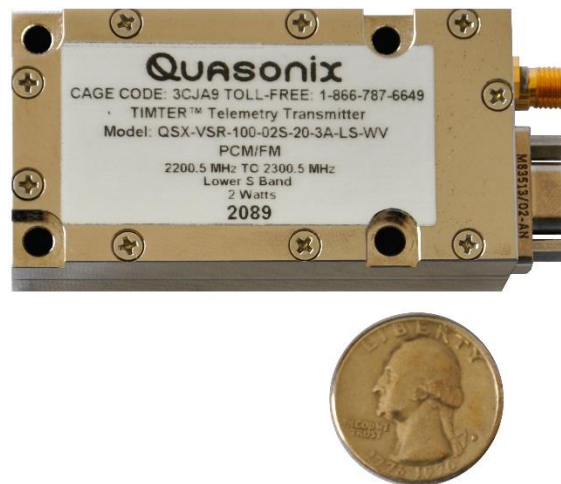


Installation and Operation Manual

GMLRS Telemetry Transmitter



Quasonix, Inc.
6025 Schumacher Park Dr.
West Chester, OH 45069
21 March 2025

Revision 1.3.19

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1 Introduction

1.1 Description

This document describes the installation and operation of Quasonix' GMLRS Multi- mode Digital Telemetry Transmitters. The GMLRS is designed to transmit airborne telemetry data from a test article to ground stations. The transmitters are developed, manufactured, and supported by:

Quasonix, Inc.
6025 Schumacher Park Drive
West Chester, OH 45069
CAGE code: 3CJA9

1.1.1 Nomenclature

The GMLRS is available in a number of variations, depending on the options specified at the time of order. The features and modes installed in each unit are identified in the model number, as depicted in Figure 1.

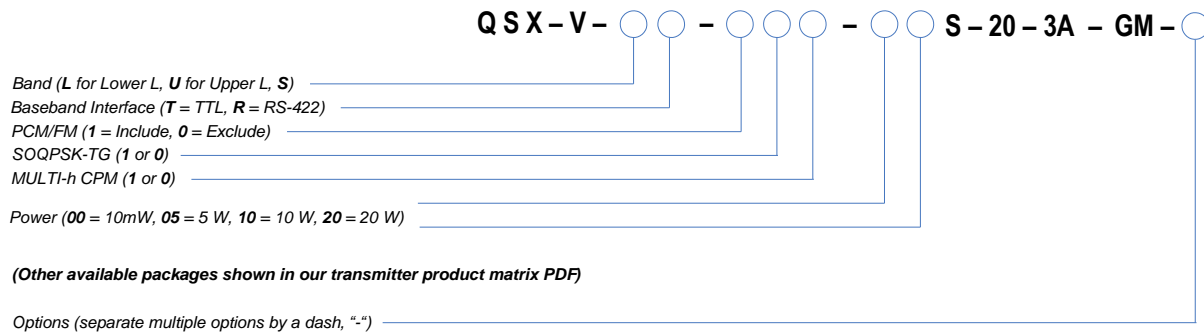


Figure 1: Transmitter Ordering Method

In this manual, the words Terminal Control and Serial Control have the same meaning and are used synonymously throughout this manual. Serial control originates from configuring the transmitter from a computer's legacy RS-232/422 serial communications (COM) port. Terminal Control reflects the more generic case where the transmitter could be controlled by other standard computer interfaces such as Ethernet.

Other TIMTER™ transmitter models are covered in separate user manuals, available for download from the company website: www.quasonix.com.

The GMLRS™ software and hardware options include: Refer to section 1.2 for detailed descriptions of each option.

- AC Automatic carrier wave output
- ACS Auto carrier save
- AP Adapter plate for 2.5" x 3.5" footprint – Include this hardware accessory with order
- BRx Non standard bit rates
- C7 Quasonix interpretation of IRIG 106-17 Appendix 2-C serial control protocol

- CC Conformal coat boards assemblies – Include this hardware option with order
- CE Convolutional encoder (includes NRZ-M encoding)
- CF Clock-free baseband interface
- CG Clock generator output
- DP Dual power (Ability to set a low and a high setting, hardware controlled*)
- FO Frequency Offset
- GM GMLRS – Include this hardware option with order
- GN GPS notch filters to meet -147 dBm/Hz at L1 and L2 – Include this hardware option with order
- HRxx Increases max bit rate up to 46 Mbps (20 Mbps max for Clock Free mode)
- ID Internal Clock and Data can be saved as a power-up default
- LD LDPC forward error correction encoding
- LHxxxx Low band high limit (xxxx = Frequency Limit in MHz)
- LLxxxx Low band low limit (xxxx = Frequency Limit in MHz)
- LRxx Decreases min bit rate to 0.05 kbps (50 kbps min for Clock Free mode)
- LS Lower S-band (2200.5 MHz to 2289.5 MHz) only
- M0 Enables PCM/FM mode
- M1 Enables SOQPSK mode
- M2 Enables MHCPM mode
- MS Modulation scaling
- NRF No RF On/Off pin
- PS Enable hardware presets (specify 2, 4, 8, or 16 – PS2, PS4, PS8, PS16)
- PSK Adds BPSK, QPSK, OPSK, PM/BPSK
- RN Randomizer output
- SHxxxx S band high limit option (xxxx = Frequency Limit in MHz)
- SLxxxx S band low limit option (xxxx = Frequency Limit in MHz)
- STDN Supports Spacecraft Tracking and Data Network (PM/BPSK) mode
- UHxxxx U band high limit option (xxxx = Frequency Limit in MHz)
- ULxxxx U band low limit option (xxxx = Frequency Limit in MHz)
- US Upper S-band (2289.5 MHz to 2394.5 MHz) only
- VF Variable FIFO Depth
- VP Variable power (32 settings, spanning 24 dB), software controlled*
- WV Wide input voltage range

Refer to Table 13 in section 4.2.1 for detailed descriptions of each option. Due to input connector pin count limitations, certain combinations of options are not available. Please contact Quasonix for support in ordering GMLRS options.

The model number identifies the configuration of the unit. For example, model number QSX-VST-110-01S-20-3A-GM defines a unit configured as follows:

Table 1: Model Configuration Example

Identifiers	Description
QX	Quasonix Product
V	Variable bit rate
S	S band
T	TTL clock and data interface
110	Tier 0 present, Tier I present, Tier II absent
01S	1 Watt RF output
20	Standard maximum bit rate = 20 Mbps
03AA	3.5 cubic inch package, "A" configuration
GM	GMLRS option

1.2 Model Number Field Codes

1.2.1 Band

Band field codes are listed in Table 2.

Table 2: Band Field Codes

Model Number Code	Band	Minimum Freq	Maximum Freq	Default Freq
L	Lower L	1435.5 MHz	1534.5 MHz	1450.5 MHz
U	Upper L	1750.0 MHz	1855.0 MHz	1800.5 MHz
S	S	2200.5 MHz	2394.5 MHz	2370.5 MHz
LS	Lower S	2200.5 MHz	2300.5 MHz	2250.5 MHz

1.2.2 Interface

Interface field codes are listed in Table 3.

Table 3: Interface Field Codes

Model Number Code	Baseband Clock and Data Interface
T	TTL (single-ended, compatible with 3.3 volt or 5 volt logic)
R	TIA/EIA-422 (formerly known as RS-422) (differential)

1.2.3 ARTM Tier 0

ARTM Tier 0 field codes are listed in Table 4.

Table 4: ARTM Tier 0 Field Codes

Model Number Code	PCM/FM (ARTM Tier 0)
0	Absent
1	Present

1.2.4 ARTM Tier I

ARTM Tier I field codes are listed in Table 5.

Table 5: ARTM Tier I Field Codes

Model Number Code	SOQPSK-TG (ARTM Tier I)
0	Absent
1	Present

1.2.5 ARTM Tier II

ARTM Tier II field codes are listed in Table 6.

Table 6: ARTM Tier II Field Codes

Model Number Code	Multi-h CPM (ARTM Tier II)
0	Absent
1	Present

1.2.6 Output Power

Output Power field codes are listed in Table 7.

Table 7: Output Power Field Codes

Model Number Code	RF Output Power
01	1 Watt (+30 dBm), minimum
02	2 Watt (+33 dBm), minimum
05	5 Watt (+37 dBm), minimum

1.2.7 Power Supply

Power Supply field codes are listed in Table 8.

Table 8: Power Supply Field Codes

Model Number Code	DC Input Current at Standard Input Voltage
S	1 Watt models 450 mA max., 350 mA typ. @ 28 VDC 2 Watt models 570 mA max., 480 mA typ. @ 28 VDC 5 Watt models 1.0 A max., 800 mA typ. @ 28 VDC

1.2.8 Package

Package field codes are listed in Table 9.

Table 9: Package Field Codes

Model Number Code	Package Dimensions (Excluding Connectors)
03AA	3.545 in 3 1.400" (W) x 2.700" (L) x 0.938" (H)

1.2.9 Automatic Carrier Wave Output Option - AC

This option allows the TIMTER™ to transmit a carrier wave when the clock input is absent, which would normally cause the RF output to be turned off.

1.2.10 Auto Carrier Save Option – ACS

This option allows the TIMTER to transmit a carrier wave when the clock input is absent, which would normally cause the RF output to be turned off, just like the AC option. ACS uses the saved setting of AC on power up instead of forcing AC on like the legacy option.

1.2.11 Baud Rate Option – BRx

The BR option changes the default baud rate on the transmitter to the one selected. A number from 0-8 follows the BR option request. Corresponding values are as follows: 0 = 57600 (Standard default for all Quasonix transmitters); 1 = 4800; 2 = 9600; 3 = 19200; 4 = 38400; 5 = 56000; 6 = 57600; 7 = 115200, 8 = Max.

1.2.12 CP07 Control Protocol Option – C7

The Quasonix interpretation of IRIG 106-17 Appendix 2-C serial control protocol (CP07) “provides standards for commands, queries, and status information when communicating with telemetry transmitters configured with communication ports.” The Basic command set contains the minimum (required) commands for transmitter control, query, and status. The Extended command set contains optional commands that may or may not be implemented at the manufacturer’s discretion. CP07 is enabled when the C7 option is requested.

The default baud rate for CP07 transmitters is 9600.

1.2.13 Conformal Coat – CC

Use this option to include conformal coated board assemblies (hardware note) with the order. Consult Quasonix for pricing and availability.

1.2.14 Convolutional Encoder Option – CE

The CE option enables convolutional encoding and NRZ-M conversion. This encoding adds redundant information to the transmitted data stream to help detect and correct bit errors that may occur, particularly due to predominantly Gaussian noise. Use of convolutional encoding requires a matching Viterbi decoder in the receiver to extract the source data. The encoded data rate will be twice the source data rate, and the occupied bandwidth will also be doubled.

1.2.15 Clock-free Baseband Interface Option – CF

Clock-free is an optional mode that transmits user data, but uses an internal bit sync to take the place of the normal external clock. The standard TIMTER™ requires external clock and data inputs. With the CF option, no external clock is required. The clock is generated directly from the data and a user-specified bit rate.

Because the internal bit sync’s clock takes the place of the normal external clock in clock-free mode, the selected clock source must be external for clock-free just like it is for normal clock/data. This mode is most often used to retrofit older analog transmitters in TM systems where the crypto device does not deliver a clock to the transmitter.

The commanded clock-free rate can be saved using the SV command, and if so, it will be restored at power-on. When the CF option is used, the bit rate range is 0.1 kbps to 35 Mbps for all waveform modes. It is limited by the bit rate achievable for the current mode. (Refer also to the HRxx and LRxx options for extended bit rates, and the ID option for Internal Clock and Data.)

Do not confuse the **CF option** with **CS/DS commands**.

Internal clock (CS 1 Command) is used when the transmitter is to be a test source only. The unit transmits the selected internal data pattern (DS 1 command) at the bit rate set by the user via the IC command. The internal clock is not used to transmit actual payload data.

External clock (CS 0 Command) is the normal mode: the user supplies clock and data, or in clock-free mode, the user supplies only valid data. Refer to Table 13 for user commands.

1.2.16 Clock Generator Output Option – CG

The standard TIMTER™ includes internal clock and data generators, generally used for system test. The CG option takes this internal clock out of the unit on the primary MDM-9 connector. The assignment of output pins depends on the other features selected. Consult Quasonix to order the CG option.

1.2.17 Dual Power Option – DP

The standard TIMTER™ operates at its full rated RF output power. The DP option provides two software-programmed, hardware-actuated settings, designated by the user as “high power” and “low power”. There are 32 choices for “high power” and 32 choices for “low power”. The low power setting can provide as much as 24 dB of attenuation from the high power setting.

1.2.18 Frequency Offset Option – FO

This option is used to set frequencies that are NOT aligned to the synthesizer step size for their units, typically 500 kHz, and it enables the FO user command. If the FO option is present, the resolution is 1 Hz (0.000001 MHz).

1.2.19 GMLRS Option – GM

Use this option to specify the GMLRS (hardware configuration) with the order.

1.2.20 GPS Notch Option – GN

Use this option to specify GPS notch filters to meet -147 dBm/Hz at L1 and L2 (hardware note). Available for S band only. Consult Quasonix for pricing and availability.

1.2.21 High Bit Rate Option – HR

The standard GMLRS supports bit rates from 0.1 to 28 Mbps in SOQPSK-TG and MULTI-h CPM modes, 0.5 to 14 Mbps in PCM/FM (Tier 0) mode and in all modes included with the PSK option. The HRxx option increases the bit rate to a maximum of 46 Mbps (23 Mbps for PCM/FM). (The maximum bit rate with a Clock Free transmitter is 35 Mbps for SOQPSK-TG and MULTI-h CPM modes; 23 Mbps for PCM/FM and all legacy PSK modes.) Refer to the CF option for information about the Clock Free option.

Refer to Table 10 for bit rate comparisons by mode.

Table 10: Standard Bit Rates Compared to Low/High Rate Options

	Standard Bit Rate	With Low Rate Option –LR	With High Rate Option –HR*
ARTM Tier 0 Modulation (PCM/FM)	0.05 -14 Mbps	Down to 0.025 Mbps	Up to 23 Mbps
ARTM Tier I Modulation (SOQPSK-TG)	0.1 – 28 Mbps	Down to 0.050 Mbps	Up to 46 Mbps
ARTM Tier II Modulation (Multi-h CPM)	0.1 – 28 Mbps	Down to 0.050 Mbps	Up to 46 Mbps
Legacy Modulation (BPSK)	0.05 – 10 Mbps	N/A	N/A
Legacy (QPSK, OQPSK)	0.05 – 20 Mbps	N/A	N/A

*Maximum data rates on Quasonix transmitters are limited by the equipment used to test the transmitter.

Experiments and simulations suggest that the transmitters can generate “high fidelity” PCM/FM up to about 40 Mbps, and SOQPSK and ARTM CPM up to about 80 Mbps. However, our test station demodulators cannot run above the specified 23 Mbps and 46 Mbps rates, so performance above those rates is unspecified.

1.2.22 Internal Clock and Data Option – ID

This option allows internal clock and data, specified by the CS and DS user commands, to be saved and recalled by any means, including presets and power-on reset. Refer to the CF option for information about the Clock Free option.

1.2.23 Forward Error Correction / Low Density Parity Check (LDPC) Option – LDPC

This option provides the Low Density Parity Check (LDPC) encoding, which is being considered for use on the iNET program. LDPC has been adopted by the Range Commander's Council, IRIG 106-17, Appendix 2-D.

1.2.24 Low Band High Limit Option – LH

This option specifies a new high frequency limit for the lower L band. The standard maximum frequency for lower L band is 1534.5 MHz. The maximum extension is 100 MHz above the normal limit.

1.2.25 Low Band Low Limit Option – LL

This option specifies a new low frequency limit for the lower L band. The standard minimum frequency for lower L band is 1435.5 MHz. The minimum extension is 100 MHz below the normal limit.

1.2.26 Low Bit Rate Option – LR

The standard GMLRS supports bit rates from 0.1 to 28 Mbps in SOQPSK-TG and MULTI-h CPM modes, 0.5 to 14 Mbps in PCM/FM (Tier 0) mode and in all modes included with the PSK option. The LRxx option decreases the bit rate to a minimum of 50 kbps (25 kbps for PCM/FM). (The minimum bit rate with a Clock Free transmitter is 50 kbps for all modes.) Refer to the CF option for information about the Clock Free option.

1.2.27 Lower S-band Option – LS

This option limits the operating range of the S-band TIMTER™ to the lower-half of the frequency band, 2200.5 MHz to 2289.5 MHz.

1.2.28 PCM/FM Mode Option – M0

The standard GMLRS provides a carrier only mode. This option enables PCM/FM (Pulse Code Modulation/Frequency Modulation) mode.

1.2.29 SOQPSK Mode Option – M1

The standard GMLRS provides a carrier only mode. This option enables SOQPSK (Shaped Offset Quadrature Phase Shift Keying) mode.

1.2.30 Multi-h CPM Mode Option – M2

The standard GMLRS provides a carrier only mode. This option enables Multi-h CPM (Multi-h Continuous Phase Modulation) mode.

1.2.31 Randomizer Control Option – MK

The standard TIMTER™ provides a user command (RA) that reports or sets the randomizer state. This option enables ON/OFF control of the randomizer with a hardware pin. Use this option to specify the Randomizer Control (hardware configuration) with the order.

1.2.32 Modulation Scaling Option – MS

This option enables the MS and MJ commands which allow a user to set the modulation scaling factor and scale the modulation index of the transmitted signal. For additional information, refer to Table 13, or contact Quasonix.

1.2.33 No RF On/Off Pin Option – NRF

Some hardware options may require the use of additional pins (such as for setting hardware presets). This option makes a pin available by specifying no RF On/Off pin (hardware note).

1.2.34 PSK Option – PSK

The standard TIMTER™ provides a carrier only mode. Additional PSK (Phase Shift Keying) modes are enabled when the PSK option is requested. This option includes BPSK (Binary), QPSK (Quadrature), OPSK (Offset Quadrature), and PM/BPSK (Phase Modulation/Binary) modes.

1.2.35 Randomizer Output Option – RN

The standard TIMER includes the IRIG-106 randomizer for the RF output. The IRIG-106 randomizer is controlled through the serial interface. The RN option brings the randomized data out on the primary MDM-9 connector. The assignment of output pins depends on the other features selected. Consult Quasonix for details.

1.2.36 S Band High Limit Option – SH

This option specifies a new high frequency limit for the S band. The standard maximum frequency for S band is 2394.5 MHz. The maximum extension is 100 MHz above the normal limit.

1.2.37 S Band Low Limit Option – SL

This option specifies a new low frequency limit for the S band. The standard minimum frequency for S band is 2200.5 MHz. The minimum extension is 100 MHz below the normal limit.

1.2.38 Spacecraft Tracking and Data Network Option – STDN

This option supports the PM/BPSK mode (Spacecraft Tracking and Data Network mode).

1.2.39 U Band High Limit Option – UH

This option specifies a new high frequency limit for the U band (also known as Upper L band). The standard maximum frequency for U band is 1855.0 MHz. The maximum extension is 100 MHz above the normal limit.

1.2.40 U Band Low Limit Option – UL

This option specifies a new low frequency limit for the U band (also known as Upper L band). The standard minimum frequency for U band is 1750.0 MHz. The minimum extension is 100 MHz below the normal limit.

1.2.41 Upper S-band Option – US

This option limits the operating range of the S-band TIMTER™ to the upper-half of the frequency band, 2289.5 MHz to 2394.5 MHz.

1.2.42 Variable FIFO Depth Option – VF

This option enables the VF command which allows the user to set the FIFO depth on the transmitter for controlling latency time between bits in and bits out. The range is 0 to 255 with 128 being the default. If no value is entered, the current value displays.

1.2.43 Variable Power Option – VP

The standard TIMTER™ operates at its full rated RF output power. The software-based VP option provides 32 discrete power level settings, spanning a range of as much as 24 dB. The steps are non-uniform, but steps are typically no larger than 1.1 dB.

1.2.44 Wide Input Voltage Range Option – WV

The standard nanoTX™ operates from $+28 \pm 4$ VDC. The WV option extends operating input voltage range as shown in following table.

Voltage Ranges with WV Option
+8.0 to +34 VDC for 1 Watt version
+8.0 to +34 VDC for 2 Watt version
+12 to +34 VDC for 5 Watt version

2 Accessories

Quasonix offers a number of optional accessories for the GMLRS transmitter, including a fan-cooled, bench heat sink, and pre-wired male and female MDM-9 connectors. Regardless of the heat sink, Quasonix strongly suggests using a thermal pad, such as Q-Pad® II from Bergquist. Refer to section 3.2, for additional thermal information.

Contact Quasonix for pricing and availability of GMLRS accessories.

2.1 Bench Heat Sink (for ground applications only)

Part Number: QSX-AC-32-HS-12V

The heat sink assembly includes an integral +12 VDC fan and a power supply transformer, shown in Figure 2. The heat sink is shown with a mounted GMLRS in Figure 3.



Figure 2: Bench Heat Sink and Power Supply



Figure 3: Bench Heat Sink with GMLRS

2.2 Pre-wired Female MDM-9 RS-422 Connector

Part Number: QS-CBL027

A female MDM-9 connector with 24" color-coded pigtail cables for connecting to the transmitter's clock and data baseband interface is shown in Figure 4.



Figure 4: Pre-wired Female MDM-9 with 24" Pigtails

2.3 Pre-wired Male MDM-9 RS-422 Connector

Part Number: QS-CBL028

A male MDM-9 connector with 24" color-coded pigtail cables for connecting to a transmitter's clock and data baseband interface is shown in Figure 5.

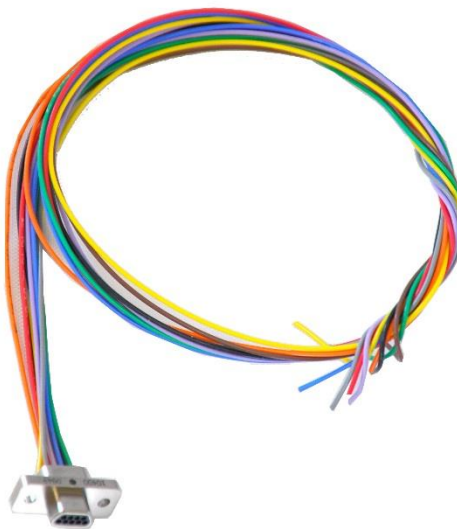


Figure 5: Pre-wired Male MDM-9 with 24" Pigtails

3 Installation Instructions

3.1 Mechanical

The 3.6 cubic inch GMLRST™ (“3A” package) is designed to be mounted by four (4) 6-32 x 1.000 screws through the holes in the four corners, as depicted in Figure 6. Mounting holes: clearance holes for 6-32 screws on a 1.11” x 1.885” rectangle.



Figure 6: 3.6 in³ GMLRS Transmitter

The primary interface connectors on the 3A package are one male MDM-9 and one female MDM-9. The RF connector is a female SMA. Pin numbers for the male MDM-9 are listed in Table 11. Pin numbers for the female MDM-9 are listed in Table 12.

Table 11: Male MDM-9 (J1) Pinout

Pin	Function
1	Power Input
2	Power Return
3	No Connection
4	TX Enable/Disable
5	No Connection
6	Power Input
7	Power Return
8	Frequency Select Return
9	Frequency Select

Table 12: Female MDM-9 (J2) Pinout

Pin	Function
1	RS-422 Data In -
2	RS-422 Data In +
3	No Connection
4	No Connection
5	No Connection
6	RS-422 Clock In -
7	RS-422 Clock In +
8	Randomizer On/Off
9	Loopback Out

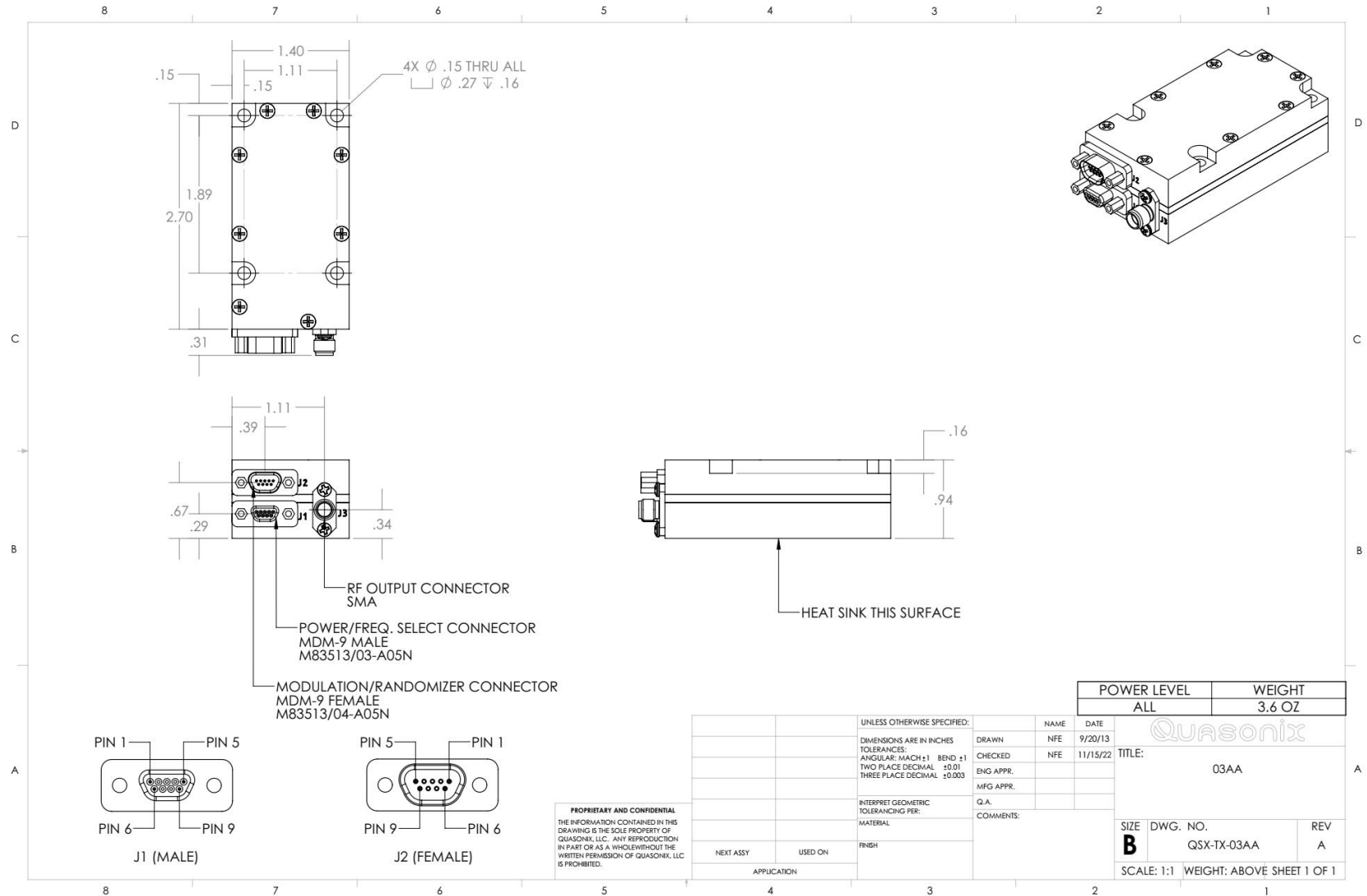


Figure 7: Outline Drawing, GMLRS Telemetry Transmitter -3A Package

3.2 Thermal

It is important that the bottom surface (on the face opposite the product label) be securely attached to a baseplate capable of dissipating the power produced by the transmitter model in use. This mounting baseplate must be flat, smooth, and clean. Contact Quasonix for the heat sink power dissipation required for your GMLRS.

ATTENTION: Do not operate the transmitter without a proper heat sink. Failure to do so may lead to permanent damage to the unit and will void the warranty. Overheating can occur in a matter of seconds when a transmitter is not properly heat-sinked. In absolutely no case should any type of stickers or labels be applied to the bottom surface of the transmitter.

The heat sink required for a particular transmitter depends heavily on the installation. Factors such as altitude, air temperature, air flow, and mass of the mounting surface all have a substantial impact on the flow of heat away from the transmitter. Quasonix offers a fan-cooled heat sink, as shown in Figure 2. Please contact Quasonix for heat sink recommendations for your particular GMLRS transmitter.

Regardless of the heat sink, Quasonix strongly suggests using a thermal pad, such as Q-Pad® II from Bergquist.

3.3 Electrical

The standard GMLRS has two external connectors, a 9-pin female modulation/randomizer connector, a 9-pin male power/frequency selection connector, and a standard SMA RF connector.

A labeled photo of the 9-pin MDM connectors is shown in Figure 8, including identification of pin 1.

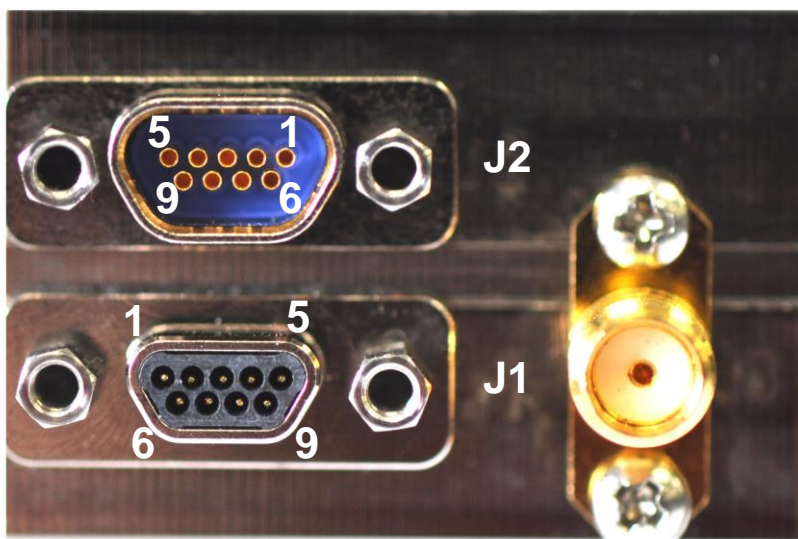


Figure 8: Female and Male MDM-9 Connectors, Standard SMA Connector

3.3.1 Signal Timing

The data is sampled on the falling edge of the clock, as shown in Figure 9.

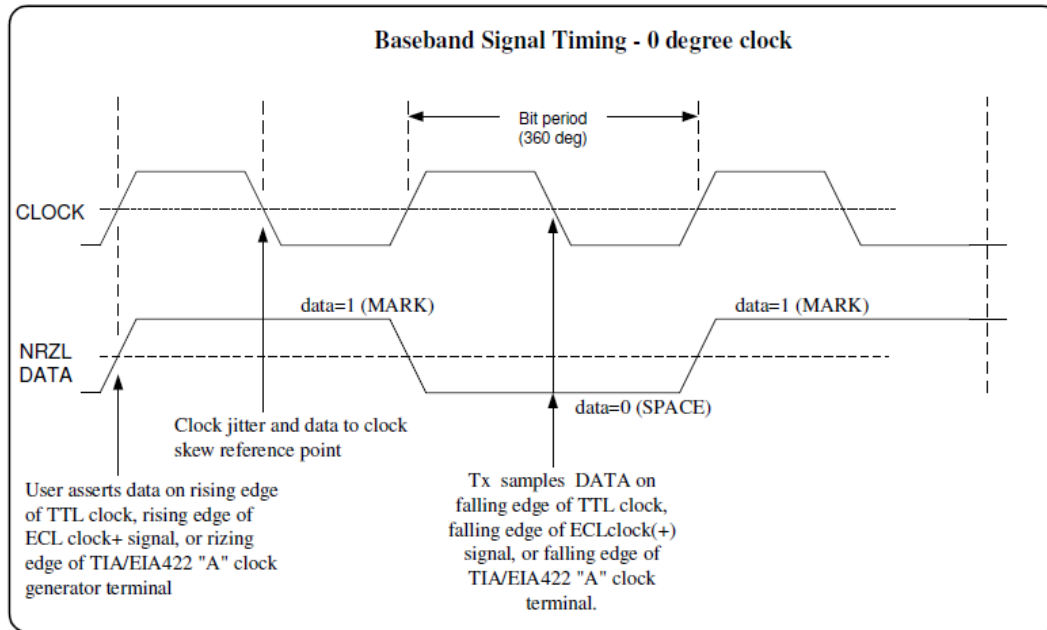


Figure 9: Baseband Signal Timing

4 Operating Instructions

4.1 Power-on Operation

Upon power up, the transmitter loads any stored parameters present in its nonvolatile memory. If parameters have not been stored previously, the transmitter initializes default parameters and then stores them in the first preset slot, 0. There are a total of 16 available software-based presets (0 through 15) for saving multiple parameters at once for future use.

4.2 GMLRS Serial Control Protocol

The GMLRS is controlled via a simple three-wire serial interface (transmit, receive, and ground). The serial port configuration is as follows:

- 57600 baud rate (changeable depending on the configuration option)
- 8 bits
- No parity
- 1 stop bit
- No flow control

For setup and configuration via a standard Windows-based PC, you may use HyperTerminal. For a more flexible, full-featured control interface, we recommend Terminal, available for download from the Quasonix website (Documents tab > Accessories link) or directly at:

http://www.quasonix.com/sites/default/files/terminal_ver20080315.zip.

If the terminal program is active when power is applied to the transmitter, the following welcome message displays, as shown in Figure 10. At this point, you can verify that your serial connection is active in both directions by issuing any standard command, such as “FR” to learn the frequency.

```

Quasonix Multi-Mode Digital Transmitter

Customer Part # = QSX-xxx-xx-xx...
Customer Name = Quasonix Customer
Contract # = 999999-9
TX Serial # = 1001
Hardware Rev: A
PA Rev: F
PA Serial #: 1001
PA Model #: XMTR-PAM-10-F-SCPA
IRIG 106-09
6025 Schumacher Park Drive
West Chester, OH 45069
(513) 942-1287
www.Quasonix.com
CAGE CODE: 3CJA9
FPGA HW Type: T4D
FPGA version: 001h 02ah
FPGA Buld: 0x5B6C5E7C = Aug 9 2018 15:32:12
Firmware version: T4 V1.131 8/9/2018

Preset 0 read
SOQPSK>HVA table not valid for any band.
DL table not valid for any band.
Ready for Commands
SOQPSK>RF on/off pin changed from 0 to 1
SOQPSK>BB clock rate out of limits (clk = 0 kHz)
SOQPSK>

```

Figure 10: GMLRS Welcome Message

4.2.1 Command Set: Standard and Optional Commands

All standard user commands in Table 13 are one or two alphabetic characters, followed by 0, 1, or 2 arguments. If the command is issued with arguments, there must be a space after the alphabetic characters. The commands are *not* case sensitive. A carriage return is required to initiate each command except for the single key commands described at the beginning of the table.

Most parameters set by these commands are stored in the unit's nonvolatile flash memory (CS and DS are the exception). On power-up, ALL settings are restored from preset 0, which is the default power on configuration.

All settings can be changed via the serial control port. Changes made by the user are NOT saved unless the Save command (SV) is issued from the serial control port before powering down.

***SV Note:** Users may save internal clock and data in presets for bench debug use BUT on a power up or when a *hardware* preset is restored, **CS** and **DS** will be forced to **0** (external clock and data). This action prevents a transmitter from powering up or changing hardware presets and being set to internal clock and/or data. The **ONLY** way to restore **CS** and/or **DS** as **1** from a saved configuration is by executing the **RC** command.

Table 13: Standard and Optional User Commands

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
[Frequency Step Down	Left square bracket key retunes the transmitter to the next lower frequency, as determined by the frequency step (FS) parameter Reply to the control window is the new frequency, in MHz No Enter key required	Standard	N/A	N/A
]	Frequency Step Up	Right square bracket key retunes the transmitter to the next higher frequency, as determined by the frequency step (FS) parameter Reply to the control window is the new frequency, in MHz No Enter key required	Standard	N/A	N/A
?	Help	Displays abbreviated list of available commands No Enter key required	Standard	N/A	N/A
<	Step Down Power	Incrementally steps down the output power level, from 31 down to 0 One step per key press No Enter key required	VP	N/A	N/A
>	Step Up Power	Incrementally steps up the output power level, from 0 up to 31 One step per key press No Enter key required	VP	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
AC	Automatic Carrier Output	<p>Report or set automatic carrier output state</p> <p>With automatic carrier ON (AC 1), the unit will output an unmodulated, on-frequency carrier if there is no clock present. When automatic carrier is OFF (AC 0), the RF output will be muted in the absence of clock.</p> <p>Note that the AI, CF, and CS commands can create a clock, even when one is not externally applied.</p> <p>Examples:</p> <p>AC Report the automatic carrier state</p> <p>AC 0 Set automatic carrier OFF</p> <p>AC 1 Set automatic carrier ON</p> <p>Refer to section 4.2.1.1.14.2.1.1.1 for additional AC command detail</p>	AC ACS	N Y	AC 1
BR	Bit Rate	<p>Report or set the bit rate of the bit sync that is locking to the externally applied data</p> <p>Not to be confused with "IC", which sets the rate of the internally generated clock</p> <p>Bit rate range is 50 kbps to 20 Mbps for all waveform modes</p> <p>Examples:</p> <p>BR Report the bit rate</p> <p>BR 5 Set the bit rate to 5 Mbps</p> <p>BR A Set the bit rate automatically</p> <p>Refer to section 4.2.1.1.2 for additional BR command detail</p>	CF	Y	BR 5

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
CC	Convolutional Encoder	<p>Enables or disables the convolutional encoder</p> <p>Examples</p> <p>CC Report convolutional encoder state</p> <p>CC 0 Set the convolutional encoder to Disabled</p> <p>CC 1 Set the convolutional encoder to Enabled</p> <p>Refer to section 4.2.1.1.3 for additional CC command detail.</p>	CE	Y	CC 0
CF	Clock Free	<p>Report or set the clock free state.</p> <p>Examples:</p> <p>CF Report the clock free state</p> <p>CF 0 Unit uses its internal bit sync (internally synthesized)</p> <p>CF 1 Unit uses its externally applied clock</p> <p>Also refer to Appendix B – Understanding Clock/Data, AC, and BR</p>	CF	Y	CF 1
CP	Clock Polarity	<p>Report or set clock polarity</p> <p>Examples:</p> <p>CP Display the current clock polarity</p> <p>CP 0 Set clock polarity to NOT inverted</p> <p>CP 1 Set clock polarity to inverted</p> <p>CP A Set clock polarity to auto; Automatically selects the most reliable clock edge</p>	Standard	Y	CP 0
CR	Current Preset Read	Reports the currently selected software preset being used by the transmitter	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
CS	Clock Source	<p>Report or set the clock source Unit always reverts to CS 0 (external) at power-up</p> <p>Examples: CS Display the current clock source CS 0 Set clock source to external CS 1 Set clock source to internal</p> <p>When set to internal clock source, the data source must also be set to internal via the DS command in order to have synchronous, usable data.</p> <p>Also refer to Appendix B – Understanding Clock/Data, AC, and BR</p>	Standard	N	CS 0
DE	Differential Encoding	<p>Report or set differential encoding for the SOQPSK-TG or other PSK mode (Differential encoding typically disabled for other modes) If LDPC enabled, DE resets to 0</p> <p>Examples: DE Report the differential encoding setting DE 0 Set differential encoding OFF DE 1 Set differential encoding ON</p>	Standard	Y	DE 1

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
DP	Data Polarity	Report or set data polarity Examples: DP Display the current data polarity DP 0 Set data polarity to NOT inverted (OFF) DP 1 Set data polarity to inverted (ON)	Standard	Y	DP 0
DS	Data Source	Report or set data source state Unit always reverts to DS 0 (external) at power-up Examples: DS Display current data source DS 0 Set data source to external DS 1 Set data source to internal (value of internal source is set by ID command)	Standard	N	DS 0
FO	Frequency Offset	Offsets the synthesizer +X MHz and the FPGA -X MHz Example: FO 0.0055 offsets 5.5 kHz Refer to section 4.2.1.1.4 for additional FO command detail	FO	Y	FO 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
FR	Frequency	<p>If no argument is passed, it reports the frequency. If an argument is passed, it sets the frequency. The argument specifies the frequency in MHz. If the command is entered with a '?', then the allowed frequency ranges for this unit display.</p> <p>This command rounds the frequency to the nearest 0.5 MHz. If the rounded frequency is within one of the transmitter's allowed bands, the transmitter will tune that frequency and confirm the change for the user.</p> <p>If the frequency is outside of the allowed range for the unit, the transmitter will NOT retune but will report an error to the user.</p> <p>If the FO option is present, the resolution is 1 Hz (0.000001 MHz).</p> <p>Examples: FR Display the current frequency FR ? Display allowed frequency ranges FR 1436.5 Set frequency to 1436.5 MHz</p>	Standard	Y	FR 1436.5

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
FS	Frequency Step	<p>If no argument is passed, it reports the current frequency step. If an argument is passed, it sets the frequency step size, which is activated by the left and right square bracket keys. The argument specifies the frequency step in MHz, with 0.5 MHz being the smallest available step.</p> <p>Valid range is 0.000000 MHz to 3000.000000 MHz</p> <p>Examples: FS Display the current frequency step FS 1 Frequency step = 1 MHz</p>	Standard	Y	FS 1
H (or HE)	Help	Displays a list of available commands	Standard	N/A	N/A
HP	High Power	<p>Report or set high power level</p> <p>Valid range is 0-31 in 1 dB steps or 0-31.5 in 0.5 dB steps, depending on the transmitter</p> <p>Examples: HP Report the present high power level HP 31 Set high power to 31 HP Max Set high power to the highest allowable value for the unit HP Min Set high power to the minimum allowable value for the unit</p>	DP	Y	HP 31
HX	eXtended Help	Displays a full list of available commands	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
IC	Internal Clock Rate	<p>Report or set the internal clock rate</p> <p>This rate is used if the clock source is set to internal (CS 1). It should not be confused with “BR”, which sets the rate of the internal bit sync, which phase locks to the externally applied data, if Clock-free is enabled.</p> <p>If no argument is passed, the unit reports the clock frequency. If a valid frequency is given, the internal clock frequency is set. The frequency is in MHz.</p> <p>Examples: IC Display current internal clock rate IC 4.95 Set internal clock rate to 4.95 MHz</p> <p>Valid range is 0.002 MHz – 46.000 MHz Refer to section 4.2.1.1.5 for additional IC command detail</p>	Standard	Y	IC 5

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
ID	Internal Data Gen	<p>Report or set the internal data pattern</p> <p>This setting is used if the Data Source is set to internal (DS 1) and the Clock Source is set to internal (CS 1).</p> <p>When setting the data, the argument must be "PN6" (or "PN06"), "PN11", "PN15", or "PN23", or a valid 4 digit hexadecimal value.</p> <p>Examples:</p> <p>ID Report the internal data pattern</p> <p>ID PN15 Set internal data pattern to PN15</p> <p>ID AA55 Set internal data pattern to 0xAA55</p> <p>In SOQPSK mode, ID USER 5555 or ID USER AAAA results in an unmodulated carrier, at the nominal carrier frequency.</p>	Standard	Y	ID PN15
INF	Information Dump	<p>INF does a large information dump providing the results of the following commands: SN, VE A, RFS, SS, ZZ, ZF, ZS, ZCP, ZC, ZR, ZY, SCP, SY, etc.</p> <p>This is typically to capture the state of the unit for debug.</p>	Standard	N/A	N/A
LC	List Configurations	<p>Lists the stored configurations on the unit</p> <p>If a configuration number is supplied, then the saved parameters for that configuration are displayed.</p> <p>Examples:</p> <p>LC List all internal saved configurations</p> <p>LC 7 Show configuration 7 details</p>	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
LD	LDPC Encoding Enable	<p>Enable, disable, or show the current state of the Forward Error Correction (FEC) / Low Density Parity Check (LDPC) encoder</p> <p>Examples:</p> <p>LD Show the current encoder state</p> <p>LD 1 Enable the LDPC encoder</p> <p>LD 0 Disable the LDPC encoder</p>	LDPC	Y	LD 0
LP	Low Power	<p>Report or set low power level</p> <p>Valid range is 0-31 in 1 dB steps or 0-31.5 in 0.5 dB steps, depending on the transmitter</p> <p>Examples:</p> <p>LP Report the present low power level</p> <p>LP 3 Set low power to 3</p> <p>LP Max Set low power to the highest allowable value for the unit</p> <p>LP Min Set low power to the minimum allowable value for the unit</p>	DP	Y	LP 0
MA	Modes Allowed	Reports the modes enabled on the transmitter, as determined by the part number	Standard	N/A	N/A
MC	NRZ-M Conversion	<p>Enables or disables the NRZ-L to NRZ-M conversion</p> <p>Examples:</p> <p>MC Show the current NRZ state</p> <p>MC 1 Enable the NRZ-L to NRZ-M conversion</p> <p>MC 0 Disable the NRZ-L to NRZ-M conversion</p>	CE	Y	MC 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
MO	Modulation	<p>Report or set modulation setting</p> <p>Mode 6, Carrier only, is present on every transmitter</p> <p>Examples:</p> <p>MO Report the modulation setting</p> <p>MO 0 Set modulation to PCM/FM</p> <p>MO 1 Set modulation to SOQPSK-TG</p> <p>MO 2 Set modulation to MULTI-h CPM</p> <p>MO 6 Carrier only, no modulation</p>	Standard	Y	MO 0 or the first one the customer has installed on the unit Example: MO 1 if no PCM/FM installed; MO 2 if only CPM installed
MS	Modulation Scaling	<p>Scales the deviation (modulation index) of the transmitted signal relative to the standard default deviation</p> <p>Example:</p> <p>For PCM/FM – if the standard modulation index is 0.7, setting MS to 2.0 scales a modulation index of 1.4</p> <p>Value range is .09 to 128.01</p>	MS	Y	MS 1
OC	Overtemperature Control Enable	<p>Enables or disables overtemperature control</p> <p>OC 0 Disable Overtemperature Control</p> <p>OC 1 Enable Overtemperature Control</p> <p>Refer to section 4.2.1.1.6 for additional OC command detail.</p> <p>Note: Highly recommended NOT to disable this feature.</p>	Standard	Y	OC 1
OTA	Over-the-Air Rate	<p>Displays the current baseband and over-the-air bit rate. This information is also displayed on the RFS output.</p> <p>OTA Display over-the-air rate</p>	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
PL	Power Level	<p>PL reports or sets the current power level setting for the dual power feature. If the user enters 1, the power level is set to current “high” power level (refer to HP command). If the user enters 0, then power is set to the current “low” power level (refer to LP command).</p> <p>Examples: PL Report the current power level state PL 0 Set the current power level to “low” PL 1 Set the current power level to “high”</p>	DP	Y	PL 0
PR or RE	Restore Defaults	<p>Restores factory default parameters for the unit</p> <p>Default is currently the lowest number modulation supported by the transmitter with the selected band and frequency limits</p> <p>Default power level is Full power</p>	Standard	N/A	N/A
QA	Query All	<p>Displays common device settings in one compact display</p> <p>Display is a subset of SS or ST</p>	Standard	N/A	N/A
QT or TE	Query Temperature	<p>Report the temperature in degrees Celsius</p> <p>Maximum safe digital board temperature is 95 degrees Celsius</p> <p>This unit is rated to 85 degrees Celsius. If the digital board temperature exceeds 95 degrees Celsius, the warranty will be void.</p>	Standard	N/A	N/A
RA or RN	Randomizer	<p>Report or set IRIG-106 randomizer output state</p> <p>Examples: RA Report the randomizer state RA 0 Set randomizer OFF RA 1 Set randomizer ON</p>	Standard	Y	RA 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
RC (or PP or RL)	Recall Configuration	<p>Load a saved configuration into the active configuration if the configuration number entered is valid</p> <p>If the selected configuration has no valid data or the command is issued without a configuration number, the transmitter is initialized with the default data and saved.</p> <p>Example: RC Load configuration 0 (default setup) RC 3 Load configuration 3</p>	Standard	N/A	N/A
RF	RF Output	<p>Report or set RF output control state</p> <p>Note that there may be no RF output, even if the software control is set to ON. This can happen if there is no valid clock in use, or if the RF on/off hardware pin is in the OFF state.</p> <p>Examples: RF Report the RF output state RF 0 Set RF output OFF RF 1 Set RF output ON</p> <p>Refer to section 4.2.1.1.7 for related RF command detail</p>	Standard	Y	RF 1 (if option CP07, default is RF 0)
RFS	RF Output State	<p>Displays information used to determine whether RF and modulation are actually On in the format</p> <p>Refer to section 4.2.1.1.8 for related RFS command detail</p>	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
RZ	RF On/Off Pin Polarity	<p>Set or show the polarity of the RF on/off pin, which is pulled high internally</p> <p>RZ 0 means the RF is ON when the RF on/off pin is low</p> <p>RZ 1 means the RF is ON when the RF on/off pin is high (floating)</p> <p>Examples:</p> <p>RZ Show the current RF on/off polarity</p> <p>RZ 0 Set RF on/off polarity to "pin low = on"</p> <p>RZ 1 Set RF on/off polarity to "pin high = on"</p> <p>The default polarity on most Quasonix transmitters is <i>high</i>.</p> <p>The RF On/Off pin is a hard OFF control. No matter what state everything else is in, setting this switch input to the inactive state will turn RF Off.</p>	Standard	Y	RZ 1
SB	Cycles per Bit	<p>Report or set cycles per bit (The subcarrier frequency is cycles per bit times bit rate.)</p> <p>SB Report cycles per bit</p> <p>SB x Set cycles per bit</p>	STDN	Y	SB 0
SI	Spectral Inversion	<p>Sets the modulation scaling to -1 * whatever the current scaling is in order to invert the spectrum</p> <p>This is in ADDITION to any changes in modulation scaling factor. That is, if you enter a negative MS and then turn SI on, you will have a NON_inverted spectrum.</p> <p>Examples:</p> <p>SI Report spectral inversion status</p> <p>SI 0 No inversion</p> <p>SI 1 Invert the spectrum</p>	Standard	Y	SI 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
SM	Modulation Sweep	<p>Sweeps the transmitter modulation between the provided limits with the provided step size at a fixed rate</p> <p>Examples:</p> <p>SM Toggle sweep ON/OFF with current values</p> <p>SM ? Displays current sweep state</p> <p>SM start stop step msec</p> <p> start = low index</p> <p> stop = high index</p> <p> step = index step size</p> <p> msec = milliseconds between steps</p>	MS	N	SM Disabled
SN	Serial Number	Report the serial number for the unit	Standard	N/A	N/A
SS	Show Settings	Displays most of the common device settings in one compact display	Standard	N/A	N/A
ST	Show Settings Alphabetical	Displays available device settings alphabetically in one compact display	Standard	N/A	N/A
SV or SA (or PS or PW)	Save Configuration	<p>Saves the current transmitter configuration to a user-selected preset number, from 0 to 15 where 0 is the power-on default unless hardware presets are enabled</p> <p>The SV command also allows the user to assign an alias to the desired preset.</p> <p>Examples:</p> <p>SV 1 Save current configuration to preset 1</p> <p>SV 7 xyz Save current configuration to preset 7 and assign alias name “xyz”</p> <p>*Refer to SV Note below for exception</p>	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
SW	Frequency Sweep	<p>Sweeps the transmitter frequency between provided limits, with provided step size, at a fixed rate</p> <p>Examples:</p> <p>SW Displays current status</p> <p>SW ? Displays command help with status</p> <p>SW Toggles the channel sweep state</p> <p>SW 2200.5 2394.5 1.0 Sweep channel 1 between 2200.5 MHz and 2394.5 MHz in 1.0 MHz steps</p> <p>Refer to section 4.2.1.1.9 for additional SW command detail</p>	Standard	N/A	N/A
SY	System Status	<p>Displays the system status of the transmitter</p> <p>The first argument specifies the period, in seconds, between status updates. Zero (0) disables continuous monitoring.</p> <p>The second argument specifies the number of status lines between header outputs.</p> <p>Examples:</p> <p>SY Displays current status report settings</p> <p>SY 5 Sets status output period to 5 seconds</p> <p>SY 5 100 Sets status header output once every 100 status updates</p> <p>Refer to section 4.2.1.1.10 for additional SY command detail.</p>	Standard	N/A	N/A
TD	Temperature Compensation Display	<p>Displays the temperature compensation table and/or the attenuator compensation table</p> <p>Examples:</p> <p>TD Displays both tables</p> <p>TD 1 Displays temperature compensation table only</p> <p>TD 2 Displays attenuator compensation table only</p>	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
VE or RV	Version (Revision Information)	Report the current Firmware (software) version information for the transmitter	Standard	N/A	N/A
VF	Variable FIFO Depth	Sets the FIFO depth for controlling latency time between bits in and bits out Valid range is 0 to 255 Example: VF 120 (120 = Variable Power)	VF	Y	VF 128
VP	Variable Power	Report or set variable power level Valid range is 0-31 in 1 dB steps or 0-31.5 in 0.5 dB steps, depending on the transmitter Examples: VP Report the variable power level VP 31 Set variable power to 31 VP 5 Set variable power to 5	VP	Y	VP Max
ZC	Show Configuration Parameters	Display all configuration parameters If there is no argument, then the current params are displayed. If there is an argument (0-15), then that preset is displayed. If 'C' for current is entered, then the current params in memory are displayed. Examples: ZC Display all parameters ZC 2 Display preset 2 params ZC C Display current params in memory	Standard	N/A	N/A
ZF	Show Detailed Options	Displays the current hardware configuration and detailed state of the options on the transmitter	Standard	N/A	N/A
ZX	Show Preset Inputs	Displays the current preset inputs on the parallel connector Available presets depend on the number specified for the unit Values are PS2, PS4, PS8, or PS16	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
ZZ	Show Options	Displays the current hardware configuration and options on the transmitter	Standard	N/A	N/A

All commands generate a response of one or more lines, which indicate successful completion of the command or an error.

After a command's response, the transmitter displays the mode name followed by the character ">" as a prompt, which may be interpreted as meaning the radio is ready to accept new characters. If the CP07 option is enabled, only the character ">" displays as a prompt.

***SV Note:** Users may save internal clock and data in presets for bench debug use BUT on a power up or when a *hardware* preset is restored, **CS** and **DS** will be forced to **0** (external clock and data). This action prevents a transmitter from powering up or changing hardware presets and being set to internal clock and/or data. The **ONLY** way to restore **CS** and/or **DS** as **1** from a saved configuration is by executing the **RC** command.

4.2.1.1 Additional Command Set Details

4.2.1.1.1 Automatic Carrier Output – AC

This command requires the AC or ACS option. These options allows the TIMTER to transmit a carrier wave when the clock input is absent, which would normally cause the RF output to be turned off.

If the AC *option* is present, the AC command is always enabled (1) even if a preset is saved with AC = 0.

If the ACS *option* is present, the saved setting of the AC command (preset 0) is used on power up instead of forcing AC = 1.

Also refer to Appendix B – Understanding Clock/Data, AC, and BR.

4.2.1.1.2 Clock Free Bit Rate – BR

The Clock Free Bit Rate is the bit rate used when the Clock Free (CF) option is specified and internal transmitter clock is in use. The BR command reports the bit rate. It also allows the user to set the hard bit rate on a clock free transmitter, or set the clock free bit rate to Automatic.

When set to Automatic, the internal transmitter logic determines the correct bit rate from the input data stream. For Automatic to work, the input data stream must be sufficiently randomized. The bit rate must be below 35 Mbps to use automatic bit rate detection.

Do not confuse the BR command with "IC", which sets the rate of the internally generated clock.

Syntax: BR [A / rate]

where A is:

Automatic

where rate is:

A bit rate in Mbps that matches the input data rate

Also refer to Appendix B – Understanding Clock/Data, AC, and BR.

Examples:

BR Report the bit rate
 BR 5 Set the bit rate to 5 Mbps
 BR A Set the bit rate automatically
 BR A D Set the bitrate mode to Auto and Disable warning
 BR A E Set the bitrate mode to Auto and Enable warning

4.2.1.1.3 Convolutional Encoder – CC

Convolutional encoding is a form of legacy forward error correction. It requires more bandwidth than all but the lowest rate LDPC codes, and its error correcting performance is inferior to LDPC. If possible, LDPC is the preferred FEC. CC is mainly used with legacy PSK modes.

4.2.1.1.4 Frequency Offset – FO

This command is still active, but has been deprecated. The desired offset may be typed with the frequency using the FR command. Offsets may be set with the FO command, but it is not required.

The frequency offset range +/- 1 MHz with a resolution of 1 Hz (0.000001 MHz).

Examples:

Frequency Offset using FO command:

SOQPSK>FO 0.0055
 Freq set to 2200.0 MHz
 Freq offset set to 0.005500 MHz
 Actual Output Freq set to 2200.005500 MHz

Frequency Offset Using FR command:

SOQPSK>FR 2200.2
 Freq set to 2200.0 MHz
 Freq offset set to 0.200000 MHz
 Actual Output Freq set to 2200.200000 MHz

FO 0 is the default value, however typing FO displays the current frequency with no offset, rather than FO 0.

SOQPSK>FO
 Freq currently 2200.0 MHz

4.2.1.1.5 Internal Clock Rate – IC

This rate is used if the clock source is set to internal (CS 1). It should not be confused with “BR”, which sets the rate of the internal bit sync, which phase locks to the externally applied data, if Clock-free is enabled.

If no argument is passed, the unit reports the clock frequency. If a valid frequency is given, the internal clock frequency is set. The frequency is in MHz.

The units used to describe the internal bit rate are sometimes used interchangeably, and may cause confusion. Megahertz (MHz) and Hertz (Hz) are cycles per second units, while Mbps (megabits per second) and bps (bits per second) are data rate units.

The internal clock is referred to as “clock,” so Hz or MHz is often used as the unit, since “clock” is a frequency.

If the clock is used to “clock” the bits at X MHz, then the throughput in bits is X Mbps. In other words, the internal clock also sets the baseband bitrate. That is why, in this case, units of Hz are equated with units of bps.

For example, 5,000,000 Hz or bps may be rewritten as 5.000 MHz or 5.000 Mbps.

4.2.1.1.6 Overtemperature Control – OC

OC is the overtemperature control enable command. The default value is enabled (set to 1).

The transmitter contains an internal thermal shutdown feature that gradually reduces transmit output power up to 6 dB below maximum as the internal temperature rises from approximately 100°C to 108°C. Transmitting automatically resumes when the temperature falls below these thresholds.

Note: This feature is not production tested and is intended as a last-ditch attempt to prevent damage. Exercising this feature can only be done by deliberately overheating the unit, which voids the warranty.

Contact Quasonix for the default overtemperature value specific to your transmitter. Refer to the technical guide “Quasonix Transmitter Overtemp Control Operation” on the Quasonix website for additional information.

4.2.1.1.7 RF Output – RF

RF enables or disables the RF power output from the transmitter. A 1 enables the output and a 0 disables it. If no parameter is entered, the current state displays.

Note that just turning the RF output on does not guarantee that RF is output. If there is not a valid clock (or in clock free, if there is no valid data (transitions) from which to derive a clock), then the RF output is Off (unless the unit has the AC option and the AC command is enabled, in which case a carrier on the current center frequency is output).

Also, if the unit has an RF On/Off pin that is pulled into the Off state (determined by the current setting of RZ), then there is no RF output.

Also refer to Appendix B – Understanding Clock/Data, AC, and BR.

4.2.1.1.8 RF Output State – RFS

The RFS command may display the following information, depending on available options, about the connected transmitter:

RFS

```
ModCtrlReg shdw = 00007013h      ModCtrlReg      = 00007013h
      GPIO_In_reg      = 7E00005Fh
BB_ctl_reg      = 78004AF5h      CF_auto_ctl_reg = 00000000h
GPIO_Out_reg    = 00000000h
MO 1            FR 2200.5         RF 1            RZ 1 (high = RF on)
RF pin = 1      DE 0              MC 0            RA 1              SI 0
CP A            DP 0              DS 1            CS 1
HP 31.0         LP 0.0           PL 1            BR 1.000 Mbps (NOT Auto)
IC 5.000        VP 10.0          SD 130          MS 1.000
bb_clk_okay: 1   clock free bitrate: N/A
DL: 2214        I gn: 7292       Q gn: 7292
Synth Lock = 1   RF pin = 1
CF option 1, CF state 1 (Normal)
```

```

EN option 0, EN state 0
AC option 1, AC state disabled
ACS option 0, AC state disabled
AI option 0, AI state disabled
FO option 0, FO = 0.000000 MHz
CE option 0, CC state 0
RH option 0, NRF option 0
P62 option 0, RAM option 0, Freq_plug_invalid state 0
desired_rf_state = 1 (On) need_to_change_rf = 0 PA_RF_state = 0
current_pwr_lvl = 10.0 dB T3 Atten = 21.0 dB PA Atten2 = 0.00 dB
    Detected baseband rate: 5.000 Mbps
    Detected over-the-air rate: 7.813 Mbps

```

4.2.1.1.9 Frequency Sweep – SW

When a frequency sweep is started, it will run continuously until manually stopped, except for the following circumstances.

- If a mode change or recall preset occurs, the sweep is automatically terminated.
- If invalid sweep parameters are entered, or an error message occurs while a sweep is running, the sweep will terminate.

This is to ensure the integrity of the transmitter frequency during the parameter changes. For example, if the mode changes to SOQPSK while a sweep is running, the sweep is automatically terminated, then the new parameters are copied. Another example: if a sweep is running and the user attempts to change the sweep to “SW 1300 1400 1”, the transmitter recognizes an invalid frequency and disables the sweep.

It is possible to change sweep parameters while a sweep is running. Entering new sweep parameters such as “SW 1435.5 1442.5 1” seamlessly restarts the sweep with the new frequencies.

The valid step size range is ≥ 1 kHz to ≤ 1000 MHz.

Examples:

SW ? Help (syntax)

SW Show the sweep status

SW 1 1435.5 1442.0 1 Set channel to enable (On), the start frequency is 1435.5 MHz, the stop frequency is 1442.0 MHz, sweep frequency step size is 1 MHz

4.2.1.1.10 System Status Command – SY

The SY command is defined as follows.

Mode	CF Rate	Freq	Tmp	CRate
	(b/s)	(Hz)	(C)	(b/s)
0	10001252	2255000000	27.0	19999948

Mode - Current mode number (such as 0 = PCM/FM)

CF Rate - Clock free estimated data rate. This rate is based on the external data input (TTL or RS-422) even if internal data is presently in use (CS = 1).

Freq - Tuned frequency

Tmp - Current temperature

CRate - Clock filter clock rate. This is the actual over the air bit rate, regardless of the selected data source, and including any increases due to encoding (LDPC or convolutional). IN clock free automatic mode, it may differ from CF Rate because it will track the bit sync rate (exact, if locked) rather than the clock free estimated rate (approximate).

5 RF Output Notes

There are three methods of muting the RF output. If you do not have RF output, check these conditions:

1. **RF On / Off command** – From the control terminal, type **RF** to query the current state of the RF On/Off variable. If it is 0, type **RF 1** to turn the output back on.
2. **External clock removal** – If the unit is configured to use the external clock ($CS = 0$), that clock's presence is detected. If it is not present AND the unit is not running in Clock Free mode, the RF output automatically shuts OFF (unless the AC or ACS option is present, in which case the RF output switches to just a carrier at the center frequency with no modulation on loss of clock). When the data clock comes back, the RF output automatically turns on. The lag from data clock state change to RF output change is about 0.1 seconds, but varies based on settings.

If the unit IS running in Clock Free mode, no clock is required, but the loss of data transitions is detected. This will cause the RF to shut OFF (or if AC or ACS option and AC is set to 1, change to a carrier on center frequency). When the data transitions begin again (or when an external clock is reapplied if NOT in Clock Free mode), the RF output turns on again.

3. **RF On / Off pin** – The RF On / Off pin is a hard OFF control for the RF output. The polarity of this pin is selectable using the RZ command. The RF On /Off pin (in the inactive state) forces RF OFF; the RF On /Off pin can only allow RF to turn on, but it cannot force it to turn on.

If $RZ = 1$ then a high level on the RF On / Off pin allows RF On.

If $RZ = 0$, then a low level (ground the RF On / Off pin) allows RF On.

The RZ command is described in section 4.2.1.

5.1 RF Troubleshooting Notes

The following is a quick, three-part test to verify that the RF output on the transmitter is working correctly. This procedure should work for most transmitters with no modifications, however the sheer number of extra options and variations means that some units will need some special instructions or may work slightly differently. Examples are auto-carrier (-AC option), clock free (-CF option) and recall-holdoff (-RH option). If the procedure below does not demonstrate the working RF output on the transmitter, please contact Quasonix technical support for further help in resolving the issue.

The three sections below demonstrate RF output functionality one step at a time: first a carrier, then a waveform based on internal clock and data, and finally the waveform using the user supplied external clock and data. Part one demonstrates a simple carrier output at the desired frequency. Part two demonstrates proper waveform modulation using internal clock and data generated by the transmitter itself. Part three switches to the user supplied external clock and data for normal operation. If the first two parts work correctly, then the only missing piece is the external clock and data, so resolving any final issues becomes easier.

Part 1: Checking for carrier power output on frequency

1. Turn on power to the transmitter.
2. Set the mode to 6 (carrier only) using command **MO 6**.
3. Set transmitter to the desired frequency using the **FR** command. For example, **FR 2200.5**.
 - To see the allowed frequencies on your unit, type **FR ?**.
4. Turn the soft RF control on with **RF 1**.

5. Use a Spectrum Analyzer to determine whether there is a stick at the desired frequency. If there is, go on to Part 2.
6. If there is no output, check the state of the RF On/Off pin.
 - If the pin appears to be in the correct state to enable the output, check the RF On/Off pin polarity using the **RZ** command.
 - If the polarity is incorrect, change it.
 - **RZ 1** sets the transmitter output to turn ON when the RF On/Off pin is high.
 - **RZ 0** sets the transmitter output to turn ON when the RF On/Off pin is low.
7. Is the output present now? If so, go on to Part 2 below. If not, call Quasonix for technical support.

Part 2: Verifying modulation output on frequency with internal data

1. Turn on the transmitter.
2. Set the mode to one of the available modes on your unit. For example, **MO 0** for PCMFM, **MO 1** for SOQPSK, etc.
3. Set transmitter to the desired frequency using the **FR** command. For example, **FR 2200.5**.
 - To see the allowed frequencies on your unit, type **FR ?**.
4. Turn the soft RF control ON with **RF 1**.
5. Enable the internal clock source with **CS 1**.
6. Enable the internal data source with **DS 1**.
7. Set the internal clock rate to 5 Mbps with **IC 5**.
8. Set the internal data pattern to PN15 with **ID PN15**.
9. Use a spectrum analyzer to verify the desired waveform on the RF output at the desired frequency.
10. If the waveform is NOT present, check the state of the RF On/Off pin. Use the **RZ** command to check the current polarity of the RF On/Off pin.
 - **RZ 1** sets the transmitter output to turn ON when the RF On/Off pin is high
 - **RZ 0** sets the transmitter output to turn ON when the RF On/Off pin is low.
11. Change either the RF On/Off pin or the polarity to turn the RF output ON.
12. Check for the RF output on the spectrum analyzer.
 - Is the output present now? If so, go on to Part 3.
 - If not, call Quasonix for technical support.

Part 3: Verifying modulation output on frequency with user data

1. Turn on the transmitter.
2. Set the mode to one of the available modes on your unit. For example, **MO 0** for PCMFM, **MO 1** for SOQPSK, etc.
3. Set transmitter to the desired frequency using the **FR** command. For example, **FR 2200.5**.
 - To see the allowed frequencies on your unit, type **FR ?**.

4. Turn the soft RF control on using **RF 1**.
5. Disable the internal clock source with **CS 0**. This is the normal state on power up for most units.
6. Disable the internal data source with **DS 0**. This is the normal state on power up for most units.
7. Be sure that a clock source is connected to the correct pins of the transmitter input connector with the correct type (TTL or RS-422) of signal and in the case of RS-422, the correct polarity.
8. Be sure that the clock source is ON and that the clock rate is within the allowed range for the mode selected. Typically this is 100 kbps to 28 Mbps for Tier 1 and 2 waveforms and 50 kbps to 14 Mbps for Tier 0.
9. Be sure that a data source is connected to the correct pins, with the correct type (TTL or RS-422) and polarity as above.
10. Use a spectrum analyzer to verify the desired waveform on the RF output at the desired frequency.
11. If the waveform is NOT present, check the state of the RF On/Off pin. Use the **RZ** command to check the current polarity of the RF On/Off pin.
 - **RZ 1** sets the transmitter output to turn ON when the RF On/Off pin is high.
 - **RZ 0** sets the transmitter output to turn ON when the RF On/Off pin is low.
12. Change either the RF On/Off pin or the polarity to turn the RF output ON.

You may issue the RF command and observe the status which is returned. This status indicates whether the transmitter believes the RF output is actually ON or not.

The **SY** command may be issued to check the actual clock rate that the transmitter sees if no RF output is detected. One of the most common problems is a clock rate that is too high or too low (or missing) for the desired modulation.

Finally, if you have a full RF loop running with a BERT and are having trouble achieving a zero bit error rate or lock, try the loop using internal data with the standard PN15 bit pattern. Be sure the BERT pattern is set to match the selected data pattern (**ID** command) on the transmitter. Assuming the internal data syncs and produces a zero bit error rate, you can switch back to the external clock and data. In this case, you can also check (and change) the clock polarity (**CP**) the data polarity (**DP**), the randomizer (**RA**), and the differential encoder (**DE** - normally on for SOQPSK and off for other waveforms) to resolve the sync and bit error rate issues.

If you are still having difficulties at this point, then contact Quasonix technical support.

Quasonix Technical Support
(1-513-942-1287) or email (support@quasonix.com)

When calling technical support, it will speed things up if you have the following information handy:

- Model number (obtained with the **ZZ** command) ***Note that this is different from the customer part number.***
- Serial number (obtained with the **SN** command)
- Software Version (obtained with the **VE** command)

It is also helpful if you can call from a phone in your lab so our tech support people can actually walk you through setting, checking, and controlling your transmitter).

6 Performance Specifications

6.1 RF Output

The minimum RF output power is one of the following: 1W, 2W, or 5 W, with the RF load VSWR < 2:1 at all phase angles from 0 to 360 degrees.

6.2 Electrical Current

The electrical current drain for GMLRS transmitters is provided in Table 14.

Table 14: DC Input Current at Standard Input Voltage

Band Type	Wattage	Maximum Amps	Typical Amps @ 28 VDC
Single band L or S	1 W	450 mA	350 mA
Single band L or S	2 W	570 mA	480 mA
Single band L or S	5 W	1.0 A	0.8 A

6.3 Environmental Specifications

GMLRS transmitters meet the following environmental requirements.

Table 15: GMLRS Environmental Specifications

Environmental Specifications	Description
Operating temperature (1 W, 2 W, and 5 W models)	-40°C to +85°C
Non-operating temperature (all models)	-40°C to +85°C
Operating humidity	0 to 95% (non-condensing)
Altitude	Up to 100,000 ft.

6.3.1 EMI Performance

Every Quasonix transmitter is designed to operate reliably and unobtrusively in the most challenging environments. This includes electromagnetic interference and compatibility (EMI/EMC) requirements. More specifically, all Quasonix transmitters in the TIMTER™ family (2 cubic inches and above) have been designed to comply with the following requirements of MIL-STD-461G (and MIL-STD-461E and -461F, when those now-obsolete standards have been applied):

Table 16: TIMTER™ EMI Compliance

Requirement	Description
CE101	Conducted Emissions, Audio Frequency Currents, Power Leads
CE102	Conducted Emissions, Radio Frequency Potentials, Power Leads
CE106	Conducted Emissions, Antenna Port
CS101	Conducted Susceptibility, Power Leads
CS114	Conducted Susceptibility, Bulk Cable Injection
CS115	Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation
CS116	Conducted Susceptibility, Damped Sinusoidal Transients, Cables and Power Leads
RE101	Radiated Emissions, Magnetic Field
RE102	Radiated Emissions, Electric Field
RS101	Radiated Susceptibility, Magnetic Field
RS103	Radiated Susceptibility, Electric Field

Quasonix transmitters have been tested for compliance with these standards approximately annually since 2004. However, such testing is only performed as part of a qualification program, and the test results are the exclusive property of the customer who paid for them. If you need EMI testing on a particular part number, please contact sales@quasonix.com for a quote.

6.4 Carrier Frequency Tuning

The carrier frequency is selectable in 0.5 MHz steps. Frequencies supported by TIMTER™ GMLRS transmitters are listed in Table 17.

Table 17: Carrier Frequencies (MHz)

Band	Minimum Freq	Maximum Freq	Default Freq
Lower L	1435.5 MHz	1534.5 MHz	1450.5 MHz
Upper L	1750.0 MHz	1855.0 MHz	1800.5 MHz
Lower S	2200.5 MHz	2300.5 MHz	2250.5 MHz
S	2200.5 MHz	2394.5 MHz	2370.5 MHz

6.5 Carrier Frequency Error

The frequency error is ± 6 ppm for all causes, including aging over five (5) years.

6.6 Bit Error Rate

The transmitter meets the following BER limits, when tested with the Quasonix multi-mode, multi-symbol trellis demodulator.

Table 18: Transmitter BER Specifications

BER	Maximum Eb/N0 (dB)		
	PCM/FM, Tier 0	SOQPSK-TG, Tier I	Multi-h CPM, Tier II
10-3	7.5	9.5	11.0
10-4	9.0	11.5	12.5
10-5	10.0	13.0	13.5
10-6	11.0	14.5	14.5

6.7 Modulated RF Power Spectrum

The transmitter's modulated spectrum complies with the IRIG-106 PSD mask:

$$M \text{ (dBc)} = \text{Max} (\{K - 100 \log \angle |f - f_c| + 90 \log (R)\}, \{-(55 + 10 \log (P))\}), \angle |f - f_c| \geq R/m \text{ where}$$

M = power relative to unmodulated carrier (i.e., units of dBc) at frequency f (MHz)

f = frequency in MHz

f_c = the carrier frequency in MHz

R = the bit rate in Mb/s

P = the rated power output of the UUT, in Watts

and the values of K and m are as tabulated in Table 19.

Table 19: K and m Values per Waveform

	K	m
PCM/FM, Tier 0	-28	2
SOQPSK TG, Tier I	-61	4
Multi-h CPM, Tier II	-73	4

As noted in the equation above, the mask has a floor at $-(55 + 10 \log (P))$ dBc, and the mask imposes no limit on the spectrum for frequency offsets less than R/m. Representative examples of the transmitted spectrum, with the appropriate mask, are shown in Figure 11, Figure 12, and Figure 13.

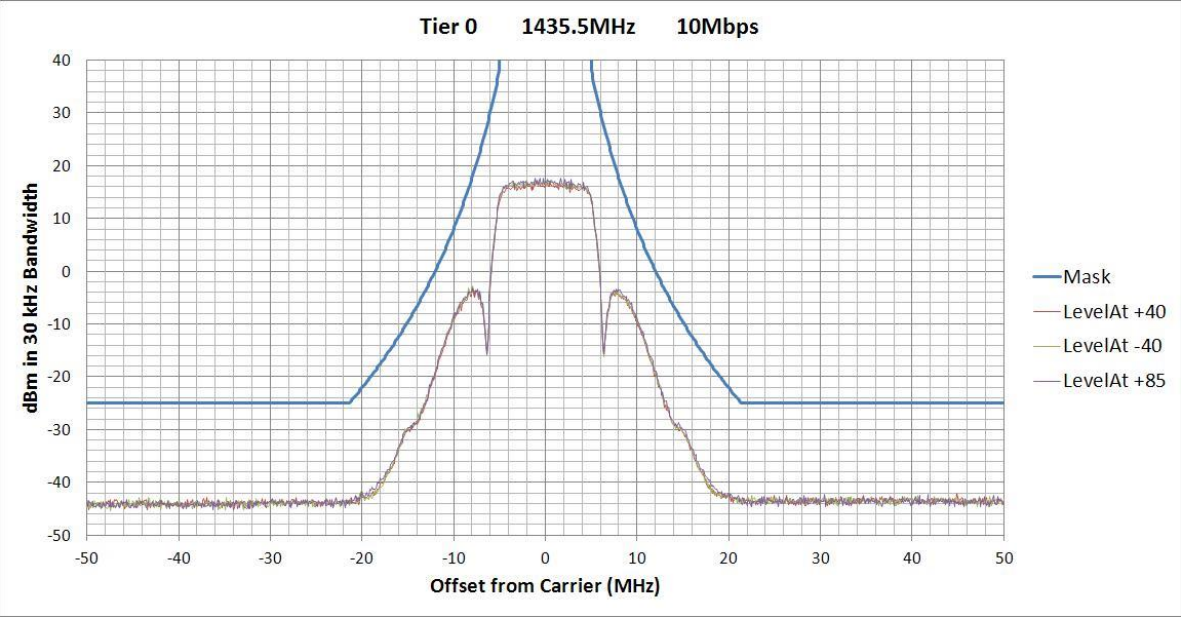


Figure 11: PCM/FM (Tier 0) PSD and Mask

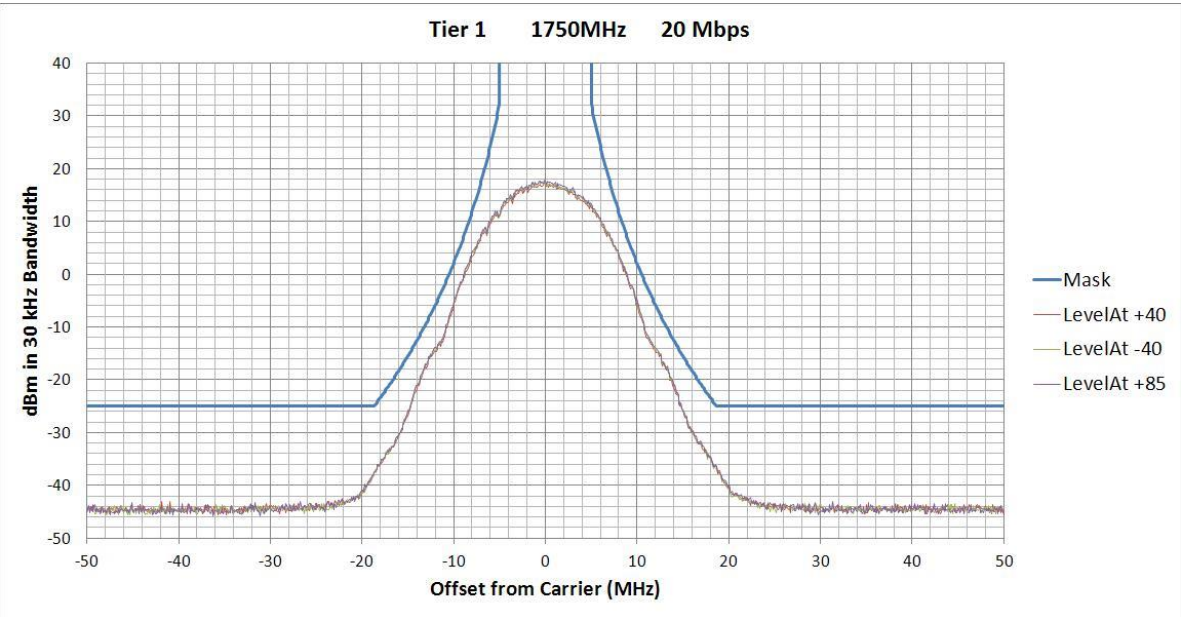


Figure 12: SOQPSK-TG (Tier I) PSD and Mask

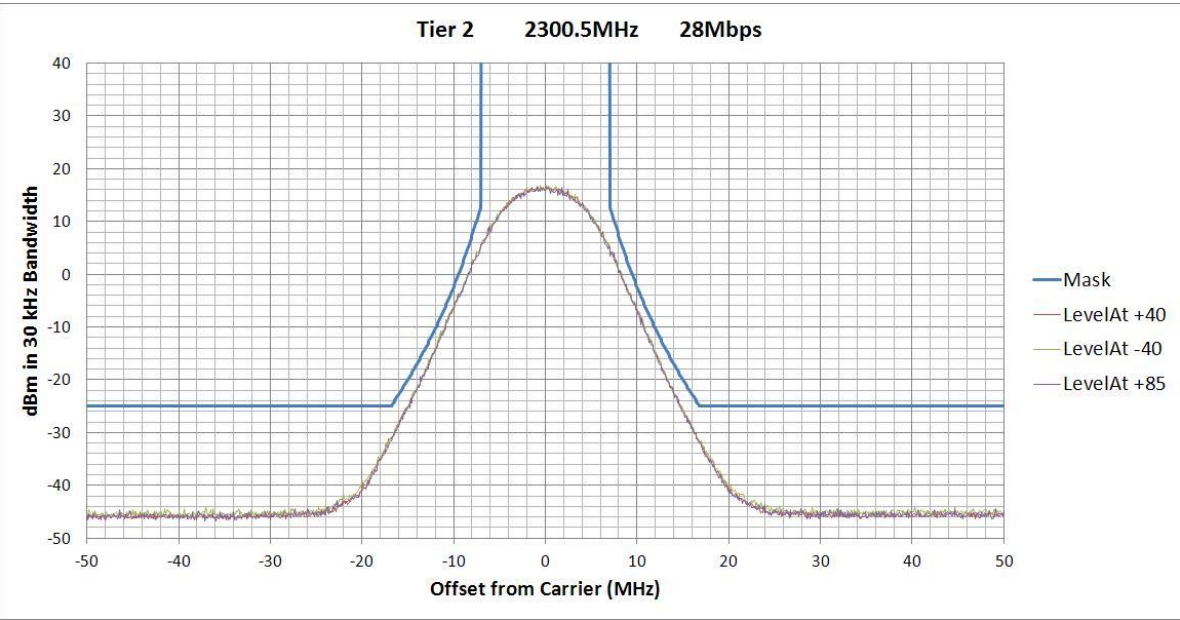


Figure 13: Multi-h CPM (Tier II) PSD and Mask

6.8 Phase Noise Power Spectrum

TIMTER™ phase noise limits are shown in Figure 14.

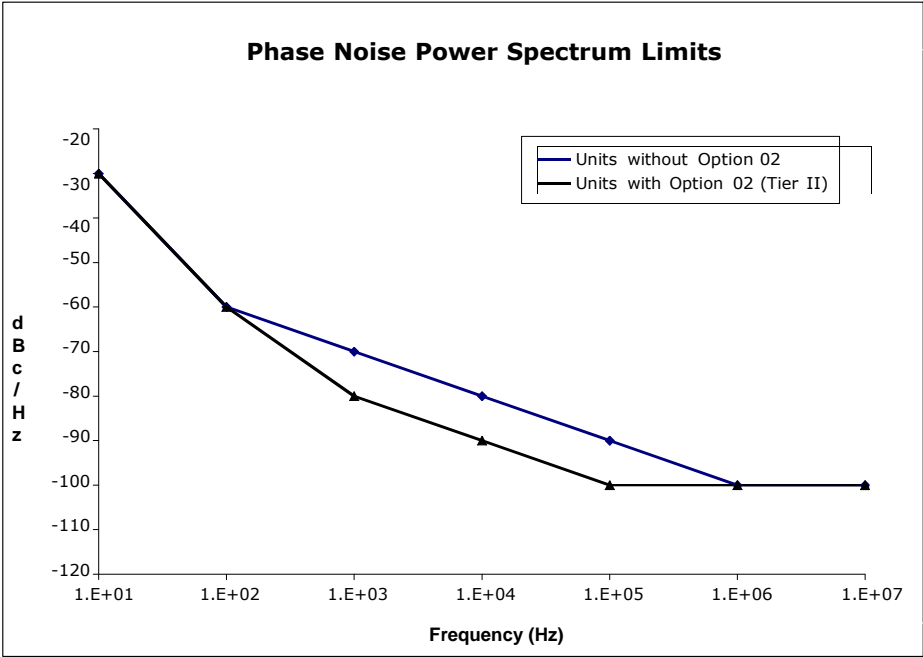


Figure 14: Phase Noise Limit Curve

6.9 Baseplate Temperature

The GMLRS transmitter is designed for efficient heat transfer between internal heat producing sources and the baseplate. The 1 W, 2 W, and 5 W GMLRS transmitter versions are rated for operation with baseplate temperatures ranging from -40°C to +85 °C.

6.10 Vibration and Shock

The transmitter is designed and tested to operate normally when subjected to random vibration and shock. The shock and vibe test setup employed by Quasonix is shown in the following figures.

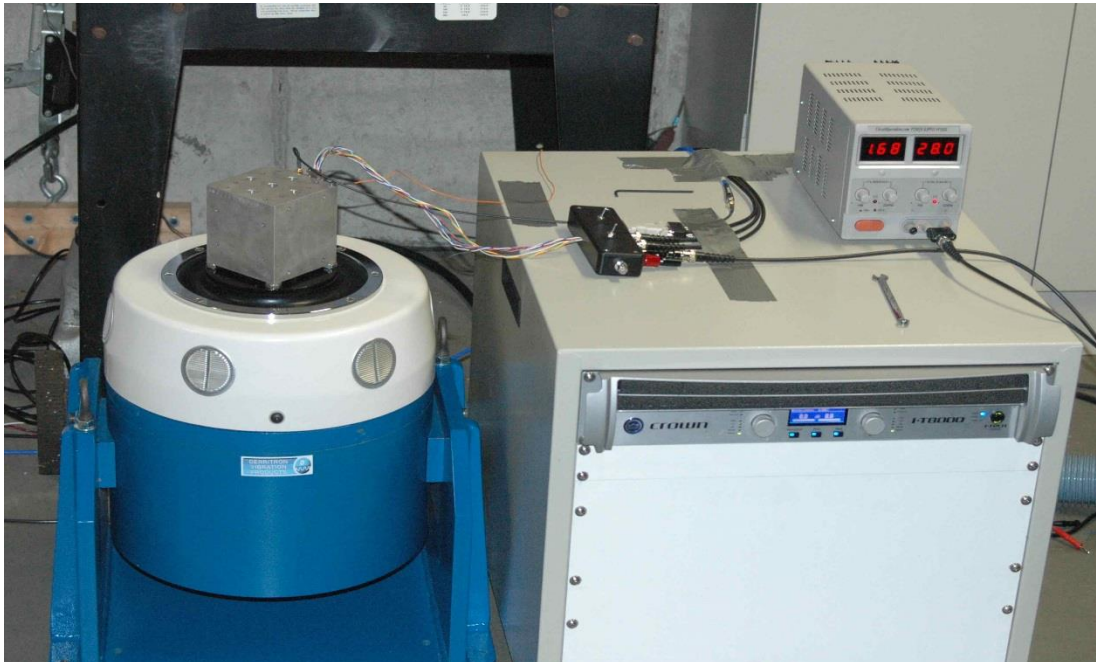


Figure 15: Vibration / Shock Testing System



Each transmitter is subjected to the random vibration spectrum depicted in Figure 19 and Table 20 prior to shipment.

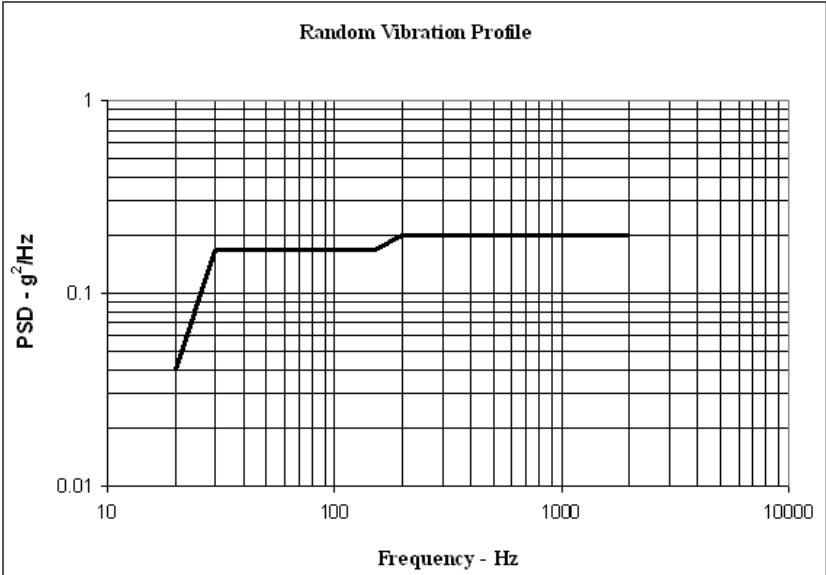


Figure 19: TIMTER™ Vibration Profile

Table 20: Random Vibration Spectrum

Breakpoints	
Frequency (Hz)	PSD (g2/Hz)
20	0.04
30	0.17
150	0.17
200	0.2
2000	0.2
G (RMS) = 19.6	

During flight-qualification testing, the unit under test (UUT) was shaken for 30 minutes in each axis. Results are shown in Figure 20, Figure 21, and Figure 22.

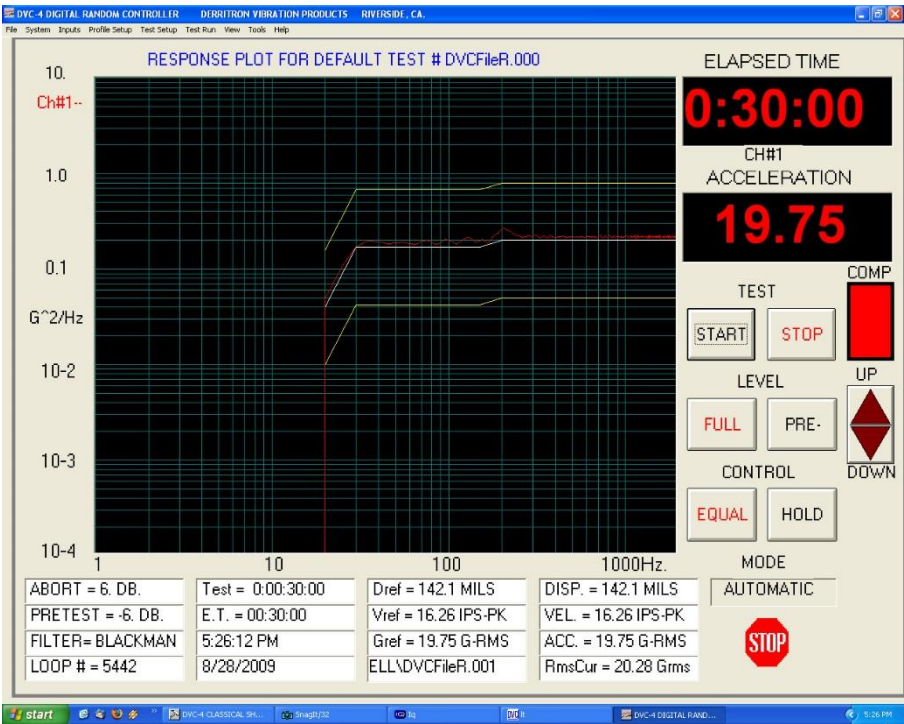


Figure 20: Z-axis Vibration Spectrum

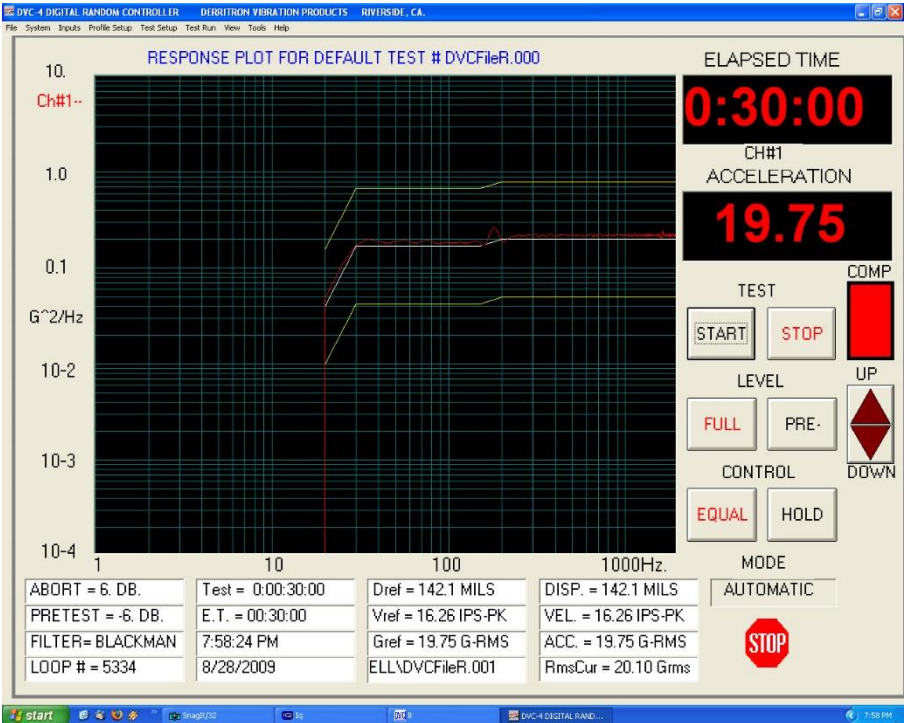


Figure 21: Y-axis Vibration Spectrum

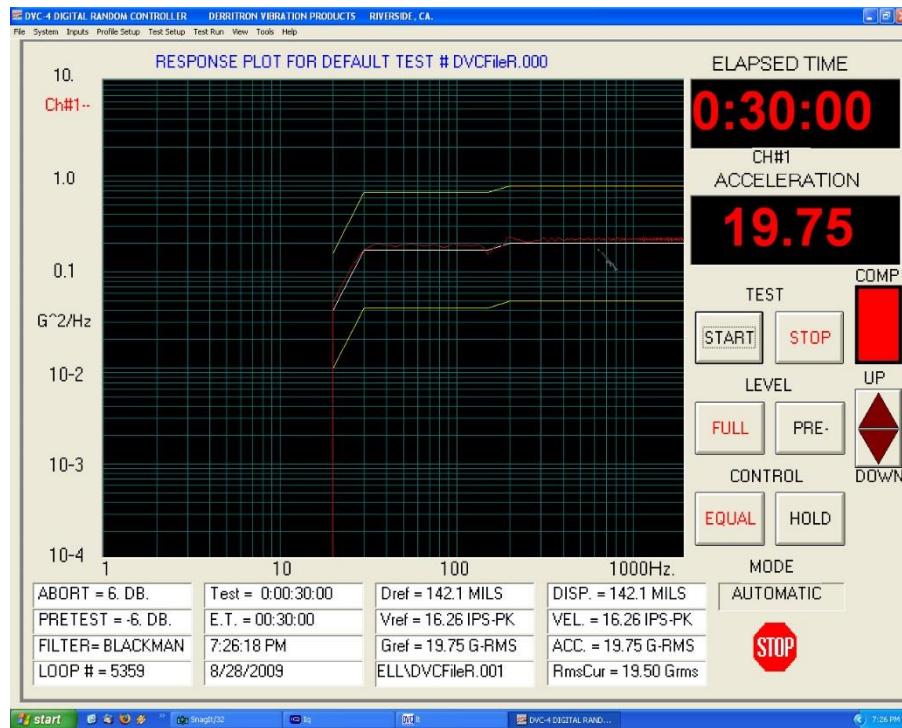


Figure 22: X-axis Vibration Spectrum

6.10.2 Shock Testing

In addition to vibration testing, the UUT was subjected to shock pulses, as follows:

- Type: Half-sine
- Level: 60 g
- Duration: 5 milliseconds

Application: Three (3) shocks in each direction of the three (3) orthogonal axes both positive and negative, for 18 shocks total

The plots of the positive and negative pulses in each of the three axes are shown in the following figures:



Figure 23: Shock Pulse, Z-axis Positive

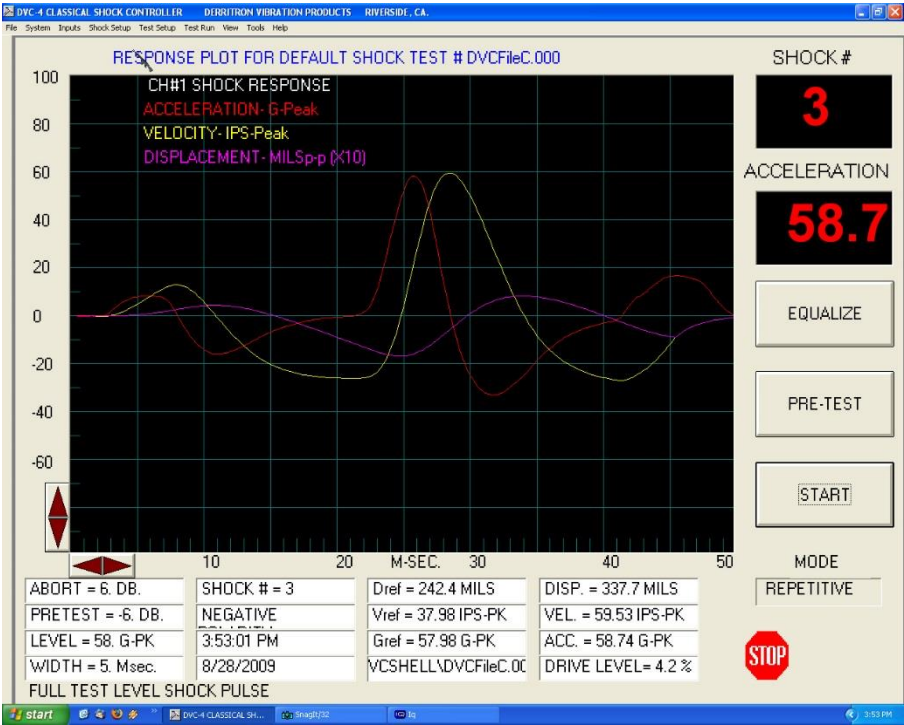


Figure 24: Shock Pulse, Z-axis Negative

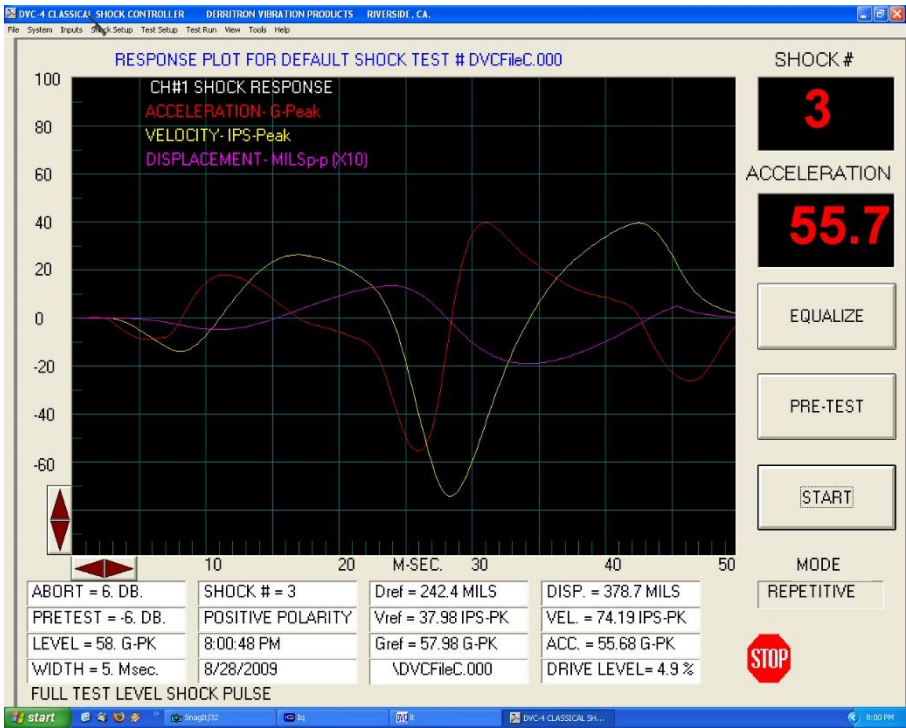


Figure 25: Shock Pulse, Y-axis Positive

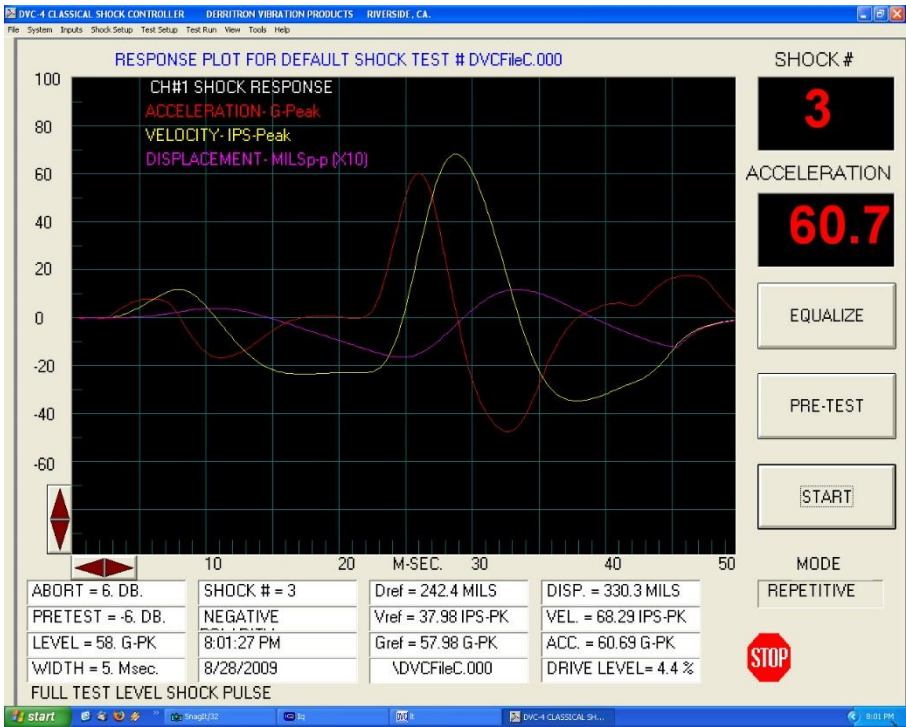


Figure 26: Shock Pulse, Y-axis Negative

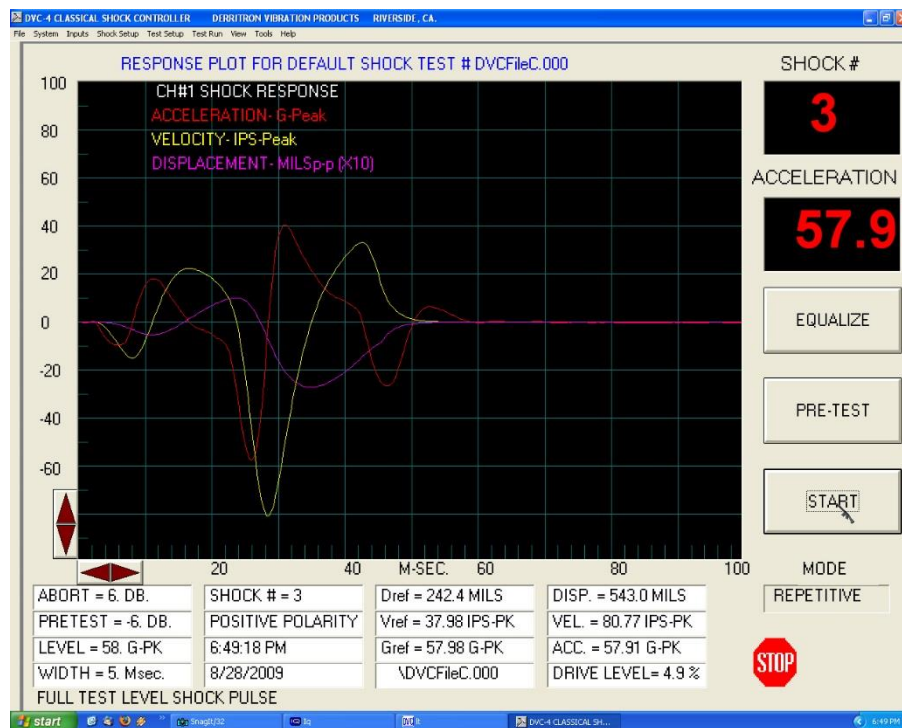


Figure 27: Shock Pulse, X-axis Positive

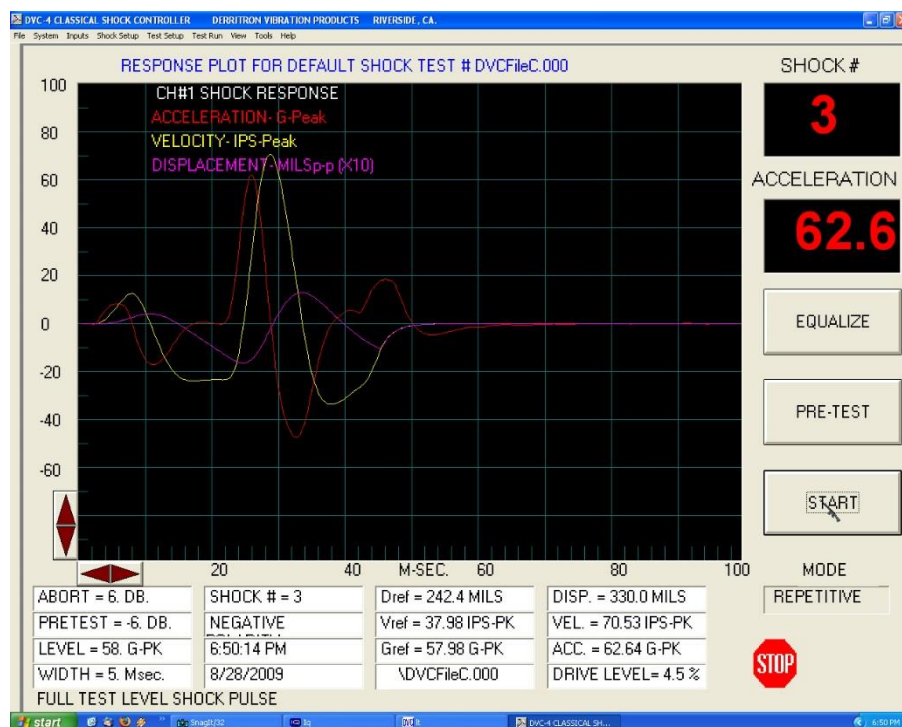


Figure 28: Shock Pulse, X-axis Negative

7 Maintenance Instructions

The GMLRS transmitter requires no regular maintenance, and there are no user-serviceable parts inside.

8 Product Warranty

The GMLRS transmitter carries a standard parts and labor warranty of one (1) year from the date of delivery.

8.1 Quasonix Limited Warranty Statement

This Limited Warranty Statement (this “Limited Warranty”) applies to all hardware and software products and internal components of such products (the “Products”) sold by Quasonix, or its representatives, authorized resellers, or country distributors (collectively referred to herein as “Quasonix”). EXCEPT AS EXPRESSLY SET FORTH IN THIS LIMITED WARRANTY, QUASONIX MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO ANY PRODUCTS SOLD BY IT. Quasonix expressly disclaims all warranties and conditions not stated in this limited warranty. There are no warranties which extend beyond the description on the face hereof. Capitalized terms not otherwise defined herein shall have the meaning set forth in those certain General Terms and Conditions of Sale for Standard Product, as amended from time to time.

Quasonix warrants to customer that for one (1) year from the date of shipment of the Products by Quasonix (the “Warranty Period”), such Products purchased from Quasonix or its authorized affiliate will materially conform to the specifications set forth in the applicable Quasonix Specifications, if any, and are free from defects in materials and workmanship under normal use during the Warranty Period. As used herein, “normal use” means the intended use of the Products for which it was designed by Quasonix.

This Limited Warranty extends only to the original purchaser of the Products and is not transferable to anyone who obtains ownership of the Products from the original purchaser.

Quasonix’s software, whether incorporated into the Products or sold separately, is warranted solely to the extent that problems or “bugs” are found in the software and affect the functional operation of the Products. At no time shall requests for changes in the software architecture or visual esthetics be considered a warranty item.

The Products are manufactured using new materials only. Replacement parts may be new or equivalent to new. Replacement parts are warranted to be free from defects in material or workmanship for thirty (30) days or for the remainder of the Warranty Period of the Products in which they are installed, whichever is longer.

During the Warranty Period, Quasonix will repair or replace the defective Products. All components or hardware products removed from the Products under this Limited Warranty become the property of Quasonix. All warranties are limited to the repair or replacement of the Products.

In no event shall Quasonix be liable for any special, consequential, incidental or indirect damages of any kind, including, without limitation, loss of profits, loss of data, “down-time,” loss of use or damage to other equipment, or personal injury or death, whether or not Quasonix has been advised of the possibility of such loss.

Notwithstanding anything to the contrary herein, Quasonix’s entire liability hereunder from any cause whatsoever and regardless of the form of action shall be limited to the amount actually received by Quasonix.

Quasonix shall not be liable for a breach of the warranty set forth in this Limited Warranty unless: (i) the customer gives written notice of the defect, reasonably described, to Quasonix’s Contracts Administrator within thirty (30) days of the time when customer discovers or ought to have discovered the defect and obtains a Return Materials Authorizations (“RMA”) number; (ii) Quasonix is given a reasonable opportunity after receiving the notice to examine such Products and customer (if requested to do so by Quasonix) returns such Products to Quasonix’s facility in Moorpark, CA, unless otherwise approved by Quasonix; and (iii) Quasonix reasonably verifies customer’s claim that the Products are defective.

Subject to the foregoing, with respect to any such Products during the Warranty Period, Quasonix shall, in its sole discretion, either: (i) repair or replace such Products (or the defective part) or (ii) credit or refund the price of such

Products at the pro rata contract rate provided that, if Quasonix so requests, customer shall, at Quasonix's expense, return such Products to Quasonix.

The customer is responsible for all costs associated with packaging and shipping of the defective Products to Quasonix's facility and clearly marking or affixing the given RMA number on the shipping label. Quasonix is not responsible for any loss or damage during shipment to Quasonix's facility. Following repair or replacement of covered Products, Quasonix will assume responsibility for the costs associated with the return of the material to the customer to an address provided by the customer. Notwithstanding the foregoing, items returned to Quasonix's facility and found to be operational or otherwise not covered by this Limited Warranty shall be returned to the customer at the customer's expense.

This Limited Warranty does not apply to expendable parts, such as cables, lamps, fuses, connectors, etc. This Limited Warranty does not extend to any Products which have been damaged or rendered defective (a) as a result of accident, misuse, abuse, or external causes; (b) by operation outside the usage parameters stated in the user documentation that shipped with the Products; (c) as a result of a failure to follow the instructions in the Operations & Maintenance Manual (d) by the use of parts not manufactured or sold by Quasonix; or (e) by modification or service by anyone other than (i) Quasonix, (ii) an Quasonix authorized service provider, or (iii) your own installation of end-user replaceable Quasonix or Quasonix approved parts if available for the Products in the servicing country.

THE TERMS OF THE WARRANTIES CONTAINED HEREIN DO NOT IN ANY WAY EXTEND TO ANY PRODUCT OR PART THEREOF OR SOFTWARE MATERIALS WHICH WERE NOT MANUFACTURED BY SELLER OR PREPARED BY SELLER OR ANY OF ITS AFFILIATES.

These terms and conditions constitute the complete and exclusive warranty agreement between the customer and Quasonix regarding the Products purchased. This Limited Warranty is applicable in all countries and may be enforced in any country where Quasonix or its authorized affiliates offer warranty service subject to the terms and conditions set forth in this Limited Warranty.

These terms and conditions supersede any prior agreements or representations (including representations made in Quasonix sales literature or advice given to the customer by Quasonix or an agent or employee of Quasonix) that may have been made in connection with the purchase of the Products. No change to the conditions of this Limited Warranty is valid unless it is made in writing and signed by an authorized representative of Quasonix.

8.1.1 Extended Warranties

Extended warranties or extra coverage are available upon request. Please contact Quasonix for details and pricing.

THE REMEDIES SET FORTH IN THIS LIMITED WARRANTY STATEMENT SHALL BE THE BUYER'S SOLE AND EXCLUSIVE REMEDY AND SELLER'S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH HEREIN.

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9 Technical Support and RMA Requests

In the event of a product issue, customers should contact Quasonix via phone (1-513-942-1287) or e-mail (support@quasonix.com) to seek technical support. If the Quasonix representative determines that the product issue must be addressed at Quasonix, a returned materials authorization (RMA) number will be provided for return shipment.

Authorized return shipments must be addressed in the following manner:

**Quasonix, Inc.
ATTN: Repair, RMA #
6025 Schumacher Park Drive
West Chester, OH 45069**

To ensure that your shipment is processed most efficiently, please include the following information with your product return:

- Ship To – Company name, address, zip code, and internal mail-drop, if applicable
- Attention/Contact person – Name, Title, Department, Phone number, email address
- Purchase Order Number – If applicable
- RMA Number – provided by the Quasonix representative

Please note that Quasonix reserves the right to refuse shipments that arrive without RMA numbers.

10 Appendix A – GMLRS Package Information

Table 21: TIMTER™ GMLRS Package Codes, Size, Interface Connectors, and Watts

Package Code	Size	Interface Connector	RF Connector	Serial Control	TTL	422	LVDS	10mW	1W	2W	5W	10W	20W
03AA	1.4" x 2.700" x 0.938"	Female MDM-9 and Male MDM-9	Female SMA	RS-232		X			X	X	X		

Notes:

1. X indicates availability with package code
2. Changes to connectors may be available at request

Table 22: TIMTER™ Package Codes and Available Bands

Package Code	L-band 1435.5MHz - 1534.5MHz	Upper L-band 1750.0MHz - 1855.0MHz	Lower S-band 2200.5MHz - 2300.5MHz	S-band 2200.5MHz - 2394.5MHz	C-band 4400.0MHz - 4940.0 MHz	Mid C-band 5091.0MHz - 5150.0 MHz	S-band / C-band 2200.5MHz - 2394.5MHz 4400.0MHz - 4940.0MHz 5091.0MHz - 5150.0 MHz	L/S band 1435.5MHz - 1534.5MHz 1750.0MHz - 1855.0MHz 2200.5MHz - 2394.5MHz	L/S/C band 1435.5MHz - 1534.5MHz 1750.0MHz - 1855.0MHz 2200.5MHz - 2394.5MHz 4400.0MHz - 4940.0MHz
03AA	X	X	X	X					

Table 23: TIMTER™ Package Codes and Available Options, A - G

Package Code	AC	AI	AP	BR	C7	CC	CE	CF	CG	CH	CL	CM	DP	EC	FO	GM	GN
03AA	X			X	X	X	X	X	X				X		X	X	

Table 24: TIMTER™ Package Codes and Available Options, H - N

Package Code	HF	HR	HS	ID	LD	LH	LL	LR	LS	MO 0	MO 1	MO 2	MCH	MCL	MK	MS	NRF
03AA		X		X	X	X	X	X	X	X	X	X			X	X	X

Table 25: TIMTER™ Package Codes and Available Options, O - Z

Package Code	P9	PA	PF	PK	PM	PS	PSK	RG	RH	RN	S4	SH	SL	SWBX	UH	UL	US	VF	VP	VR	WV
03Aa							X		X	X	X	X	X		X	X	X	X	X	X	X

11 Appendix B – Understanding Clock/Data, AC, and BR

It is important to understand clock and data priorities when using a Quasonix transmitter. Table 26 describes the possible settings for Internal Clock, Clock Free, Clock Free Bit Rate, External Clock, External Data, and Automatic Carrier Output, and the resulting RF output.

Clock and data logic (where they come from and how they are selected) is shown in Figure 29.

When set to internal clock source (CS 1), the data source must also be set to internal via the DS command (DS 1) in order to have synchronous, usable data.

Table 26: Transmitter Priority of CS, CF, BR, and AC When RF is On

CS	CF	BR auto/manual	Ext Clk In	Ext Dat In	AC	RF Out
1	x	x	x	x	x	RF out is based on IC and ID
0	0	Auto	x	present	x	RF out is based on auto CF rate derived from ext data input
0	0	Auto	x	not present	0	RF Off
0	0	Auto	x	not present	1	RF stick at Carrier frequency
0	0	Manual	x	x	x	RF out based on BR setting (may be trash if no data is present or rate is wrong on ext dat input)
0	1	x	present	x	x	RF out based on ext clock and data (may be trash if no data is present on ext dat input)
0	1	x	not present	x	0	RF Off
0	1	x	not present	x	1	RF stick at Carrier frequency

***Note that ‘x’ means ‘don't care’**

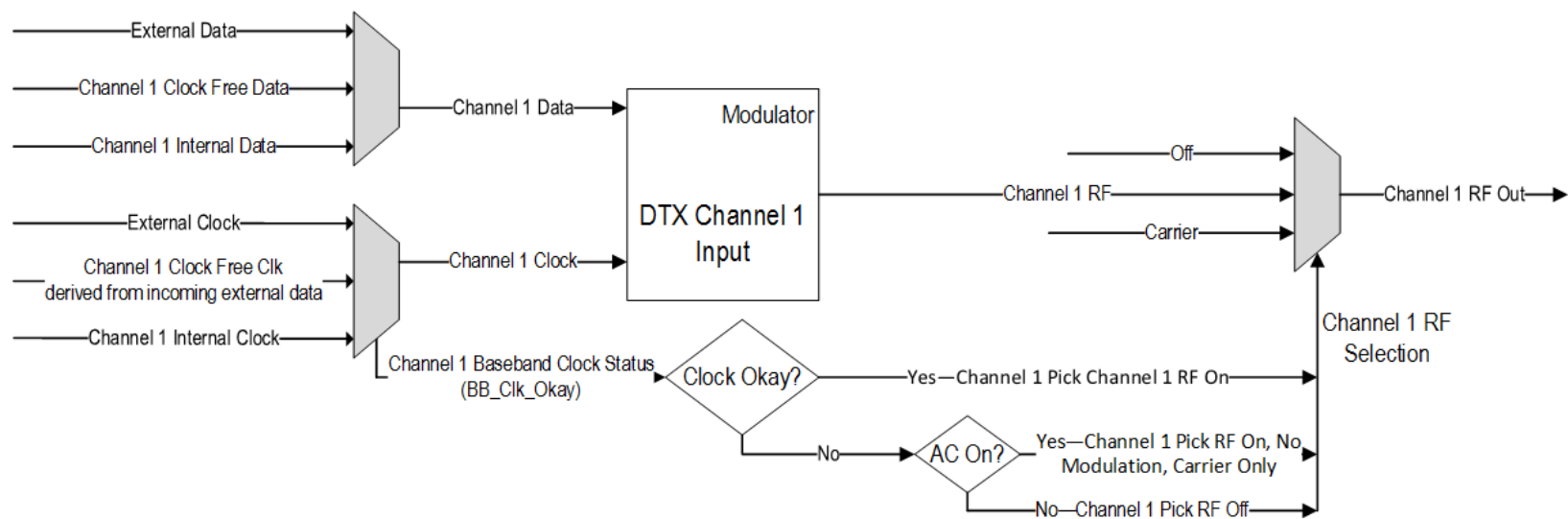


Figure 29: Transmitter Clock and Data Logic

12 Appendix C – Acronym List

Acronym	Description
AGC	Automatic Gain Control
AM	Amplitude Modulation
AQPSK	Variant of Quadrature Phase Shift Keying
ARTM	Advanced Range Telemetry
AUQPSK	Variant of Quadrature Phase Shift Keying
BER	Bit Error Rate
BNC	Bayonet Neill-Concelman Connector (RF Connector)
BPSK	Binary Phase Shift Keying
CD	Compact Disk
CPM	Continuous Phase Modulation
DB-9	D-subminiature 9 pin Serial Connector
DC	Diversity Combiner
DHCP	Dynamic Host Configuration Protocol
DPM	Digital Phase Modulation
FPGA	Field Programmable Gate Array
IF	Intermediate Frequency
IP	Internet Protocol
kbps	Kilobits per second
KHz	Kilohertz
LCD	Liquid Crystal Display
mbps	Megabits per second
MCX	Snap on subminiature connector
MHCPM	multi-h Continuous Phase Modulation
MHz	Megahertz
N	(connector type) Threaded RF connector
OQPSK	Offset Quadrature Phase Shift Keying
PCMFM	Pulse Code Modulation/Frequency Modulation
PM	Phase Modulation

Acronym	Description
PSK	Phase Shift Keying
QPSK	Quadrature Phase Shift Keying
RDMS	Receiver DeModulator Synchronizer
RF	Radio Frequency
RJ-45	Ethernet Connection Jack
RM	Rack Mount
RRC	Remote RDMS Client
RS-232	Recommended Standard 232 (Serial Communications)
SAW	Sawtooth Wave
SDI	System Degradation Indication
SOQPSK	Shaped Offset Quadrature Phase Shift Keying
SOQPSK-TG	Shaped Offset Quadrature Phase Shift Keying –Telemetry Group
TRL	Tracking Loop
TTL	Transistor Transistor Logic
UDP	User Datagram Protocol
UQPSK	Unbalanced Quadrature Phase Shift Keying
USB	Universal Serial Bus
VAC	Voltage Alternating Current
VSWR	Voltage Standing Wave Ratio
WAN	Wide Area Network