



## Appendix G7 G.703/E1 Interface M7 Series G.703/E1 Interface Addendum

### Revision History

Revision Number	Revision Date	Change Summary
Rev 0.10	2-1-2012	Initial Release.

### 1.0 Optional G.703/E1 Interface Overview

G.703/E1 is a legacy interface standard that is used in Telephony and Cellular Backhaul applications. The installation of the optional G7 (G.703/E1) interface provides the M7 Class modems (M7/M7L/M7LT) with an economical access solution for E1 and Fractional E1 network services over satellite. The G7 fully meet all of the E1 rate 2048 kbit/s specifications including ITU recommendations:

- G.703 - Physical/electrical characteristics of hierarchical digital interfaces.
- G.704 - Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels.
- G.706 - Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704.
- G.732- Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s.
- G.823 - The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.

NOTE: If the G7 interface card is not already installed in the modem refer to Section 4 for installation information.

Typical use of the G7 interface is in a duplex point to point link with a similarly configured M7 series modem at the other end of the link. The setup of the satellite link is very simple because the modems at both ends of the link are connected to DTE equipment with this same G.703/E1 interface type. Each port of the G7 interface can be configured independently for either Full E1 or Fractional E1 operation.

The Full E1 mode allows for transmission of an the 2.048Mbps input data stream without synchronizing to the imbedded framing of the E1 signal. In this case the port data rate though the satellite link is the full 2.048Mbps of the E1 transport stream. Note in Unframed E1 there is no requirement for G.704 framing.

The Fractional E1 mode allows for data rates of Nx64kbps to be transmitted over the satellite. The G7 interface has flexible selection the number of timeslots to be transmitted and for selection of standard signaling formats.

- PCM30-CAS (Channel Associated Signaling) (Nx64Kbps, N = 1 to 15, 17 to 31 TS).
- PCM31-CCS (Common Channel Signaling) (Nx64Kbps, N = 1 to 31 TS).

The FullE1 or Fractional E1 modes are controlled via the G.703 Frame parameter. Any combination of Full E1 or Fractional E1 can be used independently on each port, and can be used independently on the transmit or receive side of each port.

## Key Features

- Single or Dual port G.703/E1
- Unframed & Fractional E1 operation
- Data rate: User selectable N x 64Kbps in PCM30-CAS or PCM31-CCS modes
- Fully transparent signal conversion under unframed mode
- Clock Regeneration from incoming HDB3 or AMI formatted data
- CRC4 ON/OFF modes.
- Diagnostic Loopbacks for both Terrestrial and Satellite side
- E1 alarm monitoring for all common E1 transport stream alarms:

LOS	Loss Of Signal. (All Modes)
AIS	All 1's at input port. (All Modes).
LFA	Loss of Framing Alignment. (PCM30-CAS and PCM31-CCS).
LMFA	Loss of Multi-Frame Alignment. (PCM30-CAS only).
RAI	Remote Alarm Indication. (PCM30-CAS and PCM31-CCS).
TS16AIS	All 1's in TS 16. (PCM30-CAS only).

The G7 G.703/E1 interface is only available for M7 Series of modems, either new or as an upgrade to existing customer modems. This optional Interface card is designed to be installed in the option interface position inside the main modem assembly.

## 2.0 Technical Specifications:

### 2.1. E1 Signal Structure

The G.703/E1 interface operates at a nominal rate of 2.048Mbps. The data transferred over the E1 transport stream is organized in frames. Each E1 frame contains 256 bits which are comprised of 32 timeslots, each containing eight bits. The data rate of each timeslot is 64Kbps. For 8-bit PCM encoded voice audio, each timeslot provides for an 8 kHz sampling rate.

Timeslot 0 is used for frame synchronization and alarms. Timeslot 16 is used for signaling, alarms, or data. Timeslot 1 to 15 and 17 to 31 are used for carrying data or PCM encoded voice audio.

There are two E1 frame formats,

1. Normal frame (PCM31-CCS)
2. Multi-frame (PCM30-CAS)

Framing is necessary in order for equipment receiving the E1 signal to identify timeslot alignment and extract or insert the proper data. E1 signals configured with the PCM31-CCS format use the frame alignment signal (FAS) for synchronization. When the PCM30-CAS format is used the multi-frame alignment signal (MFAS) is used along with the FAS. The multi-frame structure also provides channel associated signaling (CAS) for PCM30. There is also an optional a cyclic redundancy check (CRC) in both PCM30-CAS and PCM31-CCS modes that is used to detect errors in the data stream.

#### 2.1.1. Frame Alignment Signal (FAS)

Timeslot 0 of every other frame is reserved for the FAS. Alternate frames contain the FAS Distant Alarm indication bit and others bits reserved for national and international use.

#### 2.1.2. Multi-Frame Alignment Signal (MFAS)

MFAS framing provides Channel Associated Signaling (CAS) that transmits A/B/C/D bit signaling information for each of 30 channels in timeslot 16. This method uses the 32 timeslot frame format with timeslot 0 for the FAS and timeslot 16 for the MFAS and the CAS.

### **2.1.3. Channel Associated Signaling (CAS)**

When timeslot 16 of the E1 frame is used for Channel Associated Signaling (CAS) purposes, frame 0 contains the MFAS and timeslot 16 of frames 1-15 is used to convey the state of the A,B,C and D signaling bits.

NOTE: The ABCD state of 0000 is not allowed. If all bits in timeslot 16 are 0, a loss of the MFAS can be assumed. When A-Bit only signaling is used (No BCD bits), the BCD bits should be fixed at: B=1, C=0, D=1 (101). A detection of all 1's in timeslot 16 declares a TS16AIS alarm, which indicates a remote alarm with the upstream E1 equipment.

### **2.1.4. Common Channel Signaling (CCS)**

When Common Channel Signaling (CCS) is employed, G.704 allows for various types of signaling information to be carried in any timeslot, therefore timeslot 16 is available for user or bearer data.

Common channel signaling (CCS) is signaling in which a group of voice-and-data channels share a separate channel that is used only for control signals. This signaling protocol can be SS7, ISDN, or PBX/Switch Proprietary protocols. The channel used for common-channel signaling does not carry user information.

### **2.1.5. E1 Line Coding**

The basic E1 signal is coded using the Alternate Mark Inversion (AMI) or High-Density Bipolar 3 (HDB3). In AMI coding, "ones" are alternately transmitted as positive and negative pulses, whereas "zeros" are transmitted as a zero voltage level. AMI is not used in most E1 transmissions because synchronization loss will occur during long strings of data zeros. In HDB3 coding, a string of four consecutive zeros is replaced with a substitute string of pulses containing an intentional bipolar violation. The HDB3 code substitutions provide high pulse density so that the receiving equipment is able to maintain synchronization with the received signal.

The G7 supports two E1 link line codes:

- AMI coding
- HDB3 coding.

### **2.1.6. E1 Cyclic Redundancy Check (CRC)**

The ITU standard describes an optional implementation where a 4-bit Cyclic Redundancy Check (CRC4) can be used to provide error detection for Frames 0 through 7, and Frames 8 through 15. When this CRC4 format is used, the even frame's International Bit is replaced with a CRC-4 bit. The National Bits are relabeled as spare bits.

The G7 interface allows for the CRC4 function to be Enabled or Disabled.

### **2.1.7. Other Interface Specifications**

- Balanced: 120 ohm impedance on a RJ48c
- Unbalanced: 75 ohm impedance using an external 120 ohm to 75 ohm converter (i.e. Balun-B2S)
- Jitter performance is in according to ITU G.823

### **2.1.8. Alarm Indication Signal (AIS)**

The AIS signal is an unframed "all-ones" signal, and is used to maintain line signal synchronization in case of loss of input signal. The G7 interface will provide an AIS on the receive data line if there is a fault condition in the demodulator. There will also be an indication on the G7 interface if there is an AIS condition received on the transmit data line.

## **3.0 G7 Setup and Operation**

The addition of a the G7 interface card provides G.703/E1 physical and electrical interfaces designed to operate at 2.048 Mbps. When installed, the G7 interface card is automatically

recognized by the M7 modem controller and the user interface menus are populated with the appropriate G7 interface selection menu's. Refer to Section 3 in the M7 Installation and Operation Manual for instructions on how to navigate the front panel menus.

Selection of G.703 as the currently active interface is accomplished by using the front panel or the remote control protocols. Refer to Section 3.1 below for operation via the front panel and Appendix B (Rev-0.96 or higher) for the remote protocol that is used to select and control the G7 interface.

### 3.1. Configuring the G7 G.703/E1 Interface from the front panel.

From the front panel you would select <Intf: I/O – Mode> for the G.703 option. This is accomplished by pressing the Intf button at the bottom of the LCD display, then scroll right to display "I/O" in the upper left of the display, and down if necessary to display "Mode" in the upper right of the display. To select G.703 you can then either press "?" and "Enter", or press the "Edit" key and scroll up or down until "G.703" is displayed in the LCD lower line, pressing "Enter" to select that option.

The G7 has the ability to perform local loopback from either the terrestrial data side or the satellite. When used with a BERT, the terrestrial loopback function allows testing of the E1 interface cables and connectors. IF Loopback allows for complete modem testing by connecting the modulator output to the demodulator input. Section 4.2 describes these tests in more detail.

Table 1 G7 Interface Front Panel Parameter Details

Interface Parameter Detail (when G.703 is Active)				
Representation	Type	Entry	Description	
Status Online	I/O	Read Only	N/A	Interface Status **
Status Off	RTS	Read Only	N/A	Interface RTS line status
Status On	CTS	Read Only	N/A	Interface CTS line status
Status On	DCD	Read Only	N/A	Interface DCD line status
Status Off	DTR	Read Only	N/A	Interface DTR line status
Status Off	DSR	Read Only	N/A	Interface DSR line status
Status Mod BER	Test	Read Only	N/A	Interface Test status
Status 0.0 E-7	BER	Read Only	N/A	Interface Test status
Status 3	SyncLoss	Read Only	N/A	Interface Test status
Status 7	Errors	Read Only	N/A	Interface Test status
Status 1.45 E7	Bits	Read Only	N/A	Interface Test status
Status 99.95%	EFS	Read Only	N/A	Interface Test status
Status 1	ErredSec	Read Only	N/A	Interface Test status
Status 2135	TotalSec	Read Only	N/A	Interface Test status

I/O G.703	Mode	Selection	0 = Disable 1 = RS-232 2 = RS-449 3 = RS-449/Unterm 4 = V.35 5 = V.36 6 = EIA-530 7 = EIA-530A 8 = Ethernet IP (Option) 9 = G.703(Option) 10 = (Reserved) 11 = HSSI (Option)	Interface electrical mode.  Some option interfaces may replace the SnIP, HSSI or Ethernet IP, and Dual G.703 interface.  Other options may be added in the future.
I/O Ignore	RTS	Selection	0 = Normal 1 = Control CXR 2 = Ignore	Interface RTS line control
I/O Normal	CTS	Selection	0 = Normal, 1 = Force Active	Interface CTS line control
I/O Normal	DCD	Selection	0 = Normal, 1 = Force Active	Interface DCD line control
I/O Normal	DTR	Selection	0 = Normal, 1 = Ignore	Interface DTR line control
I/O Normal	DSR	Selection	0 = Normal, 1 = Force Active	Interface DSR line control
I/O Normal	XmtData	Selection	0 = Normal, 1 = Inverted	Transmit Data Inversion
I/O Normal	XmtClock	Selection	0 = Normal, 1 = Inverted, 2 = Auto	Transmit Clock Phase. Auto is now default standard.
I/O Normal	RcvData	Selection	0 = Normal, 1 = Inverted	Receive Data Inversion
I/O Normal	RcvClock	Selection	0 = Normal, 1 = Inverted	Receive Clock Phase
I/O Normal	RTSMonitor	Selection	0 = Disabled, 1 = to Alarm A, 2 = to Alarm B	Allows using Alarm relay contacts to show RTS Status, overriding other alarms.
			For Advanced I5 Option Only	
IIP Type	Mode	Selection	Read Only	Displays type of IP interface present (I5, SnIP, etc.)
IIP 192.168.100.1	IPAddr	Numeric		IP Address for Ethernet IP Interface.
IIP 255.255.255.0	NetwrkMask	Numeric		IP Mask Address for Ethernet IP Interface.
IIP 0080A800256C	MACAddr	Read Only	Read Only	Allows read of fixed Interface MAC Address..
IIP 00007f	Options	Read Only	Read Only	Displays Ethernet IP Options enabled

IIP 021771-001-50	Version	Read Only	Read Only	Displays Ethernet IP Software Version Number
IIP 1000047	Serial#	Read Only	Read Only	Displays Ethernet IP Serial Number
G703P1 E1	TxMode	Selection	1=E1	G.703/E1 interface Port 1 always active if G.703 IO Mode selected.
G703P1 HDB3	TxCode	Selection	0=AMI 1=HDB3	Line Coding selection.
G703P1 PCM31-CCS	TxFrame	Selection	0=Full E1 1=PCM30-CAS 2=PCM31-CCS	Input Framing selection; Full E1 = Unframed Mode.
G703P1 Enable	TxCRC4	Selection	0=Disable 1=Enable	Cyclic Redundancy Check for error reporting.
G703P1 512 kbps	TxNx64k	Read Only		Nx64kbps fractional E1 rate for Port 1 transmitter.
G703P1 TS08-On	DropMap	Selection	TSxx – 0=Off, 1=On. xx = 01 to 31. Press Up/Down key to toggle between Off and On. Press Left/Right keys to change Timeslot number. Press enter to program all timeslots.	Used for FractionalE1 mode to select which timeslots (1-31) that are to be dropped from the input E1 framed signal and transmitted over the satellite. Timeslot 16 not available in PCM30-CAS framing.
G703P1 E1	RxMode	Selection	1=E1	G.703/E1 interface Port 1 always active if G.703 IO Mode selected.
G703P1 HDB3	RxCode	Selection	0=AMI 1=HDB3	Line Coding selection.
G703P1 PCM31-CCS	RxFrame	Selection	0=Full E1 1=PCM30-CAS 2=PCM31-CCS	Output Framing selection
G703P1 Enable	RxCRC4	Selection	0=Disable 1=Enable	Cyclic Redundancy Check for error reporting
G703P1 512 kbps	RxNx64k	Read Only		Nx64kbps fractional E1 rate for Port 1 receiver.
G703P1 TS08-On	InsMap	Selection	TSxx – 0=Off, 1=On. xx = 01 to 31. Press Up/Down key to toggle between Off and On. Press Left/Right keys to change Timeslot number. Press enter to program all timeslots.	Used for FractionalE1 mode to select which timeslots (1-31) that are to be inserted to the output E1 framed signal received over the satellite. Timeslot 16 not available in PCM30-CAS framing.
Port 2				
G703P2 E1	TxMode	Selection	0=Disable 1=E1	Activate the G.703/E1 interface Port 1
G703P2 HDB3	TxCode	Selection	0=AMI 1=HDB3	Line Coding
G703P2 PCM-31-CCS	TxFrame	Selection	0=Full E1 1=PCM30-CAS 2=PCM31-CCS	Input Framing selection

G703P2 PCM-31	TxCRC4	Selection	0=Disable 1=Enable	Cyclic Redundancy Check for error reporting
G703P2 512 kbps	TxNx64k	Read Only		Display the Nx64kbps satellite rate
G703P2 TS08-On	DropMap	Selection	TSxx – 0=Off, 1=On. xx = 01 to 31. Press Up/Down key to toggle between Off and On. Press Left/Right keys to change Timeslot number. Press enter to program all timeslots.	Used for FractionalE1 mode to select which timeslots (1-31) that are to be dropped from the input E1 framed signal and transmitted over the satellite. Timeslot 16 not available in PCM30-CAS framing.
Port 2				
G703P2 E1	RxMode	Selection	0=Disable 1=E1	Activate the G.703/E1 interface Port 1
G703P2 HDB3	RxCode	Selection	0=AMI 1=HDB3	Line Coding
G703P2 PCM-31	RxFrame	Selection	0=Full E1 1=PCM30-CAS 2=PCM31-CCS	Input Framing selection
G703P2 PCM-31-CCS	RxCRC4	Selection	0=Disable 1=Enable	Cyclic Redundancy Check for error reporting
G703P2 512 kbps	RxNx64k	Read Only		Display the Nx64kbps satellite rate
G703P2 TS08-On	InsMap	Selection	TSxx – 0=Off, 1=On. xx = 01 to 31. Press Up/Down key to toggle between Off and On. Press Left/Right keys to change Timeslot number. Press enter to program all timeslots.	Used for FractionalE1 mode to select which timeslots (1-31) that are to be inserted to the output E1 framed signal received over the satellite. Timeslot 16 not available in PCM30-CAS framing.
Alarm to Alarm A	TstActive	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm to Alarm B	BERLoss	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm to Alarm A	Enet	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm to Alarm	E1-Port1	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm to Alarm A	E1-Port2	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Test Disabled	TerLoopbck	Selection	0 = Disable 1 = Enable	Interface terrestrial loop-back Send Data input to Receive Data output.
Test Disabled	SatLoopbck	Selection	0 = Disable 1 = Enable	Interface satellite loop-back demodulator output to modulator input.
Test Satellite	BERI/O	Selection	0 = Satellite 1 = Terrestrial	BERT Function. See Main User Manual for Description

Test Disabled	ModBER	Selection	0 = Disable 1 = 2047 2 = 2 <sup>23</sup> -1 3 = Insert 1 Error (if enabled)	BERT enable to modem transmit input.
Test Disabled	DemodBER	Selection	0 = Disable 1 = 2047 2 = 2 <sup>23</sup> -1	BERT enable from modem receive output.

### 3.2. Making Connections to the G7 Interface

[New pic]

Figure 1 shows the rear interface panel of the M7 series modem with the G7 optional interface installed.

[New pic]

Figure 1 - M7 rear panel G7 Interface Location

#### 3.2.1. G7 Connections

The G7 interface has five (5) user interface connectors on the rear panel of the optional card. Refer to Table 2 through Table 4 for the connector type, signal names, and connector pinouts.

[New pic]

Figure 2 – G7 Option Rear Interface View

##### 3.2.1.1. G.703/E1 120 ohm Balanced Interface

The G7 interface offers dual G.703/E1 balanced interface presented on 2 RJ48c connectors – (Port 1) and (Port 2). The pinouts for the two connectors are shown in Table 2 and



Figure shows picture of the interface connectors using a balanced (120ohm) to unbalanced (75ohm) converter on Port 1.

Table 2 Port 1 & Port 2 Connector – 120 ohm Balanced Pinouts (RJ48c)

Signal Name	Description	Direction	Pins
SD-T	Send Data Tip	To Modem	1
SD-R	Send Data Ring	To Modem	2
RD-T	Receive Data Tip	From Modem	4
RD-R	Receive Data Ring	From Modem	5
GND	Ground	n/a	3,6

3.2.1.2.

##### G.703/E1 75 ohm Unbalanced

The G7 interface offers dual G.703/E1 120 ohm balanced interface presented on 2 RJ-48c connectors – (Port 1) and (Port 2). For 75 ohm unbalanced connections, a balanced (120ohm) to



unbalanced (75ohm, BNC) converter must be used, like shown in Figure 3. This Balun adapter is available from Datum Systems.



Figure 3 - Balanced to unbalanced converter (Balun)

### 10/100 Ethernet (via the GbE- IP Connection)

The 10/100 Ethernet interface connector is used for SNMP control and monitor of the M7 modem.

3.2.1.4 Please refer to SnIP SNMP Guide for support information.

Table 3 GbE-IP Connector Pinouts (RJ45)

Name	Description		Pin
TX D1+	Transmit Data+		1
TX D1-	Transmit Data-		2
RX D2+	Receive Data+		3
BI D3+	Bi-directional pair C +		4
BI D3-	Bi-directional pair C -		5
RX D2-	Receive Data-		6
BI D4+	Bi-directional pair D +		7
BI D4-	Bi-directional pair D -		8

3.2.1.4. Figure 4 - Ethernet SNMP interface

### Console Connector

The console connector is available for command line control and monitor of the Optional G7 processor card.

Table 4 Console Connector Pinouts (9 pin D female)

3.2.1.5.

Signal Name	Description	Direction	Pins	Notes
RXD	Console RX	From Modem	2	EIA 232
TXD	Console TX	To Modem	3	EIA232
GND	Ground		5	

### USB2.0

The USB2.0 interface is reserved for future use.

## 4.0 G7 Interface Installation

The G7 interface is normally factory installed, but can be field installed by technical personnel. The option card itself is an approximate 3.5-inch by 7.25 inch printed circuit board designed to be mounted in the interface option position inside the M7 series modem chassis.

Remove the modem unit from service before installation of the G7 Interface option. Unplug the modem unit and remove the power cord from the rear for safety.

Place the unit on a flat surface and remove the 8 flathead screws holding the cover to the main chassis using a number 2 Philips screwdriver. The location for the option card installation is shown in below.

**WARNING:** Failure to remove power from the modem unit before removal of the cover can expose the operator to hazardous voltages and result in harm to personnel and equipment.

#### 4.1. Installing the G7 Interface

Position the rear option plate supplied into the chassis and align the mounting plate holes with the holes in the chassis rear panel. Just start inserting the two #4 pan head screws without lock washers to hold the plate in place. Slide the G7 interface assembly into the chassis and line up the connectors with its opening on the rear plate. Slide the interface back and align the card's standoffs with the 4 standoffs in the chassis.

[new pic]

Figure 5 - G7 Interface Installation

Mount the G7 card to the chassis using the 4 #6 mounting screws with lock washers. An additional flat washer may be required to keep the PCB mounting screws from extending beyond the chassis bottom. Tighten the rear plate mounting screws and then the PCB mounting screws.

Connect the upper 40 pin ribbon cable connector to the main PCB header and press down to close the latches. Care must be taken to avoid bending the installed FEC card which is very close to one latch.

Re-install the cover and plug the unit in. Using the front panel arrow keys scroll down to the interface parameter and verify that the modem recognizes the newly installed card. The modem is now ready to be put into service.

#### 4.2. Physical Connectivity Tests

The following tests will verify the proper installation and performance of the G7 card within the M7 modem. Connectivity and performance will require the use of a Bit Error Rate Tester (Fireberd or similar) with an E1 and/or Fractional E1 interface.

##### 4.2.1. Local Loopback

This first test checks the local interfaces and cable and does not require a satellite link or other earth station equipment.

The G7 interface will loopback the transmit input data back out on the receive data port by using the Local Loopback settings on the front panel **<Intf:Test>** menu. Refer to the front panel configuration menus in the M7 I&O Manual and Table 1 above for setup information of all the modem functions. Table 5 shows the menu selection for enabling the local terrestrial loopback function.

Table 5 Front Panel Terrestrial Loopback menu

Function	Type	Entry	Description
Test Enable	TerLoopbck Selection	0 = Disable 1 = Enable	Interface terrestrial loopback Send Data input to Receive Data output.

Verify that the BER tester is able to achieve data synchronization and there are no errors. Once the test is finished, remove the test mode by setting the TerLoopbck to Disable.

#### 4.2.2. Modem IF Loopback

If the Local Loopback test passed, then test the performance of the G7 interface within the M7 modem. The test setup for this test is shown in **Error! Reference source not found.**

The M7 modem will loopback the Modulator TX IF Output back to the Demodulator RX IF input by using the Local Loopback settings on the front panel **<Dem:Test>** menu. Refer to the front panel configuration menus in the M7 I&O Manual and Table 1 above for setup information of all the modem functions. Table 6 shows the menu selection for enabling the IF Loopback function.

Table 6 Front Panel IF Loopback menu

Function	Type	Entry	Description
Test Enable	IFLoopbck Selection	0 = Disable 1 = Enable	IF Loop-back control.

Verify that the BER tester is able to achieve data synchronization and there are no errors. Once the test is finished, remove the test mode by setting the IF Loopback to Disable. The unit is now ready for normal operation.