Installation and Operation Manual

DMS^{TM} Telemetry Demodulator

Quasonix, Inc.
6025 Schumacher Park Dr.
West Chester, OH 45069
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Specifications subject to change without notice.

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Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Description

This document describes the installation and operation of the Quasonix DMS™ multi-mode trellis demodulator / synchronizer (referred to throughout this document as the "DMS"). The DMS is designed to demodulate 70 MHz IF signals in multiple formats.

The following waveform formats are supported by RDMS:

- PCM/FM (ARTM Tier 0)
- SOQPSK-TG (ARTM Tier I)
- ARTM CPM / Multi-h CPM (ARTM Tier II)
- Legacy (PSK) suite, which includes:
  - BPSK
  - QPSK
  - Offset QPSK (OQPSK)
  - Asymmetric QPSK (AQPSK)
  - Unbalanced QPSK (UQPSK)
  - Asymmetric Unbalanced QPSK (AUQPSK)
  - Digital PM

Of the aforementioned, DMS provides true multi-symbol trellis demodulation in all three ARTM modes, PCM/FM, SOQPSK-TG, and Multi-h PCM. It also provides a clock signal, eliminating the need for any outboard bit synchronizer.

RDMS is manufactured by:

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

1.2 Nomenclature

The DMS 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.

Airborne DMS™ Demodulator Part Numbering Example
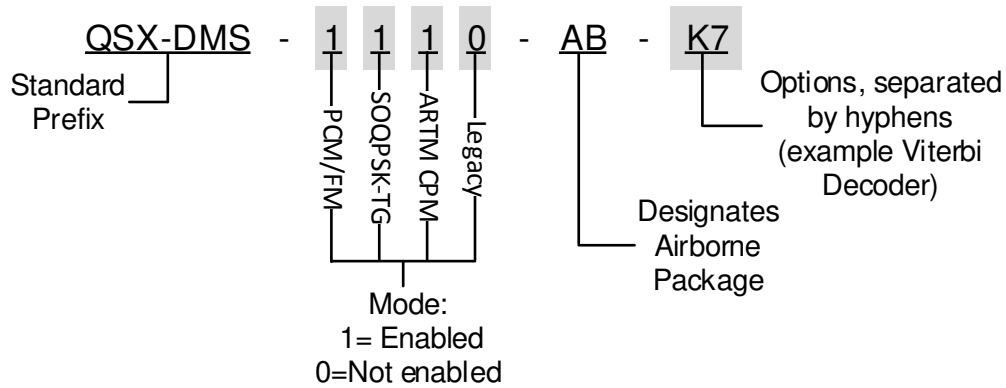
Figure 1: Airborne Demodulator Part Number Construction

Rack Mount DMS™ Demodulator Part Numbering Example
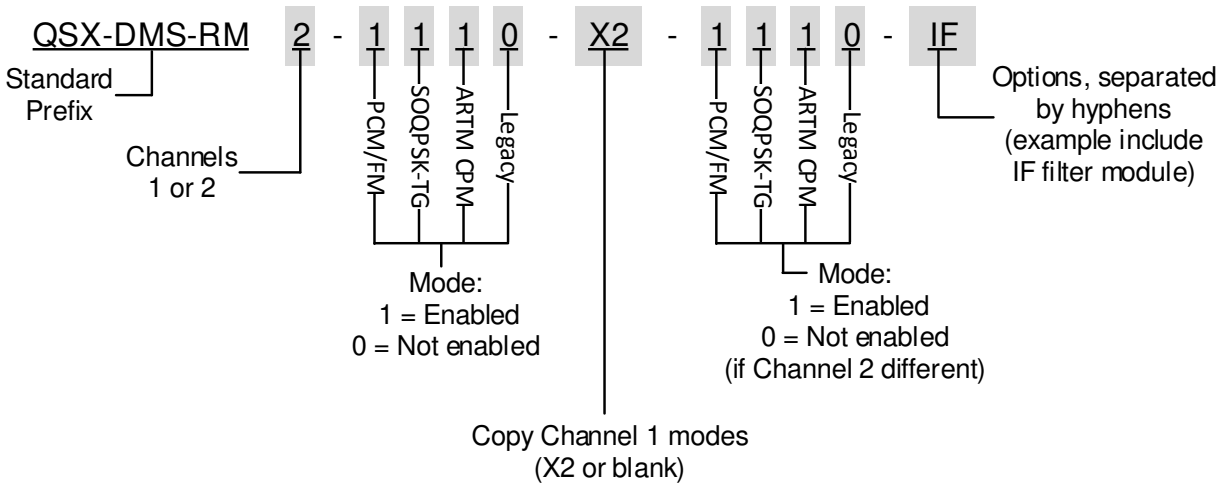
Figure 2: Rack Mount Demodulator Part Number Construction

The available options include:

- 14   14 SAW filters (adds 70 kHz, 1.4, 3, 6, 14, and 28 MHz filters)

- 37   37-pin connector. Replaces 15-pin connector. Includes 3 sets of Clock and Data (single-ended or differential), 2 high speed analog outputs, 1 low speed analog output (Airborne Model only)

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

- DR   Double-speed SOQPSK-TG, increasing max bit rate to 46 Mbps (Airborne Model only)

- IF   Include IF filter module (Airborne Model only, increases chassis height)

- RG   Reverse gender of external connector to female/socket (Airborne Model only)

For example, a model QSX-DMS-1101-AB-K7 is configured as follows:

Table 1: Model Configuration Example

Identifiers	Description
QSX	Quasonix product
DMS	Demodulator / Bit Synchronizer
1101	Tier 0 present, Tier I present, Tier II absent, Legacy (PSK) present
AB	Airborne demodulator
K7	K7 Viterbi decoder (k=7, rate ½)

2 Specifications

Characteristic	Specification
IF Filter Section	*(Standard for Rack-Mount Model, Optional for Airborne Model)*
IF frequency	70 MHz
IF output level	0 dBm nominal (AGC mode)
IF output impedance	50 ohms
VSWR	2:1 Max; 1.5:1 Typical
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	
Input dynamic range	-30 to +10 dBm for Rack-Mount Model, -5 to 0 dBm for Airborne Model
Demodulator type	PCM/FM (ARTM Tier 0) SOQPSK-TG (ARTM Tier I) ARTM CPM (ARTM Tier II) Legacy suite: BPSK, QPSK, Offset QPSK (OQPSK), Asymmetric QPSK (AQPSK) Unbalanced QPSK (UQPSK) Asymmetric Unbalanced QPSK (AUQPSK), Digital PM
Bit rates	Tier 0: 24 kbps to 23 Mbps in 1 bps steps Tier I: 100 kbps to 23 Mbps in 1 bps steps (46 Mbps with Rack-Mount Model) Tier II: 1 Mbps to 37 Mbps in 1 bps steps (46 Mbps) Legacy: 50 kbps to 10 Mbps in BPSK, 50 kbps to 20 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; Tier I: -6.0 dB Eb/N0; Tier II: -7.0 dB Eb/N0
Sensitivity (BER = 1e-5)	Tier 0: 8.6 dB Eb/N0; Tier I: 11.2 dB Eb/N0; Tier II: 13.0 dB Eb/N0
Bit Synchronizer Section	
Input codes	NRZ-L/M/S, BIΦ-L/M/S
Output codes	NRZ-L/M/S, BIΦ-L/M/S
Data and clock out	TTL or RS-422 (dual redundant outputs)

Characteristic	Specification
Lock detector out	TTL
Video out	Dual wideband outputs, DC to 35 MHz
Environmental Section – Rack-Mount Model	
Operating temperature	0°C to +50°C
Non-operating temperature	0°C to +70°C
Operating humidity	0 to 95% (non-condensing)
Altitude	Up to 30,000 ft. (with no displays option)
Environmental Section – Airborne Model	
Operating temperature	-20°C to +70°C
Non-operating temperature	-20°C to +70°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 – Rack-Mount Model	
Size / Weight	1U rack-mount chassis; 19" wide, 1.75" tall, 14-5/16" rack depth, 15-11/16" overall depth / 8 lbs.
Connectors – per channel	I, Q, Clock A, Data A, Clock B, and Data B outputs, IF input: BNC female Status/SDI Out: DB-9 female
Connectors – per combined channel	Clock Out, Data Out, AGC Out, AM Out
Connectors – per chassis	Ethernet: Standard (T568A) RJ-45 Data: USB
Power	100 to 240 VAC, 50/60 Hz
Physical Section – Airborne Model	
Size / Weight	2.000" x 3.000" x 0.674" (4.044 in.^{3}) / 3.9 oz.
Connectors	IF input: Hirose U.FL pigtail (standard) or SMA female (optional IF filter module) Baseband: MDM-15 or MDM-37 ("37" option)
Power	+5 VDC, 1.7 A typical (1.9 A with optional IF filter module)

3   Installation Instructions

3.1   Mechanical

3.1.1   Airborne Housing

In the standard airborne housing (AB), the DMS is designed to be mounted by four (4) 6- 32 screws through the holes in the four corners, as depicted in Figure 2.
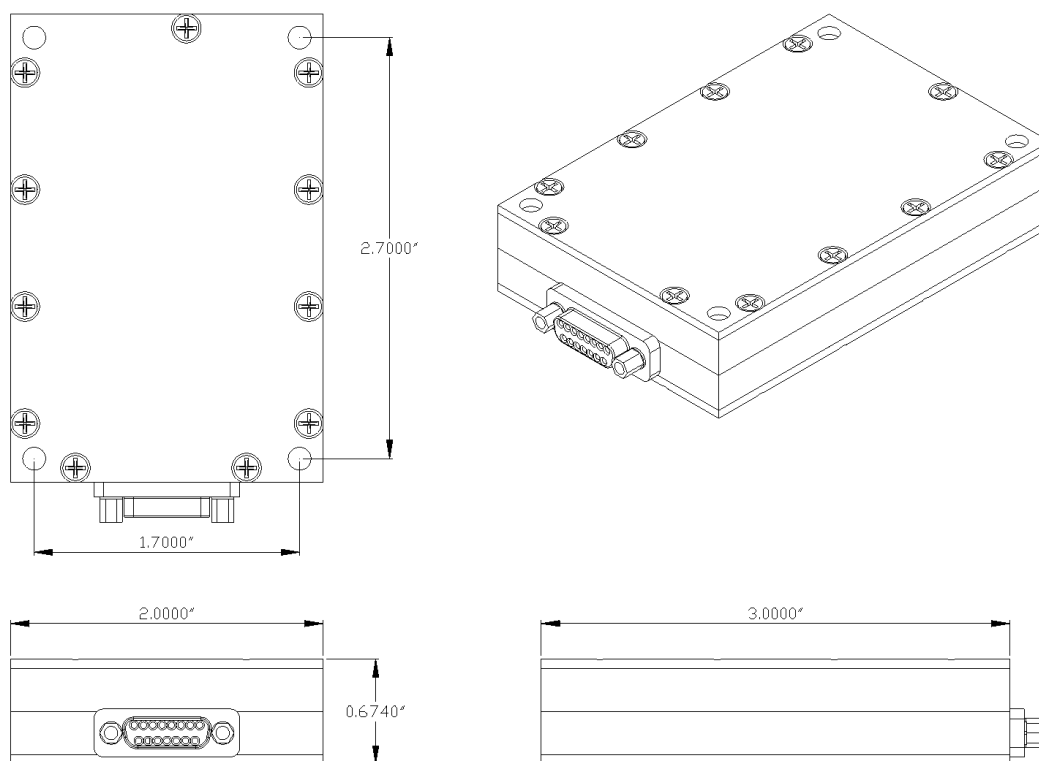
Figure 3: DMS in 2.00" x 3.00" x 0.674" Airborne Housing

3.2   Thermal

It is important that the DMS be kept within its specified operating range of -40°C to +70°C. At maximum bit rates, the unit dissipates approximately 10 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 DMS in the airborne housing has two external connectors, an MDM-15 male for all baseband interfaces, and a Hirose U.FL pigtail for the 70 MHz IF input. Units with the optional IF module have a female SMA connector for the IF input.

The pin numbering and wiring for the MDM-15 male connector is shown in Figure 6.

Figure 4: MDM-15 Pin Assignments

Table 2: Pin Assignments

Pin	Signal	Description
1	+5V	Primary 5 VDC power to module, 2 amps maximum current drain. Internally tied to pin 9.
2	GND	Primary power return, 2 amps maximum. Internally tied to pins 3, 6, and 10.
3	Signal GND	Ground return for TTL clock and data signals. Internally tied to pins 2, 6, and 10.
4	Data Out	Primary 3.3 volt TTL data output for all modes.
5	Clock Out	Primary 3.3 volt TTL clock output for all modes.
6	232 Ground	Ground return for RS-232 control lines. Internally tied to pins 2, 3, and 10.
7	Demod Lock Out	3.3 volt TTL lock detector output for all modes.
8	232 Tx Output	RS-232 responses to host controller
9	+5V	Secondary 5 VDC power to module, 2 amps maximum current drain. Internally tied to pin 1. Can be used for remote sensing of actual voltage present inside demod module.
10	GND	Secondary power return, 2 amps maximum. Internally tied to pins 2, 3, and 6.
11	Power ON	Power on reset pin. Temporarily grounding this pin is equivalent to power cycling the module.
12	Data 2 Out	Secondary 3.3 volt TTL data output for all modes. This pin carries identical data to pin 4 in all modes except QPSK, UQPSK, AQPSK and AUQPSK, where it carries the second channel data.

Pin	Signal	Description
13	Clock 2 Out / Ones Detector Out	Secondary 3.3 volt TTL clock output for all modes. This pin carries identical clock to pin 4 in all modes except QPSK, UQPSK, AQPSK and AUQPSK, where it carries the second channel clock. In sync test mode, this pin carries the ones detector output (refer to section xxx).
14	SDI Out	Signal degradation indicator, for interface to RF Networks model 2241 Diversity Branch Selector
15	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 8. The polarity of the output clock may be inverted by use of the "CP 1" command.
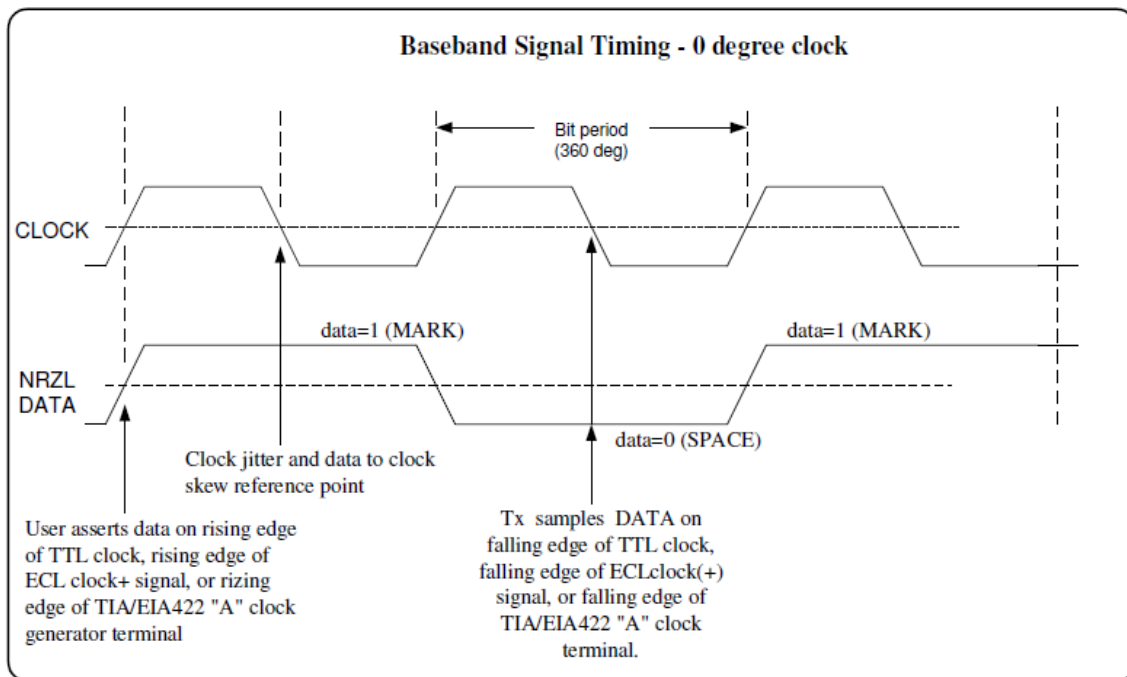
Figure 5: Baseband Signal Timing

The 70 MHz input to the demod module is a 50-ohm interface, with VSWR less than 1.4:1. The IF input level depends on the configuration, as shown in Table 3.

Table 3: IF Input Levels

Base demod (no IF module, no AGC option)	2 dBm
Base demod with AGC (no IF module)	25 dBm to +15 dBm
Demod with IF module (no AGC)	30 dBm
Demod with IF module and AGC	30 dBm to +5 dBm

4   Operating Instructions

4.1   Power-on Operation

When the DMS is powered up it defaults to a modulation based on what mode(s) are installed. For units with more than one modulation present, the default order is shown in Table 4.

Table 4: Default Modulation Startup

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

The DMS will only default to the modulation according to the preceding table when the user does not save a mode in the Flash memory.

4.2   DMS Serial Control Protocol

The DMS 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, you may use HyperTerminal. For a more flexible, full-featured control interface, we recommend Terminal, available for download from the Quasonix website: http://www.quasonix.com/uploads/terminal_v1-9b.zip.

If the terminal program is active when power is applied to the transmitter, a welcome message displays, as shown in Figure 6.

At this point, you can verify that your serial connection is active in both directions by issuing the Help command, "?". If the unit responds with a list of the available commands, then your serial communications are working correctly.
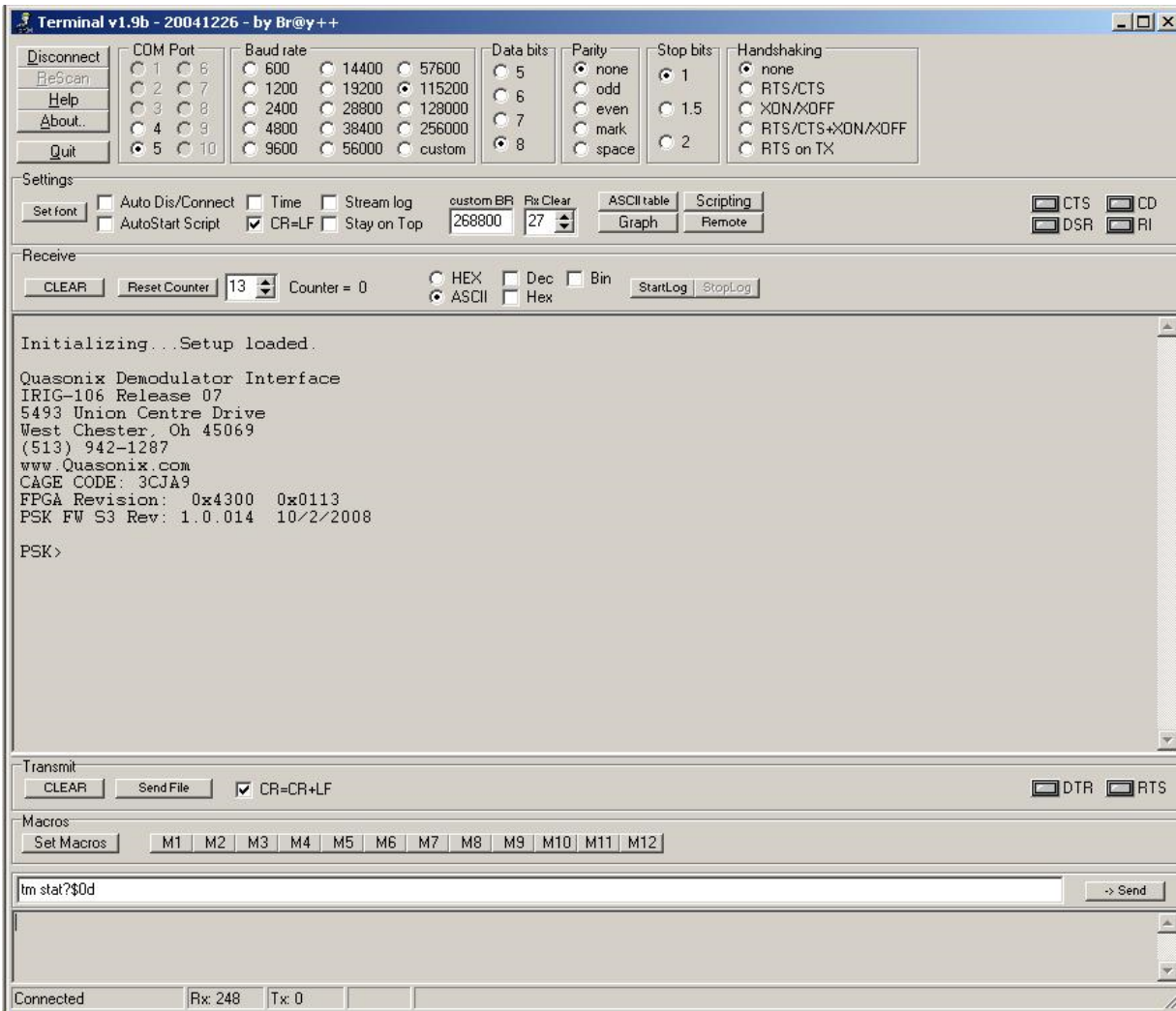
Figure 6: DMS Control Via Terminal Application

All commands are one or two alphabetic characters, followed by 0, 1, or 2 arguments. If the command is issued with arguments, there must be a space after the alphabetic characters. The commands are not case sensitive.

All commands generate a response of one or more lines. The length of the response depends on the verbosity level (set by the VL command). The last response line is always the currently selected mode (PCM/FM, SOQPSK, CPM, or PSK), followed by the character "+" as a prompt which may be interpreted as meaning that the DMS is ready to accept new characters.

4.2.1.1 Tier 0 (PCM/FM), Tier I (SOQPSK-TG), and Tier II (MULTI-H CPM) Commands

The following table describes all demodulator 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 demodulators, basic or advanced command, and whether the command is restricted to specific waveform modes.

Note: If a user issues a command that does not apply to a given mode, an "Invalid Command" message is displayed. Any command that is valid in a mode but is disabled due to the option not being installed, returns an "Option Not Installed" message.

Table 5: Standard and Optional User Commands

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
?	Help Message	Displays abbreviated list of available commands	Standard	Basic	None
AD	Downconvert Antenna	AD Report the downconvert antenna state AD 0 Set downconvert antenna state to OFF (Disabled) AD 1 Set downconvert antenna state to ON (Enabled) **Downconverting antenna control only available when using a 5-band downconverter AND P and C bands are available on the unit. (applies to customers using downconverting antennas for C-band)	**Standard	Basic	None
AV	Manual Attenuator Control	Report or set the value of the input attenuator Valid range is 0 to 124 dB Examples: AV Report the input attenuator setting AV 0 Set input attenuator to 0 dB AV 124 Set input attenuator to 124 dB	Standard	Basic	None

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
BE	Bit Error Rate	For Bit Error Rate commands and information, refer to Appendix A, Bit Error Rate Testing.	Standard	Advanced Command	None
BL	Break Lock	Breaks false locks No additional parameters	Standard	Basic	PSK (legacy)
BM	Bit Rate Measurement	Report bit rate measurement	Standard	Basic	PSK (legacy)
BR	Bit Rate	Report or set baseband bit rate Examples: BR Report the bit rate setting BR 5 Set bit rate to 5 Mbps BR 0.6 Set bit rate to 600 Kbps	Standard	Basic	For Asynch PSK (legacy) modes, BR A and BR B must be specified separately
CC	Convolutional Decoder Enable	Enables or disables the convolutional decoder Examples CC Report convolutional decoder state CC 0 Set the convolutional decoder to Disabled CC 1 Set the convolutional decoder to Enabled	K7	Basic	PSK (legacy)
CP	Clock Polarity	Report or set clock polarity inversion state Examples: CP Report the clock source state CP 0 Set clock inversion OFF CP 1 Set clock inversion ON	Standard	Basic	For Asynch PSK (legacy) modes, CP A and CP B must be specified separately

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
DE	Differential Decoder Enable	Report or set differential decoding Examples: DE Report the differential decoding setting DE 0 Set differential decoding OFF DE 1 Set differential decoding ON	Standard	Basic	SOQPSK
DP	Data Polarity	Report or set data polarity inversion state Examples: DP Display the current data polarity DP 0 Set data polarity to NOT inverted (OFF) DP 1 Set data polarity to inverted (ON)	Standard	Basic	For Asynch PSK (legacy) modes, DP A and DP B must be specified separately
FL	Force Lock Indication	Diagnostic tool to force the system to indicate locked or unlocked status; primarily used to verify wiring setup Examples: FL Show the force lock state FL 1 Force lock to ON FL 0 Force lock to Normal FL -1 Force lock to OFF	Standard	Advanced Command	None
FS	IF Filter Select	Report or set the current IF filter in the receiver FS Display the current IF filter FS A Set IF filter to automatic FS (0-7) Manually set IF filter (not recommended)	Standard -14 option permits 7 additional filters	Basic	None

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
GO	Start/Restart	Apply changes then reset demodulator. Initiate demodulation with current parameters. This command is required when setting both the modulation and the bit rate. GO command is issued any time the bit rate is changed. This forces the demodulator to rescale all of its loop parameters and digital filtering so they are set properly for the bit rate.	Standard	Basic	None
HX	eXtended Help	Displays a full list of available commands	Standard	Basic	None
LD	LDPC Decode Enable	Enable, disable, or show the current state of the Forward Error Correction (FEC) / Low Density Parity Check (LDPC) decoder Examples: LD Show the current decoder state LD 1 Enable the LDPC decoder LD 0 Disable the LDPC decoder	LD	Advanced Command	PSK (legacy) Select mode 7 (OQPSK)
LP	Lock Output Polarity	Report or set the active level of the lock indication to active high or active low Examples: LP Show the current lock output polarity LP 1 Set the active level to high LP 0 Set the active level to low	Standard	Advanced Command	None

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
MA	Modulations Allowed	Report the available waveform modes (modulations) available for this unit	Standard	Basic	None
MI	Modulation Index	Report or Set Modulation Index Tracking or Acquire Examples MI Report Mod Index Track Status 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	Standard	Basic	PCM/FM

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
MO	Modulation	Report or set modulation setting Examples: MO Report the modulation setting MO 0 Set modulation to PCM/FM MO 1 Set modulation to SOQPSK-TG MO 2 Set modulation to Multi-h CPM MO 3 Set modulation to BPSK MO 4 Set modulation to QPSK MO 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)	Standard	Basic	Limited to modes installed
NZ	NRZ Encoding	Report or set the non-return to zero (NRZ) value used by the receiver Examples: NZ Show the current NRZ value NZ L Set the NRZ to Level NZ M Set the NRZ to Mark (1) NZ S Set the NRZ to Space	Standard	Advanced Command	PCM/FM and PSK (legacy)

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
OC	Output Control	Report or set the channel source values Examples: OC Show current OC settings OC D Set the default outputs OC c s Set the channel and clock source For detailed syntax information, refer to Appendix C	37	Basic	None
OM	Output Muting	Report or set the operation of clock and data output muting; clock and data outputs can be disabled after some period of time without lock Examples: OM Show the output muting state OM 0 Disables output muting OM 1 Enables output muting OM T x Sets the delay between loss of lock and muted outputs in milliseconds from 0 to 46016	Standard	Advanced Command	None
PA	Reset Stored Configuration	Resets ALL parameters in ALL waveform modes to the factory default state and sets the receiver to the lowest default mode and lowest bit rate Refer to Appendix E for a list of factory default values by mode	Standard	Basic	None

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
PL	Input Power Level	Reports or sets the current input power level setting Examples: PL Report the current input power level information tracking state 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 reports the Input signal level of the receiver, the signal level into the demod, the digitally scaled signal level, the SNR, and eb/N0	Standard	Advanced Command	None
PN	Phase Noise Compensation	Report or set phase noise compensation state Examples: PN Report the phase noise compensation state PN 0 Set phase noise compensation to OFF PN 1 Set phase noise compensation to ON	Standard	Basic	PCM/FM
PR	Reset Defaults for Currently Selected Mode	Restores factory default parameters for the currently selected mode on the unit Refer to Appendix E for a list of factory default values by mode	Standard	Advanced Command	None
QT	Query Temperature	Report the temperature in degrees Celsius	Standard	Basic	None

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
RN	Derandomizer State	Report or set the derandomizer state Examples: RN Report the derandomizer state RN 0 Set the derandomizer OFF RN 1 Set the derandomizer ON	Standard	Basic	None
SN	Show Serial Number	Report the serial number for the unit	Standard	Basic	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	Basic	None

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
SY	System Status Tracking	Displays the system status of the receiver 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. Examples: SY Displays current status report settings SY 5 Sets status output period to 5 milliseconds SY 5 100 Sets status header output once every 100 status updates The SY command reports system status information about the timing and frequency tracking loops, as well as mod scaling, lock indication and eb/n0 data. This command is very effective for troubleshooting link issues.	Standard	Advanced Command	Available for all EXCEPT PSK (legacy)
TO	Tape Output	Displays the status of the Tape Output option Example: TO Displays current tape output status settings (enabled/disabled and output frequency)	37	Advanced Command	PCM/FM

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
TO F	Tape Output Frequency	Sets the carrier frequency of the pre-detection complex Tape Output Examples: TO F 0 Sets the Tape Output Frequency to Off (carrier frequency = 0 MHz) TO F 1 Sets the Tape Output Frequency to a specific frequency number Value range is 0.000 to 20.000 MHz	37	Advanced Command	PCM/FM
TO T	Tape Output Source	Sets the test output to a Tape source; Enables or Disables the pre-detection complex baseband as the tape output source When enabled (T=1), pre-detection complex baseband is selected as the source of data to send on I and Q analog outputs When disabled (T=0), the I and Q analog outputs (frequency/phase information) are restored to their normal defaults which vary by mode Examples: TO T 0 Sets the Tape Output Source to disabled TO T 1 Sets the Tape Output Source to enabled	37	Advanced Command	PCM/FM
VE	Version	Report the current Firmware (software) version information for the receiver	Standard	Basic	None

Mnemonic	Name	Description	Option (s) Required	Basic or Advanced Command	Mode Restriction
*VF	Viterbi Forget Factor	Report or set the Viterbi forget factor, on a scale from 0.01 – 0.99 Examples: VF Report the Viterbi forget factor VF 0.04 Set the Viterbi forget factor to 0.04 VF 0.62 Set the Viterbi forget factor to 0.62	Standard	Advanced Command	PCM/FM
VL	Verbosity Level	Report or set verbosity level, on a scale of 0 – 9 Examples: VL Report the verbosity level VL 0 Set the verbosity level to 0 VL 5 Set the verbosity level to 5	Standard	Advanced Command	None
ZZ	Show Options	Displays the current hardware configuration and options on the receiver	Standard	Advanced Command	None

*Note regarding VF command: The VF command sets the observation window for the Viterbi decoder in the trellis demod. The longer the window, the more coding gain. The smaller the window, the more resistant to phase noise. Quasonix recommends NOT manually changing this value. The Phase Noise Compensation mode automatically adjusts this as needed.

5   Performance Specifications

5.1   IF Input

The DMS operates at 70 MHz. The input impedance is 50 ohms, with a VSWR of less than 1.5:1. Standard models perform optimally with a drive level of -2 dBm ±2 dB. Input drive level is reported by the PL command. Custom configurations tailored for other drive levels are available on request.

5.2   DC Input

The DMS operates from 5 VDC, with a current consumption of no more than 2.0 amps.

5.3   RF Frequency Error

The DMS is capable of acquiring a signal with a frequency error of up to ±100 kHz.

5.4   Bit Error Rate

The DMS meets the following BER limits, when tested with a signal source, which complies with IRIG 106-05.

Table 6: DMS 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 7, is significantly superior to that tabulated above.
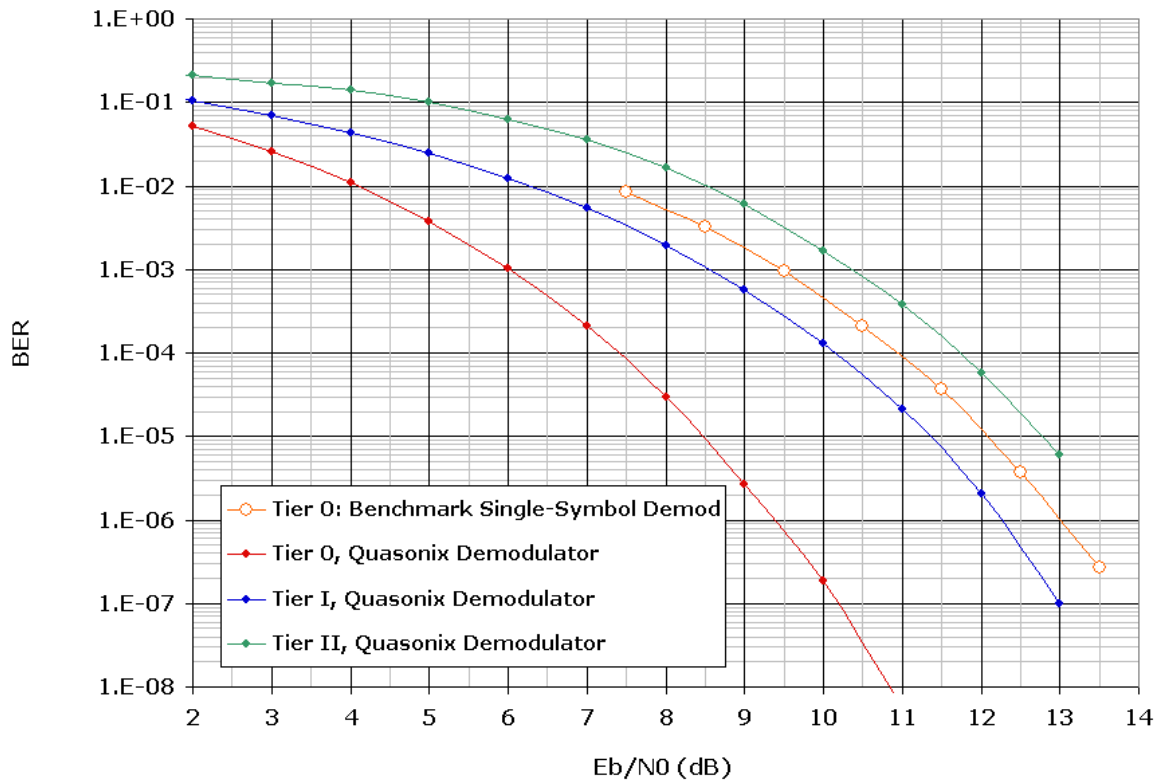
Figure 7: BER Performance for Tier 0, I, and II

5.5 Synchronization

The DMS 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 8.
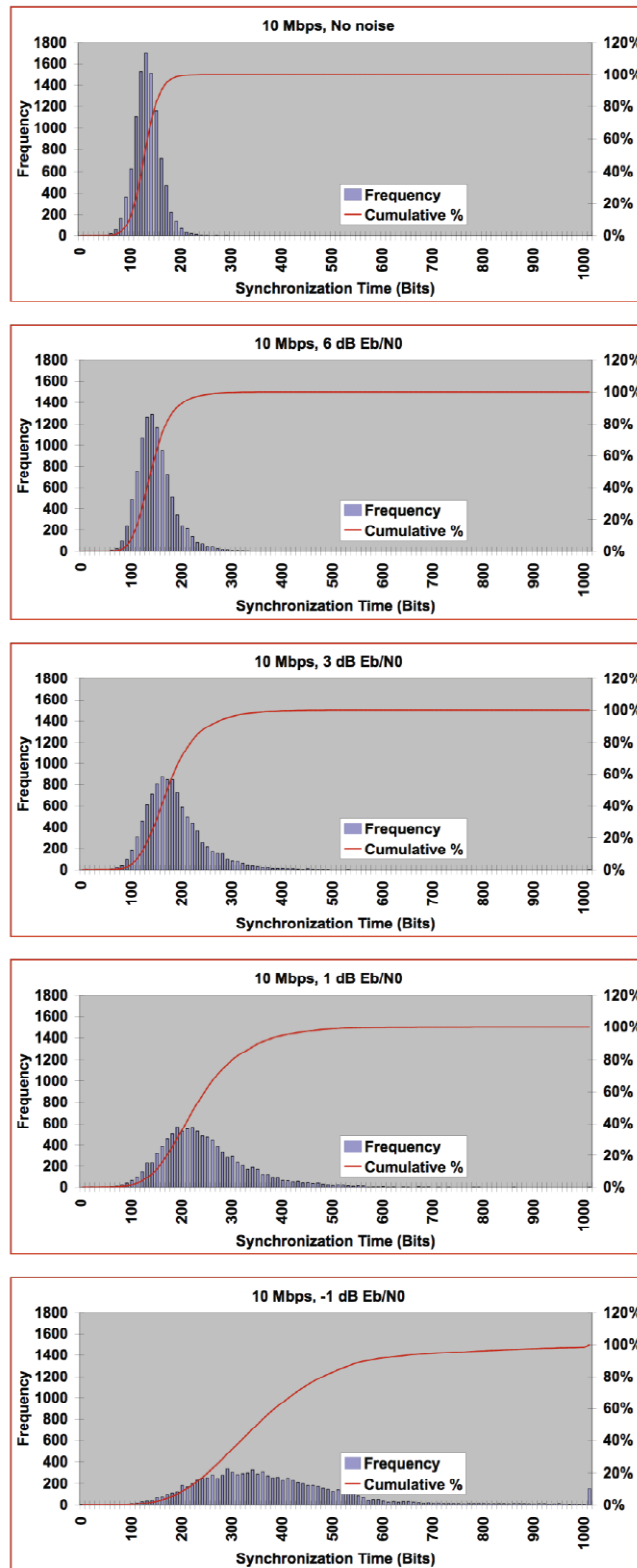
Figure 8: Synchronization Time at Various Signal-to-Noise Ratios

6 Maintenance Instructions

The DMS Telemetry Demodulator requires no regular maintenance, and there are no user-serviceable parts inside.

7   Optional IF Module

For applications in which the 70 MHz input signal is unfiltered or where there is unusually severe adjacent channel interference, Quasonix offers an optional IF filter module, shown in Figure 12. This module has 8 SAW filters, ranging in bandwidth from 250 kHz to 40 MHz in approximately one-octave steps. These filters serve as anti-aliasing filters ahead of the A/D converter in the demod itself. In addition, they can provide an added measure of adjacent channel interference rejection. The measured responses of the 8 filters are shown in Figure 14 and Figure 15 (note the change of horizontal scale between the two Figures).
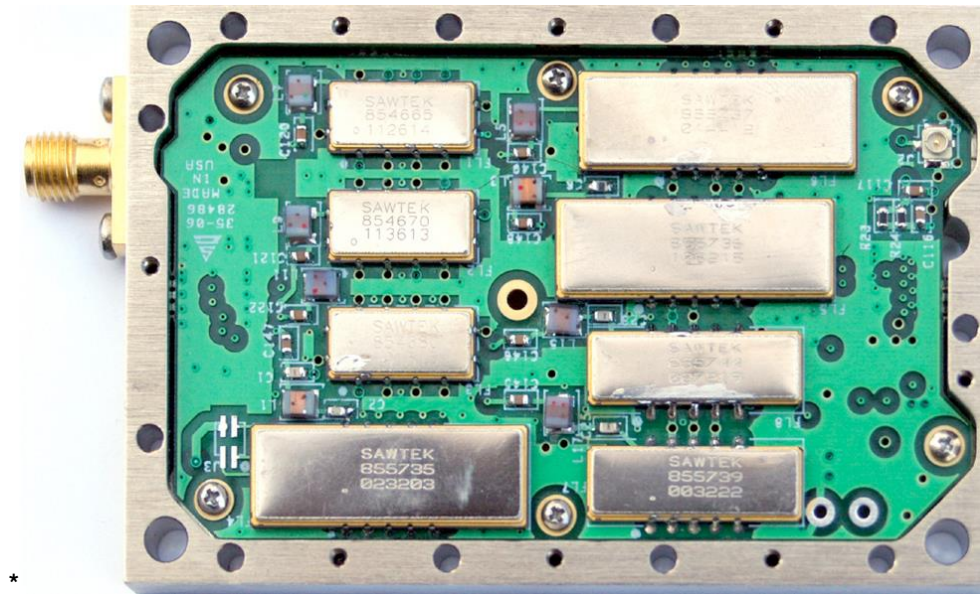

Figure 9: 70 MHz IF module in 2" x 3" chassis

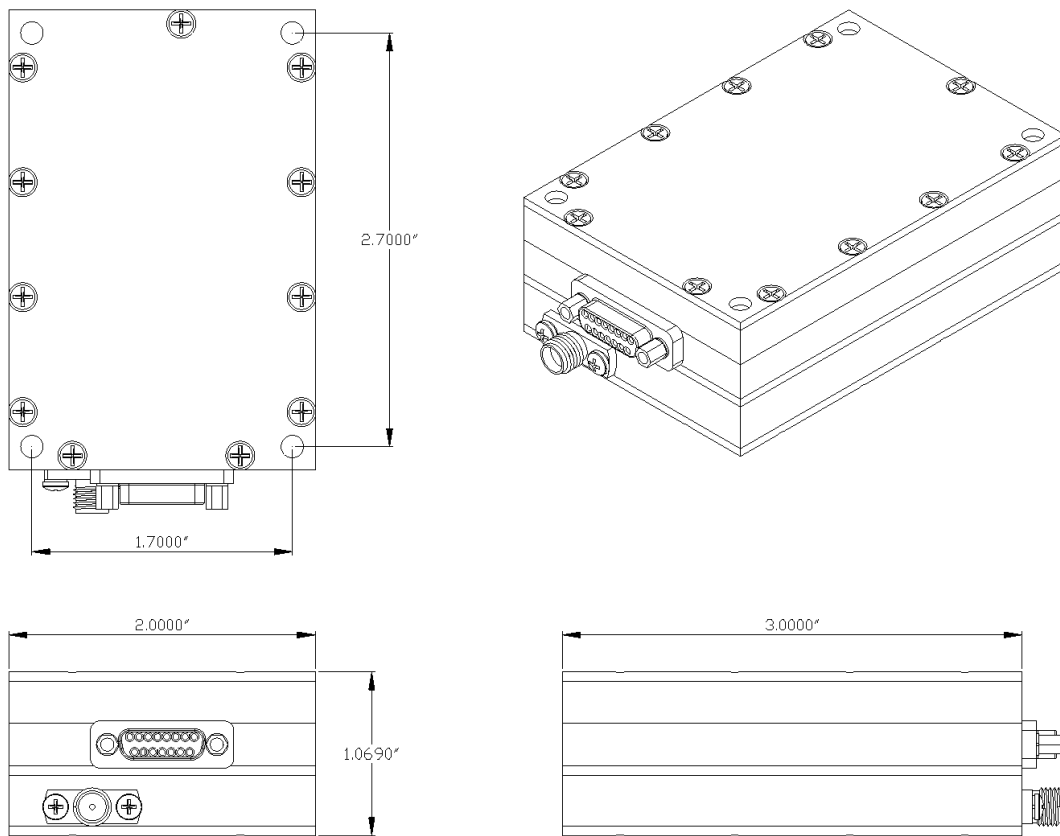The IF module attaches directly to the demod modules, as shown in Figure 13.
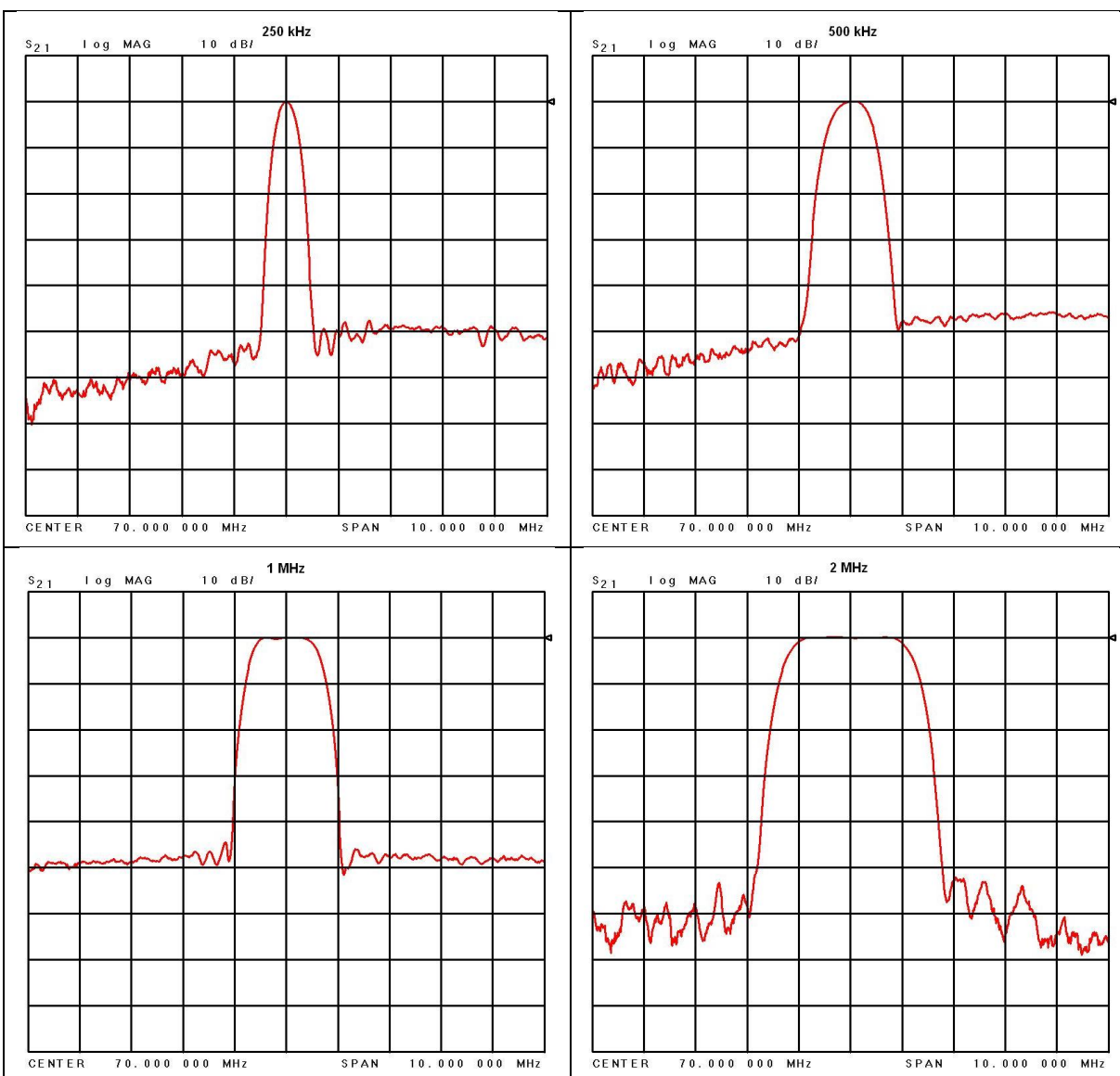
Figure 10: Demod with IF Module

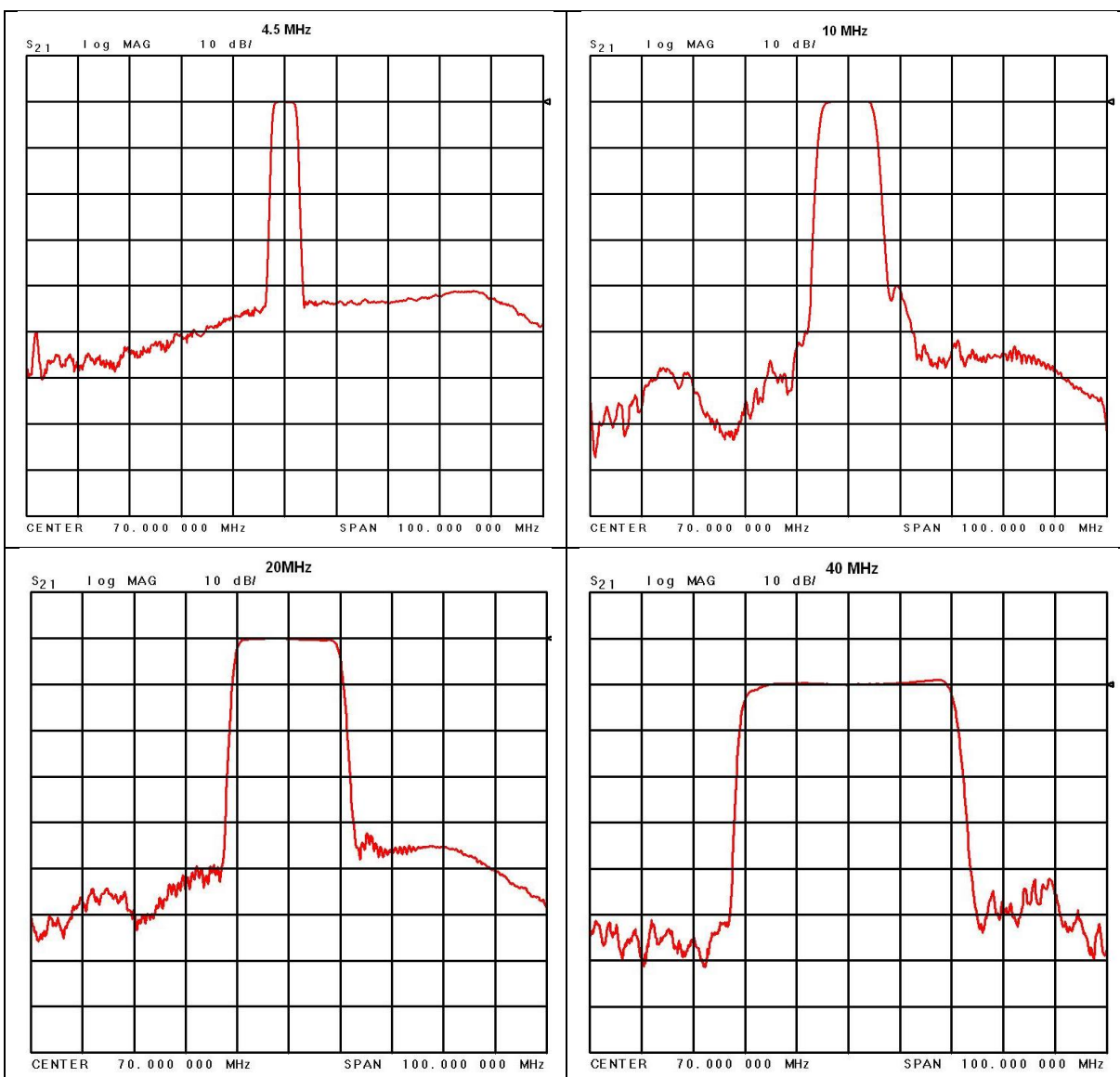**Figure 11: 70 MHz IF Module in 2" x 3" Chassis SAW Filter Responses, Narrow Group (10 MHz Span)**

Figure 12: SAW Filter Responses, Wide Group (Plotted on 100 MHz Span)

8 Product Warranty

The DMS Telemetry Demodulator carries a standard parts and labor warranty of one (1) year from the date of delivery.

8.1 Quasonix Limited Warranty Statement

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

8.1.1   Extended Warranties

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

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

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9   Technical Support and RMA Requests

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

Authorized return shipments must be addressed in the following manner:

<div align="center">

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

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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 – Acronym List

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

Acronym	Description
PSK	Phase Shift Keying
QPSK	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	Sawtooth Wave
SDI	System Degradation Indication
SOQPSK	Shaped Offset Quadrature Phase Shift Keying
SOQPSK-TG	Shaped Offset Quadrature Phase Shift Keying –Telemetry Group
TRL	Tracking Loop
TTL	Transistor Transistor Logic
UDP	User Datagram Protocol
UQPSK	Unbalanced Quadrature Phase Shift Keying
USB	Universal Serial Bus
VAC	Voltage Alternating Current
VSWR	Voltage Standing Wave Ratio
WAN	Wide Area Network