



QM1003-1-2-X | L-band RF Downconverter, Single (X=1) or Dual (X=2) Channel

**Typical Applications**

- Frequency Conversion
- Laboratory Test Equipment
- Digital Receiver Systems
- Communication systems, SATCOM
- EW, ELINT, SIGINT, Direction Finding
- Phased array antenna systems
- Radar systems



QM1003-1-2-2 with Option 100, 200, 1U 19" Rack-Mount



QM1003-1-2 in Optional Outdoor Unit Form-Factor

**RF Input Frequency Range**

QM1003-2-18-X 950-2150 MHz

**IF Output Frequency Range**

Option 201 (70 MHz IF) 52 to 88 MHz  
Option 202 (140 MHz IF) 104 to 176 MHz

**Features**

- Single (X=1) or Dual (X=2) channel options
- Internal LO generation with USB and TCP/IP control
- 36 MHz (OPT 201) or 72 MHz (OPT 202) instantaneous bandwidth
- Option for external LO tuning
- Independent (110) or common channel frequency control available on dual channel systems
- Frequency agile across entire tunable band

**Form-Factor**

- 1U 19" Rack module
- Optional weather-tight outdoor unit (11.81"x16.90"x4.76")

**General Description**

The QM1003-1-2-X Wideband Downconverter is a frequency agile RF downconverter unit capable of tuning input frequencies centered between 950 and 2150 MHz with 36 MHz (OPT 201) or 72 MHz (OPT 202) of instantaneous bandwidth. The downconverted IF output frequency is typically centered at 70 MHz (OPT 201) or 140 MHz (OPT 202).

QM1003 Series frequency converters now come standard with internally generated LOs (formerly Option 100). The downconverter channel also includes optional I and Q IF outputs (OPT 400). A variable attenuator is included standard at the RF input to the downconversion path. An optional parallel TTL interface is provided on the back panel for fast tuning through a parallel DB-37 connector.



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## **QM1003-1-2-X** **L-band RF Downconverter**

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The QM1003-1-2-X is controlled via USB or TCP/IP and uses VISA control drivers with the USBTMC protocol, enabling seamless integration into Windows®, Linux®, and Macintosh® environments. A Windows® GUI is provided.

All QM1003 Series specifications are customizable upon request. Please contact [sales@quonsetmicrowave.com](mailto:sales@quonsetmicrowave.com) for more information. Detailed performance specifications are also available upon request.



**Electrical Specifications with Option 201 selected**

Parameter	Min.	Typ.	Max.	Units
IF Output Center Frequency	52	70	88	MHz
RF Input Frequency Range	950		2150	MHz
Instantaneous Usable Bandwidth		36		MHz
IF Ripple (+/- 250 MHz)		3		dB
RF Gain, 950-2150 MHz	0		25	dB
Noise Figure (NF), Atten= 0 dB		6		dB
Input P1dB, 2-18 GHz, Atten= 0 dB		10		dBm
Output P1dB, 2-18 GHz, Atten= 0 dB				dBm
Phase Noise, 1 KHz Offset		-85		dBc/Hz
Phase Noise, 10 KHz Offset		-97		dBc/Hz
Phase Noise, 100 KHz Offset		-105		dBc/Hz
Phase Noise, 1 MHz Offset		-118		dBc/Hz
Phase Noise, 10 MHz Offset		-117		dBc/Hz
In-Band Spurious, +/- 36 MHz		-70		dBc
SFDR (Two-tone test)		70		dB
I/Q Output Phase Balance		5		deg
I/Q Amplitude Balance		1.0		dB



**Electrical Specifications with Option 202 selected**

Parameter	Min.	Typ.	Max.	Units
IF Output Center Frequency	104	140	176	MHz
RF Input Frequency Range	950		2150	MHz
Instantaneous Usable Bandwidth		72		MHz
IF Ripple (+/- 250 MHz)		3		dB
RF Gain, 950-2150 MHz	0		25	dB
Noise Figure (NF), Atten= 0 dB		6		dB
Input P1dB, 2-18 GHz, Atten= 0 dB		10		dBm
Output P1dB, 2-18 GHz, Atten= 0 dB				dBm
Phase Noise, 1 KHz Offset		-85		dBc/Hz
Phase Noise, 10 KHz Offset		-97		dBc/Hz
Phase Noise, 100 KHz Offset		-105		dBc/Hz
Phase Noise, 1 MHz Offset		-118		dBc/Hz
Phase Noise, 10 MHz Offset		-117		dBc/Hz
In-Band Spurious, +/- 36 MHz		-70		dBc
SFDR (Two-tone test)		70		dB
I/Q Output Phase Balance		5		deg
I/Q Amplitude Balance		1.0		dB



**Common Specifications**

Parameter	Min.	Typ.	Max.	Units
Operating Voltage		+12		VDC
Current Draw			5	Amps
Tune Frequency Step Size				
Integer Mode*		50		MHz
Fractional Mode		2.44		KHz
LO1 Input Frequency Range	3.4		4.4	GHz
LO1 Input Power		0		dBm
External Reference Input	10		100	MHz
External Reference 1 Output		100		MHz
External Reference 2 Output		10		MHz

\* With use of the internal 20 MHz reference with a reference divider of 1



### Options Overview

To provide flexibility for system integration, the QM1003-1-2-X series of downconverters has multiple configuration options that pertain to three categories – (1) Local Oscillator (LO) generation, (2) Independent vs. common channel control for dual channel systems, (3) IF frequency modifications. An internal common LO (Option 100) is not included with the Base system.

To select options related to LO generation and independent/common channel control, the following option codes are provided.

Option Code	Description
100 (Base System)	With the Base System (Option 100), a common LO1 and LO2 are included in the unit. Both a USB Type-A connector and an RJ-45 (TCP/IP) connector are added to the back panel for LO control. In dual channel systems with the Base Option Code 100 selected, LOs are common, meaning both channels (up- and downconversion) are always tuned to the same frequency.
110	When Option 110 is specified, separate independent LOs are included for the downconverter channels if two channels are included.
200	The IF output is 52-88 MHz
201	The IF output is 104-176 MHz
400	Both inphase (I) and quadrature (Q) outputs provided.



### QM1003 Series System Block Diagrams

For the Base System (**Option 100**), LO1 and LO2 frequencies are generated internally. The LOs are PLL based and require a reference clock and digital control. Figure 1 depicts the system elements for the Base System (Option 100) with internal LOs. The LOs are controlled digitally via a microcontroller, which interfaces to a PC through USB or TCP/IP. The microcontroller outputs basic status messages on a 32-character Liquid Crystal Display (LCD) mounted on the faceplate of the unit. An internal low phase noise 20 MHz reference clock is phase-locked to all of the internal the LOs, with a BNC-F connector providing the option for LOs to lock to a user-provided external reference in the range of 10-100 MHz. A second BNC-F connector outputs an internally-generated 100 MHz reference is used by the LOs for daisy chaining multiple pieces of equipment. Switching between the internal and external LO reference clocks is controlled by the microcontroller and a reference selector switch. The LO1 signal may be provided externally, and the selection between internal and external LO1 is provided by a back-panel switch. A DB-37 connector is provided on the back panel for optional fast-tuning that is controlled by an external TTL signal.

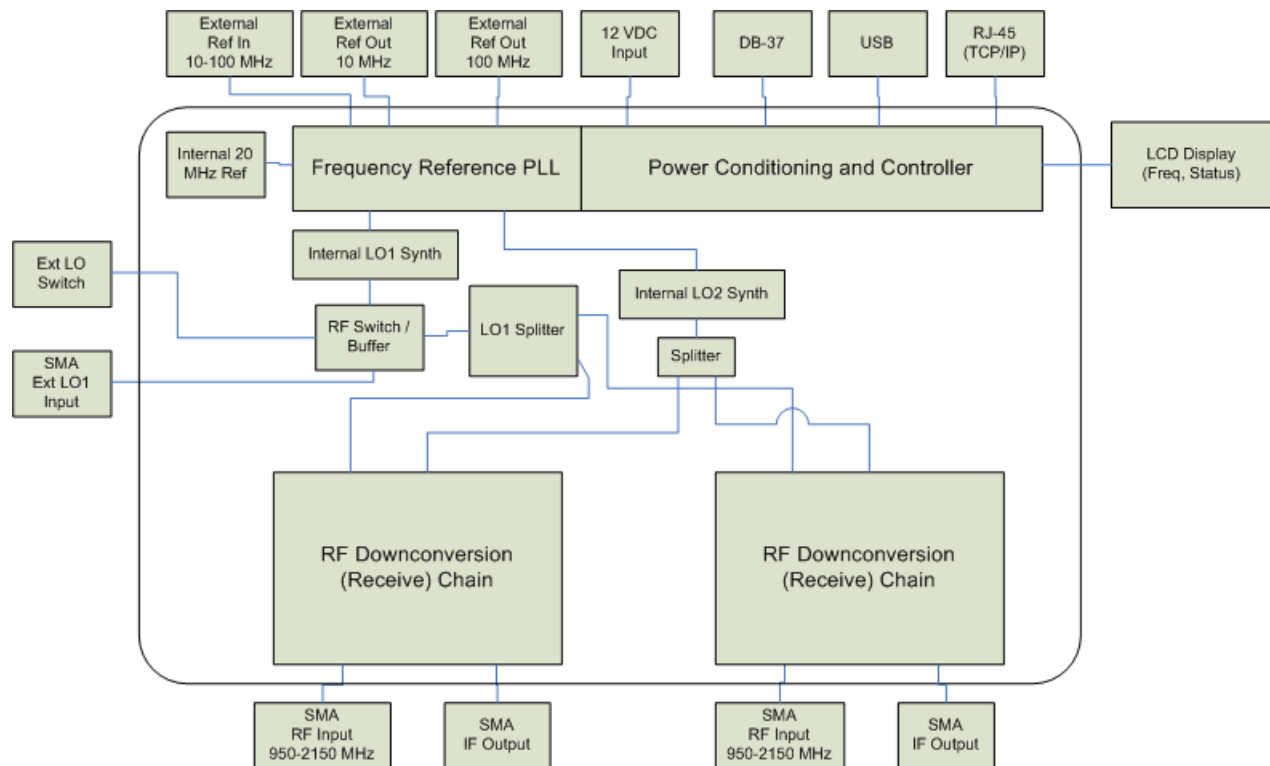


Figure 1. QM1003-2-18 block diagram for the Base System (Option 100) with optional third LO for optional third conversion stage (Options 200 or 201) shown in dashed line.

### RF Signal Chain

QM1003 Series Wideband RF Downconverters use a dual stage conversion architecture to convert 950-2150 MHz RF frequencies to a 70/140 MHz center-frequency IF. For details on the RF conversion signal chain, please contact sales@quonsetmicrowave.com.



In order to control the RF transmit/receive frequency, the internal LO1 synthesizer is tuned using either the provided Windows GUI or using VISA interface commands. Optionally, an external LO1 signal may be provided between 3.4 and 4.4 GHz.

Using the internal LOs, the LO1 frequency calculation is performed internally, and the user need only digitally choose their desired transmit/receive frequency. Otherwise, the LO1 input frequency can be calculated using the desired RF tune frequency with equation (1).

$$LO1 = RF_{tune} + 2.4 \quad (1)$$

**Controlling QM1003 Downconverters with Internal LOs (Option 100)**

QM1003 Downconverters with internal LOs have been designed to be VISA and USBTMC compliant. Any PC and operating system with Virtual Instrument Software Architecture (VISA) drivers installed should be able to communicate with QM1003 units. VISA drivers are provided by many Test and Measurement companies, including Agilent Technologies, National Instruments, and Tektronix. USB and TCP/IP communication and command structure is discussed in detail in the frequency conversion programming manual. A lightweight GUI, supported in Windows®, will be provided for units with internal LOs, providing control of all commonly used commands.

**Interface Connections**

The necessary front and back panel input/output connections on a QM1003 Series frequency converter are summarized in Table 1. The front-panel connections are shown in Figure 2 while the rear-panel connections are shown in Figure 3. Interface connections for the optional Outdoor Unit are similar.



**Figure 2. Front panel connections to QM1003-2-18.**



**Figure 3. Rear-panel connections to QM1003-2-18.**

Table 1. Input and output connections for QM1003-2-18-X (19" Rack Form-Factor)

Parameter	Connector Style	Type	Location
Channel 1 RF Input	SMA	Female	Front Panel
Channel 1 IF Output (I)	SMA	Female	Front Panel
Channel 1 IF Output (Q)	SMA	Female	Front Panel
Channel 2 RF Input	SMA	Female	Front Panel
Channel 2 IF Output (I)	SMA	Female	Front Panel

For price, delivery, and to place orders, please contact Quonset Microwave:  
315 Commerce Park Road, North Kingstown, RI 02852 Phone: 401-295-0062





Channel 2 IF Output (Q)	SMA	Female	Front Panel
Reference Input (10-100 MHz)	BNC	Female	Rear Panel
Reference 1 Output (100 MHz)	BNC	Female	Rear Panel
Reference 2 Output (10 MHz)	BNC	Female	Rear Panel
LO1 Input (12-20 GHz)	SMA	Female	Front Panel
LO1 Int/Ext Switch	Toggle	SPDT Switch	Rear Panel
Int/Ext Ref Switch	Toggle	SPDT Switch	Rear Panel
USB/Ethernet Combined	RJ-45 (Ethernet) Type-A (USB)	Female	Rear Panel
Power Jack	2.1 mm Barrel	Male	Rear Panel
TTL Input (Frequency Tuning, Attenuation Control, Lock Status)	DB-37	Female	Rear Panel

**Power Interface**

The QM1003 Downconverter requires a DC input voltage of 15V applied at the 5.5mm power jack (2.5mm barrel) on the back panel of the instrument. An AC-DC power adapter is supplied with the unit.

**Absolute Maximums**

<b>Operating Temperature</b>	+40 °C
<b>RF Input Power</b>	+2 dBm



**ELECTROSTATIC SENSITIVE DEVICE**  
**OBSERVE HANDLING PRECAUTIONS**

**Ordering Information**

QM1003-1-2-X-[Options]-[ODU]

where

X= 1, 2 (# of Channels)

Options= 100, 110, 200, 201, 400, etc.

ODU= Optional Outdoor Unit Form-Factor