



AnaPico Products for Quantum Computing Applications

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Content

1. About AnaPico Switzerland
2. AnaPico Product Portfolio
3. Quantum Computing: Functional Diagram
4. Multi-Channel SGs as Phase-Coherent Local Oscillators
5. Multi-Channel VSGs for QuBit Manipulation
6. Total Solution for QuBit Manipulation and Readout
7. Contact AnaPico

Anapico Switzerland

**100% Swiss Company
Supplying RF and MW Test Instruments**

 **Represented in more than 40 countries**

 **Over 250 years of combined experience**

ISO 9001:2015 certified

Founded in 2004 in Zurich, Switzerland

Privately held

Own R&D, partly outsourced manufacturing

Profitable for > 10 consecutive years

AnaPico Product Portfolio

SINGLE-CHANNEL RF / MW SIGNAL GENERATORS



APSINX010: single-channel RF SG up to 2, 4, 6 GHz, analog modulations

APSINXXG: single-channel MW SG up to 12, 20, 26 GHz, analog modulations

APULN: high-performance RF and MW SG up to 6, 12, 20, 26, 40 GHz, analog modulations

APVSG: ultra-agile, vector RF and MW SG up to 4, 6, 12, 20, 40 GHz, digital modulations

MULTI-CHANNEL RF / MW SIGNAL GENERATORS



APMS-X: up to 4 fully independently adjustable, phase-coherent and phase memory, up to 6, 12, 20, 33, 40 GHz

APVSG-X: up to 4 fully independently adjustable, phase-coherent, 4, 6, 12, 20, 40 GHz

FREQUENCY SYNTHESIZERS SINGLE- / MULTI-CHANNELS



APSYN420, APSYN140: single and multi-channel frequency synthesizers up to 20, 40 GHz

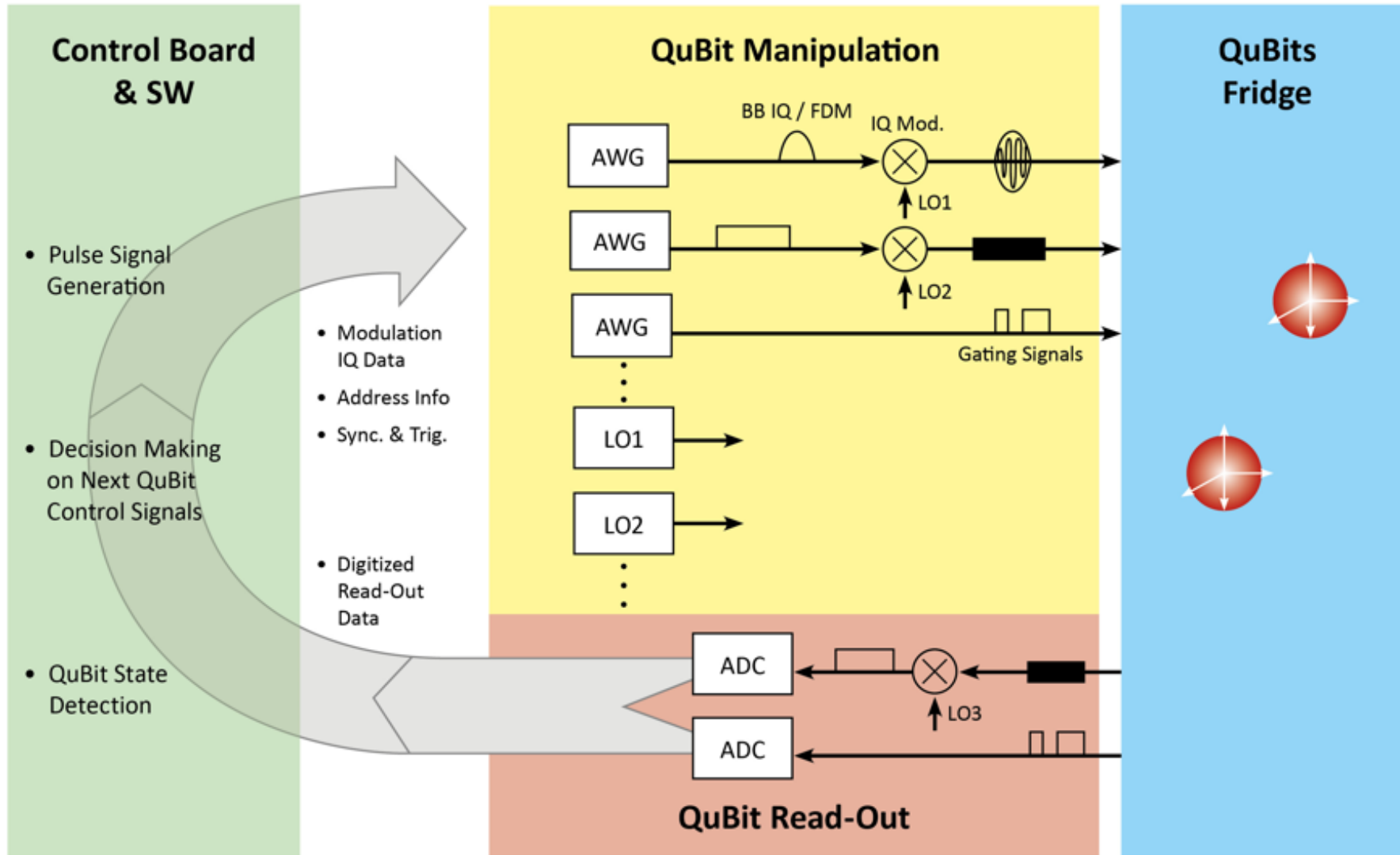
APUASYN20: ultra-compact up to 20 GHz, 1/2/3/4 channels

SIGNAL SOURCE ANALYZERS / PHASE NOISE TESTERS



APPH: versatile, broadband instruments up to 7, 26, 40, 50, 65 GHz with very high measurement sensitivity

Quantum Computing: Functional Diagram



Multi-Channel SGs as Phase-Coherent LOs



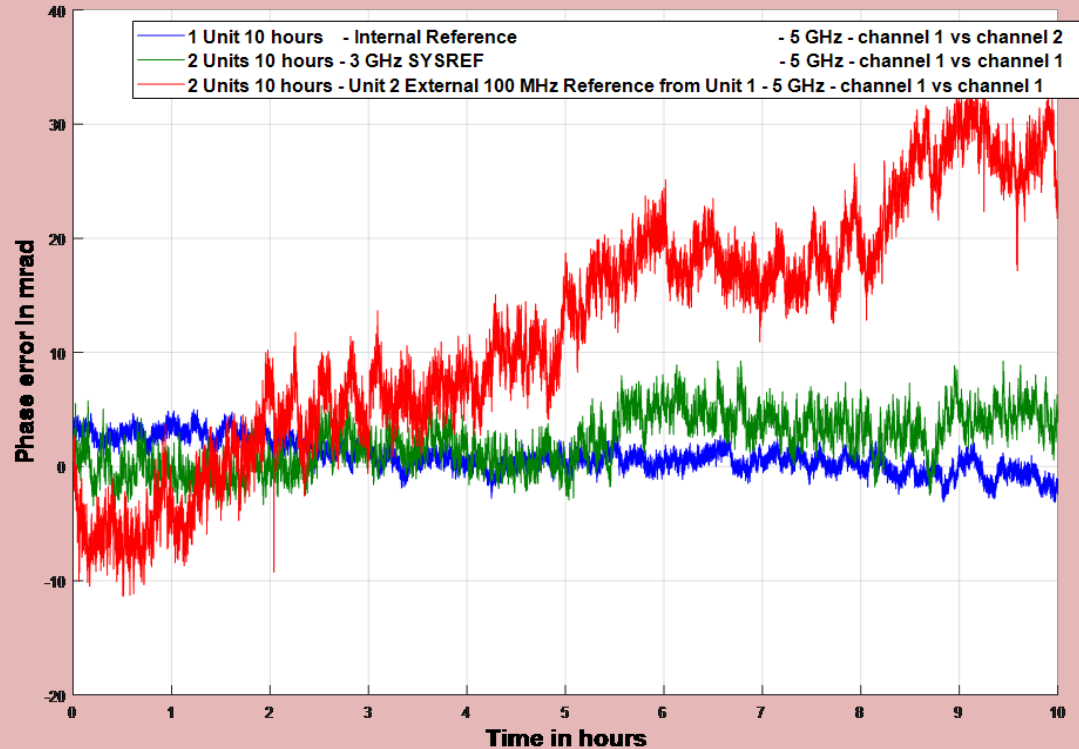
Models	Description	Output Power
APMS06G-2/3/4-ULN	300 kHz to 6 GHz	-80 to +25 dBm
APMS12G-2/3/4-ULN	300 kHz to 12 GHz	-80 to +23 dBm
APMS20G-2/3/4-ULN	300 kHz to 20 GHz	-80 to +20 dBm
APMS33G-2/3/4-ULN	300 kHz to 33 GHz	-50 to +19 dBm
APMS40G -2/3/4-ULN	300 kHz to 40 GHz	-50 to +19 dBm

Features

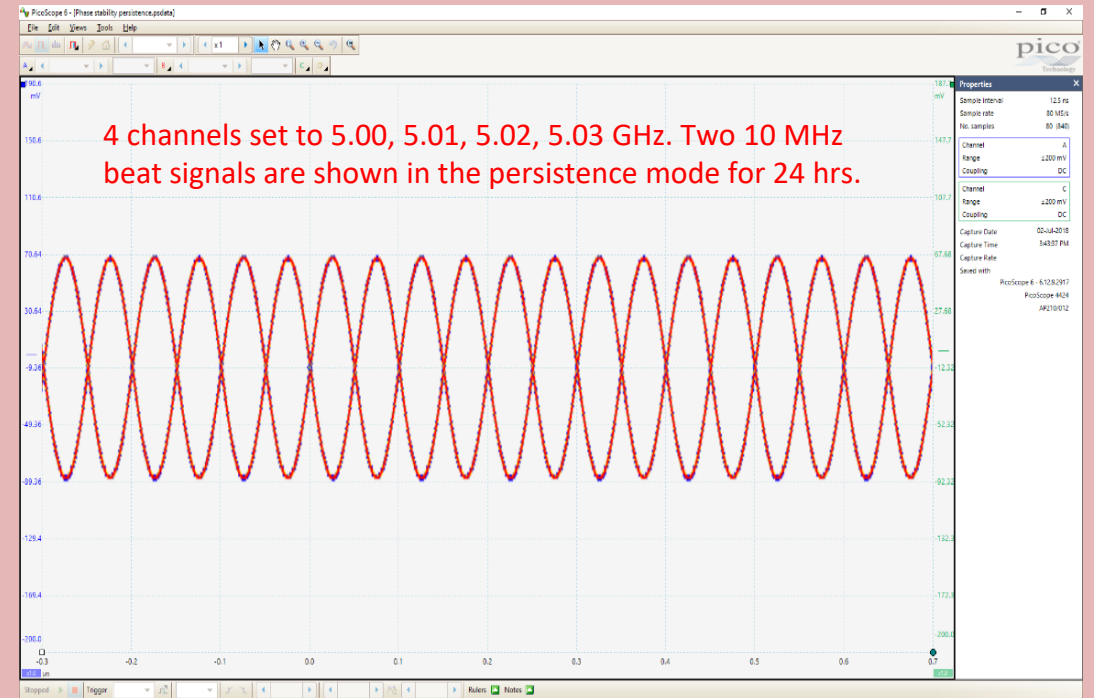
- Very Low phase noise: at 1 GHz and 20 kHz offset: -145 dBc/Hz
- Fast switching: 500 us and 25 us with option FS
- Phase-coherent, phase memory
- independently adjustable phase of each channel
- Dedicated inter-module 3 GHz synchronization
- Analog modulations
- Up to 100 dB isolation between the channels with option HI

Multi-Channel RF & MW Analog SGs – Phase Coherence (1)

Phase Coherence at 5 GHz



Relative frequency stability



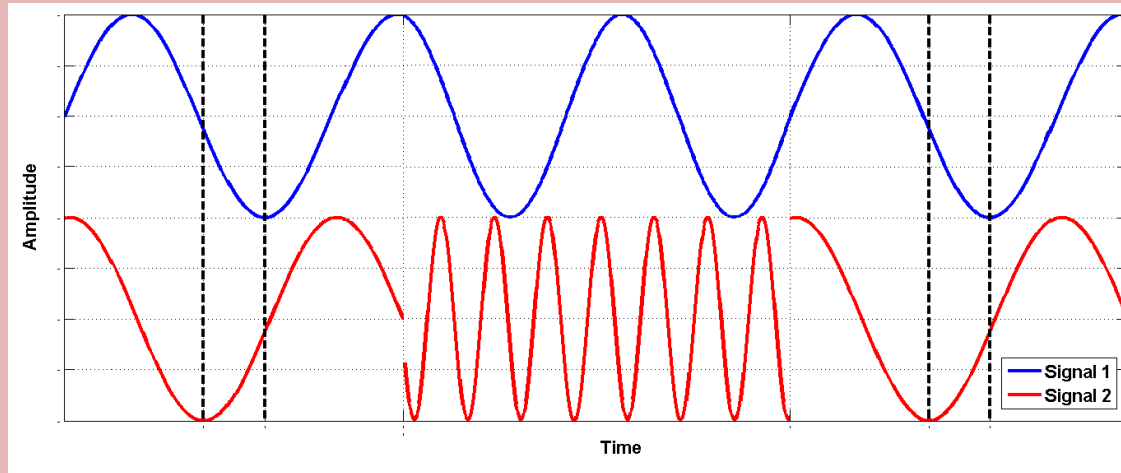
Multi-Channel RF & MW Analog SGs – Phase Coherence (2)

The reason for the excellent phase coherence:

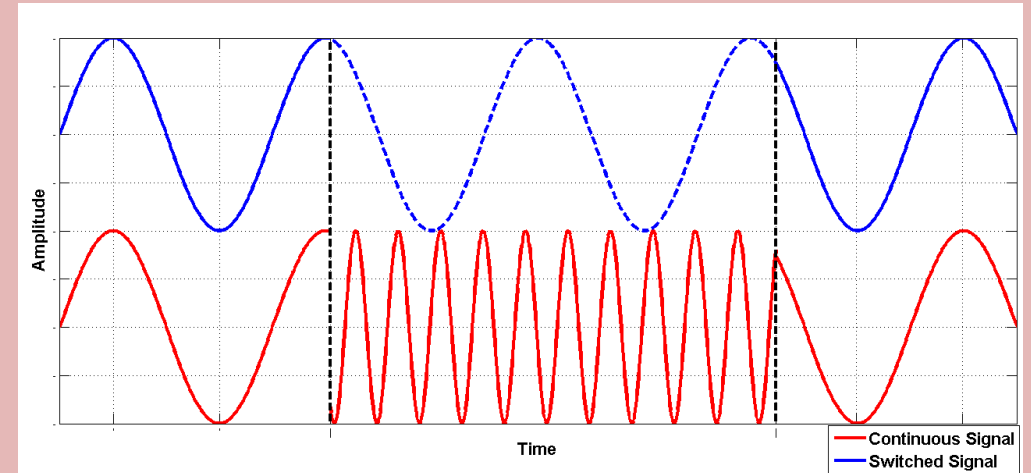
- Each APMS module has a common highly stable OCXO frequency reference. Frequencies of all channels are digitally synthesized / derived from the common reference frequency with high resolution.
- Homogeneous frequency synthesis circuitries of the parallel channels ensures the maximum phase coherence and inter-channel frequency stability.
- All the channels in the APMS module are in a similar ambient environment that ensures min. drift difference.
- Each module features a pair of high-frequency (3 GHz) clock ports allowing for excellent synchronization between the multiple APMS modules.
- Flexible synchronization to different external references: 10 MHz, 100 MHz, and even a reference range of 1 to 250 MHz.

Multi-Channel RF & MW Analog SGs – Phase-Coherent Switching

Option PHS: Phase-Coherent Switching



Option PHS: Phase Memory

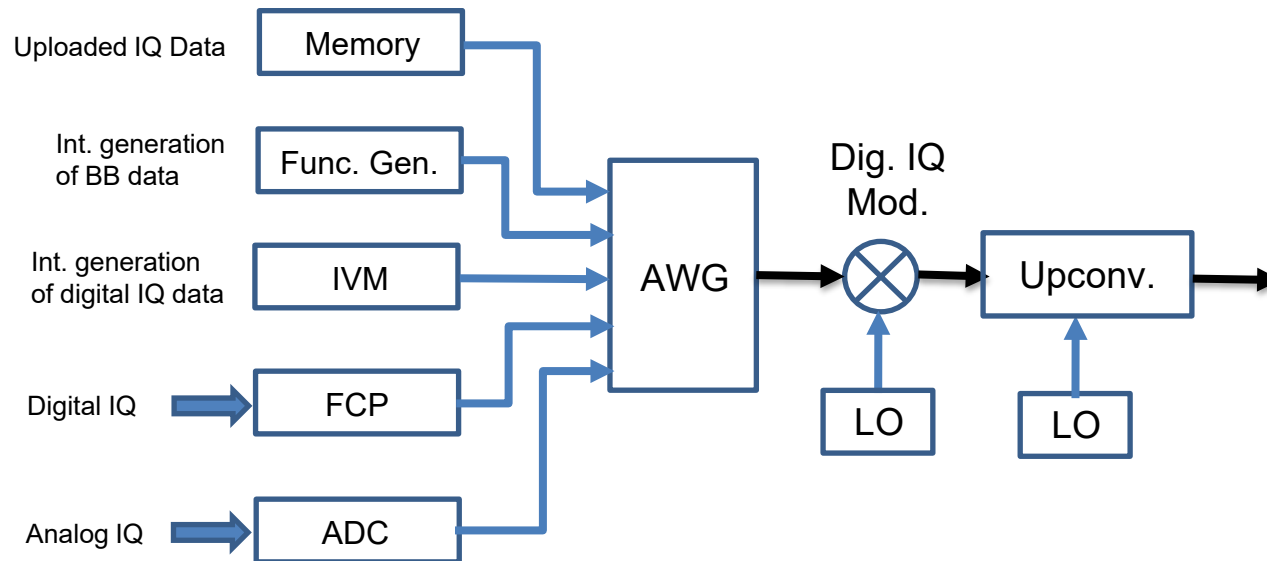


Multi-Channel RF & MW Analog SGs – Options



Option	Description	Supported Models
Option LN	Enhanced close-in phase noise and frequency stability	All
Option FS	Ultra-fast switching speed	All
Option PHS	Phase coherent switching	All
Option PE4	Electrical step attenuator	All
Option VREF	Variable reference frequency 1 to 250 MHz	All
Option HI	Higher channel-to-channel isolation	All
Option MOD	Add modulations	All
Option GPIB	Add GPIB interface	All

Functional Diagram of APVSG



Main Features:

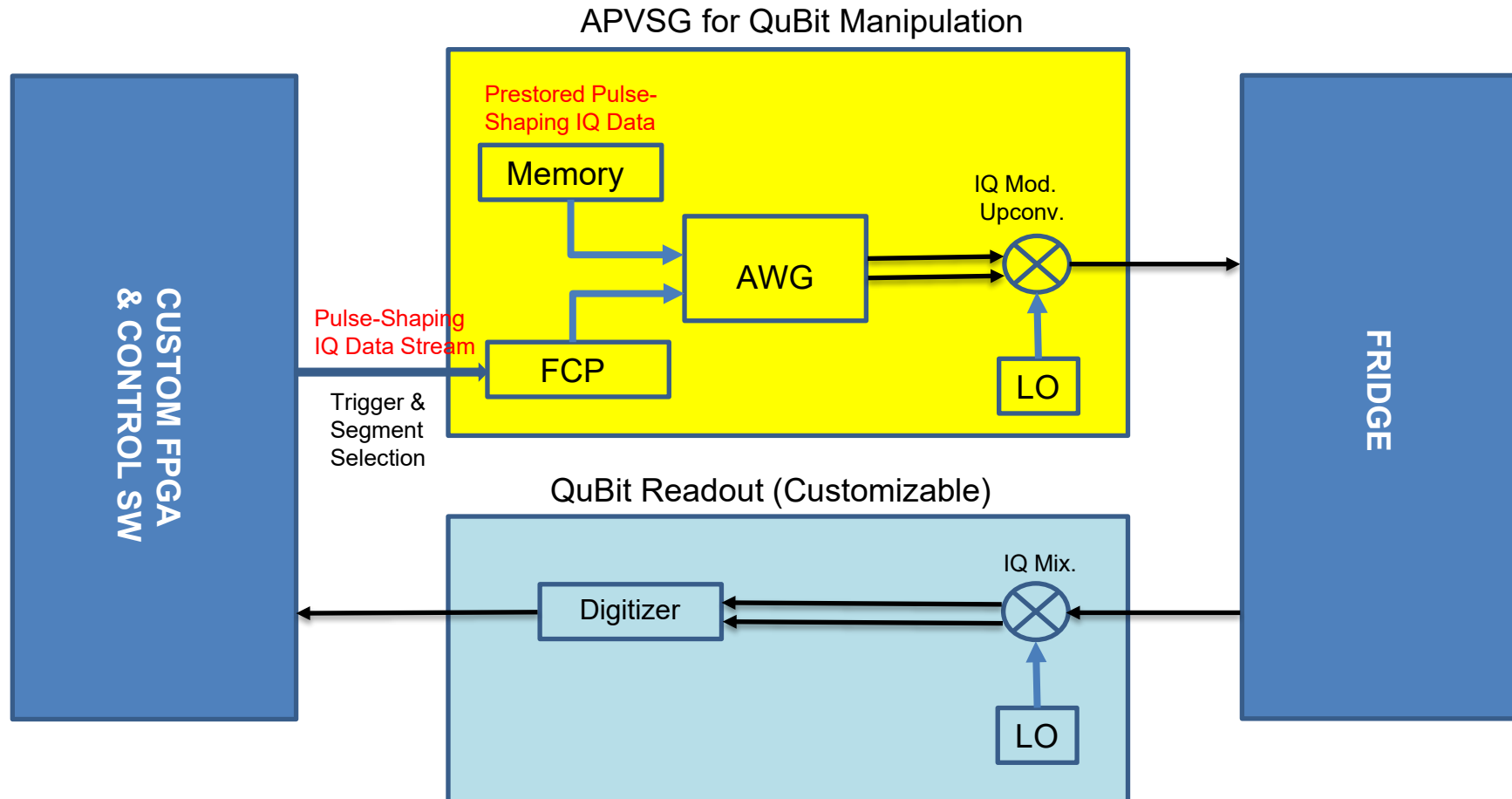
- Freq range: 4, 6, 12, 20, 40 GHz, 1 MHz resolution.
- Full digital IQ modulator, 400 MHz BW, LO leakage < -70 dBc, image suppression > 65 dBc.
- Digital IQ input: up to 250 MS/s
- Analog IQ: 125 MHz BW
- Ultra-fast freq. sweeping, chirping, intra-pulse modulation, pulse shaping, very low phase noise.
- Multiple flexible operation modes

APVSG Operation Modes

- Upload IQ Data segments into APVSG Memory. An APVSG GUI supports data formats from various vendors. The internal RAM can store up to 512 MS (32 bits per Sample) of IQ data. **The APVSG internal AWG can play selected sections of the RAM upon a user trigger.**
- Use APVSG to synthesize and play predefined digital modulation formats (option IVM)
- **Use FCP interface (option FCP) to live stream and play digital IQ data up to 125 to 250 MS/s**
- Use the analog IQ inputs (option AIQ) with up to 125 MHz IQ bandwidth
- Use FCP to control the APVSG for ultra-fast frequency hopping (options UFS, FCP)

: Possibly QC relevant due to high agility

APVSG for Quantum Computing



APVSG – Configuration

HOST MODEL	PRODUCT	DESCRIPTION
APVSG	APVSG04	4 GHz model
APVSG	APVSG06	6 GHz model
APVSG	APVSG12	12 GHz model
APVSG	APVSG20	20 GHz model
APVSG	APVSG40	40 GHz model
APVSG-X	APVSG04-X	4 GHz model (X channels)
APVSG-X	APVSG06-X	6 GHz model (X channels)
APVSG-X	APVSG12-X	12 GHz model (X channels)
APVSG-X	APVSG20-X	20 GHz model (X channels)
APVSG-X	APVSG40-X	40 GHz model (X channels)
APVSG(-X)	Option LN	Enhanced close-in phase noise & frequency stability
APVSG(-X)	Option UFS	Ultra-fast switching speed
APVSG(-X)	Option FCP	Fast control port (digital IQ data streaming)
APVSG(-X)	Option MOD	Analog modulations
APVSG(-X)	Option IVM	Internal vector modulations
APVSG(-X)	Option AVIO	Avionic modulations
APVSG(-X)	Option VREF	Variable REF input
APVSG(-X)	Option AIQ	External analog I/Q Inputs
APVSG(-X)	Option WE	One year warranty extension
APVSG(-X)	Option ReCal	Recalibration

APVSG – Phase and Amplitude Noise

Figure 1: SSB Phase Noise Performance, CW without option LN, Pout=10 dBm

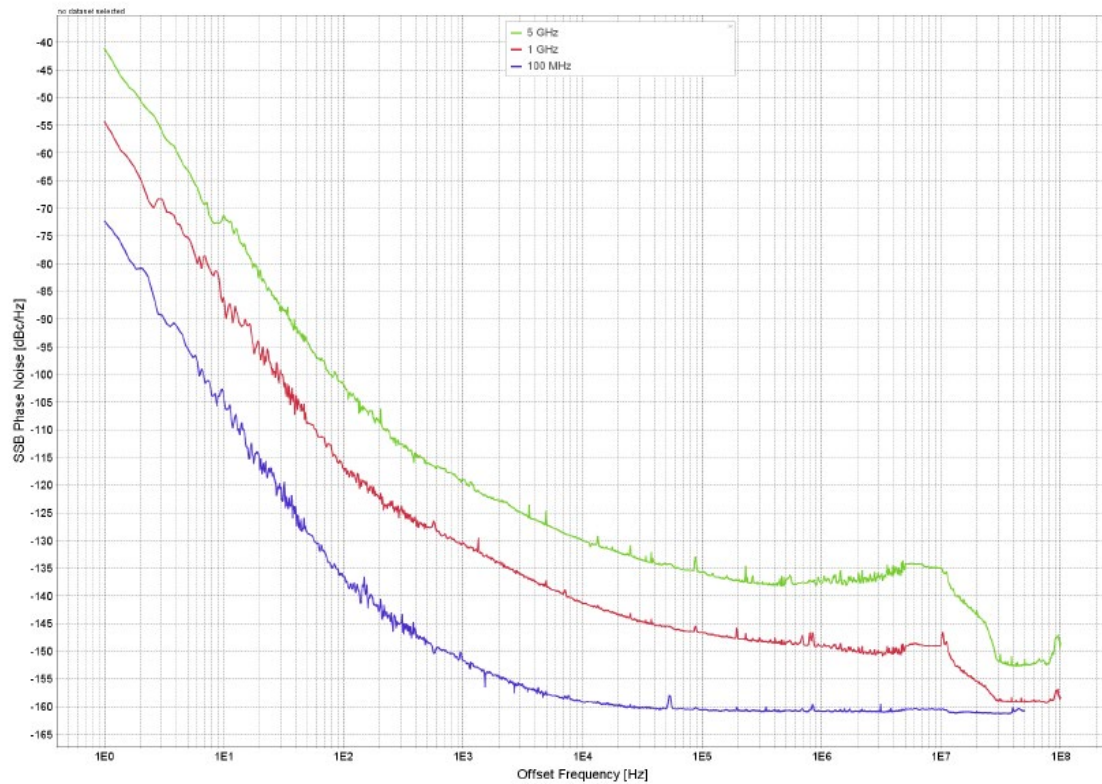
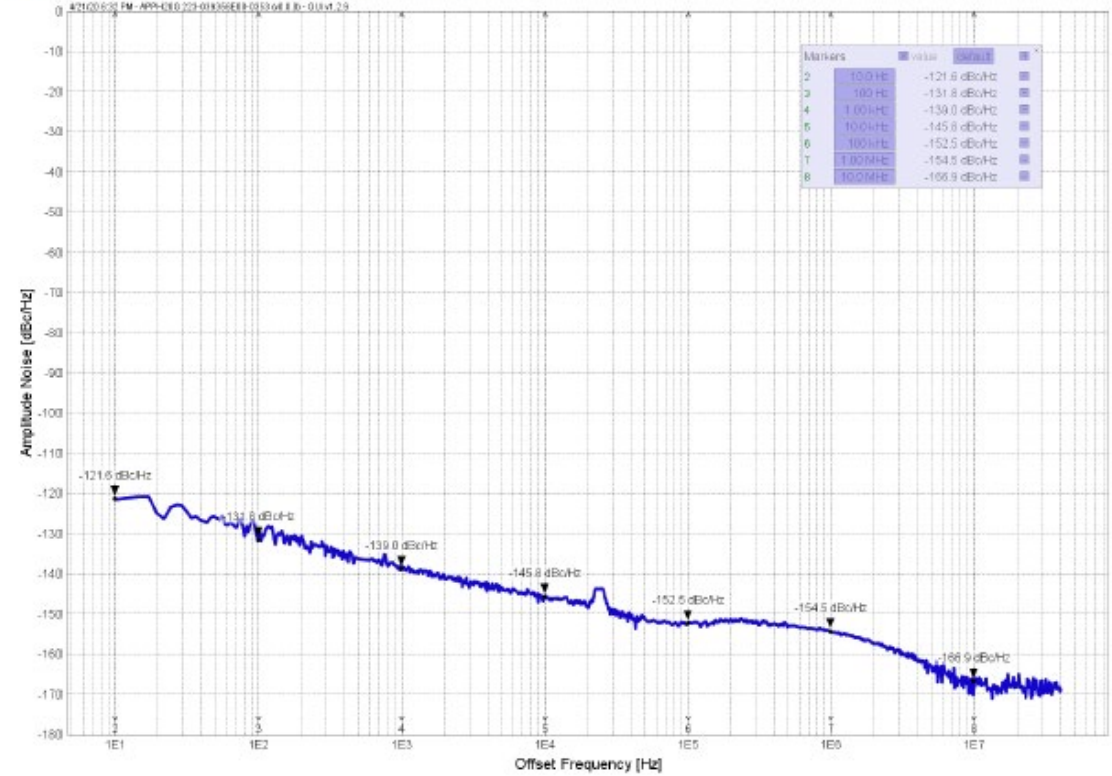
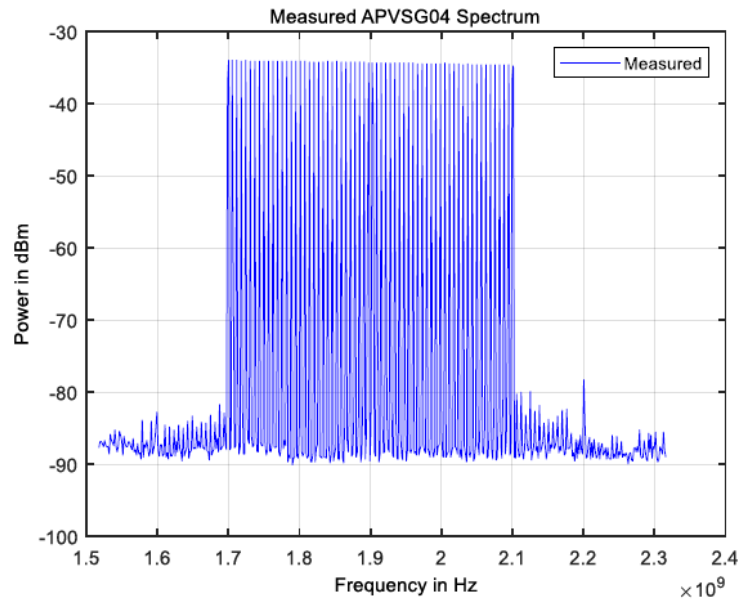


Figure 2: Amplitude Noise, 2 GHz, Pout=10 dBm

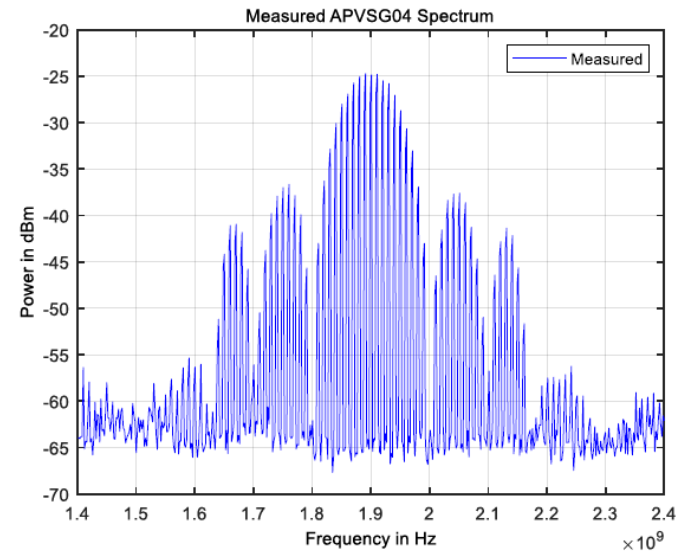


APVSG – Modulation Examples

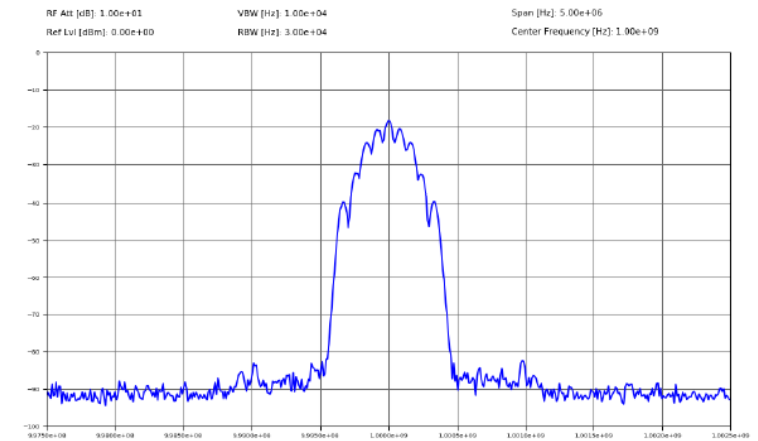
64-tone 400 MHz bandwidth signal



Pulse modulation (10 MHz rate, 10 ns pulse width)



DME Spectrum (X channel, raised cosine filter)



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