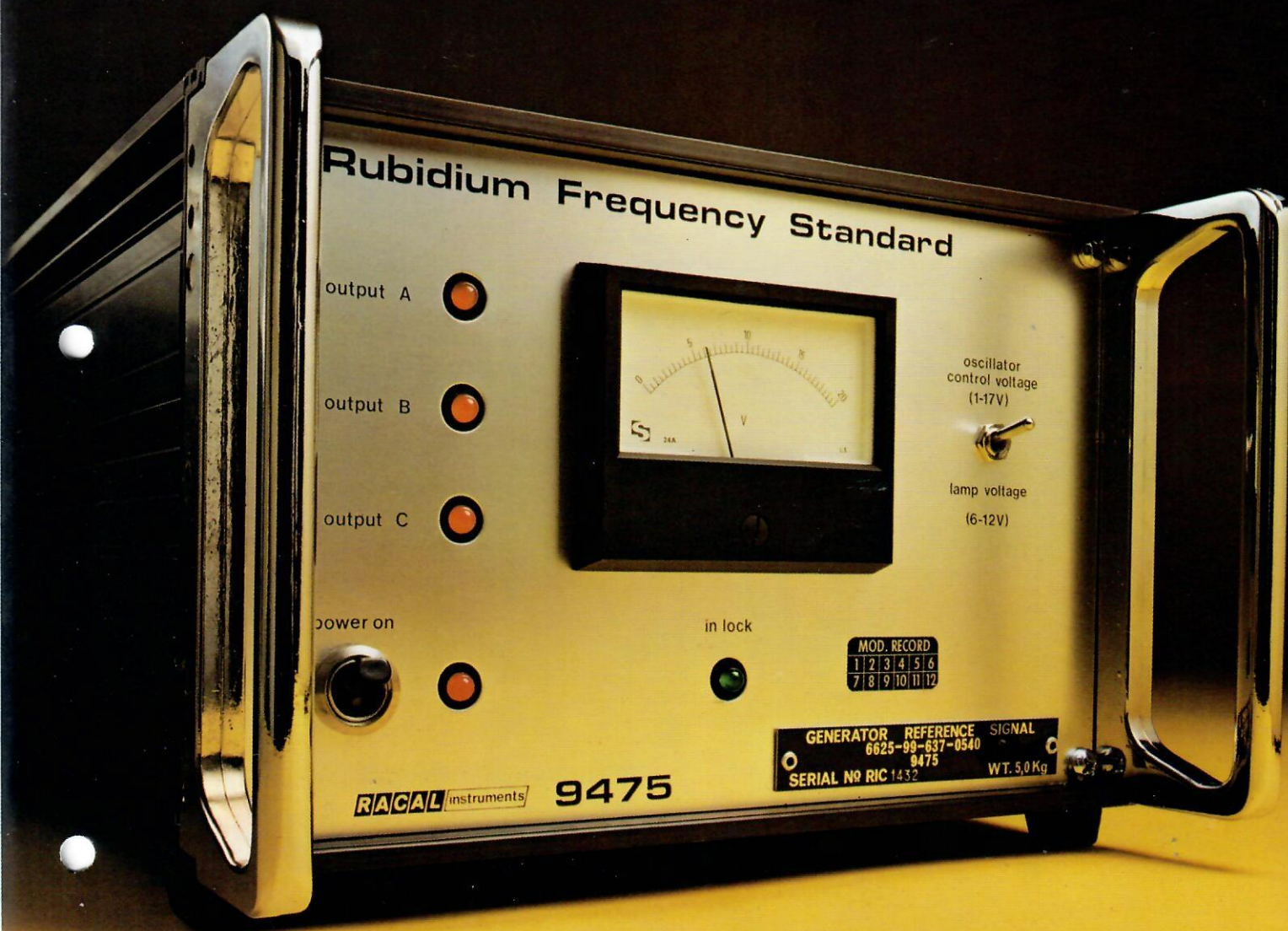


RACAL-DANA

9475 Rubidium Frequency Standard

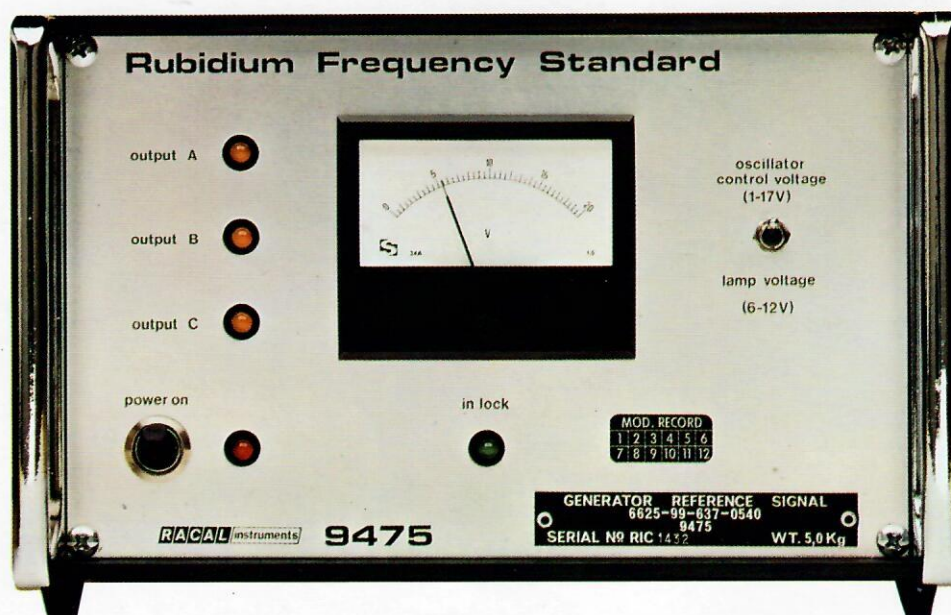


RACAL-DANA 9475 Rubidium Frequency Standard

The Racal 9475 Rubidium Frequency Standard is an ultra stable atomic oscillator of small size and rugged construction which satisfies the requirement for an accurate, fast warm-up standard for use in field and laboratory installations. It bridges the gap between today's most advanced crystal oscillators and the more expensive and larger high performance atomic frequency standards. The 9475 provides a highly reliable and economical reference for short term and long term stability measurements as well as excellent phase reproducibility. It can be readily applied where precision quartz crystal oscillators have been used in the past. The outputs are well suited to frequency division or multiplication into the microwave spectrum due to excellent spectral purity and the high signal-to-noise ratio. The small size and light weight have been made possible by the application of new physical and technological concepts including recent advances in package design.

FEATURES

Atomic Stability
High spectral purity
Fast Warm-up
Compact and lightweight
Built to military specifications



General Description

Three Outputs

The 9475 provides three buffered, short-circuit protected outputs at 1MHz. These output signals are stabilized sinusoidal waveforms of high spectral purity and of amplitude greater than 1 volt into 50 ohms. An additional 10MHz square wave output is provided for monitoring purposes. The front panel meter monitors the most important circuit functions, while a visual indication of the rubidium lamp operation is provided on the rear panel. Also on the front panel is an indication of output presence.

Applications

The 9475 can be applied as a primary standard in laboratories, for precise timekeeping, calibration of crystal oscillators and for high performance communications and navigation systems to assure adequate carrier and sub-carrier frequency and phase stability. Further applications are found in TV frequency control, radio astronomy, doppler radar, precise time interval generators and standard time installations.

Principles of operation

The 9475 makes use of the atomic resonance of Rb 87 to control and lock the frequency of a quartz crystal oscillator. The light of a rubidium spectral lamp is passed through a rubidium vapour cell and applied to a photo detector. The vapour cell is contained within a microwave cavity which is excited at 6.834GHz, the resonant frequency of rubidium. The 6.834GHz signal is generated by a frequency synthesizer which is phase locked to a voltage controlled 10MHz crystal oscillator (VCXO). When the VCXO frequency is precisely 10MHz, the output frequency of the synthesizer is exactly at the rubidium atomic resonance and the light from the spectral lamp is absorbed to the maximum extent in the vapour cell, causing the photo detector current to reach a minimum. This effect is used to generate an error control signal which permits continuous automatic regulation of the VCXO.

The rubidium unit is designed as an integrated, rugged sub-assembly. The remaining circuitry is mounted on a printed circuit board. An internal pre-set control is provided to correct for crystal oscillator aging and adjustment is achieved by correcting the oscillator control voltage indicated on the front panel meter. An aperture in the rear panel permits access to a fine frequency correction control.

Each equipment is supplied complete with a power cord and an operator's manual.

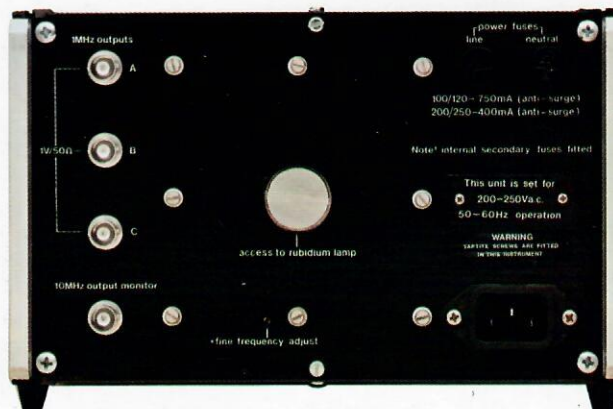
NATO Approved

The 9475 is a portable compact instrument and yet is sufficiently rugged to withstand the most severe tactical applications, regardless of terrain or climatic conditions. It is therefore ideally suited for installation in a field workshop or in an electronic repair vehicle. The 9475 has been allocated NATO No. 6625-99-637-0540.

New Improved Stability

The stability of the 9475, always exceptional, has recently been improved by a factor of two and a half, and is now better than 4×10^{-11} per month. The yearly aging rate is typically up to an order better than this, as can be seen from the typical aging characteristics shown below.

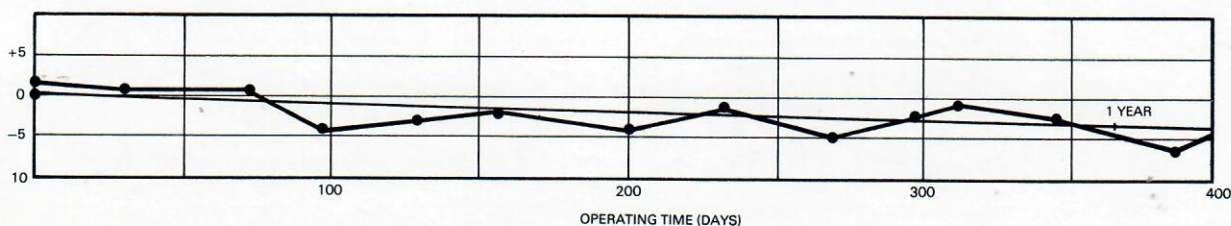
Rear view of 9475 showing outputs and lamp access.



Typical Rubidium Standard Aging characteristic.

Calculated aging rate (best RMS approximation) is -4 parts in 10^{11} per annum.

Frequency Deviation from 10MHz (parts in 10^{11})



Technical Specification

OUTPUT SIGNALS

Outputs

Three isolated and protected outputs are provided.

Frequency

1MHz.

Amplitude

Greater than 1 volt RMS into 50 ohms.

Impedance

50 ohms.

Signal-to-Noise Ratio

Greater than 100dB measured in a 1Hz band at 200Hz from carrier.

Non-Harmonically Related Spurious

Greater than 100dB below carrier.

Hum Related Sidebands

Greater than 80dB below carrier.

Harmonic Distortion

Greater than 30dB below carrier.

STABILITY

Long Term

Average drift rate less than 4×10^{-11} /month.

Short Term

Less than 3×10^{-11} over a sampling time of 1 second.

Warm-Up Characteristics

(a) 2×10^{-10} of final frequency within 15 minutes.

(b) 1×10^{-10} of final frequency within 1 hour.

These times are after switch-on following 24 hours switched off in the temperature range $+5^{\circ}\text{C}$ to $+30^{\circ}\text{C}$.

Temperature Effect

Less than 1×10^{-11} per $^{\circ}\text{C}$ between 0° and $+45^{\circ}\text{C}$

Effect of external magnetic field on Frequency Stability

Less than 1×10^{-10} for 1 gauss DC change or 1 gauss peak AC 50-60Hz.

Range of Frequency Adjustment

Greater than 2×10^{-9} .

POWER SUPPLIES

Voltage

100-120V $\pm 6\%$ or 200-250V $\pm 6\%$.

Frequency

50-60Hz $\pm 10\%$.

Consumption

65VA initially.

40VA after warm-up.

ENVIRONMENTAL CONDITIONS

Operating Temperature Range

0°C to $+45^{\circ}\text{C}$.

Storage Temperature

-40°C to $+70^{\circ}\text{C}$.

Weight

5.2kg. (11.5lb)

SUPPLIED ACCESSORIES

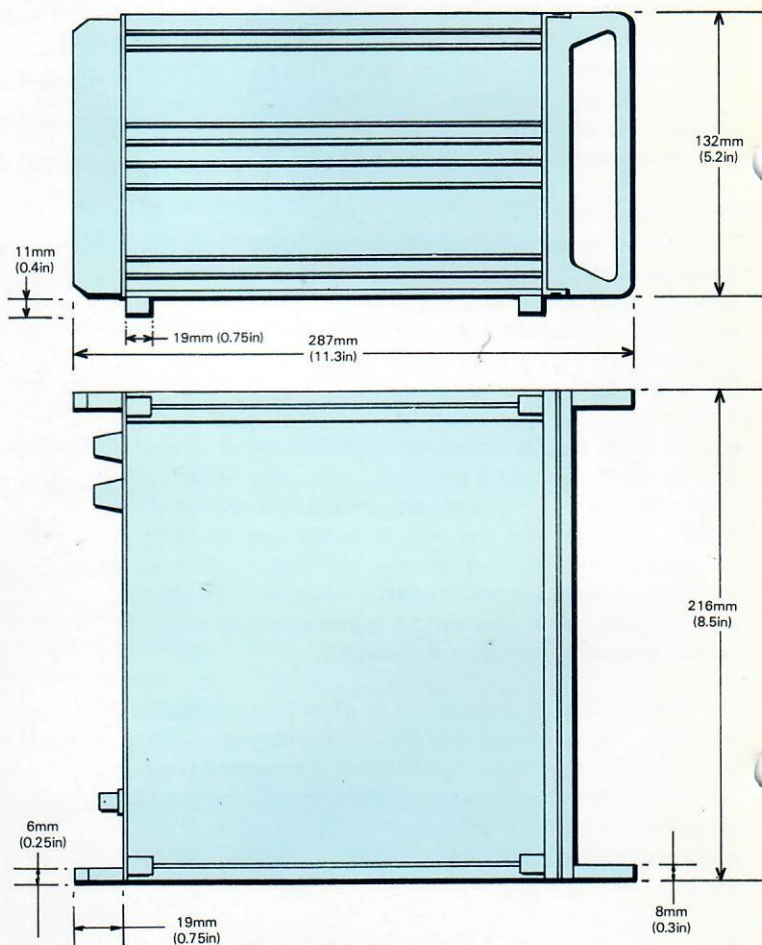
Power Lead

Part No. 23-3227

750mA Fuse

(100-120V Operation) Part No. 23-0023

DIMENSIONS



The RACAL policy is one of continuous development and consequently the equipment may vary in detail from the description and specification in this publication.

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RACAL

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