



# DATASHEET APLCXX Specification (preliminary) v0.91

Single & Multi-Channel High Performance Sources

9 kHz to 20, 40 and 54 GHz



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## DEFINITIONS

The specifications in the following pages describe the warranted performance of the instrument for  $23 \pm 5$  °C after a 30-minute warm-up period

**Typical:** Expected mean values, not warranted performance

**Min and max:** Parameter range that is guaranteed by product design, and/or production tested. Warranted performance specifications include guard-bands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

## INTRODUCTION

The APLCxx is a series of phase-coherent, single or multi-channel, ultra-fast switching and ultra-low phase noise signal generators with a frequency range up to 20, 40, and 54 GHz. It is ideally suited for a wide range of applications, where good signal quality, accurate and wide output power ranges, and very stable phase coherence among all channels are required. Excellent phase noise is combined with good spurious, harmonic rejection and optionally leading-edge switching speed of 15  $\mu$ s.

A high-stability OCXO reference provides excellent frequency accuracy and stability. The generator accepts a wide range of external references including the commonly used 10 and 100 MHz for higher phase synchronization, and a flexible reference choice in the range of 1-250 MHz for those applications with customer- or system-specific reference frequencies. Moreover, the APLCxx features a pair of AnaPico-specific high-frequency CLK ports (3 GHz, one input and one output) that enables excellent phase synchronization among the outputs of multiple APLCxx instruments.

The APLCxx(-X) comes in a standard tubus enclosure (single channel) or in a 19 inch 2U (1 up to 4 channels) rack-mountable module form. It can be intuitively controlled by a PC based GUI software. Moreover, the instrument offers various communication interfaces like USB, LAN or GPIB. Each interface allows for easy and fast communication using SCPI 1999 command set. Remote control of the instrument can be quickly achieved from any host system. A customer-supplied application programming interface (API) or programming examples for Matlab, Labview, C++ and other commercially available tools make the control implementation very straightforward.

# FACTS & FIGURES & SPECIFICATIONS

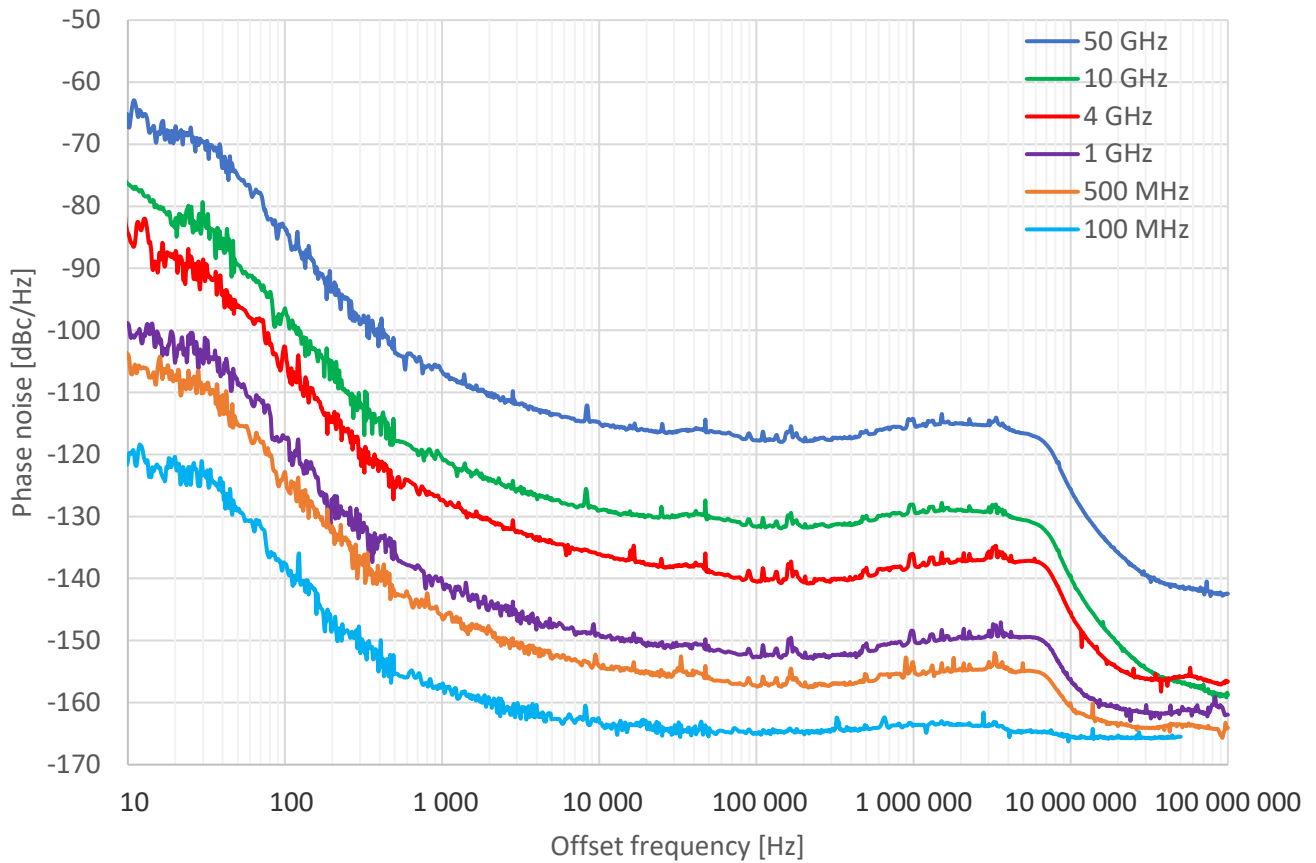
## Signal Specifications

PARAMETER	MIN	TYPICAL	MAX	NOTE
Channels	1		4	
Frequency Ranges				
APLC20	10 MHz		20 GHz	
APLC40	10 MHz		40 GHz	
APLC50	10 MHz 9 kHz		54 GHz	<b>Option 9K</b>
Resolution		<0.001 Hz		
Phase Adjustment Range	0 deg		360 deg	individually adjustable per channel
Phase Resolution		0.1 deg		
Deterministic Relative Phase between channels (Phase Memory)				Option PHS
Switching Speed		1.5 ms		after SCPI command received
CW Mode		500 $\mu$ s		
Sweep / List Mode		5 $\mu$ s	15 $\mu$ s	<b>Option FS</b>
Thermal Drift		0.015 dB/ $^{\circ}$ C		

## Phase Noise

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>SSB Phase noise at 1 GHz (+10 dBm output power)</b>				see plots/tables
at 10 Hz from carrier		-85 dBc/Hz -100 dBc/Hz	-80 dBc/Hz -95 dBc/Hz	<b>Option LN(+)</b>
at 1 kHz from carrier		-140 dBc/Hz	-135 dBc/Hz	
at 10 kHz from carrier		-150 dBc/Hz	-145 dBc/Hz	
at 100 kHz from carrier		-152 dBc/Hz	-148 dBc/Hz	
at 20 MHz from carrier		-158 dBc/Hz	-153 dBc/Hz	
<b>SSB Phase noise at 4 GHz (+15 dBm output power)</b>				
at 10 Hz from carrier		-73 dBc/Hz -88 dBc/Hz	-68 dBc/Hz -83 dBc/Hz	<b>Option LN(+)</b>
at 1 kHz from carrier		-130 dBc/Hz	-125 dBc/Hz	
at 10 kHz from carrier		-138 dBc/Hz	-134 dBc/Hz	
at 100 kHz from carrier		-140 dBc/Hz	-137 dBc/Hz	
at 20 MHz from carrier		-150 dBc/Hz	-145 dBc/Hz	
<b>SSB Phase noise at 10 GHz (+15 dBm output power)</b>				
at 10 Hz from carrier		-65 dBc/Hz -80 dBc/Hz	-60 dBc/Hz 75 dBc/Hz	<b>Option LN(+)</b>
at 1 kHz from carrier		-122 dBc/Hz	-117 dBc/Hz	
at 10 kHz from carrier		-130 dBc/Hz	-126 dBc/Hz	
at 100 kHz from carrier		-132 dBc/Hz	-128 dBc/Hz	
at 20 MHz from carrier		-140 dBc/Hz	-135 dBc/Hz	
<b>SSB Phase noise at 50 GHz (+15 dBm output power)</b>				
at 10 Hz from carrier		-51 dBc/Hz -66 dBc/Hz	-46 dBc/Hz -61 dBc/Hz	<b>Option LN(+)</b>
at 1 kHz from carrier		-108 dBc/Hz	-105 dBc/Hz	
at 10 kHz from carrier		-118 dBc/Hz	-114 dBc/Hz	
at 100 kHz from carrier		-119 dBc/Hz	-114 dBc/Hz	
at 20 MHz from carrier		-130 dBc/Hz	-123 dBc/Hz	

Figure 1: Phase Noise at different frequencies, power +10 dBm, Option LN



## Spectral Purity

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Harmonics</b>				at +5 dBm output power
9 kHz to 150 MHz		-30 dBc		
150 MHz to 1 GHz		-45 dBc	-40 dBc	
1 GHz to 12 GHz		-50 dBc	-40 dBc	
12 GHz to 22 GHz		-55 dBc	-45 dBc	
22 GHz to 30 GHz		-50 dBc	-40 dBc	
30 GHz to 54 GHz		-60 dBc	-50 dBc	
<b>Sub-Harmonics</b>				
9kHz to 100 MHz		-80 dBc		
100 MHz to 11.3 GHz		-80 dBc	-70 dBc	
11.3 GHz to 54 GHz		-70 dBc	-55 dBc	
<b>Non-Harmonic Spurious</b>				10 kHz to 0.5 GHz offset from carrier
< 1.2 GHz		-90 dBc	-80 dBc	
1.2 to 2.5 GHz		-92 dBc	-86 dBc	
2.5 to 5 GHz		-90 dBc	-80 dBc	
5 to 10 GHz		-84 dBc	-74 dBc	
10 to 20 GHz		-80 dBc	-68 dBc	
20 to 54 GHz		-67 dBc		
<b>Channel to Channel Performance</b>				
<b>Isolation</b>				
300 kHz to 54 GHz	80 dB	> 90 dB		

Figure 2: Harmonics (tba)

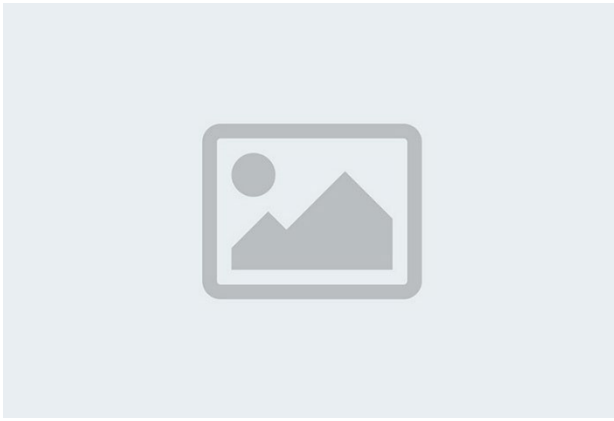


Figure 3: Non-Harmonic Spurs (tba)

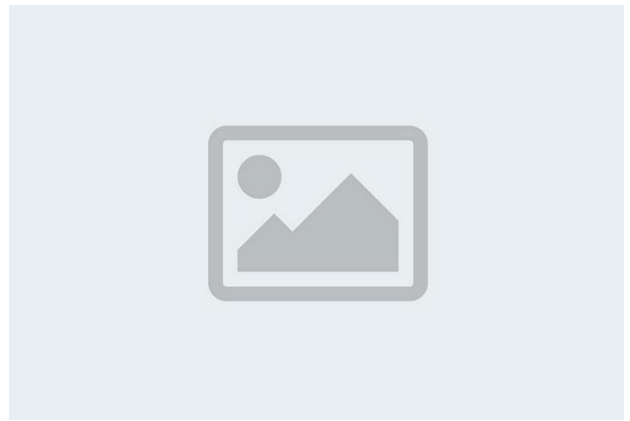
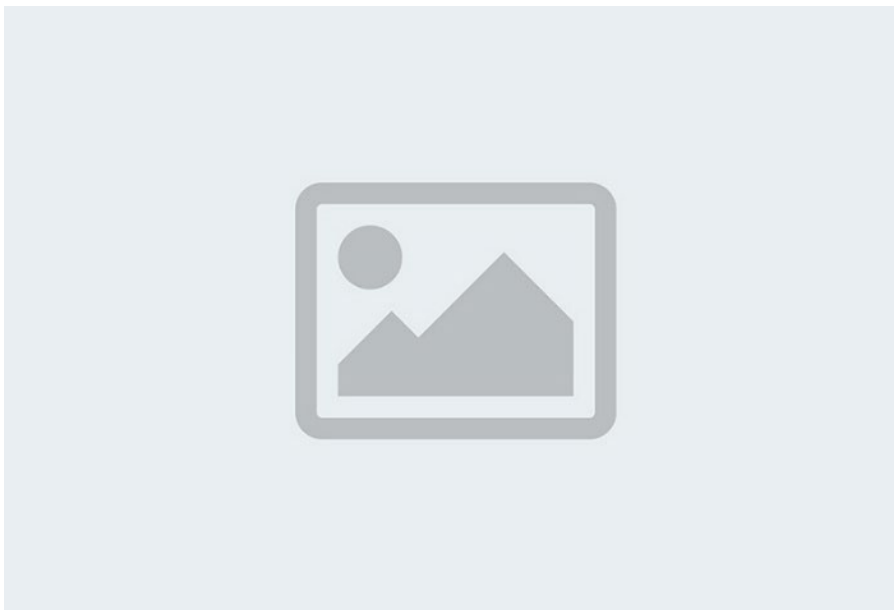


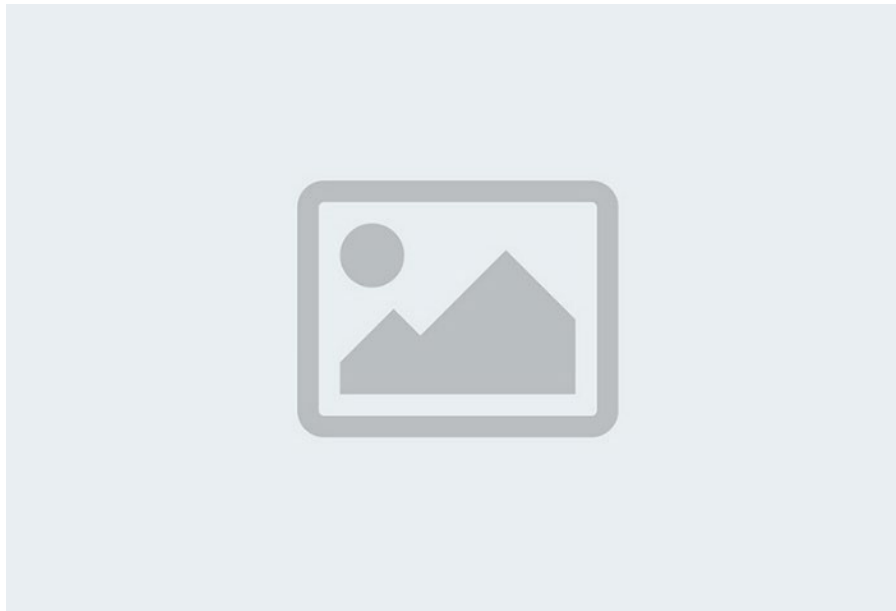
Figure 4: Channel-to-channel Isolation (tba)



## Phase Coherence

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Relative Phase Stability</b>			tba	See plot
Between channels			tba	
Between synchronized Modules			tba	
<b>Phase-Coherent Switching</b>				
Phase mismatch at outputs				

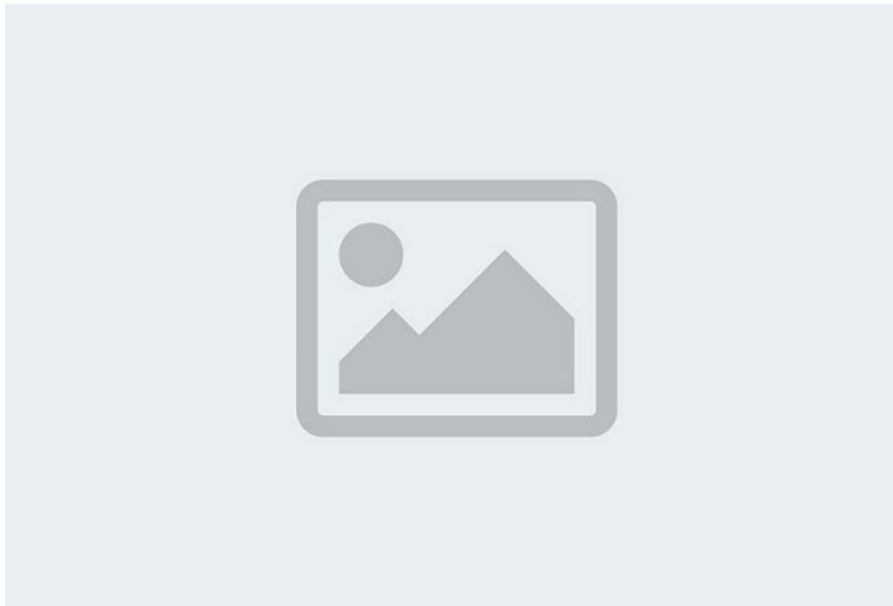
Figure 5: Relative Channel to channel Phase Stability -  
Measured at XX GHz, 10 dBm output in temperature-controlled environment over 10 hours (tba)



## Level Performance

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Output Power Level</b>				
9 kHz to 1 MHz	-20 dBm		+7 dBm	
1 MHz to 10 MHz	-20 dBm		+12 dBm	
10 MHz to 200 MHz	-20 dBm		+17 dBm	
200 MHz to 22 GHz	-20 dBm		+20 dBm	
22 GHz to 40 GHz	-20 dBm		+18 dBm	
40 GHz to 54 GHz	-20 dBm		+17 dBm	
<b>Output Power Level</b>				<b>Option PE2</b>
9 kHz to 1 MHz	-110 dBm		+7 dBm	
1 MHz to 10 MHz	-110 dBm		+12 dBm	
10 MHz to 200 MHz	-110 dBm		+16 dBm	
200 MHz to 22 GHz	-110 dBm		+17 dBm	
22 GHz to 40 GHz	-110 dBm		+15 dBm	
40 GHz to 54 GHz	-110 dBm		+11 dBm	
<b>Power Resolution</b>		0.01 dB		
<b>Reverse Power Protection</b>				
DC Voltage			±10 V	
RF Power			26 dBm	
<b>Output impedance</b>		50 Ohms		
<b>VSWR</b>		1.3	1.5	< 15 GHz
		1.6	1.8	15 to 35 GHz
		1.9	2.2	> 35 GHz

Figure 6: Maxpower 100 MHz to 54 GHz (tba)



## Power Level Uncertainty

( ): Typical value

Frequency Range	-110 to -50 dBm Option PE2	-50 to -15 dBm Option PE2	-15 to +15 dBm	+ 15 dBm to Max Power
300 kHz to 6 GHz	2.0 dB	1.2 dB	0.8 dB (0.3 dB)	1.2 dB
6 to 12 GHz	2.0 dB	1.3 dB	0.9 dB (0.3 dB)	1.3 dB
12 to 20 GHz	2.0 dB	1.8 dB	1.0 dB (0.3 dB)	2.0 dB
20 to 26 GHz	2.3 dB	2.0 dB	1.2 dB (0.4 dB)	2.3 dB
26 to 54 GHz	2.5 dB	2.0 dB	1.3 dB (0.5 dB)	2.5 dB

Figure 7: Level accuracy over frequency (tba)

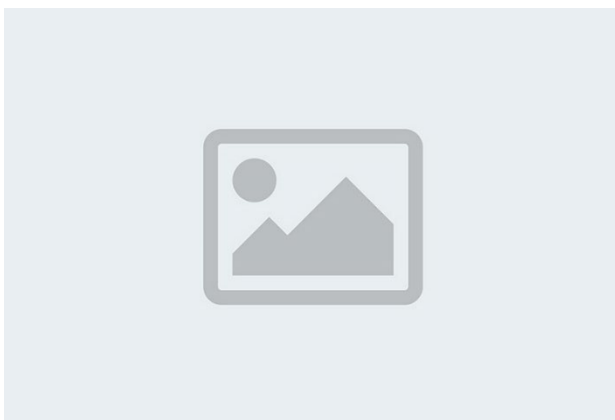


Figure 8: Level accuracy at low frequency (tba)

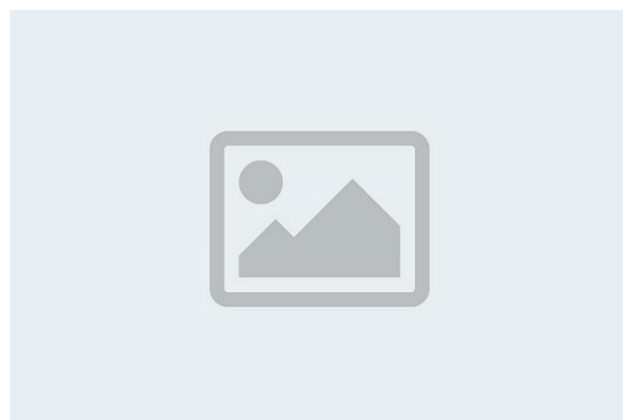
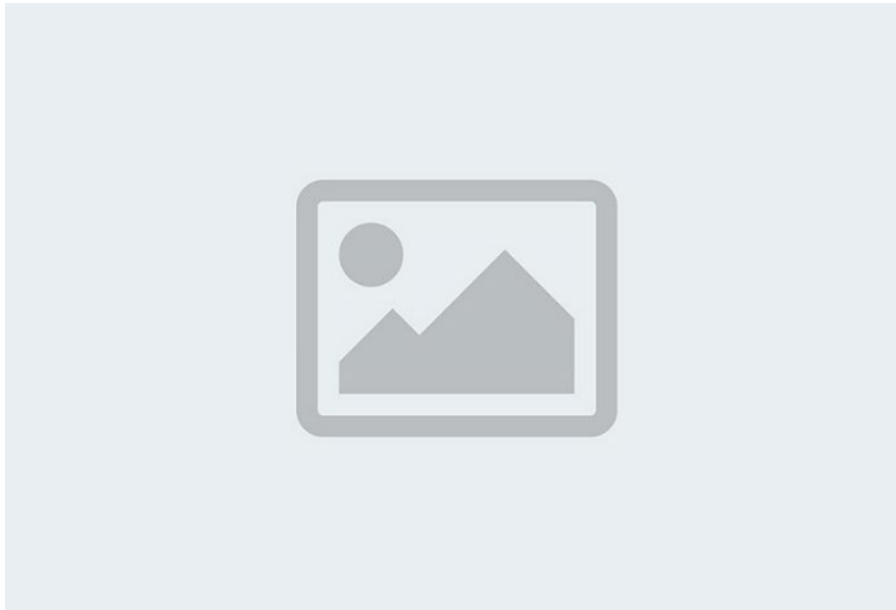




Figure 9: Power Linearity at different frequencies (tba)



**Relative Power Error (0.1 dB step)**

( ): Typical value

Frequency Range	-110 to -50 dBm Option PE2	-50 to -15 dBm Option PE2	-15 to +15 dBm	+ 15 dBm to Max Power
300 kHz to 20 GHz	(< 0.1 dB)	0.5 dB (< 0.1 dB)	0.5 dB (< 0.1 dB)	(< 0.1 dB)
20 GHz to 26 GHz	(< 0.1 dB)	(< 0.1 dB)	(< 0.1 dB)	(< 0.1 dB)
26 GHz to 54 GHz	(< 0.1 dB)	(< 0.1 dB)	(< 0.1 dB)	(< 0.1 dB)

Figure 10: Absolute Power error at 54 GHz  
Option PE2 (tba)

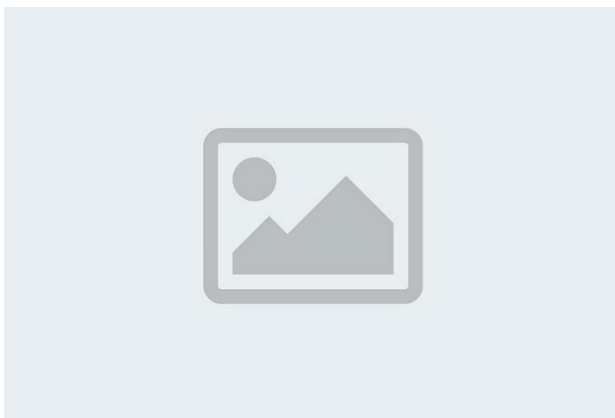
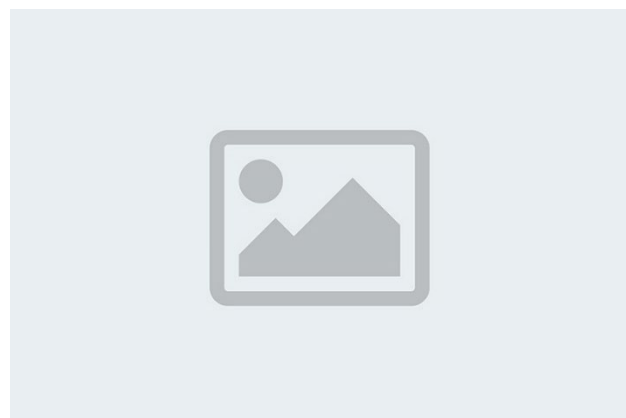


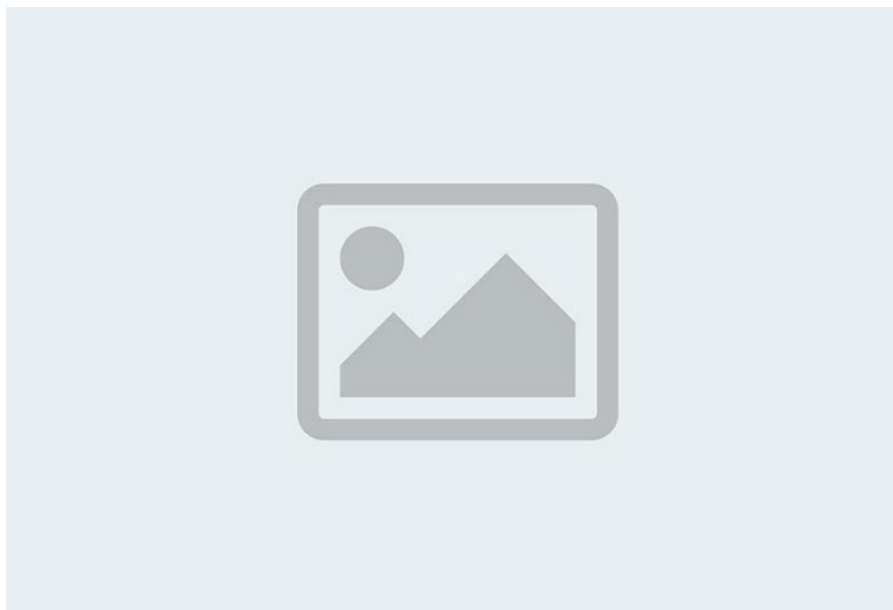
Figure 11: Relative Power error in 0.1 dB step at 54 GHz  
Option PE2 (tba)



## Modulation Capabilities

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Pulse Modulation</b>				
Modulation Source		Internal/ External		
External input amplitude	TTL			
Pulse rise/fall time		10 ns		
On/off ratio (power $\geq +10$ dBm)	80 dB 70 dB 70 dB 70 dB	90 dB 80 dB 80 dB 80 dB		f < 6.5 GHz 6.5 to 18 GHz 18 GHz to 40 GHz 40 to 54 GHz
Pulse overshoot			10%	
Pulse delay		20 ns		
Pulse polarity		Normal, inverse		selectable
<b>Internal pulse generator</b>				
Repetition frequency (PRF)	0.1 Hz		50 MHz	= 1/T
Duty cycle	1 % to 99 % in 1% steps			within specified minimum pulse width
Pulse Pattern Modulation & Staggered PRF				using internal pattern generator
Pulse width	100 ns 10 ns		20 s	f < 125 MHz f $\geq$ 125 MHz
Programmable pattern length	2		65536	
Duty cycle	0.05%		99.95%	
Pulse width resolution		5 ns		
Pulse period (T) accuracy		0.00005xT+ 3ns		
Pulse width accuracy		0.00005xT+ 5ns		
Pulse jitter		2 ns	5 ns	
Polarity		selectable		

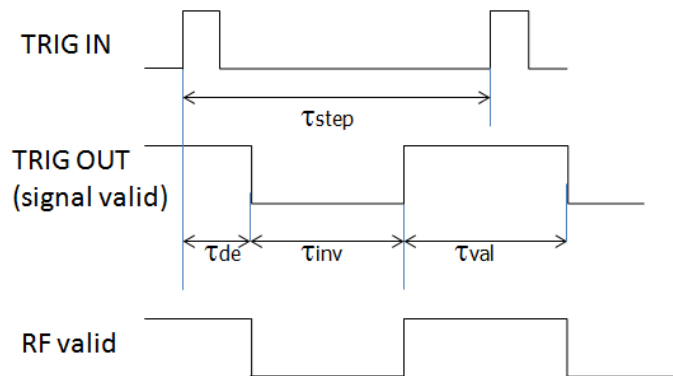
Figure 12: Polarity Pulse On / Off ratio at +10dBm output power



<b>Amplitude Modulation</b>		tbd		<b>Option MOD</b>
Modulation Source		Internal		
Modulation Depth	0%		80%	
Deviation accuracy		2%	4%	1 kHz rate, 30% depth
Deviation resolution		1%		
Distortion (THD)			1%	1 kHz rate, 30% depth
Modulation rate	0.1 Hz		30 kHz	
Modulation waveforms	Sine			
<b>Frequency Modulation</b>		tbd		<b>Option MOD</b>
Modulation source		Internal		
Maximum Frequency deviation (peak)		10% off out  N · 50 MHz		< 1.25 GHz (N=1) 1.25 GHz to 2.5 GHz (N=0.125) 2.5 GHz to 5 GHz (N=0.25) 5 GHz to 10 GHz (N=0.5) 10 GHz to 20 GHz (N=1) 20 GHz to 40 GHz (N=2)
Deviation accuracy		0.50%	2%	
Distortion (THD)		< 1 %		1 kHz rate, 10 kHz deviation
Modulation rate	0.1 Hz		30 kHz	
Modulation waveforms	Sine			
<b>Phase Modulation</b>		tbd		<b>Option MOD</b>
Modulation Source		Internal		
Phase deviation (peak)	0		100 · N· rad	
Deviation accuracy		0.50%	2%	
Modulation rate	0.1 Hz		30 kHz	
Modulation waveforms	Sine			
Distortion (THD)	< 1%	1 kHz rate & N x rad deviation		

## Sweeping Capability

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Sweep Parameters</b>	Frequency, power, phase, list			
<b>Sweep type</b>	Linear, logarithmic, random			
Step time ( $t_{step} = t_{dwell} + t_{off}$ )	500 $\mu$ s		19998 s	<b>Option FS</b>
	15 $\mu$ s			
Dwell time ( $t_{dwell}$ )	0 $\mu$ s		9999 s	
Off time ( $t_{off}$ )	0 $\mu$ s		9999 s	
Time resolution		5 ns		
Timing delay ( $\tau_{de}$ )		50 ns		
Transient time ( $\tau_{inv}$ )			15 $\mu$ s	
Timing accuracy per point		5 ns		
Number of points	2		10000	Per channel





## Frequency Reference

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Internal Reference Frequency</b>		100 MHz 10 MHz		<b>Option LN</b>
Temperature stability 0 to 50 degC			±100 ppb ±20 ppb	<b>Option LN</b>
Aging 1st year			1000 ppb 30 ppb 20 ppb	<b>Option LN</b> <b>Option LN+</b>
Aging per day			5 ppb 0.5 ppb	after 30 days operations <b>Option LN</b>
Warm-up time		5 min		
Output of internal reference		10 MHz 100 MHz		REF OUT port, selectable
Output of High Frequency Clock		3 GHz		CLK OUT port high phase synchronous mode
Output power		0 ± 3 dBm 9 ± 3 dBm		10 MHz, 3 GHz 100 MHz
Output impedance		50 Ohms		
<b>Bypass Internal Reference Input</b>		100, 1000 MHz		*Options LN/LN+ are disabled
<b>Phase Lock to External Reference</b>	1 MHz	10 MHz integer MHz	250 MHz	REF IN port <b>Option VREF</b> *Options LN/LN+ are disabled
<b>High Frequency Clock Input (Bypass Internal Reference)</b>		3 GHz		CLK IN port high phase synchronous mode
<b>Reference input level</b>				
10 MHz or 1-250 MHz or 3 GHz	-5 dBm	0 dBm	+10 dBm	
100, 1000 MHz	+5 dBm		+13 dBm	
<b>Lock Range</b>				
10 MHz or 1-250 MHz			±1.5 ppm	
Bypass 100 MHz			100 ppm	
<b>Reference Input Impedance</b>		50 Ohms		

## Trigger (TRIG IN)

PARAMETER	MIN	TYPICAL	MAX	NOTE
Trigger Types		Continuous Single (point) Gated Gated direction		
Trigger Source		External Bus (LAN, USB)		
Trigger Modes		Continuous free run Trigger and run Reset and run		
Trigger latency		5 ns		
Trigger uncertainty		10 ns		
External trigger delay	50 ns		40 s	settable
External delay resolution		5 ns		
Trigger Modulo	1		255	execute only on Nth trigger event
Trigger Polarity		Rising Falling		
External trigger input threshold	0.85 V	0.9 V	0.95 V	TTL compatible
External trigger input voltage range	-0.5 V		+5.5 V	TTL compatible
External trigger input hysteresis		60 mV		

## Multi-Purpose Output (FUNC OUT)

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>VIDEO OUTPUT (of internal pulse modulator)</b>				
Output		CMOS		
Period	30 ns		50 s	
Pulse width	15 ns		50 s	
RF delay		10 ns		
<b>TRIGGER OUT Synchronization mode for multiple sources</b>				
Modes		Trigger on sweep start Trigger on each point Signal Valid		

## Front panel (19" 2 HU)



- RF outputs:
  - APLC20: SMA female
  - APLC40: K female
  - APLC50: 1.85/2.4 mm female
  -
- External pulse modulation inputs: BNC female
- 

## Rear panel (19" 2 HU)

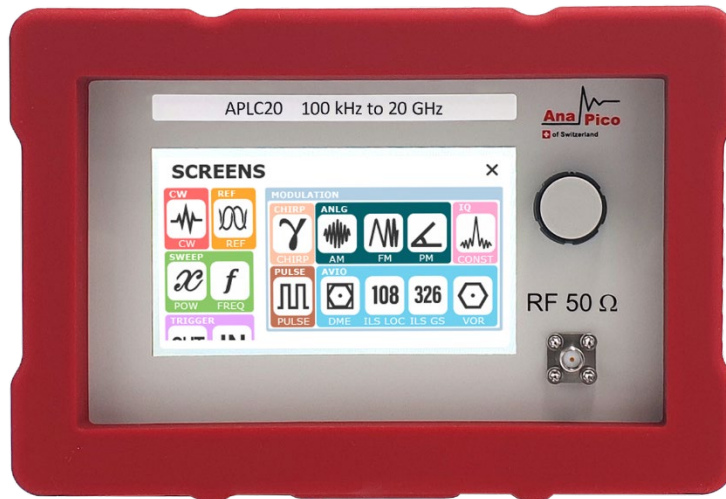


- High Stability Reference input (CLK IN, 3 GHz): SMA female
- High Stability Reference output (CLK OUT, 3 GHz): SMA female
- Multi-purpose output (FUNC OUT): BNC female
- Trigger input (TRIG IN): BNC female
- Reference output (REF OUT): BNC female
- Reference input (REF IN): BNC female
- GPIB: IEEE-488.2, 1987 with listen and talk (optional)
- USB 2.0 device
- LAN connection: RJ-45
- FUSE (3.15 A)
- 100-240V AC power plug
- Power switch

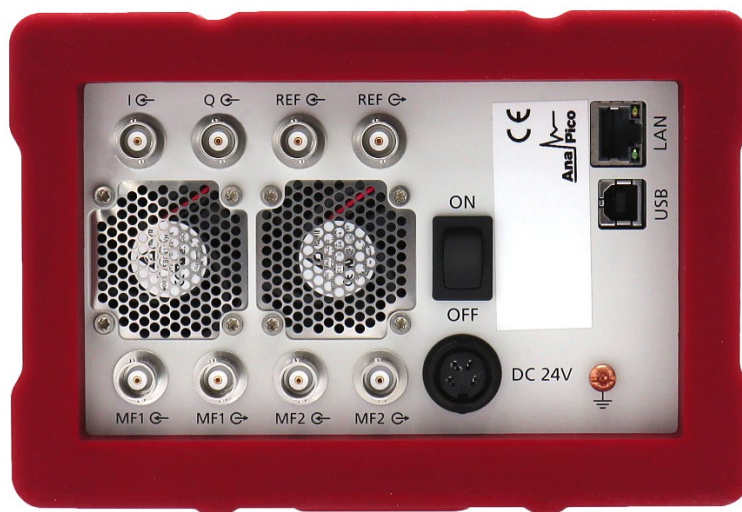
## High Isolation Casing 19" 2HU (rack mount kit included)



## Front panel (Bench top)



## Rear panel (Bench top)





## ORDERING INFORMATION

Host Model No.	Product	Description
APLC-X	APLC20 -1	1-channel 10 MHz to 20 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC20 -2	2-channel 10 MHz to 20 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC20 -3	3-channel 10 MHz to 20 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC20 -4	4-channel 10 MHz to 20 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC40 -1	1-channel 10 MHz to 40 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC40 -2	2-channel 10 MHz to 40 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC40 -3	3-channel 10 MHz to 40 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC40 -4	4-channel 10 MHz to 40 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC50 -1	1-channel 10 MHz to 54 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC50 -2	2-channel 10 MHz to 54 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC50 -3	3-channel 10 MHz to 54 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC-X	APLC50 -4	4-channel 10 MHz to 54 GHz ultra-low phase noise, fast switching signal generator, 19" 2HU rack-mount module
APLC50	<b>Option FS</b>	Ultra-fast switching speed
APLC50	<b>Option 9K</b>	Frequency range extension to 9 kHz
APLC50	<b>Option LN</b>	Enhanced close in phase noise and frequency stability
APLC50	<b>Option LN+</b>	Option LN with improved long term frequency stability
APLC50	<b>Option MOD</b>	Analog modulations added
APLC20/40	<b>Option PE2-20/40</b>	Mechanical step attenuator down to -120dBm
APLC50	<b>Option PE2-50</b>	Mechanical step attenuator down to -110dBm
APLC50	<b>Option PHS</b>	Phase coherent switching
APLC50	<b>Option ReCal</b>	Recalibration with test data (recommended: 2 years interval)
APLC50	<b>Option VREF</b>	Flexible external reference frequency support in range 1 to 250 MHz
APLC50	<b>Option WE</b>	One-year warranty extension (standard: 2 years)
APLC50	<b>Option DATA</b>	Commercial Calibration Certificate with test data (per channel)
APLC50	<b>Option FLASH</b>	MicroSD card slot for removable SD memory
APLC50	<b>Option GPIB</b>	GPIB interface

## GENERAL CHARACTERISTICS

### Remote programming interfaces:

- 1Gbit Ethernet interface
- USB 2.0 device
- GPIB (IEEE-488.2,1987) with listen and talk (Option GPIB)
- Control Language SCPI Version 1999.0

**Power requirements:** 100 - 240 VAC, 50 or 60 Hz, 200W maximum (80W + 30W per channel)

**Environmental:** Levels similar to MIL-PRF-28800F Class 3/4



Safety / EMC comply with applicable Safety and EMC regulations and directives.

**Weight:** ≤ 14.0 kg net

**Dimensions:** 19" 2HU HI enclosure

88 mm H x 440 mm W x 500 mm L



