3608-04 Digroup Interface Unit — Redundant (DIU-R)

1.   GENERAL

1.1   Document Purpose

This document provides general, application, circuit, optioning, installation and testing information for the Charles Industries 3608–04 Digroup Interface Unit – Redundant (DIU–R), shown in Figure 1. Complete the switch optioning in Part 5 before installing the unit.

1.2   Equipment Function

The 3608–04 Digroup Interface Unit is part of the common equipment set for the Charles Industries 360–22 D4 Digital Carrier Terminal (DCT). The 3608–04 provides framing, timing, alarms, trunk processing, and 1:1 protection switch control.

Note: The 3608-04 can only be used with the 3609-04 (–48 volts) or 3609–22 (+/–24 volts) PSU-R as a common equipment set for the 360-22 D4 DCT.

The 3608–04 DIU–R, along with the 3603–02 LIU–3E and the 3609–04 or 3609–22 PSU–R, form the common equipment set required for the 360–22 D4 DCT. To provide for 1:1 common equipment protection in the DCT, two common equipment sets are required; one for active control and the other as a standby set. The 3608–04 DIU–R controls the routing of the DS1 facility to and from its associated LIU–3E. If the common equipment set is active, the associated LIU–3E is connected directly to the DS1 facility and the LIU–3E's composite clock output is routed to the rear panel connector. In the standby set, the DIU–R will remove this connection. The 3608–04 DIU–R provides the intelligence to the common equipment set which includes monitoring the functional performance and operation of itself, the LIU–3E, and the PSU–R.

The 3608–04 DIU–R provides the necessary circuitry for sequencing the channel units per D1D, D2, and D3 channel time slot assignments. The DIU–R also generates the framing bits for transmission and checks the receive framing pattern for errors. The unit can be optioned for SF or ESF framing. The DIU–R can also be optioned for B8ZS to provide clear channel capabilities. The 3608–04 DIU–R provides various front panel indicators which include ACTIVE, AR, AY, TP, ESF, B8ZS, LT and 1KHZ. A front-panel four-character display provides system status messages, and the current trunk processing count, if any

When two 3608–04s are installed in a DCT, they work in a master/slave configuration via their own serial link. The active unit is always in charge and is responsible for gathering all performance data and making necessary arbitration decisions. When the active unit determines that it's own errors are service affecting, it will request that the standby unit go active and provide a minor alarm. The newly active unit would take over all system responsibilities. If a failure exists in both 3608–04s, the major alarm would be set indicating a service-affecting condition.
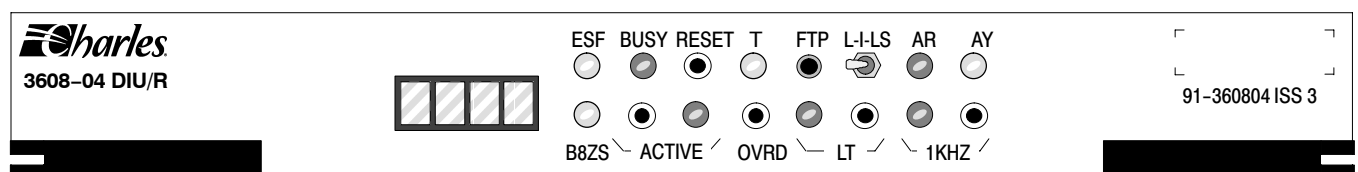

Figure 1. 3608–04 DIU–R Front Panel

1.3 Equipment Location/Mounting

The 3608−04 is designed for horizontal mounting in the Charles Industries 360−22 D4 DCT.

1.4 Equipment Features

The 3608−04 includes the following features:

- Intelligent system monitoring with arbitration control

- Compatible with either Superframing (SF) or Extended Superframing (ESF)

- Binary 8 Zero Substitution (B8ZS) or Bit 7 Zero Code Suppression (AMI)

- Front panel display for activity, error messages, trunk processing count, and operating modes

- Front panel LEDs to indicate if the unit is active and associated push button to force active

- Front panel push button for switching override

- Front panel LED to indicate local alarms (AR) and remote alarms (AY)

- Front panel LED to indicate B8ZS selection

- Front panel LED to indicate ESF selection

- Front panel BUSY LED to indicate when any channel unit is manually busied

- Front panel pushbutton to enable or disable looped terminal (LT) function with associated status LED

- Front panel pushbutton to enable or disable 1 KHz tone generator with associated status LED

- Front panel pin jack for forcing trunk processing

- Control for Major/Minor alarms

- Composite clock output control

- Voice muting/quiet code during AY alarm

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 is-sue 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-dissipative 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 3608−04 can only be used with the 3603−02 LIU−3E and the 3609−04 PSU−R as a common equipment set for the 360−22 D4 DCT.

The 3608−04 DIU−R is configured for a specific application via a set of PCB−mounted DIP switches. See Part 5.

4. CIRCUIT DESCRIPTION

4.1 Transmit Timing

The transmit timing circuit provides the transmit framing and command sequence (D1D, D2, D3) timing for the 360−22 terminal under control of the 1.544 MHz clock from the LIU−3E. This circuit generates the same sequence timing for both SF and ESF modes.

The DIU provides the framing bits to the LIU−3E for transmission in the total bit stream. In the SF mode, the framing pattern generator generates the terminal framing (Ft) pattern (101010) and the signaling framing (Fs) pattern (001110). The frame bit alternates between ter-
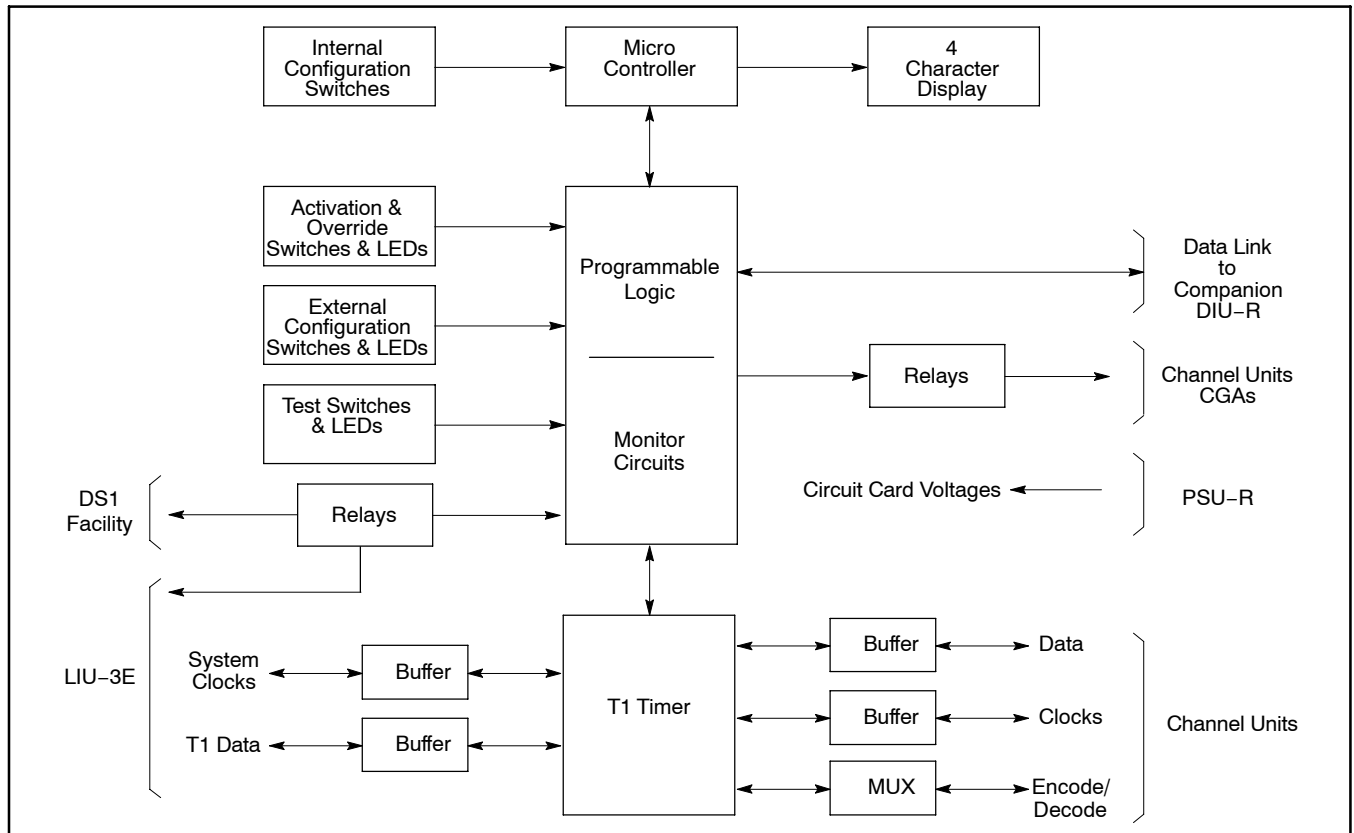
2

Figure 2. 3608−04 Digroup Interface Unit − Redundant (DIU−R) Block Diagram

minal framing and signaling framing. Signaling occurs in the 6th and 12th frame. In the ESF mode, the framing pattern generator generates the terminal framing (Fe) pattern (001011). Signaling occurs in the 6th, 12th, 18th, and 24th frame. The Data Link has a span of 4 KB/s. The Cyclic Redundancy Check (CRC) Bit Error has a span of 2 KB/s. The framing alignment format is 2 KB/s.

4.2   Receive Timing

The receive timing circuit provides the receive framing and channel sequence (D1D, D2, D3) timing for the 360−22 terminal under control of the 1.544 MHz clock from the LIU−3E. This circuit generates the same sequence timing for both SF and ESF modes.

4.3   Composite Clock

Figure 3 shows the connection of the DIU−R when used in a 360−22 Channel Bank. The relays were added to allow the composite clock to work as an output on pins 1 and 6 for the J33 connector, and are used to control the DDS output (pins 62 and 64) from the active LIU−3E. The input connections are still on the same pins on the composite clock connector (J33).

4.4   Transmit Path

The data from the four data-out buses is applied to the DIU via the XDATA (1−4) leads. The four data streams from these inputs are combined into one bit stream by the XMT−XDATA interface section. This is accomplished by interweaving the words as they are received by the DIU. This is possible due to the sequencing of encoder activation by the DIU, which prevents simultaneous reception of data or overlapping of data from any of the channel unit data-out buses. The channel unit sequences for the three different formats are shown in Table 1.

The DIU transmits its re-timed data to the LIU−3E. This is accomplished through the XDTP and XDTN leads. The data stream thus consists of frames and superframes for either the SF or ESF mode. One frame consists of one 8−bit word from each of the 24 channel units and one framing bit (193 bits). A superframe, in the SF mode, consists of 12 frames.

The transmit channel timing circuit decodes the transmit timing signals and provides 24 Encode Command
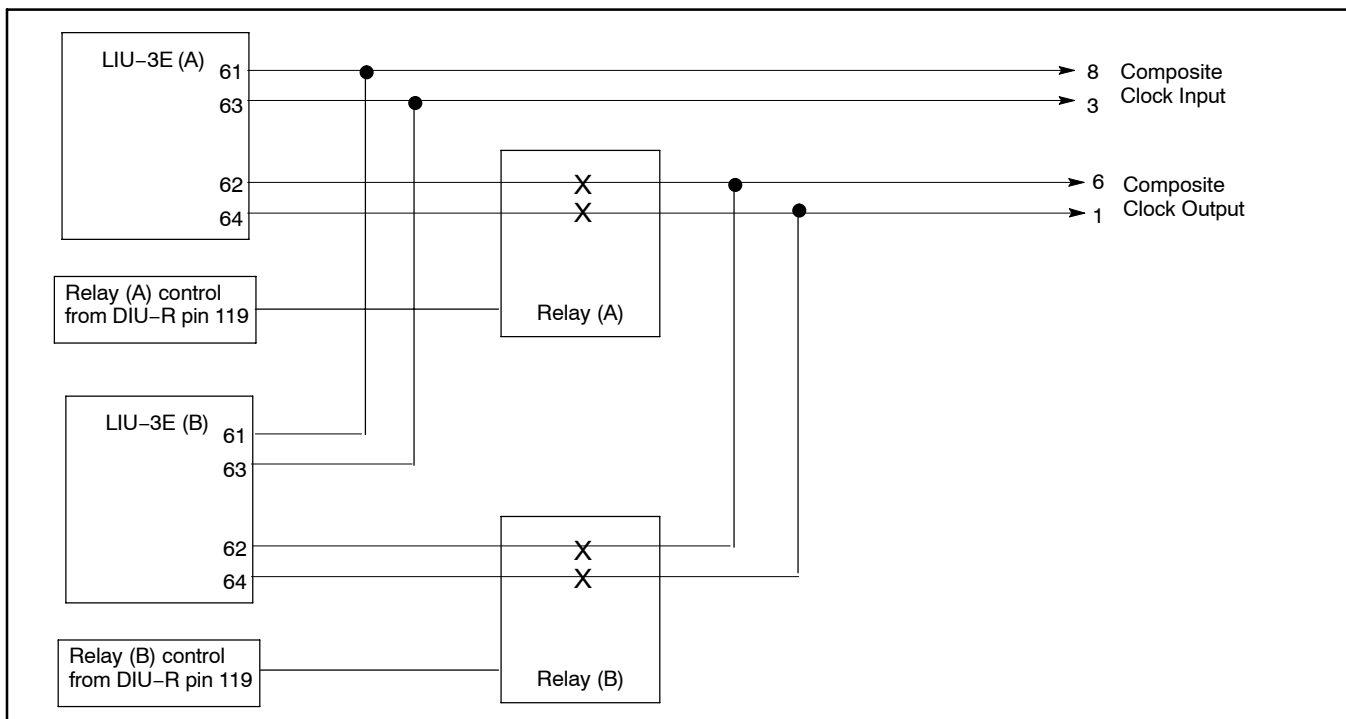
3

Figure 3. Composite Clock Connections

(ECM) signals for addressing the channel units. The encoder sequence is optioned for either D1D, D2, or D3 channel sequence (refer to Table 1).

Table 1. Channel Unit Slot Assignment

Timeslots	D3 Channel	D2 Channel	D1D Channel
1	1	12	1
2	2	13	13
3	3	1	2
4	4	17	14
5	5	5	3
6	6	21	15
7	7	9	4
8	8	15	16
9	9	3	5
10	10	19	17
11	11	7	6
12	12	23	18
13	13	11	7
14	14	14	19
15	15	2	8
16	16	18	20
17	17	6	9
18	18	22	21
19	19	10	10
20	20	16	22
21	21	4	11
22	22	20	23
23	23	8	12
24	24	24	24

4.5 Receive Path

The DIU receives data from the LIU-3E via leads RDTP and RDTN. The data is re-timed by the DIU receive interface circuit and transmitted on the RDATA bus to the channel units. The recovered clock (R1ACK) is received from the LIU-3E. In the looped condition, the receive data RDTP and RDTN are replaced by inserting the 1 KHz code or the quiet code, as controlled by the front-panel push button switches on the DIU. The R1ACK clock is bypassed, and the transmit clock is used to control both transmit and receive circuits.

The RDATA lead (DATA-IN-BUS) is routed to all channel units in the digroup. However, the data is not written into a channel unit decoder until the channel unit is addressed by the DIU via one of the 24 Decode Command (DCM) signals generated by the receive DCM Generator circuit. The DIU-R will address the channel units in the sequence dictated by the selected D1D, D2, D3 format. This format is the same for the ESF mode.

The alarm timing circuit provides the necessary indications for alarms and the proper timing for trunk processing. Hit integration for frame loss is provided so that unnecessary 1:1 protection switching and trunk processing does not take place during intermittent frame losses.

When both units are in standard CGA operation, a protection switch will occur 2.5 seconds after detection of a failure within the active common equipment set. With one unit failed, the second unit will initiate trunk processing 2.5 seconds after detection of an active failure, and

will transmit a yellow alarm. If both units are configured for the CM2 option (see page 7) the protection switch and the trunk processing would occur 1 second after detection. No yellow alarm is transmitted. If configured for CM3 operation, operation is similar to CM2 except trunk processing does not occur.

During a red alarm at the far end in standard CGA operation, the far end bank will transmit a yellow alarm (AY) code to the near end. In the SF mode, at the near end an AY alarm code is indicated when all received bit 2's are zeros. In the ESF mode, an AY alarm code is indicated when the received data link m-bits have a repeated pattern of eight 1's followed by eight 0's. After detection of the yellow alarm bit pattern, the DIU lights the AY and TP LEDs and trunk processing begins. When an AY alarm exists, and a loss of signal or framing occurs, the AR LED will also be illuminated. This condition is known as a red-over-yellow alarm, indicating that the far-end terminal may have been looped after sending an AY code. Receive voice transmission will be muted by the quiet code during a received AY alarm.

An AR alarm can be forced by inserting a test probe into the FTP jack. The probe must have a diameter large enough to cause a short across the pack. The probe does not need to be grounded. The AR and TP LEDs illuminate, when the probe is inserted, after 2.5 and 5 seconds respectively, in standard operation. In the CM2 and CM3 operation, it would be 1 and 2 seconds, respectively.

4.6   Display Modes

The L–I–LS switch, located on the front panel, which is used in conjunction with the loop terminal function, also provides two display modes while in normal operation: standard and history mode. The L or I position selects the standard mode, and the LS position selects the history mode. Typically the L–I–LS switch would be set to the standard mode. This mode is used to display activity, error messages, trunk processing, and operating modes.

History mode serves two purposes: to log the type of failure for trunk processing, and to store the firmware version. When history mode is selected, L–I–LS switch set to the LS position, the first item displayed is the firmware version number. The DIU–R has the ability to log the last five failure types for trunk processing. To view the failures, use the TP RESET switch to either step through the listing (latest displayed first) or depress and hold to continually scroll. Pressing the TP RESET switch in standard display will clear the TP count and history log. While in history display mode, the DIU–R continues normal operation except that the display is not updated. Also, activating the loop terminal function eliminates the history display.

4.7   Displayed Failure Messages

Table 2 lists failure messages that may appear on the front-panel display. Interpretation of these messages for system turn−up and troubleshooting are described in Sections 360−022−600 and 360−022−700, respectively.

Table 2. Failure Message Display

Displayed Message	Message Description
BAD MODE S7−6 S7−7 OPEN	Invalid mode selected for channel sequencing.
WARN S7−X	System warning of a configuration mismatch between the two DIU−Rs (X = switch #).
SCLK FAIL	System clock for the DIU−R is not responding.
SWCH FAIL	DIU−R has an active switch failure. History mode ID = SW.
PSUR FAIL	Power supply loss. History mode ID = PS.
RING FAIL	Ring generator loss (based on optioning). History mode ID = RG.
SPAN FAIL	T1 signal loss (external or internal). History mode ID = SP.
CCLK FAIL	Loss of composite clock. History mode ID = CC.
BCLK FAIL	DIU−Rs internal clocks that drive the channel unit buses are at fault. History mode ID=BC.
BUSD FAIL	Bus drivers for the BCLKs have failed. History mode ID = BU.
XDAT FAIL	Channel unit transmit data malfunction. History mode ID = XD.
RECV YEL	Yellow alarm, far end. History mode ID = RY.
FAIL	General card failure.

4.8   Miscellaneous System Messages

Table 3 lists miscellaneous system messages that may appear on the front panel display.

5.   OPTIONS

The 3608−04 DIU−R contains a PCB−mounted, 10−segment DIP switch labelled S7, as shown in Figure 4. This switch is used to configure the system for particular applications. Note that both of the 3608−04 DIU−R units in a 360−22 DCT must have S7 configured the same. Set S7 as described in the following paragraphs.

Table 3. Miscellaneous System Message Display

| Displayed Message	Message Description
ACTV	Common equipment set is active.
STBY	Common equipment set is in standby.
OVRD	DIU-R in override, protection switching defeated (based on optioning, manual or timed).
TP=X	Trunk processing counter (X = current count, E = overflow).
TEST	When the loop terminal function is activated.
FTPR	Unit placed into forced trunk processing. History mode ID = FT.
DIUR	Unit type.
VX.X	Firmware version (x = version number), display during power−up and in history mode.
X →AA	Failure types for trunk processing, only displayed in history mode (X = log number, AA = history mode ID).
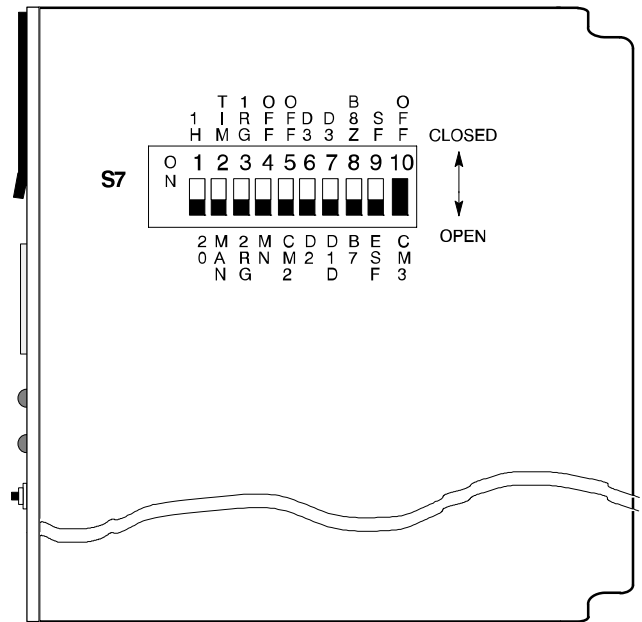
Figure 4. 3608−04 DIU−R Option Locations

Table 4. 3608−04 DIU−R Option Description

Switch	Position	Function	✔ one
S7−1	1H	Selects a one−hour time−out override period.	
	20	Selects a 20−minute time-out override period.	
S7−2	TIM	Selects timed override mode.	
	MAN	Selects manual override mode.	
S7−3	1RG	Selects a single-ring ringing supply configuration.	
	2RG	Selects a dual-ring ringing supply configuration.	
S7−4	OFF	Sets ringing supply monitor to off.	
	MN	Sets ringing supply monitor to on.	
S7−5	OFF	Selects standard trunk processing	
	CM2	Selects CM2 trunk processing operation	
S7−6	D3	Selects D3/D1D channel sequence.	
	D2	Selects D2 channel sequence	
S7−7	D3	Selects D3/D2 channel sequence	
	D1D	Selects D1D channel sequence	
S7−8	B8Z	Selects B8ZS line coding.	
	B7	Selects B7 line coding (AMI).	
S7−9	SF	Selects SF framing.	
	ESF	Selects ESF framing.	
S7−10	OFF	Selects standard trunk processing	
	CM3	Selects CM3 trunk processing operation	

5.1 Switches S7−1 and S7−2

These switches are associated with the 1:1 protection switching override function. When S7−2 is in the MANUAL (open) position, the override function can be activated or deactivated via an external input (REMA and REMB leads) to the DCT or via the front panel push button on the DIU−R (see Figure 5). When S7−2 is in the TIMED (closed) position, the override function can still be activated via the above means, but it will be automatically deactivated after a preset time−out period controlled by S7−1. Set S7−1 and S7−2 as follows:

Table 5. Options for switches S7−1 and S7−2

Mode	Time−Out	S7−1	S7−2
Manual	N/A	N/A	Open
Timed	20 minutes	Open	Closed
Timed	60 minutes	Closed	Closed

5.2 Switches S7−3 and S7−4

These switches control the ring generator monitor function of the DIU−R. Depending on the application, the 360−22 DCT may be provided with an external source of 20 Hz ringing voltage (20 Hz ringing is required if the DCT is to be equipped with FXS or ringdown−type channel units). One or two 20 Hz ringing feeds may be provided to the 360−22 (see section 360−022−50X). Option S7−3 and S7−4 as shown below:

Table 6. Options for switches S7−3 and S7−4

Mode	S7−3	S7−4
No ringing or monitor disable	N/A	Closed
One ringing feed	Closed	Open
Two ringing feeds	Open	Open

5.3 Switches S7−5 and S7−10

These switches allow the bank to be configured for one of three types of carrier group alarm (CGA) processing: Standard, CM2, or CM3. The following times and functions are listed in Table 7 for both options. Set S7−5 and S7−10 as shown in Table 8. For standard CGA operation, both S7−5 and S7−10 should be CLOSED (OFF). For CM2, set S7−5 to OPEN (CM2) and S7−10 to CLOSED (OFF). For CM3, set S7−5 to CLOSED (OFF) and S7−10 to OPEN (ON).

Table 7. CGA processing times and functions

Sequence	STD	CM2	CM3
Failure to AR illumination (sec)	2.5	1	1
Failure to TP illumination (sec)	5	2	N/A
Timed	Yes	Yes	No
Failure clears to TP extinguishes (sec)	15	1	N/A
Transmit yellow during alarm	Yes	No	No

Table 8. Options for switches S7−5 and S7−10

Mode	S7−5	S7−10
Standard	Closed	Closed
CM2	Open	Closed
CM3	Closed	Open

5.4 Switches S7−6 and S7−7

Switches S7−6 and S7−7 are used to set the DCT for either D1D, D2, or D3 channel counting sequences, as shown in Table 1. Normally the bank will be configured for the D3 counting sequence. Set these switches as follows:

Table 9. Options for switches S7−6 and S7−7

Sequence	S7−6	S7−7
D3	Closed	Closed
D2	Open	Closed
D1D	Closed	Open

5.5 Switch S7−8

This switch configures the DIU−R for either AMI bit 7 zero code suppression or for B8ZS clear channel operation. Set S7−8 as follows:

Table 10. Options for switch S7−8

Mode	S7−8
B7	Open
B8ZS	Closed

5.6 Switch S7−9

This switch configures the DIU−R for either SF or ESF framing. Set S7−9 as follows:
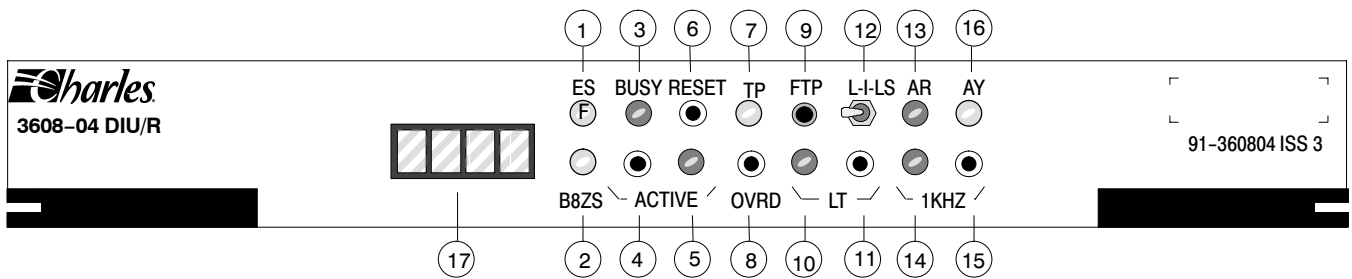
Table 11. Options for switch S7−9

Framing	S7−9
SF	Closed
ESF	Open

Figure 5. 3608−04 DIU−R Front Panel Layout

Table 12. 3608−04 DIU−R Front Panel Description

#	Label	Type	Function	Switch
1	ESF	LED	Extended superframe indicator. Will be lit when S7−9 is set for ESF framing operation.	
2	B8ZS	LED	Bipolar 8−zero substitution indicator. Will be lit when S7−8 is set for B8ZS operation.	
3	BUSY	LED	Channel unit busy indicator. Will be lit when any channel unit is busy or has been manually busied.	
4	ACTIVE	Pushbutton	Activate common equipment switch.	S3
5	ACTIVE	LED	Common equipment active indicator.	
6	RESET	Pushbutton	Trunk processing reset switch in standard display mode. History log switch in history display mode.	S1
7	TP	LED	Trunk processing indicator.	
8	OVRD	Switch	Override DIU−R 1:1 protection switching.	S4
9	FTP	Jack	Force trunk processing shorting jack.	
10	LT	LED	Loop terminal indicator.	
11	LT	Pushbutton	Loop terminal switch.	S5
12	L−I−LS	Switch	Loop (L), Idle (I) selects standard display mode in normal operation. Loop Shift (LS) selects history display mode in normal operation. Used for testing in loop terminal operation.	S2
13	AR	LED	Local alarm indicator.	
14	1kHz	LED	1kHz tone indicator.	
15	1kHz	Pushbutton	1kHz tone indicator switch.	S6
16	AY	LED	Remote alarm indicator. When lit, indicates that the terminal is receiving a yellow alarm from the distant terminal.	
17	STATUS DISPLAY	Display	This 4−character alphanumeric display will display system status messages and the trunk processing count.	

6.   INSTALLATION

The 3608−08 DIU−R mounts in dedicated common equipment slots of a 360−22 D4 DCT as shown in Figure 6.

7.   TESTING

Refer to Section 360−022−700 for troubleshooting procedures.

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.

Channel Units 1 through 12	
Channel Units 13 through 24	
3608−04 DIU−R A	3603−02 LIU−3E A
3608−04 DIU−R B	3603−02 LIU−3E B
3609−04 PSU−R A	3609−04 PSU−R B

Figure 6. 360-22 DIU−R Locations, Front View

8. 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)

9. WARRANTY & CUSTOMER SERVICE

9.1 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)

9.2 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.

9.3 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.

9.4 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
   – 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.

10. SPECIFICATIONS

The 3608−04 is part of the 360−22 system. See Section 360−022−501 for 360−22 system specifications and Table 13 for physical specifications.

Table 13. Physical Specifications

Feature	U.S.	Metric
Height	1.2 inches	3.05 centimeters
Width	8.5 inches	21.59 centimeters
Depth	10.2 inches	25.91 centimeters
Weight	20 ounces	567 grams
Temperature	32 to 122° F	0 to 50° C
Humidity	To 95% (no condensation)	

11. REFERENCES

Refer to the following documents when implementing and testing PCM terminal digroups employing the 3608−04 DIU−R module:

360−022−50X	360-22 D4 Digital Carrier Terminal General Description, Application and Installation Procedures
360−022−700	360-22 D4 Digital Carrier Terminal Troubleshooting Procedures
360−302−20X	3603-02 And 3603-32 Line Interface Units (Mode 3 ESF (LIU-3E)
360−904−20X	3609-04 Power Supply Unit – Redundant (PSU-R)