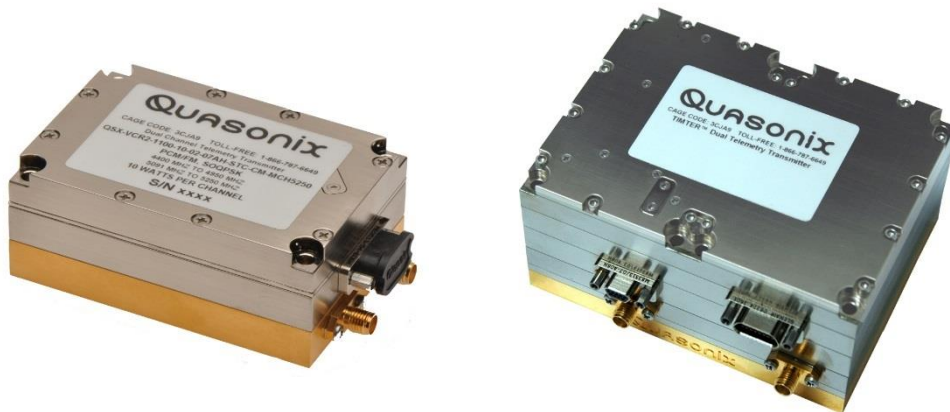# TIMTER™ Multi-mode Dual Telemetry Transmitter

Installation and Operation Manual

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

*** *Revision 1.6.17* ***

Applies to Dual Transmitter Firmware V1.xxx

Specifications subject to change without notice.

All Quasonix transmitter products are under U.S. Department of Commerce jurisdiction categorized as EAR99; not covered by ITAR.

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1 Introduction

1.1 Description

This document describes the Installation and Operation of Quasonix' TIMTER™ Multi- mode Dual Telemetry Transmitters. The 7.2 cubic inch TIMTER™ Dual Transmitter has a compact 2.0 inch by 3.0 inch design that provides a single MDM-15 interface as a primary connector for power, clock and data, and serial communications, while providing two separate RF outputs via SMA connectors. This single band configuration is ideal for two antenna applications that utilize Space-Time Coding (STC) or Frequency Diversity. Quasonix also offers a 24 cubic inch dual transmitter, which provides the same connectors while enabling multiple band functionality. The transmitters are 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

1.2 Nomenclature

The earliest models of these transmitters were referred to as Tier I Missile Test Transmitters (TIMTER™) because they were intended for missiles and offered only ARTM Tier I (SOQPSK) modulation. Although the model line now includes much more than ARTM Tier I, and they are in widespread use on many platforms besides missiles, the "TIMTER" name remains. Now in its third generation and commonly referred to as TIMTER™ 3, the transmitter is available in a number of variations, depending on the options specified at the time of order. The type of features and modes installed in each unit are identified in the model number, as depicted in Figure 1. Package field codes are listed in Table 10. For questions about specific packages, please contact Quasonix.

Dual Transmitter Part Numbering Example
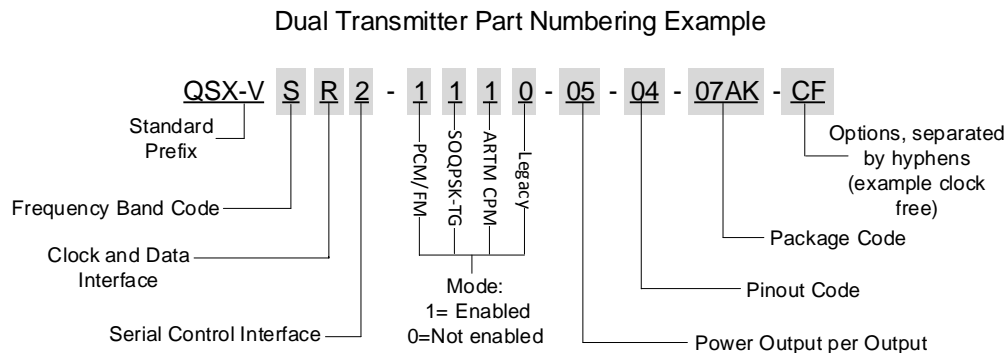
Figure 1: Quasonix Part Number Construction Description

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.

The available TIMTER™ software and hardware options are listed below. Refer to section 1.3 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   Request non standard baud rate for serial control

- C7   Quasonix interpretation of IRIG 106-17 Appendix 2-C serial control protocol

- CE   Convolutional encoder (includes NRZ-M encoding) (k=7 rate 1/2)

- CF   Clock-free baseband interface

- CG   Clock generator output to baseband connector

- DP   Dual power (Ability to set a low and a high setting, hardware controlled*)

- DSWBX   Includes switch box and 18" MDM-9 to MDM-9 cable harness (For use with P9 option)

- FO   Frequency Offset

- HR   Increases max bit rate up to 46 Mbps (23 Mbps for PCM/FM) (20 Mbps max for Clock Free mode)

- ID   Internal Clock and Data can be saved as a power-up default

- LC   Low current in the RF Off state, 10 mA (hardware option)

- LD   LDPC forward error correction encoding

- LD6   Extended LDPC

- LR   Decreases min bit rate to 50 kbps (25 kbps for PCM/FM) (50 kbps min for Clock Free mode)

- MS   Modulation scaling

- PS   Enable hardware presets (specify 2, 4, 8, or 16 – PS2, PS4, PS8, PS16)

- PW020   RF Output 20 mW (+13 dBm)

- RH   Recall Holdoff

- STC   Space-Time Coding

- VF   Variable FIFO Depth, controls transmitter latency

- VP   Variable power (31 settings, spanning 24 dB), software controlled*

- XD   External Device Control

Refer to Table 12 in section 4.2.3 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 TIMTER™ options or for information regarding upgrades to TIMTER™ units that you may already own.

The model number identifies the configuration of the unit. For example, model number QSX-VSR2-1100-10-04-07AH-STC defines a unit configured as shown in Table 1.

Table 1: Model Configuration Example

Identifiers	Description
QSX	Quasonix product
V	Variable bit rate
S	S band code
R	RS-422 clock and data interface code
2	RS-232 serial control interface
1100	Tier 0 present, Tier I present, Tier II absent, Legacy absent
10	10 Watt RF output
04	Pinout code 04
07AH	Package code
STC	Space-Time Coding

1.3   Part Number Field Codes

1.3.1   Frequency Bands

Frequency band codes are listed in Table 2. All frequency bands may be tuned 0.5 MHz above or below the stated frequency, except for units with the FO (frequency offset) option. For higher power requirements, contact Quasonix.

Table 2: Frequency Band Codes

Band ID Code	Band	Minimum Freq	Maximum Freq	Default Freq	Tuning Steps	Max Power
A	Lower S	2200.5 MHz	2300.5 MHz	2250.5 MHz	0.5 MHz	10 W
B	Mid C and Euro Mid C	5091.0 MHz 5150.0 MHz	5150.0 MHz 5250.0 MHz	5120.0 MHz	0.5 MHz	10 W
C	C "Low"	4400.0 MHz	4950.0 MHz	4620.0 MHz	0.5 MHz	10 W
D	C (with Mid C)	4400.0 MHz and 5091.0 MHz	4950.0 MHz and 5150.0 MHz	4620.0 MHz	0.5 MHz	10 W

Band ID Code	Band	Minimum Freq	Maximum Freq	Default Freq	Tuning Steps	Max Power
E	All bands	1435.5 MHz 1750.0 MHz 2200.5 MHz 4400.0 MHz 5091.0 MHz 5150.0 MHz	1534.5 MHz 1855.0 MHz 2394.5 MHz 4950.0 MHz 5150.0 MHz 5250.0 MHz	1450.5 MHz	0.5 MHz	10 W
F	S and C	2200.5 MHz and 4400.0 MHz	2394.5 MHz and 4950.0 MHz	2370.5 MHz	0.5 MHz	10 W
G	Euro Mid C	5150.0 MHz	5250.0 MHz	5150.0 MHz	0.5 MHz	10 W
H	L and C	1435.5 MHz and 4400.0 MHz	1534.5 MHz and 4950.0 MHz	1450.5 MHz	0.5 MHz	10 W
J	C, Mid C, and Euro Mid C	4400.0 MHz and 5091.0 MHz 5150.0 MHz	4950.0 MHz and 5150.0 MHz 5250.0 MHz	5120.0 MHz	0.5 MHz	10 W
K	S and C, Mid C, and (with Euro Mid C)	2200.5 MHz 4400.0 MHz and 5091.0 MHz 5150.0 MHz	2394.5 MHz 4950.0 MHz and 5150.0 MHz 5250.0 MHz	2370.5 MHz	0.5 MHz	10 W
L	Lower L	1435.5 MHz	1534.5 MHz	1450.5 MHz	0.5 MHz	10 W
M	Lower L, Upper L, and S	1435.5 MHz 1750.0 MHz and 2200.5 MHz	1534.5 MHz 1855.0 MHz and 2394.5 MHz	1450.5 MHz	0.5 MHz	10 W
N	Upper S	2300.5 MHz	2394.5 MHz	2370.5 MHz	0.5 MHz	10 W
Q	Lower L, Upper L, S, C, and Mid-C	1435.5 MHz 1750.0 MHz 2200.5 MHz 4400.0 MHz 5091.0 MHz	1534.5 MHz 1855.0 MHz 2394.5 MHz 4950.0 MHz 5150.0 MHz	1450.5 MHz	0.5 MHz	10 W
S	S	2200.5 MHz	2394.5 MHz	2370.5 MHz	0.5 MHz	10 W

Band ID Code	Band	Minimum Freq	Maximum Freq	Default Freq	Tuning Steps	Max Power
T	Lower L, C, and Mid C	1435.5 MHz 4400.0 MHz 5091.0 MHz	1534.5 MHz 4950.0 MHz 5150.0 MHz	1450.5 MHz	0.5 MHz	10 W
V	S and C (with Mid C)	2200.5 MHz 4400.0 MHz and 5091.0 MHz	2394.5 MHz 4950.0 MHz and 5150.0 MHz	2370.5 MHz	0.5 MHz	10 W
W	S and C, Mid C, (with Euro Mid C)	2200.5 MHz 4400.0 MHz and 5091.0 MHz 5150.0 MHz	2394.5 MHz 4950.0 MHz and 5150.0 MHz 5250.0 MHz	2370.5 MHz	0.5 MHz	10 W
X	Mid C band	5091.0 MHz	5150.0 MHz	5120.0 MHz	0.5 MHz	10 W
Y	L and C	1435.5 MHz 1750.0 MHz and 4400.0 MHz 5091.0 MHz	1534.5 MHz 1855.0 MHz and 4950.0 MHz 5150.0 MHz	1450.5 MHz	0.5 MHz	10 W
Z	Lower L, Mid C, and Euro Mid C	1435.5 MHz 5091.0 MHz and 5150.0 MHz	1534.5 MHz 5150.0 MHz and 5250.0 MHz	1450.5 MHz	0.5 MHz	10 W

1.3.2   Clock and Data Interface

Clock and data interface codes are listed in Table 3.

Table 3: Clock and Data Interface Codes

Clock and Data Interface Code	Baseband Clock and Data Interface	Defaults
H	TTL — 10k ohms to ground	TTL 10k ohms
T	TTL — 75 ohms to ground	TTL 75 ohms
A	TTL — Selectable between 75 ohms to ground and 10k ohms to ground	TTL 75 ohms
R	TIA/EIA-422 (RS-422) — 120 ohms differential	422 120 ohms

Clock and Data Interface Code	Baseband Clock and Data Interface	Defaults
B	TIA/EIA-422 (RS-422) — 120 ohms differential, even when unit is powered off	422 120 ohms
M	Dual-mode — Selectable between TTL (terminated 10k ohms to ground) and RS-422 (terminated 120 ohms differential)	422 10k ohms
D	Dual-mode — Selectable between TTL (terminated 75 ohms to ground) and RS-422 (terminated 120 ohms differential)	422 75 ohms
S	Tri-mode — Selectable between TTL (terminated 75 ohms to ground), TTL (terminated 10k ohms to ground), and RS-422 (terminated 120 ohms differential)	422 75 ohms
L	LVDS (Low Voltage Differential Signal)	LVDS

1.3.3   Serial Control Interface

Serial control interface codes are listed in Table 3.

Table 4: Serial Control Interface Codes

Serial Control Interface Code	Serial Control Interface
1	LVTTL
2	RS-232
T	TTL
4	RS-422
6	RS-422, 120 ohms differential, even when unit is powered off

1.3.4   ARTM Tier 0 (PCM/FM)

ARTM Tier 0 codes are listed in Table 5.

Table 5: ARTM Tier 0 Codes

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

1.3.5 ARTM Tier I (SOQPSK-TG)

ARTM Tier I codes are listed in Table 6.

Table 6: ARTM Tier I Codes

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

1.3.6 ARTM Tier II (Multi-h CPM)

ARTM Tier II codes are listed in Table 7.

Table 7: ARTM Tier II Codes

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

1.3.7 Legacy

Legacy modes include BPSK, QPSK, and OQPSK. Legacy codes are listed in Table 7.

Table 8: Legacy Codes

Part Number Code	Legacy Modes
0	Absent
1	Present

1.3.8 RF Output Power

RF output power codes are listed in Table 9.

Table 9: RF Output Power Codes

Part Number Code	RF Output Power
10	10 watts (+40 dBm), minimum per output

1.3.9 Packages

Package field codes are listed in Table 10. For questions about specific packages, please contact Quasonix.

Table 10: Package Codes

Band	Primary Connector	TIMTER™ Package	Volume	Width	Length	Height
L or S band	Female MDM-15	07AH	7.200 in^3	2.000"	3.000"	1.200"
L or S band	Male MDM-15	07AN	7.200 in^3	2.000"	3.000"	1.200"
C band	Female MDM-15	09AK	9.450 in^3	2.000"	3.000"	1.575"
C band	Male MDM-15	09AM	9.450 in^3	2.000"	3.000"	1.575"
L/S band	Female MDM-15	18AG	18.420 in^3	4.000"	3.000"	1.535"
L/C, S/C, or L/S/C band	Contact Quasonix	24xx	24.000 in^3	4.000"	3.000"	2.000"

Transmitter weight may vary depending on packages and applications. For information about the weight of a particular transmitter, please contact Quasonix.

1.3.10 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.

1.3.11 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.

1.3.12 Adapter Plate – AP

Use this option to include the 2.5" x 3.5" adapter plate (hardware accessory) with the order.

1.3.13 Baud Rate Option – BRx

The BR option changes the serial communications 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 = 230400.

1.3.14 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.

1.3.15 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.

For example, the transmitter has two encoders, one for in-phase ("I") data and one for quadrature ("Q") data. Call the input symbol stream I0/Q0, I1/Q1, … . Each encoder outputs 2 bits for every input bit, so call the output bit stream from the first convolutional encoder I0(1), I0(2), I1(1), I1(2), … , and call the output bit stream from the second convolutional encoder Q0(1), Q0(2), Q1(1), Q1(2), … . Combining the outputs of the two encoders, then, the output symbol stream is I0(1)/Q0(1), I0(2)/Q0(2), I1(1)/Q1(1), I1(2)/Q1(2), … .

For modes that do not employ Quadrature modulation, such as PCM/FM, Multi-h CPM, and BPSK, only a single encoder is used.

A single encoder is implemented exactly as described in the "Consultative Committee for Space Data Systems, Recommendation for Space Data System Standards, TM Synchronization and Channel Coding, CCSDS 131.0-B-1, Blue Book, September 2003, Section 3."

A basic convolutional encoder block diagram, as illustrated in CCSDS 131.0-B1, is shown in Figure 2.
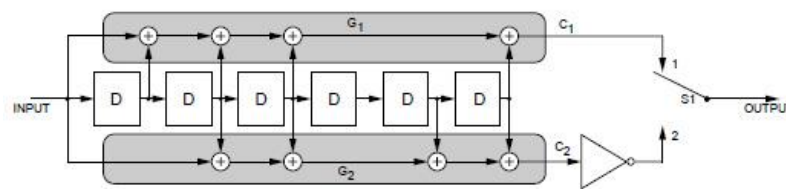
NOTES:

1. →[D]→ = SINGLE BIT DELAY.

2. FOR EVERY INPUT BIT, TWO SYMBOLS ARE GENERATED BY COMPLETION OF A CYCLE FOR S1: POSITION 1, POSITION 2.

3. S1 IS IN THE POSITION SHOWN (1) FOR THE FIRST SYMBOL ASSOCIATED WITH AN INCOMING BIT.

4. ⊕ = MODULO-2 ADDER.

5. →▷o– = INVERTER.

Figure 3-1: Basic Convolutional Encoder Block Diagram

"Consultative Committee for Space Data Systems, Recommendation for Space Data System Standards, TM Synchronization and Channel Coding, CCSDS 131.0-B-1, Blue Book, September, 2003," page 3-2.

Figure 2: CCSDS 131.0-B-1 Rendering of Basic Convolutional Encoder Diagram

1.3.16 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 to 35 Mbps for all waveform modes. It is limited by the bit rate achievable for the current mode. (Refer also to the HR and LR options for extended bit rates, and the ID option for Internal Clock and Data.)

Do not confuse the **CF option** with the CS **command**.

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 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 provides only valid data. Refer to Table 12 for user commands.

1.3.17 Clock Generator Output Option – CG

The standard TIMTER includes internal clock and data generators, generally used for system test. The CG option enables this internal clock out of the unit on the primary MDM-15 connector. The assignment of output pins depends on the other features selected.

1.3.18 Dual Power Option – DP

The DP option provides two software-programmed, hardware-actuated settings, designated as "high power" and "low power". There are 64 choices for "high power" and 64 choices for "low power." Valid range is 0 to 31.5 dB in 0.5 dB steps.

1.3.19 Digital Switch Box Option – DSWBX

The TIMTER™ provides a standard configuration interface that is easily accessible via a computer terminal. Some users prefer configuration via an external switch box. The 2nd Generation Quasonix switch box provides six LED digits used to display the mode and frequency. This includes a total of five digits of frequency step up or down, in MHz, and one digit of mode selection, in terms of the ARTM "Tier" number. There is also a channel selector for channel 1 or channel 2. Two channel operation is only valid when connected to a Dual Telemetry Transmitter. Standard transmitters default to Channel 1. An 18" MDM-9 to MDM-9 cable harness is included with the switch box. (For use with the P9 option)

1.3.20 Frequency Offset – FO

This option is used to set frequencies that are NOT aligned to the synthesizer step size for their units, typically 500 kHz. If the FO option is present, the resolution is 1 Hz (0.000001 MHz). The desired offset may be typed with the frequency using the FR command.

1.3.21 High Bit Rate Option – HR

The standard TIMTER supports bit rates from 0.1 to 28 Mbps in SOQPSK-TG and MULTI-h CPM modes, 0.05 to 14 Mbps in PCM/FM (Tier 0) mode and in all legacy modes. The HR 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 modes.) Refer to the CF option for information about the Clock Free option. Refer to Table 11 for bit rate comparisons by mode.

Table 11: 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.

1.3.22   Internal Clock and Data Option – ID

The ID option allows the CS user setting to be reloaded on power up or on a manual recall of a setup. Without the ID option, CS is forced to 0. Refer to the CF option for information about the Clock Free option.

1.3.23   Limited Current Option — LC

This option is used to specify low current in the RF Off state. Current draw is less than 10 mA when the transmitter is Off. This is a hardware option.

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

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.

1.3.25   Forward Error Correction / Low Density Parity Check (LDPC) Option – LD6

This option adds the extended LDPC option to the unit. It lets the user select from the six implemented LDPC codes, and allows the randomizer command to select the CCSDS randomizer, if LDPC is enabled. Adding this option automatically enables the existing LD option.

The IRIG standard calls out six variants of LDPC codes—all combinations of two different information block sizes (k=4096 bits and k=1024 bits) and three different code rates (r=1/2, r=2/3, and r=4/5).

K=4096, r=1/2	k=4096, r=4/5
k=1024, r=1/2	k=1024, r=4/5
k=4096, r=2/3	

k=1024, r=2/3

1.3.26 Low Bit Rate Option – LR

The standard TIMTER™ supports bit rates from 0.1 to 28 Mbps in SOQPSK-TG and MULTI-h CPM modes, 0.05 to 14 Mbps in PCM/FM (Tier 0) mode and in all legacy modes. The LR 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. Refer to Table 11 for bit rate comparisons by mode.

1.3.27 Modulation Scaling Option – MS

This option enables the MS command which allows a user to scale the modulation index of the transmitted signal. For additional information, refer to Table 12, or contact Quasonix.

1.3.28 Hardware Preset Option – PS (PS2, PS4, PS8, or PS16)

The TIMTER™ supports one or more hardware presets. A single preset defines the complete state of the transmitter, including carrier frequency, modulation mode, data polarity, randomizer state, etc. Without the PS option, the TIMTER™ supports only one hardware preset, which it reverts to at power-up. The PS in the option string specifies that the unit supports multiple hardware presets (2, 4, 8, or 16). Presets are engaged by grounding various combinations of pins on the terminal/parallel control selection. The number of presets available and which pins engage the presets depend on the other features specified. Due to the limited number of pins available, the PS option may require the elimination of the RF On/Off pin. Due to firmware part number parsing requirements, the hardware preset option code must be at the very end of the part number to be valid. On units which use the standard MDM-15 connector, the ZY command displays the connector pinout showing preset pin locations. For additional information, refer to Appendix A – Preset Option.

1.3.29 Recall Holdoff Option – RH

If this option is enabled, AND the recall holdoff pin is held low on powerup, THEN the software will do an 'RF 0' to prevent the RF output from coming on until the user explicitly enters 'RF 1.' If the pin is high, then this option has no effect.

1.3.30 Space-Time Coding — STC

Space-Time Coding is a waveform coding technique that uses transmit diversity to avoid destructive interference in two-antenna systems with a similar bandwidth and power efficiency of SOQPSK. It has been adopted by the Range Commander's Council, IRIG 106-17, Appendix 2-E.

1.3.31 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.

1.3.32 Variable Power Option – VP

The standard TIMTER™ operates at its full rated RF output power. The software-based VP option provides 64 discrete power level settings. Valid range is 0 to 31.5 dB in 0.5 dB steps.

1.3.33 External Device Control – XD

This option lets the user control the state and operation of the new TTL output pins on the switchbox interface connector. Refer to section 4.2.3 for command descriptions.

2   Accessories

Quasonix offers a number of optional accessories for TIMTER™, including a fan-cooled, bench heat sink, a 2.5" x 3.5" adapter plate, pre-wired mating MDM-15 connectors, complete MDM-15 cable assemblies, a ruggedized handheld programmer, and a USB to serial converter cable. 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 TIMTER™ 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 3. The heat sink is shown with a mounted 6 cubic inch TIMTER™ in Figure 4.

Figure 3: Bench Heat Sink and Power Supply

Figure 4: Bench Heat Sink shown with 6 cubic inch TIMTER™

2.2   Airborne IntelliCool™ Heat Sink, 2 x 3 or 4 x 3

Part Number: (QSX-AC-32-HS-28V-SP) or (QSX-AC-34-HS-28V-SP)

The heat sink assembly includes an integral +12 VDC fan, power supply, and temperature-controlled power on at +37°C. Fan speed is regulated to compensate for changes in air pressure/density under high altitude conditions. Two MDM-15 connectors and a provided pigtail cable, shown in Figure 5, allow the heat sink to draw power directly from a TIMTER™ transmitter eliminating the need for a separate external power supply.
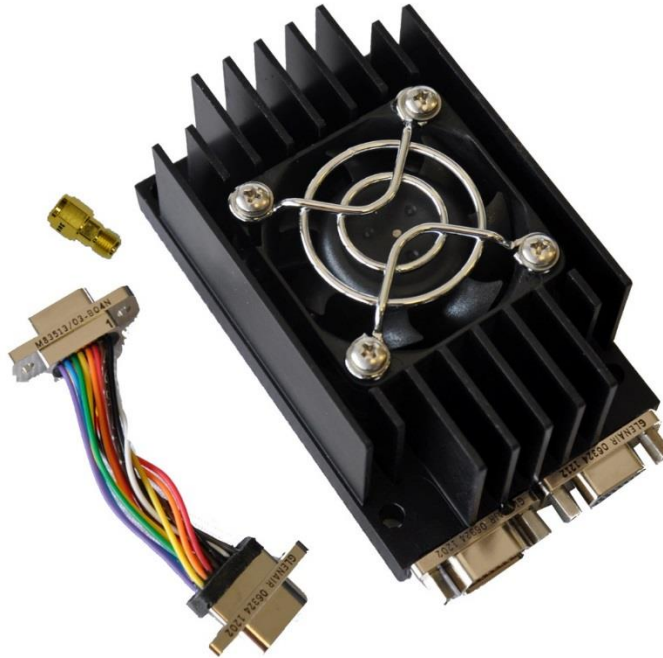
Figure 5: 2 x 3 Airborne IntelliCool™ Heat Sink, Pigtail Cable, and SMA Extender

The pigtail cable connects to any TIMTER™, regardless of MDM-15 gender, by plugging the pigtail into either the male or female connector, as shown in Figure 6 and Figure 7.

Two Airborne IntelliCool™ Heat Sinks are shown in Figure 8 mounted on a TIMTER™ 24xx package. Two MDM-15 connectors enable use with either gender on the transmitter. The SMA extender(s) ensures convenient RF connector access.

A 4 x 3 Airborne IntelliCool™ Heat Sink (QSX-AC-34-HS-28V-SP) is also available for use with Dual Transmitters, as shown in Figure 9.

Figure 6: Close-up Using Female MDM-15 Connector

Figure 7: Close-up Using Male MDM-15 Connector
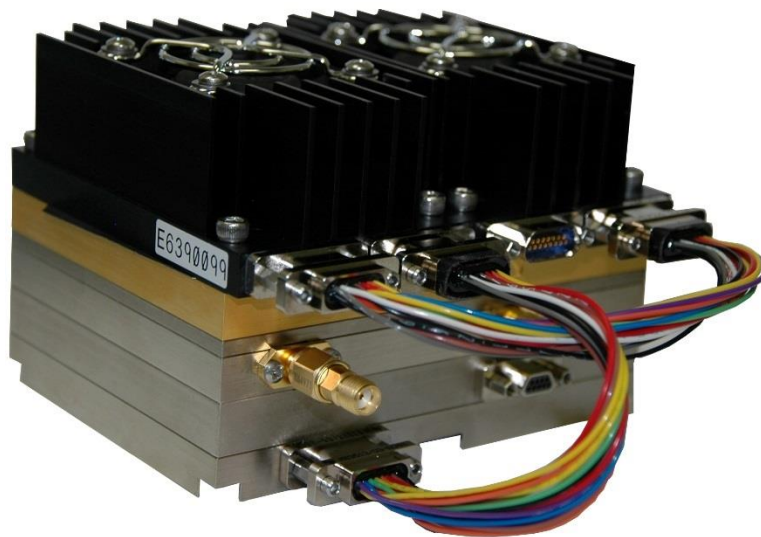
Figure 8: Two Airborne IntelliCool™ Heat Sinks Connected to 4 x 3 Dual Transmitter (24xx Package)
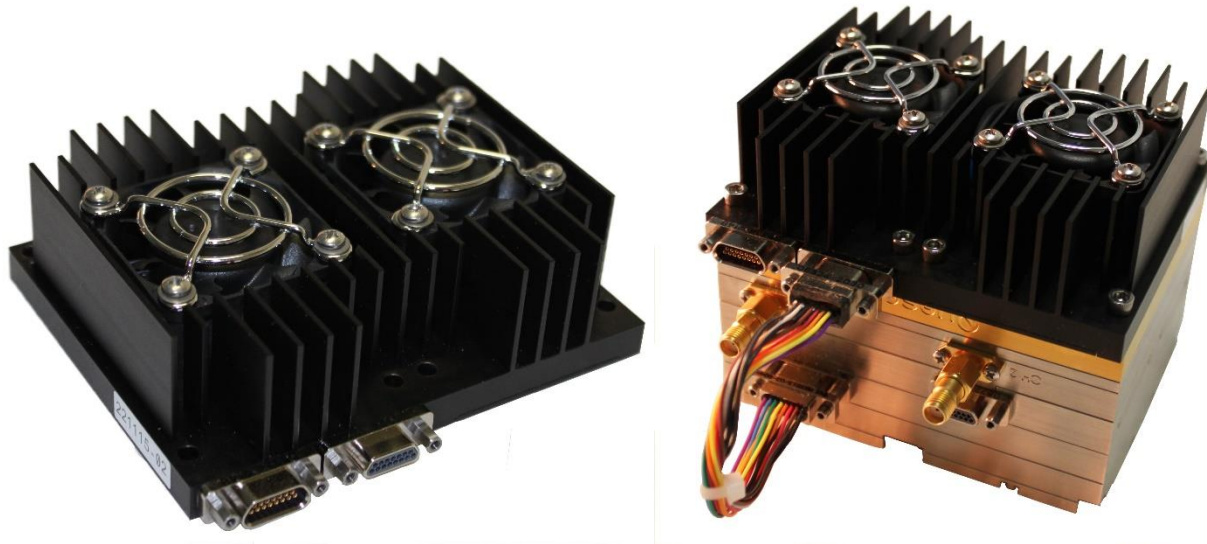
Figure 9: One 4 x 3 Airborne IntelliCool™ Heat Sink Connected to a 4 x 3 Dual Transmitter (24xx Package)

2.3   Pre-wired MDM-15 for RS-422 Units

Part Number: QSX-AC-MDM15-36-PIN

An MDM-15 connector with 36" color-coded pigtail cables for connecting to transmitters with the RS-422 clock and data baseband interface is shown in Figure 10.

Figure 10: Pre-wired MDM-15 with 36" Pigtails for RS-422

2.4   Pre-wired MDM-15 for TTL Units

Part Number: QSX-AC-MDM15-36-SOCK

Quasonix offers an MDM-15 connector with 36" color-coded pigtail cables for connecting to transmitters with the TTL clock and data baseband interface.

Figure 11: Pre-wired MDM-15 with 36" Pigtails for TTL

2.5   MDM-15 Wiring Harness for RS-422 Units

Part Number: QSX-AC-MDM15-HARNESS-PIN

An MDM-15 wiring harness for connecting to transmitters with RS-422 clock and data baseband interface is shown in Figure 13. It includes banana plugs for power and ground, BNC connectors for clock and data, and a DB-9 connector for serial control and is 35 to 36 inches long depending on the connectors.

Figure 12 shows the MDM-15 socket connector installed on RS-422 transmitters.
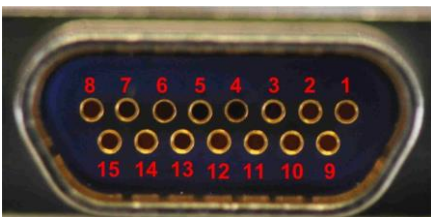
**Figure 12: MDM-15 Socket
Connector on an RS-422
Transmitter**

**Figure 13: MDM-15 Cable Harness Used with RS-422
Transmitters**

2.6   MDM-15 Wiring Harness for TTL Units

Part Number: QSX-AC-MDM15-HARNESS-SOCK

Quasonix offers an MDM-15 wiring harness for connecting to transmitters with TTL clock and data baseband interface, as shown in Figure 15. It includes banana plugs for power and ground, BNC connectors for clock and data, and a DB-9 connector for serial control and is 35 to 36 inches long depending on the connectors.

Figure 14 shows the MDM-15 pin connector installed on TTL transmitters.
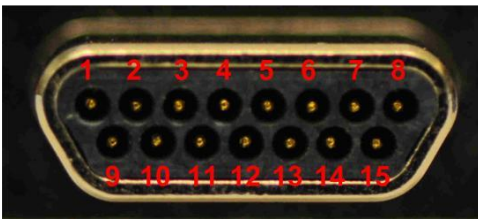
**Figure 14: MDM-15 Pin Connector on
a TTL Transmitter**

**Figure 15: MDM-15 Cable Harness Used with TTL
Transmitters**

2.7   USB to Serial Converter Cable

Part Number: QSX-AC-USBSER-CONV

The 36 inch long USB to serial converter cable allows for configuration of the transmitter with a computer that does not have a serial port. The cable is pictured in Figure 16. An 18 inch long cable is also available.

Figure 16: USB to Serial Converter Cable

2.8   2nd Generation Switch Box

Part Number: QSX-AC-DSWBX

This accessory enables configuration of a TIMTER™ via an external digital switch box. Six LED digits are used to display the mode and frequency. A channel selector for channel 1 or channel 2 enables operation with a Quasonix Dual Telemetry Transmitter. Standard transmitters default to channel 1. Included with the switch box is an 18" MDM-9 to MDM-9 cable harness. The switch box and cable harness is pictured in Figure 17.
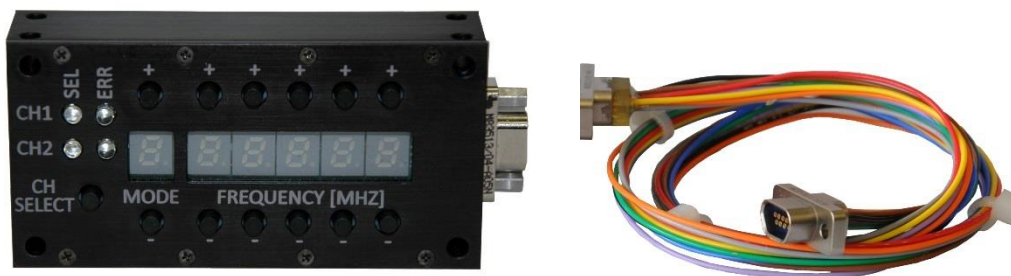
Figure 17: Switch Box with 18" MDM-9 to MDM-9 Cable Harness

3 Installation Instructions

3.1 Mechanical

3.1.1 Standard Dual Transmitter

The 7.2 cubic inch L or S band TIMTER™ Dual Transmitter is designed to be mounted by four (4) 1 1/4 inch screws through the holes in the four corners, as depicted in Figure 22 and Figure 23. At 1.2 inches tall, the Dual TIMTER™ can serve as a drop-in replacement for common 2.0 inch x 3.0 inch transmitters.

Quasonix also offers a 9.0 cubic inch C band TIMTER™ Dual Transmitter. This 1.5 inch tall dual transmitter is designed to be mounted by four (4) 1 1/2 inch screws through the holes in the four corners

Your mounting requirements may be different. Contact Quasonix with all mechanical or installation questions.

Figure 18: 7.2 in3 TIMTER™ Dual Transmitter

Dual RF outputs (Figure 19), up to 10 watts each with a single Micro-D input, can be configured with a single or dual data input.

Figure 19: Dual Transmitter RF Outputs

In the Space-Time Coding (STC) mode of operation, the data stream is encoded into two separate signals that each contain a complete copy of the source data. These two signals are transmitted simultaneously on the same RF frequency (usually over two separate antennas) to produce a radiated over-the-air signal that eliminates antenna self-interference and improves message detectability with a similar bandwidth requirement as a conventional SOQPSK system.

Direct connection to dual antenna platforms via dual outputs, shown in Figure 20, eliminates losses due to unnecessary RF power splitters or couplers. Connecting to each antenna results in streamlined, robust installation and improves Effective Isotropic Radiated Power (EIRP).

Using Space-Time Coding, link outages caused by the "two antenna problem" are eliminated with negligible bandwidth expansion.
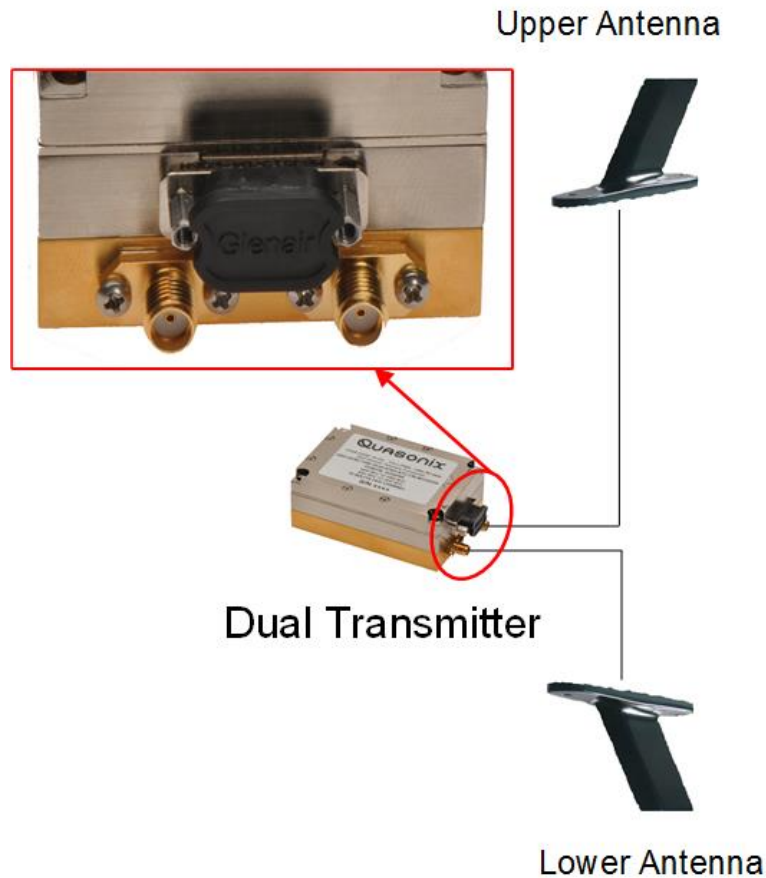
Figure 20: Dual Transmitter RF Outputs Connected to Upper and Lower Antenna

The following example (Figure 21) shows the appropriate dual transmitter connections and expected signal locations when transmitting to a Quasonix 3rd Generation RDMS™ Receiver running in STC mode.

With the PA on the bottom and the dual transmitter facing the user, the left connector corresponds to channel 2 output ("code 2" if referring to the STC constellation display on a Quasonix receiver) and the right connector corresponds to channel 1 output ("code 1" if referring to the STC constellation display on a Quasonix receiver).
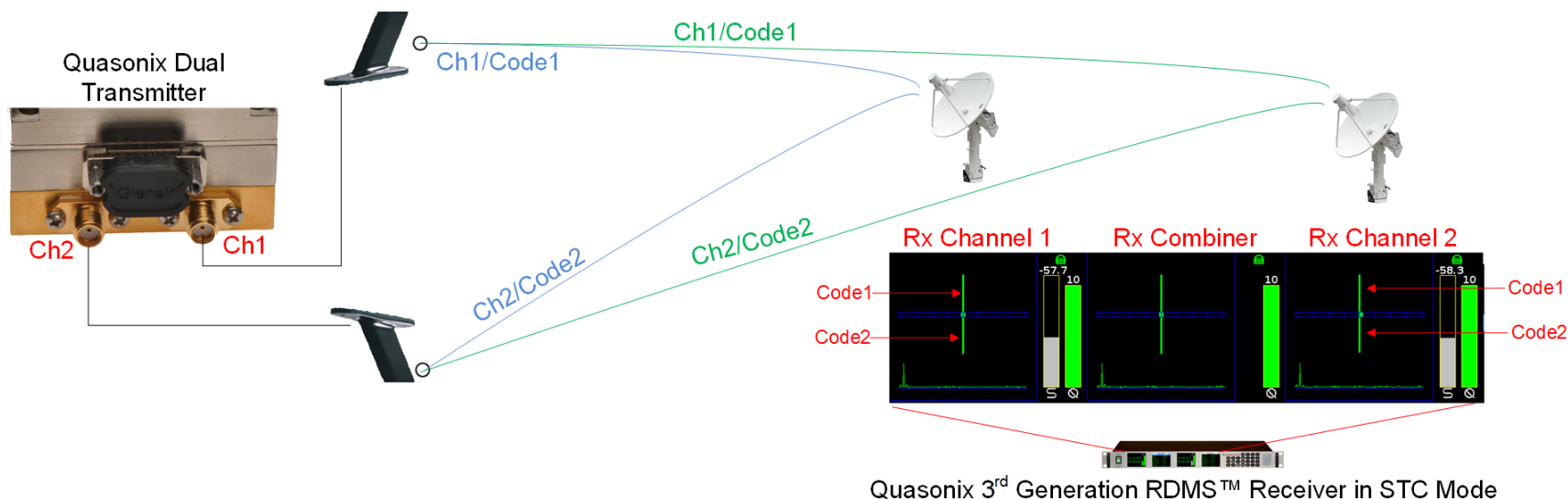
Figure 21: Dual Transmitter RF Outputs Connected to Upper and Lower Antenna Transmitting to Receiver in STC Mode

Explanation of Dual Transmitter to RDMS Receiver Example

The signals from the two transmitter RF connectors are transmitted simultaneously. The signals from the upper (Ch1) and lower (Ch2) antennas are received at the ground antenna(s) providing input to the receiver. STC consists of the sum of the two unsynchronized phase modulated signals with seemingly unrelated data that must be recombined to recover the original source data.

Since no traditional constellation exists for this mode, the receiver displays the relative strength of each signal, the difference in time of arrival between them, and the received strength of the embedded pilot sequences. In this example, one of the signals is transmitted out the top antenna of a vehicle while the other signal is transmitted from the bottom. In this setup, the height of the green line above the blue graduated horizontal bar represents the relative strength of the top antenna, while the length of the green line below the bar represents the strength of the bottom. The small green square within the blue bar represents the time difference of arrival in increments of ¼ of a bit period with all the way to the left or right representing a full bit period.

For information about bench set up for STC and LDPC, refer to Appendix B – Bench Set Up for STC and LDPC.

MOUNTING HARDWARE	TIGHTENING TORQUE	CLAMPING FORCE
#6 (MINIMUM SCREW LENGTH: 1 3/8")	9.6 IN-LB +/- 10%	380 LB +/- 10%

HEAT SINK THIS SURFACE

RF OUTPUT CONNECTOR
SMA FEMALE

PRIMARY CONTROL CONNECTOR
MDM-15 FEMALE
M83513/04-B05N

RF OUTPUT CONNECTOR
SMA FEMALE

PIN 8   PIN 1
PIN 15   PIN 9
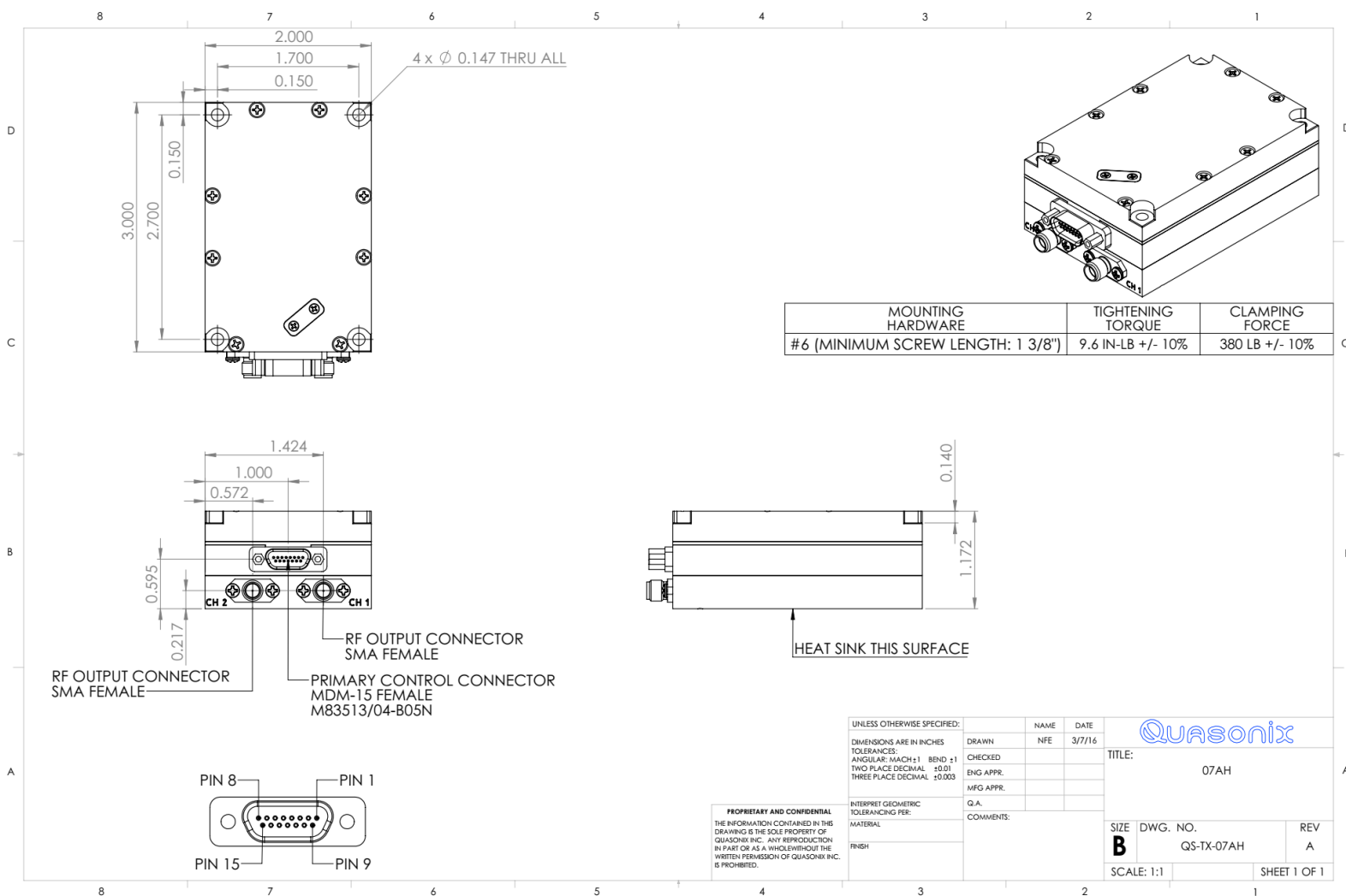
Figure 22: Outline Drawing, TIMTER™ Dual Transmitter, 07AH Package, S-band Female MDM-15

MOUNTING HARDWARE	TIGHTENING TORQUE	CLAMPING FORCE
#6 (MINIMUM SCREW LENGTH: 1 3/8")	9.6 IN-LB +/- 10%	380 LB +/- 10%

4 x Ø 0.147 THRU ALL

RF OUTPUT CONNECTOR
SMA FEMALE

PRIMARY CONTROL CONNECTOR
MDM-15 MALE
M83513/03-BO5N

RF OUTPUT CONNECTOR
SMA FEMALE

HEAT SINK THIS SURFACE

PIN 1   PIN 8
PIN 9   PIN 15

UNLESS OTHERWISE SPECIFIED:	NAME	DATE
DIMENSIONS ARE IN INCHES	DRAWN	NFE	5/2/16

TITLE: 07AN

SIZE **B** DWG. NO. QS-TX-07AN REV -

SCALE: 1:1   SHEET 1 OF 1
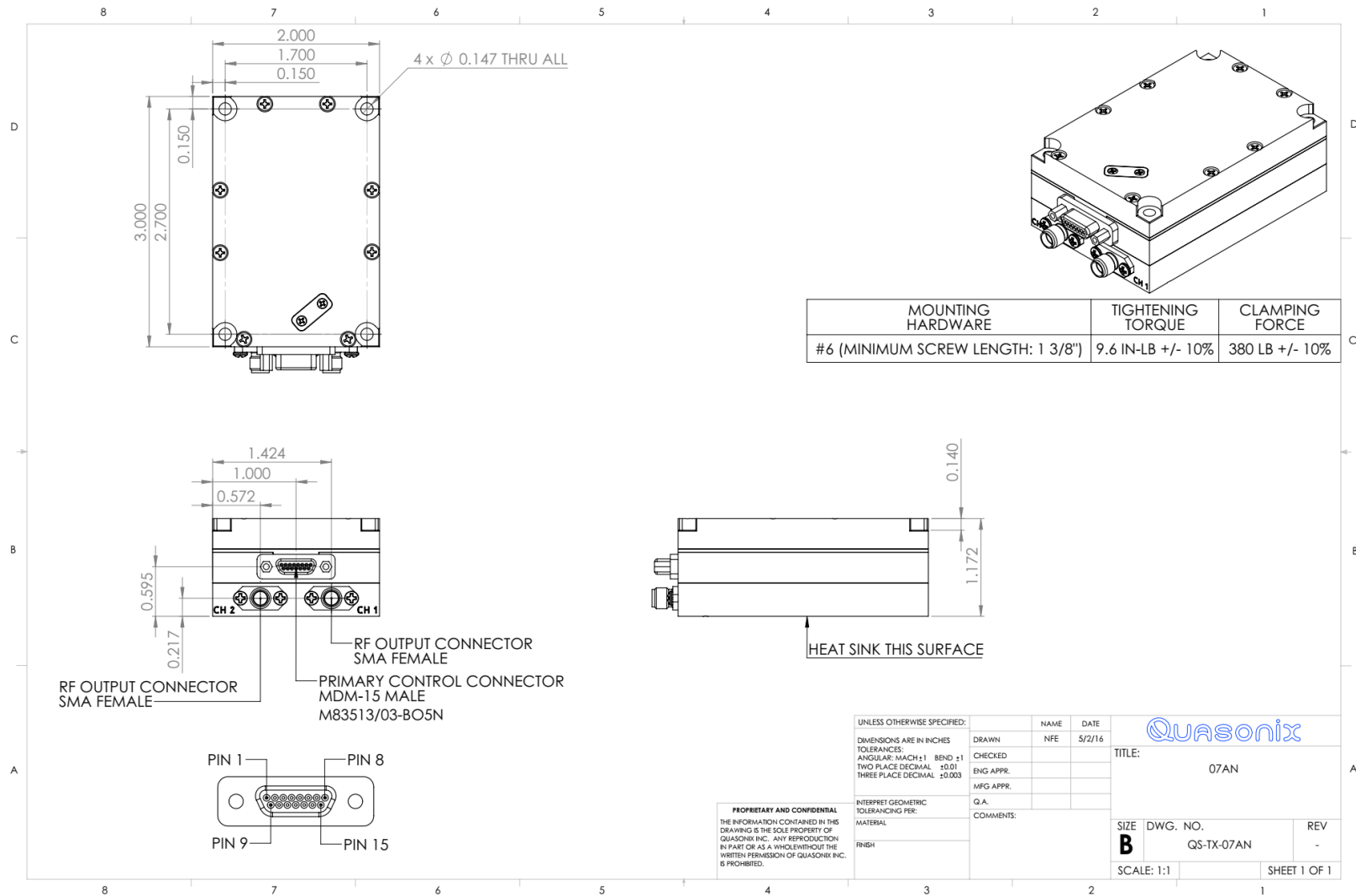
Figure 23: Outline Drawing, TIMTER™ Dual Transmitter, 07AN Package, S-band Male MDM-15

3.1.2   Side By Side Dual Transmitter

The 24.0 cubic inch TIMTER™ Dual Transmitter is designed to be mounted by eight (8) 2 1/4 inch screws through the holes in the four corners and in the center, as depicted in Figure 25. Your mounting requirements may be different.

At 2.0 inches tall, the Dual TIMTER™, the main difference between the side by side (4.00 x 3.00) dual transmitter and the 2.00 by 3.00 dual transmitter is band availability. The side by side dual transmitter offers multiple bands (L/S, S/C, L/C, or L/S/C), while the 2.00 x 3.00 dual transmitter provides single band options (L, S, or C).

Figure 24: 24.0 in3 TIMTER™ Dual Transmitter
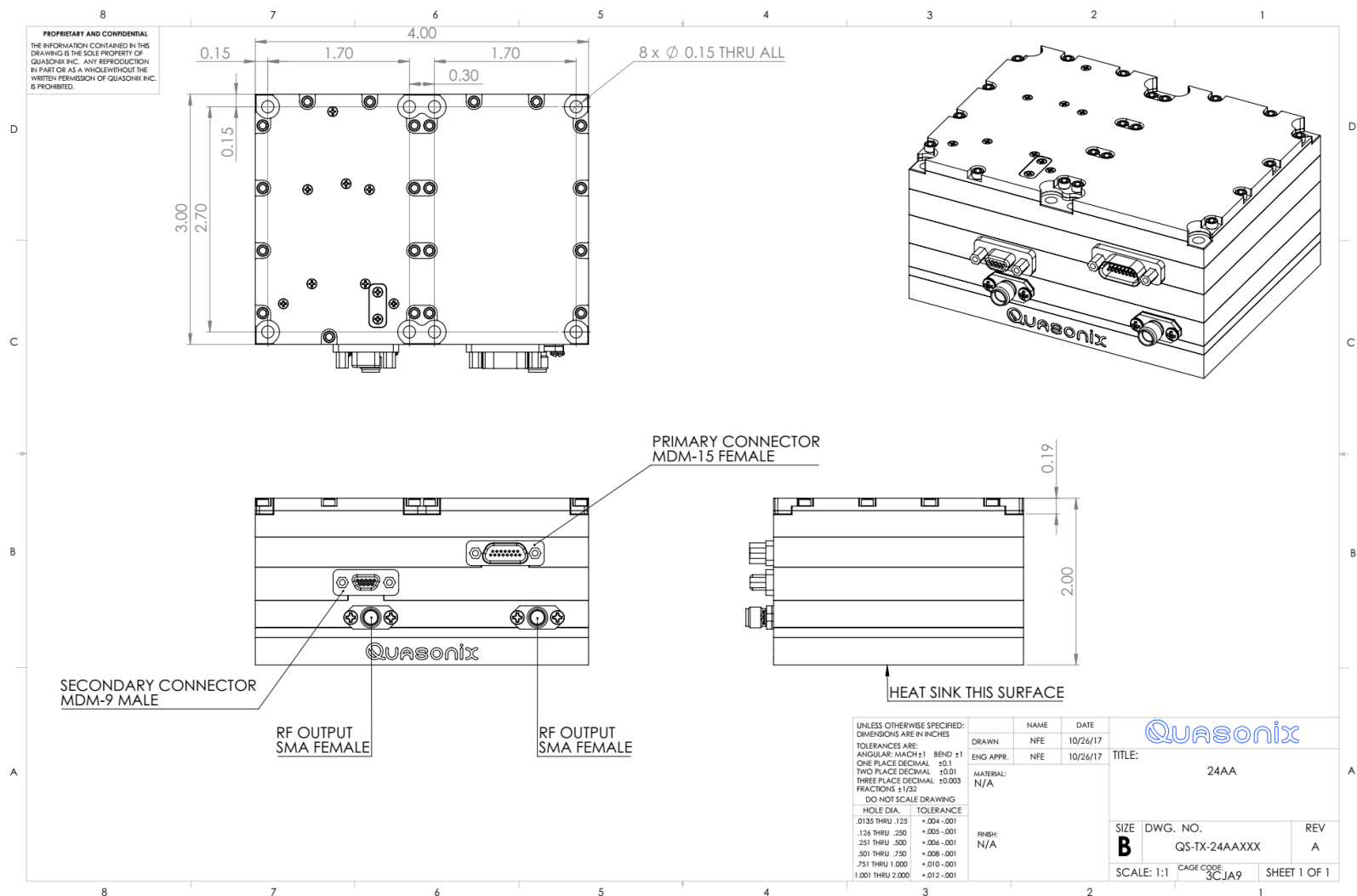
Figure 25: Outline Drawing, TIMTER™ Dual Transmitter, 24AA Package, Male MDM-15

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 transmitter model.

> **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 several types of integrated and add-on heat sinks (refer to Section 2). Please contact Quasonix for heat sink recommendations for your particular TIMTER™ transmitter.

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

3.3   Electrical

The Dual TIMTER™ has three external connectors, an MDM-15 type connector known as the primary, and two SMA female connectors for the RF output connections. Certain transmitter options may require additional connectors.

The pin numbering and pin assignments for the transmitter connectors vary depending on the interface type, connector gender, and options ordered. A pinout code is assigned based on transmitter type and options. Section 1.2 describes the nomenclature/part number breakdown for transmitters.

Each pinout drawing contains the pinout code, a description of the connector (such as Female MDM-15), a photograph of the connector with the pins numbered appropriately, and a table showing the designated pin assignments, drawing name, and revision. Drawings may contain more than one connector (such as an MDM-15 and an MDM-9) depending on the application.

A sample pinout drawing is shown in Figure 26. This is only an example. Pinout drawings for all transmitters may be obtained from the Quasonix web site. Customers with security rules that prevent Internet access or file downloads may contact Quasonix Customer Service for assistance.

For pinout drawings, go to www.quasonix.com.

1. Select Resources from the menu bar.

2. Click on Product Drawings.

3. Select Product Category > Transmitters, Drawing Type > Pinouts.

4. Type the pinout code in the Search box and press Enter.

5. Click on the link or the pdf icon in the list.

When you click on the pinout link in the list, it should open the file in a new tab in the same browser window. Some applications may only allow downloads, but most browsers allow viewing, depending on the local settings. Most browsers allow you to right click on the link and determine how to open it or print it, regardless of the default setting.
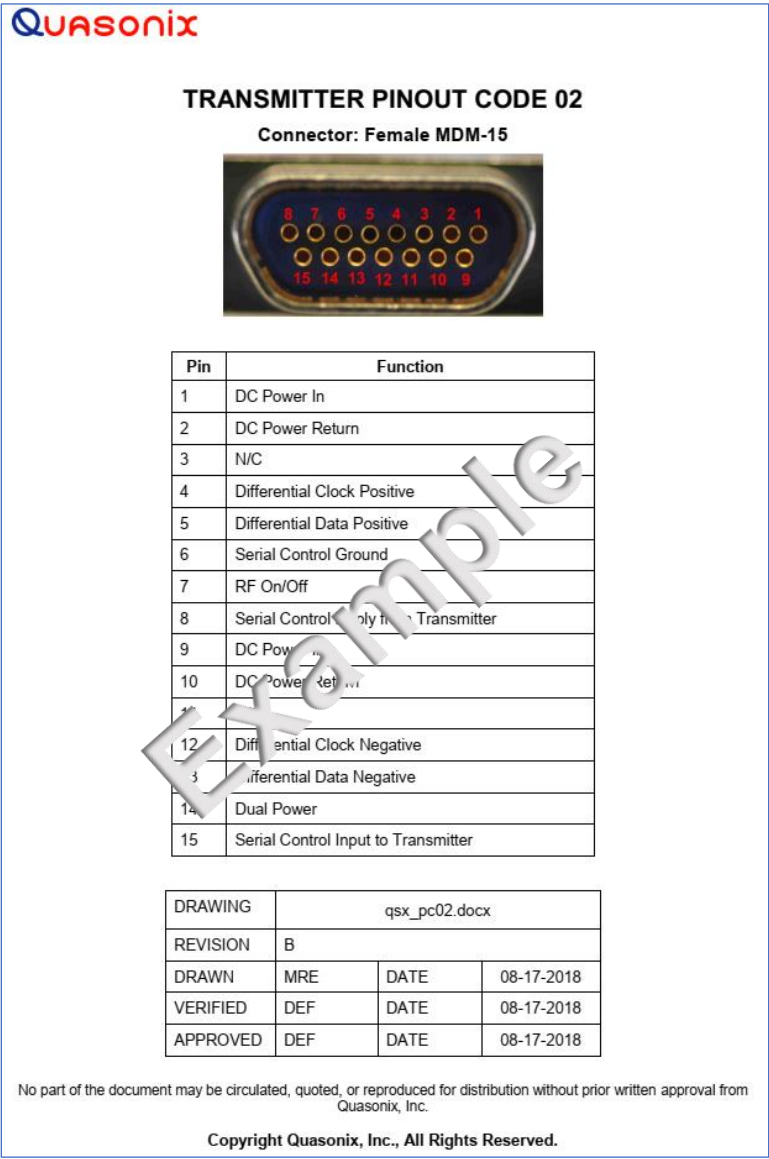
Figure 26: Example Quasonix Pinout Drawing

The data is sampled on the falling edge of the clock, as shown in Figure 27.
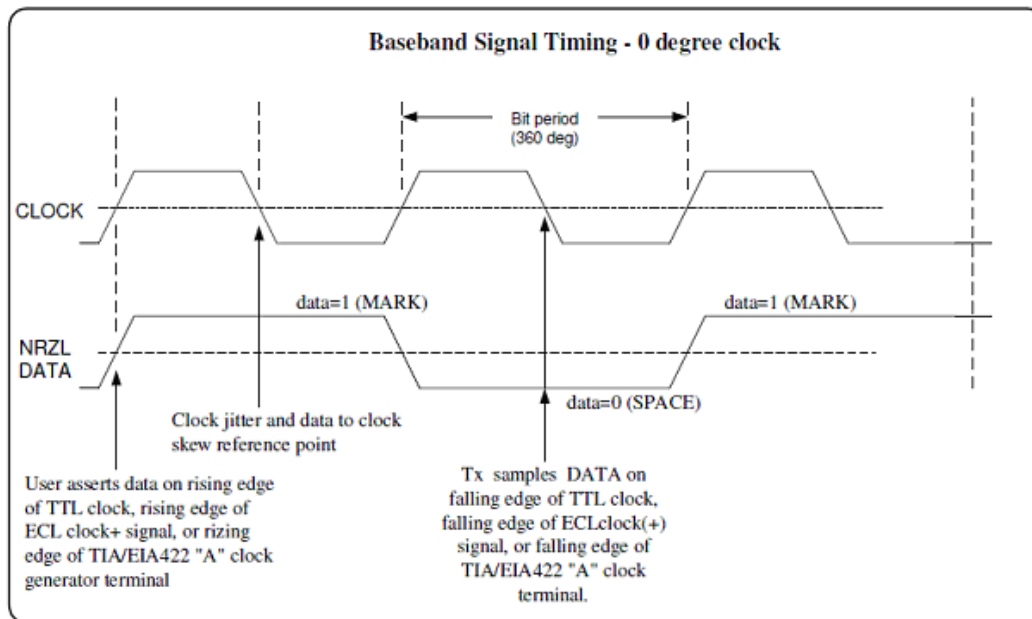
Figure 27: Baseband Signal Timing

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.

> PF / PM OPTION NOTE: Stored parameters are loaded based on the state of the startup configuration (SC) setting. The SC setting allows the user to choose the priority between the parameters stored in nonvolatile memory and the frequency and/or mode settings designated by pins on the external parallel control connector. For other variations, contact Quasonix.

4.1.1   Dual Power via Hardware Control

When the dual power option (DP) is specified, the transmitter uses the hardware pin to switch between the low power setting and the high power setting.

When the pin is left floating or pulled high (logical 1), the transmitter enters the high power mode. When the pin is grounded (logical 0), the transmitter enters the low power mode.

4.2   TIMTER™ Serial Control Protocol

When in Serial Control (Terminal) mode, the TIMTER™ 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 28. This example also shows the commands that display when a digital switch box is attached to the transmitter. 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.

The current firmware version information for the transmitter may be displayed any time by typing the VE command.

```
Quasonix Multi-Mode Digital Transmitter

Customer Name = Quasonix Customer
Contract # = 999999-9
Customer Part # = QSX-VMR-111-10S-20-18A-SBS-AC-CF-DSWBX-HR-LD6-PF-PM-VP-STC
DTX Transmitter SN : 1001
Quasonix Inc.
6025 Schumacher Park Drive
West Chester, OH 45069
(513) 942-1287
www.Quasonix.com

DTX FPGA Rev: 000h 015h
DTX FPGA Build: 0x5DF3F335 =  Dec 13 2019 20:23:17
Dual TX Firmware Rev: DTX V1.290 8/17/2020

Preset 0 read
Ready for Commands
3_PCMFM>>RF on/off pin changed from 0 to 1

3_PCMFM>>BB clock rate chan 1 out of limits (clk =   0.000000 Mbps, src = Ext Clk)

3_PCMFM>>BB clock rate chan 2 out of limits (clk =   0.000000 Mbps, src = Ext Clk)

3_PCMFM>>DTXIB signon...  Side-by-Side DTX assumed

3_PCMFM>>DTXIB signon received

3_PCMFM>>SWBX ver: SWITCHBOX GEN2 V1.018  8/9/2018

3_PCMFM>>Gen 2 Switchbox version signon received

3_PCMFM>>Switchbox Startup Setup sent, reading switchbox

3_PCMFM>>Switchbox setup done

3_PCMFM>>SWBX Chan 1, Freq set to 2200.0 MHz

3_PCMFM>>SWBX Chan 2, Freq set to 2200.0 MHz

3_PCMFM>>SWBX Chan 1, Mode set to BPSK

3_PCMFM>>SWBX Chan 2, Mode set to BPSK

3_BPSK_PCMFM>>SWBX Chan 1 LDPC set to 0 (disabled) with code 2

3_BPSK>SWBX Chan 2 LDPC set to 0 (disabled) with code 2
3_BPSK>
```

Figure 28: TIMTER™ Welcome Message

Note: The V1.xxx Dual Transmitter software, displays current channel and mode as part of the prompt, as shown in Figure 28. If the Dual Transmitter has the CP07 (C7) option, only the current channel displays as part of the prompt, such as 2> for Channel 2.

4.2.1 Frequency Notes

- Channel 1 and Channel 2 can use the same source data and frequency.

- Frequency control is available only via the serial port in the 2 x 3 inch dual transmitter. The 4 x 3 dual transmitter also supports the new 2nd Generation Switch Box for setting frequency and mode.

4.2.2   2nd Generation Switch Box Notes

If a Quasonix 2nd Generation Digital Switch Box is attached to the dual transmitter, and the digital switch box option is present (check the part/model number of the transmitter for DSWBX), all changes made to mode, frequency, or LDPC selections on the dual transmitter are also updated immediately on the Switch Box. This ensures the switch box settings always match those of the transmitter.

4.2.3   Command Set: Standard and Optional Commands

All standard and optional user commands in Table 12 consist of 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 is the exception). On power-up, ALL settings are restored from preset 0, which is the default power on configuration. If the parallel interface is active, then any applicable configuration settings are read from the parallel port and updated accordingly after the initial power on sequence is completed. Refer to the Startup Configuration command (SC) for exceptions.

All settings can be changed via the serial control port; however, parallel port settings will in general override the serial port settings. However, configurations can only be saved from the serial control port. Changes made by the user via either method 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** 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 data. The ONLY way to restore **CS** as **1** from a saved configuration is by executing the **RC** command or by having the ID option available on the unit.

Note: All user commands do not apply to all transmitters. Command availability varies depending on the options ordered and any project specific customization applied. Questions? Please call Quasonix for assistance.

Table 12: Standard and Optional User Commands

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
?	Help	Displays abbreviated list of available commands No Enter key required	Standard	N/A	N/A
Ctrl N		Turns gv.debug Off immediately (gv.debug = 0)	Standard	N/A	N/A
Ctrl R	Repeat Command	Repeats the last typed command and allows editing	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
[	Active Channel Frequency Step Down	Left square bracket key retunes the transmitter to the next lower active channel 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
]	Active Channel Frequency Step Up	Right square bracket key retunes the transmitter to the next higher active channel 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
, (comma)	Active Channel Step Down Power	Incrementally steps down the active channel output power level, from 31 down to 0 One step per key press No Enter key required	VP	N/A	N/A
. (period)	Active Channel Step Up Power	Incrementally steps up the active channel 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	Report or set automatic carrier output state 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. Note that the AI, CF, and CS commands can create a clock, even when one is not externally applied. Examples: AC Report the automatic carrier state AC 0 Set automatic carrier OFF AC 1 Set automatic carrier ON Refer to section 4.2.3.1.1 for related AC command detail	AC ACS	N Y	AC 1

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default

AT	Attenuator Control	*This is a read only command*; Use the VP command (if the option is enabled) to change the output power.
		
		Uses currently selected channel from the CH command as the target and returns a single response, regardless of channel—unless channel = 3 AND the two channels have different values
		
		Example:
		
		AT Report the current value of AT
		
		3_SOQPSK>AT
		        3_SOQPSK>Atten currently 31.5 dB
		
		After VP on chan 1 changed to 5:
		        1_SOQPSK>AT
		        1_SOQPSK>Atten currently 26.5 dB
		        1_SOQPSK>CH 3
		        3_SOQPSK>Cmd Channel set to 3
		        3_SOQPSK>AT
		        3_SOQPSK>Chan 1 Atten currently 26.5 dB
		        3_SOQPSK>Chan 2 Atten currently 31.5 dB
			Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default

BBCK	Check BB Clock	Displays the current baseband clock value and source for each channel
		
		Example:
		`1>BBCK`
		`BB clock rate chan 1 =`
		`5.000010 Mbps, src = Int`
		`Clk C1`
		`BB clock rate chan 2 =`
		`0.999998 Mbps, src = Int`
		`Clk C2`
		Refer to section 4.2.3.1.2 for related BBCK command detail
			Standard	N/A	N/A

BD	Send bias display	The BD command sends a request for bias data to the PA. If the PA_BD debug is enabled, then the response is displayed on the transmitter Terminal window.	Standard	N/A	N/A
BR	Bit Rate	Used when the Clock Free (CF) option is specified and internal transmitter clock is in use Report or set the bit rate of the bit sync that is locking to the externally applied data Not to be confused with "IC", which sets the rate of the internally generated clock Bit rate must be below 35 Mbps to use automatic bit rate detection Examples: BR Report the bit rate BR 5 Set the bit rate to 5 Mbps BR A Set the bit rate automatically Refer to section 4.2.3.1.3 for related BR command detail	CF	Y	BR 5

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
BT	Baseband Interface Type	Report or set baseband interface type Clock and data interfaces are set to either TTL or RS-422. Clock interface and data interface are always the same type. Examples: BT Report the baseband interface type BT T Set the baseband type to TTL single ended, bias 1.65V BT R Set the baseband type to RS-422 differential input Refer to section 4.2.3.1.4 for related BT command detail. Refer to Table 3 for Clock/Data Interface codes.	Interface type D, M, or S	Y	BT R
CC	Convolutional Encoder	Enables or disables the convolutional encoder Currently no independent channel operation; uses last command entered Examples CC Report convolutional encoder state CC 0 Set the convolutional encoder to Disabled CC 1 Set the convolutional encoder to Enabled Refer to section 4.2.3.1.5 for additional CC command detail.	CE	Y	CC 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
CD	Channel Delay	Report or set the channel delay for the currently active channel(s) Valid range is 0 to 5000 in nanoseconds. This is useful when the goal is to adjust the delay on a channel to compensate for antenna length differences. To Enable or Disable the delay, use the CDE command. Examples: CD Report the current channel delay value CD 500.0 Set the channel delay to 500 nanoseconds	Standard	Y	CD 0
CDE	Channel Delay Enable	Enables or disables the use of the channel delay This is useful when the goal is to adjust the delay on a channel to compensate for antenna length differences. Set the channel delay value with the CD command. Examples: CDE Show the current CDE state CDE 0 Disable channel delay CDE 1 Enable channel delay	Standard	Y	CDE 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
CF	Clock Free Disable	Report or set the clock free state In clock free mode, the transmitter uses the narrowest data pulses to determine the clock rate of the data, and no input clock is needed (any input clock is ignored) Examples: CF Report the clock free state CF 0 Unit uses its internal bit sync (internally synthesized) CF 1 Unit uses its externally applied clock Also refer to Appendix C – Understanding Clock/Data, AC, and BR.	CF	Y	CF 0
CG	Clock Generator Source Select	Report or set the clock generator output source Examples: CG Report the clock free state CG 0 Clock Gen output Off CG 1 Use DG0 Internal clock Refer to section 4.2.3.1.6 for additional CG command detail	CG	Y	CG 0
CH	Current Channel	Selects current channel for commands Valid options are: 1 Apply commands to channel 1 2 Apply commands to channel 2 3 Apply commands to both channels Example: CH Report current channel CH 1 Set current channel to 1	Standard	Y	CH 1

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
CHD	Channel Difference	Report all differences between the Channel 1 and Channel 2 configurations Refer to section 4.2.3.1.7 for additional CHD command detail	Standard	N	N/A
CLKS	Clock Source	Refer to CS command	Standard	N	CS 0
CMNIO	Common IO Display	Displays common IO enable and output registers When ? entered as argument, bit definitions for registers are listed Example: CMNIO ? List bit definitions	Standard	N/A	N/A
CP	Clock Polarity	Report clock polarity; the Dual Transmitter only supports Automatic clock polarity and cannot be changed; Automatically selects the most reliable clock edge Example: CP Display the current clock polarity	Standard	Y	CP A
CR	Current Preset	Displays the currently loaded preset CR Display current preset	Standard	N/A	CR 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
CS	Clock Source	Report or set the clock source Unit always reverts to CS 0 (external) at power-up Examples: CS Display the current clock source CS 0 Set clock source to external CS 1 Set clock source to internal When set to internal clock source, the data source is automatically set to internal in order to have synchronous, usable data. Also refer to Appendix C – Understanding Clock/Data, AC, and BR.	Standard	N	CS 0
DB	Debug	Sets the gv.debug level Each debug occupies one bit; turn on multiple gv. debugs ORs the bits Examples: DB ? Displays debug level DB 5 Sets gv.debug level to five	Standard	Y	DB 0
DC	Duplicate Channel	Copies settings from one channel to another (channel 1 to channel 2 or channel 2 to channel 1) An "are you sure?" prompt displays before the command runs. Examples: DC Copies Channel 1 to Channel 2 DC 2 Copies Channel 2 to Channel 1	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
DE	Differential Encoding	Report or set differential encoding for the SOQPSK-TG or other PSK mode (typically disabled for all other modes) Currently no independent channel operation; uses last command entered Examples: DE Report the differential encoding setting DE 0 Set differential encoding OFF DE 1 Set differential encoding ON	Standard	Y	DE 1
DIOR	Display I/O Register Addresses	Displays I/O addresses of machine registers to make it easier to debug Example: DIOR Displays I/O addresses	Standard	N/A	N/A
DL	DAC Level	*This is a read only command*; Displays digital DAC level internal to the transmitter Valid range is 1 to 16383 Example: DL Display DAC level	Standard	N/A	N/A
DP	Data Polarity	Report or set data polarity Examples: DP Display the current data polarity DP 0 Set data polarity to normal (NOT inverted) DP 1 Set data polarity to inverted	Standard	Y	DP 0
FP	Frequency Plug Read	Returns current value of mode and frequency from a switch box	DSWBX	Y	FP 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
FPD	Frequency Plug Debugs	Displays the frequency plug (switch box) debugs with the current state for each channel	DSWBX	N/A	N/A
FR	Frequency	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. 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. 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. If the FO option is present, the resolution is 1 Hz (0.000001 MHz). Examples: FR Display the current frequency FR ? Display allowed frequency ranges FR 1436.5 Set frequency to 1436.5 MHz Refer to section 4.2.3.1.8 for related FR command detail	Standard	Y	FR 1436.5

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
FS	Frequency Step	If no argument is passed, it reports the current frequency step. If an argument is passed, it sets the frequency step size, which is used by the left and right square bracket keys (for step up/step down). The argument specifies the frequency step in MHz, with 0.5 MHz being the smallest available step. Valid range is 0.000000 MHz to 3000.000000 MHz Examples: FS Display the current frequency step FS 1 Frequency step = 1 MHz	Standard	Y	FS 10
HB	Heartbeat	Controls the heartbeat LEDs on the board; the LEDs function based on user selection Examples: HB Displays current state HB 1 LEDs Off HB 2 LEDs blinking HB 3 Binary count cycling HB 4 LEDs match RF state on the channel	Standard	Y	HB 3
H or HE	Help	Displays a list of available commands Commands require a carriage return at the end of the line and may also accept parameters Some commands may not be enabled depending on required options	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
HP	High Power	Report or set high power level to use with dual power option Valid range is 0-31 in 1 dB steps or 0-31.5 in 0.5 dB steps, depending on the transmitter 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	DP	Y	HP 31
HX	eXtended Help	Displays a full list of available commands	Standard	N/A	N/A
IC	Internal Clock Rate	Report or set the internal clock rate 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. Examples: IC Display current internal clock rate IC 4.95 Set internal clock rate to 4.95 MHz Valid range is 0.002 MHz – 46.000 MHz Observes same bit rate limits as HR/LR cmds (PCM/FM half) Refer to section 4.2.3.1.9 for additional IC command detail	Standard	Y	IC 5

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
ID	Internal Data Gen	Report or set the internal data pattern This setting is used if the Clock and Data Source is set to internal (CS 1). When setting the data, the ID name must be PN6, PN9, PN11, PN15, PN17, PN20, PN23, PN31, MARK, SPACE, ALT01, a valid 4 digit hexadecimal value, or USER. If USER, two or more arguments may be included in format: ID USER pattern bitlen Pattern = A 32 bit hex pattern Bitlen = Number of bits (1-32) in the user pattern Examples: ID Report the internal data pattern ID PN15 Set internal data pattern to PN15 ID USER AA55 Set internal data pattern to 0xAA55 ID USER 5555 16 Set pattern to 16 bit pattern of 5555h or bin 0101010101010101 In SOQPSK mode, ID USER 5555 or ID USER AAAA will result in an unmodulated carrier, at the nominal carrier frequency.	Standard	Y	ID PN15
IMN	Internal Model Number	Display the internal model number for the transmitter	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
IMP	Impedance Control	Allows user to change impedance of the clock and data inputs from 75 ohms to 10k ohms Examples: IMP 0 Set impedance to 10k input IMP 1 Set impedance to 75 ohms Refer to Table 3 for Clock/Data Interface codes.	Clock/Data interface code of A	Y	IMP 1
INF	Information Dump	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. This is typically to capture the state of the unit for debug.	Standard	N/A	N/A

IR	Read FPGA IO Register	Reads and displays any IO register on the FPGA;
		
		If a valid hex register address is specified, the [len] dwords starting at that address display.
		
		If no length is specified, the last length is used. Default on power up is 10h.
		
		If no address is specified, the last address is reread and displayed.
		
		Syntax:
		
		IR addr [len]
		
		Examples:
		
		IR ? Show the IR syntax
		
		IR 04C00074H 2 displays:
		`Data 0009313Ah read from IO 04C00074h`
		`Data 2880004Ch read from IO 04C00078h`
			Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
LC	List Configurations	Lists the stored configurations on the unit If a configuration number is supplied, then the saved parameters for that configuration are displayed. These are the same configurations used by presets. Valid configurations 0-15 Examples: LC List all internal saved configurations LC 7 Show configuration 7 details	Standard	N/A	N/A
LD	LDPC Encoding Enable	Enable, disable, or show the current state of the Forward Error Correction (FEC) / Low Density Parity Check (LDPC) encoder Valid options are 0 and 1 Examples: LD Show the current encoder state LD 1 Enable the LDPC encoder LD 0 Disable the LDPC encoder Automatically disables differential encoding; *PSK modes default to DE enabled Automatically re-enables DE for SOQPSK mode Refer to section 4.2.3.1.10 for additional LD command detail	LD, LD6 *PSK modes	Y	LD 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
LP	Low Power	Report or set low power level when dual power option enabled on unit Valid range is 0-31 in 1 dB steps or 0-31.5 in 0.5 dB steps, depending on the transmitter Examples: LP Report the present low power level LP 3 Set low power to 3 LP Max Set low power to the highest allowable value for the unit LP Min Set low power to the minimum allowable value for the unit	DP	Y	LP 0

MA	Modes Allowed	Reports the modes (modulations) enabled on the transmitter, as determined by the part number
		
		Example:
		
		MA Show available modes
		  0 – PCMFM
		  1 – SOQPSK
		  2 – MHCPM
		  3 – BPSK
		  4 – QPSK
		  5 – AQPSK
		  6 – Carrier Only
		  7 – OQPSK
		  8 – UQPSK
		  9 – AUQPSK
		 13 – STC
			Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
MC	NRZ-M Conversion	Selects among the available encodings; no longer limited to nrz-l or nrz-m Examples: MC Show the current NRZ state MC 1 Enable the NRZ-L to NRZ-M conversion MC 0 Disable the NRZ-L to NRZ-M conversion Refer to section 4.2.3.1.11 for additional MC command detail	CE	Y	MC 0
MO	Modulation	Report or set modulation setting Mode 6, Carrier only, is present on every transmitter Examples: (depending on modes ordered) MO Report the modulation setting MO 0 Set modulation to PCM/FM MO 1 Set modulation to SOQPSK-TG MO 2 Set modulation to MULTI-h CPM MO 3 Set modulation to BPSK MO 4 Set modulation to QPSK MO 6 Carrier only, no modulation MO 7 Set modulation to OQPSK MO 8 Set modulation to UQPSK MO 9 Set modulation to AUQPSK MO 13 Set modulation to STC Refer to section 4.2.3.1.12 for additional MO command detail	MO 13 requires STC option All other mode availability dependent on modes ordered	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

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
MR	Memory Read	Displays memory as bytes and ASCII in the format MR address len Address = Optional valid SRAM starting address to display Len = Number of bytes to read Valid RAM range is 10000000 to 100FFFFFh Examples: MR Displays memory from wherever it left off the last time it was called MR 10010000 40 Displays 40 bytes starting at 10010000	Standard	N/A	N/A
MRF	Memory Read Flash	Displays flash memory as bytes and ASCII in the format MRF address len Address = Optional valid FLASH starting address to display Len = Number of bytes to read Valid FLASH range is 000000 to 7FFFFF Examples: MRF Displays flash memory from wherever it left off the last time it was called MRF 000070 3 Displays 3 bytes starting at address 000070	Standard	N/A	N/A
MS	Modulation Scaling	Scales the deviation (modulation index) of the transmitted signal relative to the standard default deviation and writes it to the FPGA; the value is saved with the configuration Example: For PCM/FM – if the standard modulation index is 0.7, setting MS to 2.0 scales a modulation index of 1.4 Value range is 0.09 to 128.01	MS	Y	MS 1.0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default

MV	Digital Board ADC Voltages	Displays the digital board voltage ADC values; PA HVA voltage and current readings
		
		Example:
		
		MV Display current values
		
		`5V Voltage   : 5.586 V`
		`28V Current  : 0.789 A`
		`28V input    : 27.365 V`
		`HVA 2 Current: 0.008 A`
		`HVA 2 voltage: 13.958 V`
		`HVA 1 Current: 0.108 A`
		`HVA 1 voltage: 13.763 V`
		`3.6V RF Voltage : 3.623 V`
		`5.5VDC Voltage  : 5.564 V`
		`1.1V Voltage    : 1.096 V`
		
		3.6V Dig Voltage: 3.626 V
			Standard	N/A	N/A

OC	Overtemperature Control Enable	Enables or disables overtemperature power backoff control OC 0 Disable Overtemperature Control OC 1 Enable Overtemperature Control Refer to section 4.2.3.1.13 for additional OC command detail. **Note:** Highly recommended NOT to disable this feature.	Standard	Y	OC 1
OTA	Over-the-Air Rate	Displays the current baseband and over-the-air bit rates on each channel. This information is also displayed on the RFS output. OTA Display over-the-air rate	Standard	N/A	N/A
PAT	PA Attenuator	*This is a read only command* to display the current attenuator settings PAT Reports PA attenuator setting in dB	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
PF	PSK Filter Select	Sets or shows the current PSK filter selection This is valid if the PSK mode option is enabled and for any *PSK (legacy) modes AND for DPM (no option required) if that mode exists on the transmitter. Valid filter range is 0 to 255 Examples: PF Show current PSK filter PF 42 Set PSK filter to 42	All *PSK	Y	PF 255 (PF 10 if DPM)
PL	Power Level	*This is a read only command;* PL reports the current power level setting for the dual power feature Examples: PL Report the current power level state Disabled in Parallel Mode	DP	Y	PL 0
PR or RE	Restore Defaults	Restores factory default parameters for the unit Default is currently the lowest number modulation supported by the transmitter with the selected band and frequency limits Default power level is Full power (VP Max) AT (attenuator) defaults to 0.0 on both channels	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
PSTP	Power Level Step	Sets the power level step, in dB, to be used when the power stepping commands are issued to step the power up or down for a channel Valid stepping commands are > < . and , (greater/less than symbols, period, and comma) Examples: PSTP Show current power level step size PSTP 1 Set power level step to 1 dB	Standard	N/A	1.0
QA	Query All	Displays common device settings in one compact display	Standard	N/A	N/A
QC	Internal Clock Rate	Sets the internal Q clock rate, in MHz, to be used if the clock source is set to internal Value is rate in Mbps (or freq in MHz) Examples: QC Show internal Q clock rate QC 10 Set internal Q clock rate to 10 MHz	Standard	Y	QC 5

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
QD	Internal Q Data Pattern	Sets the internal data pattern to either a pseudorandom bit pattern (PN 6, 9, 11, 15, 17, 20, 23, and 31 are currently supported) or to a fixed 16 bit word pattern. (Currently independent mode not available; If independent I and Q data is enabled with the IQ command, then this sets the Q data pattern.) Examples: QD Report the current internal data pattern QD PN15 Set pattern to PN15 QD USER 5555 16 Set pattern to 16 bit pattern of 5555h or bin 0101010101010101	Standard	Y	QD PN15
QT or TE	Query Temperature	Report the temperature in degrees Celsius	Standard	N/A	N/A
RA or RN	Randomizer	Report or set randomizer state Examples: RA Report the randomizer state RA 0 Set randomizer OFF RA 1 Set IRIG-106 randomizer ON RA 2 Set CCSDS randomizer ON	Standard RA 2 requires LD6 option and LDPC enabled	Y	RA 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
RC (or PP or RL)	Recall Configuration	Load a saved configuration into the active configuration if the configuration number entered is valid 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. Valid range is 0-15 RC always changes the prompt to channel 3, no matter which channel the RC command was issued from Example: RC Load configuration 0 (default setup) RC 3 Load configuration 3	Standard	N/A	RC 0
RF	RF Output	Report or set RF output control state 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. Examples: RF Report the RF output state RF 0 Set RF output OFF RF 1 Set RF output ON	Standard	Y	RF 1

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
RFOR	RF Off on Retune	Specifies whether RF should be turned off during a frequency retune (even if the new frequency is in the same band) RF will always be turned off during a retune if the frequency requires a hardware band change. Examples: RFOR Show current setting RFOR 0 Disable RF Off on Retune RFOR 1 Enable RF Off on Retune	Standard	Y	RFOR 1
RFS	RF Output State	Displays information used to determine whether RF and modulation are actually On in the format RFS chan Chan = An optional channel parameter used to override the current channel for display information Valid channels are 1, 2, or 3 (to display both) Example: RFS 2	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
RZ	RF On/Off Pin Polarity	Set or show the polarity of the RF On/Off pin, which is pulled high internally to 3.3 VDC RZ 0 means the RF is ON when the RF On/Off pin is low RZ 1 means the RF is ON when the RF On/Off pin is high (floating) Examples: RZ Show the current RF On/Off polarity RZ 0 Set RF On/Off polarity to "pin low = on" RZ 1 Set RF On/Off polarity to "pin high = on" The default polarity on most Quasonix transmitters is *high*. 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.	Standard	Y	RZ 1
SC	Set Configuration Priority	Set or show current configuration priority setting. Valid settings are: 1 – Ignore stored setting; read frequency plug on power up 2 – Ignore frequency plug (always) Refer to section 4.2.3.1.14 for additional SC command detail	DSWBX	Y	SC 1 or 2 (refer to additional detail)
SD	Digital Pot	Report the value of the digital pot for HVA on the transmitter. Range is 0 to 255	Standard	N/A	255

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
SI	Spectral Inversion	Sets modulation scaling to -1 * whatever the current scaling is in order to invert the spectrum This is in addition to any changes in modulation scaling factor. For example, if a negative MS is entered and then SI is enabled, the spectrum result is non-inverted. Examples: SI Show current setting SI 0 Disable spectral inversion SI 1 Enable spectral inversion	Standard	Y	SI 0
SN	Serial Number	Report the serial number for the unit	Standard	N/A	N/A
SPB	Serial Port Buffers	Displays the serial port buffer addresses and current pointers Example: SPB ?	Standard	N/A	N/A
SS	Show Settings	Displays most of the common device settings in one compact display On in the format SS chan Chan = An optional channel parameter used to override the current channel for display information Valid channels are 1, 2, or 3 (to display both) Example: SS 1	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
SV or SA	Save Configuration	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 The SV command also allows the user to assign an alias to the desired preset. Examples: SV 1 Save current configuration to preset 1 SV 7 xyz Save current configuration to preset 7 and assign alias name "xyz" SV always saves everything (not just settings for one channel) and is not channel specific. *Refer to SV Note below for exception	Standard	N/A	N/A
SW	Frequency Sweep	Sweeps the transmitter frequency between provided limits, with provided step size, at a fixed rate Enables independent channel sweep and start/stop (individually or together); Channel 3 sets both channels Examples: SW Displays current status SW ? Displays command help with status SW [chan] Toggles the channel sweep state SW 1 2200.5 2394.5 1.0 Sweep channel 1 between 2200.5 MHz and 2394.5 MHz in 1.0 MHz steps Refer to section 4.2.3.1.15 for additional SW command detail	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
SY	System Status	Displays the system status of the transmitter The first argument specifies the period, in milliseconds, between status updates. Zero (0) disables continuous monitoring. The second argument specifies the number of status lines between header outputs. Examples: SY Displays current status report settings SY 0 Disables continuous reporting SY 5000 210 Sets status header output once every 210 status updates Refer to section 4.2.3.1.16 for additional SY command detail	Standard	N/A	N/A
SYN	Synthesizer RF Out Control	Sets or shows the current state of the synthesizer RF output control in the CTRL register of the machine in the format SYN chan enable Chan = A channel parameter used to address a specific channel Valid channels are 1, 2, or 3 (to display both) Enable = 1 for synthesizer On or 0 for synthesizer Off Examples: SYN Show current state SYN 2 0 Channel 2 synthesizer RF out disabled (Off)	Standard	Y	SYN 0

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
SZ	Set Up System Status Reporting	Selects values to be reported by the SY command; the argument is a string of characters that specifies, in order, the values included in the status report output Values may include: A – Clock rate 0 B – Clock rate 1 C – Clock rate 2 D – Clock rate 3 F – Frequency 1 G – Frequency 2 I – CF rate1 J – CF rate2 M – Mode 1 N – Mode 2 T – Temperature 1 U – Temperature 2 Examples: SZ ? SZ command Help with up to date list of status values SZ Show current values to be included in status report SZ MFGT Set status to show Mode 1, Frequency 1, Frequency 2, and Temperature 1	Standard	Yes	
TD	Temperature Compensation Display	Displays the HVA table and/or the DL table Examples: TD Displays both tables TD ALL Displays both tables TD HVA Displays HVA table only TD DL Displays DL table only	Standard	N/A	N/A
TTS	Temperature Table State	Displays the current state of the temperature tables and bands Example: TTS Show current band and temperature table states	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
TXBR	Dual Transmitter Baud Rate	Temporarily changes system baud rate; for odd baud rates (non-standard) accuracy may vary Valid range is about 300 to 230, 400 baud – Not saved when the transmitter is powered off Examples: TXBR Displays current system baud rate TXBR 200 Sets system baud rate to 200	Standard	N	N/A
UN	User Notes	Sets or displays the user notes for the current setup UN [notes] [notes] is up to 80 characters of string data	Standard	Y with preset	blank
VE	Software Version	Report the current Firmware (software) version information for the transmitter Syntax: VE – Displays current software version of the transmitter VE [a] – Displays ALL version information including models, revisions, software versions for attached components	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

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
VP	Variable Power	Report or set variable power level Typically the transmitter defaults to full power (VP Max); 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 Max Set variable power to the highest allowable value for the unit VP Min Set variable power to the minimum allowable value for the unit	VP	Y	VP Max
XDC	External Device Control	Report or set the state of the extra RS-422 output to use it to control an external device Refer to section 4.2.3.1.17 for additional XDC command detail.	XD	Y	XDC 0
XDF	External Device Frequency Switching Threshold	Report or set the frequency threshold at which the extra RS-422 output changes states Refer to section 4.2.3.1.18 for additional XDF command detail.	XD	Y	XDF 4400.0
XDP	External Device Polarity Invert	Report or set the polarity of the extra RS-422 output Refer to section 4.2.3.1.19 for additional XDP command detail.	XD	Y	XDP 0
ZC	Show All Parameters	Displays all parameters and global variables (mainly for Quasonix factory use) Examples: ZC Show all configuration parameters ZC 2/C Show current parameters for preset 2 Valid presets are 0-15; default is 0	Standard	N/A	N/A

Mnemonic Command	Name	Description	Option (s) Required	Setting Saved?	Factory Default
ZCP	Show Critical Parameters	Displays the current value of all critical parameters	Standard	N/A	N/A
ZF	Show All Options	Displays all options (like ZZ) except ZF shows all options whether enabled or not	Standard	N/A	N/A
ZS	Show Machine State	Displays all of the machine registers for a specified block; if no block is specified, blocks 0 and 1 are displayed Block range is 0-3 Examples: ZS Show blocks 0 and 1 ZS 3 Show block 3	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 If the PS option is not specified, there is only one (1) hardware preset on the transmitter.	PSn	N/A	N/A
ZY	Show Connector	Displays the transmitter's baseband connector pinout with proper gender, numbering, and signal labeling Valid only with standard 15-pin transmitters	Standard	N/A	N/A
ZZ	Show Options	Displays the current hardware configuration and options on the transmitter based on the transmitter part number	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** 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 data. The ONLY way to restore **CS** as **1** from a saved configuration is by executing the **RC** command or by having the -ID option available on the unit.

4.2.3.1   Additional Command Set Details

4.2.3.1.1   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.

AC always applies to both channels simultaneously. If AC is enabled while in Channel 1 or Channel 2, it will always be enabled in both channels, but the active channel number is not changed.

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

4.2.3.1.2   Baseband Clock – BBCK

The BBCK command displays the actual current baseband clock rate and source.

If Clock Free (CF command) is enabled, and the bit rate (BR command) is fixed at 5.5 Mbps:

    3>BBCK

    BB clock rate chan 1 = 5.465334 Mbps, src = CF Man C1 (Man indicates the bit rate was set manually)

    BB clock rate chan 2 = 5.464573 Mbps, src = CF Man C2

If Clock Free is enabled, and the bit rate is set to Auto:

    3>BBCK

    BB clock rate chan 1 = 7.699997 Mbps, src = CF Data C1 (bit rate determined based on the input stream)

    BB clock rate chan 2 = 7.699997 Mbps, src = CF Data C2

If Clock Free is disabled, and the bit rate is set to anything (doesn't matter since CF is disabled):

    3>BBCK

    BB clock rate chan 1 = 7.699997 Mbps, src = Ext Clk (external clock)

    BB clock rate chan 2 = 7.699997 Mbps, src = Ext Clk

For details about specific commands, refer to AC, BR, CF, or IC.

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

4.2.3.1.3   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

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

Suppose this sequence of commands are issued:

      1>BR A

      CF Bitrate Mode set to Auto

      1>BR

      CF Bitrate Mode currently Auto

      CF Bitrate currently 7.700 Mbps (CF Operation Enabled)

The rate shown is the rate determined by the bit sync looking at the data input.

Instead of using the automatic setting, the next example uses a manually set clock free data rate:

      1>BR 6

      CF Bitrate set to 6.000 Mbps fixed

> 1>BR
>
> CF Bitrate currently 5.000 Mbps (CF Operation Enabled)

Since BR is set to a fixed rate, the displayed rate *is* the fixed rate. There could be garbage if the manually set fixed rate does not match the actual incoming data rate.

Next, assume the transmitter is NOT in clock free mode:

> 1>CF 1
>
> CF Disable set to 1 (Normal)
>
> 1>BR A
>
> CF Bitrate Mode set to Auto
>
> 1>BR
>
> CF Bitrate Mode currently Auto
>
> CF Bitrate currently 7.700 Mbps (CF Operation NOT Enabled)

Since the current setting is BR Auto, the rate shown is what would be used (as determined by the measured data input) if clock free were enabled.

If BR is set to a fixed value and clock free is disabled:

> 1>BR 6.1
>
> CF Bitrate set to 6.100 Mbps fixed
>
> 1>BR
>
> CF Bitrate currently 6.100 Mbps (CF Operation NOT Enabled)

This example set BR to a fixed rate, but since clock free is not enabled, it is not used.

Use the BBCK command to see the actual current clock rate being used.

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

For details about specific commands, refer to AC, BBCK, CF, or IC.

4.2.3.1.4   Baseband Interface Type – BT

BT sets the baseband interface type using the following options:

> T = TTL single ended, bias 1.65V
>
> R = RS422 differential input

This command is only valid if the transmitter has the VR option which now includes clock and data interface types D, M, or S.

If the unit has the EG option, the BT command and the VR option are not allowed.

4.2.3.1.5 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.

4.2.3.1.6 Clock Generator Source Select Command – CG

The CG command allows the user to pick any of the listed items for the clock generator output source. This command requires the -CG (clock generator) option. CG 0 is the default to match legacy units.

Syntax: CG [src / ?]

        where src is:

            0 Clock Gen output Off

            1 DG0 Internal clock always

            2 DG1 Internal clock always

            3 DG2 Internal clock always

            4 DG3 Internal clock always

            5 Ext Clock input always

            6 Ext Data input always

            7 Ch1 Clock free clock

            8 Ch2 Clock free clock   <When independent modes have been implemented by Quasonix>

            9 Manual control with NIOS TX DI pin in CMNIO (Quasonix factory use only)

            '?' displays a syntax listing

Examples:

CG 5   // Set CG output to external clock always

CG ?   // Display the choices

4.2.3.1.7 Channel Difference – CHD

CHD shows the user all of the differences between the Channel 1 and Channel 2 configurations. Any parameters which do not match are shown. For example:

```
1_PCMFM_PCMFM>>CHD
freq_desired_hz                 Ch 1: 5100.000000 MHz, Ch 2: 4430.000000 MHz
freq_actual_hz                  Ch 1: 5100.000000 MHz, Ch 2: 4430.000000 MHz
band_sel                Ch 1: 64, Ch 2: 32
band_sel                Ch 1: 64, Ch 2: 32
id_type                 Ch 1: 10, Ch 2: 11
internal_i_clock_hz             Ch 1: 5000000, Ch 2: 1000000
DTX_atten_level                 Ch 1: 21.5, Ch 2: 6.5
vp_desired_power_level              Ch 1: 10.0, Ch 2: 25.0
pa_current_atten_dB             Ch 1:  3.00, Ch 2:  7.00
clock_free_bitrate_bps              Ch 1: 2999996, Ch 2: 5999989
```

```
Found 10 differences between channel 1 and channel 2
Independent mode required
```

*D2 option coming soon. CHD always shows 'Independent mode required' when D2 = 1.

If there are any differences between channel 1 and 2 configurations (as shown with CHD above), then a second '>' is added to the prompt after the channel number to let the user know the channels are not set to the same parameters.

Prompt with no channel differences	Prompt with channel differences
1_PCMFM_PCMFM>	1_PCMFM_PCMFM>>
2_PCMFM_PCMFM>	2_PCMFM_PCMFM>>
3_PCMFM_PCMFM>	3_PCMFM_PCMFM>>

4.2.3.1.8   Frequency – FR

When the FO option is installed, the desired offset may be typed with the frequency using the FR command. The frequency offset range +/- 1 MHz with a resolution of 1 Hz (0.000001 MHz).

The FO option offsets the synthesizer +X MHz and the FPGA -X MHz.

Examples:

Frequency Offset Using FR command:

1_STC>FR 2200.2

Freq set to 2200.0 MHz

Freq offset set to 0.200000 MHz

Actual Output Freq set to 2200.200000 MHz

When programming a transmitter using a digital switch box, the switch box displays an error light if the user tries to program a frequency outside the range. Note that the transmitter allows up to 10 MHz outside of the standard defined frequency range, however this is not recommended, and behavior outside the range is not guaranteed. The switch box will send the appropriate value to the transmitter, but will still flash an error to indicate the value is outside the frequency range. If the frequency value passes 10 MHz, the transmitter displays a frequency not set message.

The example below shows a display from a Terminal session. The first line shows a message sent from the switch box (indicated by SWBX) with a frequency of 2200.5 MHz. The second line shows a frequency of 2190.5. The third line shows an attempt to change the frequency to 2190.0, which is 10.5 MHz outside the standard frequency range. In this case, the desired frequency was not set.

3_STC>SWBX Chan 2, Freq set to 2200.5 MHz

3_STC>SWBX Chan 2, Freq set to 2190.5 MHz

3_STC>SWBX Chan 2, Freq Invalid (2190.0 MHz). Freq NOT set

4.2.3.1.9   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.

4.2.3.1.10   Low Density Parity Check Command – LD

The LD command enables or disables the Low Density Parity Check coding on a dual transmitter. This is only valid in *PSK modes, and it automatically turns OFF differential encoding. When LDPC is disabled, the state of DE is determined by the mode (for example, all *PSK modes default to DE On.)

In the Dual Transmitter, the LD command operates on the currently selected channel(s).

There is an optional selection for the block and rate selection. This requires purchase of the LD6 option which enables LD and enables user code selection. LD6 also allows the randomizer command (RA or RN) to select CCSDS if LDPC is enabled.

The default code is 4096 2/3.

If the transmitter includes the LD option (but not LD6), then LD 0 or LD 1 are used to disable or enable LDPC, as shown in the example immediately following. With the LD option, the block size and code rate are always 4096 2/3.

Examples:

LD   Show the current encoder state

LD 1   Enable the LDPC encoder

LD 0   Disable the LDPC encoder

If the transmitter includes the LD6 option, the user may select from the six implemented LDPC codes. This also allows user selection of the CCSDS randomizer using the RA or RN command. Adding LD6 automatically enables the existing LD option.

The IRIG standard calls out six variants of LDPC codes—all combinations of two different information block sizes (k=4096 bits and k=1024 bits) and three different code rates (r=1/2, r=2/3, and r=4/5).

LD6 Code	Block Size and Code Rate
0	k=4096, r=1/2

LD6 Code	Block Size and Code Rate
1	k=1024, r=1/2
2	k=4096, r=2/3
3	k=1024, r=2/3
4	k=4096, r=4/5
5	k=1024, r=4/5

With the LD6 option, use LD 0 or 1 to disable or enable LDPC, then use 0-5 to indicate the desired LDPC code. A space is required between the disable/enable code and the desired LDPC selection, as shown in the examples.

Examples:

LD 0   Disable the LDPC encoder

LD 1 0 Enable the LDPC encoder and set the block size and code rate to k=4096, r=1/2

LD 1 1 Enable the LDPC encoder and set the block size and code rate to k=1024, r=1/2

LD 1 2 Enable the LDPC encoder and set the block size and code rate to k=4096, r=2/3

LD 1 3 Enable the LDPC encoder and set the block size and code rate to k=1024, r=2/3

LD 1 4 Enable the LDPC encoder and set the block size and code rate to k=4096, r=4/5

LD 1 5 Enable the LDPC encoder and set the block size and code rate to k=1024, r=4/5

4.2.3.1.11 NRZ-M Conversion – MC

MC enables selection of available PCM encoding values. The encoding values are as follows:

0   NRZ-L: Non-return-to-zero, level

1   NRZ-M: Non-return-to-zero, mark

2   NRZ-S: Non-return-to-zero, space

3   Biphase-S: Biϕ, space

4   DM-M: Delay modulation (Miller code), mark

5   DM-S: Delay modulation (Miller code), space

6   RZ: Return-to-zero

7   Biphase-L: Biϕ, level

8   Biphase-M: Biϕ, mark

9   M2-M: Modified delay modulation (Miller squared code), mark

10   M2-S: Delay modified modulation (Miller squared code), space

MC options, other than 0 (Off), are forms of differential encoding, so they are not used with LDPC, STC, or DE On. They are typically only used with PCM/FM or legacy PSK modes.

4.2.3.1.12 Mode – MO

4.2.3.1.12.1 STC

When the mode is changed to 13 (STC) on a Dual Transmitter, the active channel settings are automatically copied to the other channel. This is true regardless of the method used to change the mode (Terminal, Switch Box, Handheld Programmer, etc.). If MO 13 was issued from channel 1, the transmitter copies channel 1 settings to channel 2. If MO 13 was issued from channel 2, the transmitter copies channel 2 settings to channel 1. This is

because STC needs both channels to match to function properly. STC is the only mode that is always duplicated on both channels.

When both channels are set to STC (Mode 13), and one channel is changed to a different mode, both channels are changed to the new mode. This prevents a situation where one channel is set to STC and the other is not. After that, if one channel is changed, only that channel is changed, unless the channel is set to 3. When the channel is set to 3, both channels are changed at the same time, regardless of the mode.

4.2.3.1.13 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.

4.2.3.1.14 Set Configuration Priority – SC

The SC command sets or shows the current configuration priority setting. When the transmitter is first powered on, it loads the default configuration from preset 0. Based on the setting of the SC parameter, the transmitter may look for a digital switch box sign-on and then attempt to read the frequency, mode, and LDPC settings from the switch box. This command requires the DSWBX (digital switch box) option to be valid.

Valid SC settings are:

- 1 – Read the switch box (frequency plug) on power up; thereafter, changes from either the switch box or Terminal interface are allowed.

- 2 – Ignore the switch box (frequency plug) ALWAYS; Only the Terminal interface works until the SC setting changes.

The default value is SC 1 if the DSWBX option is present on the transmitter.

The default value is SC 2 if the DSWBX option is NOT present on the transmitter.

The SC setting is only saved as part of a preset save. If SC is changed during regular operation and power is cycled on the transmitter, the SC setting reverts to the saved setting.

Switch Box Behavior Notes:

a. If a switch box is present during power up of the transmitter, AND the SC command is set to 1, the switch box settings are read, and the mode, frequency, and LDPC values (if applicable), are set based on the switch box values.

b. After a transmitter is powered up, if a switch box is disconnected from the transmitter and then reconnected (also referred to as hot plug-in), OR if the switch box was NOT detected on power up, but was detected at a later time (also a hot plug-in), then the transmitter settings for the mode, frequency, and LDPC are sent to the switch box to keep it in sync with the transmitter.

c. After a transmitter is powered up, and a switch box is connected and detected, any change of mode, frequency, or LDPC on the switch box is detected by the transmitter and acted upon (if SC = 1)—a message *from* the switch box displays on the terminal or Handheld Programmer, such as "SWBX Chan 2, Mode set to SOQPSK" and the mode on transmitter channel 2 is changed to SOQPSK—and any changed

mode, frequency, or LDPC setting on the transmitter, is sent to the switch box to keep it in sync with the transmitter.

4.2.3.1.15 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 (from a terminal, Handheld Programmer, or switch box) or recall preset occurs, the sweep is automatically terminated.

- If the frequency on an attached switch box is changed while a sweep is running, the sweep terminates.

- 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, and to keep the frequencies displayed on a connected switch box in sync with the transmitter. For example, if the mode changes to STC while a sweep is running, on either or both channels, 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 1 1 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 2 1 1435.5 1442.5 1" seamlessly restarts the sweep with the new frequencies. An attached switch box is only updated with the original starting sweep frequency and the stop frequency. Changes during a sweep are not reported to the switch box.

The valid step size range is >= 1 kHz to <= 1000 MHz.

The frequency sweep syntax is:

SW [chan [enable [start stop step]]]

> Where:
>
>> **channel** is 1, 2, or 3 for both channels
>>
>> **enable** is 0 for Off, 1 to enable (On)
>>
>> **start** is starting frequency in MHz
>>
>> **stop** is ending frequency in MHz
>>
>> **step** is frequency step size in MHz

SW ? displays help (syntax)

SW displays current status

SW chan shows state of specified channel sweep

Examples:

SW ?   Help (syntax)

SW   Show the sweep status for the current channel

SW 2   Show the sweep status for channel 2

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

4.2.3.1.16 System Status Command – SY

The status reporting period must be > 200 ms or zero (0) to disable. Items in the SY command are defined with the SZ command. The minimum update period is 200 ms (about 5 times per second).

The SY command is defined as follows.

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).

This example display shows selected parameters for one channel.

CRateB0 (b/s)	CFRate1 (b/s)	Mode 1	Freq 1 (Hz)	Temp 1 (C)
7812666	0	0	1852000000	32.5

Examples:

SY ?   Help

SY   Show the current system status reporting period

SY 5000   Set the status output period to 5 seconds

SY 5000 100   Set the status header output once every 100 status updates

4.2.3.1.17 External Device Control Command – XDC

The XDC command controls the state and operation of the new TTL output pins on the switchbox interface connector.

Connector: Male MDM-9

Pin	Function
1	Ground
2	**XDC Control Ground

Pin	Function
3	**CH1 XDC Control Out
4	No Connection
5	Transmitter Replies to Switch Box
6	3.3VDC + Output
7	No Connection
8	**CH2 XDC Control Out
9	Switch Box Commands to Transmitter

**Currently used only by Dual Transmitter with XD option only

The user can manually set the output to 0, 1, or Automatic as follows.

In automatic mode, the actual XDC outputs are based on current frequency and the XDF and XDP settings.

Note that these are channel specific. If you are on Channel 3, both change together. On either Channel 1 or Channel 2, you change only that channel.

XDC 0 means set the current channel TTL control output to 0 unless XDP (polarity invert) is set, in which case it is set to 1.

XDC 1 means set the current channel TTL control output to 1 unless XDP (polarity invert) is set, in which case it is set to 0.

XDC A means set the current channel TTL control output based on the current frequency such that

if FR >= XDF then output is 1 if XDP is 0 (no invert)

or 0 if XDP is 1 (invert)

if FR < XDF then output is 0 if XDP is 0 (no invert)

or 1 if XDP is 1 (invert)

Examples:

XDC ?   Help

XDC   Show the current external device control state

XDC 1 Set the current channel TTL control output to 0 (assume polarity invert is set to 0)

XDC 0 Set the current channel TTL control output to 1 (assume polarity invert is set to 0)

4.2.3.1.18 External Device Frequency Switching Threshold Command – XDF

The XDF command sets the frequency threshold at which the TTL control output changes states. This command has no effect unless XDC is set to Auto.

XDF accepts and displays up to six decimal places, meaning the frequency (in MHz) can have precision down to 1 Hz. The trip point may be set to any frequency the transmitter supports. The valid range is 200.0 MHz to 5260.0 MHz.

Syntax: **XDF** [**?/freq**]

> where freq is the frequency at which the TTL control output changes states if XDC is set to auto. Which state it changes to depends on the setting of XDP:
>
>> if FR >= XDF then output is 1 if XDP is 0 (no invert)
>>
>>> or 0 if XDP is 1 (invert)
>>
>> if FR < XDF then output is 0 if XDP is 0 (no invert)
>>
>>> or 1 if XDP is 1 (invert)

Examples:

XDF ?	Help
XDF	Show the current external device frequency switching threshold
XDF 4430.0	Set the current external device frequency switching threshold to 4430.0 MHz

4.2.3.1.19 External Device Polarity Invert Command – XDP

The XDP command sets the polarity of the TTL control output. In the definition, 0 means do NOT invert the polarity of the output, 1 means invert the polarity of the output.

It looks at the frequency and compares it to XDF to see whether XDC is set to auto, or just an XDC parameter, which will otherwise be 0 or 1. The output is determined from those.

Then, if XDP is 0, do nothing. If XDP is 1, invert the output.

Syntax: **XDP** [**?/0/1**]

> where **XDP 0** (no invert) means set the TTL control output to
>
>> 1 if XDC = 1 or if XDC = A and current FR >= XDF
>>
>> 0 if XDC = 0 or if XDC = A and current FR < XDF
>
>> **XDP 1** (invert) means set the TTL control output to
>
>> 0 if XDC = 1 or if XDC = A and current FR >= XDF
>>
>> 1 if XDC = 0 or if XDC = A and current FR < XDF

Examples:

XDP ?	Help
XDP	Show the current external device polarity invert state

4.2.3.2   Channel Override Format

Some commands support channel override format. This means that these commands can be sent with a 1, 2, or 3 in front of them, and it will override whatever the current channel is (as shown in the prompt), instead of changing a channel, issuing a command, and then changing back to the previous channel. So if the channel is 3 and the user sends the '2RF 0' command, only channel 2 will receive the RF Off command, just as though the channel had been 2, and the user sent a normal 'RF 0' command. The current channel is NOT changed by this.

Commands supporting channel override are:

- CS - Clock source

- DP - Data polarity

- FR - Frequency

- IC - Internal clock rate

- ID – Internal data pattern

- LD – Low Density Parity Check

- MO - Mode

- QT - Query temperature

- RF - RF On/Off

- VP - Variable power

5   RF Output Notes

5.1   RF Power

In a dual transmitter, Channel 1 and Channel 2 *can* use independent RF output power to eliminate an RF power divider. For example:

> When RF output power is 10 W,
>
>> Upper antenna: 1 W
>>
>> Lower antenna: 9 W

5.2   Muting RF Output

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 4.2.3.

5.3   Troubleshooting the RF on a Quasonix Transmitter

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 (3.3 VDC).

     - **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 PCM/FM, **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 and data source with **CS 1.**

6. Set the internal clock rate to 5 Mbps with **IC 5**.

7. Set the internal data pattern to PN15 with **ID PN15**.

8. Use a spectrum analyzer to verify the desired waveform on the RF output at the desired frequency.

9. 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 (3.3 VDC).

   - **RZ 0** sets the transmitter output to turn ON when the RF On/Off pin is low.

10. Change either the RF On/Off pin or the polarity to turn the RF output ON.

11. 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 PCM/FM, **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 and data source with **CS 0**. This is the normal state on power up for most units.

6. 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.

7. 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.

8. Be sure that a data source is connected to the correct pins, with the correct type (TTL or RS-422) and polarity as above.

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 (3.3 VDC).

    - **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.

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 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 10 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 TIMTER™ transmitters is provided in Table 13.

Table 13: DC Input Current at Standard Input Voltage

Band Type	Wattage	Maximum Current	Typical Current @ 28 VDC
L or S band	10 Watts per Output	3.5 amps	3.2 amps
L/S band (4x3)	10 Watts per Output	3.5 amps	3.2 amps
C band	10 Watts per Output	3.8 amps	3.5 amps
L/C band or S/C band (4x3)	10 Watts per Output	5.0 amps	4.5 amps
L/S/C band (4x3)	10 Watts per Output	5.0 amps	4.5 amps

6.3   Environmental Specifications

TIMTER™ transmitters meet the environmental requirements shown in Table 14.

Table 14: TIMTER™ Environmental Specifications

Environmental Specifications	Description
Operating temperature (10 W per Output)	-40°C to +70°C
Non-operating temperature (all models)	-55°C to +100°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 15: 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, except for units with the FO (frequency offset) option. Frequencies supported by TIMTER™ Dual Transmitters are listed in Table 16. For higher power requirements, contact Quasonix.

Table 16: Carrier Frequencies (MHz)

Band ID Code	Band	Minimum Freq	Maximum Freq	Default Freq	Tuning Steps	Max Power
A	Lower S	2200.5 MHz	2300.5 MHz	2250.5 MHz	0.5 MHz	10 W
B	Mid C and Euro Mid C	5091.0 MHz 5150.0 MHz	5150.0 MHz 5250.0 MHz	5120.0 MHz	0.5 MHz	10 W
C	C "Low"	4400.0 MHz	4950.0 MHz	4620.0 MHz	0.5 MHz	10 W
D	C (with Mid C)	4400.0 MHz and 5091.0 MHz	4950.0 MHz and 5150.0 MHz	4620.0 MHz	0.5 MHz	10 W

Band ID Code	Band	Minimum Freq	Maximum Freq	Default Freq	Tuning Steps	Max Power
E	All bands	1435.5 MHz 1750.0 MHz 2200.5 MHz 4400.0 MHz 5091.0 MHz 5150.0 MHz	1534.5 MHz 1855.0 MHz 2394.5 MHz 4950.0 MHz 5150.0 MHz 5250.0 MHz	1450.5 MHz	0.5 MHz	10 W
F	S and C	2200.5 MHz and 4400.0 MHz	2394.5 MHz and 4950.0 MHz	2370.5 MHz	0.5 MHz	10 W
G	Euro Mid C	5150.0 MHz	5250.0 MHz	5150.0 MHz	0.5 MHz	10 W
H	L and C	1435.5 MHz and 4400.0 MHz	1534.5 MHz and 4950.0 MHz	1450.5 MHz	0.5 MHz	10 W
J	C, Mid C, and Euro Mid C	4400.0 MHz and 5091.0 MHz 5150.0 MHz	4950.0 MHz and 5150.0 MHz 5250.0 MHz	5120.0 MHz	0.5 MHz	10 W
K	S and C, Mid C, and (with Euro Mid C)	2200.5 MHz 4400.0 MHz and 5091.0 MHz 5150.0 MHz	2394.5 MHz 4950.0 MHz and 5150.0 MHz 5250.0 MHz	2370.5 MHz	0.5 MHz	10 W
L	Lower L	1435.5 MHz	1534.5 MHz	1450.5 MHz	0.5 MHz	10 W
M	Lower L, Upper L, and S	1435.5 MHz 1750.0 MHz and 2200.5 MHz	1534.5 MHz 1855.0 MHz and 2394.5 MHz	1450.5 MHz	0.5 MHz	10 W
N	Upper S	2300.5 MHz	2394.5 MHz	2370.5 MHz	0.5 MHz	10 W
Q	Lower L, Upper L, S, C, and Mid-C	1435.5 MHz 1750.0 MHz 2200.5 MHz 4400.0 MHz 5091.0 MHz	1534.5 MHz 1855.0 MHz 2394.5 MHz 4950.0 MHz 5150.0 MHz	1450.5 MHz	0.5 MHz	10 W
S	S	2200.5 MHz	2394.5 MHz	2370.5 MHz	0.5 MHz	10 W

Band ID Code	Band	Minimum Freq	Maximum Freq	Default Freq	Tuning Steps	Max Power
T	Lower L, C, and Mid C	1435.5 MHz 4400.0 MHz 5091.0 MHz	1534.5 MHz 4950.0 MHz 5150.0 MHz	1450.5 MHz	0.5 MHz	10 W
V	S and C (with Mid C)	2200.5 MHz 4400.0 MHz and 5091.0 MHz	2394.5 MHz 4950.0 MHz and 5150.0 MHz	2370.5 MHz	0.5 MHz	10 W
W	S and C, Mid C, (with Euro Mid C)	2200.5 MHz 4400.0 MHz and 5091.0 MHz 5150.0 MHz	2394.5 MHz 4950.0 MHz and 5150.0 MHz 5250.0 MHz	2370.5 MHz	0.5 MHz	10 W
X	Mid C band	5091.0 MHz	5150.0 MHz	5120.0 MHz	0.5 MHz	10 W
Y	L and C	1435.5 MHz 1750.0 MHz and 4400.0 MHz 5091.0 MHz	1534.5 MHz 1855.0 MHz and 4950.0 MHz 5150.0 MHz	1450.5 MHz	0.5 MHz	10 W
Z	Lower L, Mid C, and Euro Mid C	1435.5 MHz 5091.0 MHz and 5150.0 MHz	1534.5 MHz 5150.0 MHz and 5250.0 MHz	1450.5 MHz	0.5 MHz	10 W

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 17: Transmitter BER Specifications with Quasonix Demodulator

BER	Maximum Eb/N0 (dB)		
	PCM/FM, Tier 0	SOQPSK-TG, Tier I	MULTI-h CPM, Tier II
10-3	7.0	9.0	11.8
10-4	8.5	11.0	13.3

BER	Maximum Eb/N0 (dB)		
	PCM/FM, Tier 0	**SOQPSK-TG, Tier I**	**MULTI-h CPM, Tier II**
10-5	9.5	12.5	14.3
10-6	10.5	14.0	15.3

6.7   Modulated RF Power Spectrum

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

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

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 18.

Table 18: 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 29, Figure 30, and Figure 31.
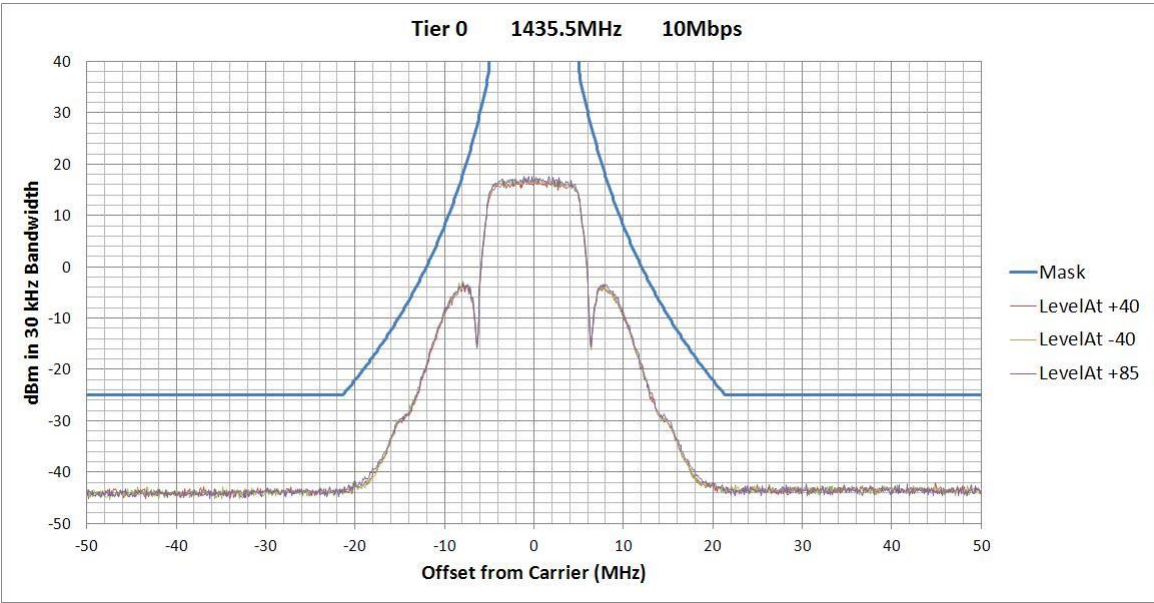
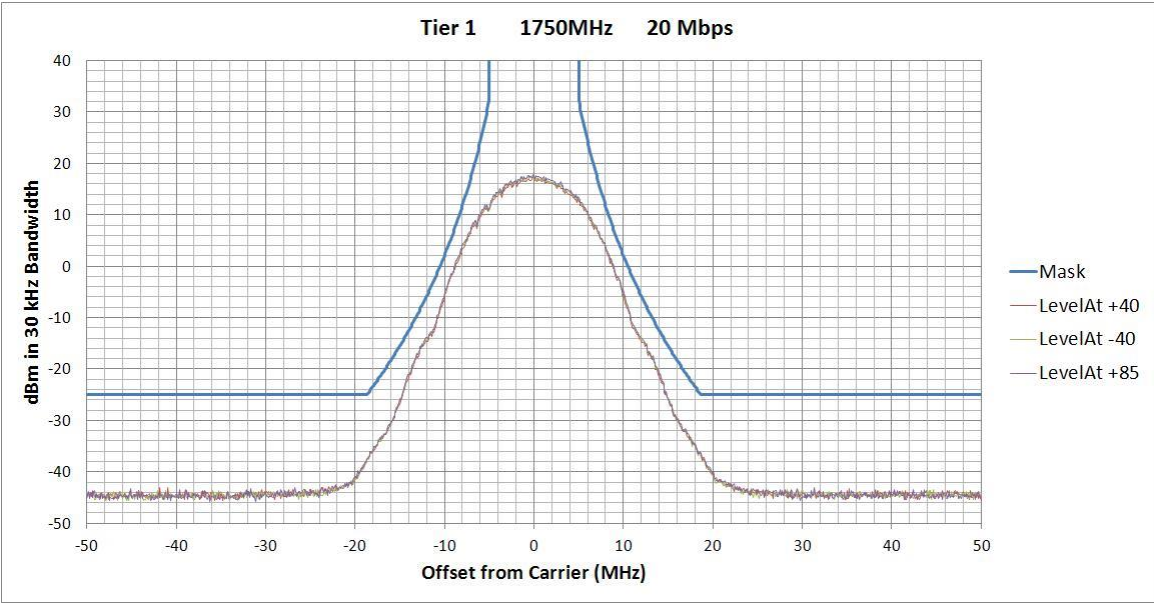**Figure 29: PCM/FM (Tier 0) Power Spectral Density with Mask**

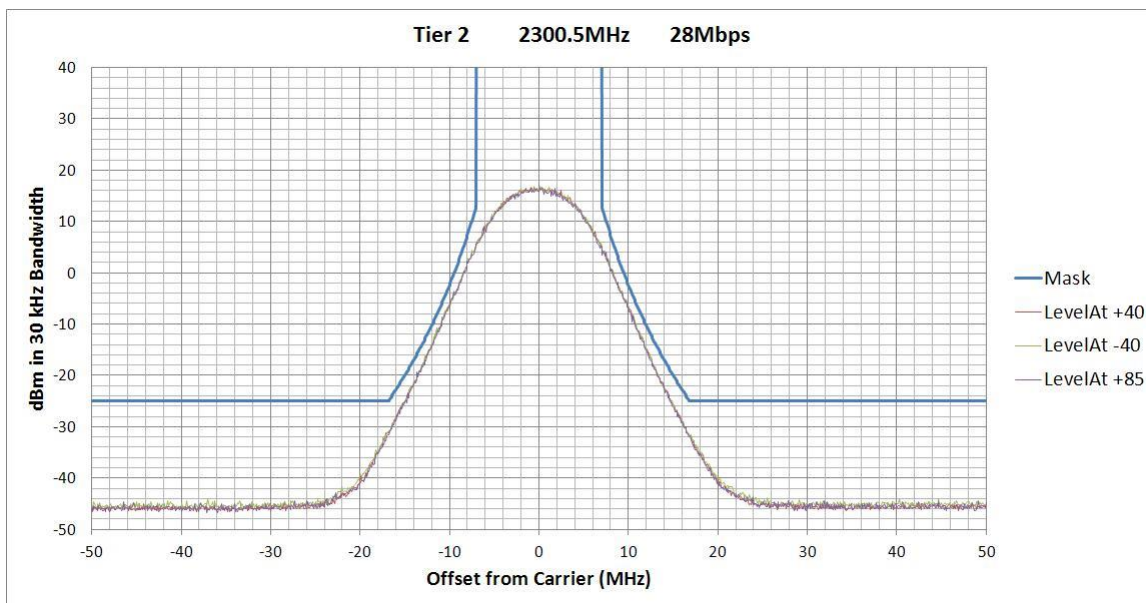**Figure 30: SOQPSK-TG (Tier I) Power Spectral Density with Mask**

Figure 31: MULTI-h CPM (Tier II) Power Spectral Density with Mask

6.8   Phase Noise Power Spectrum

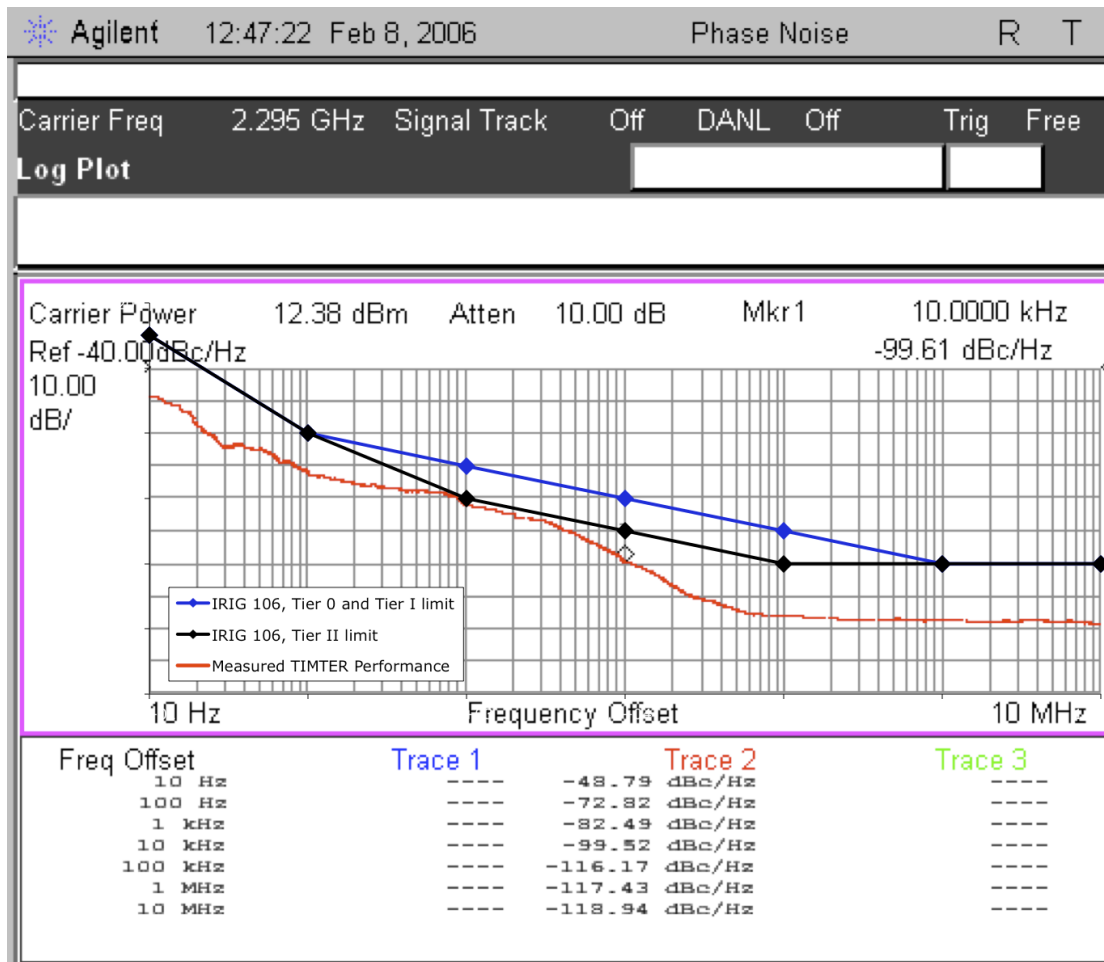TIMTER™ phase noise limits are shown in Figure 32.

Figure 32: Phase Noise Limit Curve

6.9 Baseplate Temperature

TIMTER™ transmitters are designed for efficient heat transfer between internal heat producing sources and the baseplate. The 10 W TIMTER™ Multi-mode Dual Telemetry Transmitter is 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 33: Vibration / Shock Testing System

Figure 34: TIMTER™ Mounted for Z-axis Testing

Figure 35: TIMTER™ Mounted for X-axis Testing   **Figure 36: TIMTER™ Mounted for Y-axis Testing**

6.10.1   Vibration Testing

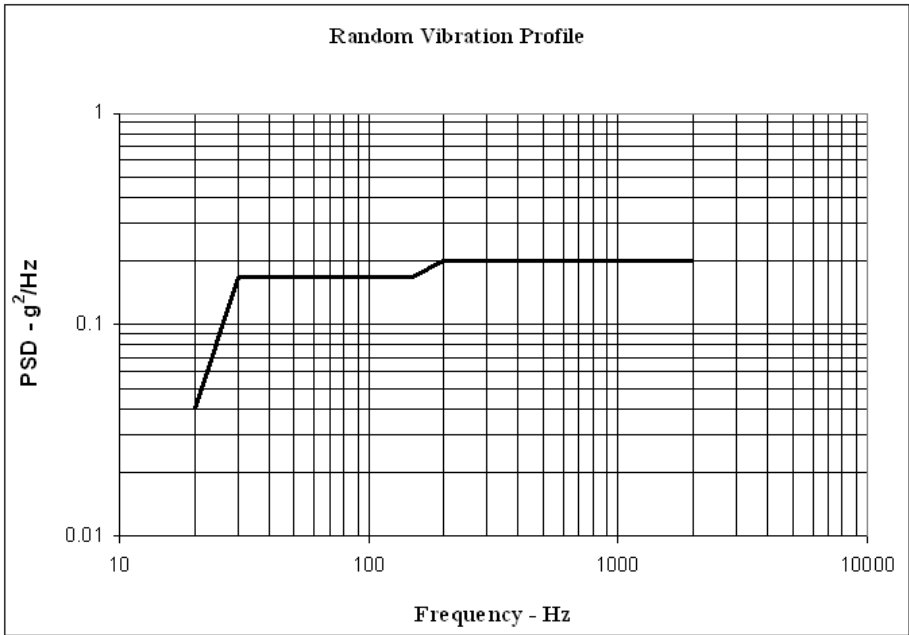Each transmitter is subjected to the random vibration spectrum depicted in Figure 37 and Table 19 prior to shipment.

Figure 37: TIMTER™ Vibration Profile

Table 19: 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. The results are shown in Figure 38, Figure 39, and Figure 40.
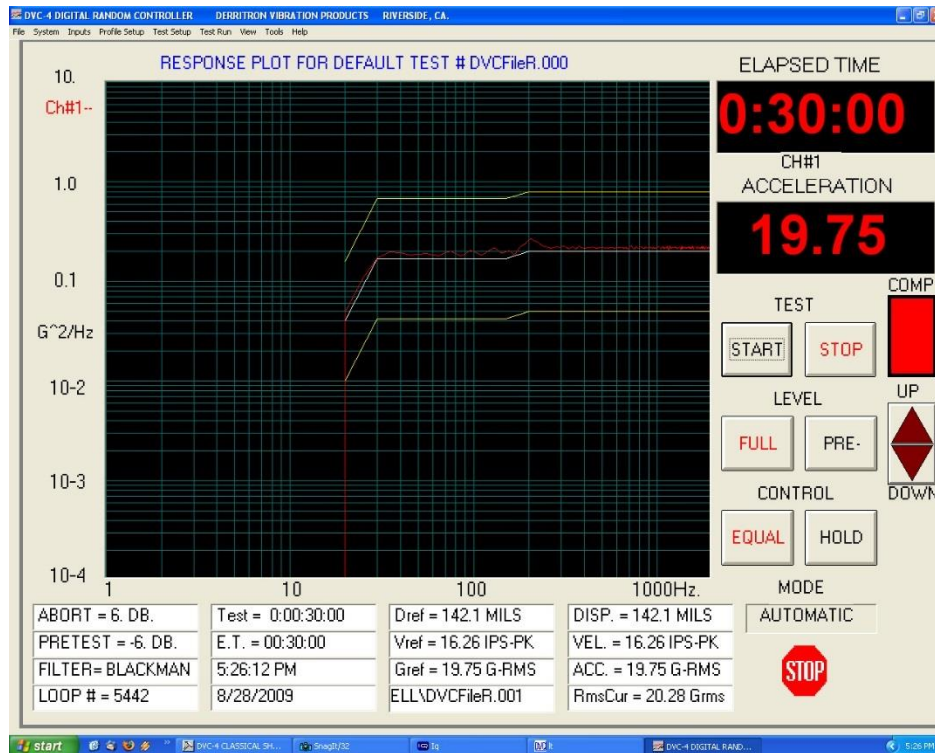
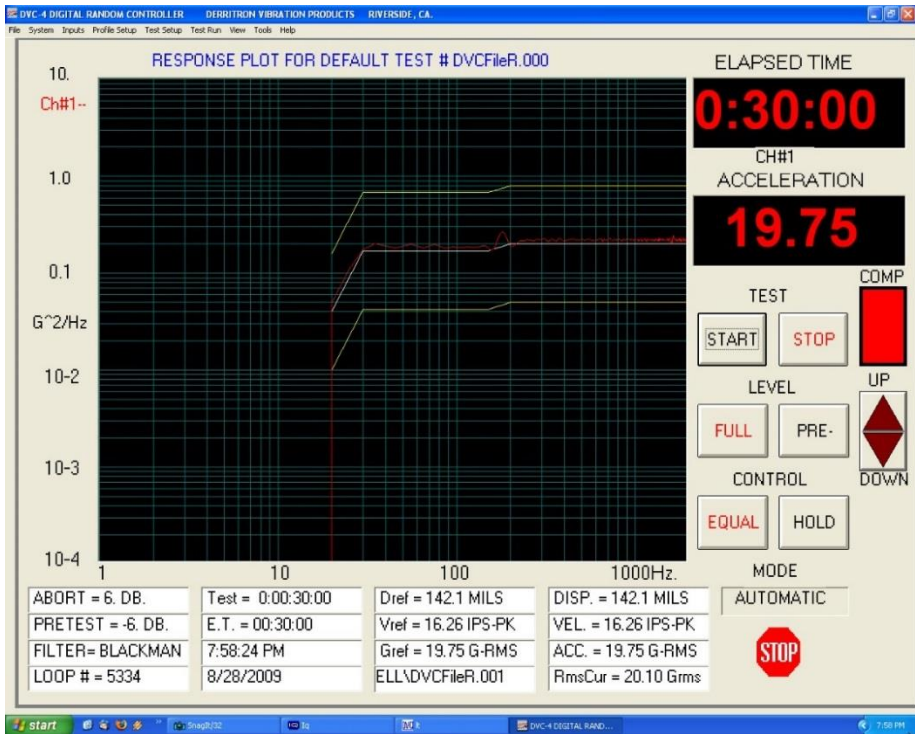**Figure 38: Z-axis Vibration Spectrum**
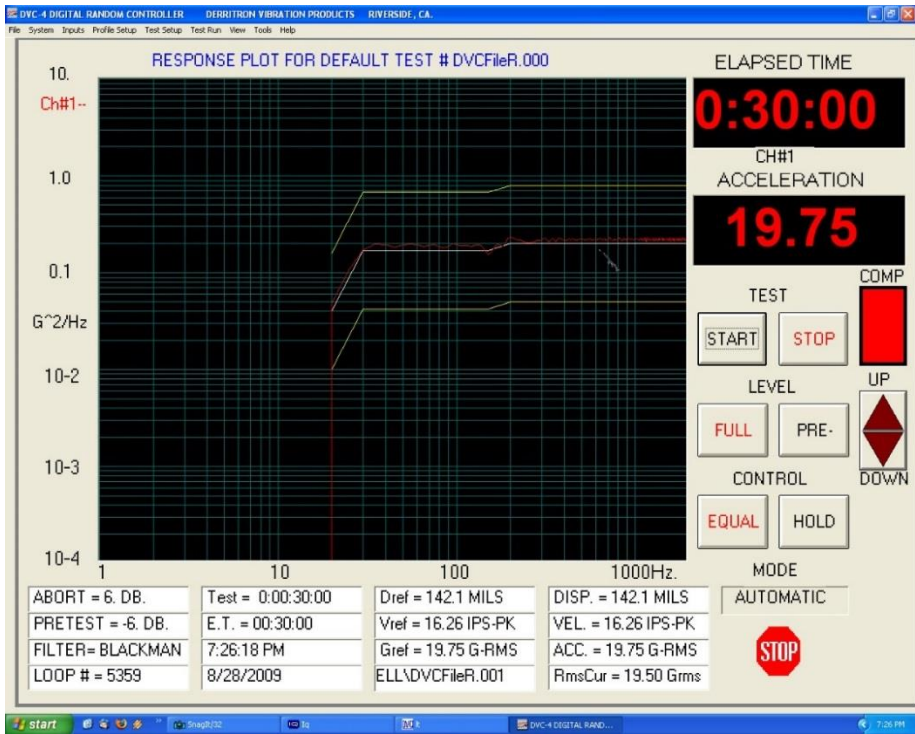
Figure 39: Y-axis Vibration Spectrum

Figure 40: 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:

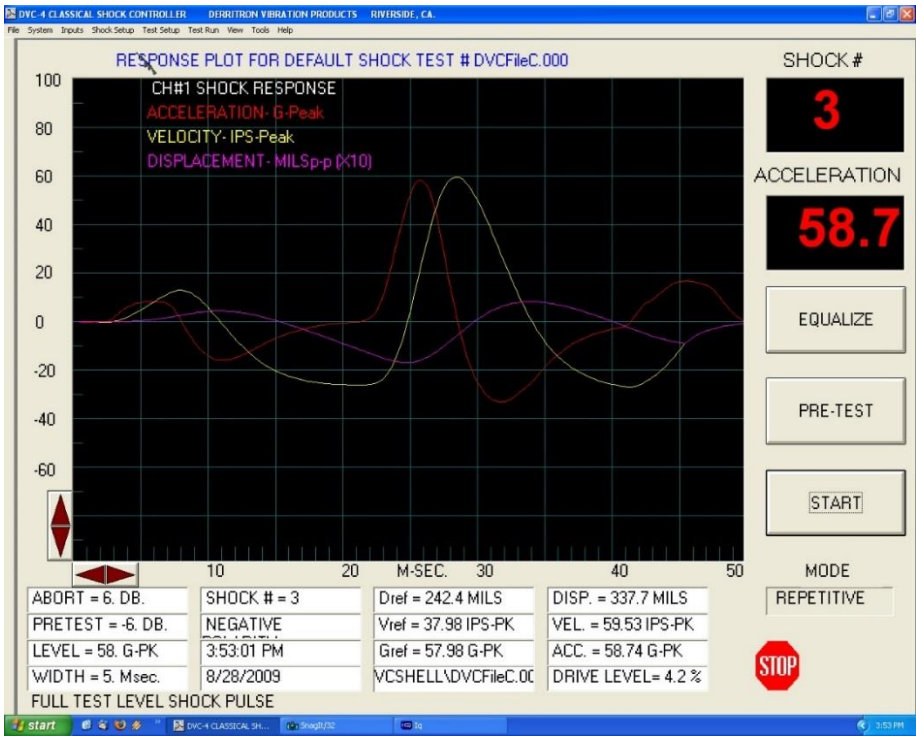

Figure 41: Shock Pulse, Z-axis Positive
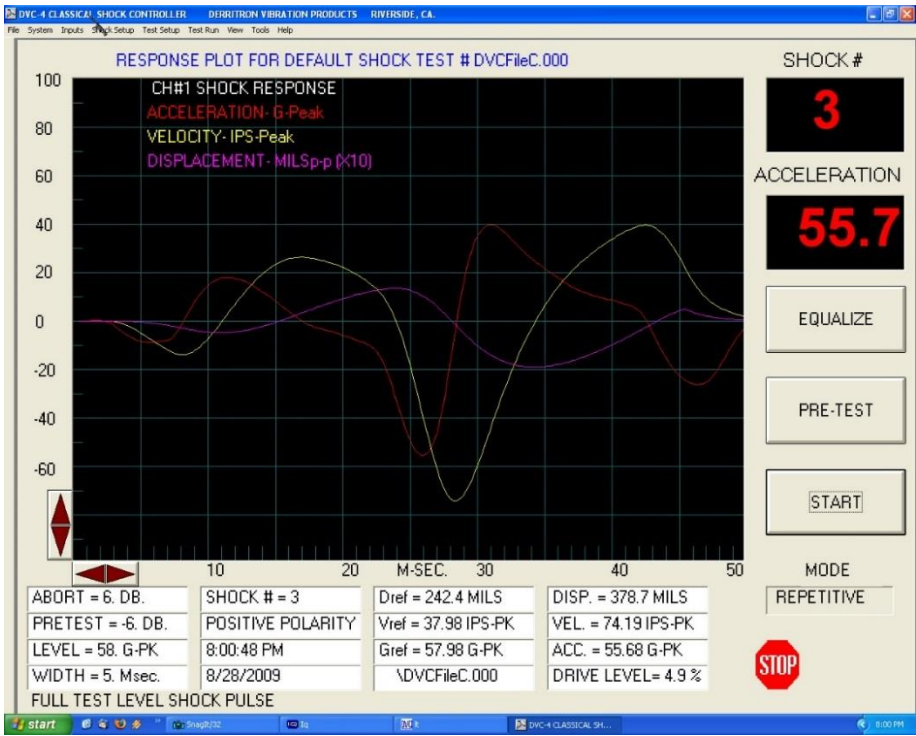
Figure 42: Shock Pulse, Z-axis Negative
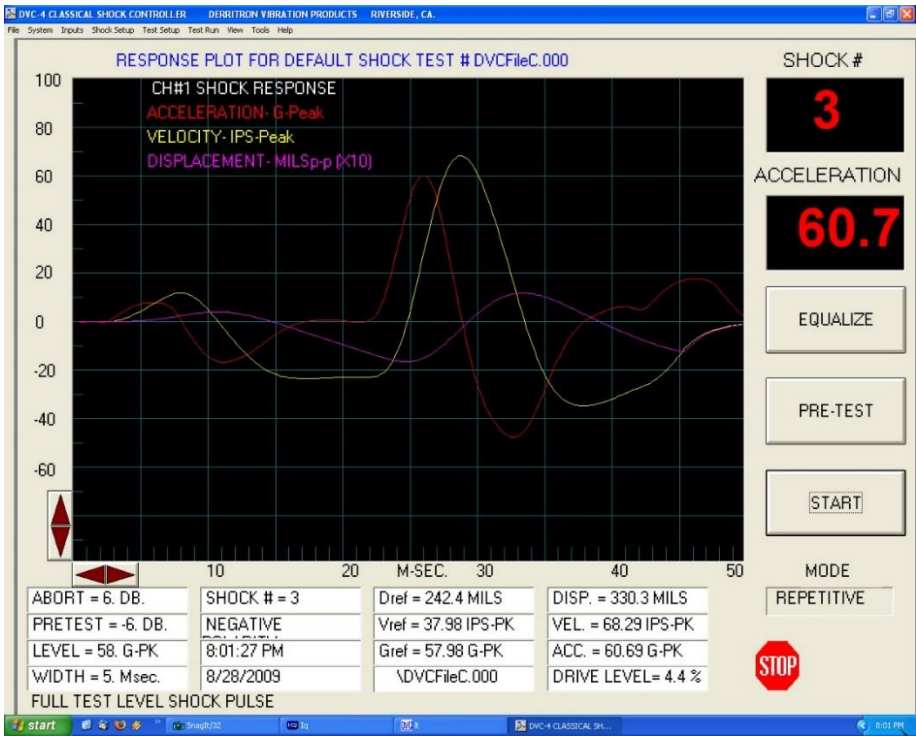

Figure 43: Shock Pulse, Y-axis Positive

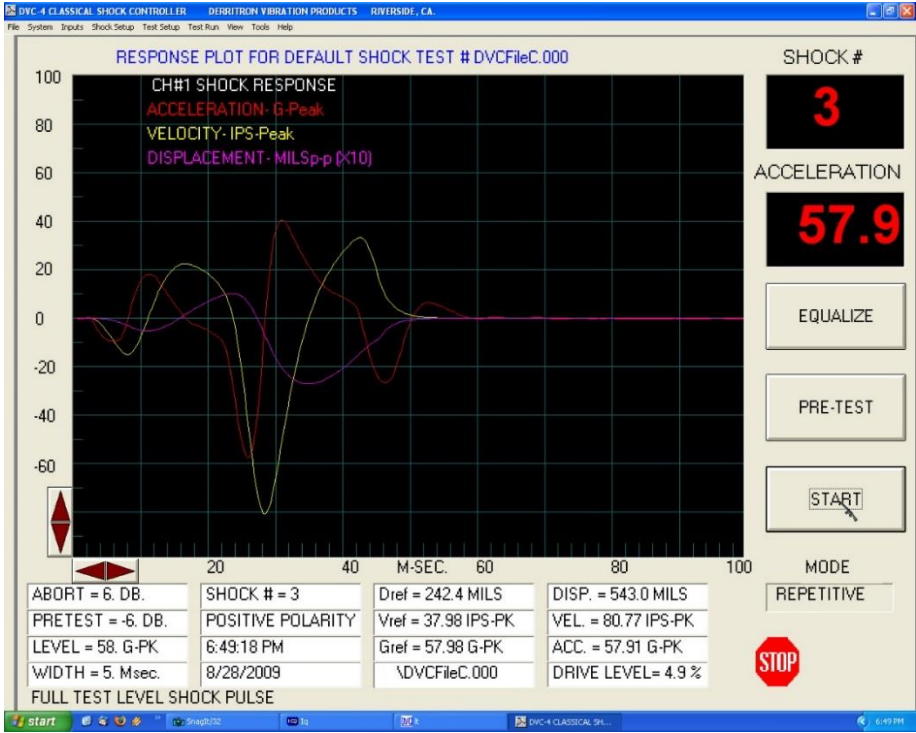**Figure 44: Shock Pulse, Y-axis Negative**
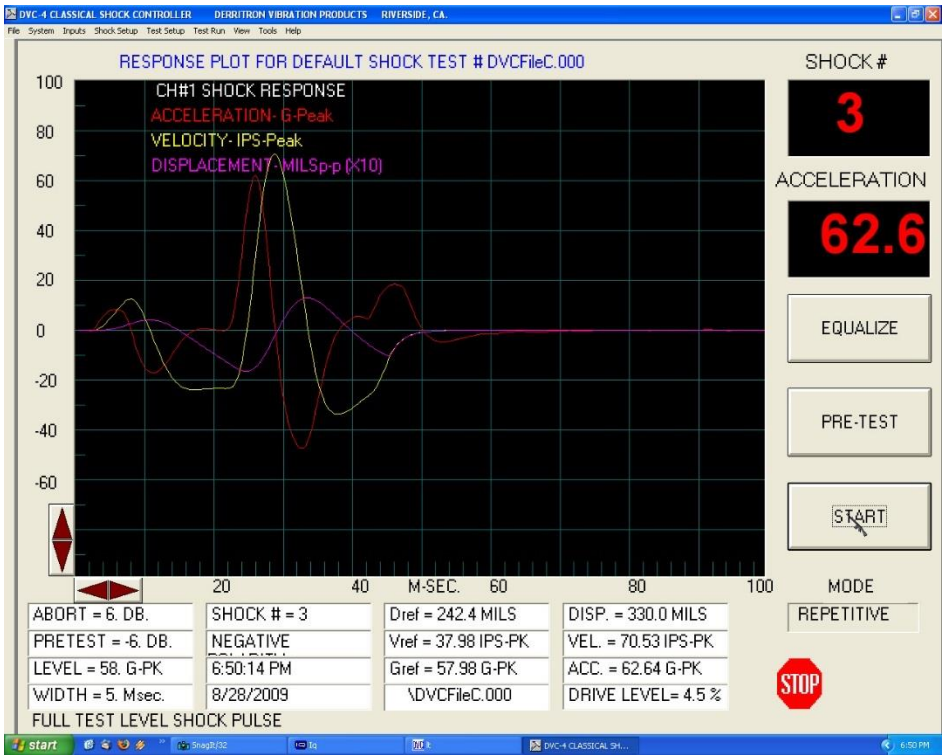

Figure 45: Shock Pulse, X-axis Positive

Figure 46: Shock Pulse, X-axis Negative

7   Maintenance Instructions

The TIMTER™ requires no regular maintenance, and there are no user-serviceable parts inside.

8   Product Warranty

The TIMTER™ 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 – Preset Option

The preset feature operates similar to the stored presets in a car radio. The presence of this option is designated by the characters "PS" and a number (2, 4, 8 or 16) appended to the standard model number. Transmitters with the preset option operate as follows:

1. The potential preset selection pins are pins 2, 6, 10, 11, 12 and 13 on the male MDM-15 connector, or pins 3, 7, 11, 12, 13 and 14 on the female MDM-15 connector. Of these pins, up to four may be used for presets depending on the device options. To see which pins are used for presets and which bits they represent, use the ZY command on the transmitter or refer to the documentation that came with your transmitter.

2. Left floating, (the pins are pulled up to 3.3 VDC internally), a pin represents a "0", grounded is a "1".

3. The 0000 state (all pins floating) provides normal operation.

4. The (up to) 15 other states (one or more pins grounded) select one of the presets.

5. Each preset stores a carrier frequency, modulation type, and various configuration values like randomizer, data inversion, differential encoding, etc. These settings can be viewed with the LC (list configurations) command from a terminal.

6. The preset pins are read only at power up. Changing the preset pins after power-on has no effect.

7. The presets are set (in your lab) from the 0000 state, using the "SV" command. Storing a preset is done by configuring the device as you wish it to operate, then saving the setup to a particular preset. The save is performed by typing the following command:

    SV x [name]

    where x is the preset number (1-15 depending on the options) and name is an optional setup name stored with the setup. Alternatively, issue the "SV" command with a single-digit parameter (1 thru 15). So, "SV 5", for example will store the current frequency and modulation setting in preset 5. "SV", with no numeric value after it, reports the state of all presets. The LC command displays names for all setups or, if a setup number is entered, all the settings for that particular configuration.

8. Electrical connection note: The preset pins are connected directly to the FPGA in the unit, so it is important that the voltage on those pins never get outside the range of zero to 3.3 VDC. Voltages outside this range can cause permanent damage. Also, the internal pull-up is through a 25k Ohm resistor inside the FPGA, so it is important that the pins have a high impedance to ground (> 1 M Ohm) when the pins are floating. A true switch closure is ideal, although a transistor switch can be used as long as its "Off" impedance is sufficiently high.

11 Appendix B – Bench Set Up for STC and LDPC

Note: This appendix only refers to the 7.200 in^3 Dual Transmitter pictured in Figure 47. For information about bench set up for a Legacy Dual Transmitter, refer to the Legacy Dual Transmitter user manual.

Figure 47: Quasonix Dual Transmitter

Configuring STC and LDPC in a lab or bench set up requires emulating a field set up, some aspects of which may not be intuitively obvious. This appendix covers set up and command usage for the Dual Transmitter as well as its connection to Compact or Rack Mount RDMS Receivers.

Before setting up the transmitter, it is important to understand the differences in receiver configuration required. A field set up using a Dual Transmitter and Rack Mount Receiver in STC mode is pretty straight forward. A transmit antenna connects to each RF output on the transmitter and a receive antenna connects to each RF input on the receiver. The rest of the connection occurs through the air. This is not the case in a bench configuration.
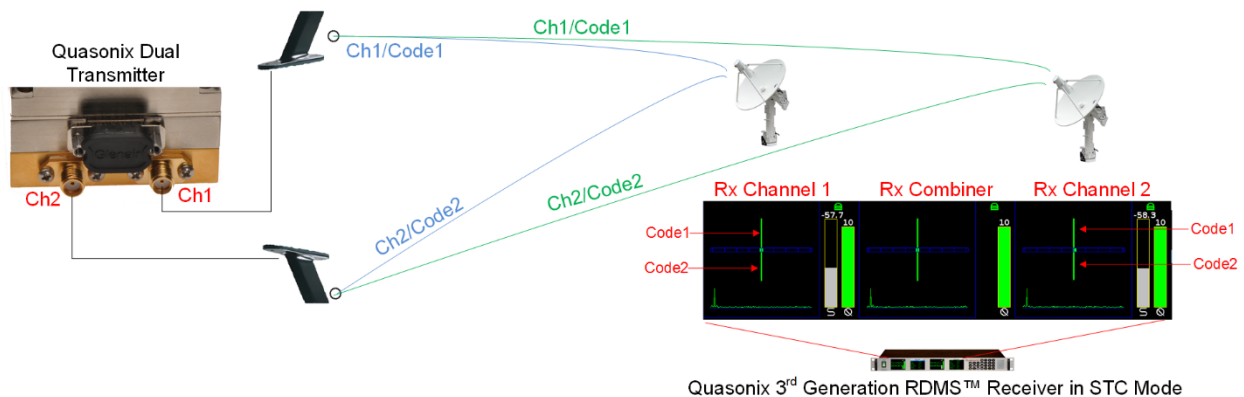

**Figure 48: Example STC Field Configuration for Dual Transmitter and Rack Mount Receiver**

11.1 Receiver Connections

Two types of receiver may be configured, the Compact Receiver, which must be accessed via a Handheld Programmer or a PC running the Terminal application, or the Rack Mount Receiver, which may be accessed via the front panel or the browser based graphical user interface (GUI).
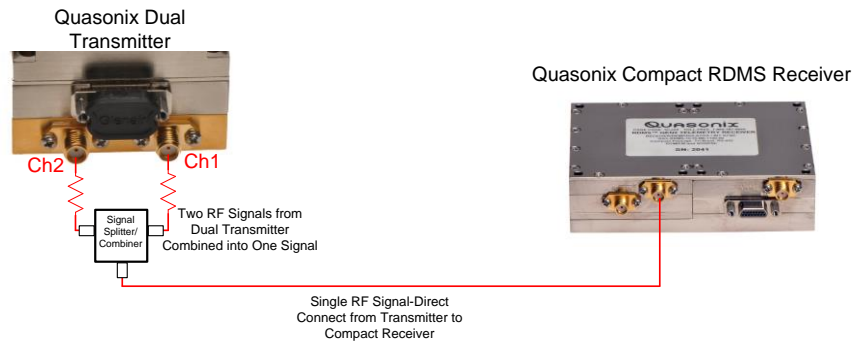
11.1.1 Compact Receiver

The Compact receiver normally requires only a single direct connection of the RF input from a transmitter, as shown in Figure 49.
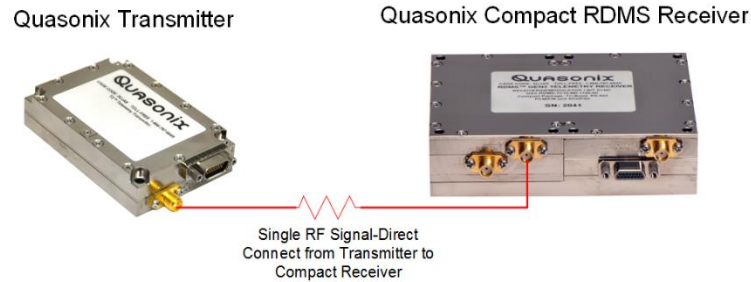
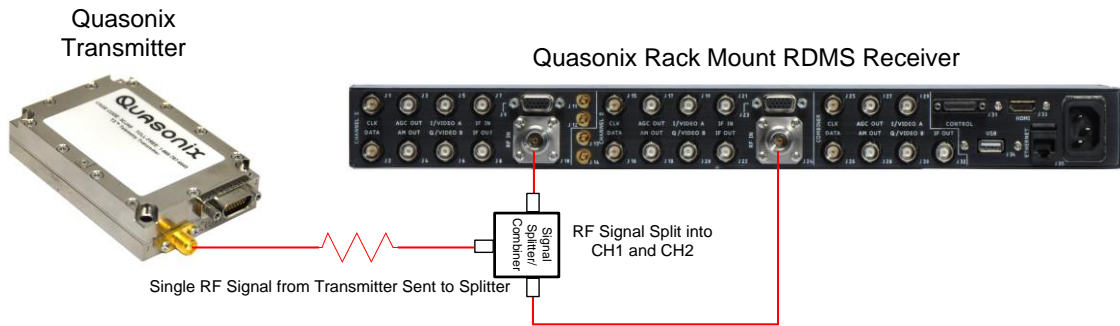**Figure 49: Example Bench RF Configuration for Single Transmitter and Compact Receiver**

For STC, the Compact receiver still requires only a single RF input but it must be the combined RF outputs from Channel 1 and Channel 2 of the dual transmitter, as shown in Figure 50.
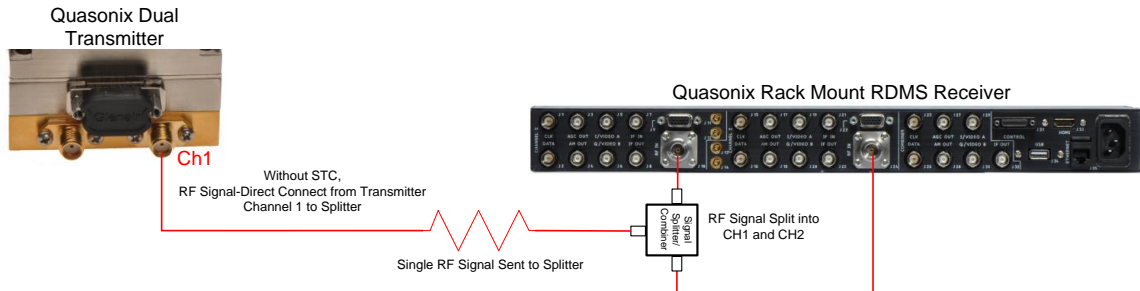

Figure 50: Example Bench RF Configuration for Dual Transmitter and Compact Receiver

11.1.2 Rack Mount Receiver

A Rack Mount receiver normally requires a splitter to accept the RF input from a transmitter to separate it into Channel 1 and Channel 2 inputs at the receiver, as shown in Figure 51 and Figure 52.

Figure 51: Example Bench RF Configuration for Single Transmitter and Rack Mount Receiver

Figure 52: Example Bench RF Configuration for Dual Transmitter and RM Receiver—Without STC

For STC, the Rack Mount receiver still requires a splitter to accept the RF input, but the input to the splitter must be combined RF outputs from Channel 1 and Channel 2 of a dual transmitter, as shown in Figure 53.
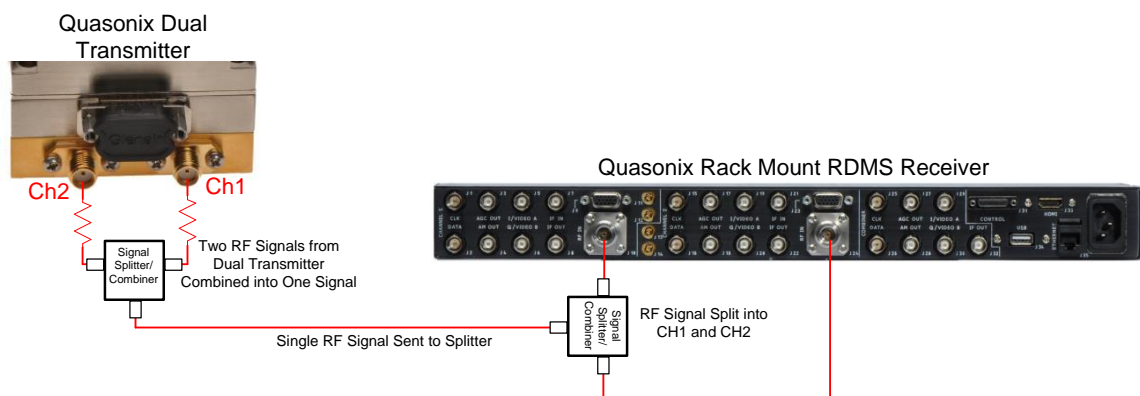
Figure 53: Example Bench RF Configuration for Dual Transmitter and RM Receiver—With STC

11.2 Transmitter Commands

The Dual transmitter, shown in Figure 54, enables several configurations including SOQPSK only, SOQPSK with LDPC, SOQPSK with STC, and SOQPSK with LDPC and STC. In addition to establishing the correct connection(s) to a receiver, proper configuration requires setting up the transmitter with a small number of commands.

Figure 54: Quasonix Dual Transmitter

When running STC on a Dual Transmitter, both channels must be set up identically.

To facilitate this, type the CH 3 command prior to the other commands to automatically set both channels to the same parameters. The channels may be set up one at a time but CH 3 prevents duplication of work.

Table 20 shows the commands required to set up the four possible configurations.

Table 20: Dual Transmitter Input Commands for Channel 1 and Channel 2

SOQPSK only	SOQPSK + LDPC	SOQPSK + STC	SOQPSK + STC + LDPC
CH 3	CH 3	CH 3	CH 3
MO 1	MO 1	MO 13*	MO 13*
LD 0	LD 1	LD 0	LD 1

*MO 13 sets the mode to STC.

When running SOQPSK or SOQPSK with LDPC, the frequency may be changed separately for Channel 1 and Channel 2 by using the FR command on the appropriate channel.

# 12 Appendix C – Understanding Clock/Data, AC, and BR

It is important to understand clock and data priorities when using a dual transmitter. Table 21 describes the possible settings for Channel 1 Internal Clock, Clock Free, Clock Free Bit Rate, External Clock, External Data, and Automatic Carrier Output, and the resulting RF output for Channel 1 AND Channel 2.

The dual transmitter clock and data logic stream (where they come from and how they are selected) is shown in Figure 55. For details about specific commands, refer to AC, BBCK, BR, CF, or IC.

Table 21: Dual Transmitter Priority of CS, CF, BR, and AC When RF is On

CS	CF	BR auto/manual	Ext Clk In	Ext Dat In	AC	Channel 1 RF Out	Channel 2 RF Out
1	x	x	x	x	x	RF out is based on Channel 1 IC and ID	RF out is based on Channel 1 IC and ID
0	0	Auto	x	present	x	RF out is based on auto CF rate derived from external data input	RF out is based on auto CF rate derived from external data input
0	0	Auto	x	not present	0	RF Off	RF Off
0	0	Auto	x	not present	1	RF stick at Carrier frequency	RF stick at Carrier frequency
0	0	Manual	x	x	x	RF out based on Channel 1 BR setting (may be trash if no data is present or rate is wrong on external data input)	RF out based on Channel 1 BR setting (may be trash if no data is present or rate is wrong on external data input)
0	1	x	present	x	x	RF out based on external clock and data (may be trash if no data is present on external data input)	RF out based on external clock and data (may be trash if no data is present on external data input)
0	1	x	not present	x	0	RF Off	RF Off
0	1	x	not present	x	1	RF stick at Carrier frequency	RF stick at Carrier frequency

*Note that 'x' means 'don't care'; Blue cells denote channel specific settings, the rest are global to the dual transmitter
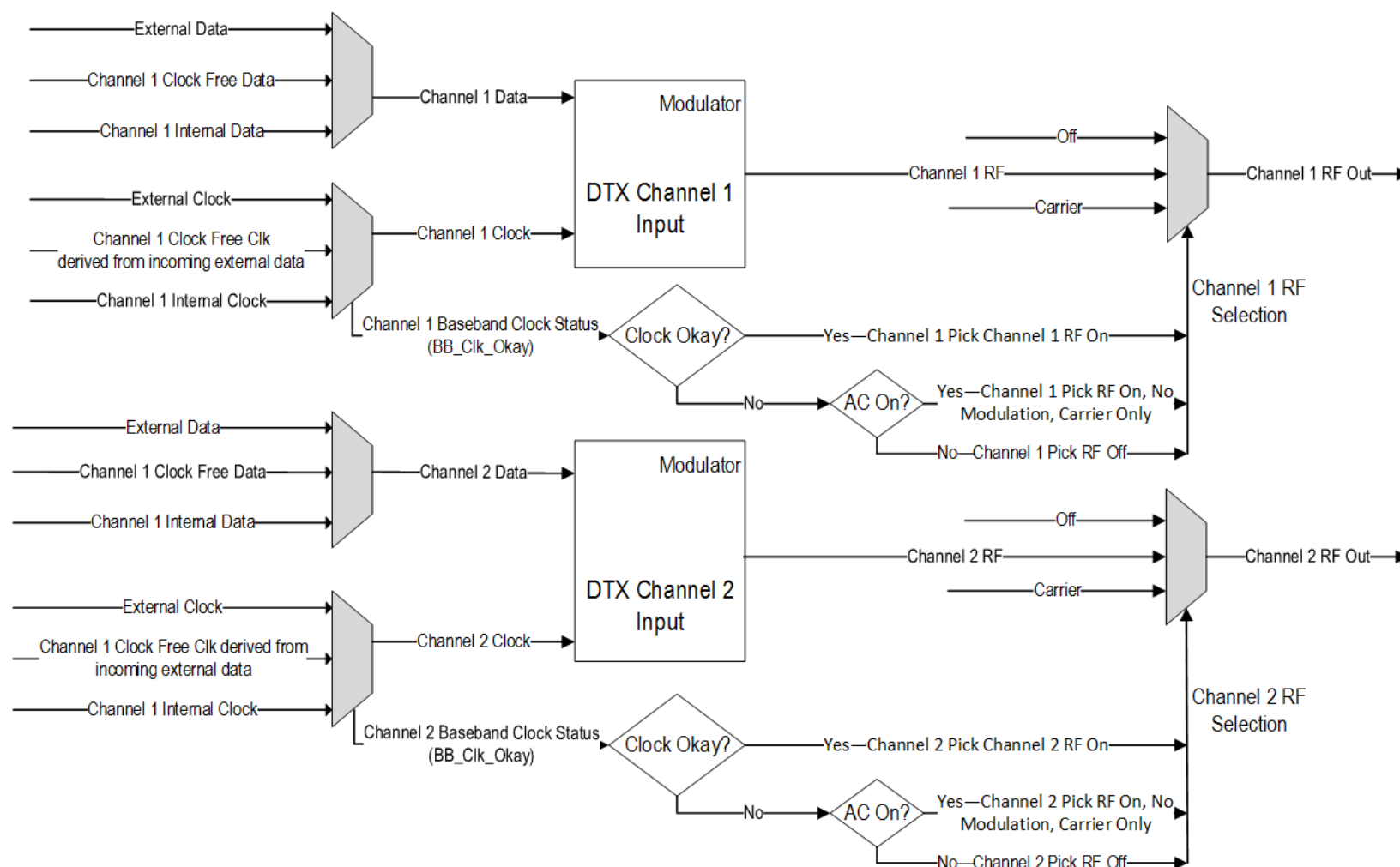
Figure 55: Dual Transmitter Clock and Data Logic

13 Appendix D – Acronym List

Acronym	Description
A	Amperes (amps)
AC	Automatic Carrier Wave option
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
CF	Clock Free option
CG	Clock Generator option
CPM	Continuous Phase Modulation
DB	Data Bias Level option
DB-9	D-subminiature 9 pin Serial Connector
DD	Debounce Delay
DE	Differential Encoding
DDS	Direct Digital Synthesizer
DP	Data Polarity option
DP	Dual Power
DPM	Digital Phase Modulation
FPGA	Field Programmable Gate Array
FS	Frequency Step
HR	High Bit Rate
ID	Internal Data
kbps	Kilobits per second
KHz	Kilohertz
LC	List Configurations option

Acronym	Description
LR	Low Bit Rate
LS	Lower S-band
MA	Modulations Allowed option
mbps	Megabits per second
MHCPM	multi-h Continuous Phase Modulation
MHz	Megahertz
MO	Modulation
mwatt	Megawatt
N	(connector type) Threaded RF connector
OQPSK	Offset Quadrature Phase Shift Keying
PCMFM	Pulse Code Modulation/Frequency Modulation
PF	Parallel Port Frequency
PL	Power Level
PM	Parallel Port Mode
PM	Phase Modulation
PSK	Phase Shift Keying
PW	Parameter Write option
QPSK	Quadrature Phase Shift Keying
QT	Query Temperature option
RC	Recall Configuration option
RF	Radio Frequency
RG	Reverse Gender option
RJ-45	Ethernet Connection Jack
RN	Randomizer option
RS-232	Recommended Standard 232 (Serial Communications)
SC	Startup Configuration option
SN	Serial Number
SOQPSK	Shaped Offset Quadrature Phase Shift Keying
SOQPSK-TG	Shaped Offset Quadrature Phase Shift Keying –Telemetry Group

Acronym	Description
STC	Space-Time Coding
SV or PS	Preset Save option
TIMTER	Tier I Missile Test Transmitter
TRL	Tracking Loop
TTL	Transistor Logic
UDP	User Datagram Protocol
UQPSK	Unbalanced Quadrature Phase Shift Keying
US	Upper S-band
USB	Universal Serial Bus
UUT	Unit Under Test
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VP	Variable Power option
VR	Variable Reference Level
VSWR	Voltage Standing Wave Ratio
W	Watt
WAN	Wide Area Network