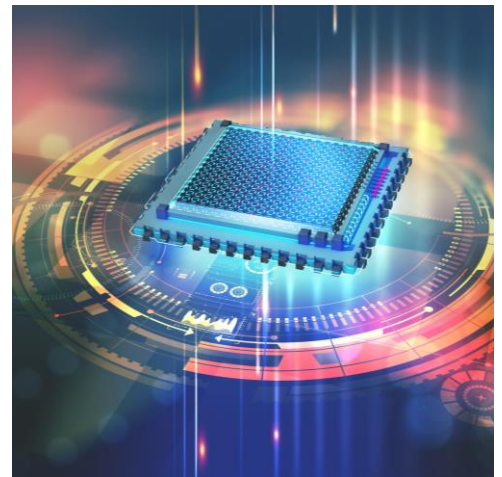


# Model 866-M Compact Frequency Synthesizer



## Features

- Small size flange-mount module
- CW and pulse modulation
- Low power consumption as low as 23 W, passive cooling

## Applications

- System clock source
- Multi-channel phase-coherent configurations for radar signal generation and testing
- Spectroscopy



### Model 866-M

1 MHz to 40 GHz Compact Frequency Synthesizer

# CONTENTS

<b>CONTENTS</b> .....	<b>2</b>
<b>DEFINITIONS</b> .....	<b>3</b>
<b>INTRODUCTION</b> .....	<b>3</b>
<b>FACTS &amp; FIGURES &amp; SPECIFICATIONS</b> .....	<b>4</b>
Signal Specifications .....	4
Frequency Reference .....	4
Level Performance .....	5
Level Uncertainty .....	5
Reverse Power Protection and VSWR .....	6
Phase Noise .....	6
Spectral Purity .....	7
Modulation Capability .....	8
Sweeping Capability .....	9
Trigger (TRIG) .....	9
<b>MECHANICAL SPECIFICATIONS</b> .....	<b>10</b>
Dimensions & Weight .....	10
Installation Instructions .....	10
<b>CONNECTORS</b> .....	<b>11</b>
Front Panel .....	11
Rear Panel .....	11
Power Connector Assembly .....	12
Reset Functionality .....	12
<b>ORDERING INFORMATION</b> .....	<b>13</b>
<b>GENERAL CHARACTERISTICS</b> .....	<b>13</b>
Document History .....	14
<b>NOTES</b> .....	<b>15</b>

## 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 (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 Model 866-M is a compact-size frequency synthesizer for the generation of accurate and stable frequency signals in both CW and pulse form, covering a frequency range of 1 MHz to 40 GHz, with a fast-switching time of 50  $\mu$ s, an output power of -20 to +25 dBm. The device shows excellent phase noise performance, e.g., at 10 GHz and 20 kHz offset -127 dBc/Hz is measured.

The synthesizer is in a very compact flange-mountable form of 6.5 x 2.4 x 1 inches [165 x 60 x 26 mm], weighs less than 1.3 lbs, and consumes less than 23 W and is only passively cooled. The Ethernet communication port is used for remote connection to a PC for control over GUI software using standard SCPI commands.

The module can receive and provide external references of 100 MHz or 1 GHz. Multiple units can be phase synchronized with one unit acting as the master and the others as slaves, to implement multi-channel PHASE-COHERENT outputs.

The product is suitable for many applications: as low phase noise system clock or reference sources, in the multi-channel phase-coherent configurations for radar, EW, quantum computing, etc.

## FACTS & FIGURES & SPECIFICATIONS

### Signal Specifications

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Frequency Range</b>	1 MHz		40 GHz	
Frequency Resolution		0.001 Hz		GUI SW setting resolution
Phase Adjustment Range	0 deg		360 deg	
Phase Resolution		0.1 deg		
Switching Speed		500 $\mu$ s 50 $\mu$ s	85 $\mu$ s	Option FS

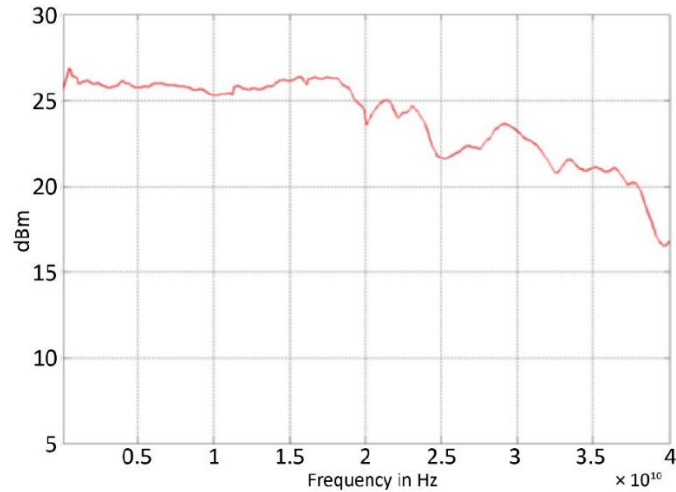
### Frequency Reference

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Internal reference frequency</b>		100 MHz		
Calibrated accuracy of int. reference		$\pm 30$ ppb		Calibrated at $23 \pm 3$ °C
Temperature stability (0 to 50 °C)			$\pm 100$ ppb	
Aging 1 <sup>st</sup> year			500 ppb	
Aging per day			5 ppb	After 30 days operation
Warm-Up time		5 min		
<b>Reference frequency input</b>	100 MHz, 1 GHz			
Reference input level				
100 MHz	-5 dBm		+10 dBm	
1 GHz	-5 dBm		+10 dBm	
Reference input impedance		50 $\Omega$		
<b>Reference frequency output</b>	100 MHz, 1 GHz			100 MHz reference out not possible when using 1 GHz external reference
Output power				
100 MHz	0 dBm		5 dBm	
1 GHz	-1 dBm		5 dBm	
Reference output impedance		50 $\Omega$		
<b>Multi-Channel configurability</b>				
Recommended configuration	One master and multiple slave units are synchronized by the common 1 GHz reference from the master unit			
Relative phase stability among the multi-channels (phase coherence)		15 mrad		@ 5 GHz over 5 hours

## Level Performance

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Output power level</b>				See plot below
< 1 GHz	-10 dBm		24 dBm	
1 GHz to 18 GHz	-10 dBm		25 dBm	
18 GHz to 23 GHz	-10 dBm		23 dBm	
23 GHz to 32 GHz	-20 dBm		21 dBm	
32 GHz to 40 GHz	-20 dBm		17 dBm	
<b>Power resolution</b>		0.5 dB		

Figure 1: Typical Maximum Output Power



## Level Uncertainty

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Power level uncertainty</b>				See plots below
<15 GHz		0.5 dB	1.0 dB	0 to 15 dBm
15 GHz to 35 GHz		1.0 dB	1.5 dB	0 to 15 dBm
35 GHz to 40 GHz		1.0 dB	2.0 dB	0 to 15 dBm

Figure 2: Power Level Linearity

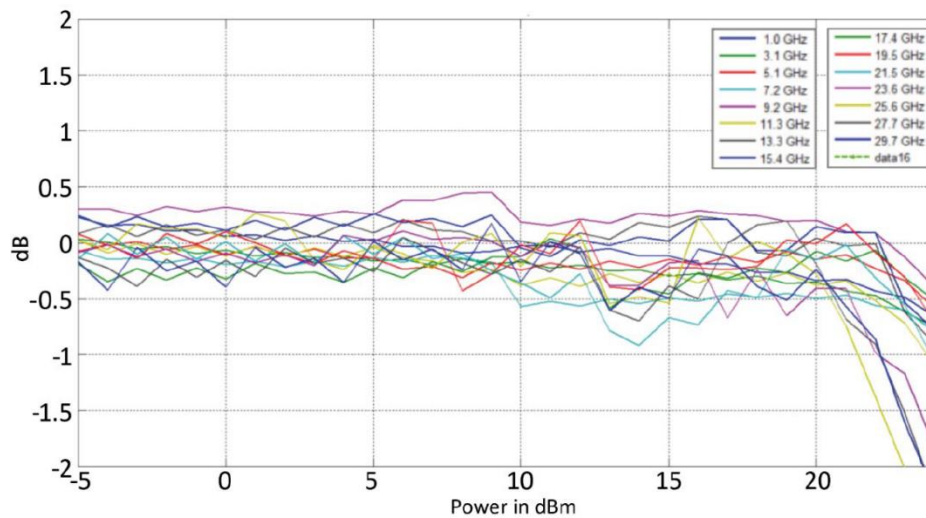
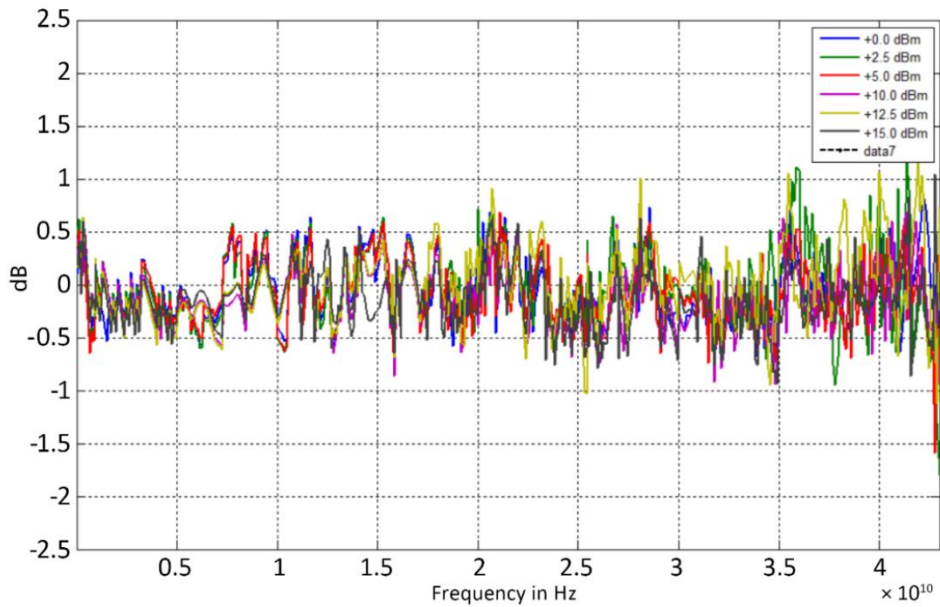


Figure 3: Frequency Response



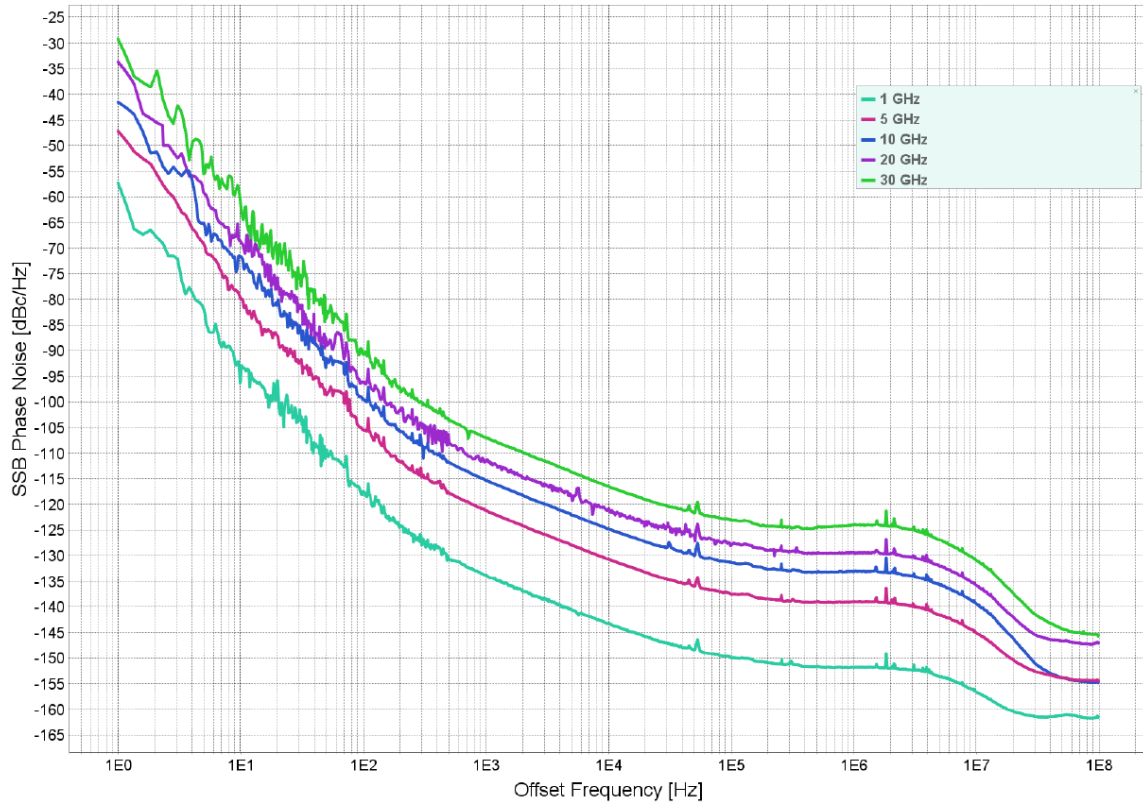
### Reverse Power Protection and VSWR

PARAMETER	MIN	TYPICAL	MAX	NOTE
Output impedance		50 $\Omega$		
VSWR		1.7		
Reverse power protection				
DC voltage			7 V	
RF power			23 dBm	

### Phase Noise

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>SSB Phase noise at 1 GHz</b>				See plot below
at 10 Hz from carrier		-87 dBc/Hz	-80 dBc/Hz	
at 1 kHz from carrier		-130 dBc/Hz	-125 dBc/Hz	
at 100 kHz from carrier		-145 dBc/Hz	-140 dBc/Hz	
at 10 MHz from carrier		-155 dBc/Hz	-150 dBc/Hz	
<b>SSB Phase noise at 10 GHz</b>				See plot below
at 10 Hz from carrier		-66 dBc/Hz	-60 dBc/Hz	
at 1 kHz from carrier		-113 dBc/Hz	-108 dBc/Hz	
at 100 kHz from carrier		-129 dBc/Hz	-124 dBc/Hz	
at 10 MHz from carrier		-138 dBc/Hz	-133 dBc/Hz	

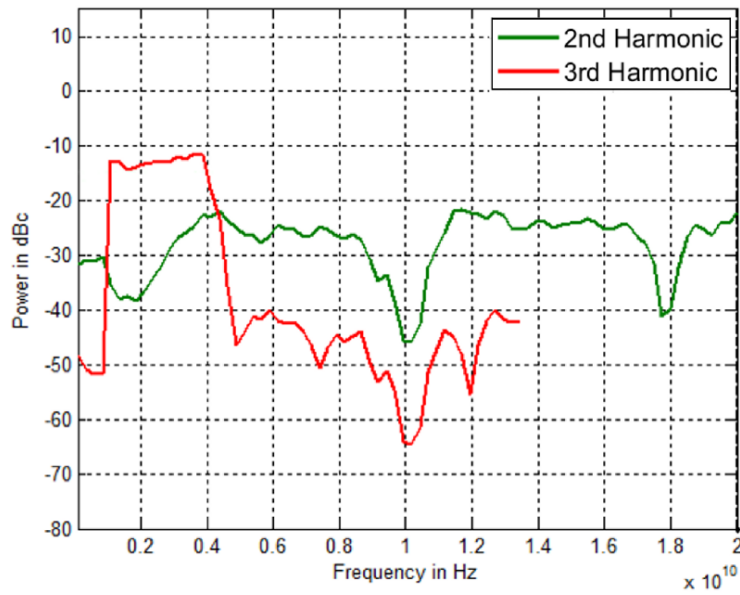
Figure 4: SSB Phase Noise Performance



**Spectral Purity**

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Harmonics</b>				At 10 dBm; See plot below
< 1 GHz		-30 dBc	-25 dBc	
1 GHz to 4 GHz		-15 dBc	-10 dBc	
4 GHz to 20 GHz		-25 dBc	-15 dBc	
20 GHz to 40 GHz		-20 dBc		
<b>Sub-harmonics</b>				At 10 dBm
< 4 GHz		-80 dBc	-70 dBc	
4 GHz to 20 GHz		-70 dBc	-75 dBc	
20 GHz to 40 GHz		-55 dBc	-40 dBc	
<b>Non-harmonic spurious</b>				>10 kHz offset
< 1 GHz		-55 dBc	-50 dBc	
1 GHz to 20 GHz		-70 dBc	-60 dBc	
20 GHz to 40 GHz		-60 dBc		

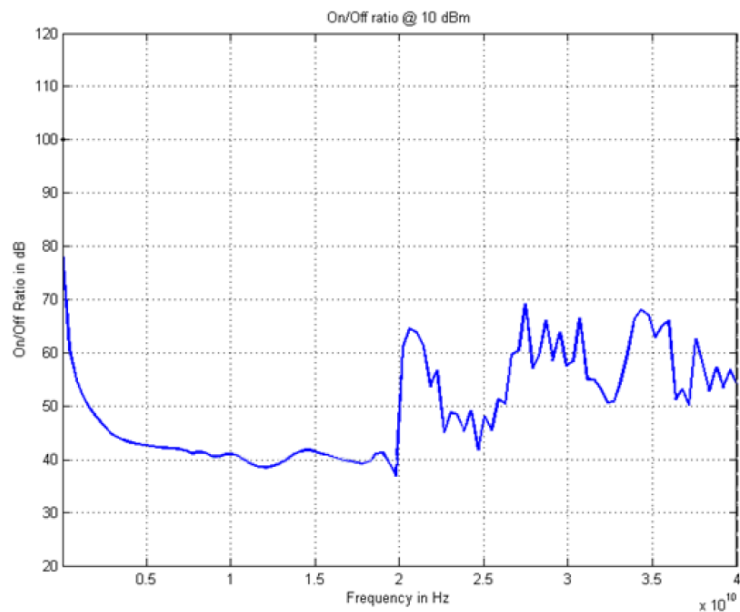
**Figure 5: Harmonics (at 10 dBm Output Power)**



**Modulation Capability**

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Pulse modulation</b>				
Modulation source	Internal External			Trigger port can be reconfigured as external modulation port
On/off ratio				At 10 dBm; See plot below.
< 1 GHz		60 dB	50 dB	
1 GHz to 20 GHz		40 dB	30 dB	
20 GHz to 27 GHz		45 dB	35 dB	
27 GHz to 40 GHz		55 dB	45 dB	
Repetition frequency	DC		10 MHz	
Pulse width	30 ns		20 s	
Pulse rise/fall time		9 ns		
Pulse train length	1		4096	

**Figure 6: On/Off Ratio – Pulse Modulation (at 10 dBm Output Power)**





## Sweeping Capability

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Sweep parameters</b>	Frequency, power, list			
<b>Sweep type</b>	Linear, logarithmic, random			
Step Time	500 $\mu$ s 50 $\mu$ s		20 s 20 s	<b>Option FS</b>
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.

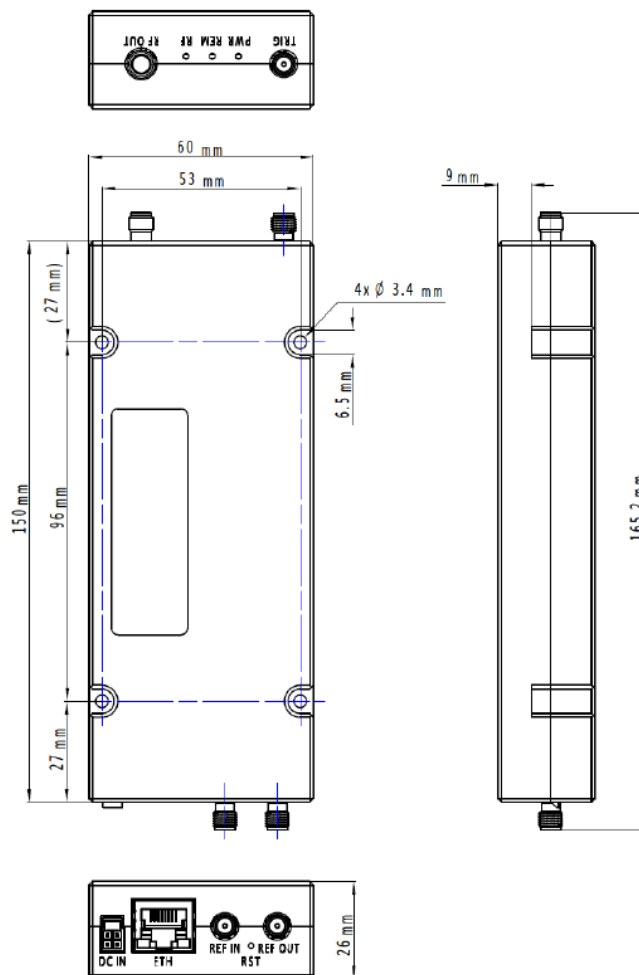
## Trigger (TRIG)

PARAMETER	MIN	TYPICAL	MAX	NOTE
<b>Trigger types</b>	Continuous Single (point) Gated Gated direction			
<b>Trigger source</b>	External Ethernet			
<b>Trigger modes</b>	Continuous free run Trigger and run Reset 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		
<b>Trigger modulo</b>	1		255	Execute only on Nth trigger event
<b>Trigger polarity</b>		Rising Falling		
<b>External trigger input threshold</b>	0.85 V	0.9 V	0.95 V	TTL compatible
<b>External trigger input voltage range</b>	-0.5 V		+5.5 V	TTL compatible
<b>External trigger input hysteresis</b>		60 mV		

## MECHANICAL SPECIFICATIONS

### Dimensions & Weight

Dimensions / Weight	
Including Connectors	W x L x H = 6.5 x 2.4 x 1" [165 x 60 x 26 mm] / 1 lb [0.45 kg]



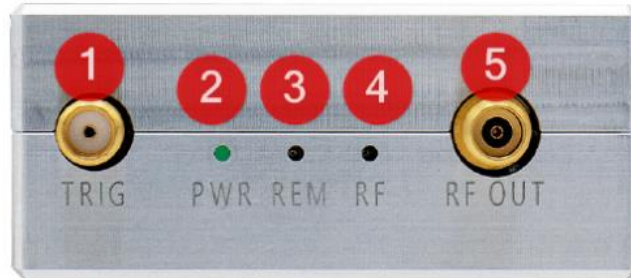
### Installation Instructions

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

## CONNECTORS

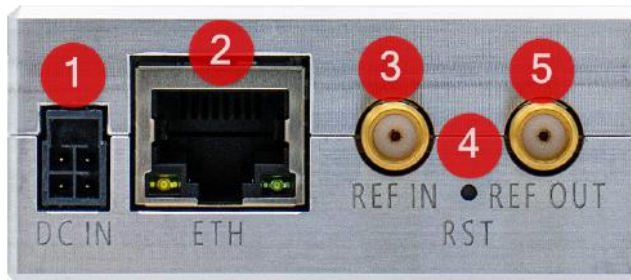
### Front Panel

LABEL	TYPE	DESCRIPTION
1. TRIG	SMA	Trigger Signal input
2. PWR	LED	Power ON/OFF indicator
3. REM	LED	Remote connection status indicator
4. RF	LED	RF output ON/OFF indicator
5. RF OUT	2.92 mm	RF output



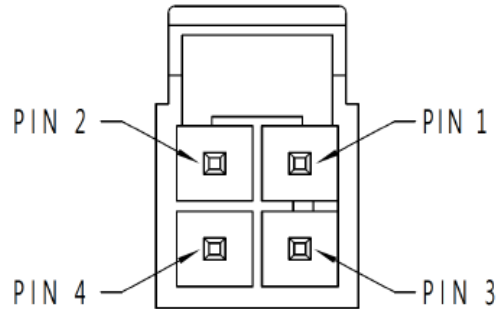
### Rear Panel

LABEL	TYPE	DESCRIPTION
1. DC IN	1053141104 (Molex)	DC input (see also chapter "Power Connector Assembly")
2. ETH	RJ-45	Ethernet port
3. REF IN	SMA	Reference Signal input
4. RST	Button	Reset Button
5. REF OUT	SMA	Reference Signal output



## Power Connector Assembly

PIN	ASSIGNMENT
1	DC Supply (see also "Power requirements")
2	GND
3	DC Supply (see also "Power requirements")
4	GND



The power connector is a 4 pin, 2.50 mm spaced double-row header. BNC recommends Molex manufactured receptacles 1053081204 and contacts 1053002200 with TPA retainer 1053252002 from its Nano-Fit 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 BNC Signal Generator UI.

## ORDERING INFORMATION

HOST MODEL	PRODUCT	DESCRIPTION
866-M	866-M	40 GHz wideband frequency synthesizer module (with AC adapter)
866-M	Option FS	Fast Switching

## GENERAL CHARACTERISTICS

### Remote Programming Interfaces:

Ethernet

Control language: SCPI Version 1999.0

**Power requirements:** 24±6 VDC; 23 W maximum

**Mains adapter supplied:** 100-240 VAC in / 24 V, 2.7 A DC out

**Storage temperature range:** -40 to 70 °C

**Operating temperature range:** 0 to 45 °C, non-condensing

**Operating and storage altitude:** up to 15,000 feet



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

**Recommended calibration cycle:** 24 months



