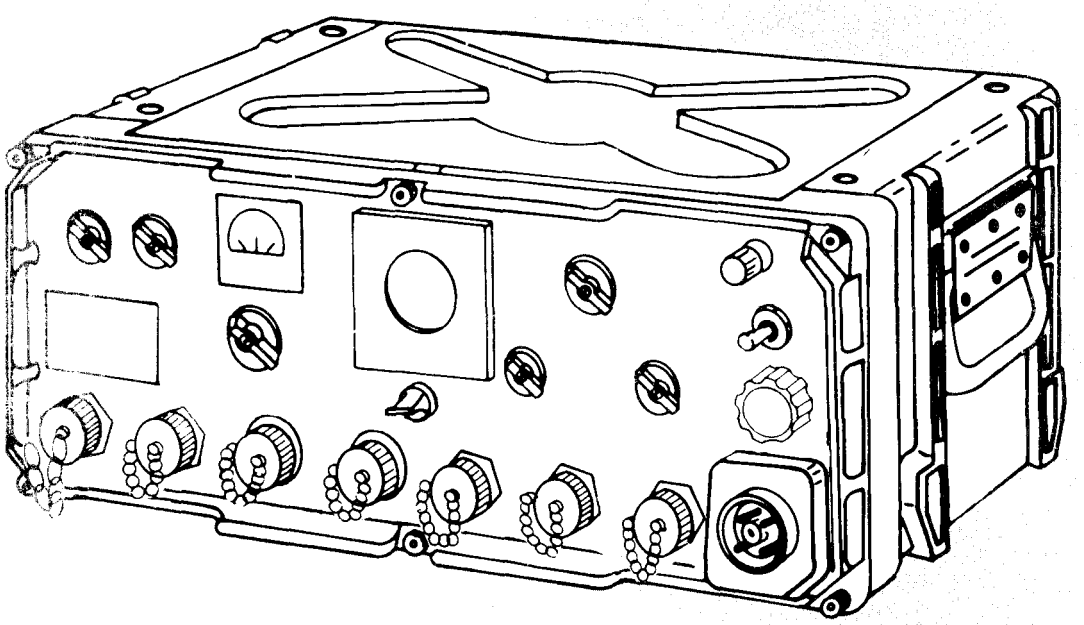
TM 11-5805-387-34-1

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE



MODEM RADIO TELETYPEWRITER

MD-522/GRC
(NSN 5815-00-999-5277)

HEADQUARTERS, DEPARTMENT OF THE ARMY

11 MAY 1984

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1. DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL
2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER
3. IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A WOODEN POLE OR A ROPE OR SOME OTHER INSULATING MATERIAL
4. SEND FOR HELP AS SOON AS POSSIBLE
5. AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

WARNING

DON'T TAKE CHANCES!

CAPABLE OF CAUSING DEATH

HIGH VOLTAGES EXIST IN THE FOLLOWING EQUIPMENT:

Various connectors and power supply components.	27 vdc
DC LOOP NO. land DC LOOP NO. 2 connectors	120 vdc
Loop battery module A5	90 vdc
Scope module A2	1,100 vdc

USE EXTREME CAUTION WHEN HANDLING, TESTING AND ADJUSTING DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

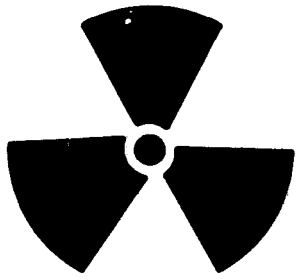
SAFETY PRECAUTION

A periodic review of safety precautions in TB 385-4, Safety Precautions for Maintenance of Electrical/ Electronic Equipment, is recommended. When the equipment is operated with covers removed, DO NOT TOUCH exposed connections or components. MAKE CERTAIN you are not grounded when making connections or adjusting components inside the test instrument.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT

Breakage of the cathode-ray tube (CRT) causes a high velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety masks and gloves.

WARNING
RADIATION HAZARD



RADIOACTIVE MATERIAL
CONTROLLED DISPOSAL REQUIRED
ACCOUNTABILITY NOT REQUIRED

Meter	Ra226	1.0uCi	6625-00-257-1103
Meter	Ra226	0.6uCi	6625-00-226-5680
Meter arbitrary scale	Ra226.	1.0uCi	6625-00-226-5679
Meter, arbitrary scale	Ra226.	1.0uCi	6625-00-226-5681

Radiation Hazard Information The following radiation hazard information must be read and understood by all personnel operating or repairing Radio Teletypewriter Sets AN/GRC-142, AN/GRC-142A, AN/GRC-142B, AN/GRC-122, AN/GRC-122A,and AN/GRC-122B. Hazardous radioactive materials are present in the above listed components of the MD-522/GRC, RT-662/GRC, RT-824/GRC, and the AM-3349/GRC. The components are potentially hazardous when broken. See qualified medical personnel and the local Radiological Protection Officer (RPO) immediately if you are exposed to or cut by broken components. First aid instructions are contained in TB 43-0116, TB 43-0122, and AR 385-11.

NEVER place radioactive components in your pocket. Use extreme care NOT to break radioactive components while handling them.

NEVER remove radioactive components from cartons until you are ready to use them.

If any of these components are broken, notify the local RPO immediately.

The RPO will survey the immediate area for radiological contamination and will supervise the removal of broken components.

The above listed radioactive components will NOT be repaired or disassembled.

Disposal of broken, unserviceable, or unwanted radioactive components will be accomplished in accordance with the instructions in AR 385-11.

TECHNICAL MANUAL

No. 11-5805-387-34-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 11 May 1984

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

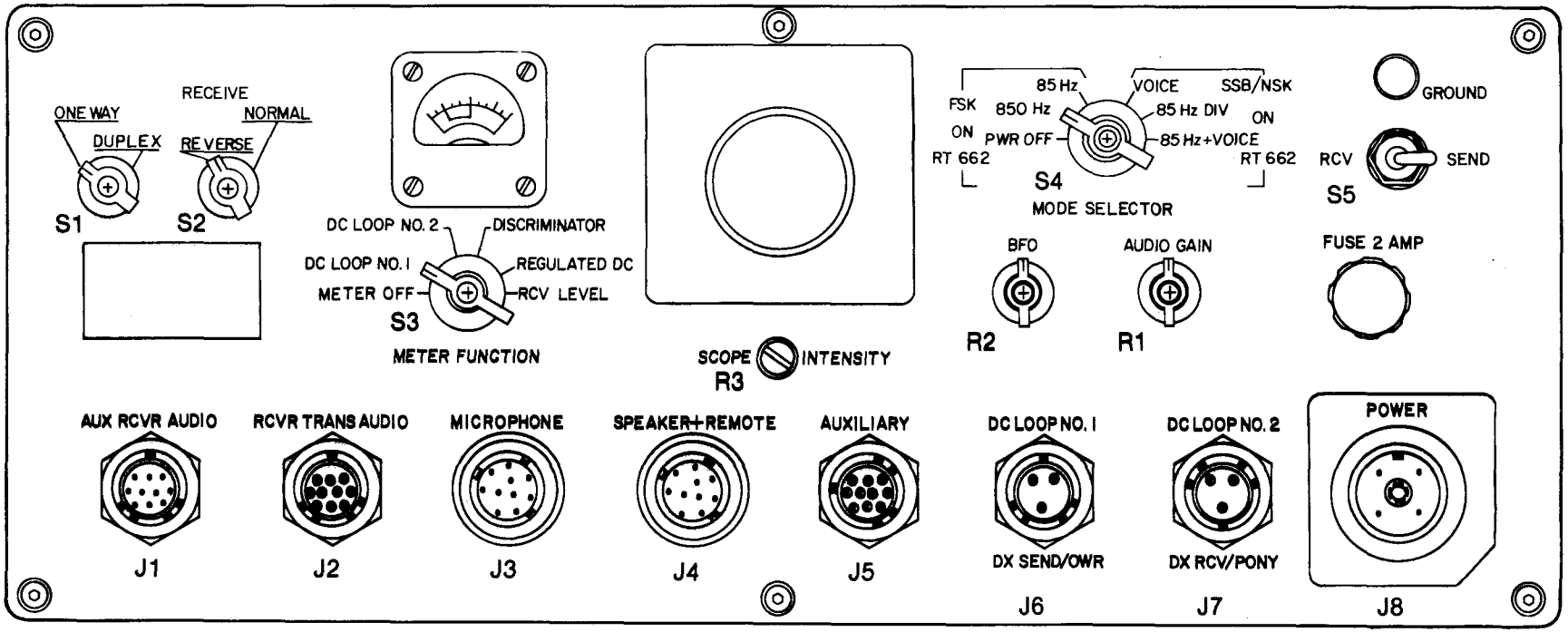
MODEM RADIO TELETYPEWRITER MD-522/GRC (NSN 5815-00-999-5277)

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, New Jersey 07703. In either case; a reply will be sent to you.

*This manual supersedes TM 11-5805-387-15-1, as pertains to direct support and general support maintenance.

MODEM RADIO TELETYPEWRITER MD-522/GRC



CHAPTER 1
INTRODUCTION

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SECTION I

SECTION II

SECTION III

SECTION IV

CHAPTER 1

Section I. GENERAL INFORMATION

1-1. SCOPE

This manual describes direct and general support maintenance for Modem Radio Teletypewriter MD-522/GRC. It includes instructions for troubleshooting, repairing, and testing the equipment. it also lists all the tools, test equipment, and materials needed for maintenance.

The modem and its major electronic components are described in section II of this chapter. Operating instructions are covered in TM 11-5805-387-10-1; organizational maintenance is covered in TM 11-5805-387-20-1.

NOTE

In this manual, Modem Radio Teletypewriter MD-522/GRC is refered to as modem.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS

a. Reports of Maintenance and Unsatisfactory Equipment

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750 as contained in Maintenance Management Update.

b. Report of Packaging and Handling Deficiencies

Fill out and forward SF 364 (Report of Discrepancy (ROD)) is prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73A/AFR 400.54/MCO 4430.3F.

c. Discrepancy in Shipment Report (DISREP) (SF 361)

Fill out and forward Discrepancy in Shipment Report (D IS REP) (SF 361) as prescribed in AR 55-38/ NAVSUPINST 4610.33C/AFR 75.18/MCO P4610.19D/DLAR 4500.15.

1-4. DESTRUCTION OF ARMY ELECTRONICS MATERIEL

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-5. ADMINISTRATIVE STORAGE

Administrative Storage of Equipment is issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage the PMCS should be performed to assure operational readiness. Disassembly and repacking of equipment for shipment or limited storage are covered in paragraphs in TM 740-90-1, Administrative Storage of Equipment.

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMMENDATIONS (EIR)

If your modem needs improvement, let us know. Send us and E I R. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency report). Mail it to us at: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, New Jersey 07703. We'll send you a reply.

1-7. TECHNICAL CHARACTERISTICS

See TM 11-5805-387-10-1

Section II. EQUIPMENT DESCRIPTION AND DATA

1-8. PURPOSE AND USE

PURPOSE:

. Provides single channel, one-way reversible, or duplex communication in line with radio transmitters and receivers.
. Converts dc mark and spaced pulses into audio tones.
. Converts audio tones into dc mark and space pulses.

USE:

. Used with any standard teletypewriter equipment using 20- or 60-milliampere inputs and outputs.
• Converts dc marks and spaces to audio tones that modulate radio transmitters for signal transmission to distant stations.
. Converts signal received from distant transmitters into marks and spaces for printing on a teletypewriter.

NOTE

Signals received and transmitted are frequency-shift-keyed (fsk), radio frequency (rf) signals.

1-9. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

See TM 11-5805-387-10-1.

1-10. DIFFERENCES IN MODELS

There are several physical and electronic differences between the modem and Modem Radio Teletypewriter MD-522A/GRC. For a complete description of MD-522A/GRC, see TM 11-5805-387-10-2.

1-11. EQUIPMENT CONFIGURATIONS

The modem is always used as a component of a radio teletypewriter system. The modem's function in a radio teletypewriter system in shelters AN/GRC-142 and AN/GRC-122 is described in TM 11-5805-334-12.

1-12. SAFETY, CARE, AND HANDLING

Safety instructions are on the warning page found inside the manual's front cover.

Be very careful when cabling the modem. Connectors and cable assemblies are keyed for easy installation. The equipment may be damaged if cable assemblies are not properly aligned.

Carry the modem by both handles at all times, even though it is lightweight.

Read all warnings, cautions, and notes. Think safety!

1-13. REFERENCE DESIGNATIONS AND ABBREVIATIONS

Assembly numbers identify the modem's modules and subassemblies.

A1 Receive audio module
A2 Scope module
A3 Transmitter module
A4 Receiver module
A5 Loop battery module
A6 Signal filter subassembly
A7 Meter bias subassembly
A8 Loop connectors filter subassembly
A9 Preregulator subassembly

Similar designators identify module subassemblies:

EXAMPLE: Subassembly A2 of transmitter module A3 is designated A3A2.

Abbreviations of component and subassembly parts complete the full reference designation:

EXAMPLE: Capacitor C1 on subassembly A3A2 is designated A3A2C1.

Section III. TECHNICAL PRINCIPLES OF OPERATION

1-14. BLOCK DIAGRAM ANALYSIS

The block diagram describes the modem's major electronic components and circuits.

TRANSMIT SIGNAL PATH

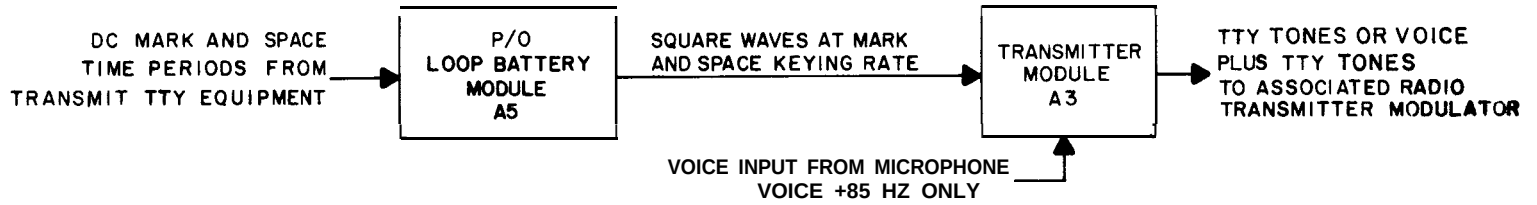
Input signal: Dc mark and space time periods transmitted by tty equipment.

Loop battery modules: Senses dc marks and spaces, creates output signal.

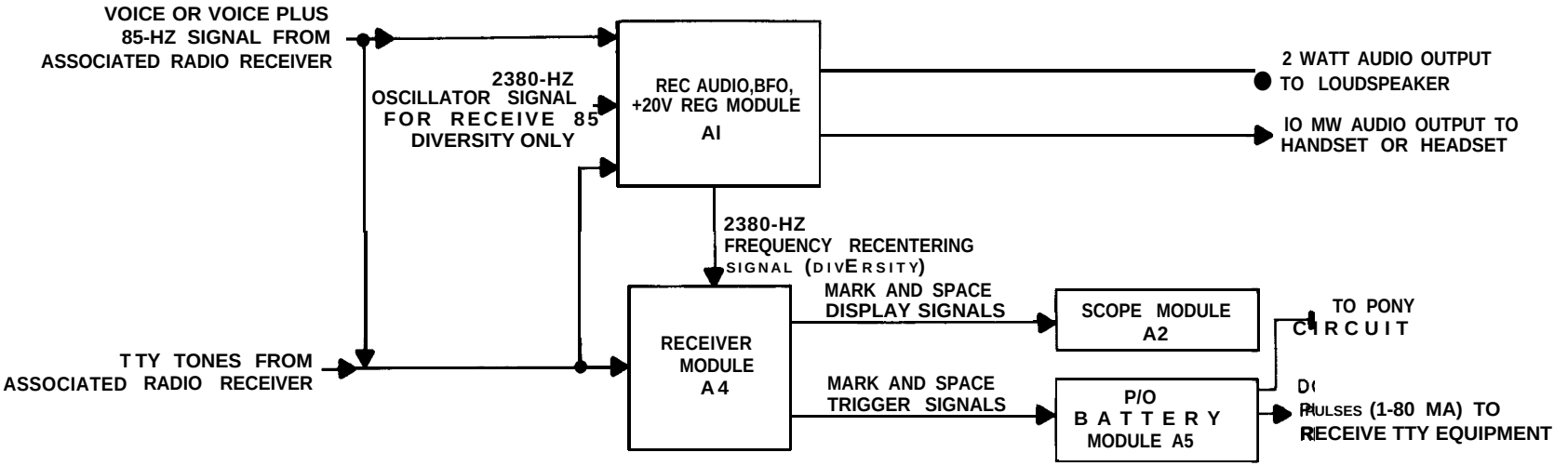
Output signal: Dc loop current during mark periods, no loop current during space periods. Signal flows into transmitter module.

Transmitter module: Converts mark and space current pulses to frequency-shift tty tones. Module amplifies tones and sends them to modulator of associated radio transmitter. During voice plus tty transmission, module combines tones with voice signals from local microphone (this happens only in nsk mode).

MODEM, TRANSMIT AND RECEIVE SIGNAL PATHS



A. TRANSMIT PATH



B. RECEIVE PATH

NOTE

During voice transmission, voice signals from a local microphone may be routed through the modem for switching purposes. The modem does not process these signals.

NOTE

In the nsk mode, a mark pulse is 2,762.5 Hz, a space pulse 2,847 Hz. In the 850 Hz-mode (fsk), a mark pulse is 1,575 Hz, a space pulse 2,425 Hz.

NOTE

During normal transmission, lower frequency tones are marks and higher frequency tones are spaces. With modem RECEIVE switch at REVERSE, higher frequency tones are spaces. With modem RECEIVE switch at REVERSE, higher frequency tones are marks, and lower frequency tones are spaces.

RECEIVE SIGNAL PATH

Input: Rf signals from an associated radio receiver. Receiver filters separate voice signals from tty tone signals. Voice signals feed into regulated power supply module; tty tone signals feed into receiver module. During 850-Hz, 85-Hz, and 85-Hz diversity modes, tty tone signals also feed into the regulated power supply module so the operator can listen to them.

Regulated power supply module: Amplifies voice signals and feeds them to two audio outputs. There is a 2-watt output for a loudspeaker and a 10-milliwatt audio output for a handset or headset. During the 85-Hz diversity mode, this module sends a recentered signal to the receiver module.

Receiver module: Converts tty tone signals into two types of mark and space signals.

Mark and space display signals flow into the scope module.

Mark and space trigger signals flow into the loop battery module.

The receiver module feeds dc current into the dc receive loop during mark periods and stops current during space periods. The dc receive loop is in series with tty receive equipment (page printer, tape punch, etc.).

Front panel RECEIVE NORMAL/REVERSE switch reverses the dc receive loop's operation. With the switch at REVERSE, loop current is a space and no current is a mark.

Scope module: Receives mark and space display signals and tunes them on a cathode-ray tube (CRT). The signals are seen as ellipses on the screen; one represents a mark signal and the other a space signal. In 85-Hz modes, the ellipses are at a 30° angle to each other. In the 850-Hz mode, the ellipses are at a 90° angle.

Loop battery module: Receives mark and space trigger signals and feeds them to tty receive equipment. During one-way transmission the module sends mark and space pulses to a pony circuit.

1-15. MODEM FILTERS (fig. FO-10)

The following will aid in understanding the functional analysis in this section.

Filter	Mode Selector Switch Setting	Function	Filter Name	Bandpass or Center Frequency
FL1	85 Hz DIV; 85 Hz	Filters harmonics and noise from transmitter module output.	Transmit narrow band output.	Dual bandpass 2,805/425 Hz.
FL2	850 Hz	Filters harmonics and noise from transmitter module output.	Transmit wide band output.	Bandpass 2,000 Hz.
FL3	85 Hz + VOICE	Establishes transmit voice bandwidth.	Transmit voice	Low-pass 2,260 Hz (3-db point).
FL4	85 Hz DIV; 85 Hz	Separates composite signals in diversity mode; improves receive signal-to-noise ratio.	Receive input	Dual bandpass 2,805/425 Hz.
FL5	85 Hz + VOICE	Separates voice and tty tones; establishes receive voice bandwidth.	Receive voice	Low-pass 2,260 Hz (3-db point).
FL6	85 Hz DIV	Suppresses mixing harmonics.	Narrow band mixer	Narrow bandpass 2,805 Hz.
FL7	850 Hz	Suppresses mixing harmonics.	Wide band mixer	Wide bandpass with notch at 2,805 Hz.

1-16. TRANSMIT OPERATION (fig. FO-2)

Main Signal Flow.

NOTE

Prefix ail partial loop battery module reference designations below with A5 (fig. FO-4).

- The associated tty transmit equipment is connected through front panel connector J6, chassis connector XA5-14 and XA5-13, and INT-EXT switch (A5) S3 to diode bridge A2CR9, A2CR10, A2CR11, A2CR12, and steering quad A2CR12, A2CR14, A2CR15, A2CR16. When the DX SEND/OWR (J6) loop is closed (mark output from the tty transmit equipment), the diode bridge and steering quad are series-connected with the DX SEND/OWR (J6) loop, and current flows through the diode bridge and steering quad.

- When INT-EXT switch S3 is set at INT, current for the diode bridge and steering quad is provided by dc-to-ac inverter Q3, Q4, and T2. The minimum current can be from 1 to 60 mA with minimums of 1, 5, 20, 40, or 60 mA as selected by positions 1 through 5 respectively, or loop battery DC LOOP NO. 1 CURRENT ADJ switch S2. The steering quad maintains the same loop current direction regardless of the input loop polarity trom an external source. This provides protection against an input voltage opposite in polarity to that which is normally applied. The current range is selected according to operating requirements. When INT-EXT switch S3 is set at EXT, an external current source is required for the input loop. Dc-to-ac inverter Q3, Q4, and T2 is not used in this case. Dc-to-ac inverter Q3, Q4, and T2 switches the applied +24 volts dc input at a 5-kiloHertz (kHz) rate (determined by the core saturation time of T2), producing a square-wave output. When the DX SEND/OWR (J6) loop is closed, the output from dc-to-ac inverter Q3, Q4, and T2 and diode bridge A2CR9, A2CR10, A2CR11, A2CR12 passes through steering quad A2CR13, A2CR14, A2CR15, A2CR16. The resulting dc energizes keyed oscillator A2Q2, causing it to oscillate for that period of time that the DX SEND/OWR (J6) loop is closed. The oscillator output is a frequency burst, which is envelope-detected and amplitude-doubled by detector-doubler A2CR19, A2CR20. This produces an output of a positive square wave during each marking period and no output during spacing periods.

NOTE

Prefix all partial transmitter module reference designations in the following subparagraphs with A3 (fig. FO-5).

- The output from detector-doubler A5A2CR19, A5A2CR20 is connected to switch A1Q1 when transmitter module internal NORMAL/REVERSE switch (A3) A1S1 is set at NORMAL. Switch A1Q1 (on during marking periods) turns switch A1Q2 off during marking periods and on during spacing periods. Switch A1Q2 turns diode gate A1CR3 and switch A1Q3 off when A1Q1 is off and on when A1Q1 is on. Similarly, switch A1Q3 turns diode gate A1CR4 on and off according to the condition of A1Q2. With a space input from the tty equipment (DX SEND/OWR loop (J6) open), no output occurs from detector-doubler A5A2CR19, A5A2CR20. Therefore, with no input (space), switch A1Q1 is off, switch A1Q2 is on, and switch A1Q3 is off. This turns on diode gate A1CR4, which passes the 227.8-kHz output of space oscillator A1Q21, A1Q22 to shaper amplifier A1Q4. At the same time, switch A1Q2, which is turned on, grounds the output signal of mark oscillator A1Q19, A1Q22 through A1C1.

- With a mark output from the tty equipment (loop (J6) closed), a positive pulse output from detector-doubler A5A2CR19, A5A2CR20 is applied to and turns on switch (A3) A1Q1. This action turns off switch A1Q2, which turns on diode gate A1CR3. The 221.0-kHz output from mark oscillator A1Q19, A1Q20 is applied through diode gate A1CR3 to shaper amplifier A1Q4. Switch A1Q2, when turned off, also turns on switch A1Q3, which grounds the output signal of space oscillator A1Q21, A1Q22 through A1C2. Thus, the signal applied to shaper amplifier A1Q4 consists of bursts of mark or space oscillator frequencies generated at the mark-space keying rate of the tty equipment.

- With the transmitter module internal NORMAL/REVERSE switch set at REVERSE, the sequence in which the mark and space oscillators are turned on and off is reversed; that is, the mark oscillator is turned on with a space input, and the space oscillator is turned on with a mark input. The output signal from detector-doubler A5A2CR19, A5A2CR20 is applied to switch (A3) A1Q2. Switch A1Q1 is not used. With no input (space input from the tty equipment), switch A1Q2 is turned off and switch A1Q3 is turned on. With switch A1Q2 off, diode gate A1CR3 is on and passes the 221.0-kHz output of mark oscillator A1Q19, A1Q20 to shaper amplifier A1Q4. Switch A1Q3, being turned on, grounds the space oscillator A1Q21, A1Q22 output signal through A1C2. With a mark input, switch A1Q2 turns on, grounding the mark oscillator A1Q19, A1Q20 output signal through A1C1 and turning on switch A1Q3. Diode gate A1CR4 is now turned on to pass the 227.8-kHz output from space oscillator A1Q21, A1Q22 to shaper amplifier A1Q4. The operation of the circuits from this point is the same as that for normal operation. Therefore, the output signal will have the same characteristics, except that the higher frequency audio tone will represent a mark, and the lower frequency audio tone will represent a space.

NOTE

The remaining functional analysis of the modem is presented according to front panel MODE SELECTOR switch S4 settings. Partial transmitter module reference designators should be prefixed by A3 (fig. FO-6).

850-Hz Operation. Shaper amplifier (A3) A1Q4 shapes the space mark frequencies to provide a trigger for divide-by-eight flip-flops A1Q5, through A1Q10 at the rate of the space and mark oscillator frequencies. The output from the divide-by-eight flip-flops is 27.625 kHz (mark) or 28.475 kHz (space), which is applied to the tuned circuit consisting of A2L1, A2C1, and A2C2. With the MODE SELECTOR switch set at 850 Hz, capacitor A2C1 is not used (disconnected from ground), and the passband of this circuit is resonant at 28,050 kHz. The output from the tuned circuit is a sinusoidal signal, which is amplified by amplifier A2Q1 and applied to mixer A2T2, A2CR1, A2CR2. The second input to mixer A2T2, A2CR1, A2CR2 is the 26,050-kHz output from mixer oscillator A2Q3, A2Q4. (MODE SELECTOR switch S4 switches in the 26.050-kHz crystal.) This output is mixed in mixer A2T2, A2CR1, A2CR2 with the space and mark outputs from the divide-by-eight flip-flops. The mixing action produces audio tones of 2,425 Hz (space) or 1,575 Hz (mark), spaced 850 Hz apart with an effective center frequency at 2,000 Hz. The mixer output is amplified by amplifier A2Q2. The 850-Hz GAIN potentiometer A2R9 controls the input level to amplifier A2Q2. The output from amplifier A2Q2 is passed by diode gate A2CR4 through 2,000-Hz GAIN control A2R52 to the transmit wide band output filter (part of FL2). The filter output is then raised in level by amplifiers A2Q5 and A2Q6 and applied to the 600-ohm audio input circuits of the associated radio transmitter through RCVR TRANS AUDIO connector J2.

85-Hz and 85-Hz Diversity Operation.

- When the MODE SELECTOR switch is set at 85 Hz or 85 Hz DIV, the output from the divide-by-eight flip-flops is further divided by 10 in two successive divider circuits. (The MODE SELECTOR switch connects +20 volts dc to these circuits.) The output from the divide-by-eight circuits consists of square-wave pulses at either 27.625 kHz (mark) or 28.475 kHz (space). This output is applied to the divide-by-eight circuits consisting of (A3) A1Q11, A1Q12, A1Q15, A1Q16, A1Q17, and A1Q18. The resulting output consists of square-wave pulses at the rate of 5.525 kHz (mark) or 5.695 kHz (space). This output is then applied to divide-by-two circuit A1Q13, A1Q14 which produces square-wave pulses at the rate of 2,762.5 Hz (mark) or 2,847.5 Hz (space). The output from divide-by-two circuits A1Q13, A1Q14 is applied to tuned circuit A2L1, A2C1, A2C2. When the MODE SELECTOR switch is set at 85 Hz or 85 Hz DIV, capacitor A2C1 is connected into this tuned circuit to change its center frequency to 2.8050 kHz. The output from tuned circuit A2L1, A2C1, A2C2 is applied to amplifier A2Q1, where it is raised in level and applied through 85 Hz GAIN potentiometer A2R4 and matching pads R7 and R8 to the 2,805 Hz section of transmit narrow band output filter FL1.

- In 85-Hz diversity operation, the output from amplifier A2Q1 is applied to mixer A2T2, A2CR1 and A2CR2, where it is subtractively mixed with the 2,380.0-HZ output from mixer oscillator A2Q3, A2Q4. (The MODE SELECTOR switch switches in the 2,380.0-HZ crystal when set at 85 Hz, 85 Hz DIV, or 85 Hz + VOICE.) The resulting output from mixer A2T2, A2CR1, A2CR2 consists of audio tones at 382.5 Hz (mark) and 467.5 (space) about a center frequency of 425 Hz. The output from mixer A2T2, A2CR1, A2CR2 is then raised in level by amplifier A2Q2 and passed through diode gate A2CR3 to the 425-Hz section of FL1. The 425-Hz filter output is combined with the 2,805-Hz filter output and both are applied through connector XA3 to amplifiers A2Q5 and A2Q6, where they are raised in level and applied to the 600-ohm input circuits of the associated radio transmitter through RCVR TRANS AUDIO connector J2.

85-Hz Plus Voice Operation. When the MODE SELECTOR switch is set at 85 Hz + VOICE, the voice input from the microphone is connected through MICROPHONE connector J3, MODE SELECTOR switch S4, and connector XA3 to diode gate (A3) A2CR8. The voice input signals are passed through diode gate A2CR8 to transmit voice filter FL3 when the keyline is activated. VOICE GAIN control A2R40 adjusts the level of voice-applied input signals through diode gate A2CR8. Voice signals are combined with the 2,805-Hz filter (part of FL1) output, raised in level by audio amplifiers A2Q5 and A2Q6, and applied to the 600-ohm input circuits of the associated radio transmitter through RCVR-TRANS AUDIO connector J2.

Voice Operation. When the MODE SELECTOR switch is set at VOICE, the keyline and the microphone voice signals are applied directly through the modem to the 50-ohm input circuit of the associated radio transmitter. In addition, audio amplifiers A2Q5 and A2Q6 are inoperative for this mode of operation.

1-17. RECEIVE OPERATION

(fig. FO-3)

NOTE

Prefix all partial receiver module reference designations with A4 (fig. FO-7).

Main Signal Flow.

- **General.** Received tty tone signals from an associated radio receiver are applied to the modem either through RCVR TRANS AUDIO connector J2, with ONE WAY/DUPLEX switch S1 set at ONE WAY, or from an auxiliary receiver through AUX RCVR AUDIO connector J1, with ONE WAY/DUPLEX switch S1 set at DUPLEX. in either case, the received signal is applied through ONE WAY/DUPLEX switch S1 and MODE SELECTOR switch S4 to the appropriate receiver module A4 circuits.
- 850-Hz operation.
  - With the MODE SELECTOR switch set at 850 Hz, the received radio tty tone signal is applied to mixer (A4) A1CR1, A1CR2 in the receiver module through connector XA4. The center frequency of this signal will be between 1,425 and 2,575 Hz. The signal is mixed with the output from bfo circuit A1A3Q1 (3,805 to 5,805 Hz) as adjusted by BFO control R2. The signals are mixed in mixer A1CR1, A1CR2. By adjusting front panel BFO control R2, the received signal is recentered at 2,805 Hz. The received signal is known to be recentered through the use of Lissajous patterns obtained on scope module A2 cathode-ray tube. The mixer output is applied through wide band mixer filter FL7 to limiter amplifier (A4) A1Q1. After limiting, the signal is applied through the MODE SELECTOR switch to limiter amplifier A1Q2. Limiter amplifiers A1Q1 and A1Q2 maintain a nearly constant discriminator input for a 60-decibel (db) range of operation. From limiter amplifier A1Q2, the signal is applied to driver A1Q3, which provides the necessary input drive for phase discriminator A3Q1, A3Q2.

  - Phase discriminator (A4) A3Q1, A3Q2 is resonant at 2,805 Hz (the center frequency of the applied signal) and produces a differential voltage for an input frequency above or below resonance. At resonance, the phase angle of the voltage across capacitor A3C1 is 90° with respect to the input voltage at the secondary of transformer A3T1, resulting in no differential output. The phase angle voltage is applied to scope module A2 for monitoring.

  - When the frequency of the incoming signal is below resonance, corresponding to a mark, the phase shift across capacitor (A4) A3C1 is greater than 90” with respect to the input. This results in a differential output voltage from phase discriminator A3Q1, A3Q2, which is sensed and amplified by differential amplifier A1Q4, A1Q5 and used to trigger bistable multivibrator A1Q6, A1Q7. A1Q6, A1Q7 shapes the differential voltage and switches bistable multivibrator A1Q8, A1Q9 so that the normal mark line goes positive and the reverse mark line goes to ground.

  - When the frequency of the applied signal is above resonance, corresponding to a space, the phase shift angle across capacitor (A4) A3C1 is less than 90°. This results in a differential output voltage opposite in polarity than that for a mark input, which is sensed and amplified by differential amplifier A1Q4, A1Q5. This differential output voltage, being opposite in polarity to that for a mark input, switches bistable multivibrator A1Q8, A1Q9 so that the normal mark line goes to ground and the reverse mark line goes positive. The signal on the normal mark line will be a series of positive pulses occurring at the mark-space keying rate of the incoming signal, and the reverse mark line will be the same pulse with a 180° phase shift.

NOTE

Prefix all partial loop battery module reference designations below with A5 (fig. FO-4).

- The output from bistable multivibrator A4A1Q8, A4A1Q9 is applied through RECEIVE NORMAL/REVERSE switch S2 to gated oscillator (A5) A2Q3. A positive voltage from the normal mark line turns on gated oscillator A2Q3. The A2Q3 output is envelope-detected and amplitude-doubled by detector-doubler A2CR17, A2CR18. This turns on switch A2Q1 at the rate of the applied pulses, causing one of the following actions to take place.

- With the ONE WAY/DUPLEX switch at ONE WAY and the SEND/RCV switch at RCV, the DX SEND/OWR (J6) loop is opened and closed at the received tty signal keying rate. The dc loop current supplied by dc-to-ac inverter (A5) Q3, Q4, T2 and diode bridge A2CR9, A2CR10, A2CR11, A2CR12 flows through steering quad A2CR13, A2CR14, A2CR15, A2CR16 and front panel DC LOOP NO.1 DX SEND/OWR connector J6 to the associated tty receive equipment. Transmit operation is covered in paragraph 1-14.

- With the ONE WAY/DUPLEX switch at DUPLEX, the DX RCV/PONY (J7) loop is opened and closed at the keying rate of the received tty signal. The loop current supplied by dc-to-ac inverter (A5) Q1, Q2, T1 and diode bridge A2CR1, A2CR2, A2CR3, A2CR4 flows through steering quad A2CR5, A2CR6, A2CR7, A2CR8 and front panel DC LOOP NO. 2 DX RCV/PONY connector J7 to the associated tty equipment. The operation of these circuits is identical with that used for transmit operation (para 1-16). The DX RCV/PONY (J7) loop current is applied to the associated tty equipment through front panel DC LOOP NO. 2 DX RCV/PONY connector J7.

- 85-Hz operation. The operation of the modem in 85-Hz mode is similar to that for 850-Hz operation, except that the received signal consists of two audio tones shifted ± 42.5 Hz from a center frequency of 2,805 Hz, which is applied through the 2,805-Hz section of filter FL4 and limiter (A4) A2CR1, A2CR2 to limiter amplifier A2Q1. Since the center frequency of this signal is the same as that of phase discriminator A3Q1, A3Q2, the bfo mixer (A4) Al CR1, Al CR2 and limiter amplifier A1Q1 are not used. The output from limiter amplifier A2Q1 is applied through MODE SELECTOR switch S4 to limiter amplifier A1Q2.

NOTE

Prefix all partial receiver module reference designations below with A4 (fig. FO-6).

- 85-Hz diversity operation.

. The 85-Hz diversity signal consists of two 85-Hz tone shifts; one at 2,805 Hz *42.5 and the other at 425 Hz ± 42.5. The upper tone shift is centered at 2,805 Hz and is applied through the MODE SELECTOR switch, the 2,805-Hz section of filter FL4 and limiter (A4) A2CR1, A2CR2 to limiter amplifier A2Q1. These circuits are also used in 85-Hz operation. However, the output from limiter amplifier A2Q1 is applied to driver A2Q2, which is turned on with the MODE SELECTOR switch at 85 Hz DIV. Driver A2Q2 provides input drive for phase discriminator A4Q1, A4Q2. This circuit functions the same as phase discriminator A3Q1, A3Q2. The output from phase discriminator A4Q1, A4Q2 is amplified and clipped by differential amplifier A2Q7, A2Q8. The resulting signal is combined with the output of A1Q4, A1Q5.

Ž The lower tone shift, at a center frequency of 425 Hz, is applied through the MODE SELECTOR switch and the 425-Hz section of filter FL4 to mixer A1CR1, A1CR2. As in 850-Hz operation, the center frequency must be recentered to 2,805 Hz before being applied to phase discriminator A3Q1, A3Q2. This is accomplished by an injection frequency of 2,380 Hz from mixer oscillator A3A2Q3, A3A2Q4, which is applied through amplifier A1A2Q6 to mixer (A4) A1CR1, A1CR2. This 85-Hz tone shift is now centered at 2,805 Hz. The output from mixer (A4) A1CR1, A1CR2 is applied through narrow band mixer filter FL6 to limiter amplifier A1Q1. After limiting, the output of limiter amplifier A1Q1 is applied through the MODE SELECTOR switch to limiter amplifier A1Q2. The operation is then identical with 850-Hz operation.

NOTE

Prefix all partial **receiver module reference designations with A4.**

. In the 85-Hz diversity mode, the 425-Hz signal applied to receiver module mixer diodes (A4) A1CR1, A1CR2 is also applied to amplifier A2Q3. Also, the 2,805-Hz signal applied to limiter diodes A2CR1, A2CR2 is applied to amplifier A2Q4. The negative portion of the amplified output signal from A2Q3 (425 Hz) is detected by diode A2CR6 and filtered by the capacitor combination A2C11 and A2C13. The resultant voltage may be either positive or negative, depending on whether 2,805 Hz or the 425-Hz signal voltage is of greater magnitude. A positive voltage (smaller 425-Hz signal voltage) from the combination of A2C11 and A2C13 passes through V-gate diode A2CR9, switching on A2Q5. This action disables the 425-Hz channel by shunting the 425-Hz signal to ground. Similarly, when the voltage of the 2,805-Hz signal is 3 db (or more) down from that of the 425-Hz signal, the 2,805-Hz signal channel is bypassed to ground by A2Q6. When not in the diversity mode of operation, the +20 volt dc supply to A2Q3, A2Q4 is turned off by MODE SELECTOR switch S4, disabling the diversity control function.

NOTE

The diversity circuits operate only when the difference in levels between the 2,805-Hz and the 425-Hz signal is greater than 3 db. In the 85-Hz diversity mode of operation, the scope display disappears whenever the diversity control is switched to the 2,805-Hz signal.

NOTE

Prefix all partial receiver module reference designations below with A4.

Tty Automatic Mark-Hold. The automatic mark-hold circuit in reciever module A4 is used to switch the receive loop (DX RCV/PONY loop J7 in duplex operation or DX SEND/OWR loop J6 during one-way receive operation) to a continuous mark condition with no signal input to module A4.

- As long as there is a signal input to module A4, the switching action of bistable multi vibrator (A4) A1Q8, A1Q9 keeps the voltage at the common point of voltage divider A1R44, A1R53 below the 10.8-volt breakdown voltage of zener diode A1VR1. However, when there is no signal input, C20 charges (in about 2 seconds) up to the 10.8-volt breakdown voltage of zener diode A1VR1. As the breakdown potential is reached, C20 discharges through A1VR1, causing switch A1Q11 to conduct, which cuts off gate A1Q10. This locks bistable multi vibrator A1Q8, A1Q9 in its existing state by disconnecting their emitters from ground. Reset diode CR8 insures that the base of A1Q8 will always be slightly more positive than the base of A1Q9. Thus, with the above conditions, the bistable multivibrator will always be in the normal mark **state** for the steady mark-hold condition. Regardless of the position of the RECEIVE NORMAL/REVERSE switch, dc loop current flows and the associated tty equipment is held at mark-hold until an input signal is received. The setting of differential bias adjust control A1R32 determines the level of input signal required to return module A4 to normal operating condition.

- With an adequate tty signal input applied to module A4, zener diode A1VR1 cuts off, which turns off switch A1Q11. This action turns on gate A1Q10. With A1Q10 on, the emitters of bistable multivibrator A1Q8, Q9 are grounded, returning module A4 to normal operating condition.

NOTE

Prefix all partial regulated power supply module reference designations below with Al (fig. FO-8).

Audio Amplifier and Squelch Circuit. In the 85-Hz plus voice mode, audio from an associated radio receiver is applied through the MODE SELECTOR switch to voice filter FL5. After filtering, the audio is again applied through the MODE SELECTOR switch and AUDIO GAIN control R1 to audio amplifier (A1) A1Q1. In voice operation, the audio output from the associated radio receiver is applied direct to audio amplifier AIQ1 through AUDIO GAIN control R1. Audio amplifier A1Q1 raises the audio signal level and applies to it to module Al push-pull amplifier Q1, Q2, which provides a 2-watt audio output to a loudspeaker and a 600-ohm 10-milliwatt output for driving a headset or handset. Bias adjust potentiometer A1R10 is used to balance push-pull amplifier (Al) Q1Q2. A portion of the receiver input is applied to detector-driver Al CR1, A1Q2 through SQUELCH SENSITIVITY control A1R16. With audio applied, detector-driver A1CR1, A1Q2 is forward-biased by the positive portion of the audio signal. Timing gate A1Q3 is at saturation, which biases threshold detector A1VR1 below the firing point. Thus, switch A1Q4 is turned off, and the circuit is unsquelched. When audio is removed, detector-driver A1CR1, A1Q2 is at cutoff. However, timing gate A1Q3 is still conducting and hangtime capacitor A1C7 (not shown) begins to charge to the voltage threshold of A1VR1. If no audio signal is applied, hangtime capacitor A1C7 charges to the applied voltage of timing gate A1Q3 and cuts if off. At this time, threshold detector A1VR1 fires, gating on switch A1Q4. This effectively grounds the input to audio amplifier A1Q1, and the circuit is squelched. The circuit remains squelched until audio is applied, at which time detector-driver A1CR1, A1Q2 is again forward-biased. When detector driver A1CR1, A1Q2 begins to conduct, hangtime capacitor A1C7 discharges, and timing gate A1Q3 turns on. Threshold detector A1VR1 is then biased below the firing point. This turns off switch A1Q4 and removes ground from the input to audio amplifier A1Q1.

Beat-Frequency Oscillator Circuit. The output from the beat-frequency oscillator (bfo) circuit in regulated power supply module Al is used to recenter the center frequency of the incoming teletypewriter signal (850-Hz shift operation only) to 2,805 Hz, from any range between 1,000 and 3,000 Hz. Bfo circuit A3 is inclosed in a hermetically sealed oven. PWR OFF. With power applied, the oven is heated to 75° C by a thermostat-controlled heater element. Bfo A3Q1 is a unijunction oscillator that operates at a frequency between 7.6 and 11.6 kHz, the upper limit of which is set by frequency limit potentiometer A2R7. Tuning of bfo A3Q1 is accomplished from the front panel by BFO control R2. The center frequency is 9.6 kHz. The pulse output from bfo A3Q1 is formed by shaper A2Q3 for triggering divide-by-2 flip-flop A2Q4, A2Q5. The result is an output of square-wave pulses at the rate of 3,805 to 5,805 kHz (center frequency of 4,805 kHz). The amplitude of the square waves is raised in level by amplifier A2Q6 and applied to mixer A4A1CR1, A4A1CR2.

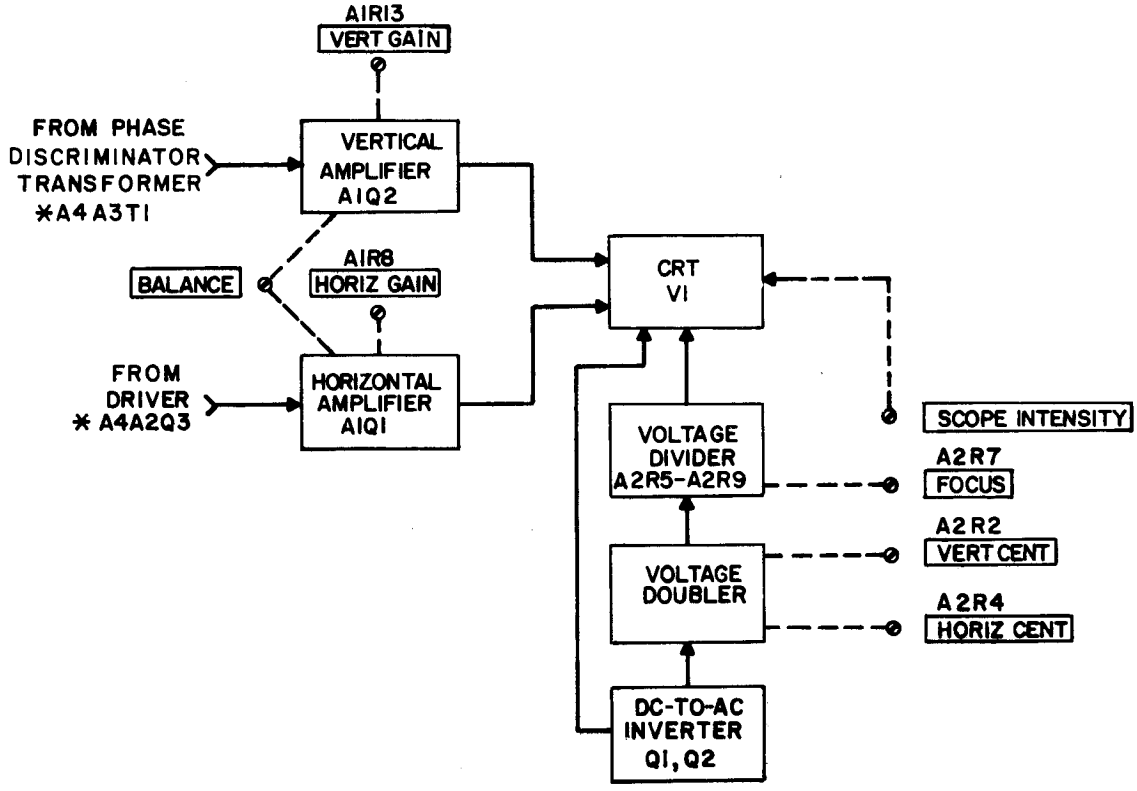
NOTE

Prefix all partial scope module reference designations below with A2 (fig. FO-9).

Scope Module. The scope module is used for monitoring the operation of phase discriminator A4A3Q1, A4A3Q2 above. The circuit provides Lissajous patterns, two ellipses of less than 90° from each other, indicating the voltage phase shift angles as developed by phase discriminator A4A3Q1, A4A3Q2 for a mark or space input.

- The voltage from driver A4A1Q3 is applied to horizontal amplifier (A2) A1Q1. The voltage is raised in level and applied to the horizontal deflection plates of cathode-ray tube V1. The level of the output voltage from horizontal amplifier A1Q1 is determined by the setting of HORIZONTAL GAIN control A1R8. The voltage from phase discriminator transformer A4A3T1 is applied to vertical amplifier (A2) A1Q2. This voltage is raised in level and applied to the vertical deflection places of crt V1. The level of output voltage from vertical amplifier A1Q2 is determined by setting of VERTICAL GAIN control A1R13. The phase angle between the voltage applied to the horizontal and vertical deflection plates is determined by the voltage phase shift developed by the phase discriminator. With a mark input to the phase discriminator, a voltage phase angle of less than 90° is developed. Therefore, the voltage phase angle between the horizontal and vertical deflection plates of crt V1 is less than 900 resulting in a Lissajous pattern (ellipse) of less than 90°. With a space input applied to the phase discriminator, a voltage phase shift angle greater than 90° is developed, resulting in a Lissajous pattern (ellipse) greater than 90°.

- Operating and control voltages for crt V1 are developed by dc-to-ac inverter (A2) Q1, Q2 and voltage doubler A2CR1, A2CR2. With +24 volts dc applied, dc-to-ac inverter Q1, Q2 switches the applied voltage at a 5-kHz rate, producing a square-wave output. This is applied to the filaments of crt V1 as heater voltage. The output from dc-to-ac inverter Q1, Q2 is also applied to voltage doubler A2CR1, A2CR2. This results in a dc voltage that is applied to voltage divider A2R5 through A2R9, which provides the necessary dc control voltages for the horizontal and vertical deflection plates of crt V1. Front panel SCOPE INTENSITY control R3 controls the brilliance of the pattern displayed on crt V1. VERTICAL CENTERING control A2R2 HORIZONTAL CENTERING control A2R4 are set for a center display of patterns on crt V1. FOCUS control A2R7 is set to provide good definition of the display on crt V1.



SCOPE MODULE A2

1-18. POWER CONTROL AND PROTECTIVE CIRCUITS

(fig. FO-11)

NOTE

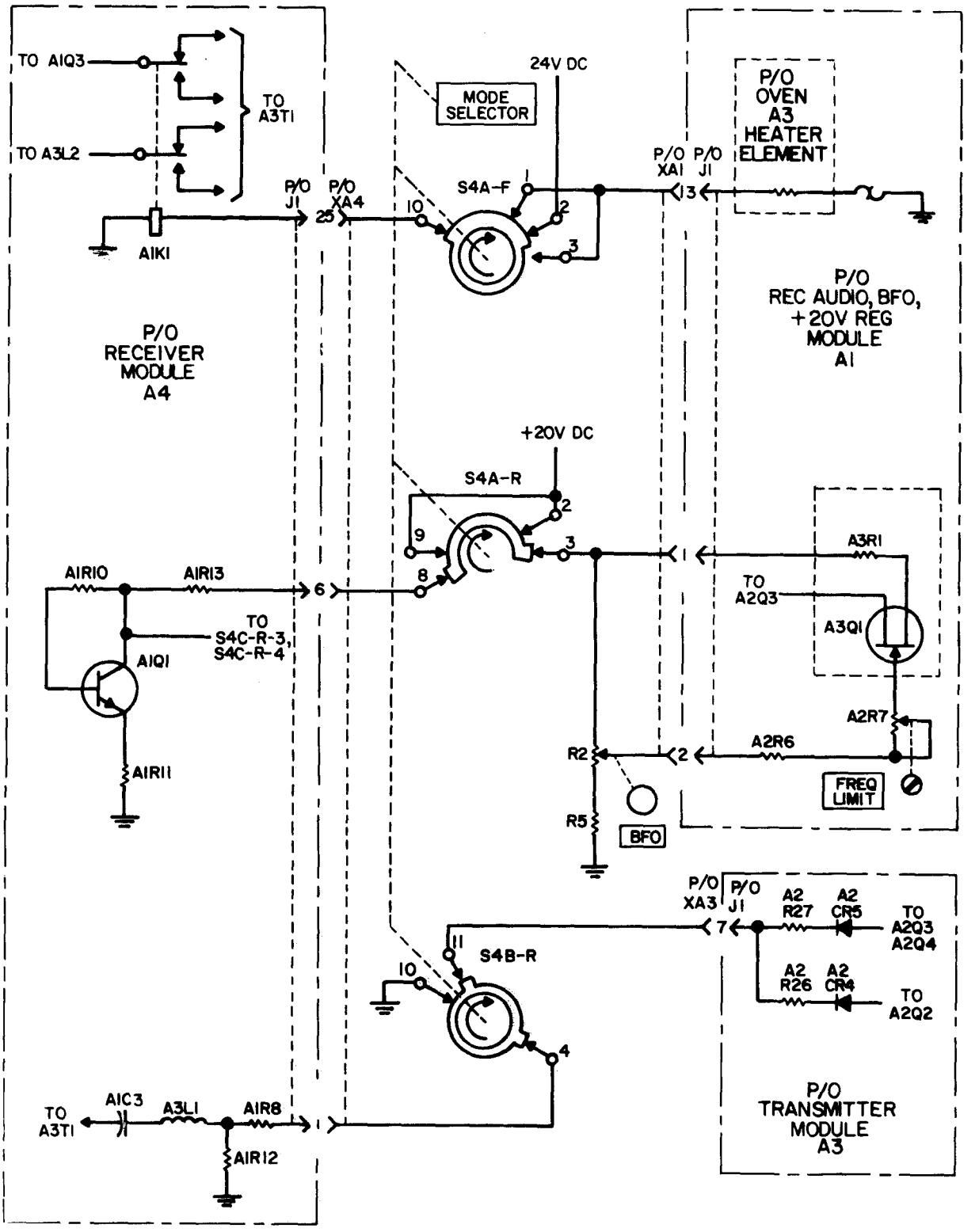
Reference designations without assembly prefixes are for components located on the front panel or chassis.

When MODE SELECTOR switch S4A-F is placed in any of the operating positions, +27.5 volts dc is applied through pin B of power connector J8, fuse F1, polarity diode CR1, and preregulator module A9 to contact 2 of MODE SELECTOR switch S4A-F. The overvoltage zener diode VR1 conducts if the primary input voltage exceeds a predetermined level, and draws enough current to burn out fuse F1. Resistor A9R1 limits the current flow through zener diode VR1. Preregulated +24 volts dc from module A9 is connected to contacts 1 and 3 of MODE SELECTOR switch S4A-F, where it is distributed as operating voltage throughout the modem. In addition, the +24 volts dc is applied through pin 13 of connector XA1 to the +20 volt dc regulator circuit in regulated power supply module A1 to all modules. This +24 volts dc is also connected through pin 7 of connector XA5 and INT-EXT switch A5S3 (at INT) to the dc-to-ac inverters in loop battery module A5.

When MODE SELECTOR switch S4 is set at any operating position other than VOICE, +24 volts dc is applied via contact 11 or 5 of MODE SELECTOR switch S4A-F and pin 12 of connector XA2 to the dc-to-ac inverter in scope module A2. This dc-to-ac inverter furnishes operating voltages for the crt in scope module A2.

In preregulator A9, reference diode VR1 provides an 18-volt reference voltage to the voltage divider consisting of A9RT1, A9R5, and A9R6. Resistor A9R5 is adjusted to select the desired +24 volt regulator output. The output is sampled through series diodes A9VR2 and A9VR3, which maintain a constant voltage drop of 10.2 volts from the +24 volt output. As loading or other factors cause the preregulator output voltage to drop, the voltage drop across emitter resistor A9R3 is lowered, forward-biasing comparator A9Q2. This causes A9Q2 to conduct more heavily, lowering the base voltage of amplifier A9Q1 with respect to its emitter. Amplifier A9Q1 then conducts more heavily, raising the base voltage of series regulator Q1. Series regulator Q1 conducts more heavily, raising the output voltage of preregulator A9 (equivalent to reducing the series resistance of Q1), which compensates for the original drop in output voltage. The unit operates in the opposite manner to counter a rise in output voltage. Capacitor A9C1 filters out noise generated in A9VR1, and A9C2 smooths out both line transients and noise. Polarity diode CR1 protects against the application of reversed polarity voltages. Chassis mounted zener diode VR1 provides over-voltage protection. If primary input voltage exceeds approximately 34 volts, VR1 conducts, drawing enough current to burn out F1. Resistor A9R1 limits the current flow through VR1. (Short circuit protection is a design feature of preregulator A9.) When the output is shorted to ground, the voltage across reference diode A9VR1 drops to zero. This sequentially cuts off A9Q2, A9Q1 and series regulator Q1. When the short is removed, A9R2 provides a voltage source to reference zener A9VR1 to re-start preregulator A9. This short circuit feature should be remembered when troubleshooting a loss of +24 volts dc due to a short circuit since the fuse will not burn out.

850-HZ MODE OPERATIONAL CONTROL CIRCUIT



1-19. OPERATIONAL CONTROL CIRCUITS

850-Hz Operation. When the MODE SELECTOR switch is set at 850 Hz, the +24 volts dc, +20 volts dc, and ground are applied to the appropriate circuits as follows:

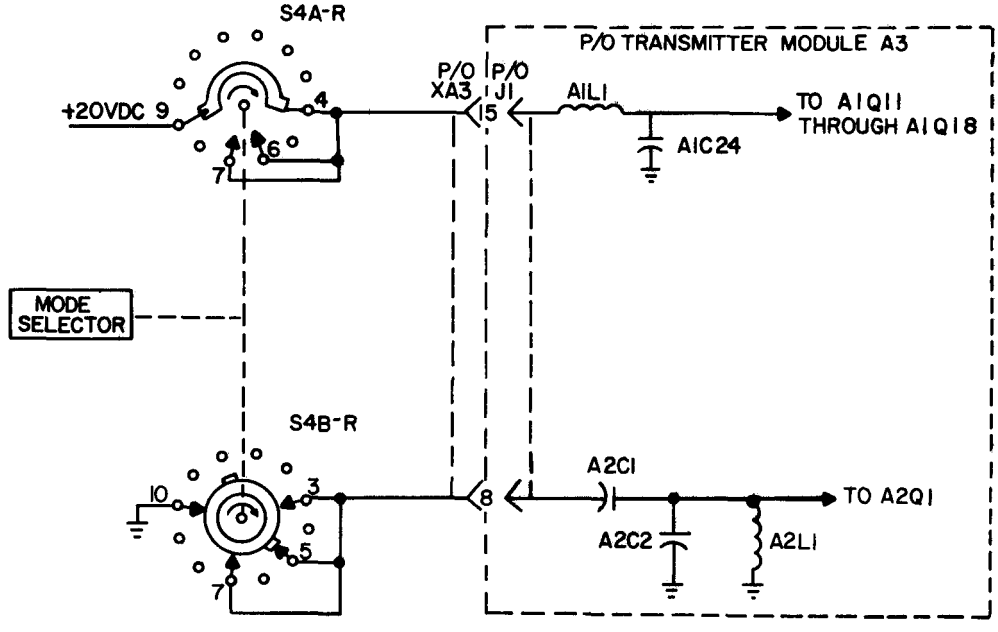
- The +24 volts dc is applied through contacts 2 and 10 of MODE SELECTOR switch S4A-F, pin 25 of connectors XA4 and A4J1 to energize relay A4A1K1 in receiver module A4. Relay A4A1K1 then switches the passband of the phase discriminator to 850 Hz.

- The +24 volts dc at contacts 1 and 3 of MODE SELECTOR switch S4A-F is also applied through pin 13 of connectors XA1 and A1J1 to the oven heater element in regulated power supply module A1. This allows the oven to heat to the required temperature (75°C) in all operating modes.

The output (regulated +20 volts ac) of the +20 volt dc regulator circuit in module Al is applied through pin 6 of connectors XA1 and A1J1 (not shown) to pins 2 and 9 of MODE SELECTOR switch S4A-R. Thus +20 volts dc is applied through the switch rotor to contacts 3 and 8 of MODE SELECTOR switch S4A-R to the modem modules indicated below.

- The +20 volts dc at contact 8 of switch S4A-R is applied through pins 6 of connectors XA4 and A1J1 and resistor A4A1R13 to provide collector voltage for limiter amplifier A4A1Q1 during 850-Hz operation. The +20 volts dc at contact 3 of MODE SELECTOR switch S4A-R is developed across BFO control R2 and resistor R5. The frequency of bfo A1A3Q1 is determined by the amount of voltage that is applied from BFO control R2 through pin 2 of connectors XA1, J1, A1A2R6, and frequency limit potentiometer A1A2R7 to A1A3Q1.
- Ground is connected at pin 10 of MODE SELECTOR switch S4B-R. When MODE SELECTOR switch S4B-R is set at 850 Hz, pin 10 is connected to contacts 11 and 4. Contact 11 is connected through pin 7 of connectors XA3 and J1 to diodes A3A2CR4 and A3A2CR5 in transmitter module A3, forward-biasing the diodes. Diode A3A2CR5 enables mixer oscillator A3A2Q3, A3A2Q4 in the transmitter module to operate at 26,050kHz. Diode A3A2CR4 gates the mixed output of amplifier A3A2Q2 in the transmitter module to the appropriate filter. The ground at contact 4 of A4A1R8 in receiver module A4. This increases the bandwidth of phase discriminator (A4) A3 to obtain the proper response curve for 850-Hz operation.

85-HZ MODE OPERATIONAL CONTROL CIRCUIT

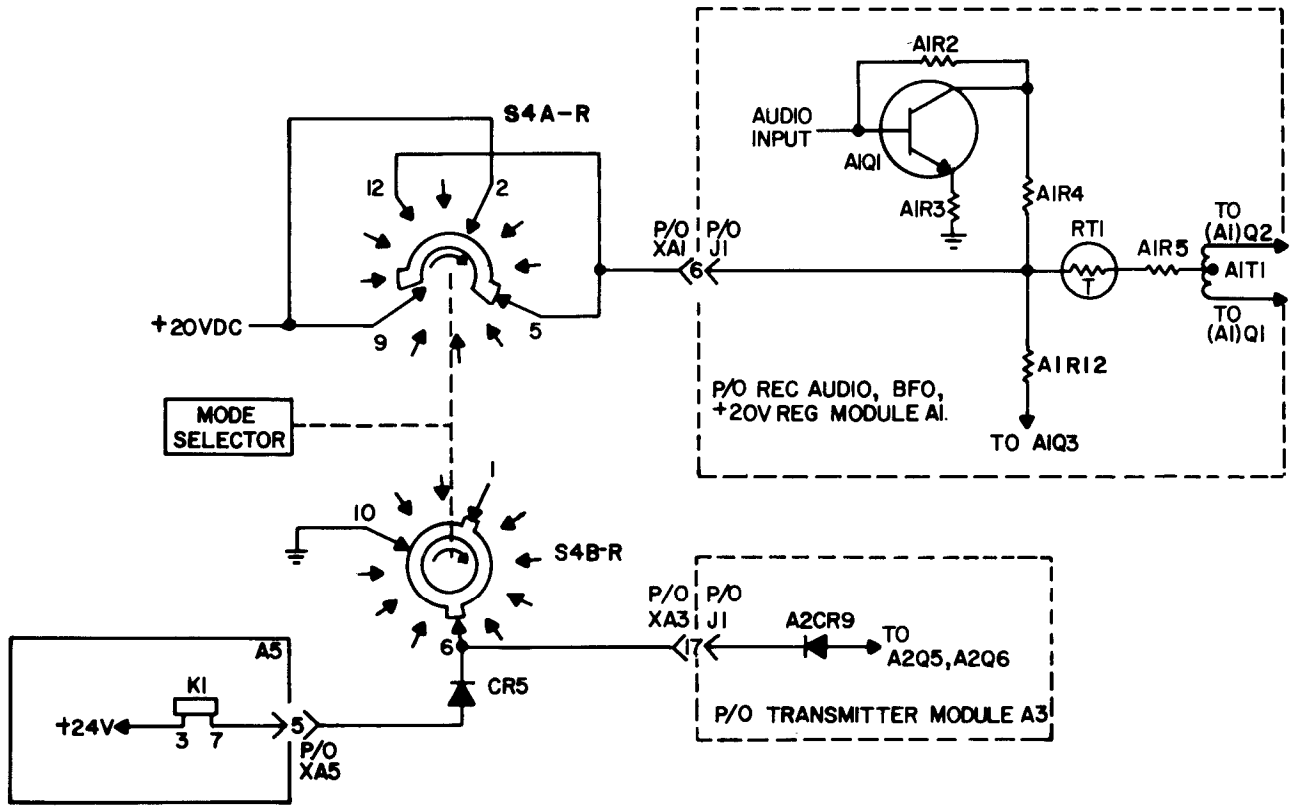


85-Hz Operation. When MODE SELECTOR switch S4 is set at 85 Hz, the functions of switch sections S4A-R and S4B-R are similar to those for 850-Hz operation.

- In 85-Hz operation, +20 volts dc is applied through contacts 9 and 4 of MODE SELECTOR switch S4A-R, to pin 15 of connectors XA3 and A3J1, and inductor A3A1L1 to divide-by-ten circuit A3A1Q11 through A3A1Q18 in transmitter module A3. This circuit divides the output of the divide-by-eight circuit in the transmitter to derive the appropriate frequencies for 85-Hz operation.

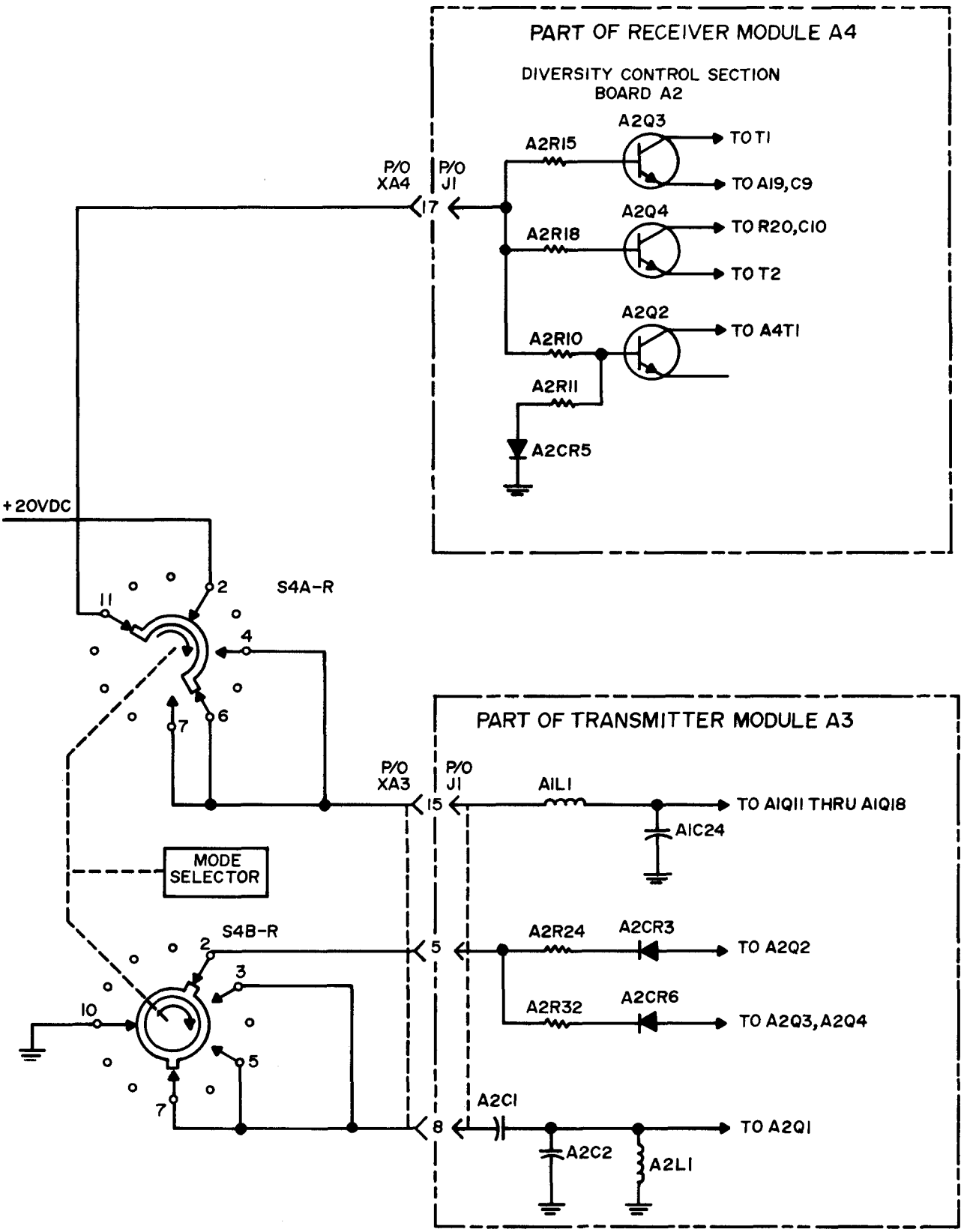
- Ground is applied through contact 5 of MODE SELECTOR switch S4B-R and pin 8 of connectors XA3 and A3J1 to tuned circuit A3A2C1, A3A2C2, and A3A2L1 in transmitter module A3. This changes the center frequency of this tuned circuit from 28,050 Hz to 2,805 Hz.

VOICE MODE OPERATIONAL CONTROL CIRCUIT



Voice Operation. When the MODE SELECTOR switch is set at VOICE, + 20 volts dc from the 20 volt dc regulated MODE SELECTOR switch S4A-R and pin 2 of supply is applied through contacts 2 and 5 of connectors XA1 and A1J1 to the audio amplifier and squelch circuit in regulated power supply module A1. Ground is connected through contacts 10 and 6 of MODE SELECTOR switch S4B-R and pin 17 of connectors XA3 and A3J1 to diode A3A2CR9 in transmitter module A3. This gates off the amplifiers at the transmitter module output to prevent transmission of teletypewriter signals when the MODE SELECTOR switch is set at VOICE. Contacts 10 and 6 also provide a ground for relay A5K1, through CR5, preventing interaction with units attached to the modem through pin A of auxiliary connector J5.

85-HZ DIVERSITY MODE OPERATIONAL CONTROL CIRCUIT



85-Hz Diversity Operation. When the MODE SELECTOR switch is set at 85 Hz DIV, the functions are the same as in 85-Hz operation except for the following:

- The +20 volts dc is applied through contacts 2 and 11 of MODE SELECTOR switch S4A-R, and pin 17 of connectors XA4 and A4J1 to driver A4A2Q2 and differential amplifier A4A2Q7, A4A2Q8 in receiver module A4. The +20 volts dc is also applied to diversity control board amplifiers A4A2Q3, A4A2Q4. This turns these circuits on during 85-Hz diversity operation.

- Ground is applied through contacts 10 and 2 of MODE SELECTOR switch S4B-R and pin 5 of connectors XA3 and A3J1 to diode gates A3A2CR3, A3A2CR6 in transmitter module A3. Diode gate A3A2CR6 becomes forward-biased to enable mixer oscillator A3A2Q3, A3A2Q4 to operate at 2,380 Hz. Diode gate A3A2CR3 gates the output of mixer amplifier A3A2Q2 to the 425-Hz section of transmit narrow band output filter FL1.

85-Hz Plus Voice. When the MODE SELECTOR switch is set at 85 HZ + VOICE, the functions described for 85-Hz operation and those for voice operation apply to 85-Hz plus voice operation and occur simultaneously. The one exception is that ground is not connected to diode A3A2CR9 in the transmitter module. This is a function of voice operation only.

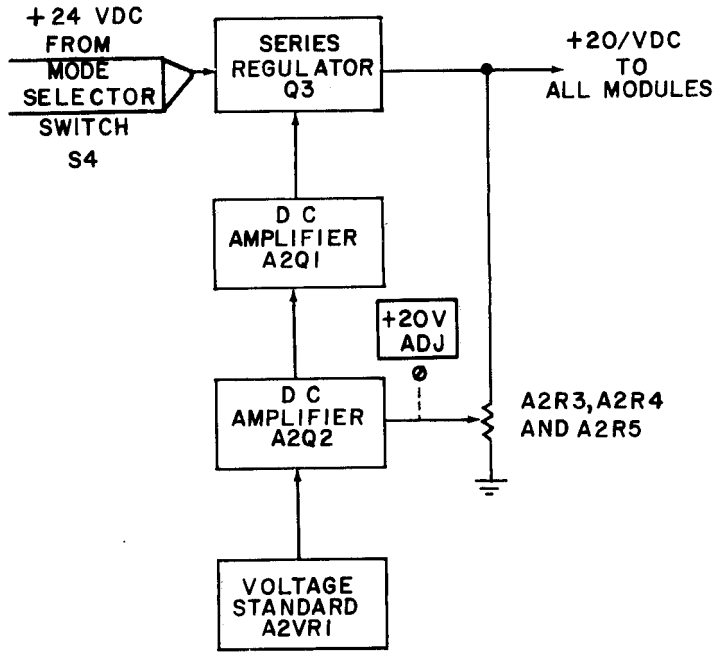
1-20. TWENTY-VOLT REGULATOR

NOTE

Prefix all partial regulated power supply module reference designations in this paragraph with A1.

The 20-volt regulator portion of regulated power supply module A1 is used to provide a +20 volt dc regulated output to all circuits, for appropriate operating settings (850 Hz, 85 Hz, VOICE, 85 Hz DIV, and 85 Hz + VOICE) of MODE SELECTOR switch S4. Twenty-four volts dc is applied through MODE SELECTOR switch S4 to series regulator (A1) Q3. The effective collector-to-emitter resistance of Q3 in series with the 24-volt dc line drops the voltage to +20 volts dc for any given current required by the applicable circuits. Dc amplifier A2Q2 compares the output level with a level established by voltage standard A2VR1. The circuit is adjusted by + 20 V REG ADJ control A2R4 so that the output is maintained at +20 volts dc + 0.2 volt dc. The difference between the voltage standard and 20 volt dc output is raised in level by dc amplifier A2Q2 and applied to dc amplifier A2Q1. Since dc amplifier A2Q1 is direct-coupled to series regulator Q3, the conduction of Q3 is controlled by the conduction of A2Q1. Therefore, the output of dc amplifier A2Q1 will alter the amount of conduction (effective collector-to-emitter resistance) of series regulator Q3, causing the output voltage to be maintained at +20 volts dc.

RECEIVE AUDIO MODULE A1



Section IV. ANALYSIS OF LOOP BATTERY MODULE A5 (MODIFIED)

1-21. COMPARISON OF MODIFIED AND UNMODIFIED LOOP BATTERY MODULES A5

Loop battery modules A5 (modified) having serial number beginning with 201 and higher differ mechanically and electrically from loop battery modules A5 with serial numbers 1 to 200. Despite the difference in details of operation, the units are functionally interchangeable and may be directly interchanged without any readjustments; therefore, the inputs and outputs of unmodified loop battery module A5 described in paragraphs 1-16 and 1-17 remain the same, but operate differently. Serial numbers 201 and higher will be referred to as loop battery module A5 (modified).

1-22. DIFFERENCES OF MODULE A5 (MODIFIED)

(fig. FO-12)

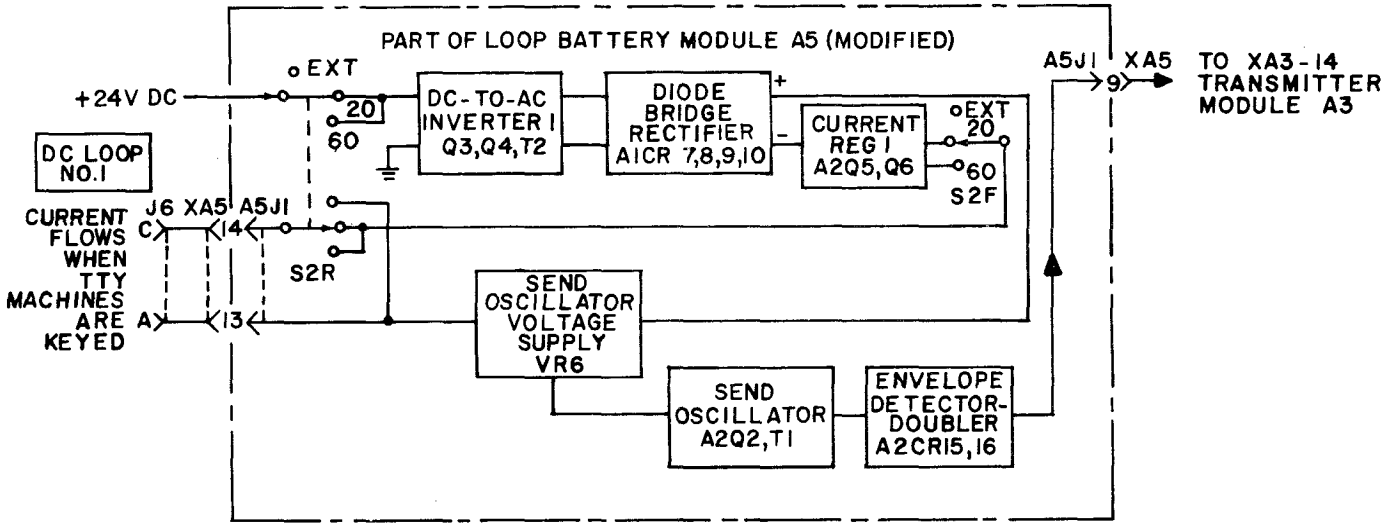
Module A5 (modified) differs from modules A5, serial numbers 1 to 200 in two major respects: a regulated current supply with a choice of 20- or 60-mA regulated current for each loop has replaced the earlier design which provided a range of five unregulated currents; the reference designators for nearly all components have been changed.

1-23. PURPOSE AND DESCRIPTION OF MODULE A5 (MODIFIED)

Module A5 (modified) supplies dc current for dc loops 1 and 2. It also isolates dc loops 1 and 2 from the rest of the modem.

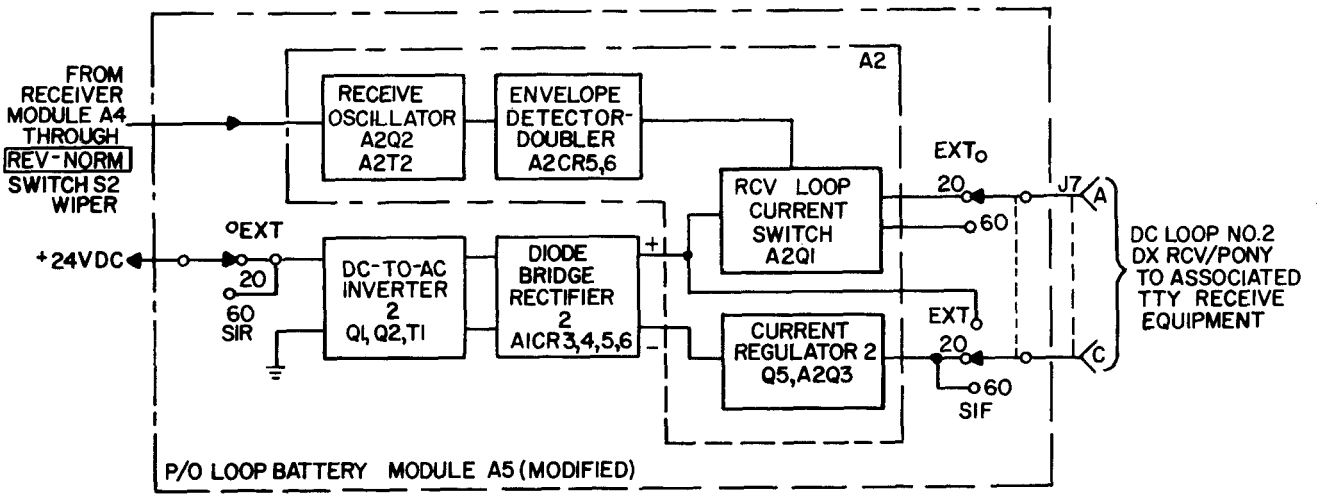
- **Module A5 (Modified) in Transmit Operation.** A tty machine connected to dc loop No. 1 turns the loop current on or off when the machine is keyed and the modem is set at SEND or DUPLEX. Module A5 (modified) converts the current in dc loop No. 1 into dc send pulses. These pulses key transmitter module A3 which produces nsk or fsk tty tones for transmission to remote stations.

- **Module AS (Modified) in Receive Operation.** Receiver module A4 converts received nsk and fsk tones into dc pulses. These dc pulses are fed to module A5 (modified) where they are converted into loop currents which operate local tty machines. Dc loop No. 1 is used for received information on the ONE WAY and RCV mode; dc loop No. 2 is used for received information when the modem is set at DUPLEX.

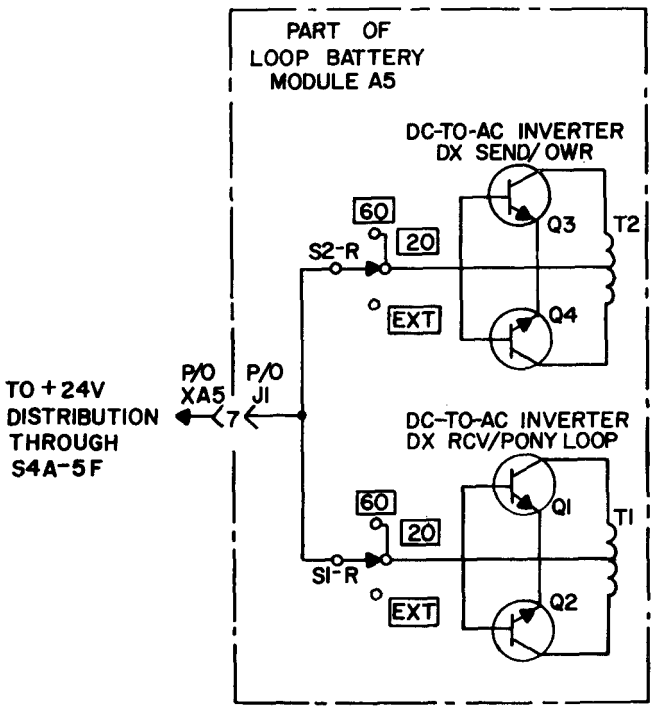


MODULE A5 (MODIFIED) PORTION OF TRANSMIT SIGNAL PATH

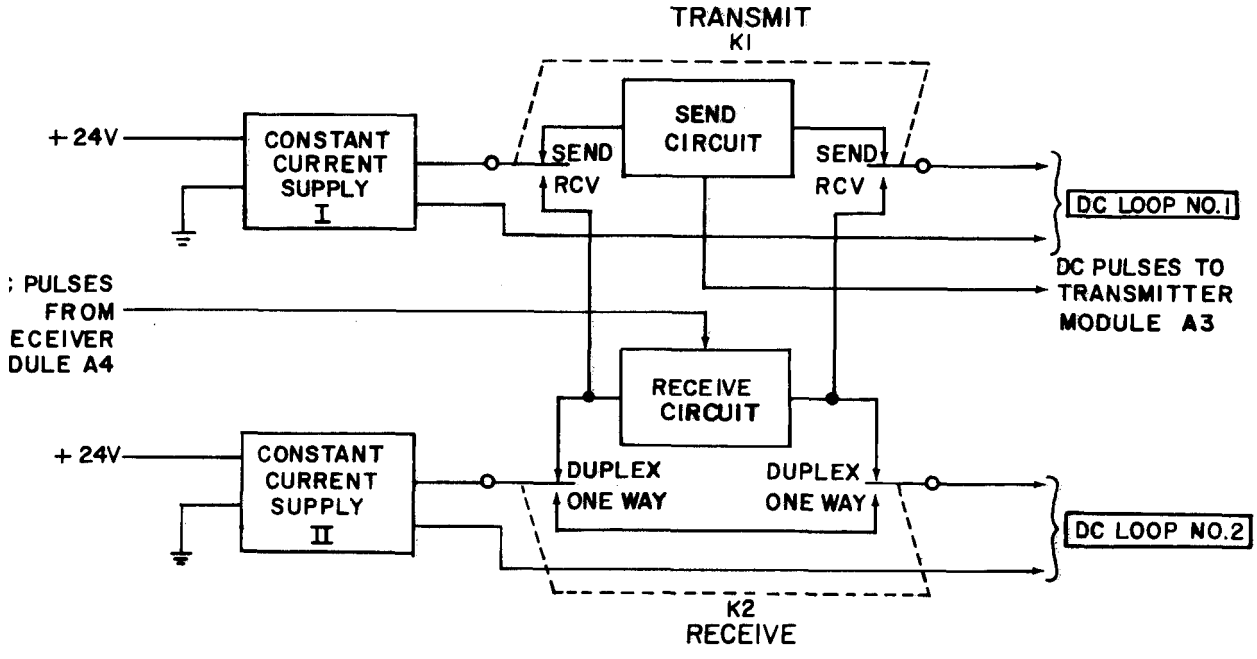
MODULE A5 (MODIFIED) PORTION OF RECIEVE SIGNAL PATH



MODULE A5 (MODIFIED) PORTION OF POWER CONTROL AND PROTECTIVE CIRCUITS

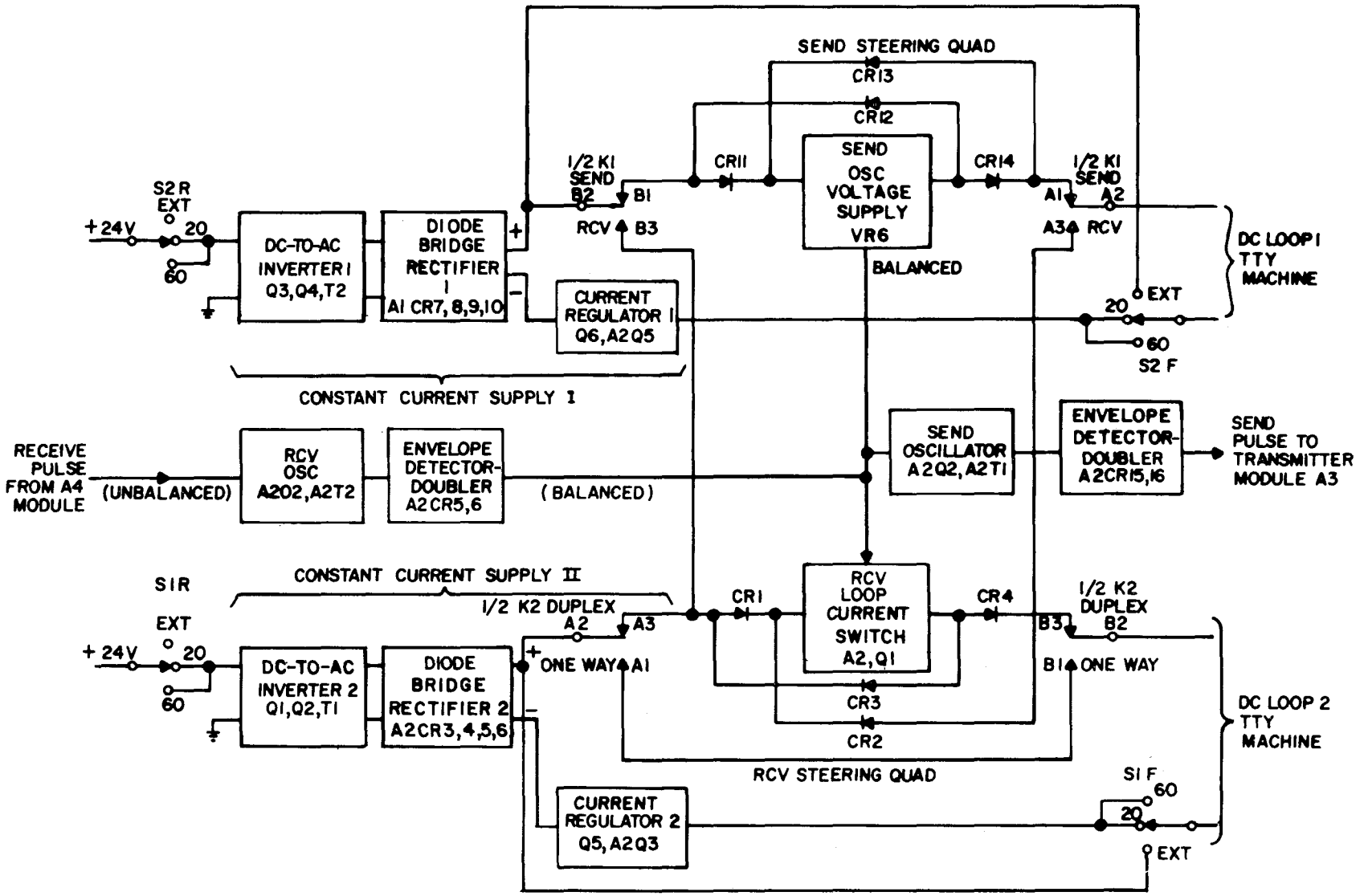


MODULE A5 (MODIFIED), SIMPLIFIED BLOCK DIAGRAM



- **General Description.** Module A5 (modified) contains the following major circuit configurations:
  - Two identical constant current supplies, which provide a 20- or 60-mA source of current to operate tty machines connected to dc loops No. 1 and No. 2.
  - A receive circuit which converts dc pulses from receiver module A4 into loop current. The circuit also isolates receiver module A4 from dc loops No. 1 and No. 2.
  - A send circuit, which converts loop current into dc send pulses and provides isolation between dc loop No. 1 and the transmitter module.
  - Relays controlled by front panel switches which select ONE WAY/DUPLEX and SEND/RCV operation.
  - A steering quad associated with both the send and receive circuits. The steering quad permits connection of an optional external supply without regard to polarity.

MODULE A5 (MODIFIED), DETAILED BLOCK DIAGRAM



TM 11-5805-387-34-1

1-24. MODES OF OPERATION

- Module A5 (modified) switches A5S1 and A5S2 (LOOP 2 CURRENT and LOOP 1 CURRENT, respectively) permit selection of 20 or 60 mA loop currents, or the use of an external current source.

- Front panel ONE WAY/DUPLEX switch S1 selects one-way or duplex (simultaneous send-receive) operation through relay A5A2K2.

- Front panel SEND/RCV switch S5 selects send or receive operation (through relay A5A2K1) when S1 is set to ONE WAY. (With S1 at DUPLEX, A5A2K1 is automatically at SEND)

Interconnection of loop battery module A5 (modified) major circuit configuration							
Mode	From + terminal diode bridge rectifier	Through relay	To supplied circuit	Through relay	To Dc loop No.	Through switch	To terminal current regulator
DUPLEX	1 2	K1-B1,B2 K2-A3,A2	Send circuit Receive circuit	A2K1-A1,A2 A2K2-B2,B3	1 2	S2-F S1-F	1 2
SEND/ ONE WAY	1 2	K1-BI,B2 K2-A2,A1	Send circuit (For external use such as pony circuit).	A2K1-A1,A2 A2K2-B1,B1	1 2	S2-F S1-F	1 2
RCV/ ONE WAY	1 2	K1-B2, B3 K2-A2,A1	Receive circuit (For external use such as pony circuit).	A2K1-A3,A2 A2K2-B1,B2	1 2	S2-F S1-F	1 2

1-25. DETAILED OPERATION OF CONSTANT CURRENT SUPPLIES

The constant current supply consists of a dc-to-ac inverter, a diode bridge rectifier, and a current regulator. The operation of these circuits is identical for both constant current supplies 1 and 2; therefore, only constant current supply 1 is described in full detail.

NOTE

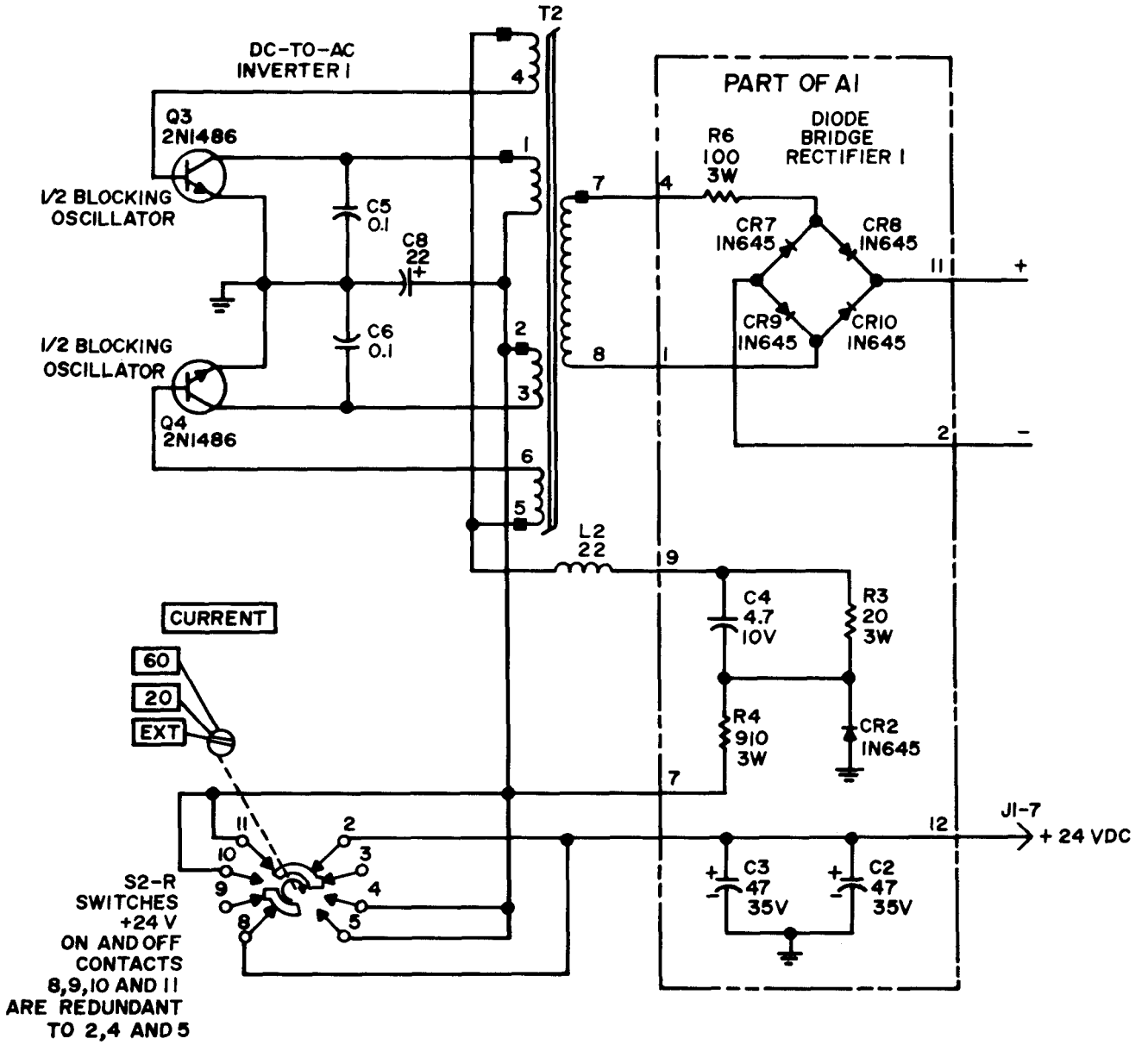
Prefix all partial reference designations with A5.

- Dc-to-ac inverter 1 with diode bridge rectifier 1 converts ±27 volts dc from the modem power supply to 127 volts dc for operation of dc loops 1 and 2. The inverter consists of power input circuitry, blocking oscillator using two transistors, Q3 and Q4, and transformer T2, starting circuitry A1R4, R3, feedback diode A1CR2, capacitor A1C4, and associated circuitry. The diode bridge rectifier is a standard configuration.

- **Power input to inverter:** A preregulated +24 volts supplied by board A3 is applied to A5J1-7. Capacitors A5A1C2 and A5A1C3 filter out noise superimposed on the +24 volt dc. The filtered +24 volts dc is then applied to the blades of A5S2 through contacts 2 and 8. The +24 volts dc is cut off in the external position and is applied to dc-to-ac inverter 1 in the 20- and 60- (mA) position. The right and left halves of the switch are redundant.

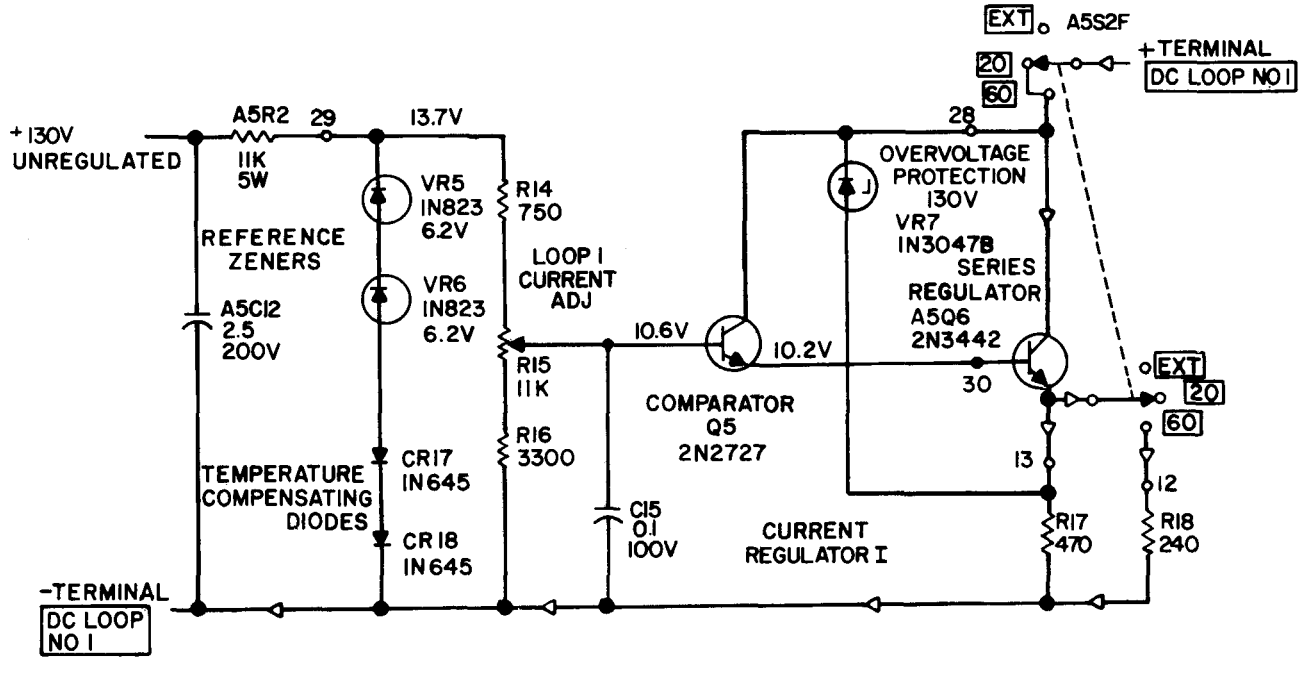
- **Blocking oscillator:** Dc-to-ac inverter 1 is a power blocking oscillator. Transistors Q3 and Q4 alternately switch the +24 volt dc input from one-half of the T2 primary to the other half. Initially, one transistor (for example Q3) is biased on through the blocking network consisting of A1R4 and A1R3. As Q3 starts to conduct, it is driven into full conduction by the positive feedback from winding 4-5 on transformer T2. (The feedback return is through A1CR2 and A1C4.) When the core of T2 saturates, the feedback to Q3 is reduced, and Q3 turns off. The changing flux caused by Q3 turning off generates a negative feedback in winding 4-5 of T2, driving Q3 even further into nonconduction. The same collapsing field generates a voltage in winding 5-6 of proper polarity to turn Q4 on. In this manner, an alternating square wave is impressed on the primary of T2. The frequency of operation is determined by the magnetic characteristics of the saturable core in T2. Capacitor A1C4 speeds up the switching time of Q3 and Q4. Indicator L1 and capacitors C5, C6 and C8 filter switching transients and noise. The secondary voltages of T2 are established by the turns ratio of the windings. The output square waves are rectified by diode bridge rectifier A1CR7, A1CR8, A1CR9 and A1CR10 filtered by C12 and applied to dc loop No. 1. At this point, the voltage is approximately 127 volts dc. The rectified, filtered dc is also applied to current regulator 1.

MODULE A5 (MODIFIED), DC-TO-AC INVERTER AND DIODE BRIDGE RECTIFIER



- Current regulator 1 consists of (right to left) series regulator Q6, sampler resistors A1R17 and A1R18, comparator A2Q5, reference zener diodes A2VR5 and A2VR6, and reference voltage divider A1R14, A1R15, A1R16. Comparator transistor A2Q5 compares a reference voltage to the voltage drop caused by a current flow through a sampler resistor. Correspondingly with the comparator transistor conduction, the series regulator, conducts more or less, regulating the current in the associated dc loop. Zener diodes A1VR5 and A1VR6 and diodes A2CR17 and A1CR18 provide a constant 13.7 volts for the reference voltage divider consisting of A2R14, A2R15, A2R16. Diodes A2CR17 and A2CR18 also compensate for changes in zener voltage caused by temperature variations. Assume A5S2-F is set at 20 (mA). When current through sampler resistor A2R17 drops below 20 mA, the emitter voltage of series regulator Q6 drops and its base voltage follows. Since the base of Q6 is common with the emitter of comparator A2Q5, and since the base of A2Q5 is held at a constant reference voltage by reference zener diodes A2VR5 and A2VR6, A2Q5 is biased on and conducts. This biases series regulator Q6 into greater conduction, increasing the current flow through sampler resistor A2R17 until the desired 20-mA loop current is restored. Similarly, if the loop current tends to exceed the 20-mA loop current, A2Q5 will bias series regulator Q6 to conduct less, maintaining the proper loop current. When LOOP CURRENT switch S2-R is set at 60 (mA), A2R18 parallels A2R17, changing the overall resistance of the sampler network so that the current regulator operates at 60 mA rather than 20 mA. By use of LOOP 1 CURRENT ADJ A2R15, the output of current regulator 1 may be adjusted ± 10 percent. A2C15 supresses zener noise and provides the capacitance for a capacitor multiplier consisting of A2Q5 and Q6. The capacitor multiplier assists in smoothing ripples and transients. Zener diode A2VR7 provides overvoltage protection for transistors A2Q5 and Q6. Voltage peaks over 130 volts will bypass A2Q5 and Q6 through A2VR7.

MODULE A5 (MODIFIED) CURRENT REGULATOR



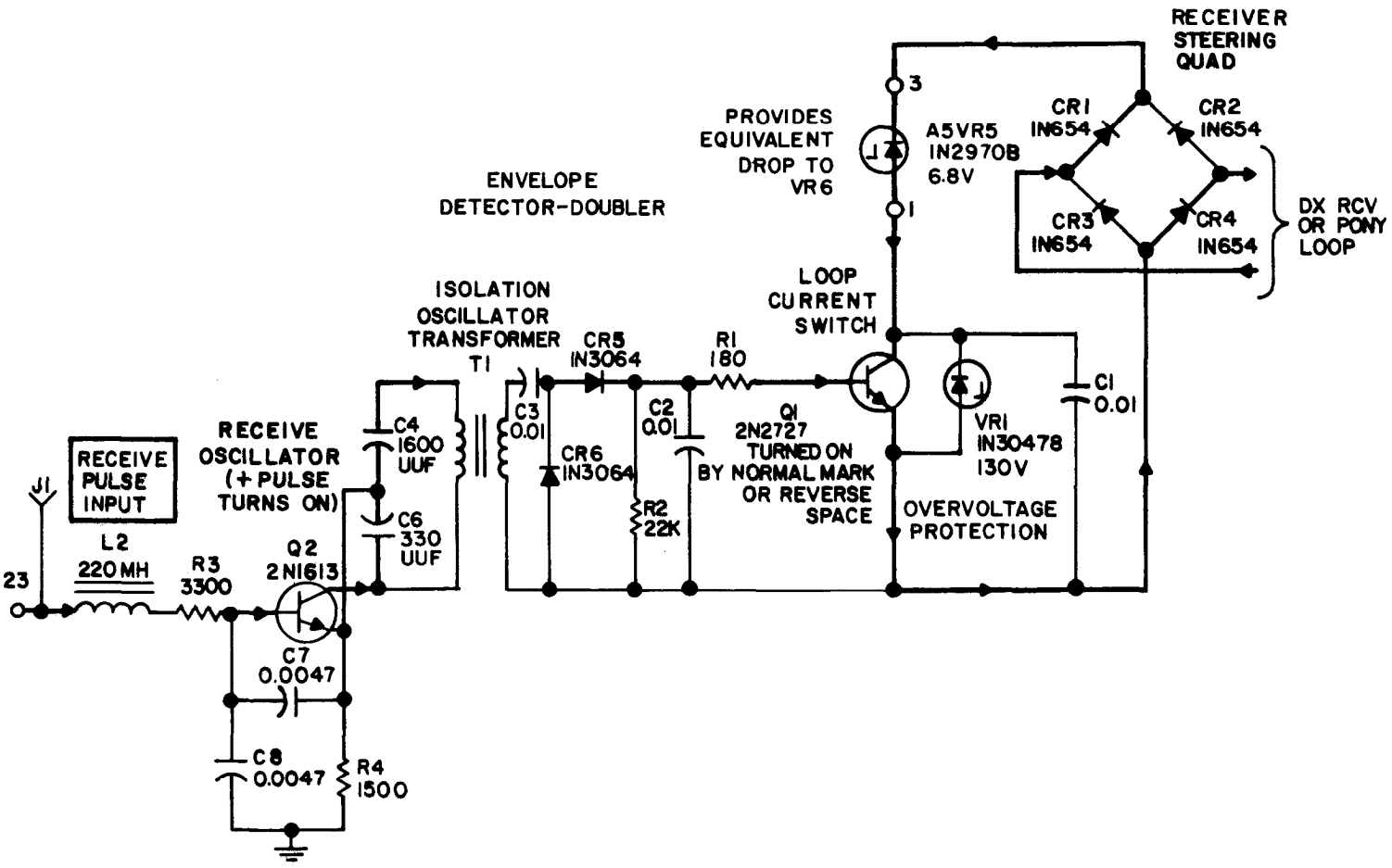
1-26. DETAILED OPERATION, MODULE A5 (MODIFIED)

Only duplex operation is described, since the duplex mode consists of simultaneous use of the send and receive circuitry.

- **Receive Operation, Module A5 (Modified):** Received tty signals are applied to receiver module A4 through AUX RCVR audio jack J1. The receiver module converts the received tty signals to dc pulses (receive pulses) and applies them to loop battery module A5 (modified) through XA5-1 and A5J1-1. A2L2, A2R3, and A2C8 filter out transients and noise. The receive pulse is then applied to receive oscillator A2Q2. When a positive pulse (representing a received normal mark tty signal) is applied to receive oscillator A2Q2, it is turned on for the duration of the pulse. The signal from the oscillator is applied through oscillator-isolation transformer A2T1 to an envelope detector-doubler consisting of A2CR6, A2CR5, A2C2, A2C3 and A2R2. The resulting dc output from the envelope detector-doubler is applied to the base of loop current switch A2Q1 through A2R1. Therefore, when a normal mark pulse is received, loop current switch A2Q1 is turned on. With A2Q1 biased on, loop current supplied by diode bridge rectifier 2 flows from the positive side of the rectifier through terminals A2 and A3 of A2K2, steering quad diode A2CR1, VR5, the collector of forwardbiased A2Q1, steering quad diode A2CR4 and terminals B3 and B2 of A2K2, through A5J13 to operate tty machines connected to DC LOOP NO. 2 (the DX RCV PONY LOOP). The return path is provided through A5J115, meter sampler resistor A2R11, and switch S1-F through series regulator Q5 and current regulator 2 sampler resistor A2R8 (and A2R9 for 60-mA operation). The return path ends at the negative terminal of diode bridge rectifier 2. When a normal space is received, A2Q1 is reverse-biased and no current flows through dc loop No. 2. Zener diode VR5 duplicates the voltage drop of regulator zener diode VR6 in the send circuit. This permits use of either current regulator 1 or 2 with either the send or receive circuit, as is required when the mode of operation is switched from duplex to ONE WAY/RCV. ONE WAY/RCV operation is the same as the duplex-receive operation described above, except dc loop No. 1 is used in conjunction with current supply 2. Also, the input to the modem is through RCVR TRANS AUDIO jack J2 rather than J1.

- **External Operation of Receive Loop:** If LOOP CURRENT 2 switch A5S1-F is set at EXT for operation from an external supply, diode bridge rectifier 2 and current regulator 2 are switched off and out of dc loop No. 2. The resulting loop current path is exactly the same as for 20- or 60-mA operation, except that the supply is external and unregulated. The steering quad permits connection of the external supply without regard for polarity of the supply. If the external supply is connected backwards, loop current will be routed through steering quad diodes A2CR2 and A2CR3 (rather than A2CR1 and A2CR4). Therefore, the polarity of the loop current flow through loop current switch A2Q1 is the same, regardless of the polarity of the external supply.

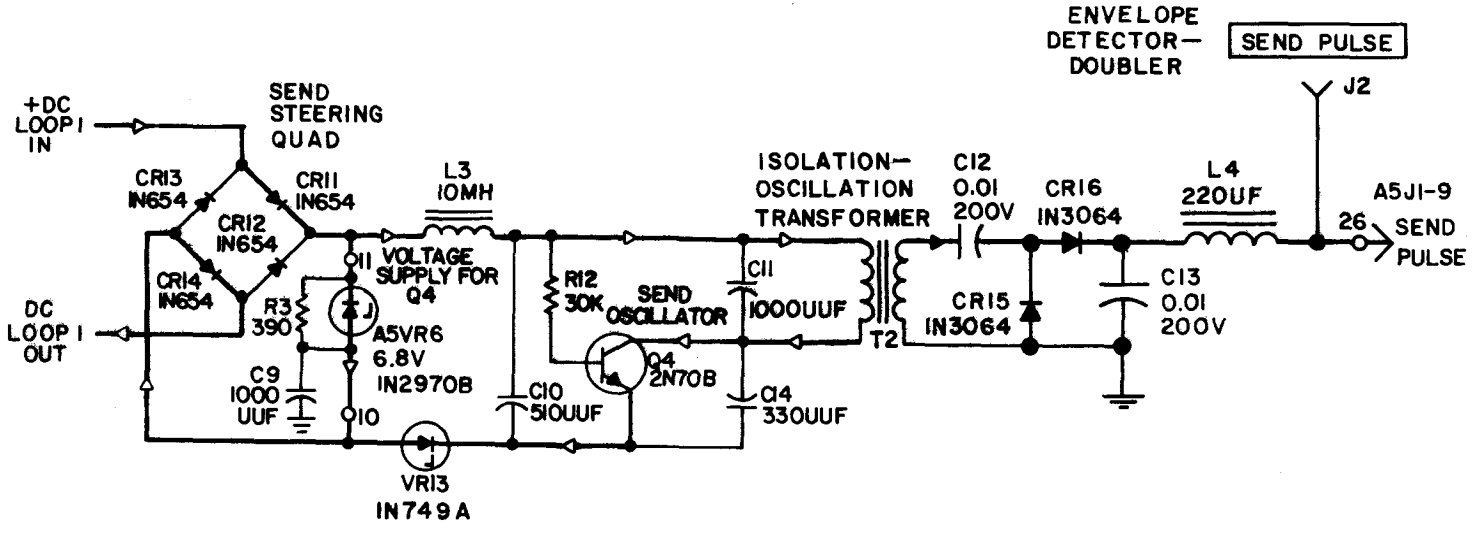
MODULE A5 (MODIFIED) RECEIVE CIRCUIT



- **Send Operation, Module A5 (Modified):** (Only duplex operation is described: One way/send operates in the same manner.) When the tty machine connected to dc loop No. 1 is keyed, current flows through the loop as supplied by current supply 1. When the tty machine closes dc loop No. 1, current flows through terminal 11 (positive) of diode bridge rectifier 1 and terminals B2 and B1 of energized relay A2K1. It passes through steering quad diode A2CR11, send oscillator voltage supply zener diode BR6, steering quad diode A2CR14, terminals A1 and A2 or A2K1, meter sampler resistor A2R19 and through A5J1-13 to the tty machine. The return path is provided through A5J1-14, S2-F, series regulator Q)6, and sampler resistor A2R17 (and A2R18 for 60-mA operation) to the negative terminal of diode bridge rectifier 1. Therefore, when the dc loop No. 1 loop current is on, representing a send normal mark pulse, +6.8 volts dc appears across send oscillator voltage supply zener diode BR6. The 6.8 volts dc is filtered through A2L3 and is simultaneously applied to the collector and base of send oscillator A2Q4, gating the oscillator on. The frequency of the send oscillator is determined by the resonant circuit, consisting of A2C11 and the primary of A2T2. Transformer A2T2 isolates the circuitry from dc loop No. 1 and associated tty units preventing problems associated with grounding. The signal generated by send oscillator A2Q4 in response to keying from dc loop No. 1 is induced on the secondary of A2T2 and is rectified by an envelope detector-doubler consisting of A2C12, A2CR15, A2CR16 and A2CR13. The resulting dc pulse, called the send pulse, is applied to transmitter module A5 through A5J1-9. When dc loop No. 1 is opened (representing a normal space), no voltage appears across VR6 and send oscillator Q4 is inoperative. Consequently, no send pulse appears at the module A5 (modified) output (A5J1-9).

- **External Operation in Send.** If LOOP CURRENT 1 switch S2-F is set at EXT for operation from an external supply, diode bridge rectifier 1 and current regulator 1 are switched off and out of dc loop No. 1. The resulting loop current path is exactly the same as for internal operation in the 20- or 60-mA modes, except that the supply is external and unregulated. The steering quad permits connection of the external supply without regard for polarity of the supply. If the external supply is connected backwards, loop current will flow through steering quad diodes A2CR12 and A2CR13 (rather than A42CR11 and A2CR14); therefore, the polarity of the loop current flow through send oscillator voltage supply VR6 is the same, regardless of the polarity of the external supply.

MODULE A5 (MODIFIED) SEND CIRCUIT



CHAPTER 2
DIRECT SUPPORT MAINTENANCE

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SECTION II

TROUBLESHOOTING

SECTION III

MAINTENANCE PROCEDURES

SECTION IV

ADJUSTMENT PROCEDURES

CHAPTER 2
DIRECT SUPPORT MAINTENANCE

Section I. GENERAL INFORMATION

WARNING

High voltage in modem modules. Scope module A2 contains 1,100 volts dc; Loop battery module A5 contains 90 volts dc. Serious injury or death may result from contact with these voltages.

2-1. GENERAL

This chapter covers direct support troubleshooting, maintenance, and test procedures for the modem. Section I lists the tools, test equipment, and materials needed to perform direct support maintenance. Troubleshooting and test procedures are described in section II. Maintenance procedures are covered in section III and adjustments in section IV.

2-2. REPAIR PARTS, TOOLS, TEST EQUIPMENT, AND MATERIALS

Repair Parts: Refer to TM 11-5805-387-24P-1.

Special Tools: No special tools are needed.

Tools, Test Equipment, and Materials:

TOOLS

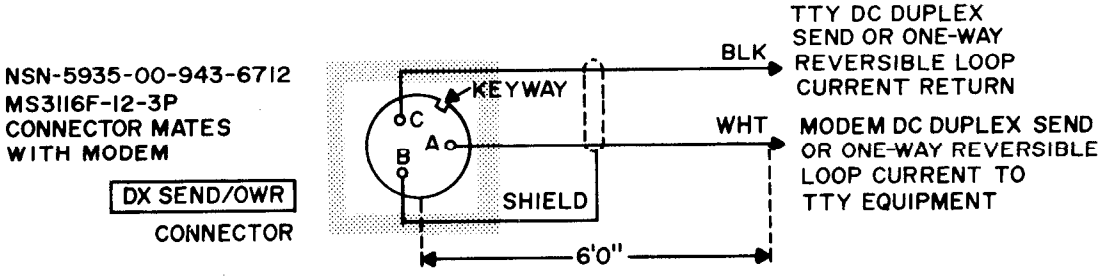
	NATIONAL STOCK NUMBER
Tool Kit, Electronic Equipment TK-100/G	5180-00-605-0079
Tool Kit, Electronic Equipment TK-105/G	5180-00-610-8177

TEST EQUIPMENT

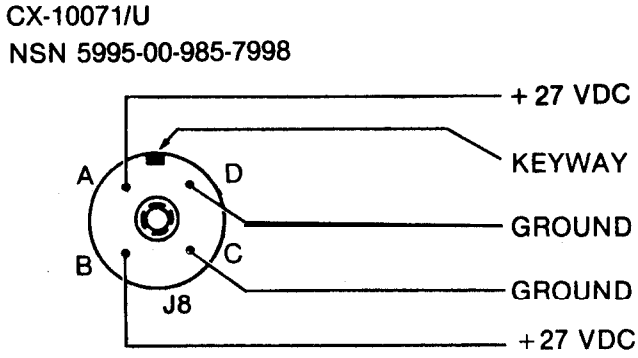
Counter, Electronic, Digital Readout AN/USM-207	6625-00-911-6368
Electronic Voltmeter AN/URM-145	6625-00-973-3986
Generator, Signal AN/URM-127	6625-00-783-5965
Handset H-33/PT	5965-00-163-9947
Multimeter ME-26B/U	6625-00-646-9409
Oscilloscope AN/USM-281A	6625-00-228-2201
Power Supply PP-3940/G	6130-00-404-1727
Test Set, Teletypewriter TS-799A/UGM-1	6625-00-965-0195
Voltmeter ME-30/U	6625-00-553-01421
Multimeter TS-352B/U	6625-00-553-0142
600 Ohm, ½ Watt Test Potentiometer	

MATERIALS

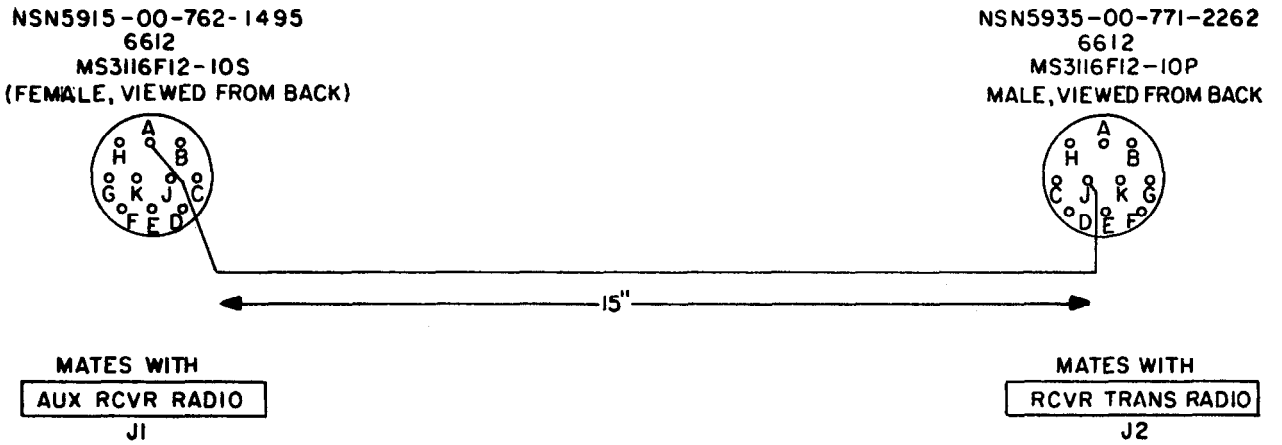
TEST CABLE NO. 1



TEST CABLE NO. 2



TEST CABLE NO. 3



Test cable No. 3 is to be constructed to permit back-to-back operation of the modem for testing. It connects the output of the transmit section of the modem to the input of the receive section.

- **Cable: 17-inch length of No. 24 ASW single-conductor strand cable.**
- **Connectors: NSN 5935-00-762-1495 J1**
  NSN 5935-00-771-2262 J2

Connect one end of cable to pin J of connector 6612 MS 3116F12-10P and the other end to pin A of connector 6612 MS 3116F12-10S. Connect a ¼-inch wire between pins B and D of 6612 MS 3116F12-10P.

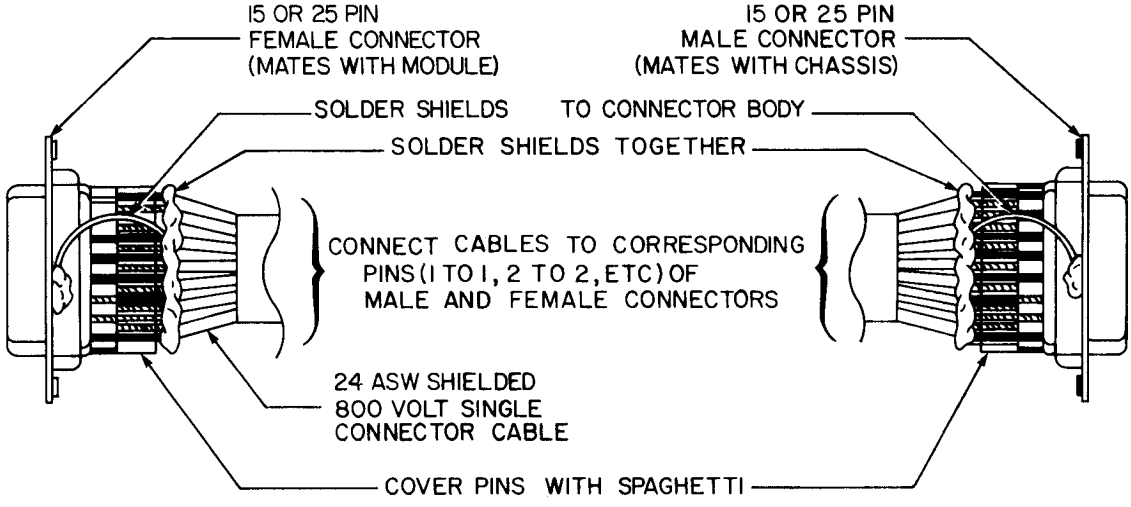
OPTIONAL MATERIALS

Extender test cables mav be needed to reach operating modem modules. Construct these cables if you need them. Construct at least one 15-pin and one 25-pin test cable.

- Cable: 3-foot lengths of No. 24 ASW shielded single-conductor stranded audio cable.
- Connectors: NSN 5935-00-914-2287 A3J1
  NSN 5935-00-930-7025 A1J1
  NSN 5935-00-930-7026 XA1
  NSN 5935-00-880-2884 XA3

Strip shielding back 1 inch from female connector on both test cables. Connect shields at male end to a heavy bus that can be secured to the modem chassis common ground point.

EXTENDER CABLE



Section II. TROUBLESHOOTING

WARNING

DEATH ON CONTACT may result from contact with high voltage in modem modules. Scope module A2 contains 1,100 volts dc; loop battery module A5 contains 90 volts dc.

NOTE

This section supplements the troubleshooting procedures found in the modem's operator (TM 11-5805-387-10-1) and organizational maintenance (TM 11-5805-387-20-1) manuals. It also supplements the troubleshooting procedures found in the maintenance manuals for Radio Teletypewriter Sets AN/GRC-142(*) and AN/GRC-122(*) (TM 11-5815-334-12, TM 11-5815-334-35).

2-3. GENERAL INFORMATION

DEFINITION

Troubleshooting has three steps - sectionalization, localization, and isolation.

- Sectionalization means tracing the fault to a module or assembly.
- Localization means tracing the fault to a subassembly within a module or assembly.
- Isolation means pinpointing the specific part or connection causing trouble.

PROCEDURES

SENSE the trouble:

- Check meter readings and other visual signs to sectionalize trouble.
- Check for dirt, dust, or moisture.
- Check for loose screws or nuts.

OPERATE the unit:

An operational test can help pinpoint trouble quickly. See TM 11-5805-387-10-1.

USE the CHART:

The troubleshooting chart lists common symptoms, troubles, and corrective measures. Not all trouble symptoms are listed in the chart, so use it as a guide for analyzing symptoms not listed.

TEST POINT DATA:

Paragraph 2-7.

Use the troubleshooting chart to isolate defective parts.

REMOVING AND REPLACING PARTS: Refer to section III

ADJUSTING AND ALIGNING MODULES: Refer to section IV

NOTE

When conducting tests, investigate the possibility of intermittent troubles. Jarring or tapping the equipment may expose this type of problem. Do not try to correct trouble this way. Check the modem's wiring and connections to eliminate trouble caused by loose connections.

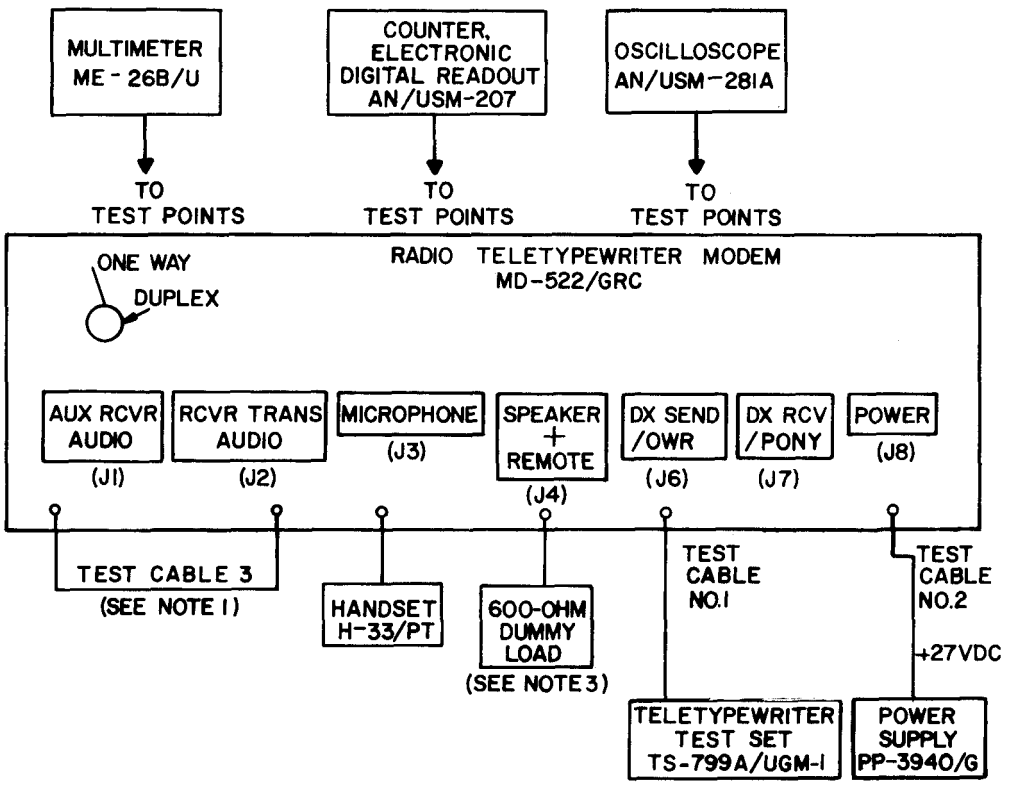
2-4. MODEM BENCH TEST SETUP AND TEST CONDITIONS

- Perform all checks in the troubleshooting chart with the equipment connected as shown below.
- Make sure that all the modem's modules are secure in the chassis.
- Read all instructions carefully before starting the tests, so you will understand what is to be accomplished.

POWER CONNECTIONS

Use Power Supply PP-3940/G or an equivalent dc power source for all electrical servicing and test procedures. The power source must supply +27 volts dc at 2.6 amperes with less than 1 volt root-mean-square (rms) ripple.

TEST EQUIPMENT



NOTES

1. Set ONE WAY/DUPLEX switch at DUPLEX when test cable No. 3 is used.
2. Use extender cables for access to operational module for internal adjustments.
3. The 600-ohm dummy load must be connected to J4-A for 10 mw and to J4-L for 2 watt audio output measurements.

TEST CONDITIONS

- Turn on the test equipment and allow a 5-minute warmup period.
- When checking all transmit modes except VOICE, set the MODE SELECTOR switch to the desired mode of operation, and set the TS-799A/UGM-1 controls as follows:

POWER - 115V ON

RATE -7.5 BAUDS

DISTORT SELECT - OFF

CURRENT SELECT -60

MESSAGE TRANSMIT - ON

MESSAGE SELECT - DOT/CY (sets up equipment to produce an output of alternate marks and spaces)

MESSAGE SELECT - SELECTED PULSES (sets up equipment to produce a continuous selected character as determined by the position of the MARK - SPACE toggle switches)

NOTE

Use the same procedures to check the receiving modes; the transmit operation controls both transmitter output and receiver input through test cable No. 3. Warm up the BFO oven for 5 minutes before performing tests or adjustments in the 850-Hz mode. After the warmup period, adjust the BFO control for a symmetrical Lissajous pattern (when keying).

2-5. TROUBLESHOOTING SYMPTOM INDEX

Use this index to quickly find procedures in the troubleshooting chart.

TROUBLESHOOTING SYMPTOM	PROCEDURE NO.	PAGE
MODEM		
Does not transmit	5	2-13
Does not transmit voice	9	2-17
Does not transmit voice (at 85 Hz + VOICE)	10	2-18
Incorrect scope display	8	2-16
MODEM TEST METER		
No DC LOOP NO. 1 current reading	4	2-13
No DC LOOP NO. 2 current reading	7	2-15
No DISCRIMINATOR reading	6	2-15
No reading	1	2-9
No reading, scope display present	2	2-12
No REGULATED DC reading	3	2-12

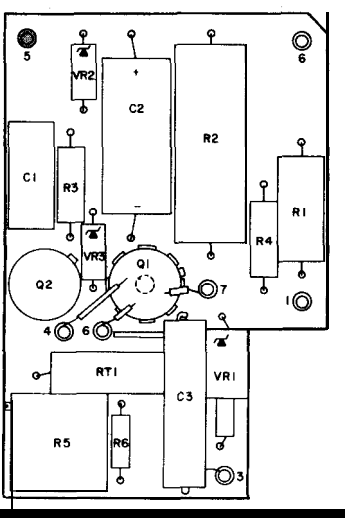
2-6. TROUBLESHOOTING CHART

Use the troubleshooting chart to localize and isolate trouble. The chart supplements the operational checks, troubleshooting charts, and PMCS tables in TM 11-5805-387-10-1 and TM 11-5805-387-20-1. Also, the chart is designed to be used with the foldouts at the back of this manual.

If operational checks or organizational maintenance have designated a defect, find that malfunction in the Symptom Index (para 2-5) and go directly to that problem.

The troubleshooting chart is indexed by MALFUNCTION/SYMPTOM, for which PROBABLE CAUSES are listed. Follow the TEST PROCEDURES for which in turn an INDICATION and YES or NO instructions are given.

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
1 NO TEST METER OR SCOPE READINGS FOR ANY POSITION OF METER FUNCTION SWITCH.	**Defective: Power source. Fuse F1. Polarity diode CR1. Over voltage zener VR1. Circuit board A9. Series regulator transistor Q1. Mode selector switch S4. Receive audio module A1.**		
1. Check polarity and voltage to POWER connector J8.	Proper polarity and +27 vdc	Go to 2.	Replace defective power source (TM 11-5805-387-10-1).
2. Set MODE SELECTOR switch to PWR OFF. Check fuse.	Fuse blown	Replace fuse F1 (TM 11-5805-387-10-1). Go to 9.	Go to 3.
3. With power on, connect ME-26B/U between terminal 5 of circuit board A9 and ground. Measure voltage.	24 vdc ± 0.5		Go to 4.



MALFUNCTION/SYMPTOM		PROBABLE CAUSE	
TEST PROCEDURE	INDICATION	YES	NO

NOTE

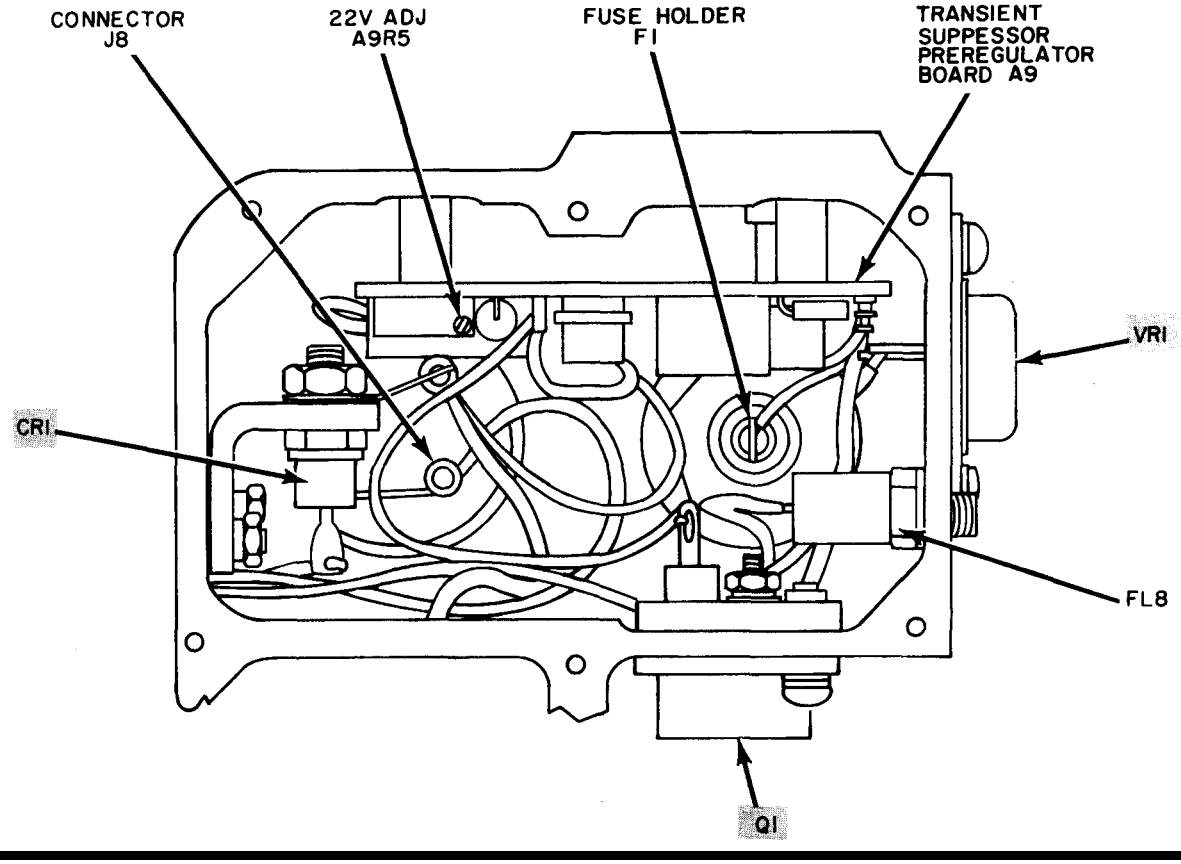
Series regulator Q1 automatically cuts off when the +24 dc volt output of preregulator board A9 is shorted. Normal operation will resume when short is removed,

4. On the inside of the front panel remove the L-shaped compartment housing (para 2-9). Connect ME-26B/U across collector of transistor Q1; measure voltage.	+27 vdc ± 3	Go to 6.	Go to 5.

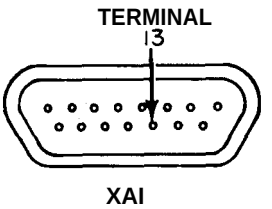
WARNING

Do all continuity and resistance checks with all power removed.

5. With power off, connect TS-352B/U to opposite ends of polarity diode CR1. Check continuity.	Zero ohm in one direction, infinity (or high resistance) in other direction	Continue test.	Replace defective CR1 (para 3-8).



MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
Connect TS-352B/U to opposite ends of over voltage zener VR1. Check continuity.	Zero ohm in one direction, infinity (or high resistance) in other direction	Go to 6.	Replace defective VR1 (para 3-8).
6. With power on, connect ME-26B/U between terminal 5 of circuit board A9 and ground. Measure voltage.	Zero volt or nominal voltage	Go to 7.	
	Less than 23.5 volts or more than 24.5 volts	Go to 8.	
7. Check for short prior to MODE SELECTOR switch wafer S4A-F, terminal 2 (fig. FO-6)	Short	Repair circuit wiring.	Replace defective board A9 (para 2-10).
8. Remove transistor Q1 from socket. Check for shorted or open circuit condition.	Transistor defective	Replace defective transistor Q1 (para 2-11).	Replace defective board A9 (para 2-10).
9. Connect ME-26B/U across +20 V REG test point of receive audio module A1.	+20 vdc	Replace defective switch S4 (para 3-8).	Go to 10.
10. Connect ME-25B/U across pin 13 of XA1; measure voltage.	+24 vdc	Replace defective module A1 (para 3-8).	.....



MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO

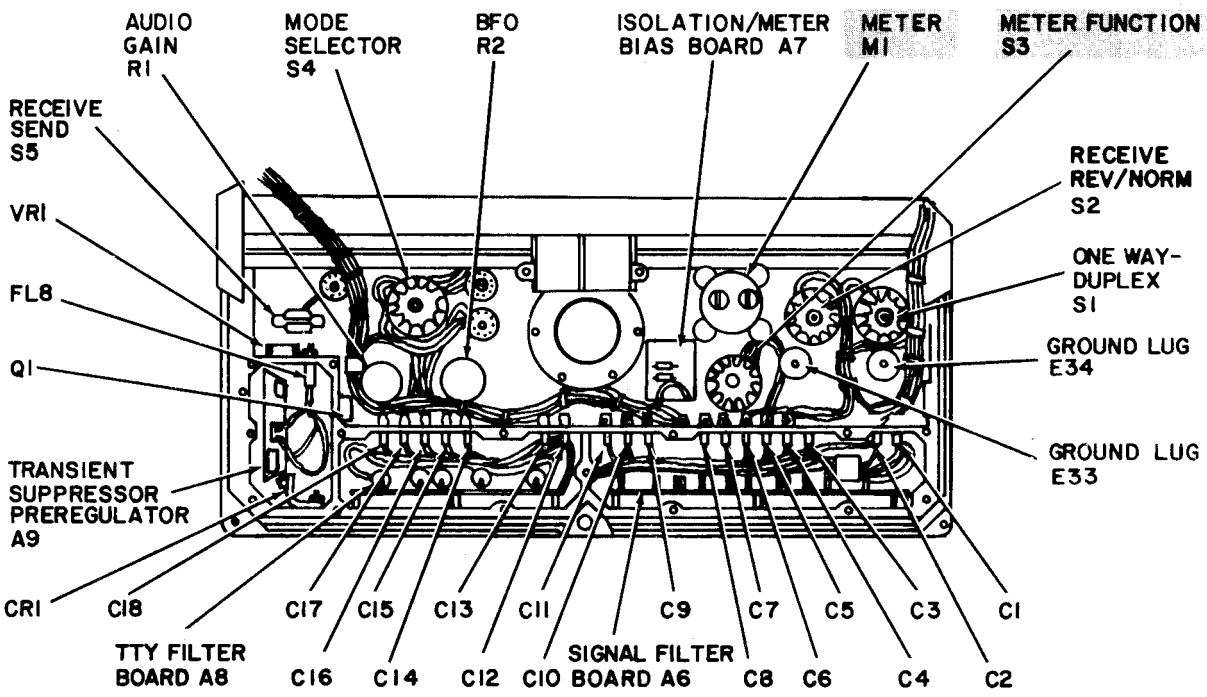
2 NO TEST METER READINGS FOR ANY POSITION OF METER FUNCTION SWITCH; SCOPE DISPLAY PRESENT.

Defective: Meter function switch S3. Test meter M1.

WARNING

Do all continuity and resistance checks with all power removed.

1. Check continuity of METER FUNCTION switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S3 (para 3-8).
2. Check continuity of meter Ml (fig. FO-6).	Continuity	.....	Replace defective meter M1 (para 3-8).



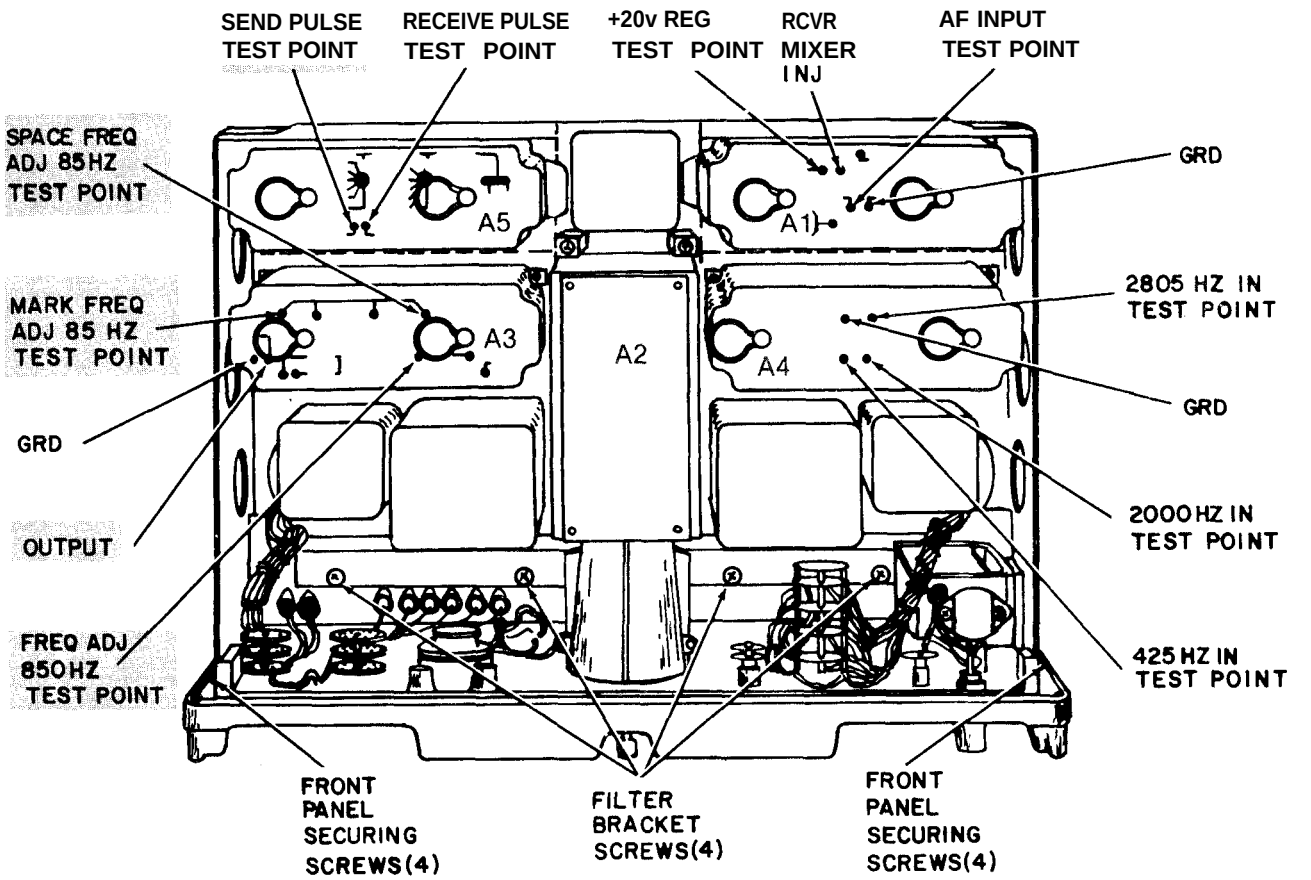
3 METER FUNCTION SWITCH IN REGULATED DC POSITION: NO TEST METER INDICATION.

Defective: Receive audio module A1. Mode selector switch S4. Test meter M1.

1. Connect ME-26B/U across +20 V REG test point of receive audio module A1.	+20 vdc	Replace defective switch S4 (para 3-8).	Go to 2.

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	No
2. Connect ME-26B/U across pin 13 of XA1; measure voltage.	+24 vdc	Replace defective module A1 (para 2-8).	Go to 3.
WARNING Do all continuity and resistance checks with all power removed.			
3. Check continuity of meter M1 (fig. FO-6).	Continuity	----------	Replace defective meter M1 (para 3-8).
4 ONE WAY-DUPLEX SWITCH S1 IN DUPLEX POSITION: NO DC LOOP NO. 1 CURRENT.	**Defective: Receive audio module A1.**		
1. Set METER FUNCTION switch at REGULATED DC. Observe test meter M1.	+20 vdc	----------	Go to 2.
2. Connect ME-26B/U across +20 V REG test point of receive audio module A1.	+20 vdc	Repair meter circuit wiring.	Replace defective module A1 (para 2-8).
5 MODEM NOT TRANSMITTING.	**Defective: Loop battery module A5. Transmitter module A3.**		
1. Set METER FUNCTION switch at DC LOOP NO. 1. Observe test meter M1 while transmitting.	Direct current flow	Go to 2.	Replace defective module A5 (para 2-8).
2. Connect TS-799A/UGM-1 (para 2-4) and test cable No. 3 Connect ME-26B/U across SEND PULSE of loop battery module A5.	+ 0.6 vdc	Go to 3.	Replace defective module A5 (para 2-8).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO



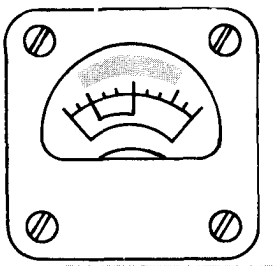
3. Connect TS-799A/UGM-1 (para 2-4) and test cable No. 3. Make the following tests across test points of transmitter module A3 (internal NORM/REV switch at NORM) with the AN/USM-207:	. . . . .	Replace defective module A3 (para 2-8).
SPACE FREQ ADJ 85 Hz	227.8 kHz	
MARK FREQ ADJ 85 Hz	221.0 kHz	
FREQ ADJ 850 Hz (MODE SELECTOR switch at 850 Hz)	26,050 Hz	
FREQ ADJ 850 Hz (MODE SELECTOR switch at 85 Hz DIV)	23,800 Hz	
OUTPUT (MODE SELECTOR switch at 850 Hz)	Space: 2,425 Hz ± 25 Mark: 1,575 Hz ± 25	
OUTPUT (MODE SELECTOR switch at all 85-Hz modes)	Space: 2,847.5 Hz ± 2 Mark: 2,762.5 Hz ± 2	
OUTPUT (MODE SELECTOR switch at VOICE)	200-2,400 Hz	

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO

6 METER FUNCTION SWITCH IN DISCRIMINATOR POSITION (STEADY MARK OR SPACE INPUT): NO TEST METER INDICATION.

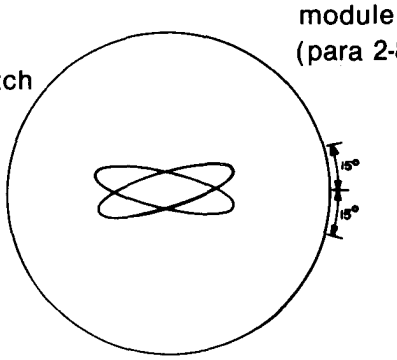
Defective: Mode selector switch S4. Test meter M1. Receiver module A4. Receive audio module A1.

WARNING

1. Check continuity of MODE SELECTOR switch (fig. FO-6).	Continuity	Go to 2	Replace defective switch S4 (para 3-8).
2. Check continuity of meter M1 (fig. FO-6).	Continuity	Go to 3	Replace defective meter M1 (para 3-8).
3. Set MODE SELECTOR switch at 850 Hz. Replace receiver module A4 with known good module.		----------	Put back original module A4. Go to 4.
4. Replace receive audio module A1 with known good module.		----------	Put back original module A1.

7 METER FUNCTION SWITCH AT DC LOOP NO. 2: NO DC LOOP NO. 2 CURRENT READING ON TEST METER.

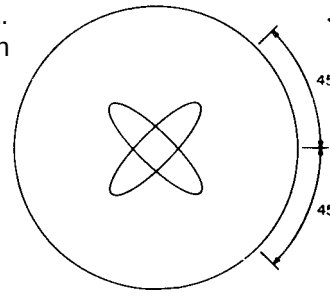
Defective: Loop battery module A5. Receiver module A4. Transmitter module A3. Receive audio module A1.

1. Connect TS-799A/UGM-1 (para 2-4) and test cable No. 3. Connect ME-26B/U across RECEIVE PULSE of loop battery module A5.	+8.0 vdc	Go to 2	Replace defective module A5 (para 2-8).
2. On the TS-799A/UGM-1 set the MESSAGE TRANSMIT switch to ON. Connect test cable No.3 (para 2-4) and set the modem ONE WAY/DUPLEX switch to DUPLEX. Set the MODE SELECTOR switch to 85 Hz and observe the modem CRT.		Replace defective module A4 (para 2-8).	Go to 3.

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	**INDICATION**	**YES**	NO
3. Connect TS-799A/UGM-1 (para 2-4) and test cable No. 3. Make the tests across test points of transmitter module A3 (internal NORM/REV switch at NORM) with the AN/USM-207:		Go to 4.	Replace defective module A3 (para 2-8).
SPACE FREQ ADJ 85 Hz	227.8 kHz		
MARK FREQ ADJ 85 Hz	221.0 kHz		
FREQ ADJ 850 Hz (MODE SELECTOR switch at 850 Hz)	26,050 Hz		
FREQ ADJ 850 Hz (MODE SELECTOR switch at 85 Hz DIV)	23,800 Hz		
OUTPUT (MODE SELECTOR switch at 850 Hz)	Space: 2,425 Hz ± 25 Mark: 1,575 Hz ± 25		
OUTPUT (MODE SELECTOR switch at 85-Hz modes)	Space: 2,847.5 Hz ± 2 Mark: 2,762.5 Hz ± 2		
OUTPUT (MODE SELECTOR switch at VOICE)	200-2,400 Hz		
4. Set MODE SELECTOR switch at 850 Hz. Connect AN/USM-207 across RCVR MIXER INJ of receive audio module Al.	3,805 Hz-5,805 Hz varied by BFO control.	----------	Replace defective module Al (para 2-8).
8 INCORRECT DISPLAY ON FRONT PANEL CRT.	**Defective: Scope module A2. Receiver module A4. Receive audio module A1. Transmitter module A3.**		
1. Connect TS-799A/UGM-1 (para 2-4) and test cable No.3. Set METER FUNCTION switch to DISCRIMINATOR. Make the following tests across test points of receiver module A4 with the AN/USM-207:		Replace defective module A2 (para 2-8).	Go to 2.
2,000-Hz IN (MODE SELECTOR switch at 850 Hz)	Space: 2,425 Hz ± 25 Mark: 1,575 Hz ± 25		
2,805-Hz IN (MODE SELECTOR switch at 85 Hz)	Space: 2,847.5 Hz ± 2 Mark: 2,762.5 Hz ± 2		
425-Hz IN (MODE SELECTOR switch at 85 Hz DIV)	Space: 467.5 Hz ± 2 Mark: 382.5 Hz ± 2		

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO

2. Set MODE SELECTOR switch to 850 Hz. Replace receiver module A4 with known good module.

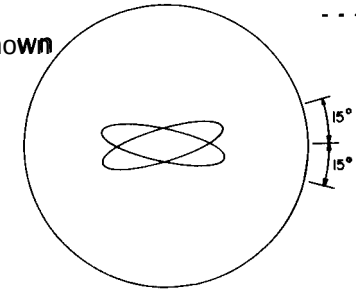


Put back original module A4. Go to 3.

3. Replace receive audio module Al with known good module.

Put back original module A1. Go to 4.

4. Set MODE SELECTOR switch to 85 Hz. Replace transmitter module A3 with known good module.



Put back original module A3.

9 NO VOICE TRANSMISSION IN LOCAL OR REMOTE OPERATION.

Defective: Connector J3 (local operation). Connector J4 or J2 (remote operation). Mode selector switch S4.

WARNING

Do all continuity and resistance checks with all power removed.

1. Check continuity of connectors J3 (local operation), J4 and J2 (remote operation) (fig. FO-6).	Continuity	Go to 2.	Replace defective connector (para 3-8).
2. Check continuity between pin F of J3 and contact 9; contact 10; contact 8 of MODE SELECTOR switch wafer S4B-F (fig. FO-6).	Continuity	Go to 3.	Replace defective switch S4 (para 3-8).
3. Check continuity between pin F of J4 or J2 and contact 9; contact 10; contact 8 of MODE SELECTOR switch wafer S4B-F (fig. FO-6).	Continuity	----------	Replace defective switch S4 (para 3-8).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
(10) MODE SELECTOR SWITCH AT 85 HZ + VOICE: NO VOICE TRANSMISSION.	Defective: Mode selector switch S4. Circuit board A6. RCV-SEND switch S5. Transmitter module A3.		
WARNING			
Do all continuity and resistance checks with all power removed.			
1. Check continuity between pin C of connector J3 and contact 4 of MODE SELECTOR switch wafer S4B-F (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S4 (para 3-8).
2. Check continuity between contact 5 of MODE SELECTOR switch wafer S4B-F and pin 12 of XA3 (fig. FO-6).	Continuity	Go to 3.	Replace defective switch S4 (para 3-8).
3. Connect TS-799A/UGM-1 (para 2-4) and test cable No.3. Connect the AN/USM-207 across OUTPUT of transmitter module A3 (internal NORM/REV switch at NORM).	Space: 2,847.5 Hz. . . . . ±2 Mark: 2,762.5 Hz ±2		Go to 4.
4. Connect ME-26B/U between pin 1 of XA3 and terminal 2 of circuit board A6. Check for continuity.	Continuity	Go to 5.	Repair wiring.
5. Connect ME-26B/U between terminals 2 and 13 on circuit board A6. Measure resistance.	50 ohms ±20	Go to 6.	Replace defective board A6 (para 2-10).
6. Connect ME-26B/U between terminals 14 and 15 on circuit board A6. Measure resistance.	50 ohms ±20	Go to 7.	Replace defective board A6 (para 2-10).
7. Check continuity of RCV/SEND switch S5 (fig. FO-6).	Continuity	Go to 8.	Replace defective switch S5 (para 3-8).
8. Check continuity of keyline by connecting ME-26B/U between pin 11 of XA3 and pin F of connector J3 (fig. FO-6).	Continuity	Go to 9	Replace defective module A-3 (para 2-8).

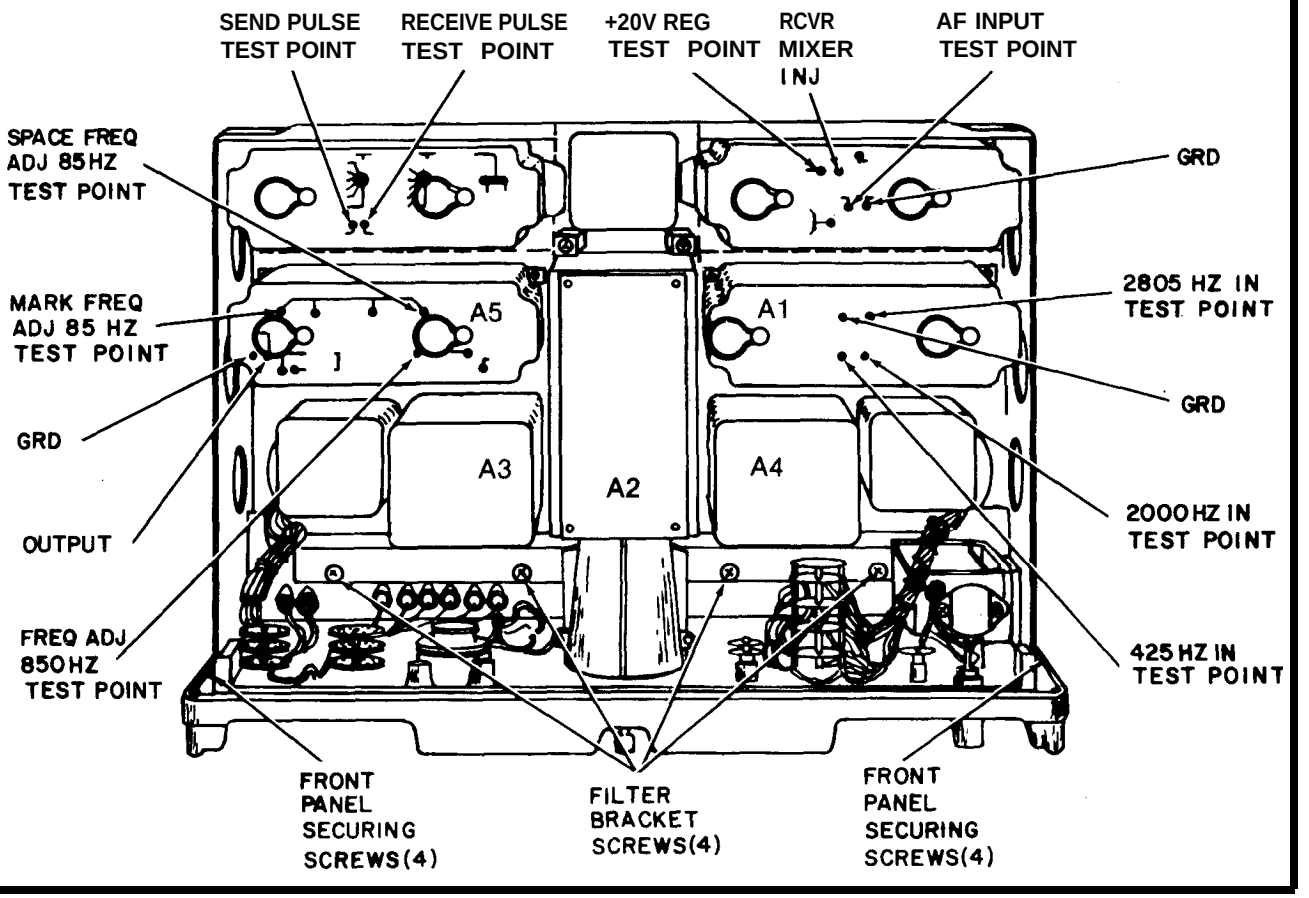
MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
9. Check continuity of keyline by connecting ME-26B/U between pin 11 of XA3 and pin F of connector J4 (fig. FO-6).	Continuity	Go to 10	Replace defective module A3 (para 2-8).
10. Check continuity of keyline by connecting ME-26B/U between pin 11 of XA3 and pin F of connector J2 (fig. FO-6).	Zero ohm in one direction, infinity (or HIGH resistance) in other direction		Replace defective module A3 (para 2-8).

2-7. TEST POINT MEASUREMENTS

CAUTION

Do not short the test point jacks to the modem chassis. This could cause equipment damage.

- The values listed in test point chart 1 are for troubleshooting purposes only; they represent average values measured at module test points.
- Test equipment: See paragraph 2-2.
- Bench setup and test conditions: See paragraph 2-4.
- Test point locating: Illustrated below.



TEST POINT CHART 1

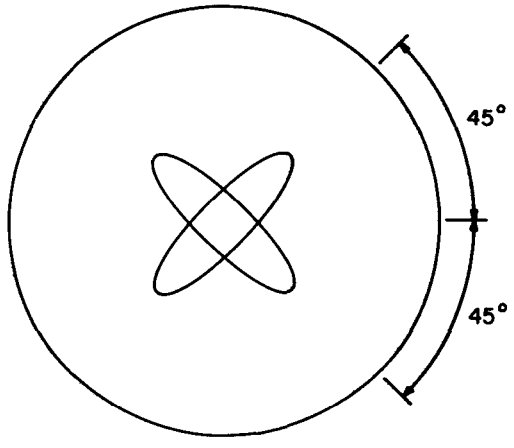
MODULE UNDER TEST	TEST EQUIPMENT	
TEST POINT	**MODEM SWITCH SETTING**	**INDICATION**
1 RECEIVE AUDIO MODULE A1	AN/URM-145 or ME-26B/U, AN/USM-207	
1. +20V REG	Any setting	+20 volts dc ±2 vdc.
2. RCVR MIXER INJ	850 Hz	3,805 Hz -5,805 Hz, varied by BFO control
	85 Hz DIV	2,380 Hz
2 SCOPE MODULE A2	TS-799A/UGM-1	

NOTE

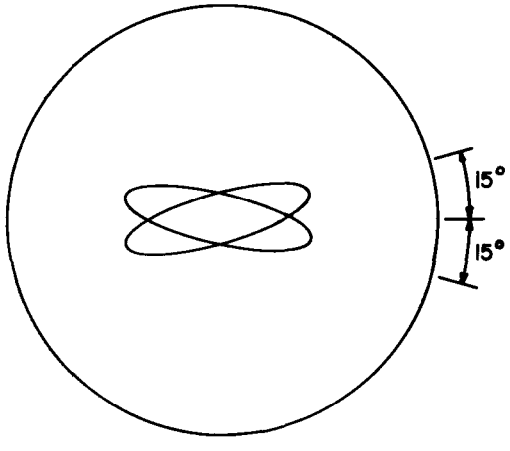
Test cable No.3 must be connected and MESSAGE TRANSMIT SWITCH of TS-799A/UGM-1 must be ON. Key microphone to obtain waveshapes shown below.

No test point, observe modem CRT,

MODE SELECTOR switch: 850 Hz
ONE/WAY DUPLEX switch: DUPLEX



MODE SELECTOR switch: 85 Hz
ONE/WAY DUPLEX switch: DUPLEX



MODULE UNDER TEST TEST POINT	TEST EQUIPMENT MODEM SWITCH SETTING	 INDICATION
3 TRANSMITTER MODULE A3	**AN/USM-207, TS-799A/UGM-1**	
	Transmitter internal NORM-REV switch at NORM	
1. SPACE FREQ ADJ 85 Hz	Any setting	227.8 kHz ± 2 Hz
2. MARK FREQ ADJ 85 Hz	Any setting	221.0 kHz ± 2 Hz
3. FREQ ADJ 850 Hz	850 Hz	26,050 Hz ± 2 Hz
	85 Hz DIV	23,800 Hz ± 2 Hz
4. OUTPUT	850 Hz	Space: 2,425 Hz ± 25 Mark: 1,575 Hz ± 25
	85 Hz, 85 Hz DIV 85 Hz VOICE 200-2260 VOICE 200-3500	Space: 2,847.5 Hz ± 2 Mark: 2,762.5 Hz + 2 (varies w/input) (varies w/input)
4 RECEIVER MODULE A4	**AN/USM-207, TS-799A/UGM-1**	
1. 2,000 Hz IN	850 Hz	Space: 2,425 Hz ± 25 Mark: 1,575 Hz ± 25
2. 2,805 Hz IN	85 Hz	Space: 2,847.5 Hz ± 2 Mark: 2,762.5 Hz ± 2
3. 425 Hz IN	85 Hz DIV	Space: 467.5 Hz ± 2 Mark: 382.5 Hz ± 2
5 LOOP BATTERY MODULE A5	**ME-26B/U, TS-799A/UGM-1**	
1. SEND PULSE	Any setting	0.6 volt min
2. RECEIVE PULSE	Any setting	8.0 volts 'in

Section III. MAINTENANCE PROCEDURES

2-8. REMOVING AND REPLACING MODULES

WARNING

DEATH ON CONTACT may result from contact with high voltage in modem modules. Scope module A2 contains 1,100 volts dc; loop battery module A5 contains 90 volts dc. Set MODE SELECTOR switch on the front panel to PWR OFF before attempting any removal procedures.

CAUTION

Be careful during removal and replacement. You can prevent accidental damage to other parts, and can prevent potential short circuits caused by dropped hardware. When removing and replacing a part, check carefully for loose hardware or insecure electrical connections. Do not operate the equipment until you make these checks.

NOTE

The procedures below are for modules A1 through A5. The procedure for scope module A2 is listed separately in this paragraph.

REMOVING MODEM CHASSIS FROM CASE

- Loosen six captive screws around outside edge of front panel.
- Grasp ribbed frame around outside edge of front panel.
- Carefully pull modem chassis out of the case.

RECEIVE AUDIO, TRANSMITTER, RECEIVER LOOP BATTERY MODULES

REMOVE

- Loosen the four captive screws holding module to chassis.
- Pull up on bail handles to unplug module from chassis connector.
- Lift out module.
- To remove module dust cover, turn bail handles approximately 90° counterclockwise until they release.
- Lift off cover.

REPLACE

- Replace dust cover Place cover over modules; press down bail handles and turn approximately 90° clockwise until they lock in place.
- Plug new module into chassis connector.
- Tighten the four captive screws to secure module to the chassis.

SCOPE MODULE A2 CRT

WARNING

DEATH ON CONTACT may result from contact with high voltage in scope module A2. Scope module contains 1,100 volts dc.

CAUTION

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT

Breakage of the cathode-ray tube (CRT) causes a high velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the installment. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety masks and gloves.

REMOVE

- Loosen the four captive screws holding module to chassis.
- Lift out module.

REPLACE

- Plug new module into chassis connector.
- Tighten the four captive screws to secure module to chassis.

2-9. REMOVING AND REPLACING FRONT PANEL ASSEMBLY

The modem's front panel cannot be removed completely, but it can be swung away from the chassis to allow access to the components inside.

REMOVE

- Remove eight screws holding front panel assembly to the right and left side of chassis.
- Remove four filter bracket screws holding front panel assembly to chassis bottom.
- Grasp the sides of the front panel near the bottom edge and pull the panel upward until it is parallel to the chassis.
- Turn the chassis and front panel bottom side up.
- Remove the screws holding the cover of the L-shaped compartment housing along the bottom edge of the front panel. (This provides access to the printed circuit boards.)

REPLACE

- Screw on cover of the L-shaped compartment housing.
- Turn the chassis and front panel top side up.
- Grasp the sides of the front panel and push the panel downward until it is perpendicular to the chassis.
- Secure the front panel to the right and left sides of the chassis with eight screws.

2-10. REMOVING AND REPLACING PRINTED CIRCUIT BOARDS A6 THROUGH A9

NOTE

When board A6 must be removed, unsolder diode CR4 connection at board terminal 5 in addition to the procedures below.

REMOVE

- Detach and swing front panel away from chassis (para 2-9). Remove compartment cover.
- Remove screws holding printed circuit board to compartment housing.
- Lift printed circuit board out of compartment to gain access to all terminals on the board.
- Tag and unsolder all wires connected to the board terminals.
- Remove board.

REPLACE

- Solder all wires to the terminals of the replacement board. Be sure to connect each wire to the proper terminal. For board A6, be sure to connect diode CR4 connection to terminal 5.
- Carefully insert board into its compartment. Be sure that all wires are out of the way.
- Replace screws to secure board to compartment housing.
- Reattach front panel to chassis (para 2-9).

2-11. REMOVING AND REPLACING POWER TRANSISTOR Q1

REMOVE

- Detach and swing front panel away from chassis (para 2-9). Remove compartment cover.
- Tag, unsolder and remove all wires from transistor.
- Remove nuts, lockwashers, nylon bushing, screws holding transistor to compartment housing.
- Remove transistor.

NOTE

Do not remove mica insulator unless it is damaged.

REPLACE

- Replace mica insulator if it is damaged. Apply a coat of grease, laboratory stock (NSN 9150-00-598-7445) on mounting surface area before placing mica insulator in position.
- Position transistor on compartment housing.
- Replace screws, nylon bushing, lockwasher, nuts.
- Solder wires to transistor terminals.
- Reattach front panel to chassis (para 2-9).

Section IV. ADJUSTMENT PROCEDURES

2-12. GENERAL INSTRUCTIONS

- Make adjustments after performing maintenance. These tests determine if the modem has been properly repaired and can be returned to use. Adjustments are necessary after replacing modules A1, A2, A5, and board A9. The chart below lists the specific adjustments for each.

ASSEMBLY REPLACED	ADJUSTMENT PROCEDURE	PARAGRAPH
Receive audio module A1	Regulated voltage adjustment;	2-13
	BFO frequency limits adjustment	2-15
Scope module A2	Centering, focus and gain adjustment	2-16
Loop battery module A5	Loop current adjustment	2-14
Preregulator board A9	Regulated voltage adjustment	2-13

- Tools and test equipment: See paragraph 2-2.
- Bench test setup: See paragraph 2-4 for test equipment setup.
- Modem settings: Before starting each adjustment procedure, preset the modem's front panel controls and switches this way:

CONTROL OR SWITCH	SETTING
ONE WAY/DUPLEX	DUPLEX
RECEIVE	NORM
SCOPE INTENSITY	MIDRANGE
METER FUNCTION	REGULATED DC
MODE SELECTOR	850 Hz
RCV/SEND	SEND
BFO	MIDRANGE
AUDIO GAIN	MIDRANGE

- Internal switches: Set A3S1 NORM-REV switch to NORM.

NOTE

Modems with serial numbers 201 and up have a modified loop battery module A5 (assembly 583081). For these units, set loop battery module switches A5S1 and A5S2 to CURRENT position 20. For unmodified units (loop battery module assembly 583150), set switches A5S1 and A5S2 to DC LOOP CURRENT ADJ, position 4.

- Adjustment precautions: Observe the following precautions when making adjustments.

- Before making adjustments, make sure that the front panel meter reads 20 volts dc, indicating proper regulated voltage.
- Before starting a procedure, carefully read all steps to become familiar with them.

- Use insulated test probes, or wrap test probes in insulated tape. Use a nonmetallic screwdriver. This will prevent signals to the module cover from being accidentally shorted.
- During adjustment, do not disconnect test equipment until instructed to do so.
- Do not use adjustment procedures as a substitute for troubleshooting.
- Make adjustments only if the value being measured is outside the given tolerance.

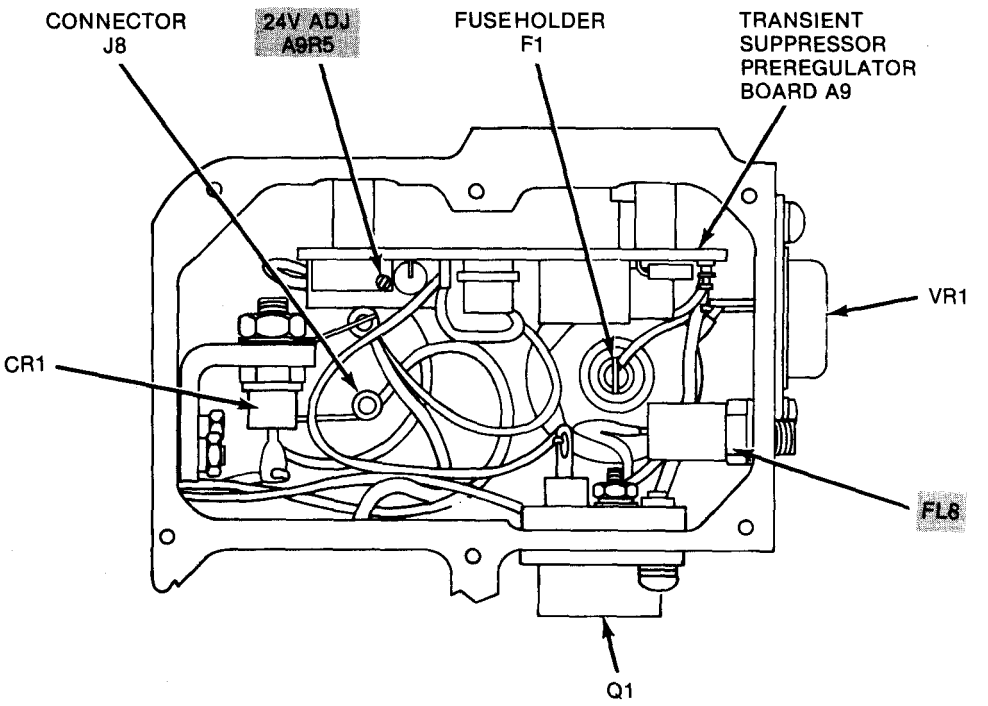
2-13. REGULATED VOLTAGE ADJUSTMENT

TEST EQUIPMENT

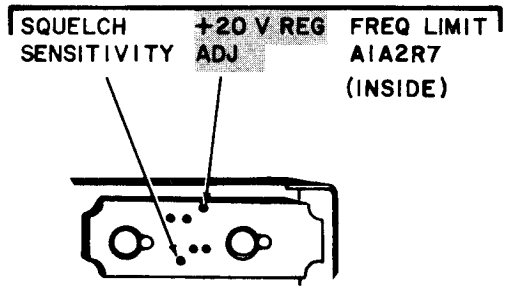
Multimeter ME-26B/U

TEST CONNECTIONS

- Connect multimeter's positive probe to filter FL8.
- Connect ground probe to chassis.
- Remove dust cover from receive audio module A1.



REC AUDIO, BFO, +20 V REG MODULE A I



PROCEDURE	INDICATION	NO
1. Set MODE SELECTOR to 850 Hz.	+24 volts dc + 0.2	Go to 2.
2. Adjust +24 V ADJ potentiometer A9R5 until multimeter reading is correct.		
3. Connect multimeter's positive probe to +20 V REG test point on module A1.	+20 volts dc +0.1	Go to 4.
4. Adjust +20 V REG ADJ potentiometer A1A2R4 until meter reads 20 vdc ± 0.1		
5. Set MODE SELECTOR to PWR OFF. Disconnect test setup.		

2-14. LOOP CURRENT ADJUSTMENT

NOTE

No loop current adjustment is needed for unmodified loop battery modules (serial numbers below 201, assembly 583150).

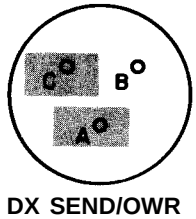
TEST EQUIPMENT

Multimeter TS-352B/U (set up for current measurement)

TEST CONNECTIONS

- Connect multimeter's positive lead to pin A of DC LOOP NO. 1 DX SEND/OWR connector J6. Connect ground lead to pin C of connector J6.
- Remove dust cover from loop battery module A5.

DC LOOP NO. 1



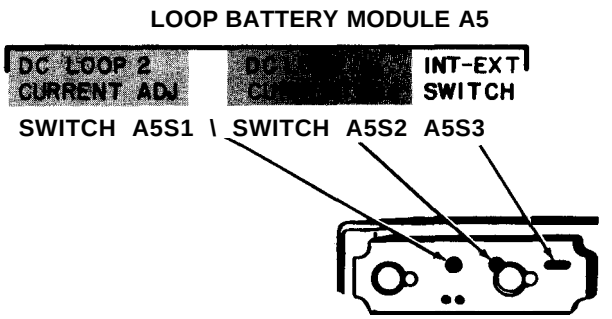
DX SEND/OWR

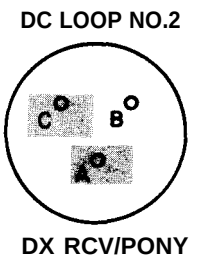
PROCEDURE	INDICATION	NO

NOTE

For one given setting of the LOOP 1 ADJ or LOOP 2 ADJ potentiometers, it may not be possible to adjust both the 20 mA and 60 mA loop currents within tolerance. In this case, adjust each loop for the current to be used during operation (20 mA or 60 mA). Disregard the other current adjustment.

1. Set LOOP 1 CURRENT switch on loop battery module A5 to 60 MA position.		
2. Adjust LOOP 1 ADJ potentiometer A5A2R15.	60mA+5	
3. Set LOOP 1 CURRENT switch to 20 MA.	Multimeter reads 20mA+5	Go to 4.
4. Readjust LOOP 1 ADJ until multimeter reading is correct.		





5. Connect multimeter's positive lead to pin A of DC LOOP NO. 2 DX RCV/PONY connector J7. Connect ground lead to pin C of J7.		
6. Set LOOP 2 CURRENT switch to 60 MA.		
7. Adjust LOOP 2 ADJ potentiometer A5A2R6.	Multimeter reads 60mA+5	
8. Set LOOP 2 CUR RENT switch to 20 MA.	Muitimeter reads 20mA+5	Go to 9.
9. Readjust LOOP 2 ADJ until multimeter reading is correct.		
10. Set LOOP 2 CURRENT switch back to 60 MA.		
11. Set MODE SELECTOR to PWR OFF. Disconnect test setup.		

2-15. BFO FREQUENCY LIMITS ADJUSTMENT

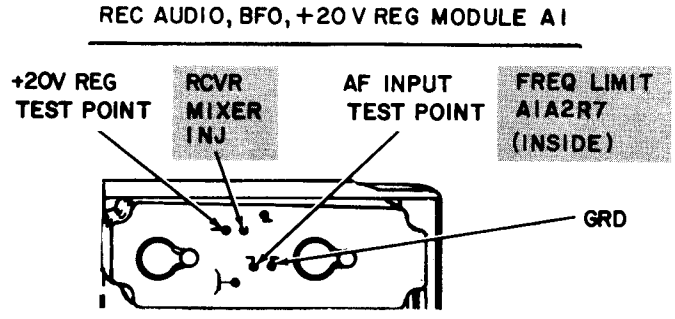
TEST EQUIPMENT

Electronic Digital Readout Counter AN/USM-207

Extender cable (para 2-2)

TEST CONNECTIONS

- Make sure that the front panel BFO control is in the center of its range.
- Remove dust cover from receive audio module A1.
- Connect extender cable to module A1.
- Connect electronic counter to RCVR MIXER INJ test point.



PROCEDURE	INDICATION	NO
1. Set MODE SELECTOR to 850 Hz and allow a 15-minute warmup.		
2. Adjust BFO FREQ LIMIT ADJ potentiometer A1A2R7 (inside module A1).	Counter reads 4,805 Hz +5	
3. Rotate front panel BFO control fully counterclockwise.	Counter reading is no higher than 3,805 Hz. This is the lower frequency limit.	Go to 4, then to 5.
4. Rotate front panel BFO control fully clockwise.	Counter reading is at least 5,805 Hz. This is the upper frequency limit.	Go to 5.
5. Readjust BFO FREQ LIMIT ADJ until tolerances in steps 3 and 4 are met.		
6. Set MODE SELECTOR switch to PWR OFF. Disconnect test setup.		

2-16. SCOPE MODULE A2 CENTERING, FOCUS AND GAIN ADJUSTMENTS

TEST EQUIPMENT

Teletypewriter Test Set TS-799A/UGM-1

TEST CONNECTIONS

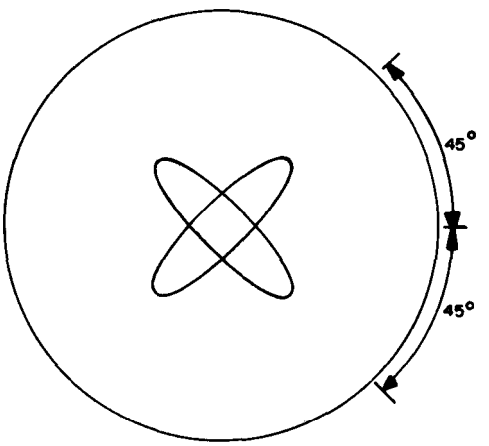
- Connect TS-799A/UGM and turn MESSAGE TRANSMIT switch to ON. Connect test cable No. 4.

PROCEDURE	INDICATION

WARNING

DEATH ON CONTACT may result from contact with high voltage in module. Scope module A2 contains 1,100 volts dc.

1. Refer to general instructions (para 2-12).
2. Rotate front panel SCOPE INTENSITY control fully clockwise.
3. Adjust front panel BFO control for a centered pattern on the scope face.
4. Adjust scope module HORIZONTAL CENTERING. — Pattern is horizontally centered.
5. Adjust scope module VERTICAL CENTERING. — Pattern is vertically centered.
6. Adjust scope module FOCUS. — Pattern is well defined.
7. Adjust scope module HORIZONTAL GAIN and VERTICAL GAIN.
8. Set MODE SELECTOR switch to PWR OFF. Turn off power to all test equipment. Disconnect test setup.



CHAPTER 3
GENERAL SUPPORT MAINTENANCE

INDEX

SECTION I

SECTION II

SECTION III

CHAPTER 3
GENERAL SUPPORT MAINTENANCE

Section I. GENERAL INFORMATION

WARNING

DEATH ON CONTACT may result from contact with high voltage in modem modules. Scope module A2 contains 1,100 volts dc; loop battery module A5 contains 90 volts dc.

3-1. GENERAL

This chapter covers general support troubleshooting, maintenance and test procedures for the modem. Section I lists the tools, test equipment, and materials needed to perform general support maintenance. Troubleshooting and test procedures are described in section II. Maintenance procedures are covered in section III. General support adjustment procedures will be the same as those for direct support (chap. 2, sect IV).

3-2. REPAIR PARTS, TOOLS, TEST EQUIPMENT, AND MATERIALS

General support maintenance requires the same repair parts, tools, test equipment, and materials as for direct support (para 2-2).

Section II. TROUBLESHOOTING

3-3. GENERAL INFORMATION

The general support troubleshooting chart supplements the direct support troubleshooting chart. Refer to chapter 2, section II, for troubleshooting definitions and procedures.

TEST POINT DATA:

Paragraph 3-7.

Use with troubleshooting chart to isolate defective parts.

REMOVING AND REPLACING PARTS:

Section III.

ADJUSTING AND ALINING MODULES:

Chapter 2, section IV.

NOTE

When conducting tests, investigate the possibility of intermittent troubles. Jarring or tapping the equipment may expose this type of problem. Do not try to correct trouble this way. Check the modem's wiring and connections to eliminate trouble caused by loose connections.

3-4. MODEM BENCH TEST SETUP AND TEST CONDITIONS

General support maintenance requires the same modem bench test setup and test conditions as for direct support (para 2-4).

3-5. TROUBLESHOOTING SYMPTOM INDEX

Use this index to quickly find procedures in the troubleshooting chart.

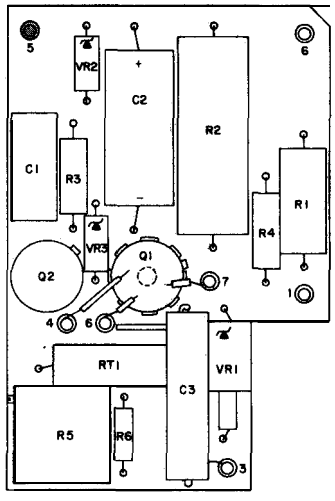
3-6. TROUBLESHOOTING CHART

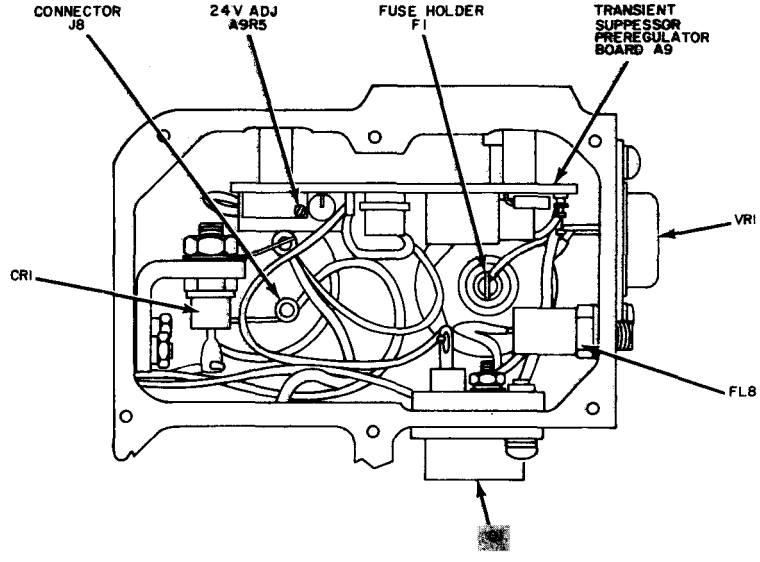
Use the troubleshooting chart to localize and isolate trouble. The chart supplements the direct support troubleshooting chart of paragraph 2-6 and the foldouts at the back of this manual.

The troubleshooting chart is indexed by MALFUNCTION/SYMPTOM, for which PROBABLE CAUSES are listed. Follow the TEST PROCEDURES for which in turn an INDICATION and YES or NO instructions are given.

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
1 **NO TEST METER AND SCOPE READINGS FOR ANY POSITION OF METER FUNCTION SWITCH.**	**Defective: Power Source. Fuse F1. Polarity diode CR1. Overvoltage zener VR1. Circuit board A9. Series regulator transistor Q1. Connector J8.**		
1. Check polarity and voltage to POWER connector J8.	Proper polarity and +27 vdc	Go to 2.	Replace defective power source (TM 11-5805-387-10-1).
2. Set MODE SELECTOR switch to PWR OFF. Check fuse.	Fuse blown	Replace fuse F1 (TM 11-5805-387-10-1).	Go to 3.
WARNING Do all continuity and resistance checks with all power removed.			
3. Connect TS-352B/U to opposite ends of polarity diode CR1. Check for continuity.	Zero ohm in one direction, infinity (or high resistance) in other direction	Go to 4.	Replace defective CR1 (para 3-8).
4. Connect TS-352B/U to opposite ends of overvoltage zener VR1. Check for continuity.	Zero ohm in one direction, infinity (or high resistance) in other direction	Go to 5.	Replace defective VR1 (para 3-8).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
5. Connect ME-26B/U across terminal 5 of circuit board A9.	+24 vdc ± 0.5	Go to 6.	Replace defective board A9 (para 2-10).





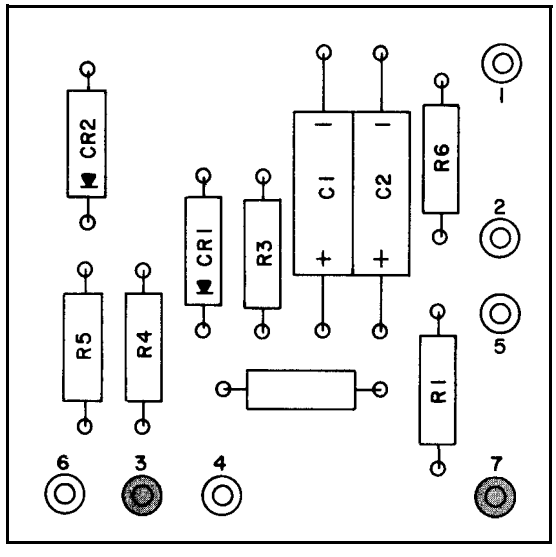
6. With power off, remove transistor Q1 from socket. Check for shorted or open condition.	Transistor defective	Replace defective transistor Q1 (para 2-11).	Go to 7.
7. Connect ME-26B/U between pin A of connector J8 and terminal 1 of circuit board A9. Check for continuity.	Zero ohm one direction, infinity (or high resistance) in other direction	----------	Replace defective connector J8 (para 3-8).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
2 NO +20 VOLTS DC TEST METER INDICATION.	Defective: Test meter M1. Meter function switch S3. Circuit board A7.		

WARNING

Do all continuity and resistance checks with all power removed.

1. Check continuity of meter M1 (fig. FO-6).	Continuity	Go to 2.	Replace defective meter Ml (para 3-8).
2. Check continuity of METER FUNCTION switch (fig. FO-6).	Continuity	Go to 3.	Replace defective switch S3 (para 3-8).
3. Connect ME-26B/U across pin 13 of XA1; measure voltage.	+24 vdc	Go to 4.	Replace defective wiring.
4. Connect ME-26B/U across terminal 3 of circuit board A7; measure voltage.	+20 vdc ± 0.2	Continue test.	Continue test.
Connect ME-26B/U across terminal 7 of circuit board A7; measure voltage.	0.06 vdc or nominal voltage	----------	Replace defective board A7 (para 2-10).



MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
3 METER FUNCTION SWITCH IN REGULATED DC POSITION: LOW OR HIGH READING ON TEST METER.	Defective: Series regulator transistor Q1. Circuit board A9.		

NOTE

Series regulator Q1 automatically cuts off when +24 volt output of preregulator board A9 is shorted. Normal operation will resume when short is removed.

1. With power off, remove transistor Q1 from socket. Check for shorted or open circuit condition.	Transistor defective	Replace defective transistor Q1 (para 2-11).	Go to 2.
2. Connect ME-26B/U across terminal 5 of circuit board A9; measure voltage.	+24 vdc ±0.5	----------	Replace defective board A9 (para 2-10).

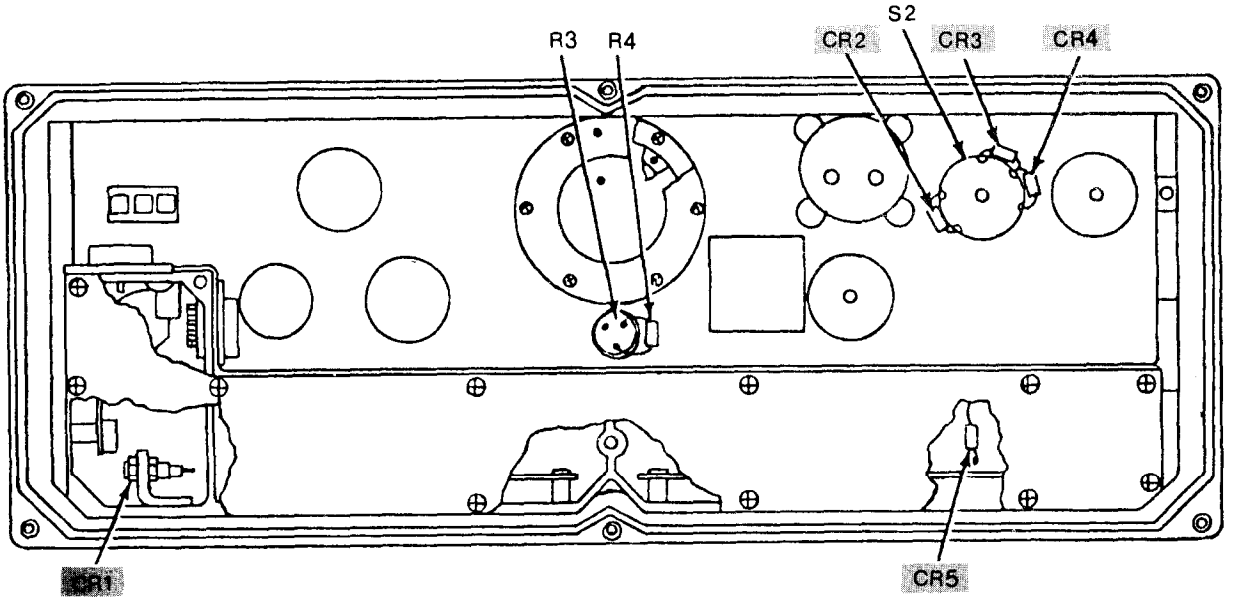
4 MODEM DOES NOT KEY TRANSMITTER	Defective: RCV-SEND switch S5. Diodes CR1, CR2, CR3, CR4, CR5. Connectors J4, J3, J2. Circuit board A6.		

WARNING

Do all continuity and resistance checks with all power removed.

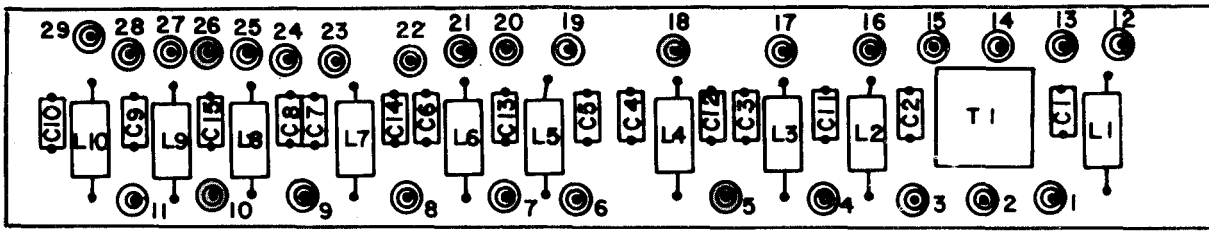
1. Check continuity of RCV/SEND switch S5 (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S5 (para 3-8).

MALFUNCTION/SYMPTOM		PROBABLE CAUSE	
TEST PROCEDURE	INDICATION	YES	NO



2. Connect TS-352B/U to opposite ends of diode CR1; CR2; CR3; CR4; CR5. Measure forward and reverse resistance of each diode.	Zero ohm in one direction, infinity (or high resistance) in other direction	Go to 3.	Replace defective diode (para 3-8).
3. Connect ME-26B/U between pin F of connector J2 and terminal 18 of circuit board A6. Check for continuity.	Continuity	Go to 4.	Replace defective connector J2 (para 3-8).
4. Connect ME-26B/U between pin F of connector J3 and terminal 26 of circuit board A6. Check for continuity.	Continuity	Go to 5.	Replace defective connector J3 (para 3-8).
5. Connect ME-26B/U between pin F of connector J4 and terminal 26 of circuit board A6. Check for continuity.	Continuity	Go to 6.	Replace defective connector J4 (para 3-8).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO



6. Connect ME-26B/U between terminals 5 and 18 of circuit board A6. Measure resistance.	4 ohms ± 2	Go to 7.	Replace defective board A6 (para 2-10).
7. Connect ME-26B/U between terminals 10 and 26 of circuit board A6. Measure resistance.	4 ohms ±2	----------	Replace defective board A6 (para 2-10).

5 MODEM NOT TRANSMITTING EITHER VOICE OR TTY.

Defective: Circuit board A6. RCV-SEND switch S5. Connector J2.

WARNING

Do all continuity and resistance checks with all power removed.

1. Connect ME-26B/U between terminals 2 and 13 of circuit board A6. Measure resistance.	50 ohms ±20	Go to 2.	Replace defective board A6 (para 2-10).
2. Connect ME-26B/U between terminals 14 and 15 of circuit board A6. Measure resistance.	50 ohms ±20	Go to 3.	Replace defective board A6 (para 2-10).
3. Check continuity of RCV/SEND switch (fig. FO-6).	Continuity	Go to 4.	Replace defective switch S5 (para 3-8).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
4. Connect ME-26B/U between pin J of connector J2 and terminal 14 of circuit board A6. Check for continuity.	Continuity	Go to 5.	Replace defective connector J2 (para 3-8).
5. Connect ME-26B/U between pin D of connector J2 and terminal 15 of circuit board A6. Check for continuity.	Continuity	----------	Replace defective connector J2 (para 3-8).
6 MODEM NOT TRANSMITTING TTY WITH MODE SELECTOR SWITCH AT 85 Hz, 85 Hz DIV, or 85 Hz + VOICE.	Defective: Filter FL1.		
1. Connect TS-799A/UGM-1 (para 2-4) and test cable No. 3. Connect ME-30/U across terminal 2 of filter FL1.	3 mv rms ± 1	Go to 2.	Replace defective filter FL1 (para 3-9).
2. Connect ME-30/U across terminal 4 of filter FL1.	3mv rms ±1	----------	Replace defective filter FL1 (para 3-9).
7 MODEM NOT TRANSMITTING TTY WITH MODE SELECTOR SWITCH AT	Defective: Filter FL2.		
Connect TS-799A/UGM-1 (para 2-4) and test cable No. 3. Connect ME-30/U across terminal 3 of filter FL2.	3 mv rms kl	----------	Replace defective filter FL2 (para 3-9).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO

8 MODEM NOT TRANSMITTING VOICE: MODE SELECTOR SWITCH AT VOICE OR 85 Hz + VOICE.

Defective: Mode selector switch S4. Connectors J3, J4, J2. Keying circuitry. Filter FL3. Circuit board A6.

WARNING

Do all continuity and resistance checks with all power removed.

1.	Check continuity of MODE SELECTOR switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S4 (para 3-8).
2.	Check continuity of connectors J3 (local operation), J4 and J2 (remote operation) (fig. FO-6).	Continuity	Go to 3.	Replace defective connector (para 3-8).
3.	Check continuity of keyline by connecting ME-26B/U between pin 11 of XA3 and pin F of J3 (fig. FO-6).	Continuity	Go to 4.	Repair defective wiring.
4.	Connect AN/USM-207 across terminal 1 of filter FL3. Speak into mike.	200-2,300 Hz	Continue test.	Continue test.
	Connect AN/USM-207 across terminal 3 of filter FL3. Speak into mike.	200-2,300 Hz	Go to 5.	Replace defective filter FL3 (para 3-9).
5.	Connect ME-26B/U between terminal 7 of circuit board A6 and pin C of connector J3. Check for continuity.	Continuity	Go to 6.	Replace defective board A6 (para 2-10).
6.	Connect ME-26B/U between terminal 4 of circuit board A6 and pin C of connector J2. Check for continuity.	Continuity	. . . . .	Replace defective board A6 (para 2-10).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
9 NO RCV LEVEL READiNG ON METER M1. RECEIVE CHANNEL MALFUNCTIONING.	Defective: One way-duplex switch S1. Circuit board A6. Connectors J1, J2.		

NOTE

There will be no RCV LEVEL indication when using test cable No.3.

WARNING

Do all continuity and resistance checks with all power removed.

1. Check continuity of ONE WAY/DUPLEX switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S1 (para 3-8).
2. Connect ME-26B/U between terminal 7 of circuit board A6 and pin C of connector J3. Check for continuity.	Continuity	Go to 3.	Replace defective board A6 (para 2-10).
3. Connect ME-26B/U between terminal 4 of circuit board A6 and pin C of connector J2. Check for continuity.	Continuity	Go to 4.	Replace defective board A6 (para 2-10).
4. Connect ME-26B/U between connector J1 and circuit board A6. Check for continuity (fig. FO-6).	Continuity	Go to 5.	Replace defective connector J1 (para 3-8).
5. Connect ME-26B/U between connector J2 and circuit board A6. Check for continuity (fig. FO-6).	Continuity	----------	Replace defective connector J2 (para 3-8).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
(10) NO RCV LEVEL READING ON METER M1. RECEIVE CHANNEL FUNCTIONING.	Defective: Meter function switch S3. Circuit board A7.		
WARNING			
Do all continuity and resistance checks with all power removed.			
1. Check continuity of METER FUNCTION switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S3 (para 3-8).
2. Connect ME-26B/U across terminal 3 of circuit board A7; measure voltage.	+20 vdc ± 0.2	Continue test.	Continue test.
Connect ME-26B/U across terminal 7 of circuit board A7; measure voltage.	0.06 vdc or nominal voltage	----------	Replace defective board A7 (para 2-10).
(11) RCV LEVEL READING ON TEST METER, NO DISCRIMINATOR READING. ABNORMAL SCOPE DISPLAY.	Defective: Circuit board A7. Filters FL6, FL7. Relay K1.		
1. Connect ME-26B/U across terminal 3 of circuit board A7; measure voltage.	+20 vdc ±0.2	Continue test.	Continue test,
Connect ME-26B/U across terminal 7 of circuit board A7; measure voltage.	0.06 vdc or nominal voltage	Go to 2.	Replace defective board A7 (para 2-10).
WARNING			
Do all continuity and resistance checks with all power removed.			
2. Check continuity of relay K1 (fig. FO-6).	Continuity	Go to 3.	Replace defective relay K1 (para 3-9).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
3. Set MODE SELECTOR switch at 85 Hz DIV. Connect TS-799A/UGM-1 (refer to para 2-4) and test cable No. 3. Check for signal continuity across terminal 1 of filter FL6 (fig. FO-6).	Input signal present on AN/USM-281A	Go to 4.	Replace defective filter FL6 (para 3-9).
4. Set MODE SELECTOR switch at 850 Hz. Check for signal continuity across terminal 3 of filter FL7 (fig. FO-6).	Input signal present on AN/USM-281A	----------	Replace defective filter FL7 (para 3-9).

(12) RCV LEVEL READING ON METER M1. RECEIVE TTY MALFUNCTION. — **Defective: Mode selector switch S4, Filter FL4, Relay K1, Filters FL6, FL7.**

WARNING

Do all continuity and resistance checks with all power removed.

1. Check continuity of MODE SELECTOR switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S4 (para 3-8).
2. Set MODE SELECTOR switch to 85 Hz DIV. Connect TS-799A/UGM-1 (para 2-4) and test cable No. 3. Check for input signal across terminal 2 of filter FL4 (fig. FO-6).	Input signal present on AN/USM-281A	Go to 3.	Replace defective filter FL4 (para 3-9).
3. Check for input signal across terminal 4 of filter FL4.	Input signal present on AN/USM-281A	Go to 4.	Replace defective filter FL4 (para 3-9).

WARNING

Do all continuity and resistance checks with all power removed.

4. Remove module A4 (refer to para 2-8). Check continuity of relay K1 with MODE SELECTOR switch at positions 850 Hz and 85 Hz (fig. FO-6).	Continuity	Go to 5.	Replace defective relay K1 (para 3-9).

TEST PROCEDURE	INDICATION	YES	NO
5. Replace module A4. Set MODE SELECTOR switch at 85 Hz DIV. Connect TS-799A/ UGM-1 (refer to para 2-4) and test cable No. 3. Check for signal continuity across terminal 3 of FL6 (fig. FO-6).	Input signal present on AN/USM-281A	Go to 6.	Replace defective filter FL6 (para 3-9).
6. Set MODE SELECTOR switch at 850 Hz. Check for signal continuity across terminal 3 of FL7 (fig. FO-6).	Input signal present on AN/USM-281A	----------	Replace defective filter FL7 (para 3-9).
7. Set MODE SELECTOR switch at 85Hz DIV. Check for input signal across terminal 3 of FL4 (fig. FO-6).	Input signal present on AN/USM-281A	.....	Replace defective filter FL 4 (para 3-9).

13 NO CURRENT IN RECEIVE DC LOOP, MODEM IN MARK-HOLD CONDITION.

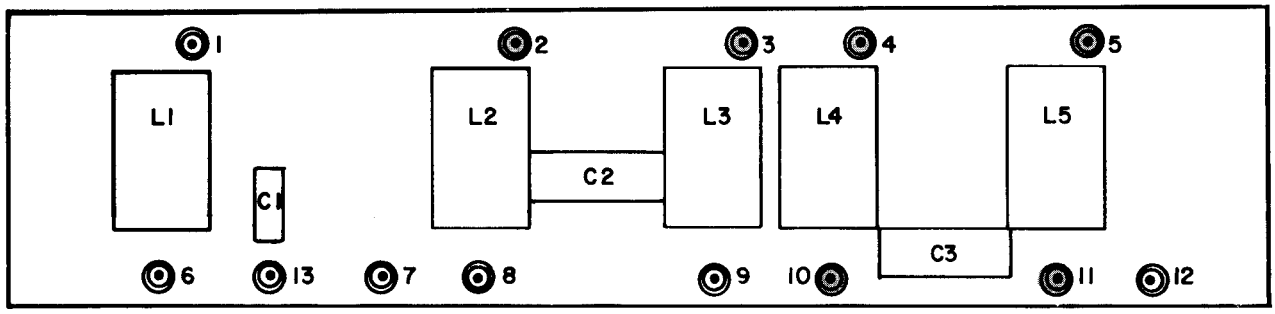
Defective: Meter function switch S3. Connector J7. Circuit board A8.

WARNING

Do all continuity and resistance checks with all power removed.

1. Check continuity of METER FUNCTION switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S3 (para 3-8).
2. Connect ME-26B/U between pin A of connector J7 and terminal 10 of board A8. Check for continuity.	Continuity	Go to 3.	Replace defective connector J7 (para 3-8).
3. Connect ME-26B/U between pin C of connector J7 and terminal 11 of board A8. Check for continuity.	Continuity	Go to 4.	Replace defective connector J7 (para 3-8).
4. Connect ME-26B/U between terminals 2 and 3 on board A8. Measure voltage.	90 to 100 vdc (120 to 140 vdc for modified module A5 - serial numbers 201 and higher).	Go to 5.	Replace defective board A8 (para 2-10).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO



5. Connect ME-26B/U between terminals 4 and 5 on board A8. Measure voltage.	90 to 100 vdc (120 to 140 vdc for modified module A5 - serial numbers 201 and higher)	Go to 6.	Replace defective board A8 (para 2-10).
6. Connect ME-26B/U between terminals 10 and 11 on board A8. Measure voltage.	90 to 100 vdc (120 to 140 vdc for modified module A5 - serial numbers 201 and higher)	----------	Replace defective board A8 (para 2-10).

14	NO CURRENT IN SEND DC LOOP.	Defective: Meter function switch S3. Connector J6. Circuit board A8.

WARNING

Do all continuity and resistance checks with all power removed.

1. Check continuity of METER FUNCTION switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S3 (para 3-8).
2. Connect ME-26B/U between pin A of connector J6 and terminal 8 of board A8. Check for continuity.	Continuity	Go to 3.	Replace defective connector J6 (para 3-8).

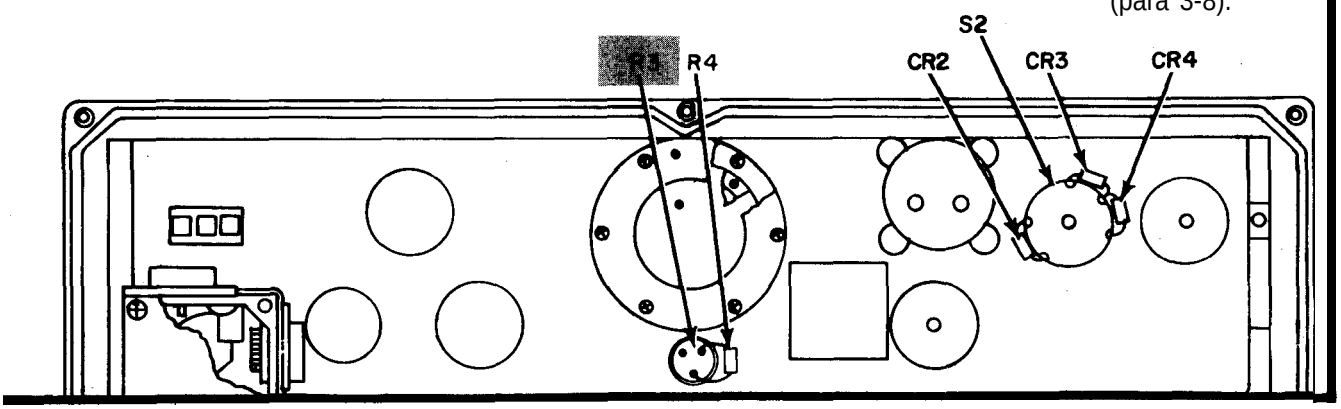
MALFUNCTION/SYMPTOM	PROBABLE CAUSE		
TEST PROCEDURE	INDICATION	YES	NO
3. Connect ME-26B/U between pin C of connector J6 and terminal 9 of board A8. Check for continuity.	Continuity	Go to 4.	Replace defective connector J6 (para 3-8).
4. Connect ME-26B/U between terminals 2 and 3 on board A8. Measure voltage.	90 to 100 vdc (120 to 140 vdc for modified module A5 - serial numbers 201 and higher)	Go to 5.	Replace defective board A8 (para 2-10).
5. Connect ME-26B/U between terminals 4 and 5 on board A8. Measure voltage.	90 to 100 vdc (120 to 140 vdc for modified module A5 - serial numbers 201 and higher)	Go to 6.	Replace defective board A8 (para 2-10).
6. Connect ME-26B/U between terminals 10 and 11 on board A8. Measure voltage.	90 to 100 vdc (120 to 140 vdc for modified module A5 - serial numbers 201 and higher)		Replace defective board A8 (para 2-10).
〈15〉 **MODEM NOT TRANSMITTING VOICE**	**Defective: Mode selector switch S4. Connectors J3, J4, J2. 50-ohm mike keying circuitry. Circuit board A6.**		
WARNING Do all continuity and resistance checks with all power removed.			
1. Check continuity of MODE SELECTOR switch (fig. FO-6).	Continuity	Go to 2.	Replace defective switch S4 (para 3-8).

TEST PROCEDURE	INDICATION	YES	NO
2. Check continuity of connectors J3 (local operation), J4 and J2 (remote operation) (fig. FO-6).	Continuity	Go to 3.	Replace defective connector (para 3-8).
3. Check continuity of keyline by connecting ME-26B/U between pin 11 of XA3 and pin C of connector J3 (fig. FO-6).	Continuity	Go to 4.	Repair defective wiring.
4. Connect ME-26B/U between pin C of connector J3 and terminal 7 of board A6. Check for continuity.	Continuity	Go to 5.	Replace defective board A6 (para 2-10).
5. Connect ME-26B/U between pin C of connector J2 and terminal 4 of board A6. Check for continuity.	Continuity	----------	Replace defective board A6 (para 2-10).

MALFUNCTION/SYMPTOM	PROBABLE CAUSE
16 [illegible] SCOPE PRESENTATION, [illegible] DISCRIMINATOR INDICATION [illegible] TEST METER M1.	Defective: Resistor R3.

DEATH ON CONTACT may result from contact with the terminals of R3. With module A2 operating, -800 volts dc appears on scope intensity control resistor R3. Do the following continuity check with all power removed.

Remove scope module A2 (para 2-8). Check continuity of variable resistor R3 (fig. FO-6).	Continuity	----------	Replace defective resistor R3 (para 3-8).



3-7. TEST POINT MEASUREMENTS

CAUTION

Do not short the test point jacks to the modem chassis. This could cause equipment damage.

GENERAL INSTRUCTIONS

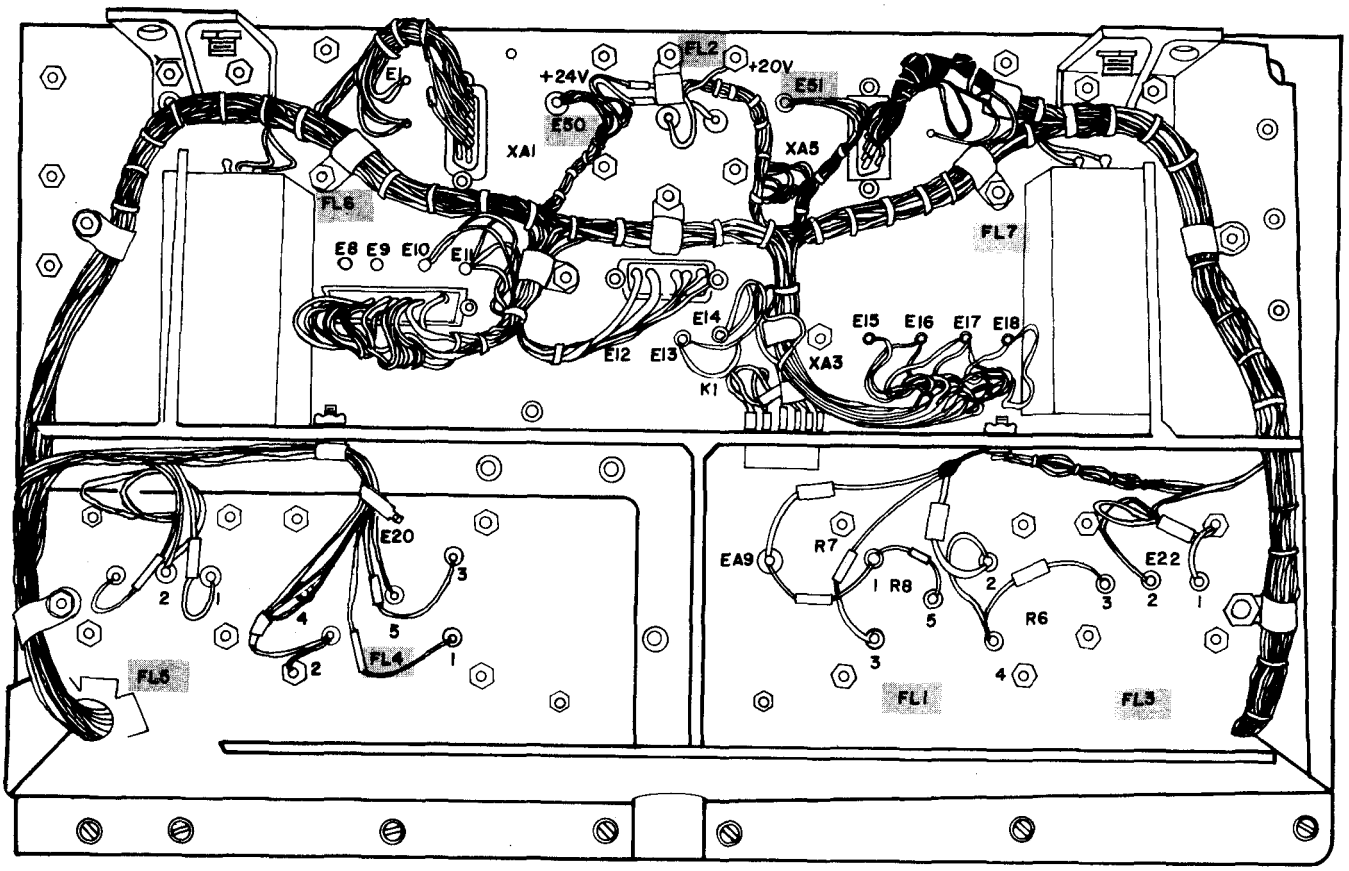
- Test Equipment: See paragraph 2-2.
- Bench setup and test conditions: See paragraph 2-4.

PROCEDURES

- The values listed in the charts below are for troubleshooting purposes only; they represent average values measured at designated test points.
- Use the signal generator for MODEM INPUT.
- Use the voltmeter to measure across test points.

TEST POINT CHARTS

- Test point chart 2: Front panel and chassis test points.
- Test point chart 3: Transistor Q1 voltage chart.



TEST POINT CHART 2

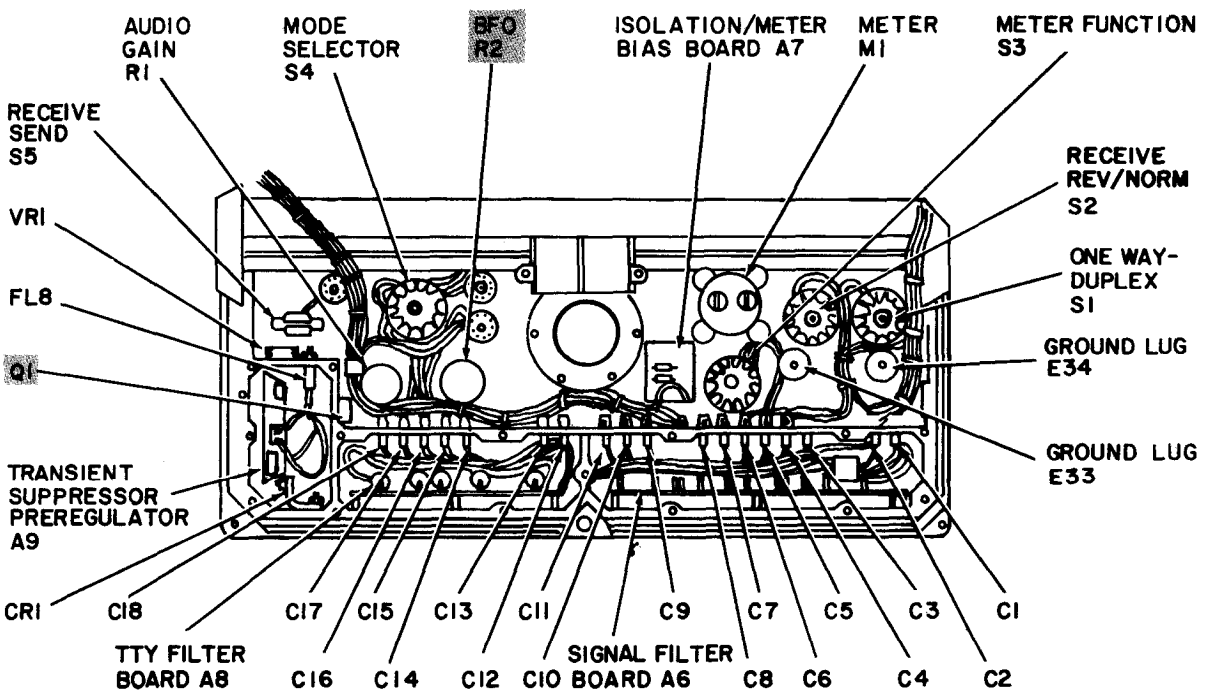
TEST POINT	MODEM INPUT	MODEM SWITCH SETTING	INDICATION
1. Chassis terminal E-50	**No** input needed.	MODE SELECTOR: 850 Hz	+24 volts dc ±0.5
2. Chassis terminal E-51	No input needed.	MODE SELECTOR: 850 Hz	+20 volts dc ±0.5
3. FL1-1	Test cable No. 3 connected.	MODE SELECTOR: all 85-Hz modes	8 mv rms ±2
4. FL1-2	Test cable No. 3 connected.	MODE SELECTOR: all 85-Hz modes	3 mv rms ±2
5. FL1-3	Test cable No. 3 connected.	MODE SELECTOR: 85 Hz DIV	15 mv rms ±5
6. FL1-4	Test cable No. 3 connected.	MODE SELECTOR: 85 Hz DIV	3 mv rms ± 1
7. FL2-1	Test cable No. 3 connected.	MODE SELECTOR: 850 Hz	13 mv rms ±3
8. FL2-3	Test cable No. 3 connected.	MODE SELECTOR: 850 Hz	3 mv rms ±1
9. FL3-1	1 kHz, 200 mv signal at J3-C (J3-E shorted to ground).	MODE SELECTOR: 85 Hz or 85 Hz + VOICE	8 mv rms ±2
10. FL3-3	1 kHz, 200 mv signal at J3-C (J3-E shorted to ground).	MODE SELECTOR: 85 Hz or 85 Hz + VOICE	8 mv rms ±2
11. FL4-1	2,805 Hz, 2.45 volts rms at J1-A.	MODE SELECTOR: all 85-Hz modes	2.45 mv rms
12. FL4-2	2,805 Hz, 2.45 volts rms at J1-A.	MODE SELECTOR: all 85-Hz modes	1.3 mv rms ±0.2
13. FL4-3	425 Hz, 2.45 volts rms at J1-A.	MODE SELECTOR: 85 Hz DIV	2.45 volts rms
14. FL4-4	425 Hz, 2.45 volts rms at J1-A.	MODE SELECTOR: 85 Hz DIV	1.7 volts rms ±0.3
15. FL5-1	1 kHz, 2.45 volts rms signal at J1-A.	MODE SELECTOR: 85 Hz + VOICE	2.45 volts rms
16. FL5-3	1 kHz, 2.45 volts rms at J1-A.	MODE SELECTOR: 85 Hz + VOICE	2.1 volts rms ±0.4
17. FL6-1	425 Hz, 2.45 volts rms at J1-A.	MODE SELECTOR: 85 Hz DIV ONE WAY/DUPLEX: DUPLEX	100 mv rms ±20
18. FL6-3	425 Hz, 2.45 volts rms at J1-A.	MODE SELECTOR: 85 Hz DIV ONE WAY/DUPLEX: DUPLEX	40 mv rms ±10
19. FL7-1	2 kHz, 2.45 volts rms at J1-A.	MODE SELECTOR: 850 Hz ONE WAY/DUPLEX: DUPLEX	65 mv rms ±15

TEST POINT CHART 2. Continued

TEST POINT	MODEM INPUT	MODEM SWITCH SETTING	INDICATION
20. FL7-3	2 kHz, 2.45 volts rms at J1-A.	MODE SELECTOR: 850 Hz ONE WAY/DUPLEX: DUPLEX	30 mv rms ±10
21. R2 (wiper)	No input needed.	MODE SELECTOR: 850 Hz (BFO fully ccw)	3.6 volts p-p ± 0.6
22. R2 (wiper)	No input needed.	MODE SELECTOR: 850 Hz (BFO fully cw)	+20 volts dc ± 0.1

TEST POINT CHART 3

TEST POINT	EMITTER	BASE	COLLECTOR
Q1	24 ± 0.1 volts	24.8 ± 0.5 volts	26 ± 0.2 volts



Section III. MAINTENANCE PROCEDURES

3-8. REMOVING AND REPLACING FRONT PANEL COMPONENTS

NOTE

For all procedures in this paragraph, follow instructions in paragraph 2-9 for removing and replacing the front panel.

CONNECTORS J1, J2, J3, J4

REMOVE

- Remove printed circuit board A6 from compartment housing (para 2-10).
- Remove hex nut (connectors J1, J2) or spanner nut (J3, J4) holding connector to front panel.
- Carefully push connector out from inside the panel.
- Connectors J3, J4: Tag, unsolder, and remove wires from connector. Remove connector.
- Connectors J1, J2: Unscrew rubber bushing retainer ring. Push the brushing back against wires, away from connector, to expose solder terminals. Tag, unsolder, and remove wires from connector remove connector.

REPLACE

- Solder wires to new connector.
- Connectors J1 and J2: Replace screws on rubber bushing retainer ring.
- Carefully push connector into front panel.
- Replace hex nut (J1, J2) or spanner nut (J3, J4).
- Replace printed circuit board A6 (para 2-10).

CONNECTORS J5, J6, J7, J8

REMOVE

- Remove printed circuit board A8 from compartment housing (para 2-10).
- Remove hex nut or spanner nut (J8) holding connector to front panel.
- Carefully push connector out from inside of panel.
- Unscrew rubber bushing retainer ring. Push the bushing back against wires, away from connector, to expose solder terminals.
- Tag, unsolder, and remove wires from connector; remove connector.

REPLACE

- Solder wires to new connector.
- Replace screws on rubber bushing retainer ring.
- Carefully push connector into front panel.
- Replace nut.
- Replace printed circuit board A8 (para 2-10).

MODEM SWITCHES

S1 ONE WAY/DUPLEX
S2 RECEIVE
S3 METER FUNCTION
S4 MODE SELECTOR
S5 RCV/SEND

REMOVE

- Tag, unsolder, and remove all wires connected to switch terminals.
- On-front panel remove control knob retainer screw or hex nut.
- On inside of front panel remove any hex nuts.
- Carefully push switch out from outside of panel.

REPLACE

CAUTION

Wafer switch terminals are easily bent and broken. When installing a new switch containing wafers, carefully position wiring harness to prevent strain on switch terminals.

- Place new switch into position.
- On inside of front panel replace any hex nuts.
- On front panel replace control knob retainer screw or hex nut.
- Solder wires to new switch terminals.

DIODES CR1 - CR5

REMOVE

- Tag, unsolder, and remove leads from diode.
- Remove diode.

REPLACE

- Position new diode.
- Solder leads to new diode.

ZENER VR1

REMOVE

- Tag, unsolder, and remove leads from zener.
- Remove zener.

REPLACE

- Position new zener.
- Solder leads to new zener.

VARIABLE RESISTORS

R1 AUDIO GAIN
R2 BFO
R3 SCOPE INTENSITY

REMOVE

- Tag, unsolder, and remove leads from resistor.
- Remove control knob retainer screws.
- Remove resistor.

REPLACE

- Put new resistor in place.
- Replace control knob retainer screws.
- Solder leads to new resistor.

METER M1

CAUTION

Do not press on meter glass.

REMOVE

- Tag and unsolder wire leads to meter terminals.
- Remove four front panel screws.
- Remove meter.

REPLACE

- Install new meter.
- Replace four front panel screws.
- Solder wires to meter.

3-9. REMOVING AND REPLACING CHASSIS COMPONENTS

- To gain access to chassis components, remove modem from chassis (para 2-8).
- Stand modem on end for simultaneous access to top and bottom of chassis.

FILTERS FL1 , FL2, FL3, FL4, FL5

REMOVE

- On the bottom side of the chassis remove four hex nuts holding filter to chassis.
- Tag, unsolder, and remove leads from terminals.
- Lift out filter.

REPLACE

- Place new filter into position.
- Tighten four hex nuts.
- Solder leads to filter terminals.

FILTERS FL6, FL7

REMOVE

- On the top side of the chassis remove two hex nuts holding filter to chassis.
- Tag, unsolder, and remove leads from terminals.
- Lift out filter.

REPLACE

- Place new filter into position.
- Tighten two hex nuts.
- Solder leads to filter terminals.

RELAY K1

REMOVE

- Tag, unsolder, and remove all wires from relay.
- Remove two captive screws holding relay to compartment housing.
- Remove relay.

REPLACE

- Position relay on compartment housing.
- Replace two captive screws.
- Solder wires to relay terminals.

3-10. ADJUSTMENT PROCEDURES

General support adjustment procedures are the same as direct support procedures. Refer to chapter 2, section IV.

APPENDIX A

REFERENCES

A-1. INTRODUCTION

The Consolidated Index of Army Publications and Blank Forms, DA PAM 310-1 should be consulted frequently for revisions and new publications that pertain to this manual. The following is a list of all forms, technical bulletins, and technical manuals referenced in this manual.

A-2. FORMS

DA Form 2028	Recommended Changes to Publication and Blank Forms
DA Form 2404	Equipment Inspection and Maintenance Worksheet
SF Form 361	Discrepancy in Shipment Report
SF Form 364	Report of Discrepancy (ROD)
SF Form 368	Quality Deficiency Report

A-3. TECHNICAL BULLETINS

TB 43-0116	Identification of Radioactive Items in the Army Supply System
TB 43-0122	Instructions for the Safe Handling and Identification of the US Army Communications-Electronics Command Managed Radioactive Items in the Army Supply System
TB 385-4	Safety Precautions for Maintenance of Electrical/Electronic Equipment

A-4. TECHNICAL MANUALS

TM 11-5805-387-10-1	Operator Maintenance Manual: Radio Teletypewriter Modem MD-522/GRC (NSN 5815-00-999-5277)
TM 11-5805-387-10-2	Organizational Maintenance Manual: Radio Teletypewriter Modem MD-522A/GRC (NSN 5815-00-819-4800)
TM 11-5805-387-15-2	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Modem, Radio Teletypewriter MD-522/GRC (NSN 5815-00-999-5277)
TM 11-5805-387-20-1	Organizational Maintenance Manual: Radio Teletypewriter Modem MD-522A/GRC (NSN 5815-00-999-5277)
TM 11-5805-387-20-2	Organizational Maintenance Manual: Radio Teletypewriter Modem MD-522A/GRC (NSN 5815-00-919-4800)
TM 11-5805-387-20P-2.	Organizational Repair Parts List: Modem, Radio Teletypewriter MD-522A/GRC
TM 11-5805-387-24P-1	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Modem, Radio Teletypewriter MD-522/GRC (NSN 5815-00-999-5277)

TM 11-5805-387-34P-2	Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Radio Teletypewriter Modem MD-522A/GRC (NSN 5805-00-919-4800)
TM 11-5815-334-12	Operator's and Organizational Maintenance Manual for Radio Teletypewriter Sets AN/GRC-142, AN/G RC-142A (NSN 5815-00-401-9720), AN/GRC-142B (5815-00-443-5511), AN/GRC-142C (5815-01-100-6815), AN/GRC-142D (5815-01-104-7264), AN/GRC-142E (5815-01-095-6258), AN/GRC-122, AN/GRC-122A (5815-00-401-9719), AN/GRC-122B (5815-00-937-5295), AN/GRC-122C (5815-01-095-1211), AN/GRC-122D (5815-01-104-7264) and AN/GRC-122E (5815-01-095-1212) (Reprinted w/basic including C1-9)
TM 11-5815-334-34.	Direct Support, General Support, and Depot Maintenance Manual, Radio Teletypewriter Sets AN/GRC-142, AN/GRC-142A (NSN 5815-00-401-9720), AN/GRC-142B (5815-00-443-5511), AN/GRC-142C (5815-01-100-6815), AN/GRC-142D (5815-01-104-7264), AN/GRC-142E (5815-01-095-6258), AN/GRC-122 and AN/GRC-122A (5815-00-401-9719), AN/GRC-122B (5815-00-937-5296), AN/GRC-122C (5815-01-095-1211), AN/GRC-122D (5185-01-104-7264) and AN/GRC-122E (5815-095-1212) (Reprinted w/basic and C1-4)
TM 11-5965-202-35	Department of the Army and Air Force (TO 31W1-2PT-364) Technical Manual: Field and Depot Maintenance; Handsets H-330/PT, H-33E/PT, and H-33F/PT
TM 11-6130-247-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual for Power Supply, PP-3940/6
TM 11-6625-200-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Multimeters ME-26A/U (NSN 6625-00-360-2493), ME-268/U and ME-28C/U (6625-00-646-9409), and ME-26D/U (6625-00-913-9781) (Reprinted w/basic including C1-3)
TM 11-6625-320-12	Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic, ME-30B/U, ME-30C/U and ME-30E/U
TM 11-6625-366-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Multimeter TS-352B/U (NSN 6625-00-553-0142) (Reprinted w/basic including C1-4)
TM 11-6625-524-15-1	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Electronic Voltmeter, AN/URM-145 (NSN 6625-00-973-3986)
TM 11-6625-620-45-1	General Support and Depot Maintenance Manual: Test Set, Teletypewriter TS-799/USM-1 (Reprinted with basic C1)
TM 6625-700-10	Operator's Manual: Digital Readout, Electronic Counter AN/USM-207 (NSN 6625-00-911-6368)

TM 11-6625-1703-15 . . . . . **Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Oscilloscope AN/USM-281A (NSN 6625-00-228-2201) (Reprinted with basic C1-2)**
TM 740-90-1 . . . . . **Administrative Storage of Equipment**
TM 750-244-2 . . . . . **Procedures for Destruction of Army Electronic Materiel to Prevent Enemy Use (Electronic Command)**

A-5. MISCELLANEOUS PUBLICATIONS

AR 385-11 . . . . . **Ionizing Radiation Protection (Licensing, Control, Transportation, Disposal, and Radiation Safety)**
DA Pam 310-1 . . . . . **Consolidated Index of Army Publications and Blank Forms**
DA Pam 738-750 . . . . . **The Army Maintenance Management System (TAMMS)**
SC 5180-91-CL-R07 . . . . . **Tool Kit, Electronic Equipment, TK-105/G (NSN 5180-00-61 0-8177) (LIN W37388)**
SC 5180-91-CL-S21 . . . . . **Tool Kit, Electronic Equipment, TK-100/G (NSN 51 80-00-605-0079) (LIN W37251)**

INDEX

INDEX-Continued

INDEX-Continued

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

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10 July 1975

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 11-5840-340-12	23 Jan 74	Radar Set AN/PRC-76

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PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2^{o} IFF antenna lag rather than 1^{o}. REASON: Experience has shown that with only a 1^{o} lag, the antenna servo system is too sensitive to wind gusting in excess of 25 knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2^{o} without degradation of operation.
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3db." REASON: The adjustment procedure the the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		FO3		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. +24 VDC is the input voltage.

SAMPLE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
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I. M. DeSpiritof

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