

## 443-00 and 443-01 Term Sets

CLEI Code for 443-00: 4T96W121AB

CLEI Code for 443-01: 4T96W111AB

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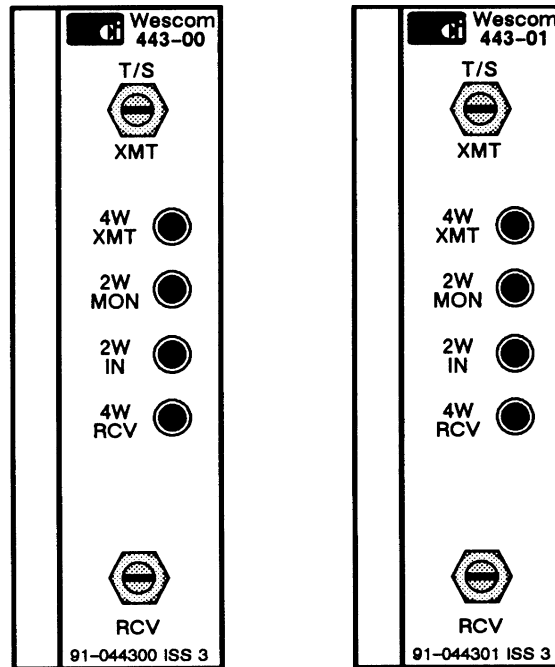


Figure 1. 443-00 and 443-01 Term Sets

## 1. GENERAL

### 1.1 Document Purpose

This document provides a circuit description, installation procedures, and basic testing information for the Charles Industries 443-00 and 443-01 Term Sets (Figure 1).

### 1.2 Document Status

This document is reprinted to include a general editorial update.

### 1.3 Equipment Function

The 443-00/01 modules each provide 2-wire termination of a 4-wire facility; however, the 443-01 contains an Idle Line Terminating (ILT) relay, while the 443-00 does not. Issue 3 of both modules was issued to provide surge protection in the 4-wire paths. In addition, screw options A, B, C, D, E, F, G, H, J, K, L, NBO, and COMP NET have been replaced by two slide switches, 36 and S7, and switches S1-1 through 31-5.

The 443-00/01 modules also feature front panel jacks for easy access to the 2- and 4-wire ports and a modular printed circuit board which plugs into one mounting position of the Charles Type 400 Mounting Assembly. This assembly accommodates from 1 to 13 modules and allows for either Key Telephone (KTU) apparatus-case or relay-rack mounting. Electrical connections are made via a 56-pin, wire-wrapped card-edge connector, which is provided as part of the mounting assembly.

### 1.4 Equipment Location/Mounting

Occupies one position in a Type 400 Mounting Assembly which provides for either KTU apparatus-case or relay-rack mounting.

### 1.5 Equipment Features

The 443-00/01 Term Sets provide the following features:

- A 2-transformer hybrid which is tapped for 600- or 900-ohm impedance matching and is in series with a 2.15uF capacitor.
- A compromise network which is used to match the impedance of the 2-wire line with the impedance of the term set.
- Network Build-Out (NBO) capacitors which are used to balance the hybrid to the impedance of the 2-wire facility.
- A provision for connecting an external precision balance network which is used when circuit requirements dictate the need for a more accurate match than can be achieved with the compromise network.
- Front panel mounted, continuously adjustable from 0 to 30dB, 3-section T-pad on both the transmit and receive lines which provides a nearly constant 600-ohm impedance toward the line side.
- Front panel mounted jacks which are used to monitor the 2-wire and 4-wire receive and transmit ports as well as a 2-wire input jack for injecting signals into the module.
- In addition to the previous features, the 443-01 also contains an ILT relay which is used to terminate the 4-wire transmit path during an idle condition.

## 2. INSPECTION

### 2.1 Inspect for Damages

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

### 2.2 Equipment Identification

Charles Industries' 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 1 and imprinted on subsequent units manufactured. Therefore, be sure to include both the model number and its issue number when making inquiries about the equipment.

### 2.3 Static Concerns

Each unit is shipped in static-protective packaging to prevent electrostatic charges from damaging static-sensitive devices. Use approved static-preventive measures, such as static-conductive wrist straps and a static-dissipative mat, when handling units outside of their protective packaging. A unit intended for future use should be tested as soon as possible and returned to its original protective packaging for storage.



**This equipment contains static-sensitive electronic devices. To prevent electrostatic charges from damaging static-sensitive units:**

- Use approved static preventive measures (such as a static-conductive wrist strap and a static-dissipative mat) at all times whenever touching units outside of their original, shipped static-protective packaging.
- Do not ship or store units near strong electrostatic, electromagnetic, or magnetic fields.
- Use static-protective packaging for shipping or storage.

## 3. CIRCUIT DESCRIPTION

The 443-00/01 Term Sets are designed to terminate a 2-wire drop with a 4-wire line or drop. Refer to the schematic diagram in Figure 2, which shows the 443-00, or to Figure 3, which shows the 443-01 Schematic Diagram, while reading the following paragraphs.

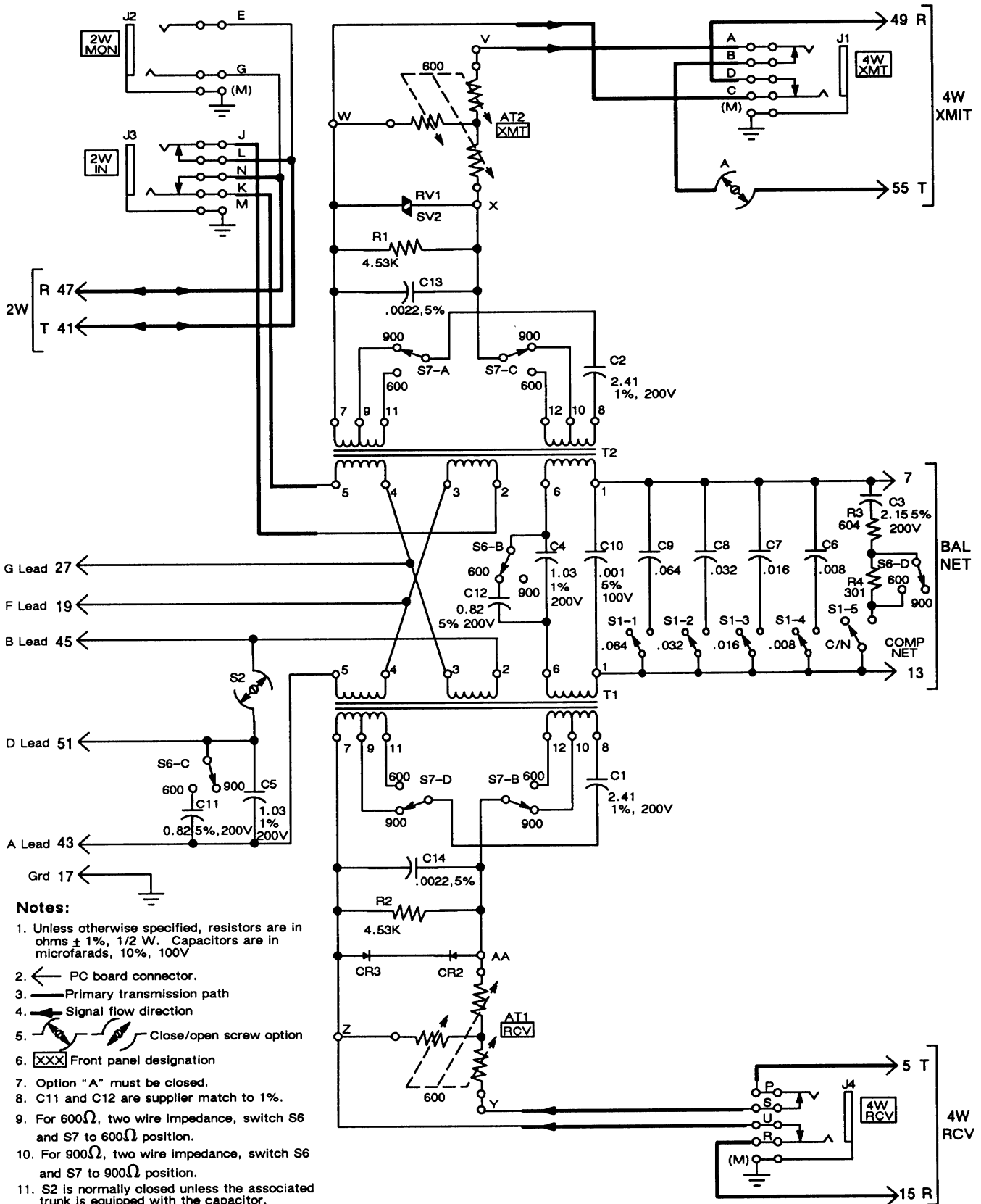
When speech energy enters from the 2-wire drop (pins 47 and 41), it flows through line windings 2-3 and 4-5 of transformers T2 and T1 and the capacitors which are associated with the A and B leads. This incoming speech energy divides equally between the secondaries of T1 and T2, inducing equal energy into 7-9 and 10-8 windings of each transformer. One-half of this power is transferred across T1 and fed to the receive path where it is blocked by a one-way device in the connecting equipment. The other half of input power is transferred across T2 where the T pad attenuator (AT2) provides the proper levels for transmission to the transmitting side of the 4-wire circuit (pins 55 and 49).

When speech energy enters the 4-wire receive side of the module (pins 5 and 15), it is attenuated by AT1 and coupled through impedance matching capacitor (C1) to windings 7-9 and 8-10 of transformer T1. This transformer design is such that equal voltages appearing across the 2-3, 4-5, and 1-6 windings of transformer T1 results in equal currents flowing through the 2-3, 4-5, and 1-6 windings of transformer T2. Network winding 1-6 of T2 is polarized to cancel the magnetic fluxes in windings 2-3 and 4-5 of T2. As a result of this, no signal is induced into the transmit side if the impedances terminating the 2-wire and compromise network are equal. In the ideal condition, the impedance of the network exactly matches the impedance of the 2-wire drop in both magnitude and phase. One-half the receive energy is therefore dissipated in the compromise network and the remaining energy is transmitted to the 2-wire drop (pins 47 and 41).

Capacitors C5 and C11 are inserted at the midpoint of the 2-wire windings of transformer T1 and T2 to derive A and B leads for loop signaling. Leads A, B, F, D and G are brought out at the 56-pin, wire-wrapped card connector for developing pad control and signaling functions. In some applications, the trunk circuit opens the midpoint of the 2-wire line for signaling and closes the connection for transmission. By opening the S1 option, a D lead is made available, allowing an external 2-wire signaling circuit to open and close the B and D leads.

## 4. MOUNTING

The 443-00 or 443-01 Term Set is designed to mount in one module position of a Type 400 Mounting Assembly. This assembly can accommodate from 1 to 13 modules and may be equipped and prewired for a variety of modules in the Charles product line. In addition, Type 400 Mounting Assemblies allow for either KTU apparatus-case or relay-rack mounting. For more information on these mounting assemblies, refer to Sections 400-103 and 400-U-101/3.



**Notes:**

1. Unless otherwise specified, resistors are in ohms  $\pm 1\%$ , 1/2 W. Capacitors are in microfarads, 10%, 100V
2.  $\leftarrow$  PC board connector.
3.  $\longrightarrow$  Primary transmission path
4.  $\dashrightarrow$  Signal flow direction
5.  $\leftarrow$  Close/open screw option
6. [XXX] Front panel designation
7. Option "A" must be closed.
8. C11 and C12 are supplier match to 1%.
9. For 600 $\Omega$ , two wire impedance, switch S6 and S7 to 600 $\Omega$  position.
10. For 900 $\Omega$ , two wire impedance, switch S6 and S7 to 900 $\Omega$  position.
11. S2 is normally closed unless the associated trunk is equipped with the capacitor.

Figure 2. 443-00 Schematic Diagram

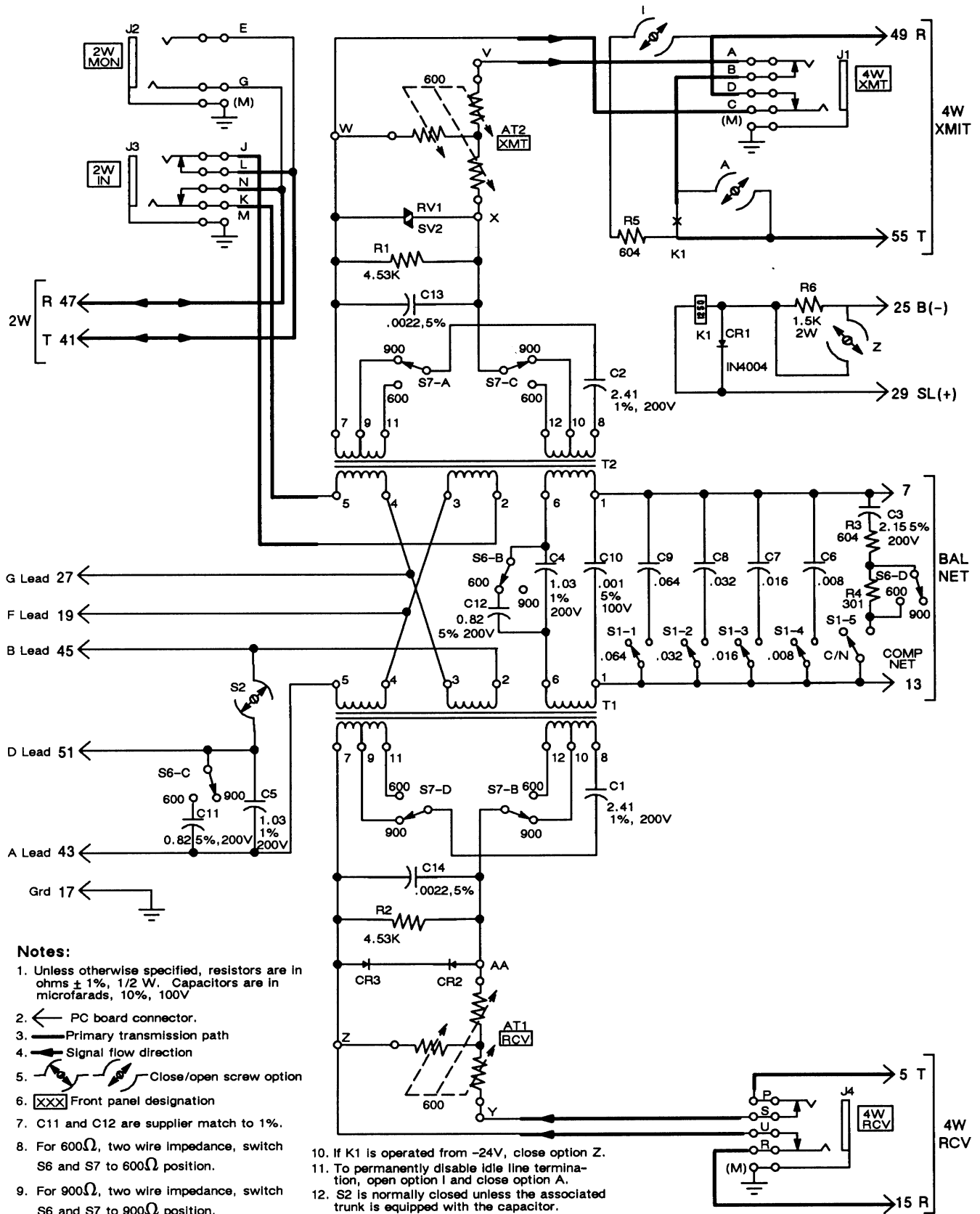


Figure 3. 443-01 Schematic Diagram

## 5. INSTALLER CONNECTIONS

When the 443-00 or 443-01 Term Set is installed in a Type 400 Mounting Assembly, it makes electrical connection to associated equipment through a 56-pin, wire-wrapped card connector which is provided as part of the mounting assembly. Make all installer connections in accordance with Table 1.

### CAUTION

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

Table 1. Installer Connections

Connect	To Pin
4-wire XMT, T and R	55 and 49
4-wire RCV, T and R	5 and 15
2-wire, T and R	41 and 47
External BAL NET	7 and 13
A lead	43
B lead	45
D lead	51
F lead	19
G lead	27
*B() -48 or -24VDC	25
*SL(+) Ground	29
GRD	17
* Connect when using ILT relay.	

## 6. OPTIONS

The 443-00/01 modules are equipped with options which provide the means to select a 600- or 900-ohm impedance match, an appropriate value of NBO capacitance, an internal compromise network, and an option for combining midpoint capacitance values which are derived from C11 and C5. In addition, both modules also have a provision for connecting an external precision balance network. Refer to Figure 4.

### CAUTION

**When opening an option, rotate the screw counterclockwise two revolutions to ensure that the connection is broken. When closing a screw down option, do not over-tighten. This may result in damage to the plating of the printed circuit board.**

### 6.1 443-00/01

Transformers T1 and T2 are tapped to match either a 600- or 900-ohm 2-wire line impedance. For 600- or 900-ohm 2-wire impedance match, place switches S6 and S7 into the appropriate positions marked on the component side of the printed circuit board. Switch S7 is used to select 2-wire impedance for T1 and T2. Switch S6 in either the 600- or 900-ohm position provides the following: In the compromise network, contacts S6-D provide either 600- or 900-ohm impedance; in the balance network winding 1-6 of T2 and T1, contacts S6-B provide 1.08 $\mu$ F in the 900-ohm position and 1.9  $\mu$ F in the 600-ohm position; and, across the A and B leads, contacts S6-C provide 1.08  $\mu$ F in the 900-ohm position and 1.9  $\mu$ F in the 600-ohm position.

### 6.2 S2 Option

The S2 screw down option is normally closed, permitting the selection of capacitance values which are derived from C11 and C5 and placed across A and B leads.

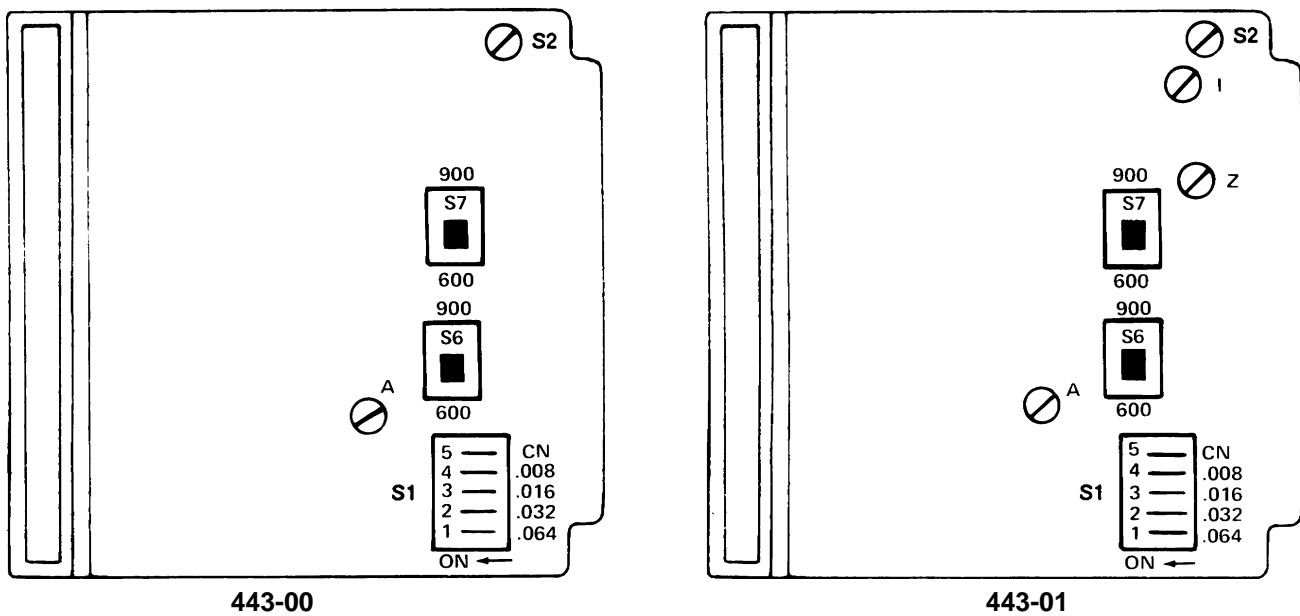


Figure 4. Option Locations

*Note:* If the associated trunk circuit has an external capacitor, it must be removed and the term set capacitor used instead. However, when using a tie trunk circuit to open and close the B and D leads, open the S2 option in the term set and insert the required capacitance in the external circuit.

### 6.3 Balancing Network

If an external precision balance network (PBN) is not specified on the circuit layout record (CLR), the term set's internal compensation network (CN) option is used. This option is located on the S1-5 contacts of the DIP switch. Set S1-5 ON to use the internal CN feature. To use an external PBN via pins 7 and 13, set S1-5 OFF.

### 6.4 NBO Capacitors

These term sets are provided with NBO capacitors which may be optioned to add from 0.008 to 0.120  $\mu\text{F}$  of capacitance, in 0.008  $\mu\text{F}$  increments, to match the 2-wire drop capacitance. NBO adjustments are made using DIP switches S1-1 through S1-4. Refer to page 9.

### 6.5 Idle Line Termination Option

The 443-01 Term Set is equipped with an ILT relay which is operated with either a  $-24$  or  $-48$  VDC supply. Use the following steps to condition the ILT relay for either voltage level:

Step	Action
1.	If the ILT relay is operated with a $-24\text{VDC}$ supply, close options I and Z. Connect an insulated jumper wire from pin 25 B(-) at the rear term set mounting assembly to the $-24\text{VDC}$ supply and connect pin 29 SL (+) to the associated trunk.
2.	If the ILT relay is operated with a $-48\text{VDC}$ supply, close option I and open option Z. Connect an insulated jumper wire from pin 25 B(-) at the rear term set mounting assembly to the $-48\text{VDC}$ supply and connect pin 29 SL(+) to the associated trunk. If the ILT relay is not required, open option I and close option A (see Figure 4).

### 6.6 Inserting Modules

When all installer connections and screw-down option conditioning have been completed, insert the 443-00/01 module into the mounting assembly.

#### CAUTION

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

## 7. ALIGNMENT

Use the following basic steps to align the 443-00/01 Terminating Sets:

1. Perform the preliminary alignment procedure.
2. Adjust receive and transmit level.
3. Adjust hybrid balance.

### 7.1 Test Equipment

Test equipment required at both the local and distant terminals to align and test the term sets are as follows:

- Transmission Test Set (TTS): WECO 23A or Hewlett-Packard 3550 (or equivalent), with self-contained Variable Frequency Oscillator (VFO),
- Associated Test Cords: Two, 2-conductor test cords equipped with a type 310 plug at each end,
- Charles 415 Card Extender.

### 7.2 Preparation for Alignment

Use the following steps to prepare for alignment:

Step	Action
1.	Set the 2-wire impedance of the term set as outlined in the Options section.
2.	If the 443-01 is used, ascertain that the ILT relay is connected and energized or bypassed to maintain circuit continuity.
3.	Verify the need for the S2 option and determine whether the internal COMP NET option or an external precision balance network is used. Normally the internal COMP NET is used. Verify that the NBO capacitors are not connected in at this time.
4.	Loosen the controls of the XMT and RCV lock nuts which are on the term set's front panel.
5.	Install the 443-00 or 443-01 in the 415 Card Extender and install the 415 Card Extender in the 400 Type Mounting Assembly.
6.	Proceed to XMT and RCV level adjustments.

### 7.3 Transmit and Receive Level Adjustments

Use the following steps to perform the transmit and receive level adjustments:

Step	Action	Result
1.	Condition the local VFO to apply a 1000 Hz test-tone at the proper level and impedance specified on the CLR card and connect VFO into the 2W IN test jack.	
2.	Adjust the TTS for 600-ohm termination and connect it into the 4W XMT test jack on the term set.	
3.	Rotate the XMT control until the TTS indicates the value specified on the CLR card for the transmit level.	Level indicated on TTS
4.	Remove the VFO from the 2W IN test jack and remove the TTS from the 4W XMT test jack.	
5.	Connect the TTS (set for terminated measurement) into the 4W RCV test jack.	
6.	Request the distant terminal to send a 1kHz test-tone at the proper level.	Proper input level indicated on the TTS.



Step	Action	Result
7.	Remove the ITS from the 4W RCV test jack and connect it into the 2W IN test jack.	
8.	Adjust the RCV control until the TTS indicates the level specified on the CLR card.	Proper output level indicated on the TTS.
9.	Proceed to Hybrid Balance Adjustments.	

#### 7.4 Hybrid Balance Adjustments

Use the following steps to make hybrid balance adjustments.

*Note: Refer to Table 2 as an aid in selection of NBO capacitance values. These values are derived by closing different combinations of switches S1-1 through S1-4.*

Step	Action	Verification
1.	Condition the ITS for a 600-ohm terminating measurement. Connect it into the 4W XMT test jack.	
2.	Verify that the 2-wire drop is appropriately connected.	
3.	Request the distant 4-wire receive terminal to send a 1kHz test-tone at the proper level.	Level indicated on ITS
4.	Add NBO capacitance values by closing different combination of switches S1-1 through S1-4. These switches are used to add capacitance in increments of 0.008 uF.	Reduce ITS reading to lowest level. (Optimize the trans-hybrid loss.)
5.	Disconnect all test equipment and remove the 415 Card Extender and module from the mounting assembly. Remove the module from the card extender and install it in the mounting assembly.	

**Table 2. NBO Capacitor Options**

In the ON Position	Results in a Capacitance Of (uF)
S1-4	0.008
S1-3	0.016
S1-3, S1-4	0.024
S1-2	0.032
S1-2, S1-4	0.040
S1-2, S1-3	0.048
S1-2, S1-3, S1-4	0.056
S1-1	0.064
S1-1, S1-4	0.072
S1-1, S1-3	0.080
S1-1, S1-3, S1-4	0.088
S1-1, S1-2	0.096
S1-1, S1-2, S1-4	0.104
S1-1, S1-2, S1-3	0.112
S1-1, S1-2, S1-3, S1-4	0.120

## 8. TESTING

If trouble is encountered with the operation of the 443-00 or -01, verify that all installer connections have been properly made in accordance with Table 1 and that all options have been conditioned as required. Make certain that the module is making good connection with the mounting assembly card connector, remove and reinsert the module.

## 9. TECHNICAL ASSISTANCE

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. WARRANTY & CUSTOMER SERVICE

### 10.1 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

847-806-6300 (Main Office)

847-806-6231 (FAX)

### 10.2 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.

### 10.3 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 pre-addressed shipping label provided. Call your customer service representative at the telephone number above for more details.

### 10.4 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  
 503 N.E. 15th St., P.O. Box 339  
 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.

## 11. SPECIFICATIONS

### 11.1 Electrical

The electrical and physical characteristics of the 443-00/01 (Issue 3) are as follows:

- (a) 2-WIRE IMPEDANCE: 600 or 900 ohms, in series with 2.15  $\mu$ F.
- (b) 4-WIRE IMPEDANCE: 600 ohms, 5 percent.
- (c) TRANS-HYBRID LOSS: As specified in Figure 5.

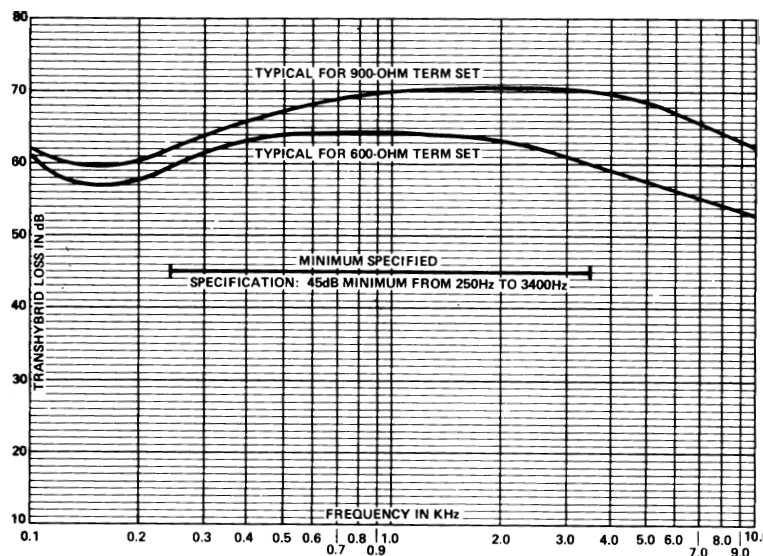


Figure 5. Trans-hybrid Loss Specification

- (d) 2-WIRE RETURN LOSS: As specified in Figure 6.
- (e) HYBRID INSERTION LOSS: Arranged for 600-ohm 2-wire impedance as shown in Figure 7.
- (f) HYBRID INSERTION LOSS: Arranged for 900-ohm 2-wire impedance as shown in Figure 8.
- (g) ENVELOPE DELAY DISTORTION: As shown in Figure 9.
- (h) LONGITUDINAL BALANCE: As shown in Figure 10.
- (i) CURRENT SURGE PROTECTION: Maximum 30A up to 150 ms.

- (j) MAXIMUM A- AND B-LEAD CURRENT: 100 mA.
- (k) 4-WIRE ECHO RETURN LOSS: Relative to 600 ohms, 19dB minimum when 2-wire is conditioned for 600 ohms + 2.15uF, or 23dB minimum when 2-wire is conditioned for 900 ohms + 2.15uF.

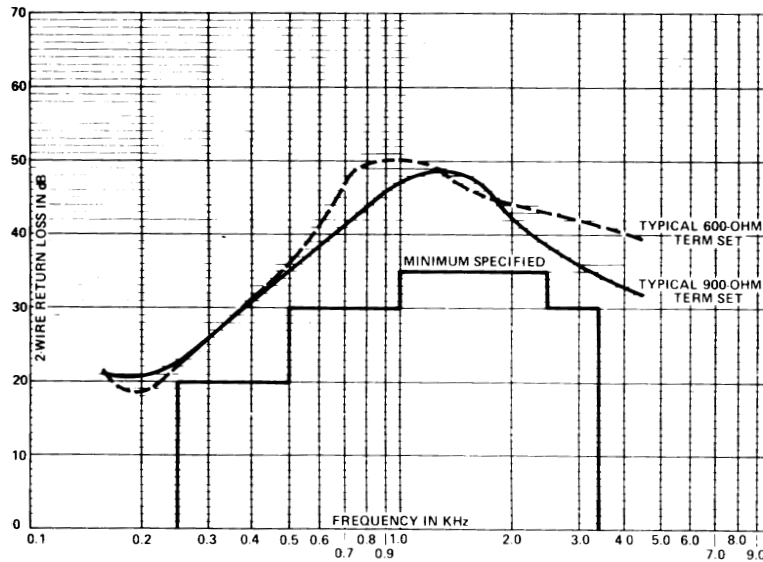


Figure 6. 2-Wire Return Loss Specification

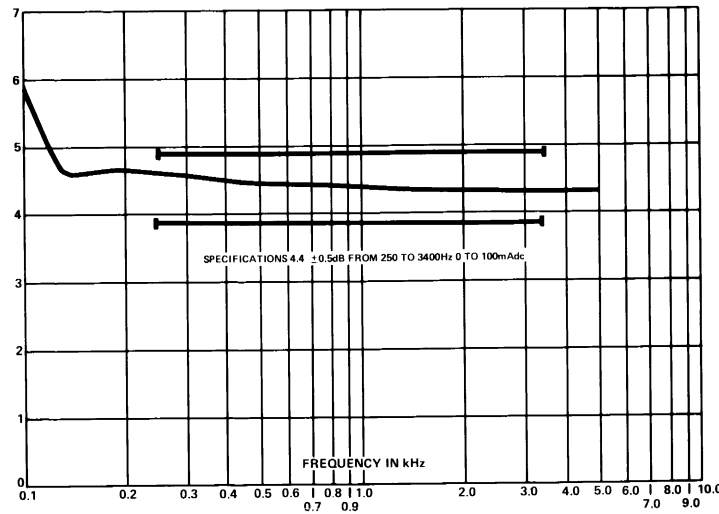


Figure 7. Hybrid Insertion Loss Specification Arranged for 600-Ohm 2-Wire Impedance

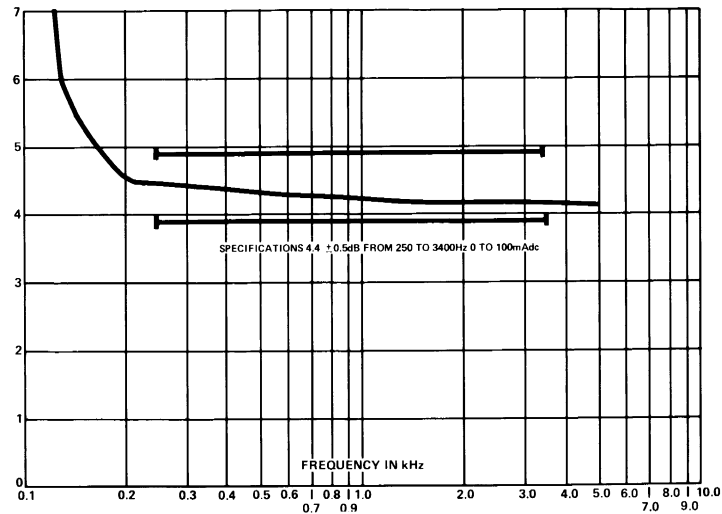


Figure 8. Hybrid Insertion Loss Specification Arranged for 900-Ohm 2-Wire Impedance

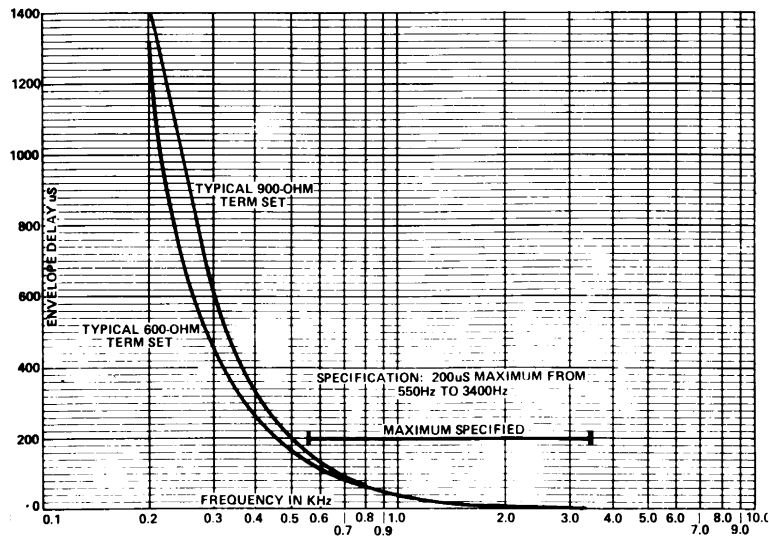


Figure 9. Envelope Delay Distortion Specification

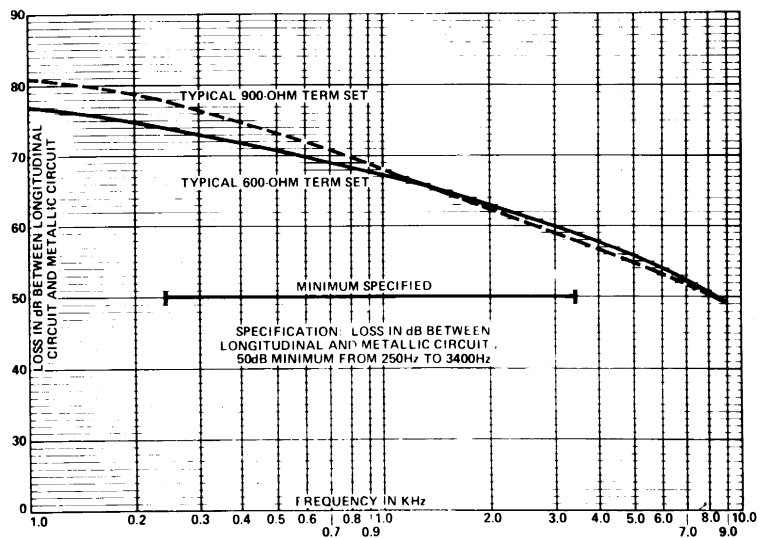


Figure 10. Longitudinal Balance Specification

11.2 Physical

See Table 3 for the physical characteristics of the units.

**Table 3. Physical Specifications**

<b>Feature</b>	<b>U.S.</b>	<b>Metric</b>
Height	5.6 inches	14.2 centimeters
Width	1.5 inches	3.8 centimeters
Depth	6.0 inches	15.2 centimeters
Weight	1 pound, 13 ounces	822 grams
Temperature	32° to 120° F	0° to 49° C
Humidity	to 95% (no condensation)	

