

# SRO-5680 RUBIDIUM OSCILLATOR

## ULTRA-LOW NOISE AND GPS/GNSS-DISCIPLINED



The ultra-low noise SRO-5680 GPS/GNSS-disciplined rubidium oscillator (GPSDO) features an EMI-shielded, rugged packaging, while integrating complex synchronization functionality all in one low-cost, super-small package.

It is compatible with the FEI-5680 Rb model and utilizes the SmarTiming+® technology to provide a host of integrated GPS/GNSS disciplining and timing features. The SRO intelligently synchronizes, disciplines, and controls any primary 1PPS reference signal, such as GPS/GNSS, Cesium, Hydrogen Maser, and T1/E1, at cutting-edge 1ns resolution. Its slim and rugged packaging and ultra low noise features make it greatly suitable for next gen SATCOM, airborne and other stringent MIL applications.

### Applications

- Telecom
- Navigation
- Broadcast
- Defense
- Battery Powered Instruments

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## KEY FEATURES

### Smart Low Noise, Low g Sensitivity & Rugged SRO-5680 Rubidium Oscillator

- Single power supply voltage : 11 – 16V or 18 – 32V (standard model only)  
12V±5% (with low noise LN and ULN options)
- Frequency offset over temp. range : ±5E-11
- Short-term stability : 1E-12 / 100 sec.
- 1PPS output : CMOS 0-5V
- Low warm-up current : < 1.2A
- Ultralow aging : < 5E-11/ month
- Low noise (LN) option : -130dBc @ 10 Hz (12V35% supply option only)
- Extreme ultralow low noise (EULN) option : -138dBc @ 10 Hz (12V35% supply option only)
- Low g sensitivity : 2E-10/g per axis
- Slim profile : 1.12” height
- RS232 standard interface : Control & monitoring commands, 9600 b/s

# Technical Specifications

## ELECTRICAL

Spec	Smart SRO-5680			
Type	Standard			
RFOUT Frequency	10 MHz			
Frequency Change	Operating temperature range (Thermal chamber with air flow)	$< 2E^{-10}$ -10°C to +60°C	(Option code: E65) -20°C à 65°C	
Frequency Accuracy @ Shipment	$< 5E^{-11}$ (+25°C), typical			
Aging (After 3 months of continuous operation)	$< 5E^{-11}$ / month (typical: $3E^{-11}$ / month)			
Short Term Stability			w/LN,ULN or EULN	STS1
	1s	$2E^{-11}$	5E-12	3E-12
	10s	$8E^{-12}$	4E-12	3E-12
	100s	$2E^{-12}$	2E-12	3E-12
Phase Noise (dBc/Hz) (RFOUT 10 MHz)			(Option codes)	
	1 Hz	-75	LGS	LN
	10 Hz	-95	-85	-100
	100 Hz	-125	-130	-130*
	1k Hz	-145	-150*	-145
	10K Hz	-145	-160	-155
			-162	-155
			-160	-158
			-161	-161
			-166	-166
			* Subject to export control (end user statement required)	
Frequency Retrace	Off/On (In stable temperature, gravity, pressure & magnetic field conditions)	$< 5E^{-11}$ 24 hr / 1 hr		
Warm-up Time @ +25°C	Frequency stability	12 min $5E^{-10}$		
Analog Frequency Adjustment	Tolerance	$5 \times 10^{-9} \pm 20\%$		
[An external voltage (0-5 VDC) can be applied to pin 6 (FA). The cursor pin of a 10 kΩ variable resistor placed between pin 7 and GND can provide this voltage. If not used, pin 7 must be floating]				
Digital Frequency Adjustment	Internal crystal oscillator freq. Resolution (Through RS-232 commands)	$\pm 1.67E^{-8}$ 60MHz $5.12E^{-13}$		
RFOUT	Output level Output impedance	Sine wave 0.5 Vrms ( $\pm 10\%$ / 50Ω) 50 Ω $\pm 20\%$		
	Harmonics Spurious $f_0 \pm 100\text{kHz}$ (DDSout off) 60MHz sub-harmonics	$< -25\text{dBc}$ $< -80\text{dBc}$ $< -45\text{dBc}$	(Option code X)* $< -40\text{dBc}$ $< -110\text{dBc}$ $< -70\text{dBc}$	
Supply Voltage (DC)	24V	(with LN, ULN, EULN* or LGS option) 12V (12V $\pm 5\%$ )		
	Max Power Supply Ripple	$< 50$ mV peak to peak (from 1Hz to 1 MHz frequency band)		
Input Power	Warm up @+25°C (typical)	$< 28\text{W}$ @12V or $< 32\text{W}$ @24V	(with LN, ULN, EULN* or LGS option) $< 32$ W @12V	
	0°C	$< 20$ W	$< 23$ W	
	+25°C	$< 13$ W	$< 15$ W	
	+60°C	$< 7$ W	$< 9$ W	
Communication Interface	Protocol speed Compatible with	RS-232 commands for control & monitoring (see commands below) Timing and locking control functions VMGA messages 9600, n, 8, 1 SRO model		
Conformal coating (CC)	None	CC (option code: CC)		

\* 'EULN' & 'X' options cannot be selected together

Spec	Smart SRO-5680		
Reverse Voltage Protection	< -40V (up to -40V on power input / no damage)		
PPSOUT Output Current	1PPS, CMOS 0-5V +20 mA sink/source		
PPSOUT Pulse Width (PW)	1PPS, 0 to 1s in 133 ns/step		
PPSOUT Holdover Time Stability  Temperature window (After careful user frequency & 1PPS phase adjustment)	< 1µs / 24 hr < 7µs / 1 week Within ± 2°C	< 3µs / 24 hr  Within 20°C	< 7µs / 24 hr  Within 40°C

## ENVIRONMENTAL

Spec	Smart SRO-5680		
Magnetic Field Sensitivity	< 2E-10 / Gauss in worst axis		
Storage Temperature	- 55°C to + 85°C		
Humidity	GR-CORE-63, Section 5.1.2		
Operating Vibration	GR-CORE-63, Section 5.4.2 Random and Sinusoidal MIL-PRF-28800F, Class 3, 4	Ruggedized (ordering code: VIB) Profile: MIL-STD-810F, Method 514.5, Category 24 Average acceleration: 7.7g rms Duration: 1 hour/axis Axis: on each X/Y/Z axis For longer vibration periods , please contact Factory	
Low g sensitivity	n/a	(ordering code: LGS) 2E-10/g per axis	
Shock	Survival: 40g / 11ms		
Helium concentration sensitivity	< 1E-10 per ppm of Helium concentration change		
G-Tip-Over Test	< 2E-10 / g in worst axis		

## PHYSICAL

Spec	Smart SRO-5680		
Size (L x W x H)	140 x 101.3 x 28.5 mm		
Weight	720gr		
Mounting & Mechanical Layout	See drawings below		
Connector	Male D-sub 15 pins (see drawing below)		

## MODEL PN ORDERING INSTRUCTIONS

(Example: SRO-5680/10M/LP/ULN/CC)

**SRO-5680** / **10M** / **x**

Type      Frequency      Option(s)

## STANDARD RS-232 CONTROL & MONITORING COMMANDS

### Frequency Adjustment & Monitoring Functions

The operating and monitoring parameters of the SRO-5680 are accessible for read and write operations through the serial RS-232 port (9600 bits/sec., no parity, 1 start bit, 8 data bits, 1 stop bit).

There are 2 basic commands, which are M, Cxxxx

M<CR><LF>: monitors the basic internal signals of the atomic clock.

The returned answer looks like

HH GG FF EE DD CC BB AA <CR> <LF>

Where each returned byte is an ASCII coded hexadecimal value, separated by a <Space> character.

All parameters are coded at full scale.

HH: Read-back of the user provided frequency adjustment voltage on pin 2 (0 to 5V)

GG: reserved

FF: peak voltage of Rb-signal (0 to 5V)

EE: DC-Voltage of the photocell (5V to 0V)

DD: varactor control voltage (0 to 5V)

CC: Rb-lamp heating current (Imax to 0)

BB: Rb-cell heating current (Imax to 0)

AA: reserved

Cxxxx<CR><LF>: output frequency adjustment through the synthesizer, by steps of  $5.12 \times 10^{-13}$ , where xxxx is a signed 16 bits word in hexa coded ASCII. This value is automatically stored in a EEPROM as last frequency which is applied after RESET on power-ON operation.

In Track mode this correction is not in use. The function FCsdddd do the same. But the data format is different.

## Timing & Locking Control Functions

Using the same data interface, the smart USRO models can accept the following basic ASCII commands: Data is in decimal ASCII code.

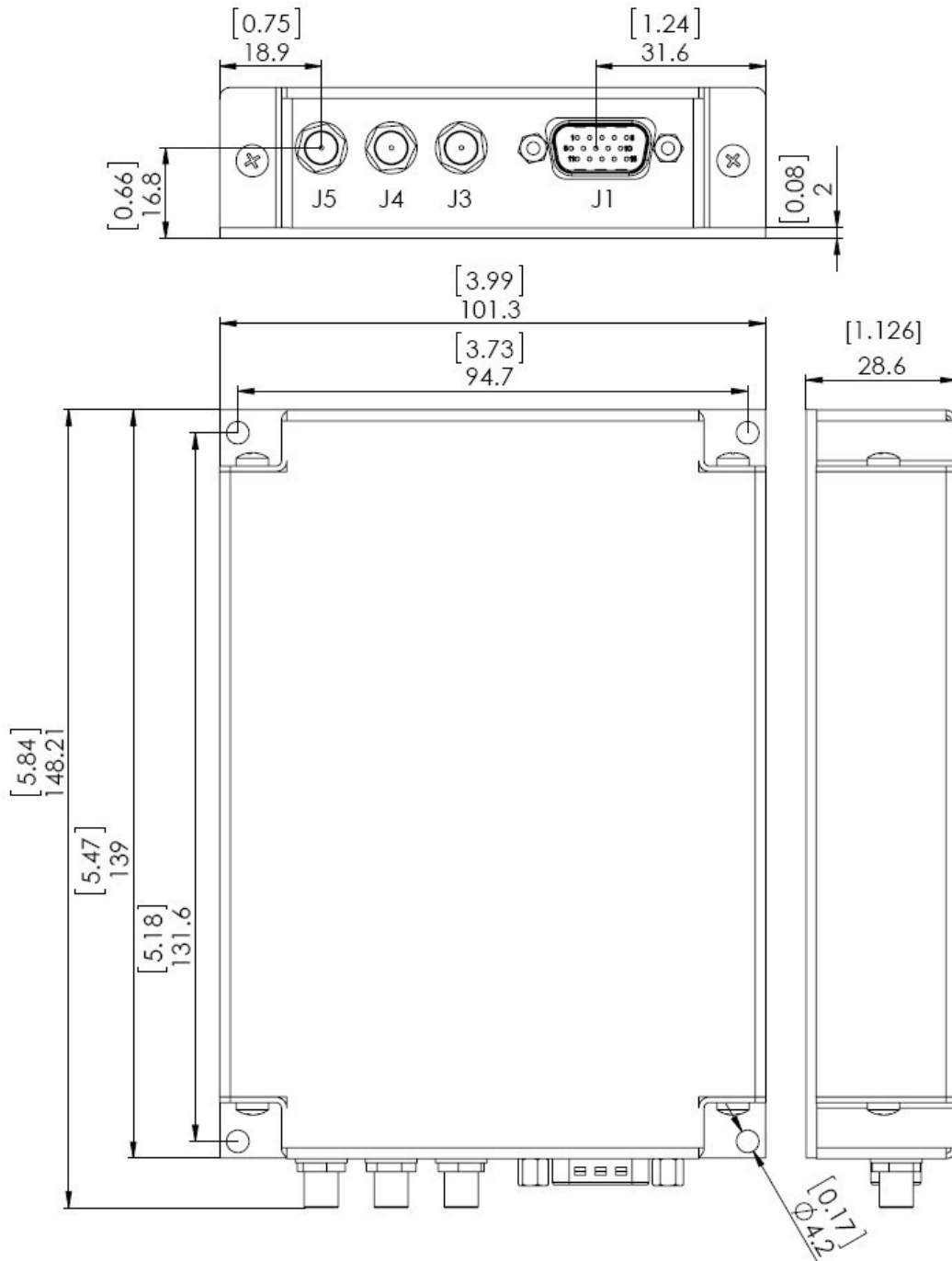
Command name	Syntax command	Data field (if any)	Response syntax	Response data (if any)
Identification	ID<CR><LF>	-	TNTSRO-aaa/rr/s.ss <CR><LF>	aaa: 100 rr: revision number s.ss: software version
Serial number	SN<CR><LF>	-	xxxxxx<CR><LF>	xxxxxx : 6 digits serial nbr
Status	ST<CR><LF>	-	s<CR><LF>	s:Status s=0 :warming up s=1 :tracking set-up s=2 :track to PPSREF s=3 :synch to PPSREF s=4 :Free Run. Track OFF s=5 :FR. PPSREF unstable s=6 :FR. No PPSREF s=7 :factory used s=8 :factory used s=9 :fault or Rb OOL
Set PPSOUT delay	DEdddddd<CR><LF>	ddddddd=delay by 133ns step. Max 7499999 DE0000000 :synch to PPSREF	ddddddd<CR><LF>	ddddddd=delay by 133ns step. Max 7499999
Set PPSOUT Pulse Width	PWddddddd<CR><LF>	ddddddd=pulse Width by 133ns step. Max 7499999 PW0000000: no pulse	ddddddd<CR><LF>	ddddddd=Pulse Width by 133ns step. Max 7499999 0000000: no pulse
Time of day	TD<CR><LF>	-	hh:mm:ss<CR><LF>	hh:hours mm:minutes ss:seconds
Set time of day	TDhh:mm:ss<CR><LF>	hh:Hours mm:Minutes ss:seconds	hh:mm:ss<CR><LF>	hh:hours mm:minutes ss:seconds
Date	DT <CR><LF>		yyyy-mm-dd	yyyy : year mm : month dd : day
Set date	DT yyyy-mm-dd <CR><LF>	yyyy : year mm : month dd : day	yyyy-mm-dd	yyyy : year mm : month dd : day
Beat every second on serial port.	BTx<CR><LF>	x=0 : Stop beat x=1 : Effective Time interval PPSOUT vs PPSREF x=2 : Phase comparator x=3 : Both x=1 & x=2 x=4 : Beat Time of day x=5 : Beat status x=6 : Beat <CR><LF> x=7 : Beat Date, Time, Status x=A : Beat NMEA \$PTNTA, x=B : Beat NMEA \$PTNTS,B,	ddddddd<CR><LF> or sPPP<CR><LF> or ddddddd sPPP <CR><LF> or hh:mm:ss<CR><LF> s<CR><LF> <CR><LF> yyyy-mm-dd hh:mm:ss s	ddddddd : delay in 133ns step sPPP:phase error in ns s: +/- signe hh:hours mm:minutes ss:secondes s: status  yyyy:year, mm:month,dd:day
Set frequency adjustment	FCsdddd<CR><LF>	s=+/- signe dddddd = limited within range : +32767/-32768 FC+99999 : interrogation	sdddd<CR><LF>	s: +/- signe dddddd : frequ. Adj. in 5.12 x 10 <sup>-13</sup> step
Set frequency save. Integral part, when Status = 2, 3	FSx<CR><LF>	x=0 : never save x=1 : save every 24 hours x=2 : save right now x=3 : save actual freq. now x=9 : interrogation	x<CR><LF>	x=0 : never save x=1 : save every 24 hours
Set module customization	MCsxx [cc...c] <CR><LF>	s = L : Load parameter s = S : Store parameter ccc...c s = B : Load start behaviour s = A : Activate msg at start s = C : Cancel msg at start s = H : Load Help s = T : Load Data Type xx = 00..FF: msg number, ccc...c : new welcome message, up to 24 characters	cc...c<CR><LF> or d<CR><LF> or xy- <CR><LF>	ccc...c : response to MCLxx or to MCHxx.  d : 0, 1 response to MCBdd or xy : Data Type, response to MCTxx, x=0 RAM, x=1 eeprom, x=2 Flash, y=0 Byte, y=1 sByte, y=2 Word, y=3 sWoord, ... y=8 string ASCII, y=9 strng binary
Reset micro controller	RESET<CR><LF>			(Identification & welcome message, GPS binary)

## NMEA 0183 FORMAT (BTA, BTB)

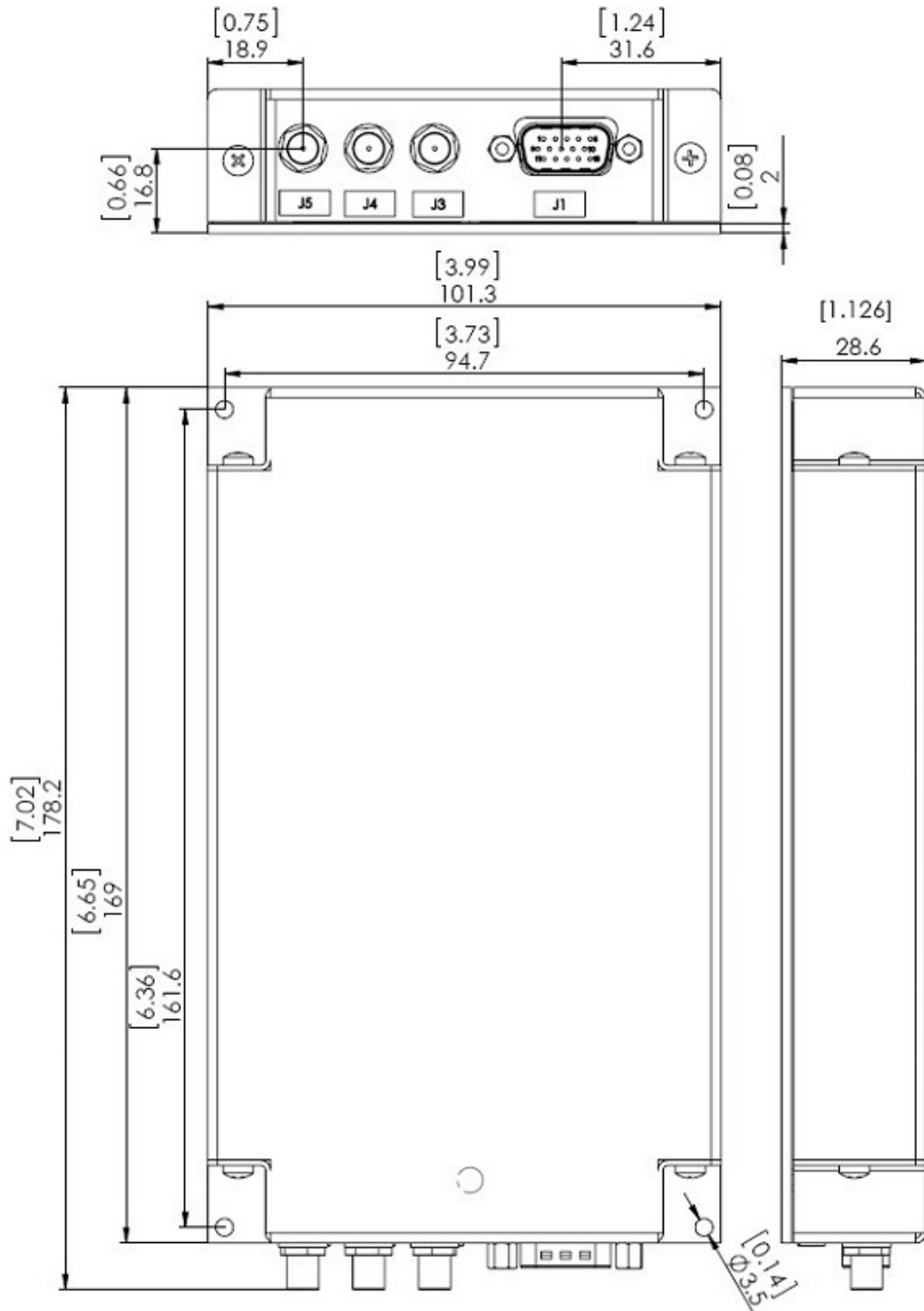
\$PTNTA,yyyymmddhhnnss,q,T3,rrrrrr,sfff,x,y\*CS<CR><LF>

yyyy: year; mm:month; dd: day; hh: hour; nn: minute; ss: second; q: quality, 0: Rb line not locked, 1: Free Run, 2: Disciplined; T3: format descriptor; rrrrrr: effective time interval PPSOUT vs PPSREF; sff: phase comparator; x,y: reserved; CS: checksum.

## MOUNTING & MECHANICAL LAYOUT (STANDARD MODEL)



**MOUNTING & MECHANICAL LAYOUT (WITH LN, ULN , LGS OR EULN OPTION)**



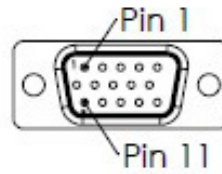


## PIN FUNCTIONS LAYOUT (All options)

Connector: 15 pins in 3 rows:

Pin	Function
1	Power +24V (+12V)
2	GND
3	Freq. Adj
4	GND
5	Vrefout
6	Power +24V (+12V)
7	GND
8	/Sync
9	/Track
10	PPSREF IN
11	PPS OUT
12	BITE (lock monitor)
13	Track/Sync alarm
14	RxD
15	TxD

Connector	Function
J3	PPSREF IN
J4	PPS OUT
J5	RF OUT



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