# Orbital Research Made for Satellite Oscillators

## Quiet, Stable, Pure and Enduring...!

Sounds like characters from old Hollywood movies. You know, the old strong, silent types. Very much like Orbital's Oscillators built specifically for the Satellite industry. The benefits of extremely low phase noise are, a better carrier to noise ratio, less indeterminacy, and ultimately, a better bit error rate - and Orbital Oscillators are extremely quiet in terms of phase noise, maximizing carrier to noise ratio, and minimizing bit error rate.

We do get questions about the importance of stability, however, so lets unpack the concept a bit.

The four circumstances for defining stability are as follows:
1. Stability at any instant
2. Stability at a given temperature
3. Stability over a range of temperatures
4. Stability over a long period of time

Each unpacks as follows:

1. Instantaneous stability is, of course, phase noise - (which is the most critical metric for low rate burst mode - for instance). At -147 dBc/Hz at 1 KHz offset, MOM (Master Oscillator Module) is unmatched in its price range, and POP at -160 dBc/Hz at 1 KHz offset, is even better.

2. The stability at operating temperature on a second by second basis is extremely good, once the Oscillator has achieved operating temperature - the variation is less than the spec of $1.5 \times 10^{-8}$.
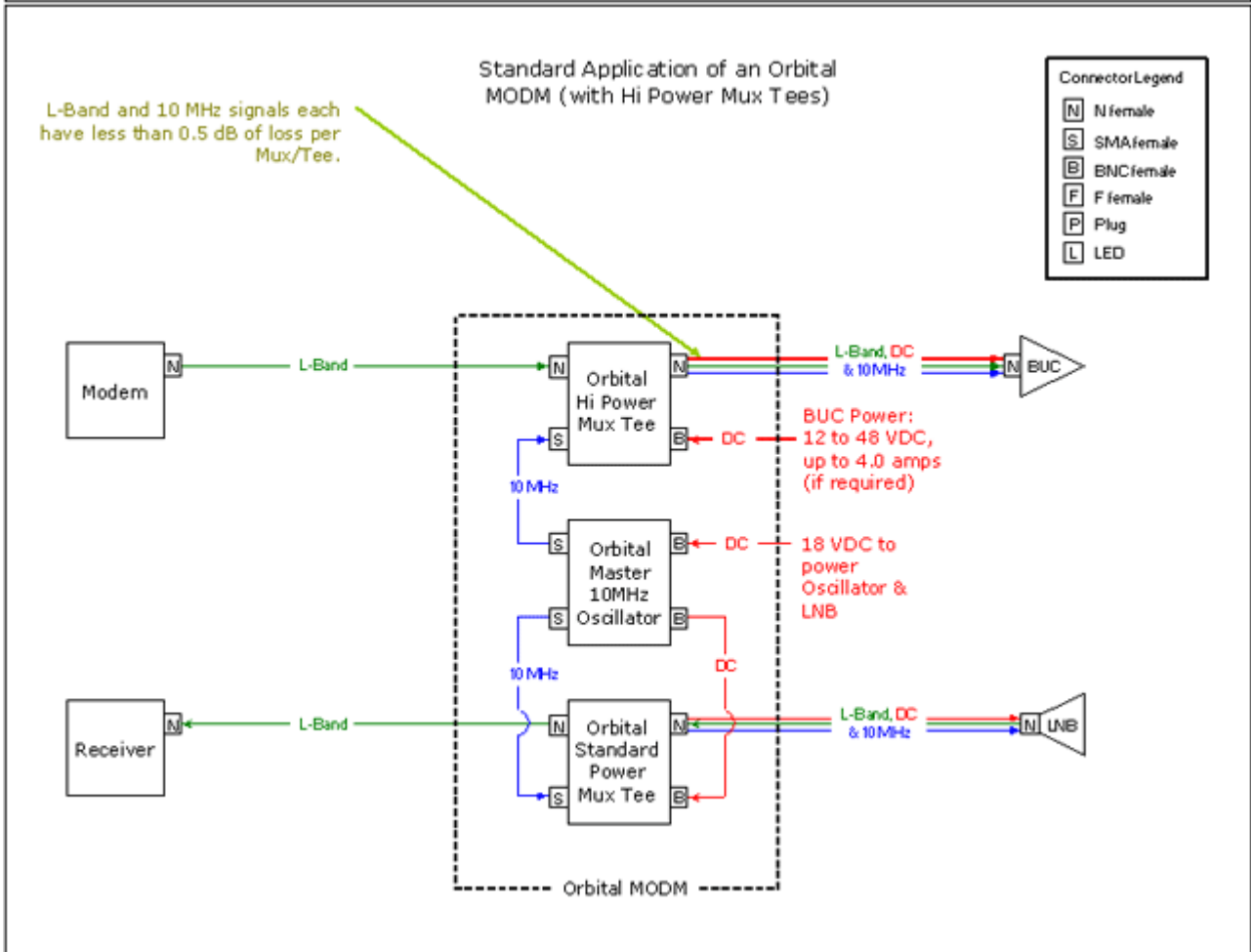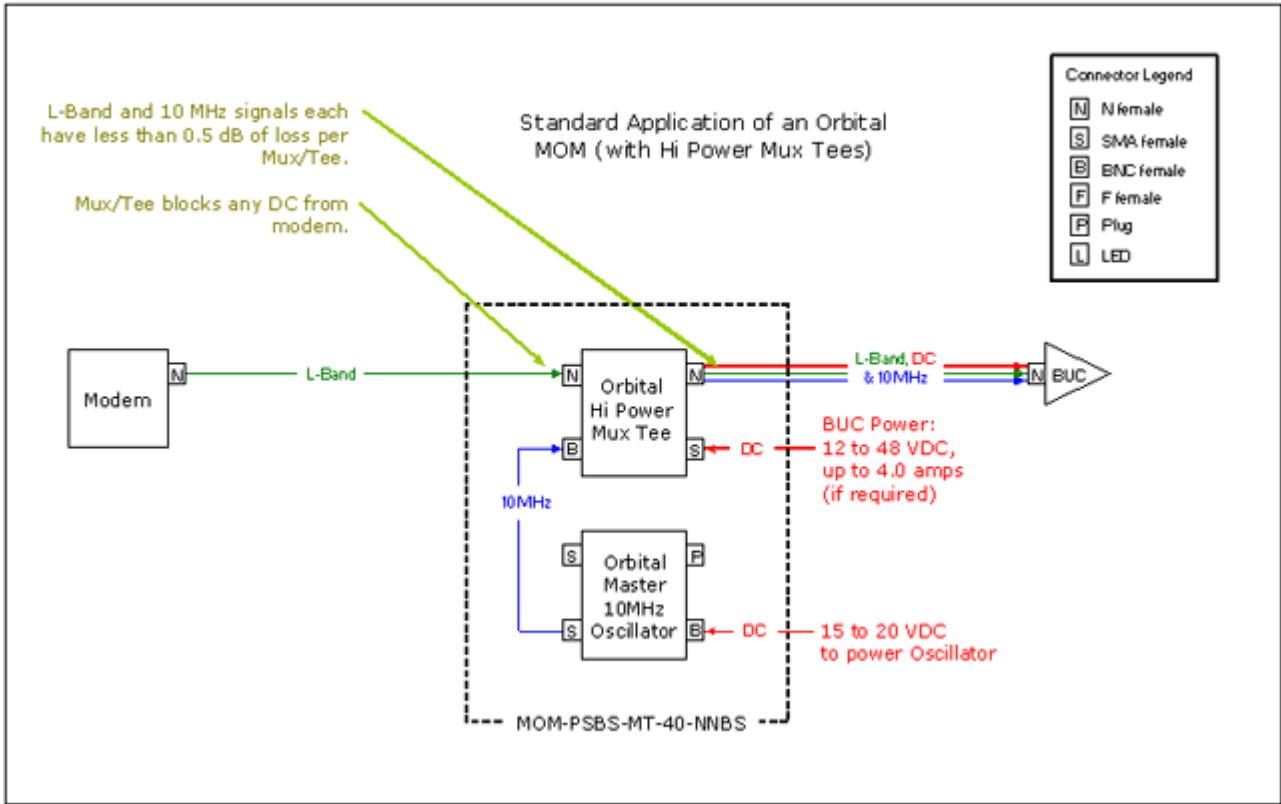
3. Where the oscillator is exposed to the elements, the drift over temperature becomes important. Out MOM units are selected for 0.3 ppm from 0 to 50 degrees C, and are temperature compensated for stability - this drift is very good and occurs slowly over time and over temperature. There is never a sudden jump in stability that would cause a loss of lock or data errors. For applications where this becomes a critical metric, use the POP (Precision Oscillator Package), which features an ovenized oscillator - at 0.05 ppm from 0 to 50 degrees C, it is unbeatable in its price range.
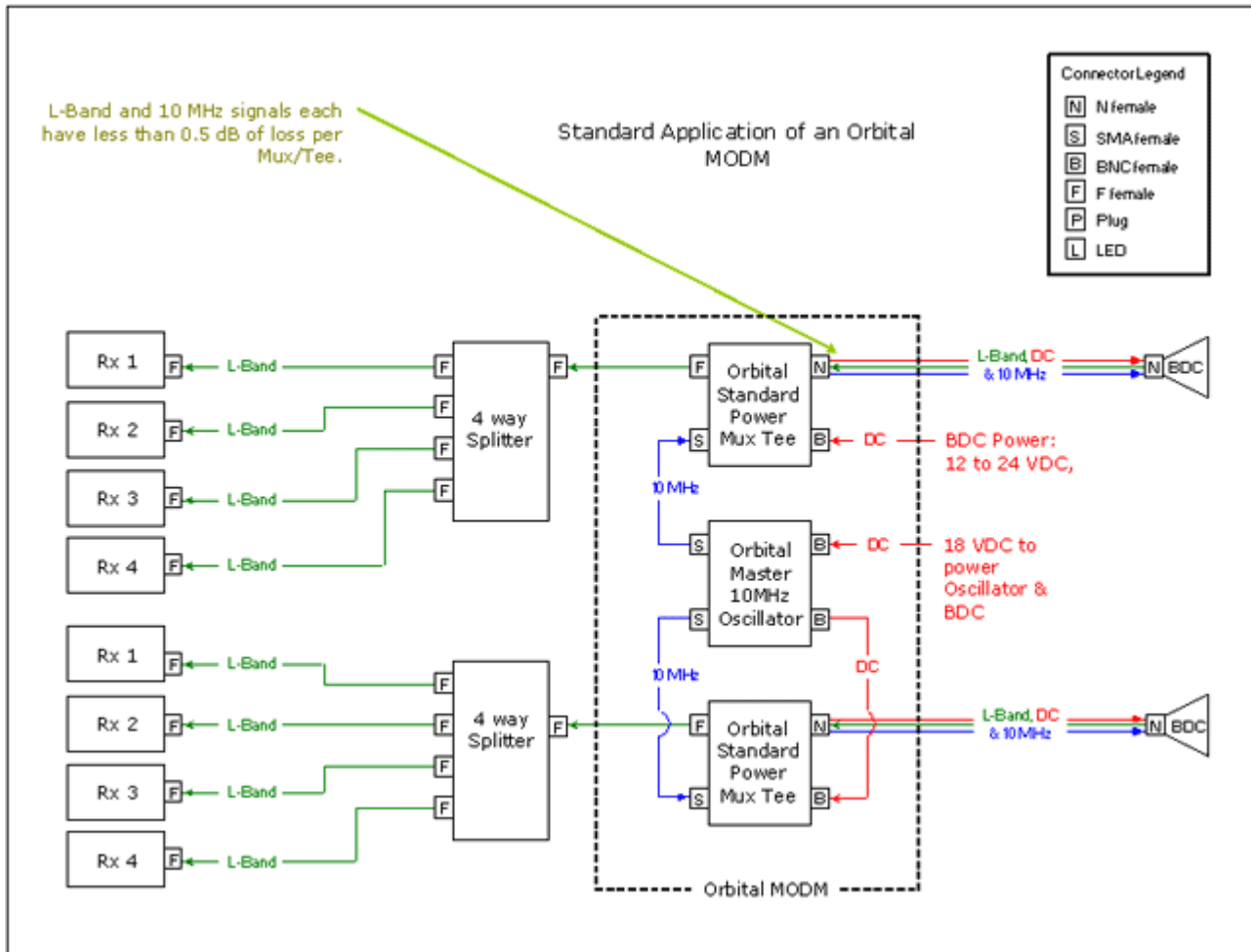
4. Stability over time means that the quartz crystal ages, and in doing so, goes slightly off frequency. All crystals do this, and to mitigate this effect, crystals are aged for a period of time at elevated temperatures to minimize the long term drift. It means that after a year or two, the crystal will be slightly off frequency and can be retuned if a high level of frequency accuracy is required. It does not mean that it changes back and forth in the short or long term. In most applications being a couple of cycles off after a year or two is inconsequential. If a higher magnitude of stability is required, the POP features an ovenized and aged crystal.

In any event, the stability of the TCXO MOM (Master Oscillator Module), will exceed most modem references, and if you need to go better than that, there is always the ovenized, (OCXO), POP (Precision Oscillator Package).
Both Orbital Oscillators possess sine wave purity, and low harmonic content.

As for enduring, both Orbital Oscillators age well - the MOM at $\pm 1 \times 10^{-6}$ per day after 30 days ($\pm 5 \times 10^{-6}$ per year after 180 days), and POP at $\pm 1 \times 10^{-9}$ per day after 30 days ($\pm 10^{-7}$ per year after 180 days).

## 3 Ways to use an Orbital Oscillator ( there are many more! )

Standard Application of an Orbital
MOM (with Hi Power Mux Tees)

L-Band and 10 MHz signals each have less than 0.5 dB of loss per Mux/Tee.

Mux/Tee blocks any DC from modem.

Connector Legend
N  N female
S  SMA female
B  BNC female
F  F female
P  Plug
L  LED

Modem

Orbital Hi Power Mux Tee

Orbital Master 10MHz Oscillator

10MHz

L-Band

L-Band, DC & 10MHz

BUC

DC

BUC Power:
12 to 48 VDC,
up to 4.0 amps
(if required)

DC

15 to 20 VDC
to power Oscillator

MOM-PSBS-MT-40-NNBS

Standard Application of an Orbital
MODM (with Hi Power Mux Tees)

L-Band and 10 MHz signals each have less than 0.5 dB of loss per Mux/Tee.

Connector Legend
N  N female
S  SMA female
B  BNC female
F  F female
P  Plug
L  LED

Modem

Orbital Hi Power Mux Tee

Orbital Master 10MHz Oscillator

Orbital Standard Power Mux Tee

Receiver

L-Band

10 MHz

10 MHz

L-Band

L-Band, DC & 10MHz

BUC

L-Band, DC & 10MHz

LNB

DC

DC

DC

BUC Power:
12 to 48 VDC,
up to 4.0 amps
(if required)

18 VDC to power Oscillator & LNB

Orbital MODM

**Orbital Oscillators** diagram — Standard Application of an Orbital MODM

L-Band and 10 MHz signals each have less than 0.5 dB of loss per Mux/Tee.

Standard Application of an Orbital MODM

ConnectorLegend
- N  N female
- S  SMA female
- B  BNC female
- F  F female
- P  Plug
- L  LED

Rx 1  F — L-Band →
Rx 2  F — L-Band →
Rx 3  F — L-Band →
Rx 4  F — L-Band →

4 way Splitter

F — Orbital Standard Power Mux Tee — N → L-Band, DC & 10 MHz → N BDC
S — 10 MHz / B ← DC   BDC Power: 12 to 24 VDC,

Orbital Master 10MHz Oscillator  S / B ← DC   18 VDC to power Oscillator & BDC

10 MHz  DC

Rx 1  F — L-Band →
Rx 2  F — L-Band →
Rx 3  F — L-Band →
Rx 4  F — L-Band →

4 way Splitter

F — Orbital Standard Power Mux Tee — N → L-Band, DC & 10 MHz → N BDC
S / B

Orbital MODM

## Orbital Oscillators

We build Orbital Oscillators specifically for the satellite industry as stand alone units or integrated with other Orbital SIP (Systems Interface Products), such as the MT25/40 Mux Tee, the DPT – Dual Power Tee, or SP10 – 10 MHz Splitter - providing the 10 MHz source that synchronizes an entire system.  You can lock the signals of your LNB, BDC, BUC, modem, or VSAT to the same precise reference.  Combining a pair of Mux / Tees locks both the horizontal and vertical polarity feeds to the same timebase.

When integrated with other Orbital SIP (Systems Interface Products), the oscillators gain the benefits of those products - such as impedance transforms, low loss insertion, signal multiplexing, DC filtering, etc.

### Functional features:

   - Will operate with LNBs, BDCs, VSATs, BUCs, and Modems
   - Will filter and condition the DC power to eliminate extraneous signals coming in through the power supply

### Structural features:

   - Machined from a solid aluminum billet for strength and stability
   - Allodyne finish for corrosion protection and excellent RF shielding/grounding
   - 'Back O Rack' mounting for ease of installation and lead dress (Reduces the mess of cables at the back of the  rack and provides stability for cables)
   - Connectors are 'O' ring sealed for weather resistant operation

**Master Oscillator (MOS)**
**(TCXO Oscillator)**

**Precision Oscillator(POS)**
**(OCXO Oscillator)**

## Oscillator features:

- Great phase noise: -147 dBc/Hz @ 1 kHz
- Excellent thermal stability: ±1.5 x 10-8, +10 to + 40º C
- Sine wave purity, low harmonic content
- Good aging: ±1 x 10-6 per day after 30 days
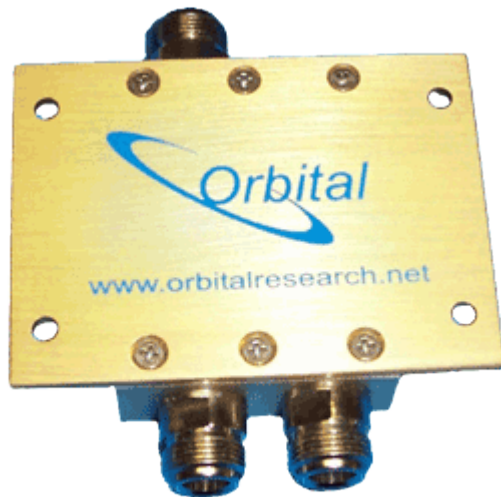
## Ovenized Oscillator features:

- Exceptionally low phase noise: -160 dBc/Hz @ 1 kHz
- Exceptionally low drift: 0.05ppm, 0 to 50ºC
- Exceptionally stable: ±1 x 10-9 per day after 30 days
- High output level for service as master system oscillator
- Sine wave purity, low harmonic content
- Red LED extinguishes when ovenized oscillator reaches stable operating equilibrium



The beauty of Orbital SIPs (Systems Interface Products) is that they are members of an integrated line of independent modules that can work as standalones, together as separate components of a system, or as combined units.

If we integrate an Orbital MT25/40 Mux / Tee (which is a combination Bias Tee/Diplexer/Mux Tee), we add two new configurations to the Orbital 'family' of products...
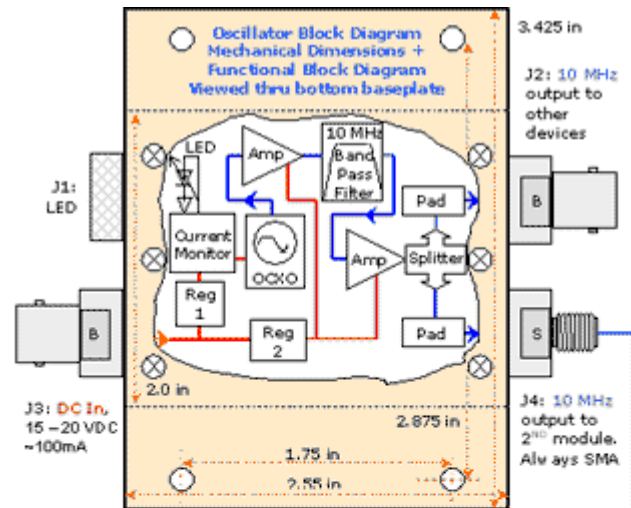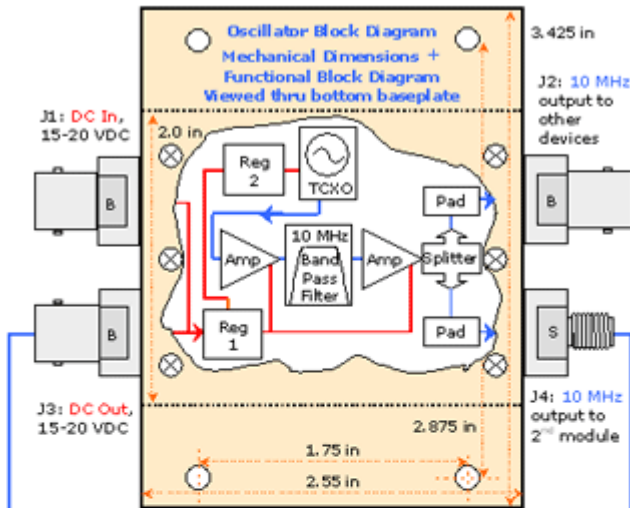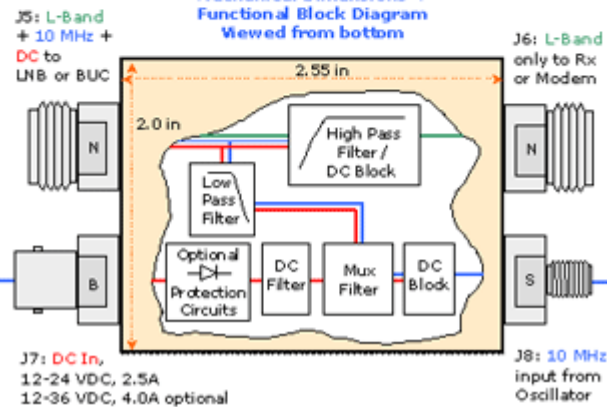
### A MOM
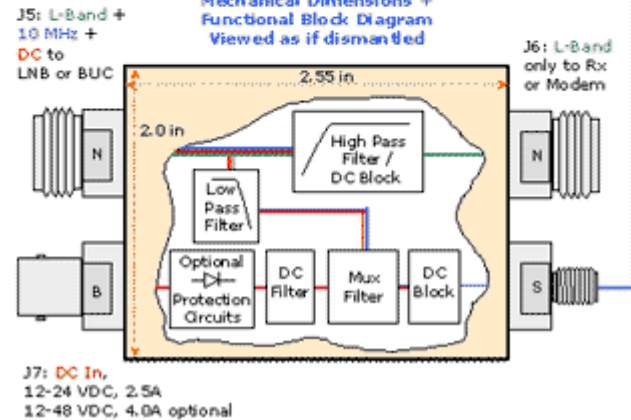(Master Oscillator Module)
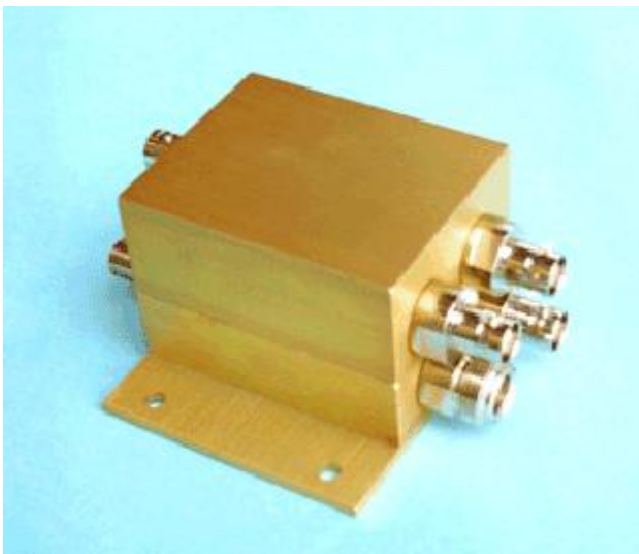
### AND a POP
(Precision Oscillator Package)

**Master Oscillator Module**
**Mechanical Dimensions +**
**Functional Block Diagram**
**Viewed as if dismantled**

Oscillator Block Diagram
Mechanical Dimensions +
Functional Block Diagram
Viewed thru bottom baseplate

3.425 in

J1: DC In,
15-20 VDC

J2: 10 MHz
output to
other
devices

2.0 in

Reg 2
TCXO
Amp
10 MHz Band Pass Filter
Amp
Splitter
Pad
Pad
Reg 1

J3: DC Out,
15-20 VDC

J4: 10 MHz
output to
2ⁿᵈ module

2.875 in

1.75 in

2.55 in

Oscillator Block Diagram
Mechanical Dimensions +
Functional Block Diagram
Viewed thru bottom baseplate

3.425 in

J1:
LED

LED
Amp
10 MHz Band Pass Filter
Current Monitor
OCXO
Amp
Splitter
Pad
Pad
Reg 1
Reg 2

J2: 10 MHz
output to
other
devices

J3: DC In,
15 – 20 VDC
~100mA

2.0 in

1.75 in

2.875 in

2.55 in

J4: 10 MHz
output to
2ⁿᵈ module.
Always SMA

**Mux/Tee Block Diagram**
**Mechanical Dimensions +**
**Functional Block Diagram**
**Viewed from bottom**

J5: L-Band
+ 10 MHz +
DC to
LNB or BUC

2.55 in

2.0 in

High Pass Filter / DC Block
Low Pass Filter
Optional Protection Circuits
DC Filter
Mux Filter
DC Block

J6: L-Band
only to Rx
or Modem

J7: DC In,
12-24 VDC, 2.5A
12-36 VDC, 4.0A optional

J8: 10 MHz
input from
Oscillator

**Mux/Tee Block Diagram**
**Mechanical Dimensions +**
**Functional Block Diagram**
**Viewed as if dismantled**

J5: L-Band +
10 MHz +
DC to
LNB or BUC

2.55 in

2.0 in

High Pass Filter / DC Block
Low Pass Filter
Optional Protection Circuits
DC Filter
Mux Filter
DC Block

J6: L-Band
only to Rx
or Modem

J7: DC In,
12-24 VDC, 2.5A
12-48 VDC, 4.0A optional

Or we could add an additional SIP module ( an MT25/40 Mux Tee, in this case ) to make, for instance, an MODM (Master Oscillator Dual Modules) - that locks both the horizontal and vertical polarity feeds to the same timebase...
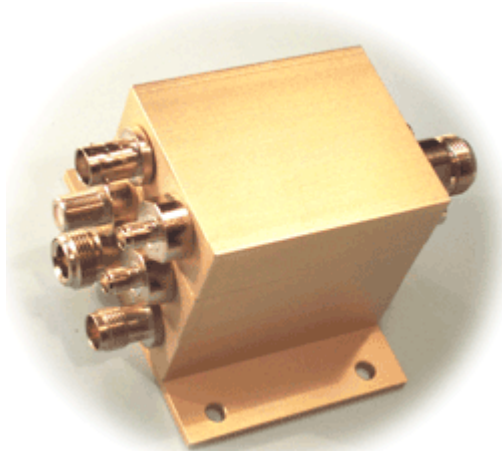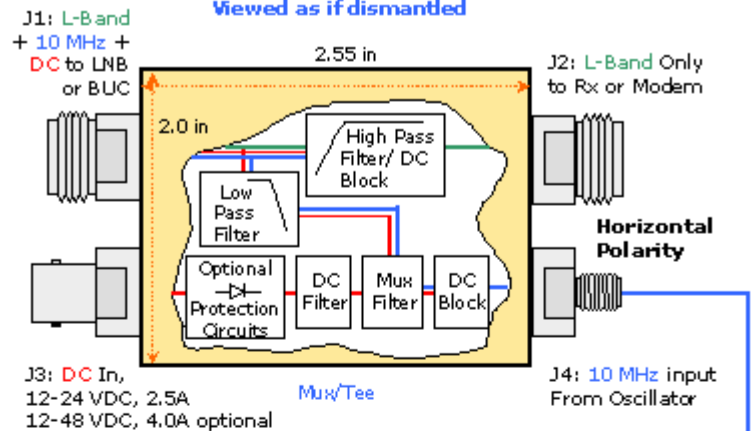
Now an MODM uses a MOS Oscillator, but a Precision Oscillator could just have easily been used in this configuration, then the devise would be a PODM, a Precision Oscillator Dual Modules. The Orbital MT25/40, that works as a Bias Tee, Diplexer or Mux Tee, could just as easily have been used to provide a 10 MHz reference to an LNB and a receiver, or to a BUC and a modem.

Alternatively, an SP10 – 10 MHz Splitter could have been used to provide a reference to several devices, and a DPT could have been employed to provide dual redundant power supplies to the Oscillator.

All of these devices can not only be used 'Back O Rack', where they save on valuable rack space, but also, because they are weather sealed – in enclosures at the dish. An increasing number of our largest clients prefer this method of system integration.



MODM Block Diagram
Mechanical Dimensions +
Functional Block Diagram
Viewed as if dismantled

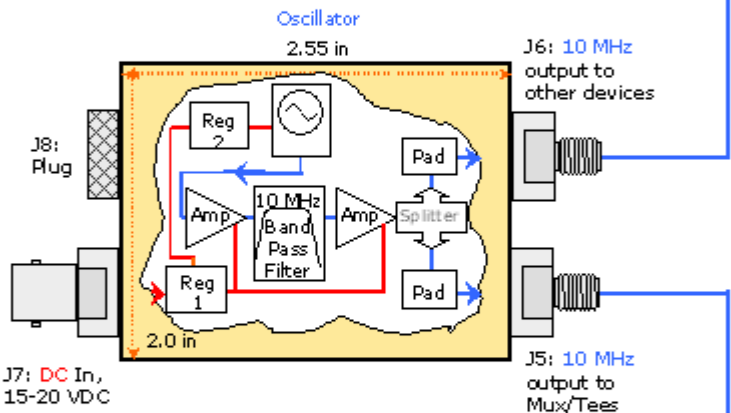J1: L-Band + 10 MHz + DC to LNB or BUC

J2: L-Band Only to Rx or Modem

2.55 in
2.0 in

High Pass Filter/ DC Block
Low Pass Filter
Optional Protection Circuits
DC Filter
Mux Filter
DC Block

Horizontal Polarity

J3: DC In, 12-24 VDC, 2.5A 12-48 VDC, 4.0A optional

Mux/Tee

J4: 10 MHz input From Oscillator

Oscillator
2.55 in

J6: 10 MHz output to other devices

J8: Plug

Reg 2
Amp
10 MHz Band Pass Filter
Amp
Pad
Splitter
Reg 1
Pad

2.0 in

J7: DC In, 15-20 VDC

J5: 10 MHz output to Mux/Tees
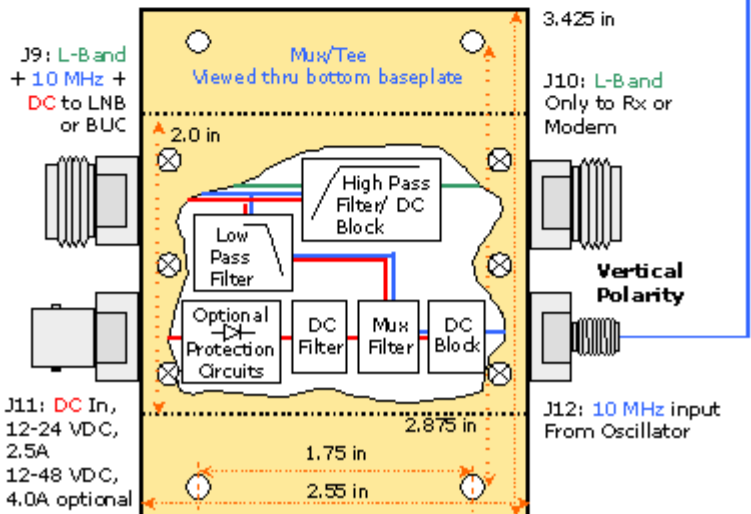
J9: L-Band + 10 MHz + DC to LNB or BUC

Mux/Tee
Viewed thru bottom baseplate

3.425 in

J10: L-Band Only to Rx or Modem

2.0 in

High Pass Filter/ DC Block
Low Pass Filter
Optional Protection Circuits
DC Filter
Mux Filter
DC Block

Vertical Polarity

J11: DC In, 12-24 VDC, 2.5A 12-48 VDC, 4.0A optional

2.875 in
1.75 in
2.55 in

J12: 10 MHz input From Oscillator

## Master Oscillator:

**Specifications**

Frequency:   10 MHz
Level:       +3 dBm
Stability:   ±1.5 x10-7, +10 to +40ºC
Aging:       ±1 x 10-6, per day after 30 days
             ±5 x 10-6, per day after 180 days
Phase Noise: 100Hz    -130 dBc/Hz
             1kHz     -147 dBc/Hz
             10kHz    -148 dBc/Hz
             100kHz   -148 dBc/Hz

## Precision Oscillator:

**Specifications**

Frequency:   10 MHz
Level:       +10 dBm
Stability:   ±5 x10-8, + 0 to +50ºC
Aging:       ±1 x 10-9, per day after 30 days
             ±5 x 10-7, per year after 180 days
Phase Noise: 10Hz     -120 dBc/Hz
             100Hz    -145 dBc/Hz
             1kHz     -160 dBc/Hz
             10kHz    -165 dBc/Hz
             100kHz   -165 dBc/Hz

## Contact Orbital Research at:

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