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Find the *Quasonix QSX-RDMS-S-1100-AB-RS-NV* at our website: *Click HERE*

Installation and Operation Manual

QSX-RDMS-x-xxxx
Multi-Mode Trellis Receiver / Demodulator / Bit Synchronizer



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Quasonix

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Quasonix

1.0 INTRODUCTION

1.1 Description

This document describes the installation and operation of the Quasonix QSX-RDMS-x-xxxx multi-mode trellis receiver / demodulator / bit synchronizer (referred to throughout this document as the "RDMS"). The RDMS is designed to demodulate RF signals in several 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
  - Offset QPSK (OQPSK)
  - Asymmetric QPSK (AQPSK)
  - Unbalanced QPSK (UQPSK)
  - Asymmetric Unbalanced QPSK (AUQPSK)
  - Digital PM

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.

The RDMS is manufactured by:

Quasonix, LLC
5493 Union Centre Drive
West Chester, OH 45069
CAGE code: 3CJA9

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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 below.

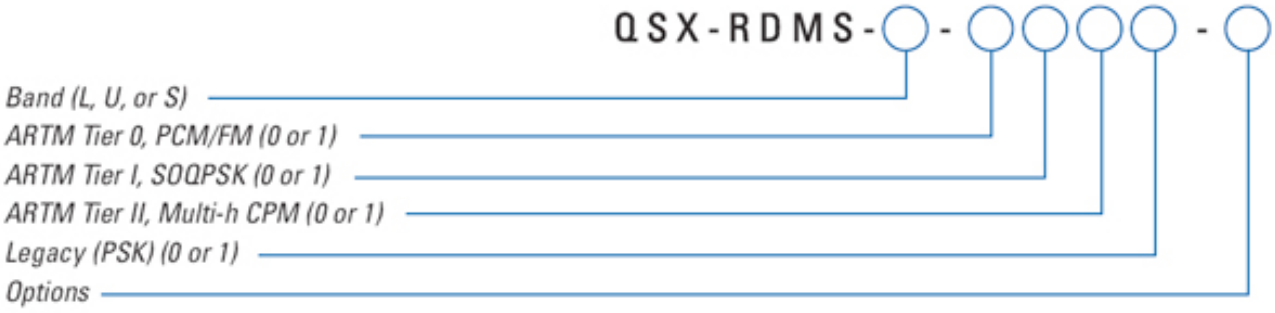


Figure 1. Receiver Types and Options.

The available options include:

- AB Airborne package (4.00” x 3.00” x 1.00”)
- NV Non-volatile memory
- RM 19-inch rack-mount (blank front panel)
- FP Keypad & display on front panel (requires RM package)
- DUAL Two receivers in one rack mount chassis (requires RM)

For example, a model QSX-RDMS-L-1101-AB is configured as follows:

QSX	Quasonix product
RDMS	Receiver / Demodulator / Bit Synchronizer
L	L-band operation
1101	Tier 0 present, Tier I present, Tier II absent, Legacy (PSK) present
AB	Airborne package

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2.0 INSTALLATION INSTRUCTIONS

2.1 Mechanical

Unless the RM (rack-mount) option is specified, the 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.

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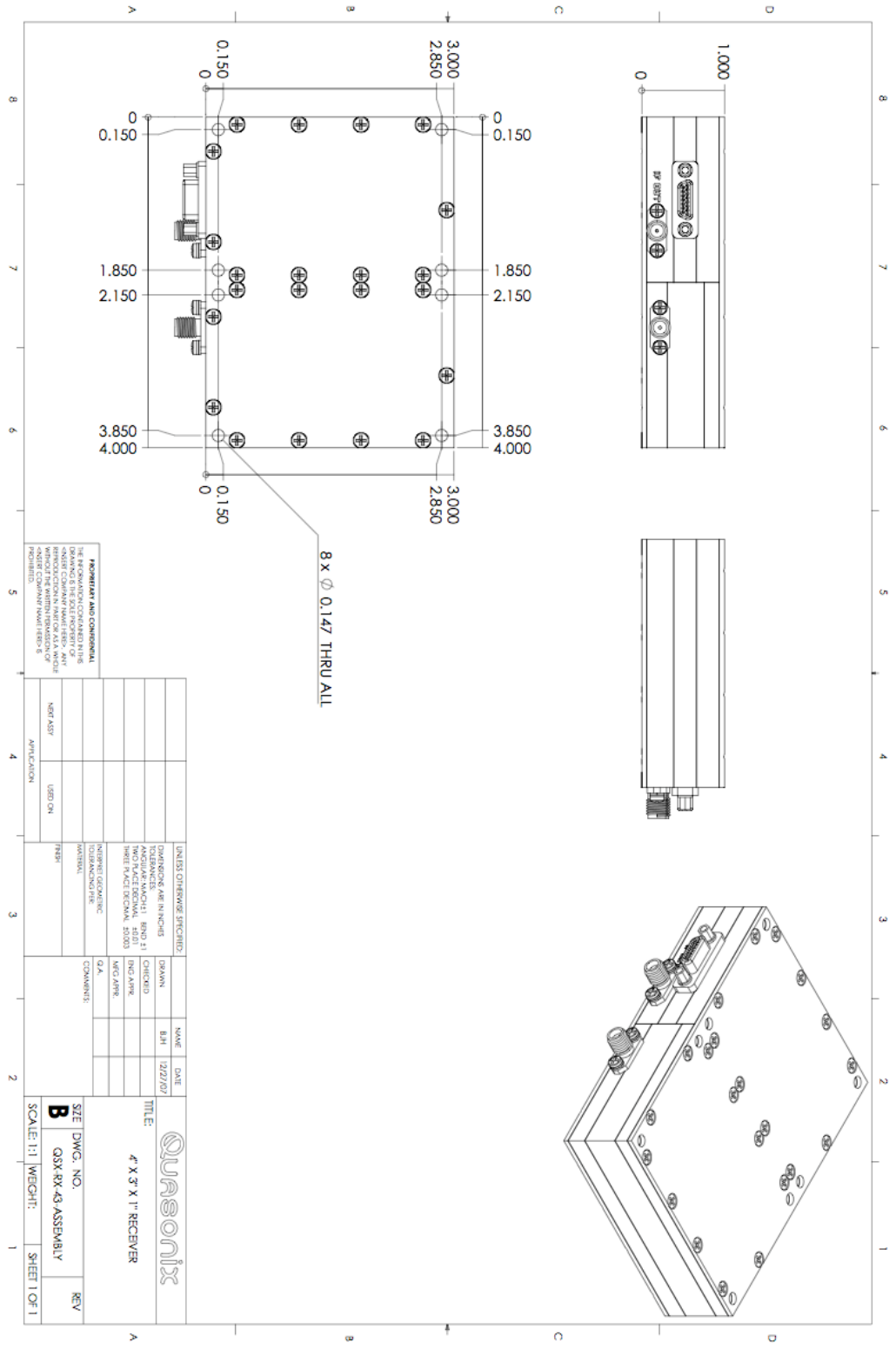


Figure 2. RDMS in 4.00” x 3.00” x 1.00” Airborne Housing.

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2.2 *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 12 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.

2.3 *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 initial shipments of the RDMS did not include the IF output. The pin numbering and wiring for the MDM-15 male connector is shown in Figure 3. MDM-15 Pin Numbers.



Figure 3. MDM-15 Pin Numbers.

Pin	Signal	Description
1	Disconnected	Pin disconnected.
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	+28VDC	Primary 28 VDC power to module, 0.7 amps maximum current drain.
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

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		data to pin 4 in all modes except QPSK, UQPSK, AQPSK and AUQPSK, where it carries the second channel data.
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 (see 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.

Table 1. Pin Assignments.

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 (see below).

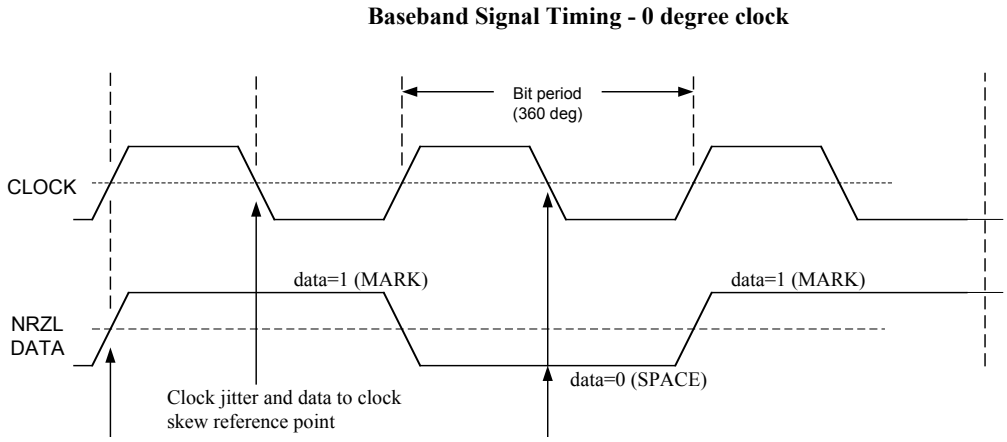


Figure 4. Baseband Signal Timing.

The RF input to the receiver module is a 50 Ohm interface, with VSWR less than 1.4:1.

The RDMS also provides a 70 MHz IF output through an SMA connector for troubleshooting purposes. The IF is resistively coupled from the input of the demodulator. Therefore, the signal level on the IF output should be within 2 dB of the demodulator's input.

The IF output must have a 50-ohm load at all times. Therefore, if it is not connected to external test equipment, then the 50-ohm terminator that comes installed on the port must remain attached.

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3.0 OPERATING INSTRUCTIONS

3.1 Power-on Operation

When the RDMS 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 is determined by the following table.

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

Table 2. Default Modulation Startup.

For units with the non-volatile memory option (NV) present, the RDMS will only default to the modulation according to the preceding table when a modulation is *not* saved in the Flash memory by the user.

3.2 RDMS Serial Control Protocol

The 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 use of *Terminal*, a flexible, full-featured control interface that is included in the RDMS Product CD. Otherwise, one can use *HyperTerminal*, included with the standard Windows installation (Start -> All Programs -> Accessories -> Communications -> HyperTerminal).

If you have your terminal program active when you apply power to the RDMS, you will see a welcome message as shown in Figure 5 below.

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```
Initializing...
downconverter init...
Quasonix Demod/Receiver Interface
IRIG-106 Release 07
5493 Union Centre Drive
West Chester, Oh 45069
(513) 942-1287
www.Quasonix.com <http://www.Quasonix.com>
CAGE CODE: 3CJA9
FPGA Revision:  0x3132  0x0000
PSK FW Revision: 2.0.043  7/29/2008

PSK>
```

Figure 5. RDMS Welcome Message.

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 (PCMFM, 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.

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

Mnemonic	Name	Description
?	Help Message	Displays abbreviated list of available commands
FR	Frequency	Report or set receiver center frequency. Examples: `FR` Report the frequency setting `FR 2200.5` Set modulation to 2200.5 MHz
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 PSK

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BR	Bit Rate	Report or set baseband bit rate Examples: `BR` Report the bit rate setting `BR 20` Set bit rate to 5 Mbps `BR 0.6` Set bit rate to 600 Kbps
DP	Data Polarity	Report or set data polarity inversion state Examples: `DP` Report the polarity inversion state `DP 0` Set data inversion off `DP 1` Set data inversion on
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
GO	Start/Restart	Initiate demodulation with current parameters. This command is required when setting both the modulation and the bit rate.
SV	Save Parameters (Requires NV option)	Saves the current parameters in non-volatile memory, including frequency, modulation, bit rate, data polarity, clock polarity, AGC state, verbosity level, etc.
RE	Restart Demodulator	Restart Demodulator without reconfiguration
SC	Saturation Count	Report the saturation count
PL	Input Power Level	Report current input power level
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
BM	Bit Rate Measurement	Report bit rate measurement
RV	FPGA & Firmware Revision	Report the revision numbers for both the FPGA load and the Firmware load
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
SQ	Signal Quality	Report the signal quality information

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DS	SDI Status	Report the SDI (System Degradation Indication) status required for the RF Networks 2241 Diversity Branch Selector
TH	TRL High Mark	Report or set the TRL high mark, on a scale from 0.0 – 5.0. Examples: `TH` Report the TRL high mark level `TH 0.2` Set the TRL high mark to 0.2 `TH 4.9` Set the TRL high mark to 4.9
TL	TRL Low Mark	Report or set the TRL low mark, on a scale from 0.0 – 5.0. Examples: `TL` Report the TRL low mark level `TL 0.1` Set the TRL low mark to 0.1 `TL 3.7` Set the TRL low mark to 3.7
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
VS	Viterbi Status	Report the Viterbi lock status and strength
PS	Show Parameters	Displays all parameters
AA	AGC State	Report or set the receiver's automatic gain control (AGC). Examples: `AA` Report the AGC state `AA 0` Set AGC off `AA 2` Set AGC on

Table 3. Tiers 0 / I / II Basic Serial Commands.

3.2.2 PSK Commands

Mnemonic	Name	Description
?	Help Message	Displays abbreviated list of available commands
FR	Frequency	Report or set receiver center frequency. Examples: `FR` Report the frequency setting `FR 2200.5` Set modulation to 2200.5 MHz

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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 PSK
BR	Bit Rate	Report or set baseband bit rate Examples: `BR` Report the bit rate setting `BR 20` Set bit rate to 5 Mbps `BR 0.6` Set bit rate to 600 Kbps
DP	Data Polarity	Report or set data polarity inversion state Examples: `DP` Report the polarity inversion state `DP 0` Set data inversion off `DP 1` Set data inversion on
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
GO	Start/Restart	Initiate demodulation with current parameters
RE	Restart Demodulator	Restart Demodulator without reconfiguration
SC	Saturation Count	Report the saturation count
PL	Input Power Level	Report current input power level
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
BM	Bit rate Measurement	Report bit rate measurement
SV	Save Parameters (Requires NV option)	Saves the current parameters in non-volatile memory, including frequency, modulation, bit rate, data polarity, clock polarity, AGC state, verbosity level, etc.
RV	FPGA & Firmware Revision	Report the revision numbers for both the FPGA load and the Firmware load

Table 4. Legacy PSK Basic Serial Commands.

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4.0 PERFORMANCE SPECIFICATIONS

4.1 RF Input

The RDMS is available in three bands:

Lower L-band models: 1435.5 to 1534.5 MHz
Upper L-band models: 1750.0 to 1855.0 MHz
S-band models: 2200.5 to 2394.5 MHz

The input impedance is 50 ohms, with a VSWR of less than 1.5:1.

4.2 DC Input

In its airborne configuration, the RDMS operates from 28 VDC, with a current consumption of no more than 0.7 amps. The rack mount models are powered from standard 120 VAC power.

4.3 RF Frequency Error

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

4.4 Bit Error Rate

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

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

Table 5. RDMS BER Specifications.

Typical BER performance, plotted in Figure 6, is significantly superior to that tabulated above.

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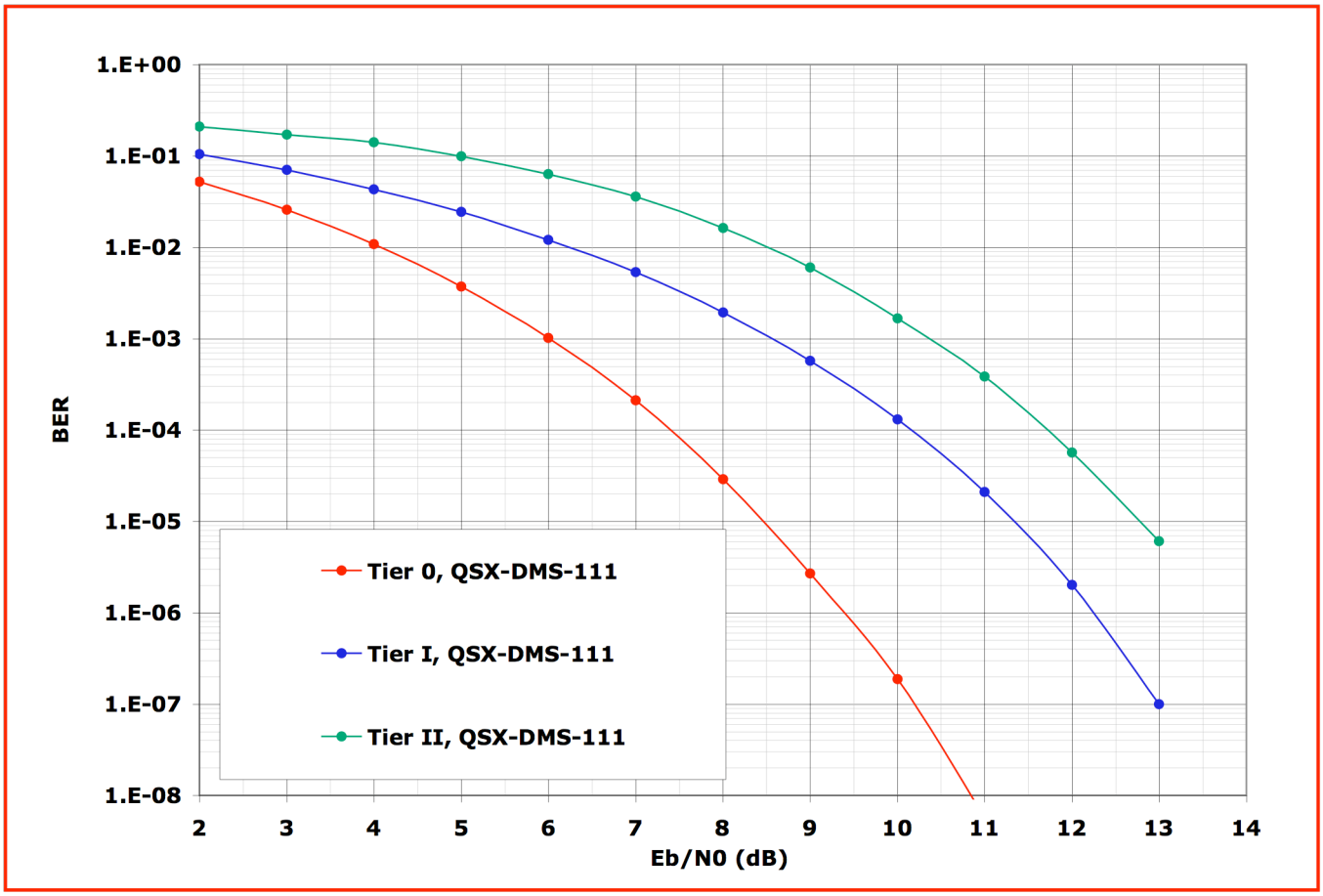


Figure 6. BER Performance for Tier 0, I, and II.

4.5 Synchronization

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

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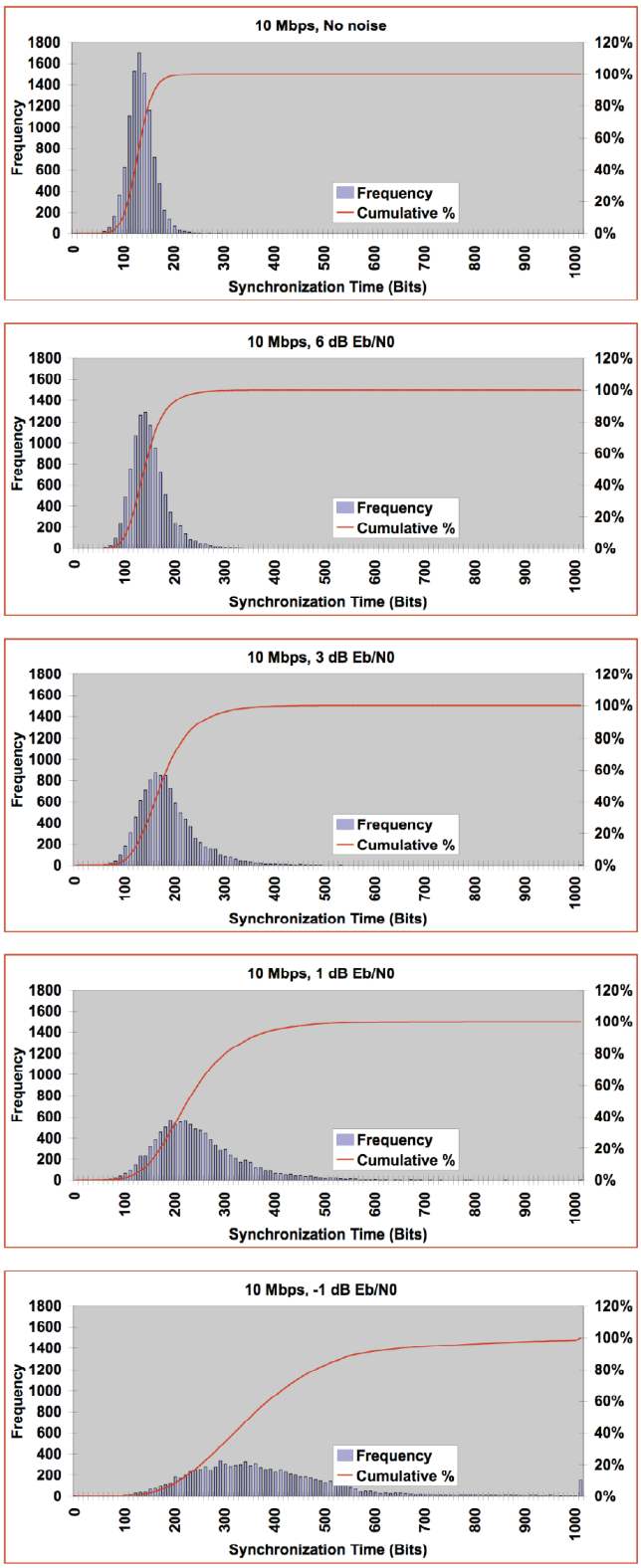


Figure 7. Synchronization Time at Various Signal-to-Noise Ratios.

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5.0 MAINTENANCE INSTRUCTIONS

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

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6.0 IF MODULE

The built-in IF filter module, shown in Figure 8, 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 9 and Figure 10 (note the change of horizontal scale between the two Figures).

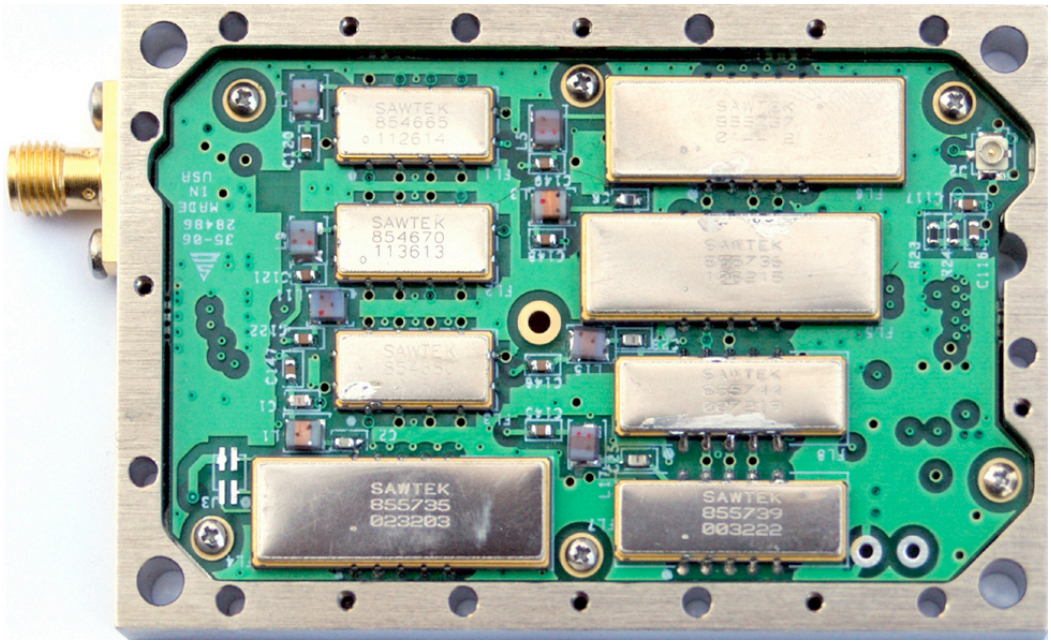


Figure 8. 70 MHz IF Module in 2” x 3” Chassis.

The IF module attaches directly to the demod modules.

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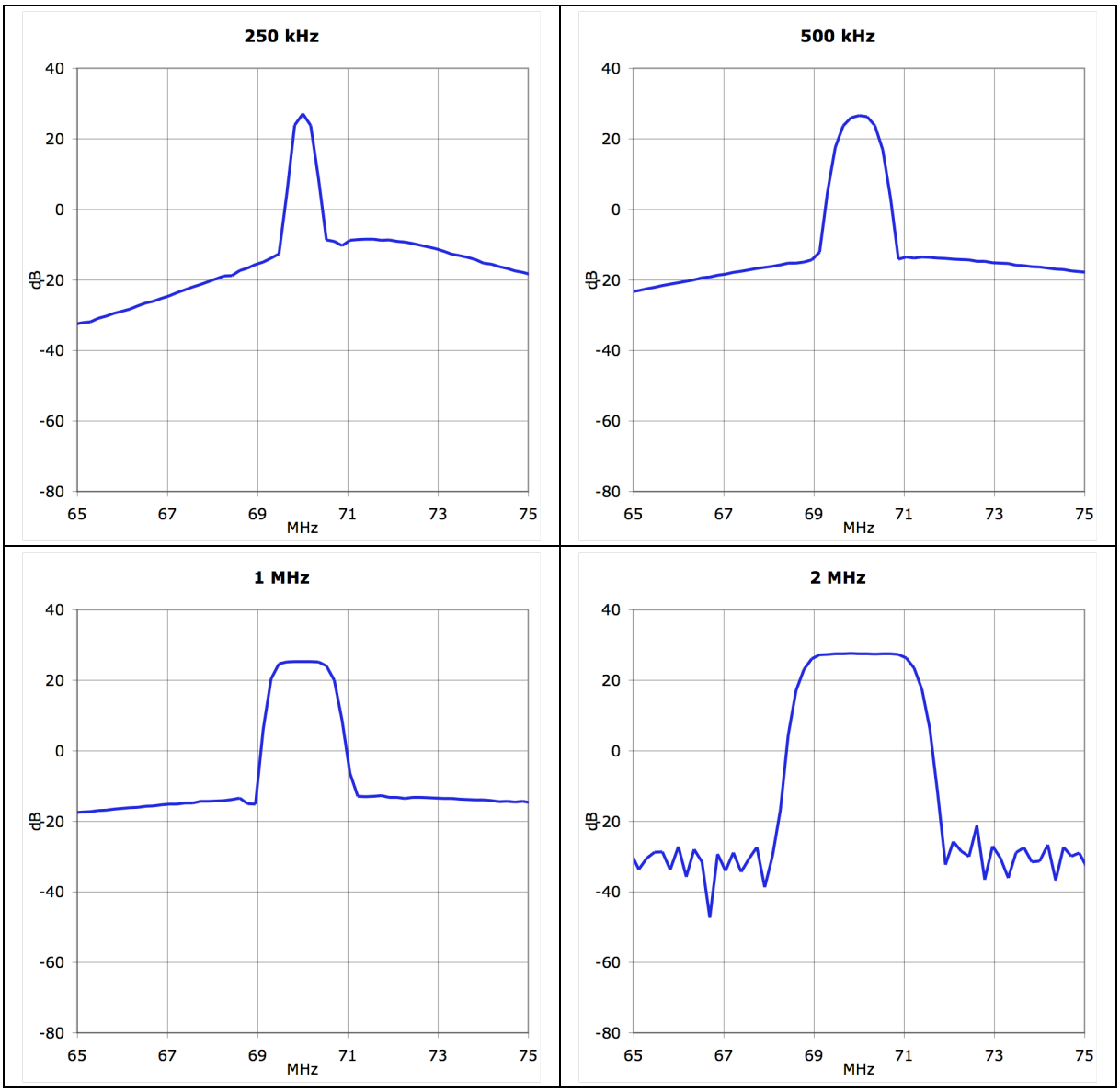


Figure 9. SAW Filter Responses, Narrow Group (Plotted on 10 MHz Span).

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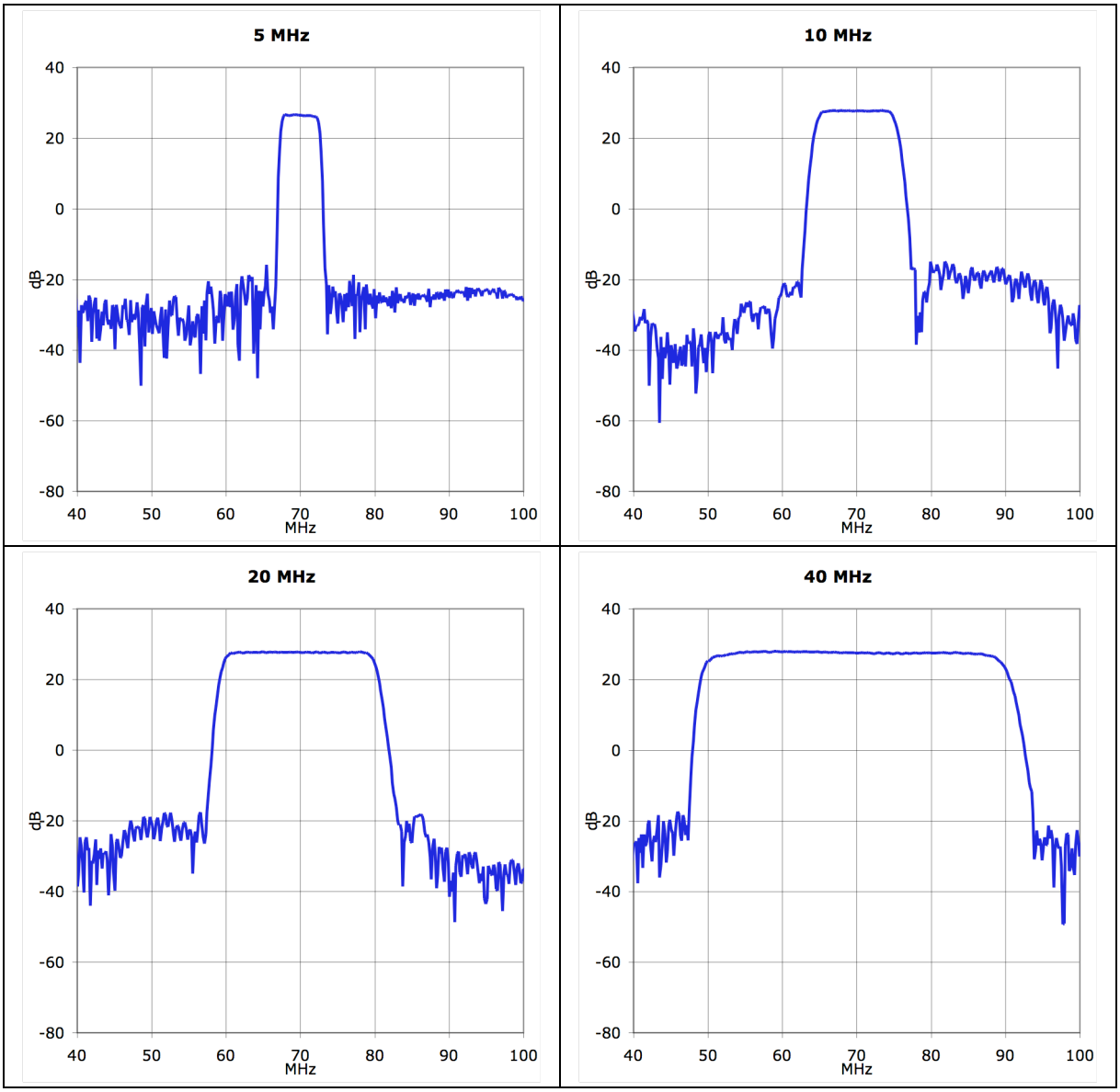


Figure 10. SAW Filter Responses, Wide Group (Plotted on 60 MHz Span).

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Authorized return shipments must be addressed in the following manner:

Quasonix, LLC
ATTN: Repair, RMA # _____
5493 Union Centre Drive
West Chester, OH 45069

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