

### Introduction

LTE-A and LTE-TDD cellular network technologies require phase alignment at base stations. The current 3GPP requirement is as low as  $\pm 1.5 \mu\text{s}$  at base stations, though new versions of interference mitigation and location services push the requirements down to less than  $0.5 \mu\text{s}$ . GNSS-based synchronisation technologies are key to the implementation of such systems. Rakon offers a wide variety of timing references for GNSS-based synchronisation systems.

### Rakon's GNSS Based Synchronisation Markets and Applications

- > GNSS modules for Synchronisation systems
- > Grand Master Timing solutions
- > Edge Grand Master solutions
- > Small Cell solutions
- > Micro and Pico Base Station solutions
- > Long Term Holdover modules (Guaranteed  $1.5 \mu\text{s}/24 - 72$  hours)

### Rakon Advantages

#### Cutting Edge TCXO Technology

Rakon's in-house developed Pluto+™ ASIC powers world class TCXO technology, providing tight temperature stability ( $\pm 50 - 500$  ppb), very low phase noise (20 MHz, -130 dBc/Hz @100Hz), excellent temperature sensitivity (10 ppb/°C), and very low power consumption (20 mW). The superior performance of Rakon's Pluto+™ based products enables the development of competitively priced, high performance timing and synchronisation solutions.

#### World's First IC-Based OCXO Technology

Rakon's Mercury™ ASIC has made possible the smallest (14 x 9 mm and 9 x 7 mm), lowest power consuming (350 mW) and most reliable (FIT of < 50) OCXOs in the industry. The Mercury™ OCXO enables applications that require high frequency stability ( $< \pm 5$  ppb) with low profile and power.

#### SMART OCXO Technology

Rakon's extensive experience and knowledge in the Frequency Control Product (FCP) domain enabled the ability to add SMART technologies to the oscillator solutions by compensating for temperature variations, aging, hysteresis, power supply variations and other system effects. These high end OCXOs feature temperature stabilities of <0.2 ppb over the operating temperature range and <0.05 ppb/day aging. These OCXOs also offer digital control, which reduces unwanted noise in the system and eliminates analogue design complexities.



# GNSS-Based Synchronisation Solutions

## OCXO Key Specifications



Models	RFPO40	ROM1490E	ROX2522S4	ROX2522S3	ROX3827T2	ROX5252T1
Package size	9.7 x 7.5 mm	14.5 x 9.6 mm	25 x 22mm	25 x 22 mm	38 x 27 mm	52 x 52 mm
Frequency	5 to 50 MHz	5 to 50 MHz	5 to 40 MHz	10 to 40 MHz	10 to 40 MHz	10 to 20 MHz
Stability (-40 to 85°C)	≤ ±20 ppb	10 ppb pk-pk	±5 ppb	2 ppb pk-pk	0.5 ppb pk-pk	0.05 ppb
Frequency holdover (100 ppb)	> 1 month	> 3 months	> 3 months	> 6 months	4 years	6 years
Time holdover over (±1.5 μs @ 20°C window, 1°C/hour variation)	0.5 hours (constant temperature)	1 hour (constant temperature)	3 hours	4 hours	24 hours	72 hours
Phase Noise (Typical)	20 MHz: -155 dBc/Hz, @ 10kHz	20 MHz: -155 dBc/Hz, @ 10kHz	26 MHz: -145 dBc/Hz, @ 10kHz	10 MHz: -150 dBc/Hz, @ 1kHz	10 MHz: -150 dBc/Hz, @ 1kHz	10 MHz: -150 dBc/Hz, @ 1kHz
Ageing	±1 ppb/day	±1 ppb/day	±0.5 ppb/day	±0.3 ppb/day	±0.2 ppb/day	<±0.1 ppb/day
Power	350 mW	440 mW	1.5 W	1.5 W	3 W	3 W

## TCXO Key Specifications

Parameter	High Stability TCXO	Ultra Stable TCXO	Beacons TCXO	Low g Sensitivity TCXO
Package size	3.2 x 2.5 mm 2.5 x 2.0 mm 2.0 x 1.6 mm	7.5 x 5.0 mm 5.0 x 3.2 mm	7.0 x 5.0 mm 5.0 x 3.2 mm	14.7 x 9.2 mm 7.0 x 5.0 mm
Frequency	10 to 40 MHz	1.25 to 52 MHz	10 to 20 MHz	16 to 40 MHz
Stability	±0.5 ppm (-40 to 85°C)	±0.1 ppm (-40 to 85°C) ±1.0 ppm (-55 to 105°C)	±0.2 ppm (Class 1, -40 to 55°C) ±0.2 ppm (Class 2, -20 to 55°C)	±0.1 ppm (-0 to 70°C) ±0.2 ppm (-40 to 85°C)
Slope	±0.1 ppm/°C	0.05 ppm/°C	See Medium term stability below	± 0.02 to 0.1 ppm/°C
Phase Noise (Typical)	26 MHz: -149 dBc/Hz, ≥ 10 kHz	26 MHz: -151 dBc/Hz ≥ 10 kHz	12.688 MHz: -135 dBc/Hz ≥ 10 kHz	20 MHz: -152 dBc/Hz @ 10 kHz
Supply voltage	1.8 to 3.7 V	2.4 to 6 V	3 to 3.6 V	2.5 to 6 V
Output type	Clipped Sinewave	HCMOS, Clipped Sinewave	HCMOS, Clipped Sinewave	HCMOS, Clipped Sinewave
Application	GNSS, Fitness, PND	RTK, Differential GNSS	Emergency beacons, COSPAS SARSAT	Defense, Guidance, Avionics
Specialty features	Frequency drift: 100 ppb over first 600 seconds	Linearity: ≤1 % Extended Temperature: -55 to 105°C Tilt compensation: Yes	Medium term stability: ±0.7ppm/min (ΔT/Δt steady state) ±1.7ppm/min (ΔT/Δt during and 15 minutes after variable temperature) ±2ppm/min (Residual ΔF from slope, ΔT/Δt ≤±5°C/hour)	g-Sensitivity: ≤0.2 ppb/g

## Additional Rakon Products for complete GNSS Based Synchronisation Design

Products Family	Product Series	Key Capabilities
VCXO	M / P / R	8 to 1500 MHz with low phase-noise and CMOS/PECL/LVDS in 7.0 x 5.0, 5.0 x 3.2 or 2.5 x 2.0 mm packages.
	X	10 to 50 MHz commercial CMOS output in 7.0 x 5.0 or 5.0 x 3.2 mm packages.
XO	M / P / R	8 to 1500 MHz with <1 ps jitter and CMOS/PECL/LVDS in 7.0 x 5.0, 5.0 x 3.2 or 2.5 x 2.0 mm packages.
	Q	8 to 1500 MHz selectable frequency, 1.0/2.0 ps jitter and CMOS/PECL/LVDS output in 2.5 x 2.0 mm package.
Crystals	X	10 to 50 MHz commercial CMOS output in 7.0 x 5.0 or 5.0 x 3.2 mm packages.
	RSX	12 to 48 MHz for Ethernet, WiFi and USB.
	RTF	32 kHz for real time clocks.

