Quasonix

ISO 9001:2015 Certified

Installation and Operation Manual

3rd Generation Compact RDMS™ Telemetry Receiver

Quasonix, Inc.
6025 Schumacher Park Dr.
West Chester, OH 45069
30 May 2025

Revision 1.2.25

Specifications subject to change without notice.

All Quasonix receiver products are under U.S. Department of Commerce jurisdiction categorized as 5A991; not covered by ITAR.

No part of the document may be circulated, quoted, or reproduced for distribution without prior written approval from Quasonix, Inc.

Copyright Quasonix, Inc., All Rights Reserved.

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Description

This document describes the installation and operation of the Quasonix 3rd Generation Compact RDMS™ Telemetry Receiver. The RDMS™ (Receiver / DeModulator / bit Synchronizer) is designed to demodulate RF signals in multiple formats:

- PCM/FM (ARTM Tier 0)
- SOQPSK-TG (ARTM Tier I)
- Multi-h CPM (ARTM Tier II or ARTM CPM)
- Legacy (PSK) suite, including
    - BPSK
    - QPSK
    - Asymmetric QPSK (AQPSK) *Requires -37 option*
    - Asymmetric Unbalanced QPSK (AUQPSK) *Requires -37 option*
    - Offset QPSK (OQPSK)
    - Unbalanced QPSK (UQPSK)
    - Digital PM
    - STC
    - SOQPSK/LDPC
    - STC/LDPC

The RDMS™ provides true trellis demodulation in ARTM Tier 0, Tier I, and Tier II modes, delivering BER performance within 0.2 dB of theory. It also provides a clock signal (two clock signals in the AQPSK and AUQPSK modes), obviating the need for any outboard bit synchronizer.

Modes that support LDPC use IRIG-standard low-density parity check coding to dramatically improve link margin by up to 9 dB.

The RDMS™ is manufactured by:

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

1.2 Nomenclature

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

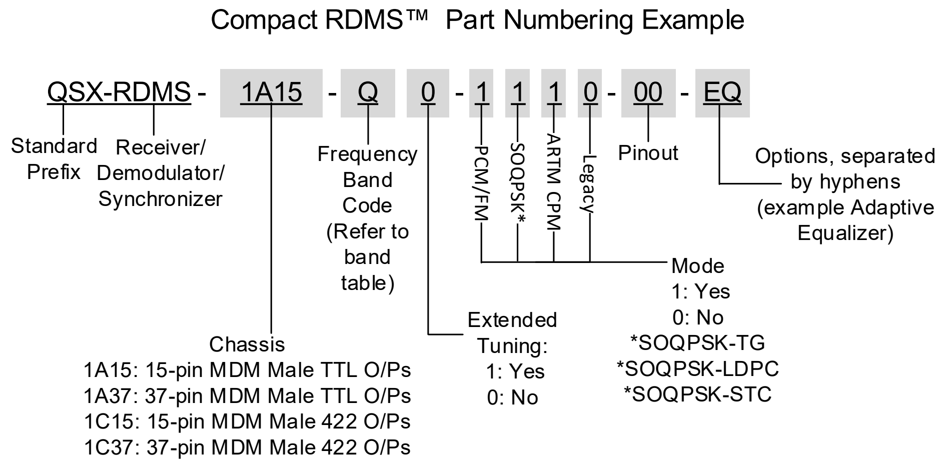


Figure 1: Receiver Types and Options

1.2.1 Options

The available options include:

- 14 14 SAW filter option (Adds 70 kHz, 1.4, 3, 6, 14, and 28 MHz filters)
- EN Ethernet Payload
- EQ Adaptive Equalizer
- ET Extended temperature range (-40°C to +85°C)
- K7 K7 Viterbi Decoder (k=7, rate 1/2)
- WV Wide voltage operating range (12 VDC – 35 VDC)

For example, a model QSX-RDMS-1-A15-Q0-1110-00-EQ is configured as follows:

Table 1: Model Configuration Example

Identifiers	Description
QSX	Quasonix product
R	Receiver / Demodulator / Bit Synchronizer
DMS	Demodulator / Bit Synchronizer
1	Channels
A15	15-pin MDM Male TTL Outputs

Identifiers	Description
Q	Frequency band code
0	No Extended Tuning
1110	Tier 0 present, Tier I present, Tier II present, Legacy (PSK) absent
00	Pinout
EQ	Adaptive Equalizer option

1.2.2 Detailed Option Descriptions

1.2.2.1 SAW Filter Option – 14

This option adds additional SAW filters, for a total of 14. Additional filters are 70 kHz, and 1.4, 3, 6, 14, and 28 MHz.

1.2.2.2 Ethernet (EVTM) Payload, Receive Only – EN

When the EN option is enabled, the RDMS will recover EVTM encoded data and convert it from Serial Streaming Telemetry back to the original Ethernet packets. Standard SST operation is not replaced, and can still be used. This option requires a change in package code—E for TTL Clock and Data outputs, or F for RS-422. This hardware must be paired with an EN enabled transmitter for proper data recovery.

1.2.2.3 Adaptive Equalizer – EQ

The Adaptive Equalizer option in the Quasonix receiver improves reception in multipath channels by using digital signal processing to compensate for the signal distortion due to multipath. This option is compatible with standard telemetry applications and installations and it works with any brand of transmitter.

Multipath fading can seriously degrade the quality of wireless telemetry data. Radio transmissions can reflect off of the airframe or other objects and arrive at the receiving antenna with different time delays, carrier phases, and relative strengths. The sum of these multiple transmission paths can produce serious distortion and signal fading resulting in poor data quality and long periods of data outage. Contrary to most situations, increasing the transmit power will not improve the link quality and may actually make the situation worse. Narrowing the beamwidth of the antenna may help eliminate some of the reflections and reduce the overall fading and distortion, but constraints on dish size and antenna tracking performance impose beamwidth limits.

Another solution is to mitigate the effects of the multipath channel by applying a filtering operation at the receiver that effectively undoes the distortion caused by the channel, thereby ‘equalizing’ the received signal. Since the transmitter is typically moving relative to the receiver, the RF propagation environment dynamically changes over time requiring the equalizer to ‘adapt’ to continually combat the perceived channel distortion. The ‘adaptive equalizer’ automatically calculates and applies a compensating filter to the received signal that restores its ability to be recovered by a traditional telemetry detector.

1.2.2.4 Extended Temperature – ET

The ET option specifies an extended operating temperature range (-40°C to +85°C).

1.2.2.5 Viterbi Decoder (for Legacy PSK Only) – K7

The K7 option (k=7, rate 1/2) enables Viterbi decoding of a convolutionally encoded data stream, which converts it back to the original (uncoded) source data stream.

Convolutional 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 decoded data rate is half the encoded data rate.

The receiver has two independent decoders, one for in-phase ("I") data and one for quadrature ("Q") data. For BPSK, only a single decoder is used. Each decoder is compatible with the convolutional encoding 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."

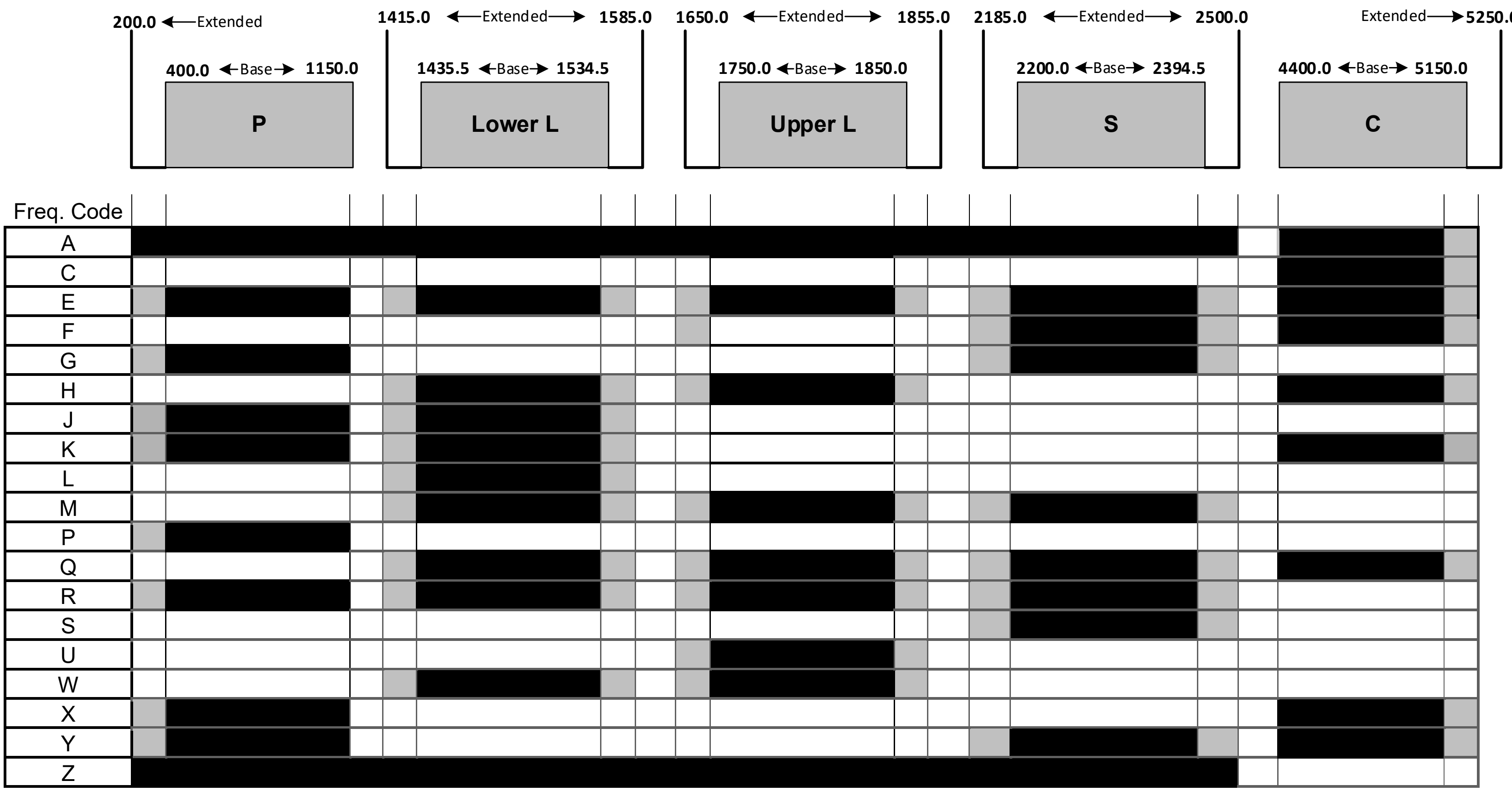
1.2.2.6 Wide Voltage – WV

This option specifies a wide voltage operating range (12 VDC – 35 VDC).

1.2.3 Band Configurations

Band configuration codes are listed in Table 2. Two additional band codes are described in section 1.2.3.1.

Table 2: Band Configuration Codes



Legend:
Frequency Gap
Standard (Base) Frequency Range
Extended Frequency Range (available by selecting Extended Tuning = 1 in part number)

1.2.3.1 Additional Band Codes

Two additional band codes are available:

- Band Code 7: (External IF Input) 70 MHz through any SAW filter, 0.075 MHz-20 MHz
- Band Code T: 2025.0 MHz to 2110.0 MHz standard range

2 Specifications

Characteristic	Specification
Receiver Section	
Type	Dual-conversion superheterodyne
Input RF Frequency	Refer to Table 2
Tuning resolution	Tunes in 62.5 kHz increments, to the 70 MHz IF output, after the 70 MHz IF output, receiver tunes in increments of less than 1 Hz
Frequency stability	1 ppm over temperature 1 ppm per year aging
Reference oscillator	20 MHz
Noise figure	3.5 dB (typical), 5 dB (maximum)
LO phase noise, measured at 70 MHz IF output	-115 dBc/Hz @ 1 MHz offset
Maximum RF input	+20 dBm (+10 dBm for C-band)
Available gain (to 70 MHz IF output)	114 dB
Gain control	128 dB control range; User selectable: AGC or MGC (AGC freeze)
AGC time constant	Adjustable, 0.1 ms to 1000 ms
First IF bandwidth	60 MHz (nominal)
IF rejection	> 90 dB
Image rejection	70 dB
RF input impedance	50 ohms
Second IF Section	
IF frequency	70 MHz
IF output level	-10 to -20 dBm nominal (AGC mode)
IF output impedance	50 ohms
IF bandwidths	250 kHz, 500 kHz, 1 MHz, 2 MHz, 4.5 MHz, 10 MHz, 20 MHz, 40 MHz. Automatic selection based on data rate, with manual override Optional: 70 kHz, 1.4 MHz, 3 MHz, 6 MHz, 14 MHz, 28 MHz
Demodulator Section	
Demodulator type	ARTM Tier 0 (PCM/FM), ARTM Tier I (SOQPSK-TG), ARTM Tier II (Multi-h CPM) Legacy suite: Analog FM, BPSK, QPSK, Offset QPSK (OQPSK), Asymmetric QPSK (AQPSK), Unbalanced QPSK (UQPSK), Asymmetric Unbalanced QPSK (AUQPSK), Digital PM, Space-Time Coding (STC)

Demodulator Section	
Bit Rates	Tier 0: 24 kbps to 23 Mbps in 1 bps steps Tier I: 100 kbps to 46 Mbps in 1 bps steps Tier II: 1 Mbps to 46 Mbps in 1 bps steps STC: 5 Mbps to 22 Mbps in 1 bps steps Legacy: 25 kbps to 23 Mbps in Analog FM, 25 kbps to 23 Mbps in BPSK, 50 kbps to 46 Mbps in QPSK in 1 bps steps
Synchronization time(Average, at BER = 1e-5)	Tier 0: 250 bits, Tier I: 385 bits, Tier II: 2,800 bits
Synchronization threshold	Tier 0: -8.0 dB Eb/N0; RF Input (dBm): -118.0 (1 Mbps), -108.0 (10 Mbps) Tier I: -6.0 dB Eb/N0; RF Input (dBm): -116.0 (1 Mbps), -106.0 (10 Mbps) Tier II: -7.0 dB Eb/N0; RF Input (dBm): -117.0 (1 Mbps), -107.0 (10 Mbps)
Sensitivity (BER = 1e-5)	Tier 0: 8.6 dB Eb/N0; RF Input (dBm): -101.4 (1 Mbps), -91.4 (10 Mbps) Tier I: 11.2 dB Eb/N0; RF Input (dBm): -98.8 (1 Mbps), -88.8 (10 Mbps) Tier II: 13.0 dB Eb/N0; RF Input (dBm): -97.0 (1 Mbps), -87.0 (10 Mbps)
Bit Synchronizer Section	
Input codes	NRZ-L/M/S, BIΦ-L/M/S
Output codes	NRZ-L; or input code unaltered
Data and clock out	TTL or RS-422
Lock detector out	TTL
RSSI	Single 0 – 5 VDC, 50 kHz bandwidth (-37 option required)
Video out	Four (4) wideband outputs, DC to 35 MHz (-37 option required)
Environmental Section	
Operating Temperature	-20°C to +70°C
Non-operating Temperature	-40°C to +85°C
Operating Humidity	0 to 95% (non-condensing)
Vibration	20 G, 5 Hz to 2 kHz (all axes)
Acceleration	100 G (all axes)
Shock	100 G pk, half-sine, 5 ms (all axes)
Altitude	Up to 100,000 ft.
Physical Section	
Size / Weight	4.00” x 3.00” x 1.00” / 11 oz.
Connectors	RF input: SMA female IF output: SMA female Baseband: MDM-15 or MDM-37 (-37 option)
Power	28 VDC ± 4 VDC, 750 mA typical
Inrush Current	12 VDC, 3.3 A max (as measured with a Fluke i30s AC/DC current clamp)

3 Installation Instructions

3.1 Mechanical

The Compact RDMS™ is designed to be mounted by eight (8) 6-32 screws through the holes along the front and back edges, as depicted in Figure 2 on the following page.

The Compact RDMS™ with the EN (EVTM) option is shown in Figure 3. It includes a male MDM-9 connector for Ethernet.

Pin assignments are listed in section 3.3.

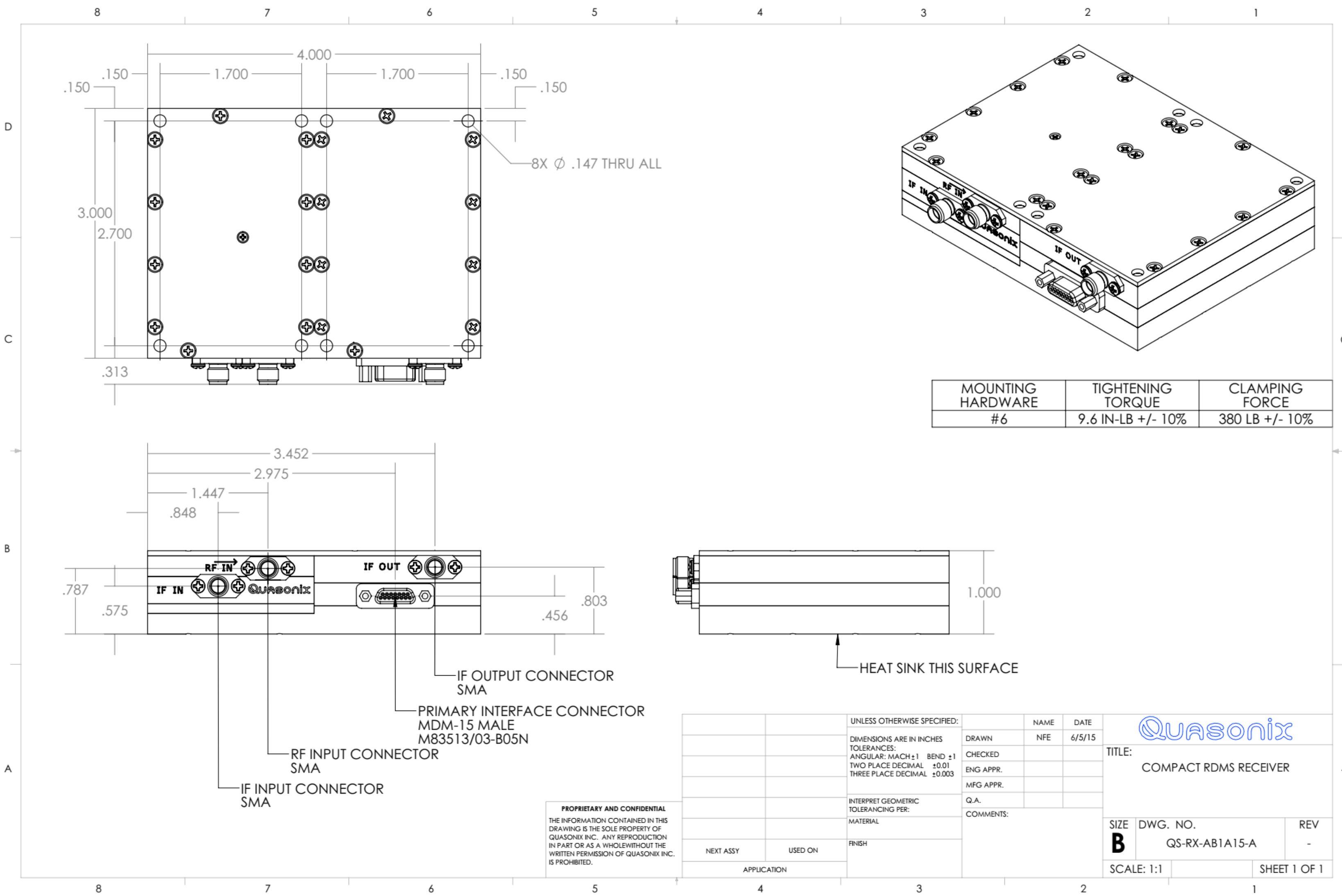


Figure 2: 3rd Generation RDMS™ in 4.00" x 3.00" x 1.00" Compact Housing

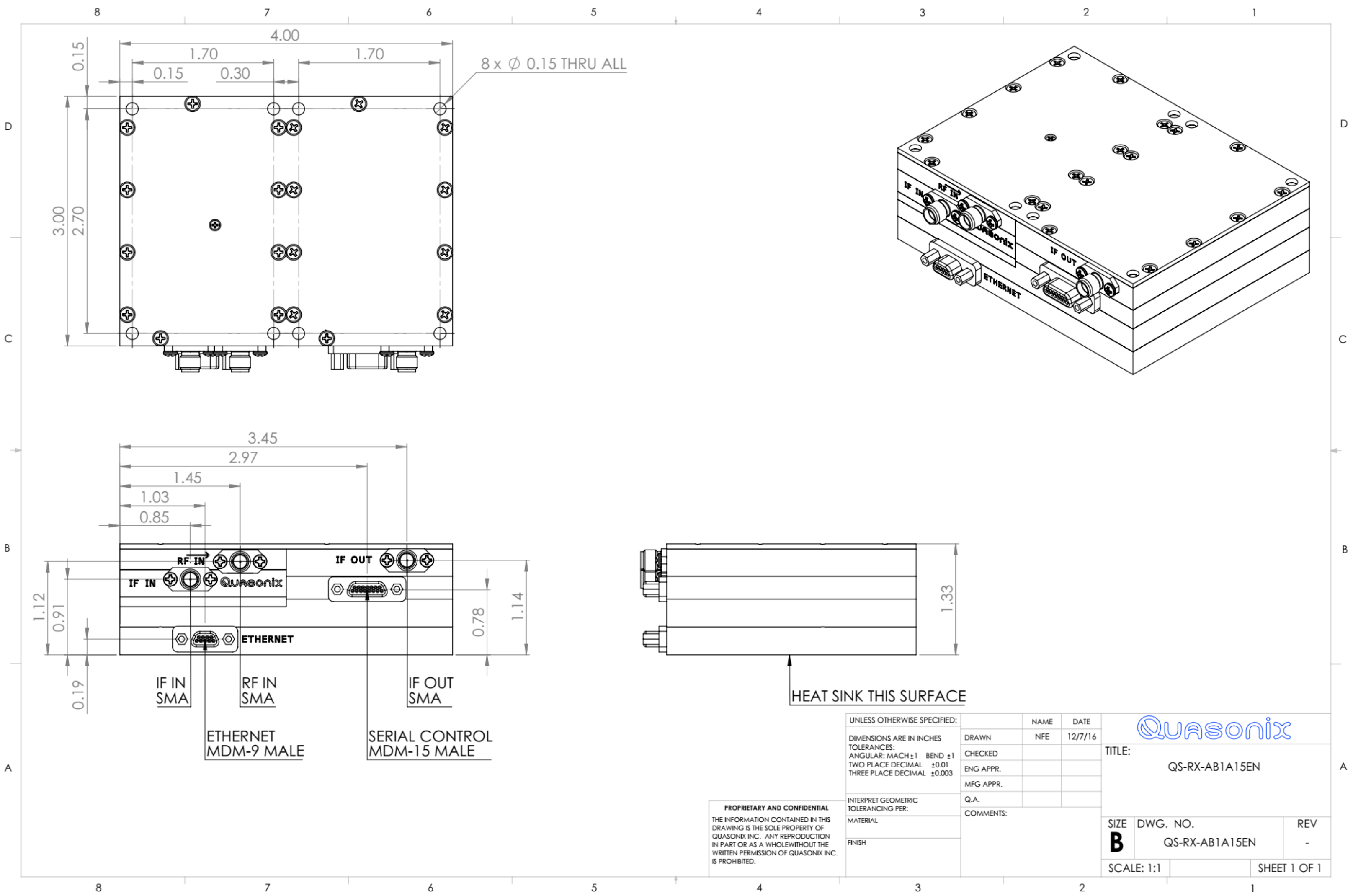


Figure 3: 3rd Generation RDMS™ in 4.00" x 3.00" x 1.00" Compact Housing with EN (EVTM) Option

3.2 Thermal

It is important that the RDMS™ be kept within its specified operating range of -40°C to +70°C. At maximum bit rates, the unit dissipates approximately 20 watts. At normal ambient room temperatures, a small fan blowing across the top cover is adequate. Higher ambient temperatures will require more airflow and/or a finned heat sink on the cover.

3.3 Electrical

The RDMS™ has three external connectors, an MDM-15 male for all baseband interfaces, a female SMA connector for the RF input, and a second female SMA connector for an IF output. Note that first generation hardware did not include the IF output. The pin numbering for the MDM-15 male connector is shown in Figure 4. Pin assignments for the MDM-15 are shown in Table 3. Refer to Appendix B for optional 37 pin information.

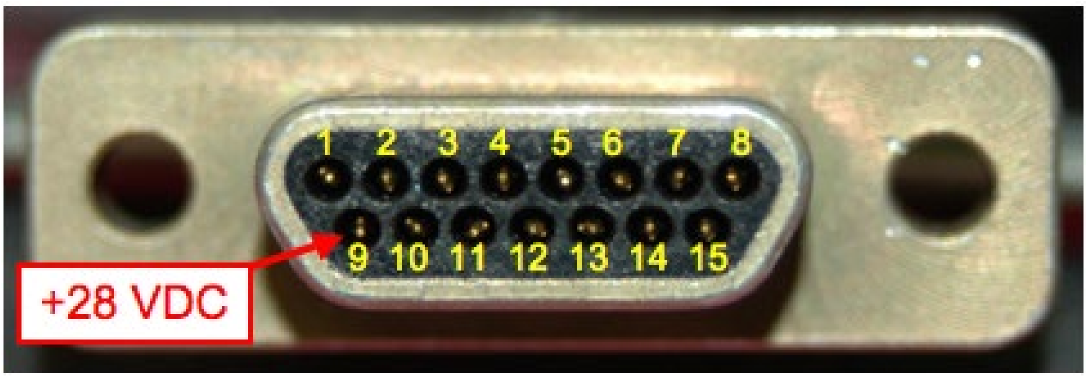


Figure 4: MDM-15 Pin Numbers

Table 3: MDM-15 Pin Assignments

Position	Signal	Description
1	+28 VDC	Primary 28 VDC power to module
2	Ground	Primary power return, 2 amps maximum; Internally tied to pins 3, 6, and 10
3	Ground	Primary power return, 2 amps maximum; Internally tied to pins 2, 6, and 10
4	Clock Out	Primary TTL clock output, Clock+ for RS 422 output
5	Data Out	Primary TTL data output, Data+ for RS 422 output
6	RS-232 Ground	Ground return for RS-232 control lines; Internally tied to pins 2, 3, and 10
7	Lock Detect	LVTTL lock detector output for all modes

Position	Signal	Description
8	RS-232 Tx Output	RS-232 responses to host controller
9	+28 VDC	Primary 28 VDC power to module
10	Ground	Secondary power return, 2 amps maximum; Internally tied to pins 2, 3, and 6
11	Power on Reset	Open = Power On, Ground = Power Off (Reset)
12	Clock Return	Ground for TTL outputs, Clock- for RS 422 outputs
13	Data Return	Ground for TTL outputs, Data- for RS 422 outputs
14	Ones Detect	LVTTL signal use for sync time testing
15	RS-232 Rx Input	RS-232 commands from host controller

By default, the output data is valid on the falling edge of the clock, as shown in Figure 4. The polarity of the output clock may be inverted by use of the "CP 1" command described below.

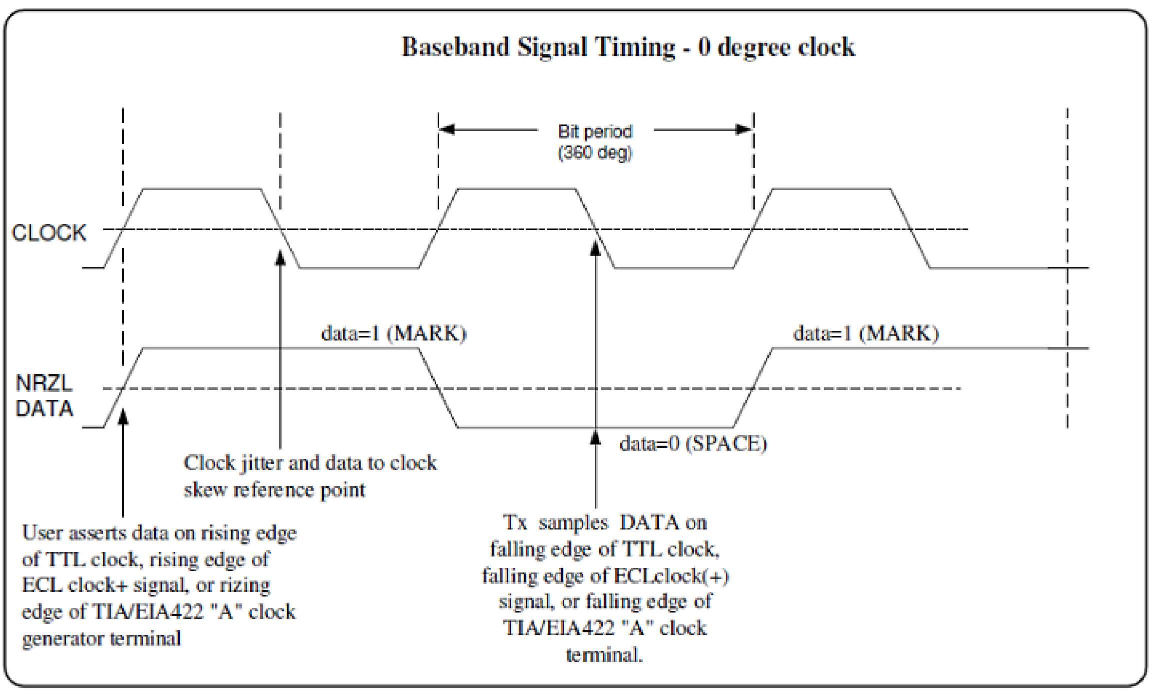


Figure 5: Baseband Signal Timing

IMPORTANT – Connector Notes

The 70 MHz IF output on the second SMA connector, labeled "IF OUT", is provided for troubleshooting purposes.

Figure 6: Compact Receiver Front Panel with Labeled Connectors

The IF output must have a 50 Ohm load at all times. If it is not connected to external test equipment, then the 50 Ohm terminator *(metal cap) that comes installed on the port must remain attached*.

The IF input connector is only active if the correct part number is ordered. The metal cap on the connector upon delivery is a *dust cap only* and is NOT interchangeable with the 50 Ohm termination on the IF output.

Do not remove dust caps unless the connector is being used.

3.3.1 Pin Assignments for Ethernet Connector

The RDMS™ with the EN (EVTM) option includes one additional external connector, a male MDM-9. The pin numbering for the male MDM-9 connector is shown in Figure 7. Pin assignments for the MDM-9 are listed in Table 4.

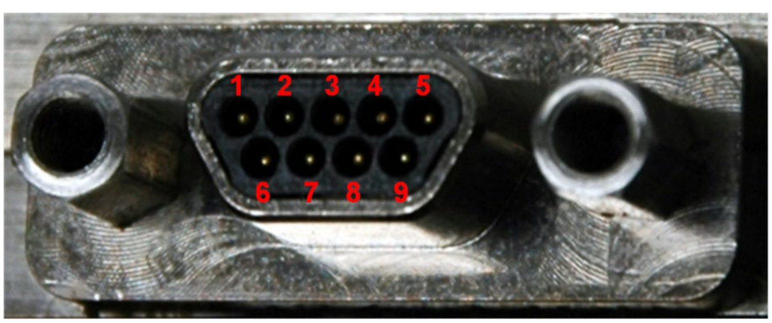


Figure 7: MDM-9 Pin Numbers

Table 4: MDM-9 Pin Assignments

Pin	Function
1	Positive leg of a differential pair; Transmit data on Ethernet network Pin 1 on a standard (T568A) RJ-45 (Tx + on Ethernet/Rx + on MDM-9)
2	No Connection
3	No Connection
4	No Connection
5	Positive leg of a differential pair; Receive data on Ethernet network Pin 3 on a standard (T568A) RJ-45 (Rx + on Ethernet/Tx + on MDM-9)
6	Negative leg of a differential pair; Transmit data on Ethernet network Pin 2 on a standard (T568A) RJ-45 (Tx – on Ethernet/Rx – on MDM-9)
7	No Connection
8	No Connection
9	Negative leg of a differential pair; Receive data on Ethernet network Pin 6 on a standard (T568A) RJ-45 (Rx – on Ethernet/Tx – on MDM-9)

4 Operating Instructions

4.1 Power-on Operation

When the receiver is powered up, the integral demodulator defaults to a particular modulation mode, which is based on the configuration of the unit. The modulation mode priority is outlined in Table 5.

Table 5: Default Modulation Start Up

Startup Order	Modulation
1	Legacy PSK
2	PCM/FM (Tier 0)
3	SOQPSK (Tier I)
4	Multi-h CPM (Tier II)

4.2 Stored Parameters

The following parameters are stored in the unit's nonvolatile flash memory. The descriptions and default values are listed in Table 6. As with the Quasonix part number ordering method, parameters are typically stored in binary format. That is, "1" designates the feature is enabled, "0" designates the feature is disabled.

Table 6: Stored Parameters

Parameter Name	Description	Default Value
Bit Rate	24 kbps – 46 Mbps depending on mode	1 Mbps
Clock Polarity	1 or 0, denoting clock polarity inverted or not, respectively	0 (inversion OFF)
Data Polarity	1 or 0, denoting data polarity inverted or not, respectively	0 (inversion OFF)
De-Randomizer	1 or 0, denoting derandomizer ON or OFF, respectively	0 (de-randomizer OFF)
Differential Decoding	1 or 0, depending on whether differential decoding is ON This is only meaningful for SOQPSK-TG modulation. Note: IRIG 106-17 stipulates the use of differential encoding, so operation without differential encoding is only possible with a demodulator operating in a "non-IRIG 106" mode.	1 (differential decoding ON)

Parameter Name	Description	Default Value
Frequency	This is the desired frequency of the receiver in MHz.	1450.5 MHz, 1800.5 MHz, or 2370.5 MHz for Lower-L band, Upper-L band, or S band, respectively 1450.5 MHz for tri band 4675.0 MHz for C band
Modulation	This is the modulation method used. Value of 0-10 Options are: 0 – PCM/FM 1- SOQPSK 2 – MHCPM 3 – BPSK 4 – QPSK 5 – AQPSK 6- AUQPSK 7 – OQPSK 8 – UQPSK 9 – DPM 11 – STC 12 – SOQPSK/LDPC 13 – STC/LDPC	QPSK, if it exists If not, then PCM/FM If not, then SOQPSK If not, then MHCPM
Modulation Index Tracking*	In PCM/FM mode only Allows Trellis demodulator to automatically detect and adjust to Modulation Indices not at ideal 0.7	A (Acquire)

***Note:** If the user cannot guarantee that the transmit source is a new generation, digitally synthesized transmitter, the receiver should be left in Tracking mode. Failure to do so will cause the receiver to fail to acquire improperly deviated signals altogether. All tracking loops are already optimized for fastest synchronization, and should not be adjusted in any way.

If the user knows for sure that the transmit source is digitally synthesized, the tracking should be set to Off, for the minimum acquisition time.

4.3 RDMS Serial Control Protocol

The Compact RDMS™ is controlled via a simple three-wire serial interface (transmit, receive, and ground). Configure your controller's serial port to the following settings:

- Baud rate of 115,200
- 8 bits
- No parity
- 1 stop bit

For setup and configuration via a standard Windows-based PC, Quasonix recommends the application called *Terminal*, a flexible, full-featured control interface that is included in the RDMS Product CD. Otherwise, one can use other terminal emulators, such as PuTTY or TeraTerm.

When power is applied to the receiver, a welcome message, shown in Figure 5, displays. After the welcome message, the mode status displays (in this example, PCM/FM). This varies depending on the modes and versions loaded into the RDMS. Additional status information about RDMS initialization displays last. This also varies depending on RDMS settings and options.

```
Quasonix, Inc
6025 Schumacher Park Dr
West Chester, OH 45069
(513) 942-1287
www.quasonix.com
CAGE CODE: 3CJA9
IRIG-106 Release 07

PCMFM App Rev: 1.0.10.166 Dec  3 2015 09:42:16
PCMFM FPGA Rev: 0000102E  Nov 12 2015 02:34:51

AGC tables loaded
RF attenuator calibration loaded
IF attenuator calibration loaded
Gain calibration data loaded
RF filter tune data loaded
Synthesizer data loaded
Saved parameters DEFAULTED
Warm start>
```

Figure 8: RDMS™ Welcome Message Example

The base command syntax is "a command followed by zero or more command parameters." If the command is issued with arguments, there must be a space after the alphabetic characters. The commands are not case sensitive.

All commands generate a response of one or more lines. The length of the response depends on the verbosity level. The last response line is always the currently selected mode (PCM/FM, SOQPSK, CPM, or PSK), followed by the character "+" or ">", depending on the version of the firmware. This prompt signifies that the RDMS is ready to accept new characters.

4.3.1 Tier 0 (PCM/FM), Tier I (SOQPSK-TG), Tier II (Multi-h CPM) and PSK Commands

The following table describes all receiver user commands. Listed are the command code, name, description of the command, whether specific options must be ordered or the command is standard on all receivers, basic or advanced command, and whether the command is restricted to specific waveform modes.

Multiple commands may be typed on a command line if they are separated by a semicolon ";". There is a limit of 256 characters per command line, including semicolons. Commands with no parameters request status only.

Refer to command HA in section 4.3.2.22 for specific help in reading the command sets.

Refer to section 4.3.2 for additional command set detail and examples. This information is also available in the command Help.

For example:

PCM/FM>FR 2200.5; BR 6.000; AGC

results in the following:

Frequency set to 2200.5 MHz

Bit Rate set to 6.000 Mbps

and status for all AGC parameters are displayed as:

AGC control enabled

AGC control mode RF

AGC automatic mode select enabled

AGC zero mode Auto

AGC zeroed at -110.22 dBm (13.38 dB attenuation)

AGC auto zero hold threshold 0.000 dB

AGC auto zero time constant 0.250 seconds

AGC loop total power 13.375 dB

Bulk attenuator AGC control enabled, switched out

Ctrl Y repeats the command sequence without having to retype the commands.

Table 7: Standard and Optional User Commands

Mnemonic	Name	Description	Option (s) Required	Mode Restriction
?	Help Message	Displays abbreviated list of available Help commands	Standard	None
ACU	Antenna Control Unit	Report or set antenna control unit automatic gain control (AGC) settings	-37	None
AEQ	Adaptive Equalizer	Report equalizer status and control adaptive equalizer settings	-EQ	None
AFC	Automatic Frequency Control	Report or set a variety of automatic frequency control parameters	Standard	None
AHM	Analog High Speed Mixer	Displays and controls high speed (video) output mixer settings	-37	None
AHO	Analog High Speed Output (Tape Output)	Displays and controls high speed (video) output settings	-37	None
ALM	Analog Low Speed Mixer	Displays and controls low speed (video) output mixer settings	-37	None
ALO	Analog Low Speed Output	Displays and controls low speed (ACU) output settings	-37	None
AL	Lock Status Command	Reports system lock status	Standard	None
BER	Bit Error Rate	For Bit Error Rate commands and information, refer to the Technical Guide, Bit Error Rate Testing	Standard	None
BR	Bit Rate	Report or set baseband bit rate	Standard	For Asynch PSK (legacy) modes, BR A and BR B must be specified separately
CLH	Command Line History	Reports last 25 commands issued	Standard	None

Mnemonic	Name	Description	Option (s) Required	Mode Restriction
CP	Clock Polarity	Report or set clock polarity inversion state	Standard	For Asynch PSK (legacy) modes, CP A and CP B must be specified separately
DA	Downconverting Antenna	Displays and controls receiver C band to P band downconverting antenna	P band enabled receiver	None
DD	Differential Decoding	Enable or disable differential decoding	Standard	SOQPSK
DHO	High Speed Digital Output	Displays and controls high speed digital output settings	Standard	None
DLO	Low Speed Digital Output	Displays and controls low speed digital output settings	Standard	None
DOM	Digital Output Muting	Control shut down of clock and data outputs	Standard	None
DP	Data Polarity	Report or set data polarity inversion state	Standard	For Asynch PSK (legacy) modes, DP A and DP B must be specified separately
DQ	Data Quality Encapsulation and Metrics	Display and control data quality encapsulation and DQ metrics	Standard	ARTM modes
DR	Derandomizer State	Report or set the derandomizer state	Standard	None
DSO	Digital Status Output	Controls the source, polarity, and override states	Standard	None
FEC	Forward Error Correction Mode	Report FEC status for enabled modes	-K7	Legacy PSK
FL	Force Lock Indication	Diagnostic tool to force the system to indicate locked or unlocked	Standard	None
FM	FM Demodulator Settings	Displays and controls FM demodulator settings	Standard	PCM/FM
FR	Frequency	Report or set receiver center frequency	Standard	None

Mnemonic	Name	Description	Option (s) Required	Mode Restriction
HA	Advanced Help Command	Displays Help commands not frequently used or with more complex construction than the basic two character Help commands	Standard	None
IF	IF Filter Control	Display and control IF filter settings	Standard	None
LDPC	Low Density Parity Check	Display and control Forward Error Correction settings	Standard	SOQPSKLDPC or STCLDPC
MI	Modulation Index	Report or Set Modulation Index Tracking or Acquire	Standard	PCM/FM
MO	Modulation	Report or set modulation setting	Standard	Limited to modes installed
OCM	Output Clock Measurement	Displays measured output clock frequency	Standard	None
PDC	PCM Decoding	Controls digital decoding such as NRZ-L, NRZ-M, and bi-phase	Standard	None
PDF	PCM Deframing	Displays and controls PCM deframing settings	Standard	None
PER	Parameters Erase	Erases the stored parameter set for the current mode; Upon power cycle, resets current operating parameter set to factory default values	Standard	None
PERA	All Parameters Erase	Reset all modes to factory default values	Standard	None
PL	Input Power Level	Reports or sets the current input power level setting	Standard	None
PLD	Parameters Load	Loads the stored parameter set into the current operating parameter set	Standard	None
PNC	Phase Noise Compensation	Report or set phase noise compensation state	Standard	PCM/FM
PRS	Reset 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	Standard	None

Mnemonic	Name	Description	Option (s) Required	Mode Restriction
PSV	Parameters Save	Writes the current operating parameter set into a (previously erased) stored parameter set	Standard	None
QT	Query Temperature	Report the temperature in degrees Celsius	Standard	None
RFD	Reset Defaults	Reset all parameters to factory default values Erases all parameter data Resets to default Mode	Standard	None
SDI	Signal Degradation Information	Sets signal degradation information enable or disable parameters	Standard	SOQPSK
SI	Spectrum Inversion	Accounts for downconverting antenna spectral inversion	Standard	None
SN	Show Serial Number	Report the serial number for the unit	Standard	None
SV	Save Parameters	Saves the current parameters in non-volatile memory, including frequency, modulation, bit rate, data polarity, clock polarity, AGC state, verbosity level, etc.	Standard	None
SYS	System Status Tracking	Displays the system status of the receiver	Standard	None
TOD	Time of Day	Sets the current calendar date and time of day	Standard	None
UP	Show Options	Displays the current hardware configuration and options on the receiver	Standard	None
VE	Version	Report the current Firmware (software) version information for the receiver; displays the current application, FPGA, and adaptive equalizer versions	Standard	None

4.3.2 Additional Command Set Details

4.3.2.1 Antenna Control Unit - ACU

The ACU command displays and controls the antenna control unit settings.

ACU [M <m>|C <e>|O <s>]

M <m> - Sets antenna control mode to <m>

where: <m> - Control mode

M - AGC time constant and AM bandwidth set manually

S - AGC time constant and AM bandwidth set based on antenna scan

C <e> - Sets AGC compensated AM enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

O <s> - Sets antenna control output to <s>

where: <s> - Signal source

0 - Channel 0

1 - Channel 1

C - Combiner

ACU [S [T <t>|R <r>]] - Antenna scan settings

T <t> - Sets antenna mode scan type to <t>

where: <t> - Scan type

C - Conical scan

E - E-scan

R <r> - Sets antenna mode scan rate to <r>, 10.00 to 50.00 Hz

ACU [AM [<p>|S <s>|B <b>]] - Antenna control unit AM settings

<p> - Sets AM output polarity to <p>

where: <p> - Polarity

{0|+} - Normal

{1|-} - Inverted

S <s> - Sets AM output scale to <s>, -128.0 to 128.0

B <b> - Sets manual mode AM detector bandwidth to <b>, 5.00 to 50000.00 Hz

ACU [AGC [<p>|S <s>|T <n>]] - Antenna control unit AGC settings

<p> - Sets AGC output polarity to <p>

where: <p> - Polarity

{0|+} - Normal

{1|-} - Inverted

S <s> - Sets AGC output scale to <s>, 1.0 to 50.0 dB/V

T <n> - Sets manual mode AGC time constant to <n>, 0.1 to 1000.0 ms

Examples:

```
ACU     Report ACU related status
        PCMFM$acu
        ACU mode manual
        AGC compensated AM on
        Antenna scan type conical
        Antenna scan rate 30.0 Hz
        Manual AM bandwidth 100.0 Hz
        Manual AGC time constant 100.0 ms
        AM output polarity +
        AGC output polarity +
        AGC output scale 10.0 dB/V
        AM scale 1.0

ACU AGC 0       Set polarity to Normal
ACU AGC 1       Set polarity to Inverted
ACU AGC S 42.0          Set AGC output scale to 42.0 dB/V
                        Valid range is 1.0 to 50.0 dB/V
ACU AGC T 222.0         Set manual mode AGC time constant to 222.0 ms
                        Valid range is 0.1 to 1000.0 ms
```

4.3.2.2 Adaptive Equalizer Control - AEQ

The AEQ command displays and controls adaptive equalizer settings.

AEQ [<e>|T <e>|M <c>|H <t>|R {<e>|S <s>}|C {<e>|R <r>}]

<e> - Sets adaptive equalizer enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

T <e> - Sets equalizer information tracking display to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

H E - Sets equalizer hold reference to Eb/N0

H Q - Sets equalizer hold reference to DQM BEP

HE <t> - Sets EQ hold below Eb/N0 <t>, -20.000 to 30.000 dB or -100.000 is Off

HD <t> - Sets EQ hold/run delay <t>, 10 to 60000 ms or 0 is Off

HQ <t> - Sets EQ hold below DQM BEP <t>, 1e-12 to 0.5 or 0.0 is Off

M <c> - Sets EQ Mu <c>, -0.125 to 0.125

S <s> - Sets EQ input scale to <s>, 0.000 to 16.000

R <e> - Sets auto reset enable to <e>

<e> - Sets adaptive equalizer enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

R S <s> - Sets auto reset speed to <r>

where: <s> - Speed

F - Fast

S - Slow

C <e> - Sets power centering enable to <e>

<e> - Sets adaptive equalizer enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

C R <r> - Sets power centering rate to <r>, 0 to 65535

AEQ [N {C <c>|L <l>}]

N C <c> - Sets added noise coefficient to <c>, 0.000 to 1.000

N L <l> - Sets added noise limit to <l>, 0.000 to 1.000

AEQ [P {T <t>|S <s>}]

P T <t> - Sets power check target to <t>, 0.000 to 16.000

P S <s> - Sets power check scale to <s>, 0.000 to 16.000; default is 0.0

AEQ [SC {C <c>|D <d>}]

SC C <t> - Sets symbol check count to <c>, 0 to 16777215

SC D <s> - Sets symbol check delta to <d>, 0 to 16777215

AEQ TAPS [C|CC|CP|G][F[<w>]] - Display equalizer tap values

C - Display using CSV format

CC – Display complex values using CSV format

CP – Display polar values using CSV format

G - Display as graphic only

F[<w>] - Display taps in frequency domain of width <w>, 2 to 64

AEQ BINS [C] - Display equalizer bin values

C - Display using CSV format

Examples:

AEQ Report equalizer status
PCMFM$aeq
Adaptive equalizer disabled
Filter Mu 0.000122
Center power 0.250 Total power 0.250 (0.000 dB)
Error magnitude 0.000244
Added noise 0.000000
EQ Eb/N0 auto hold enabled below 10.000 dB Eb/N0
EQ DQM auto hold enabled below 1.000e-02
EQ auto hold reference DQM (and held)

AEQ 0 Disable adaptive equalizer
AEQ 1 Enable adaptive equalizer
AEQ H x Set equalizer hold below Eb/N0 to a value between -20.000 and 30.000 dB; -100.000 sets equalizer hold to Off
AEQ T 0 Disable equalizer information tracking display
AEQ T 1 Enable equalizer information tracking display

4.3.2.3 Automatic Frequency Control - AFC

The Automatic Frequency Control command reports or sets various AFC parameters.

AFC [M <m>|H <t>|C {A|<c>}|L <m>|T {L|H} <t>|R <e>|AD <d>|AS <s>] or AFC SYS <d>

M <m> - Sets AFC mode to <m>

where: <m> - mode

O - Off

H - Hold

T - Track

A - Acquire

H <t> - Sets AFC hold below Eb/N0 <t>, -20.000 to 30.000 dB or -100.000 is off

C A - Sets AFC coefficient to be automatically set based on bit rate

C <c> - Sets AFC coefficient to <c>, 0.0003511 to 46.018 seconds

L <m> - Sets AFC correction limit to <m>, 0.000006 to 46.666661 MHz

T L <t> - Sets AFC power detect low threshold to <m>, 0.000000 to 0.999985

T H <t> - Sets AFC power detect high threshold to <m>, 1.000015 to 65536.000000

O <e> - Sets AFC data path override enable to <e>

where: <e> - enable

0 - Disabled

1 - Enabled

AD <d> - Sets Acquire mode minimum delta offset coefficient to <d>, 0.000 to 5.000

AS <s> - Sets Acquire mode settling time to <s>, 10 to 10000 ms with a 5 ms resolution

SYS <d> - Sets the AFC status tracking display mode to <d>

where: <d> - display mode

D - Detected

C - Compensated

The Sys d setting is used to change whether detected or compensated offset is displayed in the SYS output Note these display values are only different in Acquire mode.

When AFC mode is set to Acquire, the RDMS goes to the 'armed' state. In the armed state, the AFC tracks and compensates any detected offset regardless of the signal Eb/N0. (In Tracking mode, if the Eb/N0 hold is enabled, the tracking and compensation stop if the signal Eb/N0 is below the hold threshold.) In this case, the detected and compensated offset are the same.

The detected offset is averaged over the specified settling time (AFC AS <s>) and then the delta to the last average is determined. If the delta is less than or equal to the minimum delta (AFC AD <d>), the AFC moves to the 'triggered' state, the compensated offset remains at the point where it was when triggered, and the Eb/N0 and detected AFC duty cycle where the trigger occurred are saved. In the triggered state, the AFC still detects the offset but the compensated offset remains fixed at the point where the AFC triggered. In this case, the detected and compensated offset will likely be different. The detected offset continues the averaging and delta comparison and if either the delta comparison or the absolute offset relative to the current trigger point exceeds the minimum delta AND the Eb/N0 is greater than or equal to the Eb/No where the last trigger occurred, the AFC will 'retrigger' and move the compensated offset to the current, new, offset.

AFC C - Sets the automatic frequency control coefficient

Examples:

AFC C A	Set AFC coefficient to be automatically set based on bit rate
AFC C 0.00001	Set AFC coefficient to 0.00001 seconds (ten times slower tracking than default) Valid range is 4.389e-05 to 5.752 seconds

AFC H - Sets the automatic frequency control hold threshold below Eb/N0

Example:

AFC H 6.000	Set AFC to automatically hold tracking below 6.000 dB E_b/N_0 Valid range is -20.000 dB to 30.000 dB; -100.000 dB is Off

AFC L - Sets the automatic frequency control correction limit

Example:

AFC L 42.123456	Set AFC correction limit to 42.123456 MHz Valid range is 0.000006 to 46.666661 MHz

AFC M - Sets the automatic frequency control mode

Examples:

AFC M O	Set AFC to Off
AFC M H	Set AFC to Hold
AFC M T	Set AFC to Track
AFC M A	Set AFC to Auto

AFC T - Sets the automatic frequency control power detect threshold

Example:

AF T 0.0000	Set AFC to power detect threshold to 0.000 Valid range is 0.000 to 1.000

Example:

AFC

AFC auto operation mode Off
AFC tracking auto hold below 10.00000 dB Eb/N0
Compensated frequency offset -0.004606 MHz
Detected frequency offset -0.004718 MHz
Duty cycle   0.08 %
Auto AFC bandwidth is enabled
AFC coefficient 0.03573 seconds
AFC limit 0.50000 MHz
AFC power threshold 0.000

4.3.2.4 Automatic Gain Control - AGC

The Automatic Gain Control command reports and sets a variety of AGC parameters. Additional AGC commands are described in separate subsections 4.3.2.4.1 through 4.3.2.4.7. A detailed explanation of AGC Compensation is located in Appendix B –.

AGC [-V] - Shows advanced AGC status

AGC [<e>] - Sets the AGC enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

Example:

AGC (shows total actual power attenuation readings)

AGC control enabled
AGC control mode RF
AGC automatic mode select enabled
AGC zero mode Manual
AGC zeroed at -60.36 dBm (60.38 dB attenuation)
AGC auto zero hold threshold 0.000 dB SNR
AGC auto raising zero time constant 0.250 seconds
AGC auto lowering zero time constant 0.250 seconds
AGC loop total attenuation 60.062 dB
Bulk attenuator AGC control enabled, switched outCMFM$agc
AGC control enabled
AGC control mode RF
AGC automatic mode select enabled
AGC zero mode Manual
AGC zeroed at -60.36 dBm (60.38 dB attenuation)
AGC auto zero hold threshold 0.000 dB SNR
AGC auto raising zero time constant 0.250 seconds
AGC auto lowering zero time constant 0.250 seconds
AGC loop total attenuation 60.062 dB
Bulk attenuator AGC control enabled, switched out

4.3.2.4.1 Automatic Gain Control Bulk Attenuation - AGC BA

The **AGC BA x** command sets the bulk attenuation parameters. The bulk attenuator has three modes In, Out, and Auto. Setting the bulk attenuator to In or Out removes the bulk attenuator from AGC control and forces it In or Out, respectively. Setting it to Auto allows the AGC mode to control it.

There are no hard value limits for the switch in/out threshold at input power due to variances in other parameters such as gain, calibration, and temperature. It will clip to a minimum or maximum value and report that setting.

The bulk attenuation switch out threshold is forced to match the switch in threshold when the AGC is in IF mode. This is to prevent the AGC from attempting to switch the bulk attenuator while using a path that doesn't have a bulk attenuator.

AGC [BA [<e>|V <a>|D <t>|{I|O <t> [A]}]] - AGC bulk attenuation settings

<e> - Sets bulk attenuation control enable to <e>

where: <e> - Enable

0 - Disabled, switched out

1 - Enabled, switched in

A - AGC control enabled

V <a> - Attenuation value to <a>, 0.0000 to 511.9375 dB

D <t> - Switch out threshold delta attenuation <t>, -255.5 to -0.0 dB

I|O <t> - Switch In|Out threshold at input power <t>, in dBm

I|O <t> A - Switch In|Out threshold at attenuation <t>, 0.0 to 255.5 dB

Examples:

AGC BA 1	Bulk attenuator AGC control enabled, switched in
AGC BA V 17.000	Set attenuation value to 17.000 dB Valid range 0.0000 to 511.9375 dB
AGC BA D 33.3	Set switch out threshold delta attenuation to -33.3 dB Valid range -255.5 to -0.0 dB
AGC BA I x	Set switch in threshold at input power to x dBm
AGC BA O x	Set switch out threshold at input power to x dBm

4.3.2.4.2 Automatic Gain Control Data Settings - AGC DATA

The AGC DATA command is used to set the AGC table attenuation value for a specific attenuator along with an attenuation or data operation value. Parameter values are explained below.

AGC DATA [<p> <a> = <v>|<o>] - AGC data settings

<p> <a> = <v> - Set AGC table attenuation <p>, attenuator <a> to attenuation <v> dB

where:

<p> - 0.0 to 255.5 dB

<a> - Attenuator A, B, C, D, E

<v> - Attenuation 0.0 to 31.5 dB or 'MIN' or 'MAX'

<o> - Data operation

LOAD - Load data

ERASE - Erase data

SAVE - Save data

Example:

AGC DATA 2.2 E MIN   Set AGC table attenuation to 2.2 dB for attenuator E with attenuation of minimum

4.3.2.4.3 Automatic Gain Control Mode - AGC M

The **AGC M** command sets the automatic gain control loop mode.

AGC [M <m>] - Sets the AGC loop mode to <m>

where: <m> - AGC control mode

A - Automatically select mode based on source

R - Use RF attenuators

I - Use IF attenuators

Setting the AGC Mode to Auto automatically sets the AGC mode to RF/IF based on IF input path (which is based on the receiver frequency).

Setting the AGC Mode to RF forces control of the RF attenuators and (if the bulk attenuator is set to Auto) the bulk attenuator under AGC control.

Setting the AGC mode to IF forces control of the IF attenuators under AGC control and disables AGC control of the bulk attenuator. This also forces AGC Zero to Auto because when playing back recorded signals, such as demod/playback-demod, the noise floor changes as the AGC in the original recording holds the signal power steady and allows the noise floor to move. The dynamic range of the AGC closely matches the dynamic range of the auto zero.

Examples:

AGC M A	Automatically select mode based on source
AGC M R	Set AGC control mode to use RF attenuators
AGC M I	Set AGC control mode to use IF attenuators

4.3.2.4.4 Automatic Gain Control Loop Parameter - AGC L

The AGC L command sets AGC loop parameters.

AGC [L {P <t>|S <t>|A <t>|D <d>|C <d>|T <d>}] - Set AGC loop parameter

P <t> - Sets period to <t>, 0.000 to 5.464 us

S <t> - Sets sample time to <t>, 0.000 to 2.732 us

A <t> - Sets averaging sample time to <t>, 0.002 to 2100.897 ms

D <d> - Sets deadband to <d>, 0.0000 to 15.9375 dB

C <t> - Sets time constant to <t>, 0.100 to 1000.000 ms

T <d> - Sets power target to <d>, -100.0 to 13.0 dBm

Examples:

AGC L P 0.567   Set AGC loop period to 0.567 µs

	Valid range is 0.000 to 5.464 µs
AGC L S 1.987	Set AGC sample time to 0.567 µs
	Valid range is 0.000 to 2.732 µs
AGC L A 42.000	Set AGC averaging sample time to 42.000 ms
	Valid range is 0.002 to 2100.897 ms
AGC L D 0.0010	Set AGC deadband to 0.0010 dB
	Valid range is 0.0000 to 15.9375 dB
AGC L C 25.000	Set AGC time constant to 25.000 ms
	Valid range is 0.100 to 1000.000 ms
AGC L T -70.0	Set AGC power target to -70.0
	Valid range is -100.0 to 13.0 dBm

4.3.2.4.5 Automatic Gain Control Attenuator Look Up Table - AGC LUT

The **AGC LUT** command displays or rebuilds the attenuator look up table.

AGC LUT [<p>|R] - AGC attenuator Look Up Table

<p> - Show AGC LUT <p> attenuation

R - Rebuild AGC LUT

Examples:

AGC LUT 111.5	Display AGC look up table 111.5 attenuation
	Valid range is 0.0 to 255.5 dB
AGC LUT R	Rebuild AGC look up table

4.3.2.4.6 Automatic Gain Control Auto Zero - AGC AZ

The **AGC AZ** command enables or disables AGC auto zero and sets hold threshold or time constants.

AGC [AZ [H <t>|T <t>]]

H <t> - Sets the AGC DSP auto zero hold threshold to <t>, -30.000 to 100.000 dB SNR

TR <c> - Sets the AGC DSP auto zero raising time constant to <c>, 0.050 to 100.000 seconds

TL <c> - Sets the AGC DSP auto zero lowering time constant to <c>, 0.050 to 100.000 seconds

Examples:

AGC AZ 0	Disable AGC auto zero
AGC AZ 1	Enable AGC auto zero
AGC AZ H 20.000	Set AGC DSP auto zero hold threshold to 20.000 dB
	Valid range -30.000 dB to 100.000 dB
AGC AZ T 0.100	Set AGC DSP auto zero time constant to 0.100 seconds
	Valid range 0.050 seconds to 100.000 seconds

4.3.2.4.7 Automatic Gain Control Zero - AGC Z

The **AGC Z** command sets the AGC Zero operating mode and the value at which zero can be set.

AGC [Z [M <m>]] - Sets the AGC zero mode to <m>

where: <m> - AGC zero mode

A - Auto: Automatically set AGC zero level

M - Manual: Manually set AGC zero level, reset on frequency or IF bandwidth change, reset on power cycle

H - Hold: Manually set AGC zero level, NO reset on frequency or IF bandwidth change, reset on power cycle

S - Hold and Save: Manually set AGC zero level, NO reset on frequency or IF bandwidth change, NO reset on power cycle

AGC [Z [<p>|Z|R]]

<p> - Sets the AGC output zero to <p> in dBm

Z - Sets the AGC output zero to current

R - Resets the AGC output zero to nominal

Examples:

AGC Z A	Automatically set AGC zero level
AGC Z M m	Manually set AGC zero level, reset on frequency, or IF bandwidth change; Reset on power cycle
AGC Z H	Manually set AGC zero level, NO reset on frequency or IF bandwidth change; Reset on power cycle
AGC Z S	Manually set AGC zero level, NO reset on frequency or IF bandwidth change; NO reset on power cycle
AGC Z 2	Set AGC output zero to 2 dBm
AGC Z R	Reset AGC output zero to nominal
AGC Z Z	Set AGC output zero to current

4.3.2.5 High Speed Output Mixer Settings - AHM

The AHM command displays and controls high speed (video) output mixer settings.

AHM [<f>|<c> [<e>]] - Sets high speed (video) mixer parameters

<f> - Sets mixer frequency for ALL channels to <f>, -46.6667 to 46.6667 MHz

<c> <e> - Sets channel <c> mixer enable to <e>

where:

<c> - Channel to set enable

A - Channel DAC A

B - Channel DAC B

C - Channel DAC C

D - Channel DAC D

<e> - Enable

0 - Disabled

1 - Enabled

Examples:

AHM

high speed (video) mixer at 0.0000 MHz

Channel DAC A mixer disabled

Channel DAC B mixer disabled

Channel DAC C mixer disabled

Channel DAC D mixer disabled

AHM x	Sets mixer frequency for all channels in MHz
	Valid range is -46.6667 to 46.6667 MHz
AHM c x	Sets a specific channel (c) mixer to enabled or disabled
	Valid channel mixer values are A, B, C, or D
For example:	AHM B 1 sets channel DAC B to Enabled
	AHM D 0 sets channel DAC D to Disabled.

4.3.2.6 High/Low Speed Outputs

The receiver has four generic high speed (video) analog outputs, four generic low speed analog outputs, and four generic clock/data paired digital outputs. While there are signals that are normally found on these outputs, there is also a list of other sources that can be connected.

A receiver channel is conceptually divided into two basic parts. One is the common 'platform' and the other is the 'demodulator'. The 'platform' is common to all telemetry modulations schemes. The demodulator is specific to the telemetry modulations scheme.

Some commands operate at the platform level, some at the demodulator level, and some at specific configurations of the demodulator. This is why the Help displays in this manner:

System Commands

H ? for help on help

ACU Antenna control unit	ADC ADC register
UP Unit Parameters	VE Version

Demodulator/Receiver Commands

AEQ Adaptive equalizer	DLS Data path lock status

PCMFM Commands

FM FM demodulator	MI Modulation index scale

Some of these sources are part of the 'platform' and some of these sources are specific to the demodulator in use.

The commands AHO, ALO, DHO, and DLO are the source control commands for the platform.

These commands control source, (for analog outputs, scale, offset,) and polarity.

- AHO - Analog High-Speed Outputs
- ALO - Analog Low-Speed Outputs
- DHO - Digital High Speed Outputs
- DLO – Digital Low Speed Outputs

4.3.2.6.1 Analog High Speed Output - AHO

The AHO command displays and controls the high speed (video) output settings.

Parameter values are explained below.

AHO [<c> [<s>|<p>|S <s>|O <o>] |E <e>]

where:

<c> is the channel to set; Valid entries are:

- A - Channel DAC A
- B - Channel DAC B
- C - Channel DAC C
- D - Channel DAC D

  <s> sets the channel source to one of the options below (if desired):

  - IF0 - Physical channel 0 IF input
  - IF1 - Physical channel 1 IF input
  - P0I - Physical channel 0 downconverted baseband I only
  - P0Q - Physical channel 0 downconverted baseband Q only
  - P0T - Physical channel 0 tape output source (needs mixer)
  - P1I - Physical channel 1 downconverted baseband I only
  - P1Q - Physical channel 1 downconverted baseband Q only
  - P1T - Physical channel 1 tape output source (needs mixer)
  - CMBI - Combiner baseband I only
  - CMBQ - Combiner baseband Q only
  - CMBT - Combiner tape output source (needs mixer)
  - DP0 - Data path high-speed signal 0
  - DP1 - Data path high-speed signal 1
  - DP2 - Data path high-speed signal 2
  - DP3 - Data path high-speed signal 3
  - F0 - Fixed value 0

- F1 - Fixed value 1

OR

<p> sets the channel polarity to one of the values below:

- {0|+} - Active high (normal)
- {1|-} - Active low (inverted)

OR

S <s> sets the channel scale to a value between -128.0000 and 127.9961

OR

O <o> sets the channel offset to a value between -1.0000 and 0.9995

E <e> sets the channel enable to enabled or disabled

- 0 - Disabled
- 1 - Enabled

Example:

AHO Displays current high speed (video) output status settings (enabled/disabled and output frequency)

high speed (video) Channel DAC A

Source Data path high-speed signal 0

Scale - 1.0000

Offset - 0.0000

Polarity - High (+)

high speed (video) Channel DAC B

Source Data path high-speed signal 1

Scale - 1.0000

Offset - 0.0000

Polarity - High (+)

high speed (video) Channel DAC C

Source Physical channel 0 downconverted baseband I only

Scale - 1.0000

Offset - 0.0000

Polarity - High (+)

high speed (video) Channel DAC D

Source Physical channel 0 downconverted baseband Q only

Scale - 1.0000

Offset - 0.0000

Polarity - High (+)

70 MHz modulator disabled

AHO B P1T	Sets the channel to Channel DAC B with Physical channel 1 tape output source; (Needs mixer)
AHO D S -42.0000	Sets the channel to Channel DAC D with a channel scale of -42.0000
AHO C O 0.1234	Sets the channel to Channel DAC C with a channel offset of 0.1234
AHO A E 1	Sets the channel to Channel DAC A and enables the channel

AHO M - Sets the 70 MHz modulator output to enable or disable

Examples:

AHO M 0	Disabled
AHO M 1	Enabled

AHO -V ? - Shows extended Help for the AHO command

4.3.2.6.2 Analog Low Speed Output - ALO

The ALO command displays and controls the low speed (ACU) output settings.

Parameter values are explained below.

ALO [<c> [<s>|<p>|S <s>|O <o>] |E <e>]

where:

<c> is the channel to set; Valid entries are:

- A - Channel A (AM)
- B - Channel B (Aux Analog A Out)
- C - Channel C (AGC)
- D - Channel D (Aux Analog B Out)

<s> sets the channel source to one of the options below (if desired):

- AM - Demodulated AM
- AGC - AGC output
- DP0 - Data path low-speed source 0
- DP1 - Data path low-speed source 1
- DP2 - Data path low-speed source 2
- DP3 - Data path low-speed source 3
- F0 - Fixed value 0
- F1 - Fixed value 1

OR

<p> sets the channel polarity to one of the values below:

- {0|+} - Active high (normal)
- {1|-} - Active low (inverted)

OR

S <s> sets the channel scale to a value between -128.0000 and 127.9961

OR

O <o> sets the channel offset to a value between -1.0000 and 0.9995

E <e> sets the channel enable to enabled or disabled

- 0 - Disabled
- 1 - Enabled

Examples:

ALO C AGC	Sets the channel to Channel C (AGC) with AGC output
ALO D 1	Sets the channel to Channel D (Aux Analog B Out) with polarity active low (inverted)
ALO A S 98.6543	Sets the channel to Channel A (Demodulated AM) with channel scale set to 98.6543
ALO B E 0	Sets the channel to Channel B and disables the channel

ALO -V ? - Shows extended Help for the AHO command

Example:

ALO Displays current low speed (ACU) output status settings (enabled/disabled and output frequency)

low speed (ACU) Channel A (AM)

Source Demodulated AM

Scale - 1.0000

Offset - 0.0000

Polarity - High (+)

low speed (ACU) Channel B (Aux Analog A Out)

Source Fixed value 0

Scale - 1.0000

Offset - 0.0000

Polarity - High (+)

low speed (ACU) Channel C (AGC)

Source AGC output

Scale - 1.0000

Offset - 0.0000
Polarity - High (+)
low speed (ACU) Channel D (Aux Analog B Out)
Source Fixed value 0
Scale - 1.0000
Offset - 0.0000
Polarity - High (+)

4.3.2.6.3 High Speed Digital Output - DHO

DHO displays and controls high speed digital output settings.

DHO [<c> <s>] - Sets channel <c> to source <s>

where:

<c> - Output channel

AC - Channel A Clock

AD - Channel A Data

BC - Channel B Clock

BD - Channel B Data

CC - Channel C Clock

CD - Channel C Data

DC - Channel D Clock

DD - Channel D Data

TH1 - Top Hat 1

TH2 - Top Hat 2

<s> - Signal source

F0 - Fixed 0

F1 - Fixed 1

GC - Generator Clock

GD - Generator Data

AC - Clock A

AD - Data A

BC - Clock B

BD - Data B

DP0 - Datapath 0

DP1 - Datapath 1

DP2 - Datapath 2

DP3 - Datapath 3

DP4 - Datapath 4

DP5 - Datapath 5

DP6 - Datapath 6

DP7 - Datapath 7

DHO [<c> <p>] - Sets channel <c> polarity to <p>

where:

<c> - Output channel

AC - Channel A Clock

AD - Channel A Data

BC - Channel B Clock

BD - Channel B Data

CC - Channel C Clock

CD - Channel C Data

DC - Channel D Clock

DD - Channel D Data

TH1 - Top Hat 1

TH2 - Top Hat 2

<p> - Output polarity

{0|+} - Active high (normal)

{1|-} - Active low (inverted)

4.3.2.6.4 Low Speed Digital Output – DLO

DLO displays and controls low speed digital output settings.

DLO [<c> <s>] - Sets channel <c> to source <s>

where:

<c> - Output channel

UTX - UART Tx

TH3 - Top Hat 3

TH4 - Top Hat 4

TH6 - Top Hat 6

TH13 - Top Hat 13

TH15 - Top Hat 15

TH16 - Top Hat 16

TH17 - Top Hat 17

TH19 - Top Hat 19

TH22 - Top Hat 22

<s> - Signal source

F0 - Fixed 0

F1 - Fixed 1

UT0 - UART Tx 0

UT1 - UART Tx 1

DP0 - Datapath 0

DP1 - Datapath 1

DP2 - Datapath 2

DP3 - Datapath 3

DP4 - Datapath 4

DP5 - Datapath 5

DP6 - Datapath 6

DP7 - Datapath 7

DLO [<c> <p>] - Sets channel <c> polarity to <p>

where:

<c> - Output channel

UTX - UART Tx

TH3 - Top Hat 3

TH4 - Top Hat 4

TH6 - Top Hat 6

TH13 - Top Hat 13

TH15 - Top Hat 15

TH16 - Top Hat 16

TH17 - Top Hat 17

TH19 - Top Hat 19

TH22 - Top Hat 22

<p> - Output polarity

{0|+} - Active high (normal)

{1|-} - Active low (inverted)

4.3.2.7 Low Speed Mixer Control - ALM

The ALM command displays and controls low speed (ACU) output mixer settings

ALM [<f>|<c> [<e>]] - Sets low speed (ACU) mixer parameters

<f> - Sets mixer frequency for ALL channels to <f>, -100.0000 to 100.0000 kHz

<c> <e> - Sets channel <c> mixer enable to <e>

where:

<c> - Channel to set enable

A - Channel A (AM)

B - Channel B (Aux Analog A Out)

C - Channel C (AGC)

D - Channel D (Aux Analog B Out)

<e> - Enable

0 - Disabled

1 - Enabled

Examples:

ALM x	Sets mixer frequency for all channels in MHz Valid range is -46.6667 to 46.6667 MHz
ALM c x	Sets a specific channel (c) mixer to enabled or disabled Valid channel mixer values are A, B, C, or D
For example:	ALM B 1 sets channel DAC B to Enabled ALM D 0 sets channel DAC D to Disabled.

ALM

low speed (ACU) mixer at 0.0000 kHz

Channel A (AM) mixer disabled

Channel B (Aux Analog A Out) mixer disabled

Channel C (AGC) mixer disabled

Channel D (Aux Analog B Out) mixer disabled

4.3.2.8 Lock Status Command - AL

The Lock Status command reports the system lock status.

Example:

AL

System Lock is active

4.3.2.9 Bit Rate - BR

The Bit Rate command sets or reports the baseband bit rate.

BR [<r>|M|SM]

<r> - Set bit rate to <r>, 0.0240 to 23.0000 Mb/s

M - Show measured bit rate

SM - Set bit rate to measured bit rate

BR M - Show the current measured bit rate

BR M Display measured bit rate in Mbps

BR SM - Set the bit rate to the measured bit rate

BR SM Set the bit rate to the measured bit rate in Mbps

Examples:

BR Report the bit rate setting

Bit rate: 1.000000 Mb/s

BR 5 Set bit rate to 5 Mbps

BR 0.6 Set bit rate to 600 Kbps

Valid range is 0.0080 to 23.0000 Mbps

4.3.2.10 Clock Polarity - CP

The Clock Polarity command displays and controls clock output polarity.

CP [<p>] - Sets clock component output polarity

<p> - Set clock polarity to <p>

where:

<p> - Polarity

{0|+} - Active high (normal)

{1|-} - Active low (inverted)

Examples:
CP Report the clock source state
Clock polarity active High (+)

CP 0 Set clock inversion Off
CP 1 Set clock inversion On

4.3.2.11 Downconverting Antenna - DA

The Downconverting Antenna command displays and controls receiver C band to P band downconverting antenna

DA [<e>] - Sets the C band downconverting antenna enable to <e>

where: <e> - Enable

0 - Disabled (C band tunes directly)

1 - Enabled (C band tunes to downconverted P band)

Examples:
DA
Downconverting antenna is disabled

DA 0 Set downconvert antenna state to Off (Disabled); C band tunes directly
DA 1 Set downconvert antenna state to On (Enabled); C band tunes to downconverted P band

**Downconverting antenna control only available when using a 5-band downconverter AND P and C bands are enabled.

4.3.2.12 Differential Decoding - DD

The Differential Decoding command displays and controls differential decoder settings (SOQPSK mode only). Differential Decoding for DPM defaults to Disabled (Off).

DD <e> - Sets the differential decoder enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

Example:
DD
differential decoder disabled

4.3.2.13 Digital Output Muting - DOM

The Digital Output Muting command displays and controls lock detect controlled output settings.

DOM [<e>|T <t>|C <e>|D <e>]

<e> - Sets the output muting enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

T <t> - Sets the output muting unlock timeout to <t>, 0 to 46016 ms

C <e> - Sets clock output muting on unlock to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

D <e> - Sets data output muting on unlock to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

Example:

DOM

Output muting timeout 1000
Output muting clock enable 0
Output muting data enable 0

4.3.2.14 Data Polarity - DP

The DP command displays and controls data output polarity.

DP [<p>] - Sets data component output polarity

<p> - Set data polarity to <p>

where:

<p> - Polarity

{0|+} - Active high (normal)

{1|-} - Active low (inverted)

Examples:

DP

Data polarity active High (+)
DP 0 Set data polarity to NOT inverted (Off)
DP 1 Set data polarity to inverted (On)

4.3.2.15 Data Quality Encapsulation – DQ

The Data Quality command displays and controls data quality settings.

DQ [<e>|B <b>]

[<e>] - Enables data quality encapsulation

where: <e> - Enable

0 - Disabled

1 - Enabled

[B <b>] - Sets data quality encapsulation block size to <b>, 1 to 16384

DQ [RAW <t> <e>] - Sets data quality raw metric enable for table <t> to <e>

where: <t> - Table

DP - datapath LUT

DEC - decode LUT

OUT - output LUT

where: <e> - Enable

0 - Disabled

1 - Enabled

DQ LUT <t> [<p>[= <v>]] - Show/set data quality LUT value(s) for table <t>

where: <t> - Table

DP - datapath LUT

DEC - decode LUT

OUT - output LUT

where:

<p> - Data quality LUT index <p>, 0 to 255

<v> - Data quality LUT value <v>, 0.0000 to 0.999985

DQ [M <e> [<r>]] - Sets data quality encapsulation dump enable to <e> at rate <r>

where: <e> - Enable

0 - Disabled

1 - Enabled

<r> - Display rate <r>, 1 to 60000 ms

Example:
PCMFM$dq
Data quality encapsulation disabled
Data quality encapsulation block size 4096 bits
Average datapath BEP 1.005e-12
Average decode BEP 1.005e-12
Average output BEP 1.140e-12
DQ datapath bit count: 3253769216 error count: 2.70774440e+07 BEP: 8.322e-03
DQ decode bit count: 1725284352 error count: 2.58360140e+07 BEP: 1.497e-02
DQ output bit count: 1725284352 error count: 2.09354580e+07 BEP: 1.213e-02
DQ decode raw disabled
DQ datapath raw disabled

System status display elements:
DQ DP - - Average datapath DQ
DQ DEC - - Average decode DQ
DQ OUT - Normal Wide CSV - Average output DQ
DQ DPC - - DQ datapath counts
DQ DECC - - DQ decode counts
DQ OUTC - - DQ output counts

4.3.2.16 Derandomizer State - DR

The DR command displays and controls derandomizer settings.

The CCSDS derandomizer is used, if enabled, ONLY in LDPC modes.

The IRIG derandomizer is always used if enabled.

DR [I <e>] – Sets the IRIG derandomizer enable to <e>

where: <e> - Enable

0 – Disabled

1 – Enabled

DR [C <e>] – Sets the CCSDS derandomizer enable to <e>

where: <e> - Enable

0 – Disabled

1 – Enabled

Examples:
DR Derandomizer disabled
DR I 1 Enable IRIG Derandomizer
DR C 1 Enable CCSDS Derandomizer

4.3.2.17 Digital Status Output - DSO

There are two generic discrete digital outputs that are normally lock status and sync detect (used for synchronization time testing) but also have other potential sources. The Digital Status Output command controls the source, polarity, and override states.

DSO [<c> [<s>|<p>|M <f>]]

<c> <s> - Sets channel <c> source to <s>

where:

<c> - Channel

L - Lock detect output

S - Sync detect output

<s> - Signal source

LD - Lock detect

SD - Sync detect

PL - PCM frame lock

PS - PCM sub-frame valid

<c> <p> - Sets channel <c> polarity to <p>

where: <p> - Output polarity

{0|+} - Active high (normal)

{1|-} - Active low (inverted)

M <m> - Sets channel <c> output mode to <m>

where: <m> - Output mode

0 - Allows normal output

1 - Forces output to 1 (active)

-1 - Forces output to 0 (inactive)

Example:
DSO

Lock detect output = Lock detect active High (+) normal operation
Sync detect output = Sync detect active High (+) normal operation

4.3.2.18 Forward Error Correction - FEC

Forward Error Correction requires the K7 option in the serial number.

The FEC command displays and controls Forward Error Correction settings.

FEC [M <m>|S <m> <s>]

M <m> - Sets FEC mode to <m>

where: <m> - Mode

N – None

L – LDPC Block decode

V – Viterbi K = 7 Rate

S <m> <s> - Sets soft decision scale for mode <m> to <s>

where: <m> - Mode

N – None

L – LDPC Block decode

V – Viterbi K = 7 Rate

where: <s> is a value between -32.000 and 31.984

FEC M – Sets the FEC mode for all enabled modes

Examples:

FEC M N	Set FEC mode to None
FEC M V	Set FEC mode to Viterbi K=7 Rate=1/2

Examples:
FEC
FEC mode None

4.3.2.19 Force Lock Indication - FL

The FL command displays and controls lock forcing settings.

FL [<l>] - Sets lock state to <l>

where: <l> - Lock state

0 - Normal operation

1 - Forced active

-1 - Forced inactive

Examples:

FL

Lock is normal
System lock is active
Datapath lock is active

FL 0 Force lock to Normal
FL 1 Force lock to On
FL -1 Force lock to Off

4.3.2.20 FM Demodulator Settings - FM

The FM command displays and controls FM demodulator settings.

Parameter values are explained below.

FM [<p>|S <s>|B <b>|D <m>]

where:

<p> sets the channel polarity to one of the values below:

- {0|+} - Active high (normal)
- {1|-} - Active low (inverted)

OR
S <s> sets the FM output scale to a value between -128.0 and 128.0

OR
B <b> sets the FM detector bandwidth to a value between 0.02 MHz and 46.00 MHz

The FM detector bandwidth cannot be less than current bit rate bandwidth (1.40 MHz). Refer to section 4.3.2.20.1 for additional details about the FM B x command.

OR
D <m> sets the NTSC Video deemphasis filter mode to one of three values

- 0 - Off
- N - NTSC
- P - PAL

Example:

FM

FM output polarity +
FM demodulator bandwidth 1.4 MHz
FM output scale 1.0
Video de-emphasis filter Off

4.3.2.20.1 FM Video Bandwidth Control - FM B

The FM B x command adjusts the I/Q (video) output bandwidth with PCM/FM in mind. Setting the FM (video) bandwidth wider than it would normally be set by the bit rate (this would be 1.1 to 1.4 wider than the bit rate) configures the system to allow a higher bandwidth on the output while allowing normal PCM/FM demodulation on the lower frequency PCM/FM.

- The video bandwidth can never be set narrower than the required bandwidth for the specified bit rate.
- The IF filter selection, if set to FS A, is wide enough to accommodate the wider FM (video) bandwidth.
- This configuration only operates properly in Phase Noise Compensation mode (PN 1).
- Modulation Index tracking must be turned OFF as it is incompatible with modulations like PCM/FM/FM.
- The video bandwidth must be set AFTER the bit rate has been set.
- Setting the bit rate sets the video bandwidth compatible with the bit rate.

4.3.2.21 Frequency - FR

The FR command displays and controls receiver frequency.

FR [<f>] - Sets receiver to <f> in MHz

where: <f> - Receiver frequency

P band: 200.0 to 1150.0 MHz

CT band: 1150.0 to 2500.0 MHz

C band: 4400.0 to 5250.0 MHz

70 MHz band: 70.0 to 70.0 MHz

Playback band: 0.1 to 20.0 MHz

Examples:

FR

Rx frequency 2200.500000 MHz

FR 2200.5 Set modulation to 2200.5 MHz

4.3.2.22 Advanced Help Command - HA

HA [-v] - Displays extended help for each command, if available

HA [<s>] - Searches help for <s> and displays it

Help on Help...

- Commands are tiered according to their degree of complexity/frequency of use into basic, advanced, or extended
- Basic command help can be accessed by 'H' or '?'
- Detailed help on any command is accessed by following the command with '?' such as <command> ?

Help/Command conventions:

- All commands are entered followed by 0 or more parameters.

- Each parameter is separated by one or more spaces.
- Each parameter may be either a value parameter to the command or a command control parameter that specifies the operation of the command.

<command> <parameter 1> <parameter 2> ...

- In general, a command with no parameters will display the commands associated status.

Detailed help displays follow a common convention:

- Upper case parameters indicate command control parameters that must be entered as specified:

BR M - BR command followed by the command control parameter 'M'

- Angle brackets '<' and '>' indicate value parameters. A value parameter is a variable parameter to a command. A value parameter may be either a numeric or text value, or an additional command control parameter:

FR <f> - FR command followed by the value parameter <f>

- Square brackets '[' and ']' indicate optional parameters:

MO [<m>] - MO command followed by optional value parameter <m>

- Vertical bars '|' indicate a choice of parameters:

AGC [M <m>|<e>]

AGC command followed by optional M control parameter followed by the <m> value parameter OR AGC command followed by just the <e> value parameter.

- Braces '{' and '}' indicate a required value:

DDT [P {<s>|<p>}]

DDT command followed by optional command control parameter 'P'. If the 'P' command control parameter is used it is followed by a required <s> OR <p> value parameter.

A complex example:

AGC BA [<e>|V <a>|I|O <t> [A]]

The AGC command followed by the BA command control parameter, followed by one of:

<e> value parameter

OR

the V command parameter followed by the <a> value parameter

OR

the I or O command parameter followed by the <t> value parameter followed by an optional A command parameter

4.3.2.23 IF Filter Control - IF

The IF filter control command displays and controls the filter selections.

IF filters may be set to automatic based on the bit rate or the second IF filter may be set to a value based on a filter index.

IF [A|<s>|F <f>] - Sets IF filter control

A - Sets IF filter selections to automatic based on bit-rate

<s> - Sets second IF filter to <s>

where: <s> - Filter index

The **IF A** command sets the IF filter selections to automatic based on bit rate.

IF x sets the second IF filter to one of the filter index values listed below:

- 0 - 70 kHz
- 1 - 250 kHz
- 2 - 500 kHz
- 3 - 1.0 MHz
- 4 - 1.4 MHz
- 5 - 2.0 MHz
- 6 - 3.0 MHz
- 7 - 4.5 MHz
- 8 - 6.0 MHz
- 9 - 10.0 MHz
- 10 - 14.0 MHz
- 11 - 20.0 MHz
- 12 - 28.0 MHz
- 13 - 40.0 MHz
- 14 - OPEN

IF F x sets the first IF filter to one of the filter index values below:

- 0 - 12.0 MHz
- 1 - bypassed

Examples:

IF
    Auto IF filter select enabled
    First IF filter (0) 12.0 MHz
    Second IF filter (5) 2.0 MHz
IF F 0   Sets the first IF filter to 12.0 MHz
IF 9   Sets the second IF filter to 10.0 MHz

4.3.2.24 Low Density Parity Check – LDPC

The LDPC command displays and controls Forward Error Correction settings.

LDPC [M <m>|A <t>|I <s>]

M <m> - Sets LDPC mode to <m>. LDPC mode is stored and transferred if the (waveform) Mode changes.

where: <m> - LDPC Mode

4k1 – 4k Rate 1/2

1k1 – 1k Rate 1/2

4k2 – 4k Rate 2/3

1k2 – 1k Rate 2/3

4k4 – 4k Rate 4/5

1k4 – 1k Rate 4/5

A <t> - Sets ASM threshold to <t>, 0 to 65535. This is not a stored parameter.

I <s> - Sets half iteration scale to <s>, 0.100 to 1.000

Examples:
LDPC
LDPC mode 4k Rate 2/3
LDPC decode ASM threshold 192
LDPC decode half iteration scale 0.900

LDPC A 42	LDPC decode ASM threshold 42
LDPC I .567	LDPC decode half iteration scale 0.567

4.3.2.25 Modulation Index - MI

The MI command displays and controls modulation index scale settings.

MI [<s>|M <m>|TH <h>|THE <e>|AD <d>|AS <s>|P <e>]

<s> - Sets modulation index scale to <s>, 0.350 to 8.000, this forces the mode to hold at the specified value

M <m> - Sets modulation index scale mode to <m>

where: <m> - Mode

O - Off (sets scale 1.0 for nominal deviation of 0.70)

H - Hold

A - Acquire

T - Tracking

TH <h> - Sets tracking-mode hold below Eb/N0 of <h>, -20.000 to 30.000

THE <e> - Sets tracking-mode hold below Eb/N0 enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

AD <d> - Sets acquire mode minimum delta H to <d>, 0.000 to 8.000

AS <s> - Sets acquire mode settling time to <s>, 20 to 10000 ms with a 10 ms resolution

P <e> - Sets the modulation index scale parameter (mode and H value) persistence to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

MI [TS {M <i>|T <i>|H <i>}]

M <i> - Sets modulation index trellis maximum index to <i>, 0.000 to 8.000

T <i> - Sets modulation index trellis target index to <i>, 0.000 to 8.000

H <i> - Sets modulation index trellis hysteresis to <i>, 0.000 to 8.000

Examples:

MI

Modulation index scaling mode acquire (Triggered at 27.57 Eb/N0)
Modulation index 0.701, estimated index 0.701
Tracking mode hold threshold 10.000 Eb/N0
Tracking mode hold enabled
Acquire mode delta H 0.005
Acquire mode settle time 500 ms
Operation persistence disabled

MI x	Sets mod index scale to a value between 0.350 and 8.000 and forces mode to hold at specified value
MI O	Disable Mod Index Tracking (Set to h=0.7)
MI A	Acquire mode enable
MI A D	Sets the maximum delta h (indicates a change in h defaults to 0.005)
MI A S	Sets the delta h settling time defaults to 500 ms
MI H	Hold Mod Index Tracking at current position
MI I	Sets Trellis Index
MI T	Tracking mode enable
MI T H x	Sets the Tracking Hold threshold below Eb/N0 (x) Valid range is -20.000 to 30.000

4.3.2.26 Modulation - MO

The MO command displays and controls mode settings.

MO [<m>] - Sets the demodulation mode to <m>

where: <m> - Mode

{0|PCMFM} - Pulse Code Modulation/Frequency Modulation

{1|SOQPSK} - Shaped Offset Quadrature Phase Shift Keying

{2|MhCPM} - Multi-h Continuous Phase Modulation

{3|BPSK} - Bi-Phase Phase Shift Keying

{4|QPSK} - Quadrature Phase Shift Keying

{5|AQPSK} - Asymmetrical Quadrature Phase Shift Keying

{6|AUQPSK} - Asymmetrical/Unbalanced Quadrature Phase Shift Keying

{7|OQPSK} - Offset Quadrature Phase Shift Keying

{8|UQPSK} - Unbalanced Quadrature Phase Shift Keying

{9|DPM} - Digital Phase Modulation

{11|STC} - Space Time Coding

{12|SOQPSK/LDPC} - Shaped Offset Quadrature Phase Shift Keying With LDPC

{13|STC/LDPC} - Space Time Coding With LDPC

Examples:

MO

Mode PCMFM - Pulse Code Modulation/Frequency Modulation

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 5 Set modulation to AQPSK

MO 6 Set modulation to AUQPSK

MO 7 Set modulation to OQPSK

MO 8 Set modulation to UQPSK

MO 9 Set modulation to Digital PM (DPM)

MO 11 Set modulation to Space Time Coding (STC)

MO 12 Set modulation to SOQPSK/LDPC

MO 13 Set modulation to STC/LDPC

4.3.2.27 Output Clock Measurement - OCM

The Output Clock Measurement command displays measured output clock frequency. Most of the time this is the same as the commanded bit rate but, depending on encoding/decoding and other factors, this may or may not be the commanded bit rate.

OCM - Shows measured clock rate

Example:

OCM

Component A measured datapath rate 0.999998 - commanded 0.999998
Component B measured datapath rate 0.000000 - commanded 0.000000

4.3.2.28 PCM Decoding - PDC

The PCM Decoding command displays and controls PCM digital decoder settings.

PDC [<t>] - Sets the PCM decoding to <t>

where: <t> - Decoding

NRZL - Non-return-to-zero, level

NRZM - Non-return-to-zero, mark

NRZS - Non-return-to-zero, space

RZ - Return-to-zero

BIPL - Bi-phase, level

BIPM - Bi-phase, mark

BIPS - Bi-phase, space

DMM - Delay modulation (Miller code), mark

DMS - Delay modulation (Miller code), space

M2M - Modified delay modulation (Miller squared code), mark

M2S - Delay modified modulation (Miller squared code), space

Example:
PDC
PCM decode NRZL - Non-return-to-zero, level

4.3.2.29 PCM Deframing - PDF

The PCM Deframing command displays and controls PCM Deframing settings.

PDF [<f>] – Shows the PCM deframing display in format <f>

where: <f> - Format (last used, if not specified)

N - Normal

C - CSV

PDF [<e> [-h][<f>][<r>]] - Sets PCM deframing tracking display enable to <e> in format <f> at rate <r>

where:

<e> - Enable

0 - Disabled

1 - Enabled

<f> - Format (last used, if not specified)

N - Normal

C - CSV

<r> - Display rate <r>, 100 to 60000 ms (500 ms if not specified)

Options:

-h - Do not display header

PDF [HEAD <f>] - Shows the system status header in format <f>

where: <f> - Format

N - Normal

C - CSV

PDF [CNT <e>|R]

[CNT <e>] – Sets the Frame count enable

where:

<e> - Enable

0 - Disabled

1 - Enabled

[CNT R] – Resets frame counts

PDF [A <e>]

A <e> - Sets automatic frame detection enable to <e>

where:

<e> - Enable

0 - Disabled

1 – Enabled

PDF [MA <l>|MI <l>]

MA <l> - Sets the major frame length to <l>, 1 to 256 minor frames

MI <l> - Sets the minor frame length to <l>, 1 to 16384 bits

PDF [FS <p>|OS <l>]

FS <p> - Sets the frame synchronization pattern to <p> in binary where:

<p> - Pattern; single binary string or multiple binary triplets

Example:

Single binary string - 1110101110010000

Multiple binary triplets - 111 010 111 001 000 0

OS <l> - Sets the frame synchronization pattern to be optimum for <l> bits, 16 to 33

PDF -V ? - Show optimum synchronization patterns

PDF [DM <m>] - Sets the PCM frame discard mode to <m>

where: <m> - Mode

N - Discard none

FH - Discard minor frame header

FI - Discard minor frame header and ID

PDF ME [A|<e>] - Sets maximum number of synchronization bit errors to <e>, 0 to 64 or A for automatic

PDF [WL <l>|LT <t>|UT <t>]

WL <l> - Sets the synchronization window length <l>, 0 to 15 bits

LT <t> - Sets the 'lock' threshold to <t> consecutive good frames, 1 to 16

UT <t> - Sets the 'unlock' (search) threshold to <t> consecutive bad frames, 1 to 16

4.3.2.30 Receiver Channel Parameters

Six of the listed commands, PER, PERA, PLD, PRS, PSV, and RFD operate within the following constraints.

There are two forms the receiver channel parameters take. One is the current operating parameter set that controls the operation of the receiver brick and the other is the stored parameter set.

The current operating parameters are volatile in nature in that when the power is removed, the parameters are lost. The stored parameters are saved in FLASH memory in the receiver brick. When the receiver brick is turned on, the stored parameters are loaded into the current operating parameter set.

Parameters in the current operating parameter set can be changed without affecting the stored parameter set. When the receiver brick is powered down, current operating parameters go away and when powered on, the stored parameter set becomes the current operating parameter set.

4.3.2.30.1 Parameters Erase - PER

The Parameters Erase command erases the stored parameter set for the current mode. It has no impact on the current operating parameter set. If the receiver brick is power cycled, the current operating parameter set is set to defaults.

Example:

PER

Erasing parameter data... ok

4.3.2.30.2 All Parameters Erase - PERA

The Parameters Erase command erases the stored parameter set for all modes. It has no impact on the current operating parameter set. When the receiver brick is power cycled, all operating parameters set are set to defaults.

Example:

PERA

Erasing parameter data... ok

4.3.2.30.3 Parameter Load - PLD

The Parameter Load command loads the stored parameter set into the current operating parameter set.

Example:

PLD

Loading parameter data... ok

4.3.2.30.4 Parameter Reset - PRS

The Parameter Reset command resets the current operating parameter set to the defaults. This does not affect the stored parameter set.

Example:

PRS

Initializing parameter data... ok

4.3.2.30.5 Parameters Save - PSV

The Parameters Save command writes the current operating parameter set into a (previously erased) stored parameter set.

Example:

PSV

Saving parameter data... ok

4.3.2.30.6 Reset to Factory Defaults - RFD

The Reset to Factory Defaults command erases the stored parameter set for ALL modes then resets the current operating parameter set to the defaults including mode (it changes to the default mode).

Example:

RFD

WARNING: ALL CONFIGURATION PARAMETER DATA IS ABOUT TO BE ERASED!!

THIS CANNOT BE UNDONE!!

Enter "YES" to continue!$

Aborted

4.3.2.31 Power Level - PL

The PL command reports or sets the current input power level setting.

PL [<t>|C <m>|H <e>|S <s>|P <p>|M <t>|F <e>]

<t> - Sets power level information tracking display to <t>

where: <t> - Enable

0 - Disabled

1 - Enabled

C <m> - Sets power level control mode to <m>

where: <m> - Mode

F - Fixed scale

A - Automatic leveling

H <e> - Sets automatic leveling hold to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

S <s> - Sets the fixed scale to <s>, -48.16 to 24.08 dB

P <p> - Sets automatic leveling target to <p>, -32.15 to 16.01 dBm

M <t> - Sets power level measurement to <t>

where: <t> - Type

T - Total power

S - Signal power

F <e> - Sets power filtering to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

Examples:

PL

Input dBm	Atten dB	Signal dBm	Adj dBm	Eb/N0 dB	Saturation
60.48	59.750	-3.43	13.03	27.30	0

Power leveling automatic
Power leveling active
Power level target power 13.00 dB
Power level scale 0.00 dB
Power level measurement signal only
Power level filtering enabled

PL 0 Set the current power level information tracking display to Off

PL 1 Set the current power level information tracking display to On

PL C A - Sets power level automatic control mode

Examples:

PL C A 0 Set the power level automatic control mode to Software

PL C A 1 Set the power level automatic control mode to Hardware

PL F - Sets the average and adjusted power level filter coefficient

Example:

PL F 5 Set the power level filter coefficient to 5
Valid range is 1 to 16

PL M - Sets the power level measurement type

Examples:

PL M 0 Set the power level measurement type to Total Power

PL M 1 Set the power level measurement type to Signal Power

PL S - Sets the power level scale value

Example:

PL S 2.517 Set the power level scale value to 2.517
Valid range is 0.000 to 7.996

4.3.2.32 Phase Noise Compensation - PNC

The PNC command reports or sets the phase noise compensation state.

Examples:

PNC

Phase noise compensation off

PNC 0 Set phase noise compensation to Off

PNC 1 Set phase noise compensation to On

4.3.2.33 Query Temperature - QT

The Query Temperature command reports the temperature in degrees Celsius.

Example:

QT

FPGA temperature: 41.0°C (85°C Max)

Demod temperature: 43.0°C (85°C Max)

4.3.2.34 Signal Degradation Information - SDI

The Signal Degradation Information command sets and displays a variety of signal degradation information settings.

SDI [<e>|T <e>|S <s>|P <p>|L <l>|IT <t>|ET <t>]

<e> - Sets the SDI enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

T <e> - Sets the SDI tracking display enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

S <s> - Sets the SDI data source to <s>

where: <s> - Data source

P0 - Physical input 0

P1 - Physical input 1

CMB - Combiner

P <p> - Sets source polarity to <p>

where: <p> - Polarity

{0|+} - Active high (normal)

{1|-} - Active low (inverted)

L <l> - Sets lock state to <l>

where: <l> - Lock state

0 - Normal operation

1 - Forced active

-1 - Forced inactive

I <t> - Sets internal threshold to <t>, 0 to 65535, or A for automatic

E <t> - Sets external threshold to <t>, 0 to 65535, or A for automatic

Examples:

SDI

SDI enabled
SDI datasource Physical input 0
Lock is normal
SDI lock is inactive

	Polarity - High (+)
	SDI internal threshold automatically set to 32768
	SDI external threshold automatically set to 403
SDI 0	Disable SDI
SDI 1	Enable SDI

SDI E - Sets signal degradation information external threshold

Examples:

SDI E A	Set SDI external threshold to automatic
SDI I 1943	Set SDI external threshold to 1943
	Valid range 0 to 65535

SDI I - Sets signal degradation information internal threshold

Examples:

SDI I A	Set SDI internal threshold to automatic
SDI I 4242	Set SDI internal threshold to 4242
	Valid range 0 to 65535

SDI L - Sets signal degradation information lock state

Examples:

SDI L 0	Set SDI lock state to normal operation
SDI L 1	Set SDI lock state to forced active
SDI L -1	Set SDI lock state to forced inactive

SDI P - Sets signal degradation information source polarity

Examples:

SDI P 0	Set SDI source polarity to active high (normal)
	Valid active high 0 or +
SDI P 1	Set SDI source polarity to active low (inverted)
	Valid active low 1 or -

SDI S - Sets signal degradation information source

Examples:

SDI S P0	Set SDI data source to Physical Input 0
SDI S P1	Set SDI data source to Physical Input 1
SDI S CMB	Set SDI data source to Combiner

SDI T - Sets signal degradation information tracking display enable or disable parameters

Examples:

SDI T 0 Disable SDI tracking display

SDI T 1 Enable SDI tracking display

4.3.2.35 Spectrum Inversion - SI

The SI command displays and controls receiver spectrum inversion.

SI [<e>]

where: <e> - Enable

0 - Disabled

1 - Enabled

Example:

SI

Spectrum inversion is disabled

4.3.2.36 Show Serial Number - SN

The SN command displays the part number and serial number for the connected RDMS™.

Example:

SN

Part Number: QSX-RDMS-3R1D-A1-1311-00-14-K7-EQ

Customer Model: CHANNEL 1

Serial Number: 2091

Hardware Rev:

4.3.2.37 Save Parameters - SV

The Save Parameters command erases the stored parameter set and writes the current operating parameter set into the stored parameter set in a single command.

Example:

SV

Saving parameter data... ok

4.3.2.38 Sync Detect - SYNC

The Sync Detect command displays and controls sync detect settings. The SYNC detect subsystem does not support fixed patterns.

SYNC <e> - Sets sync detect enable to <e>

where: <e> - Enable

0 - Disabled

1 - Enabled

Example:

SYNC

Sync detect inactive at 50.085 %
Sync detect disabled
Sequence is PN15
Sync detect window length 4095 bits
Sync detect threshold 99.000 %
Sync detect display tracking disabled

SYNC [D <e> [<r>]

<e> [<r>] - Sets sync detect tracking display enable to <e> at rate <r>

where:

<e> - Enable

0 - Disabled

1 - Enabled

<r> - Display rate <r>, 100 to 60000 ms

Example:

SYNC D 0	Disable sync detect tracking display
SYNC D 1	Enable sync detect tracking display

SYNC [P <n>]

Sets sync detect pattern to PN sequence <n>

where: <n> is PN sequence PN6, PN9, PN11, PN15, PN17, PN20, PN23, or PN31

Examples:

SYNC P PN6	Set sync detect pattern to PN6

SYNC [L <l>|T <t>]

[L <l>] - Sets sync detect window length to <l>, 1 to 4095 bits

[T <t>] - Sets sync detect correlation threshold to <t>, 0.000 to 100.000 percent

Example:

SYNC L 317	Set sync detect window length to 317 Valid range is 1 to 4095 bits

SYNC T - Sets sync detect correlation threshold

Example:

SYNC T 35 Set sync detect correlation threshold to 35 percent

Valid range is 0.000 to 100.00 percent

4.3.2.39 System Status Tracking - SYS

The SYS command displays system status.

SYS [<e> [<r>]] - Sets system status tracking display enable to <e> at rate <r>.

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 output.

where:

<e> - Enable

0 - Disabled

1 - Enabled

<r> - Display rate <r>, 100 to 60000 ms

Examples:

SYS

System status display tracking disabled

Input dBm Eb/N0 dB AFC kHz BR Mb/s L Avg DQM TED Q mu Avg TRL MI

-108.18 -45.15 0.178 0.998965 2.044e-01 -0.000979 1.914 1.614#

SYS 5 Sets status output period to 5 milliseconds

SYS 5 100 Sets status header output once every 100 status updates

4.3.2.40 Time of Day - TOD

The Time of Day command displays and sets the current calendar date and time of day values. This is primarily used to add a hard reference to the BERT (BER command) output. It is volatile and *must be reset after every power cycle or mode change*.

TOD [[mm/dd/yyyy] [hh:mm[:ss]]

where:

mm - Month 1 - 12

dd - Day of month 1 - 31

yyyy - Year

hh - Hour 0 - 23

mm - Minutes 0 - 59

ss - Seconds 0 = 59

Examples:

TOD

10/16/2015 14:34:06

Friday, October 16, 2015 02:34:06 PM

TOD 10/16/2015 14:34:00

4.3.2.41 Show Options - UP

The Show Options command displays unit parameter settings.

Example:

UP

Part Number: QSX-RDMS-3R1D-A1-1311-00-14-K7-EQ

Customer Model: CHANNEL 1

Serial Number: 2091

Hardware Rev:

Revisions options: None

Configured as receiver with IF SAW filters

1 channel

Housing is rack mount, IF input, TTL output

Enabled extended bands:

P band: 200.0 to 1150.0 MHz

CT band: 1150.0 to 2500.0 MHz

C band: 4400.0 to 5250.0 MHz

70 MHz band: 70.0 to 70.0 MHz

Playback band: 0.1 to 20.0 MHz

Enabled modes:

PSK

MHCPM

SOQPSK

STC

PCMFM

Pin out:

00 - Standard

Options:

EQ - Adaptive Equalizer

14 - 14 SAW Filters

K7 - Viterbi decode (k = 7 rate = 1/2)

4.3.2.42 Version - VE

The Version command displays the current application, FPGA, and adaptive equalizer versions.

Example:

VE

```
PCMFM App Rev: 1.0.7.137  Sep 18 2015 13:49:13
PCMFM FPGA Rev: 0000102A   Sep  9 2015 19:19:51
AEQ Rev: 1.0.5      Sep  9 2015 19:13:52
```

5 Performance Specifications

5.1 DC Input

The Compact RDMS™ operates from a nominal 28 VDC, +/- 4 VDC with a current consumption of no more than 25 Watts.

5.2 RF Frequency Error

By default, the Compact RDMS™ is capable of acquiring a signal with a frequency error of up to ±100 kHz.

5.3 Bit Error Rate

The RDMS™ meets the following BER limits, when tested with a signal source, which complies with IRIG 106-17.

Table 8: RDMS BER Specifications

BER	Maximum E_b/N_0 (dB)		
	PCM/FM, Tier 0	SOQPSK-TG, Tier I	Multi-h CPM, Tier II
10^{-3}	7.5	9.5	11.0
10^{-4}	9.0	11.5	12.5
10^{-5}	10.0	13.0	13.5
10^{-6}	11.0	14.5	14.5

Typical BER performance, plotted in Figure 9, is significantly superior to that tabulated above.

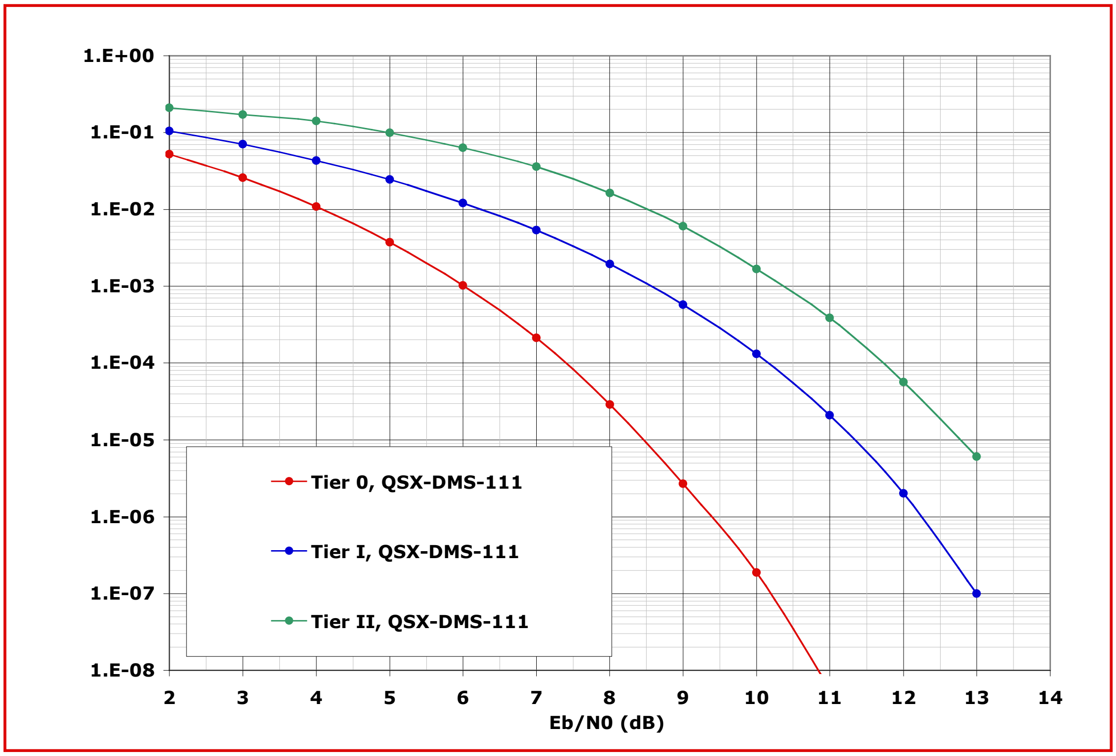


Figure 9: BER Performance for Tier 0, I, and II

5.4 Synchronization

The Compact RDMS™ offers very fast, reliable acquisition, even at very low signal to noise ratio. Synchronization time is a function of modulation type and IF frequency error. Typical SOQPSK results (from 10,000 synchronization trials) are shown in Figure 10.

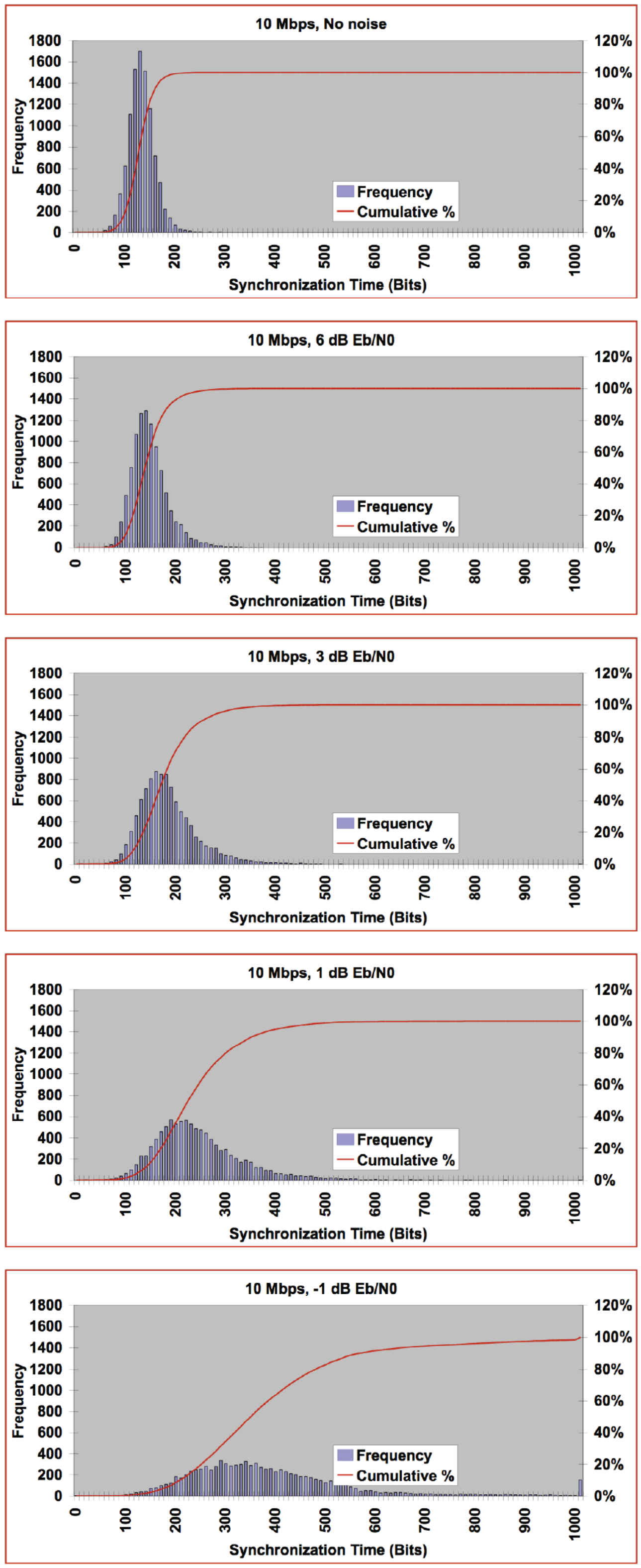


Figure 10: Synchronization Time at Various Signal-to-Noise Ratios

6 IF Module

The receiver's integrated IF filter module, shown in Figure 11, includes eight (8) SAW filters, ranging in bandwidth from 250 kHz to 40 MHz in approximately one octave steps. The standard eight filters are 250 kHz, 500 kHz, 1 MHz, 2 MHz, 4.5 MHz, 10 MHz, 20 MHz, and 40 MHz. These filters serve as anti-aliasing filters ahead of the A/D converter in the demodulator itself. In addition, they can provide an added measure of adjacent channel interference rejection. The measured responses of the eight filters are shown in Figure 12 and Figure 13 (note the change of horizontal scale between the two figures).

Six additional filters are available allowing for a total of 14. The optional filters are 70 kHz, 1.4 MHz, 3 MHz, 6 MHz, 14 MHz, and 28 MHz. The measured responses of the optional filters are shown in Figure 14 and Figure 15. Contact Quasonix for information about the optional filters.

Based on the receiver's high level of integration, the proper IF filter is automatically selected based on the current mode and bit rate settings of the demodulator. Although manual filter selection is available, it is not recommended.

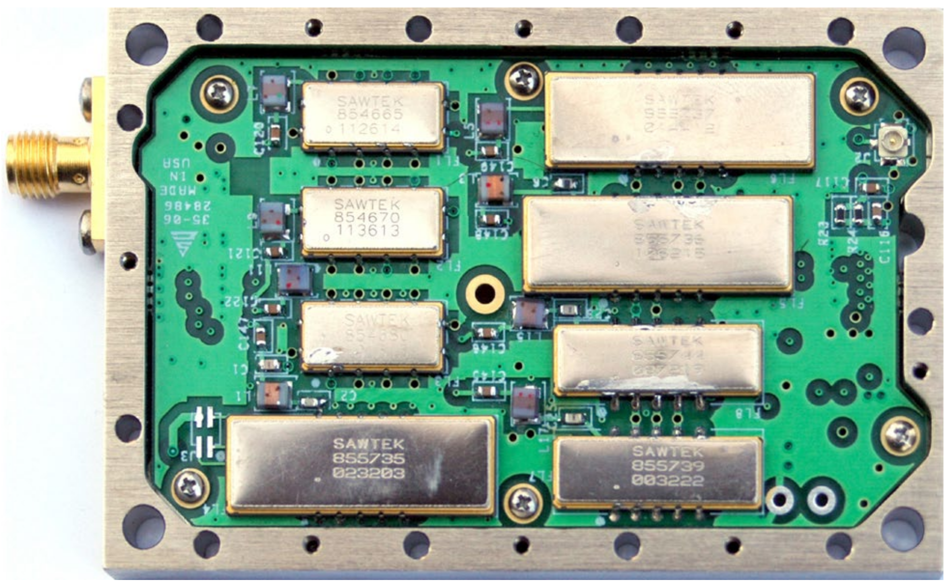


Figure 11: 70 MHz IF Module in 2" x 3" Chassis

The IF module attaches directly to the demod modules.

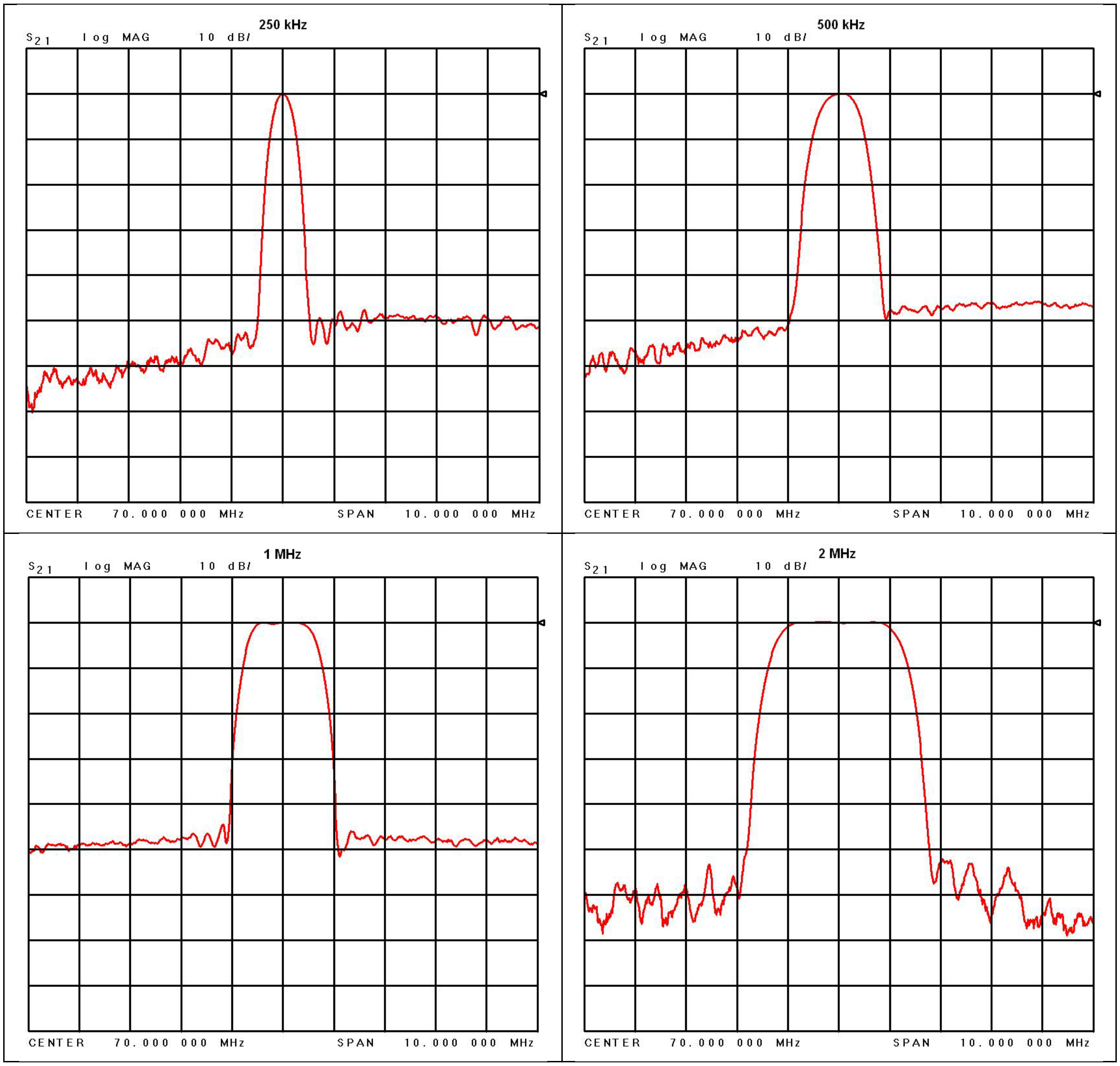


Figure 12: 70 MHz IF Module in 2” x 3” Chassis SAW Filter Responses, Narrow Group (10 MHz Span)

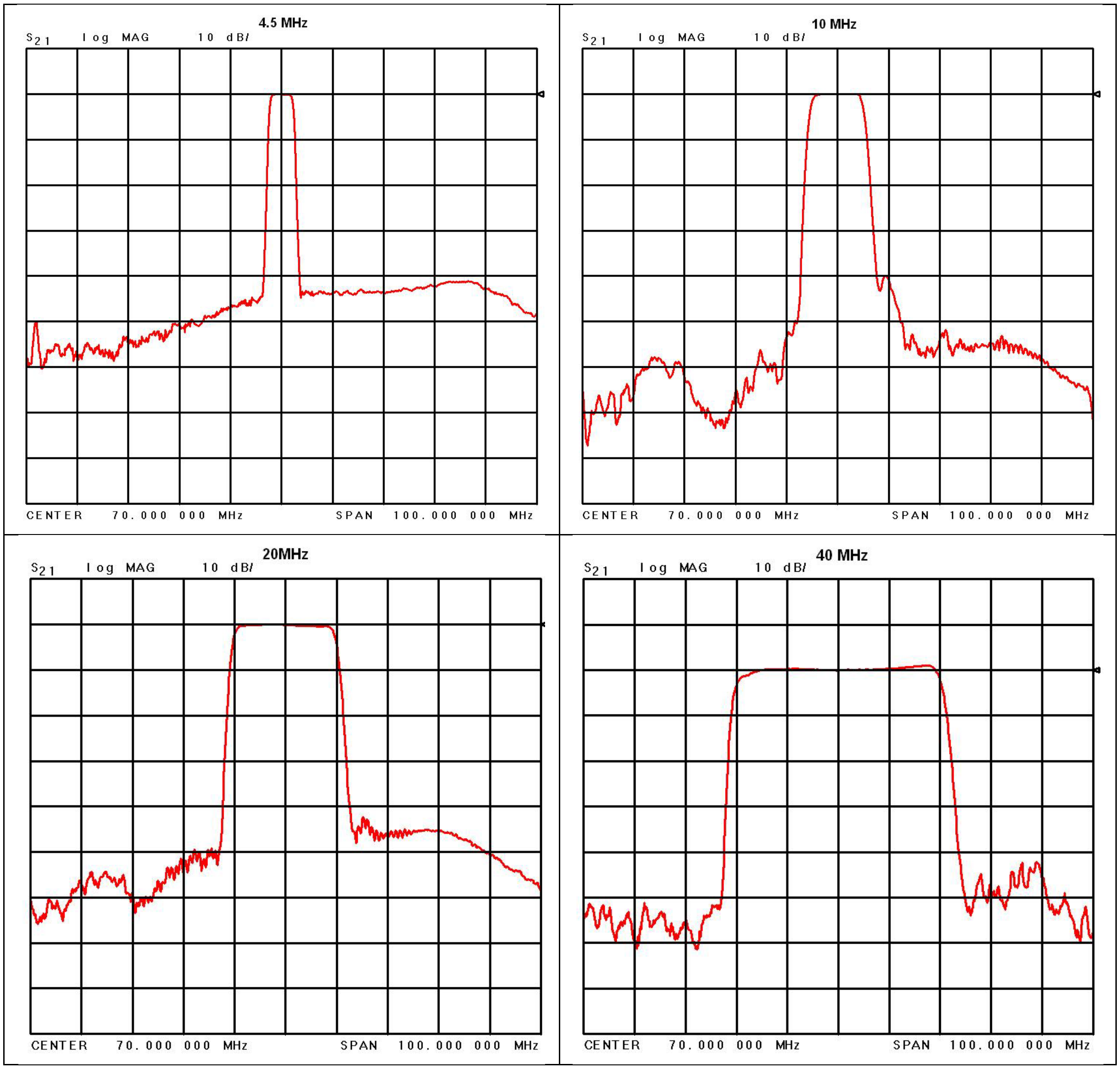


Figure 13: SAW Filter Responses, Wide Group (Plotted on 100 MHz Span)

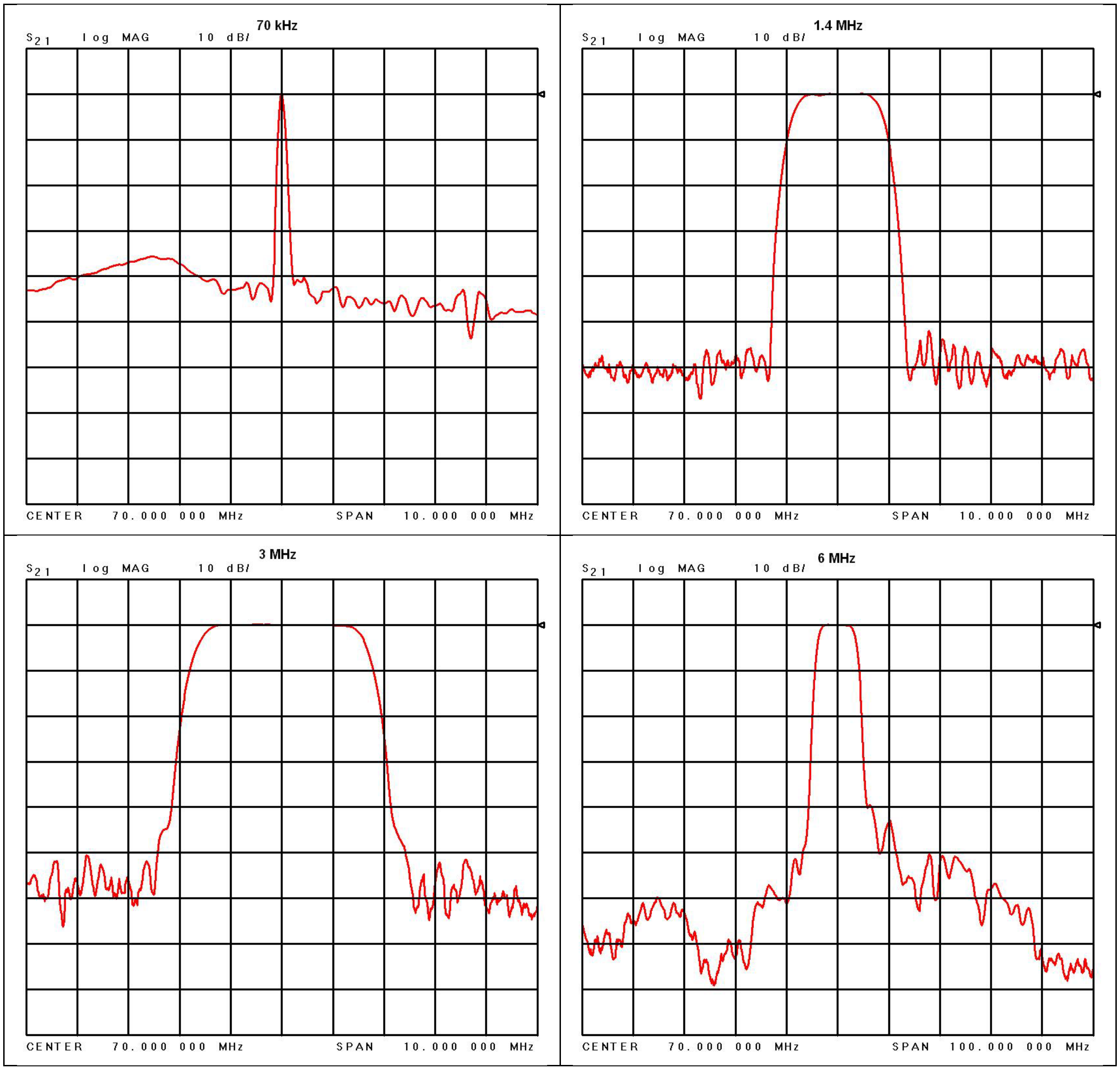


Figure 14: Optional SAW Filter Responses for 70 kHz to 6 MHz

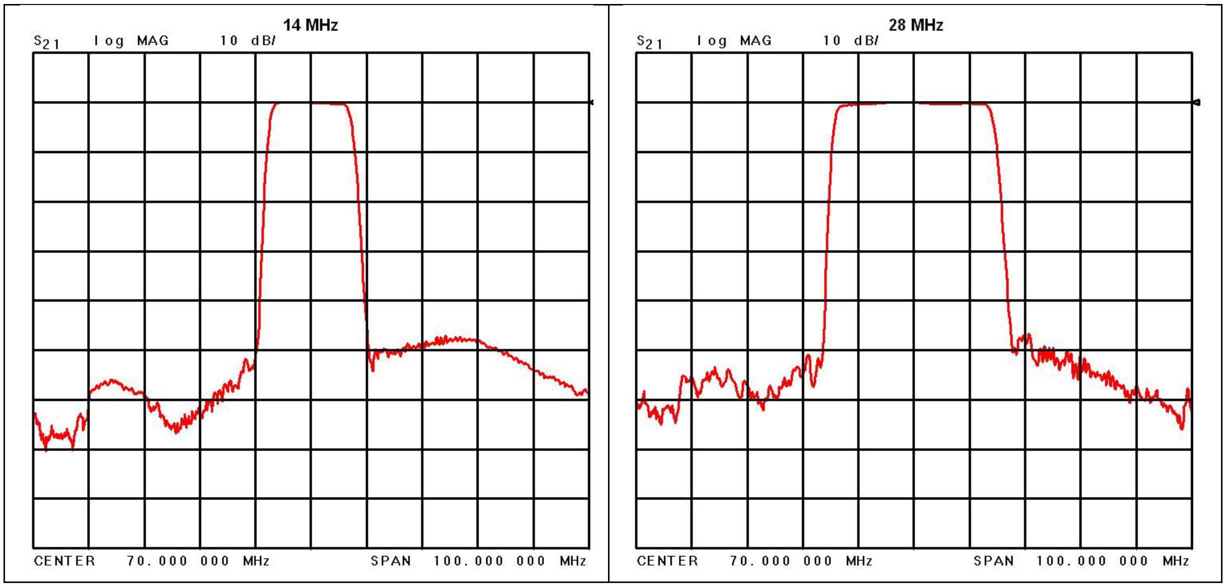


Figure 15: Optional SAW Filter Responses for 14 MHz and 28 MHz

7 Maintenance Instructions

The Compact RDMS™ requires no regular maintenance, and there are no user-serviceable parts inside. Please consult the factory for any maintenance, upgrade, or repair requirements.

8 Product Warranty

The Compact RDMS™ 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.

052217mbb002

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 – Pinouts for Optional 37 Pin Connector

The optional 37-pin connector provides three sets of clock and data, two high-speed analog outputs, and one low-speed analog output. Pin assignments are detailed in the following documents located on the Quasonix web site.

https://www.quasonix.com/files/compact-receiver-pinout-c37-00.pdf

https://www.quasonix.com/files/compact-receiver-pinout-c37-04.pdf

An example of a Quasonix pinout document is shown in Figure 16.

Quasonix

RECEIVER PINOUT CODE Cxx-xx

Connector: Male MDM-37

Pin	Function	Description
1	High Speed DAC B	+/- 5V, 35 MHz
2	High Speed DAC A	+/- 5V, 35 MHz
3	High Speed DAC C	+/- 5V, 35 MHz
4	DAC Ground	Analog output (GND)
5	AM Out	+/- 5V, 50 kHz
6	Low Speed DAC A	+/- 5V, 50 kHz
7	DC Power In	Primary 28 V DC power to module
8	DC Power Return	Primary power return, 2 amps maximum; Internally tied to pins 9, 12, and 27
9	DC Power Return	Primary power return, 2 amps maximum; Internally tied to pins 8, 12, and 27
10	Differential Clock Positive	Primary TTL clock output, Clock+ for RS-422 output
11	Differential Data Positive	Primary TTL clock output, Data+ for RS-422 output
12	Serial Control Ground	Ground return for RS-232 control lines; Internally tied to pins 8, 9, and 27
13	Lock Detect	LVTTL lock detector output for all modes
14	Serial Control Reply from Receiver	RS-232 responses to host controller
15	Differential Clock B Positive	Secondary TTL clock output, Clock+ for RS-422 output

Example

DRAWING	RX_PC_C37-00_REV A.docx		
REVISION	A		
DRAWN	MRE	DATE	02-11-2025
VERIFIED	RS	DATE	02-14-2025
APPROVED	RS	DATE	02-14-2025

No part of the document may be circulated, quoted, or reproduced for distribution without prior written approval from Quasonix, Inc.

Copyright Quasonix, Inc., All Rights Reserved.

Figure 16: Example Quasonix Pinout Drawing

11 Appendix B –Recommended AM and AGC Settings for ACU Interfaces

11.1 AM and AGC

In a typical flight test scenario, Automatic Gain Control (AGC) tracks out slow variations in received signal strength. Ideally, the net received signal has constant signal strength except for higher-frequency amplitude modulation (AM) induced by the antenna tracking mechanism. If the antenna system uses conical scan, sinusoidal AM is induced by physical motion of the antenna feed. If the antenna system uses e-scan, square-wave AM is induced by switching between antenna elements.

The receiver demodulates the AM on the received signal and provides it to the antenna control unit (ACU). From the magnitude and phase of this AM signal, the ACU detects and corrects pointing error.

11.2 AM AGC Compensation

In some systems, vehicle rotation or other dynamics can induce additional undesired low-frequency AM. If the frequency of this undesired AM is close enough to the scan rate, the AGC will not track it out. Worse, inherent lag in the AGC may result in severe distortion of the desired AM.

AGC Compensation adjusts the AM output to neutralize these effects. This allows the AGC to fully track out undesired AM at frequencies just below the antenna scan rate. However, the compensation adds a large amount of delay to the AM output, proportional to the AGC time constant. This delay may make antenna tracking difficult or impossible. Therefore, AGC Compensation should only be enabled when:

- The antenna tracking system experiences degradation due to undesired AM at roughly 1/20 to 1/2 the antenna scan rate
- The added compensation delay on the AM signal does not cause the antenna tracking loop to become unstable; this can only be verified on a case-by-case basis

11.3 Recommended Settings

Recommended AM and AGC settings depend on three primary parameters: antenna scan type (conical or e-scan), antenna scan rate, and whether the system is subject to undesired low-frequency AM (refer to section 11.2). Table 9 describes recommended settings based on these parameters:

Table 9: Recommended AM/AGC Settings

Antenna Scan Type	Undesired Low Frequency AM?	AGC Time Constant (ms, 0.1 to 1000)	AM Bandwidth (Hz, 5 to 50,000)	AGC Compensation
Conical scan	No	1000 / ScanRate	5 * ScanRate	OFF
Conical scan	Yes	850 / ScanRate	5 * ScanRate	ON
E-scan	No	1000 / ScanRate	10 * ScanRate	OFF
E-scan	Yes	850 / ScanRate	10 * ScanRate	ON

In Table 9, ScanRate is the antenna scan rate in Hz.

For example, suppose a conical scan system with no undesired low-frequency AM has a scan rate of 30 Hz. This system has a recommended AGC Time Constant of 1000 / 30 = 33.3 ms, and an AM Bandwidth of 5 * 30 = 150 Hz, with AGC Compensation OFF.

The AGC Time Constant should *never* be set lower than recommended. Setting the AGC Time Constant higher is unlikely to affect performance, though it may degrade performance if vehicle dynamics cause relatively rapid changes in received signal strength.

The AM Bandwidth may be set lower to reduce noise on the AM signal, or higher to reduce delay on the AM signal. At the recommended settings, AM phase delay is approximately 30 degrees for typical conical scan and e-scan scan rates.

If AGC Compensation is enabled, the AGC Time Constant and AM Bandwidth should both be set only as indicated in Table 9.

12 Appendix C – Phase Noise Compensation

12.1 Trellis Demodulation Basics

Legacy Single-Symbol Detection:

- Uses basic Limiter-Discriminator operation
- Frequency in this bit above nominal → data = 1
- Frequency in this bit below nominal → data = 0
- Makes no use of adjacent symbols for error correction

Trellis Detection:

- Uses the phase tree for data detection
- Uses adjacent symbols to help decide on "iffy" bits
- Improves BER performance by 3.5 to 5.0 dB

The Phase Tree shown in Figure 17, shows all of the possible paths the phase trajectory can take over a period of seven bits. Figure 18 shows the two unique paths, based on whether the second bit is a 1 or 0.

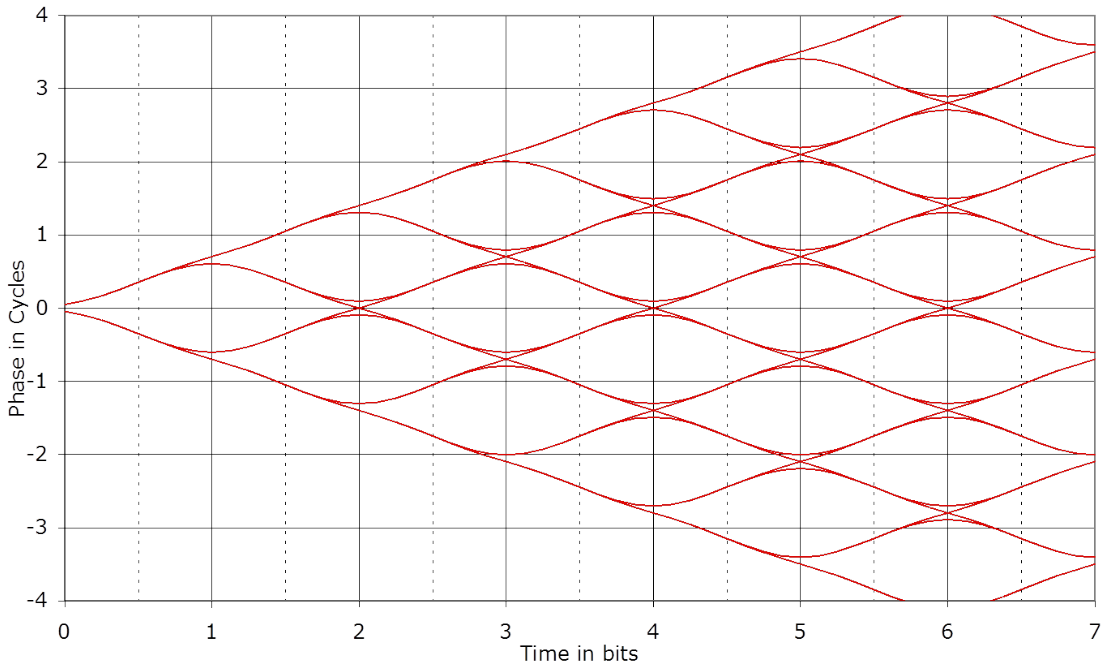


Figure 17: Ideal PCM/FM Phase Tree (h = 0.7)

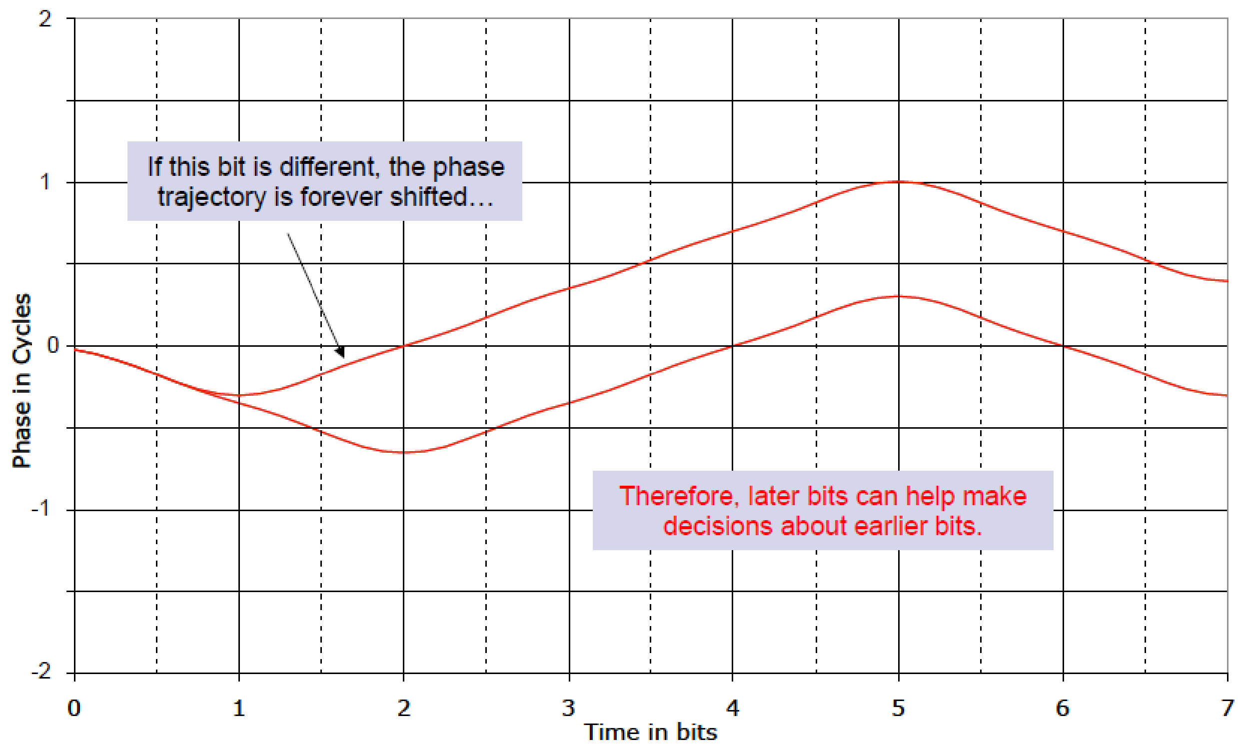


Figure 18: Phase Trajectory Never Forgets

12.1.1 Trellis Demodulation Summary

The basic premise of trellis demodulation is that the signal from the transmitter follows a known path through the phase tree. When the demodulator knows this, it can use a sequence of several symbols to help make better decisions about each individual bit. This process improves BER performance by about 3.5 to 5 dB over conventional FM detection. However, this assumes that the transmitter is really following the "known" and "correct" phase tree, and this assumption is NOT always true.

High phase noise can reduce the trellis detection gain because phase noise corrupts the tree. The following figures illustrate the differences in trellis detection gain depending on the amount of phase noise introduced.

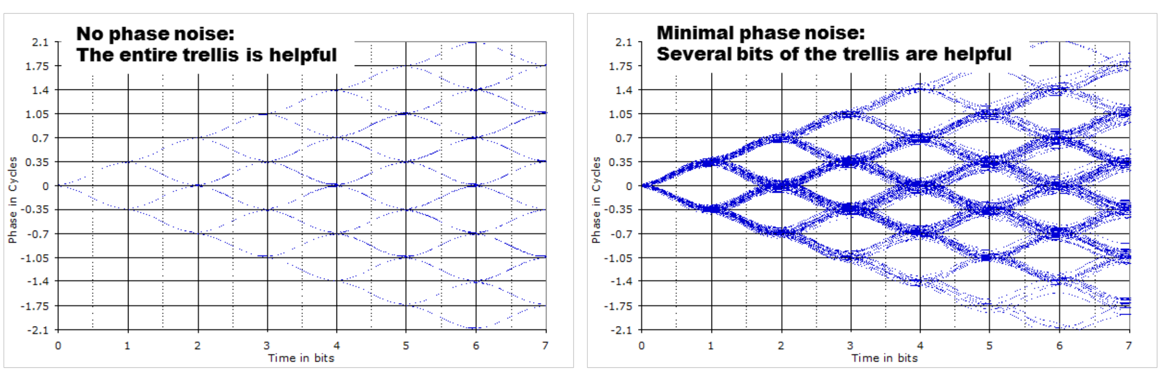


Figure 19: Trellis Detection Gain with Zero to Minimum Phase Noise

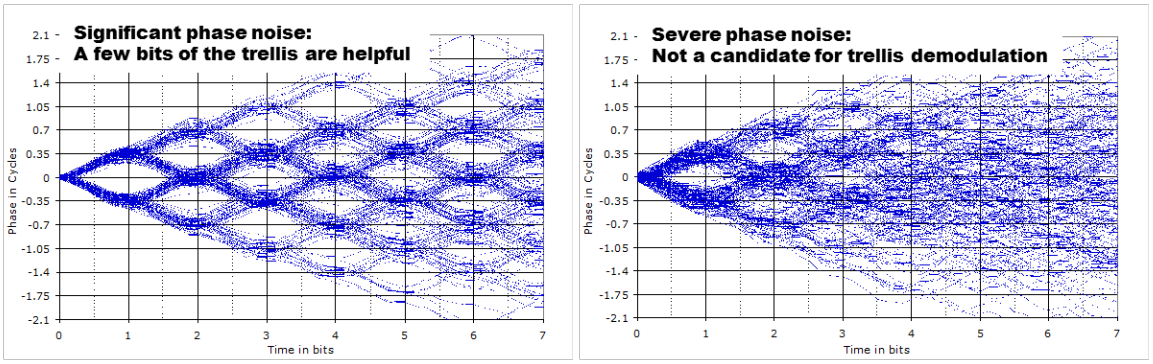


Figure 20: Trellis Detection Gain with Significant to Severe Phase Noise

12.2 Phase Noise Impact

Trellis demodulation is based on the assumption that the signal is following a predictable path through the trellis. If this is not true (due to high phase noise), then a trellis demodulator cannot provide the expected performance gain.

- Many legacy analog transmitters (a simple modulated VCO) have high phase noise.
- Vibration often further increases phase noise.
- Phase noise is generally more damaging at low bit rates.
- Phase Noise Compensation (PNC) gives back some of the trellis detection gain, by shortening the trellis observation span.

12.3 Clock Jitter Impact

Many older PCM encoders are susceptible to large inaccuracies in clock rate or have clock stability issues, especially under harsh vibration conditions. While the RDMS is capable of tracking static clock rate errors as large as 1000 ppM, excessive jitter causes the integrated bit sync to lose lock. Enabling the PNC mode opens the tracking loop bandwidth to accommodate for these issues. This increase in bandwidth does have a tradeoff. A wider tracking range allows the RDMS to deal with the additional jitter, but it may also increase synchronization times slightly, and slightly increase the minimum SNR at which the RDMS declares lock.

12.4 When to Use PNC

There is no bullet-proof test for whether PNC is needed, but there are good indicators. Turn on PNC if:

- The demodulator is struggling to lock, even with good Signal to Noise Ratio (SNR). ("Good" SNR means the Quality bar is above one-quarter height.)
- The eye pattern NEVER looks “clean,” as in Figure 21
- Symptoms get worse when the transmitter is under vibration
- Symptoms get worse at low bit rates

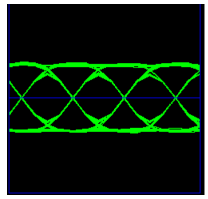


Figure 21: "Clean" Eye Pattern

12.5 Know Your Transmitter

If you know the brand and type of transmitter, these tips can help determine when to use PNC.

If your transmitter was manufactured by these companies, PNC should be OFF:

- Quasonix – guaranteed
- Nova Engineering – highly likely
- L3 – probably, but digital transmitters only

If the transmitter was manufactured by the companies below, PNC should be ON:

- Microwave Innovations
- Emhiser
- Southern California Microwave
- L3 (analog transmitters)

13 Appendix D - PCM Framer/Deframer Function

Quasonix RDMS™ receivers recognize PCM frames as defined by IRIG 106-17 Chapter 4 and Appendix 4-A. The receiver can provide basic processing of a large subset of possible frame configurations, including sync word detection, subframe ID checking, and data extraction from the frame structure (without decommutation). Within the receiver, this functionality is referred to as the PCM Deframer.

To facilitate testing the PCM Deframer, Quasonix Receiver Analyzers can generate PCM frames using external (user) data or internal test patterns for the frame payload. Within the Receiver Analyzer, this functionality is referred to as the PCM Framer.

This note describes the detailed capabilities of the PCM Framer and Deframer.

13.1 PCM Framer

The PCM Framer supports fixed-length PCM frame generation with the following parameters:

- Major frame length up to 256 minor frames
- Minor frame length up to 16,384 bits
- Minor frame sync pattern 16 to 33 bits (user-selectable pattern and length)
- Optional subframe ID (SFID) insertion (word 1 position only)

The resulting PCM frame format appears as:

Minor Frame Maximum Length, N Words or B Bits

Class I: Shall not exceed 8192 bits nor exceed 1024 words

Class II: Shall not exceed 16,384 bits

	Word 1	Word 2	Word 3		Word N-1
Minor Frame Sync Pattern	SFID = 1	Data 1	Data 2	• • •	Data N-2
Minor Frame Sync Pattern	SFID = 2	Data N-1	Data N		Data 2N-4
Minor Frame Sync Pattern	SFID = 3	Data 2N-3	Data 2N-2		Data 3N-6
		⋮			⋮
Minor Frame Sync Pattern	SFID = Z	Data (Z-1)(N-2)+1	Data (Z-1)(N-2)+2	• • •	Data (Z-1)(N-2)+N-2

Figure 22: Frame Format with SFIC Insertion Enabled

*Major Frame Length = Minor Frame Maximum Length multiplied by Z

The PCM Framer uses serial streaming data, either from an external source or an internal pattern generator, to fill the data portion of the frame. There is no mechanism to align specific sets of serial bits to Data words, and there is no mechanism to align specific data words to a given position within the frame format. Therefore, the PCM Framer cannot generate frames with data parameters suitable for decommutation. It can, however, be used to test frame synchronization and link quality via SFID verification. Further, if the serial streaming data is a known pattern, the data can be monitored by a BERT at the receiving end after data extraction.

13.2 PCM Deframer

The PCM Deframer supports **fixed-length** PCM frame recognition with the following parameters:

- Major frame length up to 256 minor frames
- Minor frame length up to 16,384 bits
- Minor frame sync pattern 16 to 33 bits (user-selectable pattern and length)
- Optional subframe ID (SFID) checking (word 1 position only)

Acquisition of PCM frame lock takes place according to the process recommended by RCC 119 Section 4.6. There are four settable parameters that are used to configure acquisition and re-acquisition:

- CORR_APERTURE – Number of bits, early or late, that the sync pattern may appear relative to other detected sync patterns and still be detected
- CORR_THRESH – Number of bits of the sync pattern that must match to declare sync pattern detect
- LOCK_THRESH – Number of valid sync pattern detects required to declare PCM frame lock
- SEARCH_THRESH – Number of invalid sync pattern detects required to declare loss of PCM frame lock (once locked)

The PCM Deframer acquires frame lock using the following states:

- Search – Detect sync pattern if correlation of any set of bits exceeds CORR_THRESH
- Check – Declare PCM frame lock if valid sync pattern appears LOCK_THRESH consecutive times
- Lock – Maintain PCM frame lock until invalid sync pattern appears SEARCH_THRESH consecutive times

SFID checking occurs whenever PCM frame lock is detected. The SFID is expected to be located in the first word after the sync pattern, as shown in Figure 22, and it is considered valid if it is one greater than the previous SFID, or if it is 1 and the previous SFID was Z (the major frame length).

The PCM Deframer cannot be programmed to perform decommutation. It can, however, optionally strip the sync pattern and SFID (if present) to leave only the frame data. If the fame data is a known pattern, it can be monitored by a BERT to measure link performance.

The RDMS™ receiver can output PCM frame lock and/or SFID valid indications on the DEMOD_LOCK and/or SYNC_DETECT back-panel outputs.

14 Appendix E – Factory Reset Values

When a reset command is activated, the frequency defaults to the lowest valid frequency for the lowest authorized band on the unit. The reset priority is:

1. PCM/FM
2. SOQPSK
3. Multi-h CPM
4. QPSK

Reset values for each mode are listed in the following tables.

The default Frequency is 2200.000 MHz.

Table 10: PCM/FM Factory Reset Values

Parameter	Reset State	Parameter	Reset State
Bit Rate	1	Phase Noise Compensation	Off
Combiner (if available)	Off	Muting Timeout	1000
Clock Polarity	Normal	Output Muting	Off
Data Polarity	Normal	Downconvert Antenna	Disabled
Equalizer (if available)	Off	AGC Polarity	+ (Positive)
DQ Encapsulation (if available)	Disabled	AGC Scale	10
Derandomizer	Disabled	AGC Time Constant	100
Differential Decoder	N/A	AGC Zero Mode	Manual
Modulation Scaling	Acquire	AM Bandwidth	100
Modulation Persist	Off	AM Polarity	Normal
IF Filter	Auto	AM Scale	1
Video De-emphasis	Off	AGC Compensation	Enabled

Table 11: SOQPSK Factory Reset Values

Parameter	Reset State
Bit Rate	1
Modulation Scaling	N/A
Clock Polarity	Normal
Data Polarity	Normal
Derandomizer	Disabled
Differential Decoder	Enabled
IF Filter	Auto
Downconvert Antenna	Disabled
AGC Zero Mode	Manual
Convolutional Decoder	N/A
Lock Output Polarity	Active High
NRZ Encoding	N/A
Output Control	Default
Output Muting	Disabled
Phase Noise Compensation	Disabled
Tape Output	Disabled

Table 12: Multi-h CPM Factory Reset Values

Parameter	Reset State
Bit Rate	1
Modulation Scaling	N/A
Clock Polarity	Normal
Data Polarity	Normal
Derandomizer	Disabled
Differential Decoder	N/A
IF Filter	Auto
Downconvert Antenna	Disabled
AGC Zero Mode	Manual
Convolutional Decoder	N/A
Lock Output Polarity	Active High
NRZ Encoding	N/A
Output Control	Default
Output Muting	Disabled
Phase Noise Compensation	Disabled
Tape Output	Disabled

Table 13: QPSK Factory Reset Values

Parameter	Reset State
Bit Rate	1
Modulation Scaling	N/A
Clock Polarity	Normal
Data Polarity	Normal
Derandomizer	Disabled
Differential Decoder	N/A
IF Filter	Auto
Downconvert Antenna	Disabled
AGC Zero Mode	Manual
Convolutional Decoder	Disabled
Lock Output Polarity	Active High
NRZ Encoding	NRZ-L
Output Control	Default
Output Muting	Disabled
Phase Noise Compensation	Disabled
Tape Output	Disabled

Table 14: Multi-h CPM Factory Reset Values

Parameter	Reset State
Bit Rate	1
Modulation Scaling	N/A
Clock Polarity	Normal
Data Polarity	Normal
Derandomizer	Disabled
Differential Decoder	N/A
IF Filter	Auto
Downconvert Antenna	Disabled
AGC	Enabled
Convolutional Decoder	N/A
Lock Output Polarity	Active High
NRZ Encoding	N/A
Output Control	Default
Output Muting	Disabled
Phase Noise Compensation	Disabled
Tape Output	Disabled

15 Appendix F – Acronym List

Acronym	Description
AGC	Automatic Gain Control
AM	Amplitude Modulation
AQPSK	Variant of Quadrature Phase Shift Keying
ARTM	Advanced Range Telemetry
AUQPSK	Variant of Quadrature Phase Shift Keying
BER	Bit Error Rate
BNC	Bayonet Neill-Concelman Connector (RF Connector)
BPSK	Binary Phase Shift Keying
CCSDS	Consultative Committee for Space Data Systems (coding standard)
CD	Compact Disk
CPM	Continuous Phase Modulation
DB-9	D-subminiature 9 pin Serial Connector
DC	Diversity Combiner
DHCP	Dynamic Host Configuration Protocol
DPM	Digital Phase Modulation
DQ	Data Quality
DQE	Data Quality Encapsulation
DQM	Data Quality Metric
FPGA	Field Programmable Gate Array
IF	Intermediate Frequency
IP	Internet Protocol
kbps	Kilobits per second
KHz	Kilohertz
LCD	Liquid Crystal Display
LDPC	Low Density Parity Check
Mbps	Megabits per second
MCX	Snap on subminiature connector
MHCPM	multi-h Continuous Phase Modulation

Acronym	Description
MHz	Megahertz
N	(connector type) Threaded RF connector
OQPSK	Offset Quadrature Phase Shift Keying
PCMFM	Pulse Code Modulation/Frequency Modulation
PM	Phase Modulation
PSK	Phase Shift Keying
QPSK	Offset Quadrature Phase Shift Keying
RDMS	Receiver DeModulator Synchronizer
RF	Radio Frequency
RJ-45	Ethernet Connection Jack
RM	Rack Mount
RRC	Remote RDMS Client
RS-232	Recommended Standard 232 (Serial Communications)
SAW	Surface Acoustic Wave
SDI	System Degradation Indication
SOQPSK	Shaped Offset Quadrature Phase Shift Keying
SOQPSK-TG	Shaped Offset Quadrature Phase Shift Keying –Telemetry Group
STC	Space-Time Coding
TRL	Tracking Loop
TTL	Transistor Logic
UDP	User Datagram Protocol
UQPSK	Unbalanced Quadrature Phase Shift Keying
USB	Universal Serial Bus
VAC	Voltage Alternating Current
VDC	Voltage, Direct Current
WAN	Wide Area Network