

15-KHZ PROGRAM CHANNEL UNITS
DESCRIPTION
D4 CHANNEL BANK
DIGITAL TRANSMISSION SYSTEMS

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1. GENERAL

1.01 This section provides a general description of the D4 15-kHz program channel units. These units provide high quality 15-kHz bandwidth program channels suitable for television audio and frequency modulation (FM) monaural or stereophonic service. Table A lists each unit with equipment code and schematic/circuit description (SD/CD) numbers.

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

1.03 The 15-kHz program service is a one-way service requiring a transmit channel unit (PG15T) at one end and a receive channel unit (PG15R) at the other. Each channel unit transmits a single monaural program signal. For stereo, two identical PG15 channel units are used at each end.

1.04 One 15-kHz program service channel uses six adjacent channel time slots in one transmission direction only. Each channel unit physically occupies three channel positions which correspond to the first three time slots used. Channel positions corresponding to the last three time slots used may be filled with blank channel units or used for program service in the reverse direction.

1.05 The PG15 channel units may be used in any D4 bank with printed wiring board backplanes.

D4 banks having wire-wrapped backplanes must be modified for 15-kHz program service compatibility by wiring changes under J98726 List D and VA. These wiring changes are part of the modification needed for dataport compatibility; therefore, banks modified for dataport service are suitable for 15-kHz program service. However, dataport and program service may not be provided by the same digroup.

2. PHYSICAL DESCRIPTION

2.01 Each PG15 channel unit is three times as wide as a message channel unit and therefore occupies three adjacent channel unit slots. The PG15T channel unit is shown in Fig. 1 and the PG15R channel unit is shown in Fig. 2. Three blank channel units are supplied with each program channel unit. The blank channel units may be used to plug the three channel unit slots that are adjacent to the slots occupied by a PG15 channel unit.

2.02 Two test jacks (MON and TST) and two pin jacks (TONE and MUTE) are located on the PG15T channel unit faceplate. The function of each jack is explained in the functional description section of this document.

3. FUNCTIONAL DESCRIPTION

3.01 Figure 3 is a transmission block diagram of the PG15T and PG15R channel units. Relative signal levels at different points are indicated by the volume unit (VU) point designation and the transmission level point (TLP) designation.

Note: The VU point is a reference level point used for program transmission. The following formula is used to convert from VU point to TLP: $dB TLP = VU \text{ point} - 8$. Therefore, a + 8 VU point is equal to a 0 dB TLP.

3.02 The basic design of a 15 kHz circuit is for a +8.0 VU point at the audio input and output.

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However, loss and gain adjustment is provided in both channel units to accommodate a PG15T input level from -7.0 to $+9.5$ VU point (-15.0 to $+1.5$ dB TLP) and a PG15R output level from -7.4 to $+9.1$ VU point (-15.4 to $+1.1$ dB TLP). For a $+8.0$ VU point input, the PG15T channel unit transmit attenuator must be set for 15.0 dB loss. For a $+8.0$ VU point output, the PG15R channel unit attenuator must be set for 1.1 dB loss. At the $+8.0$ VU point, the 15 kHz channel units can handle up to a $+21.0$ dBm sine wave.

3.03 As shown in Fig. 3, the input transformer of the PG15T and the output transformer of the PG15R have selectable impedances of 150 or 600 ohms. Each channel unit has an adjustable attenuator to accommodate a range of input and output levels. The PG15T channel unit contains an adjustable equalizer intended for use with (but not limited to) 26-gauge nonloaded cable. It is designed to equalize to an accuracy of 0.5 dB up to two miles of 26-gauge nonloaded cable using the 150-ohm transformer impedance option and about one mile using the 600-ohm option. The equalizer is provided as a convenience for use in situations where the equalization is easy and use of an external equalizer is difficult. However, an external equalizer is strongly recommended where practical to avoid noise caused by unequalized low level program signals near the channel bank.

3.04 All channel unit options are listed and defined in Table B (PG15T) and Table C (PG15R). The TST jacks of each channel unit provide splitting test access to the line and drop sides at the 0.0 VU point (-8.0 dB TLP). The MON jack of each channel unit may be used for in-service monitoring at the -6.0 VU point (-14.0 dB TLP) using 600-ohm headphones. The channel units contain per channel code and decode (codec) circuitry. This allows the PG15T channel unit to transmit pulse code modulation (PCM) signals to the D4 bank and the PG15R channel unit to receive PCM signals from the D4 bank, thus bypassing the voice channel codec. This provides much higher signal quality than is available from voice or previous program channel units.

3.05 The PG15T channel unit provides two reference signals for use in program network alignment and troubleshooting applications. A pin plug inserted in the PG15T TONE jack sends a $+18.0$ dBm0 1.0 kHz test sine wave toward the PG15R channel unit. Since this tone is stored in a digital memory inside the PG15T channel unit, it will be identical for every PG15T and may be used to accurately calibrate

the TLP at any succeeding point in the network. It is similar to the R CODE function provided in the channel bank receive unit. However, use of the TONE jack for extended periods of time is not recommended as this could cause improper reframing which will impair transmission on all channels. A pin plug inserted in the PG15T MUTE jack provides noise-free silence (all ones) on the T-carrier line. It may be used to measure the noise of the receive circuits independent of the transmit circuits.

3.06 The bit format of a program channel is different from that of a message channel. Figure 4 illustrates how six 8-bit message channels are divided into four 12-bit program samples for one 15-kHz bandwidth program channel. The 12-bit sample allows finer resolution to provide much higher signal quality. Also, the program bit format enables the program channel units to continue to operate during a yellow alarm condition.

3.07 The parity (P) bit (Fig. 4) allows the PG15R channel unit to detect samples with audible errors due to errors on the T-carrier line. If an error is detected, the most recently received correct sample is substituted to prevent audible clicks for line error rates of 10^{-6} or better. If a burst of errors is received, the output to the receive end customer is muted for the duration of the burst. Also, if the receive signal is lost or random digits are received, the muting circuit will prevent transmission of high-level noise to the receive end customer. These muting functions have no relation to the MUTE pin jack on the PG15T channel unit.

4. APPLICATION RULES

4.01 The following application rules apply to 15-kHz program circuits in the D4 channel bank. Additional D4 application information may be found in Section 855-351-105.

- (a) A PG15 channel unit physically occupies three adjacent channel slots, such as channel unit slots 1-2-3, 10-11-12, 13-14-15, or 22-23-24. Because of the physical design of the D4 bank, the three adjacent channel slot sequences beginning with 11, 12, 23, or 24 cannot be used.
- (b) The channel (time) slots used by one 15-kHz circuit will be the three occupied by the channel unit plus the next three for a total of six. If channel slot position 20 or higher is used, the chan-

nel slot count folds back to 1 and continues. For example, if channel slot positions 21-22-23 are occupied by a 15-kHz program unit, the time slots for that circuit will be 21-22-23-24-1-2.

(c) Opposite direction program units may be installed in unoccupied channel slot positions. For example, a near end bank can have a PG15T channel unit installed into slots 1-2-3 and a PG15R channel unit installed into slots 4-5-6. In this case, the far end bank would have a PG15R channel unit installed into slots 1-2-3 and a PG15T channel unit in slots 4-5-6.

(d) The maximum number of 15-kHz circuits in a digroup is four transmitting and four receiving. This could be obtained by completely equipping all channel slot positions in a digroup with PG15T and PG15R channel units mounted in alternate positions; eg., PG15T in 1-2-3, PG15R in 4-5-6, etc. Figure 5 illustrates a D4 channel digroup equipped with alternate 15 kHz program transmit and receive units.

(e) The PG15T and PG15R channel units provide automatic time slot distortion compensation. This compensation is necessary to prevent distortion from uneven sampling due to the framing bit or line jitter. No switch setting is required.

(f) Program circuits (channels) should be treated with the same restrictions and cautions as other special service circuits in order to prevent accidental service interruption. In no case should a working channel bank be looped before patching the program channels to other circuits.

4.02 The PG15 channel units may be used in SLC*-96 carrier system applications but not as efficiently as in D4 systems. When the 15 kHz

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channel units are used in SLC-96 channel banks, the following rules apply.

(a) A PG15 channel unit will use 10 channels of a SLC-96 channel bank operating in Mode I. Two PG15 channel units will use 18 channels and three will use all 24 channels of a digroup.

(b) A PG15 channel unit will use 7 channels of a SLC-96 channel bank operating in Mode III. Two PG15 channel units will use 13 channels and three will use 19 channels.

(c) A PG15 channel unit may not be used in a SLC-96 channel bank operating in Mode II.

(d) The SLC-96 banks must be located in a central office environment or other location meeting the same environmental conditions. The environment of a SLC-96 remote terminal inside an unairconditioned remote hut is not satisfactory for program channel unit operation.

(e) More specific rules for use in a SLC-96 channel bank, such as channel slot assignments, are contained in Section 915-710-110.

5. REFERENCES

5.01 The following is a list of sections associated with 15-kHz program channel units and other D4 equipment.

SECTION	TITLE
365-005-048	PG15T Channel Unit Data Sheet
365-005-049	PG15R Channel Unit Data Sheet
365-170-000	D4 Channel Bank—TOP
365-170-100	D4 Channel Bank—Description
365-170-101	D4 Channel Bank—General Channel Unit Description
855-351-105	D4 Channel Bank Channel Units—Application Engineering—Carrier Engineering
915-710-110	SLC-96 Subscriber Loop Carrier—Application Engineering—Loop Transmission Systems

TABLE A

15 kHz CHANNEL UNIT EQUIPMENT CODE AND SD/CD NUMBERS

CHANNEL UNIT	EQUIPMENT CODE	SD/CD NUMBER
PG15T	J98726CE	7C321-01
PG15R	J98726CF	7C322-01

TABLE B

PG15T CHANNEL UNIT OPTIONS

OPTION	DEFINITION
J301 150/600	Provides balanced input impedance of 150 or 600 ohms. For 150 ohms, insert both plugs in positions marked 150. For 600 ohms, insert both plugs in positions marked 600. J301 should be set to match the load of the previous stage of the source equipment. When the source equipment permits a choice of 150 or 600, the 150 value should be selected because it permits better equalization capability. When no choice is available, either value should be used as applicable.
AT301	Provides attenuation of 0.0 to 16.5 dB in steps of 0.1 dB to accommodate an input level of from -7.0 VU point (-15.0 dB TLP) to +9.5 VU point (+1.5 dB TLP).
J401	Provides up to 63 equalization settings plus a flat response. The equalization setting is the sum of the exposed numbers (1,2,4,8,16, and 32) corresponding to positions not containing plugs. If all positions contain plugs, a flat response (no equalization) results. If J401 contains no plugs, maximum equalization is achieved. The higher the equalization setting, the higher the gain at 15 kHz relative to 1 kHz. This compensates for high frequency loss in the subscriber cable.
J402	Provides a place to store plugs not needed for a particular equalization setting.
TONE Jack	Provides +18.0 dBm0 1.0 kHz sine wave for circuit or network testing purposes.
MUTE Jack	Provides noise-free silence on the carrier which can be used to measure noise in the receive circuits.
MON	Provides in-service monitoring at the -6.0 VU point (-14.0 dB TLP) using 600 ohm headphones.
TST	Provides splitting test access to the line and drop sides at the 0.0 VU point (-8.0 dB TLP).

TABLE C

PG15R CHANNEL UNIT OPTIONS

OPTION	DEFINITION
J201 150/600	Provides balanced output impedance of 150 or 600 ohms. For 150 ohms, insert both plugs in positions marked 150. For 600 ohms, insert both plugs in positions marked 600. J201 should be set to match the load of the succeeding stage of the termination equipment.
AT201	Provides attenuation of 0.0 to 16.5 dB in steps of 0.1 dB to accommodate an output level of from -7.4 VU point (-15.4 dB TLP) to +9.1 VU point (+1.1 dB TLP).
MON Jack	Provides in-service monitoring at the -6.0 VU point (-14.0 dB TLP) using 600 ohm headphones.
TST Jack	Provides splitting test access to the line and drop sides at the 0.0 VU point (-8.0 dB TLP).

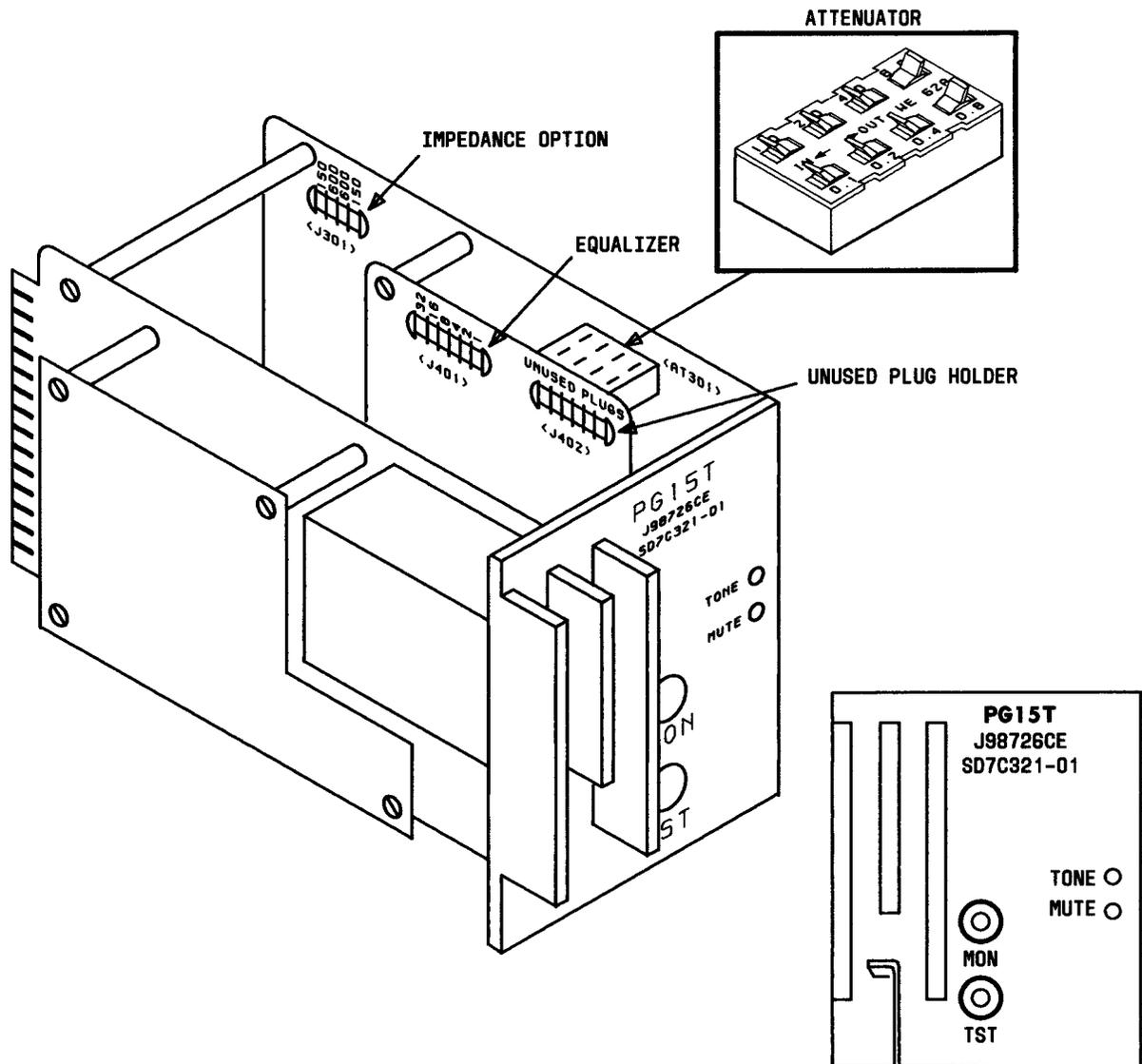


Fig. 1—PG15T Channel Unit

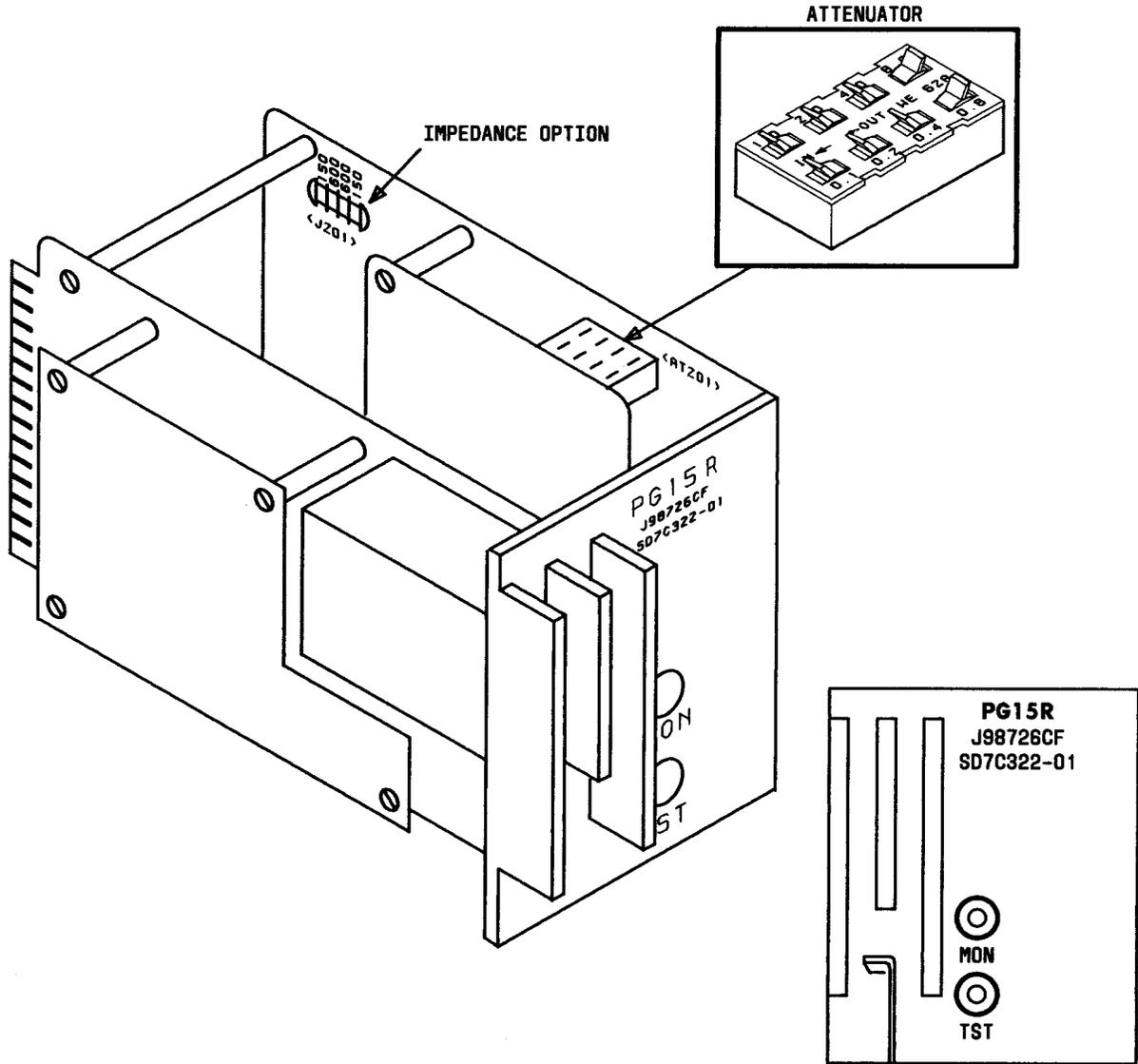
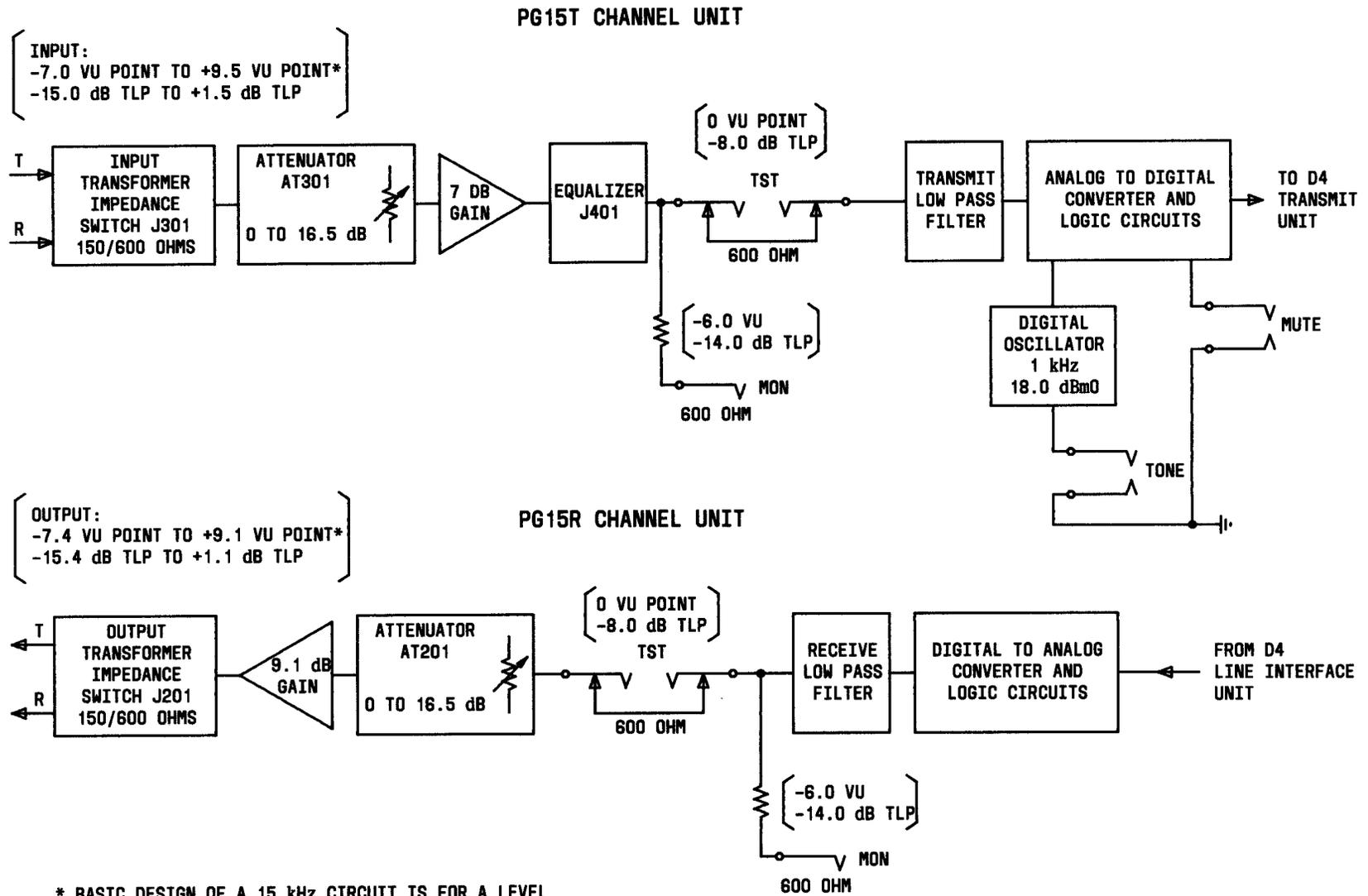


Fig. 2—PG15R Channel Unit



* BASIC DESIGN OF A 15 kHz CIRCUIT IS FOR A LEVEL OF +8.0 VU POINT (0 dB TLP) AT THE AUDIO INPUT AND OUTPUT. FOR THIS LEVEL, THE PG15T ATTENUATOR MUST BE SET FOR 15.0 dB AND THE PG15R ATTENUATOR MUST BE SET FOR 1.1 dB.

Fig. 3—PG15T and PG15R Channel Units Transmission Block Diagram

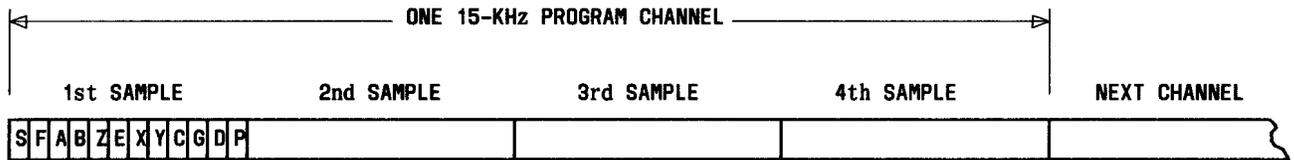
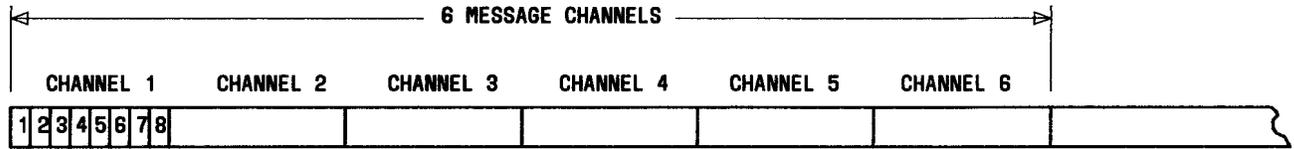
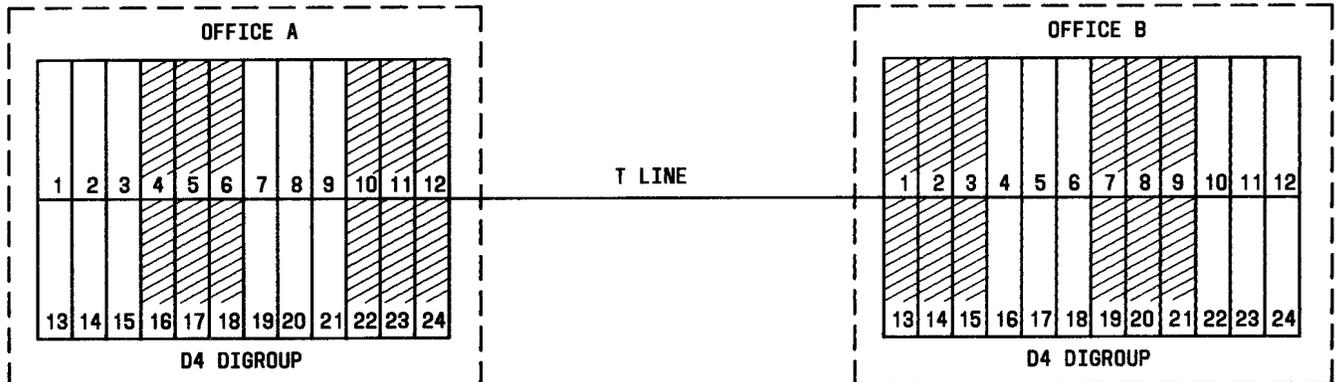


Fig. 4—15 kHz Program Bit Format With Program Channel Unit Installed in Channel Slots 1, 2, 3



NOTE:
 CLEAR SLOTS CONTAIN PG15T CHANNEL UNITS
 SHADED SLOTS CONTAIN PG15R CHANNEL UNITS

Fig. 5—Alternate D4 15 kHz Program Transmit and Receive Units