



QM1004-2-18 | 2 to 18 GHz Frequency Converter – 1 Channel Transmit & 1 Channel Receive

Typical Applications

- Frequency Conversion
- Laboratory Test Equipment
- Digital Receiver Exciter (DREX) Systems
- Digital RF Memory (DRFM) Kernel
- Communication systems, SATCOM
- EW, ELINT, SIGINT
- Wideband systems
- Phased array antenna systems
- Radar systems

RF Frequency Range

QM1004-2-18 2 to 18 GHz

IF Frequency Range

Base Unit	750 to 1250 MHz
Option 200	50 to 550 MHz
Option 201	50 to 90 MHz
Option 202	104 to 176 MHz
Option 203	700 to 1700 MHz
Option 204	DC to 1000 MHz
Option 205	2000 to 3000 MHz



QM1004-2-18 with Option 100, 200, 1U 19" Rack-Mount

Features

- Provides a single channel of upconversion and downconversion in a single unit
- Base Option 100 provides internal LO generation with USB and TCP/IP control
- Up to 1 GHz instantaneous bandwidth
- Option for external LO tuning
- Frequency agile across entire tunable band

Form-Factor

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



QM1004-2-18 in Optional Outdoor Unit Form-Factor

General Description

The QM1004-2-18 Wideband Frequency Converter is an frequency agile RF receiver-exciter unit capable of producing and receiving frequencies centered between 2 and 18 GHz with up to 1 GHz of instantaneous bandwidth. The QM1004 series of frequency converters combines a single channel of upconversion and downconversion from Quonset Microwave's QM1002 and QM1003 series of frequency converters in a single unit. The intermediate frequency (IF) for both the receiver and exciter channels is typically centered at 1 GHz

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QM1004-2-18 **2-18 GHz Combined RF** **Up-Down Converter**

(750 to 1250 MHz), with an optional (OPT 200) third stage to further convert down to 50-550 MHz or to 50-90 MHz with OPT 201 or 104-176 MHz with OPT 202. We are now offering a 1 GHz bandwidth unit with Option 203 with IF frequency 700-1700 MHz. Option 204 is again 1 GHz bandwidth, but the IF input/output signal from DC-1000 MHz.

QM1004 Series frequency converters now come standard with internally generated LOs (formerly Option 100). The downconverter channel also includes both I and Q IF outputs (OPT 400) when a third stage downconversion (Opt 200/201) is employed. A 5 Watt limiter and variable attenuator are included standard at the RF input to the downconversion path. A switched LNA is included on the upconverter with Options 200 and 201. An optional parallel TTL interface is provided on the back panel for fast tuning through a parallel DB-37 connector.

The QM1004-2-18 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 QM1004 Series specifications are customizable upon request. Please contact sales@quonsetmicrowave.com for more information. Detailed performance specifications are also available upon request.



Electrical Specifications Base Unit without Option 200 or 201 selected
Upconverter/Transmitter Channel

Parameter	Min.	Typ.	Max.	Units
IF Input Center Frequency	750	1000	1250	MHz
RF Output Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		4		dB
Gain, 2-18 GHz, LNA In		40		dB
Gain, 2-18 GHz, LNA Out		25		dB
Noise Figure (NF), LNA In		12		dB
Noise Figure (NF), LNA Out		25		dB
Input P1dB, 2-18 GHz, LNA In		-15		dBm
Input P1dB, 2-18 GHz, LNA Out		0		dBm
Output P1dB, 2-18 GHz, LNA In		25		dBm
Output P1dB, 2-18 GHz, LNA Out		25		dBm
Phase Noise, 1 KHz Offset		-78		dBc/Hz
Phase Noise, 10 KHz Offset		-80		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-106		dBc/Hz
Phase Noise, 10 MHz Offset		-120		dBc/Hz
Harmonics (-30 dBm input)		-40		dBc
In-Band Spurious, +/- 250 MHz		-60		dBc
Wideband Spurious, 2-18 GHz		-50		dBc
SFDR (Two-tone test)		50		dB

Downconverter/Receiver Channel

Parameter	Min.	Typ.	Max.	Units
IF Output Center Frequency	750	1000	1250	MHz
RF Input Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		5		dB
Gain, 2-18 GHz, Atten= 0 dB		45		dB
Noise Figure (NF), Atten= 0 dB		6.8		dB
Input P1dB, 2-18 GHz, Atten= 0 dB		-40		dBm
Output P1dB, 2-18 GHz, Atten= 0 dB		13		dBm
Phase Noise, 1 KHz Offset		-72		dBc/Hz
Phase Noise, 10 KHz Offset		-77		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-105		dBc/Hz
Phase Noise, 10 MHz Offset		-117		dBc/Hz



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In-Band Spurious, +/- 250 MHz		-50		dBc
SFDR (Two-tone test)		50		dB
I/Q Output Phase Balance		5		deg
I/Q Amplitude Balance		1.0		dB

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Electrical Specifications with Option 200 selected
Upconverter/Transmitter Channel

Parameter	Min.	Typ.	Max.	Units
IF Input Center Frequency	50	300	550	MHz
RF Output Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		4		dB
Gain, 2-18 GHz, LNA In		40		dB
Gain, 2-18 GHz, LNA Out		25		dB
Noise Figure (NF), LNA In		12		dB
Noise Figure (NF), LNA Out		25		dB
Input P1dB, 2-18 GHz, LNA In		-15		dBm
Input P1dB, 2-18 GHz, LNA Out		0		dBm
Output P1dB, 2-18 GHz, LNA In		25		dBm
Output P1dB, 2-18 GHz, LNA Out		25		dBm
Phase Noise, 1 KHz Offset		-78		dBc/Hz
Phase Noise, 10 KHz Offset		-80		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-106		dBc/Hz
Phase Noise, 10 MHz Offset		-120		dBc/Hz
Harmonics (-30 dBm input)		-40		dBc
In-Band Spurious, +/- 250 MHz		-60		dBc
Wideband Spurious, 2-18 GHz		-50		dBc
SFDR (Two-tone test)		50		dB

Downconverter/Receiver Channel

Parameter	Min.	Typ.	Max.	Units
IF Output Center Frequency	50	300	550	MHz
RF Input Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		5		dB
Gain, 2-18 GHz, Atten= 0 dB		45		dB
Noise Figure (NF), Atten= 0 dB		6.8		dB
Input P1dB, 2-18 GHz, Atten= 0 dB		-40		dBm
Output P1dB, 2-18 GHz, Atten= 0 dB		13		dBm
Phase Noise, 1 KHz Offset		-72		dBc/Hz
Phase Noise, 10 KHz Offset		-77		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-105		dBc/Hz
Phase Noise, 10 MHz Offset		-117		dBc/Hz



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In-Band Spurious, +/- 250 MHz		-50		dBc
SFDR (Two-tone test)		50		dB
I/Q Output Phase Balance		5		deg
I/Q Amplitude Balance		1.0		dB



Electrical Specifications with Option 201 selected
Upconverter/Transmitter Channel

Parameter	Min.	Typ.	Max.	Units
IF Input Center Frequency	50	70	90	MHz
RF Output Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		4		dB
Gain, 2-18 GHz, LNA In		40		dB
Gain, 2-18 GHz, LNA Out		25		dB
Noise Figure (NF), LNA In		12		dB
Noise Figure (NF), LNA Out		25		dB
Input P1dB, 2-18 GHz, LNA In		-15		dBm
Input P1dB, 2-18 GHz, LNA Out		0		dBm
Output P1dB, 2-18 GHz, LNA In		25		dBm
Output P1dB, 2-18 GHz, LNA Out		25		dBm
Phase Noise, 1 KHz Offset		-78		dBc/Hz
Phase Noise, 10 KHz Offset		-80		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-106		dBc/Hz
Phase Noise, 10 MHz Offset		-120		dBc/Hz
Harmonics (-30 dBm input)		-40		dBc
In-Band Spurious, +/- 250 MHz		-60		dBc
Wideband Spurious, 2-18 GHz		-50		dBc
SFDR (Two-tone test)		50		dB

Downconverter/Receiver Channel

Parameter	Min.	Typ.	Max.	Units
IF Output Center Frequency	50	70	90	MHz
RF Input Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		5		dB
Gain, 2-18 GHz, Atten= 0 dB		45		dB
Noise Figure (NF), Atten= 0 dB		6.8		dB
Input P1dB, 2-18 GHz, Atten= 0 dB		-40		dBm
Output P1dB, 2-18 GHz, Atten= 0 dB		13		dBm
Phase Noise, 1 KHz Offset		-72		dBc/Hz
Phase Noise, 10 KHz Offset		-77		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-105		dBc/Hz
Phase Noise, 10 MHz Offset		-117		dBc/Hz



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In-Band Spurious, +/- 250 MHz		-50		dBc
SFDR (Two-tone test)		50		dB
I/Q Output Phase Balance		5		deg
I/Q Amplitude Balance		1.0		dB

Upconverter and Downconverter Common Specifications

Parameter	Min.	Typ.	Max.	Units
Operating Voltage		+15		VDC
Current Draw			5	Amps
Tune Frequency Step Size				
Integer Mode*		400		MHz
Fractional Mode		100		KHz
LO1 Input Frequency Range	12		20	GHz
LO1 Input Power		0		dBm
External Reference Input	10		250	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



Electrical Specifications with Option 203 selected
Upconverter/Transmitter Channel

Parameter	Min.	Typ.	Max.	Units
IF Input Center Frequency	700	1200	1700	MHz
RF Output Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		4		dB
Gain, 2-18 GHz, LNA In		40		dB
Gain, 2-18 GHz, LNA Out		25		dB
Noise Figure (NF), LNA In		12		dB
Noise Figure (NF), LNA Out		25		dB
Input P1dB, 2-18 GHz, LNA In		-15		dBm
Input P1dB, 2-18 GHz, LNA Out		0		dBm
Output P1dB, 2-18 GHz, LNA In		25		dBm
Output P1dB, 2-18 GHz, LNA Out		25		dBm
Phase Noise, 1 KHz Offset		-78		dBc/Hz
Phase Noise, 10 KHz Offset		-80		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-106		dBc/Hz
Phase Noise, 10 MHz Offset		-120		dBc/Hz
Harmonics (-30 dBm input)		-40		dBc
In-Band Spurious, +/- 250 MHz		-60		dBc
Wideband Spurious, 2-18 GHz		-50		dBc
SFDR (Two-tone test)		50		dB

Downconverter/Receiver Channel

Parameter	Min.	Typ.	Max.	Units
IF Output Center Frequency	700	1200	1700	MHz
RF Input Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		5		dB
Gain, 2-18 GHz, Atten= 0 dB		45		dB
Noise Figure (NF), Atten= 0 dB		6.8		dB
Input P1dB, 2-18 GHz, Atten= 0 dB		-40		dBm
Output P1dB, 2-18 GHz, Atten= 0 dB		13		dBm
Phase Noise, 1 KHz Offset		-72		dBc/Hz
Phase Noise, 10 KHz Offset		-77		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-105		dBc/Hz
Phase Noise, 10 MHz Offset		-117		dBc/Hz



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In-Band Spurious, +/- 250 MHz		-50		dBc
SFDR (Two-tone test)		50		dB
I/Q Output Phase Balance		5		deg
I/Q Amplitude Balance		1.0		dB



Electrical Specifications with Option 205 selected
Upconverter/Transmitter Channel

Parameter	Min.	Typ.	Max.	Units
IF Input Center Frequency	2000	2500	3000	MHz
RF Output Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		4		dB
Gain, 2-18 GHz, LNA In		40		dB
Gain, 2-18 GHz, LNA Out		25		dB
Noise Figure (NF), LNA In		12		dB
Noise Figure (NF), LNA Out		25		dB
Input P1dB, 2-18 GHz, LNA In		-15		dBm
Input P1dB, 2-18 GHz, LNA Out		0		dBm
Output P1dB, 2-18 GHz, LNA In		25		dBm
Output P1dB, 2-18 GHz, LNA Out		25		dBm
Phase Noise, 1 KHz Offset		-78		dBc/Hz
Phase Noise, 10 KHz Offset		-80		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-106		dBc/Hz
Phase Noise, 10 MHz Offset		-120		dBc/Hz
Harmonics (-30 dBm input)		-40		dBc
In-Band Spurious, +/- 250 MHz		-60		dBc
Wideband Spurious, 2-18 GHz		-50		dBc
SFDR (Two-tone test)		50		dB

Downconverter/Receiver Channel

Parameter	Min.	Typ.	Max.	Units
IF Output Center Frequency	2000	2500	3000	MHz
RF Input Frequency Range	2		18	GHz
Instantaneous Usable Bandwidth		500		MHz
IF Ripple (+/- 250 MHz)		5		dB
Gain, 2-18 GHz, Atten= 0 dB		45		dB
Noise Figure (NF), Atten= 0 dB		6.8		dB
Input P1dB, 2-18 GHz, Atten= 0 dB		-40		dBm
Output P1dB, 2-18 GHz, Atten= 0 dB		13		dBm
Phase Noise, 1 KHz Offset		-72		dBc/Hz
Phase Noise, 10 KHz Offset		-77		dBc/Hz
Phase Noise, 100 KHz Offset		-77		dBc/Hz
Phase Noise, 1 MHz Offset		-105		dBc/Hz
Phase Noise, 10 MHz Offset		-117		dBc/Hz



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In-Band Spurious, +/- 250 MHz		-50		dBc
SFDR (Two-tone test)		50		dB
I/Q Output Phase Balance		5		deg
I/Q Amplitude Balance		1.0		dB

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Option 200/201 Discussion for Upconversion Channels

QM1004 series frequency converter units are offered with an optional 50-550 MHz intermediate frequency range (Option 200) or an optional 50-90 MHz IF (Option 201). For applications utilizing a digital waveform generator, we recognize that DACs operating in the first Nyquist zone generally have output power levels approaching 0 dBm. Other applications for upconversion would utilize a lower-level analog input. With this in mind, we have included a switched LNA along with Options 200 and 201.

Options Overview

To provide flexibility for system integration, the QM1004-2-18 series of receiver-exciter have 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.
200	The IF input/output is changed to 50-550 MHz.
201	The IF input/output is changed to 50-90 MHz (70 MHz center).
202	The IF input/output is changed to 104-176 MHz (140 MHz center).
203	The IF input/output is changed to 700-1700 MHz, now with 1 GHz instantaneous BW.
204	The IF input/output is DC-1000 MHz I/Q with an instantaneous bandwidth of 1 GHz.
205	The IF input/output is 2000-3000 MHz with an instantaneous bandwidth of 1 GHz.
400	Both inphase (I) and quadrature (Q) outputs provided.



QM1004 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.

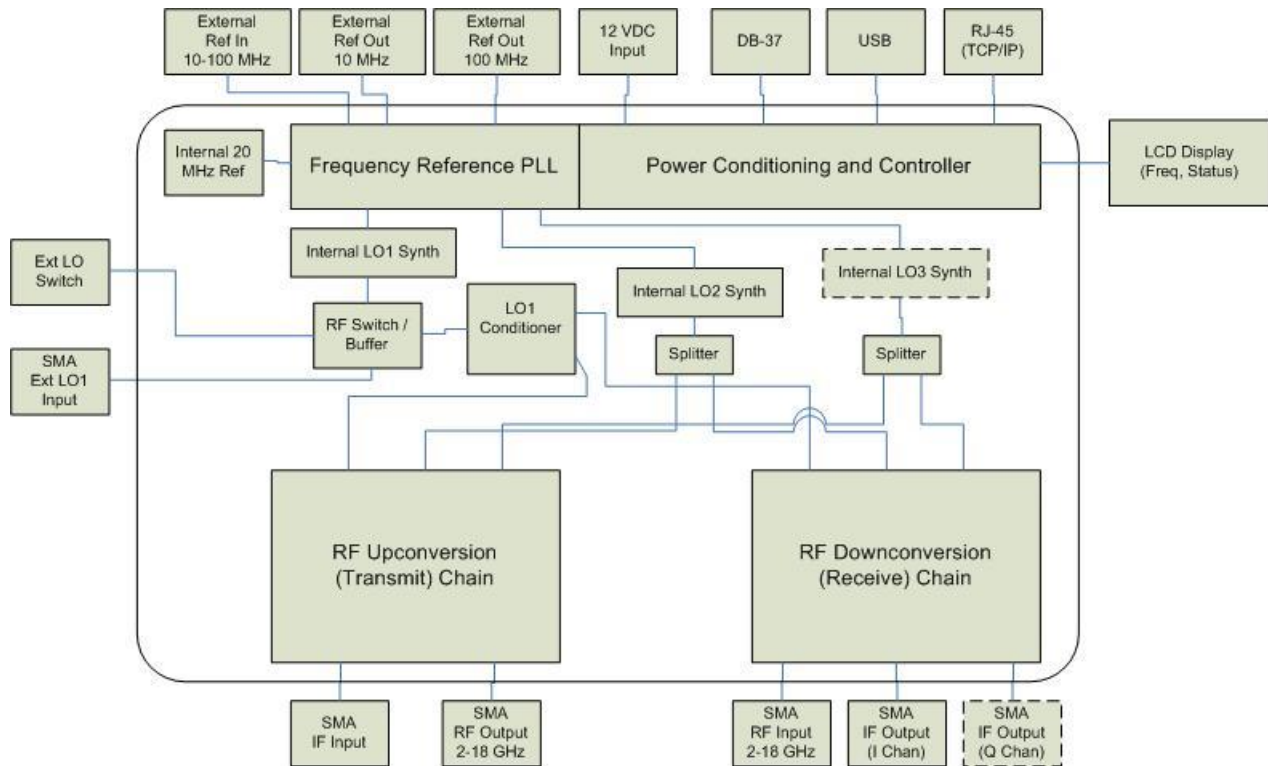


Figure 1. QM1004-2-18 block diagram for the Base System (Option 100) with optional third LO for optional third conversion stage (Options 200 or 201) shown in dashed line.

RF Signal Chain

QM1004 Series Wideband Combined RF Up-Down Converters use a dual stage conversion architecture to convert frequencies up and down from a 1 GHz center-frequency IF (or 300 MHz with Option 200 and 70 MHz with Option 201) to an RF centered between 2 and 18 GHz. 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 11.3 and 19.3 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).

$$LO1 = \frac{(RF_{tune} + 22)}{2} \quad (1)$$

Option 200/201 RF Chain Modifications

Option 200 moves the IF from 750-1250 MHz down to 50-550 MHz and to 50-90 MHz for Option 201. This modification requires a third frequency conversion stage which converts the 1 GHz output IF to an IF output frequency centered at 300 MHz (Option 200) or 70 MHz (Option 201). As with all QM1004 series frequency converter units, knowledge of the LO input frequencies and frequency plan calculation is only necessary if user-generated external LOs are required.

Controlling QM1004 Downconverters with Internal LOs (Option 100)

QM1004 Rack Mount Up/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 QM1004 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 QM1004 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 QM1004-2-18.

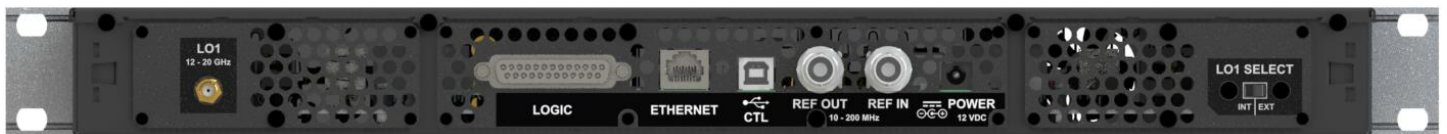


Figure 3. Rear-panel connections to QM1004-2-18.



Table 1. Input and output connections for QM1004-2-18 (19" Rack-Mount Form-Factor)

Parameter	Connector Style	Type	Location
Upconverter IF Input	SMA	Female	Front Panel
Upconverter RF Output	SMA	Female	Front Panel
Downconverter RF Input	SMA	Female	Front Panel
Downconverter IF (I) Output	SMA	Female	Front Panel
Downconverter IF (Q) Output	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-44 (Formerly DB-25)	Female	Rear Panel

Power Interface

The QM1004 Combined Up/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

Operating Temperature	+40 °C
RF Input Power	+2 dBm



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Ordering Information

QM1004-2-18-[Options]-[ODU]

where

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

ODU= Optional Outdoor Unit Form-Factor