User's Manual

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Messenger Digital Transmitter-D (MDT-D)

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1.0 Acronyms

This section lists and describes the various acronyms used in this document.

Name	Meaning
16 QAM	16-state Quadrature Amplitude Modulation
64 QAM	64-state Quadrature Amplitude Modulation
A/V	Audio/Video
AES	Advanced Encryption System (32 bit)
ABS	Messenger Basic Scrambling (8 bit)
ASI	Asynchronous Serial Interface
COFDM	Coded Orthogonal Frequency Division Multiplexing
CVBS/Y	Composite video/Luminance with S-video
C	Chroma video
D/C	Down-Converter
DDR	Digital Diversity Receiver
DVB-T	Digital Video Broadcasting-Terrestrial
DDPC	Digital Data Processor Card
FEC	Forward Error Correction
GUI	Graphical User Interface
HS TS	High Speed Transport Stream
I/O	Input/ Output
Kbaud	Kilobaud per second
Kbps	Kilobits per second
Mbps	Megabits per second
LVDS	Low Voltage Differential Signaling
LVTTL	Low Voltage TTL
MDL	Messenger Digital Link
MDR	Messenger Digital Receiver
MDT-D	Messenger Digital Transmitter
MER	Modulation Error Rate
MPEG	Moving Picture Experts Group
MSR	Messenger Smart Receiver
NTSC	National Television System Committee
PAL	Phase Alternation Line
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RX	Receiver
SDI	Serial Digital Interface
SDML	Standard Definition Messenger Link
SDMT	Standard Definition Messenger Transmitter
S/N	Signal-to-Noise Ratio
THD	Total Harmonic Distortion
TX	Transmitter
VDC	Volts (Direct Current)

2.0 Introduction

GMS' Messenger Digital Transmitter (MDT-D) with high-speed digital data option is one of the smallest and lowest power consumption DVD-T (Digital Video Broadcasting-Terrestrial) compliant COFDM (Coded Orthogonal Frequency Division Multiplexed) transmitters available. The MDT-D will transmit any digital data stream through a COFDM link. The input interface can be LVTTL (Low Voltage TTL) or LVDS (Low Voltage Differential Signaling). Additionally, GMS offers a wide variety of companion products required to form a complete link.

A Messenger Digital Link (MDL) is formed when the MDT-D model is combined with one of GMS' Messenger Digital Receivers (MSR) with a Digital Data Processor Card (DDPC) installed, one or more external Down-Converters and antennas. The MDT-D accepts high-speed digital data. The data is presented at the output of the MSR via the DDPC at the same rate and sequence as was received by the transmitter. The MDL uses COFDM digital modulation, which is very robust, provides frequency diversity and powerful Forward Error Correction (FEC) algorithms. The MDL provides a robust wireless link that is effective against the multi-path interference experienced by analog systems.

This manual provides information on how to operate the MDT-D model as well as pertinent technical information related to the overall system. Also, refer to model identifier (on-line document, *100-MNI0041*) at GMS website, www.cobham.com/gms , for available frequency and power configurations along with available options.

2.1 Key System Features

- Coded Orthogonal Frequency Division Multiplexed (COFDM) Modulation
- Output Frequency 360 MHz to 6 GHz (In-Bands)
- Low Power Consumption
- Local and Remote Control Interfaces
- Rugged and Compact Portable Design

3.0 Theory of Operation

The MDT-D transmitter with high-speed digital data option accepts LVTTL or LVDS digital data, which is clocked out via a programmable clock from the transmitter. This continuous clock can be set to use LVTTL or LDVS output interface. The transmitter automatically encapsulates the generic data into a DVB compliant MPEG-2 Transport Streams (TSs) along with time tags that are used to recover both the data and the input data timing. This system is not sensitive to data structure. The stream can be scrambled with an AES scrambling algorithm (option sold separately) to provide protection in sensitive applications prior to the final step of DVB-T compliant FEC coding and COFDM Modulation. Data rates from 100 Kbps to 30 Mbps can be supported. However, the system is optimized for high rate transmission above 5 Mbps. The transmitter is compatible with GMS' MSR receiver, which outputs the recovered MEG2 stream to its optional Digital Data Processing Card (DDPC). The DDPC accepts the MPEG2 stream from the MSR and performs the de-scrambling operation (if optionally purchased, recovers the generic digital data and outputs it via a data/clock output interface. The Rx system can also support LVTTL or LVDS interfaces as a user settable option. The system provides automatic timing synchronization with the input rate into the MDT-D.
The transmitter is microprocessor controlled. Normally the transmitter is controlled either through an RS-232 or USB interface via either GMS' MS Windows control SW or a simple command line interface. Local Frequency control is also available via rotary switches on the side of the housing.

4.0 Hardware Overview

The hardware for the MTD-D configuration is shown below:

4.1 MDT-D

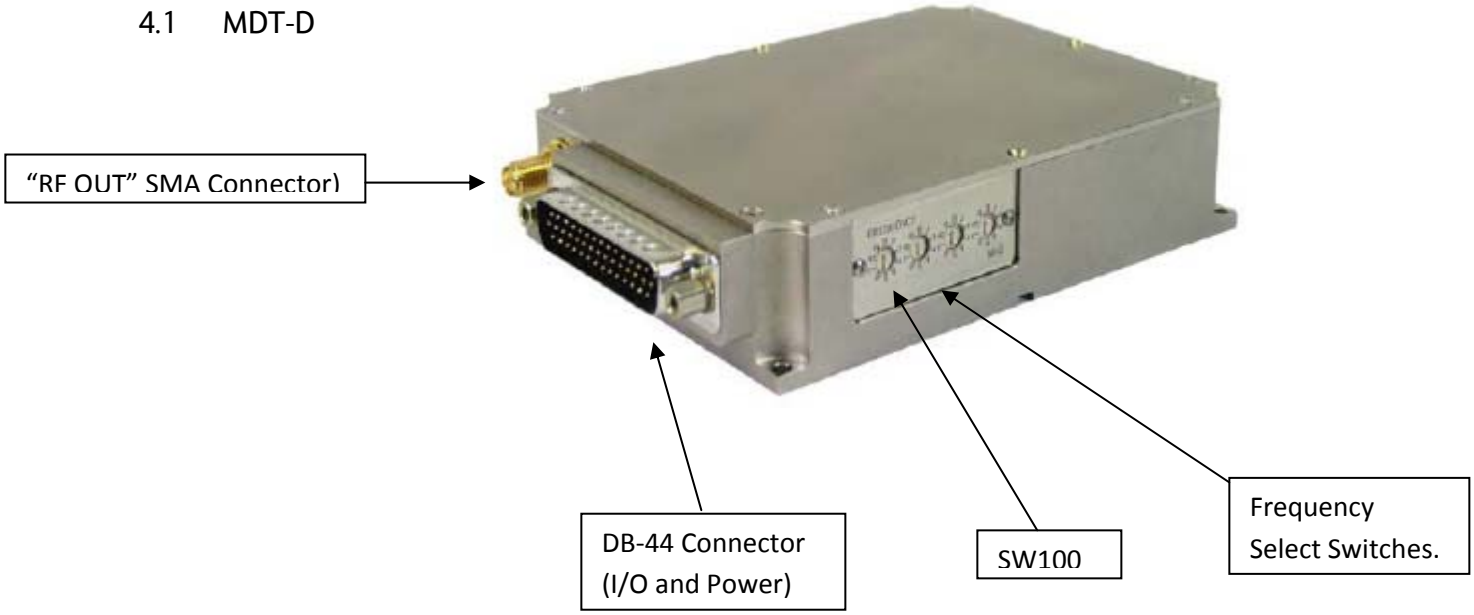


Figure 1 – MDT-D Connectors

4.1.1 MDT-D Connectors

4.1.1.1 RF Output

The MDT-D uses a female SMA bulkhead connector for its 'RF Output' port.

Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working. A proper heat sink is also required.

4.1.1.2 I/O

The 'I/O' connector is a male, high-density DB-44. It is used to provide the interface for external power, digital data, USB and RS-232 signals. The MDT-D has a separate RS232 channel (labeled "Control" on the external breakout cable) for control and monitoring the unit. GMS MDT-D Configurator software program (as explained in section 5) makes use of the RS232 control lines. The RS-232 channel utilizes a 3-wire configuration. The pin out for the I/O connector is shown in Table 1. *NOTE: An additional RS232 channel (labeled "USER DATA") is currently provided with the external breakout cable for future update capabilities, which are currently under development. The " USER Data" RS232 channel will be dedicated for low-rate data to be transmitted along with the audio and video.*

The USB connector is an alternate method of interfacing to the PC if DB-9 connectors are not available.

Table 1 - I/O DB-44 Connector Pin Out

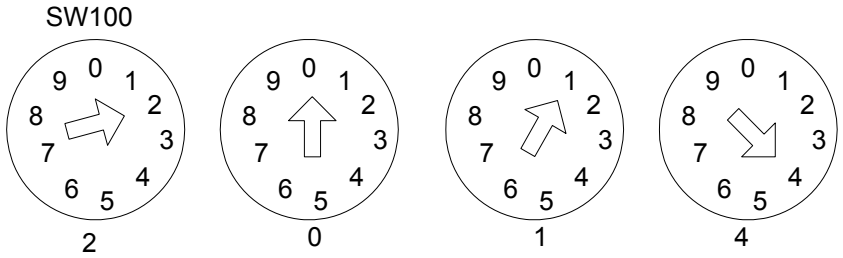
Pin	Signal	Notes
1	RS232 USER Data Tx	*Under development*
2	RS232 USER Data Rx	*Under development*
3	RS232 GND	*Under development*
4	Not connected	
5	SDA	I^2 C bus
6	SCL	I^2 C bus
7	CVBS/Y	Dual use input. 1. **Composite video in**; 2. **Luminance in** (when used with S or Component Video). Must be selected with GMS Control Software or through the front panel of the in-line camera mount box
8	GND	GND for composite video
9	C/Pr	Dual use input. 1.**Chroma video** (when used with S-video); 2. **Pr** (red component when used with Component Video). Must be selected with GMS Control Software or through the front panel of the in-line camera mount box.
10	GND	GND for Chroma video/Pr component
11	Pb	Blue component when used with Component Video.
12	GND	GND for Pb component
13	GND	GND
14	11-15Vdc	Input power to unit
15	Not connected	
16	USB power, Reset	*+5V*
17	USB Data -	
18	USB Data +	
19	USB Gnd	
20	Digital Data -	High speed digital data differential -
21	Digital Data +	High speed digital data differential + or LVTTL output
22-30	Not connected	
31	RS232 Control Tx	
32	RS232 Control-Rx	
33	RS232 GND	
34	Not connected	
35	Digital Clock -	High speed digital data clock differential -
36	Digital Clock +	High speed digital data clock differential + or LVTTL output
37	Audio right +	
38	Audio right -	
39	Audio right line opt.	Pin 39 is connected to pin 38 for audio right channel input impedance of 600 ohms, balance in (mic or line level)
40	Audio right GND	
41	Audio left +	
42	Audio left -	
43	Audio left line opt	Pin 43 is connected to pin 42 for audio left channel

		input impedance of 600 ohms; balance in (mic or line level).
44	Audio left GND	

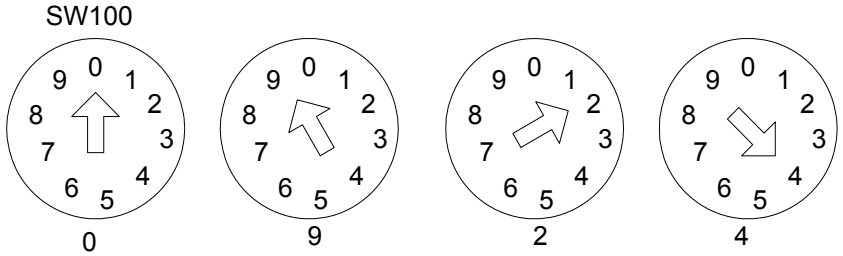
4.1.2 Frequency Select Switches

There are four external rotary switches mounted into the chassis of the MDT-D (see Figure 1 & 2). They are used to control RF frequency selection manually. Frequency selection can also be controlled through GMS control software; see section 5. The rotary switches can be disable or enable using GMS control software; refer to section 5.3.3.2 under Configuration/Special Setup/Others. The most significant switch (SW100) represents 1000 MHz (0-9) units, the second switch (SW101) represents 100 MHz (0-9) units, the third switch (SW102) represents 10 MHz (0-9) units and the fourth switch (SW103) represents 1 MHz (0-9) units. Hence the highest switch selection can be 9999 MHz and the lowest is 0000 MHz.

For example with the switches in the following positions, the frequency will read 2014 MHz:



And with the switches in the following positions the frequency will read 924 MHz:



Note the following: If the switches are selected for a frequency outside the range of the frequency band of the MDT-D: the transmitter will default to the high side of the frequency band. If the switches are set for a frequency higher than the transmitter frequency band. It will default to the low side of the frequency band if the switches are set for a frequency lower than the transmitter frequency band.

5.0 Software Overview

Configuration, control and monitoring of the MDT-D unit is accomplished by using GMS' optional (sold separately) MS Windows-based MDT-D Configurator software program. This Graphical User Interface (GUI) program provides the end user with a straightforward way to interface with the MDT-D. During normal operation, once a MDT-D link is established, the MDT-D Configurator GUI does not need to be active and can be disconnected from the MDT-D.

5.1 System Requirements

The MDT-D Configurator program has been developed and tested on Windows 2000, Windows XP and Windows NT. Although the MDT-D Configurator program may work properly on other operating systems, only the Windows 2000, Windows XP and Windows NT environments have been used at GMS and no support or assistance can be provided concerning other operating systems.

5.2 Installation

The following instructions outline the installation process for the MDT-D Configurator program:

1. Insert provided CD-ROM into computer.
2. Click on 'setup.exe' file. This will launch the GMS_MDT-D Configurator Setup program and several initial setup files will begin to be copied onto the computer.
3. After the initial setup files are copied over, the GMS_MDT-D Configurator Setup program will prompt the user to close any applications that are running. Once all other programs are exited, click on the 'OK' button.
4. The GMS_MDT-D Setup program will prompt the user to click on the 'computer icon' button to begin installation. If desired, the user can change the destination directory from the default. Click on the 'computer icon' button.
5. The GMS_MDT-D Setup program will then prompt the user to 'Choose Program Group'. If desired, the user can change the program group from the default. Click on the 'Continue' button.
6. After installing the MDT-D Configurator program, it will display a window indicating that setup was completed successfully. Click 'OK'.

5.3 MDT-D Configurator Functions

The MDT-D Configurator program provides the user access to many different configuration, control and monitoring options. When the MDT-D Configurator program is launched, the screen shown in Figure 4 is displayed. The user should first select the serial port their computer is connected to via the Serial Port Selector and Status region. If the selected serial port is valid, the gray-colored status box will show 'Ready. To configure a MDT-D, select the 'MDT-D' box in the Device Selector region. Once the 'MDT-D' box is selected, the screen shown in Figure 3 is displayed. The MDT-D Configurator program contains function buttons and all the configurable settings available on a MDT-D. The following sections explain, in detail, the various options.

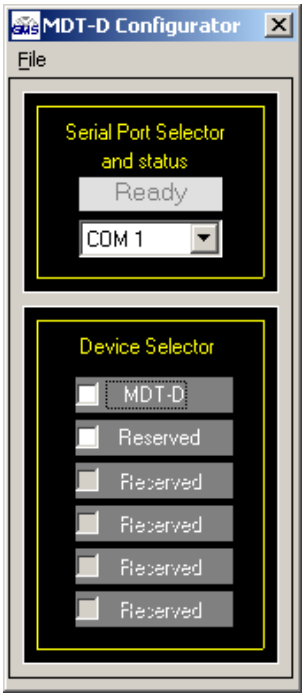


Figure 2 – MDT-D Configurator Main Screen

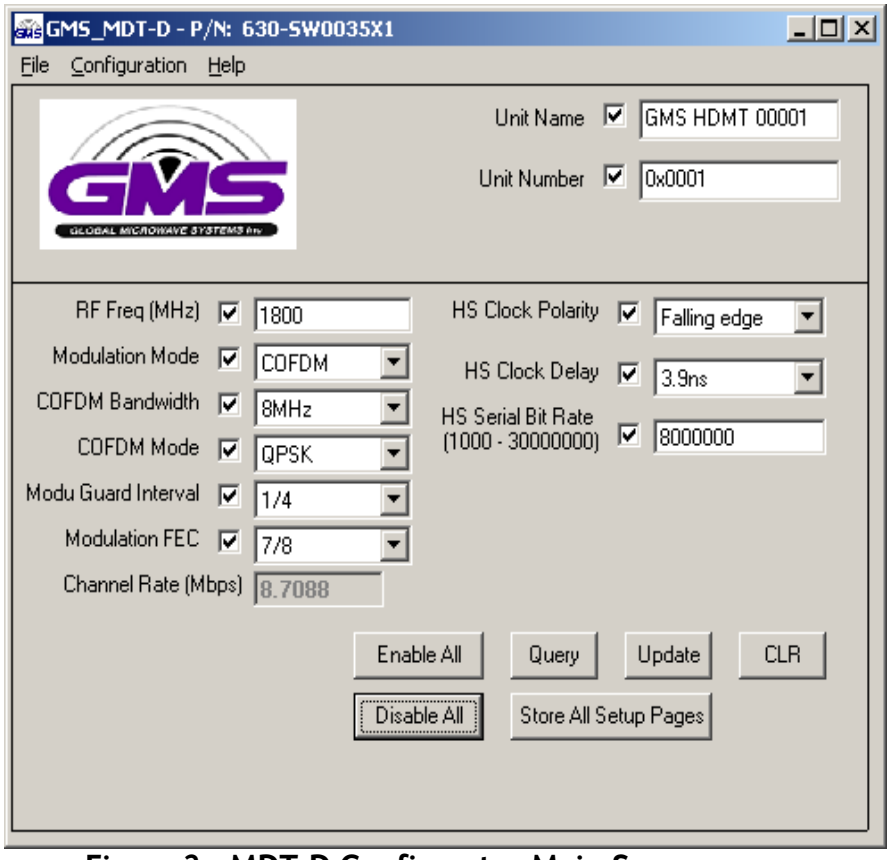


Figure 3 - MDT-D Configurator Main Screen

5.3.1 Function Buttons

- "**Enable All" Button**: Clicking on this button enables all the check boxes on the screen. This operation is done to prepare all the fields to be written to (or read from). Alternatively, the end user can individually select a given field by using the mouse and clicking its corresponding check box.

- "**Disable All" Button**: Clicking on this button disables all the check boxes on the screen. This operation is done to inhibit all the fields to be written to (or read from). Alternatively, the end user can individually deselect a given field by using the mouse and clicking its corresponding check box.

- "**Query" Button**: Clicking on this button performs a read operation on all the fields that have their check box enabled. Once clicked, all the selected fields will be read back reflecting their current configuration.

- "**Update" Button**: Clicking on this button performs a write operation on all the fields that have their check box enabled. Once clicked, all the selected fields will be written to with the value denoted in their respective field.

- "**CLR" Button**: Clicking on this button clears out all fields on the screen, regardless of whether the fields' check boxes are selected or not. This button proves useful when the end user wants to verify that a write operation has been correctly performed. An example scenario would be to 1) enable all fields, 2) change desired field(s), 3) perform a 'Update' (write) operation, 4) perform a 'CLR' operation and 5) perform a 'Query' operation. As a result of the 'Query' operation, the fields on the screen should all update to those values that were written during the 'Update' operation.

- "**Store All Setup Pages" Button**: Clicking on this button will store all setup pages, even if they are not shown.

5.3.2 Field Definitions

There are several different fields that can be configured by the MDT-D Configurator. The fields located in the main screen of Figure 2 and their associated values are defined in Table 2 below. Also noted in the table is whether the field is read, write-able or both

Table 2 - MDT-D Field Definitions

Field	R/W	Description
Unit Name	R/W	Allows the user to assign a unique unit name to the MDT.
Unit Number	R/W	Allows the user to assign a unique unit number to the MDT
RF Freq (MHz)	R/W	RF output frequency. Desired frequency is entered in MHz (i.e., 1.296GHz would be entered as 1296). Default frequency step size is 500KHz. For S2 band it's 250KHz.

Field	R/W	Description
Modulation Mode	R/W	Modulation mode. Desired modulation mode is selected from the following values*: C-OFDM (default) Off (shuts off modulation)* or I/Q *CAL ON (puts unit in calibration mode).*
COFDM Bandwidth	R/W	**COFDM** transmit bandwidth. Desired bandwidth is selected from the following values: *6, 7 or 8 MHz*.
COFDM Mode	R/W	**COFDM** modulation type. Desired **COFDM** modulation type is selected from the following values: *QPSK, 16 QAM* or 64 QAM
Mod Guard Interval	R/W	Modulation guard interval size. Desired modulation guard interval size is selected from the following values: *1/32, 1/16, 1/8 or ¼*.
Modulation FEC	R/W	Modulation FEC (Forward Error Correction) rate. Desired modulation FEC rate is selected from the following values: *½, 2/3, ¾, 5/6, 7/8*.
Channel Rate (Mbps)	R	Channel rate is displayed based on parameters selected such as COFDM mode, FEC and Guard Interval.
HS Clock Polarity	R/W	Choice between sampling the data on the rising or falling edge of the clock.
HS Clock Delay	R/W	Delay from clock edge to actual data sample.
HS Serial Bit Rate	R/W	Digital data rate in Mbits/Sec. Data rates are from 100Kbits/Sec to 30Mbits/Sec.

5.3.3 Pull-Down Menu Definitions

There are several different pull-down menus that are included in the MDT-D Configurator program. Each of these pull-down menus contains further user-configurable options or commands. The following sections describe these menus in detail.

5.3.3.1 File

This pull-down menu offers to exit the MDT-D Configurator program. Alternatively the 'X' box in the upper right hand corner of the window can be used to exit the program. The "Store All Setup Pages" button on the main menu will save all parameters.

5.3.3.2 Configuration

This pull-down menu contains several different configuration options. These are outlined below:

- ***Special Setup***
  - ***Scrambling Mode (Option)*** – This pull down menu displays the following (see Figure 4A & 4B):
    - ***OFF***– Scrambling (Encryption) turned off (disabled).
    - ***AES,Never Store the key in the TX*** – Scrambling is turned on (Enabled). When scrambling is turned on, a key code (a series of 32 Hex characters) must be entered. Entering the key

code is discussed in the following section (Scrambling Key). In this mode the key code is not stored in the transmitters memory. When power is removed the key code will be lost and must be re-entered when power is re-applied. The same key code must be entered in the DDPC of the MSR. See DDPC manual 100-M0070.

- ***AES, Store the key in the Tx*** – Scrambling is turned on (Enabled). In this mode the key is stored in the transmitters memory. When power is removed the key code will not be lost.
- ***Query*** – Clicking this button performs a read operation which will read back the current scrambling mode configuration.
- ***Apply –*** Clicking this button will perform a write operation of the selected mode.

  NOTE: When the Scrambling Mode is changed, a popup window will appear informing you that the transmitter will be rebooted.
- ***Exit*** - Exit the scrambling mode.

o ***Scrambling Key (Option)*** – This menu displays the following (see Figure 5):

- ***Enter Scrambling Key from Keyboard –*** The 32 character key code can be manually entered from the keyboard. The characters must be Hex numbers. When the numbers have been typed use the ***Apply*** button to enter the code.
- ***Load Scrambling from a file –*** The key code can be selected from a file. The ***browser*** button can be used to search thru the Directory for a file containing the key code. Once a path has been established it can be saved using the ***Save Path*** button. The ***Load Key from File*** is used to retrieve a key code from a file as specified by the path. Use the ***Exit*** key to close this window.

o ***HS TS Setup –*** This menu displays the following (see Figure 6):

- ***HS TS Data PID –*** This is the program ID for the data packet applied to the MPEG2 transport stream. This a hex value. The range of values is 0x000 – 0x1FFF. The corresponding Data PID of DDPC card in the MSR must match this setting. See DDPC manual 100-M0070.
- ***HS TS PCR PID –*** This is the program ID for the PCR packet applied to thru MPEG2 transport stream. This a hex value. The range of values is from 0x000 – 0x1FFF. The corresponding PCR PID of the DDPC card in the MSR must match this setting. See DDPC manual 100-M0070.
- ***HS TS PCR Insert Rate*** – This is the rate at which the Program Clock Reference (PCR) is sent to the receiver (via MPEG2) in PCRs per second. The PCR is used to synchronize the digital data transfer between the transmitter and receiver.
- ***HS TS Pattern Generator*** – The transmitter can generate a

built in fixed digital test pattern to be to be transmitted instead of the digital data supplied at the transmitters input. Use the pull down menu and select enable then press update for this feature to be turned on. The DDPC at the MSR must also be enabled (See DDPC manual 100-M0070). The pattern will be seen at the output of the DDPC card. The pattern will be a re-cycling 8-bit counter.

- ***Others*** - This menu displays the following (see Figure 7):
  - **RF Output Attenuation (0-5 dB)** – The RF output can be attenuated in 1 dB increments up to 5 dB.
  - ***COFDM Spectrum Inversion*** - choices include normal or inverted. The transmitter is configured with the receiver it ships with and the inversion mode shouldn't have to be changed. However if a different receiver is used the inversion mode may have to be changed. Some receivers will accept either inversion mode. Check the parameters of the receivers to ensure the correct inversion mode is selected.
  - ***Sleep Mode***–Can be used to put transmitter in a sleep mode, a low power mode where the encoder functions and many of the power regulators are shut down enabling a saving in current (approx. 40%) when transmitter is not active.
  - ***Frequency switch*** – Choices offered are enabled or disabled. These are the four frequency select switches discussed under section 5.1.2. If disabled the switches will not respond to changes (frequency changes could still be accomplish by changing the "RF FREQ MHz" field in the GMS MDT-D control software. Enabling them allows the frequency to be changed when the switches are moved. Factory default enables the switches. Keep in mind that you must click on the "Store All Setup Pages" button for any new selection to take place.

- ***Ctrl Port Baud Rate***- The control port baud rate menu allows different baud rates to be selected when attached to the PC RS232 port. 115200-baud rate is the default value. Some computers may need the baud rate adjusted for optimal communications
- ***Factory Setup –*** reserved for factory use and is password protected.

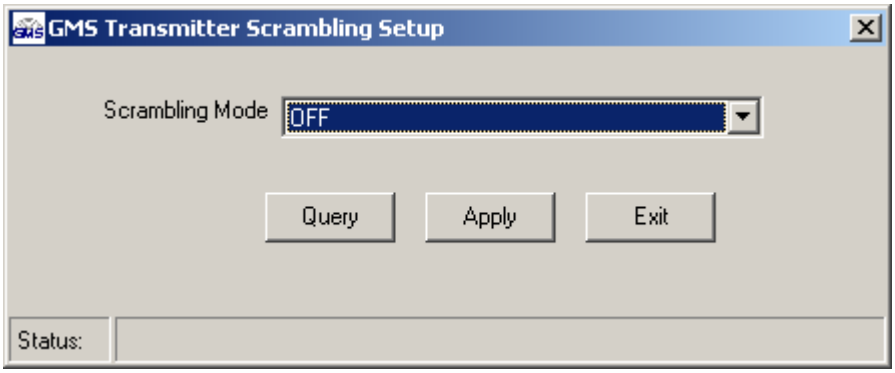


Figure 4A -Scambling Mode Setup

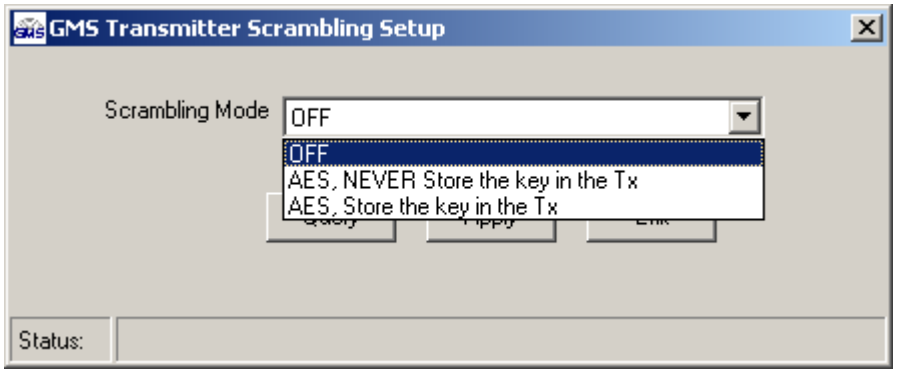


Figure 4B Scambling Mode Setup

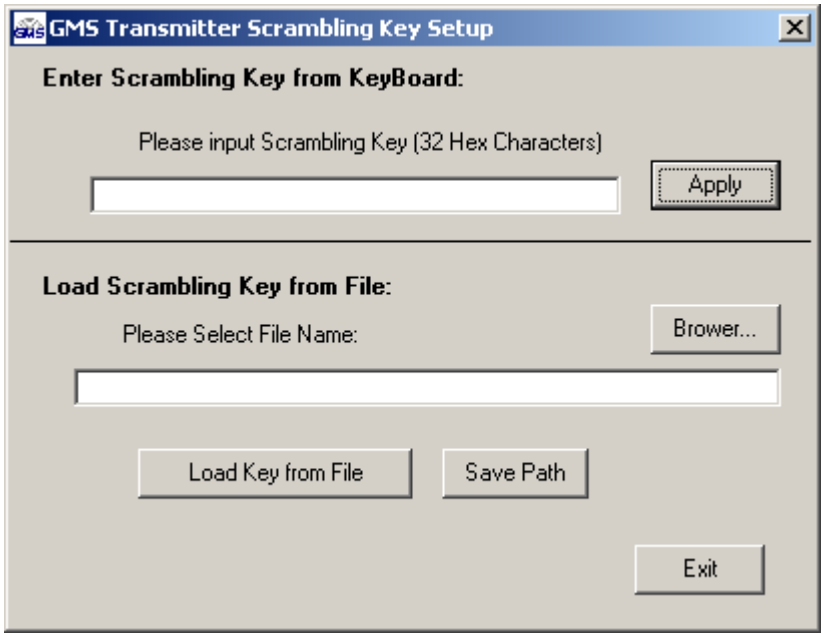


Figure 5 Scambling Mode Key Setup

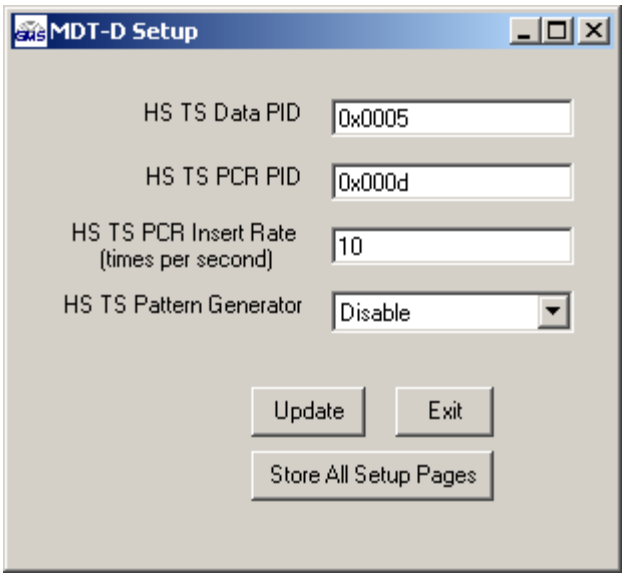


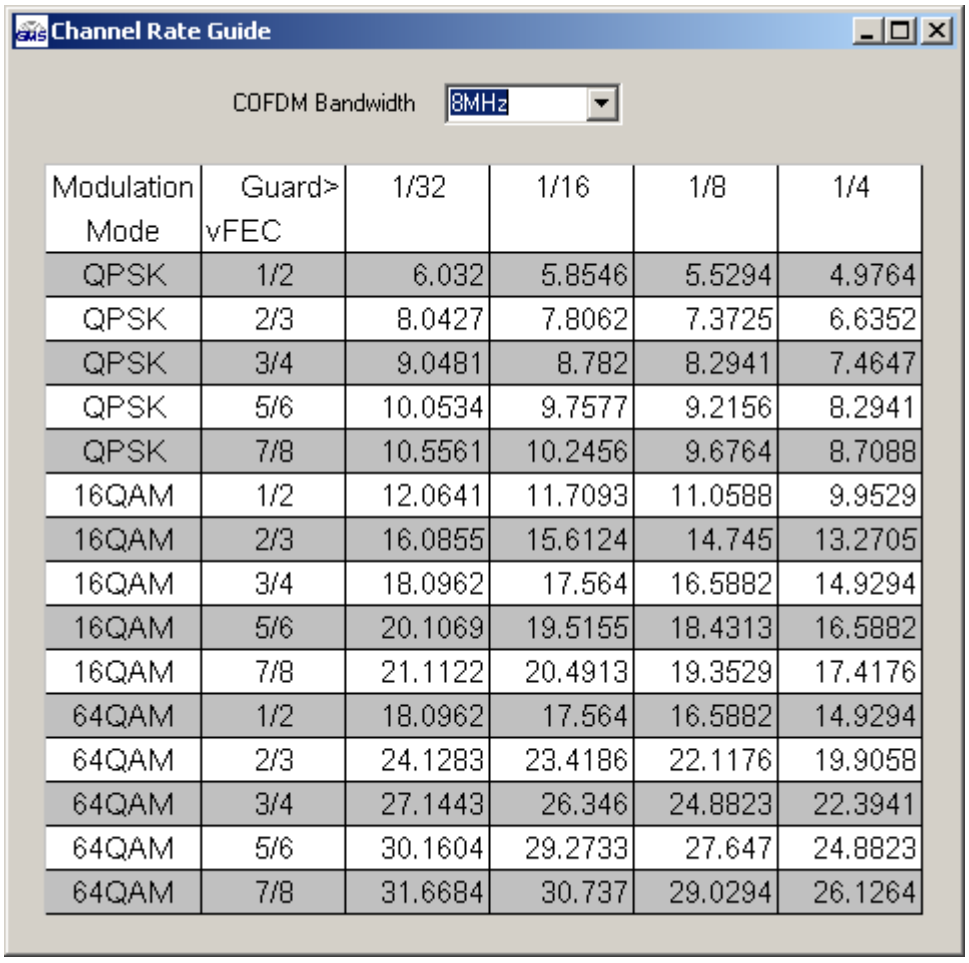
Figure 6 – HS TS SETUP

Figure 7 – Others

5.3.3.3 Help

This pull-down menu contains information about the MDT-D firmware and the MDT-D Configurator software. This information is outlined below:

- *Channel Rate Guide*: This selection pulls up a table which displays the relationship between the Modulation mode, Modulation Guard Interval and FEC mode in which the channel rate (Mbps) is derived. Table values will change depending on which COFDM Bandwidth is selected. See figure 8. Also keep in mind that all values may not be available, they are MDT-D configuration type dependant.
- *FW version*: This selection pulls up a window that displays the MDT-D Software Version date, the FPGA Version and Serial Number. See Figure 9.
- *About*: This selection pulls up a window that displays the Version Number of the GMS MDT-D Configurator program.



Modulation Mode	Guard> vFEC	1/32	1/16	1/8	1/4
QPSK	1/2	6.032	5.8546	5.5294	4.9764
QPSK	2/3	8.0427	7.8062	7.3725	6.6352
QPSK	3/4	9.0481	8.782	8.2941	7.4647
QPSK	5/6	10.0534	9.7577	9.2156	8.2941
QPSK	7/8	10.5561	10.2456	9.6764	8.7088
16QAM	1/2	12.0641	11.7093	11.0588	9.9529
16QAM	2/3	16.0855	15.6124	14.745	13.2705
16QAM	3/4	18.0962	17.564	16.5882	14.9294
16QAM	5/6	20.1069	19.5155	18.4313	16.5882
16QAM	7/8	21.1122	20.4913	19.3529	17.4176
64QAM	1/2	18.0962	17.564	16.5882	14.9294
64QAM	2/3	24.1283	23.4186	22.1176	19.9058
64QAM	3/4	27.1443	26.346	24.8823	22.3941
64QAM	5/6	30.1604	29.2733	27.647	24.8823
64QAM	7/8	31.6684	30.737	29.0294	26.1264

Figure 8 - Channel Rate Guide

Figure 9 - FW Version

6.0 Getting Started

The standard MDT-D kit includes the following items:

- MDT-D unit (example GMS p/n MDT-DCBA0NXXX)
- MDT-D full breakout cable (GMS p/n 780-C0269)
  (Power, Data, Control interfaces)

NOTE: Based on customer application GMS may deliver additional cables and antennas. Contact GMS for further information.

The MDT-D is pre-configured by GMS prior to shipment (based on customer requirements), thus is ready to work "right out of the box".

6.1 Initial Checkout

Prior to installing a MDT-D unit into the desired target environment, an initial checkout should be performed to ensure proper operation of the unit. The initial checkout consists of configuring a basic MDL (Messenger Digital Link).

Figure 12A shows a basic interconnection configuration to establish a wireless MDL link (NOTE: Receivers, down converters (D/C) units and their associated hardware are sold separately). MDT-D stand-alone units require the use of GMS' breakout cable to provide power and the necessary interfacing to communicate to the transmitter. The steps necessary to set up the configuration shown in Figure 10A are shown below.

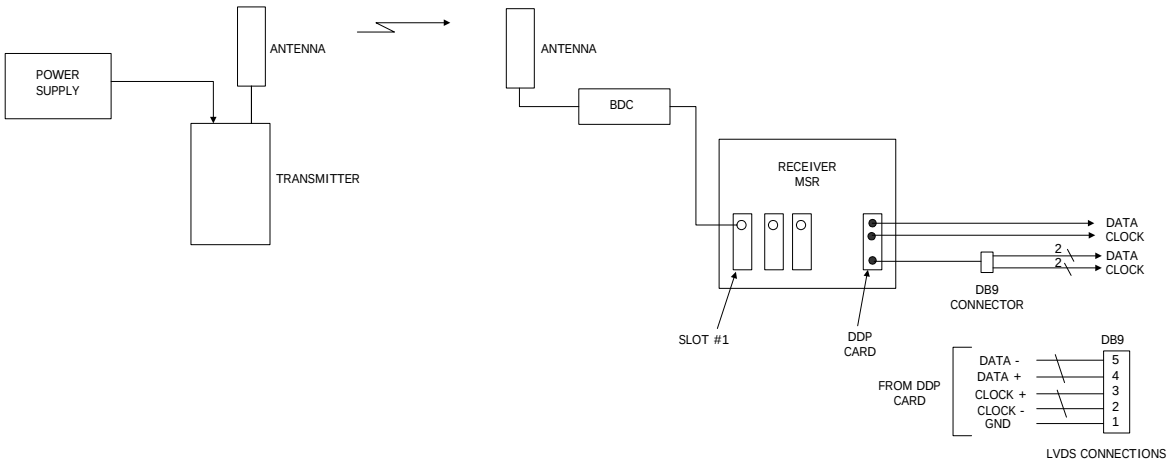


Figure 10A - Basic SDML Setup

1. Install omni-directional antennas onto the MDT-D RF output port and Down- Converter (D/C) RF input port. ***Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working. A proper heat sink is also required.***
2. Attach the breakout cable (DB-44 end) to the MDT-D unit.
3. Attach an RF cable from the D/C IF output port to RF in port of the receiver.
4. To prepare to power the MDT-D unit, attach the red and black wires from the breakout cable to +12V terminal and ground of power supply, respectively. NOTE: The power supply (for the transmitter) needs to be able to provide at least 1 Amp of current at a nominal +12VDC input. Apply power to the MDT-D and the receiver unit. Also ensure the down converter is powered (+12 Vdc to pin 1, GND to pin 3 of the DB-9 pin connector located on the bottom side of the D/C). If the down converter is installed in an enclosure it will have a power switch on the side of the unit. Ensure the switch is turned to the "On" position.
   The BDC can be optionally powered thru the coax cable from the MSR receiver. See the MSR manual 100-M0061.
5. After approximately 10 seconds, the link should be established. Using the MSR Control software monitor the appropriate RF channel. If the link is established the MSR will display the locked condition. See the MSR manual 100-M0061 for Setup.

The initial checkout described above is simply to check the basic operation of the MDT-D unit. For further details on monitoring and controlling the MDT-D using GMS' optional MS Windows-based MDT-D Configurator software program, see Section 6.0.

Figure 10B shows a diagram of an MDL link using a High power transmitter.

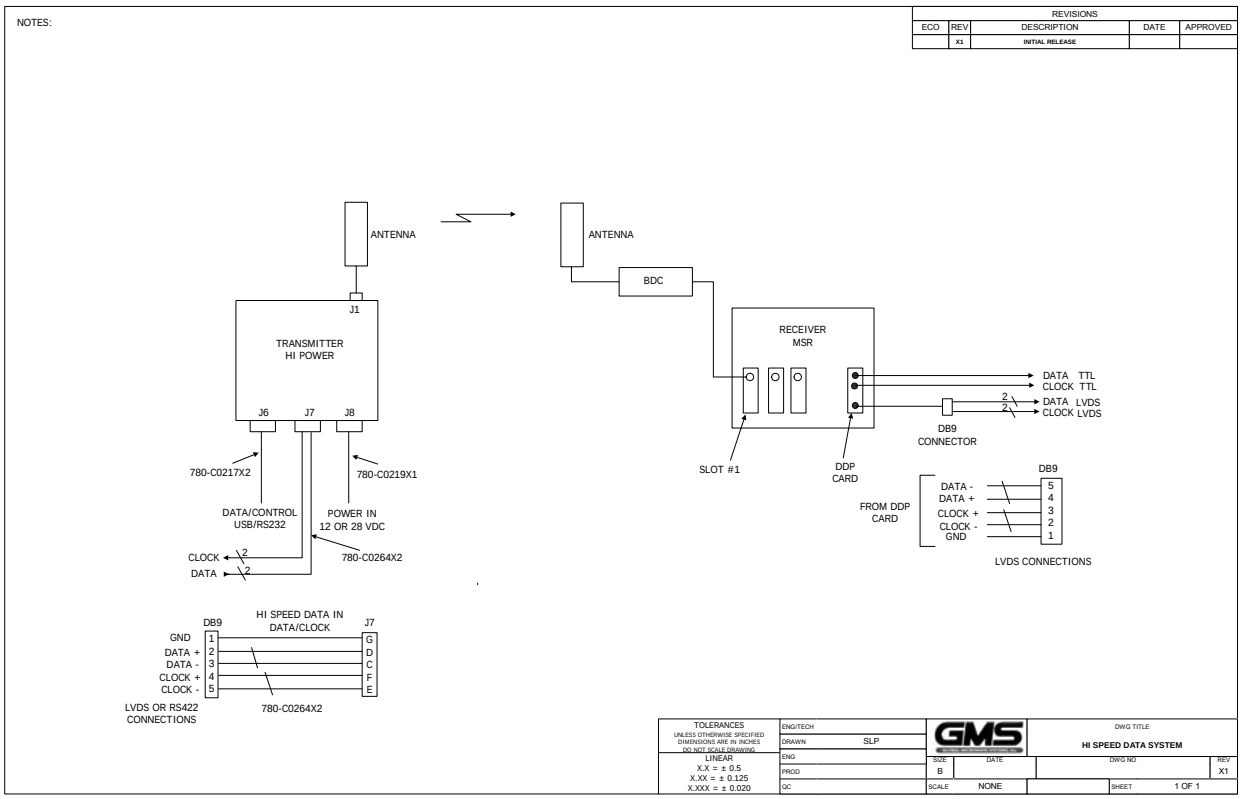


Figure 10B - Basic SDML Setup w/Hi Power Transmitter

7.0 Specifications

The following sections outline the overall specifications for the MDT-D unit.

7.1 Transport Stream

Standard: per ISO/IEC 13818-1

Packet Size: 188 byte

Bit Rate: Automatically set from active service settings.

7.2 RS-232 Interfaces/RCU/USB

Control Port: 3-wire interface (Tx,Rx,Gnd)

USB 1.0

RCU A remote portable control unit is also available

In addition a "Data" RS232 channel under development will be dedicated for low-rate data to be transmitted along with the audio and video.

7.3 COFDM RF Output

Output Frequency: 0.36 to 6 GHz (In-Bands).

Frequency step size is 500 KHz for all bands except S2 (1999-2500 MHz) which is 250 KHz.

Bandwidth: Selectable 6, 7 or 8 MHz

Output Power: Up to100 mW (programmable) [200 mW on some models]

Connector: **SMA-F**
Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working. A proper heat sink is also required.

7.4 Modulation

Modulation Type: COFDM w/ QPSK, 16 QAM
FEC: ½, 2/3, ¾, 7/8
Guard Intervals: 1/32, 1/16, 1/8, ¼
Spurious: 50dBc
Number of C-OFDM Carriers: 2k
C-OFDM MER: > -45dB
Standard: DVB-T compliant

7.5 Data Port

Interface: Serial Data/Clock Interface, Continuous
Interface Type: LVTTL or LVDS (Programmable)
Clock: Output from Tx (Programmable)
Clock Range: 100 KHz to 30 MHz
Clock Resolution: 1 Hz
Clock Accuracy: +/- 10 ppm
Data Sampling: On rising or falling edge of the clock (Programmable)
Connector: p/o DB-44 female

7.6 Power

MDT-D (Frequency 0.36 to 6GHz In-Bands
DC Input Voltage Range: 9 to 15 VDC
Power Consumption: 8.5 Watts to 10.8watts (MDT-D configuration type dependent)

7.7 Physical Dimensions (without mating connectors)

MDT-D (Frequency 0.36 to 6GHz In-Bands)
MDT-D unit
Size: 3.25 in. (W) x 4.5 in. (D) x 1.00 in. (H)
(8.26 cm x 11.43cm x 2.54cm)
Weight: 10.69 oz
(303.1 grams)

7.8 Environmental

Operational Temperature: -10 to +70 °C
Humidity: Up to 100% (non-condensing)

7.9 MDT-D Special Features

Security Option
The MDT-D can optionally be provided with an Advanced Encryption System (AES) for protecting the data in sensitive applications.

8.0 The D/C (Down Converter)/IF frequencies explained

8.1 IF Frequencies

- GMS' MDRs (Messenger Digital Receivers) and MSRs (Messenger Smart Receivers) are capable of receiving direct frequencies in the range of approximately 49MHz to 861MHz. If the transmitter is not in this range then a down-converter is used to convert the frequency to this range. The frequency from the down-converter is called the IF (intermediate frequency) which is fed to the receiver.

  Down-converters have a LO (local oscillator) which is mixed with the transmitter frequency (MDT-D) and converts it to the IF frequency. MDRs need to know the LO (local oscillator) of the down-converter and is factory programmed with this information (MSRs also need the LO information but is not factory programmed with this information). The receiver then automatically calculates the IF frequency once the RF (transmitter frequency) is entered. Thus as the desired RF frequency is dialed in on the MDR (or MSR) the IF is taken care of automatically. For example, if the transmitter frequency (MDT-D) is set for 2000MHz, then the MDR can be set for 2000MHz (it automatically calculates the IF frequency based on pre-programmed LO information of the down-converter). The IF frequency changes as the RF frequency changes; the LO remains constant.

On non-GMS commercial digital receiver it may be necessary to program the receiver with the IF frequency directly. The user may have to do the simple math to arrive at the IF frequency so that it can be entered into the receiver. ***The down-converter LO must be known***. The math involve is as follows: " RF (transmitter frequency) – LO (local oscillator) = IF frequency". For example, it the transmitter is set for 2000 MHz and the LO of the down-converter is 2800 MHz then the IF frequency is -800 MHz (2000-2800MHz = -800). The receiver will need to be set to 800 MHz to receive the transmitter frequency of 2000 MHz. Each time the transmitter frequency is changed the IF must be re-calculated and entered into the receiver. It must also be mentioned, as you may have noticed, a negative LO may indicate the receiver wants the signal to be inverted. See section 5.3.3.2 for inverting the signal.

8.2 Local and Remote Power

Customers may have the option of using remote or local power to power up a down converter depending on the receiver used. GMS' MDRs (Messenger Digital Receiver) and MSRs (Messenger Smart Receiver) can provide DC +12 volts to power the D/C remotely through the RF cables. Refer to GMS' MDRs or MSRs operating instructions for turning on the DC power for the D/C when using remote power.

If the D/C is located relatively close to the receiver then using remote power makes sense. However, if the D/C is located at great distances away from the receiver there may be excessive DC voltage drop in the coax cable (due to cable resistances). If this is the case then local DC power should be considered as discussed below. If unsure of the DC voltage drop measure the DC voltage present (using a DMM) at the end of the coax cable run. The D/C normal operating voltage is approximately +12Vdc but can operate down to +10 Vdc.

- Local power is provided by applying +12 Vdc to pin 1, GND to pin 3 of the DB-9 connector located on the bottom of the D/C. The +12 Volt power supply must be able to source at least 500mA. The power switch (located on the side of the D/C) enables the user to control the 'ON'/'OFF' positions for local

power. If using local power then ensure the remote power (if the receivers have this capability) is turned off. (See figure 11)

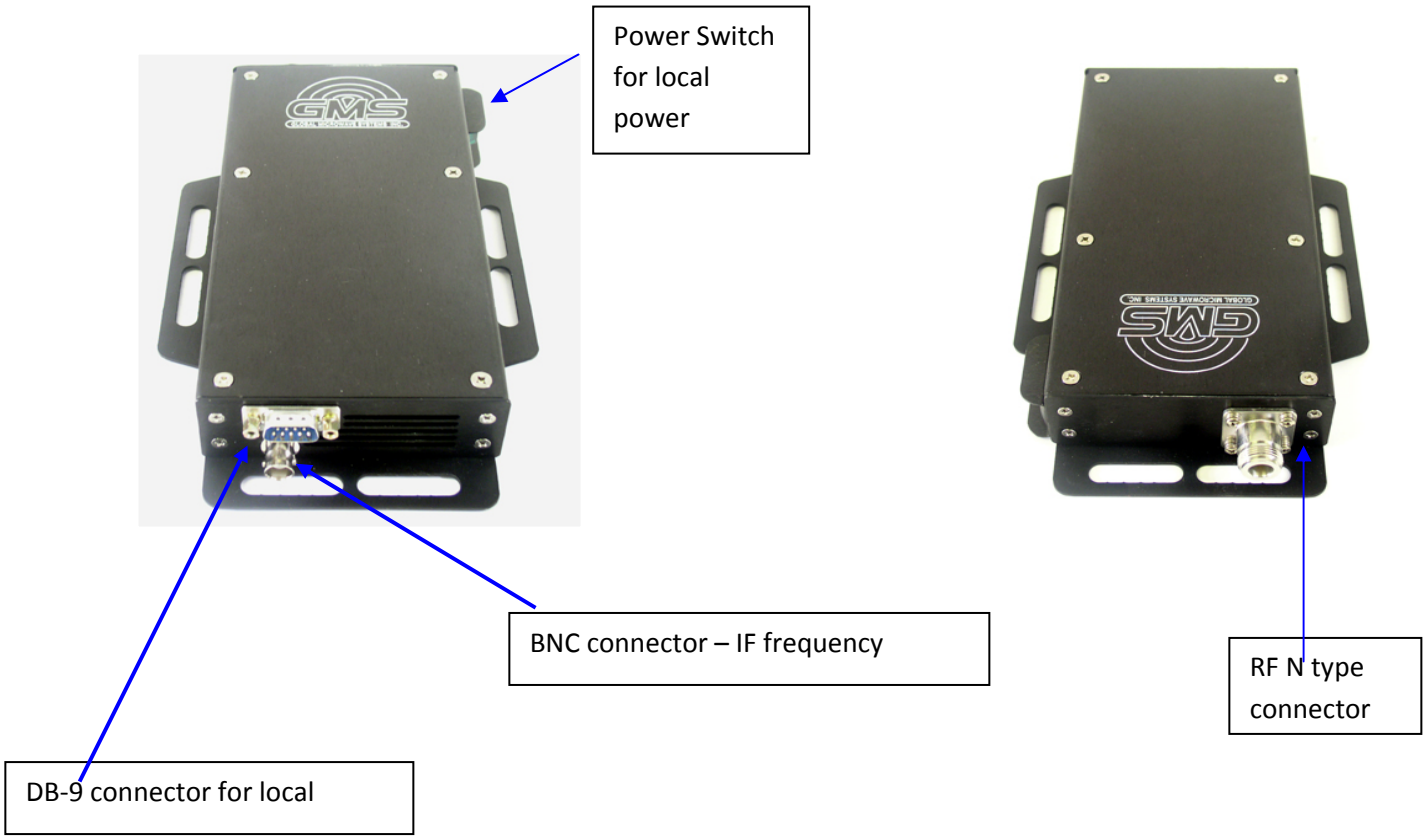


Figure 11 - BDC Connectors

Table 3 - DB-9 Connector Pin Out for the D/C

Pin	Signal	Notes
1	+12Vdc	Power supply must be able to source at least 500mA. Voltage should not drop below +10Vdc.
3	GND	Power ground
2, 4-9	NC	Not Connected

9.0 Cable Losses

9.1 Coax Cable

Cable losses must be taken into consideration if the D/C is located a great distance from the receiver. As mentioned above long cable runs can contribute to more resistance in the lines and also can contribute to signal attenuation because of the additional capacitance. Even when using a good coax cable such as RG59/U the attenuation of the signal can be significant. For example, RG59/U coax will drop approximately 2dB per 100 feet at 50 MHz and 8 dB per 100 feet at 900 MHz. The intermediate frequency (IF) in this system can fall between 49 MHz to 850 MHz. An inline amplifier matching the cable losses should be considered if losses exceed 6 dB

NOTES:

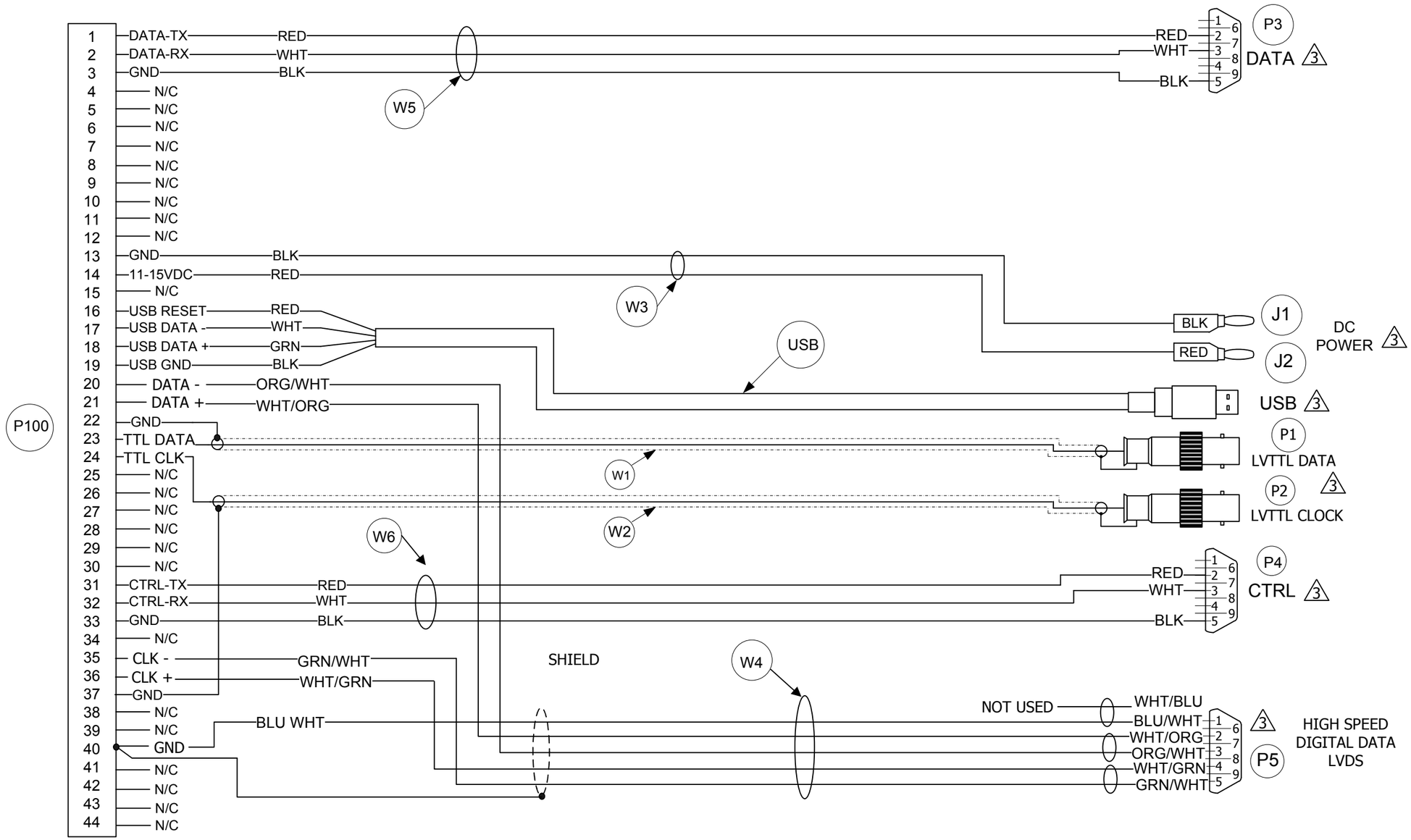
1. REFERENCE BOM 780-C0269X2 FOR REFERENCE DESIGNATIONS (SHOWN AS [] ON DRAWING) AND PART DESCRIPTIONS .

2. LABEL FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0269X2 USING BEST COMMERCIAL METHOD.

3. LABEL CONNECTOR WITH REFERENCE DESIGNATOR AND DESCRIPTION AS SHOWN USING BEST COMMERCIAL METHOD. LABEL TO BE WITHIN 3.0 OF CONNECTOR.

4. REFERENCE MANUFACTURING INSTRUCTION 100-MI0112.

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
EO525	X1	INITIAL RELEASE	02/22/06	
E0580	X2	WIRING MODIFICATIONS FOR TTL	04/26/06	



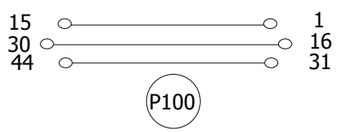


FIGURE 1
CABLE WIRING DIAGRAM

TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING	ENG/TECH	T. Giotta	COBHAM GMS Products
LINEAR X.X = ± 0.5 X.XX = ± 0.125 X.XXX = ± 0.020	DRAWN	RJE	DWG TITLE: CABLE, MDT-D EXTERNAL BREAKOUT FOR HIGH SPEED DIGITAL DATA VERSION
	ENG		
	PROD		SIZE B; DATE 2/9/06; DWG NO 100-C0269X2; REV X2
	QC		SCALE: NONE; SHEET 1 OF 5