GNSS Receiver DUAL

The GNSS Receiver DUAL is a highly integrated advanced NewSpace GNSS Receiver proposed as a full housing or as a PC104[1] board format. It is an off-the-shelf dual GNSS Receiver with low power consumption and is specifically designed for small and nanosatellites. With multi-band and multi-constellation support, this advanced solution enables GNSS Receiver to process signals from up to 448 channels simultaneously to provide high performance position, velocity and timing.

Compared with Rakon's GNSS Receiver DB, the GNSS Receiver DUAL is equipped with two GNSS receivers, a highly performant rad-hard microcontroller and a clock management function. This solution is ideal for applications requiring high availability GNSS receiver, full attitude GNSS receivers (Heading, Roll and Pitch) or cold/hot redundancy.

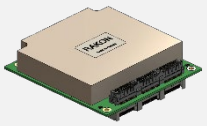
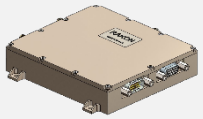
As well as the SINGLE, the GNSS Receiver DUAL is able to provide advanced features like GNSS data monitoring, innovative navigation algorithms and clock synchronisation. Used with Rakon's RK508NS or RK409NS OCXO, this last feature allows the microcontroller to discipline the oscillator on GNSS signals. Advanced algorithms are implemented to ensure smooth synchronisation while avoiding any glitches or jumps in the frequency.

This advanced GNSS product is available as a PC104 format or as a stand-alone equipment protected by in a space-grade mechanical housing.

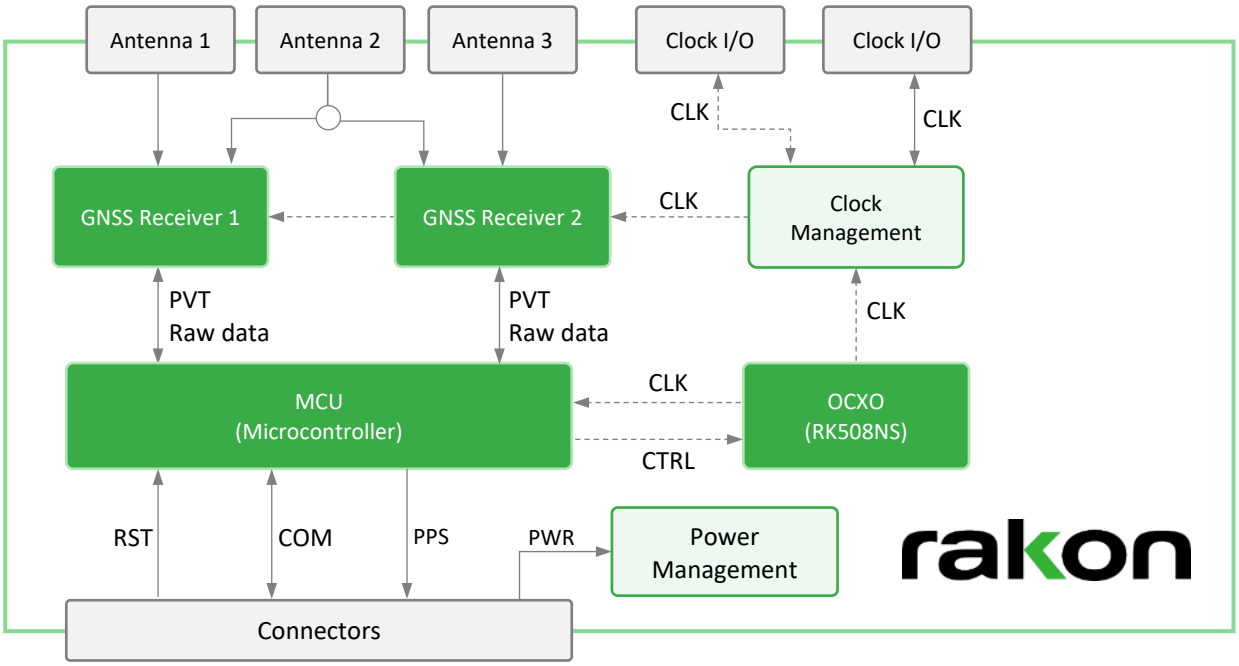
The GNSS Receiver DUAL is part of Rakon's NewSpace Equipment portfolio which includes timing and frequency distribution products (MROs), GNSS receivers and S-Band communication devices for NewSpace constellations.

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
- Bi or Tri Antennas (active or passive)
- PPS signal output
- Rad-hard microcontroller
- Disciplined OCXO
- 10 MHz output
- Power consumption: <5 W
- Supply voltage: 3.3 to 32 V

96 x 90 x 28 mm	130 x 122 x 24 mm
PC104 format	Full housing format
	

Block Diagram



[1] PC104: Standards defining PCB form factors and connectivity widely used in CubeSats and embedded computer industry.

Issue: A0, 59XXXXXX.110, 8 November 2023

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				
Standalone	800 km altitude (RMS)	1.2		m
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		3.3	5	32	VDC
Antenna					
Pre-amplification range		15		50	dB
Antenna supply voltage			3.3		VDC
Antenna supply current				150	mA
Power consumption			4.5	5.4	W
Electrical interfaces					
UART	RS485		1		
CAN			1		
PPS outputs	RS422		1		
On/Off input	+3.3V LVTTL input		1		
External reset input	+3.3V LVTTL input		1		
Clock I/O	Input/output		2		

GNSS Disciplined Oscillator

An optional Rakon OCXO can be disciplined on the PPS output of GNSS receivers. A control loop is implemented in the microcontroller to synchronize the OCXO output with the PPS. Advanced algorithms are applied to compensate temperature and ageing effects on stability while avoiding any glitch or jump on the frequency. In the event of loss of GNSS signals, 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 RK508NS or an external RK409NS.

Free running Performance

The following parameters are taken form RK508NS datasheet and RK409NS datasheet. Full parameters can be found there.

Parameter	Condition / Remarks	RK508NS Typ.	RK409NS Typ.	Units
Initial frequency accuracy	At ambient temperature at DC/DC turn ON within 1.5 hour	±100	±20	ppb
Frequency stability vs. temperature	For any 24 hours at any temperature within acceptance temperature range, under vacuum	±100	±1	ppb
Overall Frequency drift	Initial, temperature range, EOL (12 years)	±700	±500	ppb

Disciplined Performances – OCXO locked to PPS signal

Parameter	Condition / Remarks	RK508NS Typ.	RK409NS Typ.	Units
10 MHz output stability	Allan deviation	0.05	0.01	ppb
10 MHz output accuracy	Locked (at ambient temperature; after 48h locked)	±5	±5	ppt
Time stability	Locked (-20°C, +60°C; after 0.5 hour)	10	10	ns (TDEV)
Time accuracy	Locked (at ambient temperature at DC/DC turn ON within 1.5 hour)	±10	±10	ns

Holdover mode

Parameter	Condition / Remarks	RK508NS Typ.	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	±0.005	ppb
Time stability	Holdover (/24h; -20°C, +60°C; sine cycle of 1.5 hour)	800	10	us (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
Synchronization	Phase locked with the internal/external 10MHz clock				

Physical Parameters

Parameter	Condition / Remarks	
Dimensions	PC104 format	96 x 90 x 28 mm
	Full housing format	130 x 122 x 24 mm
Mass	PC104 format	< 250 g
	Full housing format	< 450 g

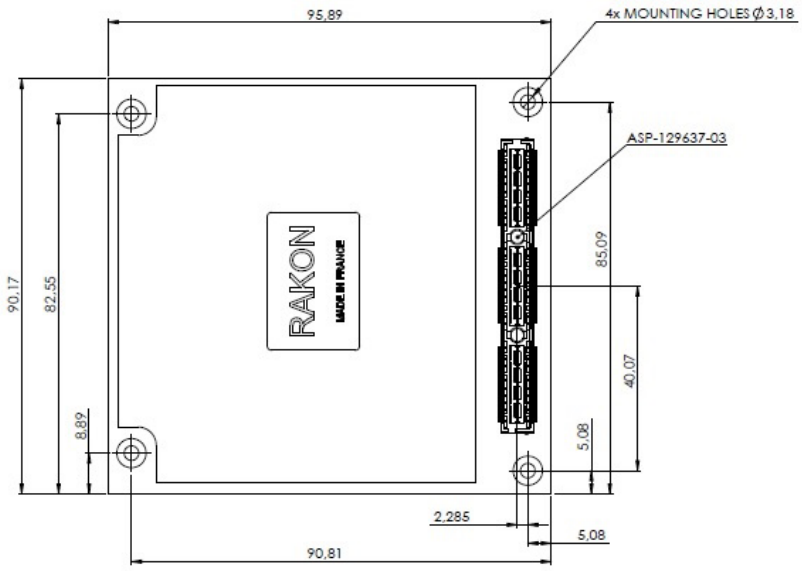
Environmental Conditions

Parameter	Condition / Remarks	Min.	Typ.	Max.	Unit
Non-operating temperature		-40		85	°C
Operating temperature		-30		70	°C
Thermal cycles	8 cycles ±5 °C/minute slope 1 hour at min/max temperature	-30		70	°C
Random vibration	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
Sine vibration	20Hz - 100Hz:		20		g
Mechanical shock	MIL-STD-202 method 213: • Half sine with a peak acceleration of 2000g for a duration of 0.3msec • 3 shocks per direction, applied along the 3 mutually perpendicular axes • 18 shocks in total				
Radiation	LEO		5	7	year

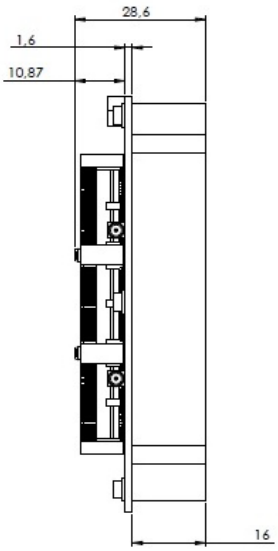
Testing

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

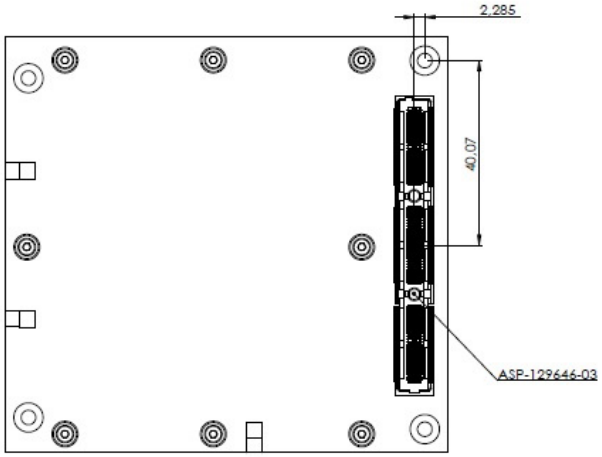
Product Outline - PC104 format



TOP VIEW



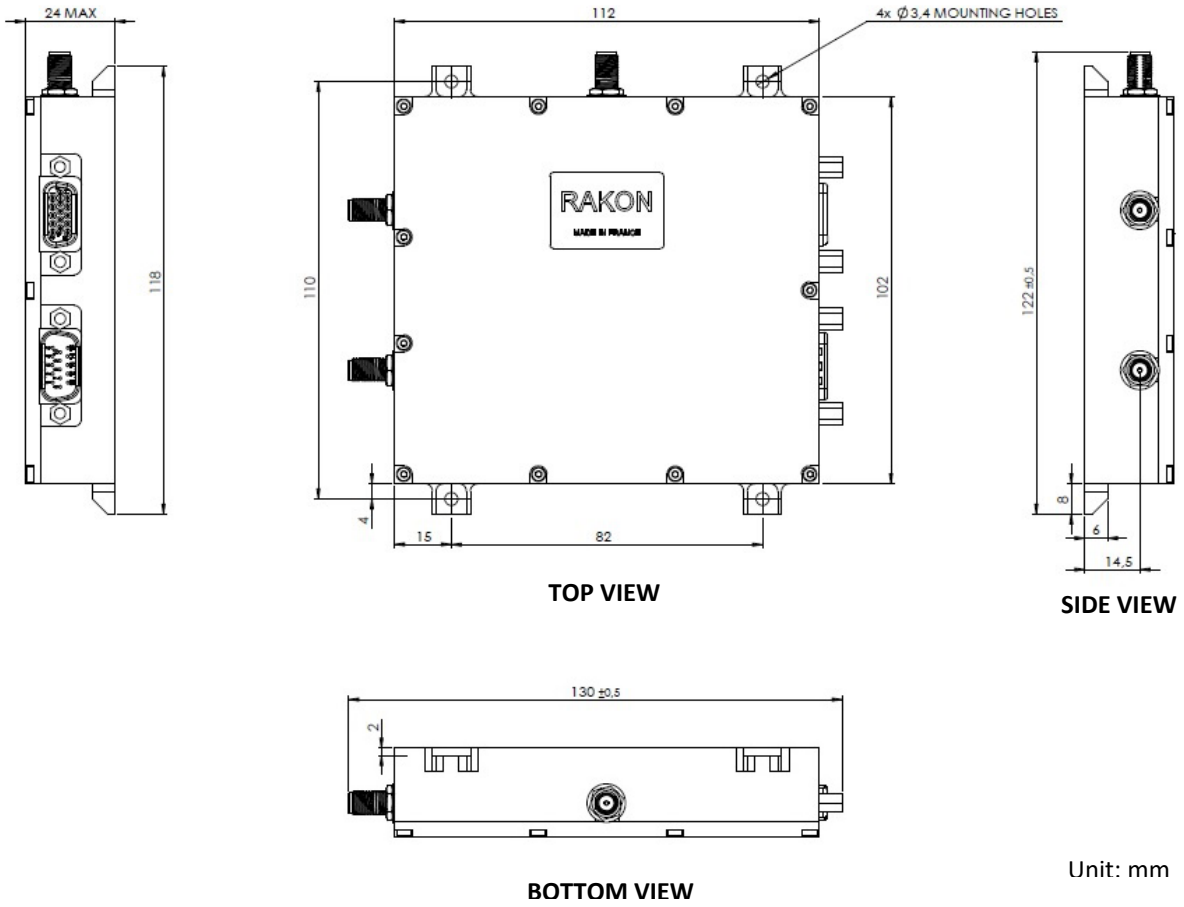
SIDE VIEW



BOTTOM VIEW

Unit: mm

Product Outline - Full housing format



TOP VIEW

SIDE VIEW

BOTTOM VIEW

Unit: mm