

MODULAR FREQUENCY SYSTEM

PART NO. 103788

1.0 DESCRIPTION

The Efratom Modular Frequency Standard, Model MFS-267, can consist of the following modules installed in a 19" rack assembly:

- One Modular GPS - Receiver Controller, Efratom Model MGPS, Part No. 82204099, Module A1.
- One Rubidium (Rb) Oscillator, Model MRK-L, Part No. 101656-001, Module A3.
- One Power Supply Assembly, Model MPS, Part No. 808-460-5, Module A4.
- One MGPS Connector Panel, Part Number 82209040, Module A5.
- Wired Rack Assembly, Part No. 103792-001. The wired rack assembly consists of the rack, internal connectors, and wiring.

The Efratom MFS-267 is designed in a modular configuration consisting of a wired rack assembly, and four plug-in modules. The system provides two 10 MHz outputs and one 1 PPS output derived (through the MGPS module) from a precise and stable 10 MHz sine-wave reference generated by the MRK-H Rb Oscillator, which is the primary frequency source for the system. Light-emitting diodes (LEDs) on individual modules provide visual indications of operating conditions.

The MGPS module uses the Rb oscillator as a reference frequency as it generates and maintains its own time scale. It automatically locks this time scale to the GPS satellite based navigation and positioning system.

The MFS-267 connector panel accepts appropriate connectors for the TANS antenna, Time Code Counter output, 1 PPS input, 1 PPS output, and RS232 interface.

The Modular Power Supply, (MPS) accepts ac or dc input power and provides dc power for the system electronics.

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SPECIFICATIONS

ELECTRICAL

Sine Outputs: Two 10 MHz 0.5 Vrms into 50 ohms at the front panel of the MRK module.

1 PPS Output: One, available at MGPS connector panel.

NOTE

For more detailed specifications, refer to the individual manuals included with this system manual.

ENVIRONMENTAL

Operating Temperature: -0°C to +50°C ambient.

PHYSICAL

Size: 133 mm x 482 mm x 518 mm (5.25 in x 19.0 in x 20.4 in)
Weight: ~30 lbs.

2.0 CONNECTORS

The rf and 1 PPS outputs are from BNC connectors. 10 MHz outputs from MRK module are from BNC-type connectors (female), which mate with BNC-type connectors (male).

The ac input power is applied to the MPS through a 3-prong filter connector, J1 (Corcom connector 6J4), and dc input power is applied to the MPS through a 4 pin Cannon connector, J3 (KPT02E8-4P).

3.0 POWER REQUIREMENTS AND ELECTRICAL PROTECTION

The MFS operates from ac or dc power. The system was set at the factory to operate from 115 Vac at 60 Hz and +22.5 to +32 Vdc power. The MFS can also be operated from 100, 220, or 240 Vac at 47 to 400 Hz, but the ac input voltage selector PC board must be removed and reinserted to the corresponding configuration of the selected ac voltage level (see the MPS manual). The input voltage selector PC board is part of the ac input power connector on the MPS module. The ac and dc power lines are short circuit protected by fuses accessible from the front panel of the module.

4.0 SYSTEM INSTALLATION AND OPERATION.

After unpacking the MFS, inspect the system for damage. If none is found, the MFS can be installed in a 19 inch cabinet. Before installing the MFS, refer to the MGPS manual for guidelines on how to install the GPS antenna. Also, determine that there will be enough room for signal cables at the rear of the cabinet so that they will not be crimped as the system is pushed fully back into position and fastened into place.

Once the antenna has been installed and cables run, and the system has been placed

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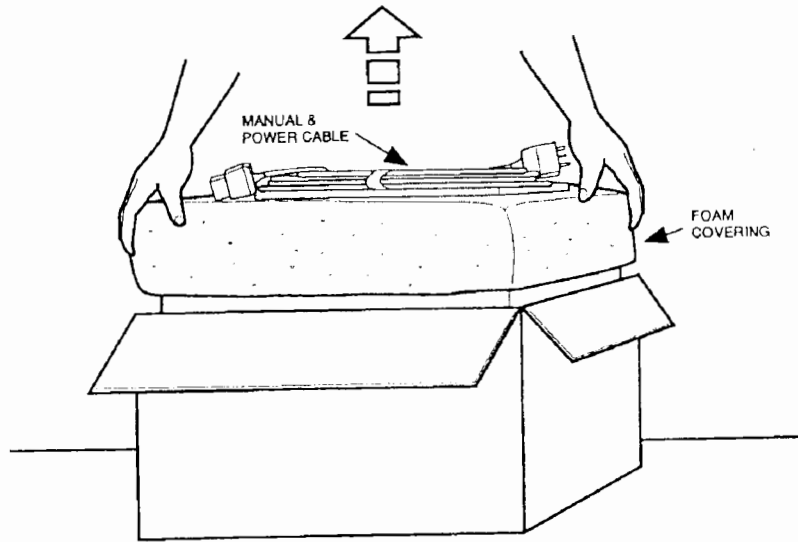


Figure 1. Unpacking a Modular Frequency System.

securely in the rack, make all cable connections referenced in the system block diagram (refer to Appendix). The MRK and MGPS modules face to the front. The MPS and MGPS connector panel modules face to the rear (refer to Figure 3).

Plugging in the power cord powers up the system. MPS switch S1 allows power to be turned off to the MFS while keeping power on the MRK, preventing the need for a subsystem Cold Start when swapping out another module. The MPS module accepts 115 Vac and 24 Vdc.

Once the MPS ac voltage connection board is inserted in the desired position, all module connectors installed as required, and the power cord inserted in the MPS module, the Rb oscillator(s) of the MFS will begin a warm-up period, (which is about 10 minutes, typically 4 minutes), and a stabilization period during which the system reaches thermal equilibrium (duration: about 1 hr).

4.1 Calibration and Adjustments

4.1.1 MRK Test Points

The MRK Printed Circuit (PC) board provides three test points (TP) for monitoring the Rb oscillator's critical operating parameters. These test points are accessible from the top of the A1 module. TP1 allows monitoring the crystal control voltage for the internal crystal oscillator, TP2 provides an indication of an atomic lock condition, and TP3 provides the rubidium lamp voltage indication.

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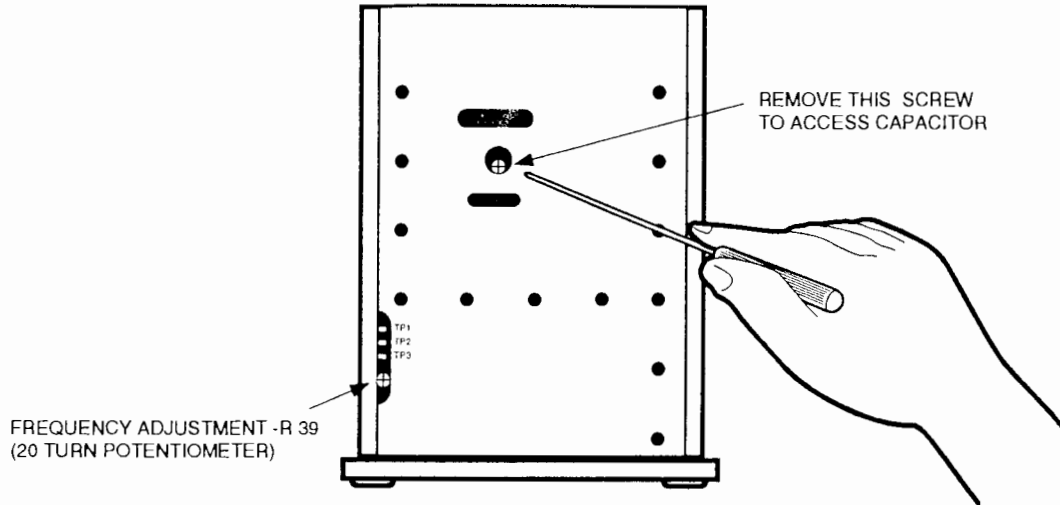


Figure 2. MRK Test Points

If the ADJUST CRYSTAL LED indicator illuminates after warm-up, the crystal control voltage is either at its positive or negative voltage limit. The MFS should still be within the operating specifications, but the crystal control voltage should be readjusted to the center of its range.

During normal operation the voltage at TP1 should be between +2 and +12 Vdc. If the crystal control voltage is less than 2 Vdc, or greater than 12 Vdc, the front panel ADJUST CRYSTAL indicator will light.

Use a small, nonconducting screw driver inserted through the access hole in the top cover of the MRK to make adjustments to the trim capacitor that controls the crystal voltage. It is necessary to monitor the adjustments by connecting a digital multimeter at TP1. If the control voltage is LOW, turn the trim capacitor *slowly* clockwise until the meter indicates approximately 8 to 9 Vdc. If the voltage is high, *slowly* turn the trim capacitor counter-clockwise until the meter indicates 7 to 8 Vdc.

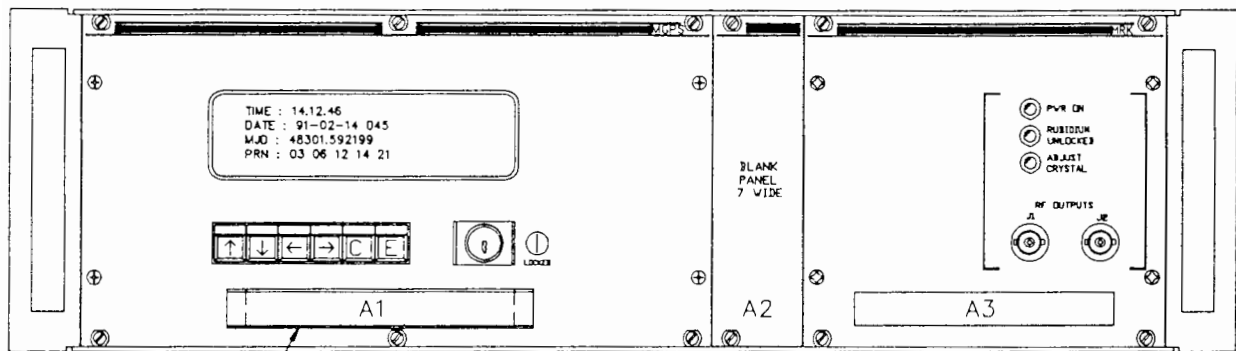
NOTE

The adjustment of the base frequency of the crystal oscillator does not affect the 10 MHz output frequency of the MRK, as long as the trim capacitor is turned SLOWLY, thus maintaining "locked" operation. If the trim capacitor is turned too rapidly, the control loop (crystal oscillator/atomic resonance) opens and a search circuit is automatically initiated to relock to the atomic resonance. This may take up to 30 seconds. If this occurs, the 10 MHz output will be offset in frequency during the search time.

4.1.3 Lock Indicators

A normal atomic lock indication at TP2 is a reading of < .5 Vdc as measured between TP2 and ground. An unlocked indication will read > 4.0 Vdc between TP2 and ground. If the Rb oscillator fails to obtain atomic lock, or loses atomic lock during operation, the RUBIDIUM UNLOCKED indicator on the front of the MRK module will light. An acceptable voltage indication for the Rb spectral lamp, as measured between TP3 and ground, is between +5 and +12 Vdc.

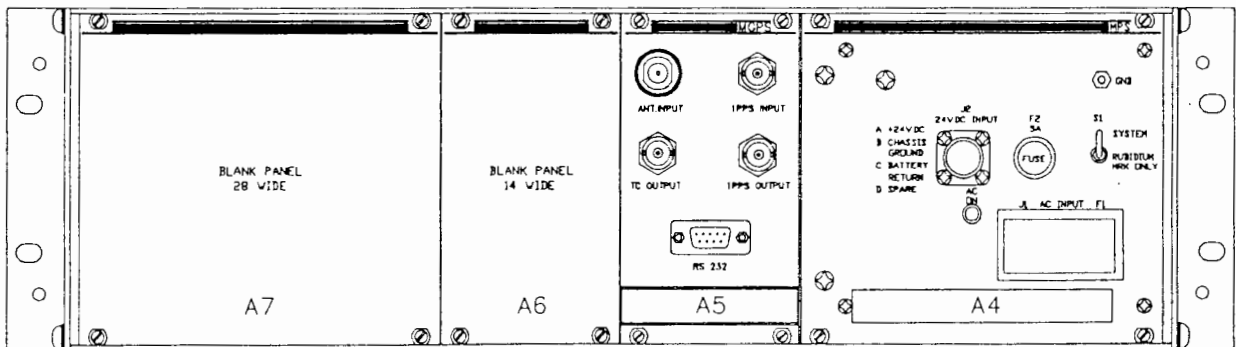
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FRONT VIEW

TABULATION

MARK HANDLE LABELS WITH REFERENCE DESIGNATOR.



REAR VIEW

Figure 3. Front and Rear View of MFS-267 System

4.2 Operating Sequence

The operating sequence of a system begins with a Cold Start (beginning when operating power is first applied) and continues through the Primary mode, at which time the MFS is fully operational. System status is monitored by LED indicators on the modules.

a) COLD START

When ac or dc operating power is initially applied, the Rb oscillator begins generating a 10 MHz sinewave signal. Until the Rb oscillator has obtained an atomic locked condition during Cold Start, the output signals available from the MRK module could be off by parts in ten to the sixth, or more, due to the internal sweep circuits sweeping the oscillator, and due to the temperature sensitivity of the crystal oscillator itself. The LED indicators on the individual modules will appear as follows:

A1 & A5 modules - have no LED indicators, however the MGPS display does show status messages during startup. Refer to the MGPS manual for messages shown during startup.

A3 module, MRK Rb Oscillator - the PWR ON and RUBIDIUM UNLOCKED indicators will light, the ADJUST CRYSTAL indicator may blink during warm-up (prior to obtaining atomic lock).

A4 module, Power Supply - the AC ON LED will light.

b) PRIMARY MODE OPERATION

The LED indicators of a subsystem operating in Primary Mode will appear as follows:

A3 module, Rb Oscillator - the PWR ON indicator will light, the RUBIDIUM UNLOCKED and ADJUST CRYSTAL indicators will not light.

The LED indications on the remaining modules will appear as described above.

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4.3 MGPS Setup

The MGPS module includes a built-in Trimble GPS receiver. Mount the Trimble GPS antenna in a suitable location, one that maximizes satellite visibility.

Once the MPS ac voltage connection board is inserted in the desired position, the antenna and receiver are installed, all module connectors installed as required, the power cord inserted in the MPS module, and the MPS 'S1' switch put in the system position the MRK module will produce 10 MHz sinusoidal output signals. Once the MGPS module is "Locked to GPS" the system will begin to output a 1 PPS output signal. Placing MPS switch 'S1' in the 'Rubidium Only' position removes power from the system modules.

The LED contact closure indicators on the individual modules will appear as follows at start-up:

A3 Module, MRK-H Rb Oscillator - The PWR ON and RUBIDIUM UNLOCKED indicators will light, the ADJUST CRYSTAL indicator may blink during warm-up (prior to obtaining atomic lock).







A1 Module, MGPS display panel will show "Warm up", followed by "WARM UP ENDED" and "LOCKED TO GPS" once the Rb oscillator has locked and one or more satellites have been acquired (refer to MGPS manual for a complete list of possible status codes).

A4 Module, Power Supply - the AC ON indicator will light.

A5 Module, Connector Panel, no fault indicators present.

4.3.1 MGPS Keypad Display Menus

The system status and data on Position, Time, and frequency are displayed on the front panel of the MGPS module in a series of menus selected by toggling the keys of the keypad, as described below:

		Used to toggle through the information menus and to increment or decrement digits or parameters in the edit menus.
		Used to increment or decrement display brightness when in the information menus and to select digits or parameters when in the edit menu.
		Used to return to main menu with changes being cancelled.
		Used to select an edit menu and to return to main menu with changes made effective. Available only when enabled by keylock switch.

Refer to the MGPS module manual for more indepth infomation on MGPS display menus and operation of this module.

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5.0 OVERVIEW OF MODULE OPERATION

In the primary mode, a precise and stable 10 MHz output is derived from the 10 MHz output of the Rb oscillator (which is referenced and locked to the ground-state hyperfine transition frequency of rubidium). This 10 MHz signal is used as a reference by the system.

For a detailed explanation of the operation of the modules making up the MFS, or the internal Rb oscillator's operation (found in the FRK manual), refer to the manuals provided. The following sections provide an overview of module operation.

5.1 Module Replacement

If a module fault indicator illuminates and the module must be replaced, shut the system power off (either switch S1 on the MPS to RUBIDIUM ONLY, or, if it is the MPS being replaced, unplug the power cord) and loosen the captive screws (one or two each at the top and bottom of the module, depending on size of module). Grasp the module by either its extractor handle (if it has one), or by the top and bottom of the front panel and pull straight out. The P1 connector will separate from the MFS rack and allow the module to be fully removed. Lay the failed module aside and insert the replacement module so that its P1 connector seats properly in the MFS rack. Tighten down the four captive screws and power up the system. Once the MRK achieves lock, the system, and replaced module(s) should function normally without adjustment.

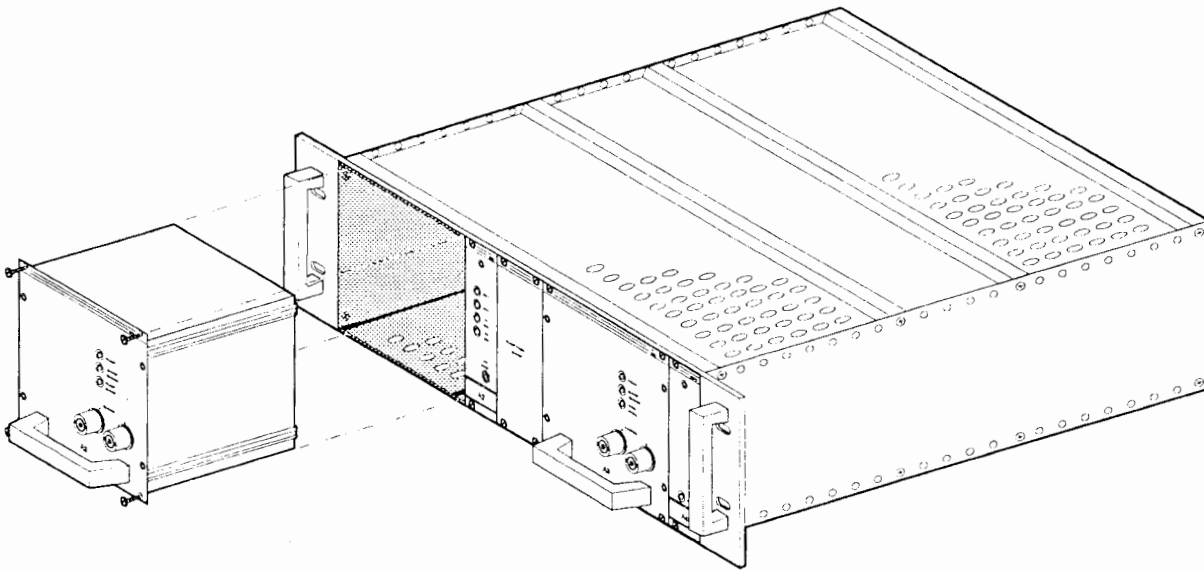


Figure 4. Module Replacement

5.2 Module A1, Modular Global Positioning System

The modular Global Positioning System module interfaces with the MRK to combine the precision of GPS with the stability of a rubidium oscillator. The MGPS takes the stable reference frequency from the MRK and generates its own time scale, which can be locked to GPS through the receiver, or to other external timing devices. During periods when GPS or external timing is not available, the MRK provides the necessary reference to maintain a high degree of accuracy.

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5.3 Module A3, Modular Rubidium Oscillator

The MRK incorporates a Rb cell, a Rb lamp, and servo electronics to control the frequency of an internal voltage-controlled crystal oscillator.

5.4 Module A4, Power Supply

The power supply module provides primary operating power for all modules and the rack assembly for the system. When ac input is being applied, the power supply module provides filtering, rectification, and regulation of the input, and supplies +20 Vdc regulated and 23-33 Vdc unregulated power for the MFS electronics. The power supply module also supplies the Rb oscillator heater power.

“Priority Switching” is employed in the power supply module. When ac and dc are both present, ac is chosen as long as it satisfies the minimum input voltage requirement. If only dc power is connected, the power supply will automatically switch to it, and dc power will be used in the rack. Refer to the Modular System Block Diagram for dc input pin function information.

5.5 Module A5, Connector Panel

The MGPS connector panel provides connectors for inputs and outputs of the GPS receiver.

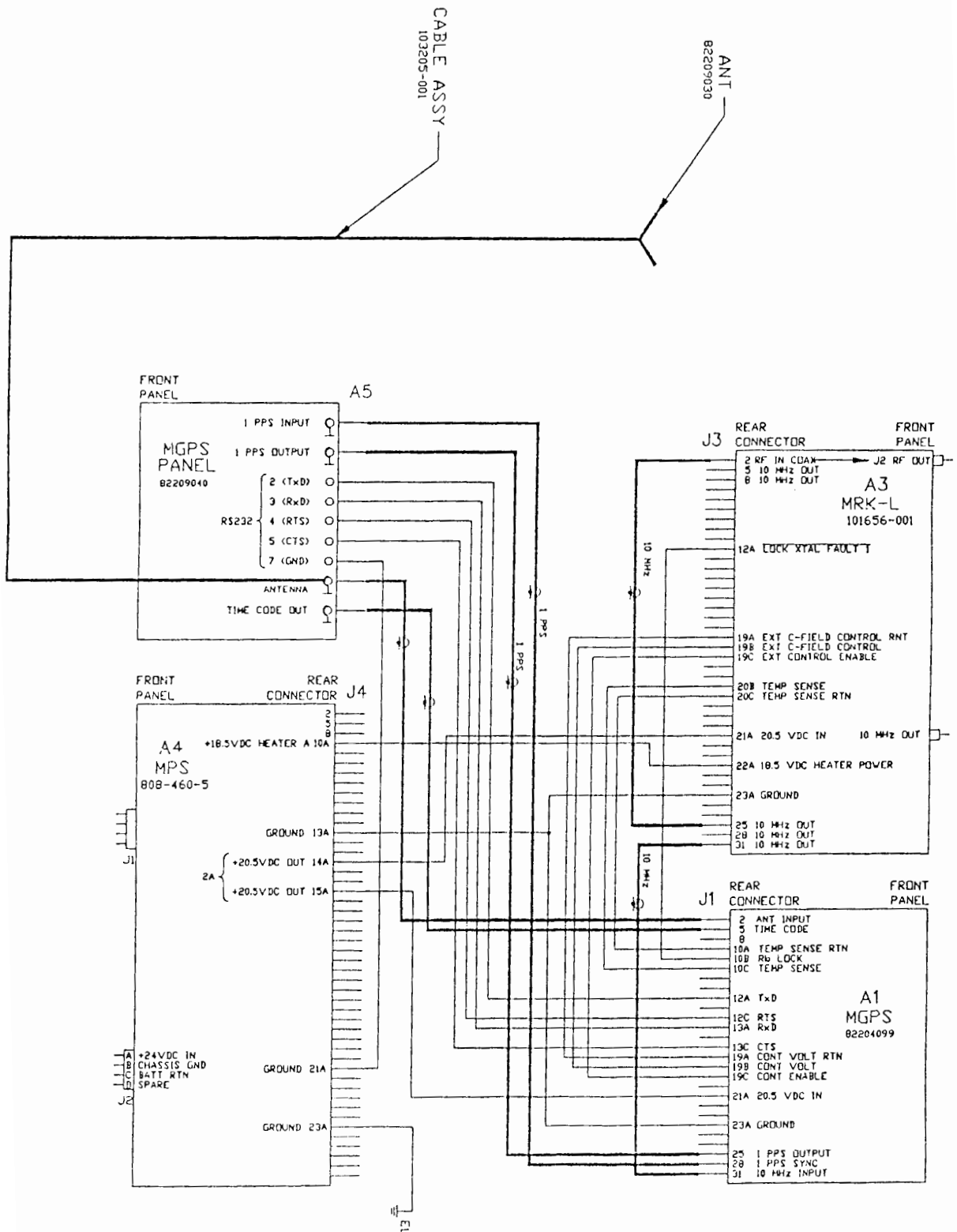
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APPENDIX

LIST OF DRAWINGS

DRAWING NO.	DESCRIPTION	PAGE NO.
103997	BLOCK DIAGRAM	A1
101365	OUTLINE & MOUNTING DRAWING	A2
103995	UNIT ASSEMBLY & PL	A3
103996	RACK ASSEMBLY / WIRING	A4, A5

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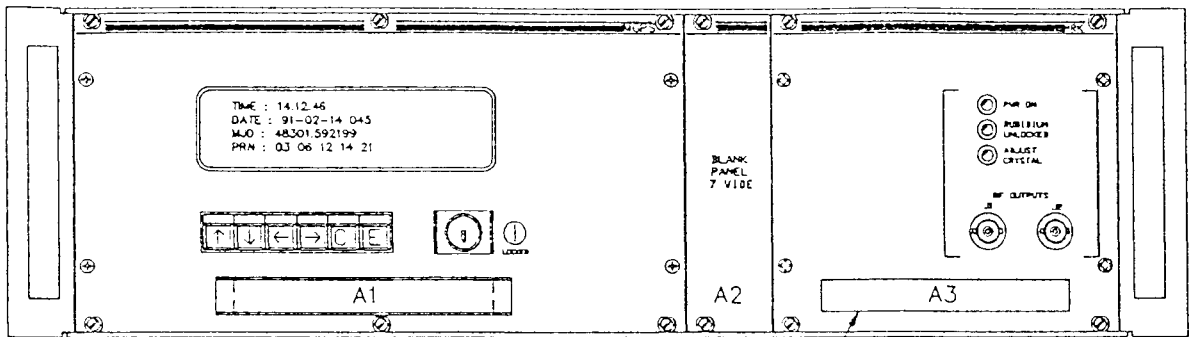


Block Diagram, Modular Frequency System (103997)

Modular Frequency System

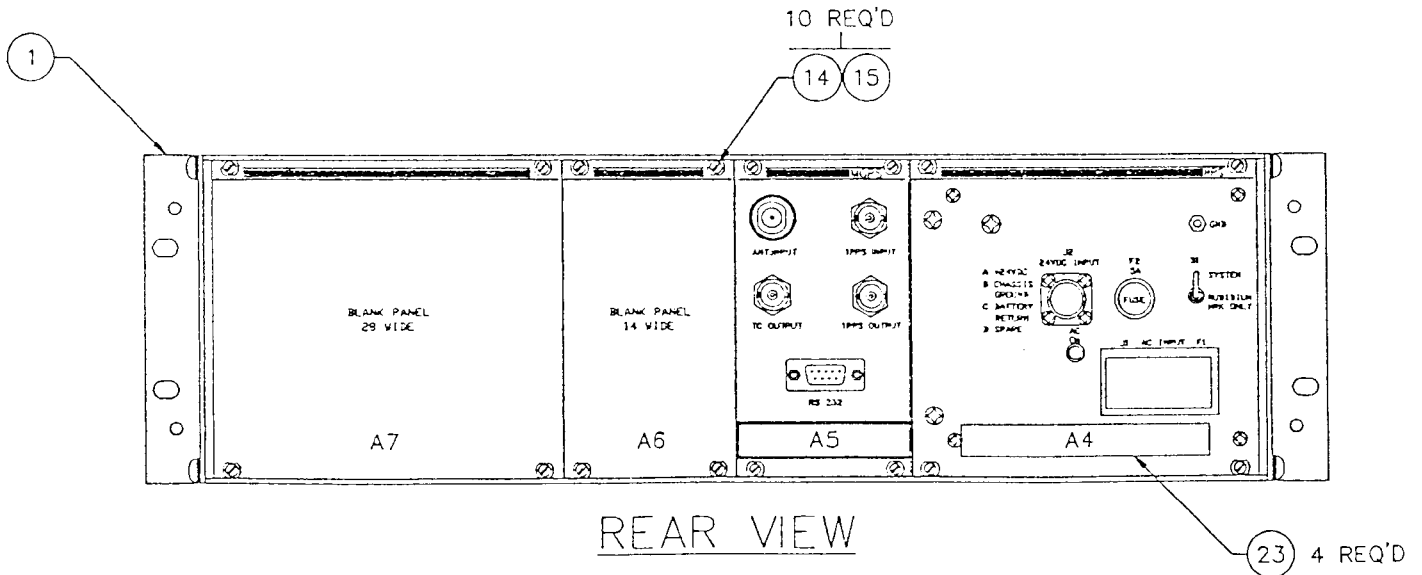
NOTES: UNLESS OTHERWISE SPECIFIED

1. SEE PARTS LIST FOR ALL DOCUMENTS PERTINENT TO THE PRODUCTION OF THIS ASSEMBLY.
2. ALL MODULES ARE PLUG-IN TYPE.
3. ACCESSORY KIT, 101380-001 TO ACCOMPANY EACH UNIT.



FRONT VIEW

MARK HANDLE LABELS WITH REFERENCE DESIGNATOR.



REAR VIEW

Unit Final Assembly, Modular Frequency System (103995)

MODULAR FREQUENCY SYSTEMS LIMITED WARRANTY

"The seller warrants that each article of goods sold by it will at the time of shipment be free of defects in materials furnished and workmanship performed by the seller. This warranty and seller's liability are limited to either granting credit or repairing or replacing, at seller's option, with reasonable promptness after return to seller of any article which is disclosed to seller's satisfaction to be defective, and only if said article is returned to the seller promptly after discovery of such defect and in no event later than 12 months (or such other time period as may be specified in writing as a warranty period for a particular article) from the date of delivery thereof. Normal transportation charges in connection with an article returned shall be at the seller's expense but only if the seller is responsible under the terms of this warranty. This warranty does not extend to any article that has been subject to misuse, neglect, or accident, nor does it extend to any article which has been repaired or altered by other than the seller. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND THE RIGHTS AND REMEDIES PROVIDED HEREIN ARE EXCLUSIVE AND IN LIEU OF ANY OTHER RIGHTS OR REMEDIES. IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES."

RECEIVING INSPECTION

Efratom modules and systems are packaged and shipped in foam-packed containers. The units are inspected mechanically and tested electrically prior to shipment. Upon receipt of the unit, a thorough inspection should be made to verify that no damage has occurred during shipping. If any damage is discovered, contact Ball Corporation, Efratom Division, 3 Parker, Irvine, CA 92718-1605. Telephone: (714) 770-5000, FAX: (714) 770-2463, TELEX: 685-635. In Europe: Ball Efratom Elektronik GmbH, Fichtenstrasse 25, 8011 Hofolding, Germany. Telephone: 49-8104-9040, FAX: 49-8104-9040, TELEX: 529 701.

SHIPPING

Retain the shipping carton and foam-packing material for the carrier's inspection. If reshipment is necessary, the original container and packing should be used. If the original container is not available, a similar container with foam packing is recommended.

CHANGE INFORMATION

Any changes made to the form, fit, or function of units manufactured after this printing will be referenced in a "Technical Notice" supplied in the front of this manual. Be sure to examine any enclosed Technical Notices for any changes that apply to your unit and record these changes in the manual where applicable.

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