PULSE LINK REPEATER AND TANDEM 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 pulse link repeater (PLR) and tandem (TDM) channel units for the D4 channel bank. These units incorporate many of the same design features (card jack, attenuators, and option blocks—Fig. 1 and 2) found on other D4 channel units and can be used in any of the D4 channel positions. Both units are 4-wire units and are intended to connect to other channel units to provide back-to-back channel unit application. Equipment coding and schematic coverage is given in Table A.

1.02 This section is reissued to clarify Tables C and D and the use of F signaling (3-state vs 4-state). Revision arrows are used to emphasize the more significant changes.

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 demodulator 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) ▶or work order record and details (WORD).◀ The procedures for making the settings and adjustments shown on the CLRC ▶or WORD◀ are covered in Section 365-170-000 (TOP).

2. CIRCUIT DESCRIPTION

A. Applications

PLR Channel Unit

2.01 The PLR channel unit is used with an E&M channel unit of another carrier channel in the office to extend that channel over a T carrier link (Fig. 3A) without the need for an external pulse link repeater. The E&M channel may be in an analog or a digital channel bank, and the voice and signaling connections are made at an intermediate distribution frame. Test access is provided at the PLR TST jack or with a channel unit extender. Primarily, the PLR-E&M combination is used at the intermediate office to produce an E&M circuit end to end, but the combination can be used for any 2-state signaling circuit. The PLR channel unit contains attenuators for the channel interconnections (+7 dB ▶TLP channel output, −16 dB TLP◀ channel input) and contains circuits for signaling conversions between the channels.

2.02 With the capability of ▶accepting at the mating E & M unit a +7 dB analog trunk◀ output,

the PLR channel unit is well suited for use in a D4 channel bank in a digital toll office for connecting an analog channel to a 4 ESS switch. In this arrangement, the D4 bank connects to the 4 ESS through a digroup terminal or a digital interface frame (DIF). A nonstandard transmit jack level may be encountered in this application because the PLR must be adjusted to obtain the required trunk loss of the connecting analog trunk.

TDM Channel Unit

2.03 This unit is used with another tandem unit in the office for back-to-back connection of channels (Fig. 3B). The connecting tandem unit may be in another D Channel Bank or in an F ◗or G◖ signaling bay. The TDM unit has 4-state signaling capability and is primarily used that way, but it can also be used in channels for 2-state signaling. Pads in the unit adjust the levels for channel interconnections. Separate signaling circuits for 2- and 4-state signaling make conversions between dc conditions on the drop side and digital signaling on the line side.

2.04 Restrictions on the use of TDM units for foreign exchange (FX) circuits involving loop start only FX units or involving different D channel banks at the end are covered in Section 365-010-105.

B. Transmission

PLR Channel Unit

2.05 Figure 4 is the block diagram of this unit. In both the transmit and receive paths are a transformer, a fixed pad, adjustable attenuator, TST jack contacts, and the active gates and filters. The transformers have 600-ohm windings connected to balanced circuits. The fixed pad and adjustable attenuator reduce the output from one channel to the input of the connecting channel and vice versa. Input and output signal ranges are controlled by the adjustable attenuators and recommended operating levels, as specified in Part 3. The TST jack contacts normally provide a through connection; but when a test cord is inserted, both the transmit and receive paths are opened and either the line or drop side can be accessed for testing. These test points are at a 600-ohm unbalanced impedance and are defined as −8.5 TLP transmit and +4.0 TLP receive.

TDM Channel Unit

2.06 Figure 5 is a block diagram of the unit. In the transmit path are a transformer, fixed pad, adjustable attenuator, TST jack contacts, and the active gate and filter. The receive path differs by having no adjustable attenuation. The function of these circuit blocks is the same as described in paragraph 2.05 for the PLR unit.

C. Signaling and Supervision

PLR Channel Unit

2.07 This unit contains a signaling detector (transmitting) for the E lead and a signaling generator (receiving) for the M lead (Fig. 4). These lead designations are reversed from the input/output E&M convention; instead, the lead designations match the E&M channel unit leads to which they connect (Fig. 3A). The signaling detector controls the logic state applied to the TA common signaling bus to represent the two input dc conditions. Ground (off-hook) on the E lead produces a logic 0 on the bus and an open (on-hook) produces a logic 1. These logic states are inverted by the bank common equipment so that off-hook is represented by pulses on the T line and on-hook is represented by absence of pulses. The signaling generator produces a battery/ground signal on the M lead in response to the received signaling, a ground (on-hook) for a received logic 1, and battery (off-hook) for a logic 0. Battery is either supplied internally or externally (on SB lead) depending on the type of E&M interface. The EB lead supplies ground to the connecting E&M unit for a looped signaling interface. The ballast lamp in the M lead 48-volt supply is a self adjusting variable resistance. Two sets of TST jack contacts are wired in the E&M leads of the PLR allowing access to the line and drop sides.

2.08 The trunk processing option (MPD) in the PLR allows the −48SD input from the TPU to control the signaling generator. When a carrier failure occurs, the TPU signal releases; then after 2.5 seconds it operates the signaling generator producing an on-hook indication followed by an off-hook indication. These indications are passed on to the connecting channel, making the overall trunk release and appear busy. If the option is not provided, the channels will remain in the on-hook condition.

TDM Channel Unit

2.09 This unit contains two transmitting signaling detectors (Fig. 5). The detector for the TSA lead represents the open/ground condition on the EX

lead by different logic states for the primary signaling information. Option selection determines which logic state corresponds to the incoming condition. This flexibility is required for compatibility with existing channel units. The detector for the TSB lead represents the two dc conditions occurring at the center tap of the transformer in the receive direction by different logic states for the secondary signaling channel. An open from the companion TDM unit is sensed at the center tap and produces a logic 0, and a ground produces a logic 1. The logic levels (pulses) on TSA and TSB are transferred to bank common leads TA and TB, respectively; but the logic levels are inverted in the bank common equipment for transmission on the T line. One set of TST jack contacts is wired in the EX1 lead for 2-way test access.

2.10 The primary (A) channel signaling generator (receiving) responds to the logic state of the RDA or RDNA leads (logic complements) by producing an open/ground signal on the E lead. Option selection determines which logic lead is connected to the signaling generator for end-to-end compatibility. For the RNDB bus, the B signaling generator responds to the received logic states by opening the E1 lead (on-hook) for a logic 1 and grounding the E1 lead (off-hook) for a logic 0. The E1 lead connects to the center tap of the transformer in the transmitting direction. One set of TST jack contacts is wired in the E1 lead for 2-way test access.

2.11 The trunk processing option (EG) in the TDM allows an input from the TPU to control the primary signaling receiver. When a carrier failure occurs, the TPU signal releases, then after 2.5 seconds, operates the E relay, producing an on-hook followed by an off-hook. These indications are passed on to the connecting channel, making the overall trunk release and then appear busy. If the option is not selected, the channels will remain in the on-hook condition which is always the case on the secondary signaling path.

3. CIRCUIT OPTIONS

3.01 The transmit (T) and receive (R) attenuators in the PLR unit are the larger rocker-switch type (60A). Units of attenuation are marked above the switches with the maximum that can be set being 6.3 dB. On the TDM unit, the only attenuator is in the transmit path, and it is the smaller switch type (62A). This type has two rows of switches. The upper row is for whole values of attenuation; but these are not used, and must be switched OUT. The lower row is for fractional values. Instructions on how to make attenuator settings are given in Section 365-170-000 (TOP).

3.02 Table B lists the insertion loss, the attenuation range, and the drop side input and output for the PLR and TDM units. Although a wider range of drop side levels is realizable with the attenuators, only the recommended operating levels are given. The insertion losses and levels include the circuits between the drop side leads and the channel TST jack contacts with attenuators set at zero.

3.03 The trunk and signaling options on the channel units are the socket-plug type. General descriptive information and instructions on how to select the options are contained in Section 365-170-101. Care must be taken when selecting options on the TDM unit because two option blocks on the TDM have both a single option, like EG which can be in or out (white or black showing) on one-half of the block; and a choice of options, Y or Z for example, on the other half. The options on the units are listed and defined in Table C. In addition, Table D provides information on determining which TDM unit options are needed for the application.

3.04 Options W and V in the TDM unit connect the center tap of the voice transformers to the secondary signaling circuits. These options should not be selected with the idea that 4-state signaling may be used later. Placing the options to the out position when not required improves the longitudinal balance of the voice pairs.

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
179-365-101	Special Access Auxiliary Units—Description, Type F Signaling System
365-010-105	Channel Unit Compatibility—D-Type Channel Banks
365-170-000	D4 Channel Bank—TOP

SECTION	TITLE
365-170-100	D4 Channel Bank Description
365-170-101	D4 Channel Bank—General Channel Unit Description

TABLE A

CHANNEL UNIT IDENTIFICATION

CHANNEL UNIT	SD/CD
J98726BN PLR	3C331-01 and -02
J98726SF TDM	7C028-01

TABLE B

INSERTION LOSSES

CHANNEL UNIT	TRANSMIT PATH				RECEIVE PATH			
	INSERTION LOSS (dB)	TRMT ATTENUATOR RANGE (dB)	INPUT (T & R) LEVEL (dB)		INSERTION LOSS (dB)	RCV ATTENUATOR RANGE (dB)	OUTPUT LEVEL	
			MIN	MAX			MIN	MAX
PLR	12.6	0 — 6.3	+4.1	+10.4	16.3	0 — 6.3	–18.6	–12.3
TDM	4.9	0 — 1.5*	–3.6	–2.1	6.1	NONE	– 2.1	– 2.1

* The 1, 2, 4, and 8 dB switches on attenuator must be switched out.

▶TABLE C◀

CHANNEL UNIT OPTIONS

CHANNEL UNIT	OPTION	FUNCTION
PLR (Gray Dot), J98726BN SD3C331 -	MPD	Option MPD selected (plug in black side of J2) forces the M relay to an on-hook condition for 2.5 seconds; then forces an off-hook condition. When not selected, continuous idle occurs during a failure.
	MB, MG	Option MB provides local –48V battery and option MG provides local ground. Both are selected (plugs in black side of J2) for Type I E&M interface, neither is selected for Type II, and MG is selected and MB is not selected for Type III.
TDM (Gray Dot) J98726SF SD7C028 -	EG	Option EG selected (plug in black side of J8) forces the primary channel busy after 2.5 seconds of idle when carrier failure occurs. When not selected, continuous idle occurs during a failure.
	E	Option E is selected (plug in white side of J6) when looped signaling between two tandem units is desired.
	W and V	Option W is selected (plug in black side of J4) to connect the E1 signaling lead to simplexed pair T-R. Option V is selected (plug in black side of J5) to connect EX1 signaling lead to simplexed pair T1-R1.
	S or T	Option S is selected (plug in white side of J7) to provide transmit signaling A (TSA) bit to be 1 for open and 0 for ground conditions at the EX lead. Option T is selected (plug in black side of J7) to provide TSA bit to be 0 for open and 1 for ground conditions at the EX lead.
	R	Option R is selected (plug in black side of J7) to force TSB to follow TSA during 2-state signaling.
	Y or Z	Option Y or Z selects which logic output is connected to the signaling receiver for the E relay. Y selected (plug in white side of J8) provides receive inverted digit A (RNDA) to be 1 for open and 0 for ground conditions at the E lead. Z selected (plug in black side of J8) provides receive digit A (RDA) to be 1 for open and 0 for ground conditions at the E lead.

▶TABLE D◀

TANDEM UNIT OPTION SELECTION

TYPE OF CONNECTION			OPTION DESIGNATION (NOTE)							
			Z	Y	E	W	V	T	S	R
Foreign Exchange	Nonlooped Signaling Leads	D4 Tandem Connecting Through the T Carrier Toward the CO	NC	C	C	C	C	NC	C	NC
		D4 Tandem Connecting Through the T Carrier Toward the Sub	C	NC	C	C	C	C	NC	NC
	Looped Signaling Leads	D4 Tandem Connecting Through The T Carrier Toward the CO	NC	C	NC	C	C	NC	C	NC
		D4 Tandem Connecting Through the T Carrier Toward the Sub	C	NC	NC	C	C	C	NC	NC
2-State Signaling*	Nonlooped Signaling Leads		C	NC	C	NC	NC	NC	C	C
	Looped Signaling Leads		C	NC	NC	NC	NC	NC	C	C
F Signaling Tandem	D4 Tandem Connecting Through T Carrier Towad the CO		NC	C	C	C	C	NC	C	NC
	D4 Tandem Connecting Through T Carrier Toward the Sub		C	NC	C	C	C	C	NC	NC

* Except when operating in a loop start circuit.

Note: C = Option(s) selected (connected).
NC = Option(s) not selected (not connected).

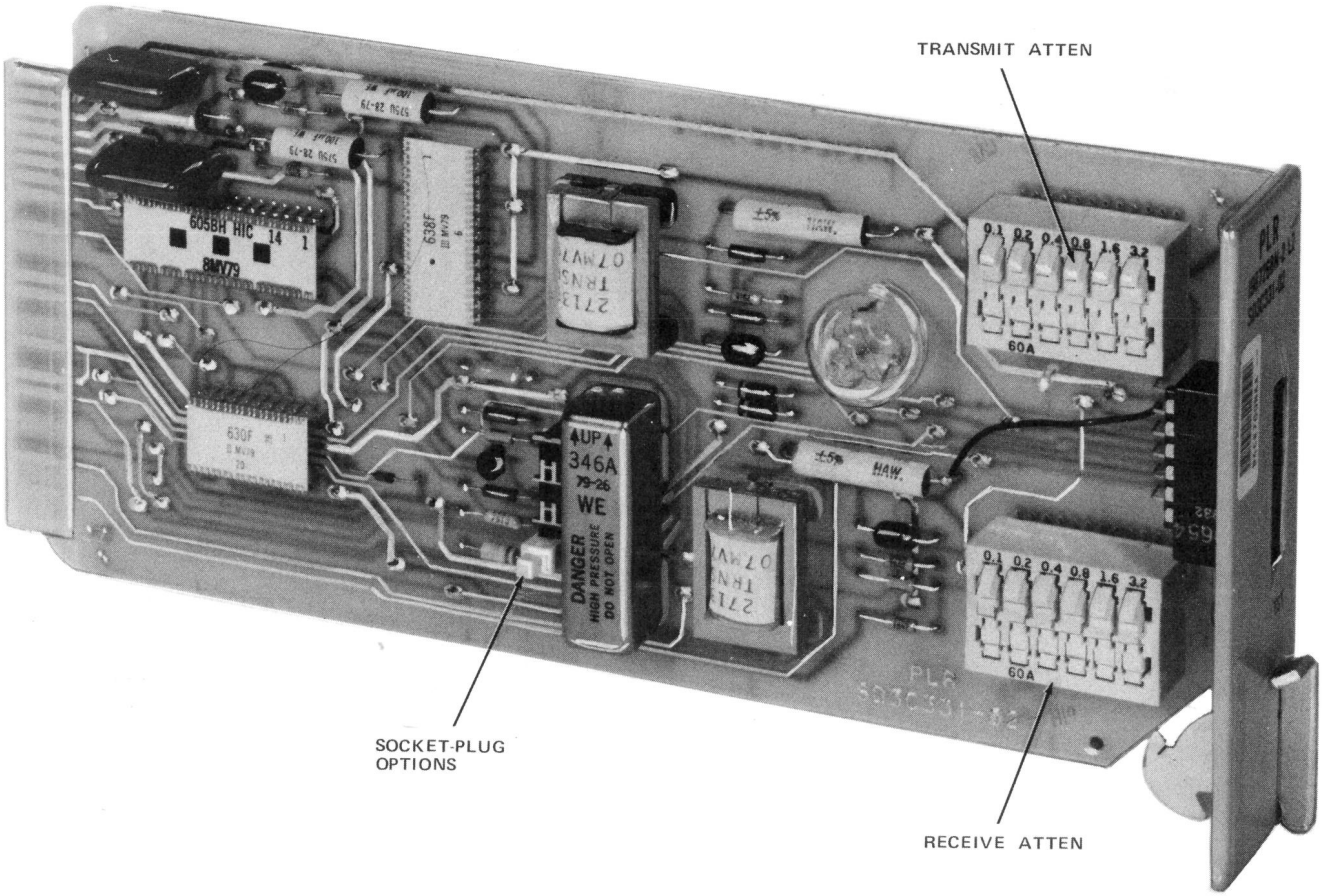

Fig. 1—PLR Unit

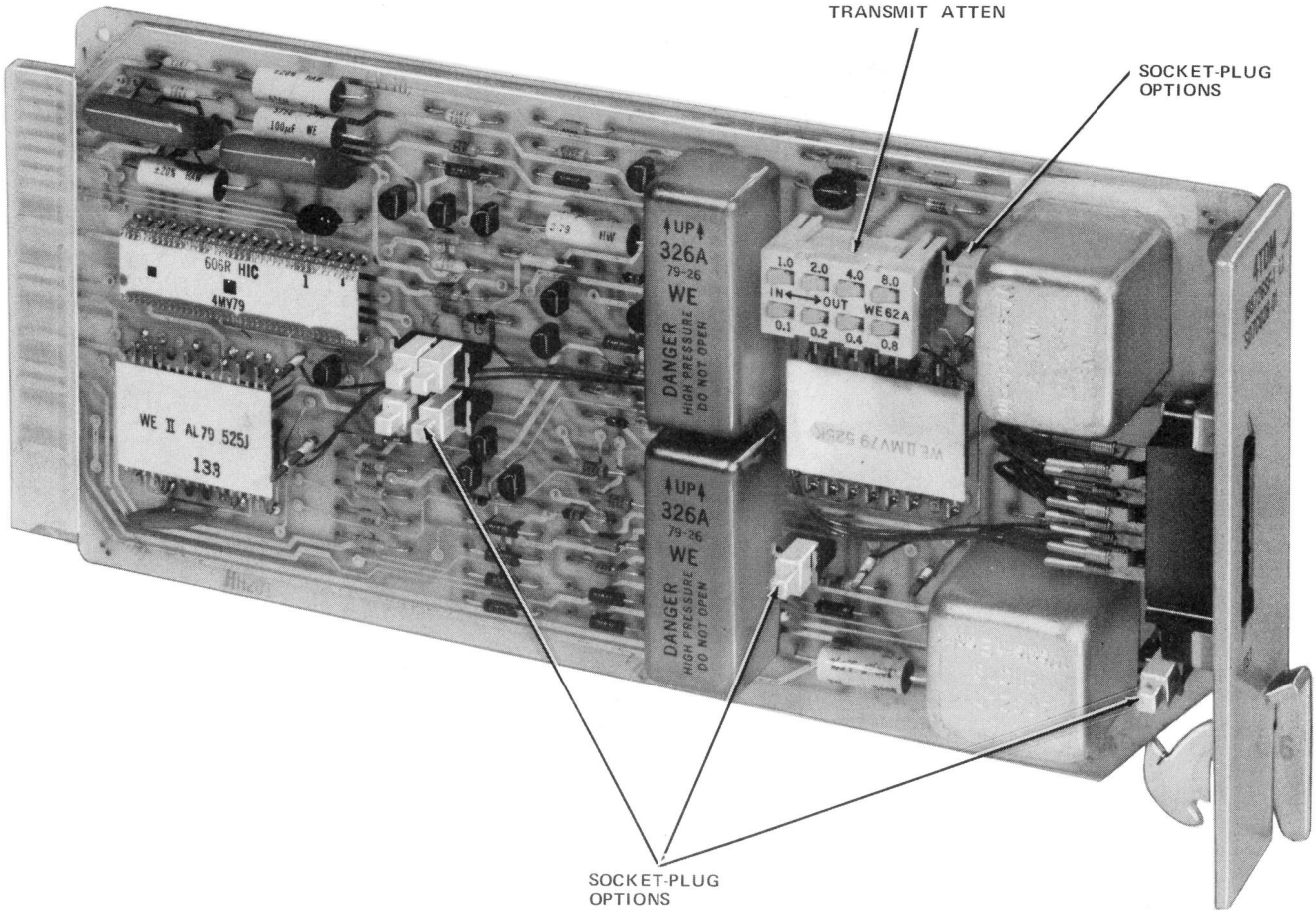

Fig. 2—TDM Unit

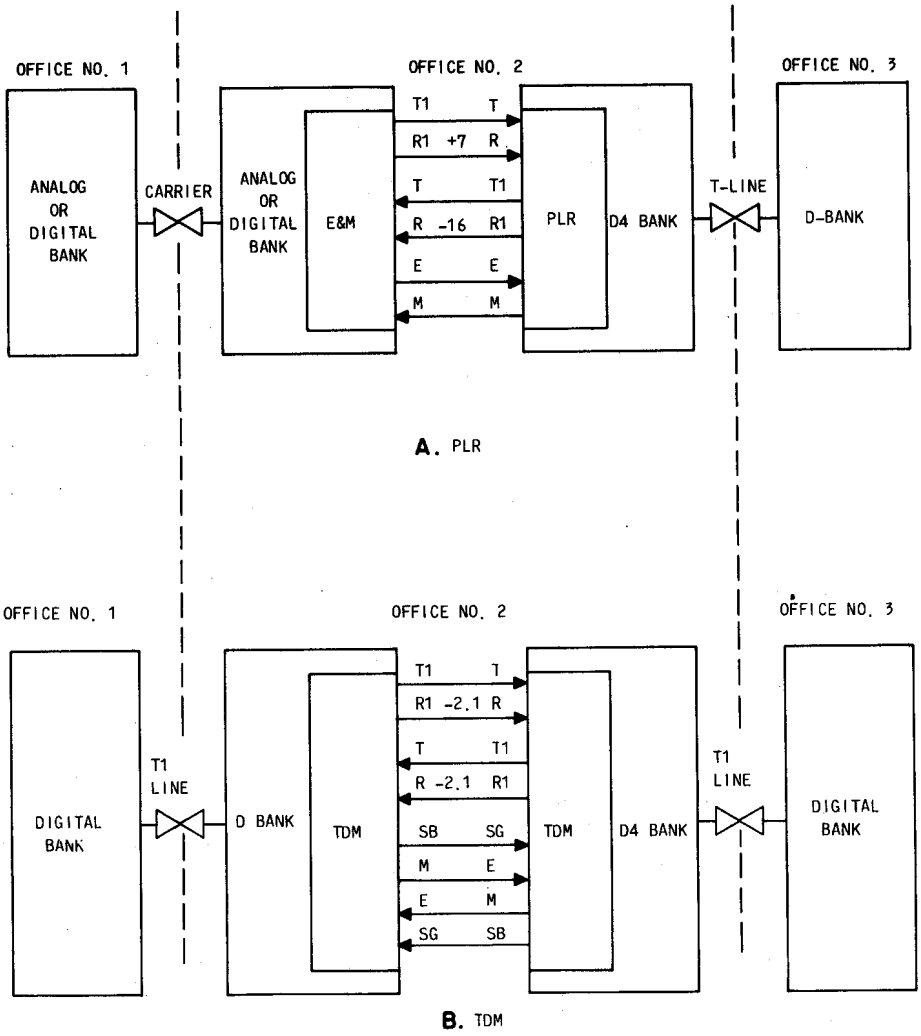

Fig. 3—Channel Interconnections

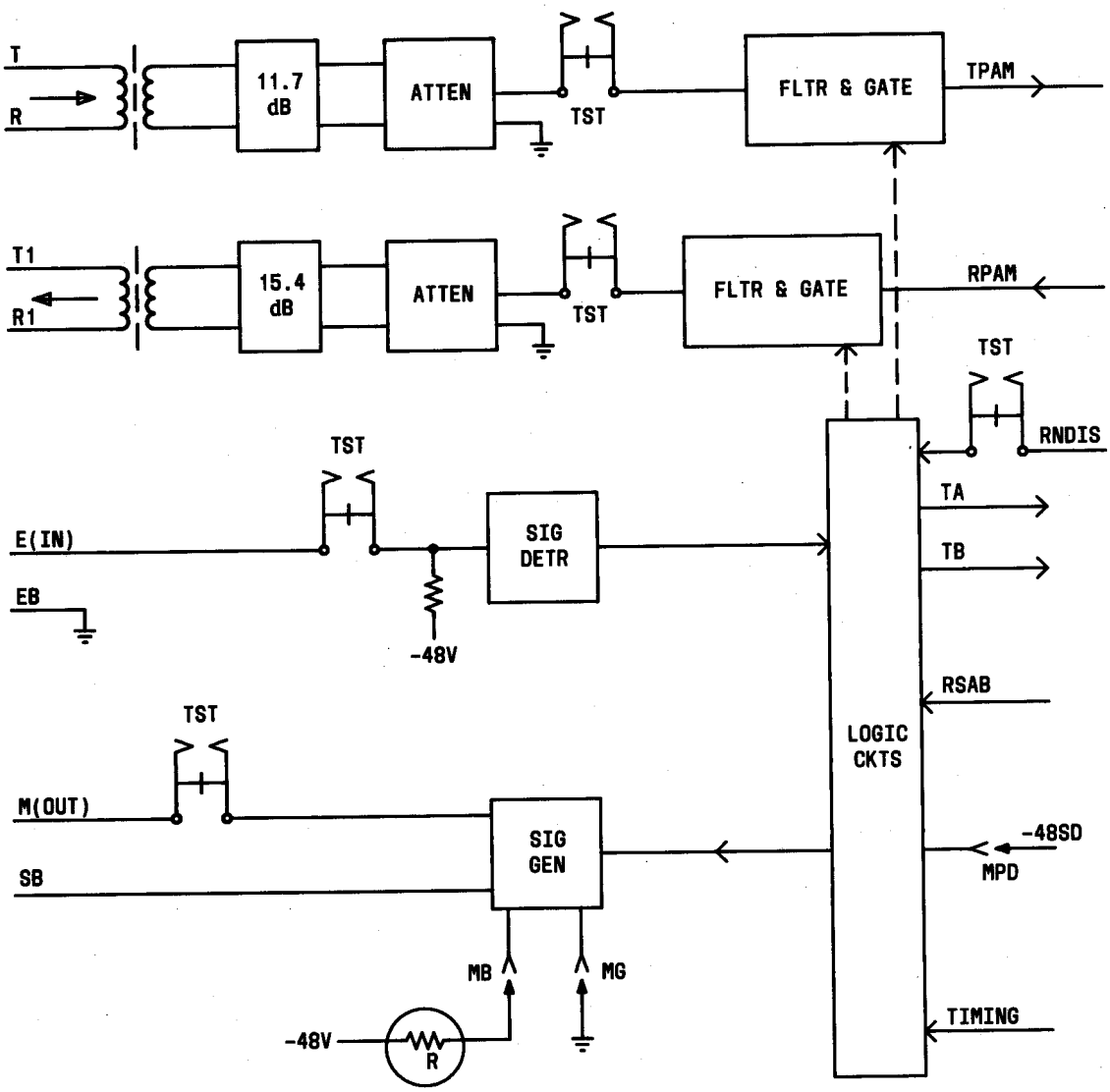

Fig. 4—PLR Block Diagram

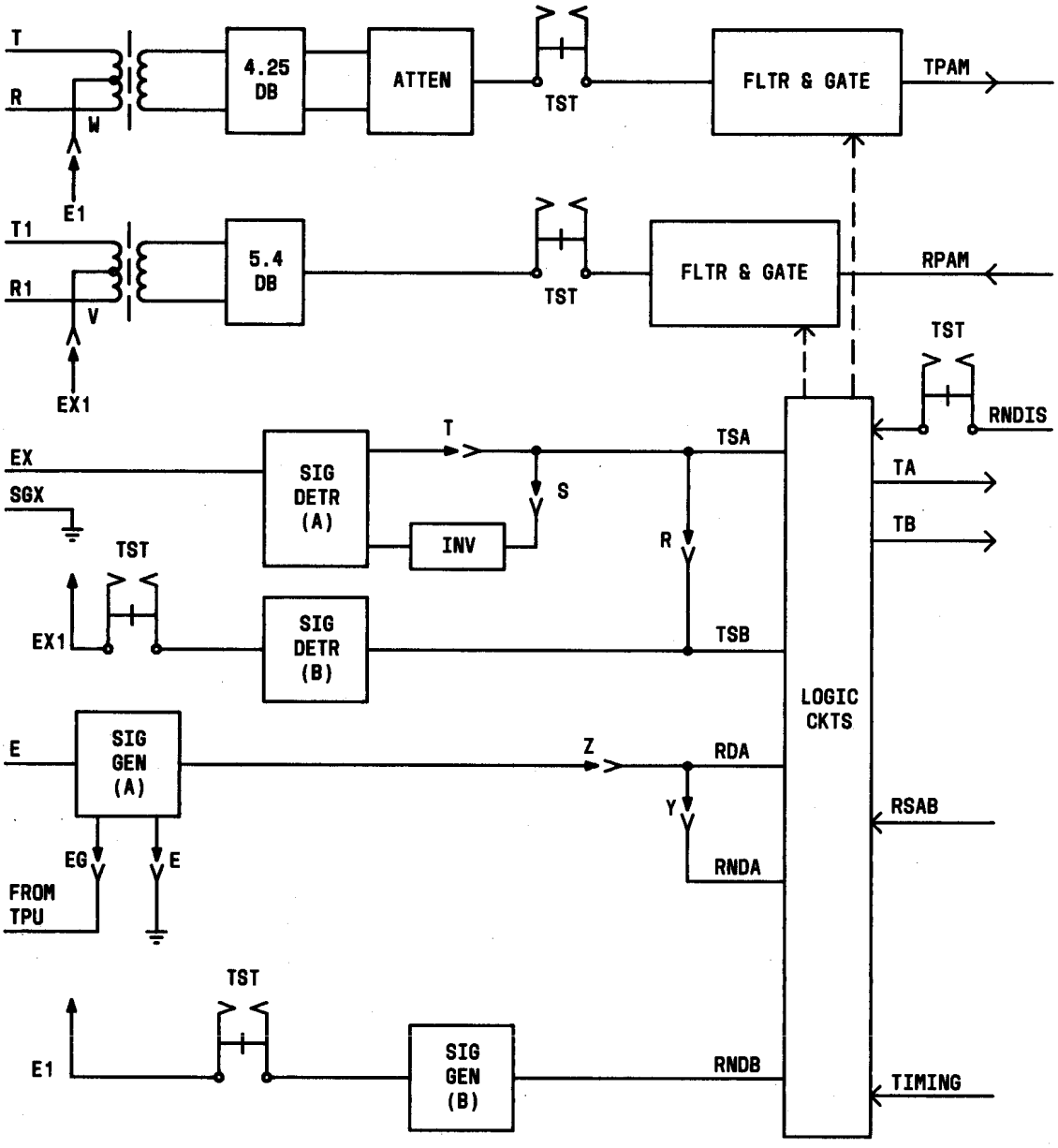

Fig. 5—TDM Block Diagram