



ALAN

M-100

CHAPTER 1
INTRODUCTION & SPECIFICATIONS

1-1 INTRODUCTION AND DESCRIPTION. The Efratom Model M-100 Rubidium Frequency Standard (RFS), Part Number (P/N) 70502-1, is a sub-compact, lightweight, atomic resonance-controlled oscillator. The unit provides a pure and stable 10 MHz sinusoidal signal from a 10 MHz voltage-controlled crystal oscillator (VCXO), which is referenced and locked to the hyperfine transition of Rubidium 87 (Rb^{87}). The reference element is an optically-pumped integrated rubidium vapor cell, contained within the physics package. For the standard M-100, this technique provides long-term stability of $\leq 6 \times 10^{-11}$ /month ($\leq 3.6 \times 10^{-10}$ for first year) improving to $\leq 2 \times 10^{-10}$ /yr starting with the second year; if ordered with the low-drift option the long-term stability is $\leq 1 \times 10^{-11}$. Short-term stability is rated at $\leq 3 \times 10^{-11}$ rms averaged over a one-second period.

The M-100 was designed to be used by the military as a Master oscillator in high-performance communication systems, frequency standard equipment, advanced navigation equipment, and all other systems which require extremely precise frequencies and time intervals. With the proper input power provided and suitable cooling provisions, the M-100 can be used as a free-standing secondary frequency standard for laboratory and testing purposes.

NOTE

The Efratom Model M-100 Rubidium Frequency Standard does NOT utilize nuclear radioactivity.

1-2 MANUAL CONTENT. This manual contains all information concerning the operation, field maintenance, and troubleshooting/repair for the Model M-100, Efratom P/N 70502-1. A Model M-100 with a Part Number other than 70502-1 is a modified unit. If a modified unit differs operationally from the standard unit an addendum will have been added. If an addendum has been added, it is important to read the addendum prior to reading this manual. Addendums are provided in Appendix B of this manual for the various options.

TABLE 1-1. Model M-100 General Performance Specifications

OUTPUT CHARACTERISTICS

Frequency: 10 MHz Sine Wave, ($\pm 5 \times 10^{-11}$ at shipment)
 Amplitude: 0.5 vrms (-10% + 30%) into 50 ohm load
 Phase Noise (SSB 1 Hz BW): > 120 dB at 100 Hz from carrier
 (Signal-to-Noise) > 130 dB at 1000 Hz from carrier
 Harmonic Distortion: > -30 dBc
 Non-Harmonic Distortion: > -80 dBc
 Warm-up: < 10 minutes to reach 10 MHz $\pm 2 \times 10^{-10}$ at 25°C ambient
 < 30 minutes to reach 10 MHz $\pm 5 \times 10^{-11}$ at 25°C ambient
 Peak current during warm-up: approx. 2.2 amps max. at 25°C with 26 vdc input.

INPUT

Voltage: 22.5 to 32.0 Vdc (50 V, 50 ms transient).
 Power: 18 watts max. at 25°C with 26 vdc input.
 < 1×10^{-11} for $\pm 10\%$ input voltage change.

STABILITY

Long-Term Drift: $\leq 6 \times 10^{-11}$ for the first month after 14 days of continuous
 operation. $\leq 3.6 \times 10^{-10}$ for the first year, total period;
 $\leq 2 \times 10^{-10}$ for the second year.
 Short-Term Stability: $\sigma_y(\tau) = 3 \times 10^{-11} \times (\tau^{-1/2})$ for 1 sec < τ < 100 seconds
 Magnetic Field: < $3 \times 10^{-13}/\text{AM}^{-1}$ worst case orientation ($2.4 \times 10^{-11}/\text{Gauss}$)

GENERAL

Frequency Trim Range Adjustment: $\geq 3 \times 10^{-9}$
 Settability: 1×10^{-11}
 Retrace: $\pm 1 \times 10^{-11}$
 Operating Temperature: < 3×10^{-10} from -55°C to +68°C
 (-67°F to 155°F) at baseplate
 Storage Temperature (non-operational): -62°C to +85°C (-80°F to 185°F)
 Size (inches): 4.81 high x 3.90 wide x 3.94 deep (see Outline Dwg No. 70549-1)
 Weight: 4.0 lb max. without heat sink
 4.5 lb max. with standard heat sink attached.