

## INMARSAT and AFC Block Converters

### INMARSAT C-Band Up and Downconverters C and Ku-Band Block Up and Downconverters Automatic Frequency Control (AFC)



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  $\pm 60$  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)

Upconverters		Downconverters	
RF Frequency (GHz)	Model Number	RF Frequency (GHz)	Model Number
5.925–6.475	U-98-INMST-1K U-98-INMST-1K-AFC	3.575–4.225	D-98-INMST-1K D-98-INMST-1K-AFC

Specifications	Upconverter	Downconverter
Type	Dual conversion	
Frequency step size	1 kHz	
Frequency sense	No inversion	
Input characteristics		
Frequency	70 ±20 MHz (140 ±40 MHz Option 4)	3.575–4.225 GHz
Impedance	75 ohms (50 ohms Option 15)	50 ohms
Return loss	26 dB minimum (70 ±20 MHz), 20 dB minimum (140 ±40 MHz)	20 dB minimum
Signal monitor	-20 dBc nominal	
LO leakage	N/A	-80 dBm maximum
Input level (non-damage)	+15 dBm maximum	
Output characteristics		
Frequency	5.925–6.475	70 ±20 MHz (140 ±40 MHz Option 4)
Impedance	50 ohms	75 ohms (50 ohms Option 15)
Return loss	20 dB minimum	26 dB minimum (70 ±20 MHz), 20 dB minimum (140 ±40 MHz)
Signal monitor	-20 dBc nominal	
LO leakage	-75 dBm maximum	N/A
Power output (P1dB)	-5 dBm minimum, +5 dBm minimum (Option 11A), +15 dBm minimum (Option 11B)	+15 dBm typical, +10 dBm minimum, +20 dBm minimum (Options 16A and 16C)
Transfer characteristics		
Gain	20 dB minimum at 23°C, 25–30 dB at 23°C (Option 11A), 30–35 dB at 23°C (Option 11B)	30–35 dB at 23°C, 43–50 dB at 23°C (Option 16A), 55–61 dB at 23°C (Option 16C)
Noise figure at min. atten.	20 dB typical, 25 dB maximum	12 dB maximum
Image rejection	80 dB minimum	
Level stability	±0.25 dB/day maximum at constant temperature	
Amplitude response		
70 ±20 MHz	±0.25/±20 MHz; ±0.2/±18 MHz	
140 ±40 MHz	0.75/±36 MHz	
Group delay (70 ±18 MHz)		
Linear	0.03 ns/MHz maximum	
Parabolic	0.01 ns/MHz <sup>2</sup> maximum	
Ripple	1 ns peak-to-peak maximum	
Group delay (140 ±36 MHz)		
Linear	0.025 ns/MHz maximum	
Parabolic	0.0035 ns/MHz <sup>2</sup> maximum	
Ripple	1 ns peak-to-peak maximum	
Intermodulation distortion (third order) two signals each at -10 dBm output	30 dBc minimum (+5 dBm IP3 pt.), 50 dBc minimum (Option 11A), 70 dBc minimum (Option 11B)	60 dBc minimum (+20 dBm IP3 pt.), 80 dBc minimum (+30 dBm IP3 pt., Options 16A and 16C)
AM/PM conversion	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)	0.1°/dB to -1 dBm out, 0.1°/dB to +8 dBm out (Options 16A and 16C)
Gain slope		
70 ±20 MHz	0.03 dB/MHz maximum (10 MHz maximum)	
140 ±40 MHz	0.05 dB/MHz maximum (10 MHz maximum)	
Spurious outputs		
Signal related	65 dBc	
Signal independent	-90 dBm maximum	
	-80 dBm maximum (Option 11A), -70 dBm maximum (Option 11B)	-80 dBm maximum (Option 16A), -70 dBm maximum (Option 11C)
Gain adjustment	30 dB in 0.2 dB steps (45 dB in 0.2 dB steps Option1)	
Gain slope adjustment	±1 dB in 0.2 dB steps	

Specifications (Cont.)	Upconverter	Downconverter
Frequency stability	$\pm 2 \times 10^{-8}$ , 0 to 50°C (higher stability options available) $\pm 5 \times 10^{-9}$ /day typical (fixed temperature after 24 hour on time)	
Upconverter mute	60 dB minimum	N/A
External reference	5 or 10 MHz, +4 $\pm$ 3 dBm Unit will automatically switch to internal reference with loss of external reference	
Phase noise	See graph	
Primary power	100-240 (-10%, +6%) VAC, 47-63 Hz 60 W typical	
AFC input	5 MHz $\pm$ 60 kHz, 0 $\pm$ 3 dBm	
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 MITEQ ICD 200574	

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

## Phase Noise Specifications

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

LO Frequency	Offset [Hz]							
	10	100	1K	10K	100K	300K	1M	
U-98-INMST-1K	57/60	77/80	90/92	94/97	99/102	99/102	117/120	Maximum Phase Noise (dBc/Hz) (1 Hz bandwidth) Straight line curve defined by the points in the table
U-98-INMST-1K-AFC	57/60	77/80	90/92	94/97	99/102	99/102	117/120	
D-98-INMST-1K	57/60	77/80	90/92	94/97	99/102	99/102	117/120	
D-98-INMST-1K-AFC	57/60	77/80	90/92	94/97	99/102	99/102	117/120	

### Maximum External Reference To Achieve Above Phase Noise

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

### Block Downconverter

Input Frequency (GHz)	Output Frequency (GHz)	LO Frequency (GHz)	Model Number
3.4–4.2	0.95–1.75	5.15	DNB-1B-3.8-AFC-INV
10.7–11.5	0.95–1.75	9.75	DNB-1B-11.1-AFC

### Block Upconverter

Input Frequency (MHz)	Output Frequency (MHz)	LO Frequency (MHz)	Model Number
0.95–1.75	5.85–6.65	4.9	UPB-1B-6.25-AFC
0.95–1.45	12.75–13.25	11.8	UPB-1B-13-AFC

#### 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 <sup>-8</sup> , 0 to 50°C (higher stability options available), ±5 x 10 <sup>-9</sup> /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

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

## General Specifications

### 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 $\pm$ 57.5 kHz, 0 $\pm$ 3 dBm
Power output (P1dB) .....	+20 dBm minimum
Gain slope.....	0.03 dB/MHz maximum (over 10 MHz)
Gain stability .....	$\pm$ 0.25 dB/day maximum at constant temperature, 1 dB peak-to-peak maximum/0-50°C
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.	
  
10. Higher frequency stability reference.
 

<b>B.</b> $\pm 5 \times 10^{-9}$ , 0 to 50°C, 1 $\times 10^{-9}$ /day typical (fixed temperature after 24 hour on time).
<b>C.</b> $\pm 2 \times 10^{-9}$ , 0 to 50°C, 1 $\times 10^{-9}$ /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.
 

<b>C.</b> RS232.
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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.
- 4.** 140 MHz IF frequency.
- 5.** Group delay equalization.
  - A.** 1 ns peak-to-peak maximum/70  $\pm$ 18 MHz IF output.
  - B.** 2 ns peak-to-peak for maximum/140  $\pm$ 36 MHz IF output.
- 8.** LO level alarm detect.  
Summary alarm is generated for loss of RF output power in any of the required local oscillators.
- 10.** Higher frequency stability reference
  - B.**  $\pm 5 \times 10^{-9}$ , 0 to 50°C,  
1  $\times 10^{-9}$ /day typical (fixed temperature after 24 hour on time).
  - C.**  $\pm 2 \times 10^{-9}$ , 0 to 50°C,  
1  $\times 10^{-9}$ /day typical (fixed temperature after 24 hour on time).

Note: Converter may require 7-10 days to reach stability after long storage periods.
- 11.** 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).
- 15.** 50 ohm IF impedance.
- 16.** 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).
- 17.** Remote control.
  - 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

## Typical Rear Panel View

### Block Converter with AFC



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

### INMST Upconverter with AFC



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

### INMST Downconverter with AFC



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