

**2-WIRE E&M, 2-WIRE E&M 600-OHM,
4-WIRE E&M, 4-WIRE E&M EXTENDED RANGE, AND 4-WIRE E&M DUAL
CHANNEL UNIT DESCRIPTION
D4 CHANNEL BANK
DIGITAL TRANSMISSION SYSTEMS**

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phasize the more significant changes.

(1) To include the 4-wire E&M dual (4E&MD) test channel unit, which has been designed for DACS and DATS application

(2) To correct the EG option selection when using a Type II interface (Fig. 8)

(3) To include functional block diagrams and option locations for all E&M channel units.

1.03 This section provides a functional description of the channel unit(s) at a block diagram level. The transmission paths and signaling circuits that characterize the unit(s) are described herein. Circuit elements that are common to all units (active filters, pulse amplitude modulators and demodulators, gates, and channel unit logic functions) are mentioned in this section and described in detail in the general channel unit descriptive section, 365-170-101. Voice frequency levels, circuit and signaling options, and attenuator settings are given on the circuit layout record card. The procedures for making the settings and adjustments are covered in Section 365-170-000 (TOP).

1. GENERAL

1.01 This section provides a detailed description of the 2-wire and 4-wire E&M message channel units and 4-wire E&M test channel unit used in the D4 channel banks. A typical 2-wire channel unit is shown in Fig. 1 and a typical 4-wire channel unit is shown in Fig. 2. The J and SD drawing numbers and faceplate markings are shown in Table A.

1.02 The reasons for reissuing this section are listed below. Revision arrows are used to em-

2. CHANNEL UNIT DESCRIPTION

A. Application

2.01 The message channel units (2E&M, 2E&M6, 4E&M, and 4E&MER) provide an interface between 2-wire and 4-wire E&M circuits and the D4 channel bank common circuits. The test channel unit (4E&MD) provides test access for the Digital Access and Cross Connect System (DACS) and the Digital Access Timeslot Selector (DATS). The channel units provide:

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- (1) Impedance and level conversion at voice frequencies (VF)
- (2) E&M signaling and supervision
- (3) Jack access for system measurements and analysis
- (4) Trunk processing in response to carrier failure (message channel units only)
- (5) ♦Dual signaling circuits for checking both signaling bits A and B (test channel unit only).♦

2.02 The 2-wire E and M (2E&M) channel unit is designed for use with 900-ohm VF circuits. The 2-wire E and M 600-ohm (2E&M6) channel unit is designed for use with 600-ohm VF circuits and has additional receive gain to allow direct connection to toll connecting trunk circuits.

2.03 The 4-wire E and M channel unit (4E&M) is designed to interface with 600-ohm VF circuits. The 4-wire E and M extended range (4E&MER) channel unit is provided with additional transmit and receive gain to allow direct connection to a 4-wire switching system without the need for external pads (unless a 4-wire or 6-wire patching bay is used).

2.04 ♦The 4-wire E and M dual channel unit (4E&MD) is designed primarily for test access capabilities of the DACS and DATS. Since this channel unit does not include signaling freezing during out-of-frame intervals prior to TPU operation, it is not recommended for message use.♦

B. Transmission Paths

2E&M and 2E&M6

2.05 The balanced 2-wire 600-ohm and 900-ohm trunk circuits are converted to 4-wire 600-ohm unbalanced circuits by means of the hybrid transformers. The nominal loss between the 2-wire and 4-wire parts is 4.0 dB, see Fig. 3 (2E&M) ♦or Fig. 4 (2E&M6).♦

2.06 To balance the hybrid, a compromise network (COMP NET) is provided. In the 2E&M unit, the COMP NET consists of a 900-ohm resistor in series with a 2.15 μ F capacitor, and the 2E&M6 has a 600-ohm resistor in series with a 2.15 μ F capacitor to balance the line impedance. The shunt capacitance of

the office cabling is balanced by connection of a network buildout capacitor (NBOC) in parallel with the COMP NET. The NBOC is adjusted by means of jumper plugs.

2.07 A transmitting attenuator (TRMT ATTEN) provides adjustment for a VF level of -8.5 dB TLP at the test jack (TST). The attenuation of 6.3 dB is adjustable in steps of 0.1 dB to allow for various office levels and cabling losses. The output of the TRMT ATTEN is coupled to the transmitting filter and gating circuit. The active bandpass filter (BPF) is a low pass filter with a bandpass of 200 to 3400 Hz and a 60 Hz rejection peak.

2.08 A junction field effect transistor gate in the pulse amplitude modulator (PAM) circuit samples the output of the BPF via IC1 at a rate determined by timing pulses from the D4 common circuits. The PAM samples are then connected to the transmitting D4 common circuitry.

2.09 The receive gate in the PAM is turned on by channel logic circuits IC1 to allow PAM samples from the D4 common circuits as input to the receive active low pass filter (LPF). The output of the LPF is the reconstructed VF waveform at a VF level of +4.0 dB TLP at the TST jack. In the 2E&M channel unit, a receive attenuator (RCV ATTEN) provides a maximum of 6.3 dB loss in steps of 0.1 dB to adjust for the required VF level at the 2-wire hybrid port.

2.10 In the 2E&M6 channel unit, a receive amplifier with 1.4 dB gain is added, and RCV ATTEN is increased 6.4 dB to a total of 12.7 dB. These additions allow adjustment of the VF level at the 2-wire output for connection to a 600-ohm toll connecting trunk circuit.

4E&M ♦and 4E&MD♦

2.11 ♦The transmitting 600-ohm, balanced 4-wire trunk circuit (4E&M) or test circuit (4E&MD) is converted to 600-ohm unbalanced by transformer T1, and is connected to the transmitting amplifier, see Fig. 5 (4E&M) or Fig. 6 (4E&MD). In these channel units, the output of the amplifier is adjusted by attenuator (TRANSMIT ATTEN) to present a VF level of -8.5 dB TLP at the test jack (TST). The TRANSMIT ATTEN has a maximum loss of 1.5 dB and is adjustable in 0.1 dB steps. Input levels between -16.0 dB and -17.5 dB can be adjusted to -8.5 dB TLP at the TST jack.♦

2.12 The output of the TST jack connects to the transmit/receive filter logic circuit which con-

tains a transmit active BPF. The BPF rejects unwanted frequencies above and below the VF band of 200 to 3400 Hz, with a 60 Hz rejection peak. The output of the BPF connects to the TRMT GATING circuit.

2.13 The output (TPAM) is controlled by the TRMT gate. The TRMT gate is driven to conduction by timing pulses from the D4 common circuits. The TPAM samples via the gate are transmitted to the D4 common circuitry for transmission over the T type carrier facilities.

2.14 The RPAM samples received from the D4 common circuits pass through the RCV gate at a rate determined by timing pulses from the D4 common circuits to the transmit/receive filter logic circuit which contains an LPF. The output of the LPF is reconstructed VF at a level of +4.0 dB TLP at the TST jack. The output from the TST jack connects to the RECEIVE ATTEN. The RECEIVE ATTEN has a total loss of 1.5 dB adjustable in steps of 0.1 dB. Attenuator RECEIVE ATTEN adjusts the receive amplifier output to a level between +7.0 dB TLP and +8.5 dB TLP at the line side of the receiving transformer.

4E&MER

2.15 The transmission circuits of the 4E&MER (see Fig. 7) are the same as the 4E&M with two exceptions:

- (1) The gain of the transmitting and receiving amplifiers is higher.
- (2) Attenuation of 0 to 25.5 dB appears in the transmit and receive circuits.

2.16 With the added transmit gain and attenuator range, a trunk circuit input level range of +8.0 dB to -17.5 dB can be adjusted to obtain the required -8.5 dB TLP at the TST jack input to the transmit active BPF.

2.17 The increased gain and attenuator range in the receive circuit will allow adjustment of the +4.0 dB TLP at the TST jack to a trunk circuit input range of +8.6 dB TLP to -16.9 dB TLP.

C. Message Channel Unit Signaling And Supervision

2.18 Signaling and supervision is accomplished between the D4 channel unit and the trunk

circuit with three types of interfaces. These are types I, II, and III.

Type I Interface

2.19 This interface is a 2-wire E&M lead signaling interface between the D4 channel unit and the trunk circuit as shown in Fig. 8. Signaling from the trunk circuit to the channel unit is over the M lead, and signaling from the channel unit to the trunk circuit is over the E lead. Ground signals from the trunk circuit indicate an on-hook condition, while negative battery indicates an off-hook condition. The type I interface is used with electromechanical switching systems.

Type II Interface

2.20 The type II interface is a 4-wire looped E&M lead signaling interface between the D4 channel unit and the trunk circuit as shown in Fig. 8. Signaling in either direction between these circuits is by means of an open for on hook and a closure for off hook. The M and SB loop leads signal from the trunk circuit to the channel unit and the E and SG loop leads signal from the channel unit to the trunk circuit. The type II interface is used with electronic switching systems.

Type III Interface

2.21 The type III interface is a 4-wire partially looped E&M lead signaling interface between the D4 channel unit and the trunk circuit. Signaling over the M lead is the same as type I except that battery and ground for M-lead signaling are provided to the trunk circuit over the SB and SG leads. The E lead functions are the same as type I. A distinction of the type III interface is that three conductors are used for M-lead signaling. The type III provides better protection from interference problems than type I and is used with electronic switching systems.

3. CIRCUIT OPTIONS

A. Attenuation, Gain, and Loss Parameters

3.01 Table B provides a listing by channel unit of the insertion gain or loss of the unit, the range of the unit attenuators, and the input and output TLP levels at the connecting circuit. This is based on the normal transmit TLP of -8.5 dB and receive TLP of +4.0 dB at the TST jacks.

3.02 The transmit and receive path insertion gain or loss takes into consideration any hybrids,

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transformers, amplifiers, or fixed pads in the transmission path with all attenuation controls set to zero. As shown in Table B, the attenuator range for individual channel units varies considerably from unit to unit and in some cases from transmit to receive path. In general, the attenuators are variable in precise 0.1 dB steps over the entire range. These channel units use the plug and socket type attenuator setting.

B. Trunk and Signaling Options

3.03 Options on these channel units are described in Table C and use the plug and socket method to select an option in the trunk, signaling, or test path. Figures 9 through 13 give the option and major component location.

C. Network Build-Out Capacitors (NBOC)

3.04 The NBOC is in the network side of the hybrid in the 2E&M and 2E&M6 channel units. The

NBOC balances the wiring capacitance and provides a good return loss in the hybrid circuit.

4. REFERENCES

4.01 The following is a list of sections associated with D4 equipment.

SECTION	TITLE
179-100-311	D4 Channel Bank - Signaling Compatibility
365-170-000	D4 Channel Bank (TOP)
365-170-100	D4 Channel Bank Description
365-170-101	D4 Channel Units - General Description

◆TABLE A◆

D4 CHANNEL UNITS

J98726()	SD/CD	CHANNEL UNIT TYPE	FACEPLATE MARKING
BC	3C324-0_	4-Wire E&M	4E&M
BJ	3C327-0_	2-Wire E&M	2E&M
BP	3C332-0_	4-Wire E&M Extended Range	4E&MER
BT	3C337-0_	2-Wire E&M 600 Ohm	2E&M6
CG	3C397-0_	4-Wire E&M Dual	4E&MD

♦TABLE B♦

CHANNEL UNIT ATTENUATION, GAIN, AND LOSS PARAMETERS

CHANNEL UNIT	TRANSMIT PATH (T, R TO TST JACK —8.5 DB TLP POINT)				RECEIVE PATH [TST JACK + 4.0 dB TLP POINT TO T1&R1, OR T&R (2W)]			
	G_T INSERTION GAIN (+) OR LOSS (—) (dB)	ATTEN RANGE (dB)	INPUT LEVEL AT T&R (dB)		G_T INSERTION GAIN (+) OR LOSS (—) (dB)	ATTEN RANGE (dB)	OUTPUT LEVEL AT T1&R1 (dB)	
			MIN	MAX			MIN	MAX
2E&M	—4.0	0 - 6.3	— 4.5	+ 1.8	—4.0	0 - 6.3	— 6.3	0
2E&M6	—4.0	0 - 6.3	— 4.5	+ 1.8	—2.6	0 - 12.7	—11.2	+1.5
4E&M	+9.0	0 - 1.5	—17.5	—16.0	+4.5	0 - 1.5	+ 7.0	+8.5
4E&MER	+9.0	0 - 25.5	—17.5	+ 8.0	+4.5	0 - 25.5	—16.9	+8.6
4E&MD	+9.0	0 - 1.5	—17.5	—16.0	+4.5	0 - 1.5	+ 7.0	+8.5

TABLE C

CHANNEL UNIT OPTIONS

CHANNEL UNIT MARKING	OPTION	FUNCTION
2E&M (Yellow dot) J98726BJ SD3C327-0___ OR 2E&M6 (No Dot) J98726BT SD3C337-0___	1G	<p>Provides a ground on the 1 lead (make-busy lead) when trunk processing is initiated. After a 2.5-second delay, the ground disappears for 100 milliseconds and then reappears for the duration of the carrier failure. Normally selected for all electromechanical switching machines except No. 5 crossbar.</p>
	EG	<p>Selected for type I interface (standard for electromechanical switching system) or type III (partially looped, for some electronic switching machines) which provides a local ground to E lead to indicate off-hook state. The EG option is not selected in type II electronic switching (completely looped) interfaces because the trunk circuit supplies the ground.</p>
	EPD	<p>When selected, this option causes the channel unit to open the E lead when trunk processing begins and then grounds the E lead after a 2.5-second delay. This option is normally employed when make-busy leads are not available at the originating end of a 1-way trunk or at either end of a 2-way trunk. Option EG continues to determine the type (I, II, or III) of signaling interface.</p>
	EPI	<p>When selected, this option causes channel unit to ground E lead immediately when trunk processing occurs. Supplying an immediate E lead ground to a dial-long-line circuit can suppress erratic ringing at the subscriber end. When neither EPD nor EPI is selected, the E lead opens when trunk processing occurs.</p>
	CN	<p>When selected, connects internal compromise network in the circuit. Disconnected when external network is required [precision balance network (PBN)].</p>
	X	<p>Selected when capacitance is not provided in the trunk circuit. It connects 2.5 μF across T1 and R1 (A & B) leads.</p>
	Y	<p>Placed into the circuit when capacitance is 4.0 μF of capacitance or greater in the trunk circuit.</p>
	Z	<p>Placed into the circuit when the capacitance across T1 and R1 leads in the trunk circuit is 1.0 μF.</p>
	NBOC 2, 4, 8, 16, 32, 64	<p>Values given on the circuit layout record card and procedures covered in Section 365-170-000 (TOP).</p>

◆TABLE C (Contd)◆

CHANNEL UNIT OPTIONS

CHANNEL UNIT MARKING	OPTION	FUNCTION
4E&M (White Dot) J98726BC SD3C324-0___ OR 4E&MER (No dot) J98726BP SD3C332-0___	1G	Provides a ground on the 1 lead (make-busy lead) when trunk processing is initiated. After a 2.5-second delay, the ground disappears for 100 milliseconds and then reappears for the duration of the carrier failure. This option is normally selected for all electromechanical switching machines except No. 5 crossbar.
	EG	Selected for type I interface (standard, for electromechanical switching system) or type III (partially looped, for some electronic switching machines) which provides a local ground to E lead to indicate off-hook state. The EG option is not selected in type II electronic switching (completely looped) interfaces because the trunk circuit supplies the ground.
	EPD	When selected, this option causes the channel unit to open the E lead when trunk processing begins and then grounds the E lead after a 2.5-second delay. This option is normally employed when make-busy leads are not available at the originating end of a 1-way trunk or at either end of a 2-way trunk. Option EG continues to determine the type (I, II, or III) of signaling interface.
	EPI	When selected, this option causes channel unit to ground E lead immediately when trunk processing occurs. Supplying an immediate E lead ground to a dial-long-line circuit can suppress erratic ringing at the subscriber end. When neither EPD nor EPI is selected, the E lead opens when trunk processing occurs.
4E&MD (No dot) J98726CG SD-3C397-0___	E1G and E2G	When selected, provides a ground on the E1 and E2 leads in the off-hook state. When not selected, provides a ground-free loop between E1-EB2 and E2-EB2 in the off-hook state.
	X	When selected with EG not selected, provides -48 volts on the E1 and/or E2 lead in the off-hook state.

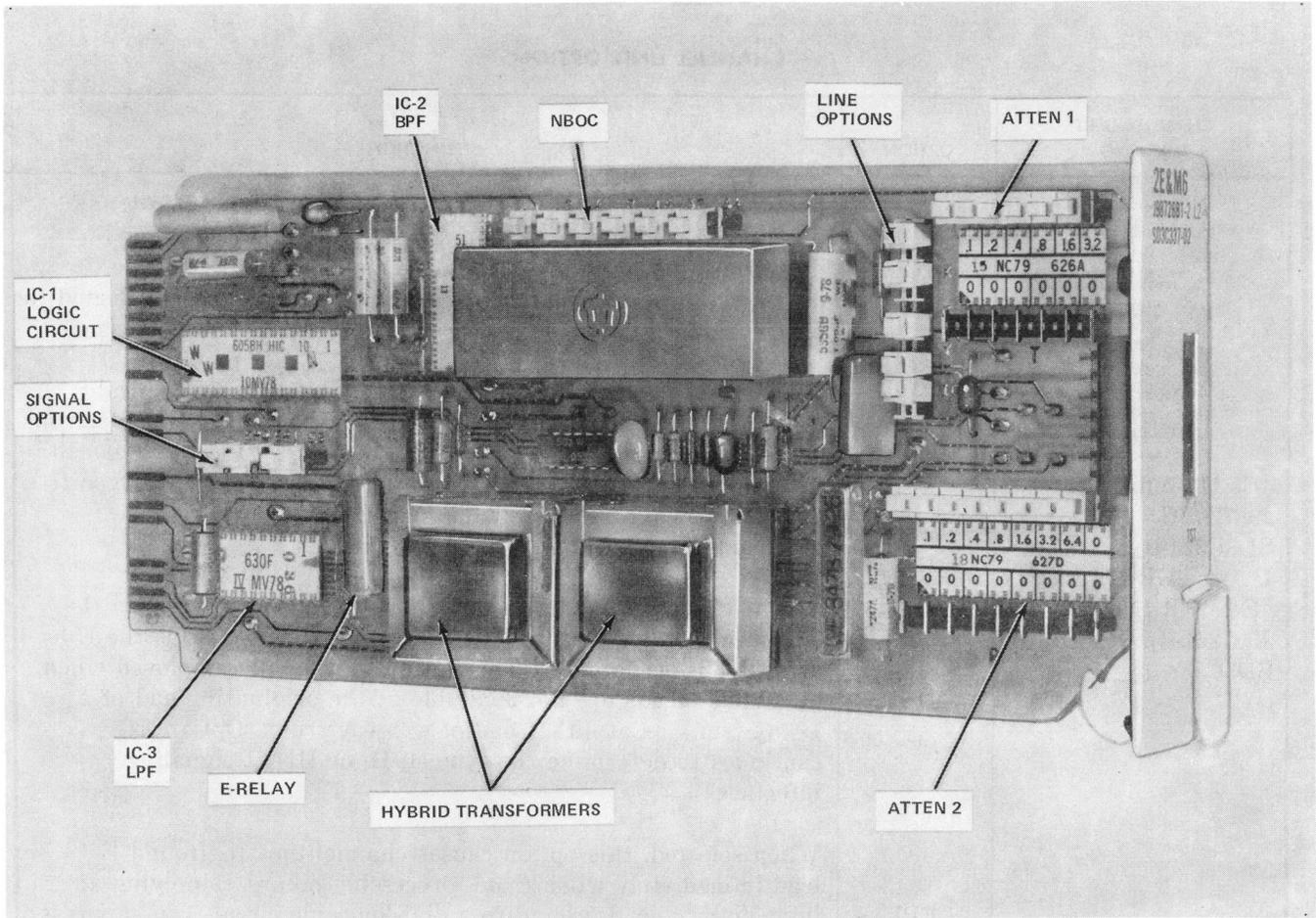


Fig. 1—Typical 2-Wire E&M Channel Unit

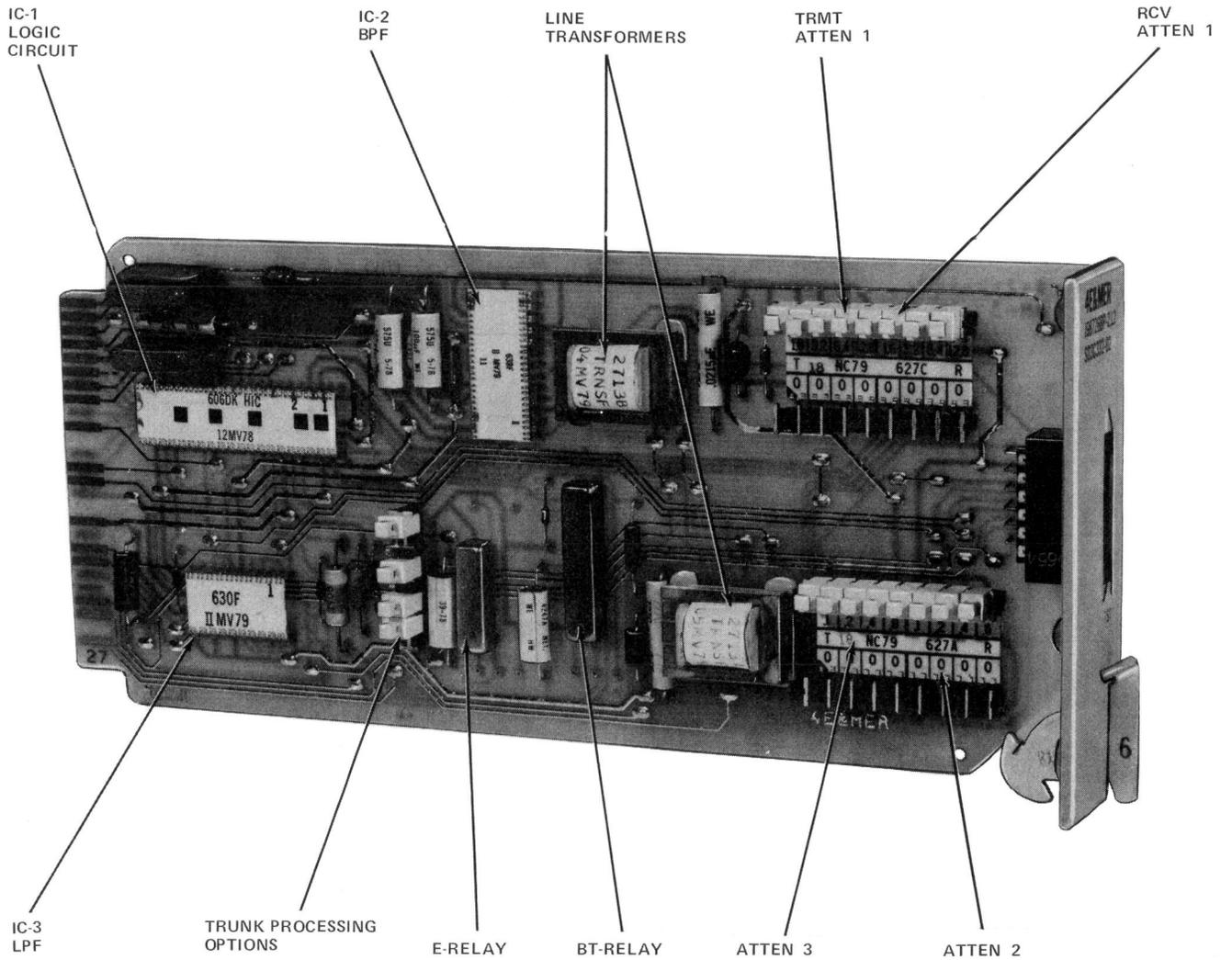


Fig. 2—Typical 4-Wire E&M Channel Unit

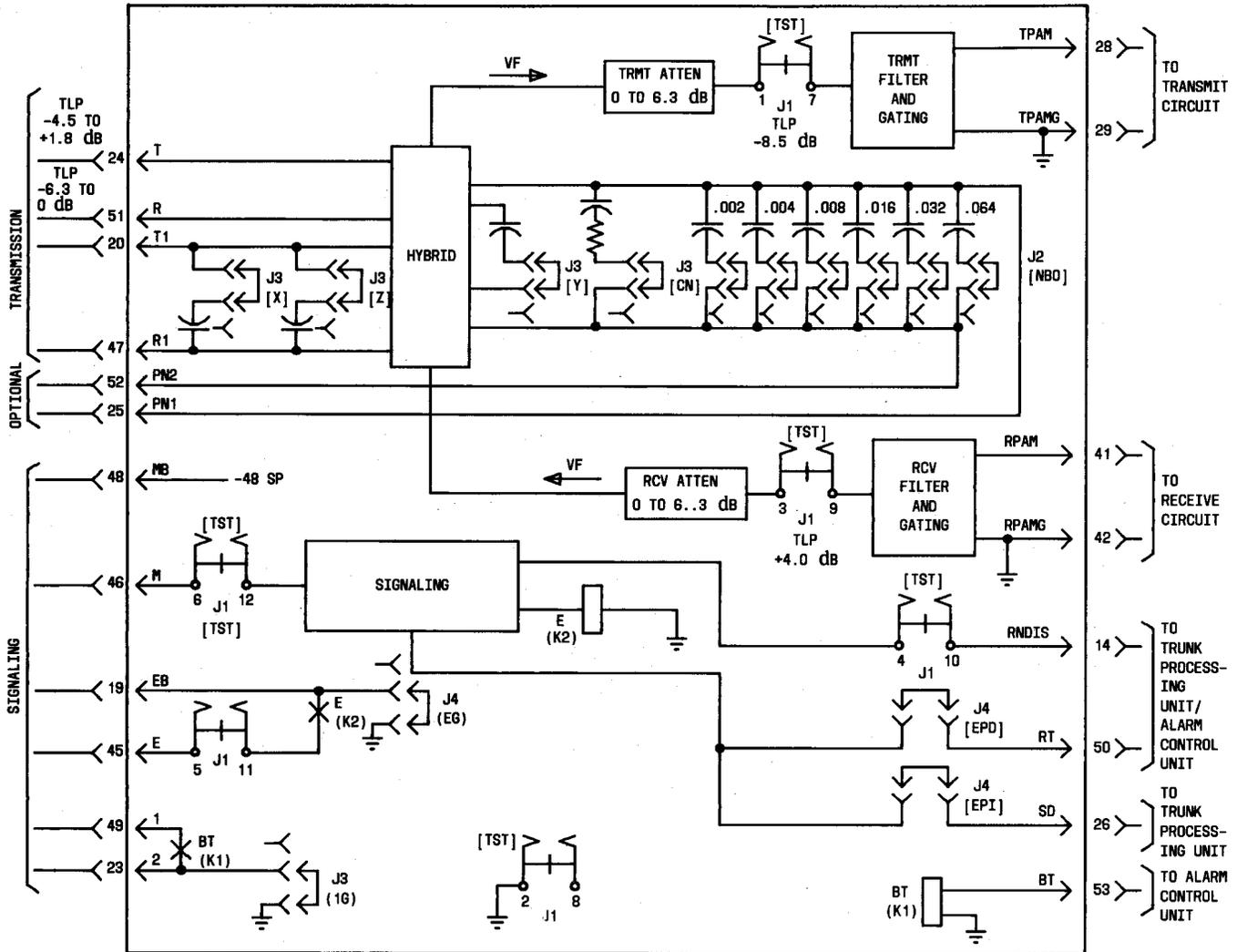


Fig. 3—2E&M Functional Block Diagram

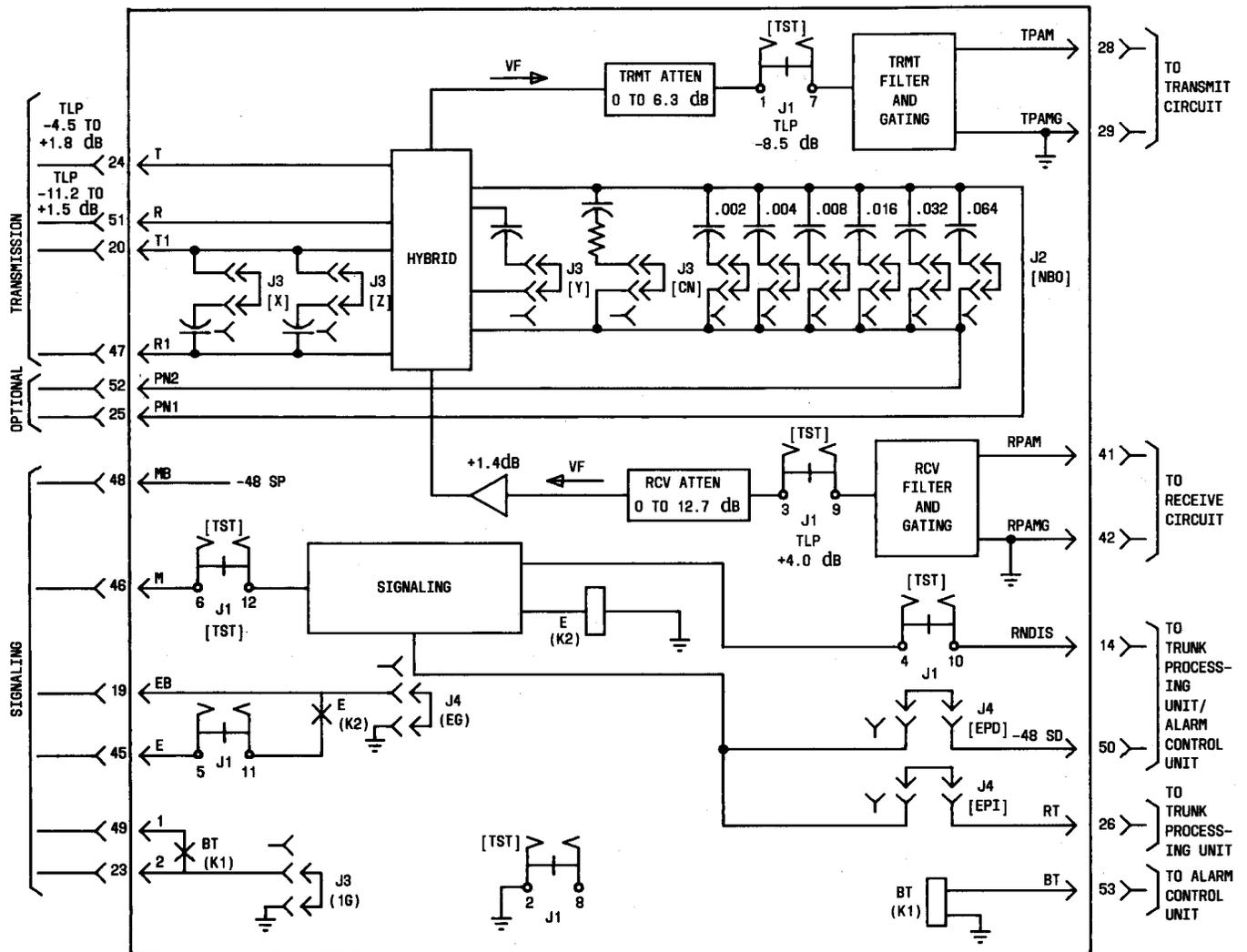


Fig. 4—2E&M6 Functional Block Diagram

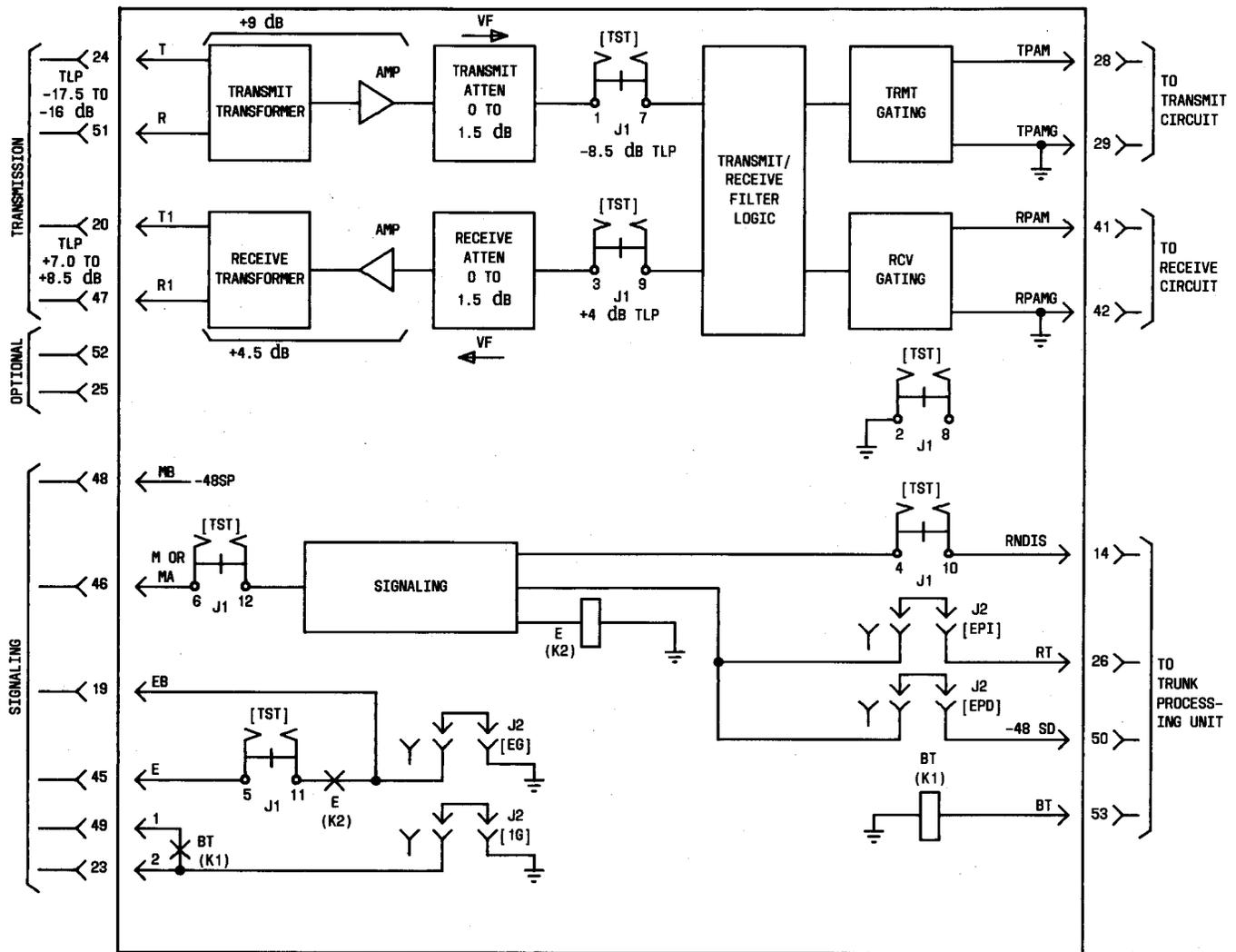


Fig. 5—4E&M Functional Block Diagram

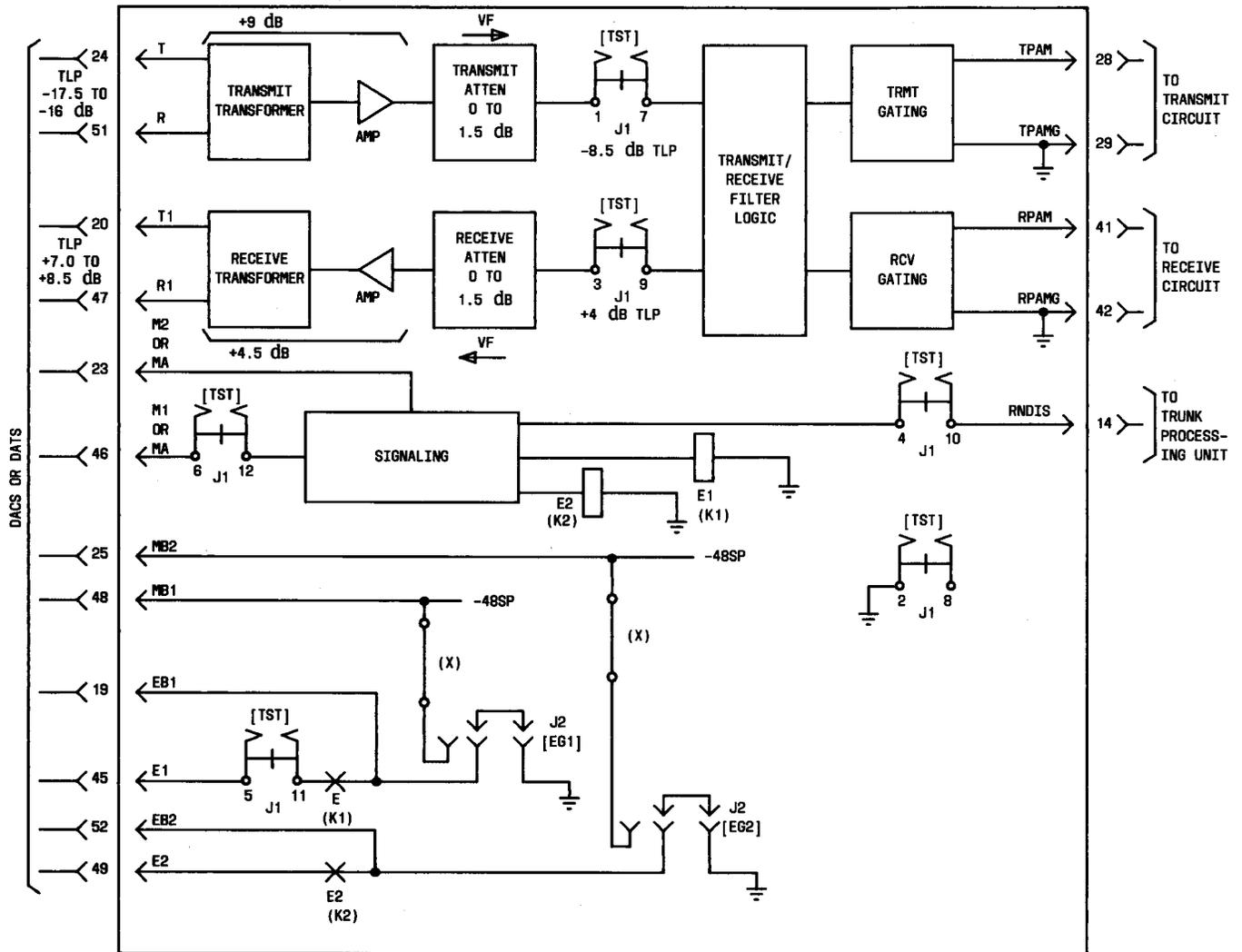


Fig. 6—4E&MD Functional Block Diagram

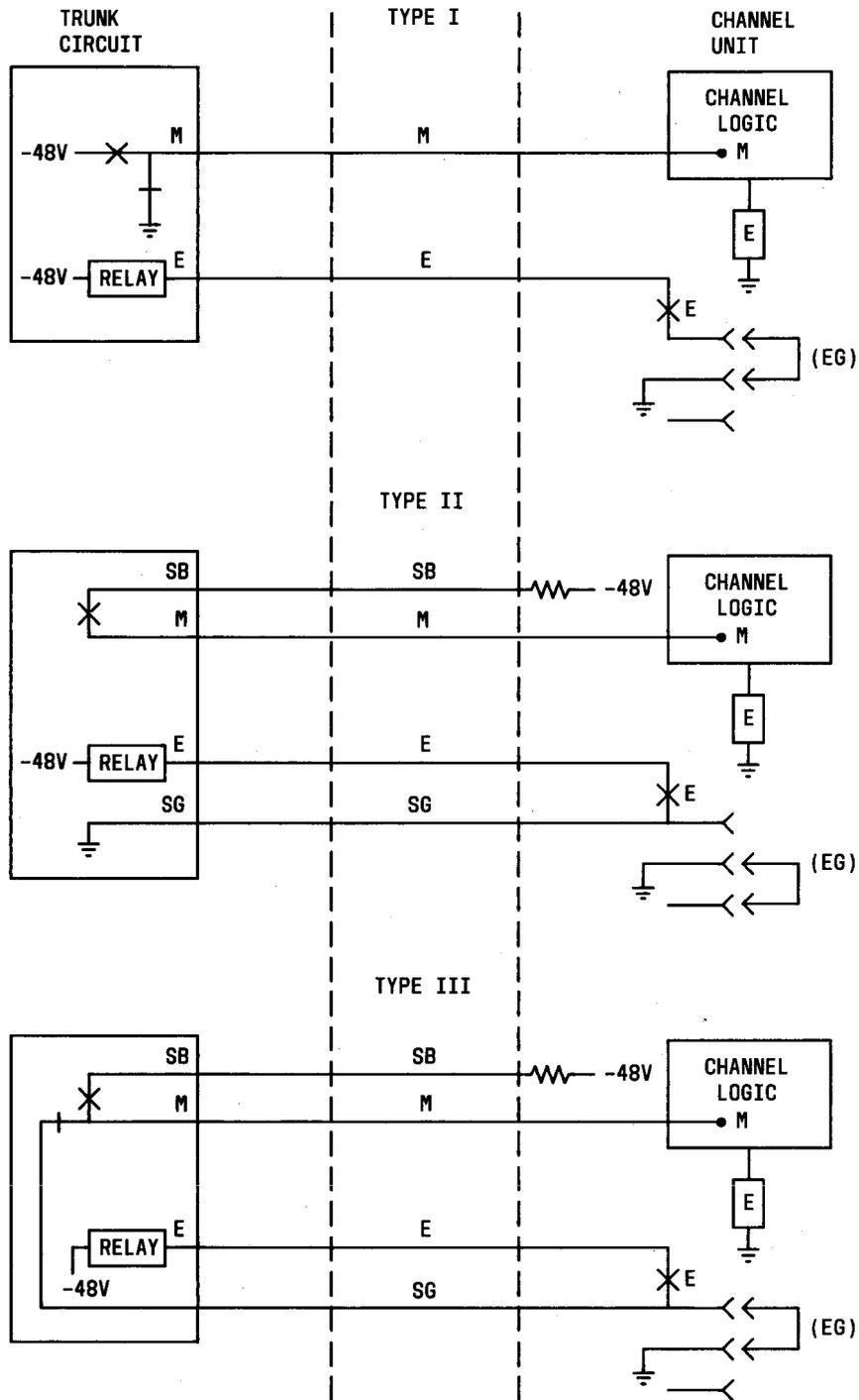


Fig. 8—E&M Signaling Interfaces

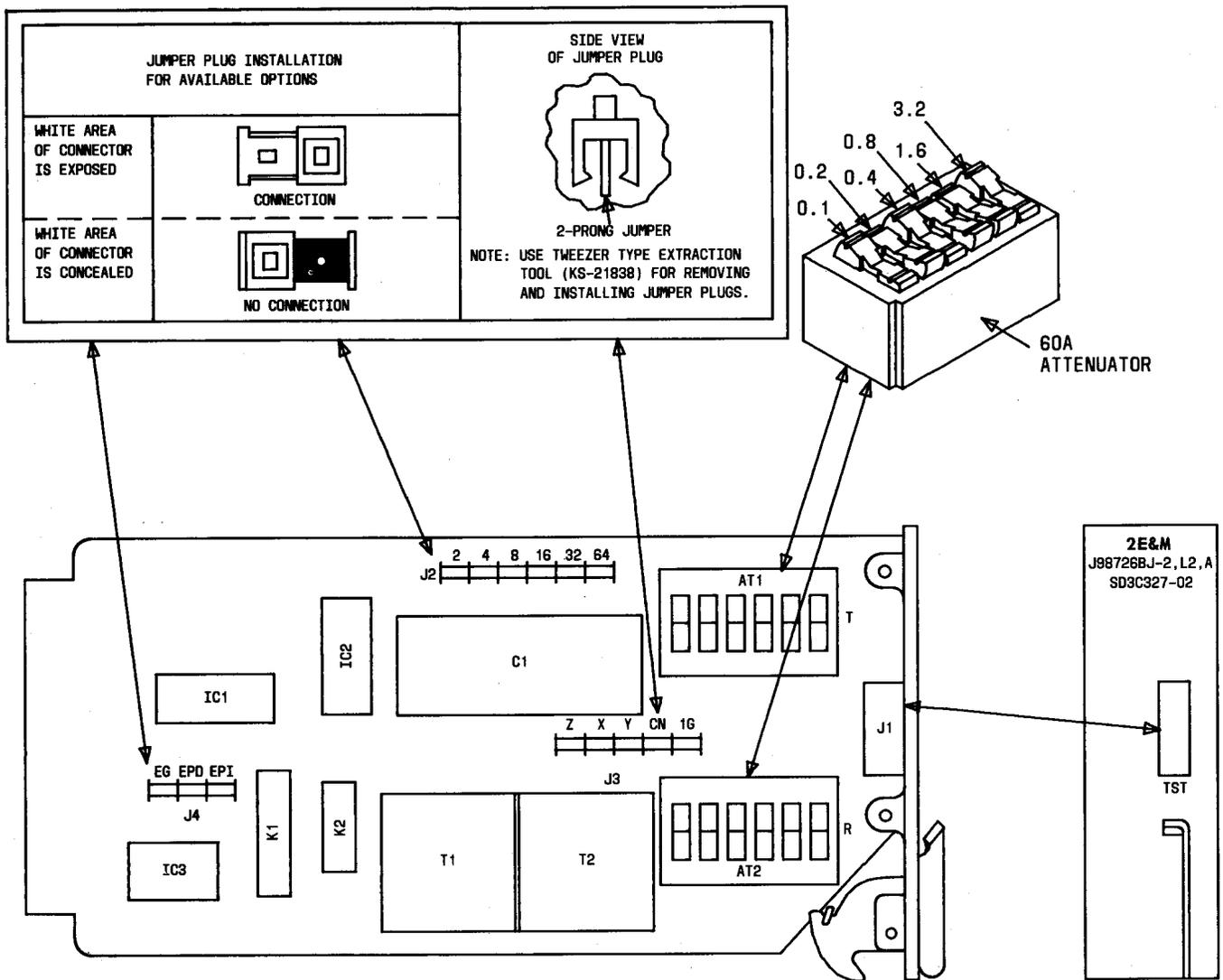


Fig. 9—2E&M Option and Major Component Location

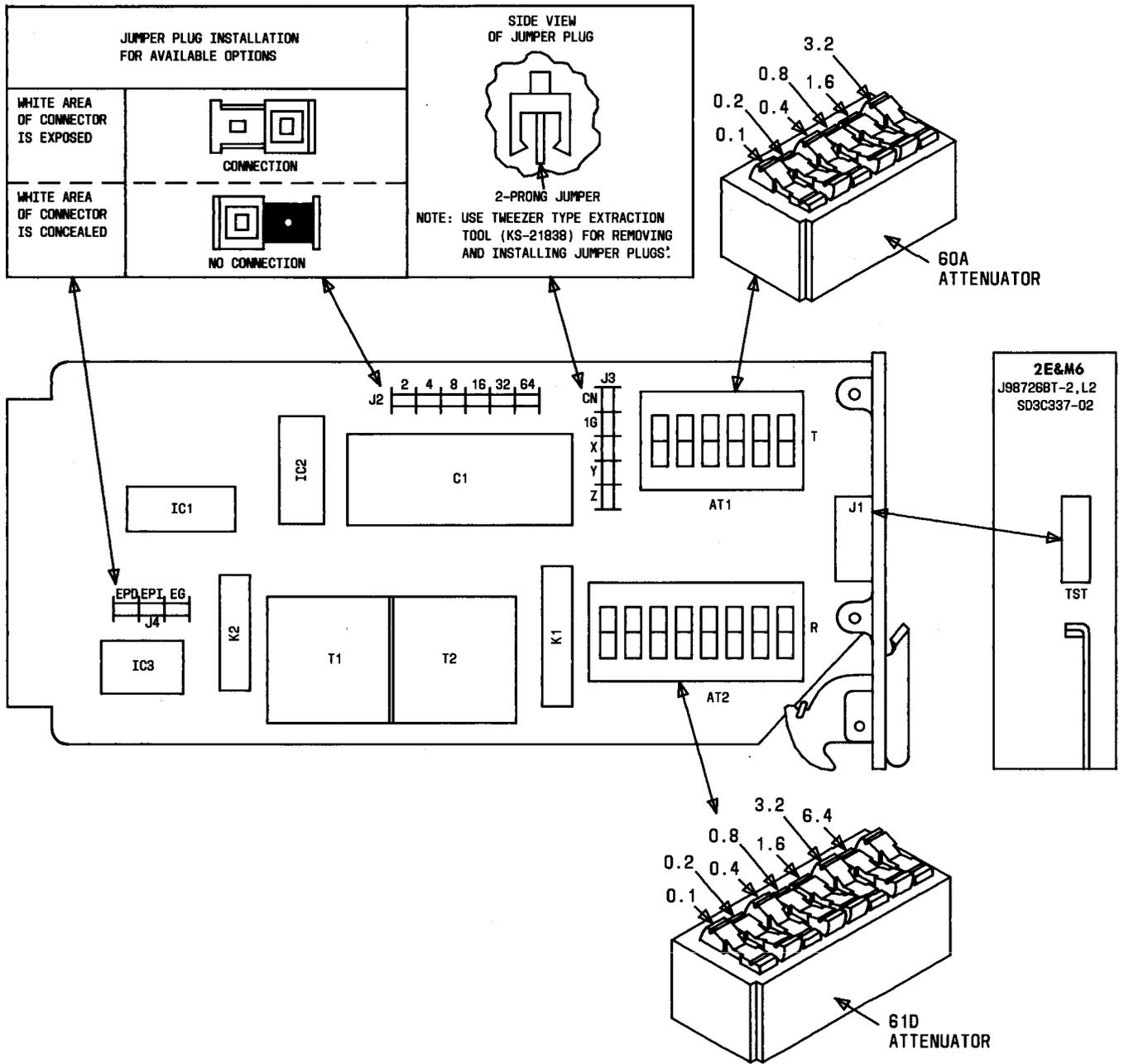


Fig. 10—2E&M6 Option and Major Component Location

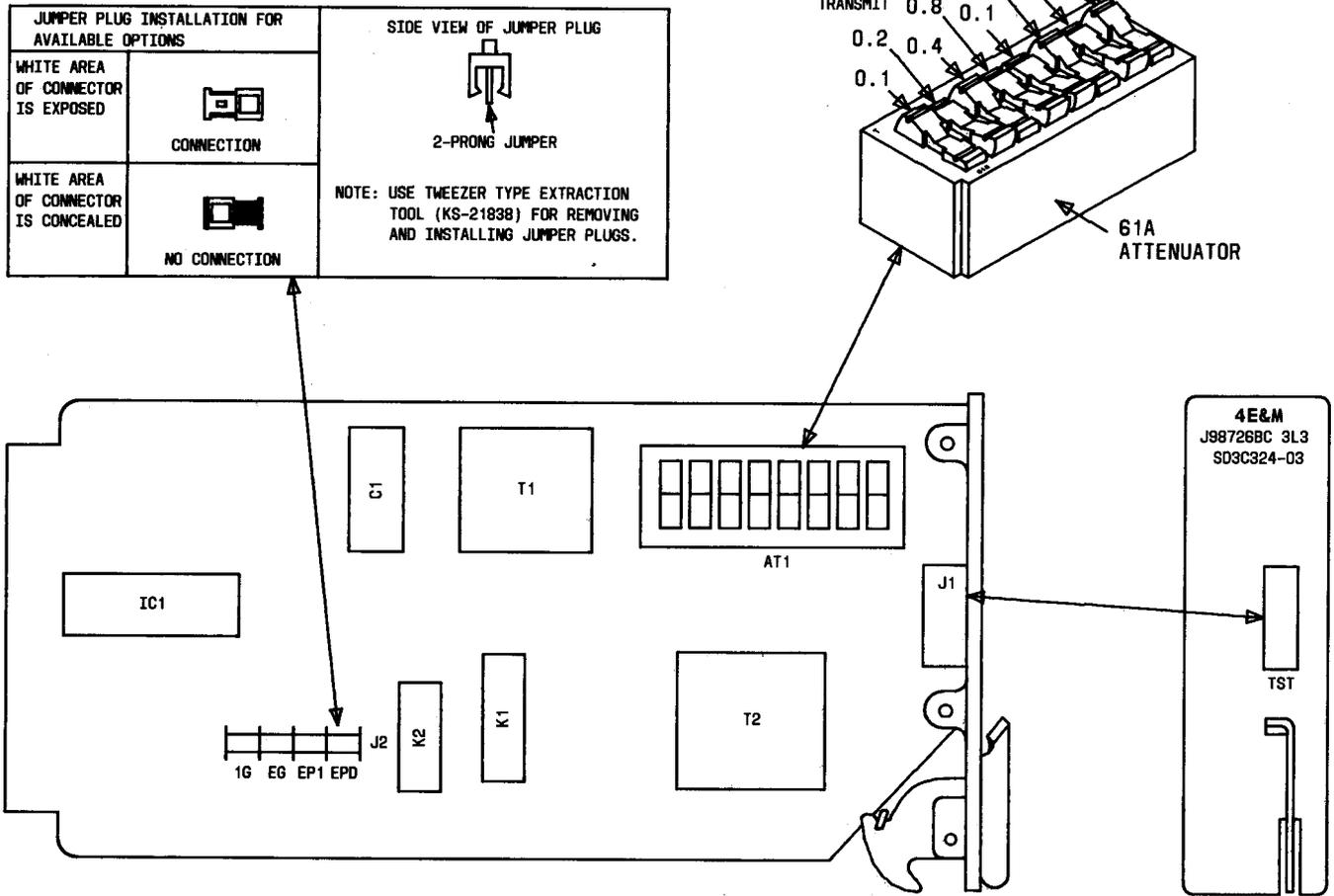


Fig. 11—4E&M Option and Major Component Location

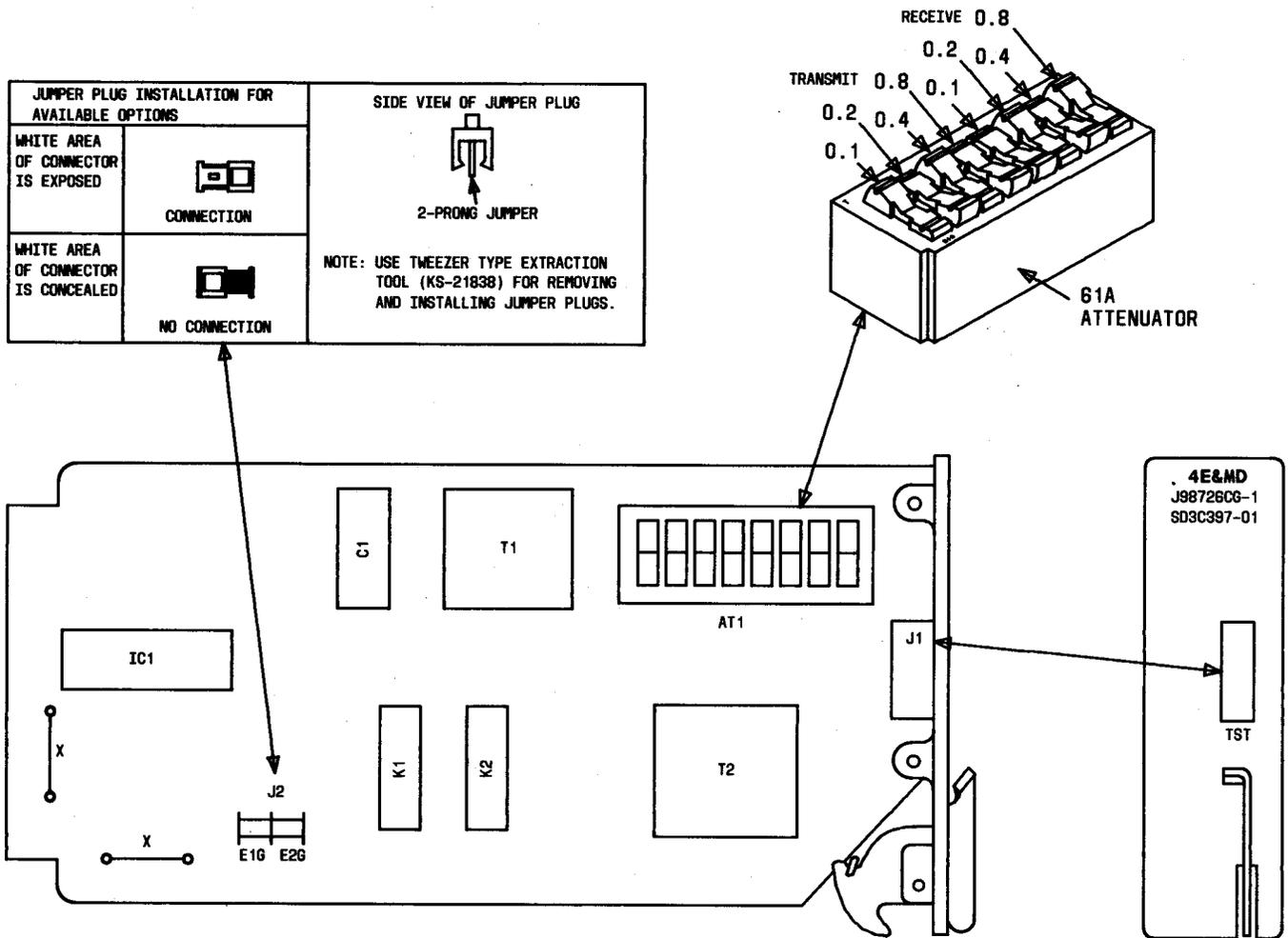


Fig. 12—4E&MD Option and Major Component Location

JUMPER PLUG INSTALLATION FOR AVAILABLE OPTIONS		SIDE VIEW OF JUMPER PLUG  2-PRONG JUMPER
WHITE AREA OF CONNECTOR IS EXPOSED	 CONNECTION	
WHITE AREA OF CONNECTOR IS CONCEALED	 NO CONNECTION	

NOTE: USE TWEEZER TYPE EXTRACTION TOOL (KS-21838) FOR REMOVING AND INSTALLING JUMPER PLUGS.

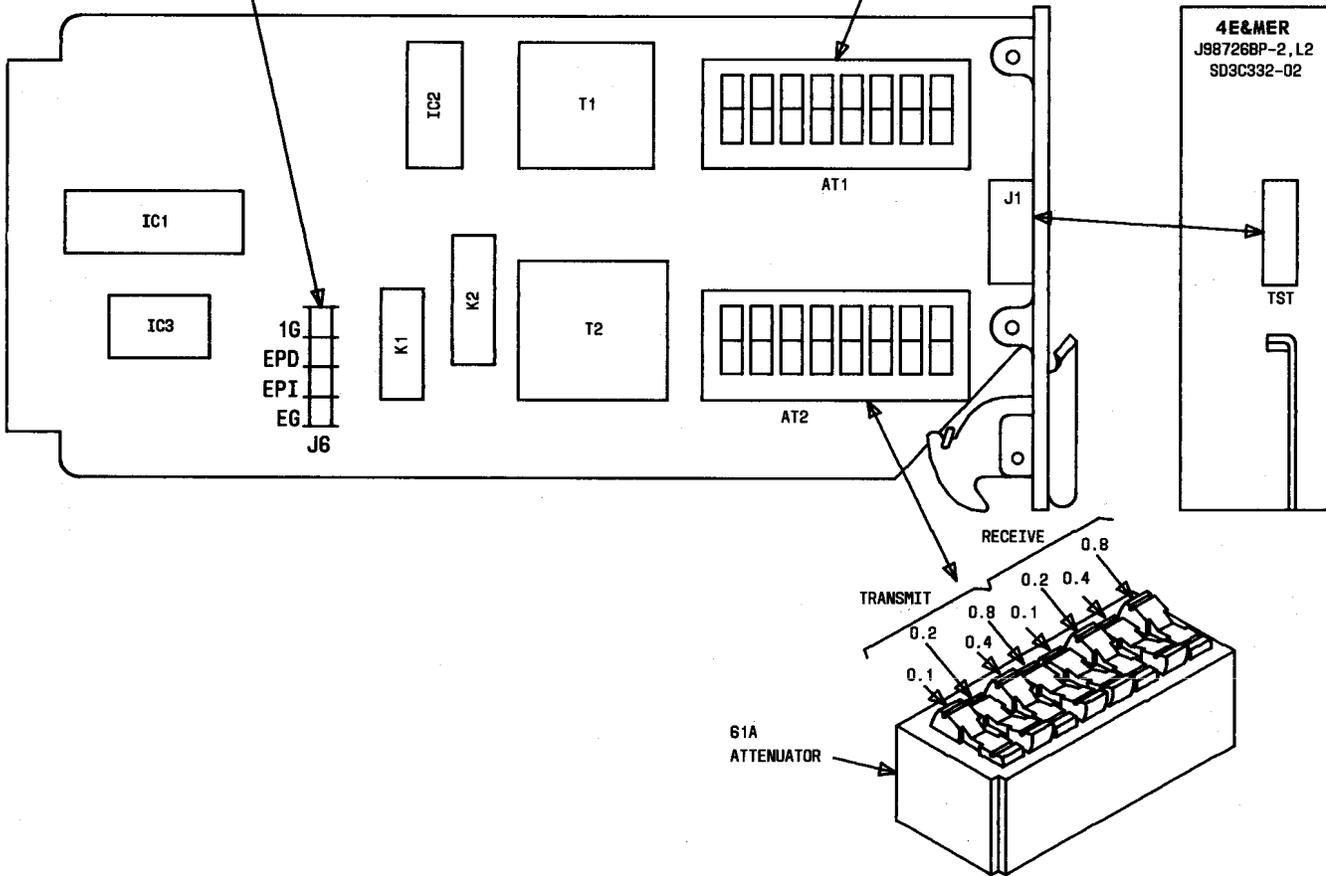
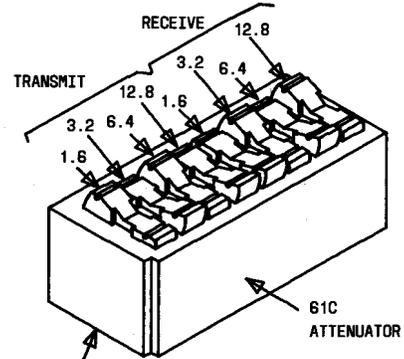


Fig. 13—4E&MER Option and Major Component Location