



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 1.5×10^{-8} .

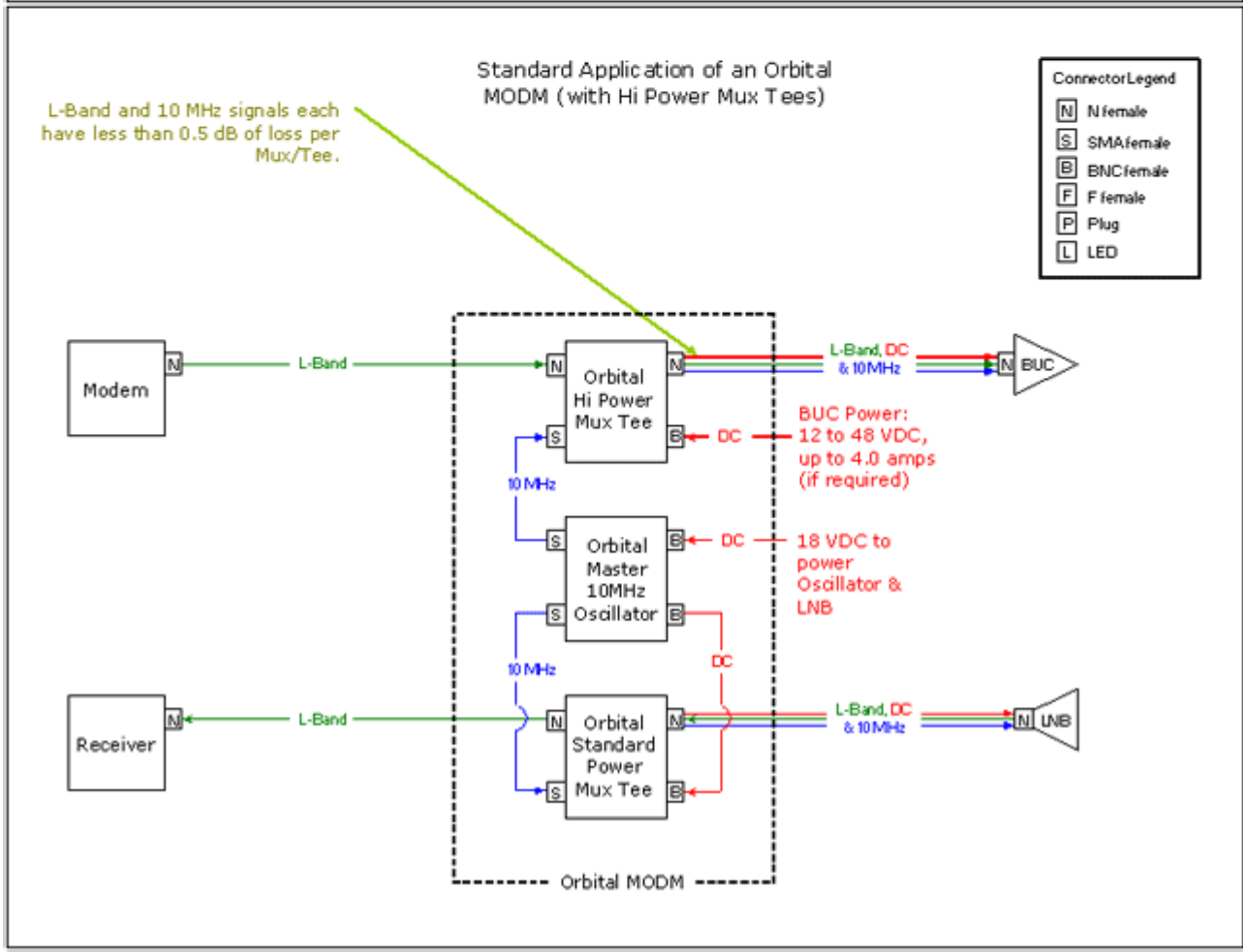
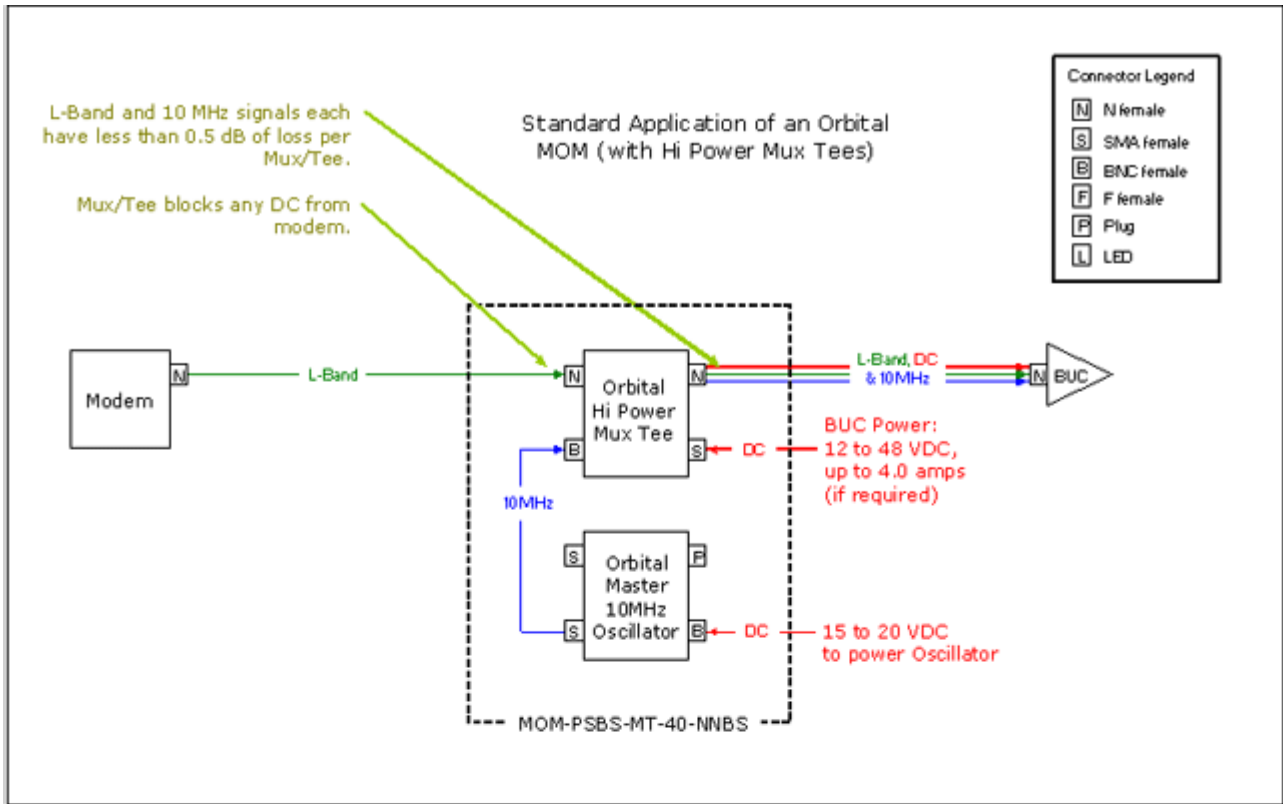
3. Where the oscillator is exposed to the elements, the drift over temperature becomes important. Our MOM units are selected for 0.3 ppm from 0 to 50 degrees C, and are temperature compensated for stability - this drift is very good and occurs slowly over time and over temperature. There is never a sudden 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.

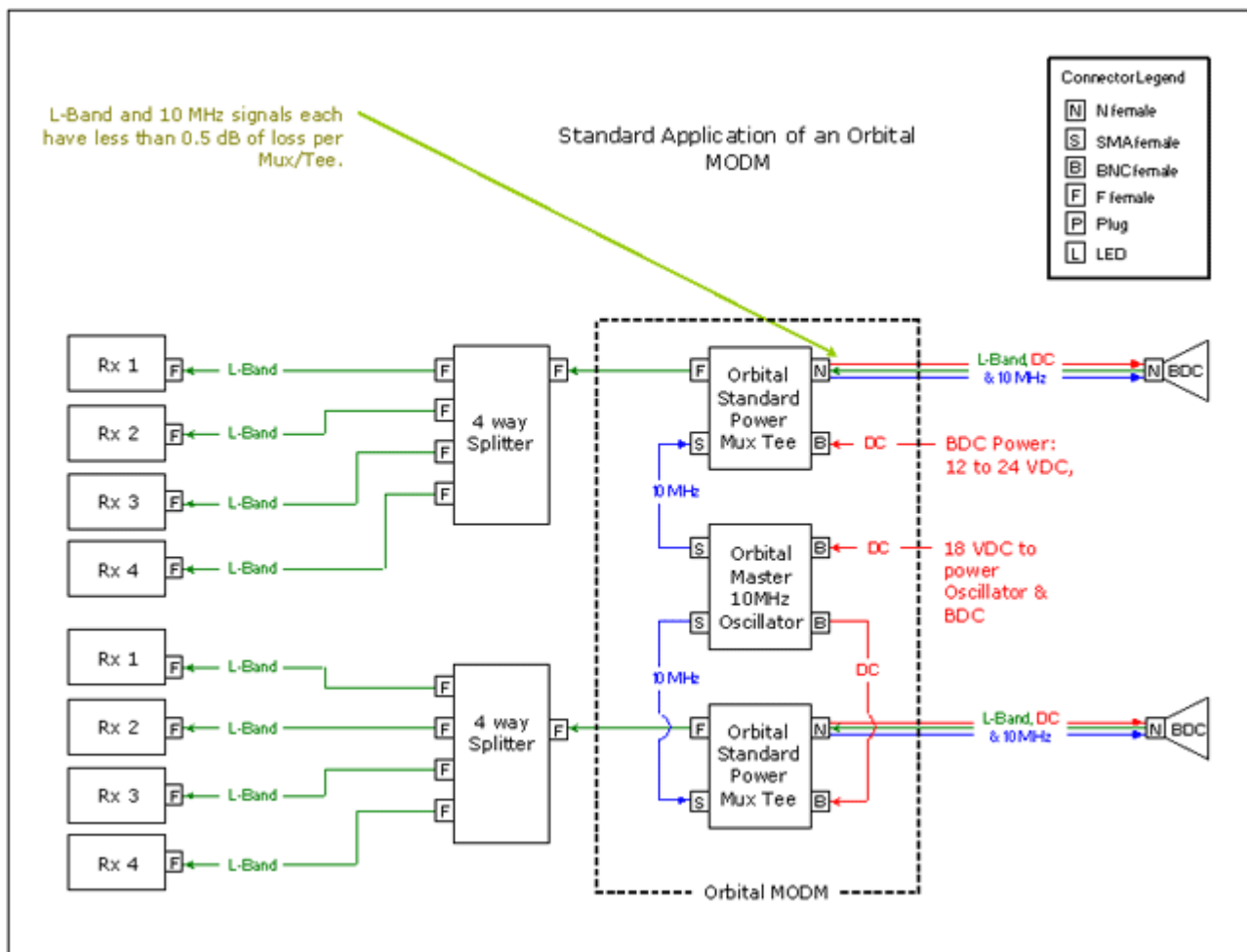
4. Stability over time means that the quartz crystal ages, and in doing so, goes slightly off frequency. All crystals do this, and to mitigate this effect, crystals are aged for a period of time at elevated temperatures to minimize the long term drift. It means that after a year or two, the crystal will 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!)





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:

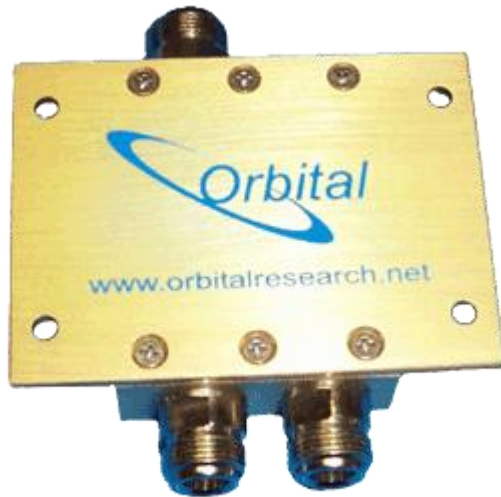
- Machined from a solid aluminum billet for strength and stability
- Allodyne finish for corrosion protection and excellent RF shielding/grounding
- 'Back O Rack' mounting for ease of installation and lead dress (Reduces the mess of cables at the back of the rack and provides stability for cables)
-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

Master Oscillator (MOS)
(TCXO Oscillator)

Precision Oscillator(POS)
(OCXO Oscillator)

Oscillator features:

- Great phase noise: $-147 \text{ dBc/Hz @ 1 kHz}$
- Excellent thermal stability: $\pm 1.5 \times 10^{-8}$, $+10$ to $+ 40^\circ \text{ C}$
- Sine wave purity, low harmonic content
- Good aging: $\pm 1 \times 10^{-6}$ per day after 30 days



Ovenized Oscillator features:

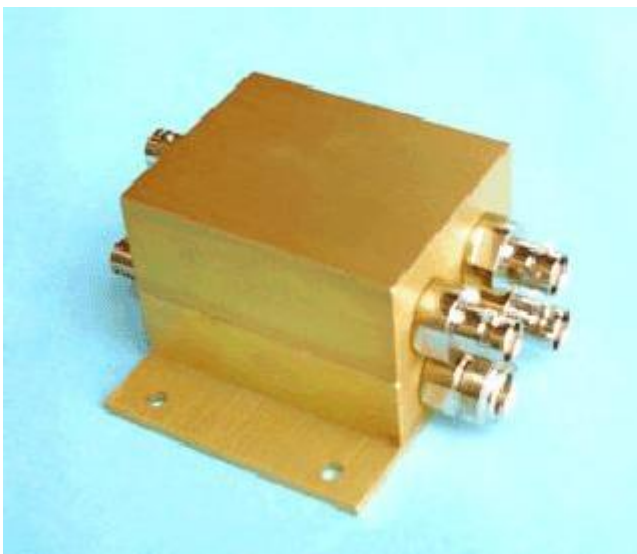
- Exceptionally low phase noise: $-160 \text{ dBc/Hz @ 1 kHz}$
- Exceptionally low drift: 0.05 ppm , 0 to 50° C
- Exceptionally stable: $\pm 1 \times 10^{-9}$ per day after 30 days
- High output level for service as master system oscillator
- Sine wave purity, low harmonic content
- Red LED extinguishes 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...

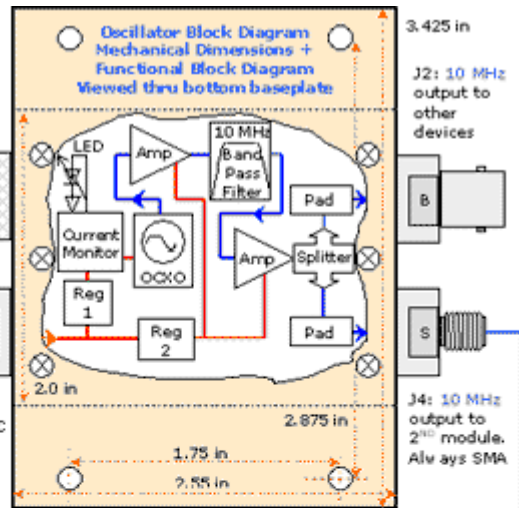
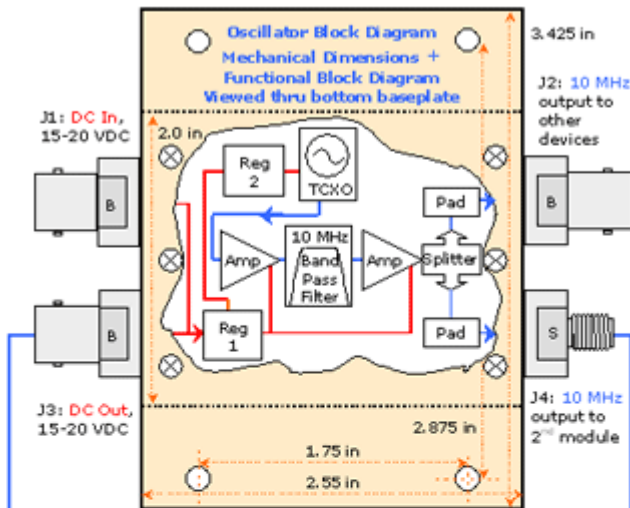
A MOM
(Master Oscillator Module)



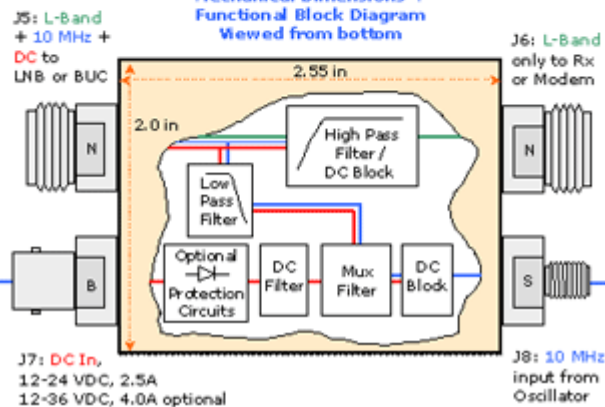
AND a POP
(Precision Oscillator Package)



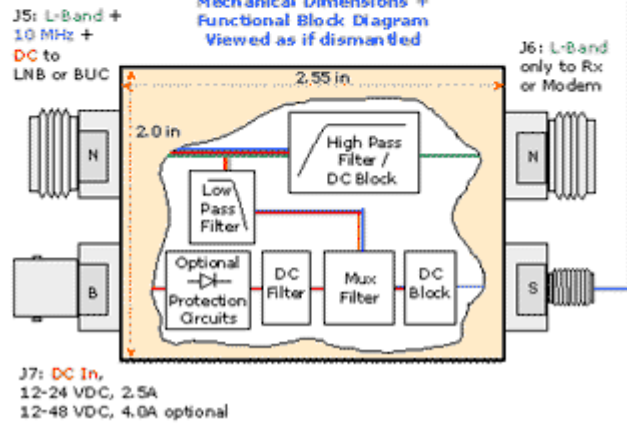
Master Oscillator Module
Mechanical Dimensions +
Functional Block Diagram
Viewed as if dismantled



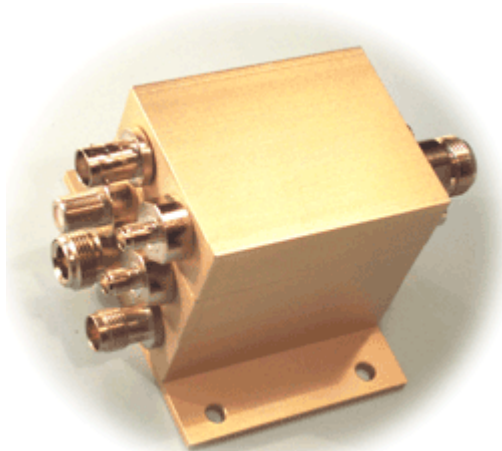
Mux/Tee Block Diagram
Mechanical Dimensions +
Functional Block Diagram
Viewed from bottom



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



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...

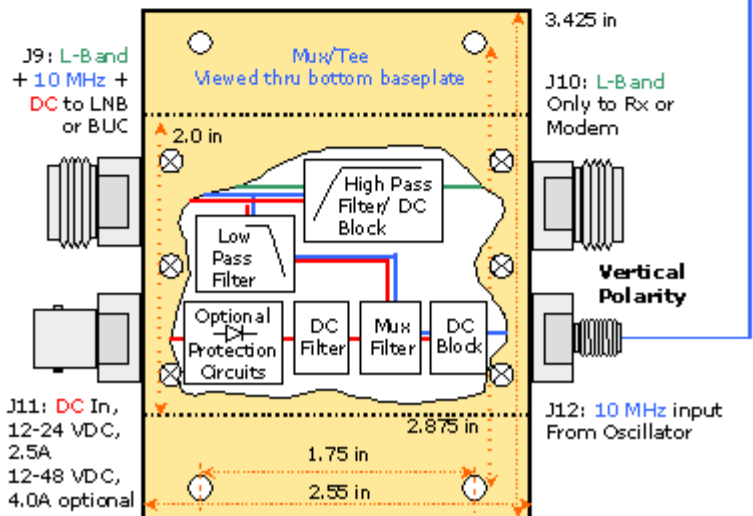
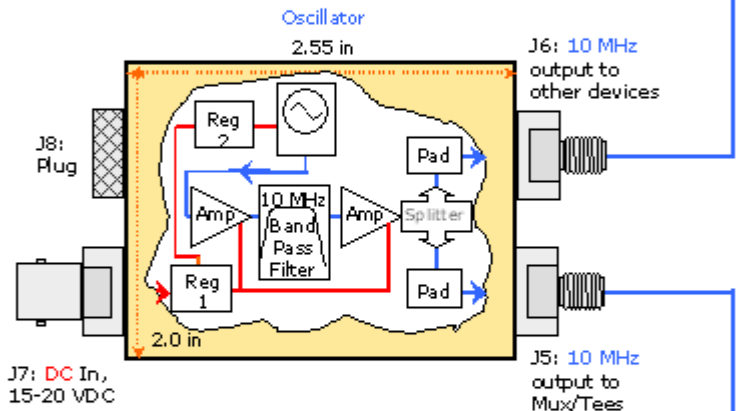
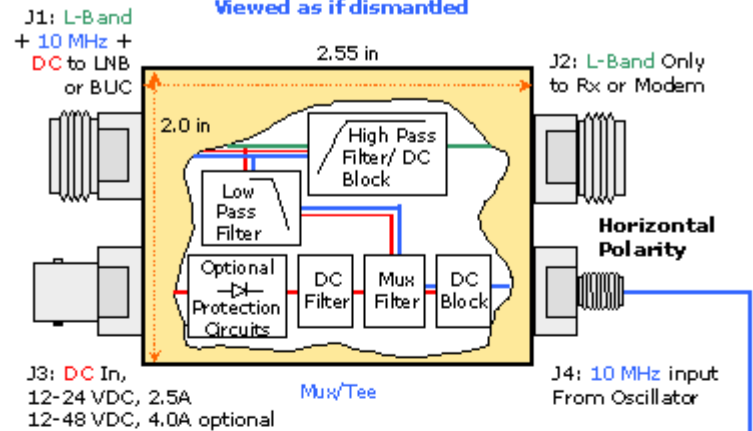


Now an MODM uses a MOS Oscillator, but a Precision Oscillator could just have easily been used in this configuration, then the device would be a PODM, a Precision Oscillator Dual Modules. The Orbital MT25/40, that works as a Bias Tee, Diplexer or Mux Tee, could just as easily have been used to provide 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**



Master Oscillator:**Specifications**

Frequency: 10 MHz
Level: +3 dBm
Stability: $\pm 1.5 \times 10^{-7}$, +10 to +40°C
Aging: $\pm 1 \times 10^{-6}$, per day after 30 days
 $\pm 5 \times 10^{-6}$, 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: $\pm 5 \times 10^{-8}$, + 0 to +50°C
Aging: $\pm 1 \times 10^{-9}$, per day after 30 days
 $\pm 5 \times 10^{-7}$, 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

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