GNSS Receiver TIMING

The GNSS Receiver TIMING is a highly integrated advanced NewSpace GNSS Receiver available as a stand-alone subsystem protected by a space-grade mechanical housing. It is an off-the-shelf GNSS Receiver with low power consumption and is specifically designed for small and nanosatellites. With multi-band and multi-constellation support, this advanced GNSS Receiver can process signals from up to 448 channels simultaneously to provide high performance position, velocity and timing.

The GNSS Receiver TIMING has a highly performant rad-hard microcontroller and a clock management function to provide advanced features like GNSS data monitoring, innovative navigation algorithms and clock synchronisation.

The GNSS Receiver TIMING includes Rakon's RK409NS Ultra Stable Oscillator (USO) to provide a highly stable clock output and increase the reliability of GNSS measurements. The clock's short-term stability is ensured by the intrinsic OCXO performance and long-term stability is guaranteed by the microcontroller, which disciplines the oscillator on GNSS PPS signal. Advanced algorithms are implemented to ensure smooth synchronisation while avoiding any glitches or jumps in the frequency.

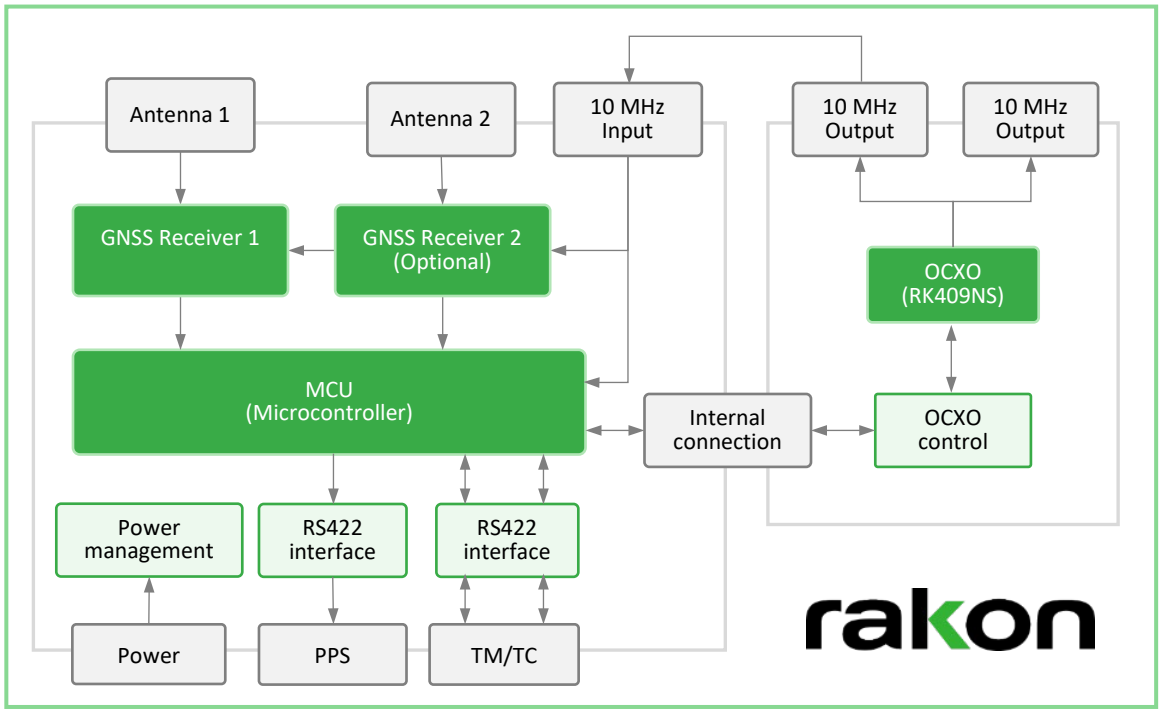
The GNSS Receiver TIMING is part of a full range of NewSpace GNSS Receivers that offers options around PC104 or full housing, mono/bi/tri antennas and clock management functions. In addition to the GNSS Receiver range, Rakon offers timing and frequency distribution products (MROs) and SDR (Software Define Radio) devices as part of its NewSpace Equipment portfolio.

Key Features

- Multi-constellation, multi-band
- Up to 448 channels
- Position accuracy (800 km altitude): <1.2 m
- Warm/cold TTFF: <20 s / <45 s
- Mono antenna (active or passive)
- PPS signal output
- SINGLE or DUAL GNSS Receiver
- Rad-hard microcontroller
- Disciplined OCXO
- 10 MHz output
- GNSS Supply voltage: 5 V to 28 V
- RK409NS Supply voltage: 12 V
- GNSS Power consumption: <3 W
- RK409NS Power consumption: <3.5 W

128 x 110 x 64 mm

Block Diagram



Issue: A0, 59XXXXXX.110, 15 November 2024

GNSS Constellation

Parameter	Condition / Remarks	Specification
Channels		Up to 448
GPS		L1C/A, L1PY, L2C, L2PY, L5
GALILEO		E1, E5a, E5b, E5 AltBoc, E6*
BEIDOU		B1I, B1C, B2a, B2I, B3
QZSS		L1C/A, L2C, L5
GLONASS		L1CA, L2CA, L3 CDMA
NAVIC		L5
SBAS		Egnos, WAAS, GAGAN, MSAS, SDCM (L1, L5)

**support of HAS corrections messages*

Performances

Parameter	Condition / Remarks	Typ.	Max.	Units
Time To First Fix (TTFF)				
Cold start	No information available (no almanac, no approx. position)	45		s
Warm start	Ephemeris and approx. position known	20		s
Positioning accuracy	800 km altitude (RMS)			
	Horizontal	1.2		m
	Vertical	1.9		
Velocity accuracy	(RMS)	3		cm/s
Time precision				
1PPS out	After convergence	5		ns
Event accuracy	C/N0 threshold		20	ns
Tracking performance				
Tracking		20		dB-Hz
Acquisition		33		dB-Hz
PVT update rate			10	Hz

Electrical Parameters

Parameter	Condition / Remarks	Min.	Typ.	Max.	Units
Power supply	GNSS Receiver SINGLE	4.75	5 to 28	32	VDC
	RK409NS	11.4	12	12.6	VDC
Power consumption	GNSS Receiver SINGLE		2	3	W
	RK409NS		1	3.5	W
Antenna					
Pre-amplification range		15		50	dB
Antenna supply voltage			3.3		VDC
Antenna supply current				150	mA
Electrical interfaces					
UART	RS422		2		
PPS output	RS422		1		
On/Off input	+3.3V LVTTL input		1		
External reset input	+3.3V LVTTL input		1		
10MHz clock output			1		

GNSS Disciplined Oscillator

Rakon OCXO is disciplined on the PPS output of the GNSS receiver. A control loop is implemented in the microcontroller to synchronise the OCXO output with the PPS. Advanced algorithms are applied to compensate for temperature and ageing effects on the stability while avoiding any glitch or jump in frequency. In the event of a loss of GNSS signal, the output frequency stability will rely on the intrinsic performances of the OCXO to provide a stable clock.

The disciplined oscillator can be implemented based on an internal RK409NS.

Free running Performance

For full parameters of RK409NS, please refer to the RK409NS datasheet.

Parameter	Condition / Remarks	RK409NS Typ.	Units
Initial frequency accuracy	At ambient temperature at DC/DC turn ON within 1.5 hour	±20	ppb
Frequency stability vs. temperature	For any 24 hours at any temperature within acceptance temperature range, under vacuum	±1	ppb
Overall Frequency drift	Initial, temperature range, EOL (12 years)	±500	ppb

Disciplined Performances – OCXO locked to PPS signal

Parameter	Condition / Remarks	RK409NS Typ.	Units
10 MHz output stability	Allan deviation	0.01	ppb
10 MHz output accuracy	Locked (at ambient temperature; after 48h locked)	±5	ppt
Time stability	Locked (-20°C, +60°C; after 0.5 hour)	10	ns (TDEV)
Time accuracy	Locked (at ambient temperature at DC/DC turn ON within 1.5 hour)	±10	ns

Holdover mode

Parameter	Condition / Remarks	RK409NS Typ.	Units
10 MHz output accuracy	Holdover (at ambient temperature; after 48h locked) – at the start of the holdover period (see locked mode)	±0.005	ppb
Time stability	Holdover 24h; -20°C, +60°C; sine cycle of 1.5 hour	10	µs (MTIE)

PPS Output

Parameter	Condition / Remarks	Min.	Typ.	Max.	Units
Level			3.3		VDC
Interval	Configurable	0.01	1	60	s
Pulse width	Configurable	0.001	0.005	1	s
Synchronisation	Phase locked with the 10MHz clock				

Physical Parameters

Parameter	Condition / Remarks	
Dimensions		128 x 110 x 64 mm
Mass		800 g

Environmental Conditions

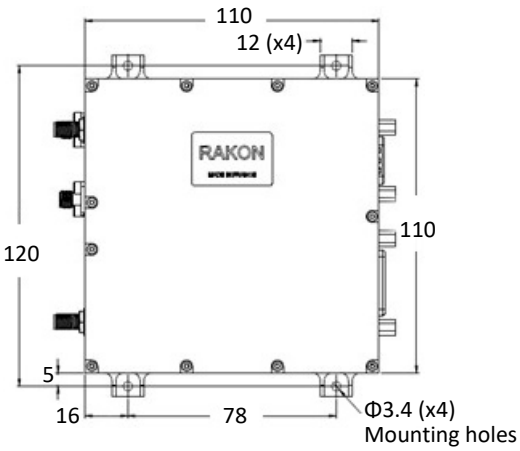
Parameter	Condition / Remarks	Min.	Typ.	Max.	Unit
Non-operating temperature		-40		85	°C
Operating temperature		-20		65	°C
Thermal cycles					
Qualification	100 cycles ±5 °C/minute slope 30 minutes at min/max temperature	-20		65	°C
Acceptance	8 cycles ±5 °C/minute slope 1 hour at min/max temperature	-20		65	°C
Random vibration	On 6 axes				
Qualification	20 to 50 Hz: 50 to 350 Hz: 350 to 2000 Hz: Overall:		+6 0.8 -6 22		dB/octave g^2/Hz dB/octave grms
Acceptance	20 to 50 Hz: 50 to 350 Hz: 350 to 2000 Hz: Overall:		+6 0.4 -6 15.6		dB/octave g^2/Hz dB/octave grms
Sine vibration	On 6 axes 20Hz - 100Hz:		20		g
Mechanical shock	MIL-STD-202 method 213: • Half sine with a peak acceleration of 1500g for a duration of 0.5msec • 3 shocks per direction, applied along the 3 mutually perpendicular axes • 18 shocks in total				
Radiation	LEO		5	7	year

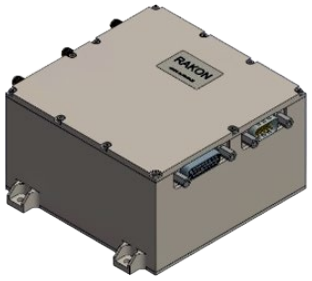
Testing

Test	Condition / Remarks	Qualification testing	Acceptance testing
Functional		✓	✓
Vibration		✓	✓
Mechanical shocks		✓	–
Thermal cycling		✓	✓
Thermal vacuum		✓	–

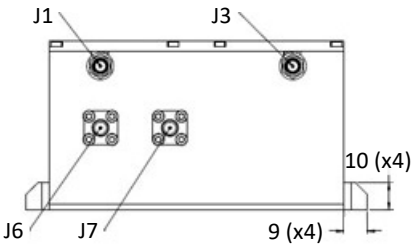
Issue: A0, 59XXXXXX.110, 15 November 2024

Product Outline

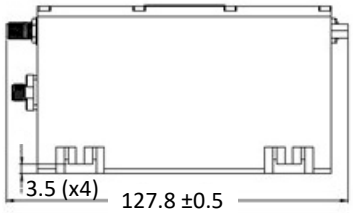




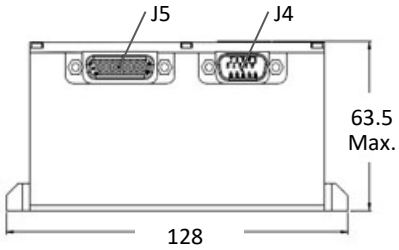
TOP VIEW



LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW

CONNECTOR	TYPE	FUNCTION
J1	SMA-Jack	10 MHz Input
J3	SMA-Jack	Antenna Input
J4	D-SUB 15 HD Plug	Power
J5	D-SUB 26 HD Socket	Data
J6	SMA-Jack	10 MHz Output
J7	SMA-Jack	10 MHz Output

Note: All dimensions are in mm.