

## FREQUENCY GENERATION PRODUCTS



- Oscillators
- Free-Running Dielectric Resonator Oscillators
- Synthesizers



Oscillators



Free-Running Dielectric Resonator Oscillators



Synthesizers

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## CORPORATE OVERVIEW

MITEQ, an acronym for (M)icrowave (I)nfomation (T)ransmission (EQ)uipment, designs and manufactures a complete line of high-performance components and subsystems for the microwave electronics community.

Located on Long Island, New York for more than forty years, it has grown into a company, which is dedicated to achieving technical excellence, producing quality products and satisfying our customer's specific needs.

### STANDARD PRODUCT LINES

MITEQ's product lines are basically split between two market segments:

- **Microwave components and integrated assemblies**
- **Satellite communications & earth station equipment**

The Microwave Component Division offers designs up to and over 60 GHz, including:

- **Amplifiers:** Moderate to broadband, ultralow-noise to high-power, bipolar, and GaAs FET designs
- **Mixers:** Single-, double-, and triple-balanced, MESFET and Schottky mixers and low-noise receiver front ends
- **Frequency multipliers:** Active and passive
- **Passive power components**
- **Microwave control products:** Solid-state switches, digital attenuators, limiters, and phase shifters
- **RF and IF signal processing components:** Log amplifiers, frequency discriminators and limiting amplifiers
- **Oscillators:** Crystal, voltage, free-running, and phase-locked
- **Frequency synthesizers**
- **Integrated multifunction assemblies**
- **Fiber optic products**

MITEQ's Satellite Communication and Earth Station Equipment Groups manufactures the following:

- **Up/downconverters**
- **Test translators**
- **IF/video equalizers**
- **Redundancy switchover units**

MCL manufactures the following:

- **Indoor and outdoor TWTAs**
- **Redundant and phase combined systems**
- **Satellite news gathering transportable amplifiers**
- **Military application satellite communication amplifiers**

Specific products include synthesized converters with 1.0 kHz and 125 kHz frequency step sizes, INMARSAT L- and C-band converters, pilot generators and receivers, crystal controlled converters, video exciters, and custom designed products.

### CUSTOM DESIGN CAPABILITIES

Although MITEQ offers one of the broadest lines of standard catalog items, the bulk of MITEQ's business is in customized components, assemblies, and systems designed specifically around the customer's needs. MITEQ's heavy emphasis on internal R&D throughout its history has led to the creation of a company with the ability to adapt quickly to the changing needs of the customer and market while at the same time offering competitive prices and fast turnaround times.

### APPLICATIONS

MITEQ's components and systems are supplied to a wide variety of military and commercial markets including:

- Satellite and ground-based communication systems
- Missile guidance
- Military electronic countermeasures, radar warning and surveillance systems
- Land, sea, and airborne radar
- Air traffic control radar
- Radioastronomy
- Research and development efforts

### MANUFACTURING AND DESIGN CAPABILITIES

MITEQ's state-of-the-art facilities presently consist of four adjacent buildings totaling 215,000 square feet in Hauppauge, NY and 124,000 square feet in Bolingbrook, IL. In addition to housing separate engineering and manufacturing groups, MITEQ prides itself on its support groups including: drafting, which uses the latest commercial CADD and proprietary software programs; and an extensive machine shop, which includes top-of-the-line numerically controlled Okuma, Mitsui Seiki and Matsuura vertical machines capable of machining to the tightest of tolerances, guaranteeing repeated accuracy and reliability. MITEQ has five Class 100,000 and two Class 10,000 clean rooms in order to support our high reliability space and military projects.

### QUALITY ASSURANCE

MITEQ, a recognized world class supplier with an outstanding reputation for product quality, has undergone the extensive **ISO-9001** certification process to help secure its future as a primary source for advanced microwave products.

### SPACE HERITAGE

MITEQ's continued advancements in this state-of-the-art and unique capability have led to wide acceptance by the microwave community as a forerunner in spaceborne technology. Our space-qualified components include mixers, oscillators, amplifiers, synthesizers, and supercomponents. MITEQ's Space-Qualified Quality Assurance Plan establishes the actions necessary to provide confidence that the end item will meet the quality, reliability, and electrical performance required for space-qualified applications. MITEQ has been involved on the following space platforms:

TANDEM X • AQUARIUS • RADARSAT • SSMIS • GEOSAT • SEAWINDS • TERRASAR X • SEASAT • SPINSAT • TOPEX • HERSCHEL • EOS-MILS • SAR-LUPE • NPOESS • CORVAIR • GPM • CLOUDSAT • MEGATROPICS • JASON-2 • MIRO • WINDSAT • ALPHA I-IV • ETB • MHS • SSMIS • AMSU-B • NEW HORIZONS • GMI

### CUSTOMER SERVICE

MITEQ continually evaluates its service procedures to ensure that a close relationship is maintained between the company and its customers. The goal in every case is to deliver products of exceptional quality, backed by responsive technical and administrative support. MITEQ remains committed to offering comprehensive technical support to its customers through a direct customer-to-MITEQ link. This enables a quick response to the customer's needs, and ensures receipt of exactly what the customer requires; delivery of cost-effective solutions for the most demanding applications.

# INTRODUCTION TO FREQUENCY SOURCES

MITEQ offers a wide selection of high-performance frequency sources. This includes fixed-frequency, frequency-agile with phase-locked sources and frequency synthesizers from 5 MHz to 40 GHz. Our frequency source products are used throughout the world, on numerous space projects as well as in commercial and military applications. MITEQ's highly experienced team of engineers, technicians and assembly people bring today's cutting edge technologies to all of our frequency source products.

## PHASE-LOCKED OSCILLATORS AND SYNTHESIZERS

Low noise phase-locked frequency sources and synthesizers offer system designers a distinct advantage. Because phase-locked sources have well characterized reliable noise and spurious performance, it allows the system designer to only consider their signal path and frequency planning in the system block. MITEQ uses several configurations in both the oscillator and synthesizer product lines. High performance single loop and more powerful multi-loop designs give our customers a perfect fit for any system requirement. In addition, our products can be easily customized to meet the most demanding system challenges and extreme environmental conditions.

A well-designed phase-locked frequency source is both an accurate and stable signal source. Its stability and accuracy are directly related to the stability and accuracy of a lower-frequency reference and can take many forms. It can be a fixed-frequency, high-stability crystal oscillator supplied as an integral part of the phase-locked assembly, or it can be an externally-supplied crystal reference, a bank of switched crystal oscillators, or even an externally-supplied low-frequency Direct Digital Synthesizer (DDS) or similar synthesized source. The reference source is sometimes a phase-locked oscillator itself, locked to a low-frequency standard. MITEQ synthesizers are compatible with many standard serial or parallel interfaces to program frequency, and can be customized to meet any user protocol. Standard user interfaces can be downloaded from the MITEQ web site and operate from any windows based PC.

## SOURCE DESIGN APPROACHES

MITEQ uses both analog and digital phase-locked loop designs in fixed and frequency-agile synthesized sources. An analog design multiplies the reference signal up to the output frequency of the microwave oscillator and uses conventional analog phase detectors and sampling mixer circuits for detection at microwave frequencies. A digital phase-locked loop uses fixed or fractional division ratio dividers for the main signal as well as for the reference signal. Digital phase detectors form the final link of the phase-locked loop coupled with active and passive filtering to tailor noise and spurious performance. Our homegrown

resources for many of the internal components used include; VCOs, DROs, mixers, sampling phase detectors, digital phase detectors, fractional dividers, delta-sigma or DDS fractional dividers, and frequency multipliers which help us to independently lead the market with product performance and reliability.

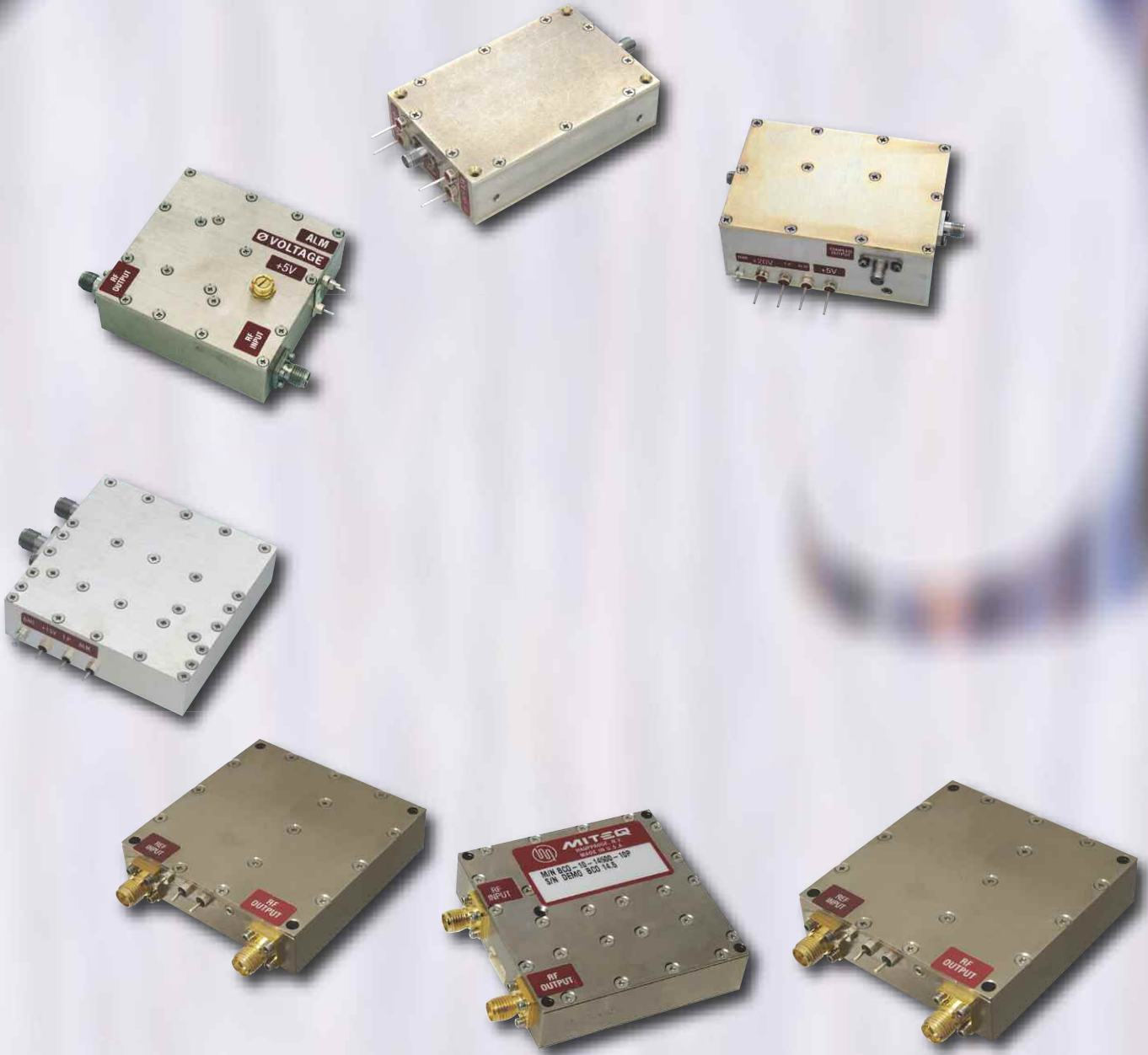
## NEW PRODUCT DEVELOPMENT

MITEQ continually strives to improve product offerings to meet the demand of today's aerospace, military and earth station radio product needs. In addition to improving our current products we will continue to expand our catalog offerings utilizing the best available components which equates to an improvement in performance, increased value, saved power and an overall decrease in the size of our sources.

## PRODUCT LINE DESCRIPTION

In addition to our standard products, MITEQ offers its customers an extensive custom design capability. Requirements for custom designs can usually be met with minor engineering changes, while others might require extensive design work. We offer custom designs up to as high as 40 GHz with the use of our internally designed frequency multipliers. In addition, we continuously design and manufacture frequency sources for our own SATCOM converters and receivers as well as use our unique product expertise to design sophisticated ECM and communications systems.

If in doubt about the suitability of a particular synthesizer requirement, give our design engineers a call. They can help you to properly select a wide range of output frequency bands, the right frequency resolution, coding, and acquisition times as well as environmental conditions.



# OSCILLATOR section



# INTRODUCTION TO OSCILLATORS

## PHASE-LOCKED OSCILLATORS

MITEQ phase-locked oscillator products are rugged modular components that can be used in a wide variety of applications, from laboratory test stations to space flight. The phase-locked oscillators have found their way into every type of high quality telecommunications, lab testing, medical imaging, radar and many other applications that require the high quality and performance that we design into our products.

The phase locked-oscillator design begins by defining the performance parameters required. The most significant of these requirements is usually associated with the frequency band and frequency resolution. Next would be performance requirements such as phase noise, spurious, harmonics, reference, operating voltage and power consumption. These are all factors that must be considered before choosing a phase-locked oscillator design. Phase noise requirements and contributions of either an internal or externally supplied reference will usually dominate the choice or type of design required, followed by frequency resolution. If the output frequency maintains integer multiples of the reference frequency, a simple single analog loop can be applied. If the reference noise is not adequate when multiplied to the output or if the output frequency is not an integer multiple of the reference frequency, we would need to either use a single loop digital approach or introduce a multi-loop design.

Single loop analog designs are preferred due to the very low noise floor the analog phase detector can provide. Generally this noise can be below -160 dBc. In most cases this will do very little to degrade a good reference frequency. The output noise will be degraded only by the frequency multiple of the reference to the output.

With the digital phase-locked loop, the reference frequency can be divided or fractionally divided to allow fine resolution of output frequency. The drawback to the digital loop is usually due to a poorer phase detector noise floor which will result in a higher output loop phase noise. The finer resolution will also adversely

affect spurious performance. Digital single loop designs usually incorporate narrow loop bandwidths and higher quality VCO performance to offset these limitations.

The multiple loop design will allow us to utilize the best of the very low noise analog circuits along with digital and analog sub-loops to enable very fine frequency resolution and mask the noise contribution of the reference frequency. This mask effect of the reference noise is another strong attribute of the multiple loop design choice. Multiple loop phase-locked oscillators designed by MITEQ use a proprietary approach that allows extremely fine resolution without large N multiples that reference division will cause. Our dual loop PLO designs incorporate a high performance digitally locked VCXOs using prescreened crystals with extremely low noise CROs or DROs to offer the best phase noise performance achievable.

Lowest possible phase noise solutions are met using ovenized SC cut crystal for a reference oscillator or a base frequency that can be multiplied. The multiplied crystal usually starting at 10 MHz or above is a tried and true method of preserving the fundamental crystal oscillator noise and many pieces of high-level test equipment still use this technique. Multiples of the crystals are easily generated by bringing the crystal oscillator power level to a minimum of 0.25 Watts to drive passive or active comb generators and then filtering the desired multiple. Although extremely reliable and effective, this method does have many disadvantages. The first disadvantage is size and complexity of filters that are needed to reject the unwanted comb energy. The other disadvantage is the power required allowing signal levels to maintain immunity from amplifier noise figure and other sources of thermal noise.

MITEQ offers multiple solutions for high quality signal source requirements. The entire product line can be customized to meet any environmental and dynamic operating conditions. Our engineering staff will be happy to assist you in choosing the appropriate solution for your signal source needs.

## SPECIFICATIONS

**PHASE-LOCKED OSCILLATOR SELECTION TABLE**

MODEL	TYPE	BAND	OUTLINE	DESCRIPTION
PLD	Locked Crystal	30–130 MHz	3.2 X 2.1 X 0.87 Inch 81.3 X 53.3 X 22.1 mm	High performance phase-locked crystal oscillator
PLD1C	Locked Crystal Multiplied	130 MHz–1 GHz	3.15 X 2.15 X 1.33 Inch 80 X 54.6 X 33.8 mm	High performance phase-locked multiplied crystal oscillator
PLX	Locked Crystal	7.5–250 MHz	2.25 X 2.25 X 0.55 Inch 57.2 X 57.2 X 14.0 mm	Small size high value phase-locked crystal oscillator
BCO	Single loop CRO	125 MHz–16 GHz	2.25 X 2.25 X 0.55 Inch 57.2 X 57.2 X 14.0 mm	Low cost single loop; fixed or frequency agile phase-locked oscillator
DLCRO	Dual Loop VCXO/CRO	600 MHz–40 GHz	2.25 X 2.25 X 0.55 Inch 57.2 X 57.2 X 14.0 mm	High performance dual loop fixed frequency phase-locked oscillator
PLDRO	Single or Dual Loop DRO	6.7–40 GHz	2.25 X 2.25 X 0.8 Inch 57.2 X 57.2 X 20.3 mm	High performance single or dual loop phase-locked DRO

# PHASE-LOCKED CRYSTAL OSCILLATOR

## PLD SERIES:

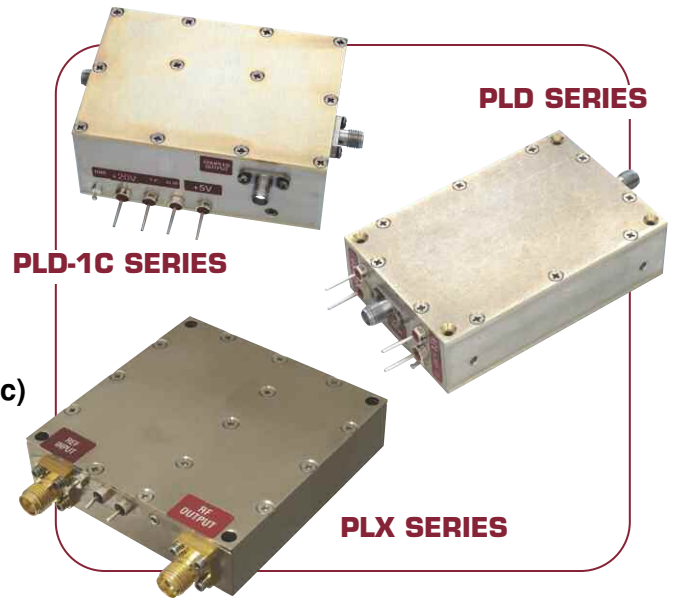
**30-130 MHz (PLD)**  
**130-1000 MHz (PLD-1C)**  
**7.5-250 MHz (PLX)**

## FEATURES

- Low phase noise design
- Fractional frequency division available
- Low subharmonics for multiplied models (-70 dBc)
- +13 dBm standard output power
- Industry standard footprint

## OPTIONS

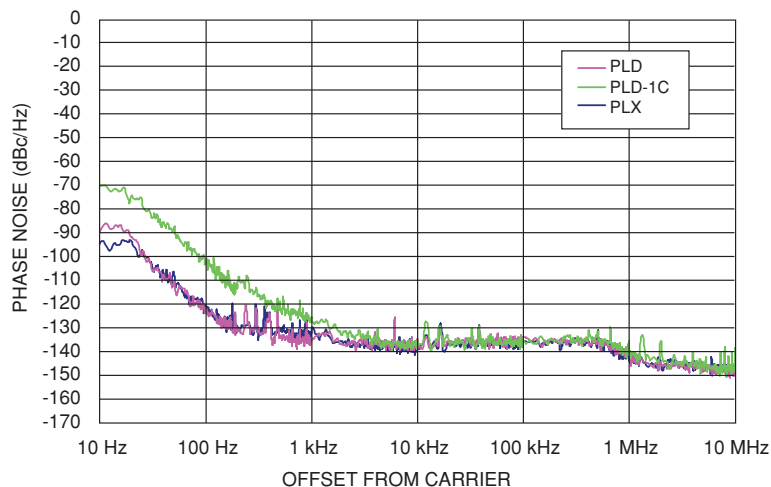
- Higher output power
- Coupled RF output



## ELECTRICAL SPECIFICATIONS

Output frequency range	
PLD	30 – 130 MHz
PLD-1C	130 – 1000 MHz
PLX	7.5 – 250 MHz
Output power	+13 dBm minimum
Output power variation	±1 dB maximum
Output harmonic	-20 dBc maximum
Output spurious	-70 dBc maximum
Phase noise	See graph
Input reference frequency	1 – 20 MHz
Input power level	0 ±3 dBm
Input impedance	50 ohms
Load VSWR	1.5:1 nominal
DC power requirements	+15 or +20 volts @ 370 mA and +5 volts @ 200 mA, max.

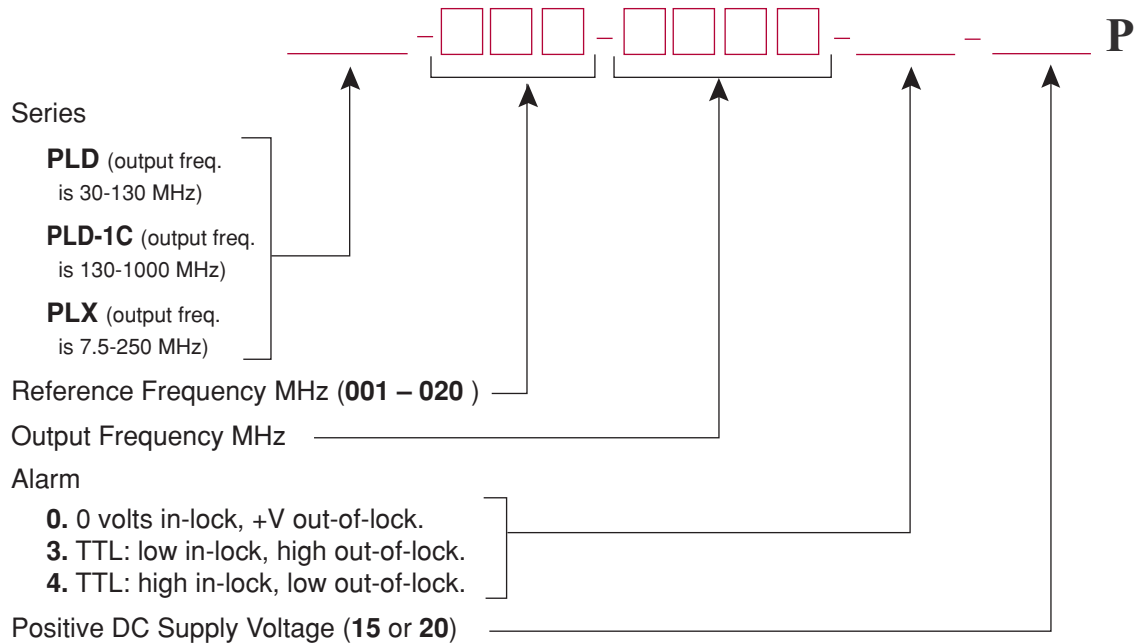
## TYPICAL PHASE NOISE





# PHASE-LOCKED CRYSTAL OSCILLATOR

## ORDERING INFORMATION



EXAMPLE: Part Number PLD-010-0100-3-15P is a PLD series 100 MHz Phase-Locked Crystal Oscillator with 10 MHz reference, TTL low in-lock alarm and +15 volt DC supply.

## MECHANICAL SPECIFICATIONS

### Outline drawings

PLD .....	138410
PLD-1C .....	138413
PLX .....	186242

### Size

PLD .....	2.10" x 3.20" x 0.87"
PLD-1C .....	2.15" x 3.15" x 1.33"
PLX .....	2.25" x 2.25" x 0.55"

### Weight

PLX .....	100 grams nominal
Fundamental .....	250 grams nominal
Multiplied .....	300 grams nominal
RF connectors .....	SMA female
DC connectors .....	Feedthru filter

## ENVIRONMENTAL SPECIFICATIONS

### Temperature

Operating .....	-10 to 60°C
Storage .....	-50 to +100°C

Humidity..... 95% at 40°C, noncondensing

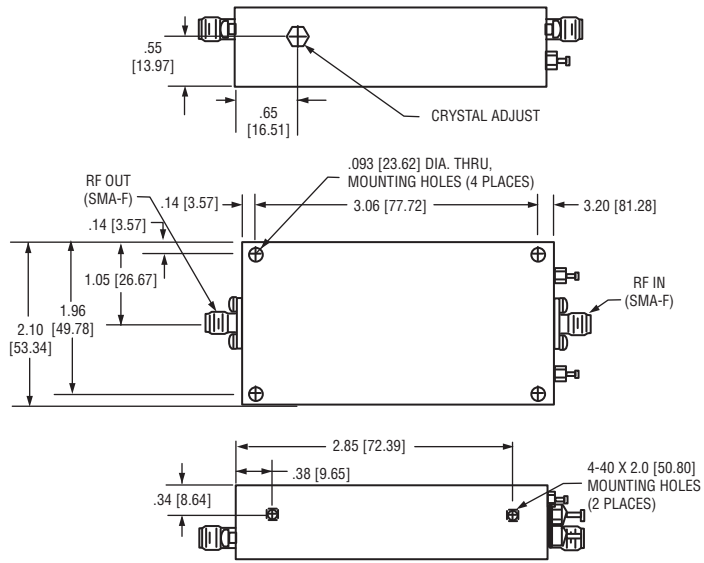
Shock (survival)..... 30 g's, 10 ms pulse

Vibration (survival)..... 20 to 2000 Hz random to 4 g's rms

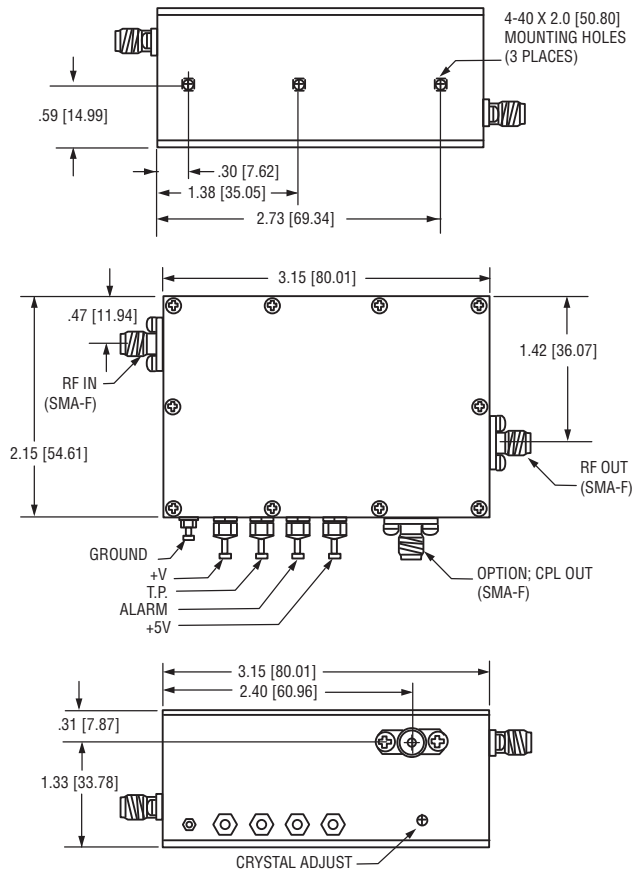
Note: Extended temperature available, please contact MITEQ.

# OUTLINE DRAWINGS

## 138410 PLD SERIES



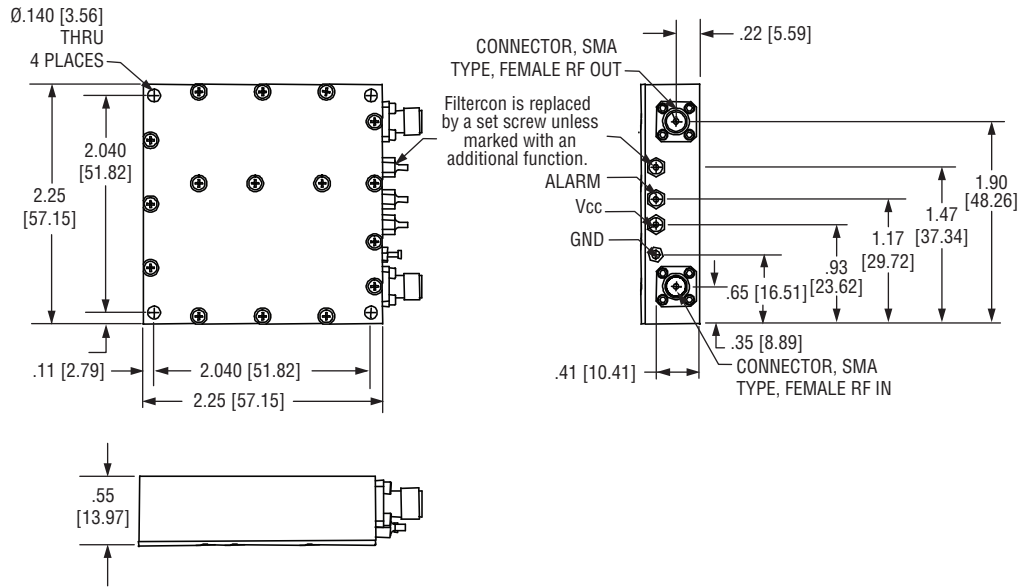
## 138413 PLD-1C SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# OUTLINE DRAWINGS (CONT.)

## 186242 PLX SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.



# HIGH-VALUE PHASE-LOCKED COAXIAL RESONATOR OSCILLATOR

## BCO SERIES

**.1-4 GHz (Fundamental)**  
**4-16 GHz (Multiplied)**

## FEATURES

- Low cost
- Phase locked to external standard or internal crystal reference
- High Q ceramic resonator
- Low phase noise
- Small package
- 100% burn-in and temperature testing
- Three-year warranty



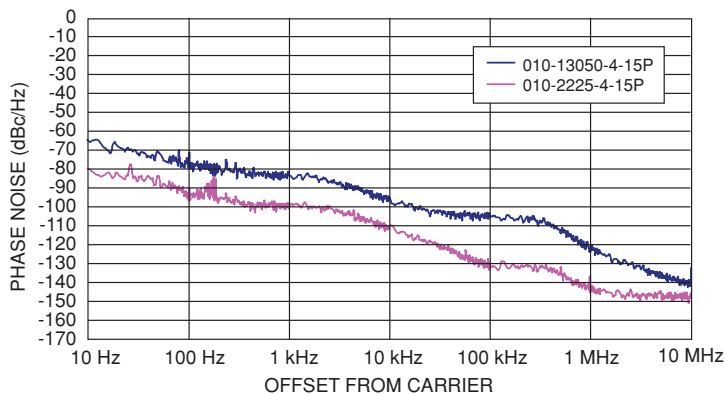
The BCO Series phase-locked source offers excellent phase noise and spurious performance in a 2.25" W x 2.25" L x .6" H housing. Available in fixed frequencies from 125 MHz to 16 GHz in fundamental or multiplied configurations. Reference tracking capable for up to octave bandwidths. Units can operate from either external reference or internal TCXO with stability up to 1 ppm. Available with operating voltages from 5.2 to 15 VDC, and feedthru filtercons or a 4 pin interface connector.

## ELECTRICAL SPECIFICATIONS

Output frequency range	100 MHz – 16 GHz
Output power (See Note)	+13 dBm minimum
Output harmonic	
Fundamental	-30 dBc maximum
Multiplied	-20 dBc maximum
Output spurious	-70 dBc maximum
Phase noise	See graph
Input reference frequency	1 – 200 MHz
Input impedance	50 ohms
Load VSWR	1.5:1 nominal
DC power requirements	
Fundamental	+5.2 to +15 volts @ 300 mA
Multiplied	+5.2 to +15 volts @ 350 mA

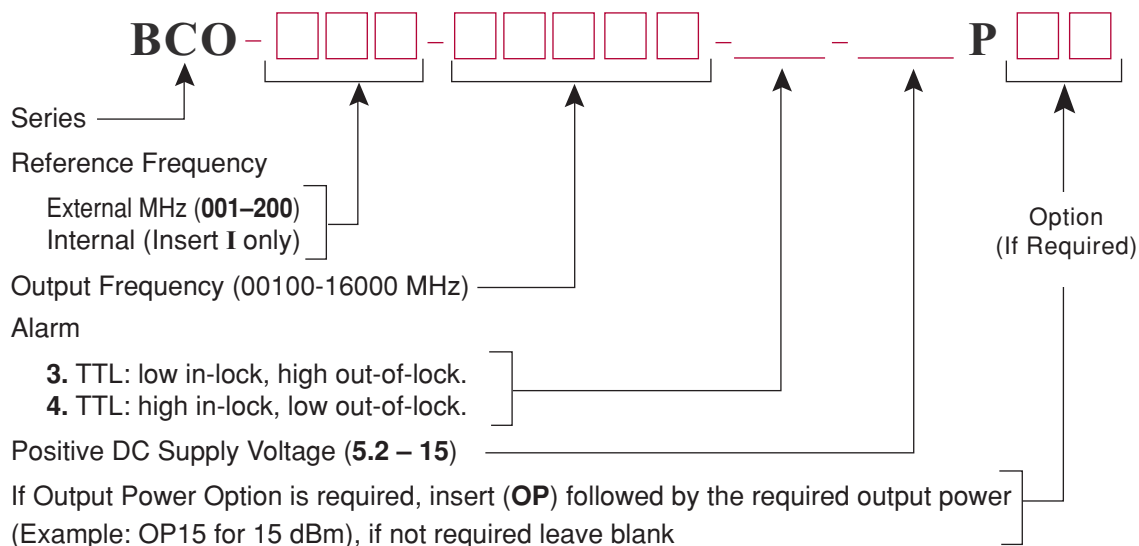
Note: On fundamental units, output power of 20 dBm is available. Please contact MITEQ.

## TYPICAL PHASE NOISE



# HIGH-VALUE PHASE-LOCKED COAXIAL RESONATOR OSCILLATOR

## ORDERING INFORMATION



Note: When specifying options, include applicable detailed information.

EXAMPLE: Part Number BCO-010-13500-4-15P BCO Phase-Locked Oscillator with 13.5 GHz output locked to 10 MHz reference with TTL high in-lock alarm and +15 volt DC supply voltage.

## MECHANICAL SPECIFICATIONS

Outline drawings	
Multiplied .....	154937, 166825
Fundamental .....	166055, 166552
Size .....	2.25" x 2.25" x 0.6"
Weight .....	≤ 100 grams
RF connectors .....	SMA female
DC connectors	
Fundamental .....	Feedthru filter
Multiplied .....	4-pin JST™

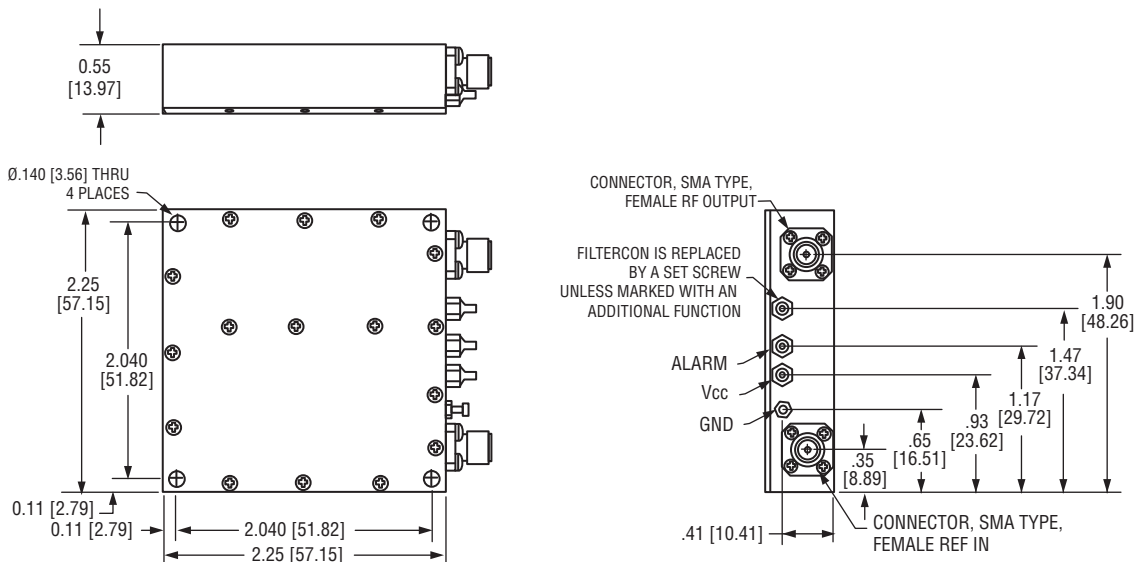
## ENVIRONMENTAL SPECIFICATIONS

Temperature	
Operating .....	-10 to +60°C
Storage .....	-50 to +100°C
Humidity .....	95% at 40°C noncondensing
Shock (survival) .....	30 g's, 10 ms pulse
Vibration (survival) .....	20 to 2000 Hz random to 4 g's rms

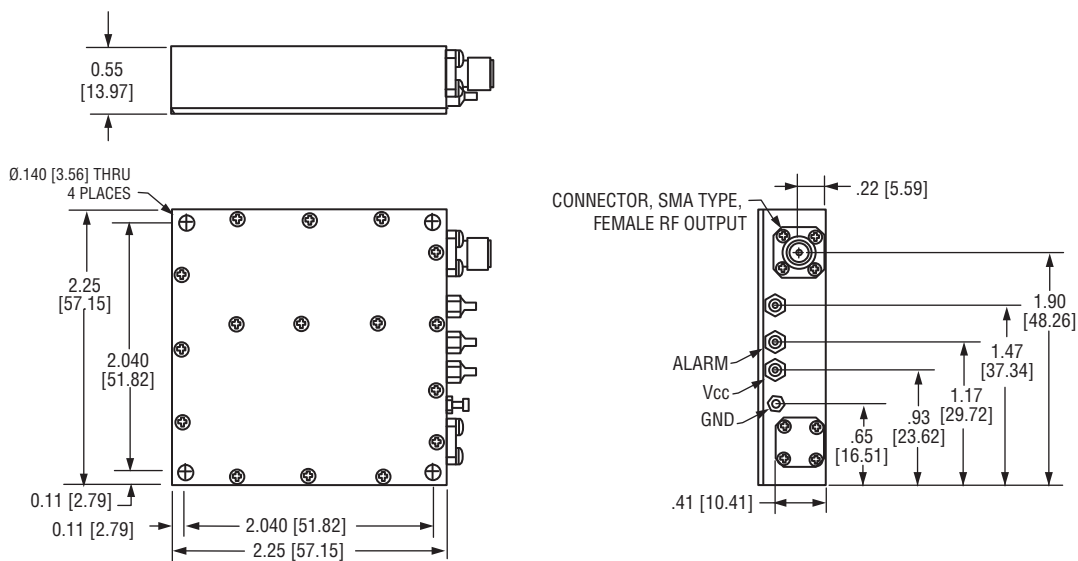
Note: Extended temperature available, please contact MITEQ.

# OUTLINE DRAWINGS

## 166055 BCO SERIES (STANDARD FUNDAMENTAL)



## 166552 BCO SERIES (FUNDAMENTAL WITH INTERNAL INTERFACE)

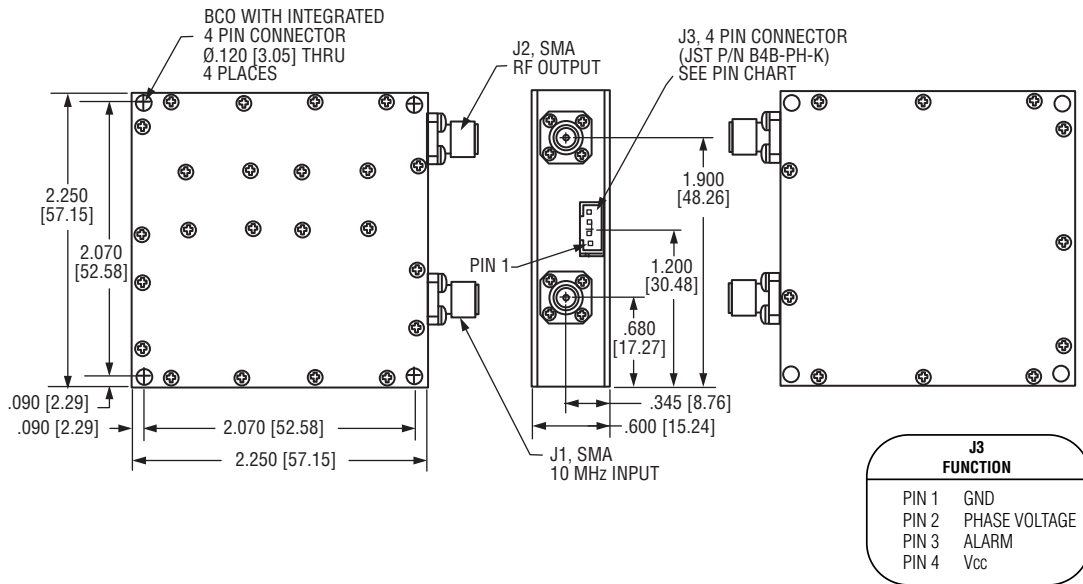


NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

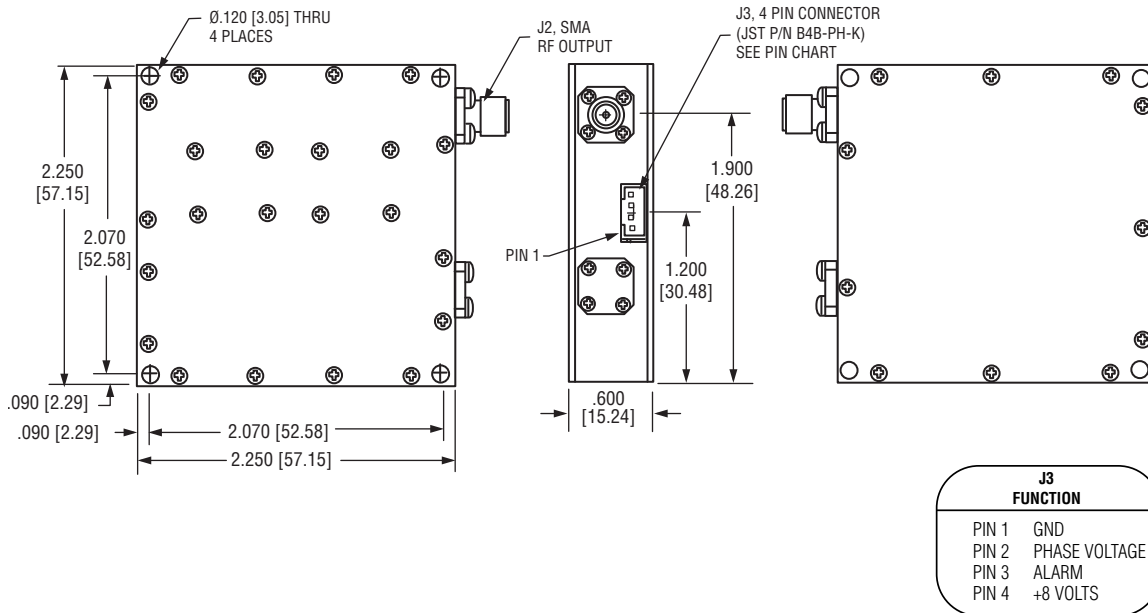


# OUTLINE DRAWINGS (CONT.)

## 154937 BCO SERIES (STANDARD MULTIPLIED)



## 166825 BCO SERIES (MULTIPLIED WITH INTERNAL INTERFACE)



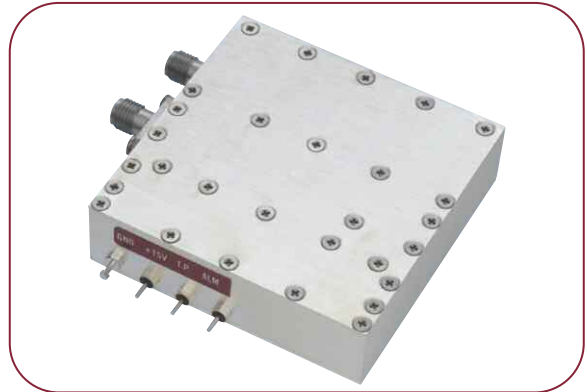
NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

## LOWEST NOISE PHASE-LOCKED DIELECTRIC RESONATOR OSCILLATOR

**DLCRO SERIES:**  
**0.6–4 GHz (Fundamental)**  
**4–15 GHz (Multiplied)**

### FEATURES

- High performance in a small package
- Excellent spurious performance
- Excellent performance/cost ratio
- 100% burn-in and temperature testing
- Three-year warranty
- Now offered with RF connectors on same side



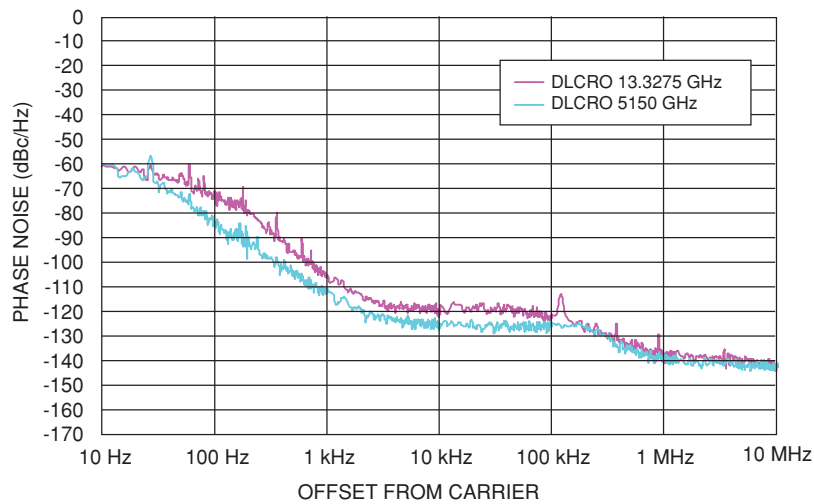
The DLCRO Series phase-locked source offers excellent phase noise and spurious performance in a 2.25" W x 2.25" L x .60" H housing. The dual loop configuration improves phase noise and spurious performance compared to a single loop design, and has the flexibility to allow output frequencies that are not direct multiples of the input. Available in fixed frequencies from 600 MHz to 15 GHz in fundamental or multiplied configurations. The DLC can operate with external reference of 1 to 200 MHz, and with 8 to 15 VDC supply input.

### ELECTRICAL SPECIFICATIONS

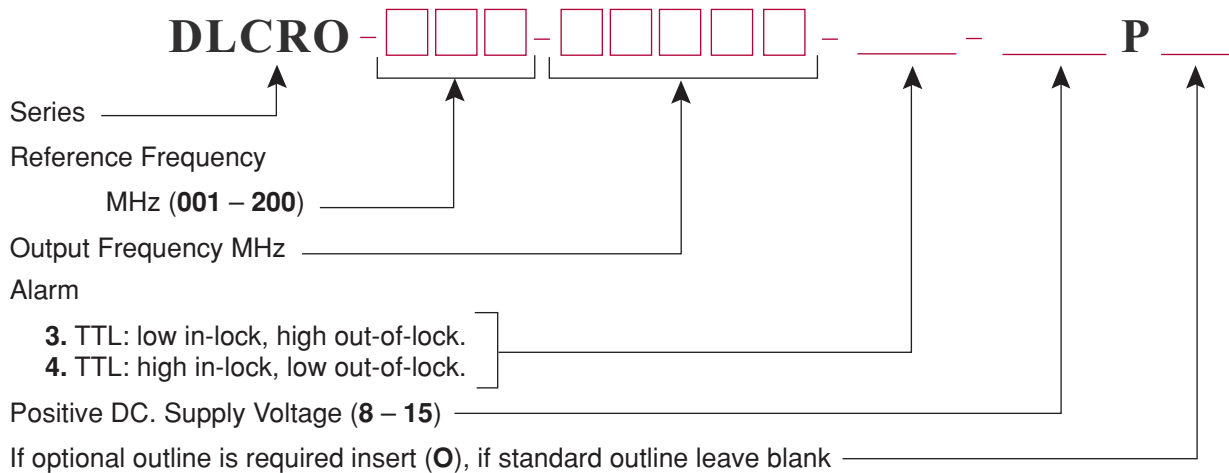
Output frequency range Fundamental Multiplied	0.60 – 4 GHz 4 – 15 GHz
Output power	+13 dBm minimum
Output harmonic Fundamental Multiplied	-20 dBc maximum -50 dBc maximum
Output spurious	-70 dBc maximum
Phase noise	See graph
Input frequency range	1 – 200 MHz
Input impedance	50 ohms
Load VSWR	1.5:1
DC power requirements Fundamental Multiplied	+8 to +15 volts @ 275 mA +8 to +15 volts @ 375 mA

# LOWEST NOISE PHASE-LOCKED DIELECTRIC RESONATOR OSCILLATOR

## TYPICAL PHASE NOISE



## ORDERING INFORMATION



EXAMPLE: Part Number DLCRO-010-10000-3-12P Dual Loop Phase-Locked Oscillator with 10 GHz output locked to 10 MHz reference with TTL low in-lock alarm and +12 volts DC supply voltage with standard outline.

## MECHANICAL SPECIFICATIONS

Outline drawings  
Standard ..... 153748  
Optional ..... 174279  
Size ..... 2.25" x 2.25" x 0.60"  
Weight ..... 90 grams  
RF connectors ..... SMA female  
DC connectors ..... Feedthru filter

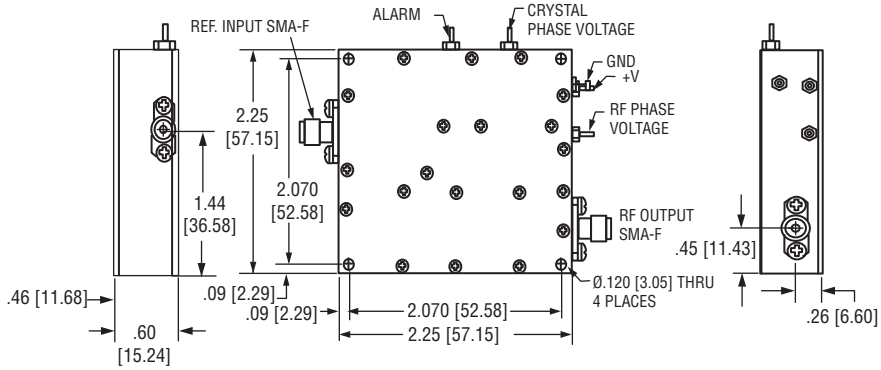
## ENVIRONMENTAL SPECIFICATIONS

Temperature  
Operating ..... -10 to +60°C  
Storage ..... -50 to +100°C  
Humidity ..... 95% at 40°C noncondensing  
Shock (survival) ..... 30 g's, 10 ms pulse  
Vibration (survival) ..... 20 to 2000 Hz random to 4 g's rms

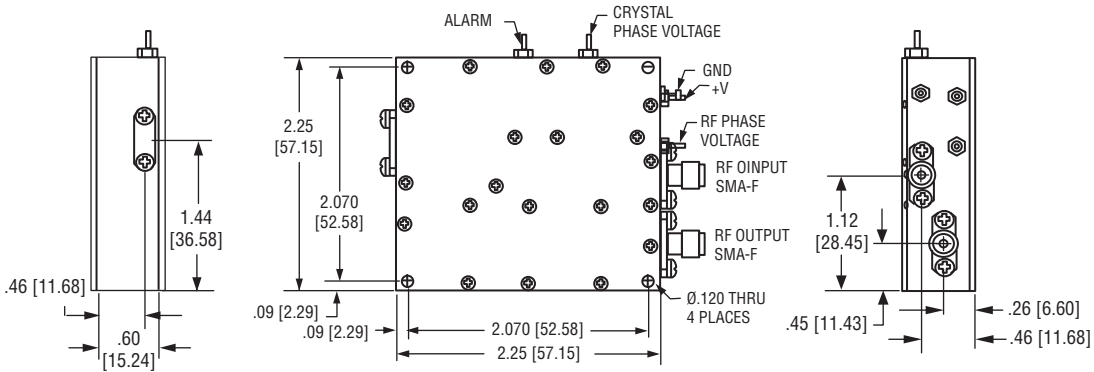
Note: Extended temperature available, please contact MITEQ.

# OUTLINE DRAWINGS

## 153748 DLCRO SERIES (STANDARD)



## 174279 DLCRO SERIES (OPTIONAL)



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

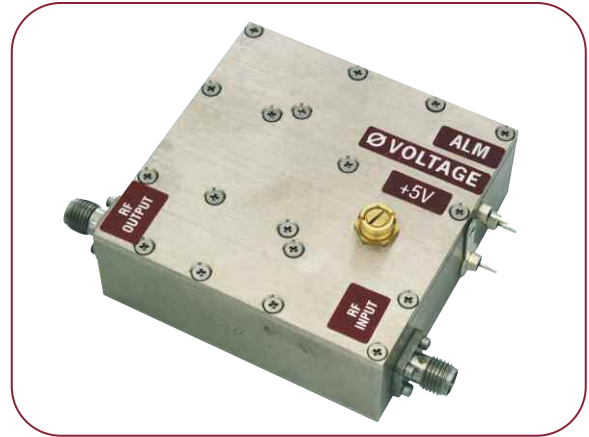
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# ULTRA-LOW NOISE PHASE-LOCKED DIELECTRIC RESONATOR OSCILLATOR

## PLDRO SERIES: 6.7–40 GHz

### FEATURES

- Lowest phase noise
- Very fine frequency resolution
- Reference from 5 to 100 MHz
- Internal reference available
- Small package
- Low power consumption
- 100% burn-in and environmentally tested
- Three-year warranty



PLDRO's are available in both single loop and dual loop designs. Dual loop designs offer very low frequency resolution and the added feature of reference cleanup. The bipolar PLDRO design offers the best oscillator phase noise in the industry.

### ELECTRICAL SPECIFICATIONS

Output frequency range	
Fundamental unit	6.7 – 13.4 GHz
Multiplied X2 unit	13.4 – 26.8 GHz
Multiplied X4 unit	26.8 – 40 GHz
Output power	+13 dBm minimum
Multiplied X4 unit	+10 dBm minimum
Output harmonic	
Fundamental unit	-20 dBc maximum
Multiplied unit	-50 dBc maximum
Output spurious (Note1)	
Fundamental unit	-75 dBc maximum
Multiplied X2 unit	-70 dBc maximum
Multiplied X4 unit	-65 dBc maximum
Phase noise	See graph and table
Reference frequency (Note 2)	5 – 100 MHz
Reference input power	0 ±3 dBm
DC power requirements	
Fundamental unit	+5.4 VDC, or +8 VDC, or +12 VDC, or +15 VDC
Multiplied units	+8 VDC, or +12 VDC, or +15 VDC
Voltage tolerance	-0 or +0.4 VDC
Current	
Fundamental unit	370 mA maximum
Multiplied units	600 mA maximum
Load VSWR	2:1
Lock alarm (Note 3)	TTL "high" in-lock
Connectors	
RF/IN/OUT	SMA or K female
Voltage/Alarm/Phase	Solder pin feedthru

#### Notes:

1. Resolution dependent, table indicates output frequencies in 10 MHz intervals. For finer frequency resolution, please contact MITEQ for spurious limits.
2. Reference frequency above 100 MHz and below 5 MHz is available, please contact MITEQ.
3. Reverse logic available.

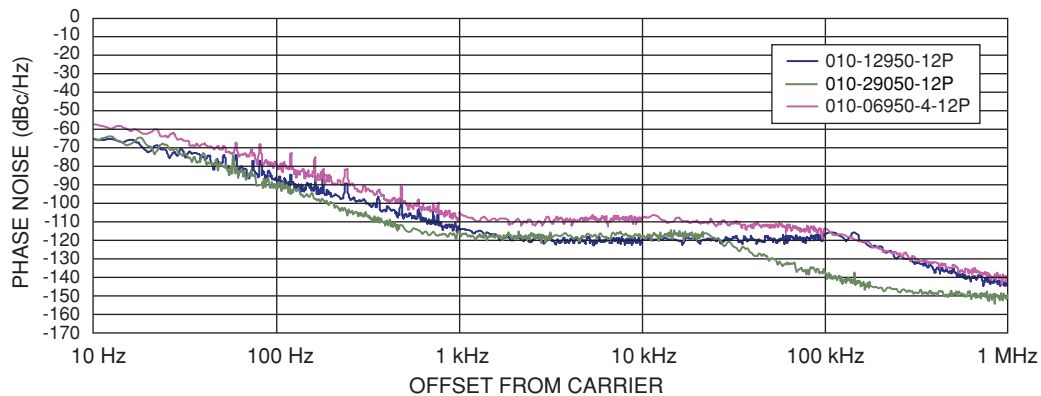


# ULTRA-LOW NOISE PHASE-LOCKED DIELECTRIC RESONATOR OSCILLATOR

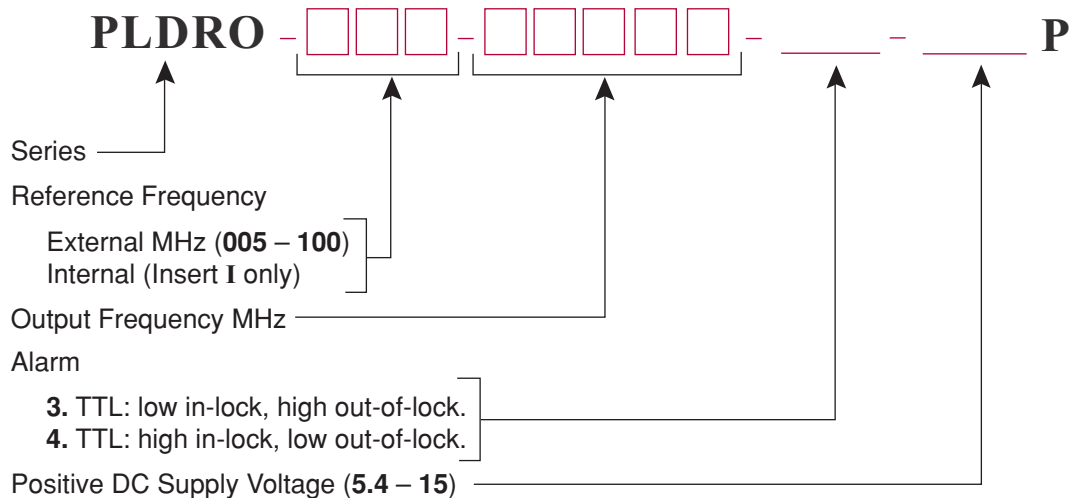
## MAXIMUM PHASE NOISE

Phase Noise @	PLDRO FUNDAMENTAL			PLDRO MULTIPLIED X 2			PLDRO MULTIPLIED X 4	
	6.7–8.0 GHz	8.0–11.5 GHz	11.5–13.4 GHz	13.5–16 GHz	16–23 GHz	23–26.8 GHz	26.9–32 GHz	32–40 GHz
10 Hz	-53 dBc	-48 dBc	-48 dBc	-47 dBc	-42 dBc	-42 dBc	-41 dBc	-36 dBc
100 Hz	-76 dBc	-73 dBc	-72 dBc	-70 dBc	-67 dBc	-66 dBc	-64 dBc	-58 dBc
1 kHz	-110 dBc	-108 dBc	-105 dBc	-104 dBc	-102 dBc	-99 dBc	-98 dBc	-92 dBc
10 kHz	-117 dBc	-115 dBc	-106 dBc	-111 dBc	-109 dBc	-100 dBc	-105 dBc	-100 dBc
100 kHz	-120 dBc	-118 dBc	-106 dBc	-114 dBc	-112 dBc	-100 dBc	-108 dBc	-106 dBc
1 MHz	-143 dBc	-141 dBc	-130 dBc	-137 dBc	-135 dBc	-124 dBc	-131 dBc	-129 dBc

## TYPICAL PHASE NOISE



## ORDERING INFORMATION



EXAMPLE: Part Number PLDRO-010-11500-3-15P Phase-Locked Dielectric Resonator Oscillator with 11.5 GHz output locked to 10 MHz reference with TTL low in-lock alarm and +15 volt DC supply voltage.

# OUTLINE DRAWINGS

## MECHANICAL SPECIFICATIONS

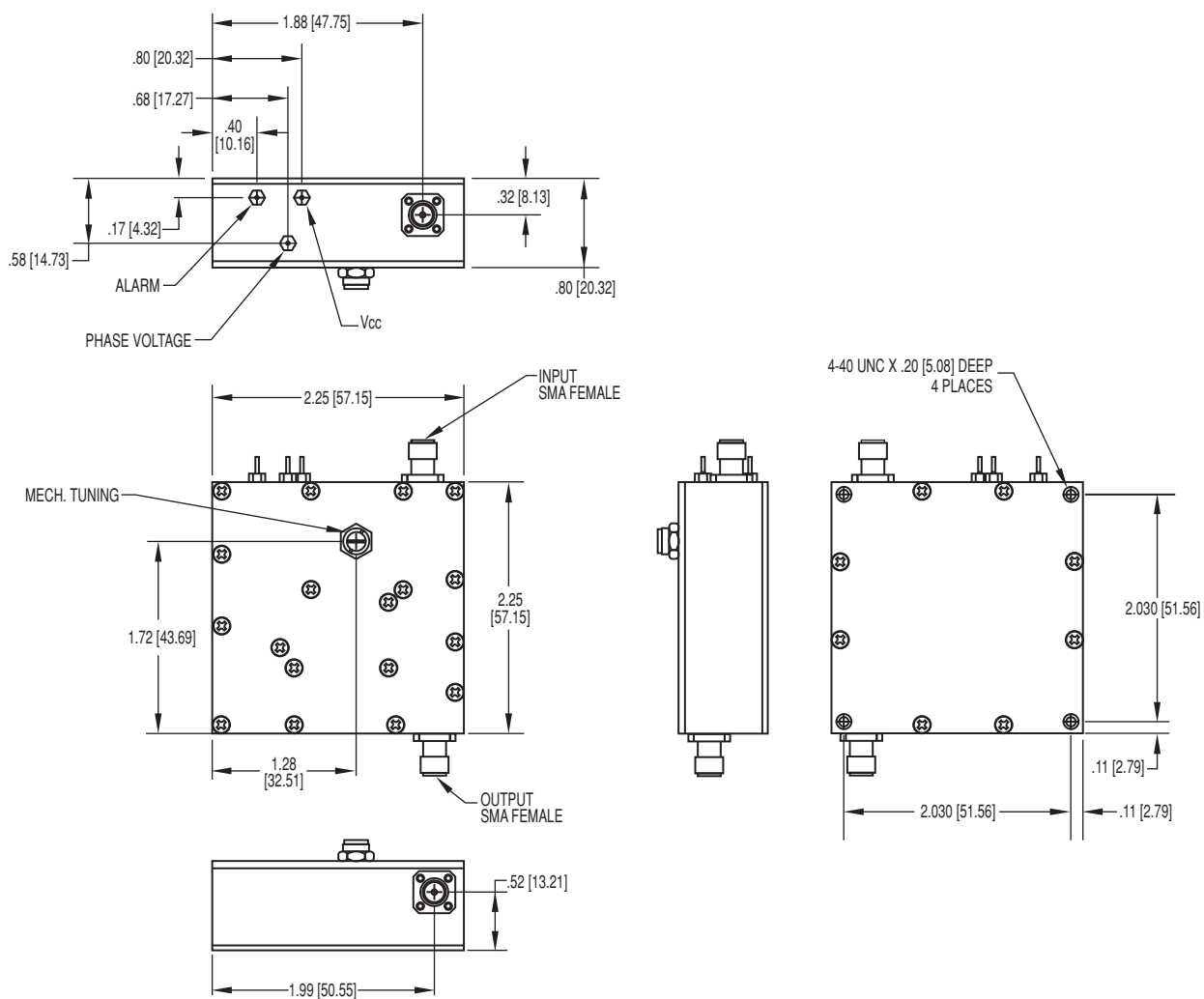
Outline drawings  
 Fundamental..... 148748  
 Multiplied ..... 156650  
 Size  
 Fundamental..... 2.25" x 2.25" x 0.95"  
 Multiplied ..... 2.70" x 3.00" x 1.05"  
 Weight ..... ≤ 200 grams  
 RF connectors..... SMA female,  
 SMA/K-female  
 DC connectors ..... Feedthru filter

## ENVIRONMENTAL SPECIFICATIONS

Temperature  
 Operating ..... -20 to +70°C  
 Storage ..... -50 to +100°C  
 Humidity ..... 95% at 40°C noncondensing  
 Shock (survival) ..... 30 g's, 10 ms pulse  
 Vibration (survival) ..... 20 to 2000 Hz random to 4 g's rms

Note: Extended temperature ranges available,  
 please contact MITEQ.

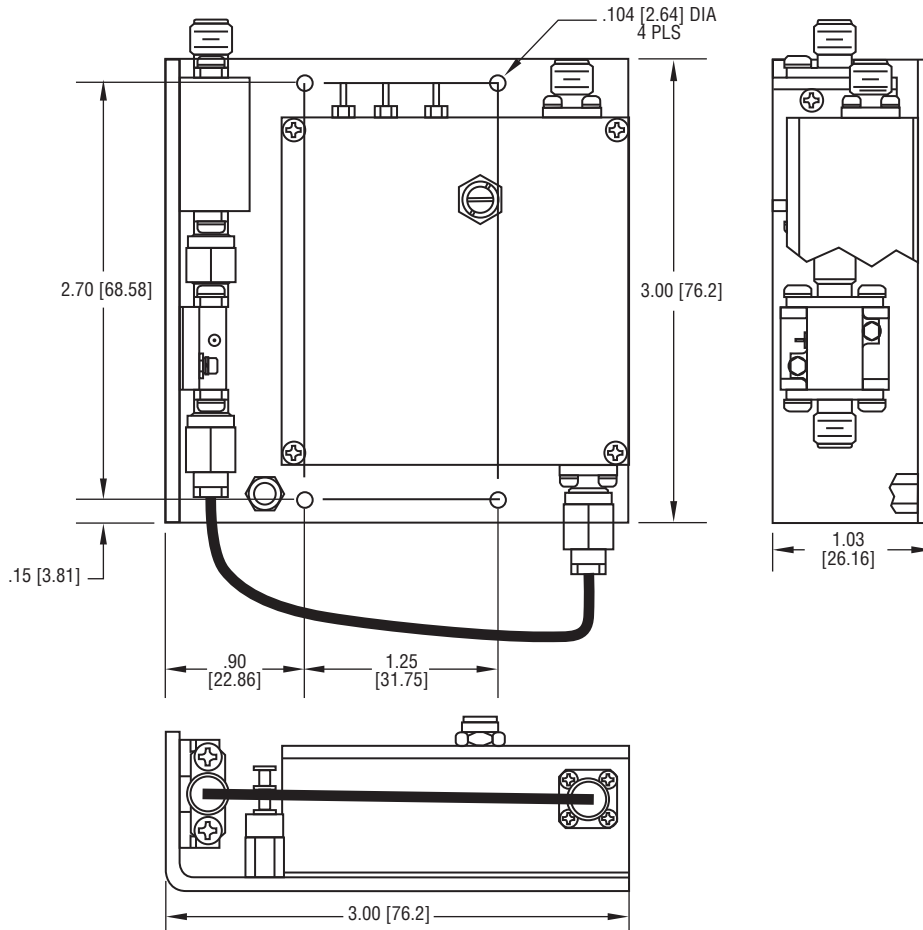
### 148748 PLDRO SERIES (FUNDAMENTAL)



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# OUTLINE DRAWINGS (CONT.)

## 156650 PLDRO SERIES (MULTIPLIED)



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.



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# FREE-RUNNING DIELECTRIC RESONATOR OSCILLATOR section

# INTRODUCTION TO DROs

## INTRODUCTION TO DROs

Dielectric Resonator Oscillators (DROs) are microwave oscillators that use a dielectric resonator (DR) as the frequency stabilizing element in order to achieve excellent frequency stability, high Q and very low microphonics. The DR, when used as part of the resonating circuit of any active microwave device, produces a steady state oscillation under the right conditions at the resonant frequency of the DR.

## OSCILLATOR THEORY AND CIRCUIT DESIGN

MITEQ's DRO circuits utilize both silicon bipolar transistors and GaAs MESFET devices. All microwave oscillators are designed by adding resonating elements (L, C or R) in various configurations to different ports of a transistor. These elements generate a negative resistance at a certain resonant frequency and set the device into oscillation. In the case of a DRO, the resonating element is the DR, which can be modeled electrically as an L, C, R network, as shown in Figure 1.

### DIELECTRIC RESONATOR ELECTRICAL MODEL

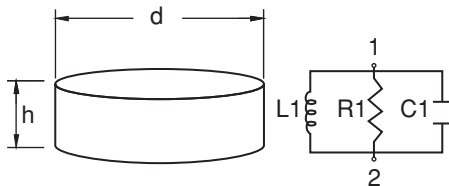


FIGURE 1

The Dielectric Resonator is made of a high dielectric constant ( $\epsilon = 30$  to  $80$ ) ceramic material, often barium titanate ( $\text{Ba}_2\text{Ti}_9\text{O}_{20}$ ). This material exhibits a high Q ( $9000 @ 10 \text{ GHz}$ ) and low temperature coefficient of frequency (TC to  $\pm 6 \text{ ppm}/^\circ\text{C}$  typical).

The cylindrical shape as shown in Figure 1 is the most popular. It has good separation between the desired  $\text{TE}_{\delta}(0,1)$  mode and other higher order resonant modes, making it easier to couple to microstrip circuits, as well as easy to mount.

The resonator is magnetically coupled to one or more ports of the transistor using a transmission line, as shown in Figure 2.

### DIELECTRIC RESONATOR MAGNETICALLY COUPLED TO DIFFERENT PORTS OF TRANSISTOR USING TRANSMISSION LINE

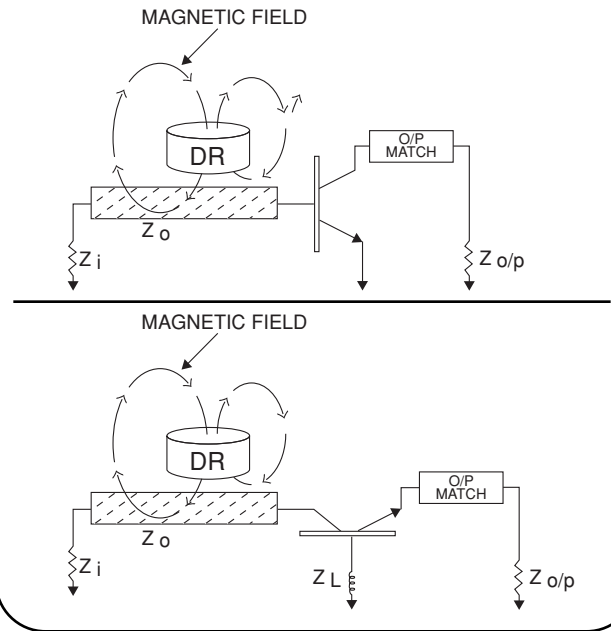


FIGURE 2

## OSCILLATOR FABRICATION TECHNIQUES

MITEQ DROs are manufactured using state-of-the-art thin-film hybrid micro-circuit technology. These DROs are suited for applications requiring rugged construction for operation under severe environmental stress.

## TYPICAL DRO PERFORMANCE SPECIFICATIONS AND APPLICATIONS

When comparing different types of oscillators versus a DRO, an engineer may wish to consider the following performance specifications:

### FREQUENCY ACCURACY AND SETTABILITY

The frequency accuracy of a free-running DRO is typically within 500 kHz and can be set to within 100 kHz.

### FREQUENCY STABILITY

DROs are highly stable free-running oscillators exhibiting low temperature coefficient of frequency drift (typically  $4 \text{ ppm}/^\circ\text{C}$ ) and have better stability than free-running cavity oscillators, Gunn diode oscillators or VCOs.



## INTRODUCTION TO DROs (CONT.)

### FREQUENCY PULLING FACTOR

Pulling is an oscillators sensitivity to VSWR changes. Since the DRO is a high Q oscillator, its frequency pulling factor is better than other free-running sources. The frequency pulling figure for an unbuffered (at 10 GHz) DRO is typically less than 5 MHz peak-to-peak for a 1.5:1 VSWR varying through all phases.

### RF POWER OUTPUT

A DRO exhibits good power efficiency compared to other oscillators, such as a Gunn oscillator or VCO, due to lossless coupling of dielectric resonator element. It also has less power variation over temperature.

### EFFECT OF POWER SUPPLY VARIATION AND OTHER NOISE CONSIDERATION

Frequency pushing is small, typically 15 kHz/volt. Also, residual noise is lower and the oscillator exhibits low microphonics (noise caused by mechanical vibrations).

### LIMITATIONS OF A DROs PERFORMANCE

#### FREQUENCY STABILITY

DRO stability is not as good as phase-locked oscillators, but for applications requiring small size, low cost and a slightly lesser stability specification, the DRO is more suitable.

#### BANDWIDTH

Mechanical tuning bandwidth is another limiting factor. Typically the bandwidth is 0.2% of center frequency, it can only be increased up to 3% of center frequency for special applications.

#### PHASE NOISE

DROs typically offer excellent phase noise performance. Typical phase noise curves can be seen on page 30.

## SPECIFICATIONS

### FREE-RUNNING CRYSTAL OSCILLATORS, DRO'S, AND ETCRO'S TABLE

MODEL	TYPE	BAND	OUTLINE	DESCRIPTION
XTO	Ovenized crystal oscillator	5–130 MHz	2.0 X 2.0 X 1.0 Inch	High stability, High performance ovenized crystal oscillator
DRO	Free running dielectric resonator oscillator	2.4–40 GHz	Various See catalog selection	Low-noise dielectric resonant oscillator
TCDRO	Temperature compensated dielectric resonator oscillator	2.4 GHz–40 MHz	2.5 X 2.34 X 0.8 Inch 63.5 X 59.5 X 20.3 mm	Low-noise temperature compensated dielectric resonant oscillator
ETCO	Electrically-tuned coaxial resonator oscillator	0.1–15 GHz	2.25 X 2.25 X 0.55 Inch 57.2 X 57.2 X 14.0 mm	Modular voltage controlled oscillator

# ULTRA LOW-NOISE CRYSTAL OSCILLATOR

## XTO-05 SERIES: 5-130 MHz

### FEATURES

- Ultra low phase noise
- Low current consumption
- Low cost
- Oven controlled

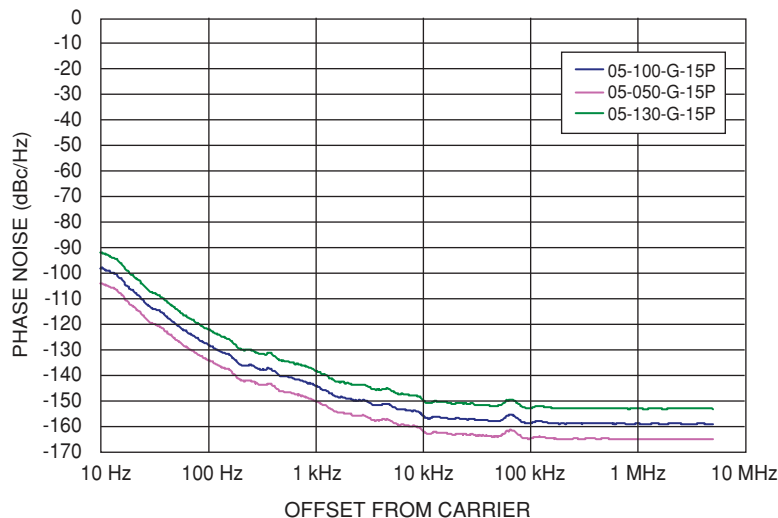


### ELECTRICAL SPECIFICATIONS

Output frequency range	5 – 130 MHz
Output power	+11 dBm minimum (standard) +15 dBm maximum (optional*)
Output power variation (0 to 60°C)	±1 dB maximum
Output impedance	50 ohms
Output harmonic	-30 dBc minimum
Frequency stability	F. ±1 ppm, (0 to 60°C) G. ±0.1 ppm (0 to 60°C) J. ±0.01 ppm (0 to 50°C)
Phase noise	See graph
Aging rate	2 x 10 <sup>-9</sup> per 24 hours
Load VSWR	1.5:1 nominal
DC power requirements	+15, +20 or +24 volts @ 350 mA (warm-up) @ 210 mA (continuous)

\* For +15 dBm option, please contact MITEQ.

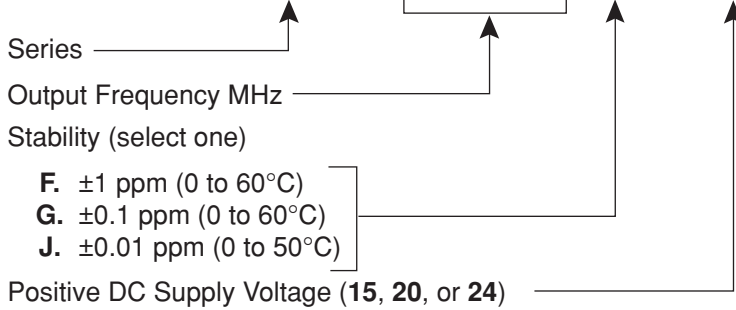
### TYPICAL PHASE NOISE



# ULTRA LOW-NOISE CRYSTAL OSCILLATOR

## ORDERING INFORMATION

**XTO-05** - [ ] [ ] [ ] - [ ] - [ ] **P**



EXAMPLE: Part Number XTO-05-96.0-G-15P Ultra Low-Noise Crystal Oscillator with 96 MHz and ±0.1 ppm stability, +15 VDC supply.

## MECHANICAL SPECIFICATIONS

Outline drawing..... 138427  
 Size..... 2.0" x 2.0" x 1.0"  
 Weight..... 100 grams nominal  
 RF connectors ..... SMA female  
 DC connectors..... Feedthru filter

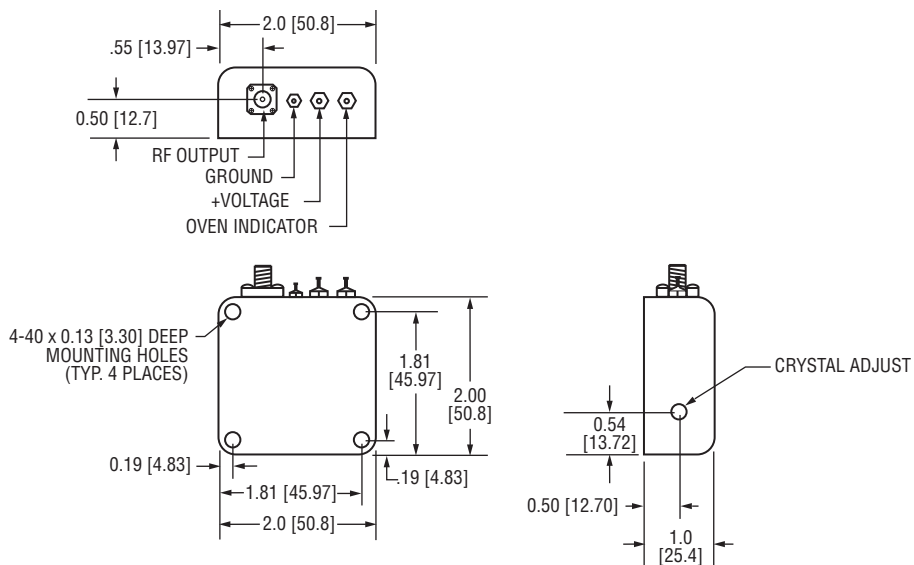
## ENVIRONMENTAL SPECIFICATIONS

Temperature  
 Operating ..... 0 to 60°C\*  
 Storage..... -50 to +100°C  
 Humidity..... 95% at 45°C, noncondensing  
 Shock (survival)..... 30 g's, 10 ms pulse  
 Vibration (survival)..... 20 to 2000 Hz random to 4 g's rms

\*0 to 50° C for J stability.

## OUTLINE DRAWING

### 138427 XTO-05 SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.



# MECHANICALLY-TUNED DIELECTRIC RESONATOR OSCILLATOR

## DRO SERIES

### FEATURES

- Ultra-clean source ideal for low spur application
- Miniaturized designs
- High-reliability construction
- Low phase noise

### OPTIONS

- Standard (-ST)
- High power (-HP-ST)
- Voltage tuning (-VT-ST)



## ELECTRICAL SPECIFICATIONS

PARAMETERS	UNITS	SERIES													
		D	E	EF	F	G	H	J	K	L	M	N	P	R	
		<b>ST (STANDARD)</b>													
Operating frequency range (Note 1)	GHz	2.4-3.7	3.7-4.8	4.8-6.5	6.5-8.8	8.8-12	12-16	16-18	18-20	20-22	22-24	24-26	26-33	33-40	
Output power (Note 2)	dBm, min.	+13	+13	+13	+13	+13	+13	+11	+11	+11	+11	+11	+11	+11	
Output power variation over temperature range	dB, max.	±2	±2	±2	±2	±2	±2	±2	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	
Fundamental	dBc, max.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-20	-20	-20	-20	-20	-20	
Harmonics	dBc, max.	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	
Spurious	dBc, max.	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	
Mechanical tuning	MHz, min.	±3	±5	±10	±10	±10	±10	±10	±10	±10	±10	±10	±10	±10	
Frequency pushing	kHz/V, max.	10	10	15	15	15	20	25	30	30	30	30	40	50	
Frequency pulling (1.5:1 VSWR)	MHz, P-P max.	2	2	3	5	5	5	5	1	1	1	1	1	1	
Frequency drift temp. coefficient (Note 3)	ppm/°C, max.	5	5	5	5	5	5	5	5	5	5	5	5	5	
Phase noise @ 10 kHz offset	dBc/Hz, typ.	105	105	95	90	85	80	80	80	80	80	75	75	70	
DC power (Note 4)	Volts	15	15	15	15	15	15	15	15	15	15	15	15	15	
Current	mA, max.	150	150	120	120	120	120	120	120	120	120	120	200	200	
Outline drawing		184074		184075	184076	184077						184090			
Temperature range	°C	-20 to +70													

# MECHANICALLY-TUNED DIELECTRIC RESONATOR OSCILLATOR

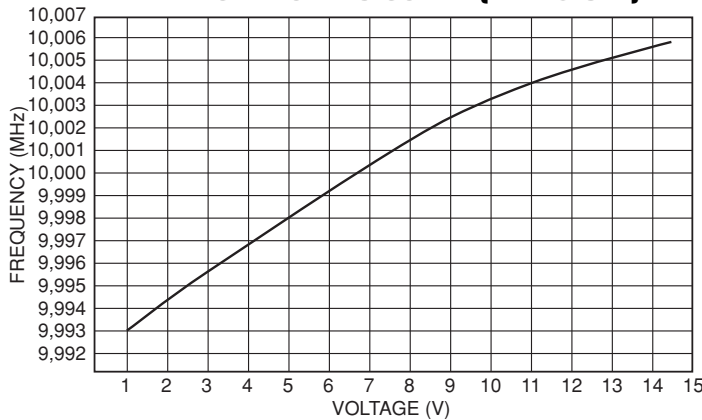
## ELECTRICAL SPECIFICATIONS (CONT.)

PARAMETERS	UNITS	SERIES													
		D	E	EF	F	G	H	J	K	L	M	N	P	R	
<b>VOLTAGE TUNABLE OPTION (VT-ST)</b>															
Electrical tuning @ Vvar = 1–15 V	MHz, min.	N/A	N/A	N/A	8	12	16	20	25	25	25	25	32	40	
Phase noise @ 10 kHz offset	dBc/Hz, typ.	N/A	N/A	N/A	85	80	75	75	75	75	75	70	70	65	
<b>HIGH POWER OPTION (HP-ST)</b>															
Output power (Note 5)	dBm, min.	+17	+17	+17	+17	+17	+17	+17	+17	+17	+14	+14	+14	+14	
Current	mA, max.	220	220	220	220	220	230	230	230	230	220	220	220	300	
Frequency pulling (1.5:1 VSWR)	MHz, P-P max.	2	2	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	2	
Outline drawing		184074			184075	184076	184077					184090			

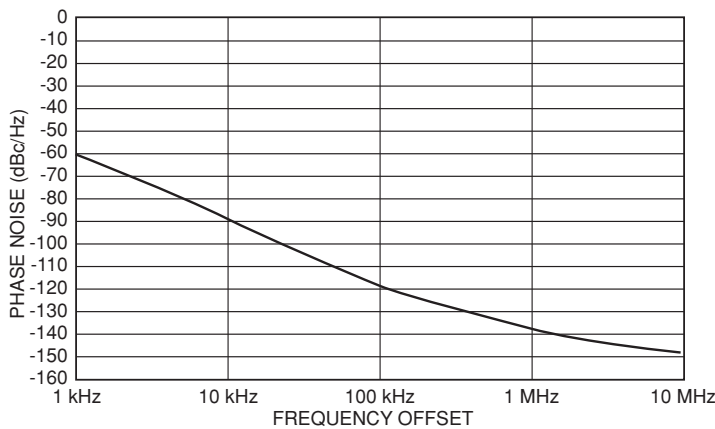
**Notes:**

1. Operating frequency must be specified.
2. Output power is guaranteed into 50 ohm load.
3. Averaged over the full temperature range.
4. Alternate DC voltage available.
5. For high power series R model, negative bias is required with 20 mA available current.
6. For all units that do not fall directly under one of the standard categories specified, please contact MITEQ.

**TYPICAL TUNING CURVE (F = 10 GHz)**

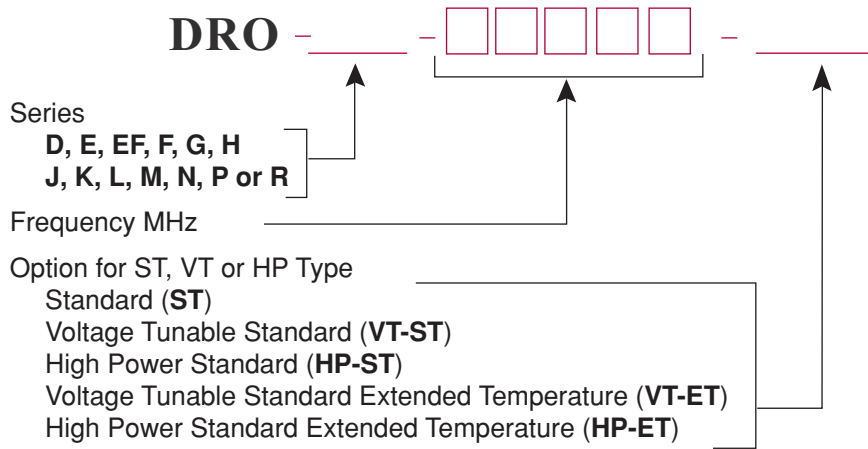


**TYPICAL PHASE NOISE CURVE (F = 10 GHz)**



# MECHANICALLY-TUNED DIELECTRIC RESONATOR OSCILLATOR

## ORDERING INFORMATION



Note: If unit is outside these standard options, please contact MITEQ.

Example 1: 12 GHz DRO standard: Part Number DRO-G-12000-ST.

Example 2: 4.5 GHz DRO with +17 dBm power: Part Number DRO-E-04500-HP-ST.

Example 3: 15 GHz DRO with voltage tuning: Part Number DRO-H-15000-VT-ST.

## MECHANICAL SPECIFICATIONS

Size per outline number

184074 .....	2.1" x 2.75" x 1.08"
184075 .....	1.75" x 2" x 0.85"
184076 .....	1.39" x 1.6" x 0.7"
184077 .....	1.05" x 1.45" x 0.63"
184090 .....	1.05" x 1.87" x 0.63"

Weight ..... Frequency dependent,  
please contact MITEQ.

RF connectors ..... SMA female

DC connectors ..... Feedthru filter

## ENVIRONMENTAL SPECIFICATIONS

Temperature

Operating -ST ..... -20 to +70°C

Operating -ET ..... -54 to +85°C

Storage ..... -65 to +115°C

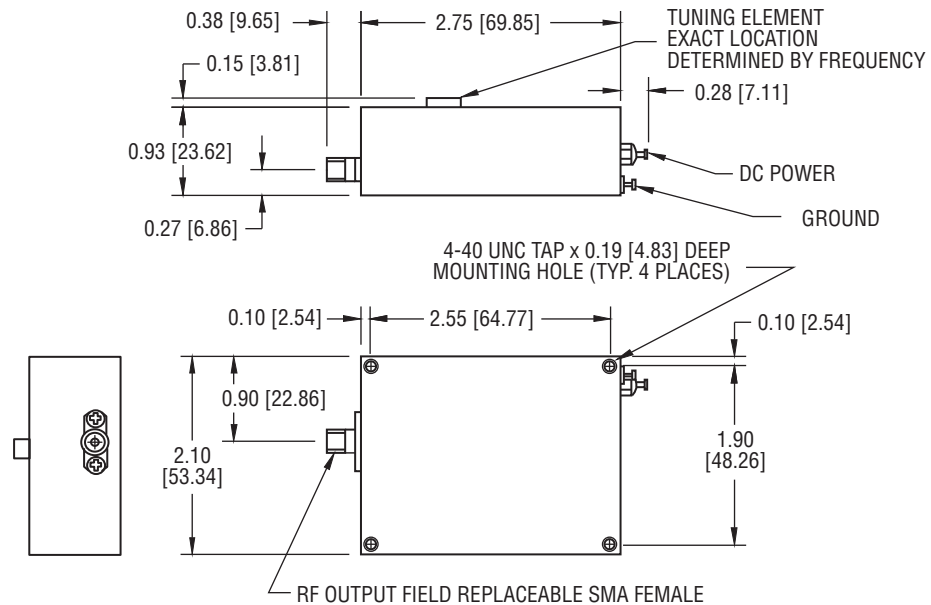
Humidity ..... 95% at 40°C noncondensing

Shock (survival) ..... 30 g's, 10 ms pulse

Vibration (survival) ..... 20 to 2000 Hz random to 4 g's rms

## OUTLINE DRAWINGS

### 184074 D, E SERIES

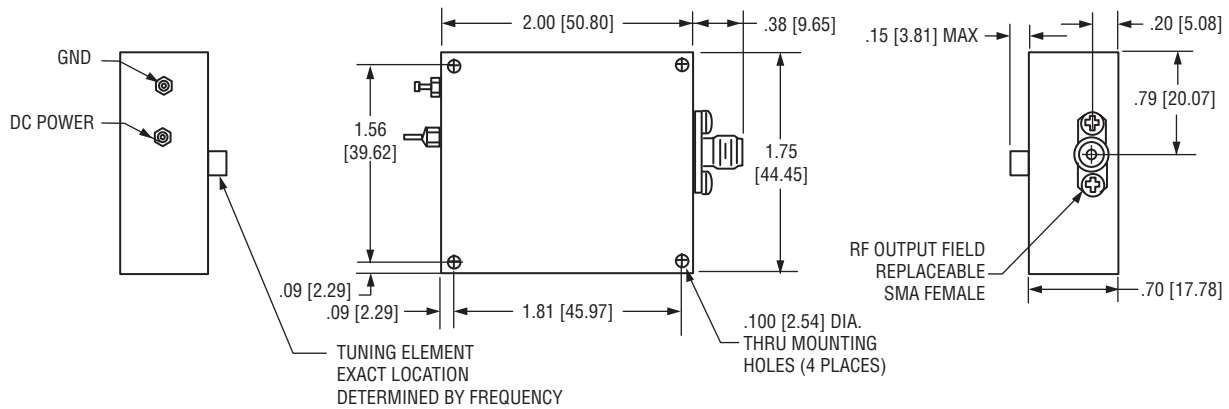


NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

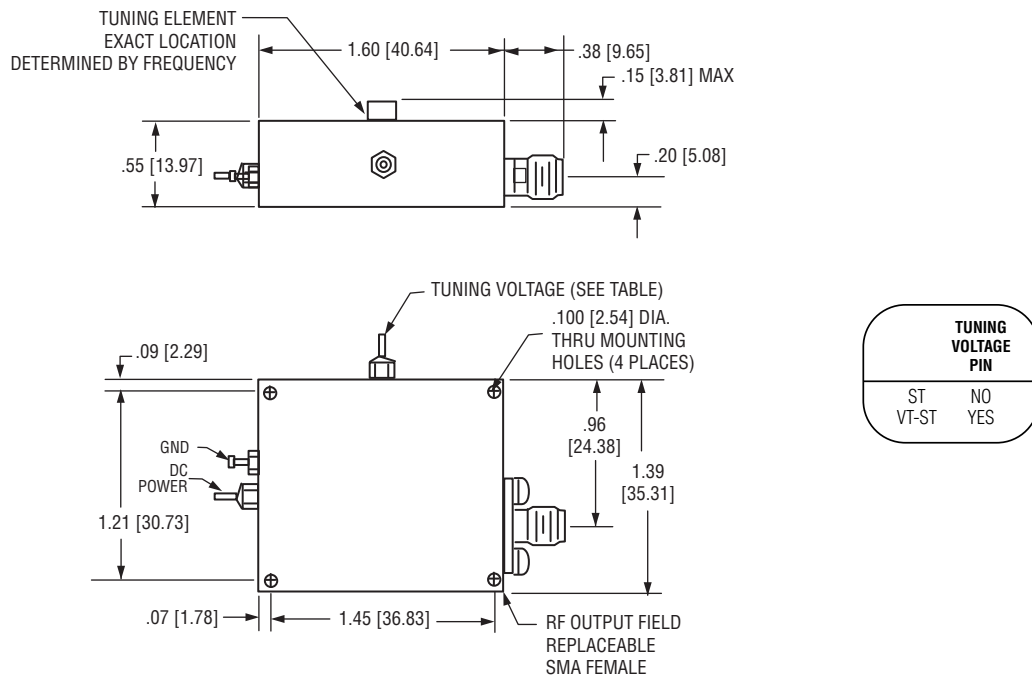


# OUTLINE DRAWINGS (CONT.)

## 184075 EF SERIES



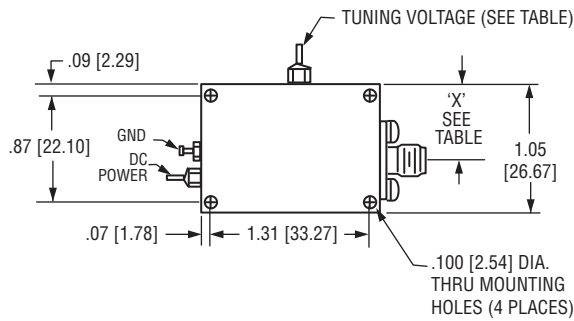
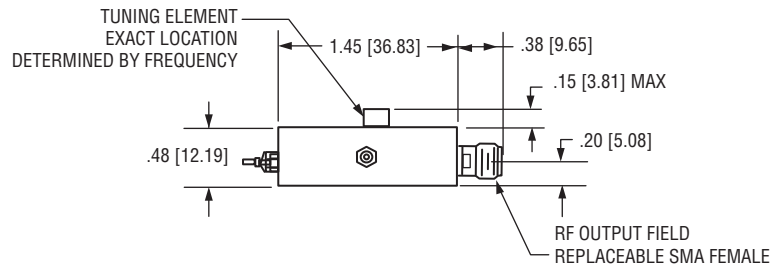
## 184076 F SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

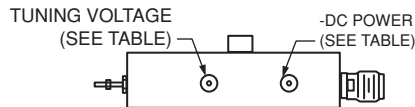
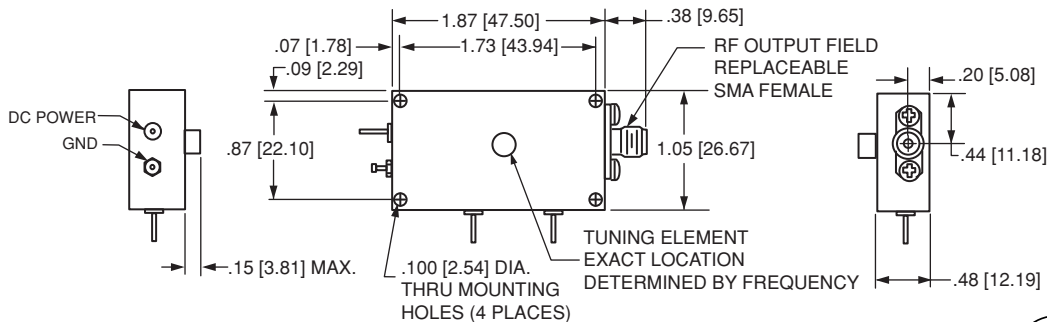
# OUTLINE DRAWINGS (CONT.)

## 184077 G, H, J, K, L M, N SERIES



TUNING VOLTAGE PIN	DIM. "X"	DIM. "X"
HP	NO	.50 (12.70)
ST	NO	.62 (15.74)
HP-VT	YES	.50 (12.70)
VT	YES	.62 (15.74)

## 184090 P, R SERIES



TUNING VOLTAGE PIN	DC POWER PIN	DC POWER PIN
ST	NO	NO
VT	YES	NO
HP	NO	YES
HP-VT	YES	YES

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

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# TEMPERATURE COMPENSATED DIELECTRIC RESONATOR OSCILLATORS

## TCDRO SERIES

### FEATURES

- Ultra-clean source ideal for low spur application
- High-reliability design
- Very low frequency drift over temperature
- Buffered output
- 100% burn-in



### ELECTRICAL SPECIFICATIONS

PARAMETERS	UNITS	SERIES									
		F	G	H	J	K	L	M	N	P	R
		<b>ST (STANDARD)</b>									
Operating frequency range (Note 1)	GHz	6.5–8.8	8.8–12	12–16	16–18	18–20	20–22	22–24	24–26	26–33	33–40
Output power (Note 2)	dBm, min.	+17	+17	+17	+17	+11	+11	+11	+11	+11	+11
Output power variation over temperature range	dB, max.	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5	±1.5
Harmonics and fundamental	dBc, min.	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20
Spurious	dBc, min.	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80
Mechanical tuning	MHz, min.	±10	±10	±10	±10	±10	±10	±10	±10	±10	±10
Frequency pushing	kHz/V, max.	15	15	20	25	30	30	30	30	40	50
Frequency pulling (1.5:1 VSWR)	MHz, P-P max.	0.5	0.5	0.5	0.5	1	1	1	1	1	2
Frequency drift temp. coefficient (Note 3)	ppm/°C, max.	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Phase noise @ 10 kHz offset	dBc/Hz, typ.	85	80	75	75	75	75	75	70	70	65
DC power	Volts	15	15	15	15	15	15	15	15	15	15
Current	mA, max.	220	220	220	230	120	120	120	120	200	200
Outline drawing		184091	184092								
Temperature range	°C	-20 to +70									

Notes:

1. Operating frequency must be specified.
2. Output power is guaranteed into 50 ohm load.
3. Averaged over the full temperature range.

# TEMPERATURE COMPENSATED DIELECTRIC RESONATOR OSCILLATOR

## ORDERING INFORMATION

**TCDRO** - [ ] [ ] [ ] [ ] -

Series

F, G, H, J,  
K, L, M, N, P or R

Frequency MHz

Type

Standard (ST)

Extended Temperature Range (ET)

(If unit is non-standard, please contact MITEQ)

Note: When specifying options, include applicable detailed information.

Example: 6.5 GHz TCDRO standard: Part Number TCDRO-F-06500-ST.

## MECHANICAL SPECIFICATIONS

Size per outline number

184091 ..... 2.5" x 2.34" x 0.8"

184092 ..... 1.8" x 2" x 0.65"

Weight..... Frequency dependent, please contact MITEQ where critical.

RF connectors ..... SMA female

DC connectors ..... Feedthru filter

## ENVIRONMENTAL SPECIFICATIONS

Temperature

Operating ..... -20 to +70°C

-ET ..... -54 to +85°C

Storage..... -65 to +115°C

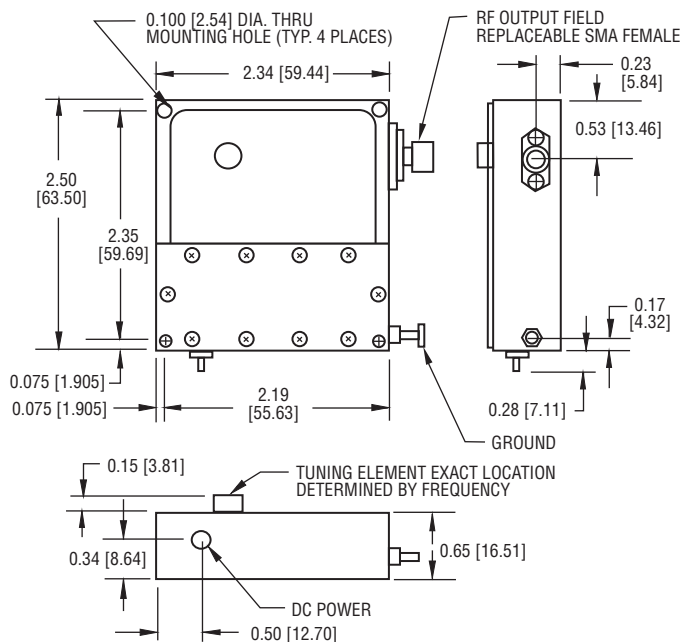
Humidity..... 95% at 40°C noncondensing

Shock (survival)..... 30 g's, 10 ms pulse

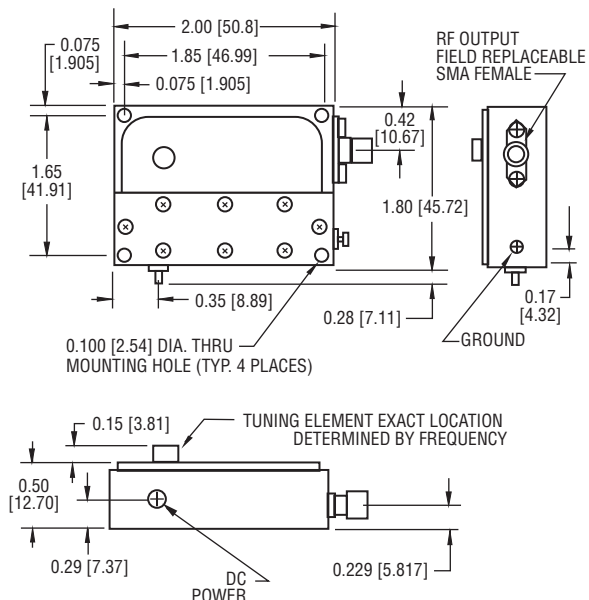
Vibration (survival)..... 20 to 2000 Hz random to 4 g's rms

## OUTLINE DRAWINGS

### 184091 F SERIES



### 184092 G, H, J, K, L M, N, P, R SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# ELECTRICALLY-TUNED COAXIAL OSCILLATOR

## ETCO SERIES

**0.10-4 GHz (FUNDAMENTAL)**

**4-15 GHz (MULTIPLIED)**

## FEATURES

- Flexible design for customer requirements
- Electronically tuned for low noise source
- High Q resonator (narrow band units)
- Internal regulation for improved phase noise
- Small package
- 100% temperature testing
- Three-year warranty



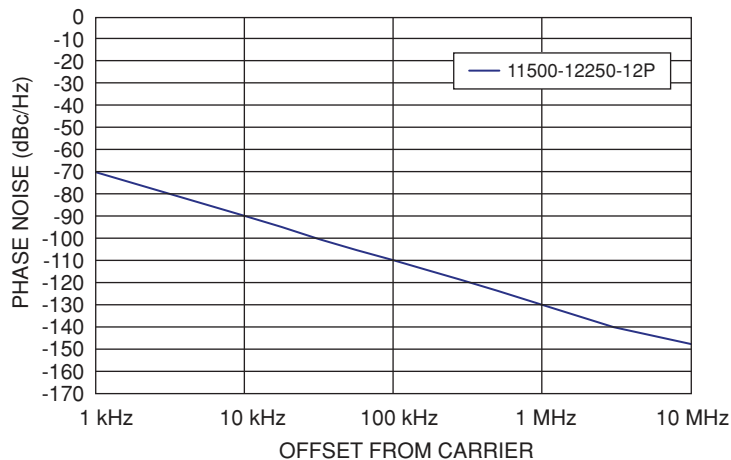
In a package less than 60 mm x 60 mm, this modular voltage controlled oscillator is capable of octave bandwidth up to 15 GHz. Applications for fast tuning, modulation bandwidth up to 1 MHz.

## ELECTRICAL SPECIFICATIONS

Output frequency range coverage (in bands)	0.10 – 15 GHz
Output power	+13 dBm minimum
Output harmonic 0.10 GHz – 12 GHz 12 GHz – 15 GHz	-20 dBc maximum -15 dBc maximum
Output spurious and subharmonics	-50 dBc maximum
Phase noise	See graph
Input tuning voltage (tuning bandwidth related)	0–15 V maximum
Input tuning (modulation) bandwidth	up to 1 MHz maximum
Load VSWR	1.5:1
DC power requirements (typical) Fundamental (.1–4 GHz) Multiplied (4–15 GHz)	+12 to +15 V @ 200 mA +12 to +15 V @ 300 mA

Note: Nonstandard tuning requirements available, please contact MITEQ.

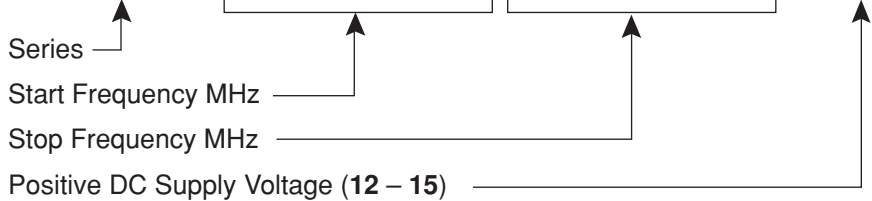
## TYPICAL PHASE NOISE



# ELECTRICALLY-TUNED COAXIAL OSCILLATOR

## ORDERING INFORMATION

ETCO - [ ] [ ] [ ] [ ] [ ] - [ ] [ ] [ ] [ ] [ ] - [ ] [ ] [ ] [ ] [ ] P



Example: Part Number ETCO-5000-6300-12P Electrically-Tuned Coaxial Oscillator tunes from 5 to 6.3 GHz with +12 volt supply.

## MECHANICAL SPECIFICATIONS

- Outline drawing..... 166335
- Size..... 2.25" X 2.25" X 0.6"
- Weight..... 100 grams
- RF connectors ..... SMA female
- Voltage input..... Filtercon
- Tuning input..... Filtered or non  
(Customer specify)

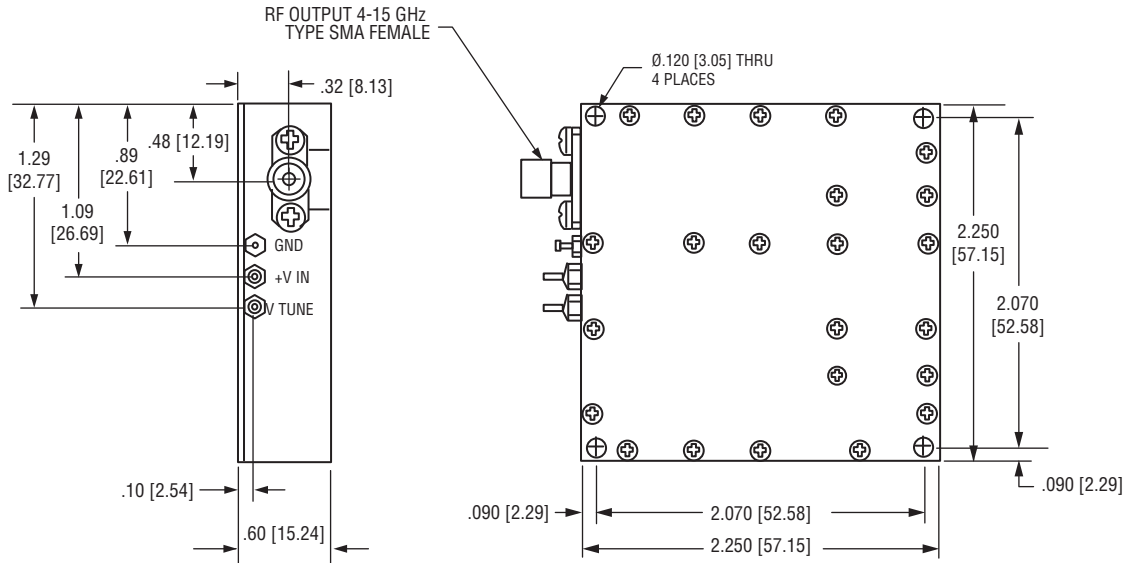
## ENVIRONMENTAL SPECIFICATIONS

- Temperature
  - Operating..... -10 to +60°C
  - Storage..... -50 to +100°C
- Humidity ..... 95% at 40°C noncondensing
- Shock (survival) ..... 30 g's, 10 ms pulse
- Vibration (survival) ..... 20 to 2000 Hz random to 4 g's rms

Note: Extended temperature ranges available, please contact MITEQ.

## OUTLINE DRAWING

### 166335 ETCO SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.



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# SYNTHESIZER section

# INTRODUCTION TO FREQUENCY SYNTHESIZERS

Frequency synthesizers manufactured by MITEQ extend up to 40 GHz and have bandwidths that can cover multi-octaves. MITEQ synthesizers are a rugged modular design and can be customized for any type of interface and use either a single or multi-loop design. Single-loop configurations are used for applications where reference phase noise is good and fine resolution is not required. Multi-loop designs are in systems where extremely low phase noise and fine frequency resolution are necessary for system operation. Phase noise and frequency resolution are just some of the considerations for choosing a synthesizer design, others include frequency bandwidth, spurious, switching speed, output power, and type of interface. The following descriptions will hopefully demonstrate how MITEQ's synthesizer product line can find a good fit for your requirements.

## PHASE NOISE AS A FUNCTION OF SYNTHESIZER BANDWIDTH

The phase noise or noise power spectral density of a frequency synthesizer depends on several factors. The key to providing good phase noise performance is to begin with the a lowest possible noise oscillator device. Voltage controlled oscillators (VCO) that are used and the range of bandwidth that they provide is proportional to the noise performance. As the tuning range of the VCO increases, so does the phase noise power spectral density. This degradation to phase noise performance is caused by the lower Q of the tuned circuits associated with the widely tunable oscillators. This performance degradation can be overcome by the use of multiple switched oscillators, each with a narrow tuning range. Typical oscillator phase noise for a 20% tuning bandwidth VCO in S band is approximately -95 dBc at 10 kHz offset. Higher band synthesizers will multiply the S band VCO and this will also degrade noise depending on the multiple. Modern designs will use VCOs that operate at or half of the synthesizer output frequency as high as 14 GHz. The phase noise of these oscillators is higher, but wider loop bandwidths can still provide excellent phase noise performance with them.

## SPURIOUS OUTPUTS

Spurious outputs are the undesired byproducts of the various frequency divisions, multiplications and frequency translations. They can be suppressed and their numbers minimized, but cannot be completely eliminated. Techniques of spurious minimization include judicious frequency selections for the various sub-loops, proper frequency division and multiplication ratios, sufficient selectivity in the loop filters and, of course, sufficient filtering, decoupling and regulation of the power supplies. Careful ground current steering diminishes the level of spurious sidebands caused by

the line frequencies, their harmonics and other stray signal leakage. The most troublesome types of spurious are those that fall in-band. They cannot be filtered by adding output filters. Only out-of-band spurious signals can be decreased by additional filtering.

## SYNTHESIZER OPERATION

Frequency synthesizers account for the RF and microwave signals used for communication radio, radar, aerospace telemetry, satellite imaging, test systems, and many other radio transmission applications. Synthesizers come in many forms and performance levels, from tiny phase-locked-loop (PLL) integrated circuits (ICs) to rack-mountable subsystems and precision test instruments with programmable control.

Instrument-grade frequency synthesizers offer some of the highest performance levels among synthesizer products since they must provide excellent reference signals for testing and equipment evaluation. These synthesizers are generally used in laboratory environments. They change frequency at moderate speeds and usually rely on very wide bandwidth YIG oscillator as the output frequency source. Moderate-speed synthesizers are characterized by frequency switching speeds in the millisecond range, the slower speed is usually attributed by the YIG oscillator frequency source. This speed is adequate for the majority of test applications. The YIG oscillator synthesizer has other drawbacks as well as the slow speed. They tend to be extremely expensive due to the lengthy manual tuning required to produce the YIG. They are extremely inefficient with power consumption, they are large and heavy, and have not proven to be reliable enough for portable type systems.

MITEQ synthesizers use state of the art oscillator sources, both discrete and monolithic. The synthesizers rival the performance of YIG based units with similar bandwidth coverage and phase noise performance without paying the penalty of slower switching and higher power dissipation.

A frequency synthesizer phase-locked loop (PLL) circuit comprises of a VCO, a loop amplifier, a low-pass filter, and a phase detector to establish frequency and phase coherence to a stable reference signal. This reference signal can be something internal such as a crystal oscillator or a received reference from any broadcast location. The synthesizer will establish and maintain lock to this reference. The synthesizer reference frequency is generally higher than that of its' reference signal. This requires the output signal to need a conversion and or division step to allow for frequency and phase comparison of the output and reference signals.

## INTRODUCTION TO FREQUENCY SYNTHESIZERS (CONT.)

Good synthesizer designs minimize the noise contribution of these frequency conversions. Phase noise performance is generally limited by the noise of the VCO, the noise floor of the phase detector and the multiple from reference to output frequency (N). Phase detectors can be comprised of digital blocks or radio type frequency mixers. In either case, maintaining a very low N is essential to good noise performance no matter what it's used for.

MITEQ's broad range of synthesizers, utilize all latest available technologies from internal and external sources. A typical synthesizer block will include high speed DDS, Delta Sigma dividers, frequency multipliers, high quality mixers, lowest noise DC regulators and filters. State of the art (Field Programmable Gate Arrays) FPGAs are used for controller functions and can be customized to meet any interface and control protocol or speed.

## SPECIFICATIONS

**SYNTHESIZERS SELECTION TABLE**

MODEL	TYPE	BAND	OUTLINE
MOS/MOSM	Frequency Generator 1 kHz step	0.1–20 GHz continuous	20.0 X 5.5 X 1.34 Inch 508 X 140 X 24 mm
UWB	Wideband multi-loop YIG alternative 1 kHz step	5–12.5 GHz continuous	8 X 5 X 0.72 Inch 203 X 127 X 18.3 mm
OW	Octave band multi-loop YIG alternative 1 kHz step	2–4 GHz 4–8 GHz	12.4 X 5 X 1.45 Inch 315 X 127 X 36.8 mm
BTE	High performance multi-loop 20% BW 100 Hz step	1–40 GHz in Bands	8 X 5 X 0.72 Inch 203 X 127 X 18.3 mm
MFS	High performance multi-loop	0.9–16.88 GHz	Various See outlines
LFTS	High Performance octave band 100 Hz step	0.1–0.33 GHz	6.25 X 5.0 X 0.64 Inch 158.8 X 127 X 16.1 mm
HSLs	High performance single loop 10 MHz step	0.6–28.5 GHz in Bands	4.03 X 3.78 X 0.54 Inch 102.4 X 96 X 13.72 mm
SLFS	Low cost single loop 1 MHz step	0.1–14 GHz	2.25 X 2.25 X 0.55 Inch 57.2 X 57.2 X 14.0 mm

# MULTI-OCTAVE FREQUENCY SYNTHESIZER

**MOS SERIES: .1-20 GHz**

## FEATURES

- Low cost
- 1/3 rack space
- Multi-octave
- Standard step size: 1 kHz
- INTELSAT phase noise compliant
- Field-tested reliability
- Low power dissipation
- MIL-STD-188-164A microphonic compliant
- ETSI 300019-1-4 compliant

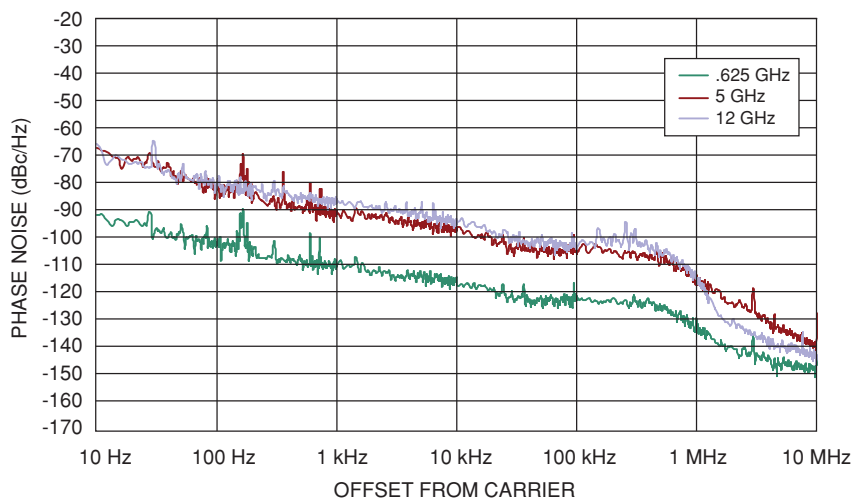
## OPTIONS

- Fast switching
- Custom frequency bands
- Fixed LO frequencies
- Custom step sizes
- Custom packaging
- Low phase noise option
- Available in modular form (MOSM)



MITEQ's MOS Series of multi-octave wide, low phase noise synthesizers offer an economical solution for lab and communication test applications. Band coverage is from 100 MHz to 20 GHz. The MOS Series has a standard 1 kHz step size, with optional full-band fast switching available. The field-tested design and low power dissipation proves to demonstrate higher MTBF and higher reliability. These synthesizers are available in either one third-rack mounted chassis with front panel control, or a modular 5" x 8" x 1.25" package with either serial or parallel control.

## TYPICAL PHASE NOISE



# MULTI-OCTAVE FREQUENCY SYNTHESIZER

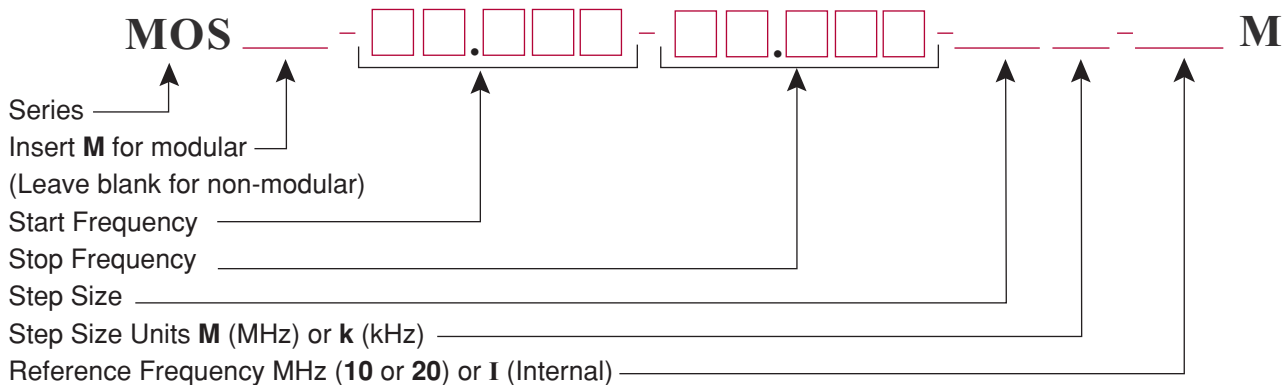
## ELECTRICAL SPECIFICATIONS

	Tunable
Output frequency range (Note 1, 2)	.1 – 20 GHz
Step size (Note 3, 4)	1 kHz
Output power	+13 dBm minimum
Output power variation	±2 dB maximum
Input reference frequency (Note 5)	10 MHz
Input power level	0 ±3 dBm
Output spurious	
In-band	-60 dBc minimum
Out-of-band	-60 dBc minimum
Phase noise	See graph
Offset from carrier	At 20 GHz
10 Hz	-55 dBc
100 Hz	-65 dBc
1 kHz	-75 dBc
10 kHz	-85 dBc
100 kHz	-90 dBc
1 MHz	-100 dBc
10 MHz	-120 dBc
Output harmonic	-15 dBc typical
Output impedance	50 ohm nominal
Load VSWR	2.0:1 maximum, all phases
Acquisition time (to phase lock)	300 us typical, 750 us maximum
Summary alarm	In lock TTL 1
DC power requirements	
MOS	+90 volts to +250 VAC, 12 W Typical
MOSM	+5.2 @ 2 amps, 15.2 @ 900 mA, -15.0 @ 50 mA
Outline drawing	
Third rack	175415
Module	185134
User interface (Note 6)	Front panel

**Notes:**

1. Custom frequency bands available, please contact MITEQ.
2. Frequency accuracy  $\pm 2.95 \times 10^{-9}$ .
3. Custom step size available, please contact MITEQ.
4. Other reference frequency option available, please contact MITEQ.
5. Close in Phase Noise dependent on reference.
6. Rear panel ethernet interface option available, please contact MITEQ.
7. MOSM available with RS485 9700 or parallel interface.
8. For serial interface, 9700 serial protocol, visit [www.miteq.com](http://www.miteq.com)

### ORDERING INFORMATION



Note: Consult factory for additional rear parallel interface.

EXAMPLE: Part Number MOS-0.1-13.0-1k-10M for frequency synthesizer covering 0.1 to 13 GHz with a step size of 1 kHz and a reference frequency of 10 MHz.

# MULTI-OCTAVE FREQUENCY SYNTHESIZER

## MECHANICAL SPECIFICATIONS

Outline drawing  
 Third rack ..... 175415  
 Module ..... 185132  
 Size ..... 1.34" x 5.71" x 20"  
 Weight ..... 8 pounds typical in third rack  
 RF connectors ..... SMA female  
 Control connector ..... Modular 34-pin header for parallel operation. Third rack, Ethernet, through RJ45 or 9-pin D for RS485.

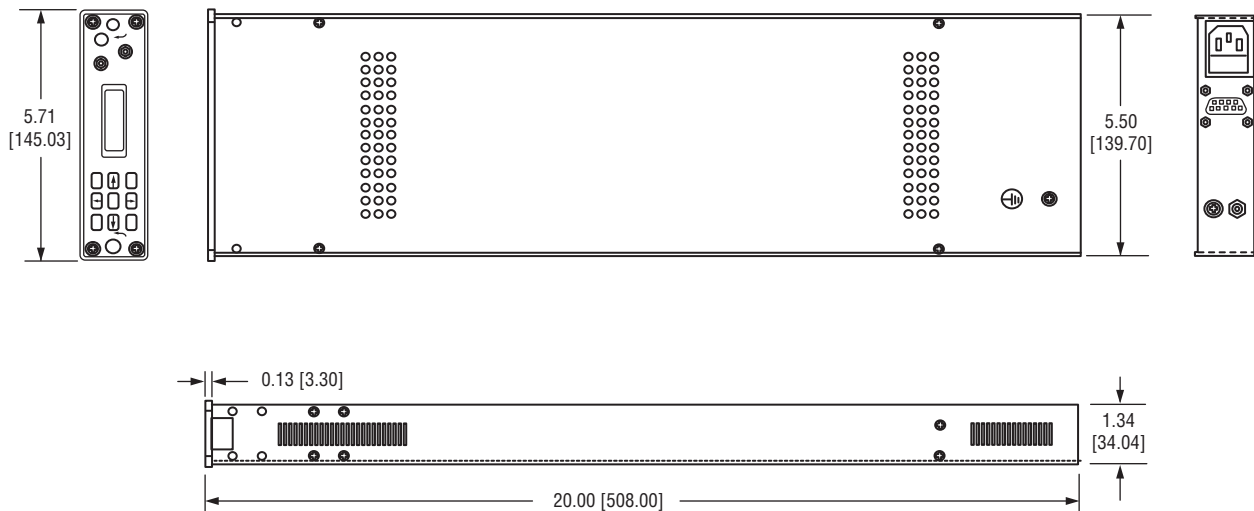
## ENVIRONMENTAL SPECIFICATIONS

Temperature  
 Operating ..... 0 to 60°C  
 Storage ..... -50 to +100°C  
 Humidity ..... Up to 95% at 40°C noncondensing  
 Shock (nonoperating) ..... 30 g's, 10 ms pulse  
 Vibration (survival) ..... 20 to 2000 Hz random to .04 G<sup>2</sup>/Hz  
 Altitude ..... Up to 13,500 feet  
 100% testing ..... Frequency range  
 Output power  
 Discrete power  
 Spectral purity  
 Phase bursts  
 Alarm and monitors  
 100% screening ..... Temperature cycle/monitor

Note: Wider operating temperatures are available, please contact MITEQ.

## OUTLINE DRAWINGS

### 175415 MOS SERIES

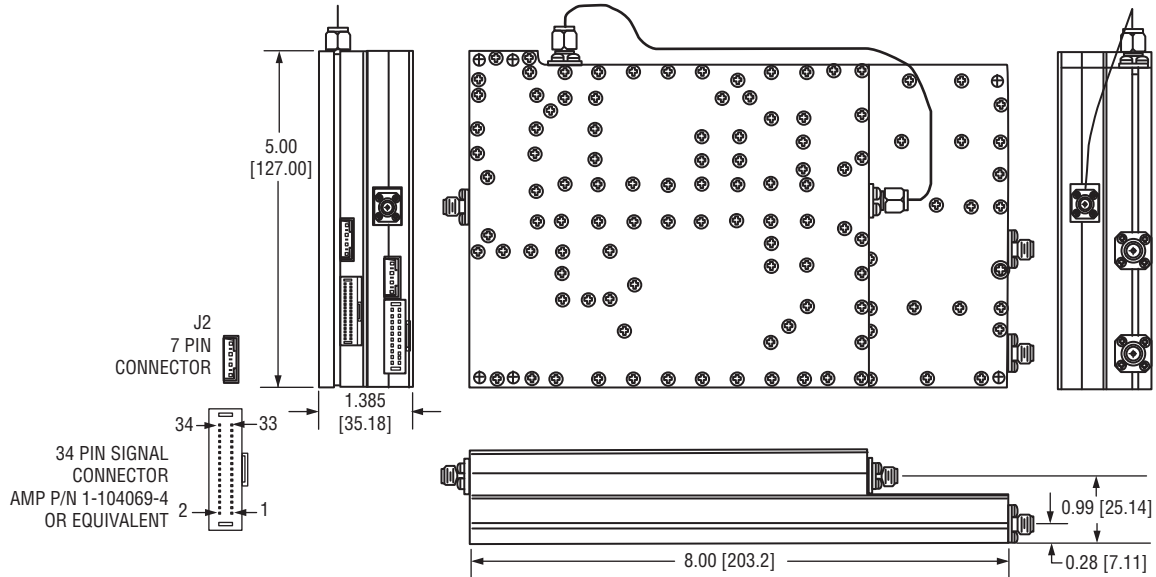


NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.



# OUTLINE DRAWINGS (CONT.)

## 185132 MOSM SERIES



### DATA CONNECTIONS - BCD INTERFACE

PIN 1	10 GHz (8)	PIN 2	10 GHz (4)
PIN 3	10 GHz (2)	PIN 4	10 GHz (1)
PIN 5	1 GHz (8)	PIN 6	1 GHz (4)
PIN 7	1 GHz (2)	PIN 8	1 GHz (1)
PIN 9	100 MHz (8)	PIN 10	100 MHz (4)
PIN 11	100 MHz (2)	PIN 12	100 MHz (1)
PIN 13	10 MHz (8)	PIN 14	10 MHz (4)
PIN 15	10 MHz (2)	PIN 16	10 MHz (1)
PIN 17	1 MHz (8)	PIN 18	1 MHz (4)
PIN 19	1 MHz (2)	PIN 20	1 MHz (1)
PIN 21	100 kHz (8)	PIN 22	100 kHz (4)
PIN 23	100 kHz (2)	PIN 24	100 kHz (1)
PIN 25	10 kHz (8)	PIN 26	10 kHz (4)
PIN 27	10 kHz (2)	PIN 28	10 kHz (1)
PIN 29	1 kHz (8)	PIN 30	1 kHz (4)
PIN 31	1 kHz (2)	PIN 32	1 kHz (1)
PIN 33	STROBE	PIN 34	GND

### POWER CONNECTIONS

PIN 1	+5.2 VDC
PIN 2	GND
PIN 3	+15 VDC
PIN 4	GND
PIN 5	PHASE VOLTAGE
PIN 6	GND
PIN 7	-15 VDC

### DATA CONNECTIONS BINARY INTERFACE

PIN 1	NOT USED
PIN 2	NOT USED
PIN 4	NOT USED
PIN 5	NOT USED
PIN 8	NOT USED
PIN 9	MSB
THRU	
PIN 32	LSB
PIN 33	STROBE
PIN 34	GND

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# ULTRA WIDEBAND FREQUENCY SYNTHESIZER

## UWB SERIES: 4.5–13 GHz

### FEATURES

- Multi-octave wide operation
- Fast switching speed
- Low power dissipation
- Wide selection of fixed LO
- MIL-STD-188-164A microphonic compliant
- ETSI 300019-1-4 compliant
- Ideal for YIG replacement
- Superior phase noise without YIG heat



MITEQ's UWB Series of synthesizers are designed as a replacement for YIG based synthesizers, without the power dissipation and microphonics. Available in 4.5 – 13 GHz range, the ultra wide synthesizer is ideal for ELINT, test translation and instrumentation. Fast switching time coupled with low power dissipation makes this series an ideal replacement for YIG based broadband synthesizers.

### ELECTRICAL SPECIFICATIONS

	Tunable	Fixed LO
Output frequency range (Note 1)	4.5 – 13 GHz	2160 MHz (Note 2)
Step size (Note 3, 4)	1 kHz	
Output power	+13 dBm minimum	+13 ±2 dBm
Output power variation	±2 dB maximum	
Input reference frequency (Note 5)	10 MHz	
Input power level	0 ±3 dBm	
Output spurious		
In-band	-65 dBc minimum	-80 dBc minimum
Out-of-band	-70 dBc minimum	-70 dBc minimum
Phase noise (Note 6)	See graph	
Offset from carrier	At 12 GHz	At 2160 MHz
10 Hz	-60 dBc	-68 dBc
100 Hz	-71 dBc	-95 dBc
1 kHz	-80 dBc	-100 dBc
10 kHz	-90 dBc	-100 dBc
100 kHz	-96 dBc	-110 dBc
1 MHz	-105 dBc	-135 dBc
10 MHz	-130 dBc	-145 dBc
Output harmonic	-15 dBc typical	-20 dBc typical
Output impedance	50 ohm nominal	
Load VSWR	1.5:1 maximum, all phases	
Frequency control (Note 7)	Parallel or serial	
Acquisition time (to phase lock)	250 μs typical (while in band)	
	750 μs maximum (band switching)	
Summary alarm	In lock TTL 1	

General Note: For parallel standard, please contact MITEQ for serial interface.



# ULTRA WIDEBAND FREQUENCY SYNTHESIZER

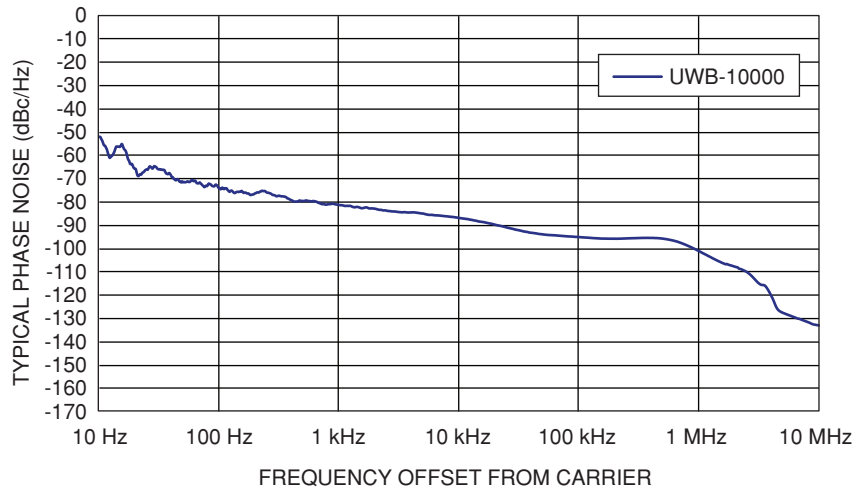
## ELECTRICAL SPECIFICATIONS (CONT.)

	Tunable	Fixed LO
DC power requirements	+15 volts, 0.4 amps typical +5.2 volts, 1.6 amps typical	
Outline Drawing	164794	

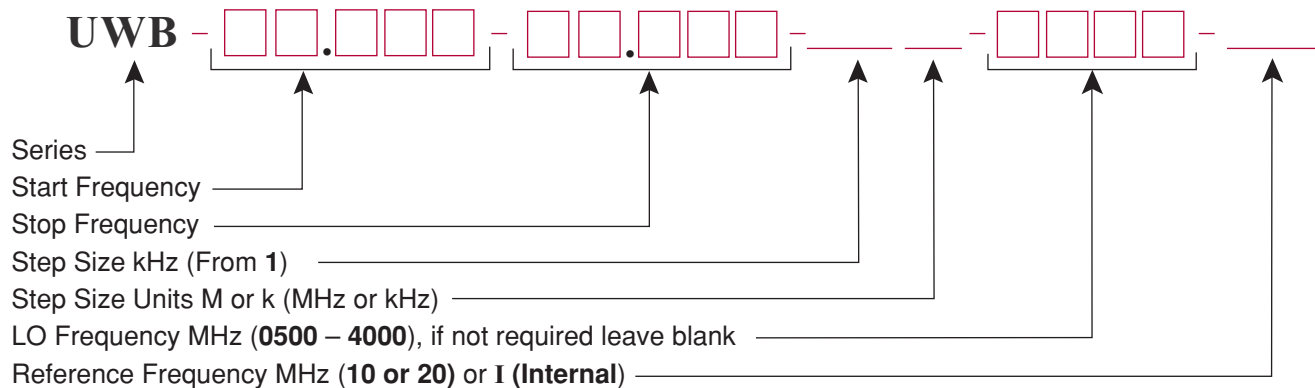
### Notes:

1. Custom frequency bands available, please contact MITEQ.
2. Fixed LO frequencies available from 500 to 5000 MHz in 10 MHz intervals.
3. Frequency accuracy  $\pm 17$  Hz.
4. Custom step sizes available, please contact MITEQ.
5. Other reference frequency options available, please contact MITEQ.
6. Close in phase noise dependent on reference.
7. For serial interface, 9700 serial protocol, visit [www.miteq.com](http://www.miteq.com)

### TYPICAL PHASE NOISE



### ORDERING INFORMATION



EXAMPLE: Part Number UWB-04.500-12.500-1K-2160-10M for frequency synthesizer covering 4.5 to 12.5 GHz with a step size of 1 kHz having a fixed LO of 2160 MHz with 10 MHz external reference.

# ULTRA WIDEBAND FREQUENCY SYNTHESIZER

## MECHANICAL SPECIFICATIONS

Outline drawing ..... 164794  
 Size ..... 8" x 5" x 0.71"  
 Weight ..... 1.5 pound typical  
 RF connectors ..... SMA female  
 DC power connectors ..... JST™ 7-pin header  
 Control connectors ..... 34-pin header

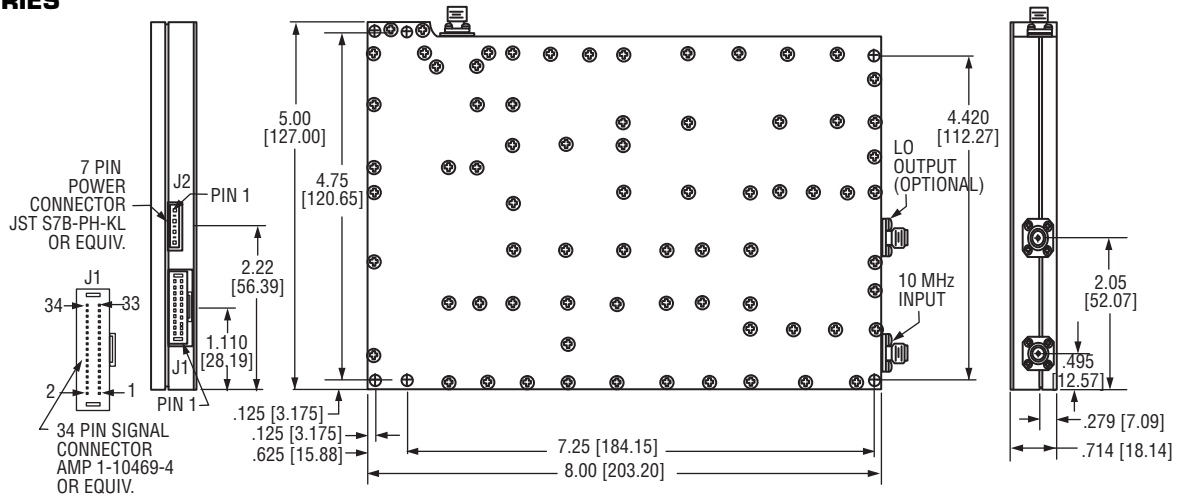
## ENVIRONMENTAL SPECIFICATIONS

Temperature  
 Operating ..... -10 to +60°C  
 Storage ..... -50 to +100°C  
 Humidity ..... Up to 95% at 40°C noncondensing  
 Shock (nonoperating) ..... 30 g's, 10 ms pulse  
 Vibration (survival) ..... 20 to 2000 Hz random to .04 G<sup>2</sup>/Hz  
 Altitude ..... Up to 13,500 feet  
 100% testing ..... Frequency range  
 Output power  
 Discrete power  
 Spectral purity  
 Phase bursts  
 Alarm and monitors  
 100% screening ..... Temperature cycle/monitor

Note: Wider operating temperatures are available, please contact MITEQ.

## OUTLINE DRAWING

### 164794 UWB SERIES



#### J1 OPTIONAL PARALLEL DATA CONNECTION

PIN 1	10 GHz (8)	PIN 2	10 GHz (4)
PIN 3	10 GHz (2)	PIN 4	10 GHz (1)
PIN 5	1 GHz (8)	PIN 6	1 GHz (4)
PIN 7	1 GHz (2)	PIN 8	1 GHz (1)
PIN 9	100 MHz (8)	PIN 10	100 MHz (4)
PIN 11	100 MHz (2)	PIN 12	100 MHz (1)
PIN 13	10 MHz (8)	PIN 14	10 MHz (4)
PIN 15	10 MHz (2)	PIN 16	10 MHz (1)
PIN 17	1 MHz (8)	PIN 18	1 MHz (4)
PIN 19	1 MHz (2)	PIN 20	1 MHz (1)
PIN 21	100 kHz (8)	PIN 22	100 kHz (4)
PIN 23	100 kHz (2)	PIN 24	100 kHz (1)
PIN 25	10 kHz (8)	PIN 26	10 kHz (4)
PIN 27	10 kHz (2)	PIN 28	10 kHz (1)
PIN 29	1 kHz (8)	PIN 30	1 kHz (4)
PIN 31	1 kHz (2)	PIN 32	1 kHz (1)
PIN 33	STROBE	PIN 34	GND

#### POWER CONNECTIONS

PIN 1	+5.2 VDC
PIN 2	GND
PIN 3	+15 VDC
PIN 4	GND
PIN 5	PHASE VOLTAGE
PIN 6	GND
PIN 7	TTL ALARM

#### DATA CONNECTIONS BINARY INTERFACE

PIN 1	NOT USED
PIN 2	NOT USED
PIN 4	NOT USED
PIN 5	NOT USED
PIN 8	NOT USED
PIN 9	MSB
THRU	
PIN 32	LSB
PIN 33	STROBE
PIN 34	GND

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

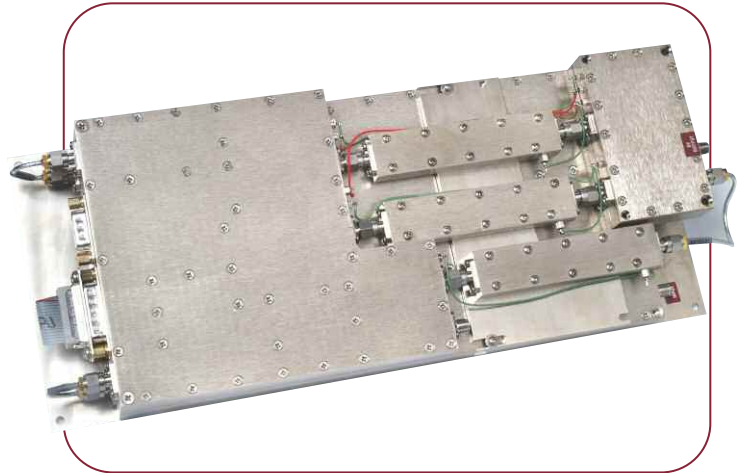
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# OCTAVE WIDE FREQUENCY SYNTHESIZER

**OW SERIES: 2-4 GHz  
4-8 GHz**

## FEATURES

- Octave wide operation
- 1 kHz standard step size
- Low power dissipation
- Wide selection of fixed LO
- MIL-STD-188-164A microphonic compliant
- ETSI 300019-1-4 shock and vibration compliant
- Ideal for YIG replacement
- Superior phase noise without YIG heat



MITEQ's OW Series synthesizers are designed as a replacement for YIG based synthesizers, without the power dissipation and microphonics. Available in 2-4 or 4-8 GHz range, these octave wide synthesizers are ideal for ELINT, test translation and instrumentation. Superior phase noise performance coupled with low power dissipation make an ideal replacement for YIG based broadband synthesizers.

### GUI INTERFACE (for serial programming):

Now available at:

<http://amps.miteq.com/Amps2007/synthesizers/SynthControl.zip>

## ELECTRICAL SPECIFICATIONS

Output frequency range (Note 1, 3)	Tunable		Fixed LO (Note 2)
		2 – 4 GHz 4 – 8 GHz	
Step size (Note 4)	1 kHz		
Output power	+13 dBm minimum		+13 ±2 dBm
Output power variation	± 2 dB maximum		
Input reference frequency (Note 5)	10 MHz		
Input power level	0 ±3 dBm		
Output spurious			
In-band	-70 dBc minimum		-80 dBc minimum
Out-of-band	-65 dBc minimum		-70 dBc minimum
Phase noise (Note 6)	See graph		
Offset from carrier	Typical @ 4 GHz	Typical @ 8 GHz	At 2160 MHz
10 Hz	-60 dBc	-60 dBc	-68 dBc
100 Hz	-75 dBc	-70 dBc	-95 dBc
1 kHz	-100 dBc	-95 dBc	-100 dBc
10 kHz	-110 dBc	-105 dBc	-100 dBc
100 kHz	-110 dBc	-105 dBc	-110 dBc
1 MHz	-125 dBc	-118 dBc	-135 dBc
10 MHz	-145 dBc	-145 dBc	-145 dBc
Output harmonic	-15 dBc typical		-20 dBc typical
Output impedance	50 ohm nominal		
Load VSWR	1.5:1 maximum, all phases		

# OCTAVE WIDE FREQUENCY SYNTHESIZER

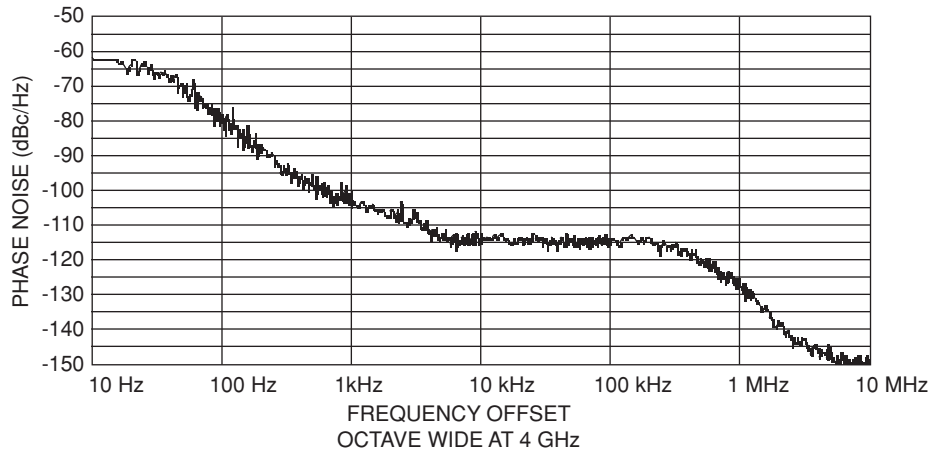
## ELECTRICAL SPECIFICATIONS (CONT.)

	Tunable	Fixed LO (Note 2)
Frequency control	RS485 (4 wire)	
Acquisition time (to phase lock)	50 ms typical, 100 ms maximum	
Summary alarm	In-lock TTL 1	
DC power requirements	+15 volts, 0.5 amps typical +5.2 volts, 1.3 amps typical	
Outline drawings	151016, 151061	

**Notes:**

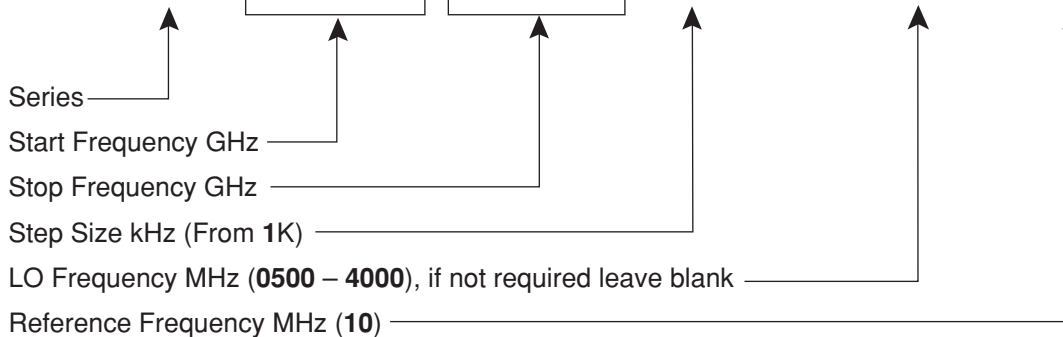
1. Custom frequency bands available, please contact MITEQ.
2. Optional fixed LO frequencies available from 500 to 5000 MHz in 10 MHz intervals.
3. Frequency accuracy  $\pm 1.27 \times 10^{-9}$ .
4. Custom step sizes available, please contact MITEQ.
5. Other reference frequency options available, please contact MITEQ.
6. Close in phase noise dependent on reference.
7. For serial interface, 9700 serial protocol, visit [www.miteq.com](http://www.miteq.com)

### TYPICAL PHASE NOISE AT 4 GHz



### ORDERING INFORMATION

OW - . - . -  K -  - 10 M



EXAMPLE: Part Number OW-2.00-4.00-1K-10M for frequency synthesizer covering 2 to 4 GHz with a step size of 1 kHz, reference frequency of 10 MHz and no LO output.

# OCTAVE WIDE FREQUENCY SYNTHESIZER

## MECHANICAL SPECIFICATIONS

Outline drawings..... 151016, 151061  
 Size..... 12.35" x 5" x 1.5"  
 Weight ..... 5 pounds typical  
 RF connectors ..... SMA female  
 DC power connectors..... Subminiature D9P  
 Control connectors ..... 20-pin header

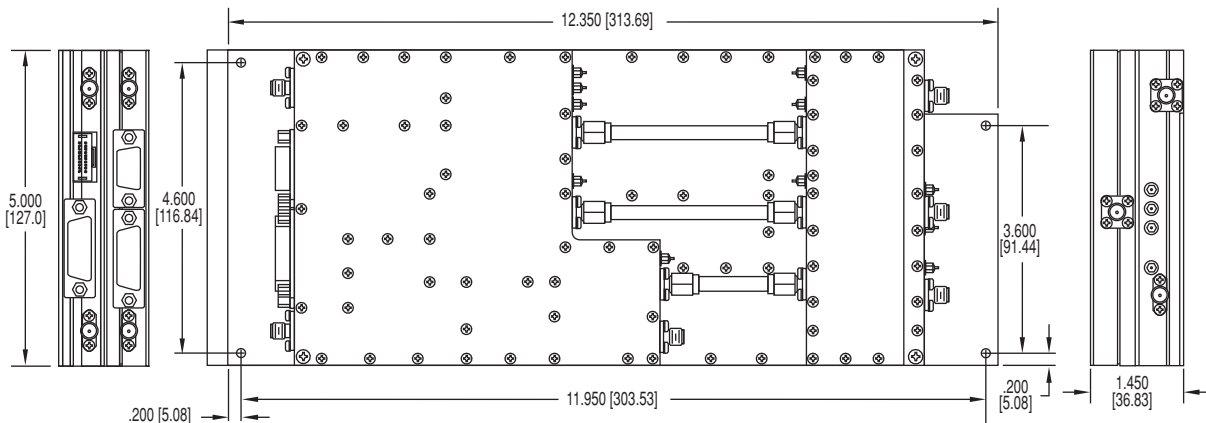
## ENVIRONMENTAL SPECIFICATIONS

Temperature  
 Operating ..... -10 to +60°C  
 Storage ..... -50 to +100°C  
 Humidity ..... Up to 95% at 40°C  
 noncondensing  
 Shock (nonoperating)..... 30 g's, 10 ms pulse  
 Vibration (survival) ..... 20 to 2000 Hz  
 random to .04 G<sup>2</sup>/Hz  
 Altitude ..... Up to 13,500 feet  
 100% testing ..... Frequency range  
 Output power  
 Discrete power  
 Spectral purity  
 Phase bursts  
 Alarm and monitors  
 100% screening ..... Temperature cycle/monitor

Note: Wider operating temperatures are available,  
 please contact MITEQ.

## OUTLINE DRAWINGS

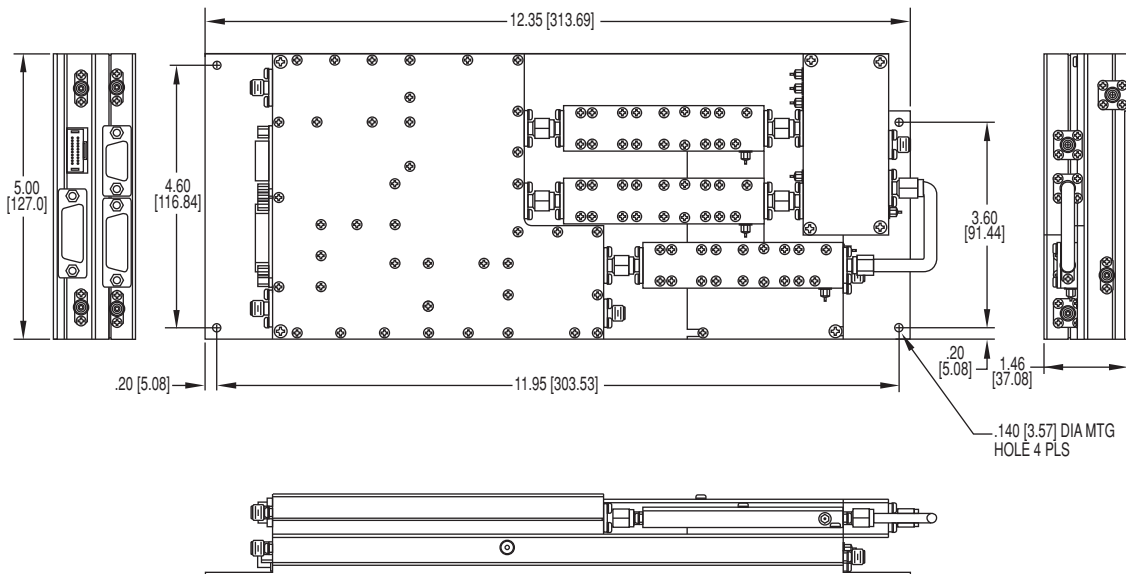
### 151016 OW SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# OUTLINE DRAWINGS (CONT.)

## 151061 OW SERIES



NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.



# HIGH PERFORMANCE MULTI-LOOP FREQUENCY SYNTHESIZER

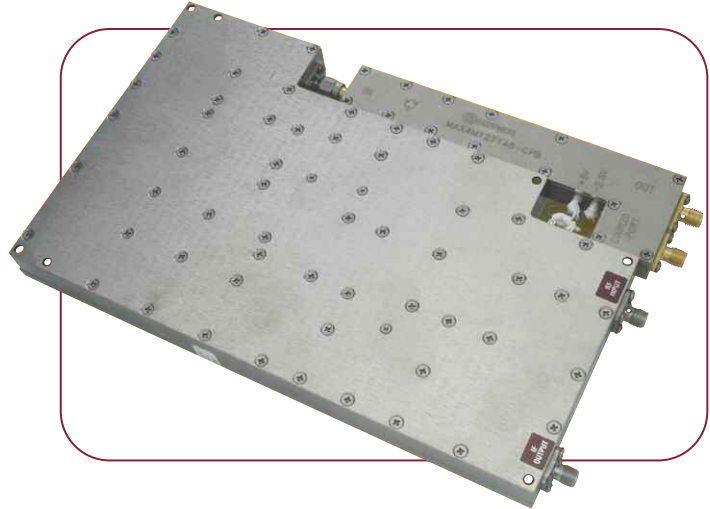
**BTE SERIES: 1.94–1.97 GHz**  
**2.21–2.24 GHz**  
**3.33–3.80 GHz**  
**8.47–9.06 GHz**  
**11.45–12.57 GHz**  
**12.72–14.84 GHz**

## FEATURES

- 20 dB below INTELSAT phase noise mask
- Ideal for use in dual conversion up and downconverters
- 1 kHz standard step size
- Wide bandwidth
- Large selection of fixed LO frequencies
- MIL-STD-188-164A microphonic compliant
- ETSI300019-1-4 shock and vibe compliant

## OPTIONS

- Custom frequency bands
- Wide selection of fixed LO frequencies
- High output power
- Custom step size



MITEQ's BTE Series of high spectral purity synthesizers offer a low price alternative for L-, Ku-band INTELSAT satellite communication applications offering 20 dB below INTELSAT phase noise mask. With standard 1 kHz step size output at L-, Ku-band with no error, the BTE series synthesizers are ideal for dual conversion up- and downconverters. With +13 dBm output power and 70 dBc spurious suppression, the BTE series will support the most stringent system applications.

### GUI INTERFACE (for serial programming):

Now available at:

<http://amps.miteq.com/Amps2007/synthesizers/SynthControl.zip>

## ELECTRICAL SPECIFICATIONS

Output frequency range	Tunable	Fixed LO
		1.94 – 1.97 GHz (Note 1) 2.21 – 2.24 GHz 3.33 – 3.80 GHz 8.47 – 9.06 GHz 11.45 – 12.57 GHz 12.72 – 14.84 GHz
Step size	1 kHz	
Output power	+13 dBm minimum	+13 ±2 dBm
Output power variation	±2 dB maximum	
Input reference frequency (Note 3)	10 MHz	
Input power level	0 ±3 dBm	
Output spurious		
In-band	-70 dBc minimum	-80 dBc minimum
Out-of-band	-65 dBc minimum	-70 dBc minimum
Phase noise (Note 4)	See graph	



# HIGH PERFORMANCE MULTI-LOOP FREQUENCY SYNTHESIZER

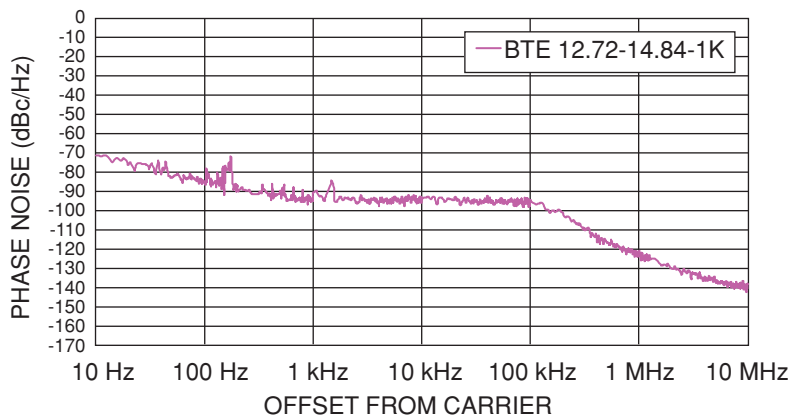
## ELECTRICAL SPECIFICATIONS (CONT.)

Offset from carrier (cont.)	Tunable (14.84 GHz maximum)	Fixed LO (1080 MHz maximum)
10 Hz	-62 dBc	-68 dBc
100 Hz	-70 dBc	-90 dBc
1 kHz	-87 dBc	-101 dBc
10 kHz	-91 dBc	-100 dBc
100 kHz	-91 dBc	-100 dBc
1 MHz	-111 dBc	-135 dBc
10 MHz	-135 dBc	-145 dBc
Output harmonic	-15 dBc typical	-20 dBc typical
Output impedance	50 ohm nominal	50 ohm nominal
Load VSWR	1.5:1 maximum, all phases	1.5:1 maximum, all phases
Summary alarm	In lock TTL 1	
Frequency control (Note 5)	RS485 (4 wire), Parallel BCD	
Acquisition time (to phase lock)	40 ms typical 100 ms maximum	
DC power requirements	+15.3 volts, 0.5 amps typical +5.3 volts, 1.0 amps typical	
Outline Drawing	180990	

**Notes:**

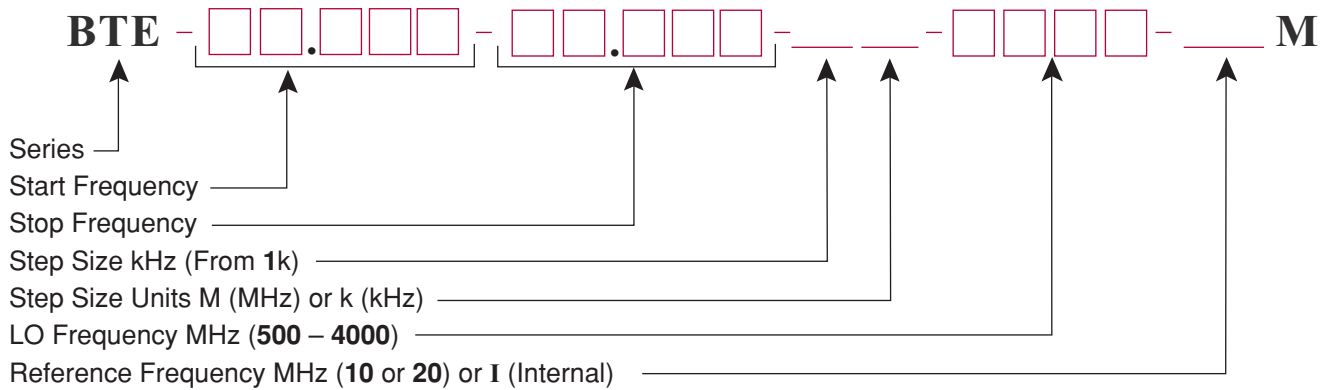
1. Custom frequency bands available, please contact MITEQ.
2. Fixed LO frequencies available from 500 to 5000 MHz in 10 MHz integers.
3. Other reference frequency options available, please contact MITEQ.
4. Close in phase noise dependent on reference.
5. Standard interface is 485 serial 9700. Please contact MITEQ for alternate serial or parallel interface.
6. For serial interface, 9700 serial protocol, visit [www.miteq.com](http://www.miteq.com)

### TYPICAL PHASE NOISE



# HIGH PERFORMANCE MULTI-LOOP FREQUENCY SYNTHESIZER

## ORDERING INFORMATION



EXAMPLE: Part Number BTE-12.720-14.480-1K-1150-10M for frequency synthesizer covering 12.720 to 14.480 GHz with a step size of 1 kHz, a LO of 1150 MHz, and a reference frequency of 10 MHz.

## MECHANICAL SPECIFICATIONS

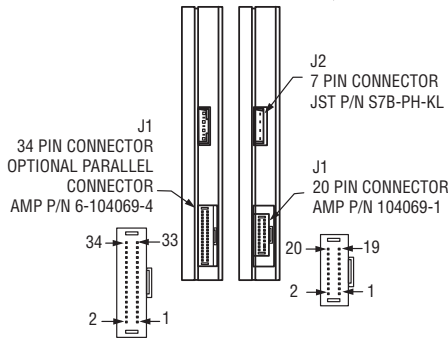
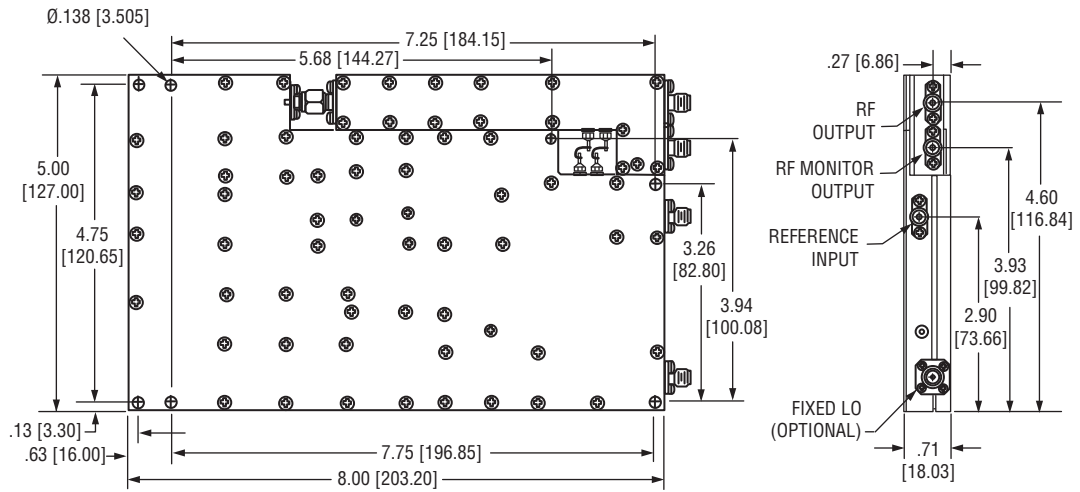
- Outline drawing ..... 180990
- Size ..... 8" x 5" x 0.7"
- Weight ..... 2 pounds typical
- RF connectors ..... SMA female
- DC power connectors ..... JST™ 7-pin header
- Control connectors ..... 20-pin header,  
34-pin header (optional)

## ENVIRONMENTAL SPECIFICATIONS

- Temperature
    - Operating ..... -10 to +60°C
    - Storage ..... -50 to +100°C
  - Humidity ..... Up to 95% at 40°C  
noncondensing
  - Shock (nonoperating) ..... 30 g's, 10 ms pulse
  - Vibration (survival) ..... 20 to 2000 Hz  
random to .04 G<sup>2</sup>/Hz
  - Altitude ..... Up to 13,500 feet
  - 100% testing ..... Frequency range  
Output power  
Discrete power  
Spectral purity  
Phase bursts  
Alarm and monitors
  - 100% screening ..... Temperature cycle/monitor
- Note: Wider operating temperature ranges available, please contact MITEQ.

# OUTLINE DRAWING

## 180990 BTE SERIES



### J1 OPTIONAL PARALLEL DATA CONNECTION

PIN 1	10 GHz (8)	PIN 2	10 GHz (4)
PIN 3	10 GHz (2)	PIN 4	10 GHz (1)
PIN 5	1 GHz (8)	PIN 6	1 GHz (4)
PIN 7	1 GHz (2)	PIN 8	1 GHz (1)
PIN 9	100 MHz (8)	PIN 10	100 MHz (4)
PIN 11	100 MHz (2)	PIN 12	100 MHz (1)
PIN 13	10 MHz (8)	PIN 14	10 MHz (4)
PIN 15	10 MHz (2)	PIN 16	10 MHz (1)
PIN 17	1 MHz (8)	PIN 18	1 MHz (4)
PIN 19	1 MHz (2)	PIN 20	1 MHz (1)
PIN 21	100 kHz (8)	PIN 22	100 kHz (4)
PIN 23	100 kHz (2)	PIN 24	100 kHz (1)
PIN 25	10 kHz (8)	PIN 26	10 kHz (4)
PIN 27	10 kHz (2)	PIN 28	10 kHz (1)
PIN 29	1 kHz (8)	PIN 30	1 kHz (4)
PIN 31	1 kHz (2)	PIN 32	1 kHz (1)
PIN 33	STROBE	PIN 34	GND

### J2 7 PIN DC POWER CONNECTIONS

PIN 1	+5.2 VDC
PIN 2	GND
PIN 3	+15 VDC
PIN 4	GND
PIN 5	PHASE VOLTAGE
PIN 6	GND
PIN 7	TTL ALARM

### J1 20 PIN DATA CONNECTOR

PIN 2	WAKE UP
PIN 4	DATA OUT +
PIN 5	DATA OUT -
PIN 8	DATA IN +
PIN 9	DATA IN -
PIN 10	ALARM

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# LOW PHASE NOISE SATCOM SYNTHESIZER

## MFS SERIES: 0.9–16.88 GHz

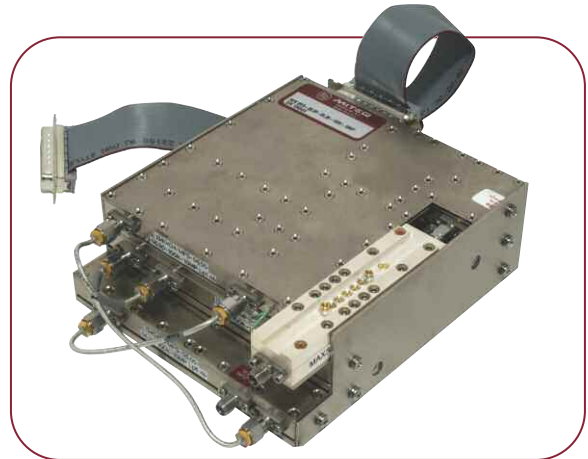
### FEATURES

- Superior phase noise, 20 dB below INTELSAT phase noise mask
- 100% environmental screening
- Options for extended bandwidths

#### GUI INTERFACE (for serial programming):

Now available at:

<http://amps.miteq.com/Amps2007/synthesizers/SynthControl.zip>



### ELECTRICAL SPECIFICATIONS

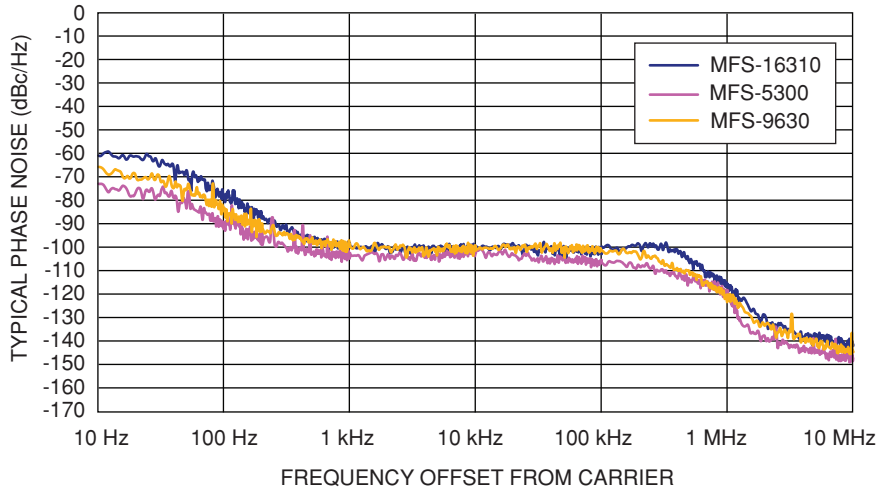
Output frequency range	STANDARD BANDS			
	1.610 – 3.335 GHz	3.52 – 5.305 GHz	9.46 – 16.88 GHz	8.46 – 16.88 GHz
	1.610 – 1.670 GHz	3.52 – 3.89 GHz	9.46 – 10.52 GHz	8.46 – 9.97 GHz
	2.670 – 2.690 GHz	4.625 – 5.285 GHz	10.91 – 11.53 GHz	8.71 – 10.52 GHz
	3.210 – 3.330 GHz	4.625 – 5.285 GHz	11.46 – 12.03 GHz	9.45 – 11.25 GHz
			12.71 – 13.53 GHz	11.46 – 13.28 GHz
			12.72 – 13.79 GHz	12.97 – 14.29 GHz
			13.21 – 13.58 GHz	12.72 – 14.87 GHz
				12.97 – 13.79 GHz
				16.01 – 16.88 GHz
Step size (Note 2)	Down to 1 kHz			
Tuning speed (to w/in 10° RMS)	10 ms typical/100 ms maximum			
Output power	+13 dBm minimum			
Output power variation	±1.5 dB maximum			
Input reference frequency	5 or 10 MHz			
Input power level	0 ±3 dBm			
Output spurious (Note 1)				
In-band	-70 dBc minimum			
Out-of-band	-65 dBc minimum			
Phase noise	See graphs			
Offset from carrier	1.610 – 3.335 GHz	3.52 – 5.305 GHz	9.46 – 16.88 GHz	8.46 – 16.88 GHz
100 Hz	-86 dBc	-80 dBc	-72 dBc	-68 dBc
1 kHz	-100 dBc	-94 dBc	-88 dBc	-85 dBc
10 kHz	-105 dBc	-99 dBc	-93 dBc	-90 dBc
100 kHz	-105 dBc	-99 dBc	-93 dBc	-90 dBc
1 MHz	-120 dBc	-114 dBc	-110 dBc	-107 dBc
10 MHz	-140 dBc	-134 dBc	-130 dBc	-127 dBc
Output harmonic	-20 dBc typical			
Output impedance	50 ohm nominal			
Load VSWR	1.5:1 maximum, all phases			
Frequency control	BCD, TTL, parallel lines or serial RS422			
Summary alarm	In-lock TTL high			
DC power requirements				
> 125 kHz step size	+20/+15 volts, 1 amp typical, +5.2 volts, 0.8 amp typical			
< 125 kHz step size	+20/+15 volts, 1.2 amps typical, +5.2 volts, 1.1 amps typical			

#### Notes:

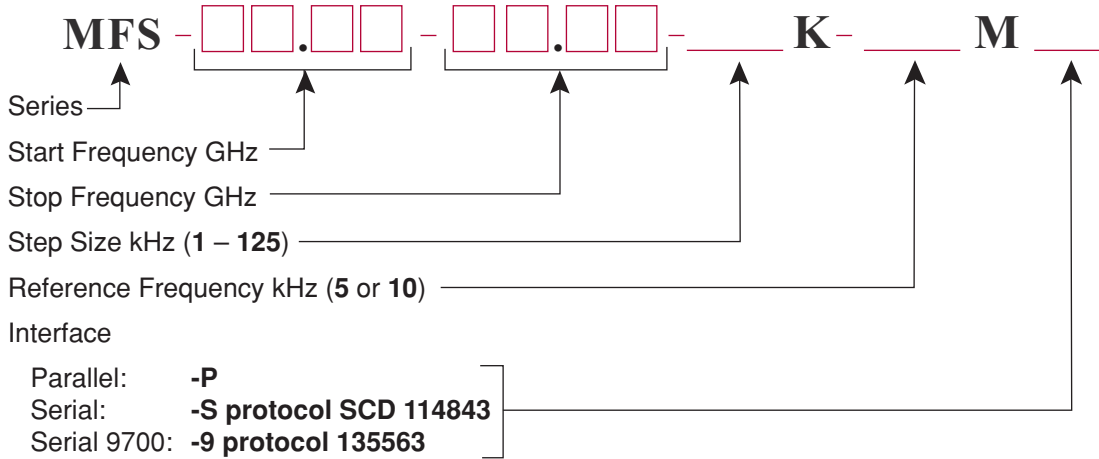
1. Extended bandwidths beyond standards are optional.
2. Close in phase noise dependent on reference.
3. For serial interface, 9600 and 9700 serial protocols, visit [www.miteq.com](http://www.miteq.com)

# LOW PHASE NOISE SATCOM SYNTHESIZER

**TYPICAL PHASE NOISE**



**ORDERING INFORMATION**



EXAMPLE: Part Number MFS-03.21-03.31-1K-5M-S for frequency synthesizer covering 3.21 to 3.31 GHz with 1 kHz step size, 5 MHz reference and serial interface.

# LOW PHASE NOISE SATCOM SYNTHESIZER

## MECHANICAL SPECIFICATIONS

Outline drawings

1.610-3.335 GHz .....	125 kHz step size: 174285, 180502
	1 kHz step size: 168386, 180504
3.52-5.305 GHz .....	125 kHz step size: 121226, 121865
	1 kHz step size: 121232, 179862
8.46-13.58 GHz .....	125 kHz step size: 121226, 119455
	1 kHz step size: 179862, 120001
9.46-16.88 GHz .....	125 kHz step size: 169302,
	1 kHz step size: 140069

Size ..... Refer to outline drawings

Weight

- > 125 step size ..... 3 pounds typical
- < 125 step size ..... 4.6 pounds typical

RF connectors ..... SMA female

DC power connectors ..... Refer to outline drawings

Control connectors ..... Refer to outline drawings

## ENVIRONMENTAL SPECIFICATIONS

Temperature

- Operating (surface) ..... -10 to +60°C
- Storage ..... -50 to +100°C

Humidity ..... Up to 95% at 40°C noncondensing

Shock (survival) ..... 30 g's, 10 ms pulse

Vibration (survival) ..... 20 to 2000 Hz random to .04 G<sup>2</sup>/Hz

Altitude ..... Up to 13,500 feet

100% testing ..... Frequency range

Output power

Discrete power

Spectral purity

Phase bursts

Alarm and monitors

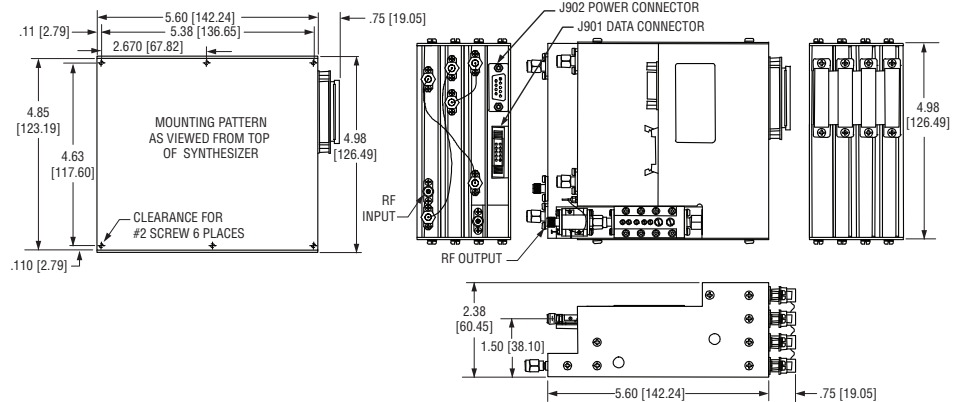
100% screening ..... Temperature cycle/monitor

## OUTLINE DRAWINGS

REFER TO MECHANICAL SPECIFICATION TABLE

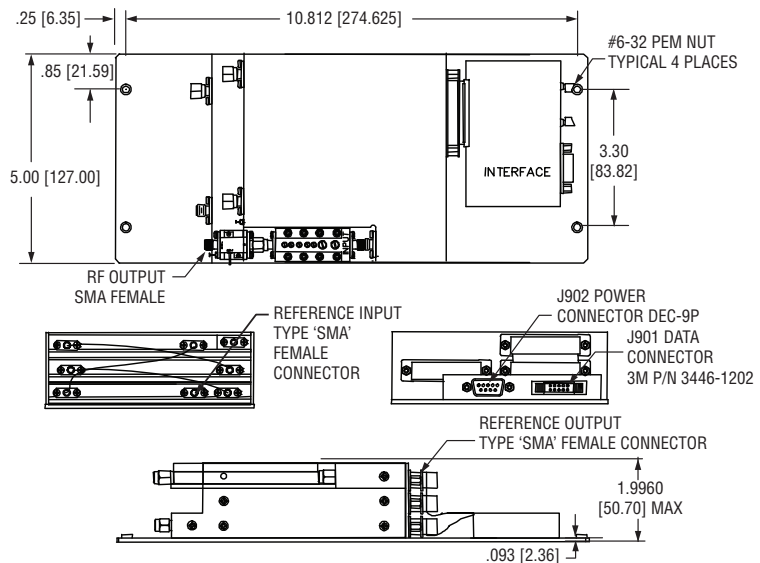
### 119455 MFS SERIES

INTERFACE CONNECTIONS	
<b>J901-DATA CONNECTIONS</b>	<b>J902-POWER CONNECTIONS</b>
PIN 1 CLOCK +	PIN 1 +20 VDC/+15 VDC
PIN 2 LOAD	PIN 2 PHASE VOLTAGE
PIN 3 CLOCK -	PIN 3 ALARM
PIN 4 LOAD	PIN 4 +5.2 VDC
PIN 5 DATA	PIN 5 GND
PIN 6 N/C	PIN 6 +20 VDC/+15 VDC
PIN 7 DATA	PIN 7 TTL ALARM
PIN 8 N/C	PIN 8 +5.2 VDC
PIN 9 N/C	PIN 9 GND
PIN 10 N/C	



### 120001 MFS SERIES

INTERFACE CONNECTIONS	
<b>J901 DATA CONNECTIONS</b>	<b>J902 POWER CONNECTIONS</b>
PIN 1 CLOCK +	PIN 1 +20 VDC
PIN 2 LOAD -	PIN 2 PHASE VOLTAGE
PIN 3 CLOCK -	PIN 3 ALARM
PIN 4 LOAD +	PIN 4 +5.2 VDC
PIN 5 DATA -	PIN 5 GND
PIN 6 N/C	PIN 6 +20 VDC
PIN 7 DATA +	PIN 7 TTL ALARM
PIN 8 N/C	PIN 8 +5.2 VDC
PIN 9 N/C	PIN 9 GND
PIN 10 N/C	

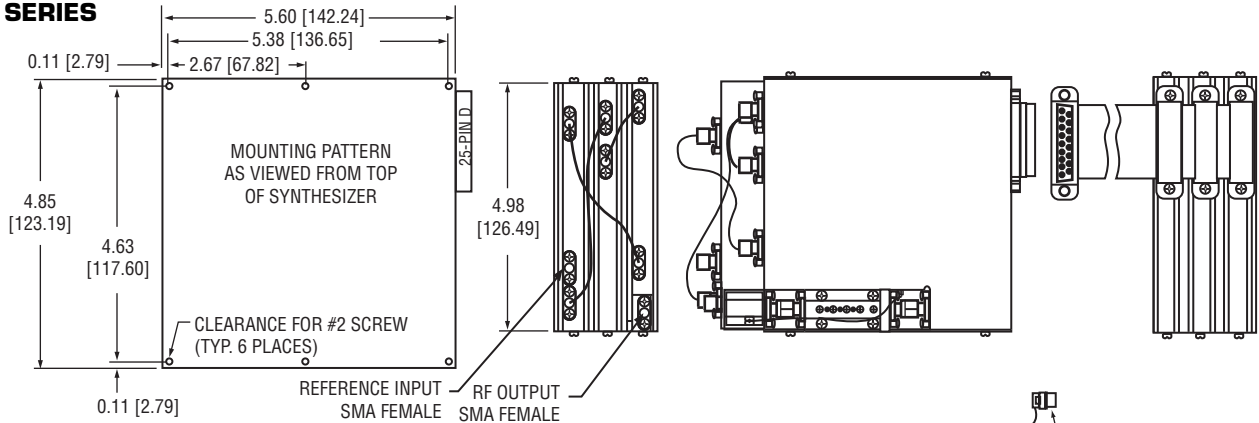


NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# OUTLINE DRAWINGS (CONT.)

REFER TO MECHANICAL SPECIFICATION TABLE

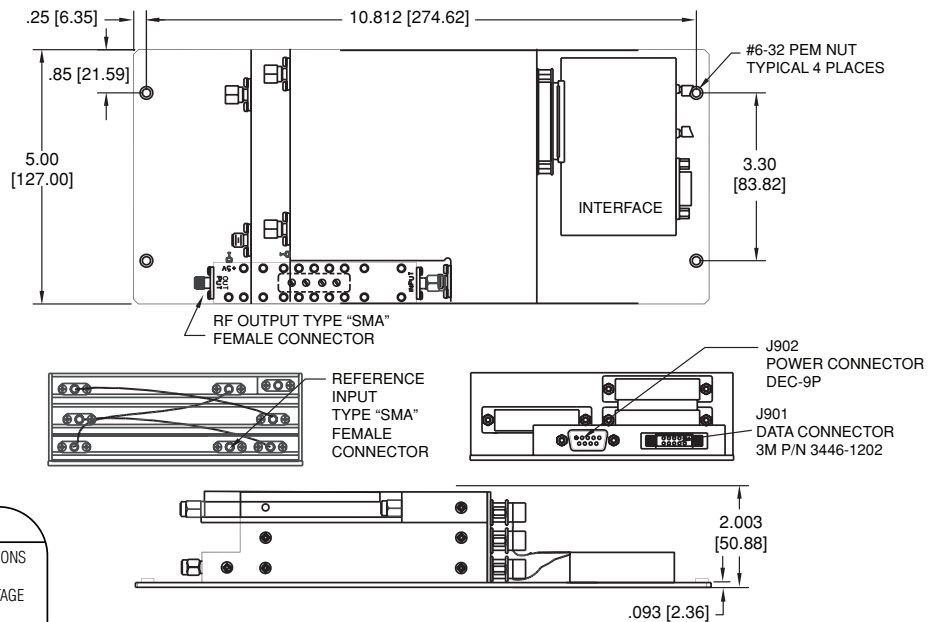
## 121226 MFS SERIES



### INTERFACE CONNECTIONS

PIN 1	GROUND	PIN 14	GROUND
PIN 2	+20 VDC	PIN 15	+20 VDC
PIN 3	+5.2 VDC	PIN 16	+5.2 VDC
PIN 4	TEST POINT	PIN 17	10 MHz (1)
PIN 5	TTL ALARM	PIN 18	1 MHz (8)
PIN 6	PHASE VOLTAGE	PIN 19	1 MHz (4)
PIN 7	100 MHz (8)	PIN 20	1 MHz (2)
PIN 8	100 MHz (4)	PIN 21	1 MHz (1)
PIN 9	100 MHz (2)	PIN 22	125/100 kHz (8)
PIN 10	100 MHz (1)	PIN 23	125/100 kHz (4)
PIN 11	10 MHz (8)	PIN 24	125/100 kHz (2)
PIN 12	10 MHz (4)	PIN 25	125/100 kHz (1)
PIN 13	10 MHz (2)		

## 121232 MFS SERIES



### INTERFACE CONNECTIONS

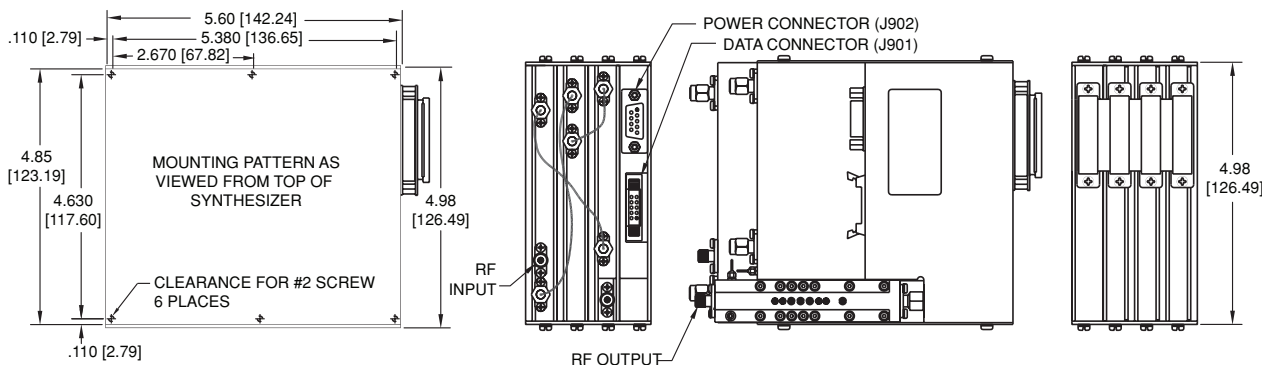
J901- DATA CONNECTIONS		J902- POWER CONNECTIONS	
PIN 1	CLOCK +	PIN 1	+20 VDC
PIN 2	LOAD -	PIN 2	PHASE VOLTAGE
PIN 3	CLOCK -	PIN 3	ALARM
PIN 4	LOAD +	PIN 4	+5.2 VDC
PIN 5	DATA -	PIN 5	GROUND
PIN 6	N/C	PIN 6	+20 VDC
PIN 7	DATA +	PIN 7	TTL ALARM
PIN 8	N/C	PIN 8	+5.2 VDC
PIN 9	N/C	PIN 9	GROUND
PIN 10	N/C		

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# OUTLINE DRAWINGS (CONT.)

REFER TO MECHANICAL SPECIFICATION TABLE

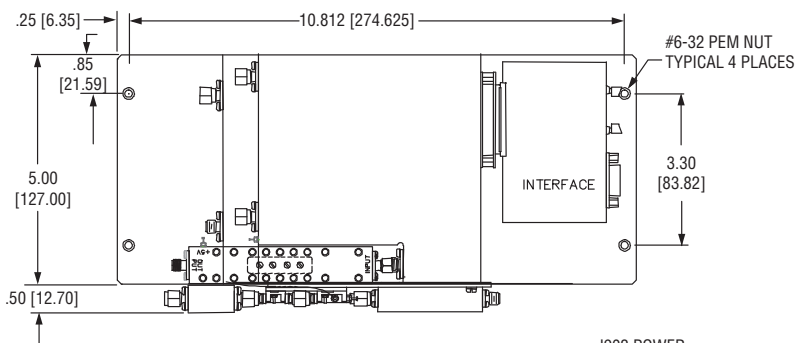
## 121865 MFS SERIES



### INTERFACE CONNECTIONS

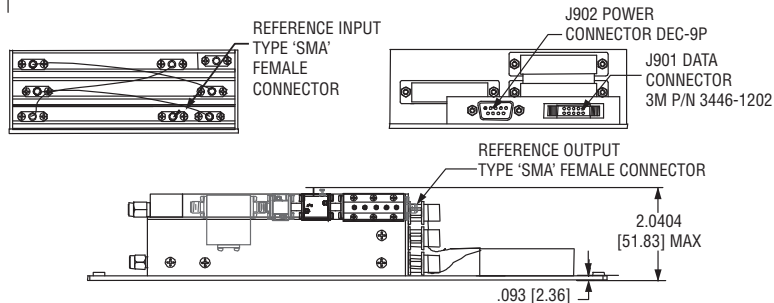
J901- DATA CONNECTIONS		J902- POWER CONNECTIONS	
PIN 1	CLOCK +	PIN 1	+20 VDC/+15 VDC
PIN 2	LOAD	PIN 2	PHASE VOLTAGE
PIN 3	CLOCK -	PIN 3	ALARM
PIN 4	LOAD	PIN 4	+5.2 VDC
PIN 5	DATA	PIN 5	GROUND
PIN 6	N/C	PIN 6	+20 VDC/+15 VDC
PIN 7	DATA	PIN 7	TTL ALARM
PIN 8	N/C	PIN 8	+5.2 VDC
PIN 9	N/C	PIN 9	GROUND
PIN 10	N/C		

## 140069 MFS SERIES



### INTERFACE CONNECTIONS

J901-DATA CONNECTIONS		J902-POWER CONNECTIONS	
PIN 1	CLOCK +	PIN 1	+20 VDC
PIN 2	LOAD -	PIN 2	PHASE VOLTAGE
PIN 3	CLOCK -	PIN 3	ALARM
PIN 4	LOAD +	PIN 4	+5.2 VDC
PIN 5	DATA -	PIN 5	GND
PIN 6	N/C	PIN 6	+20 VDC
PIN 7	DATA +	PIN 7	TTL ALARM
PIN 8	N/C	PIN 8	+5.2 VDC
PIN 9	N/C	PIN 9	GND
PIN 10	N/C		



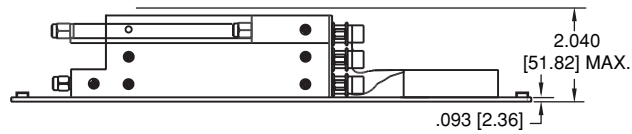
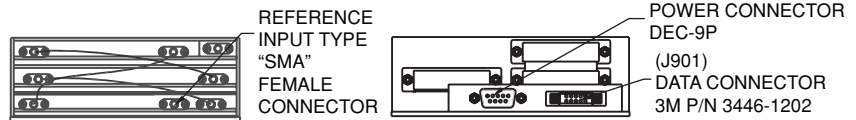
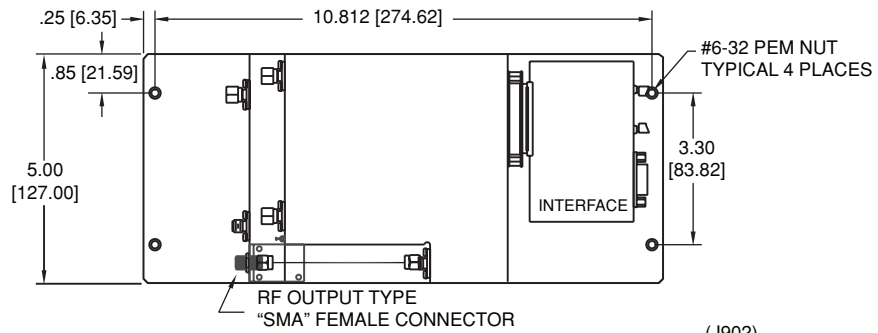
NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.



# OUTLINE DRAWINGS (CONT.)

REFER TO MECHANICAL SPECIFICATION TABLE

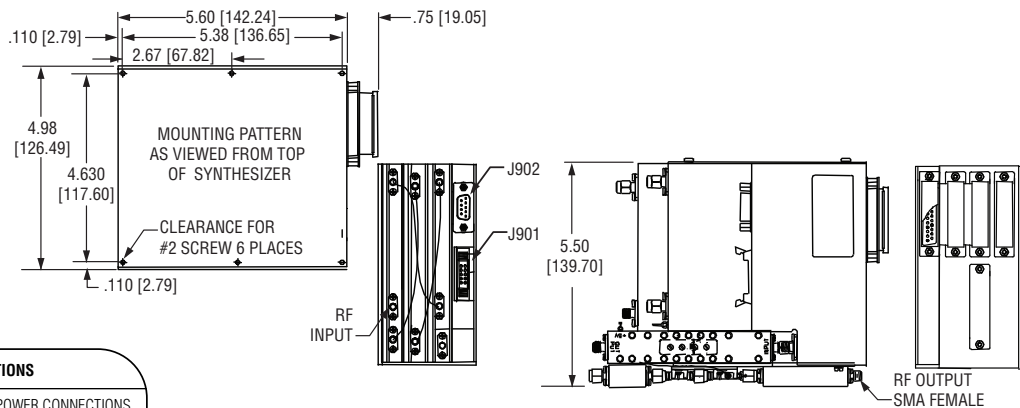
## 168386 MFS SERIES



### INTERFACE CONNECTIONS

J901- DATA CONNECTIONS		J902- POWER CONNECTIONS	
PIN 1	CLOCK +	PIN 1	+20 VDC/+15 VDC
PIN 2	LOAD -	PIN 2	PHASE VOLTAGE
PIN 3	CLOCK -	PIN 3	ALARM
PIN 4	LOAD +	PIN 4	+5.2 VDC
PIN 5	DATA -	PIN 5	GROUND
PIN 6	N/C	PIN 6	+20 VDC/+15 VDC
PIN 7	DATA +	PIN 7	TTL ALARM
PIN 8	N/C	PIN 8	+5.2 VDC
PIN 9	N/C	PIN 9	GROUND
PIN 10	N/C		

## 169302 MFS SERIES



### INTERFACE CONNECTIONS

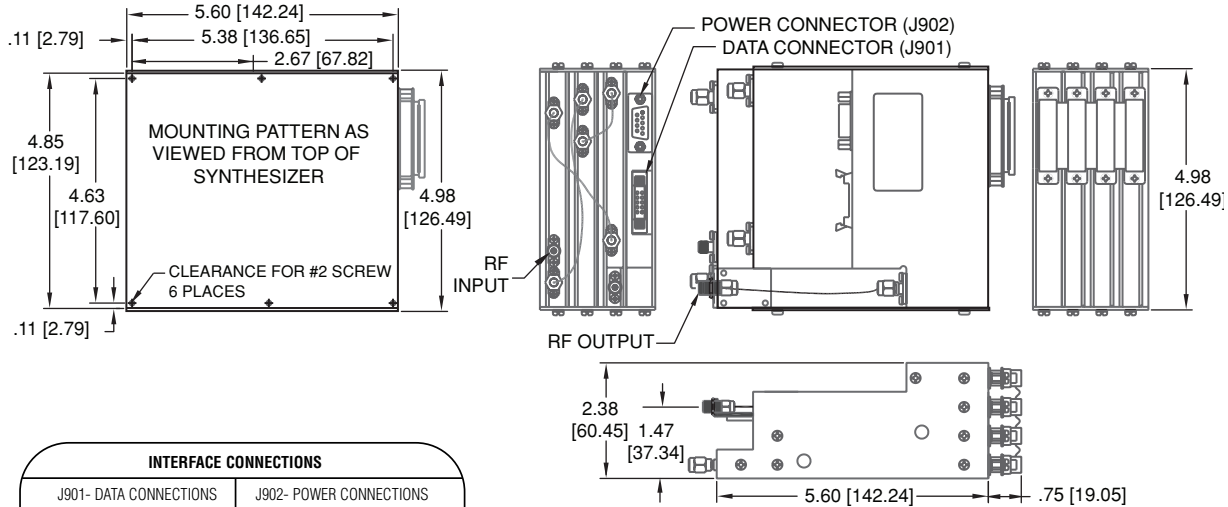
J901-DATA CONNECTIONS		J902-POWER CONNECTIONS	
PIN 1	CLOCK +	PIN 1	+20 VDC
PIN 2	LOAD	PIN 2	PHASE VOLTAGE
PIN 3	CLOCK -	PIN 3	ALARM
PIN 4	LOAD	PIN 4	+5.2 VDC
PIN 5	DATA	PIN 5	GND
PIN 6	N/C	PIN 6	+20 VDC
PIN 7	DATA	PIN 7	TTL ALARM
PIN 8	N/C	PIN 8	+5.2 VDC
PIN 9	N/C	PIN 9	GND
PIN 10	N/C		

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# OUTLINE DRAWINGS (CONT.)

REFER TO MECHANICAL SPECIFICATION TABLE

## 174285 MFS SERIES



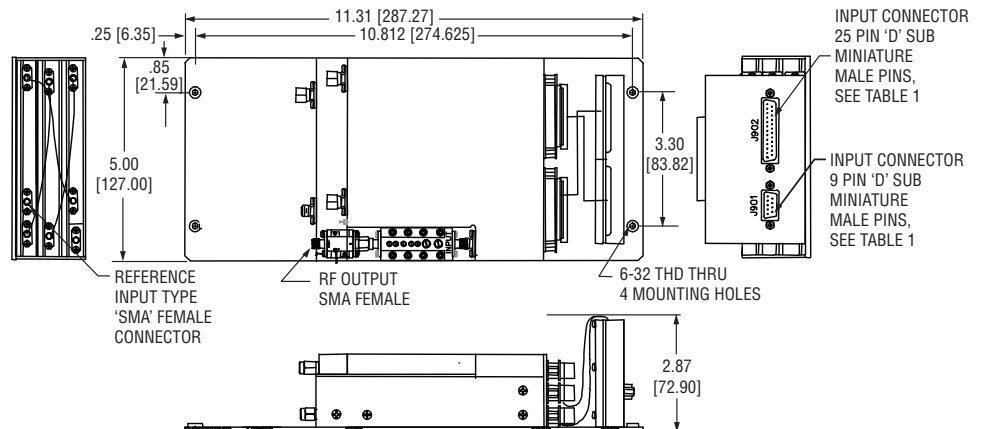
### INTERFACE CONNECTIONS

J901- DATA CONNECTIONS		J902- POWER CONNECTIONS	
PIN 1	CLOCK +	PIN 1	+20 VDC/+15 VDC
PIN 2	LOAD	PIN 2	PHASE VOLTAGE
PIN 3	CLOCK -	PIN 3	ALARM
PIN 4	LOAD	PIN 4	+5.2 VDC
PIN 5	DATA	PIN 5	GROUND
PIN 6	N/C	PIN 6	+20 VDC/+15 VDC
PIN 7	DATA	PIN 7	TTL ALARM
PIN 8	N/C	PIN 8	+5.2 VDC
PIN 9	N/C	PIN 9	GROUND
PIN 10	N/C		

## 179862 MFS SERIES

### INTERFACE CONNECTIONS

PIN 1	GROUND	PIN 1	+20 VDC/+15 VDC
PIN 2	+15 VDC	PIN 2	PHASE VOLTAGE
PIN 3	+5.2 VDC	PIN 3	ALARM
PIN 4	TEST POINT	PIN 4	+5.2 VDC
PIN 5	TTL ALARM	PIN 5	GND
PIN 6	PHASE VOLTAGE	PIN 6	+20 VDC/+15 VDC
PIN 7	1 GHz (8)	PIN 7	TTL ALARM
PIN 8	100 MHz (4)	PIN 8	+5.2 VDC
PIN 9	100 MHz (8)	PIN 9	GND
PIN 10	100 MHz (4)		
PIN 11	100 MHz (2)		
PIN 12	100 MHz (1)		
PIN 13	10 MHz (8)		
PIN 14	GROUND		
PIN 15	+15 VDC		
PIN 16	+5.2 VDC		
PIN 17	10 MHz (4)		
PIN 18	10 MHz (2)		
PIN 19	10 MHz (1)		
PIN 20	1 MHz (8)		
PIN 21	1 MHz (4)		
PIN 22	1 MHz (2)		
PIN 23	1 MHz (1)		
PIN 24	250 kHz (2)		
PIN 25	250 kHz (1)		

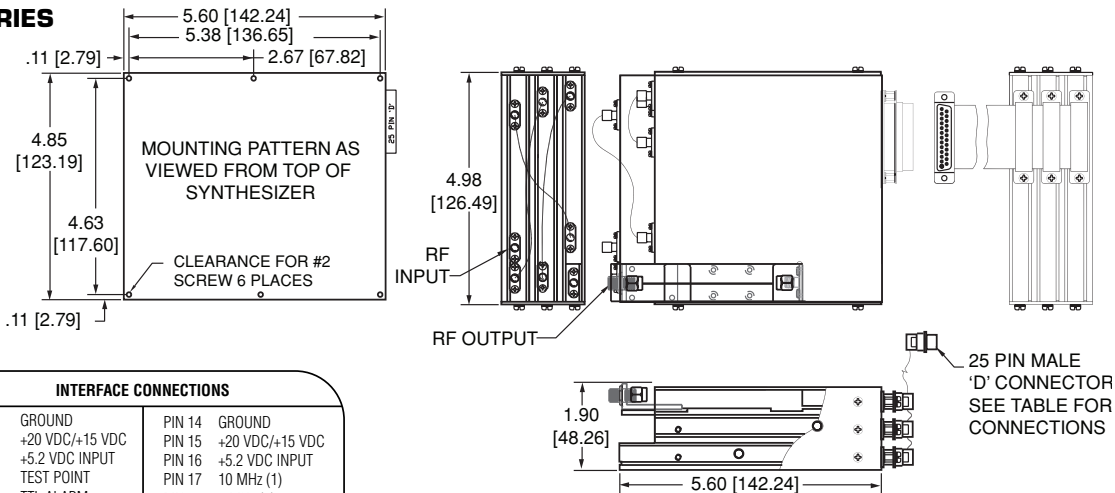


NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# OUTLINE DRAWINGS (CONT.)

REFER TO MECHANICAL SPECIFICATION TABLE

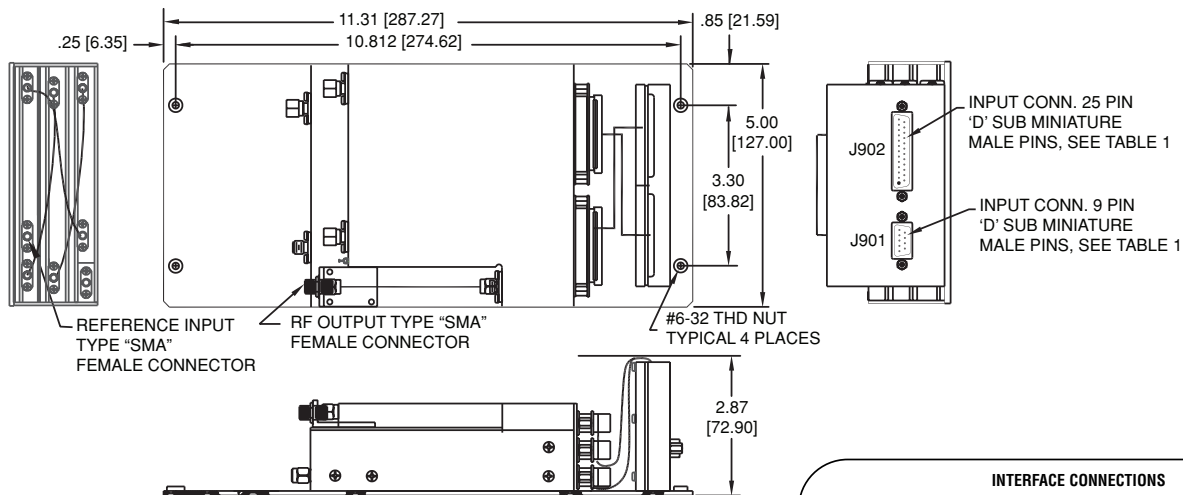
## 180502 MFS SERIES



### INTERFACE CONNECTIONS

PIN 1	GROUND	PIN 14	GROUND
PIN 2	+20 VDC/+15 VDC	PIN 15	+20 VDC/+15 VDC
PIN 3	+5.2 VDC INPUT	PIN 16	+5.2 VDC INPUT
PIN 4	TEST POINT	PIN 17	10 MHz (1)
PIN 5	TTL ALARM	PIN 18	1 MHz (8)
PIN 6	PHASE VOLTAGE	PIN 19	1 MHz (4)
PIN 7	100 MHz (8)	PIN 20	1 MHz (2)
PIN 8	100 MHz (4)	PIN 21	1 MHz (1)
PIN 9	100 MHz (2)	PIN 22	125/100 kHz (8)
PIN 10	100 MHz (1)	PIN 23	125/100 kHz (4)
PIN 11	10 MHz (8)	PIN 24	125/100 kHz (2)
PIN 12	10 MHz (4)	PIN 25	125/100 kHz (1)
PIN 13	10 MHz (2)		

## 180504 MFS SERIES



### INTERFACE CONNECTIONS

J902 DATA CONNECTIONS				J901 POWER CONNECTIONS	
PIN 1	GROUND	PIN 14	100 kHz (8)	PIN 1	+20 VDC/+15 VDC
PIN 2	100 MHz (8)	PIN 15	100 kHz (4)	PIN 2	PHASE VOLTAGE
PIN 3	100 MHz (4)	PIN 16	100 kHz (2)	PIN 3	ALARM
PIN 4	100 MHz (2)	PIN 17	100 kHz (1)	PIN 4	+5.2 VDC
PIN 5	100 MHz (1)	PIN 18	10 kHz (8)	PIN 5	GROUND
PIN 6	10 MHz (8)	PIN 19	10 kHz (4)	PIN 6	+20 VDC/+15 VDC
PIN 7	10 MHz (4)	PIN 20	10 kHz (2)	PIN 7	TTL ALARM
PIN 8	10 MHz (2)	PIN 21	10 kHz (1)	PIN 8	+5.2 VDC
PIN 9	10 MHz (1)	PIN 22	1 kHz (8)	PIN 9	GROUND
PIN 10	1 MHz (8)	PIN 23	1 kHz (4)		
PIN 11	1 MHz (4)	PIN 24	1 kHz (2)		
PIN 12	1 MHz (2)	PIN 25	1 kHz (1)		
PIN 13	1 MHz (1)				

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

## LOW FREQUENCY TRACKING SYNTHESIZER

**LFTS SERIES: 50 – 90 MHz  
155 – 330 MHz**

### FEATURES

- Standard step size: 1 kHz
- INTELSAT phase noise compliant
- Field tested reliability
- Low power dissipation
- MIL-STD-188-164A microphonic compliant
- ETSI 300019-1-4 compliant

### OPTIONS

- Custom frequency bands
- Fixed LO frequencies
- Custom step size



MITEQ's LFTS Series of UHF-band low phase noise synthesizers offer an economical solution for UHF-band INTELSAT satellite communications applications. In addition to the 1 kHz step size, the LFTS series synthesizers provide a standard second output used as the second conversion LO for dual conversion up- and downconverters.

### ELECTRICAL SPECIFICATIONS

Output frequency range (Note 1)	Tunable		Fixed LO (Note 2)
		50 – 90 MHz	155 – 330 MHz
Step size (Note 3)	1 kHz		
Output power	+13 dBm minimum		+13 ±2 dBm
Output power variation	±1.5 dB maximum		
Input reference frequency (Note 4)	5 or 10 MHz		
Input power level	0 ±3 dBm		
Output spurious			
In-band	-65 dBc minimum		-80 dBc minimum
Out-of-band	-65 dBc minimum		-70 dBc minimum
Phase noise	See graph (Note 6)		See graph
Offset from carrier (Note 5)	At 90 MHz	At 330 MHz	
10 Hz	-89 dBc	-78 dBc	
100 Hz	-99 dBc	-88 dBc	
1 kHz	-109 dBc	-98 dBc	
10 kHz	-109 dBc	-98 dBc	
100 kHz	-121 dBc	-110 dBc	
1 MHz	-141 dBc	-130 dBc	
Output harmonic	-20 dBc		-20 dBc
Output impedance	50 ohm nominal		
Load VSWR	1.5:1 maximum, all phases		

# LOW FREQUENCY TRACKING SYNTHESIZER

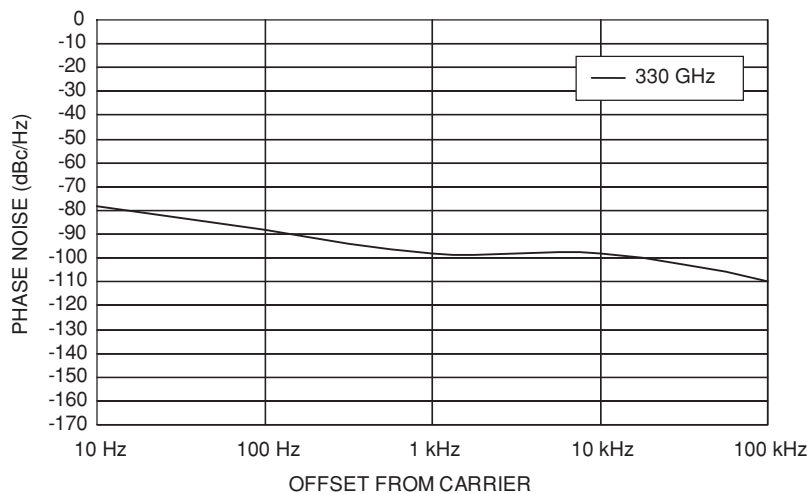
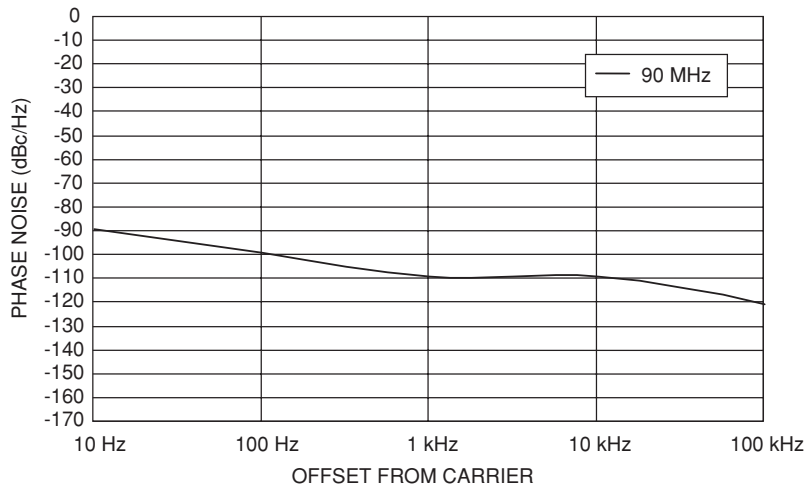
## ELECTRICAL SPECIFICATIONS (CONT.)

	Tunable	Fixed LO (Note 2)
Summary alarm	In-lock TTL 1	
Frequency control	Serial RS485 (4 wire), parallel	
Acquisition time (to phase lock)	30 ms typical, 100 ms maximum	
DC power requirements	+15 volts, 0.3 amps typical +5.2 volts, 0.9 amps typical	
Outline drawing	177326	

**Notes:**

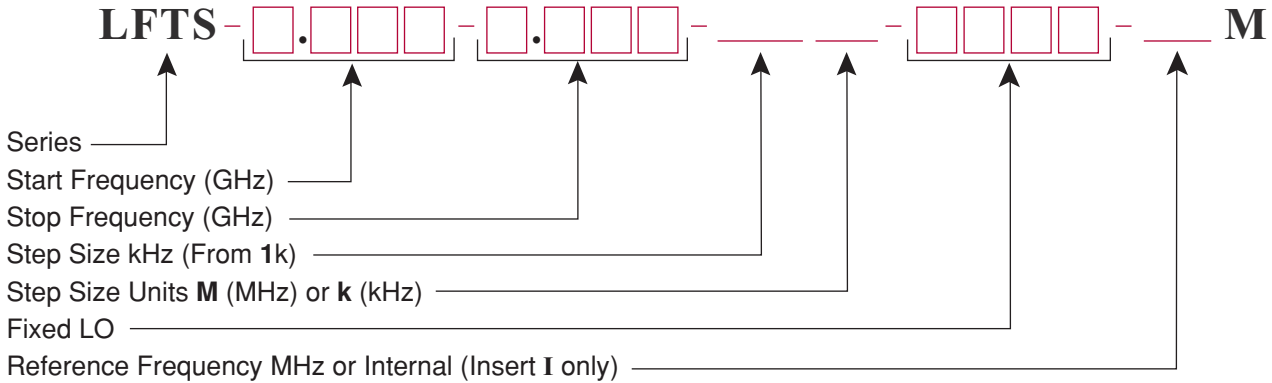
1. Custom frequency bands available, please contact MITEQ.
2. Optional fixed LO frequencies available from 780 to 1700 MHz in 10 MHz intervals.
3. Custom step sizes available, please contact MITEQ.
4. Other reference frequency options available, please contact MITEQ.
5. Close in phase noise dependent on reference.
6. Wider operating temperatures are available, please contact MITEQ.
7. For serial interface, 9700 serial interface protocol, visit [www.miteq.com](http://www.miteq.com)

### TYPICAL PHASE NOISE



# LOW FREQUENCY TRACKING SYNTHESIZER

## ORDERING INFORMATION



### EXAMPLE:

1. Part number LFTS-0.050-0.090-1k-10M for frequency synthesizer covering .05 to .09 GHz with a step size of 1 kHz and a reference frequency of 10 M.
2. Part number LFTS-0.050-0.090-1k-0920-10M for frequency synthesizer covering .05 to .09 GHz with a step size of 1 kHz a fixed LO of 920 MHz and a reference frequency of 10 M.

## MECHANICAL SPECIFICATIONS

Outline drawing .....	177326
Size.....	8" x 5" x 0.7"
Weight .....	1.0 pound typical
RF connectors .....	SMA female
DC power connectors.....	JST™ 7-pin header
Control connectors .....	34-pin header for parallel operation or 20-pin serial

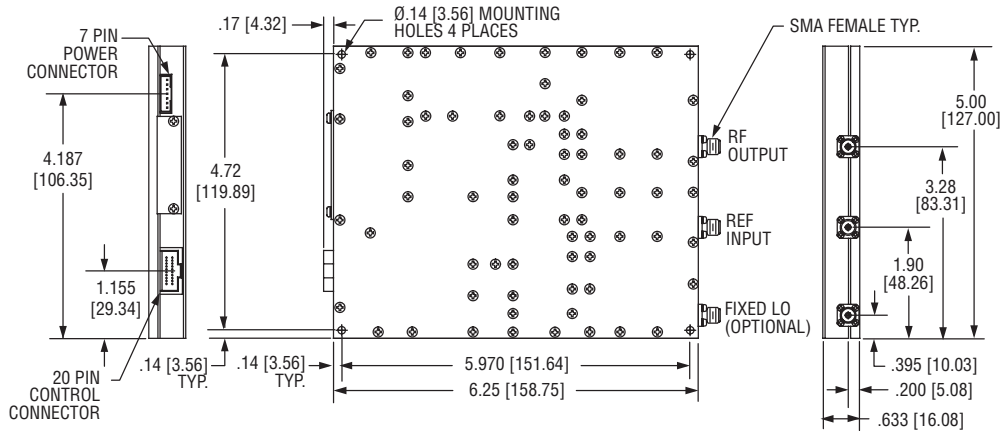
## ENVIRONMENTAL SPECIFICATIONS

Temperature	
Operating .....	0 to 65°C
Storage .....	-55 to +95°C
Humidity .....	Up to 95% at 40°C noncondensing
Shock (nonoperational) .....	30 g's, 10 ms pulse
Vibration (survival) .....	20 to 2000 Hz random to .04 G <sup>2</sup> /Hz
Altitude .....	Up to 13,500 feet
100% testing .....	Frequency range
	Output power
	Discrete power
	Spectral purity
	Phase bursts
	Alarm and monitors
100% screening .....	Temperature cycle/monitor

Note: Wider operating temperatures are available, please contact MITEQ.

# OUTLINE DRAWING

## 177326 LFTS SERIES



### J2 7 PIN DC POWER CONNECTIONS

PIN 1	+5.2 VDC
PIN 2	GND
PIN 3	+15 VDC
PIN 4	GND
PIN 5	PHASE VOLTAGE
PIN 6	GND
PIN 7	TTL ALARM

### J1 20 PIN DATA CONNECTOR

PIN 2	WAKE UP
PIN 4	DATA OUT +
PIN 5	DATA OUT -
PIN 8	DATA IN +
PIN 9	DATA IN -
PIN 10	ALARM

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

# HIGH PERFORMANCE SINGLE-LOOP SYNTHESIZER

## HLSL SERIES: 1-23 GHz

### FEATURES

- Low cost
- Phase locked to external reference
- High Q ceramic resonator VCO's
- Low phase noise
- Small package
- 100% burn-in and temperature testing
- Three-year warranty



### GUI INTERFACE (for serial programming):

Now available at:

<http://amps.miteq.com/Amps2007/synthesizers/SynthControl.zip>

MITEQ's HSL Series of frequency synthesizers are designed for Ka-band synthesized converter requirements. The HSL can tune up to a 3 GHz bandwidth for signals in Ka-band in 50 MHz steps. The lower band versions of HSL will tune to 2 GHz of bandwidth for S-, C-, X-, and Ku-band with step sizes as low as 10 MHz. The HSL Series will meet phase noise 15 dB below Intelsat IESS 308/309 phase noise requirements from L- through Ka-band. This synthesizer produces +16 dBm of output power from L- to X-band and is capable of delivering up to +22 dBm in Ku- and Ka-band. Frequency selection is made via a simple three-wire serial interface and operates with as little as 3 Watts of power. Interface GUI and cables can be supplied to operate from any Windows based PC. Supply voltages can be chosen anywhere between 5 and 15 VDC. The HSL is packaged in a modular 4.0" x 3.75" x 0.5" low EMI nickel plated aluminum chassis.

### ELECTRICAL SPECIFICATIONS

Output frequency range	1 – 23 GHz (Note 1)
Step size	50 MHz (Note 2)
Output power	+13 dBm minimum
Output power variation	±1.5 dB maximum
Input reference frequency	1 – 100 MHz (Note 3)
Input power level	0 ± dBm
Output spurious	-60 dBc minimum
Phase noise	See graph
Offset from carrier	At 22 GHz typical (Note 4)
10 Hz	-63 dBc
100 Hz	-80 dBc
1 kHz	-90 dBc
10 kHz	-92 dBc
100 kHz	-115 dBc
1 MHz	-135 dBc
Output harmonic	-20 dBc typical
Output impedance	50 ohm nominal



# HIGH PERFORMANCE SINGLE-LOOP SYNTHESIZER

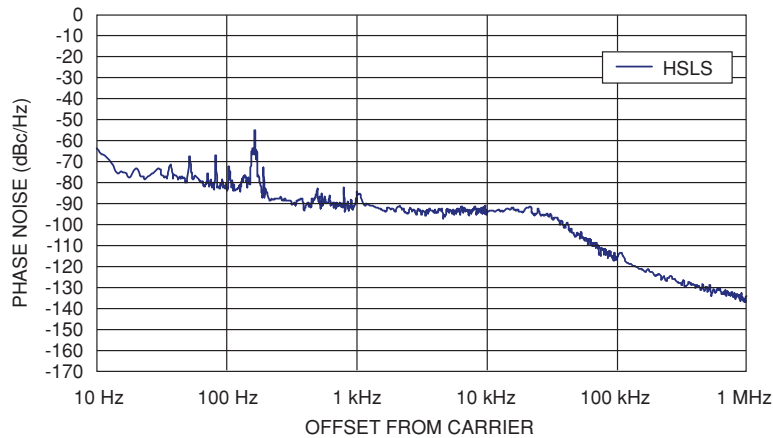
## ELECTRICAL SPECIFICATIONS (CONT.)

Load VSWR	1.5:1 maximum, all phases
Frequency control	Serial (3 wire)
Acquisition time (to phase lock)	100 ms maximum
Summary alarm	In-lock TTL 1, no lock TTL 0
DC power requirements	+5.2 to +15 volts @ 650 mA maximum
Outline drawing	182690

**Notes:**

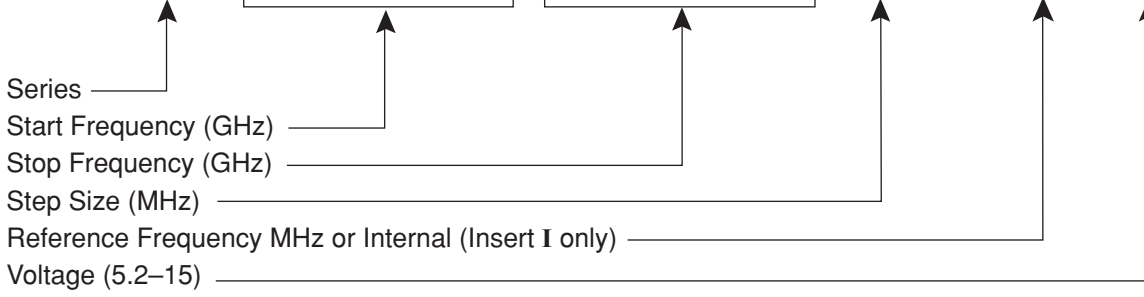
1. Custom frequency bands available, please contact MITEQ.
2. Custom step size available, please contact MITEQ.
3. Other reference frequency options available, please contact MITEQ.
4. Close in phase noise dependent on reference.

### TYPICAL PHASE NOISE



### ORDERING INFORMATION

**HSLs** -   .    -   .    -  -  -  **M** -  -  **P**



**EXAMPLE:**

1. Part number HSLs-20.500-23.000-50M-10M-15P for Single-Loop Synthesizer is 20.5 to 23 GHz in 50 MHz steps with a 10 MHz reference and uses +15 VDC.

# HIGH PERFORMANCE SINGLE-LOOP SYNTHESIZER

## MECHANICAL SPECIFICATIONS

Outline drawing..... 182690  
 Size..... 3.78" x 4.03" x .54"  
 Weight..... 90 grams  
 RF connectors ..... SMA female  
 DC power connectors..... JST™ 7-pin header

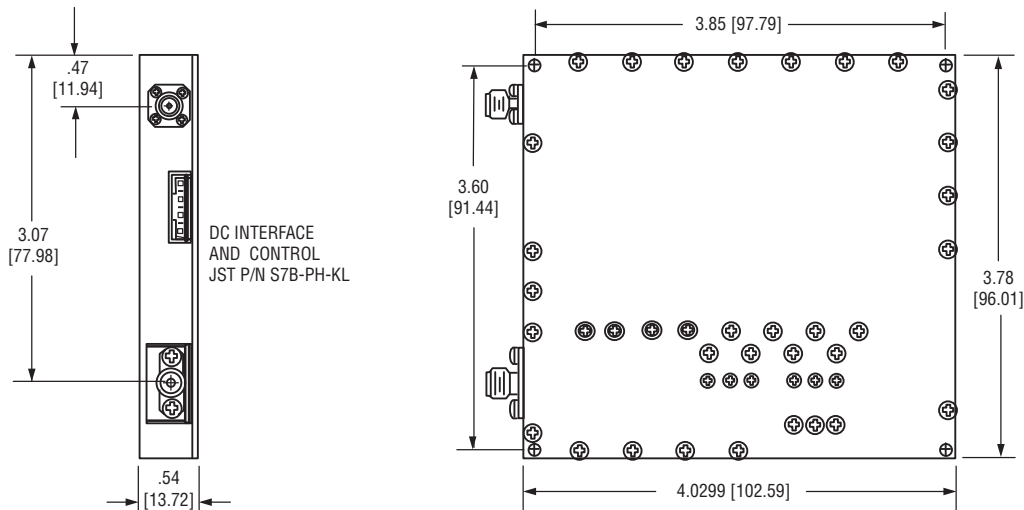
## ENVIRONMENTAL SPECIFICATIONS

Temperature  
 Operating ..... -10 to +60°C  
 Storage ..... -50 to +100°C  
 Humidity ..... Up to 95% at 40°C  
 noncondensing  
 Shock (nonoperational)..... 30 g's, 10 ms pulse  
 Vibration (survival) ..... 20 to 2000 Hz  
 random to 4 G<sup>2</sup>/Hz  
 Altitude ..... Up to 13,500 feet  
 100% testing ..... Frequency range  
 Output power  
 Discrete power  
 Spectral purity  
 Phase bursts  
 Alarm and monitors  
 100% screening ..... Temperature cycle/monitor

Note: Wider operating temperatures are available,  
 please contact MITEQ.

# OUTLINE DRAWING

## 182690 HSLs SERIES



CONNECTION PIN	FUNCTION
J1-1	CLK
J1-2	DATA
J1-3	LE
J1-4	N/C
J1-5	GND
J1-6	ALARM
J1-7	Vcc

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

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# SINGLE-LOOP FAST SWITCHING SYNTHESIZER

## SLFS SERIES: 0.1-14 GHz (IN BANDS)

### FEATURES

- 1 MHz standard step size
- Small package size
- Low power dissipation
- INTELSAT phase noise compliant

### OPTIONS

- Custom frequency bands

### GUI INTERFACE (for serial programming):

Now available at:

<http://amps.miteq.com/Amps2007/synthesizers/SLFS-GUI.zip>



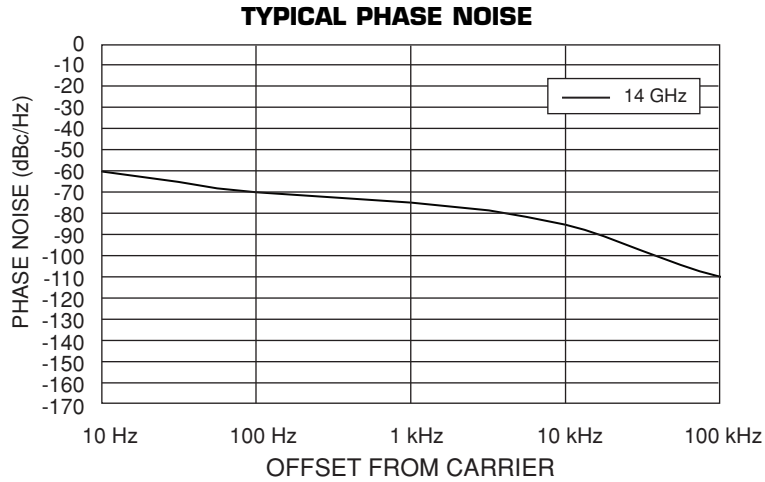
MITEQ's SLFS Series of synthesizers offer a compact and economical solution for SATCOM and VHF Ku-band microwave communication systems. The SLFS can be controlled with any notebook or desktop PC with a user friendly Graphic User Interface. This series is available in VHF through Ku-band with typical bandwidths of 800 MHz, with an efficient design that dissipates only 2.5 Watts. The SLFS is available in wider bandwidths and custom step sizes as required. Package size is modular, 2.25" x 2.25" x 0.6", SMA input and output with 7 PIN JST interface connector.

### ELECTRICAL SPECIFICATIONS

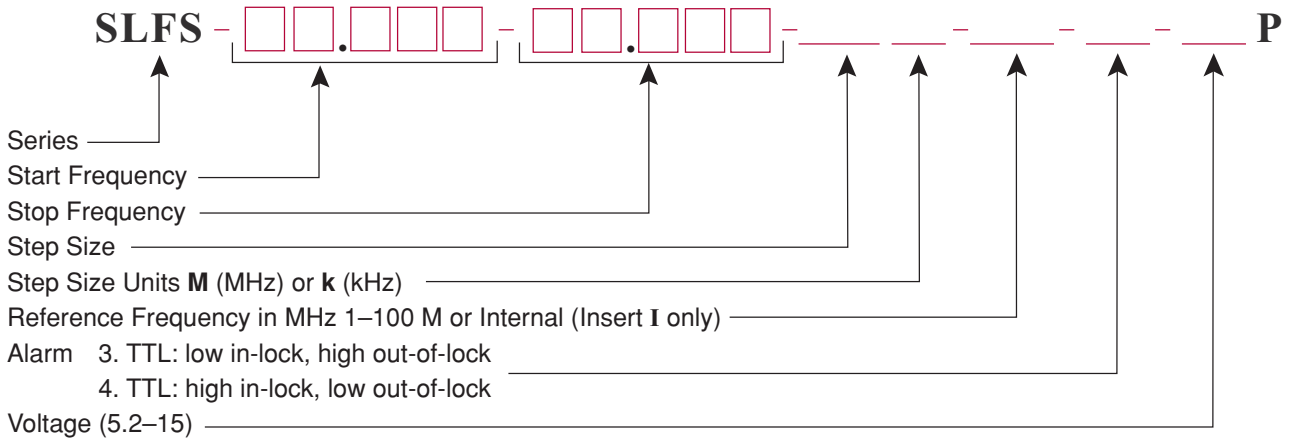
Output frequency range	0.1 – 14 GHz (in bands)		
Output power	+13 dBm minimum		
Output power variation	±2 dB maximum		
Step size	1 MHz*		
Input reference frequency	1–100 MHz (Internal reference available)		
Input reference power	0 ±3 dBm		
Output harmonic	-20 dBc		
Output spurious	-60 dBc		
Regulation	±5%		
Noise and ripple	10 mV, P-P maximum		
Summary alarm	TTL high in-lock, low out-lock		
Frequency control	Serial (3 WIRE) – 4 BIT Parallel Option		
Acquisition time (to phase lock)	100 ms maximum		
Phase noise	See graph		
Offset from carrier	1 GHz	7 GHz	14 GHz
10 Hz	-70 dBc	-60 dBc	-60 dBc
100 Hz	-75 dBc	-70 dBc	-65 dBc
1k Hz	-80 dBc	-75 dBc	-65 dBc
10 kHz	-90 dBc	-85 dBc	-75 dBc
100 kHz	-115 dBc	-110 dBc	-100 dBc
1 MHz	-125 dBc	-120 dBc	-120 dBc
DC power requirements	+5.2 to +15 VDC @ 350 mA		

\*Note: Smaller step sizes available depending on output band, please contact MITEQ.

# SINGLE-LOOP FAST SWITCHING SYNTHESIZER



## ORDERING INFORMATION



EXAMPLE: Part Number SLFS-09.000-11.000-2M-10M-4-15P frequency synthesizer covering 9 to 11 GHz with a step size of 2 MHz, a reference frequency of 10 MHz, TTL high in-lock alarm and 15 volts DC supply.

# SINGLE-LOOP FAST SWITCHING SYNTHESIZER

## MECHANICAL SPECIFICATIONS

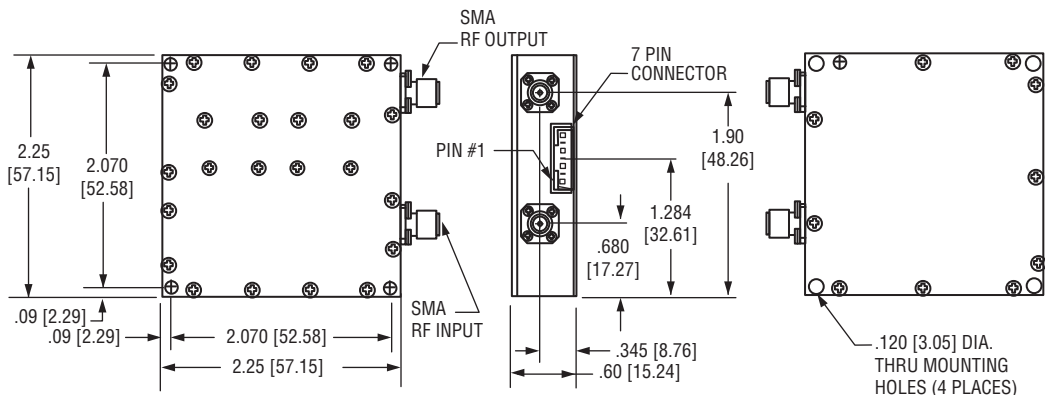
Outline drawing ..... 172526  
 Size ..... 2.25" x 2.25" x .60"  
 Weight ..... 100 grams  
 RF connectors ..... SMA female  
 DC power connectors ..... JST™ 7-pin header

## ENVIRONMENTAL SPECIFICATIONS

Temperature  
 Operating ..... -10 to +60°C  
 Storage ..... -50 to +100°C  
 Humidity ..... Up to 95% at 40°C  
 noncondensing  
 Shock (nonoperational) ..... 30 g's, 10 ms pulse  
 Vibration (survival) ..... 20 to 2000 Hz  
 random to .04 G<sup>2</sup>/Hz  
 Altitude ..... Up to 13,500 feet  
 100% testing ..... Frequency range  
 Output power  
 Discrete power  
 Spectral purity  
 Phase bursts  
 Alarm and monitors  
 100% screening ..... Temperature cycle/monitor

## OUTLINE DRAWING

### 172526 SLFS SERIES



JST PIN	USE (PARALLEL COMMUNICATIONS)	USE (SERIAL COMMUNICATIONS)
1	DATA bit 1 (LSB)	CLK
2	DATA bit 2	DATA
3	DATA bit 3	LE
4	GND	GND
5	DATA bit 4	N/C
6	ALARM	ALARM
7	Vcc	Vcc

NOTE: DIMENSIONS SHOWN IN BRACKETS [ ] ARE IN MILLIMETERS.

## SPACEBORNE OSCILLATOR PRODUCTS

### Ku-BAND PHASE-LOCKED OSCILLATOR

Features Include:

- Frequency range: 0.1-40 GHz
- Power output: +13 to +27 dBm
- Phase noise [8 GHz]: -115 dBc/Hz @ 100 kHz
- Input reference: 10-200 MHz
- Radiation immunity: 100 Krads
- Life test: 1000 hours



### DUAL OUTPUT Ku-BAND PHASE-LOCKED OSCILLATOR

Features Include:

- Frequency range: 0.1-40 GHz
- Power output: +13 dBm
- Phase noise: -115 dBc/Hz @ 100 kHz
- Input reference: 10-200 MHz
- Radiation immunity: 100 Krads
- Dual output phased-locked oscillator



### FREE-RUNNING OSCILLATOR

Features Include:

- Frequency range: 5-16 GHz
- Power output: +13 to +27 dBm
- Phase noise: [10.4 GHz]: -90 dBc/Hz @ 10 kHz
- Radiation immunity: 100 Krads
- Life test: 1000 hours



## ISO 9001:2000 CERTIFIED

MITEQ attained its original ISO 9001 registration in June 1993, when fewer than 1500 companies were registered. ISO 9001 has since become a recognized standard for quality in over 90 countries. Nationally, it is accepted by an ever-increasing number of government agencies in place of longstanding military specifications covering quality and inspection criteria. Among those are MIL-Q-9858 and MIL-I-45208.



MITEQ's quality system is certified to ISO 9001 by **National Quality Assurance USA (NQA)**, an accredited registrar of the **American National Standards Institute - Registration Accreditation Board (ANSI-RAB)**. NQA performs a quality audit at MITEQ every six months to assure continued compliance to the standard. Additionally, MITEQ's internal auditing system, coupled with regular management reviews, assures that the quality system is effective, updated and constantly improved.

## GENERAL INFORMATION

### PRICING AND TERMS

A quotation on any item in the catalog is available by contacting the factory. All quotations, unless otherwise noted, are valid for 60 days from the date of issue, F.O.B. (FCA) Hauppauge, NY 11788. Pricing does not include customer or government source inspection unless otherwise noted. On international orders, an irrevocable letter of credit may be required. MITEQ accepts these credit cards:



### QUANTITY DISCOUNTS

A quantity discount is generally available on most catalog items. Due to the wide variety of devices in the catalog, it is not possible to provide a standard discount schedule. When quantities are involved, please contact the factory and the appropriate information will be provided.

### SOURCE INSPECTION

Government / customer source inspection is available on any item upon receipt of the complete written confirmation of purchase order items, including the prime government contract number. Source inspection with respect to some products increases the unit price and extends delivery because of duplicate standard final inspection and testing. It is recommended wherever possible that a Certificate of Compliance be substituted for source inspection to minimize price and delivery delays.

### SHIPPING INFORMATION

Unless instructed otherwise by the customer, we will ship UPS in the U.S. F.O.B. (FCA) Hauppauge. Air freight will be used as the primary international means of shipment. Please indicate at time of purchase what method of shipment you require.

### RETURNED MATERIAL

When returning material for repair or replacement, please ensure that there is complete information included with the shipment, giving a detailed description of the reason for its return, the date and purchase order on which it was obtained, and the exact address to which the material is to be reshipped. All returns must arrive freight, postage, duties and handling prepaid.

### REPAIR COSTS

Warranty repairs will be made at no cost to the customer. Units out of warranty, or those which have been mishandled, will require approval by the customer for the charges involved before the repairs can be accomplished. We will provide an estimate for the cost of the repair, which can be applied to the repair, if approval is granted. For those items that are deemed beyond repair, or where the customer may decide not to repair the unit, an evaluation fee and handling charge will be applicable.

### APPLICATION ENGINEERING

We maintain a large support staff of engineers who are experts in specific areas of microwave technology. Each has an engineering background that combines both a formal engineering education with training and experience in product design. As further technical support, we make available the services of our engineering and scientific staff, who may be consulted on more advanced circuit designs or application problems.

### DRAWINGS AND SPECIFICATIONS

The material presented in this catalog was current at the time of publication. MITEQ Inc.'s continuing product improvement program makes it necessary to reserve the right to change our mechanical and electrical specifications without notice. If either of these parameters is critical, please contact the factory to verify that the information is current.



## WARRANTY

1. MITEQ, Inc. warrants to the purchaser that each of its products, when shipped will be free from defects in material and workmanship and will perform in full accordance with applicable specifications. The limit of liability under this warranty is at MITEQ, Inc.'s option to repair or replace any product or part thereof which shall within: (a) three years of delivery for indoor equipment, (b) two years of delivery for outdoor equipment and (c) one year of delivery for integrated assemblies or equipment having RF output powers equal to or greater than +24 dBm, be returned by the purchaser to MITEQ, Inc., at 100 Davids Drive, Hauppauge, New York, 11788, and shall, as determined by examination by MITEQ, Inc., prove defective in material and/or workmanship. Warranty returns must first be authorized in writing by MITEQ, Inc. Disassembly of any MITEQ, Inc. product by anyone other than an authorized representative of MITEQ, Inc. voids this warranty in its entirety. MITEQ, Inc. reserves the right to make changes in any of its products without incurring any obligation to make the same changes on previously delivered products.
2. Components and subsystems having been repaired by MITEQ, Inc. shall be warranted for that repair for ninety (90) days. For products that are still within the original warranty period as described above, the original warranty (if longer) will take precedence. For all SATCOM products, that portion of the system that is repaired, will be warranted for one year.
3. As a condition to the warranties provided for herein, the Buyer will prepay the shipping charges for all products returned to MITEQ, Inc. for repair and MITEQ, Inc. will pay the return shipping with the exception of rack mountable hardware returned from outside the United States in which case the buyer will pay the shipping charges.
4. The buyer will pay the cost of inspecting and testing any goods returned under the warranty or otherwise which are found to meet the applicable specifications or which are not defective or not covered by the warranty.
5. Products sold by MITEQ, Inc. shall not be considered defective or non-conforming to the Buyers' order if they (a) satisfactorily fulfill the performance requirements that were (i) provided by the Buyer to MITEQ, Inc. or (ii) as published in the Sellers' product specification literature, or (b) or in accordance with any written or verbal agreement between the Buyer and MITEQ, Inc., or (c) are in accordance with samples approved by the Buyer. This warranty shall not apply to any products or parts thereof which have been subject to accident, negligence, alteration, abuse or misuse. MITEQ, Inc. makes no warranty whatsoever in respect to accessories or parts not supplied by it.
6. Limitations of Warranty, Damages and Liability

EXCEPT AS EXPRESSLY SET FORTH HEREIN, THERE ARE NO WARRANTIES, CONDITIONS, GUARANTEES OR REPRESENTATIONS AS TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTIES, CONDITIONS, GUARANTEES OR REPRESENTATIONS, WHETHER EXPRESSED OR IMPLIED, IN LAW OR IN FACT, ORAL OR IN WRITING.

MITEQ, INC.'S AGGREGATE LIABILITY IN DAMAGES OR OTHERWISE SHALL NOT EXCEED THE PAYMENT, IF ANY, RECEIVED BY MITEQ, INC. FOR THE UNIT OF PRODUCT OR SERVICE FURNISHED OR TO BE FURNISHED, AS THE CASE MAY BE, WHICH IS THE SUBJECT OF CLAIM OR DISPUTE. IN NO EVENT SHALL MITEQ, INC. BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES, HOWSOEVER CAUSED.

7. All matters regarding this warranty shall be interpreted in accordance with the laws of the State of New York and any controversy that cannot be settled directly shall be settled by arbitration in New York, New York in accordance with the rules then prevailing of the American Arbitration Association, and judgement upon the award rendered may be entered in any court having jurisdiction thereof.
8. As required by Article 10(3) and Article 11(2) of Directive 2002/96/EC (WEEE Directive) of the European Parliament and the Council of the European Union, and in accordance with European Standard EN 50419, MITEQ Inc. labels its products with the following symbol:

This symbol indicates that the product cannot be thrown into the trash, and must be collected and treated in accordance with Directive 2002/96/EC and local regulations.



**MITEQ FEDERAL SUPPLY CODE**

**Our Federal Supply Code is: 33592**





100 Davids Drive • Hauppauge, NY



320 Oser Avenue • Hauppauge, NY



380 Oser Avenue • Hauppauge, NY



330 Oser Avenue • Hauppauge, NY

