

## **Installation, Operation & Diagnostics**

**for the**

**MD202T**

**Industrial Grade, Bell 202T  
Rack Mount Modem**



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## TABLE OF CONTENTS

<b>1. STANDARDS .....</b>	<b>2</b>
<b>2. PRODUCT OVERVIEW .....</b>	<b>2</b>
<b>3. GENERAL PRODUCT SPECIFICATIONS .....</b>	<b>2</b>
<b>4. MODEM SPECIFICATIONS .....</b>	<b>2</b>
<b>5. ANALOG LINE SPECIFICATIONS .....</b>	<b>3</b>
<b>6. ANALOG MICROWAVE INTERFACE.....</b>	<b>4</b>
<b>7. POWER SUPPLY .....</b>	<b>5</b>
<b>8. SERIAL DATA PORT PIN-OUT .....</b>	<b>5</b>
<b>9. DIP SWITCH FUNCTIONS.....</b>	<b>6</b>
<b>10. MODEM CONFIGURATION .....</b>	<b>7</b>
<b>11. LED INDICATOR.....</b>	<b>8</b>
<b>12. OUTLINE DRAWING &amp; MOUNTING.....</b>	<b>8</b>
<b>13. DIAGNOSTICS.....</b>	<b>8</b>

## 1. STANDARDS

Meets FCC Rules Part J, Subpart 15, Class A for radiated emissions.

## 2. PRODUCT OVERVIEW

The **MD202T** is an industrial grade Bell202T modem board for use in the Myriad rack mount chassis and is for connection to unconditioned and conditioned, voice grade, type 3002 two or four-wire leased lines and metallic lines (eg; pilot wires). The MD 202T will operate in temperatures from -40 to +85 deg C.

The MD202T is packaged specifically for the harsh environments found in utility substations and industrial facilities. Though functionally similar to commercial modems, the MD202T includes special features that make it particularly well suited for utility and industrial applications:

**Environment:** The MD202T has been designed specifically for use in harsh environments. In addition to an extended temperature range (-40 to +85° C), the MD202T includes surge, shock, vibration, and safety features superior to those of conventional commercial modems.

**Power Supply:** The MD202T is powered by the Myriad power supply. Please see the Myriad Manual for details.

**Industrial:** The MD 202T is packaged on a rugged, printed circuit card with 10 status LED's on the front panel. Configuration is by dipswitches on the printed circuit board.

## 3. GENERAL PRODUCT SPECIFICATIONS

<b>Dimensions:</b>	6.75" L X 7.9" inches H
<b>Weight:</b>	0.3 lb
<b>Operating Temperature:</b>	-40 to +85 deg C
<b>Operating Humidity:</b>	0 to 90% (non-condensing.)
<b>Storage Temperature:</b>	-55 to 100 deg C

## 4. MODEM SPECIFICATIONS

<b>Modulation:</b>	Bell202T
<b>Modulation Type:</b>	FSK
<b>Synch/Async:</b>	Asynchronous Only
<b>Data Rate:</b>	0 – 1800bps
<b>Transmit Frequency:</b>	Mark: 1200Hz Space: 2200Hz
<b>Error Correction:</b>	None
<b>Data Compression:</b>	None
<b>Data Modulation Connectivity:</b>	Using 16ms Polling Test

99.999% or better at -37dBm  
99.5% or better at -40dBm  
95% or better at -43dBm

**Serial Formats and Flow Control:**

Asynchronous and RTS/CTS flow control

**Analog Interface**

Tx Output Level: -0 dBm or -10 dBm \*  
 JP2 1-2 0dBm 2 -3 -10dBm  
 Rx Sensitivity: -43dBm or -33dBm \*  
 JP3 2 -3 -33dBm 1 - 2 0dBm  
 -43dBm for constant carrier  
 -40dBm for polling carrier  
 Line Termination: Dip Switch Selectable \*  
 Line Impedance: 600 ohms balanced  
 2 or 4 Wire Configuration: Dip Switch Selectable \*

**Other Features**

Receiver Equalization: Compromise Equalization  
 Self-Test Diagnostics: Front panel mounted momentary switch, with LED display.  
 Local Analog Loopback: See Section 13  
 Local Digital Loopback: See Section 13  
 Remote Analog Loopback: See Section 13  
 Remote Digital Loopback: See Section 13  
 Anti-Streaming: OFF or 45 Seconds ( $\pm 5$  sec) \*  
 RTS/CTS delay: 1ms, 12ms, 35ms or 50ms ( $\pm 5\%$ ) \*  
 Note: Soft Carrier will effect RTS/CTS delay time (see Dip Switch Settings ~ Section 9)  
 Constant Carrier: Switch Selectable ON or OFF  
 Soft Carrier Turn Off: 20ms of 900Hz after RTS is turned Off  
 Carrier Turn ON/OFF: 8ms  $\pm 0.5$ ms

\* Dip Switch Selectable ~ See Section 9

**5. ANALOG LINE SPECIFICATIONS**

The MD202T contains analog circuitry for connection to the public conditioned or unconditioned, Bell type 3002, 2 or 4-wire, full duplex voice grade leased lines or metallic lines (eg; pilot wires). The MD202T will also interface to Power Line Carrier or Microwave radio voice channel networks.

The MD202T connects to an RJ-11 terminated connector on the back plane. The following lists the MD202T analog interfaces

**Analog Line Type:**

Conditioned or unconditioned, Bell type 3002, 2 or 4-wire, full duplex voice grade or metallic lines or better.

**Analog Line Specifications:**

Bandwidth	300 Hz to 3400 Hz ( $\pm 3$ dB)
Impedance	600 / 900 ohms, balanced
Frequency Response	400 to 3000Hz ( $\pm 2$ dB)
Receiver Input Level	-16dBm max.
Output Level	+7 dBm
Noise Signal Level	-48 dBmO

**6. ANALOG MICROWAVE INTERFACE**

The MD202T is designed to interface to a Microwave radio voice channel network with the following specifications:

Phase Jitter (10 to 300Hz) 1-degree peak-to-peak, max.

Frequency Response:           300 - 3400Hz -3, +0.7 dB  
  400 - 3000Hz -1, +0.7 dB  
  600 - 2400Hz  $\pm 0.7$  dB

Frequency Stability:           With Synchronization    0.1 Hz  
  Without Synchronization 0.5 Hz / month

Level Stability (w/o regulation):  $\pm 0.5$  dB (6 months)

Harmonic Distortion:         1% max, 0.3 % typical  
  (1Khz, 0 dBmO test tone)

Absolute Delay:               Option – 001:    1500  $\mu$ sec, maximum  
  Option – 002:    1900  $\mu$ sec, maximum

Group Delay (option - 001):  600 - 3200 Hz 1200  $\mu$ sec, maximum  
  800 - 2800 Hz 550  $\mu$ sec, maximum  
  1000-2600 Hz 350  $\mu$ sec, maximum

Group Delay (option - 002):  600 - 3200 Hz with 1000  $\mu$ sec, maximum  
  800 - 2800 Hz with 400  $\mu$ sec, maximum  
  1000-2600 Hz with 180  $\mu$ sec, maximum

Linearity:                      0.3 dB +3.5 dBmO

Limiting:                        +7.5dBmO, max (+6.5 dBmO typical)  
  For +20dBmO input

Crosstalk (intelligible)(1KHz test tone at 0 dBmO):  
 Inter-channel 65 dBmO maximum, 80 dBmO typical  
 Intra-channel 70 dBmO maximum

Crosstalk (unintelligible):  
 Adjacent channel 28dBrc0 maximum (24 455B weighted noise at 0 dBmO dBrnc0 typical).  
 Intra-channel 28 dBrnc0, maximum (18 dBrnc0, typical)  
 (1KHz test tone at 0 dBmO)

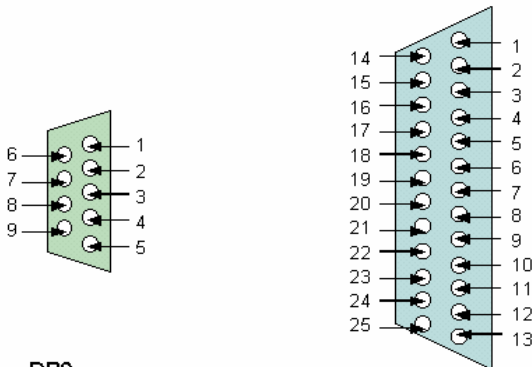
Out of Band Signalling: Frequency 3825 Hz  
 Level -20 dBmO  
 Pulse speed (30 to 80% break) 8 to 14 pps  
 Pulse distortion  $\pm 3$  dB, level var. 3% max.  
 Signaling leak -60 dBmO, maximum

**7. POWER SUPPLY** Standard Myriad Supply

**8. SERIAL DATA PORT PIN-OUTS**

RS232C is the most commonly used serial data interface and defines the Physical, Functional and Electrical boundaries between two or more communicating devices

~ D-SHAPED SERIAL PORT CONNECTORS ~  
 are usually used to interconnect DTEs (computers, controllers, etc.) and DCEs (modems, converters, etc.)



DB9		DB25	
Pin	Signal	Pin	Source
1	CD - Carrier Detect	8	MODEM
2	RXD - Receive Data	3	MODEM
3	TXD - Transmit Data	2	TERMINAL
4	DTR - Data Term/I Ready	20	TERMINAL
5	Signal Ground	7	N/A
6	DSR - Data Set Ready	6	MODEM
7	RTS - Ready to Send	4	TERMINAL
8	CTS - Clear to Send	5	MODEM
9	RI - Ring Indication (Dial Modems Only)	22	MODEM

## 9. DIP SWITCH & JUMPER FUNCTIONS

**Table 1**

Switch	Function	ON	OFF
Switch 1	Anti-Streaming	45 secs	OFF
Switch 2	RTS/CTS Delay	See Table 2	
Switch 3	RTS/CTS Delay	See Table 2	
Switch 4	Switched/Constant Carrier	Constant Carrier	Switched Carrier (Follows RTS State)
Switch 5	2 or 4- Wire Selection	2-Wire	4-Wire
Switch 6	Line Termination	600 ohms	None
Switch 7	Soft Carrier (900Hz) Turn Off	ON	OFF
Switch 8	Spare		

**Table 2: RTS/CTS Delay Time**

2 Wire	4 Wire	Switched Carrier	Constant Carrier	Switch 2	Switch 3	Switch 9 Soft Carrier	RTS/CTS Delay Time
NO	YES	YES	YES	ON	ON	OFF	50 ms
YES	NO	YES	NO	ON	ON	ON	50 ms
NO	YES	YES	NO	ON	ON	ON	50 ms
YES	NO	YES	NO	ON	ON	OFF	50 ms
NO	YES	YES	YES	OFF	ON	OFF	35 ms
NO	YES	YES	NO	OFF	ON	ON	35 ms
YES	NO	YES	NO	OFF	ON	ON	35 ms
YES	NO	YES	NO	OFF	ON	OFF	35 ms
NO	YES	YES	YES	ON	OFF	OFF	12 ms
NO	YES	YES	NO	ON	OFF	ON	12 ms
YES	NO	YES	NO	ON	OFF	ON	12 ms
YES	NO	YES	NO	ON	OFF	OFF	12 ms
NO	YES	NO	YES	OFF	OFF	OFF	1 ms
NO	YES	YES	NO	OFF	OFF	OFF	1 ms
NO	YES	YES	NO	OFF	OFF	ON	1 ms
YES	NO	YES	NO	OFF	OFF	OFF	1 ms
YES	NO	YES	NO	OFF	OFF	ON	1 ms

### Jumper Selection

#### JP1 DSR STATE

1 – 2 DSR TRUE

2 – 3 DSR at +8V

#### JP2 Tx Analog Signal

1 – 2 0dBm Tx Analog signal output

2 – 3 -10dBm output

#### JP 3 Rx Receiver Sensitivity

1 – 2 -43dBm in

2 – 3 - 33dBm

## 10. MODEM CONFIGURATION

The following table provides the Dip Switch settings required for most modem application configurations:

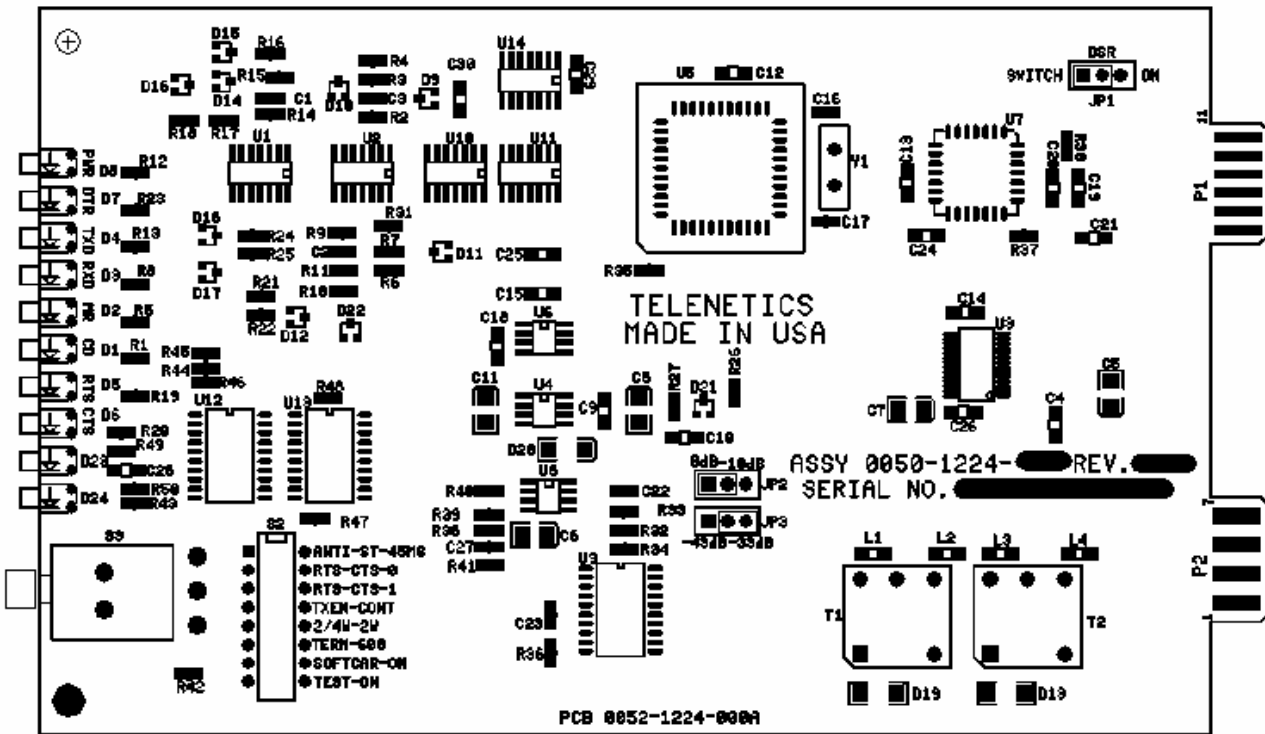
	Dip Switch Setting							
	1	2	3	4	5	6	7	8
<b>4-Wire Point-to-Point</b>				ON		ON		
<b>4-Wire Multi-Point Master</b>				ON		ON		
<b>4-Wire Multi-Point Slave Rx Term. OFF</b>	ON	ON						
<b>4-Wire Multi-Point Slave Rx Term. ON</b>	ON	ON					ON	
<b>2-Wire Point-to-Point</b>	ON	ON			ON	ON	ON	
<b>2-Wire Multi-Point Master Line Term. ON</b>	ON		ON		ON	ON	ON	
<b>2-Wire Multi-Point Slave Line Term. ON</b>	ON		ON		ON	ON	ON	
<b>2-Wire Multi-Point Slave Line Term. OFF</b>	ON		ON		ON		ON	

**For clarity, a blank space = OFF**

## 11. LED INDICATOR

Green	-Power	Rack power is on
Red	-DTR	Data Terminal Ready
RED	-TXD	Transmit Data (From Attached Terminal)
Red	-RXD	Received Data (To attached Terminal)
Red-	-MR	Modem Ready (Data Set ready)
Red	-CD	Carrier Detect
Red	-RTS	Request to Send
Red	CTS	Clear to Send
Amber	AL	Analog Loopback
Amber	DL	Digital Loopback

## 12. OUTLINE DRAWING & MOUNTING



## 13. DIAGNOSTICS

The following pages provide hardware techniques for diagnosing communication problems and thereby isolating the problem at the local modem, the remote modem or the interconnecting line.

### (a) LOCAL ANALOG LOOPBACK (Figure 2)

Operate push button switch until AL LED is illuminated.

Set Dip Switches as follows...

Switch 5 = OFF	4-Wire
Switch 7 = ON	Soft Carrier Turn Off Enabled

JP2 1 – 2                    Transmit (TxA) Signal Level = 0dBm  
Switch 1 = OFF            Anti-Streaming  
JP3 2 - 3                    Receive (RxA) Signal Level = -33dBm  
Switch 4 = OFF            Switched Carrier  
Switch 2&3 = ON          RTS/CTS Delay = 50ms

### **Test 1: RTS/CTS Analog Control**

Set RTS “ON” and check that CD (Carrier Detect) turns “ON”.

Turn RTS “OFF” and ensure that CD turns “OFF”

With RTS “ON”, run a test message at TxD and verify that the same message is received at RxD with no data errors.

### **Test 2: Transmit Signal Power & Receive Levels**

Set JP2 2 – 3    (TxA = -10dBm)

CD will be OFF.

Change JP2 1 – 2 (TxA = 0dBm)

CD should now be ON.

### **Test 3: Received Signal Level**

Set JP2 2 – 3 (TxA = -10dBm) and JP3 1 – 2  
(RxA = -43dBm).

CD will be ON.

Run a test message at TxD and verify that the same message is received at RxD with no data errors.

**Test 4:** Repeat Test 3 for various RTS/CTS delay times and with soft carrier ON and OFF.

## **(b) LOCAL DIGITAL LOOPBACK – 4/Wire Network (Figure 4)**

Operate push button switch until DL LED is ON.

JP2 1 – 2                    (TxA = 0dBm)  
Switch 1 = OFF Anti-Streaming  
JP3 2 – 3                    (RxA = -33dBm)  
Switch 2 = OFF (RTS/CTS = 35ms)  
Switch 3 = ON (RTS/CTS = 35ms)  
Switch 4 = ON (Constant Carrier mode).  
Switch 5 = OFF (4-Wire)  
Switch 6 = ON (Line Termination = 600 ohms)  
Switch 7 = ON (Soft Carrier = ON)

Transmit a test message from a terminal device and confirm that the same message is received back at RxD with no data errors.

**(c) Space Key transmission** – Press momentary switch until both AL and DL LED’s are ON. The modem is now transmitting carrier at the spacing frequency.

## **(d) LINE DIAGNOSTICS**

(i) Typical modem configuration for **4-wire Point-to-Point** system...

JP2 1 – 2 (TxA = 0dBm)  
Switch 1 = Anti Streaming  
JP3 2 – 3 (RxA = -33dBm)  
Switch 2 = OFF (RTS/CTS = 1ms)  
Switch 3 = OFF (RTS/CTS = 1ms)  
Switch 4 = ON (Constant Carrier mode).  
Switch 5 = OFF (4-Wire)  
Switch 6 = ON (Line Termination = 600 ohms)  
Switch 7 = OFF (Soft Carrier = OFF)

(ii) Typical modem configuration for **4-wire Multi-Point** system...

JP2 1 – 2 (TxA = 0dBm)  
Switch 1 = OFF Anti Streaming  
JP3 2 – 3 (RxA = -33dBm)  
Switch 2 = OFF (RTS/CTS = 1ms)  
Switch 3 = OFF (RTS/CTS = 1ms)  
Switch 4 = ON (Constant Carrier mode).  
Switch 5 = OFF (4-Wire)  
Switch 6 = ON (Line Termination = 600 ohms)  
Switch 7 = OFF (Soft Carrier = OFF)

**Adjustments...**

In a network with high line loss (greater than 16dB) change Switch 3 (RxA) to OFF (-43dBm).

If there are conditions that can cause cross-talk (TxA leaking into RxA path) set Switch 1 (TxA) to OFF (-10dBm).

Note that noise level should be -50dBm or lower for most FSK operation (signal-to-noise ratio of 15dB or higher)

Addendum: 202T built on 1224 printed circuit board.

**Test Functions:**

A momentary push button switch and two yellow LED's are provided to perform the test functions. When both LED's are OFF, the modem is in normal mode. Power ON reset insures the modem starts in normal mode.

- 1) Pressing the switch once causes the DL LED to turn ON and the modem is in DIGITAL loopback.
- 2) Pressing the switch a second time illuminates both LED's, and the modem provides a SPACE frequency carrier.
- 3) Pressing the switch a third time turns on the AL LED, and the modem is in Analog Loopback.
- 4) Pressing the switch one more time returns the modem to normal mode.

**NOTES:**