DATASHEET APSYN140 Specification V1.14

Wideband Synthesizer

8 kHz to 40 GHz

CONTENTS

DEFINITIONS

The specifications in the following pages describe the warranted performance of the instrument for 23 ±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

Ultra-compact, fast and ultra-low phase noise Frequency Synthesizer with USB & LAN interface

The APSYN140 is a wideband low phase-noise synthesizer settable from 8 kHz to 40 GHz. The settable output power range is from -10 to +25 dBm.

The module has a milli-Hz frequency resolution and uses a high-stability internal reference. The internal reference can be phase-locked to a user-settable external reference. For highest phase coherence, multiple APSYN140 can be cascaded with just one master reference clock.

The APSYN140 offers dedicated sweeping capabilities with switching speeds of only 500 μs (20 μs with option FS) and internal phase and narrow pulse modulation.

The module has USB and LAN interfaces and can be controlled using the SCPI 1999 command set. Operated with an external 24V DC supply, it consumes less than 25 W.

FACTS & FIGURES & SPECIFICATIONS

Signal Specifications

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency Range	100 kHz		40 GHz	Settable from 100 kHz to 43.5 GHz
	8 kHz		40 GHz	Option 8K
Resolution		0.001 Hz		
Phase Resolution		0.01 deg		
Switching Speed		1.5 ms		after SCPI command received
CW Mode		500 µs		
Sweep / List Mode		500 µs		
		20 µs		Option FS

Frequency Reference

PARAMETER	MIN	TYPICAL	MAX	NOTE
Internal reference frequency		100 MHz		
		10 MHz		Option LN
Internal Reference Output Frequency				
Temperature stability			±100 ppb	0 to 50 degC
			±20 ppb	Option LN / LN+
Aging 1st year			1 ppm	
			0.03 ppm	Option LN
			0.02 ppm	Option LN+
Aging per day			5 ppb	after 30 days operations
			0.5 ppb	Option LN
			< 0.5 ppb	Option LN+
Warm-up time		5 min		
Output of internal reference		100 MHz		
		10 / 100 MHz		Option LN / LN+
Output power	0 dBm	5 dBm		
Output impedance		50 Ohms		
Bypass Internal reference Input		100 MHz		High phase synchronous mode *Options LN/LN+ are bypassed
Phase Lock to External Reference	1 MHz	10 MHz integer MHz	250 MHz	Option VREF *Options LN/LN+ are bypassed
Reference Bypass Mode		100 MHz		
Reference input level				
10 MHz or 1-250 MHz	-5 dBm	0 dBm	+13 dBm	
Bypass 100 MHz	5 dBm		+15 dBm	
Reference input impedance		50 Ohm		
Lock Range				
10 MHz or 1-250 MHz			±1.5 ppm	
Bypass 100 MHz			>100 ppm	

Level Performance

PARAMETER	MIN	TYPICAL	MAX	NOTE
Output power level				(see also plot)
10 MHz to 1.2 GHz	0 dBm		+20 dBm	
			+18 dBm	Option FILT
1.2 GHz to 20 GHz	-10 dBm		+20 dBm	
			+13 dBm	Option FILT
20 to 30 GHz	10 dBm		+20 dBm	
			+13 dBm	Option FILT
30 to 40 GHz	0 dBm		+18 dBm	
			+10 dBm	Option FILT
Power Resolution		0.5 dB		
Power Accuracy		±0.5 dB	±2 dB	

Figure 1: Maximum Output Power (Standard)
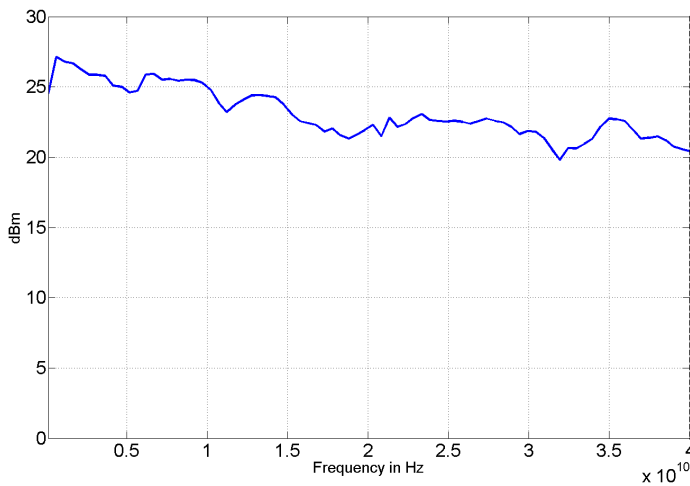
Figure 2: Maximum Output Power with FILT
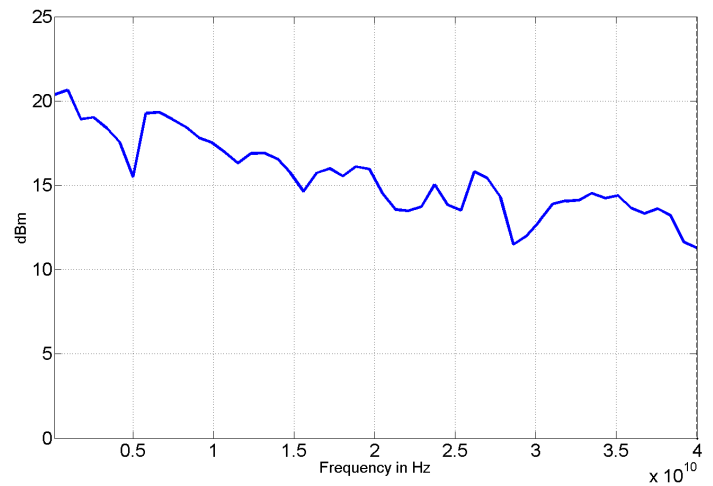
Reverse Power Protection and VSWR

PARAMETER	MIN	TYPICAL	MAX	NOTE
Reverse Power Protection				
DC Voltage		7 V		
RF Power			20 dBm	
Output impedance		50 Ohm		
VSWR		1.8		

Phase Noise

PARAMETER	MIN	TYPICAL	MAX	NOTE
SSB Phase noise at 1 GHz				(see also plot)
at 10 Hz from carrier		-93 dBc/Hz		Option LN / LN+
at 1 kHz from carrier		-130 dBc/Hz		
at 100 kHz from carrier		-145 dBc/Hz		
Wideband noise		-160 dBc/Hz		
SSB Phase noise at 10 GHz				
at 10 Hz from carrier		-73 dBc/Hz		Option LN / LN+
at 1 kHz from carrier		-110 dBc/Hz		
at 100 kHz from carrier		-125 dBc/Hz		
Wideband noise		-160 dBc/Hz		

Figure 3: Phase Noise Performance with Option LN

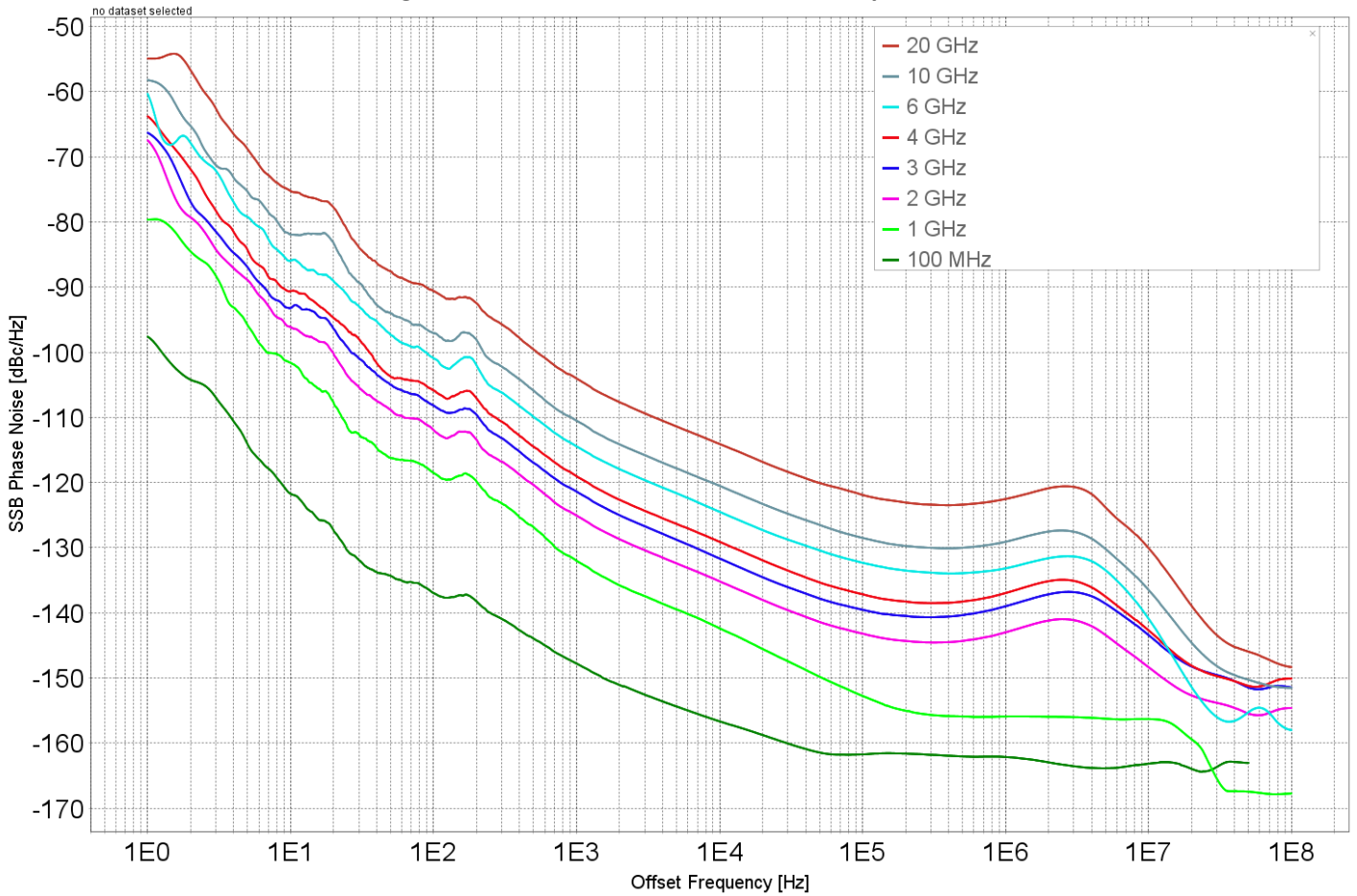**Figure 4: Phase Noise Performance without Option LN (10, 20, 30, 40 GHz)**
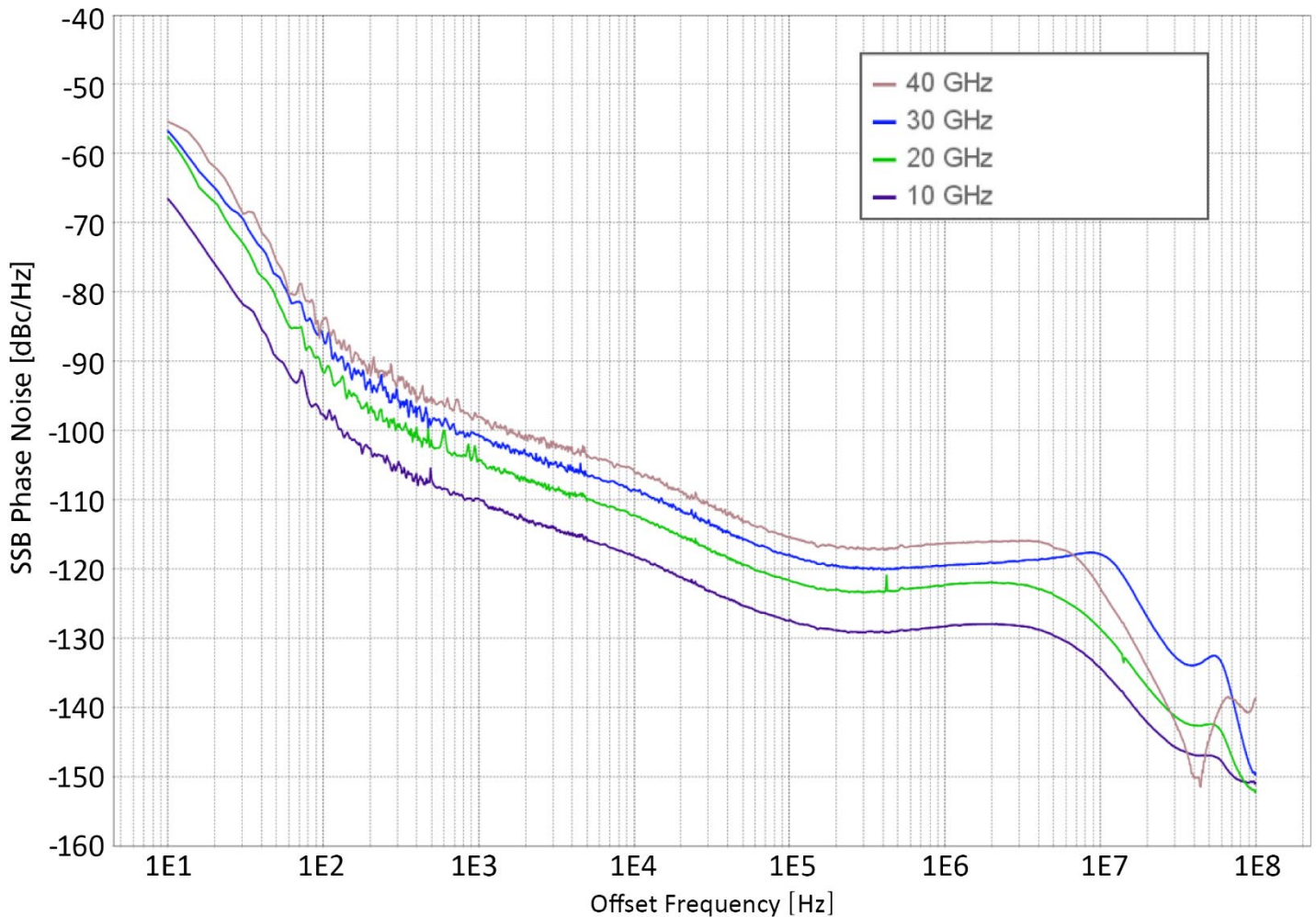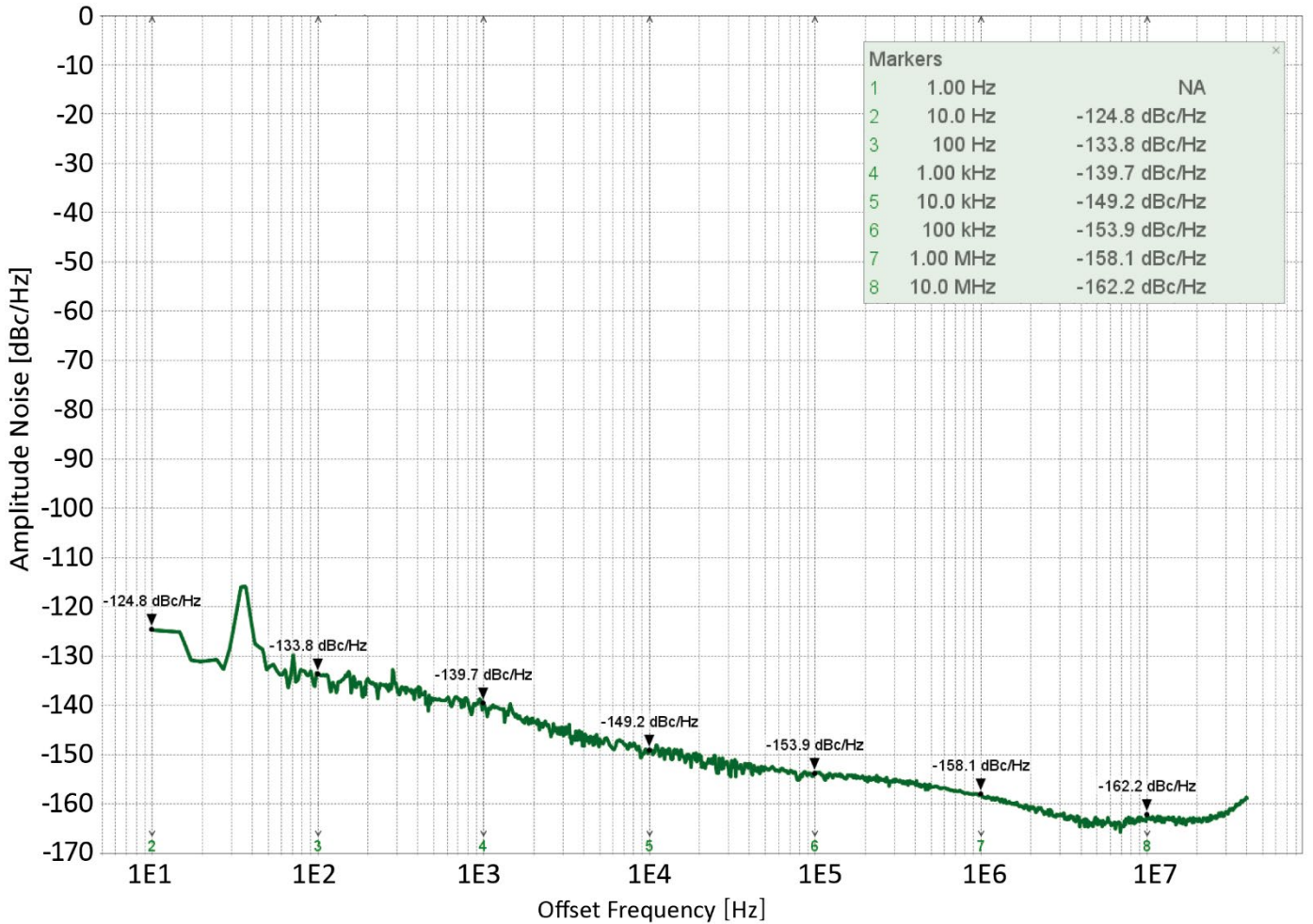
Figure 5: Amplitude Noise at 10 GHz

Markers		
1	1.00 Hz	NA
2	10.0 Hz	-124.8 dBc/Hz
3	100 Hz	-133.8 dBc/Hz
4	1.00 kHz	-139.7 dBc/Hz
5	10.0 kHz	-149.2 dBc/Hz
6	100 kHz	-153.9 dBc/Hz
7	1.00 MHz	-158.1 dBc/Hz
8	10.0 MHz	-162.2 dBc/Hz

Spectral Purity

PARAMETER	MIN	TYPICAL	MAX	NOTE
		-15 dBc		
Output harmonics		-55 dBc	-45 dBc	Option FILT, > 1 GHz
Sub-harmonics		-75 dBc	-45 dBc	< 20 GHz
		-50 dBc	-30 dBc	>20 GHz
Non-harmonic spurious		-75 dBc	-60 dBc	

Figure 6: Harmonics @ 0 dBm (with option FILT)

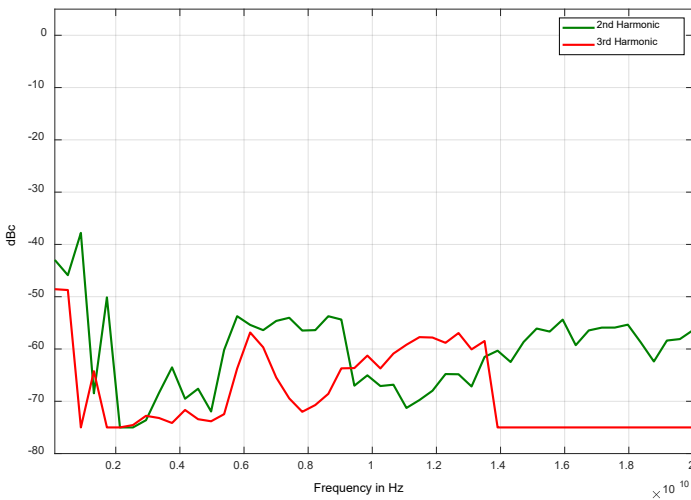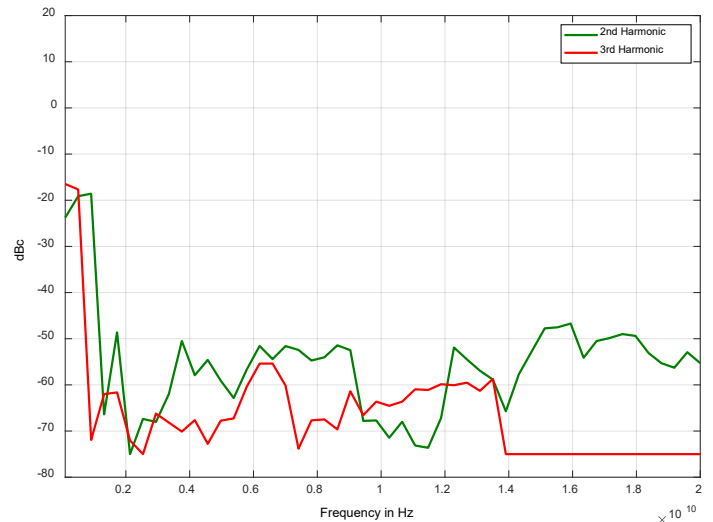### Figure 7: Harmonics +15 dBm(with option FILT)

Modulation Capabilities

Pulse Modulation

PARAMETER	MIN	TYPICAL	MAX	NOTE
Modulation source		Internal/ External		
Pulse rise/fall time		10 ns		
On/off ratio		40 dB		Pout > +10 dBm, see plot
Pulse overshoot			10%	
Pulse delay		20 ns		
Pulse polarity		Normal, inverse		selectable
External input threshold	0.85 V	0.9 V	0.95 V	TTL compatible
External input voltage range	-0.5 V		+5.5 V	TTL compatible
External input hysteresis		60 mV		

Figure 8: Pulse Modulation on-off ratio
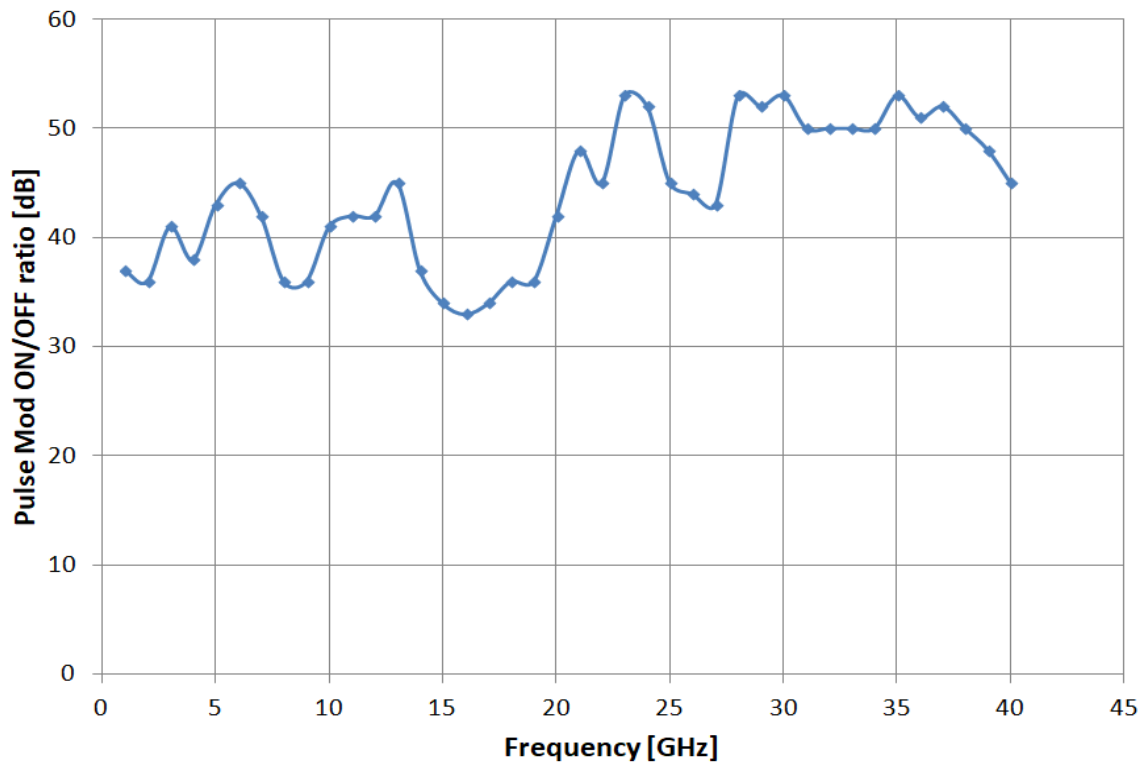
Internal pulse generator

PARAMETER	MIN	TYPICAL	MAX	NOTE
Repetition frequency (PRF)	0.1 Hz		100 MHz	= 1/T
Duty cycle	1 % to 99 % in 1% steps			within specified minimum pulse width
Pulse width settling range	30 ns		5 s	
Pulse Pattern Modulation & Staggered PRF				Using internal pattern generator
Programmable pattern length	2		65536	
Duty cycle	0.05%		99.95%	
Pulse period (T) accuracy		0.00005xT+ 3ns		
Pulse width accuracy		0.00005xT+ 5ns		
Pulse width resolution		5 ns		
Pulse jitter		2 ns	5 ns	
Polarity		selectable		

Frequency Modulation

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency Modulation				
Modulation source		Internal		
Maximum Frequency deviation (peak)		N · 400 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		80 kHz	
Modulation waveforms	Sine			

Phase Modulation

PARAMETER	MIN	TYPICAL	MAX	NOTE
Modulation source		Internal		
Phase deviation (peak)	0		$300 \cdot N \cdot$ rad	
Deviation accuracy		0.50%	2%	
Modulation rate	0.1 Hz		80 kHz	
Modulation waveforms		Sine		
Distortion (THD)		< 1%		1 kHz rate & N x rad deviation

Sweeping Capability

Sweep type: linear, logarithmic, random

PARAMETER	MIN	TYPICAL	MAX	NOTE
Frequency Sweep				
Step time (t_{step})	500 μs 20 μs			Option FS
Dwell time (t_{dwell})	15 μs			

Trigger (TRIG IN): Input is TRIG IN at front panel

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	
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		

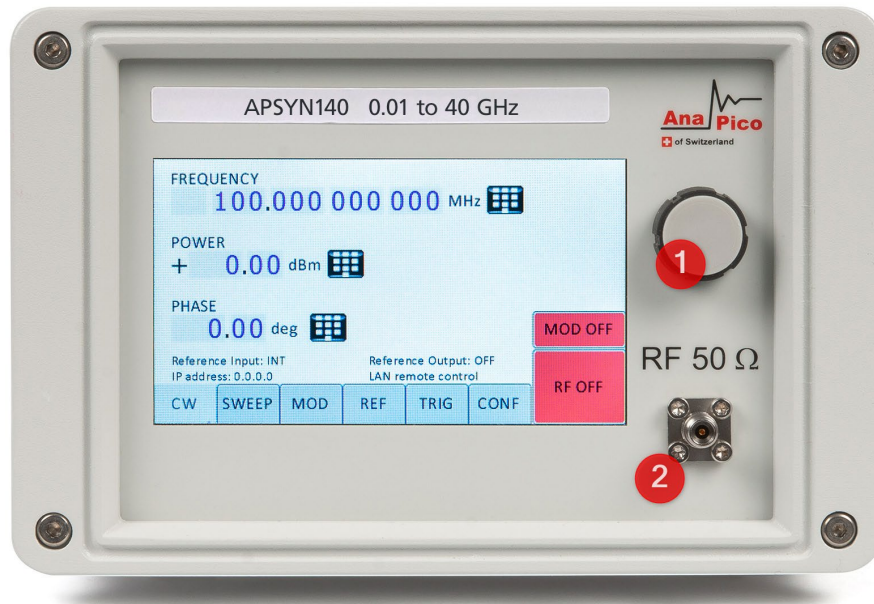## Connectors

Standard Front

1. **Power switch**
2. **RF connector** K-type (female)
3. **REF IN** External reference input: BNC female
4. **REF OUT** Internal reference output: BNC female
5. **PULSE** Pulse modulation input: BNC female
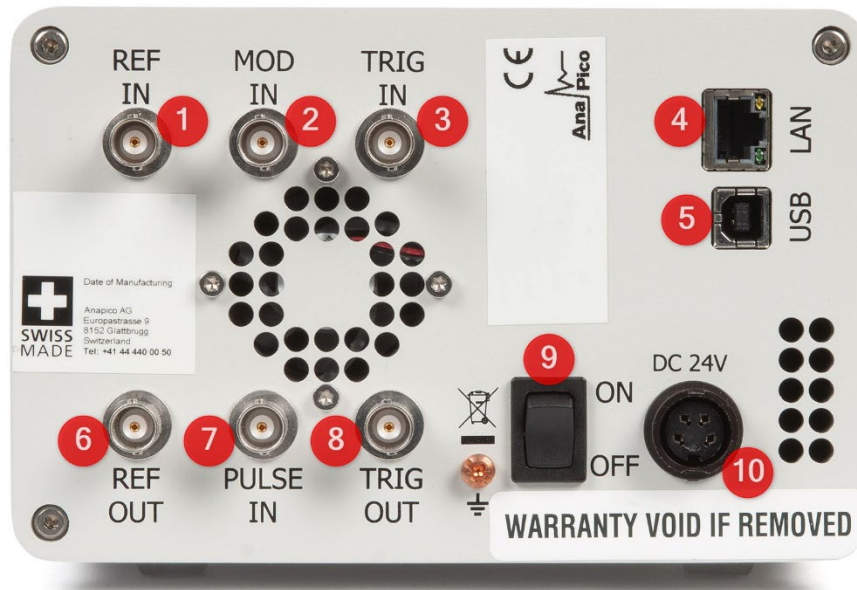6. **TRIG** Trigger input: BNC female

Standard Rear

1. **DC Power plug** (24 V, 3 A)
2. **LAN connection** RJ-45
3. **USB 2.0** host and device

Front with option TOUCH

1. **Rotary Button** The rotary button is used to change the value selected on the screen.

2. **RF 50 Ω connector** This female K-type connector provides the output for generator signals. The impedance is 50 ohm. The reverse power damage level is +20 dBm maximum. The maximum allowed DC level is +/- 7 V. Please check the data sheets for more details.

Rear with option TOUCH

1. **REF IN** External reference input: BNC female
2. **MOD IN** Modulation input for FM/PM: BNC female
3. **TRIG IN** Trigger input: BNC female
4. **LAN connection** RJ-45
5. **USB 2.0** host and device
6. **REF OUT** Internal reference output: BNC female
7. **PULSE IN** Pulse modulation input: BNC female
8. **TRIG OUT** Trigger output: BNC female
9. **DC power switch**
10. **DC Power plug** (24 V, 3 A)

ORDERING INFORMATION

HOST MODEL	PRODUCT	DESCRIPTION
APSYN140	APSYN140	100 kHz to 40 GHz Synthesizer, flange-mount module
APSYN140	Option 8K	Frequency range extension to 8 kHz
APSYN140	Option LN	Enhanced close in phase noise & frequency stability
APSYN140	Option LN+	Enhanced close in phase noise & further enhanced long term frequency stability
APSYN140	Option EB	External power bank adapter cable
APSYN140	Option FILT	Improved harmonic rejection (only in combination with Option TOUCH)
APSYN140	Option FS	Ultra-fast switching speed
APSYN140	Option TOUCH	Desktop / Portable instrument with color touch display
APSYN140	Option DATA	Commercial Calibration Certificate with test data (per channel)
APSYN140	Option IEC	IEC 17025 calibration with certificate
APSYN140	Option FLASH	MicroSD card slot for removable SD memory
APSYN140	Retrofit	Applies when options are back-ordered per channel
APSYN140	Option VREF	Variable external reference
APSYN140	Option WE	One year warranty extension (standard: 2 years)
APSYN140	Option ReCal	Recalibration with certificate (recommended: 2 years interval)

Remote programming interfaces
Ethernet 100BaseT LAN interface, USB 2.0, Control language SCPI Version 1999.0

Power requirements 24V ± 3.0 VDC; 25 W maximum

Mains adapter supplied: 100-240 VAC in/ 24 V 4.0 A DC out

Environmental (Levels similar to MIL-PRF-28800F Class 3/4)

Operating temperature range 0 to 45 °C

Storage temperature range –40 to 70 °C

Operating and storage altitude up to 15,000 feet (4600 m)

CE

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

Weight: ≤ 1.0 kg (2.2 lbs) net

Dimensions (W x L x H): 10.5 x 27 x 6 cm [4.13 x 10.63 x 2.36 in]

Document History

Version/Status	Date	Author	Notes
V10	2018-05-01	jk	first release
V101	2018-08-13	jk	
V102	2018-11-27	jk	Power ranges, Pictures, Ordering Info
V103	2018-12-10	mm	Introduction text
V1031	2019-01-28	db	Output of internal reference: 100 MHz
V104	2019-03-18	jk	Corrections
V110	2020-09-15	jk	Max power plot
V111	2021-02-25	db	Pulse and trigger input electrical specifications
V112	2022-11-18	yg	Add option FILT, TOUCH
V113	2022-10-02	ap/ee	Added option LN+, updated layout
V114	2024-02-07	ap/mh/yg	External reference mode amendment

AnaPico of Switzerland

Europa-Strasse 9
8152 Glattbrugg
Switzerland

Phone +41 44 440 00 50   www.anapico.com
Email   sales@anapico.com   www.anapico.com/downloads/

NOTES