LINE TERMINATION
with LOOP-BACK

Module	Description
19D427353 G28	3360Hz low-pass filter
19D427353 G30	2500Hz low-pass filter

A. DESCRIPTION

The Line Termination module provides balanced isolated interfaces between the NS40 Audio Tone transmitter equipment and the transmission medium and between the transmission medium and NS40 receiver equipment. Each balanced interface contains a high pass filter that attenuates power frequency noise at 60 Hz.

The input to the module from transmitter equipment is on pin 5, a bridging input which will accept signals from one or more transmitters. A 15-turn variable resistor mounted on the front of the module is used to adjust the composite transmit line level. The signal then passes through the isolation transformer and the 60 Hz high-pass filter.

The balanced input to the receive side of the unit is through the 60 Hz high pass filter components and through an active low-pass filter. The receive output level adjustment is a 15-turn variable resistor mounted on the front of the module.

The local loop-back functions in conjunction with the LOOP TEST module in the same shelf. The latter applies a DC voltage of +24 volts to pin 18 which will energize relays KI and K2. Their respective contacts disconnect the line side paths from the equipment paths and connect the internal transmit circuit to the internal receive circuit for a local loop-back.

B. OPERATION

Refer to Fig.3 - Schematic Diagram - and Fig.2 - Outline Diagram which are included at the end of this instruction.

Transmit path

The transmit input at pin 5 is designed to be driven from a I0K ohm source. Any number of inputs can be paralleled at pin 5. Variable gain stage ARl-1 amplifies the single or composite signal level which is measured across a 600 ohm load across pins 6 and 7. R2 sets the gain of the transmit circuit. Strappable jumper A adds 20 dB attenuation in the transmit path in the Low Output position (2-3). This strap should be used when composite signals below -20 dBm are desired. The 1-2 position is normal.

TI is an isolation and unbalance-to-balance audio hybrid transformer at the input of the high-pass filter. This high-pass filter attenuates 60 Hz signals by at least 40 dB, passes 600 Hz and higher frequencies and is composed of components C2 through C8 and inductor L1.

RV1 and RV3 are secondary surge protection devices.

The 600 ohm balanced output is on pins 6 and 7.

Receive path

The Receive input is a balanced 600 ohms at pins 11 and 12 formed by the balanced high-pass filter which is identical to the filter in the Transmit side. The high-pass filter is composed

of components C9 through C15 and inductor L2. Isolation transformer T2 provides the balance-to-unbalance function. Zeners Z1 and Z2 serve as fast surge protection devices while MOV- RV2 performs secondary protection.

Amplifier AR2-1 is an isolation stage at the input of the active FDNR lowpass filter composed of resistors R38 through R56; capacitors C40 through C46; and op-amps AR2-2 through AR3-3. Amplifier AR3-4 is an isolation and gain stage at the output of the active lowpass filter.

The filter response is a seventh order Cauer lowpass with three finite poles. The filter has been adjusted at the factory and requires no user adjustments.

The filter in the G28 module passes frequencies up to 3360 Hz and attenuates frequencies from 3900 Hz to 8 kHz by at least 40 dB.

The filter in the G30 module passes frequencies up to 2500 Hz and attenuates frequencies from 2800 Hz to 8 kHz by at least 40 dB.

The composite level at the receive output is adjusted by R14 which is mounted on the front of the module. Strappable jumper B gives an additional 10 dB of fixed attenuation in the 2-3 position. The 1-2 position is normal.

Loop-back

The LOOP TEST module operates relays K1 and K2 by applying +24 VDC to pin 18 which opens and terminates the transmit and receive lines and connects the local transmitted signals to the local receiver through amplifier AR1-2. The level of the loop-back signal can be adjusted with R27, which is a 15-turn variable resistor mounted on the front of the module. This level can be monitored at TP6, REC OUT, on the front of the module.

When the +24 VDC is removed from pin 18, the unit reverts to normal 4-wire operation.

C.NOMINAL OPERATING CHARACTERISTICS

Transmitter Input	-10 dBsr per channel through a 10 Kilohm resistance
Line A Transmit	-45 to +8 dBm (composite)
Line B Receive	-30 to +10 dBm (composite)
Receive and loop-back Output	-30 dBsr (*) per channel
Low-pass roll-off	Typically 1dB at cut-off frequency
"60Hz filter" loss	Typically 1dB (transmit or receive path)

(*) 0dBsr - 778mVrms

ITEM NO.		Identification Number	Description	Group number and	Quantity
				28	30
		19D427353g028 REV#03	LINE TERM. LOOPBACK (STD)		
		19D427353g030 REV#03	LINE TERM. LOOPBACK (SPEC)		
AR1		0246A9387P258	ULTRA-LOW NOISE	1	1
AR2		0246A9367P003	J-FET OP AMP	1	1
AR3		0246A9367P003	J-FET OP AMP	1	1
C1		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C2		0246A9036P103	CAP .01UF 50V 5% POLY	1	1
C3		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C4		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C5		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C6		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C7		0246A9037P105B	CAP 1MFD 400VDC 20%	1	1
C8		0246A9037P105B	CAP 1MFD 400VDC 20%	1	1
C9		0246A9037P105B	CAP 1MFD 400VDC 20%	1	1
C10		0246A9037P105B	CAP 1MFD 400VDC 20%	1	1
C11		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C12		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C13		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C14		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C15		0246A9036P103	CAP .01UF 50V 5% POLY	1	1
C16		0246A9009P151BM	CAP 150UF 20V 10% TANTX	1	1
C17		0246A9009P151BM	CAP 150UF 20V 10% TANTX	1	1
C18		0246A9036P103	CAP .01UF 50V 5% POLY	1	1
C19		0246A9036P103	CAP .01UF 50V 5% POLY	1	1
C20		0246A9036P103	CAP .01UF 50V 5% POLY	1	1
C21		0246A9006P102	CAP 1000PF 500V MICA	1	1
C30		0246A9040P226	CAP 22UF 35V 10% TANT	1	1
C31		0246A9040P226	CAP 22UF 35V 10% TANT	1	1
C34		0246A9036P684	CAP .68UF 50V 5% POLY	1	1
C40		5491871P3300G	CAP 3300PF 300V 2% MICA	1	1
C41		5491871P3300G	CAP 3300PF 300V 2% MICA	1	1
C42		5491871P3300G	CAP 3300PF 300V 2% MICA	1	1
C43		5491871P3300G	CAP 3300PF 300V 2% MICA	1	1
C44		5491871P3300G	CAP 3300PF 300V 2% MICA	1	1
C45		5491871P3300G	CAP 3300PF 300V 2% MICA	1	1
C46		5491871P3300G	CAP 3300PF 300V 2% MICA	1	1
D3		0246A9401P4148	DIODE JAN 1N4148	1	1
D4		0246A9401P4148	DIODE JAN 1N4148	1	1
K1		0207A5516P044	RELAY	1	1
K2		0207A5516P044	RELAY	1	1
L1		19B218975G004	COIL	1	1
L2		19B218975G004	COIL	1	1
R1		0246A9134P1002	RES 10K OHM 1/4W 1% MTL	1	1
R2		0246A9104P104	POT 100K .5W 10%	1	1
R3		0246A9134P1620	RES 162 OHM 1/4W 1%	1	1
R4		0246A9134P2430	RES 243 OHM 1/4W 1% MTL	1	1
R5		0246A9134P2371	RES 2.37KOHM 1/4W 1% MTL	1	1
R6		0246A9134P2490	RES 249 OHM 1/4W 1% MTL	1	1
R7		0246A9103P240	RESISTOR	1	1
R8		0246A9103P240	RESISTOR	1	1
R9		0246A9103P240	RESISTOR	1	1
R10		0246A9103P240	RESISTOR	1	1
R11		0246A9134P1501	RES 1.5K OHM 1/4W 1% MTL	1	1
R12		0246A9134P1501	RES 1.5K OHM 1/4W 1% MTL	1	1
R13		0246A9134P4320	RES 432OHM 1/4W 1%	1	1
R14		0246A9104P102	POT 1K .5W 10%	1	1
R15		0246A9134P22R1	RES	1	1
R16		0246A9102P100	RES 10 OHM .5W 5%	1	1
R17		0246A9102P100	RES 10 OHM .5W 5%	1	1
R18		0246A9134P6040	RES 604 OHM 1/4W 1% MTL	1	1
R21		0246A9134P2430	RES 243 OHM 1/4W 1% MTL	1	1
R23		0246A9134P6040	RES 604 OHM 1/4W 1% MTL	1	1
R24		0246A9134P2211	RES 2.21KOHM 1/4W 1% MTL	1	1
R25		0246A9134P1001	RES 1K OHM 1/4W 1% MTL	1	1
R26		0246A9134P3011	RES 3.01K OHM 1/4W 1%	1	1

Figure 1 (19D427353) Parts List Line Termination, G28 and G30

ITEM NO.		Identification Number	Description	Group number and	Quantity
				28	30
R27		0246A9104P104	POT 100K .5W 10%	1	1
R28		0246A9134P3011	RES 3.01K OHM 1/4W 1%	1	1
R29		0246A9134P1002	RES 10K OHM 1/4W 1% MTL	1	1
R30		0246A9134P5361	RES 5.36KOHM 1/4W 1% MTL	1	1
R31		0246A9134P6810	RES 681 OHM 1/4W 1% MTL	1	1
R32		0246A9134P6810	RES 681 OHM 1/4W 1% MTL	1	1
R36		0246A9134P1002	RES 10K OHM 1/4W 1% MTL	1	1
R37		0246A9134P1000	RES 100 OHM 1/4W 1% MTL	1	1
R38		0246A9134P1542	RES 15.4KOHM 1/4W 1% MTL	1	
R38		0246A9134P2102	RES 21K OHM 1/4W 1% MTL		1
R39		0246A9134P9091	RES 9.09KOHM 1/4W 1% MTL	1	
R39		0246A9134P1272	RES 12.7KOHM 1/4W 1% MTL		1
R40		0246A9134P1402	RES 14K OHM 1/4W 1% MTL	1	
R40		0246A9134P1872	RES 18.7KOHM 1/4W 1% MTL		1
R41		0246A9128P502	POT 5K 1/2W 10%	1	1
R42		0246A9134P1212	RES 12.1KOHM 1/4W 1% MTL	1	
R42		0246A9134P1652	RES 16.5KOHM 1/4W 1% MTL		1
R43		0246A9134P1402	RES 14K OHM 1/4W 1% MTL	1	
R43		0246A9134P1872	RES 18.7KOHM 1/4W 1% MTL		1
R44		0246A9134P1402	RES 14K OHM 1/4W 1% MTL	1	
R44		0246A9134P1872	RES 18.7KOHM 1/4W 1% MTL		1
R45		0246A9128P502	POT 5K 1/2W 10%	1	1
R46		0246A9134P2152	RES 21.5KOHM 1/4W 1% MTL	1	
R46		0246A9134P2942	RES 29.4KOHM 1/4W 1% MTL		1
R47		0246A9134P1402	RES 14K OHM 1/4W 1% MTL	1	
R47		0246A9134P1872	RES 18.7KOHM 1/4W 1% MTL		1
R48		0246A9134P1272	RES 12.7KOHM 1/4W 1% MTL	1	
R48		0246A9134P1742	RES 17.4KOHM 1/4W 1% MTL		1
R49		0246A9134P1822	RES 18.2KOHM 1/4W 1% MTL	1	
R49		0246A9134P2612	RES 26.1KOHM 1/4W 1% MTL		1
R50		0246A9134P1402	RES 14K OHM 1/4W 1% MTL	1	
R50		0246A9134P1872	RES 18.7KOHM 1/4W 1% MTL		1
R52		0246A9134P1372	RES 13.7KOHM 1/4W 1% MTL	1	
R52		0246A9134P1822	RES 18.2KOHM 1/4W 1% MTL		1
R53		0246A9134P1402	RES 14K OHM 1/4W 1% MTL	1	
R53		0246A9134P1872	RES 18.7KOHM 1/4W 1% MTL		1
R54		0246A9134P1332	RES 13.3KOHM 1/4W 1% MTL	1	
R54		0246A9134P1782	RES 17.8KOHM 1/4W 1% MTL		1
R55		0246A9134P3831	RES 3.83KOHM 1/4W 1% MTL	1	
R55		0246A9134P5491	RES 5.49KOHM 1/4W 1% MTL		1
R56		0246A9134P6191	RES 6.19KOHM 1/4W 1% MTL	1	
R56		0246A9134P8451	RES 8.45KOHM 1/4W 1% MTL		1
RV1		0246A9433P002	DIODE	1	1
RV2		0246A9433P002	DIODE	1	1
RV3		0246A9433P002	DIODE	1	1
T1		19B218976G003	XFMR	1	1
T2		19B218976G003	XFMR	1	1
TP1		0268A9913P001	SPRING	1	1
TP2		0268A9913P001	SPRING	1	1
TP3		0268A9913P001	SPRING	1	1
TP4		0268A9913P001	SPRING	1	1
TP5		0268A9913P001	SPRING	1	1
TP6		0268A9913P001	SPRING	1	1
Z1		0246A9427P6R8A	TRANSIENT SUPPRESSOR	1	1
Z2		0246A9427P6R8A	TRANSIENT SUPPRESSOR	1	1

Figure 1 (19D427353) Parts List Line Termination, G28 and G30, continued

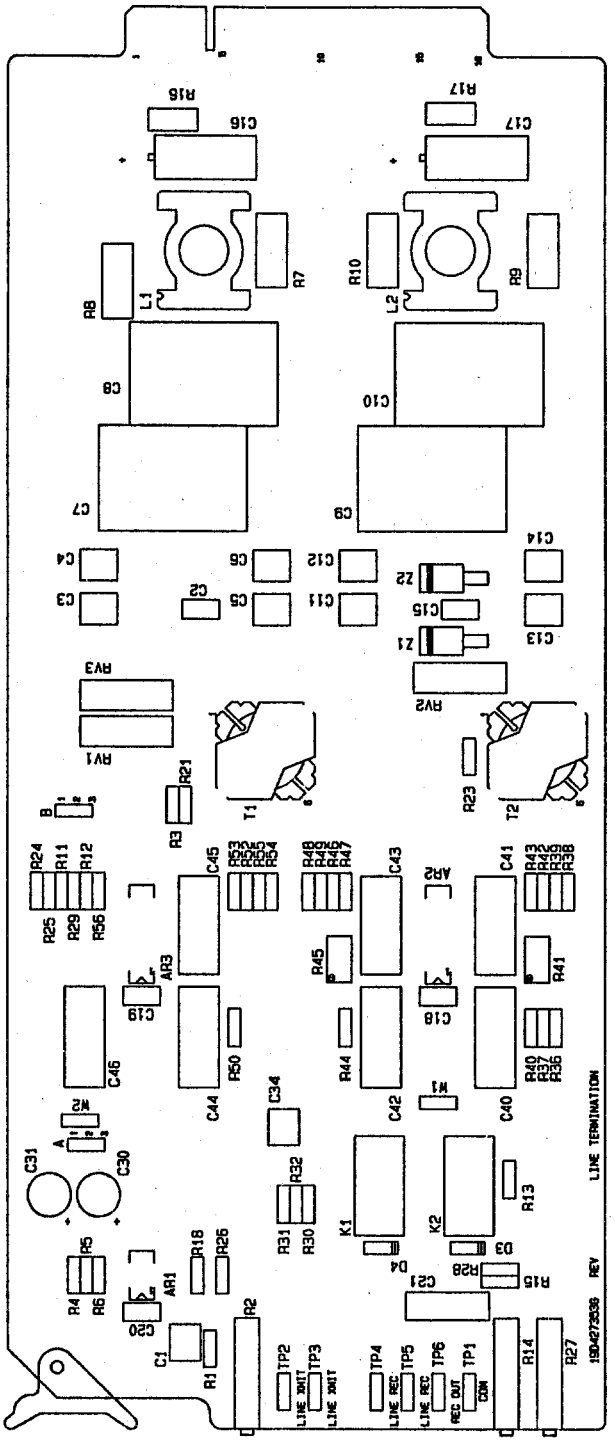
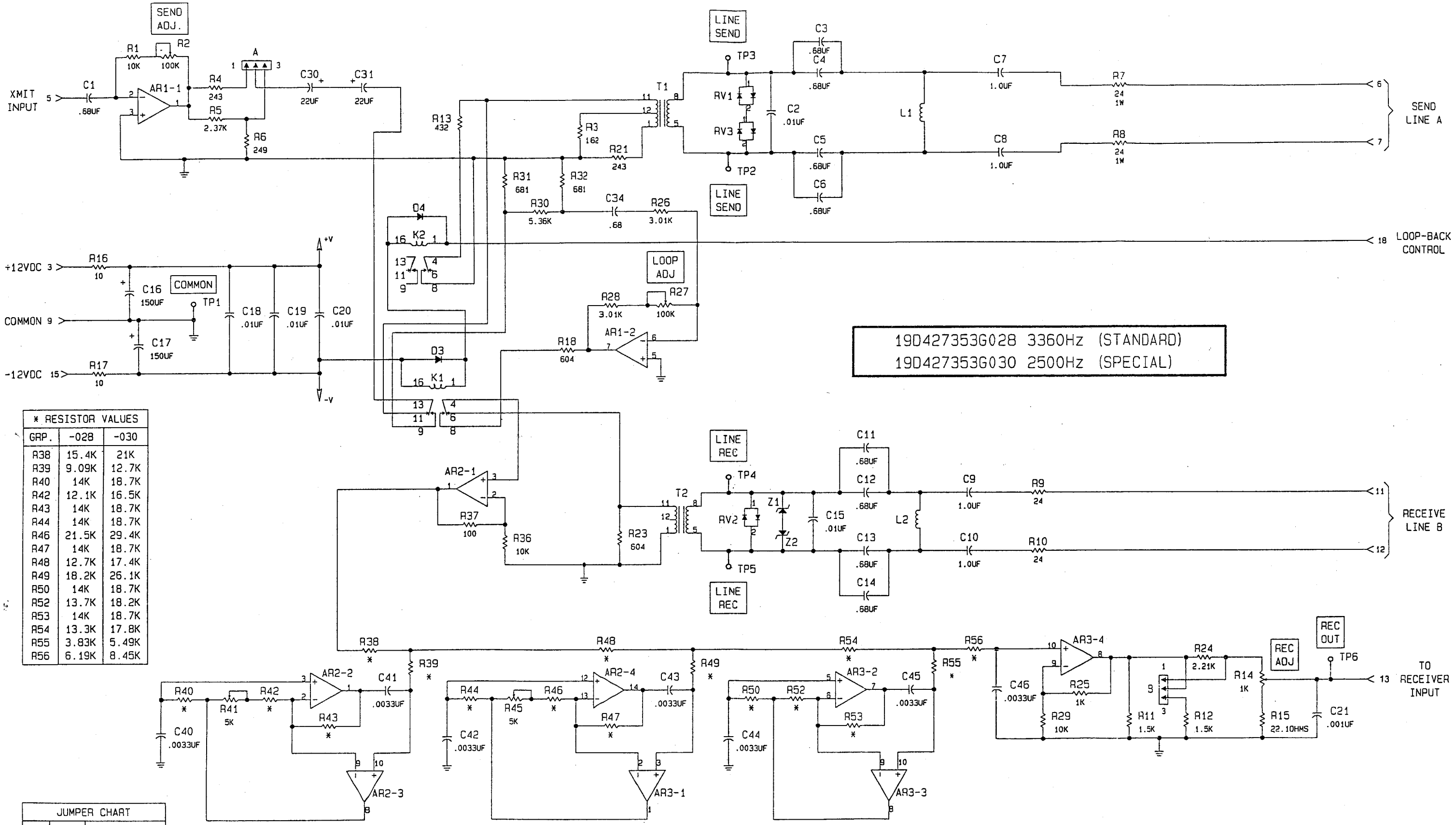


Figure 2 (0215B8764 Sh.1 [0]) Outline Diagram Line Termination, G28 and G30



19D427353G028 3360Hz (STANDARD)
19D427353G030 2500Hz (SPECIAL)

* RESISTOR VALUES		
GRP.	-028	-030
R38	15.4K	21K
R39	9.09K	12.7K
R40	14K	18.7K
R42	12.1K	16.5K
R43	14K	18.7K
R44	14K	18.7K
R46	21.5K	29.4K
R47	14K	18.7K
R48	12.7K	17.4K
R49	18.2K	26.1K
R50	14K	18.7K
R52	13.7K	18.2K
R53	14K	18.7K
R54	13.3K	17.8K
R55	3.83K	5.49K
R56	6.19K	8.45K

JUMPER CHART		
	POS	FUNCTION
A	1-2	NORMAL
	2-3	LOW OUTPUT
B	1-2	NORMAL
	2-3	10dB ATTEN.

Figure 3 (0145D8465 Sh.4[4]) Schematic Diagram
Line Termination, G28 and G30