

The most important thing we build is trust.

Messenger 2 Transmitter - Camera Mount (M2T- C)

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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
X2D	10/19/10	Add Fan Maintenance-Section 8	TG

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)
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
DRL	Data Return Link
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
M2D	Messenger Two Decoder
MSR	Messenger Smart Receiver
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 Camera-Mount 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-C employs a specially designed 'Ultra-Low Delay' coding technology, which provides 44mS (~ 1 frame) end-to-end system delay when using GMS's AVC Decoder. This ensures that the picture you see is what is happening now; crucial for applications such as sports and news coverage!

The internal Data Return Link (DRL) provides a bi-directional serial data path (up to 115.2 kBaud) that can be used for a variety of remote control and communications requirements including control of all of the M2T operating parameters and enables the addition of camera control, audio communication and many other special features.

This manual provides information on how to operate the M2T-C 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 (16.5 Watts)
- Low System Latency (~1 frame with GMS AVC Decoder)
- Local Control plus Data Return Link
- User Data Support
- AES 128/256 Bit Security
- C-OFDM Modulation w/Local Control
- Output Frequency: 1 to 7 GHz (In-Bands)
- High-Throughput 4K option for maximum link performance
- Rugged and Compact Portable Design
- Companion C-OFDM receiver with Maximal-Ratio Pre-Detect Diversity reception

3.0 Theory of Operation

The Messenger 2 Transmitter – Camera-mount (M2T-C) 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 – Camera mount (M2T-C), the Messenger Smart Receiver (MSR), a Messenger Two Decoder (M2D) and one or several external Block Down – Converters (BDC), as shown in the figure 1 below. The M2T-C 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 MSR 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 4K 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 4K 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-C kit includes the following items:

- M2T-C unit
- M2T-C 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-C 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-C 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-C link.

Figure 1 shows a basic standard M2T-C wireless link configuration. (NOTE: MSR, M2D 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-C require additional hardware (which includes two MSRs, a DDP plug in card and a combiner).

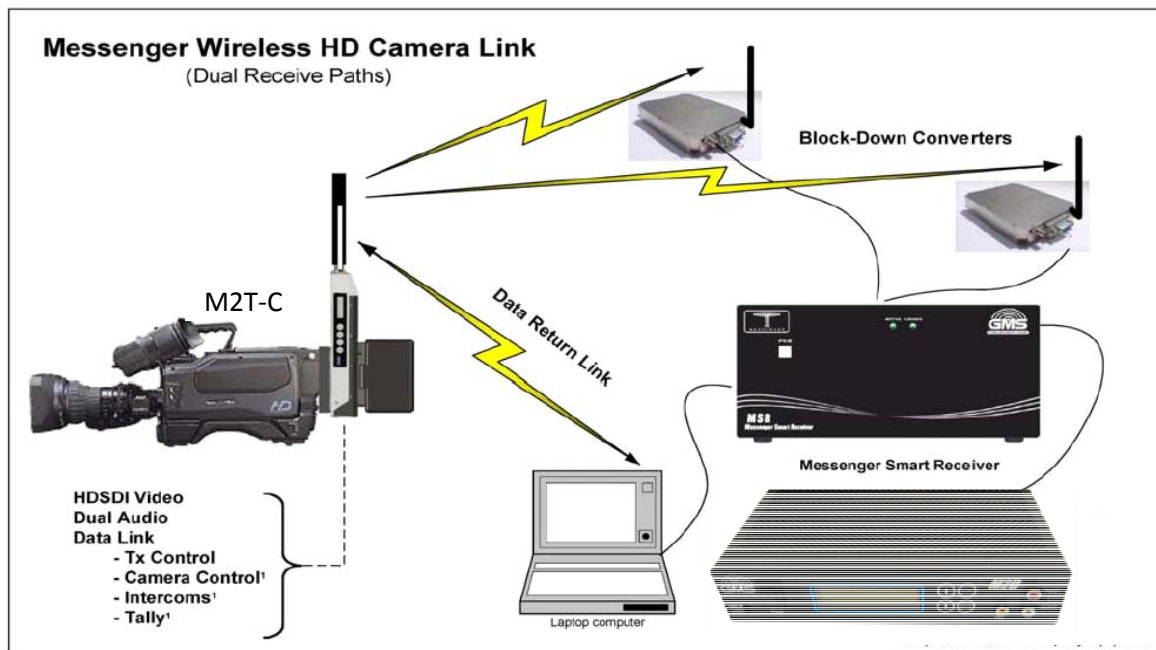


Figure 1 Basic M2T-C Link Setup

1. Install omni-directional antennas onto the M2T-C 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-C SDI BNC (J1) video input. A composite signal can also be applied to the M2T-C BNC J6 composite in connector however keep in

- mind that the video source must match the configuration group setting of the transmitter. Refer to section 5.1.1.9.2.1, “TX HD Enc Setup” configuration group display, section 6 and section 7.3.2 on the selection of the transmitter (M2T-C) groups, the use of the keypad and the navigation of the menus.
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.
 5. Provide power to the M2T-C (+12 Volts) by switching on the power switch to the down position. This is a three-position switch. The down position allows an IDX or AB battery to power the unit. In the up position external power through the DB-15 connector (J5) can be provided to power up the unit. In the middle position the unit is off. The LCD backlight display will light up immediately upon power although no meaningful characters are displayed until the unit has fully initialized (approx. 20 seconds).
 6. Turn on the video source and video monitor equipment.
 7. After approximately 20 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-C unit. For further details on monitoring and controlling the M2T-C using GMS’ optional MS Windows-based M2T-C Configurator software program, see Section 7.3.

5.0 Hardware Overview

The basic M2T-C transmitter configuration is outlined in this section:

5.1 Standard M2T-C

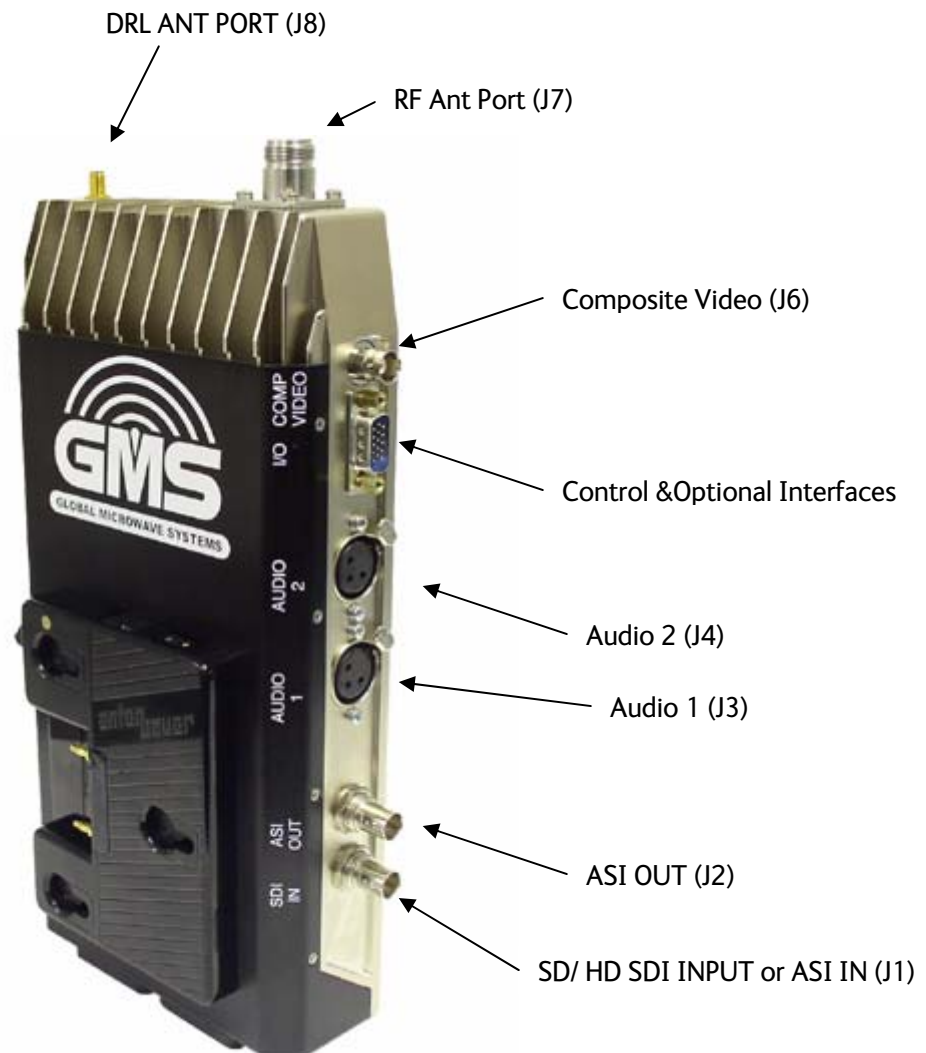


Figure 2 M2T-C Connectors

5.1.1 M2T-C Connectors

There are eight connectors located on the M2T-C unit as shown in Figure 2. They are for interfacing the RF, DRL, SD/HDSDI/ASI, Audio, Video (component & composite), and Control signals. There is also an on/off power switch shown in figure 4.

5.1.1.1 RF Output (J7)

The M2T-C uses a female 'N' Type bulkhead 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 DRL Antenna Port (J8)
The M2T-C uses a female SMA bulkhead connector for the DRL (Data Return Link) port. The DRL allows remote control of M2T-C operating parameters and the ability to control external devices. Features like camera control, tally, pan and tilt control can be accomplished using additional third party hardware. This is an optional module.
- 5.1.1.3 SD/HD SDI_ASI IN (J1)
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 6, software overview, for details on Input Modes. The section explains how to switch from SDI IN to ASI IN using the GMS M2T Configurator.
- 5.1.1.4 ASI Out (J2)
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.
- 5.1.1.5 Audio inputs (channels 1 and 2) (J3 & J4)
Two female XLR connectors are provided for balanced 600 Ohm audio input (see section 5.1.1.8 for other audio input configurations). The audio signal can be set for line or mic level. If audio is not used it's a good idea to disable audio inputs, either through the front panel keypad (see section 5.1.1.9) or using GMS M2T-C Configurator (see section 7.3.5).
- 5.1.1.6 Composite Video input (J6)
A female BNC connector is provided for composite video input. For this input to function correctly the transmitter must be set up for SD mode by selecting the correct video Group using either the PC control application software (GMS M2T-C Configurator, see section 7.3) or the front control panel (see section 5.1.1.9).
- 5.1.1.7 Control & Optional Interfaces (J5)
The Control connector is a female, DB-15. It is used to provide the interface for USB signals (control and monitoring), external power, and the Pb (blue) and C/Pr (red) portions of component video (the composite input, J6, is used as the "Y" portion of component video). The C/Pr is also used as the "C" portion of S-Video (also using the composite input, J6, as the "Y" portion of S-Video). Additionally, the bi-directional DRL's external two wire RS-485 connections are provided. Note that the multi-drop RS-485 interface can be used to access multiple devices. This includes RS-232 devices using external third party conversion modules. A GMS external break out cable (GMS # 780-C0291) is available which incorporates the pin outs for the I/O connector as shown in Table 1.

Table 1 – Control DB-15 Connector Pin Out

Pin	Signal	Notes
1	Gnd/Pb	GND/Pb
2	Pb	Pb, Component Video
3	C/Pr	C/Pr, S-Video/Component Video
4	Gnd/Pr	GND Pr
5	RS-485-	DRL RS-485- (B) inverted
6	USB_DATA -	USB MINUS
7	USB_PWR_RESET	USB POWER/RESET
8	USER DATA TX	USER DATA TRANSMIT
9	USER DATA RX	USER DATA RECEIVE
10	RS-485+	DRL RS-485 + (A) non-inverted
11	USB_DATA +	USB PLUS
12	USB_GND	USB GND
13	GND/PWR	POWER GND
14	+12 PWR	+ 12 VDC POWER
15	+12 PWR	+ 12 VDC POWER

5.1.1.8 Audio Input Configurations

The default audio input configuration is balanced 600 Ohm input impedance. Other configurations are possible and they are listed below, however any changes to the default must be made at the factory since it involves opening up the transmitter.

Possible configurations include:

- **Balanced 600 Ohm impedance (default configuration)**
- Balanced high input impedance (>2K)
- Single ended high input impedance (>2K)
- Single ended 600 Ohm impedance

5.1.1.9 Front Panel Control Keypad & LCD Display

The Front Panel Control consists of a LCD and a four-button keypad. Upon power up of the transmitter the LCD backlight lights (indicating to the user power has been applied), displays “TX is booting...wait, then very briefly displays the GMS M2T-C logo and the software major release date such as ‘July23 2009 11’ before jumping to the opening RF Frequency Display.

Keep in mind because of the complexity of the unit there are many parameters that can be changed only by using the PC GUI control software (GMS Configurator) which is explained in section 7.3.

Note: The PC GUI control software (see section 7.0) may interfere with requests made from the LCD front panel controls. Hence, before using the LCD front panel controls ensure the PC GUI software is disconnected from the transmitter.

Also note the following menu structure corresponds to the latest firmware installed into the transmitter. Your display may vary a little depending on the

firmware installed at the time of the transmitter build. Refer to earlier versions of this manual for other menu structures.

5.1.1.9.1 LCD Menu

The following items can be accessed through the keypad using the 'ENTR', 'CTRL' and the 'Up ↑' and 'Down ↓' arrows.

- **Main Menu** consists of the following displays:
TX RF FREQ
VIDEO LOCKED (status screen)
TX HD ENC SETUP
TX POWER LEVEL
ENTR DETAIL MENU
TX AUDIO
TX AUDIO GAIN (if available)
- **Detail Menu** (sub-menu of less used functions) consist of the following displays:
TX CHANNEL MODE
TX DELAY MODE
TX RF ON/OFF
TX LCD Backlight
EXIT DETAIL MENU

The menu flowchart trees are shown in Figure 3 below.

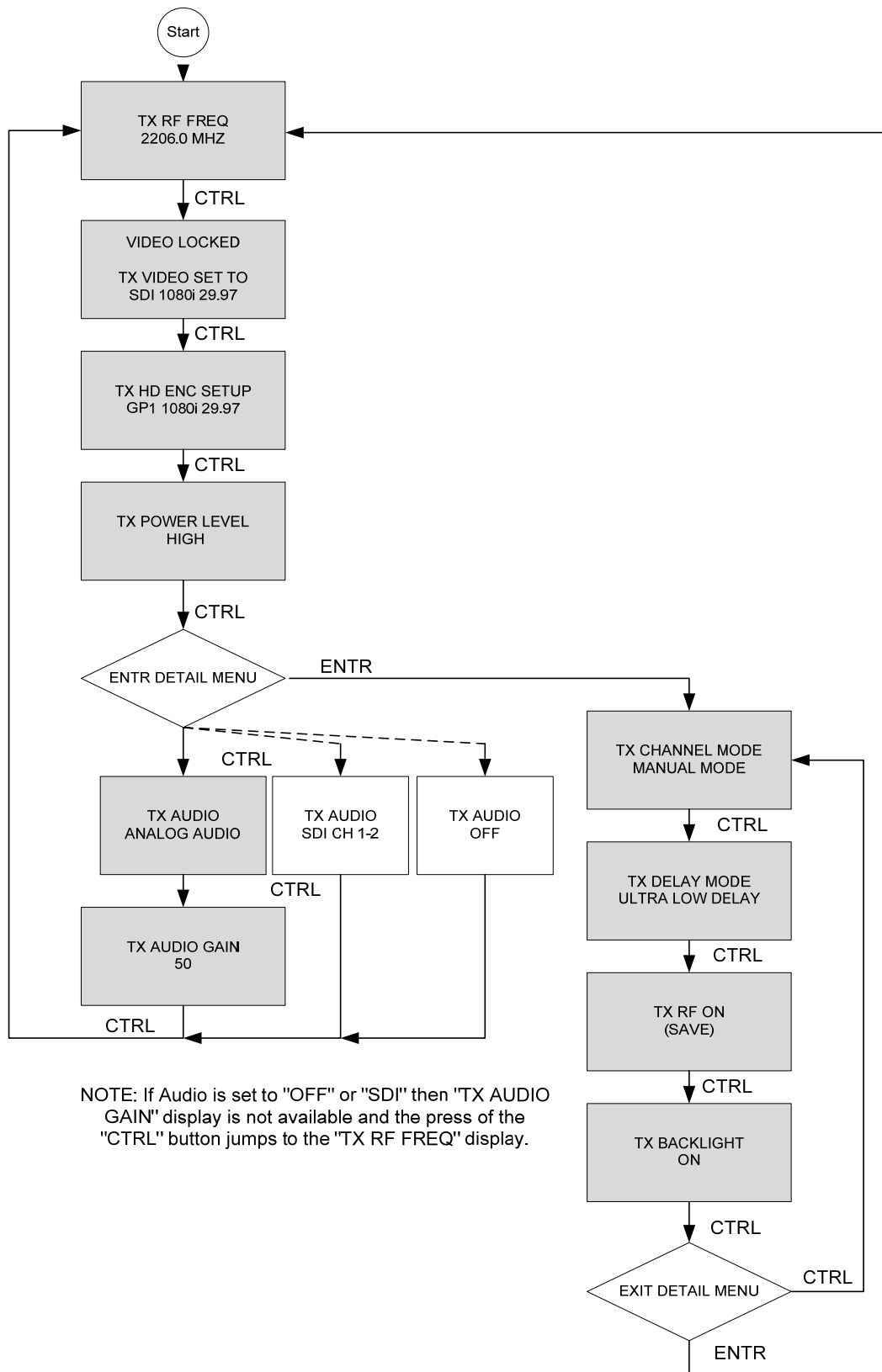


Figure 3 – Default Menu Tree LCD Front Panel Control

5.1.1.9.2 Explanation of the LCD Displays

When the unit is first powered up the LCD backlight lights up, serving as a power indicator; however, no meaningful characters are displayed until the unit has fully initialized which takes approximately 20 seconds.

5.1.1.9.2.1 MAIN MENU

Note that most of the displays in the main menu (except for the VIDEO LOCKED/UNLOCK status display) will time out after about 10 seconds. After that time the LCD automatically jumps to the TX RF FREQ display.

Opening Display

Upon power up the LCD very briefly displays the GMS M2T-C logo and software version number and then jumps to the opening RF Frequency Display.

'TX RF FREQ' Display

The *TX RF FREQ* display shows the current RF frequency setting in MHz. The frequency can be changed with the UP ↑ or DOWN ↓ arrow. Changes will not take place until the ENTR key is pressed. As the frequency is changed the "2250.0 MHz" portion of the display flashes indicating a change is taking place however if the ENTR key is not pressed after approximately 10 seconds (or the CTRL key is pressed) the frequency resets itself to the original frequency. The RF frequency displayed is in the band that is purchased, for example, S2 band, C1 band, etc. and may not reflect the numbers shown in the examples below.

IF for any reason the RF is disabled (intentionally or not) or if the Video becomes unlocked, this display will indicate to the user by flashing "RF IS OFF", or by flashing "VIDEO UNLOCK". This is a very useful indication to let the user know that perhaps the video input to the transmitter is not connected or maybe the RF was turned off and hasn't been turned back on.

The next display is presented with the press of the CTRL key.

'VIDEO LOCKED/VIDEO UNLOCK' Display

This screen shows the current status of the video if is locked or unlock and what video format the transmitter has been set to. It will display on one line, alternating between parts of the message the transmitter video setup format such as "TX Video set toSDI 1080i 29.97.


Keep in mind this is only a status screen. Video formats (associated with configuration groups) cannot be changed here. If a change is desired it must be done in the next display 'Tx HD Enc Setup'.

The next display is presented with the press of the CTRL key.

'Tx HD Enc Setup' Configuration Group Display

The *Tx HD Enc Setup* display shows the current configuration group selected and within this display a different configuration group can be selected. A group number (GP1 in this example) is associated with each group. The video frame size (1080i) and video frame rate (29.97) in this example is part of the title for this group. There are other very important parameters associated with each configuration group which are factory defaulted (see Appendix B) The

parameters can be viewed, changed and saved using the GMS Configurator (as explained in section 6) along with the group titles. Group selection can be changed with the UP ↑ or DOWN ↓ arrow. The “TX” portion of the display flashes indicating a change is in process but does not take effect until the ENTR key is pressed. Appendix B lists the default Groups that the M2T-C supports.

 *NOTE: Keep in mind the RF frequency (along with several other important parameters) is tied in to the configuration group. Hence changing a configuration group will also change the RF frequency. Thus there are two ways to change the RF frequency, directly from the TX RF FREQ display or by changing the configuration group from the TX HD Enc Setup display.*

The next display is presented with the press of the CTRL key.

‘ENTR DETAIL MENU’ Display

Pressing the ENTR key directs the user to the detail sub-menu where the *TX Channel Mode*, *TX Delay Mode*, *TX RF ON/OFF*, and the *TX LCD Backlight* screens are accessed (see section 5.1.1.9.2.2 below). Pressing the CTRL key takes the user to the TX Audio screen still in the main menu,

The next display is presented with the press of the CTRL key.

‘Tx Audio’ Display

The current audio setting is displayed here. In addition audio selections can be changed by use of the UP ↑ or DOWN ↓ arrow. The three selections are: “OFF”, “Analog Audio” or “SDI” audio. Keep in mind SDI audio selections have two channels associated with each selection. The choices are Ch1-2, Ch 3-4, and so on up to Ch 15-16. Based on the parameters of the current embedded audio in the SDI stream, that is which audio groups and which channels are active, the user can select two channels from the stream.

If the ‘Tx Audio’ display shows that audio is “OFF” or “SDI” audio is active then the press of the CTRL key jumps to the opening TX RF FREQ screen. There is no ‘Tx Audio Gain’ display associated with either of these selections.

The next display is presented with the press of the CTRL key if Analog Audio is active.

‘TX Audio Gain’ Display (if available)

The *TX Audio Gain* display shows the current gain setting for analog audio only. This menu is not available if audio has been turned to ‘OFF’ or if ‘SDI’ audio has been selected. In this example it reads “50”. The range is from 0 to 100. Pressing the UP ↑ or DOWN ↓ arrow will either increase or decrease the current value (value eventually wraps around). The gain value entered takes place immediately.

The next display is presented with the press of the CTRL key, which is the return to the *TX RF FREQ* display.

5.1.1.9.2.2 DETAIL MENU

Unlike the main menu displays these displays do not time out. The user needs to manually get back to the main menu (by using the key pad) or on a power cycle the transmitter will default to the TX RF FREQ menu.

'TX Channel Mode' Display

The TX Channel Mode display allows customers to choose different channel plans: manual channel mode (default), user defined, new BAS (S2 band only), and old BAS (S2 band only). Pressing the UP ↑ or DOWN ↓ arrow toggles the display between these plans. The "TX" portion of the display flashes as a change takes place (up or down arrows are pressed) but does not take place until the ENTR key is pressed. Once a pre-defined channel plan is selected the channels can then be selected from the TX RF FREQ display or by selecting a different configuration group (under the TX HD Enc Setup display). A more detailed description of the channel plans is explained in section 7.3.6.2.1.1, the software overview.

The next display is presented with the press of the CTRL key.

'TX Delay Mode' Display

The M2T-C transmitter encoder is associated with two different delay modes (keep in mind that the type of decoder used can also add delays):

Normal – this mode gives the best picture but the delay is longer than the ultra-low mode.

Ultra-Low – this mode is the default which can only be used with GMS M2D HD decoder and offers the fastest <44mS system latency.

Pressing the UP ↑ or DOWN ↓ arrow toggles the display between these two modes. The "TX" portion of the display flashes indicating a change is in process but does not take effect until the ENTR key is pressed.

The next display is presented with the press of the CTRL key.

'TX RF' Display

This display allows the user to turn OFF the RF or if the RF is OFF already then to turn it back ON. One of four options can be selected by using the UP ↑ or DOWN ↓ arrows. The options are:

- **RF OFF w/o saving** to EEPROM. The RF is turned OFF, but on the next power cycle the transmitter RF mode is determined by the previous saved state.
- **RF OFF w/saving** to EEPROM. The RF is turned OFF and on the next power cycle of transmitter the RF remains OFF.
- **RF ON w/o saving** to EEPROM. The RF is turned ON and the next power cycle of the transmitter RF mode is determined by the previous saved state.
- **RF ON w/saving** to EEPROM. The RF is turned ON and on the next power cycle of transmitter the RF remains ON.

The next display is presented with the press of the CTRL key.

'Tx LCD Backlight' Display

The *TX LCD Backlight* display shows the current status of the backlight, on or auto. Pressing the UP ↑ or DOWN ↓ arrow toggles the display between ON or AUTO. Change does not take place until the ENTR key is pressed. Pressing any key on the keypad activates the LCD backlight automatically for approximately 20 seconds if the backlight is set for AUTO. The backlight also lights immediately upon power up serving as a power indicator.

The next display is presented with the press of the CTRL key.

'EXIT DETAIL MENU' Display

This display allows user to exit the detail menu and return to the main menu. Pressing the CTRL key takes you back to the *TX Channel Mode* display which is a continuation of the detail menu. Pressing the ENTR key takes the user to the main menu *TX RF FREQ* display.

5.1.1.10 Power Switch

The power switch is a three-position switch. In the down position power is sourced from a battery (IDX or AB). In the up position external power is provided through the DB-15 connector, J5, pins 13 (GND), 14 and 15 (+12Vdc). When the power switch is in the center position the M2T-C is off. See Figure 4. The backlight of the LCD serves as a power indicator and lights immediately upon power up. It takes approximately 20 seconds for the transmitter to fully initialize.

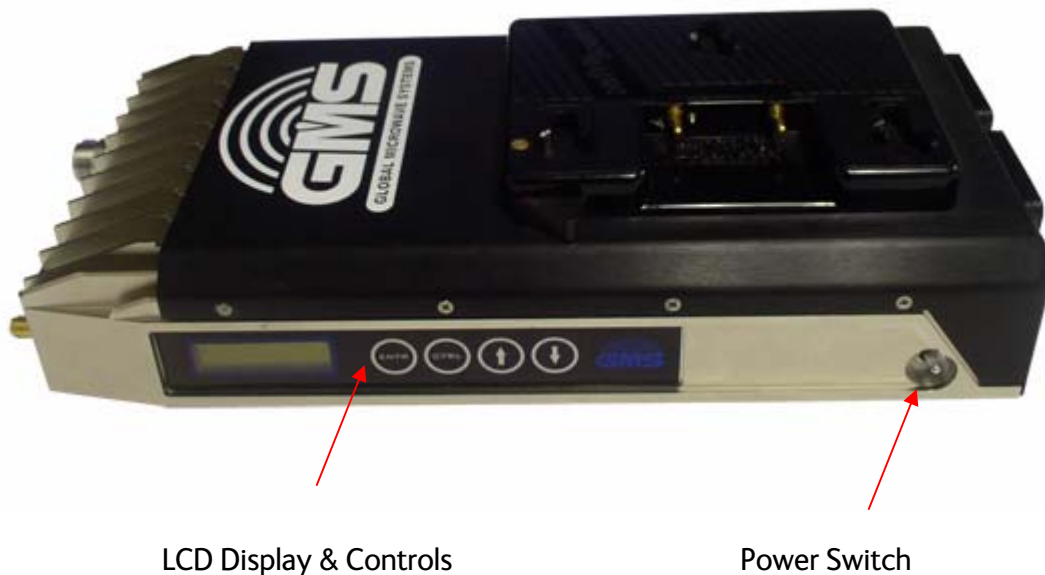


Figure 4 LCD Display & Control

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 local control panel or remotely through the M.S. Windows Application programs (see section 7.3, software overview below). The M2T-C 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-C 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-C. During normal operation the M2T-C Configurator GUI does not need to be active and can be disconnected from the transmitter unit.

 *Note: The PC application control software can interfere with requests made from the LCD front panel controls. Hence, before using the LCD front panel controls (see section 5.1.1.9) ensure the PC application control software is disconnected from the transmitter.*

7.1 System Requirements

The GMS M2T-C Configurator program has been developed and tested on Windows 2000, Windows XP and Windows NT. Although the GMS M2T-C 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-C 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-C Setup program and several initial setup files are copied to the computer.
3. After the initial setup files are copied over, the GMS_M2T-C 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-C 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-C 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-C_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-C Configurator Functions

The M2T-C Configurator program provides the user access to many different configuration, control and monitoring options. When the M2T-C Configurator program is launched, the screen shown in Figure 5 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'.

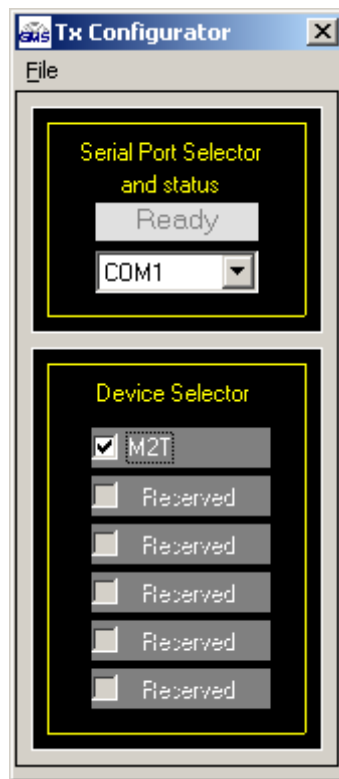


Figure 5 M2T-C Configurator

The M2T-C 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-C 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 6 appears. *Notice that if the text in any of the fields is gray in color this indicates that the field cannot be changed by the current user. Only administrators (with the correct password) can change the fields or they can allow users the ability to modify fields for which they have been given access.*

The M2T-C Configurator program contains function buttons and configurable settings. The following sections explain, in detail, the various options available.

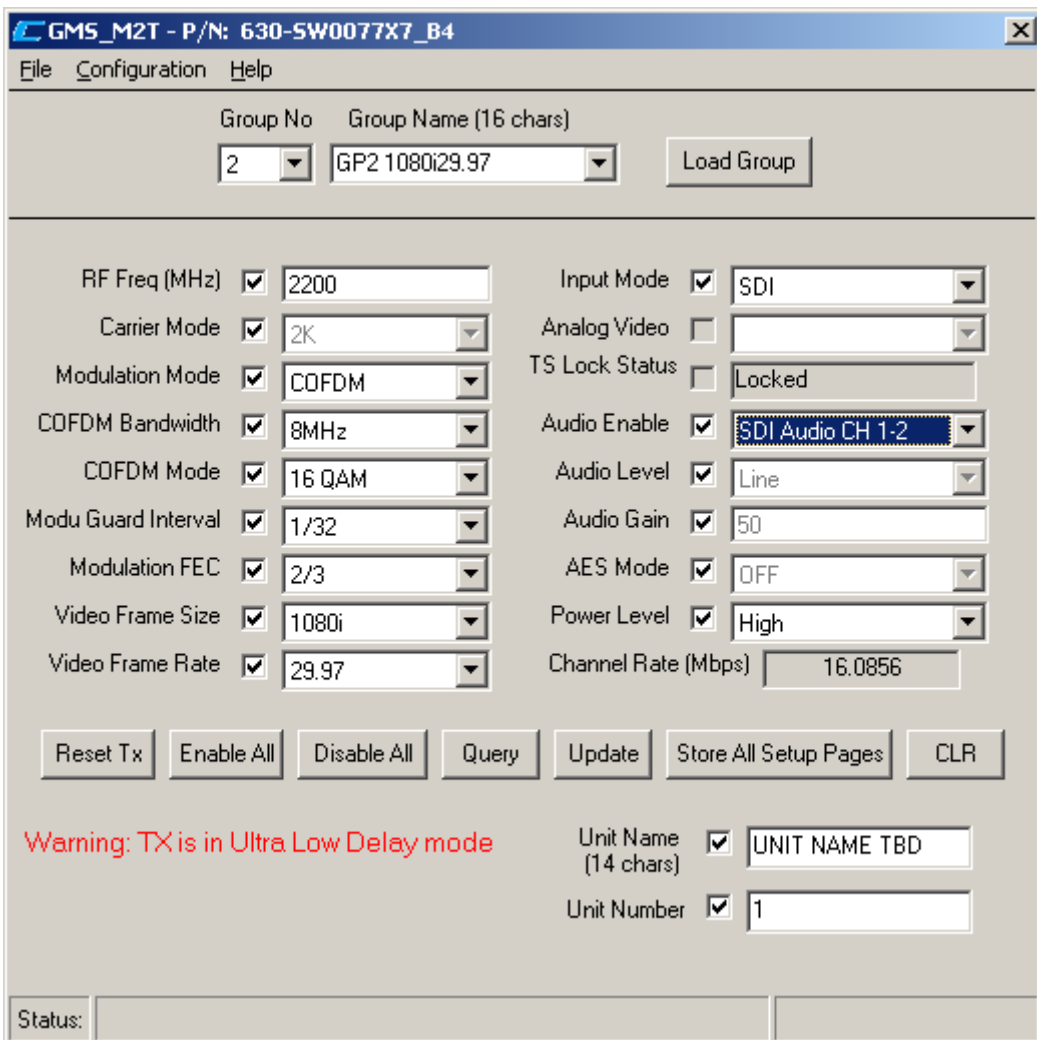


Figure 6 M2T-C Configurator Main Screen

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 7 below. Type in the appropriate password (*initial password is “admin”*) and then return to the main opening screen by clicking “OK”.

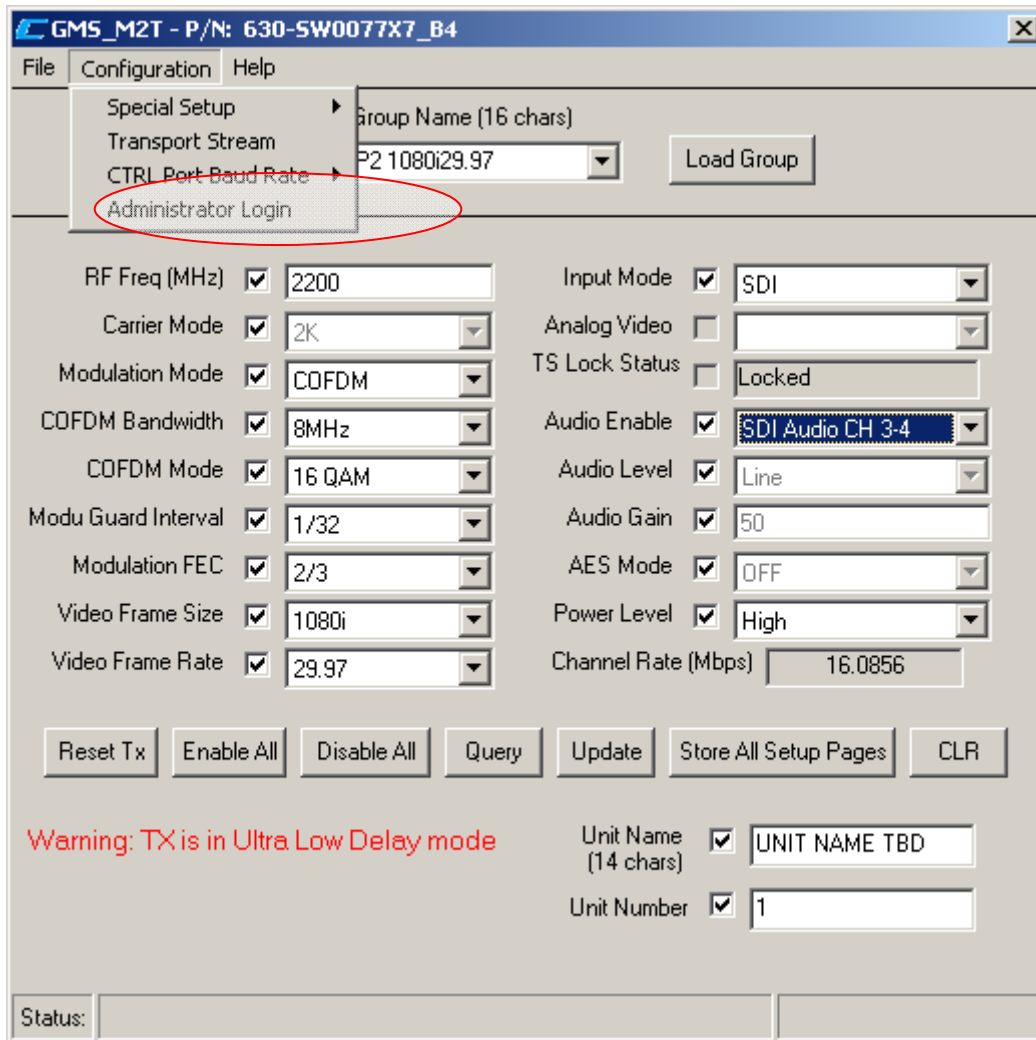


Figure 7 Admin Login

This time under the “Configuration” pull down menu the “Access Control” sub menu appears, see Figure 8.

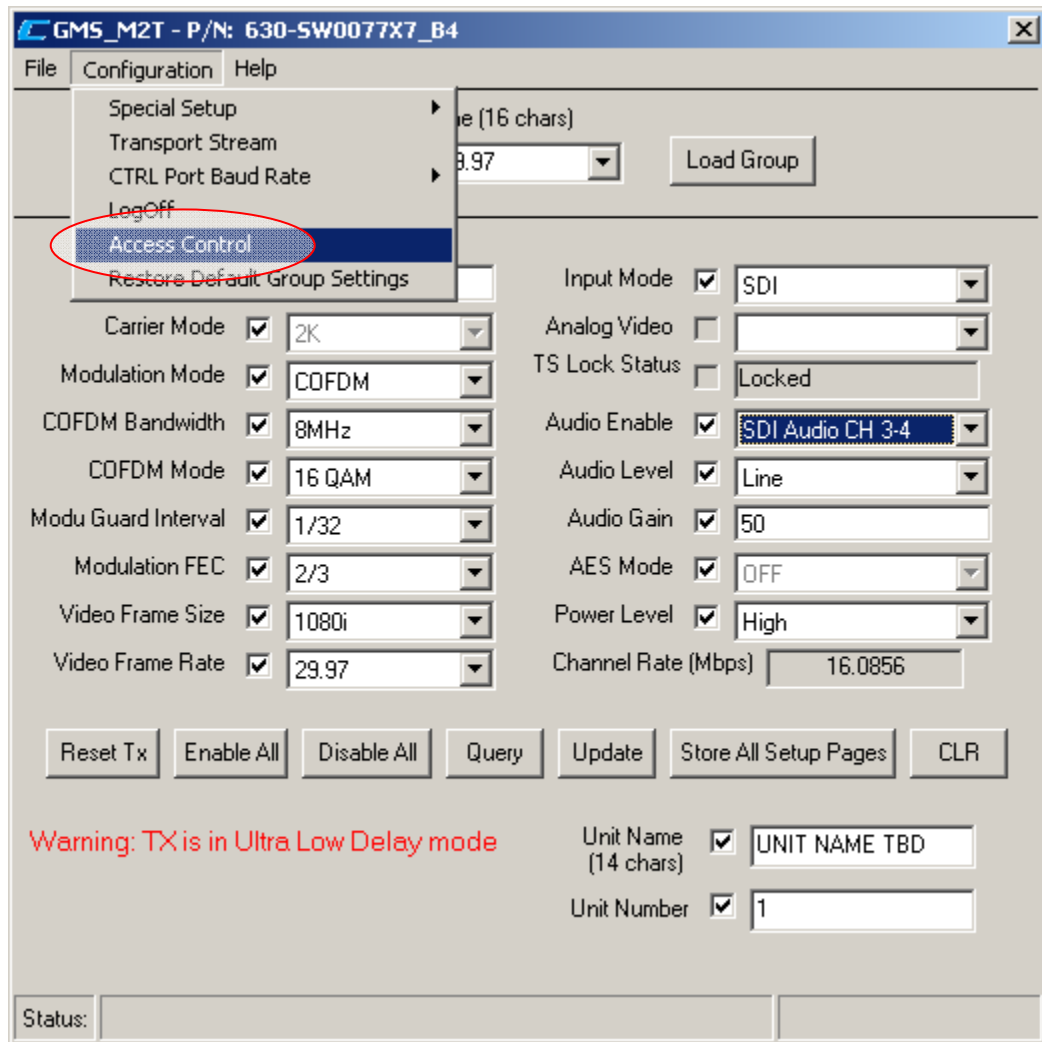


Figure 8 Access Control Sub Menu

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 9). 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 6 above).
2. The "Encoder Setup Access Control" (see figure 10). The encoder parameters such as Video delay mode and GOP length are listed here.
3. The "TS PID Access Control" (see figure 11). The various PIDs which are changeable are listed here.
4. The "Scrambling and User Data Access Control. If these options are not available then the message in figure 12 appears. Otherwise the parameters associated with scrambling and user's data are listed as shown in figure 13.

5. The “Others Access Control” (see figure 14) contain various other parameters such as ‘power mode’, ‘spectrum inversion’, etc.
6. The “Admin Password” (see figure 15). 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.

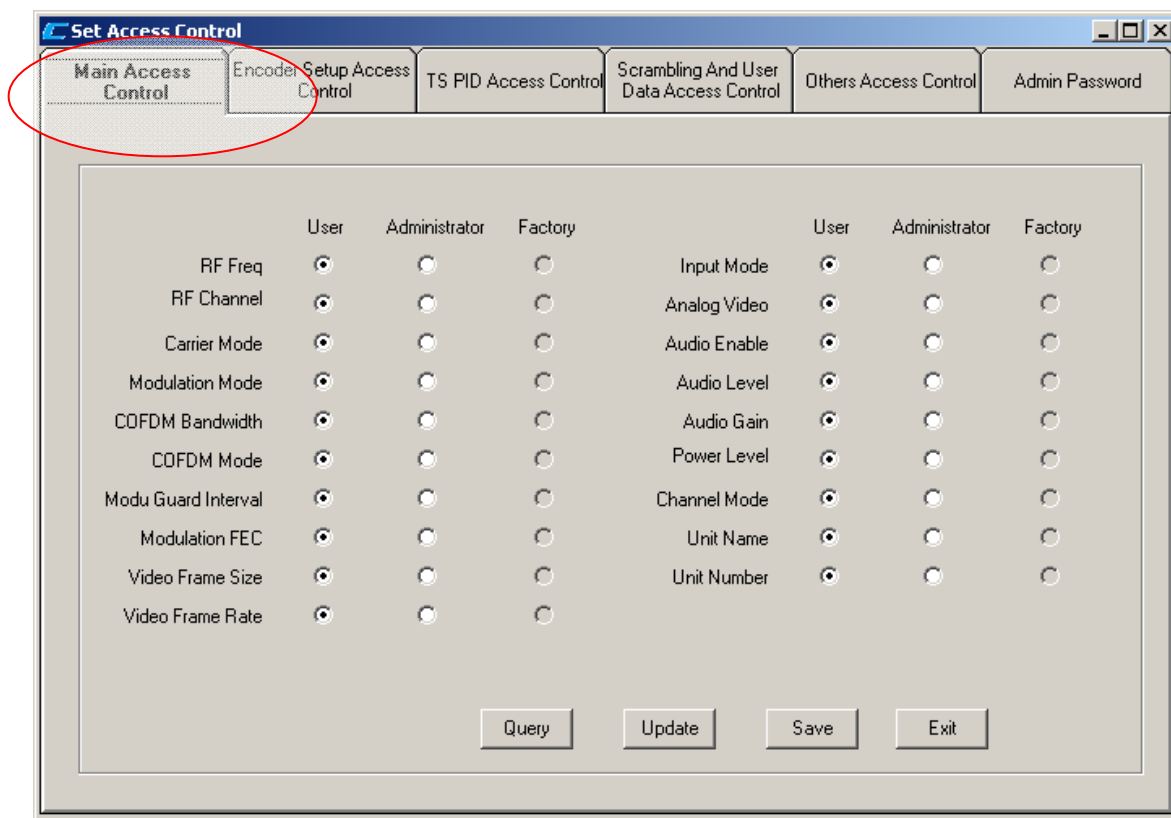


Figure 9 Main Access Control

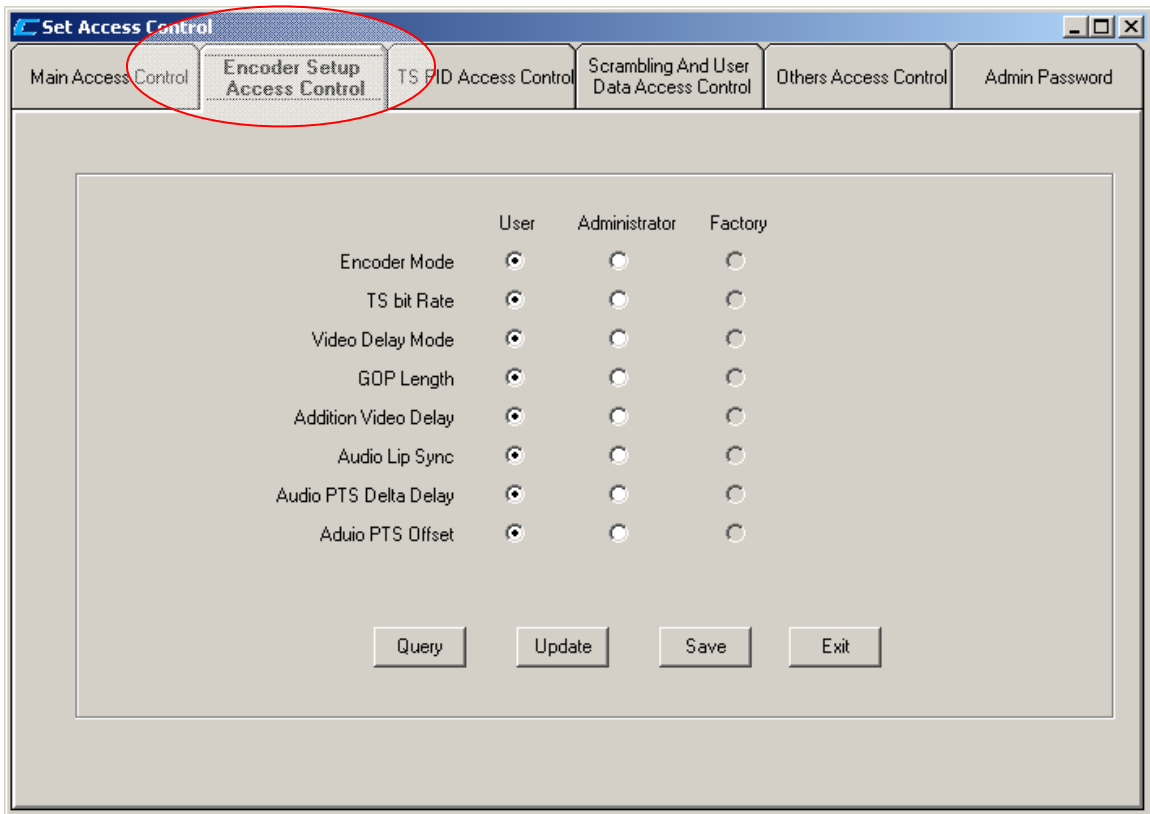


Figure 10 Encoder Access Control Window

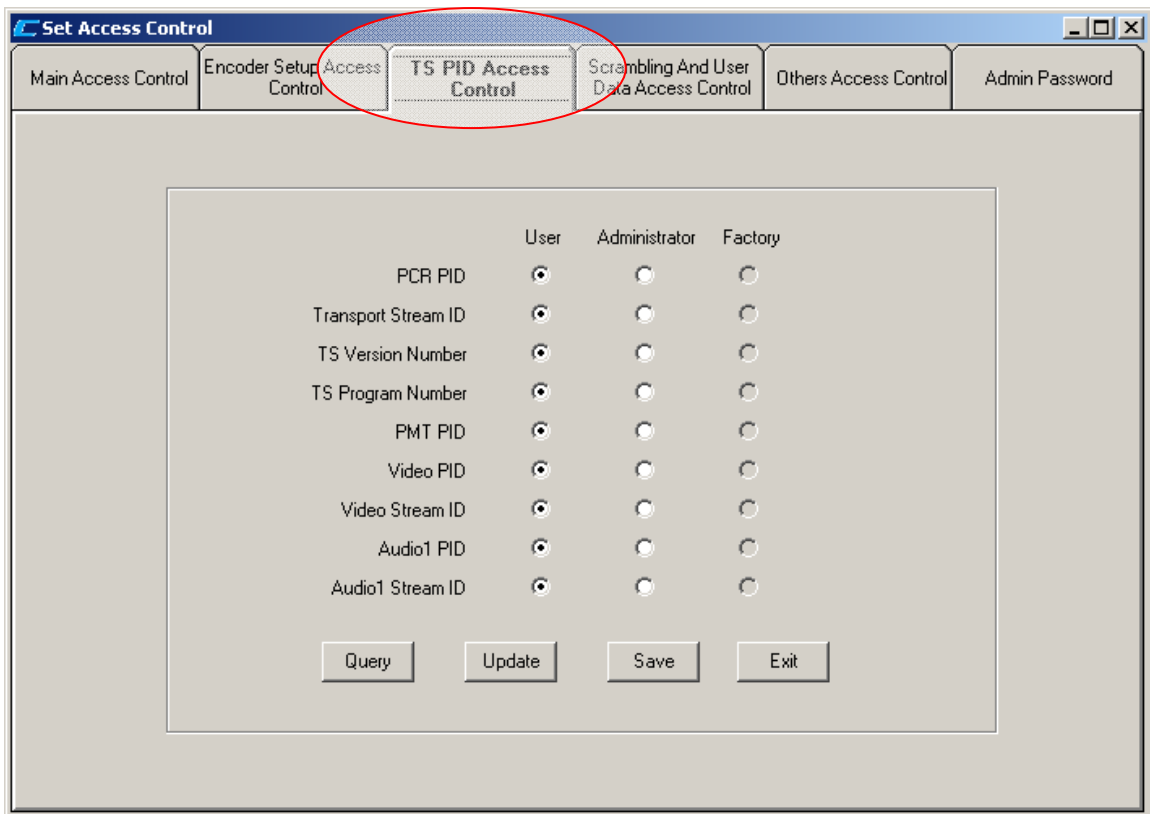


Figure 11 PID Access Control Window



Figure 12 Scrambling Access Control Window (optional)

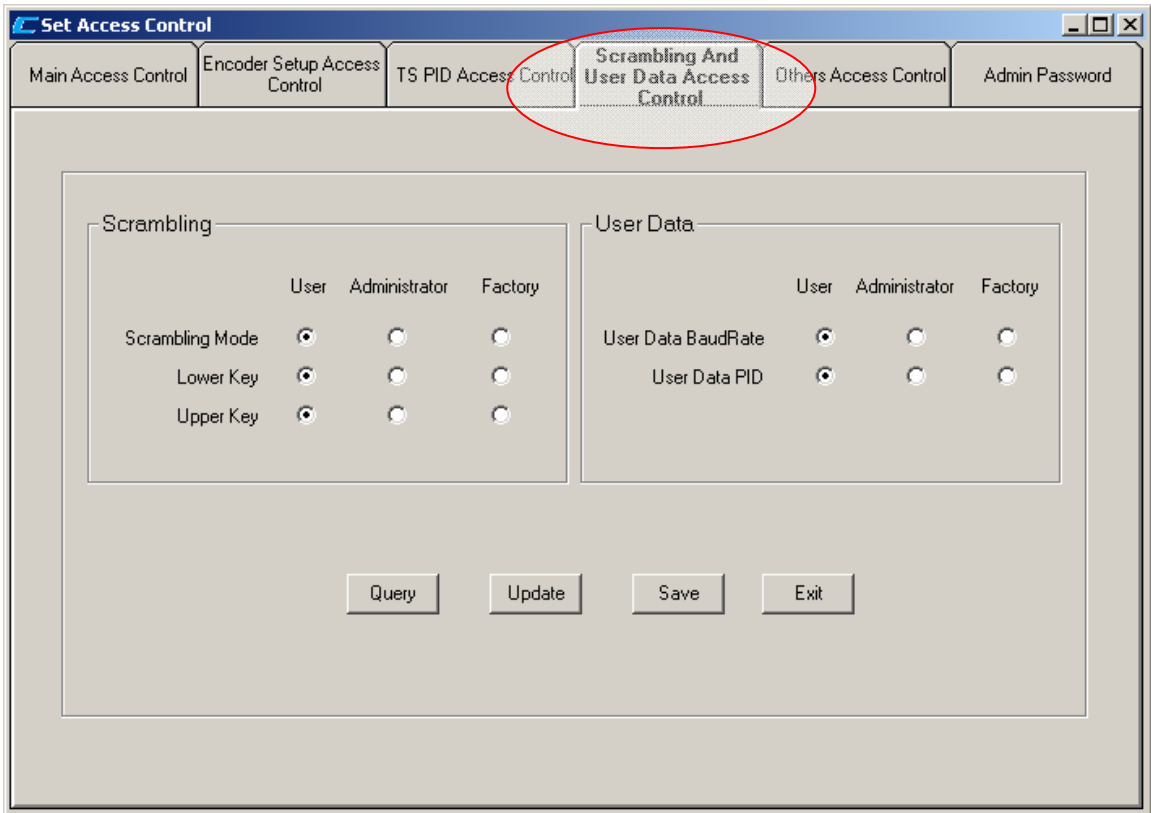


Figure 13 Scrambling Access Control Window

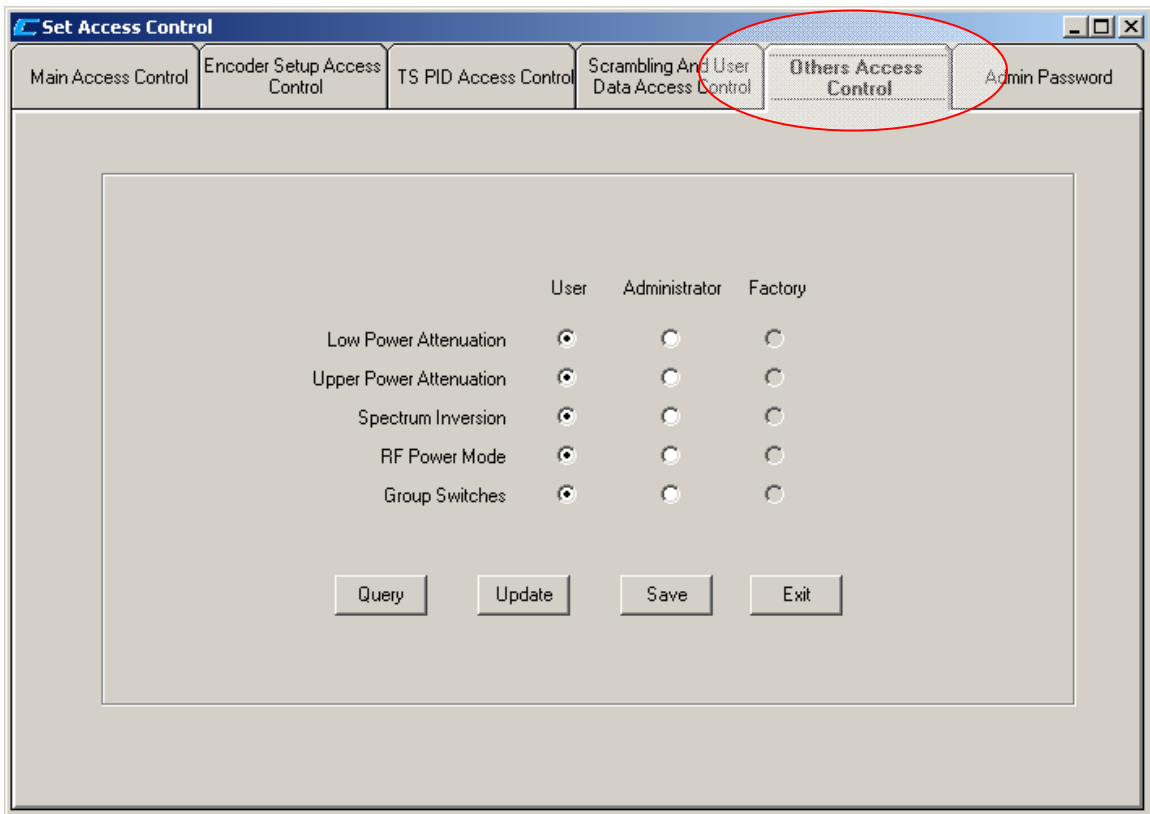


Figure 14 Others Access Control Window

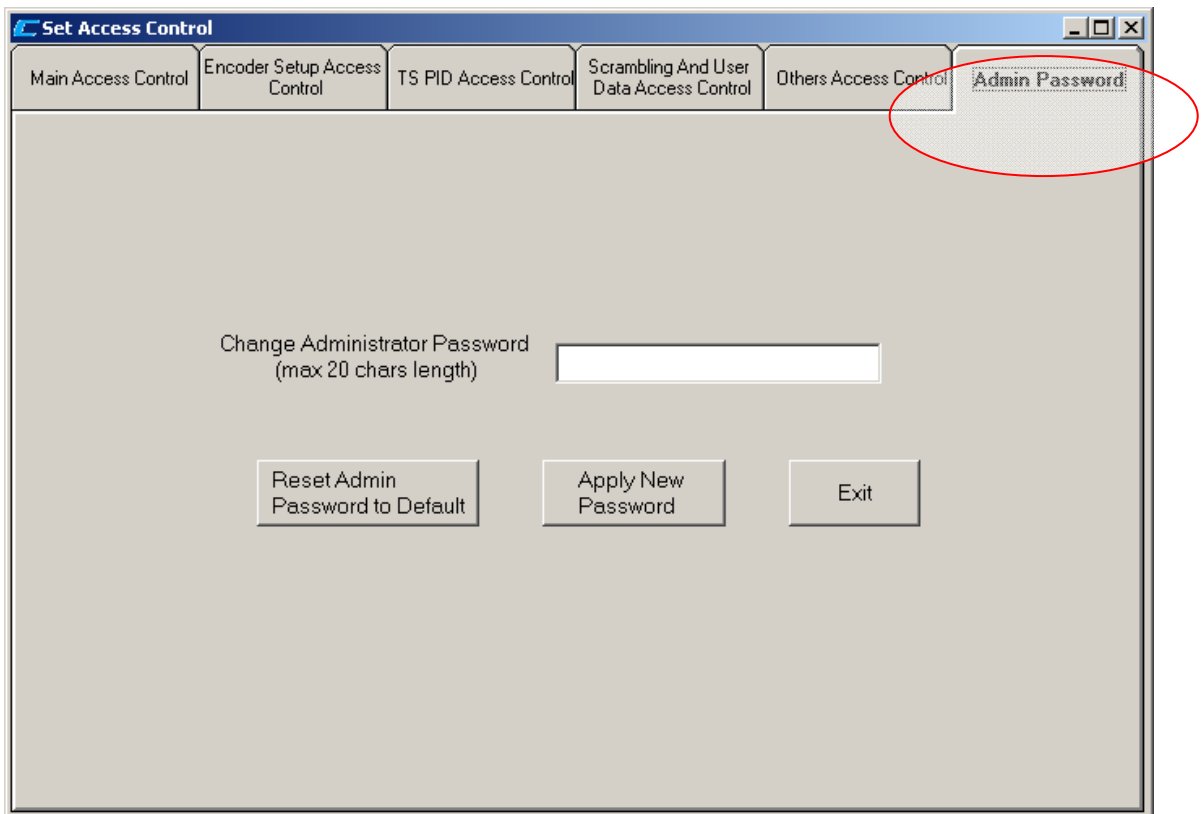


Figure 15 Admin Password Window

7.3.2 Function Buttons

- **“Reset Tx”**: Clicking on this button re-boots the transmitter re-initializing the M2T-C 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-C is organized into “Groups” of selected fields. A Group contains the following fields (refer to Figure 6 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-C. 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-C 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.

The group names as listed under the pull down box (“Group Name 16 chars”) also appear on the M2T-C front control panel LCD (see section 5.1.1.9.2.1) under the ‘TX HD Enc Setup’ menu. This allows the user to select the various groups from the front panel without the need of the PC application connection.

7.3.3 Field Definitions

The fields as shown in Figure 6 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-C Field Definitions

Field	R/W	Description
Group No.	R/W	The number assigned to a specific video group
Group Name	R/W	The name assigned to a specific video group
RF Freq (MHz)	R/W	RF output frequency. Desired frequency is entered in MHz (i.e., 1.296GHz would be entered as 1296).
Carrier Mode	R/W	The number of Carriers within a C-OFDM carrier: Selects 2K carriers per C-OFDM or 4K carriers (optional) per COFDM.
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 in 2K carrier mode or 12, 14 or 16 MHz in 4K carrier mode.
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: $\frac{1}{32}$, $\frac{1}{16}$, $\frac{1}{8}$, or $\frac{1}{4}$
Modulation FEC	R/W	Modulation FEC (Forward Error Correction) rate. Desired modulation FEC rate is selected from the following values: $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$.
Video Frame	R/W	Video frame size (resolution). “i” stands for interlaced; “p”

Field	R/W	Description
Size		stands for progressive.
Video Frame Rate	R/W	Video Frame Rate in number of frames per second. Only legitimate video frame rates are shown for the selected video frame size.
Input Mode	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.
Analog Video	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.
TS (transport stream, video) Locked Status	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.
Audio Enable	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.)
Audio Level	R/W	Choice between mic or line level audio (only applies to analog audio)
Audio Gain	R/W	Adjustable gain values are adjustable between 0-100 (only applies to analog audio).
AES Mode (optional feature)	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 previously setup under 'Configuration' menu under sub-menu 'SPECIAL SETUP\SCRAMBLING'. This is an option that may or may not be activated.
Power Level	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'
Channel Rate (Mbps)	R	Channel rate is displayed in Mbps and is based on parameters selected such as C-OFDM mode, FEC and Guard Interval. See <i>Channel Rate Guide</i> under the <i>HELP menu</i> .
Unit Name	R/W	Allows the user to assign a unique unit name to the M2T-C.
Unit Number	R/W	Allows the user to assign a unique unit number to the M2T-C

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 16 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.

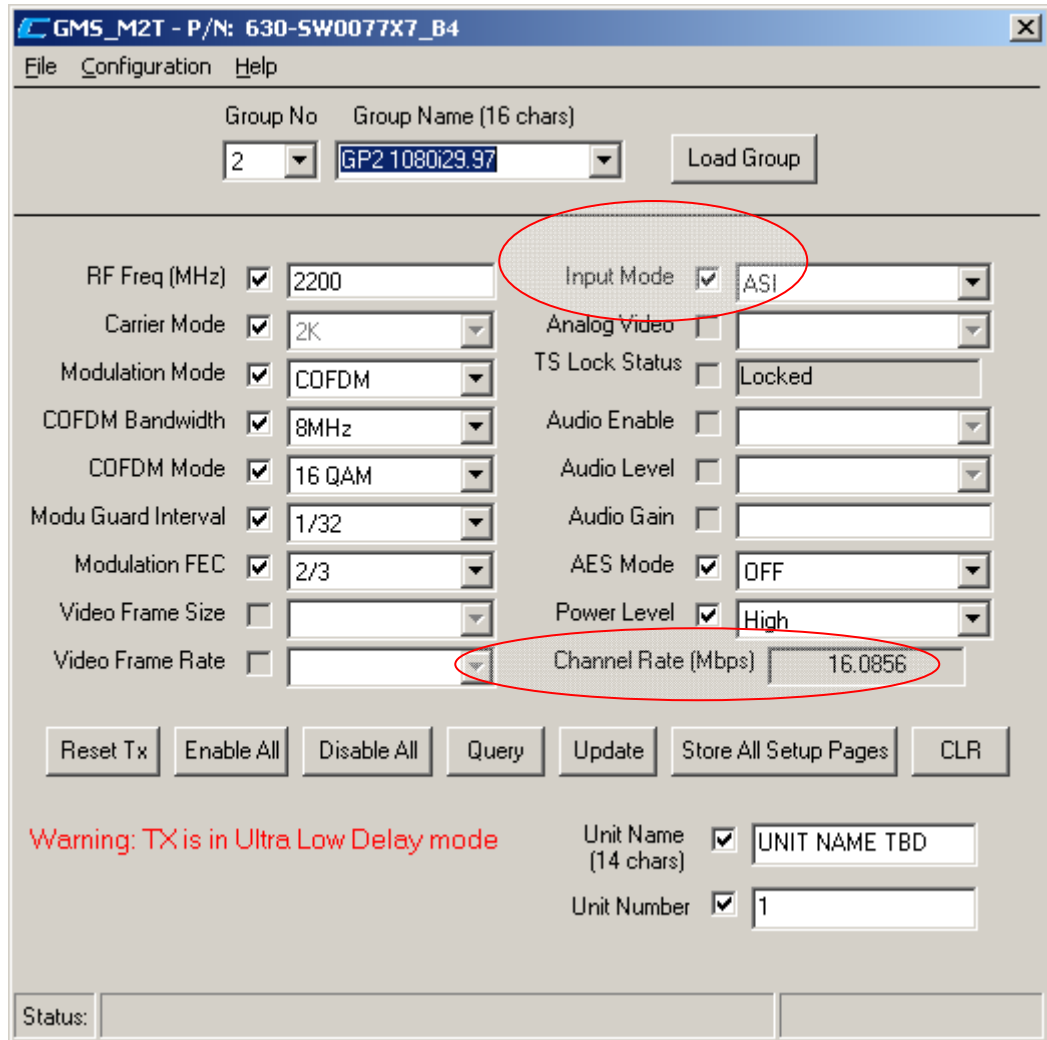


Figure 16 Input Mode

7.3.5 Audio Enable- Switching between Analog audio and Embedded SDI audio
 The M2T-C 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 5.1.1.8 for the 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 17 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.

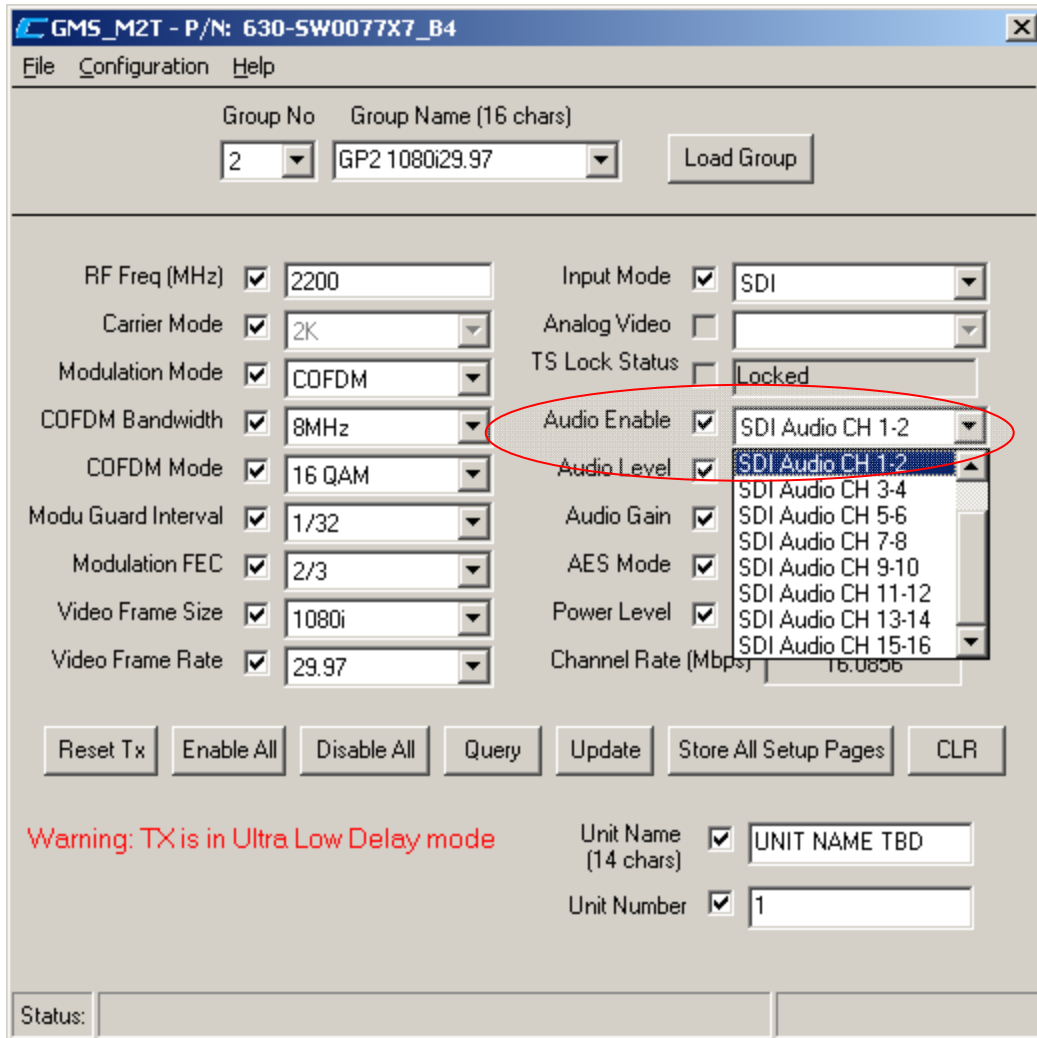


Figure 17 Audio Selection

7.3.6 Pull-Down Menu Definitions

There are several different pull-down menus that are included in the M2T-C 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 18) contains several different configuration options. These are outlined below:

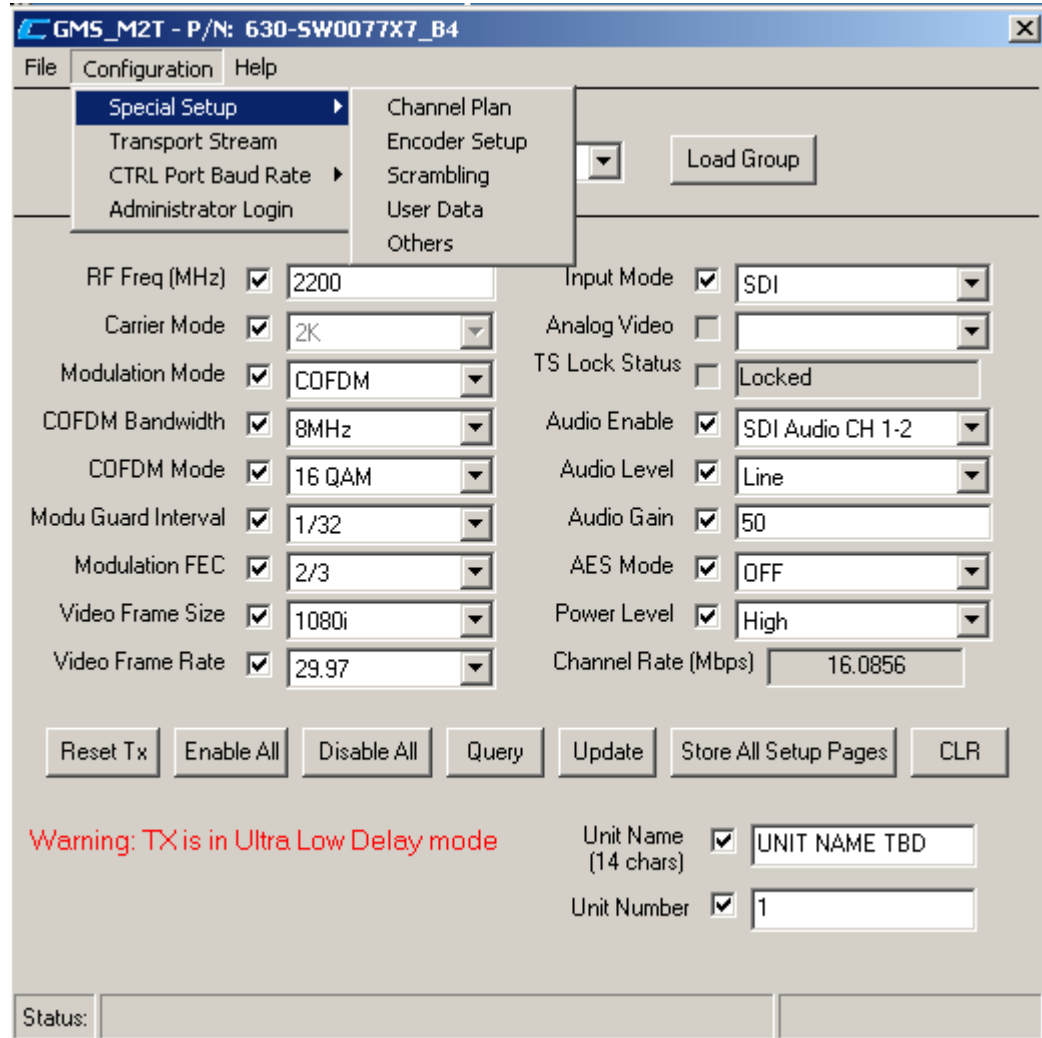


Figure 18 Configuration Pull Down Menus

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 19. 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 5.1.1.9.2.1 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 20) – 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 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 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.

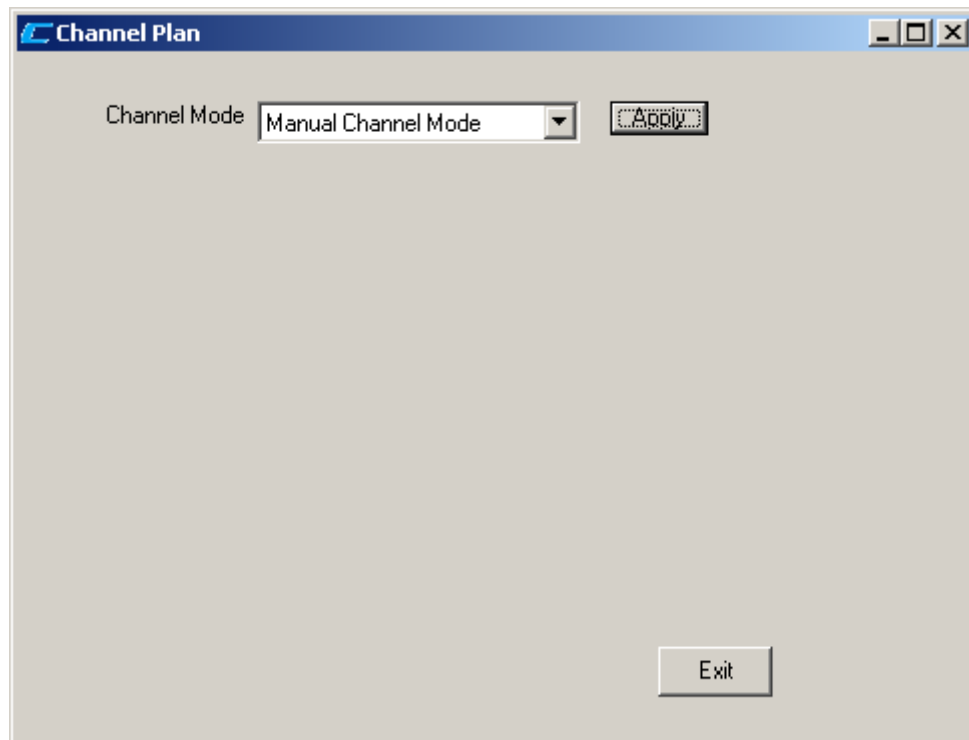


Figure 19 Channel Plan Opening Screen

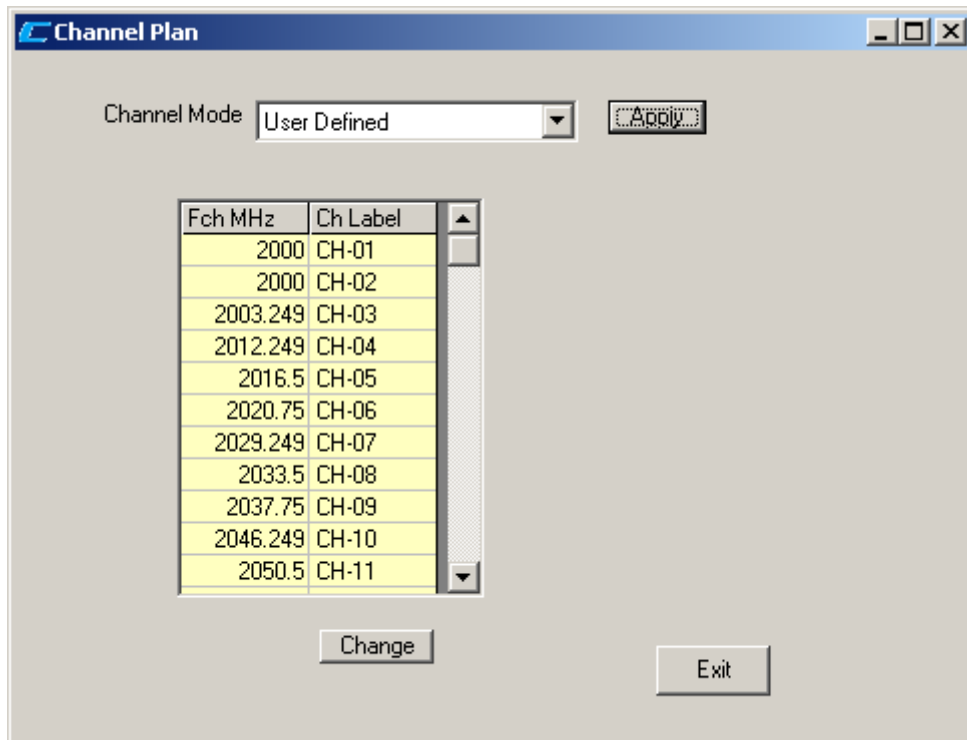


Figure 20 User Defined Channel Mode Screen

7.3.6.2.1.2 Encoder Setup

This pull-down menu (see Figure 21) 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 standalone module encoding rates up to 50 Mbps using the ASI out (J2) port of the M2T-C. 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-C 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. Choices include 10, 20, 30, 40 or 50 GOP.

- **Video Delay Mode** – User can select from three different delay modes involving different trade offs:
Normal – this mode is the default, gives the best picture but the delay is longer than the other two modes.
Low – this mode is faster (less delay) however the picture quality is not as good as Normal mode.
Ultra-Low – this mode which can only be used with GMS HD decoder offers the fastest, < 44mS system latency (future upgrade).
- **Additional Video Delay (frames)**
 Additional video delay (in units of frames) from 0 to 500 can be added.
- **Additional Audio Delay (frames)**
 Additional audio delay (in units of frames) can be added (fractional values are allowed).



Figure 21 HD Setup

7.3.6.2.1.3 Scrambling Mode (Optional)

Scrambling Mode (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– The “Scrambling Mode” pull down text box offers three choices (see Figure 22):

- **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 under ‘Scrambling Key’. 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. 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 transmitter’s 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.
- **Exit** - Exit the scrambling mode

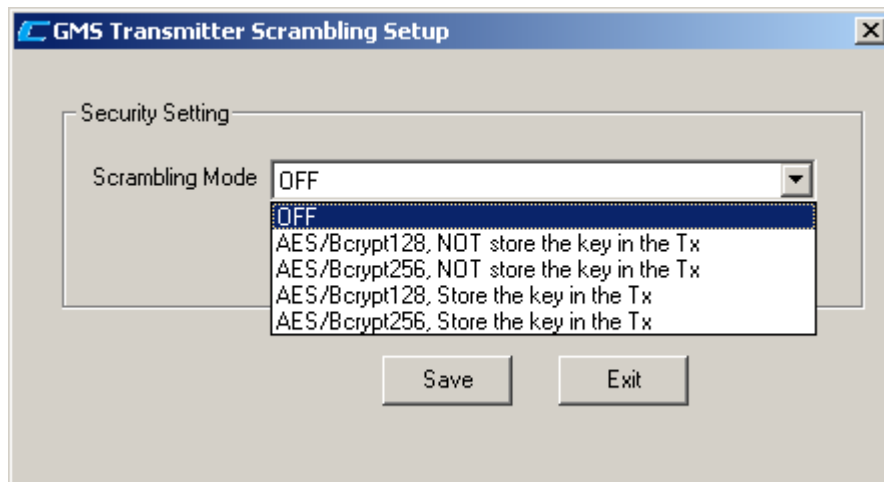


Figure 22 Scrambling Set-Up

7.3.6.2.1.4 Scrambling Key (Optional)

Scrambling Key (this menu may not be available if the option has not been purchased) – This menu displays the following (see Figure 23):

- **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 initialize 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

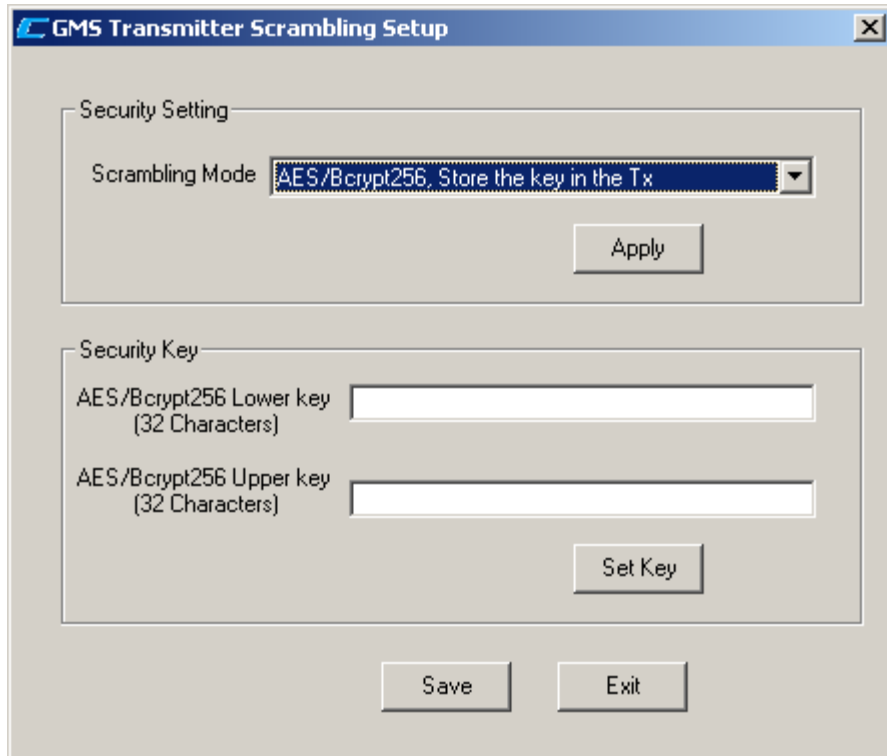


Figure 23 Scrambling Key Set-Up

7.3.6.2.1.5 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-C 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 24):

- **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.

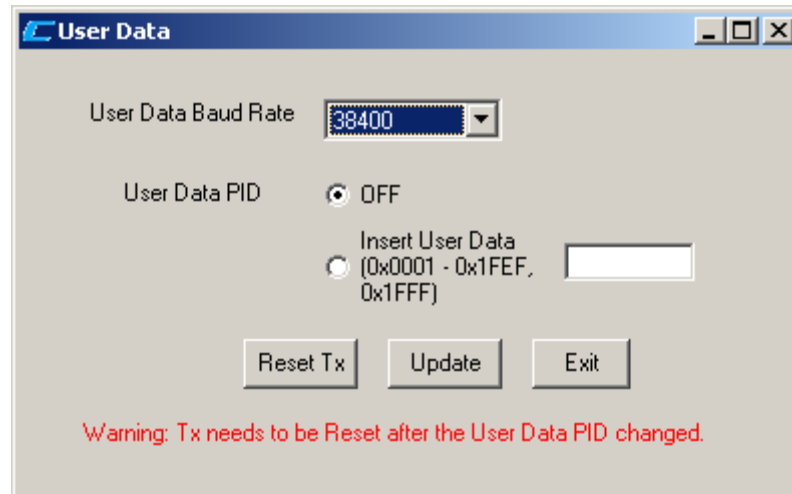


Figure 24 User Data Setup

7.3.6.2.1.6 Others

This menu displays the following (see Figure 25)

- **RF Output Att (0dB – 7dB)** – The RF output can be attenuated in 1 dB increments up to a frequency band defined maximum.
- **C-OFDM 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.
- **Sleep 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.

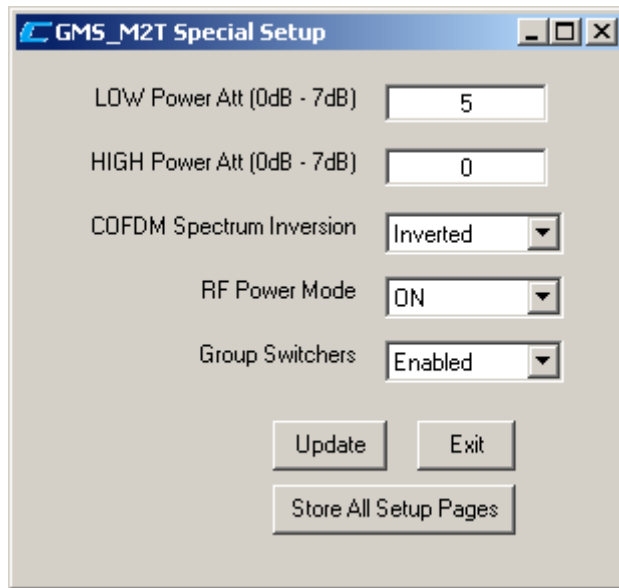


Figure 25 Others

7.3.6.2.2 Transport Stream

The transport stream menu (reference Figure 26) 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.

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.

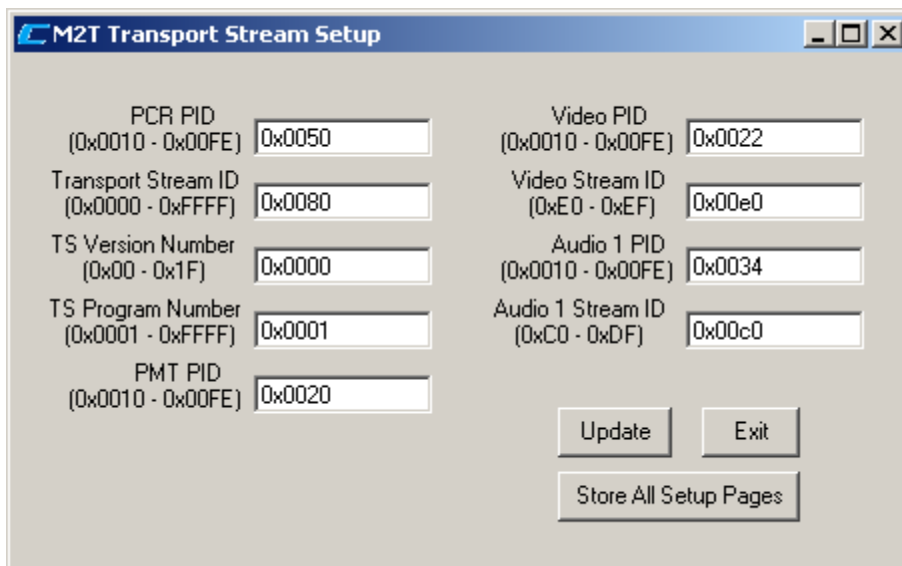


Figure 26 Transport Stream Setup

7.3.6.3 Help

This pull-down menu contains information about the M2T-C firmware and the M2T-C 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 27.
- **FW version:** This selection pulls up a window that displays the M2T-C unit serial number and current versions of firmware. See figure 28.
- **About:** This selection pulls up a window that displays the Version Number of the M2T-C Configurator program.

The screenshot shows a window titled "Channel Rate Guide" with a dropdown menu for "COFDM Bandwidth" set to "8MHz". Below the dropdown is a table with the following data:

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	10.5581	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 27 Channel Rate Guide

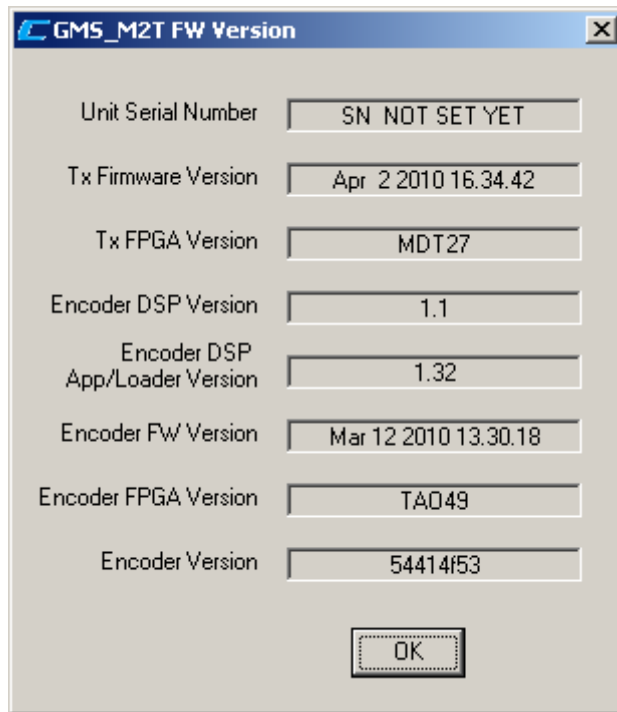


Figure 28 FW Version

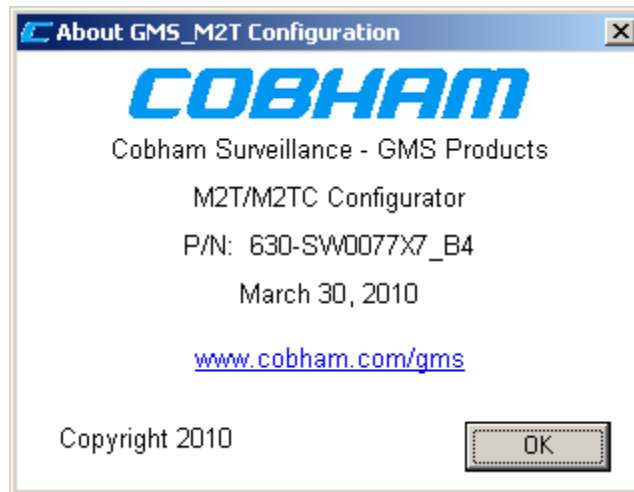


Figure 29 About Box

8.0 Fan Filter Maintenance

At least twice a year the filters for the two external fans should be cleaned. The recommended procedure is to use compressed air, blowing through the fans in the direction indicated, see figure 30 below. The debris exits through the cooling fins as shown. Don't use excessive air pressure, start with a reasonable setting, around 30 PSI and increase as necessary to clean the filters noting that excessive pressure may damage the fan housing or the fans.



9.0 Spec

The fo

9.1 Vide

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	1920X1080i @ 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

9.2 Video Encoding (SD)

Interfaces: SDI, Component, Composite or S-Video

Standards: SMPTE-282M

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: BNC-F, p/o DB-15F

9.3 Audio Encoding

Analog Audio: Dual, Line-Level or Mic-Level, Differential or Single-Ended, Clip Level 12dBm (see section 5.1.1.8 for audio input configuration setups)

Input Impedance: 600 Ohms or 2K Ohms (see section 5.1.1.8 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)

9.4 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.

9.5 Control

The M2T-C can be controlled locally via internal control panel or remotely through USB-1 via a MS Windows based application. The DRL can also be used to control the transmitter remotely.

9.6 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: N-Type Female

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.

9.7 Modulation

Modulation Type: C-OFDM w/ QPSK, 16QAM or 64 QAM

9.8 Standard DVB-T Compliant

FEC: $1/2, 2/3, 3/4, 5/6, 7/8$

Guard Intervals: $1/32, 1/16, 1/8, 1/4$

Spurious: 50dBc

Number of C-OFDM Carriers: 2k

9.9 High Throughput Option

FEC: $1/2, 2/3, 3/4, 5/6, 7/8$

Guard Intervals: $1/32, 1/16, 1/8, 1/4$

Spurious: 50dBc

Number of COFDM Carriers: 4k Carriers

9.10 Power

DC Input Voltage Range: 9 to 15 VDC

******Power Consumption:** approx. 16 Watts (ASIC version)

Power supplied via battery connector or through DB-15 connector.
(DB-15F pins 14, 15 +Vcc, Pin 13 GND)

9.11 Environmental

Operational Temperature: -10 to +65 °C

Humidity: Up to 100% (non-condensing)

9.12 Physical

Dimensions (less connectors): 10.5" (L) x 5.25" (W) x 1.85" (H)
26.67 cm x 13.34 cm x 4.7 cm

Weight: 3.7lbs (1.68 kilograms)

9.13 Physical Interfaces

RF Antenna Port: N-Type-F

DRL Antenna Port: SMA F

Composite Input: BNC-F

ASI Out: BNC-F

SDI/HDSI Input: BNC-F

Audio Inputs: 3-pin XLR-F

Control/Optional: DB-15F

9.14 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

9.15 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-15

Requires DDPC with AES Option on Rx Side

9.16 Data Return Link (DRL)(Option)

Frequency: 902-928 MHz

Modulation: FHSS

Output Power: Up to 1W, adjustable

Data Rates: Up to 115.2K baud, Full Duplex

Interface: RS485C via DB-15F (RS232C Converters Available)

* With 4K High-Throughput Option

** C-OFDM modulator limits high end of bit rate to 32 Mbps or 64 Mbps*.

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

**** When Data Return Link is off.

10.0D/C (Down Converter) IF frequencies explained

10.1 IF Frequencies

- MSR receivers (and many other digital receivers) are capable of receiving direct frequencies in the range of approximately 49 MHz to 861 MHz. 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-C) 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 7.3.6.2.1.6 for inverting the signal.

10.2 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 +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 the remote power should be set to "OFF".

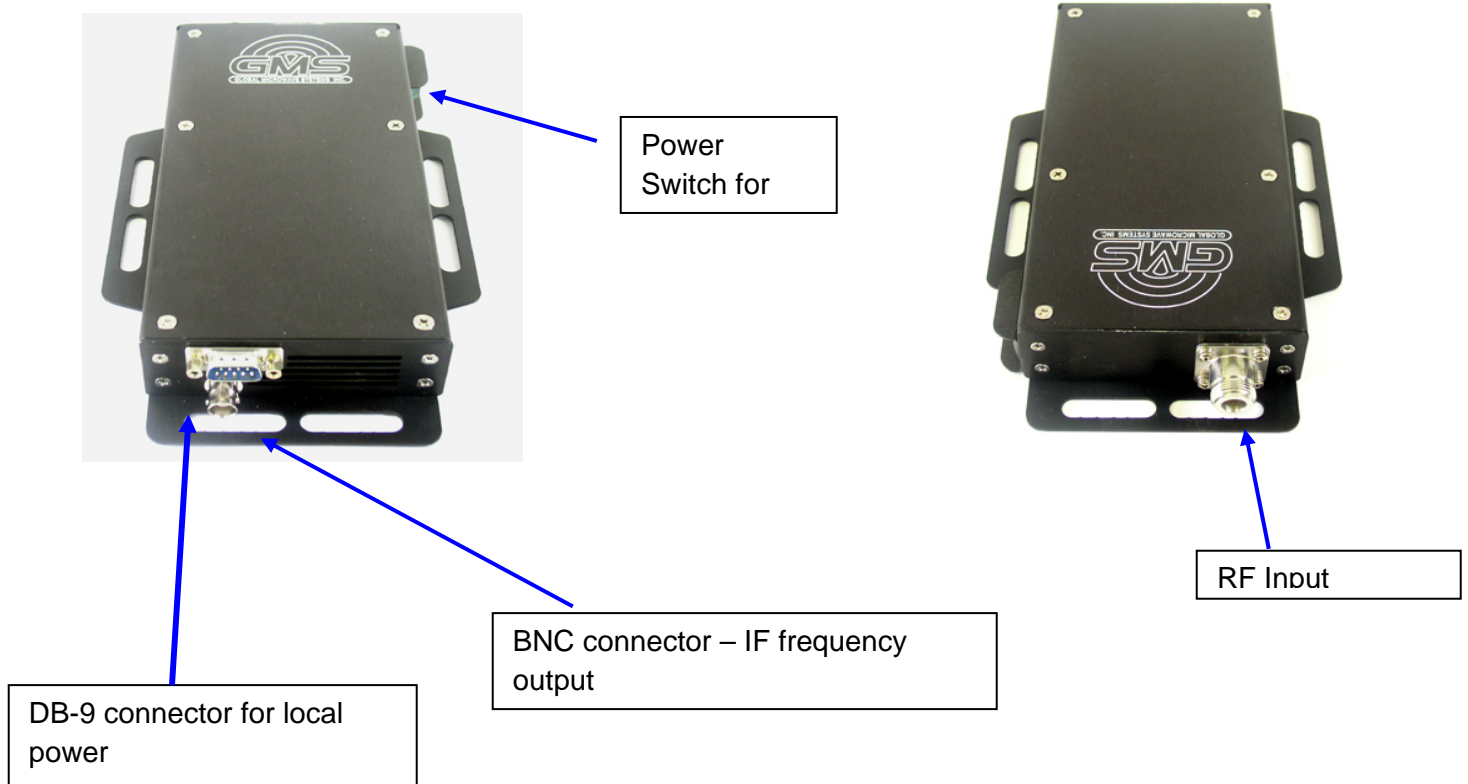


Figure 31 BDC Connectors

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

11.0 Cable Losses

11.1 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 8dB 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 6dB.

Appendix A – Cable, M2T-C External Breakout

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_Level/Line	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