

### **MRT Series, (1/2) 19-inch rack Rubidium Frequency Standard**

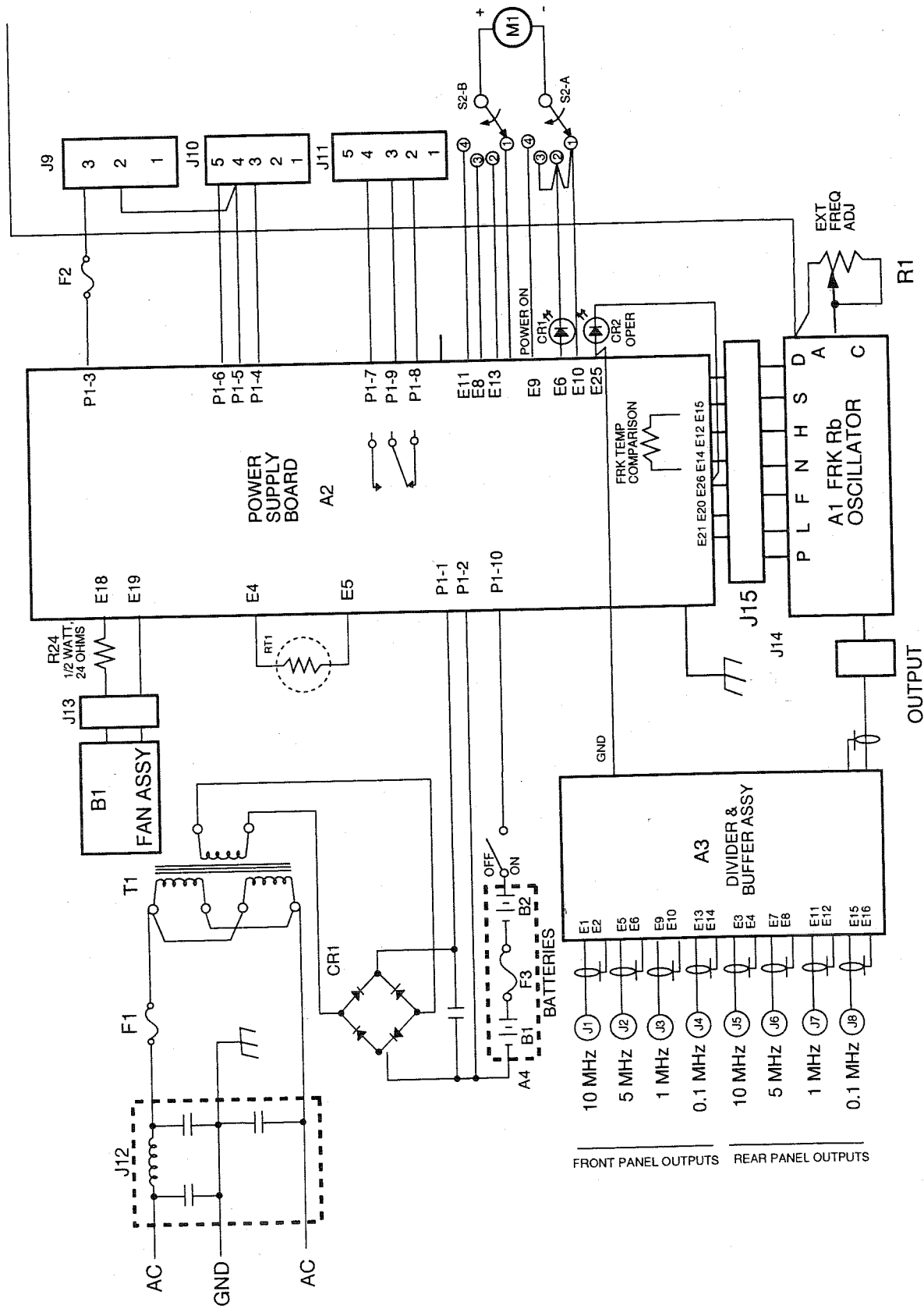
This unit represents Model FRK rubidium technology in a portable or rack mounted configuration. The MRT is designed for ac/dc operation and has a 5-hour internal back-up battery.

The MRT is generally used in ground stations, laboratories, bench test stations, check-out equipment, and in facilities as a house reference.

The MRT-HT version provides additional temperature stability through full 19-inch rack mounting and an added fan assembly. Due to the additional thermal structure, the internal battery operation is about 3.5 hours, instead of 5 hours.

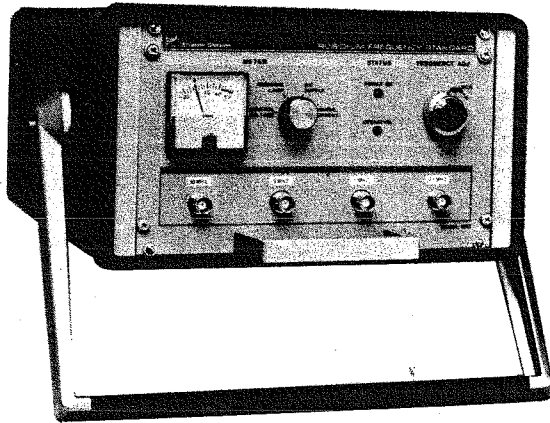


# MODEL MRT BLOCK DIAGRAM





## MRT Rubidium Frequency Standard



- Excellent for Lab, Ground Station, and Test Equipment Applications
- Outstanding Stability
- High Spectral Purity
- Front and Rear Outputs
- Internal Battery – Portable
- Options Available:
  - H (Low Aging)
  - LN (Low Noise)
  - 1 PPS Outputs

### Description

The Model MRT Rubidium Frequency Standard is part of Efratom's family of Frequency Standards/Test Instruments. The MRT employs a rugged, compact design consisting of the Model FRK-L/H rubidium oscillator, dividers, buffer amplifiers, and a regulated power supply including stand-by batteries. The MRT is available for rack mount installation, occupying half the width of a standard 19" rack, with 5.25 in. panel height, or with a portable instrument case for laboratory or field use. Buffered outputs of 10, 5, 1, and 0.1 MHz sine waves are provided at the front and rear panel connectors. All outputs feature short circuit protection. Different output combinations are optionally available and the factory should be contacted for specific requirements. A front panel helipot permits fine frequency adjustments to  $\pm 2E-12$  within the specified trim range. A front panel meter allows monitoring of rubidium lamp voltage, crystal control voltage, DC supply, and battery pack charging current. Each function is independently selectable by means of a front panel mounted switch.

In addition to the four buffered outputs available on the rear panel of the Model MRT, other features included are two separate fuses for input power, a switch to enable/disable the internal battery supply, receptacles for external DC power, 110/220 Vac line voltage, remote monitoring of oscillator lock condition, and provision for connecting auxiliary equipment to provide remote frequency control.

### Applications

The Model MRT may be used as a master oscillator in laboratories, on aircraft, aboard ships, and for field calibration services. It provides ultra-stable frequency and time intervals with excellent short-term stability and phase noise characteristics as normally required for narrow band communication, radio astronomy, doppler radar, satellite tracking and guidance control, and Very Long Baseline Interferometry. Other uses are VLF and satellite navigation, television frequency control, precise timekeeping systems, time and frequency transport.

### Operation

The basic Model FRK makes use of the atomic resonance of rubidium ( $^{87}\text{Rb}$ ) to control the frequency of a quartz crystal oscillator. A microwave signal derived from the crystal oscillator is applied to the  $^{87}\text{Rb}$  vapor within a cell. The light of a rubidium spectral lamp also passes through this cell and illuminates a photo detector. When the frequency of the applied rf signal corresponds to the frequency of the ultra-stable rubidium atomic resonance, the light is absorbed to an increased extent causing a change in the photo detector current. This effect is used to generate a control signal which permits continuous automatic regulation of the quartz crystal oscillator frequency of 10 MHz. This is fed through dividers and buffer amplifiers and provides standard frequency outputs of 10, 5, 1, and 0.1 MHz.

# MRT Rubidium Frequency Standard (continued)

FIGURE 1. TIME DOMAIN STABILITY

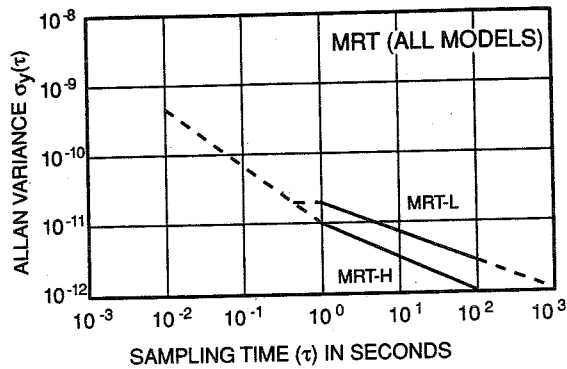
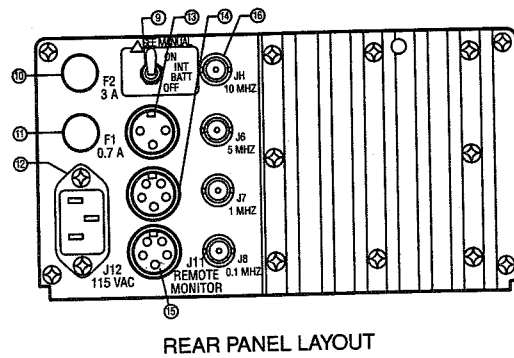
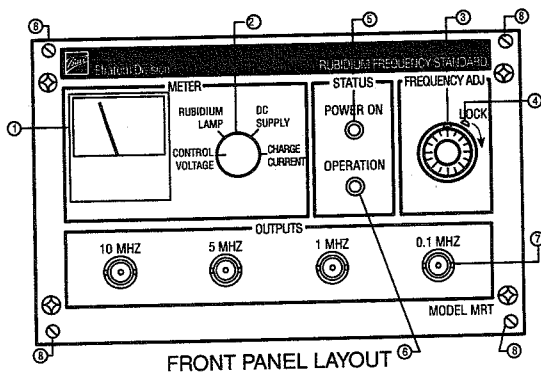
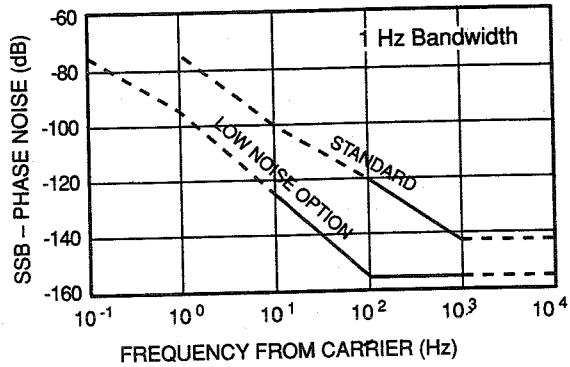


FIGURE 2. PHASE NOISE



- |                                 |                         |                          |                                  |                           |                           |
|---------------------------------|-------------------------|--------------------------|----------------------------------|---------------------------|---------------------------|
| 1 METER                         | 4 FREQUENCY ADJUST LOCK | 7 OUTPUTS J1, J2, J3, J4 | 10 F2 3A                         | 13 DC INPUT RECEPTACLE J9 | 16 OUTPUTS J5, J6, J7, J8 |
| 2 METER FUNCTION SWITCH (S2)    | 5 POWER INDICATOR       | 8 RACK MOUNTING SCREW    | 11 F1 0.7A                       | 14 AUX EQUIPMENT J10      |                           |
| 3 FREQUENCY ADJUST VERNIER (R4) | 6 OPERATION INDICATOR   | 9 INT BATTERY SWITCH     | 12 AC POWER INPUT RECEPTACLE J12 | 15 REMOTE MONITOR J11     |                           |

## Electrical Performance

<b>Outputs</b>	10 MHz, 5 MHz, 1 MHz, 0.1 MHz both front and rear; 1 Vrms into 50 ohms, sinewave	
<b>Option</b>	1 PPS instead of one 0.1 MHz output (Consult factory for optional outputs)	
<b>Phase Noise -dBc/√Hz (SSB 1 Hz BW)</b>	-120 dBc @ 100 Hz from carrier	
	-145 dBc @ 1000 Hz from carrier	
<b>Low Noise Option-LN</b>	-125 dBc @ 10 Hz from carrier	KHz
	-155 dBc @ 100 Hz from carrier	KHz
<b>Aging per month</b>	-L 4E-11	
	-H 1E-11	
<b>Short-Term Stability</b>		
1.0 Second (Allan Var.)%	-L 3E-11	-H 1E-11
10 Second (Allan Var.)%	-L 1E-11	-H 3.16E-12
100 Second (Allan Var.)%	-L 3E-12	-H 1E-12
<b>Trim Range</b>	2E-9	
<b>Fine Tuning Resolution</b>	2E-12	
<b>Voltage Variation</b>	<1E-11/± 10% Vac	
<b>Warm-Up Characteristics</b>	<10 minutes to reach 2E-10 at 25°C ambient	
<b>Input Power</b>	50 W at 115/220 Vac (+10%, -15%), 47-400 Hz <30 W at 23-32 Vdc	
<b>Internal Battery</b>	More than 5 hours capacity at 25°C ambient Automatic recharge	

## Environmental Performance

<b>Operating Temp. Range</b>	-L <4E-10 from -10°C to +50°C
	-H 1E-10 from -10°C to +50°C
<b>Storage Temp</b>	-40°C to +60°C
<b>Altitude</b>	1E-13/mbar (sea level to 40,000 ft.)
<b>Humidity</b>	95%
<b>Magnetic Field</b>	≤4E-13/Am <sup>-1</sup> (3E-11/gauss)

## Physical

<b>Size</b>	Panel height 5.05 in. high x 8.38 in. wide x 14.50 in. long. Suitable for 19" rack, or portable carrying case
<b>Weight</b>	35 lbs. with battery and portable case, 28 lbs. without portable case
<b>Controls/Indicators</b>	Power and operation: LED indicators for power and operation; meter to monitor VCXO control voltage, Rb lamp, dc supply voltage battery charging current; battery switch; frequency vernier potentiometer
<b>Connectors</b>	Frequency outputs, ext. battery, aux. equipment, remote monitor
<b>Warranty</b>	1 year
<b>Option</b>	5 year extended warranty

