3653–36 4W Transmission Only with Extended Range and Loopback (4W TO/ER/LB) Channel Unit

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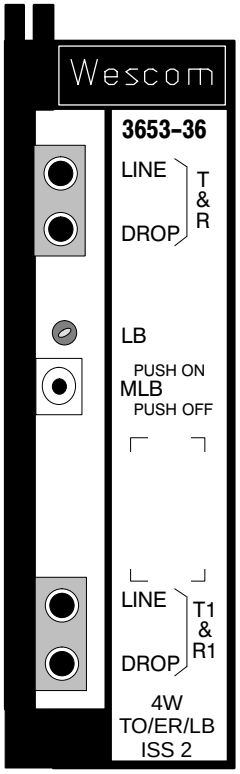


Figure 1. 3653–36 Front Panel

1. GENERAL

1.1 Document Purpose

This practice provides general, application, circuit, optioning, installation and testing information for the Charles Industries 3653–36 4-Wire Transmission Only with Extended Range and Loopback (4W TO/ER/LB) channel unit, shown in Figure 1.

1.2 Document Status

This document is reprinted to include a general editorial update

1.3 Equipment Purpose/Description

The 3653–36 provides a direct interface between 600 ohm 4W VF or voiceband data (modem) circuits and the 360/363 D4 Digital Carrier Terminal common equipment.

1.4 Equipment Location/Mounting

The 3653–36 is mounted in a Wescom 360/363 D4 Channel Bank or Digital Carrier Terminal.

1.5 Equipment Features

The 3653–36 provides the following features:

- Complies with AT&T Pub. 43801 Specifications
- Accommodates transmit and receive TLP levels from –19.5 to +13dBm
- Provides 600 ohms impedance at the 4W port interface
- Provides 2713Hz tone-activated loopback
- Provides selectable 4-min/20-min/none loopback automatic timeouts
- Provides selectable tone loopback disable
- Prescription adjustable loopback level of up to 31.5dB of gain/attenuation in 0.5dB increments
- Front-panel manual loopback switch
- Front-panel-mounted bantam jacks for accessing the transmit and receive ports
- Front-panel LED indicating loopback status
- Optional sealing current configuration with automatic ZAP

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 module 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-dissi-

pative mat, when handling modules outside of their protective packaging. A module 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 3653–36 provides an interface between 600-ohm balanced 4-wire (4W) VF/DATA circuits and the 360/363 D4 Digital Carrier Terminal common equipment. The receive and transmit paths of the 3653–36 provide level controls to accommodate TLP levels from –19.5 to +13.0 dBm. The 3653–36 also provides tone or manually activated loopback function that can eliminate the need for external loopback equipment. A typical application is shown in Figure 2.

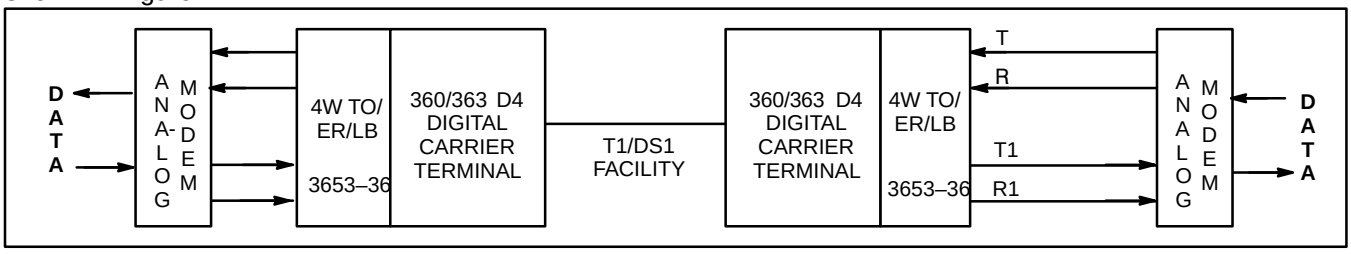


Figure 2. Typical 3653–36 4W TO/ER/LB Application

4. CIRCUIT DESCRIPTION

Refer to Figure 3, the 3653–36 block diagram, as needed while reading the following circuit description.

4.1 Transmit VF Path

VF signals applied to the input T&R (pins 50 and 48) are routed through the DROP and LINE lifting jacks to transformer T1. Transformer T1 provides a balanced input and DC isolation from the line.

Voice energy from transformer T1 is routed to the XMT level control circuit.

The XMT level control provides a total of 32.5 dB of level control in 0.1 dB increments. Switches S2 and S3 associated with this circuit allow the transmit port to accommodate a –19.5 to +13.0 dBm input TLP range.

The adjusted VF signal is then applied to the XMT FILTER circuit. The filter suppresses frequencies that are outside of the standard voice frequency and prevents them from entering the ENCODER. The ENCODER performs an analog-to-digital (A/D) conversion and sends the resulting PCM signal to the 360/363 common equipment via the XDATA lead.

4.2 Receive VF Path

The PCM digital signal from the far end is received by the 360/363 common equipment, is routed to the 3653–36 via the RDATA lead, and is applied to the DECODER circuit. The DECODER then performs a digital-to-analog (D/A) conversion of the signal. The analog signal from the DECODER circuit is applied to the RCV FILTER. The RCV FILTER suppresses frequencies that are outside the bandwidth of the standard voice band.

The output of the RCV filter is applied to the RCV level control. The RCV level control provides a total of 32.5 dB of level control in 0.1 dB increments. Switches S4 and S5 allow the receive port to accommodate a –19.5 to +13.0 dBm input TLP range.

The adjusted VF signal is then routed through transformer T2 which provides dc isolation from the line and a balanced output level. The signal is then fed to the T1 & R1 leads (pins 8 and 7) via the LINE and DROP jacks.

4.3 Sealing Current

Three different configurations of Sealing Current are provided and are selected by option Switch S1.

The SX (Simplex) position supplies ground to leads T and R and –48Vdc, through a 750-ohm thermistor, to leads T1 and R1. When the module is first plugged in, the current surges to approximately 100mA and decreases quickly to a steady simplex current of approximately 30mA. This low value of dc current being applied to the 4W cable pairs, on a simplex basis, will break down any resistance film which may build up at nonsoldered splices. Continued application of this dc sealing current sustains the normal resistance of the cable pairs and prevents degradation of transmission performance.

In the LP (Loop) position, the simplex leads of T1 and T2 are shorted together. Sealing current from the analog facility will be looped by the channel unit.

The OPN (Open) position is used when no sealing current is required.

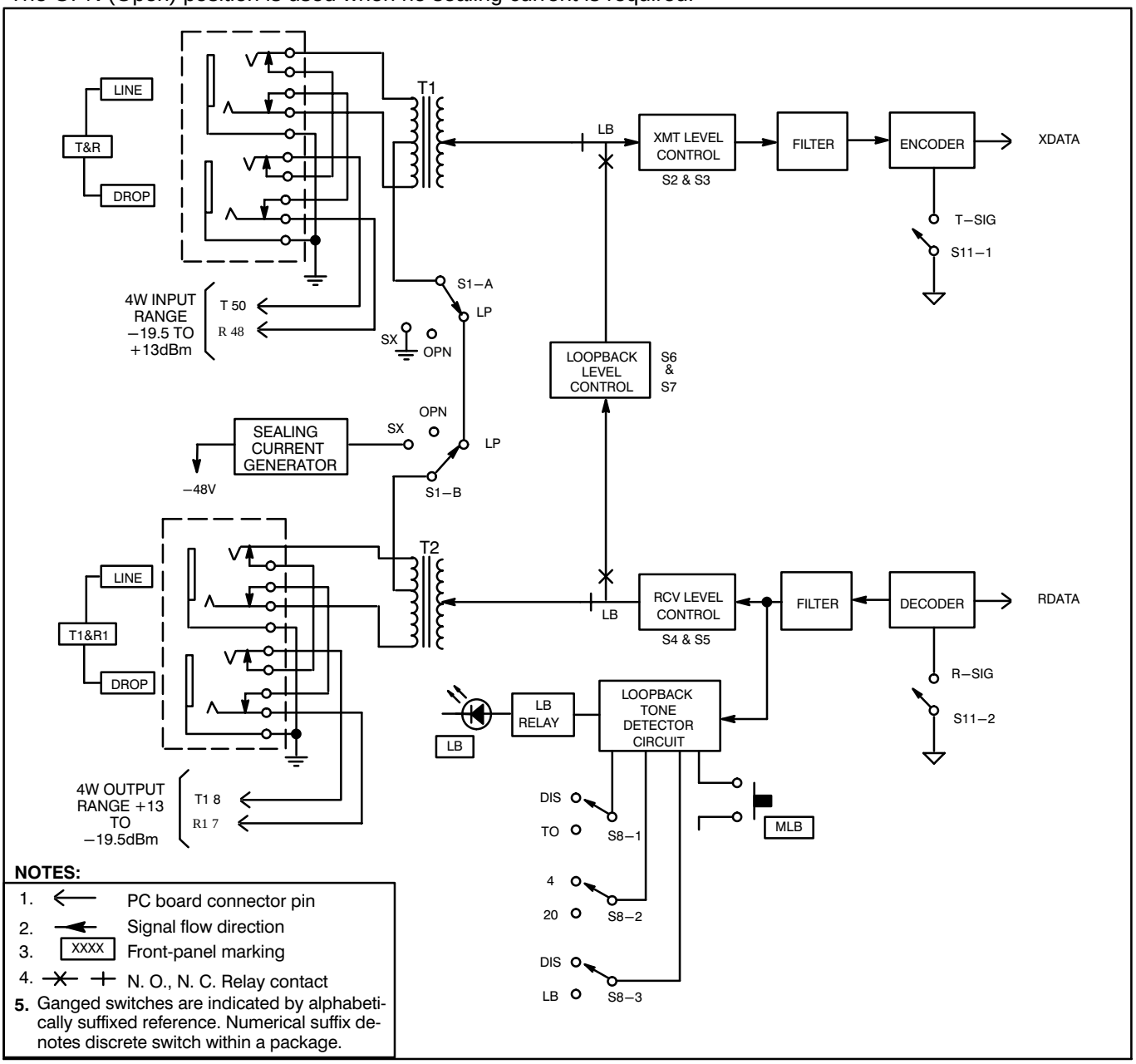


Figure 3. 3653–36 Block Diagram

4.4 2713Hz Tone-Activated Loopback

The 3653–36 provides tone-operated loopback toward the digital facility. A continuous 2713Hz loopback control signal applied from the far end for a minimum of 2.2 seconds and then removed will result in the operation and latching of the LB RELAY and the illumination of the front-panel LB LED. While operated, the LB RELAY will perform the following functions:

- Opens the 4W port to the 4W equipment preventing transmission.
- Loops all voice-band signals from the RCV output to the XMT path, enabling all active components to be verified.

The EQUAL LEVEL LOOPBACK circuit provides prescription level adjustment of ±31.5dB in 0.5dB steps to match the RCV output to the XMT path input.

Loopback release is accomplished by the reapplication of 2713Hz tone (for a minimum of 1.1 seconds) to the 3653–36. After the 2713Hz tone has been received, the LB RELAY releases and the LB LED extinguishes, ending the loopback condition.

The loopback control circuit provides several control options as selected by switch S8. The tone activated loopback feature can be disabled or enabled. In addition, when the unit has been looped via a 2713 Hz tone, the circuit can be optioned to have a 4-min, 20-min, automatic release, or no timeout.

4.5 Manual Loopback

The 3653–36 can be manually placed in the loopback mode by momentarily operating the front-panel MLB pushbutton switch (S9). The module will remain in the manual loopback mode regardless of the settings of S8. To release the manual loopback mode, the MLB switch is again momentarily operated.

4.6 7 5/6-Bit or 8-Bit (Encoding & Decoding)

The 3653–36 provides 7 5/6-bit or 8-bit encoding and decoding schemes for the transmit and receive paths to/from the facility. The 7 5/6-bit encoding/decoding scheme provides for end-to-end compatibility with E&M channel units. In this scheme a constant off-hook (logic 1) is transmitted on the A+B signaling bits to the far end. The full 8-bit encoding/decoding scheme provides a greater signal-to-noise ratio than the 7 5/6-bit scheme and does not transmit an off-hook signal to the far end.

5. MOUNTING

The 3653–36 mounts in one channel unit slot of a 360/363 D4 terminal. The 3653–36 is equipped with an insert/eject lever in the form of a hinged front panel which ensures a positive connection of the channel unit's card-edge connector to the backplane connector when the unit is installed. The insert/eject lever also facilitates removal of the unit.

CAUTION

Installation and removal of modules should be done with care. Do not force a module into place. If excessive resistance is encountered while installing a module, remove the module and check the card guides and connector to verify proper alignment and the absence of foreign material.

Step	Action
1.	Align the channel unit with the appropriate card-guided slot of the terminal.
2.	Slide the unit into the slot with the hinged front panel in a horizontal (up) position.
3.	When the top portion of the hinged front panel is under the front lip of the terminal, push down on the front panel until it is in the vertical position. The channel unit's card-edge connector will begin to make contact with the inner portion of the backplane connector.
4.	Continue applying light pressure onto the bottom edge of the front panel until the unit snaps into place.

6. INSTALLER CONNECTIONS

Installer connections are made to the channel unit via connectorized cable connectors that are part of the channel bank assembly. Refer to the appropriate channel bank installer practice for pin assignments.

7. OPTIONS

The 3653–36 is equipped with push button, DIP, and slide switch options that are used to condition the module for proper application and operation. Refer to Figure 4 and Table 1 for the location of these options while reading the following instructions.

7.1 Slide-Switch S1 – Sealing Current Control

When S1 is placed in the SX (Simplex) position the 3653–36 provides sealing current to the 4W facility. In the SX position the module also provides an automatic ZAP when it is first plugged in. When switch S1 is placed in the LP (Loop) position, the simplex leads of T1 and T2 are shorted together, which allows the channel unit to loop sealing current applied from the other end of the analog facility. The OPN (Open) position is used when no sealing current source or sink is required.

7.2 Switches S2 and S3 – XMT ATTN (Transmit Prescription Attenuation)

Switches S2 and S3 form a 9-section DIP switch that provides up to 32.5dB of attenuation, in 0.1dB steps, to accommodate various input TLPs. Refer to Transmit Alignment in Part 8.

7.3 Switches S4 and S5 – RCV ATTN (Receive Prescription Attenuation)

Switches S4 and S5 form a 9-section DIP switch that provides up to 32.5dB of attenuation, in 0.1dB steps, to accommodate various output TLPs. Refer to Receive Alignment in Part 8.

7.4 Switches S6 and S7 – ELL GAIN/ATTN (Equal Level Loopback Prescription Gain/Attenuation)

Switch S6 is a 6-section DIP switch that provides up to 31.5dB of equal level loopback in 0.5dB steps. S7 is a two-position slide switch to set equal level loopback for gain or attenuation. Refer to Equal Level Loopback Alignment in Part 8.

7.5 Switch S8 – Loopback Controls

S8 is a 3-position DIP switch that controls the loopback features of the unit. To disable the tone-activated loopback feature completely, set S8–3 to DIS; to enable the tone-activated loopback feature, set S8–3 to LB. To allow for a 4-minute automatic loopback timeout, set S8–2 to 4; to allow for a 20-minute timeout, set S8–2 to 20. To allow for no (infinite) loopback release timeout, set S8–1 to DIS; to allow for a 4 or 20-minute automatic timeout, set S8–1 to TO.

7.6 Switch S9 – MLB (Manual Loopback)

The MLB front-panel switch (S9) is a ‘push-on/push-off’ push-button switch. With each actuation of the MLB switch, the channel unit will alternate between loopback and the normal operating mode. When placed into loopback via the manual switch, the channel unit will remain in the loopback state, regardless of the optioning of S8 loopback controls.

7.7 Switch S11 – T-SIG, R-SIG (7 5/6-Bit or 8-Bit Encoding and Decoding)

S11 is a 2-section DIP switch. Place switch S11–1 (T-SIG) and S11–2 (R-SIG) to the ON position for a 7 5/6-bit encoding/decoding scheme for end-to-end compatibility with E&M channel units. In this scheme an off-hook (logic 1) is transmitted on the A&B signaling bits to the far end. Place switch S11–1 (T-SIG) and S11–2 (R-SIG) to the OFF position for a full 8-bit encoding/decoding scheme which provides a greater signal-to-noise ratio than the 7 5/6-bit scheme and does not transmit an off-hook to the far end.

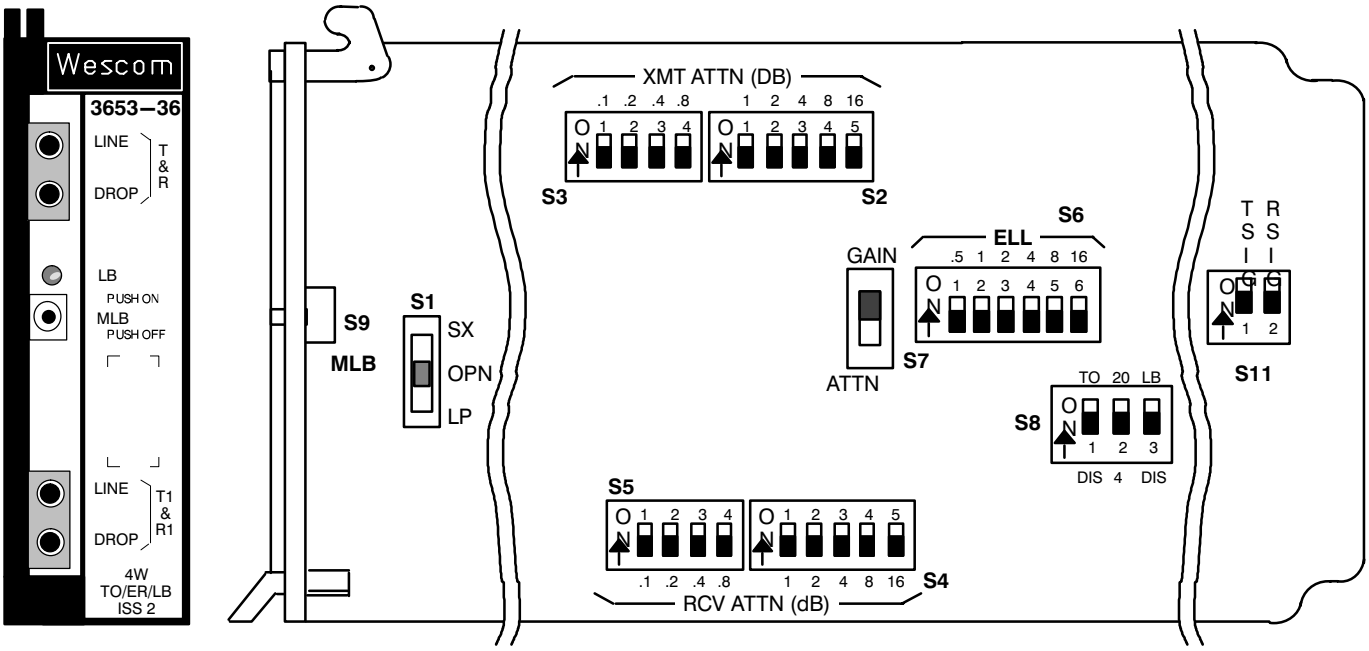


Figure 4. 3653–36 Option Locations

Table 1. Description of Figure 4

Option	Position	Use to
S1	SX (Simplex)	Sealing current is generated by the channel unit with automatic ZAP when the module is first plugged in.
	OPN (Open)	No sealing current.
	LP(Loop)	Loop sealing current supplied from the other end of the analog facility by the channel unit via the simplex leads of transformers T1 and T2.
S2, S3	ON/OFF as required. Refer to Transmit Alignment in Part 8	Switches S2 and S3 form a 9-section DIP switch that provides up to 32.5dB of attenuation, in 0.1dB steps, for adjusting the transmit path to the proper operating level at the ENCODER input.
S4, S5	ON/OFF as required. Refer to Receive Alignment in Part 8	Switches S4 and S5 form a 9-section DIP switch that provides up to 32.5dB of attenuation, in 0.1dB steps, for adjusting the receive path to the proper operating level output at leads T1 & R1.
S6, S7	ON/OFF as required. Refer to Equal Level Loopback Alignment in Part 8	Switch S6 is a 6-section DIP switch that provides up to 31.5dB of equal level loopback in 0.5dB steps. S7 is a 2-position slide switch that selects loopback path gain or attenuation.
S8–1	TO (ON)	For automatic loopback timeout.
	DIS (OFF)	For no loopback timeout.
S8–2	20 (ON)	For 20-minute loopback timeout.
	4 (OFF)	For 4-minute loopback timeout.
S8–3	LB (ON)	For tone-activated loopback enable.
	DIS (OFF)	To disable tone-activated loopback.

Option	Position	Use to
S9 (MLB) front-panel push-button	With each operation of switch S9, the channel unit alternates between manual loopback and normal operating mode. Manual loopback mode overrides the optioning of S8.	To manually activate Loopback (MLB).
		To manually release Loopback (MLB).
S10	————	Not used
S11–1 (T–SIG)	OFF	For 8-bit encoding.
	ON	For 7 5/6 encoding. (Normal mode)
S11–2 (R–SIG)	OFF	For 8-bit decoding.
	ON	For 7 5/6 decoding. (Normal mode)

8. ALIGNMENT

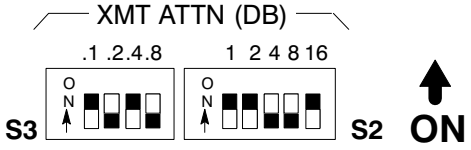
8.1 Transmit Alignment

The XMT ATTN switches S2 and S3 are prescription controls that provide attenuation from 0.0 to 32.5dB in increments of 0.1dB to accommodate an input TLP range from –19.5 to 13.0dBm. To adjust the transmit path to the proper operating level, the difference between –19.5 and the transmit TLP at T&R must be obtained:

XMT ATTN = TLP – (–19.5)

Use Table 2 for common TLP values.

For example, for a 0 db transmit TLP, set the sum of S2 and S3 to 19.5 by placing the switch sections shown below in the ON position.



16 + 2 + 1 + 0.4 + 0.1 = 19.5

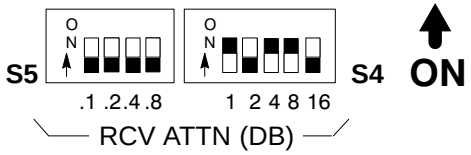
8.2 Receive Alignment

The RCV ATTN switches S4 and S5 are prescription controls that provide attenuation from 0.0 to 32.5dB in increments of 0.1dB to accommodate an output TLP range from +13.0 to –19.5dBm. To adjust the receive path to the proper operating level, the difference between +13.0 and the receive TLP at T1 & R1 must be obtained:

RCV ATTN = 13.0 – TLP

Use Table 3 for common TLP values.

For example, for a 0 db receive TLP, set the sum of S4 and S5 to 13 by placing the switch sections shown below in the ON position.



8 + 4 + 1 = 13

8.3 Equal Level Loopback (ELL) Alignment

The ELL switches S6 and S7 are prescription controls that provide adjustment to match the RCV path output to the XMT path input. Perform the ELL alignment as follows:

Step	Action
1.	Determine the required ELL by adding the setting for the XMT ATTN and RCV ATTN settings and subtracting 32.5. ELL = XMT ATTN + RCV ATTN – 32.5
2.	Set switch S6 to the required ELL to the nearest 0.5dB.
3.	If the ELL is a negative number, set switch S7 to ATTN position; if the ELL is a positive number, set switch S7 to the GAIN position.

Table 2. Common Transmit TLP Values

Desired TLP	Set S3 & S2	Desired TLP	Set S3 & S2
+13	32.5	–3	16.5
+12	31.5	–4	15.5
+11	30.5	–5	14.5
+10	29.5	–6	13.5
+9	28.5	–7	12.5
+8	27.5	–8	11.5
+7	26.5	–9	10.5
+6	25.5	–10	9.5
+5	24.5	–11	8.5
+4	23.5	–12	7.5
+3	22.5	–13	6.5
+2	21.5	–14	5.5
+1	20.5	–15	4.5
+0.5	20	–16	3.5
0	19.5	–17	2.5
–0.5	19	–18	1.5
–1	18.5	–19.5	0
–2	17.5		

Table 3. Common Transmit TLP Values

Desired TLP	Set S4 & S5	Desired TLP	Set S4 & S5
+13	0	–3	16
+12	1	–4	17
+11	2	–5	18
+10	3	–6	19
+9	4	–7	20
+8	5	–8	21
+7	6	–9	22
+6	7	–10	23
+5	8	–11	24
+4	9	–12	25
+3	10	–13	26
+2	11	–14	27
+1	12	–15	28
+0.5	12.5	–16	29
0	13	–17	30
–0.5	13.5	–18	31
–1	14	–19.5	32.5
–2	15		

9. TESTING

After completing Parts 4 through 8, perform end-to-end transmission test per local practice to verify proper operation. If trouble is encountered, recheck all installer connections, options and alignment settings, and verify that the channel unit is making positive connection to the backplane connector. If trouble persists, replace the unit with a similar unit known to be in proper operating order and retest the facility.

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 pre-addressed 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

12.1 Agency Compliance

(a) Recognized under Underwriters Laboratories Standard 1459, Second Edition. Compliance is restricted to inside plant wiring. Field repairs may void compliance.

(b) FCC P.15 Class A.

(c) Meets Canadian CSA and DOC requirements.

12.2 Electrical Specifications

12.2.1. Power

(a) POWER REQUIREMENTS: Power is supplied via the 3609–XX PSU which is part of the 360/363 Channel Bank common equipment.

12.2.2. Transmission

(b) 4W XMT INPUT TLP RANGE: +13.0 to –19.5dB.

(c) 4W RCV OUTPUT TLP RANGE: +13.0 to –19.5dB.

(d) TRANSMIT AND RECEIVE PRESCRIPTION ATTENUATION: 0.0 to 32.5dB in 0.1dB steps.

(e) LONGITUDINAL BALANCE (REFERENCED TO –16dBM TLP): 74dB minimum at 200Hz to 1KHz; 69dB minimum at 3kHz.

(f) SIGNAL TO DISTORTION RATIO: 35dB minimum at zero to –30dBm0; 29dB minimum at –40dBm0; 25dB minimum at –45dBm0.

(g) RETURN LOSS: 23dB minimum at 300Hz to 3KHz; 28dB minimum at 1kHz.

(h) TRANSMIT/RECEIVE IDLE CHANNEL NOISE: 20dBrnC0 maximum.

(i) TRANSMIT AND RECEIVE PATH FREQUENCY RESPONSE: (Referenced at 1kHz)

Table 4. Frequency Response

FREQ (Hz)	XMT (dB)	RCV (dB)
60	Less than –14.0	———
200	+0.15 to –2.0	+0.15 to –1.0
300	+0.15 to –0.15	+0.15 to –0.15
1000	0 (REF)	0 (REF)
3000	+0.15 to –0.15	+0.15 to –0.15
3400	0 to –1.5	0 to –1.5
4000	Less than –14.0	Less than –14.0

(j) CROSSTALK: 61dBm0 minimum at 400Hz; 71dBm0 minimum at 700Hz to 1KHz; 70dBm0 minimum at 3kHz.

(k) LEVEL TRACKING SINGLE-ENDED AT 1020Hz: ±0.25dB from +3 to –37dBm0, ±0.5dB from –38 to –50dBm0.

12.2.3. Loopback

(l) DETECTOR FREQUENCY: Will detect within 2713 ± 7Hz; will not detect outside of 2713 ± 35Hz.

(m) DETECTOR AMPLITUDE: Will detect 0.0 to –30dBm0; will not detect less than –40dBm0.

(n) DETECTOR TIMING: Activate, 2.2 seconds; deactivate, 1.1 seconds.

(o) ELL GAIN/ATTENUATION RANGE: 0.0 to 31.5dB in 0.5dB increments.

12.3 Physical Specifications

The physical characteristics of the 3653–36 4W are shown in Table 5.

Table 5. Physical Specifications

Feature	U.S.	Metric
Height	4.25 inches	10.8 centimeters
Width	1.31 inches	3.3 centimeters
Depth	10.31 inches	26.2 centimeters
Weight	9.25 ounces	263 grams
Temperature	32 to 122° F	0 to 50° C
Humidity	To 95% (no condensation)	