

The most important thing we build is trust.

# Messenger 2 Transmitter (M2T) OPERATIONS MANUAL



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## Revision History

Version	Date	Main Changes from Previous version	Edited by
X2A	9-23-2009	FW – UPDATE PSF SUPPORT WAS ADDED TO CODE	RM
X2B	6/2/10	ADDED EMBEDDED AUDIO FUNCTIONS, ASI IN, NEW PCB GUI	TG
X2C	07/15/10	Update audio section	TG

## 1.0 Acronyms

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

<b>Name</b>	<b>Meaning</b>
16 QAM	16-state Quadrature Amplitude Modulation
64 QAM	64-state Quadrature Amplitude Modulation
A/V	Audio/Video
AES	Advanced Encryption System (32 bit)
ASI	Asynchronous Serial Interface
BDC or BDCC	Block down converter
COFDM	Coded Orthogonal Frequency Division Multiplexing
CVBS/Y	Composite video/Luminance with S-video
C	Chroma video
D/C	Down-Converter
FEC	Forward Error Correction
GUI	Graphical User Interface
HD	High Definition
I/O	Input/ Output
Kbaud	Kilobaud per second
Kbps	Kilobits per second
Mbps	Megabits per second
MER	Modulation Error Rate
MPEG	Moving Picture Experts Group
MSR	Messenger Smart Receiver
M2D	Messenger Two Decoder
M2T	Messenger Two Transmitter
M2L	Messenger Two Link
NTSC	National Television System Committee
PAL	Phase Alternation Line
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RX	Receiver
S/N	Signal-to-Noise Ratio
THD	Total Harmonic Distortion
SD	Standard Definition
SDI	Serial Digital Interface
TX	Transmitter
VDC	Volts (Direct Current)

## 2.0 Introduction

GMS introduces the Broadcast industry's first AVC / h.264 COFDM wireless transmitter for transport of Standard (SD) plus High Definition (HD) audio /video streams.

The Messenger 2 Series (M2) product line incorporates many of the original "Messenger" product line capabilities with two major upgrades. The M2 series incorporates the AVC compression technology with one frame delay which replaces the MPEG-2 compression, and they cover all the SD and HD formats up to 1080P.

One of the biggest problems encountered in the transition from an analog to a digital A/V platform has been the inherent digital coding delay that in some digital systems are 1.5 seconds or more for HD. The M2T employs a specially designed 'Ultra-Low Delay' coding technology, which provides 44mS (~ 1 frame) end-to-end system delay when using GMS's AVC M2D Decoder. This ensures that the picture you see is what is happening now; crucial for applications such as sports and news coverage!

This manual provides information on how to operate the M2T as well as pertinent technical information related to the overall system. Refer to the model identifier (on-line document, 100-MNI0063 - latest revision) at GMS website, <http://www.cobham.com/gms>, for available frequency and power configurations along with options.

### 2.1 Key System Features

- Built-In AVC / h.264 Encoder
- SD and HD formats up to 1080p
- Low Power Consumption (~15 Watts)
- Low System Latency (~1 frame with GMS AVC Decoder)
- Local Control
- User Data Support
- Supports up to 2 channels audio embedded in the SDI stream
- AES 128/256 Bit Security
- COFDM Modulation
- Output Frequency: 1 to 7 GHz (In-Bands)
- High-Throughput 4K option for maximum link performance
- Rugged and Compact Portable Design
- Companion COFDM receiver with Maximal-Ratio Pre-Detect Diversity reception

## 3.0 Theory of Operation

The Messenger 2 Transmitter (M2T) accepts Standard Definition (SD) or High Definition (HD) 4:2:2 digital video or analog SD video and analog stereo audio inputs (Mic or Line level). The video is compressed according to the Advanced Video Compression (AVC) /h.264 specifications. The low-latency AVC Encoder supports the Baseline Profiles with resolutions from 480 to 1080 with support for either interlaced or progressive formats. The audio is compressed using MPEG layer II compression. Low rate user data up to 38.4K Baud can be optionally supported. The audio, video and user data packets PES streams are multiplexed with basic service data to indicate the service name. The stream can be scrambled with AES scrambling system to provide protection in sensitive applications.

A complete GMS Messenger 2 Camera Link for wireless camera application includes the Messenger 2 Transmitter, the Messenger Smart Receiver (MSR), the Messenger Two Decoder (M2D) and one

or several external Block Down – Converters (BDC), as shown in the Figure 1 below. The M2T provides professional Audio/Video (A/V) interfaces and processing. All versions of the Messenger Digital Link family use a robust digital modulation system known as Coded Orthogonal Frequency Division Multiplexed (COFDM) that provides frequency diversity and powerful Forward Error Correction (FEC) algorithms.

The Messenger Smart Receiver (MSR) provides for *Spatial Pre-Detect Maximal-Ratio Diversity Combining* of up to six independent antennas per MSR to increase the Signal Strength, Signal-to-Noise Ratio and combat short delay spread multipath reflections found in indoor environments. There is a dramatic increase in the operating threshold when multiple high-gain antennas and Block Down-Converters (BDC) are used with the MSR, greatly enhancing link robustness when operating at the high data rates as required for HD transmission. The MDR outputs a transport stream simultaneously over ASI and SPI interfaces. External Audio/Video/Data MPEG Decoders are sold separately that support HD or SD AVC Decoding.

The 4K HIGH-THROUGHPUT OPTION enables user-selectable options to set bandwidths from 6 MHz to 16 MHz and to double the throughput of our standard M2T (Up to 63 Mbps!). Using 4 K carriers and the 16 MHz bandwidth, the link can support HD operation with > 12 Mbps while running QPSK and ½ FEC. This increases link robustness and provides an additional 13.5 dB increase in link margin (>4.7 x increase in operating range!) for the same throughput rate in a standard HD MPEG-2 DVB-T system! With the HIGH-THROUGHPUT OPTION you can run with fully DVB-T compliant 2K carriers and bandwidths of 6, 7, or 8 MHz. When switched to 4 K carriers user can select 12, 14 or 16 MHz bandwidth.

The 4K HIGH-THROUGHPUT OPTION is also useful when transmitting multiple video streams through one transmitter. This option requires a special receiver configuration. Please contact GMS Sales for additional information.

## 4.0 Getting Started

The standard M2T kit includes the following items:

- M2T unit
- M2T full breakout cable (GMS p/n 780-C0291)  
(Power, A/V input, User Data, Control interfaces)

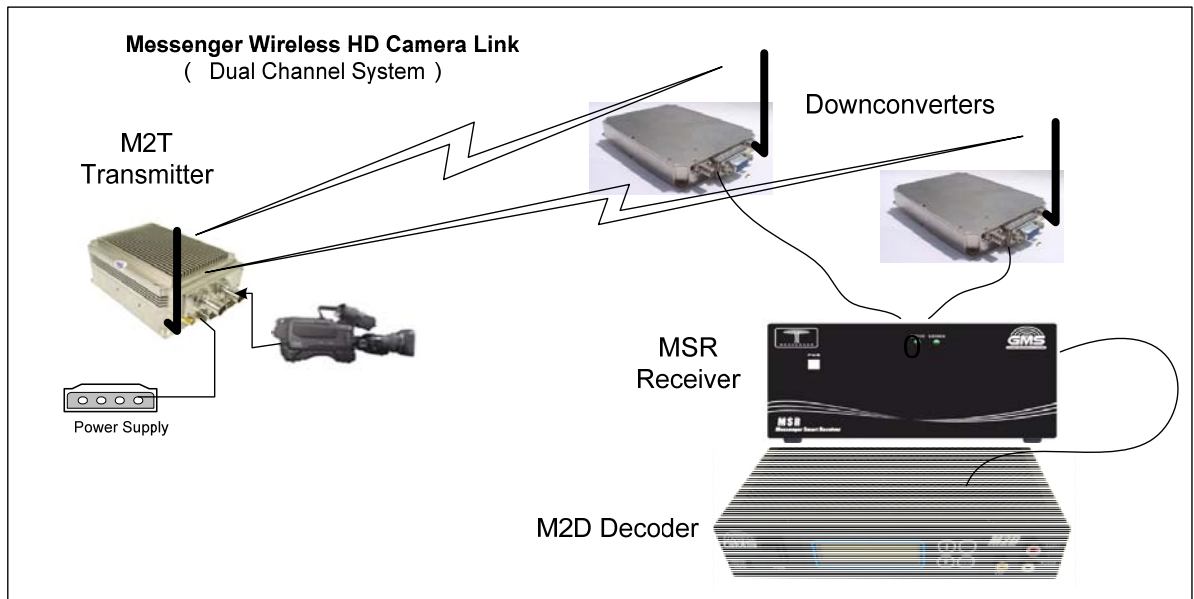
NOTE: Based on customer application GMS may deliver a receiving system, additional cables and antennas. Contact GMS for further information.

The M2T is pre-configured by GMS prior to shipment (based on customer requirements), thus is ready to work “right out of the box”.

### 4.1 Initial Checkout

Prior to installing a M2T 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 MT2 link.

Figure 1 shows a basic standard M2T wireless link configuration. (NOTE: MSR and D/C units and their associated hardware are sold separately). The steps necessary to setup the configuration shown in Figure 1 are shown below. High throughput optional M2T require additional hardware (which includes two MSRs, a DDP plug in card and a combiner).



**Figure 1 Basic M2T Link Setup**

1. Install Omni-directional antennas onto the M2T transmitter RF output port and at the receiver end Down-Converter(s) RF input port. **Note: Transmitters should not be powered on without a load attached to the RF output connector. The internal PA could be damaged.**
2. Attach an SDI video source to the M2T SDI BNC video input. A composite signal can also be applied to the M2T I/O DB-44 connector using GMS break out cable, however keep in mind that the video source must match the group setting of the transmitter. Refer to the software section 7.0 and section 6.0 on the selection of the transmitter (M2T) video groups.
3. The MSR should be pre-configured from the factory (refer to the GMS web site for the online manual). In short ensure the MSR is powered, has a cable from the ASI out to the decoder ASI input, that each tuner has a RF cable which runs to each block down converter (each tuner is provided power either through the MSR or locally) and is set to the same RF frequency as the transmitter.
4. Attach a video cable from the video out of the decoder to a video monitor. Refer to the decoder's operational manual for proper setup.

**NOTE: Before providing power to the M2T in the following step ensure to use a proper heat sink with adequate air flow or equivalent heat sinking method.**

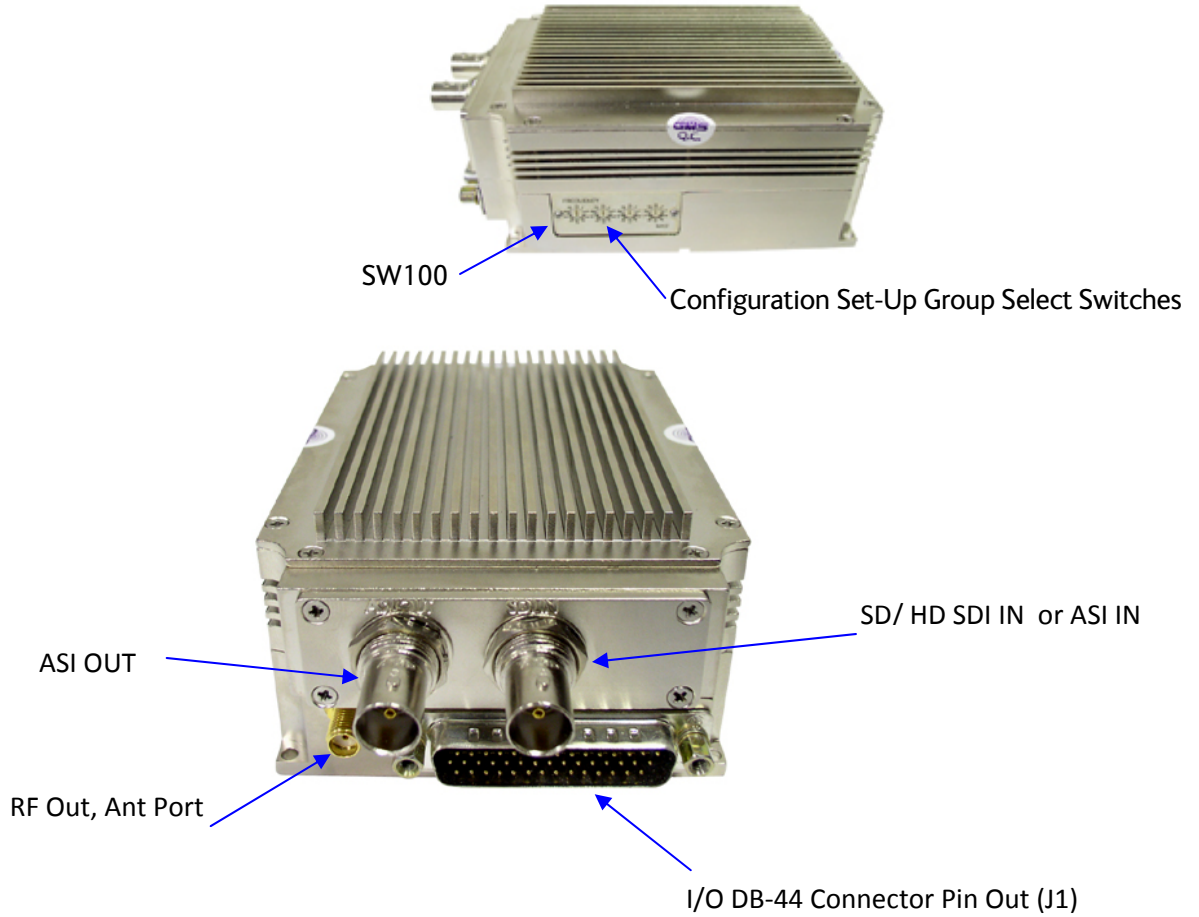
5. Provide power to the M2T (+12 Volts) using GMS break out cable (780-C0291) which connects to the I/O DB-44 pin connector. Power supply should be able to source approximately 2 amps.
6. Turn on the video source and video monitor equipment.
7. After approximately 30 seconds the link should be established and video provided by the source should be displayed on the monitor. An optional computer with the MSR control software installed can be used to monitor the receive parameters such as BER, MER and Signal to Noise. This connection can be through the USB or RS232 port.

The initial checkout described above is simply to check the basic video operation of the M2T unit. For further details on monitoring and controlling the M2T using GMS' optional MS Windows-based M2T Configurator software program, see Section 7.0.

## 5.0 Hardware Overview

The basic M2T transmitter configuration is outlined in this section:

### 5.1 Standard M2T



**Figure 2 M2T Connectors**

## 5.1.1 M2T Connectors

There are four connectors located on the M2T unit as shown in Figure 2. They are for interfacing the RF, SD/HD SDI Video, ASI out, audio, component and composite video and Control signals. There are also configuration group select switches (refer to section 6 on configuration groups) located on the side of the transmitter also shown in Figure 2

### 5.1.1.1 RF Output, Ant Port

The M2T uses a female SMA connector for its 'RF Output' port. The antenna is attached here.

**Note: Transmitters should not be powered on without a load attached to the RF output. Doing so could damage the internal Power Amplifier (PA).**

### 5.1.1.2 SD/HD SDI IN/ASI IN

A female BNC connector is provided for SD-SDI or HD-SDI video input streams. The input bit rate is 270 Mbps for SD and 1.485 Gbps for HD.

In addition this input connector can be used as an input for ASI DVB compliant Transport Streams. See section 7.3.4, software overview, for details on the Input Modes. This section explains how to switch from SDI IN to ASI IN using the GMS M2T Configurator.

### 5.1.1.3 ASI Out

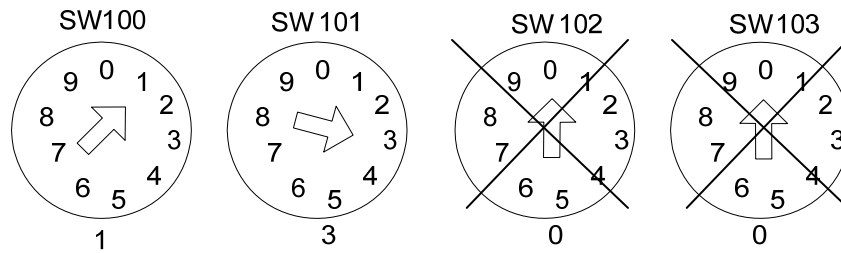
A female BNC connector is provided for DVB-ASI Transport Stream Output. The output bit rate is 270 Mbps. This transport stream does not include the SI tables, User-Data, or AES encryption which is added later in the processing chain.

### 5.1.1.4 Configuration Set-Up Group Select Switches

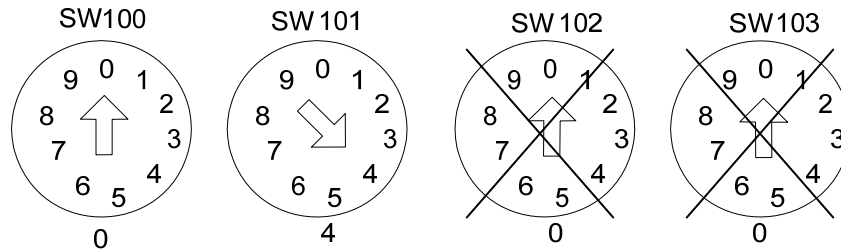
There are four external rotary switches mounted into the chassis of the M2T (reference Figure 2). Two of them, SW100 and SW101 are used to control Set Up Group selection (the other two, SW102 and SW103 are not used in this mode). Set-Up Group selection can also be controlled through GMS control software; see section 6.0.

User Administrators define the Set-Up Groups for specific applications. Each Set-Up Group completely defines all of the Transmitter's set up parameters including **Center Frequency; Output RF Power Level, Modulation Parameters, Video, Audio, User Data and Encryption** . Each Set Up Group can be completely different from any other group. Field personnel will select specific Set Up Groups via pre-determined guidance from the Administrators. Matching the Transmitter operation to the Receiver operation is as simple as selecting the same Set-Up Groups. For example: if the transmitter is set to preset #19, then the receiver needs to be set to preset #19 for them to operate together.

Switch SW100 represents the most significant digit (selections from 0-9) representing tens and switch SW101 is the least significant digit representing ones. They are used to select a Set Up Group from 1 to 20. Switches SW102 and SW103 are not used in this application. For example with the switches in the following positions the Video group reads 13.



And with the switches in the following positions configuration set-up group #4 is selected:



**Figure 3 Configuration Group Set-Up Select Switches**

- 5.1.1.5 I/O DB-44 Connector Pin Out (J1)  
 The 'I/O' connector is a male, high-density DB-44. It is used to provide the interface for external power, audio, analog video and RS-232 signals. The M2T has a separate RS232 channel (labeled "Control" on the external breakout cable) for control and monitoring the unit. GMS M2T Configurator software program (as explained in section 6) 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: A USB connector and an additional RS232 channel (labeled "DATA") are currently provided with the external breakout cable. The USB interface is an alternate method of interfacing to the PC if DB-9 connectors are not available. The "Data" RS232 channel is dedicated for low-rate data to be transmitted along with the audio and video.

Table 1 Control DB-44 Connector Pin Out

Pin	Signal	Notes
1	RS232 Data Tx	
2	RS232 Data Rx	
3	RS232 GND	
4	Not connected	
5	SDA	I <sup>2</sup> C bus
6	SCL	I <sup>2</sup> C bus
7	CVBS/Y	Dual use input. 1. <b>Composite video in</b> ; 2. <b>Luminance in</b> (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. <b>Chroma video</b> (when used with S-video); 2. <b>Pr</b> (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	
17	USB Data -	
18	USB Data +	
19	USB Gnd	
20-29	Not connected	
30	PA_Shut_DN	Provides TTL level [+3V] signal for control of external PA
31	RS232 Control Tx	
32	RS232 Control-Rx	
33	RS232 GND	
34-36	Not connected	
37	Audio right +	See section 5.1.1.6 table 1A below for audio configurations
38	Audio right -	
39	Audio right line opt.	
40	Audio right GND	
41	Audio left +	See section 5.1.1.6 table 1A below for audio configurations
42	Audio left -	
43	Audio left line opt	
44	Audio left GND	

#### 5.1.1.6 Audio Input Configurations

The default audio input configuration is balanced 600 Ohm input impedance (see table 1A below). Other configurations are possible and they are listed below,

however either the GMS # 780-C0224 breakout cable must be modified or a user cable can be built by the customer as the pin outs of the 44 DB connector are provided above in table 1.

Table 1A Audio Configurations

<b><i>Audio Configuration</i></b>	<b>Audio Right Channel (reference table 1 above)</b>	<b>Audio Left Channel (reference table 1 above)</b>
<b><i>Balanced 600 Ohm impedance (default configuration)</i></b>	<b>Pin 37 ( + input) Jumper Pin 38 to Pin 39 ( - input) Pin 40 (GND)</b>	<b>Pin 41 ( + input) Jumper pin 42 to pin 43 ( - input) Pin 44 (GND)</b>
Balanced high input impedance (>2K)	No jumpers Pin 37 (+ input) Pin 38 (- input) Pin 40 (gnd)	No jumpers Pin 41( + input) Pin 42 (- input) Pin 44 (gnd)
Single ended high input impedance (>2K)	Pin 37 (+ input) Jumper pin 38 to pin 40 ( - input grounded)	Pin 41 (+ input) Jumper pin 42 to pin 44 ( - input grounded)
Single ended 600 Ohm impedance	Pin 37 (+ input) Jumper pins 38, 39 and 40 together ( - input grounded with 600 ohm impedance)	Pin 41 (+ input) Jumper pins 42, 43 and 44 together ( - input grounded with 600 ohm impedance)

## 6.0 Product Control & Status Monitoring Approach

GMS transmitters provide programmable presets or set-up groups that can be configured through special programming software by administrators. Set-up “Groups” are selected by the

user through either the transmitter's group select switches on the side of the transmitter or remotely through the M.S. Windows Application programs (see section 7.3.1, software overview below). The M2T allows 20 set-up groups.

Administrators define the set-up groups for specific applications. Each set-up group (see appendix B for default configuration group set-ups) completely defines all of the transmitter's set-up parameters including **Center Frequency**, output **RF Power Level**, **Modulation Parameters**, **Video**, **Audio**, **User Data** and **Encryption**. Each set-up group can be completely different from any other group. Field personnel can select specific set-up groups via pre-determined guidance from the administrators. Matching the transmitter operation to the receiver operation is as simple as selecting the same set-up groups. For example: If the transmitter is set to preset #19, then the receiver needs to be set to preset #19 for them to operate together.

It should also be noted that GMS transmitters are designed to remember the last set of saved settings and will always power-up in the saved set-up group settings that it had prior to shut-down.

## 7.0 Software Overview

A PC based application (MS Windows) called the GMS M2T Configurator has been developed to provide in depth control, configuration and monitoring of the transmitter.

This Graphical User Interface (GUI) program provides the end user with a straightforward way to interface with the M2T. During normal operation the M2T Configurator GUI does not need to be active and can be disconnected from the transmitter unit.

### 7.1 System Requirements

The GMS M2T Configurator program has been developed and tested on Windows 2000, Windows XP and Windows NT. Although the GMS M2T Configurator program may work properly on other operating systems, no support or assistance can be provided with regards to other operating systems.

### 7.2 Installation

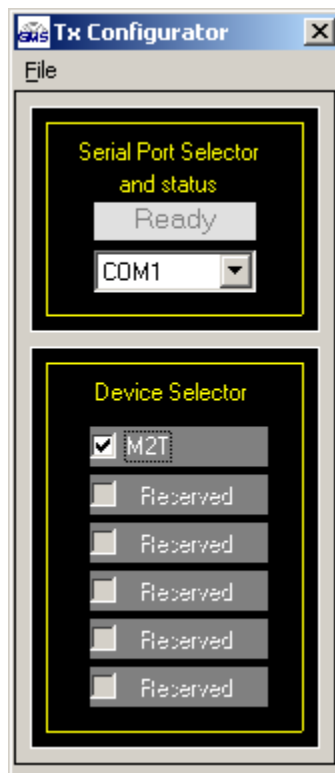
The following instructions outline the installation process for the GMS M2T Configurator program:

1. Insert provided CD-ROM into the computer.
2. View the folders (and files) on the CD-ROM and double click on the 'setup.exe' file. This launches the GMS\_M2T Setup program and several initial setup files are copied to the computer.
3. After the initial setup files are copied over, the GMS\_M2T Setup program prompts the user to close any applications that are running. Once all other programs are exited, click on the 'OK' button.
4. The GMS\_M2T Setup program prompts 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\_M2T Setup program then prompts 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 program, the GMS\_M2T\_Setup program shows a status window stating that the setup was completed successfully. Click 'OK'.

7. The USB drivers can be installed now. View the folders on the CD and open the USB folder “USB\_9052151”. Open the file named “AN232-05\_how to install.pdf” and follow the step-by-step instructions on how to load the USB drivers.

### 7.3 M2T Configurator Functions

The M2T Configurator program provides the user access to many different configuration, control and monitoring options. When the M2T 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. Use the pull down menu to select a port. If the selected serial port is valid, the gray-colored status box will show ‘Ready’.

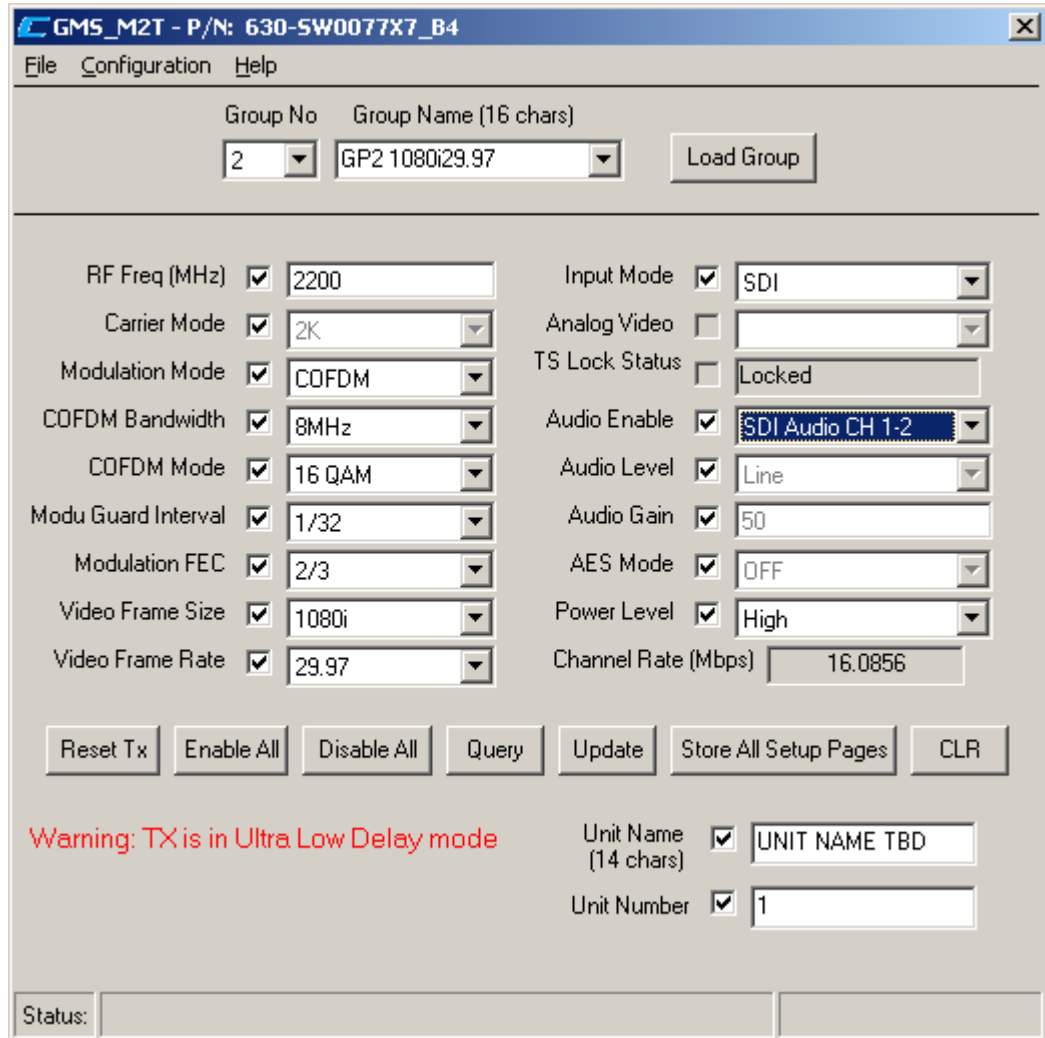


**Figure 4 M2T Configurator**

The M2T also works with a USB connection (correct drivers need to be loaded which are provided on the CD). The computer maps the USB port to an active RS-232 COM port. You need to check which port the computer has mapped the RS-232 COM port (this may also change each time the transmitter is booted). Check the port by right clicking on “My Computer” icon and select “properties”. Under the “Hardware” tab select “Device Manager” button (you can also get to the same menu from the “Control Panel” under the “Start” button and click on the “System” icon). Then select the “Ports (COM & LPT)”. Under this section the computer shows which port has been mapped to which COM port. Note this COM port and use it when selecting the COM port under the “Serial Port Selector and status” of the M2T Configurator software.

The Device Selector region allows the end user to select from various devices. Presently the existing selections are reserved for future devices. To start the application, select the ‘M2T’ check box in the Device Selector region. Once the box is selected, the opening screen as

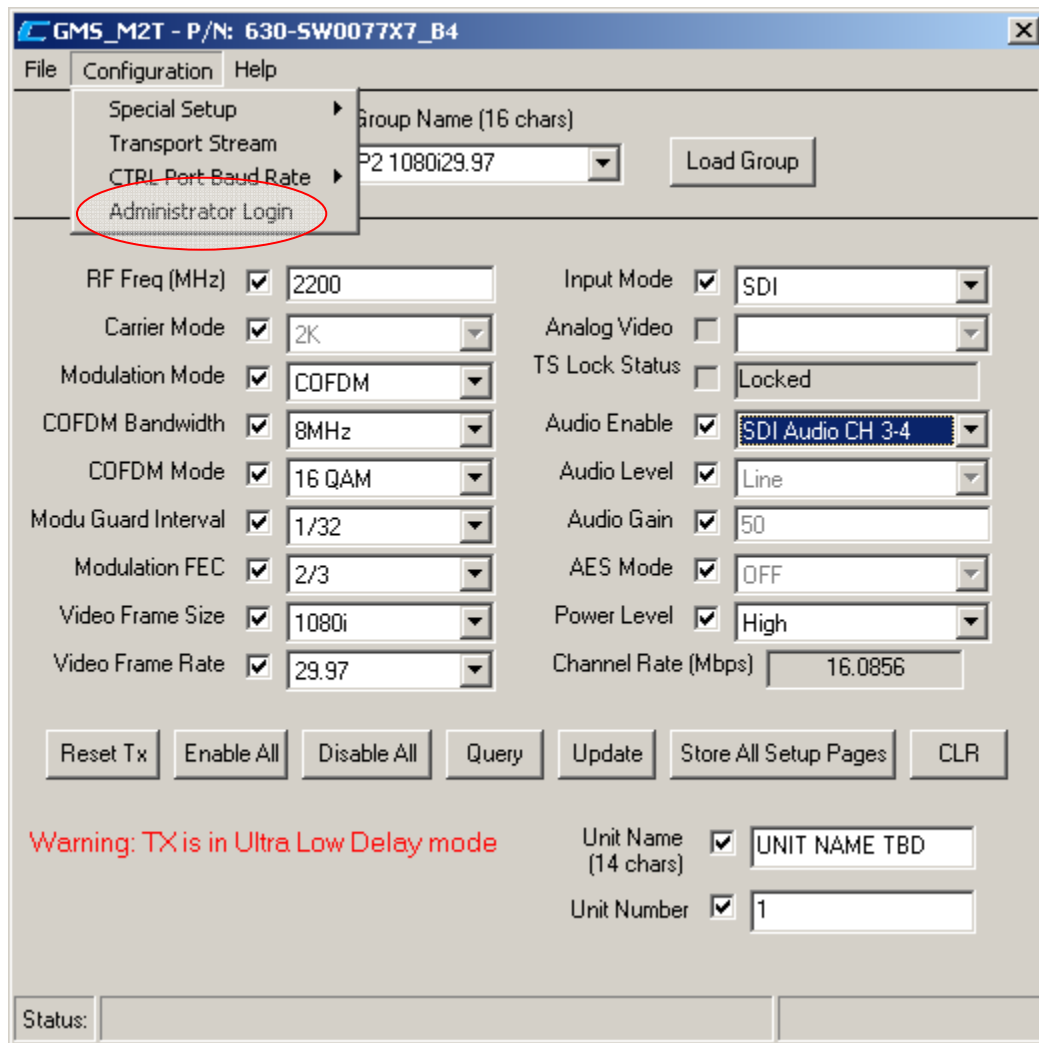
shown in Figure 5 appears. The M2T Configurator program contains function buttons and configurable settings. The following sections explain, in detail, the various options available.



**Figure 5 M2T Configurator Main Screen**

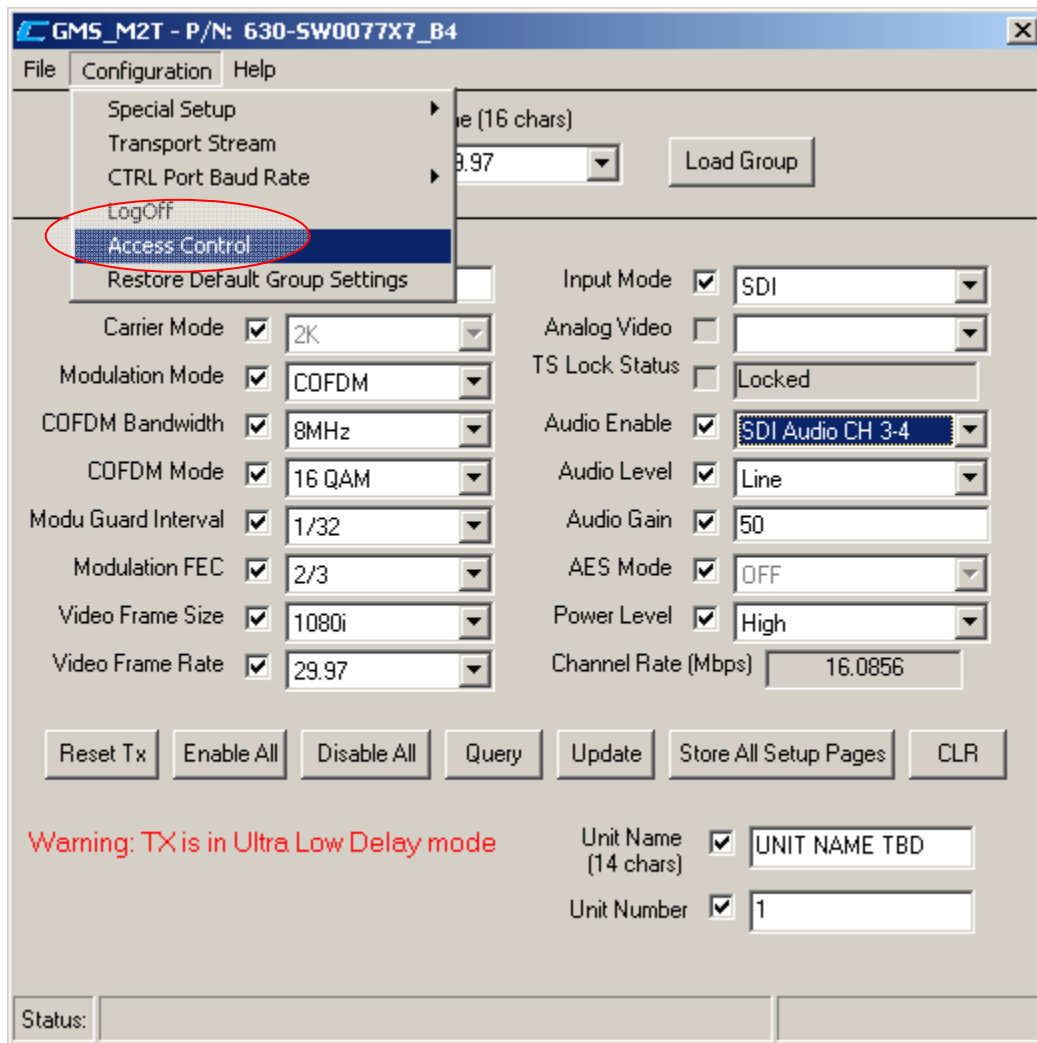
### 7.3.1 Administrator Setup & Usage

Under the “Configuration” pull down menu click on the “Administrator Login” sub menu; an administrator login box appears, see Figure 5A below. Type in the appropriate password (*initial password is “admin”*) and then return to the main opening screen by clicking “OK”.



**Figure 5A Admin Login**

This time under the “Configuration” pull down menu the “Access Control” sub menu appears see figure 5B.



**Figure 5B Access Control Sub Menu**

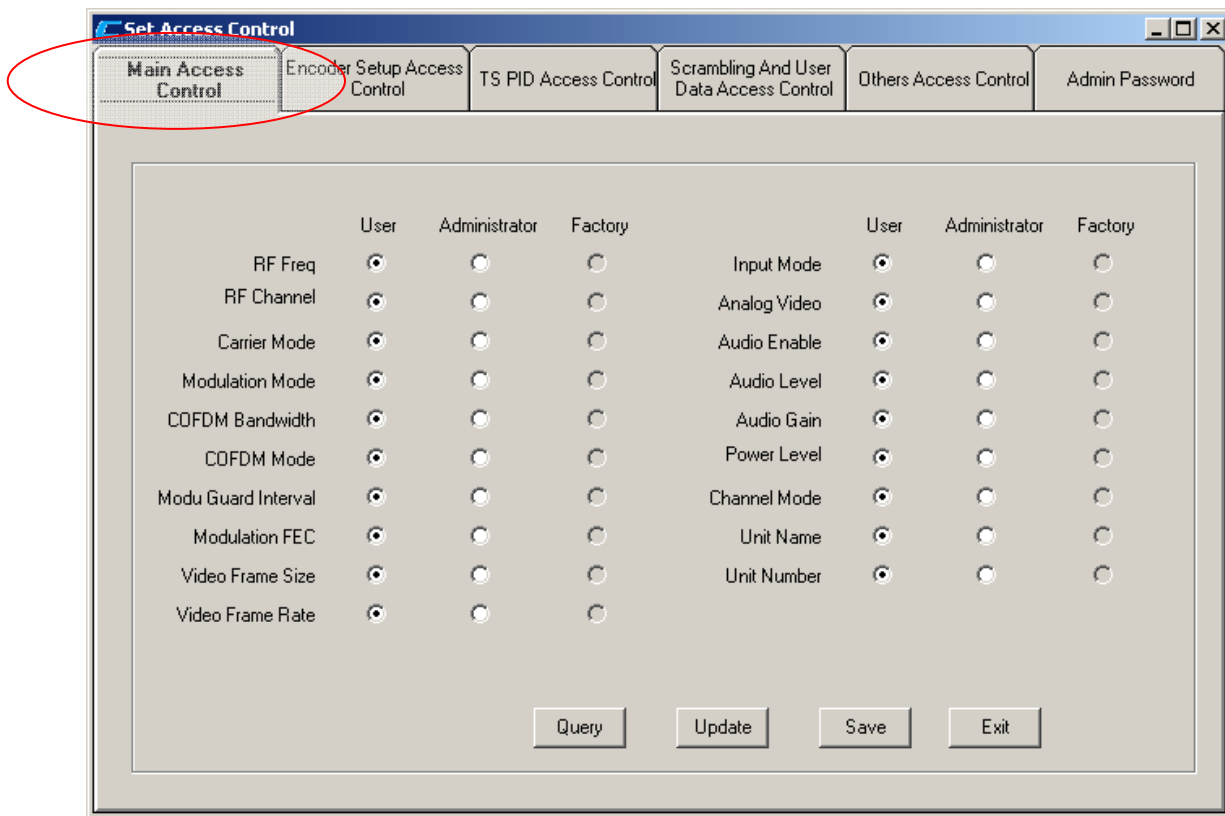
Click on this submenu and it brings up six Access control tabs. Here the Administrator defines the user's rights by clicking on the radio buttons under "User". They are briefly explained below:

1. The "Main Access Control" (see figure 5C). The parameters associated mostly with the video and RF setups of the transmitter are located under this tab (elements the user would normally see from the front page of the GUI as shown in figure 5A above).
2. The "Encoder Setup Access Control" (see figure 5D). The encoder parameters such as Video delay mode and GOP length are listed here.
3. The "TS PID Access Control"(see figure 5E). The various PIDs which are changeable are listed here.

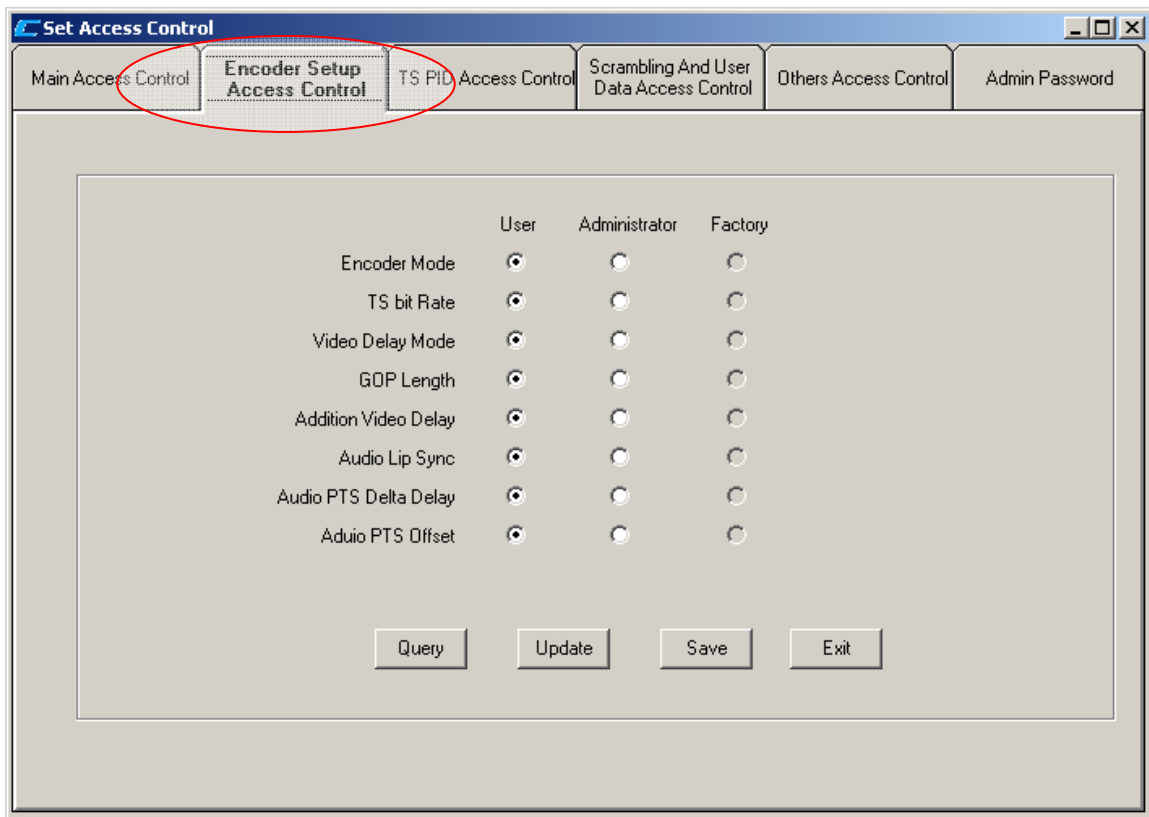
4. The “Scrambling and User Data Access Control (see figure 5F & 5G). If these options are not available then the message in figure 5F appears. Otherwise the parameters associated with scrambling and user data are listed as shown in figure 5G.
5. The “Others Access Control” (see figure 5H) contain various other parameters such as ‘power mode’, ‘spectrum inversion’, etc.
6. The “Admin Password” (see figure 5I). The administrator password can be changed in this window or reset back to the default which is “admin”.

Before exiting any of the ‘Access Control’ windows ensure to click on the “Update” and then “Save” buttons; if the intention is to save the changes. The “Update” button only implements the changes until the next time the transmitter is powered cycled.

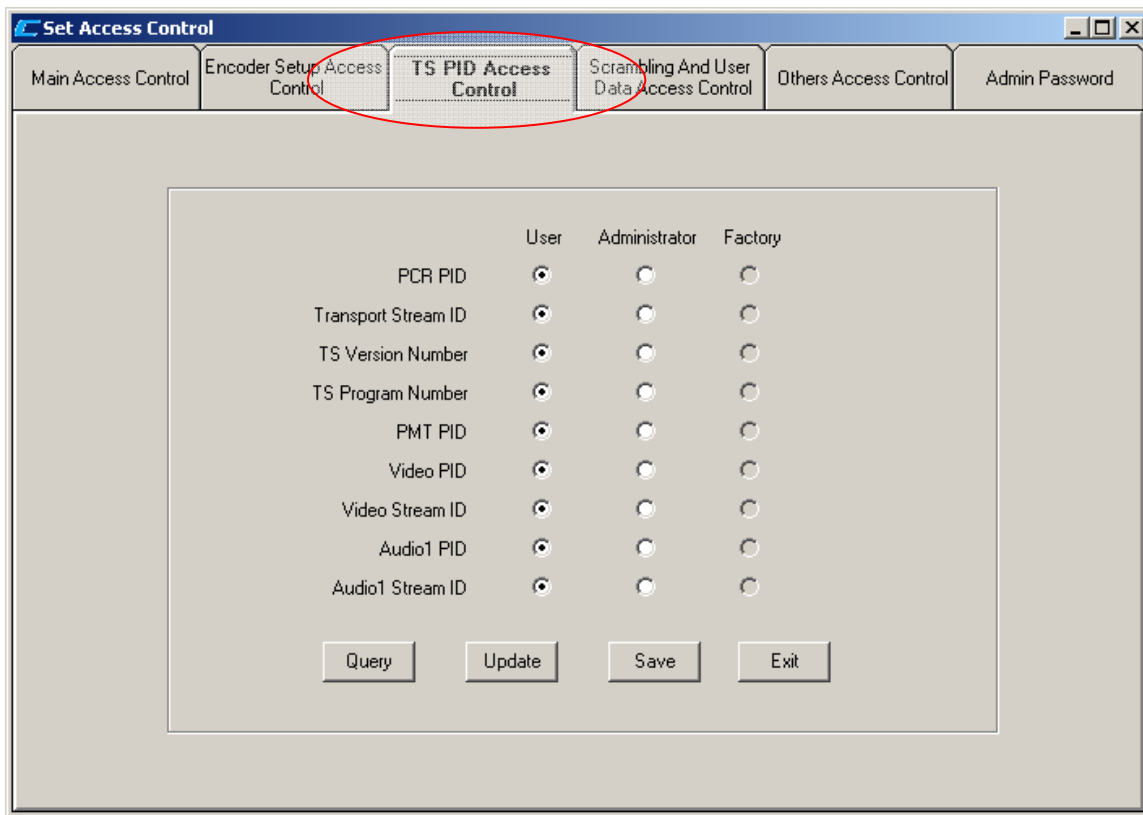
After making changes return to the main screen, under the “Configuration” menu select “Logoff” to exit the Access Control windows.



**Figure 5C Main Access Control**



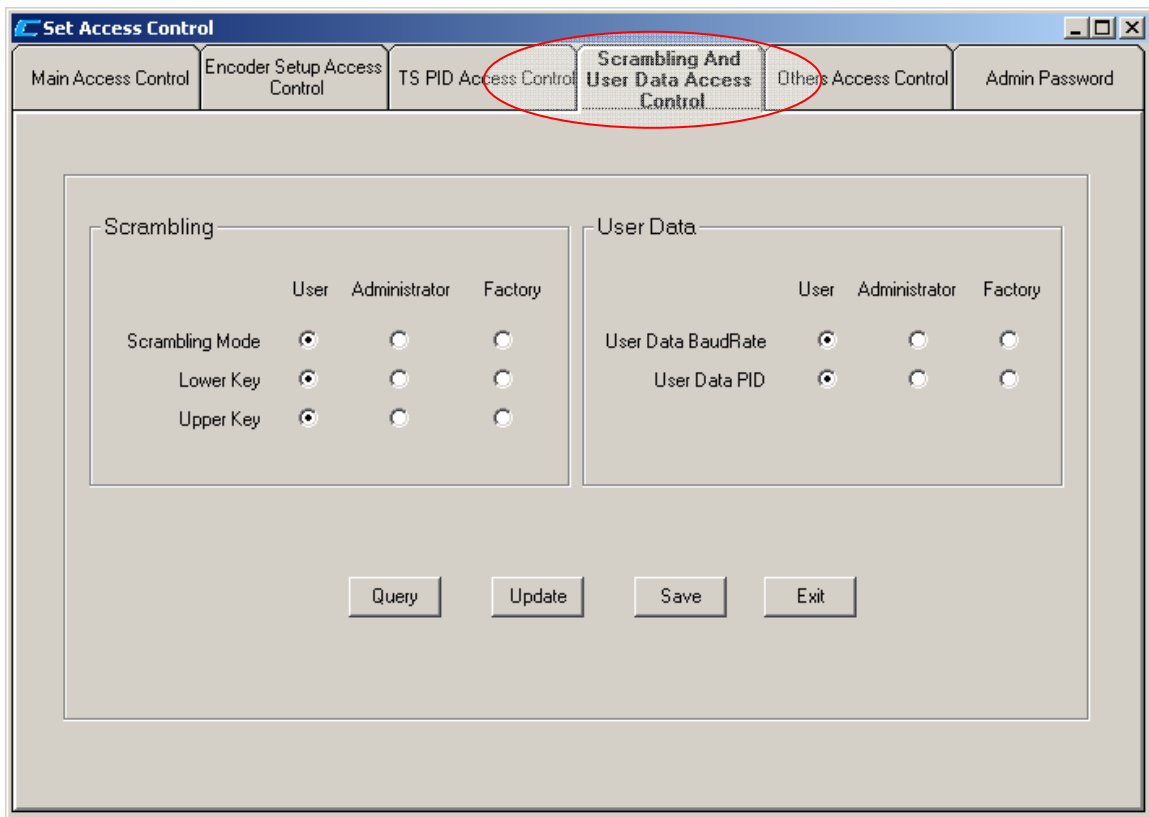
**Figure 5D Encoder Access Control Window**



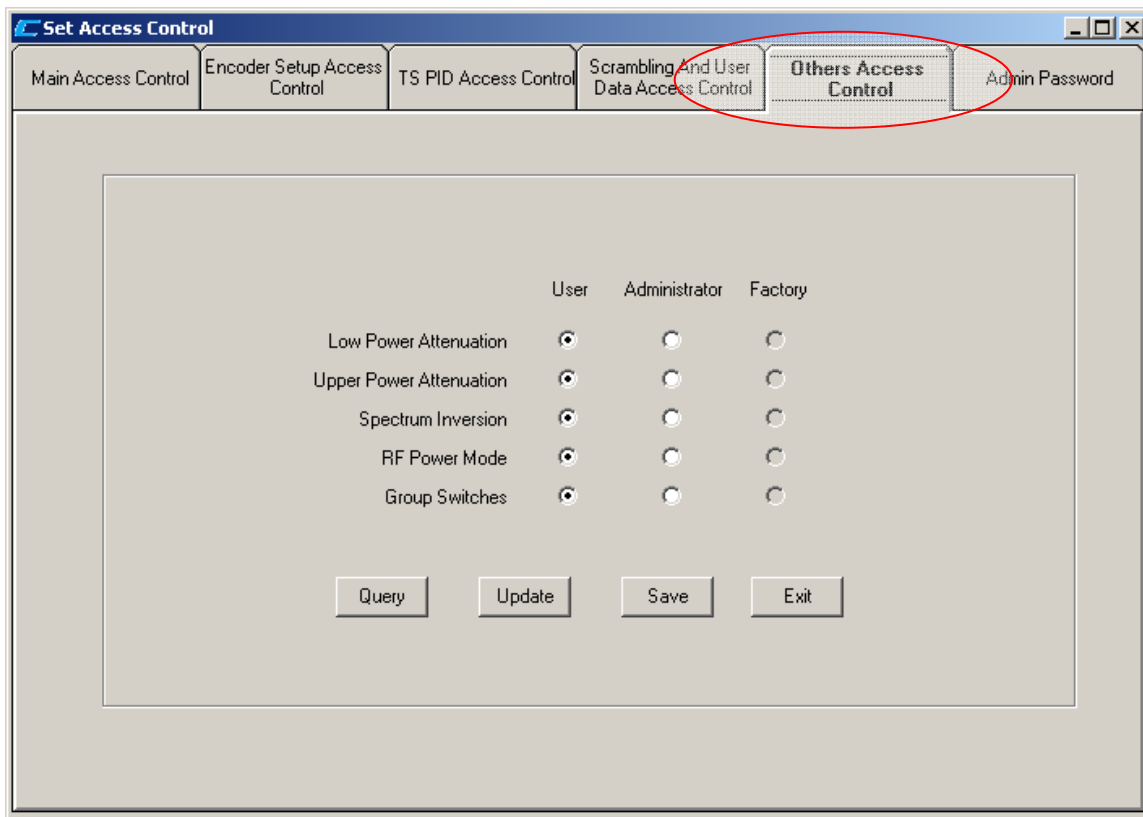
**Figure 5E TS PID Access Control Window**



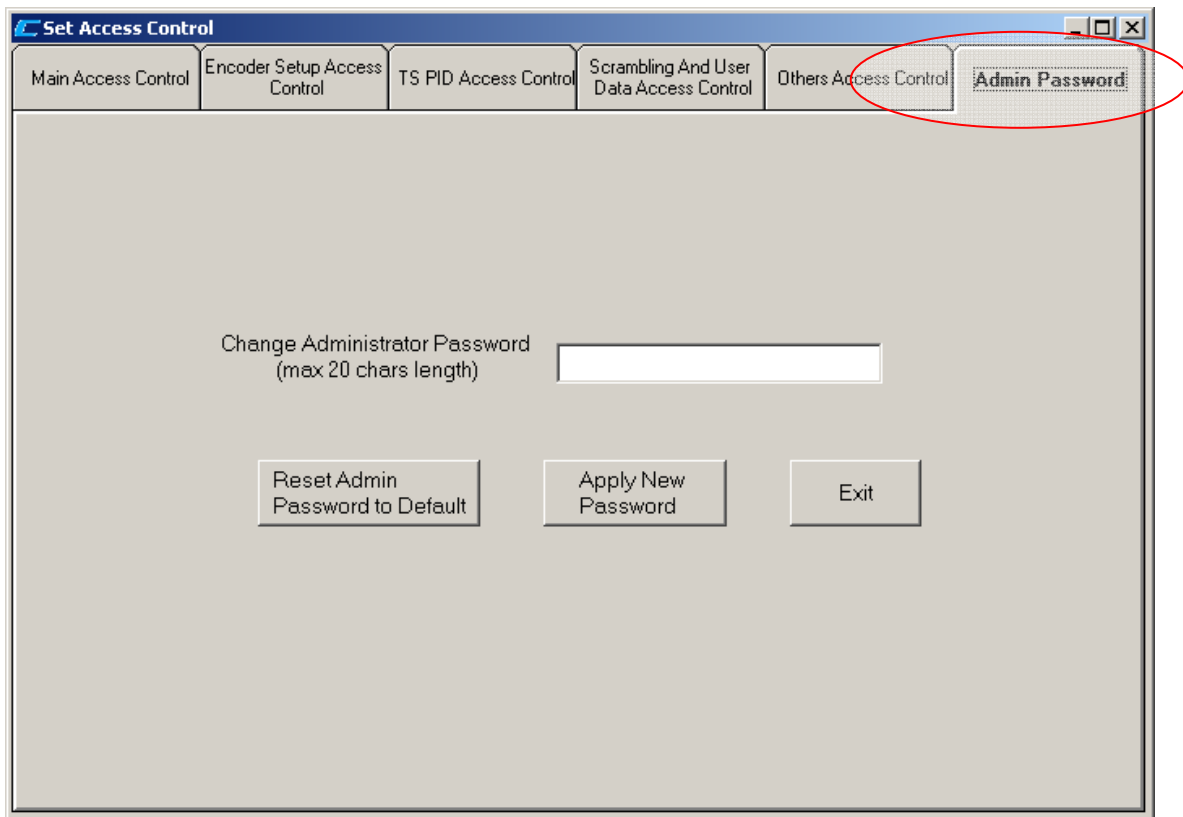
**Figure 5F Scrambling Access Control Window (optional)**



**Figure 5G Scrambling Access Control Window**



**Figure 5H Other Access Control Window**



**Figure 5I Admin Password Window**

### 7.3.2 Function Buttons

- **“Reset Tx”**: Clicking on this button re-boots the transmitter re-initializing the M2T to a known state. Be aware that it may take approximately 30 seconds for the transmitter to fully initialize.
- **“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 (individual selection of a given field speeds up the read write operations significantly).
- **“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 (text box).
- **“Store All Setup Pages” Button:** Clicking on this button stores all setup pages, even if they are not shown.
- **“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 an ‘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.
- **“Load Group” Button:** The data structure of the M2T is organized into “Groups” of selected fields. A Group contains the following fields (refer to Figure 7 above): **Carrier Mode, Modulation Mode, COFDM Bandwidth, COFDM mode, Guard Interval, Modulation FEC, Video Frame Size, Video Frame Rate and Input Mode.**


Clicking on the ‘Load Group’ button loads the selected Group to be operated on by the M2T. A Group can be selected by selecting Group Name under the pull down text box “Group Name (16Chars)” or by its Group Number under the “Group No” pull down text box.

 **Note: After selecting a group by either its’ group number or group name you must click on the “Load Group” button for the group to take effect.**

The M2T allows up to 20 group types to be stored in the non-volatile memory each with its’ own unique Group name and associated Group Number. The unit is provided with 20 established groups (see appendix B) in which the parameters have been carefully chosen for optimal performance.

The end user has the ability to change the name of a group (limited to 16 characters), and to change the parameters of the fields associated with a group. Once the group is saved (pressing the “stored all setup pages”) the default parameters of the existing group are overwritten.

The sequence to change the default parameters of any group or group name is as follows: First load a group by clicking on the “Load Group” button. After the group loads change the parameters as desired (group name can also be changed) and then click on the “Update” button. To save the changes click on the “Stored All Setup Pages” button.

 *Note: Clicking on the ‘Update’ button only implements any changes made temporary (until the transmitter is re-powered). The ‘Stored All Setup Pages’ must be clicked on for the changes to be saved and stored permanently.*

### 7.3.3 Field Definitions

The fields as shown in Figure 5 of the main screen (above) are defined below in Table 2. The Table also indicates if the field is a read or a write field or both.

Table 2 – M2T Field Definitions

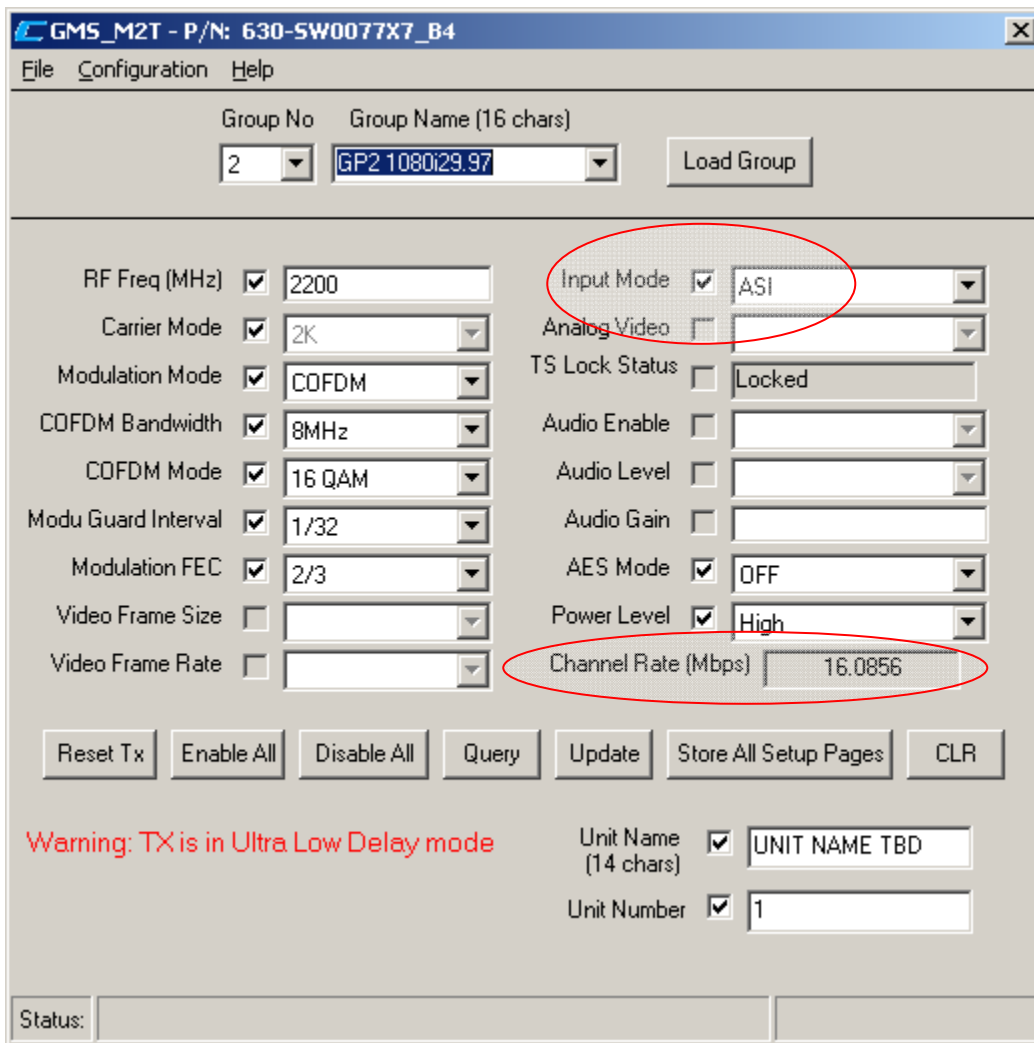
Field	R/W	Description
<b>Group No.</b>	R/W	The number assigned to a specific video group
<b>Group Name</b>	R/W	The name assigned to a specific video group
<b>RF Freq (MHz)</b>	R/W	RF output frequency. Desired frequency is entered in MHz (i.e., 1.296GHz would be entered as 1296).
<b>Carrier Mode</b>	R/W	The number of Carriers within a COFDM carrier: Selects 2K carriers per COFDM or 4K carriers (optional) per COFDM.
<b>Modulation Mode</b>	R/W	Modulation mode. Desired modulation mode is selected from the following values: COFDM (default), Off (shuts off modulation) or I/Q CAL ON (puts unit in calibration mode).
<b>COFDM Bandwidth</b>	R/W	<b>COFDM</b> transmit bandwidth. Desired bandwidth is selected from the following values: 6, 7 or 8 MHz in 2K carrier mode or 12, 14 or 16 MHz in 4K carrier mode.
<b>COFDM Mode</b>	R/W	<b>COFDM</b> modulation type. Desired <b>COFDM</b> modulation type is selected from the following values: QPSK, 16 QAM or 64 QAM
<b>Mod Guard Interval</b>	R/W	Modulation guard interval size. Desired modulation guard interval size is selected from the following values: $\frac{1}{32}$ , $\frac{1}{16}$ , $\frac{1}{8}$ , or $\frac{1}{4}$
<b>Modulation FEC</b>	R/W	Modulation FEC (Forward Error Correction) rate. Desired modulation FEC rate is selected from the following values: $\frac{1}{2}$ , $\frac{2}{3}$ , $\frac{3}{4}$ , $\frac{5}{6}$ , $\frac{7}{8}$ .
<b>Video Frame Size</b>	R/W	Video frame size (resolution). “i” stands for interlaced; ‘p’ stands for progressive.
<b>Video Frame Rate</b>	R/W	Video Frame Rate in number of frames per second. Only legitimate video frame rates are shown for the selected video frame size.
<b>Input Mode</b>	R/W	Default mode is SDI (serial digital interface). Supports both HD SDI and SD SDI. User can also select ASI when there is a need to transmit an ASI stream.
<b>Analog Video</b>	R/W	Video input format. Desired video input format is selected from the following values: PAL, NTSC, S-video PAL, S-video NTSC, and Component Video.
<b>TS (transport stream, video) Locked Status</b>	R	Video lock status. This read-only field indicates that the M2T has line-locked onto the SD or SDI video input signal. This is not meant as an indicator of the correct video input format only that video is detected on the input and the transmitter is able to lock to it.
<b>Audio Enable</b>	R/W	Analog audio or embedded SDI audio. Desired mode of operation of the audio is selected from the following values: OFF/Analog/SDI (CH 1-2, up to CH 15-16.)
<b>Audio Level</b>	R/W	Choice between mic or line level audio (only applies to analog audio)
<b>Audio Gain</b>	R/W	Adjustable gain values are adjustable between 0-100 (only applies to analog audio).
<b>AES Mode (optional feature)</b>	R/W	The encryption can be turned ‘OFF’ here or a selection can be made from the four selections offered (128, 256 bit), however it must be previous setup under ‘Configuration’ menu under sub-menu ‘SPECIAL SETUP\SCRAMBLING’. This is an option that may

Field	R/W	Description
		or may not be activated.
<b>Power Level</b>	R/W	Power level choices for the RF output are 'HIGH' or 'LOW'. These levels (the amount of attenuation associated with high and low) are user defined under the 'Configuration' menu under sub-menu, 'SPECIAL SETUP\ OTHERS'
<b>Channel Rate (Mbps)</b>	R	Channel rate is displayed in Mbps and is based on parameters selected such as COFDM mode, FEC and Guard Interval. See <i>Channel Rate Guide under the HELP menu.</i>
<b>Unit Name</b>	R/W	Allows the user to assign a unique unit name to the M2T.
<b>Unit Number</b>	R/W	Allows the user to assign a unique unit number to the M2T

#### 7.3.4 Input Mode - Switching between SDI in or ASI in

The default mode for the "Input Mode" field is **SDI** in. However a user can select the input mode for **ASI** in if there is a need to transmit an ASI stream. See figure 5J below. If the ASI input mode is selected then other fields which are not associated with transmitting an ASI stream are disabled. For example the "Video Frame Size", "Video Frame Rate", "Audio Enable" and "Audio Gain" are fields which are not needed and hence disabled.

Keep in mind when transmitting an ASI stream ensure the transmitter channel rate is set to at least 10% above the data rate of the input ASI stream.



**Figure 5J Input Mode**

### 7.3.5 Audio Enable - Switching between Analog audio and Embedded SDI audio

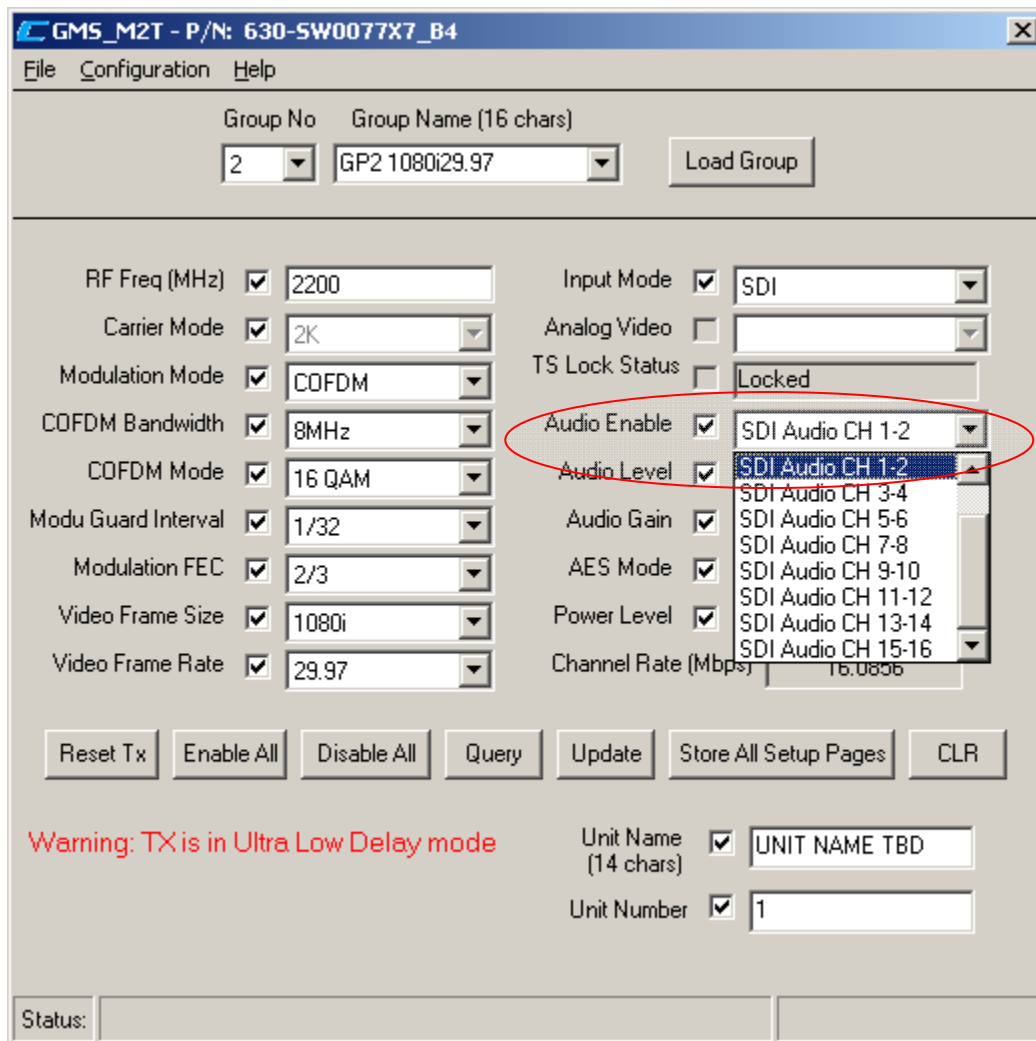
The M2T supports 2 analog audio channels or up to two channels of SDI embedded audio. It also supports balanced input and single ended inputs (see section 5.1.1.6 and table 1A for configurations supported).

Under the “Audio Enable” field there are three basic selections:

- OFF (no audio on the Transport stream)
- Analog audio
- SDI CH 1-2..... ..to SDI CH 15-16 (see figure 5K below)

When choosing SDI audio, selections are based the ability of the transmitter to support two audio channels. Hence depending on the parameters of the embedded audio in the SDI stream, that is which group is activated (1 to 4) and which audio channels are

activated (1 to 16) the user is able to select up to two channels (SDI CH 1-2 to SDI CH 15-16) to place on the Transport Stream.



**Figure 5K Audio Selection**

### 7.3.6 Pull-Down Menu Definitions

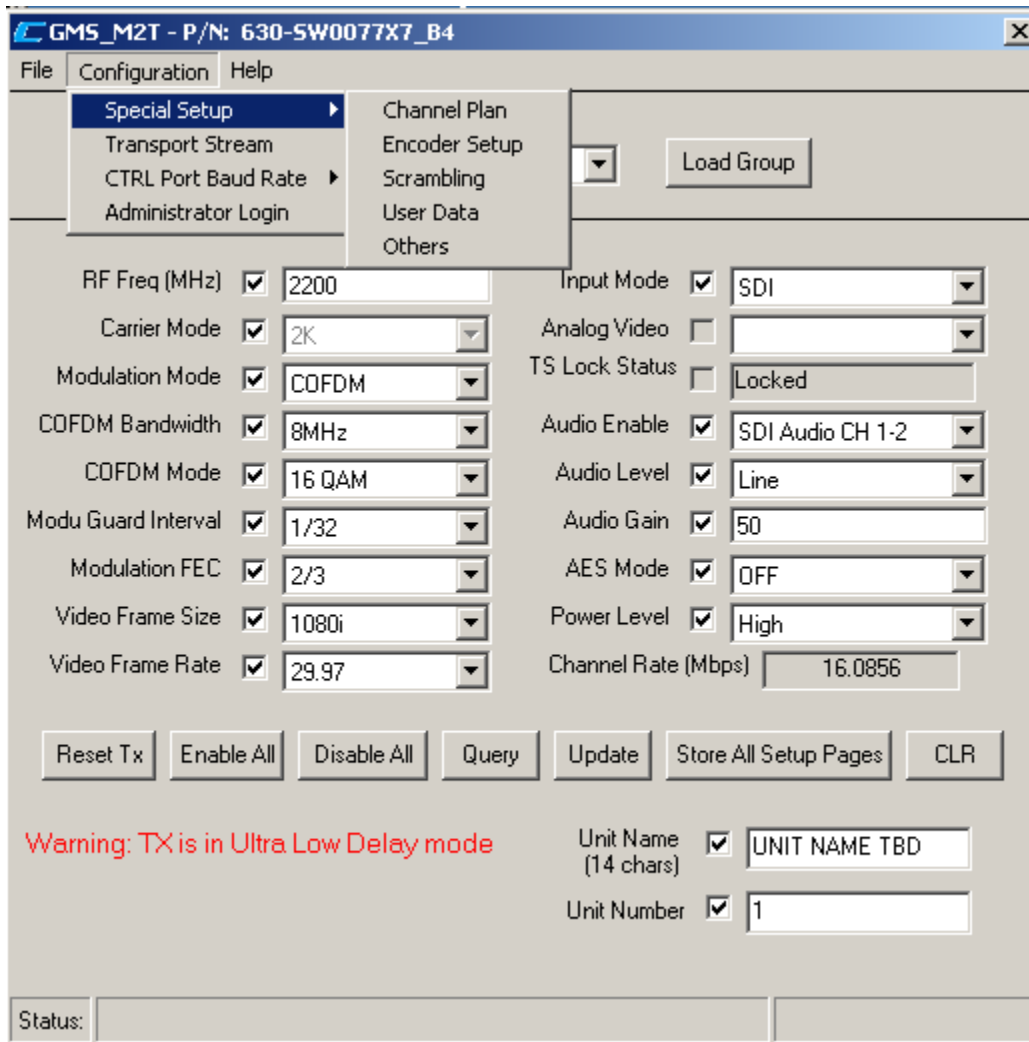
There are several different pull-down menus that are included in the M2T Configurator program. Each of these pull-down menus contains further user-configurable options or commands. The following sections describe these menus in detail.

#### 7.3.6.1 File

You can exit the program by clicking on the 'X' box in the upper right hand corner or by clicking on the 'File' menu and choosing 'Exit'. You can save the settings before exiting by clicking on the 'Store All Setup Pages' button on the front page or by choosing the 'Save Parameters' under the 'File' menu.

### 7.3.6.2 Configuration

This pull-down menu (reference Figure 6) contains several different configuration options. These are outlined below:



**Figure 6 Configuration Pull Down Menus**

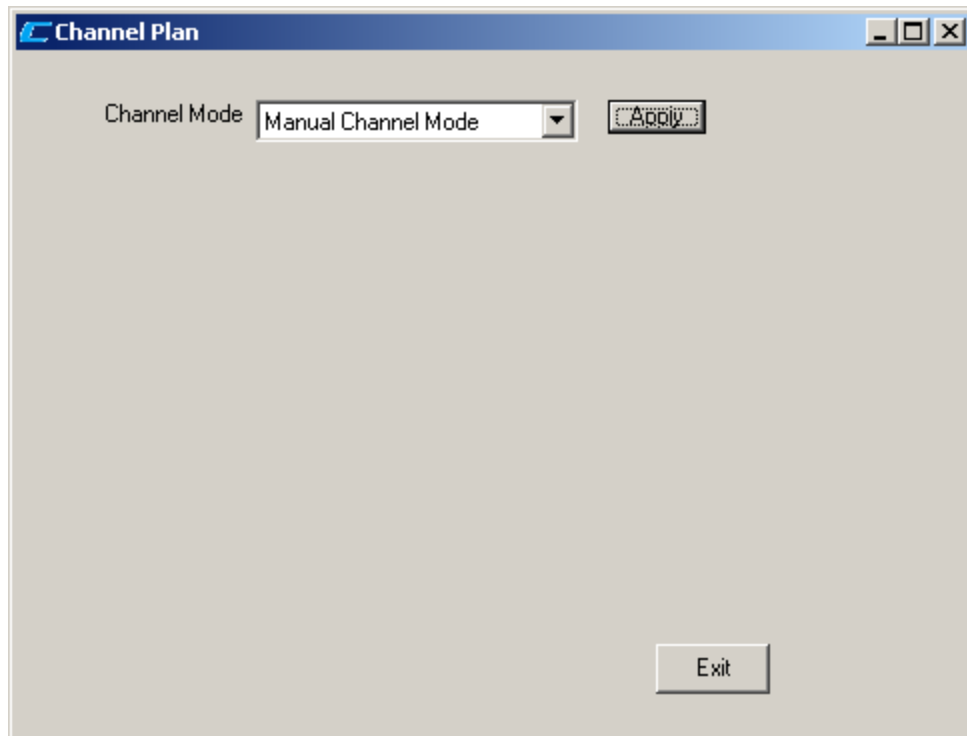
#### 7.3.6.2.1 Special Setup

##### 7.3.6.2.1.1 Channel Plan

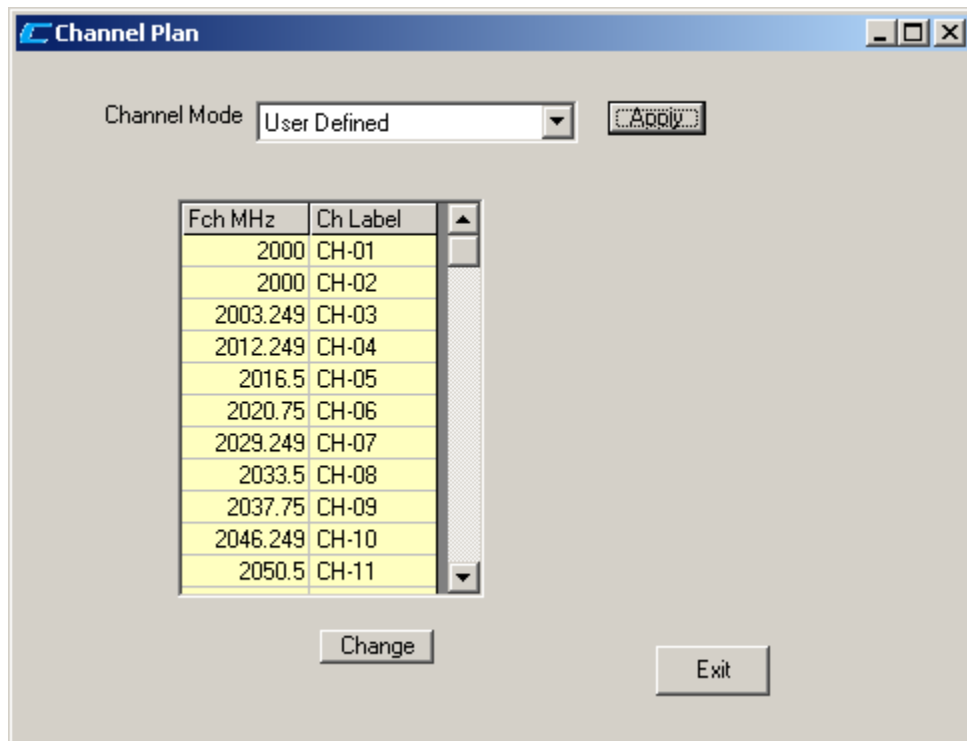
The Channel Plan default channel mode is Manual as shown in the opening screen in Figure 7. The other channel modes available are User Defined, and for S2 band units New BAS and Old BAS. Use the pull down box to select the channel mode and then click on the "APPLY" button (Note: The channel mode can also be selected from the front LCD panel, see section 5.1.1.8.1 under the detail menu under the 'TX Channel Mode' display). The RF channel mode selected here is also reflected in the 'RF Freq (MHz)' text box

on the front page of the GMS configurator and also displayed on the LCD display under the main menu under the 'TX RF FREQ' display.

- Manual mode – allows user to select frequencies in pre-determined frequency step sizes (for example 250 kHz for S2 band and 1 MHz for frequencies other than S2 band) in the band which was purchased.
- User Defined (reference Figure 8) – this channel plan is defaulted with 30 pre-defined channels initially but any channel and channel label can be modified. Select the 'User Defined' channel mode using the pull down box and then click on the 'Apply' button. Then click on the 'Change' button. Enter the frequency in the "Center Freq (MHz)" text box and the label in the "Channel Label" text box as shown. Then click on the 'Accept' button to save or 'Cancel' to cancel the operation.
- New BAS – (only applies to S2 Band units) this channel plan is pre-determined frequency plan with 30 channels. Select 'New BAS' from the pull down box and click on the 'Apply' button.
- Old BAS – (only applies to S2 Band units) this channel plan is pre-determined frequency plan with 30 channels. Select 'Old BAS' from the pull down box and click on the 'Apply' button.



**Figure 7 Channel Plan Opening Screen**



**Figure 8 User Defined Channel Mode Screen**

#### 7.3.6.2.1.2 Encoder Setup

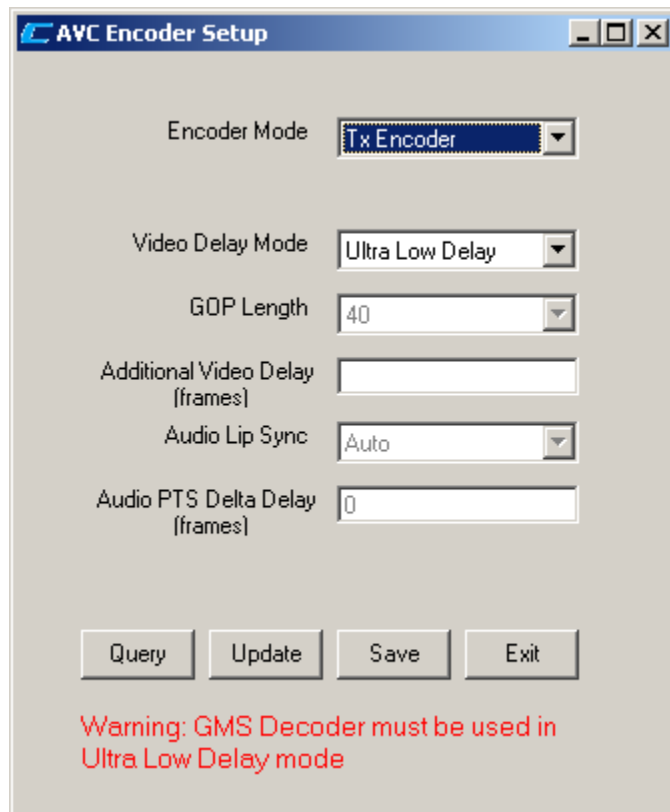
This pull-down menu (see Figure 9) displays the following choices:

- 'Encoder Mode' – There are two selections from this pull-down menu, 'Tx Encoder' or 'Encoder Only'. 'Tx Encoder' is the default mode in which the transmitter module provides an external clock source for the encoder and the transmitter COFDM modulator limits the high end of bit rate to 32 Mbps (64 Mbps using the 4 K high-throughput option).

When the "Encoder Only" mode is selected an internal clock source (from the encoder module itself) is used as the source. The bit rate is limited to the high end bit rate of the encoder (up to 50 Mbps). The encoder module can be used as a stand alone module encoding rates up to 50 Mbps using the ASI out (J2) port of the M2T. This Transport Stream does not include the SI tables, User-Data, or AES encryption which is added later in the processing chain.

*Note: If the transmitter is suspected of having RF interference the user can test the encoder section of the M2T by attaching a cable from the ASI port (J2) to a decoder ASI input port directly.*

- *GOP Length* - User can select GOP (Group of pictures) length when in Normal mode only .Choices includes 10, 20, 30, 40 or 50 GOP. In Ultra-low delay mode there are no choices.
- *Video Delay Mode* – User can select from two different delay modes involving different trade offs:  
*Normal* – this mode gives the best picture but the delay is longer than the other two modes however it can be used with commercial decoders.  
*Ultra-Low* – this mode is the default mode and can only be used with GMS HD decoder. It offers the fastest < 44mS system latency.
- *Additional Video Delay (frames)*  
 Additional video delay (in units of frames) from 0 to 500 can be added.
- *Audio Lip Sync* (“auto” mode is set to a constant value; “manual” selection here allows user to select various values to line up audio and video if “auto” mode is not sufficient.
- *Audio PTS Delta Delay (frames)*  
 Additional audio delay (in units of frames, fractional quantities allowed) can be added.



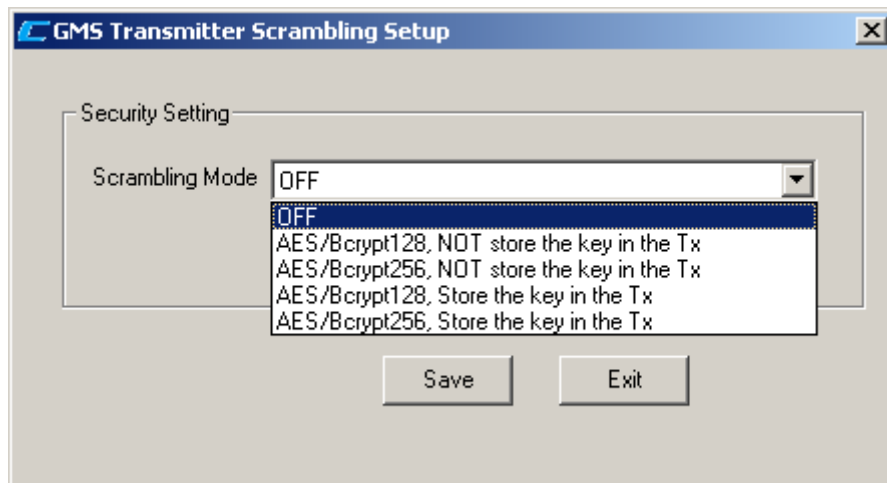
**Figure 9 HD Setup**

#### 7.3.6.2.1.3 Scrambling (Optional)

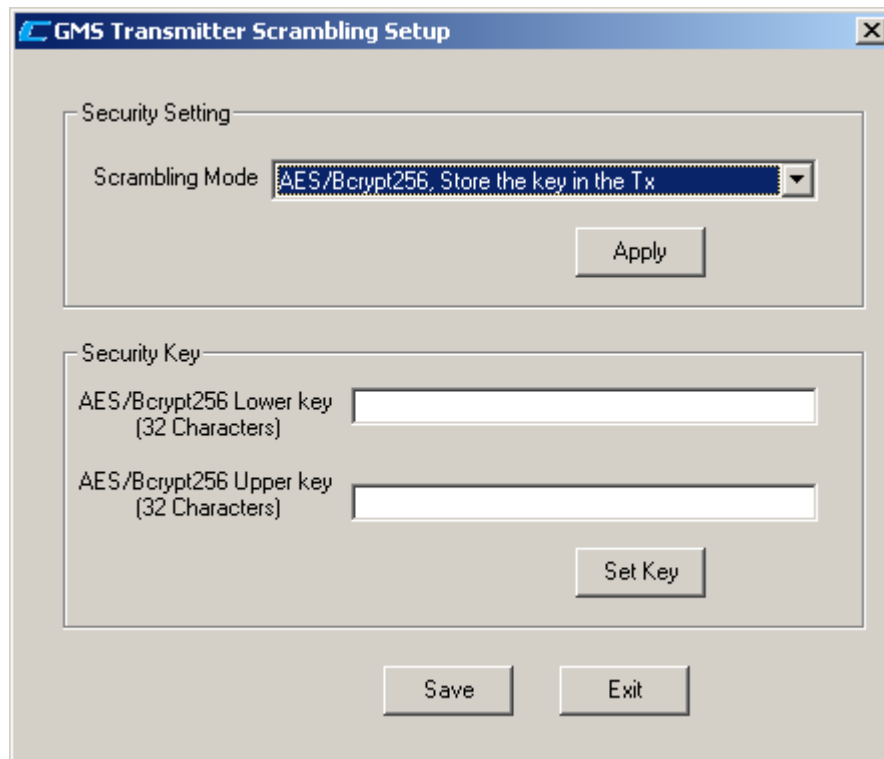
*Scrambling (this menu may not be available if the option has not been purchased). The “Scrambling” text box displays the following options: (see Figure 10 & 11):*

*NOTE: The “AES MODE” field on the front page of the GUI (see figure 5 above) will automatically update according to any of the choices selected in this window.*

- *OFF- Scrambling (Encryption) turned OFF (disabled).*
- *Bcrypt256 Do Not store the key in the Tx – Scrambling is turned ON (enabled). A Key Code (a series of 32 Hex characters for the lower key and a series of 32 Hex characters for the upper key) must be entered. In this mode the Key Code is not stored in the Transmitter’s memory. When power is removed the Key Code will be lost and must be re-entered when power is re-applied. Click on the “Set Key” button before exiting.*
- *Bcrypt128 Do Not store the key in the TX - Scrambling is turned ON (enabled). A key Code (a series of 32 Hex characters) must be entered. . In this mode the Key Code is not stored in the Transmitter’s memory. When power is removed the Key Code will be lost and must be re-entered when power is re-applied. Click on the “Set Key” button before exiting.*
- *Bcrypt256 Store the key in the Tx – Scrambling is turned ON (enabled). A Key Code (a series of 32 Hex characters for the lower key and a series of 32 Hex characters for the upper key) must be entered. In this mode the key is stored in the Transmitter’s memory. When power is removed the Key Code will not be lost. Click on the “Set Key” button before exiting.*
- *Bcrypt128 Store the key in the Tx – Scrambling is turned ON (enabled). A Key Code (a series of 32 Hex characters) must be entered. In this mode the key is stored in the Transmitter’s memory. When power is removed the Key Code will not be lost. Click on the “Set Key” button before exiting.*
- *Save – Click on this button to save the settings otherwise the transmitter will resort back to the defaults after a power cycle.*
- *Exit - Exit the scrambling mode*



**Figure 10 Scrambling Set-Up**



**Figure 11 Scrambling Key Set-Up**

#### 7.3.6.2.1.4 User Data (Optional)

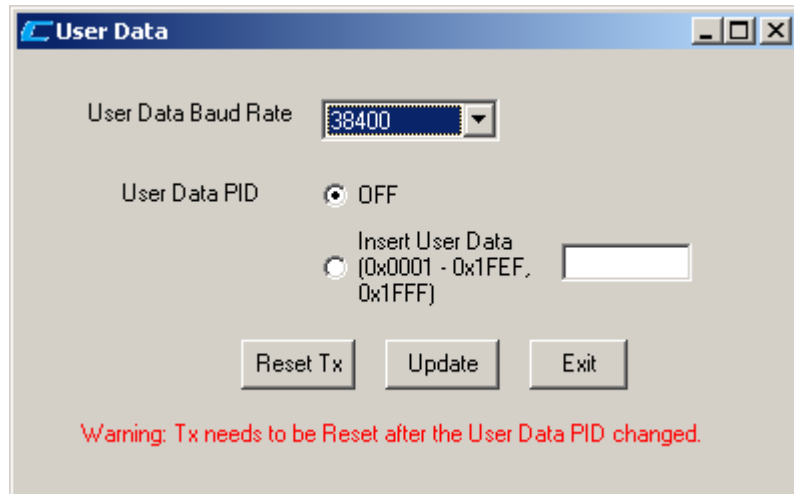
*User Data (this menu may not be available if the option has not been purchased). This option requires GMS DDPC card with AES option on RX side.*

M2T transmitters with 'User Data' option can simultaneously transmit video/audio and ASCII user data. Baud rates up to 38400 (encoder

dependant) are supported. Input ASCII data is injected into the 'Data' port of the transmitter using the format: 8 data bits, no parity, 2 stop bits (when transmitting continuous data) and no flow control. Received user data is taken from the GMS MSR receiver on the DDPC RS232 User data port.

This pull down menu displays the following (see Figure 12):

- User Data Baud Rate: Baud rate is selected with this pull down box. High end baud rate is limited to 38400.
- User Data PID: If 'OFF' is selected 'User Data' is disabled. When 'Insert User Data' is selected 'User Data' is enabled. Default PID is shown in text box in which user can change, however note that PIDs are limited to the range 0x0001 – 0x1FFF, and the receive side user data PID must match this PID.
- Reset Tx: Clicking on this button resets the transmitter to a known state. Transmitter needs to be reset after changing user data PID.
- Update: When any change is made, baud rate selection, new PID, etc, click on the 'Update' button so that the changes take effect.
- Exit: Clicking on this button exits the window.



**Figure 12 User Data Setup**

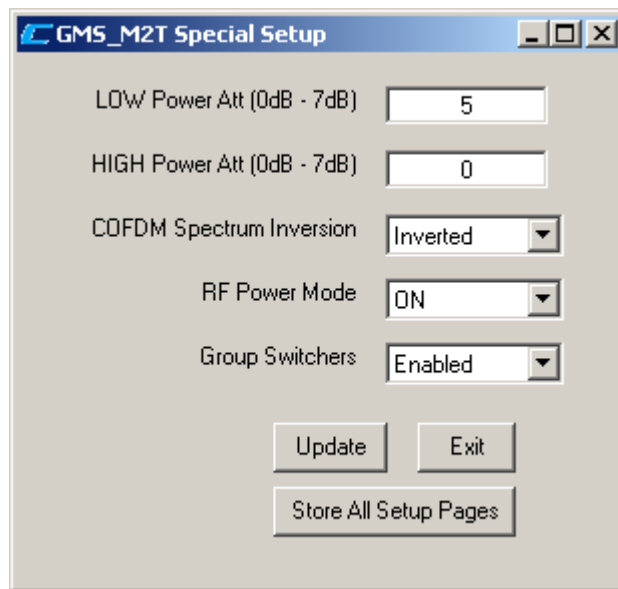
#### 7.3.6.2.1.5 Others

This menu displays the following (see Figure 13)

- *Low Power Att (0dB –12dB)* – When in low power mode the RF attenuator range is from 0 to 12 dB, attenuated in 1 dB increments.
- *High Power Att (0-12dB)* - When in high power mode the RF attenuator range is 0 to 12dB, attenuated in 1 dB increments.
- *COFDM Spectrum Inversion* – Choices include normal or inverted. The transmitter is configured with the receiver it ships

with and the inversion mode does not require changing. However if a different receiver is used the inversion mode may be required to be changed. Some receivers will accept either inversion modes.

- *RF Power Mode* – Can be used to put the Transmitter in a Sleep Mode, where the Encoder functions and many of the Power Regulators are shut down enabling a saving in current (approx. 40%) when the Transmitter is not active.
- *Group Switches* – These are the group select switches on the side of the transmitter (see section 5.1.1.4). They can be enabled (default) or disabled. *Note: The switches can also be configured as frequency select switches however the configuration must be done at the factory.*



**Figure 13 Others**

#### 7.3.6.2.2 Transport Stream

The transport stream menu (reference Figure 14) displays the parameters of the current transport stream (of the transmitter). The fields are read/write-able. Normally the fields require no manipulation and should work quite well as defaulted from the factory. However, high end users may have a need to change the transport stream parameters.

In addition the NIT (network information table, PID 0x0010) and the SDT (service description table, PID 0x0011) are also added to the Transport Stream when transmitting out through the RF port. These two tables are not added when using the ASI stream (ASI OUT-BNC connector) out of the transmitter.

#### 7.3.6.2.3 Ctrl Port Baud Rate

The control port baud rate menu allows different baud rates to be selected. Some computers may need the baud rate adjusted for optimal communications.

#### 7.3.6.2.4 Factory Setup

Factory Setup – The menu is for factory use only.

PCR PID (0x0010 - 0x00FE)	0x0050	Video PID (0x0010 - 0x00FE)	0x0022
Transport Stream ID (0x0000 - 0xFFFF)	0x0080	Video Stream ID (0xE0 - 0xEF)	0x00e0
TS Version Number (0x00 - 0x1F)	0x0000	Audio 1 PID (0x0010 - 0x00FE)	0x0034
TS Program Number (0x0001 - 0xFFFF)	0x0001	Audio 1 Stream ID (0xC0 - 0xDF)	0x00c0
PMT PID (0x0010 - 0x00FE)	0x0020		

Update    Exit

Store All Setup Pages

**Figure 14 Transport Stream Setup**

#### 7.3.6.3 Help

This pull-down menu contains information about the M2T firmware and the M2T Configurator software. This information is outlined below:

- **Channel Rate Guide:** This selection pulls up a table that displays the relationship between the Modulation mode, Modulation Guard Interval and FEC mode resulting in the bit rate displayed in 'Mbps'. For example with a modulation mode of 16 QAM, a guard interval of 1/8 and a FEC of 2/3 the bit rate displayed is 14.745 Mbps. Table values will change depending on COFDM Bandwidth selected. See Figure 15.
- **FW version:** This selection pulls up a window that displays the M2T unit serial number and current versions of firmware. See Figure 16.
- **About:** This selection pulls up a window that displays the Version Number of the M2T Configurator program. See Figure 17.

**Channel Rate Guide**

COFDM Bandwidth: 8MHz

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	29.0293	26.1264

**Figure 15 Channel Rate Guide**

**GMS\_M2T FW Version**

Unit Serial Number: SN NOT SET YET

Tx Firmware Version: Apr 2 2010 16.34.42

Tx FPGA Version: MDT27

Encoder DSP Version: 1.1

Encoder DSP App/Loader Version: 1.32

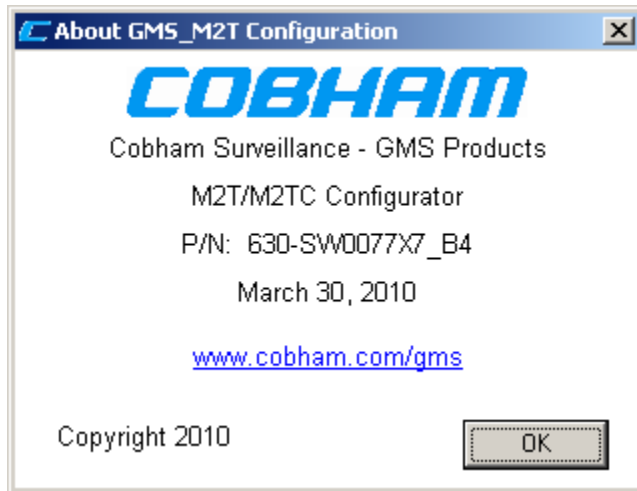
Encoder FW Version: Mar 12 2010 13.30.18

Encoder FPGA Version: TA049

Encoder Version: 54414f53

OK

**Figure 16 FW Version**



**Figure 17 About Box**

## 8.0 Specifications

The following sections outline the overall specifications for the M2T unit.

### 8.1 Video Encoding (HD)

**Interfaces:** HD-SDI (1.4875Gbps)

**Standards:** SMPTE-274M, -293M, -294M, -296M

**Compression Standard:** AVC / h.264 (per ISO/IEC 14496-10)

**Motion Est. Range:** +/-192 Horiz., +/-128 Vert.

**Video formats/resolutions supported:**

Format	Resolution @ Frame Rate
1080i	1920x1080i @ 23.98/24/25/29.97/30 fps
1080PsF	1920x1080 @ 23.98/24/25/29.97/30 fps
1080p	1920x1080 @ 23.98/24/25/29.97/30 fps
720p **	1280x720 @ 50/59.94/60 fps

**Variable GOP Structure:** I-only and IP

**PsF supported with Interlaced Format**

**Profiles: supported** BP@HL

**\*\*Video bit rates:** HDTV to 50Mbps

**\*\*\*System Latency:** <44mS(Ultra-Low Mode using GMS M2D decoder)

**Connector:** BNC-F

### 8.2 Video Encoding (SD)

**Interfaces:** SDI, Component, Composite or S-Video

**Standards:** SMPTE-292M

**Compression Standard:** AVC / h.264  
(Per ISO/IEC 14496-10)

**Motion Est. Range:** +/- 192 Horiz., +/- 128 Vert.

**Video format standards:** NTSC or PAL

Format	Resolution @Frame Rate
576i	720x576 @ 25/29.97 fps (PAL)
480i	720x480i @ 25/29.97 fps (NTSC)

**Variable GOP Structure:** I-only and IP

**Profiles:** BP@ML

**\*\*Video bit rates:** to 50 Mbps

**\*\*\* System Latency:** <44mS (Ultra-Low Mode using GMS decoder)

**Connectors:** p/o DB-44

### 8.3 Audio Encoding

**Analog Audio:** Dual, Line-Level or Mic-Level, Differential or Single-Ended, Clip Level 12dBm (see section 5.1.1.6 and table 1A for audio input configuration setups)

**Input Impedance:** 600 Ohms or 2K Ohms (see section 5.1.1.6 for audio input configuration setups)

**Standards:** SMPTE-272M, -299M

**Digital Audio:** Supports up to 2 channels of audio embedded in the SDI stream

**Compression Standard:** MPEG layer II

**Audio Enable:** OFF/Analog/SDI  
**Bit Rates:** 256 kbit/s/ch  
**Sampling Frequency:** 32kHz, 44.1kHz or 48kHz  
**THD:** < 0.1% maximum  
**Response:** 20Hz to 20kHz, +/- 0.25dB  
**Crosstalk:** >55dB minimum  
**S/N:** >60 dB RMS  
**Connector:** XLR-F (Qty 2)

#### 8.4 Transport Stream

**Standard:** per ISO/IEC 13818-1  
**Packet Size:** 188 byte  
**Bit Rate:** Automatically set from active service settings.  
**ASI output**  
**ASI Input**  
**Connector:** BNC-F

*Note: ASI input is shared with the SDI input (see hardware section 5.1). Input mode (SDI or ASI) must be switched using GMS PC GUI. See software under section 7.3.4. If transmitting an ASI stream ensure the transmitter channel rate is set to at least 10% above the data rate of the input ASI stream.*

#### 8.5 Control

Local frequency control is provided on housing. The M2T can be fully controlled through either the RS-232 or USB-1 control ports via a MS Windows based control application (sold separately). A Remote Control Unit (RCU) is also available for either local or remote control.

#### 8.6 COFDM RF Output

**Output Frequency:** 1 to 7 GHz (In-Bands)  
**Bandwidth:** Selectable 6, 7 or 8 MHz Standard  
6, 7, 8, 12, 14, 16 MHz Optional\*  
**RF Output Power:** Standard - Up to 200mW  
2W available for L/S Band  
**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.*

#### 8.7 Modulation

**Modulation Type:** COFDM w/ QPSK, 16QAM or 64 QAM

#### 8.8 Standard DVB-T Compliant

**FEC:**  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{3}{4}$ ,  $\frac{5}{6}$ ,  $\frac{7}{8}$   
**Guard Intervals:**  $\frac{1}{32}$ ,  $\frac{1}{16}$ ,  $\frac{1}{8}$ ,  $\frac{1}{4}$   
**Spurious:** 50dBc  
**Number of COFDM Carriers:** 2k

### 8.9 High Throughput Option

**FEC:**  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{3}{4}$ ,  $\frac{5}{6}$ ,  $\frac{7}{8}$

**Guard Intervals:**  $\frac{1}{32}$ ,  $\frac{1}{16}$ ,  $\frac{1}{8}$ ,  $\frac{1}{4}$

**Spurious:** 50dBc

**Number of COFDM Carriers:** 4k Carriers

### 8.10 Power

**DC Input Voltage Range:** 9 to 15 VDC

**Power Consumption:** 16 Watts HD Mode (ASIC version)

**Power supplied through DB-44 connector.**

(DB-44 pins 14, +Vcc, Pin 13 GND)

### 8.11 Environmental

**Operational Temperature:** -10 to +65 °C

**(EXTERNAL COOLING REQUIRED)**

**Humidity:** Up to 100% (non-condensing)

### 8.12 Physical

**Dimensions (less connectors):** 3.25" (W) x 4.5" (D) x 1.95" (H)

8.26 cm x 11.43 cm x 4.95 cm

**Weight:** 13.4 oz (380.5 grams)

### 8.13 Physical Interfaces

**RF Antenna Port:** SMA-F

**ASI Out:** BNC-F

**SDI/HDSDI/ASI Input:** BNC-F

**Control/Audio/Power/Component & Composite Video:** DB-44F

### 8.14 Scrambling Option

**Type:** 128/256 Bit Advanced Encryption Standard (AES)

**Key Storage:** User Controlled, Local or Remote

**Implementation:** Everything except TS Header

**Requires:** DDPC with AES Option on RX side

### 8.15 User Data Option

**Protocol:** RS232C, Asynchronous, 8 Bits, No Parity, 2 Stop Bits (when sending continuous data).

**Data Rate:** Selectable, Up to 38.4 kBaud

**User Data PID:** Selectable

**Connector:** p/o DB-44 F

**Requires:** DDPC with AES Option on Rx Side

\* With 4K High-Throughput Option

\*\* COFDM modulator limits high end of bit rate to 32 Mbps or 64 Mbps\*.

\*\*\* End to End System Latency Delay is Decoder Dependent

## 9.0 D/C (Down Converter) IF frequencies explained

### 9.1 IF Frequencies

- MSR receivers (and many other digital 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 (also refer to a BDC, block down converter) is used to convert the frequency to this range. The frequency out of 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 (M2T) and converts it to the IF frequency. MSR receivers need to know the LO (local oscillator) of the down-converter and the RF frequency of the transmitter. It then automatically calculates the IF frequency. The IF frequency changes as the RF frequency changes however the LO remains constant.

On non-GMS receivers 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: “LO – transmitter frequency (or transmitter frequency – LO) = IF frequency”. For example, if the transmitter is set for 2000MHz and the LO of the down-converter is 2800MHz then the IF frequency is 800MHz (2800-2000 = 800). The receiver will need to be set to 800MHz to receive the transmitter frequency of 2000MHz. 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 with the equation “LO-transmitter frequency or transmitter frequency – LO” that two answers are possible. For example 2800-2000 = 800 or 2000-2800 = -800. The negative answer may indicate the receiver wants the signal to be inverted. See section 6.3.3.2 for inverting the signal.

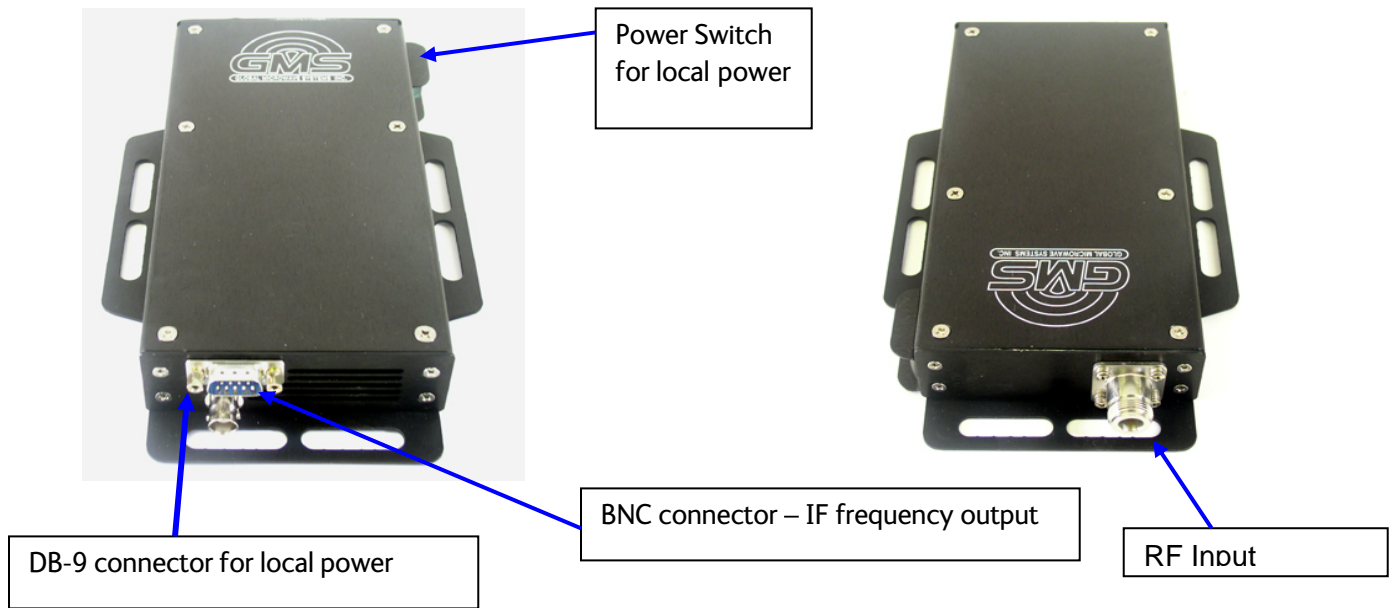
### 9.2 Local and Remote Power for Down Converters

Customers have the option of using remote or local power:

- Remote power is provided from the MSR through the BNC connector from each of the tuners located on the rear panel. Power is turned on through the software control application (refer to the MSR online manual). The +12Vdc provided from the receiver will travel through the coax cable to the D/C.

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 +10Vdc.

- Local power is provided by applying +12Vdc 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 the remote power should be set to “OFF”.



**Figure 18 BDC Connectors**

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

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

## 10.0 Cable Losses

### 10.1 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-C0291X2B FOR PART REFERENCE DESIGNATIONS.
2. LABEL FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0291X2B, USING BEST COMMERCIAL METHOD APPROXIMATELY WHERE SHOWN.
3. LABEL EACH CONNECTOR WITH CONNECTOR REFERENCE DESIGNATION AS SHOWN, USING BEST COMMERCIAL METHOD.
4. REFERENCE SHEET 1, FIGURE 1 FOR CABLE WIRING DIAGRAM.
5. REFERENCE SHEETS 2 THROUGH 4 FOR CABLE ASSEMBLY INSTRUCTIONS.

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0567	X1	INITIAL RELEASE	04/24/06	
E0602	X1A	DRL RS-485 LABELS REPLACE RS232	07/20/06	
E0725	X2	DBL UP VID GROUNDS/ ADD PA SHUT DN	03/13/07	
E0949	X2A	CHANGE LABEL 485 TO CONTROL	04/01/08	
E1430	X2B	DELETE SOLDER SLEEVES & MODIFY DWG	05/04/10	

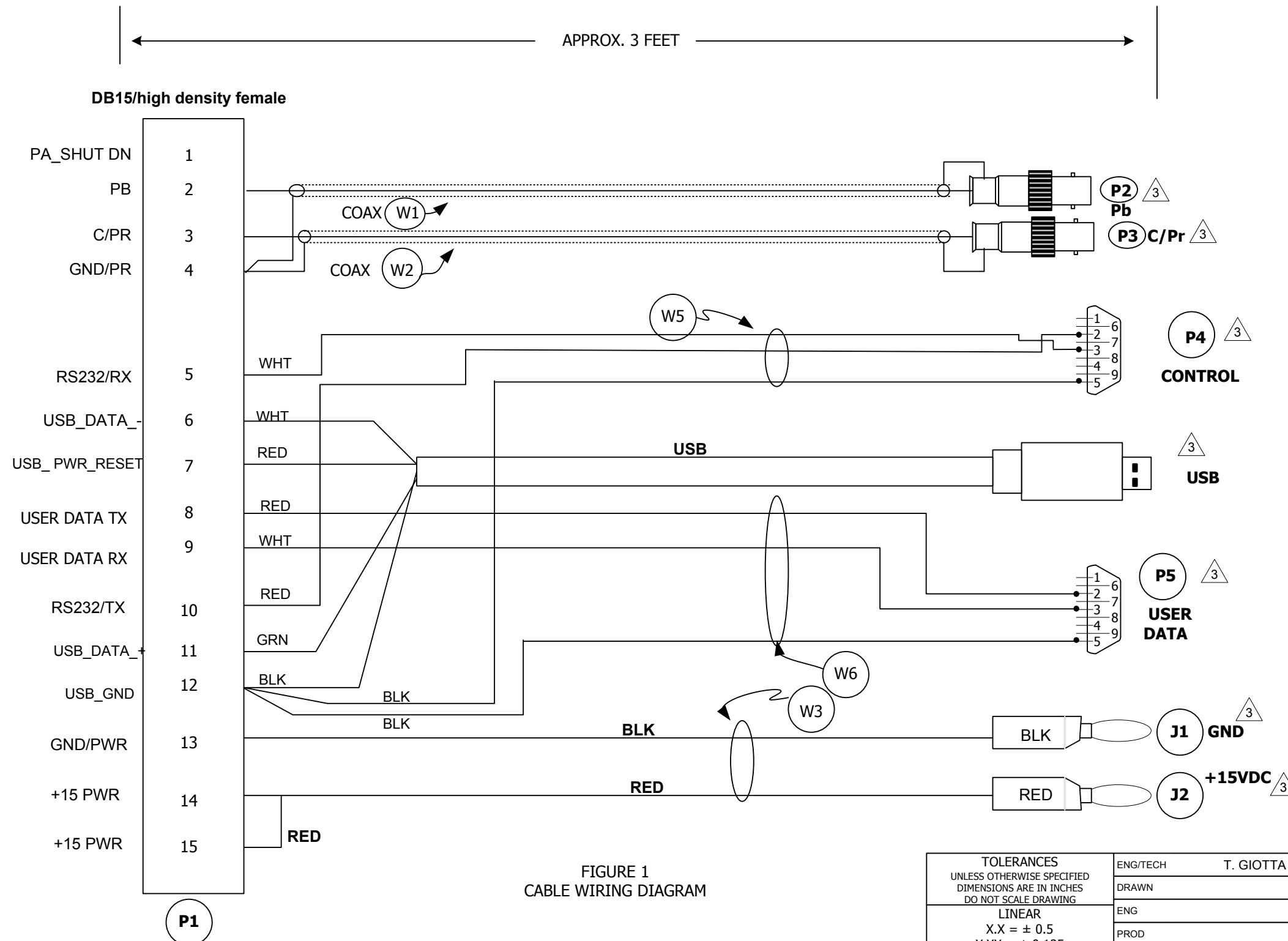


FIGURE 1  
CABLE WIRING DIAGRAM

TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING	ENG/TECH	T. GIOTTA		COBHAM GMS Products		DWG TITLE	
	DRAWN					CABLE,CMT,EXTERNAL BREAKOUT	
LINEAR X.X = ± 0.5 X.XX = ± 0.125 X.XXX = ± 0.020	ENG			SIZE	DATE	DWG NO	
	PROD				05/04/10	100-C0291X2B	
	QC			SCALE	NONE	SHEET 1 OF 5	
						REV	X2B

## Appendix B – Default Groups

Group #	Video Frame	Video Rate	Chroma Format	Input Mode	RF FREQ	COFDM Mode	COFDM BW	MOD GI	MOD -FEC	Carrier Mode	Audio Enable	Audio_Mic/Line Level	Audio-Level	AES	High/Low Power
GP1	1080i	29.97	4:2:0	SDI	2200	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP2	1080i	29.97	4:2:0	SDI	2300	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP3	1080i	25	4:2:0	SDI	2400	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP4	1080i	30	4:2:0	SDI	2200	64 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP5	1080i	23.98	4:2:0	SDI	2400	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP6	1080p	29.97	4:2:0	SDI	2200	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP7	1080p	29.97	4:2:0	SDI	2300	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP8	1080p	25	4:2:0	SDI	2400	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP9	1080p	30	4:2:0	SDI	2200	64 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP10	1080psf	24	4:2:0	SDI	2400	16 QAM	8 MHz	1/32	2/3	2K	ON	LINE	50	OFF	High
GP11	1080psf	30	4:2:0	SDI	2200	16 QAM	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP12	720p	59.94	4:2:0	SDI	2300	16 QAM	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP13	720p	50	4:2:0	SDI	2400	16 QAM	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP14	720p	60	4:2:0	SDI	2200	16 QAM	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP15	720p	60	4:2:0	SDI	2400	64 QAM	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP16	480i	29.97	4:2:0	SDI	2200	QPSK	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP17	480i	29.97	4:2:0	SDI	2400	QPSK	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP18	576i	25	4:2:0	SDI	2300	QPSK	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP19	PAL Comp	25	4:2:0	Comp	2450	QPSK	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High
GP20	NTSC Comp	29.97	4:2:0	COMP	2400	QPSK	8 MHz	1/8	2/3	2K	ON	LINE	50	OFF	High