401–00 4-Wire Line Amplifier

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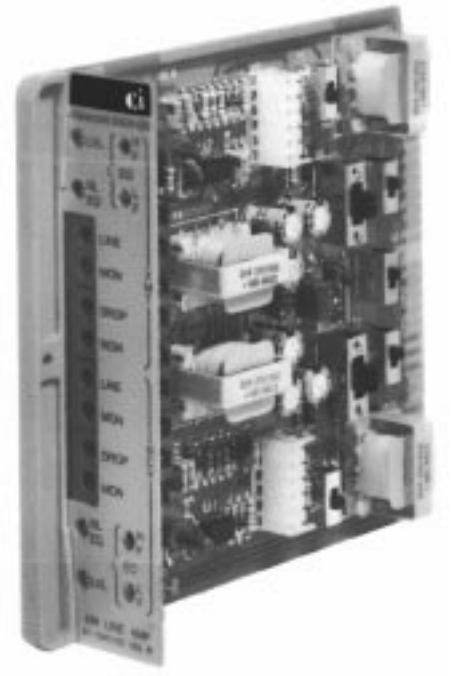

Figure 1. 401–00 4-Wire Line Amplifier

1. GENERAL

1.1 Document Purpose

This section provides a circuit description, installation procedures, and basic testing information for the Wescom 401–00 4-Wire Line Amplifier (Issue 8) shown in Figure 1.

1.2 Document Status

This document is reprinted to provide a general editorial update.

1.3 Equipment Features

The 401–00 (issue 8) features include the following:

- Switch-selectable impedances of 150, 600, and 1200 ohms on both the line and drop sides
- Amplifier gain range is –10dB to +28dB
- Standard 400-type card with narrow front panel
- Standard 400–00 pin-out configuration. plus internal strapping to accommodate the 72 Family Universal Wiring Plan
- Multi-turn amplifier gain potentiometers
- Accepts optional Wescom 7407–01 Equalizer Subassembly for H88 loaded cable in both the receive and transmit paths
- Maximum output level +8dBm
- Front-panel-mounted Bantam test jacks
- SX lead Normal-Reverse switch
- SX lead bypass switch
- External control of repeater enable
- Input voltage from –21 to 56Vdc
- Input power 30mA maximum

The Voice Frequency (VF) receive and transmit amplifiers each have a continuous gain range of –10 to +28dB and a maximum output level of +8dBm. In addition, the receive and transmit voice paths each have amplitude equalizers for improving the frequency response of nonloaded cable facilities up to 12dB. Graphs showing the degree of correction obtainable with these equalizers are shown in Figure 2. When required for H88 loaded cable facilities, optional Wescom 7407–01 Equalizer Subassemblies can be added to both the receive and/or the transmit voice paths to provide post- and / or pre-equalization. (The 7407–01s should be ordered separately.) Typical graphs for H88 loaded cable equalization are shown in Figure 3.

Bridging and break jacks are provided at each port of the 4-wire line and 4-wire drop for use in alignment and testing. These bantam jacks are conveniently located on the front panel of the module.

All gain and equalization controls (including those of the optional loaded cable equalizers) are accessible through the front panel. The module provides proper operation on supply voltages ranging from –21 to –56Vdc having nominal values of –24 to –48Vdc.

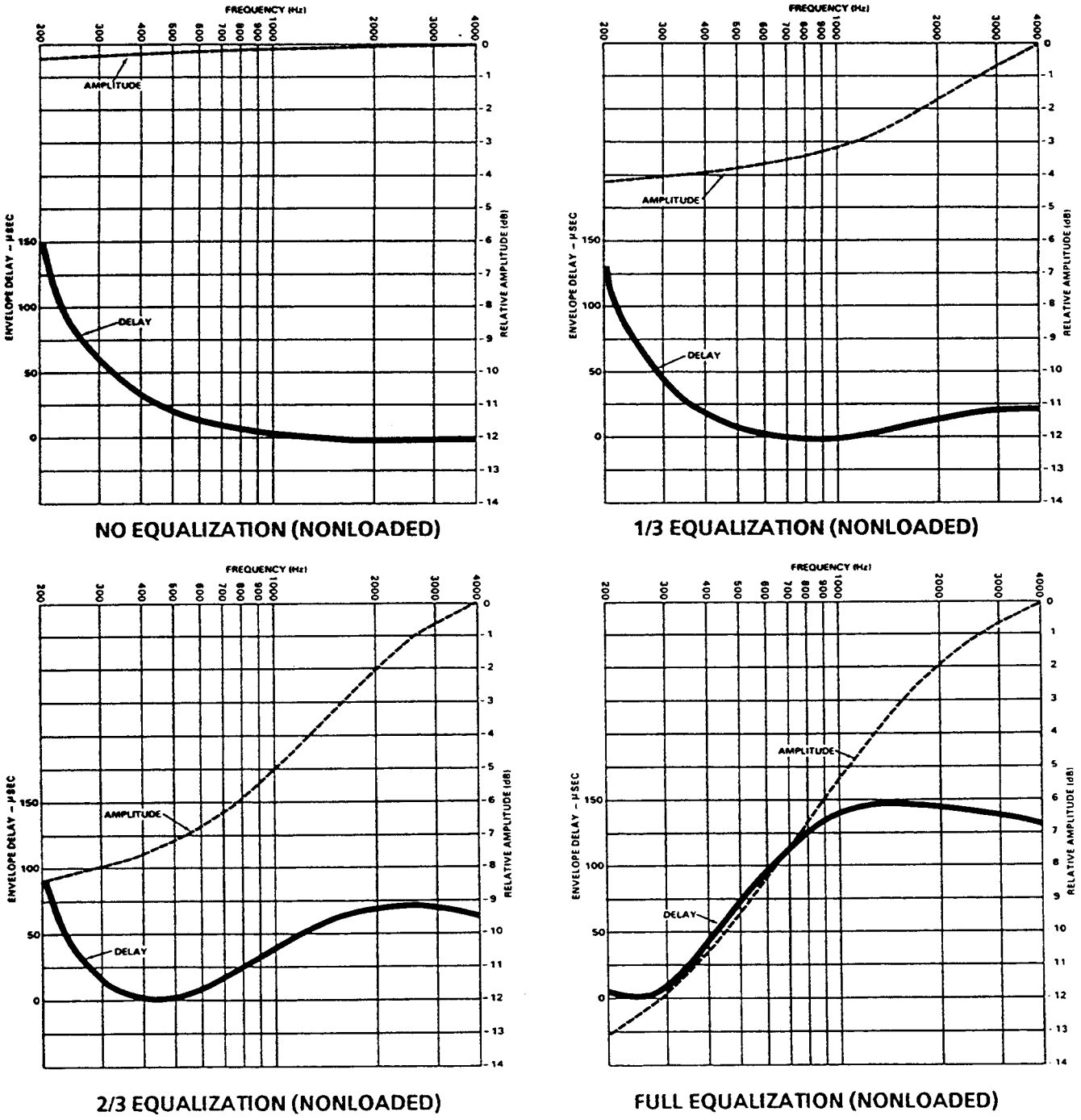

Figure 2. Typical Nonloaded Cable Equalization Curves

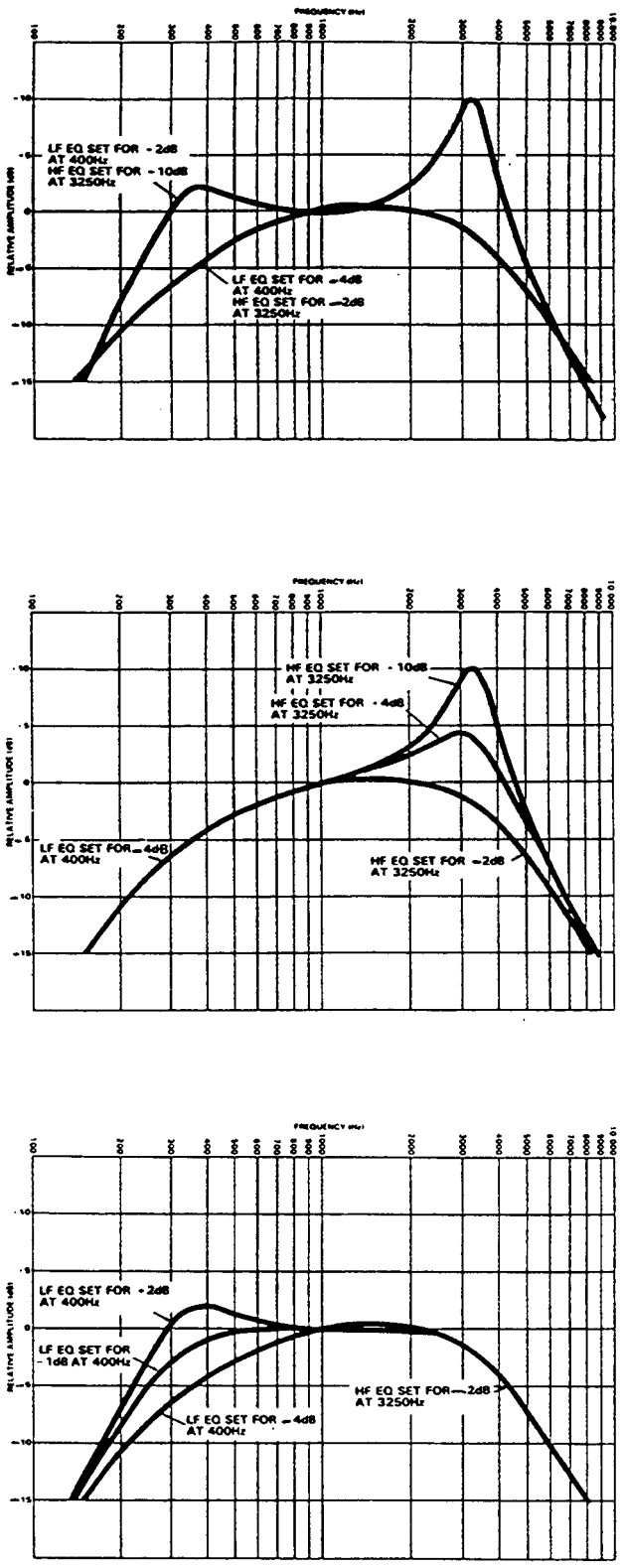

Figure 3. Typical H88 Loaded Cable Equalization Curves Using Optional 7407–01 Equalizers

2. APPLICATION GUIDELINES

Typical applications of the 401–00 Issue 8 are shown in Figure 4, Figure 5, and Figure 6. In Figure 4, the 401–00 is shown in a stand-alone application such as that of an intermediate VF repeater on a long metallic facility. In this application, sealing currents or DX signaling currents that may be present on the receive and transmit pairs of the 4-wire line are by-passed through the unit (via S3 and S4) to the receive and transmit pairs of the drop-side facility.

Note: In Figure 4, Figure 5, and Figure 6, only the voice and signaling leads are shown; other leads, not shown, such as battery, ground, and repeater-enable are also used to provide an operating circuit.

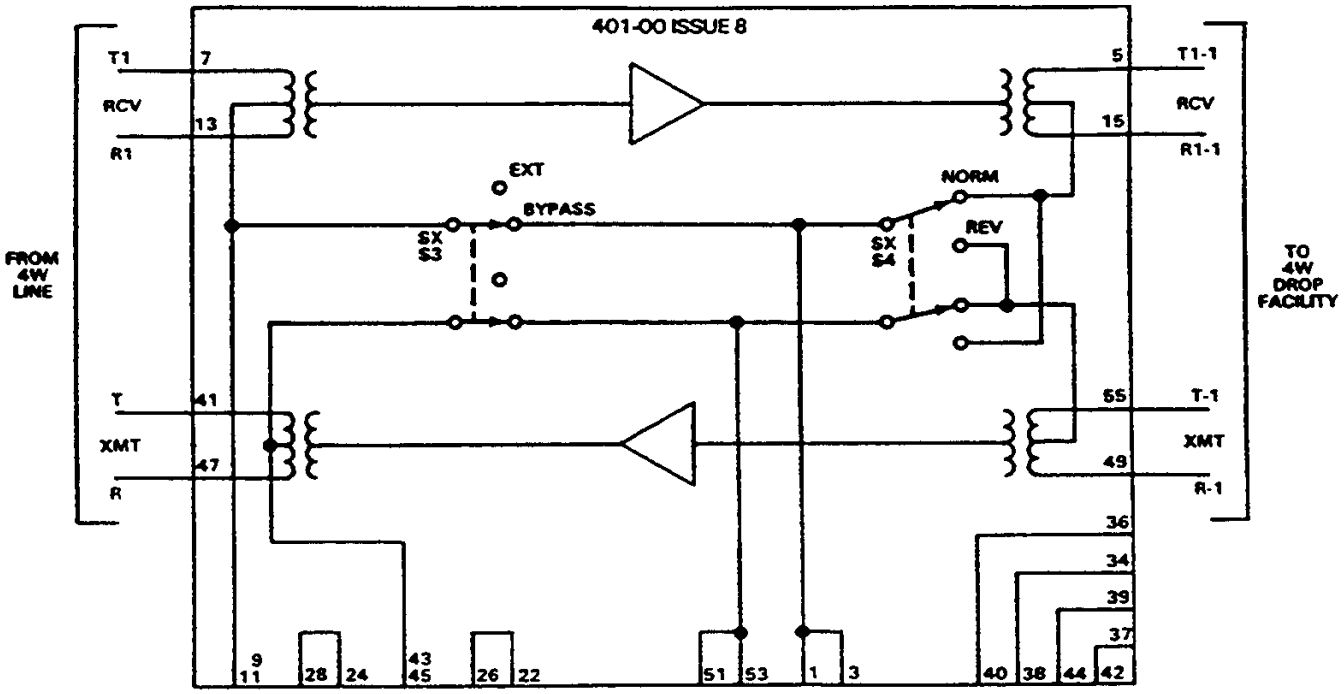

Figure 4. 401–00 Stand-Alone Arrangement Including Optioning To Bypass DC Signaling

In the application shown in Figure 5, the 401–00 is used with a 7316–00 DX Signaling Module to terminate a DX signaling facility. The 401–00 restores the VF facility levels and required bandpass characteristics following their degradation by cable loss on the facility. The 7316–00 provides signaling conversion for interfacing E&M signaling equipment or an E&M trunk circuit.

The application shown in Figure 6 is functionally equivalent to that of Figure 5, however, the 401–00 and its companion signaling module are mounted in a prewired shelf of the Type 72 Family. A 7283–00 DX Signaling Applique is substituted for the 7316–00 DX Signaling Module in this application to provide pin-out compatibility with the Universal Wiring format of the Type 72 Shelf. Connections made by the installer consist only of those required to terminate the 4-wire drop on the Type 66 Terminal Block or 25-pair Amphenol-type connector provided with the Type 72 Shelf.

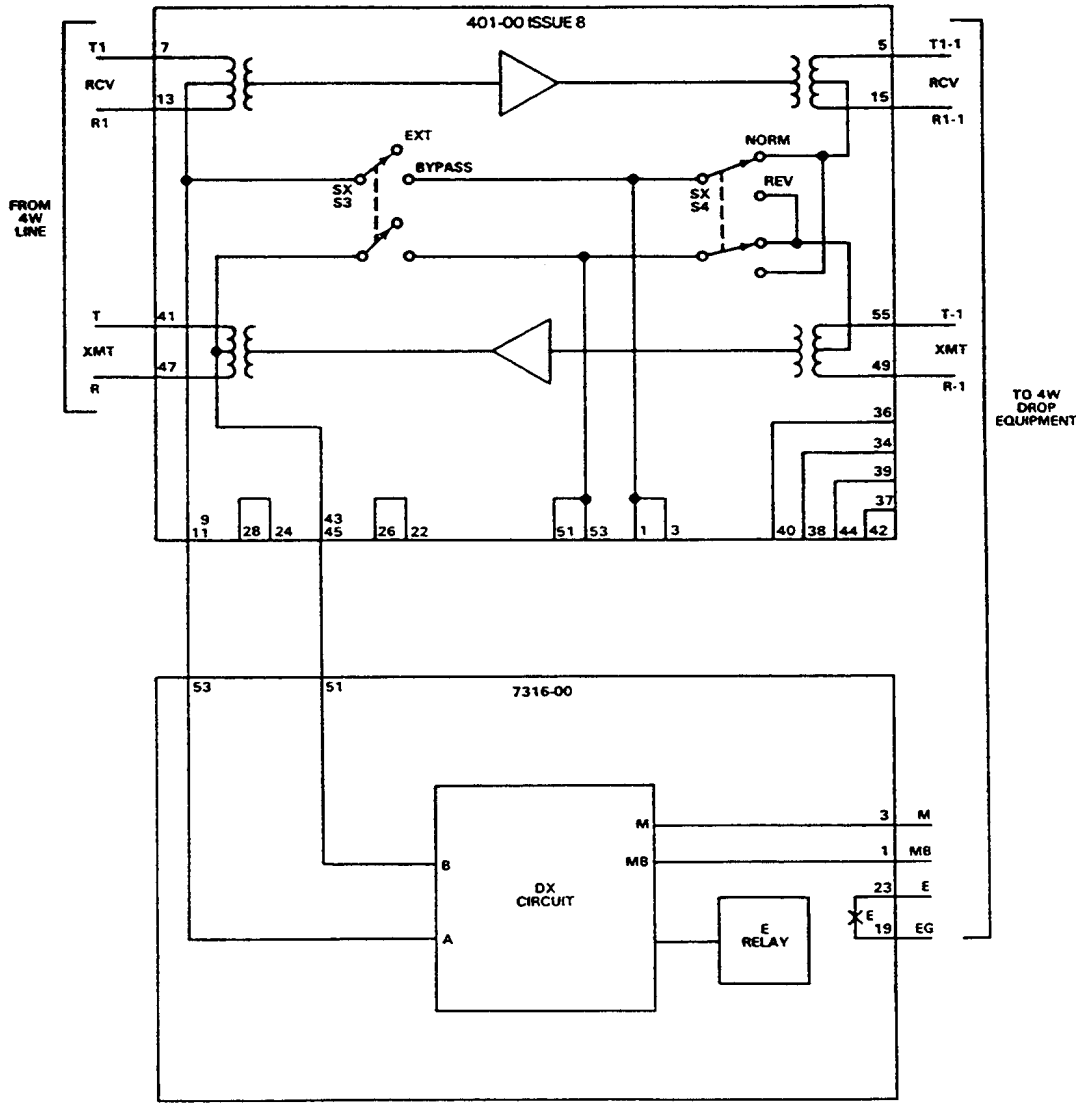

Figure 5. Type 400 Arrangement For 4-Wire DX Signaling Termination

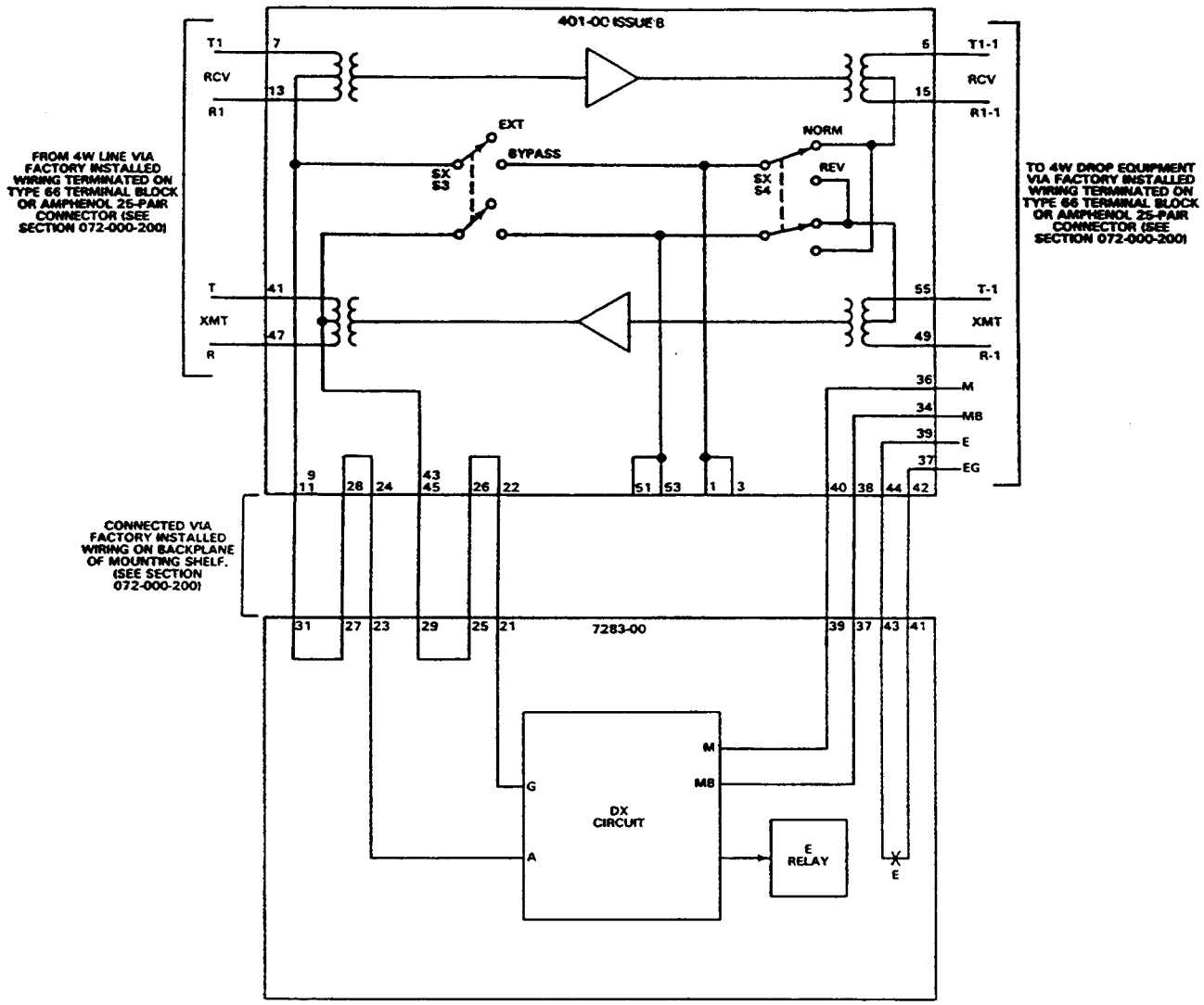

Figure 6. Type 72 Arrangement For 4-Wire DX Signaling Termination

3. CIRCUIT DESCRIPTION

Refer to Figure 7, the 401–00 4-Wire Line Amplifier (Issue 8) Block Diagram, while reading the following circuit description.

3.1 Receive Voice Path

The receive voice path and the transmit voice path are configured identically. Therefore, to avoid redundancy in the following paragraphs, the detailed circuit description will be limited to the receive voice path.

Voice energy from the receive pair of the 4-wire facility enters the line side of the 401–00 on T (pin 7) and R (pin 13) and is passed through the RCV LINE and MON test jacks into TI. Transformer T1 derives an SX lead from the facility receive pair and also matches the receive pair impedance (150, 600, or 1200 ohms) to the input impedance of the receive amplifier. The output of TI is ’passed through impedance selector switch S1–A and the HI/LOW attenuator switch S5 to the receive amplifier. The receive amplifier increases the level of incoming voice energy by up to 28dB, depending upon the setting of the RCV LVL control located on the front panel.

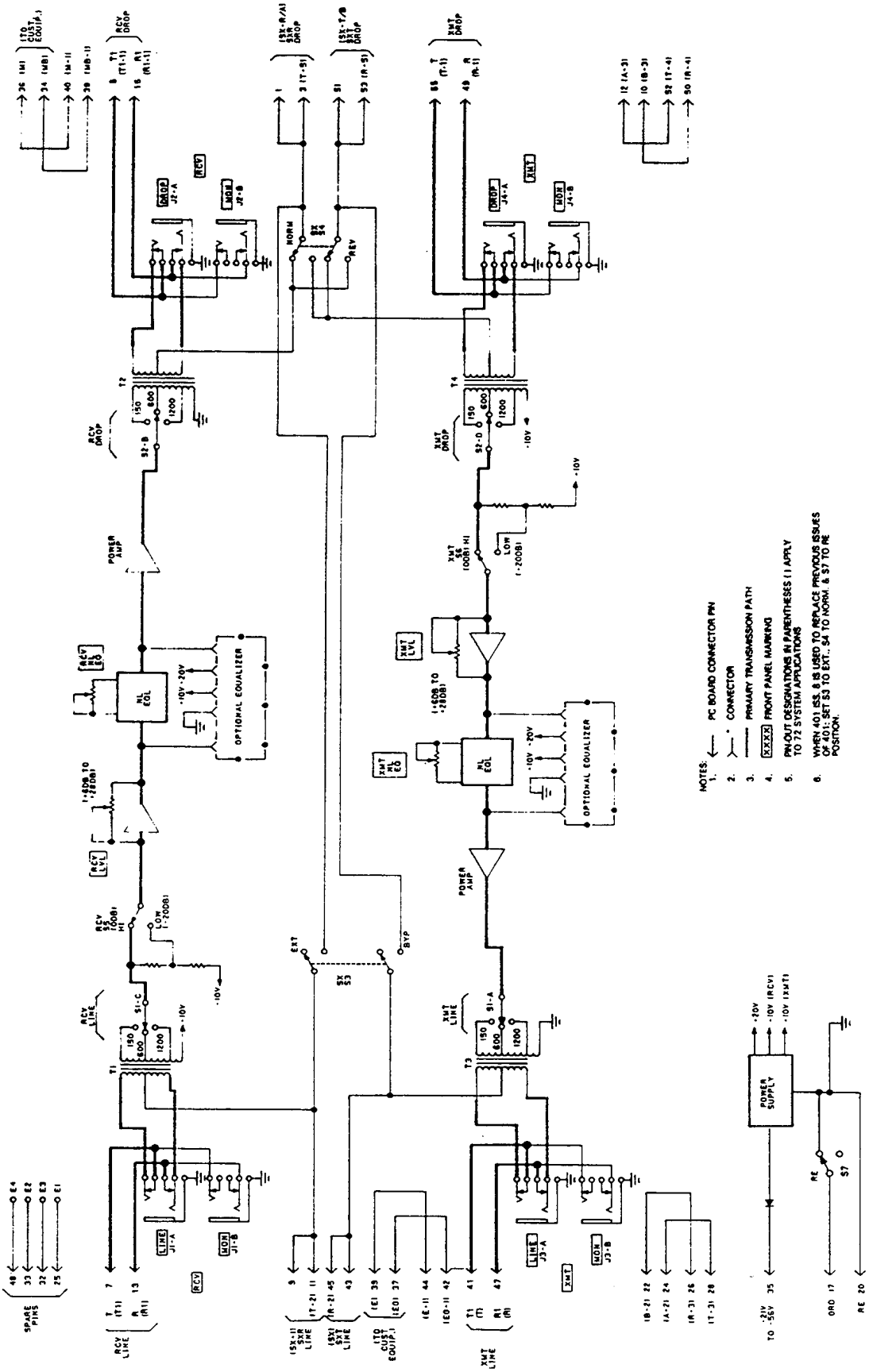

Figure 7. 401–00 4-Wire Line Amplifier (Issue 8) Block Diagram

Voice energy leaving the receive amplifier is passed through the Nonloaded Equalizer (NL EQL) or through the optional 7407–01 Equalizer for H88 loaded cable (if used) where amplitude equalization is applied to correct for any bandpass distortion incurred as a result of cable frequency-response characteristics. Voice energy leaving the equalizer is amplified by the POWER AMP and then coupled via T2 and the RCV DROP and MON jacks to the receive drop interface on T1 (pin 5) and R1 (pin 15). Transformer T2 and impedance selector switch S2–A match the output impedance of the POWER AMP to the impedance of the receive drop facility (150, 600, or 1200 ohms). Additionally, T2 derives from the receive pair of the drop-side facility, an SX lead which may be used to pass dc signaling current or sealing current to the drop equipment.

3.2 Transmit Voice Path

Voice energy from the drop equipment or facility enters the 401–00 on T (pin 55) and R (pin49) and is processed as in the receive path description of the preceding paragraphs. Subsequently, it exits the 401–00 via Tl (pin 41) and R1(pin 47) which are connected to the facility transmit pair.

3.3 SX Lead Signaling Path

Transformers T1 and T3 derive SX leads from the facility receive and transmit pairs, respectively. The SX lead derived from the receive pair is terminated on pins 9 and 11, while the SX lead derived from the transmit pair is terminated on pins 43 and 45. Similarly, T2 and T4 derive SX leads from the receive and transmit pairs of the drop side facility, respectively. These leads pass through the NORM/REV switch (SX S4) to their terminations on the module connector. Setting SX S4 to the NORM position connects the SX lead derived from the receive drop side pair to pins 1 and 3, while it connects the SX lead derived from the transmit drop side pair to pins 51 and 53. Setting SX 54 to the REV position exchanges the drop side transmit pair and receive pair SX leads relative to their terminations on the module connector.

Normally, the line side SX leads are isolated from the drop side SX leads, permitting the line and drop side SX leads to be used independently of each other. However, option switch SX S3 can be closed to interconnect the line side and drop side SX leads when it is required to bypass dc signaling through the 401–00 from line to drop.

3.4 Power Regulation

Operating power for the 401–00, which may range from –21 to –56Vdc, enters the module on pin 35 and feeds the POWER SUPPLY circuit. This circuit provides constant output voltages of –20 and –10, regardless of input voltage variation, for powering the integrated circuit amplifiers in the transmit and receive paths of the module.

4. INSPECTION

Inspect the equipment thoroughly upon delivery. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company.

Wescom equipment is identified by a model and issue number imprinted on the front panel or located elsewhere on the equipment. 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 both the model number and its issue number when making inquiries about the equipment.

5. MOUNTING

The 401–00 is arranged for mounting in standard Wescom 400-type mounting assemblies. For additional information, refer to the Section on Type 400 Mounting Assemblies and the Section on Types 4402–XX through 4407–XX Universal Mounting Shelves.

Alternatively, the 401–00 (beginning with issue 6) may be mounted in one position of a 72MA–XX or 72MB–XX Station Package. These mounting arrangements are factory prewired and have wire-wrap or connectorized terminations. Further information on these mounting arrangements can be found in Section 072–000–200.

6. INSTALLER CONNECTIONS

All electrical connections to the 401–00 are made through a 56-pin, wire-wrap, card-edge connector provided as a part of the mounting shelf. If the module is installed in a 400-type shelf, make all installer connections in accordance with information contained in Table 1. If the 401–00 is mounted in the prewired Type 72 Family, no installer connections are required.

Table 1. 401–00 Installer Connections

GENERAL 401–00 APPLICATIONS	
LEAD DESIGNATIONS	**PIN NO.**
T tip RCV LINE R ring	7 13
T1 tip XMT LINE R1 ring	41 47
T1 tip RCV DROP R1 ring	5 15
T tip XMT DROP R ring	55 49
SXT LINE	43, 45
SXR LINE	9, 11
SXT DROP	51, 53
SXR DROP	1, 3
–21 TO –56	35
GRD	17
RE (repeater enable)	20

TYPE 72 FAMILY UNIVERSAL WIRING PLAN	
LEAD DESIGNATIONS	**PIN NO.**
T tip RCV LINE R ring	7 (T1) 13 (R1)
T1 tip XMT LINE R1 ring	41 (T) 47 (R)
T1 tip RCV DROP R1 ring	5 (T1–1) 15 (R1–1)
T tip XMT DROP R ring	55 (T–1) 49 (R–1)
SXT LINE	43, 45 (R–2)
SXR LINE	9, 11 (T–2)
SXT DROP	51, 53 (R–5)
SXR DROP	1, 3 (T–5)
–21 TO –56	35
GRD	17
RE (repeater enable)	20
Strapping for compatibility with Type 72 Universal Wiring Plan.	10 (B–3) to 50 (R–4) 12 (A–3) to 52 (T–4) 22 (B–2) to 26 (R–3) 24 (A–2) to 28 (T–3) 34 (MB) to 38 (MB–1) 36 (M) to 40 (M–1) 37 (EG) to 42 (EG–1) 39 (E) to 44 (E–1)

7. OPTIONS

The 401–00 (Issue 8) has all slide switch options for selecting the line side and drop side 4-wire impedances, transmit and receive path attenuation (HI/LOW gain), drop side SX lead interchange and line side to drop side SX lead by-pass. In addition, it has jacks for accepting optional H88 Loaded Cable Equalizer Subassemblies in the transmit and receive paths. Refer to Figure 8 for the locations of these options on the 401–00 circuit board. Condition the options as instructed in the following paragraphs and Table 2.

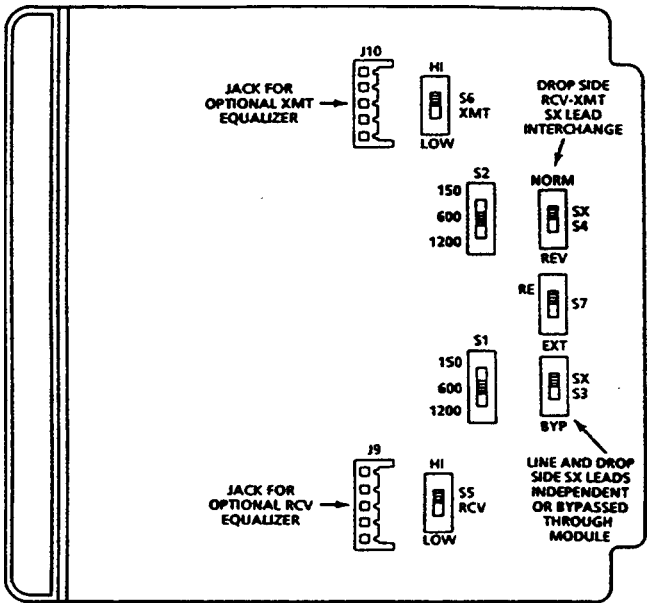

Figure 8. 401–00 Option Locations

7.1 Impedance Matching Selector Switches at the Line (S1) and Drop (S2) Interfaces (150, 600,1200 Ohms)

Select the required impedance at the line interface by placing selector switch S1 in the 150, 600, or 1200 ohm position as required to match the line impedance. Place selector switch S2 in the 150, 600, or 1200 ohm position as required to match the impedance of the drop equipment or facility.

7.2 Transmit and Receive Path Gain Range Switches S6 and SS (HI/LOW)

The amount of gain (or loss) required in each direction through the 401–00 depends upon the design requirements. This gain requirement is determined in the Alignment Procedures (Part 8) of this Section. Two gain ranges are provided; for a range of –10dB to + 12dB, place the XMT (S6) or RCV (SS) gain range switch (as required) in the LOW position. For a range of + 8dB to + 28dB, place the appropriate gain switch in the H1 position.

7.3 Drop Side RCV-XMT SX Lead Interchange (SX S4 NORM-REV)

The connections to the SX leads derived from. the receive and transmit paths on the drop side of the 401–00 can be interchanged by means of the SX S4 switch. To connect the receive path SX lead to pins 1 and 3, and the transmit path SX lead to pins 51 and 53, place the SX S4 switch in the NORM position. To interchange these leads such that the receive path SX lead exists on pins 51 and 53 and the transmit path SX lead exists on pins 1 and 3, place the SX S4 switch in the REV position.

CAUTION

When using an issue 8 (or Issue 6) to replace an Issue 5 or earlier 401—00, place the SX S4 option switch in the NORM position to ensure compatibility with existing shelf wiring.

7.4 SX Lead Bypass From Line To Drop (SX S3 EXT-BYP)

The pair of SX leads derived from the line and the pair of leads derived from the drop can be isolated from each other (external mode) or the line SX leads can be connected through the 401–00 to the drop SX leads (bypass

mode). The external mode is usually the required mode for repeater application at a signaling terminal. The by-pass mode is usually the required mode for repeater application at an intermediate location between signaling terminals if signaling regeneration is not required. For external SX leads with line-drop isolation, place the SX S3 switch in the EXT position. For line SX lead extension to the drop SX leads, place the SX S3 switch in the BYP position.

CAUTION

When using an Issue 8 (or issue 6) to replace an issue 5 or earlier 401—00, place the SX S3 option switch in the EXT position to ensure compatibility with existing shelf wiring.

Table 2. 401–00 Optioning Information

SWITCH DESIG.	SWITCH POSITIONS	SWITCH FUNCTIONS
S1 LINE SIDE	150	150 ohm line side impedance
	600	600 ohm line side impedance
	1200	1200 ohm line side impedance
S2 DROP SIDE	150	150 ohm drop side impedance
	600	600 ohm drop side impedance
	1200	1200 ohm drop side impedance
S3 (SX S3 EXT-BYP)	BYP	SX lead bypass from line to drop
	EXT	External SX leads with line-drop isolation
S4 (SX S4 NORM-REV)	NORM	Connects drop side RCV path SX lead to pins 1 and 3 and XMT path SX lead to pins 51 and 53
	REV	Connects drop side RCV path SX lead to pins 51 and 53 and XMT path SX lead to pins 1 and 3
S5 (HI/LOW)	LOW	Selects RCV path gain range of –10dB to +12dB
	HI	Selects RCV path gain range of +8dB to +28dB
S6 (HI/LOW)	LOW	Selects XMT path gain range of –10dB to +12dB
	HI	Selects XMT path gain range of +8dB to +28dB
S7 (RE-OFF)	RE	Selects continuous repeater enable
	Off (unmarked)	Selects repeater enable via the application of a ground signal to pin 20
Jacks J9 & J10		Jacks in RCV and XMT paths in for optional Wescom 7407–01 Equalizer Subassemblies
OPTIONAL 7407–01 EQUALIZER SUBASSEMBLIES		
S1 (EQUAL)	IN	Enable 7407–01
	OUT	Disable 7407–01

7.5 External Repeater Enable (Switch S7)

For continuous repeater enable, place switch S7 in the RE position. For enabling the repeater via the application of a ground signal to pin 20, place switch S7 in the unmarked position.

CAUTION

When using an Issue 8 to replace an earlier 401—00, place switch S7 in the RE position to ensure compatibility with existing shelf wiring.

7.6 Jacks J9 And J10 For Optional 7407–01 Equalizer Subassemblies (H88 Loaded Cable Equalization)

When either the line side facility, the drop side facility, or both, are comprised of H88 loaded cable, amplitude equalization for this type of facility is usually required. Suitable amplitude equalization can be provided in the receive path by installing an optional Wescom 7407–01 Equalizer Subassembly into jack J9. When such equalization is required in the transmit path, a 7407–01 can be installed into jack J 10. Adjust the LF EQ and HF EQ controls on the 7407–01 equalizer according to the instructions in the Alignment Procedure in Part S. (The LF EQ and HF EQ controls are both accessible through the front panel of the 401–00.) An EQUALIZER IN/OUT slide switch for enabling/disabling the unit is located on the 7407–01 circuit board. 7407–01 option locations are shown in Figure 9.

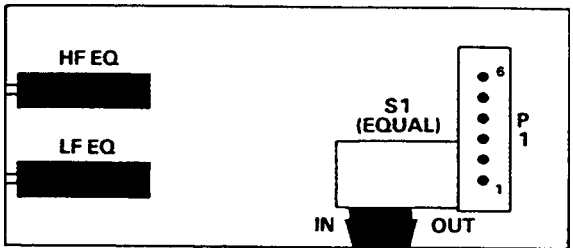

Figure 9. 7407–01 Option Locations

For option location diagrams and other information for 401–00 (Issue 6 and earlier), refer to Section 040–100–206.

8. ALIGNMENT

The 401–00 has gain controls which must be adjusted to set the transmit drop Transmission Level Point (TLP) and the receive drop TLP. It also has gain controls for nonloaded cable equalization and, when equipped with the optional 7407–01 Equalizer Subassemblies, there are additional controls for H88 loaded cable equalization. Perform the alignment of the 401–00 using these controls in accordance with the Alignment Procedure in either 9.1 or 9.2, as required. Use 9.1 when the line side of the repeater interfaces with nonloaded cable or when amplitude equalization is not required. Use 9.2 when the line side interfaces with H88 loaded cable and an optional 7407–01 Equalizer Sub-assembly is installed in either the receive path, or the transmit path, or both.

To perform the Alignment Procedure, the following test equipment is required:

- Transmission Measuring Set (TMS); WECo 23A, Hewlett Packard 3550, or equivalent with a self-,contained Variable Frequency Oscillator (VFO). One such unit is required at both near and far ends of the facility.
- Three-conductor test cords having one end terminated in bantam plugs and the other end terminated in plugs suitable for connecting to the TMS and VFO.
- One open bantam plug.

9. TESTING

After all installer connections, optioning. and alignment procedures have been completed in accordance with the appropriate instructions, it is recommended that a talk path and signaling test of the facility be conducted to verify proper performance. If the 401–00 is used with a companion signaling applique and a signaling problem is encountered. replace the applique with a spare one and restest. If the condition is not corrected, replace the 401–00 with a spare and perform the alignment procedure again.

9.1 Alignment Procedure for a Nonloaded Cable Facility

Step	Action
1.	**Facility Line Verification** Arrange the TMS for terminated measurement at the impedance of the line side facility's receive pair. Connect the TMS to the RCV MON (LINE) jack on the front panel of the401–00. Insert an open bantam plug into the RCV LINE jack on the 401–00 to disconnect the repeater circuit from the receive pair.
2.	Arrange for the transmission of a 1000Hz test tone by the terminal at the far end of the facility, at the level and impedance specified on the Circuit Layout Record (CLR) card.
3.	Observe the level on the TMS. If the observed level is below the minimum specified on the CLR card for the receive line port of the 401–00, locate and repair the facility fault before proceeding with the alignment.
4.	**Receive Alignment** Arrange the TMS for terminated measurement at the impedance of the drop side facility's receive pair and connect it to the RCV DROP jack on the 401–00. (Remove the open bantam plug from the RCV LINE jack.)
5.	Rotate the RCV NL EQ control (401–00 front panel) to the extreme counterclockwise (CCW) position (25 turns). Set the RCV HI/LOW gain switch on the circuit board of the 401–00 to the LOW position. Adjust the RCV LVL control on the front panel to set the gain of the receive path to the level specified on the CLR card (clockwise to increase gain; counterclockwise to reduce gain). If the required level cannot be reached, set the gain switch to HI and readjust the RCV LVL control.
6.	**RECEIVE EQUALIZATION ADJUSTMENT (If Required)** Change the frequency of the tone transmitted by the far-end terminal to that specified for low-frequency test tone on the CLR. Measure and record the level of low-frequency test tone observed on the TMS.
7.	Change the frequency of the signal transmitted by the far-end terminal to that specified for high-frequency test tone on the CLR card. Measure and record the level observed on the TMS.
8.	Subtract the level recorded in Step 7 for high-frequency test tone from that recorded in Step 6 for low-frequency test tone to determine the need for equalization. If equalization is required, turn the RCV NL EQ control on the 401–00 front panel approximately four turns clockwise (CW) and repeat Steps 6, 7, and 8 to determine the degree of correction obtained. Advance the RCV NL EQ control and repeat Steps 6, 7. and 8 as required until equalization is complete, i.e., until the difference between the levels observed in Steps 6 and 7 is minimized.
9.	Change the frequency of the signal transmitted by the far-end terminal to 1000Hz. Observe the TMS while adjusting the RCV LVL control on the 401–00 (if required) to restore the 1000Hz level specified on the CLR for the receive drop port.
10.	**TRANSMIT ALIGNMENT** Arrange the TMS for terminated measurement at the impedance of the facility transmit port and connect it to the XMT LINE jack on the front panel of the 401–00.
11.	Arrange the VFO for 1000Hz operation at the level and impedance specified on the CLR for the transmit drop port of the 1401–00 and connect it to the XMT DROP jack on the 401–00.
12.	Rotate the XMT NL EQ control (401–00 front panel) to the extreme counterclockwise (CCW) position (25 turns). Set the XMT HI/LOW gain switch on the 401–00 circuit board to the LOW position. Adjust the XMT LVL control on the front panel to set the gain of the transmit path to the level specified on the CLR card (clockwise to increase gain; counterclockwise to reduce gain). If the required level cannot be reached, set the gain switch to HI and readjust the XMT LVL control .
13.	Remove the TMS from the XMT LINE jack and arrange for the measurement of incoming test tone at the far-end terminal. Record the level observed. If this level is below the minimum specified on the CLR, locate and repair the fault in the facility before proceeding with the alignment.
14.	Change the frequency of the VFO to that specified for low-frequency test tone on the CLR card. Measure and record the level of low-frequency test tone received at the far-end terminal.
15.	Change the frequency of the VFO to that specified for high-frequency test tone on the CLR card. Measure and record the level of high-frequency test tone received at the far-end terminal.

Step	Action
16.	Subtract the level recorded in Step 15 for high-frequency test tone from that recorded in Step 14 for low-frequency test tone to determine the need for equalization.
17.	**TRANSMIT EQUALIZATION ADJUSTMENT (If Required)** Turn the XMT NL EQ control on the 401–00 front panel approximately four turns clockwise and repeat Steps 14. 15, and 16 to determine the degree of correction obtained. Advance the XMT NL EQ control and repeat Steps 14, 15. and 16 until equalization is complete, i.e. until the difference between the levels observed in Steps 14 and 15 is minimized.
18.	Change the frequency of the VFO to 1000Hz and measure the test tone level received at the far-end terminal. If equalization has affected the 1000Hz test tone level, readjust the transmit path gain as described in Step 12.
19.	This completes the nonloaded cable alignment procedure of the 401–00. Disconnect the VFO and perform a talk test as a final test of the facility.

9.2 401–00 Alignment Procedure For A H88 Loaded Cable Facility

Step	Action
1.	**Facility Line Verification** Arrange the TMS for terminated measurement at the impedance of the line side facility's receive pair. Connect the TMS to the RCV MON (LINE) jack on the front panel of the 401–00. Insert an open bantam plug into the RCV LINE jack on the 401–00 to disconnect the repeater circuit from the receive pair.
2.	Arrange for the transmission of a 1000Hz test tone by the terminal at the far-end of the facility at the level and impedance specified on the Circuit Layout Record (CLR) card.
3.	Observe the level on the TMS. If the observed level is below the minimum specified on the CLR card for the receive line port of the 401–00, locate and repair the facility fault before proceeding with the alignment.
4.	**Receive Alignment** Arrange the TMS for terminated measurement at the impedance of the drop sides facility's receive pair and connect it to the RCV DROP jack on the 401–00. (Remove the open bantam plug from the RCV LINE jack.)
5.	If receive path equalization is required, plug a 7407–01 Equalizer Subassembly into J9 on the 401–00 circuit board. Place switch S1 on the 7407–01 in the OUT position. Rotate the RCV LF L EQ and RCV HF L EQ controls 25 turns in the CCW direction. These controls are accessible through the front panel of the 401–00.
6.	Rotate the RCV NL EQ control (401–00 front panel) to the extreme counterclockwise (CCW) position (25turns). Set the RCV HI/LOW gain switch on the 401–00 circuit board to the LOW position. Adjust the RCV LVL control on the front panel to set the gain of the receive path to the level specified on the CLR card (clockwise to increase gain; counterclockwise to reduce gain). If the required level cannot be reached, set the gain switch to HI and readjust the RCV LVL control.
7.	**Receive Equalization Adjustment (if required)** Place switch S1 on the 7407–01 to the IN position. Change the frequency of the tone transmitted by the far-end terminal to 400Hz. Adjust the RCV LF L EQ control on the 7407–01 until the TMS reading is the same as the 1000Hz tone requirement given on the CLR card for the 401–00 receive drop port.
8.	Change the frequency of the tone transmitted by the far-end terminal to 2700Hz. Adjust the RCV HF L EQ control on the 7407–01 until the TMS reading is the same as the 1000Hz tone requirement given on the CLR card for the 401–00 receive drop port.
9.	Change the frequency of the tone transmitted by the far-end terminal to 1000Hz. If the reading on the TMS is still within the limits specified on the CLR card, proceed to the next step. If it is not, use the RCV LVL control on the 401–00 to restore the 1000Hz level and repeat Steps 7, 8, and 9. (The interaction between the RCV LF/HF L EQ controls and the RCV LVL control is slight, hence readjustment will not normally be required.)

Step	Action
10.	Check the overall response by measuring the facility levels at the frequency intervals specified on the CLR card, if such intervals are given. Make readjustments as required and then proceed to the transmit path alignment.
11.	**Transmit Alignment** If transmit path equalization is required, plug a 7407–01 Equalizer Subassembly into J10 on the 401–00 circuit board. Place switch S1 on the 7407–01 in the OUT position. Rotate the XMT LF L EQ and the XMT HF L EQ controls 25 turns in the CCW direction. These controls on the 7407–01 are accessible through the front panel of the 401–00.
12.	Arrange the TMS for terminated measurement at the impedance specified on the CLR card for the transmit line port of the 401–00 and connect it to the XMT LINE jack on the 401 –00.
13.	Arrange the VFO for 1000Hz operation at the level and impedance specified on the CLR card for the transmit drop port of the 401–00 and connect it to the XMT DROP jack on the 401 –00.
14.	Rotate the XMT NL EQ control (401–00 front panel) to the extreme counterclockwise (CCW) position (25 turns). Set the XMT HI/LOW gain switch on the 401–00 circuit board to the LOW position. Adjust the XMT LVL control on the front panel to set the gain of the transmit path to the level specified on the CLR card (clockwise to increase gain; counterclockwise to reduce gain). if the required level cannot be reached, set the gain switch to HI and readjust the XMT LVL control.
15.	Disconnect the TMS and measure the level of 1000Hz test tone received at the far end of the facility. If the observed level is below the minimum specified on the CLR card for the receive line at the far end of the facility, locate and repair the fault. If equalization is not required, conclude the alignment procedure by disconnecting all test equipment and performing a talk test.
16.	**Transmit Equalization Adjustment (if required)** If equalization is required, place switch S1 of the 7407–01 (in the transmit path) to the IN position. Change the frequency of the VFO to 400Hz and adjust the XMT LF L EQ control until the level received at the far end is the same as that observed for 1000Hz tone in Step 15.
17.	Change the frequency of the VFO to 2700Hz and adjust the XMT HF L EQ control until the level received at the far end is the same as that observed for 1000Hz tone in Step 15.
18.	Change the frequency of the VFO to 1000Hz and recheck the level received at the far end of the facility. If the reading on the TMS is still within the limits specified on the CLR card, proceed to the next step. If it is not, use the XMT LVL control on the 401–00 to restore the 1000Hz level and repeat Steps 16, 17, and 18 (The interaction between the XMT LF/HF L EQ controls and the XMT LVL control is slight, hence readjustment will not normally be required.)
19.	Check the overall response by measuring the facility levels at the frequency intervals specified on the CLR card, if such intervals are given. Make readjustments as required. This concludes the alignment procedure. Disconnect all test equipment at both ends of the facility and perform a talk test on the facility.

10. TECHNICAL ASSISTANCE

10.1 Technical Assistance — U.S.

If technical assistance is required, contact Charles Industries' Technical Services Center at:

847–806–8500
847–806–8556 (FAX)
800–607–8500
techserv@charlesindustries.com (e-mail)

10.2 Technical Assistance — Canada

Canadian customers call:

905–821–7673 (Main Office)
905–821–3280 (FAX)

11. TECHNICAL ASSISTANCE

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12. WARRANTY & CUSTOMER SERVICE

12.1 Warranty

Charles Industries, Ltd. offers an industry-leading, 5-year warranty on products manufactured by Charles Industries. Contact your local Sales Representative at the address or telephone numbers below for warranty details. The warranty provisions are subject to change without notice. The terms and conditions applicable to any specific sale of product shall be defined in the resulting sales contract.

Charles Industries, Ltd.
5600 Apollo Drive
Rolling Meadows, Illinois 60008–4049

Telephone: 847–806–6300 (Main Office)
847–806–6231 (FAX)

12.2 Field Repairs (In-Warranty Units)

Field repairs involving the replacement of components within a unit are not recommended and may void the warranty and compatibility with any applicable regulatory or agency requirements. If a unit needs repair, contact Charles Industries, Ltd. for replacement or repair instructions, or follow the *Repair Service Procedure* below.

12.3 Advanced Replacement Service (In-Warranty Units)

Charles Industries, Ltd. offers an "advanced replacement" service if a replacement unit is required as soon as possible. With this service, the unit will be shipped in the fastest manner consistent with the urgency of the situation. In most cases, there are no charges for in-warranty repairs, except for the transportation charges of the unit and for a testing and handling charge for units returned with no trouble found. Upon receipt of the advanced replacement unit, return the out-of-service unit in the carton in which the replacement was shipped, using the preaddressed shipping label provided. Call your customer service representative at the telephone number above for more details.

12.4 Standard Repair and Replacement Service (Both In-Warranty and Out-Of-Warranty Units)

Charles Industries, Ltd. offers a standard repair or exchange service for units either in- or out-of-warranty. With this service, units may be shipped to Charles Industries for either repair and quality testing or exchanged for a replacement unit, as determined by Charles Industries. Follow the *Repair Service Procedure* below to return units and to secure a repair or replacement. A handling charge applies for equipment returned with no trouble found. To

obtain more details of this service and a schedule of prices, contact the CI Service Center at 217–932–5288 (FAX 217–932–2943).

Repair Service Procedure

1. Prepare, complete, and enclose a purchase order in the box with the equipment to be returned.

2. Include the following information:

   – Company name and address
   – Contact name and phone number
   – Inventory of equipment being shipped
   – Particulars as to the nature of the failure
   – Return shipping address

3. Ship the equipment, purchase order, and above-listed information, transportation prepaid, to the service center address shown below.

   CI Service Center
   Route 40 East
   Casey, IL 62420–2054

4. Most repaired or replaced units will be returned within 30 or 45 days, depending on the product type and availability of repair parts. Repaired units are warranted for either 90 days from the date of repair or for the remaining unexpired portion of the original warranty, whichever is longer.

13. SPECIFICATIONS

13.1 Electrical

The electrical characteristics of the 401–00 (Issue 8) are as follows:

(a) AMPLIFIER GAIN RANGE: –10dB to +28dB (at 0dB equalization setting).

(b) MAXIMUM OUTPUT LEVEL: +8dBm.

(c) IMPEDANCE (LINE AND DROP): 150, 600 or 1200 ohms (impedances selected by slide switches).

(d) FREQUENCY RESPONSE: Within +1dB. 300Hz to 4kHz relative to 1kHz (at 0dB equalization setting).

(e) TOTAL HARMONIC DISTORTION: Less than 1% at +8dBm, at 0dB equalization setting and within an ambient temperature of 72°F (22°C).

(f) ENVELOPE DELAY DISTORTION: 600 to 3400Hz. less than 50usec; 400 to 3400Hz. less than 100usec.

(g) NOISE LEVEL: 10dBrnc maximum at +28dB gain (input terminated).

(h) NONLOADED CABLE EQUALIZATION: Gain differential between 300Hz and 4kHz is adjustable from 0 to 12dB.

(i) H88 LOADED CABLE EQUALIZATION (OPTIONAL): Module accepts plug-in 7407–01 Equalizer Subassemblies in the transmit and receive paths. The 7407–01 provides a low-frequency gain range of –4dB to +2dB at 400Hz, and a high-frequency gain range of –2dB to +10dB at 3250Hz

(j) SIMPLEX DC RESISTANCE: Input and output winding, 7 ohm maximum.

(k) SIMPLEX CURRENT: 100mA maximum without degradation of performance: maximum unbalance, 5mA.

(l) POWER REQUIREMENTS:

	Input Voltage (dc)	Maximum Idle Current (mA)	*Maximum Busy Current (mA)
With no 7407–01 equalizer	–21 –24 –48 –56	14 15 20 22	21 22 28 30
With one 7407–01 equalizer	–21 –24 –48 –56	19 20 25 27	26 27 33 35
With two 7407–01 equalizers	–21 –24 –48 –56	24 25 60 32	31 32 38 40

13.2 Physical

The physical characteristics of the 401–00 (Issue 8) are as follows:

Feature	U.S.	Metric
Height	5.6 inches	14.2 centimeters
Weight	15 ounces	425 grams
Width	1.4 inches	3.55 centimeters
Depth	6.0 inches	15.2 centimeters
Temperature	32 to 120°F	0 to 49°C
Mounting	Occupies one position in a 400-type mounting assembly. Unit may also be mounted in one position of a Type 72 Mounting Shelf or Station Package.	