TECHNICAL MANUAL
FOR
MODEL SLS-4
STRIP LINE SWITCH

SERIAL NO. 315

MODEL NO. SLS-4M (20 X 10)

NO. OF COLUMNS 20

NO. OF ROWS 10

DELTA ELECTRONICS

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TECHNICAL MANUAL
FOR
MODEL SLS-4
STRIP LINE SWITCH

This Technical Manual is Applicable to the
Model SLS-4M (20 X 10) Strip Line Switch
Serial Number 315
Delta Electronics Reference M47/R05

Manufactured Under
U. S. Patent No. 3,666,902

Delta Electronics, Inc.
5730 General Washington Drive
Alexandria, Virginia 22312

D93-116C(M47/R05/315) **ISSUE DATE: March 10, 1998**

CERTIFICATE OF WARRANTY

Delta Electronics, Inc. warrants to Purchaser that the product it delivers is free of defects in materials and has high standards of quality and workmanship.

This warranty applies to the period of one year from the date of delivery except for component parts purchased from other sources and assembled into the equipment by Delta Electronics, Inc. Such component parts bear only the warranty of the manufacturer thereof in effect at the time of shipment to Purchaser.

Delta Electronics, Inc. will, at its own expense and, after written notice has been received and acknowledged by Delta, repair or replace any product which is defective (according to the usage of the trade) during the above designated warranty period when Delta Electronics, Inc. receives such product at its Alexandria address with shipment costs prepaid by Purchaser.

Delta Electronics, Inc. is not liable for consequential damages.

No other warranty is expressed or implied.

NOTICE

This technical manual is applicable to the Model SLS-4M (20 X 10) Strip Line Switch, serial number 315, upon installation of the D42-98-1 Antenna Ground Field Modification Kit.

The subject Model SLS-4M Strip Line Switch is a 20 column by 10 row switch equipped for operation with nine transmitters and twenty antennas. The top row, Row A, provides for grounding of the antenna ports. The switch is equipped with a custom configuration of remotely controllable transmitter/antenna switching crosspoints and antenna grounding crosspoints as described in Section 10, Custom Requirements, of this manual.

Sections 1 through 9 of this technical manual provide principles of operation, installation, operation and maintenance information applicable to both the standard motorized switch and the subject custom configuration switch. Refer to Section 10 of this technical manual for custom configuration and installation information applicable only to the subject switch. Section 11 of this technical manual provides the antenna ground field modification kit installation instructions for reference.

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WARNING

Exercise caution when performing maintenance on an operating SLS-4 Strip Line Switch. The RF conductors operate at high voltage when transmitter power is applied, and touching the contact springs, rotor contacts, terminal jumpers, or RF connectors may result in injury or death. Take care to ensure against the switching of an active circuit through the crosspoint being serviced or the adjacent crosspoints as identified above.

WARNING

Perform continuity checks only on inactive transmission lines.

CAUTION

Certain RF conductors of the SLS-4 Strip Line Switch are manufactured from a beryllium copper alloy, Berylco 25. In particular, all strip line contact assemblies, part number D81-108-X, and the ground contacts, part number D75-104-1, use this alloy as an electrically conductive spring. This copper alloy contains 1.85 percent beryllium. Under normal handling and use, the solid form of this alloy poses few health hazards. However, any cutting, welding or grinding of this material will produce dust, fumes or particulate containing the hazardous component elements of this material. Dispose of these identified parts in accordance with local regulations.

CAUTION

Certain RF insulators of the SLS-4 Strip Line Switch use polytetrafluoroethylene or PTFE as an insulating material. In particular, the rotor contact, part number D81-89-X, uses PTFE as the shaft insulator and the bullet insulator, part number D82-38-1, is PTFE. Under normal handling and use, the solid form of PTFE poses no health hazards. However, the combustion products of PTFE are toxic. Dispose of these identified parts in accordance with local regulations.

CAUTION

Self-supporting SLS-4 switches are top-heavy. Be careful handling a self-supporting switch before it is securely mounted to the floor.

CAUTION

Be careful in mating the center conductor of the rigid coaxial transmission line with the switch bullet. Remove the terminal cover and support the back end of the bullet stub when pushing the coaxial line into position. Misalignment of the center conductor, or undue pressure on the bullet, could damage the teflon bullet insulator.

CAUTION

The interlock jumper must be omitted from a path that does not have a load connected or the transmitter may be accidentally operated into an open circuit.

CAUTION

For the special case of the SLS-4 Strip Line Switch equipped with either row and/or column through trunking, both immediately adjacent row crosspoints and/or both immediately adjacent column crosspoints, in addition to the crosspoint to be repaired, must be de-energized.

CAUTION

Be careful to keep the rotor contact from damaging the ground contacts during removal of the rotor contact.

CAUTION

Be careful to keep the rotor contact from damaging the ground contact during installation of the rotor contact.

CAUTION

To manually operate a motorized crosspoint, rotate the front panel knob in the counterclockwise direction. The motor actuator assembly ratchet does not permit clockwise rotation of the front panel knob. Forcing clockwise rotation will cause damage to the rotor assembly or motor actuator assembly.

CAUTION

Turn off both the +50 VDC actuator power supply and the +12 VDC Local MCU-8/-9 unit power supply prior to removing or installing the AIA in order to prevent damage to the integrated circuits.

CAUTION

Remove the column interlock jumper corresponding to a switch column which does not have an RF load connected to prevent accidental operation of a transmitter into an open circuit.

SECTION 1

GENERAL

1.1 SCOPE

This technical manual covers the description, installation, operation and maintenance for the Model SLS-4 Strip Line Switch manufactured by Delta Electronics, Inc.

1.2 GENERAL DESCRIPTION

1.2.1 The Model SLS-4 Strip Line Switch is a compact, manually or remotely controlled, 50 ohm switch matrix for connecting any of a number of transmitters having power outputs of up to 30 kW average to any of a number of antennas. The switch is based on a design principle (Patent No. 3,666,902) that permits an extremely compact system with excellent power rating, insertion VSWR and cross channel isolation characteristics. Figure 1-1 shows a typical switch.

1.2.2 The design of the switch makes it inherently impossible to connect more than one transmitter to one antenna or to connect one transmitter to more than one antenna. An electrical interlock circuit that exactly duplicates the RF circuit operates to remove power from the circuit prior to switching. At the completion of the switching sequence, the interlock circuit is rerouted and reconnected to protect the new RF circuit. An indicator circuit provides a dry contact closure for each transmitter to antenna connection for remote indication of the switch status.

1.3 CONFIGURATION

1.3.1 The size and physical configuration of the SLS-4 are extremely flexible and may be adapted to meet special installation requirements. The basic physical forms of the unit are:

1. Free standing, self-supporting structure in which the cabinet is an integral part of the switch.
2. Rack mounting for installation in a standard 19" or 24" wide EIA equipment rack.

1.3.2 The RF switching circuit is composed of identical "building blocks" or "crosspoints" consisting of identical components. The units are constructed to order to contain the number of crosspoints required for matrices ranging from one column and one row (1 X 1) to 40 columns and 30 rows (40 X 30) for the self-supporting switch, to 4 columns and 8 rows (4 X 8) for the 19" rack mounting switch, and to 6 columns and 8 rows (6 X 8) for the 24" rack mounting switch. Larger matrices are available on special order.

1.3.3 Certain basic physical configurations are identified by letters as follows.

1.3.3.1 Configuration A

This basic configuration has the column connectors facing upward on the top of the unit and the row connectors staggered on opposite sides of the unit facing to the rear. This unit may be inverted (Configuration AI) to permit the column connectors to exit from the bottom for installation in transportable vans or transmitter facilities utilizing floor cable trenches for antenna coaxial cable distribution.

1.3.3.2 Configuration B

The column connectors are identical to Configuration A. All row connectors are located along one side of the unit facing to the rear. This configuration may also be inverted.

1.3.3.3 Configuration D

This unit is designed for installation in a standard 19" or 24" wide EIA equipment rack. All row and column connectors face to the rear.

1.3.3.4 Configuration DSA

This configuration, a modification of Configuration A, double staggers the row connectors on opposite sides of the unit to provide four vertical columns of row connectors. This configuration is recommended for a switch with row extension kits in order to minimize the cabinet depth.

1.3.4 Terminations

The standard termination for the SLS-4 Strip Line Switch is the 1-5/8" EIA male flange connector. The Type N, Type LC, Type LT, and 7/8" EIA male flange connectors are available as optional terminations.

1.3.5 Trunking

On special order, the SLS-4 Strip Line Switch can be supplied with extra terminations to permit through trunking of either rows or columns.

1.4 TECHNICAL MANUAL FORMAT

To accommodate varying sizes of units, this manual describes the basic crosspoint operational principles and presents general information. The quantities that vary, such as the installation dimensions and parts, may be readily determined from the tables in the appropriate sections of this manual. When required, the manual includes a Custom Requirements section to detail unique features. For manual switches, the Custom Requirements section is Section 8. Due to the custom nature of remote control systems for a motorized SLS-4, the technical manual includes the operational principles of the motor actuator and power supply as Sections 8 and 9 only when the manual is supplied for a motorized SLS-4 system. For motorized switches, the Custom Requirements section is Section 10.

1.5 EQUIPMENT AND DOCUMENTS FURNISHED OR REQUIRED

Section 7.3, Model SLS-4 Strip Line Switch List of Material, lists all items furnished for the subject SLS-4 system. Equipment and documents not furnished but required to install, operate and maintain the SLS-4, including tools and test equipment, are listed in Table 1-1.

TABLE 1-1

EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

Equipment/Publication	Representative Equipment Model No.	Application
RF Network Analyzer	Hewlett-Packard 8754A with 8502B, 11850A and 11851	RF Performance Verification
Digital Multimeter	Fluke 8020B	Troubleshooting
Dual Trace Storage Oscilloscope	Tektronix 468	Troubleshooting
T-Wrench, 7/8" EIA	Delta D43-3	Installation/Removal of 7/8" EIA Bullet
T-Wrench, 1-5/8" EIA	Delta D43-4	Installation/Removal of 1-5/8" EIA Bullet

SECTION 2

SPECIFICATIONS

Model and Name:	Model SLS-4 Strip Line Switch
Frequency Range:	DC to 32 MHz Standard To 300 MHz Special Order
Impedance:	50 Ohms Coaxial
Insertion VSWR:	1.10 Maximum, DC to 32 MHz, matrix size up to 40 X 30; 1.20 Maximum, 32 to 300 MHz, matrix size up to 7 X 7
Insertion Loss:	0.15 dB, DC to 32 MHz, 16 X 16 matrix 0.18 dB, DC to 32 MHz, 20 X 20 matrix 0.30 dB, DC to 32 MHz, 40 X 30 matrix 0.25 dB, 32 to 300 MHz, 7 X 7 matrix
Power Rating with Unity VSWR:	30 kW Average, 100 kW Peak, DC to 32 MHz*; 5 kW Average, 20 kW Peak, 32 to 300 MHz
Cross Channel Isolation:	70 dB Minimum, DC to 32 MHz 45 dB Minimum, 32 to 300 MHz
Temperature:	Operating: 0°C to +50°C Non-Operating: -62°C to +75°C
Humidity:	0% to 95% Noncondensing
Terminations:	Standard: 1-5/8" EIA Male Flange Optional: 7/8" EIA Male Flange Type LC Receptacle Type LT Receptacle Type N Receptacle

Size - Self Supporting:	65.25" High X 17" Deep X Variable Width for 15 rows maximum. Height increases 2" for each row above 15. Depth increases to 30" for 30 rows and greater.
Size - Rack Mounting:	19" Wide Standard EIA Rack Panel X 12.06" Deep X Variable Height (8 rows maximum) 24" Wide Standard EIA Rack Panel X 12.06" Deep X Variable Height (8 rows maximum)
Weight:	Because each SLS-4 is custom built to include the options chosen by the customer, the weight of each switch varies. The following table gives approximate weights for some representative sizes of self-supporting switches.

SLS-4	(5 X 5)	Manual	140 lbs
SLS-4M	(5 X 5)	Motorized	161 lbs
SLS-4	(10 X 11)	Manual	260 lbs
SLS-4M	(10 X 11)	Motorized	338 lbs
SLS-4	(22 X 20)	Manual	540 lbs
SLS-4M	(22 X 20)	Motorized	822 lbs
SLS-4	(40 X 30)	Manual	1820 lbs
SLS-4M	(40 X 30)	Motorized	2570 lbs

System Components:

1 Each Strip Line Switch
1 Each Indicator Cable Connector (Elco #00-8017-130-217-004)
1 Each Technical Manual (D93-116C)
2 Each Contact Spreader Tools (D43-1)
*4 Each Floor Mounting Brackets (D80-145)
*4 Each Lag Screw, 1/2" X 2"
*4 Each Lag Screw Shields, 1/2" Short

Accessories Available:

Motor Actuators (Remote Control)
Actuator Interface Unit
Local/Remote Control Systems
Thru-Trunking of Columns and Rows
Row Connector Extension Kits
Built-In Dummy Load
Field Modification Kits/RF Connector Adapters
Interlock Isolation Assembly
Keylocks for Isolating Antennas
Special Row or Column for Grounding Unused Antennas

*Omitted for rack mounting.

SECTION 3

PRINCIPLES OF OPERATION

3.1 FUNCTIONAL DESCRIPTION OF RF SWITCHING

3.1.1 The design of the SLS-4 Strip Line Switch starts with a vertical center panel as shown in the section view, Figure 3-1. On the back of this panel, columns of "I" beams form vertical channels. Mounting plates cover these channels to form rectangular cavities which are used as the outer conductors of coaxial transmission lines. The inner conductors are formed by arrangements of double leaf springs suspended into the channel by insulators attached to the mounting plates. These double leaf springs are parallel to the "I" beam dividers and actually operate as a dual strip line rather than a concentric coaxial transmission line. The spacing of the leaf springs and the dividers is such that the transmission line has a 50 ohm characteristic impedance. This dual strip line design provides a large current capability, and the double fingers of each leaf spring provide positive contact for the transmission of RF energy.

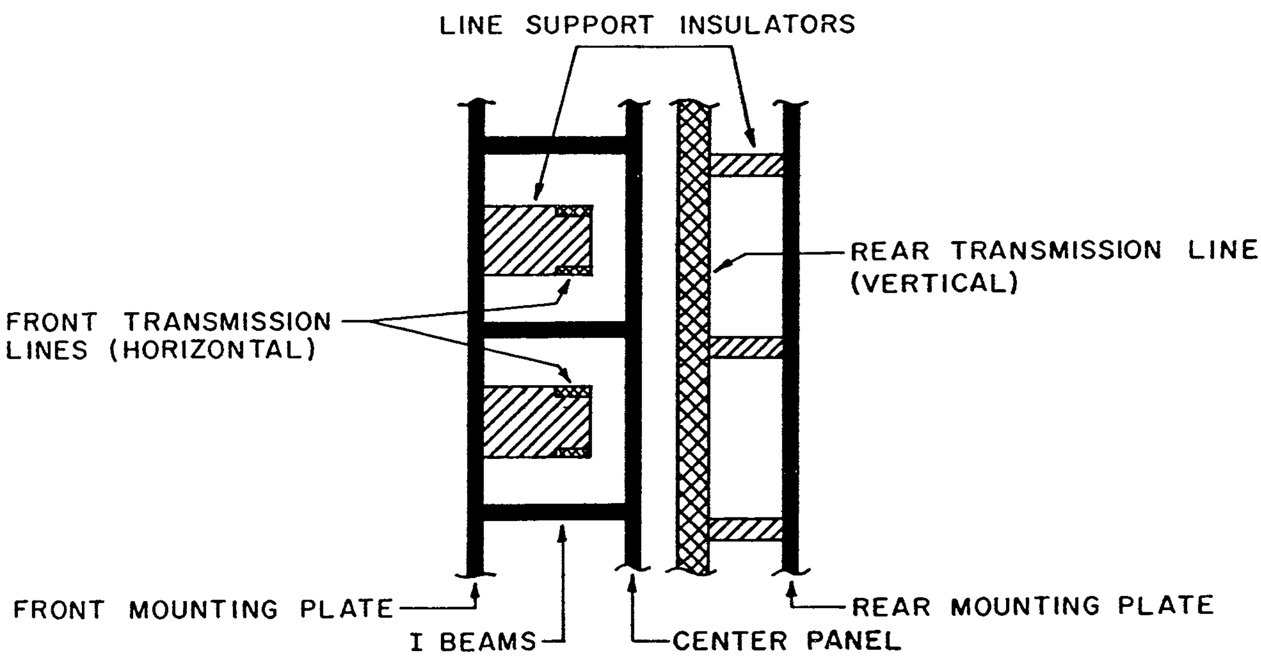


Figure 3-1

Basic Configuration

3.1.2 Identical channels are fabricated running horizontally on the front of the center panel and identical transmission lines are constructed within these channels. As shown in Figure 3-1, each of the horizontal transmission lines (rows) on the front of the unit crosses over each of the vertical transmission lines (columns) on the rear of the unit although the lines are separated by the center panel at these crossing points.

3.1.3 To transform the transmission line assembly described above into a switching matrix, a system of connecting the column lines to the row lines is required. This switching is accomplished through the use of a rotor contact at each column and row intersection. Figure 3-2A is an illustration of a column and row intersection shown in the normal Thru position. The column and row leaf springs maintain contact with their adjacent leaf springs and power flows straight through the intersection. These two Thru contacts are insulated for each other, thus, no power is transferred between the front and rear transmission lines. In addition, a grounding spring (not shown in the figure) mounted on the center panel grounds the rotor contact in the Thru position, shielding the transmission lines from each other.

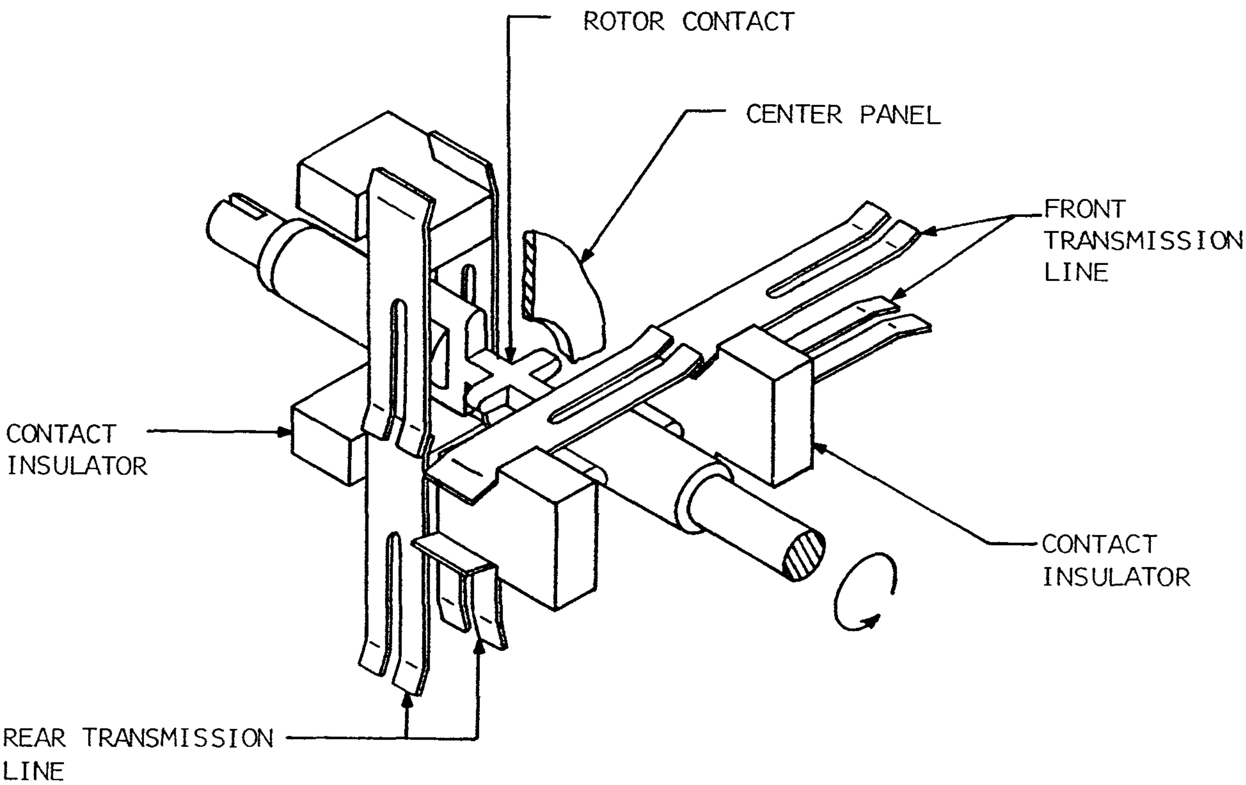


Figure 3-2A

Thru Connection

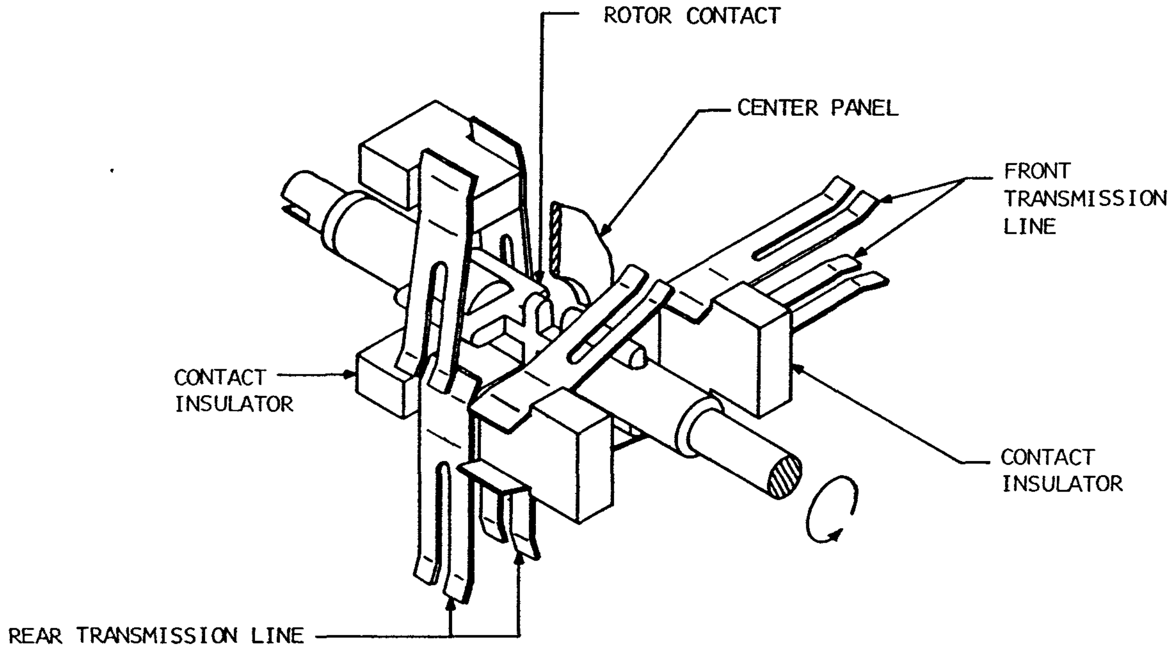


Figure 3-2B

Turn Connection

3.1.4 When the rotor contact is rotated ninety degrees, the conductive shoulders of the rotor contact connect the column transmission line to the row transmission line and accomplish the desired switching. This Turn position is shown in Figure 3-2B. The conductive shoulder of the rotor contact spread the front and rear contact springs, and thereby remove continuity from the adjacent contact spring assemblies. This action removes all transmission line stubs from the RF circuit and prevents the accidental paralleling of inputs or outputs.

3.2 INTERLOCK CIRCUIT

3.2.1 All auxiliary switching is accomplished through the use of a wafer switch deck attached to the manual switch or motor actuator located on the rear of each switch module. The rotor contact is mechanically linked to the manual switch or motor actuator. Thus, the rotation of the rotor contact automatically accomplishes the auxiliary switching.

3.2.2 The interlock switching circuit consists of three single pole switches for each crosspoint as shown in Figure 3-3. The interlock switches duplicate the switching of the RF circuit to provide complete interlock. With all of the rotor contacts in the Thru position, the column interlock bus is carried straight through by the column switches, and the row interlock bus is carried straight through by the row switches. When a rotor contact is in the Turn position, the column and row paths are connected together by the turn switch. The resulting interlock path for crosspoint B1 in the Turn position is shown in Figure 3-3.

3.2.3 The timing of the interlock circuit switching prohibits the occurrence of "hot" RF switching. The first 30 degrees of rotation open the established interlock path, removing any RF power from the crosspoint. The second 30 degrees of rotation accomplish switching of the RF path to the desired new circuit. The last 30 degrees of rotation establish the interlock circuit according to the new RF path, permitting RF power to be applied.

3.2.4 The interlock circuit is single wire circuit with a common return. Isolated interlocks may be achieved, when required, by the addition of external relays. The Model IIK Interlock Isolation Assembly may be supplied installed on the Model SLS-4 as an optional item.

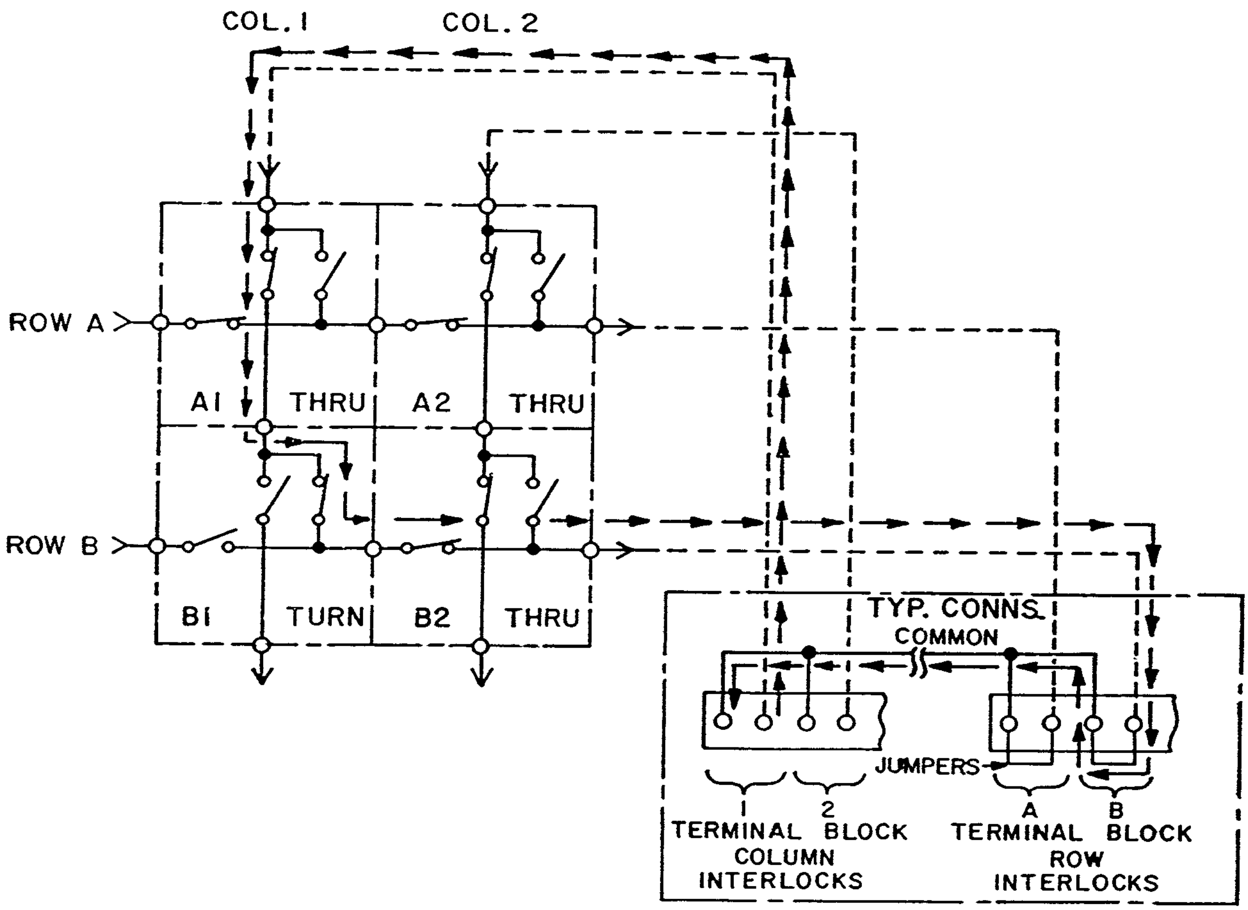


Figure 3-3

Interlock Circuit

3.3 INDICATOR CIRCUIT

The indicator circuit consists of a single pole switch for each crosspoint. This circuit is supplied as part of the wafer switch deck attached to the manual switch or motor actuator located on the rear of each switch module. The switch is closed when the rotor contact is in the Turn position, connecting the corresponding terminal on a multi-pin connector (mating connector supplied) to a common, floating bus. This circuit may be used to energize the appropriate indicator on a remote readout panel to indicate the switching status of the system.

SECTION 4

INSTALLATION

4.1 INSPECTION

CAUTION

Self-supporting SLS-4 switches are top-heavy. Be careful handling a self-supporting switch before it is securely mounted to the floor.

4.1.1 Upon receipt of the SLS-4 switch, inspect carefully for any evidence of shipping damage. Open the shipping crate and unpack the protective packing material. Keep the shipping crate and packing materials in case the switch has to be reshipped.

4.1.2 Verify that all equipment listed in the shipping/packing documents is present when the switch is unpacked. Visually inspect the switch for damage to the front, rear or side panels. Make certain all hardware fixtures are firmly fastened in place. Check the crosspoint knobs for damage. Check any enclosures for shipping damage. Check all connectors and plugs for missing or damaged pins. Immediately report any damage to the carrier.

4.1.3 To reship the Strip Line Switch, repack it in the reverse order of unpacking, using the packing material to protect the unit. If the original shipping crate is lost or damaged, construct a new shipping crate as described in Section 4.6.

4.2 INSTALLATION - SELF SUPPORTING

4.2.1 The Installation Drawings, Figures 4-2, 4-3 and 4-4, show dimensions significant to the installation of the switch. Place the switch in its final position and position the four hold-down brackets, as shown in the Installation Drawings, inside the bottom of the switch. Mark the four mounting bolt holes on the floor. Then drill the holes and fit them with the appropriate anchors. Then mount and tighten the hold-down brackets, securing the switch to the floor.

CAUTION

Be careful in mating the center conductor of the rigid coaxial transmission line with the switch bullet. Remove the terminal cover and support the back end of the bullet stub when pushing the coaxial line into position. Misalignment of the center conductor, or undue pressure on the bullet, could damage the teflon bullet insulator.

4.2.2 The column RF connectors are at the top of the switch and the row RF connectors are on the rear of the switch along the right and/or left hand sides (see Figures 4-3 and 4-4). The connectors are 1-5/8" EIA male flanges or special connectors to order. Adapter plates and bullets to adapt 1-5/8" connectors to 7/8" connectors or to adapt to special connectors such as Type LC, LT or N are available as accessory items. The 1-5/8" EIA male flange and the 7/8" EIA male flange have tapped holes for the coaxial flange bolts. For each 1-5/8" EIA male flange provided on the switch, attaching hardware consisting of four (4) each 5/16"-18 X 3/4" long stainless steel hex head bolts and four (4) each 5/16" stainless steel split lockwashers is supplied. For each 7/8" EIA male flange provided on the switch, attaching hardware consisting of three (3) each 1/4"-20 X 3/4" long stainless steel hex head bolts and three (3) each 1/4" stainless steel split lockwashers is supplied. This hardware must be used when attaching the rigid coaxial transmission line to the switch to ensure proper mounting of the transmission lines. Be careful to accurately position the coaxial flanges to match the switch flange plates so the switch structure will not be strained when the flange bolts are tightened. Be careful in mating the Type LC, LT or N coaxial cable connectors with the switch receptacles so that the center conductors are not damaged.

4.3 INSTALLATION - RACK MOUNTING

The Installation Drawings, Figures 4-5 and 4-6, show the method of mounting the switch (Configuration D) in a standard 19" or 24" wide EIA equipment rack. The center panel mounts to a set of auxiliary panel mounting angles which are located 3.312" behind the standard front panel mounting angles. The center panel mounting slots are on standard EIA spacings and mount to the auxiliary angles with standard panel mounting hardware. The front panel mounts to the front panel mounting angles in the same manner as a regular rack panel with standard panel mounting hardware. The column RF connectors are at the top rear of the switch and the row RF connectors are on the right and left rear of the switch as shown in Figures 4-5 and 4-6. Connect the coaxial transmission lines to the switch in accordance with the cautions and instructions of Section 4.2.2.

4.4 COLUMN AND ROW IDENTIFICATION

For general purpose identification, the columns and their connectors are identified by numbers (1, 2, etc.) assigned from left to right when viewed from the front. The rows and their connectors are identified by letters (A, B, etc.) assigned from top to bottom.

4.5 INTERLOCK AND INDICATOR CONNECTIONS

4.5.1 Interlock

The interlock connections are made on terminal blocks located on the front of the switch below the main panel. Figure 4-1 shows the terminal configuration. Transmitter interlock connections are made to the terminals corresponding to the input connection (column or row). The interlock circuit is completed to the common return with jumpers or external antenna or dummy load interlock switches placed on the terminal block corresponding to the load connections. The jumpers are shown installed on the row terminal blocks in Figure 4-1. A hole is provided adjacent to the terminal blocks to permit the station wire harness to be dressed through the panel and out the rear of the switch. The terminals are located on the front of the switch to provide convenient access for circuit tracing and connection modification.

CAUTION

The interlock jumper must be omitted from a path that does not have a load connected or the transmitter may be accidentally operated into an open circuit.

4.5.2 The interlock circuit has a common return. If the transmitters' interlock circuits do not have a common (or ground), auxiliary isolation relays must be installed between the switch interlock and the transmitter to obtain the required transmitter isolation. (See Section 3.2.4.)

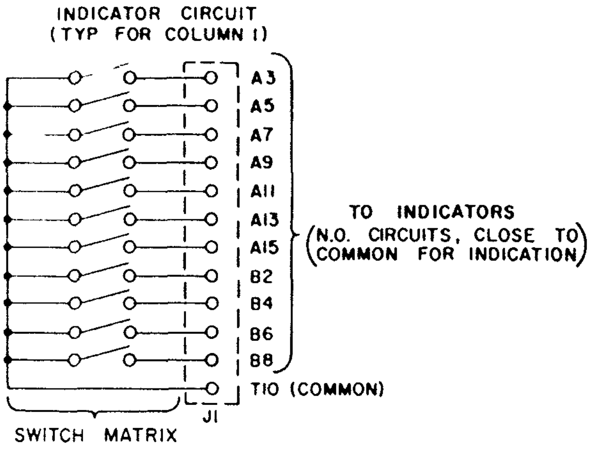
4.5.3 Indicator

The connections for a remote status panel (not supplied) are made with a multi-pin connector located on the rear of the switch below the main panel. The table in Figure 4-1 gives the pin connections to be made in the cable connector (supplied). The indicator circuit is a Form A switch closure from the connector pin shown in the PIN column of the table to the common (COM) bus when the switch corresponding to the column and row of the table is closed.

4.6 REPACKING

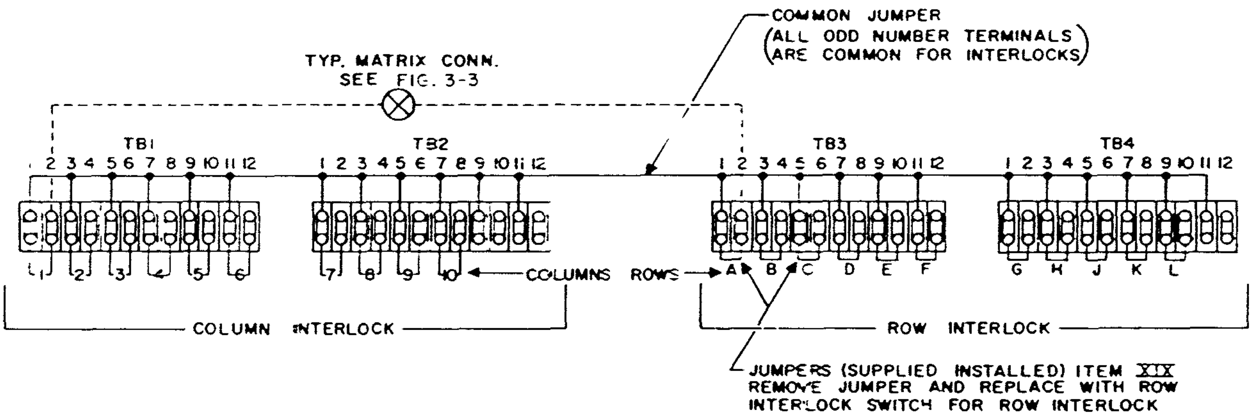
If the original shipping crate is lost or damaged, build a new shipping crate and pack the Strip Line Switch for shipping as follows:

Measure the height, width and depth of the switch. When measuring, include all switch protrusions except the eyebolts. Build a skid 3-1/4" wider and 7-1/4" deeper than the switch. Center the switch on the skid, then bolt the switch frame to the skid. Build two panels to cover the front and back of the switch, two panels to cover the sides of the switch, and a panel to cover the top of the switch. Build the front and back panels 3-3/4" higher and 3-1/4" wider than the switch. Build the side panels 3-3/4" higher and 7-1/4" deeper than the switch. Build the top panel 3-1/4" wider and 7-1/4" deeper than the switch. Make the panels out of 3/8" plywood. If shipping any enclosures with the switch, place the enclosures in a small box and secure inside the switch frame. Wrap the switch on all sides with polyurethane or plastic sheeting. Nail the front and back panels to the skid. Then enclose the switch with 2" X 4" braces on all four sides. Use two or three braces on all sides, depending on the height of the switch. First attach the side braces. Nail the side braces to the front and back panels. Then nail the two side panels to the skid. Place the front and back braces inside the front and back panels, then nail the braces to the side panels. Place one 2" X 6" brace against the front face of the top panel frame on top of the switch. The board should extend from the inside of one side panel of the crate to the inside of the other side panel. Nail the board in place. Then place three 2" X 4" braces across the top of the top panel frame. The three braces should reach from the inside of the front crate panel to the inside of the rear crate panel. It may be necessary to notch the three braces. Nail the braces in place. Nail the top panel onto the crate, and nail the tops of the front, back and side panels. Band the crate. Finally, add stabilizing A braces made from 1/2" plywood to the outside of the crate if necessary.



TABULATION OF CONNECTOR (J1) WIRING										
COL.	1	2	3	4	5	6	7	8	9	10
ROW	CONNECTOR (J1) PIN NUMBERS									
A	A3	B12	D6	E15	G9	J3	M4	N13	P7	S1
B	A5	B14	D8	F2	G11	J13	M6	N15	P9	S3
C	A7	C1	D10	F4	G13	J15	M8	O2	P11	S5
D	A9	C3	D12	F6	G15	K2	M10	O4	P13	S7
E	A11	C5	D14	F8	H2	K4	M12	O6	P15	S9
F	A13	C7	E1	F10	H4	K12	M14	O8	R2	S11
G	A15	C9	E3	F12	H6	K14	N1	O10	R4	S13
H	B2	C11	E5	F14	H8	L1	N3	O12	R6	S15
J	B4	C13	E7	G1	H10	L3	N5	O14	R8	T2
K	B6	C15	E9	G3	H12	L13	N7	P1	R10	T4
L	B8	D2	E11	G5	H14	L15	N9	P3	R12	T6
AUX.	B10	D4	E13	G7	J1	M2	N11	P5	R14	T8
COM.	T10	T12	T14	U1	U3	U5	U7	U9	U11	U13

INDICATOR CONNECTIONS



INTERLOCK CONNECTIONS

Figure 4-1

Interlock and Indicator Connections

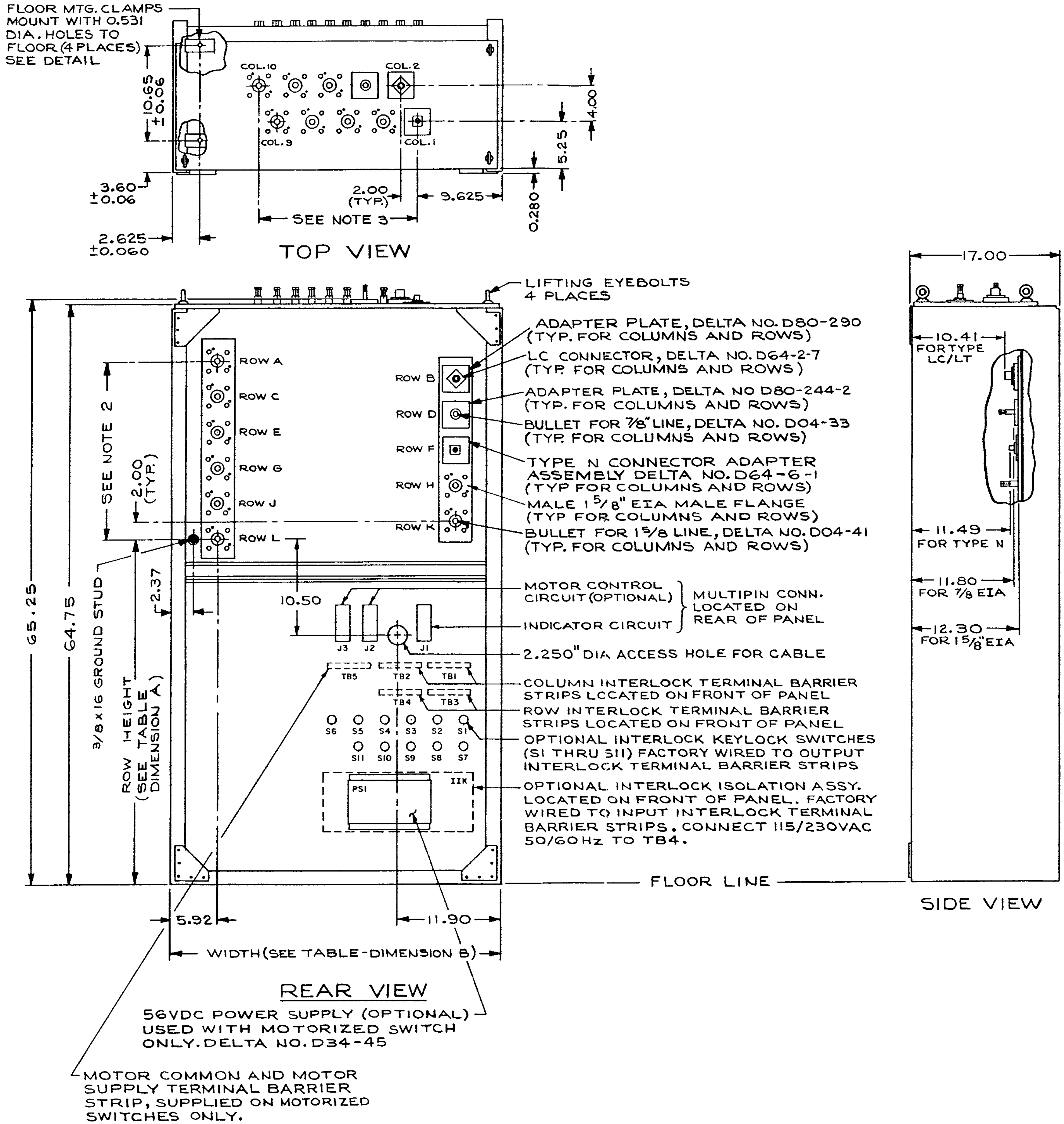
Height Functions	
Number of Rows	Row Height (Bottom Row) Configuration A and B (60.50" - 2Y)
Y	A
1	58.50"
2	56.50"
3	54.50"
4	52.50"
5	50.50"
6	48.50"
7	46.50"
8	44.50"
9	42.50"
10	40.50"
11	38.50"
12	36.50"
13	34.50"
14	32.50"
15	30.50"

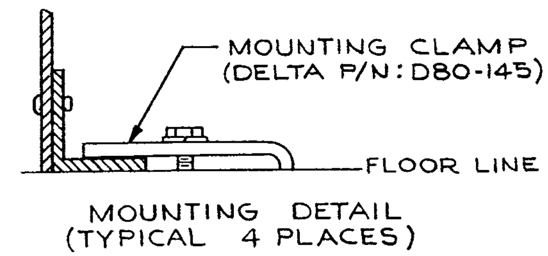
Width Functions	
Number of Columns	Overall Width Configuration A and B (2X + 17.25")
X	B
1	19.25"
2	21.25"
3	23.25"
4	25.25"
5	27.25"
6	29.25"
7	31.25"
8	33.25"
9	35.25"
10	37.25"
11	39.25"
12	41.25"
13	43.25"
14	45.25"
15	47.25"
16	49.25"
17	51.25"
18	53.25"
19	55.25"
20	57.25"

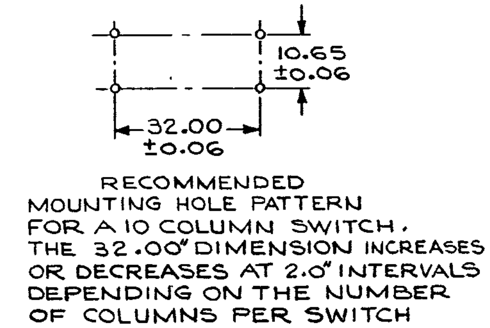
NOTE: Because units are custom built to contain different number of columns (X) and rows (Y), certain installation dimensions vary. These dimensions are given in these tables as a function of X and Y. Insert the dimensions into the proper blanks on the required drawing, Figure 4-3 or 4-4.

Figure 4-2

Installation Drawing Table of Dimensions







NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. ROW LINE TERMINALS EQUALLY SPACED ON ALTERNATE SIDES AT 2.00" INTERVALS
3. COLUMN LINE TERMINALS EQUALLY SPACED AT 2.00" INTERVALS.
4. UNLESS OTHERWISE SPECIFIED TOLERANCE TO BE ±0.250.

FIGURE 4-3

INSTALLATION DRAWING

(CONFIGURATION A)

SECTION 5

OPERATION

5.1 GENERAL

5.1.1 The fundamental objective of the SLS-4 Strip Line Switch is to connect any one of a number of transmitters to any one of a number of antennas. The design of the SLS-4 prevents the connection of more than one transmitter to one antenna or the connection of one transmitter to more than one antenna. Further, the design of the SLS-4 prevents the occurrence of "hot" switching. The timing of the switching sequence is such that the RF path is opened after the DC interlock circuit is opened and a new RF path is completed before the new DC interlock circuit is completed. Thus, switching of the RF path occurs only with the interlock circuit open and with no RF energy in the circuit.

5.1.2 The normal or Thru position of all rotor contacts is with the crosspoint knob vertical. To make a connection between a row connector and a column connector, rotate the rotor contact at the intersection of the desired row and column counterclockwise ninety degrees from the vertical. Thus, the Turn position can be identified by the crosspoint knob being horizontal. A valid connection between a row connector and a column connector can occur only when all other crosspoint knobs in the same row and column are in the vertical position.

5.1.3 The interlock and indicator switches are operated simultaneously with the rotor contact. If the knob is turned such that it is neither vertical nor horizontal, the interlock circuit will be open, and the associated transmitter cannot be operated. During normal operation all rotor contacts should be in either the Thru or Turn position, indicated by the orientation of all crosspoint knobs being either vertical or horizontal.

5.1.4 To open an interlock circuit for maintenance purposes, the knob should never be just slightly turned because another operator might believe the knob had accidentally been turned, and would restore it to its original position. Open the interlock circuit by removing the wire or jumper from the interlock terminal board. Keylock switches may be installed in the interlock circuits on special order to lockout the interlock circuit and corresponding RF output when required.

5.2 MANUAL OPERATION

To make a connection between a row connector and a column connector, rotate the crosspoint knob at the intersection of the desired row and column counterclockwise ninety degrees from the vertical. Check to ensure that all other crosspoint knobs in the same row and column are in the vertical position. Turning a horizontal crosspoint knob counterclockwise ninety degrees to the vertical position will restore a crosspoint to the Thru position.

5.3 MOTORIZED OPERATION

For remote operation of the Model SLS-4 Strip Line Switch, a motor actuator replaces the manual switch at the particular crosspoint which is motorized. The motor actuator consists of a stepping rotary solenoid and a wafer switch deck containing the interlock and indicator switches and actuator control circuits. The stepping rotary solenoid operates from a normal plus 50 VDC power supply supplied as part of the motorized SLS-4 system. Due to the custom nature of remote control systems for a motorized SLS-4, Sections 8 and 9 of this technical manual, detailing the motor actuator and power supply operational principles, respectively, are included only when the manual is supplied for a motorized SLS-4 system.

5.4 SHUTDOWN PROCEDURE

A manual Strip Line Switch not equipped with an Interlock Isolation Assembly does not require AC power and therefore does not need to be shut down. To remove RF power from the switch, turn off all transmitters and operate all crosspoints to the Thru position.

If a manual switch is equipped with an Interlock Isolation Assembly, then AC power is required to operate the assembly. Because the Interlock Isolation Assembly is normally wired directly to the AC main power, the AC power shutdown procedure requires disconnecting the AC main power. The keyline/interlock circuit of all transmitters wired to the Interlock Isolation Assembly will be open if AC power is disconnected from the assembly, thereby turning off all associated transmitters. Defeating the transmitter interlock circuit to permit continued operation is not recommended because "hot" RF can occur with resultant damage to the switch.

To shut down a motorized Strip Line Switch with power supply and Actuator Interface Unit, depress the Power button on the Actuator Interface Unit. The switch may then be operated manually as described in Section 5.2. To completely shut down the switch, remove RF power by turning off all transmitters and operating all crosspoints to the Thru position.

5.5 EMERGENCY OPERATION

In the event of a remote control system failure or an actuator power supply failure, depress the Power button on the Actuator Interface Unit to remove AC power from the actuator power supply and the Actuator Interface Unit. Operate the switch manually as described in Section 5.2.

In the event of an AC main power failure localized to the switch, depress the Power button on the Actuator Interface Unit to disconnect AC power from the switch during the power loss and restoration period. Note that the switching configuration of the switch does not change upon loss or restoration of AC power. As described in Section 5.4 above, loss of AC power to the Interlock Isolation Assembly results in the opening of all transmitter keyline/interlock circuits and the turning off of all associated transmitters. The transmitter interlock circuit may be defeated to permit continued operation. This procedure is not recommended because without the protective interlock circuit, "hot" RF switching can occur with resultant damage to the switch. Operate the switch manually as described in Section 5.2 ensuring that the transmitter is turned off before disconnecting the transmitter from an antenna and that the transmitter is not turned on until properly connected to an antenna.

SECTION 6

MAINTENANCE

6.1 CROSSPOINT REPAIR

WARNING

Exercise caution when performing maintenance on an operating SLS-4 Strip Line Switch. The RF conductors operate at high voltage when transmitter power is applied, and touching the contact springs, rotor contacts, terminal jumpers, or RF connectors may result in injury or death. Take care to ensure against the switching of an active circuit through the crosspoint being serviced or the adjacent crosspoints as identified above.

CAUTION

For the special case of the SLS-4 Strip Line Switch equipped with either row and/or column through trunking, both immediately adjacent row crosspoints and/or both immediately adjacent column crosspoints, in addition to the crosspoint to be repaired, must be de-energized.

6.1.1 The SLS-4 Strip Line Switch has been designed to permit easy access to the RF switch contacts and the rotor contact. These parts can be replaced in a matter of minutes without de-energizing the entire switch system. A maximum of three crosspoints must be de-energized to completely remove, repair, and install a particular crosspoint:

A. The crosspoint to be repaired.

B. The immediately adjacent row crosspoint located on the same side of the crosspoint to be repaired as the termination (input or output connector) for that row.

C. The immediately adjacent column crosspoint located on the same side of the crosspoint to be repaired as the termination for that column.

6.1.2 Refer to the Pictorial Parts List, Section 7.2, the List of Material, Section 7.3, the Reference List of Materials, Section 7.4, Figure 7-1, Crosspoint Components, Figure 7-2, Row Terminal Components and Figure 7-3, Column Terminal Components for help identifying components and reference designations named in the maintenance procedures.

6.1.3 Front Crosspoint Strip Line Contact Assembly and Rotor Contact Removal

A. To access the front crosspoint spring assembly and rotor contact, remove the front panel. Rotate to the Turn position (knob horizontal) the rotor contact, E1, of the crosspoint to be repaired. Rotate to the Turn position the rotor contact of the immediately adjacent row crosspoint located on the same side of the crosspoint to be repaired as the termination for that row.

B. Remove the knob, MP10, of the crosspoint to be repaired. Remove the four mounting screws and lockwashers, I, securing the front crosspoint strip line contact assembly, E2, to the horizontal dividers.

C. Insert the contact spreader tool into the crosspoint contact assembly to spread and hold the contact springs.

D. Pull the crosspoint contact assembly approximately 1/8" away from the horizontal dividers. Slide this assembly as far as possible in the opposite direction of the termination for the row so that the assembly insulator clears the adjacent crosspoint contact assembly. Remove the front crosspoint strip line contact assembly by gentle pulling.

E. With a small counterclockwise rotation of the rotor contact, remove the rotor contact by gentle pulling.

CAUTION

Be careful to keep the rotor contact from damaging the ground contacts during removal of the rotor contact.

6.1.4 Component Inspection

6.1.4.1 Crosspoint Strip Line Contact Assembly

The crosspoint contact assembly should show no signs of arcing or pitting. The leaf springs should be symmetrically positioned from the rotor contact clearance hole in the assembly mounting plate. The proper spacing at the end of the leaf springs is approximately 0.43 inches. If excessive wear or misalignment is evident, replace the assembly.

6.1.4.2 Ground Springs

Examine the ground springs for misalignment or excessive deformation. The proper distance between ground springs at a crosspoint is approximately 0.72 inches. If the proper spacing cannot be restored by bending of the ground springs, replace the springs. Replacement pop rivets are supplied with spare ground springs and a suitable pop rivet gun is required for installation.

6.1.4.3 Rotor Contact

The rotor contact should have no signs of arcing or pitting on the conductive shoulder. The surfaces bearing against the crosspoint assembly mounting plate should not exhibit excessive wear. Replace the rotor contact if either of these conditions is severe.

6.1.5 Front Crosspoint Strip Line Contact Assembly and Rotor Contact Installation

A. Rotate to the Turn position the rotor contact of the immediately adjacent row crosspoint located on the same side of the crosspoint to be installed as the termination for that row.

B. Hold the rotor contact in the Thru position (rear slot vertical).

C. Slide the rotor contact into the switch until the back of the rotor contact enters the rear crosspoint strip line contact assembly, E3.

D. Slowly rotate the rotor contact approximately 30 degrees such that the rear fingers of the rotor contact spread the rear crosspoint contact assembly and such that the ground tabs on the rotor contact clear the ground springs. Gently push and rotate the rotor contact until the rear slot engages the pin on the shaft of the manual switch, S1, or motor actuator, B1. At the completion of this step, the rotor contact should be in the Thru position.

CAUTION

Be careful to keep the rotor contact from damaging the ground contact during installation of the rotor contact.

E. Apply a light coating of conductive grease such as Eccoshield SO Silver (Emerson & Cuming, Canton, Massachusetts) to the contact surface of the front crosspoint contact assembly. Be careful not to allow grease to be deposited on the contact insulator of the assembly.

F. Insert the contact spreader tool into the crosspoint contact assembly to spread and hold the contact springs.

G. Install the front crosspoint contact assembly by sliding the contact springs over the rotor contact. Check that the contact springs are on either side of the insulator of the adjacent front crosspoint contact assembly. Secure the assembly with the four mounting screws and lockwashers. Remove the contact spreader tool. Install the knob.

H. Perform the continuity tests of Section 6.2 to check for proper operation.

I. Install the front panel.

6.1.6 Rear Crosspoint Strip Line Contact Assembly Removal and Installation

6.1.6.1 The procedures for removing, inspecting, and installing the rear contact assembly are similar to the procedures of Sections 6.1.3, 6.1.4, and 6.1.5, respectively, for the front crosspoint contact assembly. Replace references to the row crosspoints and terminations with column crosspoints and terminations. The rotor contact should not be removed from the rear of the SLS-4 due to the possibility of ground contact damage.

6.1.6.2 Access the rear crosspoint contact assembly as follows:

A. Loosen the two captive screws securing the connector plug, S1P1 or B1P1, to the manual switch, S1, or motor actuator B1, at the desired crosspoint. Unmate the connectors by gentle pulling and place the plug off to the side.

B. Remove the two mounting screws and lockwashers, I, securing the manual switch or motor actuator to the male-female standoffs, MP4.

C. Remove the manual switch or motor actuator by gentle pulling. Remove the two male-female standoffs.

6.1.6.3 Upon completion of the rear crosspoint contact assembly removal, inspection, and installation, install the manual switch or motor actuator by reversing the procedures given above. Install the male-female standoffs with a lockwasher and tighten until snug. Do not overtighten.

6.1.7 To repair a crosspoint that is adjacent to a row or column termination, the end plate must be removed so that the row terminal or column terminal may be removed from the row or column termination. Then remove the row or column terminal strip line contact assembly as a single assembly.

6.2 CONTINUITY TESTS

WARNING

Perform continuity checks only on inactive transmission lines.

6.2.1 The procedure for testing a column or row RF path for continuity is as follows:

A. Connect an ohmmeter to the column or row RF terminal and to the opposite end of the column or row.

NOTE

Access the unterminated end of the row or column by removing the small aluminum plate at the end and attach the ohmmeter lead to the exposed silver plated spring contact.

B. With all of the crosspoints in the Thru position, the ohmmeter should show continuity.

C. Rotate each crosspoint in sequence to the Turn position and check the ohmmeter for an open circuit.

6.3 TERMINAL REPAIR OR MODIFICATION

6.3.1 Figures 7-2 and 7-3 provide details of the terminal components for the row and column terminations, respectively. The arrangement of the terminal components and hardware is shown in Figure 7-4 for 1-5/8" and 7/8" EIA male flanges and in Figure 7-5 for Type LC, LT and N connectors. Be careful when performing terminal repair on the 1-5/8" and 7/8" EIA male flanges. To disconnect or remove the bullet, E13 or E14, hold the bullet with a T-Wrench, part number D43-3 for a 7/8" EIA bullet or part number D43-4 for a 1-5/8" EIA bullet, or with a thin strip of metal placed in one of the bullet's slots. Do not hold the bullet with pliers. Prevent the bullet from turning while loosening the hex nut, XIII, to avoid damaging the transmission line strap.

6.3.2 Field Modification Kits are available for the connector types shown in Figures 7-4 and 7-5. Lists of material for these Field Modification Kits are tabulated in Section 7.5. These kits contain all the required components and hardware for connector conversion.

6.4 TROUBLESHOOTING

6.4.1 The design of the SLS-4 makes problems with the switch easy to troubleshoot. Use failure mode indications to troubleshoot problems. Troubleshooting principally focuses on the interlock circuitry, the RF path, and the indicator circuitry. Failure indications are (1) the failure of a transmitter to turn on when a crosspoint is in the Turn position, or (2) the failure of a status indicating device to indicate when a crosspoint is in the Turn position.

6.4.2 If the transmitter does not turn on when a crosspoint is in the Turn position, first check the interlock circuit for proper operation. To locate a break in the interlock circuitry, remove the leads from the terminal strip connections corresponding to the row and column that are inoperative (see Figure 4-1). Check the continuity of each interlock lead and interlock switch on each manual switch (see Figure 6-1A or 6-1B) or motor actuator (see Figure 8-1) from either terminal strip and progress toward the crosspoint in the Turn position and then, toward the other terminal strip. When finished, reconnect the leads to the terminal strip connections.

WARNING

Perform continuity checks only on inactive transmission lines.

6.4.3 If the fault does not occur in the interlock circuitry, then check the RF path through the switch for continuity. Remove the transmitter and antenna connectors corresponding to the row and column that are inoperative, and check the continuity between the associated row and column terminals. The lack of continuity indicates a break in the RF path. Isolate the fault to a particular crosspoint by testing the continuity of adjacent RF circuits. The chart below demonstrates this method of fault isolation.

Col 3 In	Col 4 In	Col 5 In	
B3 Continuity? Yes	B4 Continuity? Yes	B5 Continuity? Yes	Row B Out
C3 Continuity? Yes	C4 Continuity? No	C5 Continuity? Yes	Row C Out
D3 Continuity? Yes	D4 Continuity No	D5 Continuity? Yes	Row D Out

B3 refers to the Turn connection made at the intersection of Row B and Column 3

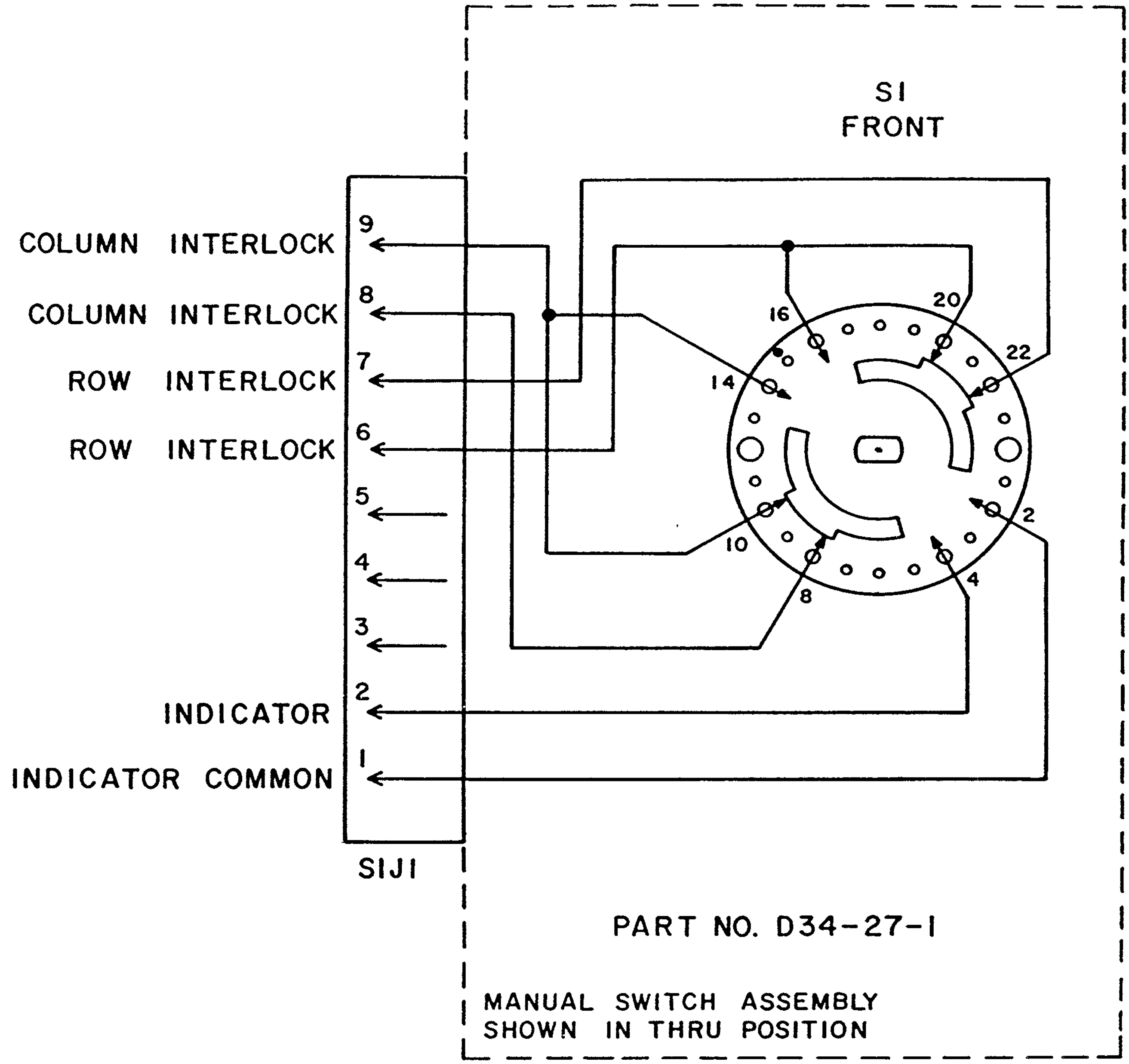
Thus, the fault occurs in the vertical transmission line between B4 and C4. If D4 had continuity, then the fault would be in the rotor contact at C4. When the fault has been isolated, follow the procedures of Section 6.1 to remove the faulty component and complete the repair. After completing the repair, reconnect the transmitter and antenna connectors.

6.4.4 The failure of a status device to indicate when a crosspoint switch is in the Turn position indicates a fault in the indicator circuitry. To locate this fault, check the indicator switch (Manual - see Figure 6-1A or 6-1B; Motorized - see Figure 8-1), the harness wiring, and the connector pin of J1 (see Connector J1 Tabulation, Figure 4-1) associated with the crosspoint switch in the Turn position. It is not necessary to de-energize the switch to locate the fault.

6.5 PERFORMANCE VERIFICATION

After repairing a crosspoint or terminal, check the insertion VSWR and isolation of the repaired RF path with a network analyzer. The insertion VSWR and isolation should be within the specifications listed in Section 2.

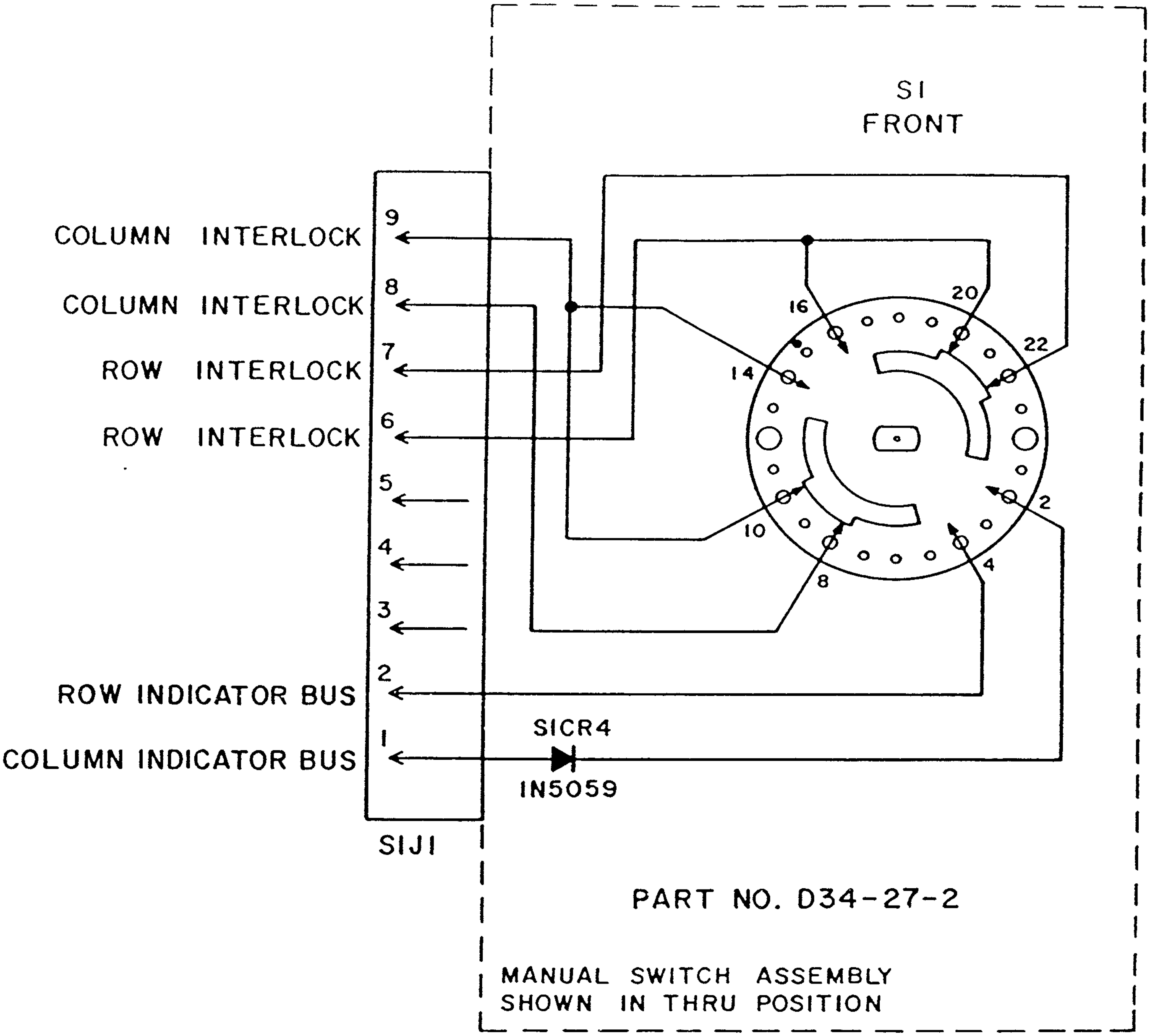
After repairing a motorized actuator, test the actuator response by sending connect (Turn) and disconnect (Thru) commands to the actuator using the remote control system. Check for correct operation of the actuator.



VIEW DECK FROM CONNECTOR END OF ASSEMBLY.

NOTE:
PART NO. D34-27-1 USED WITH STANDARD INDICATOR CIRCUIT

FIGURE 6-1A
SCHEMATIC DIAGRAM MANUAL SWITCH ASSEMBLY



VIEW DECK FROM CONNECTOR
END OF ASSEMBLY.

NOTE:
PART NO. D34-27-2
USED WITH ROW/COLUMN
BUS INDICATOR CIRCUIT

FIGURE 6-1B

SCHEMATIC DIAGRAM
MANUAL SWITCH
ASSEMBLY

SECTION 7

LIST OF MATERIAL

7.1 INTRODUCTION

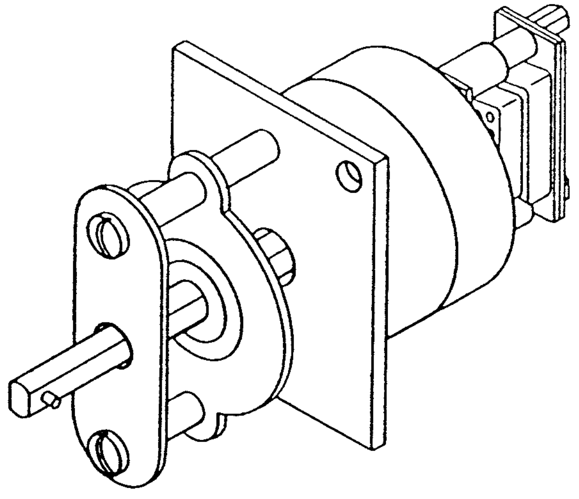
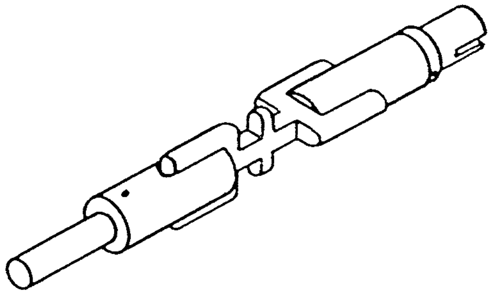
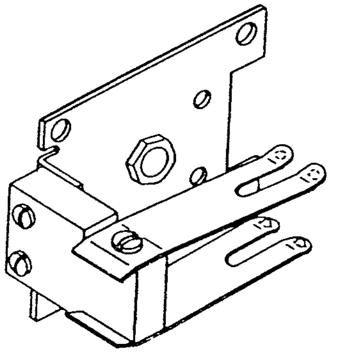
7.1.1 Reference designations identify maintenance parts in the SLS-4 Strip Line Switch. The drawings and list of material use the designations to identify the components. The letter(s) in the reference designation identifies the class of item such as a switch, electrical contact, or mechanical part. The number(s) following the letter differentiates between parts of the same class.

7.1.2 Due to the variable size of the SLS-4 Strip Line Switch, designations and the list of material have been oriented toward the common components in a crosspoint. All identical components carry the same reference designation with the exception of the connectors (J1, J2 and J3) and the terminal boards (TB1, TB2, TB3 and TB4) where sequential reference designations were assigned for reference on the schematic diagrams and connector tabulations.

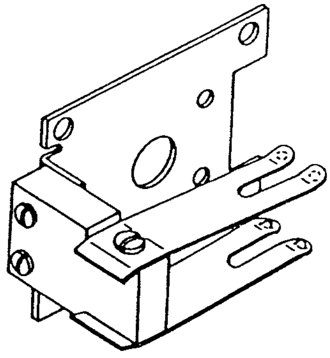
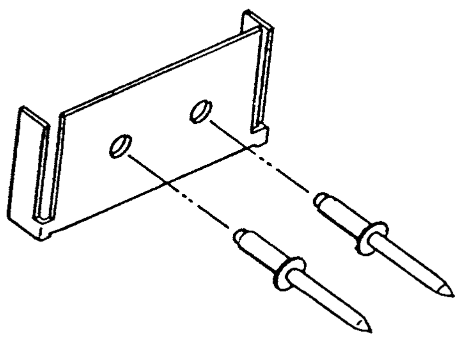
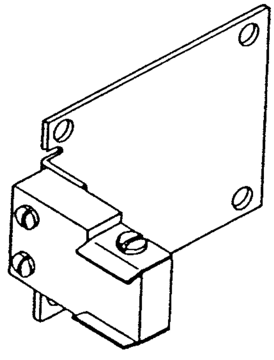
7.1.3 Refer to the Pictorial Parts List, Section 7.2, and to the crosspoint, row terminal, and column terminal component drawings, Figures 7-1, 7-2 and 7-3 for help identifying the components of the SLS-4. Repair parts are listed in the List of Material, Section 7.3. The common hardware parts are identified by Roman Numeral reference designations (I, II, etc.) and are shown on the Reference List of Material, Section 7.4.

7.1.4 Effective with Revision B of this technical manual, the list of material presents the maintenance significant RF strip line components of the SLS-4 as contact assemblies. These contact assemblies, reference designations E2, E3 and E5 through E12, enable the user to perform corrective maintenance with factory aligned assemblies and to reduce the number of different components required as spare parts. Section 7.6 provides a pictorial parts list of the assembly components and Section 7.7 details the individual components of each contact assembly to permit identification and utilization of assembly components that may have been furnished to the user as spare parts.

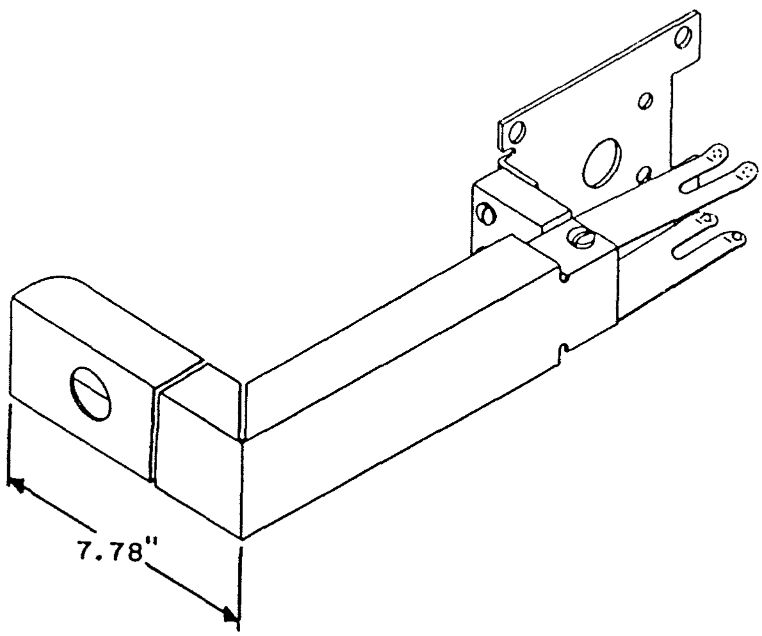
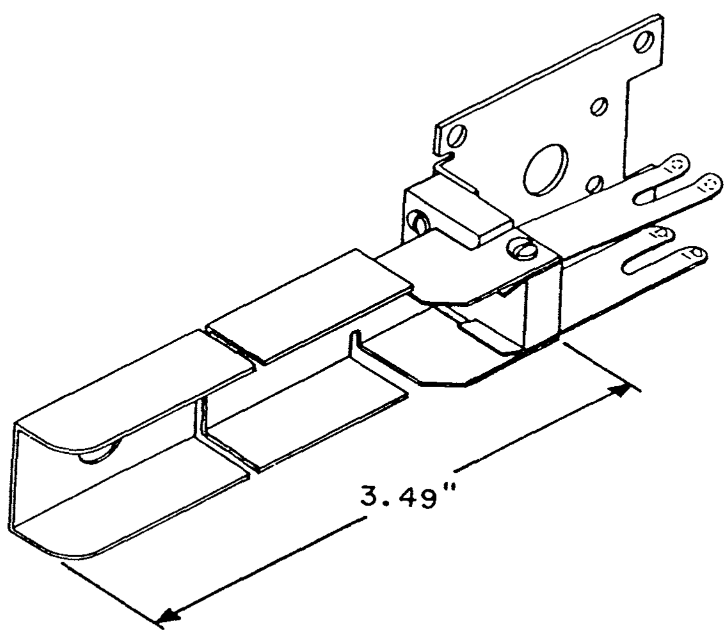
7.2 PICTORIAL PARTS LIST, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF DES	DESCRIPTION	PART NO.
1	B1	MOTOR ACTUATOR 	D35-19 See Note 4
6	E1	ROTOR CONTACT 	D81-89-1
7	E2	STRIP LINE CONTACT ASSY, CROSSPOINT, FRONT 	D81-108-1

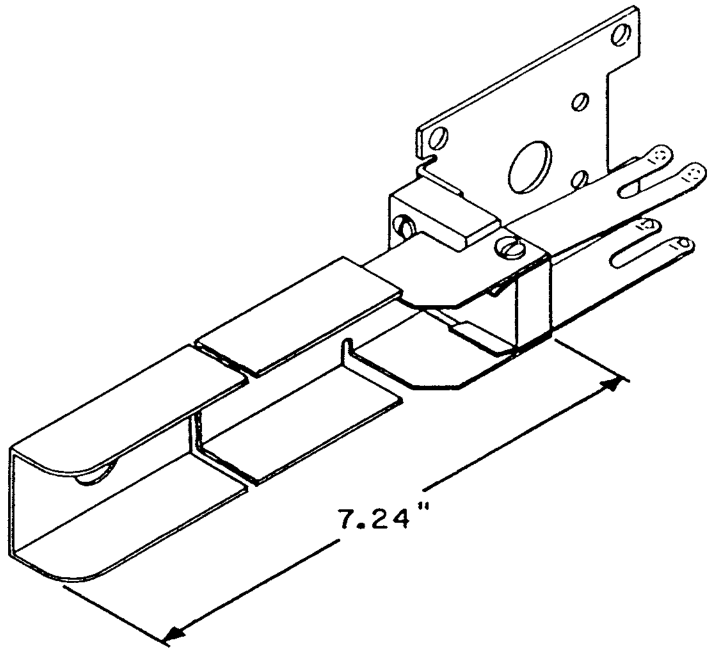
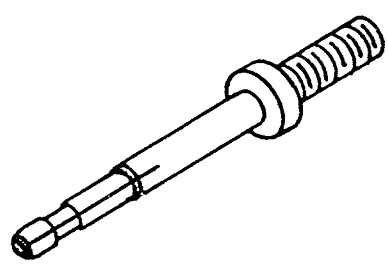
7.2 PICTORIAL PARTS LIST, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF DES	DESCRIPTION	PART NO.
8	E3	STRIP LINE CONTACT ASSY, CROSSPOINT, REAR 	D81-108-2
9	E4	CONTACT, GROUND 	D75-104-1
10	E5	STRIP LINE CONTACT ASSY, END, FLAT PLATE 	D81-108-3

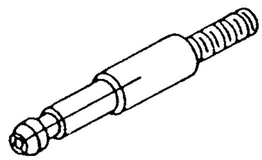
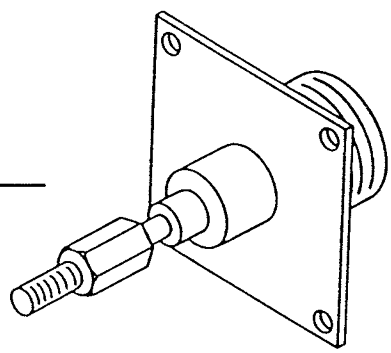
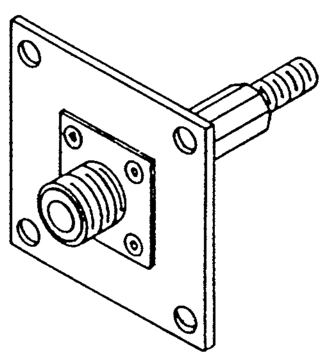
7.2 PICTORIAL PARTS LIST, MODEL SLS-4 STRIP LINE SWITCH

<table>
<tr><th>ITEM</th><th>REF DES</th><th>DESCRIPTION</th><th>PART NO.</th></tr>
<tr><td>15</td><td>E10</td><td>STRIP LINE CONTACT ASSY, COLUMN TERMINAL, LONG

</td><td>D81-108-8</td></tr>
<tr><td>16</td><td>E11</td><td>STRIP LINE CONTACT ASSY, COLUMN TERMINAL, SHORT, RACK

</td><td>D81-108-9</td></tr>
</table>

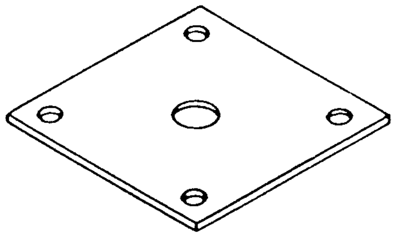
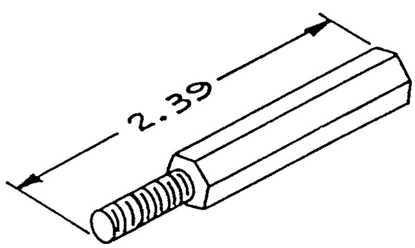
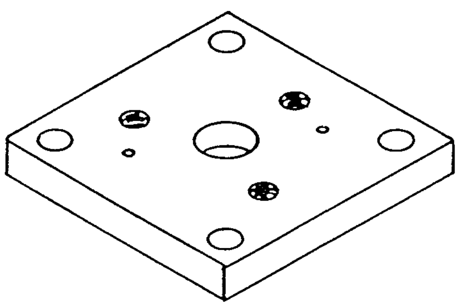
7.2 PICTORIAL PARTS LIST, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF DES	DESCRIPTION	PART NO.
17	E12	STRIP LINE CONTACT ASSY, COLUMN TERMINAL, LONG, RACK 	D81-108-10
18	E13	7/8 INCH BULLET 	D04-33

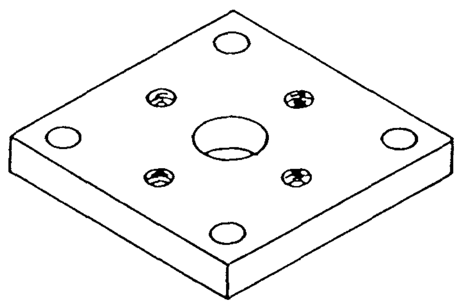
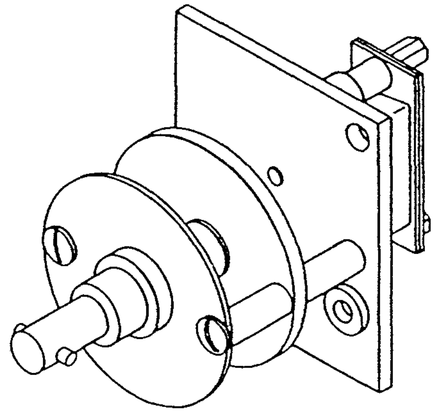
7.2 PICTORIAL PARTS LIST, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF DES	DESCRIPTION	PART NO.
19	E14	1-5/8 INCH BULLET 	D04-41
20	E15	LC CONN, MODIFIED 	D64-2-7
21	E16	LT CONN, MODIFIED	D64-2-8
22	E17	TYPE N CONNECTOR ADAPTER ASSEMBLY 	D64-6-1

7.2 PICTORIAL PARTS LIST, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF DES	DESCRIPTION	PART NO.
25	E20	BULLET INSULATOR 	D82-38
33	MP4	STANDOFF, MALE-FEMALE 	D80-250-4
37	MP8	7/8 INCH ADAPTER PLATE 	D80-244-2

7.2 PICTORIAL PARTS LIST, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF DES	DESCRIPTION	PART NO.
38	MP9	LC/LT CONNECTOR ADAPTER PLATE 	D80-290
44	S13	SWITCH, MANUAL 	D34-27 See Note 5

7.3 LIST OF MATERIAL, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF. DES.	DESCRIPTION	MFR. FSCM	PART NO.
1	B1	Motor Actuator	Delta 19482	D35-19 (See Notes 3 & 4)
2	B1P1	Connector, Plug, Electrical	Amp 00779	205203-1
3	B1P1E1	Terminal, Connector, Crimp	Amp 00779	205090-1 (See Note 1)
4	B1P1MP1	Assembly, Screw Lock, Male	Cannon 71468	D20419
5	B1P1MP2	Shell, Junction	Cannon 71468	DE110963-1
6	E1	Rotor Contact	Delta 19482	D81-89-1
7	E2	Strip Line Contact Assy, Crosspoint, Front	Delta 19482	D81-108-1
8	E3	Strip Line Contact Assy, Crosspoint, Rear	Delta 19482	D81-108-2
9	E4	Contact, Ground	Delta 19482	D75-104-1
10	E5	Strip Line Contact Assy, End, Flat Plate	Delta 19482	D81-108-3
11	E6	Strip Line Contact Assy, End, Angle Plate	Delta 19482	D81-108-4
12	E7	Strip Line Contact Assy, Row Terminal, Short	Delta 19482	D81-108-5
13	E8	Strip Line Contact Assy, Row Terminal, Long	Delta 19482	D81-108-6
14	E9	Strip Line Contact Assy, Column Terminal, Short	Delta 19482	D81-108-7
15	E10	Strip Line Contact Assy, Column Terminal, Long	Delta 19482	D81-108-8
16	E11	Strip Line Contact Assy, Column Terminal, Short, Rack	Delta 19482	D81-108-9
17	E12	Strip Line Contact Assy, Column Terminal, Long, Rack	Delta 19482	D81-105-10

7.3 LIST OF MATERIAL, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF. DES.	DESCRIPTION	MFR. FSCM	PART NO.
18	E13	7/8 Inch Bullet	Delta 19482	D04-33
19	E14	1-5/8 Inch Bullet	Delta 19482	D04-41
20	E15	LC Connector, Modified	Delta 19482	D64-2-7
21	E16	LT Connector, Modified	Delta 19482	D64-2-8
22	E17	Type N Connector Adapter Assy	Delta 19482	D64-6-1
23	E18	Unassigned		
24	E19	Unassigned		
25	E20	Bullet Insulator	Delta 19482	D82-38
26	J1	Connector, Receptacle, Electrical	Elco 91662	00-8017-130-000-007
27	J1E1	Terminal, Connector, Solder	Elco 91662	60-8017-0513-00-338 (See Note 2)
28	J2	Same as J1		
29	J3	Same as J1		
30	MP1	Unassigned		
31	MP2	Unassigned		
32	MP3	Unassigned		
33	MP4	Standoff, Male-Female	Delta 19482	D80-250-4
34	MP5	Unassigned		
35	MP6	Unassigned		
36	MP7	Unassigned		
37	MP8	7/8 Inch Adapter Plate	Delta 19482	D80-244-2
38	MP9	LC/LT Connector Adapter Plate	Delta 19482	D80-290

7.3 LIST OF MATERIAL, MODEL SLS-4 STRIP LINE SWITCH

ITEM	REF. DES.	DESCRIPTION	MFR. FSCM	PART NO.
39	MP10	Knob	Raytheon 94144	MS91525-1II2B (S/N 086 and down)
			Delta 19482	D04-67-1 (S/N 087 and up)
40	P1	Connector, Plug, Electrical	Elco 91662	00-8017-130-217-004
41	P1E1	Same as J1E1		
42	P2	Same as P1		
43	P3	Same as P1		
44	S1	Switch, Manual	Delta 19482	D34-27 (See Note 5)
45	S1P1	Connector, Plug, Electrical	Amp 00779	205203-1
46	S1P1E1	Terminal, Connector, Crimp	Amp 00779	205090-1 (See Note 1)
47	S1P1MP1	Assembly, Screw Lock, Male	Cannon 71468	D20419
48	S1P1MP2	Shell, Junction	Cannon 71468	DE110963-1
49	TB1	Terminal Board	Kulka 75382	599-12-KT35
50	TB2	Same as TB1		
51	TB3	Same as TB1		
52	TB4	Same as TB1		
53	TB5	Terminal Board	Kulka 75382	599-8-KT35
54	Tool	Contact Spreader Tool	Delta 19482	D43-1

7.3 LIST OF MATERIAL, MODEL SLS-4 STRIP LINE SWITCH

NOTES:

1. Items B1P1E1 and S1P1E1 are for field use replacement of factory installed crimp contacts. Requires military crimp tool M22520/2-01 with M22520/2-08 positioner.

2. Items J1E1 and P1E1 are for field use replacement of factory installed contacts.

3. Items B1, B1P1E1, B1P1MP1, B1P1MP2, J2, J3, P2, P3 and TB5 supplied with motorized switches only.

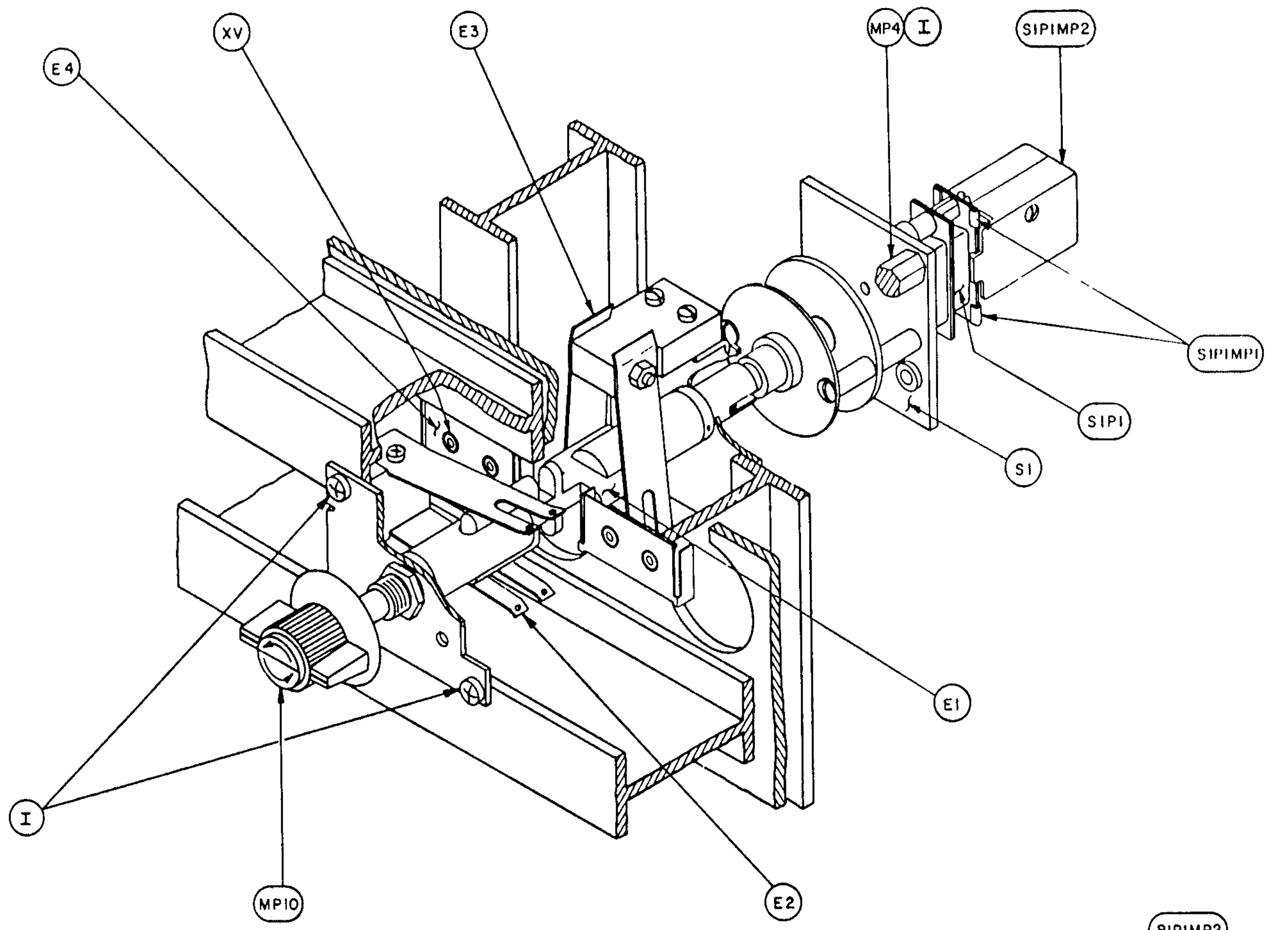
4. Part number of Item 1, Motor Actuator, may be either D35-19-1, D35-19-2 or D35-19-3 as determined by type of actuator harness and remote control system. Part number with dash number suffix is stamped on actuator for identification purposes. Complete part number must be specified when ordering replacement motor actuators.

5. Part number of Item 44, Manual Switch, may be either D34-27-1 or D34-27-2 as determined by type of indicator harness and remote control system. Part number with dash number suffix is stamped on switch for identification purposes. Complete part number must be specified when ordering replacement manual switches.

7.4 REFERENCE LIST OF MATERIAL - MODEL SLS-4 STRIP LINE SWITCH

NOTE: The following items are standard hardware and are listed for reference only.

ITEM	REFERENCE DESIGNATION	DESCRIPTION
1	I	Machine Screw, Pan Head, #6-32 X 5/16", Stainless Steel (with integral split lockwasher)
2	II	Unassigned
3	III	Unassigned
4	IV	Bolt, Hex Head, 1/4-20 X 1/2", Stainless Steel
5	V	Bolt, Hex Head, 1/4-20 X 3/4", Stainless Steel
6	VI	Bolt, Hex Head, 5/16-18 X 7/16", Stainless Steel
7	VII	Bolt, Hex Head, 5/16-18 X 3/4", Stainless Steel
8	VIII	Bolt, Hex Head, 5/16-18 X 1-1/4", Stainless Steel
9	IX	Split Lockwasher, 1/4" I.D., Stainless Steel
10	X	Split Lockwasher, 5/16" I.D., Stainless Steel
11	XI	Split Lockwasher, 3/8" I.D., Silver Plated Phosphor Bronze
12	XII	Flat Washer, 3/8" I.D., Silver Plated Brass
13	XIII	Hex Nut, Jam, 3/8-16 X 0.250 Thk, Silver Plated Brass
14	XIV	Bolt, Hex Head, 5/16-18 X 1/2", Stainless Steel
15	XV	Pop Rivet, United Shoe Machinery Corp. P/N AD(44)BS
16	XVI	Unassigned
17	XVII	Machine Screw, 82° Flat Head, #4-40 X 3/8", Nickel Plated Brass (with internal tooth lockwasher and hex nut)
		Machine Screw, Binder Head, #4-40 X 3/8", Nickel Plated Brass (with internal tooth lockwasher and hex nut)
18	XVIII	Machine Screw, 82° Flat Head, #4-40 X 3/4", Nickel Plated Brass (with internal tooth lockwasher and hex nut)
19	XIX	Terminal Board Jumper, Cinch-Jones P/N 141-J



CROSSPOINT COMPONENTS

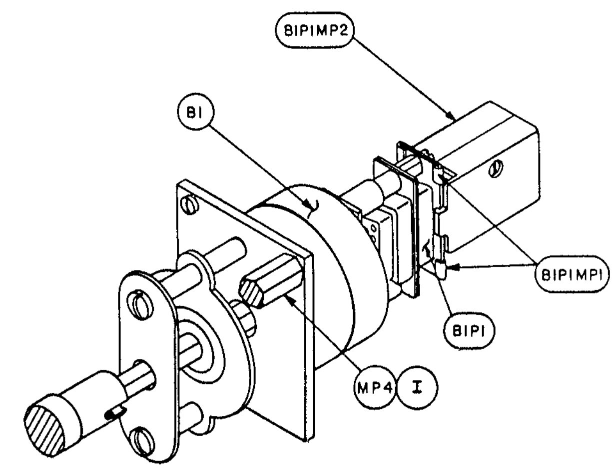
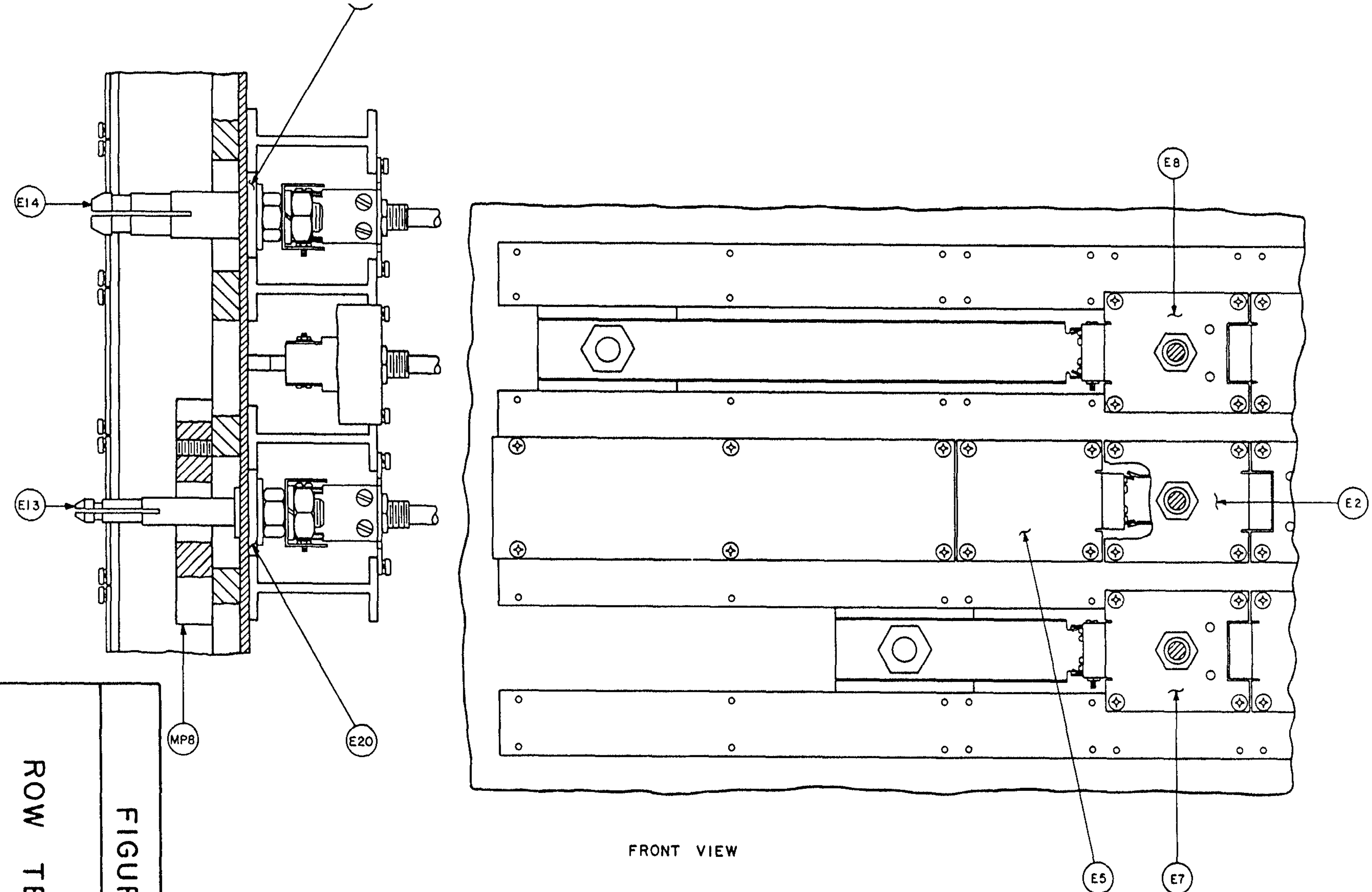


FIGURE 7-1

CROSSPOINT COMPONENTS

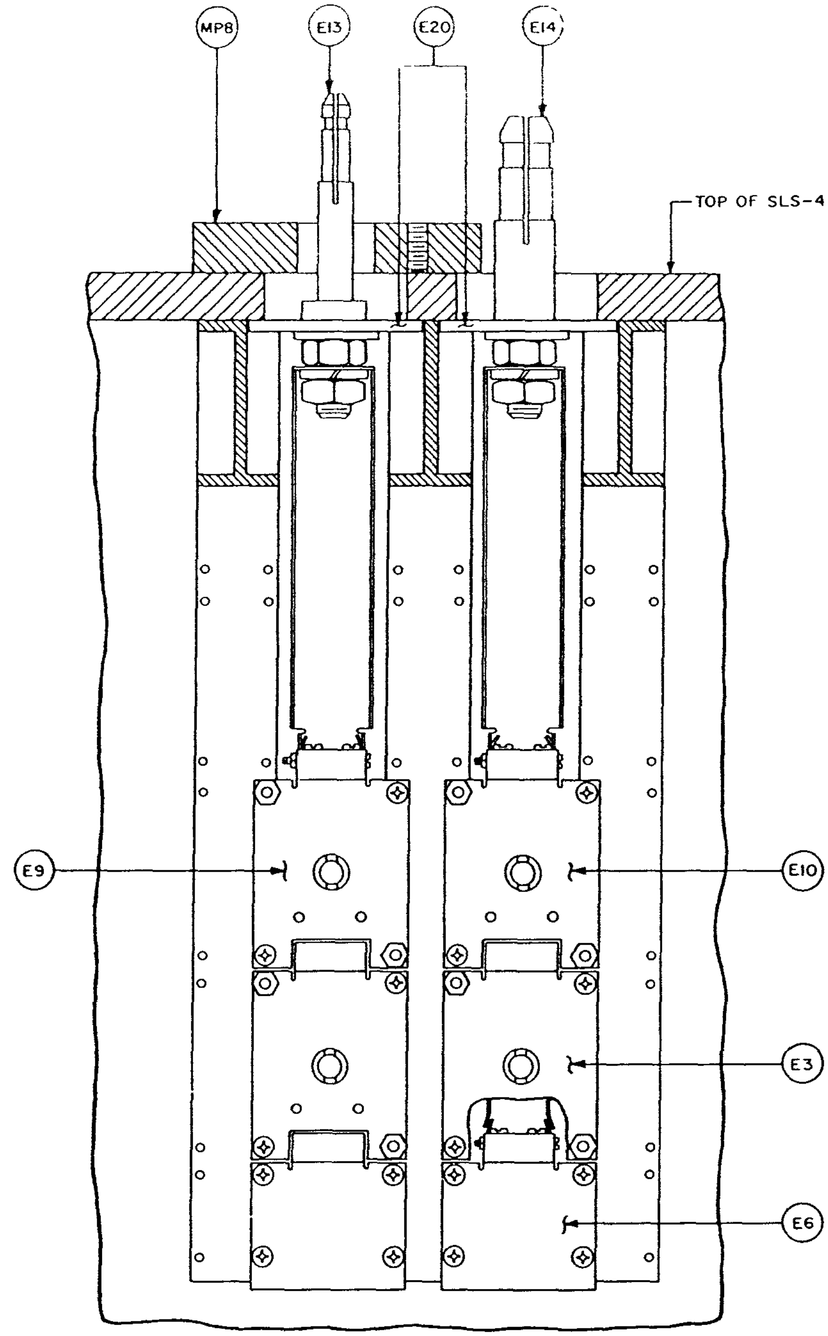


ROW TERMINAL COMPONENTS

NOTES:

1. MANUAL SWITCHES OR MOTOR ACTUATORS, MALE-FEMALE STANDOFFS AND REAR BEARING OF ROTOR CONTACTS OMITTED FOR CLARITY OF SIDE VIEW
2. ROW TERMINAL COMPONENTS SHOWN ARE FOR SLS-4 CONFIGURATIONS B AND DSA FOR CONFIGURATIONS A, DA19, AND DA24, ONLY E7 IS USED
3. SWITCH SHOWN WITH STANDARD 1-5/8" EIA MALE FLANGE AND OPTIONAL 7/8" EIA MALE FLANGE TERMINATIONS ADDITIONAL OPTIONAL TERMINATIONS ARE TYPE LC, TYPE LT AND TYPE N RECEPTACLES

FIGURE 7-2
ROW TERMINAL COMPONENTS



REAR VIEW

COLUMN TERMINAL COMPONENTS

NOTES:

1. MANUAL SWITCHES OR MOTOR ACTUATORS OMITTED FOR CLARITY.
2. COLUMN TERMINAL COMPONENTS SHOWN ARE FOR SLS-4 CABINET CONFIGURATIONS A, B, AND DSA. FOR RACK MOUNTING CONFIGURATIONS, E11 REPLACES E10, E12 REPLACES E9, AND THE COLUMN CONNECTORS FACE TO THE BACK OF THE SWITCH
3. SWITCH SHOWN WITH STANDARD 1-5/8" EIA MALE FLANGE AND OPTIONAL 7/8" EIA MALE FLANGE TERMINATIONS. ADDITIONAL OPTIONAL TERMINATIONS ARE TYPE LC, TYPE LT, AND TYPE N RECEPTACLES

FIGURE 7-3

COLUMN TERMINAL COMPONENTS

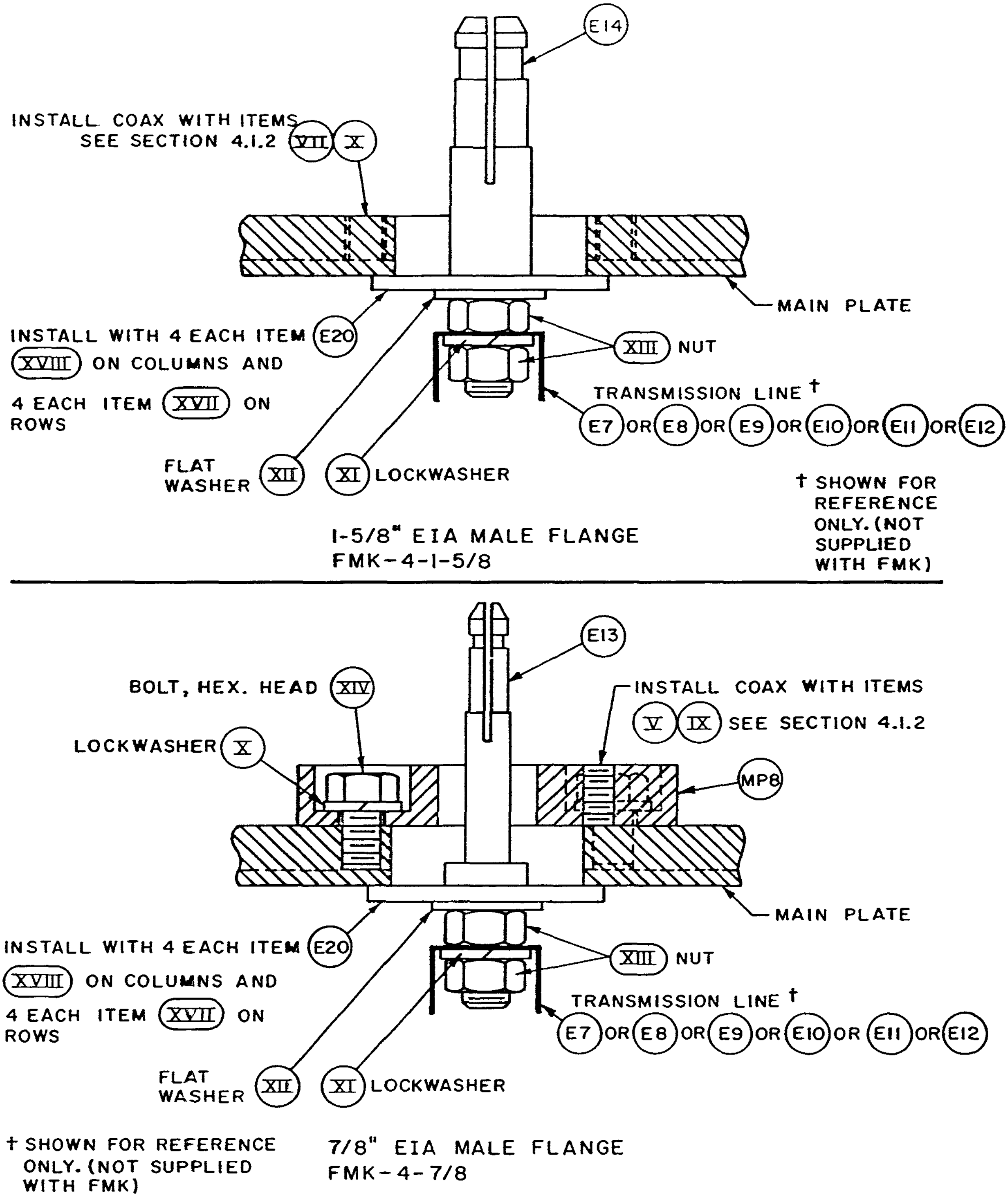


FIGURE 7-4

FMK TERMINAL COMPONENTS

7.5.2 FMK-4-7/8 (SEE FIGURE 7-4), PART NO. D42-22

QTY	REF. DES.	DESCRIPTION	MFR. FSCM	PART NO.
1	E13	7/8 Inch Bullet	Delta 19482	D04-33
1	E20	Bullet Insulator	Delta 19482	D82-38
1	MP8	7/8 Inch Adapter Plate	Delta 19482	D80-244-2
3	V	Bolt, Hex Head, 1/4-20 X 3/4", Stainless Steel		Commercial
3	IX	Split Lockwasher, 1/4" I.D., Stainless Steel		Commercial
4	X	Split Lockwasher, 5/16" I.D., Stainless Steel		Commercial
1	XI	Split Lockwasher, 3/8" I.D., Silver Plated Phosphor Bronze		Commercial
1	XII	Flat Washer, 3/8" I.D., Silver Plated Brass		Commercial
2	XIII	Hex Nut, Jam, 3/8-16 X 0.250 Thk, Silver Plated Brass		Commercial
4	XIV	Bolt, Hex Head, 5/16-18 X 1/2", Stainless Steel		Commercial
4	XVII	Machine Screw, 82° Flat Head, #4-40 X 3/8", Nickel Plated Brass (with internal tooth lockwasher and hex nut) Machine Screw, Binder Head, #4-40 X 3/8", Nickel Plated Brass (with internal tooth lockwasher and hex nut)		Commercial
4	XVIII	Machine Screw, 82° Flat Head, #4-40 X 3/4", Nickel Plated Brass (with internal tooth lockwasher and hex nut)		Commercial

7.5.3 FMK-4-LC (SEE FIGURE 7-5), PART NO. D42-30-1

QTY	REF. DES.	DESCRIPTION	MFR. FSCM	PART NO.
1	E15	LC Connector, Modified	Delta 19482	D64-2-7
1	MP9	LC/LT Connector Adapter Plate	Delta 19482	D80-290
4	IV	Bolt, Hex Head, 1/4-20 X 1/2", SS		Commercial
4	VIII	Bolt, Hex Head, 5/16-18 X 1-1/4", SS		Commercial
4	IX	Split Lockwasher, 1/4" I.D., SS		Commercial
4	X	Split Lockwasher, 5/16" I.D., SS		Commercial
1	XI	Split Lockwasher, 3/8" I.D., Silver Plated Phosphor Bronze		Commercial
1	XIII	Hex Nut, Jam, 3/8-16 X 0.250 Thk, Silver Plated Brass		Commercial

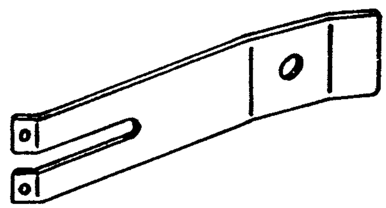
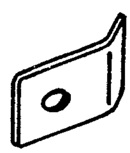
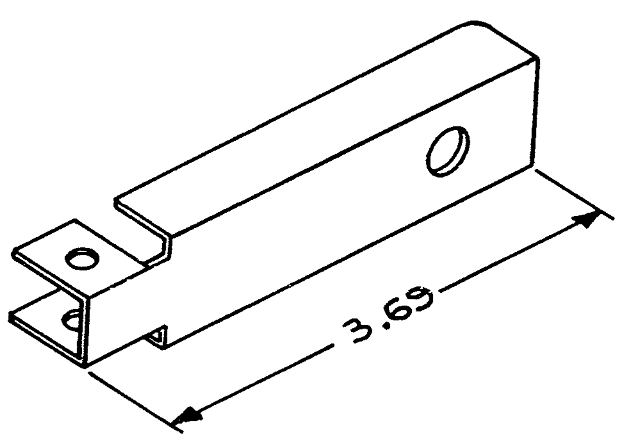
7.5.4 FMK-4-LT (SEE FIGURE 7-5), PART NO. D42-30-2

QTY	REF. DES.	DESCRIPTION	MFR. FSCM	PART NO.
1	E16	LT Connector, Modified	Delta 19482	D64-2-8
1	MP9	LC/LT Connector Adapter Plate	Delta 19482	D80-290
4	IV	Bolt, Hex Head, 1/4-20 X 1/2", SS		Commercial
4	VIII	Bolt, Hex Head, 5/16-18 X 1-1/4", SS		Commercial
4	IX	Split Lockwasher, 1/4" I.D., SS		Commercial
4	X	Split Lockwasher, 5/16" I.D., SS		Commercial
1	XI	Split Lockwasher, 3/8" I.D., Silver Plated Phosphor Bronze		Commercial
1	XIII	Hex Nut, Jam, 3/8-16 X 0.250 Thk, Silver Plated Brass		Commercial

7.5.5 FMK-4-N (SEE FIGURE 7-5), PART NO. D42-39

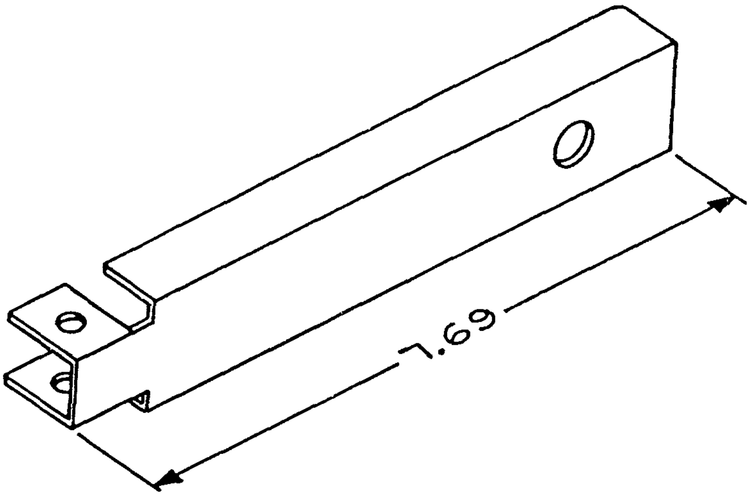
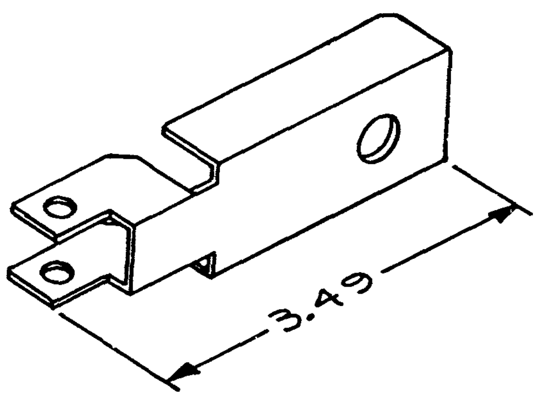
QTY	REF. DES.	DESCRIPTION	MFR. FSCM	PART NO.
1	E17	Type N Connector Adapter Assembly	Delta 19482	D64-6-1
4	VI	Bolt, Hex Head, 5/16-18 X 7/16", Stainless Steel		Commercial
4	X	Split Lockwasher, 5/16" I.D., Stainless Steel		Commercial
1	XI	Split Lockwasher, 3/8" I.D., Silver Plated Phosphor Bronze		Commercial
1	XIII	Hex Nut, Jam, 3/8-16 X 0.250 Thk, Silver Plated Brass		Commercial

7.6 PICTORIAL PARTS LIST, STRIP LINE CONTACT ASSEMBLY COMPONENTS

ITEM	REF DES*	DESCRIPTION	PART NO.
1	E2	CONTACT SPRING, ELECTRICAL 	D75-66-2
2	E3	CONTACT END, ELECTRICAL 	D75-70-2
3	E5	TERMINAL JUMPER, OUTPUT 	D75-72-5

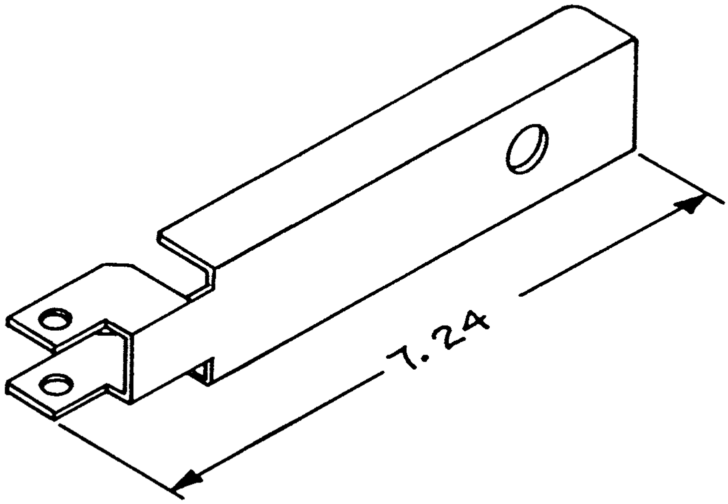
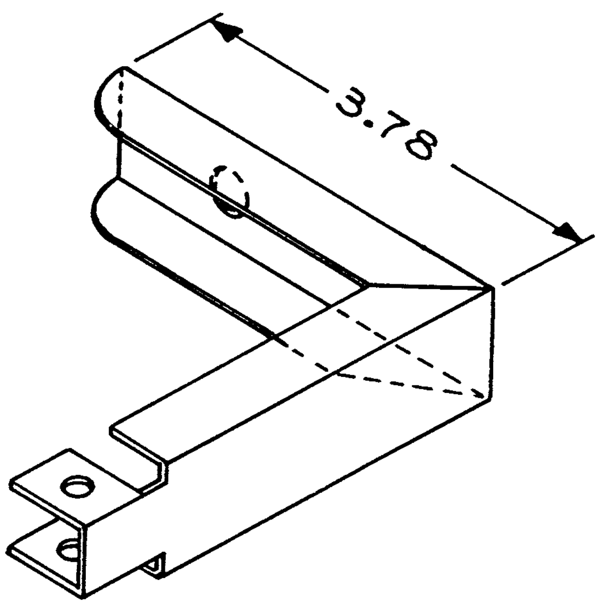
*Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.6 PICTORIAL PARTS LIST, STRIP LINE CONTACT ASSEMBLY COMPONENTS

ITEM	REF DES*	DESCRIPTION	PART NO.
4	E6	TERMINAL JUMPER, OUTPUT 	D75-72-7
5	E8	TERMINAL JUMPER, INPUT 	D75-81-1

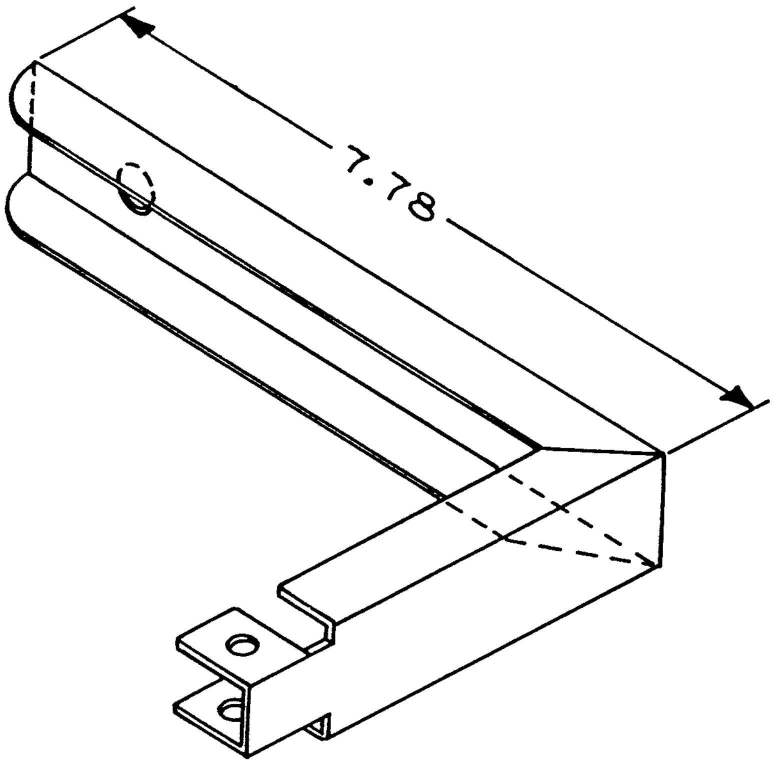
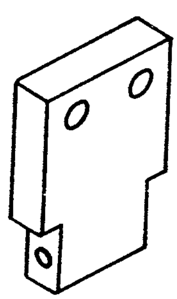
*Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.6 PICTORIAL PARTS LIST, STRIP LINE CONTACT ASSEMBLY COMPONENTS

ITEM	REF DES*	DESCRIPTION	PART NO.
6	E9	TERMINAL JUMPER, INPUT 	D75-81-2
7	E10	TERMINAL JUMPER, INPUT 	D75-73-1

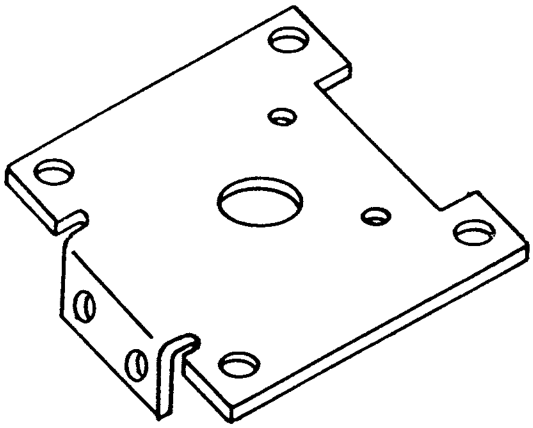
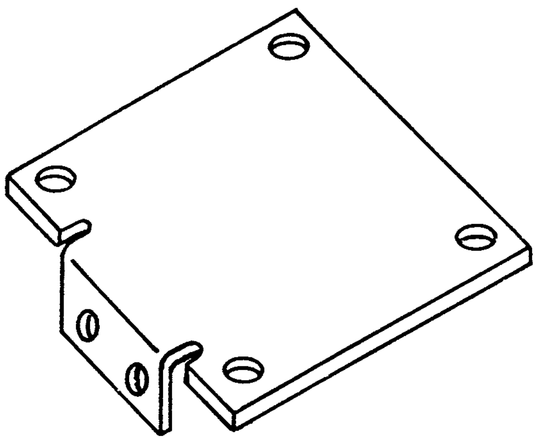
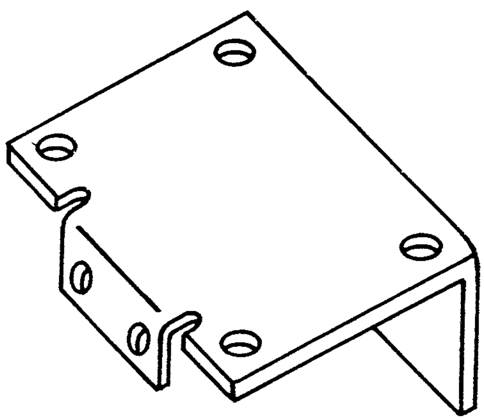
*Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.6 PICTORIAL PARTS LIST, STRIP LINE CONTACT ASSEMBLY COMPONENTS

ITEM	REF DES*	DESCRIPTION	PART NO.
8	E11	TERMINAL JUMPER, INPUT 	D75-73-2
9	E12	INSULATOR, CONTACT 	D04-37-2

*Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.6 PICTORIAL PARTS LIST, STRIP LINE CONTACT ASSEMBLY COMPONENTS

ITEM	REF DES*	DESCRIPTION	PART NO.
10	MP5	PLATE, RETAINING, SHAFT 	D71-266-2
11	MP6	PLATE, END CONTACT 	D71-285
12	MP7	PLATE, END CONTACT 	D71-269

*Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, Crosspoint, Front, Part Number D81-108-1

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E2	2	Contact Spring, Electrical	Delta 19482	D75-66-2
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP1	1	Bushing, Panel	Smith 83300	119
MP5	1	Plate, Retaining, Shaft	Delta 19482	D71-266-2
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 3/4", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, Crosspoint, Rear, Part Number D81-108-2

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E2	2	Contact Spring, Electrical	Delta 19482	D75-66-2
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP5	1	Plate, Retaining, Shaft	Delta 19482	D71-266-2
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 3/4", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, End, Flat Plate, Part Number D81-108-3

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E3	2	Contact, End, Electrical	Delta 19482	D75-70-2
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP6	1	Plate, End Contact	Delta 19482	D71-285
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 3/4", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, End, Angle Plate, Part Number D81-108-4

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E3	2	Contact, End, Electrical	Delta 19482	D75-70-2
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP7	1	Plate, End Contact	Delta 19482	D71-269
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 3/4", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, Row Terminal, Short, Part Number D81-108-5

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E2	2	Contact, Spring, Electrical	Delta 19482	D75-66-2
E5	1	Terminal Jumper, Output	Delta 19482	D75-72-5
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP1	1	Bushing, Panel	Smith 83300	119
MP5	1	Plate, Retaining, Shaft	Delta 19482	D71-266-2
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 7/8", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, Row Terminal, Long, Part Number D81-108-6

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E2	2	Contact, Spring, Electrical	Delta 19482	D75-66-2
E6	1	Terminal Jumper, Output	Delta 19482	D75-72-7
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP1	1	Bushing, Panel	Smith 83300	119
MP5	1	Plate, Retaining, Shaft	Delta 19482	D71-266-2
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 7/8", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, Column Terminal, Short, Part Number D81-108-7

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E2	2	Contact, Spring, Electrical	Delta 19482	D75-66-2
E10	1	Terminal Jumper, Input	Delta 19482	D75-73-1
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP5	1	Plate, Retaining, Shaft	Delta 19482	D71-266-2
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 7/8", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, Column Terminal, Long, Part Number D81-108-8

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E2	2	Contact, Spring, Electrical	Delta 19482	D75-66-2
E11	1	Terminal Jumper, Input	Delta 19482	D75-73-2
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP5	1	Plate, Retaining, Shaft	Delta 19482	D71-266-2
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 7/8", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

7.7 LIST OF MATERIAL, STRIP LINE CONTACT ASSEMBLIES

Strip Line Contact Assembly, Column Terminal, Short, Rack, Part Number D81-108-9

REF DES*	QTY PER ASSY	DESCRIPTION	MFR. FSCM	PART NO.
E2	2	Contact, Spring, Electrical	Delta 19482	D75-66-2
E8	1	Terminal Jumper, Input	Delta 19482	D75-81-1
E12	1	Insulator, Contact	Delta 19482	D04-37-2
MP5	1	Plate, Retaining, Shaft	Delta 19482	D71-266-2
---	2	Machine Screw, Binder Head, Slotted, #4-40 x 1/2", Nickel Plated Brass (with Split Lockwasher and Hex Nut)		Commercial
---	1	Machine Screw, Binder Head, Slotted, #4-40 x 7/8", Nickel Plated Brass (with Internal Tooth Lockwasher and Hex Nut)		Commercial

* Original component reference designation used in Revision A edition of this manual. Reference Section 7.1.4.

SECTION 8

MOTORIZED OPERATION

8.1 GENERAL

8.1.1 Sections 1 through 7 of this technical manual describe the principles of operation, installation, and maintenance of the Model SLS-4 Strip Line Switch, and are applicable to either a manual or motorized switch. This section details the particular requirements for operation of a motorized SLS-4, designated the Model SLS-4M.

8.1.2 The motor actuator assembly, B1, consists of a stepping rotary solenoid and a wafer switch deck assembly. This wafer switch assembly contains the interlock and indicator switches and the actuator control circuit. The stepping rotary solenoid operates from a plus 50 VDC (nominal) power supply which is normally supplied as part of the SLS-4M system. The operation of the motor actuator assembly may be controlled by either a Model MCU-8 Matrix Control Unit or a customer supplied control system.

8.2 ACTUATOR OPERATION

8.2.1 The Turn or Thru position of each motorized crosspoint is controlled by the motor actuator assembly. Application of plus 50 VDC to the actuator assembly results in a 90 degree rotation of the rotor assembly. An interrupter switch, operated by a cam on the actuator shaft, causes self-pulsing of the solenoid. Three pulses are required to achieve the 90 degree rotation. Figure 8-1, a schematic diagram of the motor actuator, shows the homing switch deck that controls the 90 degree rotation. As shown, the crosspoint is in the Thru position. Application of the power supply voltage to pin 3 of connector B1J1, the Turn Command pin, results in the actuator being energized. The actuator remains energized until the homing deck has rotated 90 degrees and the homing deck notch is opposite pin 15 of B1S1A Front, establishing the Turn position for the crosspoint. Similarly, application of the power supply voltage to pin 4 of connector B1J1, the Thru Command pin, with the crosspoint in the Turn position results in the actuator being energized, and rotating 90 degrees until the homing deck notch is opposite pin 21 of B1S1A Front, establishing the Thru position for the crosspoint.

8.2.2 The actuator assembly establishes the Turn or Thru position of each motorized crosspoint under the control of the MCU-8 Matrix Control Unit through the Actuator Interface Unit as described in Section 9 of this technical manual. The Matrix Control Unit provides a low level X-Y address corresponding to the row and column location of the crosspoint to be operated to the Turn position. The Model AIU Actuator Interface Unit decodes the X-Y address and provides a two step operational sequence that operates to the Thru position any crosspoint in the Turn position in the selected row and column, and operates to the Turn position the crosspoint at the intersection of the selected row and column.

8.2.3 The rotary solenoid has a ratchet-clutch assembly which is disengaged at all times except when the actuator is energized. This feature permits manual operation of a motorized crosspoint by means of the front panel knob. A 90 degree counterclockwise rotation of the front panel knob will establish the desired switch configuration.

CAUTION

The ratchet does not permit clockwise rotation of the front panel knob. Forcing clockwise rotation will cause damage to the rotor assembly or motor actuator assembly.

8.3 MOTORIZED SWITCH HARNESS

8.3.1 The harness of the motorized SLS-4M Strip Line Switch interconnects the motor actuator assemblies; the indicator, interlock and actuator control connectors, J1 through J6; the column and row interlock terminal barrier strips; and the Model IIK Interlock Isolation Assembly. This harness uses row and column buses for the indicator and actuator control circuits to provide X-Y readout and actuator address techniques. Individual interface connectors are provided for the row indicators, the column indicators, the row turn commands, the row through commands, the column actuator commons and the interlock status circuits. The interface connectors for the row and column indicators and the interlock status circuits connect directly to the Model MCU-8 Matrix Control Unit or the customer supplied control system. The interface connectors for the row turn commands and the row through commands connect to connectors J1 and J2, respectively, of the Row Driver Actuator Interface Unit via factory supply cable assemblies. The interface connector for the column actuator commons connectS to connector J1 of the Column Driver Actuator Interface Unit via a factory supplied cable assembly. The Row Driver and Column Driver Actuator Interface Units each provide a remote control connector, J3, which connects to the MCU-8 Matrix Control Unit or the customer supplied control system. The connections and functions of the circuits terminated on connectors J1 through J6 for an SLS-4M switch up to a maximum size of 40 rows and 40 columns are tabulated in Figure 8-2.

8.3.2 As shown in Figure 8-1, the Turn Command Bus and the Thru Command Bus are connected to pins 3 and 4, respectively, of connector B1P1. Silicon diodes B1CR2 and B1CR3 provide isolation between the command buses during operation of the motor actuator assembly. The Turn Command Bus and the Thru Command Bus are connected to connectors J3 and J4, respectively, on a row by row basis as tabulated in Figure 8-2B. The Actuator Common Bus, connected to pin 5 of connector B1P1, is terminated on connector J5 on a column by column basis as tabulated in Figure 8-2B.

8.3.3 The MCU-8 utilizes an X-Y strobe technique to read the status of the SLS-4M crosspoints. Silicon diode B1CR4 (motorized crosspoint) or S1CR4 (manual crosspoint) provides isolation between the row and column buses. The Row Indicator Bus and the Column Indicator Bus, connected to pins 2 and 1, respectively, of B1P1 are terminated on connectors J1 and J2, respectively. Figure 8-2A tabulates the Row Indicator Bus connections to connector J1 and the Column Indicator Bus connections to connector J2.

INDICATOR CIRCUIT			
Row Indicator Bus	Connector J1 Pin	Column Indicator Bus	Connector J2 Pin
Row A	1	Col 1	1
Row B	2	Col 2	2
Row C	3	Col 3	3
Row D	4	Col 4	4
Row E	5	Col 5	5
Row F	6	Col 6	6
Row G	7	Col 7	7
Row H	8	Col 8	8
Row J	9	Col 9	9
Row K	10	Col 10	10
Row L	11	Col 11	11
Row M	12	Col 12	12
Row N	13	Col 13	13
Row P	14	Col 14	14
Row Q	15	Col 15	15
Row R	16	Col 16	16
Row S	17	Col 17	17
Row T	18	Col 18	18
Row U	19	Col 19	19
Row V	20	Col 20	20
Row W	21	Col 21	21
Row X	22	Col 22	22
Row Y	23	Col 23	23
Row Z	24	Col 24	24
Row AA	26	Col 25	26
Row BB	27	Col 26	27
Row CC	28	Col 27	28
Row DD	29	Col 28	29
Row EE	30	Col 29	30
Row FF	31	Col 30	31
Row GG	32	Col 31	32
Row HH	33	Col 32	33
Row JJ	34	Col 33	34
Row KK	35	Col 34	35
Row LL	36	Col 35	36
Row MM	37	Col 36	37
Row NN	38	Col 37	38
Row PP	39	Col 38	39
Row QQ	40	Col 39	40
Row RR	41	Col 40	41

FIGURE 8-2A
INTERFACE CONNECTOR TABULATION

ACTUATOR CONTROL CIRCUIT				
Row Command Bus	Turn Command Bus	Thru Command Bus	Actuator Common Bus	Connector J5 Pin
	Connector J3 Pin	Connector J4 Pin		
Row A	1	1	Col 1	1
Row B	2	2	Col 2	2
Row C	3	3	Col 3	3
Row D	4	4	Col 4	4
Row E	5	5	Col 5	5
Row F	6	6	Col 6	6
Row G	7	7	Col 7	7
Row H	8	8	Col 8	8
Row J	9	9	Col 9	9
Row K	10	10	Col 10	10
Row L	11	11	Col 11	11
Row M	12	12	Col 12	12
Row N	13	13	Col 13	13
Row P	14	14	Col 14	14
Row Q	15	15	Col 15	15
Row R	16	16	Col 16	16
Row S	17	17	Col 17	17
Row T	18	18	Col 18	18
Row U	19	19	Col 19	19
Row V	20	20	Col 20	20
Row W	21	21	Col 21	21
Row X	22	22	Col 22	22
Row Y	23	23	Col 23	23
Row Z	24	24	Col 24	24
Row AA	26	26	Col 25	26
Row BB	27	27	Col 26	27
Row CC	28	28	Col 27	28
Row DD	29	29	Col 28	29
Row EE	30	30	Col 29	30
Row FF	31	31	Col 30	31
Row GG	32	32	Col 31	32
Row HH	33	33	Col 32	33
Row JJ	34	34	Col 33	34
Row KK	35	35	Col 34	35
Row LL	36	36	Col 35	36
Row MM	37	37	Col 36	37
Row NN	38	38	Col 37	38
Row PP	39	39	Col 38	39
Row QQ	40	40	Col 39	40
Row RR	41	41	Col 40	41

FIGURE 8-2B
INTERFACE CONNECTOR TABULATION

INTERLOCK STATUS CIRCUIT			
IIK-10D Barrier Strip	Connector J6 Pin	IIK-16D Barrier Strip	Connector J6 Pin
Unit 1, TB5-1	1	Unit 1, TB5-1	1
Unit 1, TB5-2	2	Unit 1, TB5-2	2
Unit 1, TB5-3	3	Unit 1, TB5-3	3
Unit 1, TB5-4	4	Unit 1, TB5-4	4
Unit 1, TB5-5	5	Unit 1, TB5-5	5
Unit 1, TB5-6	6	Unit 1, TB5-6	6
Unit 1, TB5-7	7	Unit 1, TB5-7	7
Unit 1, TB5-8	8	Unit 1, TB5-8	8
Unit 1, TB5-9	9	Unit 1, TB5-9	9
Unit 1, TB5-10	10	Unit 1, TB5-10	10
Unit 2, TB5-1	11	Unit 1, TB5-11	11
Unit 2, TB5-2	12	Unit 1, TB5-12	12
Unit 2, TB5-3	13	Unit 1, TB5-13	13
Unit 2, TB5-4	14	Unit 1, TB5-14	14
Unit 2, TB5-5	15	Unit 1, TB5-15	15
Unit 2, TB5-6	16	Unit 1, TB5-16	16
Unit 2, TB5-7	17	Unit 2, TB5-1	17
Unit 2, TB5-8	18	Unit 2, TB5-2	18
Unit 2, TB5-9	19	Unit 2, TB5-3	19
Unit 2, TB5-10	20	Unit 2, TB5-4	20
Unit 3, TB5-1	21	Unit 2, TB5-5	21
Unit 3, TB5-2	22	Unit 2, TB5-6	22
Unit 3, TB5-3	23	Unit 2, TB5-7	23
Unit 3, TB5-4	24	Unit 2, TB5-8	24
Unit 3, TB5-5	26	Unit 2, TB5-9	26
Unit 3, TB5-6	27	Unit 2, TB5-10	27
Unit 3, TB5-7	28	Unit 2, TB5-11	28
Unit 3, TB5-8	29	Unit 2, TB5-12	29
Unit 3, TB5-9	30	Unit 2, TB5-13	30
Unit 3, TB5-10	31	Unit 2, TB5-14	31
Unit 4, TB5-1	32	Unit 2, TB5-15	32
Unit 4, TB5-2	33	Unit 2, TB5-16	33
Unit 4, TB5-3	34	Unit 3, TB5-1	34
Unit 4, TB5-4	35	Unit 3, TB5-2	35
Unit 4, TB5-5	36	Unit 3, TB5-3	36
Unit 4, TB5-6	37	Unit 3, TB5-4	37
Unit 4, TB5-7	38	Unit 3, TB5-5	38
Unit 4, TB5-8	39	Unit 3, TB5-6	39
Unit 4, TB5-9	40	Unit 3, TB5-7	40
Unit 4, TB5-10	41	Unit 3, TB5-8	41
All Units, TB5-12	25	All Units, TB5-18	25

FIGURE 8-2C
INTERFACE CONNECTOR TABULATION

8.3.4 The interlock circuit shown in Figure 8-1 is identical to the interlock circuit described in Section 3.2 of this technical manual. This section should be consulted for operational principles.

8.3.5 The SLS-4M Strip Line Switch may be equipped either with one or more Model IIK Interlock Isolation Assemblies or one or more Model IIK/DL Interlock Isolation Assemblies. The Model IIK assembly provides both an isolated contact closure and an additional contact closure to a common for each valid interlock circuit (reference Model IIK Interlock Isolation Assembly Technical Manual D93-309A). The Model IIK/DL assembly provides an isolated contact closure and an additional contact closure to a common for each valid interlock circuit, and also provides contact closures to automatically control one or more dummy load blower motors (reference Model IIK/DL Interlock Isolation Assembly Technical Manual D93-312A). The Matrix Control Unit monitors the contact closure to a common provided by either assembly for remote indication of the interlock circuit status. The interlock status lines from TB5 of each Interlock Isolation Assembly are terminated on connector J6 as tabulated in Figure 8-2C.

8.3.6 The six interface connectors, J1 through J6, are 50 pin "D" series connectors, Amp part number 205212-1. The factory installed crimp pin contacts in these connectors may be replaced with Amp part number 205089-1 crimp contacts using a military standard crimp tool M22520/2-01 with M22520/2-08 positioner. The mating connectors, P1 through P6, supplied as part of the multiconductor cable assemblies with the MCU-8 Matrix Control Unit and the Row and Column Driver Actuator Interface Units, are Amp part number 205211-1. The factory installed crimp socket contacts in these mating connectors may be replaced with Amp part number 205090-1 crimp sockets using the above referenced military standard crimp tool and positioner. Disregard the references in Section 7 of this technical manual to the Elco connectors, J1 and P1, and the Elco solder terminals, J1E1 and P1E1, as this series of connectors is not used on the subject equipment.

8.4 MAINTENANCE

8.4.1 The actuator assembly has been designed to provide long, trouble free service. Exercise normal care to prevent excessive dirt or dust from accumulating in the mechanism. The actuator assembly is factory lubricated. Due to the low operating duty cycle of the actuator, field lubrication is not required.

8.4.2 Conversion of a motorized crosspoint to manual operation for emergency service or for a change in operating condition can be accomplished at any time. The procedure is as follows: (Reference designations refer to SLS-4 parts per Section 7, List of Materials.)

A. Disconnect connector plug, B1P1

B. Remove motor actuator, B1

C. Install manual interlock switch, S1

D. Connect connector plug, B1P1

8.4.3 Perform maintenance on other components of the SLS-4M as detailed in Section 6 of this technical manual.

SECTION 9

ACTUATOR INTERFACE UNIT

9.1 GENERAL

9.1.1 The Model AIU Actuator Interface Unit interfaces the low level outputs of the MCU-8 Matrix Control Unit with the high voltage and high current levels required by the actuator assemblies of the SLS-4M Strip Line Switch. The Actuator Interface Units, Part Numbers D14-35-1 and D14-35-2, described herein provide this interface for a Model SLS-4M Strip Line Switch equipped with a minimum of seventeen rows or seventeen columns and a maximum of twenty rows and twenty columns. The D14-35-1 AIU is used both for the standard switch and for a switch incorporating the optional antenna ground row feature. The D14-352 AIU is used for a switch incorporating the optional antenna ground column feature. Using the X-Y address of the crosspoint to be operated to the Turn position and a two phase operational signal supplied by the Local MCU-8 Unit, the D14-35-1 AIU establishes the desired row and column connection and automatically clears any previously established connections in the same row and column. However, if the desired connection is in the antenna ground row, any previously established connections in the same column will be cleared but previously established connections in the antenna ground row will not be cleared. Using the X-Y address of the crosspoint to be operated to the Turn position and a three phase operational signal supplied by the Local MCU-8 Unit, the D14-35-2 AIU also establishes the desired row and column connection and automatically clears any previously established connections in the same row and column. However, if the desired connection is in the antenna ground column, any previously established connections in the same row will be cleared but previously established connections in the antenna ground column will not be cleared.

9.1.2 The Actuator Interface Unit mounts on the rear side of the SLS-4M terminal panel as shown in the Installation Drawing contained in Section 10 of this technical manual. The actuator power supply, rated to supply 5 amperes at 50 VDC, mounts adjacent to the AIU. A panel mounted pushbutton switch on the AIU controls the application of AC power to the actuator power supply.

9.2 PRINCIPLES OF OPERATION

9.2.1 General

9.2.1.1 As noted, the Actuator Interface Unit provides an interface between the logic level signals from the MCU-8 and the high voltage and high current levels for the SLS-4M actuator assemblies. With reference to Figure 9-1, Actuator Interface Unit Schematic Diagram, the AIU consists of three types of plug-in printed circuit board assemblies:

1. Timing Control Assembly,
2. Row Driver Assembly, and
3. Column Driver Assembly.

Each Row and Column Driver Assembly controls up to five rows or columns, respectively, on the SLS-4M. The chassis used with the D14-35-1 and D14-35-2 Actuator Interface Units has nine printed circuit board assemblies consisting of one Timing Control Assembly installed in connector J6, four Column Drivers installed in connectors J7, J8, J9, and J10, and four Row Drivers installed in connectors J11, J12, J13, and J14. Figure 9-1, Actuator Interface Unit Schematic Diagram, is applicable for both AIU models as identical connector reference designations are employed on both AIU chassis designs.

9.2.1.2 In addition to performing the low level to high level interface, the AIU provides the logic required to automatically clear to the Thru position any crosspoint in the same row or column as the crosspoint being operated to the Turn position. When used with the D14-35-1 AIU, the Local MCU-8 Unit generates a two phase signal that controls the operation of the Row Driver and Column Driver Assemblies. During Phase 1, any crosspoint in the Turn position in the selected row is operated to the Thru position. During Phase 2, any crosspoint in the Turn position in the selected column is operated to the Thru position and the crosspoint at the intersection of the selected row and column is operated to the Turn position. However, if the selected row is the antenna ground row, then the Phase 1 signal remains high to preserve the previously established connections in the row. When used with the D14-35-2 AIU, the Local MCU-8 Unit generates a three phase signal that controls the operation of the Row Driver and Column Driver Assemblies. During Phase 1, any crosspoint in the Turn position in the selected row is operated to the Thru position. During Phase 2, the crosspoint at the intersection of the selected row and column is operated to the Turn position. If the selected column is any column other than the antenna ground column, then an active low Phase 3 signal is applied to the Row Driver Assemblies concurrent with the Phase 2 signal to operate any crosspoint in the Turn position in the selected column to the Thru position. If the selected column is the antenna ground column, then the Phase 3 signal remains high to preserve the previously established connections in the column.

9.2.1.3 Figure 9-1, Actuator Interface Unit Schematic Diagram, details the interconnections among connector J1, SLS-4M Row Turn Command Connector, connector J2, SLS-4M Row Thru Command Connector, connector J3, SLS-4M Column Actuator Common Connector, connector J4, SLS-4M Row Address Connector, connector J5, SLS-4M Column Address Connector, and the printed circuit assembly connectors. Because the wiring for the second, third and fourth Column Driver Assembly connectors J8, J9 and J10, and the second, third and fourth Row Driver Assembly connectors, J12, J13 and J14 is similar to the wiring for the first Column Driver Assembly and Row Driver Assembly connectors, J7 and J11, respectively, the wiring to these connectors is provided by tabulation in Figure 9-1.

9.2.1.4 The printed circuit assemblies of the AIU contain integrated circuits of the CMOS family. These circuits operate from the +12 VDC supply of the Local MCU-8 Unit. In the description of the operation of the printed circuit assemblies, a logic high refers to a voltage between +7 and +12 VDC while a logic low refers to a voltage between 0 and +5 VDC. In the general case, the CMOS integrated circuit logic levels are equal to 0 or +12 VDC with the exception of the outputs of the inverting buffer integrated circuits on the Row Driver and Column Driver Assemblies. The outputs have a logic high of approximately +10 VDC due to the high current output.

9.2.1.5 Because the Local MCU-8 Unit generates either a two or three phase signal that controls the operation of the Row and Column Driver Assemblies of the Actuator Interface Unit, the standard timing signals provided by the Timing Control Assembly as described in Sections 9.2.2.1 through 9.2.2.3 are not required. Thus, a Timing Control Assembly, part number D33-170-3, consisting only of a power supply status monitoring relay K1 and diode CR7 is installed in connector J6. The assembly provides power supply status to the MCU-8 as detailed in Section 9.2.2.4. The principles of operation provided in Sections 9.2.2.1 through 9.2.2.3 and the Timing Control Assembly Schematic Diagram, Figure 9-2, although not directly applicable to the subject Actuator Interface Unit, have been retained to provide supplementary information concerning the Phase 1 and Phase 2 timing signals.

9.2.2 Timing Control Assembly

9.2.2.1 The Timing Control Assembly, reference designation A3, provides the two phase signal that controls the operation of the Row Drier and Column Driver Assemblies. Once the row and column address of the crosspoint to be operated to the Turn position has been latched in the output registers of the Local MCU-8 unit and applied to the AIU, the MCU-8 generates a Data Ready Signal. With reference to Figure 9-2, Timing Control Assembly Schematic Diagram, the Data Ready signal is applied to the clock input of U3A, a J-K flip-flop wired as a D flip-flop. The positive going edge of the Data Ready signal triggers the flip-flop, sending the Q output to a high logic level. This high Q output enables steering gates U4B and U4C. The high Q output is also coupled through OR gate U2B and inverted by inverter U5C. The active low signal is then coupled through OR gate U2C to the reset terminal of oscillator/divider U1, enabling the oscillator circuit. Once enabled, the circuit oscillates at a frequency of approximately 500 Hz as determined by resistor R1 and capacitor C1. On the 16th count of the oscillator, corresponding to a pause period of approximately 36 msec., the Q5 output goes to a logic high. From counts 16 through 127, either the Q5, Q6 or Q7 outputs are high, resulting in a high output from OR gate U2A for a period of 250 msec. This high logic level from U2A is applied to inverter U5A by the steering gate U4C. The active low output of U5A (TP3) becomes the Phase 1 enable signal for the Row Driver and Column Driver Assemblies.

9.2.2.2 On the 128th count of U1, the Q8 output goes o a logic high. This logic high is applied by steering gate U4B to the clock input of U3B, a second J-K flip-flop wired as a D flip-flop. The high output of U4B is also coupled back to the reset terminal of U1 by OR gate U2C. The logic high resets U1, setting all outputs low. Flip-flop U3B triggers on the positive going edge of the clock input sending the Q output high. This high Q output enables steering gates U4A and U4D and resets flip-flop U3A which disables steering gates U4B and U4C. The high Q output of U3B is also coupled through U2B, inverted by U5C and applied to the reset terminal of U1. The active low reset signal enables the oscillator and begins the count cycle again. The 250 msec. high output of U2A is applied to inverter U5B by steering gate U4D. The active low output of U5B (TP4) becomes the Phase 2 enable signal for the Row Driver and Column Driver Assemblies.

9.2.2.3 On the 128th count of U1, the Q8 output again goes high. The high logic output is applied to the reset input of U3B by the steering gate U4A. The Q output of U3B resets to a logic low, disabling steering gates U4A and U4D, and resetting U1. This completes the two phase sequence and enables the circuit for the next Data Ready signal. Capacitor C2 and resistor R6 generate a positive pulse upon application of +12 VDC to the circuit. This pulse resets both flip-flops, U3A and U3B, and the oscillator divider U1 to start the circuit in the proper mode.

9.2.2.4 The Timing Control Assembly also monitors the status of the SLS-4M actuator power supply. With reference to Figure 9-2, relay K1 is energized when the actuator power supply is operating. The contact closure to common provided by the normally open contact of this relay is detected by the MCU-8 and used for reporting the status of the SLS-4M power supply.

9.2.3 Row Driver Assembly

9.2.3.1 The Row Driver Assembly, reference designation A1, receives he active low row address from the Local MCU-8 unit and switches the appropriate Row Turn Command Bus and Row Thru Command Bus to the +50 VDC power supply output. Each Row Driver Assembly controls five rows on the SLS-4M. As shown in Figure 9-1, the Row Driver Assembly installed in connector J11 controls Rows A through E, the assembly installed in connector J12 controls Rows F through K, the assembly installed in connector J13 controls Rows L through Q and the assembly installed in connector J14 controls Rows R through V. Because the principles of operation for each Row Driver Assembly and for each of the five row driver circuits of the assembly are identical, the following discussion describes the circuit operation for the Row Driver Assembly for Rows A through E, and in particular, the Row A driver circuit. The extension of these operational principles to the other rows and Row Driver Assemblies follows automatically. Note that on each D33-168-2 Row Driver Assembly used in the D14-35-2 AIU, jumper W1 is in the 1-3 position to enable the Phase 3 signal for proper operation of the antenna ground column feature.

9.2.3.2 With reference to Figure 9-3, Row Driver Assembly Schematic Diagram, integrated circuits U1, U2 and U3 are strobed, hex inverting buffers which invert the logic input when the disable control is a logic low. When the disable control is a logic high, the outputs are in a high impedance mode permitting the outputs of different inverters to be connected together. The Phase 1, Phase 2 and Phase 3 signals from the Local MCU-8 Unit are used as disable controls, thus determining which inverting buffers are enabled during the operational sequence.

9.2.3.3 The five row input lines on pins 5 through 9 are normally held at a high logic level by the pull-up resistors R1 through R5, respectively. Upon selection of a new SLS-4M transmitter to antenna connection, the Local MCU-8 takes the row input line corresponding to the selected row to a logic low. Thus, with Row A selected, pin 5 (TP1) is at a logic low. This logic low is applied to inverters U1A and U3A. During Phase 1, only inverter U3 is enabled by the active low Phase 1 signal. Thus, the output of U3A (TP7) is a logic high and all other outputs of U3, U3B through U3E, are logic lows. The logic high output of U3A is applied to the base of buffer transistor Q2. Transistor Q2 saturates, turning on PNP Darlington transistor Q12. The current gain of 1000 in Q12 allows the 5 mA collector current of Q2 to switch 5 Amps. With Q12 saturated, the Row A Thru Command Bus is switched to the +50 VDC power supply. As described in Section 9.2.4.3, all column driver circuits are enabled during Phase 1. Thus, any crosspoint in the Turn position in Row A is operated to the Thru position, clearing the row. At the completion of Phase 1, inverter U3 is disabled, turning off transistors Q2 and Q12.

9.2.3.4 During Phase 2 inverter U1 is enabled by the active low Phase 2 signal. Because the input to inverter U1 for Row A is a logic low, the output of U1A (TP6) goes to a logic high. The logic high output of U1A is applied to buffer transistor Q1, turning on PNP Darlington transistor Q11 and switching the Row A Turn Command Bus to the +50 VDC supply. As described in Section 9.2.4.4, only the column driver circuit for the selected column is enabled during Phase 2. Therefore, the crosspoint at the intersection of Row A and the selected column is operated to the Turn position. The Row B, C, D and E inputs to U1 are logic highs, yielding logic low outputs. These outputs are applied to the inputs of inverters U2B through U2E. On the D33-168-1 assembly, inverter U2 is enabled during Phase 2. On the D33-168-2 assembly, inverter U2 is enabled during

Phase 2 by the concurrent, active low Phase 3 signal. The outputs of U2B through U2E are logic highs (TP9, 11, 13 and 15). The logic high outputs of U2B through U2E are applied to buffer transistors Q4, Q6, Q8 and Q10, respectively, switching the Row B, C, D and E Thru Command Buses to the +50 VDC supply. As described in Section 9.2.4.4, only the column driver circuit for the selected column is enabled during Phase 2. Therefore, any crosspoint in the Turn position in the selected column is operated to the Thru position, clearing the column. At the completion of Phase 2, inverters U1 and U2 are disabled, turning off all transistors.

9.2.3.5 If the Model SLS-4 is equipped with the optional antenna ground row feature, then after every operational sequence and upon power up, the MCU-8 checks for unused antennas (any column with all crosspoints in the Thru position) and then connects any unused antennas to the antenna ground row. If Row A is the ground row and Column 1 is the unused antenna column, then the MCU-8 takes the row input line for Row A and the column input line for Column 1 to logic lows. The MCU-8 omits the Phase 1 signals so that all Row A crosspoints in the Turn position remain in that position and applies only the Phase 2 signal. During Phase 2, the Row A Turn Command Bus is connected to the +50 VDC supply and the Column 1 actuator common is connected to the power supply common. Thus, the crosspoint at the intersection of Row A and Column 1 operates to the Turn position and grounds the antenna.

9.2.3.6 If the Model SLS-4 is equipped with the optional antenna ground column feature, then after every operational sequence and upon power up, the MCU-8 checks for unused antennas (any row with all crosspoints in the Thru position) and then connects any unused antennas to the antenna ground column. If Column 1 is the ground column and Row A is the unused antenna row, then the MCU-8 takes the row input line for Row A and the column input line for Column 1 to logic lows. Because all Row A crosspoint are already in the Thru position, the MCU-8 omits the Phase 1 signal and applies only the Phase 2 signal. During Phase 2, the Row A Turn Command Bus is connected to the +50 VDC supply and the Column 1 actuator common is connected to the power supply common. Thus, the crosspoint at the intersection of Row A and Column 1 operates to the Turn position and grounds the antenna. The Phase 3 signal remains high during the antenna ground sequence so that inverter U2 is not enabled. The Thru Command Buses are not connected to the +50 VDC supply and thus, any crosspoints in the antenna ground column in the Turn position remain in that position.

9.2.3.7 While the preceding discussion described the operation of the Row Driver Assembly for Rows A through E, it should be noted that the operation of Row Driver Assemblies for additional rows of the SLS-4M will be coincident with the Row A through Row E Driver Assembly. Thus, for example, during Phase 2 when the row turn driver for Row A is switched on, the row through drivers for Rows B through V will also be switched on.

9.2.4 Column Driver Assembly

9.2.4.1 The Column Driver Assembly, reference designation A2, receives the active low column address from the Local MCU-8 unit and switches the appropriate column actuator common to the power supply common. Each Column Driver Assembly controls five columns on the SLS-4M. As shown in Figure 9-1, the Column Driver Assembly installed in connector J7 controls Columns 1 through 5, the assembly installed in connector J8 controls Columns 6 through 10, the assembly installed in connector J9 controls Columns 11 through 15 and the assembly installed in connector J10 controls Columns 16 through 20. The principles of operation for each Column Driver Assembly and for each of the five column driver circuits of the assembly are identical except for the antenna ground column. The following discussion first describes the circuit operation for the Column 1 through 5 Column Driver Assembly, and in particular, the Column 1 driver circuit. The extension of these operational principles to the other columns and Column Driver Assemblies follows automatically. Note that the Column Driver Assembly uses only the Phase 1 and Phase 2 timing signals and does not require the Phase 3 timing signal.

9.2.4.2 With reference to Figure 9-4, Column Driver Assembly Schematic Diagram, integrated circuits U1 and U2 are strobed, hex inverting buffers which invert the logic input when the disable control is a logic low. When the disable control is a logic high, the outputs are in a high impedance mode permitting the outputs of different inverters to be connected together. The Phase 1 and Phase 2 signals from the Local MCU-8 Unit are used as disable controls, thus determining which inverting buffers are enabled during the operational sequence.

9.2.4.3 The five column input lines on pins 5 through 9 are normally held at a high logic level by the pull-up resistors R1 through R5, respectively. Upon selection of a new SLS-4M transmitter to antenna connection, the Local MCU-8 unit takes the column input line corresponding to the selected column to a logic low. Thus, with Column 1 selected, pin 5 (TP1) is at a logic low which is applied to inverter U1A. During Phase 1, only inverter U2 is enabled by the active low Phase 1 signal. Because all active inputs to U2 are connected to logic common, the outputs of U2A through U2E (TP6 through TP10) are at a logic high during Phase 1. The logic high of each output is applied to the base of the respective column driver transistor, Q1 through Q5. Each column driver transistor is an NPN Darlington transistor. The current gain of 1000 in the Darlington transistors allows the 5 mA base current to switch 5 Amps. With all the Darlington transistors in a saturated mode, all the column actuator commons are switched to the power supply common. As described in Section 9.2.3.3, during Phase 1 the row thru driver circuit for the selected row is enabled. Thus, with all column driver circuits enabled, any crosspoint in the Turn position in the selected row is operated to the Thru position, clearing the row. At the completion of Phase 1, inverter U2 is disabled, turning off Darlington transistors Q1 through Q5.

9.2.4.4 During Phase 2, inverter U1 is enabled by the active low Phase 2 signal. Since the input to inverter U1 for Column 1 is a logic low, the output of U1A (TP6) goes high. All other inputs to U1 are logic highs, yielding logic low outputs at TP7, TP8, TP9 and TP10. The logic high output from U1A is applied to the base of Darlington transistor Q1 turning Q1 on. With Q1 in the saturated mode, the Column 1 actuator common is connected to the power supply common. As described in Section 9.2.3.4, during Phase 2 the row turn driver circuit for the selected row is enabled. Thus, the crosspoint at the intersection of the selected row and Column 1 is operated to the Turn position. As described in Section 9.2.3.4, on the D33-168-1 Row Driver Assembly, the Phase 2 signal enables all row thru drivers other than the selected row and on the D33-168-2 Row Driver Assembly, the active low Phase 3 signal during Phase 2 enables all row thru driver circuits other than the selected row. Thus, any crosspoint in the Turn position in Column 1 is operated to the Thru position. At the completion of Phase 2, inverter U1 is disabled, turning off Darlington transistor Q1.

9.2.4.5 If the Model SLS-4 is equipped with the optional antenna ground row feature, then after every operational sequence and upon power up, the MCU-8 checks for any unused antennas (any column with all crosspoints in the Thru position) and then connects any unused antennas to the antenna ground row. If Row A is the ground row and Column 1 is the unused antenna column, then the MCU-8 takes the row input line for Row A and the column input line for Column 1 to logic lows. The MCU-8 omits the Phase 1 signal so that all Row A crosspoints in the Turn position remain in that position and applies only the Phase 2 signal. During Phase 2, the Row A Turn Command Bus is connected to the +50 VDC supply and the Column 1 actuator common is connected to the power supply common. Thus, the crosspoint at the intersection of Row A and Column 1 operates to the Turn position and grounds the antenna.

9.3.2.2 Once the failure mode has been isolated to a particular plug-in printed circuit assembly, the faulty component can be readily identified. Refer to the principles of operation section and in particular, the schematic diagrams.

9.4 LIST OF MATERIAL

9.4.1 Maintenance parts in the Actuator Interface Unit are identified by reference designations. These designations are used on the schematic diagrams and Lists of Material to identify the components. The component reference designation is also marked adjacent to the component on the printed circuit boards. The letter(s) in the reference designation identifies the class of item such as a diode, resistor, or transistor or identifies a subassembly such as a printed circuit assembly. The number differentiates between parts or subassemblies of the same class.

9.4.2 Reference designations for the parts of a subassembly consist of the part's standard reference designation preceded by the reference designation for the subassembly. For example, reference designation A2R1 identifies resistor number 1 on subassembly number 2. When all of the prefixes are identical on a schematic diagram or printed circuit board, they may be omitted for brevity and a note to that effect is placed on the drawing or circuit board.

9.4.3 LIST OF MATERIAL, SLS-4M ACTUATOR INTERFACE UNIT SYSTEM COMPONENTS

Ref Des	Description	Manufacturer	Manufacturer Part No.	Delta Order No.
---	Actuator Interface Unit	Delta		
	SLS-4M Standard or with Optional Antenna Ground Row and with MCU-8/-9 Remote Control		D14-35-1	014-0035-001
	SLS-4M with Optional Antenna Ground Column and with MCU-8/-9 Remote Control		D14-35-2	014-0035-002
PS1	Power Supply, +50 VDC, 5 Amp	Delta	LCS-D-48-R (120 VAC)	652-0006
			LCS-D-48-V1-R (240 VAC)	652-0006-001
W1	Interface Cable Assembly (SLS-4M Conn J3 to AIU Conn J1)	Delta	D50-48-4	050-0048-004
W2	Interface Cable Assembly (SLS-4M Conn J4 to AIU Conn J2)	Delta	D50-48-4	050-0048-004
W3	Interface Cable Assembly (SLS-4M Conn J5 to AIU Conn J3)	Delta	D50-48-4	050-0048-004

9.4.4 LIST OF MATERIAL, ACTUATOR INTERFACE UNIT, D14-35-1 AND D14-35-2

Ref Des	Description	Manufacturer	Manufacturer Part No.	Delta Order No.
A1A	Row Driver Assembly (D14-35-1) Row Driver Assembly (D14-35-2)	Delta Delta	D33-168-1 D33-168-2	033-0168-001 033-0168-002
A1B thru A1D	Same as A1A			
A2A	Column Driver Assembly	Delta	D33-169-1	033-0169-001
A2B thru A2D	Same as A2A			
A3	Timing Control Assembly	Delta	D33-170-3	033-0170-003
F1	Fuse, 3AG, 4A SB (120 VAC)	Littelfuse	313004	632-1032
F1	Fuse, 3AG, 2A SB (240 VAC)	Littelfuse	313002	632-1026
J1	Conn, Rcpt, Elec, 50 Pin	Amp	205211-1	618-0075
J2	Same as J1			
J3	Same as J1			
J4	Conn, Plug, 50 Pin	Amp	2-552001-1	618-0064
J5	Same as J4			
J6	Conn, Rcpt, Card Edge, 22 Solder Terms	Elco	00-6022-022-940-002	618-0005
J7 thru J14	Same as J6			
R1	Res, Fxd, Film, 1.3KΩ, 5%, 1W		RL32S132J	206-0132
R2	Same as R1			
RV1	Varistor, 150 Vrms (120 VAC)	GE	V150LA2	604-0005
RV1	Varistor, 275 Vrms	GE	V275LA2	604-0006
S1	Switch, PB, SPDT	Illuminated Products	616-7-1	664-0026
S1DS1	Lamp, Incand, 28V		Type 7387	644-0019
TB1	Term Block, 12 Term, Feed-Thru	Kulka	599-2004-12	670-0010-012

9.4.4 LIST OF MATERIAL, ACTUATOR INTERFACE UNIT, D14-35-1 AND D14-35-2

Ref Des	Description	Manufacturer	Manufacturer Part No.	Delta Order No.
TB2	Terminal Strip	Cinch	Type 52	
XF1	Fuseholder	Littelfuse	342014AL	634-0010

9.4.5 LIST OF MATERIAL, ROW DRIVER ASSEMBLY, D33-168-1 AND D33-168-2

Ref Des	Description	Manufacturer	Manufacturer Part No.	Delta Order No.
C1	Cap, Fxd, Poly Film, 0.1 μF, 100 VDC	Roederstein	MKT1822410015	330-0001
C2 thru C6	Cap, Fxd, Ceramic, 0.01 μF, 50 VDC	Centralab	UK50-103	310-0037
Q1 thru Q10	Transistor, NPN		2N5175	410-5175
Q11 thru Q20	Transistor, Darlington, PNP		2N6668	420-6668
R1 thru R5	Res, Fxd, Film, 12KΩ, 5%, 1/4W		RL07S123J	202-0123
R6 thru R15	Res, Fxd, Film, 120KΩ, 5%, 1/4W		RL07S124J	202-0124
R16 thru R25	Res, Fxd, Film, 1.8KΩ, 5%, 1/4W		RL07S182J	202-0182
R26 thru R35	Res, Fxd, Film, 6.8KΩ, 5%, 1/2W		RL20S682J	204-0682
U1 thru U3	IC, BCMOS, Strobed Hex Inverter/Buffer	Motorola	MC14502BCP	522-0502
W1*	Wire, Tinned Copper Bus, #24 AWG, 0.5" Lg	QQ-W-343	Type S	674-0002

*D33-168-1 Assembly: W1 installed in position 1-2
D33-168-2 Assembly: W1 installed in position 1-3

9.4.6 LIST OF MATERIAL, COLUMN DRIVER ASSEMBLY, D33-169-1

Ref Des	Description	Manufacturer	Manufacturer Part No.	Delta Order No.
C1	Cap, Fxd, Poly Film, 0.1 μF, 100 VDC	Roederstein	MKT1822410015	330-0001
C2 thru C6	Cap, Fxd, Ceramic, 0.01 μF, 50 VDC	Centralab	UK50-103	310-0037
Q1 thru Q5	Transistor, Darlington, PNP		2N6368	420-6368
R1 thru R5	Res, Fxd, Film, 12KΩ, 5%, 1/4W		RL07S123J	202-0123
R6 thru R10	Res, Fxd, Film, 1.5KΩ, 5%, 1/4W		RL07S152J	202-0152
U1, U2	IC, BCMOS, Strobed Hex Inverter/Buffer	Motorola	MC14502BCP	522-0502

9.4.6 LIST OF MATERIAL, TIMING CONTROL ASSEMBLY, D33-170-3

Ref Des	Description	Manufacturer	Manufacturer Part No.	Delta Order No.
C1 thru C5	Unassigned			
CR1 thru CR6	Unassigned			
CR7	Diode, Silicon		1N4148	410-4148
K1	Relay, 1 Form C, 48 VDC Coil	American Zettler	AZ1530-03-51	654-0061
R1 thru R7	Unassigned			
U1 thru U5	Unassigned			

SECTION 10

CUSTOM REQUIREMENTS

10.1 GENERAL

The Model SLS-4M (20 X 10) Strip Line Switch, Serial Number 315, differs from the standard Model SLS-4 described in this technical manual as detailed below.

10.2 CONFIGURATION

The Model SLS-4M Strip Line Switch is a 20 column by 10 row B left configuration switch as shown in the Installation Drawing, Figure 10-1, and in the Matrix Configuration Diagram, Figure 10-2. Upon installation of the antenna ground field modification kit as described in Section 11 of this technical manual, the switch is equipped for operation with nine inputs comprising seven transmitters (Rows B through H) and two trunk inputs (Row J and K) and twenty antennas (Columns 1 through 20). Row A provides for grounding of the antenna ports and is not equipped with an RF termination. Each antenna may be individually grounded by operation of the associated Row A crosspoint to the Turn position. The antenna connectors are 7/8 inch EIA male coaxial flanges located on the top of the switch. The transmitter and trunk input connectors are 7/8 inch EIA male coaxial flanges located on the right-hand side on the rear of the switch. All crosspoints are equipped with D35-19-3 motor actuators to provide remote control of the SLS-4 transmitter/antenna switching by Model MCU-8B Local and Remote Matrix Control Units. The switch is also equipped with interlock keylock switches for positive lockout of an antenna interlock circuit so a transmitter cannot be operated with the locked-out antenna.

10.3 INSTALLATION

10.3.1 Install the Model SLS-4M Strip Line Switch according to the installation instructions contained in Section 4.1 with reference to the installation dimensions shown in Figure 10-1.

10.3.2 Connect the AC main power, 240 VAC, 50 Hz, single phase to barrier strip TB1 of the Actuator Interface Unit (AIU) as shown in the Actuator Interface Unit Schematic Diagram, Figure 9-1. The AC main power connections to barrier strip TB4 of the IIK-10D Interlock Isolation Assembly have been factory wired to barrier strip TB1 of the Actuator Interface Unit. All connections between the Actuator Interface Unit and the Actuator Power Supply, PS1, are factory wired.

10.3.3 Make the transmitter interlock connections to the Model IIK-10D Interlock Isolation Assembly in accordance with Figure 10-3, Interlock Connections, and with reference to the instructions contained in the Model IIK Technical Manual included as Appendix A. Do not make connections to the Row A interlock circuit on the Model IIK-10D. This circuit corresponds to the antenna ground row and is provided to allow reassignment of Row A as an active input.

CAUTION

Remove the column interlock jumper corresponding to a switch column which does not have an RF load connected to prevent accidental operation of a transmitter into an open circuit.

10.3.4 Make the antenna interlock connections to the Model SLS-4M column interlock barrier strips TB1 through TB4 in accordance with Figure 10-3. A jumper is supplied installed to complete each antenna interlock circuit to the common return. Replace each jumper as required with the associated antenna interlock switch closure. Remove the jumper from the column interlock circuit corresponding to a switch column which does not have an antenna or other RF circuit connected to prevent accidental operation of a transmitter into an unterminated output on the switch.

10.3.5 To provide an inter-matrix interlock circuit for a trunk input, connect the row interlock terminals of the Model IIK-10D corresponding to the trunk input to the associated output interlock terminals of the switch matrix where the trunk originates. To provide an inter-matrix interlock circuit for a trunk output, remove the jumper and connect the column interlock terminals of the Model SLS-4M corresponding to the trunk output to the associated input interlock terminals of the switch matrix where the trunk terminates.

NOTE

The Column 7 trunk output of the Model SLS-4M (8 X 9) Strip Line Switch is assigned to connect to the Row J trunk input of the Model SLS-4M (20 X 10) Strip Line Switch. Provide an inter-matrix interlock circuit by connecting TB2-1 and TB2-2 of the SLS-4M (8 X 9) to TB2-9 and TB3-9 of the Model IIK-10D on the SLS-4M (20 X 10). The Column 8 trunk output of the Model SLS-4M (8 X 9) is assigned to connect to the Row K trunk input of the Model SLS-4M (20 X 10). Provide an inter-matrix interlock circuit by connecting TB2-3 and TB2-4 of the SLS-4M (8 X 9) to TB2-10 and TB3-10 of the Model IIK-10D on the SLS-4M (20 X 10).

10.3.6 Connectors J1 through J6 of the Strip Line Switch interface the indicator, interlock and actuator control circuits of the switch with the MCU-8B Local Matrix Control Unit and the Actuator Interface Unit. SLS-4M connectors J1, J2 and J6 connect directly to connectors J6, J8 and J10, respectively, of the MCU-8B Local Matrix Control Unit using the multiconductor cable assemblies supplied with the MCU-8 Matrix Control Unit per notes 1, 2 and 6 of Figure 10-1. SLS-4M connectors J3, J4 and J5 are factory wired to connectors J1, J2 and J3, respectively, of the Actuator Interface Unit per notes 3, 4 and 5 of Figure 10-1. Connectors J4 and J5 of the AIU connect to connectors J2 and J4, respectively, of the MCU-8B Local Matrix Control Unit using the multiconductor cable assemblies supplied with the MCU-8 Matrix Control Unit per the AIU notes of Figure 10-1.

10.4 CROSSPOINT GROUND CONTACT ASSEMBLY

The Model SLS-4M (20 X 10) Strip Line Switch is equipped with Crosspoint Ground Contact Assemblies, part number D81-108-11, installed on the Row A/Column 1 through 20 crosspoints. This assembly provides the antenna grounding feature by connecting the antenna port to the switch ground when the associated Row A crosspoint is in the Turn position. This assembly is identical to the Front Crosspoint Contact Assembly, D81-108-1, as depicted in Section 7.2 except that the Contact Insulator, part number D04-37-2, is replaced by a Grounding Standoff, part number D80-431 (reference Sections 7.6 and 7.7 for Strip Line Contact Assembly Components). As with all SLS-4 Contact Assemblies, service the ground contact assembly as an assembly to maintain factory alignment. Be careful when replacing this assembly not to install the D81-108-1 Front Crosspoint Contact Assembly by mistake as this assembly would defeat the antenna ground feature.

10.5 AUTOMATIC ANTENNA GROUNDING

10.5.1 As noted above, the contact assembly installed in each of the Row A crosspoints provides antenna grounding by connecting the antenna port to the switch ground when the crosspoint is in the Turn position. The MCU-8B Local Matrix Control Unit controls the actuators installed on these crosspoints to provide automatic antenna grounding. Upon completion of an MCU-8B controlled switching sequence that clears an antenna, the MCU-8B automatically operates the associated Row A crosspoint to the Turn position to ground the unused antenna. The antenna is ungrounded by operating the crosspoint to the Thru position during an MCU-8B controlled switching sequence to connect the antenna to a transmitter.

10.5.2 During manual operation of the switch, the MCU-8B does not control the antenna grounding and clearing. When manually connecting an antenna and transmitter, operate the associated Row A crosspoint to the Thru position to unground the antenna. After manually clearing an antenna, operate the associated Row A crosspoint to the Turn position to ground the antenna.

10.6 COLUMN/ROW END GROUND CONTACT ASSEMBLY

The Model SLS-4M (20 X 10) Strip Line Switch is equipped with a column/row end ground contact assembly, part number D81-108-14, installed at the end of each column below the Row K crosspoint and at the end of each row adjacent to the Column 20 crosspoint. This assembly provides the antenna grounding feature by connecting the antenna port to the switch ground when all crosspoints in the associated column are in the Thru position. This assembly also provides the transmitter grounding feature by connecting the transmitter port to the switch ground when all crosspoints in the associated row are in the Thru position. This assembly is identical to the angle plate end contact assembly, D81-108-4, as depicted in Section 7.2 except that the contact insulator, part number D04-37-2, is replaced by a grounding standoff, part number D80-431 (reference Sections 7.6 and 7.7 for Strip Line Contact Assembly Components). As with all SLS-4 Contact Assemblies, service the ground contact assembly as an assembly to maintain factory alignment. Be careful when replacing this assembly not to install the D81-108-4 angle plate end contact assembly by mistake as this assembly would defeat the antenna/transmitter ground feature.

10.7 INTERLOCK KEYLOCK SWITCHES

The Model SLS-4M Strip Line Switch is equipped with keylock switches installed in the column interlock circuit as shown in Figure 10-3, Interlock Connections. These keylock switches provide positive lockout of the interlock circuit and the corresponding RF output when required. For each keylock switch, the interlock circuit is valid when the key is horizontal and the interlock circuit is open when the key is vertical as shown in Figure 10-4. The key can be removed only when the keylock switch is in the open interlock circuit position (key vertical). The basic keylock switch is Chicago Lock Company part number 2174-1 (SPST). However, each keylock switch is supplied with different keying as tabulated below.

SLS-4M Column	Switch Designation	SLS-4M Key S/N
1	S1	VK1
2	S2	VK2
3	S3	VK3
4	S4	VK4
5	S5	VK5
6	S6	VK6
7	S7	VK7
8	S8	VK8
9	S9	VK9
10	S10	VK10
11	S11	VK11
12	S12	VK12
13	S13	VK13
14	S14	VK14
15	S15	VK15
16	S16	VK16
17	S17	VK17
18	S18	VK18
19	S19	VK19
20	S20	VK20

10.8 APPENDED TECHNICAL MANUALS

The Model SLS-4M (20 X 10) Strip Line Switch, Serial Number 315, is supplied with a Model IIK-10D Interlock Isolation Assembly to provide an isolated interlock circuit for each row. The technical manual for the Model IIK is included as Appendix A. The switch is also equipped with a power supply assembly, part number D34-81-2, to provide 50 VDC for the actuator assemblies. The assembly consists of a Lambda power supply, part number LNS-P-48, wired for 240 VAC operation and equipped with a barrier strip for AC and DC connections. The Instruction Manual for the Lambda power supply is included as Appendix B.

			⊕ ANT 7	⊕ ANT 8	⊕ ANT 9	⊕ ANT 10	⊕ ANT 11	⊕ ANT 12	⊕ ANT 13	⊕ ANT 14	⊕ ANT 15	⊕ ANT 16	⊕ ANT 17	⊕ ANT 18	⊕ ANT 19	⊕ ANT 20	⊕ ANT 21	⊕ ANT 22	⊕ ANT 23	⊕ ANT 24	⊕ ANT 25	⊕ ANT 28	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
ANT GND		A	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚
TX 8	⊕	B	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TX 9	⊕	C	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TX 10	⊕	D	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TX 11	⊕	E	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TX 12	⊕	F	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TX 13	⊕	G	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TX 14	⊕	H	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TNK 1 FM MX A	⊕	J	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
TNK 2 FM MX A	⊕	K	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	⏚
			⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	⏚	

FRONT VIEW

CROSSPOINT KEY

- ○ MOTORIZED
- □ MANUAL
- ⊗ LOCKED IN THRU POSITION
- × BLANK FOR FUTURE EXPANSION
- ⏚ COLUMN ANTENNA GROUND
- ⏚ ROW ANTENNA GROUND
- ⏚ MOTORIZED ANTENNA GROUND

CONNECTOR KEY

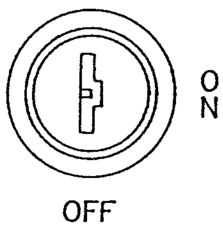
- ◎ 1-5/8" MALE FLANGE
- ⊕ 7/8" MALE FLANGE
- ○ TYPE N FEMALE RECEPTACLE

DIMENSIONS AND WEIGHT

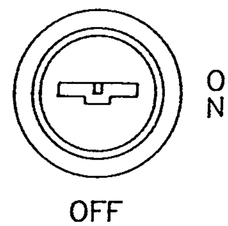
64.75" H X 57.25" W X 17.00" D
500 LBS

FIGURE 10-2
MATRIX CONFIGURATION DIAGRAM
MODEL SLS-4M (20 X 10) STRIP LINE SWITCH
SERIAL NUMBER 315

SWITCH ORIENTATION



OPEN INTERLOCK CIRCUIT
(SWITCH OPEN
AND
KEY REMOVABLE)



VALID INTERLOCK CIRCUIT
(SWITCH CLOSED
AND
KEY NOT REMOVABLE)

FIGURE 10-4
INTERLOCK KEYLOCK SWITCH

SECTION 11

FIELD MODIFICATION KIT INSTALLATION INSTRUCTIONS

The Delta Electronics, Inc. Antenna Ground Field Modification Kit, part number D42-98-1, provides the RF crosspoint components to equip Row A of the Model SLS-4M (20 X 10) Strip Line Switch, serial number 315, to enable grounding of individual antenna ports.

Installation instructions for the kit are included in this section for reference.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

INSTRUCTIONS

FOR

ANTENNA GROUND FIELD MODIFICATION KIT

MODEL SLS-4M (20 X 10) STRIP LINE SWITCH

SERIAL NUMBER 315

DELTA ELECTRONICS, INC.
5730 GENERAL WASHINGTON DRIVE
ALEXANDRIA, VIRGINIA 22312

ANTENNA GROUND FIELD MODIFICATION KIT
MODEL SLS-4M (20 X 10) STRIP LINE SWITCH
SERIAL NUMBER 315

DELTA ELECTRONICS, INC. ALEXANDRIA, VIRGINIA CODE IDENT. NO. 19482	DR. D. Petree 3/13/98	DWG. NO 1D42-98	REV. A
	APPD. W. Fox 3/13/98	USED ON SLS-4	SHEET 1 OF 10

605338

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

INSTRUCTIONS

FOR

ANTENNA GROUND FIELD MODIFICATION KIT

MODEL SLS-4M (20 X 10) STRIP LINE SWITCH

SERIAL NUMBER 315

GENERAL:

Field modification of the Model SLS-4M (20 X 10) Strip Line Switch to provide automated grounding of individual antenna ports.

GENERAL INFORMATION:

The Delta Electronics, Inc. Field Modification Kit, part number D42-98-1, contains the components and kit installation instructions for field modification of the Model SLS-4M (20 X 10) Strip Line Switch, Serial Number 315. The modification kit provides the required RF crosspoint components to enable grounding of individual antenna ports by operation of the associated Row A crosspoints to the Turn position. The MCU-8B Local Matrix Control Unit controls the actuators installed on these crosspoints to provide automatic antenna grounding. Upon completion of an MCU-8B controlled switching sequence that clears an antenna, the MCU-8B automatically operates the associated Row A crosspoint to the Turn position to ground the unused antenna. The kit also includes the components to enable transmitter grounding by connecting the transmitter port to the switch ground when all crosspoints in the associated row are in the Thru position.

TECHNICAL MANUAL CHANGES:

This kit includes a revised technical manual, Technical Manual Number D93-116C(M47/R05/315). This revised manual includes motorized operation, Actuator Interface Unit operation, custom requirements and auxiliary equipment technical manuals to support operation and maintenance of the switch upon installation of the field modification kit. This revised manual replaces the original manual, Technical Manual Number D93-116C(M47/315) dated October 12, 1992, in its entirety.

SPECIAL TOOLS AND TEST EQUIPMENT:

No special test equipment is required. A 1/16" Allen wrench is supplied with this kit.

MODIFICATION INSTRUCTIONS:

The modification process requires the removal of certain switch components, installation of RF components on the antenna ground crosspoints, and operational tests of the antenna grounding crosspoints. Components to be installed are identified in these instructions by item numbers which are used also on the list of material included with the instructions. References are also made to components and procedures described in the Model SLS-4 Technical Manual supplied with this kit.

WARNING

Remove all AC power and all RF power from the Strip Line Switch and all AC power from the Matrix Control Unit prior to beginning the modification. Attempting to maintain active RF circuits through the switch will subject installation personnel to risk of contact with hazardous RF voltages.

A. Kit Inspection

Prior to beginning the modification, compare the contents of the kit against the list of material to determine that all required items are present.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

NOTE

This Field Modification Kit enables grounding of an antenna by connecting the antenna port to the switch ground. This connection is made with a Front Crosspoint Ground Contact Assembly which is to be installed at each antenna ground crosspoint. To provide maximum protection, an antenna should be grounded as physically close to the antenna connection on the matrix as possible. Since the antenna connections to the switch are located on the top of the switch, the antenna ground crosspoints are to be installed in Row A. As Row A provides the antenna ground capability, this row cannot be used for transmitter/antenna switching. Thus, the transmitter assigned to Row A must be disconnected and reassigned.

B. Switch Preparation

1. Remove the top front panel and the bottom front panel. Remove the terminal cover from the input end of Row A. Save all hardware for use in reinstalling this cover.

2. Rotate all Row A crosspoints to the Thru position (reference Figure 3-2A in the SLS-4 Technical Manual). Using the 1/16" Allen wrench, Item 7, remove all manual operation knobs, MP10, from the Row A crosspoints by loosening the two #6-32 set screws securing each knob. Save the knobs for reinstallation.

3. Disconnect and remove the transmitter coaxial cable terminated on Row A. Disconnect and remove the Row A transmitter interlock circuit connected to TB2-1 and TB3-1 of the Model IIK-10D Interlock Isolation Assembly. To remove the Row A/Column 1 long row terminal contact assembly, E8, first remove the 3/8"-16 silver-plated brass jam hex nut and the 3/8" silver plated phosphor bronze splitlock washer securing the row terminal contact assembly to the 7/8" EIA bullet, E13 (reference Figure 7-4 in the SLS-4 Technical Manual). Remove the row terminal contact assembly by gently sliding the assembly to the left until the contact assembly springs clear the mounting plate of the right adjacent Row A/Column 2 contact assembly and then by gently pulling the contact assembly away from the switch until the contact assembly clears the front shaft of the rotor contact, E1. Remove the 3/8"-16 silver-plated brass jam hex nut and the 3/8" silver plated brass flat washer securing the 7/8" EIA bullet to the bullet insulator, E20. Remove the 7/8" EIA bullet and the bullet insulator. Remove the four 5/16"-18 x 1/2" hex bolts and the four 5/16" splitlock washers securing the 7/8" adapter plate, MP8, to the row connector plate. Save the row terminal contact assembly, 7/8" EIA connector components and mounting hardware for spare parts.
4. Remove the hardware securing the Row A/Column 2 front crosspoint contact assembly, E2. Remove this contact assembly by gently sliding the assembly to the left toward Column 1 until the contact assembly springs clear the mounting plate of the right adjacent Row A/Column 3 contact assembly and then by gently pulling the contact assembly away from the switch until the contact assembly clears the front shaft of the rotor contact, E1.
5. Repeat step B4 to remove all front crosspoint contact assemblies from Row A/Column 3 through Row A/Column 20. Ensure that each crosspoint is in the Thru position before

removing the contact assembly. Save the standard front crosspoint contact assemblies for spare parts.

6. Remove and save the angle plate end contact assembly, E6, installed at the end of Row A.

C. **Rotor Contact Lubrication**

1. Apply a light coating of conductive lubricant, Item 5, to the front conductive shoulders of each rotor contact, E1, installed on Row A. Be very careful not to allow the lubricant to be deposited on the insulators of the rotor contact.

2. Apply a light coating of general purpose white grease, Item 6, to the bearing surfaces on the front shaft of each Row A rotor contact.

D. **Front Crosspoint Ground Contact Assembly Installation**

NOTE

The front crosspoint ground contact assemblies, Item 2, are to be installed on all crosspoints of Row A. The front crosspoint ground contact assemblies are identical to the front crosspoint contact assemblies removed in steps B4 and B5 except that the front crosspoint ground contact assembly uses a grounding standoff instead of a contact insulator to support the contact springs. Exercise caution when installing these assemblies to insure that the ground assembly is installed on the Row A antenna grounding crosspoints.

1. Insert the contact spreader tool, Item 1, into the front crosspoint ground contact assembly, Item 2, to spread the spring fingers. Install this assembly on Column 1 of Row A by sliding the contact spring over the front shaft of the existing rotor contact. Align and secure the assembly with four #6-32 x 5/16" screws with captive lockwashers, Item 4.
2. Insert the second contact spreader tool into the next front crosspoint ground contact assembly. Install this assembly on Column 2 of Row A by sliding the contact springs over the existing rotor contact. Ensure the grounding standoff is positioned between the spring fingers of the left adjacent contact assembly. Align and secure the assembly with four #6-32 x 5/16" screws with captive lockwashers.
3. Remove the contact spreader tool from the front crosspoint ground contact assembly installed on Column 1 and install the tool in the next front crosspoint ground contact assembly. Install this assembly on Column 3 of Row A as described above ensuring the grounding standoff is positioned between the spring fingers of the left adjacent contact assembly. Align and secure the assembly with four #6-32 x 5/16" screws with captive lockwashers.
4. Repeat step D3 to complete the installation of front crosspoint ground contact assemblies on all twenty columns of Row A.

E. Angle Plate End Contact Assembly Removal

1. Rotate all Column 20 crosspoints in Rows B through K to the Turn position (rear slot horizontal as shown in Figure 3-2B of the SLS-4 Technical Manual).
2. Remove and save the angle plate end contact assembly, E6, installed at the end of Rows B through K.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

F. Ground Angle Plate End Contact Assembly

NOTE

The ground angle plate end crosspoint ground contact assemblies, Item 3, are to be installed at the end of each row. The ground angle plate end contact assemblies are identical to the end angle plate contact assemblies removed in steps B6 and E2 except that the ground contact assembly uses a grounding standoff instead of a contact insulator to support the contact springs. Exercise caution when installing these assemblies to insure that the ground assembly is installed at the end of each row.

1. Install the ground angle plate end contact assembly, Item 3, at the end of Row A. Ensure the grounding standoff is positioned between the spring fingers of the left adjacent contact assembly. Align and secure the assembly with four #6-32 x 5/16" screws with captive lockwashers, Item 4.

2. Repeat step F1 to complete the installation of ground angle plate end contact assemblies at the end of Rows B through K.

3. Remove and save the contact spreader tools used to assist installation of the front crosspoint ground contact assemblies.

G. Knob Installation

1. Ensure that the rotor contact installed in each Row A antenna ground crosspoint is in the Thru position (rear slot vertical as shown in Figure 3-2A of the SLS-4 Technical Manual).

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

2. Install the manual operation knob, MP10, removed in step B2 on each Row A crosspoint rotor contact. Check that the white line on the knob is vertical. Secure the knob by tightening the two #6-32 cup point set screws using the 1/16" hex allen wrench, Item 7.

CAUTION

The motor actuator ratchet does not permit clockwise rotation of the front panel knob. Forcing clockwise rotation will cause damage to the rotor contact or the motor actuator.

3. Manually rotate the crosspoint knob in the counterclockwise direction 360° and check for any binding or improper operation.

H. Refer to Section 6.2 in the SLS-4 Technical Manual to perform continuity checks on the new transmission lines. Verify grounding of each antenna port when the associated Row A crosspoint is operated to the Turn position. Verify grounding of each transmitter port when all crosspoints in the associated row are in the Thru position.

I. Install the long terminal cover on the left end of Row A with the hardware retained from cover removal in step B1. Install the 1-5/8" EIA hole cluster cover, Item 8, on the Row A connector plate. Secure the cover with four 5/16"-18 x 1/2" stainless steel hex head bolts, Item 9, and four 5/16" stainless steel splitlock washers, Item 10. Install top front panel and bottom front panel.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

J. Initial Tests

1. Apply AC power to the MCU-8B Local Matrix Control Unit and to the IIK-10D Interlock Isolation Assembly. Check that all crosspoints are in the Thru position. Check that all interlock keylock switches are closed.
2. Verify that the MCU-8B display indicates no transmitter/antenna connections, indicates all interlocks open (refer to Section 5 of the MCU-8 Technical Manual), indicates no antennas grounded, and displays the antenna ground fault message.
3. Manually operate the Row A/Column 1 (Antenna 1 ground) crosspoint to the Turn position. Verify that the MCU-8 indicates grounding of Antenna 1.
4. Manually operate the Row A/Column 2 crosspoint to the Turn position. Verify that the MCU-8 indicates grounding of Antenna 2.
5. Repeat step J4 for the Row A/Column 3 through Column 20 crosspoints verifying that the MCU-8 indicates the grounding of the associated Antennas 3 through 20.
6. Verify that the lockout memory programming of the MCU-8B Local Matrix Control Unit corresponds to the assignment of motorized crosspoints and antenna ground crosspoints on the switch (refer to Section 5.3.6 of the MCU-8 Technical Manual).
7. Apply AC power to the actuator power supply by operating the pushbutton switch on the Actuator Interface Unit.
8. Operate each motorized crosspoint to the Turn position using the MCU-8 Unit and verify status display and clearing of the grounded antenna. Operate each motorized crosspoint to the Thru position and verify status display and automatic antenna grounding operation. Repeat test for all motorized crosspoints. Verify proper operation in both the local and remote control modes.

			2	12			Technical Manual for Model SLS-4M (20 X 10) Strip Line Switch	Delta	D93-116C (M47/R05/315)	
			2	11			FMK Installation Instructions	Delta	1D42-98-1	
			4	10		102-0316	Washer, Splitlock, 5/16"		Stainless Steel	
			4	9		138-0316-008	Bolt, Hex Hd, 5/16"-18 x 1/2" Lg		Stainless Steel	
			1	8		071-0936	Cover, 1-5/8" Hole Cluster	Delta	D71-936	
			1	7		744-0023	Allen Wrench, 1/16"	Snap-On	AW2	
			1	6		890-0008	Grease, White, 1-3/4 oz Tube	Lubriplate	11387	
			1	5		890-0007	Lubricant, Silver, Conductive, 1 Gram Tube	Emerson & Cumming	SO Silver	
			120	4		142-0012	Screw, Pan Hd, Cross Recessed, #6-32 x 5/16" w/Split Lockwasher		Stainless Steel	
			10	3		081-0108-014	Strip Line Cont Assy, Crosspoint, Ground, Angle Plate	Delta	D81-108-14	
			20	2		081-0108-011	Strip Line Cont Assy, Crosspoint, Front, Ground	Delta	D81-108-11	
			2	1		043-0001	Contact Spreader Tool	Delta	D43-1	
QTY	**QTY**	**QTY**	**QTY**	**ITEM**	**CODE ID**	**DELTA NO.**	**DESCRIPTION**	**MFR**	**MFR PART NO.**	**CKT SYM**
			-1	**LIST OF MATERIAL**						

	SIGNATURE	DATE			
DR	D. Petree	12/5/97	ANTENNA GROUND FIELD MODIFICATION KIT MODEL SLS-4M (20 X 10) STRIP LINE SWITCH SERIAL NUMBER 315	**DELTA ELECTRONICS, INC. ALEXANDRIA, VIRGINIA CODE IDENT 19482**	
CHK	W. Fox			8D42-98	**REV** A
ENGR	W. Fox	2/16/98			
APP					
FILE NAME:	8D42-98.RVA		**USED ON:** SLS-4M S/N 315/R05	**SHEET** 1	**OF** 1

D95-45C

APPENDIX A

TECHNICAL MANUAL

FOR

MODEL IIK

INTERLOCK ISOLATION ASSEMBLY

TECHNICAL MANUAL

FOR

MODEL IIK

INTERLOCK ISOLATION

ASSEMBLY

DELTA ELECTRONICS, INC.
5730 GENERAL WASHINGTON DRIVE
ALEXANDRIA, VIRGINIA 22312

D93-309A

ISSUE DATE: 18 MARCH 1983

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LIST OF ILLUSTRATIONS

TECHNICAL MANUAL

FOR

MODEL IIK

INTERLOCK ISOLATION ASSEMBLY

SECTION 1

GENERAL INFORMATION

1.1 SCOPE

This Technical Manual covers the description, installation and operation of the Model IIK Interlock Isolation Assembly manufactured by Delta Electronics, Inc.

1.2 ASSEMBLY DESCRIPTION

The Model IIK Interlock Isolation Assembly is an accessory designed for use with the Delta Electronics series of Model SLS Strip Line Switches. The interlock circuit of the Model SLS switches is a single wire circuit working against a common return. Since the interlock circuits of many transmitters are above ground and may not be connected together via the switch interlock harness, the Model IIK utilizes relays to produce isolated interlock switching for each transmitter. The Model IIK also provides an additional contact closure to a common for each valid interlock circuit. This contact closure may be monitored by a control system for remote indication of the interlock circuit status.

1.3 MODEL NUMBERS

Each Interlock Isolation Assembly is manufactured to order to contain the required number of isolated interlock channels. The number of isolated channels is reflected in the model number. For example, an IIK-5D assembly contains five channels for isolating five transmitters and an IIK-14D assembly contains fourteen channels for isolating fourteen transmitters. Standard chassis sizes are the IIK-6D which provides up to six isolated interlock channels, the IIK-10D which provides up to ten isolated interlock channels and the IIK-16D which provides up to sixteen isolated interlock channels. The former example utilizes an IIK-6D chassis as shown in Figure 4-1, IIK-6D Schematic Diagram, and the latter example utilizes an IIK-16D chassis as shown in Figure 4-3, IIK-16D Schematic Diagram.

SECTION 2

SPECIFICATIONS

MODEL AND NAME:	IIK Interlock Isolation Assembly
FUNCTION:	Accessory for Model SLS Strip Line Switches to provide isolated transmitter interlock circuits and remote interlock status indication
NUMBER OF CHANNELS:	As specified -
	Model IIK-6D: Maximum of 6
	Model IIK-10D: Maximum of 10
	Model IIK-16D: Maximum of 16
INTERLOCK CONTACT RATING:	10A, 240 VAC
POWER REQUIREMENT:	115/230 VAC, 50/60 Hz
UNIT DIMENSIONS:	Standard Model IIK-6D Chassis:
	Chassis Mount: 12.3" X 6.6"H X 4.7"D
	19" Rack Mount: 19.0"W X 7.0"H X 4.7"D
	24" Rack Mount: 24.0"W X 7.0"H X 4.7"D
	Standard Model IIK-10D Chassis:
	Chassis Mount: 17.0"W X 6.6"H X 4.7"D
	19" Rack Mount: 19.0"W X 7.0"H X 4.7"D
	24" Rack Mount: 24.0"W X 7.0"H X 4.7"D
	Standard Model IIK-16D Chassis:
	Chassis Mount: 24.0"W X 6.6"H X 4.7"D

SYSTEM COMPONENTS:

1 each Model IIK Interlock Isolation Assembly:

D13-52-1-N: IIK-10D chassis/terminal panel mount

D13-52-2-N: IIK-10D chassis/19" rack mount

D13-52-3-N: IIK-10D chassis/24" rack mount

D13-52-4-N: IIK-16D chassis/terminal panel mount

D13-52-5-N: IIK-6D chassis/terminal panel mount

D13-52-6-N: IIK-6D chassis/19" rack mount

D13-52-7-N: IIK-6D chassis/24" rack mount

NOTE: N is number of channels

1 each Technical Manual (D93-309A)

SECTION 3

INSTALLATION

3.1 MECHANICAL

3.1.1 The Model IIK Interlock Isolation Assembly is generally factory supplied and installed on the terminal panel of the Model SLS Strip Line Switch. Thus, the only required installation procedure is the connection of the AC power and the transmitter interlock circuits as detailed in Section 3.2 of this Technical Manual.

3.1.2 The rack mounting versions of the Model IIK Interlock Isolation Assembly mount in a standard 19" or 24" wide equipment rack and occupy 7" of vertical panel space. When possible, the rack mounting unit should be mounted directly below the Strip Line Switch. The AC power, transmitter interlock circuits and SLS interlock circuits are connected as detailed in Section 3.2.

3.1.3 For field installation of the Model IIK on a Model SLS terminal panel, four 0.213" diameter holes on 11.560" X 3.100" centers for a Model IIK-6D chassis, on 16.260" X 3.100" centers for a Model IIK-10D chassis or on 22.260" X 3.100" centers for a Model IIK-16D chassis are required on the Model SLS terminal panel. Install the Model IIK on the terminal panel using four No. 10-32 screws.

3.2 ELECTRICAL

3.2.1 AC Power

A three terminal barrier strip, TB4, provides for connection of the 115/230 VAC, 50/60 Hz main power. The AC line connects to terminal 1, the AC neutral connects to terminal 2 and the AC ground connects to terminal 3.

CAUTION

The Model IIK is supplied wired for 115 VAC operation unless otherwise specified by the customer. The connections on the power transformer should be checked for 230 VAC operation and changed if required before applying 230 VAC power, or the equipment may be seriously damaged. The primary power fuse should be changed to 1 Amp for 230 VAC operation.

3.2.2 SLS Interlock Circuits

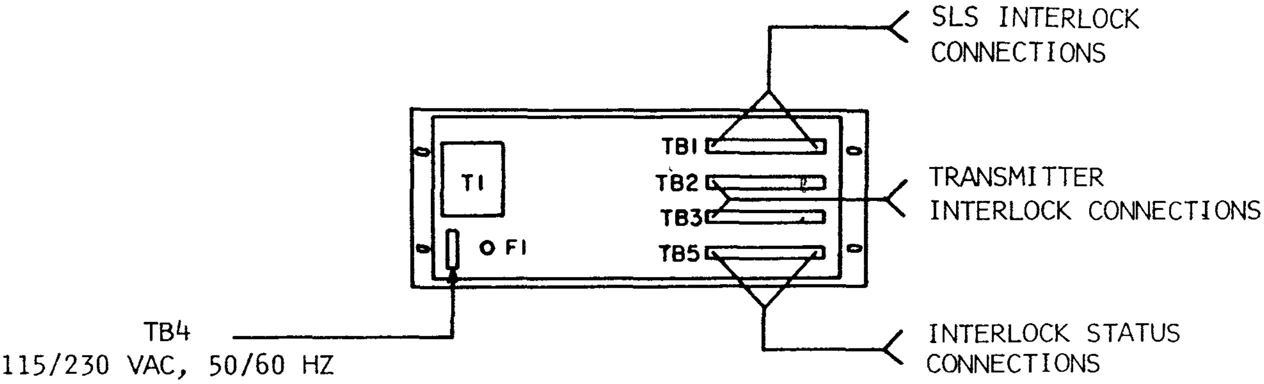
The Model SLS series of Strip Line Switches is equipped with two sets of interlock terminal blocks. For a standard SLS with a maximum of 10 columns and/or 11 rows, TB1 and TB2 are the column interlock terminal blocks, and TB3 and TB4 are the row interlock terminal blocks. (For an SLS with more than 10 columns or 11 rows, reference should be made to the Custom Requirements section of the SLS Technical Manual for designations and functions of the interlock terminal blocks.) The Model IIK connects to the SLS terminal blocks corresponding to the transmitter inputs. Thus, if the transmitters connect to the columns of the SLS, the Model IIK connects to the column interlock terminal blocks. If the transmitters connect to the rows of the SLS, the Model IIK connects to the row interlock terminal blocks. These SLS interlock connections are made to TB1 of the Model IIK as shown in Figure 3-1. The SLS interlock connections section of this figure tabulates the connections between TB1 of the Model IIK and the column interlock terminal blocks of the Model SLS. The column interlock terminal blocks specified in Figure 3-1 must be redefined to row interlock terminal blocks, i.e., TB1 and TB2 become TB3 and TB4, respectively, when the transmitters connect to the rows of the Model SLS. If the Model IIK has been factory installed on the SLS, these interlock connections are prewired.

3.2.3 Transmitter Interlock Circuits

The interlock circuit of each transmitter connects to terminal blocks TB2 and TB3 of the Model IIK as shown in Figure 3-1. Each adjacent pair of terminals on TB2 and TB3 presents an isolated switch closure to the transmitter. The interlock circuit is closed when the Model SLS is properly operated to present an RF load to the respective transmitter. The circuit opens to remove transmitter power for the duration of SLS switching. The relay contacts have a maximum rating of 10A/240 VAC. Each relay coil is individually fused.

3.2.4 Interlock Status Circuits

The Model IIK provides an additional contact closure to a common for each valid interlock circuit. These additional contact closures and the common are accessible on terminal block TB5 as shown in Figure 3-1. This contact closure may be monitored by a control system for remote indication of the interlock circuit status. If the Model IIK has been factory installed on an SLS supplied with a Delta Electronics Matrix Control Unit, these connections may be prewired to the interface connector on the SLS. Reference should be made to the corresponding SLS Technical Manual for a listing of these connections.



SLS INTERLOCK CONNECTIONS				
FROM MODEL SLS TERM. NO.	TO MODEL IIK-6D TB1 TERM. NO.	TO MODEL IIK-10D TB1 TERM. NO.	FROM MODEL SLS TERM. NO.	TO MODEL IIK-16D TB1 TERM. NO.
TB1-1	8	12	TB1-1	18
TB1-2	1	1	TB1-2	1
TB1-4	2	2	TB1-4	2
TB1-6	3	3	TB1-6	3
TB1-8	4	4	TB1-8	4
TB1-10	5	5	TB1-10	5
TB1-12	6	6	TB1-12	6
TB2-2		7	TB2-2	7
TB2-4		8	TB2-4	8
TB2-6		9	TB2-6	9
TB2-8		10	TB2-8	10
			TB2-10	11
			TB2-12	12
			TB3-2	13
			TB3-4	14
			TB3-6	15
			TB3-8	16

TRANSMITTER INTERLOCK CONNECTIONS		
TRANSMITTER NO.	TB2 TERM. NO.	TB3 TERM. NO.
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	16	16

INTERLOCK STATUS CONNECTIONS			
TRANSMITTER NO.	TB5 TERM. NO.		
	IIK-6D	IIK-10D	IIK-16D
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7		7	7
8		8	8
9		9	9
10		10	10
11			11
12			12
13			13
14			14
15			15
16			16
COMMON	8	12	18

FIGURE 3-1
INTERCONNECTION DIAGRAM

SECTION 4

LIST OF MATERIAL

4.1 INTRODUCTION

4.1.1 Maintenance components in the Model IIK Interlock Isolation Assembly are identified by reference designations. The designations are used on the drawings and in the text to identify the components. The letter(s) in the reference designation identifies the class of item such as a switch, resistor, or relay. The number differentiates between parts of the same class. Sockets are identified by a reference designation composed of the designation of the plug-in device preceded by an X.

4.1.2 Depending on the number of interlock channels required, the Model IIK Interlock Isolation Assembly may be based on either an IIK-6D chassis which provides up to six interlock channels, an IIK-10D chassis which provides up to ten interlock channels, or an IIK-16D chassis which provides up to sixteen interlock channels. Individual Lists of Material and Schematic Diagrams are provided to detail the components and wiring of these three standard chassis types.

4.2 LIST OF MATERIAL - INTERLOCK ISOLATION ASSEMBLY

Item	Description	Manufacturer	Part No.
1	Interlock Isolation Assembly, Model IIK-(N)D	Delta	
	10 Channel, Chassis Mount		D13-52-1-N
	10 Channel, 19" Rack Mount		D13-52-2-N
	10 Channel, 24" Rack Mount		D13-52-3-N
	16 Channel, Chassis Mount		D13-52-4-N
	6 Channel, Chassis Mount		D13-52-5-N
	6 Channel, 19" Rack Mount		D13-52-6-N
	6 Channel, 24" Rack Mount		D13-52-7-N
2	Technical Manual	Delta	D93-309A

NOTE: N in Model Number and in Part Number defines the number of channels.

4.3 LIST OF MATERIAL - IIK-6D INTERLOCK ISOLATION ASSEMBLY

Item	Reference Designation	Description	Manufacturer	Part No.
1	CR1-CR1(a)	Diode, Bidirectional, Transient Suppressor		1N6044
2	F1	Fuse, 3AG-2A	Littelfuse	312002
3	F1(b)	Fuse, 3AG-1A	Littlefuse	312001
4	F2-F7	Fuse, 3/8A, Slo-Blo	Littelfuse	313.375
5	K1-K6(c)	Relay, DPDT, 6 VAC	P & B	KAP11AG-6VAC
6	T1	Transformer, 115/230 VAC, 50/60 Hz, 6.3 VAC Secondary	Delta	D05-52
7	TB1, TB2 TB3, TB5	Terminal Block	Kulka	599-2004-8
8	TB4	Terminal Block	Kulka	599-2004-3
9	XF1-XF7	Socket, Fuse	Littelfuse	342014
10	XK1-XK6	Socket, Relay	Eby	TS-101-P01

(a) Effective Serial Numbers 510 and up, the 1N6044 bidirectional transient suppressor diode replaces the 1N6111 diode as reference designation CR1 through CR6. The 1N6111 diode is no longer manufactured as a bidirectional transient suppressor diode. Use the 1N6044 diode or equivalent when replacing CR1 - CR6 on any Model IIK-6D Interlock Isolation Assembly.

(b) Item 3 replaces Item 2 for 230 VAC operation.

(c) Quantity varies with number of channels.

4.4 LIST OF MATERIAL - IIK-10D INTERLOCK ISOLATION ASSEMBLY

Item	Reference Designation	Description	Manufacturer	Part No.
1	CR1-CR10(a)	Diode, Bidirectional, Transient Suppressor		1N6044
2	F1	Fuse, 3AG-2A	Littelfuse	312002
3	F1(b)	Fuse, 3AG-1A	Littelfuse	312001
4	F2-F11	Fuse, 3/8A, Slo-Blo	Littelfuse	313.375
5	K1-K10(c)	Relay, DPDT, 6 VAC	P & B	KAP11AG-6VAC
6	T1	Transformer, 115/230 VAC, 50/60 Hz, 6.3 VAC Secondary	Delta	D05-52
7	TB1, TB2 TB3, TB5	Terminal Block	Kulka	599-2004-12
8	TB4	Terminal Block	Kulka	599-2004-3
9	XF1-XF11	Socket, Fuse	Littelfuse	342014
10	XK1-XK10	Socket, Relay	Eby	TS-101-P01

(a) Effective Serial Numbers 510 and up, the 1N6044 bidirectional transient suppressor diode replaces the 1N6111 diode as reference designation CR1 through CR10. The 1N6111 diode is no longer manufactured as a bidirectional transient suppressor diode. Use the 1N6044 diode or equivalent when replacing CR1 - CR10 on any Model IIK-10D Interlock Isolation Assembly.

(b) Item 3 replaces Item 2 for 230 VAC operation.

(c) Quantity varies with number of channels.

4.5 LIST OF MATERIAL - IIK-16D INTERLOCK ISOLATION ASSEMBLY

Item	Reference Designation	Description	Manufacturer	Part No.
1	CR1-CR16(a)	Diode, Bidirectional, Transient Suppressor		1N6044
2	F1	Fuse, 3AG-2A	Littelfuse	312002
3	F1(b)	Fuse, 3AG-1A	Littelfuse	313001
4	F2-F17	Fuse, 3/8A, Slo-Blo	Littelfuse	313.375
5	K1-K16(c)	Relay, DPDT, 6 VAC	P & B	KAP11AG-6VAC
6	T1	Transformer, 115/230 VAC, 50/60 Hz, 6.3 VAC Secondary	Delta	D05-52
7	TB1, TB2 TB3, TB5	Terminal Block	Kulka	599-2004-18
8	TB4	Terminal Block	Kulka	599-2004-3
9	XF1-XF17	Socket, Fuse	Littelfuse	342014
10	XK1-XK6	Socket, Relay	Eby	TS-101-P01

(a) Effective Serial Numbers 510 and up, the 1N6044 bidirectional transient suppressor diode replaces the 1N6111 diode as reference designation CR1 through CR16. The 1N6111 diode is no long manufactured as a bidirectional transient suppressor diode. Use the 1N6044 diode or equivalent when replacing CR1 - CR16 on any Model IIK-16D Interlock Isolation Assembly.

(b) Item 3 replaces Item 2 for 230 VAC operation.

(c) Quantity varies with number of channels.

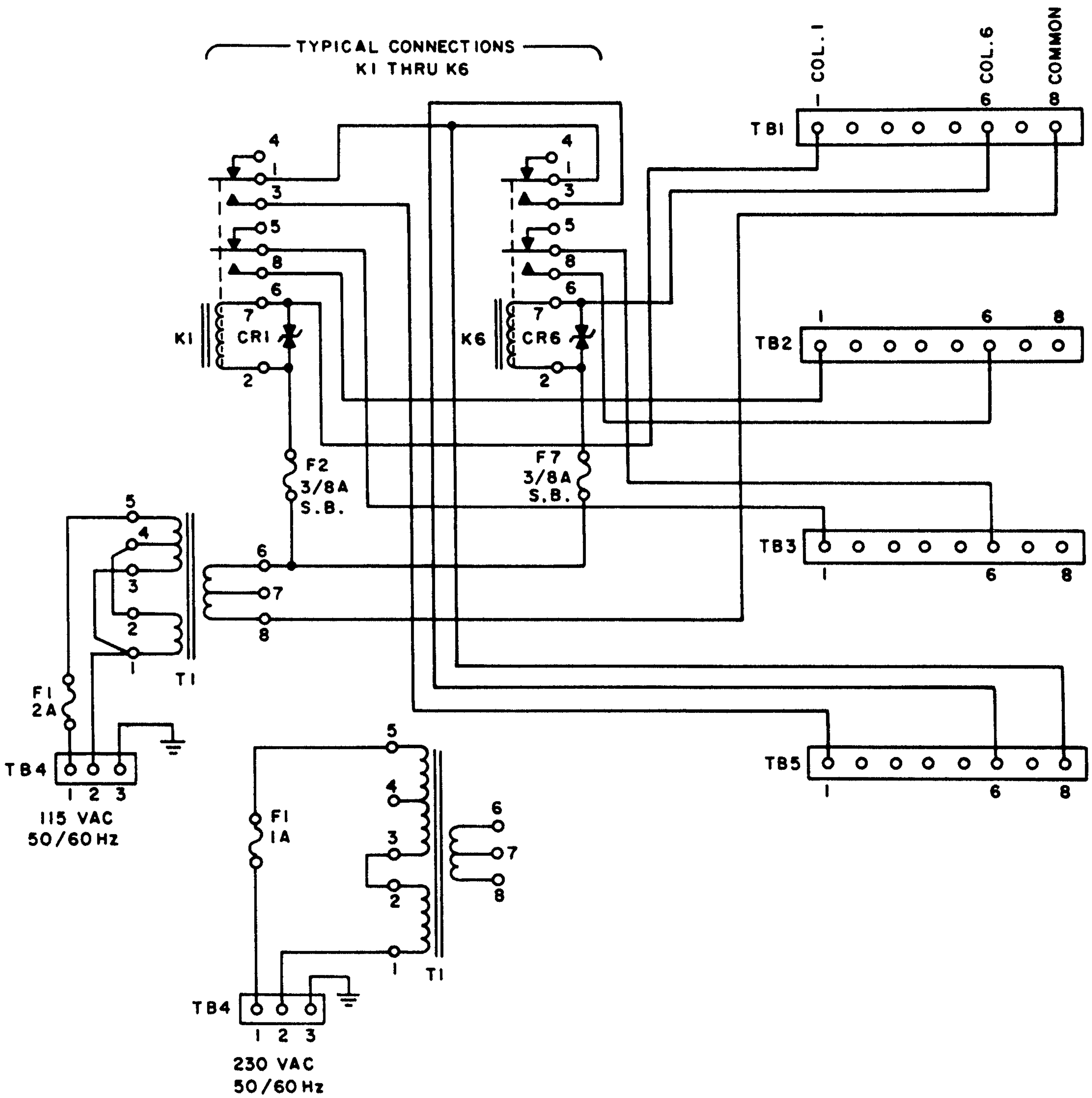


FIGURE 4-1
SCHEMATIC DIAGRAM
INTERLOCK ISOLATION
ASSY., 11K-6D

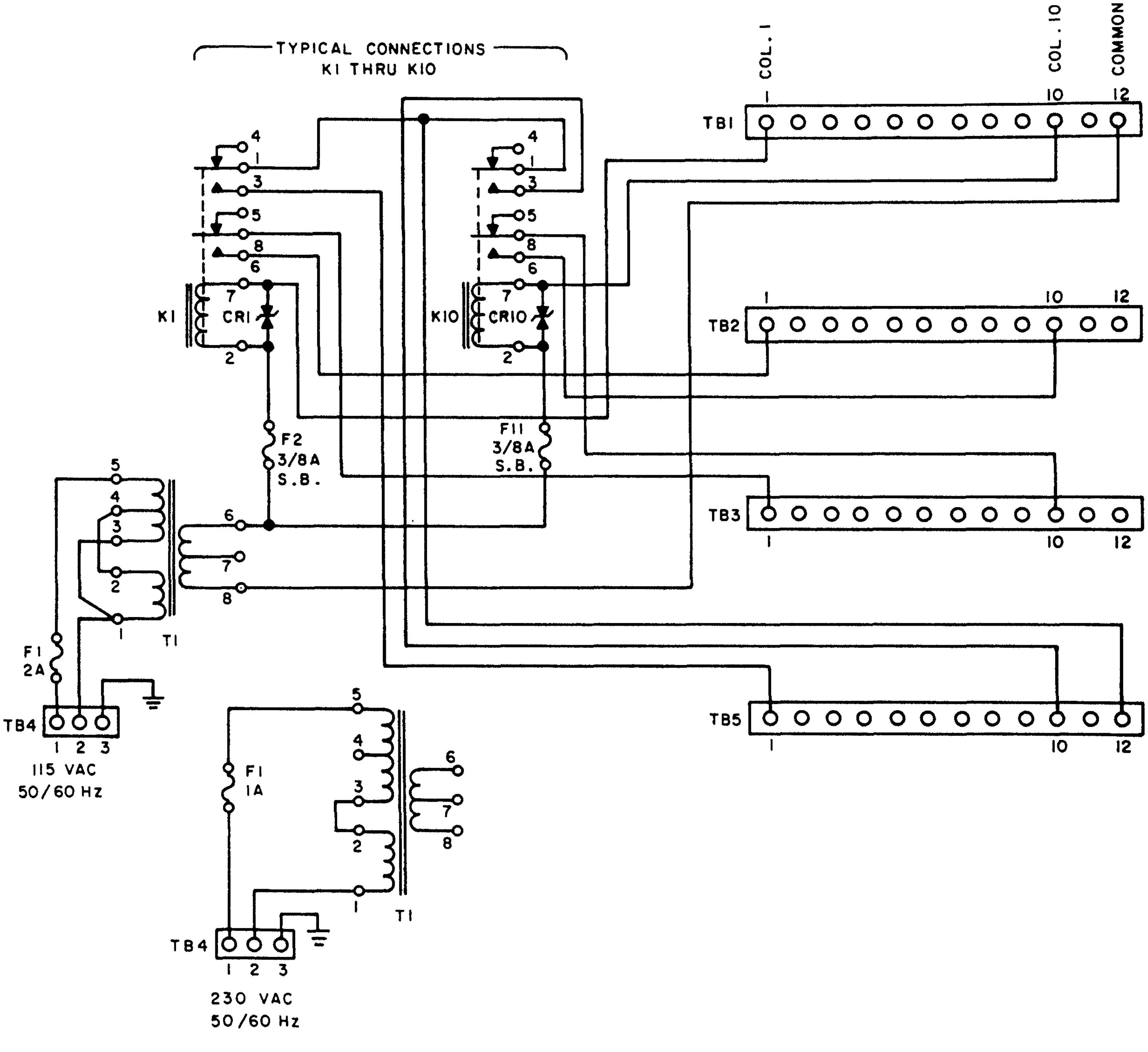


FIGURE 4-2
SCHEMATIC DIAGRAM
INTERLOCK ISOLATION
ASSY., IIK-10D

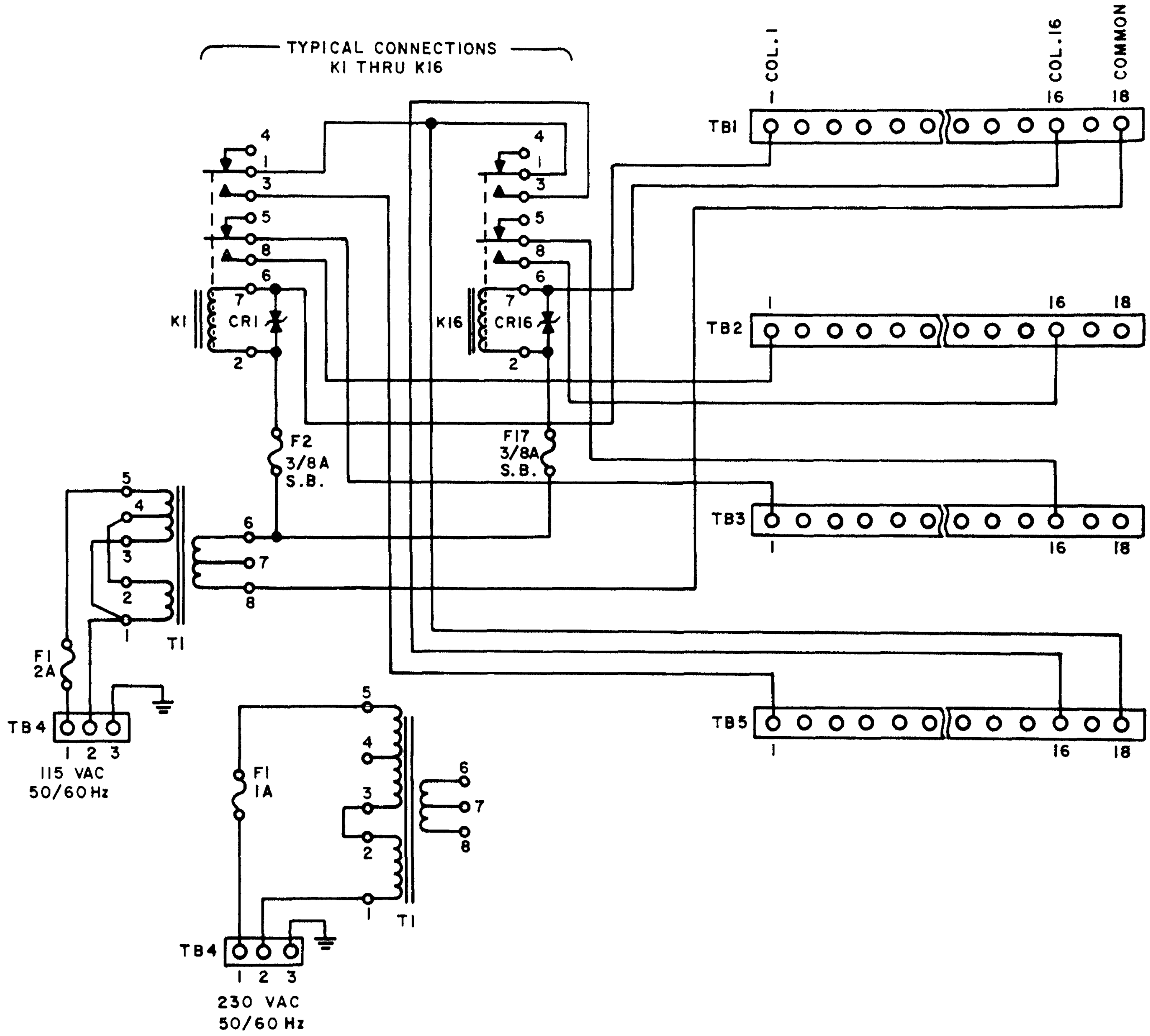


FIGURE 4-3
SCHEMATIC DIAGRAM
INTERLOCK ISOLATION
ASSY., IIK-16D

APPENDIX B

OPERATING INSTRUCTIONS

FOR

REGULATED POWER SUPPLY

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INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LNS-P SERIES

TABLE OF CONTENTS

SPECIFICATIONS AND FEATURES

D. C. OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I

MODEL	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS)* AT AMBIENT TEMPERATURE				INPUT POWER (WATTS)**
		40°C	50°C	60°C	71°C	
LNS-P-5-OV	5 ± 5%	22.0	19.5	16.5	13.0	350
LNS-P-6-	6 ± 5%	20.5	18.1	15.3	12.0	380
LNS-P-12	12 ± 5%	14.0	12.4	10.0	7.3	420
LNS-P-15	15 ± 5%	12.0	10.6	8.5	6.3	440
LNS-P-20	20 ± 5%	10.0	8.9	7.5	5.5	440
LNS-P-24	24 ± 5%	9.0	8.0	6.7	5.0	440
LNS-P-28	28 ± 5%	8.0	7.1	6.0	4.5	440
LNS-P-48†	48 ± 5%	4.5	4.0	3.4	2.5	420

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

*Ratings apply for use with cover removed. Derate current 5% for each ambient temperature if cover is used. Refer to figure 11 for cover removal.

**With output loaded to full current rating and input voltage 127 volts AC, 60 Hz.

†See addenda page A-1.

REGULATED VOLTAGE OUTPUT

Regulation (line) . . . . 0.1% for input variations from 105-127, 127-105, 210-254, or 254-210 volts AC.

Regulation (load) . . . . 0.1% for load variations from no load to full load or full load to no load.

Ripple and Noise . . . . 1.5mV rms, 5mV peak to peak with either positive or negative terminal grounded.

Temperature Coefficient. . . . . Output change in voltage 0.03%/°C.

Remote Programming

External Resistor . . . . Nominal 200 ohms/volt output.

Programming Voltage . . . . One-to-one voltage change.

Remote Sensing . . . . Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off, or power failure.

AC INPUT — 105-127 or 210-254* volts AC at 47-440 Hz. Standard LNS-P power supplies are factory wired for 105-127 volt input, but can be rewired for 210-254 volt input. See figure 8 and schematic diagram for rewiring of AC input. For input power see table I. Ratings apply for 57-63 Hz input. For 47-53 Hz or 63-440 Hz input consult factory.

*Certified by Canadian Standards Association for 210-250 volt input.
Where applicable, regulatory agency approval applies only for input voltages up to 250VAC.
Use a 7A, 250V Norm-Blo fuse in AC line (not supplied in unit) for 110 VAC input. Use a 4A, 250V Norm-Blo fuse in AC line for 220VAC input.

OVERLOAD PROTECTION

Thermal	Thermostat, resets automatically when over temperature condition is eliminated.
Electrical	Automatic electronic current limiting circuit, limits output current to a safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

OVERVOLTAGE PROTECTION — Model LNS-P-5-OV includes a fixed built-in overvoltage protection circuit which prevents damage to the load caused by excessive power supply output voltage. Overvoltage protection range varies between 6.3 and 6.9 volts D.C.

INPUT AND OUTPUT CONNECTIONS — Refer to figure 11 for location.

AC input	Screw terminals on printed circuit board
Ground	Solder terminal on chassis
DC output	8-32 studs on printed circuit board
Sensing	Screw terminals on printed circuit board
Overvoltage protection	Quick disconnect terminals on printed circuit board with mating connectors attached.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient.

STORAGE TEMPERATURE (non operating) — -55% to +85°C

FUNGUS — All LNS-P power supplies are fungus inert.

DC OUTPUT CONTROL — Screwdriver voltage adjust control permits adjustment of DC output voltage. Refer to figure 11 for location of control.

PHYSICAL DATA

Size	11" x 4-7/8" x 4-13/32"
Weight	14 lbs. net; 15-1/2 lbs. shipping
Finish	Gray, FED. STD. 595 No. 26081

MOUNTING — One surface, with tapped mounting holes, can be utilized for mounting this unit. LNS-P pow supplies can be mounted with Top or Left Side facing up. Top or Left Side must be in a horizontal plane. Air circulation is required when unit is mounted in confined areas. Refer to figure 11 for mounting details Current ratings apply for mounting with Top facing up. Derate current 15% for each ambient temperature given in table I when mounting with Left Side facing up.

ACCESSORIES

Overvoltage Protector	Internally mounted L-20-OV series Overvoltage Protectors are available for use with models LNS-P-12 through LNS-P-28. Use Overvoltage Protector L-35-OV-6 on model LNS-P-6.

THEORY OF OPERATION

GENERAL

The Lambda power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier and filter, and pre-regulator; a main regulator circuit consisting of the main rectifier and and filter, a series regulator, voltage sensing network, current sensing resistor, voltage reference*, voltage and current comparators*, and amplifier*.

*This circuit element is part of integrated circuit (IC1) in the supply.

The circuit arrangement is shown in block diagram form, Figure 9. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit which contains a thermostat to protect the supply against over heating.

The main rectifier, a full wave rectifier, provides the power which is filtered by capacitor C1 and then regulated via a series regulator and delivered to the output. Half-wave auxiliary rectifier CR3 provides voltage filtered by capacitor C2 for preregulator CR4. The reference element, powered by the preregulator, provides a reference voltage for the voltage comparator.

Constant voltage circuit operation is determined by changes in line or load which cause a change in one input to the voltage comparator through voltage dividers R9, R10, and R11. A second input to the comparator is a reference voltage developed in IC1. The comparator compares the output voltage change with the reference voltage resulting in an error signal at the output of the comparator.

The error signal from the comparator is then current amplified by driver Q4. The amplified signal from the driver controls the voltage across series regulators Q1 through Q3, which function as the active regulating elements in the supply.

Current limit circuit operation is determined by changes in the load. The current comparator samples load current through current sensing resistors R6 and R7. When the voltage drop across R6, R7 increases to a pre-set voltage reference determined by R15, R16, R17, R4, and R5, the current comparator conducts. Thus, when the output current rating of the unit is exceeded, the current comparator conducts, decreasing the current through driver Q4, resulting in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by fixed resistors R6, R7, R15, R16, R17, R5, and variable resistor R4.

When operating conditions approach short circuit, the output voltage decreases. Since the voltage determined by R4 is proportional to the output voltage, when the output voltage decreases, the amplifier is biased into turn on at lower and lower load currents until output voltage decreases to zero and current decreases to a predetermined low value.

OV CIRCUIT, FUNCTIONAL DESCRIPTION (LNS-P-5-OV only)

When the power supply output voltage increases above the overvoltage limit (6.3 to 6.9 volts), HC1 fires causing the power supply output voltage to drop.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When load exceeds 130% of 40°C rating, both voltage and current decrease until voltage reaches zero and the current at short circuit equals approximately 40 percent or less of the rated current.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminals provided. Apply input power to AC terminals; always connect the ungrounded (hot) lead to terminal indicated in figures 3 through 7.

The supply positive terminal is brought out to terminal +V. The supply negative terminal is brought out to terminal -V. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 7. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf, elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 200 ohms/volt change and shorting-type switch as shown in Figure 5. When continuous voltage variations are required, use a variable resistor with the same 200 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will be minimum output voltage plus 1 volt per 200 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 6 ma. minimum.

Alternatively, when supplies with less than 6 ma. reverse current capability are used, a resistor capable of drawing 6 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LNS-P power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of "Specifications and Features", for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the internal heat sink exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

Fuse Shutdown

Fuses will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Overvoltage Shutdown (LNS-P-5-OV only)

When the power supply output voltage increases above the overvoltage limit, HC1 will short circuit output of the supply. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the AC input circuit. (Refer to Trouble Shooting Chart.)

GENERAL

This section describes trouble analysis routine, replacement procedures, calibration and test procedures that are useful for servicing the Lambda LNS-P power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check fuse, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 9, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is always greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

> NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder, it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needlepoint probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Wherever possible use a heat sink when soldering transistors.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the com- onent by using the wicking process described below:

a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG [o. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously emove iron and wick.

'ROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic iagram.

The operating conditions assumed for the trouble chart are as follows:

a) AC power of proper voltage and frequency is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; otted lines indicate jumpers connected for local sensing operation.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
. Zero volts DC output	Short circuit across output of supply	Check load and load connections correct as necessary
	F1 open	Replace F1; if it blows immediately, check for shorted transistors Q1, Q2, Q3 and Q4 and capacitors C4 and C8; replace as necessary
	Series regulator section open	Check Q1, Q2 and Q3 for open, replace as necessary
	Current sensing resistors open	Check R6A, R7A and R7B for open
	Aux. rectifier CR3 open	Check CR3 for open; replace as necessary
	IC1 defective	Voltage at pin 6 must measure above rated output voltage. If reading exceeds nominal voltage rating by 3 volts or if less than rated output voltage, replace IC1

TROUBLE SHOOTING CHART (Cont)

Symptom	Possible Cause	Remedy
2. Unable to adjust output voltage	Damaged VDC ADJ. control	Check R10 for short or open, replace as necessary
3. High ripple at line frequency or twice line frequency and unregulated DC output	Series regulator transistors shorted	Check and replace as necessary: Q1, Q2, Q3, Q1.
	Defective main rectifier causes ripple at twice line frequency	Check for open or short CR1A, CR1B, CR2A, and CR2B.
4. Same as 3, except intermittent	Foreign matter fallen into unit	Check for loose bench hardware and wire clippings that may have fallen through cover
5. High ripple at frequency other than line or twice line frequency	Oscillation due to defective component in filter network	Check for open C8, C4, and check for open or short in C3 and R18. Replace defective component
6. Large spikes at output	Capacitors C5, C6 or, as applicable, C7 open.	Replace as necessary
7. Output voltage too high	R10 set too high; shorted Q1, Q2, Q3, Q4; open sensing lead, defective IC1	Check setting of R10; check Q1, Q2, Q3, Q4; replace as required; see Symptom 1 for "defective IC1"
8. Very low output voltage on model LNS-P-5-OV	HC1 fired due to OV condition	Momentarily interrupt AC input. If supply operates normally, a transient has occured in line or load, check wiring (switches, etc) If supply fails to reach full output voltage, remove AC input, disconnect +V pin of HC1, remove load, apply AC power and refer to procedure for: Output voltage too high "Symptom 7"

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 10. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-127 or 127-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a TVM, John Fluke Model 931B or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R4

Whenever Q1, Q2, Q3, R6, R7, R4, R5, or IC1 are replaced, and voltages and current indications do not reflect maximum ratings, adjust R4 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.

2. Break seal on wiper of R4 from resistor housing and turn to full CW position.

3. Operate power supply for constant voltage with local sensing, connected as shown in figure 3, with no external load.

4. Turn voltage adjust control until minimum rated output voltage is obtained.

5. Apply load so that output current is 130% of 40°C rating for the unit.

6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R4 in CCW direction. Adjust R4 until output ripple begins to increase.

7. Turn voltage adjust control until maximum rated output voltage is obtained.

8. Increase load. Maximum attainable load current shall not exceed 150% of 40°C rating for the unit.

9. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R4 to resistor housing.

10. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem On receipt of this information Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standrad Components and special components used the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function, and location, of the part.

PARTS LIST

The electrical parts located on Lambda models LNS-P-5-OV — LNS-P-28 are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common-parts listing. In addition there is a separate listing of parts for the "J" option.

COMMON PARTS
MODELS LNS-P-5-OV AND LNS-P-6

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 65,000 mf -10 +50% 15 vdc	CBT-65-053
C2	Cap., elect., 330 mf -10 +100% 20 vdc	CBR-33-156
C3	Cap., ceramic, 0.01 mf ±20%, 1,000 vdc	CDL-10-004
**C3	Cap., ceramic, 0.002 mf ±10%, 1,000 vdc	CDK-20-003
C4	Cap., elect., 3,500 mf -10 +100%, 15 vdc	CBS-35-079
C5, C6	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C7	Not assigned	
C8	Cap., elect., 1.5 mf ±20%, 50 vdc	CBN-15-032
*C9	Cap., ceramic, 0.001 mf ±10%, 1,000 vdc	CDK-10-010
CR1	Rectifier, dual	FBL-00-147
CR2	Not assigned	
CR3	Rectifier	FBL-00-030
CR4	Rectifier, zener diode	FBM-Z155
CR5	Same as CR3	
F1	Fuse, 30A, 4AG, NORM-BLO	FFE-30-000
IC1	Integrated circuit	FBT-00-073
Q1 thru Q3	Transistor, NPN	FBN-L164
Q4	Transistor, NPN	FBN-L109
R2	Res., carb. film, 330 ohms ±5%, 1/2 w	DDE-3315
R3	Not assigned	
R4	Res., var., cermet, 600 ohms ±10%, 1 w	DRR-60-009
R6, R7A,B	Res., center tapped, ww 0.20 ohm ±5%, 22 w	DFM-20-054
**R6A R7A,B	Res., center tapped, ww, 0.1 ohm ±5%, 22 w	DFM-10-093
R8	Not assigned	
R10	Res., var., cermet, 400 ohms ±10%, 1 w	DRR-40-013
R11	Res., film, 499 ohms ±1%, 1/2 w	DCR-50-029
R12 thru R14	Res., carb. film, 220 ohms ±5%, 1/2 w	DDE-2215
R15 thru R17	Res., carb. film, 47 ohms ±5%, 1/2 w	DDE-4705
R18	Res., carb. film, 10 ohms ±5%, 1/2 w	DDE-1005
R19 thru R30	Not assigned	
R32	Res., carb. film, 3,900 ohms ±5%, 1/2 w	DDE-3925
S1	Thermostat	FKA-148-030
XF1	Fuseholder	HRM-00-012

UNIQUE PARTS
MODEL LNS-P-5-OV

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
HC1	Hybrid circuit	L-35-OV-5
R1	Res., comp., 820 ohms ±10%, 1 w	DGB-8211

*Not used on units with serial no. prefixes A&B.
**Only used on units with serial no. prefixes A — C.

UNIQUE PARTS (Cont.)
MODEL LNS-P-5-OV (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R5	Res., film, 1,000 ohms ±1%, 1/2 w	DCS-10-036
**R5	Res., comp., 1,200 ohms ±10%, 1/2 w	DEB-1221
R9	Res., film, 392 ohms ±1%, 1/2 w	DCR-39-098
R31	Res., carb. film, 390 ohms, ±5%, 1/2 w	DDE-3925
T1	Transformer	ABA-LNSP-5

MODEL LNS-P-6

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R1	Res., comp., 1,500 ohms ±10%, 1 w	DGB-1521
R5	Res., film, 1,300 ohms ±5%, 1/2 w	DCS-13-010
**R5	Res., comp., 1,500 ohms ±10%, 1/2 w	DEB-1521
R9	Res., film, 562 ohms ±1%, 1/2 w	DCR-56-099
R31	Res., carb. film, 470 ohms ±5%, 1/2 w	DDE-4705
T1	Transformer	ABA-LNSP-6

COMMON PARTS
MODELS LNS-P-12 AND LNS-P-15

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 32,000 mf -10 +50%, 30 vdc	CBT-32-056
C2	Cap., elect., 270 mf -10 +100%, 25 vdc	CBR-27-163
C3	Cap., ceramic, 0.002 mf ±10%, 1,000 vdc	CDK-20-003
C4	Cap., elect., 1,700 mf -10 +100%, 30 vdc	CBS-17-081
C5, C6	Not assigned	
C7	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C8	Cap., elect., 1.5 mf ±20%, 50 vdc	CBN-15-032
C9	Cap., ceramic, 0.001 mf ±10%, 1,000 vdc	CBN-15-032
CR1	Rectifier, dual	FBL-00-147
CR2	Rectifier, dual	FBL-00-146
CR3, CR5	Rectifier	FBL-00-030
F1	Fuse, 30A, 4AG, NORM-BLO	FFE-30-000
IC1	Integrated circuit	FBT-00-073
Q1 thru Q3	Transistor, NPN	FBN-L164
Q4	Transistor, NPN	FBN-L109
R2	Res., carb. film, 330 ohms ±5%, 1/2 w	DDE-3315
R3	Not assigned	
R4	Res., var., cermet, 600 ohms ±10%, 1 w	DRR-60-009
R6, R7A,B	Res., center tapped, ww 0.36 ohm ±5%, 22 w	DFM-36-049
**R6 R7A,B	Res., center tapped, ww, 0.2 ohm ±5%, 22 w	DFM-20-054
R8	Not assigned	
R10	Res., var., cermet, 800 ohms ±10%, 1 w	DRR-80-014
R11	Res., film, 499 ohms ±1%, 1/2 w	DCR-50-029
R12 thru R14	Res., carb. film,, 220 ohms ±5%, 1/2 w	DDE-2215

COMMON PARTS (Cont.)
MODELS LNS-P-12 AND LNS-P-15 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R15 thru R17	Res., carb. film, 47 ohms ±5%, 1/2 w	DDE-4705
R18	Res., carb. film, 10 ohms ±5%, 1/2 w	DDE-1005
R20 thru R30	Not assigned	
R32	Res., carb. film, 3,900 ohms ±5% 1/2 w	DDE-3925
S1	Thermostat	FKA-148-030
XF1	Fuseholder	HRM-00-012

UNIQUE PARTS
MODEL LNS-P-12

CR4	Rectifier, zener diode	FBM-Z161
R1	Res., comp., 1,800 ohms ±10%, 1 w	DGB-1821
R5	Res., film, 1,910 ohms ±1%, 1/4 w	DCS-19-062
**R5	Res., comp., 2,700 ohms ±10%, 1/2 w	DEB-2721
R9	Res., film, 1,620 ohms ±1%, 1/2 w	DCS-16-113
R19	Not assigned	
R31	Res., carb. film, 680 ohms ±5%, 1/2 w	DDE-6815
T1	Transformer	ABA-LNSP-12

MODEL LNS-P-15

CR4	Rectifier, zener diode	FBM-Z105
R1	Res., ww, 1,500 ohms ±3%, 3 w	DFS-15-045
R5	Res., film, 2,550 ohms ±0.5%, 1/4 w	DCS-25-089
**R5	Res., comp., 3,300 ohms ±5%, 1/2 w	DEB-3325
R9	Res., film, 2,150 ohms ±1%, 1/2 w	DCS-22-114
R19	Res., carb. film, 4,700 ohms ±5% 1/2 w	DDE-4725
R31	Res., carb. film, 750 ohms ±5%, 1/2 w	DDE-7515
T1	Transformer	ABA-LNSP-15

COMMON PARTS
MODELS LNS-P-20 — LNS-P-28

C1	Cap., elect., 23,000 mf -10 ±100%, 50 vdc	CBT-23-042
C2	Cap., elect., 180 mf -10 ±100%, 40 vdc	CBR-18-155
C3	Cap., ceramic, 0.002 mf ±10%, 1,000 vdc	CDK-20-003
C4	Cap., elect., 1,200 mf -10 ±100%, 45 vdc	CBS-12-049
C5, C6	Not assigned	
C7	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C8	Cap., elect., 1.5 mf ±20%, 50 vdc	CBN-15-032
C9	Cap., ceramic, 0.001 mf ±10%, 1,000 vdc	CDK-10-010
CR1	Rectifier, dual	FBL-00-139
CR2	Rectifier, dual	FBL-00-141
CR3, CR5	Rectifier	FBL-00-030
F1	Fuse, 20A, 4AG, NORM-BLO	FFE-20-000
IC1	Integrated circuit	FBT-00-073
Q1 thru Q3	Transistor, NPN	FBN-L167
Q4	Transistor, NPN	FBN-L108
R2	Res., carb. film, 330 ohms ±5%, 1/2 w	DDE-3315
R3	Not assigned	
R4	Res., var., cermet, 600 ohms ±10%, 1 w	DRR-60-009
R6, R7A,B	Res., center tapped, ww, 0.60 ohm ±5%, 22 w	DFM-60-050

**Only used on units with serial no. prefixes A — C.

COMMON PARTS (Cont.)
MODELS LNS-P-20 — LNS-P-28 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
**R6, R7A,B	Res., center tapped, ww, 0.36 ohm ±5%, 22 w	DFM-36-049
R8	Not assigned	
R11	Res., film, 499 ohms ±1%, 1/2 w	DDE-2215
R12 thru R14	Res., carb. film, 220 ohms ±5% 1/2 w	DDE-2215
R15 thru R17	Res., carb. film, 47 ohms ±5%, 1/2 w	DDE-4705
R18	Res., carb. film, 10 ohms ±5%, 1/2 w	DDE-1005
R20 thru R30	Not assigned	
R32	Res., carb. film, 820 ohms ±5%, 1/2 w	DDE-8215
S1	Thermostat	FKA-148-030
XF1	Fuseholder	HRM-00-012

UNIQUE PARTS
MODEL LNS-P-20

CR4	Rectifier, zener diode	FBM-Z127
R1	Res., ww, 2,000 ohms ±3%, 3 w	DFS-20-032
R5	Res., film, 2,200 ohms ±1%, 1/2 w	DCS-22-112
**R5	Res., comp., 8,200 ohms ±10%, 1/2 w	DEB-8221
R9	Res., film, 3,010 ohms ±1%, 1/2 w	DCS-30-115
R10	Res., var., cermet, 1,400 ohms ±10%, 1 w	DRS-14-025
R19	Res., comp., 5,600 ohms ±5%, 1 w	DGB-5625
R31	Res., carb. film, 1,200 ohms ±5% 1/2 w	DDE-1525
T1	Transformer	ABA-LNSP-20

MODEL LNS-P-24

CR4	Rectifier, zener diode	FBM-Z143
R1	Res., ww, 2,500 ohms ±3%, 3 w	DFS-25-036
R5	Res., film, 3,000 ohms ±1%, 1/2 w	DCS-30-115
**R5	Res., comp., 12,000 ohms ±10%, 1/2 w	DEB-1231
R9	Res., film, 3,740 ohms ±1%, 1/2 w	DCS-37-116
R10	Res., var., cermet, 1,400 ohms ±10%, 1 w	DRS-14-025
R19	Res., comp., 4,700 ohms ±10%, 1 w	DGB-4721
R31	Res., carb. film, 1,500 ohms ±5% 1/2 w	DDE-1525
T1	Transformer	ABA-LNSP-24

MODEL LNS-P-28

CR4	Rectifier, zener diode	FBM-Z143
R1	Res., ww, 3,300 ohms ±3%, 3 w	DFS-33-072
R5	Res., film, 4,000 ohms ±0.5%, 1/4 w	DCS-40-119
**R5	Res., comp., 15,000 ohms ±10%, 1/2 w	DEB-1531
R9	Res., film, 4,420 ohms ±1%, 1/2 w	DCS-44-117
R10	Res., var., cermet, 1,600 ohms ±10%, 1 w	DRS-16-026
R19	Res., ww, 3,300 ohms ±3%, 3 w	DFS-33-072
R31	Res., carb. film, 1,500 ohms ±5% 1/2 w	DDE-1525
T1	Transformer	ABA-LNSP-28

PARTS FOR "J" OPTION

On all LNS-P models with suffix "J", transformer T1 changes. For transformer T1 used on these models, see standard LNS-P model parts list for the standard transformer part no. and add suffix "J" to the part no.

ELECTRICAL PARTS LIST
MODEL LNS-P-48

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 9,000 mf -10 +100%, 85 vdc	CBS-90-199
C2	Cap., elect., 270 mf -10 +100%, 25 vdc	CBR-27-163
C3	Cap., mylar, 560 pf ±10%, 200 vdc	CGJ-56-001
C4	Cap., elect., 500 mf -10 +100%, 75 vdc	CBR-50-056
C5,C6	Not assigned	
C7	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C8	Cap., elect., 2.5 mf, -15% +75% 100 vdc	CBN-25-010
C9	Cap., elect., 10 mf ±20%, 10 vdc	CBP-10-027
C10	Not assigned	
C11	Cap., elect., 1.5 mf ±20%, 50 vdc	CBN-15-032
CR1A, B	Rectifier, dual	FBL-00-139
CR2A, B	Rectifier, dual	FBL-00-141
CR3	Rectifier	FBL-00-030
CR4	Not assigned	
CR5, CR6	Same as CR3	
CR7	Rectifier, zener diode	FBM-Z133
CR8	Same as CR3	
F1	Fuse, 10A, 4AG	FFE-10-000
IC1	Integrated Circuit	FBT-00-016
Q1 thru Q3	Transistor, NPN	FBN-L211
Q4	Transistor, NPN	FBN-L109
R1	Res., carb. film, 680 ohms ±5%, 1/2 w	DEE-6815
**R2	Res., comp. 100,000 ohms ±10% 1/2 w	DEB-1041
**R2	Res., carb. film, 100 ohms ±5%, 1/2 w	DDE-1015
R3	Not assigned	
R4	Res., ww, 5,000 ohms ±10%, 1 w	DRS-50-010

**Only used on units with serial no. prefixes A — C.

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R5	Res., film, 44,200 ohms ±1%, 1/4 w	DCT-44-073
**R5	Res., comp., 100,000 ohms ±10%, 1/2 W	DEB-1041
R6 R7A,B	Res., center tapped, ww 310 ohms ±5%, 16 w	DFN-30-057
**R6 R7A,B	Res., ww, 0.94 ohm ±5%, 16 w, Ctr tapped	DFM-94-051
R8	Not assigned	
R9	Res., film, 680 ohms ±1%, 1/2 w	DCR-68-033
R10	Res., var., cermet, 2,000 ohms ±10%, 1 w	DRS-20-012
R11	Res., film, 9090 ohms ±1%, 1/2 w	DCS-91-129
R12 thru R14	Res., carb. film, 470 ohms ±5% 1/2 w	DDE-4715
R15 thru R17	Res., carb. film, 47 ohms ±5%, 1/2 w	DDE-4705
R18	Not assigned	
R19	Res., ww, 4,500 ohms ±3%, 3 w	DFS-45-044
R20, R21	Res., film, 3,500 ohms ±1%, 1/2 w	DCS-35-122
R22	Same as R5	
R23	Res., ww, 5,600 ohms ±3%, 3 w	DFS-56-053
R24 thru R30	Not assigned	
R31	Res., ww, 430 ohms ±3%, 3 w	DFR-43-058
R32	Res., carb. film, 3,000 ohms ±5% 1/2 w	DDE-3025
R33 thru R35	Not assigned	
R36	Res., carb. film, 1,000 ohms ±5% 1/2 w	DDE-1025
R37	Same as R23	
S1	Thermostat	FKA-148-030
T1	Transformer	ABA-LNSP-48
XF1	Fuseholder	HRM-00-012

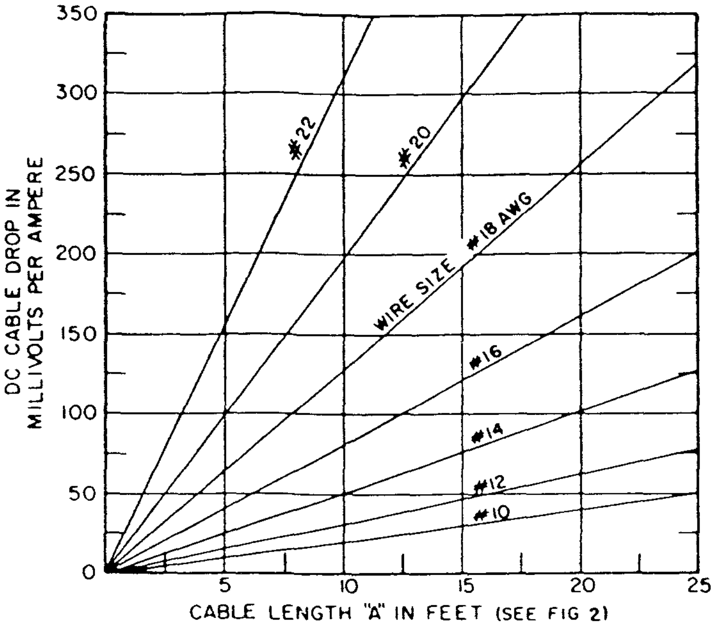


Figure 1. Cable Connection Chart

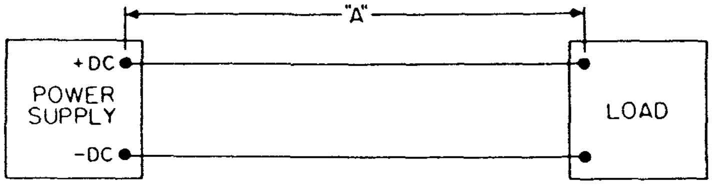
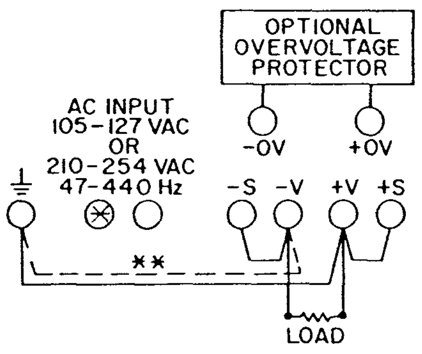


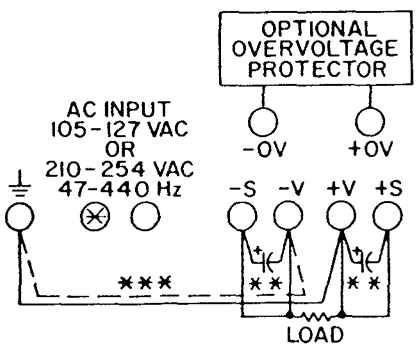
Figure 2. Cable Length "A" in Feet



* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.

** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS −V & ⏚.

Figure 3. Local Sensing Connection.

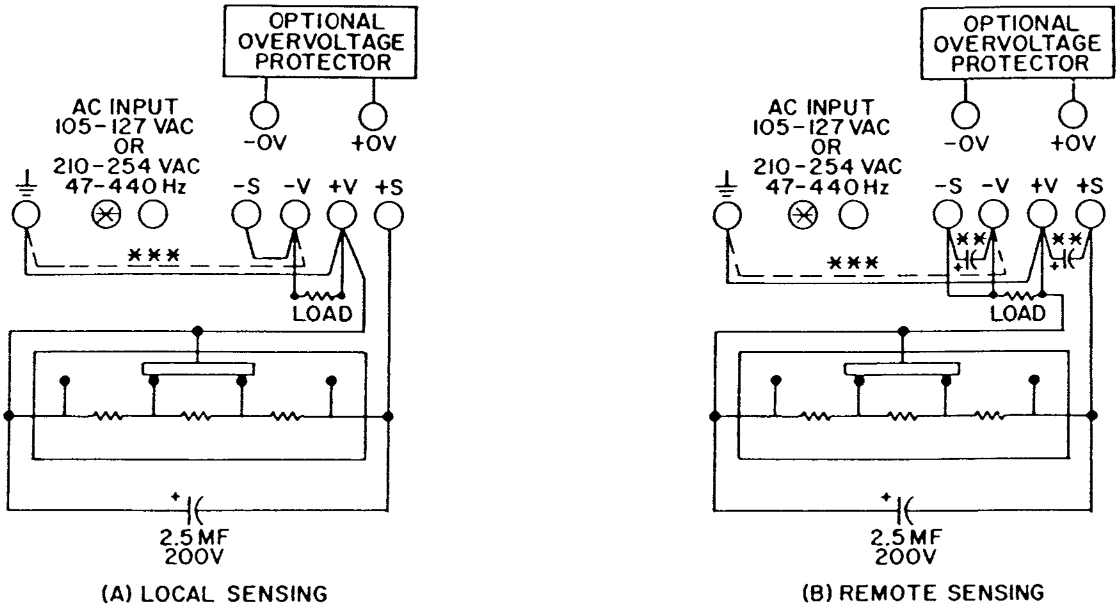


* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL

** A 2.5MF, ELECT, CAP MAY BE REQUIRED

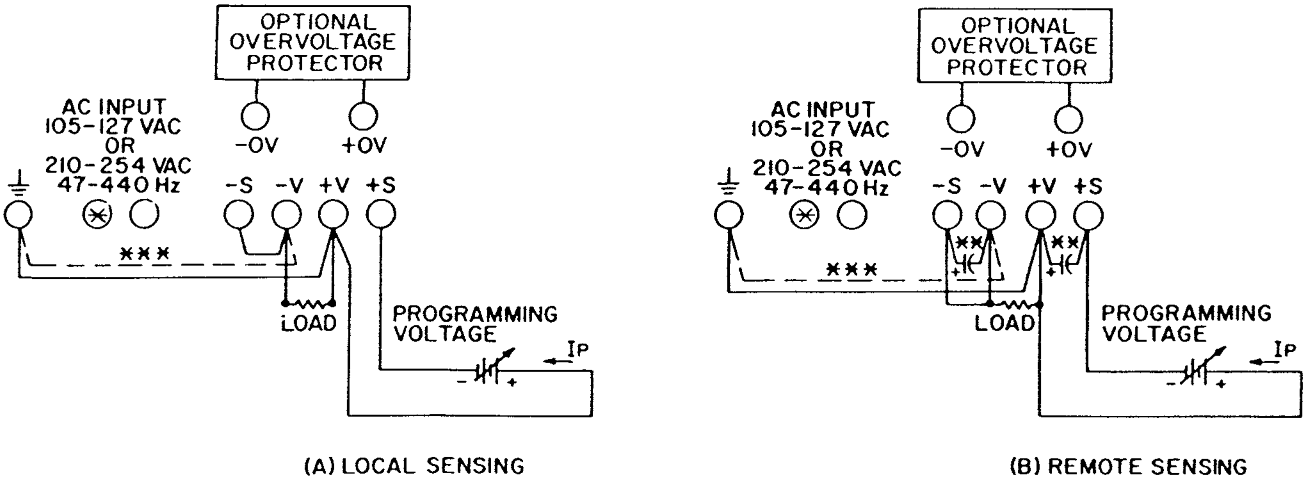
*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS −V & ⏚.

Figure 4. Remote Sensing Connection.



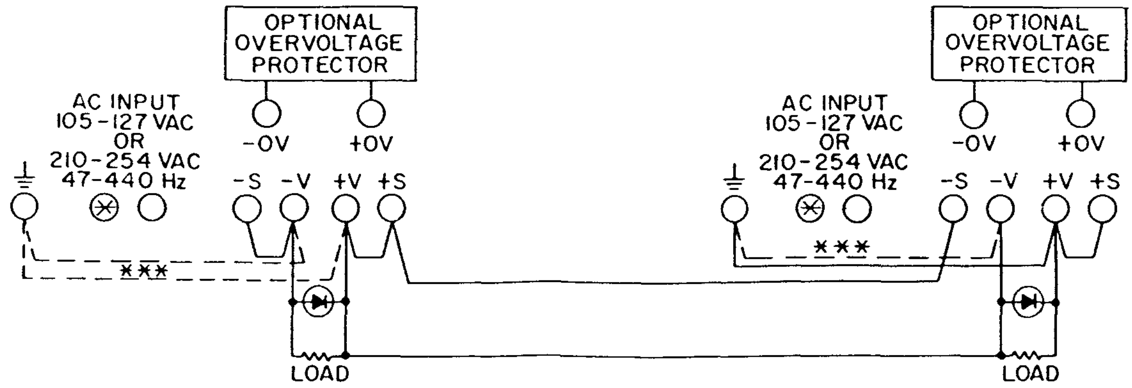
* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.
*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS −V & ⏚.

Figure 5. Programmed Voltage, With External Resistor.

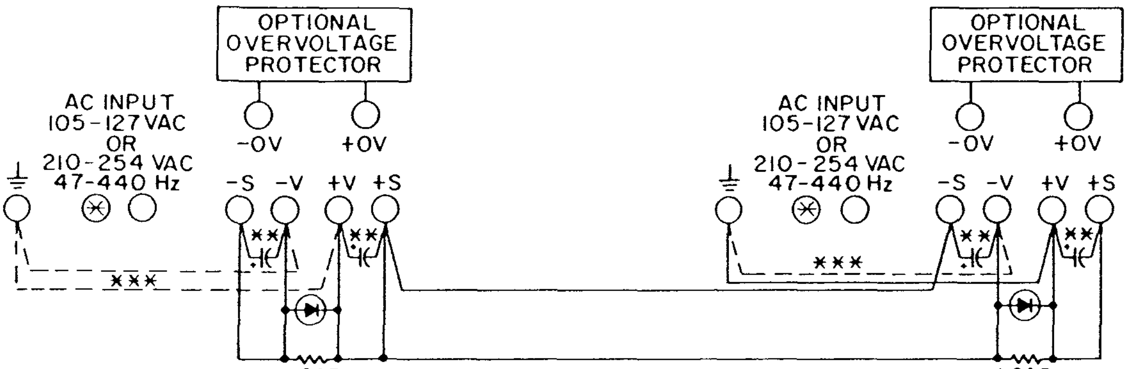


* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.
*** FOR NEGATIVE GROUND DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS −V & ⏚.

Figure 6. Programmed Voltage, With External Programming Voltage Source.



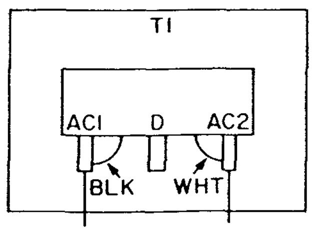
(A)LOCAL SENSING



(B) REMOTE SENSING

* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.
** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.
*** MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM +V & ⏚ ON RIGHT UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

Figure 7. Series Connection.



CONNECTION SHOWN IS FOR 105-127 VAC. FOR 210-254V INPUT, DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERMS AC1 & AC2 AND RECONNECT BOTH LEADS TO TERM D.

Figure 8. Transformer Connections for AC Input Conversion.

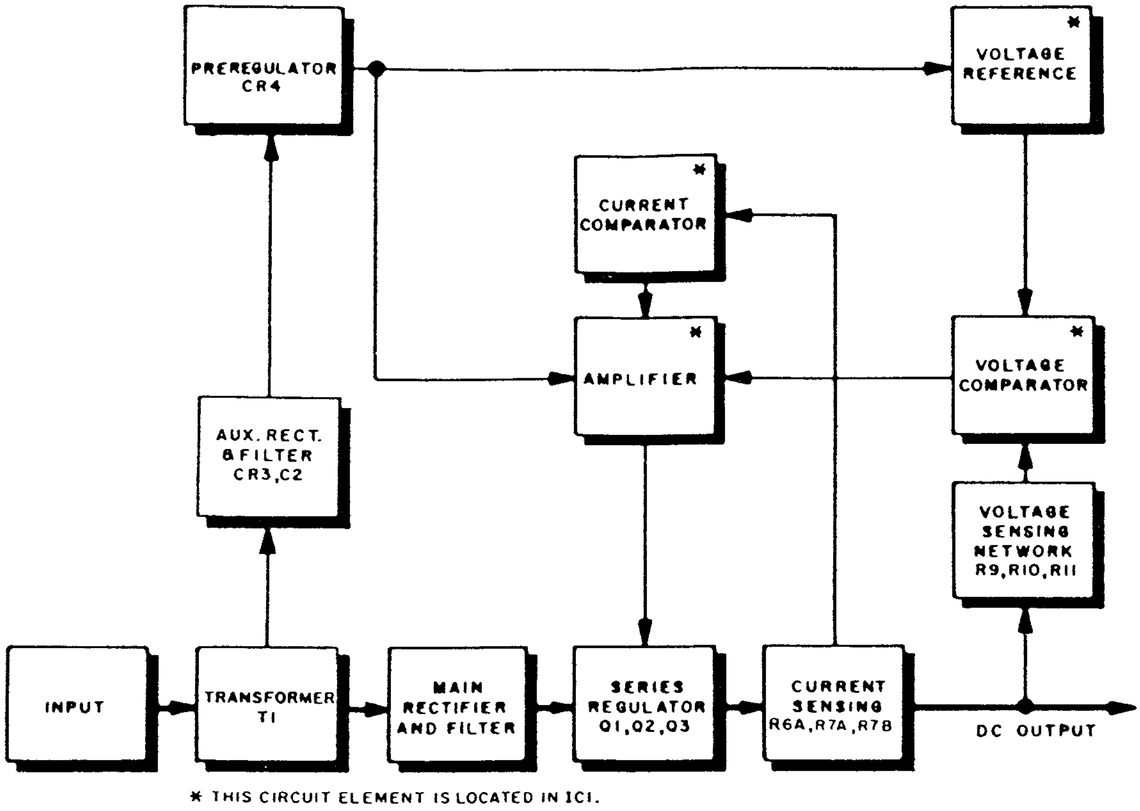
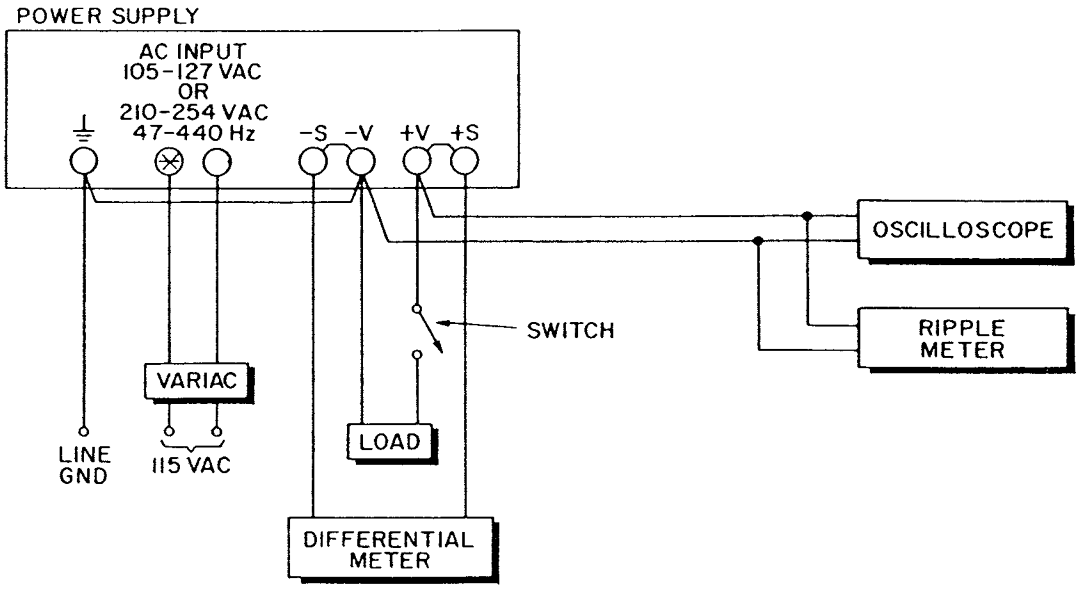


Figure 9. Typical Block Diagram.



* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.

NOTES:
1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTION ONLY.

Figure 10. Test Connections For Constant Voltage Performance Checks.

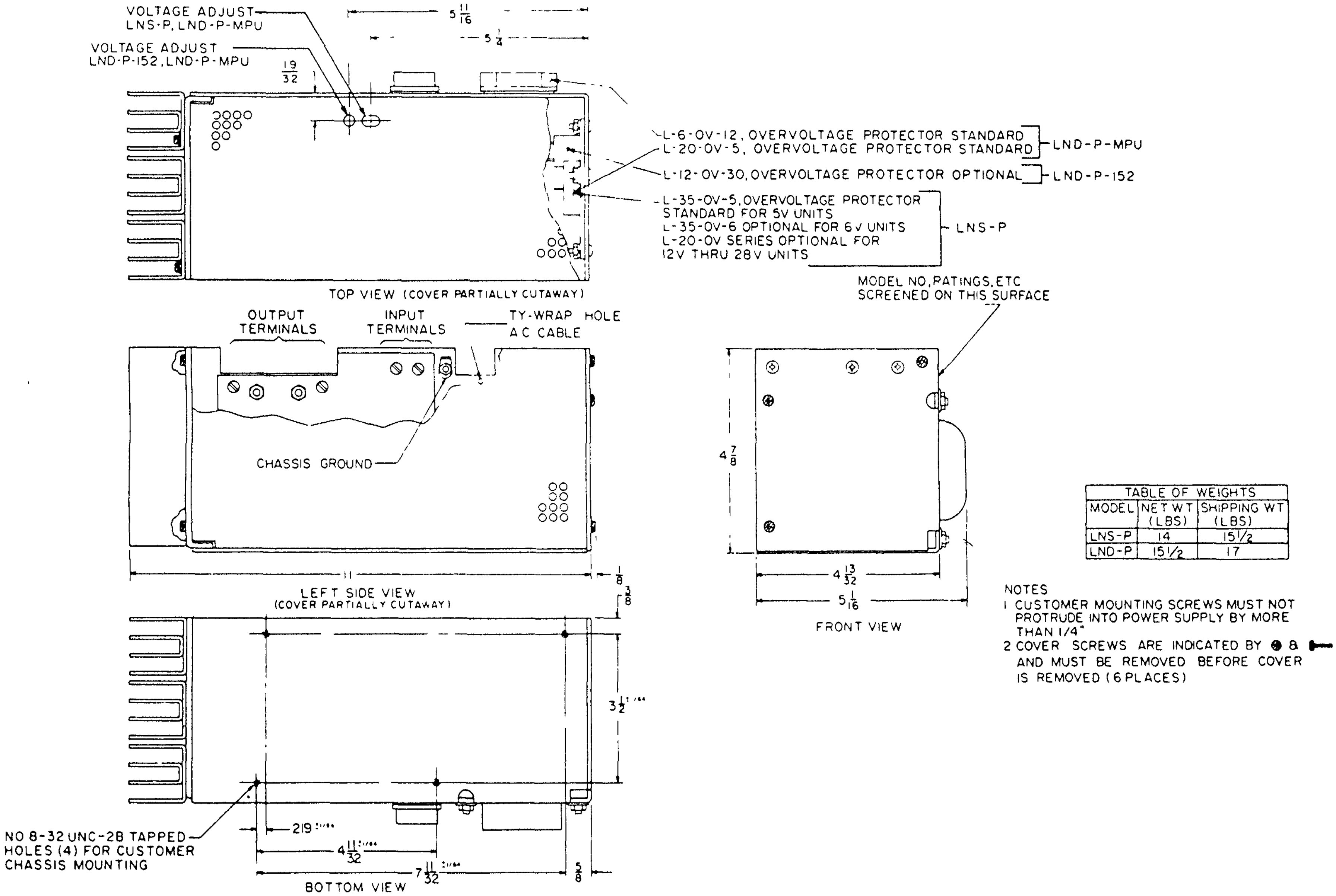
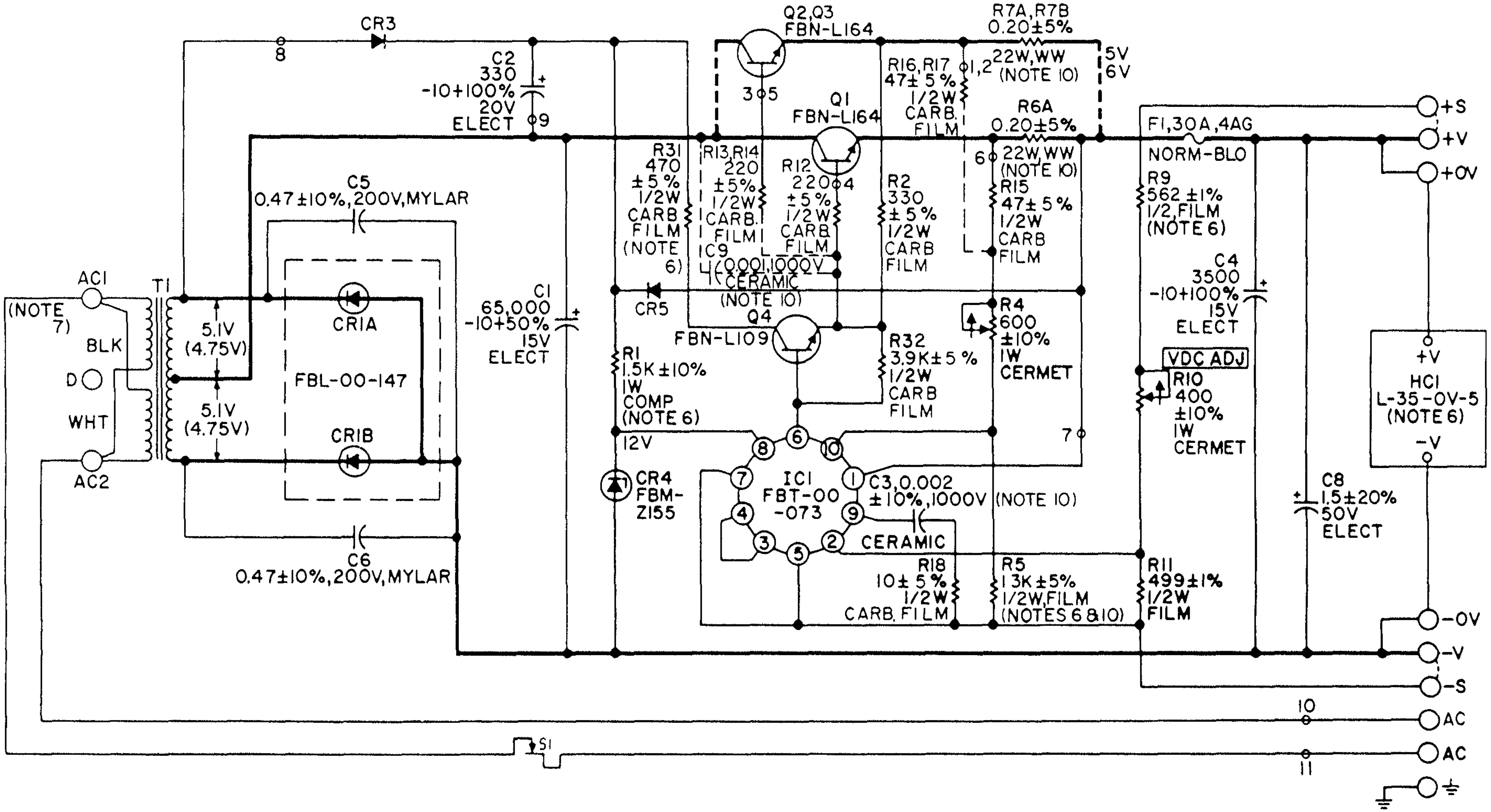


TABLE OF WEIGHTS		
MODEL	NET WT (LBS)	SHIPPING WT (LBS)
LNS-P	14	15 1/2
LND-P	15 1/2	17

NOTES
1 CUSTOMER MOUNTING SCREWS MUST NOT PROTRUDE INTO POWER SUPPLY BY MORE THAN 1/4"
2 COVER SCREWS ARE INDICATED BY ⊕ & ⊢ AND MUST BE REMOVED BEFORE COVER IS REMOVED (6 PLACES)

Figure 11. Outline Drawing.



NOTES.
1 RESISTOR VALUES ARE IN OHMS
2 CAPACITOR VALUES ARE IN MICROFARADS.
3 DESIGNATIONS ARE LAMBDA PART NUMBERS.
4 SYMBOLS
- INDICATES CLOCKWISE ROTATION OF SHAFT.
- INDICATES CONNECTION TO CHASSIS.
- LAMBDA PART NO. FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
- INDICATES TERMINAL ON PRINTED CIRCUIT BOARD.
- INDICATES ACTUAL UNIT MARKING.

5. FOR OPERATION AT 47-53Hz OR 63-440Hz, CONSULT FACTORY.
6 ON MODEL LNS-P-5-OV: R1 IS 820, R5 IS 1.2K, R9 IS 392, R31 IS 390. HC1 IS ONLY USED ON THIS MODEL; ON UNITS WITH SERIAL NO PREFIX "D" R5 IS 1K ± 1%.
7. T1 PRIMARY CONNECTION SHOWN IS FOR 105-127 VAC INPUT. FOR 210-254 VAC INPUT: DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERM'S. AC1 & AC2 AND RECONNECT BOTH LEADS TO TERM. D.
8 CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115VAC, 60Hz. NOMINAL OUTPUT VOLTAGE, NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN -S AND INDICATED POINTS UNLESS OTHERWISE NOTED. VOLTAGES IN PARENTHESIS APPLY TO MODEL LNS-P-5-OV.
9. C9 CONNECTED BETWEEN COLLECTOR AND BASE OF Q2; NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.
10 R6A, R7A, R7B WAS 0.05 11W; R5 ON 5V UNIT WAS 1.5K ±10% 1/2W COMP, R5 ON 6V UNIT WAS 1.2K ± 10% 1/2W COMP; C3 WAS 0.002MF +10% ON UNITS WITH SERIAL NO PREFIXES A-C

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A-E

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

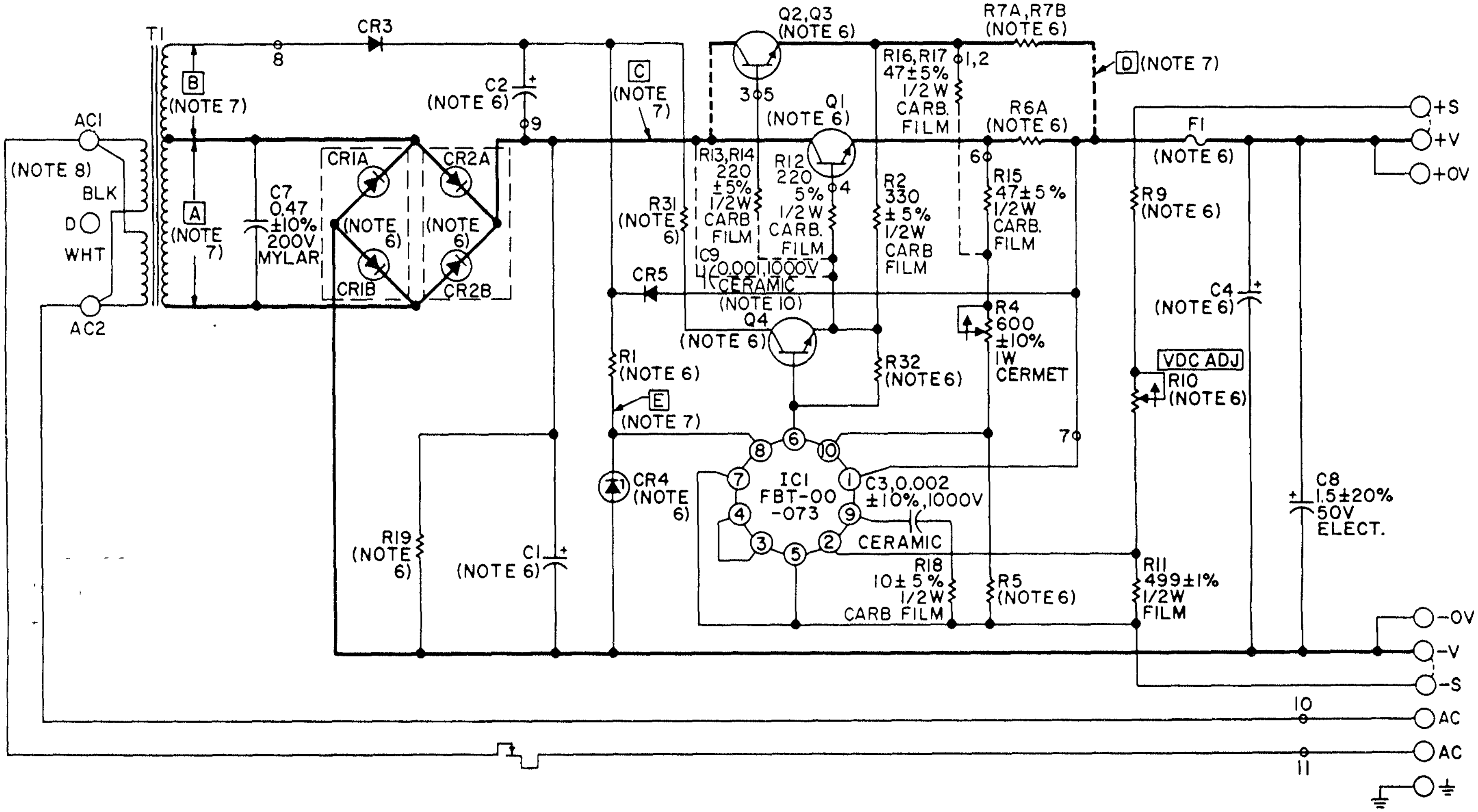
MODELS
LNS-P-5-OV
LNS-P-6

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LNS-P-12 THRU LNS-P-28

Models	Schematic Voltage Measurements					Schematic Components																		
						C1	C2	C4	CR1	CR2	CR4	F1	Q1-Q3	Q4	R1	R5**	R5	R6A,R7A,R7B		R9	R10	R19	R31	R32
	A (VAC)	B (VAC)	C (VDC)	D (VDC)	E (VDC)	ELECT.	-10+100% ELECT.	-10+100% ELECT	FBL-00-*	FBL-00-*	FBM-*	4AG NORM-BLO	FBN-*	FBN-*		½ W COMP.	¼ W FILM	±5% WW		±1%, ½ W FILM	±10%, ½ W CERMET	COMP.	±5%, ½W CARB FILM	±5%, ½W CARB FILM
																		11 W **	22 W					
LNS-P-12	16 4	13 0	23 1	12.0	20 0	32,000 mf -10 +50% 30 vdc	270 mf 25 vdc	1,700 mf 30 vdc	147	146	Z161	30A	L164	L109	1 8K ±10% 1 W, COMP	2.7K ±10%	1 91K ±1%	0 10 **	0.36	1.62K	800	Not Used	680	3 9K
LNS P-15	19 0	15 0	26 8	15 0	24.0	32,000 mf -10 +50% 30 vdc	270 mf 25 vdc	1,700 mf 30 vdc	147	146	Z105	30A	L164	L109	1 5K ±3% 3 W, WW	3.3K ±5%	2 55K ±.5%	0 10 **	0.36	2 15K	800	4.7K ±5% ½ W, CARB, FILM	750	3 9K
LNS-P-20	25 25	18 5	35.75	20 0	30 0	23,000 mf -10 +100% 50 vdc	180 mf 40 vdc	1,200 mf 45 vdc	139	141	Z127	20A	L167	L108	2K ±3% 3 W, WW	8 2K ±10%	2 2K ½ W ±1%	0 18 **	0 60	3 01K	1.4K	5.6K ±5% 1 W	1 2K	820
LNS-P-24	29.25	23 0	41.4	24 0	36 0	23,000 mf -10 +100% 50 vdc	180 mf 40 vdc	1,200 mf 45 vdc	139	141	Z143	20A	L167	L108	2.5K ±3% 3 W, WW	12K ±10%	3K ½ W ±1%	0 18 **	0.60	3.74K	1 4K	4.7K ±10% 1 W	1.5K	820
LNS-P 28	32 0	25 3	45 15	28 0	36.0	23,000 mf -10 +100% 50 vdc	180 mf 40 vdc	1,200 mf 45 vdc	139	141	Z143	20A	L167	L108	3.3K ±3% 3 W, WW	15K ±10%	4K ±0 5	0 18 **	0 60	4.42K	1.6K	3.3K ±3% 3W, WW	1.5K	820

*Lambda part no
**Only used on units with serial no. prefixes A-C.



NOTES.
1. RESISTOR VALUES ARE IN OHMS.
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. DESIGNATIONS ARE LAMBDA PART NUMBERS.
4. SYMBOLS
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS.
   - LAMBDA PART NO. FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED CIRCUIT BOARD.
   - INDICATES ACTUAL UNIT MARKING.
5. FOR OPERATION AT 47-53Hz OR 63-440Hz, CONSULT FACTORY
6. SEE TABLE I FOR COMPONENT VALUES.
7. SEE TABLE I FOR VOLTAGE VALUES.
8. T1 PRIMARY CONNECTION SHOWN IS FOR 105-127VAC INPUT. FOR 210-254VAC INPUT: DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERM'S. AC1 & AC2 AND RECONNECT BOTH LEADS TO TERM. D.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115VAC, 60Hz. NOMINAL OUTPUT VOLTAGE, NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN -S AND INDICATED POINTS UNLESS OTHERWISE NOTED.
10. C9 CONNECTED BETWEEN COLLECTOR AND BASE OF Q2; NOT USED ON UNITS WITH SERIAL NO. PREFIXES A & B.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A-E

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODELS
LNS-P-12
LNS-P-15
LNS-P-20
LNS-P-24
LNS-P-28

LAMBDA ELECTRONICS
MELVILLE, NEW YORK

ADDENDA

Model LNS-P-48

REGULATED POWER SUPPLY

The instructions, procedures, and specifications included in this manual apply, in general, to Model LNS-P-48. Specific differences are tabulated below:

SPECIFICATIONS AND FEATURES

Voltage Range . . . . 48V ± 5%
Maximum Current at Ambient Temperature.
  40°C 4.5A
  50°C 4.0A
  60°C 3.4A
  71°C 2.5A

Input Power . . . . 420 watts

Ripple and Noise .... 5m VRMS, 15 mV pk-pk with either positive or negative terminal grounded.

Accessories....Overvoltage protector LMOV-3 is available for use with model LNS-P-48 power supply. When connecting LMOV-3 to the LNS-P-48, both leads from the LMOV-3 must be lengthened with additional wire.

Mounting .... One surface with tapped mounting holes can be utilized for mounting the LNS-P-48. Mount only with Top facing up.

Basic Mode of Operation .... When load exceeds 120% of 40°C rating, both voltage and current decrease until voltage reaches zero and the current at short circuit equals approximately 25 percent or less of the rated current.

Adjustment of Calibration Control R4.

Whenever Q1, Q2, Q3, R6, R7, R4, R5, or ICI are replaced, and voltages and current indications do not reflect maximum ratings, adjust R4 as follows: The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25–30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.
2. Break seal on wiper of R4 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing, connected as shown in figure 3, with no external load.
4. Turn voltage adjust control until maximum rated output voltage is obtained.
5. Apply load so that output current is 120% of 40°C rating for the unit.
6. Using DC DVM (John Fluke Model 891A or equivalent), observe output voltage while adjusting R4 in CCW direction. Adjust R4 until output drops to 100 mV.
7. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R4 to resistor housing.
8. After sealing, check setting and repeat adjustment procedure if required.

Programmed Voltage Connection .... Programmed Voltage Connection for LNS-P-48 using external resistor or external programming voltage source differs from LNS-P models. See connection diagrams below.

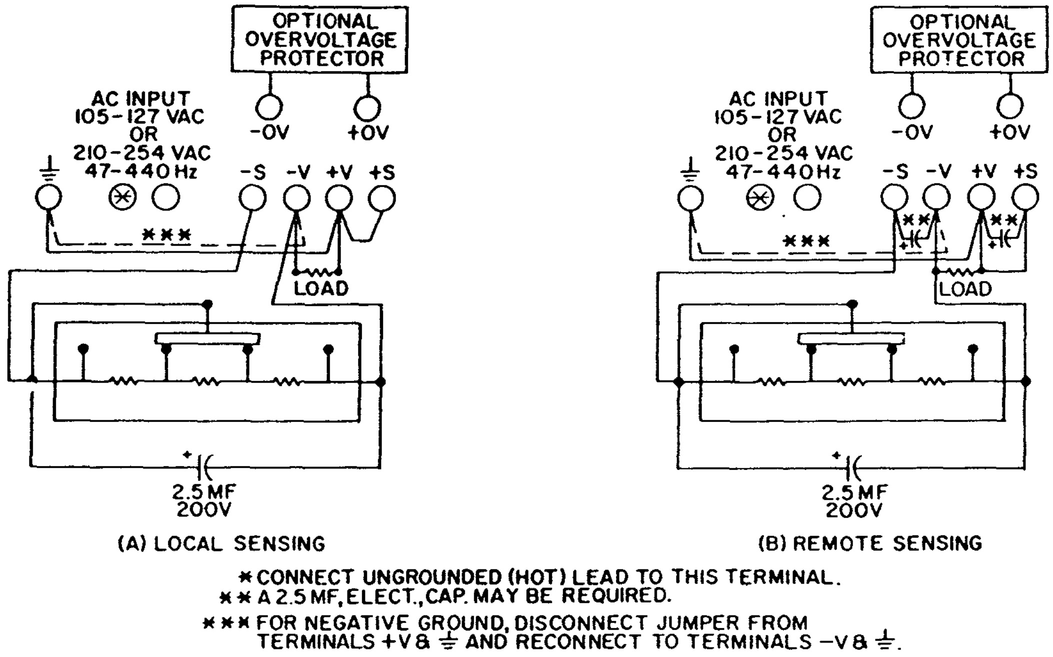


Figure 5. Programmed Voltage, With External Resistor.

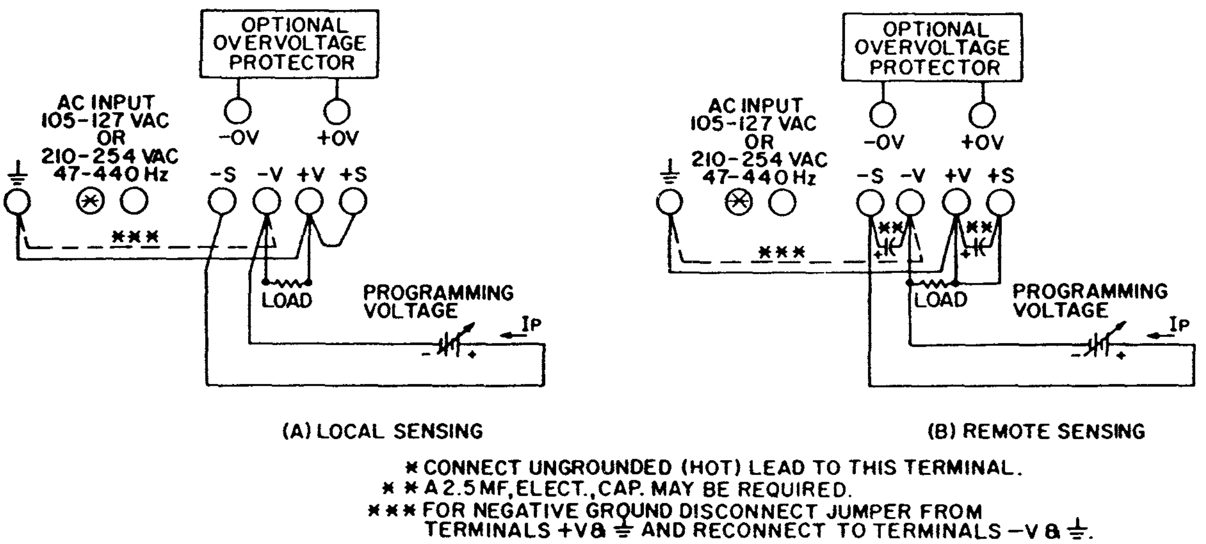
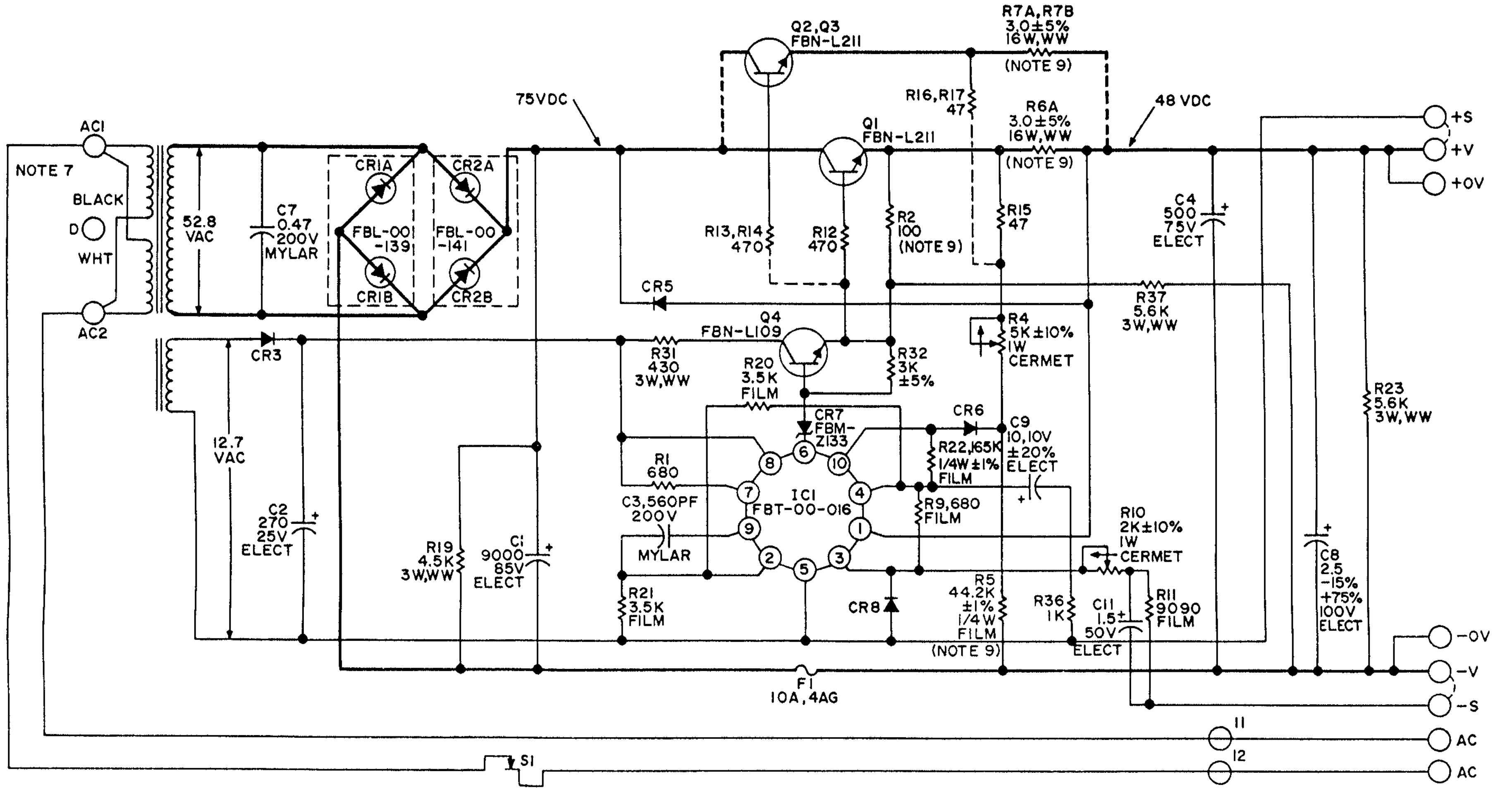


Figure 6. Programmed Voltage, With External Programming Voltage Source.



NOTES:

1. RESISTORS ARE 1/2 W CARB. FILM WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: CARB. FILM ±5%, FILM ±1%, WIREWOUND ±3%.
4. CAPACITOR TOLERANCES: ELECTROLYTIC −10 +100%, MYLAR ±10%.
5. SYMBOLS
   - ↑ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - ─▶├─ LAMBDA PART NO. FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - ─⊖─ INDICATES TERMINAL ON PRINTED CIRCUIT BOARD.
   - ▭ INDICATES ACTUAL UNIT MARKING.
6. FOR OPERATION AT 47-53 Hz OR 63-440Hz, CONSULT FACTORY.
7. T1 PRIMARY CONNECTION SHOWN IS FOR 105-127 VAC INPUT. FOR 210-254 VAC INPUT: DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERM'S. AC1 & AC2 AND RECONNECT BOTH LEADS TO TERM. D.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60 Hz. NOMINAL OUTPUT VOLTAGE, NO LOAD, +S AND +V SHORTED, −S AND −V SHORTED. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN −S AND INDICATED POINTS UNLESS OTHERWISE NOTED.
9. R6A, R7A, R7B WAS 0.94±5%, 16W; R5, R2 WAS 100K COMP ON UNITS WITH SERIAL NO. PREFIXES A-C.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A-E

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.

DOTTED CONNECTIONS SHOWN INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY
MODEL LNS-P-48

ELECTRONICS
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