

9800 Series Frequency Converters

Single Band, Synthesized Frequency Up- and Downconverters
for all SATCOM bands, L through Ka,
and TT&C applications



The MITEQ frequency converters are designed for advanced satellite communication systems and are available for a wide variety of frequency plans. Phase noise, amplitude flatness and spurious outputs have been optimized to provide the user with a transparent frequency conversion for all video and data applications.

The frequency converters include an internal tracking reference that will adjust to track the external reference with a controlled slew rate. The internal reference has memory and will maintain its last position relative to the external with the removal or loss of the external reference. Frequency will not jump upon connecting to or loss of external reference.

A strong feature set of monitor and control functions supports powerful local and remote control. Among the features are control of frequency, attenuation and 64 memory locations for each converter where various setups can be stored and recalled.

A continuously updated log of time-stamped records of activity is also provided.

Options

- Higher stability reference
- Remote RS232
- 140 MHz IF frequency
- Higher gain (downconverter)
- Selectable 70/140 MHz IF frequency
- 50 ohms IF impedance
- Selectable 50/75 ohm IF impedance
- Multiple IF outputs (downconverter)
- Group delay equalization
- LO level alarm
- Smaller frequency step size 100 Hz/200 Hz
- 45 dB level control
- Type "N" IF or RF connector
- Type "TNC" RF connector
- Fiber optic RF-band interface
- 9400 series backwards compatibility
- Ultra-low phase noise with reference suppression
- Rear panel "U" link to bypass internal reference

Features

- 1 kHz step size precise frequency selection
- Superior to IESS-308/309 phase noise
- Phase Noise suppression of external reference
- Supports expandable NSU 1:N switchover series (D-323)
- Amplitude slope adjust
- Three monitor and control ports:
 1. RS485/RS422 remote interface (J6A) changes to RS232 with Option 17C
 2. RS485/RS422 control interface (J7) is provided for use the NSU redundancy system (D-323) or as an alternative interface
 3. 10/100Base-T Ethernet interface (J6B)
 - HTTP based web server,
 - SNMP 1.0 configuration
 - Telnet access
 - Firmware can be remotely updated over Ethernet
- RF, IF and LO monitor ports
- Automatic locking to external 5/10 MHz reference and electronic frequency adjust of internal reference frequency
- Reference phase lock with memory and slew rate of 0.06 ppm/sec
- Low intermodulation distortion
- 64 programmable memory locations
- 30 dB level control
- External alarm input via contact closure
- Date and time-stamped event log
- AC power supply with power factor correction
- CE Mark

Specifications	Upconverter	Downconverter
Type	Dual conversion	
Frequency step size	1 kHz	
Frequency sense	No inversion	
Input characteristics		
Frequency	70 \pm 20 MHz (140 \pm 40 MHz Option 4)	Refer to model number table
Impedance	75 ohms (50 ohms Option 15)	50 ohms
Return loss	26 dB minimum (70 \pm 20 MHz), 20 dB minimum (140 \pm 40 MHz), 18 dB minimum (Option 14)	20 dB minimum 17 dB minimum (27 to 31 GHz)
Signal monitor	-20 dBc nominal	-20 dBc nominal (above 17.7 GHz, optional) 14 dB minimum (above 40 GHz)
LO leakage	N/A	
Input level (nondamage)	+15 dBm maximum	
Output characteristics		
Frequency	Refer to model number table	70 \pm 20 MHz (140 \pm 40 MHz Option 4)
Impedance	50 ohms	75 ohms (50 ohms Option 15)
Return loss	20 dB minimum (17 from dB 27 to 31 GHz), 14 dB minimum (above 40 GHz)	26 dB minimum (70 \pm 20 MHz), 20 dB minimum (140 \pm 40 MHz), 18 dB minimum (Option 14)
Signal monitor	-20 dBc nominal (above 17.7 GHz, optional)	-20 dBc nominal
LO leakage	-75 dBm maximum	N/A
Power output (P1dB)	+15 dBm minimum, +5 dBm minimum (above 40 GHz)	+20 dBm minimum
Transfer characteristics		
Gain	30–35 dB at 23°C	55–61 dB at 23°C (Option 16C)
Noise figure at min. atten.	15 dB maximum, 18 dB from 22 to 31 GHz, 25 dB maximum (above 40 GHz)	12 dB maximum, 15 dB above 22 GHz
Image rejection	80 dB minimum	
Level stability	\pm 0.25 dB/day maximum at constant temperature \pm 0.5 dB typical from 0 to 50°C	
Amplitude response		
70 \pm 20 MHz	\pm 0.25/ \pm 20 MHz; \pm 0.2/ \pm 18 MHz	
140 \pm 40 MHz	0.75 dB/ \pm 36 MHz	
Group delay (70 \pm 18 MHz)		
Linear	0.03 ns/MHz maximum	
Parabolic	0.01 ns/MHz ² maximum	
Ripple	1 ns peak-to-peak maximum	
Group delay (140 \pm 36 MHz)		
Linear	0.025 ns/MHz maximum	
Parabolic	0.0035 ns/MHz ² maximum	
Ripple	1 ns peak-to-peak maximum	
Intermodulation distortion (third order) two signals each at 0 dBm output	54 dBc minimum (+27 dBm IP3 pt.), 50 dBc minimum from 22 to 31 GHz (+25 dBm IP3 pt.), 30 dBc minimum above 40 GHz (+15 dBm IP3 pt.)	60 dBc minimum (+30 dBm IP3 pt.)
AM/PM conversion	0.03°/dB maximum to 0 dBm output	
Gain slope		
70 \pm 20 MHz	0.03 dB/MHz maximum (10 MHz maximum)	
140 \pm 40 MHz	0.05 dB/MHz maximum (10 MHz maximum)	
Spurious outputs		
Signal related	65 dBc up to 0 dBm output, 60 dBc from 22 to 31 GHz, 60 dBc up to -5 dBm output above 40 GHz	
Signal independent	-70 dBm maximum, -65 dBm maximum (above 40 GHz)	-75 dBm maximum, -65 dBm maximum (Option 16C)
Gain adjustment	30 dB in 0.2 dB steps	
Internal reference characteristics (see Option 10 and Note 1)	\pm 2 \times 10 ⁻⁸ , 0 to 50°C (higher stability options available, see Option 10) \pm 5 \times 10 ⁻⁹ /day typical (fixed temperature after 24 hour on time)	
Upconverter mute	60 dB minimum	N/A
External reference input characteristics	5 or 10 MHz, +4 \pm 3 dBm, Unit will automatically switch to internal reference with loss of external reference	
Phase noise	See chart	
Primary power	100–240 VAC (-10%, +6%), operational 90–265 VAC, 47–63 Hz 60 W typical	
Amplitude slope adjust	\pm 3 dB typical in 0.2 dB steps	
Noise power density	-124 dBm/Hz maximum, -121 dBm/Hz maximum above 22 GHz	N/A
Remote interface	RS485/RS422: 2 ports user selectable each port (1 port with Option 17C) Ethernet interface: HTTP based web server, SNMP 1.0 configuration, Alarm reporting via SNMP trap, Telnet access, Password protection	

Note: All specifications guaranteed at maximum gain unless otherwise noted.

Ambient temperature -50 to +70°C
Relative humidity..... Up to 95% at 40°C
Atmospheric pressure Up to 40,000 feet
Shock and vibration Normal handling
by commercial carriers

Phase Noise Specifications

Standard

Option 31 - Ultra-Low Phase Noise

Model Number	10	100	1K	10K	100K	300K	1M	10	100	1K	10K	100K	300K	1M	Offset [Hz]
U-9848-1-1K	-57	-77	-92	-97	-99	-99	-117	-60	-80	-96	-100	-101	-101	-122	Maximum Phase Noise (dBc/Hz) (1 Hz bandwidth) Straight line curve defined by the points in the table
U-9848-(2,4,5,6,7)-1K	-60	-78	-88	-96	-96	-96	-117	-65	-86	-100	-102	-105	-107	-125	
U-9853-(2,6,7)-1K	-57	-77	-90	-97	-99	-99	-117	-65	-85	-96	-99	-100	-100	-120	
U-9854-1K, U-9854-1-1K	-57	-77	-90	-97	-99	-99	-117	-62	-82	-96	-98	-100	-100	-120	
U-9855-2-1K	-51	-69	-87	-91	-93	-93	-111	-60	-79	-91	-93	-95	-95	-118	
U-9856-6-1K	-50	-66	-87	-91	-93	-93	-111	-59	-75	-91	-93	-95	-95	-118	
U-9856-7-1K, U-9857-2-1K	-50	-66	-85	-90	-93	-93	-111	-59	-75	-90	-92	-95	-95	-118	
U-9858-(2,3,4,5)-1K	-49	-63	-69	-79	-91	-91	-109	-56	-71	-84	-86	-91	-91	-113	
U-9859-4-1K	-35	-56	-80	-82	-86	-90	-108	-45	-64	-83	-85	-88	-90	-111	
D-9800-3-1K	-57	-77	-92	-97	-99	-99	-117	-60	-80	-96	-100	-101	-101	-122	
D-9800-(2,6,7,8,9)-1K	-60	-78	-88	-96	-96	-96	-117	-65	-86	-100	-102	-105	-107	-125	
D-9801-1-1K, D-9802-2-1K	-57	-77	-93	-97	-99	-99	-117	-65	-85	-96	-99	-100	-100	-120	
D-9805-1K, D-9805-1-1K	-57	-77	-92	-97	-99	-99	-117	-60	-80	-96	-100	-101	-101	-122	
D-9808-6-1K	-51	-69	-87	-91	-93	-93	-111	-60	-79	-91	-93	-95	-95	-118	
D-9813-4-1K, D-9813-5-1K, D-9813-6-1K	-49	-63	-69	-79	-91	-91	-109	-56	-71	-84	-86	-91	-91	-113	

Reverse Frequency Converters

U-9801R-1-1K, U-9802R-2-1K	-57	-77	-93	-97	-99	-99	-117	-65	-85	-96	-99	-100	-100	-120
U-9805R-1K	-57	-77	-92	-97	-99	-99	-117	-60	-80	-96	-100	-101	-101	-122
U-9808R-6-1K	-51	-69	-87	-91	-93	-93	-111	-60	-79	-91	-93	-95	-95	-118
U-9813R-4-1K, U-9813R-5-1K, U-9813R-2-1K	-49	-63	-69	-79	-91	-91	-109	-56	-71	-84	-86	-91	-91	-113
D-9853R-6-1K, D-9853R-2-1K	-57	-77	-90	-97	-99	-99	-117	-65	-85	-96	-99	-100	-100	-120
D-9854R-1K	-57	-77	-90	-97	-99	-99	-117	-62	-82	-96	-98	-100	-100	-120
D-9855R-2-1K	-51	-69	-87	-91	-93	-93	-111	-60	-79	-91	-93	-95	-95	-118
D-9856R-6-1K	-50	-66	-87	-91	-93	-93	-111	-59	-75	-91	-93	-95	-95	-118
D-9856R-7-1K	-50	-66	-85	-90	-93	-93	-111	-59	-75	-90	-92	-95	-95	-118
D-9857R-2-1K	-50	-65	-85	-90	-93	-93	-111	-59	-75	-90	-92	-95	-95	-118
D-9858R-2-1K, D-9858R-3-1K, D-9858R-4-1K	-49	-63	-69	-79	-91	-91	-109	-56	-71	-84	-86	-91	-91	-113

Maximum External Reference To Achieve Above Phase Noise with 10 MHz Reference

	10	100	1K	10K	100K	300K	1M
Systems without Option 31, 10E, 10F, 10G or 10H	-120	-150	-160	-160	-160	-160	-160
Systems with Option 10E, 10F, 10G or 10H	-95	-130	-140	-140	-140	-140	-140

Note: For 5 MHz reference decrease phase noise by 6 dB.

Options

1. 45 dB level control.
4. 140 MHz IF frequency.
5. Group delay equalization. 1 ns p-p maximum/70 \pm 18 MHz IF output. 2 ns p-p maximum/140 \pm 36 MHz IF output.
8. LO level detect. Summary alarm is generated for loss of power in any of the required local oscillators.
10. Higher frequency stability reference.
- C. $\pm 2 \times 10^{-9}$, 0 to 50°C, 1 $\times 10^{-9}$ /day typical (fixed temperature after 24 hour on time).
- E. $\pm 5 \times 10^{-9}$, 0 to 50°C, 1 $\times 10^{-9}$ /day typical (fixed temperature after 24 hour on time). See Note 1 below.
- F. $\pm 2 \times 10^{-9}$, 0 to 50°C, 1 $\times 10^{-9}$ /day typical (fixed temperature after 24 hour on time). See Note 1 below.

NOTE 1: Analog reference Phase Lock: External 5 or 10 MHz at +4 \pm 3 dBm. If external reference is below +1 dBm nominal, the converter will automatically lock to the internal reference. Reference oscillator acts as an analog phase lock with a 0.1 Hz nominal loop bandwidth. Typical loop suppression of the external reference is as follows: 28 dB at 1 Hz offset; 65 dB at 10 Hz offset and 100 dB at 100 Hz offset.

- G. Self calibrating tracking reference with controlled slew rate. Internal reference tracks external reference and uses external reference to correct for aging of the internal reference. The internal reference changes frequency at a maximum rate of 0.06 ppm/second. When external reference is lost, the reference frequency is held at the previous value. Frequency stability on internal reference: $\pm 5 \times 10^{-8}$, 0 to 50°C, 1 $\times 10^{-9}$ /day typical (fixed temperature after 72 hour on time). 5 $\times 10^{-8}$ /year typical
- H. Self calibrating tracking reference with controlled slew rate. Internal reference tracks external reference and uses external reference to correct for aging of the internal reference. The internal reference changes frequency at a maximum rate of 0.06 ppm/second. When external reference is lost, the reference frequency is held at the previous value. Frequency stability on internal reference: $\pm 2 \times 10^{-9}$, 0 to 50°C, 1 $\times 10^{-9}$ /day typical (fixed temperature after 72 hour on time). 5 $\times 10^{-8}$ /year typical
14. Front panel selectable 50/75 ohm IF impedance (If return loss 18 dB).
15. 50 ohm IF impedance.
- 16C. Higher gain (downconverters): 55–61 dB gain.
17. Remote control.
 - C. RS232 remote interface.
18. Multiple IF output module (downconverter only; not compatible with NSUN, or Option 14).
 - 4. Four IF outputs.
 - 8. Eight IF outputs.
 Output 1 dB compression point: +10 dBm.
 Intermodulation distortion at 0 dBm output: 40 dBc minimum (+20 dBm IP3).
19. RF-Band fiber optic interface (available 0.95–18 GHz; not compatible with NSU).
 - A. Upconverter output transmitter. Fiber: 9/125 (single mode fiber), Wavelength: 1540–1560 nm, Optical power in fiber: 4 mW typical, Connector: FC/APC
 - B. Downconverter input receiver. Fiber: 9/125 (single mode fiber), Wavelength: 1300–1560 nm nominal, Connector: FC/APC

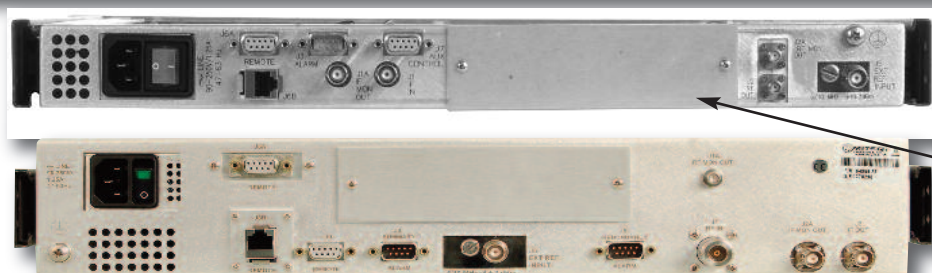
Options (Cont.)

- 20.** Selectable 70 MHz and 140 MHz IF frequencies. One IF connector provided at rear panel (BNC female). Selection of IF frequency is available from the front panel and over the remote bus.
- 23B.** An internal 10 MHz reference is provided. The internal 10 MHz reference is brought out of and back into the rear panel with a "U" link coaxial cable (SMA connectors). This allows, after "U" link removal, insertion of an external 10 MHz reference input (+4 ±3 dBm)
- 30.** 9400 compatible.
Remote command set compatible with RSU product line.
Redundancy status and summary alarm status on separate 9-pin 'D' connectors per 9400 series.
Chassis 2 RU rack-mountable with rear panel power switch.
Downconverter gain: 30 dB minimum (higher gain options available see below),
Pout 1 dB +10 dBm minimum, noise figure 12 dB maximum.
Options 16A. 40 dB minimum gain, Pout 1 dB +20 dBm minimum
Options 16C. 50 dB minimum gain, Pout 1 dB +20 dBm minimum
Upconverter gain: 20 dB minimum (higher gain options available see below),
Pout 1 dB +5 dBm minimum, noise figure 25 dB maximum.
Options 11B. 30 dB minimum gain, Pout 1 dB +10 dBm minimum, noise figure 25 dB maximum
Dedicated RS422/485 remote (J10).
Ethernet remote (J6B).
RS422/485 or RS232 (J6A).
Supports expandable NSU 1:N Switchover Series (D-323).
"N" RF connectors below 10 GHz.
Electrical specifications per datasheet (D-148).
Consult factory for front panel and display operations.
- 31A.** Ultra-low phase noise (See Phase Noise Specifications chart). Included with Options 10G and 23B (internal reference U-link, see Option 23B for more details. An external 10 MHz reference may be applied to the U-link. Higher frequency stability available with Option 31B.
- 31B.** Ultra-low phase noise (See Phase Noise Specifications chart). Included with Options 10H and 23B (internal reference U-link, see Option 23B for more details. An external 10 MHz reference may be applied to the U-link.
- 31C.** 5 MHz reference only (no internal provided) at +4 ±3 dBm. With no reference suppression there is direct reference multiplication inside 100 kHz. See below for calculation of required external reference phase noise (for Option 31C or 31D).
- 31D.** 10 MHz reference only (no internal provided) at +4 ±3 dBm. With no reference suppression there is direct reference multiplication inside 100 kHz. See below for calculation of required external reference phase noise (for Option 31C or 31D). Formula for calculation of external reference only (Option 31C or 31D):
External reference phase noise required to meet the ultra phase noise system characteristics.
$$(U-20\log(M) -3) \text{ dBc/Hz.}$$

Where U is the ultra phase noise characteristic at a specific frequency offset for a specific model and M is the multiplication factor of the reference frequency (5 or 10 MHz) divided into the operational RF frequency (Fo) of the model selected.
$$M = F_o \text{ (MHz)}/10 \text{ (MHz) or } F_o \text{ (MHz)}/5 \text{ (MHz)}$$

33.9600/9700 compatible phase noise.
- 33.** 9600/9700 compatible phase noise.
- TNCIF.** Type TNC female IF connector and IF monitor.
- NRF.** Type N female RF connector (Note: Monitor remains SMA female). RF return loss: 18 dB, 9-15 GHz, (N/A above 15 GHz).
- TNCRF.** Type TNC female RF connector (Note: Monitor remains SMA female). RF return loss: 18 dB, 9-15 GHz, (N/A above 15 GHz).
Notes: Missing option numbers are not applicable for this product. For literature describing local control (front panel) and remote control (bus protocols), refer to MITEQ Technical Note 25T063. Protocols are backwards compatible with Technical Notes 25T010 and 25T009.

9800 Series Converter Rear View Panels



(Standard)

RSM Switch Module
location (see D-323 for
more information)

(Option 30)

9800 Series Frequency Converters