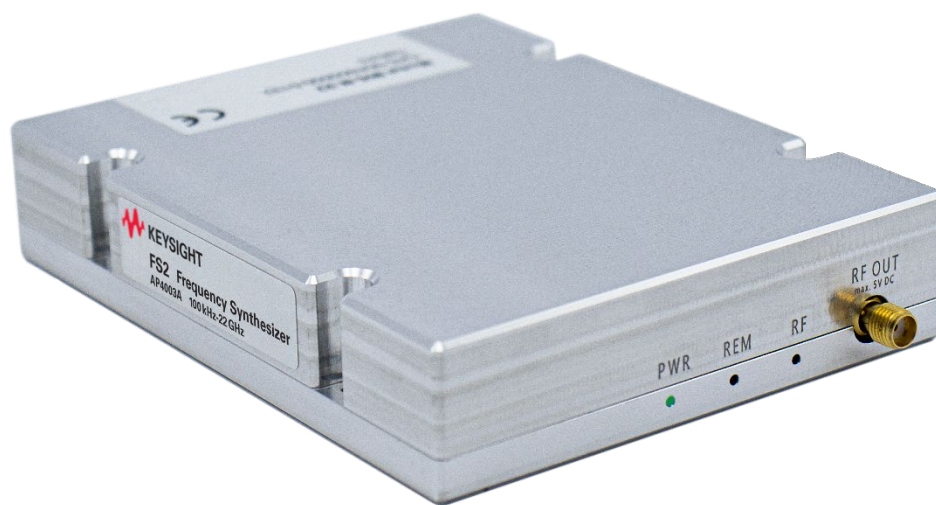


FS2 Frequency Synthesizer

Model AP4003A

100 kHz to 22 GHz



Definitions

The specifications in the following pages describe the warranted performance of the instrument for $23 \pm 5^\circ\text{C}$ after a 30-minute warm-up period (unless otherwise stated).

Min/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.

Typical: Expected mean values, not warranted performance.

Introduction

The FS2 Frequency Synthesizer (AP4003A) is a compact-size, low phase noise, ultra-fast hopping frequency synthesizer for signals in both CW and pulse form. It covers a frequency range of 100 kHz to 22 GHz, switches at 5 μs , and offers a power range from -30 to + 25 dBm. The phase noise at 1 GHz and 20 kHz offset is -131 dBc/Hz.

The synthesizer is excellently shielded and in a very compact flange-mountable form of 134 x 95 x 25 mm, weighs less than 0.5 kg, and consumes barely 14 W. It features an ETH communication port for local and remote connection to a PC for control over Graphical User Interface (GUI) software or SCPI commands.

Facts, Figures, and Specifications

Signal Specifications

Parameter	Min	Typical	Max	Note
Frequency range	100 kHz		22 GHz	
Frequency resolution		0.001 Hz		GUI SW setting resolution
Frequency switching time		500 μs 5 μs		Option UNZ
Phase adjustment range	0 deg		360 deg	
Phase resolution		0.1 deg		

Phase Noise

CW mode, power level 10 dBm, values in dBc / Hz.

Offset frequency	10 Hz		100 Hz		1 kHz		20 kHz		100 kHz		1 MHz		10 MHz	
	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.
100 MHz	-112	-105	-134	-129	-144	-139	-150	-145	-150	-145	-150	-145	-150	-145
1 GHz	-85	-75	-111	-106	-120	-115	-131	-128	-134	-131	-138	-135	-156	-151
2 GHz	-79	-71	-105	-100	-114	-110	-125	-122	-128	-125	-132	-129	-151	-148
5 GHz	-67	-59	-97	-92	-107	-103	-118	-115	-121	-118	-124	-121	-143	-140
10 GHz	-62	-54	-91	-86	-100	-96	-111	-108	-114	-111	-117	-113	-137	-134
20 GHz	-53	-45	-85	-80	-94	-90	-105	-102	-108	-105	-113	-110	-132	-129

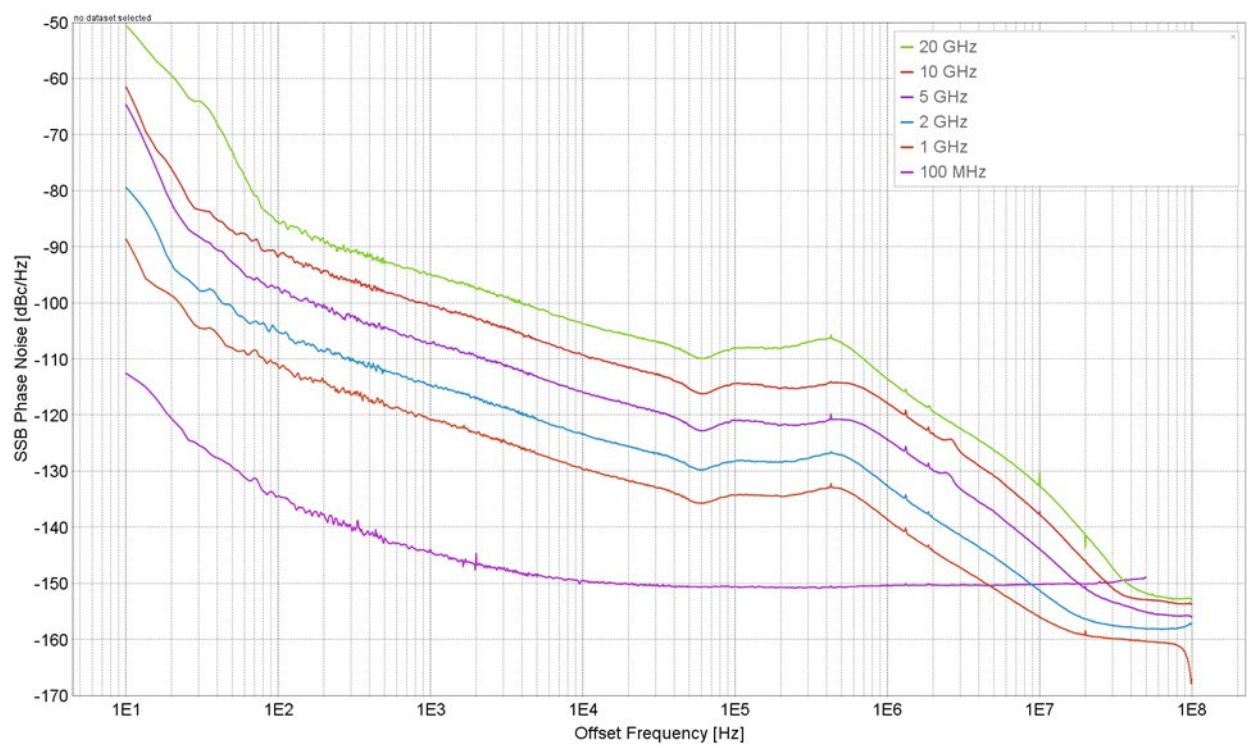


Figure 1. SSB phase noise performance

Spectral Purity

Parameter	Min	Typical	Max	Note
Harmonics				At 10 dBm; See plot below
< 4.5 GHz		-15 dBc	-5 dBc	
4.5 to 15.0 GHz		-25 dBc	-15 dBc	
15.0 to 22.0 GHz		-60 dBc	-50 dBc	
Sub-harmonics				At 10 dBm
< 11.0 GHz		-80 dBc		
11.0 GHz to 20.0 GHz		-70 dBc		
20.0 GHz to 22.0 GHz		-65 dBc		
Non-harmonic spurious				10 kHz to 0.5 GHz offset from carrier
< 1.0 GHz		-75 dBc		
1.0 GHz to 22.0 GHz		-60 dBc		

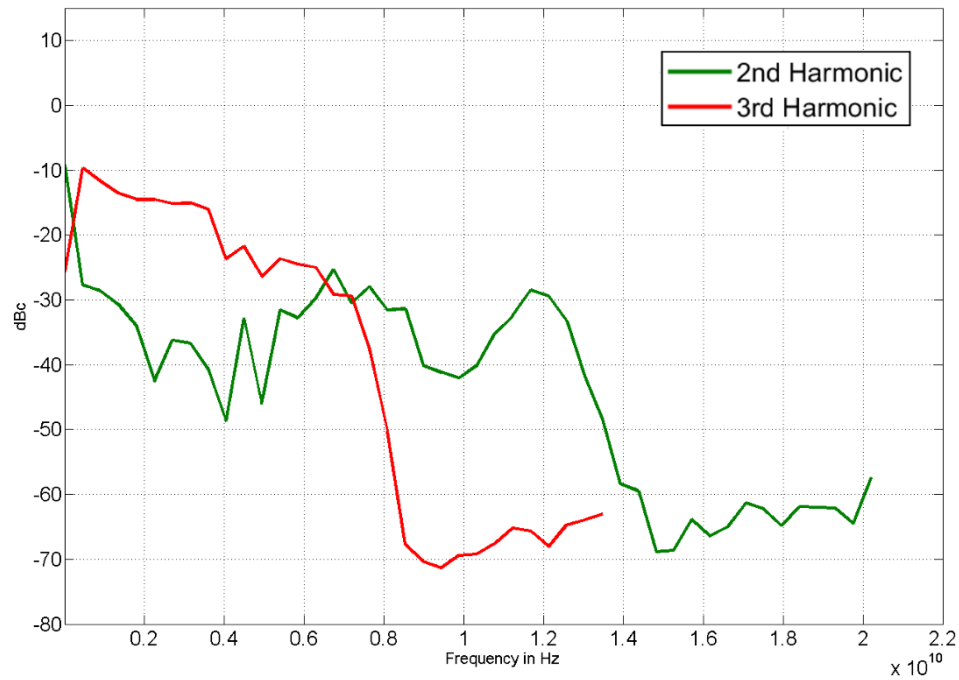


Figure 4. Harmonics (at 10 dBm output power)

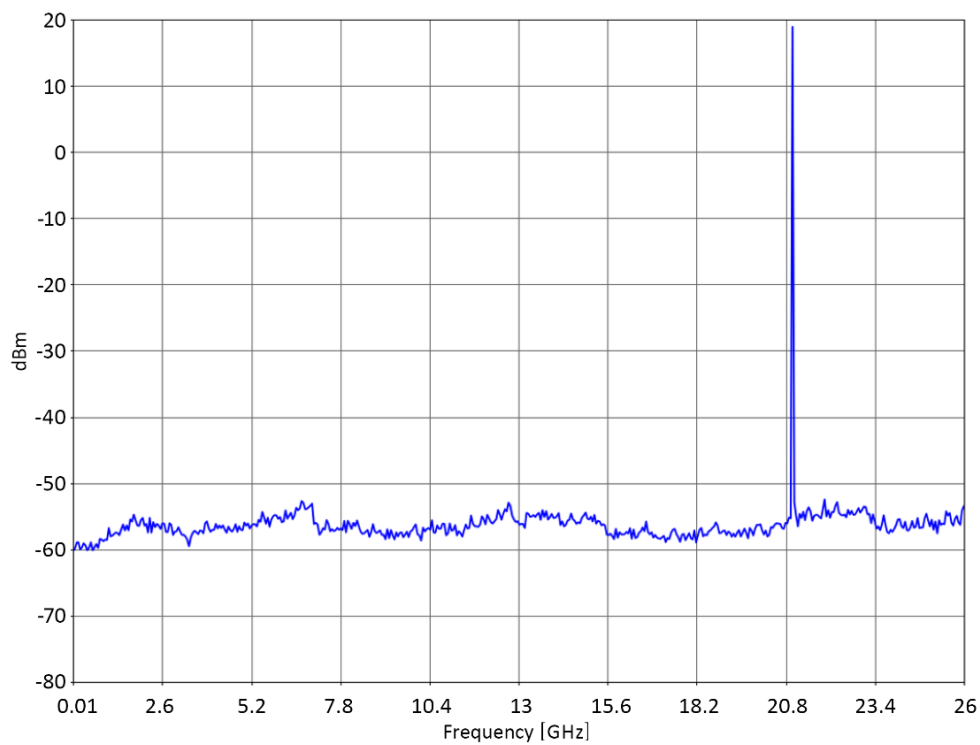


Figure 5. Wideband spectrum at 21 GHz output

Level Performance

Parameter	Min	Typical	Max	Note
Output power level				Settable to +30 dBm; See plot below
< 250 MHz	-20 dBm		20 dBm	
250 MHz to 15.0 GHz	-20 dBm		23 dBm	
15.0 GHz to 20.0 GHz	-20 dBm		18 dBm	
20.0 GHz to 22.0 GHz	-20 dBm		15 dBm	
Power level uncertainty		1.0 dB	2.0 dB	-20 to 20 dBm; < 20 GHz See plot below
Power resolution		0.5 dB		
Output impedance		50 Ω		
VSWR		1.7		
Reverse power protection				
DC voltage			7 V	
RF power			23 dBm	

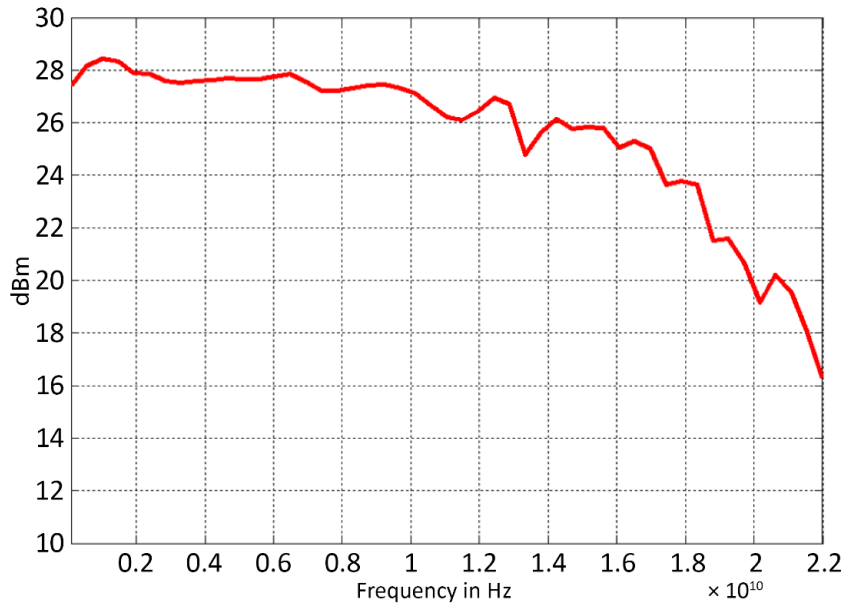


Figure 1. Typical maximum output power

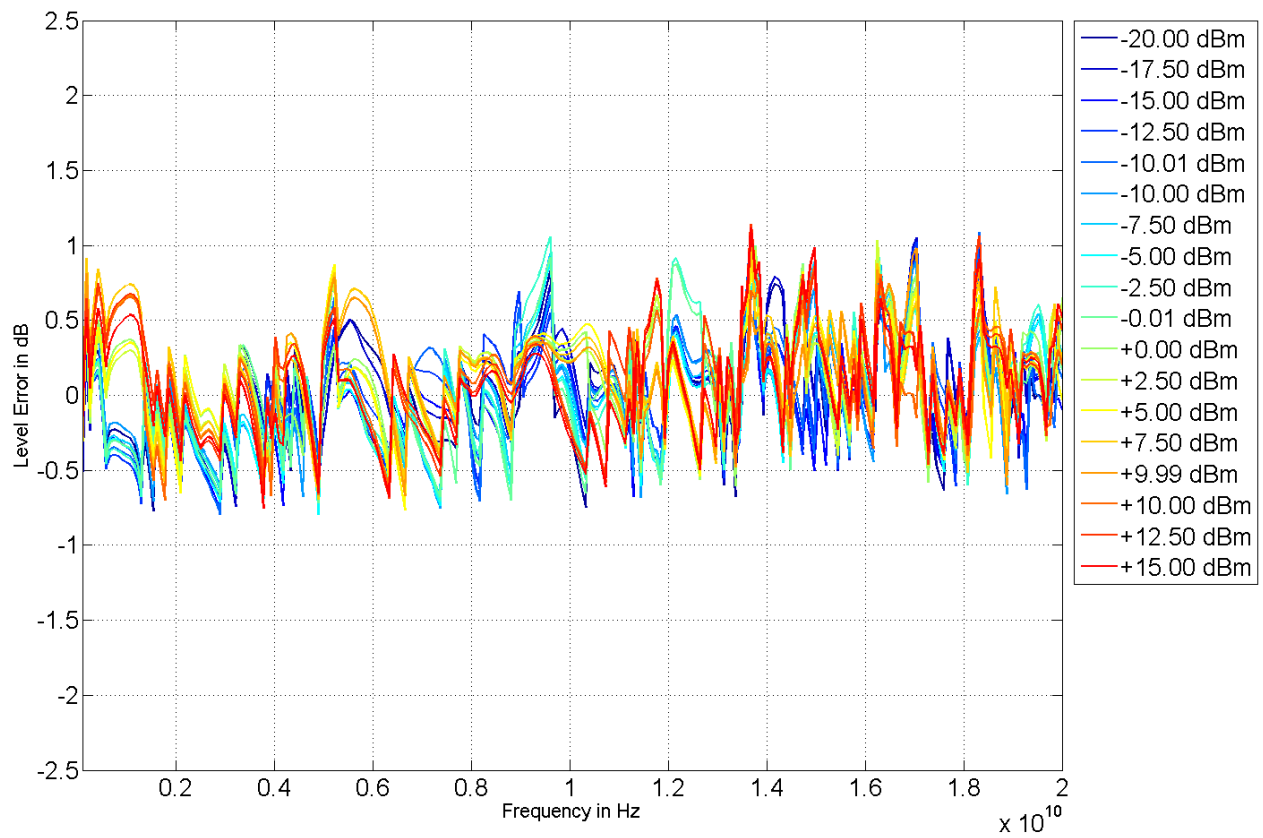


Figure 2. Frequency response

Reference Frequency

Parameter	Min	Typical	Max	Note
Internal reference frequency		100 MHz		
Calibrated accuracy of int. reference		±30 ppb		Calibrated at 23 ± 3 °C
Temperature stability (0 to 40 °C)			±100 ppb	
Aging 1st year			500 ppb	
Aging per day			5 ppb	After 30 days operation
Warm-up time		5 min		
Reference frequency input	100 MHz, 1 GHz			
Reference input level 100 MHz 1 GHz	-5 dBm -5 dBm		+10 dBm +10 dBm	
Lock range 100 MHz 1 GHz			±100 ppm ±100 ppm	
Reference input impedance		50 Ω		
Reference frequency output	1 GHz			
Output power	2 dBm		8 dBm	
Reference output impedance		50 Ω		
Reference architecture 100 MHz and 1 GHz external reference frequencies are bypassing the internal reference circuit and are acting directly as reference signal for the synthesizer.				

Modulation Capabilities

Parameter	Min	Typical	Max	Note
Pulse modulation				
Modulation source	Internal External (TRIG)			Trigger port can be reconfigured as external modulation port.
On / off ratio < 19.0 GHz 19.0 GHz to 22.0 GHz	60 dB 50 dB	70 dB 60 dB		At 10 dBm
Pulse rise / fall time		9 ns		
Pulse polarity	Normal Inverse			Selectable
External pulse latency		45 ns	60 ns	
Internal pulse generator				
Repetition frequency	47.6 mHz		25 MHz	=1/T
Pulse width	30 ns		21 s	Pulse width <= Pulse period
Pulse width resolution		10 ns		

Sweeping Capability

Parameter	Min	Typical	Max	Note
Sweep parameters	Frequency, power, list			
Number of list points	1		50'000	
Sweep type	Linear, random			
Step time	500 μs 10 μs		21 s 21 s	Option UNZ
Step delay/off time	0 s		21 s	
Timing resolution		10 ns		
Timing accuracy per point		20 ns		
Generalized list sweep				
Allows for individual setting of frequency, power, step-time and off-time for each point				

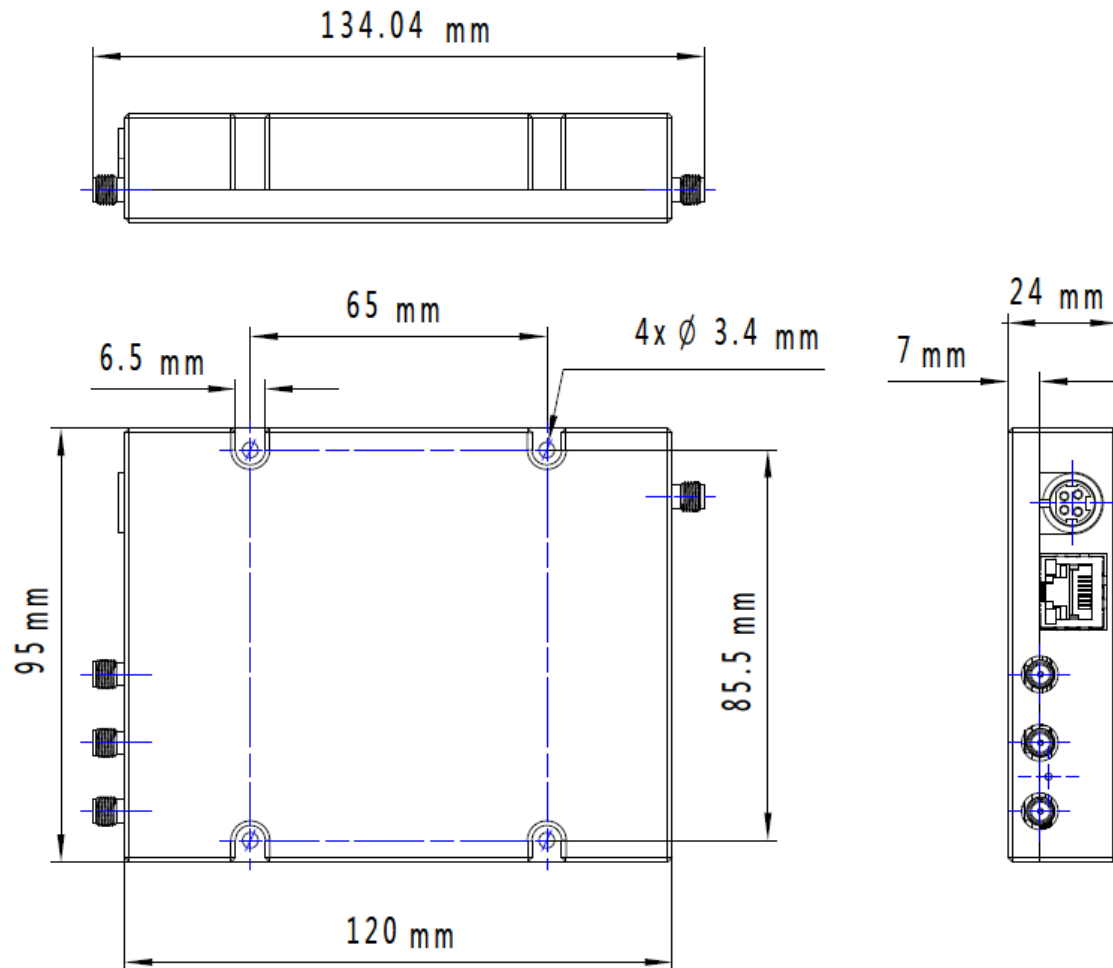
Trigger (TRIG)

Parameter	Min	Typical	Max	Note
Trigger types	Continuous Single (point) Gated			
Trigger source	External (TRIG) Bus (Ethernet)			
Trigger modes	Continuous free run Trigger and run			
External trigger latency		140 ns		
External trigger uncertainty		20 ns		
External trigger delay	0 s		20 s	Settable
External delay resolution		10 ns		
Trigger modulo	1		255	Execute only on Nth trigger event
Trigger polarity	Rising Falling			
Gated trigger polarity	Normal Inverse			
External TRIG input threshold	0.85 V	0.9 V	0.95 V	TTL compatible
External TRIG input voltage range	-0.5 V		+5.5 V	TTL compatible 10 k Ω pull-down
External TRIG input hysteresis		60 mV		

Mechanical Specifications

Dimensions and Weight

Including connectors	W x L x H = 134 x 95 x 24 mm
Excluding connectors	W x L x H = 120 x 95 x 24 mm
Weight	< 0.5 kg



Installation Instructions

The module relies on passive and/or active cooling. It is mandatory to mount the device on a heatsinking surface. Make sure the synthesizer operates under the conditions specified in this datasheet. Otherwise, the thermal protection will turn off the RF output.

Interfaces

Front Panel

Label	Type	Description
1. PWR	LED	Power ON / OFF indicator
2. REM	LED	Remote connection status indicator
3. RF	LED	RF output ON / OFF indicator
4. RF OUT	SMA	RF output



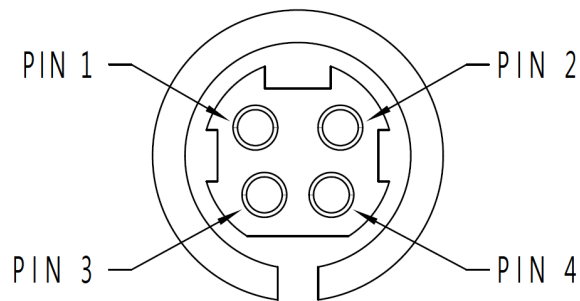
Rear Panel

Label	Type	Description
1. DC IN	KPJX-4S (Kycon)	DC input (see also chapter "Power connector assembly")
2. ETH	RJ-45	Ethernet port
3. REF IN	SMA	Reference signal input
4. TRIG	SMA	Trigger / Pulse interface
5. RST	Button	Reset button
6. REF OUT	SMA	Reference signal output



Power Connector Assembly

Pin	Assignment
1	GND
2	DC supply (see also "Power requirements")
3	GND
4	DC supply (see also "Power requirements")



The power connector is a 4 pin, snap and lock receptacle. Keysight recommends Kycon manufactured plugs KPPX-4P from its KPPX series.

Reset Functionality

The reset functionality of the device can be used if the device has a wrong configured IP address and cannot be found in the local area network anymore. While pressing the reset button (> 2 s), the device will be reconfigured to auto IP addressing mode (DHCP/Zero-conf) and restarts itself. After the device is up and running again, it gets a new IP address and can be discovered by the Keysight Signal Generator UI.

Order Information

Model Number	Option Number	Description
AP4003A	522	Frequency range, 100 kHz to 22 GHz
AP4003A	UNZ	Fast switching
AP4003A	UK6	Commercial calibration certificate with test data

General Characteristics

Remote programming interfaces:

1 Gbit Ethernet

Control language: SCPI Version 1999.0

Power requirements: 24 VDC; 14 W typical, 17 W maximum

Mains adapter supplied: 100 – 240 VAC, 50/60 Hz, 1.4 A max in / 24 V, 2.7 A DC out

Storage temperature range: -20 to 80 °C

Operating temperature range: 0 to 40 °C

Operating humidity range: 20 to 80% (non-condensing)

Operating altitude: up to 2,000 m



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

Recommended calibration cycle: 24 months