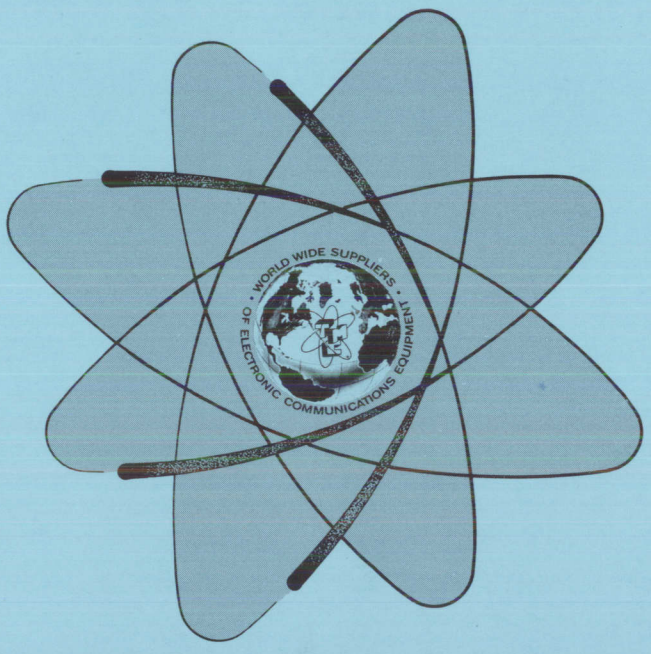
TECHNICAL MANUAL
for

FREQUENCY SHIFT CONVERTER

MODEL CFA-2



THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

Printed in U.S.A.

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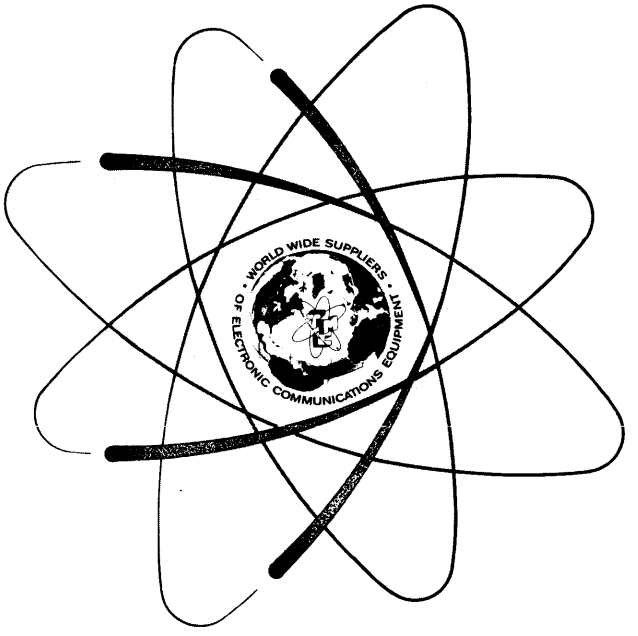

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

Printed in U.S.A.

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NOTICE

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes* furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By
1	17 April 1969	5 May 1969	Incorporated in
2	12 July 1971	12 July 1971	Manual

CHANGE NO. 3

INSTRUCTION BOOK CHANGE NOTICE

Date August 3, 1971

Manual affected: Frequency Shift Converter Model CFA-2 **IN** 4008A

Page 5-3

Change paragraph f-3 to read as follows:

Connect leads from oscilloscope to TP405. Set POWER switch of CFA at ON.

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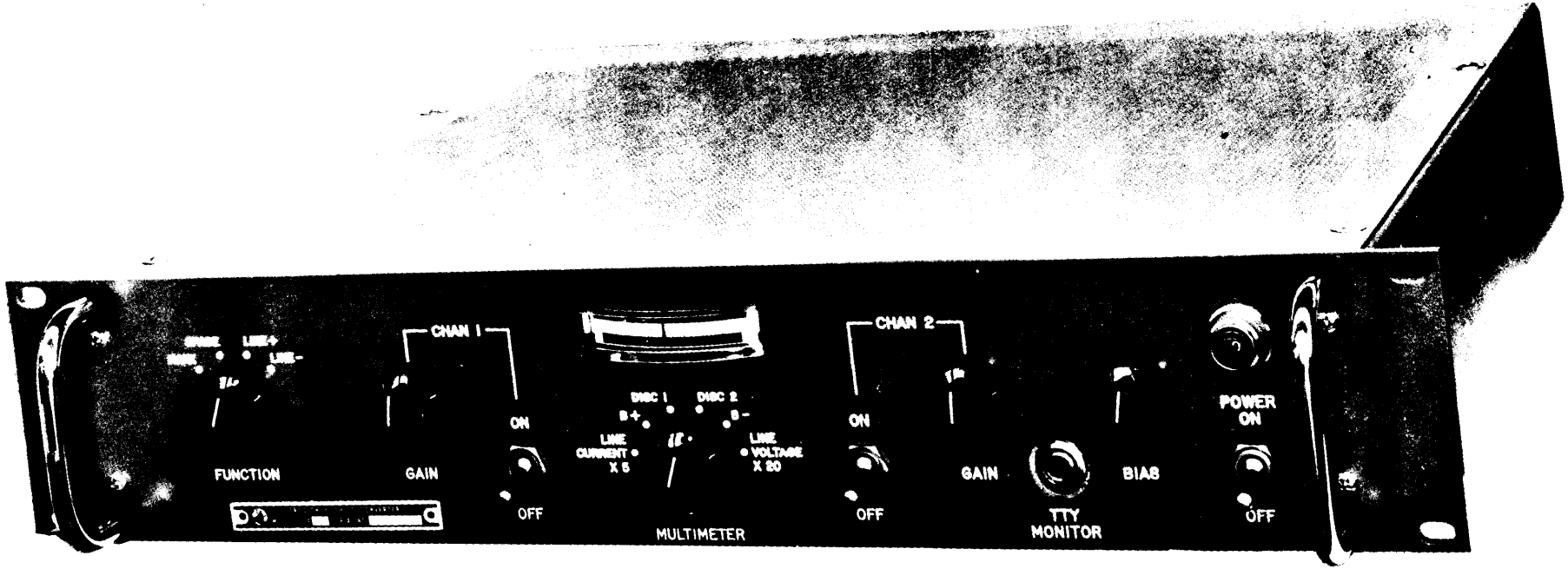

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Figure 1-1. Frequency Shift Converter Model CFA-2

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SECTION 1
GENERAL INFORMATION

1-1. PURPOSE AND DESCRIPTION.

Frequency Shift Converter, Model CFA-2 (figure 1-1) is a solid state audio type dual-channel frequency shift converter designed to be used with either diversity or single receiver communication systems. The CFA converts frequency-shift tone signals (Mark-Space) into d-c pulses the operate teleprinter equipment. The CFA accepts frequency shifts of 40 to 1000 cps through a simple change of switched discriminator networks. D-c clamping and a two-stage memory circuit provide automatic centering of the discriminator. An automatic MARK-HOLD feature places the output circuit in "marking" state during signal drop-outs. A keying stage functions as a neutral relay for the output signal to teleprinter.

Where adjacent channel or in-band interference makes reception erratic, TMC Model SFP Filter Panel may be used to provide band acceptance only to the "mark" and "space" tones and eliminate all other signals.

1-2. TECHNICAL SPECIFICATIONS.

Technical specifications for the CFA are as follows:

Input impedance	600 ohms nominal balanced and center tapped.
Input level	-20 to +30 dBm.
Input limiting	50 dB in each channel.
Input frequency shift limits and keying speeds	200 to 1000 cps shift with switch in FAST position provides a range of 40 to 450 words per minute (30 to 340 bauds). With switch in slow position, up to 120 words per minute at either 2000 or 2550 cps center frequency. 40 to 200 cps shift, up to 120 words per minute at 1000 cps frequency.
Center frequencies	Switch selectable, 1000, 2000 or 2550 cps.
Output circuit	Neutral, either side grounded or floating; output transistor will key from 1 to 75 ma and maximum loop voltage of 150.
Metering	Front panel Multimeter and switches provide metering of the following: 1. Degree and direction of signal drift. 2. Operating voltages 3. Loop current. 4. Loop voltages
Bias Correction	A front panel control provides compensation of Mark or Space bias.

Operating power	115/230 volts, ±10%, 47 to 400 cps single phase, approximately 10 watts with external loop supply approximately 25 watts with internal loop supply.
	NOTE *An optional solid state internal single loop battery supply, (TMC Model A 4347) can be plugged directly into the CFA to provide up to 75 ma at 150 volts d-c and increasing the input load by approximately 15 watts.*
Installation data	Weight: approximately 17 lbs.
	Size: 19" w x 3 1/2" h x 16" d
Environmental conditions	Designed to operate in any ambient temperature between 0°C and 50°C, and any value of humidity up to 95%.
Shipping data	Weight: approximately 70 lbs.
	Size: 22" w x 8 3/8" h x 19" d.
Components and Construction	All equipment manufactured in accordance with JAN/MIL specifications wherever practicable.

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION.

The CFA is calibrated and tested at the factory prior to shipment. When it arrives at the operating site, inspect the packing case and contents for possible damage. Inspect all packing material for parts that may have been shipped as loose items. With respect to damage to the equipment for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of parts.

The equipment is shipped with all modules and other components installed. Check that all such components are properly positioned.

2-2. POWER REQUIREMENTS.

Refer to figure 2-1. The CFA is designed for 105, 115, 125/210, 230, 250 volt, 47 to 400 cps, single phase power. Unless specifically ordered otherwise, the unit is shipped wired for 115 volt operation. When 210, 230, or 250 volt operation is used, change both a-c fuses located on the rear chassis apron from 1/2 ampere to 1/4 ampere.

2-3. INSTALLATION PROCEDURE.

a. MECHANICAL. - The CFA is designed to be mounted in a standard 19-inch relay rack or similar housing. Two tilt-slide mechanisms, one on each end of the chassis, provide accessibility to the CFA for inspection and maintenance. To install, proceed as follows: Slide both tracks of the rack compartment outwards. Position tilt-slide mechanisms in tracks, and ease CFA into compartment until release buttons lock into holes in track. Check that the tracks and mechanisms are correctly engaged, then slide out and tilt CFA in its mounting ready for initial connections.

b. ELECTRICAL. - All external connections, with the exception of patch-cord to CFA front panel TTY monitor jack, are made to screw terminals and an a-c power receptacle located on the rear of CFA (see figure 2-2).

2-4. INITIAL CONNECTIONS AND ADJUSTMENTS.

a. Connect cable from a-c source to receptacle connector J1011 and turn front panel POWER switch, OFF.

b. Connect jumpers between EXT LINE SUPPLY terminals 8 and 9, and between TTY OUTPUT terminals 10 and 11 of terminals strip TB1001.

c. Connect a 600 ohm line output from a receiver to CHAN 1 INPUT terminals 1 and 3 of TB1001.

d. Set SPEED switch S1003 at either SLOW or FAST according to desired TTY keying Speeds.

e. Set LINE SUPPLY switch S1002 at INT (when operating on batteries, set switch at EXT); set LINE CURRENT INPUT switch S1001 at 10 ma, 20 ma or 60 ma according to reception mode and type of TTY equipments in use.

f. Set front panel controls as follows:

Control	Position
FUNCTION switch	MARK
CHAN 1 GAIN	Counter clockwise
CHAN 2 GAIN	Counter clockwise
CHAN 1 switch	OFF
CHAN 2 switch	OFF
MULTIMETER switch	B+
BIAS potentiometer	Mid-position

g. Connect lead from a teletypewriter to front panel TTY MONITOR jack.

h. When operating with battery power supply make connections to EXT LINE terminals 8 and 9.

i. Terminals 4 and 6 provide connection for Receiver output to CHAN 2 input; terminal 7 provides ground for CFA.

j. Remove top cover of CFA and set both CHAN 1 and CHAN 2 DISCRIMINATOR switches to desired center frequency, then replace cover.

k. Slide CFA back into rack and secure front panel to rack with screws; set POWER switch, at ON.

The equipment is now ready to be tuned; refer to Section 3 for location and function of all operating controls and indicators.

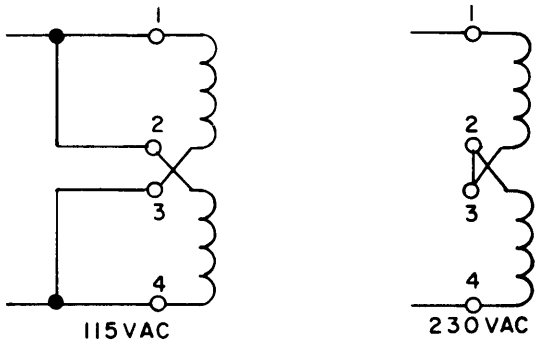

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Figure 2-1. Power Transformer Wiring

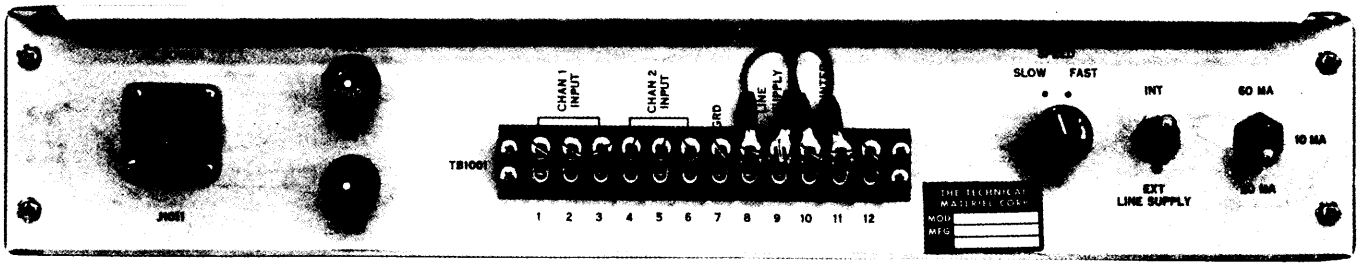

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Figure 2-2. Rear Panel Connections, CFA.

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SECTION 3
OPERATOR'S SECTION

3-1. OPERATING CONTROLS.

The operating controls for the CFA are located on the front panel, on interior subassembly and on the rear chassis apron (see figure 3-1). Table 3-1 lists the panel designation and function of each control or indicator.

3-2. PRELIMINARY CONSIDERATIONS.

a. Before attempting to operate the CFA the following must be considered:

1. Mode of reception required, either diversity or non-diversity.

2. Teletypewriter keying speeds required.

b. Depending on the Keying speeds of the auxiliary TTY equipment in use, select a Center Frequency (through CHAN 1 and CHAN 2 DISCRIMINATOR switches) to provide the following conditions:

1.	1000 cps NARROW	for an input frequency shift of 40 to 200 cps and keying speeds up to 120 wpm. SPEED switch, Slow.
2.	2000 cps WIDE	for an input frequency shift of 200 to 1000 cps and keying speeds from 40 wpm to 450 wpm SPEED switch, FAST.
3.	2550 cps WIDE	for keying speeds up to 120 wpm. SPEED switch, SLOW.

3-3. OPERATING CFA IN CONJUNCTION WITH RECEIVER AND TTY EQUIPMENT.

With CFA connected in accordance with Section 2, proceed as follows:

a. Check Receiver line level with an AC Voltmeter; it should read 0 dBm.

b. Set CHAN 1 toggle switch at ON.

c. Set MULTIMETER switch at each of six positions and check MULTIMETER readings as follows: LINE CURRENT X5, 60 ma; DISC. 1, no reading; B+, +12 volts; B-, -12 volts; DISC. 2, no reading; LINE VOLTAGE X20, approximately. 260 volts.

d. Set MULTIMETER switch at DISC 1 and advance CHAN 1 GAIN control one-quarter clockwise; there should be no reading on MULTIMETER.

e. While tuning Receiver to a zero beat signal adjust tuning until MULTIMETER reads 0.

f. Tune Receiver BFO as slowly as possible to the signal until both MARK and SPACE tones reach maximum audiable pitch, with MULTIMETER deflecting equally (plus or minus) with the signal.

g. When tuning for TRAFFIC (both MARK and SPACE signals) adjust CHAN 1 GAIN control clock-

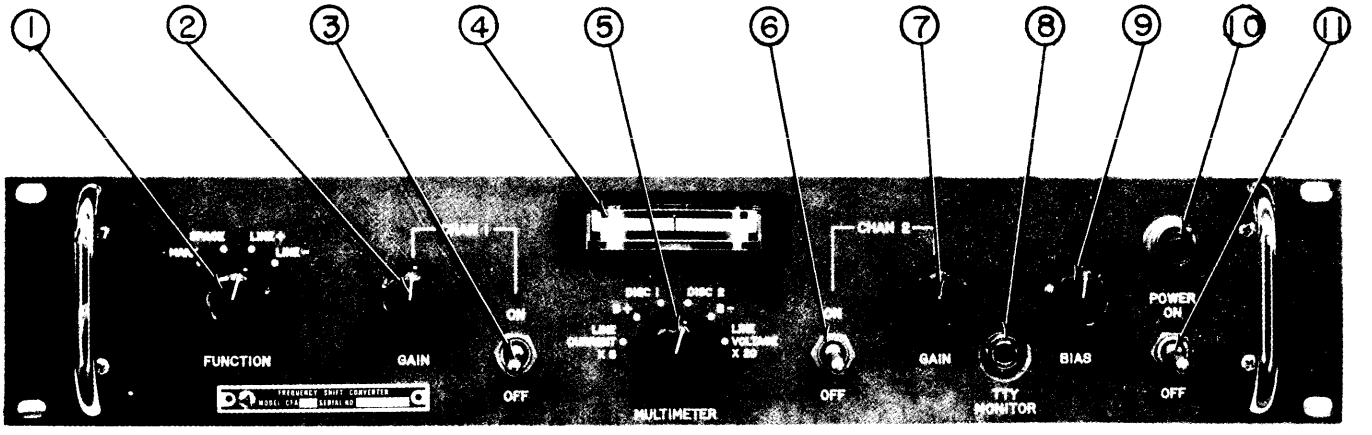

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Figure 3-1. Controls and Indicators

TABLE 3-1. OPERATING CONTROLS

FRONT PANEL		
ITEM NO. (Figure 3-1)	DESIGNATION	FUNCTION
1	FUNCTION switch S1008	4-position switch. Provides for selection of MARK bias, SPACE bias, -LINE inversion and +LINE inversion.
2	CHAN 1 GAIN control R1002	Provides adjustment of MARK-SPACE duty ratio.
3	CHAN 1 ON-OFF switch S1005	Provides non-diversity operation in ON position, with CHAN 2 switch in OFF position.
4	MULTIMETER M1001	Provides monitoring of LINE CURRENT X5, DISCRIMINATOR 1 circuit B+ bias, B- bias, LINE VOLTAGE X20, and correct Center Frequency operation. Should signal-drift occur meter shows degree and direction of drift.
5	MULTIMETER switch S1006	6-position switch. Refer to item Number 4, above.
6	CHAN 2 ON-OFF switch S1007	Provides diversity operation in ON position, with CHAN 1 switch also in ON position.
7	CHAN 2 GAIN control R1003	Provides adjustment of MARK-SPACE duty ratio.
8	TTY MONITOR jack J1012	Provides monitoring on MULTIMETER OF signals from CFA to teleprinter.
9	BIAS control R1001	Used in conjunction with CHAN 1 and CHAN 2 GAIN controls to correct any fixed duty ratio distortion that may be induced by the receiver or teleprinter.
10	POWER indicator lamp DS101	Glows during operation. Indicates that MAIN fuses are intact and that power is applied.
11	POWER switch S1001	ON-applies line voltage to CFA power supply. OFF-turns off entire CFA.
	INTERIOR (Refer to figure 5-2)	
	DISCRIMINATOR switch CHAN 1 S1009	3-position switch. Provides CHAN 1 with center frequencies of 1000, 2000 or 2550 cps.
	DISCRIMINATOR switch CHAN 2 S1010	Provides CHAN 2 with center frequencies of 1000, 2000 or 2550 cps.
	REAR PANEL (Refer to figure 2-2)	
	SPEED switch	Selects keying speeds: SLOW position up to 120 wpm; FAST up to 450 wpm.
	LINE SUPPLY switch	When set at INT, connects TTY line to internal power supply. When set at EXT, allows CFA to operate with external Loop Supply.
	60MA/10MA/20MA switch	Selects desired loop current.

wise or counter-clockwise until MULTIMETER deflects equally ±10 in synchronism with the signal. Turn MULTIMETER switch to LINE CURRENT X5 and adjust BIAS control clockwise or counter-clockwise until MULTIMETER deflects equally ±15 ma. indication

h. When tuning for MARK signals only turn FUNCTION switch to LINE + or LINE - depending on phase of signal and adjust CHAN 1 GAIN control clockwise or counter-clockwise. If signal goes to MARK and stays on MARK, MULTIMETER should deflect to either ±15. A steady MARK signal provides conditions for the greatest degree of accuracy when adjusting GAIN control.

i. When tuning for R-Y signals adjust Receiver BFO slowly until MULTIMETER deflects very slightly and equally ± (tuning away from signal moves MULTIMETER to right + while tuning toward signal moves needle to left -). Turn MULTIMETER switch to LINE CURRENT X5 and adjust BIAS control clockwise or counter-clockwise until MULTIMETER reads 15 ma R-Y signals are the easiest to tune and provide the greatest degree of tuning accuracy.

3-4. NON-DIVERSITY MODE OPERATION.

All steps described in paragraph 3-3 are required for diversity operation using CHAN 1 only to provide TTY keying speeds up to 120 wpm. For speeds from 40 to 450 wpm, turn the SPEED switch to FAST and both CHAN 1 and CHAN 2 DISCRIMINATOR switches to 2500 cps WIDE.

3-5. DIVERSITY MODE OPERATION.

For diversity operation using two receivers, (CHAN 1 and CHAN 2 of the CFA,) connect a 600 ohm output line from a second receiver to terminals 4 and 6 (CHAN 2 INPUT) on terminal board TB1001. Turn both CHAN 1 and CHAN 2 front panel toggle switches to ON. Set the DISCRIMINATOR switches and the SPEED switch the same as for non-diversity operation to produce the same range of TTY keying speeds.

SECTION 4
PRINCIPLES OF OPERATION

4-1. BLOCK DIAGRAM ANALYSIS.

Refer to figure 4-1. The CFA comprises seven major sections: (1) input module,(2) discriminator module, (3) detector amplifier Module, (4) driver module (5) output (6) line supply module and (7) low voltage supply module.

The Input Section provides input circuits for two 600-ohm line channel inputs that accept incoming FSK audio frequency signals. Because the operation of each channel is identical up to the point where they are combined in the diversity mode, only the operation of CHAN 1 in the non-diversity mode will be described.

The incoming signals are routed through an audio transformer and two d-c clamping diodes; this network matches the required 600-ohm input impedance, and also limits the incoming signals before they are applied to an input amplifier limiter Q304. The amplified signals from Q304 are fed to a Schmitt trigger circuit which produces a constant amplitude output. Constant-amplitude signals from the Schmitt trigger circuit are applied via Amplitude Limiter Q305 through CHAN 1 Gain Control to the Mark-Space filters of the Discriminator Section.

The Mark and Space Filters each comprising a fixed inductor with switch-selectable capacitors that correspond to the Mark-Space frequency centered at 2550, 2000 or 1000 cps. The outputs of the Mark-Space filters are extended to the Mark-Space amplifier stages of the detector amplifier. The amplified, independent Mark-Space signals applied to the detector amplifier are transformer-coupled to diode discriminator networks. The outputs of the Mark-Space diode discriminators are applied via a common R.C. network and Darlington amplifier through CHAN 1 ON-OFF switch to the base of the Driver modules, phase inverter. At this point CHAN 1 and CHAN 2 input circuits may be connected to the inputs of the driver module depending on the positions of Chan 1 and Chan 2 ON-OFF switches. The positive or negative output of the phase inverter (depending on the position of the function switch) is applied to an emitter follower and limiter amplifier; the amplified output of the driver stage is applied to the limiter amplifier stages within the output module. The amplified signal applied to the Output module is extended to a keyed oscillator which provides regenerative action; this regenerative action is transformer-coupled to diode rectifiers producing a keyed d-c voltage that is applied to the base of an output switching transistor. The output of the switching transistor can be connected to either the internal line supply or the external supply of a TTY printer.

4-2. INPUT MODULE, CIRCUIT ANALYSIS.

Refer to figures 7-1 and 7-2. As both Chan 1 and Chan 2 Input modules perform similar functions, only the circuit analysis of Chan 1 follows.

A 600-ohm audio output from an associated Receiver is connected (via the appropriate Chan 1 input terminals of terminal board TB 1001 on rear chassis) to transformer T 301 of the output module. The output of T 301 is extended through a clamping circuit comprising CR 303 and CR 304 to the base of the input limiter amplifier Q 304. The output of the collector of limiter amplifier Q 304 is capacitively coupled to the input of a Schmitt Trigger circuit comprising transistors Q 302 and Q 303. The output of the Schmitt Trigger circuit is resistively-coupled to base of limiter amplifier Q 305. A regulator circuit consisting of Q 301, R 305, R 303 and R 304 maintains a constant, negative, common-emitter bias level for the Schmitt trigger circuit; the output at the collector at Q 305 is transformer-coupled to Chan 1 gain control R 1003. The output of the wiper of R 1003 is directly coupled to wipers R 501, R 502 and R 503 of the Discriminator Module.

4-3. DISCRIMINATOR MODULE, CIRCUIT ANALYSIS.

Refer to figures 7-1 and 7-3. As both Chan 1 and Chan 2 Discriminator modules perform similar functions, only the circuit analysis of Chan 1 follows.

The audio is applied to the wipers R 501, R 502 and R 503 where it is simultaneously extended from both sides of the variable resistors to contacts on the discriminator selector switch S 1009; the wiper of wafer A of the discriminator selector switch is extended to the tap of Mark filter L501 and the wiper of wafer B is extended to the tap of Space filter L 502. Two L.C. filter networks are switch-selectable producing resonance at Mark and Space frequencies centered at 2550, 2000 and 1000 cps. The Mark filter L 501 is resonated by capacitors C 501, C 502 or C 503 corresponding to center frequencies of 2550, 2000 and 1000 cps respec-

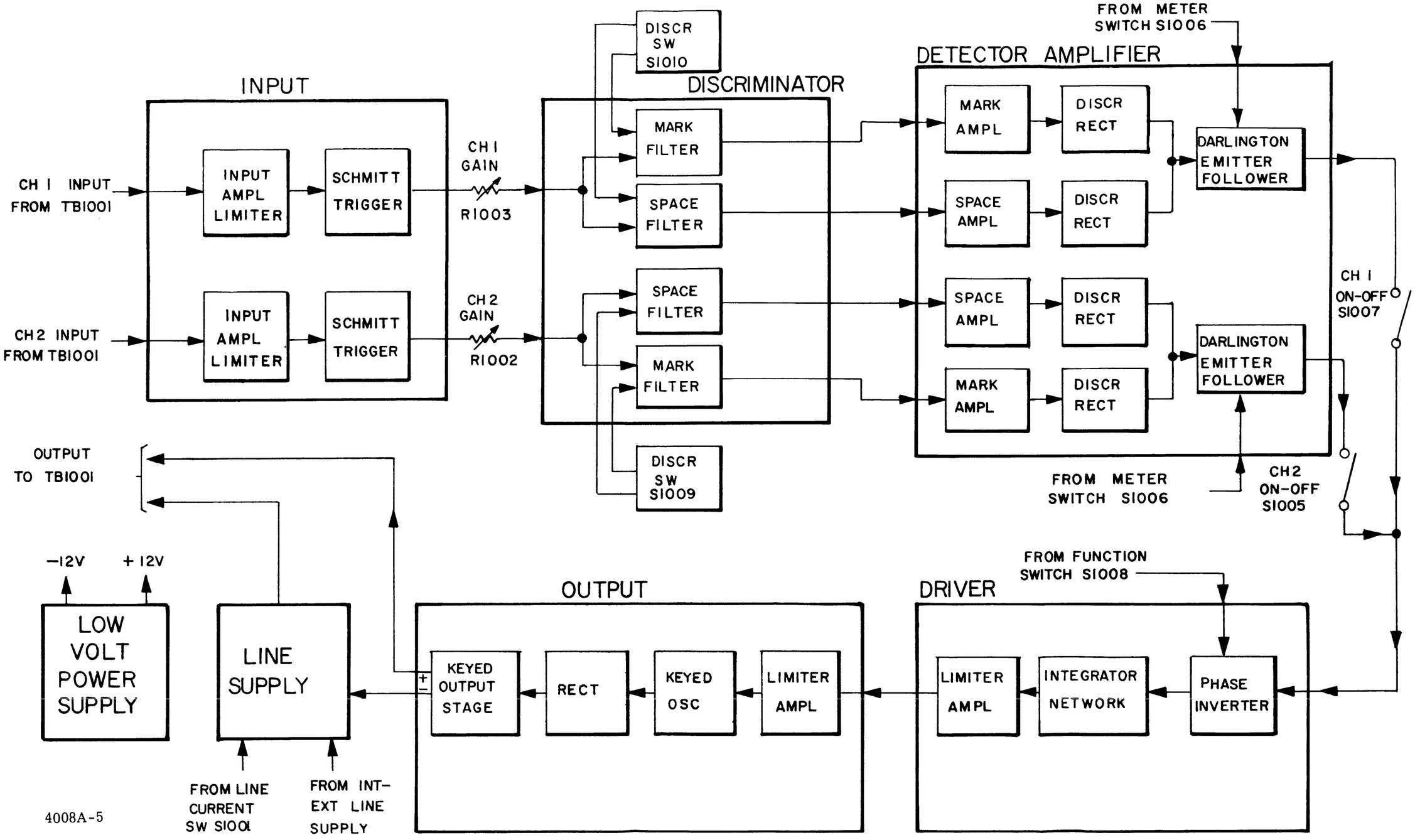

Figure 4-1. Block Diagram, CFA.

tively; the space filter L 502 is resonated by capacitors C 504, C 505 or C 506 corresponding to 2550, 2000 or 1000 cps respectively.

The six resistors, R 501 to R 506, provide equalization of the output levels of both Mark and Space frequencies; the filtered Mark and Space outputs are then extended to the Mark and Space amplifier stages within the Detector Amplifier module.

4-4. DETECTOR AMPLIFIER MODULE, CIRCUIT ANALYSIS

Refer to figures 7-1 and 7-4. As both Chan 1 and Chan 2 Detector Amplifier modules perform similar functions, only the circuit analysis of Chan 1 follows.

The output from the Mark filter (Space signal) of the Detector Amplifier module is applied to emitter follower amplifier Q 403; the amplified output of Q 403 is capacitively coupled to the base of amplifier Q 404. Variable resistor R 412 adjusts the gain of amplifier Q 404; the amplified output at the collector of Q 404 is resistively coupled to the base of emitter follower amplifier Q 405. The amplified output of Q 405 is transformer-coupled to discriminator rectifier CR 401.

The positive d-c output from the discriminator rectifier CR 401 is directly coupled to the input base of a two stage emitter follower amplifier (Darlington Configuration) comprising transistors Q 402 and Q 401.

The output from the Space filter (Mark signal) of the Detector Amplifier module is amplified and detected by transistors Q 406, Q 407, Q 408 and diode rectifier CR 402 (as is the output form the Mark Filter). The negative output from the Space discriminator rectifier CR 402 is applied via a resistive network to the input base of a two stage emitter follower amplifier (Darlington Configuration) comprising Q 401 and Q 402. The amplified output at the emitter of Q 402 is extended via Chan 1 switch S 1005 to the base of phase inverter Q 601 within the Driver module.

NOTE

The Chan 1 Analyses in paragraph 4-2 through 4-4 are the same for Chan 2 except that the amplified output at the emitter of Q 402 is extended to the input base of Phase inverter Q 601 by Chan 2 switch S 1007.

4-5. DRIVER MODULE, CIRCUIT ANALYSIS.

Refer to figure 7-1 and figure 7-5. The Chan 1 and Chan 2 information from switches S 1005 and S 1007 respectively is applied to the base of phase inverter Q 601. The output at the emitter and collector of phase inverter Q 601 is extended to contacts of FUNCTION switch S 1008. The wiper of S 1008 selects the desired phase and extends the output via resistor R 607 to the base of emitter follower amplifier Q 602. The amplifier output of the emitter of Q602 is extended via an integrater network, comprising C 603, R 611, C 604, and C 605, to the input base of a two stage limiter amplifier comprising Q 603 and Q 604. The amplified output at the collector of Q 604 is resistively coupled to the base of limiter amplifier Q 202 within the Output module. Bias control R 1001 adjusts the bias level applied to the base of Q 603, and variable resistor R 608 adjusts the gain of Q 604.

4-6. OUTPUT MODULE, CIRCUIT ANALYSIS.

Refer to figure 7-1 and figure 7-6. The amplified output from Q 604 of the Driver Module is resistively coupled to the input base of a two stage limiter amplifier comprising transistors Q 202 and Q 203. The amplified output at the collecter of Q 203 is resistively coupled to the base of oscillator Q 209. The output at the collector of Q 209, keyed by the signal from Q 203, is transformer coupled by T 1001 to a diode rectifier circuit comprising CR 202 and CR 203. The d-c voltage produced by CR 202 and CR 203 is resistively coupled to the base of switching transistor Q 201. The emitter of Q 201 is extended simultaneously via meter shunt resistor R 203 to: (1) LINE SUPPLY switch S 1002; (2) The regulated negative voltage at the Line Supply Module. Calibration variable resistor R 204 provides indication adjustment of MULTIMETER M 1001 when multimeter switch S 1006 is set at LINE CURRENT X5.

4-7. LINE SUPPLY MODULE, CIRCUIT ANALYSIS.

Refer to figure 7-1 and figure 7-7. A-c voltage from power transformer T 1001 is applied to a bridge rectifier circuit comprising diodes CR 101 through CR 104. The positive output of the bridge circuit is extended to LINE SUPPLY SWITCH S 1002. When S 1002 is set at Internal, the positive voltage is extended via TTY Monitor jack J 1002 to the TTY printer terminals of TB1001.

The negative output of the bridge circuit is extended through variable resistor R 101 and dropping resistor network comprising R 102, R 104, R 105 and R 106 to the emitter of regulator transistor Q 101. LINE CURRENT input switch S 1001 provides selection of the appropriate dropping resistance corresponding to 10, 20 or 60 ma. line current. Calibration variable resistor R 103 provides adjustment of M 1001 indication when MULTIMETER switch S 1006 is set at LINE VOLTAGE X20.

4-8. LOW VOLTAGE SUPPLY MODULE, CIRCUIT ANALSIS.

Refer to figure 7-1. A-c power from transformer T 1001 is applied to a bridge rectifier comprising diodes CR 701 through CR 704. The positive output of the bridge circuit is extended to all +12 volt d-c circuits within the CFA. The negative output of the bridge circuit is extended through (1) a series regulator circuit comprising Q 1001 and Q 1002; (2) a shunt regulator formed by resistors R 703, R 704, R705 and transistor Q701. The base bias of Q701 is developed across the ±12 volt d-c output, thus any change in output load changes the base bias at Q701 causing an increase voltage drop across R703, R704 and R705, forward-biasing series regulator transistors Q1001 and Q1002.

SECTION 5
MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

The CFA has been designed to provide long-term, trouble-free operation under continuous duty conditions. However, in order to prevent failure of the equipment due to corrosion, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

At periodic intervals, the equipment should be removed from its mounting for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring or grease. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methylchloroform may be used, providing the necessary precautions are observed.

WARNING

When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated contact with skin. Flammable solvents should not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work", etc. is prohibited in the immediate area.

CAUTION

When using trichloretylene, avoid contact with paint surfaces, due to the paint removing effect of the fluid.

5-2. TROUBLESHOOTING.

a. GENERAL CONSIDERATIONS. - When a piece of equipment has been working satisfactorily and fails suddenly, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures. In these cases, it is not necessary to follow a lengthy and orderly

TABLE 5-1. TEST EQUIPMENT REQUIRED TO TEST AND ALIGN THE CFA

EQUIPMENT	DESCRIPTION
AF Signal Generator	Hewlett Packard HP200CD or equivalent.
VOM	SIMPSON 260 or equivalent.
OSCILLOSCOPE	Tektronix 541A with type "L" head or equivalent.
Frequency Counter	Hewlett Packard HP5244L or equivalent.
AC VTVM	Ballantine 314A or equivalent.
VTVM	Hewlett Packard HP410B or equivalent.
Keyer	Digitech DT108A-1 or equivalent.
Analyzer	Digitech DT603 or equivalent.
Loop Supply	TMC PSPA-1 or equivalent.
Frequency Shift Simulator	TMC FSS or equivalent.
Line Supply	TMC A4347 or equivalent.
Card Extender	TMC A4348 or equivalent.

course of troubleshooting in order to localize and isolate the faulty part.

The first consideration in troubleshooting is to ascertain that all modules and fuses are in proper working order; also that the equipment receives proper supply voltages. Many times this eliminates further investigation.

A second consideration is to examine the equipment, section by section, for burned-out elements, charring, corrosion, arcing, excessive heat, dirt, dampness, etc. It is important to recognize that defective elements may have become defective due to overloaded operation or to allied circuit component failure.

b. TEST EQUIPMENT. - Table 5-1 lists the test equipment required to troubleshoot and align the CFA.

c. WAVESHAPES. - Table 5-2 indicates Typical Waveshape patterns that will aid in troubleshooting the CFA.

5-3. REPAIR OF PRINTED CIRCUITS.

a. GENERAL. - Breaks in the conducting strip (foil) on a module can cause permanent or intermittent trouble. In many instances, these breaks will be so small that they cannot be detected by the naked eye. These almost invisible cracks (breaks) can be located only with the aid of a powerful magnifying glass.

b. MULTIMETER CHECKOUT. - To check out and locate trouble in the conducting strips of a module, set up a multimeter (one which does not use a current in excess of 1 ma) for making point-to-point resistance tests, using needle point probes. Insert one point into the conducting strip, close to the end of terminal, and place the other probe on the terminal or opposite end of the conducting strip. The multimeter should indicate continuity. If the multimeter indicates an open circuit, drag the probe along the strip (or if the conducting strip is coated, puncture the coating at intervals) until the multimeter indicates continuity. Mark this area; then use a magnifying glass to locate the fault in the conductor.

CAUTION

Before using an ohmeter for testing a circuit containing transistors or other voltage-sensitive semiconductors, check ohmmeter current passed under test on all ranges. DO NOT use a range that passes more than 1 ma.

c. HOW TO REPAIR A BREAK. - If the break in a conductor strip is small, lightly scrape away any coating covering the area of the conducting strip to be repaired. Clean the area with a firm bristle brush and approved solvent. If this does not remove the coating use a scraping tool (spade end of a solder-aid tool or equivalent) or drill a hole through the leakage path to break continuity. When drilling be careful not to drill into parts mounted on the other side of the module. Then repair the cracked or broken area of the conducting strip by flowing solder over the break. Considerable care must be exercized to keep the solder from flowing onto an adjacent strip.

If a strip is burned out, or fused, cut and remove the damaged strip. Connect a length of insulated wire across the breach or from solder-point to solder-point.

After the repairs are completed, clean the repaired area with a stiff brush and solvent. Allow the board to dry thoroughly, and then coat the repaired area with an epoxy resin or similar compound. This coating will protect the repaired area and help strengthen it.

CAUTION

After repairs, check the board for solder drippings that may cause shorts.

5-4. ALIGNMENT.

a. GENERAL. - The alignment procedures given in this section are continuous and must be performed in the order given. Refer to figure 5-1 and 5-2 for module location. As an aid to alignment refer to table 5-2 which shows normal waveshapes obtained on oscilloscope at test points (TP) on the CFA printed circuit modules.

NOTE

Alignment of the Input, Discriminator and Detector Amplifier modules are the same for channel 1 and channel 2, therefore only channel 1 will be discused.

b. PRELIMINARY PROCEDURES. - With the CFA extended from rack, set POWER switch at OFF. Remove top cover of CFA, and remove all ten modules (Z1001 to Z1010). Set controls as follows:

CONTROL	POSITION
CHAN 1 ON-OFF switch	OFF
CHAN 2 ON-OFF switch	OFF
FUNCTION switch	SPACE
MULTIMETER switch	LINE CURRENT X5
SPEED switch	SLOW
LINE SUPPLY switch	INT.
LINE CURRENT switch	60 ma.
CHAN 1 DISCRIMMINATOR Switch	2550 WIDE
CHAN 2 DISCRIMINATOR Switch	2550 WIDE
CHAN 1 GAIN control	Fully counter clockwise
CHAN 2 GAIN control	Fully counter clockwise
BIAS control	Mid-position.

c. MODULE SETUP, - For ease of accessibility, remove the module and plug it in the Module extender card provided; then plug the Module extender in card the appropriate receptacle.

CAUTION

Ensure that number on module matches the number printed on side of bin adjacent to receptacles, it is posiible to connect a module to the wrong receptacle.

d. LOW VOLTAGE POWER SUPPLY MODULE, ALIGNMENT.

1. POWER switch, OFF. Plug module in extender card; plug extender card in receptacle J1010. Set VOM at + d-c volts on 50 volt scale. Connect positive lead of VOM to positive side of capacitor C3; connect negative lead to chassis ground. POWER switch, ON. VOM should indicated +12 volts, plus or minus 10 percent.

2. Connect positive lead of VOM consecutively, to Pin 1, of receptacles J1002, J1003, J1004, J1007, J1008 and J1009. VOM should indicate +12 vdc.

3. Set VOM at - d-c volts on 50 volt scale. Connect positive lead of VOM to positive side of resistor R704. Adjust variable resistor R706, clockwise or counter-clockwise. VOM should inicate +12 volts, plus or minus 10 percent.

4. Connect positive lead of VOM consecutively to pin 2 of receptacles J1002, J1003, J1004, J1007, J1008 and J1009. VOM should indicate -12 volts at each pin.

5. Set POWER switch, at OFF. Disconnect VOM. Remove extender card. Plug module in receptacle J1010.

e. INPUT MODULE, ALIGNMENT. - Upon completion of alignment procedure given in paragraphs 5-4d, it is necessary to assure satisfactory operation of the Input module, proceed as follows:

1. Plug module in extender card; plug extender card in recpetacle J1003. Connect leads from a-f generator to CHAN 1 input terminals 1 and 3 on rear chassis terminal board.

2. Connect leads from a-c voltmeter and frequency counter across a-f generator output. Set output of a-f generator at 0 dbm (.78 V RMS), 2550 cps.

3. Connect oscilloscope to TP303; set POWER switch at ON. Refer to table 5-2 for test points and waveshapes. (TP-2, TP-4)

4. Set POWER switch at OFF. Remove extender card. Plug module in receptacle J1003.

f. DETECTOR AMPLIFIER MODULE, ALIGNMENT. Upon completion of paragraphs 5-4d and 5-4e, Proceed as follows:

Remove discriminator card

1. Plug module into extender card; plug extender card into receptacle J1004.

2. Connect leads from a-f generator via 10 megohm resistor to TP407, and set generator frequency at 2550 cps approximately. (10 megohm resistor used as isolation between signal generator and Q3) in series with lead.

3. Connect leads from oscilloscope to Set POWER switch of CFA at ON.

4. Adjust a-f generator output to 100 millivolts peak-to-peak. Oscilloscope should indicate a sine wave.

5. Set potentiometers R412 and R415 fully clockwise. Connect leads of oscilloscope to TP403 measure voltage. Scope should indicate approximately 4 volts peak-to-peak (sine wave).

6. Connect leads from a-f generator via a 10 megohm resistor to TP408. Set a-f generator frequency at 2550 cps approximately. Connect leads from oscilloscope to TP406. Oscilloscope should indicate 100 mv peak-to-peak (sine wave). If proper indication is not obtained, re-adjust a-f generator output to get 100 mv.

7. Connect leads from oscilloscope to TP404. Measure voltage and observe wave shape. Scope should indicate 4 volts peak-to-peak (sine wave).

8. Disconnect oscilloscope. Connect VTVM to TP402; adjust VTVM for indication on -3 vdc scale. Momentarily disconnect a-f generator, and zero adjust VTVM to center of scale.

9. Temporarily connect a-f generator to TP408; VTVM should indicate approximately -.75 to 1.5 vdc.

10. Temporarily connect leads from a-f generator to TP407; VTVM should indicate approximately +.75 vdc +1.5 vdc.

NOTE

Upon completion of step 11 below potiontiometer R412 (associated with TP407) or potentiometer R415 (associated with TP408) should be fully clockwise. The other potentiometer should be between mid-position and fully clockwise

11. Repeat steps 9 and 10, and adjust R412 and R415 until indications on VTVM are equal but of opposite polarity. This should be accomplished by lowering the higher voltage.

12. Disconnect a-f generator leads from TP407. Set potentiometer R405 fully clockwise; set R403 at mid-position. Set MULTIMETER switch at DISC 1, and adjust R403 as required to obtain zero indication on MULTIMETER. Set R405 half counter clockwise.

13. Connect a-f generator to the test point (TP407 or TP408) related to the potentiometer that was set at maximum clockwise position in step 11.

14. Adjust a-f generator for .6 vdc indication on VTVM at TP-2 than adjust R405 for an indication of 20 on CFA multimeter. Recheck "0" with no signal applied.

15. Connect a-f generator to the other test point (either TP407 or TP408) and adjust the associated potentiometer R412 or R415 respectively) to obtain an indication of 20 on CFA MULTIMETER.

16. With a-f generator connected at TP407, CFA MULTIMETER should indicate +20; with a-f generator connected to TP408, CFA MULTIMETER should indicate -20. Repeat for other detector card.

g. DISCRIMINATOR MODULE, ALIGNMENT.- Upon completion of paragraphs 5-4d through 5-4f, proceed as follows:

1. Set POWER switch at OFF. Plug module in extender card; plug extender card in receptacle J1005. Set POWER switch at ON.

2. Connect a-f generator and frequency counter to terminals 1 and 3 of TB1001.

3. Connect AC VTVM across output of a-f generator. Adjust a-f generator as required to obtain 2550 cps indication on frequency counter. Set output level of a-f generator at 0 dB (.78v rms) as indicated on VTVM.

4. Set potentiometers R501 through R506 inclusive at mid-position. Set MULTIMETER switch at DISC 1; set CHAN 1 GAIN control at one-quarter clockwise position. Adjust potentimoter R501 as required to obtain zero indication on front panel meter of CFA.

5. Adjust a-f generator as required to obtain 2125 cps on frequency counter. Ensure that MULTIMETER switch is set at DISC 1. Adjust GHAN 1 GAIN control as required to obtain -15 indication on front panel meter of CFA.

6. Adjust a-f generator as required to obtain 2975 cps indication on frequency counter. Ensure that MULTIMETER switch is set at DISC 1. Adjust potentiometer R506 as required to obtain +15 indication on front panel meter of CFA.

7. Repeat steps 4, 5, and 6 above while leaving CHAN 1 GAIN control at position that aligns each of three frequencies (2550 cps, 2125 cps, and 2975 cps) to the normal indication for steps 4, 5, and 6.

8. Adjust a-f generator as required to obtain 2050 cps indication on frequency counter. Adjust CHAN 1 GAIN control as required to obtain -15 indication on front panel meter of CFA.

NOTE

When performing steps 9 and 10 below, if indications obtained are not within specified tolerance, re-adjust potentiometer R506 for that pair of frequencies, and repeat steps 8 through 10.

9. Adjust a-f generator as required to obtain 3050 cps indication on frequency counter; indication obtained on front panel meter of CFA should be within ±6 divisions of +15.

10. Repeat steps 8 and 9 for the frequencies listed below, except that upper-frequency indication must be within ±3 divisions of +15.

LOWER FREQ.	UPPER FREQ.
2125 cps	2975 cps
2150 cps	2950 cps
2200 cps	2900 cps
2250 cps	2850 cps
2300 cps	2800 cps
2350 cps	2750 cps
2400 cps	2700 cps
2450 cps	2650 cps

11. Set CHAN 1 discriminator switch (refer to figure 5-2) at 2000 WIDE; adjust a-f generator as required to obtain 2000 cps indication on frequency counter. Set CHAN 1 GAIN control at one-quarter clockwise position. Adjust potentiometer R502 as required to obtain zero indication on front panel meter of CFA.

12. Reset a-f generator to 1575 cps as indicated on frequency counter. Adjust CHAN 1 GAIN control clockwise or counter-clockwise until front panel meter of CFA indicates -15.

13. Reset a-f generator to 2425 cps as indicated on frequency counter. Adjust variable resistor R505. Clockwise or counter-clockwise until front panel meter of CFA indicates +15.

14. Repeat steps 11, 12 and 13 while leaving CHAN 1 GAIN control in the position that aligns each of the three frequencies to the normal indications for steps 11, 12 and 13.

15. Set a-f generator to indicate 1500 cps on frequency counter. Adjust CHAN 1 GAIN control until fron panel meter of CFA indicates -15.

NOTE

If indications in steps 15 and 17 below are not within the specified tolerance, re-adjust R505 for that pair of frequencies and repeat steps 16 and 17

16. Set a-f generator to indicate 2500 cps on frequency-counter, front panel meter of CFA should indicate within ±6 divisions of +15.

17. Repeat steps 15 and 16 for the frequencies listed bleow, except the upper frequency indication must be within ±3 divisions of +15.

LOWER FREQ.	UPPER FREQ.
1575 cps	2425 cps
1600 cps	2400 cps
1650 cps	2350 cps
1700 cps	2300 cps
1750 cps	2250 cps
1800 cps	2200 cps
1850 cps	2150 cps
1900 cps	2100 cps

18. Set CHAN 1 discriminator switch at 1000 NARROW; adjust a-f generator to indicate 1000 cps on frequency counter; Set CHAN 1 GAIN control at three quarters clockwise position. Adjust potentiometer R503 until front panel meter of CFA indicates "0".

19. Adjust a-f generator to indicate 900 cps on frequency counter; Set CHAN 1 GAIN control until front panel meter of CFA indicates -15.

20. Adjust a-f generator to indicate 1100 cps on frequency counter and adjust R504 until front panel meter of CFA indicates +15.

21. Repeat steps 18, 19, and 20 while leaving the CHAN 1 GAIN control in the position that aligns each of the three frequencies to the normal indications for steps 18, 19 and 20.

22. Set a-f generator to indicate 910 cps on frequency counter and adjust CHAN 1 GAIN control until front panel meter of CFA indicates -15.

NOTE

If indications in steps 23 and 24 below are not within ±3 divisions, re-adjust R504 for that pair of frequencies and repeat steps 22 through 24.

23. Set a-f generator to indicate 1090 cps on frequency counter, front panel meter of CFA should indicate within ±3 divisions of +15.

24. Repeat steps 22 and 23 for the frequencies listed below.

LOW FREQ.	HIGH FREQ.
920 cps	1080 cps
930 cps	1070 cps
940 cps	1060 cps
950 cps	1050 cps
960 cps	1040 cps
970 cps	1030 cps
980 cps	1020 cps

25. Set POWER switch at OFF. Remove extender card and module; Replace module in receptacle J1005. Disconnect a-f generator leads from CHAN 1 input terminals 1 and 3.

h. DRIVER MODULE, ALIGHMENT. - Upon completion of paragraphs 5-4d, through 5-4g. Proceed as follows:

1. Set POWER switch at OFF. Plug module in extender card; plug extender in receptacle J1009. Turn variable resistor R603 and R604 fully counter-clockwise and set MULTIMETER switch at B+. Set POWER switch at ON. Adjust R603 clockwise until CFA MULTIMETER indicates +12 volts, plus or minus 10 percent.

2. Set MULTIMETER switch at B-. Adjust R604 clockwise until CFA MULTIMETER indicates -12 volts, plus or minus 10 percent.

3. Connect a teletype keyer, a 12 vdc power source and a 330 ohm 1 watt resistor to input of a frequency shift simulator (refer to figure 5-1).

4. Connect the audio output of the frequency shift simulator to terminals 1 and 3 of TB1001 on rear of CFA.

5. Adjust teletype keyer for a 60 wpm DOT CYCLE, a stop length of 1.0 and "0" distortion.

6. Adjust frequency shift simulator to

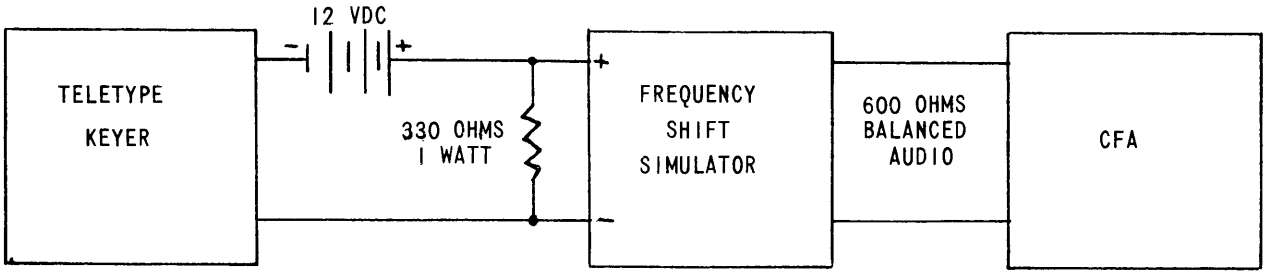

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Figure 5-1. Test Equipment Connection Diagram.

provide an 850 cps shift centered at 2550 cps.

7. Set CFA operating controls as follows:

CONTROL	POSITION
FUNCTION switch	LINE +
CHAN-1 switch	ON
MULTIMETER switch	DISC 1

8. Adjust frequency shift simulator output frequency until CFA MULTIMETER indicates "0".

9. Set teletype keyer to provide Mark signal and adjust CHAN 1 GAIN control of CFA until CFA MULTIMETER indicates -15. Re-set teletype keyer to 60 wpm DOT CYCLE.

10. Connect an oscilloscope (externally syncronized to the keying input of the frequency shift simulator) to TP601 (refer to Table 5-2 for typical indication).

11. Set CFA FUNCTION switch at LINE - and repeat step 10 for TP602 through TP606.

12. Set POWER switch at off; remove all test equipment; and replace module in receptical J1009.

i. LINE SUPPLY MODULE ALIGNEMENT.- Upon completion of paragraphs 5-4d through 5-4h, proceed as follows:

1. Set POWER switch at OFF. Plug Module in extender card; plug extender card in J1001.

2. Connect a jumper between terminals 8 and 9 of terminal board TB1001. External line supply.

3. Set VOM at 100ma. d-c scale and connect the positive (+) lead to terminal 11 of TB1001 and the negative (-) lead to terminal 10 of TB1001, in series with 1 K ohm resistor.

4. Set CFA operating controls as follows:

CONTROL	POSITION
FUNCTION switch	MARK
Line Current switch S1001	60 MA
POWER switch	ON

5. Adjust R101 for a 60ma indication on VOM.

6. Set line current switch S1001 at 20ma and 10ma and observe indications on VOM. Indications should be within + 10 percent.

7. Remove VOM test leads from TB1001 and set VOM at 1000 vdc. Connect VOM test leads across C101 VOM should indicate approximatly 250 vdc. Re-connect VOM test leads to terminals 10 and 11 of TB1001.

8. Set MULTIMETER switch at LINE VOLTAGE X20 and adjust R103 until CFA MULTIMETER indicates the same voltage obtained in step 7.

9. Set POWER switch at OFF. Remove extender card module; replace module in receptical J1001:

j. OUTPUT MODULE ALIGNMENT. - Upon completion of paragraphs 5-4d through 5-4i proceed as follows:

1. Set POWER switch at OFF. Plug module in extender card; plug extender card in receptical J1002.

2. Set CFA MULTIMETER switch at LINE CURRENT X5 and current switch S1001 at 60 ma. Set CFA POWER switch at ON and adjust R204 to obtain 60ma indication on CFA MULTIMETER.

3. Set POWER switch at OFF. Remove extender card and module; Plug module in receptical J1002.

k. FINAL ALIGNMENT. - Upon completion of paragraphs 5-4d through 5-4j, proceed as follows:

1. Set POWER switch at OFF and remove Driver module from J1009; plug module in exteder card; plug extender card in receptical J1009.

2. Remove VOM test leads and connect a 2000 ohm 10 watt resistor between terminals 10 and 11 of TB1001.

3. Set teletype analyzer at 45.5 bands (speed) 60N (input) Average bias (Function) All Transition and power at on and connect analyzer output to CFA TTY MONITOR jack (observe analyzer polarity).

4. Connect teletype keyer, 12 vdc source, 330-ohm 1 watt resistor, and frequency shift simulator as illustrated in figure 5-1 to terminals 1 and 3 of CFA terminal board TB1001.

5. Set CFA BIAS control at mid-position and CFA POWER switch at ON; Adjust R608 for minimum bias indication on teletype analyzer.

6. Set teletype analyzer at end distortion and optimize setting of R608 for minimum distortion. (Bias and end distortion should not exceed 3%.)

7. This completes the alignment proceedure. Remove extender card and module; replace module in receptical J1009; Remove all test equipment.

TABLE 5-2 CFA TEST POINTS AND WAVESHAPES

NOTE: ALL VOLTAGES SHOWN ARE NOMINAL

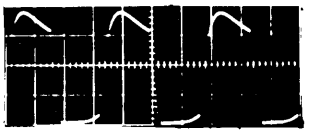
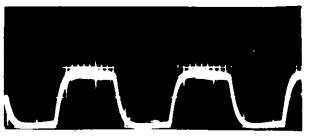
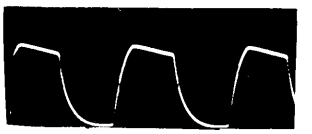
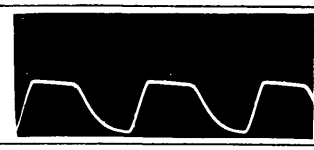
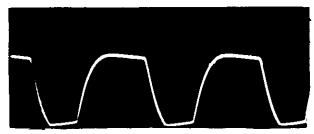
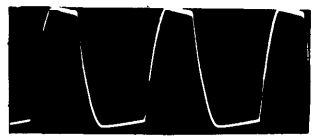
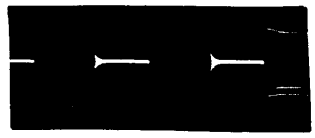
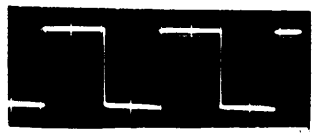
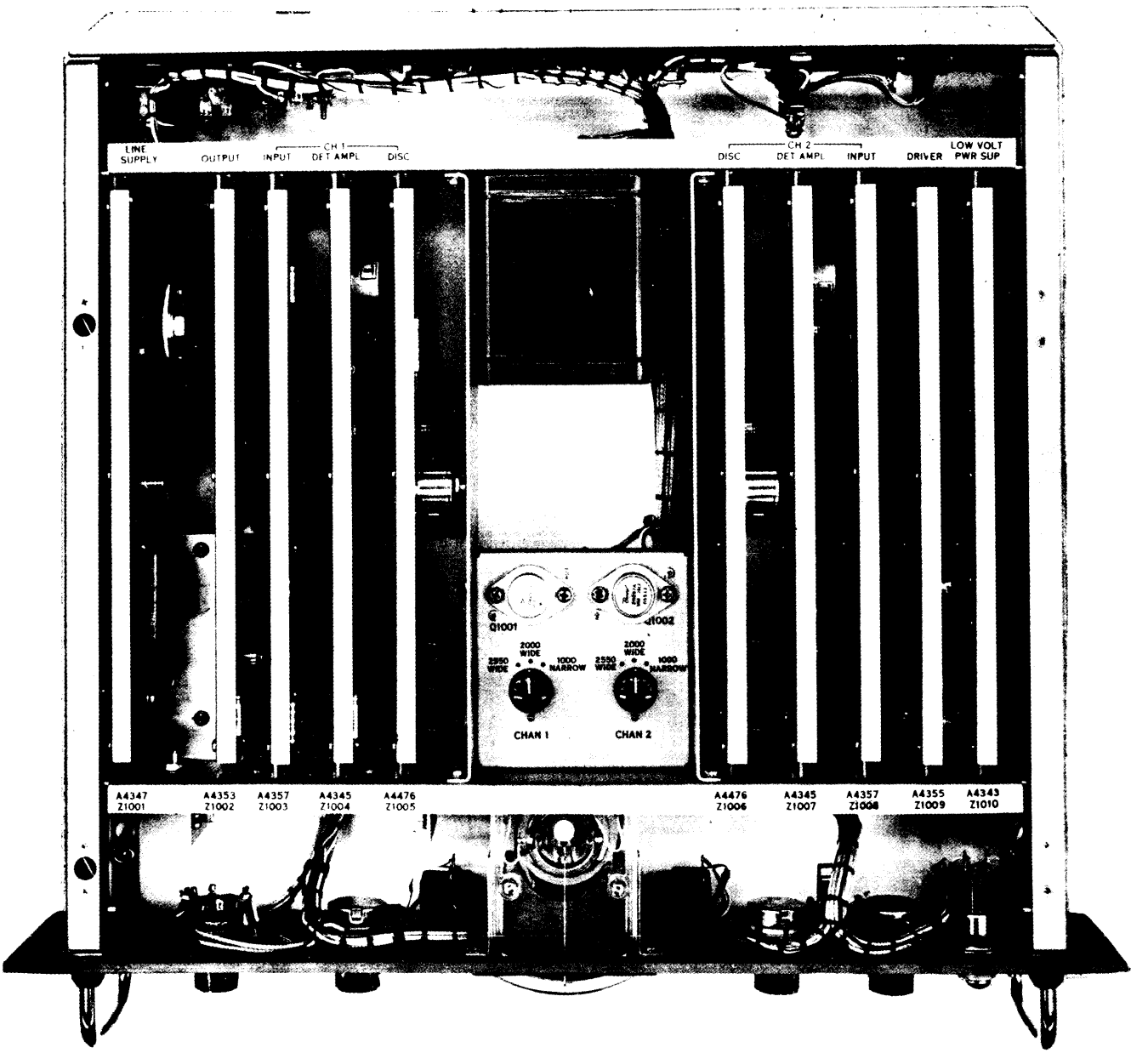
MODULE	TEST POINT	CONTROL SETTINGS	WAVESHAPE
INPUT CHAN 1 INPUT CHAN 2	TP2	VOLTS/CM 2.0V TIME/CM 0.1 us INPUT	
		NOTE Both Modules and test point, control settings and waveshapes are identical	
	TP3	VOLTS/CM 2.0V TIME/CM 0.1 us INPUT -20 dbm	
	TP3	VOLTS/CM 2.0V TIME/CM 0.1 us INPUT +30 dbm	
	TP4	VOLTS/CM 5.0V TIME/CM 0.1 us INPUT +30 dbm	
	TP4	VOLTS/CM 5.0V TIME/CM 0.1 us INPUT -20 dbm	
DRIVER	TP1	VOLTS/CM .5V TIME/CM 10.0 us	
	TP2	VOLTS/CM .2V TIME/CM 10.0 us	
	TP3	VOLTS/CM .2V TIME/CM 10.0 us	

TABLE 5-2. CFA TEST POINTS AND WAVESHAPES (Cont)

MODULE	TEST POINT	CONTROL SETTINGS		WAVESHAPE
DRIVER (Con't)	TP4	VOLTS/CM TIME/CM	2.V 10.0 us	
	TP6	VOLTS/CM TIME/CM	.2V 10.0 us	
	TP6	VOLTS/CM TIME/CM	2.0V 10.0 us	
OUTPUT	TP1/TP2	VOLTS/CM TIME/CM	.5V 10.0 us	
	TP3	VOLTS/CM TIME/CM	5.0V 10.0 us	
	TP4	VOLTS/CM TIME/CM	2.0V 10.0 us	
	TP5	VOLTS/CM TIME/CM	20.0V 10.0 us	
LINE SUPPLY	ACROSS 2500 ohms 60 ma loop	VOLTS/CM TIME/CM	50V 10 us	



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672-17-5

Figure 5-2. Top View, CFA.

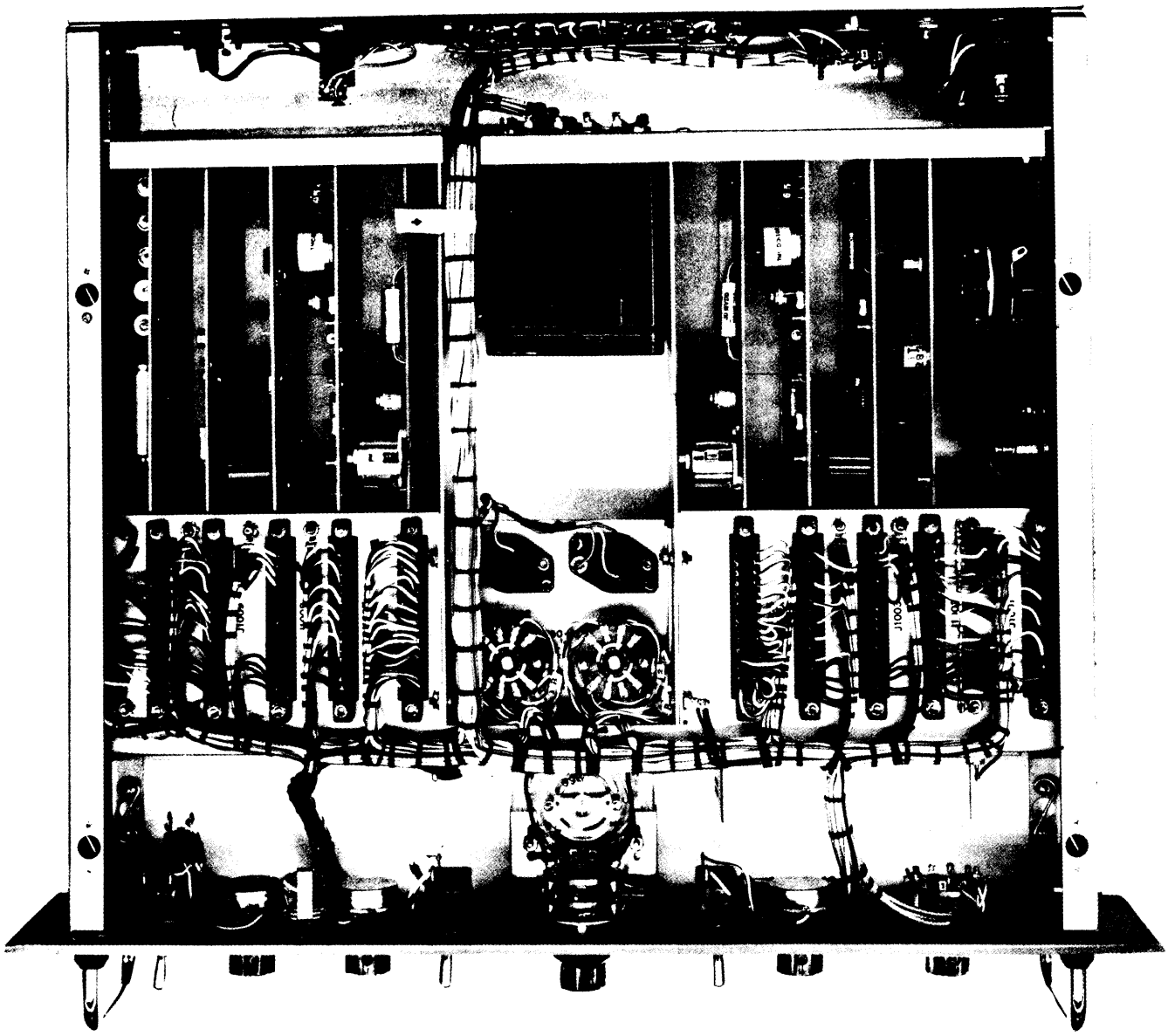

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Figure 5-3. Bottom View, CFA.

SECTION 6
PARTS LIST

6-1. INTRODUCTION

The parts list presented in this section is a cross-reference list of parts identified by a reference designation and TMC part number. In most cases, parts appearing on schematic diagrams are assigned reference designations in accordance with MIL-STD-16. Wherever practicable, the reference designation is marked on the equipment, close to the part it identifies. In most cases, mechanical and electro-mechanical parts have TMC part numbers stamped on them.

To expedite delivery when ordering any part, specify the following:

a. Reference symbol.

b. Description as indicated in parts list.

c. TMC part number.

d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

For replacement parts not covered by warranty (refer to warranty sheet in front of manual), address all purchase orders to:

The Technical Materiel Corporation
Attention: Sales Department
700 Fenimore Road
Mamaroneck, New York

PARTS LIST
for
FREQUENCY SHIFT CONVERTOR, MODEL CFA-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1001 and C1002	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 pf; GMV; 500 WVDC	CC100-29
CR1001	SEMICONDUCTOR DEVICE, DIODE	IN2978
DS1001	LAMP, INCANDESCENT: 28 V, 0.04 amps; bayonet base, T-3-1/4 bulb.	BI101-1819
F1001	FUSE, CARTRIDGE: 1/2 amp; time lag; 1-1/4" long x 1/4" dia.; slow blow.	FU102-.500
F1002	Same as F1001.	
J1001	CONNECTOR, RECEPTACLE, ELECTRICAL: 15 female contacts rated for 5 amps at 1,800 V RMS; single sided printed circuit board type; floating bushing.	JJ319A15SFE
J1002 thru J1004.	Same as J1001.	
J1005	CONNECTOR, RECEPTACLE, ELECTRICAL: 30 female contacts rated for 5 amps at 1,800 V RMS; double sided printed circuit board type; floating bushing.	JJ319A15DFE
J1006	Same as J1005.	
J1007 thru J1010	Same as J1001.	
J1011	CONNECTOR, RECEPTACLE, ELECTRICAL: male	MS3102A14S1P
J1012	JACK, TELEPHONE	JJ089
M1001	METER: full scale deflection 25-0-25 ua; 2,000 ohms, ±5%; red lance pointer.	MR191-6
Q1001	TRANSISTOR	2N297
Q1002	Same as Q1001.	
R1001	RESISTOR, VARIABLE, COMPOSITION: 5,000 ohms, ±20%; 2 watts.	RV4NAYSD502B
R1002	RESISTOR, VARIABLE, COMPOSITION: 25,000 ohms, ±10%; 2 watts.	RV4NAYSD253A
R1003	Same as R1002.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
S1001	SWITCH, TOGGLE: SPDT; 28° angle of throw; bat type handle.	ST40E
S1002	SWITCH, TOGGLE: SPDT; 28° angle of throw; bat type handle.	ST12D
S1003	SWITCH, ROTARY: 1 section, 2 positions; 30° angle of throw; non-shorting type contacts rated at 110 VAC; mycalex wafer insulation.	SW433
S1004	SWITCH, TOGGLE: DPST; 28° angle of throw; bat type handle.	ST22K
S1005	SWITCH, TOGGLE: SPST; 28° angle of throw; bat type handle.	ST12A
S1006	SWITCH, ROTARY	SW217
S1007	Same as S1005.	
S1008	SWITCH, ROTARY: 1 section, 4 positions; 30° angle of throw; non-shorting type contacts; mycalex wafer insulation.	SW280
S1009	SWITCH, ROTARY: 2 sections, 3 positions; 30° angle of throw; non-shorting type contacts rated at 110 VAC; mycalex wafer insulation.	SW432
S1010	Same as S1009.	
T1001	TRANSFORMER, POWER: step-up/step-down; primary 115/230 VAC, 50/400 Hz, single phase; secondary 175 V RMS at 100 MADC, 28 V RMS at 700 MADC.	TF343
TB1001	TERMINAL BOARD, BARRIER: twelve 6-32 thd x 1/4" long binding head machine screws.	TM100-12
XDS1001	LIGHT, INDICATOR: w/red frosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-1
XF1001	FUSEHOLDER: extractor post type; accomodates cartridge fuse 1-1/4" long x 1/4" dia.; 1-3/4" long x 11/16" dia. o/a dim.	FH103
XF1002	Same as XF1001.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XQ1001	SOCKET, TRANSISTOR: 7 pin accomodation; 0.040 or 0.050 dia.; polarized; 1 terminal lug grounding strap; o/a dim. 1-37/64" x 1" max.	TS166-1
XQ1002	Same as XQ1001.	
Z1001	LINE SUPPLY MODULE. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	A4347
Z1002	OUTPUT MODULE. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	A4353
Z1003	INPUT MODULE. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	A4357
Z1004	DETECTOR AMPLIFIER MODULE. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	A4345
Z1005	DISCRIMINATOR MODULE. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	A4476
Z1006	Same as Z1005. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	
Z1007	Same as Z1004. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	
Z1008	Same as Z1003. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	
Z1009	DRIVER MODULE. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	A4355
Z1010	LOW VOLTAGE POWER SUPPLY MODULE. SEE SEPARATE PARTS LIST FOR BREAKDOWN.	A4343

PARTS LIST
for
LINE SUPPLY MODULE, A4347

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C101	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf, -10% +150%; 350 WVDC; polarized.	CE116-12V
CR101	SEMICONDUCTOR DEVICE, DIODE	1N2484
CR102 thru CR104	Same as CR101.	
CR105	SEMICONDUCTOR DEVICE, DIODE	1N3022B
CR106	SEMICONDUCTOR DEVICE, DIODE	1N2843
Q101	TRANSISTOR: silicon	TX111
R101	RESISTOR, VARIABLE, COMPOSITION: 500 ohms, ±10%; 0.25 watt; linear taper.	RV111U501A
R102	RESISTOR, FIXED, COMPOSITION: 360 ohms, ±5%; 1/2 watt.	RC20GF361J
R103	RESISTOR, VARIABLE, COMPOSITION: 5 meg ohm, ±10%; 0.25 watt; linear taper.	RV111U505A
R104	RESISTOR, FIXED, COMPOSITION: 180 ohms, ±5%; 1/2 watt.	RC20GF181J
R105	Same as R104.	
R106	Same as R104.	
R107	RESISTOR, FIXED, WIREWOUND: 10,000 ohms, ±5%; 10 watts; non-inductive.	RR116-10000W
R108	RESISTOR, FIXED, COMPOSITION: 15 meg ohm, ±5%; 1/2 watt.	RC20GF156J
XCR106	HEAT SINK: accomodates semiconductor type TO-3.	HD105
XQ101	Same as XCR106.	

PARTS LIST
for
OUTPUT MODULE, A4353

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C201	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, -10% +150% at 120 cps (Hz) at 25°C; 25 WVDC; polarized.	CE105-10-25
C202	Same as C201.	
C203	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 0.47 uf, ±20; 25 WVDC.	CC112R474M
C204	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, +80% -20%; 25 WVDC.	CC100-33
C205	Same as C204.	
C206	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC.	CC100-28
C207	Same as C206.	
C208	CAPACITOR, FIXED, MICA DIELECTRIC: 10,000 uuf, ±1%; 100 WVDC.	CM112F103F1S
C209	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, ±5%; 500 WVDC.	CM111F221J5S
CR201	SEMICONDUCTOR DEVICE, DIODE	1N2484
CR202	SEMICONDUCTOR DEVICE, DIODE	1N627
CR203	Same as CR202.	
EQ201	HEAT SINK: heat dissipating element.	HD101-1
Q201	TRANSISTOR	2N3439
Q202	TRANSISTOR	2N697
Q203	TRANSISTOR	2N1131
Q204	Same as Q202.	
R201	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R202	Same as R201.	
R203	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±5%; 1/2 watt.	RC20GF100J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R204	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms, ±10%; 0.25 watt; linear taper.	RV111U503A
R205	RESISTOR, FIXED, COMPOSITION: 2,700 ohms, ±5%; 1/2 watt.	RC20GF272J
R206	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R207	Same as R201.	
R208	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R209	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; ½ watt	RC20GF103J
R210	Same as R208.	
R211	RESISTOR, FIXED, COMPOSITION: 120,000 ohms, ±5%; 1/2 watt.	RC20GF124J
R212	Same as R208.	
R213	Same as R208.	
R214	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1/2 watt.	RC20GF471J
R215	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±5%; 1/2 watt.	RC20GF681J
T201	TRANSFORMER, RADIO FREQUENCY: primary inductance 1.36 mh, ±5%; 1.2 ohms approx. DC resistance; secondary turns ratio 30.25:1; 0.3 ohms approx. DC resistance.	TT283

PARTS LIST
for
INPUT MODULE, A4357

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C301	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, -10% +150% at 120 cps (Hz) at 25°C; 25 WVDC; polarized.	CE105-10-25
C302	Same as C301.	
C303	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, +80% -20%; 25 WVDC.	CC100-33
C304	CAPACITOR, FIXED, ELECTROLYTIC: 2 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized.	CE105-2-15
C305	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C306	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized.	CE105-20-15
CR301	SEMICONDUCTOR DEVICE, DIODE	1N627
CR302 thru CR304	Same as CR301.	
Q301	TRANSISTOR	2N3646
Q302	Same as Q301.	
Q303	Same as Q301.	
Q304	TRANSISTOR	2N1711
Q305	Same as Q301.	
R301	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R302	Same as R301.	
R303	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R304	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R305	Same as R303.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R306	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R307	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, ±5%; 1/2 watt.	RC20GF153J
R308	Same as R307.	
R309	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±5%; 1/2 watt.	RC20GF681J
R310	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R311	Same as R304.	
R312	RESISTOR, FIXED, COMPOSITION: 39,000 ohms, ±5%; 1/2 watt.	RC20GF393J
R313	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R314	Same as R303.	
R315	Same as R303.	
R316	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R317	Same as R316.	
R318	Same as R316.	
T301	TRANSFORMER, AUDIO: primary impedance 600 ohms, CT; secondary 600 ohms; power rating 1 watt; frequency response 575 to 3,500 Hz, ±3db.	TF344
T302	TRANSFORMER , INTERSTAGE: primary impedance 20,000 ohms; DC resistance 1,600 ohms; secondary impedance 800 ohms; DC resistance 170 ohms; frequency range 100 cps (Hz) to 20 KC.	TF246-2X

PARTS LIST
for
DETECTOR AMPLIFIER MODULE, A4345

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C401	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, -10% +150% at 120 cps (Hz) at 25°C; 25 WVDC; polarized.	CE105-10-25
C402	Same as C401.	
C403	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .01 uf GMV; 500 WVDC.	CC100-16
C404	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 100 WVDC.	CC100-35
C405	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 uuf, GMV; 500 WVDC.	CC100-29
C406	Same as C405.	
C407	CAPACITOR, FIXED, ELECTROLYTIC: 5 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized.	CE105-5-15
C408 thru C412	Same as C407.	
CR401	SEMICONDUCTOR DEVICE, DIODE: germanium; four matched diodes; max. continuous voltage 80 WVDC; average rectified current 30 ma at 25°C; max. power dissipation 80 mw at 25°C.	DD100
CR402	Same as CR401.	
CR601	DIODE	IN914
CR602	Same as CR601	
Q401	TRANSISTOR	2N3646
Q402 thru Q408	Same as Q401.	
R401	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R402	Same as R401.	
R403	RESISTOR, VARIABLE, COMPOSITION: 100,000 ohms, ±10%; 0.25 watt; linear taper.	RV111U104A
R404	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R405	RESISTOR, VARIABLE, COMPOSITION: 250,000 ohms, ±10%; 0.25 watt; linear taper.	RV111U254A
R406	Same as R404.	
R407	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±5%; 1/2 watt.	RC20GF223J
R408	Same as R407.	
R409	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R410	Same as R409.	
R411	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R412	RESISTOR, VARIABLE, COMPOSITION: 50 ohms, ±10%; 0.25 watt; linear taper.	RV111U500A
R413	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R414	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R415	Same as R412.	
R416	Same as R411.	
R417	Same as R413.	
R418	Same as R414.	
R419	Same as R409.	
R420	Same as R409.	
R421	RESISTOR, FIXED, COMPOSITION: 1,800 ohms, ±5%; 1/2 watt.	RC20GF182J
R422	Same as R421.	
R423	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±5%; 1/2 watt.	RC20GF224J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R424	Same as R423.	
R425	Same as R404.	
R426	RESISTOR, FIXED, COMPOSITION: 8,200 ohms, ±5%; 1/2 watt.	RC20GF822J
R427	Same as R426.	
T401	TRANSFORMER, AUDIO FREQUENCY: primary impedance 10,000 ohms, CT; secondary 1.5 K ohms, CT; power rating 100 mw; frequency range 50-10,000 cps (Hz).	TF270
T402	Same as T401.	

PARTS LIST
for
DISCRIMINATOR MODULE, A4476

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C501	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.00341 uf, ± 0.5%; 30 WVDC.	CX104-88
C502	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.005 uf, ± 0.5%; 30 WVDC.	CX104-89
C503	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.02556 uf, ± 0.5%; 30 WVDC.	CX104-92
C504	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.00889 uf, ± 0.5%; 30 WVDC.	CX104-90
C505	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.01725 uf, ± 0.5%; 30 WVDC.	CX104-91
C506	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.0468 uf, ± 0.5%; 30 WVDC.	CX104-93
L501	COIL, AUDIO FREQUENCY: adjustable; inductance 750 mh, ±5% at 1 KC; 92 ohms approx. DC resistance.	CL397
L502	Same as L501.	
R501	RESISTOR, VARIABLE, COMPOSITION: 100,000 ohms, ±10%; 0.25 watt; linear taper.	RV111U104A
R502	Same as R501.	
R503	Same as R501.	
R504	RESISTOR, VARIABLE, COMPOSITION: 250,000 ohms, ±10%; 0.25 watt; linear taper.	RV111U254A
R505	Same as R504.	
R506	Same as R504.	

PARTS LIST
for
DRIVER MODULE, A4355

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C601	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, -10% +150% at 120 cps (Hz) at 25°C; 25 WVDC; polarized.	CE105-10-25
C602	Same as C601.	
C603	CAPACITOR, FIXED, ELECTROLYTIC: 40 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized.	CE105-40-50
C604	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1 uf, ±80%-20% 3 WVDC.	CE100-34
C605	Same as C603.	
Q601	TRANSISTOR	2N3646
Q602	TRANSISTOR	2N3694
Q603	Same as Q601.	
Q604	TRANSISTOR	2N697
R601	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R602	Same as R601.	
R603	RESISTOR, VARIABLE, COMPOSITION: 5 megohm, ±10%; 0.25 watt; linear taper.	RV111U505A
R604	Same as R603.	
R605	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J
R606	Same as R605.	
R608	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, ±10%; 0.25 watt; linear taper.	RV111U103A
R609	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R610	Same as R605.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R611	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R612	RESISTOR FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R613	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%; 1/2 watt.	RC20GF473J
R614	Same as R605.	
R615	Same as R609.	
R616	RESISTOR, FIXED, COMPOSITION: 1 megohm, ±5%; 1/2 watt.	RC20GF105J

PARTS LIST
for
LOW VOLTAGE SUPPLY MODULE, A4343

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C701	CAPACITOR, FIXED, ELECTROLYTIC: 75 uf, -10% +150% at 120 cps (Hz) at 25°C; 50 WVDC; polarized.	CE105-75-50
C702	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, +80% -20%; 25 WVDC.	CC100-33
C703	CAPACITOR, FIXED, ELECTROLYTIC: 25 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized.	CE105-25-50
C704	CAPACITOR, FIXED, ELECTROLYTIC: 200 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized.	CE105-200-15
C705	Same as C704.	
C706	CAPACITOR, FIXED, ELECTROLYTIC: 150 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized.	CE105-150-15
C707	Same as C701.	
C708	Same as C701.	
CR701	SEMICONDUCTOR DEVICE, DIODE	1N3189
CR702 thru CR704	Same as CR701.	
Q701	TRANSISTOR	2N3640
R701	RESISTOR, FIXED, COMPOSITION: 1.0 ohms, ±5%; 1/2 watt.	RC20GF1R0J
R702	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1/2 watt.	RC20GF471J
R703	RESISTOR, FIXED, COMPOSITION: 1,500 ohms, ±5%; 1/2 watt.	RC20GF152J
R704	Same as R703.	
R705	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R706	RESISTOR, VARIABLE, COMPOSITION: 250 ohms, ±10%; 0.25 watt; linear taper.	RV111U251A

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R707	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R708	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±5%; 2 watt.	RC42GF151J
R709	Same as R707.	

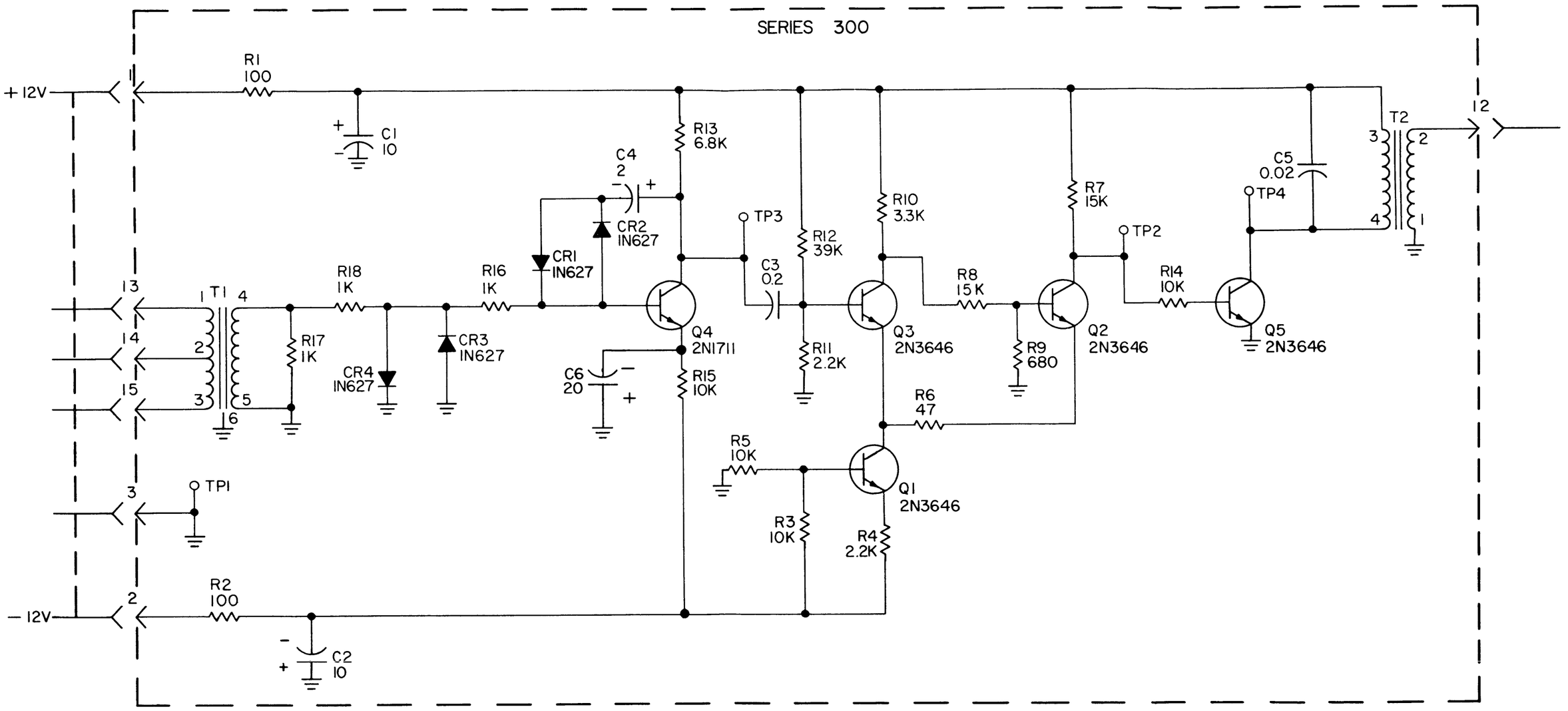
SECTION 7
SCHEMATIC DIAGRAMS

S1009, S1010 DISCRIMINATOR	
POSITION	FUNCTION
1	2550 WIDE
2	2000 WIDE
3	1000 WIDE

S1006 MULTIMETER	
POSITION	FUNCTION
1	LINE CURRENT X5
2	B+
3	DISCRIMINATOR 1
4	DISCRIMINATOR 2
5	B−
6	LINE VOLTAGE X20

S1008	
POSITION	FUNCTION
1	MARK
2	SPACE
3	LINE+
4	LINE−

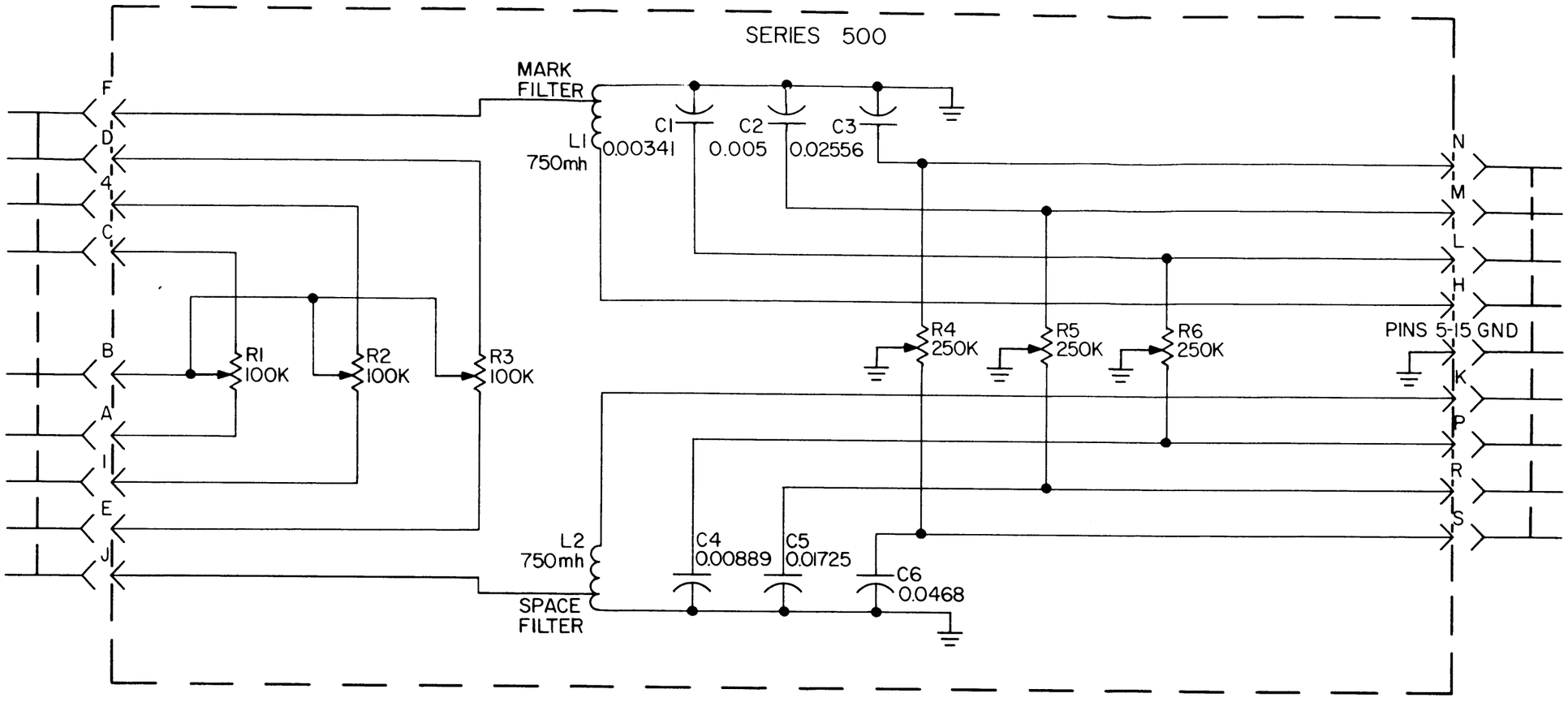
Figure 7-1. Schematic Diagram CFA



UNLESS OTHERWISE SPECIFIED

1 — ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT.
2 — ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 7-2. Schematic Diagram Input Module

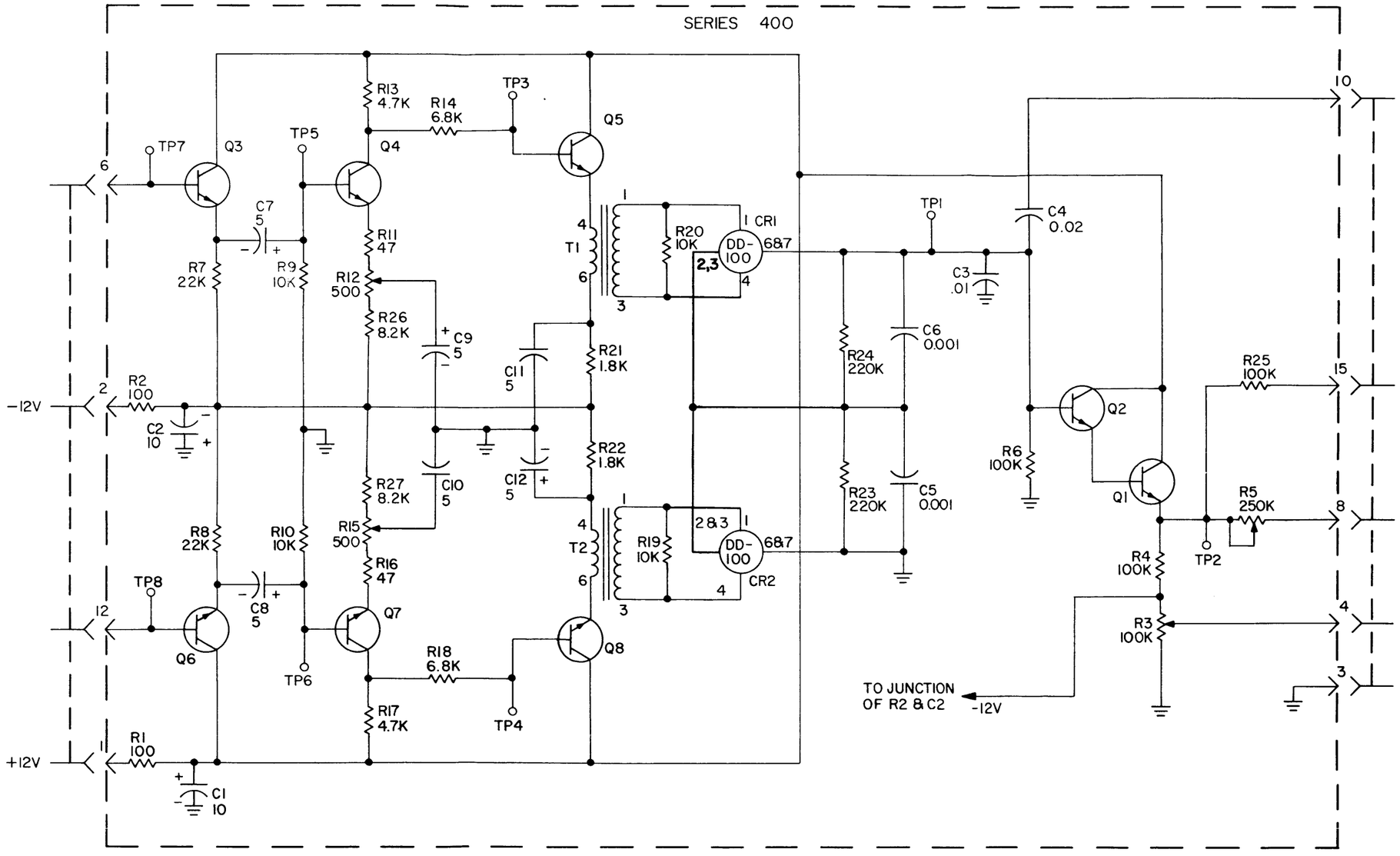


UNLESS OTHERWISE SPECIFIED

1 — ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT.

2 — ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 7-3. Schematic Diagram Discriminator Module



CK1201C

UNLESS OTHERWISE SPECIFIED

1 — ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT.
2 — ALL CAPACITOR VALUES ARE IN MICROFARADS.
3 — ALL TRANSISTORS ARE 2N3646.

Figure 7-4. Schematic Diagram, Detecter Amplifier Module,

105694008A

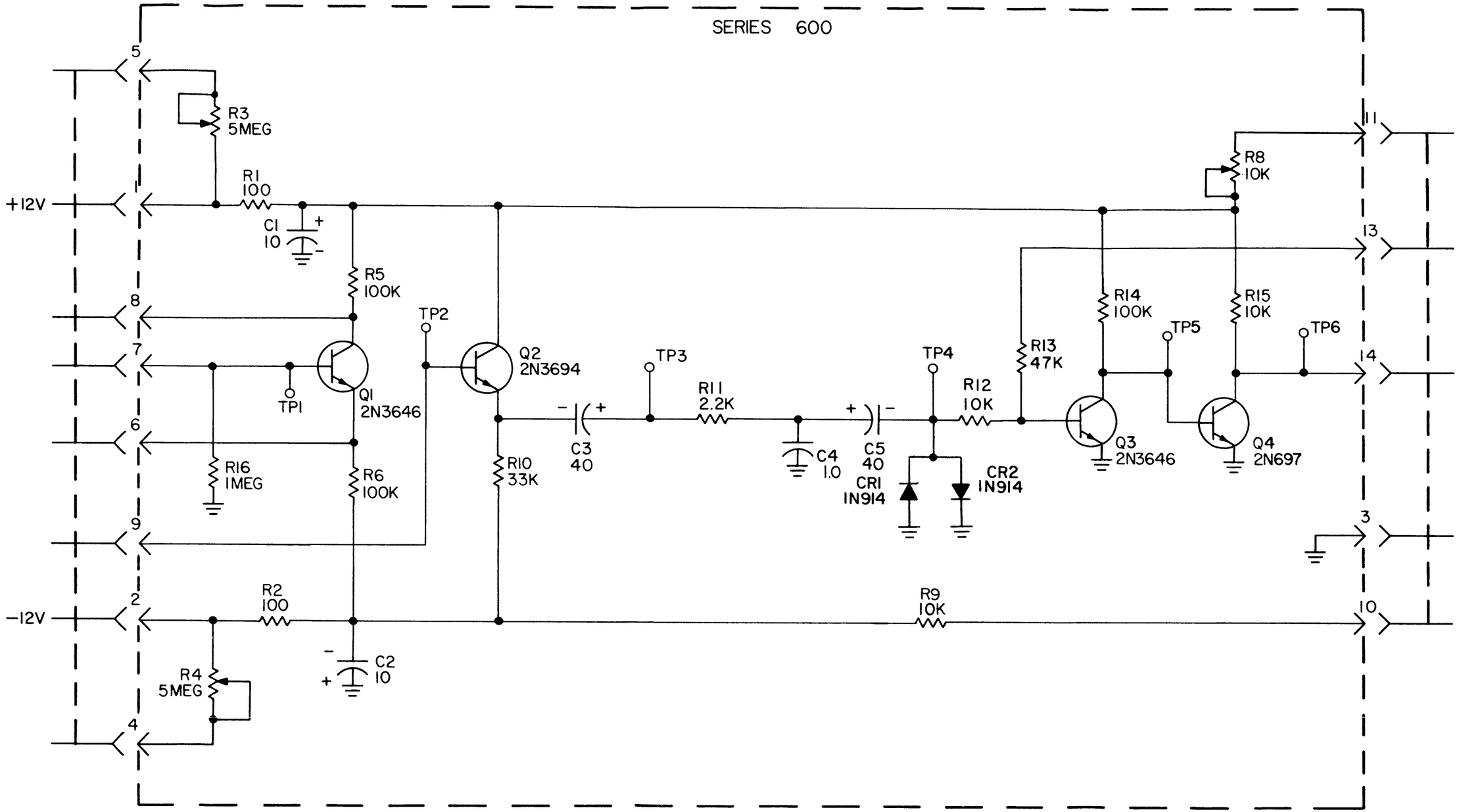
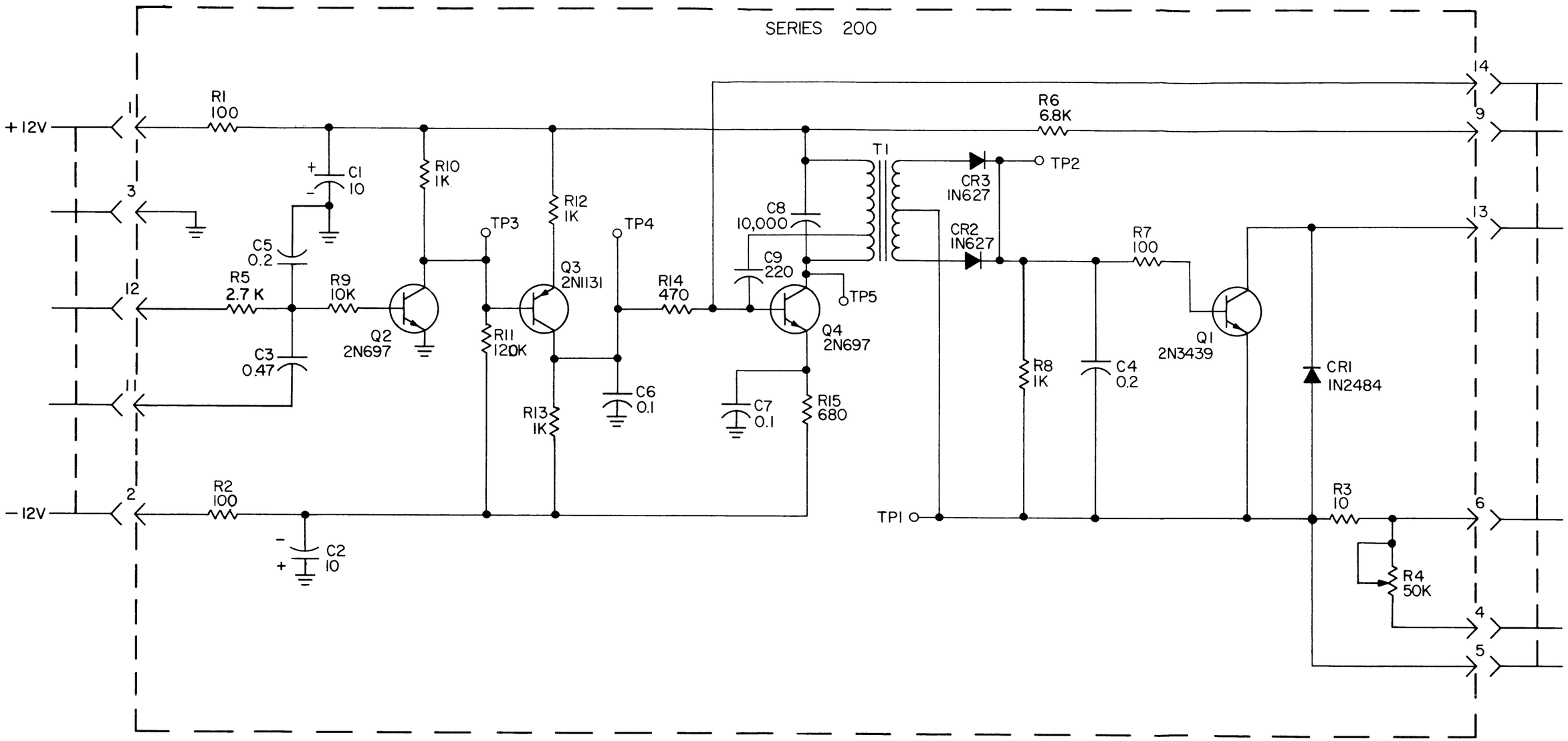


Figure 7-5. Schematic Diagram
Driver Module

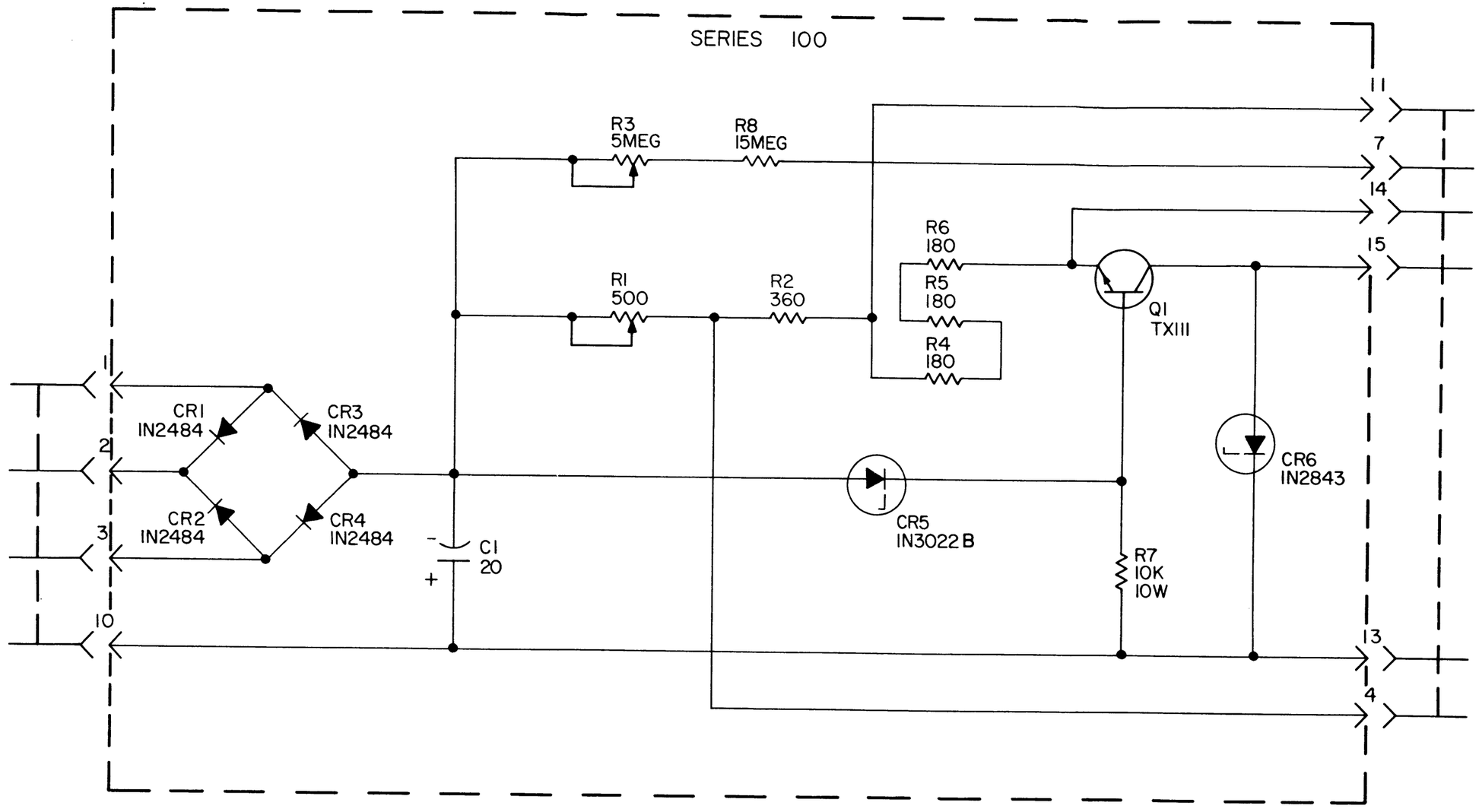


UNLESS OTHERWISE SPECIFIED

1 — ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT.

2 — ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 7-6. Schematic Diagram
Output Module
7-13/7-14



UNLESS OTHERWISE SPECIFIED

1 — ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT.
2 — ALL CAPACITOR VALUES ARE IN MICROFARADS.

CK1198A

Figure 7-7. Schematic Diagram
Line Supply Module

105394008A