
# Compact, Multi-Channel, Phase-Coherent, 22 GHz Frequency Synthesizer

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AnaPico Switzerland has released a compact frequency synthesizer that generates accurate and stable frequencies from 100 kHz to 22 GHz. The unique feature of the APMSYN22 synthesizer is that multiple units can be daisy-chained to implement phase-coherent and multi-channel sources for various applications. The unit is easy to use and, because of its small size, can be integrated into RF/microwave systems in various forms and layouts.

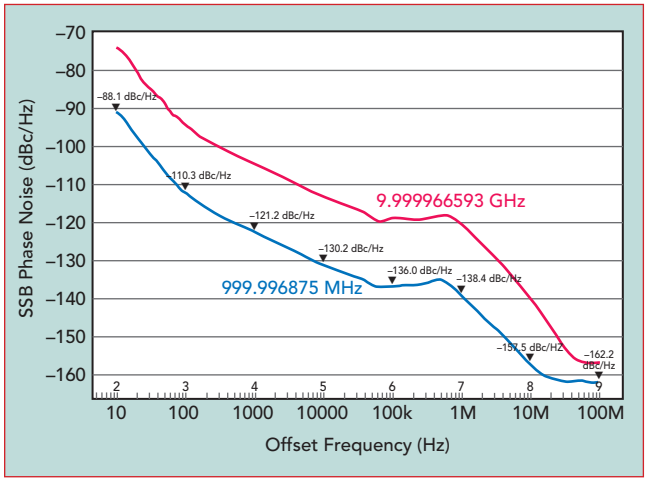



Fig. 1 **SSB phase noise measurement.**

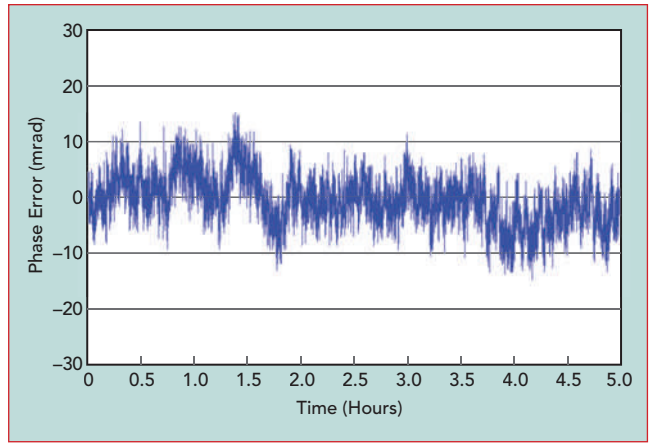
## SINGLE-CHANNEL PERFORMANCE

Covering 100 kHz to 22 GHz, the frequency setting resolution is 10 mHz using the graphical control software and higher using SCPI commands. Switching time between frequencies is just 5 µs. Its built-in, precise OCXO provides a calibrated frequency accuracy of ±30 ppb with ±0.5 ppm aging during the first year.

The APMSYN22 has adjustable output power from -40 to +25 dBm, accurate to ±1.5 dB, and a power setting resolution of 0.5 dB. The output phase can be adjusted over the entire range of 0 to 360 degrees, with a resolution of 0.1 degree. The phase noise of the synthesizer at a 20 kHz offset from a 1 GHz carrier is -132 dBc/Hz; at 100 Hz offset, it is -110 dBc/Hz. ***Figure 1*** compares the measured single-sideband (SSB) phase noise at 1 and 10 GHz. Subharmonics

and spurious signals are less than -55 dBc.

In addition to providing a CW signal, the APMSYN22 supports pulse modulation, either internally programmable or externally triggerable. The maximum modulation rate is 10 MHz and narrowest pulse width is 30 ns. A high speed triggered parameter sweeping function with flexible sweeping profiles is available with the shortest step time of 5 µs.




▲ Fig. 2 **Time stability of channel-to-channel phase difference, with both channels set to 5 GHz.**

The synthesizer is well-shielded in a compact flange-mountable module measuring 134 × 95 × 25 mm. It weighs under 0.5 kg and consumes only 17 W, which enables it to use passive heat sinking, with easy and flexible mounting to a heat sink. Internal temperature monitoring is available to prevent the synthesizer from exceeding the recommended operating temperature range; if that occurs, the RF output stage will turn off.

The synthesizer has a standard Ethernet port for connecting to a PC and controlling the unit with AnaPico's graphical interface software or using SCPI commands.

## MULTI-CHANNEL AND PHASE-COHERENT

The synthesizer supports an external reference, both 100 MHz and 1 GHz with a relatively wide frequency lock range of ±10 ppm, and it provides a 1 GHz reference output. Using this reference output, multiple units can be connected to implement phase-coherent sources. The first unit acts as the reference, with its 1 GHz reference frequency looped through the other units. To reduce cost, the APMSYN22 modules can be ordered without the internal OCXO when planned to be used with other APMSYN22 modules or an external reference.

Phase-coherence can be characterized by the relative phase difference variation between channels set to the same frequency. ***Figure 2*** shows the phase-coherence measurement with two APMSYN22 modules daisy-chained in a phase-coherent configuration, with both set to 5 GHz. The relative phase difference variation measured in a non-airconditioned room is about ±0.5 degree over 10 hours.

The synthesizer uses a low noise amplifier between the 1 GHz reference input and output. The additive phase noise of the amplifier is low and does not appreciably degrade the phase noise, enabling up to at least 16 channels to be configured as phase-coherent sources.

## APPLICATIONS

The APMSYN22 synthesizer is suitable for many applications. It can be used as an RF/microwave system clock, particularly when multi-channel, phase-coherent local oscillators are needed. The individual channel phase adjustment enables accurate timing alignment. The multi-channel, phase-coherent configuration is useful for design and testing of radar receivers, phased array beamforming networks, quantum computing instrumentation (as the RF local oscillators for the I/Q modulators), MIMO receivers and as sources in heterodyne spectroscopic systems. Also, the combination of phase-coherence and fast switching supports fast frequency hopping for agile electronic warfare systems.

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