

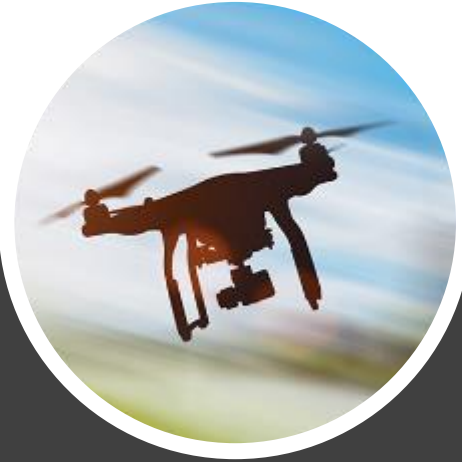
Defense Product Solutions



Rakon's Key Markets and Products



TELECOMMUNICATIONS



GLOBAL POSITIONING



SPACE & DEFENSE



EMERGING & OTHER

- SUB-SYSTEMS
- USO
- OCSSO
- OCXO
- TCXO
- VCXO
- XO
- SAW FILTERS
- CRYSTAL RESONATORS



Rakon Frequency Control Products



CRYSTALS	CRYSTAL FILTERS	XOs	VCXO & VCSOs	TCXOs	OCXOs	SAW AND RSS
SMD 	Hi-Rel Defense 	Low Noise & Jitter 	Low Noise & Jitter 	High Stability 	IC-OCXO 	SAW Filters 
T-sensing 	Hi-Rel Space 	Selectable 	Selectable 	Ultra Stable 	Discrete OCXO 	OCXO 
<i>g</i> -performance 	Hi-Rel Defense 	Hi-Rel Space 	Hi-Rel Space 	<i>g</i> -Performance 	Hi-Rel Defense 	VCXO 
Hi-Rel Space 	Hi-Rel Space 	New Space 	Hi-Rel Space 	Hi-Rel Space 	Sub-Systems 	
		New Space 	Defense & Hi-Rel 		New Space 	

Key Markets vs Product Families



TELECOMMUNICATIONS	GLOBAL POSITIONING	HI-REL SPACE	NEW SPACE	DEFENSE & OTHER HI-REL APPS	INSTRUMENTATION
<p>Crystal resonators</p> 	<p>Crystal resonators</p> 	<p>Crystal resonators</p> 	<p>XO</p> 	<p>Crystal resonators</p> 	<p>High Stability OCXO</p> 
<p>XO</p> 	<p>XO</p> 	<p>Crystal filters</p> 	<p>VCXO</p> 	<p>Crystal & SAW filters</p> 	<p>Low Noise OCXO</p> 
<p>VCXO</p> 	<p>VCXO</p> 	<p>XO</p> 	<p>OCXO</p> 	<p>XO</p> 	<p>Low Noise OCSO</p> 
<p>TCXO</p> 	<p>TCXO</p> 	<p>VCXO</p> 		<p>Low g-sensitivity TCXO</p> 	<p>Synthesizers</p> 
<p>OCXO</p> 		<p>TCXO</p> 		<p>Low Noise OCXO & OCSO</p> 	
		<p>OCXO</p> 		<p>Sub-Systems & Synthesizers</p> 	

Defense Solutions – XO, TCXO and OCXO



XO, TCXO, OCXO

LOW NOISE OSCILLATORS

HIGH STABILITY OSCILLATORS

SUB-SYSTEMS

APPLICATIONS: JET FIGHTERS, MISSILES, LAND & SEA-BASED RADARS, ELECTRONIC WARFARE SYSTEMS, UAVS

High Performance XO – RX05032AD

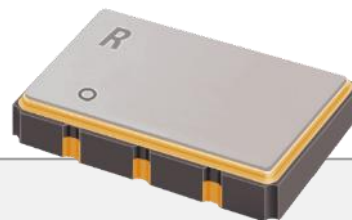


RX05032AD XO Applications:

- ❑ Aeronautics
- ❑ Defense systems
- ❑ High Reliability applications

Features:

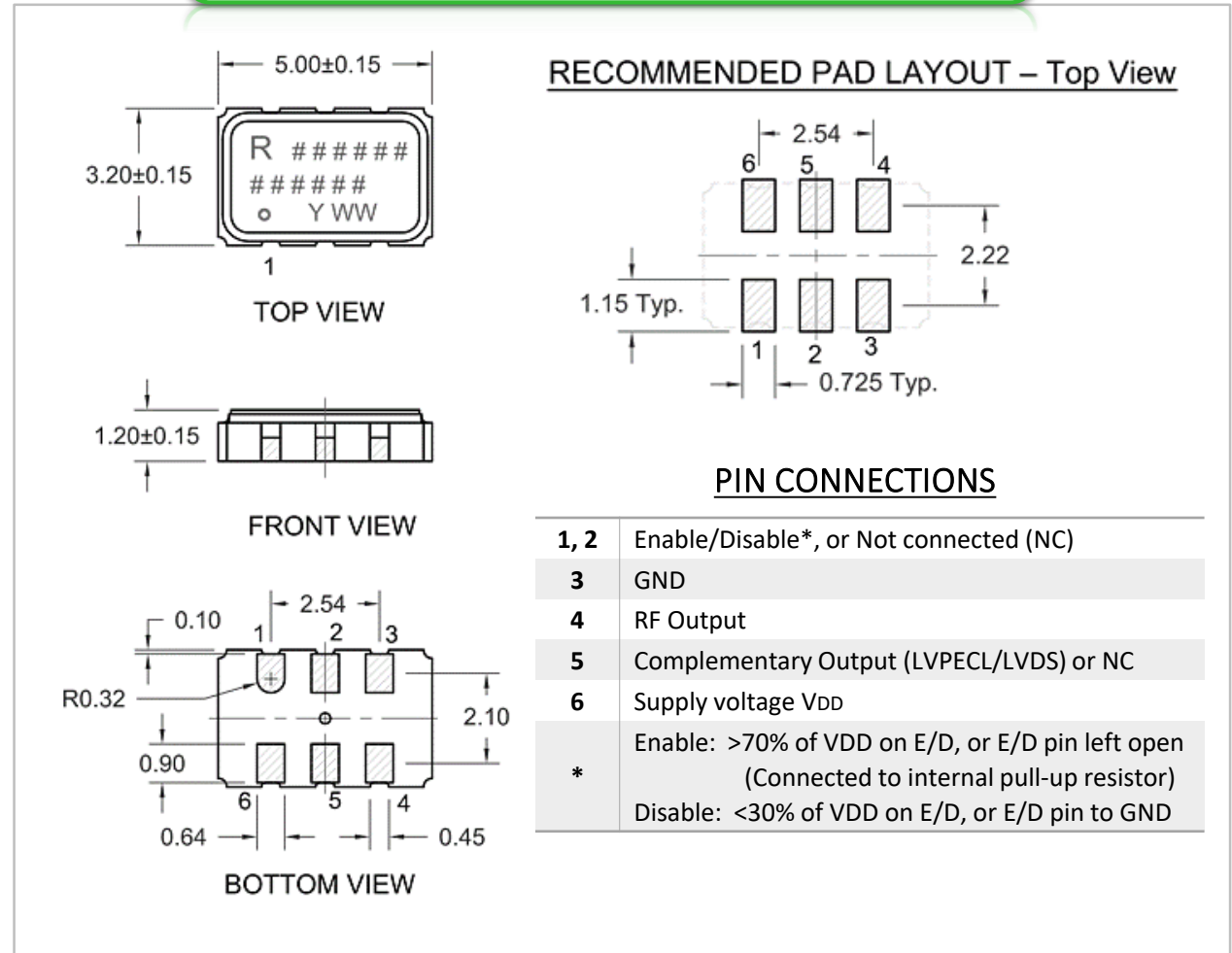
- ❑ Low phase noise and RMS phase jitter
- ❑ Short lead time



Key Specifications:

Frequency	8 to 1500 MHz
Output waveform	CMOS, LVPECL, LVDS
Absolute Frequency Drift (AFD)	
Option I:	± 50 ppm max. (-40 to +85°C)
Option M:	± 75 ppm max. (-55 to +125°C)
Supply voltage	2.5 V or 3.3 V
RMS Phase Jitter	0.9 ps Typ. (Integrated 12 kHz – 20 MHz)

RX05032AD Model Outline

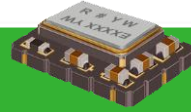


Pluto+™ TCXO Solutions for Defense



RPT7050A

7.0 x 5.0 x 2.0 mm, 10 to 60 MHz



RPT7050D

7.0 x 5.0 x 1.8 mm, 16 to 60 MHz



SPECIAL SPECIFICATIONS		HIGH STABILITY	LOW AGEING	HIGH SHOCK RESISTANCE	LOW G-SENSITIVITY	HIGH SHOCK RESISTANCE
Stability f<40 MHz	-55 to 105°C	± 0.2 ppm	± 0.2 ppm	± 1.0 ppm	± 0.5 ppm	± 1.0 ppm
	-40 to 85°C	± 0.1 ppm	± 0.1 ppm	± 0.5 ppm	± 0.2 ppm	± 0.5 ppm
Ageing f=10 MHz	1 year	<1 ppm	<0.5 ppm	<1 ppm	<1 ppm	<1 ppm
	10 year	<2.5 ppm	<1.5 ppm	<2.5 ppm	<2.5 ppm	<2.5 ppm
g-Sensitivity		≤2 ppb/g	≤2 ppb/g	≤2 ppb/g	≤0.2 ppb/g	≤0.5 ppb/g
High shock resistance		<5000 g	<5000 g	<20,000 g	<10,000 g	<20,000 g
Slope		± 0.05 ppm/°C			± 0.05 ppm/°C	
Phase Noise f=10 MHz typ		-110 dBc/Hz @ 10 Hz -157 dBc/Hz ≥ 100 kHz			-110 dBc/Hz @ 10 Hz -157 dBc/Hz ≥ 100 kHz	
Supply Voltage		2.5 – 6 V			2.5 – 6 V	
Output Type		ACMOS, HCMOS, Sinewave, Clipped Sinewave			ACMOS, HCMOS, Sinewave, Clipped Sinewave	

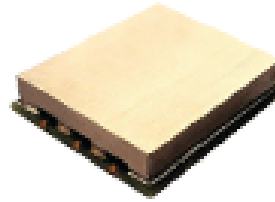
Low Noise VCSO

rakon

Enabling the connected future

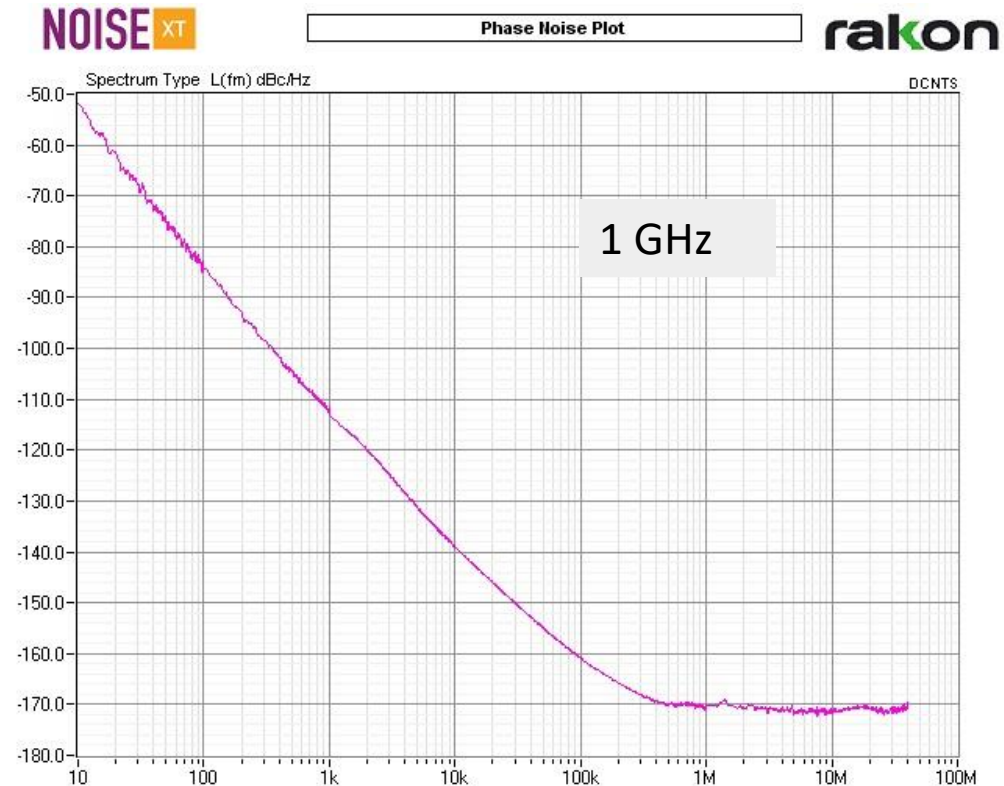
← Based on OCSO grade E format

- SMD
- 25 x 22 mm²
- Lower profile: 5 mm



← Features

- Fundamental frequency: from 500 MHz to 1 GHz
- With internal doubler: up to 2 GHz band
- +5V power supply (+12V on request)
- Consumption
 - < 50 mA for fundamental
 - < 100 mA with internal doubler activated
- Output power < +10 dBm
- Operating temperature: -40 to +85°C



Rakon's OCXO and OCSO Snapshot



A RANGE OF OCXO AND OCSO SOLUTIONS FOR TELECOMMUNICATIONS, THROUGH TO DEFENSE, INSTRUMENTATION AND SPACE APPLICATIONS, AS WELL AS GROUND STATIONS

Mercury™ IC OCXO (RFPO...)



KEY FEATURES:

- Freq.: 5 to 100 MHz
- Low component count
- Frequency stability down to 10^{-8}

MARKET:

- Telecommunications
- Defense

Discrete OCXO (ROX...)



KEY FEATURES:

- Freq.: 5 to 65 MHz
- Excellent holdover stability
- Frequency stability down to 10^{-11}

MARKET:

- Telecommunications

Ground USO (HSO1...)



KEY FEATURES:

- Freq.: 5 to 10 MHz
- 8×10^{-14} short-term stability (Allan Dev.)
- Frequency stability down to 10^{-11}

MARKET:

- Ground Stations

Space OCXO (RK4...)



KEY FEATURES:

- Freq.: 5 to 130 MHz
- High reliability Space qualified
- Frequency stability down to 10^{-11}

MARKET:

- Space

Low Noise OCXO (LNO100)



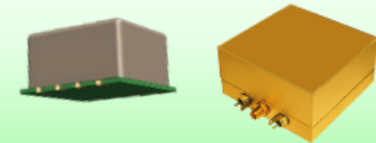
KEY FEATURES:

- Freq.: 10 to 125 MHz
- Meeting the most demanding phase noise requirements
- Frequency stability down to 10^{-6}

MARKET:

- Defense
- Instrumentation

Ultra Low Noise OCSO (LNO320...5000)



KEY FEATURES:

- Freq.: 320 MHz to 5 GHz
- Noise floor: -180 dBc/Hz for 320 – 500 MHz
- Frequency stability down to 10^{-6}

MARKET:

- Defense
- Instrumentation

ASIC OCXO for Defense (COTS* products)



Mercury™ ASIC OCXO – SMD

Applications: Time and frequency reference



Model	RFPO40, RFPO50
Package	9.7 x 7.5 x 4.3 mm 14.5 x 9.5 mm
Frequency	5 to 50 MHz
FvsT	±25 to ±100 ppb
Temperature range	-40 to +85°C
Supply voltage	2.7 – 5.5 V
Key features	<ul style="list-style-type: none"> Small form factor and low power consumption FvsT as low as ±10 ppb / -20 to 70°C

Mercury™ ASIC OCXO – DIL

Applications: Time and frequency reference



Model	RFPO60
Package	22.7 x 13.08 x 8.65 mm
Frequency	5 to 50 MHz
FvsT	±25 to ±100 ppb
Temperature range	-40 to +85°C
Supply voltage	2.7 – 5.5 V
Key features	<ul style="list-style-type: none"> Low power consumption and high reliability FvsT as low as ±10 ppb / -20 to 70°C

COTS*: Commercial Off-The-Shelf

Defense Solutions – Low Noise Oscillators



XO, TCXO, OCXO

LOW NOISE OSCILLATORS

HIGH STABILITY OSCILLATORS



SUB-SYSTEMS



APPLICATIONS: JET FIGHTERS, MISSILES, LAND & SEA-BASED RADARS, ELECTRONIC WARFARE SYSTEMS, UAVS

Ultra Low Noise Oscillators Overview

◀ Ultra low phase noise OCSO and OCXO versus applications

APPLICATIONS	INSTRUMENTATION GROUND	GROUND SHIPBOARD	AIRBORNE
<p>OCSO 1 – 10 GHz</p>	<p>E: 25x22x13 mm Frequency: 1.2 GHz</p> 	<p>B3: 120x76x23 mm Frequency: 3.2, 4.8, 5 GHz</p>  <p>B1: 95x76x23 mm Frequency: 1.28, 1.92, 2 GHz</p> 	<p>D1+SDB: 70x70x55 mm Frequency: 3.2, 4.8, 5 GHz</p> 
<p>OCSO 320 – 1000 MHz</p>	<p>E: 25x22x13 mm Frequency: 400, 500, 600, 800, 1000 MHz</p> 	<p>B1/2: as small as 48x48x13 mm Frequency: 320, 480, 500, 640, 960, 1000 MHz</p> 	<p>D1: 70x70x35 mm Frequency: 320, 480, 500, 640, 960, 1000 MHz</p> 
<p>OCXO 10 – 125 MHz</p>	<p>PTH1/2/3: as small as 25x25x13 mm Frequency: 10, 80, 100, 120, 125 MHz</p>  <p>SMD1: 25x22x13 mm Frequency: 80, 100, 120, 125 MHz</p> 	<p>PSS1: 38x38x25 mm Frequency: 80, 100, 120, 125 MHz</p> 	<p>ULN D: 60x60x40 mm Frequency: 80, 100, 120, 125 MHz</p>  <p>ULN C: 65x50x27 mm Frequency: 80, 100, 120, 125 MHz</p> 

10 MHz Ultra Low Noise & ADEV OCXO



Applications:

- SAT Communications, Test equipment, Simulator, Reference oscillator, RADAR

Performances:

Parameters	Conditions/Remarks	Min	Typ	Max	Unit
Nominal frequency	Initial tolerance ± 0.1 ppm	-	10	-	MHz
Reference voltage	V_{REF}	9.5	10	10.5	V
Frequency adjustment	Positive slope 0 to V_{REF}	± 0.3	-	± 0.7	ppm
Frequency stability vs temperature	Referenced to 25°C	-	-	± 1	ppb
Frequency variation vs. supply voltage	Over operating temperature	-	-	± 0.1	ppb
Frequency variation vs. load	@ 25°C	-	-	± 0.5	ppb
Aging	Per year	-	-	± 30	ppb
	10 years	-	150	± 300	ppb
Allan variance	1s	-	1.5E-13	3E-13	-
Output waveform	-	Sine			
Output level	$V_{CC} = 12V$	5	-	10	dBm
Harmonics level	Over operating temperature 1MHz to 500MHz	-	-	-30	dBc
Non-harmonics level	1MHz to 5GHz	-	-	-100	dBc

Phase Noise:

Parameters	1Hz	10Hz	100Hz	1kHz	10kHz	Unit
@ $V_{CC} = 12V$	-119	-140	-157	-163	-165	dBc/Hz



Dimensions: 2" x 2" x 0.63"
50 x 50 x 16 mm

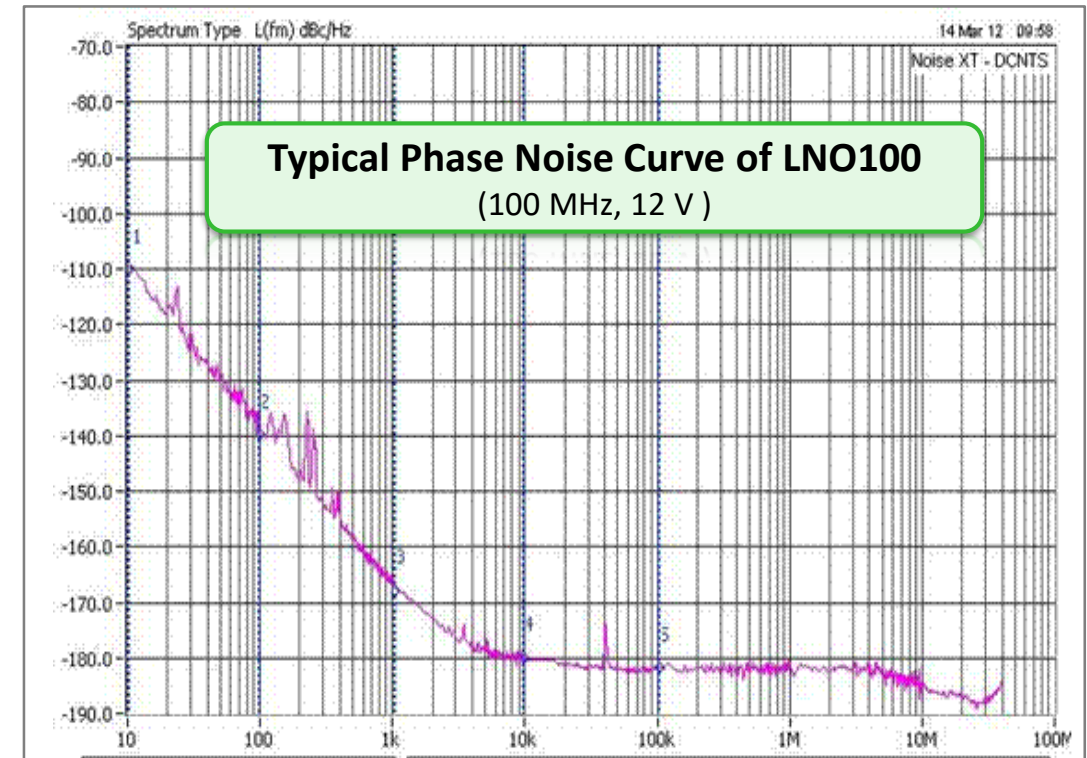
Ultra Low Noise OCXO

Applications:

- Test equipment, Simulator, Reference oscillator, Radar & Electronic Warfare systems

Key Specifications:

Frequency	80 to 125 MHz
FvsT	± 0.5 ppm (-40 to +85°C)
Temperature range	-40 to +85°C
Ageing	± 0.5 ppm/1 year
<i>g</i> -Sensitivity	2 - 0.5 ppb/g (guaranteed)
Supply voltage	12 V, 15 V



LNO100 - SMD1 (25 x 22 x 13 mm)	LNO100 - PTH1 (38 x 38x 13 mm)	LNO100 - PTH2 (38 x 25 x 13 mm)	LNO100 - PTH3 (25 x 25 x 13 mm)	LNO100 - PSS1 (38 x 38 x 25 mm)

Ultra Low Noise SAW Oscillators (OCSO)



Applications:

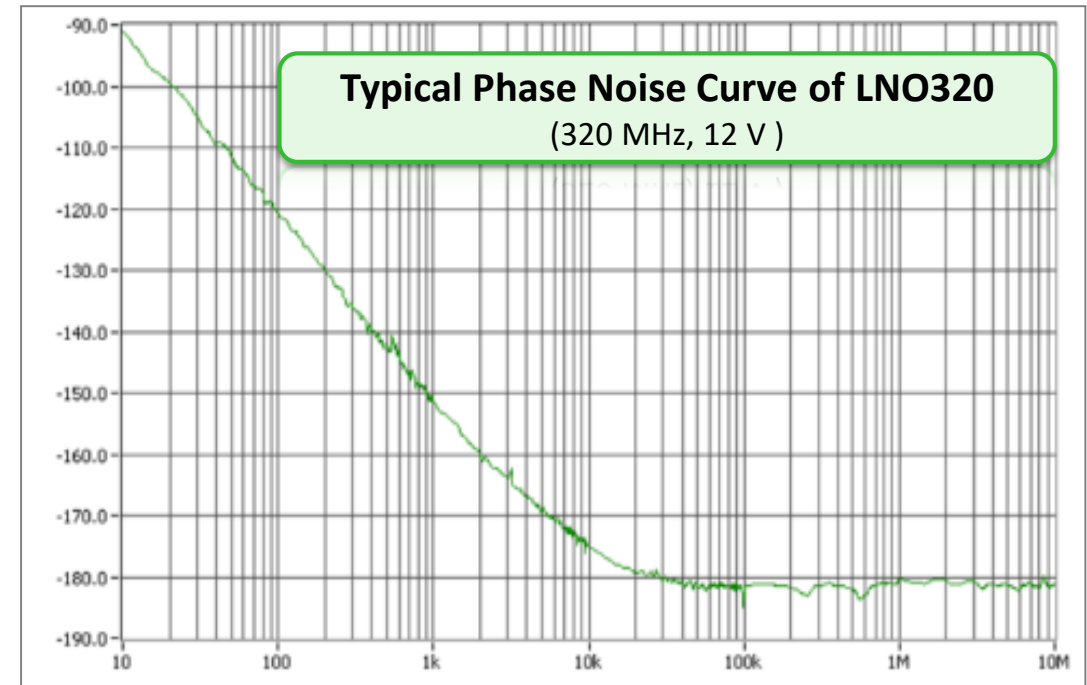
- Test equipment, Simulator, Reference oscillator, Radar & Electronic Warfare systems



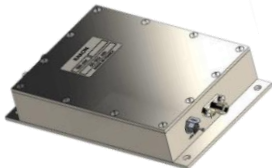


Available Frequencies:

- 320, 480, 500, 640, 800, 960 MHz
- 1000, 1200, 1280, 2000, 3200, 4800, 5000 MHz
- Custom frequency upon request

Features:

- Phase noise: -180 dBc/Hz at 100 kHz for 320 – 500 MHz
- Supply voltage: from 12V to 5V (for LNO – E1)
- g*-sensitivity: < 2 ppb/g (guaranteed)

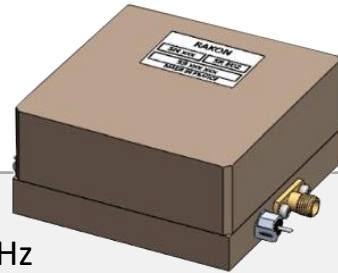


Instrumentation and Ground Systems				Airborne Systems
<p>LNO - B1 (95 x 76 x 23 mm)</p> 	<p>LNO - B2 (48 x 48 x 13 mm)</p> 	<p>LNO - B3 (120 x 76 x 23 mm)</p> 	<p>LNO - E1 (25 x 22 x 13 mm)</p> 	<p>LNO - D1 (70 x 70 x 35 mm)</p> 

Shock Absorber OCSO – Grade D1

Special Features:

- ❑ Automatic detection of the control input
- ❑ Internal shock absorbers
- ❑ Package: 70 x 70 x 35 mm



Key Specifications:

Frequencies

Fundamental :	320, 480, and 500 MHz
With internal doubler :	640, 960, and 1000 MHz

High performance internal PLL

Free running :	Vc = Open
Voltage controlled :	Vc = DC voltage
Phase locked :	Vc = 10 MHz ref

Power supply

10 V

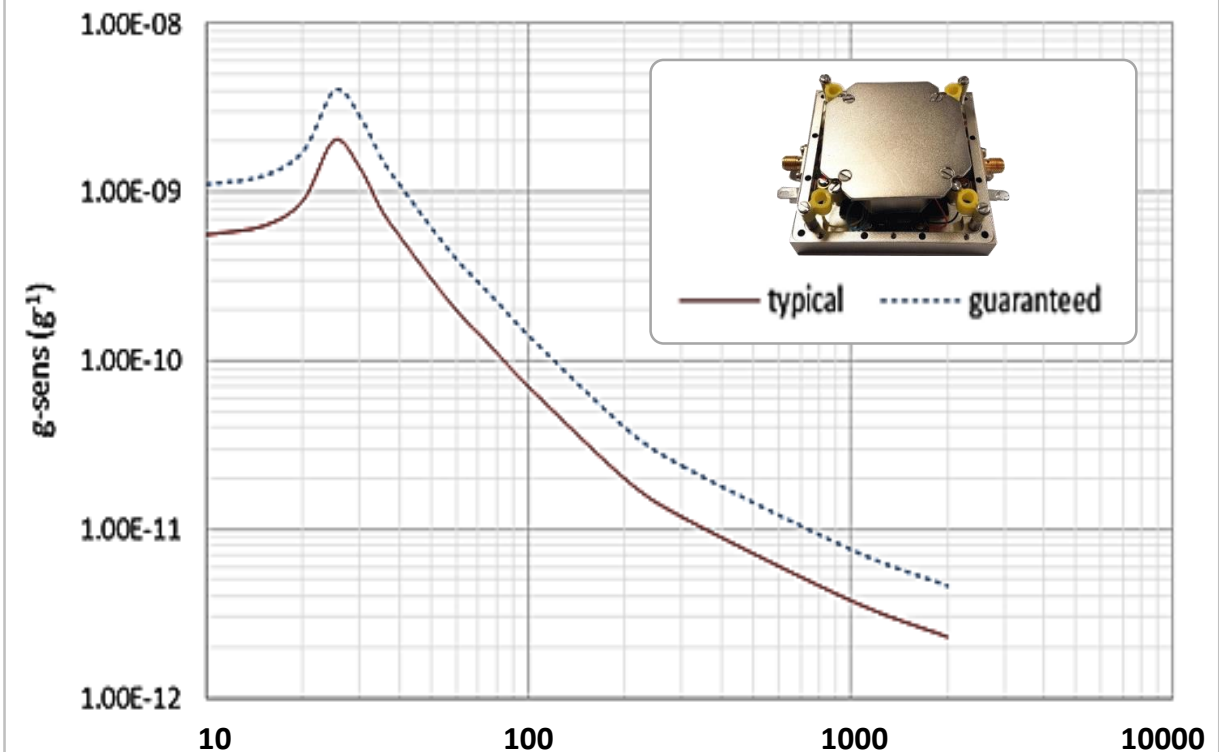
Core oscillator intrinsic g-sensitivity (each axis)

0.5 ppb/g typ., 1 ppb/g max.

g-sensitivity with vibration (each axis)

0.07 ppb/g typ., 0.14 ppb/g max. at 100 Hz
4 ppt/g typ., 8 ppt/g max. at 1000 Hz

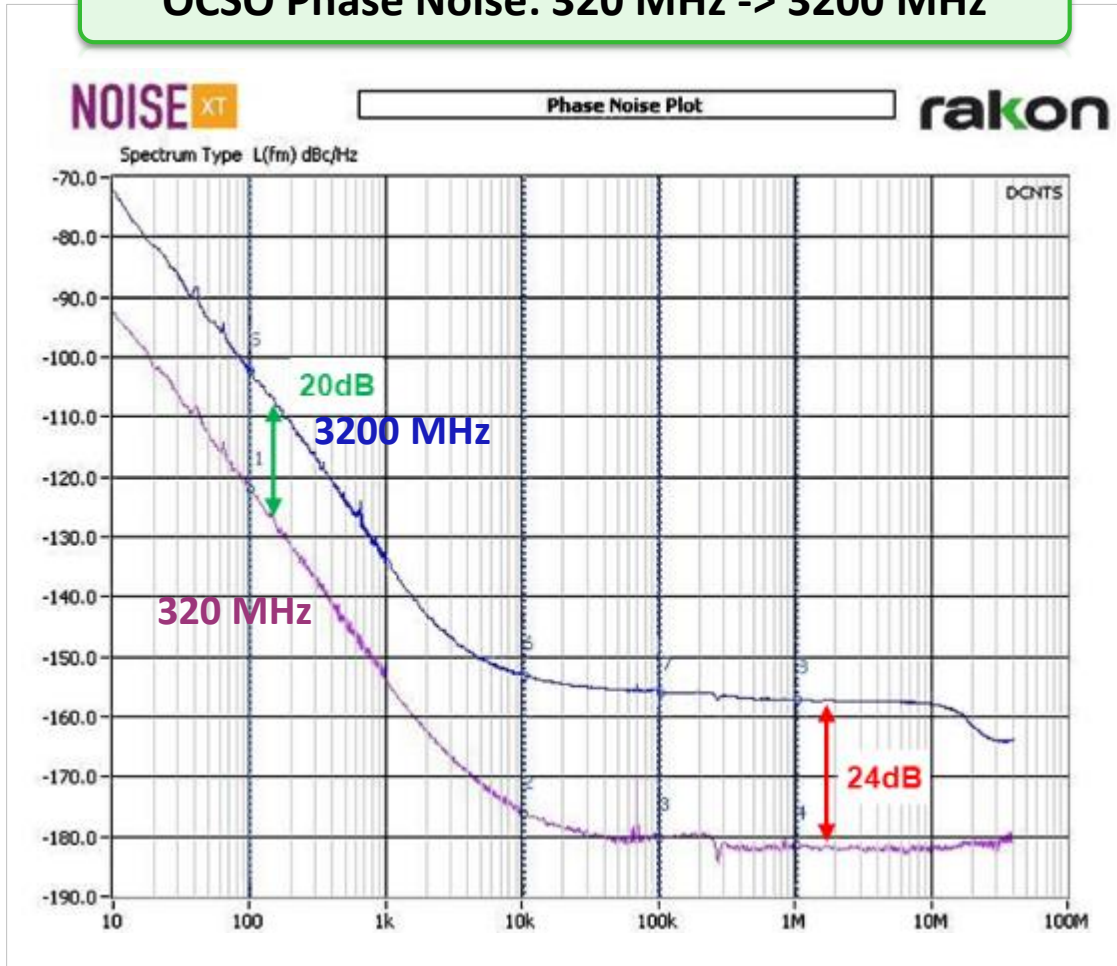
Shock Absorber OCSO g-sensitivity



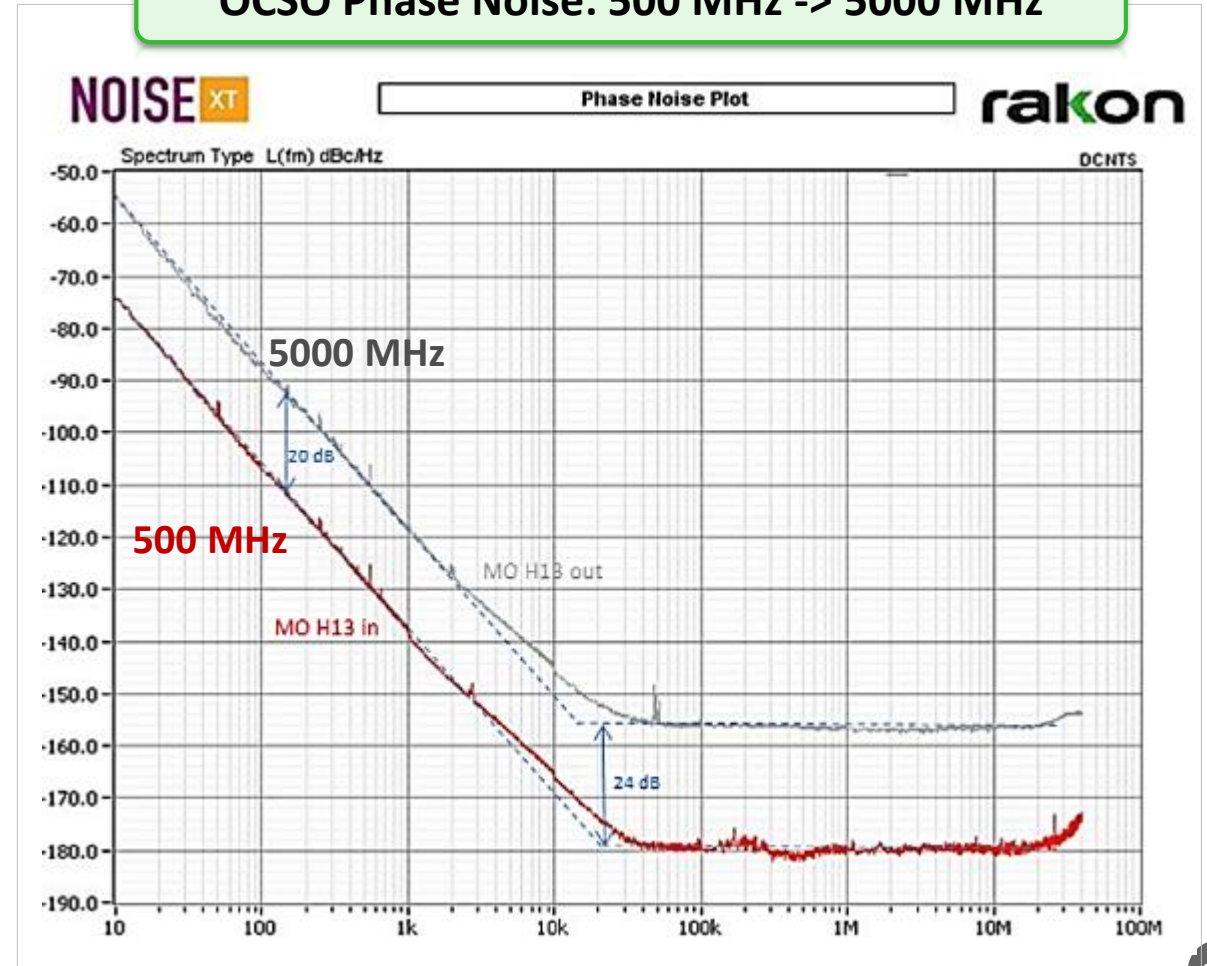
Multiplied OCSO available up to 10 GHz

◀ OCSO at fundamental frequency + multiplier by 10

OCSO Phase Noise: 320 MHz -> 3200 MHz



OCSO Phase Noise: 500 MHz -> 5000 MHz

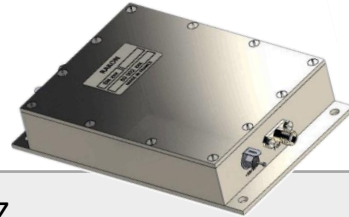


OCSO in C and S Bands – Grade B3



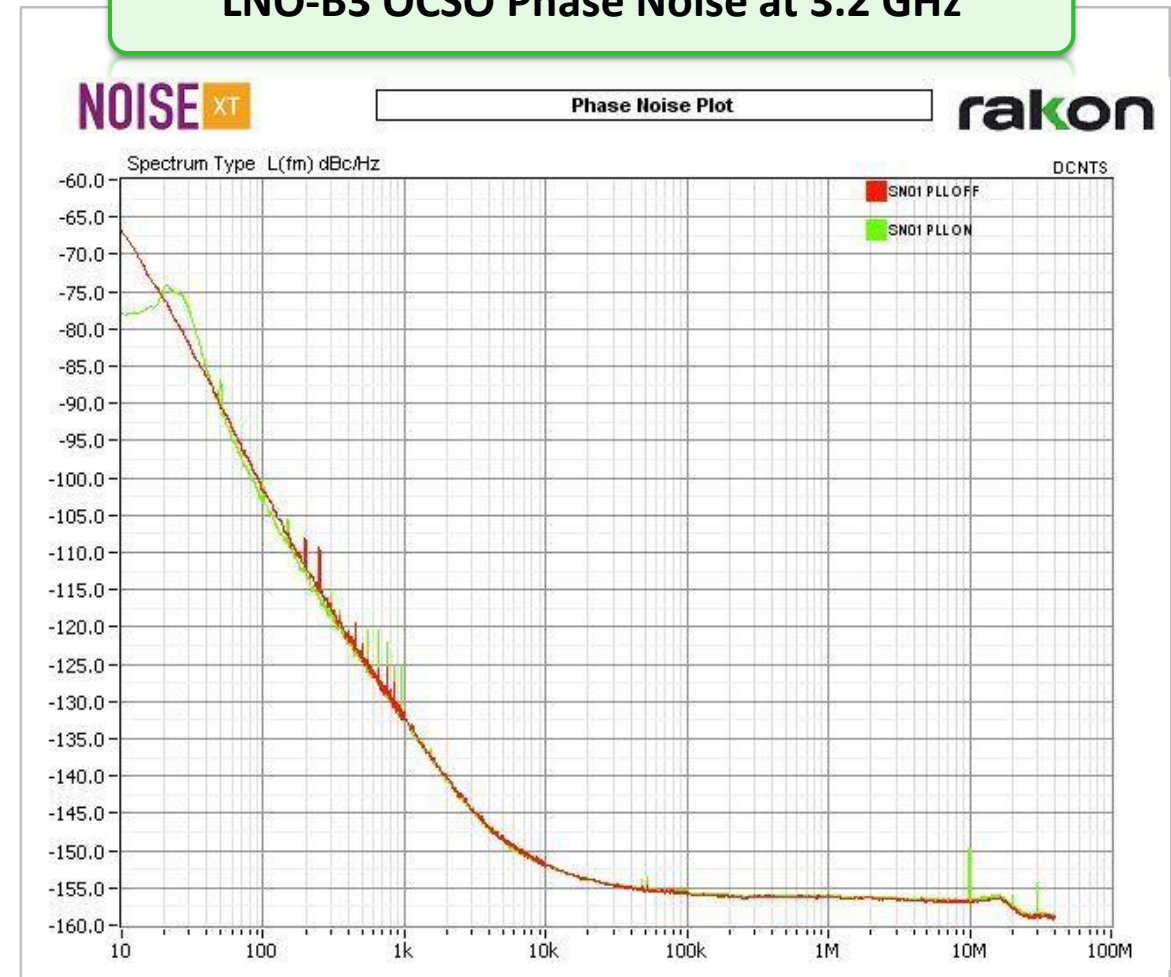
◀ Package: 120 x 76 x 23 mm

◀ Key Specifications



Frequency	3.2, 4.8, 5 GHz <i>(other frequencies up to 10 GHz upon request)</i>
Frequency multiplier	x 10
Fundamental frequency	320, 480 and 500 MHz
Phase Noise at 3.2 GHz	-130 dBc/Hz at 1 kHz -152 dBc/Hz at 10 kHz -157 dBc/Hz noise floor
Power supply	10 V
Option	Internal PLL to lock on external 10 MHz reference

LNO-B3 OCSO Phase Noise at 3.2 GHz



Defense Solutions – High Stability Oscillators



XO, TCXO, OCXO

LOW NOISE OSCILLATORS

HIGH STABILITY OSCILLATORS

SUB-SYSTEMS



APPLICATIONS: JET FIGHTERS, MISSILES, LAND & SEA-BASED RADARS, ELECTRONIC WARFARE SYSTEMS, UAVS

Product Highlight – ROD5242T1



Sampling

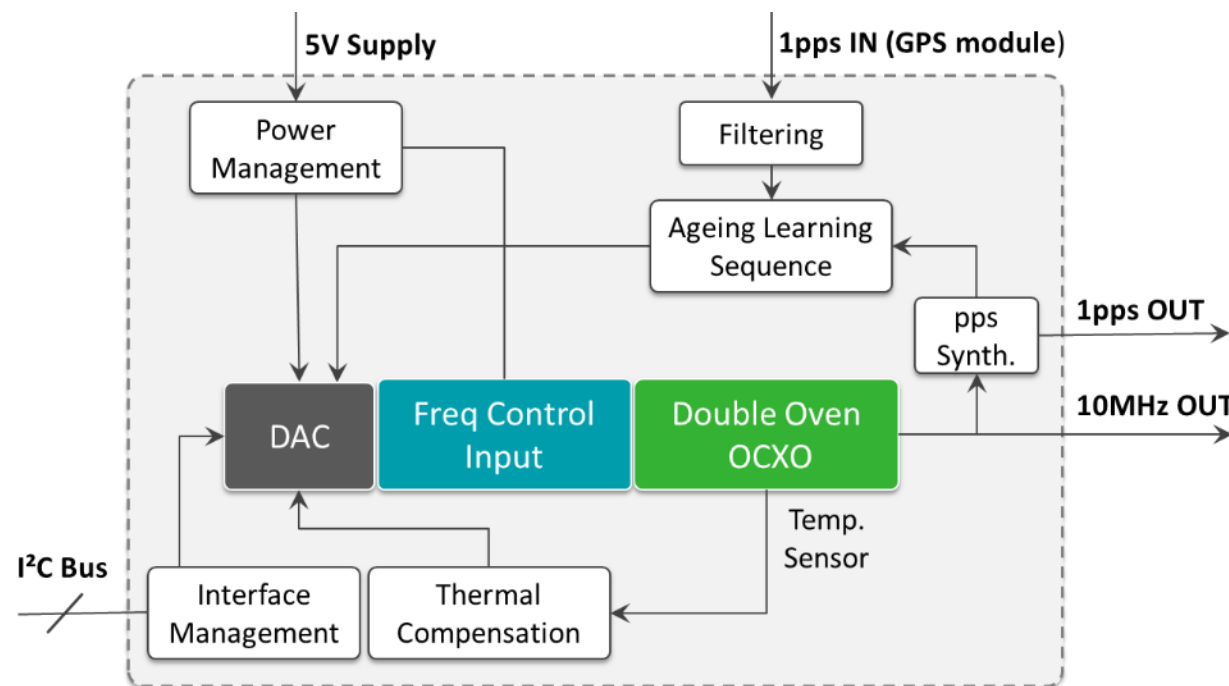
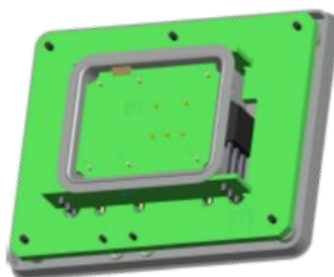
GPS Disciplined OCXO



Product	Footprint	Standard Frequencies	Key Features
ROD5242T1	52 x 42 x 14 mm	10, 12.8, 20 MHz	<ul style="list-style-type: none"> < 0.1 ppb pk-pk < 1.5 μs Holdover over >24 hours with $\pm 10^{\circ}\text{C}$ variation (10$^{\circ}\text{C}$/hour)

Key Features:

- ❑ 1 PPS
- ❑ Longest time keeping ability
- ❑ **1.5 μ s** holdover over 24 hours / up to **48h max.**
- ❑ Frequency Stability over full operating temperature range -40 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$
 - ❑ **0.1 ppb peak to peak max**
 - ❑ **Less than 50ppt** typical over temp.
- ❑ **100ns** time holdover over 4hours
- ❑ **Low Ageing :**
 - ❑ < 0.1 ppb/day
 - ❑ < 0.3 ppm/10 years



Ultra Stable Oscillator – HSO14



HSO14 – State of the art in the short term stability domain

Ground USO in the 10^{-14} short-term stability class



Customer Benefits

- ❑ Fully compatible with the obsolete BVA product (OSA 8607)
- ❑ Excellent standalone reference with reduced calibration intervals
- ❑ Clean signal generation for frequency multiplication

Application Benefits

- ❑ Frequency distribution for satellite ground stations
- ❑ Atomic fountain and other atomic frequency standards
- ❑ Test & measurement
- ❑ Network synchronisation

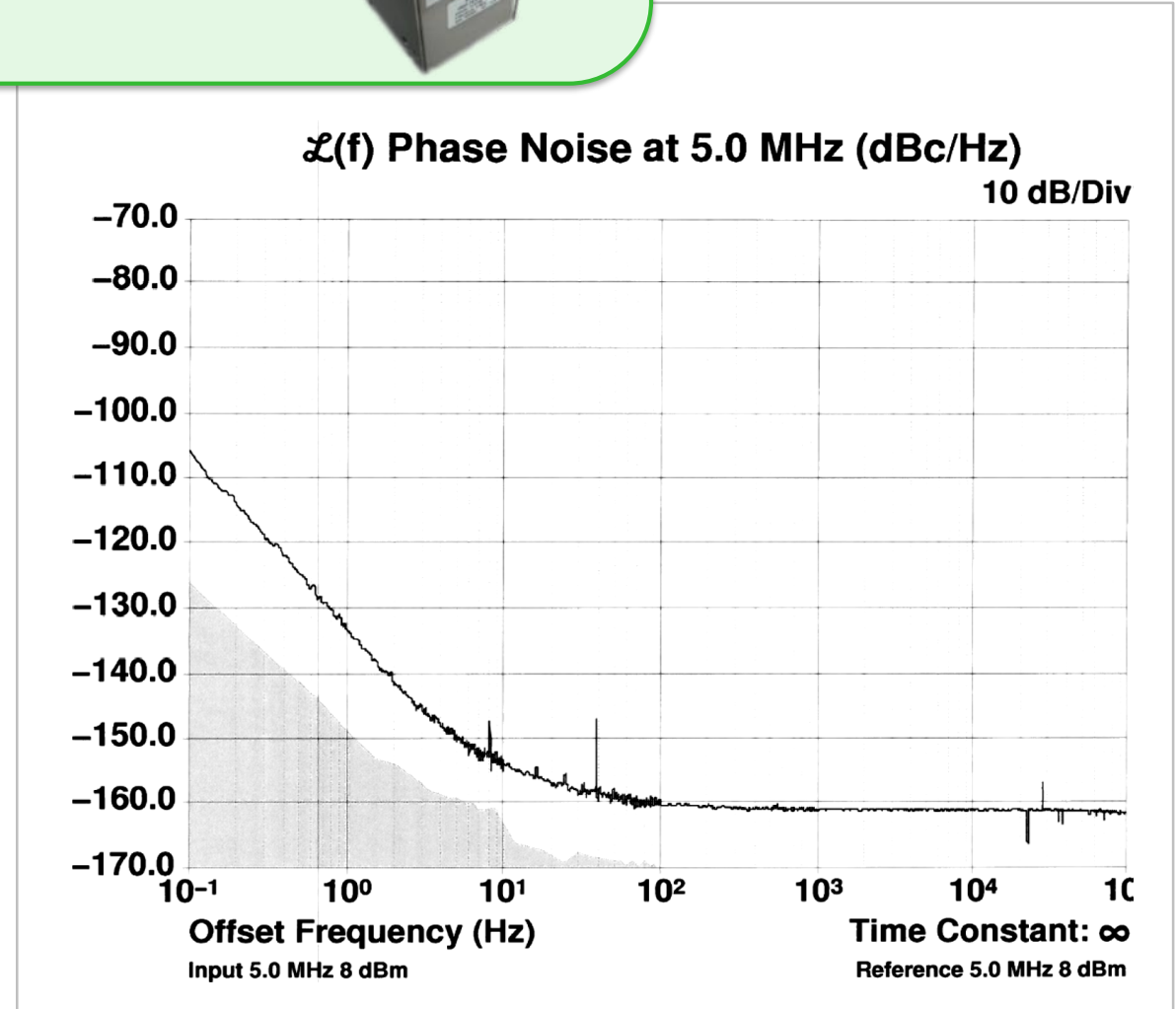
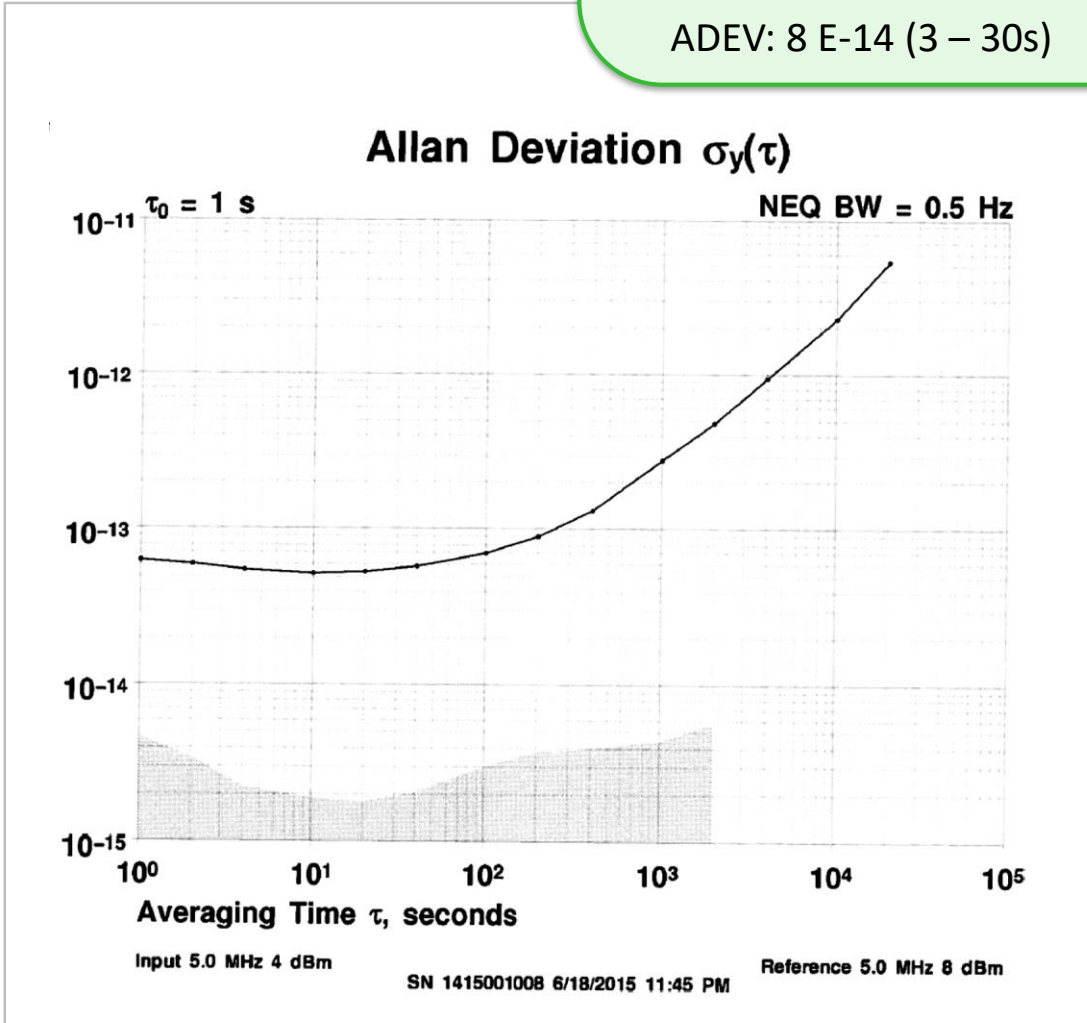
Key Specifications

Package	73 x 135 x 84 mm (2.86"x5.33"3.32") Same as OSA 8607
Frequency	5 or 10 MHz
FvsT	± 0.05 ppb (0 to 50°C)
ADEV (Allan Deviation)	6 E-14 (3 – 30s)
Ageing	± 50 ppb/10 years
Guaranteed Phase Noise at 5 MHz	-130 dBc/Hz at 1 Hz -150 dBc/Hz at 10 Hz -160 dBc/Hz at 1 kHz

HSO14 ADEV & Phase Noise Performance



HSO14 Phase Noise at 5 MHz
 ADEV: 8 E-14 (3 – 30s)



HSO14 ADEV



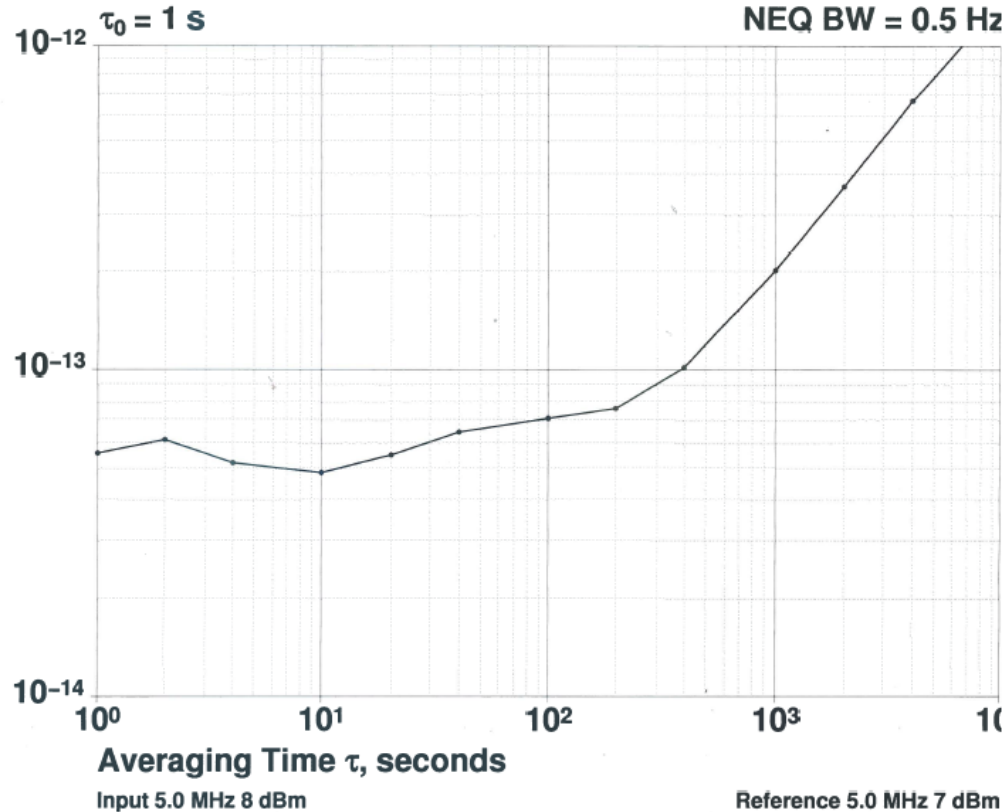
HSO14 Phase Noise at 5 MHz

ADEV: 6 E-14 (3 – 30s)



15/06/1998 22:35:43
3d 4h

Allan Deviation $\sigma_y(\tau)$ Sym



Allan Deviation $\sigma_y(\tau)$

Avg. Time (s)	Allan Deviation $\sigma_y(\tau)$	Noise Floor
1	5.566x10 ⁻¹⁴	4.09541x10 ⁻¹⁵
2	6.130x10 ⁻¹⁴	5.11608x10 ⁻¹⁵
4	5.176x10 ⁻¹⁴	2.95787x10 ⁻¹⁵
10	4.858x10 ⁻¹⁴	1.53783x10 ⁻¹⁵
20	5.477x10 ⁻¹⁴	1.01540x10 ⁻¹⁵
40	6.45x10 ⁻¹⁴	9.77081x10 ⁻¹⁶
100	7.10x10 ⁻¹⁴	9.00561x10 ⁻¹⁶
200	7.66x10 ⁻¹⁴	7.91038x10 ⁻¹⁶
400	1.026x10 ⁻¹³	6.98856x10 ⁻¹⁶
1000	2.02x10 ⁻¹³	5.48106x10 ⁻¹⁶
2000	3.69x10 ⁻¹³	6.67350x10 ⁻¹⁶
4000	6.7x10 ⁻¹³	5.40582x10 ⁻¹⁶
10000	1.34x10 ⁻¹²	1.90149x10 ⁻¹⁶
20000	2.1x10 ⁻¹²	
40000	2.0x10 ⁻¹²	
100000	1.2x10 ⁻¹²	

$\tau_0 = 1$ s NEQ BW = 0.5 Hz

Defense Solutions – Sub-Systems

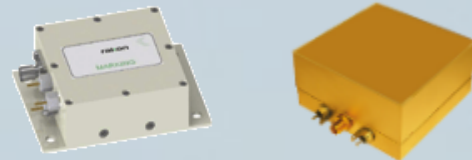


XO, TCXO, OCXO

LOW NOISE OSCILLATORS

HIGH STABILITY OSCILLATORS

SUB-SYSTEMS

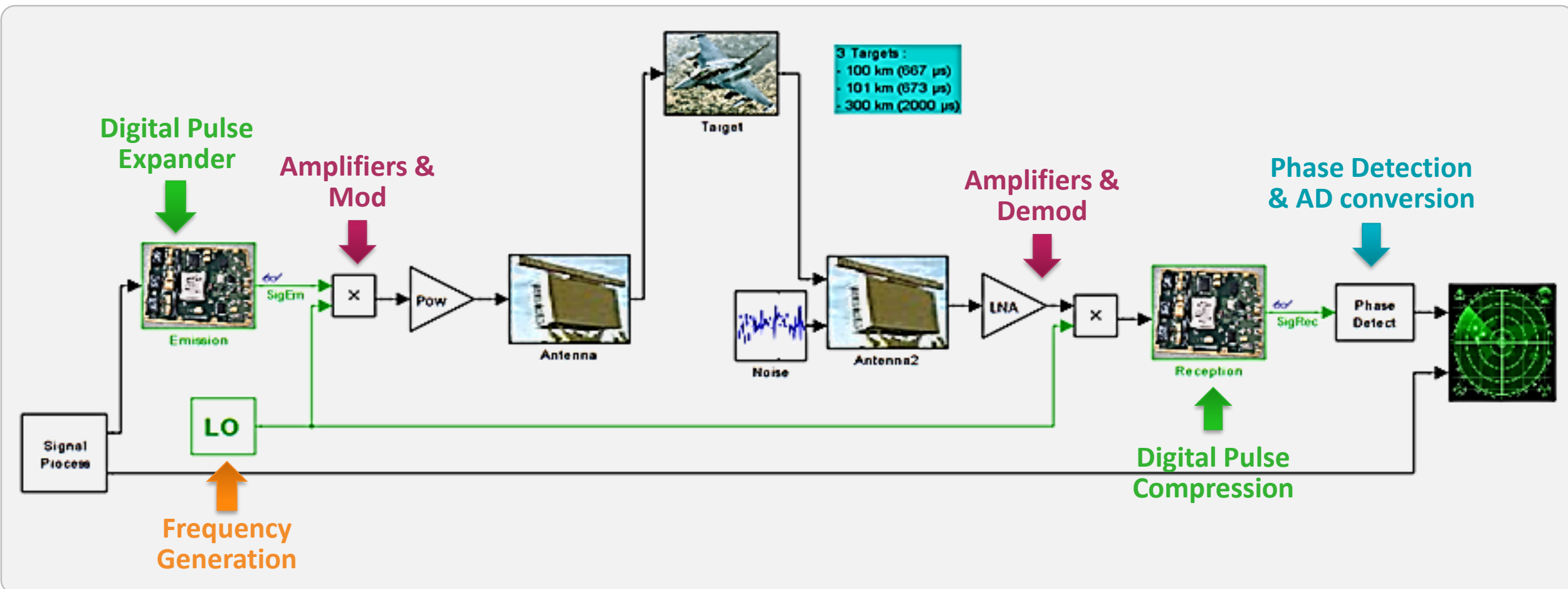


APPLICATIONS: JET FIGHTERS, MISSILES, LAND & SEA-BASED RADARS, ELECTRONIC WARFARE SYSTEMS, UAVS

Radar Sub-Systems



- ◀ Rakon offers solutions to retrofit or upgrade existing radars, allowing an improvement in overall system performance and a service life extension



RF Modules – Example of applications

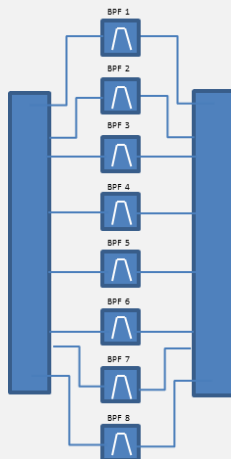


Capabilities up to 10 GHz for RF modules

Examples:

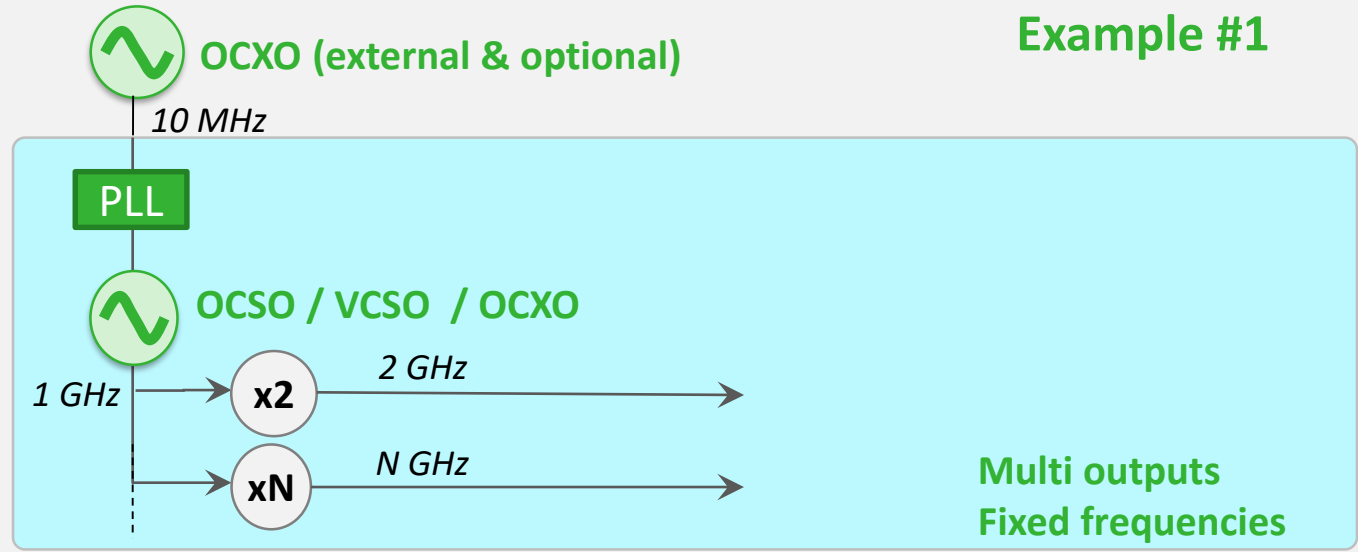
- Phase-Locked Dielectric Oscillator
- GPS Disciplined OCXO
- Transceivers for Mil Communications
- IF and RF filter banks

Filter banks

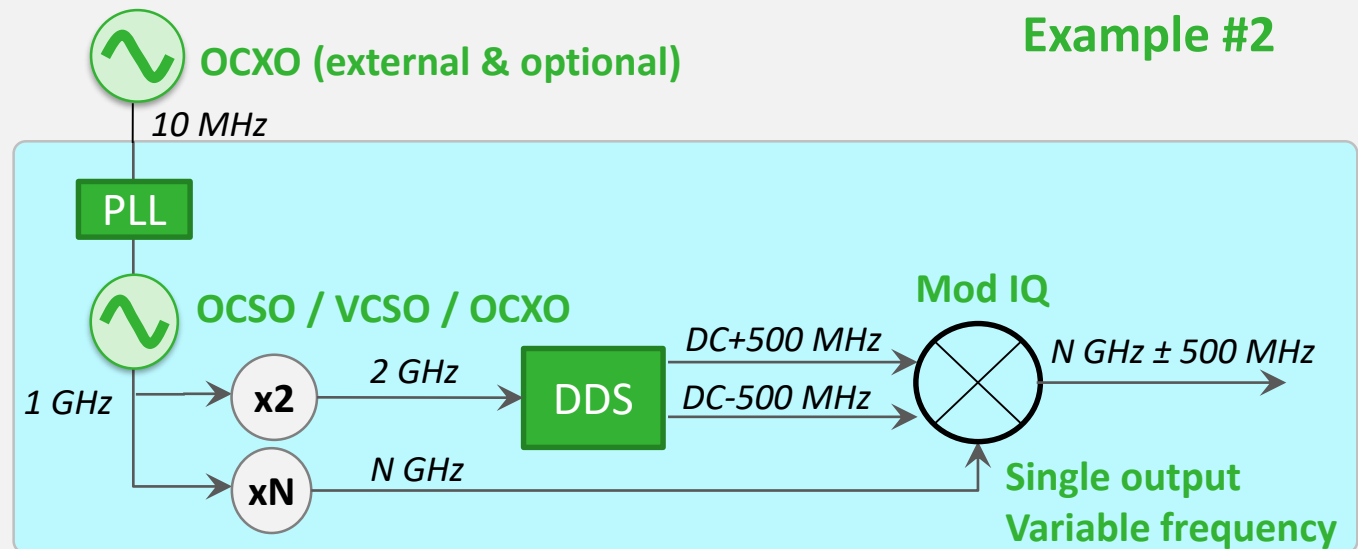


Example #3

Example #1



Example #2



PLO Series – PLO-D

The PLO-D

is a **Phase-Locked Dielectric Oscillator** dedicated to the defence market disciplined to an external or internal reference. It generates a 6 to 40 GHz frequency signal which gets its stability from the external reference. This PLO is recommended as a Local Oscillator RADAR, Communication Equipment.

Key Features

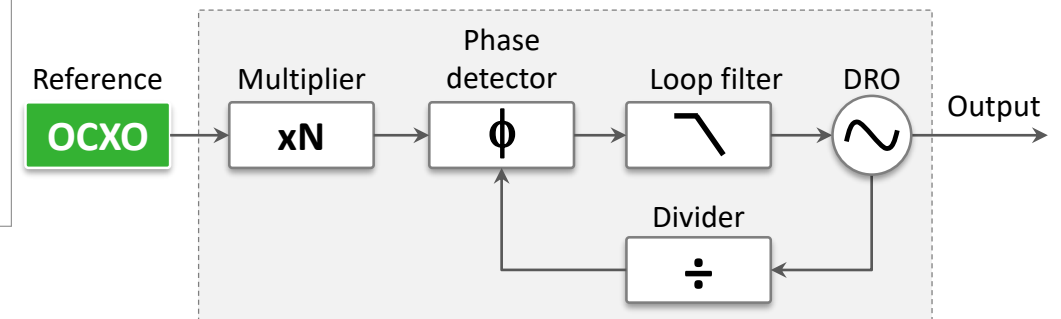
- ◀ Frequency outputs: 6 to 40 GHz
- ◀ Phase-locked to an ext. 10 or 100 MHz
- ◀ Operating temperature: 0 to 50°C
- ◀ DC power req.: 12 V @ 500 mA with OCXO
- ◀ Compact package: 57 x 57 x 16 mm

- ◀ RF connectors: SMA
- ◀ Output power: 14 dBm
- ◀ Phase noise @ 8 GHz (Typical):

Offset	8 GHz
100 Hz	-104 dBc/Hz
1 kHz	-125 dBc/Hz
10 kHz	-128 dBc/Hz
1 MHz	-138 dBc/Hz
10 MHz	-170 dBc/Hz

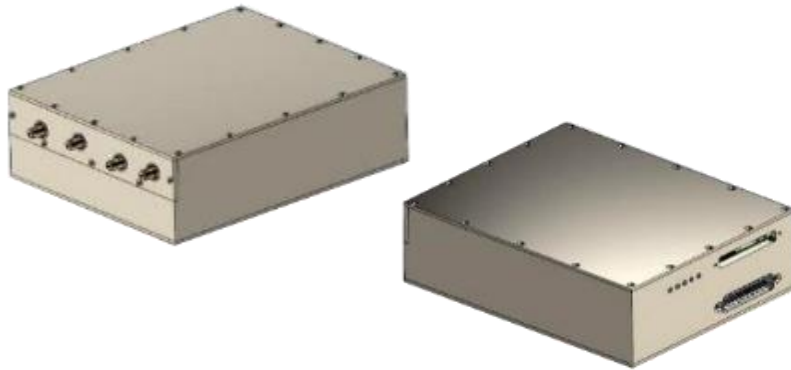
Options

- ◀ Frequency of input reference
- ◀ Customized package
- ◀ Custom output level



Example of design

Frequency Synthesizer Module – DS H01



Features

- ❑ Standard DS H01 can go up to 6 GHz
- ❑ Semi-custom design (with DS H01 inside) can go up to Ku-band
- ❑ Plug and play implementation
- ❑ Waveform generator, highly flexible
- ❑ Modes: CW, chirp, list, pulse, burst
- ❑ Synchronization with other synthesizers
- ❑ Internal or External Clock references
- ❑ Package: 174 x 131 x 54 mm

Key Specifications

Parameter	I/Q Outputs	RF Output
Outputs	2x (I/Q) or 1x RF	2x (I/Q) or 1x RF
Frequency	10 ~ 500 MHz	LO – 500 MHz ~ LO + 500 MHz with 2.5 GHz ≤ LO ≤ 3.5 GHz
SFDR	≥ 60 dBc	≥ 50 dBc
Phase noise	@ 500 MHz - @ 1 kHz - Floor	@ 3.5 GHz ≤ -120 dBc/Hz Typ. ≤ -145 dBc/Hz Typ.
Frequency step	7 μHz	
Freq. tuning agility	1 μs	
Output power	-10 dBm ~ 0 dBm, 1 dB steps	
Power consumption	~17 W	
Modes	CW, chirp, list, pulse, burst	
Programming	USB / SPI	

Thank you for your attention

rakon



www.rakon.com