

# Maury Microwave Oscillator Solutions

Low phase noise, low jitter, and high frequency stability are critical to the performance of modern radar, communications networks, high-speed clocks, and RF/microwave systems. Maury Microwave provides solutions throughout oscillator development, from accurate phase-noise characterization to clean signal generation, high-fidelity clock generation, and LO substitution for system-level validation.

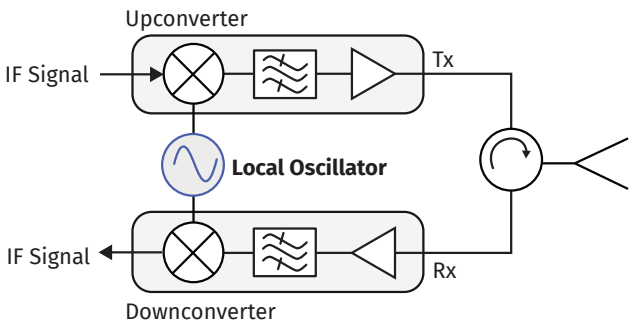
## Oscillator Applications Requiring Multi-channel RF Synthesizers

| Application                          | Description                                                                                                                                                                         |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Quantum Computing                    | Multi-channel phase-coherent RF synthesizers provide microwave control signals used to address and coordinate multiple qubits independently.                                        |
| Beamforming                          | Relative phase and amplitude of individual channels are adjusted to focus or steer the transmitted or received beam.                                                                |
| Direction Finding                    | Phase and/or timing measurements between antennas are used to determine the direction of arrival of a signal.                                                                       |
| Phase-Stable Oscillator Substitution | Phase-stable, frequency-coherent LOs help keep phase relationships predictable as signals move between intermediate-frequency and RF bands in multi-stage up/downconverter systems. |
| Coherent Combining                   | Multiple transmitter, receiver, or antenna-channel outputs are combined while controlling their relative phases.                                                                    |
| Multi-Channel Measurement            | RF paths or devices are compared without ambiguity from independently drifting sources.                                                                                             |
| MIMO and Channel Sounding            | Test channels are kept synchronized so that phase and channel relationships remain meaningful.                                                                                      |
| High-Speed Digital Tests             | RF clock and sampling events are phase-aligned across multiple ADC/DAC channels.                                                                                                    |

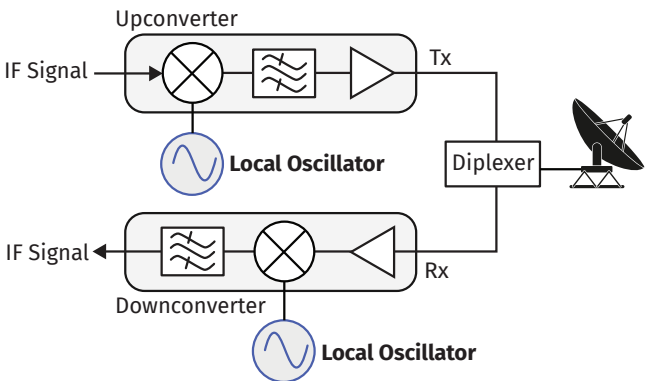
## Local Oscillator Substitution

LOs are critical to up/downconversion chains in radar and satellite communications systems. Low phase noise improves radar target detection and helps minimize symbol and bit errors in satellite communications, while fast frequency switching supports frequency-agile radar and improves test throughput for satcom applications. Maury signal generation solutions provide the low phase noise and fast frequency switching needed for LO substitution, allowing engineers to replace the system LO with a high-performance source to troubleshoot LO-related issues, evaluate system performance, or continue testing when the system LO is unavailable.

### LOs in Radar Systems



### LOs in Satellite Communications Systems



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## HSM Series

The HSM Series RF synthesizer modules are microwave CW sources that are architected on a non-PLL based platform. The digital-analog hybrid design enables low phase noise performance and fast frequency switching.

- > High amplitude accuracy
- > Agile frequency switching speeds
- > 1, 2, 3, 4, 6, 12, 18 GHz modules
- > 18 GHz Phase Noise: -106 dBc/Hz 10 kHz offset (typ)
- > Output power range: -50 dBm to +18 dBm



## HS9100 Series

Providing low phase noise, fast switching, and high channel-to-channel stability, the HS9100 Series supports up to 8 independently controllable, phase-coherent channels.

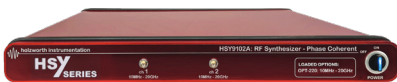
- > Up to 8 independently controlled phase coherent channels
- > Mix or match 1, 2, 3, 4, 6, 12, and 18 GHz channels
- > Compact 1U form factor
- > 18 GHz Phase Noise: -106 dBc/Hz 10 kHz offset
- > Output power range: -50 dBm to +18 dBm
- > 16 channel narrowband configuration available



## HSX9100 Series

The HSX9100 Series multi-channel RF synthesizers provide exceptional phase noise and spectral purity across up to 4 independently tunable, phase-coherent channels.

- > Up to 4 independently controlled, phase-coherent channels
- > Mix or match 3, 6, 12, 20, and 40 GHz channels
- > Compact 1U form factor
- > 40 GHz Phase Noise: -110 dBc/Hz 10 kHz offset (typ)
- > Ultra low phase noise (ULN) option available
- > Output power range: -110 dBm to +18 dBm



## HSY9100 Series

With up to 2 independently tunable channels, the HSY9100 Series multi-channel RF synthesizers provide industry-leading phase noise and spectral purity performance.

- > Up to 2 independently controlled phase coherent channels
- > Mix or match 3, 6, 12, and 20 GHz channels
- > Compact 1U form factor
- > 20 GHz Phase Noise: -118 dBc/Hz 10 kHz offset (typ)
- > Ultra low phase noise (ULN) option available
- > Output power range: -110 dBm to +18 dBm

# Maury Microwave Oscillator Solutions



## SGX1000 Series

The SGX1000 RF signal generator combines a compact, easy-to-use design with ultra-fine frequency resolution, fast switching, ultra-low phase noise and jitter, and high reliability.

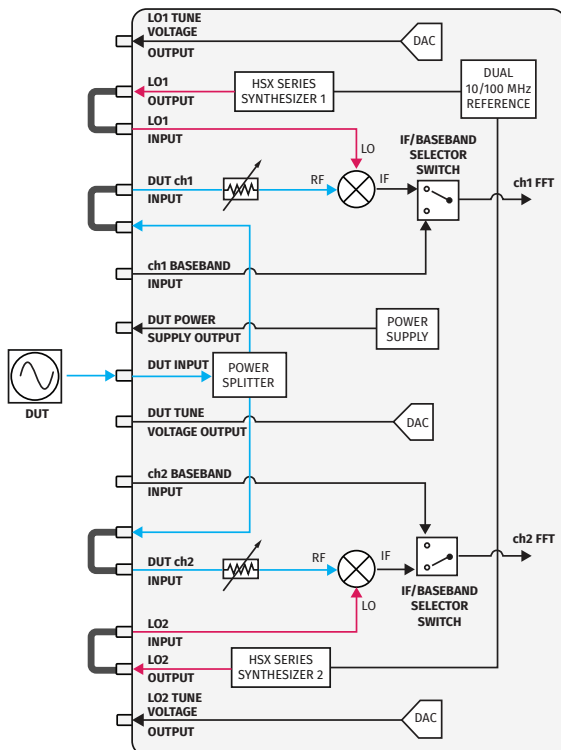
- > Frequency range: 10 MHz to 18 GHz
- > Output power range:  
-50 dBm to +18 dBm
- > Ultra-low jitter: 60 fs (typ)
- > 10/100 MHz reference input
- > Multi-touch, touchscreen
- > Lightning-fast switching speed:  
350  $\mu$ s (typ)
- > Ultra-low phase noise (3 GHz,  
10 kHz offset) -122 dBc/Hz (typ)
- > Excellent amplitude accuracy (as  
low as -40 dBm): +/-0.5 dB (typ)

## Measuring Oscillator Phase Noise

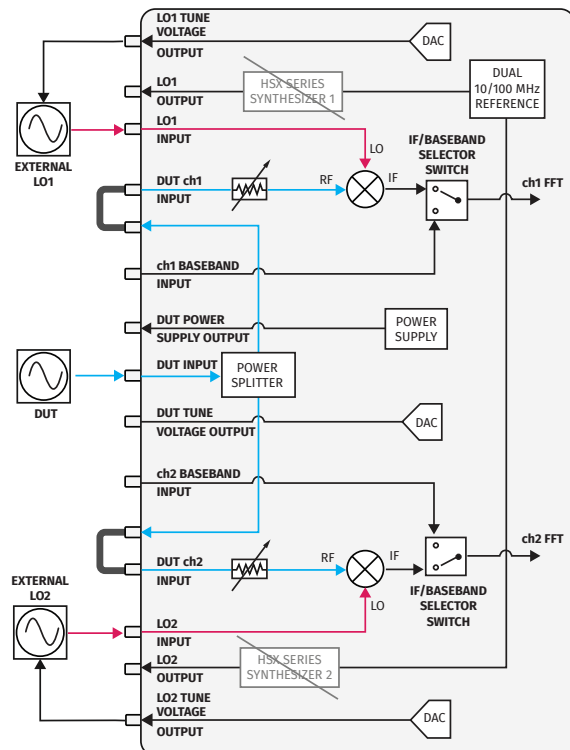
Designers and manufacturers of high-performance oscillators are pushing phase noise to increasingly lower levels, placing greater demands on phase noise measurement systems. Accurate characterization of ultra-low-phase-noise oscillators requires both a sufficiently low measurement floor and fast acquisition speeds for R&D and production test.

Maury real-time phase noise analyzers combine high measurement accuracy, speed, and configurability to characterize oscillator phase noise by comparing the DUT to the analyzer's internal low-phase-noise LOs. For ultra-low-phase-noise oscillators that outperform the internal LOs, higher-performance external sources can be used for accurate characterization.

### Absolute Measurement using Internal LOs



### Absolute Measurement using External LOs



# Maury Microwave Oscillator Solutions

## Cross Correlation

Maury real-time phase noise analyzers use cross correlation to improve phase noise measurement sensitivity by reducing the analyzer's phase noise from the final SSB trace, leaving the true phase noise of the DUT. The DUT signal is divided into two paths and mixed down to baseband using two independent LO signals by a pair of double-balanced mixers. The DUT phase noise is common to both mixers, while the phase noise from each LO is uncorrelated. Each 100X increase in the number of cross correlations reduces the phase noise contribution of the analyzer by 10 dB until reaching the noise floor of the instrument.



### HA7162C & HA7162D Series

The HA7162C and HA7162D real-time phase noise analyzers offer a unique combination of accuracy, speed, flexibility and reliability in a compact form factor. Control is easy through an intuitive GUI or simple remote commands. This makes them ideal for use in the lab and production phase-coherent channels.

- > DUT input:
  - HA7162C: 10 MHz to 6 GHz
  - HA7162D: 10 MHz to 26 GHz, option to 40 GHz
- > Automated absolute and additive (residual) measurements
- > Measure: PM/AM/baseband/spurious/jitter
- > Measurement bandwidth:
  - HA7162C: 0.1 Hz to 40 MHz
  - HA7162D: 0.1 Hz to 100 MHz
- > Only analyzers available that allow actual noise floor measurements
- > Extremely fast measurement speeds
- > Real-time cross correlation

### HA7163A Series

Designed for seamless integration with the HA7162C or HA7162D real-time phase noise analyzers, the HA7163A is a heterodyne downconversion system that provides calibrated frequency extension. It enables both absolute and additive (residual) phase noise measurements to 50 GHz without the need for external mixers phase-coherent channels.

- > Real-time full bandwidth data acquisition
- > Outstanding accuracy
- > Measure: PM/AM/baseband/spurious/jitter
- > Isolated AM/PMt
- > Versatile, reconfigurable front end
- > Automated residual measurements

## Which Solution is Right for You?



| Customer Need                         | Solution            |
|---------------------------------------|---------------------|
| Measure Oscillator Phase Noise        | HA7162C/D           |
| Phase Noise Measurements to 50 GHz    | HA7162C/D + HA7163A |
| Ultra-Low-Noise External Reference/LO | HSX/HSY             |
| Multiple Phase-Coherent LOs           | HSX/HSY/HS9100      |
| Embedded/OEM LO                       | HSM                 |
| Standalone Benchtop RF Source         | SGX1000             |
| High-Speed Digital Test Clock Source  | HSX/HSY/HS9100      |

