401 Dual Line Amplifier

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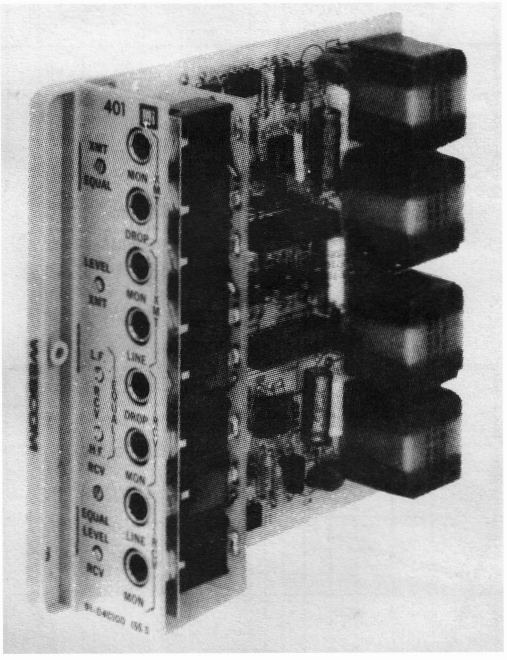


Figure 1. 401 Dual Line Amplifier

1.01 This Section provides circuit description, installation procedures, and testing information for the Wescom® 401 Dual Line Amplifier, shown in Figure 1.

1.02 This Section has been reprinted to prevent the use of a 4032 subassembly with a 401 (Issue 5). Significant changes are indicated by a change bar (▌) in the margin adjacent to the affected copy.

1.03 The 401 (Issue 5) differs from the previous issues due to the following changes: (1) plug-in options to provide 150-, 600-, or 1200-ohm impedance on the impedance matching transformer; (2) an optional 4031 Subassembly which may be added to the 401, for equalization of frequency characteristic response; (3) an optional high or low amplifier signal gain; and (4) a significant reduction in idle line noise due to circuit improvements.

1.04 The 401 is a dual voice frequency line amplifier that provides from 10dB loss to 36dB gain (continuously variable) in both receive and transmit directions.

1.05 The 401 includes both a transmit and a receive integrated circuit amplifier, impedance-matching line transformers, variable equalizer and level controls, and test jacks. The 401 incorporates a voltage regulating circuit that allows the amplifiers to operate from any input voltage between -21 to -55Vdc.

1.06 Variable equalizers are provided on the input of both the transmit and receive amplifiers to compensate for the amplitude slope characteristic of a facility (characteristic curves are shown in Figure 2). The 401, equipped with a 4031 optional subassembly can provide additional amplitude equalization on the receive side.

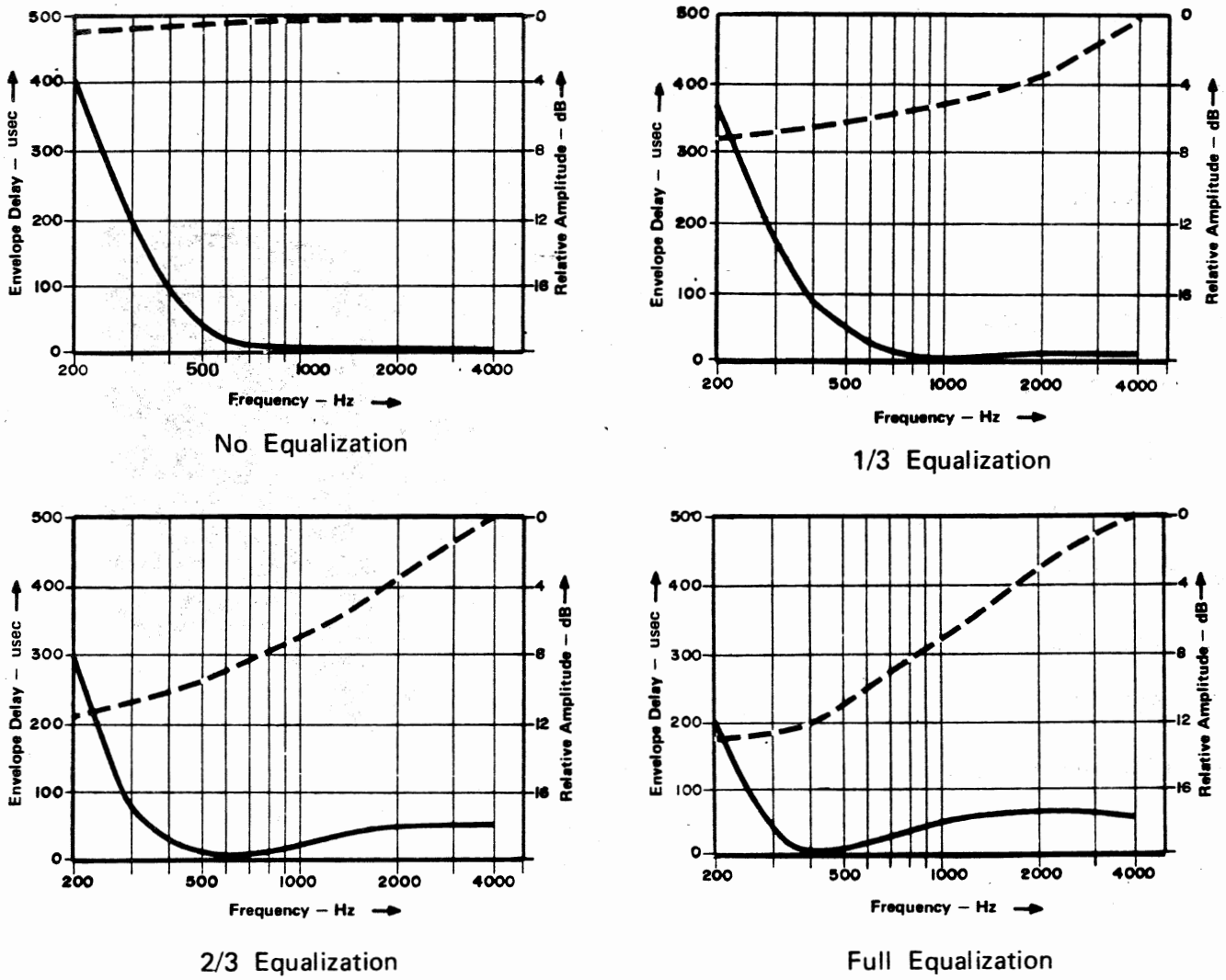


Figure 2. Typical Gain And Delay Characteristics Of The 401 Dual Line Amplifier

1.07 Both the input and output of the receive and transmit amplifiers are provided with impedance-matching line transformers. Each transformer may be strapped for 150-, 600-, or 1200-ohm impedance, and is center-tapped to provide a balanced simplex (SX) signaling lead.

2. CIRCUIT DESCRIPTION

2.01 Refer to Figure 6, the 401 (Issue 5) block diagram, while reading the following Paragraphs 2.02 through 2.09, which describe the electrically equivalent transmit and receive amplifier circuits.

Transmit Amplifier

2.02 Input signals are applied from the transmit drop to the input transformer T4, which has an electrically balanced center tap to achieve longitudinal balance and allow the device to be used in simplex operation up to 120mA dc. A plug-in option, 4D, on the secondary of the transformer, provides for matching the input impedance of 150, 600, or 1200 ohms.

2.03 A bridging type test jack (XMT MON) and a normal through jack (XMT DROP) are both located across the T4 transformer input.

2.04 From the secondary of T4, signals are applied via the XMT EQLR control, an adjustable equalization network, and the hi-low gain switch to the amplifier input. The amplifier provides between 36dB of gain and 10dB of loss for the signal.

2.05 The signal is routed from the amplifier to transformer T3. The primary winding of T3 is also provided with a plug-in option, 3C, to match 150-, 600-, or 1200-ohm line impedance. Signals are routed through XMT LINE jack, which is bridged by a MON jack and applied to the transmit line. The transmit line side of the 401 provides transient surge protection up to 1000V.

Receive Amplifier

2.06 Input signals from the receive line are routed through the receive line jack, which is bridged by the RCV MON jack and applied to the input transformer T1, which also has an electrically balanced center tap. A plug-in option, 1A, is found on the secondary of the transformer; the matching input impedance can be set at 150, 600, or 1200 ohms.

2.07 From the secondary of T1, signals are applied via the RCV EQLR control, the adjustable equalization network, and a hi-low gain switch, to the amplifier input. The amplifier provides between 36dB of gain and 10dB of loss for the signal.

2.08 The AA option is located between the op-amp and the T2 transformer, and is normally set in the ON position. When a 4031 optional equalizer subassembly is used, the AA option is moved to the OFF position; this switches the voice path so it passes through the subassembly before going on to T2.

2.09 The primary winding of T2 is also provided with plug-in option 2B to match 150-, 600-, or 1200-ohm line impedances. Signals are routed through the RCV DROP jack, which is bridged by a MON jack and applied to the receive drop. The receive line side of the 401 provides transient surge protection up to 1000V.

3. INSPECTION

3.01 Inspect the equipment thoroughly as soon as possible after delivery. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company.

3.02 Wescom equipment is identified by a model and issue number imprinted on the front panel. Each time a major engineering design change is made on the equipment, the issue number is advanced by one number on any following models that are manufactured. Therefore, be sure to include the issue number along with the model number when making inquiries about the equipment.

4. MOUNTING

4.01 The 401 (Issue 5) is designed to mount in one module position of a Type 400 Mounting Assembly. The 400 Mounting Assemblies are available in various module capacities and allow for Key Telephone Unit (KTU) apparatus-case or relay-rack mounting. Refer to Section 4402-XX thru 4407-XX for further information on these mounting assemblies.

5. INSTALLATION

5.01 When the 401 is installed in a Type 400 Mounting Assembly, it makes electrical connection to the associated equipment through a 56-pin, wire-wrapped card-edge connector, provided as part of the mounting assembly. Make all installer connections to this connector in accordance with Table 1.

5.02 The 401 is provided with surge protection on both the receive and transmit lines. This protection is designed to prevent damage to

the 401 when provided with normal station protection at the line interfaces. It is recommended that 3 MIL or 5 MIL carbon block protectors and/or gas tube protectors be provided in the standard manner from both sides of the line to ground. This will ensure protection of the input or output terminals connected directly to an outside cable.

CAUTION

Do not make any connections with power applied to the equipment or modules installed in the mounting assembly.

Power Requirements

5.03 Each 401 requires a source of -21 to -55Vdc at 70mA maximum.

CAUTION

To avoid damage to voltage-sensitive solid-state devices from transient or surge voltages, it is recommended that the 401 be operated from a well-filtered battery source.

Table 1. Installer Connections

CONNECT	RESPECTIVE BLOCK DIAGRAM DESIGNATION	TO PIN(S)
Transmit drop	T&R	55 and 49
Transmit drop simplex	SXT DROP	53 or 51
Transmit line	T&R	41 and 47
Transmit line simplex	SXT LINE	43 or 45
Receive line	T&R	7 and 13
Receive line simplex	SXR LINE	9 or 11
Receive drop	T&R	5 and 15
Receive drop simplex	SXR DROP	1 or 3
-21 to -55 Vdc input		35
Ground		17

6. OPTIONS

6.01 The 401 is provided with plug-in options (Figures 3, 4, and 5) for 150-, 600-, and 1200-ohm input and output impedences (factory set for 600 ohms). Another plug-in option, AA, is in the OFF position when used with a plug-in receive equalizer; otherwise, it should be in the ON position (factory set for ON). There are two switches, S1 and S2, for setting high and low gains in the receive and transmit amplifiers.

6.02 The plug-in options on the 401 are easily removed with a needle-nose pliers. The options are then set on the desired pair of male terminals.

6.03 Option AA bypasses (ON) or enables (OFF) the 4031 subassembly. The 4031 provides equalization for amplitude versus frequency characteristic of loaded cable. The 4031 is described at length in Section 4031-, 4032-101/3.

6.04 Figure 3 shows a typical transformer option terminal block on the 401 Issue 5, and Figure 4 shows the terminals of the AA option. Figure 3, strapped for 600-ohm line impedance, is shown with a dotted line to indicate a seated option. Figure 4 shows the AA option in the ON position, which would bypass the subassembly. Figure 5 shows the locations and factory set positions of the plug-in and switch options on the 401 (Issue 5).

7. ALIGNMENT

7.01 The alignment procedure for the 401 is described in Tables 2 and 3. The procedure in Table 2 consists of first injecting 1000Hz test-tone into the transmit amplifier and adjusting the transmit equalizer (XMT EQLR) and transmit level (XMT LEVEL) control. The procedure in Table 3 consists of requesting the distant terminal to send a 1000Hz test-tone through the receive amplifier. This is followed by the adjustment of the receive equalizer (RCV EQLR) and the receive level (RCV LEVEL) controls. Test jacks and variable controls to properly align the

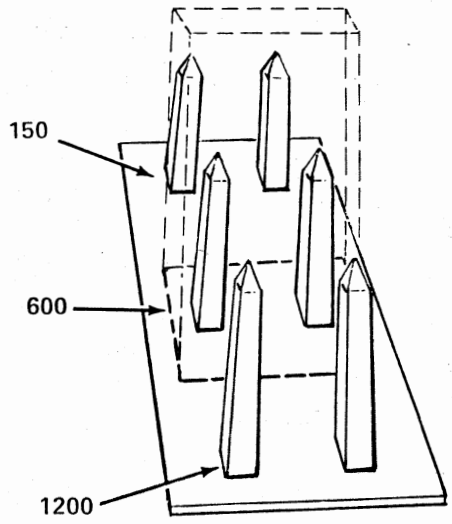


Figure 3. Transformer Plug-In Option For Transformer Impedance Biasing

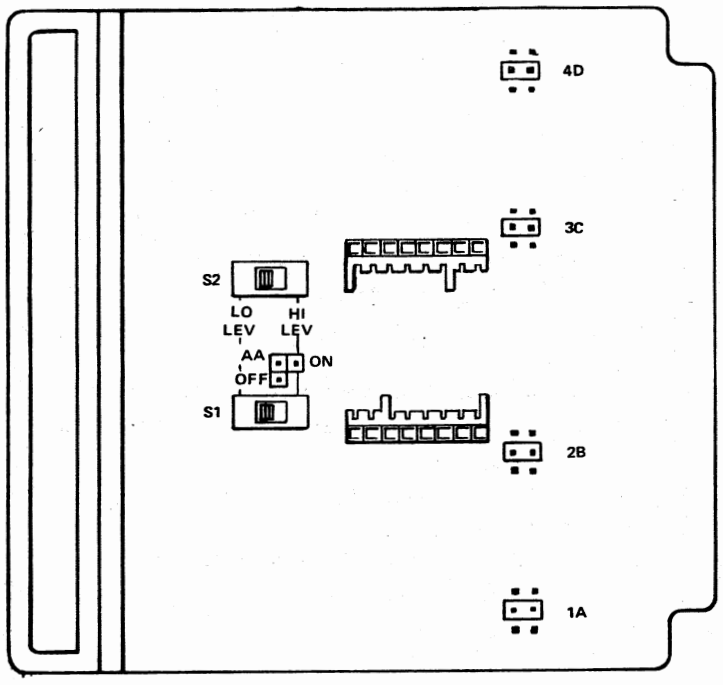


Figure 5. Option And Connector Locations And Positions

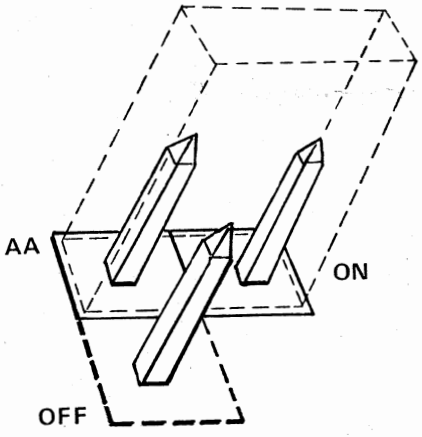


Figure 4. AA Option In ON Position

401 are located on the equipment front panel, plus hi-lo switchable levels on the PC board.

Test Equipment

7.02 The test equipment (or functional equivalent) required at both the local and distant terminals to properly align the 401 is as follows:

(a) Transmission Test Set (TTS): Northeast Electronics TTS-4C or WECo 23A.

(b) Variable Frequency Oscillator (VFO): Hewlett-Packard 200CD. (If the Northeast Electronics TTS-4C is used, the VFO is not required).

8. TESTING

8.01 If trouble is encountered with the operation of the 401, verify that all installer connections have been properly made in accordance with Table 1 and that all options have been conditioned as required. With power removed, make certain that the module is making good connection with the mounting assembly card connector; remove and reinsert the module. If technical assistance is required, contact the Wescom Technical Services Department by calling:

(312) 971-2010
TWX 910-695-4735 or
DATAPHONE (312) 971-1698

Canadian Customers:
(416) 877-0191
TWX 610-492-2646

Table 2. Transmit Alignment Procedure

STEP	ACTION	VERIFICATION
1	Set transmit high/low switch before inserting card. Determine gain by consulting Circuit Layout Record (CLR). If gain required is 14dB or less, set switch to low. If gain required is more than 14dB, set switch to high.	
2	Check that all installer connections and plug-in options have been properly made.	
3	Condition the local VFO to apply a 1000Hz test-tone at the required level and impedance specified on the CLR card and connect it to the XMT DROP test jack on the 401 front panel.	
4	Connect the TTS (set for terminating measurement and impedance specified on the CLR to the XMT LINE test jack. Adjust the XMT LEVEL control until the TTS indicates the level specified on CLR.	TTS should indicate level specified on CLR.
5	Remove the TTS from the XMT LINE jack on the 401 and request the distant terminal to measure the 1000Hz test-tone.	TTS should indicate level specified on CLR.
6	If equalization is not required by the CLR, proceed to Step 10. If equalization is required, change the frequency (not the level) of the local VFO to send a 300Hz test-tone. Request the distant end to measure and record the 300Hz test-tone level.	
7	Change the frequency (not the level) of the local VFO to send a 2700Hz test-tone. Request the distant terminal to measure and record the 2700Hz test-tone level.	
8	Adjust the local XMT EQUAL control clockwise and repeat Steps 6 and 7 until the distant terminal reports that the difference between 300Hz and 2700Hz test-tone levels is within limits specified on the CLR for the grade of service required.	The difference between the 300Hz and 2700Hz test-tone levels is within the limits specified on the CLR.
9	Again, change the frequency of the local VFO to send a 1000Hz test-tone and readjust the local XMT LEVEL control until the distant terminal reports that the receive level coincides with that specified on the CLR.	Level specified on CLR at distant terminal.
10	Disconnect all test equipment and verify circuit operation on the transmit line. This completes the transmit amplifier alignment.	

Table 3. Receive Alignment Procedure

STEP	ACTION	VERIFICATION
1	Set receive high/low switch before inserting card. Determine gain by consulting CLR card. If gain required is 14dB or less, set switch to low. If gain required is more than 14dB, set switch to high.	
2	At the local terminal, connect the TTS (set for "bridging" measurement) to the RCV LINE MON test jack. Request the distant terminal to send a 1000Hz test-tone to the local terminal at the required level.	1000Hz test-tone within the limits specified on the CLR for the grade of service required.
3	Remove the TTS from the RCV LINE MON test jack (reset for terminating measurement and impedance specified on CLR) and connect it to the RCV DROP test jack. Adjust the RCV LEVEL control until the local TTS indicates the level specified on the CLR.	TTS should indicate level specified on CLR.
4	If equalization is not required by the CLR, proceed to Step 8. If equalization is required, request the distant terminal to change the frequency (not the level) of the distant VFO to 300Hz. Measure and record the 300Hz test-tone level.	
5	Request the distant terminal to change the frequency (not the level) of the VFO to send a 2700Hz test-tone. Measure and record the 2700Hz test-tone level.	
6	Adjust the local RCV EQUAL control clockwise and repeat Steps 4 and 5 until the difference between the 300Hz and 2700Hz test-tone levels is within limits specified on the CLR for the grade of service required.	The difference between the 300Hz and 2700Hz test-tone levels is within the limits specified on the CLR.
7	Request the distant terminal to send 1000Hz test-tone at the required CLR level and readjust the local RCV LEVEL control until TTS level coincides with that specified on the CLR.	Level specified on CLR at distant terminal.
8	Disconnect all test equipment, restore all equipment to normal, and verify overall circuit operation. This completes the 401 alignment procedure.	

9. WARRANTY

9.01 STANDARD WARRANTY: Wescom products are warranted to be free from defects in material, workmanship, and design, given proper installation and regular maintenance. Wescom's obligations under this warranty are limited to correction and replacement, at Wescom's production facility, of any defective items received by Wescom, transportation prepaid, for

a period of five years from the date of original shipment. Warranty and remedies on products not manufactured by Wescom are in accordance with the warranty of the respective manufacturer. WESCOM MAKES NO OTHER WARRANTY OF ANY KIND WHATEVER, EXPRESSED OR IMPLIED; AND ALL IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEEDS THE AFORESAID OBLIGATIONS IS HEREBY DISCLAIMED BY WESCOM.

9.02 Field repairs involving the replacement of components within a unit are not recommended. If an item is found to be defective, contact Wescom, Inc., by telephone or TWX, for instructions regarding replacement or repair.

9.03 If a replacement unit is required, it will be shipped in the fastest manner consistent with the urgency of the situation. Upon receipt of a replacement unit, return the defective unit in the carton in which the replacement was shipped, using the shipping label provided, to:

Wescom, Inc.
8245 Lemont Road
Downers Grove, Illinois 60515

Canadian Customers:

Wescom Canada, Ltd.
45 Sinclair Ave.
Georgetown, Ontario
L7G 4X4

Repair Or Exchange Services

9.04 In addition to the standard Wescom Warranty Service, Wescom offers a repair or exchange service for those items out of warranty. Under this arrangement, faulty units may be shipped to Wescom and either completely repaired and quality tested or exchanged for a replacement unit. To obtain details of this service and a schedule of prices, contact your local Wescom Sales Representative.

10. SPECIFICATIONS

10.01 Specifications describing the electrical and physical characteristics of the 401 are as follows:

(a) AMPLIFIER GAIN RANGE: -10 to +36dB (no equalization).

(b) MAXIMUM OUTPUT LEVEL: +16dBm.

(c) FREQUENCY RESPONSE: 300Hz to 4kHz (no equalization) ±1dB.

(d) EQUALIZATION: Gain differential between 300 and 4000Hz is adjustable from 0 to 12dB (see Figure 2).

(e) ENVELOPE DELAY: Less than 100us, 400Hz to 4kHz.

(f) NOISE LEVEL: 15dBrnC, maximum (input terminated).

(g) INPUT IMPEDANCE: 150, 600, or 1200 ohms ±10 percent, strappable.

(h) OUTPUT IMPEDANCE: 150, 600, or 1200 ohms ±10 percent, strappable.

(i) TOTAL HARMONIC DISTORTION: Less than 1 percent at ±10dBm, with no equalization or roll-off correction and an ambient temperature of 72°F (22°C).

(j) POWER REQUIREMENTS: -21 to -55Vdc (from filtered battery source) with 70mA maximum.

(k) SURGE PROTECTION: 1000V.

(l) SIMPLEX DC RESISTANCE: Input winding, 5 ohms; output winding, 9 ohms.

(m) SIMPLEX CURRENT: 120mA (5mA maximum, unbalanced).

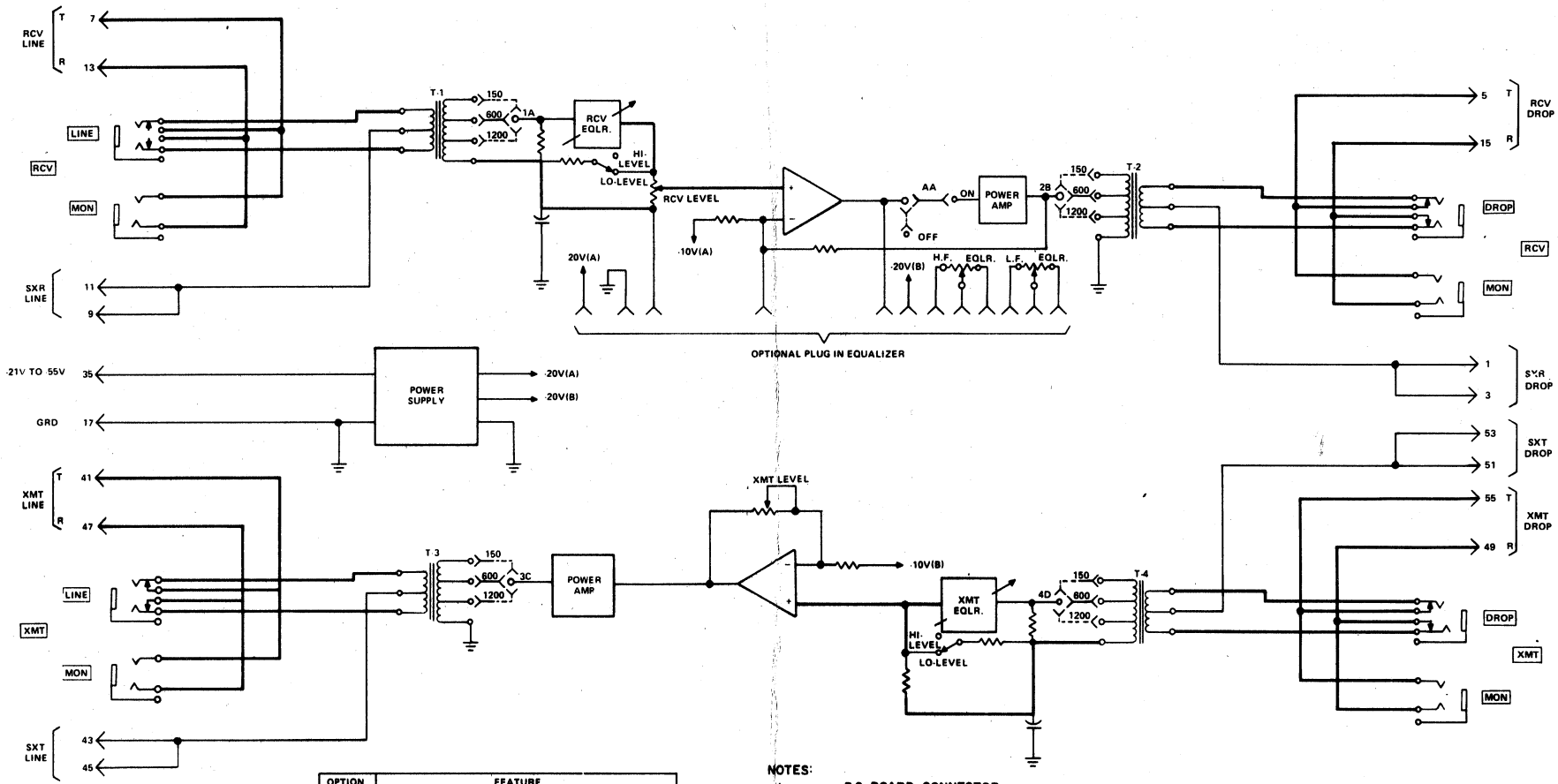
(n) CROSSCOUPLING: -70dB, minimum.

(o) OPERATING ENVIRONMENT: Temperature, 32° to 120°F (0° to 49°C); humidity to 95 percent (no condensation).

(p) WEIGHT: 19.5 oz (0.53kg) approximately.

(q) DIMENSIONS: Height, 5.6 in. (14.2cm); width, 1.5 in. (3.8cm); depth, 6.0 in. (15.2cm).

(r) MOUNTING: Module occupies one position in a Wescom Type 400 Mounting Assembly.



OPTION	FEATURE
AA	ON WHEN NO SUBASSEMBLY IS ATTACHED OFF WHEN OPTIONAL EQUALIZER SUBASSEMBLY IS ATTACHED.
1A, 2B, 3C 4D	THESE OPT FOR IMP MATCHING ON LINE AND DROP SIDES
RCV LEV SWITCH	LO POSITION WHEN OUTPUT WILL NOT EXCEED 14dB GAIN HI POSITION WHEN OUTPUT WILL EQUAL OR EXCEED 14dB GAIN
XMT LEV SWITCH	LO POSITION WHEN OUTPUT WILL NOT EXCEED 14dB GAIN HI POSITION WHEN OUTPUT WILL EQUAL OR EXCEED 14dB GAIN

NOTES:
1. →x— P.C. BOARD CONNECTOR
2. xxx FRONT PANEL MARKING.
3. >—< FACTORY INSTALLED STRAP.
4. >---< OPTIONAL STRAP.

Figure 6. 401-00 (Issue 5) Block Diagram