



QM1007 | VST Frequency Extender – Fixed RF frequency, 1.0 GHz bandwidth
QM1007S | VST Frequency Extender – Switchable over two or more 1.0 GHz RF bands (can be adjacent)
QM1007D | VST Frequency Extender – Separate Tx and Rx frequencies for Full Duplex Comms
QM1007T* | VST Frequency Extender – Tunable over a wide range of RF bands
 *Note: QM1007T has reduced phase noise compared to QM1007, QM1007S

Typical Applications

- NI Vector Signal Transceiver (VST) Extender
- Compatible with National Instruments (NI) PXIe-5646R and PXIe-5840
- Radar test target generation
- Extremely low phase-noise
- Microwave and mmW communication
- Laboratory Test Equipment
- Communication systems, SATCOM
- EW, ELINT, SIGINT
- Wideband systems
- Radar systems

Performance

RF Frequency Range

| | |
|--------------------------------|------------------------------------|
| QM1007-8.5-9.5 | 8.5 to 9.5 GHz |
| QM1007-9.0-10.0 | 9.0 to 10.0 GHz |
| QM1007-9.5-10.5 | 9.5 to 10.5 GHz |
| QM1007-16.0-17.0 | 16.0 to 17.0 GHz |
| QM1007-34.5-35.5 | 34.5 to 35.5 GHz |
| QM1007S/16.5/17.0/17.5 | 16.0 to 18.0 GHz |
| QM1007S/16.5/35.0 | 16-17/34.5-35.5 |
| QM1007T-24.0-29.0 | 24.0 to 29.0 GHz |
| QM1007D-7.5Tx-8.15Rx -500BW | 7.25-7.75 GHz Tx 7.0-8.4 GHz Rx |

IF Frequency Range

| | |
|---------------|------------------|
| 2.0 – 3.0 GHz | VST Input/Output |
|---------------|------------------|

Bandwidth when Interfaced to NI VST

| | |
|------------|--------------|
| PXIe-5646R | 200 MHz max |
| PXIe-5840 | 1000 MHz max |

Features

- Fixed frequency conversion
- Extremely low phase noise (-110 dBc@10 kHz), internal LO sources
- Provides a single channel of upconversion and downconversion in a single unit
- Additional up- or down-conversion channels optional
- Interfaces directly with National Instruments Vector Signal Transceivers (VST)
- Programmable attenuation 124.5 dB on transmit and 62.4 dB on receive
- USB and TCP/IP control
- Low-noise receiver front-end with limiter
- Low spurious

Form-Factor

- 1U 19" Rack module



QM1007, 1U 19" Rack-Mount



General Description

The QM1007 VST Frequency Extender is specifically designed to interface with the National Instruments (NI) Vector Signal Transceiver (VST) including the PXIe-5646R with a maximum 200 MHz and the PXIe-5840 with a maximum 1000 MHz bandwidth. The QM1007 provides an external low phase noise reference clock (10 MHz) and a local oscillator (LO) to the VST, and contains an additional stage of frequency conversion internal to the QM1007. This QM1007 VST Frequency Extender is designed for fixed frequency applications, such as X-band radar test sets, where the VST I/Q output is translated to a fixed band, including 8.5-9.5 GHz, 9.0-10.0 GHz, and 9.5-10.5 GHz. Other bands are available on request.

Of particular importance, the QM1007 provides internal extremely low phase noise sources, which are important for diverse applications including radar target generators and communications. The spurious performance is also exceptional, which reduces bit error rates in communications applications, reduces false targets in radar applications, and enhances detectability of weak signals in electronic sensing.

The QM1007 product line has recently been extended to incorporate both SWITCHABLE frequency units (QM1007S) and TUNABLE units (QM1007T). The QM1007S line offers the ability to switch between bands, while enjoying the same extremely low phase noise performance of the original single-band QM1007. For example, the QM1007S/16.5/17.0/17.5 switches between three center frequencies of 16.5, 17.0 and 17.5 GHz with a 1.0 GHz instantaneous bandwidth at each of the three switched bands. The frequency bands can be adjacent as in the example above, or disparate, as in QM1007S/16.5/35.0 where the unit switches between Ku-band (16.0 – 17.0 GHz) and Ka-band (34.5 – 35.5 GHz).

The tunable QM1007T product line is designed to extend the cost-effective QM1007 line to cover a range of frequencies for VST interface applications. The phase noise is increased slightly compared to the QM1007 and QM1007S due to the internal synthesizer (consult factory for details). Also, RF filtering is limited in these units, and the user is expected to supply their own RF filter to meet their application requirements over the specific band of operation.

Internal attenuators are included in all of the QM1007, QM1007S and QM1007T units on both transmit and receive to extend the dynamic range on transmit and receive. The QM1007 units provide 124.5 dB transmit attenuation control, which is useful for target simulation, and 62.5 dB receive attenuation control. Both transmit and receive attenuation may be controlled statically via software commands or external TTL connector inputs. The transmit attenuation may also be programmed to automatically follow an exponential time profile, triggered by a TTL pulse-repetition-interval (PRI).

The QM1007 is controlled via the USB or TCP/IP port as a USBTMC or TCPIP device using VISA protocol, enabling seamless integration into Windows®, Linux®, and Macintosh® environments. A Windows® GUI is provided. External TTL control is also provided for time-varying attenuation control, frequency switching, etc.

All QM1007 Series specifications are customizable upon request. Please contact sales@quonsetmicrowave.com for more information. Detailed performance specifications are also available upon request.



Upconverter/Transmitter Channel

| Parameter | Min. | Typ. | Max. | Units |
|---|--------|-------|----------|--------|
| IF Input Center Frequency (from VST) | | 2.5 | | GHz |
| RF Output Frequency Range | | | | |
| QM1007-8.5-9.5 | 8.5 | 9.0 | 9.5 | GHz |
| QM1007-9.0-10.0 | 9.0 | 9.5 | 10.0 | GHz |
| QM1007-9.5-10.5 | 9.5 | 10.0 | 10.5 | GHz |
| Instantaneous Usable Bandwidth | | 1000 | | MHz |
| IF Ripple (+/- 500 MHz) | | 3 | | dB |
| Gain | -112.5 | 12 | | dB |
| Programmable Attenuation Range | | 124.5 | | dB |
| Output RF level for various attenuation settings Assuming VST output level -50 to + 10 dBm | | | | |
| Atten= 0 dB (G= +10 dB) | -40 | | 10 (sat) | dBm |
| Atten= 30 dB (G= -20 dB) | -70 | | -10 | dBm |
| Atten= 60 dB (G= -50 dB) | -100 | | -40 | dBm |
| Atten= 90 dB (G= -80 dB) | -150 | | -70 | dBm |
| Atten= 120 dB (G= -110 dB) | -180 | | -100 | dBm |
| Noise Figure (NF) | | 12 | | dB |
| Output P1dB | | 20 | | dBm |
| Group Delay | | 50 | | ns |
| Phase Noise | | | | |
| 100 Hz | | -80 | | dBc/Hz |
| 1 KHz | | -90 | | dBc/Hz |
| 10 KHz | | -100 | | dBc/Hz |
| 100 KHz | | -105 | | dBc/Hz |
| 1 MHz | | -135 | | dBc/Hz |
| 10 MHz | | -140 | | dBc/Hz |
| Harmonics | | -60 | | dBc |
| In-Band Spurious, +/- 500 MHz | | -60 | | dBc |
| Wideband Non-Harmonic Spurious, 0.5-18 GHz | | -60 | | dBc |
| SFDR (Two-tone test) | | 50 | | dB |

Downconverter/Receiver Channel

| Parameter | Min. | Typ. | Max. | Units |
|-------------------------------------|------|------|------|-------|
| IF Output Center Frequency (to VST) | | 2.5 | | GHz |
| RF Input Frequency Range | | | | |
| QM1007-8.5-9.5 | 8.5 | 9.0 | 9.5 | GHz |
| QM1007-9.0-10.0 | 9.0 | 9.5 | 10.0 | GHz |
| QM1007-9.5-10.5 | 9.5 | 10.0 | 10.5 | GHz |



Quonset Microwave
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 division of Applied Radar, Inc.

QM1007
VST Frequency Extender

| | | | | |
|---|-------|------|--|--------|
| Instantaneous Usable Bandwidth | | 1000 | | MHz |
| IF Ripple (+/- 500 MHz) | | 3 | | dB |
| Gain | -37.5 | 25 | | dB |
| Programmable Attenuation Range | | 62.5 | | dB |
| Noise Figure (NF) | | 8 | | dB |
| Output P1dB | | 20 | | dBm |
| Group Delay | | 50 | | ns |
| Phase Noise | | | | |
| 100 Hz | | -80 | | dBc/Hz |
| 1 KHz | | -90 | | dBc/Hz |
| 10 KHz | | -100 | | dBc/Hz |
| 100 KHz | | -105 | | dBc/Hz |
| 1 MHz | | -135 | | dBc/Hz |
| 10 MHz | | -140 | | dBc/Hz |
| In-band Harmonics, +/- 500 MHz | | -40 | | dBc |
| In-Band Non-Harmonic Spurious, +/- 500 MHz | | -60 | | dBc |
| Out-of-Band Spurious and Harmonics, 0.5-18 GHz | | -50 | | dBc |
| SFDR (Two-tone test) | | 50 | | dB |
| I/Q Output Phase Balance | | 5 | | deg |
| I/Q Amplitude Balance | | 1.0 | | dB |
| Attenuation switching speed (externally-controlled) | | 10 | | ns |

Upconverter and Downconverter Common Specifications

| Parameter | Min. | Typ. | Max. | Units |
|-----------------------------|------|------|------|-------|
| Operating Voltage | | +15 | | VDC |
| Current Draw | | | 5 | Amps |
| External Reference Input | | 100 | | MHz |
| External Reference 1 Output | | 100 | | MHz |
| External Reference 2 Output | | 10 | | MHz |

For price, delivery, and to place orders, please contact Quonset Microwave (div. of Applied Radar, Inc.):
 315 Commerce Park Road, Unit 3, North Kingstown, RI 02852 Phone: 401-295-0062



QM1007 Series System Block Diagram

A system block diagram for the QM1007 VST Frequency Extender is shown in Figure 1. Internal attenuators in the upconverter and downconverter blocks are controlled digitally via an FPGA and 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 100 MHz reference clock is phase-locked to all of the internal LOs, with a BNC-F connector providing the option for LOs to lock to a user-provided 100 MHz external reference. Two additional BNC-F connectors output an internally-generated 10 MHz and 100 MHz reference for use by external test equipment. An external 2.5 GHz LO2 is provided to the VST for phase locking. Switching between the internal and external LO reference clocks is controlled either by the microcontroller or 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. When the internal LO1 setting is used, the LO1 signal is also output on the external LO1 connector for multi-channel or MIMO applications. A DB-37 connector is provided on the back panel for fast-tuning of the up-converter and down-converter attenuators via TTL hardware control as well as providing status bits.

For target generation applications, the transmit attenuation may be controlled automatically in real-time via internal FPGA control. An external pulse repetition interval (PRI) trigger is provided via the 37-pin DB-37 connector, which triggers the automatic transmit attenuation control. Optionally, the transmit attenuation may be programmed to a static value via either the provided control GUI or VISA commands over the USB or TCP/IP interface. Static attenuation may also be set by rear-panel DB-37 control.

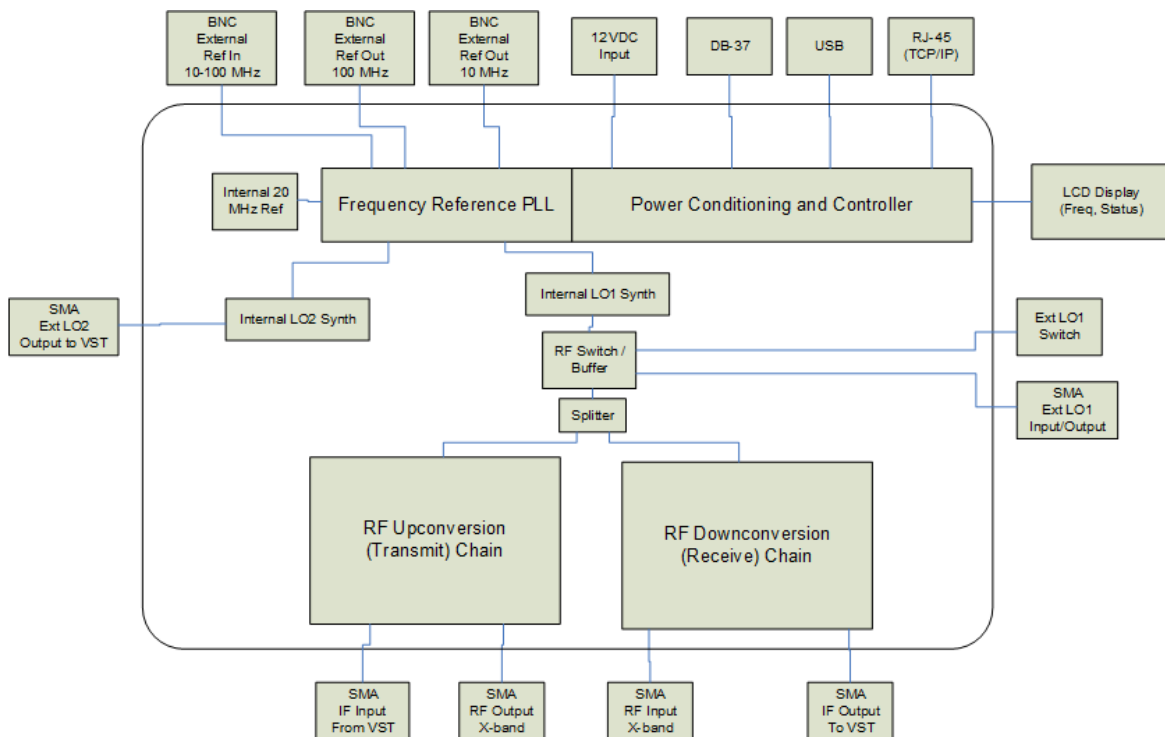


Figure 1. QM1007 system block diagram.



Controlling QM1007 VST Frequency Extender

The QM1007 VST Frequency Extender has been designed to be VISA, USBTMC, IEEE-488.2, and SCPI compliant. Any PC and operating system with Virtual Instrument Software Architecture (VISA) drivers (suggest using NI-VISA) installed should be able to communicate with QM1007 units. USB and TCP/IP communication and command structure is discussed in detail in the VST Frequency Extender 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 QM1007 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 QM1007.



Figure 3. Rear-panel connections to QM1007.

Table 1. Input and output connections for QM1007-8.5-9.5 (19" Rack-Mount Form-Factor)

| Parameter | Connector Style | Type | Location |
|--|----------------------------------|-------------|-------------|
| Upconverter IF Input (from VST) | SMA | Female | Front Panel |
| Upconverter RF Output | SMA | Female | Front Panel |
| Downconverter RF Input | SMA | Female | Front Panel |
| Downconverter IF Output (to VST) | SMA | Female | Front Panel |
| Ext LO1 Input/Output | SMA | Female | Rear Panel |
| Ext LO2 Output (to VST) | SMA | Female | Front Panel |
| Reference Input (100 MHz) | BNC | Female | Rear Panel |
| Reference 1 Output (100 MHz) | BNC | Female | Rear Panel |
| Reference 2 Output (10 MHz) | BNC | Female | Rear Panel |
| Int/Ext Ref Switch | Toggle | SPDT Switch | Rear Panel |
| Ext LO1 Ref Switch | Toggle | SPDT Switch | Rear Panel |
| USB/Ethernet Combined | RJ-45 (Ethernet) Type-A (USB) | Female | Rear Panel |
| Power Jack | 2.5 mm Barrel | Female | Rear Panel |
| TTL Input (Attenuation Control / Status) | DB-37 | Female | Rear Panel |



Interface between NI VST and VST Frequency Extender

The interface between the National Instruments VST-1 or VST-2 for a single-channel application (one channel of up-conversion, and one channel of down-conversion) is illustrated in Figure 4 below. In this case, the QM1007 VST Frequency Extender provides a 10 MHz reference as well as an external LO2 signal to the VST. The IF input and outputs provided by the QM1007 connect directly to the VST-1 or VST-2.

The interface for a multi-channel (or MIMO) configuration is illustrated in Figure 5. In this case, one QM1007 VST Frequency Extender unit is designated as the “master”, and its 10 MHz output is connected to an external splitter, which is fed to the two VST units and the second “slave” QM1007 VST Frequency Extender. Similarly, the LO1 and LO2 outputs are also fed to splitters (in the case of more than two channels) and fed to the slave VST Frequency Extender. This is necessary to ensure the same startup phase for multi-channel applications.

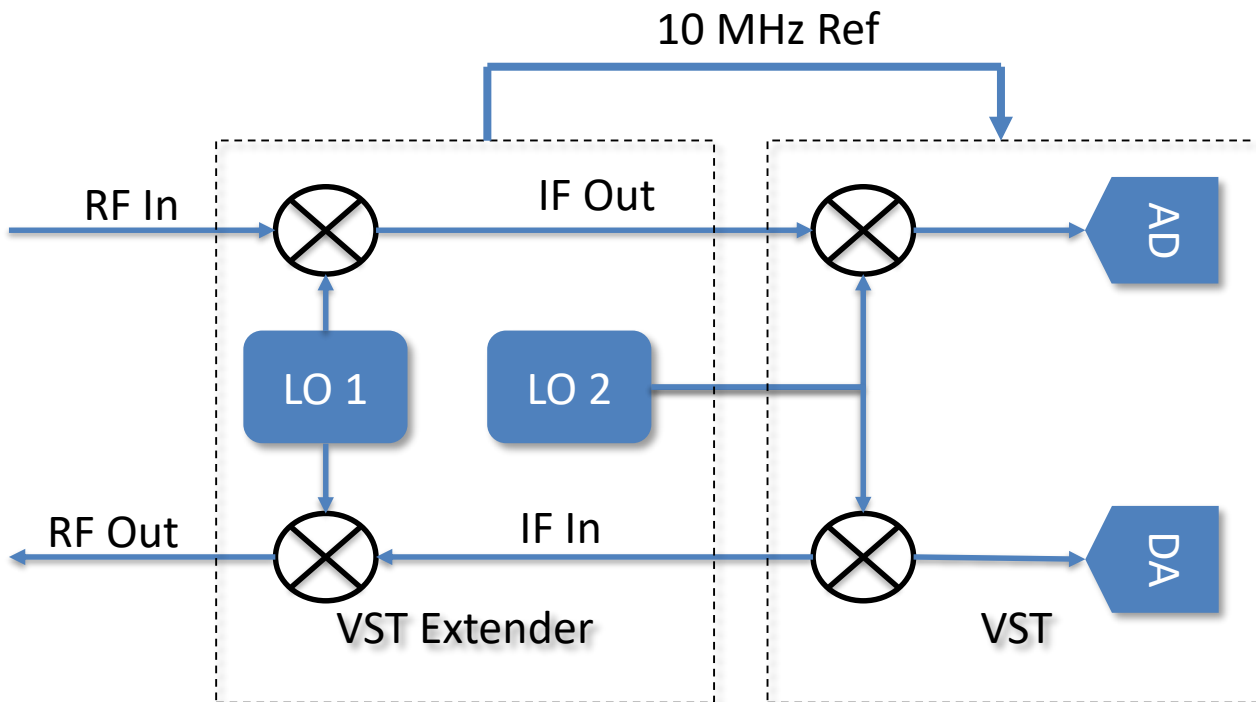


Figure 4. Interface between NI VST and VST Frequency Extender in a single-channel configuration.

Multi-Channel (MIMO) Configuration

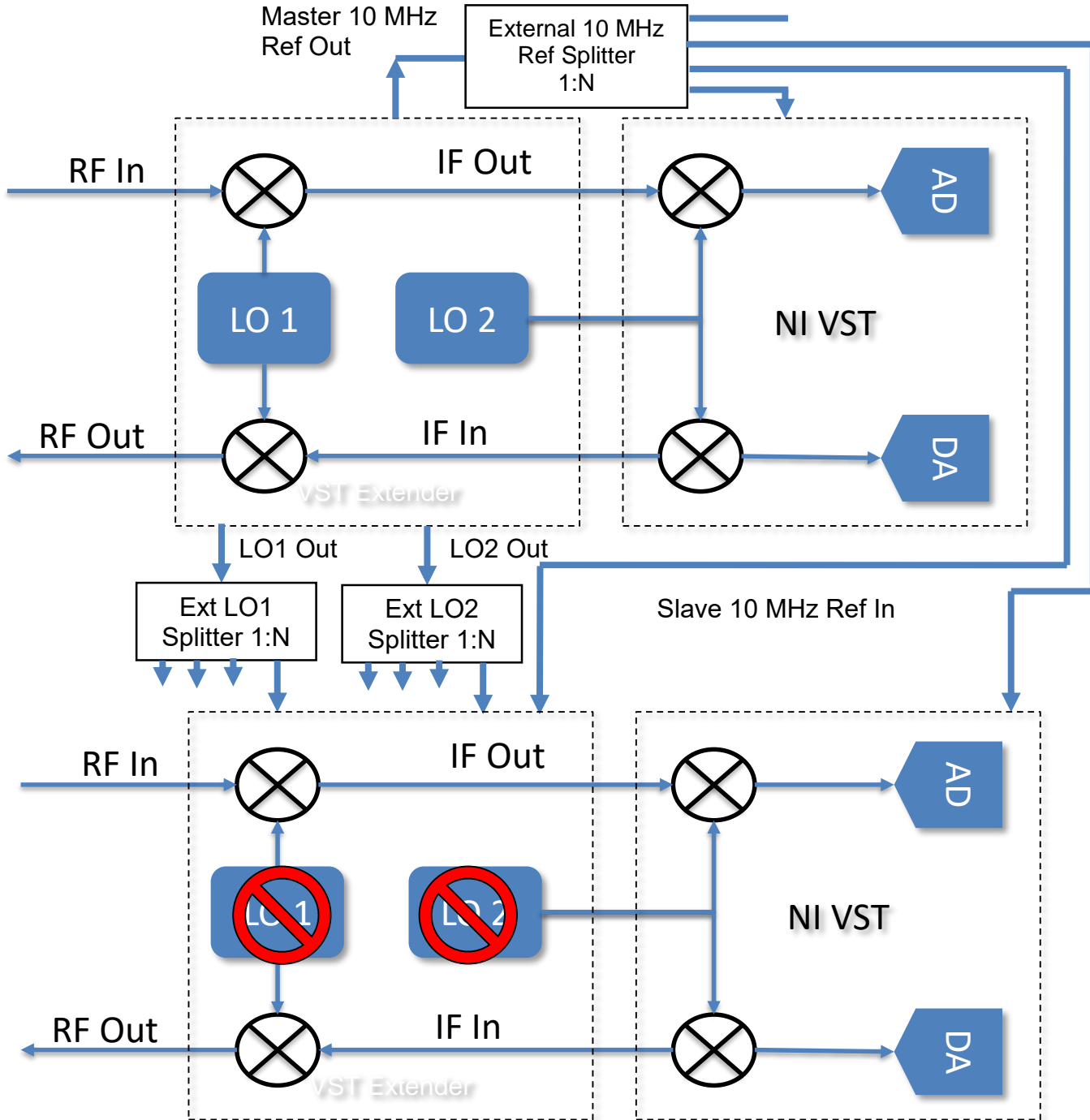


Figure 5. Interface between NI VST and VST Frequency Extender in a multi-channel (or MIMO) configuration.



Power Interface

The QM1007 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 |
| Downconverter RF Input Power | +10 dBm |
| Upconverter IF Input Power | +12 dBm |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Ordering Information

QM1007-XX-YY-[Options]
QM1007S/F1/F2-[Options]
QM1007T-XX-YY-[Options]

where

XX= Lower RF Output Frequency in GHz

YY= Upper RF Output Frequency in GHz

F1, F2 are center frequencies of switched bands

Options=