

441 and 442 Terminating Sets

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1. GENERAL

1.01 This Section provides circuit description, installation, and basic testing information for the Wescom 441 and 442 Terminating Sets.

1.02 The 441 and 442 Terminating Sets (Figure 1) are plug-in, printed-circuit modules used to provide two-wire termination of a four-wire facility.

1.03 Features provided by the 441 and 442 Terminating Sets are:

(a) A strappable compromise balance network and strappable network buildout (NBO) capacitors are provided to balance the term set two-wire impedance to the impedance of the two-wire drop. Connections are also included for the use of an external precision balance network to optimize transhybrid loss, when required.

(b) Attenuation provided by continuously variable, 0 to -30 dB "T" pads, used on

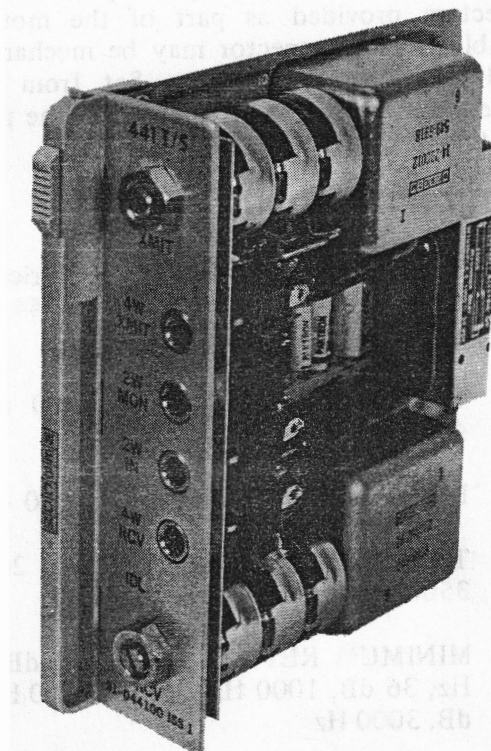


Figure 1. 441 Terminating Set

both the transmit and receive lines to provide a nearly constant 600-ohm impedance (unaffected by attenuator setting) towards the four-wire line.

(c) An optional Idle Line Termination (ILT) relay may be included within either the 441 or 442 module, as specified when ordering. The ILT relay, inserted in the transmit leg between the transmit line and the hybrid, provides a 600-ohm termination toward the hybrid, during idle.

(d) Plug-in module construction to allow the application of the substitution approach which assures rapid servicing of the equipment and provides minimum down time.

1.04 Each Term Set is constructed as a plug-in module, designed to mount in one position of the Wescom Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in

capacities of from 1 to 13 modules and allow for either KTU apparatus-case or relay-rack mounting.

1.05 The Term Sets make electrical connection to the system through 56-pin, wire-wrap connectors provided as part of the mounting assembly. Each connector may be mechanically keyed to prevent the Term Set from being inserted into any position other than the proper mounting-assembly position.

2. SPECIFICATIONS

2.01 Specifications describing the electrical and physical characteristics of the 441 and 442 Term Sets are as follows:

- (a) TWO-WIRE IMPEDANCE: 900 ohms, 441; 600 ohms, 442.
- (b) FOUR-WIRE IMPEDANCE: 600 ohms.
- (c) TRANSHYBRID LOSS: 50 dB, 200 to 3500 Hz (Matched Transmission).
- (d) MINIMUM RETURN LOSS: 30 dB, 500 Hz; 36 dB, 1000 Hz; 38 dB, 2000 Hz; 38 dB, 3000 Hz.
- (e) HYBRID INSERTION LOSS: 4.0 dB nominal.
- (f) BALANCE NETWORK: 2.15 uF and 600 or 900 ohms.
- (g) MAXIMUM A & B LEAD CURRENT: 100 mA without degradation in specifications.
- (h) NETWORK BUILD OUT CAPACITANCE: 0.010 to 0.150 uF (in 0.010 uF steps).
- (i) OPERATING ENVIRONMENT: Temperature, -5° to 150° F (-20 to 65° C) Humidity, 95%.
- (j) DIMENSIONS: Height, 7 inches; Width, 1-13/16 inches; Depth, 7-3/8 inches (including one-position mounting assembly).
- (k) WEIGHT: 1.75 lbs (3.25 lbs including one-position mounting assembly).

- (l) MOUNTING: KTU apparatus case or relay rack.

3. INSPECTION

3.01 Inspect the equipment thoroughly, as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately. If the equipment is to be stored for some time before installation, make an operational check at once. The purpose of this check is to make sure that the equipment is in proper working order as received from the factory. If this check indicates satisfactory performance, the equipment may be stored for future installation. If the System is to be installed at once, make an operational check after the installation is completed.

3.02 Wescom equipment is specifically identified by the model number and final-assembly number silk screened on the front panel of the plug-in module. At the start of production, the final-assembly number is assigned an issue number of 1 which becomes an integral part of the final-assembly number. After the start of production, this issue number is advanced each time a major engineering change occurs. Therefore, be sure to use the model number and final-assembly number when making inquiries about the equipment. The issue number of the instruction manual and schematic diagram attached should be the same as the issue number assigned to the equipment. If a one-to-one correspondence does not exist between these items request from Wescom the instruction manual required for your equipment.

4. MOUNTING

4.01 The 441 and 442 Term Set is designed to mount in one module position of a Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and may be factory-wired and equipped with any combination of 441 and 442 Term Set modules and other Wescom products (line amplifiers, SF signaling units, echo suppressors, etc.).

KTU apparatus case mounting

4.02 Type 400-1 (one-module) through 400-5 (five-module) Mounting Assemblies may be installed in a 15A (equivalent to W.E. Co. 31B)

KTU apparatus case. Type 400-1 through 400-13 Mounting Assemblies may be installed in a 16C (equivalent to W.E. Co. 16C) KTU apparatus case.

relay rack mounting

4.03 Type 400-1 through 400-9 Mounting Assemblies require the use of mounting bars, when mounted on either a 19- or 23-inch relay rack. 400-10 and 400-11 Mounting Assemblies are provided with mounting brackets for mounting directly across 19-inch relay racks. Type 400-12 and 400-13 Mounting Assemblies are also provided with mounting brackets for 23-inch relay rack mounting.

4.04 Because Type 400-1 through 400-9 Mounting Assemblies must be installed on mounting bars, 7 inches of vertical space (four-mounting spaces) are required for relay-rack mounting. Type 400-10 through 400-13 Mounting Assemblies, however, are provided with mounting extensions located on the sides of the mounting assemblies and require only 6 inches of vertical rack space. Install the mounting assembly in a KTU apparatus case or on a relay rack (as described above) with mounting hardware provided.

universal shelf mounting

4.05 When a high degree of flexibility is required to provide for new circuit arrangements as well as circuit rearrangements, the Term Set may be mounted in a Wescom Universal Shelf. The Universal Shelf permits all inter-module wiring and installer connections to be made at the front of the mounting assembly and provides maximum accessibility to these connections when changes are required. The Type 400UA-11 and 400UB-11 Universal Shelves provide mounting positions for up to 11 modules and are designed for mounting in a 19-inch relay rack. Type 400UA-13 and 400UB-13 Universal Shelves provide mounting positions for up to 13 modules and are designed for mounting in a 23-inch relay rack.

5. INSTALLER CONNECTIONS

5.01 The 441 and 442 Term Sets make electrical connection to the system through 56-pin, wire-wrap card connectors provided as part of the mounting assembly; all installer connections are made to these connectors. Make the connections in accordance with Table 1.

Table 1. 441 and 442 Term Set, Installer Connections

INSTRUCTION	LABEL DESIGNATION	56-PIN CONNECTOR ASSIGNMENT
Connect:	To:	At:
transmit line receive line system ground two-wire drop A lead B lead D lead (when required) F lead (when required) G lead (when required) ILT relay coil (when required) external balance network (when required)	XMIT LINE T & R RCV LINE T1 & R1 GRD 2W DROP T & R A LEAD B LEAD D LEAD F LEAD G LEAD SL (+) & B (-) BAL NET	55 and 49 5 and 15 17 41 and 47 43 45 51 19 27 29 (+) and 25 (-) 7 and 13

5.02 Type 400UA-11 and 400UA-13 Universal Shelves provide terminal block locations above the mounting assembly, whereas Type 400UB-11 and 400UB-13 Universal Shelves provide terminal block locations below the mounting assembly. When the Term Set is installed in a universal shelf, make all installer connections to these terminal blocks in accordance with Table 1.

CAUTION: Do not make any connections with power applied to the equipment.

strapping

5.03 The 441 and 442 Terminating Sets are provided with four strapping options. Strapping posts are provided on the printed-circuit side of the boards to facilitate strapping. Perform the strapping procedures as required, in accordance with the following paragraphs and Figure 2.

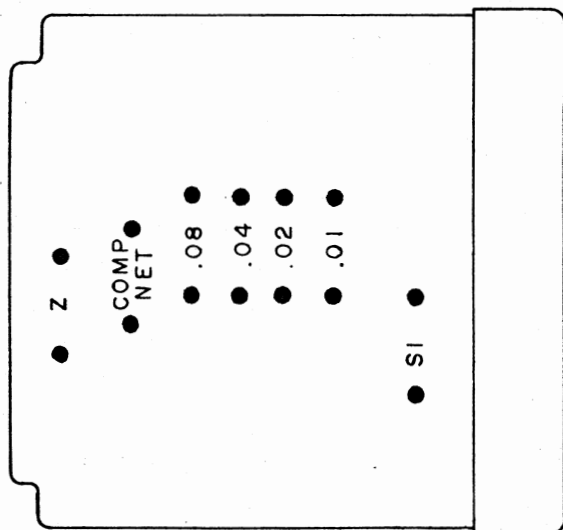


Figure 2. Strapping Post Location

CAUTION: When soldering straps, use insulated strap wire and NOT larger than a 30-watt iron.

5.04 Balancing Network-If an external precision balancing network is NOT specified on the Circuit Layout Record (CLR) card, the Term Set internal COMP NET will be used; place

an insulated wire strap across the COMP NET strapping posts (if not present). If an external precision balancing network has been provided, make certain that the COMP NET strap is removed.

5.05 S1 Option – The S1 strapping option places a capacitor across the A and B leads. Unless otherwise specified on the CLR card, the S1 strap is normally required and is installed in each term set at the factory. If an external capacitor has been provided across the A and B leads, it may be used in place of the capacitor provided by the S1 option.

NOTE: For optimum performance it is preferable to remove any external capacitance wired across the A and B leads and to provide the required capacitance internally by using the S1 option.

When using a tie trunk circuit to open and close the B and D leads, remove the S1 strap in the Term Set and insert the required capacitance in the external circuit.

5.06 Idle Line Termination Option-All of the 441 and 442 Terminating Sets are arranged to accept the optional Idle Line Termination (ILT) relay. To determine if the Term Set is equipped with ILT relay, examine the component side of the Term Set. If a Magnecraft Relay is located near the connector, the ILT feature has been provided and the strapping procedures discussed in paragraphs 5.07 and 5.08 must be considered. If the ILT feature has not been provided, no strapping is required; proceed to paragraph 5.09.

5.07 If the ILT relay has been provided, but is not required, the relay must be strapped and wired so that it is held operated at all times. Perform the strapping procedures in accordance with step (a) (24 Vdc operation) or step (b) (48 Vdc operation) below.

- (a) 24 Vdc Operation. If the ILT is to be held operated by a 24-Vdc supply, make certain that strapping option "Z" is connected. Connect an insulated wire jumper from pin 25B (-) at the rear of the Term Set Mounting Assembly to the -24 Vdc supply and connect another jumper from pin 29 SL (+) to ground.

jumper from pin 29 SL (+) to ground.

- (b) 48 Vdc Operation. If the ILT is to be held operated by a 48-Vdc supply, make certain that any existing strap across the "Z" strapping posts is removed. Connect an insulated wire jumper from pin 25 B (-) at the rear of the mounting assembly to the -48 Vdc supply and connect another jumper from pin 29 SL (+) to positive ground.

5.08 NBO Capacitors – Each of the term sets is provided with NBO capacitors which may be strapped to add from 0.010 to 0.150 uF capacitance (in 0.010 uF steps) to match the capacitance of the two wire drop. After performing the Line-Up procedure strap these capacitors as outlined in paragraph 6.06.

inserting modules

5.09 When all installer connections and strapping have been completed insert the Term Set into the mounting assembly. An identification label designated 441 or 442 is also provided on the front lower lip of the mounting assembly if the mounting assembly is factory wired.

CAUTION: Do not force a module into place. If you encounter excessive resistance while installing the Term Set, remove the module and check the card guides and connector for improper alignment or the presence of foreign particles.

6. LINE-UP

6.01 The alignment procedure for the 441 or 442 Terminating Set consists of first adjusting the transmit level by injecting test tone into the 2W IN test jack and measuring it at the 4W XMIT test jack while adjusting the XMIT control to obtain the desired transmission level. The receive level is then adjusted, measuring test tone from the distant terminal at the 2W IN test jack while adjusting the RCV control to obtain the desired receive level.

6.02 The NBO capacitors should be strapped for maximum return loss using the procedure in paragraph 6.06.

test equipment

6.03 Test equipment required at both the local and distant terminals to align and test the 441 or 442 Term Set is as follows:

- (a) Transmission Measuring Set (TMS): Northeast Electronics TTS4AN or W.E. Co. 23A (or equivalent) capable of measuring to at least -60 dBm will be required.
- (b) Variable Frequency Oscillator (VFO): Hewlett Packard 200 CD (or equivalent) capable of generating 300- to 3000-Hz signals.

NOTE: If the Northeast Electronics TTS4AN is used and is equipped with the TTS4XDV cover accessory, the VFO is not required.

- (c) Associated Test Cords: Two, two-conductor test cords equipped with a 310 plug at each end.

- (d) Capacitor Decade Box: General Radio 1419 or 1419A (or equivalent) capable of simulating 0.010 to 0.150 uF capacitance in 0.010 uF steps (optional for hybrid balance procedure).

6.04 Perform the following preliminary steps to prepare for the alignment procedure:

- (1) Verify the two-wire impedance of the Term Set. The 441 Term Set two-wire impedance is 900 ohms and 442 Term Set is 600 ohms. The four-wire impedance is fixed at 600 ohms.

- (2) If the ILT feature has been provided on the Term Set ascertain that it is connected and energized (or bypassed) to maintain circuit continuity.

- (3) Verify the need for the S1 option and whether the internal COMP NET strap or an external precision balance network is used. Normally the internal is used. Verify that the NBO capacitors are NOT strapped in at this time.

- (4) Loosen the locknuts on the XMIT and RCV controls on the Term Set front panel.

transmit and receive level

6.05 Adjust transmit and receive levels of the Terminating Set as follows:

- (1) Condition the local VFO to apply a 1000-Hz test tone at the level and impedance specified on the CLR card and connect it to the 2W IN test jack on the Term Set front panel.
- (2) Connect the TMS (set for 600-ohm termination) to the 4W XMIT test jack on the Term Set.
- (3) Rotate the XMIT control until the TMS indicates the value specified on the CLR card for the transmit level.
- (4) Disconnect the VFO and the TMS; connect the TMS (set for 2W line termination) To the 2W IN test jack.
- (5) Remove the leads from terminals 5 and 15 (receive line) and connect the VFO (600 ohms) set for 1000 Hz at the level specified on the CLR card.
- (6) Rotate the RCV control until the TMS indicates the value specified on the CLR card for the station receive level.

hybrid balance (return loss)

6.06 Perform the hybrid balance procedure on the 441 or 442 Terminating Set as follows:

- (1) With conditions as described in paragraph 6.05 step (5) connect the capacitor decade box (set to 0 uF) to pins 7 and 13 (balance network). Connect the TMS (set for 600 ohms terminating measurement) to the 4W XMIT test jack.
- (2) Increase the capacitance of the capacitor decade box (in 0.010 uF steps) until the TMS indicates the lowest level (best hybrid balance).

NOTE 1: A 415 card extender may be used if a capacitor decade box is not available. Remove the term set and connect it to the card extender. Insert the card extender with the term set into the mounting assembly. With conditions as described in paragraph 6.05 step 5, connect the TMS

(set for 600 ohm terminating measurement) to the 4W XMIT test jack. Strap in the NBO capacitors temporarily, one step at a time according to the NBO capacitor strapping chart (Table 2), starting with 0.010. Continue until no further decrease in TMS reading is noted. (Capacitors are paralleled to increase total capacity). After achieving the lowest level possible, solder the straps for the required NBO capacitance.

NOTE 2: If a capacitor decade box or a 415 card extender are not available, remove the Term Set from the mounting assembly. Strap in the NBO capacitors temporarily, one step at a time according to the NBO capacitor strapping chart (Table 2), starting with 0.010. Replace the term set and note if TMS reading is lower. Continue until no further decrease in TMS reading is noted. Remove the term set and solder the straps for the required NBO capacitance.

- (3) Remove the Term Set from the mounting assembly and strap the NBO capacitors for the value of capacitance nearest to the value indicated on the capacitor decade box, using the NBO capacitor strapping chart (Table 2).
- (4) Replace the Term Set into the mounting assembly, and disconnect the test equipment, reconnect the original wiring, and restore all equipment to normal. This completes the hybrid balance procedure.

Table 2. NBO Capacitor Strapping

CAPACITANCE- UF	CAPACITOR COMBINATIONS
.01	C6
.02	C7
.03	C6 & C7
.04	C8
.05	C6 & C8
.06	C7 & C8
.07	C6 & C7 & C8
.08	C9
.09	C6 & C9
.10	C7 & C9
.11	C6 & C7 & C9
.12	C8 & C9
.13	C6 & C8 & C9
.14	C7 & C8 & C9
.15	C6 & C7 & C8 & C9

7. CIRCUIT DESCRIPTION

7.01 The 441 and 442 Terminating Sets are composed of a two-transformer hybrid circuit, a series blocking capacitor at the midpoint of the two-wire windings to derive a dc path for loop signaling, a compromise network, NBO capacitors, transmit and receive impedance matching networks and variable "T" pads. Refer to the attached schematic diagrams during the following discussion:

7.02 Speech currents from the two-wire drop flow through line windings 5-4 and 3-2 of transformers T1 and T2 and the midpoint capacitor associated with the A and B leads. Since the balancing network winding 1-6 of transformer T2 is connected in series, but with a reverse poling with respect to the network winding 1-6 of transformer T1, no signal voltages appear across the compromise network and therefore, the incoming speech power will divide equally between the 8-10 and 7-9 windings of transformers T1 and T2, respectively. The power across T1 is fed to the receive line, where it is usually blocked by one-way devices in the connecting equipment. The power developed across T1 (one-half the input power) is applied through the impedance matching network C2 and through an adjustable pad at AT2 to provide the proper levels for transmission to the transmitting side to the four-wire circuit.

7.03 When the ILT option is furnished, R4 provides termination toward the line during the idle condition. With battery on the B (-) lead and ground on SL (+) lead relay ILT operates, which removes the termination and passes the signal directly through. Relay ILT is factory strapped for 24-Vdc operation and therefore the strap across R5 must be removed when 48 Vdc is the source voltage.

7.04 Speech signals that enter the receive side of the circuit are attenuated by the adjustable pad AT1 and pass through impedance matching network C1 to windings 7-9 and 8-10 of transformer T1. The transformer design is such

that equal voltages appearing across the 3-2, 5-4, and 1-6 windings of transformer T1 will result in equal currents flowing through the 3-2, 5-4, and 1-6 windings of transformer T2. Network windings 1-6 have opposite poling therefore, the fluxes cancel and no signal is induced into the transmit side. In the ideal condition, the impedance of the network exactly matches the impedance of the two-wire drop in both magnitude and phase. Approximately one-half the receive power will therefore be dissipated in the compromise network and the remaining energy will be transmitted to the two-wire drop.

7.05 Each terminating set has a compromise network (COMP NET) to balance the office two-wire impedance, a capacitor between each of the hybrid coil network windings, and NBO capacitors strappable from 0.010 to 0.150 microfarads in 0.010 microfarad steps to balance the two-wire line. Adjustments for the NBO capacitors are controlled by strapping posts located on the bottom side of the printed-circuit card. Pins 7 and 13 on the mounting assembly connector allow for connecting precision-type networks when required.

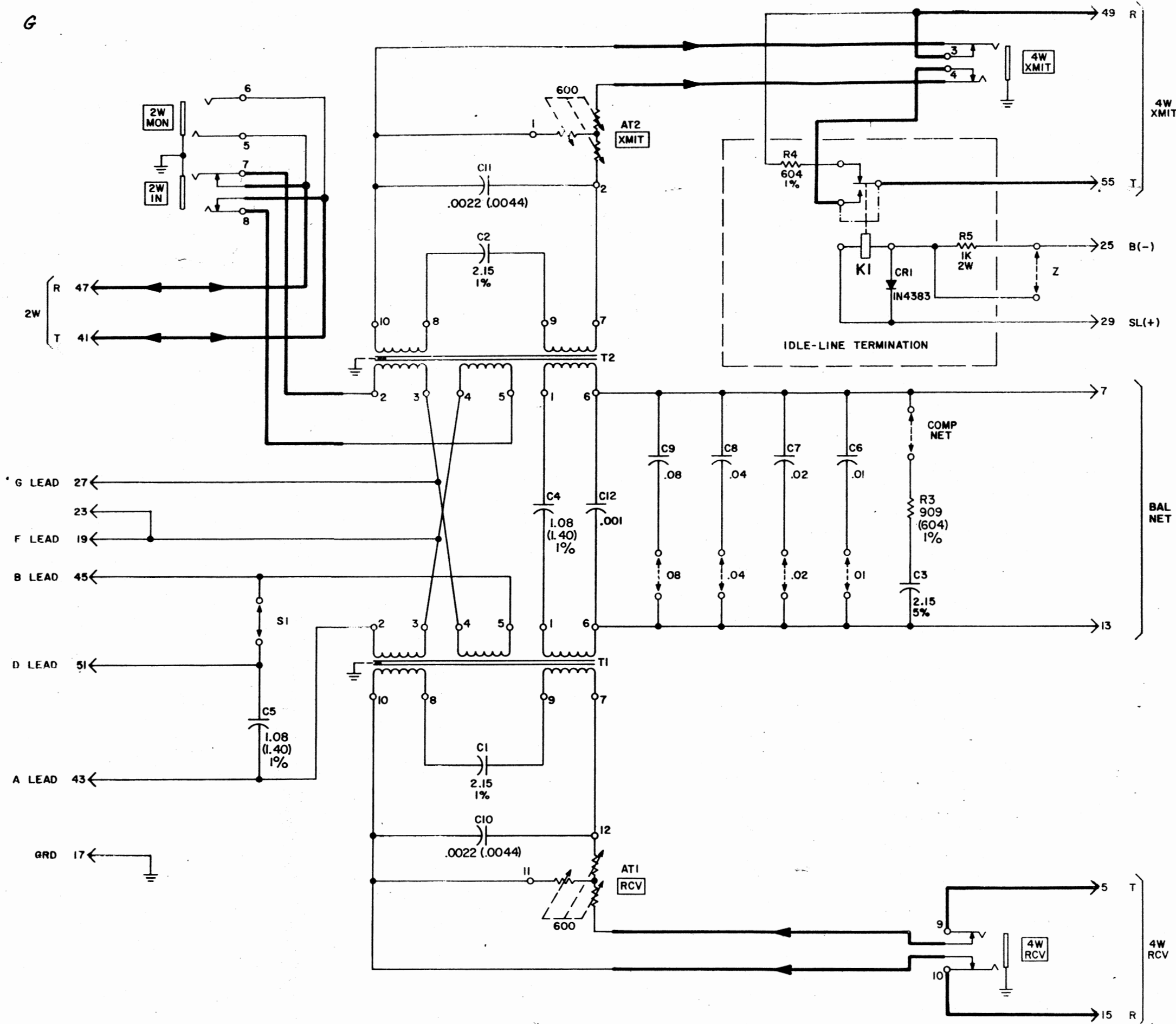
7.06 Capacitor C5 inserted at the midpoint of the two-wire windings of transformer T1 and T2 is used to derive A & B leads for loop signaling. Direct current up to 100 mA can be applied through the two-wire line without degrading the performance of the term set. For flexibility A, B, F, D and G leads are brought out at the 56-pin, wire-wrap connector for developing pad control and signaling functions. In some applications, the trunk circuit opens the midpoint of the two-wire line for signaling and closes the connections for transmission. When using a tie trunk circuit to open and close the B and D leads remove the S1 strap and insert the S1 strap in the tie trunk circuit.

8. TESTING

8.01 If trouble is encountered with the operation of the 441 or 442 verify that all installer connections (Table 1) have been properly made. Make certain that the 441 or 442 module is making good connection with the mounting-assembly card connector; snap the module out and in several times. If the trouble persists verify that the proper voltage is applied to the module.

8.02 Field repairs involving replacement of components within a module are not recommended. All Wescom systems and component boards are warranted for 1 year from the

date of purchase. Return to Wescom, Inc., 501 Rogers Street, Downers Grove, Illinois 60515. For technical assistance, call 312-971-2010 or TWX 910-695-4725.



- NOTES:
- UNLESS OTHERWISE SPECIFIED:
RESISTORS ARE IN OHMS, +5%, 1/2WATT
CAPACITORS ARE IN MICROFARADS.
 - ← PC BOARD CONNECTOR.
 - PRIMARY TRANSMISSION PATH.
 - XXX FRONT PANEL DESIGNATIONS.
 - OPTIONAL STRAP.
 - FACTORY INSTALLED OPTIONAL STRAP.
 - WHEN UNIT IS EQUIPPED WITH IDLE LINE TERMINATION OPTION, ITEMS ENCLOSED IN DASHED BOX ARE PROVIDED.
 - WHEN UNIT IS NOT EQUIPPED WITH IDLE LINE TERMINATION OPTION, A WIRE IS PROVIDED AS INDICATED BY THE DASHED LINE (-----).
 - IF K1 IS OPERATED FROM -24V, STRAP OPTION Z.
 - COMPONENT VALUES SHOWN APPLY TO BOTH THE MODEL 441 AND 442 TERM SET, EXCEPT FOR THOSE VALUES SHOWN IN PARENTHESIS WHICH APPLY TO THE 442 ONLY.

Figure 3. 441 and 442 Terminating Sets Schematic Diagram