the gate time selected by the time-base switch, or the multiple B signal corresponding to the appropriate PERIOD B measurement selected by the FUNCTION switch.

The MANUAL START and SCALE A functions require the gate control signal to be zero volts. When either of these functions is selected, FF12 is saturated to produce zero volts at the gate control signal output. Resetting the gate flip-flop causes the gate control signal to become +6 volts and the count decades to stop counting. The gate flip-flop may be reset by any of the signals that set it, or by the C signal. When the counter is operating in any function except TIME B $\Rightarrow$ C, the set and reset inputs to the gate flip-flop are connected together by AND gate AG16.

The multiple B signal and selected clock signal are coupled to AND gates AG14 and AG13, respectively. The output of both of these AND gates is coupled to Schmitt trigger ST15. The output of the Schmitt trigger is applied through AG16 to the set and reset inputs of the gate flip-flop FF9. The C signal is coupled through AND gate AG17 to the reset side of the gate flip-flop when the counter is operated in the TIME B $\Rightarrow$ C function.

The output of the FF9 is coupled to emitter follower EF12; the output of this stage becomes the gate control signal. The output of the gate flip-flop is also coupled to inverters INV3 and INV18 consisting of A1A10Q11 and A1A10Q18; the output of INV18 becomes the gate signal used by the cycle control functional section.

Once the gate flip-flop has produced the gate signal, lt must be prevented from producing another one until the cycle control has completed its control of the display and produced a reset pulse. This is the function of the latch flip-flop FF6 consisting of A1A10Q13 and A1A10Q15. This flip-flop is set by the gate flip-flop at the time corresponding to the start of the gate time. Once the latch flip-flop is set it prevents the gate flip-flop from producing another gate control signal. The latch flip-flop remains set until the cycle control produces a reset pulse at the end of the display time. The reset pulse from the cycle control is delayed by the reset delay generator DG4, consisting of A1A10Q7 and A1A10Q10, and resets the latch flip-flop. Once the latch flip-flop is reset, the gate flip-flop produces another gate control signal and the cycle is repeated.

b. GATE CONTROL TROUBLE SHOOTING. - Problems in the gate control functional section are usually caused by improper or no operation of gate flip-flop FF9 and latch flip-flop FF6. The first step in trouble shooting the gate control is to check that both flip-flops can be made to change state, by shorting the collector of the cutoff transistor to ground. If both flip-flops are operating properly, trace the signals that set and reset the gate flip-flop through the gating circults AG14, AG17, AG13, and AG19, the Schmitt trigger ST15, and trace the outputs of the gate flip-flop through the inverter and emitter follower stages INV3, INV18 and EF12. The latch circuits can be checked by tracing the reset pulse through the reset delay generator DG4, to the latch flip-flop FF6 and to the reset input of the gate flip-flop FF9. The gate control trouble- shooting chart, table 4-11, is based on the above procedure.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-16, 5-45, and 5-69.

TABLE 4-11. GATE CONTROL TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
1	Set the controls on the front panel on the counter as follows: POWER switch to TRACK. FUNCTION switch to MAN START. Monitor voltage at test point 1. Determine cutoff transistor in FF9 and short its collector to ground.	Voltage changes by more than 5 volts and remains at that level.	2
		If voltage does not change, check A1A10Q12, A1A10Q14, A1A10Q16, A1A10Q19, A1A10CR10, A1A10CR11, A1A10CR19, and A1A10CR21.	
		If voltage changes by more than 5 volts but returns to its original level, check A1A10Q12, A1A10Q14, A1A10CR10, A1A10CR11, A1A10CR19, and A1A10CR21.	
2	Monitor voltage at test point 2. Determine cutoff transistor in FF9 and short its collector to ground.	Voltage changes by more than 10 volts and remains at that level.	3
		If voltage does not change, check A1A10Q11 and A1A10Q18.	
3	Monitor voltage at test point B. Determine cutoff transistor in FF6 and short its collector to ground.	Voltage changes by more than 10 volts and remains at that level.	4
		If voltage does not change, check A1A10Q13, A1A10Q15, A1A10Q17, A1A10CR13, A1A10CR17, A1A10CR22, and A1A10CR23.	
		If voltage changes by more than 10 volts but returns to its original level, check A1A10Q13, A1A10Q15, A1A10CR13, and A1A10CR17.	
4	Monitor voltage at test point 1.	Voltage is more negative than +1 volt.	5
		If voltage is more positive than +1 volt, check A1A10Q16 and A1A10CR3.	
5	Set the FUNCTION switch to SCALE A. Monitor voltage at test point 1.	Voltage is more negative than +1 volt.	6
		If voltage is more positive than +1 volt, check A1A10CR4.	
6	Set the FUNCTION switch to FREQ and set time-base switch to 10^3. Observe waveform at test point A and compare with that shown in figure 4-16.	Waveform is correct.	7
		If waveform is incorrect, check A1A10Q7, A1A10Q10, A1A10CR8, and A1A10CR9.	
7	Observe waveform at C and compare with that shown in figure 4-16.	Waveform is correct.	8
		If waveform is incorrect, check A1A10Q4, A1A10Q5, A1A10Q6, A1A10Q7, and A1A10CR6.	
8	Observe waveform at test point D and compare with that shown in figure 4-16.	Waveform is correct.	9
		If waveform is incorrect, check A1A10Q9.	

TABLE 4-11. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
9	Set controls on the front panel of the counter as follows: FUNCTION switch to PERIOD B x 1. Mode selector switch to COM. B MULTIPLIER switch to 1. B TRIGGER VOLTS control to 0. Apply a l-volt rms, 1000-cps sine wave to the B AC connector. Observe the waveform at test point C and compare with that shown in figure 4-16.	Waveform is correct.	10
		If waveform is incorrect, check A1A10Q1.	
10	Set the FUNCTION switch to TIME B⇒X. Observe the waveform at test point D and compare with that shown in figure 4-16.	Waveform is correct.	11
		If waveform is incorrect, check A1A10Q2.	
11	Monitor voltage at test point 3.	Voltage more positive than +17 volts,	12
		If voltage is more positive than +17 volts, check A1A10CR1.	
12	Set FUNCTION switch to PERIOD Bx 1. Monitor voltage at test point 3.	If voltage is more positive than +17 volts, check loadlng of gate control and gate signals.	
		If voltage is more negative than +17 volts, check A1A10CR2.	

NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ——— — — ——— indicates assembly boundaries.
3. Dc voltages are preceded by "+" or "–".
4. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5 v/cm.
   Sweep time: 20 μs/cm, 1 ms/cm.

5. Explanation of symbols placed at waveforms.

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.

6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Abbreviations within logic or circuit blocks are as follows:

   AG AND Gate
   DG Delay Generator
   EF Emitter Follower
   FF Flip-Flop
   INV Inverter
   OR OR Gate
   ST Schmitt Trigger

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.

8. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
9. Time duration of this waveform is dependent upon setting of DISPLAY control.
10. Operating control settings:

    POWER switch to TRACK.
    FUNCTION switch to MAN START.

11. F and T select terms are defined in table 4-1.

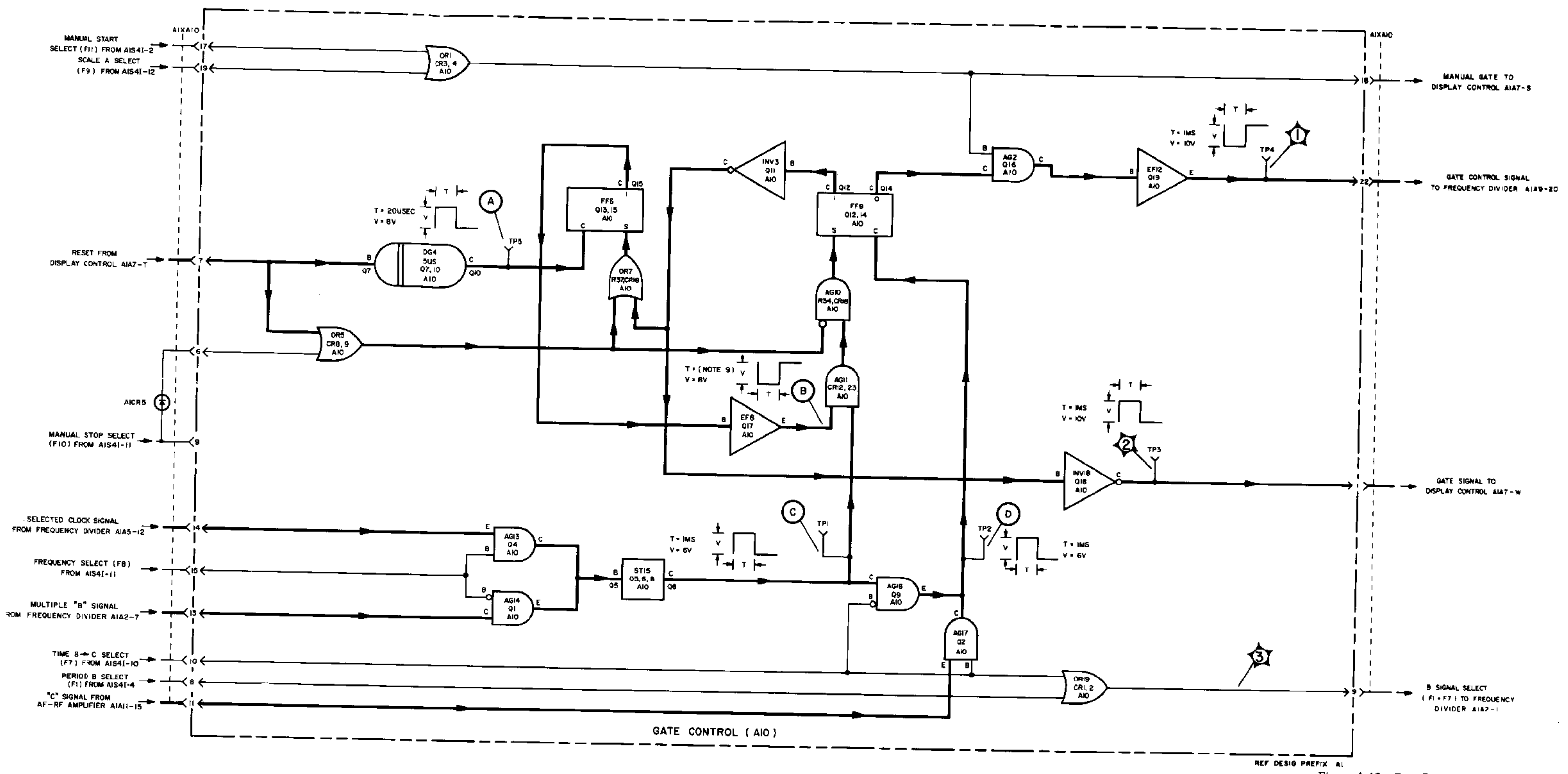


Figure 4-16. Gate Control, Functional and Servicing Block Diagram

4-12. COUNT CONTROL.

a. COUNT CONTROL FUNCTIONAL DESCRIPTION. - The count control consists of circuits which select the proper count signal to be supplied to the count decades. This functional section is constructed on one printed circuit board (A1A8). Figure 4-17 is the functional and servicing block diagram of the count control.

The A signal, selected clock signal, C signal and 10-mc test signal can be counted by the count decades. These four signals are supplied to the count control where one is selected and appears at the count signal output.

The A signal appears at the coaxial connector mounted directly on the printed circuit board A1A8. This signal is passed through a three-stage amplifier AMPL10, AMPL11, and EF12 (A1A8Q8, A1A8Q9, and A1A8Q10), and applied to Schmitt trigger ST13 consisting of A1A8Q11 and A1A8Q12. The output of the Schmitt trigger is applied to discriminator DISCR14 (A1A8Q13). This transistor is biased so that it does not amplify any noise present at the output of the Schmitt trigger. The output of the discriminator is applied to AND gate AG7.

The selected clock signal, C signal and 10-mc test signal are applied to AND gates AG3, AG6, and AG5, respectively. AND gate AG3 is selected when the counter is operated in any PERIOD mode (except when 10-mc is selected as the clock signal) or in the TIME B $\Rightarrow$ C mode. AND gate AG5 is selected when the counter is operated in the TEST mode, or when 10-mc is selected as the clock signal in PERIOD mode. The outputs of these three AND gates are connected together and applied to inverters INV7 and INV7A consisting of A1A8Q5 and A1A8Q14. The output of the inverter is applied to another AND gate, AG8.

AND gate AG8 and AND gate AG15 are controlled by the front panel SENSITIVITY switch. When this switch is in either the . 1 V, 1 V, 10 V, 100 V, or PLUG-IN position AG15 is selected, and the A signal is applied to the count decades. When the switch is in either the TEST or FREQ. C position AG8 is selected, and the signal from INV7A is applied to the count decades.

b. COUNT CONTROL TROUBLE SHOOTING. - Problems in the count control functional section usually result in the absence of one or more of the four possible signals at the count signal output. If the A signal does not appear at the output of the amplifier stages when it normally should, check the Schmitt trigger, discriminator, and AG15. If any of the other signals do not appear at the count signal output check the appropriate AND gate AG3, AG5, or AG6, INV7, INV7A, and AG8. The trouble- shooting table, table 4-12, is organized in this manner. Before starting the trouble-shooting procedure, be sure the problem is not due to improper adjustment of the amplifier stages. The adjustment procedure is given in paragraph 5-4f.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-17, 5-43, and 5-70.

TABLE 4-12. COUNT CONTROL TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
1	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. FUNCTION switch to FREQ. SENSITIVITY switch to 1 V Time-base switch to 1. Apply a l-volt rms, 1000-cps sine-wave to the FREQ. A connector. Observe the waveform at test point 1 and compare with that shown in figure 4-17.	Waveform is correct.	2
		If waveform is incorrect, check A amplifier, A1A8C9, A1A8C10, and A1A8Q8.	
2	Observe the waveform at test point A and compare with that shown in figure 4-17.	Waveform is correct.	3
		If waveform is incorrect, check A1A8Q8, A1A8Q9, A1A8Q10, A1A8C14, A1A8C15, and adjustment of A1A8R30.	
3	Observe the waveform at test point B and compare with that shown in figure 4-17.	Waveform is correct.	4
		If waveform is incorrect, check A1A8Q10, A1A8Q11, A1A8Q12, and A1A8CR1O.	

TABLE 4-12. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
4	Observe the waveform at test point 2 and compare with that shown in figure 4-17.	Waveform is correct.	5
		If waveform is incorrect, check A1A8Q13, A1A8Q7, A1A8CR11, A1A8CR12, and A1A8CR13.	
5	Set FUNCTION switch to SCALE A. Monitor voltage at test point C.	Voltage is more positive than +17 volts.	6
		If voltage is more negative than +17 volts, check A1A8CR5.	
6	Set FUNCTION switch to MANUAL START. Monitor voltage at test point C.	Voltage is more positive than +17 volts.	7
		If voltage is more negative than +17 volts, check A1A8CR6.	
7	Set time-base switch to 10^8. Monitor voltage at test point C.	Voltage is more positive than +17 volts.	8
		If voltage is more negative than +17 volts, check A1A8CR7.	
8	Set time-base switch to 10^7. Observe waveform at test point D and compare with that shown in figure 4-17.	Waveform is correct.	9
		If waveform is incorrect, check A1A8Q2 and A1A8CR3.	
9	Set FUNCTION switch to FREQ. Observe voltage at test point D.	Voltage is a constant level.	10
		If voltage is not a constant level, check A1A8Q4.	
10	Set SENSITIVITY switch to FREQ. C, mode selector switch to SEP, C MULTIPLIER switch to 1, and C TRIGGER VOLTS control to **o.** Apply a l-volt rms, 1000-cps sine wave to the C AC connector. Observe waveform at test point D, and compare with that shown in figure 4-17.	Waveform is correct.	11
		If waveform is incorrect, check A1A8Q1.	
11	Observe waveform at test'point 2 and compare with that shown in figure 4-17.	If waveform is correct, check count decades and gate control.	
		If waveform is incorrect, check A1A8Q5, A1A8Q14, A1A8Q6, and A1A8CR8.	

NOTES

1. Primary signal paths weighted.
2. ——— — — ——— indicates assembly boundaries.
3. Dc voltages are preceded by "+" or "–".
4. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5 v/cm, 10 v/cm.
   Sweep time: 1 ms/cm, 0.1 μs/cm.
5. Explanation of symbols placed at waveforms:

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Abbreviations within logic or circuit blocks are as follows:

AG	AND Gate
AMPL	Amplifier
DISCR	Discriminator
EF	Emitter Follower
INV	Inverter
OR	OR Gate
ST	Schmitt Trigger

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.
8. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
9. Operating control settings.

   POWER switch to TRACK.
   FUNCTION switch to FREQ to produce waveform at A, B, and 2.
   FUNCTION switch to SCALE A or MANUAL START to produce voltage level at C.
   Time-base switch to 1 to produce waveform at A, B, and 2.
   Time-base switch to 10^7 to produce 10-mc waveform at D.
   Sensitivity switch to 1 V or FREQ. C to produce waveform at A, B, and 2.
   Mode selector switch to SEP.
   C MULTIPLIER switch to 1.
   C TRIGGER VOLTS control to 0.
10. F, T, and S select terms are defined in table 4-1.

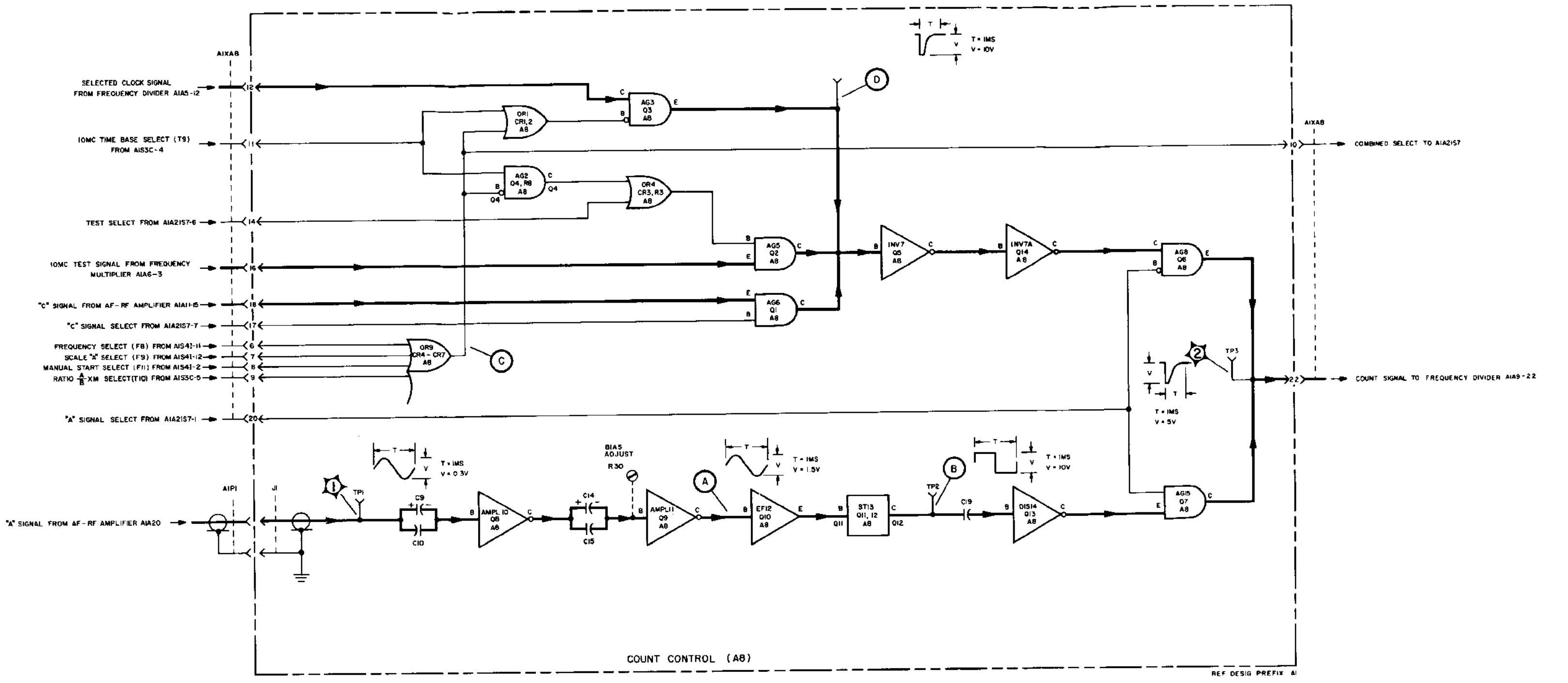


Figure 4-17. Count Control, Functional and Servicing Block Diagram

4-13. CYCLE CONTROL.

a. CYCLE CONTROL FUNCTIONAL DESCRIPTION. - The cycle control functional section produces all signals necessary for controlling the display and memory and for recycling the counter. It is constructed on printed circuit board A1A7. Figure 4-19 shows the functional relationship of all circuits in the cycle control, and gives test points and performs as an aid in trouble shooting.

Input to the cycle control is the count signal obtained from the gate control functional section. When the gate opens the gate signal causes SW7 to conduct and the GATE lamp to light. At the same time the 150-millisecond single-shot SS8, consisting of A1A7Q7 and A1A7Q8, is triggered. Its output is coupled through OR6 to SW7 to insure that the GATE lamp remains lighted for at least that duration. This permits the operator to observe the operation of the GATE lamp when short gate times are chosen. When gate times longer than 150 milliseconds are chosen the GATE lamp is controlled by the gate signal.

When the gate closes, the gate signal (or output of SS8) triggers the display time generator DGl1 consisting of A1A7Q10 and A1A7Q11. This generator produces an output after a time delay determined by the setting of the DISPLAY control A1R1. The output of the display time generator triggers INV12 and EF13. These transistors (A1A7Q12 and A1A7Q13) produce the reset output. In manual reset the +12-volt output of the RESET switch A1S6 is fed through A1A7CR10 to the output of EF13.

As the GATE lamp goes off the 10-millisecond single-shot SS5, consisting of A1A7Q4 and A1A7Q5, is triggered. Its output is de-coupled to INV4 and at-coupled by A1A7C1 to EF2. These two transistors (A1A7Q1 and A1A7Q2) produce the memory transfer pulse and memory clear set pulse, respectively. If memory operation is not required, INV1 conducts, causing INV4 and EF2 to produce proper outputs for track operation. Figure 4-18 is a timing diagram for the cycle control functional section.

b. CYCLE CONTROL TROUBLE SHOOTING. — To trouble shoot the cycle control, follow the procedure given in table 4-13.

c. USEFUL ILLUSTRATIONS. — Illustrations useful in maintaining this functional section are: figures 4-18, 4-19, 5-42, and 5-71.

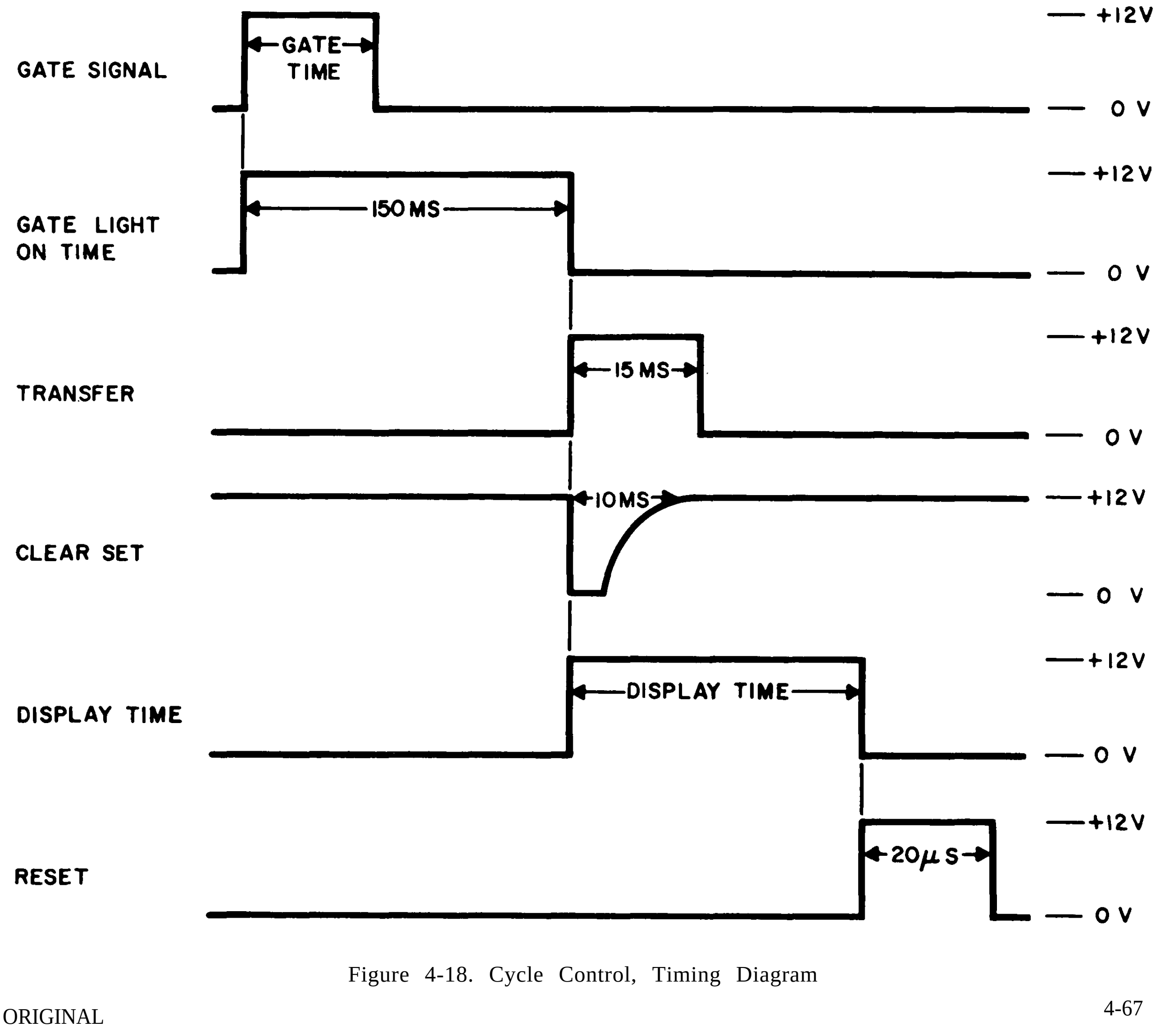


Figure 4-18. Cycle Control, Timing Diagram

TABLE 4-13. CYCLE CONTROL TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
1	Set the controls on the front panel of the counter as follows: POWER switch to STORE. FUNCTION switch to FREQ. Time-base switch to 10^6. DISPLAY control to MIN. Observe waveform at test point B and compare with that shown in figure 4-19.	Waveform is correct.	2
		If waveform is incorrect, check AlA7Q7, A1A7Q8, and A1A7CR5.	
2	Observe waveform at test point C and compare with that shown in figure 4-19.	Waveform is correct.	3
		If waveform is incorrect, check A1A7Q9, A1A7Q1O, A1A7Q11, A1A7C6, A1A7CR7, and A1A7CR22.	
3	Observe waveform at test point D and compare with that shown in figure 4-19.	Waveform is correct.	4
		If waveform is incorrect, check A1A7C4 and AIR1.	
4	Observe waveform at test point 3 and compare with that shown in figure 4-19.	Waveform is correct.	5
		If waveform is incorrect, check A1A7Q12, A1A7Q13, and A1A7CR11.	
5	Observe lighting of GATE lamp.	GATE lamp cycles off and on.	6
		If GATE lamp does not light, or remains lighted all the time, check A1A7Q6.	
6	Observe waveform at test point A and compare with that shown in figure 4-19.	Waveform is correct.	7
		If waveform is incorrect, check A1A7Q4, A1A7Q5, and A1A7CR3.	
7	Observe waveform at test point 2 and compare with that shown in figure 4-19.	Waveform is correct.	8
		If waveform is incorrect, check A1A7Q1.	
8	Observe waveform at test point 1 and compare with that shown in figure 4-19.	Waveform is correct.	9
		If waveform is incorrect, check A1A7Q2 and and A1A7CR21.	
9	Change POWER switch to TRACK and monitor voltage at test point 1.	Voltage is more negative than +2 volts.	10
		If voltage is more positive than +2 volts, check A1A7Q3, A1A7CR1, and A1A7CR2.	
10	Press RESET switch and monitor voltage at test point A.	Voltage is more negative than +2 volts.	11
		If voltage is more positive than +2 volts, check A1A7CR9.	
11	Press RESET switch and monitor voltage at test point 3.	If voltage is more positive than +10 volts, check loading on all outputs of A1A7.	
		If voltage is more negative than +10 volts, check A1A7CR10.	

NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ——— — — ——— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "−".
5. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:

   Sensitivity: 5 v/cm.
   Sweep time: 2 ms/cm, 1 sec/cm.
6. Explanation of symbols placed at waveforms.

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. The letters CCW, placed adjacent to the appropriate terminals of A1R1, indicate the direction of rotation viewed from the shaft end.
9. Abbreviations within logic or circuit blocks are as follows:

   AG AND Gate
   DG Delay Generator
   EF Emitter Follower
   INV Inverter
   OR OR Gate
   SS Single Shot
   SW Switch

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.
10. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
11. Operating control settings:

    POWER switch to STORE.
    FUNCTION switch to FREQ.
    Time-base switch to 10^6.
    DISPLAY control maximum counterclockwise.

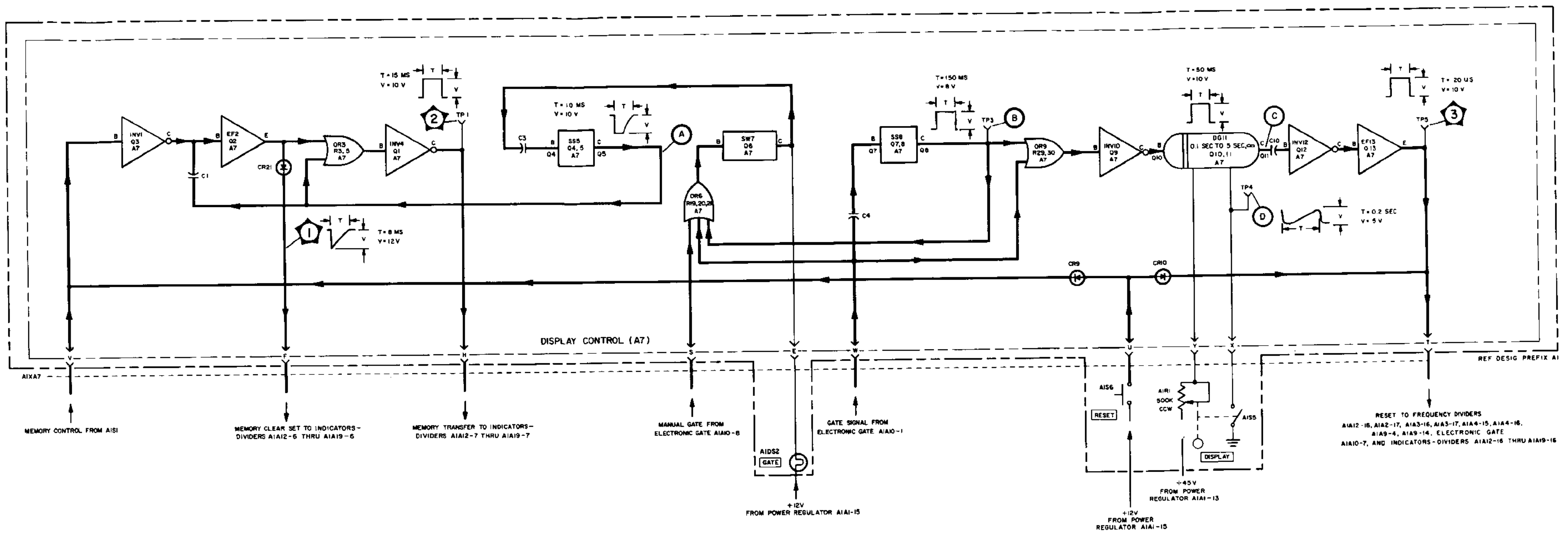


Figure 4-19. Cycle Control, Functional and Servicing Block Diagram

4-14. COUNT DECADES.

a. COUNT DECADE FUNCTION DESCRIPTION. - The count decade functional section consists of three types of counting decades. The first type is capable of counting at a 100-mc rate; one of this type is included in the counter. It is constructed on printed circuit board A1A9. The second type is capable of counting at a 10-mc rate; two of this type are included in the counter. These two decades are constructed on the same printed circuit boards as their associated readout circuits, A1A17 and A1A18. The third type is capable of counting at a 300-kc rate; five of this type are included in the counter. These five decades are constructed on the same printed circuit boards as their associated readout circuits, A1A12 through A1A16. Figure 4-24 shows the functional relationship of all circuits in the count decades, and gives test points and waveforms as an aid in trouble shooting.

Each count decade consists of four bi-stable multivibrators (flip-flops) coupled together in such a way so as to produce one output pulse for each ten input pulses. Figure 4-20 shows a typical flip-flop used in the 10-mc and 300-kc counting rate decades. Reference designators assigned in figure 4-20 apply to figure 4-20 only.

The input to the flip-flop is applied at the junction of capacitors Cl and C2, the output is taken at the collector of Q2. Resistors R1 and R2 and diodes CR3 and CR4 form steering networks which steer input pulses to the base of the saturated transistor. These pulses cut off this transistor and cause the flip-flop to change state. The resulting output is a train of pulses with half the repetition rate of the input pulses. Diodes CR1. CR2, CR5, and CR6 are used in the 10-mc counting rate decades to permit this increased speed.

Figure 4-21 is a simplified schematic diagram showing the method of coupling the four flip-flops

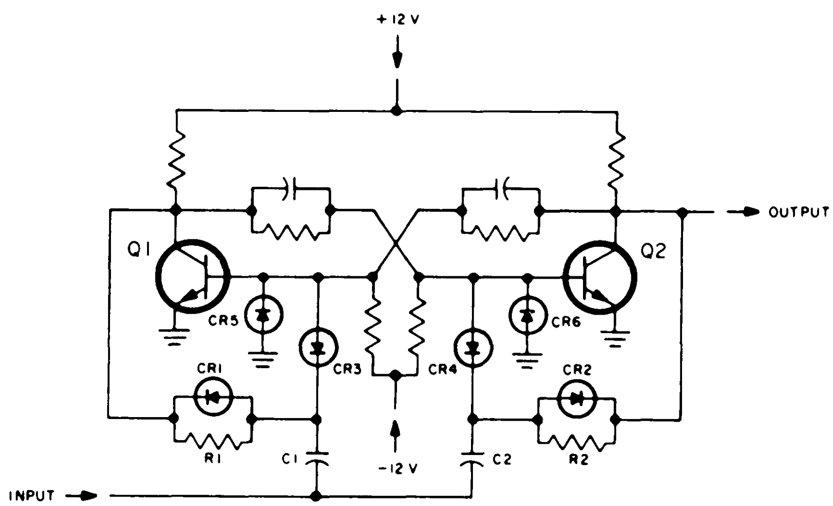


Figure 4-20, Typical Low-Speed Count Decade Flip-Flop, Simplified Schematic Diagram

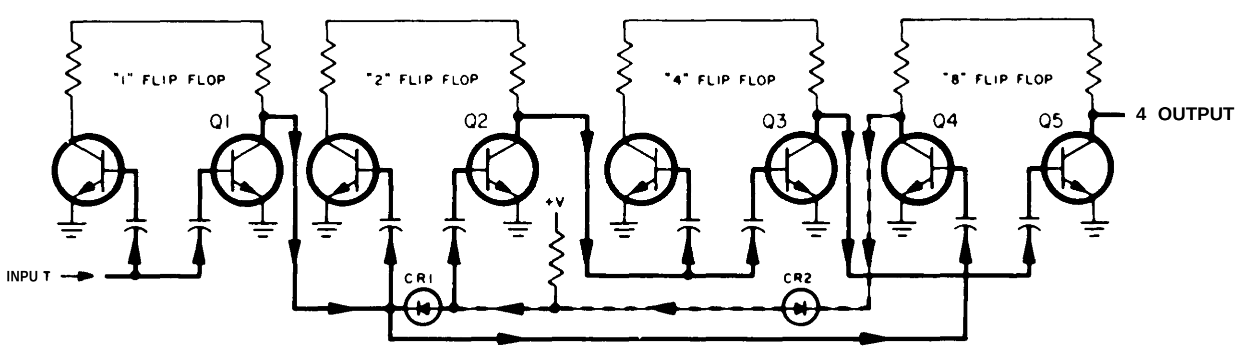


Figure 4-21. Coupled Low-Speed Count Decade Flip-Flops, Simplified Schematic Diagram

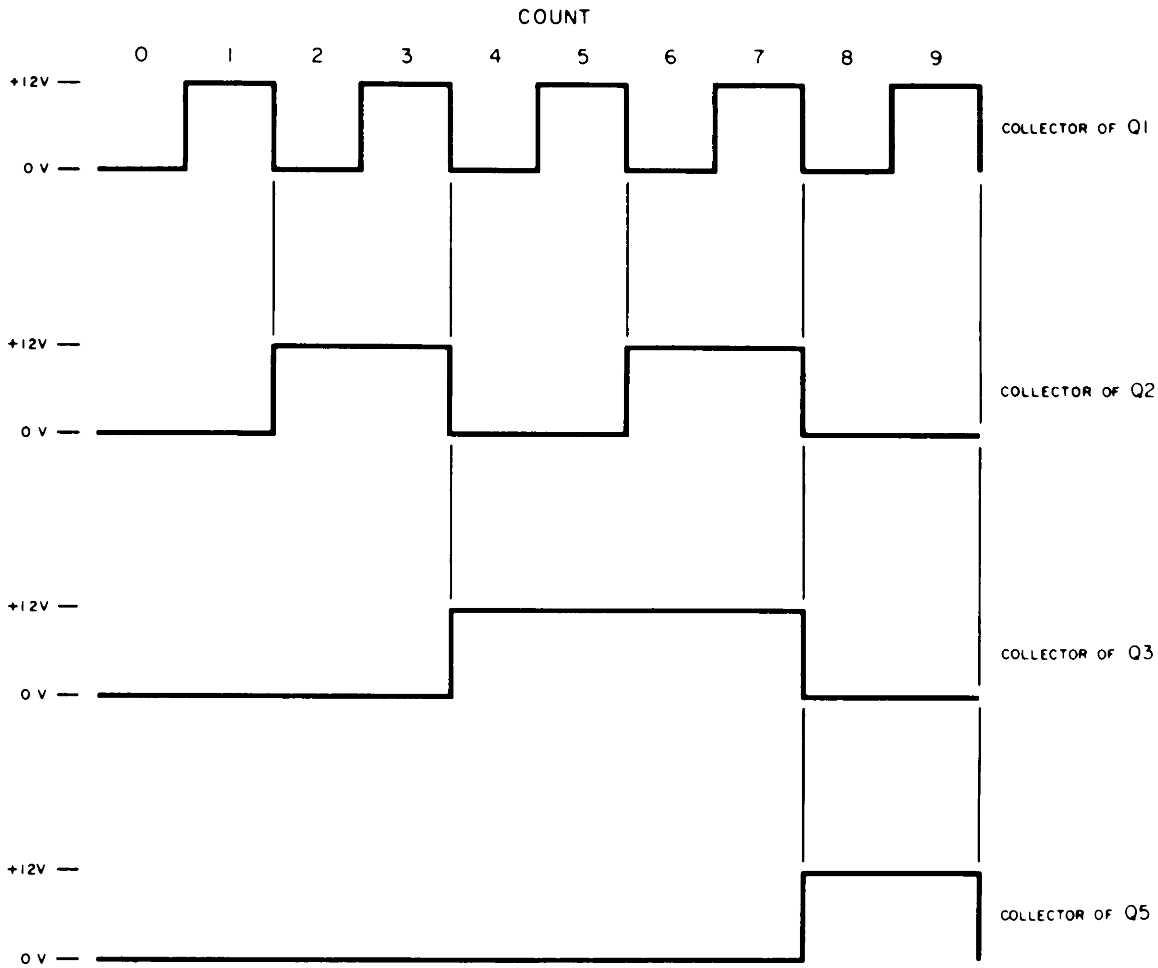


Figure 4-22. Coupled Count Decade Flip-Flops, Collector Waveforms

together to provide one output pulse for each ten input pulses. Figure 4-22 shows the idealized waveforms at the output of each flip-flop. At the count of zero. Ql, Q2, Q3, and Q5 are saturated and their collectors are at approximately zero volts. Diodes CR1 and CR2 form an AND gate at the input to the Q2-side of the "2" flip-flop. This AND gate prevents the "2" flip-flop and "4" flip-flop from changing state after the eighth input pulse is applied to the count decade. Since the C4 side of the "8" flip-flop is driven directly by "l" flip-flop, the tenth input pulse causes the "8" flip-flop to change state. This, in effect causes the "8" flip-flop to change state at the counts of eight and ten. The change of state at the count of ten is used as the decade output. The 10-mc and 300-kc counting rate decades operate in this manner Outputs are taken from both collectors of each flip-flop to drive the readout decoding circuits. An AND gate is provided on each decade which may be selected to provide the appropriate scaled frequency A when the counter is operated in the scale A mode.

four coupled flip-flops to produce a similar divide-by-ten action. The flip-flop circus and method of coupling are different from the slower speed count decades. Figure 4-23 shows a typical flip-flop used in this decade.

Transistors Q1 and Q2 form the flip-flop transistors, Q3 and Q4 arc trlggcr transistors. The input to the binary is applied at the junction of capacators Cl and C2, the output is taken at the junction of the load resistor R4 and inductor L2 in the collector curcult of Q2. Diodes CR1 and CR2 form steering networks which steer input pulses to the base of the cutoff trigger transistor. These pulses cause the trigger transistor to start conducting. thereby lowering its collector voltage to approximately zero volts. This negative-going voltage triggers both flip-flop transistors; it is coupled to the base of the conducting transistor through C3 or C4, and to the collector of the cutoff transistor through R1 or R2. The regeneration action of the flip-flop completes the change of state. The diodes in the base circuits of the flip-flop prevent saturation of either Q1 or Q2.

The input pulses to the 100-mc decade are passed through four amplifier stages EF1, AMPL2, AMPL4, and AMPL5. AND gate AG3 allows the input signal to be counted when the gate control signal is at the zero-volt level. The output of AMPL5 is coupled to TRIG6 and TRIG7 which drive FF8. Flip-flop FF8 divides the input pulse repetition rate by two; the output of the flip-flop is amplified by EF9, AMPL10, AMPL11, and EF12 and applied to the inputs of each of the other three flip-flops. Diodes A1A9CR24, A1A9CR27, A1A9CR34, A1A9CR37, A1A9CR40, A1A9CR45, A1A9CR50, A1A9CR51, A1A9CR53, and A1A9CR61 steer the output pulses from EF12 to the proper trigger transistor in the proper sequence to produce one output pulse from the FF21 for every ten input pulses to the decade. Emitter follower EF22 provides the decade output.

The outputs from one side of each flip-flop are supplied to additional circuits located on the printed circuit board A1A19. The decade output pulse is applied to the two inverters INV31 and INV32. The carry output pulse to the following count decade is taken at the output of INV31. The output of INV32 drives an AND gate AG55 which provides the scaled count signal when the counter is operated in the SCALE A MODE. The signal from each flip-flop on count decade A1A9 is applied to the input of a separate two- stage inverter. These inverters provide TRUE and FALSE signals of the proper voltage level to drive the readout circuits.

b. COUNT DECADE TROUBLE SHOOTING. - The first step in trouble shooting the count decade section is to determine in which particular decade the fault lies. This can be done by observing the readout display associated with each decade, one at a time, until the faulty decade is located. Check the 100-mc decade and inverter circuits first. If this decade is operating properly, check the amplifiers which supply the carry pulse to the next decade. If they are operating properly, check the remaining decades in the following order: A1A18, A1A17, A1A16, A1A15, A1A14, A1A13, and A1A12.

Problem symptoms in a particular count decade fall into three categories: (1) improper decade output, (2) absence of decade output, and (3) absence of scale output when the scale gate is selected. Because the circuits of count decades A1A12 through A1A18 are similar, the trouble- shooting procedures for those decades are identical. In trouble shooting for improper or no output from any of these decades, the first

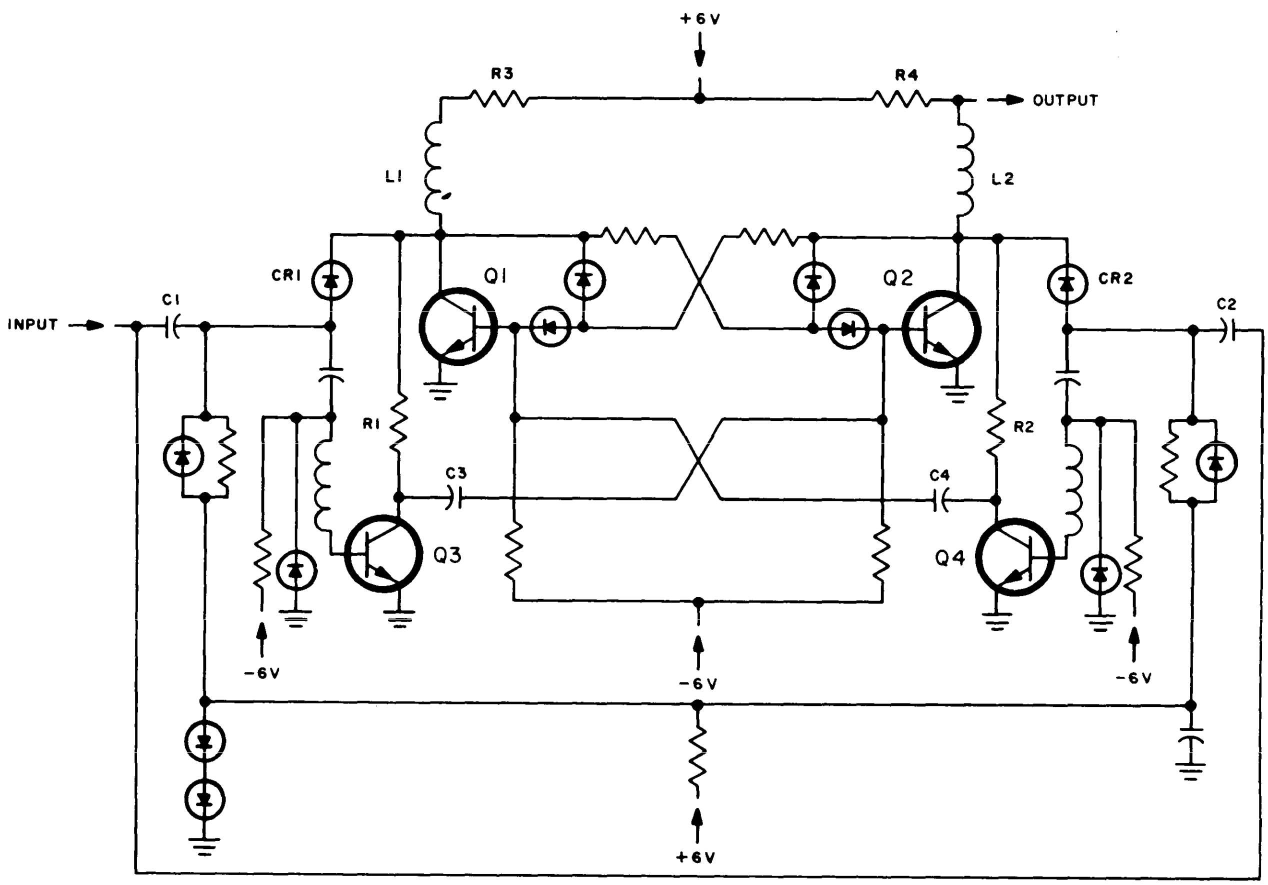


Figure 4-23. Typical High-Speed Count Flip-Flop, Simplified Schematic Diagram

step is to check that each flip-flop can be made to change state by shorting the collector of the cutoff transistor to ground. If a flip-flop does change state but does not operate with an input signal, check its triggering circuits. If the decade divides the repetition rate of the input signal by a factor other than ten, check the AND gate diodes at the input of FF35 and FF41. If the decade does not produce a scale frequency output, check the scale gate circuits AG38 and AG44.

Problems in the 100-mc decade can originate in the flip-flops, the coupling between flip-flops, or in the inverter circuits which drive the readout display. Problems in this decade can be caused by improper adjustment. Before the trouble- shooting procedure is started, check for proper adjustment. The procedure for adjusting the decade is given in paragraph 5-4g. When trouble shooting the amplifiers, AND gate, and first flip-flop circuits follow the input signal through the individual stages. The input signal should be present at the output of AMPL5 if A1A9Q3 is kept at cutoff (count gate open). The proper output of the "l" flip-flop is a pulse train of one-half the input repetition rate. If this flip-flop is found to be bad, check its ability to change state by shorting the collector of the cutoff transistor to ground. If the flip-flop does change state but does not operate with an input signal, check its triggering circuits. The signal from the output of the FF8 can be followed through amplifiers EF9, AMPL10, AMPL1l, and EF12.

Check the remaining three flip-flops for their ability to change state, by shorting the collector of each cutoff transistor to ground. If a flip-flop is found which does not change state, check the parts which make up the stage. If all flip-flops do change state, the cause of trouble may be a bad trigger circuit. Finally, check the coupling diodes between the flip-flops. When the faulty part has been replaced, the output signal from the "8" flip-flop can be followed through emitter follower EF22 and inverters INV31 and INV32 on the digital display indicator A1A19. If the decade does not produce a scale frequency output, check the scale gate circuit AG33. When all flip-flops are operating properly the output signal from each can be followed through the inverter stages INV23 through INV30 on the digital display indicator printed circuit board A1A19.

Table 4-14 is the count decade trouble shooting chart.

c. USEFUL ILLUSTRATIONS. - Illustrations useful in maintaining this functional section are: figures 4-20, 4-21, 4-22, 4-23, 4-24, 5-47, 5-48, 5-49, 5-72, 5-73, 5-74, 5-75, and 5-76.

TABLE 4-14. COUNT DECADES TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADES ON A1A12 THROUGH A1A16			
	Note Test point designations in this column refer to test points on the applicable assembly.	Note Prefix all reference designations in this column by the applicable assembly number.	
1	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. FUNCTION switch to TIME B ⇒ DC. Mode selector switch to SEP. Press RESET switch. Turn B TRIGGER VOLTS control in either direction until the GATE lamp goes on. Rotate time-base switch until digital display indicator associated with faulty count decade changes display *once* each second. Observe waveform at test point 5 and compare with that shown in figure 4-24.	Waveform is correct.	2
		If voltage does not change, check previous decade.	
2	Observe waveform at test point X and compare with that shown in figure 4-24.	Waveform is correct.	4
		Waveform is absent.	3

TABLE 4-14. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADES ON A1A12 THROUGH AlA18 (cont)			
3	Monitor voltage at test point X. Determine cutoff transistor in FF40 and short its collector momentarily to ground.	If voltage changes by more than 10 volts and remains at that level, check CR17 and CR18.	
		If voltage does not change, check Q10 and Q1l.	
		If voltage changes by more than 10 volts but returns to its original level, check Q10 and Q1l.	
4	Observe waveform at test point Y and compare with that shown in figure 4-24.	Waveform is correct.	6
		Waveform is absent.	5
5	Monitor voltage at test point Y. Determine cutoff transistor in FF41 and short its collector momentarily to ground.	If voltage changes by more than 10 volts and remains at that level, check CR19, CR21, CR20, and CR22.	
		If voltage does not change, check Q12 and Q13.	
		If voltage changes by more than 10 volts but returns to its original level, check Q12 and Q13.	
6	Observe waveform at test point Z and compare with that shown in figure 4-24.	Waveform is correct.	8
		Waveform is absent.	7
7	Monitor voltage at test point Z. Determine cutoff transistor in FF42 and short its collector temporarily to ground.	If voltage changes by more than 10 volts and remains at that level, check CR23 and CR24.	
		If voltage does not change, check Q14 and Q15.	
		Lf voltage changes by more than 10 volts but returns to its original level, check Q14 and Q15.	
8	Observe waveform at test point 6 and compare with that shown in figure 4-24.	If waveform is correct, check load on decade output.	9
		Waveform is absent.	
9	Monitor voltage at test point 6, Determine cutoff transistor in FF43 and short its collector momentarily to ground.	If voltage changes by more than 10 volts and remains at that level, check Q18, CR25 and CR26.	
		If voltage does not change, check Q16, Q17, Q18, and CR22.	

TABLE 4-14. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADES ON A1A12 THROUGH AlA18(cont)			
9 (cont)		If voltage changes by more than 10 volts but returns to its original level, check Q16, Q17, Q18, and CR22.	
10	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. FUNCTION switch to TIME B ⇒ C. Mode selector switch to SEP. Press RESET switch. Turn B TRIGGER VOLTS control slowly in either direction, until the GATE lamp goes on. Rotate time-base switch until digital display indicator associated with faulty count decade changes display once each second. Observe waveform at test point 3 and compare with that shown in figure 4-24.	Waveform is correct.	11
		Waveform is absent.	
11	Observe waveform at test point U and compare with that shown in figure 4-24.	Waveform is correct.	13
		Waveform is absent.	12
12	Monitor voltage at test point U. Determine cutoff transistor in FF34 and short its collector momentarily to ground.	If voltage changes by more than 10 volts and remains at that level, check CR17, CR18, CR20, and CR21.	
		If voltage does not change, check Q10, Qll, CR19, and CR20.	
		If voltage changes by more than 10 volts but returns to its original level, check Q10, Qll, CR19, and CR20.	
13	Observe waveform at test point V and compare with that shown in figure 4-24.	Waveform is correct.	15
		Waveform is absent.	14
14	Monitor voltage at test point V. Determine cutoff transistor in FF35 and short its collector momentarily to ground.	If voltage changes by more than 10 volts and remains at that level, check CR23, CR24, CR27, CR28, CR29, and CR30.	
		If voltage does not change, check Q12, Q13, CR25, and CR26.	
		If voltage changes by more than 10 volts but returns to its original level, check Q12, Q13, CR25, and CR26.	
15	Observe waveform at test point W and compare with that shown in figure 4-24.	Waveform is correct.	17
		Waveform is absent.	16

TABLE 4-14. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADES ON A1A12 THROUGH A1A18 (cont)			
16	Monitor voltage at test point W. Determine cutoff transistor in FF36 and short its collector momentarily to ground.	If voltage changes by more than 10 volts and remalns at that level, check CR31, CR32. CR35, and CR36.	
		If voltage does not change, check Q14, Q15, CR33, and CR34.	
		If voltage changes by more than 10 volts but returns to its original level, check Q14, Q15, CR33, and CR34.	
17	Observe waveform at test point 4 and compare with that shown in figure 4-24.	If waveform is correct, check load on decade output.	
		Waveform is absent.	18
18	Monitor voltage at test Point 4. Determine cutoff transistor m FF37 and short lts collector momentarily to ground.	If voltage changes by more than 10 volts and remains at that level, check Q18, CR37, CR38, CR41, and CR42.	
		If voltage does not change, check Q16, Q17, Q18, CR29, CR39, and CR40.	
		If voltage changes by more than 10 volts but returns to its original level, check Q16, Q17, Q18, CR29, CR39, and CR40.	
COUNT DECADE A1A9			
19	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. FUNCTION switch to TIME B ⇒ C. Time-base switch to 1. Mode selector switch to SEP. Press RESET switch. Turn B TRIGGER VOLTS control slowly in either direction until GATE lamp goes on. Observe waveform at test point A and compare with that shown in figure 4-24.	Waveform is correct.	20
		If waveform is incorrect, check A1A9Q1.	
20	Observe waveform at test point B and compare with that shown in figure 4-24.	Waveform is correct.	21
		If waveform is incorrect, check A1A9Q2, A1A9Q3, A1A9CR1, A1A9CR2, and A1A9CR3.	
21	Observe waveform at test point C and compare with that shown in figure 4-24.	Waveform is correct.	22
		If waveform is incorrect, check A1A9Q4, A1A9Q5, A1A9CR4, A1A9CR5, A1A9CR6, A1A9CR7, and A1A9CR8.	

TABLE 4-14. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADE A1A9 (cont)			
22	Observe waveform at test point E and compare with that shown in figure 4-24.	Waveform is correct.	24
		If lower level of waveform is more negative than +0.8 volt, check A1A9CR16 and A1A9CR17.	
		If voltage change is less than 4 volts, check A1A9Q9, A1A9Q10, A1A9CR18, A1A9CR19, and A1A9CR20.	
		Waveform is absent.	23
23	Monitor voltage at test point E. Determine cutoff transistor in FF8 and short its collector momentarily to ground.	If voltage changes by more than 4 volts and remains at that level, check A1A9Q6, A1A9Q9, A1A9CR9, A1A9CR10, A1A9CR11, A1A9CR14, A1A9CR15, A1A9CR18, A1A9CR19, and A1A9CR20.	
		If voltage changes by less than 4 volts, check A1A9Q9, A1A9Q10, A1A9CR18, A1A9CR19, and A1A9CR20.	
		If voltage does not change, check A1A9Q7, A1A9Q8, A1A9CR12, A1A9CR13, A1A9CR16, and A1A9CR17.	
		If voltage changes by more than 4 volts but returns to its original level, check A1A9Q7, A1A9Q8, A1A9CR12, A1A9CR13, A1A9CR16, and A1A9CR17.	
		If voltage is more negative than +0.8 volt or changes to more negative than +0.8 volt, check A1A9CR12, A1A9CR13, A1A9CR16, and A1A9CR17.	
24	Observe waveform at test point D and compare with that shown in figure 4-24.	Waveform is correct.	25
		If lower level of waveform is more negative than +0.8 volt, check CR12 and CR13.	
25	Observe waveform at test point F and compare with that shown in figure 4-24.	Waveform is correct.	26
		Lf waveform is incorrect, check A1A9Q1O, A1A9Q11, and A1A9CR21.	
26	Observe waveform at test point G and compare with that shown in figure 4-24.	Waveform is correct.	27
		If waveform is incorrect, check A1A9Q12, A1A9Q13, A1A9CR22, and A1A9CR23.	
27	Observe waveform at test point I and compare with that shown in figure 4-24.	Waveform is correct.	29

TABLE 4-14. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADE A1A9 (cont)			
27 (cont)		If lower level of waveform is more negative than +0.8 volt, check A1A9CR30 and A1A9CR31.	
		Waveform is absent.	28
28	Monitor voltage at test point H. Determine cutoff transistor in FF15 and short its collector momentarily to ground.	If voltage changes by more than 4 volts and remains at that level, check A1A9Q14, A1A9Q17, A1A9CR24, A1A9CR25, A1A9CR26, A1A9CR27, A1A9CR32, A1A9CR33, A1A9CR34, and A1A9CR35.	
		If voltage changes by less than 4 volts, check A1A9Q15, A1A9Q16, A1A9CR24, A1A9CR27, A1A9CR34, A1A9CR37, A1A9CR50, and A1A9CR53.	
		If voltage does not change, check A1A9Q14, A1A9Q15, A1A9Q16, A1A9Q17, A1A9CR28, A1A9CR29, A1A9CR30, and A1A9CR31.	
		If voltage changes by more than 4 volts but returns to its original level, check A1A9Q14, A1A9Q15, A1A9Q16, A1A9Q17, A1A9CR28, A1A9CR29, A1A9CR30, and A1A9CR31.	
		If voltage is more negative than +0.8 volt or changes to more negative than +0.8 volt, check A1A9CR30 and A1A9CR31.	
29	Observe waveform at test point K and compare with that shown in figure 4-24.	Waveform is correct.	31
		If lower level of waveform is more negative than +0.8 volt, check A1A9CR43 and A1A9CR44.	
		Waveform is absent.	30
30	Monitor voltage at test point J. Determine cutoff transistor in FF18 and short its collector momentarily to ground.	If voltage changes by more than 4 volts and remains at that level, check A1A9Q18, A1A9Q21, A1A9CR37, A1A9CR38, A1A9CR39, A1A9CR40, A1A9CR45, A1A9CR46, A1A9CR47, A1A9CR48, A1A9CR49, and A1A9CR80.	
		If voltage changes by less than 4 volts, check A1A9Q18, A1A9Q21, A1A9CR40, A1A9CR47, and A1A9CR51.	
		If voltage does not change, check A1A9Q18, A1A9Q19, A1A9Q20, A1A9Q21, A1A9CR41, A1A9CR42, A1A9CR43, and A1A9CR44.	

TABLE 4-14. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADE A1A9 (cont)			
30 (cont)		If voltage changes by more than 4 volts but returns to its original level, check A1A9Q18, A1A9Q19, A1A9Q20, A1A9Q21, A1A9CR41, A1A9CR42, A1A9CR43, and A1A9CR44.	
		If voltage is more negative than +0.8 volt or changes to more negative than +0.8 volt, check A1A9CR41 and A1A9CR42.	
31	Observe waveform at test point M and compare with that shown in figure 4-24.	Waveform is correct.	33
		If negative portion of waveform is less than +0.8 volt, check A1A9CR57 and A1A9CR58.	
		Waveform is absent.	
32	Monitor voltage at test point L. Determine cutoff transistor in FF20 and short its collector momentarily to ground.	If voltage changes by more than 4 volts and remains at that level, check A1A9Q22, A1A9Q25, A1A9CR51, A1A9CR52, A1A9CR53, A1A9CR59, A1A9CR60, A1A9CR61, A1A9CR62, and A1A9CR63.	
		If voltage changes by less than 4 volts, check A1A9Q22, A1A9Q25, A1A9Q26, A1A9CR24, and A1A9CR61.	
		If voltage does not change, check A1A9Q22, A1A9Q23, A1A9Q24, A1A9Q25, A1A9Q26, A1A9CR55, A1A9CR56, A1A9CR57, and A1A9CR58.	
		If voltage changes by more than 4 volts but returns to its original level, check A1A9Q22, A1A9Q23, A1A9Q24, A1A9Q25, A1A9Q26, A1A9CR55, A1A9CR56, A1A9CR57, and A1A9CR58.	
		If voltage is more negative than +0.8 volt or changes to more negative than +0.8 volt, check A1A9CR55 and A1A9CR56.	
33	Observe waveform at test point 2 and compare with that shown in figure 4-24.	Waveform is correct.	34
		If waveform is incorrect, check A1A9Q26.	
34	Observe waveform at test point N (on digital display indicator A1A19) and compare with that shown in figure 4-24.	Waveform is correct.	35
		If waveform is incorrect, check A1A19Q10 and A1A19CR17.	

TABLE 4-14. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
COUNT DECADE A1A9 (cont)			
35	Observe waveform at test point P (on digital display indicator A1A19) and compare with that shown in figure 4-24.	Waveform is correct.	36
		If waveform is incorrect, check A1A19Q11, A1A19Q12, and A1A19CR18.	
36	Observe waveform at test point Q (on digital display indicator A1A19) and compare with that shown in figure 4-24.	Waveform is correct.	37
		If waveform is incorrect, check A1A19Q13 and A1A19Q14.	
37	Observe waveform at test point R (on digital display indicator A1A19) and compare with that shown in figure 4-24.	Waveform is correct.	38
		If waveform is incorrect, check A1A19Q15 and A1A19Q16.	
38	Observe waveform at test point S (on digital display indicator A1A19) and compare with that shown in figure 4-24.	Waveform is correct.	39
		If waveform is incorrect, check A1A19Q17 and A1A19Q18.	
39	Observe waveform at test point T (on digital display indicator A1A19) and compare with that shown in figure 4-24.	If waveform is correct, check readout circuits.	
		If waveform is incorrect, check A1A19Q19 and A1A19Q20.	

NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ——— — — ——— Indicates assembly boundaries.
3. Dc voltages are preceded by "+" or "–".
4. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:
   Sensitivity: 5 v/cm.
   Sweep time: 1 sec/cm.
5. Explanation of symbols placed at waveforms:

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Abbreviations within logic or circuit blocks are as follows:

AG	AND Gate
AMPL	Amplifier
EF	Emitter Follower
FF	Flip-Flop
INV	Inverter
OR	OR Gate

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.
8. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
9. Counter circuits of assemblies A1A17 and A1A18 are identical. Only A1A18 is shown in detail.
10. Counter circuits of assemblies A1A12 through A1A16 are identical. Only A1A16 is shown in detail.
11. Operating control settings:

    POWER switch to TRACK.
    FUNCTION switch to TIME B→C.
    Mode selector switch to SEP.
12. To corresponding parts on readout portion of same assembly:

    Example: On 10^3 Count Decade, corresponding parts are as listed at 10^2 Count Decade with prefix changed to A1A17.
13. To corresponding parts on readout portion of same assembly.

    Example: On 10^6 Count Decade, corresponding parts are as listed at 10^4 Count Decade with prefix changed to A1A13.
14. An asterisk (*) indicates that the assembly designator is the same as that listed in the lower left-hand corner of the applicable dashed-line block.

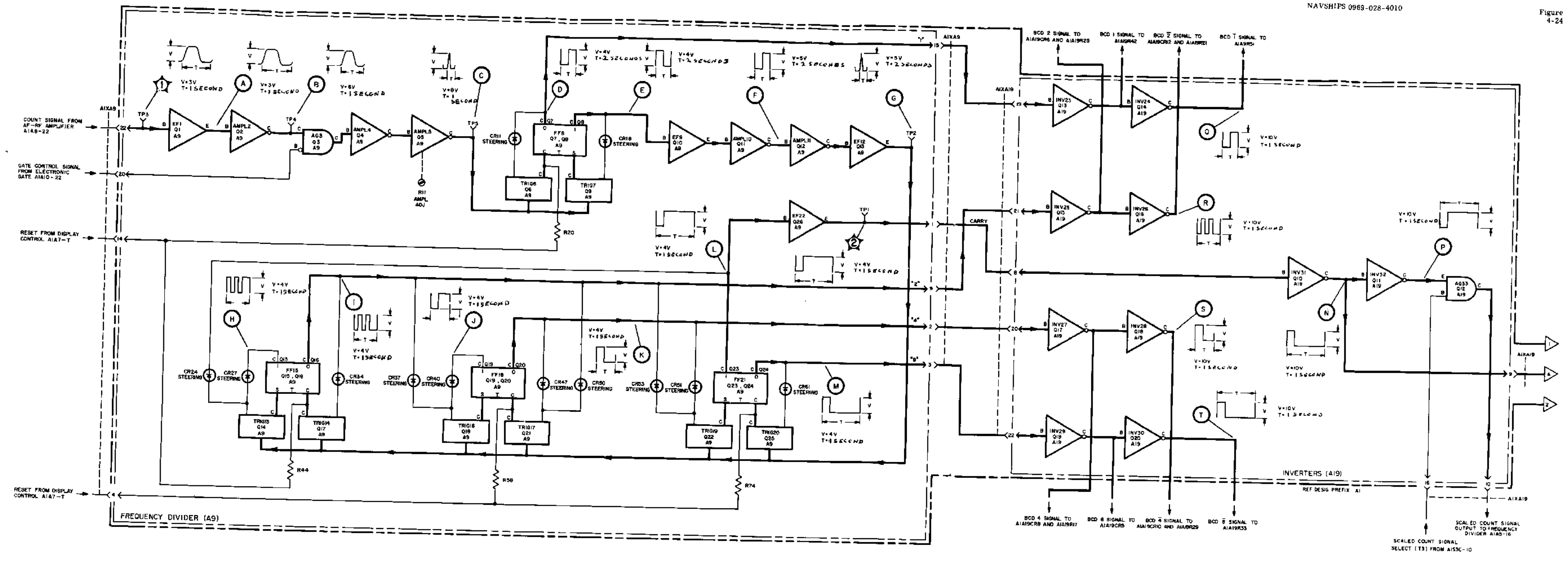
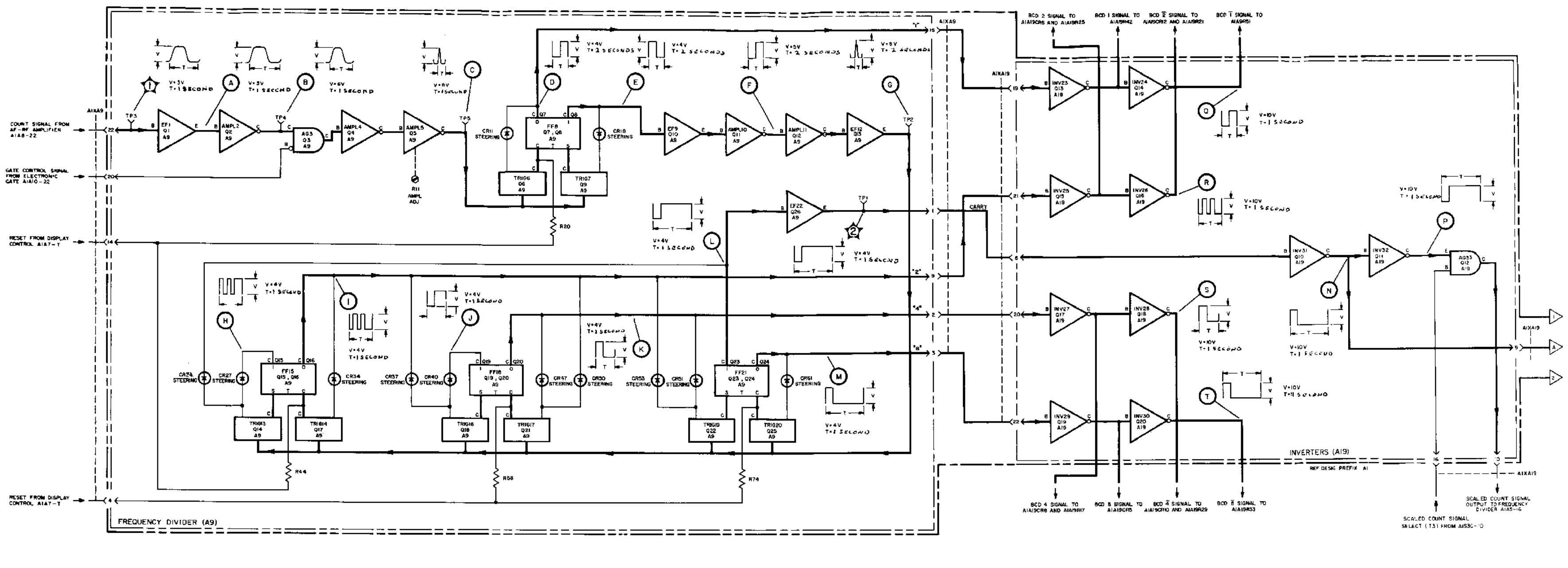


Figure 4-24. Count Decade, Functional and Servicing Block Diagram (Sheet 1 of 3)



NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ——— — — ——— indicates assembly boundaries.
3. Dc voltages are preceded by "+" or "−".
4. Waveforms recorded with an AN/USM-140B Oscilloscope.

   Control settings:
   Sensitivity: 5 v/cm.
   Sweep time: 1 sec/cm.

5. Explanation of symbols placed at waveforms:

   T – Duration of the portion of waveform indicated.
   V – Peak-to-peak voltage.

6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Abbreviations within logic or circuit blocks are as follows:

AG	AND Gate
AMPL	Amplifier
EF	Emitter Follower
FF	Flip-Flop
INV	Inverter
OR	OR Gate

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.

8. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
9. Counter circuits of assemblies A1A17 and A1A18 are identical. Only A1A18 is shown in detail.
10. Counter circuits of assemblies A1A12 through A1A16 are identical. Only A1A16 is shown in detail.
11. Operating control settings:

    POWER switch to TRACK.
    FUNCTION switch to TIME B→C.
    Mode selector switch to SEP.

12. To corresponding parts on readout portion of same assembly:

    Example: On 10^3 Count Decade, corresponding parts are as listed at 10^2 Count Decade with prefix changed to A1A17.

13. To corresponding parts on readout portion of same assembly.

    Example: On 10^6 Count Decade, corresponding parts are as listed at 10^4 Count Decade with prefix changed to A1A13.

14. An asterisk (*) indicates that the assembly designator is the same as that listed in the lower left-hand corner of the applicable dashed-line block."

Figure 4-24. Count Decade, Functional and Servicing Block Diagram (Sheet 1 of 3)

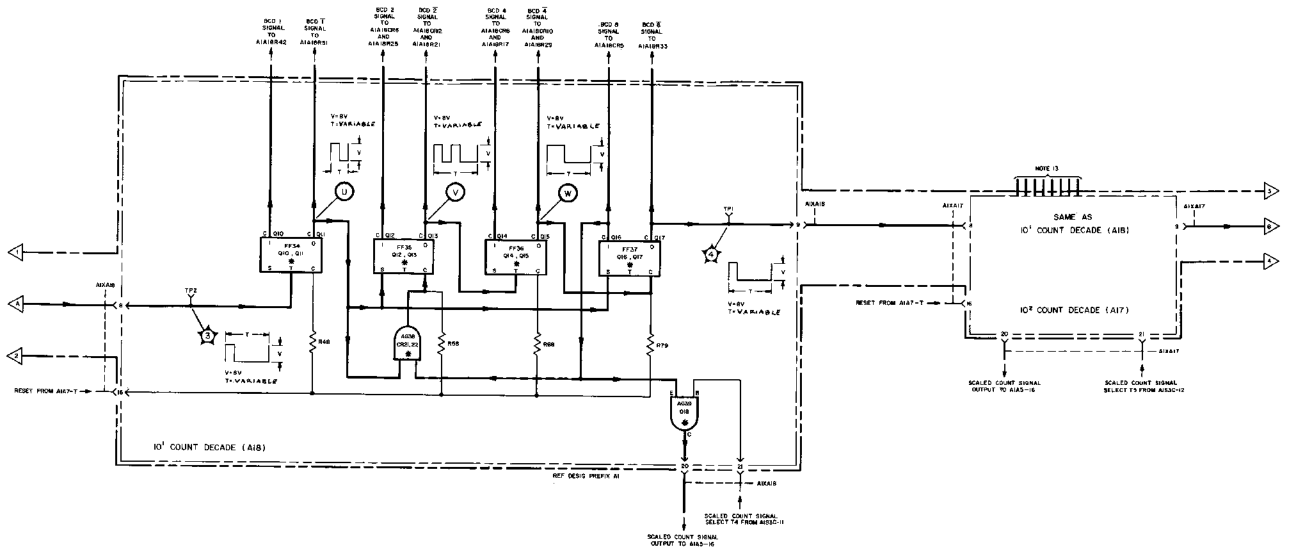


Figure 4-24. Count Decade, Functional and Servicing Block Diagram (Sheet 2 of 3)

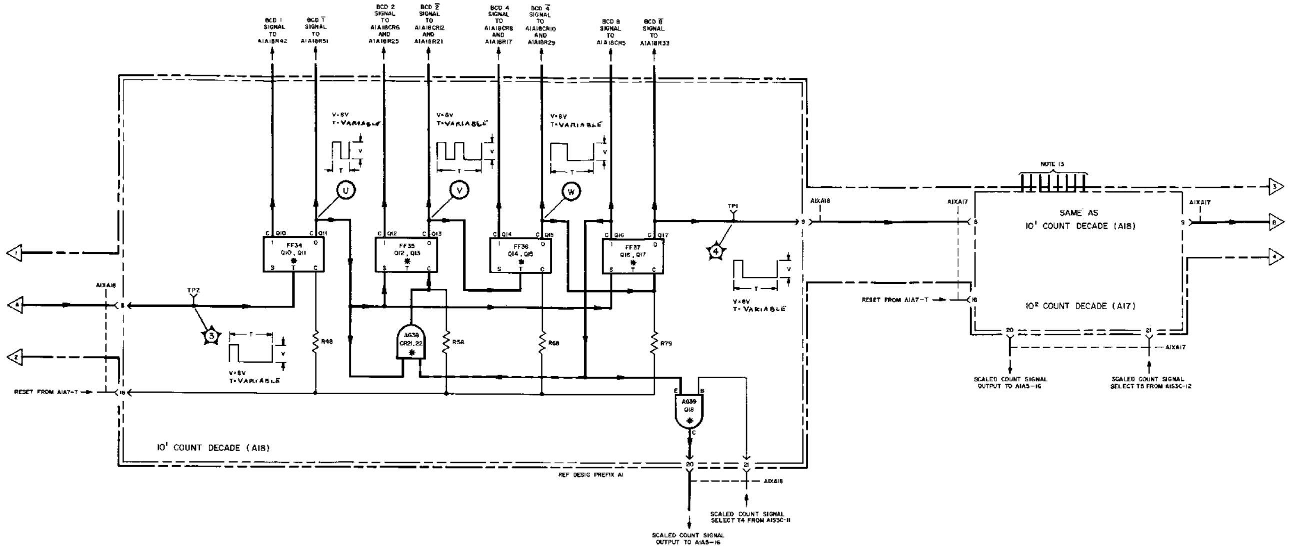


Figure 4-24. Count Decade, Functional and Servicing Block Diagram (Sheet 2 of 3)

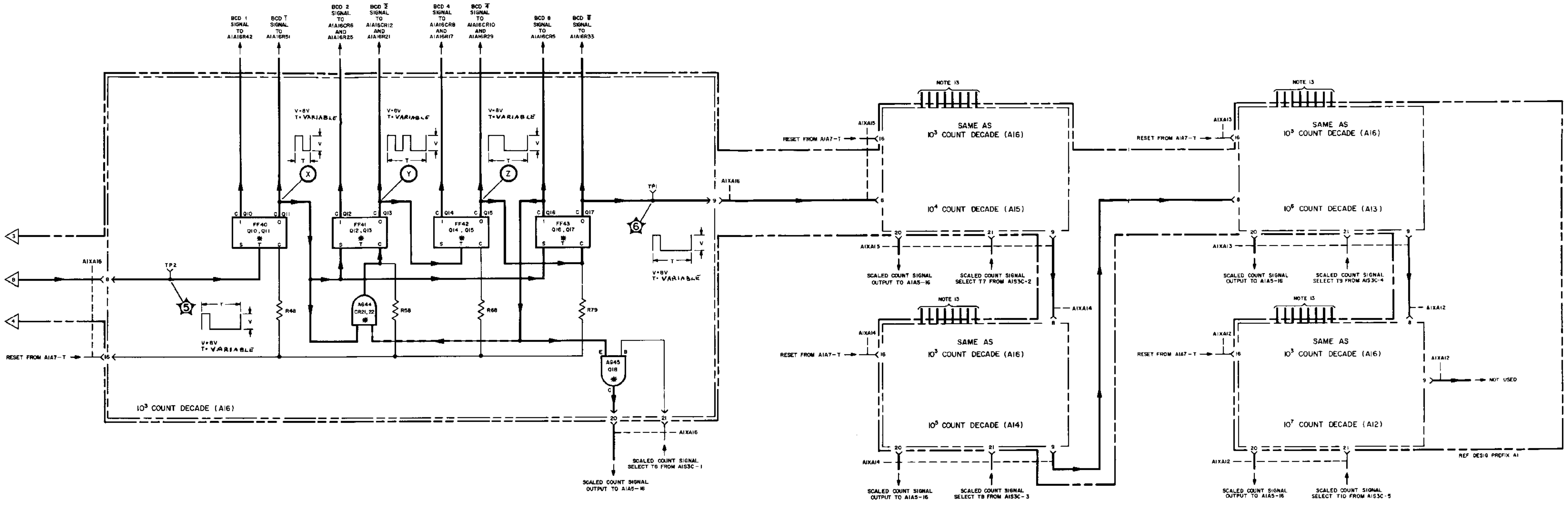


Figure 4-24. Count Decade, Functional and Servicing Block Diagram (Sheet 3 of 3)

4-15. READOUT.

a. READOUT FUNCTIONAL DESCRIPTION. - The readout functional section is constructed on portions of printed circuit boards A1A12 through A1A19 and A1A7. A readout indicator tube and circuits for its operation are mounted on printed circuit boards AIA12 through A1A19. The circuits for the coding of decimal point position information for the printer output are constructed on printed circuit board A1A7. Figure 4-29 shows the readout circuits and the decimal point coding circuits of one of the eight printed circuit boards, A1A12; the others are identical to A1A12 and are not shown separately.

The readout section decodes the binary-coded-decimal information obtained from the count decades into decimal information, and displays this information on the readout indicator tube. The readout also stores the information displayed on the readout indicator when the counter is operated in the store mode.

The readout indicator tube is a cold-cathode, gas-filled indicator consisting of two anodes, and five pairs of cathodes. Each cathode consists of two decimal indicators: 0-1, 2-3, 4-5, 6-7, and 8-9. The two anodes are termed odd or even. Igniting any particular number requires a voltage between one of the two anodes and one of the five cathode pairs. The circuits which drive the readout indicator can be divided into two parts: the anode selection and the cathode selection.

The reference designations used in the following description are not prefixed by assembly designations. The descriptions apply to any of assemblies A1A12 through A1A19.

The circuits that select the appropriate annode consist of FF3, SW1 and SW2. When the counter is operated in the track mode, the flip-flop is driven directly by the “1” flip-flop on the associated count decade, and reverses its state each time the count advances by one number. The flip-flop is in one state (Q3 conducting) for even numbers and in the opposite state (Q4 conducting) for odd numbers. The outputs of FF3 are used to drive SW1 and SW2. These two switches are in shunt across the readout indicator. When an even number is to be displayed, Q1 (SW1) cuts off and Q2 (SW2) saturates, causing the voltage at the even anode to rise and at the odd anode to fall. When an odd number is to be displayed, the reverse occurs. To complete the ionization of the readout indicator the voltage at one cathode must be lowered until the ignition voltage between anode and cathode is reached.

The circuits that select the appropriate cathode consist of five silicon-controlled switches (SW6 through SW10). The input to each switch is an AND gate. The inputs to the AND gates are taken from the "2", "4", and "8" flip-flops on the associated count decade. One additional input is supplied by the transfer pulse for store operation. When all inputs to any AND gate are positive and the counter is in the track mode, the AND gate produces a positive output causing the silicon- controlled switch to conduct. This conducting switch lowers the cathode voltage to the point where the readout indicator ignites. Table 4-15 shows the inputs necessary to activate each AND gate.

TABLE 4-15. READOUT DIGITS DECODING

AND GATE	CATHODE	POSITIVE INPUTS NECESSARY TO ACTIVATE AND GATE
AG11	0, 1	2, 4, 8, and transfer pulse
AG12	2, 3	$\overline{2}$, 4, and transfer pulse
AG13	4, 5	2, $\overline{4}$, and transfer pulse
AG14	6, 7	$\overline{2}$, $\overline{4}$, and transfer pulse
AG15	8, 9	$\overline{8}$, and transfer pulse

When the counter is in the TRACK mode of operation, the transfer pulse input to the AND gates is held at approximately +12 volts. This allows the gates to be activated entirely by the count-decade flip-flops. The clear-set signal supplied to the silicon-controlled switch is held at approximately zero volts; this allows the switch to conduct when the AND gate is activated and to cut off when it is not, In this mode of operation the number displayed changes each time the count changes in the count decades.

The silicon-controlled switches are also used as the storage elements when the counter is operated in the store mode. In this mode of operation the positive clear-set voltage keeps the silicon-controlled switch in conduction after the AND gate is no longer activated. This causes the number displayed to remain illuminated even though the number in the count decade changes. When the clear-set voltage is removed the silicon controlled switch cuts off. To turn on the switch the AND gate must be reactivated. In the store mode this requires the presence of the transfer signal as well as the proper inputs from the count decades. Thus, the AND gate turns on the silicon-controlled switch, application of the clear- set signal holds it on, and removal of clear set turns it off. Figure 4-25 shows the relationship between the clear set and transfer signals during store and track operation.

The remainder of the readout section consists of the decimal point and unit lamp system and decimal lamp position coding. All the lamps are controlled by the front panel FUNCTION and time-base switches. Table 4-16 shows which lamp light in each position of the FUNCTION and time-base switches.

The decimal lamp coding system is constructed on part of printed circuit board A1A7. The seven decimal-point lamp positions on the readout are assigned the numbers D0 through D6 with D0 being at the far right when the counter is viewed from the front. The position number of the lamp that is lighted is coded into binary-coded-decimal form and terminated at the PRINTER connector. Since there is no term requiring a binary-coded-decimal 8, this term is always at the +12-volt level.

b. READOUT TROUBLE SHOOTING. - Problems in the readout section fall into five categories:

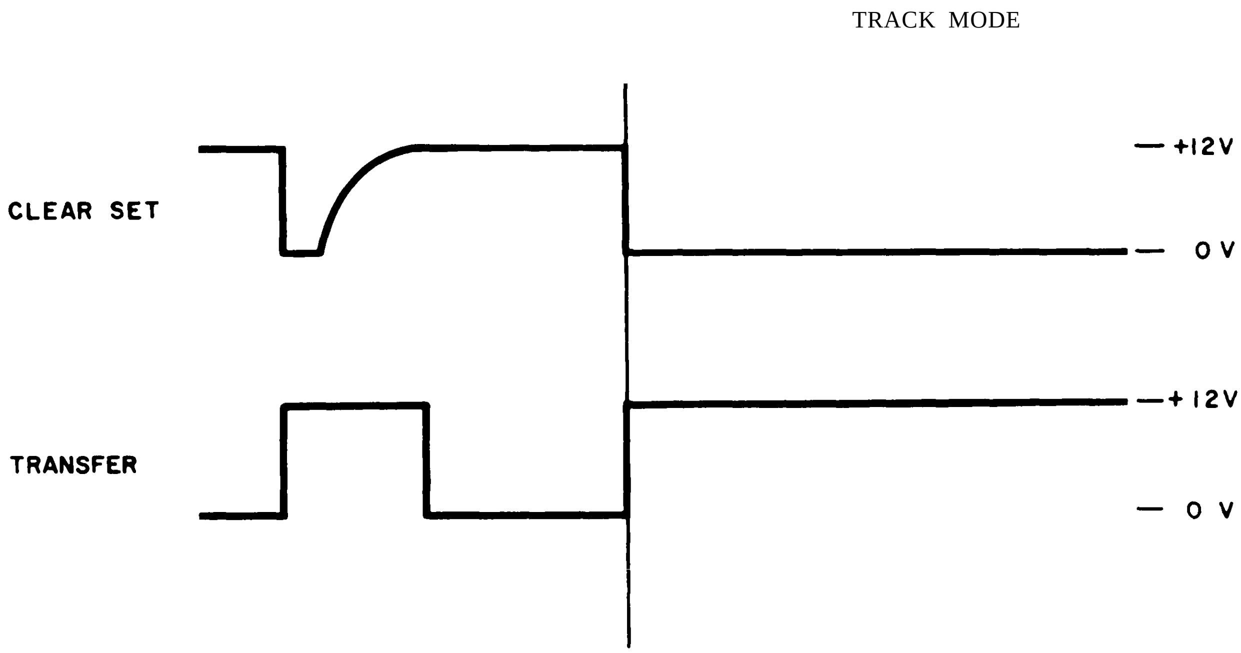


Figure 4-25. Store and Track Mode Readout Waveforms

TABLE 4-16. ANNUNCIATOR LAMP ILLUMINATION

FUNCTION SWITCH POSITION	TIME BASE SWITCH POSITION									
	10^{-1}	1	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^8
PERIOD B x 1		sec, D0	sec, D1	sec, D2	ms, D0	ms, D1	ms, D2	ms, D0	ms, D1	D0
PERIOD B x 10		sec, D1	sec, D2	ms, D0	ms, D1	ms, D2	ms, D0	ms, D1	ms, D2	D1
PERIOD B x 10^2			ms, D0	ms, D1	ms, D2	ms, D0	ms, D1	ms, D2	ms, D3	D2
PERIOD B x 10^3				ms, D2	ms, D0	ms, D1	ms, D2	ms, D3	ms, D4	D3
PERIOD B x 10^4					ms, D1	ms, D2	ms, D3	ms, D4	ms, D5	D4
PERIOD B x 10^5						ms, D3	ms, D4	ms, D5	ms, D6	D5
TIME B → C		sec, D0	sec, D1	sec, D2	ms, D0	ms, D1	ms, D2	ms, D0	ms, D1	
FREQ	kc, D4	kc, D3	kc, D2	kc, D1	kc, D0	mc, D2	mc, D1	mc, D0		
SCALE A										
MANUAL STOP										
MANUAL START										

(1) improper decoding of count decade signals; (2) improper memory operation; (3) improper numeral illumination; (4) faults in the readout indicator tubes; and (5) improper decimal-lamp position coding. Table 4-17 is the readout trouble-shooting chart.

If only odd or only even numbers are displayed on the readout indicator, check FF3 and associated switches SW1 and SW2. The flip-flop is driven through R51 and R42 from the collectors on the "1" flip-flops of the associated count decade. The collectors of Q3 and Q4 drive the switch transistors Q1 and Q2. If any of these four transistors is open or shorted, the readout may display only odd or only even numbers.

Figure 4-26 is useful in trouble shooting problems resulting in absence of ignition voltage at any numeral.

In figure 4-26, the only situation which allows the voltage between the anode and cathode to reach the ignition voltage occurs when the silicon-controlled switch is conducting and the transistor is cutoff. If this situation is found to exist and the readout indicator is not ionized, check the tube.

A partial schematic diagram of one of the silicon-controlled switches and associated AND gate is shown in figure 4-27. This diagram is useful in trouble

In figure 4-27, positive levels at all inputs produce a positive voltage at the AND gate output. When this occurs, turn-on current is supplied to the silicon-controlled switch through the AND gate resistor. This causes the silicon-controlled switch to saturate and the anode gate is at the cathode bias voltage. If the voltage at the anode is made positive, the switch remains saturated when the inputs to the AND gate are removed. If two numbers corresponding to a single cathode do not light, the silicon-controlled switch driving them is probably open. If more than one number lights at a time, check the parts making up the AND gate associated with those numbers.

A partial schematic diagram of the coding of one decimal point lamp (D4) is shown in figure 4-28. When the switch is closed the lamp lights and the input to the OR gate is grounded. The output of the OR gate is zero volts and the binary-coded-decimal output is 4, corresponding to lamp D4 being lighted. The other lamps are coded in an identical manner.

Table 4-17 is the readout trouble-shooting chart.

c. USEFUL ILLUSTRATIONS. — Illustrations useful in maintaining this functional section are: figures 4-25, 4-26, 4-27, 4-28, 4-29, 5-42, 5-47, 5-48, 5-49, 5-77, 5-78 and 5-79.

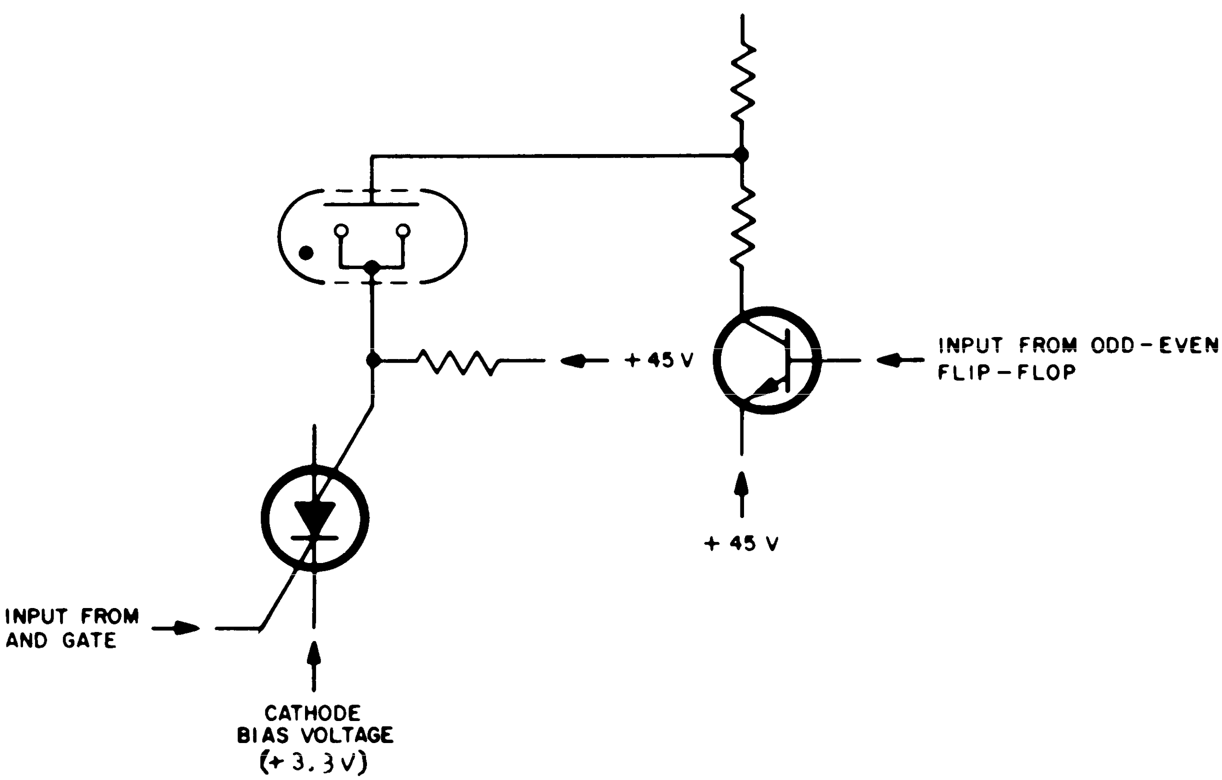


Figure 4-26. Typical Readout Indicator Driver, Simplified Schematic Diagram

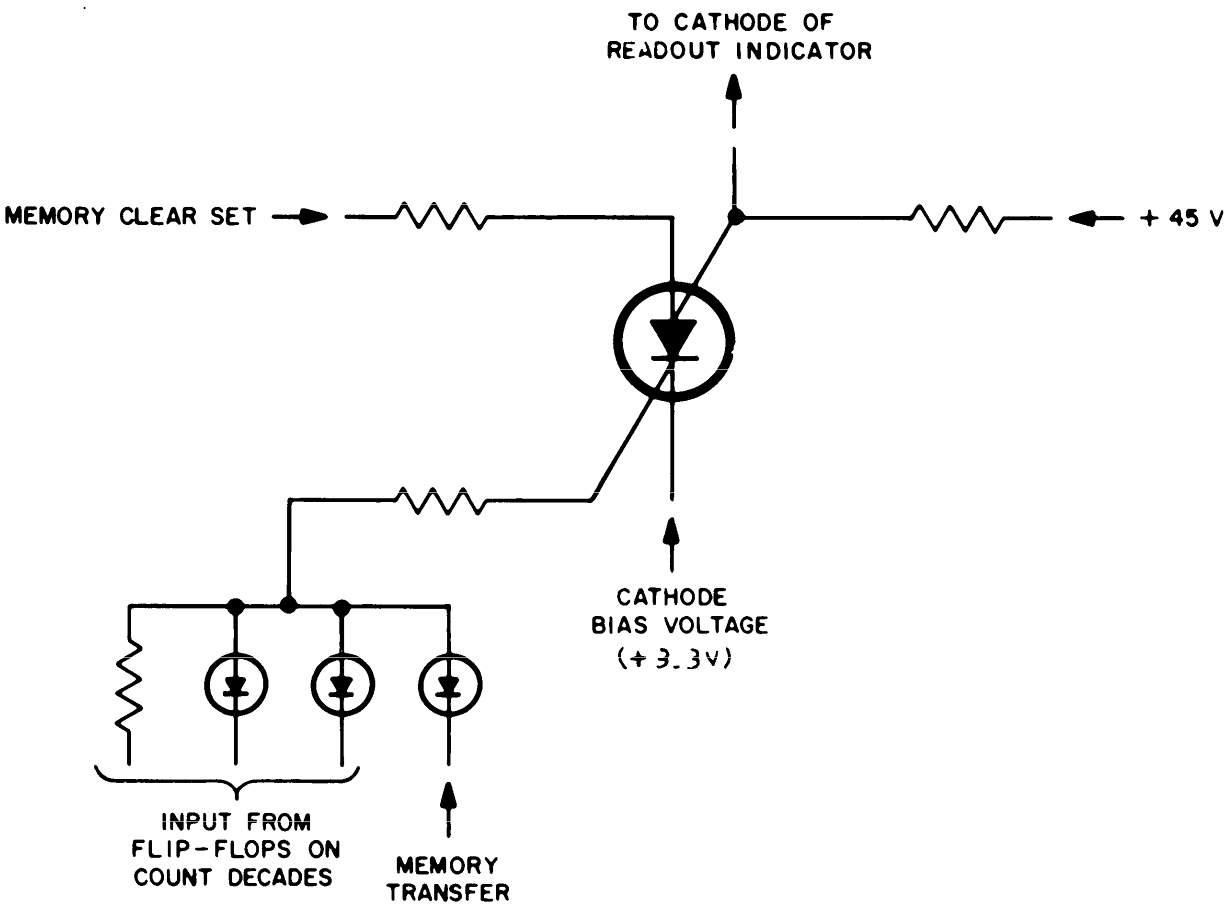


Figure 4-27. Typical Readout Decoding, Simplified Schematic Diagram

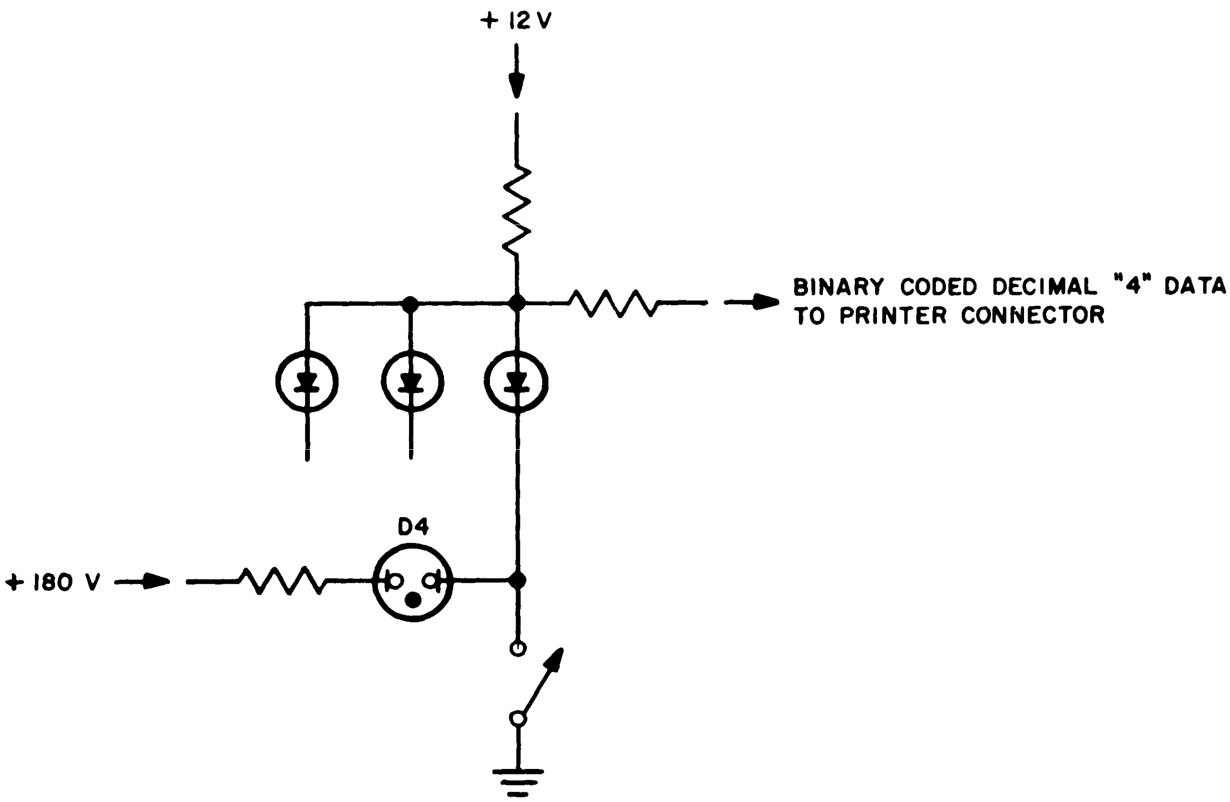


Figure 4-28. Typical Decimal Point Lamp Coding,
Simplified Schematic Diagram

TABLE 4-17. READOUT TROUBLE SHOOTING

STEP	ACTION	RESULTS	NEXT STEP
		Note Prefix all reference designations in this column by the applicable assembly number.	
1	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. FUNCTION switch to TIME B ⇒ C. Mode selector switch to SEP. Press RESET switch. Turn B TRIGGER VOLTS control slowly in either direction until the GATE lamp goes on. Rotate time-base switch until faulty digital display indicater advances once each second.	Readout counts in the proper sequence of 0 through 9.	2
		If readout displays only even or only odd numbers, check Q1 through Q4.	
		If readout displays five single numbers and five double numbers, check Q1 through Q4, CR1 and CR2.	
		If readout becomes blurred during part of count sequence, check CR7, CR9, CR1l, and CR13.	
		If readout displays double numbers with the exception of a single 8 or 9, check CR14.	
		If readout advances while either 0 or 1 is on all the time, check Q5.	
		If readout advances while either 2 or 3 is on all the time, check Q6.	
		If readout advances while either 4 or 5 is on all the time, check Q7.	
		If readout advances while either 6 or 7 is on all the time, check Q8.	
		If readout advances while either 8 or 9 is on all the time, check Q9.	
		If readout advances but 0 and 1 are blurred, check Q6.	
		If readout advances but 4 and 5 are blurred, check Q7.	
		If readout advances but 6 and 7 are blurred, check Q8.	
		If readout advances but 8 and 9 are blurred, check Q9.	
		If readout advances but two consecutive numbers light at once, check Q1 through Q4.	
		If readout advances in an improper sequence, check CR5, CR6, CR8, CR1O, and CR12.	
		If readout displays random double numbers, check CR5, CR6, CR8, CR1O, and CR12.	

TABLE 4-17. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
1 (cont)		If readout blinks on and off, check cathode bias voltage (correct voltage is approximately +1 volt).	
2	Set the controls on the front panel of the counter as follows: POWER switch to TRACK. FUNCTION switch to FREQ. SENSITIVITY switch to .1 V. Time-base switch to 1. Apply a signal to the FREQ. A connector with a frequency which causes faulty digital display indicator to advance approximately once each second. Set POWER switch to STORE. Vary frequency of input signals to cause the faulty digital display indicator to store as many different numbers as possible.	Readout stores every number properly.	3
		If readout becomes blurred when 0 or 1 should be stored, check R19 and Q5.	
		If readout becomes blurred when 2 or 3 should be stored, check R23 and Q6.	
		If readout becomes blurred when 4 or 5 should be stored, check R27 and Q7.	
		If readout becomes blurred when 6 or 7 should be stored, check R31 and Q8.	
		If readout becomes blurred when 8 or 9 should be stored, check R35 and Q9.	
		If 0 or 1 light along with number being stored, check CR7.	
		If 2 or 3 light along with number being stored, check CR9.	
		If 4 or 5 light along with number being stored, check CR1l.	
		If 6 or 7 light along with number being stored, check CR13.	
		If 8 or 9 light along with number being stored, check CR14.	
3	Monitor binary-coded-decimal output of the following pins on PRINTER connector, (TRUE output is normally more negative than +0. 5 volts, FALSE is more positive than +11. 5 volts): BCD 1 pin 9 BCD 2 pin c BCD 4 pin b BCD 8 pin x Vary positions of FUNCTION and time-base switches to change position of decimal point light and check lamp coding.	If BCD 1 coding is incorrect, check A1A7CR12, A1A7CR13, and A1A7CR14.	
		If BCD 2 coding is incorrect, check A1A7CR15, A1A7CR16, and A1A7CR17.	
		If BCD 4 coding is incorrect, check A1A7CR18, A1A7CR19, and A1A7CR20.	
		If BCD 8 coding is not always FALSE (about +12 volts), check A1A7R49.	
		If all BCD outputs remain at zero volt, check power supply.	

NOTES

1. Primary signal paths weighted.
2. ——— — — ——— indicates assembly boundaries.
3. Dc voltages are preceded by "+" or "−".
4. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
5. Abbreviations within logic or circuit blocks are as follows:

   AG AND Gate
   FF Flip-Flop
   SW Switch

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.
6. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
7. Readout circuits of assemblies A1A12 through A1A19 are identical. Only A1A19 is shown in detail.
8. Operating control settings:

   POWER switch to TRACK.
   FUNCTION switch to TIME B→C.
   Mode selector switch to SEP.
9. To corresponding parts on count decade portion of same assembly.
10. To corresponding parts on count decade portion of assembly A1A19.

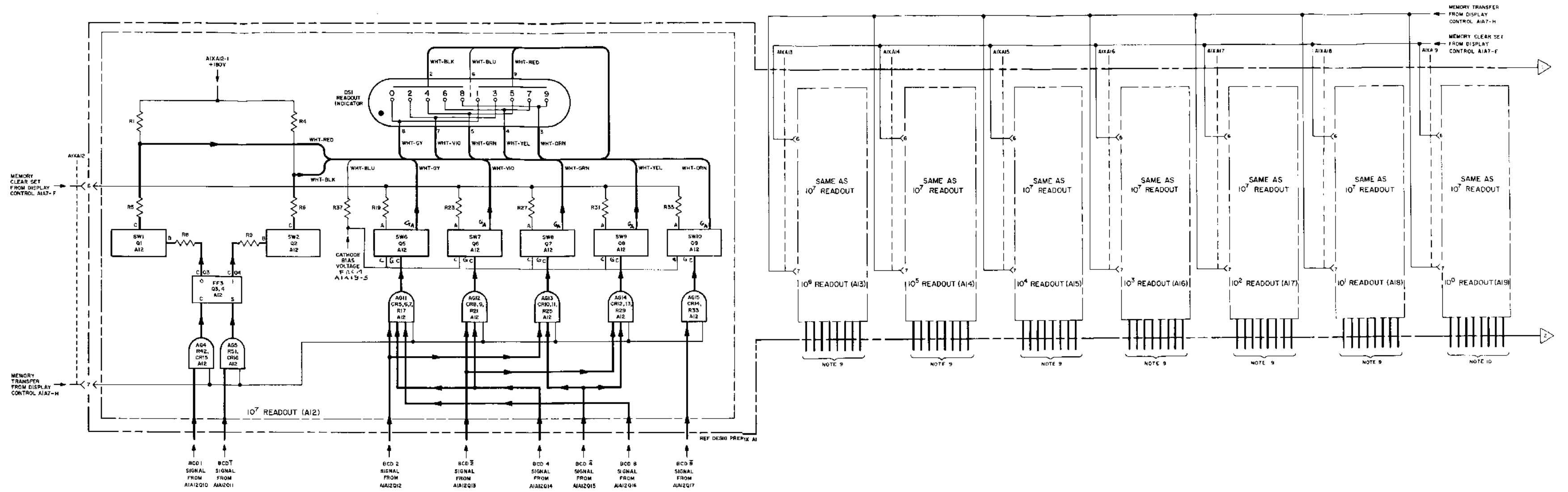
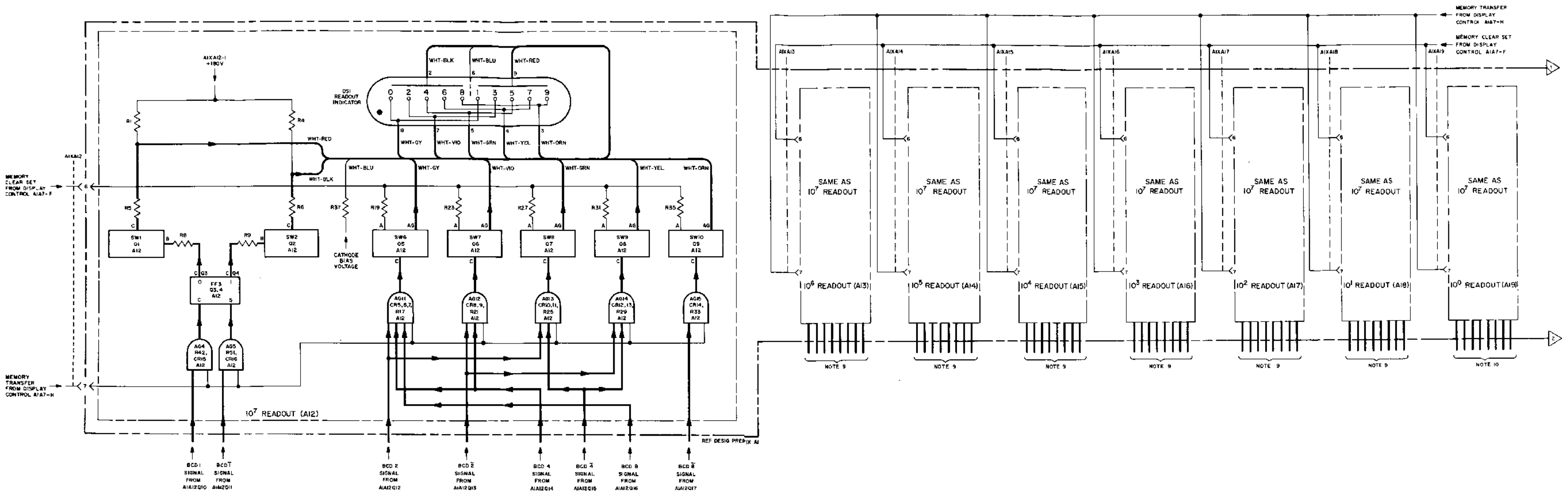


Figure 4-29. Readout, Functional and Servicing Block Diagram (Sheet 1 of 2)



NOTES

1. Primary signal paths weighted.
2. ——— — — ——— indicates assembly boundaries.
3. Dc voltages are preceded by "+" or "-".
4. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
5. Abbreviations within logic or circuit blocks are as follows:

   AG AND Gate
   FF Flip-Flop
   SW Switch

   Identification within logic blocks is as follows: The first line identifies the logic function symbol on the drawing. The symbols are numbered in general data flow sequence. The second line identifies the major parts associated with the logic function. The third line identifies the assembly containing the logic function.
6. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
7. Readout circuits of assemblies A1A12 through A1A19 are identical. Only A1A19 is shown in detail.
8. Operating control settings:

   POWER switch to TRACK.
   FUNCTION switch to TIME B→C.
   Mode selector switch to SEP.
9. To corresponding parts on count decade portion of same assembly.
10. To corresponding parts on count decade portion of assembly A1A19.

Figure 4-29. Readout, Functional and Servicing Block Diagram (Sheet 1 of 2)

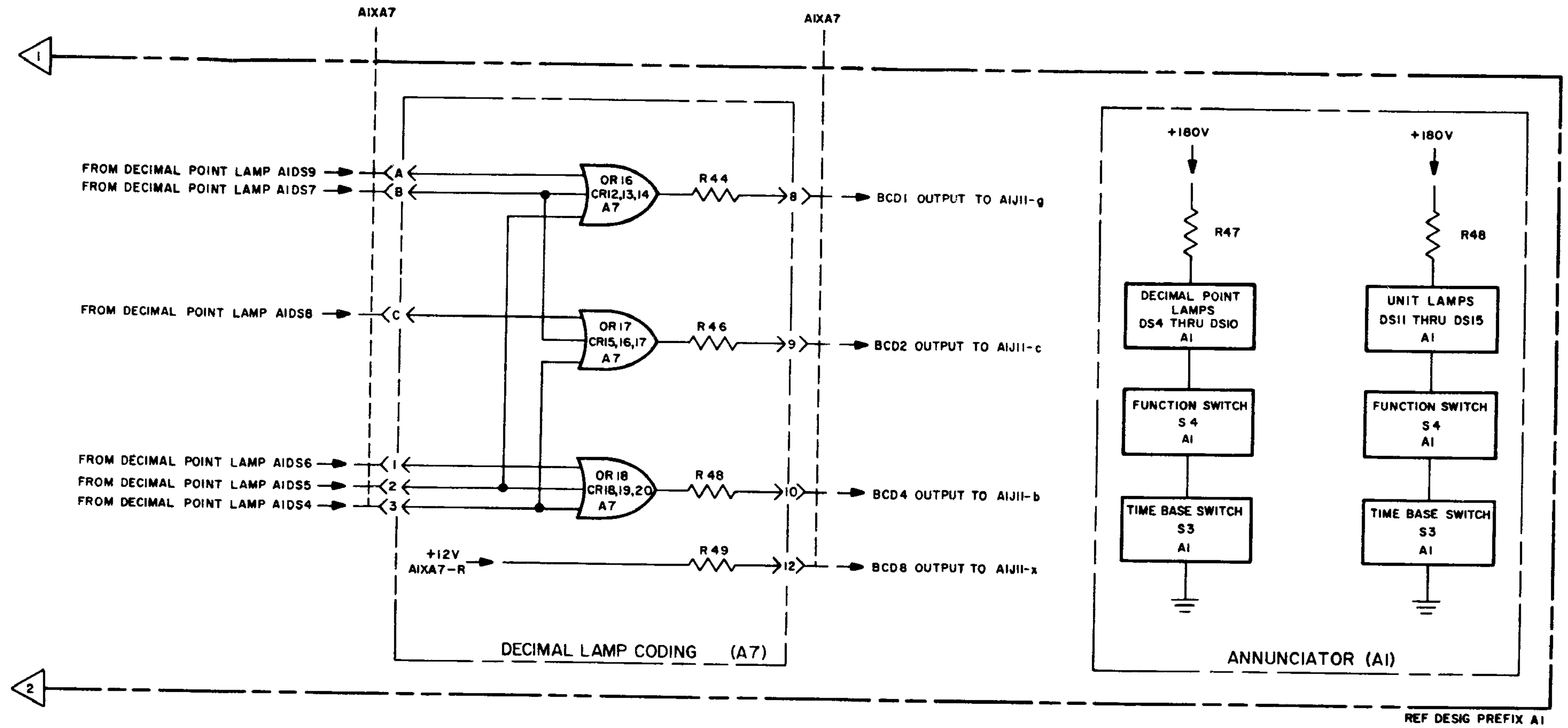


Figure 4-29. Readout, Functional and Servicing Block Diagram (Sheet 2 of 2)

NOTES

1. Primary signal paths weighted. Feedback paths weighted and dashed.
2. ━━ ━ ━ ━━ indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Dc voltages are preceded by "+" or "−"; ac ripple voltages are followed by VAC.
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. The letters CW, placed adjacent to the appropriate terminals of potentiometer A1A1R8 indicate the direction of rotation viewed from the shaft end.
7. Letters and numbers outside of some logic or circuit blocks indicate transistor elements.
8. Operating control setting:

   POWER switch to TRACK.

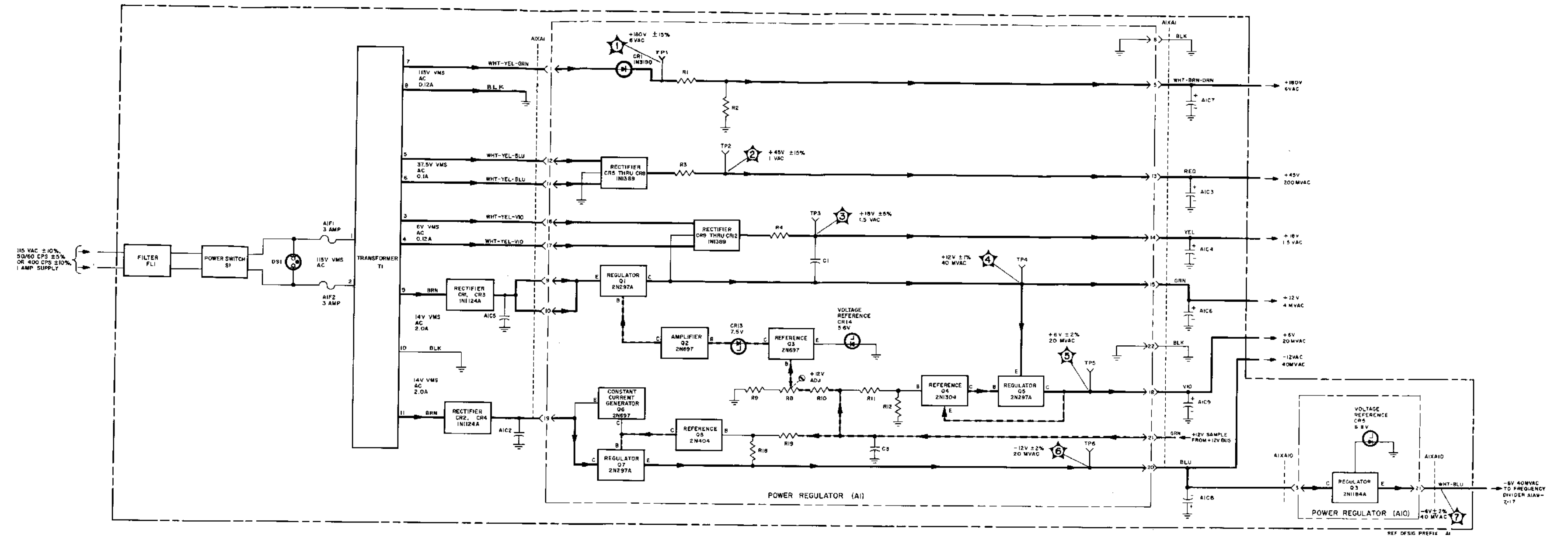


Figure 4-30. Power Supply, Functional and Servicing Block Diagram

4-16. POWER SUPPLY.

a. POWER SUPPLY FUNCTIONAL DESCRIPTION. - The power supply functional section consists of seven dc supplies. Five of these supplies (+18-volt, +12-volt, +6-volt, –6-volt, and -12-volt) are regulated and two (+180-volt and +45-volt) are unregulated. The majority of the power supply circuits is constructed on printed circuit board AlAl. The power transformer, four rectifier diodes, and eight filter capacitors are mounted on the main chassis. The regulator for the -6-volt supply is constructed on part of printed circuit board A1A10. Figure 4-30 shows the functional relationship of all circuits in the power supply.

The +12-volt regulated supply consists of rectifier A1CR1, A1CR2, regulator A1A1Q1, amplifier A1A1Q2, reference A1A1Q3, and associated circuits. Regulator A1A1Q1 acts as a variable impedance connected between the rectifier and the load, and regulates the load voltage around +12 volts. Regulation is controlled by reference A1A1Q3. It compares a sample of the load voltage against a fixed voltage supplied by diode A1A1CR14, and produces an error voltage proportional to the change in load voltage, This error voltage is amplified in amplifier A1A1Q2 and applied to the base of the regulator, changing the impedance of the regulator. The change in impedance is such that it returns the output voltage to its regulated value. The +12-volt regulated output serves as a stable reference for the other regulated supplies.

The +6-volt regulated supply consists of regulator A1A1Q5, reference A1A1Q4, and associated circuits. it receives its input from the +12-volt supply, and reduces it to +6 volts by dropping the remainder across regulator A1A1Q5. Regulation is controlled by reference A1A1Q4. It compares the load voltage against a portion of the fixed +12 volts, and produces an output proportional to the load voltage variation. This output changes the impedance of regulator A1A1Q5 accordingly, offsetting the initial change in load voltage.

The -12-volt regulated supply consists of rectifier A1CR2, A1CR4, constant current generator A1A1Q6, regulator A1A1Q7, reference A1A1Q8, and associated circuits. Operation of the -12-volt regulated supply is similar to the +12-volt regulated supply.

The -6-volt regulated supply consists of regulator A1A1OQ3, voltage reference A1A10CR5, and associated circuits. It is similar in operation to the operation to the +6-volt regulated supply, and derives its output voltage from the -12-volt regulated supply.

The +18-volt regulated supply consists of rectifier A1A1CR9 through A1A1CR12 and associated circuits. It is essentially a +6-volt supply superimposed on +12 volts. The rectifier produces a potential difference of 6 volts, and its negative side is returned to +12 volts, Since the output is taken from the positive side of the rectifier, this output is 18 volts positive with respect to ground.

b. POWER SUPPLY TROUBLE SHOOTING.- Problems in the power supply function section fall into five categories: (1) no output; (2) high or low output; (3) output voltage does not remain constant as the line voltage is varied ±10% from 115 volts; and (4) a ripple level on the output that is greater than specified. Table 4-18 is a trouble-shooting chart for the power supply. The step-by- step trouble - shooting procedure given is based on the trouble-shooting techniques discussed below.

Since the regulator circuits are interdependent, the first step in trouble shooting is to determine which supply is faulty. Check the +12-volt supply first, since it serves as a reference for the other supplies. Next, check the -12-volt supply, -6-volt supply, +6-volt supply, and the +18-volt supply, in that order. First measure the dc output voltage of the regulator under test, then vary the line voltage ±10% while making the same measurement, to assure that the regulator operates properly with line voltage variations. Next measure the ripple level on the output of the regulator and then vary the line voltage ±10% while repeating the same measurement. These measurements identify the trouble symptom; the trouble can be further localized by following subsequent steps of the trouble-shooting chart.

To better understand the sympton of high-ripple level in the output voltage of a power supply regulator, consider that the complete circuits consist of the dc power source (rectifiers and filter), regulator circuit, and the load. The ripple level across the load is equal to the ripple level across the dc power source minus the ripple level across the series regulator. The ripple level across the series regulator is a function of the dc gain of the regulator amplifier. The ripple level across the dc power source is a function of the line voltage and the filter capacity that follows the rectifiers. An increase in ripple level can be caused by a loss of gain in the regulator amplifier (which would also cause a loss in dc regulation) by a loss of capacity in the input filter (which may not be accompanied by a loss of dc regulation), or by a large undesired increase in load current resulting from a short circuit. Ripple voltage measurement tests are included in the trouble-shooting chart, table 4-18.

c. USEFUL ILLUSTRATIONS.- Illustrations useful in maintaining this functional section are: figures 4-30, 5-38, 5-45, and 5-80.

TABLE 4-18. POWER SUPPLY TROUBLESHOOTING

STEP	ACTION	RESULTS	NEXT STEP
		+180-VOLT SUPPLY	
1	Set POWER switch to TRACK. Measure dc voltage at test point 1.	Voltage is correct (+180 volts ±15%).	2
		If voltage is incorrect, check A1F1, A1F2, A1T1, A1A1CR1, and A1C2.	
2	Measure ac ripple voltage at test point 1.	Ripple voltage is 6 volts peak-to-peak or less.	3
		If ripple voltage is greater than 6 volts peak-to-peak, check A1C2.	
		+45-VOLT SUPPLY	
3	Measure dc voltage at test point 2.	Voltage is correct (+45 volts ±15%).	4
		If voltage is incorrect, check A1T1, A1A1CR5, A1A1CR6, A1A1CR7, A1A1CR8, and A1C3.	
4	Measure ac ripple voltage at test point 2.	Ripple voltage is 1.0 volt peak-to-peak or less.	5
		If ripple voltage is greater than 1.0 volt peak-to-peak, check A1C3.	
		+18-VOLT SUPPLY	
5	Measure dc voltage at test point 3.	Voltage is correct (+18 volts ±5%).	6
		If voltage is incorrect, check +12-volt supply, A1T1, A1A1CR9, A1A1CR10, A1A1CR1l, A1A1CR12, and A1C4.	
6	Measure ac ripple voltage at test point 3.	Ripple voltage is 1.5 volt peak-to-peak or less.	7
		If ripple voltage is greater than 1.5 volt peak-to-peak, check A1C4.	
		+12-VOLT SUPPLY	
7	Measure dc voltage at test point 4.	Voltage is correct (+12 volts ±l%).	8
		If voltage is incorrect, check A1T1, A1CR1, A1CR3, A1A1Q1, A1A1Q2, A1A1Q3, A1A1Q5, A1A1CR13, A1A1CR14, A1C5, and A1C6.	
8	Measure ac ripple voltage at test point 4.	Ripple voltage is 40 millivolts peak-to-peak or less.	9
		If ripple voltage is greater than 40 millivolts peak-to-peak, check A1A1Q1, A1A1Q2, A1A1Q3, A1C5, A1C6, and A1A1C6.	

TABLE 4-18. (Continued)

STEP	ACTION	RESULTS	NEXT STEP
		+6-VOLT SUPPLY	
9	Measure dc voltage at test point 5.	Voltage is correct (+6 volts ±2%).	10
		If voltage is incorrect, check A1A1Q4, A1A1Q5, and A1C9.	
10	Measure ac ripple voltage at test point 5.	Ripple voltage is 20 millivolts peak-to-peak or less.	11
		If ripple voltage is greater than 20 millivolts peak-to-peak, check A1A1Q4, A1A1Q5, and A1C9.	
		-12-VOLT SUPPLY	
11	Measure dc voltage at test point 6.	Voltage is correct (–12 volts ±2%).	12
		If voltage is incorrect, check +12-volt supply, A1T1, A1CR2, A1CR4, A1A1Q6, A1A1Q7, A1A1Q8, A1A1CR15, A1A1CR16, A1C7, and A1C8.	
12	Measure ac ripple voltage at test point 6.	Ripple voltage is 40 millivolts peak-to-peak or less.	13
		If ripple voltage is greater than 40 millivolts peak-to-peak, check A1A1Q6, A1A1Q7, A1A1Q8, A1C7, and A1C8.	
		-6-VOLT SUPPLY	
13	Measure dc voltage at test point 7 (on A1A10).	Voltage is correct (-6 volts ±2%).	14
		If voltage is incorrect, check -12-volt supply, A1A10Q3, A1A10CR5, and A1A10C2.	
14	Measure ac ripple voltage at test point 7.	If ripple voltage is 40 millivolts or less, check loading on all supplies.	
		If ripple voltage is greater than 40 millivolts peak-to-peak, check A1C8, A1A10Q3, A1A10CR5, and A1A10C2.	

SECTION 5

MAINTENANCE

5-1. FAILURE, AND PERFORMANCE AND OPERATIONAL REPORTS.

Note

The Bureau of Ships no longer requires the submission of failure reports for all equipments. Failure Reports and Performance and Operational Reports are to be accomplished for designated equipment (refer to Electronics Installation and Maintenance Book, NAVSHIPS 900,000) only to the extent required by existing directives. All failures shall be reported for those equipments requiring the use of Failure Reports.

5-2. PREVENTIVE MAINTENANCE.

Preventive maintenance consists mainly of cleaning the air filter and respecting the lnterior of the counter.

Note

Screws mounted on the outside surfaces of the counter are differentiated by means of a color code; those normally removed prior to maintenance have the color of stainless steel; the others, which are not expected to be removed, are the same color as the instrument.

a. SERVICING THE AIR FILTER. - The air filter is located on the rear panel of the counter. Inspect the air filter bi-weekly and clean as often as necessary. Monthly cleaning is sufficient in normal operating environments; clean it more often when the instrument is used in extremely dusty environments. The procedure is as follows:

(1) Remove the two screws which secure the filter unit to the rear panel and remove the filter unit.

(2) Wash the filter unit in warm water and detergent, Specification MIL-D-16791C; then dry it thoroughly.

(3) Replace the filter unit and secure the two screws. Be sure that it is oriented so that the open sides of the louvers are at the bottom.

(4) Prepare and maintain a maintenance check-off list for the air filter using the following format:

WEEKOF	AIR FILTER	
	CLEANING NOT REQUIRED	CLEANED

b. FAN MOTOR. - The fan motor is designed to operate without periodic lubrication.

c. VISUAL INSPECTION. - Inspect the Interior of the counter each time It is serviced; more frequently when it is subjected to excessive physical shock or operated in high-temperature environments. The procedure is as follows:

(1) Set POWER switch to OFF.

(2) Remove left and right protective panels. Each is fastened on by 16 screws.

(3) When protective panels are removed, four additional screws are exposed on each side. Remove the two top ones on each side.

(4) Remove the 11 screws on top. Note that the two at the front center are flat-head screws, and that the four screws on the right side are shorter than the others.

(5) Lift top cover up and away.

(6) Check that all plug-in printed circuit boards are firmly seated in their sockets.

(7) Check that all readout lamps are intact, firmly seated in their sockets, and secured by the tiedown bracket.

(8) Check for burned or bulging components.

(9) Replace top cover, using the reverse procedure of steps (2) through (5).

5-3. REFERENCE STANDARDS PROCEDURES.

Note

The procedures listed below constitute the minimum number of reference standards which will indicate, when completed, the relative performance of the counter and its plug-in units. The procedures are arranged in groups, each group is associated with a functional section of the counter. The power-supply procedure must be performed first, The remaining tests may be performed in any order without affecting the unity or result of the reference standards.

TABLE 5-1. REFERENCE STANDARDS PROCEDURES

SECTION	ACTION REQUIRED	PROCEDURE STEPS
Power Supply (Table 5-3)	Check dc voltages.	1
	Check ac ripple voltages.	2
Radio Frequency Oscillator (Table 5-4)	Check oscillator power supply.	3
	Check amplitude and frequency of radio-frequency oscillator, output signal.	4

TABLE 5-1. (Continued)

SECTION	ACTION REQUIRED	PROCEDURE STEPS
10 mc and 1 mc Multiplier (Table 5-5)	Check amplitude and frequency of the 1-mc standard-frequency output, using the internal radio-frequency oscillator as a standard.	5
	Check amplitude and frequency of the 10-mc standard-frequency output, using the internal radio-frequency oscillator as a standard.	6
	Check amplitude and frequency of the 10-mc standard-frequency output, using an external 100-kc standard.	7
Count Decades, Readout, and Cycle Control (Table 5-6)	Check count sequence of count decades, and decoding operation of readout section.	8
	Check cycle control in track mode.	9
	Check cycle control and readout section in store mode.	10
Scaler (Table 5-7)	Check amplitude and frequency of the scaled 10-MC test signal.	11
	Check amplitude and frequency of the scaled standard-frequency signal.	12
"A" Amplifier (Table 5-8)	Check sensitivity of "A" amplifier at frequencies between 10 cps and 100 mc.	13 through 22
"B" and "C" Amplifiers (Table 5-9)	Check sensitivity of "B" and "C" amplifiers at frequencies between 1 cps and 1 mc.	23 through 9
	Check that "B" amplifier triggers on negative slope of input signal.	30
	Check that "C" amplifler triggers on negative slope of input signal.	31
Gate Control (Table 5-10)	Check operation of gate control in frequency mode.	32
	Check operation of gate control in manual mode.	33
	Check operation of gate control in period mode.	34
	Check operation of gate control in time-interval mode.	35
	Check operation of gate control in frequency-ratio mode.	36
Count Control (Table 5-11)	Check operation of count control in frequency mode.	37
	Check operation of count control in manual mode.	38
	Check operation of count control in period mode.	39

TABLE 5-1. (Continued)

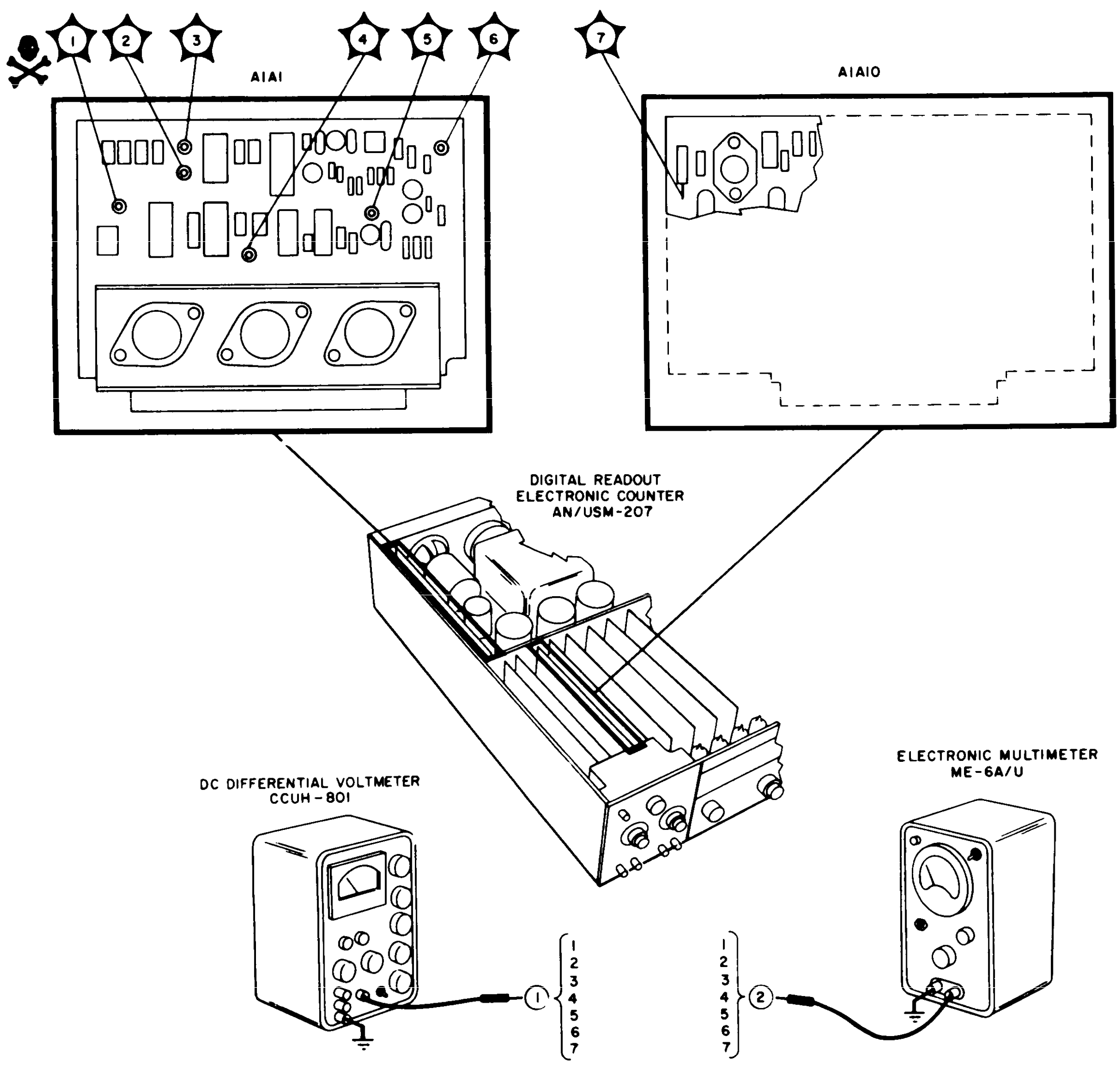
SECTION	ACTION REQUIRED	PROCEDURE STEPS
	Check operation of count control in time-interval mode.	40
	Check operation of count control in frequency-ratio mode,	41
Electronic Frequency Converter (Table 5-12)	Check sensitivity of frequency converter at frequencies between 35 mc and 100 mc.	42
	Check sensitivity and operation of frequency converter at frequencies between 100 mc and 500 mc.	43 through 60
	Check sensitivity and operation of frequency converter between frequencies of 500 mc and 550 mc.	61

TABLE 5-2. TEST EQUIPMENT REQUIRED FOR
REFERENCE STANDARD PROCEDURES

DESIGNATION	NAME
CCUH-801	Dc Differential Voltmeter
ME-6A/U	Electronic Multimeter
AN/USM-140B	Oscilloscope
CAQI-411A	Rf Millivoltmeter
TS-382C/U	Audio Oscillator
Model 1000	Synthesizer (CMC)*
Model 439A	Attenuator (Kay Electric)*
Model 608C	Vhf Signal Generator (Hewlett-Packard)*
Model 612A	Uhf Signal Generator (Hewlett-Packard)*

*Or equal

TABLE 5-3. POWER SUPPLY REFERENCE STANDARDS PROCEDURE



Control Settings:

POWER switch to TRACK

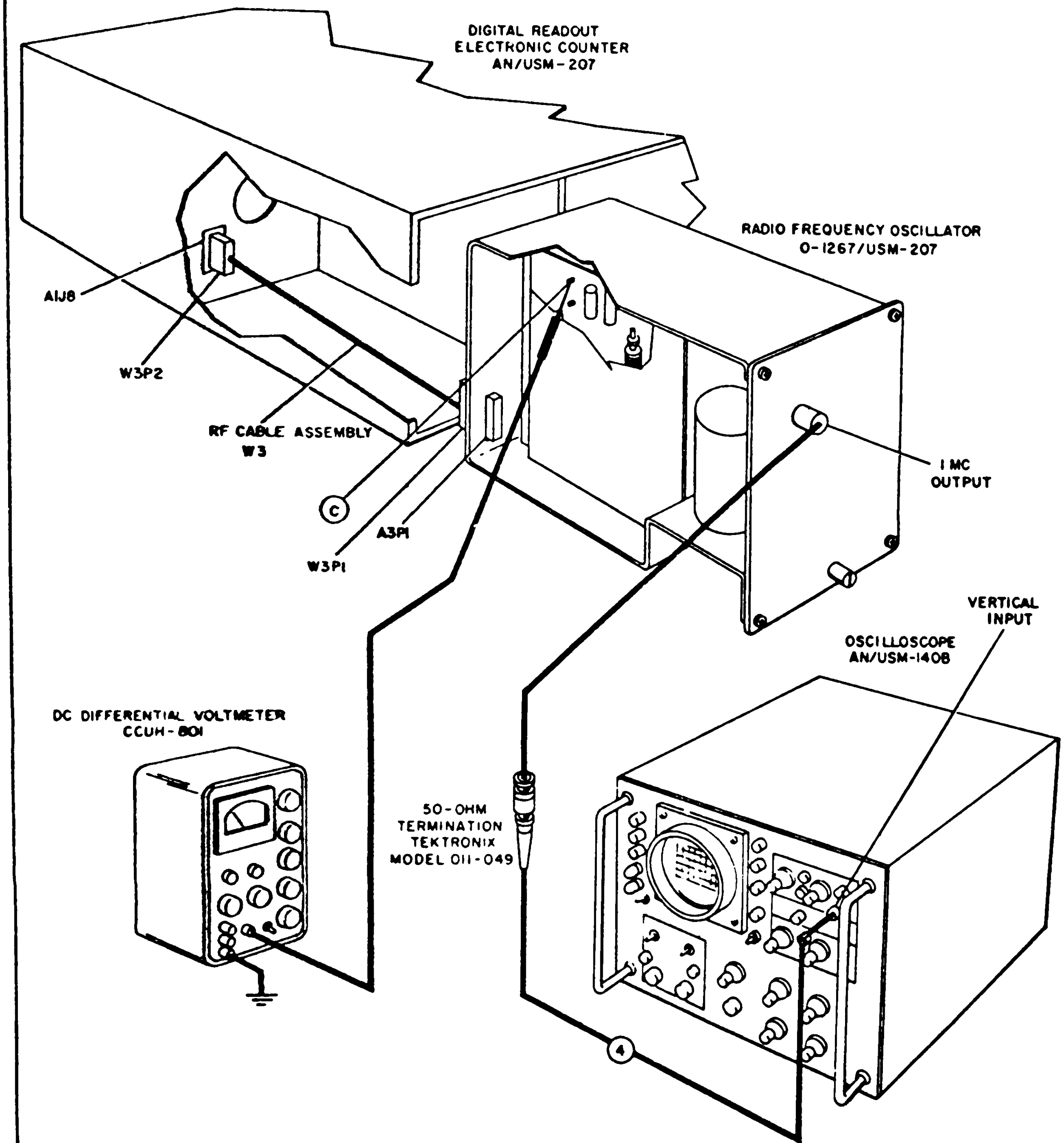
Test Equipment Required:

Dc Differential Voltmeter, CCUH-801
Electronic Multimeter, ME-6A/U

TABLE 5-3. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE Standards
1	Check dc voltages.	Voltmeter	Test point: +180 volts ± 15% Test point 2: +45 volts ± 15% Test point 3: +18 volts ± 15% Test point 4: +12 volts ± 1% Test point 5: +6 volts ± 2% Test point 6: -12 volts ± 2% Test point 7: -6 volts ± 2 %
	PROCEDURE: Remove the top cover from the counter. Ground the voltmeter to the counter chassis and measure voltage at test points illustrated.		
2	Check ac ripple voltages.	Multimeter	Test point 1: 2.5 volt rms Test point 2: 0.14 volt rms Test point 3: 0.6 volt rms Test point 4:14 rms Test point 5: 7 mv rms Test point 6: 14 mv rms Test point 7: 14 mv rms
	PROCEDURE: Disconnect the voltmeter and ground the multimeter to the counter chassis. Measure voltage at test points illustrated.		

TABLE 5-4. RADIO FREQUENCY OSCILLATOR REFERENCE STANDARDS PROCEDURE



Control Settings:	Adapter Required:	Test Equipment Required:
POWER switch to TRACK	50-ohm BNC Termination Tektronix Model 011-049	Dc Differential Voltmeter, CCUH-801 Oscilloscope, AN/USM-140B

TABLE 5-4. (Continued)

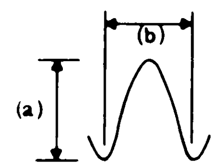
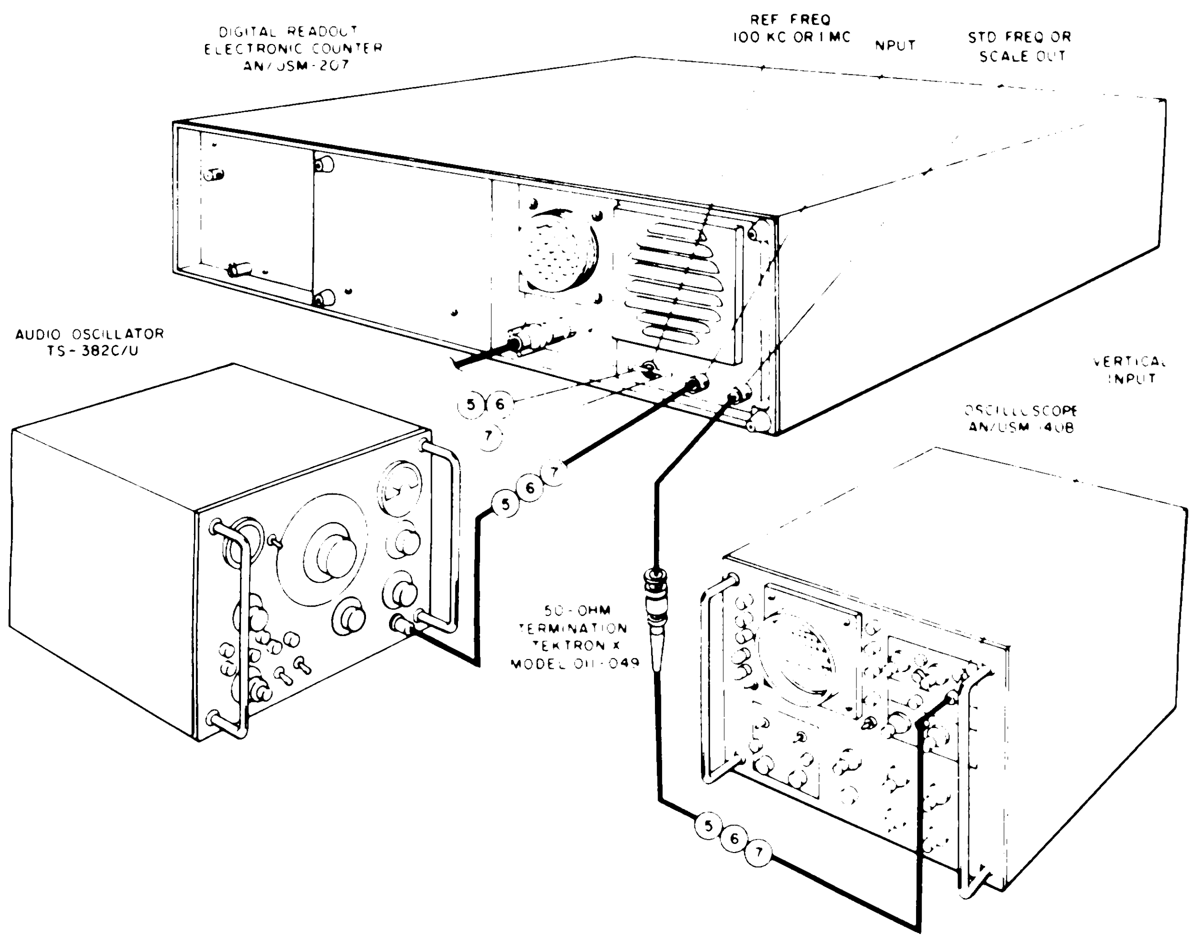
STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
3	Check oscillator power supply.	Voltmeter	+25 volts dc : 10%
	PROCEDURE: Ground voltmeter to counter chassis and measure voltage at test point C. To gain access to test point C, remove the oscillator plug-in from the counter then reconnect it by means of the rf cable per paragraph 5-5aa.		
4	Check amplitude and frequency of radio frequency oscillator output signal.	Oscilloscope 	(a)____________vpp (3.5 to 4.5) (b)____________µsec (1)
	PROCEDURE: Set oscilloscope controls for a vertic: 1 deflection of 2 v cm, a sweep rate of 1 µS/cm, and internal triggering. Connect 50-ohm termination to the 1 MC OUT connector. Observe output through the 50-ohm termination.		

TABLE 5-5. 10 MC and 1 MC MULTIPLIER REFERENCE STANDARDS PROCEDURE



Control Settings:	Adapter Required:	Test Equipment Required:
POWER switch to TRACK FUNCTION switch to TIME B→C	Tektronix Model 011-049 50 ohm BNC Termination	Oscilloscope, AN/USM-140B Audio Oscillator, TS-382C/U

TABLE 5-5. (Continued)

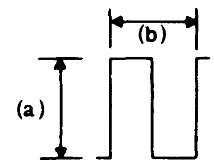
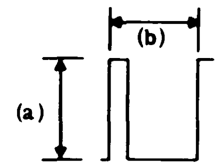
STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
5	Check amplitude and frequency of the 1-mc standard frequent y output, using the internal radio-frequency oscillator as a standard.	Oscilloscope 	(a)_________vpp (1.2 to 1.8) (b)_________μsec (1)
	PROCEDURE: Set the REF FREQ 100 KC OR 1 MC switch to INT. Set the STD FREQ OUT switch to 106. Set the oscilloscope controls for a vertical deflection of 0.5 v/cm, a sweep rate of 1 μS/cm, and internal triggering. Connect 50-ohm termination to the STD FREQ OR SCALE OUT connector, and observe output through the 50-ohm termination.		
6	Check amplitude and frequency of the 10-mc standard frequency output, using the internal radio-frequency oscillator as a standard.	Oscilloscope 	(1.2 to 1.8) (b)_________μsec (0.1)
	PROCEDURE: Set oscilloscope controls for a sweep rate of 0.1 μS/cm. Set STD FREQ OUT switch to 107, and observe output as in step 4.		
7	Check amplitude and frequency of the 10-mc standard frequency output, using an external 100-kc standard.	Oscilloscope	Same as in step 6 above.
	PROCEDURE: Set signal generator controls for a cw output signal fo 100 kc with an amplitude of approximately 0.5 volt rms, Connect output of signal generator to the time base INPUT connector. Set REF FREQ 100 KC OR 1 MC switch to EXT, and observe output as in step 5.		

TABLE 5-6. COUNT DECADES, READOUT, AND CYCLE CONTROL REFERENCE STANDARDS PROCEDURE

Control Settings:

POWER switch to TRACK
FUNCTION switch to TIME B ⇒ C or PERIOD B x M-1
Mode selector switch to SEP

Test Equipment Required:

None

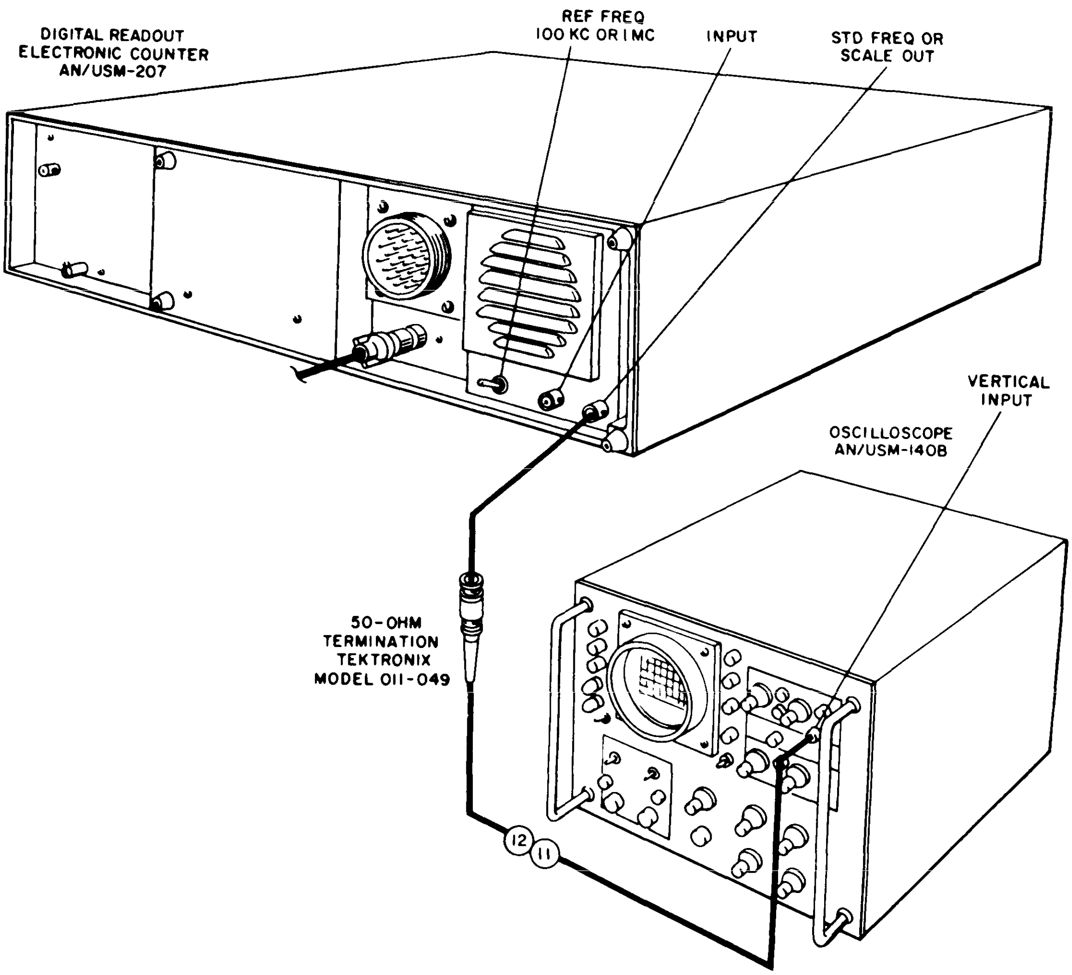
STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
8	Check count sequence of count decades, and decoding operation of readout section.	Readout	A. Right digit advances from 0 through 9 in numerical order.

TABLE 5-6. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
8 (cont)	PROCEDURE: Press RESET switch. Turn B TRIGGER VOLTS control slowly clockwise and then counterclockwise until GATE lamp lights. Set time base switch to the positions shown below, and observe the appropriate readout-digit in each position. A. 1. B. 10. C. 10^2 through 10^7, one position at a time.		B. Next most-significant digit advances from 0 through 9 in numerical order. C. Remaining six digits advance from 0 through 9 in numerical order.
9	Check cycle control in track mode. PROCEDURE: Set FUNCTION switch to FREQ. Set time base switch to l. Set SENSITIVITY switch to TEST. Set DISPLAY control fully counterclockwise, then turn approximately 1/4 turn in a clockwise direct ion.	Readout and GATE lamp	GATE lamp goes on for 1 second and goes off for approximately 200 milliseconds, in a continuous cycle. When the DISPLAY control is turned clockwise, GATE lamp off-time increases. While the GATE lamp is on, readout cycles. When the GATE lamp is off readout is stationary at 10000.000 ± 1 count.
10	Check cycle control and readout section in store mode. PROCEDURE: Set POWER switch to STORE.	Readout and GATE lamp	GATE lamp cycles as in step 8. Readout changes only when gate lamp goes out.

TABLE 5-7. SCALER REFERENCE STANDARDS PROCEDURE

TABLE 5-7. SCALER REFERENCE STANDARDS PROCEDURE



Control Settings:	Adapter Required:	Test Equipment Required:
POWER switch to TRACK SENSITIVITY switch to TEST REF FREQ 100 KC OR 1 MC switch to INT FUNCTION switch to SCALE A	50-ohm BNC termination, Tektronix Model 011-049	Oscilloscope, AN/USM-140B

TABLE 5-7. (Continued)

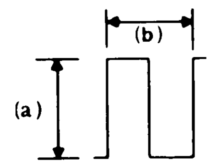
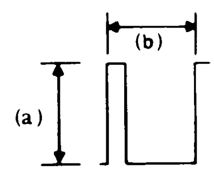
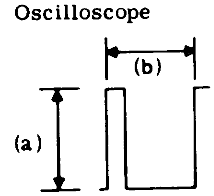
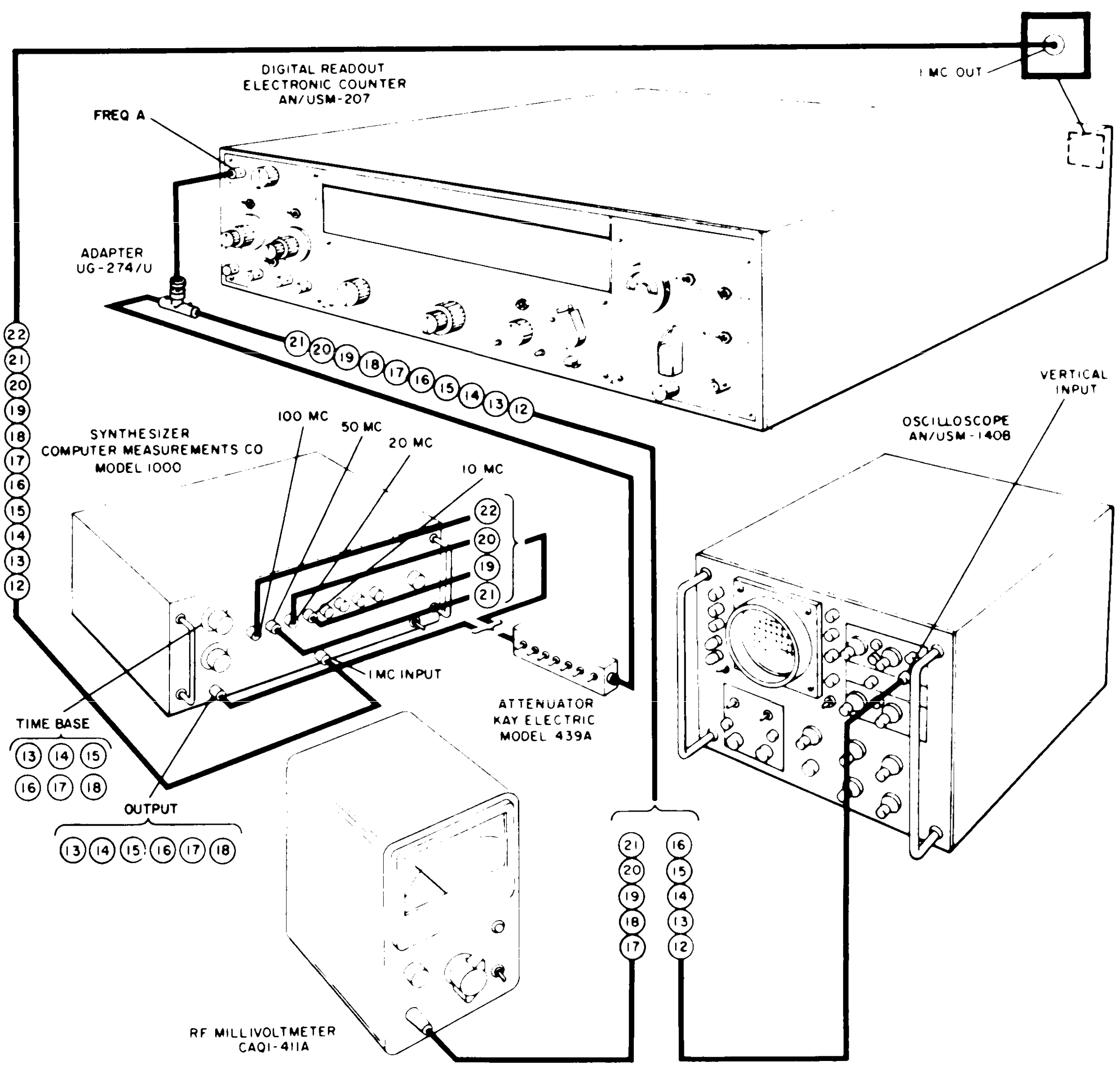
STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
11	Check amplitude and frequency of scaled 10-mc test signal.	Oscilloscope 	A. (a)__________vpp (1.2 to 1.8) (b)__________μsec (1)
	PROCEDURE: Set oscilloscope controls for a vertical deflection of 0.5 v/cm, a sweep rate of 0.1 μS/cm, and internal triggering. Connect the 50-ohm termination to the STD FREQ OR SCALE OUT connector. Observe output through the 50-ohm termination. Set time base switch to the positions shown below; reduce sweep rate of oscilloscope progressively, and observe waveform at each position of the time base switch.		B. (a)__________vpp (1.2 to 1.8) (b)__________μsec (10)
	A. 10 B. 10^2 C. 10^3 D. 10^4 E. 10^5 F. 10^6 G. 10^7 H. 10^8	 Oscilloscope 	C. (a)__________vpp (1.2 to 1.8) (b)__________μsec (100) D. (a)__________vpp (1.2 to 1.8) (b)__________msec (1) E. (a)__________vpp (1.2 to 1.8) (b)__________msec (10) F. (a)__________vpp (1.2 to 1.8) (b)__________msec (100) G. (a)__________vpp (1.2 to 1.8)

TABLE 5-7. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
11 (cont)			(b)________sec (1) H. (a)________vpp (1.2 to 1.8) (b)________sec (10)
12	Check amplitude and frequency of the scaled standard-frequency signal.	Oscilloscope	A. Same as H in step 11.
	PROCEDURE: Set FUNCTION switch to TIME B ⇒ C. Set oscilloscope controls for a sweep rate of 5 see/cm. Set STD FREQ OUT switch to the positions shown below; increase sweep rate of oscilloscope progressively, and observe waveform at each position of the STD FREQ OUT switch.		B. Same as G in step 11. C. Same as F in step 11.
	A. 10^{-1} B. 1 C. 10 D. 10^{2} E. 10^{3} F. 10^{4} G. 10^{5} H. 10^{6}		D. Same as E in step 11. E. Same as D in step 11. F. Same as C in step 11. G. Same as B in step 11. H. Same as A in step 11.

TABLE 5-8. A AMPLIFIER REFERENCE STANDARDS PROCEDURE



Control Settings:

SENSITIVITY switch to .1 V
FUNCTION switch to FREQ
POWER switch to TRACK
DISPLAY control to MIN
REF FREQ 100 KC OR 1 MC switch to INT

Adapter Required:

UG-274/U

Test Equipment Required:

Synthesizer, Computer Measurements Company Model 1000
Attenuator, Kay Electric Model 439A
Rf millivoltmeter, CAQI-411A
Oscilloscope, AN/USM-140B

TABLE 5-8. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
13	Check sensitivity of "A" amplifier at 10 cps.	Oscilloscope and Readout	0000.0100 KC ± 0. 0001 kc
	PROCEDURE: Set synthesizer frequency switch to 10 cps. Connect output of synthesizer through the attenuator to the FREQ A connector. Set attenuator switches for a 280-millivolt peak-to-peak reading on the oscilloscope. Set counter time base switch to 10-1.		
14	Check sensitivity of "A" amplifier at 100 cps.	Oscilloscope and Readout	0000.10000 KC ± O. 0001 kc
	PROCEDURE: Set synthesizer frequency switch to 100 cps. Set attenuator switches for a 280-millivolt peak-to-peak reading on the oscilloscope.		
15	Check sensitivity of "A" amplifier at 1 kc.	Oscilloscope and Readout	0.0001.0000 KC ± 0.0001 kc
	PROCEDURE: Set synthesizer frequency switch to 1 kc. Set attenuator switches for a 280-millivolt peak-to-peak reading on the oscilloscope.		
16	Check sensitivity of "A" amplifier at 10 kc.	Oscilloscope and Readout	0010.0000 KC ± 0.0001 kc
	PROCEDURE: Set synthesizer frequency switch to 10 kc. Set attenuator switches for a 280-millivolt peak-to-peak reading on the oscilloscope.		
17	Check sensitivity of "A" amplifier at 100 kc.	Oscilloscope and Readout	0100.0000 KC ± O. 0001 kc
	PROCEDURE: Set synthesizer frequency switch to 100 kc. Set attenuator switches for 280-millivolt peak-to-peak reading on the oscilloscope.		
18	Check sensitivity of "A" amplifier at 1 mc.	Rf millivoltmeter and Readout	001000.00 KC ± 0.01 kc
	PROCEDURE: Set synthesizer frequency switch to 1 mc. Set attenuator switches for a 100-millivolt reading on the rf millivoltmeter. Set counter time base switch to 10.		
19	Check sensitivity of "A" amplifier at 10 mc.	Rf millivoltmeter and Readout	010000.00 KC ± 0.01 kc
	PROCEDURE: Obtain 10-mc output from the synthesizer and connect through the attenuator to the FREQ A connector. Set attenuator switches for a 100-millivolt reading on the rf millivolt meter.		
20	Check sensitivity of "A" amplifier at 20 mc.	Rf millivoltmeter and Readout	020000.00 KC ± 0.01 kc
	PROCEDURE: Obtain 20-mc output from the synthesizer and connect through the attenuator to the FREQ A connector. Set attenuator switches for a 100-millivolt reading on the rf millivoltmeter.		
21	Check sensitivity of "A" amplifier at 50 mc.	Rf millivoltmeter and Readout	

TABLE 5-8. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
21 (cont)	PROCEDURE: Obtain 50-mc output from the synthesizer and connect through the attenuator to the FREQ A connector. Set attenuator switches for a 100-millivolt reading on the rf millivoltmeter.		050000.00 KC ± 0.01 kc
22	Check sensitivity of "A" amplifier at 100 mc.	Rf millivoltmeter and Readout	
	PROCEDURE: Obtain 100-mc output from the synthesizer and connect through the attenuator to the FREQ A connector. Set attenuator switches for a 100-millivolt reading on the rf millivoltmeter.		100000.00 KC ± 0.01 kc

TABLE 5-9. B AND C AMPLIFIERS REFERENCE STANDARDS PROCEDURE

NOTE

The following procedure must be performed with special test equipment not available on board ship.

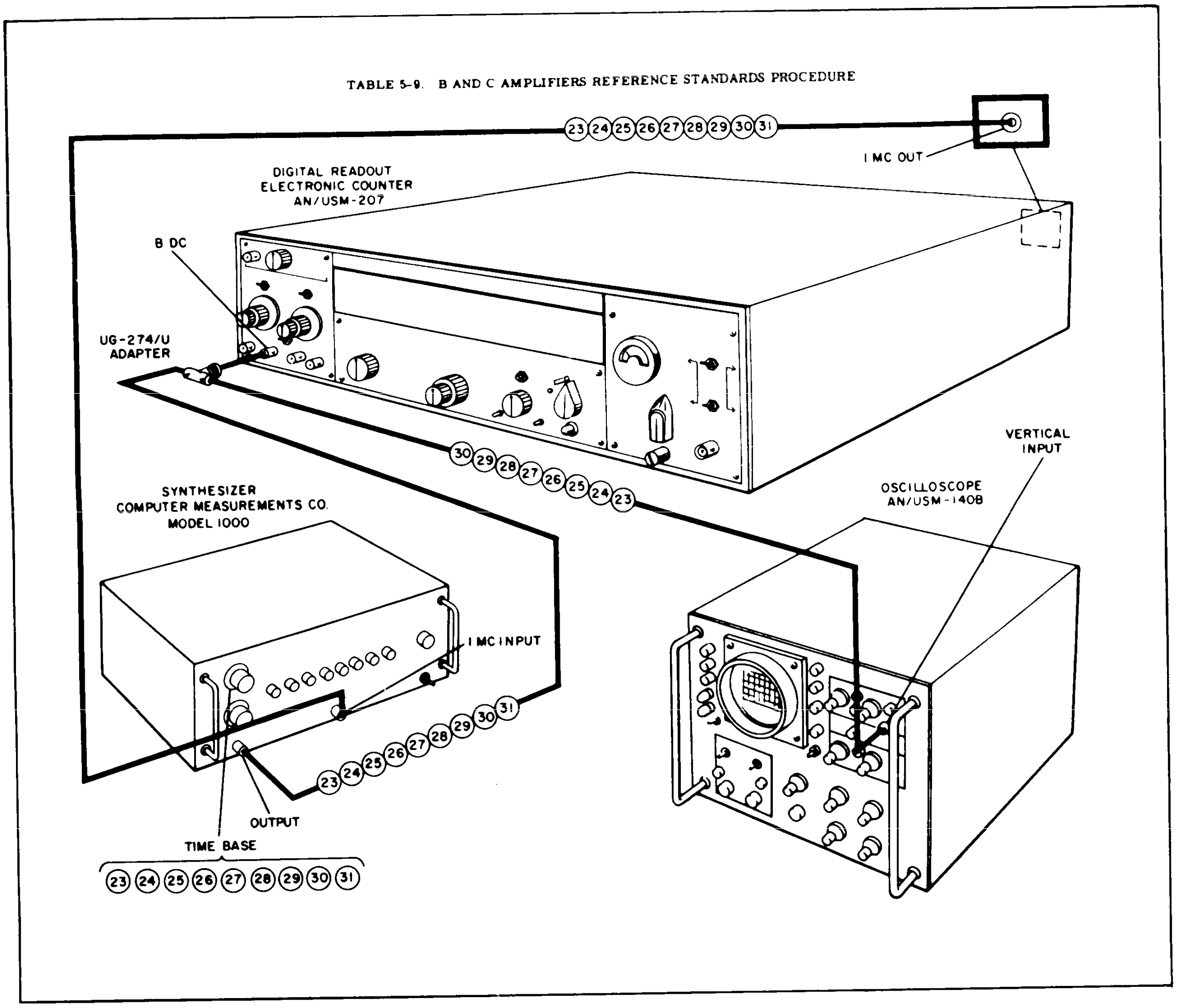


TABLE 5-9. (Continued)

Control Settings:	Adapter Required:	Test Equipment Required:
FUNCTION switch to TIME B → C POWER switch to TRACK DISPLAY control to MIN REF FREQ 100 KC OR 1 MC switch to INT Mode switch to COM B SLOPE switch to + B MULTIPLIER switch to , 1 B TRIGGER VOLTS control to 0 C SLOPE switch to + C MULTIPLIER switch to .1 C TRIGGER VOLTS control to 0	UG-274/U	Synthesizer, Computer Measurements Company Model 1000 Oscilloscope, AN/USM-140B

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
23	Check sensitivity of "B" and "C" amplifiers at 1 cps.	Oscilloscope and Readout	01000000. µS ± 1 µS
	PROCEDURE: Set synthesizer frequency switch to 1 cps, and connect output to the B DC connector. Adjust output level of synthesizer for a 280-millivolt peak-to-peak reading on the oscilloscope. Set time base switch to 106.		
24	Check sensitivity of "B" and "C" amplifiers at 10 Cps.	Oscilloscope and Readout	00100000. µS ± 1 µS
	PROCEDURE: Set synthesizer frequency switch to 10 cps. Adjust output level of synthesizer for a 280-millivolt peak-to-peak reading on the oscilloscope.		
25	Check sensitivity of "B" and "C" amplifiers at 100 cps.	Oscilloscope and Readout	00010000. µS ± µS
	PROCEDURE: Set synthesizer frequency switch to 100 cps. Adjust output level of synthesizer for a 280-millivolt peak-to-peak reading on the oscilloscope.		
26	Check sensitivity of "B" and "C" amplifiers at 1 kc.	Oscilloscope and Readout	00001000. µS ± 1 µS
	PROCEDURE: Set synthesizer frequency switch to 1 kc. Adjust output level of synthesizer for a 280-millivolt peak-to-peak reading on the oscilloscope.		
27	Check sensitivity of "B" and "C" amplifiers at 10 kc.	Oscilloscope and Readout	0000100.0 µS ± 1µS
	PROCEDURE: Set synthesizer frequency switch to 10 kc. Adjust output level of synthesizer for a 280-millivolt peak-to-peak reading on the oscilloscope. Set time base switch to 107.		
28	Check sensitivity of "B" and "C" amplifiers at 100 kc.	Oscilloscope and Readout	

TABLE 5-9. (Continued)

STEP No.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
28 (cont)	PROCEDURE: Set synthesizer frequency switch to 100 kc. Adjust output level of synthesizer for a 280-millivolt peak-to-peak reading on the oscilloscope.		0000010.0 S ± µS
29	Check sensitivity of "B" and "C" amplifiers at 1 mc.	Oscilloscope and Readout	0000001.0 S ± 1 µS
	PROCEDURE: Set synthesizer frequency switch to 1 mc. Adjust output level of synthesizer for a 280-millivolt peak-to-peak reading on the oscilloscope.		
30	Check that "B" amplifier triggers on negative slope of input signal.	Oscilloscope and Readout	00000050. MS ± 0.1 ms
	PROCEDURE: Set synthesizer frequency switch to 10 cps. Adjust output level of synthesizer for an approximate reading on the oscilloscope of 700 millivolts peak-to-peak. Set time base switch to 103, B SLOPE switch to - and C SLOPE to +.		
31	Check that 'C' amplifier triggers on negative slope of input signal.	Readout	00000050. MS ± 0.1 ms
	PROCEDURE: Set B SLOPE switch to + and C SLOPE switch to -; leave synthesizer time base switch at 100 milliseconds.		

TABLE 5-10. GATE CONTROL REFERENCE STANDARDS PROCEDURE

Control Settings:

POWER switch to TRACK
REF FREQ 100 KC OR 1 MC switch to INT
DISPLAY control to MIN

Test Equipment Required:

None

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
32	Check operation of gate control in frequency mode.	GATE lamp	GATE lamp cycles on and off in a continuous cycle. On-time is 10 seconds in the 10-1 position, 1 second in the 1 position, and 150 milliseconds in all other positions of the time base switch.
	PROCEDURE: Set FUNCTION switch to FREQ. Set SENSITIVITY switch to TEST. Starting at the 10^{-1} position, turn time base switch clockwise, one position at a time, through the 10^{7} position. Observe action of GATE lamp in each position of the time base switch.		
33	Check operation of gate control in manual mode.	GATE lamp and digital display.	When the FUNCTION switch is set to START, GATE lamp goes on, and display cycles. When the FUNCTION switch is set to STOP,
	PROCEDURE: Set FUNCTION switch first to START and then to STOP.		

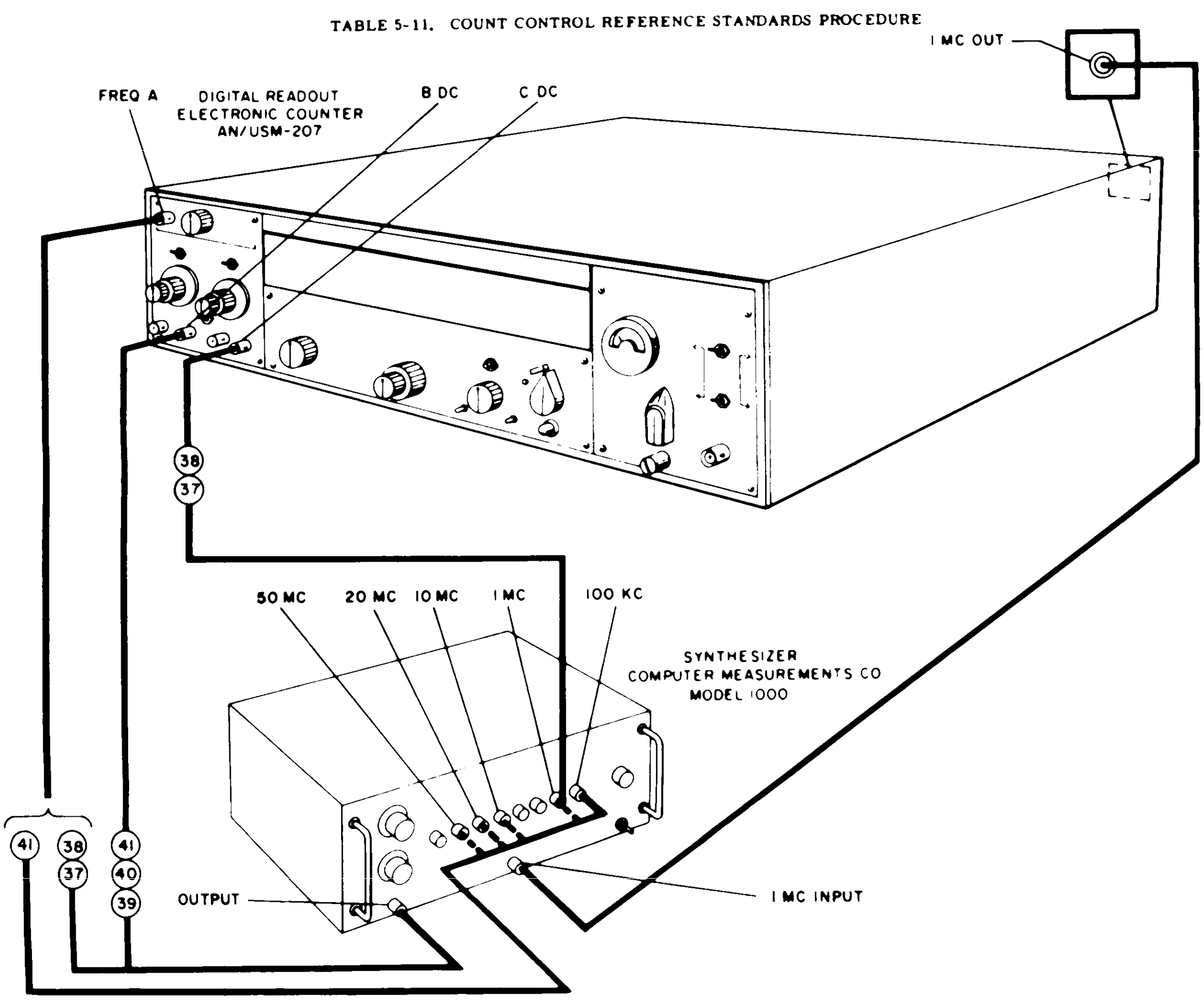
TABLE 5-10. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
(cont)			GATE lamp goes off and display is stationary.
34	Check operation of gate control in period mode.	GATE lamp	GATE lamp goes on and off, alternately, each time the B TRIGGER VOLTS control is turned in both directions.
	PROCEDURE: Set FUNCTION switch to PERIOD x 1. Set B SLOPE switch to +. Turn B TRIGGER VOLTS control slowly clockwise and then counterclockwise, wait approximately 5 to 10 seconds, then turn again clockwise and counterclockwise.		
35	Check operation of gate control in time-interval mode.	GATE lamp	GATE lamp goes on the first time the B TRIGGER VOLTS control is turned in both directions; subsequent turnings of the B TRIGGER VOLTS control do not affect the GATE lamp. GATE lamp goes off the first time the C TRIGGER VOLTS control is turned in both directions; subsequent turnings of the C TRIGGER VOLTS control do not affect the GATE lamp.
	PROCEDURE: Set FUNCTION switch to TIME B-C. Set B and C SLOPE switches to +. Turn B TRIGGER VOLTS control slowly clockwise and then counterclockwise several times in succession. Next, turn the C TRIGGER VOLTS control slowly clockwise and then counterclockwise several times in succession,		
36	Check operation of gate control in frequency-ratio mode.	GATE lamp	As in step 34.
	PROCEDURE: Set time base switch to RATIO $\frac{A}{B}$ x M. Set other controls as in step 34.		

TABLE 5-11. COUNT CONTROL REFERENCE STANDARDS PROCEDURE

NOTE

The following procedure must be performed with special test equipment not available on board ship.



Control Settings:

POWER switch to TRACK
REF FREQ 100 KC OR 1 MC switch to INT
DISPLAY control to MIN

Test Equipment Required:

Synthesizer, Computer Measurements Company Model 1000

TABLE 5-11. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
37	Check operation of count control in frequency mode.	Readout	A. 0010.0000 KC ±. 0001 kc B. 1000.0000 KC ±. 0001 kc
	PROCEDURE: A. Set FUNCTION switch to FREQ. Set SENSITIVITY switch to 1 V. Set counter time base switch to 10^{-1}. Set synthesizer frequency switch to 10 kc, and connect output to the FREQ A connector. Set synthesizer amplitude control fully clockwise. B. Set SENSITIVITY switch to FREQ C. Set C SLOPE switch to +. Set C TRIGGER VOLTS CONTROL to 0. Set C MULTIPLIER switch to .1. Obtain another, 1 -mc, output from the synthesizer and connect to the C DC connector.		
38	Check operation of count control in manual mode.	Readout	Display advances numerically at a slow rate when SENSITIVITY switch is set to 1 V, and at a fast rate when the SENSITIVITY switch is set to FREQ C.
	PROCEDURE: Set SENSITIVITY switch to 1 V. Set C TRIGGER VOLTS control to 0. Set C MULTIPLIER switch to .1. Set C SLOPE switch to +. Set synthesizer frequency switch to 1 cps and connect output to the FREQ A connector; set amplitude control of synthesizer fully clockwise. Obtain another, l-me, output from the synthesizer and connect to the C DC connector. Set FUNCTION switch to STOP. Press RESET switch. Set FUNCTION switch to START. While observing digital display, set SENSITIVITY switch alternately to FREQ C and 1 V.		
39	Check operation of count control in period mode.	Readout	A. 1000000.0 µS ±0.1 microsecond. B. 0100000.0 µS ±0.1 microsecond C. 100000.00 µS ±0.01 microsecond D. 10000.000 µS ±0.001 microsecond E. 1000.0000 µS ±0.0001 microsecond F. 100.00000 µS ±0.00001 microsecond G. 10 000000 µS ±00.000001 microsecond H. 01.000000 µS ±0.000001 microsecond
	PROCEDURE: Set B TRIGGER VOLTS control to 0. Set B MULTIPLIER switch to .1. Set B SLOPE switch to +. Set time base switch to 10^{7}. Obtain output from synthesizer and connect to the B DC connector. Set synthesizer amplitude control fully clockwise. Set synthesizer frequency switch and counter FUNCTION switch to the positions shown below: A. 1 cps and 1. B. 10 cps and 1. C. 10 cps and 10. D. 100 cps and 10^{2}. E. 1 kc and 10^{3}. F. 10 kc and 10^{4}. G. 100 kc and 10^{5}. H. 1 mc and 10^{5}.		

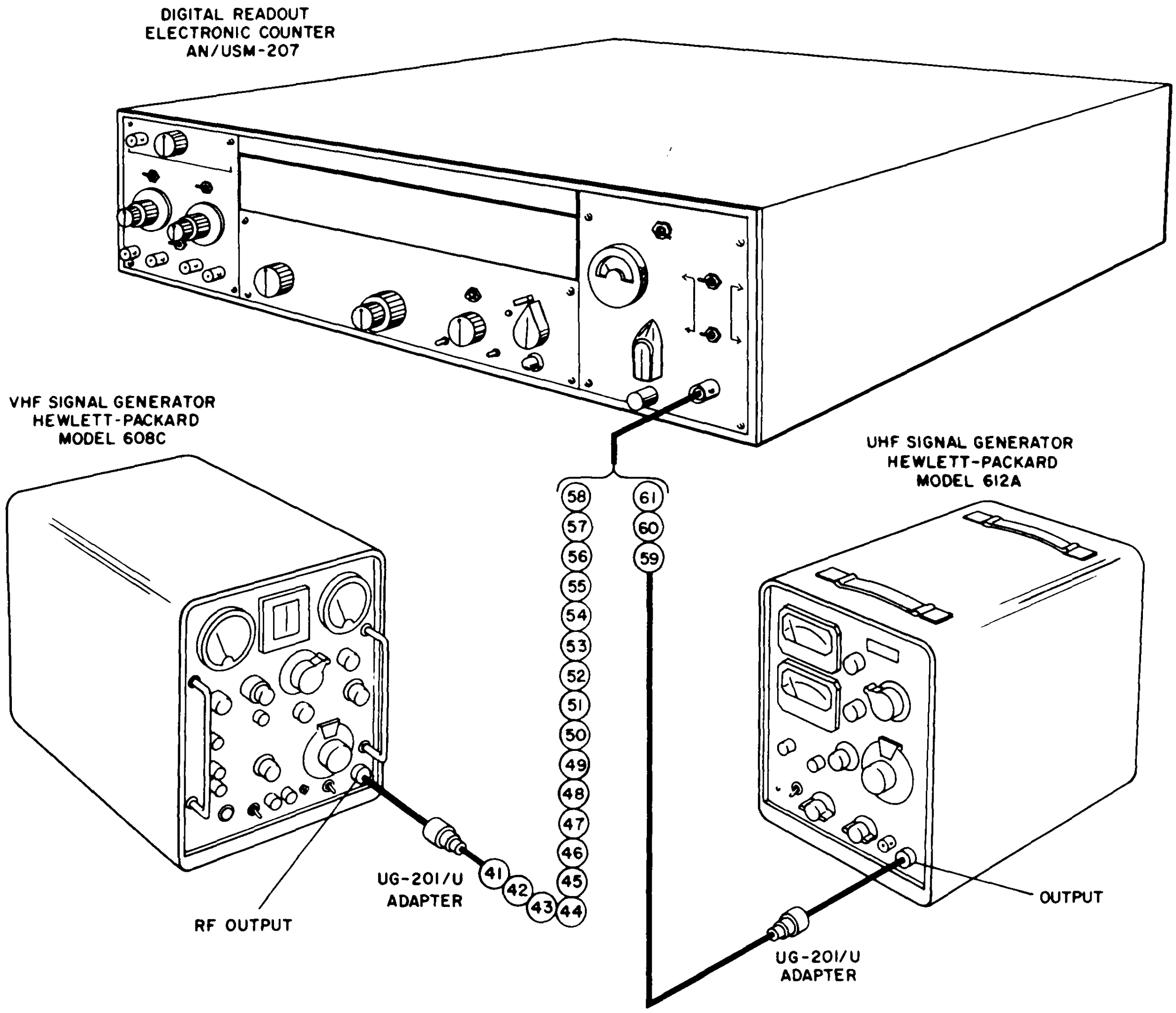
TABLE 5-11. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE STANDARDS
40	Check operation of count control in time-interval mode.	Readout	A. 00000001. SEC ±1 second B. 0000001.0 SEC ±0.01 second C. 000001.00 SEC ±0.01 second D. 00001000. MS ±1 millisecond E. 0001000.0 MS ±0.1 millisecond F. 001000.00 MS ±0.01 millisecond
	PROCEDURE: Set FUNCTION switch to TIME B→C. Set all B controls as in step 39. Set all C controls as in step 38. Set mode switch to COM. Set synthesizer frequency switch to 1 cps and connect output to the B DC connector. Set synthesizer amplitude control fully clockwise. Set counter time base switch to: A. 1 B. 10 C. 10^2 D. 10^3 E. 10^4 F. 10^5 G. 10^6 H. 10^7		
41	Check operation of count control in frequency-ratio mode.	Readout	A. 00050000. ±1 B. 0020000.0 ±0.1 C. 010000.00 ±0.01 D. 01000.000 ±0.001 E. 0100.0000 ±0.0001
	PROCEDURE: Set time base switch to RATIO $\frac{A}{B}$ x M. Set SENSITIVITY switch to 1 V. Set all B controls as in step 39. Set synthesizer frequency switch to 1 kc and connect output to the B DC connector. Obtain other output frequencies from the synthesizer as listed below, and connect to the FREQ A connector. For each frequency, set FUNCTION switch to the position shown below: A. 50 mc and 1. B. 20 mc and 10. C. 10 mc and 10^2. D. 1 mc and 10^3 E. 100 kc and 10^4.		

TABLE 5-12. ELECTRONIC FREQUENCY CONVERTER REFERENCE STANDARDS PROCEDURE

NOTE

The following procedure must be performed with special test equipment not available on board ship.



Control Settings:

POWER switch to TRACK
REF FREQ 100 KC OR 1 MC switch to INT
DISPLAY control to MIN
SENSITIVITY switch to PLUG-IN
FUNCTION switch to FREQ
Both converter attenuator switches to the right (10V MAX position)
Time base switch to 10^3

Adapters Required:

Two Adapters UG-201/U

Test Equipment Required:

Vhf Signal Generator, Hewlett-Packard Model 608C
Uhf Signal Generator, Hewlett-Packard Model 612A

TABLE 5-12. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE* STANDARDS
42	Check sensitivity of the frequency converter at frequencies between 35 mc and 100 mc.	LEVEL METER and digital display	Digital display is:
	PROCEDURE: Set DIRECT-HETERODYNE switch to DIRECT. Connect output of vhf signal generator to the converter INPUT connector. Set level control and attenuation control of the vhf signal generator fully counterclockwise. Set output frequency of vhf signal generator to approximately 50 mc. Adjust level control and attenuation control of vhf signal generator for a 10-millivolt output. Set both converter attenuator switches to the left (0.1V MAX position). Set output frequency of vhf signal generator as shown below. For each output frequency, readjust level control for a 10-millivolt output. A. 35 mc B. 50 mc C. 75 mc D. 100 mc		A. 00035000. KC ±1 kc B. 00050000. KC ±1 kc C. 00075000. KC ±1 kc D. 00100000. KC ±1 kc LEVEL METER in all cases reads in the green zone.
43	Check sensitivity and operation of frequency converter at 85 mc.	LEVEL METER and digital display	Digital display is:
	PROCEDURE: Set output frequency of vhf signal generator to 85 mc. Adjust level control of the vhf signal generator for a 10-millivolt output. Set both converter attenuator switches to the left. Set the mixing frequency selector switch to 100, and the DIRECT-HETERODYNE switch to HETERODYNE.		00015000. KC ±1 kc LEVEL METER reads in the green zone.
44	Check sensitivity and operation of frequency converter at 101 mc.	LEVEL METER and digital display	Digital display is:
	PROCEDURE: Set output frequency of vhf signal generator to 101 mc, and adjust output level for 10 millivolts. Set mixing frequency selector switch to 150.		00049000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
45	Check sensitivity and operation of frequency converter at 150 mc.	LEVEL METER and readout	Digital display in both cases is:
	PROCEDURE: Set output frequency of vhf signal generator to 150 mc, and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 100 B. 200		00050000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
46	Check sensitivity and operation of frequency converter at 194 mc.	LEVEL METER and readout	Digital display is:
	PROCEDURE: Set output frequency of vhf signal generator to 194 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below:		A. 00044000. KC ±1 kc

*Numerical display-values, as listed, represent those obtained under ideal conditions. Actual values depend on the dial accuracy of the signal generator.

TABLE 5-12. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE* STANDARDS
(cont)	A. 150 B. 200		B. 00006000. KC ±l kc LEVEL METER in both cases reads in the green zone.
47	Check sensitivity and operation of frequency converter at 196 mc. PROCEDURE: Set output frequency of vhf signal generator to 196 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 150 B. 250	LEVEL METER and digital display.	Digital display is: A. 00046000. KC ±l kc B. 00054000. KC ±l kc LEVEL METER in both cases reads in the green zone.
48	Check sensitivity and operation of frequency converter at 210 mc. PROCEDURE: Set output frequency of vhf signal generator to 210 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 200 B. 250	LEVEL METER and readout	Digital display is: A. 00010000. KC ±l kc B. 00040000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
49	Check sensitivity and operation of frequency converter at 242 mc. PROCEDURE: Set output frequency of vhf signal generator to 242 mc and adjust output level for 10 millivolts. Set mixing frequency select or switch to the positions shown below: A. 200 B. 250 C. 300	LEVEL METER and readout	Digital display is: A. 00042000. KC ±l kc B. 00008000. KC ±1 kc C. 00058000. KC ±1 kc LEVEL METER in all three cases reads m the green zone.
50	Check sensitivity and operation of frequency converter at 250 mc. PROCEDURE: Set output frequency of vhf signal generator to 250 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 200 B. 300	LEVEL METER and readout	Digital display in both cases is: 00050000. KC ±l kc LEVEL METER in both cases reads in the green zone.

*Numerical display-values, as listed, represent those obtained under ideal conditions, Actual values depend on the dial accuracy of the signal generator.

TABLE 5-12. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE* STANDARDS
51	Check sensitivity and operation of frequency converter at 304 mc.	LEVEL METER and readout	Digital display is: A. 00054000. KC ±1 kc B. 00046000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
	PROCEDURE: Set output frequency of vhf signal generator to 304 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 250 B. 350		
52	Check sensitivity and operation of frequency converter at 306 mc.	LEVEL METER and readout.	Digital display is: A. 00056000. KC ±1 kc B. 00006000. KC ±1 kc C. 00044000. KC ±1 kc LEVEL METER in all three cases reads m the green zone.
	PROCEDURE: Set output frequency of vhf signal generator to 306 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 250 B. 300 c. 350		
53	Check sensitivity and operation of frequency converter at 350 mc.	LEVEL METER and readout	Digital display in both cases is: 00050000. KC ±1 kc LEVEL METER in both cases reads in the green zone
	PROCEDURE: Set output frequency of vhf signal generator to 350 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 300 B. 400		
54	Check sensitivity and operation of frequency converter at 394 mc.	LEVEL METER and readout	Digital display is: A. 00044000. KC ±1 kc B. 00006000. KC ±1 kc C. 00056000. KC ±1 kc LEVEL METER in all three cases reads m the green zone.
	PROCEDURE: Set output frequency of vhf signal generator to 394 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 350 B. 400 c. 450		
55	Check sensitivity and operation of frequency converter at 396 mc.	LEVEL METER and readout	Digital display is: A. 00046000. KC ±1 kc

* Numerical display-values, as listed, represent those obtained under ideal conditions. Actual values depend on the dial accuracy-of the signal generator.

TABLE 5-12. (Continued)

STEP NO.	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE* STANDARDS
55 (cont)	PROCEDURE: Set output frequency of vhf signal generator to 396 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 350 B. 450		B. 00054000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
56	Check sensitivity and operation of frequency converter at 404 mc.	LEVEL METER and readout	Digital display is: A. 00054000. KC ±1 kc B. 00046000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
	PROCEDURE: As in step 55, with output frequency of vhf signal generator set to 404 mc.		
57	Check sensitivity and operation of frequency converter at 406 mc.	LEVEL METER and readout.	Digital display is: A. 00056000. KC ±1 kc B. 00006000. KC ±1 kc C. 00044000. KC ±1 kc LEVEL METER in all three cases reads in the green zone.
	PROCEDURE: Set output frequency of vhf signal generator to 406 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch as shown below: A. 350 B. 400 C. 450		
58	Check sensitivity and operation of frequency converter at 450 mc.	LEVEL METER and readout	Digital display in both cases is: 00050000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
	PROCEDURE: Set output frequency of vhf signal generator for 450 mc and adjust output level for 10 millivolts. Set mixing frequency selector switch to the positions shown below: A. 400 B. 500		
59	Check sensitivity and operation of frequency converter at 494 mc.	LEVEL METER and readout	Digital display is: A. 00044000. KC ±1 kc B. 00006000. KC ±1 kc LEVEL METER in both cases reads in the green zone.
	PROCEDURE: Replace vhf signal generator with uhf signal generator and connect its output to the converter INPUT connector. Set level control and attenuation control of uhf signal generator fully counter-clockwise. Set output frequency of uhf signal generator to 494 mc. Adjust level control and attenuation control of uhf signal generator for a 10-millivolt output. Set mixing frequency selector switch to the positions shown below:		

*Numerical display-values, as listed, represent those obtained under ideal conditions. Actual values depend on the dial-accuracy of the signal generator.

TABLE 5-12. (Continued)

STEP NO	ACTION REQUIRED	READ INDICATION ON	PERFORMANCE* STANDARDS
59 (cont)	A. 450 B. 500		
60	Check sensitivity and operation of frequency converter at 500 mc.	LEVEL METER and readout	LEVEL METER reads in the green zone, and digital display is 00050000. KC ±1 kc.
	PROCEDURE: As in step 59, with the output frequency of uhf signal generator set to 500, and with the mixing frequency selector switch set to 450 only.		
61	Check sensitivity and operation of frequency converter at frequencies between 500 mc and 550 mc.	LEVEL METER and readout	Digital display is: A. 00006000. KC ±1 kc B. 00011000. KC ±1 kc C . 00050000. KC ±1 kc LEVEL METER in all three cases reads in the green zone.
	PROCEDURE: Set mixing frequency selector to 500. Set both converter attenuator switches to the left. Set output of the uhf signal generator to the frequencies shown below. At each frequency, readjust the output level control of the uhf signal generator for 10 millivolts. A. 506 mc. B. 511 mc. C. 550 mc.		

*Numerical display-values, as listed, represent those obtained under ideal conditions. Actual values depend on the dial-accuracy of the signal generator.

TABLE 5-13. COUNTER CONTROL SETTINGS

CONTROL	SETTING
POWER switch (A1S1)	STORE
DISPLAY control (A1R1)	MIN (fully counterclockwise)
FUNCTION switch (A1S4)	FREQ
Time base switch (AlS3)	10^6
SENSITIVITY switch (A1A21S7)	TEST
REF FREQ 100 KC OR 1 MC switch (A1S13)	INT
Mode selector switch (A1S9)	SEP

CONTROL	SETTING
B TRIGGER VOLTS control (A1A22R33)	0
C TRIGGER VOLTS control (A1A23R46)	0
B SLOPE switch (A1S10)	+
C SLOPE switch (A1S12)	+
B MULTIPLIER switch (A1A22S8)	.1
C MULTIPLIER (A1A23S11)	.1

5-4. TUNING AND ADJUSTMENT.

a. REMOVING THE TOP COVER. — To perform adjustments on the counter, it is first necessary to remove the top cover as described in paragraph 5-2.

b. CONTROL SETTINGS. — Unless instructed otherwise, perform all adjustment procedures with the counter controls set to the positions shown in table 5-13.

c. EXTENDING PRINTED-CIRCUIT BOARDS. — In order to gain access to all adjustments, test points and parts, certain printed-circuit boards must be extended. For this purpose, a printed-circuit board extender is supplied. When extended, all parts of the printed-circuit board are exposed while electrical connection is maintained. Refer to figure 5-1 and proceed as follows:

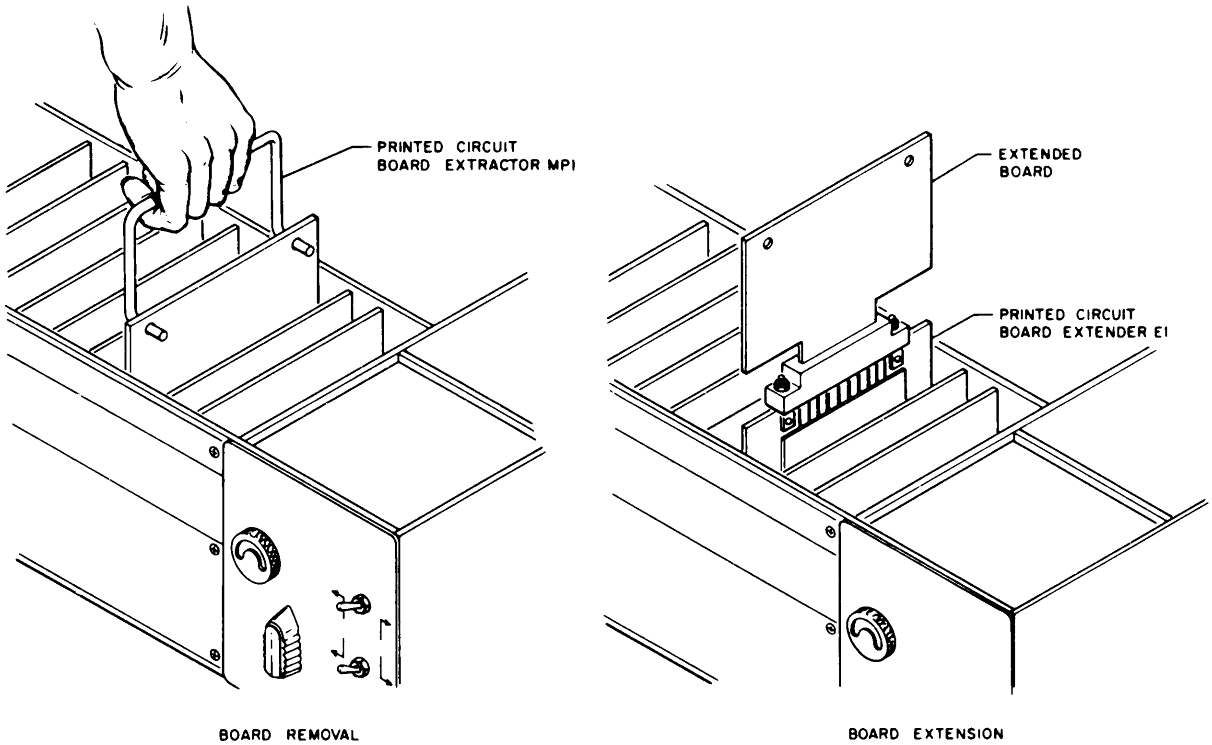


Figure 5-1. Printed Circuit Board Removal and Extension

(1) Set POWER switch to OFF.

CAUTION

Do not install circuit board into or remove circuit board from extender until 5 seconds after POWER switch is set to STBY or OFF.

Note

If the printed-circuit board contains a readout indicator, it is first necessary to remove the tie-down bracket A1MP23 which secures these printed-circuit boards. The tie-down bracket is fastened by the two screws, one at each end.

(2) Insert board-extractor hooks into the two holes at the top of the printed-circuit board to be extended.

(3) Note orientation of the printed-circuit board.

(4) Grasp the board-extractor handle firmly and pull up with a slow, even pressure.

(5) Insert the printed-circuit board extender into the empty socket.

(6) Insert the printed-circuit board into the socket on top of the printed-circuit board extender. Be sure it is oriented as noted in step (3).

(7) Set POWER switch to TRACK or STORE, and perform adjustment procedure as required.

(8) After the adjustment procedure has been completed, set POWER switch to OFF.

(9) Remove the printed-circuit board from the extended socket.

(10) Remove the printed-circuit-board extender.

(11) Orient the printed-circuit board as noted in step (3); it is keyed with its socket and can be inserted only when oriented the correct way.

(12) Insert the replacement board evenly within each guide channel, then push down with a slow, even pressure until it is seated firmly in its socket.

(13) Replace tie-down bracket if it was removed following step (1).

d. POWER SUPPLY REGULATOR A1A1 ADJUSTMENT. — The power supply regulator adjustment and test points are shown on figures 4-30, 5-2, 5-38, and 5-45.

WARNING

Regulated voltages as high as 180 volts which are dangerous to life may be encountered in the following procedure. Use extreme caution and follow the instructions carefully.

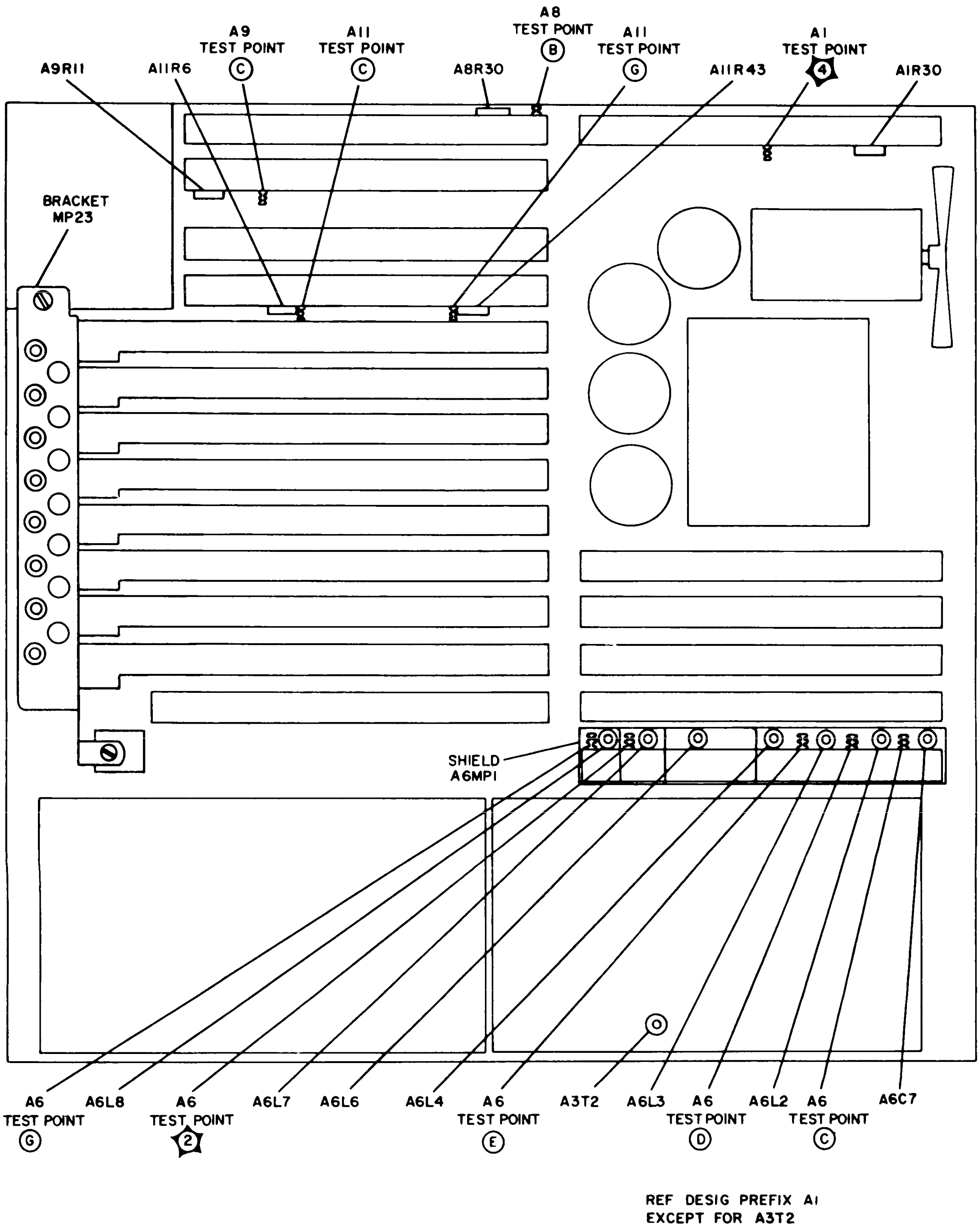


Figure 5-2. Counter Top View, Location of Adjustments and Test Points

Note

The following procedure must be performed with special test equipment not available on board ship.

(1) TEST EQUIPMENT.

(a) Dc Differential Voltmeter, CCUH-801.

(b) Wattmeter, Hickcock Model 900C, or Triplett Model 661 with a minimum range of 0 to 200 watts and O to 150 volts.

(c) Transformer, Variable Output, Superior Model 3PN116 or equivalent, with an input voltage of 115 rms ±10%, a voltage-calibrated dial and output voltage adjustable from 0V to 135 volt rms, a current rating of 5 amperes or greater and a three-terminal output receptacle.

(2) TEST SETUP.

(a) Insert power plug of transformer into a 115-volt power source, and set power switch of transformer to on.

(b) Insert power plug of wattmeter into the output receptacle of the transformer, and set transformer output voltage for approximately 115 volts .

(c) Insert power plug of counter into the output receptacle of the wattmeter, and adjust transformer output control for an exact reading of 115 volts on the wattmeter voltage-scale.

(3) INSTRUCTIONS.

(a) Set voltmeter RANGE switch to 50 and monitor test point 4.

(b) Adjust A1A1R8 to obtain an exact reading of ±12 volts dc at test point 4.

e. FREQUENCY MULTIPLIER A1A6 ADJUSTMENT. — The frequency multiplier A1A6 adjustments and test points are shown on figures 4-10, 5-2, and 5-41.

Note

The following procedure must be performed with special test equipment not available on board ship.

(1) TEST EQUIPMENT AND REFERENCE INPUT.

(a) Oscilloscope, AN/USM-140B,

(b) External frequency standard, AN/URQ-9 or AN/URQ-10.

(2) INSTRUCTIONS.

(a) Extend A1A6 per paragraph 5-4c.

(b) Set time base switch to 10^6.

(c) Set REF FREQ 100 KC OR 1 MC switch to EXT.

(d) Connect the 100-kc output of the external reference standard to the time base INPUT receptacle.

(e) Set oscilloscope controls for a vertical deflection of 5 v/cm, for a sweep rate of 1 ins/cm, and for internal triggering,

(f) Connect oscilloscope ground lead to the counter chassis.

(g) While monitoring the test points with the oscilloscope probe, perform the adjustments listed in table 5-14. When necessary, change the oscilloscope control settings to obtain an optimum trace. When properly adjusted, the tuning slugs of A1A6L2, A1A6L3 and A1A6L4 extend approximately 1/4 inch from the top of the coil form, and the tuning slugs of A1A6L6, A1A6L7, and A1A6L8 extend approximately l/2 inch from the top of the coil form.

(h) Set REF FREQ 100 KC OR 1 MC switch to INT.

(i) Turn the time base switch from 10^6 to 1 in a counterclockwise direction, and observe the readout at each position. Readout should be as indicated in table 3-4.

(j) If readout is not as indicated in table 3-4, repeat the procedure of table 5-14.

(k) Replace A1A6 per paragraph 5-4c.

f. AMPLIFIER ELECTRONIC GATE A1A8 ADJUSTMENT. — The af-rf amplifier A1A8 adjustment and test point are shown on figures 4-17, 5-2 and 5-43.

(1) TEST EQUIPMENT.

(a) Oscilloscope, AN/USM-140A.

(b) Audio oscillator, TS-382C U.

(2) INSTRUCTIONS.

(a) Extend A1A8 per paragraph 5-4c.

(b) Set audio oscillator controls for a 10-kc, 0.3-volt-rms output, and connect output signal to the FREQ A receptacle.

(c) Set oscilloscope controls for a vertical deflection of 5 v/cm, for a sweep rate of 10 ms/cm, and for internal triggering.

(d) Set counter SENSITIVITY switch to .1V.

(e) Connect oscilloscope ground lead to the counter chassis, and connect oscilloscope-probe to test point B.

(f) While observing waveform on oscilloscope, adjust A1A8R30 until the positive and negative halves of the waveform are of the same width (50% duty cycle).

(g) Replace A1A6 per paragraph 5-4c.

g. FREQUENCY DIVIDER A1A9 ADJUSTMENT. — The frequency divider test point and adjustment are shown in figures 4-24, 5-2, and 5-44.

(1) TEST EQUIPMENT. Oscilloscope, AN/USM-140A.

(2) INSTRUCTIONS.

(a) Set counter SENSITIVITY switch to 100 v.

(b) Set oscilloscope controls for a vertical deflection of 1 v/cm, for a sweep rate of 1 ms/cm or less, and for internal triggering.

(c) Adjust oscilloscope trigger level control to obtain a bright horizontal trace.

(d) Connect oscilloscope ground lead to the counter chassis.

(e) Connect oscilloscope probe to test point C.

(f) Turn A1A9R11 fully counterclockwise.

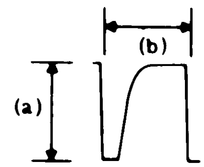
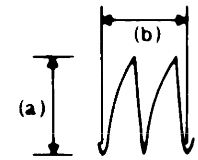
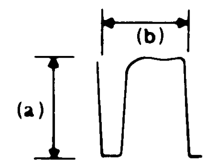
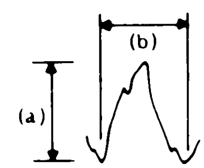
(g) Position the trace on the center horizontal grid line.

(h) Turn A1A9R11 slowly clockwise to a point where trace just starts to move up, then back off two turns.

(i) Set SENSITIVITY switch to TEST, time base switch to 104, and observe the readout. Readout should be as indicated in table 3-4.

h. AF-RF AMPLIFIER AlAll AIM ADJUSTMENT. — The AF-RF amplifier A1A11 adjustments

TABLE 5-14. FREQUENCY MULTIPLIER A1A6 ADJUSTMENTS

MONITOR TEST POINT	ADJUST	CORRECT TRACE
C	A1A6C7	 (a) ________ vpp (10) (b) ________ μsec (2)
D	A1A6L2	 (a) ________ vpp (12) (b) ________ μsec (1)
E	A1A6L3 and A1A6L4, alternately	 (a) ________ vpp (3) (b) ________ μsec (1)
G	A1A6L6, A1A6L7, and A1A6L8, alternately	 (a) ________ vpp (3) (b) ________ μsec (0. 1)

and test points are shown in figures 4-8, 4-9, 5-2, and 5-46.

(1) TEST EQUIPMENT.

(a) Oscilloscope, AN/USM-140A.

(b) Audio Oscillator, TS-382C/U.

(2) INSTRUCTIONS.

(a) Set audio oscillator controls for a 10-kc, 0.3-v rms output, and connect output signal to the B AC input connector.

(b) Set oscilloscope controls for a vertical deflection of 2 v/cm, for a sweep rate of 10 ms/cm, and for internal triggering.

(c) Set mode selector switch to COM.

(d) Connect oscilloscope ground lead to the counter chassis, and connect oscilloscope probe to test point C.

(e) While observing waveform on oscilloscope, adjust A1A11R6 until the positive and negative-halves of the waveform are of the same width (50% duty cycle).

(f) Transfer oscilloscope probe to test point G and adjust A1A11R43 until the positive and negative halves of the waveform are of the same width

l. RADIO FREQUENCY OSCILLATOR A3, FREQUENCY ADJUSTMENT. -- The frequency adjustments of the radio frequency oscillator are accessible when the electronic frequency convertor is removed (figure 5-36).

(1) REMOVING THF ELECTRONIC FRF - QUENCY CONVERTER A1A2.

(a) Loosen the thumbscrew on the bottom center of the converter front panel.

(b) Slide the converter towards the front and out of the counter chassis.

(2) WARMUP. Allow a minimum period of 8 hours for warmup before adjusting the oscillator. Warmup power is delivered to the oscillator when the counter is connected to a 115-volt power source and the counter POWER switch is set to either STBY, TRACK, or STORE.

Note

The following procedure must be performed with special test equipment not available on board ship.

(3) TEST EQUIPMENT AND FREQUENCY STANDARD.

(a) Oscilloscope, AN/USM-l40A.

(b) Frequency standard, AN/URQ-9 or AN/URQ-10.

(4) TEST SETUP.

(a) Connect frequency standard to the trigger input connector of the oscilloscope.

(b) Connect lead between oscilloscope chassis and frequency standard ground.

(c) Set oscilloscope controls for a vertical deflection of 0.2 v/cm and sweep rate of 1 ms/cm.

(d) Connect oscilloscope probe to the 1 MC OUT connector of the counter.

(5) INSTRUCTIONS.

(a) Set oscilloscope triggering source switch to external ac, and observe waveform. Waveform will be drifting across the face of the screen.

(b) Loosen the two hold-down screws (figure 5-36).

(c) Adjust COARSE control to obtain minimum waveform drift.

(d) Set oscilloscope time/cm switch to 0.1 ms, and note that drift rate increases.

(e) Allow approximately 10 seconds for the oscillator to stabilize; then adjust COARSE control to obtain zero drift. If this is not possible, proceed to step (f).

(f) Set FINE control to the center of its tuning range.

(g) Adjust COARSE control to obtain minimum waveform drift.

(h) Adjust the FINE control to obtain zero waveform drift.

(i) Tighten the two hold-down screws.

(j) Replace converter and secure with thumbscrew.

j. RADIO FREQUENCY OSCILLATOR A3 AMPLITUDE ADJUSTMENT. — The radio frequency oscillator amplitude adjustment A3T2 is shown in figures 4-4 and 5-2.

(1) TEST EQUIPMENT. Oscilloscope, AN/USM-140A.

(2) DUMMY LOAD. 50-ohm BNC Termination, Tektronix Model 011-049.

(3) TEST SETUP.

(a) Connect male-end of 50-ohm termination to the 1 MC OUT connector.

(b) Connect oscilloscope probe to the female-end of the 50-ohm termination.

(c) Set oscilloscope controls to obtain a vertical deflection of 0.5 v/cm and sweep rate of 1 ins/cm.

(4) INSTRUCTIONS.

(a) Set oscilloscope triggering source switch to internal, and observe waveform.

(b) Adjust A3T2 for a symmetrical sinewave with minimum amplitude of O.5 v rms (2. 8 cm vertical deflection).

k. ELECTRONIC FREQUENCY CONVERTER A2 ADJUSTMENT.

(1) PRELIMINARY TEST SETUP (figure 5-3).

(a) Set POWER switch to OFF.

(b) Loosen the thumbscrew on the bottom center of the converter.

(c) Slide the converter towards the front and out of the counter chassis, and set it on a work bench near the counter.

(d) Connect W3P1 connector of rf cable assembly W3 to A2P2 of the converter; connect W3P2 connector of rf cable assembly W3 to A1J9 of the counter (figures 5-36 and 5-51).

(e) Connect rf cable assembly W2 to A2P1 of the converter; connect the male end to A1J10 of the counter.

(f) Set POWER switch to STORE.

Note

The following procedures must be performed with special test equipment not available on board ship.

(2) TEST EQUIPMENT.

(a) Uhf Signal Generator, Hewlett Packard Model 612A or equivalent, with a minimum frequency range of 480 mc to 650 mc, and with an adjustable output level.

(b) Vhf Signal Generator, Hewlett Packard Model 608C or equivalent, with a minimum frequency range of 100 mc to 480 mc, and with an adjustable output level.

(c) Rf Millivoltmeter, CAQI-411A.

(d) Oscilloscope, AN/USM-l40B and/or Tektronix Model 585 with Type 82 Plug-in.

(3) TEST ACCESSORIES.

(a) 50-ohm BNC Termination, Tektronix Model 011-049 or equivalent.

(b) BNC Probe Adapter, Tektronix Model 013-054 or equivalent.

(c) Two connector adapters, Type UG-201/U or equivalent.

(4) INSTRUCTIONS FOR ADJUSTING THE FREQUENCY MULTIPLIER A2A1.

(a) Set POWER switch to OFF.

(b) Unsolder center conductor of coaxial lead from test point B (figures 4-4 and 5-4).

(c) Connect a 51-ohm resistor between test point B and converter ground.

(d) Connect test setup as shown in figure 5-5.

(e) Set POWER switch to TRACK or STORE.

(f) Set oscilloscope controls for a vertical deflection of 2 v/cm, a sweep rate of O. 02 ins/cm, and internal triggering. To obtain this sweep time, set variable time/cm switch to .1 and use 5 x magnifier.

(g) Connect oscilloscope probe to test point B and oscilloscope ground lead to the converter chassis.

(h) Adjust A2A1T5 (figure 5-4) for a 50-mc sine wave with a maximum amplitude.

(i) Adjust A2A1T4 for a 50-mc sine wave with a maximum amplitude.

(j) Adjust A2A1T3 for a 50-mc sine wave with a maximum amplitude.

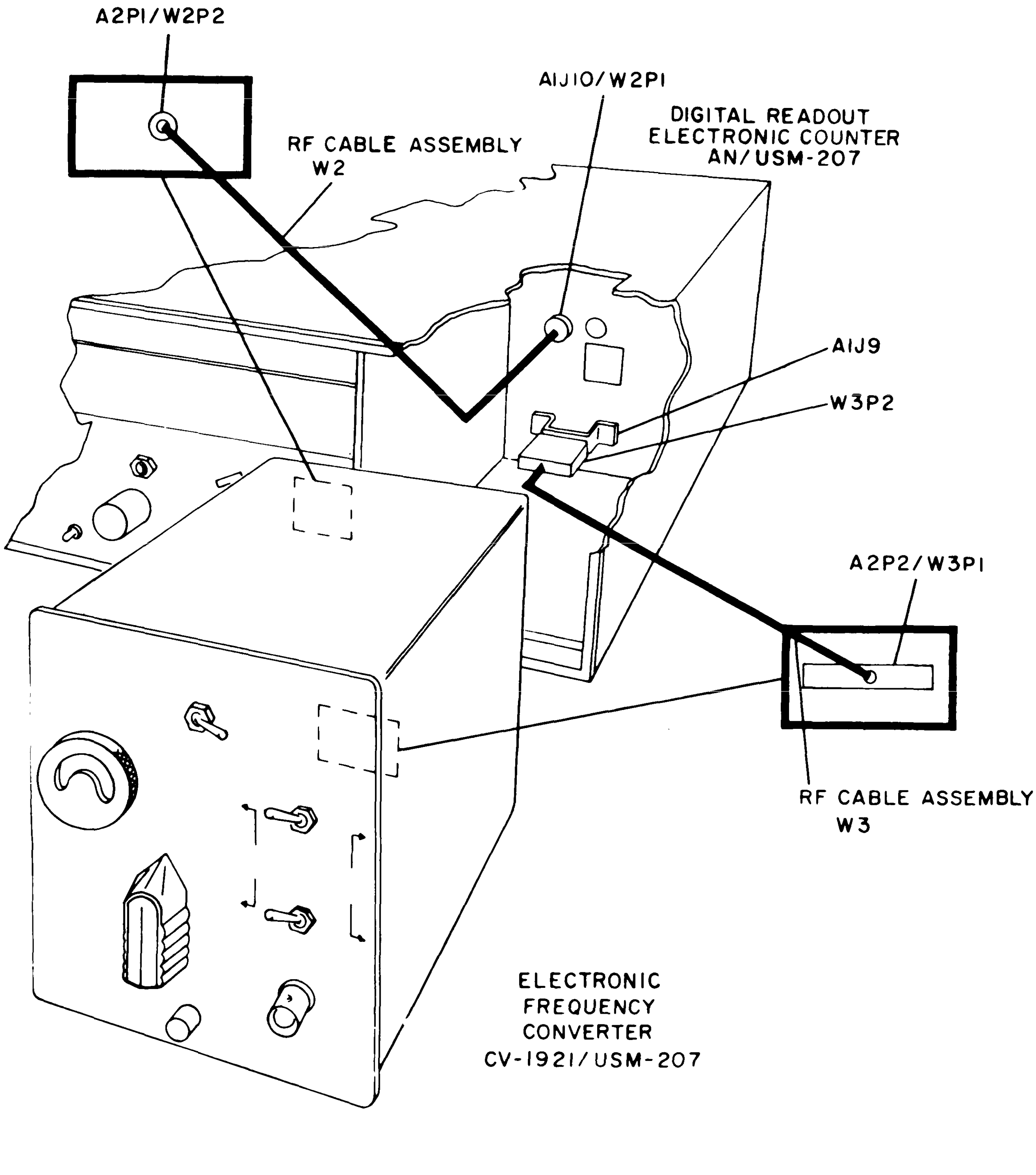


Figure 5-3. Electronic Frequency Converter A2, Preliminary Test Setup

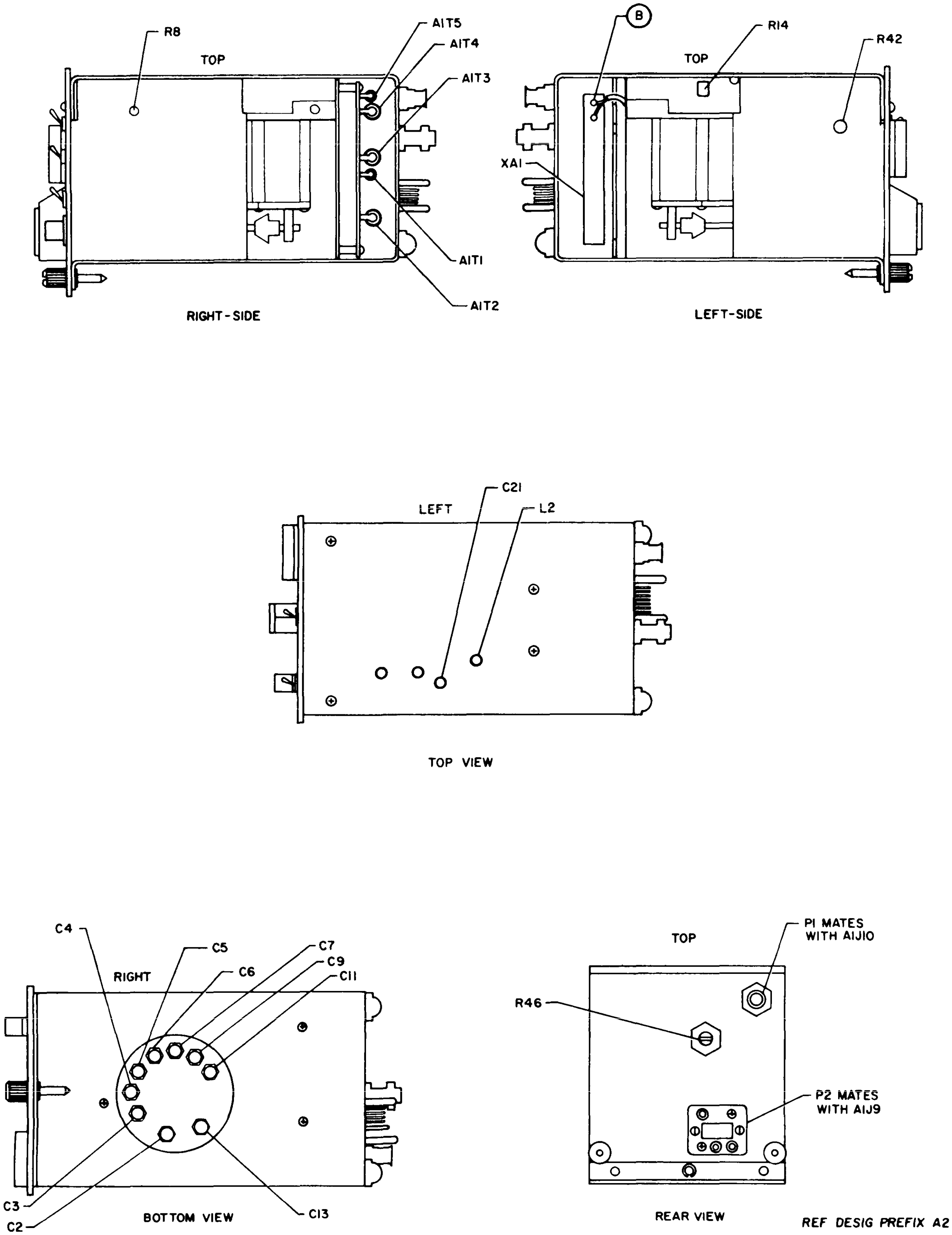


Figure 5-4. Electronic Frequency Converter A2, Location of Adjustments and Test Points

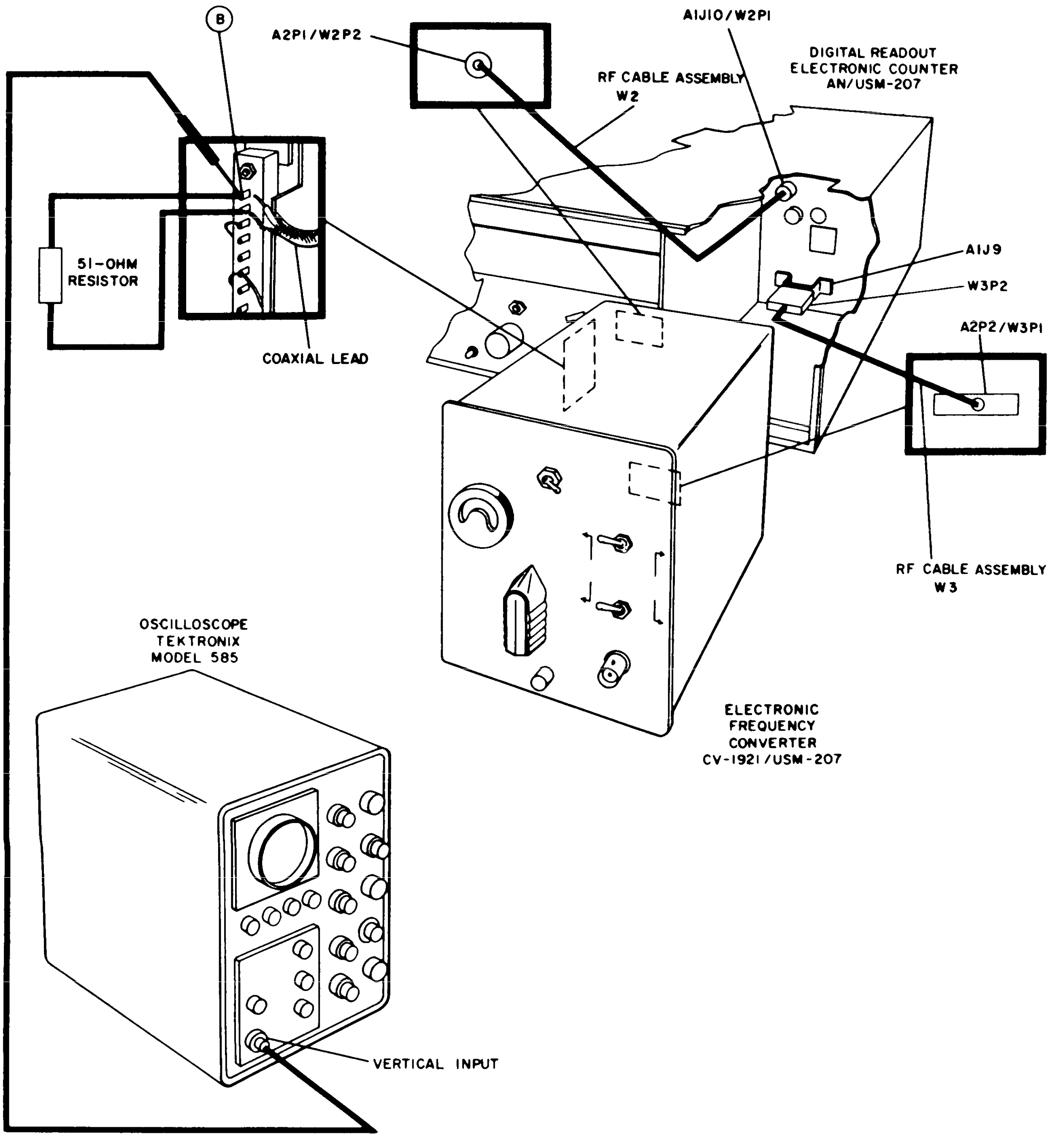


Figure 5-5. Frequency Multiplier A2Al Adjustment, Test Setup

(k) Adjust A2A1T2 for a 50-mc sine wave with a maximum amplitude.

(1) Adjust A2A1T1 for a 50-mc sine wave with a maximum amplitude.

(m) Adjust A2R46 (figure 5-4) for a 3-cm vertical wave-form-deflection.

(n) Set POWER switch to OFF.

(o) Disconnect resistor connected in step (c) and resolder the coaxial lead to test point B.

(5) INSTRUCTIONS FOR ADJUSTING THE HARMONIC GENERATOR AND CAVITY.

(a) Connect test setup as shown in figure 5-6. Connect uhf signal generator first, and leave the vhf signal generator and rf millivoltmeter disconnected.

(b) Set mixing frequency selector switch to 500, both converter attenuator switches to the left, and DIRECT-HETERODYNE switch to HETERODYNE.

(c) Set uhf signal generator output frequency for 490 mc, output level for approximately 100 mv rms, function switch to CW, PULSE switch to +, and modulation switch to NORMAL.

(d) Set oscilloscope controls for a vertical deflection of 0.1 v/cm, a sweep rate of 0.1 us/cm, and internal triggering.

(e) While observing waveform on oscilloscope, adjust band 500 adjustment capacitor A2C2 (figure 5-4), for a maximum 10-mc output. The waveform will be clipped.

(f) Reduce output level of uhf signal generator to a point where waveform is no longer clipped; then readjust A2C2 for a maximum 10-mc output.

(g) Adjust matching adjustment coil A2L2 for a maximum 10-mc output.

(h) Connect the rf millivoltmeter as shown in figure 5-6 and set its RANGE switch to 0.03.

(i) Adjust matching adjustment capacitor A2C21 for minimum noise level as indicated on the rf millivoltmeter. When properly adjusted, noise level should be less than 20 millivolts,

(j) Disconnect the rf millivoltmeter.

(k) Set mixing frequency selector switch to 450.

(1) Set output frequency of uhf signal generator for 460 mc, and output level for 100 millivolts.

(m) While observing waveform on oscilloscope, adjust band 450 adjustment capacitor A2C3 for a maximum 10-mc output. The waveform will be clipped.

(n) Reduce output level of uhf signal generator, as required, to eliminate clipping; then readjust A2C3 for a maximum 10-mc output.

(o) Set mixing frequency selector switch to 400.

(p) Disconnect uhf signal generator and replace it with the vhf signal generator.

(q) Set FREQUENCY RANGE switch of vhf signal generator to E, FINE FREQ ADJUST switch to the marker, FREQUENCY control for a 410-mc output, MOD SELECTOR switch to CW, and attenuator control fully counterclockwise.

(r) Adjust AMP TRIMMER control of vhf signal generator for a maximum reading on the OUTPUT VOLTS meter; then set OUTPUT LEVEL control for a reading on the set level (red arrow) of the OUTPUT VOLTS meter, and set attenuator control for 100 millivolts.

(s) While observing waveform on oscilloscope, adjust band 400 adjustment capacitor A2C4 for a maximum 10-mc output. The waveform will be clipped.

(t) Turn attenuator control of vhf signal generator counterclockwise to a point where waveform is no longer clipped, then readjust A2C4 for a maximum 10-mc output.

(u) Set mixing frequency selector switch to 350.

(v) Set output frequency of vhf signal generator for 360 mc. Leave other controls of vhf signal generator as in step (q).

(w) Repeat the procedure of step (r).

(x) While observing waveform on oscilloscope, adjust band 350 adjustment capacitor A2C5 for a maximum 10-mc output. The waveform will be clipped.

(y) Reduce output level of vhf signal generator as in step (t); then readjust A2C5 for a maximum 10-mc output.

(z) Set mixing frequency selector switch to 300.

(aa) Set output frequency of vhf signal generator for 310 mc. Leave other controls of vhf signal generator as in step (q).

(ab) Repeat the procedure of step (r).

(ac) While observing waveform on oscilloscope, adjust band 300 adjustment capacitor A2C6, for a maximum 10-mc output. The waveform will be clipped.

(ad) Reduce output level of vhf signal generator as in step (t); then readjust A2C6 for a maximum 10-mc output.

(ae) Set mixing frequency selector switch to 250.

(af) Set output frequency of vhf signal generator for 260 mc. Leave other controls of vhf signal generator as in step (q).

(ag) Repeat the procedure of step (r).

(ah) While observing waveform on oscilloscope, adjust band 250 adjustment capacitor A2C7 for a maximum 10-mc output. The waveform will be clipped.

(ai) Reduce output level of vhf signal generator as in step (t); then readjust A2C7 for a maximum 10-mc output.

(aj) Set mixing frequency selector switch to 200.

(ak) Set FREQUENCY RANGE switch of vhf signal generator to D, and set output frequency for 210 mc. Leave other controls of vhf signal generator as in step (q).

(al) Repeat the procedure of step (r).

(am) While observing waveform on oscilloscope, adjust band 200 adjustment capacitor A2C9 for a maximum 10-mc output. The waveform will be clipped.

(an) Reduce output level of vhf signal generator as in step (t); then readjust A2C9 for a maximum 10-mc output.

(ao) Set mixing frequency selector switch to 150.

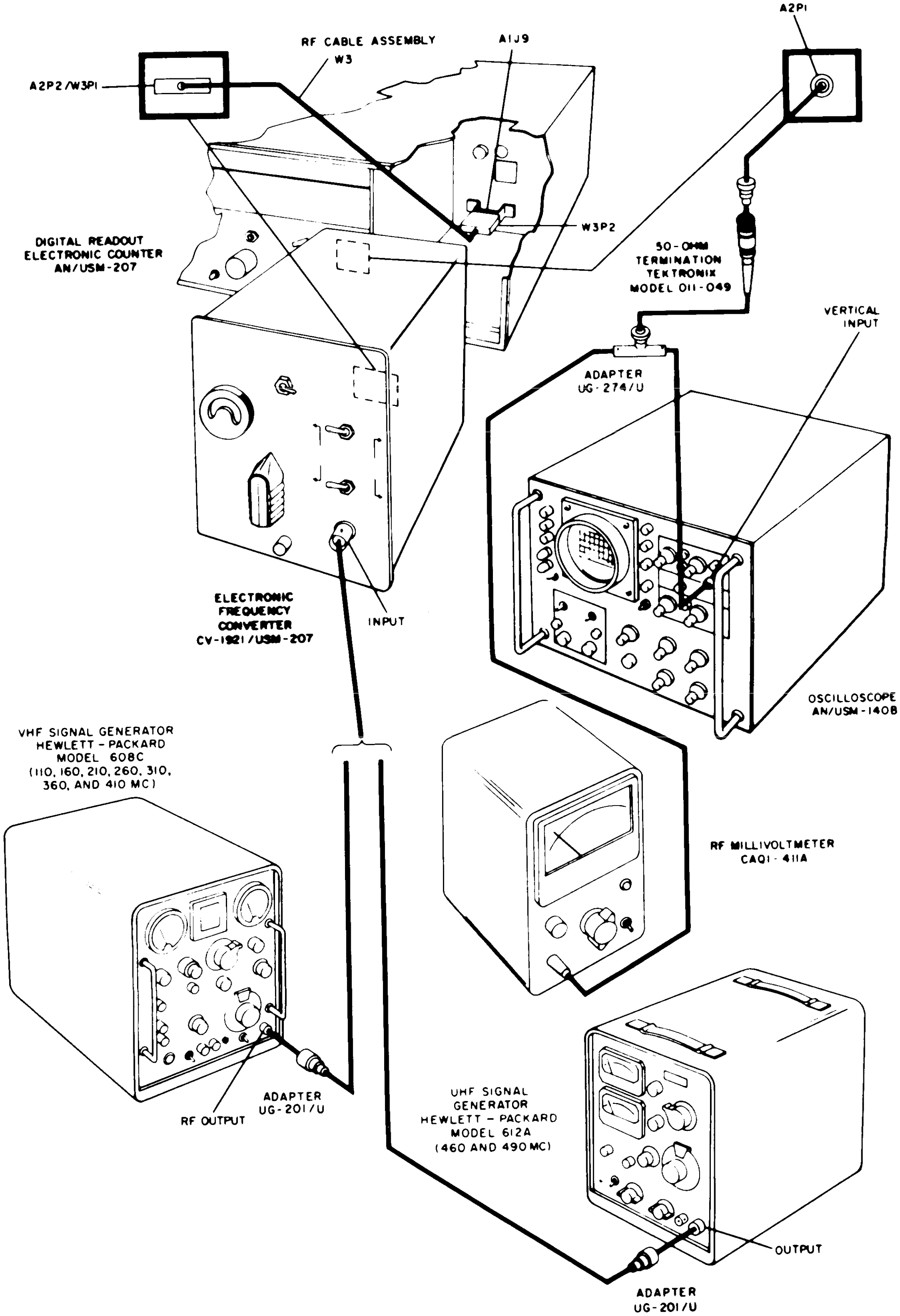


Figure 5-6. Harmonic Generator and Cavity, Test Setup

(ap) Set output frequency of vhf signal generator for 160 mc. Leave other controls of vhf signal generator as in step (ak).

(aq) Repeat the procedure of step (r).

(ar) While observing waveform on oscilloscope, adjust band 150 adjustment capacitor A2C11 for a maximum 10-mc output. The waveform will be clipped.

(as) Reduce output level of vhf signal generator as in step (t); then readjust A2C11 for a maximum 10-mc output.

(at) Set mixing frequency selector switch to 100.

(au) Set output frequency of vhf signal generator for 110 mc. Leave other controls of vhf signal generator as in step (ak).

(av) Repeat the procedure of step (r).

(aw) While observing waveform on oscilloscope, adjust band 100 adjustment capacitor A2C13 for a maximum 10-mc output. The waveform will be clipped.

(ax) Reduce output level of vhf signal generator as in step (t); then readjust A2C13 for a maximum 10-mc output.

(ay) Connect the rf millivoltmeter as shown in figure 5-6, and set its RANGE switch to O. 3.

(az) Adjust attenuator control of the vhf signal generator for a 100-millivolt reading on the rf millivoltmeter. Observe the setting of the attenuator control. If more than 10 millivolts, reduce it accordingly.

(ba) Adjust the bias adjustment resistor A2R8 for a peak reading on the rf millivoltmeter. Note the value of this reading.

(bb) Set the mixing frequency selector switch to 250.

(bc) Set the FREQUENCY RANGE switch of the vhf signal generator to E, and set the output frequency for 260 mc. Peak the AMP. TRIMMER control; then set the OUTPUT LEVEL control to the set level of the OUTPUT VOLTS meter. Do not change the setting of the attenuator control.

(bd) Observe the reading on the rf millivoltmeter, and compare it with the reading obtained in step (ha). If the two readings are within 10 percent of each other, no further adjustments are necessary and the procedure is complete. If the reading in this step is less by more than 10 percent, proceed to step (be).

(be) Adjust the bias adjustment resistor A2R8 for a reading approximately halfway between the difference of the two readings.

(bf) Set the mixing frequency selector switch to 100.

(bg) Set the FREQUENCY RANGE switch of the vhf signal generator to D, and set the output frequency for 110 mc. Peak the AMP. TRIMMER control; then set the OUTPUT LEVEL control to the set level of the OUTPUT VOLTS meter. Do not change the setting of the attenuator control.

(bh) Observe the reading on the rf millivoltmeter and compare it with the reading obtained in step (be). If the two readings are within 10 percent of each other, no further adjustments are necessary and the procedure is complete. Otherwise, proceed to step (bi).

(bi) Adjust the bias adjustment resistor A2R8 for a reading approximately halfway between the difference of the two readings.

(bj) Repeat the procedure of steps (bb) through (bi) as many times as necessary until the readings on band 100 and band 250 are within 10 percent of each other.

(6) BALANCING THE MIXER. The mixer is adjusted for minimum noise on all channels according to the following procedure:

(a) Set POWER switch to OFF.

(b) Loosen the thumbscrew on the bottom center of the converter.

(c) Slide the converter toward the front and out of the counter chassis, and set on a work bench near the counter.

(d) Connect W3P1 connector of rf cable assembly W3 to A2P2 of the converter; connect W3P2 connector of rf cable assembly W2 to A1J9 of the counter (figures 5-36 and 5-51).

(e) Connect 50-ohm termination, Tektronix Model 011-049, to A2P1 of the converter (see figure 5-6).

(f) Connect rf millivoltmeter, Hewlett-Packard Model 411A or equivalent, to the 50-ohm termination.

(g) Set POWER switch to STORE.

(h) Set DIRECT-HETERODYNE switch to HETERODYNE.

(i) Set RANGE switch of rf millivoltmeter to 0.03.

(j) Observe the rf millivoltmeter reading in each position of the mixing frequency selector switch; note the switch position where the reading is the highest and set it to that position.

(k) Adjust the balance adjustment resistor A2R14 (figure 5-4) for a minimum reading on the rf millivoltmeter.

(l) Repeat the procedure of step (j).

(m) Compare the results of step (j) with step (l). If the switch position with the highest reading is the same in steps (j) and (l), the adjustment is complete. Otherwise, proceed to step (n).

(n) Repeat the procedure of steps (j) through (m) as many times as necessary to obtain the correct results. When the mixer is properly balanced, the noise level reading in any position of mixing frequency selector switch is less then 20 millivolts.

(7) CALIBRATING THE LEVEL METER A2M1.

(a) Set counter POWER switch to OFF.

(b) Connect test setup as shown in figure (5-7).

(c) Set DIRECT HETERODYNE switch to DIRECT.

(d) Set both converter attenuator switches to the right.

(e) Set vhf signal generator for a 100-mc output frequency.

(f) Set vhf-signal-generator OUTPUT LEVEL control to mid-range, and attenuator fully clockwise (maximum attenuation).

(g) Set rf millivoltmeter RANGE switch to 0.3.

(h) Set counter POWER switch to TRACK.

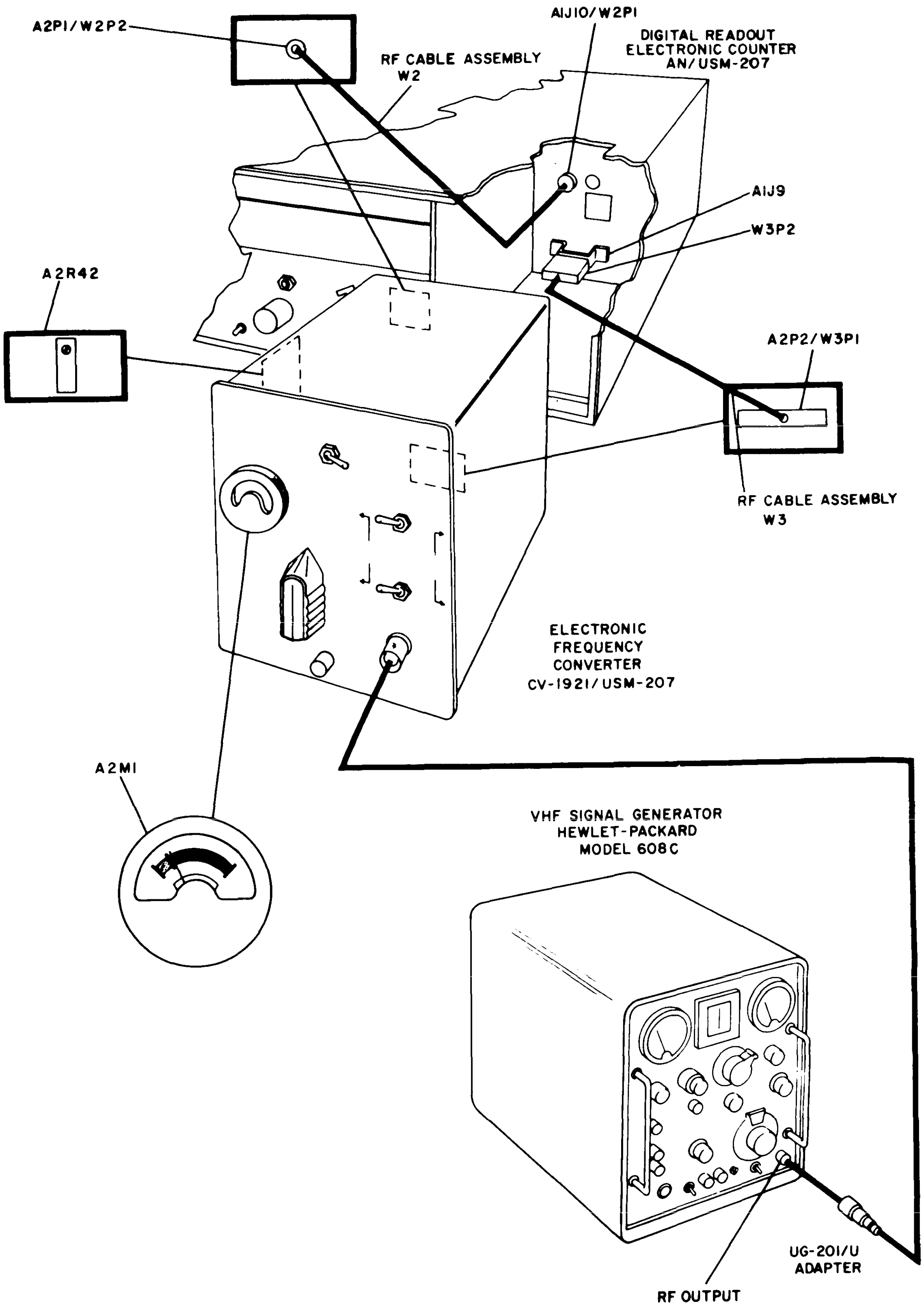


Figure 5-7. Level Meter A2M1 Calibration, Test Setup

(i) Set both converter attenuator switches to the left.

(j) Adjust attenuator of vhf signal generator for a 100-millivolt reading on the rf millivoltmeter.

(k) Observe indication on LEVEL METER. Adjust resistor A2R42 (figure 5-4) until needle reads at the low-end of the green zone near the border marker

(1) Set vhf-signal-generator output frequency to 50 mc, 20 mc, 10 mc, and 5 mc, At each frequency, adjust attenuator vhf signal generator for a 100-millivolt reading on the rf millivoltmeter and observe LEVEL METER indication. If necessary, readjust resistor A2R42 until, at each of the above frequencies, LEVEL METER reading is as in step (k).

5-4A. REMOVAL OF TOP AND BOTTOM COVERS.

When replacing parts of the counter, first remove the top and bottom covers as follows:

a. Set POWER switch to OFF.

b. If panel protectors are installed, proceed to step c. If panel protectors are not installed, remove the 16 pan-head screws and four flat-head screws from each side of the counter and proceed to step e.

c. Remove left and right panel protectors. Each is fastened on by 16 pan-head screws.

Note

Do not install these screws temporarily in the mounting holes while the panel protectors are removed.

d. When panel protectors are removed, four additional screws are exposed on each side. Remove all eight screws.

e. Remove the 11 screws on top. Note that the two at the front center are flat-head screws, and that the four screws on the right side are shorter than the others.

f. Lift top cover up and away.

g. Set the counter upright with the front facing up and the bottom cover to the front.

h. Remove the 11 screws on the bottom.

i. Slide the bottom cover forward and off the counter.

j. To replace the top and bottom covers, perform steps a through g in a reverse order.

5-5. REPLACEMENT. (See figure 5-33).

a. PRINTED-CIRCUIT BOARDS A1A2 THROUGH A1A7, A1A9, and A1A10. —

(1) Set POWER switch to OFF.

(2) For A1A9 or AlAl0, remove the two screws and shield that fit over these boards.

(3) Insert board-extractor hooks into the two holes at the top of the board to be removed.

(4) Note orientation of printed-circuit board.

(5) Grasp the board-extractor handle firmly and pull up with a slow, even pressure.

(6) Orient replacement board per step (4).

(7) Insert replacement board evenly within each guide channel, then push it down with a slow, even pressure into its socket.

(8) For A1A9 or A1A10, replace the shield and secure with the two screws.

b. PRINTED-CIRCUIT BOARD AlAl. —

(1) Set POWER switch to OFF.

(2) Remove the two screws that secure the heat sink of A1A1 to chassis.

(3) Perform the procedure of steps (2) through (6) of paragraph 5-5a.

(4) Secure the heat sink with the two screws removed in step (2).

PRINTED-CIRCUIT BOARDS A1A12 THROUGH A1A19 (figure 5-33). — Printed-circuit boards A1A12 through A1A19 are secured at the top by means of a tiedown bracket. When replacing any one of these boards, first remove the two screws that fasten the tiedown bracket and remove the tiedown bracket. Next, replace the applicable board as in paragraph 5-5a, then replace the tiedown bracket.

d. PRINTED-CIRCUIT BOARD A1A8. —

(1) Set POWER switch to OFF.

(2) Using an open-end wrench loosen the fastening nut on the coaxial-cable connector and disconnect the coaxial cable from the board.

(3) Replace board by following the procedure of paragraph 5-5a.

(4) Connect coaxial cable to the board and secure with the open-end wrench.

e. PRINTED-CIRCUIT BOARD AlAll. —

(1) Set POWER switch to OFF.

(2) Remove printed-circuit board A1A12 per paragraph 5-5c.

(3) Using an open-end wrench, loosen the fastening nuts on the two coaxial-cable connectors, and disconnect the coaxial cables.

(4) Replace AlAll per paragraph 5-5c.

(5) Connect the two coaxial cables to the board and secure with the open-end wrench.

(6) Reinsert printed-circuit board A1A12 per paragraph 5-5c.

f . REPLACEMENT OF PARTS ON PRINTED-CIRCUIT BOARDS. — To replace a part on a printed-circuit board, cut the leads of the defective part near the lead hole. Use a low-power soldering iron (50 watts maximum), and apply heat sparingly to the cut lead from the circuit side of the board. Slip the lead from the board as soon as the solder melts. Use a toothpick to clean the solder from the lead hole. Clean the board with isopropyl alcohol to Specification TT-I-735. Bend the tinned leads of the replacement part and insert in the cleaned holes; allow the leads to extend approximately 1/16 of an inch beyond the circuit side of the board. Solder leads from both sides of the board. Use resin-core solder type 63-37 (preferred) or 60-40 with a maximum diameter of 1/16 inch to Specification QQ-S-571 with flux to MIL-F- 14526. If the replacement part is a transistor or a diode, use a heat sink, such as a pair of long-nosed pliers, between the part and the soldering iron. Transistors are mounted on insulated spacers that provide added support to the leads. When replacing a transistor, save the spacer of the defective transistor and place it on the replacement transistor. Printed-circuit board A1A9 contains terminal studs which mount one or more electrical parts. When a terminal stud mounts more than one part, these parts are to be replaced as a group. For example when a terminal stud mounts four parts of which one is defective, the other three must also be replaced.

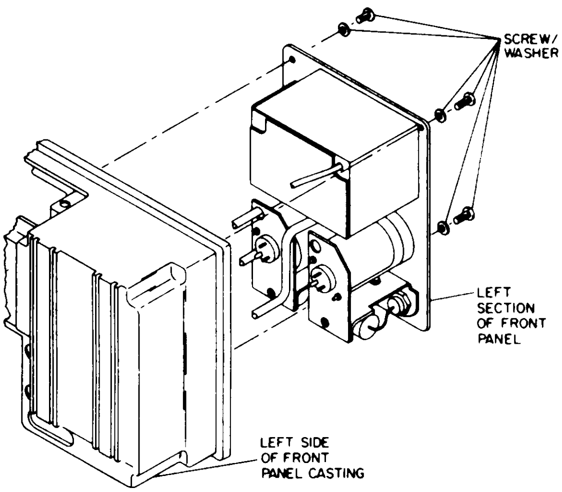


Figure 5-8. Left Section of Front Panel, Removal of Counter

g. ACCESS TO AF-RF AMPLIFIER A1A20, A CHANNEL VARIABLE ATTENUATOR A1A21, B AND C CHANNEL VARIABLE ATTENUATOR AND TRIGGER LEVEL CONTROLS A1A22 and A1A23, B AND C SLOPE SWITCHES A1S10, AND A1S12, MODE SELECTOR SWITCH A1S9, AND CONNECTORS A1J1, A1J2, A1J3, A1J4, AND A1J5. — These attenuator assemblies and parts are mounted on the left section of the front panel, and become accessible when the left section of the front panel is removed from the chassis (figure 5-8). To remove the left section of the front panel, remove the three screws (one at the bottom and two at the top), then slide it slowly forward and out of the chassis.

h. REPLACING AF-RF AMPLIFIER A1A20. —

Note

Steps (1) through (9) apply to AN/US M- 207 counters with A1A21 part No. MP13-523. See steps (10) through (18) for counters with A1A21 part No. MP13-537.

(1) Perform the procedure of paragraph 5-5g to gain access to A1A20.

(2) Remove and save the two screws, washer and solder lug that mount A1A20 to its bracket MP23 (figure 5-9).

(3) Disconnect the coaxial lead and braid from the component side of A1A20. Code-mark coaxial cable to insure proper reassembly.

(4) Disconnect the red, white, and black leads and shield of the cable and teflon-sleeved bus wire from the circuit side of A1A20. Code-mark leads and save the three ferrite beads to insure proper reassembly.

(5) Orient replacement A1A20 such that the component side faces the bracket.

(6) Solder the red, white, and black leads and the shield of the cable and the teflon- sleeved bus wire to the points shown in figure 5-50 and as marked in step (4). Use resin-core solder type 63-37 (preferred) or 60-40 with a maximum diameter of 1/16 inch to Specification QQ-S-571 with flux to MIL-F-14526.

(7) Solder coaxial lead and shield to the circuit side of A1A20 as shown in figure 5-48 and as marked in steps (3) and (4).

(8) Remount A1A20 to its bracket MP23 with the two screws, washer and solder lug removed in step (2).

(9) Replace the left section of the front panel in the chassis, and secure with the three screws.

Note

Steps (10) through (18) apply to AN/USM-207 counters with A1A21 part No. MP13-537.

(10) Perform the procedure of paragraph 5-5g to gain access to A1A20.

(11) Remove and save the two screws, washer and solder lug that mount A1A20 to AlA21 (figure 5-9).

(12) Disconnect the coaxial lead and braid from the component side of A1A20. Code-mark coaxial cable to insure proper reassembly.

(13) Disconnect the red, white, and black leads and shield of the cable and teflon-sleeved bus wire from the circuit side of A1A20. Code-mark leads to insure proper reassembly.

(14) Orient replacement A1A20 such that the component side faces A1A21.

(15) Solder the red, white, and black leads and the shield of the cable and the teflon-sleeved bus wire to the points shown in figure 5-50 and as marked in step (13). Use resin-core solder type 63-37 (preferred) or 60–40 with a maximum diameter of 1/16 inch to Specification QQ-S-571 with flux to MIL-F-14526.

(16) Solder coaxial lead and shield to the circuit side of A1A20 as shown in figure 5-48 and as marked in steps (12) and (13).

(17) Remount A1A20 to A1A21 with the two screws, washer and solder lug removed in step (11)

(18) Replace the left section of the front panel in the chassis, and secure with the three screws.

i. REPLACING THE CHANNEL A VARIABLE ATTENUATOR A1A21. —

Note

Steps (1) through (16) apply to AN/USM-207 counters with A1A21 part No. MP13-523. See steps (17) through (43) for counters with A1A21 part No. MP13-537.

(1) Perform the procedure of paragraph 5-5g to gain access to A1A21.

(2) Unsolder the lead from connector A1J1 (figure 5-9). Remove and save the nut and lock washer that mount connector A1J1 and remove A1J1.

(3) Loosen the two setscrews on knob A1MP14 and remove the knob.

(4) Remove and save the mounting nut and washer that secure the shaft of A1A21 to the left seetion of the front panel.

(5) Remove and save the screw and washer that secure bracket A1MP23 to the left section of the front panel.

(6) Disconnect the external leads from A1A21 as follows (figure 5-10).

(a) White-black-brown, white-black-red. white-black-orange, and white-black-yellow from wafer C.

(b) Lead of capacitor A1A21C20 from A1J1.

(c) Teflon-sleeved bus wire from wafer A that connects to A1A20. Be sure that the three ferrite beads, El through E3, stay on the lead.

(7) Remove the bracket, slide the shaft of A1A21 toward the rear until it clears the left section of the front panel, then remove and discard the defective A1A21.

(8) Insert replacement A1A21 from the inside, with shaft through the mounting hole on the left section of the front panel. Be sure that positioning key is seated within the recess of the left section of the front panel. Do not mount.

(9) Place bracket over A1A21; allow the bolts at the rear of A1A21 to pass through the clearing holes of the bracket.

(10) Connect and solder leads removed in step (6) to the terminals of A1A21 as shown in figures 5-9 and 5-10.

(11) Place mounting nut and lock washer on shaft of A1A21, then tighten mounting nut.

(12) Replace knob AlMP14 on shaft, temporarily tighten one of the two setscrews. then turn to the extreme counterclockwise position.

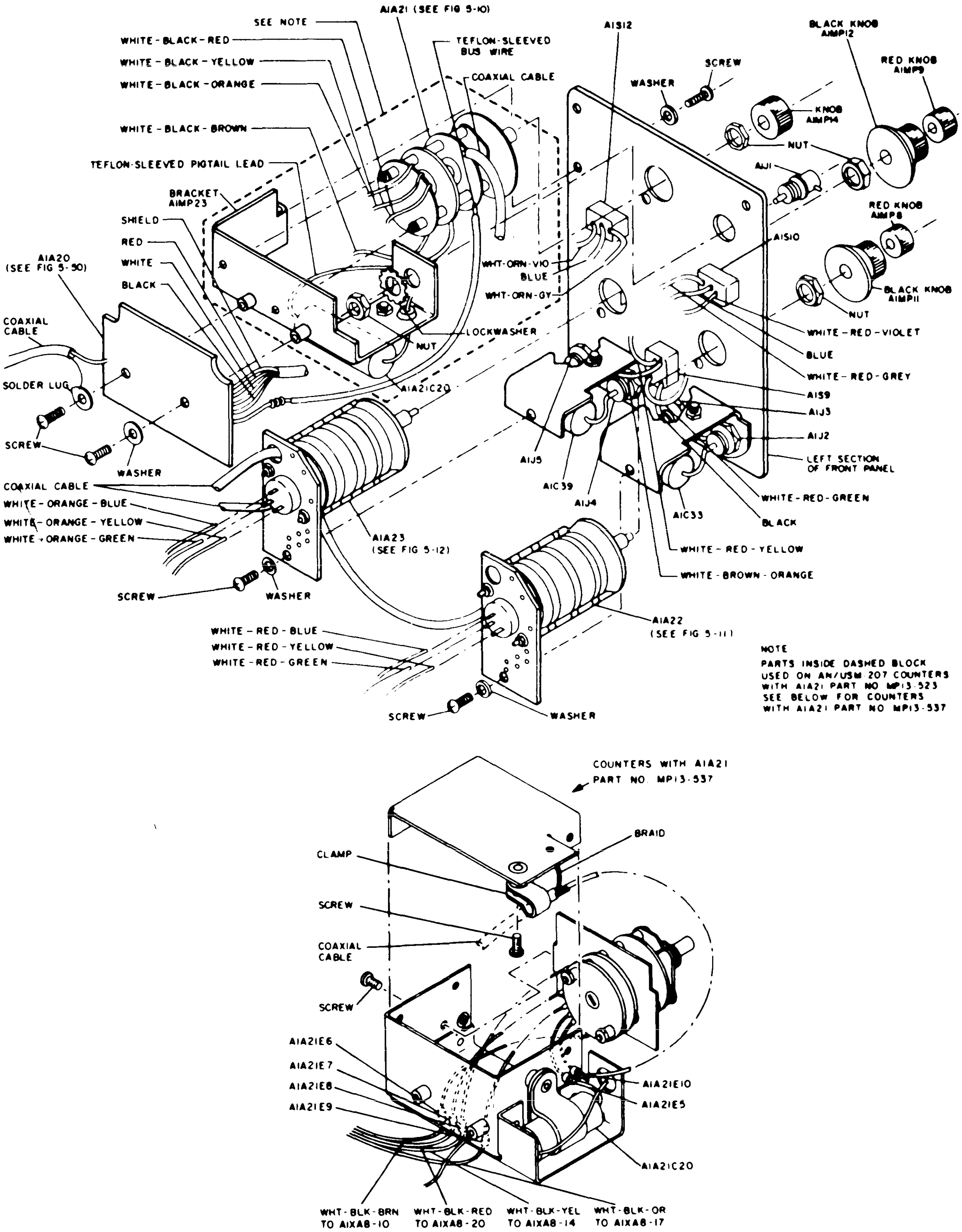


Figure 5-9. Left Section of Front Panel, Exploded View

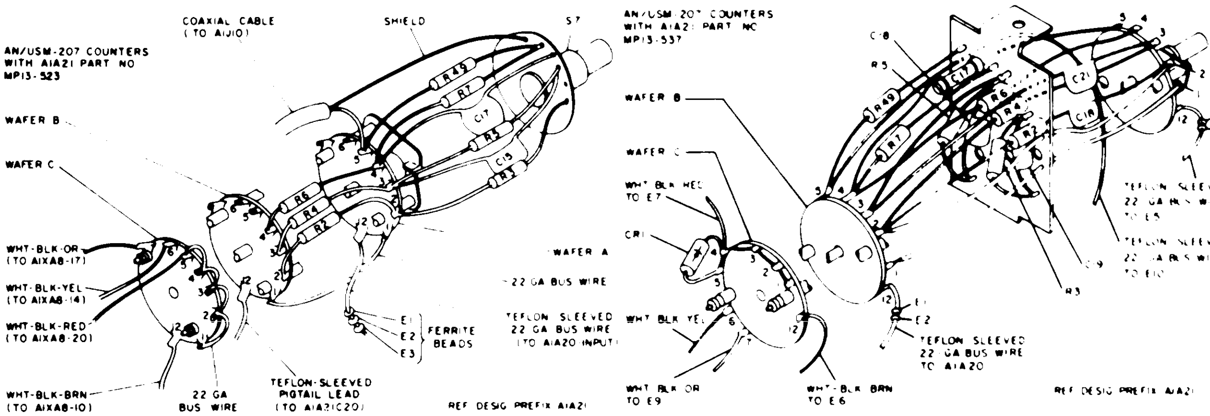


Figure 5-10. Channel A Variable Attenuator A1A21, Location of Parts

(13) Loosen the setscrew tightened in step (12), slide knob A1MP14 so that index point faces the .1 V position, then tighten both setscrews.

(14) Secure the bracket to the left section of the front panel by means of the screw removed in step (5) and receptacle A1J1 removed in step (2).

(15) Solder the lead from capacitor A1A21C20 to receptacle A1J1.

(16) Replace the left section of the front panel in the chassis, and secure with the three screws.

Note

Steps (17) through (43) apply to AN USM-207 counters with A1A21 part No. MP13-537.

(17) Perform the procedure of paragraph 5-5g to gain access to A1A21.

(18) Unsolder the lead of capacitor A1A21C20 from connector A1J1 (figure 5-9).

(19) Remove and save the nut and lock washer that mount connector A1J1, and remove A1J1.

(20) Loosen the two setscrews on knob A1MP14 and remove the knob.

(21) Remove and save the mounting nut and lock washer that secure the shaft of A1A21 to the left section of the front panel.

(22) Remove and save the screw and lock washer that secure the case of A1A21 to the left section of the front panel.

(23) Remove and save the two screws, washer, and solder lug that secure A1A21 to A1A20.

(24) Unsolder the teflon-sleeved lead that connects A1A21 to A1A20. Mark the connecting point on A1A20 to insure proper reassembly.

(25) Unsolder the white-black-brown, white-black-red, white-black-orange, and white-black-yellow leads from the bottom of A1A21. Code-mark leads to insure proper reassembly.

(26) Unsolder the coaxial cable from the feed-through terminal.

(27) Remove and save the screw from the clamp that secures the coaxial cable to the cover of A1A21. Leave the clamp on the coaxial cable.

(28) Unsolder the braid of the coaxial cable from the solder lug on the cover of A1A21.

(29) Slide A1A21 towards the rear until its shaft clears the mounting hole in the front panel; then lift A1A21 up and out of the instrument.

(30) Insert replacement A1A21 from the top, with the shaft facing forward.

(31) Solder the teflon-sleeved lead to A1A20 as marked in step (24).

(32) Mount A1A21 to A1A20 by means of the two screws, washer, and solder lug removed in step (23).

(33) Raise the shaft slightly so that the connection points on the bottom of the case become accessible.

(34) Solder the white-black-yellow, white-black-orange, white-black-red, and white-black-brown leads to the connection points as noted in step (25).

(35) Solder the coaxial cable to the feedthrough terminal of the replacement A1A21.

(36) Solder the braid of the coaxial cable to the solder lug on the cover of A1A21; then secure the clamp with the screw removed in step (27).

(37) Slide shaft through mounting hole in front panel and secure by means of the lock washer and nu'

(38) Replace screw and lock washer removed in step (22).

(39) Replace connector A1J1 and secure with the lock washer and nut.

(40) Solder the free lead of capacitor A1A21C20 to A1J1.

(41) Replace knob A1MP14 on shaft, temporarily tighten one of the two setscrews; then turn to the extreme counterclockwise position.

(42) Loosen the setscrew tightened in step (41), turn knob so that index point faces the .1 V position; then tighten both setscrews.

(43) Replace the left section of the front panel in the chassis, and secure with the three screws.

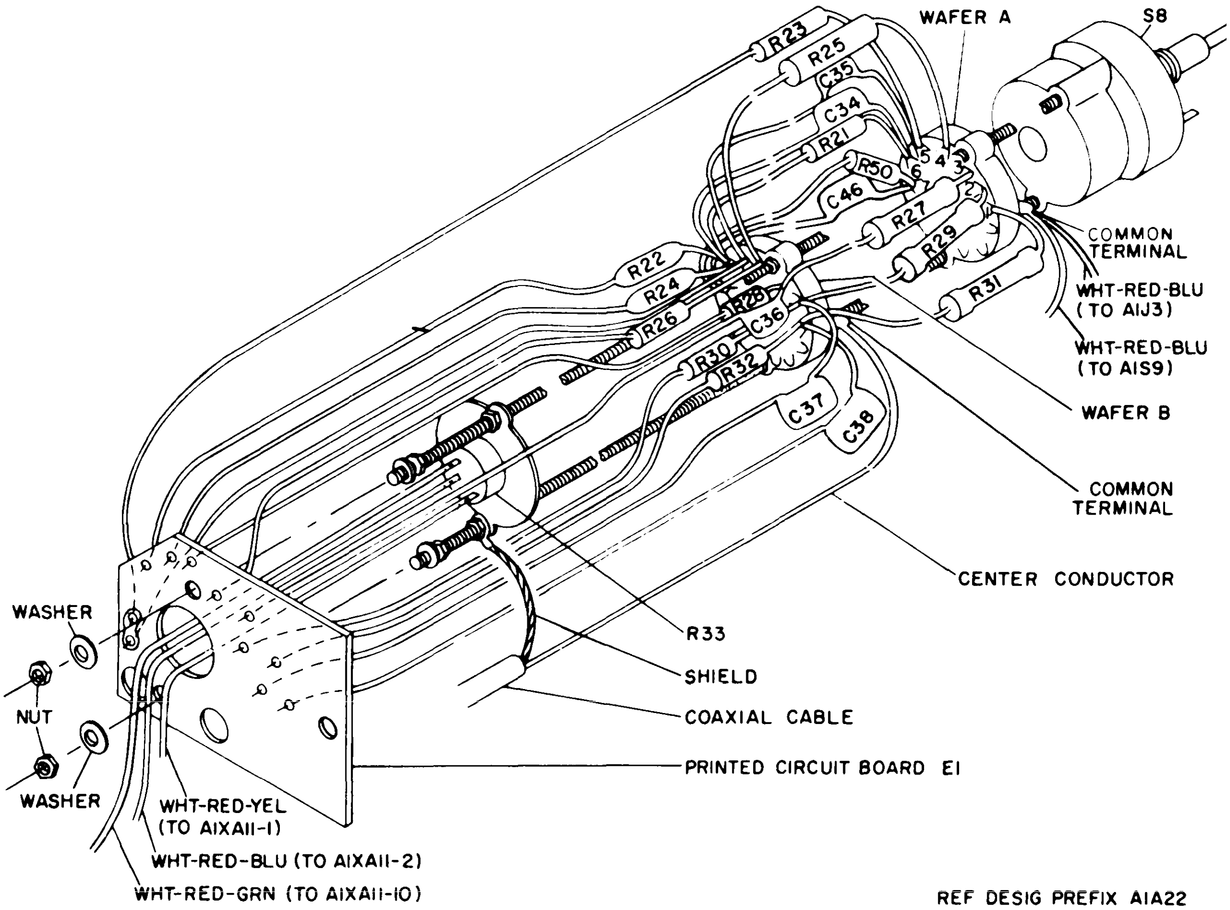


Figure 5-11. Channel B Variable Attenuator A1A22, Location of Parts

REPLACING THE B CHANNEL VARIABLE ATTENUATOR AND TRIGGER LEVEL CONTROL AlA22.—

(1) Perform the procedure of paragraph g to gain access to A1A22.

(2) Remove and save the screw and washer that mount A1A22 to its bracket (figure 5-9).

(3) Loosen the two setscrews on the red knob Al MP8 and-remove the red knob.

(4) Loosen the two setscrews on the black knob of A1A22, AlMP1l and remove the black knob.

(5) Remove and save the nut and washer that secure the outer shaft of A1A22 to the left section of the f rent pane 1.

(6) Disconnect the white-red-yellow, white-red-green, and white-red-blue leads from the three terminals at the back of A1A22. Code-mark leads to insure proper reassembly, then slip these leads through the grommet of A1A22.

(7) Disconnect the center conductor of the coaxial cable from the common terminal of wafer B, the shield from the solder lug of the index plate, and the two white-red-blue leads from the common terminal of wafer A (figure 5-11). Code-mark leads to insure proper reassembly.

(8) Remove and discard defective A1A22.

Note

The replacement A1A22 consists of two parts: printed circuit board El, and wafer assembly S8. Final assembly of these two parts is performed in the instrument.

(9) Insert replacement wafer assembly from the inside, with shaft through mounting hole in the left section of the front panel. Be sure that positioning key is seated within the recess in the left section of the front panel.

(10) Connect and solder the coaxial cable and the two white-red-blue leads removed in step (7) to the appropriate terminals of A1A22.

(11) Place mounting nut and lockwasher on outer shaft of replacement wafer assembly then tighten mounting nut.

(12) Assembly replacement printed-circuit board to the replacement wafer assembly as follows:

(a) Place printed-circuit board behind the wafer assembly; orient it so that the etched circuit is on the outside.

(b) Feed the free leads of the capacitors and resistors mounted on the wafer assembly through the adjacent solder holes of the printed-circuit board.

(c) Slide the printed-circuit board towards the front panel until the rear portion of the wafer assembly passes through the clearance hole, and the two mounting bolts of the wafer assembly pass through the mounting holes.

(d) Using the screw and washer removed in step (2), mount the replacement printed-circuit board to its bracket.

(e) Place a mounting nut and lockwasher on the end of each mounting bolt, but do not tighten the mounting nuts.

Note

Following step (e), there will be two mounting nuts with washers at the end of each mounting bolt; one pair on the outside of the printed-circuit board, the other pair on the inside.

(f) Turn the inside mounting nuts first until they are flush against the inside of the printed-circuit board, then tighten the outside mounting nuts.

(g) Cut the free leads of the resistors and capacitors to a length extending approximately 1/16 of an inch from the etched circuit side of the board; solder each lead to the etched circuit side of the board. Use resin-core solder type 63-37 (preferred) or 60-40 with a maximum diameter of 1/16 of an inch to Specification QQ-S-571, with flux to MIL-F-14526.

(13) Pass the white-red-yellow, white-red-green, and white-red-blue leads removed in step (6) through the grommet of the printed-circuit board, then solder them to the appropriate terminals as marked in step (6).

(14) Replace black knob A1MP11 on the outer shaft and temporarily tighten one of the setscrews, then turn to the extreme clockwise position.

(15) Loosen the setscrew tightened in step (14), slide knob so that the .1 marking on the knob aligns with the 0 marking on the left section of the front panel, then tighten both setscrews.

(16) Turn inner shaft to the extreme counter-clockwise position.

(17) Place red knob A1MP8 on the inner shaft so that index point faces the -6 marking on the left section on the front panel, then tighten both setscrews

(18) Replace the left section of the front panel in the chassis, and secure with the three screws,

k.. REPLACING THE C CHANNEL VARIABLE ATTENUATOR AND TRIGGER LEVEL CONTROL Al A23.—

(1) Perform the procedure of paragraph g to gain access to A1A23.

(2) Remove and save the screw and washer that mount A1A23 to its bracket (figure 5-9).

(3) Loosen the two setscrews on the red knob A1MP9 and remove the red knob.

(4) Loosen the two setscrews on the black knob A1MP12 and remove the black knob.

(5) Remove and save the nut and washer that secure the outer shaft of A1A23 to the left section of the front panel.

(6) Disconnect the white-orange-yellow, white-orange-green, and white -orange -blue leads from the three terminals at the back of A1A23. Code-mark leads to insure proper reassembly.

(7) Disconnect the center conductor of one coaxial cable from the common terminal of wafer B, the shield from the solder lug of the index plate, and the white-red-yellow lead from the common terminal of wafer A (figure 5-12). Code-mark leads to insure proper reassembly.

(8) Disconnect the other coaxial cable and shield from wafer B of A1A22. Note that this coaxial cable is longer than the one disconnected in step (7). Code-mark this cable to insure proper reassembly.

(9) Slowly pull the two coaxial cables through the grommets until they clear the printed circuit board of A1A23. Note the routing of these cables to insure proper reassembly.

Note

The replacement A1A23 consists of two parts: printed circuit board E2, and wafer assembly S1l. Final assembly of these two parts is performed in the instrument.

(10) Insert replacement wafer assembly from the inside, with shaft through mounting hole in the left section of the front panel. Be sure that positioning lug is seated firmly within recess in the left section of the front panel.

(11) Feed the two coaxial cables through the grommets in the replacement printed circuit board, and along the same route noted in step (9).

(12) Replace and solder the coaxial cable removed in step (8) to the appropriate terminals on wafer B of A1A22.

(13) Connect and solder the other coaxial cable and the white-red-yellow lead removed in step 7 to the appropriate terminals of A1A23.

(14) Place mounting nut and lockwasher on outer shaft of replacement wafer assembly, then tighten mounting nut.

(15) Assemble replacement printed circuit board to the replacement assembly wafer. Use the same procedure as in step (12) of paragraph 5-5j.

(16) Solder the white-orange-yellow, white-orange-green, and white-orange-blue leads removed in step (6) to the appropriate terminals as marked in step (6).

(17) Replace black knob A1MP12 on the outer shaft and temporarily tighten one of the setscrews, then turn to the extreme clockwise position.

(18) Loosen the setscrew tightened in step (17), slide knob so that the .1 marking on the knob aligns with the 0 marking on the left section of the front panel, then tighten both setscrews.

(19) Turn inner shaft to the extreme counter-clockwise position.

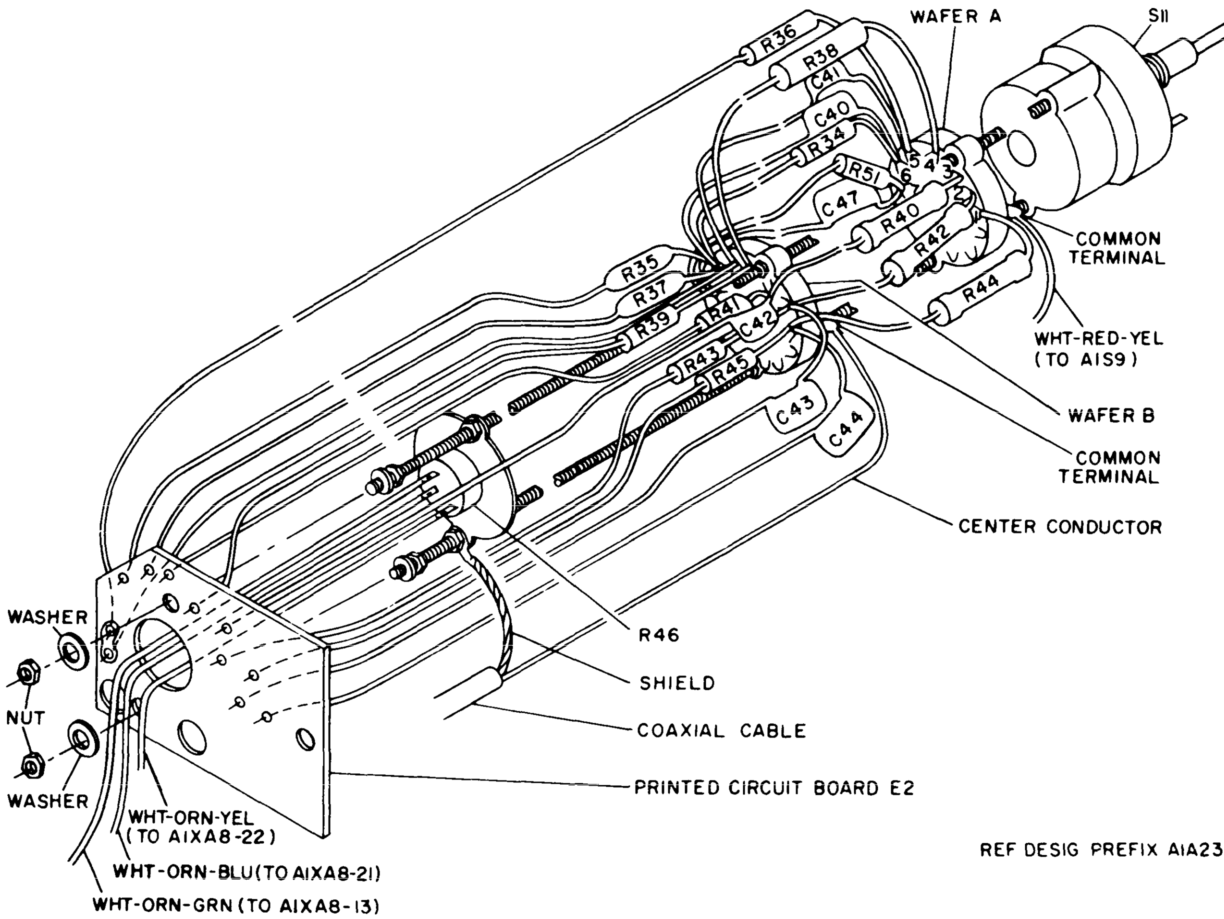


Figure 5-12. Channel C Variable Attenuator A1A23, Location of Parts

(20) Place red knob A1MP9 on the inner shaft so that the index point faces the -6 marking on the left section of the front panel, then tighten both setscrews.

(21) Replace the left section of the front panel in the chassis, and secure with the three screws.

1. ACCESS TO FUNCTION SWITCH A1S4, TIME BASE SWITCH A1S3, STD FREQ OUT SWITCH A1S2, AND POWER SWITCH A1S1. — These parts are mounted on the front panel, and become accessible when the front-panel casting is detached from the counter and is supported only by the wire harness. Refer to figure 5-13 and proceed as follows:

(1) Using the board extractor, lift printed-circuit board A1A11 partly out of its connector so that the cable fastenings become accessible. Unfasten and disconnect the two coaxial cables, then remove A1A11.

(2) Remove and save the two screws and washers on top of the tiedown bracket, and remove the tiedown bracket.

(3) Remove printed-circuit boards A1A10 and A1A12 through A1A16.

(4) Loosen the captive screw at the bottom center of electronic frequency converter A2, and slide A2 towards the front and out of the chassis.

(5) Remove and save the two screws (top and bottom) on the left side-panel which are nearest the front panel.

(6) Remove and save the two screws (top and bottom) on the right side-panel which are nearest the front panel.

(7) Remove and save the two screws on bottom front of the opening vacated by A2.

(8) Remove and save the two screws that secure the left side of the front-panel casting to the front card-guide bracket.

(9) Remove the two nuts and lockwashers that secure the bolts of A1S4 to the front card-guide bracket.

(10) Remove the two nuts and lockwashers that secure the bolts of A1A2, A1A3 to the front card-guide bracket.

(11) Pull the front-panel casting slightly forward until it is supported only by the wire harness, then pivot it down to expose the mounted parts. Place

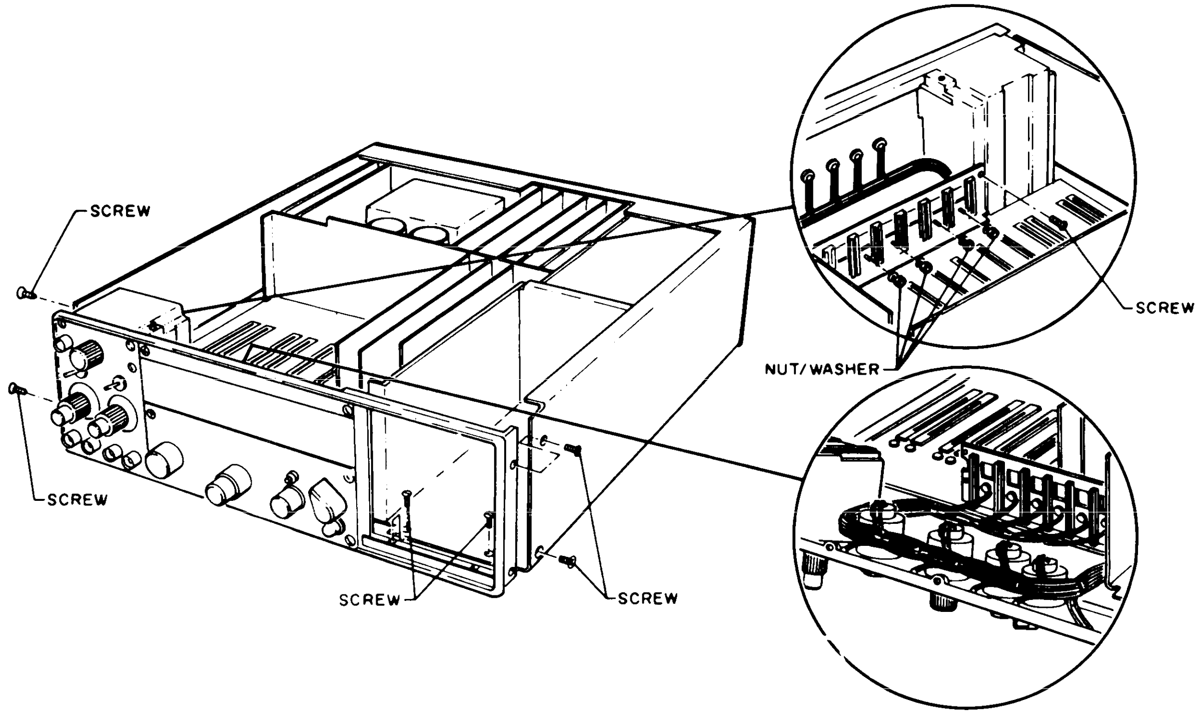


Figure 5-13. Counter, Disassembly of Front Section

a small block of wood or similar material under the bottom cover of the counter, so that the knobs mounted on the front panel do not rest on the work table.

m. REPLACING THE FUNCTION SWITCH A1S4.-

(1) Perform the procedure of paragraph 5-51 to gain access to the switch.

(2) Refer to figure 5-14 for wafer and terminal designations.

(3) Disconnect the external leads from the switch in the order listed in table 5-15. Code-mark leads to insure proper reassembly.

Note

To disconnect a lead, cut it as close to the switch terminal as possible. When all leads have been cut, and the defective switch has been removed, strip off approximately 3/16 of an inch of insulation from the leads before inserting replacement switch.

(4) Loosen the two setscrews on knob A1MP7 and remove the knob.

(5) Remove and save the front-panel mounting nut and flat washer.

(6) Remove and discard defective switch.

(7) Connect jumpers on replacement switch as listed in table 5-16.

(8) Insert replacement switch from the top, with shaft through mounting hole of front panel.

(9) Place flat washer and mounting nut on shaft and tighten finger-tight. Be sure that positioning key in front of switch is seated within recess of the front-panel casting.

(10) Connect and solder leads removed in step (3) to the replacement switch-terminals as listed in table 5-15, and in a reverse order.

(11) Tighten the front-panel mounting nut.

(12) Place knob on shaft, such that the setscrew opposite the index point is pointing towards the flat side of the shaft, then tighten the two setscrews.

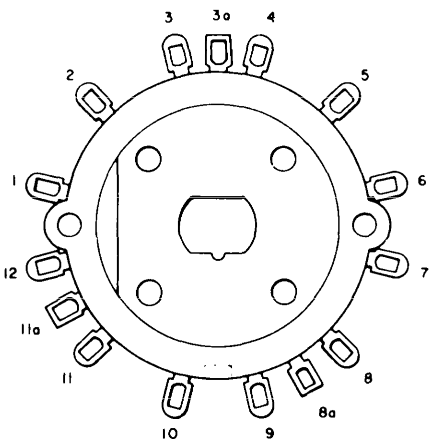
(13) Using the procedure of paragraph 5-51 in a reverse order, replace the front-panel casting and printed-circuit boards, and secure all parts.

n. REPLACING THE TIME BASE SWITCH A1S3 AND STD FREQ OUT SWITCH A1S2. — These two parts are mounted on concentric shafts, and are replaced together according to the following procedure:

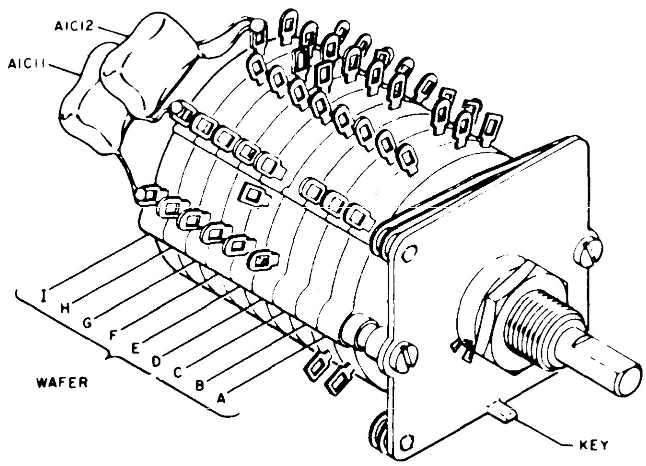
(1) Perform the procedure of paragraph 5-51 to gain access to AlS2/AlS3.

(2) Refer to figure 5-15 for wafer and terminal designations.

(3) Disconnect the external leads from AlS2/A1S3 in the order listed in table 5-17. Code-mark leads to insure proper reassembly.



TERMINAL DESIGNATIONS
OF TYPICAL WAFER



WAFER DESIGNATIONS

Figure 5-14. FUNCTION Switch A1S4, Wafer and Terminal Designations

TABLE 5-15. FUNCTION SWITCH A1S4, EXTERNAL WIRE CHART

COLOR AND GAUGE	ORIGIN OR DESTINATION	TERMINATION ON A1S4
White-green-blue 22-GA	A1XA10-9	I-1
White-green-violet 22-GA	A1XA8-9	I-2
Yellow 22-GA	AlS3/AlS2-C-7 rear	I-3a
White-yellow-grey 22-GA	A1XA8-11	1-12
White-yellow-violet 22-GA	A1XA8-12	1-11
White-yellow-blue 22-GA	A1XA8-10	I-l0
White-yellow-green 22-GA	A1XA4-2	I-9
White -orange-grey 22-GA	A1XA4-1	I-8
White-orange-violet 22-GA	A1XA3-2	I-7
White-orange-blue 22-GA	A1XA3-1	I-6
White-orange-green 22-GA	A1XA2-2	I-5
White-orange-yellow 22-GA	A1XA10-8	I-4
White-orange 22-GA	A1XA7-B	H-3
White-brown 22-GA	AIXA7-A	H-1
White-red 22-GA	A1XA7-C	H-2
White-green 22-GA	A1XA7-2	H-5
White-blue 22-GA	AlXA7-3/OS4	H-6
White-black-blue 22-GA	AlS3/AlS2-B-l front	H-5a
White-black-violet 22-GA	AlS3/AlS2-B-4 front	H-8a
White-yellow 22-GA	A1XA7-1	H-8
White-black-green 22-GA	AlS3/AlS2-B-11 front	G-3a
White-green 22- GA	AlDS5	G-5
White-brown-grey 22-GA	AlS3/AlS2-A-10 front	G-5a
White-black-yellow 22-GA	AlS3/AlS2-B-10 front	F-3a

TABLE 5-15. (Continued)

COLOR AND GAUGE	ORIGIN OR DESTINATION	TERMINATION ON A1S4
White-yellow 22-GA	A1DS6	F-4
White-brown-violet 22-GA	A1S3/A1S2-A-9 front	F-4a
White-black-orange 22-GA	AlS3/A1S2-B-9 front	E-1a
White-red 22-GA	A1DS8	E-2
White-brown-blue 22-GA	A1S3/A1S2-A-8 front	E-5a
White-brown 22-GA	AlDS9	D-1
White-black 22-GA	A1DS10	D-3
White-orange 22-GA	A1DS7	D-4
White-black-grey 22-GA	AlS3/AlS2-B-5 front	D-5a
White-brown-green 22-GA	A1S3/A1S2-A-7 front	D-8a
White-black-red 22-GA	A1S3/A1S2-B-8 front	D-10a
White-red-green 22-GA	A1S3/A1S2-B-9 rear	C-2
White-brown-yellow 22-GA	A1S3/A1S2-A-4 front	C-3
White-orange-green 22-GA	A1DS14	C-4a
White-black-brown 22-GA	AlS3/AlS2-B-7 front	C-5
White-orange-blue 22-GA	A1DS13	C-9a
White-red-grey 22-GA	A1S3/A1S2-B-12 rear	B-2
White-red-violet 22-GA	A1S3/A1S2-B-11 rear	B-3
White-red-blue 22-GA	A1S3/A1S2-B-10 rear	B-4
White-red-orange 22-GA	A1S3/A1S2-B-1 rear	B-1la
White-orange-violet 22-GA	A1DS12	B-9
White-green-violet 22-GA	A1S3/A1S2-A-9 rear	A-2
White-brown-orange 22-GA	A1S3/A1S2-A-2 front	A-3
White-green-blue 22-GA	A1S3/A1S2-A-4 rear	A-11a
White-orange-grey 22-GA	A1DS11	A-9
White-brown-red 22-GA	A1S3/A1S2-A-1 front	A-4
White-orange-yellow 22-GA	A1DS15	A-4a
White-red-yellow 22-GA	A1S3/A1S2-B-2 rear	A-6

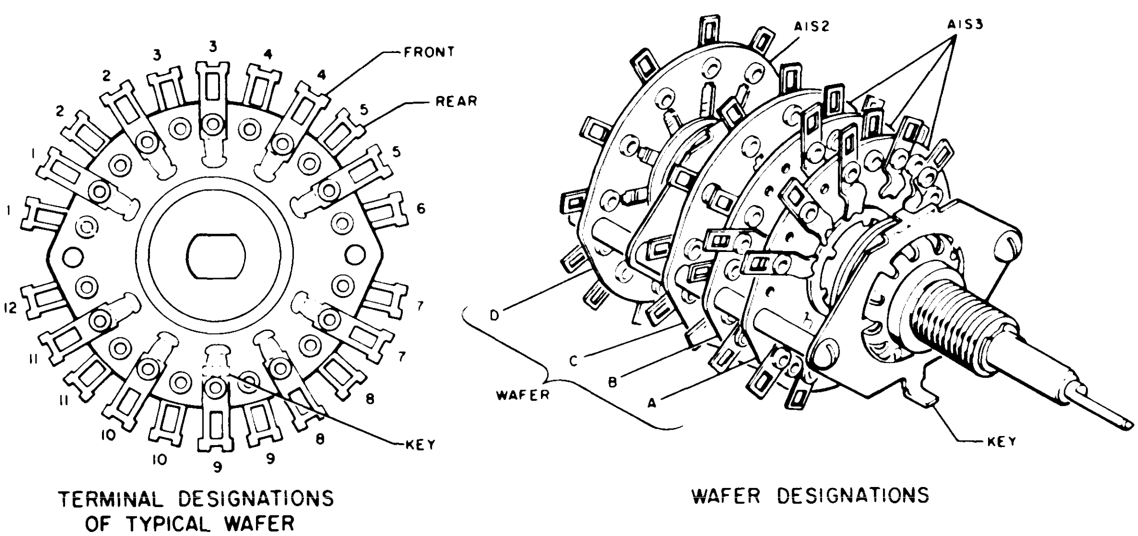


Figure 5-15. Time Base Switch A1S3 and STD FREQ OUT Switch A1S2, Wafer and Terminal Designations

TABLE 5-16. FUNCTION SWITCH, INTERNAL WIRE CHART

COLOR AND GAUGE	CONNECT
White-yellow 22-GA	From H-4 to H-8
Bus wire 22-GA	From H-4 through G-4 to F-4
Bus wire 22-GA	From H-5 to G-5
Bus wire 22-GA	From H-3 through G-3 through F-3 through E-3 to D-4
Bus wire 22-GA	From H-2 through G-2 through F-2 to E-2
Bus wire 22-GA	From H-1 through G-1 through F-1 through E-1 to D-1
White-brown 22-GA	From H-7 to F-6
White-brown 22-GA	From H-7 to E-10
Bus wire 22-GA	From E-10 to D-10
White-red 22-GA	From G-2 to F-5
White-black 22-GA	From G-6 to D-9
Bus wire 22-GA	From G-12 through F-12 through E-12 to D-12
White-red 22-GA	From F-n to F-2
Bus wire 22-GA	From F-n through D-n to E-n
Bus wire 22-GA	From F-5 to E-5
White-brown 22-GA	From F-6 to E-4
White-brown 22- GA	From E-4 to E-1
White-black 22-GA	From E-12 to D-9
White-black 22-GA	From D-12 to D-3
White-red-green 22-GA	From C-8 to C-2
Bus wire 22-GA	From C-4a to B-4a
White-red-grey 22-GA	From B-8 to B-2
White-brown-red 22-GA	From A-4 to A-7
White-green-violet 22-GA	From A-8 to A-2

TABLE 5-17. TIME BASE/STD FREQ OUT SWITCH AlS3/AlS2,
EXTERNAL WIRE CHART

COLOR AND GAUGE	ORIGIN OR DESTINATION	TERMINATION ON AlS3/AlS2
White-black-grey 22-GA	A1XA5-20	D-3 rear
White-black-violet 22-GA	A1XA5-2	D-2 rear
White-black-blue 22-GA	A1XA4-6	D-1 rear
White coaxial cable	A1XA6-2	D-4 rear
White coaxial cable	A1XA5-13	D-7 rear
White-black-brown 22- GA	A1XA2-5	D-8 rear
White-black-red 22-GA	A1XA2-6	D-9 rear
White-black-orange 22-GA	AIXA3-5	D-10 rear
White-black-yellow 22-GA	A1XA3-6	D-11 rear
White-black-green 22-GA	A1XA4-5	D-12 rear
White-blue 22-GA	A1XA16-21	C-1 rear
White-violet 22-GA	A1XA15-21	C-2 rear
White-grey 22-GA	A1XA14-21	C-3 rear
Brown 22-GA	A1XA13-21	C-4 rear
White-black 22-GA	A1XA12-21	C-5 rear
Yellow 22-GA	AlS4-I-3a	C-7 rear
White -brown 22- GA	A1XA2-4	C-8 rear
White-red 22-GA	A1XA2-3	C-9 rear
White-orange 22-GA	A1XA19-16	C-10 rear
White-yellow 22-GA	A1XA18-21	C-11 rear
White-green 22-GA	A1XA17-21	C-12 rear
White-black-grey 22-GA	AlS4-D-5a	B-5 front
White-black-violet 22-GA	AlS4-H-8a	B-4 front
White-black-blue 22-GA	AlS4-H-5a	B-1 front

TABLE 5-17. (Continued)

COLOR AND GAUGE	ORIGIN OR DESTINATION	TERMINATION ON AlS3/AlS2
White-red-orange 22-GA	AlS4-B-lla	B-1 rear
White-red-yellow 22-GA	A1S4-A-6	B-2 rear
White-black-brown 22-GA	A1S4-C-5	B-7 front
White-black-red 22-GA	A1S4-D-10a	B-8 front
White-red-green 22-GA	A1S4-C-2	B-9 rear
White-black-orange 22-GA	AlS4-E-la	B-9 front
White-red-blue 22-GA	A1S4-B-4	B-10 rear
White-black-yellow 22-GA	AlS4-F-3a	B-10 front
White-red-violet 22-GA	A1S4-B-3	B-11 rear
White-black-green 22-GA	AlS4-G-3a	B-11 front
White-red-grey 22-GA	A1S4-B-2	B-12 rear
White-brown-yellow 22-GA	A1S4-C-3	A-4 front
White-green-blue 22-GA	AlS4-A-lla	A-4 rear
White-brown-orange 22-GA	A1S4-A-3	A-2 front
White-brown-red 22-GA	A1S4-A-4	A-1 front
White-brown-green 22-GA	AlS4-D-8a	A-7 front
White-brown-blue 22-GA	AlS4-E-5a	A-8 front
White-green-violet 22-GA	A1S4-A-2	A-9 rear
White-brown-violet 22-GA	A1S4-F-4a	A-9 front
White-brown-grey 22-GA	AlS4-G-5a	A-10 front

TABLE 5-18. TIME BASE/STD FREQ OUT SWITCH
AlS3/AlS2, INTERNAL WIRE CHART

COLOR AND GAUGE	CONNECT
White-black-green 22-GA	From B-5 rear to B-11 front
White-red-yellow 22-GA	From B-2 rear to A-6 rear
Bus wire 22-GA	From B-4 rear to B-3 front
Black 22-GA	From B-3 front to A-5 rear
Bus wire 22-GA	From A-5 rear to A-3 front
Black 22-GA	From A-3 front to A-11 rear

COLOR AND GAUGE	CONNECT
White-brown-red 22-GA	From A-1 front to A-11 front
White-brown-red 22-GA	From A-11 front to A-7 rear
White-brown-orange 22-GA	From A-2 front to A-8 rear
Bus wire 22-GA	From A-4 front to A-5 front

Note

To disconnect a lead, cut it as close to the terminal as possible. When all leads have been cut, and the defective AlS2/Al S3 has been removed, strip off approximately 3/16 of an inch of insulation from the leads before inserting replacement.

(4) Loosen the two setscrews on red knob A1MP6 and remove the red knob.

(5) Loosen the two setscrews on black knob A1MP10, and remove the black knob.

(6) Remove and save the front-panel mounting nut and flat washer.

(7) Connect jumpers on replacement AlS2/A1S3 as listed in table 5-18.

(8) Insert replacement AlS2/AlS3 from top, with shaft through mounting hole on front panel.

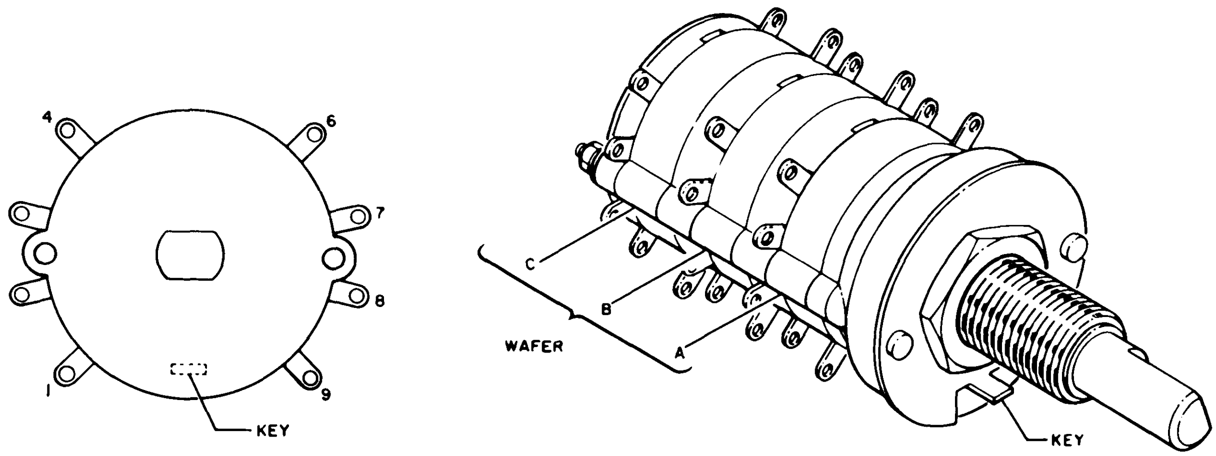
(9) Place flat washer and mounting nut on outer shaft and tighten finger-tight. Be sure that positioning key on front of AlS2/AlS3 is seated within recess of the front-panel casting.

(10) Connect and solder leads removed in step (3) to the replacement AlS2/AlS3 terminals as listed in table 5-17, and in a reverse order.

(11) Tighten the front -panel mounting nut.

(12) Place the black knob on the outer shaft, such that the setscrew opposite the index mark is pointing towards the flat portion of the outer shaft, then tighten the two setscrews on the black knob.

(13) Place the red knob on the inner shaft, such that the setscrew opposite the index point is pointing towards the flat portion of the inner shaft, then tighten the two setscrews on the red knob.



TERMINAL DESIGNATIONS OF TYPICAL WAFER

WAFER DESIGNATIONS

Figure 5-16. POWER Switch A1S1, Wafer and Terminal Designations

TABLE 5-19. POWER SWITCH A1S1, EXTERNAL WIRE CHART

COLOR AND GAUGE	ORIGIN OR DESTINATION	TERMINATION ON POWER SWITCH
Yellow 22-GA	A1C4	C -1 front
Yellow 22-GA	A1S3/A1S2-C7-R	C -1 front
White-yellow-violet 22-GA	A1XA7-V	C-3 rear
Blue 18-GA	A1F1 or A1F2	B-9 rear
Blue 18-GA	A1F2 or A1F1	B-4 rear
Grey 18-GA	A1FL1 } line	B-6 front
Grey 18-GA	A1FL1 } filter	B-1 front
Orange 18-GA	A1T1 } term	A-9 rear
Orange 18-GA	A1T1 } 1 & 2	A-4 rear
Yellow 18-GA	A1F1 or A1F2	A-6 front
Yellow 22-GA	A1DS1	A-6 front
Yellow 18-GA	A1F2 or A1F1	A-1 front
Yellow 22-GA	A1DS1	A-1 front

(14) Using the procedure of paragraph 5-51, in a reverse order, replace the front-panel casting and printed-circuit boards and secure all parts.

o. REPLACING THE POWER SWITCH A1S1.—

(1) Perform the procedure of paragraph 5-51 to gain access to the switch.

(2) Refer to figure 5-16 for wafer and terminal designations.

(3) Disconnect the external leads in the order listed in table 5-19. Code-mark leads to insure proper reassembly.

Note

To disconnect a lead, cut it as close to the switch terminal as possible. When all leads have been cut, and the defective switch has been removed, strip off approximately 1/16 of an inch of insulation from the leads before inserting replacement switch.

(4) Loosen the two setscrews on knob A1MP5 and remove the knob.

TABLE 5-20. POWER SWITCH A1S1,
INTERNAL WIRE CHART

COLOR AND GAUGE	CONNECT
Bus wire 18-GA	From B-7 rear through B-8 rear to B-9 rear
Bus wire 18-GA	From B-2 rear through B-3 rear to B-4 rear
Bus wire 18-GA	From A-8 rear to A-9 rear
Bus wire 18-GA	From A-3 rear to A-4 rear

(5) Remove and save the front-panel mounting nut and flat washer.

(6) Remove and discard the defective switch.

(7) Connect jumpers on replacement switch as listed in table 5-20.

(8) Insert replacement switch from top, with shaft through mounting hole on front panel.

(9) Place flat washer and mounting nut on shaft and tighten finger -tight. Be sure that position - ing key on front of switch is seated within the recess of the front-panel casting.

(10) Connect and solder leads removed in step (3) to the replacement switch terminals as listed in table 5-19 and in a reverse order.

(11) Tighten the front-panel mounting nut.

(12) Place the knob on the shaft of the replace- ment switch, such that the setscrew opposite the pointed-end of the knob points towards the flat portion of the shaft, then tighten the two setscrews. Perform this procedure with the switch set to any position other than OFF, so that it clears the PUSH bar.

p. REPLACING THE UNITS ANNUNCIATOR LAMPS A1DS1l THROUGH AlDS15.—

(1) Remove and save the two screws, nuts, and washers that mount the annunciator housing to the inside of the front panel (figure 5-17). Save the bolts, nuts and washers.

(2) The annunciator lamps are mounted on terminal board A1TB1 behind the annunciator housing A1MP2. Separate the terminal board from the housing to expose the lamps. Remove and save the plastic annunciator window A1MP2.

(3) Using a low-power soldering iron (50 watts), unsolder the power lead associated with the defective lamp.

(4) Apply heat simultaneously to the terminal pair associated with the defective lamp, then slip the leads of the lamp through the terminal holes as soon as the solder melts. Use a toothpick to clean the softened solder from the terminal holes.

(5) Slip the leads of the replacement lamp through the terminal holes, then wrap the leads around the two terminals.

(6) Wrap the power lead around the power terminal, then solder the leads to both terminals.

(7) Insert the terminal board with the lamps within the housing, place annunciator window on the

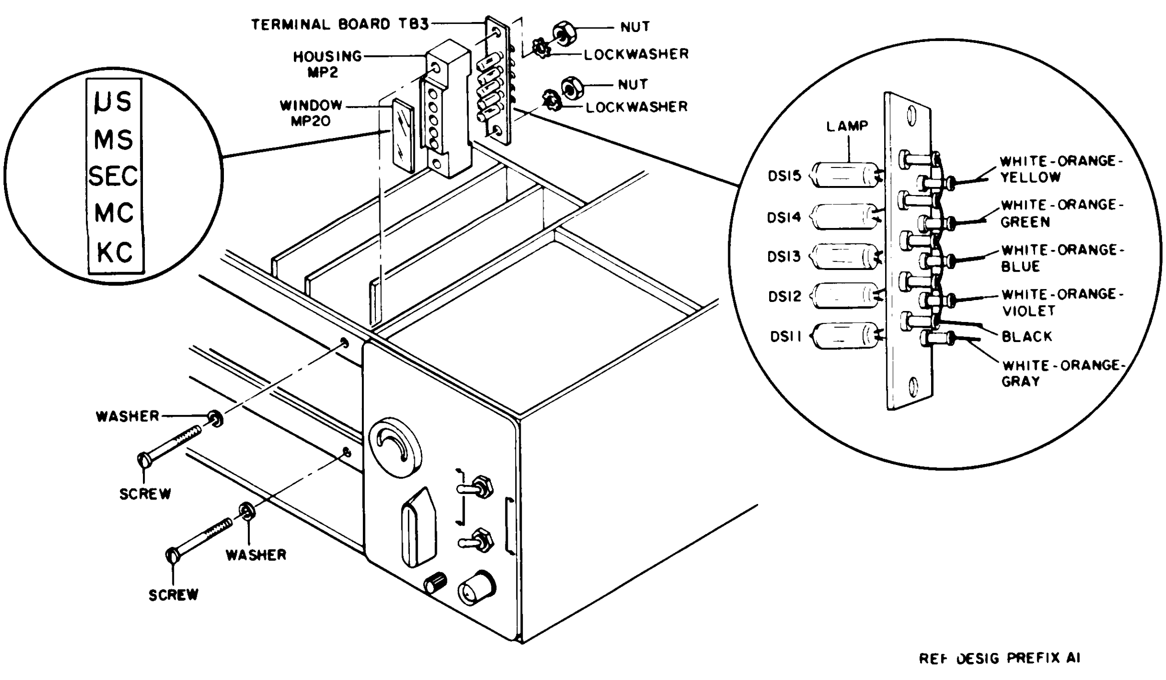


Figure 5-17. Annunciator Block, Exploded View

front side of the housing, then mount to the inside of the front panel against the readout window.

REPLACING THE DECIMAL POINT LAMPS A1DS4 THROUGH A1DSI0.—

(1) Loosen and remove the two screws on top of the tiedown bracket, and remove the tiedown bracket.

(2) Remove the two printed-circuit boards nearest the defective decimal lamp.

(3) Using a low-power soldering iron (50 watts), unsolder the two leads from the terminals below the defective decimal lamp, and remove the teflon tubing from the leads. Save the teflon tubing

(4) Remove the defective decimal lamp from its rubber grommet.

(5) Insert the replacement decimal lamp into the rubber grommet, place the teflon tubing on the two leads, and solder the leads to the terminals,

(6) Replace the printed circuit boards removed in step (2).

(7) Replace the tiedown bracket and fasten with the two screws.

r. ACCESS TO PARTS IN THE ELECTRONIC FREQUENCY CONVERTER A2.— Based on degree of accessibility, parts of the converter are divided into three groups as follows:

Group 1. Parts in this group can be replaced without disassembling the converter. Includes parts mounted on the front panel, parts mounted on the rear panel, and parts mounted at the rear Portion of the cent'erter.

Group 2. Parts in this group are accessible when the converter is disassembled to the extent that the front panel and cavity casting are separated from the converter chassis. Includes parts mounted on the top of the cavity casting.

Group 3. Parts in this group are accessible when the cavity casting is disassembled. Includes all parts inside the cavity casting.

s. SEPARATING FRONT PANEL AND CAVITY CASTING FROM CONVERTER CHASSIS. —

(1) Set counter POWER switch to OFF.

(2) Loosen the thumbscrew at the bottom of the converter, and slide the converter out of the counter.

(3) Remove and save the four screws and washers from the front panel (figure 5-18). Remove and save three screws that fasten plate A2MP35 and remove plate.

(4) Remove and save four screws from top of converter and grounding screw.

(5) Loosen nut that secures bracket to shaft; then push bracket up so that it is free to turn, and turn it away from the bottom of the chassis.

(6) Push bottom of chassis up and unhook thumbscrew.

(7) Remove and save the outside nut and washer of connector A2P1; then slide it out of its mounting hole so that the attached coaxial cable is free to move with the cavity casting.

(8) Separate the converter chassis from the front panel and cavity casting as follows: Swing the front panel slowly clockwise until the cavity casting is mechanically free of the converter chassis and connected only by the three leads. Do not disconnect these leads.

t. ACCESS TO PARTS IN THE CAVITY CASTING.—To gain access to parts inside the cavity casting, first perform the procedure of paragraph 5-5s. Next, remove and save the seven screws and washers from the cavity cover A2MP21 (figure 5-19): then lift the cavity casting up and away.

u. REPLACING THE MIXING FREQUENCY SELECTOR SWITCH A2S4.—

(1) Perform the procedure of paragraph 5-5t to gain access to the switch

(2) Unsolder the finger contact assembly A2E5 from the defective switch: then slide the finger contact assembly off the nylon bevel gearshaft A2MP22 (figure 5-19).

(3) Unsolder all fixed-capacitor leads from the switch terminals; then unsolder the jumpers between the switch terminals and the adjacent trimmer capacitors (figure 5-20). Remove excess solder from the terminal tabs of the trimmer capacitors.

(4) Disassemble the cavity switch detent on the outside of the cavity cover A2MP21 as follows: Remove and save the nylon nut (A2MP18 and A2MP19) from each nylon screw (A2MP16 and A2MP17), lift the detent spring A2MP27 off one screw, the detent arm A2MP3 off the other screw, and the two spacers A2MP25 and A2MP26.

(5) Remove the two nylon screws and ceramic spacers A2MP14 and A2MP15 from the inside of the cavity cover A2MP21.

Note

Before proceecding with step (6), note the position of the key on the defective switch with respect to the trimmer capacitors. When Installing replacement switch, be sure that its key is oriented the same way.

(6) Remove and discard the defective switch.

(7) Turn rotor of replacement switch to the position shown in figure 5-21

(8) Slide replacemtent switch on the gearshaft A2MP22, with the key oriented the same way as noted following step (5).

(9) Place one ceramic spacer A2MP14 and two nylon washers A2MP10 and A2MP11 between the replacement switch and the inside of the cavity cover Position the ceramic spacer so that it aligns with the mounting hole on the rcplacement switch

(10) Feed one nylon screw A2MP16 through the replacement switch, washers, and spacer, and screw into the mounting hole of the cavity cover. Do not tighten the screw.

(11) Insert the other ceramic spacer, washers, and nylon screw as in steps (9) and (10), and tighten both screws.

(12) Place the finger contact assembly A2E5 over the switch, such that its contacts are facing away from the cavity cover and the gearshaft is passing through the clearance hole.

(13) Turn the finger contact assembly so that its solder hole is in line with terminal 2 of the replacement switch. Terminal 2 is the common terminal and longer than the others.

(14) Solder terminal 2 of the replacement switch to the outside of the solder hole of the finger contact assembly.

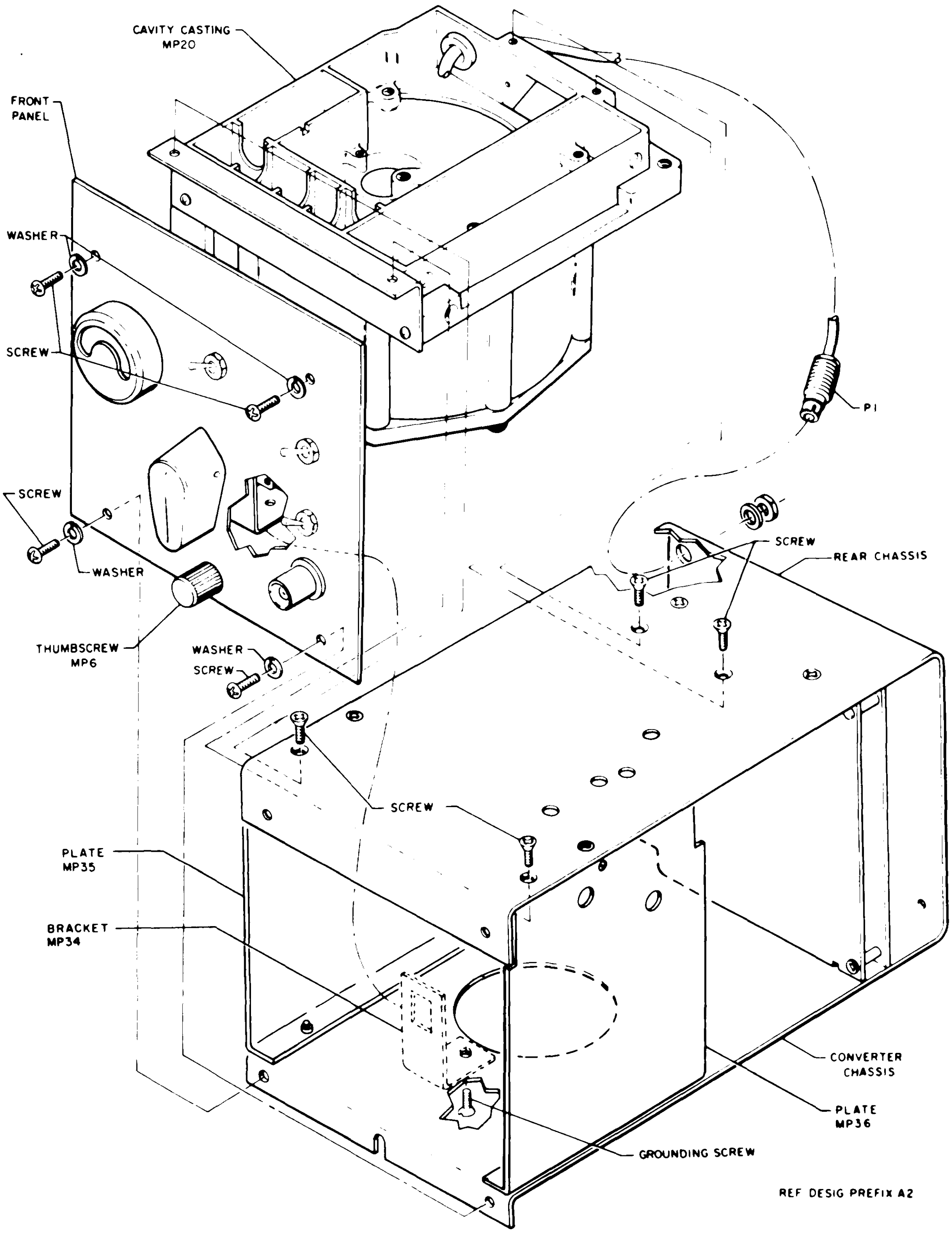


Figure 5-18. Electronic Frequency Converter A2 Exploded View, Front and Rear Chassis Separated

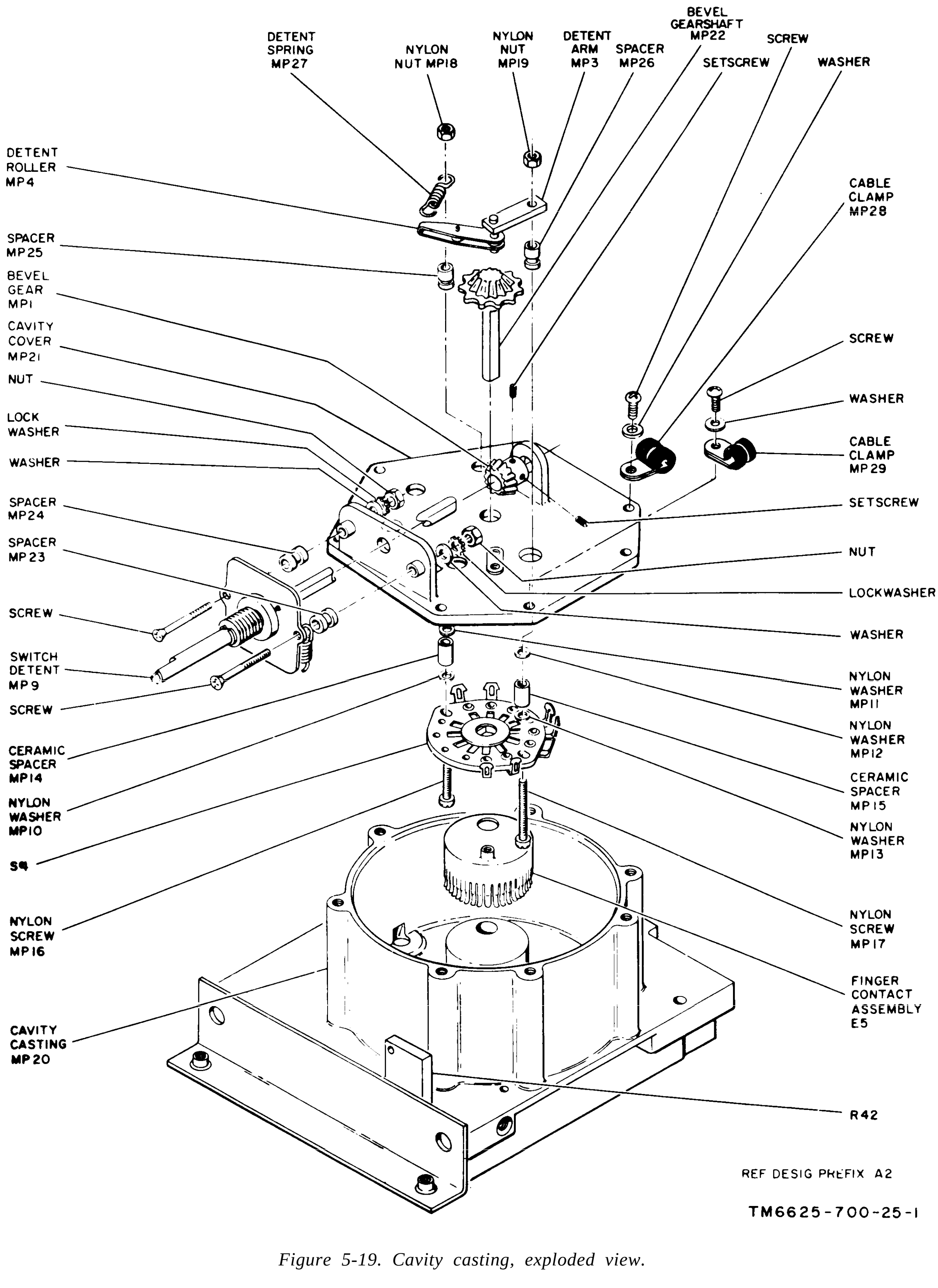


Figure 5-19. Cavity casting, exploded view.

(15) Connect and solder a short 20-gauge jumper wire between terminal 2 of the replacement switch and the tab of capacitor A2C2.

(16) Connect and solder a short 20-gauge jumper wire between each remaining terminal of the replacement switch and the tab of the adjacent trimmer capacitor. As an alternate method, these remaining switch terminals may be soldered directly to the capacitor tabs without the use of jumper wires.

(17) Reassemble the cavity switch detent on the outside of the cavity cover and secure to the nylon screws.

v. REPLACING THE NYLON BEVEL GEAR-SHAFT A2MP22.---

(1) Perform the procedure of paragraph 5-5s.

(2) Set the mixing frequency selector switch to 100.

(3) Loosen the two setscrews on the knob MP7 and slide the knob off the shaft (fig. 5-22).

(4) Loosen the setscrews on collar A2MP37; then slide collar, spring washer A2MP39, and flat washer A2MP38 off the shaft.

(5) Slide the front panel slowly forward until it clears the shaft; then tilt it down to expose the switch detent A2MP9.

(6) Remove and save the two screws, spacers A2MP23 and A2MP24, nuts, and washers that fasten the switch detent to the cavity cover (fig. 5-19).

(7) Loosen the two setscrews on the bevel gear A2MP1.

(8) Slide the switch detent forward and, at the same time, slide the bevel gear towards the rear, until the shaft clears the top of the nylon bevel gearshaft. As the bevel gear comes loose set it aside.

(9) Using a pair of long-nosed pliers, unhook the detent spring A2MP27 from the detent roller A2MP4, then slide the detent roller away from the top of the gearshaft.

(10) Remove and discard the defective gearshaft.

(11) Insert the replacement gearshaft through the opening in the center of the cavity cover, through the rotor of switch A2S4, and through the clearance hole of the finger contact assembly A2E5.

(12) Turn the gearshaft slowly until the rotor of switch A2S4 is oriented as shown in figure 5-21; hold the gearshaft in this position while performing the procedure of step (12).

(13) Pivot the detent roller against the gearshaft; then hook the detent spring to the detent roller.

(14) Pass the shaft of the switch detent through the clearance hole on the cavity cover and over the top of the nylon gearshaft.

(15) Place the bevel gear between the rear end of the shaft and the bearing on the cavity cover; orient it so that its teeth are facing the top of the bevel gear.

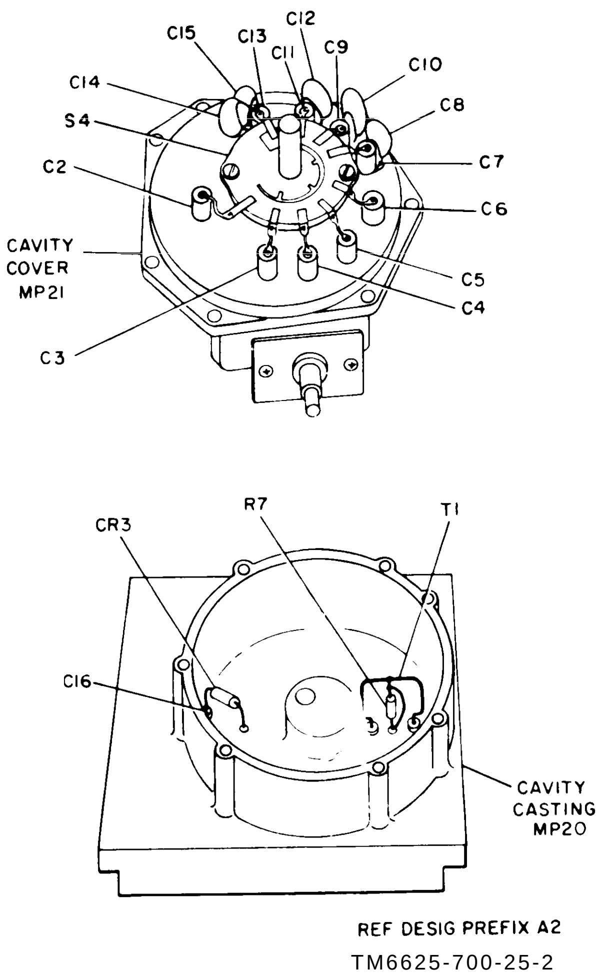


Figure 5-20. Electronic frequency converter A2, cavity, location of parts.

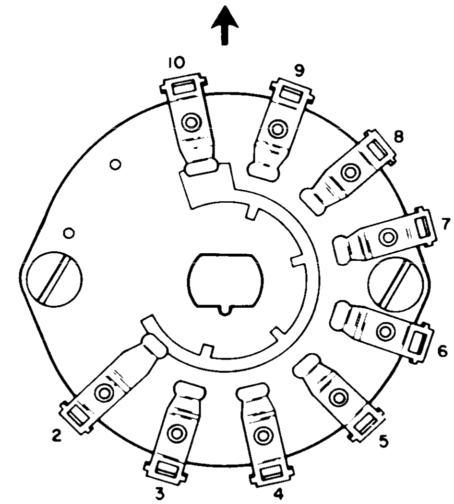


Figure 5–21. Mixing frequency selector switch A2S4, wafer diagram

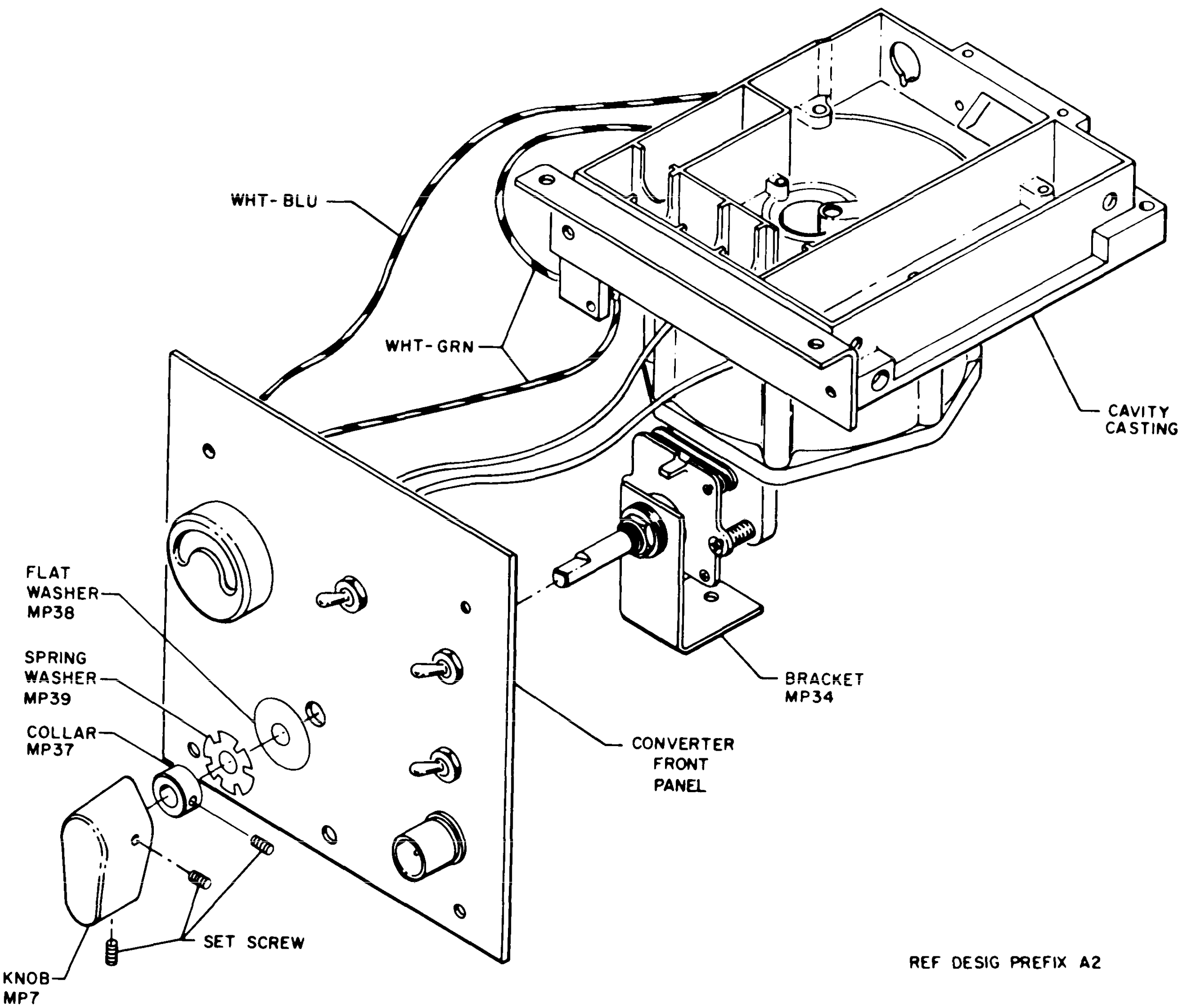


Figure 5-22. Electronic Frequency Converter A2. Front Chassis, Exploded View

(16) Pass the shaft of the switch detent through the bevel gear and the bearing.

(17) Mount the switch detent to the cavity cover by means of the two screws, spacers, washers, and nuts.

(18) Orient the bevel gear so that one of its setscrews is pointing toward the flat portion of the shaft, slide it forward until it meshes with the top of the gearshaft; and tighten both setscrews.

(19) Swing the front panel toward the front and up until it clears the front end of the shaft.

(20) Replace flat washer A2MP38, spring washer A2MP39, and collar A2MP37 on shaft, push collar against the tension of the spring washer, and secure collar with the setscrew.

(21) Place the knob on the shaft, align it with the front pane! so that it points to the 100 marking; then tighten both setscrews.

SELECTING THE VALUE OF CAPACITOR A2C14. — Capacitor A2C14 of band 100 in the cavity is a part whose value is selected at the factory. It is a 5-percent mica capacitor to Mil Standard 242. and has a median value of 22 pf, and maximum of 27 pf. and a minimum of 18 pf. Its final value is determined by the tunability of band 100. Value selection is made when replacing a defective A2C14. or following replacement of capacitor A2C15, and is performed according to the following procedure:

(1) If a defective A2C14 is being replaced. proceed to step (2). If capacitor A2C15 was replaced proceed to step (5).

(2) Disassemble the cavity casting as described in paragraph 5-5t.

(3) Choose a capacitor with a 22-pf value, and connect it temporarily to the terminals normally occupied by A2C14.

(4) Replace the cavity cover on the cavity casting and secure it temporarily with three screws.

(5) Connect test setup as shown in figure 5-23

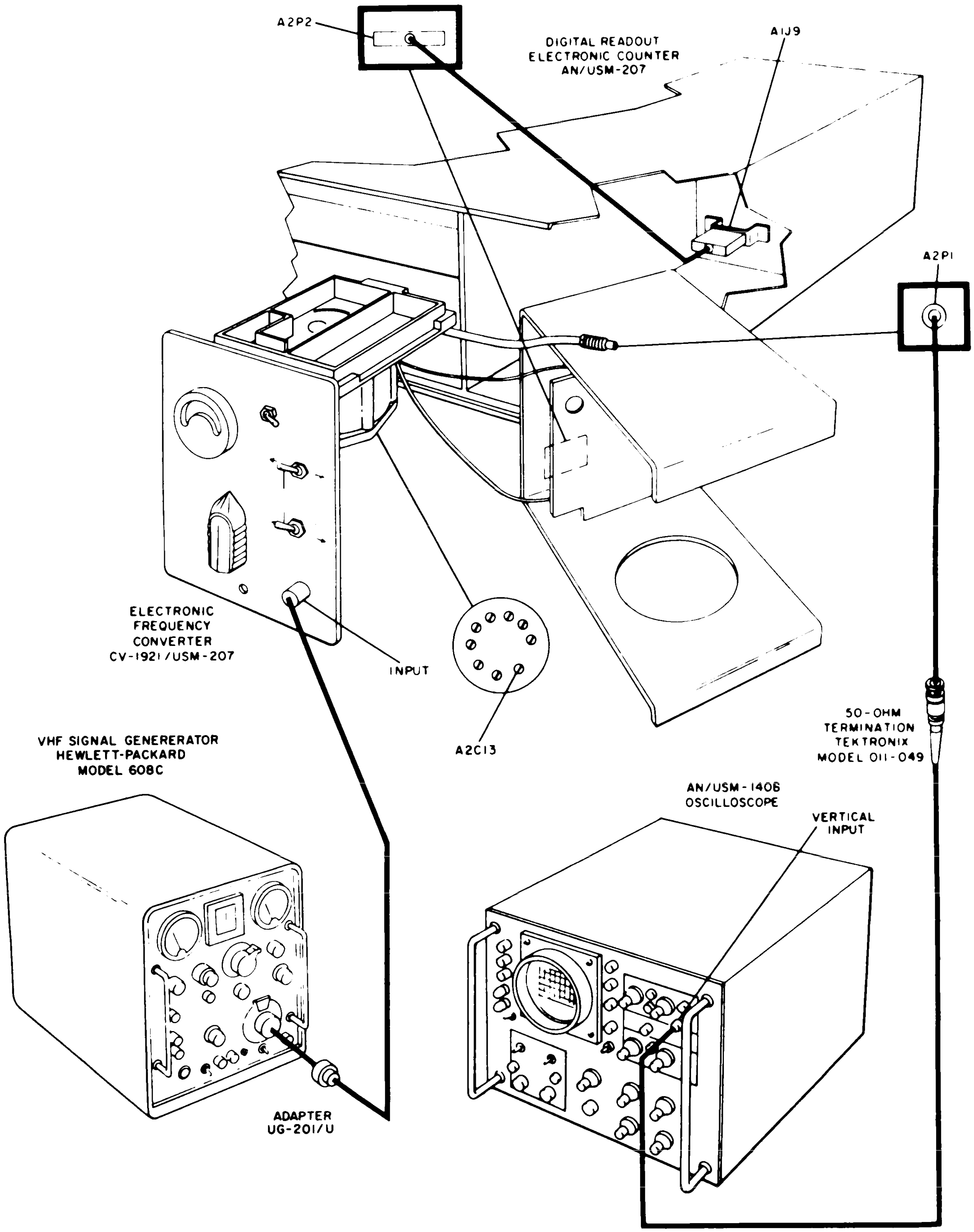


Figure 5-23. Selecting Capacitor A2C14, Test Setup

(6) Follow the procedure of steps (ar) through (av) of paragraph 5-4k(5) and adjust capacitor A2C13 for a peak 10 mc waveform. If the waveform peaks within the adjustment range of A2C13, proceed to step (7). If the waveform peaks at either end of the adjustment range of A2C13, leave the adjustment set at that end and proceed to step (8).

(7) If steps (2) through (4) were performed, disassemble the cavity casting, connect the 22-pf capacitor permanently, reassemble the cavity casting, and retouch A2C13 for a peak 10-mc waveform. If steps (2) through (4) were not performed, the existing A2C14 is of a correct value and need not be replaced.

(8) Note the adjustment setting of A2C13, select a replacement part as shown below and replace A2C14; then adjust A2C13 for a peak 10-mc waveform.

ADJUSTMENT SETTING of A2C13	VALUE OF EXISTING A2C14	VALUE AND TYPE DESIGNATION OF REPLACEMENT A2C14
All the way in	18 pf	22 pf CM05D220J03
All the way in	22 pf	27 pf CM05D270CJ03
All the way out	27 pf	22 pf CM05D220J03
All the way out	22 pf	18 pf CM05D180J03

x. REPLACING RF TRANSFORMER A2T1.-Rf transformer A2T1 (fig. 5-20) is mounted on the inside of the cavity and replaced according to the following procedure:

(1) Disassemble the cavity casting per paragraph 5-5t.

(2) Unsolder resistor A2R7 and the coaxial lead from the center of A2T1.

(3) Trace the two terminals of A2T1 to the outside of the cavity casting, and unsolder the lead from each terminal. Code-mark leads to insure proper reassembly.

(4) Remove excess solder from the terminals of A2T1 to allow them to slip through the teflon inserts, then remove the defective A2T1.

(5) Place the terminals of the replacement A2T1 into the teflon inserts; then push them all the way in.

(6) Solder the leads removed in step (3) to the terminals of A2T1 as marked in step (3).

(7) Find the geometrical center of A2T1, and solder to that point the resistor and coaxial lead removed in step (2).

(8) Reassemble the cavity and perform the balance adjustment procedure of paragraph 5-4k(6).

y. REPLACING RESISTOR A2R7.-

(1) Disassemble the cavity casting per paragraph 5-5t.

(2) On the inside of the cavity casting, unsolder the coaxial lead from the defective resistor.

(3) Unsolder the lead of the defective resistor from rf transformer A2T1.

(4) Unsolder the other lead of the defective resistor from the cavity casting; then remove the defective resistor.

(5) Place replacement resistor inside the cavity casting; insert one pigtail lead into the feedthrough hole and solder it to the outside of the cavity casting.

(6) Wrap the end of the other pigtail lead around the top of the geometrical center of rf transformer A2Tl, cut off any excess length in the lead, and solder it to the rf transformer.

(7) Solder the center conductor of the coaxial lead to the replacement resistor approximately halfway between the resistor body and the rf transformer.

(8) Reassemble the cavity and perform the balance adjustment procedure of paragraph 5-4k(6).

z. REASSEMBLING THE CONVERTER.-

(1) Place the cavity cover A2MP21 (fig. 5-19) over the cavity casting A2MP20; be sure that the finger contact assembly A2E5 of the cavity cover mates smoothly with the projection in the cavity casting.

(2) Align the mounting holes; then secure the cavity cover to the cavity casting by means of the seven screws and washers.

(3) Swing the converter front panel upwards toward the front of the shaft, and slide the shaft through the mounting hole.

(4) Replace flatwasher A2MP38, spring washer A2MP39, and collar A2MP37 on shaft, push collar toward front panel against tension of spring washer, and secure collar with the setscrew.

(5) Place the knob A2MP7 on the shaft (fig. 5-22) and temporarily tighten one of the setscrews on the knob.

(6) Swing the cavity casting along vith the converter front panel towards the converter chassis, and align the mounting holes of the converter front panel with the mounting holes on the front of the converter chassis.

(7) Replace the four screws and washers on the converter front panel (fig. 5-18). Do not tighten the screws.

(8) Replace the four screws on top of the converter chassis.

(9) Replace the thumbscrew A2MP6 within slot at the bottom of the converter chassis.

(10) Secure bracket A2MP34 to the bottom of the converter chassis by means of the grounding screw.

(11) Pass connector A2Pl (attached to the end of the coaxial cable) through the mounting hole in the converter chassis, and mount it to the converter chassis by means of the nut and washer.

(12) Loosen the setscrew on the knob tightened in step (5), turn the knob so that it points to the 100 marking on the converter front panel, and tighten both setscrews. Fasten plate A2MP35 with three screws.

aa. ACCESS TO PARTS IN THE RADIO FREQUENCY OSCILLATOR A3.-

(1) Set counter POWER switch to OFF.

(2) Loosen the captive screw on the bottom center of A3.

(3) With a screwdriver loosen the two captive screws on the top and bottom center of A3.

ab. REPLACING THE 1 MC OSCILLATOR A3Yl.-

(1) Perform the procedure 5-5aa to gain access to A3Y1.

(2) Facing the right side of A3 (figure 5-56), disconnect the red lead from the +25 VDC terminal, the two black leads from the GND terminal, and the white -brown-red lead from the OSC. OUTPUT terminal.

(3) Set A3 on its left side.

(4) Remove and save the four screws that mount A3Y1 within A3. These screws are located on the bottom side of A3 opposite each corner of A3Y1.

(5) Note orientation of A3Y1 within A3 to insure proper reassembly, then remove and discard defective A3Y1.

(6) Orient replacement A3Y1 as noted in step (5), insert within A3 and secure with the four mounting screws removed in step (4).

(7) Connect and solder white-brown-red lead to the OSC. OUTPUT terminal of A3Y1.

(8) Connect and solder the two black leads to the GND terminal of A3Y1.

(9) Connect and solder red lead to the +25 VDC terminal of A3Y1.

(10) Replace A3 within the counter, using the reverse procedure of paragraph 5-5aa.

(11) Perform frequency adjustment procedure described in paragraph 5-4i.

ac. SHIPPING INSTRUCTIONS - 1 -MC OSCILLATOR A3Y1. Ship the 1-mc oscillator to the repair facility according to the following procedure:

(1) Write on a tag the nature of the malfunction and tape it to one side of the oscillator case.

(2) Place the assembly in a plastic bag and wrap it in a double layer of 1/2-inch thick, embossed cellu-cushion. Use paper tape to hold the cellu - cushion in place.

(3) Pack the wrapped assembly in a 12 x 9 x 7-inch cardboard container. Place a layer of shredded paper or similar filler material between each surface of the wrapped assembly and the container walls to insure a snug fit.

(4) Seal the container with paper tape.

(5) Place a warning tag, similar to the one shown below, at two opposite corners of the container.

HANDLE WITH CARE

DELICATE
INSTRUMENTS

FRAGILE!

ad. ACCESS TO PARTS AND TEST POINTS IN THE 1 -MC OSCILLATOR A3Y1-Based on degree of accessibility, parts and test points of the 1-mc oscillator are divided into three groups, as follows:

Group 1. Parts in this group are accessible when the 1-mc oscillator is removed from the case and stripped of its insulation wrapping. Includes most parts of the temperature-control circuit.

Group 2. Parts in this group are accessible when the frequency generator is removed from the crystal oven. Includes parts mounted on printed circuit board A3Y1E1 as well as the crystal A3Y1Y1, and tuning capacitors A3Y1C2 and A3Y1C3.

Group 3. Parts in this group are accessible when the bottom cover is removed from the crystal oven. Includes parts of the temperature control not included in Group 1.

ae. DISASSEMBLING THE 1 -MC OSCILLATOR A3Y1.-

(1) Remove and save the eight screws (four on each side) from the case of the 1-mc oscillator (see figure 5-24).

(2) Remove and save the screw and washer that secure the top cover A3Y1MP19 and remove the top cover and insulation pad.

(3) Unsolder the yellow, red, and black leads from the feedthru terminals A3Y1E19 through A3Y1E21.

(4) Slide the 1-mc oscillator out of its case; remove the glass tape and insulation wrapping A3Y1MP20 from the crystal oven.

(5) Remove and save the two screw-shafts (A3Y1MP21 and A3Y1MP22) and locking screws (figure 5-25).

(6) Unsolder the black lead from stud terminal A3Y1E18.

(7) Remove and save the eight screws and nuts that secure the crystal-oven cover A3Y1MP23 and remove the crystal-oven cover and crystal pad.

(8) Remove and save the three screws and washers that secure the frequency generator to the crystal oven; then slide the frequency generator out of the crystal oven.

(9) Remove the two screws and six washers that secure printed circuit board A3Y1El to the panel A3Y1MP6. All test points on the printed circuit board are now accessible, including test points J and K which are located on the foil side.

(10) Remove the four screws and washers that secure the bottom cover A3Y1MP26 to the crystal oven; then remove the bottom cover. Parts mounted on the bottom of the crystal oven are now accessible.

(11) To reassemble the 1-mc oscillator, perform the procedure of steps (1) through (10) in a reverse order.

af. REPLACING TRANSISTORS A3Y1Q5 THROUGH A3YlQ7.—

(1) Perform the procedure of steps (1) through (4) of paragraph ae.

(2) Remove all connections from the three leads of the transistor to be replaced (figure 5-26). Code-mark connections to insure proper reassembly.

(3) Remove and save the disc insulator (A3Y1MP13 through 15).

(4) Place crystal oven into a temperature chamber preheated to 225°F.

(5) Leave crystal oven in the temperature chamber for approximately 1/2 hour; then remove it.

(6) Note orientation of transistor with respect to the crystal oven.

(7) With a small pair of long-nosed pliers grasp all three transistor leads; using edge of crystal oven as a pivot, pry the transistor gently but firmly out of the crystal oven.

(8) Apply Epoxy Adhesive, Type 1 Mil-S-8623, into the opening in the crystal oven which houses the transistor.

(9) Place crystal oven into a temperature chamber preheated to 225°F, and leave it there for approximately 15 minutes to cure.

(10) Remove crystal oven from temperature chamber

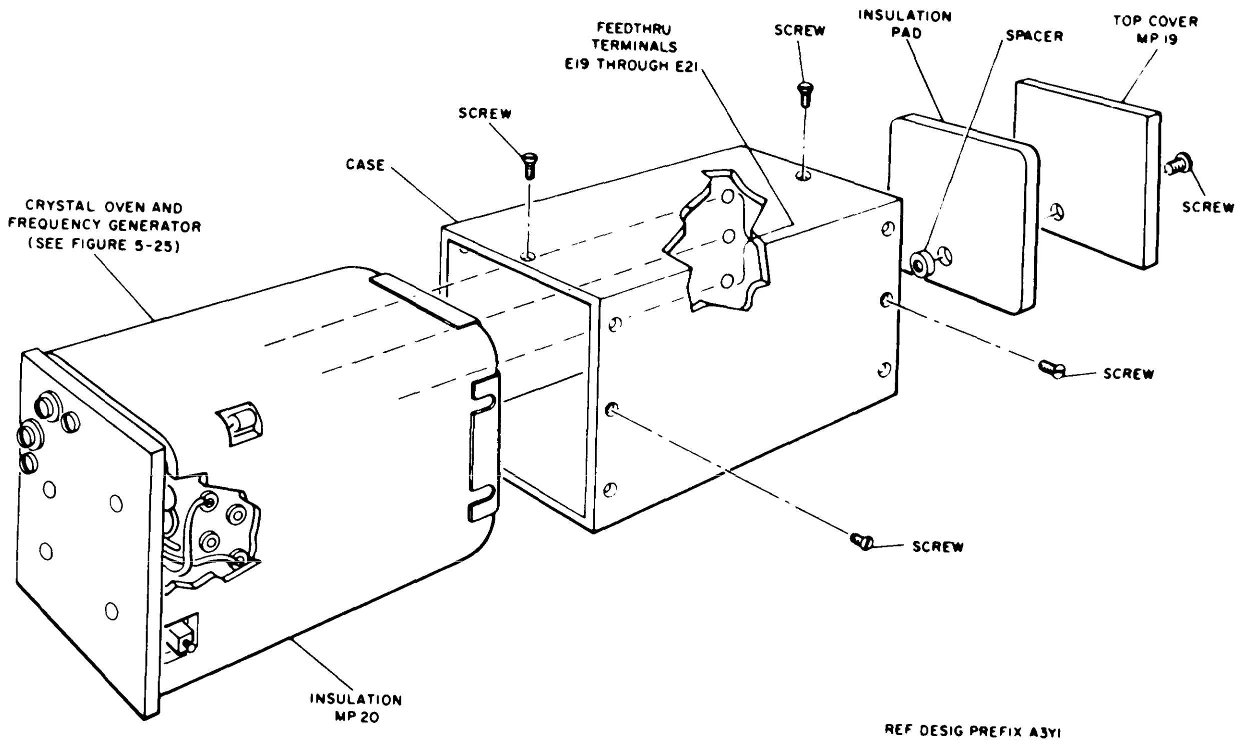


Figure 5-24. Disassembly of 1-MC Oscillator A3Y1

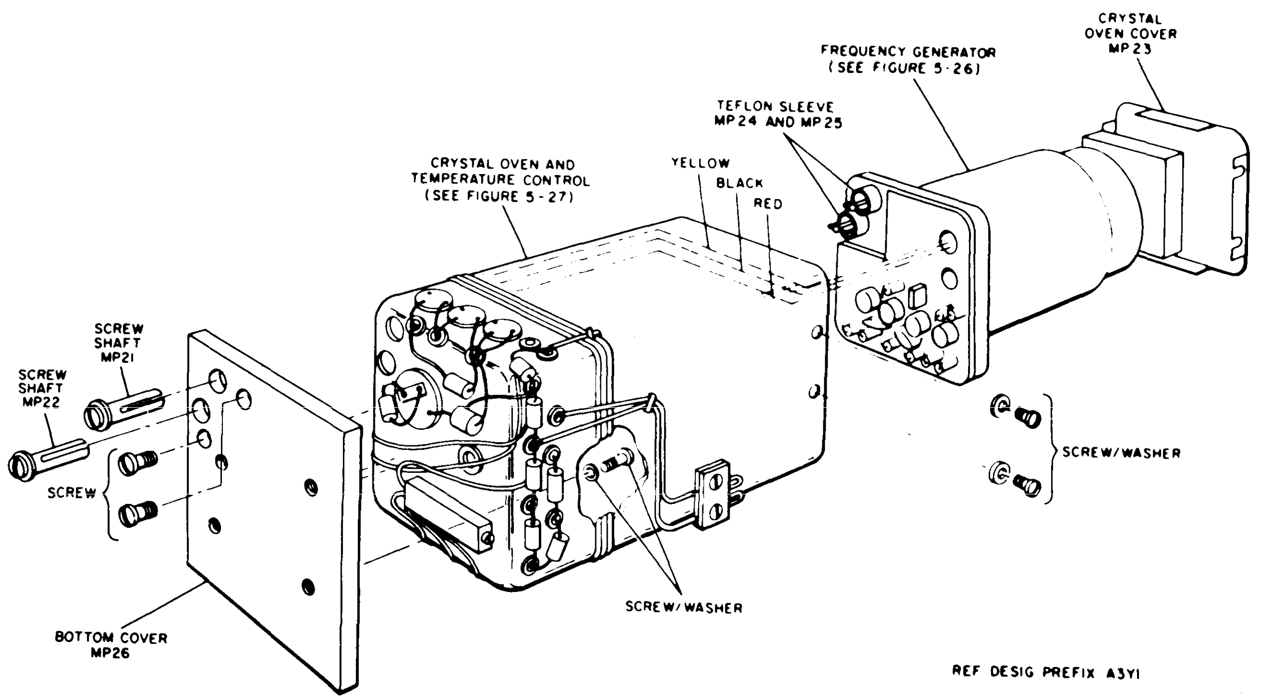


Figure 5-25. Disassembly of Crystal Oven

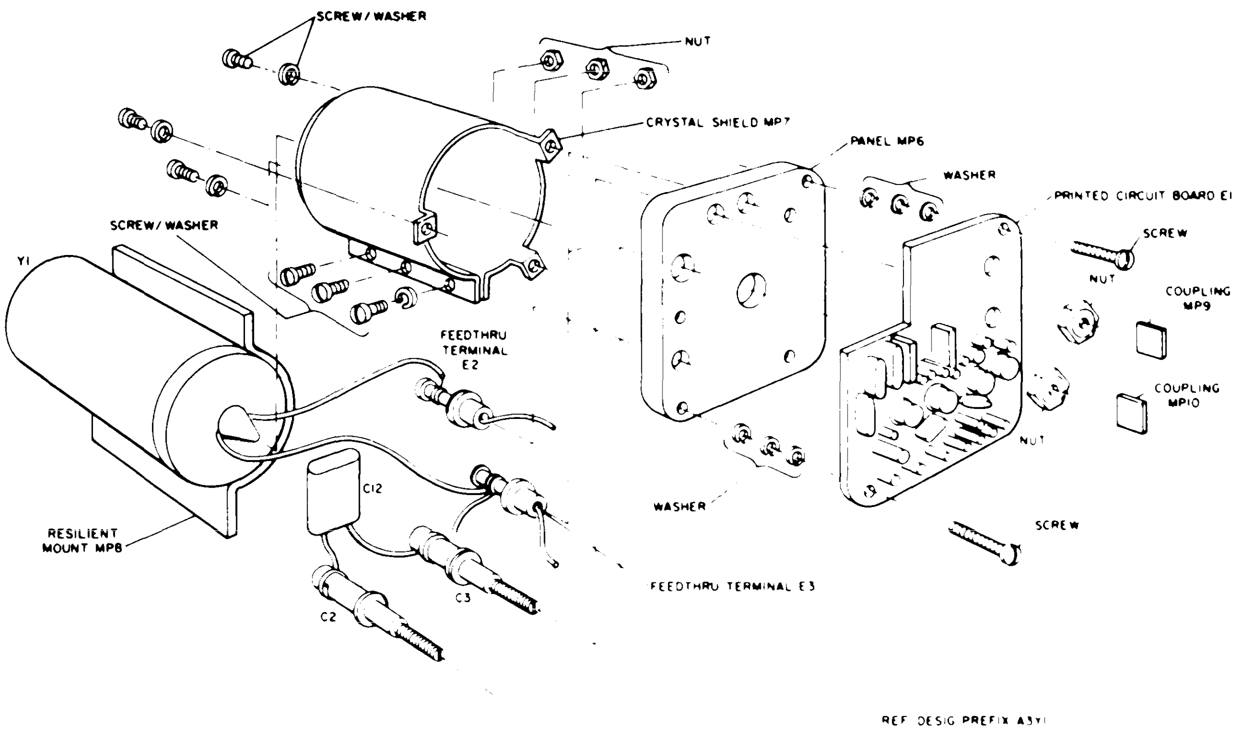


Figure 5-26. Disassembly of Frequency Generator

(11) Apply Epoxy Adhesive, Type 1 Mil-S-8623, around the entire replacement transistor, place insulation insert A3Y1MP16 (or MP17 or MP18) over the transistor, and together insert them into the opening on the crystal oven. Be sure the transistor is oriented as noted in step (6).

(12) Repeat the procedure of step (8).

(13) Replace the disk insulator.

(14) Replace the connections removed in step (2).

ag. REPLACING TRANSISTOR A3YlQ8.—

(1) Remove all connections from the three leads of the transistor. Code-mark connections to insure proper reassembly.

(2) Apply rosin-core flux and solder to the bottom surface of the transistor. Note orientation of transistor.

(3) After the transistor has warmed up sufficiently, grasp the three leads with a pair of long-nosed pliers; then pull up and out.

(4) While crystal oven is still warm, scrape off excessive adhesive from inside and around transistor mounting hole.

(5) Apply Epoxy Adhesive, Type 1 Mil-S-8623, against the flange of the replacement transistor so that it forms a ring around the transistor case.

(6) Insert transistor into the mounting hole of the crystal oven. Rotate back and forth to smooth out adhesive; then position it so that it is oriented as noted in step (2).

(7) Scrape off excessive adhesive from around the transistor case.

(8) Place crystal oven in a temperature chamber preheated to 225°F, and allow it to cure for approximately 15 minutes.

(9) Remove crystal oven from temperature chamber.

(10) Cut off a square piece of mica insulation supplied with the replacement transistor; and place it over the bottom surface of the allow the emitter and base leads to pass through the two holes of the lnsulation.

(11) Replace all connections removed in step (l).

ah. REPLACING CRYSTAL A3Y1Y1

(1) Perform the procedure of steps (1) through (8) of paragraph ae.

(2) Unsolder the two crystal leads from feed-thru terminals A3Y1E2 and A3YlF3 (figure 5-27).

(3) Remove and save the six screws and lock-washers that secure the crystal shield A3Y1MP7 to the panel A3YlMP6: then remove the crystal shield together with the crystal.

(4) Remove and save the three screws, washers, and nuts that secure the crystal shield to the crystal: then remove the crystal shield.

(5) Remove and save the resilient mount A3Y1MMP7 from around the defective crystal.

(6) Wrap resilient mount around the glass envelope of the replacement crystal: hold the wrap in

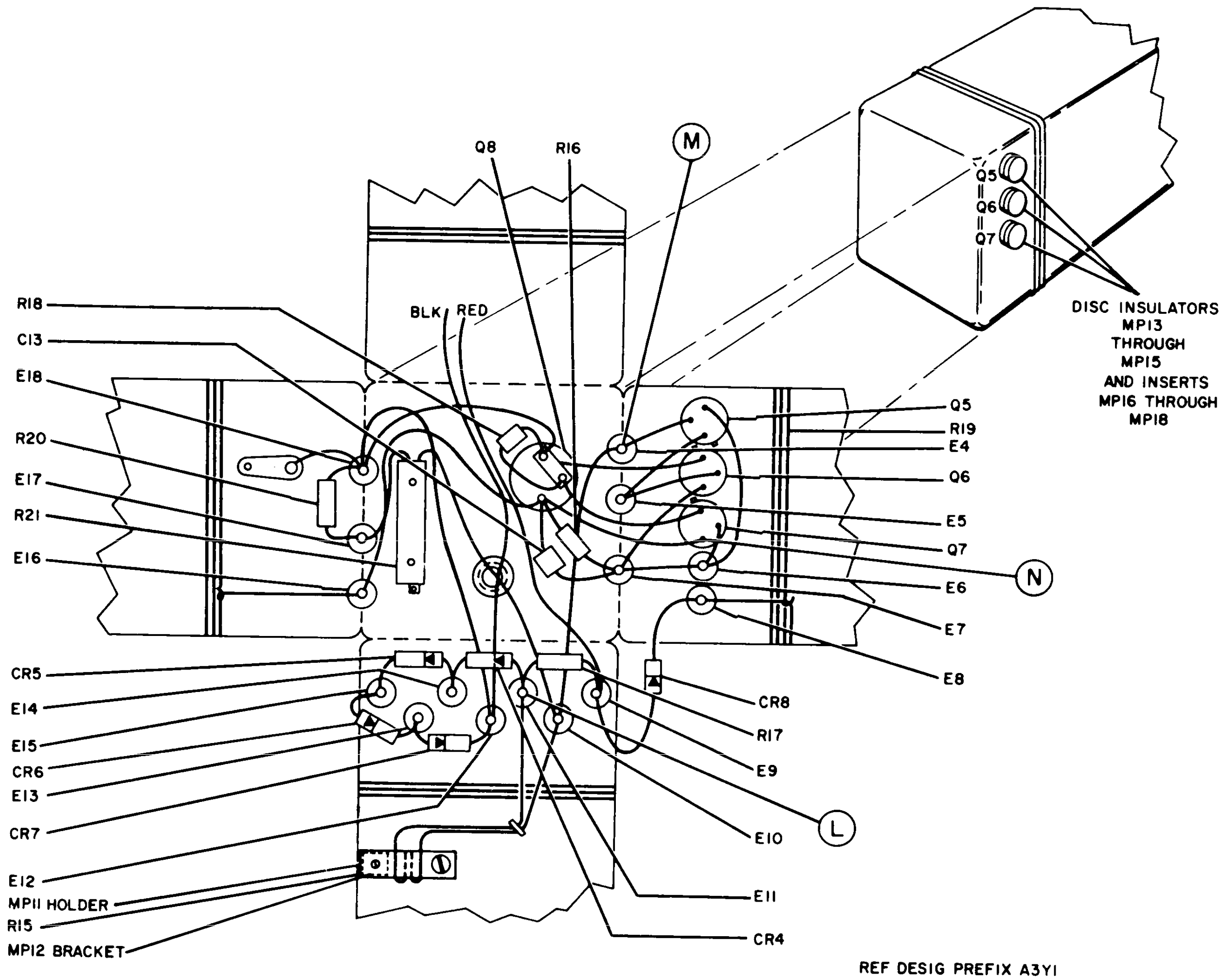


Figure 5-27. Crystal Oven, Location of Parts

place with one hand and slide the crystal shield over it. Allow the two crystal leads to pass through the bottom opening of the crystal shield.

(7) Secure crystal shield to the crystal by means of the three screws, washers, and nuts removed in step (4).

(8) Secure the crystal shield together with the crystal to the panel by means of the six screws and lockwashers removed in step (3).

(9) Place flexible tubing on each crystal lead; then solder them to the two feedthru terminals; either one of the leads may be soldered to either terminal.

(10) Reassemble the 1-mc oscillator by following steps (1) through (8) of paragraph ae in a reverse order.

(11) Perform the frequency adjustment procedure of paragraph 5-4i. Modify the test setup by applying operating power from an external power supply to the appropriate terminals of the 1-mc oscillator and obtain the 1-mc output signal from the 1-mc terminal.

(12) Set the temperature of the crystal oven to the turning point of the crystal as described in paragraph ai.

SETTING THE TEMPERATURE INSIDE THE CRYSTAL OVEN.—

Note

The temperature setting procedure must be performed with special test equipment not available on board ship.

For proper operation, the regulated value of the temperature inside the crystal oven must be set to the turning point of the crystal. The turning point of a crystal is a temperature value where the crystal frequency is least sensitive to changes in temperature. The average crystal has its turning point at +75°C. Others may range from +70°C to +80°C. The procedure for setting the crystal-oven temperature

is given below. Perform it following replacement of the crystal or a part in the temperature control circuit.

(1) EXTENT OF DISASSEMBLY. To gain access to temperature setting resistor A3Y1R21, first perform steps (1) and (2) of paragraph ae. Next, slide the 1-mc oscillator partially out of its case, until the adjustment screw of the temperature setting resistor becomes visible. Do not disconnect the leads or remove any insulation padding.

(2) TEST SETUP.

(a) Connect test setup as shown in figure 5-28.

CAUTION

Do not connect dc power supply into the test setup until its output voltage has been set to approximately +25 volts.

(b) Set counter SENSITIVITY switch to lV.
(c) Set counter POWER switch to STORE.
(d) Set counter FUNCTION switch to FREQ.
(e) Set counter time base switch to 1.
(f) Set counter REF FREQ 100 KC or 1 MC switch to EXT.
(g) Set counter DISPLAY control to MIN.

(3) WARM-UP. Allow a minimum of two hours for warmup before setting the temperature.

(4) INSTRUCTIONS.

(a) Observe and record digital display.

(b) With a screwdriver turn the adjustment screw of temperature setting resistor A3Y1R21 approximately 1/10 of a turn clockwise. Monitor digital display for five minutes; then record the results at the end of five minutes.

Note

Clockwise turn of A3WR21 increases oven temperature.

(c) Repeat the procedure of step (b) two or three times until a trend in frequency can be determined. If the frequency increases, proceed to step (d). If the frequency decreases, proceed to step (e). If the frequency remains essentially the same, proceed to step (f).

(d) Repeat the procedure of step (b) several times but turn A3Y1R21 in a counterclockwise direction. At first, the frequency will decrease with each incremental turn of A3Y1R21, followed by a region where the frequency will remain constant (inflection region), and then it will start to rise again. Note the setting of A3Y1R21 at each of the two critical points (see figure 5-29) and set it midway between these two points.

(e) Repeat the procedure of step (b) several times. As in step (d), the frequency will first decrease, followed by a region where it will essentially remain constant, and then start to increase. Note the setting of A3Y1R21 at each of the two critical points, and set it midway between these two points.

(f) Find the two critical points by turning A3Y1R21 first in one direction and then in the other

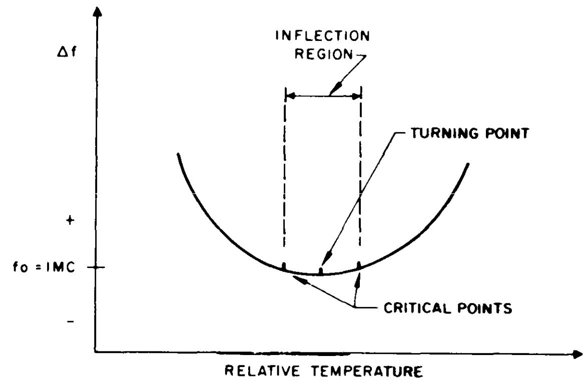


Figure 5-29. 1-MC Oscillator A3Y1, Frequency versus Temperature Curve

in 1/10-turn incremental steps; allow five minutes for each step as in step (b). Set A3Y1R21 midway between these two critical points.

aj. SELECTING THE VALUE OF CAPACITOR A3Y1C4V Capacitor A3Y1C4 is a part whose value is selected at the factory. It has an mean value of 160 pf, and may range from 56 pf to 220 pf. It is selected according to the following procedure:

NOTE

The following procedure must be performed with special test equipment not available on board ship.

(1) Loosen the two locking screws and turn the COARSE and FINE adjustment capacitors A3Y1C3 and A3Y1C2 fully counterclockwise.

(2) Follow the procedure of steps (1) through (8) of paragraph ae, and separate the frequency generator from the crystal oven.

(3) Place frequency generator into a temperature chamber preheated to +75°C; leave it in the temperature chamber for a minimum cf two hours.

(4) Remove the frequency generator from the temperature chamber.

(5) Connect frequency generator within the test setup shown in figure 5-30.

CAUTION

Before connecting the frequency generator into the test setup be sure that the dc power supply is set for an output voltage of exactly +25 volts.

(6) Set counter SENSITIVITY switch to lV.
(7) Set counter POWER switch to STORE.
(8) Set counter FUNCTION switch to FREQ.
(9) Set counter time base switch to 1.
(10) Set counter REF FREQ 100 KC OR 1 MC switch to EXT.
(11) Set counter DISPLAY control to MIN.
(12) Starting with a value of from 56 pf to 65 pf, place a capacitor into the eyelets normally occupied by A3Y1C4.

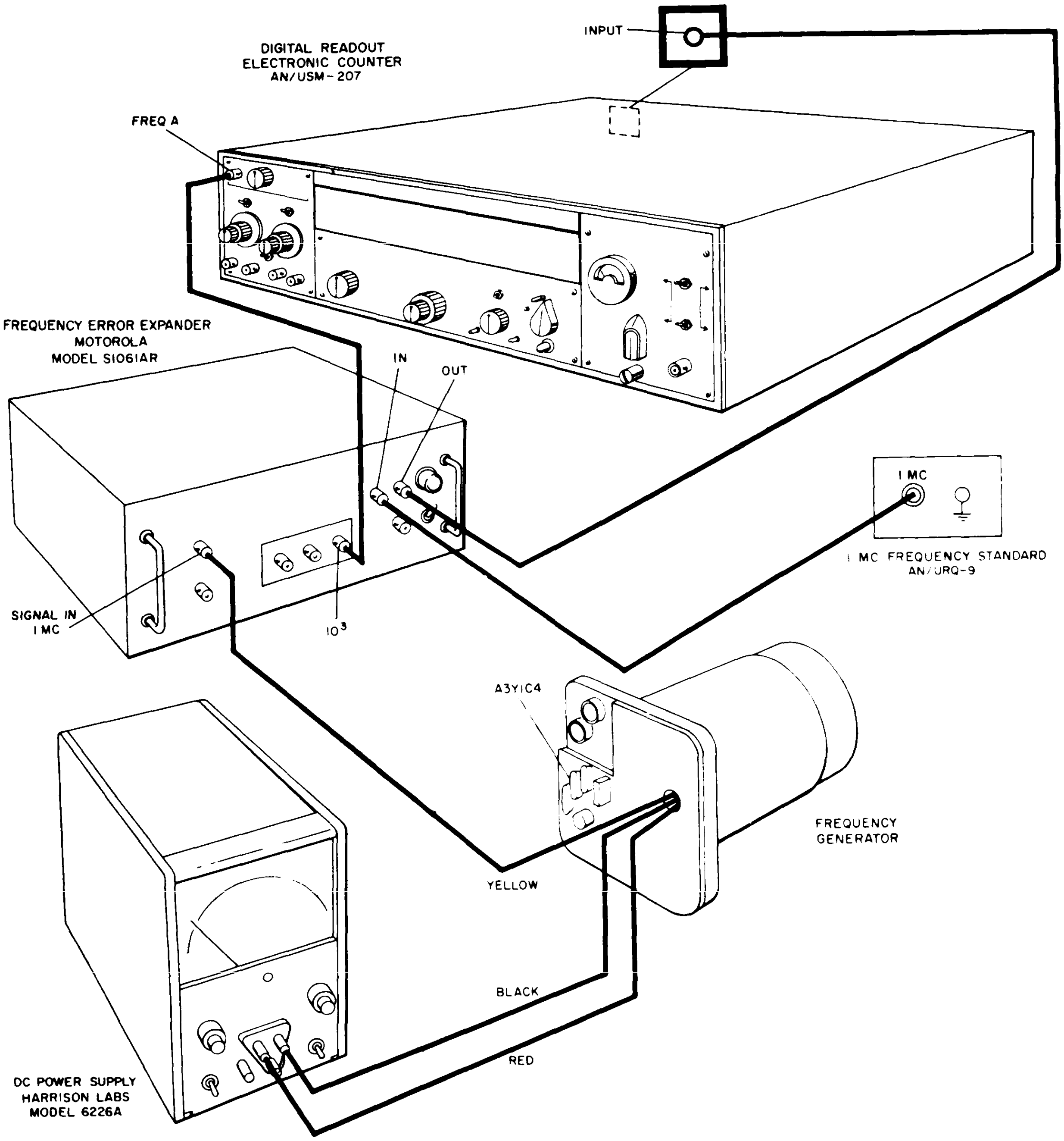


Figure 5-30. Selecting Capacitor A3YlC4, Test Setup

(13) Observe digital display. If display is greater than 01003.000 kc, gradually increase value of A3Y1C4 until a reading of 01002.000 kc ±l.000 kc is obtained.

(14) Replace frequency generator within the crystal oven and reassemble the 1-mc oscillator by following the procedure of steps (1) through (8) of paragraph ae in a reverse order.

(15) Perform the frequency adjustment procedure of paragraph 5-4i. Modify the test setup by applying operating power from an external power supply to the appropriate terminals of the 1-mc oscillator, and obtain the 1-mc output signal from the 1 mc terminal.

ak. SELECTING THE VALUE OF RESISTOR A3YlRl. Resistor A3Y1R1 is a factory-selected part which determines the gain of the 1-mc oscillator. It has a mean value of approximately 40 k and may range from 10 k to 150 k. The correct value of this resistor is one which sets the amplitude of the

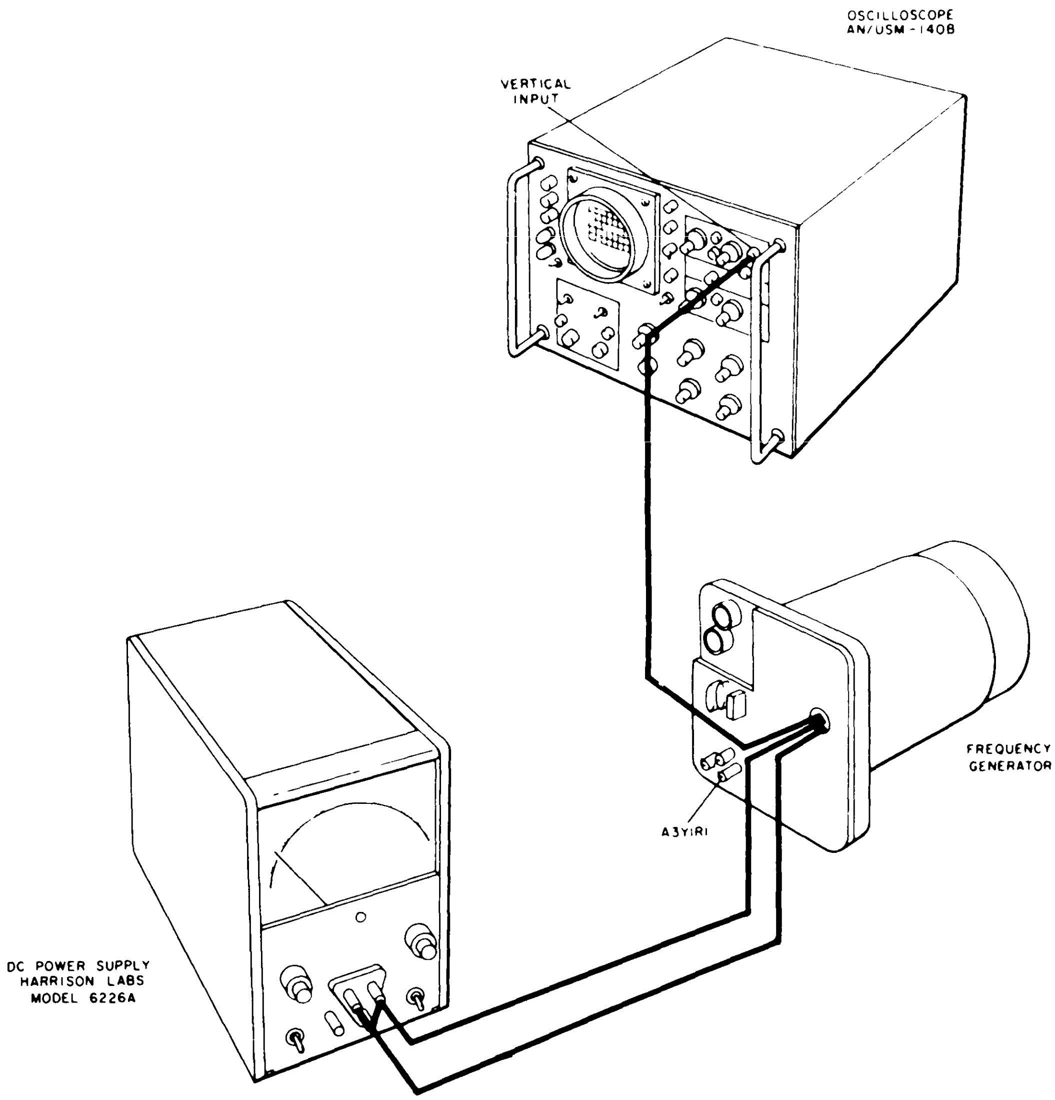


Figure 5-31. Selecting Resistor A3Y1R1, Test Setup

1-mc output signal between 3 volts and 4 volts peak-to-peak. The procedure is as follows:

Note

The following procedure must be performed with special test equipment not available on board ship.

(1) Follow the procedure of steps (1) through (8) of paragraph ae and separate the frequency generator from the crystal oven.

(2) Connect frequency generator within the test setup shown in figure 5-31.

CAUTION

Before connecting the frequency generator into the test setup, be sure that the dc power supply is set for an output voltage of exactly +25 volts.

(3) Set oscilloscope controls for a vertical deflection of 1 v/cm, a sweep rate of 1 μs/cm, and internal triggering.

(4) Connect a rheostat (or potentiometer) of approximately 200 k across the eyelets normally occupied by A3Y1R1.

(5) Adjust the rheostat for a waveform amplitude of 3.5 volts peak-to-peak.

(6) Disconnect the rheostat and measure its adjusted resistance; then connect in its place a

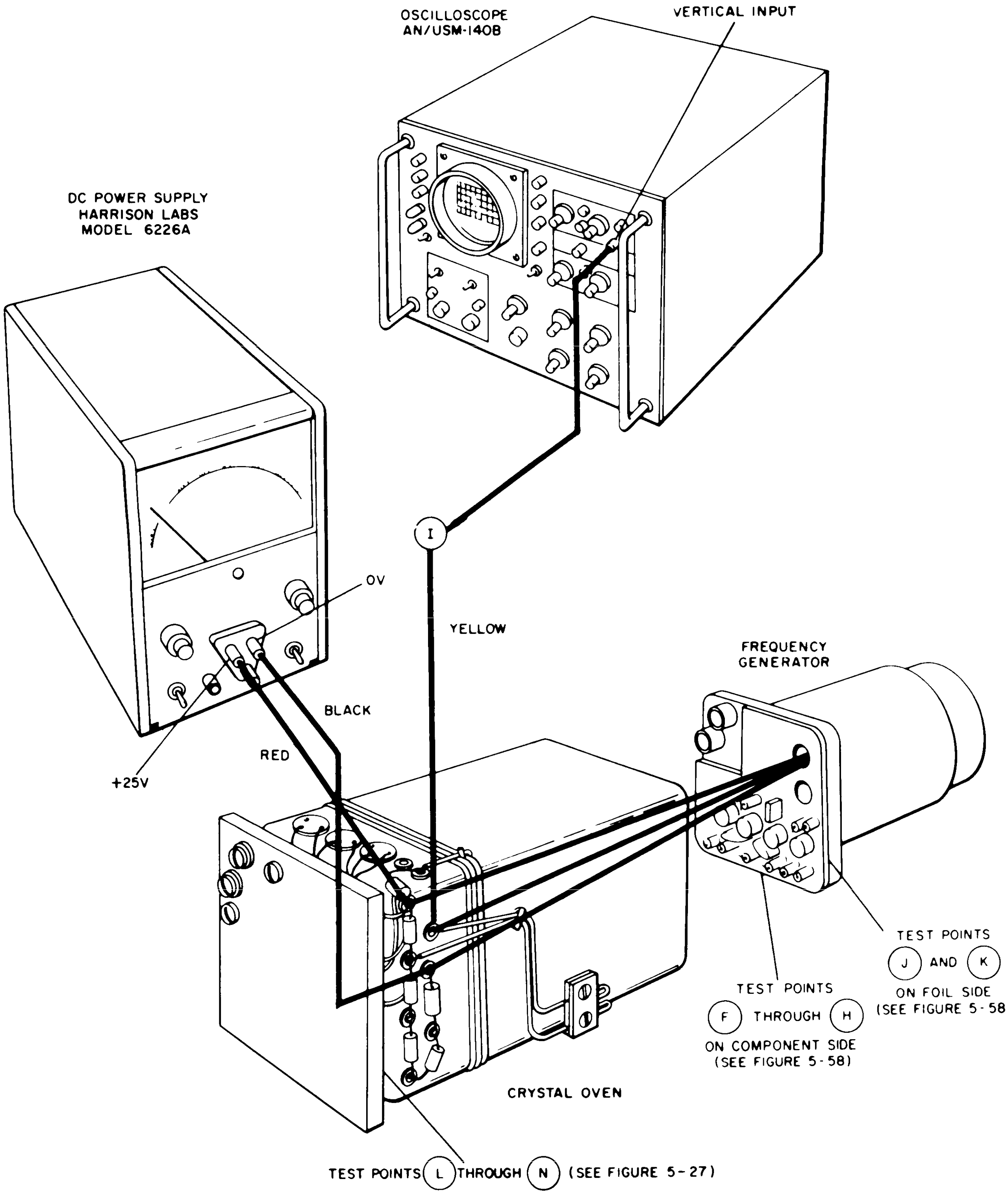


Figure 5-32. 1-MC Oscillator A3Y1 Trouble Shooting, Test Setup

l/4-watt, 2-percent resistor with an ohmic value nearest the measured value.

al. REPLACING LEADS ON CONNECTORS A1J13 AND AlJ15.—The center conductor of connectors A1J13 and A1J15 each has two wires connected to it: the pigtail lead of a capacitor and a lead which connects to mode selector switch A1S9. When, on a given connector, either the capacitor or the lead needs to be replaced, also disconnect the other lead; either lead has sufficient service loop in it, and can be reused. Insert both the replacement lead and the reused lead together within the hollow of the center conductor of the connector, and solder in one operation.

REPLACING JUMPER WIRES ON CONNECTORS A1J8 AND A1J9 OF THE COUNTER, A2P2 OF THE CONVERTER, AND A3P1 OF THE OSCILLATOR. -On these connectors, all terminals which are at ground potential are connected together by means of jumper wires. When, on a given connector, a jumper wire needs to be replaced, replace the other wire (or wires) as well. Solder each pair of wires connecting to the same terminal in one operation.

an. ALIGNMENT PROCEDURE FOLLOWING REPLACEMENT OF CONNECTORS A2P2 AND A3P1. — Each of these connectors is secured by means of two Phillips-head screws to converter A2 an oscillator A3, respectively. After replacing either of these connectors, align it according to the following procedure:

(1) Loosen but do not remove the two Phillips-head screws securing the connector to the assembly (converter or oscillator, as applicable).

(2) Slide the assembly towards the center of the counter until the two alignment prongs of the connector align with the mating receptacle of the counter.

(3) Place middle-finger on connector and hold connector firmly in its aligned position; then slide assembly slowly out of the counter until the two Phillips-head screws are accessible, and tighten the two Phillips-head screws.

ao. COMPARABILITY ADJUSTMENT BEFORE INSTALLATION OF NEW CONVERTER A2 OR AFTER INSTALLATION OF NEW MULTIPLIER A1A6. —

(1) Set counter POWER switch to OFF.

(2) Connect preliminary test setup as shown in figure 5-3 except do not made connection between A2P1 of the converter and A1J10 of the counter.

(3) Terminate A2P1 in 50 ohms. Use a Tektronix Model 011-049 or similar 50-ohm termination.

(4) Connect the probe of an AN/USM-140B oscilloscope to the 50-ohm termination.

TABLE 5-21. SCHEMATIC DIAGRAMS CROSS-REFERENCE

Note

The assemblies and parts which are referenced between schematic diagrams are listed in the left-hand column below and are shown schematically on the illustrations listed in the right-hand column.

ASSEMBLY REFERENCE DESIGNATOR	SCHEMATIC DIAGRAM FIGURE NUMBERS
A1A1	5-80
A1A2	5-68
A1A3	5-68
A1A4	5-68
A1A5	5-67
A1A6	5-66
A1A7	5-71, 5-79
A1A8	5-70
A1A9	5-72
A1A10	5-69, 5-80
A1A11	5-64, 5-65
A1A12	5-75, 5-77
A1A13	5-75, 5-77
A1A14	5-75, 5-77
A1A15	5-75, 5-77
A1A16	5-75, 5-77
A1A17	5-74, 5-77
A1A18	5-74, 5-77
A1A19	5-73, 5-77
A1A20	5-63
A1A21	5-63

ASSEMBLY REFERENCE DESIGNATOR	SCHEMATIC DIAGRAM FIGURE NUMBERS
A1A22	5-64
A1A23	5-65
A1DS4	5-78
A1DS5	5-78
A1DS6	5-78
A1DS7	5-78
A1DS8	5-78
A1DS9	5-78
A1J9	5-61
A1J10	5-63
A1J11	5-76
A1P1	5-70
A1S1	5-59, 5-80
A1S2	5-81
A1S3C	5-81
A1S4I	5-81
A1S9	5-64
A1S13	5-66
A2	5-61
A2A1	5-62
A3	5-60

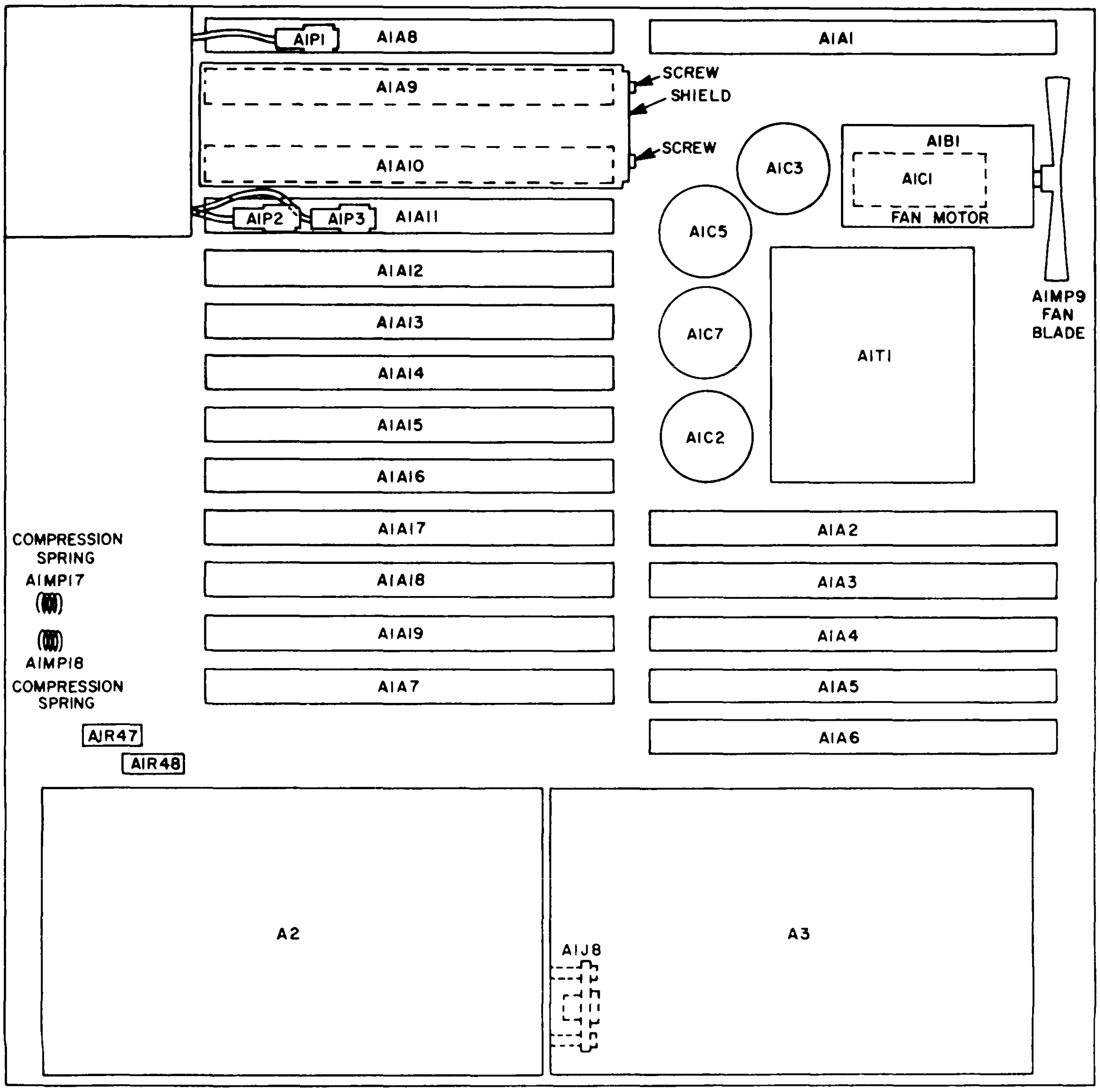


Figure 5-33. Counter Top View, Location of Parts

(5) Set oscilloscope controls for a vertical deflection of 0.05 v/cm and a sweep time of 1 μs/cm.

(6) Set counter POWER switch to TRACK or STORE.

(7) Set converter DIRECT-HETERODYNE switch to HETERODYNE.

(8) While observing oscilloscope, turn mixing frequency selector switch to all positions. Note switch position where l-mc and/or 10-mc noise is maximum; then set it to that position.

(9) Adjust A2T1 (figure 5-4) slightly for minimum noise level. The noise level should be 10 millivolts or less at all positions of the mixing frequency selector switch.

ap. REPLACING GATE LAMP A1DS2 AND OVEN LAMP AlDS3.—

(1) Unplug power cord from the power source.

(2) Set POWER switch to STBY.

(3) Turn DISPLAY control to the extreme counterclockwise position.

(4) Set time base switch and STD FREQ OUT switch to 10^4.

(5) Set FUNCTION switch to FREQ.

(6) Loosen the two setscrews on FUNCTION-switch knob A1MP7, and remove knob.

(7) Remove and save mounting nut and flat washer that secure FUNCTION switch to front panel.

(8) Loosen the two set screws on STD FREQ OUT switch red knob A1MP6, and remove the knob.

(9) Loosen the two setscrews on time base switch black knob A1MP10, and remove the knob.

(10) Remove and save mounting nut and flat washer that secure the time base switch and STD FREQ OUT switch to the front panel.

(11) Loosen the two setscrews on knob A1MP5 of the POWER switch, and remove the knob.

(12) Remove and save the mounting nut and flat washer that secure the POWER switch to the front panel.

(13) Loosen the two setscrews on knob A1MP5 of the DISPLAY control, and remove the knob.

(14) Remove and save mounting nut and flat washer that secure DISPLAY control to the front panel,

(15) Remove and save the two screws and flat washers on the front panel below the observation window.

(16) Remove and save the two screws and flat washers from the bottom of the front panel.

(17) Set the counter on its left side with the front panel facing forward.

(18) Remove and save the nut and flat washer that secure cable clamp through which the lamp leads are routed.

(19) OVEN lamp only. Unsolder the black lead and the white lead from terminal 2 of A1XA18; then unsolder the white-yellow-violet and white leads from terminal 3 of A1XA18.

(20) GATE lamp only. Unsolder the white lead and the white-orange-violet lead from terminal 2 of A1XA17; then unsolder the white lead and the green lead from terminal 3 of A1XA17.

(21) Note the routing of the two white leads removed in step (19) or step (20), as applicable; then pull these leads free of the cable clamp.

(22) With-a 5/8-inch open-end wrench remove the nut that secures the lamp to the inside of the front panel; then remove the lamp.

(23) Insert replacement lamp into the mounting hole from the inside, and secure the lamp with the mounting nut supplied.

(24) Feed the lamp leads through the cable clamp and route them as noted in step (21).

(25) Secure cable clamp with nut and washer removed in step (18).

(26) Extend end of leads to terminal 3 of AlXA18, allow approximately 1/2-inch service loop, and cut off any excess from the end.

(27) OVEN lamp only. Solder either of the white lamp leads together with the black lead removed in step (19) to terminal 2 of A1XA18; then solder the other white lead together with the white-yellow-violet lead to terminal 3 of A1XA18.

(28) GATE lamp only. Solder either of the white lamp leads together with the white-orange-violet lead of terminal 2 of A1XA17; then solder the other white lead together with the green lead of terminal 3 of A1XA17.

(29) Slide front panel slowly toward the rear, allowing the switch shafts to pass through the mounting holes, until the panel is flush with the observation window.

(30) Secure front panel with the screws and flat washers removed in steps (15) and (16).

(31) Secure POWER switch to front panel with mounting nut and washer removed in step (12). Place knob A1MP13 on shaft. with the Index pointing to the STBY marking, and tighten the two setscrews.

(32) Secure DISPLAY control to front panel with the mounting nut and washer removed in step (13). Place knob A1MP5 on shaft, with the index pointing to the MIN marking. and tighten the two setscrews.

(33) Secure the time base switch and STD FREQ OUT switch to front panel with mounting nut and washer removed in step (10). Place black knob A1MP6 on shaft. with index pointing to 10^4 marking, and tighten the two setscrews. Place red knob A1MP10 on shaft, with index pointing to the 10^4 marking, and tighten the two setscrews.

(34) Secure FUNCTION switch to front panel with mounting nut and washer removed in step (7). Place knob A1MP7 on shaft, with index pointing to the FREQ marking, and tighten the two setscrews.

aq. REPLACING RESET SWITCH A1S6. —

(1) Set POWER switch to OFF.

(2) Remove 17 screws which fasten the top cover, and remove the cover.

(3) Remove printed-circuit board A1A18.

(4) Unsolder the green lead and white-yellow-blue lead from the switch terminals.

(5) Remove and save the mounting nut and flat washer that fasten the RESET switch to the front panel.

(6) Pull the RESET switch from the inside until the switch clears the front panel: then lift the switch slightly in order to expose the switch terminals.

(7) Unsolder the green lead and the white-yellow-blue lead from the two terminals of the defective switch.

(8) Remove and discard defective switch,

(9) Solder the two leads removed in step (7) to the replacement switch terminals.

(10) Push replacement switch through the front-panel mounting hole, and secure with the nut and flat washer.

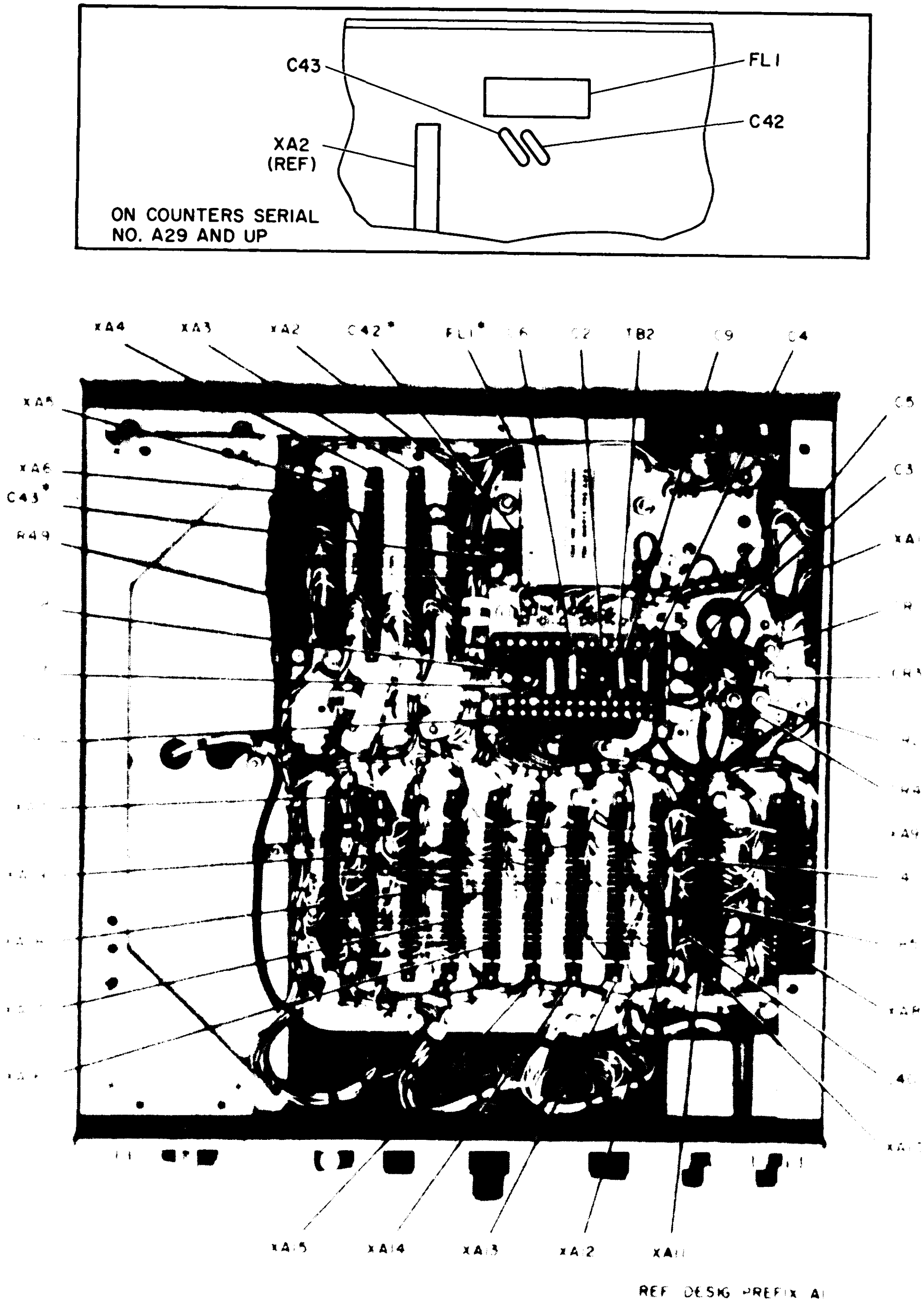
(11) Replace printed-circuit board A1A18.

(12) Replace top cover and secure with the 17 screws.

REPLACING POWER INDICATOR LAMP AlDS1. — To replace the POWER indicator A1DS1 lamp, unscrew the defective lamp from the front and insert a new lamp.

5-6. LOCATION OF PARTS.

Figures 5-33 through 5-58 show location of parts. Parts and subassemblies are identified on the illustrations by reference designations and cross--referenced in the tables adjacent to the illustrations when the number of parts exceeds 30. These tables identify the parts by use of map-type coordinates. The parts list, table 6-1, also lists all parts by reference designations, and cross-references the appropriate illustration where the part appears.



*PARTS LOCATION AS SHOWN IN PHOTOGRAPH FOR COUNTERS WITH SERIAL NO. A28 AND BELOW. SEE TOP PARTIAL VIEW FOR PARTS LOCATION ON UNITS WITH SERIAL NO. A29 AND UP.

Figure 5-34. Counter Bottom View, Location of Parts

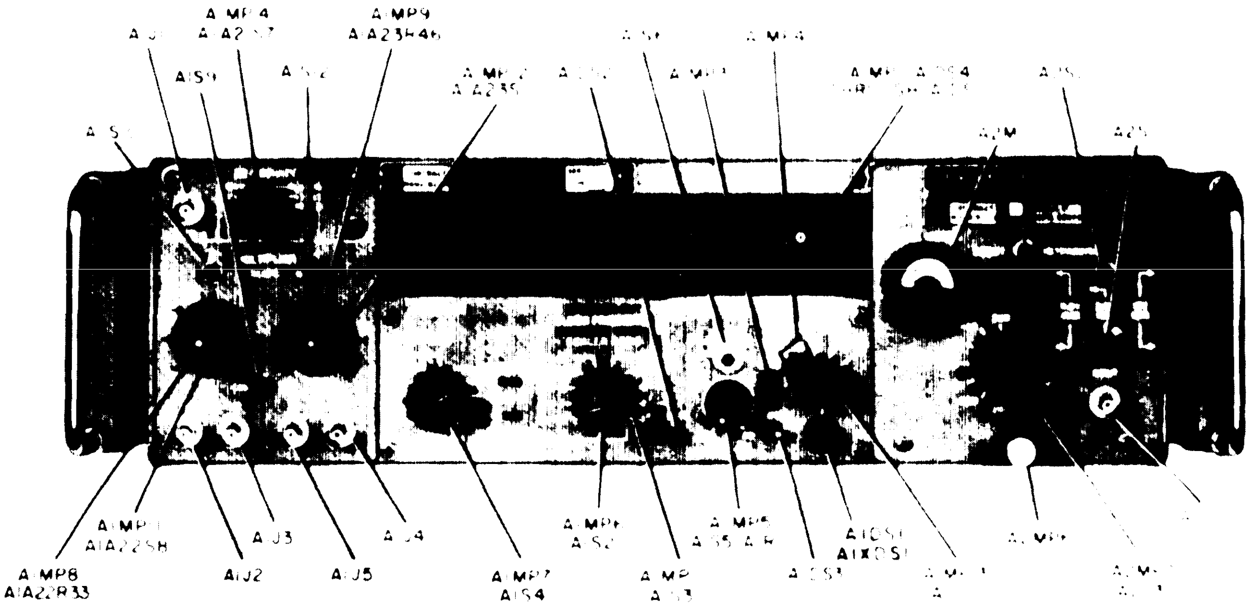


Figure 5-35. Counter Front View, Location of Parts

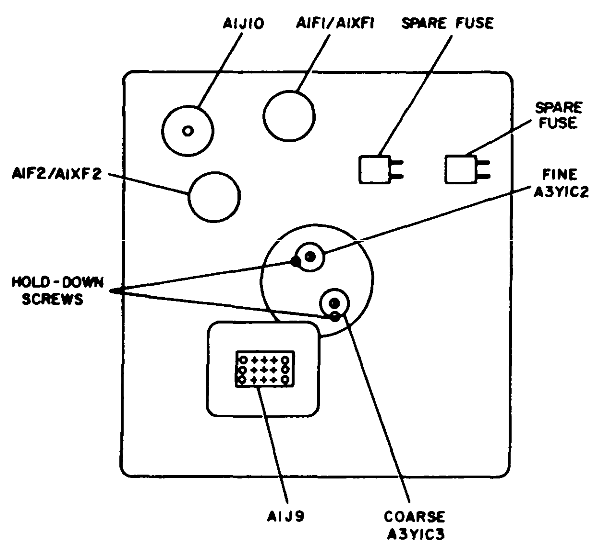


Figure 5-36. Counter Front View, with Converter Removed,
Location of Fuses and Oscillator Adjustments

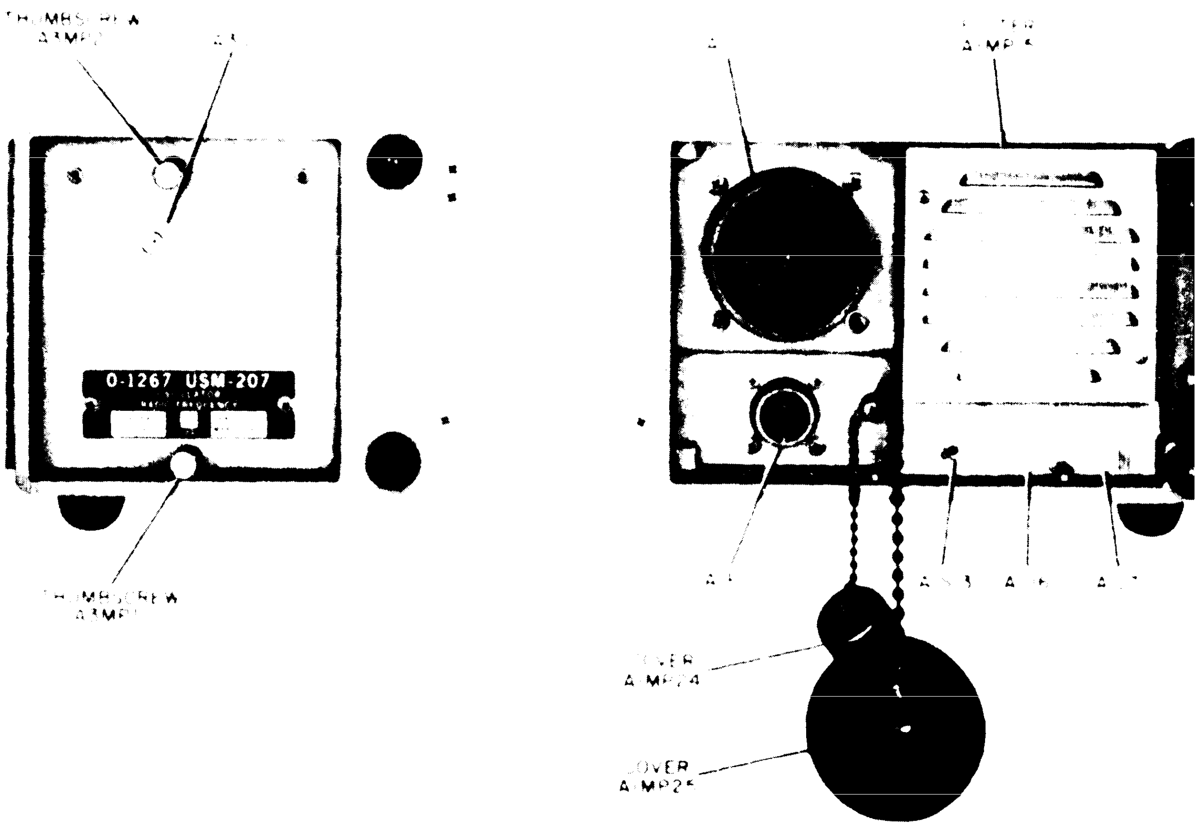
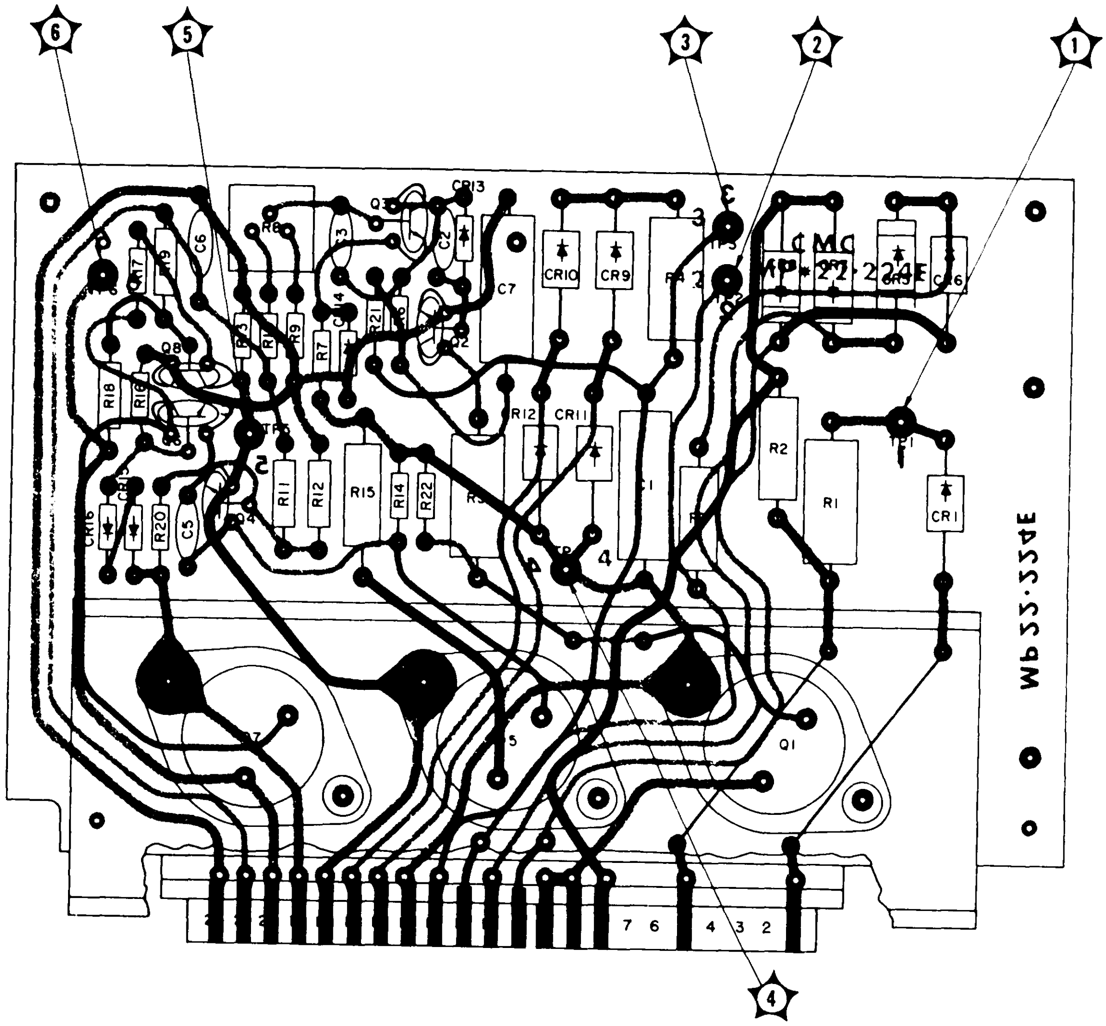


Figure 5-37. Counter Rear View, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-38

REF. DESIG.	DRAWING LOCATION
C1	5D
C2	3C
C3	3C
C5	2D
C6	2C
C7	4C
CR1	6D
CR5	6C
CR6	6C
CR7	6C
CR8	5C
CR9	4C
CR10	4C
CR11	4D
CR12	4D
CR13	4C
CR14	3C
CR15	2D
CR16	1D
Q1	5F
Q2	3C
Q3	3C
Q4	2D
Q5	4F
Q6	2D
Q7	2F
Q8	2D

REF. DESIG.	DRAWING LOCATION
R1	6D
R2	5D
R3	5D
R4	5C
R5	4D
R6	3C
R7	3C
R8	2C
R9	3C
R10	2C
R11	2D
R12	3D
R13	2C
R14	3D
R15	3D
R16	2D
R17	2C
R18	1D
R19	2C
R20	2D
R21	3C
TP1	6D
TP2	5C
TP3	5C
TP4	4D
TP5	2D
TP6	1C



PIN	SIGNAL	CONNECTION
1	115 vac	From A1T1
5	+180 v supply	To readout circuits A1A12 through A1A19
8	Ground	
9	+14 v	From A1CR1
10	+14 v	From A1CR3
11	37. 5 vac	From A1T1
12	37. 5 vac	From A1T1
13	+45 v supply	To all functional sections
14	+18 v supply	To all functional sections

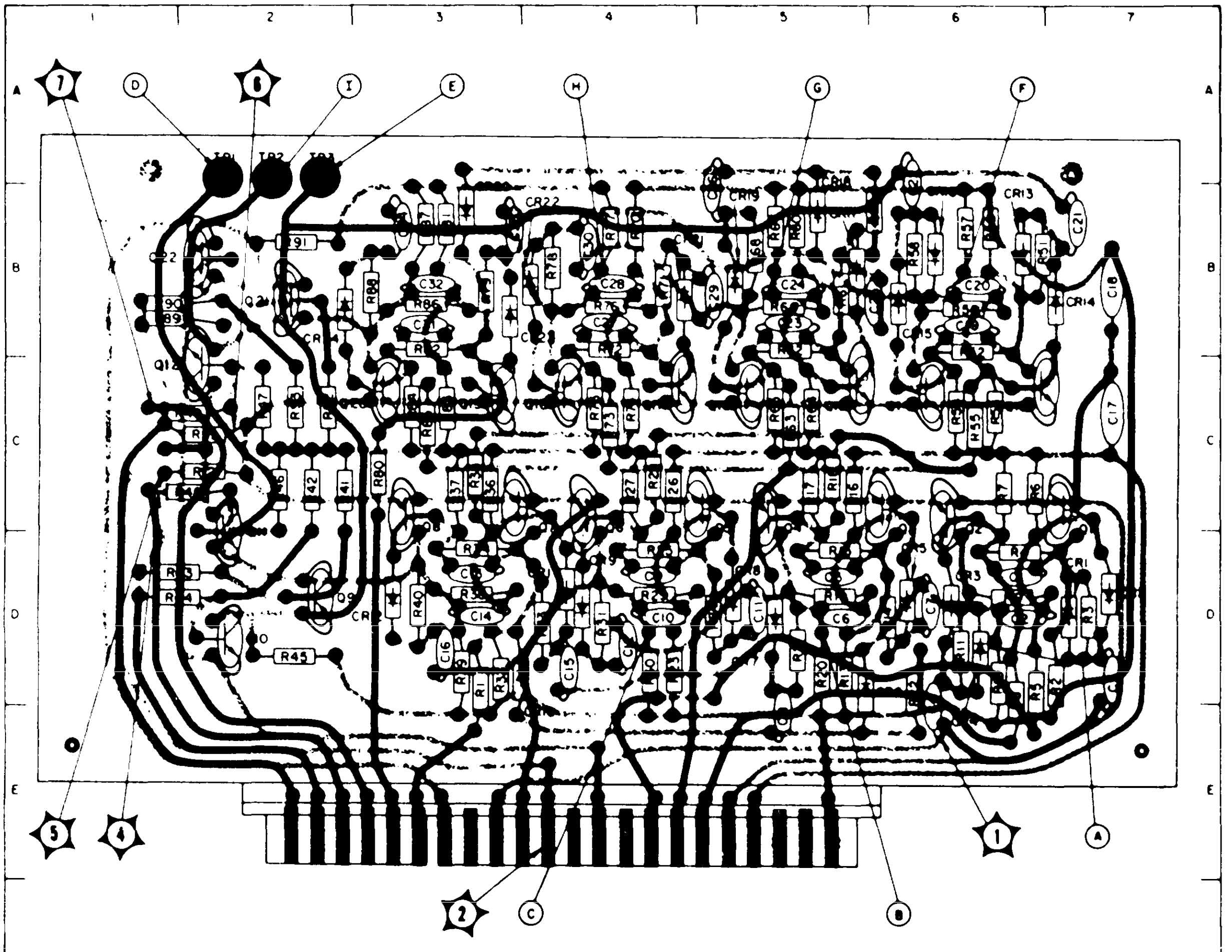
PIN	SIGNAL	CONNECTION
15	+12 v supply	To all functional sections
16	6 vac	From A1T1
17	6 vac	From A1T1
18	+6 v supply	To all functional sections
19	-14 v	From A1CR2
20	-12 v supply	To all functional sections
21	+12 v sample	
22	Ground	From +12 vdc bus

REF DESIG PREFIX A1A1

Figure 5-38. Voltage Regulator A1A1, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-39

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	6D	CR11	4D	R9	6D	R53	6C
C2	6D	CR12	3D	R10	6E	R54	6C
C3	7E	CR13	6B	R11	6D	R55	6C
C4	6E	CR14	7B	R12	2C	R56	6B
C5	5D	CR15	6C	R13	5E	R57	6B
C6	5D	CR16	6B	R14	6D	R58	6B
C7	6D	CR17	5B	R15	5D	R59	2C
C8	5E	CR18	5B	R16	5C	R60	5B
C9	4D	CR19	5B	R17	5C	R61	5B
C10	4D	CR20	3B	R18	5C	R62	5C
C11	5D	CR21	4B	R19	5D	R63	5C
C12	4D	CR22	4B	R20	5E	R64	5C
C13	3D	CR23	4B	R21	5E	R65	5C
C14	3D	CR24	2B	R22	6E	R66	5B
C15	4D	Q1	7D	R23	4E	R67	5B
C16	3D	Q2	6D	R24	5D	R68	5B
C17	7C	Q3	6D	R25	4D	R69	6B
C18	7B	Q4	5D	R26	4C	R70	4B
C19	6C	Q5	5D	R27	4C	R71	4B
C20	6B	Q6	4D	R28	4C	R72	4C
C21	7B	Q7	4D	R29	4D	R73	4C
C22	6B	Q8	3D	R30	4E	R74	4C
C23	5C	Q9	2D	R31	4D	R75	4C
C24	5B	Q10	2D	R32	3E	R76	4B
C25	6B	Q11	2D	R33	4D	R77	4B
C26	5B	Q12	1C	R34	3D	R78	4B
C27	4B	Q13	6C	R35	3C	R79	3B
C28	4B	Q14	6C	R36	3C	R80	3C
C29	5B	Q15	5C	R37	3C	R81	3B
C30	4B	Q16	5C	R38	3D	R82	3C
C31	3B	Q17	4C	R39	3D	R83	3C
C32	3B	Q18	4C	R40	3D	R84	3C
C33	3B	Q19	3C	R41	2D	R85	3C
C34	3B	Q20	3C	R42	2D	R86	3B
CR1	7D	Q21	2B	R43	2D	R87	3B
CR2	7D	Q22	1B	R44	2D	R88	3B
CR3	6D	R1	3E	R45	2D	R89	1B
CR4	6E	R2	7E	R46	2D	R90	1B
CR5	6D	R3	7D	R47	2C	R91	2B
CR6	6E	R4	6D	R48	2C	R92	2C
CR7	5D	R5	6E	R49	2C	R93	2C
CR8	5D	R6	6C	R50	6B	TP1	2B
CR9	4D	R7	6C	R51	6B	TP2	2B
CR10	4E	R8	6E	R52	6C	TP3	2B



PIN	SIGNAL	CONN A1A2	CONN A1A3	CONN A1A4
1	"B" signal select (F1 + F3 + F5 + F7)	From A1XA10-9	From A1S4I-6	From A1S4I-8
2	1/10 "B" signal select (F2 + F4 + F6)	From A1S4I-5	From A1S4I-7	From A1S4I-9
3	Divide by 10 select (T2 + T4 + T6)	From A1S3C-9	From A1S3C-11	From A1S3C-1
4	Divide by 100 select (T1 + T3 + T5)	From A1S3C-8	From A1S3C-11	From A1S3C-12
5	1/100 standard frequency	To A1S2-8	To A1S2-10	To A1S2-12
6	1/10 standard frequency	To A1S2-9	To A1S2-11	To A1S2-1
7	Divider signal* or multiple "B" signal**	**To A1XA10-13	*To A1XA2-9	*To A1XA3-9
9	Divider signal	From A1XA3-7	From A1XA4-7	From A1XA5-7
10	Ground			
11	Time base signal	To A1XA5-11	To A1XA5-11	To A1XA5-11
13	"B" signal	From A1XA11-8	From A1XA11-8	From A1XA11-8
15	Reset	Not used	Not used	From A1XA7-T
16	Reset	From A1XA7-T	From A1XA7-T	From A1XA7-T
17	Reset	From A1XA7-T	From A1XA7-T	Not used
18	Ground			
19	-12 v	From A1XA1-20	From A1XA1-20	From A1XA1-20
22	+12 v	From A1XA1-15	From A1XA1-15	From A1XA1-15

REF DESIG PREFIX A1A2, A1A3, A1A4

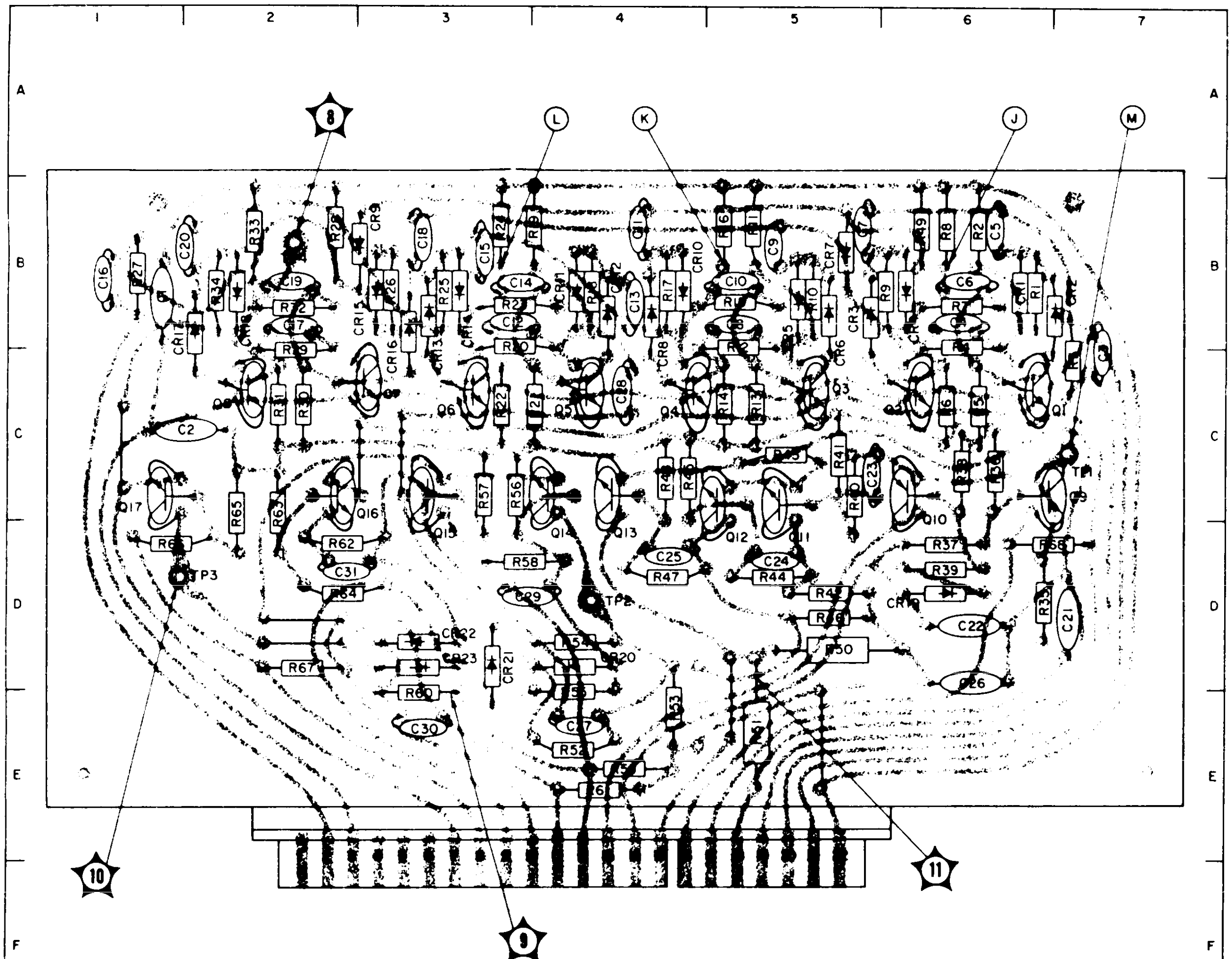
Figure 5-39. Frequency Dividers A1A2, A1A3, and A1A4, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-40

REF. DESIG.	DRAWING LOCATION
C1	1B
C2	2C
C3	7B
C4	6B
C5	6B
C6	6B
C7	5B
C8	5B
C9	5B
C10	5B
C11	4B
C12	3B
C13	4B
C14	3B
C15	3B
C16	1B
C17	2B
C18	3B
C19	2B
C20	1B
C21	7D
C22	6D
C23	5C
C24	5D
C25	4D
C26	6E
C27	4E
C28	4C
C29	3D
C30	3E
C31	2D
CR1	6B
CR2	7B
CR3	5B
CR4	6B
CR5	5B
CR6	5B
CR7	5B
CR8	4B
CR9	3B
CR10	4B
CR11	4B
CR12	4B
CR13	3B
CR14	3B
CR15	3B
CR16	3B
CR17	1B

REF. DESIG.	DRAWING LOCATION
CR18	2B
CR19	6D
CR20	4D
CR21	3D
CR22	3D
CR23	3D
Q1	7C
Q2	6C
Q3	5C
Q4	4C
Q5	4C
Q6	3C
Q7	3C
Q8	2C
Q9	7C
Q10	6C
Q11	5D
Q12	5D
Q13	4D
Q14	4D
Q15	3D
Q16	2C
Q17	1C
R1	6B
R2	6B
R3	6B
R4	7B
R5	6C
R6	6C
R7	6B
R8	6B
R9	6B
R10	5B
R11	5B
R12	5B
R13	5C
R14	5B
R15	5B
R16	5B
R17	4B
R18	4B
R19	3B
R20	3B
R21	3C
R22	3C
R23	3B
R24	3B

REF. DESIG.	DRAWING LOCATION
R25	3B
R26	3B
R27	1B
R28	2B
R29	2C
R30	2C
R31	2C
R32	2B
R33	2B
R34	2B
R35	6D
R36	6C
R37	6D
R38	6C
R39	6D
R40	5C
R41	5C
R42	5D
R43	5C
R44	5D
R45	4C
R46	5D
R47	4D
R48	4C
R49	6B
R50	5D
R51	5E
R52	4E
R53	4E
R54	4D
R55	4D
R56	3C
R57	3C
R58	3D
R59	4E
R60	3E
R61	4E
R62	2D
R63	2C
R64	2D
R65	2C
R66	1D
R67	2D
R68	6D
TP1	7C
TP2	4D
TP3	2D



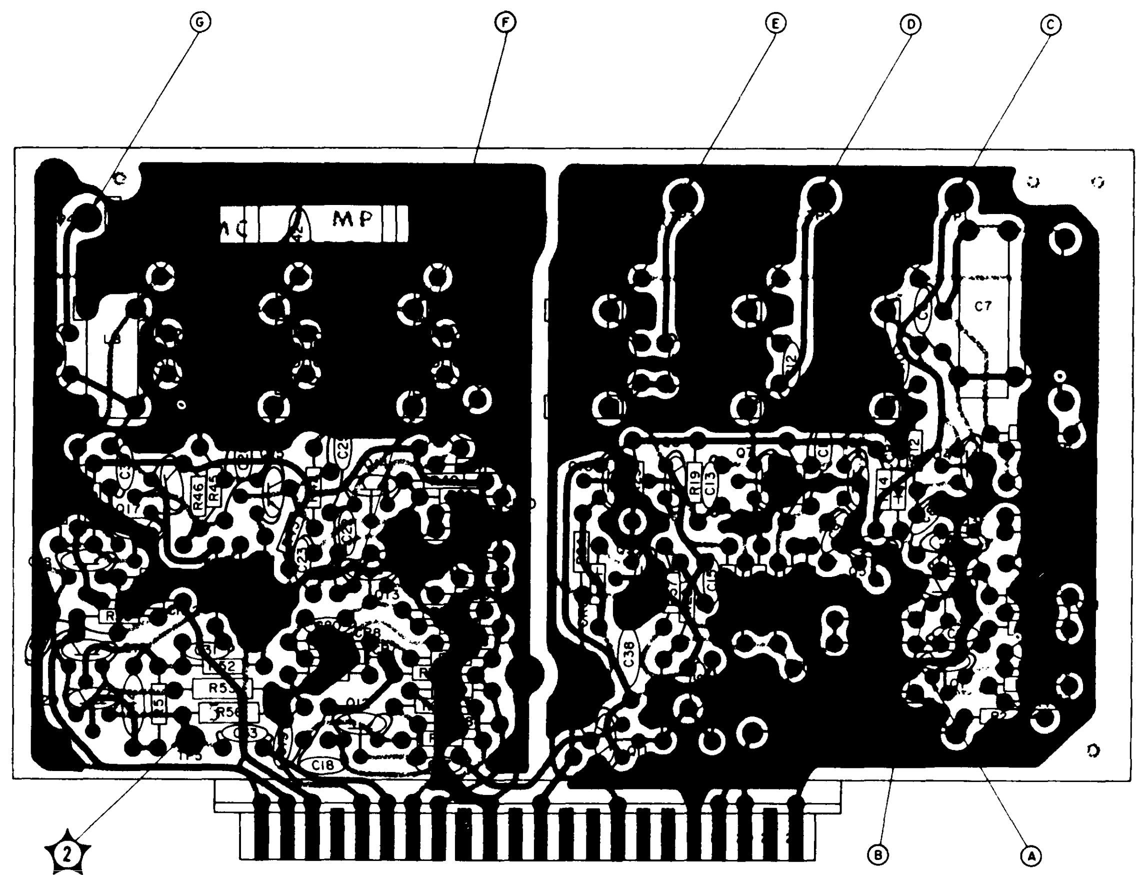
PIN	SIGNAL	CONNECTION
2	100-kc standard frequency	To A1S2-2
3	Ground	
7	Divider signal	To A1SA4-9
8	100-kc time base select (T7)	From A1S3C-2
9	1-mc time base select (T8)	From A1S3C-3
10	Ground	
11	Time base signal	From A1XA2-11, A1XA3-11, A1XA4-11
12	Selected clock signal	To A1XA8-12, A1XA10-14
13	Selected standard frequency	From A1S2-7
14	Scale "A" select (F9)	From A1S4I-12
15	Standard frequency or scale out	To A1J7
16	Scaled count signal	From A1XA12-20, A1XA13-20, A1XA14-20, A1XA15-20, A1XA16-20, A1XA17-20, A1XA18-20, A1XA19-10
17	+12 vdc	From A1XA1-15
18	Ground	
19	-12 vdc	From A1XA1-20
20	1-mc standard frequency	To A1S2-3
21	1-mc standard frequency	From A1XA6-12
22	+12 vdc	From A1XA1-18

REF DESIG PREFIX A1A5

Figure 5-40. Frequency Divider A1A5, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-41

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	6F	CR2	7E	R13	6E
C2	6E	CR3	6D	R14	6D
C3	7E	CR4	5E	R15	5E
C4	6E	CR6	4E	R16	5D
C5	7D	CR7	3E	R17	5E
C6	6C	CR8	3E	R18	5E
C7	6C	CR9	3E	R19	5D
C8	6D	CR10	3D	R20	5E
C9	5E	CR11	1D	R21	5E
C10	6D	CR12	1E	R22	5E
C11	5D	L1	7C	R23	4D
C12	5D	L2	6C	R24	4E
C13	5D	L3	5C	R25	5F
C14	4D	L4	4C	R26	5F
C15	5E	L5	3E	R27	4F
C16	5E	L6	3C	R28	3F
C17	3F	L7	2C	R29	3F
C18	3F	L8	1C	R30	3F
C19	2F	Q1	6E	R31	3F
C20	3E	Q2	6E	R32	3E
C21	3E	Q3	6E	R33	3E
C22	3E	Q4	6D	R34	3E
C23	2E	Q5	6E	R35	3E
C24	3D	Q6	6D	R36	3E
C25	3D	Q7	5D	R37	3E
C26	3D	Q8	5D	R38	3E
C27	2D	Q9	4E	R39	3D
C28	2D	Q10	4D	R40	3D
C29	2D	Q11	4F	R41	3D
C30	1D	Q12	3F	R42	2D
C31	2E	Q13	3E	R43	2E
C32	1E	Q14	3D	R44	2E
C33	2F	Q15	2D	R45	2D
C34	7E	Q16	2D	R46	2D
C35	6C	Q17	1E	R47	2E
C36	5C	Q18	1E	R48	1D
C37	4C	Q19	1E	R49	2E
C38	4E	Q20	1F	R50	1D
C39	6E	R1	6F	R51	2F
C40	3D	R2	6F	R52	2E
C41	3C	R3	7E	R53	2E
C42	2C	R4	7F	R54	2E
C43	2C	R5	7E	R55	1E
C44	1F	R6	7E	R56	2F
C45	5D	R7	6E	R57	5E
C46	1D	R8	7E	TP1	6C
C47	3D	R9	7D	TP2	5C
C48	2D	R10	7D	TP3	5C
C49	2D	R11	7D	TP4	1C
CR1	7E	R12	6D	TP5	2F



To gain access to shielded parts, remove 6 nuts, flat washers, and lock washers which fasten shield MP1 (figure 5-2).

PIN	SIGNAL	CONNECTION
1	Ground	
2	10-mc standard frequency	To A1S2-4
3	10-mc test signal	To A1XA8-16*
5	Ground	
6	10-mc standard frequency	To A1J9-16
7	-12 v	From A1XA1-20
8	+12 v	From A1XA1-15
10	Ground	
12	1-mc standard frequency	To A1XA5-20
15	Ground	
18	Ground	
19	-12 v	From A1XA1-20
20	100-kc or 1-mc reference frequency	From A1S13
22	+12 v	From A1XA1-15

REF DESIG PREFIX A1A6

*Through A1R49.

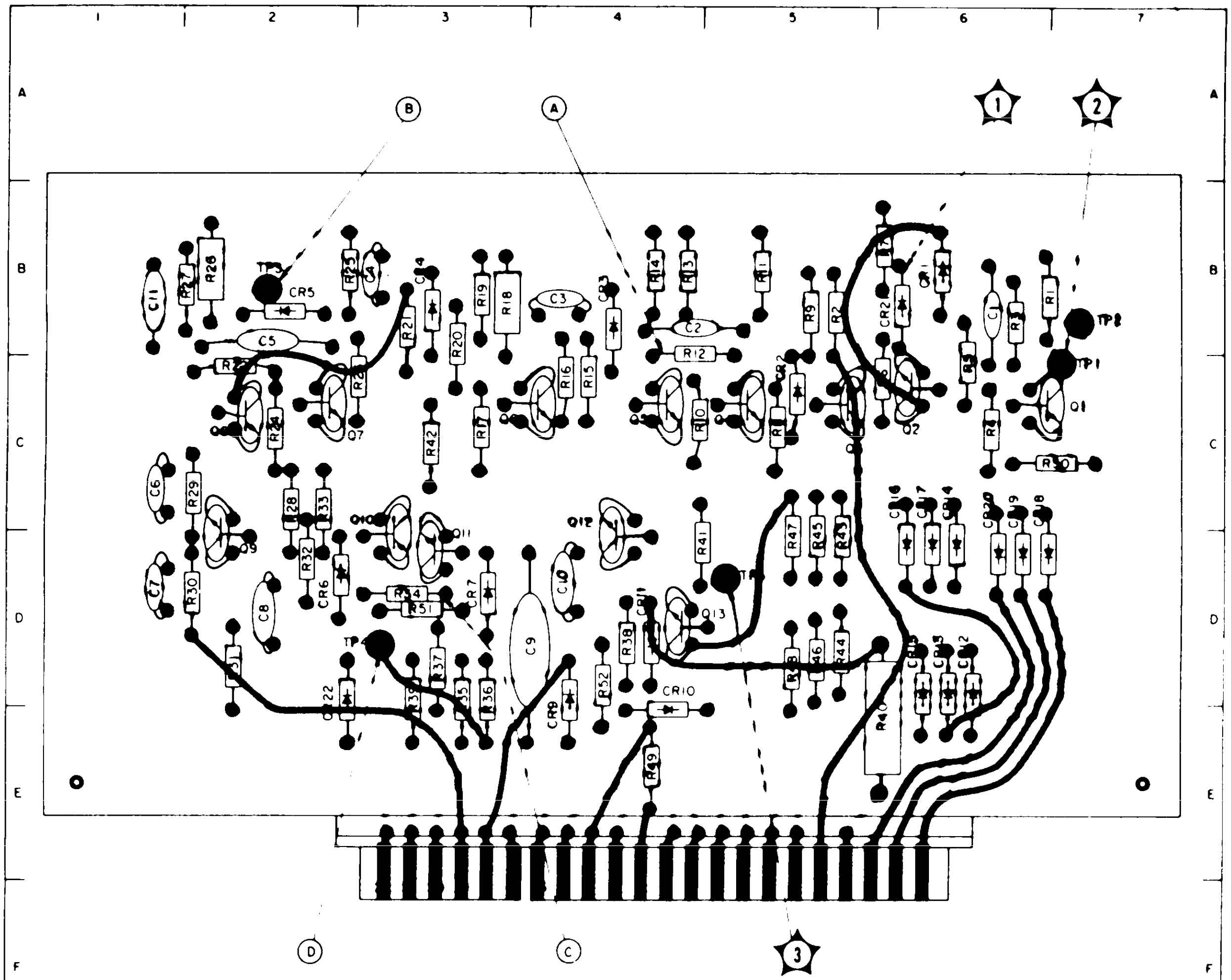
Figure 5-41. Frequency Multiplier A1A6, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-42

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	6B	Q3	5C	R24	2C
C2	4B	Q4	5C	R25	2B
C3	4B	Q5	4C	R26	2B
C4	3B	Q6	4C	R27	2B
C5	2B	Q7	2C	R28	2C
C6	1C	Q8	2C	R29	2C
C7	1D	Q9	2D	R30	2D
C8	2D	Q10	3C	R31	2D
C9	4D	Q11	3D	R32	2D
C10	4D	Q12	4C	R33	2D
C11	1B	Q13	5D	R34	3D
CR1	6B	R1	7B	R35	3D
CR2	5C	R2	5B	R36	3D
CR3	4B	R3	6B	R37	3D
CR4	3B	R4	6C	R38	4D
CR5	2B	R5	6C	R39	3D
CR6	2D	R6	6C	R40	6D
CR7	3D	R7	6B	R41	5D
CR9	4D	R8	5C	R42	3C
CR10	4D	R9	5B	R43	5D
CR11	4D	R10	5C	R44	5D
CR12	6D	R11	5B	R45	5D
CR13	6D	R12	4C	R46	5D
CR14	6C	R13	4B	R47	5D
CR15	6D	R14	4B	R48	5D
CR16	6C	R15	4C	R49	4E
CR17	6C	R16	4C	R50	7C
CR18	7C	R17	3C	R51	3D
CR19	3C	R18	3B	R52	4D
CR20	6C	R19	3B	TP1	7C
CR21	6B	R20	3B	TP2	7B
CR22	2D	R21	3B	TP3	2B
Q1	7C	R22	2C	TP4	3D
Q2	6C	R23	3C	TP5	5D

DESTINATION INFORMATION FOR FIGURE 5-42

PIN	SIGNAL	CONNECTION
1	From decimal point lamp	From A1DS6
2	From decimal point lamp	From A1DS5
3	From decimal point lamp	From A1DS4
5	Print command	To A1J11-v
20	Reset inhibit	To A1J11-S
A	From decimal point lamp	From A1DS9
B	From decimal point lamp	From A1DS7
C	From decimal point lamp	From A1DS8
D	+45 v	From A1XA1-13
E	To GATE lamp	To A1DS2
F	Memory clear set	To A1XA12-6, A1XA13-6, A1XA14-6, A1XA15-6, A1XA16-6, A1XA17-6, A1XA18-6, A1XA19-6
H	Memory transfer	To A1XA12-7, A1XA13-7, A1XA14-7, A1XA15-7, A1XA16-7, A1XA17-7, A1XA18-7, A1XA19-7
J, 8	BCD "1" output	A1J11-g
K, 9	BCD "2" output	To A1J11-c
L, 10	BCD "4" output	To A1J11-b
M, 11	Ground	
N, 12	BCD "8" output	To A1J11-x



Numbered terminals are on side of board on which parts are mounted.
Lettered terminals are on reverse side.

DESTINATION INFORMATION (Continued)

PIN	SIGNAL	CONNECTION
P	-12 v	From A1XA1-20
R	+12 v	From A1XA1-15
S	Manual gate	From A1XA10-18
T	Reset	To A1XA2-16, A1XA2-17, A1XA3-16, A1XA3-17, A1XA4-15, A1XA4-17, A1XA9-4, A1XA9-14, A1XA10-7, A1XA12-16, A1XA13-16, A1XA14-16, A1XA15-16, A1XA16-16, A1XA17-16, A1XA18-16, A1XA19-16
U	From RESET switch	From A1S6
V	Memory control	From A1S1
W	Gate signal	From A1XA10-1
X	From DISPLAY control	From A1S5
Y	From DISPLAY control	From A1R1
Z	+6 v	From A1XA1-18

REF DESIG PREFIX A1A7

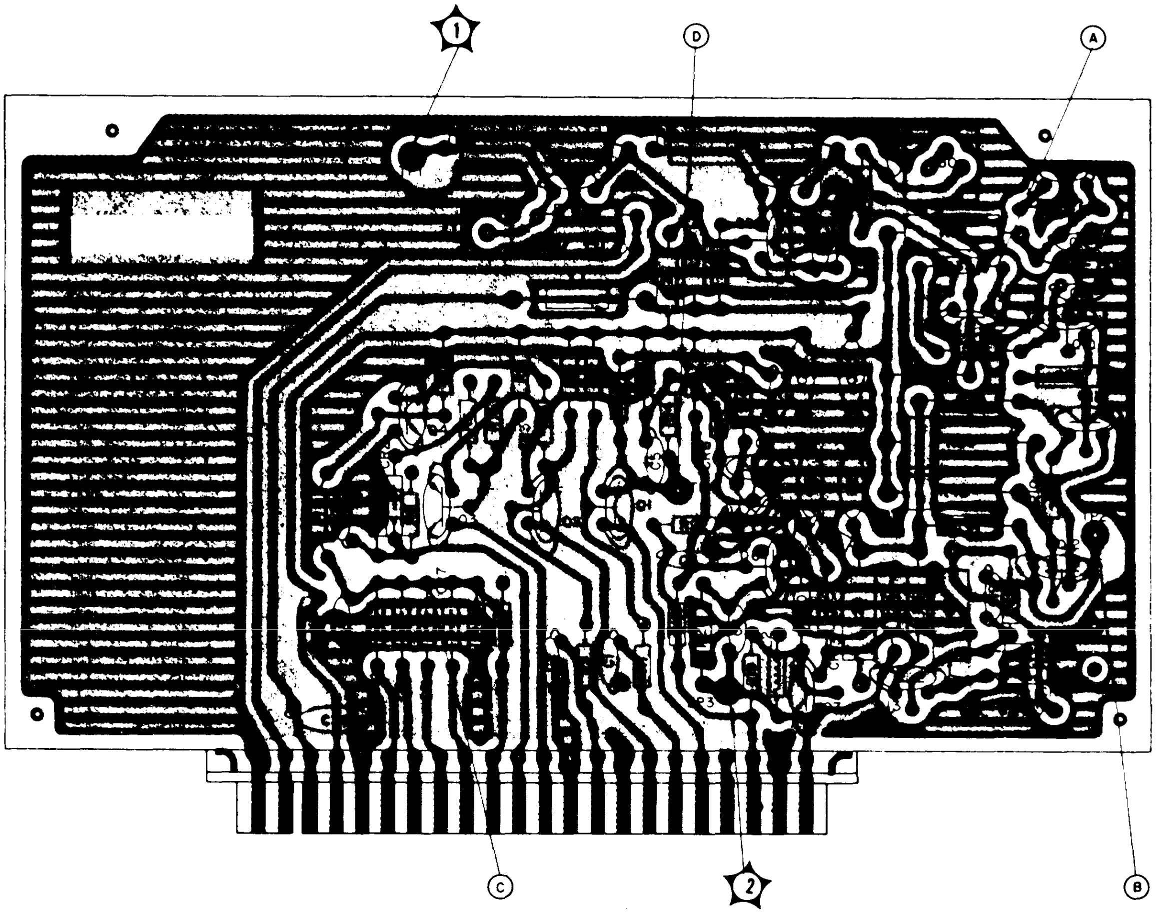
Figure 5-42. Display Control A1A7, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-43

REF. DESIG.	DRAWING LOCATION
C1	4E
C2	4E
C3	3D
C4	3E
C5	4D
C6	5C
C7	5E
C8	5D
C9	4B
C10	4B
C11	4C
C12	5B
C13	6B
C14	5B
C15	5B
C16	7B
C17	7B
C18	7C
C19	6E
C20	6C
C21	6D
C22	5D
C23	5C
C24	6E
C25	2E
C26	2E
CR1	4E
CR2	3D
CR3	4D
CR4	3E
CR5	3E
CR6	3E
CR7	3D
CR8	5D
CR9	7C

REF. DESIG.	DRAWING LOCATION
CR10	7D
CR11	7E
CR12	7E
CR13	5D
E5	4B
E6	3B
J1	3B
L1	4C
L2	5E
Q1	4D
Q2	4D
Q3	3D
Q4	3D
Q5	5D
Q6	5D
Q7	5E
Q8	5B
Q9	6C
Q10	7C
Q11	7C
Q12	7D
Q13	6E
Q14	5D
R1	4E
R2	4C
R3	4E
R4	4C
R5	4C
R6	3C
R7	3C
R8	3D
R9	3D
R10	3E
R11	3D
R12	3C
R13	4C

REF. DESIG.	DRAWING LOCATION
R14	4C
R15	4C
R16	5C
R17	5C
R18	5E
R19	5E
R20	5E
R21	5E
R22	5D
R23	5E
R24	6E
R25	4B
R26	5C
R27	4C
R28	5C
R29	5B
R30	6B
R31	6B
R32	6C
R33	6C
R34	7B
R35	6B
R36	6C
R37	7C
R38	6C
R39	6D
R40	6D
R41	6D
R42	6E
R43	6E
R44	6E
R45	5D
TP1	3B
TP2	7D
TP3	5E
TP4	5D



PIN	SIGNAL	CONNECTION
1	Ground	
2	+6.3 v	From A1A20
3	+12 v	From A1XA1-15
4	-12 v	From A1XA1-20
5	Ground	
6	Frequency select (F8)	From A1S4I-11
7	Scale "A" select (F9)	From A1S4I-12
8	Manual start select (F11)	From A1S4I-2
9	Ratio A/B x M select (T10)	From A1S3C-5
10	Combined select	To A1A21S7

PIN	SIGNAL	CONNECTION
11	10-mc time base select (T4)	From A1S3C-4
12	Selected clock signal	From A1XA5-12
13	Ground	
14	Test select	From A1A21S7
15	Ground	
16	10 mc test signal	From A1XA6-3*
17	"C" signal select	From A1A21S7
18	"C" signal	From A1XA11-15
19	+6 v	From A1XA1-18
20	"A" signal select	From A1A21S7
21	Ground	
22	Count signal	To A1XA9-22

*Through A1R49.

REF DESIG PREFIX A1A8

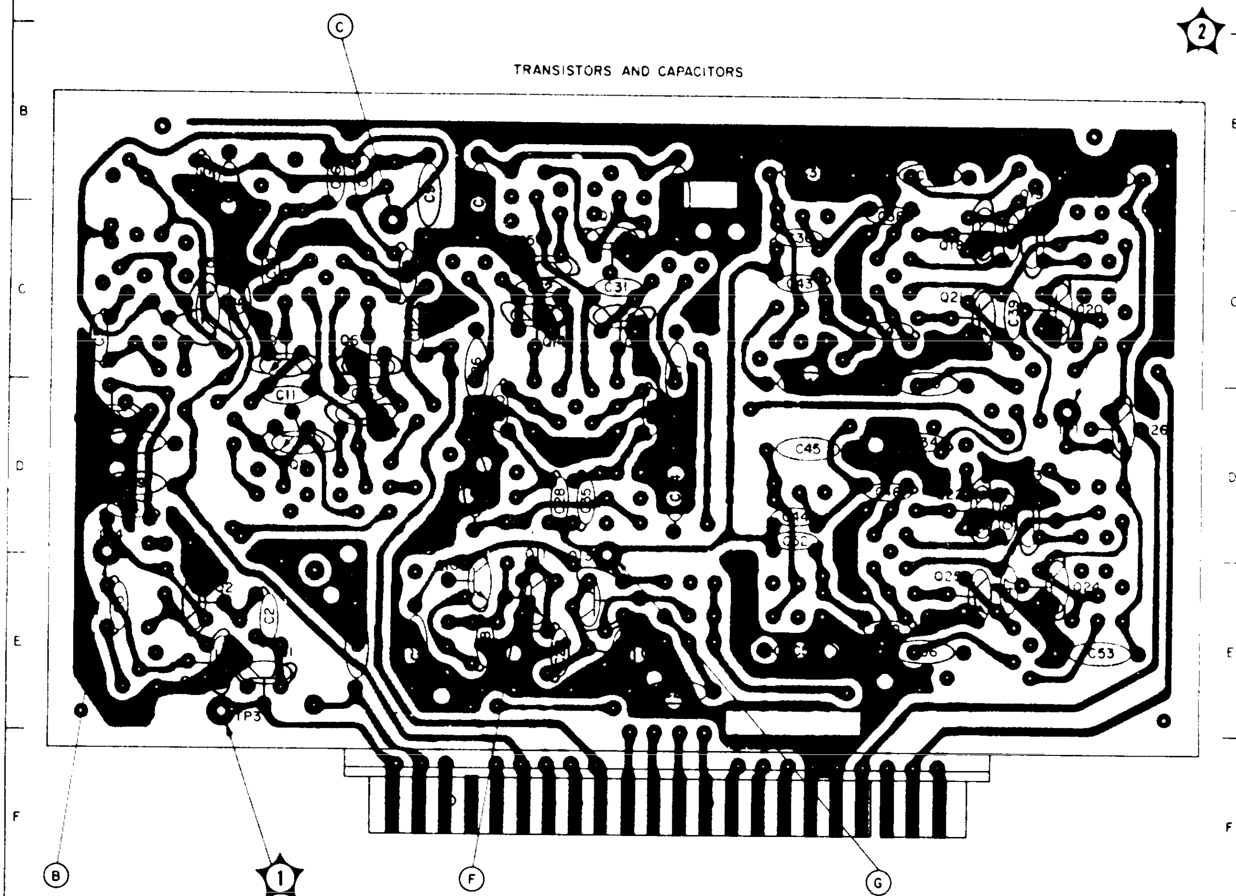
Figure 5-43. AF-RF Amplifier A1A8, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-44, SHEET 1

REF. DESIG.	DRAWING LOCATION
C1	2E
C2	2E
C3	1E
C4	1D
C5	1C
C6	2C
C7	1D
C8	2B
C9	3B
C10	3C
C11	2D
C12	3C
C13	2D
C14	2C
C15	2B
C16	2B
C17	2B
C18	3E
C19	1D
C20	3E
C21	3B
C22	4E
C23	4E
C24	4B
C25	7B
C26	3C
C27	4C
C28	3D
C29	3D

REF. DESIG.	DRAWING LOCATION
C30	3D
C31	4C
C32	3C
C33	4D
C34	6D
C35	4D
C36	5C
C37	5B
C38	5C
C39	6C
C40	6C
C41	5C
C42	5C
C43	5C
C44	5D
C45	5D
C46	5D
C47	6E
C48	6D
C49	6E
C50	6C
C51	6B
C52	5D
C53	7E
C54	4D
C55	5E
C56	6E
Q1	2E

REF. DESIG.	DRAWING LOCATION
Q2	2E
Q3	2E
Q4	1D
Q5	2C
Q6	2C
Q7	3D
Q8	2D
Q9	2C
Q10	3E
Q11	3E
Q12	4E
Q13	4E
Q14	3C
Q15	3C
Q16	4C
Q17	4C
Q18	6C
Q19	6B
Q20	7C
Q21	6C
Q22	6D
Q23	6D
Q24	7E
Q25	6E
Q26	7D
TP1	6D
TP3	2E
TP4	1D



PIN	SIGNAL	CONNECTION
1	Output	To A1XA19-8
2	BCD "4" output	To A1XA19-20
3	BCD "8" output	To A1XA19-22
4	Reset	From A1XA7-T
5	Ground	
6	Ground	
7	-6 v	From A1XA10-21
8	+6 v	From A1XA1-18
9	BCD "2" output	To A1XA19-21

PIN	SIGNAL	CONNECTION
14	Reset	From A1XA7-T
15	BCD "1" output	From A1XA19-19
16	Ground	
17	-6 v	From A1XA10-21
18	+6 v	From A1XA1-18
20	Gate control signal	From A1XA10-22
21	+12 v	From A1XA1-15
22	Count signal	From A1XA8-22

Figure 5-44. Frequency Divider A1A9, Location of Parts (Sheet 1 of 2)

PARTS LOCATION INDEX FOR FIGURE 5-44, SHEET 2

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
CR1	1D	CR44	7B	R7	2C	R47	4B
CR2	1E	CR47	6C	R8	2C	R48	4B
CR3	2D	CR48	5C	R9	1B	R49	4C
CR4	1C	CR49	5B	R10	1B	R50	4C
CR5	2C	CR50	5C	R11	1B	R51	5B
CR6	1B	CR51	5C	R12	1B	R52	5B
CR7	2B	CR52	5D	R13	2B	R53	6B
CR8	1B	CR53	5C	R14	2B	R54	7B
CR9	2B	CR54	5D	R15	3B	R55	6B
CR10	3B	CR55	7D	R16	2B	R56	7B
CR11	3C	CR56	7D	R17	3C	R57	7B
CR12	3C	CR57	7D	R18	3D	R58	6C
CR13	2C	CR58	7D	R19	3D	R59	6B
CR14	2B	CR61	6D	R20	3C	R60	7C
CR15	2B	CR62	5D	R21	2B	R61	7C
CR16	2C	CR63	5D	R22	2D	R62	6C
CR17	2C	L1	1C	R23	2D	R63	5B
CR18	2C	L2	1B	R24	2B	R64	5B
CR19	2B	L3	3B	R25	2D	R65	5B
CR20	2B	L4	3C	R26	2B	R66	5D
CR21	3D	L5	2D	R27	2B	R67	5C
CR22	4E	L6	2C	R28	3E	R68	5D
CR23	4D	L7	2B	R29	3D	R69	6C
CR24	3C	L9	3C	R30	3E	R70	7C
CR25	4D	L10	3B	R31	4D	R71	6D
CR26	3C	L11	4B	R32	5D	R72	7D
CR27	3B	L12	4C	R33	5D	R73	7D
CR28	4B	L13	6B	R34	4D	R74	6C
CR29	4B	L14	7B	R35	4D	R75	6D
CR30	4B	L15	6C	R36	4D	R76	7D
CR31	4B	L17	6D	R37	3D	R77	6E
CR34	4B	L18	6C	R38	4C	R78	6D
CR35	4C	L19	7D	R39	3B	R79	5D
CR36	4C	L20	6D	R40	3B	R80	5D
CR37	5B	R1	2D	R41	4C	R81	6C
CR38	5B	R2	2D	R42	4B	R82	2C
CR39	5B	R3	2D	R43	4B	R83	4D
CR40	6B	R4	1D	R44	3B	R84	4D
CR41	7B	R5	2D	R45	4C	R85	5C
CR42	7B	R6	2E	R46	4B	R86	5D
CR43	7B						

CR64 1D

L21 4D

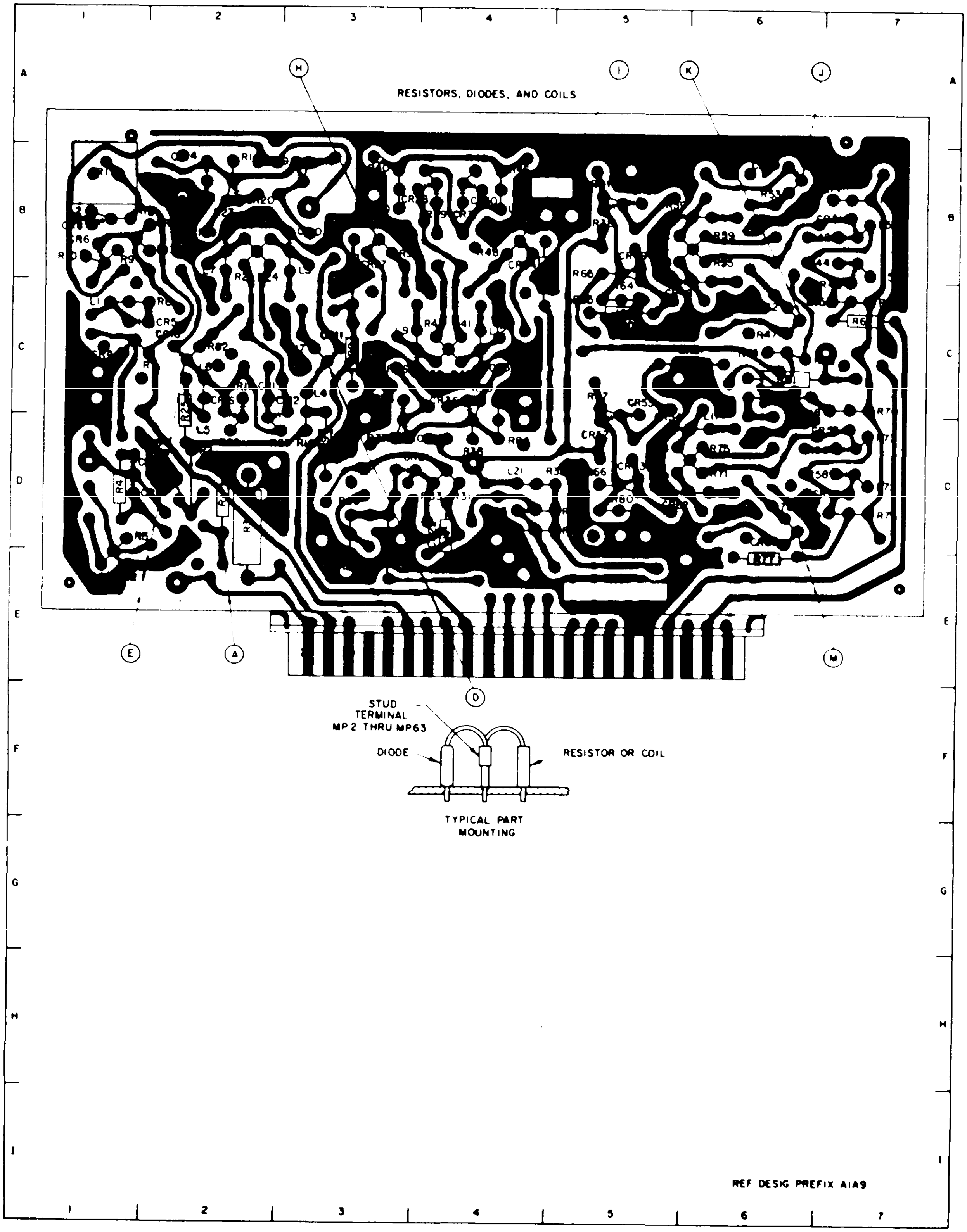
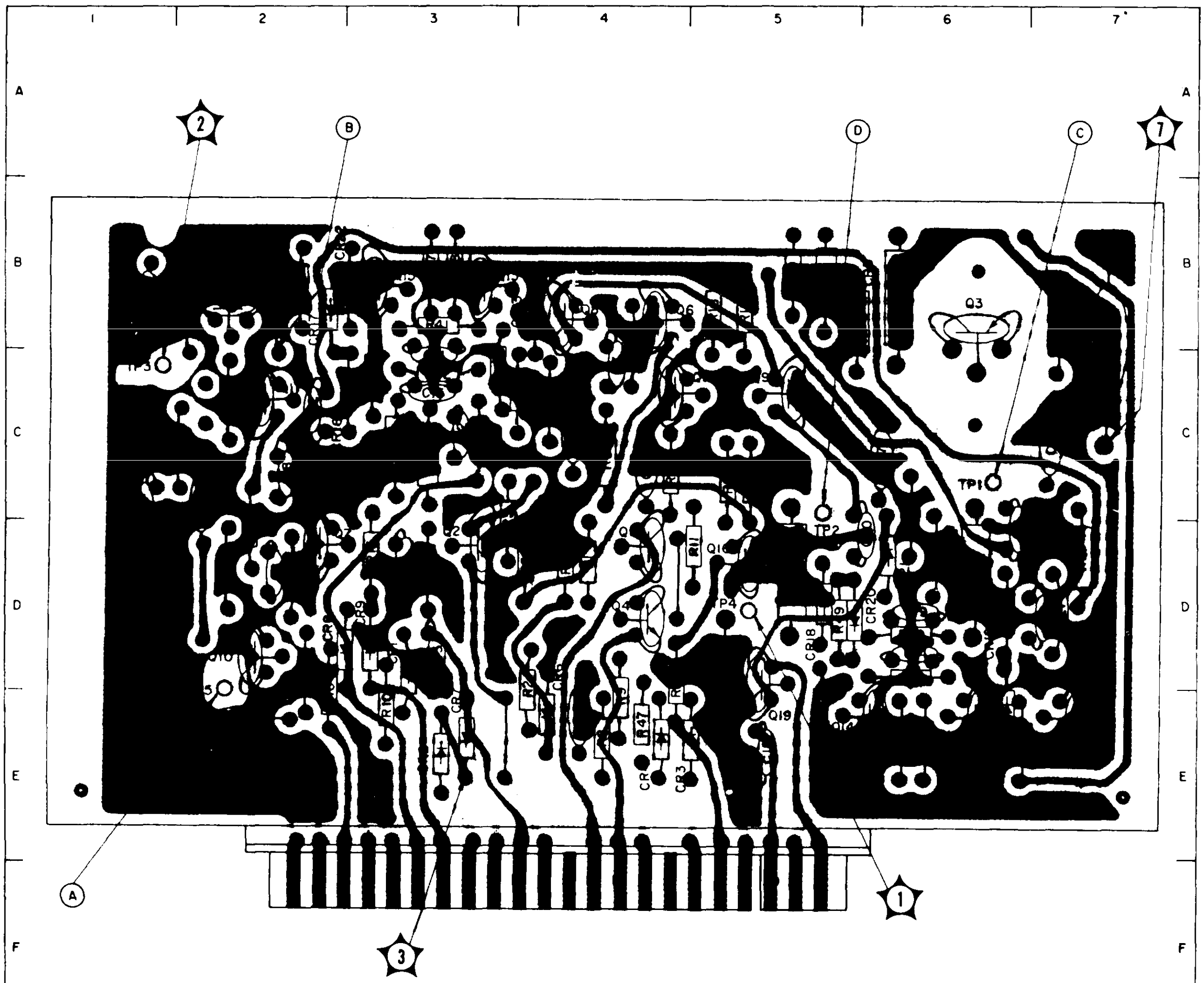


Figure 5-44. Frequency Divider A1A9, Location of Parts (Sheet 2 of 2)

PARTS LOCATION INDEX FOR FIGURE 5-45

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	4C	CR8	2D	Q17	2C	R29	6D
C2	7B	CR9	3D	Q18	2B	R30	3C
C3	3D	CR10	6D	Q19	5E	R31	3C
C4	4E	CR11	6E	R1	4D	R32	3C
C5	3D	CR12	6D	R2	4E	R33	6D
C6	1D	CR13	3B	R3	3D	R34	6E
C7	4C	CR14	4C	R4	5B	R35	6E
C8	2D	CR15	3C	R5	7B	R36	6D
C9	2C	CR16	2C	R6	6B	R37	3B
C10	7D	CR17	2B	R7	3D	R38	3B
C11	6D	CR18	5D	R8	4E	R39	4C
C12	3C	CR20	6D	R9	4D	R40	6D
C13	7C	CR21	6D	R10	3E	R41	3B
C14	6D	CR22	2B	R11	4D	R42	3C
C15	3C	CR23	2B	R12	5C	R43	2C
C16	5E	Q1	4D	R13	3D	R44	1C
C17	6C	Q2	3D	R14	4C	R45	5D
C18	2C	Q3	6B	R15	5B	R46	4D
C19	6D	Q4	4D	R16	2E	R47	4E
C20	5D	Q5	5C	R17	4C	R48	3C
C21	3C	Q6	4B	R18	5B	R49	5D
C22	2C	Q7	2D	R19	5B	R50	2B
C24	4C	Q8	4B	R20	5C	R51	2B
C25	1B	Q9	5C	R21	2D	R52	5D
C26	2E	Q10	2D	R22	2D	R53	4D
CR1	3D	Q11	7E	R23	4C	R54	4D
CR2	3E	Q12	6E	R24	2D	TP1	6C
CR3	4E	Q13	3B	R25	2D	TP2	5D
CR4	4E	Q14	5E	R26	7D	TP3	1C
CR5	5B	Q15	3B	R27	7D	TP4	5D
CR6	4D	Q16	5D	R28	6E	TP5	2E
CR7	3E						



PIN	SIGNAL	CONNECTION
1	Gate signal	To A1XA7-W
2	+45 v	From A1XA1-13
3	-12 v	From A1XA1-20
4	+12 v	From A1XA1-15
5	Ground	
6	Manual stop select (F10)	From A1S4I-1
7	Reset	From A1XA7-T
8	Period "B" select (F1)	From A1S4I-4
9	"B" signal select (F1 + F7)	To A1XA2-1
10	Time "B" "C" select (F7)	From A1S4I-10

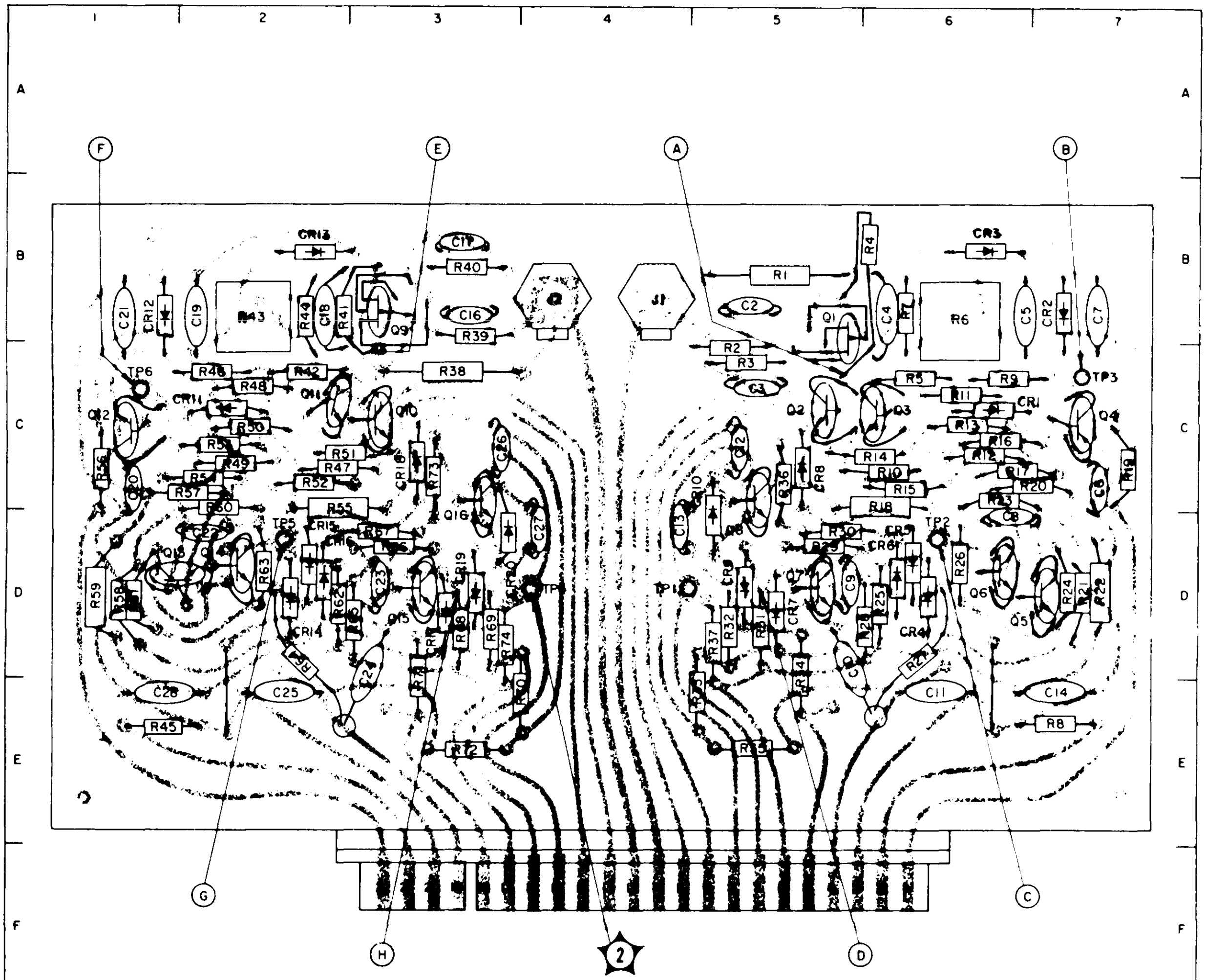
PIN	SIGNAL	CONNECTION
11	"C" signal	From A1XA11-15
13	Multiple "B" signal	From A1XA2-7
14	Selected clock signal	From A1XA5-12
15	Frequency select (F8)	From A1S4I-11
17	Manual start select (F11)	From A1S4I-2
18	Manual gate	To A1XA7-8
19	Scale "A" select (F9)	From A1S4I-12
20	+6 v	From A1XA1-18
21	-6 v	To A1XA9-7, A1XA9-17
22	Gate control signal	To A1XA9-20

REF DESIG PREFIX A1A10

Figure 5-45. Electronic Gate A1A10, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-46

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C2	5B	CR11	2C	R9	6C	R45	1E
C3	5C	CR12	1B	R10	6C	R46	2C
C4	6C	CR13	2B	R11	6C	R47	2C
C5	7B	CR14	2D	R12	6C	R48	2C
C6	7C	CR15	2D	R13	6C	R49	2C
C7	7B	CR16	2D	R14	6C	R50	2C
C8	6D	CR17	3D	R15	6C	R51	3C
C9	5D	CR18	3C	R16	6C	R52	2C
C10	5D	CR19	3D	R17	6C	R53	2C
C11	6E	CR20	3D	R18	6C	R54	2C
C12	5C	J1	4B	R19	7C	R55	2D
C13	5D	J2	4B	R20	6C	R56	1C
C14	7E	Q1	5B	R21	7D	R57	2C
C16	3B	Q2	5C	R22	7D	R58	1D
C17	3B	Q3	6C	R23	6C	R59	1D
C18	2B	Q4	7C	R24	7D	R60	2C
C19	2B	Q5	7D	R25	6D	R61	1D
C20	1C	Q6	6D	R26	6D	R62	3D
C21	1B	Q7	5D	R27	6D	R63	2D
C22	2D	Q8	5D	R28	6D	R64	2D
C23	3D	Q9	3B	R29	5D	R65	3D
C24	3D	Q10	3C	R30	5D	R66	3D
C25	2E	Q11	2C	R31	5D	R67	3D
C26	3C	Q12	1C	R32	5D	R68	3D
C27	4D	Q13	2D	R33	5E	R69	3D
C28	1E	Q14	2D	R34	5D	R70	3E
CR1	7C	Q15	3D	R35	5E	R71	3E
CR2	7B	Q16	3D	R36	5C	R72	3E
CR3	6B	R1	5C	R37	5D	R73	3C
CR4	6D	R2	5C	R38	3B	R74	3D
CR5	6D	R3	5C	R39	3C	TP1	5D
CR6	6D	R4	6B	R40	3B	TP2	6D
CR7	5D	R5	6C	R41	3B	TP3	7C
CR8	5C	R6	6B	R42	2C	TP4	4D
CR9	5D	R7	6B	R43	2B	TP5	2D
CR10	5C	R8	7E	R44	2B	TP6	1C



PIN	SIGNAL	CONNECTION
1	To B TRIGGER VOLTS control	To A1A22R33
2	To B TRIGGER VOLTS control	To A1A22R33
3	Ground	
4	To B slope switch	To A1S10
5	To B slope switch	To A1S10
6	+12 v	From A1XA1-15
7	+6 v	From A1XA1-18
8	"B" signal	To A1XA2-13, A1XA3-13, A1XA4-13
9	-12 v	From A1XA1-20
10	To B TRIGGER VOLTS control	To A1A22R33

PIN	SIGNAL	CONNECTION
13	To C TRIGGER VOLTS control	To A1A23R46
14	-12 v	From A1XA1-20
15	"C" signal	To A1XA10-11, A1XA8-18
16	+6 v	From A1XA1-18
17	+12 v	From A1XA1-15
18	To C SLOPE switch	To A1S12
19	To C SLOPE switch	To A1S12
20	Ground	
21	To C TRIGGER LEVEL control	To A1A23R46
22	To C TRIGGER LEVEL control	To A1A23R46

REF DESIG PREFIX A1A11

Figure 5-46. AF-RF Amplifier AlAll, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-47

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	4D	CR4	4F	CR25	3C	R2	5G	R23	3G	R44	4E	R65	3D
C2	4D	CR5	2H	CR26	3B	R3	5G	R24	3G	R45	4D	R66	2E
C3	3D	CR6	2H	DS1	6I	R4	5G	R25	2H	R46	4E	R67	2D
C4	3D	CR7	2H	Q1	4F	R5	5F	R26	2G	R47	4D	R68	2D
C5	4C	CR8	2H	Q2	4G	R6	5H	R27	3G	R48	4D	R69	2D
C6	4C	CR8	1G	Q3	4F	R7	4F	R28	3G	R49	4D	R70	2D
C7	4C	CR9	3G	Q4	4G	R8	4G	R29	2F	R50	4D	R71	3D
C8	3C	CR10	2H	Q5	3H	R9	4G	R30	2F	R51	3E	R72	3C
C9	3D	CR11	3G	Q6	1G	R10	4G	R31	3F	R52	3D	R73	2C
C10	3D	CR12	2F	Q7	1G	R11	3F	R32	3F	R53	3C	R74	2B
C11	2D	CR13	2F	Q8	2F	R12	3G	R33	2F	R54	4C	R75	3B
C12	3D	CR14	3F	Q9	2E	R13	5F	R34	2F	R55	4C	R76	3C
C13	3C	CR15	3F	Q10	4E	R16	5F	R35	3E	R56	4C	R77	2C
C14	3C	CR16	3E	Q11	4D	R17	2H	R36	3F	R57	4B	R78	2B
C15	2C	CR17	3E	Q12	4C	R18	2H	R37	3G	R58	4B	R79	2B
C16	3C	CR18	3D	Q13	4C	R19	3H	R38	4C	R59	3C	R80	2C
C17	4D	CR19	3C	Q14	2E	R20	3H	R39	2C	R60	4B	R81	2B
C18	4C	CR20	4B	Q15	2D	R21	2G	R40	2E	R61	3B	R82	3B
C19	3B	CR21	3D	Q16	2C	R22	2G	R41	4E	R62	4C	R83	3B
CR1	4G	CR22	3C	Q17	2B			R42	4E	R63	3E	TP1	2E
CR2	4G	CR23	3E	Q18	3B			R43	4E	R64	2E	TP2	4E
CR3	4F	CR24	3D	R1	5F							XDS1	6I

DESTINATION INFORMATION FOR FIGURE 5-47

PIN	SIGNAL	CONN A1A12	CONN A1A13	CONN A1A14	CONN A1A15	CONN A1A16
1	+180 v	From A1XA1-5	From A1XA1-5	From A1XA1-5	From A1XA1-5	From A1XA1-5
4	+45 v	From A1XA1-13	From A1XA1-13	From A1XA1-13	From A1XA1-13	From A1XA1-13
5	Cathode bias voltage	From A1XA19-5	From A1XA19-5	From A1XA19-5	From A1XA19-5	From A1XA19-5
6	Memory clear set	From A1XA7-F	From A1XA7-F	From A1XA7-F	From A1XA7-F	From A1XA7-F
7	Memory transfer	From A1XA7-H	From A1XA7-H	From A1XA7-H	From A1XA7-H	From A1XA7-H
8	Count signal	From A1XA13-9	From A1XA14-9	From A1XA15-9	From A1XA16-9	From A1XA17-9
9	Count signal	Not used	To A1XA12-8	To A1XA13-8	To A1XA14-8	To A1XA15-8
11	Ground					
12	BCD "1" output	To A1J11-(j)	To A1J11-P	To A1J11-(h)	To A1J11-(z)	To A1J11-F
13	-12 v	From A1XA1-20	From A1XA1-20	From A1XA1-20	From A1XA1-20	From A1XA1-20
14	+12 v	From A1XA1-15	From A1XA1-15	From A1XA1-15	From A1XA1-15	From A1XA1-15
15	BCD "2" output	To A1J11-(a)	To A1J11-L	To A1J11-(e)	To A1J11 - (w)	To A1J11-E
16	Reset	From A1XA7-T	From A1XA7-T	From A1XA7-T	From A1XA7-T	From A1XA7-T
17	BCD "4" output	To A1J11-V	To A1J11-K	To A1J11-(d)	To A1J11-(t)	To A1J11-D
18	BCD "8" output	To A1J11-R	To A1J11-H	To A1J11-Z	To A1J11-(r)	To A1J11-A
20	Scaled count signal	To A1XA5-16	To A1XA5-16	To A1XA5-16	To A1XA5-16	To A1XA5-16
21	Scaled count signal select	From A1S3C-5	From A1S3C-4	From A1S3C-3	From A1S3C-2	From A1S3C-1

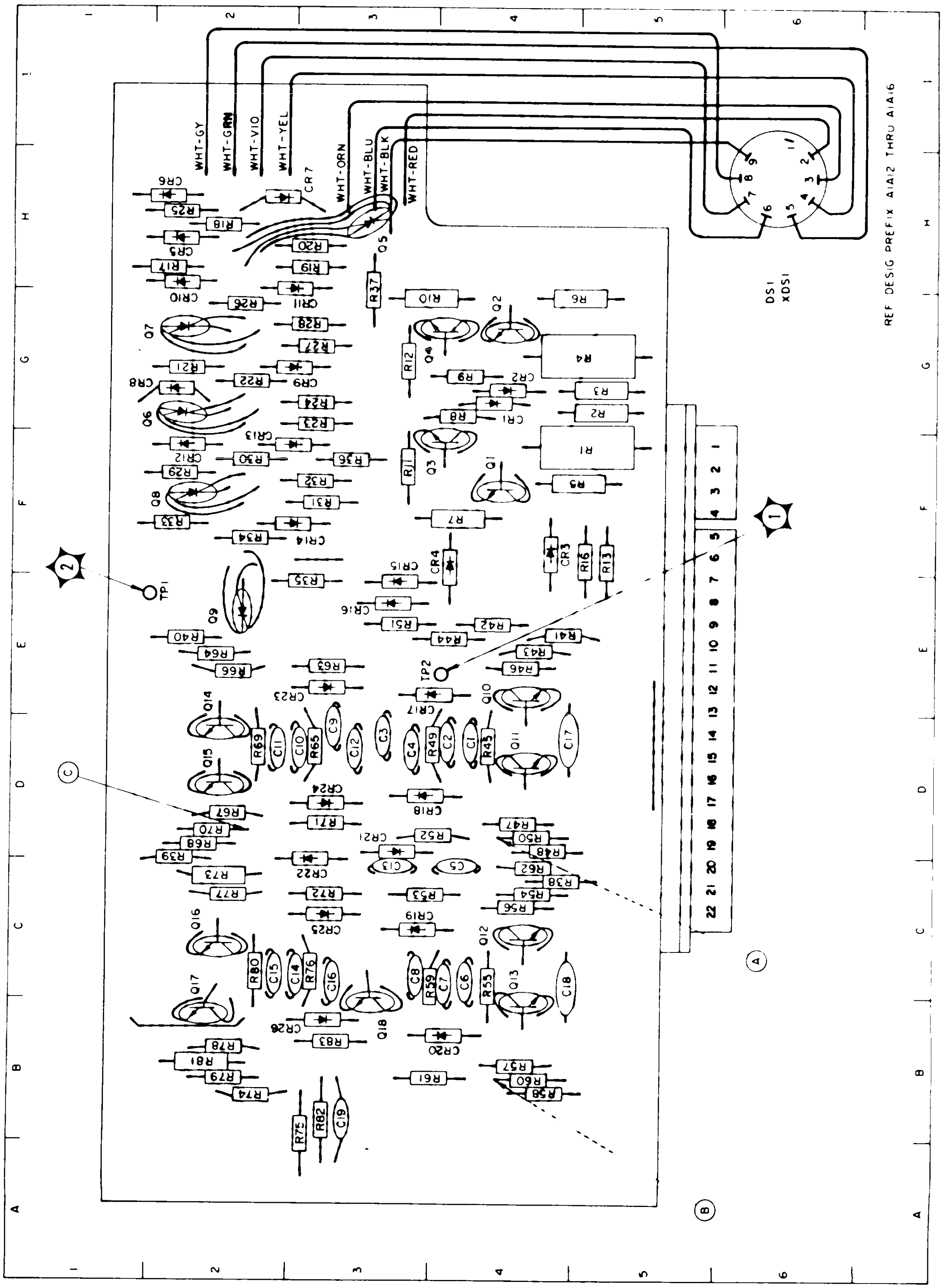


Figure 5-47. Digital Display Indicators - Frequency Dividers A1A12, A1A13, A1A14, A1A15, and A1A16, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-48

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	4D	CR6	1H	CR30	4B	Q11	4D	R17	2H	R40	2E	R63	3E
C2	4D	CR7	2H	CR31	2E	Q12	4C	R18	2H	R41	5E	R64	2E
C3	3D	CR8	1G	CR32	3E	Q13	4C	R19	3H	R42	4E	R65	3D
C4	3D	CR9	3G	CR33	2E	Q14	2D	R20	3H	R43	4E	R66	2E
C5	4C	CR10	2G	CR34	2D	Q15	2D	R21	2G	R44	4E	R67	2D
C6	4C	CR11	3G	CR35	3D	Q16	2C	R22	2G	R45	4D	R68	2D
C7	4C	CR12	2F	CR36	2D	Q17	2B	R23	3G	R46	4E	R69	2D
C8	3C	CR13	2F	CR37	2C	Q18	3C	R24	3G	R47	4D	R70	2D
C9	3D	CR14	3F	CR38	3C	R1	5F	R25	2H	R48	5C	R71	3D
C10	3D	CR15	4F	CR39	2C	R2	5G	R26	2G	R49	3D	R72	3C
C11	3D	CR16	3E	CR40	2B	R3	5G	R27	3G	R50	4D	R73	2C
C12	3D	CR17	3E	CR41	2B	R4	5G	R28	3G	R51	3F	R74	2B
C13	3C	CR18	3E	CR42	3B	R5	5F	R29	2F	R52	3D	R75	3B
C14	3C	CR19	4E	DS1	6I	R6	5G	R30	2F	R53	3C	R76	3C
C15	2C	CR20	4D	Q1	4F	R7	4F	R31	3F	R54	4C	R77	2C
C16	3C	CR21	3D	Q2	4G	R8	4G	R32	3F	R55	4C	R78	2B
C17	4D	CR22	3D	Q3	4F	R9	4G	R33	2F	R56	4C	R79	2B
C18	4B	CR23	3C	Q4	4G	R10	4G	R34	2F	R57	4B	R80	2C
C19	3B	CR24	3C	Q5	3H	R11	3F	R35	3E	R58	4B	R81	2B
CR1	4G	CR25	4C	Q6	2G	R12	3G	R36	3F	R59	4C	R82	3B
CR2	4G	CR26	4B	Q7	2G	R13	5F	R37	3H	R60	4B	R83	3B
CR3	5F	CR27	4B	Q8	2F	R16	5F	R38	5C	R61	4B	TP1	1E
CR4	4F	CR28	3C	Q9	2E			R39	2C	R62	4C	TP2	4E
CR5	2H	CR29	2C	Q10	4D							XDS1	6I

DESTINATION INFORMATION FOR FIGURE 5-48

PIN	SIGNAL	CONNECTION	
		A1A17	A1A18
1	+180 v	From A1XA1-5	From A1XA1-5
4	+45 v	From A1XA1-13	From A1XA1-13
5	Cathode bias voltage	From A1XA19-5	From A1XA19-5
6	Memory clear set	From A1XA7-F	From A1XA7-F
7	Memory transfer	From A1XA7-H	From A1XA7-H
8	Count signal	From A1XA18-9	From A1XA19-9
9	Count signal	To A1XA16-8	To A1XA17-8
11	Ground		
12	BCD "1" output	To A1J11-X	To A1J11-(u)

PIN	SIGNAL	CONNECTION	
		A1A17	A1A18
13	-12 v	From A1XA1-20	From A1XA1-20
14	+12 v	From A1XA1-15	From A1XA1-15
15	BCD "2" output	To A1J11-U	To A1J11-P
16	Reset	From A1XA7-T	From A1XA7-T
17	BCD "4" output	To A1J11-T	To A1J11-(h)
18	BCD "8" output	To A1J11-M	To A1J11-(c)
20	Scaled count signal	To A1XA5-16	To A1XA5-16
21	Scaled count signal select	From A1S3C-11	From A1S3C-12

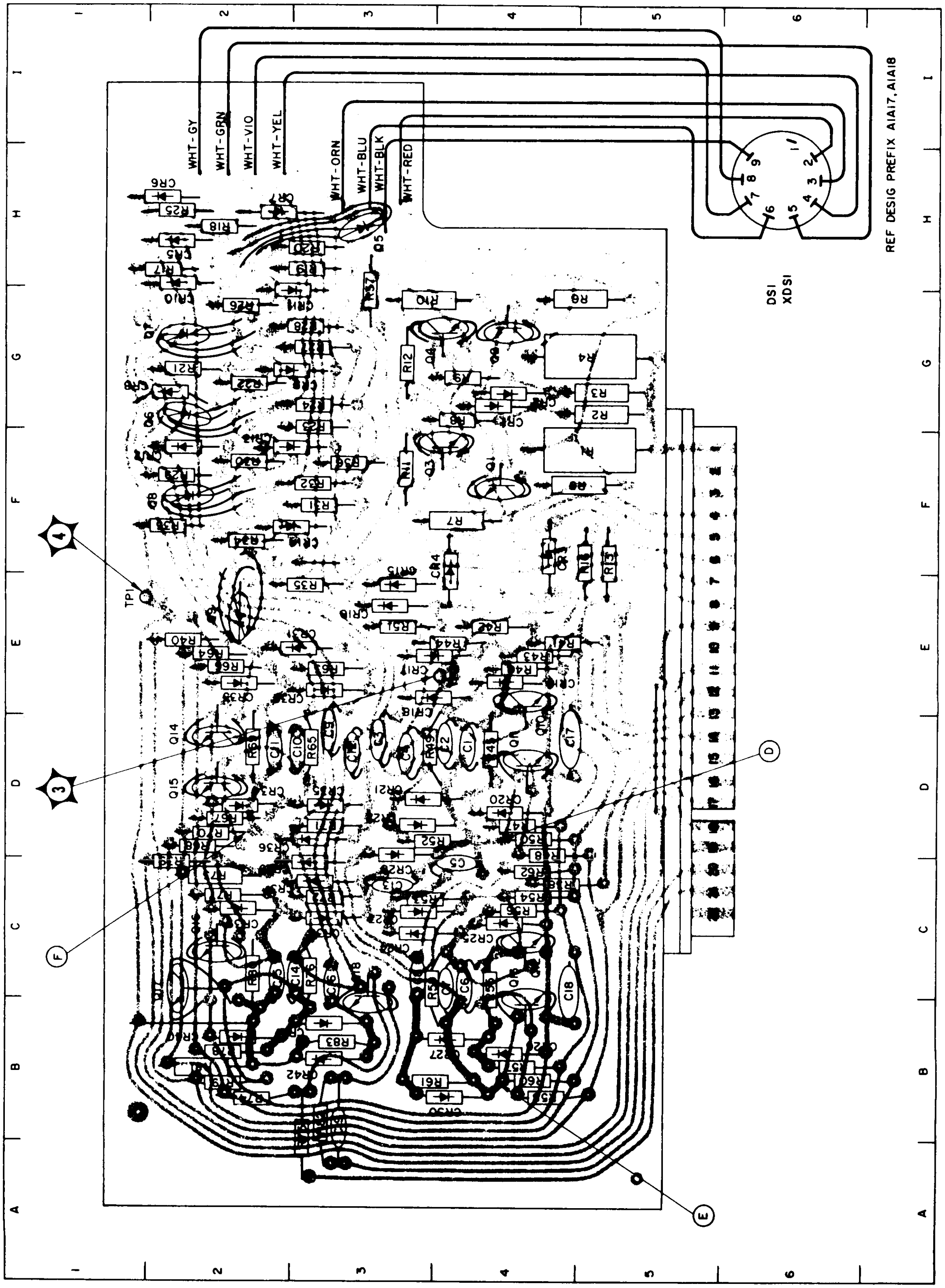


Figure 5-48. Digital Display Indicators - Frequency Dividers A1A17 and A1A18, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-49

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	5E	CR16	3E	Q17	2D	R20	3H	R41	5E	R62	4B
C2	4E	CR17	3D	Q18	2D	R21	2G	R42	3D	R63	3B
C3	5E	CR18	4E	Q19	2C	R22	2G	R43	4D	R64	3B
C4	4D	CR19	5E	Q20	2B	R23	3F	R44	4F	R65	4B
C5	2D	DS1	6I	R1	5F	R24	3F	R45	5D	R66	3B
C6	4B	Q1	4F	R2	5G	R25	2H	R46	5E	R67	2D
CR1	4F	Q2	4G	R3	5G	R26	2G	R47	5E	R68	2C
CR2	4G	Q3	3F	R4	5G	R27	3G	R48	4D	R69	3D
CR3	4E	Q4	4G	R5	5F	R28	3G	R49	5E	R70	2D
CR4	3E	Q5	3H	R6	5G	R29	2F	R50	3D	R71	2C
CR5	2H	Q6	1G	R7	4F	R30	2F	R51	3C	R72	2C
CR6	2H	Q7	2G	R8	4F	R31	3F	R52	4D	R73	2B
CR7	2H	Q8	2F	R9	4G	R32	3F	R53	4D	R74	2B
CR8	2F	Q9	2E	R10	4G	R33	2E	R54	4D	R75	2C
CR9	2G	Q10	4E	R11	3F	R34	2E	R55	5D	R76	2B
CR10	2G	Q11	4D	R12	3G	R35	3E	R56	5D	TP1	3E
CR11	3G	Q12	4D	R13	4E	R36	3E	R57	4D	TP2	3D
CR12	2F	Q13	4C	R16	4E	R37	3G	R58	4B	TP3	3C
CR13	3F	Q14	3C	R17	2G	R38	2C	R59	3C	TP4	3C
CR14	3E	Q15	4B	R18	2H	R39	2D	R60	3D	TP5	3C
CR15	3E	Q16	3B	R19	3H	R40	4B	R61	4C	XDS1	6I

DESTINATION INFORMATION FOR FIGURE 5-49

PIN	SIGNAL	CONNECTION
1	+180 v	From A1XA1-5
3	+6 v	From A1XA1-18
4	+45 v	From A1XA1-13
5	Cathode bias voltage	To A1XA12-5, A1XA13-5, A1XA14-5, A1XA15-5, A1XA16-5, A1XA17-5, A1XA18-5
6	Memory clear set	From A1XA7-F
7	Memory transfer	From A1XA7-H
8	Output	From A1XA9-1
9	Count signal	To A1XA18-8
10	Scaled count signal	To A1XA5-16
11	Ground	

PIN	SIGNAL	CONNECTION
12	BCD "1" output	To A1J11-O
13	-12 v	From A1XA1-20
14	+12 v	From A1XA1-15
15	BCD "2" output	To A1J11-J
16	Scaled "A" frequency select	From A1S3C-10
17	BCD "4" output	To A1J11-I
18	BCD "8" output	To A1J11-G
19	BCD "1" output	From A1XA9-15
20	BCD "4" output	From A1XA9-2
21	BCD "2" output	From A1XA9-9
22	BCD "8" output	From A1XA9-3

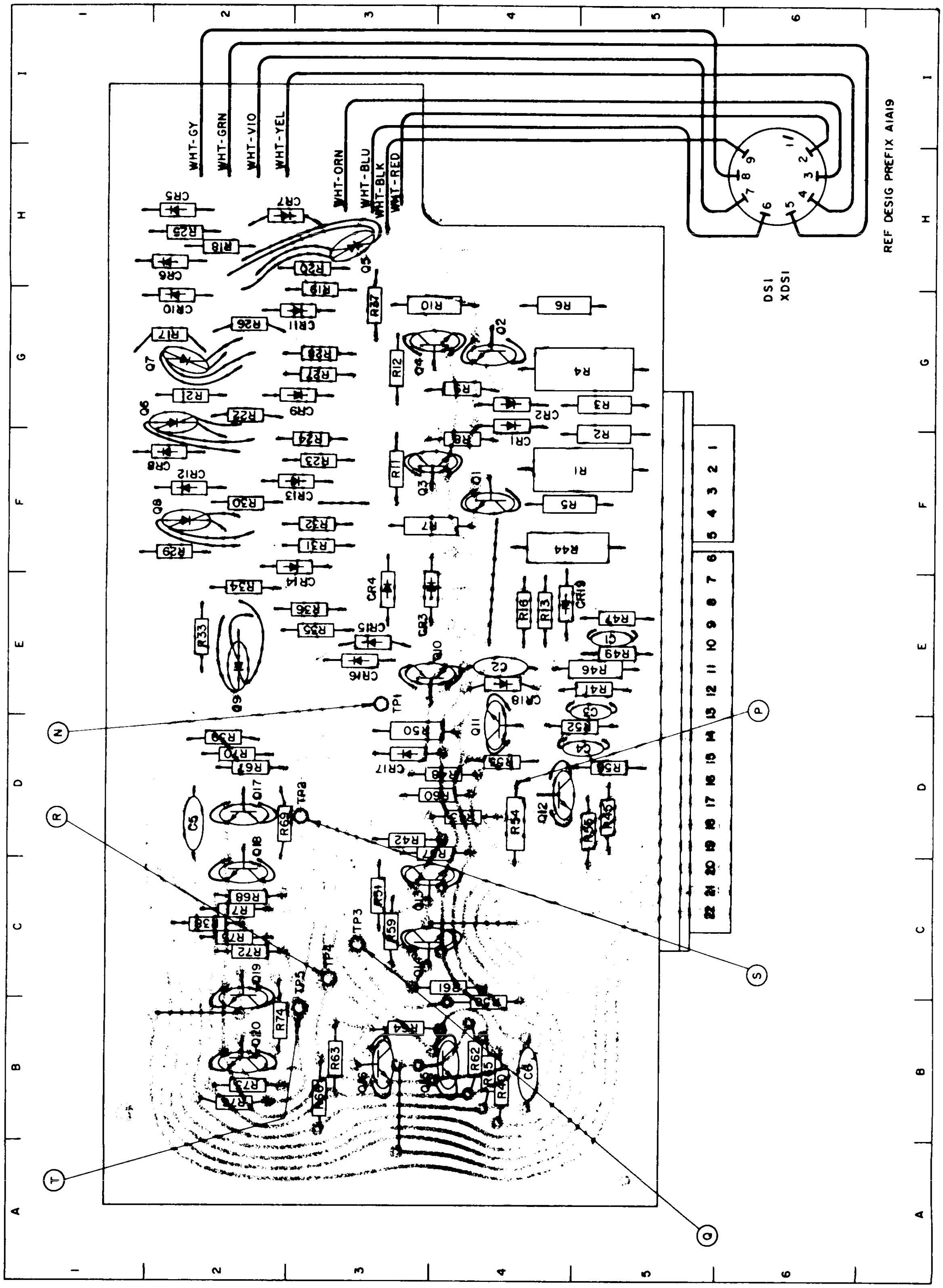


Figure 5-49. Digital Display Indicator - Frequency Divider A1A19, Location of Parts

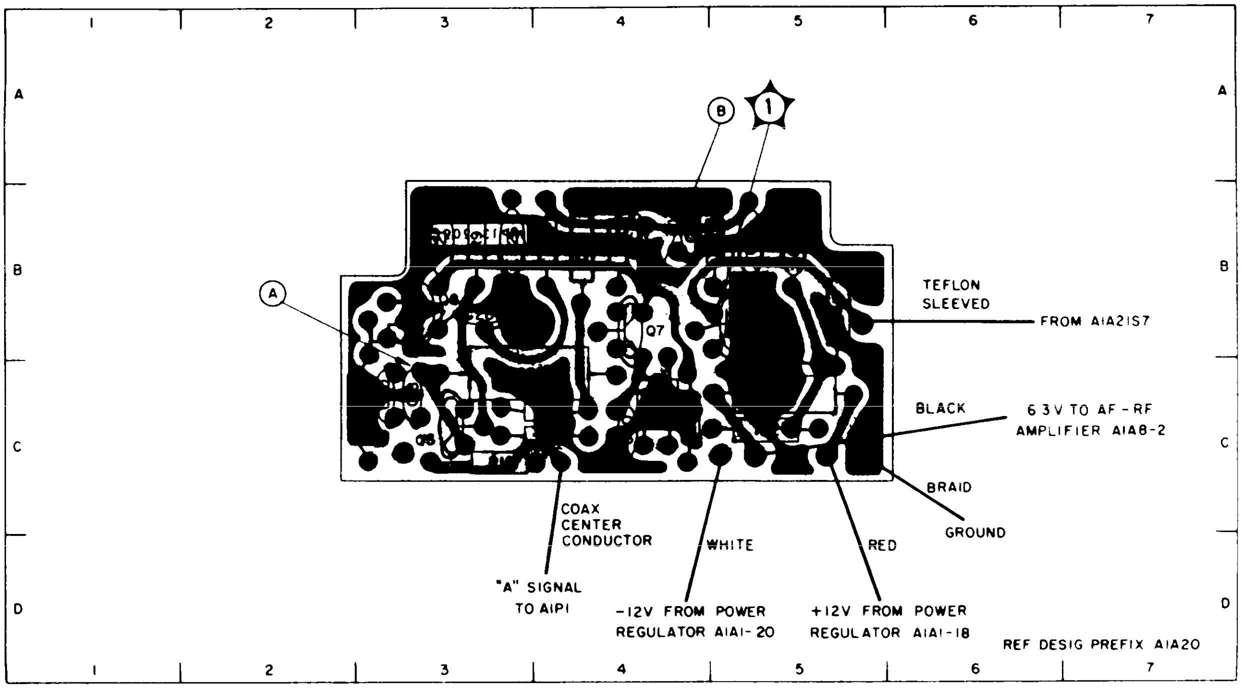


Figure 5-50. AF-RF Amplifier A1A20, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-50

REF. DESIG.	DRAWING LOCATION
C18	3C
C20	3C
C21	3B
C23	4B
C25	5B
C26	3B
C28	3B
C29	3C
C30	4C
C31	5B
C32	4B
C45	5B
CR5	4B
CR6	4C
CR7	5B
Q5	3C

REF. DESIG.	DRAWING LOCATION
Q6	3B
Q7	4B
Q8	5B
R8	5C
R9	3B
R10	3C
R11	2C
R12	5C
R13	4C
R15	4C
R16	4B
R17	4C
R18	4B
R19	4C
R20	4B

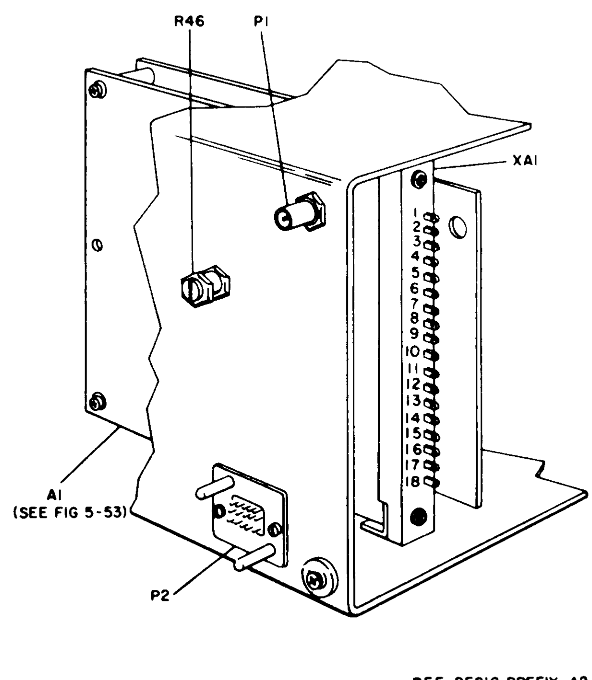


Figure 5-51. Heterodyne Frequency Converter A2 Rear View, Location of Parts

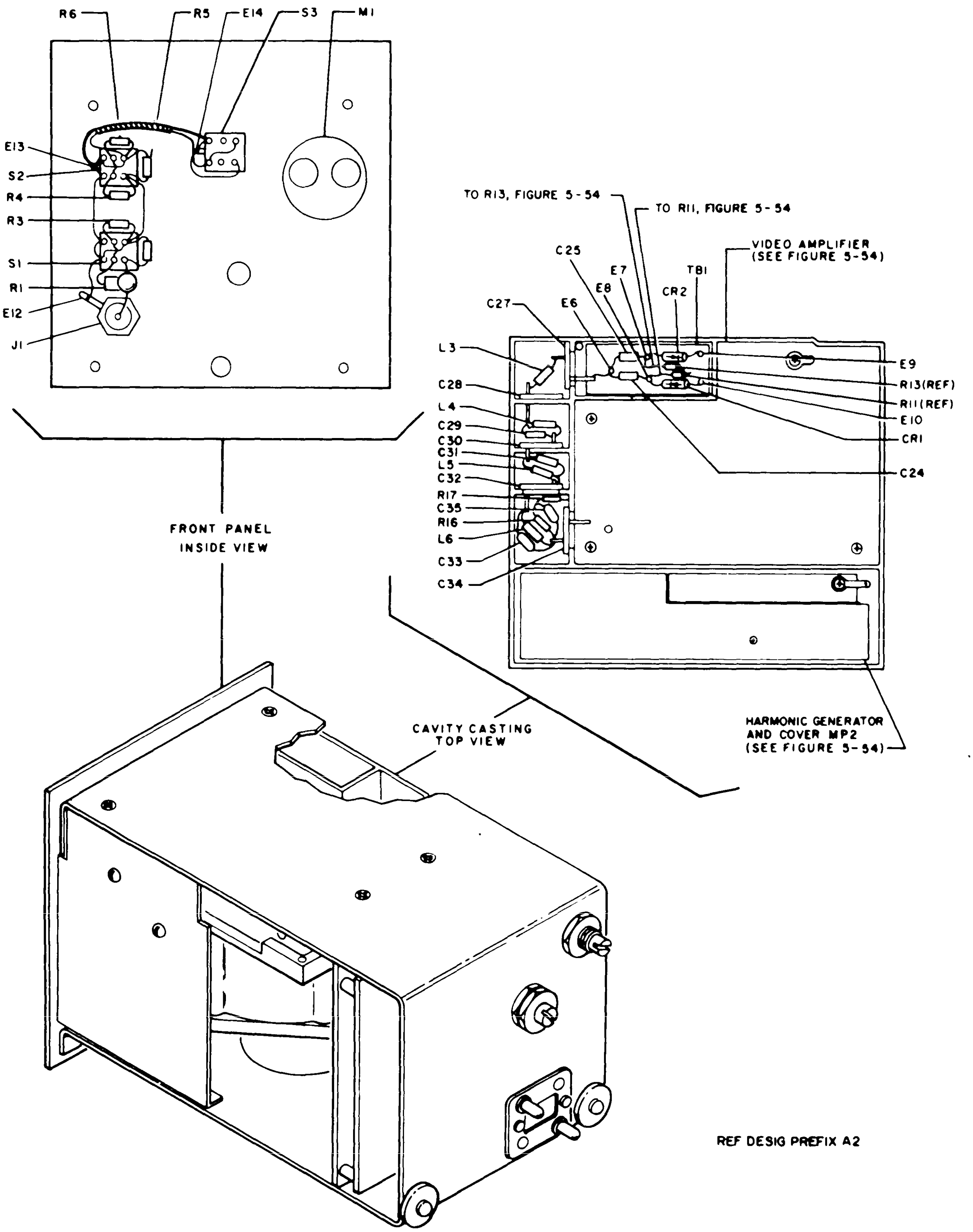
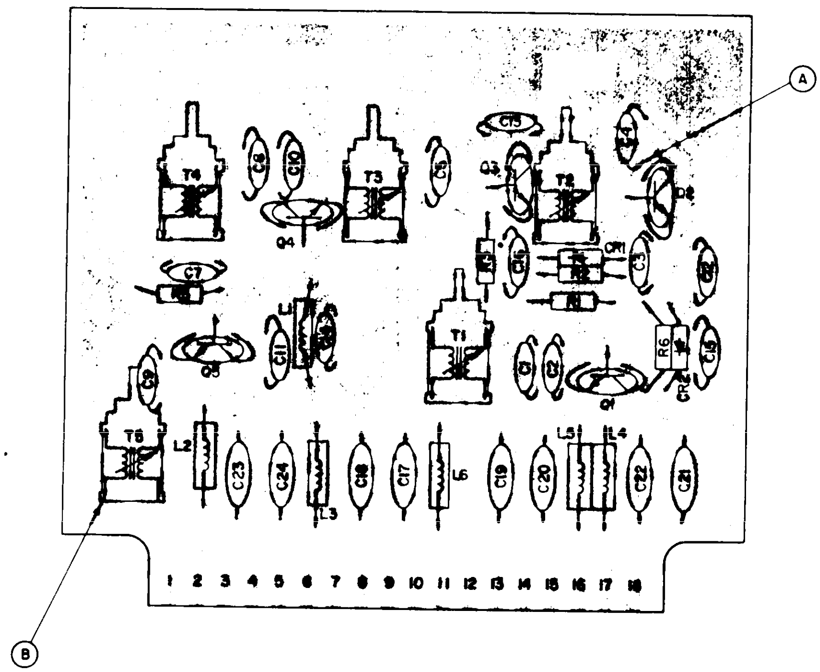


Figure 5-52. Electronic Frequency Converter A2 Top and Front View, Location of Parts

PARTS LOCATION INDEX FOR FIGURE 5-53

REF. DESIG.	DRAWING LOCATION
C1	5D
C2	5D
C3	5C
C4	5B
C5	4C
C7	3C
C8	3C
C9	3D
C10	3C
C11	3D
C12	6C
C13	5B
C14	4D
C15	6D
C16	5C
C17	4D
C18	4D
C19	5D
C20	5D
C21	6D
C22	5D
C23	3D
C24	3D

REF. DESIG.	DRAWING LOCATION
CR1	5C
CR2	6D
L1	3C
L2	3D
L3	3E
L4	5D
L5	5D
L6	4D
Q1	5D
Q2	6C
Q3	4C
Q4	3C
Q5	3D
R1	5C
R2	5C
R3	4C
R5	3C
R6	5D
T1	4D
T2	5C
T3	4C
T4	3C
T5	2D



PIN	SIGNAL	CONNECTION
1	50-mc standard frequency	To A2T3
2	Ground	
3	+12 v supply	From A2R46
6	+12 v supply	From A2P2-4, 5
8	Ground	
10	-12 v supply	From A2P2-1, 2
12	10-mc standard frequency	From A3P2-16
13	Ground	
15	+12 v supply	From A2P2-4, 5
17	+6 v supply	From A2P2-6, 7

REF DESIG PREFIX A2A1

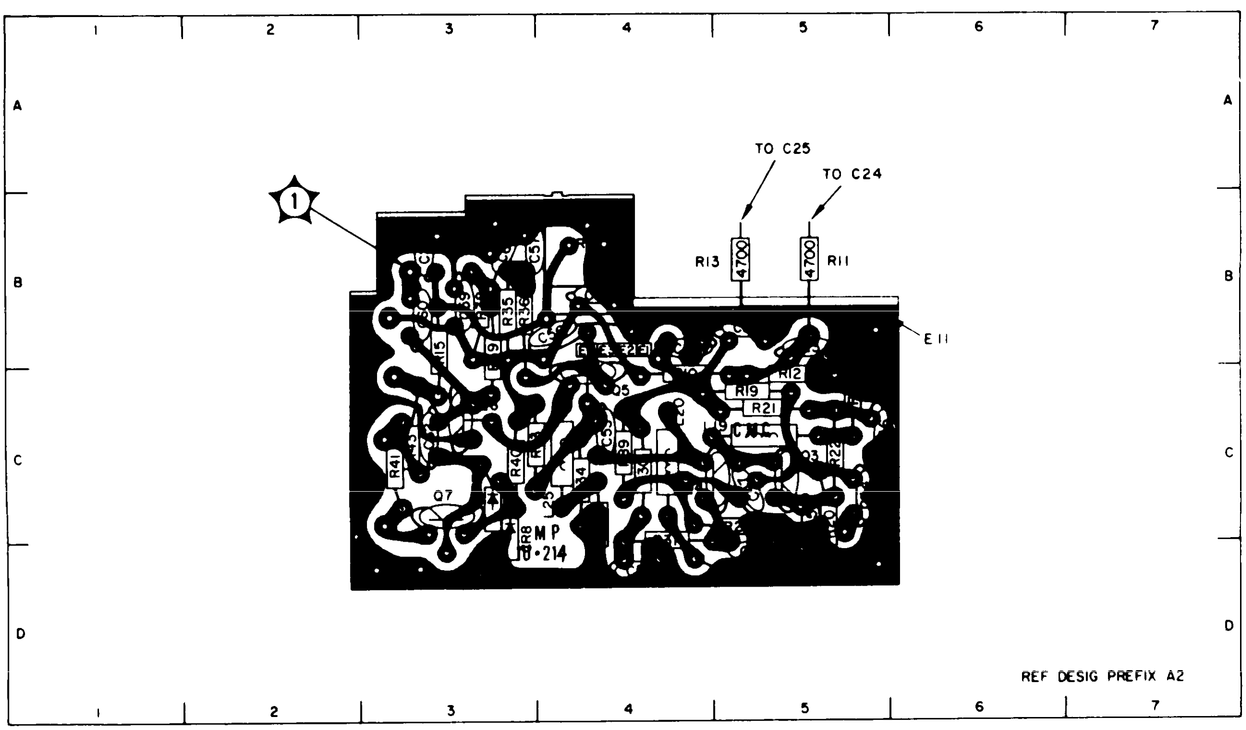
Figure 5-53. Frequency Multiplier A2A1, Location of Parts

PARTS LOCATION INDEX FOR VIDEO AMPLIFIER

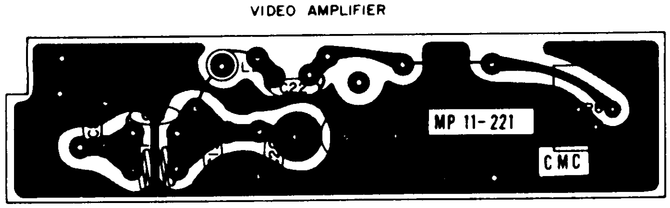
REF DESIG.	PARTS LOCATION
C23	5B
C26	3B
C44	5C
C45	5C
C46	5C
C47	5C
C50	5B
C51	5D
C52	4D
C53	4C
C54	4B
C55	4B
C56	4B
C57	3B
C59	3B
C60	3B
C61	3B
C62	3C
CR7	3C
CR8	3C

REF DESIG.	PARTS LOCATION
E1	4B
E2	4B
E3	4B
E4	4B
L19	5C
L20	4C
L25	4C
Q3	5C
Q4	4C
Q5	4C
Q6	3C
Q7	3C
R10	4C
R11	5B
R12	5C
R13	5B
R14	4B
R15	3B
R19	5C

REF DESIG.	PARTS LOCATION
R20	5C
R21	5C
R22	5C
R23	5C
R28	5C
R30	4C
R31	4C
R32	5D
R33	4C
R34	4C
R35	3B
R36	3B
R37	4C
R38	3B
R39	3B
R40	3C
R41	3C
R43	3C
R89	4C



VIDEO AMPLIFIER



REF DESIG PREFIX A2

HARMONIC GENERATOR

Figure 5-54. Video Amplifier and Harmonic Generator, Location of Parts

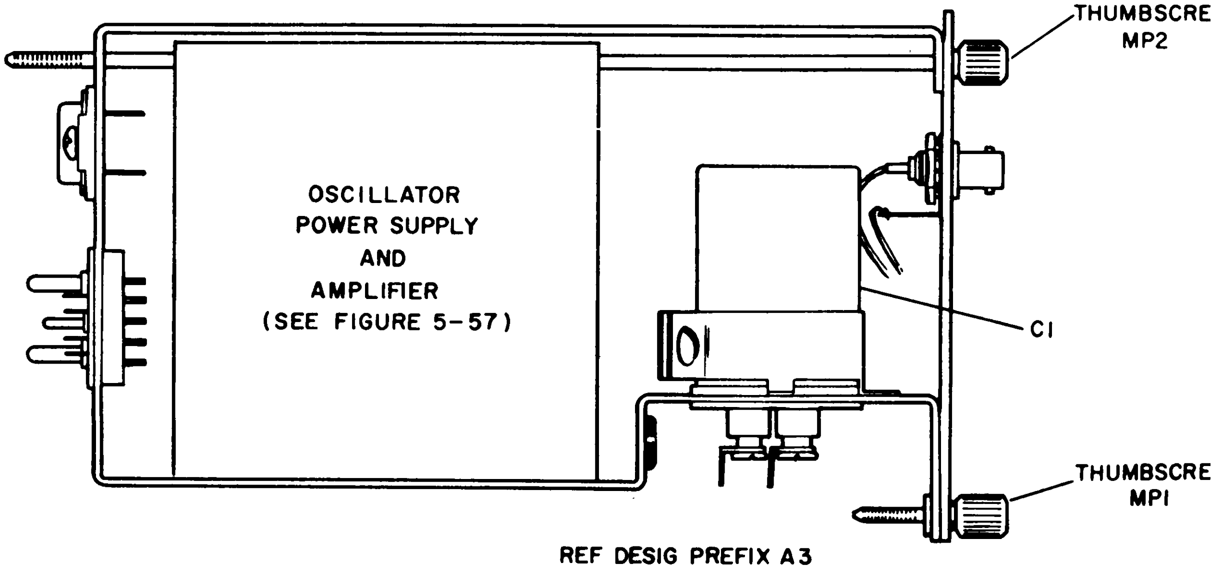


Figure 5-55. Radio Frequency Oscillator A3, Left-Side View, Location of Parts

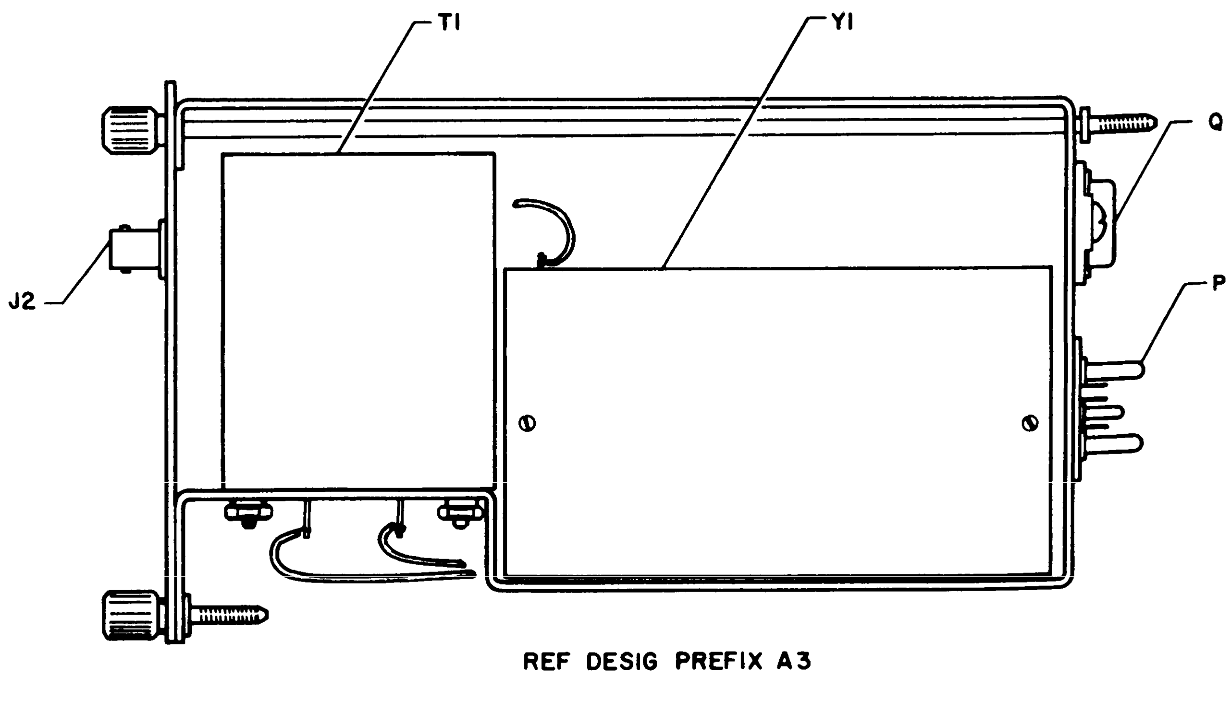
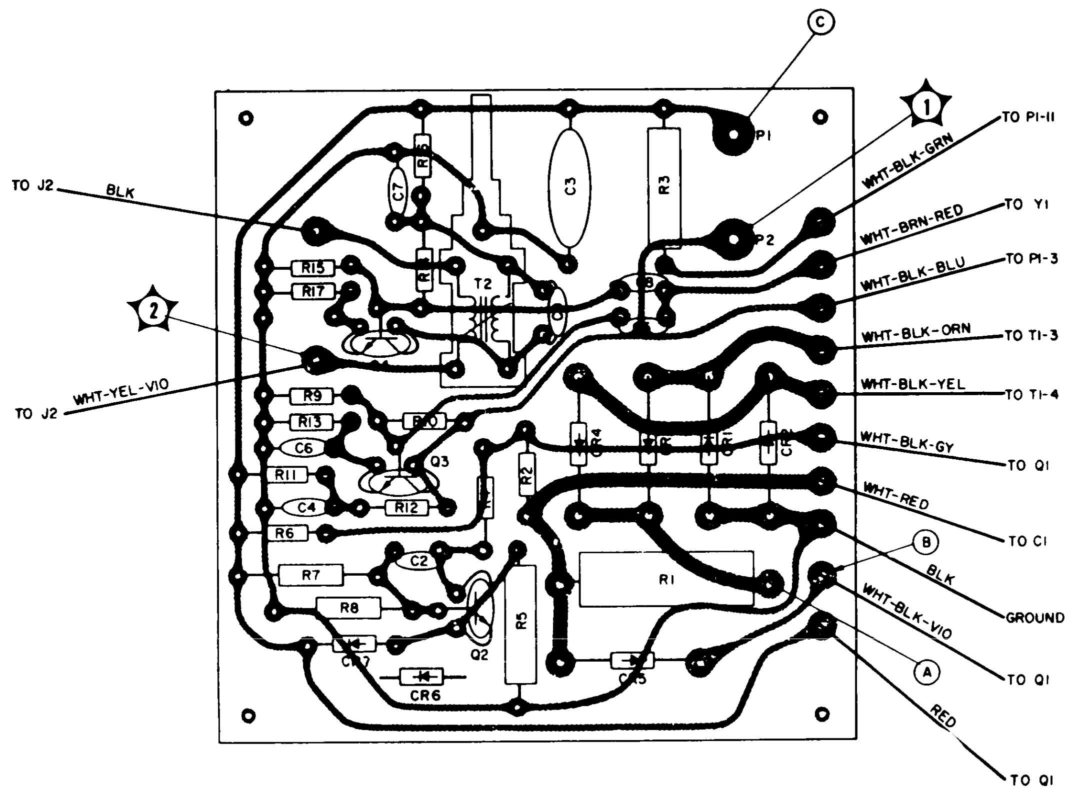


Figure 5-56. Radio Frequency Oscillator A3, Right-Side View, Location of Parts



REF. DESIG.	DRAWING LOCATION
C2	3E
C3	4C
C4	3D
C5	5C
C6	3D
C7	3B
C8	5C
C9	4D
C10	3C
CR1	5D
CR2	5D
CR3	5D
CR4	4D

REF. DESIG.	DRAWING LOCATION
CR5	4E
CR6	3E
CR7	3E
Q2	4E
Q3	3D
Q4	3C
R1	5E
R2	4D
R3	5C
R4	4D
R5	4E
R6	2D
R7	2E

REF. DESIG.	DRAWING LOCATION
R8	3E
R9	3D
R10	3D
R11	2D
R12	3D
R13	3D
R14	3C
R15	3C
R16	3B
R17	3C
T2	4C
TP1	5B
TP2	5C

REF DESIG PREFIX A3

Figure 5-57. Oscillator Power Supply and Amplifier, Location of Parts

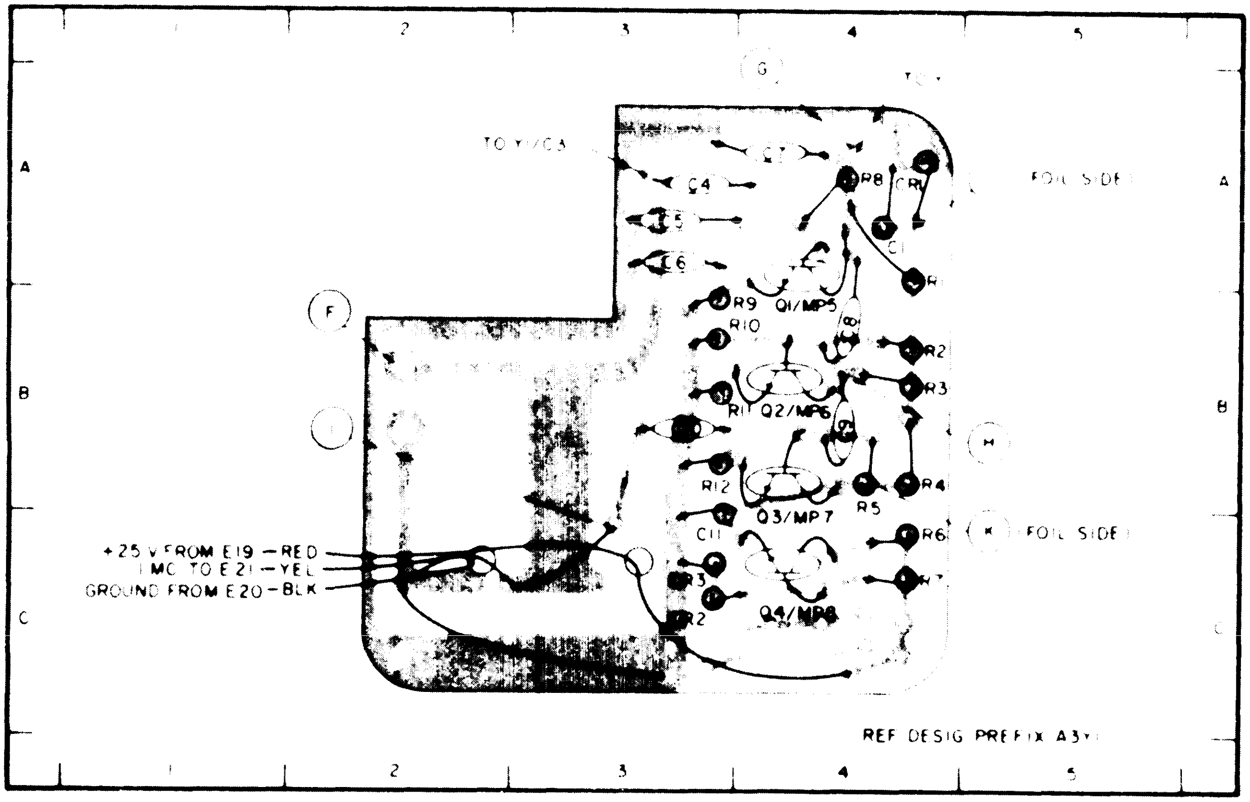


Figure 5-58. 1-Mc Oscillator A3Y1 Frequency Generator, Location of Parts

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	4A	Q1	4A
C4	3A	Q2	4B
C5	3A	Q3	4B
C6	3A	Q4	4C
C7	4A	R1	4A
C8	4B	R2	4B
C9	4B	R3	4B
C10	3B	R4	4B
C11	3C	R5	4B
CR1	4A	R6	4C
CR2	3C	R7	4C
CR3	3C	R8	4A
MP5	4B	R9	3B
MP6	4B	R10	3B
MP7	4C	R11	3B
MP8	4C	R12	3B

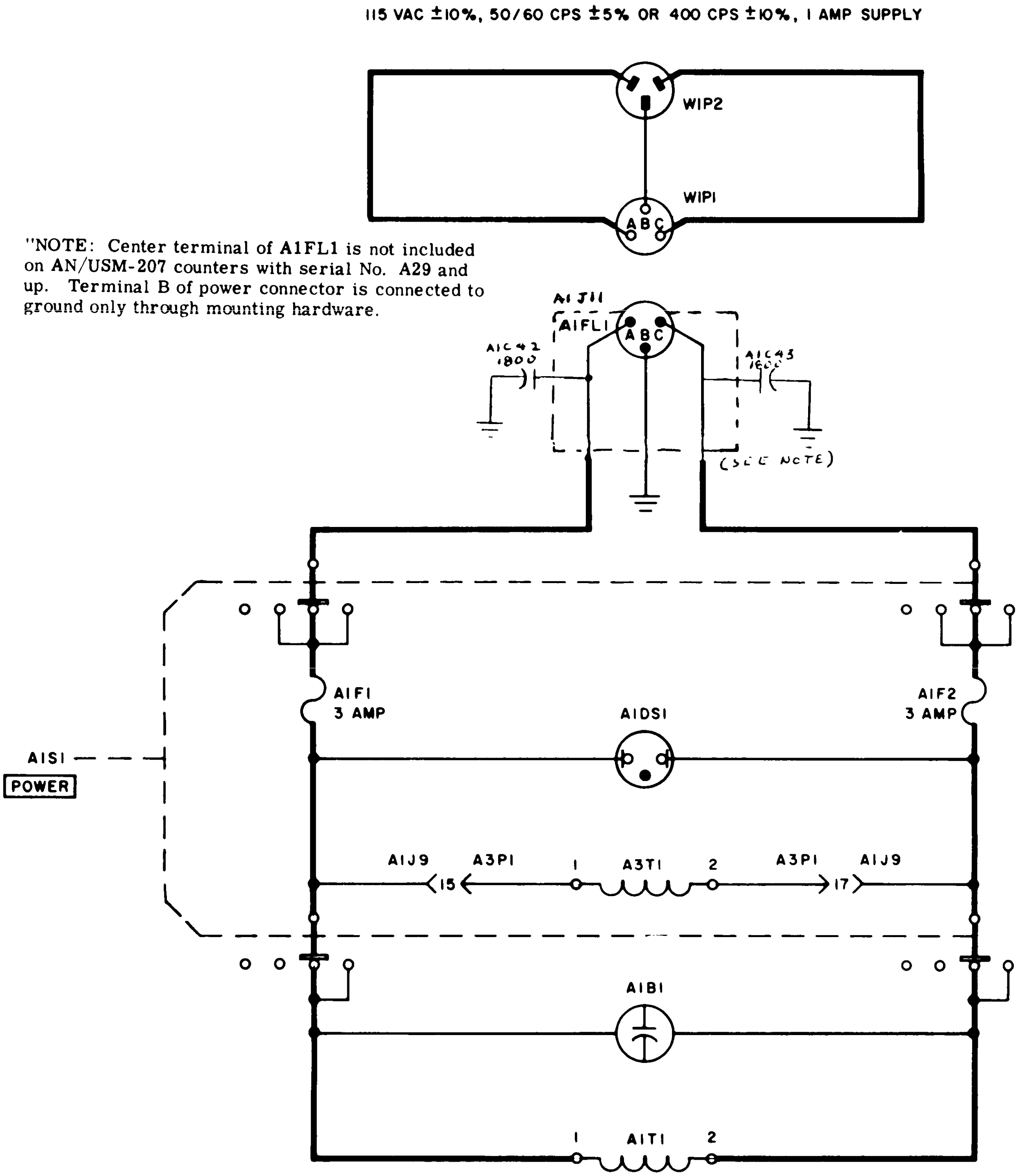


Figure 5-59. Power Distribution Diagram

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. — -- —— indicates etched circuit boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted.
5. Dc voltages are preceded by "+" or "-".
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.

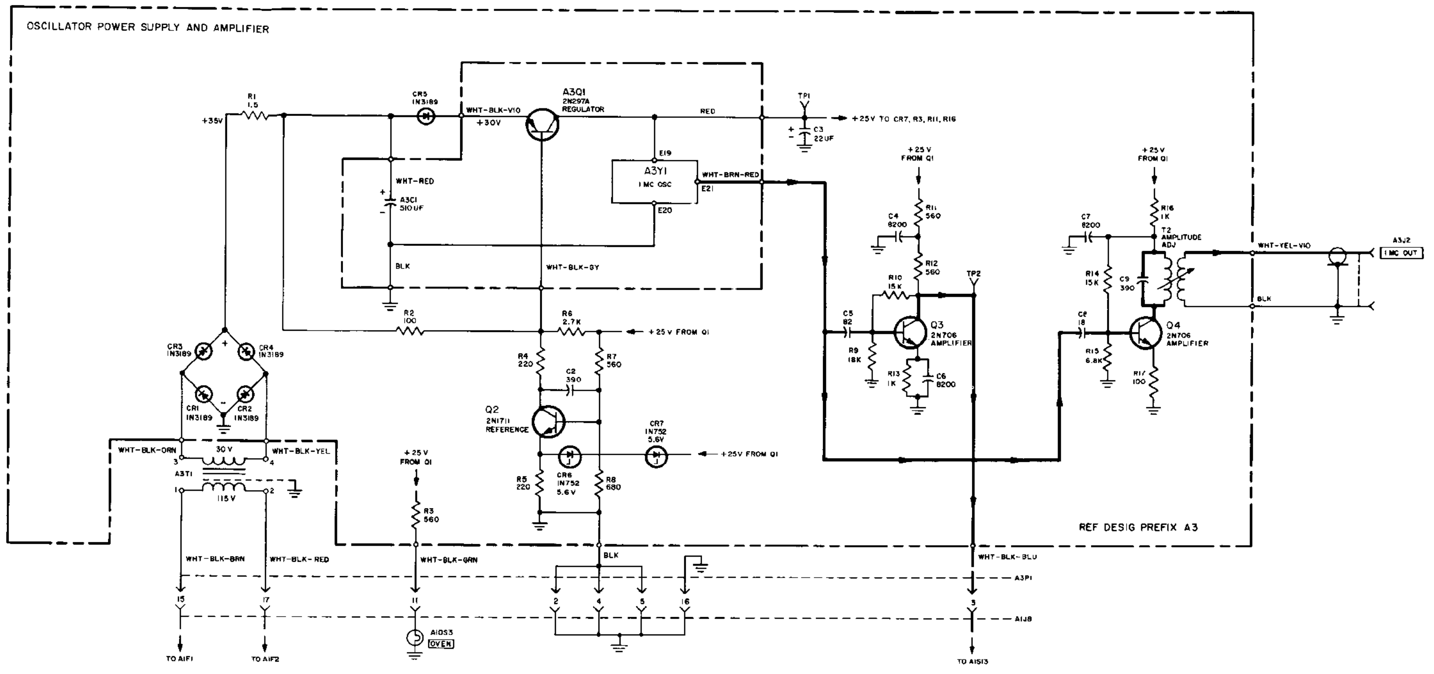


Figure 5-60. Radio Frequency Oscillator, Schematic Diagram (Sheet 1 of 2)

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. Names of panel controls enclosed in boxes.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "+" or "-".
5. The letters CW placed adjacent to A3YR21 indicate the direction of rotation viewed from the shaft end.
6. Dc voltages measured with a CCUH-801 Dc Differential Voltmeter.
7. Procedure for selecting A3Y1R1 described in paragraph 5-5ak.
8. Procedure for selecting A3Y1C4 described in paragraph 5-5aj.

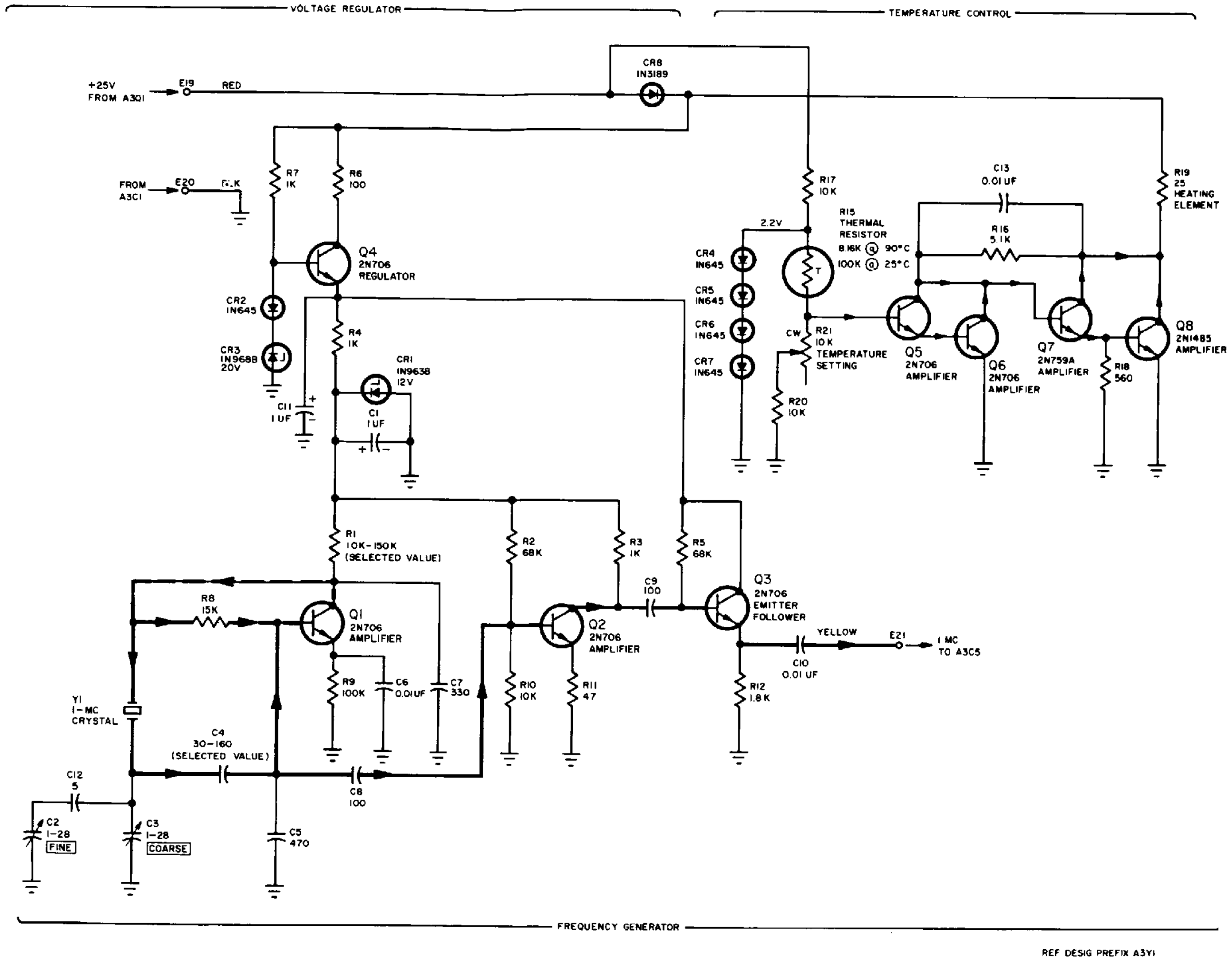


Figure 5-60. Radio Frequency Oscillator, Schematic Diagram (Sheet 2 of 2)

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	4B	C34	14E	E11	10E	R14	10F
C2	8D	C35	15E	J1	3B	R15	11F
C3	7D	C44	15D	L1	6G	R16	15E
C4	7D	C45	17D	L2	8G	R17	15E
C5	6D	C46	17C	L3	11D	R19	16C
C6	6E	C47	17E	L4	12D	R20	16D
C7	6E	C50	17B	L5	13D	R21	16B
C8	6E	C51	18D	L6	14D	R22	16C
C9	7F	C52	18C	L19	16E	R23	16E
C10	7F	C53	18E	L20	18E	R28	18E
C11	7F	C54	19B	L25	20E	R29	17C
C12	7F	C55	22B	M1	23F	R30	18B
C13	8F	C56	20D	P1	24D	R31	18C
C14	8F	C57	20C	P2	2C	R32	18F
C15	8F	C59	23B	Q3	16D	R33	19E
C16	8F	C60	23D	Q4	18D	R34	19E
C17	5H	C61	21C	Q5	20D	R35	20C
C18	6G	C62	22E	Q6	21D	R36	20C
C19	7H	CR1	10D	Q7	22E	R37	20F
C20	7H	CR2	10E	R1	4B	R38	21C
C21	7H	CR3	8F	R2	5B	R39	21C
C22	8G	CR7	22F	R3	5B	R40	22E
C23	11B	CR8	23E	R4	6B	R41	22F
C24	10D	E1	19B	R5	6B	R42	23G
C25	10E	E2	20B	R6	7B	R43	22G
C26	10F	E3	20B	R7	8E	S1	5B
C27	10E	E4	21B	R8	8H	S2	7B
C28	11E	E5	8D	R9	8H	S3	8B
C29	12D	E6	10D	R10	11B	S4	7E
C30	12E	E7	10D	R11	10C	T1	8E
C31	13D	E8	10C	R12	11C		
C32	13E	E9	9D	R13	10F		
C33	14D	E10	9C				

NOTES

1. Component values expressed in ohms and picofarads.
2. —— -- —— indicates etched circuit assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted.
5. Dc voltages are preceded by "+" or "-".
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Parts location information is given in map-type coordinates in accompanying table.
8. Circuit groups are identified by brackets.
9. A2S4 shown in [100] position viewed from control knob or actuator end.

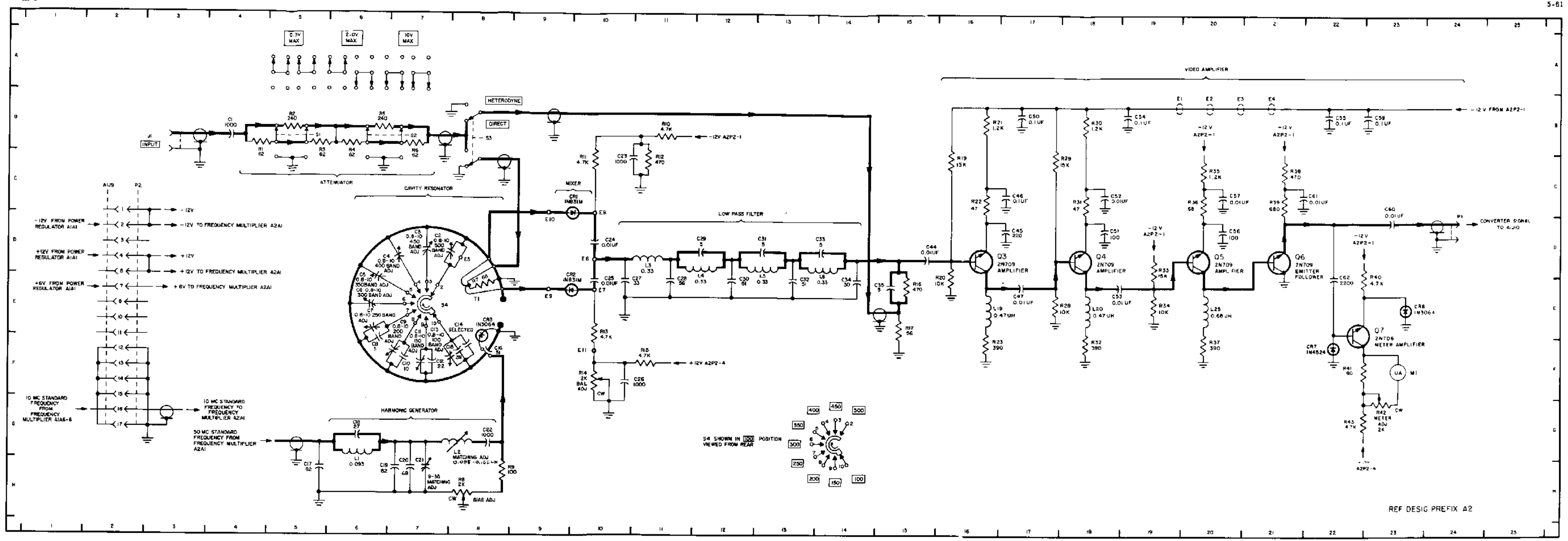


Figure 5-61. Electronic Frequency Converter less Frequency Multiplier A2A1, Schematic Diagram

NOTES

1. Component values expressed in ohms and picofarads.
2. Primary signal paths weighted.
3. Dc voltages are preceded by "+" or "-".
4. Alternate value supplied is 0.05 μf. Use 0.047 μf for replacement.

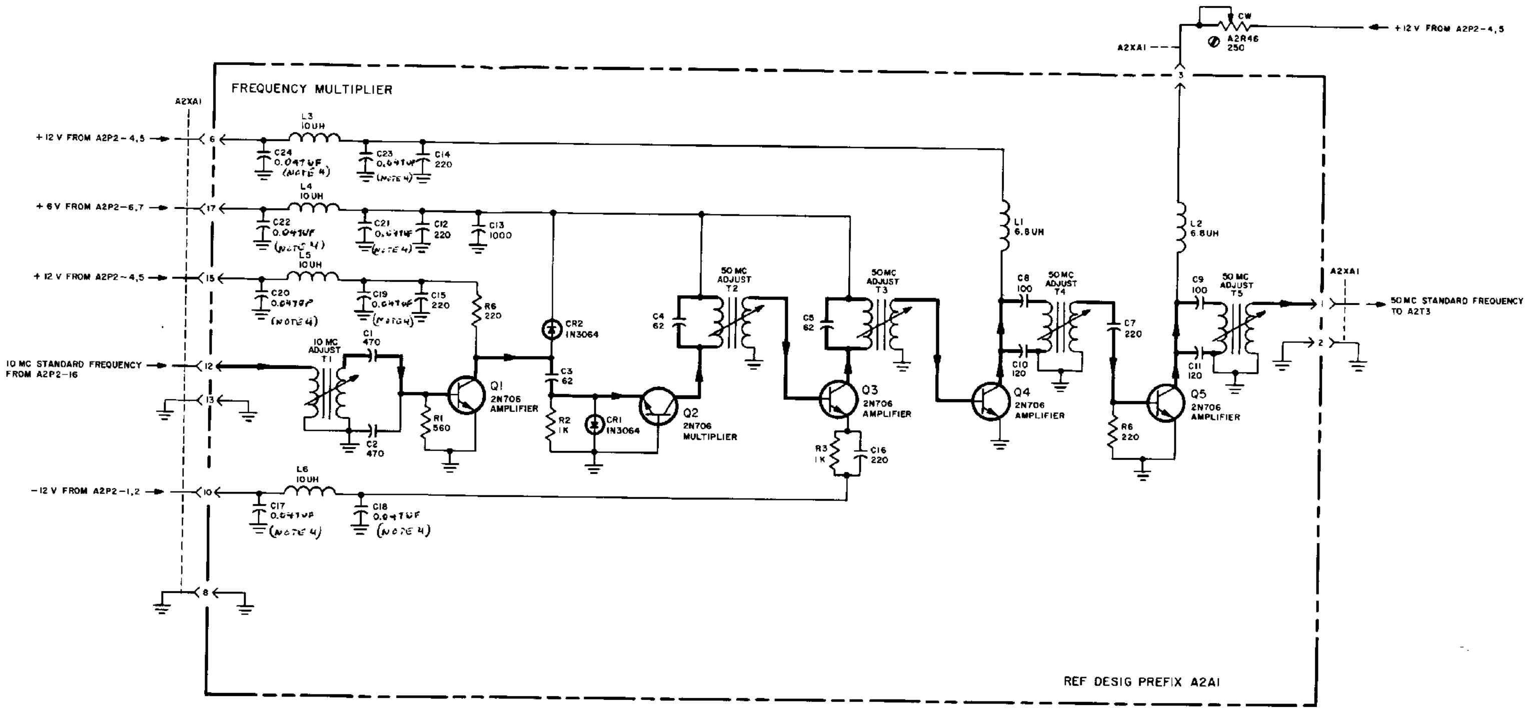


Figure 5-62. Electronic Frequency Converter Frequency Multiplier A2A1, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG. PREFIX A1A20			
REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C18	14E	Q6	15F
C20	14F	Q7	17E
C21	15F	Q8	18E
C23	12C	R8	12C
C25	16G	R9	14D
C26	12C	R10	13F
C28	15E	R11	14F
C29	15E	R12	15G
C30	17F	R13	14G
C31	14C	R15	15C
C32	18F	R16	16D
C45	16G	R17	16F
CR5	13C	R18	17D
CR6	14D	R19	17F
CR7	15G	R20	18F
Q5	15D		

REF. DESIG. PREFIX A1A21			
REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C15	8D	E7	4D
C17	8E	E8	4G
C18	7C	E9	4H
C19	8C	E10	9F
C20	5A	R2	7C
C21	7D	R3	7C
CR1	4E	R4	7D
E1	9C	R5	7D
E2	9C	R6	7E
E3	5A, 9D	R7	7E
E4	6A	R49	7F
E5	5A	S7	7A
E6	4B		

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted.
5. Dc voltages are preceded by "+" or "-".
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Parts location information is given in map-type coordinates in accompanying table.
8. On AN/USM-207 counters with A1A21 part No. MP13-523L4 the following apply:
   a. E4, zone 6A; E5, zone 5A; E6, zone 4B; E7, zone 4D; E8, zone 4G; E9, zone 4H; and E10, zone 9F not included.
   b. Capacitor C18, zone 7C, not included.
   c. Capacitor C19, zone 8C, not included.
   d. Capacitor C21, zone 7D, not included.
   e. Value of capacitor C15, zone 7D, is 15 pf.
   f. Diode CR1, zone 4E, is not included.
9. E3, zone 9D, included in AN/USM-207 counters with A1A21 part No. MP13-523L4. E3, zone 5A, included in AN/USM-207 counters with A1A21 part No. MP13-537L1.
10. Alternate value supplied is 0.05 μf. Use 0.047 μf for replacement."

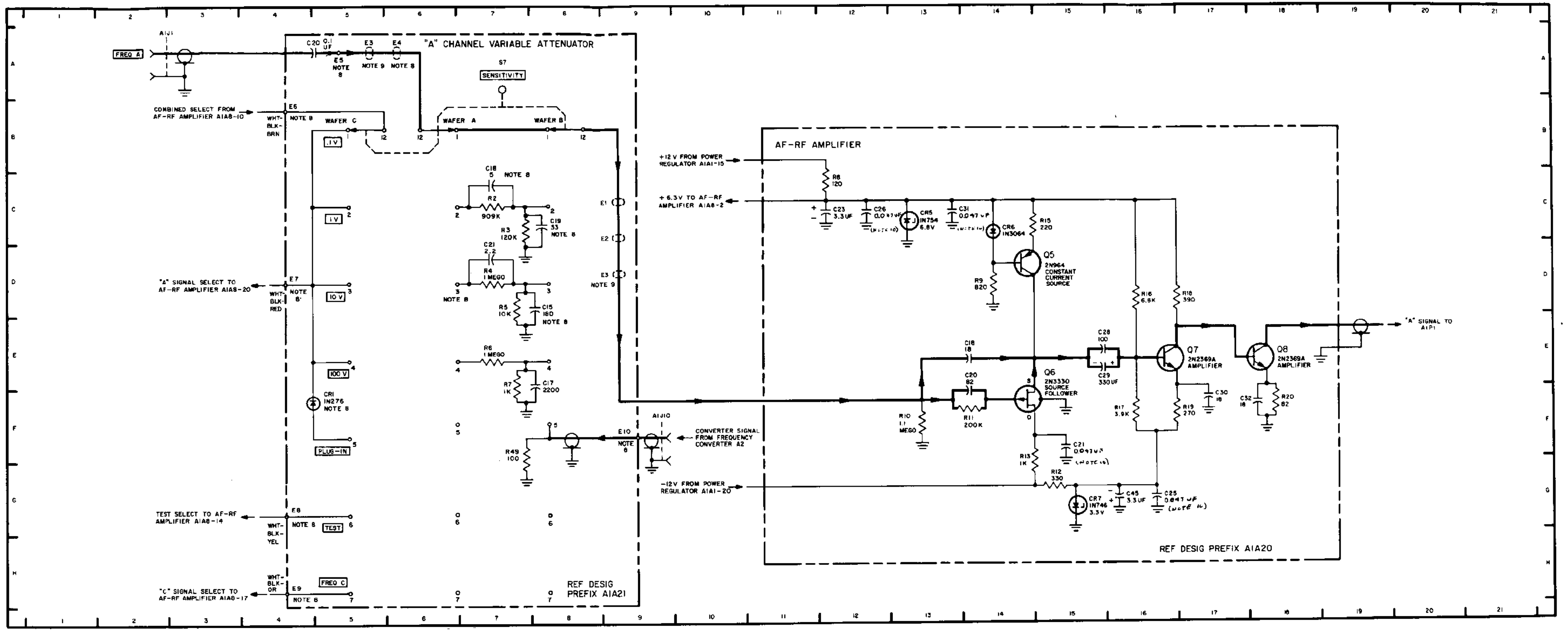


Figure 5-63. A Amplifier, Schematic Diagram

REF. DESIG.	DRAWING LOCATION
PREFIX A1A11	
C2	10C
C3	11D
C4	12D
C5	12E
C6	16C
C7	15B
C8	17C
C9	19C
C10	23F
C11	21F
C12	22D
C13	22C
C14	9E
CR1	13C
CR2	15B
CR3	13E
CR4	19C
CR5	19C
CR6	20D
CR7	21B
CR8	20C
CR9	22C
CR10	23D
J1	9D

REF. DESIG.	DRAWING LOCATION
Q1	11C
Q2	12D
Q3	14D
Q4	16D
Q5	16C
Q6	18C
Q7	21D
Q8	23C
R1	10D
R2	10D
R3	11D
R4	12C
R5	13C
R6	12E
R7	12E
R8	15F
R9	13C
R10	13E
R11	14C
R12	14C
R13	15D
R14	14E
R15	15E
R16	16C
R17	16E
R18	13E

REF. DESIG.	DRAWING LOCATION
R19	14E
R20	16C
R21	17C
R22	15B
R23	17D
R24	17E
R25	18B
R26	18E
R27	19E
R28	19C
R29	19D
R30	20E
R31	21B
R32	22B
R33	22B
R34	22E
R35	22E
R36	23E
R37	24C
TP1	23C
TP2	19C
TP3	16E

REF. DESIG.	DRAWING LOCATION
PREFIX A1A22	
C34	6B
C35	6C
C36	6F
C37	6G
C38	6H
C46	6A
R21	6C
R22	6C
R23	6D
R24	6D
R25	6D
R26	6E
R27	6E
R28	6F
R29	6F
R30	6G
R31	6G
R32	6H
R33	4B
R50	6A
PREFIX A1	
C33	2B
J2	1B
J3	1C
P2	8D
S9	3D

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted. Feedback paths weighted and dashed.
5. Dc voltages are preceded by "+" or "-".
6. The letters CW or CCW, placed adjacent to the appropriate terminals of A1A22R33 and A1A11R6, indicate the direction of rotation viewed from the shaft end.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. Parts location information is given in map-type coordinates in accompanying table.
9. C8 is 27 picofarads on units with A1A11 part No MP14-546 marked "L9"

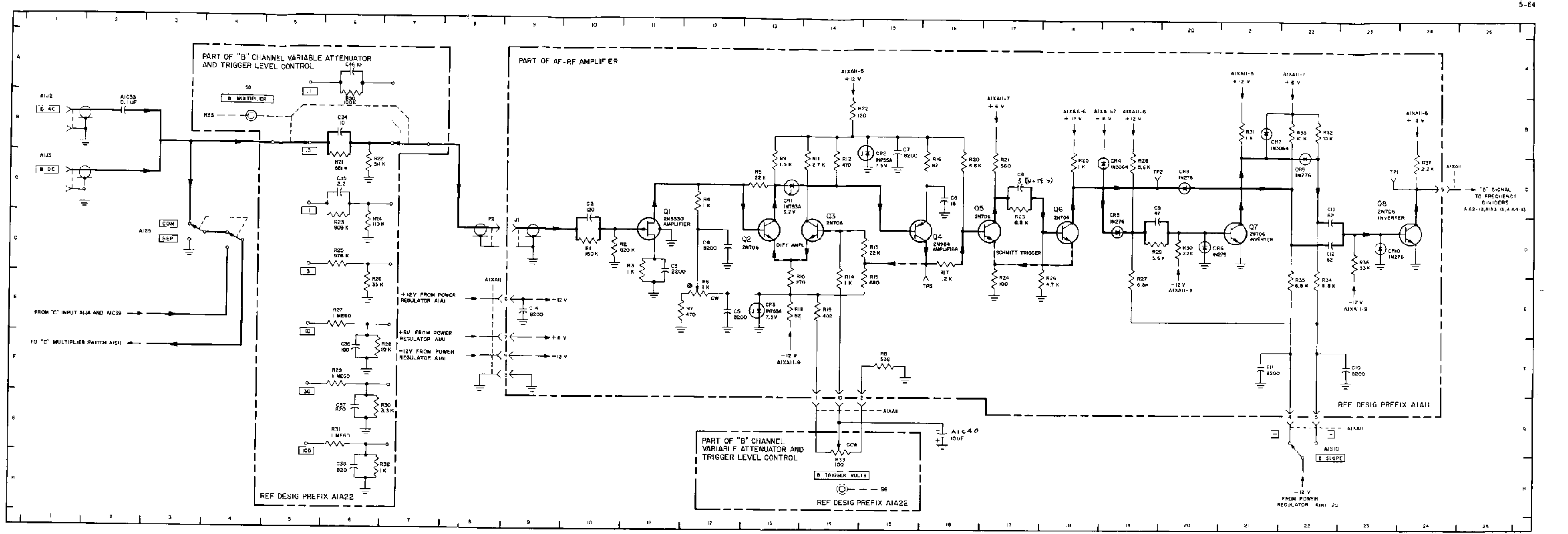


Figure 5-64. B Amplifier, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION
PREFIX A1A11	
C16	10C
C17	11D
C18	12D
C19	13E
C20	16C
C21	15C
C22	17C
C23	19C
C24	23F
C25	21F
C26	22D
C27	22C
C28	9E
CR11	13C
CR12	15C
CR13	13E
CR14	19C
CR15	19D
CR16	20D
CR17	21B
CR18	20C
CR19	22C
CR20	23D
J2	9D

REF. DESIG.	DRAWING LOCATION
Q9	11D
Q10	13D
Q11	14D
Q12	16D
Q13	16D
Q14	18D
Q15	21D
Q16	23C
R38	10D
R39	11D
R40	11E
R41	14C
R42	13C
R43	12E
R44	12E
R45	15F
R46	13C
R47	13E
R48	14C
R49	14C
R50	15D
R51	14E
R52	15E

REF. DESIG.	DRAWING LOCATION
R53	16C
R54	16E
R55	13E
R56	14E
R57	16C
R58	17C
R59	14B
R60	17D
R61	17E
R62	18C
R63	17E
R64	19E
R65	19C
R66	19D
R67	20E
R68	21B
R69	22B
R70	22B
R71	22E
R72	22E
R73	23E
R74	24C
TP4	23C

REF. DESIG.	DRAWING LOCATION
TP5	19C
TP6	16E
PREFIX A1A23	
C40	6B
C42	6F
C43	6G
C44	6H
R34	6C
R35	6C
R36	6D
R37	6D
R38	6D
R39	6E
R40	6E
R41	7F
R42	6F
R43	7G
R44	6F
R45	7H
R46	4B
PREFIX A1	
C39	1B
C41	16G
J4	1C
J5	1B
P3	9D

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted. Feedback paths weighted and dashed.
5. Dc voltages are preceded by "+" or "-".
6. The letters CW or CCW, placed adjacent to the appropriate terminals of A1A23R46 and A1A11R43, indicate the direction of rotation viewed from the shaft end.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. Parts location information is given in map-type coordinates in accompanying table.
9. C22 is 27 picofarads on units A1A11 part No. MP14-546 marked LH

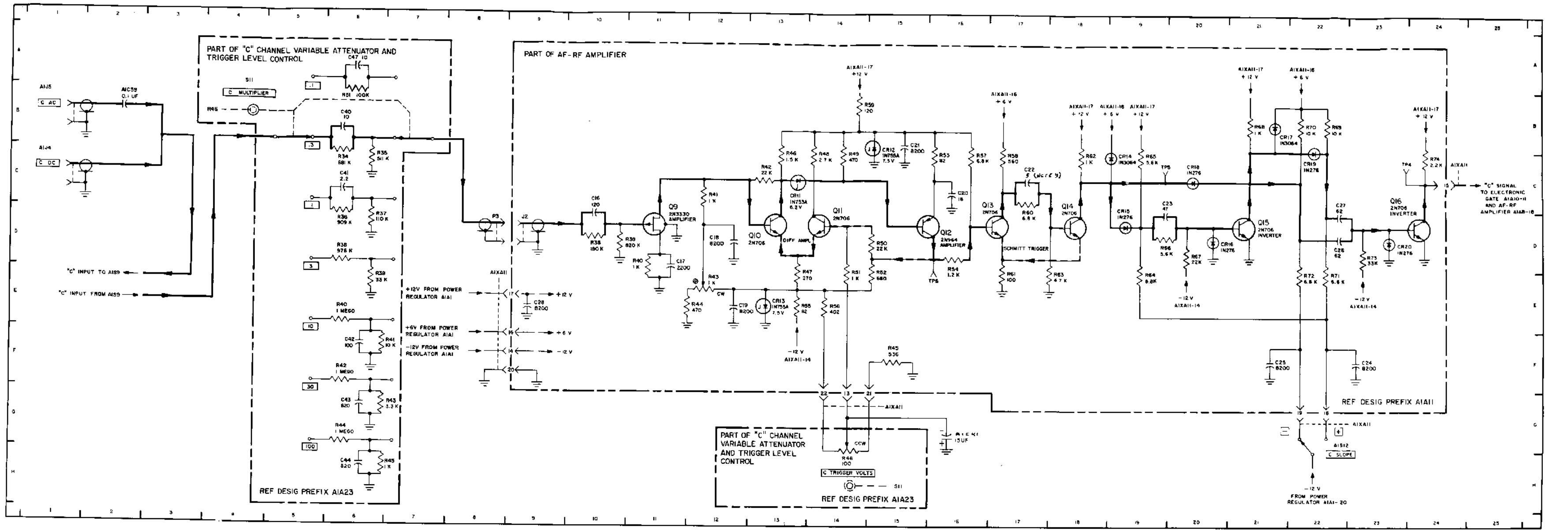


Figure 5-65. C Amplifier, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG	DRAWING LOCATION
C1	4C
C2	6B
C3	6C
C4	8C
C5	9B
C6	10B
C7	11B
C8	11C
C9	13C
C10	15B
C11	15C
C12	17B
C13	17C
C14	18B
C15	19B
C16	5F
C17	7F
C18	8E
C19	8F
C20	10F
C21	12E
C22	12E
C23	13F
C24	15E
C25	15F
C26	14F
C27	16E
C28	16E
C29	18E
C30	19E
C31	19G
C32	22E
C33	22G
C34	3E
C35	3E
C36	4E
C37	4E
C38	4E

REF. DESIG.	DRAWING LOCATION
C39	3F
C40	3F
C41	3E
C42	3E
C43	4E
C44	4E
C45	19B
C46	19E
C47	15E
C48	16E
C49	18E
CR1	7C
CR2	9C
CR3	12C
CR4	14C
CR6	22C
CR7	9F
CR8	9G
CR9	12F
CR10	13F
CR11	19F
CR12	20F
L1	10B
L2	15B
L3	16B
L4	18B
L5	11E
L6	14E
L7	16E
L8	18E
Q1	6C
Q2	8C
Q3	9C
Q4	11C
Q5	13C
Q6	15C
Q7	16C
Q8	18C

REF. DESIG.	DRAWING LOCATION
Q9	20C
Q10	22C
Q11	6F
Q12	8F
Q13	11F
Q14	14F
Q15	16F
Q16	18F
Q17	20F
Q18	21F
Q19	20G
Q20	20G
R1	4C
R2	4C
R3	5C
R4	5C
R5	6B
R6	6C
R7	6C
R8	8B
R9	8C
R10	9B
R11	10B
R12	11C
R13	12C
R14	13B
R15	14C
R16	16B
R17	16C
R18	17C
R19	17B
R20	17C
R21	18C
R22	20C
R23	20B
R24	22C
R25	6E

REF. DESIG.	DRAWING LOCATION
R26	6F
R27	6F
R28	7F
R29	7F
R30	8E
R31	8C
R32	9E
R33	9G
R34	9G
R35	10G
R36	11F
R37	11F
R38	12F
R39	14F
R40	14F
R41	15G
R42	15E
R43	15F
R44	16F
R45	17E
R46	17F
R47	18F
R48	19E
R49	18G
R50	20E
R51	19G
R52	19H
R53	20H
R54	21G
R55	22F
R56	21H
R57	19C
TP1	12B
TP2	16B
TP3	19B
TP4	19F
TP5	21G
A1J6	1C
A1R49	24F
A1S13	2C

NOTES

1. Component values expressed in ohms, picofarads, and microhenries unless otherwise noted.
2. ——— -- ——— indicates etched circuit assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted.
5. Dc voltages are preceded by "+" or "–".
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Parts location information is given in map-type coordinates in accompanying table.
8. Alternate value supplied is 0.05 μf. Use 0.047 μf for replacement.

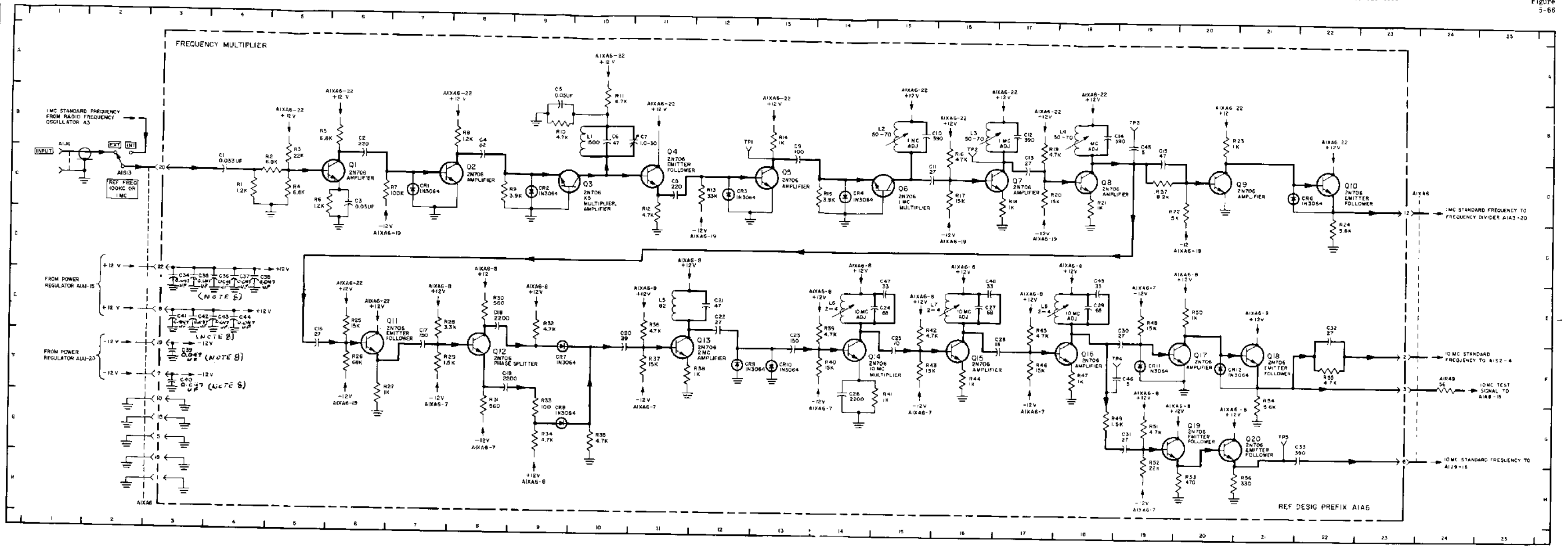


Figure 5-66. 10-Mc and 1-Mc Multiplier, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION
C1	3B
C2	3C
C3	6D
C4	7B
C5	7D
C6	8B
C7	8C
C8	11B
C9	11C
C10	12B
C11	12C
C12	15B
C13	15D
C14	16B
C15	16D
C16	22A
C17	19B
C18	19D
C19	20B
C20	20D
C21	3C
C22	4F
C23	8E
C24	9E
C25	10E
C26	4B
C27	16E
C28	15G
C29	17E
C30	17G
C31	13G
CR1	6C
CR2	7C
CR3	8C
CR4	8C
CR5	10C
CR6	11C

REF. DESIG.	DRAWING LOCATION
CR7	11D
CR8	12C
CR9	14D
CR10	12C
CR11	14C
CR12	15C
CR13	16C
CR14	16C
CR15	18C
CR16	19C
CR17	20C
CR18	20C
CR19	6F
CR20	15F
CR21	16G
CR22	17F
CR23	12G
Q1	6B
Q2	9B
Q3	10B
Q4	13B
Q5	14B
Q6	6E
Q7	17B
Q8	21B
Q9	6E
Q10	7F
Q11	9F
Q12	10E
Q13	11E
Q14	15F
Q15	18F
Q16	13F
Q17	19F
R1	6C
R2	6B

REF. DESIG.	DRAWING LOCATION
R3	6D
R4	7B
R5	7C
R6	8C
R7	8B
R8	9B
R9	9D
R10	10D
R11	10B
R12	11B
R13	11C
R14	12C
R15	13C
R16	13B
R17	12C
R18	14D
R19	14B
R20	15B
R21	15C
R22	16C
R23	16C
R24	17B
R25	17D
R26	18D
R27	22B
R28	18B
R29	19C
R30	19C
R31	20C
R32	20B
R33	21B
R34	20D
R35	7E
R36	6E
R37	6E
R38	6F

REF. DESIG.	DRAWING LOCATION
R39	6F
R40	8F
R41	8F
R42	8E
R43	9F
R44	9E
R45	9F
R46	10E
R47	10E
R48	10F
R49	14D
R50	11E
R51	12F
R52	15F
R53	15E
R54	16F
R55	16F
R56	16F
R57	17F
R58	17F
R59	17E
R60	17F
R61	19G
R62	13F
R63	13F
R64	12F
R65	19F
R66	18F
R67	18G
R68	4E
TP1	7F
TP2	15E
TP3	20F
TP4	21B
J6	1C
S3	2C

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted. Feedback paths weighted and dashed.
5. Dc voltages are preceded by "+" or "-".
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Parts location information is given in map-type coordinates in accompanying table.

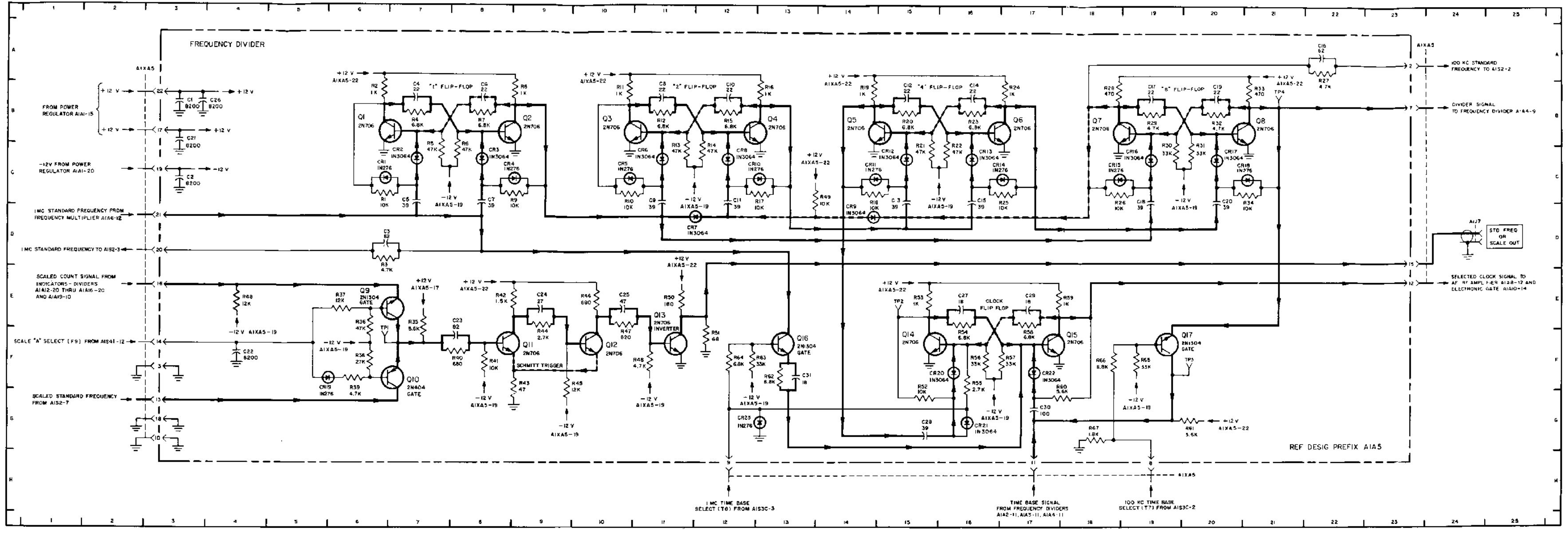


Figure 5-67. Scaler, Frequency Divider A1A5, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	6A	CR2	5B	Q13	5F	R26	14B	R62	10F
C2	7A	CR3	7B	Q14	8F	R27	15B	R63	11G
C3	6C	CR4	8B	Q15	9F	R28	15C	R64	10F
C4	7C	CR5	9B	Q16	12F	R29	15B	R65	11F
C5	10A	CR6	10C	Q17	13F	R30	16A	R66	11F
C6	11A	CR7	11B	Q18	16F	R31	15C	R67	12E
C7	9C	CR8	14B	Q19	17F	R32	17A	R68	11G
C8	11C	CR9	15B	Q20	20F	R33	17C	R69	12G
C9	14A	CR10	13C	Q21	21F	R34	18B	R70	13E
C10	15A	CR11	18B	Q22	22F	R35	18C	R71	13G
C11	13C	CR12	19B	R1	21A	R36	18B	R72	14F
C12	15C	CR13	5G	R2	5A	R37	19B	R73	15G
C13	18A	CR14	6G	R3	5C	R38	19B	R74	14F
C14	19A	CR15	7G	R4	6B	R39	20A	R75	15F
C15	18C	CR16	8G	R5	6C	R40	19C	R76	15F
C16	19C	CR17	10G	R6	6B	R41	21C	R77	16E
C17	3F	CR18	10H	R7	7B	R42	21D	R78	15F
C18	3E	CR19	11G	R8	7C	R43	21C	R79	17G
C19	6E	CR20	13G	R9	7B	R44	22C	R80	21H
C20	7E	CR21	14G	R10	8A	R46	21D	R81	17E
C21	6G	CR22	15G	R11	8C	R47	21E	R82	18F
C22	7G	CR23	18G	R12	23C	R48	20C	R83	18F
C23	10E	CR24	19G	R13	9A	R49	20E	R84	19F
C24	11E	Q1	5B	R14	9C	R50	5E	R85	18G
C25	10G	Q2	8B	R15	10B	R51	5G	R86	19F
C26	11G	Q3	9B	R16	10B	R52	6F	R87	20E
C27	14E	Q4	12B	R17	11B	R53	6F	R88	19G
C28	15E	Q5	13B	R18	11C	R54	7F	R90	22E
C29	14G	Q6	16B	R19	11B	R55	6G	R91	22G
C30	15G	Q7	17B	R20	12B	R56	7F	R92	21E
C31	18E	Q8	19B	R21	11C	R57	8E	R93	21F
C32	19E	Q9	21C	R22	12C	R58	7G	TP1	20B
C33	18G	Q10	22D	R23	13A	R59	23F	TP2	60G
C34	19G	Q11	20D	R24	13C	R60	9E	TP3	23D
CR1	5B	Q12	20E	R25	14B	R61	9G		

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "+" or "-".
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. Parts location information is given in map-type coordinates in accompanying table.
7. Assemblies A1A2, A1A3, and A1A4 are identical and are all represented by figure 5-68.
8. Source and destination of divider signal shown in tabular form.

*9. Connector designations as follows: A1XA2 for assembly A1A2, A1XA3 for assembly A1A3, and A1XA4 for assembly A1A4.

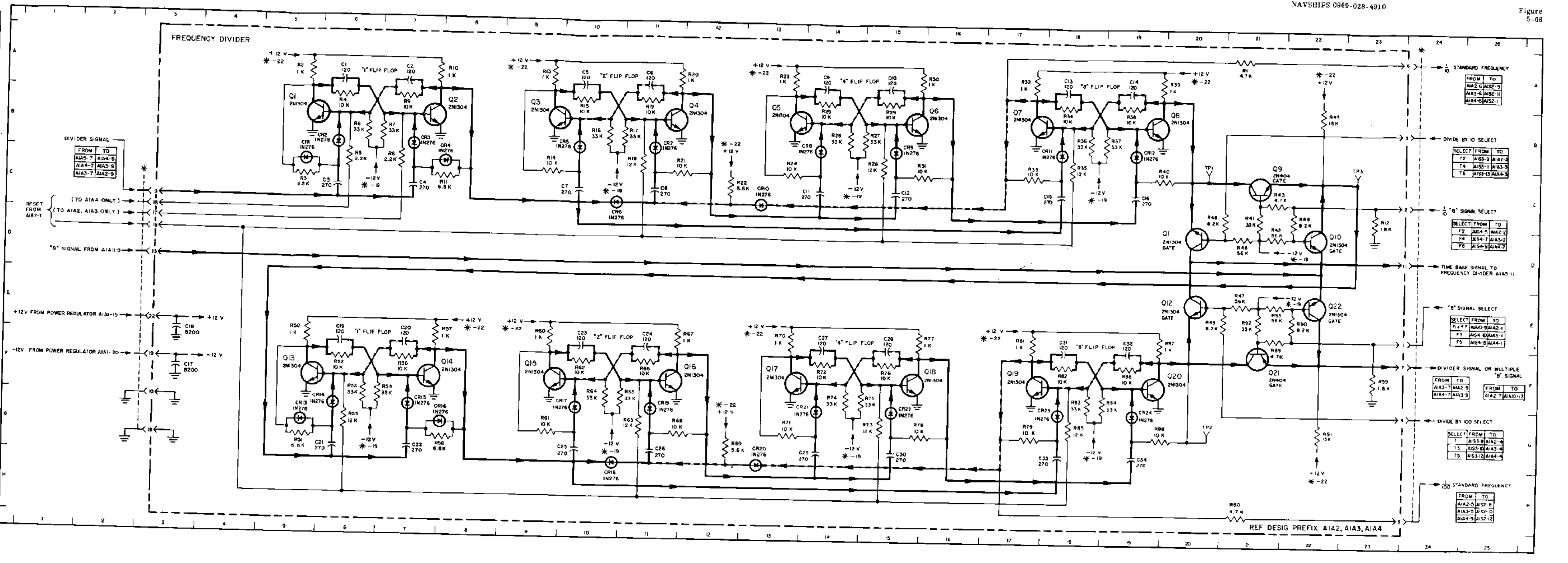


Figure 5-68. Scaler, Frequency Dividers A1A2 through A1A4, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	3G	CR8	4E	Q16	20C	R30	8B
C3	19G	CR9	4D	Q17	12C	R31	8C
C4	8G	CR10	14B	Q18	21D	R32	9B
C5	4D	CR11	15C	Q19	21C	R33	15C
C6	3D	CR12	15C	R1	9G	R34	16C
C7	14F	CR13	8C	R2	10G	R35	16C
C8	6C	CR14	8C	R3	17F	R36	15C
C9	3F	CR15	8D	R7	17G	R37	10C
C10	19D	CR16	10C	R8	9F	R38	9C
C11	15D	CR17	10C	R9	10F	R39	9C
C12	8D	CR18	17C	R10	16G	R40	17C
C13	3F	CR19	17C	R11	11F	R41	10C
C14	15B	CR20	17C	R12	11F	R42	10D
C15	9B	CR21	18B	R13	4D	R43	20D
C16	4G	CR22	12B	R14	12F	R44	21E
C17	3G	CR23	12D	R15	12G	R45	18B
C18	4F	Q1	10G	R16	4D	R46	20B
C19	17B	Q2	17G	R17	14G	R47	19C
C20	17D	Q4	10F	R18	13G	R48	11B
C21	10B	Q5	12F	R19	16G	R49	17D
C22	10D	Q6	13F	R20	16F	R50	12D
C24	4F	Q7	5C	R21	5D	R51	21E
C25	4B	Q8	15F	R22	5C	R52	21C
C26	4B	Q9	16	R23	15F	R53	7G
CR1	22G	Q10	5C	R24	6B	R54	18G
CR2	23G	Q11	20E	R25	5B	TP1	15E
CR3	23B	Q12	14C	R26	19D	TP2	16F
CR4	23A	Q13	7B	R27	19E	TP3	22E
CR6	7G	Q14	18B	R28	19E	TP4	22C
CR7	32H	Q15	11C	R29	14B	TP5	6B

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. ——— -- ——— indicates assembly boundaries.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "+" or "-".
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. Parts location information is given in map-type coordinates in accompanying table.
7. Alternate value supplied is 0.05 µf. Use ɔ.047 µf for replacement.

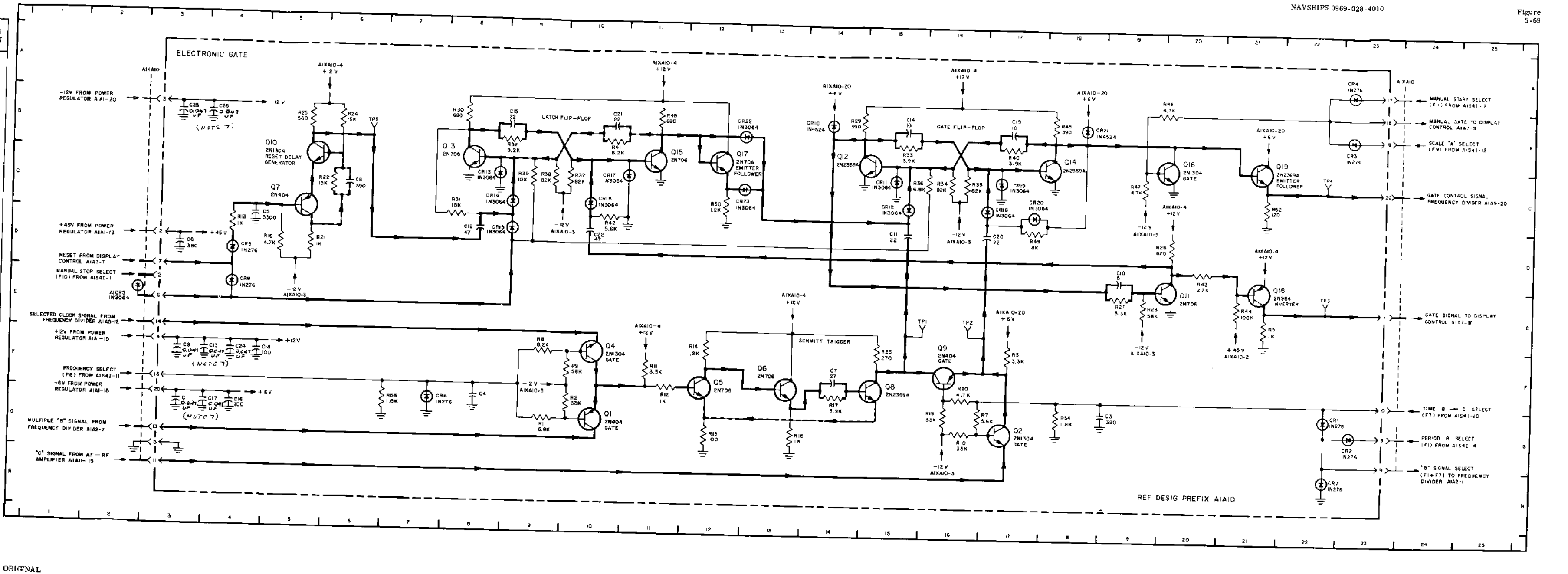


Figure 5-69. Gate Control, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	4B	CR1	4D	Q10	12E	R23	16A
C2	4C	CR2	5D	Q11	13E	R24	17C
C3	5E	CR3	7D	Q12	14E	R25	8H
C4	4G	CR4	4E	Q13	16E	R26	8E
C5	10B	CR5	4E	Q14	12B	R27	8F
C6	3D	CR6	4F	R1	5B	R28	9E
C7	15A	CR7	4F	R2	5B	R29	9F
C8	15C	CR8	10B	R3	5C	R30	9D
C9	7C	CR9	10G	R4	7C	R31	10E
C10	8G	CR10	13E	R5	6D	R32	10F
C11	8H	CR11	15F	R6	5D	R33	10E
C12	8G	CR12	16G	R7	6D	R34	11F
C13	9E	CR13	17E	R8	6D	R35	11F
C14	9E	E5	9E	R9	6E	R36	12D
C15	9F	E6	8G	R10	5G	R37	12F
C16	10F	L1	3C	R11	5G	R38	12E
C17	10G	L2	16A	R12	6G	R39	13F
C18	12E	Q1	5A	R13	9B	R40	14F
C19	15E	Q2	5B	R14	10C	R41	14E
C20	4D	Q3	5C	R15	11B	R42	15F
C21	4D	Q4	7G	R16	11A	R43	16E
C22	3G	Q5	11B	R17	14C	R44	16F
C23	3G	Q6	14A	R18	15B	R45	12A
C24	3G	Q7	17C	R19	15C	TP1	6H
C25	3G	Q8	9F	R20	15D	TP2	15E
C26	3D	Q9	11F	R21	15B	TP3	17B
				R22	16C	TP4	8A

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Dc voltages are preceded by "+" or "-".
4. The letters CW, placed adjacent to the appropriate terminals of A1A8R30 indicate the direction of rotation viewed from the shaft end.
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. Parts location information is given in map-type coordinates in accompanying table.
7. Alternate value supplied is 0.05 μf. Use 0.047 μf for replacement.

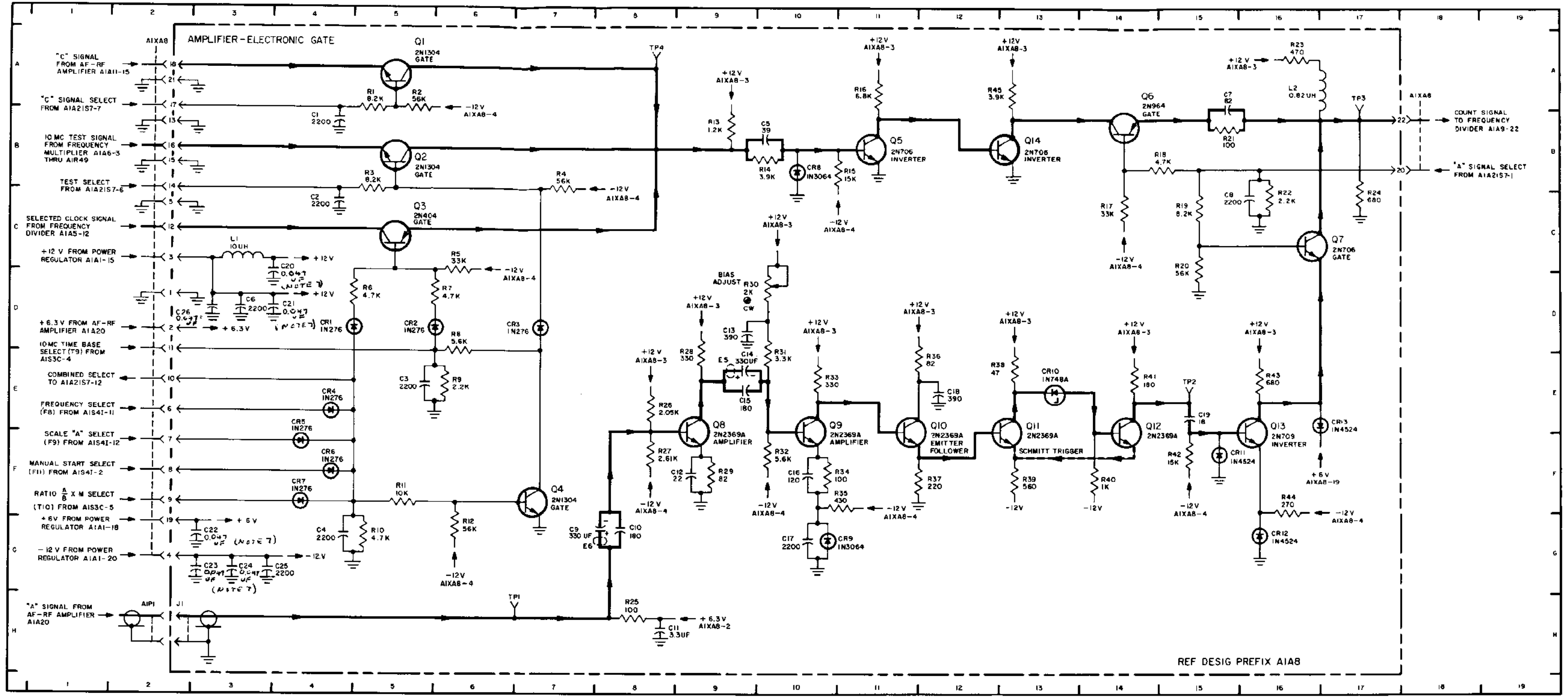


Figure 5-70. Count Control, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	7C	CR22	20C	R9	5D	R30	17D
C2	9C	Q1	8C	R10	10D	R31	18C
C3	10D	Q2	7C	R11	9C	R32	22D
C4	15D	Q3	6C	R12	10C	R33	21D
C5	15C	Q4	9C	R13	11C	R34	21B
C6	17C	Q5	11C	R14	10C	R35	19B
C7	17D	Q6	13C	R15	9D	R36	19C
C8	22D	Q7	14C	R16	13C	R37	20B
C9	19C	Q8	16C	R17	12D	R38	23C
C10	22C	Q9	18C	R18	13C	R39	21C
C11	3E	Q10	21C	R19	12D	R40	23C
CR1	6C	Q11	20C	R20	11D	R41	24D
CR2	5D	Q12	23C	R21	12D	R42	11D
CR3	9D	Q13	24C	R22	16C	R50	7D
CR4	11D	R1	8C	R23	14D	R51	20C
CR5	15D	R2	8F	R24	15D	R52	20D
CR6	21C	R3	7C	R25	14C	TP1	8C
CR7	19B	R4	8D	R26	16C	TP2	7E
CR9	19E	R5	7D	R27	15C	TP3	16C
CR10	20E	R6	6D	R28	18D	TP4	19C
CR11	23C	R7	5C	R29	17C	TP5	24E
CR21	7D	R8	5D				

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— - - - —— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted. Feedback paths weighted and dashed.
5. Dc voltages are preceded by "+" or "-".
6. The letters CCW, placed adjacent to the appropriate terminals of A1R1, indicate the direction of rotation viewed from the shaft end.
7. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
8. Parts location information is given in map-type coordinates in accompanying table.

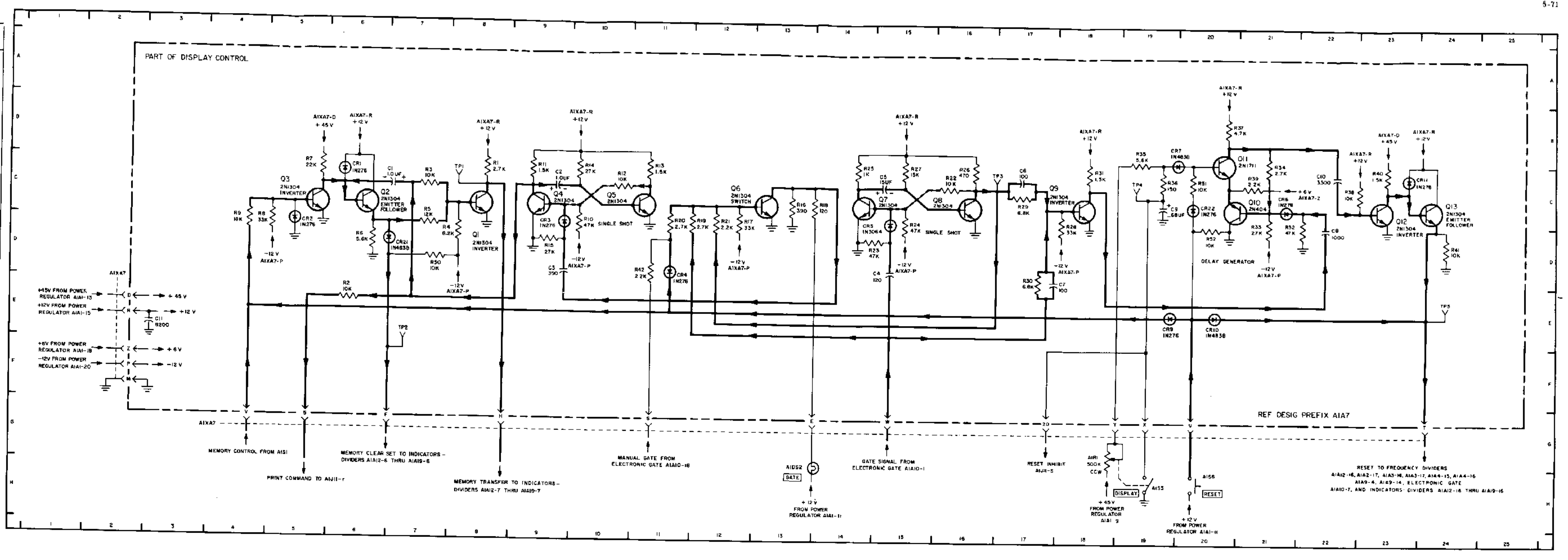


Figure 5-71. Cycle Control, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	3B	C54	4C	L4	12C	R13	9E
C2	4E	C55	4C	L5	14C	R14	13G
C3	5F	C56	4G	L6	15C	R15	10E
C4	7D	CR1	6E	L7	15E	R16	10E
C5	8D	CR2	6E	L21	22C	R17	11E
C6	9F	CR3	6D	Q1	4D	R18	12C
C7	3B	CR4	7E	Q2	5D	R19	11C
C8	10D	CR5	8C	Q3	7E	R20	13F
C9	16G	CR6	9E	Q4	7D	R21	12F
C10	11E	CR7	9E	Q5	9D	R22	13D
C11	15E	CR8	9C	Q6	12E	R23	14D
C12	13H	CR9	10E	Q7	12D	R24	14F
C13	12E	CR10	11F	Q8	14D	R25	14C
C14	15E	CR11	11D	Q9	15E	R26	16F
C16	17D	CR12	12D	Q10	17D	R27	16E
C17	4B	CR13	13D	Q11	19D	R28	18E
C18	18E	CR14	10G	Q12	20D	R29	18E
C19	3G	CR15	10G	Q13	22D	R30	19E
C20	4B	CR16	14D	R1	4E	R31	20C
C21	5B	CR17	14D	R2	5D	R32	20C
C22	19D	CR18	15D	R3	5D	R33	21C
C23	21C	CR19	16F	R4	6E	R34	21C
C24	5B	CR20	17E	R5	5F	R35	22C
C25	6B	CR21	19D	R6	5F	R82	15E
C26	4G	CR22	20D	R7	7E	R83	19C
C27	4G	CR23	21D	R8	8C	TP2	23C
C42	3C	CR64	5E	R9	9E	TP3	3D
C50	3G	L1	8C	R10	8E	TP4	6D
C51	4G	L2	9C	R11	8E	TP5	10D
C53	6B	L3	11E	R12	9C		

NOTES

1. Component values expressed in ohms, microhenries, and picrofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "+" or "-".
5. The letters CW, placed adjacent to the appropriate terminals of A1A9R11, indicate the direction of rotation viewed from the shaft end.
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Parts location information is given in map-type coordinates in accompanying table.
8. Alternate value supplied is 0.05 μf. Use 0.047 μf for replacement.

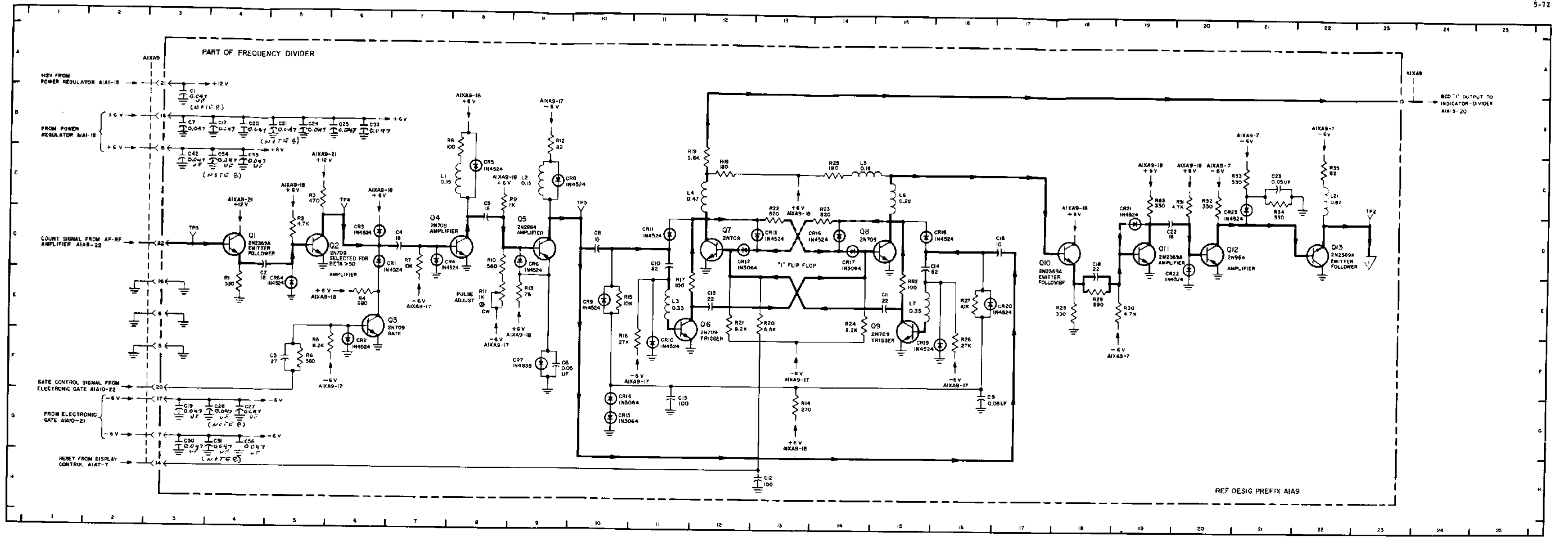
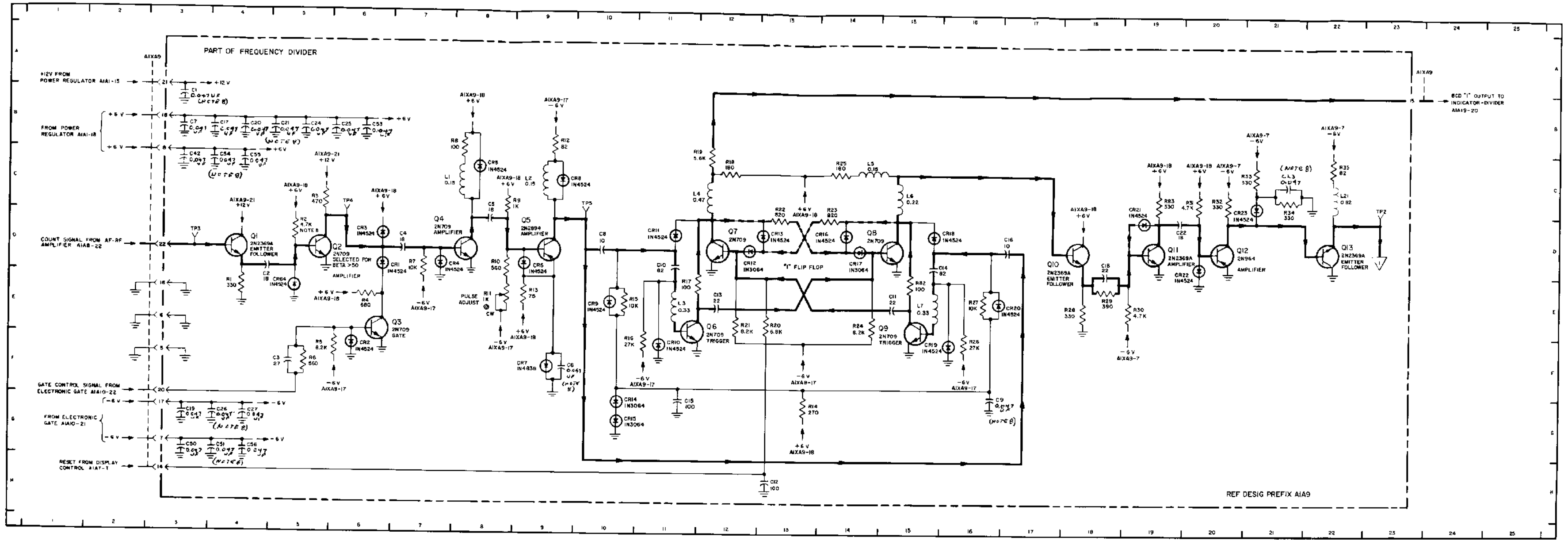


Figure 5-72. Count Decades, Frequency Divider A1A9, Schematic Diagram (Sheet 1 of 2)



PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	3B	C54	4C	L4	12C	R13	9E
C2	4E	C55	4C	L5	14C	R14	[illegible]G
C3	5F	C56	4G	L6	15C	R15	10E
C4	7D	CR1	6E	L7	15E	R16	10E
C5	8D	CR2	6E	L21	22C	R17	11E
C6	9F	CR3	6D	Q1	4D	R18	12C
C7	3B	CR4	7E	Q2	5D	R19	11C
C8	10D	CR5	8C	Q3	7E	R20	13F
C9	16G	CR6	9E	Q4	7D	R21	12F
C10	11E	CR7	9E	Q5	9D	R22	13D
C11	15E	CR8	9C	Q6	12E	R23	14D
C12	13H	CR9	10E	Q7	12D	R24	14F
C13	12E	CR10	11F	Q8	14D	R25	14C
C14	15E	CR11	11D	Q9	15E	R26	16F
C16	17D	CR12	12D	Q10	17D	R27	16E
C17	4B	CR13	13D	Q11	19D	R28	18E
C18	18E	CR14	10G	Q12	20D	R29	18E
C19	3G	CR15	10G	Q13	22D	R30	19E
C20	4B	CR16	14D	R1	4E	R31	20C
C21	5B	CR17	14D	R2	5D	R32	20C
C22	19D	CR18	15D	R3	5D	R33	21C
C23	21C	CR19	16F	R4	6E	R34	21C
C24	5B	CR20	17E	R5	5F	R35	22C
C25	6B	CR21	19D	R6	5F	R82	15E
C26	4G	CR22	20D	R7	7E	R83	19C
C27	4G	CR23	21D	R8	8C	TP2	23C
C42	3C	CR64	5E	R9	9E	TP3	3D
C50	3G	L1	8C	R10	8E	TP4	6D
C51	4G	L2	9C	R11	8E	TP5	10D
C53	6B	L3	11E	R12	9C		

NOTES

1. Component values expressed in ohms, microhenries, and picofarads unless otherwise noted.
2. —— · —— indicates assembly boundaries.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "[illegible]" or "[illegible]".
5. The letters CW, placed adjacent to the appropriate terminals of A1A9R11, indicate the direction of rotation viewed from the shaft end.
6. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
7. Parts location information is given in map-type coordinates in accompanying table
8. Alternate value supplied is 0.05 μf. Use 0.047 μf for replacement.

Figure 5-72. Count Decades, Frequency Divider A1A9, Schematic Diagram (Sheet 1 of 2)

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION
C28	3D
C29	9G
C30	4D
C31	7E
C32	5E
C33	8D
C34	13G
C35	9D
C36	10D
C37	16G
C38	11E
C39	14E
C40	12E
C41	15D
C43	16D
C44	17D
C45	23G
C46	18D
C47	21E
C48	19E
C49	22D
C52	23D
CR24	3D
CR25	3E
CR26	4F
CR27	4D
CR28	5D
CR29	6D
CR30	6D
CR31	7D
CR34	8D
CR35	8F
CR36	9E

REF. DESIG.	DRAWING LOCATION
CR37	10D
CR38	10E
CR39	11F
CR40	11D
CR41	12D
CR42	12D
CR43	13D
CR44	14D
CR47	15D
CR48	15F
CR49	16E
CR50	15D
CR51	18D
CR52	17E
CR53	17D
CR54	18F
CR55	19D
CR56	19D
CR57	20D
CR58	21D
CR61	22D
CR62	22F
CR63	23E
L9	4E
L10	5C
L11	7C
L12	8E
L13	11E
L14	12C
L15	14C
L16	15E
L17	18E
L18	19C

REF. DESIG.	DRAWING LOCATION
L19	21C
L20	22E
Q14	5E
Q15	5D
Q16	7D
Q17	8E
Q18	12E
Q19	12D
Q20	14D
Q21	14E
Q22	19E
Q23	19D
Q24	21D
Q25	21E
R36	23B
R37	3E
R38	3F
R39	4E
R40	5C
R41	5E
R42	6D
R43	6D
R44	6D
R45	7D
R46	7C
R47	8B
R48	8E
R49	9F
R50	9E
R51	10E
R52	10F
R53	11E

REF. DESIG.	DRAWING LOCATION
R54	12C
R55	14E
R56	13D
R57	13D
R58	13E
R59	12E
R60	14C
R61	14B
R62	15E
R63	16F
R64	16E
R65	13G
R66	20G
R67	17E
R68	17F
R69	18E
R70	19C
R71	19F
R72	20D
R73	20D
R74	20F
R75	21F
R76	21C
R77	22B
R78	22E
R79	22F
R80	23E
R81	23C
R84	3G
R85	10G
R86	17G
TP1	24B

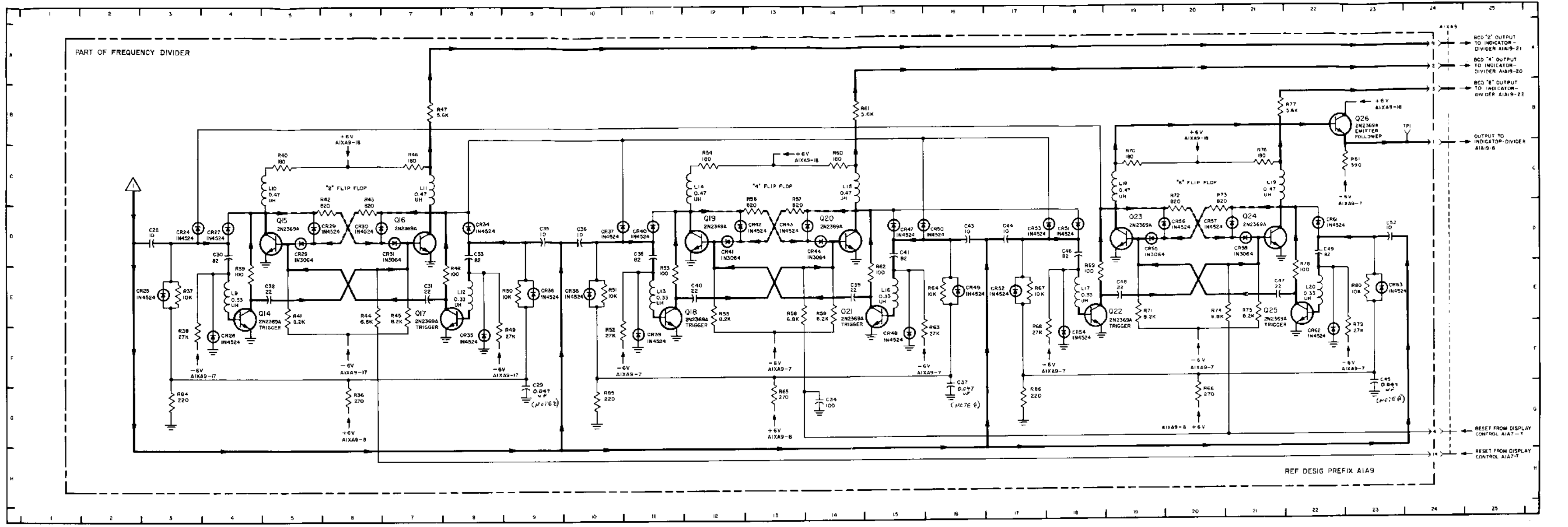


Figure 5-72. Count Decades, Frequency Divider A1A9, Schematic Diagram (Sheet 2 of 2)

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	6D	R50	7D
C2	4C	R52	12C
C3	9D	R53	9E
C4	11C	R54	10D
C5	4C	R55	11E
C6	4C	R56	11E
CR17	8D	R57	13E
CR18	10E	R58	14E
CR19	4D	R59	13D
Q10	7D	R60	14D
Q11	7D	R61	16E
Q12	10D	R62	17E
Q13	13D	R63	17E
Q14	14D	R64	16D
Q15	15D	R65	16D
Q16	17D	R66	17D
Q17	18D	R67	19E
Q18	20D	R68	20E
Q19	21D	R69	20E
Q20	23D	R70	19D
R38	23F	R71	20D
R39	20F	R72	22E
R40	17F	R73	23E
R41	9E	R74	23E
R43	14F	R75	23D
R44	4D	R76	23D
R45	11F	TP1	9D
R46	5E	TP2	21C
R47	6E	TP3	15C
R48	7E	TP4	18C
R49	8C	TP5	24C

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Primary signal paths weighted.
4. Dc voltages are preceded by "+" or "-".
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. Parts location information is given in map-type coordinates in accompanying table.

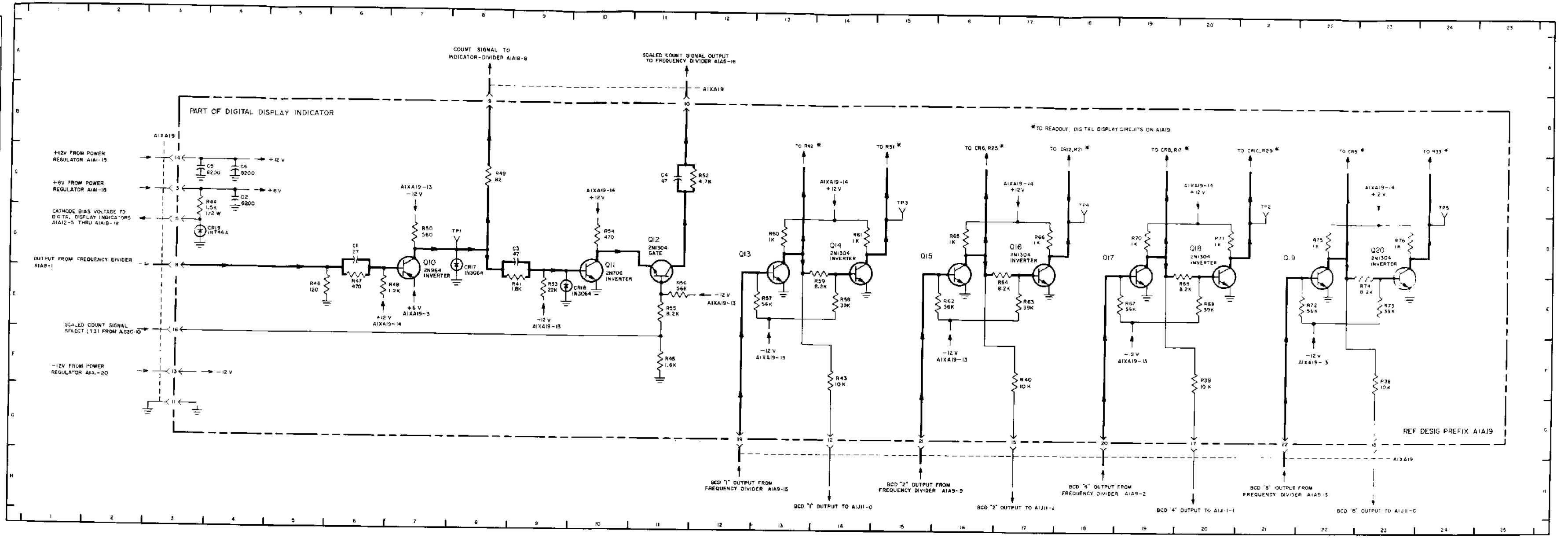


Figure 5-73. Count Decades, Inverter Circuits on A1A19, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	5D	CR23	9E	Q15	16D	R61	12E
C2	7D	CR24	10E	Q16	18D	R62	13E
C3	7E	CR25	9E	Q17	20D	R63	13E
C4	5E	CR26	12E	Q18	22F	R64	13D
C5	10E	CR27	11E	R38	9G	R65	14D
C6	10D	CR28	10E	R39	17G	R66	15E
C7	11D	CR29	15E	R40	13G	R67	15E
C8	11E	CR30	12E	R41	4G	R68	15E
C9	14E	CR31	13E	R43	5D	R69	15D
C10	14D	CR32	14E	R44	5E	R70	16D
C11	16D	CR33	14D	R45	5D	R71	16E
C12	16E	CR34	16D	R46	6E	R72	18E
C13	18E	CR35	16E	R47	6E	R73	18D
C14	19D	CR36	16E	R48	6E	R74	23F
C15	20D	CR37	18E	R49	7D	R75	22F
C16	20E	CR38	18E	R50	8D	R76	19D
C17	3E	CR39	18D	R52	7E	R77	19E
C18	3F	CR40	20D	R53	9E	R78	19E
C19	23E	CR41	20E	R54	9D	R79	20E
CR19	5E	CR42	21E	R55	10D	R80	20D
CR18	5E	Q10	5D	R56	10E	R81	21D
CR19	5E	Q11	8D	R57	11D	R82	23F
CR20	7E	Q12	9D	R58	11E	R83	21F
CR21	7E	Q13	12D	R59	11D	TP1	22C
CR22	8E	Q14	13D	R60	12D	TP2	3F

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. ——— -- ——— indicates assembly boundaries.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "+" or "-".
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. Parts location information is given in map-type coordinates in accompanying table.
7. Counter portions of assemblies A1A17 and A1A18 are identical and are represented by figure 5-74.
8. Source and destination of counter signal shown in tabular form.
*9. Connector designations as follows: A1XA17 for assembly A1A17 and A1XA18 for assembly A1A18.

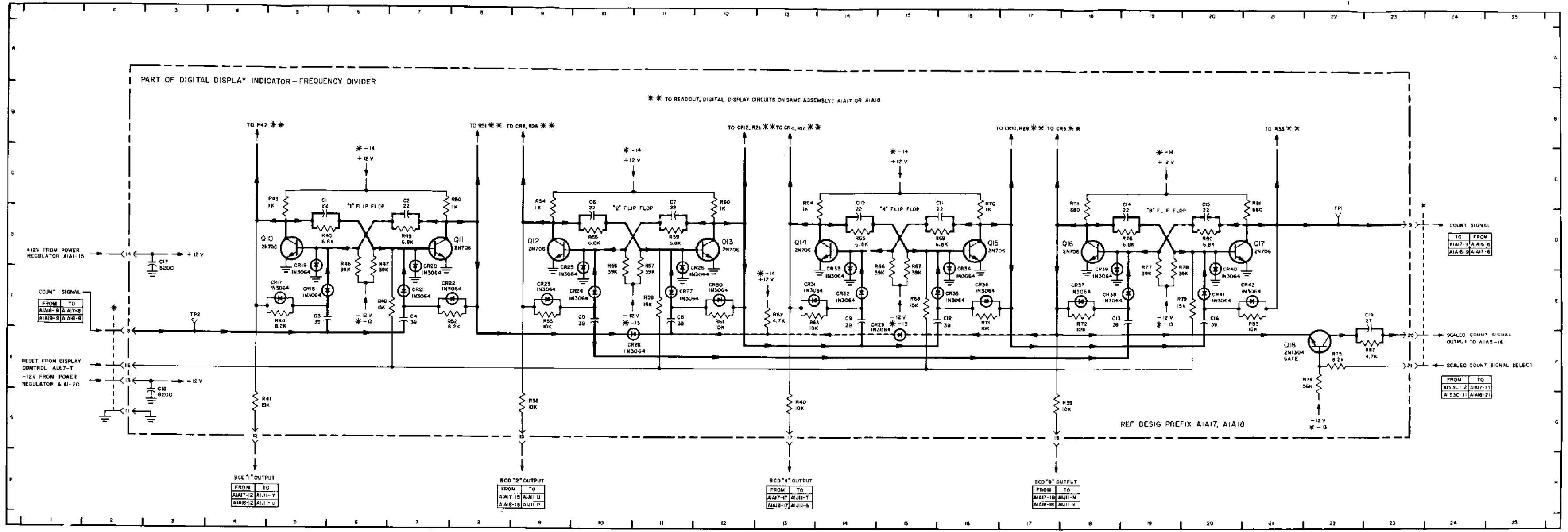


Figure 5-74 Count Decades, Frequency Divider Circuits on A1A17 and A1A18, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
C1	6D	CR26	20E	R58	11E
C2	7D	Q10	5D	R59	11D
C3	6E	Q11	8D	R60	12D
C4	7E	Q12	9D	R61	12E
C5	10E	Q13	12D	R62	13E
C6	10D	Q14	13D	R63	13E
C7	11D	Q15	16D	R64	14D
C8	11E	Q16	18D	R65	14D
C9	14E	Q17	20D	R66	15E
C10	14D	Q18	22F	R67	15E
C11	15D	R38	9G	R68	15E
C12	15E	R39	18G	R69	15D
C13	19E	R10	13G	R70	16D
C14	19E	R41	4G	R71	16E
C15	20D	R43	5D	R72	18E
C16	20E	R44	5E	R73	18D
C17	3E	R45	6D	R74	22F
C18	3F	R46	6E	R75	22F
C19	23E	R47	6E	R76	19D
CR17	5E	R48	6E	R77	19E
CR18	7E	R49	7D	R78	19E
CR19	10E	R50	8D	R79	19E
CR20	11E	R52	7E	R80	20D
CR21	10F	R53	9E	R81	20D
CR22	15E	R54	9D	R82	23F
CR23	14E	R55	10D	R83	21E
CR24	16E	R56	10E	TP1	22D
CR25	18E	R57	11E	TP2	3E

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. - - - - - - indicates assembly boundaries.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "+" or "-".
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. Parts location information is given in map-type coordinates in accompanying table.
7. Counter portions of assemblies A1A12 through A1A16 are identical and are represented by figure 5-75.
8. Source and destination of counter signal shown in tabular form.

*9. Connector designations as follows: A1XA12 for A1A12, A1XA13 for A1A13, A1XA14 for A1A14, A1XA15 for A1A15, A1XA16 for A1A16.

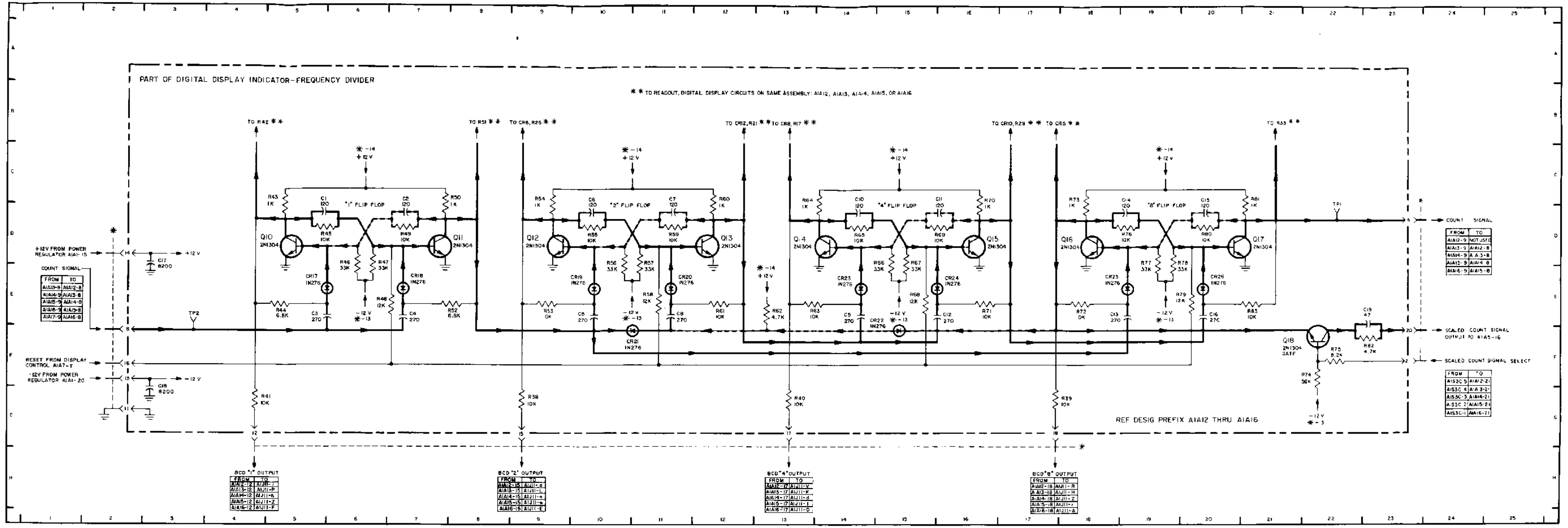


Figure 5-75. Count Decades, Frequency Divider Circuits on A1A12 through A1A16, Schematic Diagram

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION	REF. DESIG.	DRAWING LOCATION
CR1	5D	Q5	12D	R19	11D
CR2	7D	Q6	14D	R20	12D
CR3	5E	Q7	16D	R21	12F
CR4	7E	Q8	19D	R22	13E
CR5	9E	Q9	20D	R23	14D
CR6	11F	R1	5B	R24	15D
CR7	10E	R2	6B	R25	14F
CR8	13F	R3	7B	R26	15E
CR9	13E	R4	8B	R27	16D
CR10	15F	R5	5C	R28	17D
CR11	15E	R6	8C	R29	18F
CR12	17F	R7	5D	R30	18E
CR13	17E	R8	5D	R31	18D
CR14	19E	R9	7D	R32	19D
CR15	18F	R10	8D	R33	19F
CR16	7F	R11	6D	R34	20E
DS1	13B	R12	7D	R35	20D
Q1	4C	R13	6E	R36	21D
Q2	8C	R16	7E	R37	10D
Q3	4E	R17	10F	R42	5F
Q4	8E	R18	11E	R51	7F

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Primary signal paths weighted. Feedback paths weighted and dashed.
4. Dc voltages are preceded by "+" or "-".
5. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
6. Parts location information is given in map-type coordinates in accompanying table.
7. Readout portion of assemblies A1A12 through A1A19 are identical and are represented by figure 5-77.

*8. Connector designations as follows: A1XA12 for A1A12, A1XA13 for A1A13, A1XA14 for A1A14, A1XA15 for A1A15, A1XA16 for A1A16, A1XA17 for A1A17, A1XA18 for A1A18, and A1XA19 for A1A19.

9. ☠ Signifies dangerously high voltages exist. Keep clear! Use extreme care when measuring.

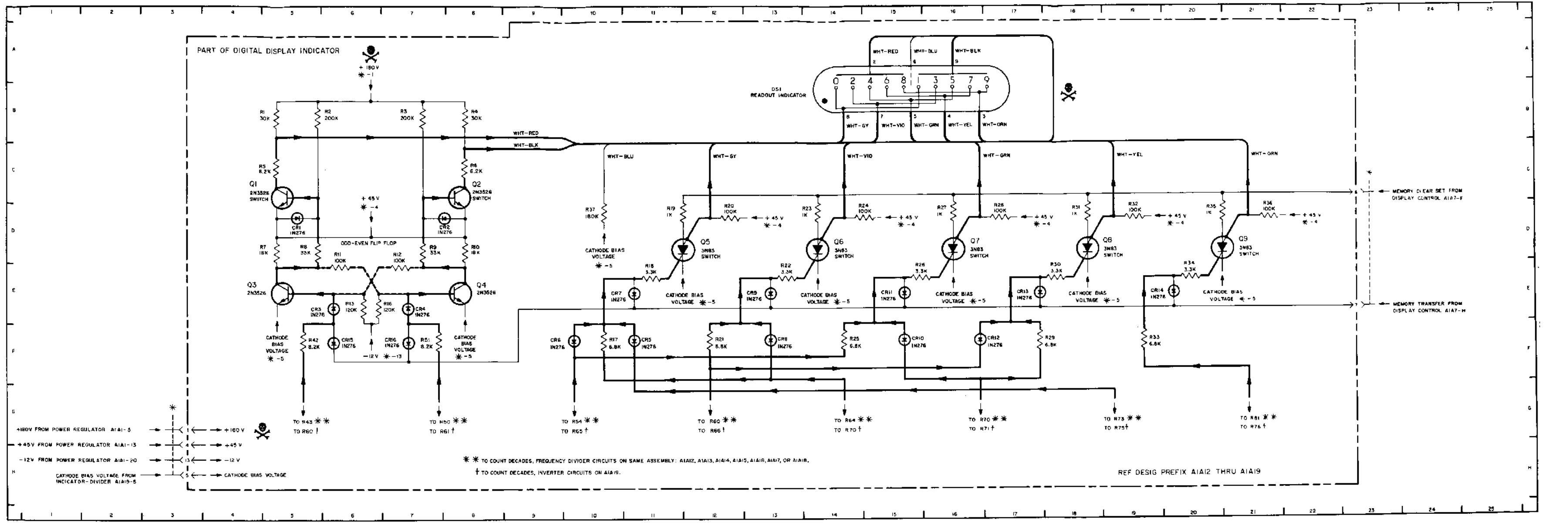


Figure 5-77. Readout, Digital Display Circuits, Schematic Diagram

NOTES

1. Component values expressed in ohms unless otherwise noted.
2. Names of panel controls and connectors are enclosed in boxes.
3. Dc voltages are preceded by "+" or "-".
4. Dc voltages are measured with the AN/USM-98 Voltmeter.
5. A1S3 shown in [10^{-1}] position viewed from control knob end.
6. A1S4 shown in [1] position viewed from control knob end.
7. Switch positions shown in figure 5-81.
8. (skull and crossbones symbol) Signifies dangerously high voltages exist. Keep clear! Use extreme care when measuring.

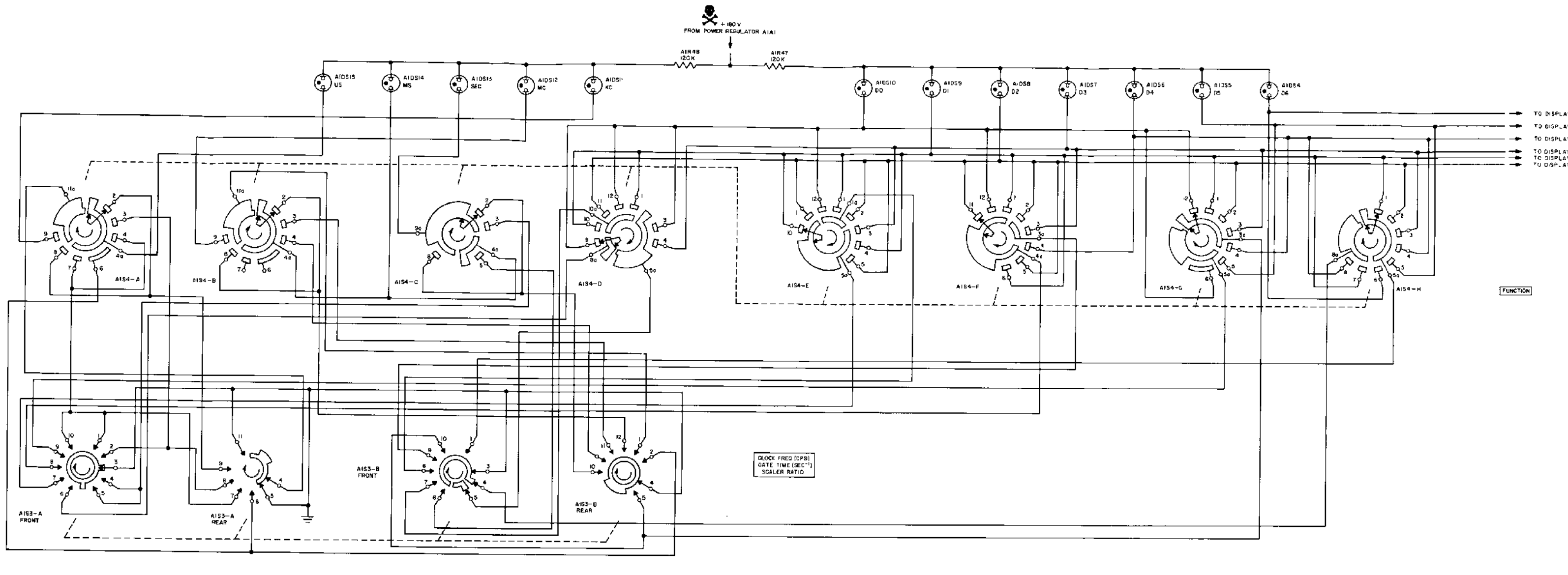


Figure 5-78. Readout, Annunciator Circuits, Schematic Diagram

NOTE

Ref desig prefix A1A1 except as specified.

PARTS LOCATION INDEX

REF. DESIG.	DRAWING LOCATION
C1	12C
C2	11E
C3	13E
C5	15E
C6	14G
C7	12F
CR1	11A
CR5	11B
CR6	11B
CR7	10B
CR8	10B
CR9	11C
CR10	11C
CR11	10C
CR12	10C
CR13	12E
CR14	14E
CR15	10G
CR16	11G
Q1	9E
Q2	10E
Q3	13E
Q4	15F
Q5	16E
Q6	11G
Q7	12H
Q8	12F
R1	12A
R2	12B
R3	12B

REF. DESIG.	DRAWING LOCATION
R4	12C
R5	10E
R6	12E
R7	14D
R8	13F
R9	13F
R10	14F
R11	14F
R12	14F
R13	15G
R14	15E
R15	16E
R16	11G
R17	12G
R18	13G
R19	13G
R20	10G
R21	12F
R22	10D
TP1	11A
TP2	13B
TP3	12C
TP4	16D
TP5	17F
TP6	17H
NOTE The following use ref desig prefix A1A10.	
C2	21G
CR4	22G

REF. DESIG.	DRAWING LOCATION
R4	20G
R5	22G
R6	22G
Q3	21G
NOTE The following use ref desig prefix A1.	
B1	5D
C1	5E
C2	18A
C3	18B
C4	18C
C5	7F
C6	18F
C7	7G
C8	19H
C9	18G
CR1	7E
CR2	7G
CR3	7E
CR4	7G
F1	3D
F2	3E
FL1	1D
S1	2F
T1	5A
J12	1E

NOTES

1. Component values expressed in ohms and picofarads unless otherwise noted.
2. —— -- —— indicates assembly boundaries.
3. Names of panel controls and connectors are enclosed in boxes.
4. Primary signal paths weighted. Feedback paths weighted and dashed.
5. Dc voltages are preceded by "+" or "-". Ac signal and ripple voltages are followed by VAC.
6. The letters CW, placed adjacent to the appropriate terminals of A1A1R8 indicate the direction of rotation viewed from the shaft end.
7. Ac signal and ripple voltages are measured with an AN/USM-140B Oscilloscope.
8. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.
9. Parts location information is given in map-type coordinates in accompanying table.
10. ☠ Signifies dangerously high voltages exist. Keep clear! Use extreme care when measuring.
11. Center terminal of A1FL1 is not included on AN/USM-207 units with serial No. A29 and up. Terminal B of power connector is connected to ground only through mounting hardware."

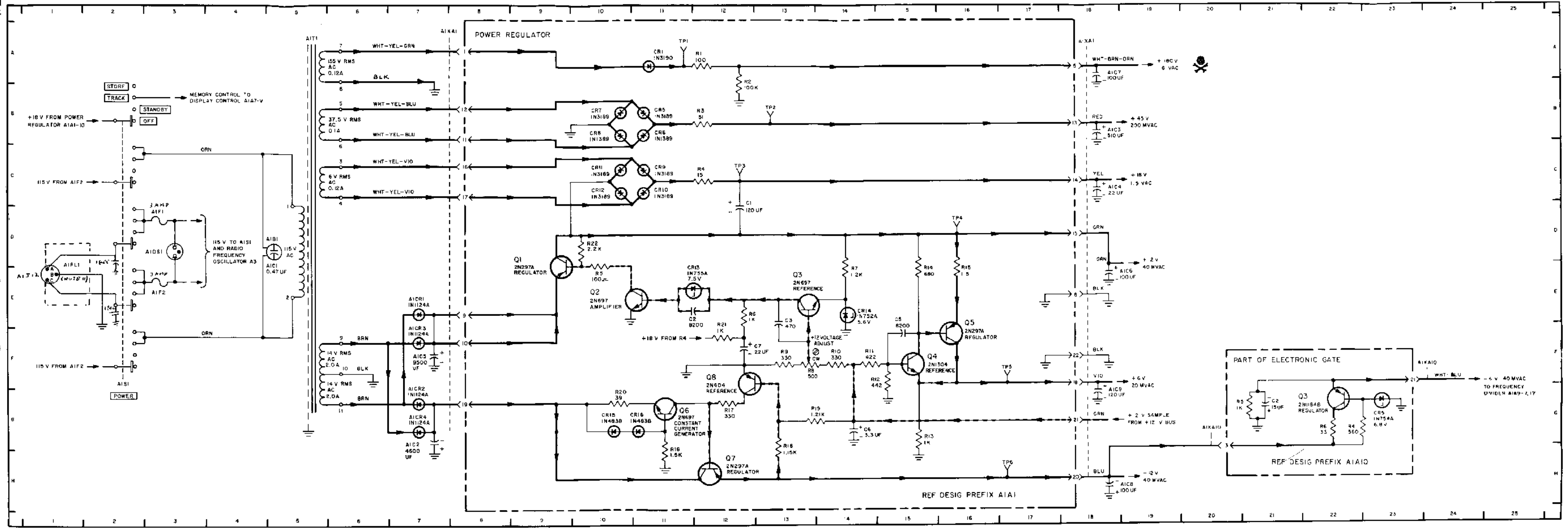


Figure 5-80. Power Supply, Schematic Diagram

NOTE

1. Name of panel connector is enclosed in box.

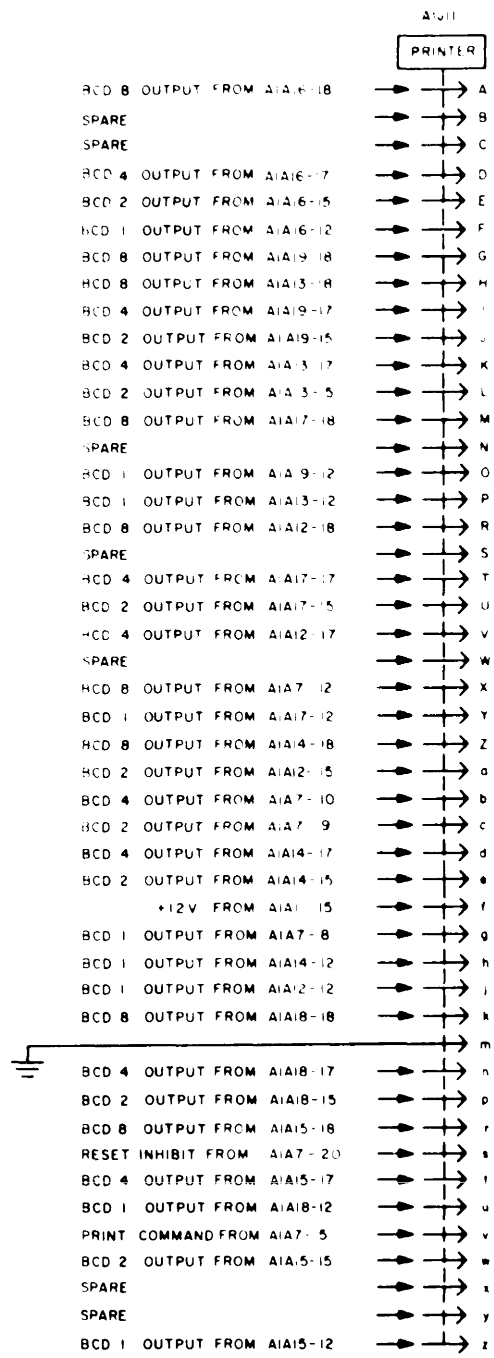


Figure 5-76. Count Decades, Printer Connector, Schematic Diagram

NOTE S

1. Component values expressed in ohms and picofarads unless otherwise noted,
2. — -- — indicates etched circuit boundaries.
3. Dc voltages are preceded by "+" or "-",
4. Dc voltages are measured with a CCUH-801 Dc Differential Voltmeter.

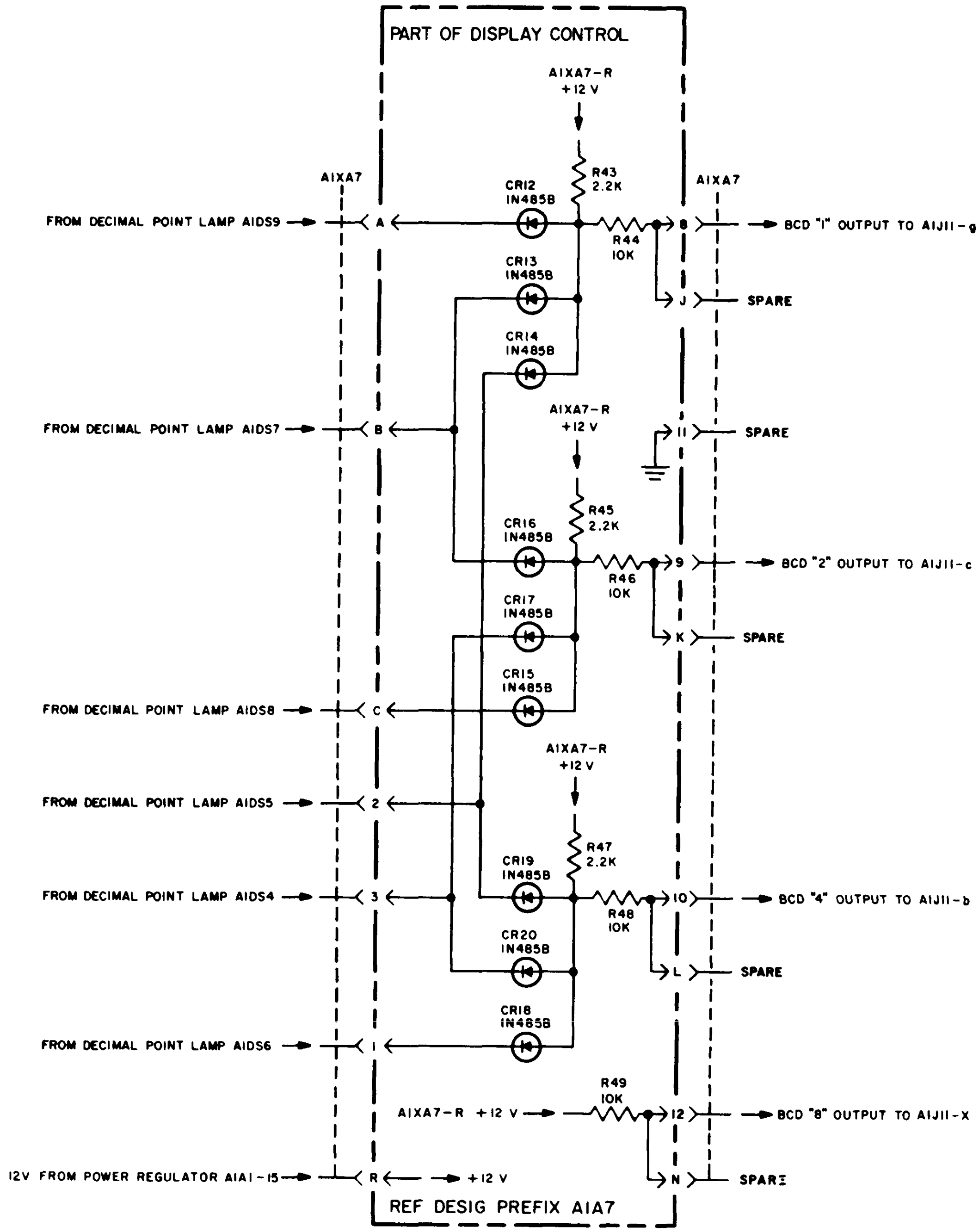


Figure 5-79. Readout, Decimal Point Coding, Schematic Diagram

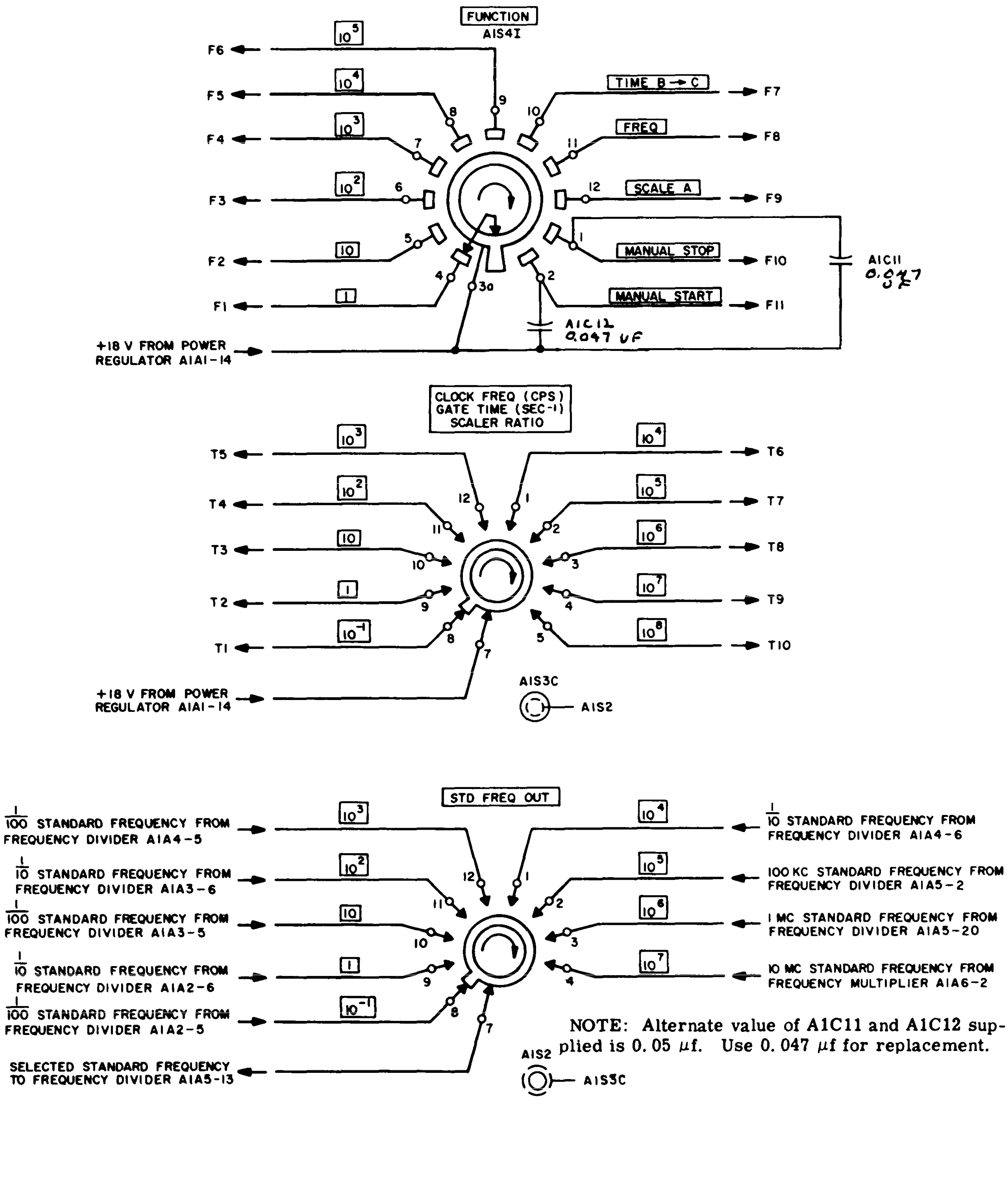


Figure 5-81. Function Switch, Wafer I; Time Base Switch, Wafer C; and Standard Frequency Output Switch, Schematic Diagram

SECTION 6

PREVENTIVE MAINTENANCE INSTRUCTIONS

6-1. Scope of Maintenance

The maintenance duties assigned to the organizational repairman of the equipment are listed below together with a reference to the paragraphs covering the specific maintenance functions.

a. Weekly preventive maintenance checks and and services (para 6-4).

b. Monthly preventive maintenance checks and services (para 6-5).

c. Quarterly preventive maintenance checks and services (para 6-6).

d. Touchup painting (para 6-7).

6-2. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in paragraph 6-7 cover routine systematic care and cleaning essential to proper upkeep and operation of the AN/USM-207.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (para 6-4, 6-5, and 6-6) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipmcnt in a combat-serviceable condition; that is, in good general (phycical) condition and in good operating condition. To assist the organizational repairman in maintaining combat serviceability, the charts indicate what to check, how to check, and the normal condition; the References column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by performing the corrective action indicated, higher category maintenance or repair is required. Record: and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

6-3. Organizational Preventive Maintenance Checks and Services Periods

Organizational preventive maintenance checks and services of the equipment are required weekly, monthly, and quarterly.

a. Paragraph 6-4 specifies the checks and services that must be accomplished weekly.

b. Paragraphs 6-5 and 6-6 specify additional checks and services that must be performed monthly and quarterly, respectively.

6-4. Organizational Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	Procedure	Reference
1	Cables	Inspect cords, cables, and wires for chafed, cracked, or frayed insulation. Replace connectors that are broken, arced, stripped, or worn excessively.	None.
2	Handles and latches	Inspect handles and latches for looseness. Replace or tighten as necessary.	None.
3	Metal surfaces	Inspect exposed metal surfaces for rust and corrosion. Touch up paint as required (para 6-7).	None.

6-5. Organizational Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	Procedure	References
1	Jacks and plugs	Inspect jacks and plugs for snug fit and good contact.	None.
2	Switch decks	Inspect switch decks for loose connections and cracks.	None.
3	Resistors and capacitors ..	Inspect the resistors and capacitors for cracks, blistering, or other defects.	None.
4	Printed circuit boards ...	Inspect printed circuit boards for cracks and breakage.	
5	Air filter	Inspect and clean the air filter, if necessary.	Para 5-22.

6-6. Organizational Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	Procedure	References
1	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
2	Modifications	Check DA Pam 310-4 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	TM 38-750.
3	Spare parts	Check all spare parts (operator and organizational) for general condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions.	

6-7. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TB SIG 364.

APPENDIX A

REFERENCES

Following is a list of references that are available to the organizational, DS, GS, and depot maintenance repairman of **Digital Frequency, Electronic Counter AN/USM-207.**

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TB SIG 364	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 38-750	Army Equipment Record Procedures.

APPENDIX B
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations for AN/USM-207. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition; i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to-Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/ components.

B-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 8, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of task-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C — Operator/Crew
O --- Organizational
F — Direct Support
H — General Support
D — Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Not applicable.

B-4. Tool and Test Equipment Requirements (Sec III).

a. Tool or Test Equipment Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category, The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/UNATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

(Next printed page is B-3)

SECTION II MAINTENANCE ALLOCATION CHART
FOR
DIGITAL READOUT ELECTRONIC COUNTERS
AN/USM-207 AND AN/USM-207A

(1) OUP BER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
00	ELECTRONIC COUNTERS AN/USM-207 AND AN/USM-207A	Inspect		0.5				Visual	
		Test				1.0		1 thru 15	
		Service		0.5				16	
		Adjust				0.5		1 thru 15	
		Align				1.0		1 thru 15	
		Repair				3.0		10	
01	DIGITAL READOUT CP-814/USM-207 AND CP-814A/USM-207	Inspect		0.5				Visual	
		Service		0.5				16	
		Replace				1.0			
		Repair				3.0		10	
0101	VOLTAGE REGULATOR MP22-524 A1A1	Inspect				0.2		Visual	
		Replace				1.0			
		Repair				2.0		10	
0102	FREQUENCY DIVIDERS MP 90563- A1A2, A1A3 AND A1A4	Inspect				0.2		Visual	
		Service				0.5			
		Replace				1.0		1 thru 15	
		Repair				2.0		12	
0103	FREQUENCY DIVIDER MP90-564- A1A5	Inspect				0.2		Visual	
		Service				0.5		1 thru 15	
		Replace				1.0			
		Repair				2.0		10	
0104	FREQUENCY MULTIPLIER MP 25-526 A1A6	Inspect				0.2		Visual	
		Service				0.5		1 thru 15	
		Replace				1.0			
		Repair				2.0		10	
0105	DISPLAY CONTROL MP20-523 A1A7	Inspect				0.2		Visual	
		Replace				1.0			
		Repair				2.0			
0106	AF-RF AMPLIFIER MP 14-545 A1A8	Inspect				0.2			
		Replace				1.0			
		Repair				3.0		10	
0107	FREQUENCY DIVIDER MP90-565 A1A9	Inspect				0.2			
		Replace				0.8			
		Repair				2.0		10	
0108	ELECTRONIC GATE MP17-525 A1A10	Inspect				0.2			
		Replace				1.0			
		Repair				2.5		10	
0109	AF-RF AMPLIFIER MP14-546 A1A11	Inspect				0.2			
		Replace				1.0			
		Repair				3.0		10	
0110	FREQUENCY DIVIDERS MP96-501 A1A12 thru A1A16	Inspect				0.2			
		Replace				1.0			
		Repair				2.0		10	
0111	FREQUENCY DIVIDERS MP96-502 A1A17 and A1A18	Inspect				0.2			
		Replace				1.0			
		Repair				2.0		10	
0112	FREQUENCY DIVIDER MP93-525 A1A19	Inspect				0.2			
		Replace				1.0			
		Repair				2.0		10	
0113	AF-RF AMPLIFIER MP13-509 A1A20	Inspect				0.2			
		Adjust				1.0			
		Repair				3.0		10	
0114	CHANNEL "A" VARIABLE ATTENUATOR MP13-537 A1A21	Inspect		0.2					
		Adjust				0.8		1 thru 15	
		Replace				1.0			
		Repair				2.0		10	
0115	CHANNEL "B" VARIABLE ATTENUATOR MP13-52424 A1A22	Inspect		0.2					
		Replace				1.0			
		Repair				2.0		10	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
DIGITAL READOUT ELECTRONIC COUNTERS
AN/USM 207 AND AN/USM-207A

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT.	(6) REMA
			C	O	F	H	D		
0116	CHANNEL "C" VARIABLE ATTENUATOR MP13-524 A1A23	Inspect Replace Repair		0.2		 1.0 2.0		10	
02	FREQUENCY CONVERTER CV-1921/USM-207 AND CV-1921A/USM-207	Inspect Repair Repair		0.2 0.5		 4.0		10	
0201	FREQUENCY MULTIPLIER MP25-527 A2A1	Inspect Replace Repair				0.2 1.5 3.0		10	
0202	VIDEO AMPLIFIER A2A2	Inspect Replace Repair				0.2 1.5 3.0		10	
0203	HARMONIC GENERATOR A2A3	Inspect Replace Repair				0.2 1.5 3.0		10	
03	OSCILLATOR, RADIO FREQUENCY O-1267/USM-207 AND O-1267A/USM-207	Inspect Repair				0.2 2.0		10	
04	CABLE ASSEMBLY, ELECTRICAL POWER W1	Inspect Repair		0.1		 0.5		10	
05	CABLE ASSEMBLY, RADIO FREQUENCY MP1350003 W2	Inspect Repair		0.1		 0.5		10	
06	CABLE ASSEMBLY, RADIO FREQUENCY MP1330068 W3	Inspect Repair		0.1		 0.5		10	
07	CABLE ASSEMBLY, RADIO FREQUENCY MP1330070 W4, W5	Inspect Repair		0.1		 0.5		10	

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIGITAL READOUT ELECTRONIC COUNTERS AN/USM-207 AND AN/USM-207A

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H	DUMMY LOAD ELECTRICAL DA-265/U	5985-00-069-8820	
2	H	FREQUENCY METER, FR-44/URM-18	6625-00-669-0083	
3	H	FREQUENCY METER, FR 45A/URM-18	6625-00-668-9732	
4	H	GENERATOR, SIGNAL, AN/USM-44	6625-00-669-4031	
5	H	GENERATOR, SIGNAL, AN/URM-127	6625-00-247-9302	
6	H	GENERATOR, SIGNAL, AN/URM-49	6625-00-669-5131	
7	H	OSCILLOSCOPE, AN/USM-281A	6625-00-228-2201	
8	H	TRANSFORMER, CN-16A/U	5950-00-235-2086	
9	H	TEST SET, TRANSISTOR, TS-1836B/U	6625-00-168-0954	
10	H	TOOL KIT, ELECTRONIC EQUIPMENT, TK-100/G	5180-00-605-0079	
11	H	VOLTMETER, ELECTRONIC, ME-20E/U	6625-00-643-1670	
12	H	VOLTMETER, ELECTRONIC, AN/USM-98	6625-00-753-2115	
13	H	VOLTMETER, ELECTRONIC, AN/URM-145	6625-00-973-3986	
14	H	VARIABLE ATTENUATOR, CN-318/G	6621-00-752-3114	
15	H	WATTMETER, AN/URM-120	6625-00-813-8430	
16	O	TOOLS AND TEST EQUIPMENT AVAILABLE TO THE REPAIR TECHNICIAN BECAUSE OF ASSIGNED MISSION.		

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