

# ***PERF10 Rubidium Atomic Clock***

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**Owner's Manual**



***Stanford Research Systems***

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**Certification**

Stanford Research Systems certifies that this product met its published specifications at the time of shipment. Stanford Research Systems further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST).

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**Warranty**

This Stanford Research Systems product is warranted against defects in materials and workmanship for a period of one (1) year from the date of shipment.

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**Service**

For warranty service or repair, this product must be returned to a Stanford Research Systems authorized service facility. Contact Stanford Research Systems or an authorized representative before returning this product for repair.

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## Safety and Preparation for Use

### WARNING!

Dangerous voltages, capable of causing injury or death, are present in this instrument. Use extreme caution whenever the instrument cover is removed. Do not remove the cover while the unit is plugged in to a live outlet or to an external DC power supply.

### Caution

- There are no user serviceable parts inside the instrument. Do not attempt to service or adjust the instrument. Refer all servicing to qualified factory personnel.
- Do not allow the instrument to become wet. Do not expose the instrument to rain or liquid spills. In the event the instrument is exposed to moisture turn it off immediately and wait until it is completely dry before attempting to operate it.

### Front Panel Switch

- The rocker switch on the front panel of the instrument is NOT a power switch — it only controls the on/off status of the outputs. Power is drawn from the AC or DC power source to power the rubidium oscillator whenever the unit is connected to one of these sources.

### External DC Power Supply

- Only units that are equipped with Option 01 can be operated from an external 12 VDC power source. Units equipped with Option 01 can be identified by the Neutrik speakON connector on the rear panel. Units without Option 01 have a blank piece of aluminum in place of the connector.
- Be sure the external 12 VDC connector is wired in accordance with the diagram given in this manual. Damage to the instrument may result if external 12 VDC is improperly applied.
- Be sure the external 12 VDC power supply used to power the instrument (when equipped with Option 01) is rated for the required current. The external supply needs to source 5.5A at 12VDC during the initial warm-up period.

### No Radioactive Components

- The Rubidium atomic oscillator used in PERF10 contains **no** radioactive components.

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# Introduction

The Stanford Research Systems PERF10 Rubidium Atomic Clock is an ultra-precise, ultra-stable 10 MHz atomic master clock designed to provide a frequency reference to audio and video equipment. Based on Stanford Research System's own PRS10 rubidium oscillator, the PERF10 provides a clocking source accurate to a staggering 0.05 parts-per-billion (at shipment) with a yearly aging of only 0.5 ppb.

The PERF10 goes beyond just accuracy to bring you a clock source specifically designed to meet the demanding requirements of digital audio. Most commercial rubidium oscillators are designed around inexpensive crystal oscillators—they have good long term stability but poor phase noise close to carrier. Only Stanford Research Systems' PERF10 rubidium clock is designed around a precision oven stabilized varactor tuned, SC-cut crystal oscillator to bring you both accuracy and the low phase noise required for precision audio applications. The PERF10's phase noise at 10 Hz off carrier is 30 dB better than a competing "Swiss-made" rubidium clock.

You won't need the spec sheet to tell the difference though— your ears will pick up the difference that comes from using the finest audio clock source available.

## PERF10 Front Panel



- 1. Output Switch.** This switch turns the 8 rear-panel 10 MHz outputs on and off. Note that this switch is **not** a power switch. The PERF10 draws power from the AC or DC power source to power the rubidium oscillator regardless of the switch status.
- 2. Output Indicator.** This group of LEDs glows green when the outputs are on, and red when the outputs are off.
- 3. AC Power indicator.** This group of LEDs glows green when the PERF10 is connected to AC Power. The PERF10 requires 90-132 VAC or 175 to 264 VAC.
- 4. DC Power indicator.** On PERF10s equipped with Option 01, this group of LEDs glows orange when the unit is connected to a 12 VDC power source.
- 5. Unlock indicator.** This group of LEDs flashes yellow to indicate that the internal rubidium oscillator is heating up and that its internal phase-lock loop is not yet locked. It takes about 6 minutes for the unit to warm up and lock from a completely cold state.
- 6. Lock indicator.** When the unlock indicator stops flashing this group of purple LEDs will glow to indicate the rubidium oscillator is warmed up, locked, and the unit is ready for use.

## PERF10 Rear Panel



- 1. RS-232 Connector.** This connector is used to communicate with the internal rubidium oscillator. It is only used during calibration and is not necessary for normal use. Advanced users who are interested will find the manual for the PRS10 rubidium oscillator, along with its RS-232 command set, at <http://www.thinksrs.com/downloads/PDFs/Manuals/PRS10m.pdf>.
- 2. AC Power Connector.** Used to connect PERF10 to the AC mains. PERF10 accommodates AC voltages from 90-132 VAC or 175 to 264 VAC without the need for any user configuration.
- 3. Chassis Ground.** Provides a convenient chassis ground reference point.
- 4. DC Power Connector.** On units equipped with Option 01 12 VDC power is provided to the instrument through this connector. The connector is a Neutrik speakON NL4MP socket, designed to accept a speakON NL4FX cable connector. See the section on “Using External 12 VDC Power” for a wiring diagram. On units without Option 01 this connector is replaced by a blank piece of aluminum.
- 5. Outputs 1-8.** 75Ω BNC connectors which carry the 10 MHz output. Each output is a 10 MHz sine wave with an amplitude of 1 Vpp when terminated in 75 Ω. For best results use quality 75Ω BNC cable to connect PERF10 to other devices, and minimize the length of cable runs.

# Operation

## Turning PERF10 On

To turn the unit on, connect it to an AC power source. The “AC Power” LEDs will glow green, and the “Unlock” LEDs will flash to indicate that the unit is warming up. If the unit is equipped with Option 01 a 12 VDC power source can be connected along with, or in place of, the AC power. The orange “DC Power” LEDs will glow when a DC power source is connected. After about 6 minutes the “Unlock” LEDs will stop flashing and the purple “Lock” LEDs will turn on indicating that the units is ready for use. Make sure that the front panel switch is in the “On” position and that the LEDs above the switch are glowing green indicating that the outputs are on.

## Connecting to Audio/Video Devices

Once the “Locked” LEDs are on the PERF10 is ready to be connected to external audio/video components. Almost all commercial audio and video devices use  $75\Omega$  interconnects for clock distribution. To minimize reflections that can degrade clocking performance use quality  $75\Omega$  cable to connect the PERF10 outputs to up to the “External Clock” inputs of up to 8 audio/video devices. Keep cable lengths to a minimum when possible.

Note that different devices have different configuration requirements for connecting them to an external 10 MHz clock. Consult the manual for each device individually to determine how to configure it to accept an external 10 MHz clock and verify that the device is locked to the PERF10’s output.



## Using External 12 VDC Power

PERF10 can be ordered with Option 01, which enables the unit to be powered from an external 12 VDC power source. When equipped with Option 01 PERF10 can be powered by 12 VDC alone, or the DC and AC power sources can be connected at the same time with the DC power providing redundant backup in case the AC power fails.

### DC Power Requirements

The external 12 VDC power supply should be capable of providing 5.5 amps of current during the rubidium oscillator's initial warm-up period. Note that this is beyond the capability of many typical small benchtop power supplies. Do not connect the unit to a power supply not capable of providing the required current. After warm-up the current requirement drops to about 1.5 amps.

### DC Power Connector

The DC power connector on the rear of the unit is designed to accept a Neutrik speakON NL4FX connector. The connector should be wired as follows:

<u>SpeakON Pin</u>	<u>Power Supply</u>
1+	+12 VDC
2-	Ground (Return)
1-	Power Supply Chassis (Earth) Ground

Make sure the power connector is wired properly. Incorrect wiring of the power connector can result in permanent damage to the instrument.

# Specifications

## Rubidium Oscillator

Accuracy at shipment	$\pm 0.05$ ppb ( $\pm 5 \times 10^{-11}$ )
Aging (after 30 days)	$< 5 \times 10^{-11}$ (monthly) $< 5 \times 10^{-10}$ (yearly) $< 5 \times 10^{-9}$ (20 years, typ.)
Spurious Harmonics	$< -60$ dBc
Phase noise (SSB)	$< -135$ dBc/Hz (10 Hz) $< -145$ dBc/Hz (100 Hz) $< -150$ dBc/Hz (1 kHz) $< -150$ dBc/Hz (10 kHz)
Short-term stability (Allan var.)	$< 2 \times 10^{-11}$ (1s) $< 1 \times 10^{-11}$ (10 s) $< 2 \times 10^{-12}$ (100s)
Warm-up time	$< 6$ minutes (time to lock)

## Outputs

Number of Outputs	8 BNC (rear panel)
Output Impedance	$75\Omega$
Output Amplitude	1 Vpp (terminated in $75\Omega$ )

## Environmental

Operating Temperature	+10 °C to +40 °C
Storage temperature	-55 °C to +85 °C
Relative humidity	$< 95$ % (non-condensing)

## General

AC Power	90 to 132 VAC or 175 to 264 VAC, 47 to 63 Hz, 66W during initial warmup, 25 W steady state.
DC Power	12 VDC, 5.5 A during warmup, 1.3 A steady state.
Dimensions	19" x 3.5" x 10.125"
Weight	8 lbs.
Warranty	One year parts and labor on defects in materials and workmanship