

# STARLPRO-1500

High Precision & Performance Rubidium Source



## Main Features

- Very low temperature sensitivity
- Excellent short term stability
- Low power consumption
- Pin compatible with industry std.
- Small volume / low profile
- Rb lamp extended life expectancy (20 years)
- Industry standard pin out
- RS 232 interface for center frequency adjustment and monitoring of the working parameters

## Applications

Telecom  
Navigation  
Broadcast  
Defense  
Instrument

**Safran Electronics & Defense is with you every step of the way, building in the intelligence that gives you a critical advantage in observation, decision-making and guidance.**

## Product Characteristics

- Ultra low aging : < 2E-12/ day
- Freq. offset over temp. range : < 2 E-10 over 0°C to 60°C
- Short-term stability : 1E-12 @ 100s
- Small volume : 28 in3 (5x3.74x1.5" / 128x95x38.1mm)
- Single power supply voltage : 12V or 24V
- RS232 standard interface : Control & monitoring commands, 9600 b/s

## Main Applications

- Synchronization telecommunications (SDH, SONET, SS7, GSM, TETRA)
- Digital Audio Broadcast
- TV transmissions (analog & digital)
- Military communications
- Navigation
- Instrumentation
- Tracking and guidance control

## Technical Specifications

### ELECTRICAL

Spec		StarLPRO-1500			
Type		Standard	Options		
RFOUT Frequency		10 MHz	Not applicable		
Frequency Change					
Operating temperature range (Thermal chamber with air flow)		< 2E <sup>-10</sup> -0°C to +60°C	+- 1E <sup>-10</sup> (order code: 60)		
Frequency Accuracy @ Shipment		< 5E <sup>-11</sup> (+25°C), typical			
Aging (After 3 months of continuous operation)		< 5E <sup>-11</sup> / month (typical: 3E <sup>-11</sup> / month)	< 3E <sup>-11</sup> / month < 2E <sup>-10</sup> / year < 1E <sup>-9</sup> / 10 years (order code: A) (typical: ±1E <sup>-11</sup> / month)		
Short Term Stability			Improved Short term stability (order code: S)		
	1s	2E <sup>-11</sup>	1E <sup>-11</sup>		
	10s	8E <sup>-12</sup>	3E <sup>-12</sup>		
	100s	3E <sup>-12</sup>	1E <sup>-12</sup>		
Phase Noise (dBc/Hz) (RFOUT 10 MHz)	1 Hz		-75		
	10 Hz		-95		
	100 Hz		-125		
	1k Hz		-145		
	10K Hz		-150		
Frequency Retrace Off/On (In stable temperature, gravity, pressure & magnetic field conditions)			< 5E <sup>-11</sup> 24 hr / 1 hr		
Warm-up Time @ +25°C		12 min	Lock	Lock	25 min 5E <sup>-10</sup>
	Frequency stability	5E <sup>-10</sup>	< 7min (order code: F)	< 5min (order code: FE)	(order code: LP)
Analog Frequency Adjustment Range Tolerance [An external voltage (0-5 VDC) can be applied to pin 7 (V adjust). And internal mechanical adjustment by screwdriver]			5 x 10 <sup>-9</sup> ±20%		
Digital Frequency Adjustment Range Resolution (Through RS-232 commands)			±1.67E <sup>-8</sup> 5.12E <sup>-13</sup>		
RFOUT Output level Output impedance Harmonics Spurious f <sub>0</sub> ± 100kHz			Sine wave 0.5 Vrms (± 10% / 50Ω) 50 Ω ±20% < -40dBc < -80dBc		
Communication Interface Protocol speed			RS-232 control & monitoring (see commands below) 9600, n, 8, 1		

Spec	StarLPRO-1500		
Type	Standard	Options	
Supply Voltage (DC)	24V (20 to 32 V)	12V (11.2 to 16 V) (order code: 12V)	
Max Power Supply Ripple	< 50 mV peak to peak (from 1Hz to 1 MHz frequency band)		
Supply Voltage Sensitivity	< 2E <sup>-11</sup> for 10% voltage change		
Input Power	with the following options:		
Warm up @+25°C (typical)	<30W @12V or <38W @ 24V	(F/E)	(FE)
		<40 W	<50 W
		(24V only)	(24V only)
0°C	<14 W	(LP)	
+25°C	< 11 W	<24W	
+60°C	< 7 W	Option GPS : +2W	
Lock Monitor : 5V CMOS LOAD (output impedance ~ 1KΩ)	Lock: < 0.5V	Unlock: > 4.2V	
Conformal coating	None	Included (order code: CC)	
Reverse Voltage Protection	< -40V (up to -40V on power input / no damage)		
Electrical Protection	An internal diode protects against reverse polarity connection		
power +24V (12V)	ESD and short-cut protected		
RF output	ESD and short-cut protected		
TxD output	ESD protected		
RxD input	ESD protected		
Frequency adjust input	Over current protected		
Lock indicator			

## ENVIRONMENTAL

Spec	StarLPRO-1500
Type	Standard
Magnetic Field Sensitivity	< 2E <sup>-11</sup> / Gauss (< 1E <sup>-10</sup> / Gauss in longitudinal 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
Shock	Survival: 40g / 11ms
Helium concentration sensitivity	< 1E <sup>-10</sup> per ppm of Helium concentration change
G-Tip-Over Test	< 2E <sup>-10</sup> / g in worst axis

## PHYSICAL

Spec	StarLPRO-1500	
Type	Standard	Options
Size (L x W x H)	5x3.74x1.5" / 128x95x38.1mm	
Weight	234g (8.25oz)	
Mounting & Mechanical Layout Screw fixture type (6 pieces)	see drawings below UNC-4-40	Not applicable M3 (order code: M3)
Connector	10 pins male TE-Connectivity 87456-6 Contacts AWG20 TE-Connectivity 86016-5	

## MODEL ORDERING INSTRUCTIONS



# STANDARD RS-232 CONTROL & MONITORING COMMANDS

The operating and monitoring parameters of the StarLPRO-1500 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 basics 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 or power-ON operation.

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

Set frequency adjustment	<b>FCsdddd</b> <CR><LF>	s= +/- signe dddd = limited within range : +32767/-32768 FC+99999 : interrogation	sdddd<CR><LF>	s: +/- signe dddd : frequ. Adj. in $5.12 \times 10^{-13}$ step
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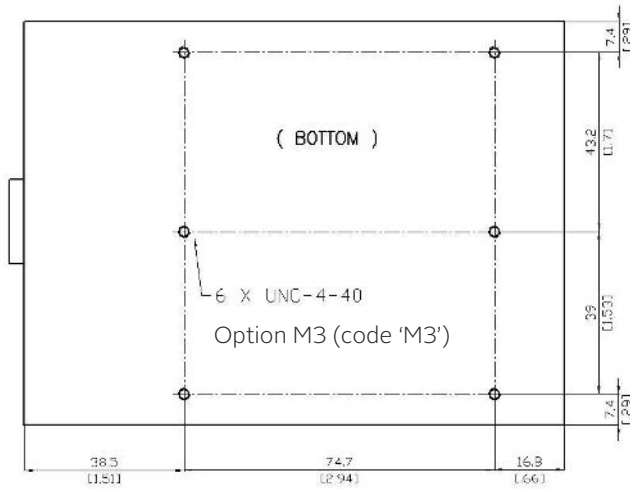
PIN FUNCTION LAYOUT			
LPFRS-01/LPRO TEMEX		LPRO DATUM	
Parameter	Requirements	Parameter	requirements
Pin 1(output)	10 Mhz RF	Pin 1(output)	10 Mhz RF
Pin 2(output)	RF return	Pin 2(output)	RF return
Pin 3(RF return)	RF return Dc insulated	Pin 3(NA...)	Reserved Requires open in use
Pin 4(output)	GND	Pin 4(output)	Chassis ground
Pin 5(RxD)	RxD (TTL) RS232 input (0-5V)	Pin 5(optional output)	Lamp voltage monitor (Acceptable level :3V to 13V after warm up)
Pin 6(output) (with CMOS load)	Lock monitor * See Option Spec.	Pin 6(output) (with CMOS load)	Lock monitor (Z=2K Ohm±10%) 0V to 0.05V locked, 4.2V to 5.4V unlocked
Pin 7(input) V adjust	>1.5x10 <sup>-8</sup> to 5V <-1.5x10 <sup>-8</sup> to 0V	Pin 7(input)	>1.5x10 <sup>-8</sup> to 5V <-1.5x10 <sup>-8</sup> to 0V
Pin 8(GND)	GND	Pin 8(output)	Vin return
Pin 9(TxD)	TxD (TTL) RS232 output (0-5V)	Pin 9(optional output)	Xtal monitor Z=20K Ohm ±10%
Pin 10(input) 24V/12V	24V (12V)	Pin 10(input)	Vin power

## HEAT SINK MOUNTING

Below are some heat sink options depending on your environmental system configuration:

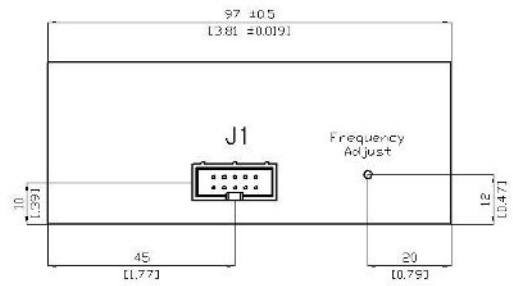
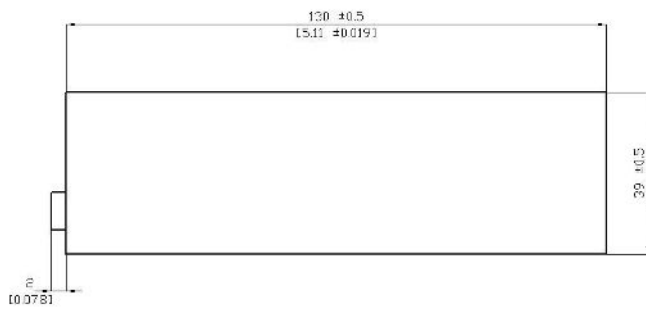
1. Mount the StarLPRO-1500 on a copper ground PCB. This mounting configuration is not recommended for >50°C ambient operational temperature.
2. Mount the StarLPRO-1500 against a system chassis using the UNC 4-40, Option M3 (code 'M3') screws with the provided thermal pad or thermal paste in between and wire bridge the connector. This mounting configuration is recommended.
3. Mount a radiator on top of the StarLPRO-1500 with the provided thermal pad or thermal paste in between, if no base plate or system chassis is available. This mounting configuration is recommended.

# MECHANICAL DRAWINGS

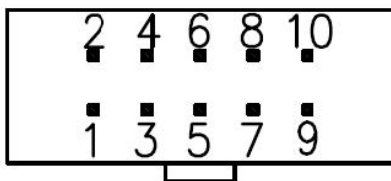


Maximum length of the fastening screws :  
 For UNC-4-40 : 0.1968"  
 For M3 : 5 mm

00 Dimension are in mm  
 [0.00] Dimension are in inche



Connector front view:



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