The MITEQ AFC frequency/block converters provide automatic frequency control to maintain communication links for Satellites with decaying or orbital perturbations. A 5 MHz AFC reference with a frequency deviation of ±60 kHz is applied to the converters to compensate for frequency shift caused by Doppler effect. The resultant output frequency of the converter will be fixed to better maintain the communication link.

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.

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 frequency stability
- Remote RS232
- Doppler deviation (AFC only)
- High performance package (blockconverters only)

**INMARSAT**
- 140 MHz IF frequency
- Higher gain
- 50 ohms IF impedance
- Selectable 50/75 ohms IF impedance
- Multiple IF outputs (downconverters only)
- Group delay equalization
- LO level alarm
- Higher gain
- 45 dB level control
- Increase output power
- 9400 series backwards compatibility

---

**Features**

- INMARSAT (model INMST) converters frequency stepsize of 1 kHz
- 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 with NSU redundancy system (D-323) or as an alternative interface
  3. 10/100Base-T Ethernet interface (J6B)
- RF, IF and LO monitor ports
- Automatic switching to external 5/10 MHz reference and electronic frequency adjust of internal reference frequency
- Low intermodulation distortion
- Better than IESS-308/309 phase noise
- 64 programmable memory locations
- 30 dB level control
- External alarm input via contact closure
- Date and time-stamped event log
- CE Mark
### Specifications (INMST Converters)

<table>
<thead>
<tr>
<th></th>
<th>Upconverters</th>
<th></th>
<th>Downconverters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RF Frequency (GHz)</strong></td>
<td>U-98-INMST-1K</td>
<td>3.575–4.225 GHz</td>
<td>D-98-INMST-1K</td>
<td></td>
</tr>
</tbody>
</table>

#### Specifications

<table>
<thead>
<tr>
<th><strong>Type</strong></th>
<th>Dual conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency step size</strong></td>
<td>1 kHz</td>
</tr>
<tr>
<td><strong>Frequency sense</strong></td>
<td>No inversion</td>
</tr>
<tr>
<td><strong>Input characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>70 ±20 MHz (140 ±40 MHz Option 4)</td>
</tr>
<tr>
<td>Impedance</td>
<td>75 ohms (50 ohms Option 15)</td>
</tr>
<tr>
<td>Return loss</td>
<td>26 dB minimum (70 ±20 MHz), 20 dB minimum (140 ±40 MHz)</td>
</tr>
<tr>
<td><strong>Signal monitor</strong></td>
<td>-20 dBc nominal</td>
</tr>
<tr>
<td>LO leakage</td>
<td>N/A</td>
</tr>
<tr>
<td>Input level (non-damage)</td>
<td>+15 dBm maximum</td>
</tr>
<tr>
<td><strong>Output characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>5.925–6.475 GHz</td>
</tr>
<tr>
<td>Impedance</td>
<td>50 ohms</td>
</tr>
<tr>
<td>Return loss</td>
<td>20 dB minimum</td>
</tr>
<tr>
<td><strong>Signal monitor</strong></td>
<td>-20 dBc nominal</td>
</tr>
<tr>
<td>LO leakage</td>
<td>-75 dBm maximum</td>
</tr>
<tr>
<td>Power output (P1dB)</td>
<td>-5 dBm minimum,  +5 dBm minimum (Option 11A), +15 dBm minimum (Option 11B)</td>
</tr>
<tr>
<td><strong>Transfer characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>20 dB minimum at 23°C, 30–35 dB at 23°C (Option 11A), 43–50 dB at 23°C (Option 16A), 55–61 dB at 23°C (Option 16C)</td>
</tr>
<tr>
<td>Noise figure at min. atten.</td>
<td>20 dB typical, 25 dB maximum</td>
</tr>
<tr>
<td><strong>Level stability</strong></td>
<td>±0.25 dB/day maximum at constant temperature</td>
</tr>
<tr>
<td><strong>Amplitude response</strong></td>
<td>±0.25/±20 MHz; ±0.2/±18 MHz</td>
</tr>
<tr>
<td><strong>Group delay (70 ±18 MHz)</strong></td>
<td>0.75/±36 MHz</td>
</tr>
<tr>
<td>Linear</td>
<td>0.03 ns/MHz maximum</td>
</tr>
<tr>
<td>Parabolic</td>
<td>0.01 ns/MHz² maximum</td>
</tr>
<tr>
<td>Ripple</td>
<td>1 ns peak-to-peak maximum</td>
</tr>
<tr>
<td><strong>Group delay (140 ±36 MHz)</strong></td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>0.025 ns/MHz maximum</td>
</tr>
<tr>
<td>Parabolic</td>
<td>0.0035 ns/MHz² maximum</td>
</tr>
<tr>
<td>Ripple</td>
<td>1 ns peak-to-peak maximum</td>
</tr>
<tr>
<td><strong>Intermodulation distortion</strong></td>
<td></td>
</tr>
<tr>
<td>(third order) two signals each at -10 dBm output</td>
<td>30 dBc minimum (+5 dBm IP3 pt.), 50 dBc minimum (Option 11A), 70 dBc minimum (Option 11B)</td>
</tr>
<tr>
<td></td>
<td>60 dBc minimum (+20 dBm IP3 pt.), 80 dBc minimum (+30 dBm IP3 pt., Options 16A and 16C)</td>
</tr>
<tr>
<td></td>
<td>0.1°/dB to -15 dBm out, 0.1°/dB to -6 dBm out (Option 11A), 0.1°/dB to -4 dBm out (Option 11B)</td>
</tr>
<tr>
<td></td>
<td>0.1°/dB to -1 dBm out, 0.1°/dB to +8 dBm out (Options 16A and 16C)</td>
</tr>
<tr>
<td><strong>Gain slope</strong></td>
<td>70 ±20 MHz 0.03 dB/MHz maximum (10 MHz maximum)</td>
</tr>
<tr>
<td></td>
<td>140 ±40 MHz 0.05 dB/MHz maximum (10 MHz maximum)</td>
</tr>
<tr>
<td><strong>Spurious outputs</strong></td>
<td></td>
</tr>
<tr>
<td>Signal related</td>
<td>65 dBc</td>
</tr>
<tr>
<td>Signal independent</td>
<td>-90 dBm maximum</td>
</tr>
<tr>
<td></td>
<td>-80 dBm maximum (Option 11A), -70 dBm maximum (Option 11B)</td>
</tr>
<tr>
<td>Gain adjustment</td>
<td>30 dB in 0.2 dB steps (45 dB in 0.2 dB steps Option 1)</td>
</tr>
<tr>
<td>Gain slope adjustment</td>
<td>±1 dB in 0.2 dB steps</td>
</tr>
</tbody>
</table>
## Specifications (Cont.)

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Upconverter</th>
<th>Downconverter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency stability</td>
<td>±2 x 10⁻⁸, 0 to 50°C (higher stability options available)</td>
<td>±5 x 10⁻⁹/day typical (fixed temperature after 24 hour on time)</td>
</tr>
<tr>
<td>Upconverter mute</td>
<td>60 dB minimum</td>
<td>N/A</td>
</tr>
<tr>
<td>External reference</td>
<td>5 or 10 MHz, +4 ±3 dBm Unit will automatically switch to internal reference with loss of external reference</td>
<td></td>
</tr>
<tr>
<td>Phase noise</td>
<td>See graph</td>
<td></td>
</tr>
<tr>
<td>Primary power</td>
<td>100-240 (-10%, +6%) VAC, 47-63 Hz 60 W typical</td>
<td></td>
</tr>
<tr>
<td>AFC input</td>
<td>5 MHz ±60 kHz, 0±3 dBm</td>
<td></td>
</tr>
<tr>
<td>Remote interface</td>
<td>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 MITEQ ICD 200574</td>
<td></td>
</tr>
</tbody>
</table>

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

### Phase Noise Specifications

1. High performance phase noise (-dBc/Hz) (maximum/typical).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>100</td>
<td>1K</td>
<td>10K</td>
<td>100K</td>
</tr>
<tr>
<td>U-98-INMST-1K</td>
<td>57/60</td>
<td>77/80</td>
<td>90/92</td>
<td>94/97</td>
<td>99/102</td>
</tr>
<tr>
<td>U-98-INMST-1K-AFC</td>
<td>57/60</td>
<td>77/80</td>
<td>90/92</td>
<td>94/97</td>
<td>99/102</td>
</tr>
<tr>
<td>D-98-INMST-1K</td>
<td>57/60</td>
<td>77/80</td>
<td>90/92</td>
<td>94/97</td>
<td>99/102</td>
</tr>
<tr>
<td>D-98-INMST-1K-AFC</td>
<td>57/60</td>
<td>77/80</td>
<td>90/92</td>
<td>94/97</td>
<td>99/102</td>
</tr>
</tbody>
</table>

### Maximum External Reference To Achieve Above Phase Noise

| All Systems | -120 | -150 | -160 | -160 | -160 | -160 | -160 |
### Specifications (AFC Block Converters)

#### Block Downconverter

<table>
<thead>
<tr>
<th>Input Frequency (GHz)</th>
<th>Output Frequency (GHz)</th>
<th>LO Frequency (GHz)</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4–4.2</td>
<td>0.95–1.75</td>
<td>5.15</td>
<td>DNB-1B-3.8-AFC-INV</td>
</tr>
<tr>
<td>10.7–11.5</td>
<td>0.95–1.75</td>
<td>9.75</td>
<td>DNB-1B-11.1-AFC</td>
</tr>
</tbody>
</table>

#### Block Upconverter

<table>
<thead>
<tr>
<th>Input Frequency (MHz)</th>
<th>Output Frequency (MHz)</th>
<th>LO Frequency (MHz)</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.95–1.75</td>
<td>5.85–6.65</td>
<td>4.9</td>
<td>UPB-1B-6.25-AFC</td>
</tr>
<tr>
<td>0.95–1.45</td>
<td>12.75–13.25</td>
<td>11.8</td>
<td>UPB-1B-13-AFC</td>
</tr>
</tbody>
</table>

### Input Characteristics

- Impedance: 50 ohms
- Return loss: 18 dB minimum (upconverters), 20 dB minimum (downconverters)
- LO leakage: -80 dBm maximum (downconverters)
- Signal monitor: -20 dBc nominal

### Output Characteristics

- Impedance: 50 ohms
- Return loss: 18 dB minimum (downconverters), 20 dB minimum (upconverters)
- Power output (P1dB): +13 dBm minimum (upconverters), +18 dBm minimum (downconverters)
- Signal monitor: -20 dBc nominal

### Transfer Characteristics

- Gain (at minimum attenuation):
  - Upconverters: 33±3 dB at 23°C
  - Downconverters: 38±3 dB at 23°C
- Gain slope: 0.03 dB/MHz (over any 10 MHz)
- Gain control: 30 dB in 0.2 dB steps
- Amplitude response: ±0.25 dB over any 40 MHz, ±1 dB over RF frequency band
- Image rejection: 80 dB minimum
- Noise figure (at min. atten.): 15 dB maximum
- Intermodulation distortion (third order): With two inband signals at 0 dBm output, third order intermodulation products are less than 60 dBc minimum (downconverters) and 50 dBc minimum (upconverters)
- Group delay: 1 ns peak-to-peak maximum
- Spurious outputs (inband):
  - Signal related: 65 dBc minimum up to 0 dBm output
  - Signal independent: -75 dBm maximum
- Phase noise: See table for maximum specifications
- Noise spectral density: -87 dBm/4 kHz maximum (upconverters), -82 dBm/4 kHz maximum (downconverters)
- AM/PM conversion (at 0 dBm output): 0.1°/dB maximum (upconverters), 0.05°/dB maximum (downconverters)
- Frequency stability: ±2 x 10⁻⁶, 0 to 50°C (higher stability options available), ±5 x 10⁻⁹/day typical (fixed temperature after 24 hour on time)
- Automatic reference: External 5 or 10 MHz at +4 ±3 dBm. With loss of external reference, the converter will automatically lock to the internal reference.
- Upconverter Mute: 80 dB minimum on summary alarm, external mute input control or mute command.
- AFC Input: 5 MHz ±60 kHz, 0 ±3 dBm
Specifications (AFC Block Converters - Cont.)

Remote interface .............................................................. 10/100Base-T Ethernet interface providing:
HTTP-based web server
SNMP 1.0 configuration
Alarm reporting via SNMP trap
Telnet access

Phase Noise Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>10</th>
<th>100</th>
<th>1K</th>
<th>10K</th>
<th>100K</th>
<th>1M</th>
<th>Offset [Hz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNB-1B-3.8-AFC-INV</td>
<td>-50</td>
<td>-73</td>
<td>-83</td>
<td>-90</td>
<td>-100</td>
<td>-103</td>
<td>Maximum Phase Noise (dBc/Hz) (1 Hz bandwidth) Straight line curve defined by the points in the table</td>
</tr>
<tr>
<td>DNB-1B-11.1-AFC</td>
<td>-45</td>
<td>-67</td>
<td>-77</td>
<td>-82</td>
<td>-97</td>
<td>-97</td>
<td></td>
</tr>
<tr>
<td>UPB-1B-6.25-AFC</td>
<td>-50</td>
<td>-73</td>
<td>-83</td>
<td>-90</td>
<td>-100</td>
<td>-103</td>
<td></td>
</tr>
<tr>
<td>UPB-1B-13-AFC</td>
<td>-45</td>
<td>-67</td>
<td>-77</td>
<td>-82</td>
<td>-97</td>
<td>-97</td>
<td></td>
</tr>
</tbody>
</table>

Maximum External Reference To Achieve Above Phase Noise

All Systems -120 -150 -160 -160 -160 -160

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

Indicators and Alarms

LO out of lock ................................................................. Red LED (front panel)
Power On indicator .......................................................... Green LED (rear panel)
Summary Alarm ............................................................... Contact closure status for DC Voltage and local oscillator

Primary Power Requirements

Voltage ........................................................................... 100-240 VAC (-10%, +6%) 
Frequency ....................................................................... 47–63 Hz
Consumption ..................................................................... 30 W typical for block converters, 50 W typical for INMST converters

Physical

INMST Converters

Weight ................................................................. 20 pounds (9.0 kg) nominal
Chassis dimensions (1RU) ........................................... 19" [482.6mm] x 20" [508mm] x 1.75" [44.45mm] panel height maximum
IF connectors/monitors .............................................. BNC female
RF connectors/monitors .............................................. SMA female
External reference/AFC input ....................................... BNC female
Overall length .......................................................... 22" [558.8mm] maximum
Alarm connector .......................................................... DE-9P
Remote interface connector ...................................... DE-9S for RS485, RS422 and RS232; RJ-45 for Ethernet
Auxiliary control interface connector ......................... DE-9S for RS485 and RS422
Primary power input connector ................................... IEC-320
Ground lug ............................................................... 10-32 screw with washers

Options 30 INMST Converters

Chassis dimensions (2RU) ........................................... 19" [482.6mm] x 20" [508mm] x 3.5" [88.9mm] panel height maximum
IF connectors/monitors .............................................. BNC female
RF connector .............................................................. N female
RF monitor ................................................................. SMA female
External reference/AFC input ....................................... BNC female
Overall length .......................................................... 22" [558.8mm] maximum
Summary alarm connector ......................................... DE-9P
Redundancy alarm connector ...................................... DE-9P
External mute connector ............................................. DE-9P
Remote interface ......................................................... DE-9S for RS485, RS422 and RS232; RJ-45 for Ethernet
Auxiliary control interface connector ......................... DE-9S for RS485 and RS422
Primary power input connector ................................... IEC-320
Ground lug ............................................................... 10-32 screw with washers
General Specifications (Cont.)

Physical
Block Converters
Weight ................................................................. 15 pounds (6.80 kg) nominal
Overall dimensions .............................................. 19" [482.6mm] x 1.75" [44.45mm] x 20" [508mm] (excluding connectors)
Connectors
- RF ................................................................. SMA female
- L-band ............................................................ N female
- RF monitor ...................................................... SMA female
- L-band monitor ............................................... SMA female
- External reference/AFC input .............................. BNC female
- Summary alarm ............................................... DE-9P
- Test points ...................................................... SMA female for LO frequency
- Remote interface ............................................. DEM-9S for RS485, RS422 and RS232, RJ-45 female for Ethernet
- Primary power input ........................................ IEC-320

Environmental
Operating
Ambient temperature ......................................... 0 to 50°C
Relative humidity ............................................... Up to 95% at 30°C
Atmospheric pressure .......................................... Up to 10,000 feet
Nonoperating
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

Options for Block Converters

1. High performance package (synthesized with AFC)
   - Frequency step size ........................................ 1 kHz
   - AFC input ..................................................... 5 MHz ±57.5 kHz, 0 ±3 dBm
   - Power output (P1dB) ........................................ +20 dBm minimum
   - Gain slope .................................................... 0.03 dB/MHz maximum (over 10 MHz)
   - Gain stability ................................................. ±0.25 dB/day maximum at constant temperature,
   - Group delay ................................................... 1 ns peak-to-peak maximum
   - Spurious outputs (inband)
     - Signal related ........................................... 65 dBc minimum at 0 dBm output
     - Signal independent ................................. -80 dBm maximum
     - Image rejection .......................................... 80 dB minimum
   - Intermodulation
distortion (third order) ................................... With two inband signals at 0 dBm output, third order intermodulation products are less than 60 dBc minimum.

    B. ±5 x 10^-9, 0 to 50°C,
        1 x 10^-9/day typical (fixed temperature after 24 hour on time).
    C. ±2 x 10^-9, 0 to 50°C,
        1 x 10^-9/day typical (fixed temperature after 24 hour on time).

Note: Converter may require 7-10 days to reach stability after long storage periods.

17. Remote control.
    C. RS232.

Note: For literature describing local control (front panel) and remote control (bus control), refer to MITEQ’s Technical Note 25T055
Options for INMARSAT Converters

1. 45 dB level control.
2. 140 MHz IF frequency.
3. Group delay equalization.
   A. 1 ns peak-to-peak maximum/70 ±18 MHz IF output.
   B. 2 ns peak-to-peak for maximum/140 ±36 MHz IF output.
4. LO level alarm detect.
   Summary alarm is generated for loss of RF output power in any of the required local oscillators.
5. Higher frequency stability reference
   B. ±5 x 10^-9, 0 to 50°C,
      1 x 10^-9/day typical (fixed temperature after 24 hour on time).
   C. ±2 x 10^-9, 0 to 50°C,
      1 x 10^-9/day typical (fixed temperature after 24 hour on time).
   Note: Converter may require 7-10 days to reach stability after long storage periods.
6. Increased output power (upconverters).
   A. +5 dBm minimum power output (1 dB compression).
   B. +10 dBm minimum power output (1 dB compression).
   Specification of signal independent spurious increases with increase in IF/RF gain (e.g., if without option, specification is -90 dBm maximum, an increase of 10 dB in gain will result in signal independent spurious of -80 dBm maximum.
7. 50 ohm IF impedance.
8. Higher gain option (downconverters).
   A. 43-50 dB RF/IF gain.
   B. 55-61 dB RF/IF gain.
   Specification of signal independent spurious increases with increase in IF/RF gain (e.g., if without option, specification is -90 dBm maximum, an increase of 10 dB in gain will result in signal independent spurious of -80 dBm maximum.
   C. RS232.
   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 2RU rack-mountable with rear panel power switch.
      • Downconverter gain, 30 dB minimum (higher gain options available).
      • Upconverter gain, 10 dB nominal (higher gain options available).
      • Gain slope, 0.02 dB/MHz maximum (10 MHz segment).
      • Dedicated RS422/485 remote (J10).
      • Ethernet remote (J6B).
      • RS422/485 or RS232 (J6A).
      • Supports expandable NSU 1:N switchover series (D-323)
      • Type ‘N’ RF connectors below 10 GHz
      • Electrical specifications per datasheet D-148.
      • Consult factory for front panel and display operations.

Note: For literature describing local control (front panel) and remote control (bus control), refer to MITEQ’s Technical Note 25T063.
INMARSAT and AFC Block Converters

Typical Rear Panel View

Block Converter with AFC

INMST Upconverter with AFC

INMST Downconverter with AFC

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