

2-WIRE AND 4-WIRE TRANSMISSION ONLY
CHANNEL UNIT DESCRIPTION
D4 CHANNEL BANK
DIGITAL TRANSMISSION SYSTEMS

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1. GENERAL

1.01 This section provides a detailed description of the 2-wire and 4-wire transmission only and the 4-wire equalized transmission only channel units used in the D4 channel bank (Table A).

1.02 Whenever this section is reissued, the reason for the reissue will be given in this paragraph.

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 (CLRC). The procedures for making the settings and adjustments are covered in Section 365-170-000 (TOP).

2. CHANNEL UNIT DESCRIPTION

A. Application

2.01 The 2TO unit is provided for use on 2-wire metallic extensions which require no signaling or use end-to-end inband signaling (eg, a short private line for data transmission). The unit provides a hybrid on the drop side with a compromise balance network of 900 ohms in the series with 2.15 μ F. It is also provided with dc loop-sealing current for extensions with hand-wrapped splices (Fig. 1).

4-Wire Transmission Only (4TO)

2.02 The 4TO unit is provided for use on circuits requiring no signaling or using end-to-end inband signaling in back-to-back carrier applications. It is also provided with dc loop-sealing current for extensions with hand-wrapped splices (Fig. 2).

4-Wire Equalized Transmission Only (4ETO)

2.03 The 4ETO unit is provided to interface the D4 bank with a relatively long 4-wire metallic extension where no signaling is required or where inband end-to-end signaling (eg, a private line for data transmission) is used. The unit contains all gain and active equalization circuits required on all loaded or nonloaded 4-wire extensions with 1-kHz losses up to 15 dB. It also is provided with dc loop-sealing current for extensions with hand-wrapped splices.

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B. Transmission Paths**2-Wire (2TO)**

2.04 The 2-wire, 900-ohm balanced line is converted to a 4-wire 600-ohm unbalanced circuit by means of hybrid transformer T1 (Fig. 3). The hybrid is balanced with a compromise network and an adjustable network buildout capacitor (NBOC). Optional sealing current is supplied over the A and B leads of the 2-wire facility to insure positive connection of wrapped splices in the cable. The nominal sealing current is 30 mA but may be momentarily increased to 60 mA by depressing the ZAP switch.

2.05 The transmit amplifier and attenuator ATTEN1 provides 16.5 dB of adjustment range in steps of 0.1 dB to adjust VF level at the test jacks to the required -8.5 dB TLP.

2.06 The active transmit band pass filter (BPF) passes a band of VF from 300 through 3000 Hz. The frequencies above 4 kHz are suppressed to prevent foldover noise below 4 kHz.

2.07 The output of the filter is connected to the TRMT gate which samples the VF at a rate determined by the channel unit logic circuit which is under control of the D4 common circuits. The output of the JFET gate is connected to the D4 common circuits for transmission.

2.08 The received PAM pulses from the D4 common circuits are passed to the low pass filter (LPF) via the JFET gate. The output of the LPF is reconstructed VF. The LPF output level at the test jack is +4.0 dB TLP.

2.09 RCV attenuator ATTEN2 adjusts the VF level at the 2-wire line to the requirement shown on the CLRC.

4-Wire (4TO)

2.10 The 4TO channel unit is coupled to the 4-wire facility via line transformers T1 and T2 (Fig. 4). A DC sealing current option is used to maintain good conduction when hand wrapped splices are used in the cable pairs. The sealing current of 30 mA is maintained with a ZAP option which momentarily increases the sealing current to 60 mA to clean the splices.

2.11 The gain of the transmit amplifier (TRMT AMP) is adjustable to compensate for variable line level inputs. For a TLP of +7 dB to -9 dB at the metallic line interface, option -7 dB TRMT (TRMT GAIN) is applied and plug P3 is inserted into Jack J3 with the white area covered. For a TLP of +0.5 dB to -16.0 dB TLP at the metallic line interface, the option -7 dB is not used and plug P3 is inserted into jack 3 with the white area showing. The output of the TRMT AMP connects to attenuator ATTEN1 which has a range of 0 to 16.5 dB in steps of 0.1 dB. With the proper setting of the TRMT AMP gain, the level at the TEST JACK is adjusted by ATTEN1 to the required -8.5 dB TLP.

2.12 The transmit BPF passes a band of frequencies from 300 through 3000 Hz and is used primarily to reject frequencies above 4 kHz which would produce foldover noise. The output of the BPF connects to the JFET gate a band of frequencies from 400 to 2800 kHz and is used primarily to reject frequencies above 4 kHz which would produce foldover noise. The output of the BPF connects to the JFET gate in the pulse amplitude modulator circuit. The JFET gate, under control of the logic circuit, samples the voice frequencies at 8 kHz rate and transmits the pulses to the D4 common circuits.

2.13 PAM pulses are received from the D4 common circuits and enter the receive LPF via the JFET gate. The JFET gate is turned on at an 8-kHz rate under control of the channel logic circuit. The output of the LPF is reconstructed VF. The receive VF level at the test jack is the standard +4.0 dB TLP.

2.14 The VF is amplified by the receive amplifier (RCV AMP) and connects to the RCV ATTEN2 which has a range of 0 to 16.5 dB adjustable in 0.1 dB steps.

2.15 The VF level at the metallic facility is adjustable by a combination setting of the RCV AMP and ATTEN2. For a metallic interface TLP of +7 dB to +9.5 dB, the RCV AMP gain is correct. For a metallic interface TLP of 0 to -16 dB, the RCV AMP gain is reduced by applying the -7 dB RCV option.

4-Wire (4ETO)

2.16 The 4ETO metallic interface is at the line side of transformers T1 and T2 (Fig. 5). The transformers provide impedance matching to loaded and short and long lengths of nonloaded cable. The 1200-ohm position is used when the channel unit connects to loaded cable. The 600-ohm position is used for average to short lengths of nonloaded cable and the 150-ohm position is used when connected to long lengths of nonloaded cable.

2.17 Sealing current is enabled when plugs P2 and P3 are inserted into jack J2 with the white area showing. Sealing current of 30 mA is applied on an optional basis over the simplex of the cable pairs to insure good connection of the hand wrapped cable pair splices. A ZAP switch when operated increases the sealing current to 60 mA on a momentary basis when required to clean excessively corroded splices.

2.18 The secondary of transformer T1 is arranged to provide a 600-ohm selected 6-dB or 13-dB pad which adjusts the VF input level to the equalizer.

3.16 The active equalizer provides equalization for all gauges of nonloaded and H-88 loaded cables with up to 15 dB of 1-kHz insertion loss. Four switch combinations provide equalization for low frequency rolloff (SL), the 3250-Hz bump height (HT), bump band width (BW), and a low frequency pole for 401 Hz for loaded cable (L) or 1800 Hz for nonloaded cable (N). The output of the equalizer passes through a high pass filter and inputs to the TRMT AMP.

2.20 The output of the TRMT AMP is adjusted to the -8.5 dB TLP at the test jack by TRMT ATTEN1 which has a range of attenuation from 0 to 16.5 dB in steps of 0.1 dB. When the input at the metallic interface is above 0 dB TLP, the -7 dB option is applied to obtain the proper -8.5 dB TLP at the test jack.

2.21 The -8.5 dB output of ATTEN1 connects to the TRMT filter. The filter is used mainly as a low pass filter suppressing frequencies above 4 kHz to prevent foldover noise below 4 kHz. The output of the filter is sampled by the TRMT unit gate which is under control of the channel logic circuit and the D4 common circuits.

2.22 The receive PAM signals from the D4 common circuits are sampled by the RCV gate controlled by the channel logic circuit and pass to the RCV filter. The output of the RCV filter is reconstructed VF signals at a +4.0 dB TLP at the test jack.

2.23 The RCV AMP operates at a fixed gain and the RCV ATTEN2 has an attenuation range of 0 to 16.5 dB in 0.1 dB steps. The VF signals are adjusted by RCV ATTEN2 to the required TLP value at the line side over a range of +7.0 to -3.0 dB TLP.

3. CIRCUIT OPTIONS

3.01 When sealing current option is required, the plug and jack settings are given in Table B.

3.02 In the 4TO channel unit, the option of a 7 dB gain increase is given in Table B.

3.03 In the 4ETO channel unit, the option to reduce the transmit gain 7 dB is given in Table B.

3.04 The options to be included in the circuit design will be shown on the CLR card.

3.05 The ranges of equalization; slope, height, and bandwidth are shown in Table C.

3.06 The transmit and receive path impedance selections are shown in Table C.

3.07 The transmit path insertion gain or loss, attenuator ranges, and metallic interface input levels are shown in Table D.

3.08 The receive path insertion gain or loss, attenuator ranges, and metallic interface input levels are shown in Table D.

3.09 The actual insertion gain or loss values, attenuator settings, and input levels to be applied to the circuit will be given on the CLRC.

4. REFERENCES

4.01 The following is a list of sections associated with the 2TO, 4TO, and 4ETO channel units.

SECTION 365-170-118

SECTION	TITLE		
365-170-000	D4 Channel Bank (TOP)	365-170-500	D4 Channel Bank - Maintenance Consideration
365-170-100	D4 Channel Bank Description		
365-170-101	D4 Channel Bank - Channel Unit Description	855-351-103	D4 Channel Bank - Channel Units Application Engineering

TABLE A

CHANNEL UNITS

J98726()	SD/CD	CHANNEL UNIT TYPE	FACEPLATE MARKING
SJ	7C031-0_	2-Wire Transmission Only	2TO
SH	7C030-0_	4-Wire Transmission Only	4TO
SQ	7C037-0_	4-Wire Equalized Transmission Only	4ETO

TABLE B
CHANNEL UNIT OPTIONS

CHANNEL UNIT MARKING	OPTION	FUNCTION
4TO (Gray) J98726SH SD7C030-0__	J4 (2 Sect.)	Exercised as a pair, provide sealing current to the loop to reduce the occurrence of high-resistance problems at hand-wrapped splices.
	ZAP	While depressed, this switch supplies additional current to loop to clean splices.
	TRMT GAIN	When selected , this option increases the transmit transmission path gain by 7 dB.
	RCV GAIN	When selected , this option increases the receive transmission path gain by 7 dB.
	-7dB TRMT	When selected , this option decreases the transmit transmission path gain by 7 dB.
	-7dB RCV	When selected , this option decreases the receive transmission path gain by 7 dB.
2TO (Gray) J98726SJ SD7C031-0__	J2 (2 Sect.)	Exercised as a pair, provide sealing current to the loop to reduce the occurrence of high-resistance problems at hand-wrapped splices.
	ZAP	While depressed, this switch supplies additional current to loop to clean splices.
	NBOC 2,4,8 16,32,64	See CLRC for values.
4ETO (Gray) J98726SQ SD7C037-0__	J2 (2 Sect)	Exercised as a pair, provide sealing current to the loop to reduce the occurrence of high-resistance problems at hand-wrapped splices.
	ZAP	While depressed, this switch supplies additional current to the loop to clean splices.
	J3 -7 dB (2 Sect.)	When selected, this option reduces the transmit transmission path gain by 7 dB.

TABLE C

EQUALIZATION AND BALANCE CONTROLS FOR 4ETO CHANNEL UNITS

CONTROL		POSITIONS	FUNCTION
NAME	CIRCUIT BOARD STAMPING		
Slope	SL	0 to 15	Switch in position 0 (no numbers showing) provides no equalization and unit frequency response is essentially flat; ie, for 0 dB at 1 kHz. 500 Hz = -0.4 dB and 3000 Hz = +0.1 dB. As switch position number increases, gain at 1 kHz increases to +6.6 dB (N) or +11.4 dB (L) for position 15 (numbers 1, 2, 4, and 8 showing). With N selected gain at 500 Hz decreases to -4 dB relative to 1 kHz and gain at 3000 Hz increases to +4.4 dB relative to 1 kHz. SL is the primary unit low-frequency equalization control.
Height	HT	0 to 15	Switch in position 0 (no numbers showing) provides no equalization. As switch position number increases, gain at 3250 Hz increases to +11 dB for position 15 (numbers 1,2,4, and 8 showing) relative to 1 kHz. Used in conjunction with bandwidth (BW) as primary unit high-frequency equalization controls.
Bandwidth	BW	0 to 15	Switch in position 0 (no numbers showing) or HT control in position 0 provides no equalization. As switch position number increases, width of gain "bump" at 3250 Hz increases; height of "bump" is still determined by HT control.
Facility	N/L	N or L	Switch set to N (N showing) for nonloaded cable applications and generally set to L (L showing) for loaded cable applications. With switch set to N, SL control provides greater equalization at higher frequencies than it does with the switch set to L.
Transmit Path Input Impedance	TRMT or OPEN/150	Open, 1200, 600, or 150	Selects input impedance seen by line; 1200 ohms for loaded cable; 600 ohms or 150 ohms for nonloaded cable.
Receive Path Output Impedance	RCV or OPEN/150	Open, 1200, 600, or 150	Selects output impedance seen by line; positions same as S1.

TABLE D

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	ATTENUATOR RANGE (dB)	INPUT LEVEL AT, T, R, (dB) (See NOTE)		G_R INSERTION GAIN (+) OR LOSS (—) dB	ATTENUATOR RANGE (dB)	OUTPUT LEVEL AT, T1, R1 (dB) (See NOTE)	
			MIN	MAX			MIN	MAX
2TO	+ 0.5	0 - 16.5	— 9.0	+5.0	— 4.0	0 - 16.5	—10.5	0
4TO	+ 7.5 (HI)	0 - 16.5	—16.0	+0.5	+ 3.0 (HI)	0 - 16.5	—9.5	+7.0
*4ETO	+ 6.5 (HI)	0 - 16.5	*	*	+ 3.0	0 - 16.5	—3.0	+7.0

Note: Special service channel unit input and output levels are recommended values. In some cases, attenuator ranges cover a wider distribution of levels. It is recommended that circuit levels be constrained within the input and output levels specified in the table.

* Units with active post equalization.

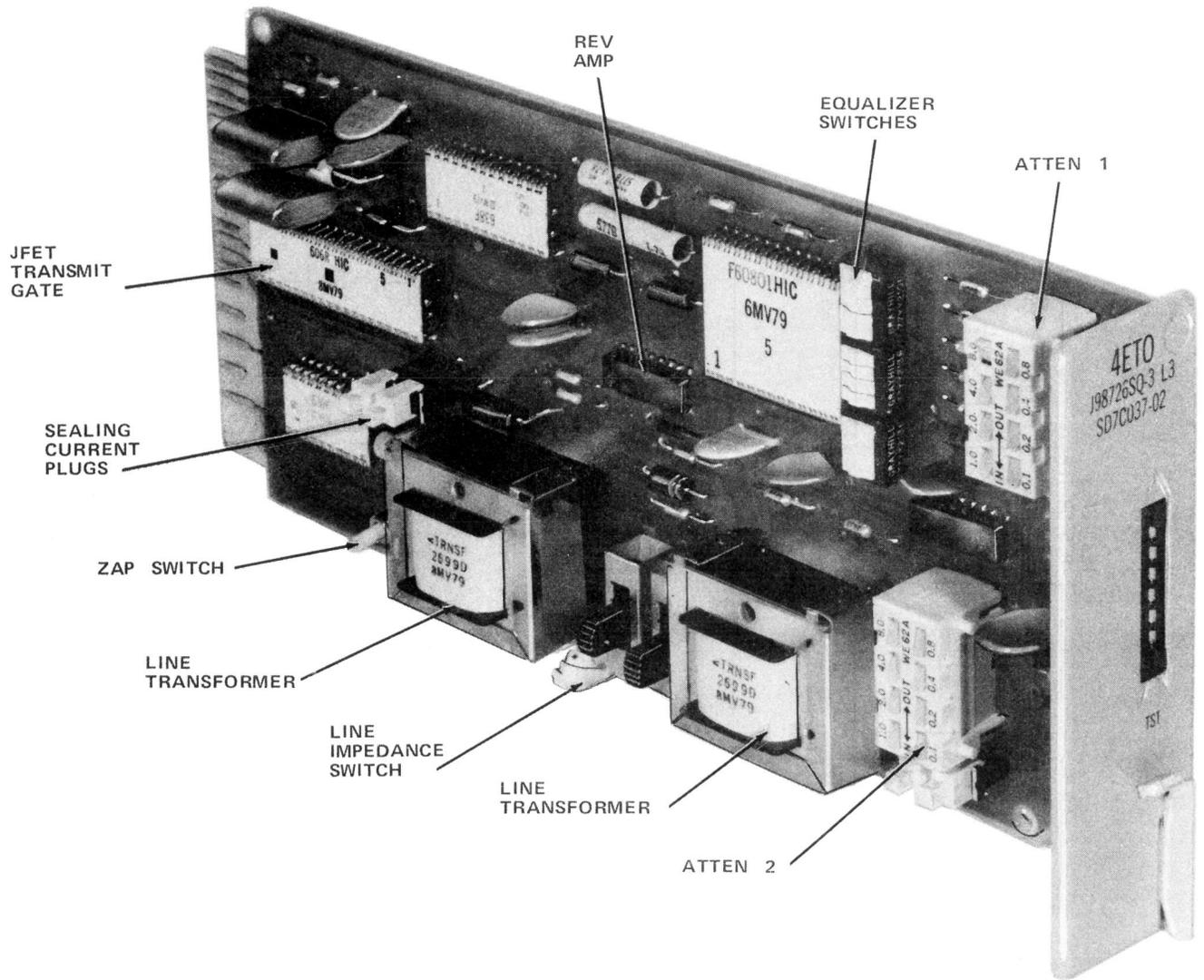


Fig. 2—4-Wire Transmission Only

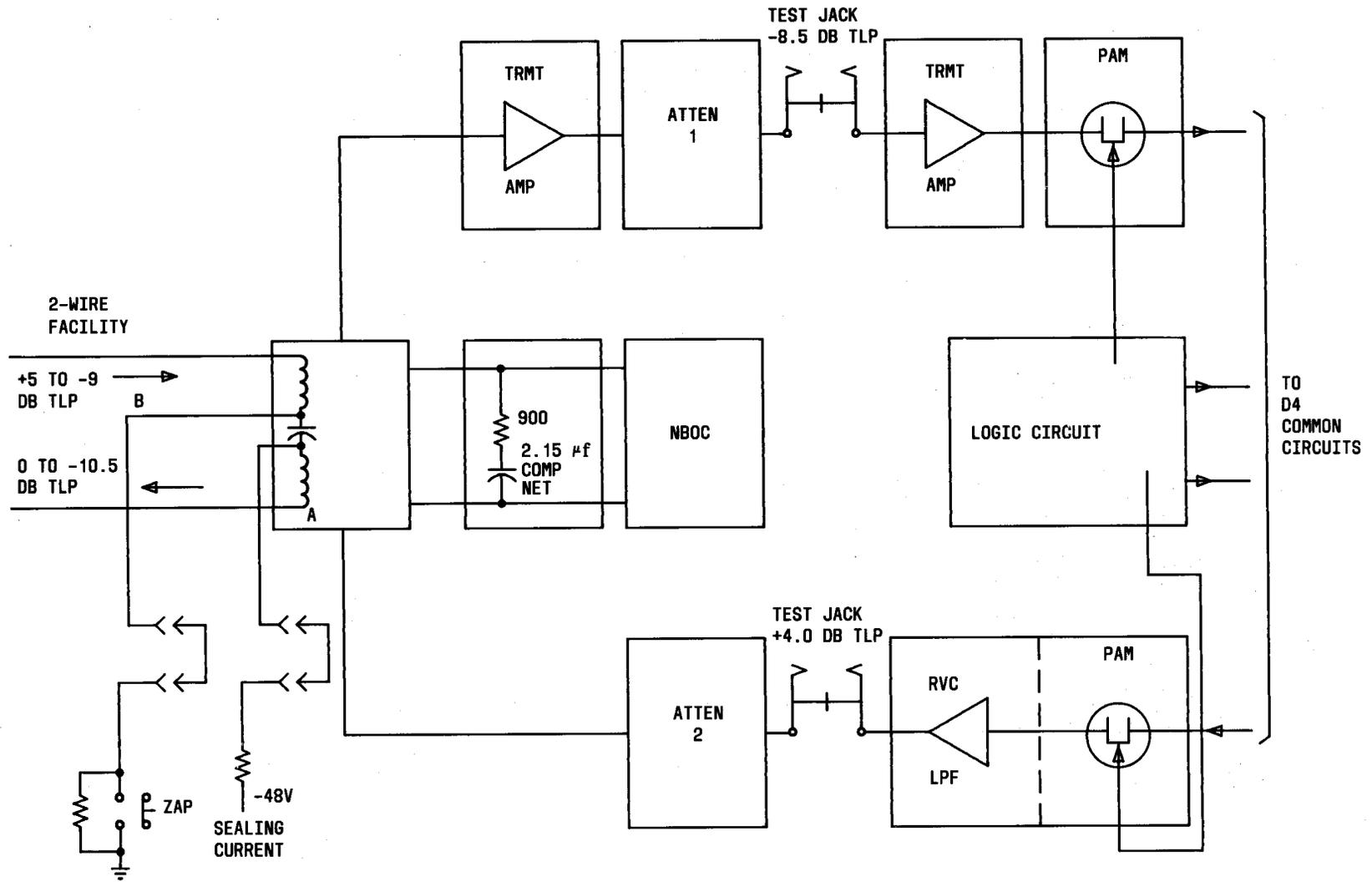


Fig. 3—2-Wire (2TO) Transmission Paths

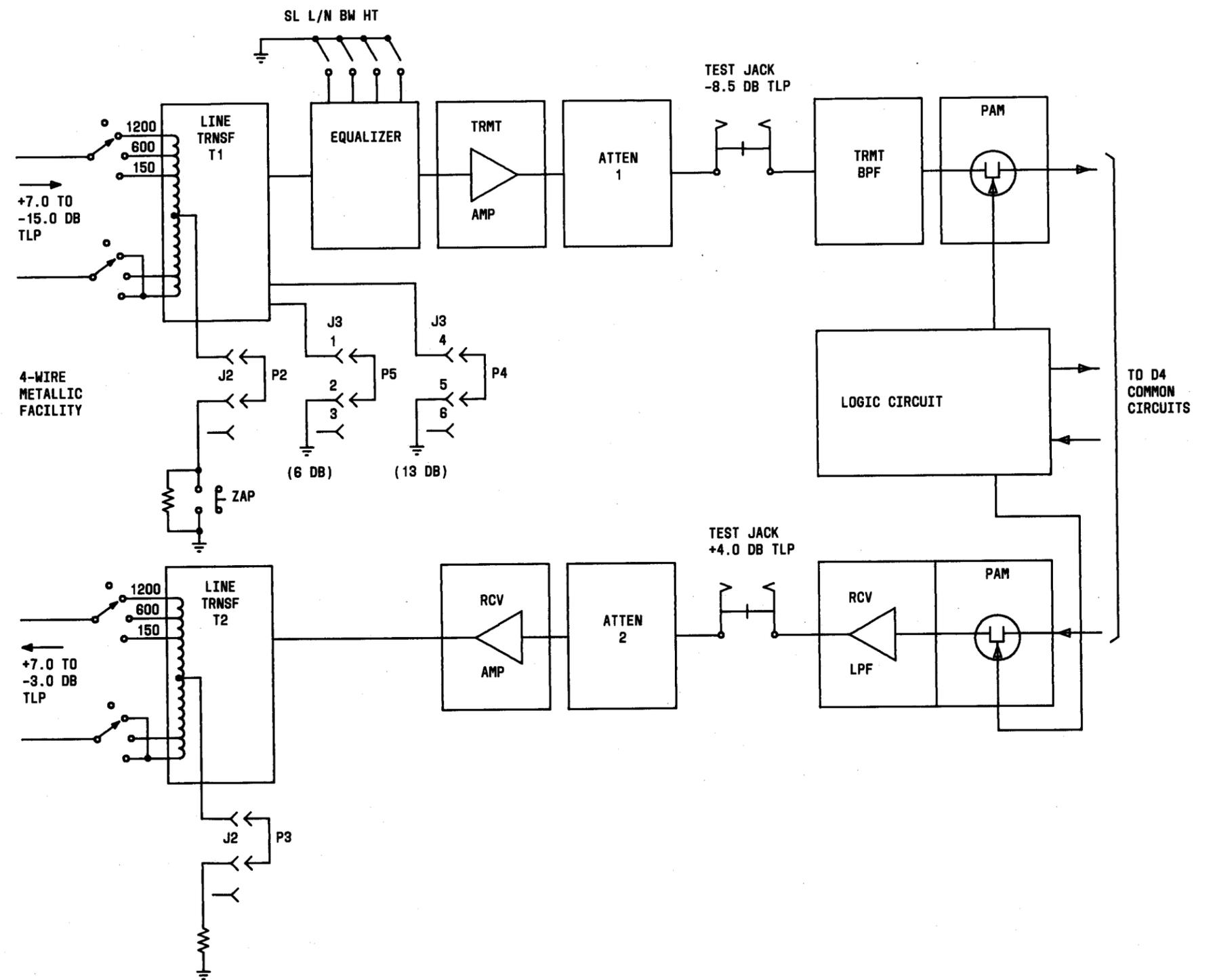


Fig. 4—4-Wire (4TO) Transmission Paths

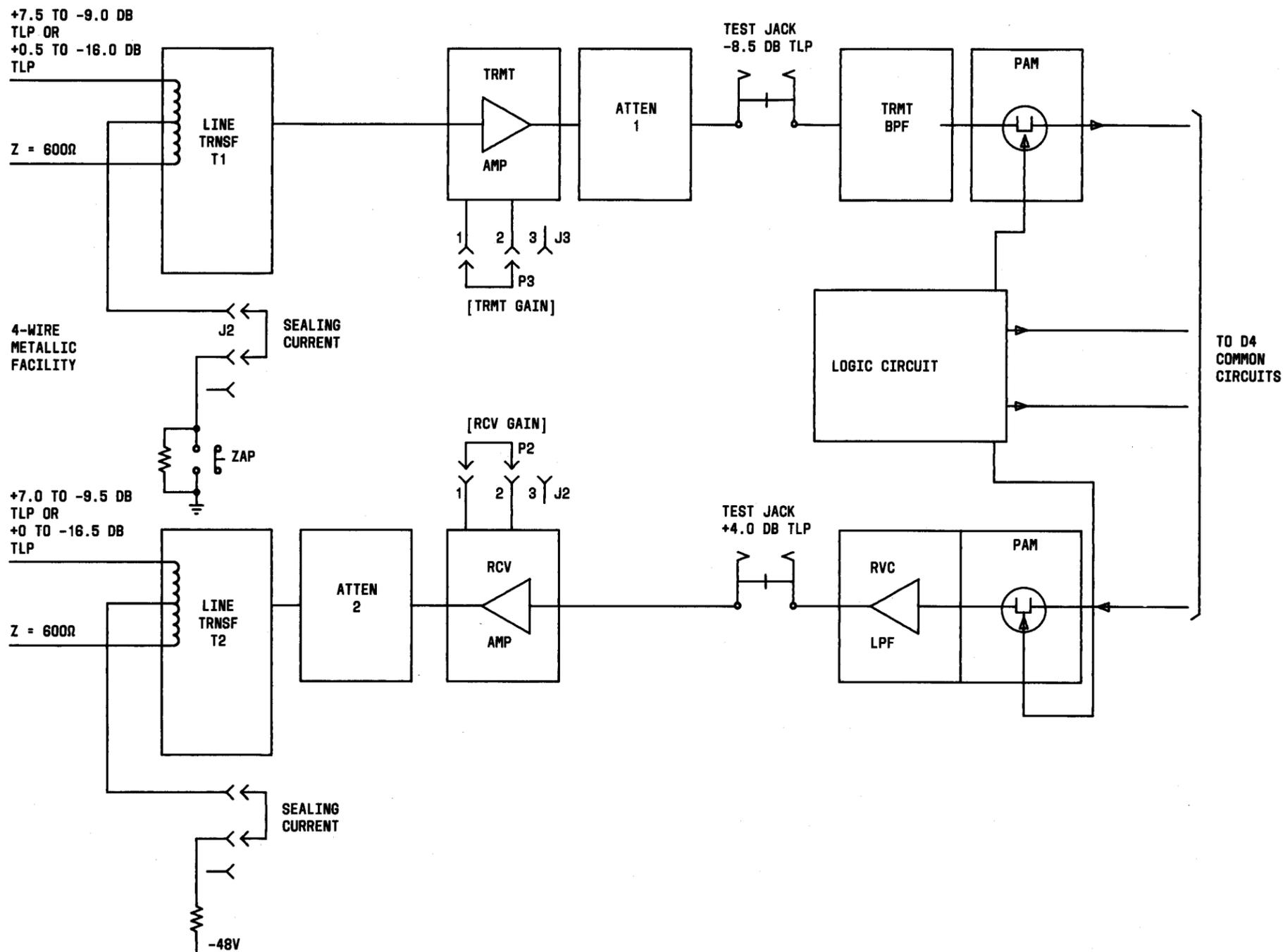


Fig. 5—4-Wire Equalized (4ETO) Transmission Paths