7535-00 2-Wire To 4-Wire Electronic Hybrid Repeater

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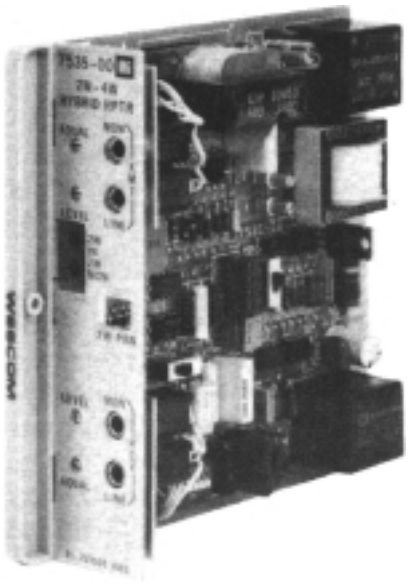

Figure 1. 7535-00 2-Wire To 4-Wire Electronic Hybrid Repeater

1. GENERAL

1.1 Document Purpose

This document provides a circuit description, installation procedures, and basic testing information for the Charles Industries 7535-00 2-Wire to 4-Wire Electronic Hybrid Repeater, shown in Figure 1.

1.2 Document Status

This document is reprinted to include a general editorial update.

1.3 Equipment Function

The 7535-00 uses active cancellation in an electronic hybrid, contrary to the conventional hybrid coils.

The 7535-00 provides -20 to +30dB of gain for each direction of transmission. Equalization is also provided in each direction. The gain and equalization adjustments are easily accessible from the front panel.

The 2-wire port has a switch-selected impedance of 600 ohms +2.15uF or 900 ohms +2.15uF. The 4-wire ports have strappable impedances of 150, 600, or 1200 ohms. Build-out capacitors (BOCs) are used to balance the line impedance of the 2-wire facility. A and B leads with an isolating inductor and simplex leads are provided on the 7535-00 to allow simplex signaling in a 4-wire circuit. The 7535-00 also allows monitor and test access to the 2-wire and 4-wire ports of the repeater via minijacks mounted on the front panel. Test cords with bantam plugs are available from Charles to access these jacks.

The 7833-XX family of precision balance network (PBN) sub-assemblies mount on the 7535-00 and provide precision balancing for the 2-wire port of the 7 535-00. The PBN plugs into a 4-pin female connector on the 7535-00 to provide precision balancing for loaded and nonloaded cable.

Note: PBN subassemblies are not provided with the 7535-00 and must be ordered separately.

1.4 Equipment Mounting

Mounts in one position of a Type 400 Mounting Assembly.

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.

STATIC-SENSITIVE

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. APPLICATION GUIDELINES

The 7535-00 Electronic Hybrid Repeater can be employed in a variety of system applications, and with loaded or nonloaded cable. Figure 2 shows terminal applications, Figure 3 shows intermediate applications, and Figure 4 shows a voltage-sensing loop signaling application.

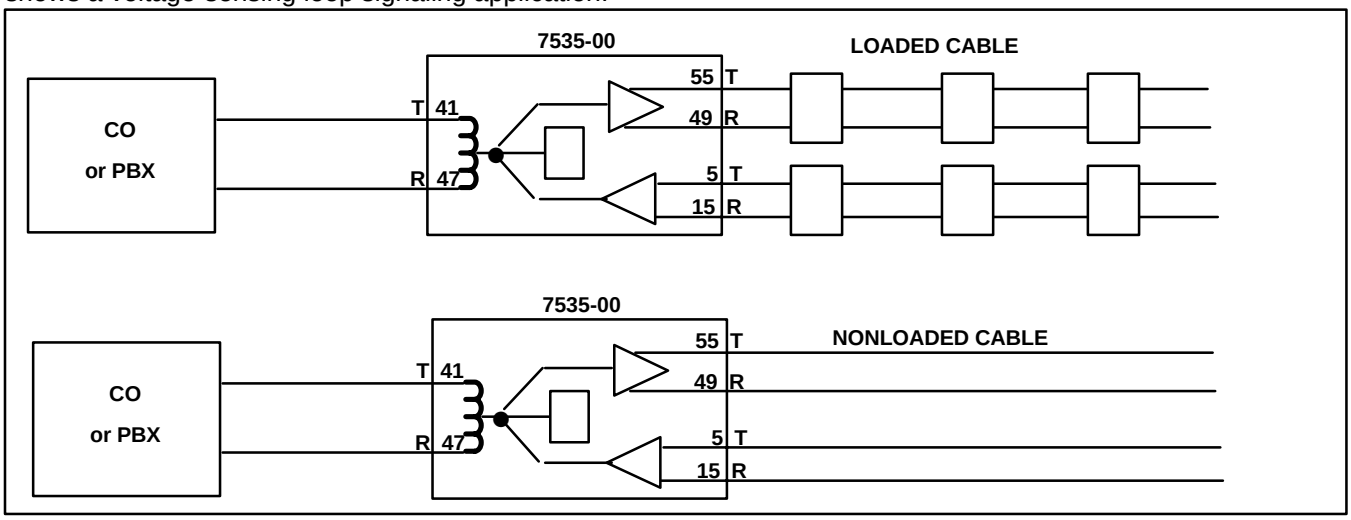

Figure 2. 7535-00 Terminal Applications

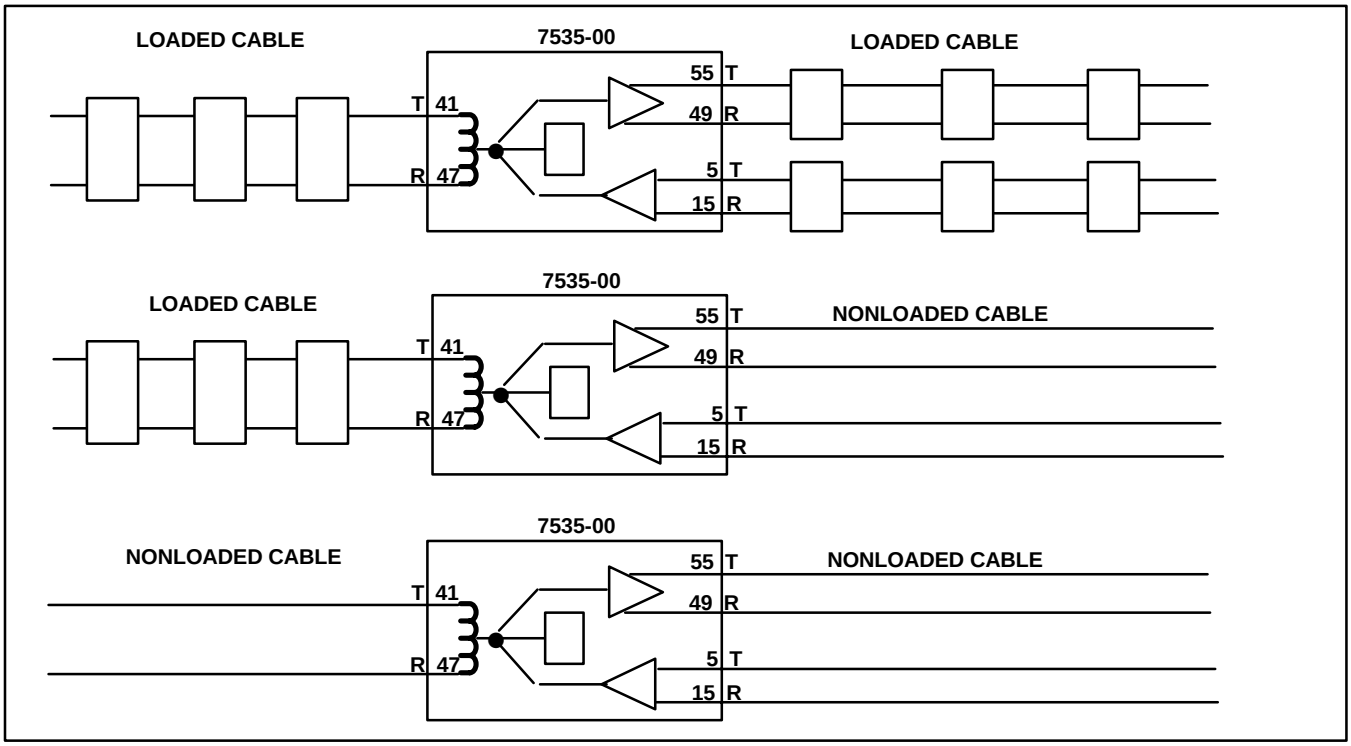

Figure 3. 7535-00 Intermediate Applications

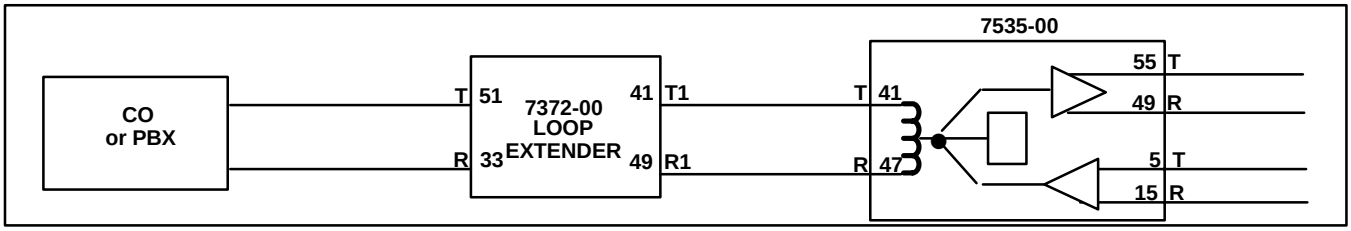

Figure 4. Voltage-Sensing Loop Signaling Extender Application

4. CIRCUIT DESCRIPTION

The 7535-00 is a 2-wire to 4-wire electronic hybrid repeater. Voice signals in one leg of the repeater are prevented from entering the other leg by means of active electronic cancellation, rather than by the transformer action of conventional repeaters.

Refer to Figure 7, the 7535-00 Electronic Hybrid Repeater (Issue 2) Block Diagram, while reading the following circuit description.

4.1 XMT Circuitry

Voice-frequency signals are coupled to the input transformer (T1) via the 2-wire tip and ring terminals (41 and 47, respectively).

A and B signaling leads are derived from the primary winding of T1 and appear at terminals 43 and 45, respectively. The voice frequency signals are induced into the secondary of T1 and enter the ELECTRONIC HYBRID.

Switch S2 determines the input impedance of the 2-wire port by applying the signals to either the 600-ohm or 900-ohm windings of T1.

4.1.1. XMT Level Circuit

The voice-frequency signals that enter the ELECTRONIC HYBRID are passed to the XMT LEVEL circuit. The XMT LEVEL circuit provides adjustable gain from -20 to +10dB via the XMT LEVEL potentiometer (R27), accessed through the front panel of the module. A HI/LO gain push-on jumper is provided to give an additional +20dB gain, if required.

4.1.2. XMT Equal Circuit

The amplified VF signals enter the XMT EQUAL circuit and undergo amplitude equalization. The amplitude equalization is adjusted by the XMT EQUAL potentiometer (R22), accessed through the front panel of the module.

4.1.3. XMT Output Circuitry

The output of the XMT EQUAL circuit feeds the POWER AMP circuit. The POWER AMP circuit drives the primary winding of transformer T2, which induces an output signal in its secondary winding. The T2 secondary provides VF output signals to the transmit pair (pins 55 and 49) of the 4-wire line. Simplex leads are derived from the T2 secondary windings also. The XMT impedance is determined by push-on jumper option C, which is optioned to apply the VF signals to either the 150, 600, or 1200-ohm winding of T2, as required.

4.2 RCV Circuitry

The VF signals entering the repeater from the RCV side (pins 5 and 15) of the 4-wire line are routed to the primary winding of transformer T3. The signals are then induced in the T3 secondary winding. The RCV line impedance is determined by a push-on jumper option which is set to apply the VF signals to either the 150-, 600-, or 1200-ohm winding of the T3 secondary, as required.

4.2.1. RCV Level Circuit

The VF signals then pass through the ISOLATION AMP circuit and enter the RCV LEVEL circuit. The RCV LEVEL circuit provides adjustable gain from –20 to +10dB via the RCV LEVEL potentiometer (R32), accessed through the front panel of the module. A Hl/LO gain push-on jumper is provided to give an additional +20dB gain, if required.

4.2.2. RCV Equal Circuit

The amplified VF signals enter the RCV EQUAL circuit and undergo amplitude equalization. The amplitude equalization provided is adjusted by the RCV EQUAL potentiometer (R37), accessed through the front panel of the module.

4.2.3. RCV Output Circuitry

The amplified and equalized signals are coupled to the RCV port of the ELECTRONIC HYBRID. The signals leave the hybrid through the 2W port and pass through the primary winding of transformer T1, where they are induced into the secondary winding. The signals then appear across the T & R leads (pins 41 & 47) of the 2-wire port.

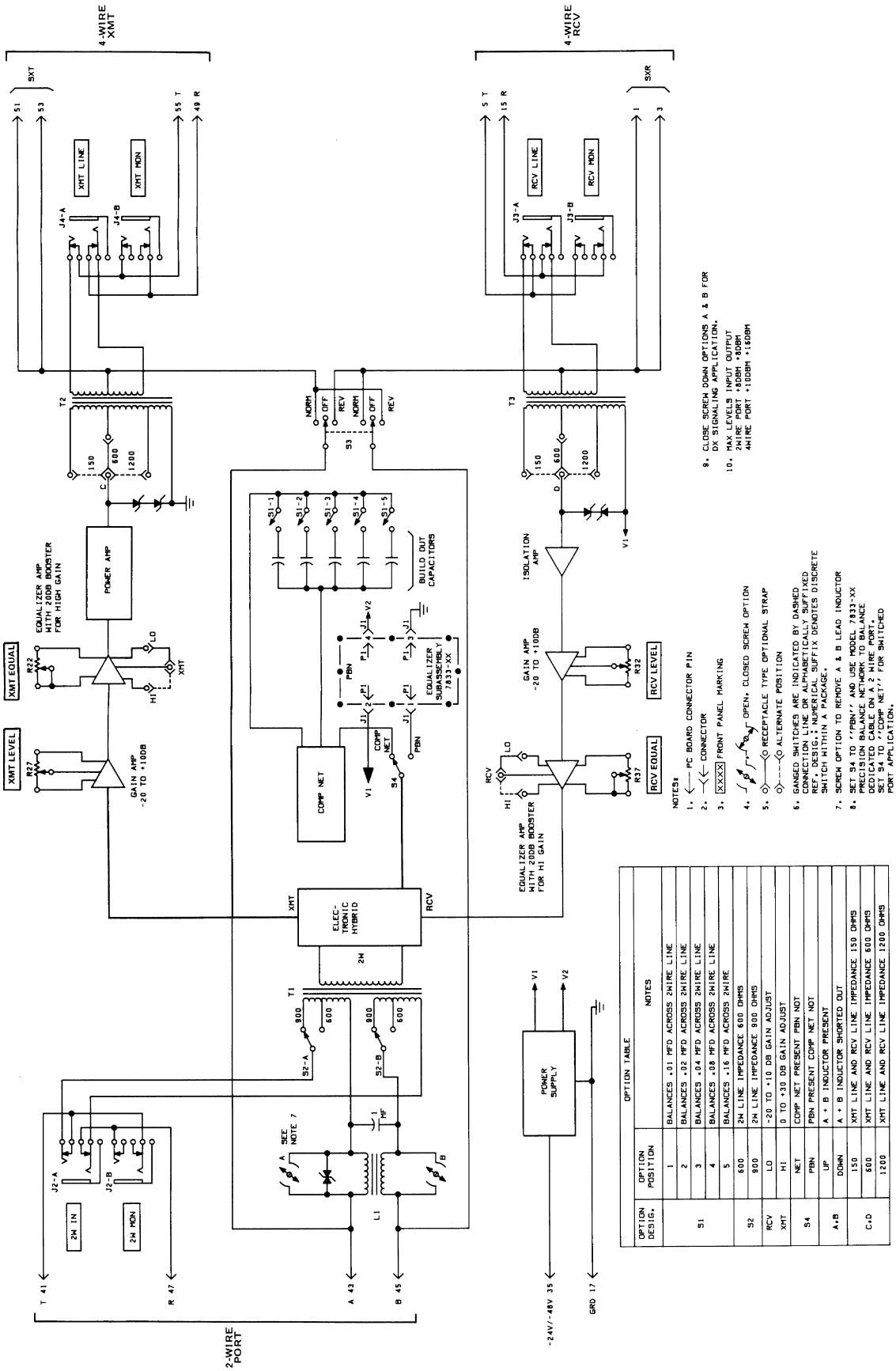

Figure 5. 735-00 2-Wire to 4-Wire Electronic Hybrid Repeater Functional Block Diagram

4.3 Impedance Matching And Balancing

The 4-wire ports can be conditioned to provide a 150-, 600-, or 1200-ohm impedance, as required, via push-on jumper options C and D. The input of the 2-wire port can be set to a 600- or 900-ohm impedance, as required, via switch S2. To balance the 2-wire port, either an external precision balance network (PBN) or the internal, fixed compromise balance network (COMP NET) and its associated buildout capacitors are employed. Switch S4 (PBN/COMP NET) conditions the 2-wire port for PBN or COMP NET operation. Switch S1 is used to provide the proper values of build-out capacitance.

When cable under 6 kilofeet is attached to the 2-wire port in a terminal application requiring build-out capacitance, switch S4 is set to the COMP NET position.

When the 2-wire port interfaces with cable longer than 6 kilofeet, it is usually necessary to use a plug-in PBN (7833-XX) to assure adequate return loss margins. The PBN/ COMP NET switch is set to the PBN position and the appropriate PBN is used.

4.4 Surge Protection

Repeat coils T2 and T3 are protected against high-voltage surges by zener diodes. Transformer T1 is protected by varistors.

4.5 DC Paths

The A and B leads derived from the 2-wire path are signaling leads and are provided with a feed inductor (Li) to prevent VF and signaling interaction. The transformers (12 and 13) at the 4-wire line provide dc isolation and impedance matching to the 4-wire line. The A and B leads may be routed to a separate signaling unit for signaling improvement or conversion.

4.6 Power Supply

The power supply for the repeater is driven by an external input of either –24 or –48Vdc. It then derives voltages to power internal circuitry.

5. MOUNTING

The 7535-00 is designed to mount in one module position of a Type 400 mounting assembly. Type 400 mounting assemblies are available in capacities of 1 to 13 modules and allow for either KTU apparatus-case or relay-rack mounting.

The PBN subassembly 7833-XX is mounted using a four-pin plug and connector, and a standoff. To install a PBN, remove the nylon screw from the end of the standoff (provided with the PBN) and plug the PBN into its mounting connector so that the hole in the 7535-00 is aligned with the threaded hole in the standoff. Finally, insert the nylon screw through the hole in the 7535-00 from the foil side of the board and screw it in place in the standoff.

6. INSTALLER CONNECTIONS

All electrical connections to the 7535-00 are made through a 56-pin, wire-wrapped, card-edge connector, provided as part of the mounting shelf. Make all required installer connections by referring to Table 1.

Table 1. Installer Connections For 7535-00

Lead Designation		PIN
T R A B	2-Wire Port	41 47 43 45
T R SXT	4-Wire XMT	55 49 51, 53
T R SXR	4-Wire RCV	5 15 1, 3

Lead Designation		PIN
–24V/–48V BATT GRD		35
GRD		17

7. OPTIONS

The 7535-00 is equipped with a DIP switch, push-on jumpers, and slide switch options that are used to condition the module for proper application-interface and operation. Refer to Figure 5 for the locations of these options while reading the following optioning instructions.

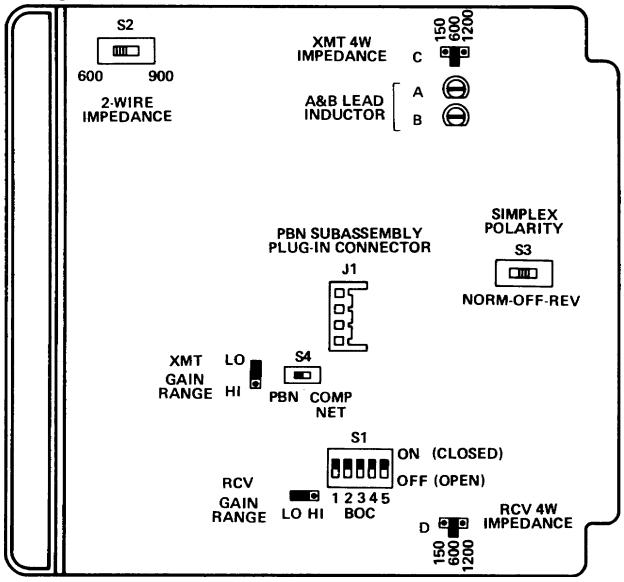

Figure 6. 7535-00 Option Locations

7.1 Build-Out Capacitors (S1)

The S1 build-out capacitors (BOCs) option switches provide variable capacitance for cable lengths less than 6 kilofeet attached to the 2-wire port. Use the following steps to condition the switches:

Note: To use this procedure, the PBN/COMP NET switch must be set to COMP NET, the 2-wire line must be connected, and power must be applied to the module.

Step	Action	Verification
1.	Plug an oscillator with a bantam plug into the RCV LINE jack.	
2.	Plug a voltmeter with a bantam jack into the XMT LINE jack.	
3.	Set the oscillator to 1000 Hz at the receive port.	
4.	Switch the vuild-out capacitors ON (closed) and OFF (open) in a binary fashion (1, 2, 1&2, 3, 1&3, 2&3, 1&2&3, etc.) until the measuring set reads a minimum value.	The measuring set reads a minimum value (optimizes trans-hybrid loss).

7.2 2-Wire Impedance (S2)

Switch S2 (600/900) is used to condition the 7535-00 for either 600- or 900-ohm operation on the 2-wire side by setting the switch to the appropriate position.

7.3 Simplex Polarity Option (53)

Switch S3 provides cut-through of the simplex leads to the A&B leads. S3 is a three-way switch (NORM/OFF/REV) that allows normal (A to SXT, B to SXR), reverse (A to SXR, B to SXT), or open lead connections, as required by the application.

7.4 PBNICOMP NET Option (S4)

Switch S4 provides the option of using either a fixed compromise balance network (COMP NET), with or without build-out capacitors, or a Precision Balance Network (PBN) to balance the cable connected to the 2-wire port. For cabling up to 6 kilofeet, set switch S4 to the COMP NET position, and follow the conditioning procedures described in Table 2.

If the 2-wire side interfaces with cable longer than 6 kilofeet, set switch S4 to the PBN position and install the appropriate PBN for the given application. The PBN applications are as follows:

- 7833-01 — for H88 loaded cable.
- 7833-02 — for nonloaded cable.
- 7833-03 — for D66 loaded cable.
- 7833-15 — for H88 or D66 loaded cable, with variable end section matching capabilities.

7.5 A&B Lead Inductor Option (A and B)

Close the A and B screw options to short out the A and B lead inductor (L1) when interfacing DX signaling at the 2-wire port. The A and B screw options are open when employing A and B lead signaling.

7.6 XMT and RCV Impedance (C and D)

To provide the 4-wire ports with the proper impedance, set the push-on jumper options to the 150-, 600-, or 1200-ohm positions on both the XMT (C) and RCV (D) paths, as required. Use the 1200-ohm position for loaded cable applications.

7.7 XMT Gain Range and RCV Gain Range (XMT HI/LO and RCV HI/LO)

The XMT HI/LO and RCV HI/LO push-on jumpers provide an additional +20 dB gain for each respective direction, when set to the HI position. Set the push-on jumpers to the LO position if additional gain is not required.

8. ALIGNMENT

The alignment procedure for the 7535-00 consists of the following parts:

1. lnsert BOCs in combination to yield maximum trans-hybrid loss, the objective being to match the capacity of the BOCs to that of the cable connected to the 2-wire port (for cable less than 6 kft only).
2. Install and condition a 7833-XX PBN to match the repeater to the 2-wire cable facility (for cable greater than 6 kilofeet only).
3. Set the gain or attenuation through the XMT and RGV paths, as required.
4. Adjust the equalization to compensate for the slope of the bandpass output of the cable.

The following test equipment is required to align the 7535-00:

- Oscillator — HEWLETT PACKARD 204 or equivalent.
- Analog Voltmeter — HEWLETT PACKARD 3400 A or equivalent.

Note: The bantam plug mentioned in the alignment procedures is equivalent to a WECo KS-20999-L1 plug.

8.1 Trans-hybrid Loss

In order to ensure a maximum level of trans-hybrid loss for cable length under 6 kilofeet attached to the 2-wire port, build-out capacitors must be used along with the compromise balance network.

CAUTION

Opening or shorting the 2-wire line and comparing the proper load is not a valid test for trans-hybrid loss for this unit. Refer to page 7 for the procedure necessary to match the BOCs to the 2-wire cable.

When the 7535-00 is used in a terminal application at the 2-wire port, the fixed impedance (600/900 ohm) COMP NET is used to match the termination. For this application, a plug-in PBN is not required. To enable the fixed 600/900 ohm COMP NET, the PBN/COMP NET switch (S4) is set to the COMP NET position.

When a loaded or nonloaded cable in excess of 6 kilofeet is connected to the 2-wire port, a plug-in PBN is used at this port. The PBN subassemblies are mounted via a 4-pin plug-in connector and a stand-off.

When using a plug-in PBN, set the PBN/ COMP NET switch to the PBN position. This disables the fixed impedance COMP NET and enables the plug-in PBN. The 7833-01, 7833-02, and 7833-03 subassemblies have one or more DIP switch blocks whose settings determine the impedance of the PBN. The 7833-15 subassembly has one DIP switch block, and a push-on jumper option to condition the subassembly for the given application. Refer to Figure 7 for PBN option locations, and refer to Table 2 (7833-01), Table 3 (7833-02), Table 4 (7833-03), or Table 5 (7833-15), for PBN option conditioning.

Table 2. PBN (7833-01) Option Switch Conditioning For H88 Loaded Cable

CABLE GAUGE	CLOSE SWITCHES
22GA H88	S1,S3,S5,S7
24GA H88	S2, S4, S5, S7
26GA H88	S7

Table 3. PBN (7833-02) Option Switch Conditioning For Nonloaded Cable

Cable Gauge	Cable Length (Kilofeet)	Close Switches
22	0–10.5	S1-1, S1-7, S2-4, S2-5, S2-6, S2-7, S2-8
22	10.51–15	S1-1, S1-6, S2-2, S2-8
22	15.01–30	S1-3, S1-7, S2-2, S2-5, S2-8
24	0–9.3	S1-1, S1-8, S2-4, S2-5, S2-8
24	9.31–11.7	S1-1, SI-8, S2-3, S2-7, S2-8
24	11.71–14.7	S1-1, S1-8, S2-3, S2-6, S2-8
24	14.71–30	S1-1, S1-8, S2-3, S2-6, S2-7
26	0–6.9	S1-1, S1-8, S2-4, S2-8
26	6.91–8.4	S1-1, S1-8, S2-4, S2-7
26	8.41–10.5	S1-1, S1-8, S2-4, S2-6
26	10.51–16.5	S1-1, S1-8, S2-4, S2-5
26	16.51–30	S1-1, S1-8, S2-4, S2-5

Table 4. PBN (7833-03) Option Switch Conditioning For D66 Loaded Cable

Cable Gauge	Close Switches
22GA D66	S1, S3, S5, S7
24GA D66	S2, S4, S5, S7
26GA D66	S7

Table 5. PBN (7833-15) Option Switch Conditioning*

Cable Loading	Cable Gauge	End Section Cable Length (ft)	Close Switches
H88	22	1050 to 1650	S6, S9, S10
		1650 to 2300	S2, S6, S8, S10
		2300 to 2800	S3, S6, S9, S10
		2800 to 3300	S4, S6, S8, S10
		3300 to 3450	S2, S4, S5, S9, S10
		3450 to 4050	S2, S4, S5, S9, S10
		4050 to 4350	S2, S4, S5, S9, S10
		4350 to 4650	S3, S4, S5, S9, S10
		4650 to 4900	S2, S3, S4, S5, S8, S10
	24	1050 to 1350	S7, S9, S10
		1350 to 1650	S7, S9, S10
		1650 to 1950	S2, S6, S8,S10
		1950 to 2250	S2, S6, S8, S10
		2250 to 2650	S1, S3, S6, S8, S10
		2650 to 2850	S1, S3, S6, S8, S10
		2850 to 3450	S4, S5, S9, S10
		3450 to 3750	S2, S4, S5, S8, S10
		3750 to 4050	S2, S4, S5, S8, S10
		4050 to 4350	S3, S4, S5, S8, S10
		4350 to 4650	S3, S4, S5, S8, S10
		4650 to 4900	S2, S3, S4, S5, S7, S10
	26	1050 to 1350	S1, S6, S9
		1350 to 1650	S1, S6, S9
		1650 to 1950	S1, S2, S6, S8
		1950 to 2250	S1, S2, S6,S8
		2250 to 2550	S1, S3, S5, S9
		2550 to 2850	S1, S3, S5, S9
		2850to3450	S1, S3, S5, S7, S10
		3450 to 3750	S1, S3, S5, S6, S10
		3750 to 4050	S1, S2, S3, S5, S6, S10
		4050 to 4650	S3, S4, S5, S6, S10
		4650 to 4900	S1, S3, S4, S5, S6

Cable Loading	Cable Gauge	End Section Cable Length (ft)	Close Switches
D66	22	750 to 1500	S2, S6, S9
		1500to2100	S1,S2,S6,S9
		2i00to2700	S1,S4, S6, S8
		2700 to 3300	S1, S4, S6, S7
		3300 to 3750	S2, S3, S4, S5, S9
	24	750 to 1200	S2, S7, S9
		1200 to 1800	S3, S6, S9
		1800 to 2400	S4, S6, S8
		2400 to 3000	S4, S5, S9
		3000 to 3750	S3, S4, S5, S8
	26	700 to 900	S1, S6, S9
		900 to 1200	S1, S6, S9
		1200 to 1500	S3, S6, S7
		1500 to 1800	S3, S6, S7
		1800 to 2100	S1, S3, S5, S9
		2100 to 2700	S4, S5, S9
		2700 to 3300	S1, S4, S5, S8
		3300 to 3600	S2,S4,S5,S7
		3600 to 3800	S1, S2, S4,S5, S7

Note: Set the 22GA/24GA/26GA push-on jumper to the appropriate position.

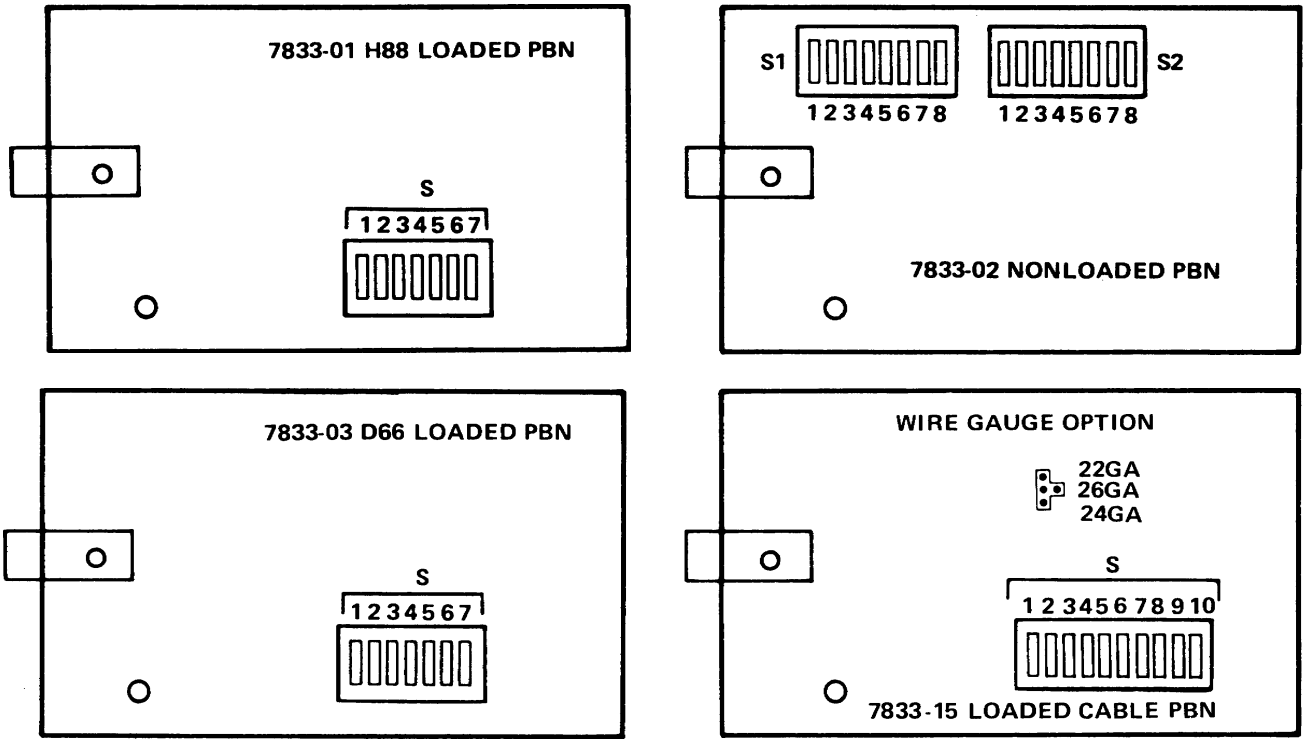

Figure 7. 7833-XX Option Locations

8.2 Alignment Procedure For XMT Side Of Repeater

Ensure that the following options and switches are set before proceeding with alignment:

- The 2-wire, transmit (XMT), and receive (RCV) impedances are at their proper values.
- If a 7833-XX PBN is used, the PBN/COMP NET switch is in the PBN position. If the compromise network is used, the switch is set to the COMP NET position.
- XMT Hl/LO gain push-on jumper is set to the LO position.
- The XMT LEVEL potentiometer screw is at its approximate center position.
- The XMT EQUAL potentiometer is as far counterclockwise as it can go.

Step	Action	Verification
1.	Plug an oscillator equipped with a bantam plug into the 2W IN jack. Plug a voltmeter equipped with a bantam plug into the XMT LINE jack. *Note: The bantam plug is equivalent to a WECo KS-20999-L1 plug.*	
2.	Set the oscillator to 1000Hz at –10 dBm.	Note the level in dBm on the voltmeter.
3.	Set the oscillator to the 2800Hz level.	Note the level in dBm on the voltmeter.
4.	Subtract the 2800Hz level reading from the 1000Hz level.	The level obtained is the slope of the XMT leg of the repeater.
5.	Alternately set the oscillator back and forth between the 1000Hz and the 2800Hz levels while turning the XMT EQUAL potentiometer clockwise, until desired level of slope is attained.	Desired slope is obtained.
6.	Set the oscillator to the 1000Hz level and adjust the XMT LEVEL potentiometer until the desired gain is shown on the voltmeter.	Voltmeter shows desired gain reading.
7.	If the desired level is not reached with the XMT LEVEL potentiometer turned fully clockwise, reset the XMT Hl/LO gain push-on jumper to the HI position.	
8.	Adjust the XMT LEVEL potentiometer until the desired gain is reached.	Voltmeter shows desired gain reading.

8.3 Alignment Procedure For RCV Side Of Repeater

Ensure that the following options and switches are set before proceeding with alignment:

- The 2-wire, transmit (XMT), and receive (RCV) impedances are at their proper values.
- If a 7833-XX PBN is used, the PBN/COMP NET switch is in the PBN position. If the compromise network is used, the switch is set to the COMP NET position.
- The RCV H l/LO gain push-on jumper is set to the LO position.
- The RCV LEVEL potentiometer screw is at its approximate center position.
- The RCV EQUAL potentiometer is as far counterclockwise as it can go.

Step	Action	Verification
1.	Plug a voltmeter equipped with a bantam plug into the RCV LINE jack. Plug an oscillator equipped with a bantam plug into the 2W IN jack. *Note: The bantam plug is equivalent to a WECo KS-20999-L1 plug.*	
2.	Set the oscillator to 1000 Hz at –10 dBm.	Note the level in dBm on the voltmeter.
3.	Set the oscillator to the 2800 Hz level.	Note the level in dBm on the voltmeter.
4.	Subtract the 2800 Hz level reading from the 1000 Hz level.	The level obtained is the slope of the RCV leg of the repeater.
5.	Alternately set the oscillator back and forth between the 1000 Hz and the 2800 Hz levels while turning the RCV EQUAL potentiometer clockwise, until desired level of slope is attained.	Desired slope is obtained.
6.	Set the oscillator to the 1000 Hz level and adjust the RCV LEVEL potentiometer until the desired gain is shown on the voltmeter.	Voltmeter shows desired gain reading.
7.	If the desired level is not reached with the RCV LEVEL potentiometer turned fully clockwise, reset the RCV HI/LO gain push-on jumper to the HI position.	
8.	Adjust the RCV LEVEL potentiometer until the desired gain is reached.	Voltmeter shows desired gain reading.

9. TESTING

After completing the installation, optioning, and alignment procedures, perform a voice and signaling test to verify proper operation. If trouble is encountered, verify that all installer connections have been properly made. Make certain that all options are properly conditioned and alignment procedures followed. Verify that the module is making proper connection to the card-edge connector; remove and reinsert the 7535-00, and recheck operation. If trouble persists, check the incoming signals on the 2-wire path, and on the 4-wire RCV path via the front-panel-mounted test jacks. If the incoming voice signals are of good quality and of proper amplitude, remove the 7535-00 and replace with a unit known to be in good operating condition. Check system operation with the new module installed.

10. 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)

11. WARRANTY & CUSTOMER SERVICE

11.1 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)

11.2 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.

11.3 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.

11.4 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.

12. SPECIFICATIONS

The electrical and physical characteristics of the 7535-00 are as follows:

12.1 Electrical

(a) Power Requirements

Voltage	Idle Current	Peak Current
–24 volts nominal (–21 to –28V)	18 mA (typical) 31 mA (maximum)	25 mA (typical) 41 mA (maximum)
–48 volts nominal (–44 to –56V)	38 mA (typical) 51 mA (maximum)	45 mA (typical) 61 mA (maximum)
*Each 7833-XX PBN subassembly draws 18 mA maximum.		

(b) MAXIMUM POWER HANDLING CAPABILITY: 2-wire input/output, +8dBm; 4-wire RCV input, +10 dBm; 4-wire XMT output, + 16dBm.

(c) GAIN RANGE: Adjustable in two steps from –20 to +10dB and 0 to +30dB.

(d) FREQUENCY RESPONSE: ±1.5dB in the range of 300 to 3200Hz relative to 1000Hz.

(e) TRANS-HYBRID LOSS: 35dB minimum at any frequency from 300 to 3200Hz, with a gain of –4dB in each direction of transmission and the 2-wire port terminated in 600 ohms +2.15uF, or 900 ohms +2.15uF.

(f) 2-WIRE RETURN LOSS: Against 600 ohms +2.15uF or 900 ohms +2.15uF, ERL is 30dB minimum; SRL is 20dB minimum.

(g) 4-WIRE IMPEDANCE: 150, 600, or 1200 ohms, set via push-on jumper options.

(h) HARMONIC DISTORTION: Harmonic distortion is less than 1 percent at 1000Hz and an output level of +10 dBm on the 4-wire port. Harmonic distortion is less than 1 percent at 1000Hz and an output level of +7dBm on the 2-wire port.

(i) NOISE: Idle noise at +30dB gain is less than l5dBrnG. Impulse noise at +30dB gain is zero counts in 5 minutes at a 35dBrnC threshold.

(j) ENVELOPE DELAY DISTORTION: Between any two frequencies in the range of 500 to 3200Hz, less than 375usec; in the range of 300 to 4000Hz, less than 950usec. In the range of 1000 to 2400Hz, less than 85usec.

(k) CROSSTALK: Between two modules in adjacent slots is greater than 70dB.

(l) EQUALIZATION: Both 4-wire amplifiers have built-in equalization providing 0 to 6dB equalization at 2800Hz relative to 1000Hz.

(m) LONGITUDINAL BALANCE: Longitudinal balance is greater than 60dB between 300 and 3000Hz.

(n) PULSE DISTORTiON: With the unit connected for simplex signaling is less than 5 percent for a make/break ratio of 40 to 60 percent at 12pps.

(o) SIMPLEX RESISTANCE: Simplex resistance between 2-wire tip and ring with the unit connected for simplex signaling and the 4-wire ports shorted together is less than 125 ohms.

(p) LIGHTNING iMMUNITY: The 2-wire and 4-wire ports can withstand 1.0kV tip-to-ring, tip-to-ground, and ring-to-ground 5 times in succession of both polarities.

12.2 Physical

See Table 6 for the physical characteristics of the unit.

Table 6. Physical Specifications

Feature	U.S.	Metric
Height	5.6 inches	14.2 centimeters
Width	1.5 inches	3.8 centimeters
Depth	6.0 inches	15.2 centimeters
Weight	Less than 20 ounces	Less than 567.0 grams
Operating Temperature	32° to 120° F	0° to 49° C