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UNCLASSIFIED

TECHNICAL MANUAL

for

CONTROL TERMINATOR

MODEL LRCD-1



THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y.

OTTAWA, ONTARIO

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THE TECHNICAL MATERIEL CORPORATION

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700 FENIMORE ROAD

MAMARONECK, N. Y.

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3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
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2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

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

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

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

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

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

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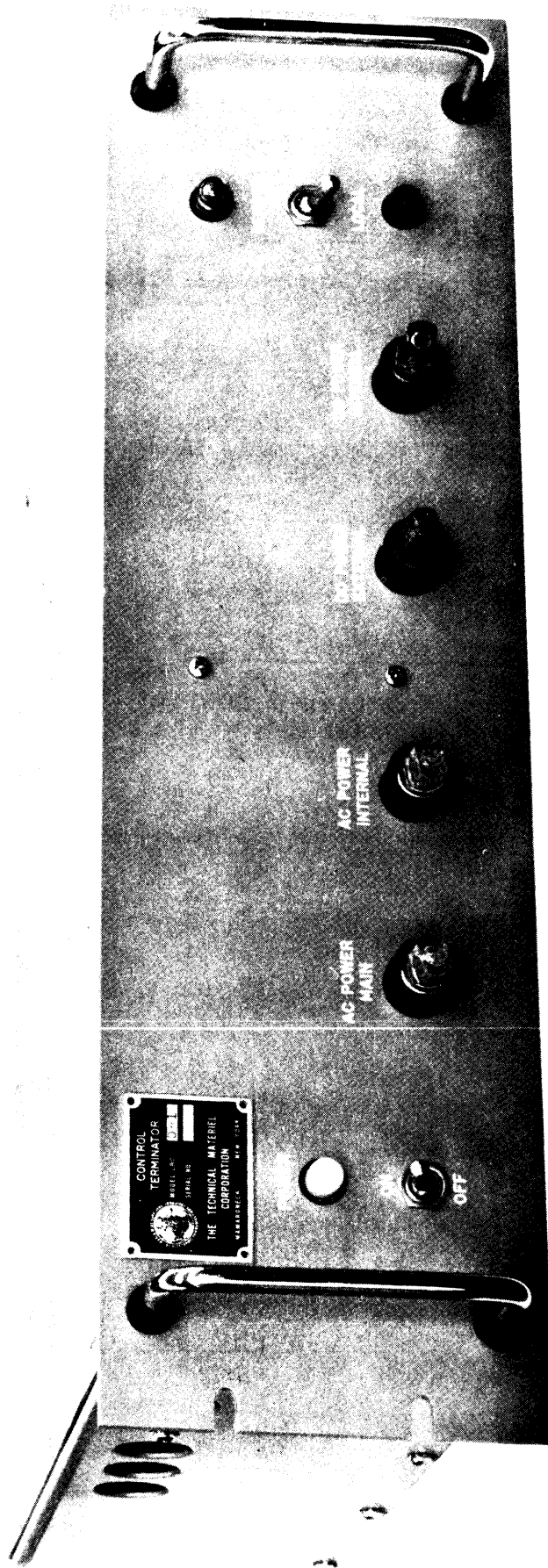


Figure 1-1-1. Control Terminator, LRCD-1

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SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

Control Terminator, Model LRCD-1 (figure 1-1), is a remote tuning and band switching control used with associated units of a transmitter system. (Refer to the functional block diagram, figure 1-2.) The LRCD provides the required voltages through its sequential relays and time-delay circuits, including a servo amplifier, for the tuning and band switching operations. Travel control circuitry, contained in the LRCD, prevents overtravel of the tuning motor in an associated unit.

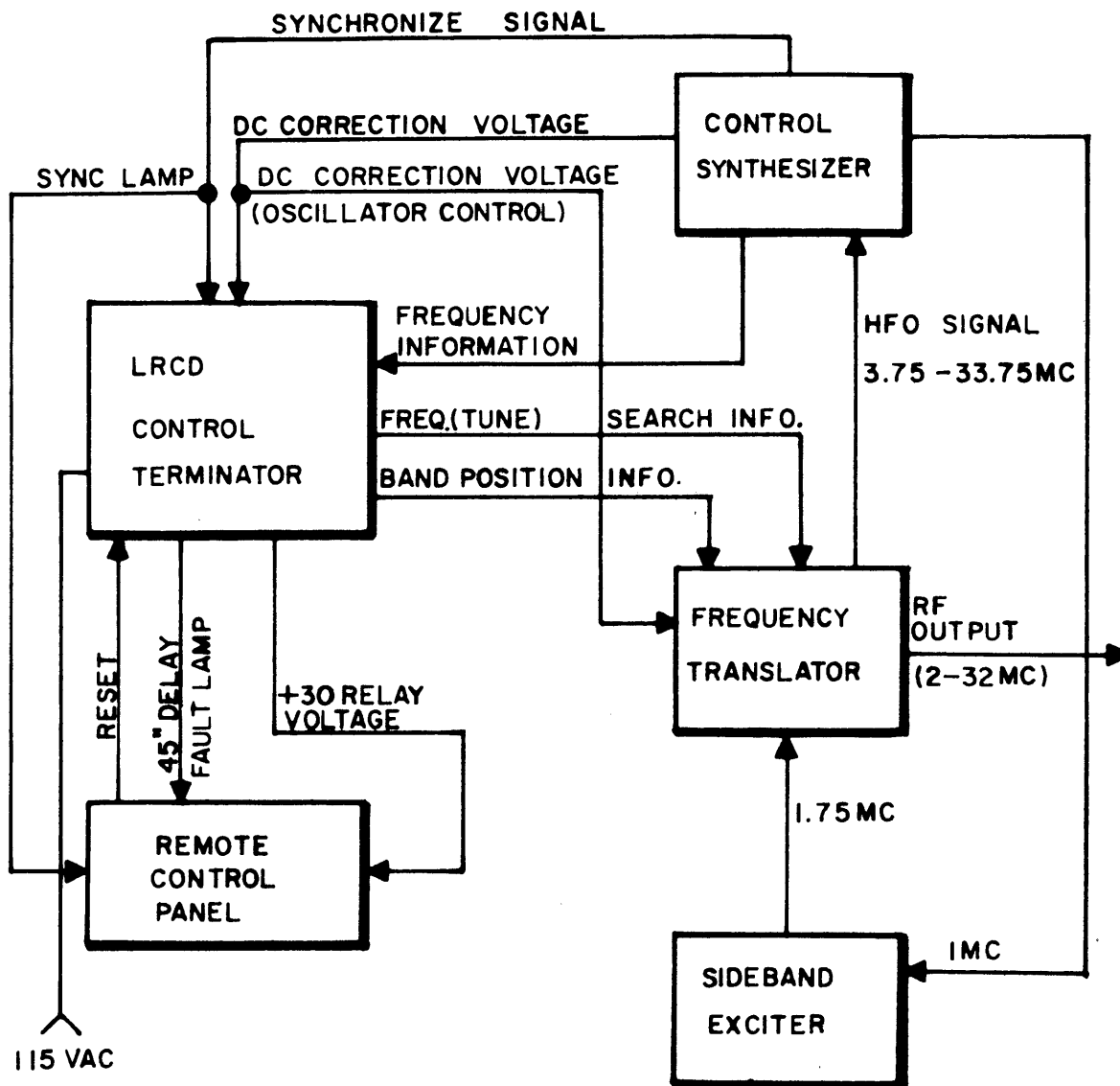
A REMOTE/LOCAL switch, located on the front panel of the LRCD, provides power cut-off (when set at LOCAL) for local tuning of the associated RF translator, and control synthesizer.

1-2. PHYSICAL DESCRIPTION.

a. EXTERNAL. - The LRCD is provided with a non-tilt slide mechanism for installation in a standard 19-inch wide rack. The switches and indicators (lamps) necessary for the operation of the LRCD are located on the front panel; the rear panel contains the power input and related connectors (refer to figure 2-2). The removable top cover of the LRCD facilitates maintenance, repair, and troubleshooting. The LRCD is 19 inches wide, 5-1/8 inches high, and 17-1/2 inches deep; the unit weighs 38 pounds.

b. INTERNAL. - The larger components in the LRCD are chassis-mounted and identified; the smaller components, such as capacitors, resistors, and diodes, are identified at their mounted locations on the terminal board.

Table 1-1 lists the semiconductor complement of the LRCD.



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Figure 1-2. Functional Block Diagram, LRCO

1-3. EQUIPMENT SUPPLIED.

Table 1-2 lists the equipment supplied with the LRCO.

1-4. TECHNICAL SPECIFICATIONS.

INPUTS: Servo Control; d-c error signal;
dry contact switch position information.

OUTPUTS: Tuning and band switch motor power;
28 volts for relay and rotary solenoid

POWER REQUIREMENTS: 115 VAC, single phase, 50/60 cps.

TABLE 1-1. SEMICONDUCTOR COMPLEMENT, LRCD

SYMBOL	TYPE	FUNCTION
CR4001 thru CR4004	1N1200A	28 vdc rectifier
CR4005 CR4006	1N2070	Relay coil damper
CR4007 thru CR4010	1N270	Relay coil damper
CR4011	1N2070	Relay coil damper
CR4012 CR4013 CR4016 CR4017	1N270	Relay coil damper
CR4018	1N3324B	28 vdc regulator
CR4019	1N270	
CR4020	1N2070	
Q4001	2N456A	Relay driver
Q4002	2N492	Time delay

TABLE 1-2. EQUIPMENT SUPPLIED

NAME	DESIGNATION	QUANTITY
AC Power Cable Assembly	CA555-4	1
Type BNC RF Connector	PL244-1	2
Connector	JJ313-2H	1
Connector	JJ313-3H	1
Rubber Bushing	MS3420-12A	2

SECTION 2
INSTALLATION

2-1. GENERAL.

The LRCB is tested at the factory and is carefully packaged to prevent damage during shipment. When it is delivered at the operating site, inspect the packing case and its content for damage that might have occurred during transit. Unpack the equipment carefully, and inspect all packaging material for parts that may have been shipped as loose items. With respect to damage to the equipment for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and furnishing of replacement parts.

2-2. MECHANICAL INSTALLATION.

The LRCB is equipped with a standard 19-inch wide front panel; install the LRCB in the equipment rack as follows (refer to figure 2-1):

- a. Pull out the center sections of tracks, located in the equipment rack, until they lock in extended position.
- b. Position slide mechanisms of LRCB in tracks, and ease the unit into the rack until release fingers engage holes in the tracks.
- c. Depress release fingers and slide the LRCB completely into the rack; secure front panel of LRCB to the rack with screws and washers.
- d. Make the necessary electrical connections, as described in paragraph 2-3.

NOTE

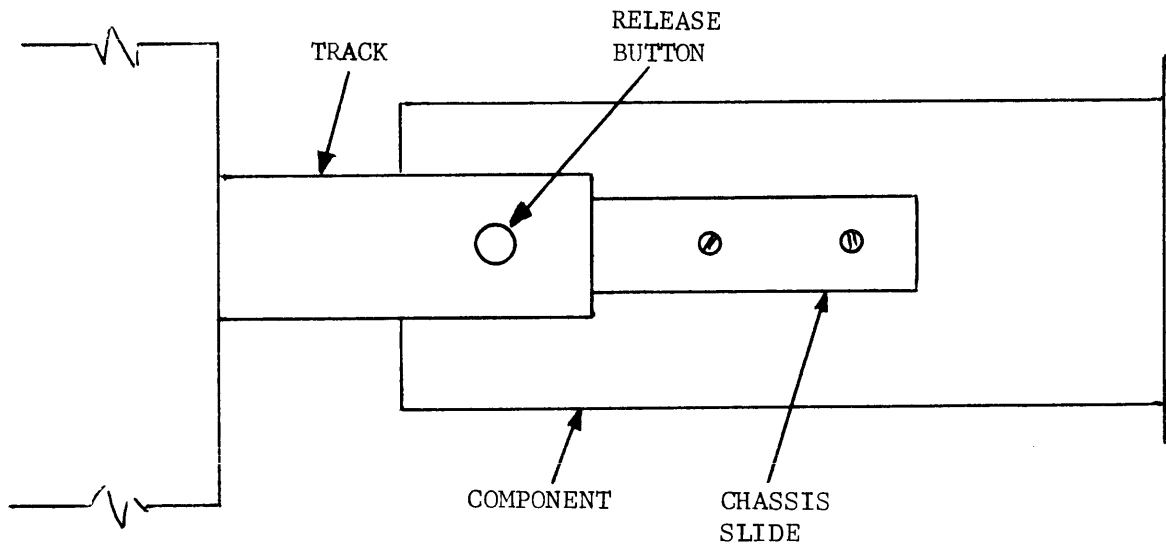
To prevent LRCB cables from snagging, attach reel-mounted springs (NEGATOR B motors) located inside the rack to the cables.

2-3. ELECTRICAL INSTALLATION.

a. INTERCONNECTIONS. - Refer to the system wiring diagram provided in the system manual and make the cabling connections between the LRCO and related units, as indicated. The rear panel of the LRCO is shown in figure 2-2; refer to table 2-1.

b. POWER SUPPLY. - The LRCO is wired for 115-volt, 50- or 60-cycle, single phase power operation.

c. INITIAL ADJUSTMENTS. - The LRCO is checked at the factory in accordance with the manufacturer's specifications and therefore no initial adjustments are required before installation and operation.



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Figure 2-1. Non-Tilt Slide Mechanism

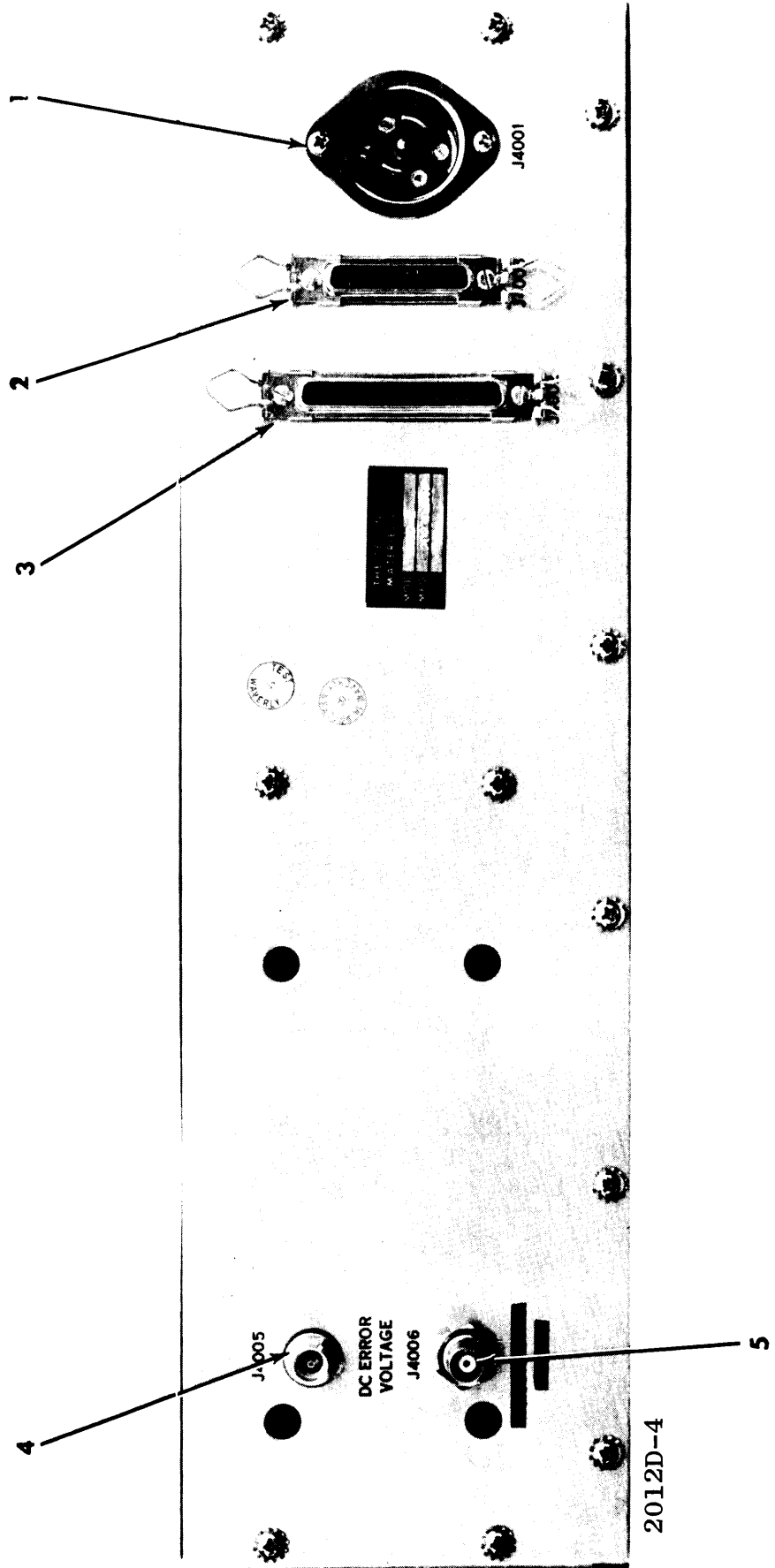


Figure 2-2. Rear Panel, LRC D

TABLE 2-1. REAR PANEL CONNECTORS, LRCD

ITEM (Fig. 2-2)	CONNECTOR	TO
1	J4001	A-C Main power supply.
2	J4003	Remote control panel.
3	J4002	R-F translator, and control synthesizer.
4	J4005	Servo control (d-c error voltage).
5	J4006	Servo control.

SECTION 3

OPERATOR'S SECTION

3-1. INDICATOR AND SWITCH FUNCTIONS.

The functions of the indicators (lamps) and switches of the LRCO are explained in table 3-1. All indicators, switches, and fuses are identified by front-panel markings, as shown in figure 3-1.

3-2. OPERATING PROCEDURE.

The LRCO functions as part of a transmitter system; refer to the system manual for operating procedures.

3-3. OPERATOR'S MAINTENANCE.

Check condition of switches, lamps, and fuses. A lit fuse cap indicates that the fuse has blown.

WARNING

Never replace a fuse with one of higher current rating. If a fuse blows immediately after replacement, do not replace it a second time until the cause of trouble has been corrected.

TABLE 3-1. OPERATING CONTROLS AND INDICATORS, LRCD

ITEM (See fig. 3-1)	Control or Indicator	Function
1	ON/OFF switch	Turns on AC power for unit and servo control amplifier.
2	POWER lamp	Lights when AC power is on.
3	AC POWER MAIN fuse	Protects main power transformer primary circuit; when lit, fuse has blown.
4	AC POWER INTERNAL fuse	Protects band switching motor and AC solenoid in associated r-f translator.
5	DC POWER EXTERNAL fuse	Protects associated r-f translator 30-volt power supply (servo amplifier).
6	DC POWER INTERNAL fuse	Protects +28 VDC power supply.
7	LOCAL lamp	Lights when REMOTE/LOCAL switch (item 9) is set at LOCAL operating position.
8	REMOTE lamp	Lights when REMOTE/LOCAL switch (item 9) is set at REMOTE operating position.
9	REMOTE/LOCAL switch	When set at LOCAL, permits local tuning of associated r-f translator and control synthesizer; when set at REMOTE, permits tuning and band selection from associated remote control panel.

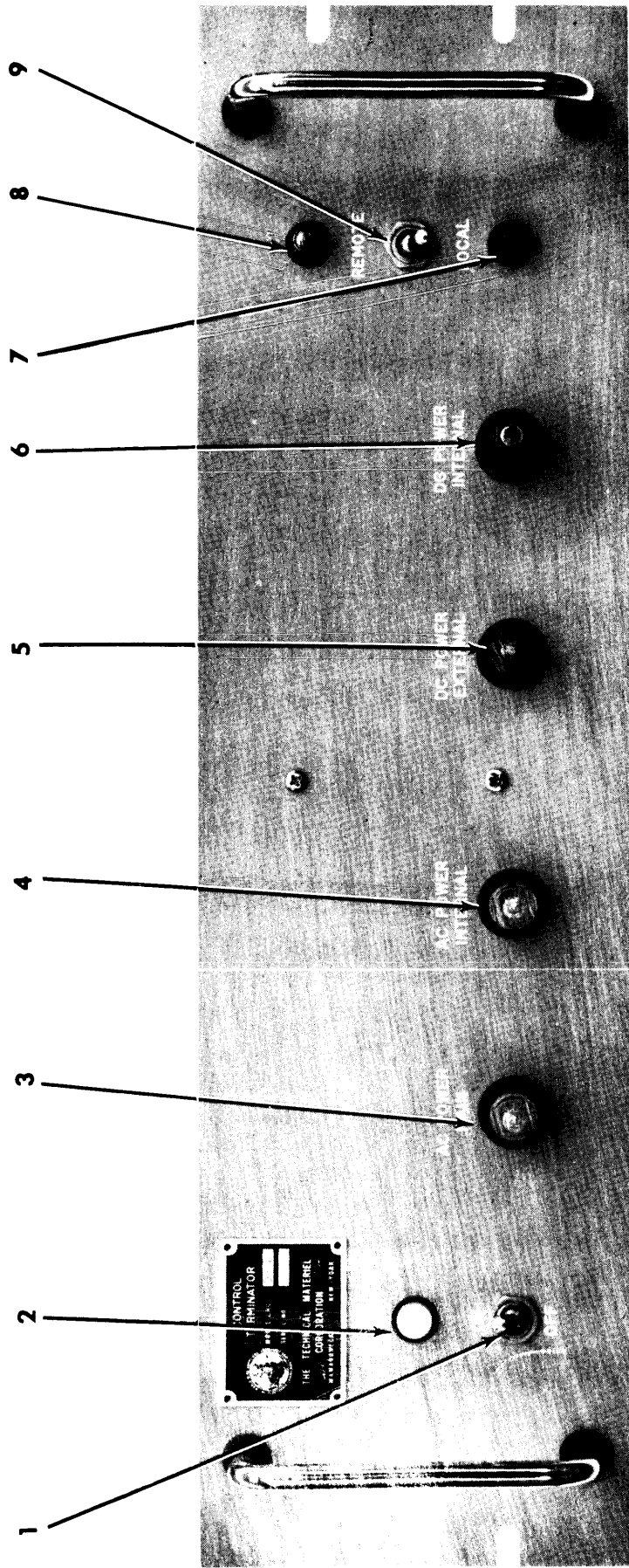


Figure 3-1. Indicators and Switches, LRCD

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SECTION 4
PRINCIPLES OF OPERATION

4-1. GENERAL

The LRCD functions with associated units of a transmitter system as a remote tuning and band switching control and provides tuning information for the transmitter. A +28 vdc power supply is contained in the LRCD; the unit is operated through a remote control panel. Master switches on the remote control panel activate corresponding slave stepping switches on the associated control synthesizer and move them to the same positions, thus tuning the control synthesizer for the carrier frequency that has been set up at the remote control panel. Additional wafers on the slave switches on the control synthesizer now send control voltages to the LRCD and to the transmitter, thus tuning the associated transmitter to the required carrier frequency.

4-2. FUNCTIONAL ANALYSIS.

The LRCD, in conjunction with associated equipment, operates in the following manner (refer to figure 1-2):

When the associated control synthesizer MC slave switch has moved to its correct position for the mc component in the carrier frequency, an extra wafer on the switch makes a connection with the sequential relays in the LRCD; another wafer relays tuning information to the transmitter. The LRCD sends a controlling voltage to the BAND switch motor of the r-f translator, moving the BAND switch control in search for the proper band to correspond with the mc figure. Another wafer on the associated control synthesizer MC switch acts as a master stepping switch to a slave homing switch in the associated r-f translator to stop the motor

at the proper band by cutting off its power supply voltage.

When the associated control synthesizer 100KC slave switch has moved to its position for the 100-kc component in the carrier, an extra wafer on the switch presents a "direction of search" signal to the associated r-f translator TUNE drive motor, via sequential relays and a servo amplifier in the LRCD. The servo amplifier sends controlling a-c voltage to the r-f translator TUNE motor. The voltage contains one of two types of phases: one phase starts the motor in a clockwise direction, and the other phase sends it counterclockwise. When the control synthesizer MC and 100KC slave switches have moved to their proper positions, wafers on both switches (depending on whether the frequency is on the left or right side of the band dial) either do or do not make a contact to ground through an LRCD relay coil, either energizing or not energizing the relay. If the frequency is on the left half of the dial, the relay is energized and works through an LRCD transformer and the servo amplifier to change the phase on the fixed phase input of the r-f translator TUNE motor, causing the TUNE capacitor to "search" towards the left on the band dial for the frequency. If the wafers do not connect the relay coil to ground, the relay remains de-energized and the r-f translator TUNE motor proceeds to search to the right. This arrangement minimizes the searching time. As the TUNE control nears the proper point, the error becomes very small, the phase detector issues d-c correction

voltage. This works through the servo amplifier to bring the TUNE control to synchronize the high frequency oscillator of the r-f translator exactly with the control synthesizer. When the d-c voltage has reduced to a small enough value for "capture", it lights the SYNC lamp on the remote control panel.

If, after approximately 45 seconds from the time that the master switches on the remote control panel were activated, there has been no d-c correction voltage appearing at the LRCD servo amplifier, the LRCD sends a signal back to the remote control panel and lights the FAULT lamp. In this case, the remote control panel RESET button may be depressed, supplying the energizing voltage necessary to re-start the sequential relay action in the LRCD.

Power for the associated control synthesizer slave stepping switches and the sequential relays in the LRCD originates in the LRCD, but is first routed through the REMOTE/LOCAL switch of the LRCD and the contacts of relay K4001. With the REMOTE/LOCAL switch in the LOCAL position, this power is cut off and local tuning of the control synthesizer and the r-f translator is possible, without interference from the remote control panel.

With the REMOTE/LOCAL switch in the REMOTE position and the TUNE OVERRIDE switch on the remote control panel in OFF position, the power is again cut off until the TUNE button on the remote control panel is depressed.

This arrangement allows the remote operator to first set up the carrier frequency (MC, 100 KC, 10 KC, 1 KC, and .1 KC switches on the remote control panel) and then press the TUNE button to start the TechniMatiC* tuning action. (If the TUNE

*Trademark applied for.

OVERRIDE switch on the rear of the remote control panel is ON, action will start as soon as any frequency control on the remote control panel is moved.)

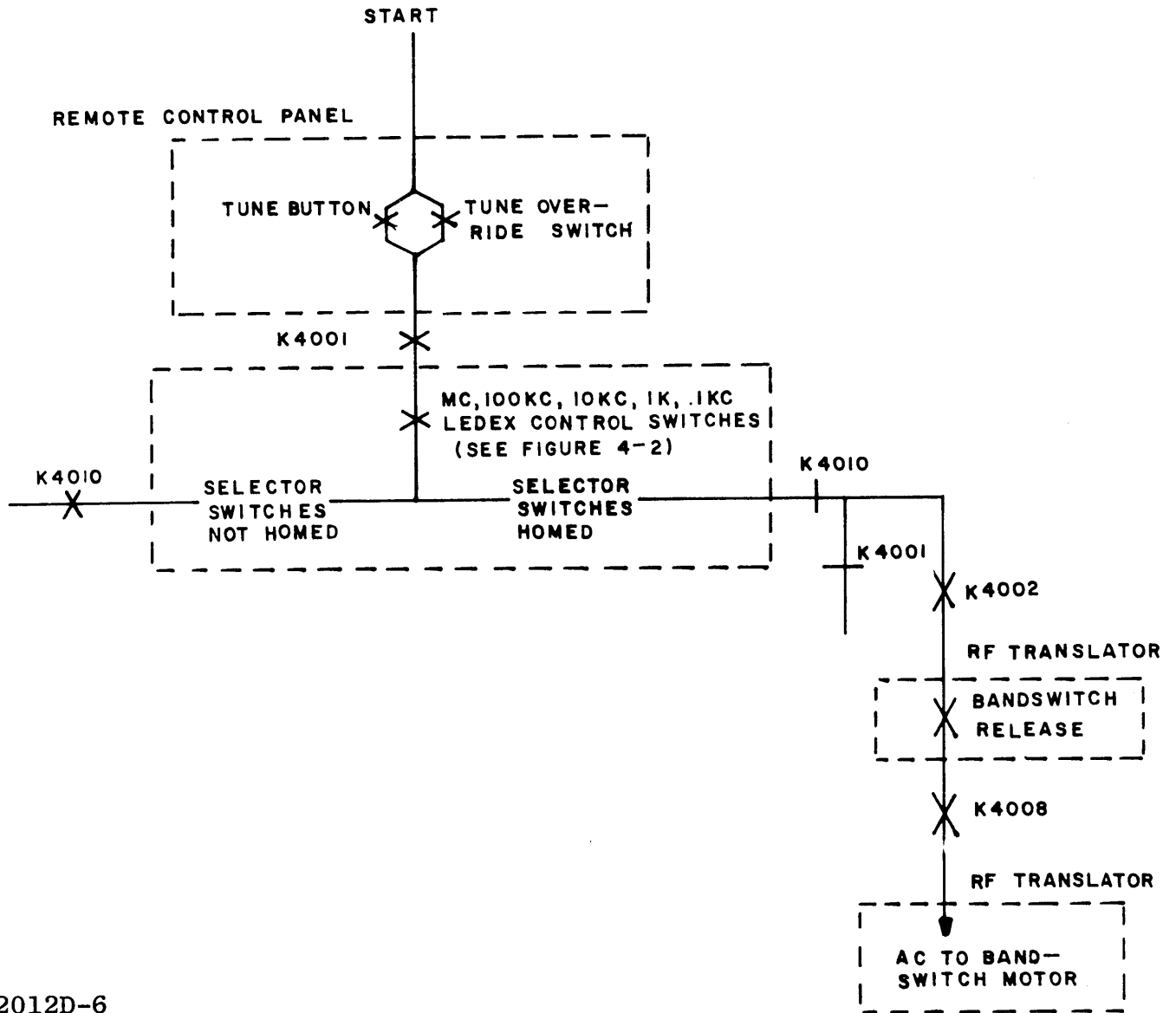
4-3. CIRCUIT ANALYSIS.

The LRCD, as part of a transmitter system, controls the associated external circuits that are used for band selection, frequency tuning, and final transmitter functions. (Refer to figure 7-1.) The rotary stepping solenoid in the associated transmitter is operated by the LRCD as follows:

a. RF Band Selection

When the TUNE SYNC button on the remote control panel is depressed, relay K4001 of LRCD is energized and a potential of 28 volts is fed to the contacts of K4001, through resistors R4006 and R4014 and then to the remote control panel through contacts 21, 22, 23, 24, and 25 of connector J4003. The 28 volts is fed through several master wafers of the remote control panel. The continuity through each remote control panel master switch, through the solenoid of a slave wafer in the associated control synthesizer, to ground will cause the solenoid to draw current until the wafer has slaved itself to the master switch. Transistor Q4001 will turn on and will energize K4010; since operation of K4010 removes power from the servo control in the LRCD (which operates the servo system), the band switch motor cannot rotate and the servo cannot begin to search. (see figure 4-1a.)

If relay K4010 is de-energized and the band switch motor is rotating, the motor will remain locked-up and continue to rotate when K4010 is energized. When K4010 is energized, relay K4001 locks and 28 volts continue to operate the rotary stepping



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Figure 4-1a. Relay Sequence, RF Band Selection

solenoid after the TUNE button on the remote control panel is released. If the TUNE OVERRIDE switch on the remote control panel is closed, relay K4001 will always remain energized (28 volts will be applied continually to the master wafers on the remote control panel), so that whenever the TUNE OVERRIDE switch on the remote control panel is closed and a master control knob is rotated, the rotary stepping solenoid on the receiver will follow, without the TUNE button having to be pushed in.

Relays K4002 and K4008 in the LRCD operate the band switch motor in the associated r-f translator. When 28 volts is applied through contacts 14 and 15 of relay K4010 to contact 8 of K4008, from where contact 9 feeds to a switch of the associated control synthesizer (this switch is part of the rotary stepping solenoid), this signal then selects the band, as follows:

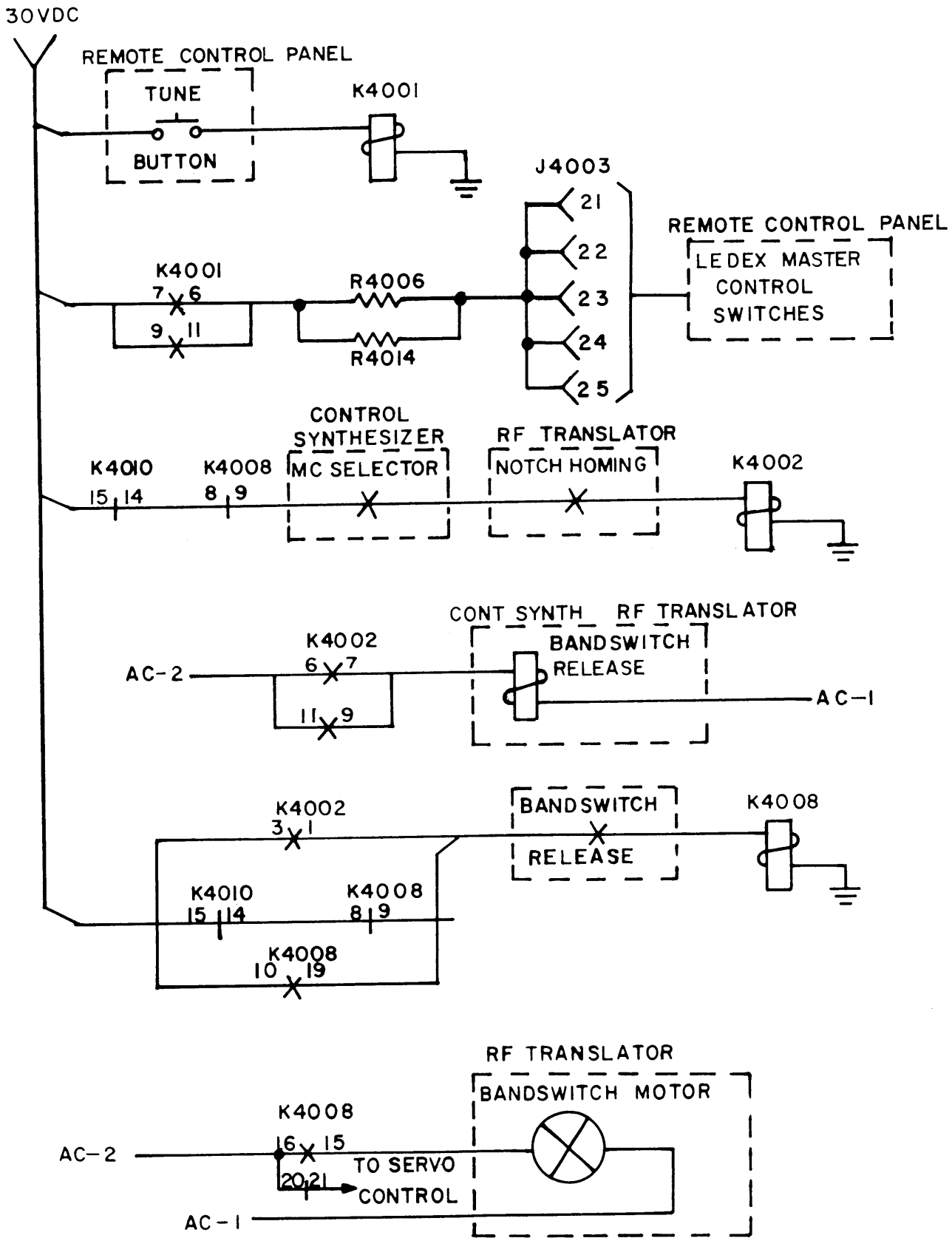
The different megacycles that make up the band are shorted out. Eight (8) leads are routed off this switch wafer and fed to the notch homing switch in the associated r-f translator. If there is continuity from contact 9 at K4008 through the switch of the associated control synthesizer, through the notch homing switch of the associated r-f translator, and back to contact 2 at K4002 (which is the relay coil), a-c is applied to the solenoid in the r-f translator and actuates the detent on the band switch gear assembly. When this solenoid is actuated, a micro switch operates and furnishes power to the coil of relay K4008 which now (through contacts 9 and 10) locks up K4002. K4008 now furnishes a-c power to the motor of the band switch gear assembly in the r-f translator. Also, when K4008 is energized, the 28 volt supply to the servo control in the LRCD is broken at

contacts 20 and 21, preventing the servo control from searching while the bandswitch motor is rotating.

When the notch homing switch in the r-f translator reaches its proper position, relay K4002 is de-energized (voltage continuity has kept K4002 energized) and the solenoid in the bandswitch in the gear assembly will de-energize, and the cam will contact the cam follower in the gear switch. When the cam follower reaches the detent it will open the micro switch and de-energize K4008. When K4008 is de-energized, the bandswitch motor stops and the bandswitch gear assembly comes to rest on the pre-selected band, and 28 volts is again applied to the servo control. (See figure 4-1b).

b. Searching and Tuning to Frequency

Frequency changes are accomplished by rotary stepping solenoids in the associated control synthesizer; this action causes the control synthesizer and r-f translator to be out of synchronization. Sync relay K3001 in the control synthesizer is de-energized, and ground is simultaneously applied to: (2) J4006 and then extended to pin 4 of the servo amplifier thus activating the servo into a search cycle (figure 4-2). (1) Contact 14 of J4002 and then extended to relay K4004 causing it to energize. Closed contacts of relay K4004 close the operate paths of relays K4011 and K4013; the direction of the search cycle depends on whether relay K4009 is energized or de-energized. Whenever there is continuity from ground through the 10KW and MC wafers of the associated control synthesizer to relay K4009 of the LRCD, K4009 will be energized and will cause the cursor on the r-f translator to search (driven by the servo) to the left; whenever K4009 is de-energized, the cursor will search to the right.



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Figure 4-1b. Relay Sequence, RF Band Selection

When the servo has driven the cursor to one end of the band, a micro switch in the r-f translator will be activated and, no matter which direction the servo started searching and no matter which micro switch is activated, relay K4005 will energize and lock itself, and will thus reverse the direction of the servo. The search signal is applied from contacts 9, 10, and 11 of the center tap winding of transformer T4001 (refer to figure 4-3).

Whenever the servo reverses and starts searching in the other direction and fails to locate the signal, the servo will continue to the other end of the band and the micro switch at this end will be activated, relay K4005 will de-energize and cause the servo to search in the opposite direction. As the cursor (driven by the servo) reaches the capture range of the frequency it is seeking, the d-c correction voltage produced by the associated control synthesizer is applied to the servo control via closed contacts of relay K4013. This is accomplished by the sync relay of the control synthesizer energizing at the beginning of the capture range thus opening the ground path to relay K4004 and to the servo amplifier. Due to a time constant developed by capacitor C4003, relay K4004 remains energized for approximately three seconds. During this time the d-c correction voltage from J4005 is applied to the servo amplifier (pin 1, J4004). The d-c correction voltage now operates the servo amplifier; when the servo amplifier centers on the d-c correction voltage (zero volts), the search cycle stops thus breaking the voltage to the servo motor.

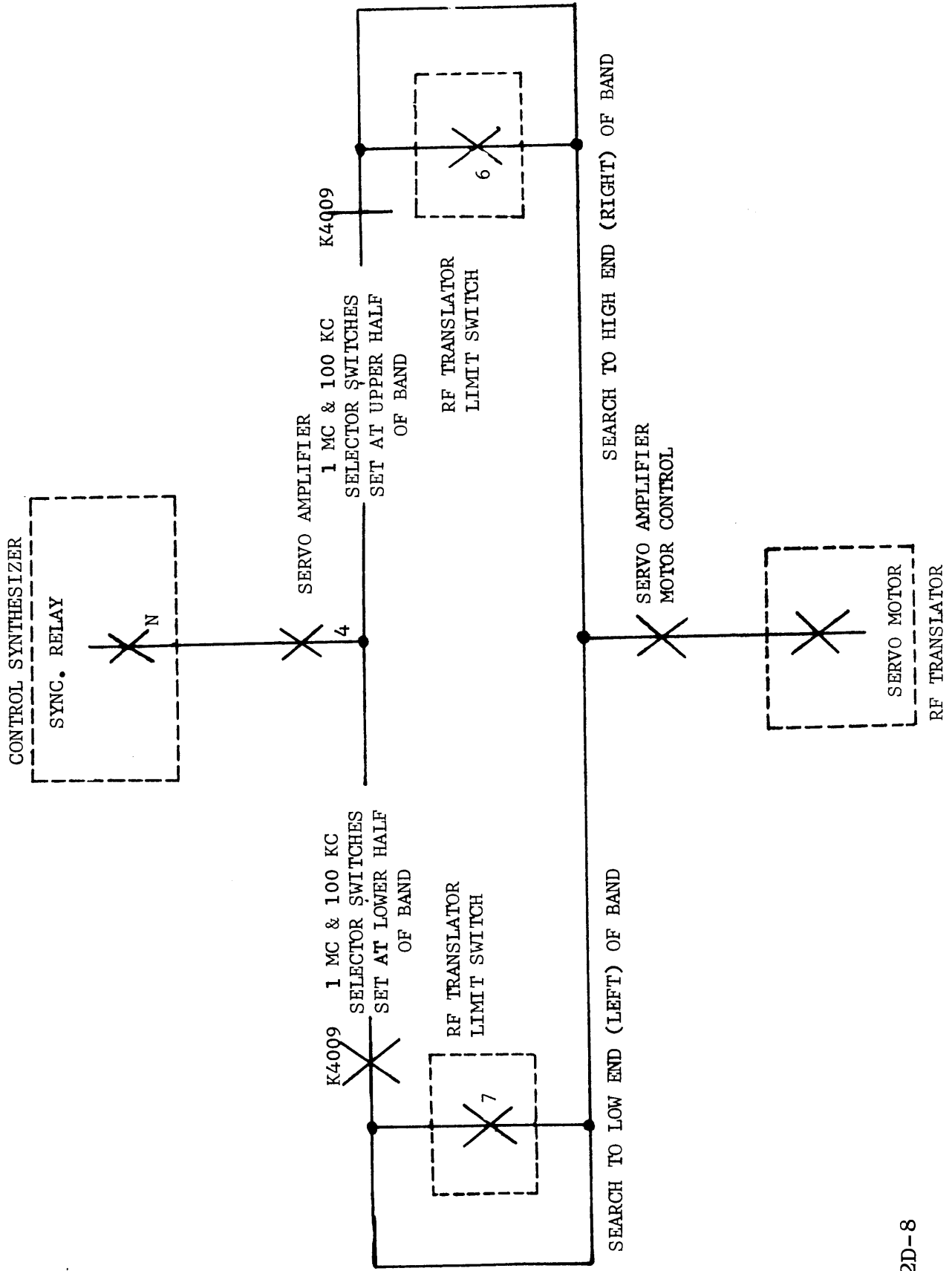
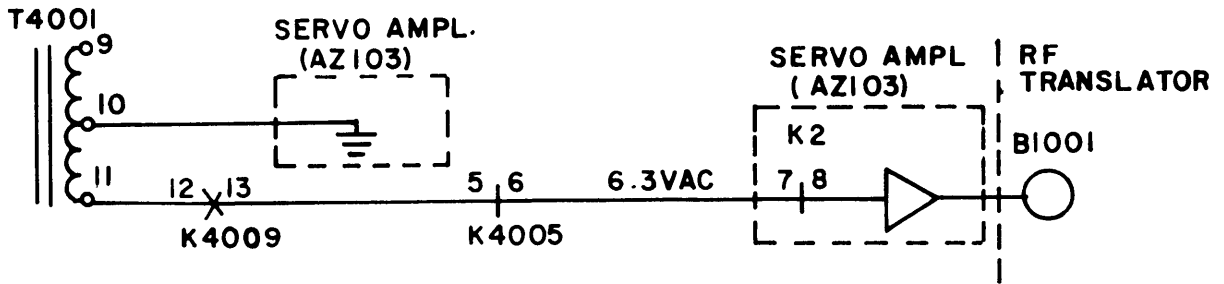
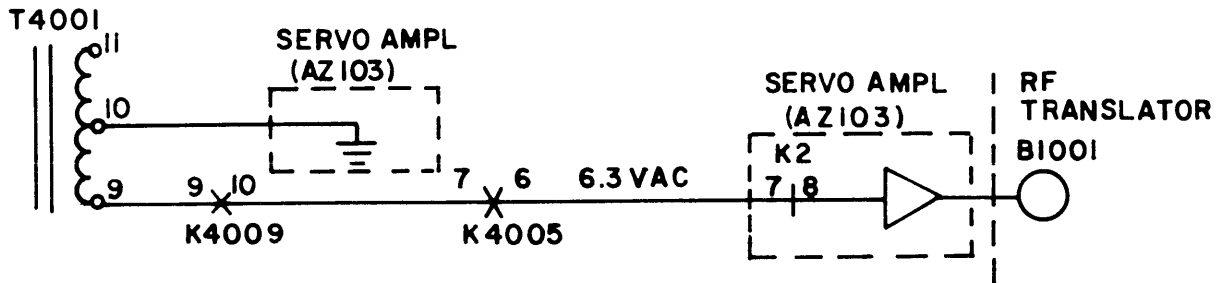


Figure 4-2. Relay Sequence, Frequency Search (no d-c correction voltage).



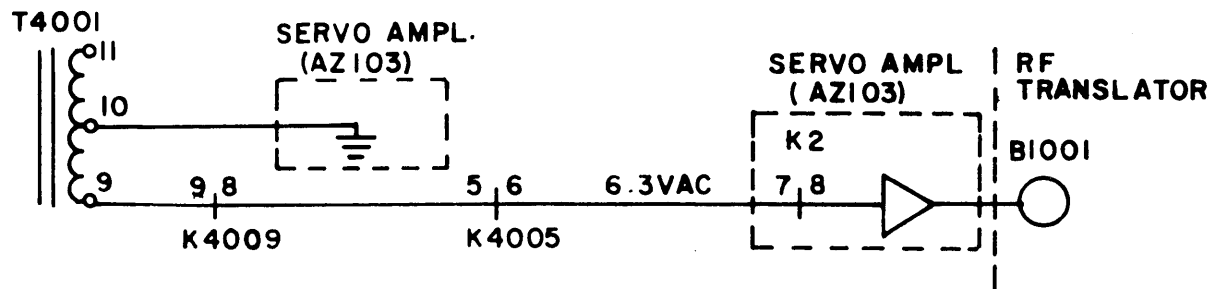
A- SEARCH TOWARD LEFT (LOW) END



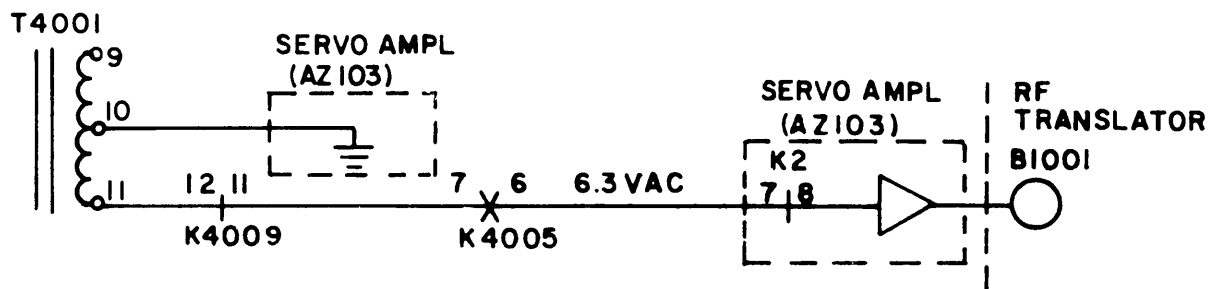
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B- SEARCH TOWARD RIGHT (HIGH) END
(LEFT-END LIMIT SWITCH HAS OPERATED)

Figure 4-3a. Frequency Tuning, Search Mode in Lower Half of Band



A- SEARCH TOWARD RIGHT (HIGH) END



B- SEARCH TOWARD LEFT (LOW) END
(RIGHT-END LIMIT SWITCH HAS OPERATED)

2012D-10

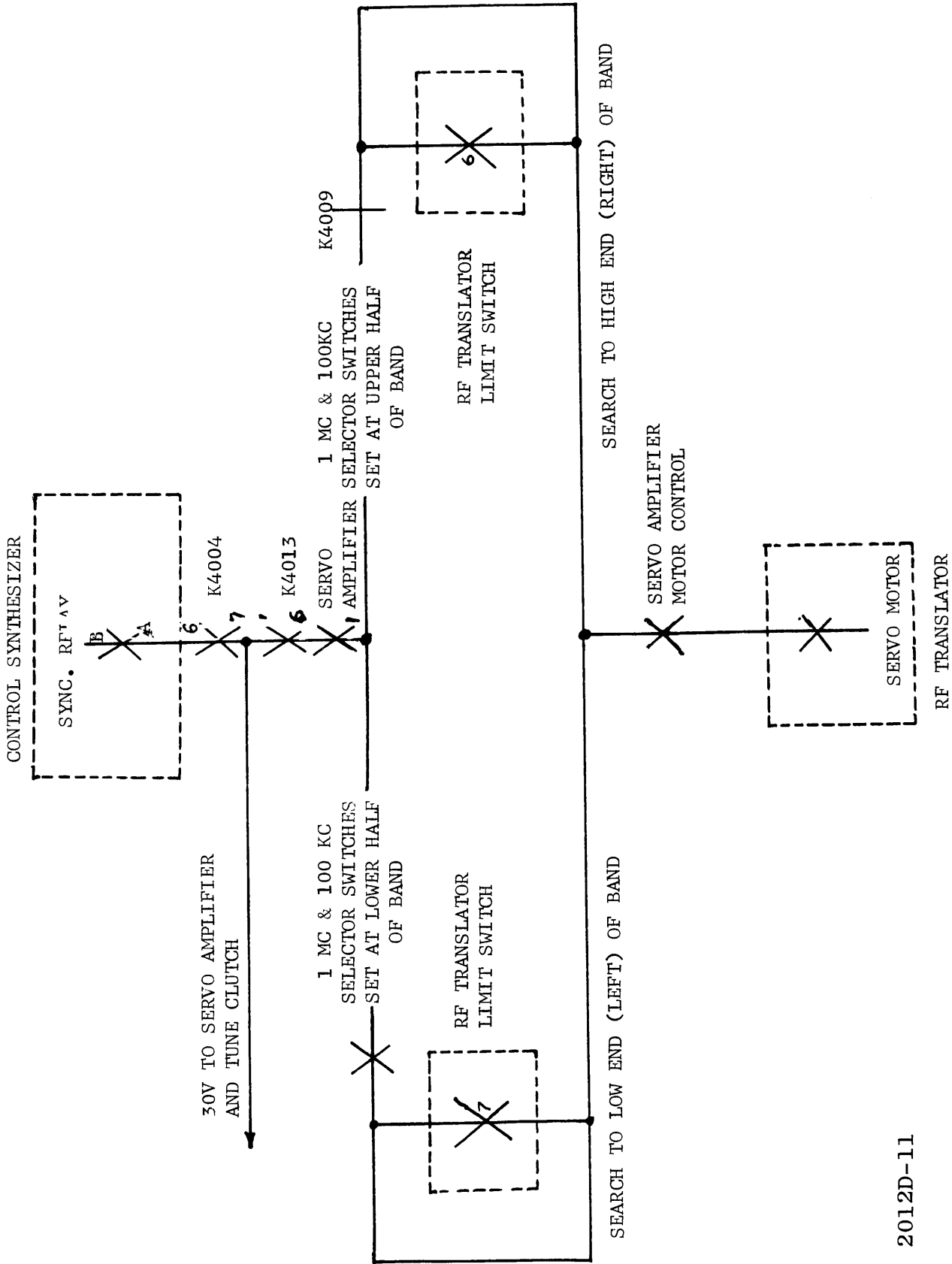
Figure 4-3b. Frequency Tuning, Search Mode
in Upper Half of Band

Voltage is supplied to the fixed phase of the servo motor and servo generator by relay K4003, which is energized from contacts on relay K4007. When K4003 is de-energized, the fixed phase voltage is removed (whenever the transmitter is in tune).

When the associated control synthesizer has been set in the 2 mc position, the ground for the transmitter master stepping switch appears at pin 33 of jack J4002 and contact 15 of relay K4009. If the "direction of search" information to the relay coil then shows that the 100 KC figure is 5 or higher, the relay remains de-energized and a ground return is provided via contact 14 of relay K4009, and at pin 32 of jack J4002, and the 2.5 - 3.0 transmitter band is selected. If the 100 KC figure is below 5, a ground return is provided via contact 16 of K4009 and pin 34 of J4002. This information is sent to the transmitter master stepping switch to position it into the correct band of bands 2 - 2.5 mc.

A 60-second time-delay circuit is formed by relay K4007, transistor Q4002, resistor R4011, and capacitor C4005; this time-delay circuit is inserted to energize K4007, stop the servo control from searching, and light a FAULT lamp on the remote control panel if the transmitter fails to tune-in within the specified length of time (the tune cycle may be started again by pushing in the RESET button on the remote control panel).

When the REMOTE/LOCAL switch on the LRCD is set at LOCAL, the LOCAL lamp will light to indicate that all power is removed from the unit, and this enables local manual tuning of the associated r-f translator and control synthesizer; when the switch is set at REMOTE, 28 volts is furnished to the unit, and this condition is indicated by the REMOTE lamp.



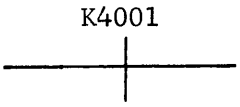
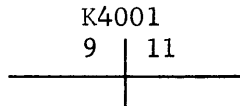
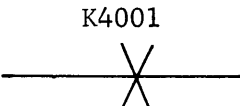
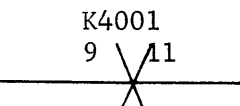
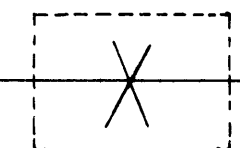
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Figure 4-4. Relay Sequence, Frequency Search Capture Range

4-4. RELAY SEQUENCE

The operation of relays is illustrated in table 4-1. For detailed description of relay operation, refer to paragraph 4-3.

TABLE 4-1 LEGEND FOR DETACHED CONTACT SCHEMATIC DIAGRAM

	<p>Relay K4001 is de-energized.</p>
	<p>Contacts 9 and 11 of relay K4001 make* when K4001 is de-energized.</p>
	<p>Relay K4001 is energized.</p>
	<p>Contacts 9 and 11 of relay K4001 make* when K4001 is energized.</p>
	<p>Relay energized within external associated equipment.</p>
	<p>* "Make" closed circuit. "Break" open circuit.</p>

SECTION 5
MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

In order to prevent equipment failure due to dust, dirt or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

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

WARNING

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

CAUTION

When using trichloroethylene, avoid contact with painted surfaces as the fluid may act as a paint remover.

5-2. TROUBLESHOOTING.

Malfunction of the LRCD could fall in one of four categories:

- (1) Power Supply Failure.
- (2) Defective relays.
- (3) Defect in relay driver Q4001 circuit.
- (4) Defect in alarm delay Q4002 circuit.

The power supply may be checked merely by measuring its output voltage (28 vdc), and checking the diodes and filter components, and transformer.

Relay failures could be due to defective contacts, or open or shorted coils. Refer to section 6, parts list, for correct relay coil resistance data.

Troubleshooting procedures for the two transistor circuits consists of checking associated resistors with an ohmmeter (with the transistors removed), and checking the transistors by substitution.

5-3. REPAIR AND REPLACEMENT.

Maintenance of the LRCD will consist mainly of component replacement. It should be noted that when replacing components having many wires connected, such as switches, relays, etc., the wires should be tagged and marked for accurate identification. When replacing components, refer to the parts list

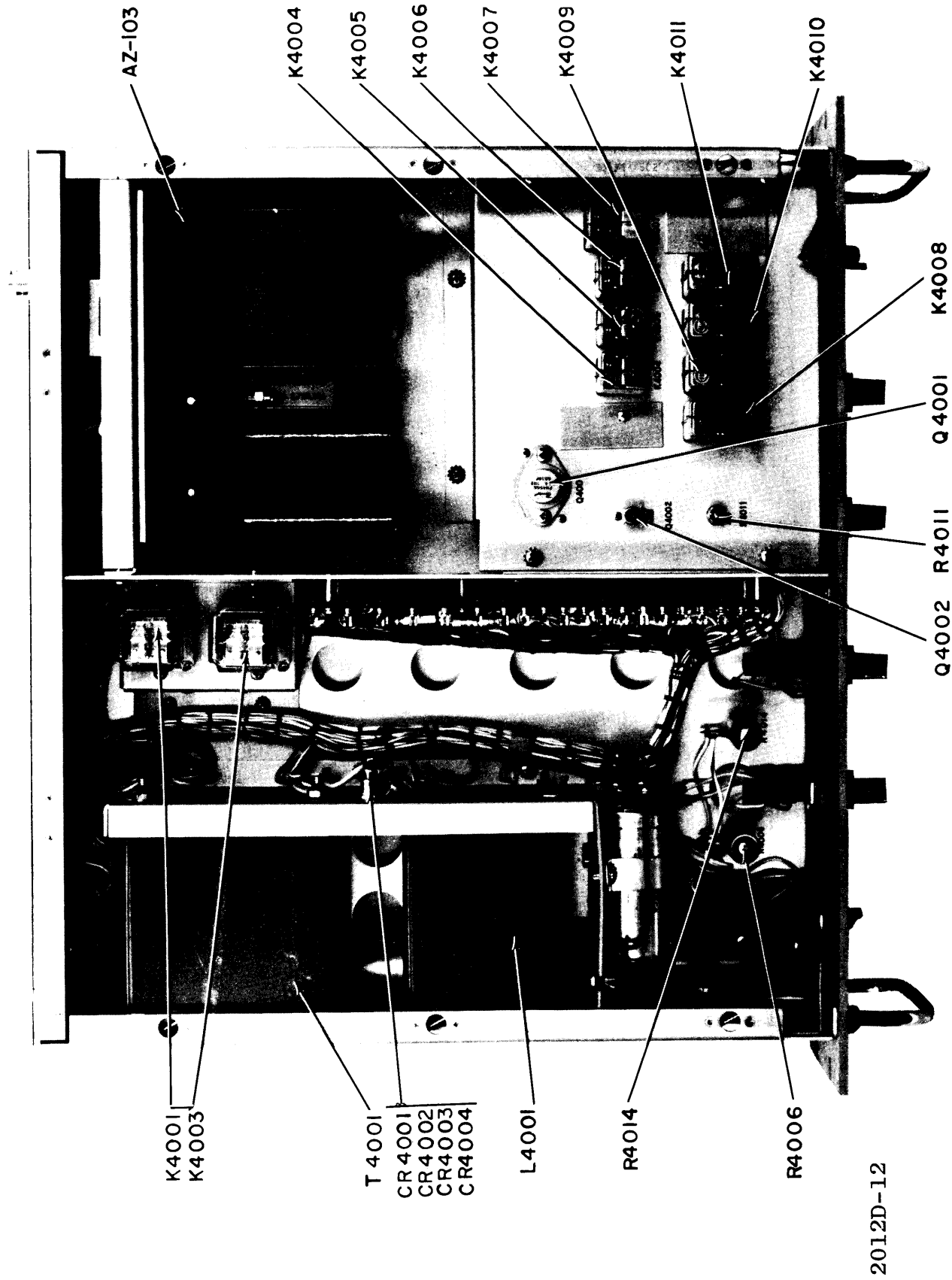


Figure 5-1. Top View, LRC D

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in section 6 for exact or equivalent replacements. Use of the schematic diagram in section 7 is advisable when replacing or disconnecting components; also refer to figure 5-1.

5-4. ADJUSTMENT OF FAULT ALARM DELAY.

To perform this adjustment, the LRCD must be connected (except as noted), and its controls must be set for transmitter remote control operation. Refer to applicable system manual for complete transmitter remote control set-up. Disconnect audio sync tone plug from jack J4006. At the remote control equipment, depress TUNE SYNC pushbutton. After 60 seconds, relay K4007 should energize, and the TUNE-SYNC lamp at the remote control equipment should light. Adjust R4011 until the correct alarm delay is obtained.

SECTION 6

PARTS LIST

6-1. INTRODUCTION

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

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

- a. Generic name.
- b. Reference designation.
- c. TMC part number.
- d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

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

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

PARTS LIST

for

CONTROL TERMINATOR, LRCD-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
AR4001	AMPLIFIER, SERVO CONTROL	AZ103
C4001	NOT USED	
C4002	CAPACITOR, FIXED, ELECTROLYTIC: 40 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized; insulated tubular case.	CE105-40-50
C4003	CAPACITOR, FIXED, ELECTROLYTIC: 75 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized; insulated tubular case.	CE105-75-50
C4004	NOT USED	
C4005	CAPACITOR, FIXED, ELECTROLYTIC: 100 uuf, -10% +150% at 120 cps at 25°C; 25 WVDC; polarized; insulated tubular case.	CE105-100-25
C4006	CAPACITOR, FIXED, ELECTROLYTIC: 2,600 uf, -10% +100%; 65 volts DC surge; 50 WVDC; aluminum case.	CE112-6
C4007	Same as C4006.	
C4008	CAPACITOR, FIXED, METALIZED PLASTIC: 0.15 uf, +5%; 400 WVDC, non-inductive winding; epoxy encapsulated case.	CN114R54J
C4009	CAPACITOR, FIXED, PAPER DIELECTRIC: 5 uf, +10% at 60 cps at 25°C, +5°C; 370 WVAC at 60 cps; hermetically sealed seamless drawn steel oval case.	CP113-2
C4010	CAPACITOR, FIXED, PAPER DIELECTRIC: 4 uf, +10% at 60 cps at 25°C, +5°C; 370 WVAC at 60 cps; hermetically sealed seamless drawn steel oval case.	CP113-1
C4011	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized; insulated tubular case.	CE105-20-50
C4012	Same as C4009.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C4013	CAPACITOR, HIGH TEMPERATURE, METALIZED PAPER: 1 uf, +20%; full voltage rating to 100°C, 75% at 125°C; 400 WVDC; hermetically sealed tubular metal case.	CP106A105-4
C4014	Same as C4006.	
C4015	CAPACITOR, FIXED, METALIZED PLASTIC: 0.10 uf, +5%; 400 WVDC, non-inductive winding; epoxy encapsulated case.	CN114R104J
CR4001	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak reverse voltage 100 V; average forward current 12 amps at 150°C; operating and storage temperature range -65°C to +200°C; hermetically sealed case.	1N1200A
CR4002 thru CR4004	Same as CR4001.	
CR4005	SEMICONDUCTOR DEVICE, DIODE: diffused silicon; peak inverse voltage 400 V; RMS voltage 280 V; average forward rectified current 750 ma at 25°C or 500 ma at 100°C; recurrent peak current 6 amps at 25°C; ambient operating temperature range -65°C to +100°C; epoxy encapsulated case.	1N2070
CR4006	Same as CR4005.	
CR4007	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 V; max. forward current 200 ma at 1.0 volts; max. reverse current 100 ua at 25°C; power dissipation 80 mw at 25°C; max. operating temperature 90°C; DO-7 case.	1N270
CR4008 thru CR4010	Same as CR4007.	
CR4011	Same as CR4005.	
CR4012	Same as CR4007.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR4013	Same as CR4007.	
CR4014	NOT USED	
CR4015	NOT USED	
CR4016	Same as CR4007.	
CR4017	Same as CR4007.	
CR4018	SEMICONDUCTOR DEVICE, DIODE	1N3324B
CR4019	Same as CR4005.	
CR4020	Same as CR4005.	
DS4001	LAMP, INCANDESCENT: 28.0 VAC/VDC; 0.04 amp; single contact; miniature T-1-3/4 bulb.	BI110-7
DS4002	Same as DS4001.	
DS4003	Same as DS4001.	
DS4004	Non-replaceable item. Part of XF4003.	
DS4005	Non-replaceable item. Part of XF4004.	
DS4006	Non-replaceable item. Part of XF4001.	
DS4007	Non-replaceable item. Part of XF4002.	
F4001	FUSE, CARTRIDGE: 3 amps; time lag; 1-1/4" long x 1/4" dia.; slow blow.	FU102-3.00
F4002	Same as F4001.	
F4003	FUSE, CARTRIDGE: 1/2 amp; quick acting; 1-1/4" long x 1/4" dia.; rated for 250 volts or less.	FU100-.5
F4004	FUSE, CARTRIDGE: 7 amps; time lag; 1-1/4" long x 1/4" dia.; slow blow.	FU102-7.00

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J4001	CONNECTOR, RECEPTACLE, ELECTRICAL: AC power; 2 male contacts rated for 10 amps, 250 V or 15 amps, 125 V; polarized; twist lock type; black bakelite.	JJ175
J4002	CONNECTOR, RECEPTACLE, ELECTRICAL: 37 female contacts, removeable crimp pin style, rated for 5 amps, 500 V RMS; connector shape polarization.	JJ310-3
J4003	CONNECTOR, RECEPTACLE, ELECTRICAL: 25 female contacts, removeable crimp pin style, rated for 5 amps, 500 V RMS; connector shape polarization.	JJ310-2
J4004	Same as J4003.	
J4005	CONNECTOR, RECEPTACLE, ELECTRICAL: bulkhead type, pressurized, series BNC.	UG657*/U
J4006	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 round female contact, straight type; series BNC to BNC.	JJ172
K4001	RELAY, POWER: 3PDT; 10 amps inductive contact current; coil rated for 24 VDC, 475 ohms, 1.2 watts; 11 pin, plug type terminals; transparent plastic construction.	RL162-1
K4002	Same as K4001.	
K4003	RELAY, ARMATURE: DPDT; 700 ohms, $\pm 10\%$ DC resistance; operating voltage 24 VDC; current rating 35 ma, 700 mw at 25°C; contacts rated for 5 amps at 29 VDC; clear high impact styrene dust cover case.	RL165-1
K4004	RELAY, ARMATURE: DPDT; 5,000 ohms, $\pm 10\%$ DC resistance; operating voltage 20.5 VDC; current rating 4.1 ma, 85 mw at 25°C; contacts rated for 1 amp at 29 VDC; clear high impact styrene dust cover case.	RL156-4
K4005	Same as K4003.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
K4006	Same as K4003.	
K4007	RELAY, ARMATURE: 4PDT; 85 ohms, $\pm 10\%$ DC resistance; operating voltage 12 VDC; current rating 60 ma, 700 mw at 25°C; contacts rated for 2 amps at 29 VDC; clear high impact styrene dust cover case.	RL156-2
K4008	RELAY, ARMATURE: 6PDT; 45 ohms, $\pm 10\%$ DC resistance; operating voltage 24 VDC; current rating 56 ma, 1,800 mw at 25°C; contacts rated for 5 amps at 29 VDC; clear high impact styrene dust cover case.	RL156-5
K4009 thru K4011	Same as K4008.	
K4012	NOT USED	
K4013	RELAY, ARMATURE: sub-miniature; coil resistance 189 ohms; contacts rated for 2 amps at 26.5 VDC resistive; operating temperature range -65°C to +125°C.	RL160-2
L4001	CHOKER, FILTER: 2 terminals; 0.12 ohms DC resistance; 0.03 hy min. with 10 VAC, 60 cps, 1.0 amp DC (terminals 1 and 2); 0.004 hy min. with 10 VAC, 60 cps, 6 amps DC (terminals 1 and 2); hermetically sealed.	TF5026
Q4001	TRANSISTOR: germanium, hi current; collector to base voltage 40 V; collector to emitter and emitter to base voltage 20 V; collector current 7 amps; base current 3 amps; power dissipation 85 watts at 25°C; operating-storage and junction temperature range -65°C to +110°C; JEDEC type TO-3 case.	2N456A
Q4002	TRANSISTOR: silicon, unijunction; emitter to base reverse voltage 60 V; RMS emitter current 70 ma; peak emitter current 2 amps; power dissipation 450 mw at 25°C; operating temperature range -65°C to +140°C; storage temperature range -65°C to +175°C; hermetically sealed glass to metal case.	2N492

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R4001	RESISTOR, FIXED, COMPOSITION: 220 ohms, $\pm 5\%$; 1 watt.	RC32GF221J
R4002	Same as R4001.	
R4003	RESISTOR, FIXED, COMPOSITION: 33 ohms, $\pm 5\%$; 1/2 watt.	RC20GF330J
R4004	NOT USED	
R4005	RESISTOR, FIXED, COMPOSITION: 270 ohms, $\pm 5\%$; 2 watts.	RC42GF271J
R4006	RESISTOR, FIXED, WIREWOUND: 0.5 ohms, current rating 6,300 ma; 20 watts.	RW110-47
R4007	RESISTOR, FIXED, WIREWOUND: 75 ohms, current rating 815 ma; 50 watts.	RW105-50
R4008	NOT USED	
R4009	NOT USED	
R4010	RESISTOR, FIXED, COMPOSITION: 470 ohms, $\pm 5\%$; 1 watt.	RC32GF471J
R4011	RESISTOR, VARIABLE, COMPOSITION: 500,000 ohms, $\pm 20\%$; 0.5 watt at 70°C; linear taper.	RV106UX8B-504B
R4012	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, $\pm 5\%$; 2 watts.	RC42GF102J
R4013	RESISTOR, FIXED, WIREWOUND: 15 ohms, current rating 1,150 ma; 20 watts.	RW110-5
R4014	Same as R4006.	
R4015	RESISTOR, FIXED, COMPOSITION: 150 ohms, $\pm 5\%$; 1 watt.	RC32GF151J
R4016	Same as R4015.	

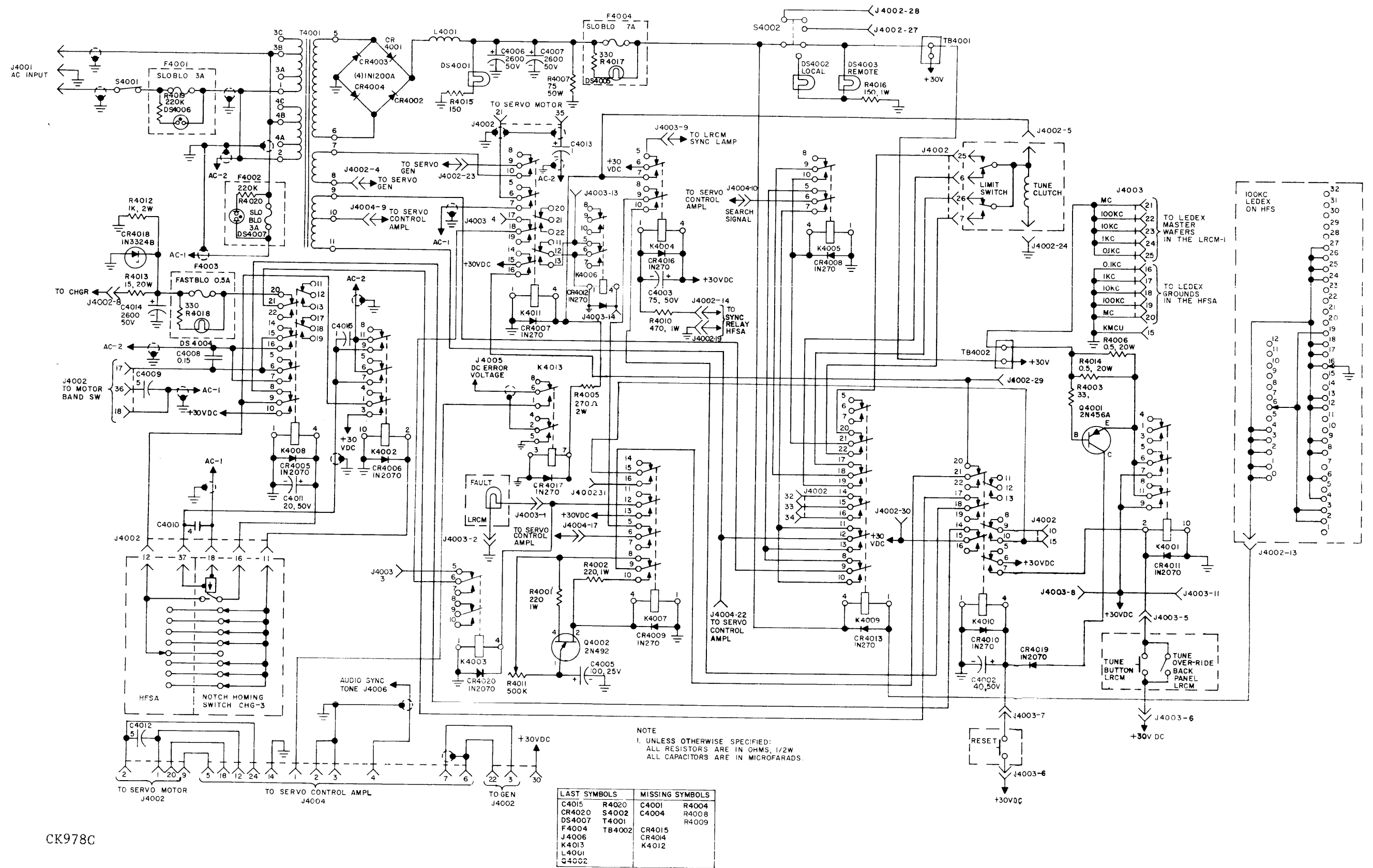
PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R4017	Non-replaceable item. Part of XF4004.	
R4018	Non-replaceable item. Part of XF4003.	
R4019	Non-replaceable item. Part of XF4001.	
R4020	Non-replaceable item. Part of XF4002.	
S4001	SWITCH, TOGGLE: SPST; 6 amps, 125 VAC; 28° angle of throw; solder lug terminals.	ST12A
S4002	SWITCH, TOGGLE: SPDT; 6 amps, 125 VAC; 28° angle of throw; solder lug terminals.	ST12D
T4001	TRANSFORMER, POWER, STEP-DOWN: primary-105, 115, 125 V, 50/60 cps, single phase; secondary- 34.8 V at 5 amps DC; 27 V, 13.1 V at 400 ma DC, center tapped; 15 solder lug type terminals; fully enclosed hermetically sealed steel case.	TF295
TB4001	TERMINAL BOARD, BARRIER: 2 double right angle solder lug type terminals; bakelite board.	TM127-2
TB4002	Same as TB4001.	
XDS4001	LIGHT, INDICATOR: white translucent lens, sub-miniature type.	TS153-5
XDS4002	LIGHT, INDICATOR: green lens, sub-miniature type.	TS153-2
XDS4003	LIGHT, INDICATOR: amber lens, sub-miniature type.	TS153-3
XF4001	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dia. ; 90 to 300 volts, 20 amps; neon lamp type with 220K ohm lamp resistor; clear transparent flat sided knob; black body; consists of DS4006, R4019.	FH104-3
XF4002	Same as XF4001. Consists of DS4007, R4020.	

PARTS LIST (CONT)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XF4003	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dia.; 22 to 33 volts, 20 amps; incandescent lamp type with 330 ohm lamp resistor; amber transparent flat sided knob; brown body; consists of DS4004, R4018.	FH104-11
XF4004	Same as XF4003. Consists of DS4005, R4017.	
XK4001	SOCKET, ELECTRON TUBE: 11 cadmium plated contacts, rated for 500 volts, 3 amps; phenolic solid black body.	TS100-5
XK4002	Same as XK4001.	
XK4003	SOCKET, RELAY: with retainer; 6 beryllium copper gold plated contacts; black phenolic socket.	TS171-1
XK4004 thru XK4006	Same as XK4003.	
XK4007	SOCKET, RELAY: with retainer; 12 beryllium copper gold plated contacts; black phenolic socket.	TS171-3
XK4008	SOCKET, RELAY: with retainer; 18 beryllium copper gold plated contacts; black phenolic socket.	TS171-2
XK4009 thru XK4011	Same as XK4008.	
XK4012	NOT USED	
XK4013	Same as XK4003.	
XQ4001	SOCKET, TRANSISTOR: 7 pin contact accommodation; 0.040 or 0.050 dia.; polarized; 1 terminal lug grounding strap; o/a dim. 1-37/64" x 1" max.	TS166-1
XQ4002	SOCKET, TRANSISTOR: 4 silver plated beryllium copper contacts with gold flash; mica filled molded phenolic socket.	TS147

SECTION 7
SCHEMATIC DIAGRAMS



CK978C

Figure 7-1. Schematic Diagram, LRCD.