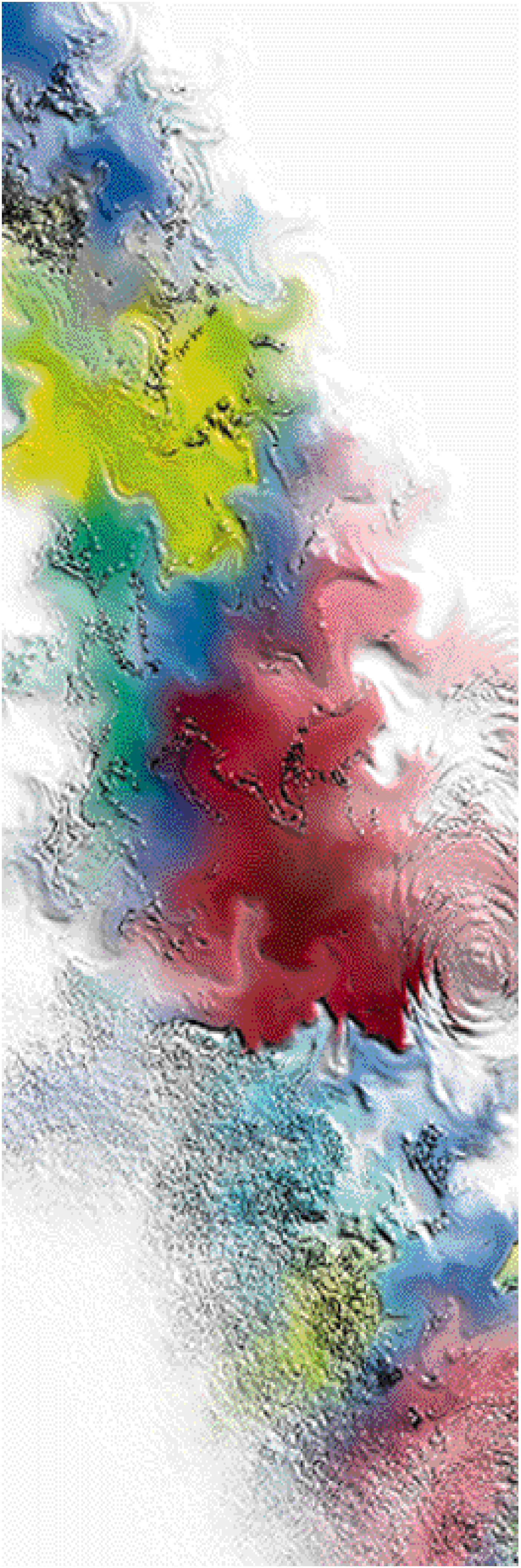

# RF-Orchestra!™ Transmitter

## for the RF-O!™ Paging Station

Installation and Operation

Series: Wireless Messaging System

System Version: WMS 3.0
Software Version: 2.0

Issue Date: July 1999
6880493G02-C

MOTOROLA

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# Foreword

## General Information

The information in this manual has been reviewed for accuracy. However, no responsibility is assumed for inaccuracies. Motorola® reserves the right to make changes to any products discussed herein. The information in this document is subject to change without notice. Motorola assumes no liability for hardware or software damage or loss of data because of errors or omissions in this manual. Motorola does not assume any liability arising from the application or use of any products or circuits described herein. Neither does Motorola convey any license under its patents or right of others.

Refer questions concerning the contents of this manual or requests for related circuit board information to the following location:

**Motorola, Inc.**
**Paging Systems Operations**
**Technical Communications Department**
**5401 North Beach St., MS E230-A**
**Fort Worth, TX  76137-2794**

or telephone: **(817) 245-4222**

To access on-line electronic information for service notices and the latest software releases, call the Paging One-Call-Support™. To request additional manuals or parts, please contact the Motorola Accessories and After Market Division:

telephone: **(800) 422-4210**
facsimile: **(847) 538-8198**

To request a part number, contact the Parts Identification Group:

telephone: **(847) 538-0021**

For Motorola Infrastructure and communicator test equipment, contact the Motorola Test Equipment Center:

telephone: **(800) 505-8378**

## Global Service Organization

Motorola provides Infrastructuretechnical support through authorized or company-owned Service Centers. Motorola also provides service for infrastructure products on a contract basis. For contract service information, please contact your local Motorola representative or the Paging One-Call-Support Center:

**Motorola, Inc.**
**Paging One-Call-Support**™
**5401 North Beach St., MS E112**
**Fort Worth, TX 76137-2794**

| | |
|---|---|
| telephone: | **(800) 520-7243** (Domestic) |
| | **(817) 245-4663** (International) |
| facsimile: | **(817) 245-2141** |
| electronic mail: | **FOCSC1@mot.com** (to have Technical Support contact you) |
| web access: | **www.pagingsystems.com** |


## Service Training

To obtain a course catalog or scheduling information, contact the training coordinator:

| | |
|---|---|
| telephone: | **(817) 245-2184** |
| | **(800) 724-3588** |
| electronic mail: | **Q10691@email.mot.com** |

## Computer Software Copyrights

## Trademarks

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Trademarks contained herein are the acknowledged property of their respective owners.

## Important Safety Information

The installation, maintenance, and / or operation of this equipment may present potentially unsafe conditions, including, but not limited to, electrical shock, improper voltage to components, and improper operation that can cause personal injury, death or damage to property.

**Read Instructions:** Read all the safety instructions before operating the equipment. Retain these safety instructions for future reference. Specialized procedures and instructions are required and must be followed. Also, all applicable safety procedures, such as Occupational, Safety, and Health Administration (OSHA) requirements, National Electric Code Requirements, local code requirements, safe working practices, and good judgement must be used by personnel.

**Heed Admonitions:** Adhere to all warnings on the equipment and in the operating instructions. Follow all operating and use instructions. Two safety admonitions are used in this instruction manual to indicate:

- Equipment damage–

CAUTION

*This safety admonition applies to an operating or maintenance procedure, practice or condition which, if not strictly observed, could result in damage to the equipment or database.*

- Personal injury or injury that may result in death–

DANGER

*This safety admonition applies to an operating or maintenance procedure, practice or condition which, if not strictly observed, could result in serious personal injury or death.*

**Mounting:** Mount the equipment only as recommended by the manufacturer. Situate the equipment away from heat sources such as radiators, heat registers, stoves, or other equipment (including amplifiers) that produces heat.

**Power Sources and Grounding:** Connect the equipment to the type of power source described in the installation instructions or as marked on the equipment. Take precautions to avoid defeating the grounding or polarization provisions of the equipment. Disconnect the power to the equipment by a circuit breaker when left unused for long periods of time.

**Cleaning:** Clean the outside of the equipment by using only a damp cloth. Do not immerse the equipment in any type of liquid, including water. Do not use liquid cleaners or aerosol cleaners. Dirt or other foreign matter should not be allowed to accumulate in the interior of the enclosure.

**Damage Requiring Service:** Do not attempt to perform service functions that are not described in the operating instructions. All other servicing should be referred to qualified service personnel.

**Telephone Line Installation:** All telephone line connections to the equipment should be accomplished with the telephone lines disconnected from the network interface.

Motorola is not responsible for static damage to equipment not sold under the Motorola logo.

# Limited Equipment Warranty for U.S. And Canadian Markets

## General Terms

1. Motorola-manufactured infrastructure equipment is warranted to be free from defects in material and workmanship to the original purchaser only as set forth herein.

2. This Warranty covers only that equipment identified in paragraph 1 that is used in the manner and for the purpose intended.

3. This Warranty specifically excludes any and all software products from any source. Software products are the subject of the Software Maintenance Program, addressed separately.

4. This Warranty shall commence 30 days after the date of shipment of the infrastructure equipment.

5. The term of Warranty for all infrastructure equipment is one (1) year parts and labor.

## Limitations and Qualifications of Warranty

6. LIMITATION—THE REMEDY UNDER THIS WARRANTY IS LIMITED TO MOTOROLA'S REPAIR OR REPLACEMENT OF DEFECTIVE EQUIPMENT. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR CONDITIONS, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

7. This Warranty does not cover, nor include a remedy for, damages, defects or failure caused by:

    a. The equipment or any part of it NOT having been installed, modified, adapted, repaired, maintained, transported or relocated in accordance with Motorola technical specifications and instructions;

    b. Storage not conforming to the Shipping, Receiving, and Installation section of the applicable Motorola Equipment Manual;

    c. Environmental characteristics not conforming to the applicable Motorola Equipment Manual;

    d. Nonconformance with the Equipment Operating Instructions in the applicable Motorola Equipment Manual;

    e. External causes including, without limitation, use in conjunction with incompatible equipment, unless such use was with or under Motorola's prior written consent;

    f. Cosmetic damages;

    g. Damages caused by external electrical stress;

    h. Lightning;

    i. Accidental damage;

    j. Negligence, neglect, mishandling, abuse or misuse;

    k. Force Majeure; and

    l. Damage caused by Shipper(s).

## Return of Equipment

8. If an item of infrastructure equipment malfunctions or fails in normal use within the Warranty Period:

    a. The Customer shall promptly notify the Motorola One-Call-Support™ Center at 1-800-520-PAGE (7243) as to the problem and provide the serial number of the defective item. Motorola shall, at its option, either resolve the problem over the telephone or issue a Return Authorization Number to the Customer. The Customer shall, at its cost, ship the item to the Motorola location designated at the time the Return Authorization Number is issued;

b. The Return Authorization Number must be shown on the label attached to each returned item. A description of the fault must accompany each returned item. The returned item must be properly packed, and the insurance and shipping charges prepaid;

c. Motorola shall either repair or replace the returned item. The replacement item may be new or refurbished. When refurbished, it shall be equivalent to new in operation. When a returned item is replaced by Motorola, the returned item shall become the property of Motorola;

d. Subject to all the terms of this Warranty and to part availability, Motorola shall complete the repair or exchange of Motorola-manufactured equipment returned under Warranty within ten (10) working days of receipt of the equipment;

e. Motorola shall, at its cost, ship the repaired or replaced item to the Customer. If the Customer has requested Express Shipping, the Customer shall pay Motorola an expedite fee; and

f. Equipment which is repaired or replaced by Motorola shall be free of defects in material and workmanship for the remainder of the original Warranty, or for 90 days from the date of repair or replacement, whichever is longer. All other terms of this Warranty shall apply to such repairs or replacements.

## Advance Replacements

9. During the Warranty Period:

a. At the Customer's request and for the Customer's convenience, Motorola may supply the Customer with Advance Replacement Parts (parts furnished in advance of Motorola's receipt of defective items). Motorola's provision of such parts will be contingent on part availability and on the Customer's maintaining a satisfactory credit standing with Motorola.

b. Motorola shall ship the Advance Replacement Parts requested by the Customer within 48 hours of Motorola determining that such service is appropriate, if stock is available at the Motorola service location. If stock is not available, Motorola will make reasonable efforts to locate and provide it to the Customer within ten (10) working days.

c. The Customer shall return defective items to Motorola within thirty (30) days from the date of shipment of the Advance Replacement Parts; failing which, Motorola shall bill and the Customer shall pay the full current list price of the Advance Replacement Parts.

10. To secure payment of the list price of Advance Replacement Parts if the defective items are not returned to Motorola, the Customer hereby grants to Motorola a purchase money security interest in any Advance Replacement Parts.

## Telephone Technical Assistance

11. During the Warranty Period, Motorola will provide the Customer with over-the-telephone technical fault analysis free of labor charges. The Customer may call the Paging One-Call-Support Center at 1-800-520-PAGE (7243) for assistance. For warranty calls in excess of 15 per location per month or for non-warranty calls, Motorola shall charge the Customer per Motorola's then-current labor rates.

## Excluded Equipment

12. The following equipment is excluded from this Warranty and is covered instead by the Original Equipment Manufacturer's Warranty:
    a. Equipment which is not an integral part of a basic system configuration and which is not manufactured by Motorola, such as batteries and satellite dish LNBs;
    b. Peripheral equipment such as printers, modems, data loggers, video display terminals, and lightning and surge protectors; and
    c. Equipment which is not listed in Motorola's Price Book.

## Force Majeure

13. Motorola shall not be responsible for failure to discharge its obligations under this Warranty due to delays by suppliers, material shortages; strikes, lockouts or other labor disputes; disturbances, government regulations, floods, lightning, fires, wars, accidents, acts of God, and any other causes beyond Motorola's reasonable control.

## Default and Termination

14. Motorola shall have the right to immediately terminate this Warranty, and to suspend its performance under this Warranty, upon notification to the Customer if the Customer:
    a. Assigns or transfers the Customer's rights or obligations under this Warranty without the prior written consent of Motorola; or
    b. Within thirty (30) days of written demand by Motorola, fails to pay (1) any charge for Advance Replacement Parts supplied under this Warranty, if the Customer has not timely returned the defective items, or (2) any other amount that may be due.

15. Notwithstanding any such termination of the Warranty to the Customer, the Customer shall remain responsible for all amounts then due.

## Limitation of Liability

16. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THIS WARRANTY, EVEN IF MOTOROLA HAS BEEN ADVISED OF THE POSSIBILITY THEREOF, INCLUDING, WITHOUT LIMITATION, LOST PROFITS AND REVENUES, FAILURE TO REALIZE EXPECTED SAVINGS, LOST DATA OR ANY CLAIMS AGAINST THE CUSTOMER BY A THIRD PARTY.

# Human Exposure Compliance

This document is intended for use with the RF-Orchestra!™ (RF-O!™) paging station, equipment type LX696FC4001.

## Human Exposure Limitation to Radio Frequency Energy

This equipment is designed to generate and radiate radio frequency (RF) energy. It should be installed and maintained by trained technicians only. Licensees of the Federal Communications Commission (FCC) using this equipment are responsible for insuring that its installation and operation comply with FCC regulations designed to limit human exposure to RF radiation, in accordance with FCC Rules Part 1, section 1.1310, and as published in title 47 code of federal regulations.

*Note: These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP) in NCRP Report No. 86, Copyright NCRP, 1986, Bethesda, Maryland 20814. Over a wide frequency range, these limits are also based on those recommended in the American National Standards Institute IEEE Standard C95.1-1991.*

This standard establishes two sets of maximum permitted exposure limits, one for occupational/controlled exposure, and another that provides lower levels for general population/uncontrolled exposure. These terms are defined by the FCC as follows:

- Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment, provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply, provided he or she is made aware of the potential for exposure.
- General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

At the frequency range of 930–931 MHz and 940–941 MHz for this Personal Communication System equipment, the maximum permitted exposure levels are set in terms of power density. Power density definitions and relationships to electric field and magnetic field strengths are described by the standard as follows:

Power density (S)—Power per unit area normal to the direction of propagation, usually expressed in units of watts per square meter (W / $m^2$) or, for convenience, units such as milliwatts per square centimeter (mW / $cm^2$). For plane waves, the power density, electric field strength (E), and magnetic field strength (H) are related by the impedance of free space, in other words, 377 Ohms. In particular:

$$S = \frac{E^2}{377} = 337\ H$$

where E and H are expressed in units of V / m and A / m, respectively, and S in units of W / $m^2$. Although many survey instruments indicate power density units, the actual quantities measured are one of the following: E, $E^2$, H, or $H^2$.

Within this frequency range, the maximum permitted exposure ceiling for general population / uncontrolled environments is a power density (mW / $cm^2$) that equals f / 1500, where f is the frequency expressed in MHz, and measurements are averaged over a period of 30 minutes. The maximum permitted exposure ceiling for occupational / controlled environments, also expressed in power density (mW / $cm^2$), is f / 300, where measurements are averaged over 6 minutes. Applying these principles to the minimum and maximum frequencies for which this equipment is intended to be used yields the maximum permitted exposure levels:

| | Uncontrolled Environment | | Controlled Environment | |
|---|---|---|---|---|
| | 930 MHz | 941 MHz | 930 MHz | 941 MHz |
| **Ceiling** | 0.6203 mW/$cm^2$ | 0.627 mW/$cm^2$ | 3.101 mW/$cm^2$ | 3.135 mW/$cm^2$ |

If you plan to operate the equipment at more than one frequency, compliance should be assured at the frequency which produces the lowest exposure ceiling (among the frequencies at which operation will occur).

Licensees must be able to certify to the FCC that their facilities meet the above ceilings. Whether a given installation meets the maximum permitted exposure ceilings depends, in part, upon antenna type, antenna placement, and the output power to which this equipment is adjusted. The following example sets forth the distances from the antenna to which access should be prevented in order to comply with the uncontrolled and controlled environment exposure limits as set forth in the ANSI IEEE standards and computed above.

## Calculations for RF-O! 900-MHz Paging Station

Calculating the minimum distance from the antenna necessary to meet the requirements of an uncontrolled environment, we assume the following:

- Transmit frequency = 930 MHz
- Base station cabinet output power, *P* = +56.02 dBm (400 Watts)
- Antenna feeder cable loss, *CL* = 2.0 dB
- Antenna input power *Pin* = *P* - *CL* = +56.02 - 2.0 = +54.02 dBm (252.35 Watts)
- Antenna gain, *G* = 9.0 dBd [11.15 dBi (13.03)] Antenna height, *h* = 3 m

Using the following relationship (cylindrical model used for near field calculation):

$$W = \frac{Pin}{2\pi h}$$

where *W* is the maximum permissible power density in $W/m^2$ and *r* is the safe distance from the antenna in meters. The desired distance can be calculated as follows:

$$r = \frac{Pin}{2\pi h\,W} = \frac{252.35}{2\pi \cdot 3 \cdot 6.2} = 2.16$$

*Note: r = 0.43m for Controlled Environment*

where *W* = 6.2 $W/m^2$ was obtained from table above and converting from $mW/cm^2$ to $W/m^2$.

*Note: The above result applies only in the direction of maximum radiation of the antenna. Actual installations may employ antennas that have defined radiation patterns and gains that differ from the example set forth above. The distances calculated can vary depending on the actual antenna pattern and gain.*

| Tx Power | Uncontrolled Environment | | Controlled Environment | |
|---|---|---|---|---|
| | 930 MHz | 941 MHz | 930 MHz | 941 MHz |
| **400 W** | 2.16 m | 2.13 m | 0.43 m | 0.43 m |
| **289 W** | 1.56 m | 1.54 m | 0.31 m | 0.31 m |
| **150 W** | 0.81 m | 0.8 m | 0.16 m | 0.16 m |
| **75 W** | 0.40 m | 0.4 m | 0.08 m | 0.08 m |

The above table summarizes the safe distance from the paging station for different powers.

While installation calculations such as the above are useful and essential in planning and design, validation that the operating facility using this equipment actually complies will require making power density measurements. For information on measuring RF fields for determining compliance with the FCC requirements, see *IEEE Recommended Practice for the Measure of Potentially Hazardous Electromagnetic Fields—RF and Microwave,* IEEE Standard C95.3-1991. Copies of IEEE C95.3-1991 may be purchased from The Institute of Electrical and Electronics Engineers, Inc., Attention: Publication Sales, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, (800) 678-IEEE or from ANSI, (212) 642-4900. Persons responsible for installation of this equipment are urged to consult the standard in determining whether a given installation complies with the applicable limits.

Whether a given installation meets the requirements of FCC Rules Part 1 section 1.1310 for human exposure to radio frequency radiation may depend not only on this equipment, but also on whether the environments being assessed are being affected by radio frequency fields from other equipment. The effects of this other equipment may add to the level of exposure. Accordingly, the overall exposure may be affected by radio frequency generating facilities that exist at the time the licensee's equipment is being installed or even by equipment installed later. Therefore, the effects of any such facilities must be considered in site selection and in determining whether a particular installation meets the FCC requirements.

# PSG Limited Equipment Warranty for Non-U.S. and Non-Canadian Markets

## General Terms

1. Motorola Paging Systems Group (PSG) manufactured infrastructure equipment is warranted to be free from defects in material and workmanship to the original purchaser only as set forth herein.

2. This Warranty covers only that equipment identified in paragraph 1 that is used in the manner and for the purpose intended.

3. This Warranty specifically excludes any and all software products from any source. PSG software products are the subject of the PSG Software Maintenance Program, addressed separately.

4. This Warranty shall commence 30 days after the date of shipment of the PSG infrastructure equipment.

5. The term of Warranty for all PSG infrastructure equipment is one (1) year parts and labor.

## Limitations And Qualifications of Warranty

6. LIMITATION—THE REMEDY UNDER THIS WARRANTY IS LIMITED TO MOTOROLA'S REPAIR OR REPLACEMENT OF DEFECTIVE EQUIPMENT. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR CONDITIONS, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

7. This Warranty does not cover, nor include a remedy for, damages, defects or failure caused by:

   a. The equipment or any part of it NOT having been installed, modified, adapted, repaired, maintained, transported or relocated in accordance with Motorola technical specifications and instructions;

   b. Storage not conforming to the Shipping, Receiving, and Installation section of the applicable Motorola Equipment Manual;

c. Environmental characteristics not conforming to the applicable Motorola Equipment Manual;

d. Nonconformance with the Equipment Operating Instructions in the applicable Motorola Equipment Manual;

e. External causes including, without limitation, use in conjunction with incompatible equipment, unless such use was with or under Motorola's prior written consent;

f. Cosmetic damages;

g. Damages caused by external electrical stress;

h. Lightning;

i. Accidental damage;

j. Negligence, neglect, mishandling, abuse, or misuse;

k. Force Majeure; and

l. Damage caused by Shipper(s).

## Return of Equipment

8. If an item of PSG infrastructure equipment malfunctions or fails in normal use within the Warranty Period:

   a. The Customer shall promptly notify the nearest Motorola Area Customer Care Center (CCC) of the problem and provide the serial number of the defective item. Motorola shall then, at its option, either resolve the problem over the telephone or issue a Return Authorization Number to the Customer. The Customer shall, at its cost, ship the item to the Motorola Area CCC location designated at the time the Return Authorization Number is issued;

   b. The Return Authorization Number must be shown on the label attached to each returned item. A description of the fault must accompany each returned item. The returned item must be properly packed, and the insurance and shipping charges prepaid;

   c. Motorola shall either repair or replace the returned item. The replacement item may be new or refurbished. When refurbished, it shall be equivalent to new in operation. When a returned item is replaced by Motorola, the returned item shall become the property of Motorola;

d. Subject to all the terms of this Warranty, part availability and the clearance of Customs, Motorola shall complete the repair or exchange of Motorola-manufactured equipment returned under Warranty within fifteen (15) working days of receipt of the equipment;

e. Motorola shall, at its cost, ship the repaired or replaced item to the Customer. If the Customer has requested Express Shipping, the Customer shall pay Motorola an expedite fee; and

f. Equipment which is repaired or replaced by Motorola shall be free of defects in material and workmanship for the remainder of the original Warranty, or for 90 days from the date of repair or replacement, whichever is longer. All other terms of this Warranty shall apply to such repairs or replacements.

## Advance Replacements

9. During the Warranty Period:

   a. At the Customer's request and for the Customer's convenience, Motorola may supply the Customer with Advance Replacement Parts (parts furnished in advance of Motorola's receipt of defective items). Motorola's provision of such parts will be contingent on part availability and on the Customer's maintaining a satisfactory credit standing with Motorola.

   b. Motorola shall ship the Advance Replacement Parts requested by the Customer within 48 hours of Motorola determining that such service is appropriate, if stock is available at the Motorola service location. If stock is not available, Motorola will make reasonable efforts to locate and provide it to the Customer within ten (10) working days.

   c. The Customer shall return defective items to the Motorola Area Customer Care Center within thirty (30) days from the date of shipment of the Advance Replacement Parts; failing which, Motorola shall bill and the Customer shall pay the full current list price of the Advance Replacement Parts.

10. To secure payment of the list price of Advance Replacement Parts if the defective items are not returned to Motorola, the Customer hereby grants to Motorola a purchase money security interest in any Advance Replacement Parts.

## Excluded Equipment

11. The following equipment is excluded from this Warranty and is covered instead by the Original Equipment Manufacturer's Warranty:
    a. Equipment which is not an integral part of a basic system configuration and which is not manufactured by Motorola, such as batteries and satellite dish LNBs;
    b. Peripheral equipment such as printers, modems, data loggers, video display terminals, and lightning and surge protectors; and
    c. Equipment which is not listed in Motorola's Price Book.

## Force Majeure

12. Motorola shall not be responsible for failure to discharge its obligations under this Warranty due to delays by suppliers, material shortages; strikes, lockouts or other labor disputes; disturbances, government regulations, floods, lightning, fires, wars, accidents, acts of God, and any other causes beyond Motorola's reasonable control.

## Default and Termination

13. Motorola shall have the right to immediately terminate this Warranty, and to suspend its performance under this Warranty, upon notification to the Customer if the Customer:
    a. Assigns or transfers the Customer's rights or obligations under this Warranty without the prior written consent of Motorola; or
    b. Within thirty (30) days of written demand by Motorola, fails to pay (1) any charge for Advance Replacement Parts supplied under this Warranty, if the Customer has not timely returned the defective items, or (2) any other amount that may be due.

14. Notwithstanding any such termination of the Warranty to the Customer, the Customer shall remain responsible for all amounts then due.

## Limitation of Liability

15. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THIS WARRANTY, EVEN IF MOTOROLA HAS BEEN ADVISED OF THE POSSIBILITY THEREOF, INCLUDING, WITHOUT LIMITATION, LOST PROFITS AND REVENUES, FAILURE TO REALIZE EXPECTED SAVINGS, LOST DATA OR ANY CLAIMS AGAINST THE CUSTOMER BY A THIRD PARTY.

# Contents

# Figures

# Tables

# Introduction

## Overview

This manual provides instructions for the installation and operation of the RF-O! transmitter. These instructions include configuration and alignment instructions, some troubleshooting techniques and fault analysis using FIPS commands, and the removal and replacement procedures of faulty modules.

### Audience

This manual is for the use of personnel responsible for the operation and maintenance of the RF-O! transmitter. It assumes that personnel performing the operation and maintenance procedures contained in this manual have a knowledge of paging systems and a background in the field of electronics.

### Contents

This manual contains the following chapters:

- Chapter 1, "Introduction" describes the manual.
- Chapter 2, "System Description" presents an overview of the Wireless Messaging System, a brief description and block diagram of each of the modules of the RF-O! transmitter along with a brief description of the different options and features, the specifications, and the electrical requirements of the RF-O! transmitter.
- Chapter 3, "Preinstallation" provides information needed in selecting and establishing a site for installing the RF-O! transmitter, grounding requirements and instructions for GPS antenna evaluation.
- Chapter 4, "Installation" provides a diagram of each model of the RF-O! transmitter, a list of the required tools, equipment and parts needed to successfully install the RF-O! paging station, and grounding and antenna connections.
- Chapter 5, "Operation" provides information on operating and configuring the RF-O! transmitter.

- Chapter 6, "Maintenance" provides troubleshooting information and instructions for replacing field replaceable units (FRUs).
- Appendix A provides a list of acronyms and abbreviations used in this manual.
- Appendix B contains information on the backplane connectors and pinout connections.
- Appendix C provides the breakdown of the RF-O! transmitter. It contains all the models, kits, and FRUs for the RF-O! transmitter.
- Appendix D provides the FIPS action commands for the RF-O! transmitter.
- Appendix E provides the FIPS commands for the Read and Write parameters.
- Appendix F provides an error and alarm code listing.
- Appendix G contains a transmitter alignment checklist.
- Appendix H contains detailed descriptions of all of the RF-O! transmitter debug traces.

# Keyboard Conventions

This section describes the software application keyboard conventions used in this manual (see Table 1-1):

*Table 1-1: Keyboard Conventions Used in This Manual*

| Convention | Description |
|---|---|
| **System input** | Text that you must type into the system and screen options appear in bold text.<br>Example: **partition** |
| **Keys** | Single keyboard keys used during input appear bold and in angle brackets.<br>Examples: **<Enter>**, **<F2>**, **<Esc>**<br>When one key is to be pressed and held while another key is pressed, the key names appear bold, in angle brackets, and joined by a plus sign.<br>Examples: **<Esc+2>**, **<Ctrl+Y>** |
| **Keyboard labeling** | Keyboard labeling varies. For example, **<Enter>**, **<Return>**, or **<Enter/Return>** may indicate the key used for information entry. These procedures use **<Enter>** to represent the various labeling. Unless otherwise noted, the sequence is:<br>**Item <Enter>**.<br>Also, **<Control>** or **<Ctrl>** may indicate the control key. These procedures use **<Ctrl>**. |
| **Variables** | Variables that you must type into the system are set inside vertical brackets [ ]. However, you do not type the brackets.<br>Examples: **[Latitude]**, **[177.12.77.34]** |
| **System output** | System responses to commands appear as Courier text.<br>Example: `COMMAND SUCCESSFUL` |

# Related Publications

The following manuals may be referenced for more information on other systems and the optional peripheral equipment associated with the RF-O! transmitter.

- *Choreographer™ Network Manager Installation and Operation*, Publication 6880492G07
- *Quality Standards Fixed Network Equipment-Installation Manual R56*, Publication 6881089E50
- *RF-Audience!™ Receiver Installation and Operation*, Publication 6880493G04
- *RF-Audience!™ Receiver Service and Type Acceptance*, Publication 6880495G01
- *RF-Baton!™ Transmitter Controller Control Module*, Publication 6880497G24
- *RF-Baton!™ Transmitter Controller Reference Module*, Publication 6880497G22
- *RF-Baton!™ Transmitter Controller System Installation and Operation*, Publication 6880497G01
- *RF-Orchestra!™ Paging Station AC Distribution Box*, Publication 6880495G26
- *RF-Orchestra!™ Paging Station AC Power Supply*, Publication 6880495G23
- *RF-Orchestra!™ Paging Station Battery*, Publication 6880497G23
- *RF-Orchestra!™ Paging Station DC-DC Converter Module*, Publication 6880495G24
- *RF-Orchestra!™ Paging Station Detector*, Publication 6880495G27
- *RF-Orchestra!™ Paging Station Exciter Module*, Publication 6880495G21
- *RF-Orchestra!™ Paging Station Service and Type Acceptance*, Publication 6880495G10
- *RF-Orchestra!™ Paging Station Orchestra Control Module*, Publication 6880495G25
- *RF-Orchestra!™ Paging Station Power Amplifier Module*, Publication 6880495G22
- *WMG-Administrator!™ Messaging Switch Installation and Operation*, Publication 6885601T01
- *WMG-Administrator!™ Administration*, Publication 6885601T02
- ETSI 300.279
- TIA-603
- IEEEC62.41 location cat.B

# System Description

## Wireless Messaging System Overview

The Wireless Messaging System (WMS), the Motorola two-way advanced messaging solution, is part of the FLEX™ family of protocols. The FLEX protocol is the high-speed, standard protocol in the one-way paging industry. The ReFLEX™ messaging protocol includes a reverse channel to support two-way messaging. The InFLEXion™ messaging protocol is a robust two-way voice and data messaging protocol.

With small, lightweight, low-power subscriber pagers, ReFLEX- and InFLEXion-based services offer many advantages:

- High transmission speeds, up to 6400 bits per second (bps) for more than 140,000 alphanumeric pagers per channel
- High resistance to signal fading
- Two-way messaging including ReFLEX messaging protocol (text messaging), InFLEXion messaging protocol (voice messaging), message receipt acknowledgment, and message retransmission
- Ability to change speed to match the system daily traffic pattern
- Extended pager battery life

The Wireless Messaging System consists of the following components (see Figure 2-1):

- WMG-Administrator!™ messaging switch or other messaging switch
- RF-Conductor!™ (RF-C!™) controller
- Choreographer!™ network manager
- RF-Baton!™ (RF-B!™) transmitter controller
- RF-Orchestra!™ (RF-O!™) Paging Station(s)
- RF-Audience!™ (RF-A!™) receiver(s)
- Pagers

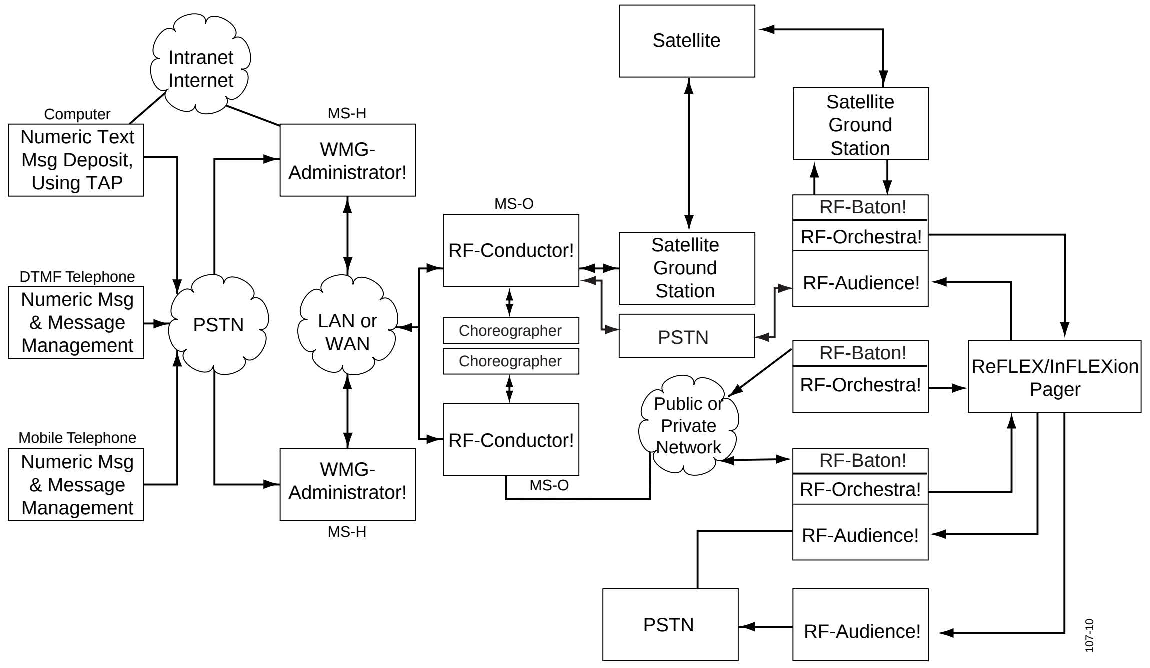



*Figure 2-1: The Wireless Messaging System Block Diagram*

## WMG-Administrator! Messaging Switch

The WMG-Administrator! Messaging Switch (MS) is a two-way switch that corresponds to a traditional paging terminal. This switch, the clearinghouse for all messages in the Wireless Messaging System, provides a wide range of messaging and administrative services. Callers access the system through the Public Switch Telephone Network (PSTN) or the Internet. The system accepts any of the following inputs:

- Ordinary and Integrated Services Digital Network (ISDN) lines
- Trunks with signaling for each channel signaling or SS7 common-channel signaling
- T1 and E1 spans

Each WMG-Administrator! MS connects to other systems in the Wireless Messaging System through a network of land lines and / or satellite links.

## RF-C! Controller

The RF-C! controller is the messaging system controller for the transmitters and receivers in a region. The RF-C! controller routes voice and text messages from the WMG-Administrator! to the appropriate transmitter(s) and returns responses from the RF-Audience! receivers to the WMG-Administrator!.

## Choreographer! Network Manager

The Choreographer! network manager is a software interface for voice and data communications, used in either the two-way or one-way messaging infrastructure. The interface manages and configures network devices.

As an integral element of the Wireless Messaging System advanced messaging network, the Choreographer! network manager integrates a wide range of utilities and services:

- Configuration management and software download
- Statistics monitoring
- Alarms and event monitor / event manager

## RF-B! Transmitter Controller

The RF-B! transmitter controller provides an interface between the RF-C! controller and the RF-O! transmitter. The RF-B! transmitter controller also provides synchronization timing for the transmitter from a GPS receiver.

## RF-O! Transmitter

The RF-O! transmitter is a linear transmitter for voice and data messaging and can support one, two or three subchannels. The RF-O! transmitter converts data received from the RF-B! transmitter controller into modulated radio frequency (RF) energy for transmission to the pagers.

## RF-A! Receivers

The RF-A! receivers return messages transmitted by the subscriber pagers to the RF-C! controller. RF-A! receivers funnel their output through a multiplexer that provides a single link back to the RF-C! controller. RF-A! receivers may be stand-alone or co-located with a transmitter.

## Pagers

Pagers are miniature radios that initiate and accept messages to and from the transmitter. ReFLEX protocol pagers receive text messages, and InFLEXion protocol pagers receive voice messages. Both ReFLEX and InFLEXion pagers provide return acknowledgments when a message is accurately received and when the subscriber accesses the message. Some ReFLEX pagers can initiate messages.

*Note: Pagers are known by different names, depending on the particular region [for example, communicators, personal messaging units (PMUs), personal communications devices (PCDs), or subscriber units (SU)].*

# FLEX, ReFLEX, and InFLEXion Messaging Protocol Overview

The delivery of advanced messaging is augmented by a family of Motorola over-the-air (OTA) message protocols. The FLEX messaging protocol provides one-way text messaging, the ReFLEX protocol provides two-way text messaging, and the InFLEXion messaging protocol provides two-way voice and data messaging. Two-way messaging, using the ReFLEX and InFLEXion protocols, provides guaranteed message delivery because a received message is acknowledged by the pager. If a message is not acknowledged after a transmission, the system retransmits the message intermittently until it is received.

The primary difference between the ReFLEX and InFLEXion protocols is in the outbound (transmitter to pager) signal path. ReFLEX is strictly a data messaging protocol, whereas the InFLEXion protocol also supports voice messaging. The protocols are identical with respect to the inbound (pager to receiver) signal path.

## FLEX Messaging Protocol

FLEX is a synchronous, multispeed time-slot paging protocol. This protocol is a continuously active paging channel where the data is transmitted at 1600, 3200, or 6400 bps. To decode this continuous stream of data, a FLEX pager synchronizes itself with the channel so that it can find the beginning and end of data blocks.

The continuous data which is transmitted on the FLEX RF channel is segmented into FLEX frames. There are a total of 128 frames (numbered 0 through 127) in a FLEX system. It takes exactly four minutes to transmit all 128 frames on the RF channel regardless of the FLEX speed. The transmission of all 128 frames is called a FLEX cycle.

Because FLEX messaging is a one-way protocol, FLEX systems cannot offer guaranteed delivery of messages.

## ReFLEX Messaging Protocol

Key features of the ReFLEX messaging protocol are the ability of the system to guarantee delivery of a data message and the ability of the subscriber to reply to the message. These functions create the closed-loop performance that makes advanced messaging a quantum leap in wireless data communications.

The system provides the following two ways for the message sender to review the response:

- Call Query—The message sender can call back to the system at a later time and use the transaction ID to retrieve the response.
- Auto MESSAGE—If the message sender is also a subscriber in the system, the system can be instructed to send the response directly to the message sender's pager.

## InFLEXion Messaging Protocol Features

The InFLEXion messaging protocol system provides for local frequency reuse based on subchannel frequencies in the 50 kHz channel bandwidth. Up to seven subchannels are available in a 50 kHz bandwidth for the InFLEXion messaging protocol, and the system is configured with a cellular-like design. Individual transmitter sites can be active and broadcasting on a given subchannel, while an adjacent transmitter is active and broadcasting on a different subchannel. Properly spaced transmitters can be operating on the same frequency, transmitting different messages at the same time.

In addition to registration and acknowledgment, InFLEXion voice messaging has support for virtual storage. Although the pager can store several minutes of voice messages, when the memory becomes full, the pager instructs the system to hold messages in the terminal. The terminal acts as a buffer until space becomes available in the pager. When pager memory becomes available, the queued messages are forwarded to the pager.

The InFLEXion voice technology has other benefits:

- The actual voice of the caller conveys the message urgency. Voice messaging provides a level of communication different from numeric or alphanumeric messaging.
- In many cases, a voice message does not require a return call because more detail can be conveyed in a voice message.
- Language independence is achieved because the message flows from the caller to the subscriber, thus negating the need for translation.

# RF-O! Transmitter Functional Description

The RF-O! transmitter, using linear technology, efficiently uses spectrum in the new narrowband Personal Communication System (PCS) 25- and 50-kHz channels. To achieve high system capacity, the RF-O! transmitters benefit from frequency reuse techniques. Using ReFLEX and InFLEXion protocols, the subscriber is always in contact with the RF-C! controller allowing the RF-C! controller to target a specific transmitter as needed. The modular design provides a variety of power levels while maintaining an average power level for the InFLEXion protocol.

## RF-O! Transmitter Features

The following paragraphs summarize the main features of the RF-O! transmitter.

### Expansion

Modular PA building blocks create a platform that is easily expandable. For InFLEXion, increasing the number of supported subchannels adds to message capacity while for ReFLEX, expansion results in increased output power. Expansion from a single InFLEXion subchannel transmitter to a 2 InFLEXion subchannel transmitter is accomplished by adding a PA, combiner, cabling and / or other peripherals.

### Power Control

The RF-O! transmitter power control feature maintains maximum power output under the most adverse conditions. Power control comprises the following:

- **Power metering**: The RF-O! transmitter FM power level is measured using both an internal (PA output) and external wattmeter (TX cavity filter output) with support from the DSP.
- **Power meter calibration**: The RF-O! transmitter is calibrated to an independent power meter traceable to the National Bureau of Standards.
- **Power leveling**: The RF-O! transmitter power is constantly monitored so that the power may be adjusted in fine increments to keep the measured power at a desired level.
- **Power set**: The user may set the power levels individually for ReFLEX (FM modulation) and InFLEXion (AM modulation). The parameter(s) are adjusted to maintain the requested power levels based on the alignment parameters and the number of subchannels.

- **Module monitoring**: The power amplifier, power supplies, exciter, circulator load, and OCM are monitored continuously for error conditions.
- **Alarm reporting**: Any error or operational condition that may degrade transmitter operation is logged and reported.
- **Power cutback**: Power is cutback when an error or operational condition requires a reduction in power level.
- **Carrier feedthrough nulling**: The carrier feedthrough of the modulation spectrum can be periodically removed from the center channel to maintain adjacent channel performance requirements and achieve accurate phase training.

For more details on power control, see Chapter 5, "Operation".

### Timing Accuracy

To ensure optimum simulcast performance, each RF-O! transmitter uses GPS to synchronize all transmitters throughout the simulcast network. Transmitter throughput delay variations are also minimized. Digital Signal Processing (DSP) technology performs the modulation waveshaping, significantly reducing traditional analog delay variations.

The timing chain shown in Figure 2-2 controls carrier and baseband frequency. Timing accuracy is maintained by GPS which disciplines a 10 MHz UHSO to 1 ppb or less. Launch time is synchronized to the GPS using the 1-PPS signal and time stamp information. When GPS is temporarily lost, the 10 MHz operates free running at 5 ppb. The synthesized GPS 1-PPS signal is not corrected by the raw GPS 1-PPS signal, but runs freely until the satellites are reacquired. The base station operates in free-run mode for 96 minutes before disabling paging. This value defaults to 96 minutes, but it is user-configurable.

The FPGA in the RF-B! transmitter controller compares the 10-MHz signal from the UHSO to the 1-PPS signal coming from the GPS. The host processor reads the difference (called the phase report) and steers the UHSO with a DC voltage to a corrected frequency. The UHSO is accurate to 1 ppb or less with GPS correction.

The 1-PPS signal from the satellite can dither or fade, so the FPGA checks to make sure the 1-PPS is within an expected window of 7.62 us. The FPGA reconstructs 1-PPS and places it in the middle of the expected window, whether 1-PPS is there or not. This reference signal is checked in the RF-O! transmitter, and similarly checked in the RF-B! transmitter controller.

The baseband signals, RF frequency, and page launch time are all disciplined by the 10 MHz reference. In both the RF-B! transmitter controller and RF-O! transmitter, a 16.8 MHz crystal oscillator coupled with a synthesizer are used as phase-locked VCOs to generate the baseband

and transmit frequencies. The sample clock (96 kHz), DSP clocks (2.1 MHz), and exciter reference frequency (4.8 MHz) are all derived from 16.8 MHz. The Exciter has 2 VCOs, which allow a fast frequency switch.

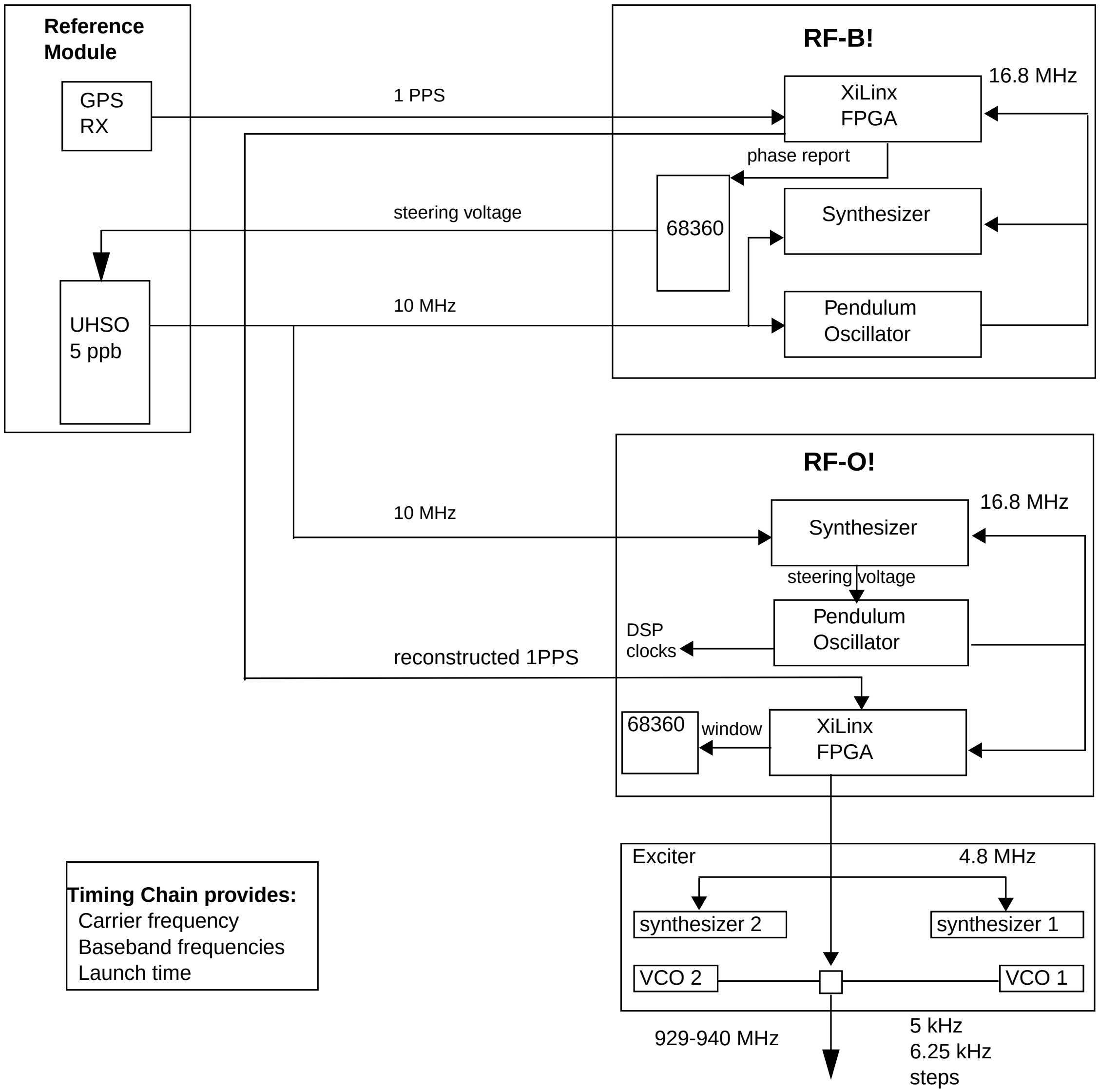



*Figure 2-2: Timing Diagram*

## System Diagnostics

Each system module contains diagnostic abilities that assess system level operational failures to the Field Replaceable Unit (FRU) level. Remote diagnostic monitoring (through a computer software terminal emulation program) is also supported. A complete list of Alarm and Error codes is provided in Appendix F.

## RF-O! Components

The RF-O! transmitter consists of the following components:

- An Orchestra Control Module containing the following submodules:
  - Orchestra Control Board (OCB)
  - RF Exciter
  - DC-DC converter
- Combiner [if using multiple power amplifiers (PAs)]
- AC power supplies
- PA(s) (one or two)
- Harmonic filter
- AC distribution panel
- Internal RF coupler / detector (wattmeter)

The following items are available options for the RF-O! paging station:

- External RF coupler / detector
- RF-B! transmitter controller
- Transmitter peripheral RF package
- Network peripheral package
- Co-located RF-A! receivers
- GPS receiver

The following paragraphs supply a brief description of each component of the RF-O! paging station. A typical cabinet layout of the RF-O! paging station shows each component in a two-channel system (see Figure 2-3).

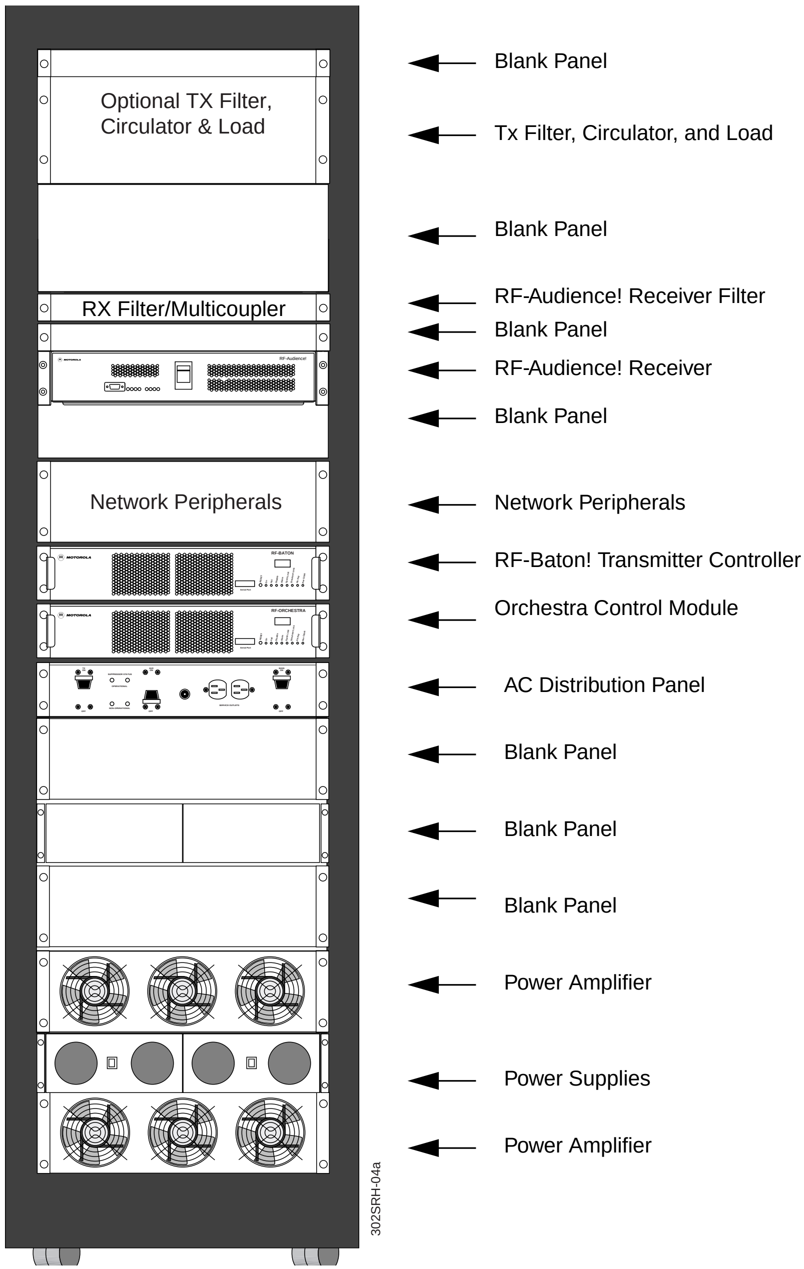



*Figure 2-3: Model PT1054 Two Channel RF-O! Paging Station Layout*

## Orchestra Control Module

The Orchestra Control Module (OCM) contains an Orchestra Control Board (OCB), Exciter, and a DC-DC Converter (see Figure 2-4). This RF-shielded enclosure interconnects the OCB, Exciter, and DC-DC converter with all other station modules through the backplane interconnect board.

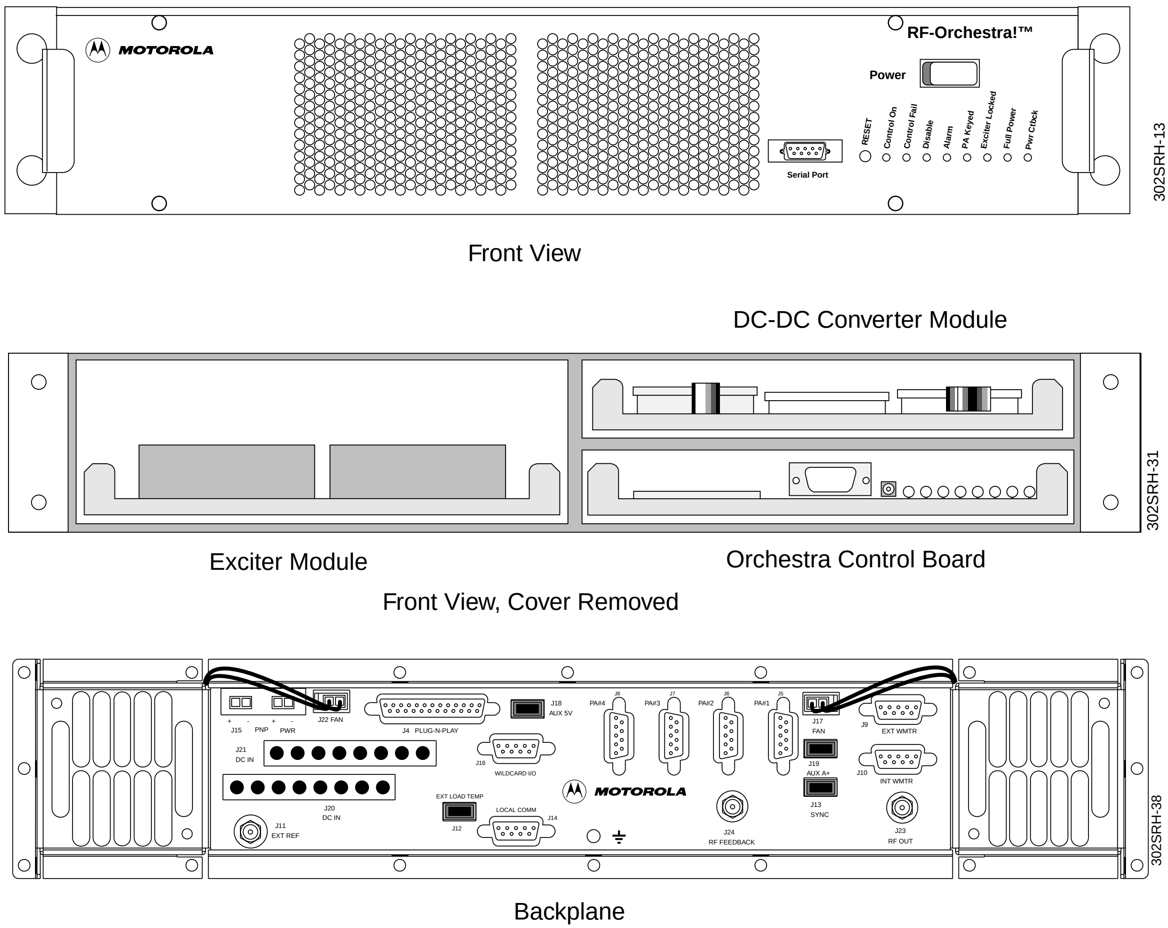



*Figure 2-4: Orchestra Control Module*

## RF-O! Transmitter Front Panel

The RF-O! transmitter front panel contains a power switch, a reset switch, eight light-emitting diodes (LEDs) and a serial port for communication. Figure 2-5 shows the location of these controls.

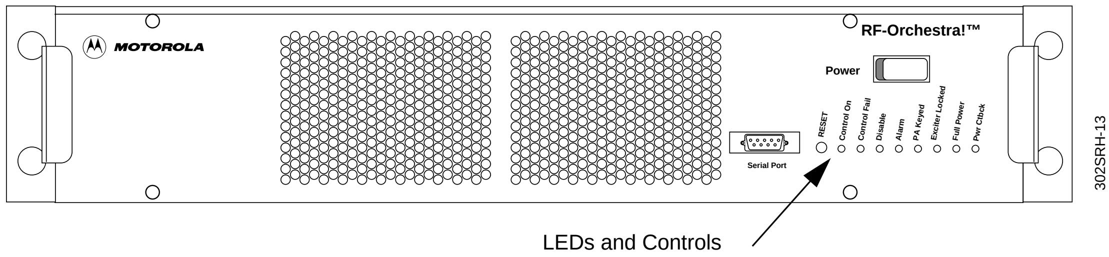



*Figure 2-5: RF-O! Transmitter Controls and LEDs*

Table 2-1 explains the controls and their functions. Table 2-2 lists the eight LEDs located on the front panel and a description of the status indicated by each LED.

*Table 2-1: RF-O! Transmitter Controls*

| Control | Function |
|---|---|
| **POWER** | Powers the RF-O! transmitter ON or OFF |
| **RESET** | Reinitializes RF-O! transmitter operation and resets all RAM values to their default settings |

*Table 2-2: RF-O! Transmitter Front Panel Indicators*

| LED | Function | Color |
|---|---|---|
| **Control On** | ON after successful completion of reset sequence | Green |
| **Control Fail** | ON when an RF-O! control module failure is detected in the reset sequence | Red |
| **Disable** | ON when messaging is disabled | Red |
| **Alarm** | ON while any station alarm is active | Red |
| **PA Keyed** | ON when paging station is keyed (regardless of power output level) | Green |
| **Exciter Locked** | ON when paging station is locked on transmit frequency | Green |
| **Full Power** | ON when paging station is operating without any cutback | Green |
| **Pwr Ctbck** | ON when power output is below the desired power setting (cutback)<br>BLINKING if paging station is disabled (shutdown) | Yellow |

## Orchestra Control Board

The OCB is a microprocessor / digital signal processor (DSP) based board located within the OCM that responds to the RF-B! transmitter controller commands (see Figure 2-6). The OCB directly controls the Exciter module to maintain proper RF modulation and time synchronization for FLEX, ReFLEX, and InFLEXion protocol operation. The OCB monitors proper operation in the Exciter and the PA through a serial peripheral interface (SPI) bus. The OCB design captures all requirements for interface with the RF-B! transmitter controller, according to the Paging Station interface (Plug and Play) protocol.

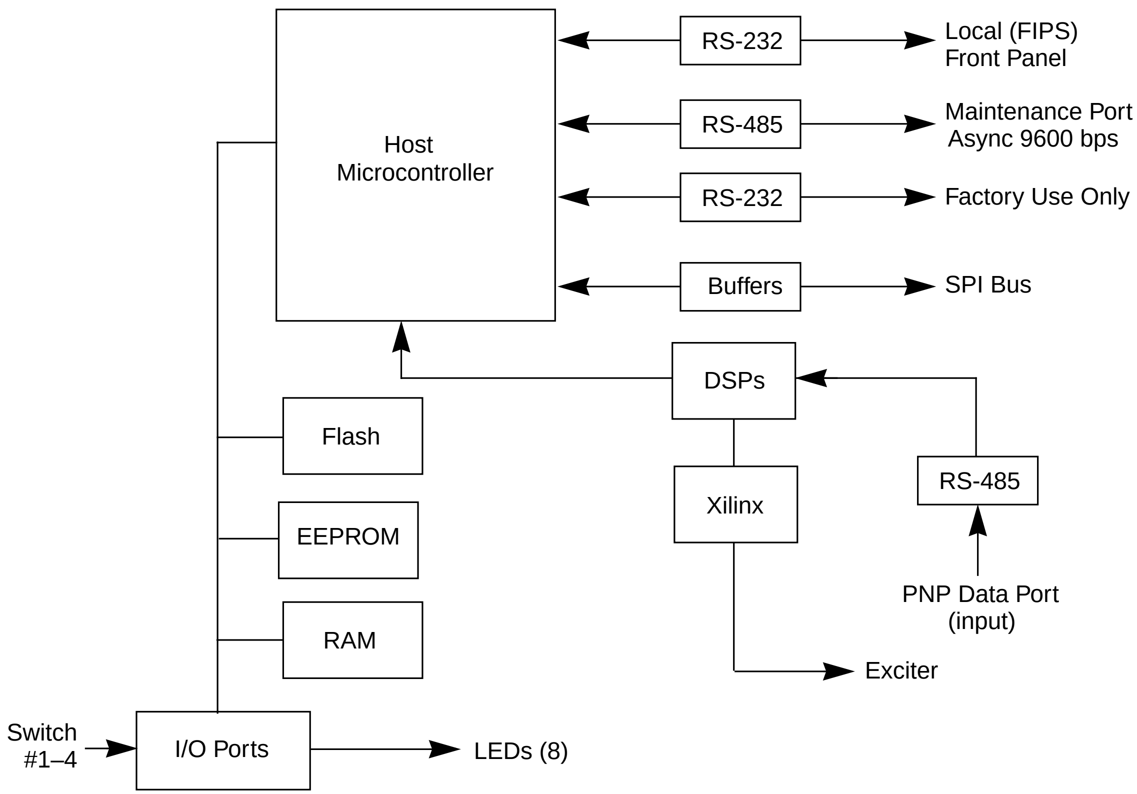



*Figure 2-6: OCB Block Diagram*

## RF Exciter Module

The RF Exciter module converts high-speed, digital baseband data generated by the OCB to selected RF frequencies. A custom linearization integrated circuit (IC) with a built-in inphase and quadrature (I/Q) digital modulator accurately shapes waves for broadcasting ReFLEX or InFLEXion protocol messages. The output of the Exciter is the station carrier frequency with the appropriate modulation needed for FLEX, ReFLEX, and InFLEXion protocol message delivery to the communicators (see Figure 2-7).

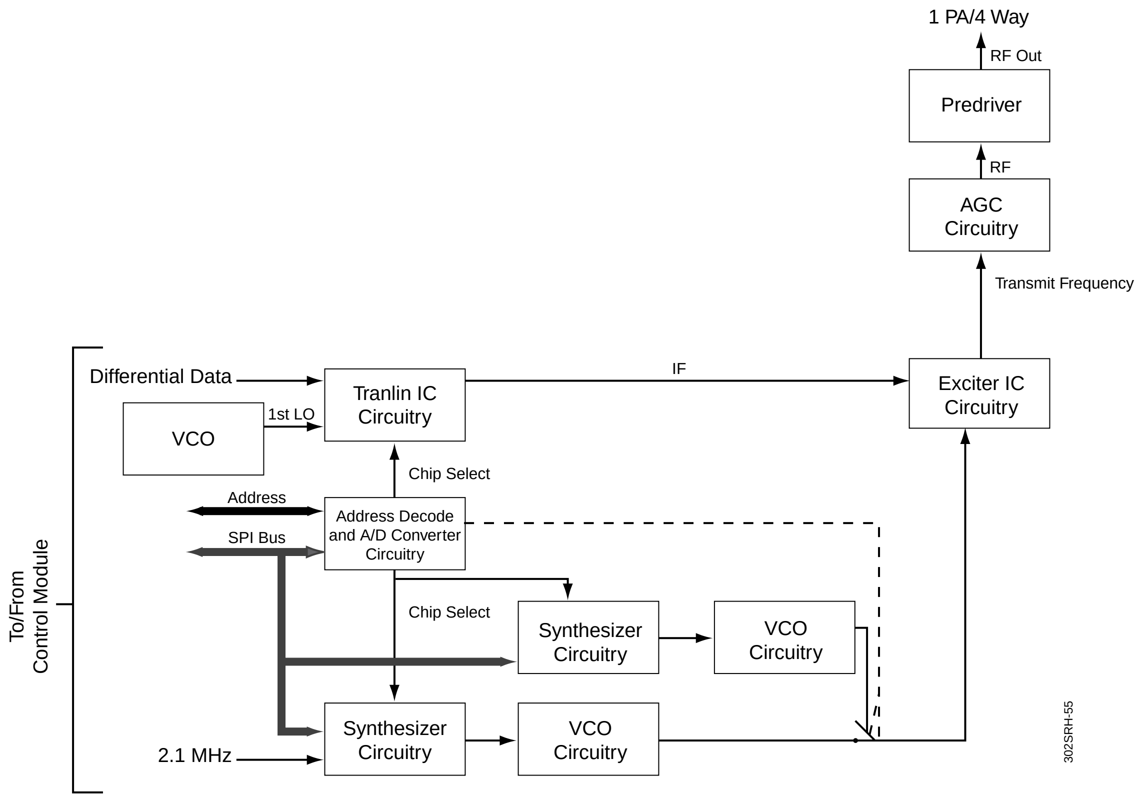



*Figure 2-7: Exciter Block Diagram*

## DC-DC Converter

The DC-DC converter provides the OCB and Exciter with +5-volt and +14-volt regulated DC voltages (see Figure 2-8). These voltages are taken from the +28-volt secondary output on one of the power supplies.

*Note: The first powered AC power supply provides +28 V to the input of the RF-O! transmitter and RF-B! transmitter controller DC-DC converters.*

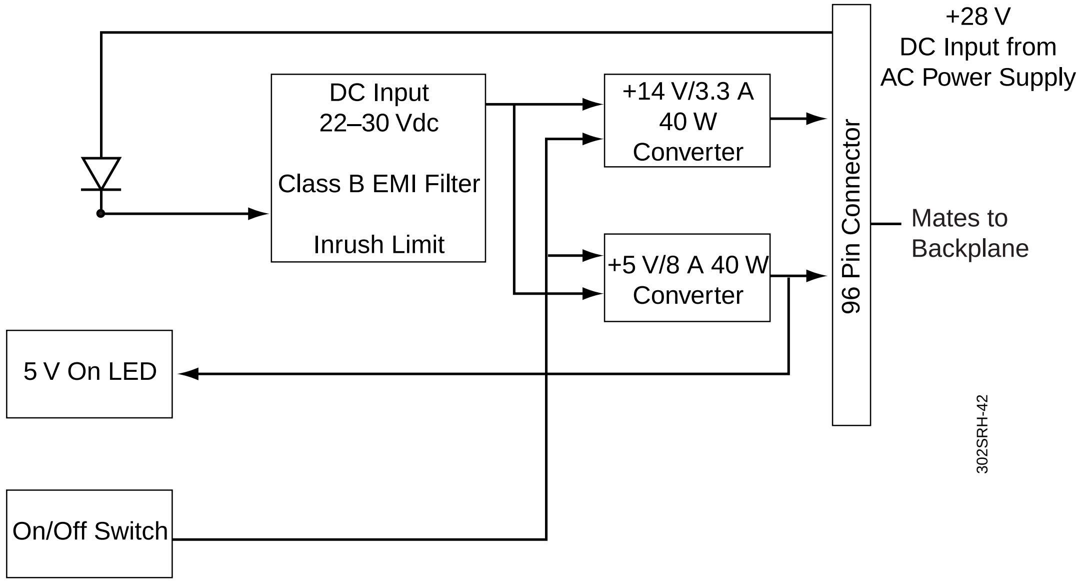



*Figure 2-8: DC-DC Converter Block Diagram*

## External Connections

The following paragraphs explain the RF-O! transmitter external connections.

### Serial Port

The RF-O! transmitter serial port is on the front panel for obtaining transmitter parameter and diagnostic information using a service terminal. The serial port uses RS-232 signaling through a DB-9 female connector.

### Backplane Connectors

The RF-O! transmitter has 24 backplane connectors, providing the connections necessary for interfacing with the RF-B! transmitter controller, power amplifier control and diagnostics, RF feedback loop and monitoring, and DC power routing. The backplane connectors are illustrated in Figure 2-9 and described in Table 2-3.

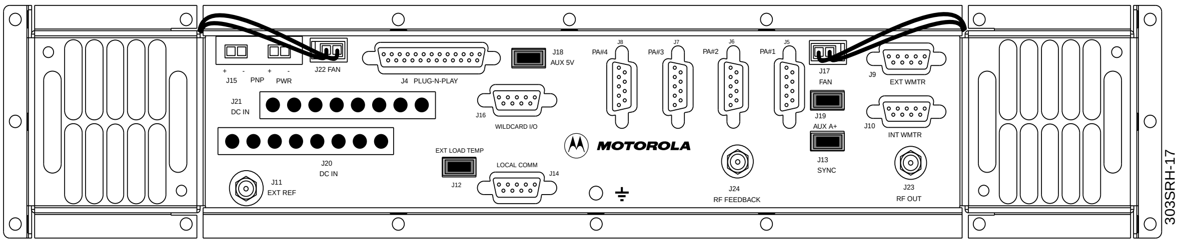



*Figure 2-9: RF-O! Transmitter Backplane*

*Table 2-3: OCM Backplane Connectors*

| Connectors | Name | Description |
|---|---|---|
| **J1, J2 and J3 are internal module connections** | | |
| **J4** | PLUG-N-PLAY | Transmitter controller interface protocol standard |
| **J5, J6,** | PA#1, 2 | Power amplifiers control and diagnostic interface |
| **J7, J8** | PS #1,2 DC Current | Used for DC Current Sensing (Only in PT1052 - Single PA) |
| **J9** | INT WMTR | Internal wattmeter interface |
| **J10** | EXT WMTR | External wattmeter RF control interface |
| **J11** | EXT REF | 10 MHz input must meet the minimum Paging Station interface protocol requirements for amplitude and frequency stability |
| **J12** | EXT_LOAD_TEMP | External circulator load temperature input monitor signal |
| **J13** | SYNC PORT | Factory use only |
| **J14** | LOCAL COMM | Factory use only |
| **J15** | PLUG-N-PLAY POWER | +28 V source for RF-Baton! (RF-B!) transmitter controller power as defined by Paging Station interface protocol |
| **J16** | WILDCARD I/O | Interfaces to external input/output circuits or module interfaces |
| **J17** | DC FAN POWER | RF-O! transmitter chassis fan connection +12 V operation |
| **J18** | AUX 5 V | +5 V source limited to 50 mA maximum current |
| **J19** | AUX A+ | +12 V source limited to 50 mA maximum current |

*Table 2-3: OCM Backplane Connectors*

| Connectors | Name | Description |
|---|---|---|
| **J20-J21** | DC INPUT | + 28 V input from each AC power supply |
| **J22** | DC FAN POWER | + 28 V input from each AC power supply |
| **J23** | RF OUT | RF output from exciter circuits for direct connection to a single PA deck or the RF splitter with multiple PA decks |
| **J24** | RF FEEDBACK | RF input from internal RF coupler at the RF output |

## AC Distribution Panel

The AC distribution panel provides the main AC power input to the transmitter and all AC powered modules. The panel has silicone diode surge protection and distributes 208 Vac and 120 Vac as required in the cabinet (see Figure 2-10). The panel includes two (120 V) service outlets located on both the front and the back of the unit.

A 12-foot line cord with a NEMA L14-30P plug exits the top of the cabinet. The main circuit breaker switch disconnects or connects AC power to all AC plugs on the panel. This breaker switch (located on the right of the panel) must be switched off before inserting or removing the AC plug.

The transmitter circuit breaker switch (located on the left side of the front panel) disconnects or connects the four 240-Vac receptacles on the back of the right side. This breaker switch connects or disconnects AC power to both RF-O! transmitter power supplies. A block diagram displays the power distribution in the RF-O! transmitter (see Figure 2-10).

The auxiliary circuit breaker switch disconnects or connects all the 110 V duplex outlets, except the service duplex outlets on the back and front of the AC distribution panel. Positioning this switch to OFF powers down the optional RF-Audience! (RF-A!) receivers and any AC powered network modules for the RF-O! Transmitter and RF-A! receiver(s).

The main circuit breaker provides the service outlets with 110-Vac power. This circuit breaker requires resetting only after detecting a high current and popping the button out of the breaker. In case of any tripped circuit breakers, investigate for shorted AC power or power supply failure by stepping through the power down and start-up procedures (see Chapter 5, "Operation").

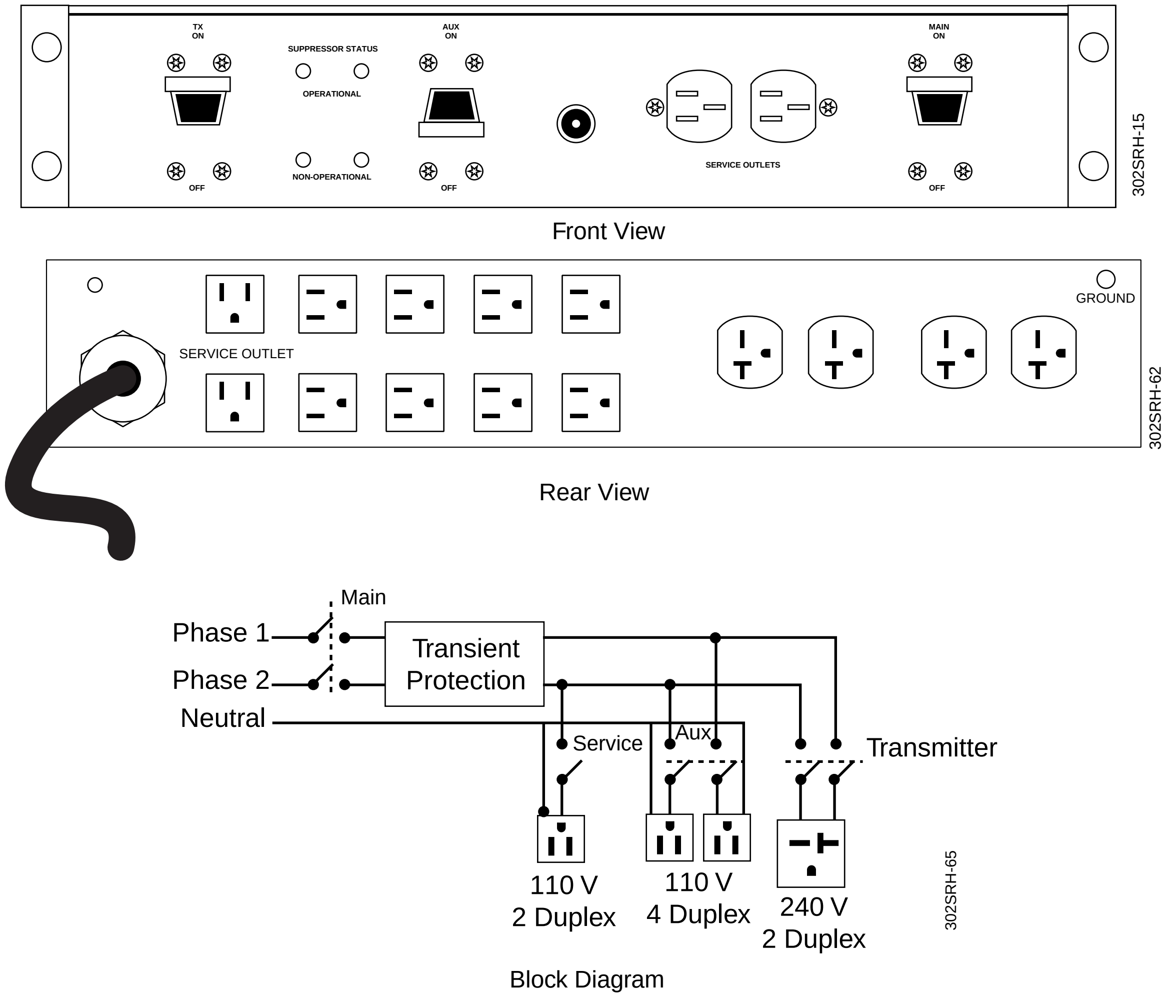



*Figure 2-10: AC Distribution Panel*

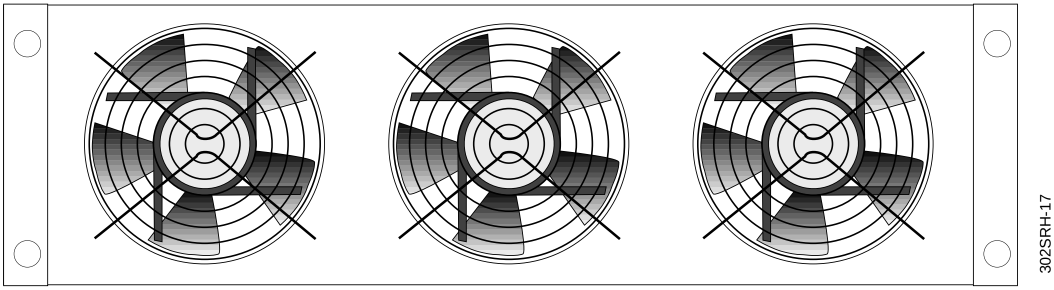
## Power Amplifier

The PA is a linear RF gain module that amplifies the Exciter output to the required amplitude for proper system operation (see Figure 2-11 and Figure 2-12). The PA module accomplishes amplification in three distinct stages. These stages are similar in operation and are connected serially.

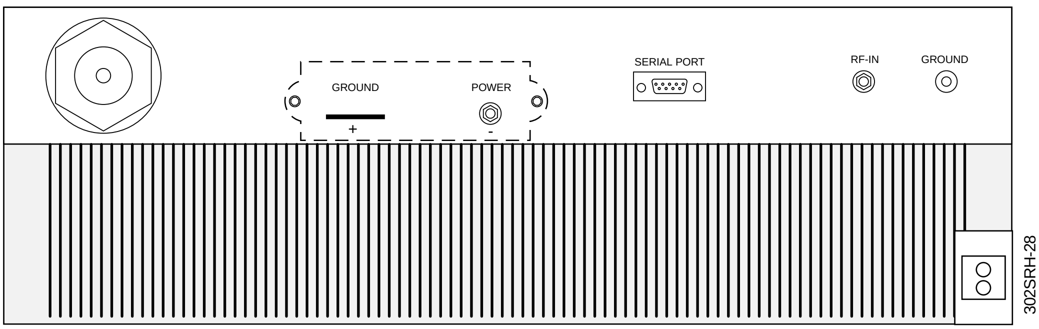
The first stage is the predriver power amplifier (PPA). This stage receives its RF input from the Exciter module located in the OCM and amplifies the RF to a higher level required for the second stage, the driver power amplifier (DPA). The DPA output is split into three equal amplitude signals for the final stage of amplification.

The final amplification step has unique requirements for high power RF generation. The final stage uses three final power amplifier (FPA) modules in parallel. Each FPA amplifies the input signal and outputs the RF signal into a combiner module. The combiner reconstructs a single output and feeds it to the PA module output. The high power output level is then monitored by a forward power detector and isolated from any external RF load variation by a circulator with an internal high power load. The circulator output connector is the 7/16 DIN connector of the PA module.

The power amplifier uses fans to provide front-to-rear airflow. Front-to-rear airflow provides the heat sink with the lowest ambient air temperature available.




Front View




Rear View

*Figure 2-11: Power Amplifier Chassis*

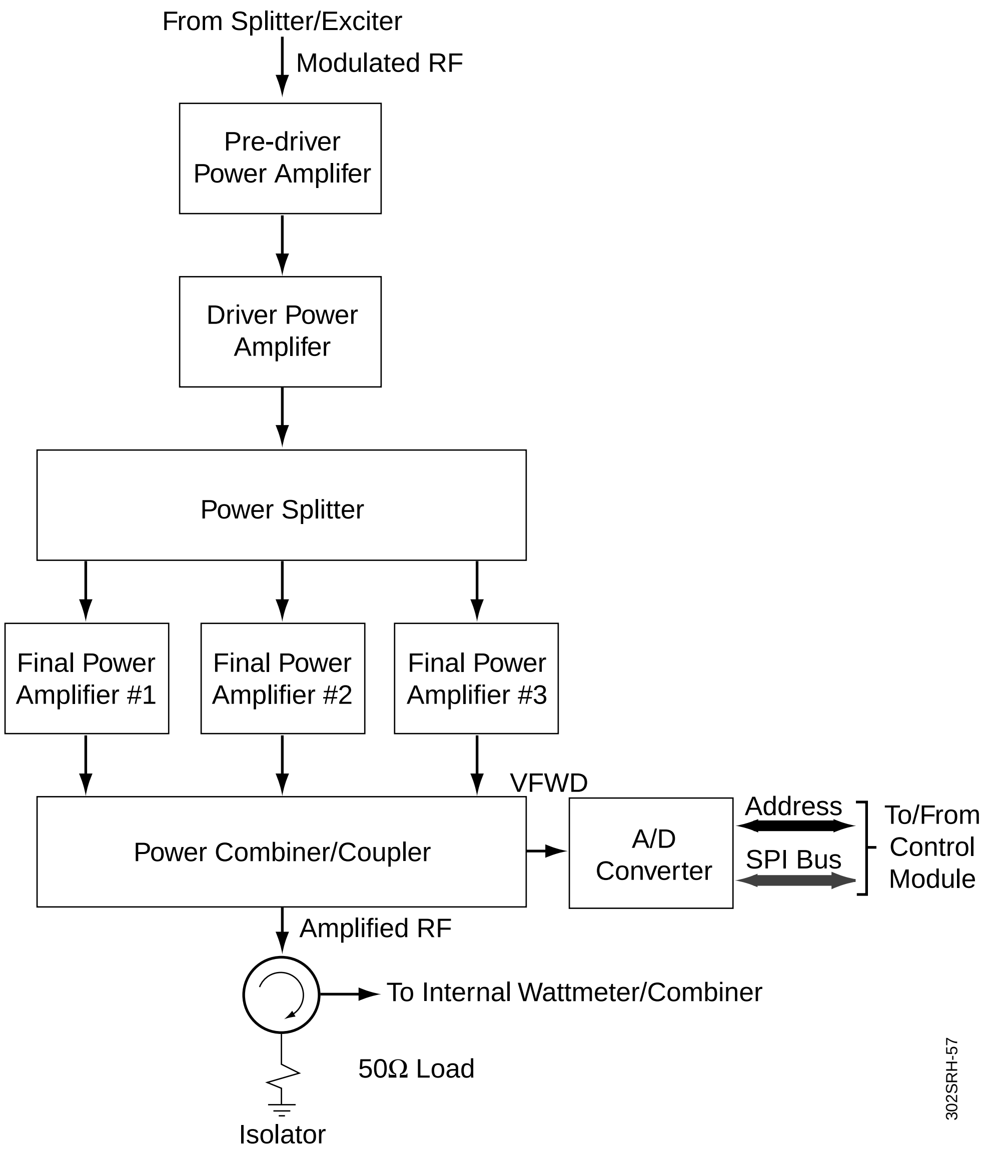



*Figure 2-12: Power Amplifier Block Diagram*

## AC Power Supply

The AC power supply receives a 240-volt input from the AC distribution panel and provides +28 Vdc power required by other modules in the transmitter (see Figure 2-13 and Figure 2-14). Input and outputs are filtered to meet FCC Part 15 Class B operation. Power supply operation meets UL and CSA agency approval.

The power converter starts with power factor correction circuitry that maintains near zero phase shift between input voltage and current. The second power conversion drops the high voltage to +28 volts. The AC power supply reacts quickly to the large power variations that exist in the InFLEXion protocol. Input current rush is limited to less than 120 A in 10 µs.

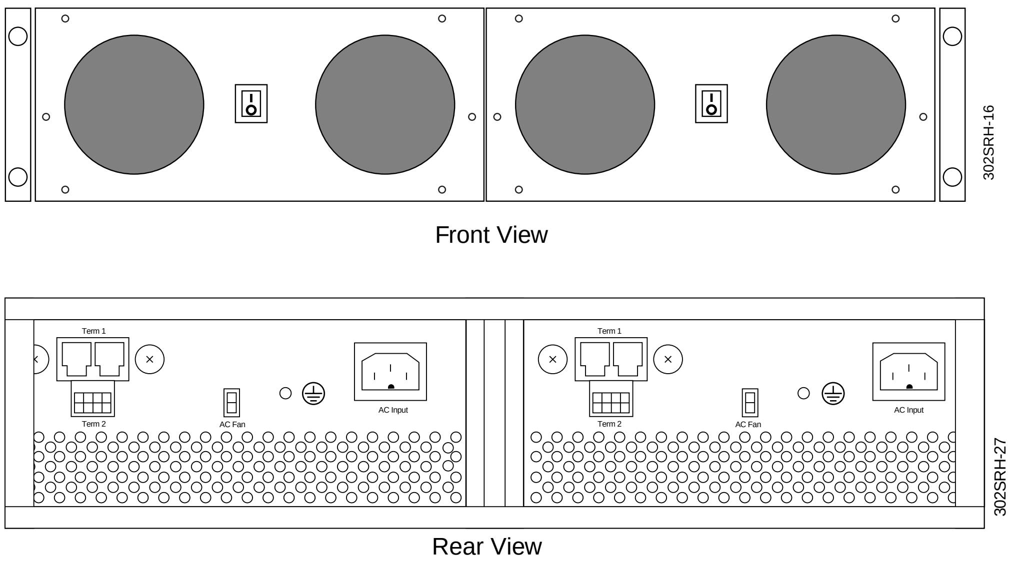



*Figure 2-13:  Power Supply Chassis*

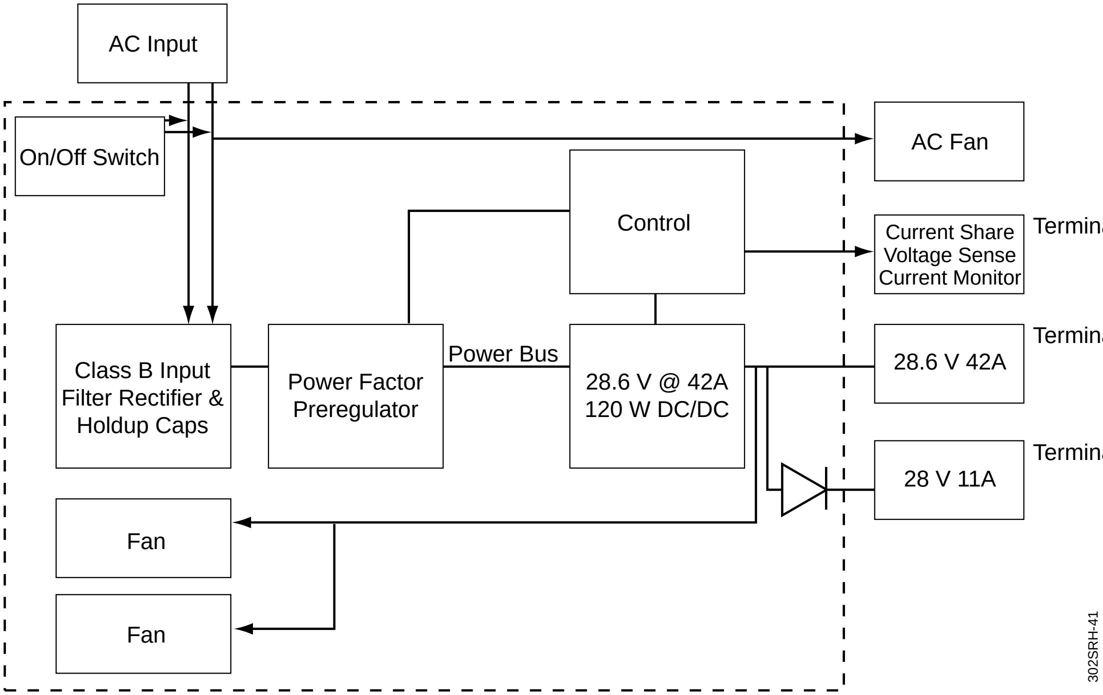



*Figure 2-14: AC Power Supply Block Diagram*

## Antenna Connector

The transmitter RF output connector to the antenna system is a 7/16 DIN RF female connector. The connector must be torqued to 110 in. lb. during installation to operate properly under high RF power requirements.

## Transmitter Peripheral RF Package

Several transmit filtering options are available to minimize interference with other communications equipment. Filtering requirements are determined by site and customer system requirements. Options include a single-stage isolator, a bidirectional coupler with linear detector, and a thermal switch integrated in an isolator load (see Figure 2-15).

This filter / isolator / wattmeter package provides transmitter noise suppression, IM protection, and post-filter forward- and reverse- power metering. This package protects itself from damaging voltage standing wave ratio (VSWR) conditions by automatically shutting down if high reflected power levels are detected.

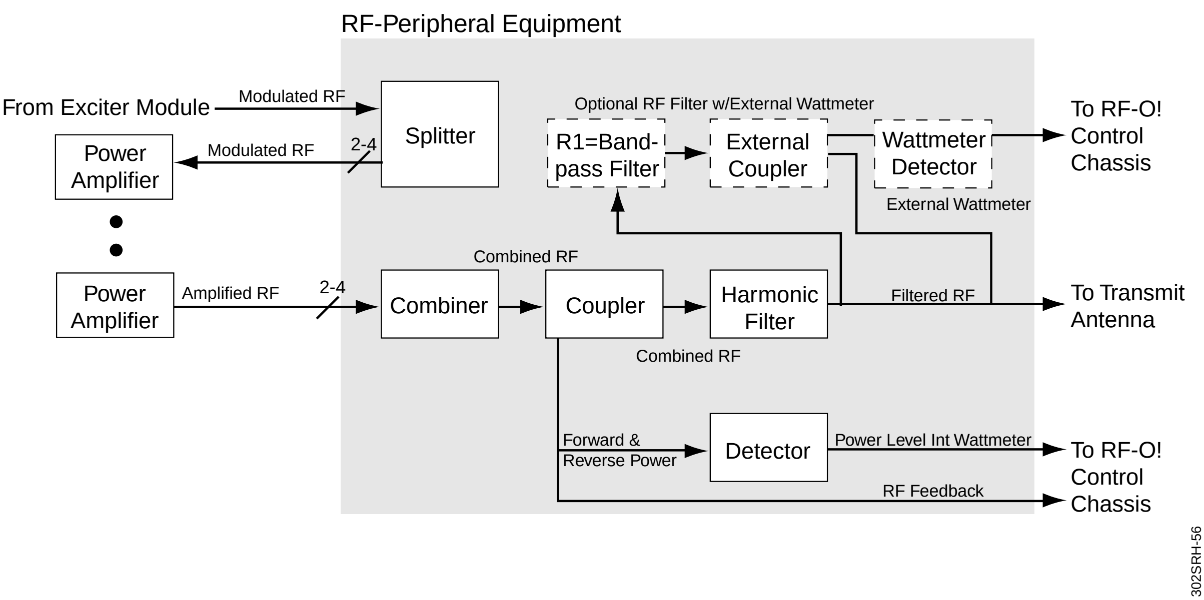



*Figure 2-15: RF Peripheral Equipment Block Diagram*

# RF-O! Paging Station Options

The following paragraphs detail the options available for the RF-O! Paging Station.

## Hardware Options

The following hardware options are available for the RF-O! paging station:

- Network peripheral options (Option X267)
- RF-B! transmitter controller without GPS receiver (Option X594)
- RF-B! transmitter controller with GPS receiver (Option X179)
- Battery revert (Option X649)
- RF-O! Transmitter peripheral options (Option X263)
- RF-A! receiver (Option X349, X351, X352, X353)
- RF-A! receiver peripheral package (Option X88, X89)

Combined FLEX, InFLEXion, and ReFLEX protocol software (Option X496)

## Software Options

The following software options are available for the RF-O! paging station:

Combined FLEX, InFLEXion, and ReFLEX protocol software (Option X496)

– RF-B! transmitter controller (Option Y967AE)

– RF-O! transmitter (Option Y967AA)

– RF-A! receiver (Option Y967AF)

## Network Peripheral Options (Option X267)

An optional network peripheral package connects with the RF-O! transmitter to a network TELCO / DDS service. These options enable communications between the RF-B! transmitter controller site and the RF-C! controller. A typical network configuration of peripheral equipment may consist of a network router, a network CSU / DSU, and a network V.34 modem. At the time of purchase, the paging system provider defines the particular complement of network interface equipment.

## RF-Baton! Transmitter Controller without GPS Receiver (Option X594)

The RF-B! transmitter controller, integrated with the transmitter, decodes the signals sent from the RF-C! controller. The RF-B! transmitter controller is a 19-inch, rack-mounted module that is two EIA rack units high (3.5 in.). Besides decoding the incoming information sent from the RF-C! controller, the RF-B! transmitter controller performs secondary voice processing for InFLEXion protocol, accepts remote software downloads, and transfers software downloads to the OCM.

A laptop computer interfacing with the RS-232 FIPS port on the RF-B! transmitter controller can be used to program transmitter parameters and run diagnostic traces. The RF-B! transmitter controller must be connected to an external GPS receiver for time synchronization. The software is set up to handle the Trimble® Accutime II™ GPS Receiver.

## RF-B! Transmitter Controller with GPS Receiver (Option X179)

This option is the same as Option X594, but includes the Motorola GPS receiver. The GPS receiver detects the signals from the U.S. Department of Defense NAV STAR GPS satellites. The GPS receiver is used for time synchronization and optimal simulcast performance.

## Battery Revert (Option X649)

The battery revert option includes the batteries, cables, and tray. This option provides power to operate the RF-Baton! transmitter controller and network modems in the event of a power failure for up to 6 hours.

## RF-O! Transmitter Peripheral Options (Option X263)

Several transmit filtering options are available to minimize interference with communications equipment located within transmission range. Included in this package is an integrated external wattmeter with a feedback loop to the exciter for additional power control capabilities. Filtering requirements are determined by site and customer system requirements.

## RF-A! Receiver (Option X349, X351, X352, X353)

Transmitter sites can consist of an RF-O! transmitter and a co-located RF-A! receiver. A maximum of four RF-A! receivers can be co-located in the 83-in. RF-O! paging station.

RF-A! receivers are required for receiving inbound messages. These messages include registration, location, and acknowledgments from the pagers. Inbound messages are sent to the RF-C! controller. A receiver site can be co-located with the transmitter sites, although some stand-alone receiver sites may be required.

Each RF-A! receiver is a 19-in. rack-mount chassis that is two EIA rack units (3.5 inches) high. Each RF-A! receiver receives signals on a single 12.5-kHz inbound channel. The receiver uses diversity antennas to maximize signal gain in multipath environments. The RF-A! receiver also uses advanced DSP demodulation techniques for inbound frequency shift keying (FSK) messages at 800 and 1600 bits per second (bps). Whether co-located or stand-alone, all RF-A! receivers support remote software downloads.

## RF-A! Receiver Peripheral Package (Option X88, X89)

Optional receiver filtering is available to minimize interference by RF generating sources in receiver range. An optional multicoupler provides for more than one RF-A! receiver to interconnect to the receiver diversity antenna lines. The receiver multicoupler contains a low noise amplifier and a splitter to distribute the receive signals to each RF-A! receiver. The GPS receiver may be located on the reference module (Option X179) in the RF-B! transmitter controller chassis or may be located external to the RF-B! transmitter controller module. The transmitter network uses the GPS timing for synchronization. For sites with co-located transmitters and receivers, the receivers monitor the GPS time and the 1-PPS timing from the GPS receiver in the RF-B! transmitter controller. For sites with stand-alone RF-A! receivers, a separate GPS receiver and antenna are required.

The RF-C! controller network that employs the GPS synchronization method requires a GPS receiver at each transmitter site, at each stand-alone receiver site, and at the RF-C! controller. Simulcast synchronization is accomplished by comparing the internal clocks of the RF-C! controller and the RF-B! transmitter controller or the RF-A! receiver control module (at the site) to the 1-PPS timing reference signal provided by the GPS receiver. The advantage of this method of synchronization is that the distribution link need not be synchronous to maintain synchronous operations.

# Equipment Specifications

The following information provides the specifications for the RF-O! transmitter. The information provided covers environmental conditions, package size, weight, transmitter frequency, transmitter power output, transmitter modulation, and input power. Specifications are summarized by equipment model number and operating parameters.

## Environmental Requirements

Environmental specifications are shown (see Table 2-4).

*Table 2-4: Environmental Specifications*

| Specification | Value |
|---|---|
| **Operating Temperature** | -30 °C to +60 °C (-22 °F to +140 °F) |
| **Operating Humidity** | 0 to 95% relative @50 °C (122 °F) in accordance with (IAW) TIA-603 |
| **Lightning Protection** | Optionally available |
| **Mechanical Shock** | Motorola shipping specification 12M80973A04 |
| **Dust** | Airborne particles must not exceed 90μg/m$^3$ |
| **Electrostatic Discharge** | IAW ETSI 300.279 |
| **Vibration** | IAW with TIA-603 |
| **AC Line Transients** | IAW IEEEC62.41 location cat. B |

## General Specifications

General specifications such as power, frequency, modulation, and control are in Table 2-5.

*Table 2-5: General Specifications (Sheet 1 of 2)*

| Specification | Value |
|---|---|
| **Input Power** | |
| Power Supply Type | Switching |
| AC Power | 196–254 Vac @ 47–63 Hz nominal; 30 A; load sharing sized IAW PA |
| Battery Revert | Control Only |
| **TX Frequency** | |
| Carrier Frequency Range | 929-941 MHz |
| Channel Switch Time | Exceeds InFLEXion Protocol specifications |
| Frequency Generation | Synthesized—5 and 6.25 kHz steps |
| Channel Spacing | 50 kHz NPCS Channels |
| Conducted Spurious | less than –80 dBc |
| Harmonic Emissions | less than –100 dBc |
| Adjacent Channel Noise | Exceeds FCC Mask; part 24 |
| Frequency Deviation (2/4-level) | IAW ReFLEX and InFLEXion specifications |
| Frequency Offsets and Deviation Adjust | +5000 Hz, programmable in 1 Hz steps |
| Frequency Stability (UHSO) | ±005 ppm –30 °C to +60 °C (-22 °F to +140 °F) |
| Isolation (built-in circulator) | 20 dB standard, 3 choices of Tx peripherals to meet site needs |
| FM Hum and Noise | –40 dB; 300 to 3000 Hz |
| Emissions Designators | 6K25B8E, 600F1D |
| Deviation Accuracy | ±1 Hz |
| **TX Modulation** | |
| Pager Signaling | 2-level and/or 4-level binary FSK-NRZ FLEX, ReFLEX, and InFLEXion codes |

*Table 2-5: General Specifications (Sheet 2 of 2)*

| Specification | Value |
|---|---|
| Modulator | Advanced DSP Technology |
| Maximum Paging Data Rates | 2-level; 2400 or 3200 bps<br>4-level; 6400 bps |
| **TX Output Power** | |
| Power Output | Continuous duty and selectable by channel |
| Antenna Connector | 7/16 DIN |
| **Control** | |
| Remote System Control | Plug-and-play transmitter controller (RF-B! or GL3000) |
| Station Programming | Remote through Choreographer! network manager or local through front panel RS-232 interface |

# Electrical Requirements

All electrical wiring for the site must meet the requirements of the National Electrical Code (NEC) and all applicable local codes. All conductors must be made of copper (designated Cu). Electrical requirements for the InFLEXion, FLEX, and ReFLEX protocols are provided.

## AC Service

The RF-O! transmitter receives AC service from the AC distribution panel equipped with a NEMA L14-30P plug. The NEMA L14-30P plug is distinguished by an inward bend on the GND plug.

The 240 V / 120 V is supplied from a center tapped transformer. The two 120 V are 180 degrees out-of-phase, therefore, 240 V is available between phase-and-phase. This type of connection is the only Motorola approved method (see Figure 2-16).

*Note:* *Equipment rooms constructed inside existing buildings that use higher voltage systems require a step-down transformer.*

*AC start-up power is 120 A. Each RF-O! transmitter configuration, by default, is at 75 Watts average RF output for each subchannel operation.*

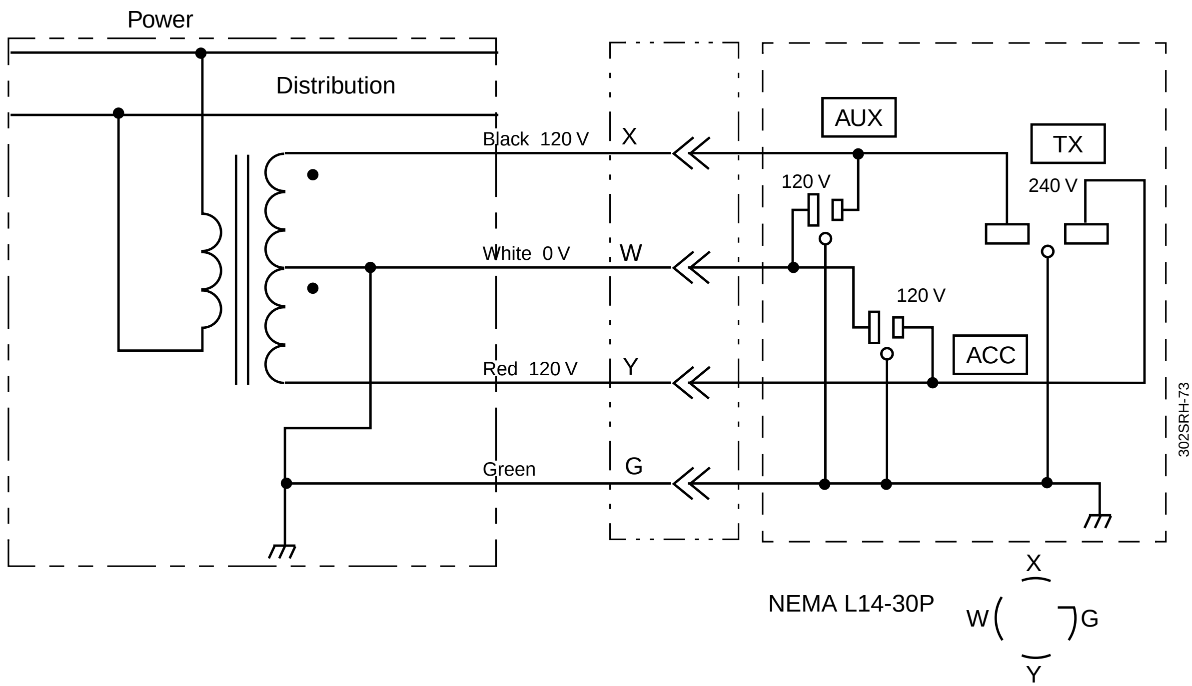



*Figure 2-16: AC Service Connection Using NEMA L14-30P Preferred Standard Plug (Supplied)*

If the preferred service is not available, a three-phase system 120 V (phase-to-neutral) may be substituted. A NEMA L15-20P plug is required for this three-phase system. The NEMA L15-20P is distinguished by the outward bend on the GND prong. This service is limited to 20 A (see Figure 2-17).

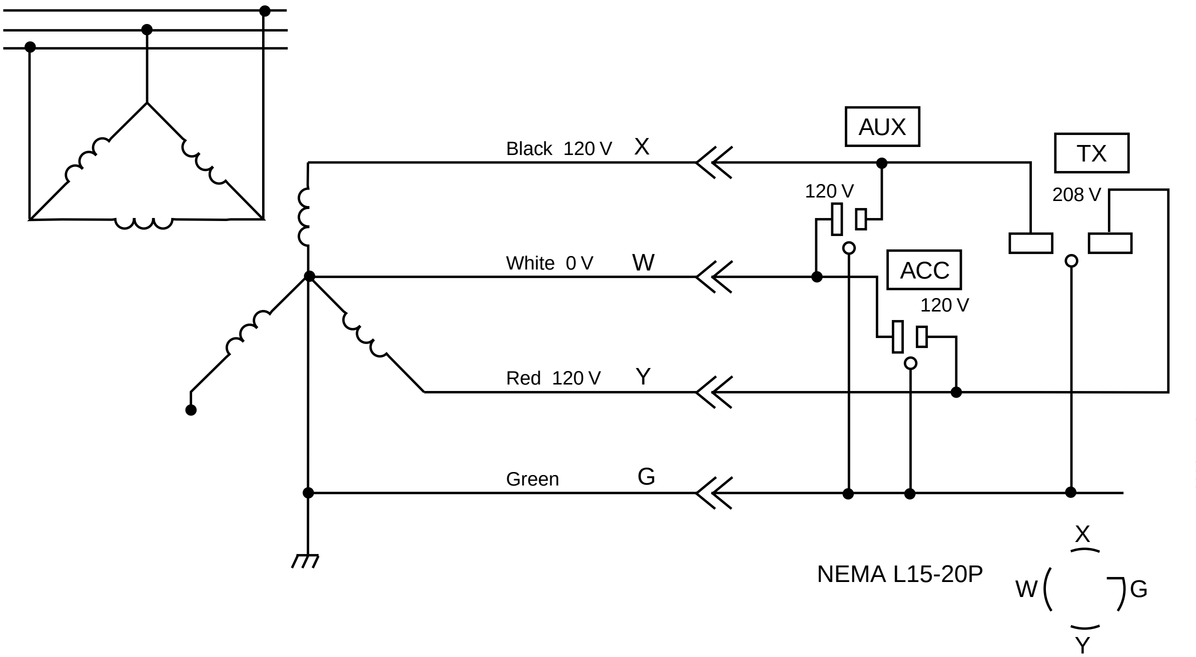



*Figure 2-17: AC Service Connection Using NEMA L15-20P (Nonpreferred Method)*

Electrical requirements (InFLEXion and ReFLEX) are in Table 2-8 and Table 2-9 respectively.

*Table 2-6: InFLEXion Electrical Requirements*

| Configuration | AC Amps[1] | BTU/Hour Heat Load (Maximum) |
|---|---|---|
| Model PT1052 Single-channel transmitter | 6.4 | 5,400 |
| Model PT1054 Two-channel RF-O! transmitter | 11.2 | 6,860 |
| Model PT1052 Single-channel RF-O! transmitter with Option X349 (Single co-located RF-A! receiver) | 6.7 | 5,611 |
| Model PT1054 Two-channel RF-O! transmitter with Option X351 (Two Co-located RF-A! receivers) | 11.8 | 7,230 |

1. AC amps maximum steady-state operation is current at 195 Vac input. Each RF-O! transmitter configuration is at 75-W average RF output for each subchannel operation. AC amps start-up is 120 A.

*Table 2-7: InFLEXion Electrical Requirements*

| Configuration | AC Amps[1] | BTU/Hour Heat Load (Maximum) |
|---|---|---|
| Model PT1052 Single-channel transmitter | 6.4 | 5,400 |
| Model PT1054 Two-channel RF-O! transmitter | 11.2 | 6,860 |
| Model PT1052 Single-channel RF-O! transmitter with Option X349 (Single co-located RF-A! receiver) | 6.7 | 5,611 |
| Model PT1054 Two-channel RF-O! transmitter with Option X351 (Two Co-located RF-A! receivers) | 11.8 | 7,230 |

1. AC amps maximum steady-state operation is current at 195 Vac input. Each RF-O! transmitter configuration is at 75-W average RF output for each subchannel operation.AC amps start-up is 120 A.

*Table 2-8: ReFLEX and FLEX Electrical Requirements*

| Configuration | AC Amps[1] | BTU/Hour Heat Load (Maximum) |
|---|---|---|
| Model PT1052 Single-channel RF-O! transmitter | 9. | 6,000 |
| Model PT1054 Two-channel RF-O! transmitter | 14.1 | 8,640 |
| Model PT1052 One-channel RF-O! transmitter with Option X349 (Single Co-located RF-A! receiver) | 10.1 | 6,190 |
| Model PT1054 Two-channel RF-O! transmitter with Option X351 (Two Co-located RF-A! receivers) | 14.7 | 9,005 |

1. AC amps maximum steady-state operation is current at 195 Vac input.

# Preinstallation

## Site Planning

Proper licensing and space availability aid in determining a site selection. On a Motorola-owned or -controlled site, field engineering and program management plan the system and site layouts. Proper planning helps prevent potential on-site and off-site interference from other radio frequency (RF) systems. Site layouts should always be planned to minimize interference between equipment in the Wireless Messaging System.

To verify proper site considerations and recommendations are being followed, refer to the *Motorola Quality Standards - Fixed Network Equipment (FNE) Installation Manual R56* Motorola part number 6881089E50.

### Site Considerations

The site must be able to resist extreme weather conditions and must not have windows. The site should meet the requirements of the American National Standards Building Code Requirements for *Minimum Design Loads in Buildings and Other Structures*.

Motorola recommends the following considerations for site selection:

- A minimum floor space of 20 square feet is recommended to allow enough space for front and rear access to the equipment. The extra space eases the installation, air flow, and maintenance of the equipment.
- The site floor should be level to within 0.125 in. (0.3175 cm) across the foot print of the cabinet and able to support the weight of the site equipment. Refer to the floor loading information provided in this chapter.
- The minimum ceiling height, above a finished floor, is 102 in. (259.08 cm). This height allows enough space between the top of the RF-O! paging station equipment cabinet(s) for cabling access across the top of the cabinets.
- The ceiling structure should be able to support a cable tray assembly for routing the intercabinet cabling and other site cabling. The cable tray assembly is mounted to the site ceiling and walls for each site plan. The cable tray should be at least 90 in. from the site floor to allow for the height of the equipment cabinets.

- The minimum door dimensions should be 36 in. (91.44 cm) wide by 84 in. (213.36 cm) high.
- All exterior doors should have tamper-proof locks installed for security.
- The interior site environment must be maintained between -30 ˚C and +60 ˚C (-22 ˚F and +140 ˚F).
- Proper surge protection is required for all antennas, data circuits, and power inputs to prevent potential damage to the site equipment.

CAUTION

*This equipment is not approved or recommended for outdoor use.*

## Equipment Cabinets

One cabinet is offered for the RF-O! paging station. The dimensions and racking information follow (see Table 3-1).

*Table 3-1: Cabinet and Rack Dimensions*

| Cabinet | Width | Depth | Height | Configuration (rack units) |
|---|---|---|---|---|
| **X128** | 23.31 in.<br>59.21 cm | 27.68 in.<br>70.31 cm | 83.50 in.<br>212.09 cm | 43 |

### Cabinet Spacing

During installation, allow at least two feet of space in front of and behind each cabinet to allow access to the cabinet for servicing and adequate air flow into and out of the equipment (see Figure 3-2).

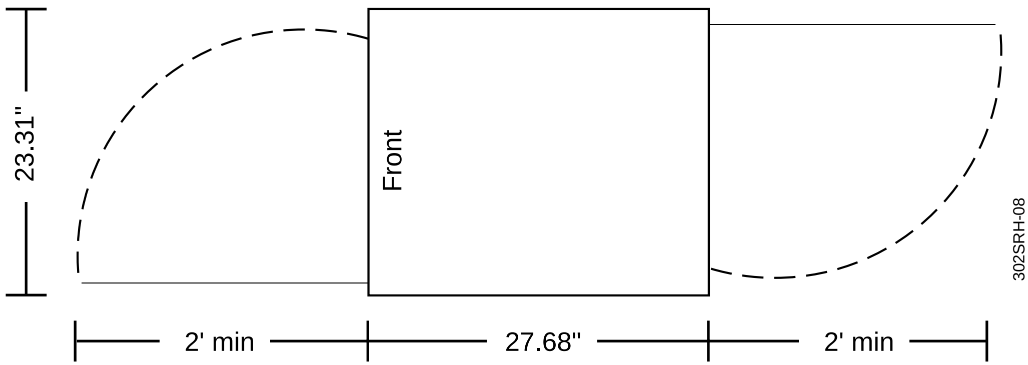



*Figure 3-1: Equipment Cabinet Footprint*

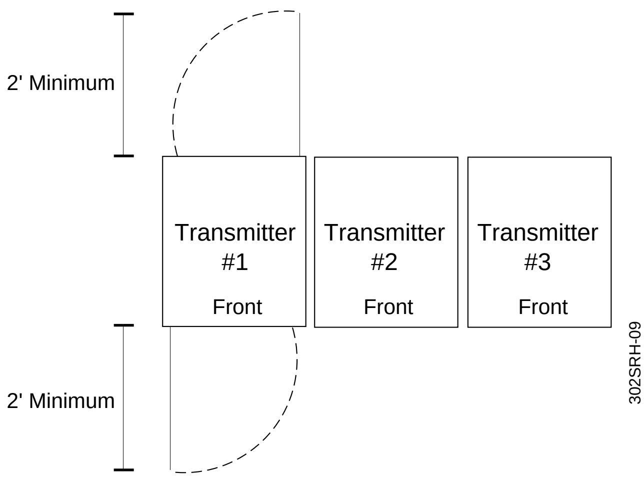



*Figure 3-2: Typical Cabinet Layout*

## Equipment Cabinet Floor Loading

Table 3-2 shows the typical weight and floor loading information for the X128 cabinet.

*Table 3-2: Equipment Cabinet Weight and Floor Loading - Cabinet X128*

| Configuration | Weight[1] | Floor Loading |
|---|---|---|
| Model PT1052 Single-channel RF-O! Transmitter | 520 lb<br>236.36 kg | 116 lb/ft$^2$<br>5.8 kg/m$^2$ |
| Model PT1054 Two-channel RF-O! transmitter | 590 lb<br>268.18 kg | 132 lb/ft$^2$<br>6.6 kg/m$^2$ |
| Model PT1052 One-channel RF-O! transmitter with Option X349 (Single Co-located RF-A! Receiver) | 605 lb<br>275 kg | 135 lb/ft$^2$<br>6.75kg/m$^2$ |
| Model PT1054 Two-channel RF-O! transmitter with Option X351 (Two Co-located RF-A! receivers) | 715 lb<br>325 kg | 160 lb/ft$^2$<br>8 kg/m$^2$ |

1. Weights include optional transmitter and network peripherals. If a co-located RF-A! receiver is supplied, weights include receiver peripherals

## Transmitter Breaker Panel Access

Follow all codes required by the National Electrical Code (NEC). The NEC requires a 36-in. clearance for electrical service access, and requires that all doors to this equipment open to a minimum of 90 degrees.

## Disabled Personnel

The customer is responsible for determining the applicable Americans with Disabilities Act (ADA) requirements that apply to the site. The ADA requires certain clearances for handicapped personnel.

## Hazardous Materials and Equipment

*Note: The following information is provided as an aid for site planning. Compliance with all local, state, and federal regulations concerning the handling and use of hazardous materials and equipment is the sole responsibility of the customer and associated agents.*

The proposed site must not have imminent hazards present in the form of hazardous materials (stored or spilled), harmful or dangerous conditions, or exposure to RF energy levels in excess of American National Standards Institute (ANSI) Occupational Guidelines.

If asbestos removal is required, use certified asbestos handling personnel.

Floors containing asbestos may be left intact. However, drilling or penetration of the floor must be done in accordance with federal and state clean air guidelines. Motorola recommends drilling be performed by certified asbestos handling personnel.

After any removal of asbestos, a certificate of air cleanliness for the site must be obtained from the contractor.

## Seismic Active Areas

Sites that are in seismic active areas may require additional bracing of the equipment cabinets. Refer to the guidelines listed in your area related to seismic bracing. Each cabinet is equipped with locking casters as a standard feature.

## Telephone Company (TELCO) Line Interface

A surge arrestor must be installed at the data link service entrance. The arrestor must be designed for operation with the appropriate data link service. The surge arrestor must be wired according to manufacturer instructions.

## Environmental Considerations

The environmental considerations include the temperature control, humidity control, and air cleanliness conditions described in this section.

### Temperature Control

Excessive and extreme temperatures can reduce the life span of the RF-O! paging station and cause permanent damage.

To combat temperature problems, a Heating, Ventilation, Air-Conditioning (HVAC) system is recommended. All HVAC systems must be thermostatically controlled and capable of automatically switching between heating and cooling modes in response to the thermostat. The environmental equipment must maintain the desired environment to meet the equipment heat dissipation requirements.

*Note: The heat dissipation requirements in British Thermal Units (BTUs) can be calculated by multiplying the power rating of the equipment by a factor of 3.414 for each hour. For example, if a piece of equipment has a power rating of 300 watts, the heat dissipation is equivalent to 1024.2 BTUs (300 x 3.414 = 1024.2) for each hour. A redundant HVAC system may also be installed. The system must be wired on a delayed circuit to prevent both HVAC systems from starting up simultaneously.*

Existing building HVAC systems may be programmed to turn off during unoccupied hours. This type of HVAC system must be evaluated to ensure that the site temperature will be maintained continuously.

### Humidity Control and Air Cleanliness

Take proper measures to ensure that the site meets the required conditions. The relative humidity within the site should be less than 95% at +50 ˚C (+122 ˚F) non-condensing.

CAUTION

*If the station is to be installed in an environment that is unusually dusty or dirty, (thus not meeting air quality requirements), the air used to cool the station modules must be treated using appropriate filtering devices. Dust or dirt accumulating on the internal circuit boards and modules is not easily removed and can cause such malfunctions as overheating and intermittent electrical connections.*

# Grounding Requirements

The RF-O! paging station site must meet certain specifications for adequate protection from lightning induced transients.

CAUTION

*Proper site grounding and lightning protection are vitally important considerations. Failure to provide proper protection for either causes may result in catastrophic damage to the station.*

Proper ground installation methods are outlined in the Motorola *Quality Standards-Fixed Network Equipment (FNE) Installation Manual (R56)* - Motorola part number 6881089E50.

## Ground Rings

Separate ground rings should surround the site building and antenna tower. Eight-foot long ground rods should be driven into the ground at 10-foot intervals for average soil. The two ground rings should be bonded together with one wire and buried at least 18 inches underground, or below frost level.

These ground rings are referred to as the exterior primary ground and must be at least #2 AWG tinned copper wire, solid or stranded. All connections to the rings should be made by exothermic welding. All exothermic welded connections should be treated with cold galvanizing spray.

Inspection wells should be provided for access to the buried ground system to allow verification of ground resistance. The ground resistance should be less than 5 ohms.

## Tower Grounding

Ground each leg of the antenna tower with an eight-foot ground rod driven near each leg. All ground connections to the antenna must be exothermically welded. Do not weld directly on tower structural members, only on provided tower grounding tabs or on the tower feet.

*Note: Ensure that welding ground connections to the antenna tower does not void the warranty of the tower.*

Metal monopole towers require a minimum of three eight-foot long ground rods to be driven into the ground, spaced approximately 10 feet apart. These ground rods may be exothermically welded to the bottom portion of the mast itself, to the monopole footing, or to the provided grounding connection tabs.

## Site Building and Equipment Grounding

On stand-alone site buildings, a polyvinyl chloride (PVC) conduit (typically 3/4 in.) must be provided for the interior ground wire to exit the building. For site buildings with floors at ground level, the conduit must exit a side wall at a 45° angle or less. For buildings with space below the floors, the conduit may exit through the floor. In both cases, the location of the opening should be close to the master ground bar inside the site.

Use of metal conduit is discouraged as the conduit provides inductance to a surge, raising the impedance of the ground. If metal conduit is required by local building codes, both ends of the conduit must be bonded to the ground wire through the use of grounding clips or other suitable means to eliminate the inductance of the conduit.

## Cabinet Grounding

Within the site, ground each cabinet with a single dedicated connection between each cabinet and the master ground bar. The connecting wire must be a #2 AWG green-insulated solid copper wire.

Use two-hole mounting lugs (and split ring washers when possible) with an antioxidant grease applied for interior grounding connections and exterior secondary grounding connections. If lock washers are used, they should be placed next to the nut to ensure the mechanical integrity of the connection. The washer must not be secured between the lug and the surface to which it is connected. Painted connections must be scraped clean before applying the antioxidant grease and lug.

DANGER

*To prevent damage to equipment and potential injury to personnel, never use a bare or damaged wire for the connection of chassis ground or other electrical wiring.*

*Note: The cabinet must be connected to the site ground using a single dedicated ground wire. Cabinet ground location is at the top rear of the cabinet (see Figure 3-3).*

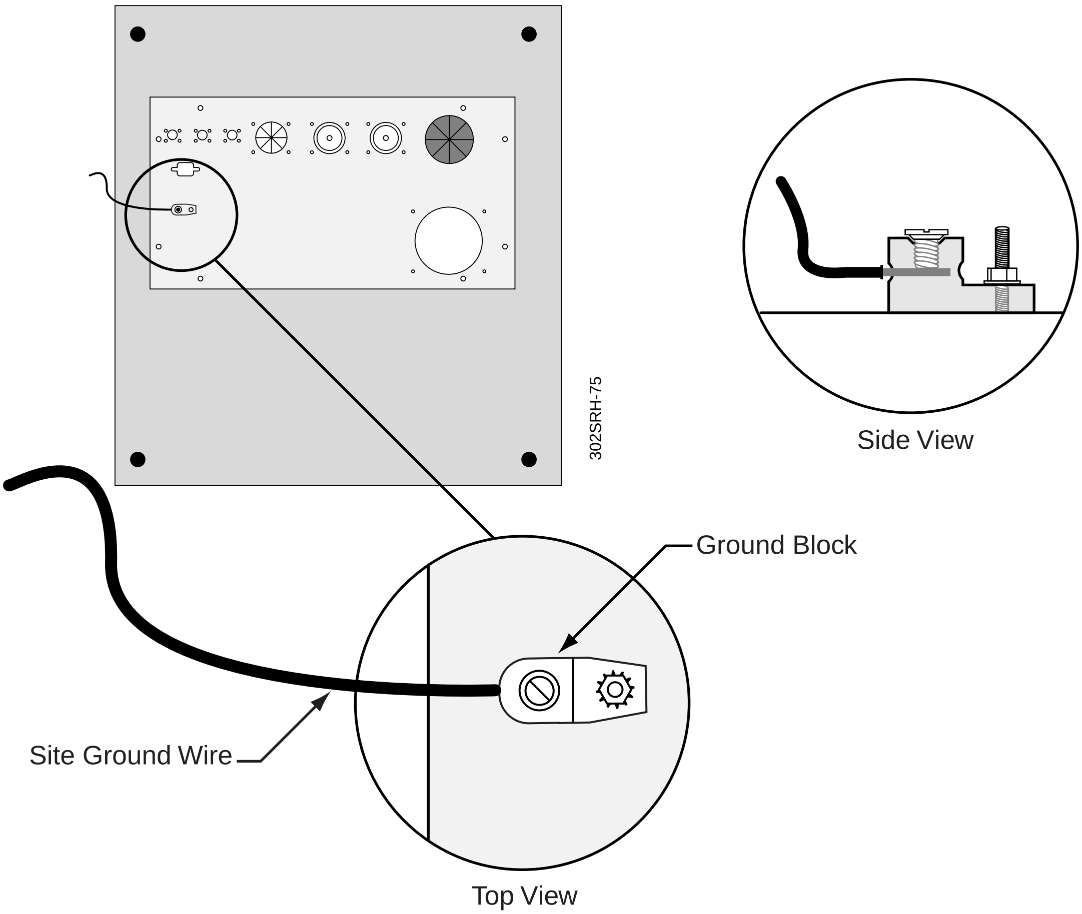



*Figure 3-3: Top View of RF-O! Paging Station*

The ground wire should drop into the Ground location at the top of the cabinet and be connected to a single dedicated grounding stud. Single hole lugs (0.5 in.(1.27 cm) diameter) are used for these grounding connections (see Figure 3-3).

CAUTION

*Do not daisy chain multiple cabinet grounds using a single ground wire. Doing so increases the overall inductance of the ground wire, which can distribute surge energy among the cabinets instead of to the master ground bus.*

The paging station is classified as a surge producer because of external coaxial cable connections. Surges from outside the site can enter the site grounding system through the coaxial cables. To prevent damage to the equipment, each cabinet must be connected to chassis ground through a minimum wire size of at least #2 AWG. Green insulated wire must be used to identify ground wiring.

### Cable Tray Grounding

The cable tray assembly must not come into contact with metal conduits, pipes, or other metal objects. The cable tray assembly must also be connected to the master ground bar through a single dedicated wire. The connecting wire shall be a minimum size of #6 AWG green insulated copper wire.

Any metal-to-metal joints on the cable tray assembly must be bonded together with a wire jumper to prevent electrical discontinuity, unless the tray connectors are specifically designed to ensure continuity. Painted surfaces on the cable tray assembly must be scraped clean at the point where the jumper wire is attached to ensure a good electrical connection. Repaint cable tray assembly surfaces, if necessary.

# Antenna Installation

This section covers antenna installation considerations and methods. For further information on antenna installation requirements and methods, refer to the *Motorola Quality Standards-Fixed Network Equipment (FNE) Installations* manual, Motorola part number 6881089E50.

## Antenna Feed Line Requirements

The transmission line entry for all antennas should be installed with a metal antenna entry plate external to the site building. All entry ports must be covered to prevent small animals or objects from entering. Transmission lines must be grounded to the exterior ground bar below the waveguide entry port using manufacturer-approved grounding kits.

To reduce interference (intermodulation) problems, connectors on the transmit antenna lines should be silver-plated. The plating on the male-female connector combination must match on both connectors. For example, a male connector containing a silver-plated center pin and silver- plated outer conductor should mate with a female connector containing a silver-plated center pin and silver-plated outer conductor.

## Antenna Feed Line Identification

All antenna feed lines should be marked appropriately to simplify proper connections. Colored vinyl tape is recommended for identifying the antenna feed lines. Use 3M™ colored outdoor marking tape or a permanent, color-fast equivalent.

*Note: The color coding scheme identified within this manual is a recommendation only. The purpose for identifying specific colors is an attempt to obtain uniformity between sites. Other color schemes may be used.*

Table 3-3 provides a color coding scheme for identifying the antenna feed lines for a typical cabinet.

*Table 3-3: Example of Antenna Identification Tape Marking*

| Color | Description |
|---|---|
| **Red** | RF-O! transmitter transmit antenna |
| **Blue** | RF-A! receiver receive antenna 1 |
| **Green** | RF-A! receiver receive antenna 2 |
| **Yellow** | Global Positioning System (GPS) antenna |

### Antenna Surge Arrestors

All antenna feed lines should terminate with a suitable surge arrestor within 12 in. inside of the entry window. Each arrestor must connect to the master ground bar located below the entry plate.

## GPS Antenna Planning

The GPS receiver permits all sites in the system to synchronize to a common timing reference. Because this timing is critical for maintaining system synchronization, the site planner must carefully evaluate proposed antenna locations before installation to ensure that an adequate lock can be obtained from the proposed site.

### GPS Antenna Evaluation

The RF-B! transmitter controller, mounted within the cabinet, must locate and track at least four satellites during initial power-up. The internal GPS receiver, or the interface with a remote GPS receiver within the RF-B! transmitter controller, is responsible for locating and tracking the satellites. These four satellites establish a three-dimensional fix (latitude, longitude, and altitude) for the site. This process can take up to 25 minutes to complete after power up of the RF-B! transmitter controller.

Once the position requirements from the GPS receiver and system engineering of the site are established, the corresponding data (almanac) is stored in memory, and normal operation resumes. Although four satellites must be tracked initially, only one satellite is necessary to maintain the timing signal.

### GPS Evaluation Kit

The Motorola GPS evaluation kits (model numbers VPEVAL0002, GTEVAL0001, and UTEVAL0001) provide a means of evaluating potential site and antenna mounting locations before site acceptance and construction begins.

The evaluation kits include the hardware, software programs, and instructions necessary for collecting site evaluation data. Use the kit to collect the following necessary data:

- Number of visible satellites
- Signal strength of tracked satellites
- Number of satellites being tracked
- Dilution of Precision (DOP) type (position or horizontal)

### GPS Tracking Criteria

The GPS receiver must have a Position Dilution of Precision (PDOP) of less than 10 to successfully initialize. A PDOP greater than 10 can delay start-up. To minimize delay, a PDOP of greater than 10 for more than 30 minutes is not recommended.

Large PDOP values typically occur when tracking less than four satellites. However, when the system is operating, a PDOP of greater than 10 does not affect the site performance as long as at least one satellite is being tracked for the timing signal.

The GPS receiver providing synchronization signals to the RF-O! transmitter must perform the following:

- Track a minimum of four satellites during initial start-up
- Have no period greater than 96 minutes without tracking any satellite

### GPS Antenna Requirements

The GPS antenna must be mounted with an unrestricted aerial down view to within 10° of the horizon in all directions and high enough to clear the peak of any site roof.

For systems in the northern hemisphere, GPS antennas must be mounted to provide a clear view of the southern sky. For systems in the southern hemisphere, GPS antennas must be mounted to provide a clear view of the northern sky.

Adjacent structures, such as trees or buildings, could obstruct signals. The GPS antenna must be mounted clear of all obstructions to provide a clear path. Other adjacent antenna towers at the RF site that protrude into the required view have a minimal effect on GPS satellite reception and are not considered obstructions.

The GPS receiver can be jammed by high power carriers in the communications bands. This symptom is the failure of the GPS receiver to track satellites. The minimum recommended separation distance from any paging station antenna should provide at least 38 dB of path loss from a 1-watt isotropic radiator. If in doubt, use at least 12 feet of horizontal separation distance. Long runs of single-braid, shielded cable along with other radio cables can be subject to jamming interference pickup. Motorola recommends solid copper outer conductor, coaxial cable between the GPS antenna and receiver.

CAUTION

*The Motorola internal GPS receiver sources +5 Vdc power to the antenna using the coax center pin.*

The RF connection of the Motorola internal GPS receiver provides +5 Vdc power to the GPS antenna. The output is not reverse polarity protected. To run multiple receivers off one antenna, choose one receiver to supply the +5 Vdc to the antenna. Place DC blocks in all other branches to the GPS receivers.

The coaxial cable used to connect the GPS antenna to the GPS input on the Motorola internal GPS receiver must be designed to satisfy the system gain requirements for the GPS receiver at a frequency of 1575.42 MHz. The standard maximum cable loss allowed between the GPS antenna and the RF-O! paging station is 6 dB. The standard maximum cable loss is included in a system gain budget with additional items, such as line-of-sight loss and minimum satellite power during satellite acquisition. The total line-of-sight loss (7 dB) includes foliage loss (for example; low density tree tops, 6 dB) and ice loss (1 dB). The foliage loss could be reduced for two other design considerations where foliage is not an issue (such as the top of a building). The cable loss in the clear view case could be increased from the standard loss to 13 dB (standard max cable loss plus line-of-site losses). Any additional trade-off is not recommended because of the reduced signal margin during satellite acquisition. Alternatively, the 6 dB for foliage loss could be used to account for an increase of the RF noise floor level from nearby (in frequency) paging station noise floor additions. The cable system between the GPS antenna and the Motorola internal GPS receiver should have a noise figure of less than 15 dB. The total system noise figure is not to exceed 4 dB.

# Inspection of Equipment

The RF-O! paging station is shipped from the factory with all modules intact in the cabinet. Inspection of the equipment must be performed while it is on the delivery truck.

*Note: If obvious damage has occurred to the shipping containers, before unpacking reject any damaged materials and equipment. Report damaged or short equipment issues to the shipping company and your Motorola sales representative.*

Inspect the RF-O! transmitter and other equipment, if applicable, for the following conditions upon delivery:

- Loose or damaged equipment
- Dents, scratches, or other damage to the side of any chassis
- Cabinet wiring to ensure that connections are in place
- Physical damage to external controls or external connectors to modules and boards
- Acknowledgment of all equipment listed on the packing list

If any equipment is damaged, immediately contact the shipping company, then your Motorola sales representative.

# Installation

The following installation procedures must be performed by certified technicians. If this is your first time installing this equipment, read both Chapter 3, "Preinstallation" and this chapter, before beginning the procedure. If you are not familiar with site preparation, grounding techniques, and lightning protection, Motorola recommends the *Quality Standards Fixed Network Equipment(FNE) Installation Manual (R56)* - (Motorola part number 6881089E50).

Before performing the installation procedures, ensure the site is equipped with all associated antennas, phone lines, and other related site equipment (see paragraph, "Antenna Connections" and paragraph, "Network Connection").

The RF-Orchestra! paging station has a single basic cabinet configuration:

1–2 channel capable cabinet, 43 RU high (84 in. — 213 cm)

Installation procedures for both cabinets are the same. Typically the RF-B! transmitter controller and RF-A! receivers are installed by the factory in the same cabinet as the RF-O! paging station. The RF-O! paging station can be used with different transmitter controllers that can change the cabling layout. For these specific cabling variations, refer to your local site documentation.

The following illustrations show the different sales model configurations (see Figure 4-1 and Figure 4-2).

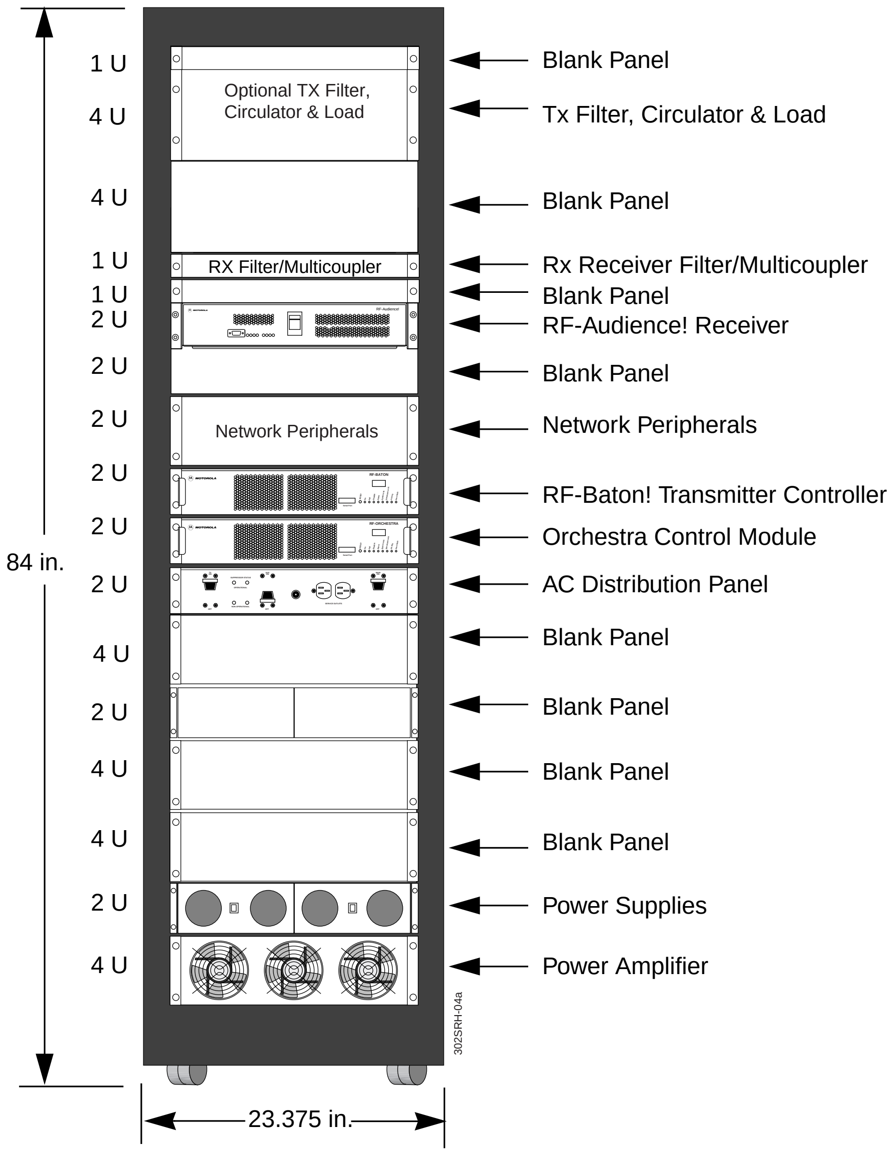



*Figure 4-1: Model PT1052 RF-Orchestra! Paging Station Single-Channel (43 RU) Cabinet Layout*

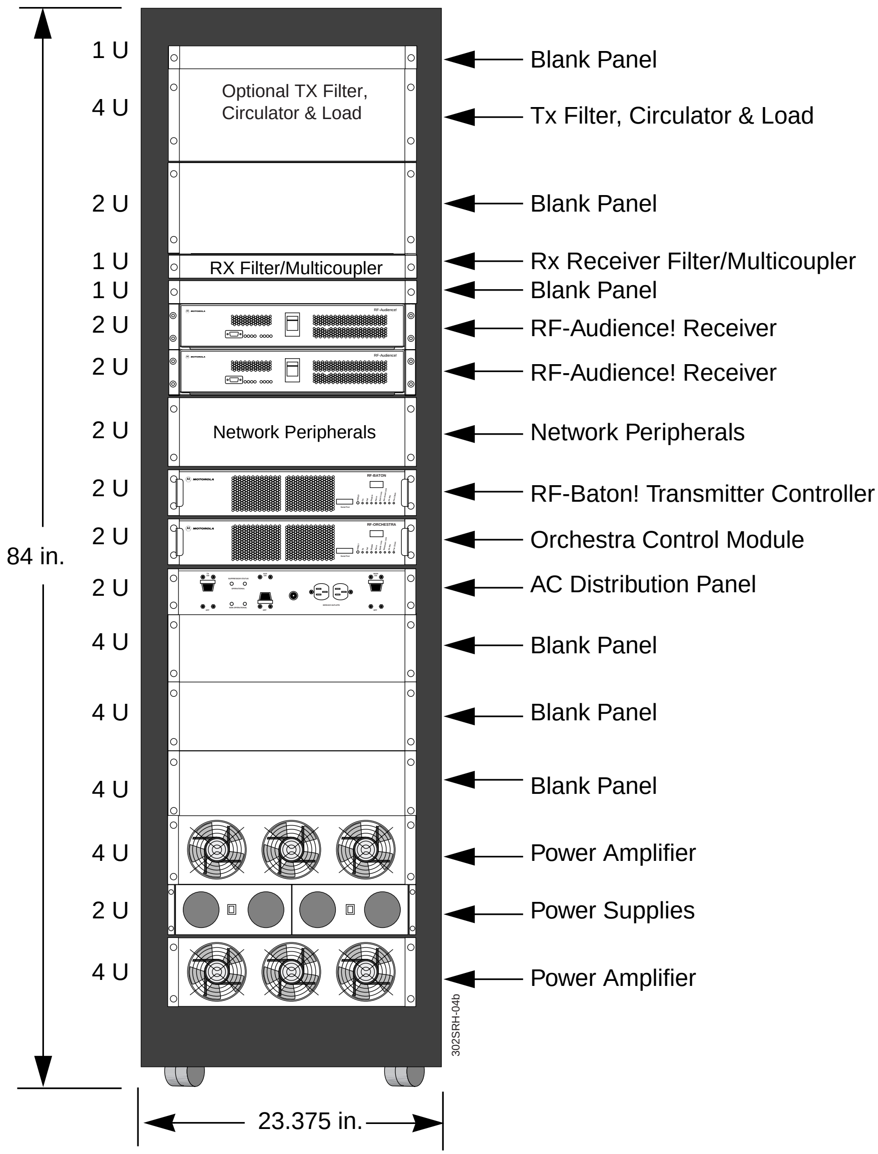



*Figure 4-2: Model PT1054 RF-Orchestra! 2-Channel (43 RU) Cabinet Layout*

# Tools and Equipment

The following tables list the tools, test equipment, and locally procured parts needed for installation, troubleshooting and maintenance. The listed model numbers are recommended, but equivalent tools and equipment are acceptable. Motorola recommends using various shades of colored, vinyl tape for wire identification.

DANGER

*Select tools and equipment that have insulated grips and handles. This insulation helps prevent potential injury resulting from electrical shock.*

## Recommended Tools

The following table lists the recommended tools for installation (see Table 4-1). These tools are not included as part of the RF-O! paging station shipment and must be procured locally.

*Table 4-1: Recommended Tools for Installation*

| Tool | Model/Type | Manufacturer | Purpose |
|---|---|---|---|
| **Crimping tool** | 8-pin modular cable | Locally procured | Customizing T1 connections |
| **Carpenters level or equivalent** | Pro Smartlevel 24 in. w/module | Pro Smartlevel | Level Cabinets |
| **Torque wrench** | Snap-On®/QP1117 (or equivalent (calibrated to 105 in. lb) | Snap-On | Torque wrench handle for RF connections |
| **1-1/4 in. crow's foot adapter** | Snap-On/GFC40A | Snap-On | Torque wrench adapter for Andrew type 7/16 DIN connectors |
| **1-1/16 in. crow's foot adapter** | Snap-On/GFC34A | Snap-On | Torque wrench adapter for Huber/Suhner type 7/16 DIN connectors |
| **TORX® driver set** | T-15 and T-30 bits | Textron | Tightening connections |
| **Fiberglass or wooden stepladder** | 7 ft. | Locally procured | Reach connections on top of cabinet |

## Recommended Test Equipment

The following table lists the recommended test equipment for installation. This equipment is not included as part of the RF-O! paging station shipment and must be procured before installation, maintenance, or troubleshooting (see Table 4-2).

*Table 4-2: Recommended Test Equipment for Installation*

| Test Equipment | Model/Type | Manufacturer | Purpose |
|---|---|---|---|
| **Communication software** | ProComm Plus™ (or equivalent) | Quarterdeck | Host communication |
| **VT-100 or equivalent (laptop PC with hard drive optional)** | Locally procured | Locally procured | Runs communication software/ provides interface to system |
| **Spectrum analyzer** | HP™-8560 or equivalent | Hewlett-Packard™ | Recommended for installation; required for troubleshooting |
| **Digital multimeter (only 1 required)** | Fluke 77<br>R1037A<br>R1073A | Fluke<br>Motorola<br>Motorola | DC measurements |
| **T1 tester/protocol analyzer (optional)** | 209A T | Bird | Testing T1 lines |
| **GPS evaluation kit (optional)** | VPEVAL0002<br>GTEVAL0001<br>UTEVAL0001 | Motorola<br>Motorola<br>Motorola | Evaluate GPS |
| **Communications systems analyzer with tracking generator** | IFR/COM-120B | Locally procured | Generates and measures communication frequencies |
| **DB-9 to DB-9 straight-through cable with null modem adapter** | No specific model recommended | Locally procured | Communications |
| **Wattmeter** | APM16 | Bird | Measure paging station power (900 MHz) up to 600 watts |
| **500 watt dummy load with 7/16 DIN connector** | No specific model recommended | Bird | Antenna load (900 MHz) |

## Recommended Parts

The following table lists the recommended parts for installation. These parts are not included as part of the RF-O! paging station shipment and must be procured locally (see Table 4-3).

*Table 4-3: Recommended Parts for Installation*

| Part | Type/Size | Manufacturer | Where used |
|---|---|---|---|
| **Anchor kit** | #2100-13 | Hendry | Cabinet floor anchors |
| **Colored vinyl tape** | Red, black, green, brown, yellow, and white | Locally procured | Wire identification |
| **Ground cables** | #2 AWG stranded copper [(Cu) green] | Locally procured | Cabinet grounding |
| | #6 AWG stranded copper [(Cu) green] | Locally procured | Cabinet grounding |
| **Ground wire** | #4 AWG bare solid | Locally procured | Cabinet grounding |
| **Split nuts** | No specific model recommended | Locally procured | Join grounds |
| **Lifting eyes** | | Locally procured | Lifting cabinets |
| **Floor anchor kit** | | Locally procured | Anchoring cabinets |

## Cabinet Installation

The following information provides procedures for installing the equipment cabinets at a site selected by the paging service provider. The procedures assume that all prerequisites are satisfied and the site is ready for equipment installation. All antenna cables, power outlets, and ground wires must be in place before installing the RF-O! paging station cabinet.

## Cabinet

All equipment cabinets are equipped with casters. The two front casters have locks that must be unlocked before moving the cabinet. Relock the casters after positioning the cabinet.

CAUTION

*Use extreme care when moving cabinets down ramps or other inclines. A fully configured two-channel paging station weighs in excess of 715lbs. Motorola recommends using two or more persons when moving a cabinet.*

1. Unlock the casters on the two front wheels and move the cabinet to the area where the cabinet is to be located.

   To unlock a caster, move the locking lever located on the two front wheels to the unlock position (counterclockwise).

2. Lock the casters on the two front wheels.

   To lock the wheels, turn the locking mechanism clockwise until it stops (see Figure 4-3).

*Note: In seismically active areas, additional bracing of the cabinet may be required to prevent the unit from tipping over (see Figure 4-3). If bracing is required, purchase the recommended cabinet anchor kit (see Table 4-3).*

3. If required, install the cabinet anchor kit according to instructions supplied with the kit.

4. Screw the feet (located at each corner of the cabinet) out until they touch the floor.

5. With one person behind the cabinet and one person in front of the cabinet, carefully tilt the cabinet back to lift the front feet off the floor.

6. Screw each foot on the front of the cabinet out approximately 0.25 in. (6.35 mm).

7. Let the front of the cabinet down to rest on the front two feet.

8. Carefully tilt the cabinet to the front to raise the rear of the cabinet off the floor.

9. Screw the two feet located on the rear of the cabinet out 0.25 in. (6.35 mm) and set the rear of the cabinet back on the floor.

10. Using a carpenter's level or an equivalent, level the cabinet front to back and left to right by adjusting the feet.

11. Once the cabinet is level, secure the feet in place using the lock nuts located on the feet.

12. If required, fasten the floor anchors to the cabinet.

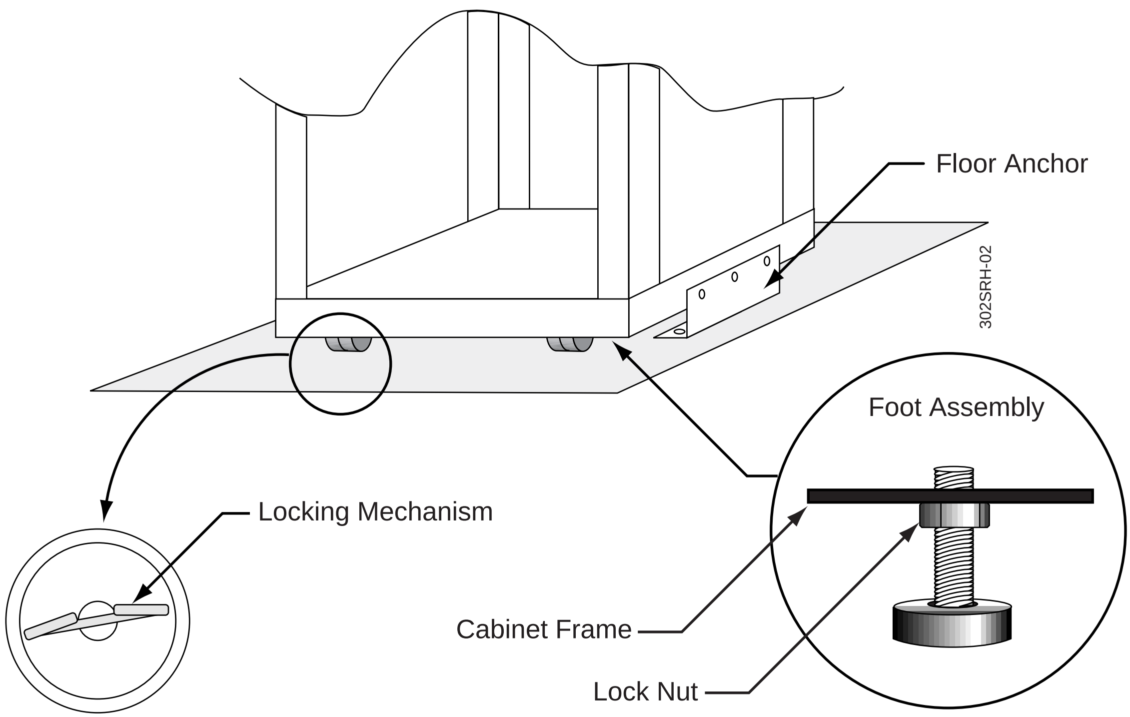



*Figure 4-3: Wheel Caster Lock and Sample of Floor Anchors*

## Cabinet Ground Connections

Safety and operation depend on proper grounding of the equipment (see Chapter 3, "Preinstallation"). Figure 4-4 shows the main cabinet ground at the top of the cabinet. The main cabinet ground connects to the cabinet rail. Each chassis installed in the cabinet has an independent ground connection to the cabinet rail (see Figure 4-4).

Locate the site ground wire and connect it to the cabinet ground as follows:

*Note: The cabinet must be connected to the site ground using a single dedicated ground wire. The connecting wire must be an AWG #2 or larger, green-insulated solid copper wire.*

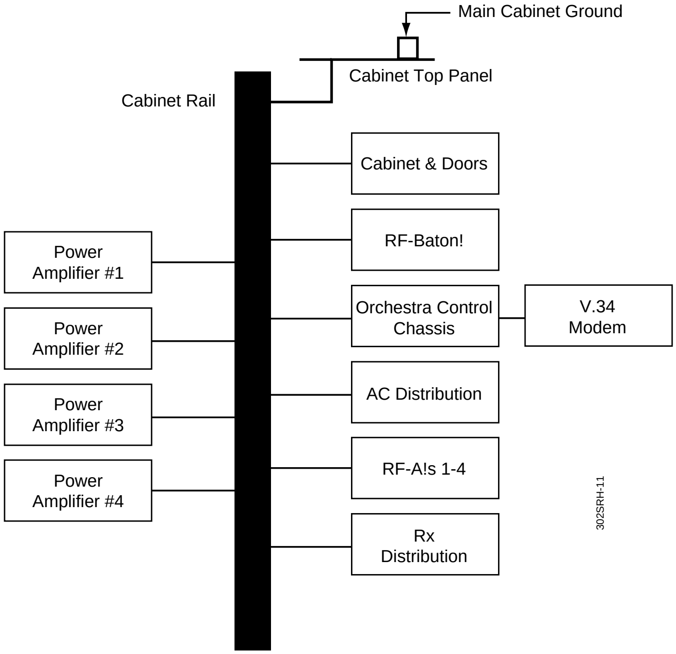
1. Place a step ladder (see Table 4-1) at the rear of the cabinet.

2. Strip 3/8 in. of insulation from the end of the ground wire.

3. Loosen the set screw in the ground block and insert the stripped end of the ground wire (see Figure 4-4).

4. Leave approximately 1/16 in. of the stripped portion of the wire outside the grounding block.

5. Tighten the set screw to secure the ground wire to the ground block.



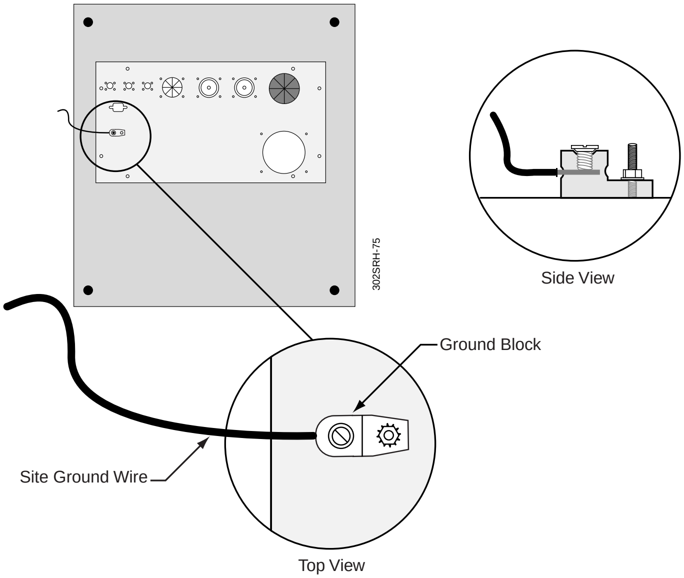




*Figure 4-4: RF-O! Paging Station Ground Connections*

# Antenna Connections

## Paging Station Antenna

The paging station antenna connector (Tx Output or Optional Tx Output) is a 7/16 DIN RF female connector located at the top of the cabinet (see Figure 4-5).

Locate the site paging station cable and connect it as follows:

1. Place the step ladder (see Table 4-1) at the rear of the cabinet.

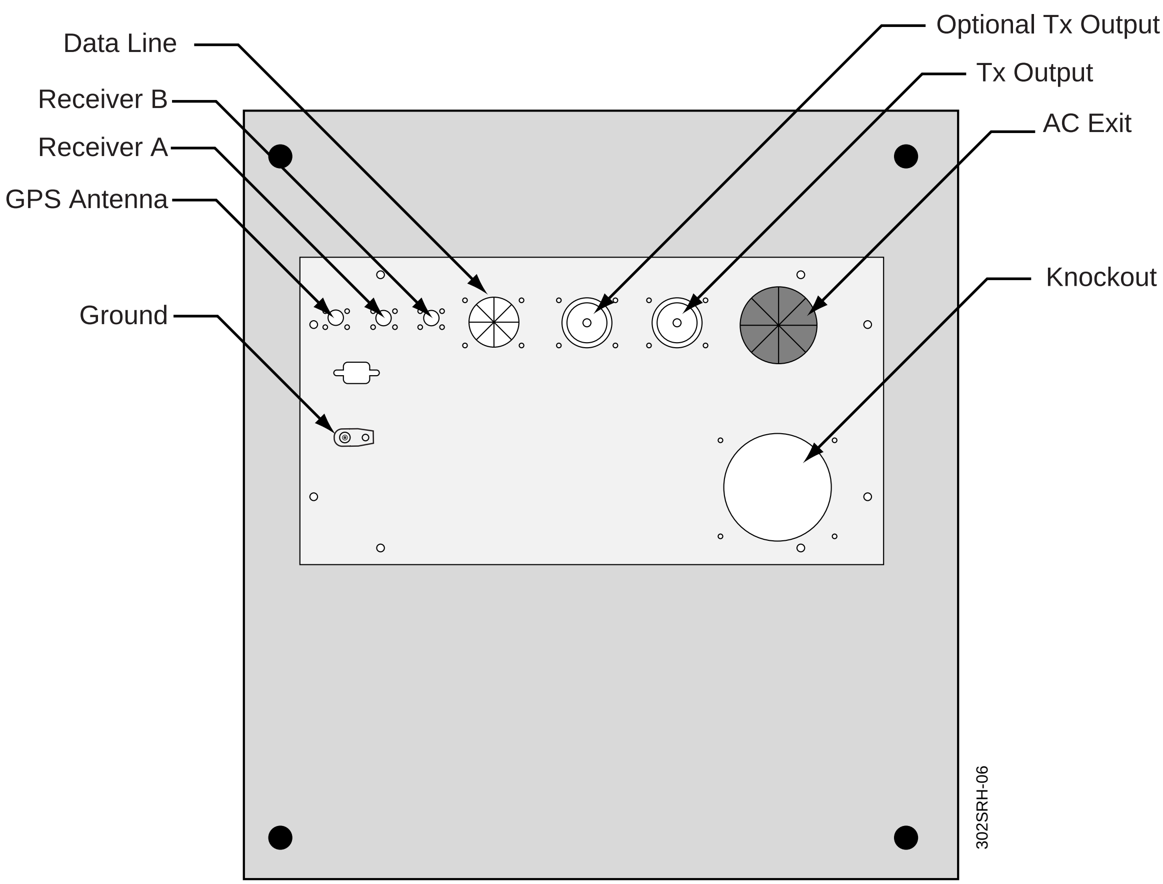



*Figure 4-5: Top of Cabinet Connector and Cable Entrance Panel*

2. At the top of the cabinet connect the site transmitter antenna cable to the transmitter output connector located on top of the cabinet using a 7/16 in. torque wrench and 1 1/4 in. crow's foot adapter (see Figure 4-5).

CAUTION

*Proper torquing of DIN connectors is critical. Failure to properly torque DIN connectors will result in cable, connector, or lightning arrestor failure.*

3. Torque the transmitter antenna connection to 105 in. lbs.

## GPS Antenna

The GPS antenna connection is also located at the top of the cabinet (see Figure 4-5). Locate and connect the GPS antenna cable to the GPS antenna connector and tighten securely.

CAUTION

*The Motorola internal GPS receiver sources +5 Vdc power to the antenna using the coaxial cable center pin.*

## Co-located RF-A! Receiver(s) Connections

The RF-A! receiver antenna connections are located at the top of the cabinet (see Figure 4-5). Locate and connect the receiver antenna cable(s) to the Receiver A and Receiver B antenna connectors and tighten securely.

## Network Connection

A typical network configuration of peripheral equipment may consist of a network router, a network Channel Service Unit/Data Service Unit (CSU/DSU), and a network V.34 modem (see Figure 4-6). The particular complement of network interface equipment is defined by the paging system provider at the time of purchase.

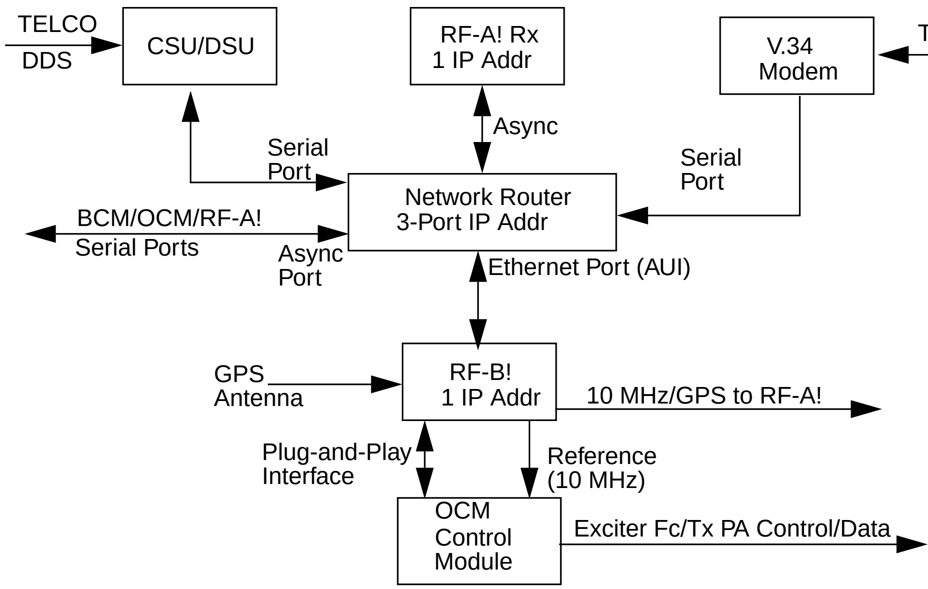



*Figure 4-6: Typical Network Peripherals with Paging Station Control Elements*

### Network Router

The network router used in the RF-O! paging station acts as a network access server that connects asynchronous devices to a Local Area Network (LAN) or Wide Area Network (WAN) through network and terminal emulation software.

Route the TELCO provided line through the top of the cabinet using the data line entry port provided (see Figure 4-5). Route the TELCO line through the cabinet to the rear of the router and connect the data line to one of the serial port connectors on the rear of the router (Figure 4-7).

The configuration and network Internet Protocol (IP) plan for a particular location are determined by the paging network provider. Refer to the appropriate router product manual for operation and configuration details of the router being used.

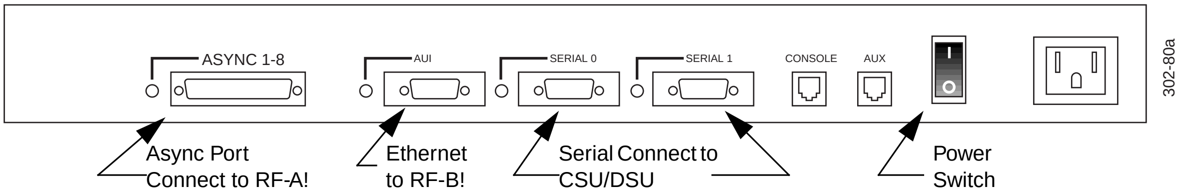



*Figure 4-7: Typical Network Router*

### Network V.34 Modem

The V.34 network series of modems used with the RF-O! paging station are synchronous/ asynchronous/fax modems. This series of modems is used for data communications over standard dial-up, private leased telephone lines or through wireless communications. Refer to the appropriate V.34 modem product manual for operation and configuration details.

Route the TELCO provided line through the data line entry port provided at the top of the cabinet (see Figure 4-5). Route the TELCO line through the cabinet to the rear of the modem and connect the data line to the data port connector on the rear of the modem (Figure 4-8).

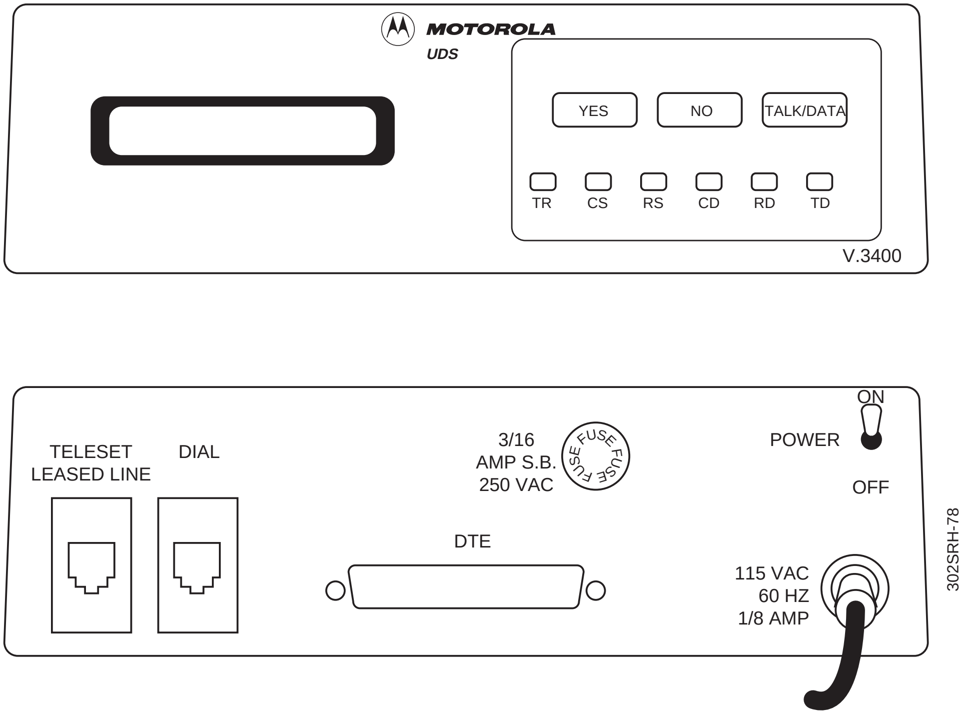



*Figure 4-8: Typical Network V.34 Modem*

## Network CSU/DSU

The network CSU / DSU is the interface point for the public or private T1 DDS network interconnect medium. The CSU / DSU sends and receives serial data from the RF-O! receiver station router through the Data Terminal Equipment (DTE) port located at the rear of the CSU / DSU. The data is multiplexed onto a 1.544 Mbps DS-1 signal that is interfaced through the CSU function to a T1 DDS network.

Route the TELCO provided line through the top of the cabinet using the data line entry port provided (see Figure 4-5). Route the TELCO line through the cabinet, and connect the data line to the DTE connector on the rear of the CSU / DSU (see Figure 4-9).

Refer to the appropriate CSU / DSU product manual for operation and configuration details.

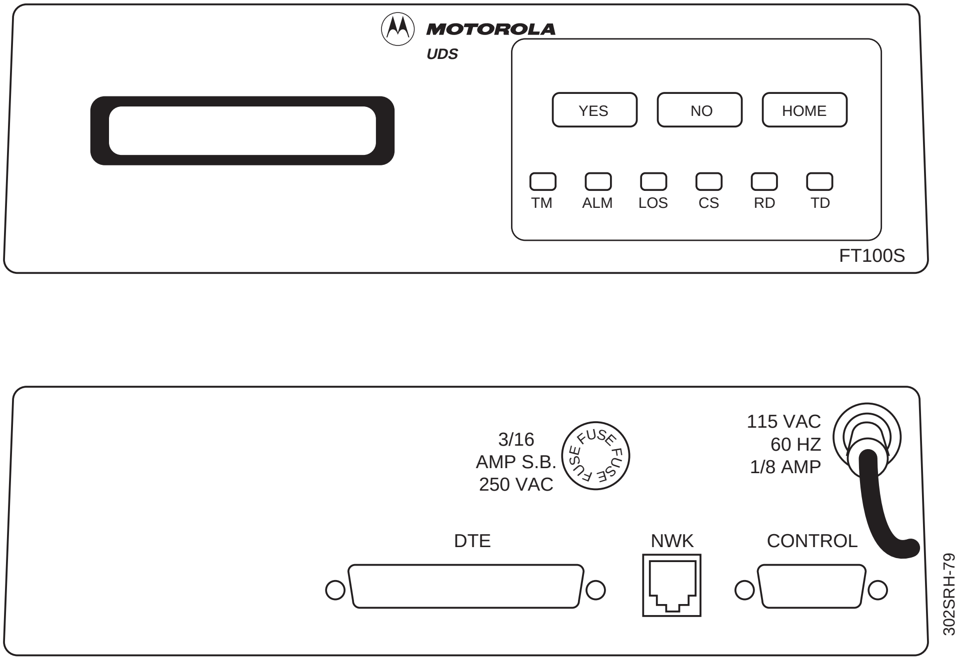



*Figure 4-9: Typical Network CSU/DSU*

# AC Power Connection

The RF-Orchestra! paging station comes from the factory with the power cord attached to the AC distribution chassis. Before plugging the line cord into the power receptacle, place all equipment power switches in the OFF position. Verify the following switches are in the OFF position (see Figure 4-10).

*Note: Numbers in parentheses correspond to the numbers shown in Figure 4-10.*

- AC Distribution Panel (three circuit breakers)
  - Main Breaker - OFF **(1)**
  - TX Breaker - OFF **(2)**
  - AUX Breaker - OFF **(3)**
- AC Power Supplies - OFF (up to four) **(4)**
- RF-Baton! (RF-B!) Transmitter Controller - OFF **(5)**

*Note: Refer to appropriate transmitter controller manual if other than the RF-B! transmitter controller.*

- Orchestra Control Module - OFF **(6)**
- Co-located RF-Audience! Receivers - OFF **(7)**
- Peripheral Equipment (if supplied) OFF **(8)**

Connect the cabinet AC power distribution chassis to the AC power source supplied for the RF-O! paging station cabinet as follows.

1. Open the rear door of the cabinet and locate the AC power cord.
2. Remove the retainer securing the power cord to the cabinet frame.
3. Place the step ladder at the rear of the cabinet.
4. Route the power cord out through the top of the cabinet (see Figure 4-10).
5. Connect the power cord to the 240-V receptacle provided for the RF-O! paging station cabinet.

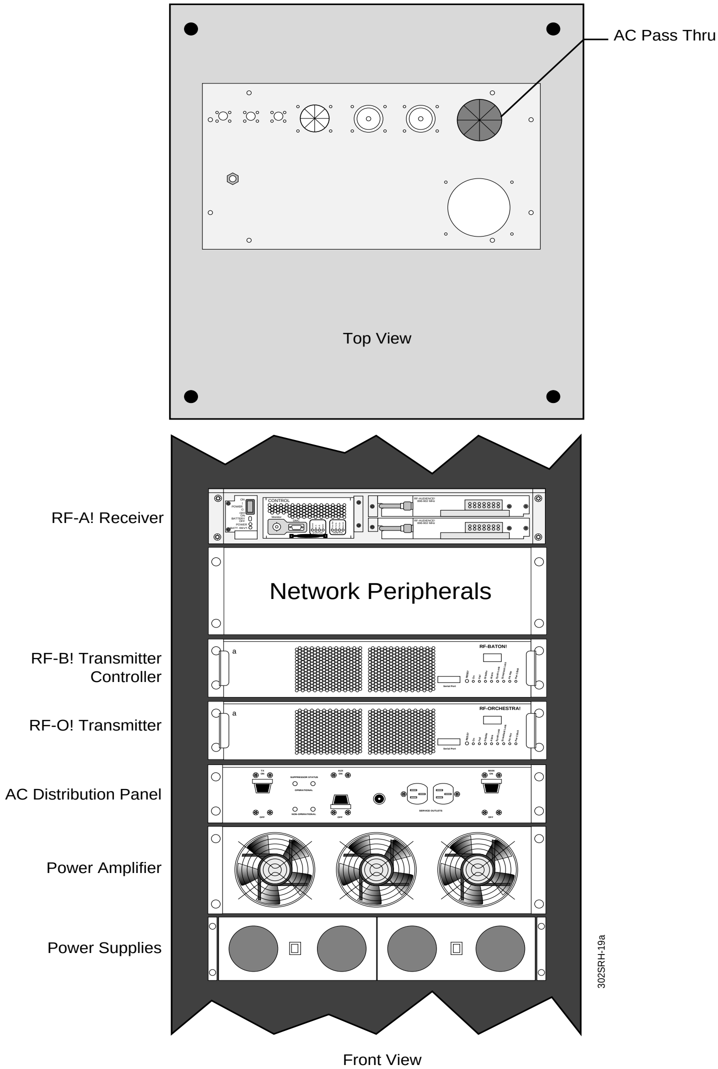



*Figure 4-10: Location of Switches for the RF-O! Paging Station*

# Powering Up the RF-O! Paging Station

Perform the following procedure to verify proper operation of the RF-O! paging station during power up (see Figure 4-10). Refer to the appropriate manuals cited in Chapter 1, Related Publications for the RF-B! transmitter controller, RF-A! receiver, and any network peripherals that are not supported in this manual.

*Note: If a third-party controller is installed, refer to the appropriate installation and operation manuals before proceeding.*

*Note: Numbers in parentheses correspond to the numbers shown in Figure 4-10.*

1. Place the main AC power distribution unit circuit breaker switch **(1)** in the ON position.

2. Place the TX and AUX circuit breaker switches **(2, 3)** in the ON position.

*Note: The green LED on the AC distribution panel indicates the surge suppression is functional.*

3. Place the ON / OFF switch **(4)** of each power supply module (qty=2) in the ON position.

*Note: Placing any AC power switch in the ON position supplies power to the RF-O! paging station and the RF-B! transmitter controller chassis.*

4. Place the RF-B! transmitter controller ON / OFF switch **(5)** to the ON position ( | ).
   a. Verify that all the RF-B! transmitter controller LEDs briefly light during power up.
   b. After about one minute, verify that CONTROL ON and ALARM are the only RF-B! LEDs still lit.
   c. After about 60 minutes, verify the RF-B! GPS LOCK and RFB REQ LEDs are lit.

*Note: When powering up the RF-B! transmitter controller for the first time at a location, ensure that power is uninterrupted for at least 60 minutes. This uninterrupted time allows the GPS receiver time to determine its location (lock on to the appropriate satellites). After the receiver determines its initial location, the GPS receiver lock time typically takes from 2 to 3 minutes after a system reset, or 10 to 15 minutes after a power cycle.*

*Note: Refer to the RF-B! manual for details on how to use FIPS to monitor GPS satellite acquisition status.*

5. Place the Orchestra Control Module Power ON / OFF switch **(6)** in the ON ( | ) position.
   a. Verify all OCM LEDs light briefly during power up.
   b. After two minutes, verify CONTROL, ALARM, and EXCITER LOCK LEDs are lit on the RF-O! paging station front panel (The DISABLE and FULL POWER LEDs may also be lit in a normal situation).

*Note: When the Exciter Lock LED lights and the GPS receiver has determined the location, the station is ready for messaging.*

6. Release the front cover of the RF-A! receiver(s) and place the power switch **(7)** in the ON position. Repeat for all co-located receivers.

7. Turn on network peripherals (refer to appropriate vendor manual) **(8)**.

# Operation

## Establishing an RF-O! FIPS Session

A service terminal provides a command line interface with the RF-O! transmitter to access all station parameters and functions using the Friendly Integrated Paging System (FIPS) protocol. The FIPS interface is used throughout this manual for RF-O! transmitter installation, operation, and troubleshooting.

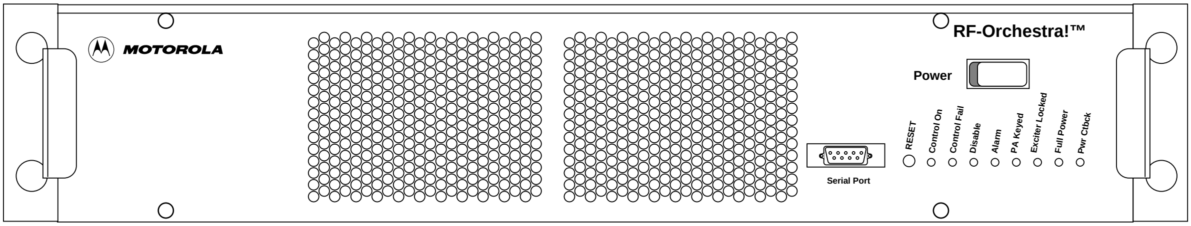



*Figure 5-1: Orchestra Control Module (Front View)*

### Service Terminal Setup

The service terminal is usually an IBM® compatible personal computer (PC) running a compatible communications software program. Procomm Plus® is the recommended communications software program; however, an equivalent program may be used.

Perform the following steps to connect your service terminal for communications:

1. Connect the service terminal to the RF-O! transmitter front panel serial port connector using an RS-232 null modem adapter cable with a DB9 connector (see Figure 5-1).

*Note: The RF-O! transmitter serial port connector is configured as Data Terminal Equipment (DTE). A null modem adapter must be used for the service terminal to interface with the serial port connector. For convenience, use an RS-232 cable at least 10-ft (3.05 m) long with a DB9 connector.*

2. Power up the service terminal.

3. Set the flow control to none.

4. Set up the terminal communication parameters (see Table 5-1).

*Table 5-1: Service Terminal Interface Parameters*

| Description | Setting |
|---|---|
| **Baud rate** | 9600 (Default Value) |
| **Parity rate** | None |
| **Data bits** | 8 |
| **Stop bits** | 1 |
| **Emulation** | VT100 |

*Note: Keyboard conventions are described in Table 1-1)*

5. At the prompt, type: **<Enter>**

   The service terminal displays:

   ENTER PROTOCOL:

6. At the prompt, type: **FIPS <Enter>**

   The service terminal displays:

   ENTER PASSWORD:

*Note: The default password set at the factory is 6000.*

7. At the prompt, type: **[password] <Enter>**

   The service terminal displays:

   RFO FIPS:

You are now connected to FIPS and ready to perform action, read, and write commands.

*Note: The RF-O! FIPS session will time out with inactivity. To access the transmitter again, repeat Step 5 through Step 7.*

## FIPS Commands

FIPS commands are used to control the RF-O! transmitter and are organized in three categories:

- Action commands
- Read parameter commands
- Write parameter commands

Table 5-2 shows the FIPS command syntax.

*Table 5-2: Commands Table*

| Command[1] | Designator | Description |
|---|---|---|
| **Action Command**<br>**a XXX YYY <Enter>** | a [2]<br>XXX<br>YYY<br>**<Enter>** | An action command<br>The numerical value of action parameter<br>An action argument<br>Pressing the **<Enter>** key performs an action |
| **Parameter Read**<br>**r XXX <Enter>** | r [2]<br>XXX<br>**<Enter>** | Read from memory command<br>Numerical value of parameter to be read<br>Pressing the **<Enter>** key performs an action |
| **Parameter Write:**<br>**w XXX YYY <Enter>** | w [2]<br>XXX<br>YYY<br>**<Enter>** | Write to memory command<br>The numerical value of a parameter to be changed<br>Argument to be written<br>Pressing the **<Enter>** key performs an action |

1. Some action commands may not need an argument; other commands may use more than one argument.
2. May be upper or lower case.

### Action Commands

An action command causes the RF-O! transmitter to change operating modes or interact with an external entity. An action command can write one or more parameters to the internal Orchestra Control Module (OCM) memory or perform a series of functions. The action command appears in the following format:

**a [command #] [parameter or list] <Enter>**

*Note: Not all action commands have parameters or lists.*

The following command is an example of an action command. This action command interfaces with power amplifier #1 and returns the PA module status to the user. Appendix D lists the RF-O! transmitter action commands.

```
RFO FIPS: a 68 1 c 0 1 0
RFO FIPS: RA 68
<<< READ PA DECK 02 A/D 01 >>>
Reg 00: DPA= 100 => 0.11 Amp(s)
Reg 01: PDPA= 092=> 1.95 Amp(s)
Reg 02: OD= 026 => 8.68 Watt(s)
Reg 03: FPA 1 A= 089 => 1.59 Amp(s)
Reg 04: FPA 1 B= 090 => 1.59 Amp(s)
Reg 05: FPA 2 A= 094 => 1.59 Amp(s)
Reg 06: FPA 2 B= 099 => 1.59 Amp(s)
Reg 07: FPA 3 A= 094 => 1.59 Amp(s)
Reg 08: FPA 3 B= 099 => 1.59 Amp(s)
Reg 09: Fwd= 050 => 41.34 Watt(s)
Reg 0A: Rfltd= 005 => 1.10 Watt(s)
Reg 0B: A/D Test= 128=> PASS (> 126)
=========================================
```

*Figure 5-2: Action Command Example*

### Read Parameter Command

A read command returns a parameter value as stored in internal RF-O! transmitter memory. The read command appears in the following format:

**r [parameter #] <Enter>**

For example, to read the Active Bank Software type the following command:

RFO FIPS: **r 148 <Enter>**

RFO FIPS: RA 148 2.0.0 (value depends on software version)

Appendix E lists the RF-O! transmitter read commands.

### Write Parameter Command

A write command writes a single parameter value to the internal RF-O! transmitter memory. The write command appears in the following format:

**w [parameter #] [parameter] <Enter>**

For example, issue a write command to set the center frequency to 940 MHz for the 1st entry in the PNP Channel Table as follows:

RFB FIPS: **w 2000 940000.0**

RFB FIPS: RW 940000.0

Appendix E lists the RF-O! transmitter write commands.

*Note: In a few cases, a write command behaves like an action command in the sense that the write command causes the RF-O! transmitter to change operating modes.*

*Note: Some parameters are write-protected. Attempting to write to write-protected parameters will not modify the value of the parameter.*

# Reset and Initialization

The RF-O! transmitter operation has three types of resets:

- Power-on reset: occurs when power to the RF-O! transmitter controller is interrupted
- Hard reset: occurs when the reset button on the RF-O! transmitter is pressed
- Software reset: occurs when FIPS action command **a 117** is issued or initiated by the software watchdog

All RF-O! transmitter resets are functionally equal and perform the following actions:

- RF-O! transmitter control software boot
- FIPS initialization
- DSP initialization
- I/O initialization
- FPGA initialization
- Parameter database initialization
- Hardware polling

After the RF-O! transmitter software boot, the reset banner is displayed on the service terminal screen (if connected) as shown in Figure 5-3.

```
>>>>>>>           MOTOROLA RF-ORCHESTRA!           <<<<<<<
>>>>>>>        WIRELESS MESSAGING SYSTEM (WMS)     <<<<<<<
>>>>>>>      (c) Copyright 1999 Motorola, Inc.     <<<<<<<
>>>>>>>            All Rights Reserved.            <<<<<<<



>>>>>>>        PARAMETER DATABASE UNCHANGED        <<<<<<<
```

*Figure 5-3:  Reset Banner*

At this point in the reset cycle, FIPS communication with the RF-O! transmitter is available. A complete reset takes approximately one minute. If DIP switches on switch SW500 are enabled during reset, the software parameter database reinitializes to default values during the software boot (Chapter 6, "Maintenance").

# Operation Modes

The RF-O! transmitter has three operation modes:

- Normal paging mode
- Trace mode
- Test-data mode

*Note: The trace mode and test-data mode are special modes that can interfere with normal transmitter operation. These modes are for advanced diagnostics only and may require assistance from a Motorola service representative.*

## Normal Paging Mode

The normal paging mode is the default mode of operation for the RF-O! transmitter controller. After any type of reset, the RF-O! transmitter control software returns to paging mode after initialization. In this mode, all RF-O! transmitter functions are available, and input message data is received from the transmitter controller.

## Trace Mode

The trace mode verifies operation or debugs the station by echoing data from various test points in the system to the FIPS display.

*Note: Notify the control center before initiating a trace. Some trace modes affect station performance and can cause loss of distribution data due to extra processing delays.*

To start a trace, perform the following steps:

1. Establish an RF-O! FIPS session.

2. To start the trace mode, type the following command:

   **a 192 [options] <Enter>**

   The trace starts immediately, but data may not display immediately.

3. When a trace is no longer needed, issue the following FIPS command to end that trace:

   **a 193 [options] <Enter>**

   The trace stops immediately.

*Note: The options must be entered exactly as they were issued in the FIPS action command 192 or the trace will not stop. Some options are case-sensitive.*

For further details on the **a 192** and **a 193** action commands, see Table H-1 RF-O! Transmitter Debug Trace TASK Identifiers in Appendix H.

## Test Data Mode

Test data mode tests the RF path and performance of the transmitter. While in this mode, the RF-B! transmitter controller or the RF-O! transmitter generates test data. The user determines the contents of the test message data.

Test data modes can be initiated using FIPS commands at either the RF-B! transmitter controller or the RF-O! transmitter using the same action command syntax.

*Note: If the test data mode is initiated at the RF-O! transmitter, normal paging data from the RF-B! transmitter controller will be ignored by the RF-O! transmitter. It is not necessary to disable network traffic at the RF-B! transmitter controller before starting the test data mode at the RF-O! transmitter.*

Before initiating a test mode, ensure that the transmitter RF output is terminated properly. To set up and execute a test transmission, perform the following steps:

1. Establish a FIPS session.

2. Set the offset of each subchannel relative to the center frequency (See Table 5-3). Type the following command:

   **a 195 w x y z <Enter>**

   The offset values are defined in kHz in Table 5-4.

*Table 5-3: Subchannel Offset From Center Frequency*

| Subchannel | Offset |
|---|---|
| **w** | Subchannel 1 offset from center frequency |
| **x** | Subchannel 2 offset from center frequency |
| **y** | Subchannel 3 offset from center frequency |
| **z** | Subchannel 4 offset from center frequency |

*Table 5-4: Offset Values Corresponding kHz*

| Valid subchannel offset values | Corresponding offset in kHz |
|---|---|
| **0** | 0 |
| **1** | 6.25 |
| **2** | 12.50 |
| **3** | 18.75 |
| **13** | -18.75 |
| **14** | -12.50 |
| **15** | -6.25 |

3. Set the transmission frequency to 1 of 16 possible values. Type:

   **a 196 x <Enter>**

   where **x** is:

   0 to transmit on the center frequency set by RF-O! parameter 2000

   1 to transmit on the center frequency set by RF-O! parameter 2001

   2 to transmit on the center frequency set by RF-O! parameter 2002

   .

   .

   .

   15 to transmit on the center frequency set by RF-O! parameter 2015

4. To start the test, type the following command:

   **a 176 [options] <Enter>**

   The test transmission starts immediately. The options specified in the 176 action command determine the contents of the test message. For example, type **a 176 0 8 0 0 0 1 10 5 1** for 1 subchannel of pulsing random 4-level FM, 6400 bps.

5. End the test by entering the following FIPS command:

   **a 177 <Enter>**

*Note: For further details on the* **a 176** *and* **a 177** *action commands, see the FIPS action command description in Appendix D.*

6. Ensure that the distribution network is reconnected, so normal processing can resume. The test transmission ends immediately, and normal processing resumes.

# Alarm and Error Logs

The RF-O! transmitter software accesses alarm and error logs. This information helps resolve performance issues or perform maintenance cycles. The RF-O! transmitter has three logs:

- Alarm log
- Error log
- Software error log

Configuration specifies errors that trigger alarms. Four alarm severity categories exist:

- **Critical:** The alarm caused paging transmissions to stop indefinitely. Without user interaction, paging may not resume.
- **Major:** The alarm caused a temporary interruption of paging transmissions. Paging will probably resume without user intervention. Under some circumstances repetitious major alarms will effectively disable the station.
- **Minor:** The alarm probably has not caused interruption of paging transmissions.
- **Informational:** The alarm is for user information only. Service was not interrupted.

Appendix F contains a complete list of logged alarms and errors along with their severity.

## Alarm Log

The alarm log has all alarms logged since the log was cleared or the OCM was reset. The alarm LED on the front panel is lit when any alarms are active. The alarm log helps determine the operational status of the RF-O! transmitter. Complete these steps to read the current alarms:

1. Establish an RF-O! transmitter FIPS session.

2. Read all alarms. Type the following command:

   **a 99 <Enter>**

   The service terminal lists the active alarms.

3. To clear the alarm log, type this command:

   **a 103 <Enter>**

   The alarm LED on the front panel should no longer be lit.

The alarm log is also cleared upon reset.

## Error Log

The error log contains the transmitter operational errors logged during operation, and this log is not cleared by a reset. Use this log to determine an operational history of the RF-O! transmitter. To read the transmitter error log, perform the following steps:

1. Establish an RF-O! transmitter FIPS session.

2. Read the transmitter error log. Type this command:

   **a 104 <Enter>**

   The service terminal lists the recorded station errors. Table 5-5 describes each error log entry. Each log entry line contains the following information:

   <Type><Action><Error Code><Caller><Line Num><Timestamp><Occurrences>

*Table 5-5: Station Error Log Entries*

| Entry | Description |
|---|---|
| **Type** | Helps to determine which subsystem within the module is responsible for the error condition. The type can take on values such as NVM, DSP, STATION_ERROR, and GPS. |
| **Action** | Tells what action the error-logging mechanism took when the error occurred. The action can be either RESET_STATION (fatal error, station was reset) or LOG_ERROR (nonfatal, error was logged, but station was not reset). |
| **Error Code** | Identifies individual errors. The tables in this document contain descriptions of each of the possible error codes. |
| **Caller** | Identifies the software source code module that logged the error. Used for software debugging. |
| **Line Num** | Identifies the physical line number of the calling software source code module from where the error was logged. Used for software debugging. |
| **Timestamp** | Marks the GPS time when the latest occurrence of the error was logged. If GPS time is not known at the time the error is logged, the Timestamp contains the current value of the onboard clock, which starts timing from 1996/04/02.12:00:00 upon reset. |
| **Occurrences** | Gives the number of times the current combination of Type, Action, Error Code, Caller, and Line Num have occurred since the log was last cleared. Note that different callers can log the same error code, in which case separate log entries are made. |

3. To clear the station error log, type:

   **a 111 <Enter>**

The station error log is maintained through all resets.

## Software Log

The software log is primarily for development logging purposes and does not contain operational errors. To read the current software log, perform the following steps:

1. Establish an RF- O! paging station FIPS session.

2. Read all alarms. Type this command:

   **a 110 <Enter>**

   The system lists the current software log.

*Note: The software log does not contain any operational errors.*

3. To clear the log, type the following command:

   **a 113 <Enter>**

The software log is maintained through all resets.

# General Operational Setup and First Time Use

The factory installs all software necessary for operating the RF-O! transmitter. Certain site-specific setups are necessary before the RF-O! transmitter is ready for paging operation. The following sections provide detailed procedures for all site-specific setups.

All setup procedures use a service terminal to access the FIPS protocol.

## Recording Data for the RF-O! Paging Station

Use the service terminal to access the frequency parameters listed for your particular location and record the information on Table 5-6.

.

*Table 5-6: Site-Specific Orchestra Control Module User Account Data*

| Command | Record | Value |
|---|---|---|
| **r 2000** | Frequency Table Entry 1 | |
| **r 2001** | Frequency Table Entry 2 | |
| **r 2002** | Frequency Table Entry 3 | |
| **r 2003** | Frequency Table Entry 4 | |
| **r 2004** | Frequency Table Entry 5 | |
| **r 2005** | Frequency Table Entry 6 | |
| **r 2006** | Frequency Table Entry 7 | |
| **r 2007** | Frequency Table Entry 8 | |
| **r 2008** | Frequency Table Entry 9 | |
| **r 2009** | Frequency Table Entry 10 | |
| **r 2010** | Frequency Table Entry 11 | |
| **r 2011** | Frequency Table Entry 12 | |
| **r 2012** | Frequency Table Entry 13 | |
| **r 2013** | Frequency Table Entry 14 | |
| **r 2014** | Frequency Table Entry 15 | |
| **r 2015** | Frequency Table Entry 16 | |

*Note: After recording this information, keep this data in a safe place for future reference.*

## RF-O! Paging Station Operational Checkout

A complete operational checkout includes the transmitter controller because the RF-O! transmitter operates in conjunction with a transmitter controller. Refer to the appropriate documentation for your transmitter controller.

Use the following steps to verify the proper operation of the RF-O! transmitter before placing the paging station into service.

1. Verify proper operational state of the transmitter controller. For an RF-B! transmitter controller, refer to *RF-Baton!™ Transmitter Controller System Installation and Operation*, Publication 6880497G01.

2. Disable all network traffic so that the message operation does not interfere with the checkout procedure. For example, network traffic on the RF-B! transmitter controller can be disabled by disconnecting the Ethernet AUI cable from the J12 connection on the back of the RF-B! transmitter controller (See Figure 5-4).

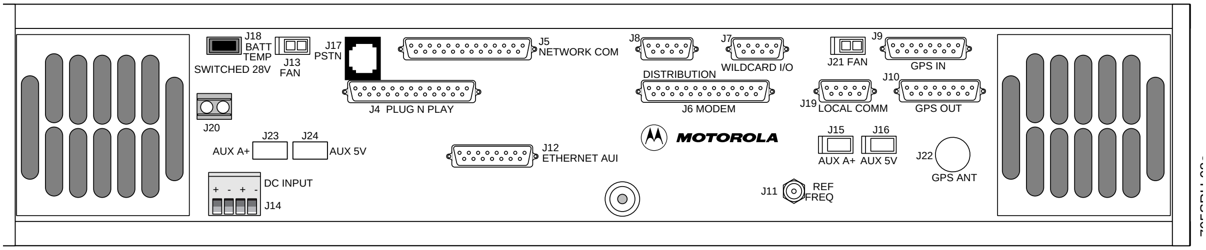



*Figure 5-4: RF-B! Transmitter Controller Backplane*

3. Establish an RF-O! transmitter FIPS session.

4. Clear the error and alarm logs of the reset error caused during power up and reset (indicated by the alarm LED). Type this command:

   **a 103 <Enter>**

   **a 111 <Enter>**

   **a 113 <Enter>**

5. Verify that the RF-O! transmitter front panel alarm LED is off.

6. Check the RF-O! transmitter panel at this point for normal condition LEDs.

*Table 5-7: Normal RF-O! Transmitter LED Conditions Without Network Data*

| LED | Normal Condition | Normal Condition |
|---|---|---|
| **Control On** | Indicates successful boot process of the RF-O! transmitter control module | ON |
| **Control Fail** | Indicates unsuccessful boot process of the RF-O! transmitter control module | OFF |
| **Disable** | Indicates whether messaging activity is disabled | OFF |
| **Alarm** | Indicates whether station alarm is detected | OFF |
| **PA Keyed** | Indicates whether transmitter is keyed | OFF |
| **Exciter Locked** | Indicates whether transmitter is locked on transmit frequency | ON |
| **Full Power** | Indicates whether transmitter is able to transmit at full power | ON |
| **Power Ctbck** | ON - Indicates whether power cutback is active<br>BLINKING - Indicates transmitter is disabled (shutdown) | OFF |

7. At the RFO FIPS prompt, type the following:

   **a 83 <Enter>**

   This command displays the current status of power control, amplitude alignment, internal and external wattmeter alignment, power cutback state, paging disabled status, and power leveling.

   If any alignments or calibrations are INVALID, the RF-O! transmitter should be aligned and/or calibrated.

   If the power leveling amount is greater than 0.5 dB or less than -0.5 dB, the amplitude alignment may not be accurate. If the amplitude alignment is accurate, then the internal wattmeter needs to be recalibrated.

   If any of the disable sources are ACTIVE, the transmitter will not key until the cause of the disable is cleared. Check the error log (RFO FIPS: **a 104**) for details on any active disable source.

```
RFO FIPS: a 83

RFO FIPS: RA   83

<<< STATION STATUS/MODE >>>

Power Control (R 992)..........ENABLED  Power Leveling (R 2999)........ 0.00dB
Int Wattmeter Calibration......VALID    Ext Wattmeter Calibration......VALID
Amplitude Alignment............VALID

POWER CUTBACK STATE.........SHUTDOWN
PA Temperature............FULL_POWER    Ambient Temperature.......FULL_POWER
PA Deck/Power Supply......FULL_POWER    Disabled Status.............SHUTDOWN

PAGING DISABLED STATUS (R 100 = 0 = 0h)
Paging Access Disabled (R 99)..OK       Power Supply A/D Read..........OK
OCM Ambient Temperature........OK       Exciter Synthesizer Lock.......OK
Txlin Local Oscillator Lock....OK       AM Clipping....................OK
FM Clipping....................OK       PA A/D SPI Read................OK
PA Current.....................OK       28 Volt Reference..............OK
14 Volt Reference..............OK       UHSO Present/Operating.........OK
Pendulum Lock..................OK       Pendulum Present...............OK
Exciter SPI Read...............OK       Circulator Load Thermal Limit..OK
PA Failure.....................OK       PA Temperature.................OK
Amplitude Alignment............OK       Power Leveling Failure.........OK
Internal Wattmeter VSWR........OK       High Int WM Reflected Power....OK
External Wattmeter VSWR........OK       High Ext WM Reflected Power....OK
External 1PPS Signal...........ACTIVE   RFB REQ Line Down..............OK
PNP Error......................OK       PNP Check Error................OK
```

*Figure 5-5: RF-O! FIPS Station Status*

*Note: Verify that the antenna return loss is adequate for transmission. Before proceeding, check that the antenna is properly fastened to the top of the paging station and that you have the output power specifications set by the factory.*

8. To set the test frequency to the frequency programmed in parameter 2000, at the prompt, type:

   **a 196 0 <Enter>**

The service terminal displays the set test channel

```
RFO FIPS: a 196 0
RFO FIPS: RA 196
<<< SET TEST CHANNEL >>>
Test Channel Set to 0.
```

*Figure 5-6: Set Test Channel Example*

9. To set the subchannel frequency offsets, at the prompt type:

   **a 195 1 2 3 0 <Enter>**

   The service terminal displays the RF-O! transmitter set subchannel frequency offsets.

```
RFO FIPS: a 195 1 2 3 0
RFO FIPS: RA 195 1 2 3 0
<<< SET SUBCHANNEL FREQUENCY OFFSETS >>>
Subchannel Frequency Offsets Set to: 1, 2, 3, 0
For Subchannels 1 Through 4, Respectively.
Where:
13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz
0 = 0.00 kHz
1 = 6.25 kHz, 2 = 12.50 kHz, 3 = 18.75 kHz
```

*Figure 5-7: Set Subchannel Frequency Offsets Example*

10. At the prompt type:

    **a 176 0 8 0 0 0 1 10 5 1 <Enter>**

    The service terminal displays the RF-O! transmitter test modes:

```
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA 176
<<< RFO TEST MODES >>>
Normal Operation is Disabled.
RFO Test Mode is Enabled.
The Station is Keyed...
```

*Figure 5-8: RF-O! Transmitter Test Modes*

*Note: The RF-O! front panel PA Keyed LED will light. For improved output power stability, allow the transmitter to warm up for at least three minutes before making any power measurements.*

11. Verify that the internal (precavity) forward power is sufficient. At the prompt type:

    **a 79 0 <Enter>**

    The system responds with FM power output readings.

*Note: The following readings are shown for example only. Your readings may be different.*

```
RFO FIPS: a 79 0
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  INTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:         79 Watts
   Total Wattmeter Voltage:  +0.93 Volts

Calibration Factor: 1.088330
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

*Figure 5-9: Internal Forward Wattmeter Reading*

12. Verify that the internal (precavity) reflected power is not too high (typically, 0 to 3 W reflected for every 100 W forward is acceptable). At the prompt type:

    **a 79 1 <Enter>**

    The system responds with the internal reflected wattmeter readings displayed.

```
RFO FIPS: a 79 1
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

========= INTERNAL REFLECTED WATTMETER =========
Last Keyed FM Readings:
   Total Station Power:          0 Watts
   Total Wattmeter Voltage:  +0.00 Volts

Calibration Factor: 1.088330
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

*Figure 5-10: Internal Reflected Wattmeter Reading*

> *Note: The internal (precavity) reflected power should not be more than five percent of the internal forward power.*

13. Verify the external (postcavity) forward power is sufficient. At the prompt, type:

    **a 79 2 <Enter>**

    The system displays the FM power output readings.

```
RFO FIPS: a 79 2
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  EXTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:         64 Watts
   Total Wattmeter Voltage:  +0.70 Volts

Calibration Factor: 1.060201
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

*Figure 5-11: External Forward Wattmeter Reading*

*Note: The external (post cavity) forward power should be at least 70 percent of the precavity forward power.*

14. Verify the external (postcavity) reflected power is not too high. At the prompt type:

    **a 79 3 <Enter>**

    The system displays external reflected wattmeter FM power output reading.

```
RFO FIPS: a 79 3
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

========= EXTERNAL REFLECTED WATTMETER =========
Last Keyed FM Readings:
   Total Station Power:          0 Watts
   Total Wattmeter Voltage:  +0.00 Volts

Calibration Factor: 1.060201
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

*Figure 5-12: External Reflected Wattmeter Reading*

*Note: The external (postcavity) reflected power should not be more than five percent of the external forward power. A good antenna system has less than two percent reflected power.*

15. Perform one last check of all wattmeters as follows. At the prompt type:

    **a 80 <Enter>**

    The system displays the RF-O! transmitter wattmeter readings.

*Note: Power readings are only taken during FM Keyups, not during the AM portion of InFLEXion frames.*

```
RFO FIPS: a 80
RFO FIPS: RA   80
<<< READ FM POWER OUTPUT >>>
 ========= RFO WATTMETER READINGS =========
 Last Keyed FM Power Readings:
   Internal Forward:        80 watts
   Internal Reflected:       0 watts
   External Forward:        64 watts
   External Reflected:       0 watts
   Number of Subchannels:    1
---------------------------------------------
The Accuracy of Each Meter is +- 10 %.
=============================================
```

*Figure 5-13: FIPS a 80 Command to View All Wattmeters*

16. Dekey the station as follows. At the prompt type:

    **a 177<Enter>**

    The station dekeys.

17. Enable the messaging operation by connecting the Ethernet AIU cable.

    The transmitter controller should recover network traffic within seconds after connecting the cable and the RF-O! transmitter should operate. If network traffic is not present and an RF-B! transmitter controller is being used, the installation, operation and troubleshooting of the RF-B! is found in *RF-Baton!™ Transmitter Controller System Installation and Operation*, Publication 6880497G01. Refer to appropriate documentation for a third-party transmitter controller. Troubleshooting procedures for the RF-O! transmitter are found in Chapter 6, "Maintenance".

## RF-O! Paging Station Parameters

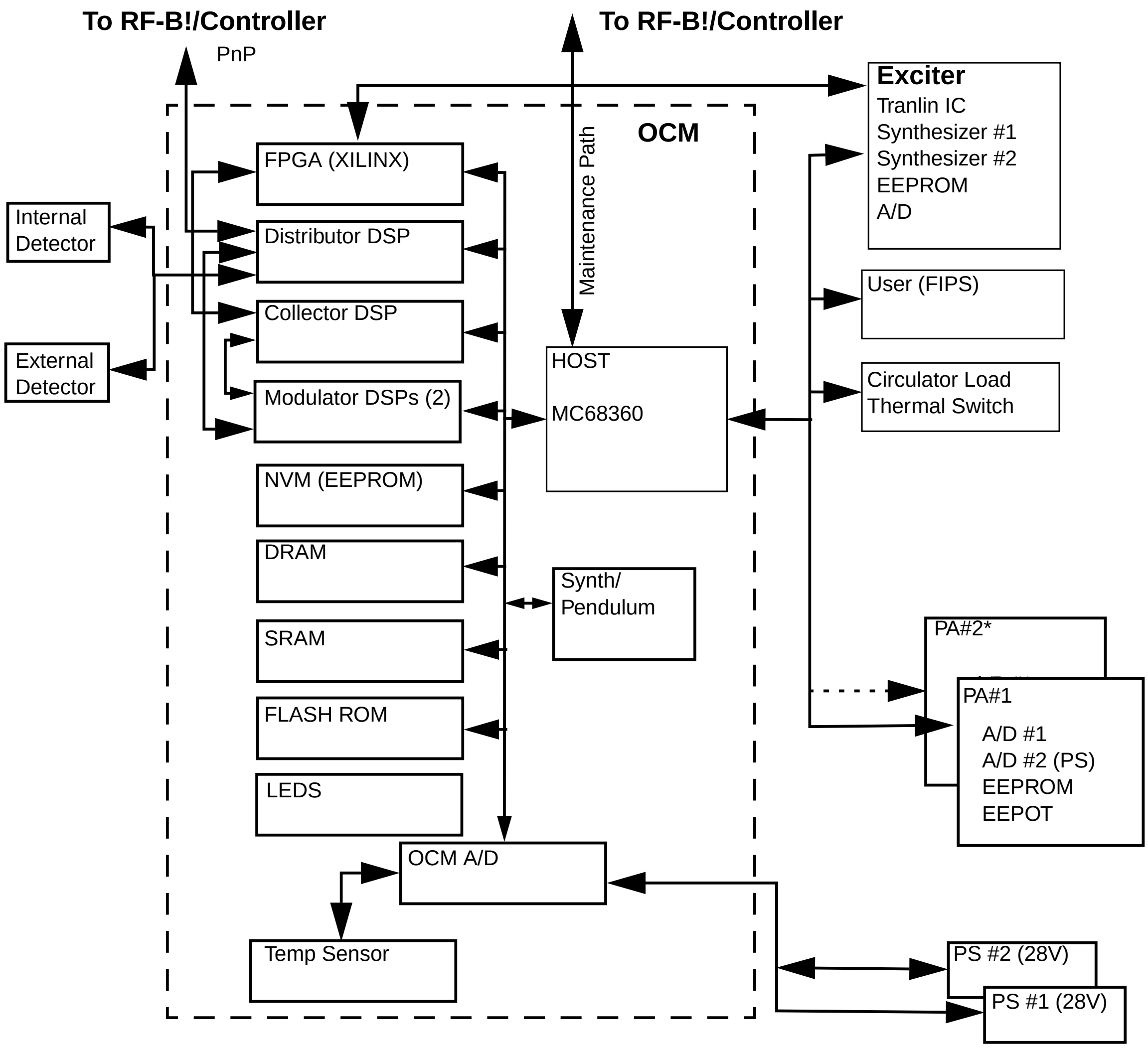
The RF-O! transmitter FIPS Action commands are listed in Appendix D, and the FIPS Read / Write parameters are listed in Appendix E.

## RF-O! Power Control

The power control feature of the RF-O! transmitter performs several functions which monitor module status and maintain maximum output power based on the status of the modules. When the modules are operating without fault, the power control software maintains the user-selected power per subchannel for both AM and FM output. Current implementations allow up to 3 FM (ReFLEX / FLEX) or 2 AM (InFLEXion) subchannels to be transmitted simultaneously. The power control software constantly adjusts various levels throughout the RF-O! transmitter, based on the modulation type and the number of subchannels.

The power control software is responsible for power metering, wattmeter calibration, power leveling, power set, module metering, alarm reporting, power cutback / shutdown, carrier feedthrough nulling, power amplifier configuration control, subchannel configuration control, and amplitude alignment.

The various communication interfaces on the RF-O! transmitter are shown in Figure 5-14.




*PA#2 present in Model PT1054.

*Figure 5-14: RF-O! Power Control Communication Interface Diagram*

## Power Metering

The station power level is measured using internal and external power detectors and support from the Distributor DSP. The combination of the Distributor DSP and the detectors form the internal and external wattmeters. The power output is determined by sampling of the internal and external detectors by the Distributor DSP when instructed to do so by the Host processor (MC68360). The Host requests samples during FM keyups only. In the case of InFLEXion voice traffic, which keys in AM modulation for the majority of the frame, the detector sampling is done during the 90ms ReFLEX and FLEX synch portion of each InFLEXion frame. When the transmitter is keyed for extended periods of time, the detectors are sampled approximately once every 2 seconds.

A debug trace was incorporated into the RF-O! software for monitoring the output of each of the wattmeters. To turn on the wattmeter trace enter the following command:

RFO FIPS: **a 192 SPCQ 64**

To turn off the wattmeter debug trace, type the following command:

RFO FIPS: **a 193 SPCQ 64**

Current wattmeter readings can also be read using the RFO FIPS: **a 79 x** and **a 80** commands.

*Note: When using the* **a 79** *and* **a 80** *commands, the readings displayed are for the last time the transmitter keyed. Even if the transmitter is dekeyed, the readings may show power output.*

Wattmeter readings are used by the RF-O! transmitter software for various purposes such as alarm reporting, power cutback, power shutdown, and power leveling.

## Wattmeter Calibration

When a detector is first installed, the accuracy of the wattmeter is within +/- 20%. To acquire more accurate readings, calibrate both the internal and external wattmeters. Once the wattmeters are calibrated, the readings are within +/- 5% accurate.

The process of calibration is fairly simple. The power is increased to a known output level (200 Watts) at each wattmeter using a calibrated power meter. Using the RFO FIPS: **a 71 x y**, the RF-O! transmitter software is told the actual power output. The software then creates a calibration factor using both the actual power reading and the reading it is getting from the detector. From that point on it multiplies its readings by the calibration factor to acquire the actual power output. The calibration factor ranges from 0.8 to 1.2. See paragraph , "Check Front Panel Indications" in Chapter 6, "Maintenance" for detailed instructions on wattmeter calibration.

## Amplitude Alignment

Once the wattmeters are calibrated, the power output can be aligned. Power amplitude alignment allows the transmitter to output the desired per-subchannel power, based on a known power output with a single FM subchannel.

When amplitude alignment is performed, the RF-O! transmitter software creates two tables of values: one for AM (voice) and one for FM transmissions. When the RF-O! transmitter receives a control command from the RF-B! transmitter controller defining the next keyup modulation and number of subchannels, the correct values are sent to the various DSPs and the Exciter to assure that the power output per-subchannel is at the desired level. To view these values, enter the RFO FIPS: **a 87 0** (FM) and **a 87 1** (AM) commands (See Figure 5-15).

```
RFO FIPS: a 87 1
RFO FIPS: RA   87
<<< AM AMPLITUDE CONTROL PARAMETERS >>>

                                             Number of Subchannels
                        Align          1           2           3           4
                       -----------------------------------------------------
  Power                  150          69          69           0           0
  K-Factor      990 1.000000    0.678233    0.959166    0.000000    0.000000
  Fdback Atten  996      255         229         229           0           0
  Phase Trng    982   -10000      -14000      -14000           0           0
  Txlin Reg2    954       84          84          20           0           0
  Txlin Reg1    953       14          14          14           0           0
  Txlin Atten   974        0           0           0           0           0
  Mod Dev      2053     4800        4800        4800           0           0
  FM Power Lvl 2054    28000       28000       28000           0           0
  AM Pilot Pwr 2055     1600        1600        1600           0           0
  AM Sdbd Pwr  2056    12426       12426       12426           0           0
                       -----------------------------------------------------
=============================================
RFO FIPS: a 87 0
RFO FIPS: RA   87
<<< FM AMPLITUDE CONTROL PARAMETERS >>>

                                             Number of Subchannels
                        Align          1           2           3           4
                       -----------------------------------------------------
  Power                  150          50          50          50           0
  K-Factor      990 0.408269    0.235714    0.471428    0.707168    0.000000
  Fdback Atten  996      255         255         255         255           0
  Phase Trng    982   -10000      -14000      -14000      -14000           0
  Txlin Reg2    954       84          84          20          20           0
  Txlin Reg1    953       14          14          14          14           0
  Txlin Atten   974        0           0           0           0           0
  Mod Dev      2053     4800        4800        4800        4800           0
  FM Power Lvl 2054    28000       28000       14000        9333           0
  AM Pilot Pwr 2055     1600        1600        1600        1600           0
  AM Sdbd Pwr  2056    12426       12426       12426       12426           0
                       -----------------------------------------------------
=============================================
```

*Figure 5-15: Power Amplitude Control Parameters*

## Power Set

The power set functionality of the RF-O! transmitter software simply regenerates the tables in Figure 5-15 based on the user's desired per-subchannel power setting. Using the RFO FIPS: **a 88 0 x** and **a 88 1 y** commands, the user can select the power output for both FM and AM transmissions. The range of power settings depends upon the number of PAs installed. Table 5-8 shows the allowable power settings for different station configurations.

*Table 5-8: RF-O! Transmitter Power Setting Chart*

| | | | Average Power Per Subchannel (Watts) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | FLEX™/ReFLEX ™ Subchannels (FM) | | | | InFLEXion™ Subchannels (AM) | | |
| | Number of | | All | One | Two | Three | All | One | Two |
| Model Number | PAs | PSs | Min | Max | Max | Max | Min | Max | Max |
| **PT1052** | 1 | 2 | 40 | 400 | 125 | 55 | 40 | 75 | -- |
| **PT1054** | 2 | 2 | 40 | 290 | 145 | 95 | 65 | 150 | 75 |

For an example, assume that the RF-O! transmitter is Model PT1052 (Single PA) and the user wants to transmit at most two subchannels of ReFLEX. The table indicates that the FM power setting must be between 40 Watts (Min) and 125 Watts (Max). Model PT1052 will only support a single subchannel of AM (InFLEXion) with a power range of 40 to 75 Watts.

To set the FM power to 75 Watts, enter the following RFO FIPS command:

RFO FIPS: **a 88 0 75**

To set the AM power to 50 Watts, enter the following RFO FIPS command:

RFO FIPS: **a 88 1 50**

The RF-O! transmitter software will not allow the user to enter a power setting which is not valid for the current RF-O! transmitter model configuration.

## Module Monitoring

The module monitoring feature monitors each of the modules within the RF-O! transmitter for failure conditions. The RF-O! transmitter software periodically checks the status of the Exciter, Power Amplifier(s), Power Supplies, Circulator Load Temperature, and OCB to determine whether the transmitter should continue transmitting at full power, cutback, or disable the transmitter completely.

Whenever a failure condition occurs, an entry is added to the error log (RFO FIPS: **a 104**). If the failure causes a cutback or shutdown, an entry is added to the alarm log (RFO FIPS: **a 99**).

## Power Cutback/Shutdown

The RF-O! transmitter constantly analyzes its current status. When it detects failures, it determines if it can continue keying at full power or if it needs to cutback or shutdown completely.

Currently the transmitter will perform a cutback due to the following station failures:

- A 3 dB cutback will occur when a PA temperature exceeds the ambient temperature by more than a user-configurable amount. For detailed information, see paragraph, "High PA vs. Ambient Temperature Cutback/Shutdown Operation".
- If the ambient temperature of the OCM rises above +45 degrees C, the transmitter will cutback. For detailed information, see paragraph, "High PA vs. Ambient Temperature Cutback/Shutdown Operation".
- A 6 dB cutback occurs if a PA failure is detected in a 2-PA configuration.

*Note: When a 6 dB cutback occurs, it is quite possible that the cutback power output will be below the minimum allowable power setting of the transmitter. In this case, the transmitter will be unable to transmit.*

There are several conditions that will cause the transmitter to no longer operate at any power output. When any of these conditions occurs, the transmitter shuts down. Some of the conditions that will cause the transmitter to shutdown are high ambient temperature, Txlin not locked, pendulum not locked or detected, PA failures, invalid amplitude alignment, high VSWR, Plug and Play errors, Exciter not locked, Circulator load temperature limit exceeded. The transmitter can also be shut down or disabled by the user entering the RFO FIPS: **w 99 1** command. A complete list of the possible shutdown/disable conditions can be found by entering the RFO FIPS: **a 83** (station status) command.

## Power Leveling

If the power leveling feature is enabled, the RF-O! transmitter constantly monitors the power output of the transmitter and automatically makes fine adjustments to keep the power output at the desired level. After every 20 internal wattmeter forward power samples are taken, the average power output for those 20 samples is calculated. If the average differs from the desired per-subchannel power output, an adjustment is made to the power tables. Parameter 2999 (P_POWER_LEVELING_DB) is adjusted to bring the average power back to the desired power. When this parameter is modified, the AM and FM power tables are recalculated. The new table values are used on the next keyup sequence. The FM and AM power tables are read by entering the RFO FIPS: **a 87 0** and **a 87 1** commands, respectively.

Power leveling functionality is enabled by default. To disable power leveling write parameter 997 to 0 (RFO FIPS: **w 997 0**). To enable power leveling, both parameters 992 (Power Control) and 997 must be set to 1 (RFO FIPS: **w 992 1** and **w 997 1**).

The amount of power leveling is determined by entering RFO FIPS: **r 2999**. The amount is also displayed as part of the RFO FIPS: **a 83** (station status) display.

A power leveling debug trace allows monitoring of the power leveling. To enable the power leveling trace, enter the RFO FIPS: **a 192 SPCQ 16** command. While the trace is active and the station is keying, information similar to the following will be printed to the FIPS console (See Figure 5-16).

```
RFO FIPS:
<SPCQ 16> LEVELING: Desired=100 W  Actual=101 W  Leveling Change=-0.04 dB  Total Leveling=-0.04 dB
<SPCQ 16> LEVELING: Desired=100 W  Actual=100 W  Leveling Change= 0.00 dB  Total Leveling=-0.04 dB
<SPCQ 16> LEVELING: Desired=100 W  Actual=100 W  Leveling Change= 0.00 dB  Total Leveling=-0.04 dB
<SPCQ 16> LEVELING: Desired=100 W  Actual=100 W  Leveling Change= 0.00 dB  Total Leveling=-0.04 dB
<SPCQ 16> LEVELING: Desired=100 W  Actual=100 W  Leveling Change= 0.00 dB  Total Leveling=-0.04 dB
```

*Figure 5-16: Power Leveling Trace*

To **disable** the power leveling trace, enter the RFO FIPS: **a 193 SPCQ 16** command. For more information on this and other debug traces see Appendix H.

## Alarm Reporting

The RF-O! transmitter constantly monitors the various components of the transmitter for conditions that may degrade or interrupt normal messaging traffic. When such a condition is detected, the appropriate error code is added to the error log (RFO FIPS: **a 104**). In cases, where the transmitter must cutback or shutdown, an alarm is added to the alarm log (RFO FIPS: **a 99**).

## Subchannel Configuration Control

The RF-O! transmitter can transmit on up to three FLEX or ReFLEX (FM) subchannels or two InFLEXion (AM) subchannels, simultaneously. The subchannel configuration control portion of power control assures that the power output is adjusted correctly based on the number of subchannels and type of modulation.

## Power Amplifier Configuration Control

The number of operational power amplifiers is constantly monitored by the RF-O! transmitter. If a PA failure is detected by the RF-O! transmitter software, the transmitter takes the appropriate action. In a two-PA system, if one PA were to fail, the RF-O! transmitter would continue to operate at a reduced power output level.

## Carrier Feedthrough Nulling

The carrier feedthrough (CFT) nulling feature of power control is responsible for removing the carrier feedthrough component of the spectrum from the center channel. If the CFT component is not minimized, messaging quality can suffer in the form of audio distortion (InFLEXion), or garbled messages (FLEX/ReFLEX). The carrier feedthrough component of a transmission is shown in Figure 5-17.

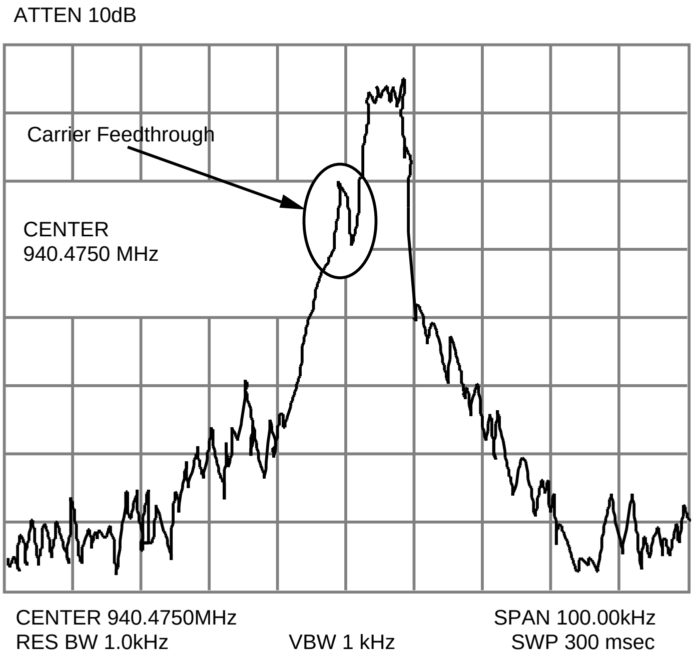



*Figure 5-17: Spectrum Analyzer Display With Carrier Feedthrough*

CFT nulling adjusts the I and Q Offset values in the Collector DSP. The I and Q Offset are RFO FIPS: parameters 979 and 980, respectively.

As the temperature of the station changes, the CFT component can change. Even a properly adjusted (nulled) transmitter must be periodically readjusted to assure that the CFT component is kept at a minimum level.

CFT nulling can be done manually, semiautomatically, or automatically.

## Manual Carrier Feedthrough Nulling

This method of nulling the carrier requires the user to enter different I and Q offset values through the FIPS interface. This method takes the most effort on the part of the user and contains the highest potential for error. (See RFO FIPS: parameters 979 and 980).

This method should only be used by development engineering. Semiautomatic or automatic CFT nulling should be used.

### Semiautomatic Carrier Feedthrough Nulling

This method requires a single FIPS command to initiate and execute the CFT nulling (RFO FIPS: **a 74**). This method is normally performed during alignment and at a specified interval thereafter. Normal paging traffic is halted for up to 30 seconds, while the Semi-automatic Carrier Feedthrough Nulling is performed.

When the nulling is completed successfully, the new I and Q offset values are written to the parameter database (parameters 979 and 980). Also, the 979A, 980A, 979B, 980B, Current Ambient Temperature, and the Vif values (See Figure 5-18) are written to the EEPROM on the Exciter. The 979A and 980A values will be used in subsequent semi-automatic and automatic CFT nulling attempts to speed up the execution. If the Exciter EEPROM does not contain valid CFT nulling parameters at startup, the 979A and 980A values will need to be acquired.

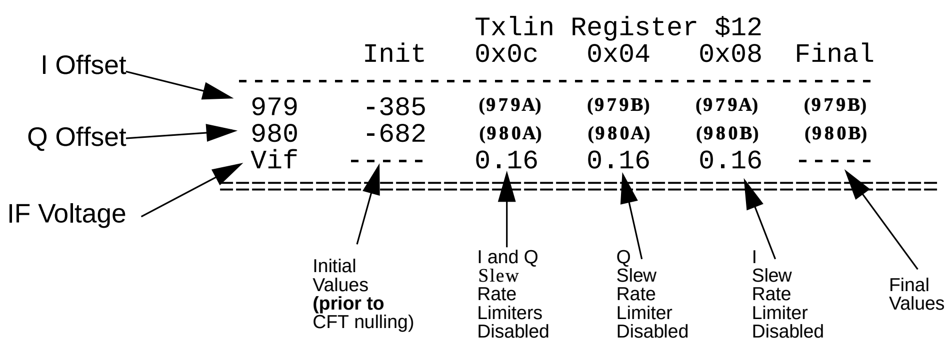



*Figure 5-18: Ambient Temperature and Vif Values*

### Automatic Carrier Feedthrough Nulling

This method requires no user intervention. Auto CFT nulling is performed when there are intervals or gaps in paging traffic which allow the RFO to make fine adjustments to the I and Q offsets, to attain the minimum IF Voltage. Auto CFT nulling should be enabled in stations transmitting InFLEXion voice traffic.

In order for Auto CFT Nulling to be effective, the station must have had an initial “complete” nulling performed, at some time. If a “complete” nulling was performed, the CFT nulling table will be present and valid in the Exciter EEPROM. If the Host does not detect a valid CFT nulling table, and Auto CFT Nulling is Enabled (RFO FIPS: **w 998 1**), the RFO will automatically perform a “complete” nulling, and store the results in the Exciter EEPROM, at the first opportunity. Once the “complete” null has been completed successfully, and the table values have been stored in the Exciter EEPROM, subsequent resets of the station will not require additional “complete” CFT nullings. If the “complete” nulling is unsuccessful (due to bad exciter, or transmitter becomes disabled, etc.), a “CFT Nulling Failed” error will be logged. The RFO will repeat nulling attempts at all subsequent opportunities, and will continue to log “CFT Nulling Failed” errors as they occur. In order to notify the control center of a potential problem with the transmitter, a “CFT Nulling Failed” alarm is also be logged.

CFT nulling will take on two possible automatic forms: Auto CFT Nulling, and DC Offset Training. The DC Offset Training is explained below. Auto CFT Nulling is a time-critical operation that is to be performed by the RF-O! software at the appropriate opportunity. A single RF-O! EEPROM parameter (998) is used to control the type of nulling to be performed. If parameter 998 is set 0, neither Auto CFT Nulling nor DC Offset Training will be performed. If it is set to 1, Auto CFT Nulling will be enabled. If it is set to 2, DC Offset training will be enabled.

When enabled, Auto CFT Nulling makes fine adjustments to the current I and Q offset values during all "Synch-Only" InFLEXion frames. The entire adjustment takes less than 1.3 seconds to execute.

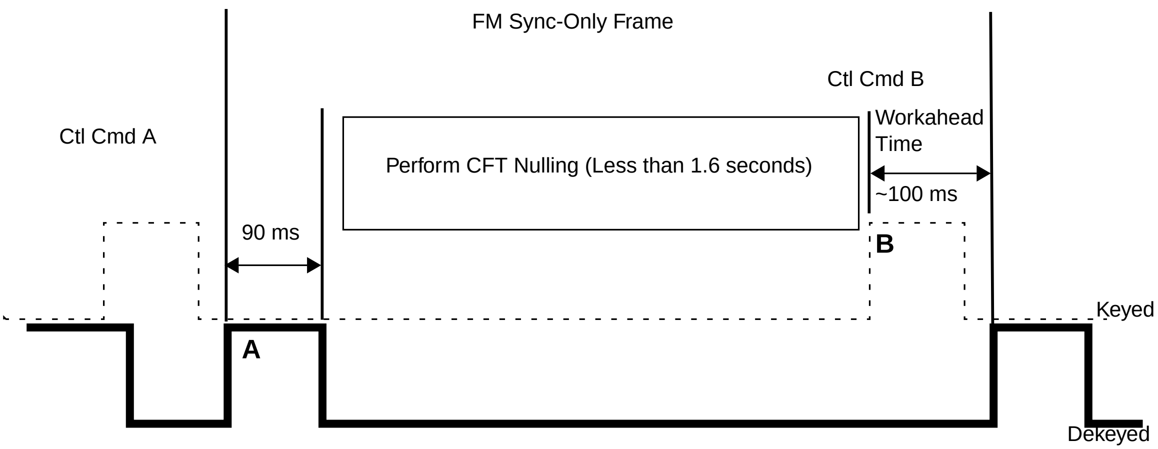



*Figure 5-19: Timing Diagram for Automatic CFT Nulling*

## DC Offset Training

DC Offset Training should be used in transmitters which will only be used for FLEX or ReFLEX (no InFLEXion) applications.

To enable DC Offset Training, write parameter 998 to 2 (RFO FIPS: **w 998 2**).

Power Control (RFO FIPS: **w 992 1**) must be enabled for DC Offset Training to function properly

*Note: Power control is enabled upon every station reset. It should only be disabled for testing purposes.*

## RF-O! Ambient Temperature Monitoring

The RF-O! transmitter monitors the ambient (room) temperature, with a sensor located just behind the LEDs on the OCM board. When correctly calibrated at about 25 degree C, the sensor has typically less than 1 degree C error over a 100 degree C range. The RF-O! transmitter uses the ambient temperature sensor on the OCM to determine two types of high temperature conditions: high ambient temperature and high PA temperature.

Ambient temperature is used to cutback or shutdown power to avoid possible damage to the PAs or other components within the transmitter. The RF-O! transmitter is specified to work at full power from –30 to +45 degrees celsius and to derate from 0 to 3 dB between +45 and +60 C. When the temperature goes above +60 C, the transmitter automatically becomes disabled (shutdown).

In addition, the ambient temperature signal is compared every 10 seconds to the PA temperature read by the host processor. When the PA temperature exceeds ambient temperature by an amount greater than the user configured trip point (called the PA vs. Ambient Temperature 3 dB setting), an alarm and error are logged while the RF power of the station is derated by 3 dB. If PA Temperature rises above the PA vs. Ambient Temperature Shutdown Offset, also configurable by the user, another alarm and error are logged, and the transmitter is disabled (shutdown).

## High Ambient Temperature Cutback/Shutdown Operation

The RF-O! transmitter makes ambient temperature sensor readings every 10 seconds. The RF-O! transmitter compares the current ambient temperature with the value stored in parameters 3001 (Ambient Temperature Power Derate Start) and 3002 (Ambient Temperature Power Shutdown). If the ambient temperature is greater than 3001, but less than 3002, a cutback will occur. The amount of cutback depends on the values of 3001, 3002, and 3003 (Ambient Temperature Derate Maximum Cutback).

For all Ambient Temperatures falling between the values programmed in parameters 3001 and 3002, the following equation applies, with the assumption that the value stored in parameter 3002 is greater than that stored in parameter 3001:

CutbackAmount (in dB) = *Param3003* * ((*CurrentAmbTemp* – *Param3001*) / (*Param3002* – *Param3001*))

*Param3001* = Ambient Temperature Power Derate Start (default: +45 C)

*Param3002* = Ambient Temperature Power Shutdown (default: +60 C)

*Param3003* = Ambient Temperature Derate Maximum Cutback (default: 3.0 dB)

*CurrentAmbTemp* = Current Ambient Temperature Reading, stored in parameter 1026.

This represents a linear derate from 0 to *Param3003* dB, between *Param3001* degrees C, and *Param3002* degrees C (See Figure 5-20).

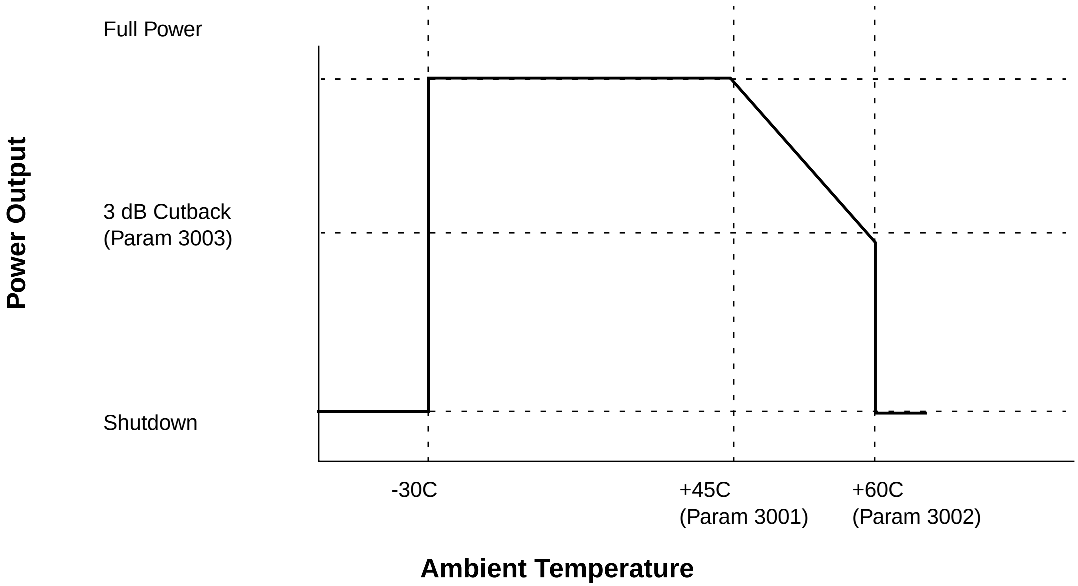



*Figure 5-20: Ambient Temperature vs. Power Output Derate Curve*

For example, using the default values for parameters 3001, 3002, and 3003, as +45 C, +60C, and 3.0 dB, respectively, we can calculate the amount of cutback that would be present at an Ambient Temperature of 50 degrees C.

CutbackAmount (in dB) = *Param3003* * ((*CurrentAmbTemp* – *Param3001*) / (*Param3002* – *Param3001*))

CutbackAmount = 3.0dB* (50-45) / (60-45)

CutbackAmount = 3.0dB* (50-45) / (60-45)

CutbackAmount = 1.0 dB, when the Ambient Temperature is +50.

When the Ambient Temperature is less than *Param3001*, there is no cutback. When it is greater than *Param3002*, the transmitter is shutdown (disabled).

It is important to note that there are many different causes for the station to Cutback or Shutdown. Use the Station Status FIPS command (**a 83**) to determine the cause of any cutback or shutdown. If several cutbacks are active, the highest cutback amount will take precedent. If any shutdowns / disables are active, the transmitter will be disabled, regardless of any cutbacks that may be active.

### High Ambient Temperature Alarms/Error Logs

The following errors and alarms are associated with the High Ambient Temperature Cutback and Shutdowns. See Appendix F, for full details.

- A 104 Error Log Entries

  E_HIGH_AMBIENT_TEMP_SHUTDOWN_ALARM

  E_HIGH_AMBIENT_TEMP_CUTBACK_ALARM

- A 99 Alarm Log Entries

  Transmitter Disabled Due To High OCM Ambient Temperature.

  Transmitter Cutback Due To High OCM Ambient Temperature.

## High PA vs. Ambient Temperature Cutback/Shutdown Operation

The RF-O! transmitter takes ambient temperature sensor and PA Temperature readings every 10 seconds. The PA temperature of each installed PA is compared to the Ambient Temperature.

If any of the PA Temperatures exceeds the Ambient Temperature by an amount greater than the value configured by the user (Parameter 1025 – PA vs. Ambient Temp 3dB Cutback Offset), an error is logged, an alarm is logged, and a 3 dB cutback occurs. Logging of the alarm will also send the alarm via the RFB-RFO Maintenance Path interface to display at the Choreographer! or MIB browser.

If any of the PA Temperatures exceeds the Ambient Temperature by an amount greater than the value configured by the user (Parameter 1025 – PA vs. Ambient Temp Shutdown Offset), an error is logged, an alarm is logged, and the transmitter is disabled (shutdown).

Either the cutback or shutdown conditions can clear if the PA temperature drops (or the Ambient Temperature rises).

### High PA vs. Ambient Temperature Alarms/Error Logs

The following errors and alarms are associated with the High Ambient Temperature Cutback and Shutdowns. See Appendix F for full details.

- A 104 Error Log Entries

  E_HIGH_PA_HS_TEMPERATURE_FAIL_DECK_1

  E_HIGH_PA_HS_TEMPERATURE_FAIL_DECK_2

  E_PA_TEMP_SHUTDWN_ALARM

  E_PA_TEMP_CUTBACK_ALARM

- A 99 Alarm Log Entries

  Power Amplifier 1 Operating Temperature Has Exceeded Specification.

  Power Amplifier 2 Operating Temperature Has Exceeded Specification.

  Transmitter Disabled Due To High PA Temperature.

  Transmitter Cutback Due To High PA Temperature.

### Configuring High PA vs. Ambient Temperature Cutback/Shutdown Thresholds

By default, the RFO is programmed to perform a 3 dB cutback whenever one or more of the installed PA's heatsink temperature is more than 30 degrees C higher than the Ambient Temperature (parameter 1026). For testing purposes, it may be necessary to change this value. To modify the PA vs. Ambient Temperature 3 dB Cutback Offset, write a value to parameter 1025.

**RFO FIPS: w 1025 <value>**

Where **<value>** is a whole number between 0 and 70, in units of degrees celsius. The default is 30. Note that if this value is higher than the value stored in parameter 1024, the cutback will never be performed prior to complete shutdown (see paragraph below).

By default, the RFO is programmed to **shutdown** whenever one or more of the installed PA's heatsink temperature is more than 45 degrees C higher than the Ambient Temperature. For testing purposes, it may be necessary to change this value. To modify **the PA vs Ambient Temperature Shutdown Offset**, write a value to parameter 1024.

**RFO FIPS: w 1024 <value>**

Where **<value>** is a whole number between 10 and 45, in degrees celsius. The default is 45.

# Maintenance

Maintenance for the RF-O! transmitter includes the following topics:

- Troubleshooting
- Removal and Replacement
- Resetting the Parameter Database
- Paging Station Alignment
- Temperature Calibration Procedure
- Software Download

# Troubleshooting

This section contains top level diagnostics for the RF-O! transmitter. If the paging station is not keying, this section is especially useful.

This troubleshooting index is a guide to isolating failures at the Field Replaceable Unit (FRU) level. The index lists indications, possible failures, and corresponding corrective actions.

The service technician performs troubleshooting whenever a failure occurs that cannot be resolved by the RF-Conductor! (RF-C!) controller. If a failure is isolated to a FRU, replace the defective module with a working unit and contact the Motorola One-Call-Support™ Center for repair.

Troubleshooting references made to the RF-B! transmitter controller, RF-C! controller and network peripherals are provided as a quick reference for resolving minor problems to those subsystems. Refer to the appropriate manuals for comprehensive diagnostics.

## Check Front Panel Indications

Table 6-1 provides information about front panel indications, possible failures, and corrective actions. (LEDs are listed as they appear on the front panel from left to right.)

*Table 6-1: RF-Orchestra! Front Panel Indications Troubleshooting Chart*

| LED | Color | Status | Condition |
|---|---|---|---|
| **CONTROL ON** | Green | On | Control module is ON and has successfully gone through boot process |
| | | Off | Control module is OFF or has not successfully gone through boot process |
| **CONTROL FAIL** | Red | On | Control module has not successfully gone through boot process |
| | | Off | Control module has successfully gone through boot process |
| **DISABLE** | Red | On | The transmitter is disabled. Paging has ceased. Check station status (**A 83**) and Alarm log (**A 99**) to determine cause of disable. |
| | | Off | Normal operation |
| **ALARM** | Red | On | Station alarm has been detected. There is an active alarm in the **A 99** log. Clear this log with **A 103**. |
| | | Off | Normal operation |
| **PA KEYED** | Green | On | Station Keyed |
| | | Off | Station Dekeyed |
| **EXCITER LOCKED** | Green | On | Station locked on transmit frequency |
| | | Off | One or both exciter synthesizers or Tranlin LO not locked |
| **FULL POWER** | Green | On | Station operating without any cutbacks |
| | | Off | Station is operating with a cutback or is shutdown. Check station status (**A 83**). |
| **POWER CUTBACK** | Yellow | On | Any PA not at full power (Cutback). Check station status (**A 83**) to determine the reason for the cutback. |
| | | Blinking | Transmitter is Disabled (Shutdown). Check station status (**A 83**) and alarm log (**A 99**). |
| | | Off | All PAs capable of transmitting at full power |

## Verify Data from the RF-B! Transmitter Controller

If the RF-O! transmitter is not transmitting, verify that the RF-B! transmitter controller is working properly. Refer to the *RF-B! Transmitter Controller for the RF-O! Paging Station Installation and Operation* manual for information about the transmitter controller.

## RF-O! Transmitter Status

1. Establish an RFO FIPS session.

2. Display the current status of the station with RFO FIPS: **a 83**. This command displays the current status of Power Control, Amplitude Alignment, Internal and External Wattmeter Calibration, Power Cutback State, Paging Disabled Status, and Power Leveling.

```
RFO FIPS: a 83
RFO FIPS: RA   83
<<< STATION STATUS/MODE >>>
Power Control (R 992)..........ENABLED  Power Leveling (R 2999)........ 0.00dB
Int Wattmeter Calibration......VALID    Ext Wattmeter Calibration......VALID
Amplitude Alignment............VALID

POWER CUTBACK STATE.........SHUTDOWN
PA Temperature............FULL_POWER    Ambient Temperature.......FULL_POWER
PA Deck/Power Supply......FULL_POWER    Disabled Status.............SHUTDOWN

PAGING DISABLED STATUS (R 100 = 0 = 0h)
Paging Access Disabled (R 99)..OK       Power Supply A/D Read..........OK
OCM Ambient Temperature........OK       Exciter Synthesizer Lock.......OK
Txlin Local Oscillator Lock....OK       AM Clipping....................OK
FM Clipping....................OK       PA A/D SPI Read................OK
PA Current.....................OK       28 Volt Reference..............OK
14 Volt Reference..............OK       UHSO Present/Operating.........OK
Pendulum Lock..................OK       Pendulum Present...............OK
Exciter SPI Read...............OK       Circulator Load Thermal Limit..OK
PA Failure.....................OK       PA Temperature.................OK
Amplitude Alignment............OK       Power Leveling Failure.........OK
Internal Wattmeter VSWR........OK       High Int WM Reflected Power....OK
External Wattmeter VSWR........OK       High Ext WM Reflected Power....OK
External 1PPS Signal...........ACTIVE   RFB REQ Line Down..............OK
PNP Error......................OK       PNP Check Error................OK
```

If the **Amplitude Alignment** or either of the **Internal** or **External Wattmeter Calibrations** are *INVALID*, the RF-O! transmitter must be aligned or calibrated.

If **CFT Nulling** is INVALID, this indicates that CFT Nulling has not been performed since RFO 2.0.0 was installed, or since a new Exciter module was installed. RFO 2.0.0 was the first version of software to store the CFT Nulling table in the Exciter EEPROM. See Chapter 5, "Operation", Carrier Feedthrough Nulling section.

If the **Power Leveling** amount is greater than 0.5 dB or less than -0.5 dB, this usually indicates that the Amplitude Alignment is not accurate. However, if the **Amplitude Alignment** is accurate, then the Internal Wattmeter must be recalibrated.

If any of the Disable Sources (under **PAGING DISABLED STATUS**) are ACTIVE, the transmitter will not key until the cause of the disable is cleared. Check the alarm and error log (RFO FIPS: **a 99** and **a 104**) for details on any active Disable Source.

*Note: The transmitter can be temporarily disabled by writing parameter 99 to '1' (RFO FIPS:* **w 99 1***). It can then be enabled, if no other disable sources are ACTIVE, by writing it back to '0' (RFO FIPS:* ***w 99 0****).*

*Table 6-2: Paging Disabled Definitions (Sheet 1 of 4)*

| Disable Source | Description |
|---|---|
| Paging Access Disabled | Parameter 99 is Set to 1 by the user. Write parameter 99 to 0 (RFO FIPS: **w 99 0**)to clear this disable source. |
| PA Power Supply A/D Read Fail | An attempt to read the Power Supply A/D Converter on one of the PA's by the RF-O! transmitter software failed, or the A/D Test voltage was not within the valid range. Check for proper installation of PAs. |
| OCM Ambient Temp High | The Ambient Temperature read on the OCM is greater than the Ambient Temperature Shutdown threshold, which is stored in parameter 3002 (in degrees Celsius). Verify that the OCM temperature sensor has been calibrated correctly. Parameter 1026 displays the current OCM ambient temperature. Parameters 1028 and 1029 are used to calibrate the temperature reading. Power Control must be Enabled for this disable source to cause the transmitter to shutdown. |
| Exciter Not Locked | One or both of the 2 LO synthesizers on the Exciter is not locked. Check for proper exciter installation, plug-and-play cable connection, Pendulum, or UHSO alarms. |
| Txlin Not Locked | The IF synthesizer on the exciter is not locked. |
| AM Clipping Detected | Clipping has occurred on 3 consecutive voice (InFLEXion) transmissions. Power Control must be Enabled (parameter 992 set to 1) for this disable source to cause the transmitter to shutdown. |

*Table 6-2: Paging Disabled Definitions (Sheet 2 of 4)*

| Disable Source | Description |
|---|---|
| FM Clipping Detected | Clipping was detected during an FM transmission. Power Control must be Enabled (parameter 992 set to 1) for this disable source to cause the transmitter to shutdown. Several conditions may cause FM clipping. |
| PA A/D Read Fail | The RF-O! transmitter was unable to read one of the PAs A/D converters. Check **a 99** or **a 104** log to determine specific PA having the problem. |
| PA Current Out of Range | Not Currently Supported |
| 28V Reference Out of Range | Not Currently Supported |
| 14V Reference Out of Range | Not Currently Supported |
| UHSO Failure | The Ultra High Stability Reference Oscillator Has Not Been Detected. |
| Pendulum Not Locked | 16.8MHz Pendulum Reference Not Phase Locked. |
| Pendulum Not Detected | 16.8MHz Pendulum Reference Not Detected. |
| Exciter SPI Read Fail | Failed to Read the Exciter A/D Converter. |
| Circulator Load Temp Exceeded | The RF-O! transmitter has detected that the Circulator Load Thermal Switch, which is connected to the RFO backplane at J12, has triggered. Parameter 1030 must be set to 1 for this feature to work. By default 1030 is set to 1 (Enabled). |
| PA Failure(s) | The number of PA failures was high enough that the transmitter was unable to continue paging. |
| PA Shutdown Temp Exceeded | The difference between any one of the installed PA's temperature and the ambient temperature is greater than the number of degrees Celsius specified in parameter 1024. Read parameter 1026 to see current ambient temperature, as read on the OCM board. Use RFO FIPS: **a 192 SHMI 4** to monitor PA and Ambient Temperature readings. |
| Amplitude Alignment Bad | At power up, it was determined that the Amplitude Alignment values within the Exciter EEPROM are not valid.Power Control must be disabled (RFO FIPS: **w 992 0**), then amplitude alignment (RFO FIPS: **a 76**) must be performed. This disable source is cleared once Amplitude Alignment is successfully performed. |
| Power Leveling Out of Range | The automatic power leveling feature of Power Control attempted to level the power by more than 1.5 dB or less than -1.5 dB. This disable signals that the amplitude alignment and/or wattmeter alignment is possibly not correct. |

*Table 6-2: Paging Disabled Definitions (Sheet 3 of 4)*

| Disable Source | Description |
|---|---|
| High Internal Wattmeter VSWR | The Voltage Standing Wave Ratio (VSWR) read at the Internal Wattmeter is greater than 3.0. That is, the reflected power reading is more than one fourth that of the forward power reading. Check for loose RF connections. |
| High Internal WM Reflected Power | An Internal Wattmeter Reflected Power reading (per subchannel), read during FM keying, was above the level indicated by parameter 143 (in Watts). NOTE: It is the user's responsibility to assure that this parameter is set to the correct value based on the desired FM power output. Use RFO FIPS: **a 192 SPCQ 64** to see periodic wattmeter readings. |
| High External Wattmeter VSWR | The Voltage Standing Wave Ratio (VSWR) read at the External Wattmeter is greater than 3.0. That is the reflected power reading is more than one fourth that of the forward power reading. Check for loose RF connections. |
| High External Reflected Power | An External Wattmeter Reflected Power reading (per subchannel), read during FM keying, was above the level indicated by parameter 146 (in Watts). NOTE: It is the user's responsibility to assure that this parameter is set to the correct value based on the desired FM power output. Use RFO FIPS: **a 192 SPCQ 64** to see periodic wattmeter readings. |
| Plug-N-Play Error | An error has been detected by the Distributor DSP. This Disable stays active for approximately 2 seconds when an error on the Plug-N-Play interface between the RFO and RFB has been detected. The errors that contribute to this disable are designated by an error source of ROUTE_MSG_FROM_DIST_DSP in the "A 104" error log. These include;<br>E_CHECK_COMMAND_FORMAT_ERROR,<br>E_CONTROL_COMMAND_FORMAT_ERROR,<br>E_END_OF_COMMAND_ERROR,<br>E_FREQ_OFFSET_ERROR,<br>E_INCOMPLETE_FRAME_ERROR,<br>E_INVALID_COMMAND_TYPE_ERROR,<br>E_INVALID_MOD_TYPE,<br>E_INVALID_NEXT_MODULATION_TYPE,<br>E_INVLAID_NUMBER_OF_SUBCHANNELS,<br>E_MOD1_INPUT_OVERFLOW_ERROR,<br>E_MOD2_INPUT_OVERFLOW_ERROR,<br>E_MODULATION_TYPE_ERROR,<br>E_START_TIME_ERROR,<br>E_SYMBOL_DATA_COMMAND_FORMAT_ERROR,<br>E_UNEXPECTED_SYMBOL_COMMAND_ERROR,<br>E_WORK_AHEAD_WINDOW_ERROR |

*Table 6-2: Paging Disabled Definitions (Sheet 4 of 4)*

| Disable Source | Description |
|---|---|
| Check Command Error | The transmitter has been disabled because the RF-O! transmitter has detected that the key state (either keyed or dekeyed) or the current channel number is not consistent with what the controller expects. The transmitter is only disabled temporarily to allow the RF-O! transmitter and controller to resynchronize. |
| Service Mode | The transmitter is not disabled, but is being keyed for one of two reasons: Test Mode (**a 176**) or CFT Nulling (**a 74**). The TX_OK line is held low to indicate to the Transmitter Controller (RF-B!) that paging data will not be transmitted. |

## Check for Timing Chain Errors on the RF-O! Transmitter

Check the alarm and error log **(RFO FIPS: a 99** and **a 104**) for details of any errors listed below that indicate 1-PPS synchronization problems:

- S_PAGING_DISABLED

  Check for paging disabled (RFO FIPS: **r 100**). This value should be 0. Use RFO FIPS: **a 83** to determine active disable source(s).

- E_SYNTH1_LOCK_FAILURE, E_SYNTH2_LOCK_FAILURE, or E_EXCITER_FRU_FAIL_ALARM

  If any of these errors are in the error log, and the condition still exists, the Exciter Locked LED on the front of the RF-O! transmitter should be off. The exciter should fail exciter diagnostics (RFO FIPS: **a 188 c**). Erase the error log (RFO FIPS: **a 111**), turn the RF-O! transmitter Power switch off, and make sure that the OCM and the exciter are properly inserted in the chassis. Turn the Power switch on and check for these errors again (RFO FIPS: **a 104**). If any of these errors are in the log, replace the exciter.

- E_PENDULUM_NOT_LOCKED or E_PENDULUM_REFERENCE_FAILURE

  The 16.8 MHz clock is created by phase locking the crystal oscillator to the 10 MHz UHSO reference. This task is accomplished by programming the synthesizer to divide the 16.8 MHz clock by 168 and the 10 Mhz reference by 100. The two 100 kHz clocks created by the division are phase compared. The phase difference is used to drive the VCO. Outputs from the synthesizer can be used to diagnose this circuit. Run the OCM limited diagnostics command (RFO FIPS: **a 62**). If diagnostics results indicate that the VCO is not locked, replace the OCM.

- <E_HIGH_STABILITY_REFERENCE_FAILURE>

  This error indicates that the 10 MHz reference may be absent. Check the coaxial cable connection from J11 on the RF-B! transmitter controller backplane to J11 on the RF-O! transmitter backplane. The daisy chained cable should have a 50 ohm termination at the end. Also, the synthesizer may be incorrectly programmed. The SPI bus coming from the host processor (MC68360) is a serial bus that is daisy chained to other devices like the synthesizers in the exciter, Tranlin, crystal oscillator, and PA sensors. Run the OCM Diagnostics command to check internal hardware (RFO FIPS: **a 62**). If diagnostics results indicate that the 10 MHz reference is not locked, replace the OCM.

- E_1PPS_INITIAL_SEARCH_FAILURE

  Check the connection between J4 on the RF-B! transmitter controller backplane and J4 on the RF-O! transmitter backplane.

Check the 1PPS search window size (RFO FIPS: **r 902**). If the window size is not the default value (5), erase the error log (RFO FIPS: **a 111**), set the window size to 5 (RFO FIPS: **w 902 5**), then check the error log after 1 minute.

If the E_1PPS_INITIAL_SEARCH_FAILURE is in the error log again, you should also check the RF-B! transmitter controller for the E_1PPS_INITIAL_SEARCH_FAILURE.

## Power Cutback LED is Blinking

When the Power Cutback LED is blinking, this indicates that the RF-O! transmitter is disabled (shutdown). When disabled the RF-O! transmitter will not key (even with test modes). Use RFO FIPS: **a 83** to determine why the transmitter is disabled. Check for any of the PAGING DISABLE STATUS sources being ACTIVE. Also, use RFO FIPS: **a 104** and **a 99** to determine the reason the transmitter is disabled.

```
RFO FIPS: a 83
RFO FIPS: RA   83
<<< STATION STATUS/MODE >>>
Power Control (R 992)..........ENABLED  Power Leveling (R 2999)........ 0.00dB
Int Wattmeter Calibration......VALID    Ext Wattmeter Calibration......VALID
Amplitude Alignment............VALID

POWER CUTBACK STATE.........SHUTDOWN
PA Temperature............FULL_POWER    Ambient Temperature.......FULL_POWER
PA Deck/Power Supply......FULL_POWER    Disabled Status.............SHUTDOWN

PAGING DISABLED STATUS (R 100 = 0 = 0h)
Paging Access Disabled (R 99)..OK       Power Supply A/D Read..........OK
OCM Ambient Temperature........OK       Exciter Synthesizer Lock.......OK
Txlin Local Oscillator Lock....OK       AM Clipping....................OK
FM Clipping....................OK       PA A/D SPI Read................OK
PA Current.....................OK       28 Volt Reference..............OK
14 Volt Reference..............OK       UHSO Present/Operating.........OK
Pendulum Lock..................OK       Pendulum Present...............OK
Exciter SPI Read...............OK       Circulator Load Thermal Limit..OK
PA Failure.....................OK       PA Temperature.................OK
Amplitude Alignment............OK       Power Leveling Failure.........OK
Internal Wattmeter VSWR........OK       High Int WM Reflected Power....OK
External Wattmeter VSWR........OK       High Ext WM Reflected Power....OK
External 1PPS Signal...........ACTIVE   RFB REQ Line Down..............OK
PNP Error......................OK       PNP Check Error................OK
```

If the RF-B! transmitter controller was recently reset, it is very likely that the External 1 PPS signal has not been acquired (See **a 83** example above). The External 1 PPS disable should clear within 10 minutes, as long as the GPS receiver eventually locks.

If **Amplitude Alignment** has not been performed, the RF-O! transmitter will be disabled if Power Control is enabled. You can turn Power Control OFF by entering RFO FIPS: **w 992 0**. This allows the user to key that station and perform the Amplitude Alignment.

## Power Cutback LED is Continuously Illuminated

The RF-O! transmitter has detected a failure condition that allows the transmitter to remain keyed, but at a reduced power level.

Use RFO FIPS: **a 83** to determine the reason for the cutback. The POWER CUTBACK STATE will indicate the amount of the cutback, and the following two lines will indicate the reason. (PA Temperature, PA Deck / Power Supply, or Ambient Temperature)

Use RFO FIPS: **a 104** and **a 99** to find more information.

If the cutback is due to Ambient Temperature, read parameter 1026 (RFO FIPS: **r 1026**) to verify that the temperature sensor has been calibrated correctly. The value read will be in Degrees Celsius. A cutback will occur at +45 degrees Celsius and higher.

If the cutback is due to PA Temperature, verify that all PA Fans are operational. Verify the power output is at the desired level.

## Check for Plug-and-Play Errors

If transmitter keying is inconsistent, check for data path errors. The RF-O! transmitter should transmit if it is receiving valid (plug-and-play) data from the RF-B! transmitter controller. Check the error log (RFO FIPS: **a 104**) for plug-and-play data errors. Extensive checks are done in the DSP to validate plug-and-play packets. Any of the following errors will result in dropped plug-and-play packets causing the transmitter to prematurely dekey, flushing the DSP buffers of any transmission data that may be pending:

E_CHECK_COMMAND_FORMAT_ERROR,
E_CONTROL_COMMAND_FORMAT_ERROR,
E_END_OF_COMMAND_ERROR,
E_FREQ_OFFSET_ERROR,
E_INCOMPLETE_FRAME_ERROR,
E_INVALID_COMMAND_TYPE_ERROR,
E_INVALID_MOD_TYPE,

E_INVALID_NEXT_MODULATION_TYPE,

E_INVALID_NUMBER_OF_SUBCHANNELS,

E_MOD1_INPUT_OVERFLOW_ERROR,

E_MOD2_INPUT_OVERFLOW_ERROR,

E_MODULATION_TYPE_ERROR,

E_START_TIME_ERROR,

E_SYMBOL_DATA_COMMAND_FORMAT_ERROR,

E_UNEXPECTED_SYMBOL_COMMAND_ERROR,

E_WORK_AHEAD_WINDOW_ERROR

These errors may be caused by incorrect network link delay or incorrect router committed information rate (CIR). If the RF-C! controller is not locked to the GPS receiver, the RF-C! controller will either send packets too late to be launched or too early and overrun the RF-B! transmitter controller buffer space. The inconsistent data may cause the RF-B! transmitter controller to illogically couple packets.

To check for plug-and-play errors, complete the following steps:

1. Verify that the following parameters are correct for the RF-O! transmitter:

   RFO FIPS: **r 2058**

   RFO FIPS: RR 2058 50000 *(default min work ahead time is 50000 us)*

   RFO FIPS: **r 2059**

   RFO FIPS: RR 2059 50000 *(default work ahead width is 50000 us)*

2. Check to ensure the plug-and-play data cable is properly connected to J4 on both the RF-O! transmitter and RF-B! transmitter controller backplanes.

## Check Control Data Received by the RF-O! Transmitter

To determine whether the RF-O! transmitter is receiving control data from the transmitter controller, complete the following steps

1. Verify the RF-O! transmitter is receiving control commands from the RF-B! transmitter controller with a Plug-and-Play Control Data trace (the trace does not show messaging data).
   – Typical Sync and SCI Pattern (FM only Data):
   – Typical Voice Page Pattern (FM and AM Data):

RFO FIPS: **a 192 RFCQ 1** ***(This starts the plug-and-play packet trace)***

RFO FIPS: RA 192

RFO FIPS:

<RFCQ 1>CTL CMD: f: 0, st: 7270e0, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 5f5e10, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 4c4b40, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 393870, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 2625a0, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 1312d0, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 000000, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 7270e0, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 5f5e10, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 4c4b40, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 1

RFO FIPS: **a 193 RFCQ 1** ***(This command stops the plug-and-play packet trace)***

RFO FIPS: RA 193

RFO FIPS: **a 192 RFCQ 1** ***(This starts the plug-and-play packet trace)***

RFO FIPS: RA 192

RFO FIPS:

<RFCQ 1>CTL CMD: f: 0, st: 249f00, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2

<RFCQ 1>CTL CMD: f: 0, st: 000000, f: 0, o3: 0, o2: 0, o1: 0, o0: 0, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 8583b0, f: 0, o3: 0, o2: 0, o1: 0, o0: 0, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: ffffff, f: 0, o3: e, o2: 2, o1: f, o0: 1, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 7270e0, f: 0, o3: 0, o2: 0, o1: 0, o0: f, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 83fd10, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2

<RFCQ 1>CTL CMD: f: 0, st: 5f5e10, f: 0, o3: 0, o2: 0, o1: 0, o0: f, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 70ea40, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2

<RFCQ 1>CTL CMD: f: 0, st: 4c4b40, f: 0, o3: 0, o2: 0, o1: 0, o0: f, m3: 0, m2: 0, m1: 0, m0: 1

<RFCQ 1>CTL CMD: f: 0, st: 5dd770, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2

RFO FIPS: **a 193 RFCQ 1** ***(This command stops the plug-and-play packet trace.)***

RFO FIPS: RA  193

*Table 6-3: Description of RFCQ Trace Fields*

| RFCQ Field | Description |
|---|---|
| f: | Frequency change 0 if same as last center frequency, 1 if new center frequency needed. |
| st: | Displays the start time for this transmission. |
| f: | Displays the center frequency index for this transmission. |
| o#: | Displays the subchannel offset (location relative to center freq) for each modulator. Its value is meaningless if m# = 0. |
| m#: | Displays the type of data for each modulator for this transmission (0=idle, 1=FM, 2=AM). |

The typical control command patterns are for network traffic.

If the ReFLEX25 station is operating with heavy traffic and does not dekey, the **RFCQ 1** trace will not show any control commands. Trace data is created only during a dekey and key cycle.

*Note: To verify remotely that the RF-O! transmitter is transmitting, enable the Wattmeter debug trace through RFO FIPS: a 192 SPCQ 64. While keyed, the wattmeter readings will be read approximately once every 2 seconds. Disable the debug trace with the RFO FIPS: a 193 SPCQ 64 command.*

If no data is present during the **RFCQ** trace, the problem may be the plug-and-play cable (connected to J4 on both the RF-B! transmitter controller and RF-O! transmitter backplane).

If data is present during the **RFCQ** trace, verify that AM and FM control commands are present and alternating in a voice page pattern; this can be accomplished by examining the modulator number, **m#** (1=FM, 2=AM) in each row of data.

Verify that the Sync and SCI data are not being lost. Sync and SCI data is sent in 0.125 **st** increments. The **st** field is the Sync and SCI time slot represented in hexadecimal in units of tenths of microseconds past 1 second, modulo 1 second. Ensure that all time slots are being sent in sequence in both the Sync and SCI pattern and when interleaved with the AM control commands. If any time slots are being dropped, the problem still exists with the RF-B! transmitter controller.

*Table 6-4: RFCQ Trace Conversion Table*

| hex (tenths of 1 us) | decimal (tenths of 1 us) | decimal (s) |
|---|---|---|
| 000000 | 0000000 | 0 |
| 8583B0 | 8750000 | 0.875 |
| 7270e0 | 7500000 | 0.750 |
| 5f5e10 | 6250000 | 0.625 |
| 4c4b40 | 5000000 | 0.500 |
| 393870 | 3750000 | 0.375 |
| 2625a0 | 2500000 | 0.250 |
| 1312d0 | 1250000 | 0.125 |

If data is scrolling across the screen, check the following parameters in the RF-O! transmitter:

RFO FIPS: **r 902**
RFO FIPS: RR 902 5 ***(1PPS window size is 5)***
RFO FIPS: **r 2049**
RFO FIPS: RR 2049 0 ***(Simulcast launch offset must be in the range 0 to 4800)***

If these parameters are outside of their normal operating range, set them to their default values and reset the OCM. (**Note:** Parameter 902, 1PPS window size, is not writable with RF-O! transmitter software version 1.4.0 or greater)

## Check RF Power Path

To verify the power path, check each step in the RF power path:

- Internal and External Wattmeters
- Power Amplifiers
- Power Supplies

## Check Power at Internal and External Wattmeters

Read the power output via RFO FIPS: **a 79** *x*, **a 80**, or **a 192 SPCQ 64**.The internal and external wattmeters are calibrated in the factory and provide for an easy way to accurately measure the power. See Chapter 5, “Operation”, for a procedure to check out the wattmeters.

- High External Reflected Power

  Reflected power should be below 2 watts. Check for bad connections or water in the antenna and connectors. A Frequency Domain Reflectometer may be used to find the location of the mismatch. Return loss should be less than 14 dB at the operating frequency.

- Low Power Output at the Antenna, High Internal Reflected Power

  For 75 Watts at the internal meter it is typical to output about 55 watts at the external meter. Check the insertion loss of the cavity filter, which can be tuned. Typical insertion loss should be 0.8 to 1.2 dB. An improperly tuned cavity filter will result in high reflected power and a poor spectral output.

- Power Not Set Correctly or Defective Power Detector

  Check the power at the couplers with a commercial power meter to verify that the built-in detectors are accurate. If not within 5%, calibrate wattmeters and align power output.

- RF Signal Path

  Check the feedback path to the exciter. If the feedback to the exciter is disconnected or there is a reflection, the PA may be unstable producing a high power wideband signal. The carrier (normally suppressed) will be too high. Check to make sure the exciter is properly inserted. Defective couplers can also cause this problem. Typically, if this problem exists, the transmitter will shutdown due to FM Clipping.

### Check Power Amplifier(s)

Use the following command to diagnose PA problems:

RFO FIPS: **a 68 #v C #x #y #z**

*Table 6-5: Variables for Checking Power Amplifier*

| Variable | Description |
|---|---|
| #v | PA number (1 or 2) |
| #x | modulation mode<br>0 = none,<br>1 = FM only<br>2 = FM and AM (requires live pages)<br>3 = AM only |
| #y | number of times you wish to read |
| #z | number of seconds between reads |

The following example shows values similar to what you would expect to see on a properly working single-PA (PT1052) station transmitting FM (See Figure 6-1). Reflected power should be less than 3 Watts.

```
RFO FIPS: a 68 1 c 0 1 0
RFO FIPS: RA 68
<<< READ PA DECK 01 A/D 01 >>>
Reg 00: PDPA     = 077 => 0.11  Amp(s)
Reg 01: DPA      = 096 => 2.73  Amp(s)
Reg 02: OD       = 032 =>14.50  Watt(s)
Reg 03: FPA 1 A  = 099 => 2.53  Amp(s)
Reg 04: FPA 1 B  = 097 => 2.92  Amp(s)
Reg 05: FPA 2 A  = 088 => 2.14  Amp(s)
Reg 06: FPA 2 B  = 093 => 2.53  Amp(s)
Reg 07: FPA 3 A  = 091 => 2.53  Amp(s)
Reg 08: FPA 3 B  = 095 => 2.92  Amp(s)
Reg 09: Fwd      = 068 =>78.6  Watt(s)
Reg 0A: Rfltd    = 003 => 0.43 Watt(s)
Reg 0B: A/D Test = 128 => PASS (> 127)
============================================
```

Check hex value for $85 +/-20

Check hex value for $32 +/-6

DPA and FPA current should be approximately 2.0 to 3.2 A.

Check hex value for $67 +/- 8

Check for less than 3.2 W

Hex

*Figure 6-1: Typical PA A/D Values for One-PA Station (FM)*

> *Note:* *Data shown for transmitter operating near 25 deg C ambient. The PA will draw higher currents at higher ambient temperatures.*

The following illustration (See Figure 6-3) shows typical PA A/D readings for a 2-PA configuration (PT 1054) set at 75 Watts by subchannel.

PA #1

```
RFO FIPS: a 68 1 c 0 1 0
RFO FIPS: RA 68
<<< READ PA DECK 01 A/D 01 >>>
Reg 00: PDPA     = 089 => 0.11  Amp(s)
Reg 01: DPA      = 097 => 2.19  Amp(s)
Reg 02: OD       = 023 => 8.57 Watt(s)
Reg 03: FPA 1 A  = 092 => 2.48  Amp(s)
Reg 04: FPA 1 B  = 094 => 1.71  Amp(s)
Reg 05: FPA 2 A  = 088 => 1.48  Amp(s)
Reg 06: FPA 2 B  = 098 => 1.71  Amp(s)
Reg 07: FPA 3 A  = 098 => 1.53  Amp(s)
Reg 08: FPA 3 B  = 096 => 1.77  Amp(s)
Reg 09: Fwd      = 047 =>40.11  Watt(s)
Reg 0A: Rfltd    = 001 => 0.42  Watt(s)
Reg 0B: A/D Test = 128 => PASS (> 126)
=========================================
```

Hex

Check hex value for $85 +/-20

Check hex value for $21 +/-6

DPA and FPA current should be approximately 1.4 to 2.3 A.

Check hex value for $44 +/- 8

Check for less than 2W

PA #2

```
RFO FIPS: a 68 2 c 0 1 0
RFO FIPS: RA   68
<<< READ PA DECK 02 A/D 01 >>>
Reg 00: PDPA     = 088 => 0.00  Amp(s)
Reg 01: DPA      = 097 => 2.18  Amp(s)
Reg 02: OD       = 025 => 8.53 Watt(s)
Reg 03: FPA 1 A  = 081 => 1.59  Amp(s)
Reg 04: FPA 1 B  = 101 => 1.71  Amp(s)
Reg 05: FPA 2 A  = 098 => 1.53  Amp(s)
Reg 06: FPA 2 B  = 095 => 1.77  Amp(s)
Reg 07: FPA 3 A  = 091 => 1.59  Amp(s)
Reg 08: FPA 3 B  = 090 => 1.77  Amp(s)
Reg 09: Fwd      = 050 =>43.28 Watt(s)
Reg 0A: Rfltd    = 003 => 0.68 Watt(s)
Reg 0B: A/D Test = 128 => PASS (> 126)
=============================================
```

Hex

Check hex value for $85 +/-20

Check hex value for $21 +/-6

DPA and FPA current should be approximately 1.4 to 2.3 A.

Check hex value for $44 +/- 8

Check for less than 2W

*Figure 6-2: Typical Values for Two-PA Station*

*Note: Data shown for transmitter operating near 25 deg C ambient. The PA will draw higher currents at higher ambient temperatures.*

### Check Power Supplies

Use the following command to diagnose PA power supply problems:

RFO FIPS: **a 69 #v C #x #y #z**

*Table 6-6: Variables for Checking Power Supplies*

| Variable | Description |
|---|---|
| #v | PA number (1 or 2) |
| #x | modulation mode<br>0 = none,<br>1 = FM only<br>2 = FM and AM (requires live pages)<br>3 = AM only |
| #y | number of times you wish to read |
| #z | number of seconds between reads |

```
RFO FIPS: a 69 2 c 0 1 0
RFO FIPS: RA 69
<<< READ PA DECK 02 A/D 02 >>>
Reg 00: 28 Vref    = 195 =>28.60  Volt(s)
Reg 01: 15 Vref    = 199 =>15.21  Volt(s)
Reg 02: PA Temp  = 207 =>28.53  Deg(s) C
Reg 03: Phase     = 000 => 0.00  Volt(s)
Reg 04: Atten      = 152 => 2.96  Volt(s)
Reg 05: N/A        = 000
Reg 06: N/A        = 000
Reg 07: N/A        = 000
Reg 08: N/A        = 000
Reg 09: N/A        = 000
Reg 0A: N/A        = 000
Reg 0B: A/D Test = 128 => PASS (> 126)
========================================
```

*Figure 6-3: Sample PA Power Supply Diagnostic Output*

```
RFO FIPS: a 192 SHMI 1
RFO FIPS: RA 192
RFO FIPS:
<SHMI   1> PS: PS1=left:   PS2=right
          PS1=>  4.22 Volt(s):  PS2=>  4.24 Volt(s)
<SHMI   1> PS: PS1=left:   PS2=right
          PS1=>  4.22 Volt(s):  PS2=>  4.24 Volt(s)
<SHMI   1> PS: PS1=left:   PS2=right
          PS1=>  4.22 Volt(s):  PS2=>  4.24 Volt(s)
```

*Figure 6-4: Sample Power Supply Debug Trace Output*

## Check Transmitter Frequency

### Transmitter Is Transmitting Far Off Frequency (More than 500 Hz)

Compare the values in the center frequency table (RFO FIPS parameters 2000-2015) to their assigned values. If other sites are experiencing the problem, have someone verify that the RF-C! controller has the correct frequencies in its table. Other failures such as *E_SYNTH_LOCK1_FAIL*, *E_SYNTH_LOCK2_FAIL*, or *E_PENDULUM_NOT_LOCKED*, which would cause the frequency to be off, will also prevent the transmitter from paging, thus making the error less likely to be detected.

### Transmitter Is Transmitting Slightly Off Frequency (Less Than 500 Hz)

The following paragraphs present possible causes for the transmitter being slightly off frequency.

- Cause 1: Measurement Error

  The transmitter is accurate to 2 ppb which is probably much better than the user test instrumentation. Frequency accuracy on a spectrum analyzer is inversely proportional to the resolution bandwidth. You can only expect 30 Hz accuracy when the RBW is set to 300 Hz. If the spectrum analyzer can accept an external reference, use a rubidium oscillator or tap the 10MHz reference line from the BCM to the OCM. If the analyzer does not have an external reference port, the accuracy is probably inadequate.

- Cause 2: Subchannel Table Is Incorrect

  Verify the following settings for subchannel offsets (in Hz):

RFO FIPS: **r 2100**

RFO FIPS: RR 2100 0

RFO FIPS**: r 2101**

RFO FIPS**:** RR 2101 6250

RFO FIPS: **r 2102**

RFO FIPS: RR 2102 12500

RFO FIPS**: r 2103**

RFO FIPS**:** RR 2103 18750

RFO FIPS**: r 2113**

RFO FIPS**:** RR 2113 -18750

RFO FIPS**: r 2114**

RFO FIPS**:** RR 2114 -12500

RFO FIPS**: r 2115**

RFO FIPS**:** RR 2115 -6250

- Cause 3: Simulcast Frequency Offset Is Incorrect

  FIPS **r 2050**

  FIPS RR 2050 0

  Compare this value against the desired value for the station. All newly installed stations should be set to 0 (Hz).

- Cause 4: RF-C! Controller Frequency Table Is Incorrect

  Verify that the RF-C! controller is using the correct frequency.

## Check RF-A! Receiver Functionality

See “RF-Audience Receiver Installation and Operation” Manual for RF-A! receiver functionality.

## Pages Not Received

Figure 6-5 and Figure 6-6 show the message transactions that must occur to receive a voice page. This is a simplification of what actually happens because it doesn’t show what happens when fragments of a message are NACKed. The important things to notice are that the transaction has three parts. The first part is where the pager is registered with the WMG, the second part is where it is located with a broadcast WRU ReFLEX message and the third part where the pager is targeted with an AM voice message. The color code, which is stored in the RF-B! transmitter controller, defines the transmitter from which the pager received the WRU message. The AM voice message is targeted to a specific transmitter based on the received color code.

### Out of Range Indication on Nearby Pager

Check for the “out of range” symbol on the pager’s LCD screen. The “out of range” symbol can be caused by incorrect modulation parameters on any nearby transmitter. A transmitter with incorrect timing or phase can interfere with other simulcasting transmitters in the area. Another cause is that the pager is programmed to the incorrect frequency.

Check the following FM modulation parameters.

RFA FIPS: **r 2053**

RFA FIPS: RR 2053 4800 *(maximum FLEX™ deviation is 4800 Hz*)

RFA FIPS: **r 991**

RFA FIPS:RR 991 1 *(spectrum invert - default is Inverted (1))*

If they are incorrect, this station is jamming the local simulcast data broadcasts. Make sure that this station is not jamming due to poor simulcast synchronization. Check the error log (**a 104**) for E_1PPS_INITIAL_SEARCH_FAILURE. Check the following RF-O! transmitter parameters:

```
RFO FIPS: r 902
RFO FIPS: RR 902 5 (1PPS search window size)
RFO FIPS: r 2049
RFO FIPS: RR 2049 0 (simulcast launch delay)
RFO FIPS: r 2050
RFO FIPS: RR 2050 0 (simulcast frequency offset)
```

### Pager Registration at the WMG

Figure 6-5 shows the registration process. The home index (gateway) of the pager must match the WMG home ID. The RF-A! receiver trace can be used to observe the registration request. A registration can be forced by turning the pager on and off.

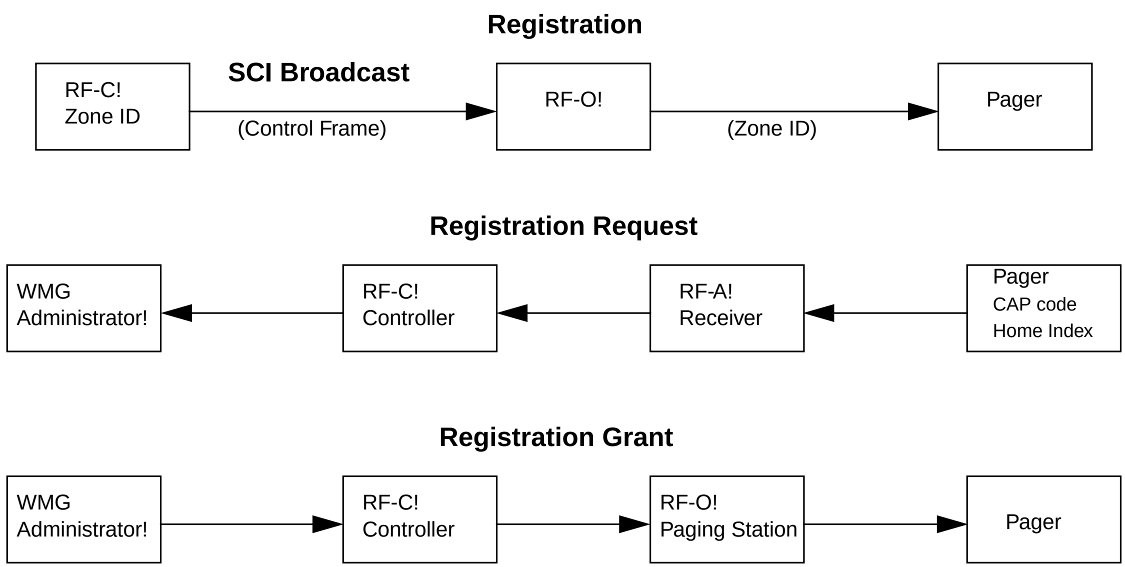



*Figure 6-5: Registration Process*

### WRU Response of Pager

Using the RF-A! receiver trace (RFA FIPS command: **w 953 1**), check to see if WRU responses are being returned with the color code of the station that is being checked. If not, isolate the problem to the transmitter or receiver by checking to see if other receivers are getting the correct response. The pager may be returning color codes from another transmitter. Check the color code of the transmitter and the codes of other nearby transmitters (RFB FIPS command: **r 704**).

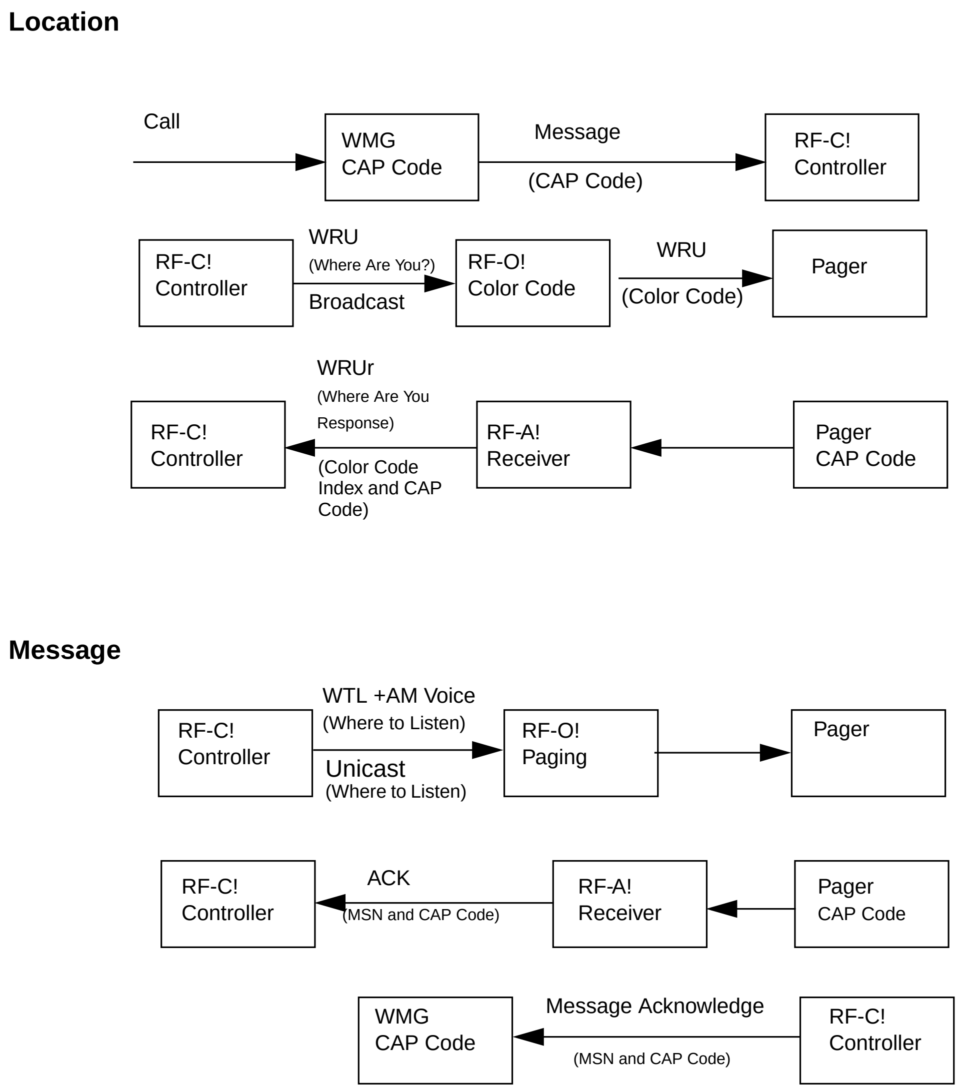



*Figure 6-6: Message Transmission Process*

### Pager Does Not Receive Pages or Receives From the Wrong Transmitter

The Where aRe yoU (WRU) transmission is broadcast across the network so that it is independent of the IP address of the target RF-B! transmitter controller. In order to get a page the RF-C! controller must be able to unicast directly to the IP address of the RF-B! transmitter controller.

- **Cause 1:**

  The tables in the network router and / or RF-B! transmitter controller that associate the IP and MAC (Ethernet) address are corrupted or RIP is turned off. Reset the RF-B! transmitter controller to force an ARP request. If this doesn't work reset the router to reload the configuration.

- **Cause 2:**

  The IP address of the RF-B! transmitter controller is wrong or the RF-C! controller configuration has the wrong IP address associated with the color code for the target transmitter.

- **Cause 3:**

  If there is heavy congestion at the transmitter under test, the RF-C! controller has the option to pick an alternate route through another transmitter.

- **Cause 4:**

  The PMU memory is full or there is an overflow condition. This can be verified without actually seeing the PMU by running the RF-A! receiver trace. The first word of the WRU response will indicate this condition.

## Voice Quality Diagnostics

The information that follows will aid in determining the cause of potential voice quality problems.

### The pages crackle

The crackling sound is due to clipping. The following are known to cause this problem.

- The pager may be too close to transmitter. Move away from the antenna.
- The peak to average parameters are incorrect (RFO FIPS command: **r/w 1100-1109**). Perform a DIP switch 2 reset to properly default the parameters.

- At least one of the Tranlin register parameters is incorrect. Run RFO FIPS command: **a 172** to check the Tranlin device. The **information** word at the bottom of the list should be an even number. Bit 0 is the **clip detect** bit. Perform a DIP switch 2 reset to properly default the parameters.
- There is not enough dynamic range in the power amplifier:
  - Check for a defective PA (RFO FIPS command: **a 68**).
  - Check for a defective power supply using RFO FIPS command: **a 192 SHMI 1** trace.
  - The average RF power level may be set too high. Realign the RF-O! transmitter power output.

### Message has pops and tones

Pops and tones in the message may stem from adjacent channel interference. Check that the carrier feedthrough is nulled and that pager selects the correct color code. It is possible to get a “near/far” problem due to a configuration problem where a close transmitter interferes with one far away. Transmitters that are off frequency or have lost simulcast synchronization can also cause this problem.

### Message is full of hornet sounds

The hornet sound is VICE decompression of noise.

- Good signal to noise ratio will reduce “hornets”. Check that SQC is turned on at the RF-C! controller and is set to the correct threshold to reject pages with bad SNR.
- A quiet environment will reduce “hornets”.
- Check microphonics (-30 dbc at > 100 Hz from carrier). Microphonics can be caused by a bad fan or excessive noise / vibration in the environment. Check by disconnecting power to the RF-B! transmitter controller and the RF-O! transmitter control board fans.

# Removal and Replacement

Replace defective Field Replaceable Units (FRUs) to restore the RF-O! transmitter to proper operation. The following procedures provide FRU removal and replacement instructions.

CAUTION

*The RF-O! transmitter contains static-sensitive modules. When servicing the equipment, take precautionary steps to prevent damage to the modules from static discharge.*

*Do not insert or remove a module or board with the power turned on. Inserting or removing a module with the power turned on may result in damage to the station or the module.*

*Do not force RF-O! transmitter modules into their slots. Connector damage may occur if the modules are not carefully inserted.*

## Cabinet Doors Removal

Perform the following steps to remove the transmitter cabinet front or rear door.

1. Unlock the top of the transmitter cabinet door.
2. Pull the top of the door toward you.
3. Lift the door.
4. Set the door to the side.

## Cabinet Doors Replacement

1. Lift the door and insert the bottom of the door into the bottom of the transmitter cabinet.
2. Swing the top of the door in and secure with the key lock.

## DC-DC Converter Removal

Perform the following procedure to remove the DC-DC converter module:

1. Power down the Orchestra Control Module (OCM) by switching off the Power On / Off switch (see Figure 6-7).

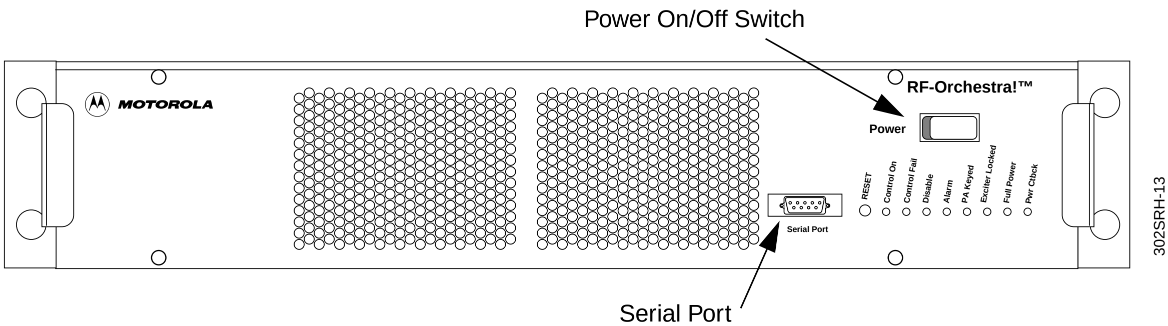



*Figure 6-7: Front View of OCM*

2. Using a #T15 TORX® driver, remove and save the four front panel mounting screws (see Figure 6-7).

3. Slide the front panel off and set it aside.

4. Using the handles located on each side of the DC-DC converter module, gently pull the DC-DC converter module out of the chassis (see Figure 6-8).

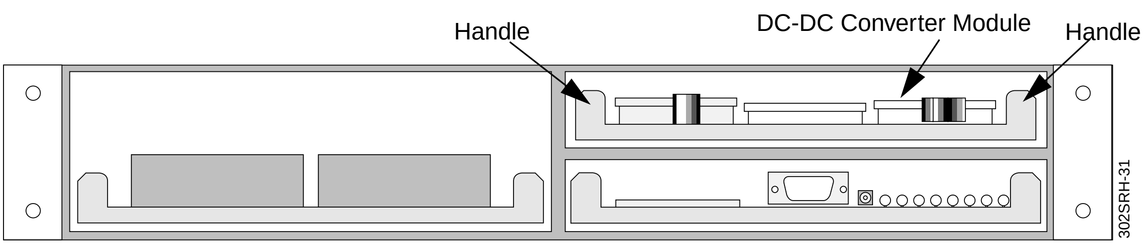



*Figure 6-8: Front View of DC-DC Converter Location in the OCM (Cover Removed)*

## DC-DC Converter Installation

Perform the following procedure to install the DC-DC converter module:

1. Verify the kit received is as follows:
   – DC-DC CONV RFO field replaceable unit (FRU).
2. Visually inspect the new DC-DC converter module.
3. Slide the DC-DC converter module into the chassis rails, using the handles on the DC-DC converter module as guides, being careful not to damage any of the components (see Figure 6-8).
4. Seat the DC-DC converter module carefully into the backplane by pushing gently.
5. Replace the front panel and secure with the four mounting screws removed in paragraph, "DC-DC Converter Removal", Step 2 (see Figure 6-7).
6. Switch on the Power On / Off switch located on the front panel (see Figure 6-7).

## Orchestra Control Board Removal

Perform the following procedure to remove the OCB:

1. Power down the RF-O! transmitter by switching off the OCM Power On / Off switch (see Figure 6-7).
2. Using a #T15 TORX® driver, remove and save the four front panel mounting screws (see Figure 6-7).
3. Slide the OCM front panel off and set it aside.
4. Using the handles located on each side of the OCB, gently pull the OCB out of the chassis (see Figure 6-9).

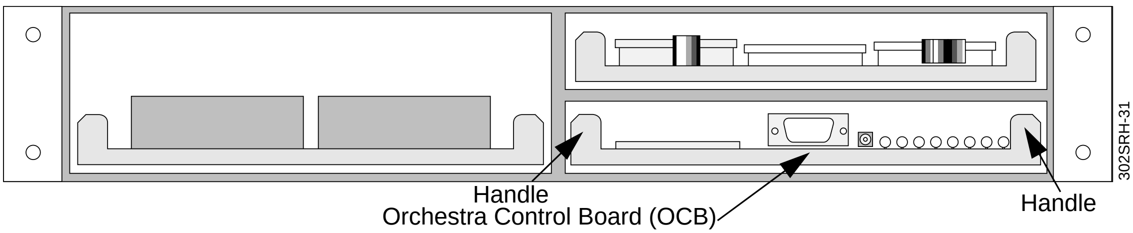



*Figure 6-9: Front View of the OCB location in the OCM (Cover Removed)*

## Orchestra Control Board Installation

Perform the following procedure to install the OCB:

1. Using the handles on the OCB as guides, slide the OCB into the bottom chassis rails being careful not to damage any of the components (see Figure 6-9).

2. Carefully seat the OCB module into the backplane with gentle pushing.

3. Replace the OCM front panel and secure with the four mounting screws removed in paragraph, "Orchestra Control Board Removal", Step 2.

4. Switch on the Power On / Off Switch located on the OCM front panel (see Figure 6-7).

## Exciter Removal

Perform the following procedure to remove the Exciter module:

1. Power down the RF-O! transmitter by switching off the OCM Power On / Off switch on the front panel (see Figure 6-7).

2. Using a #T15 TORX® driver, remove and save the four mounting screws on the OCM front panel (see Figure 6-7).

3. Slide the OCM front panel off and set it aside.

4. Using the handles located on each side of the exciter module, gently remove the module from the chassis (see Figure 6-10).

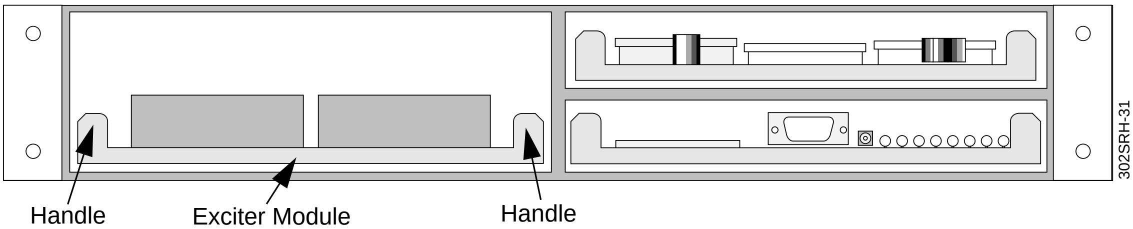



*Figure 6-10: Front View of the Exciter Location in the OCM (Cover Removed)*

## Exciter Installation

Perform the following procedure to install the RF exciter module:

1. Using the bottom guide rails, install the replacement exciter module by gently sliding the module into chassis (see Figure 6-10). Ensure that the exciter connectors are firmly seated to the backplane.

2. Replace the OCM front panel and attach with the four #T15 mounting screws removed in paragraph, "Exciter Removal", Step 2.

3. Switch on the Power On / Off switch located on the OCM front panel (see Figure 6-7).

4. Align the RF-O! transmitter as outlined in this chapter, paragraph, "RF-O! Transmitter Preparation for Alignment".

5. Perform an operational checkout as outlined Chapter 5,”Operation”.

## Power Amplifier Removal

Perform the following procedure to remove the power amplifier:

1. Power down all equipment located in the cabinet.

2. Remove the front cabinet door if the door does not open at least 90 degrees (see paragraph, "Cabinet Doors Removal").

3. From the rear of the cabinet, disconnect the SPI cable from the DB9 connector on the PA (see Figure 6-11).

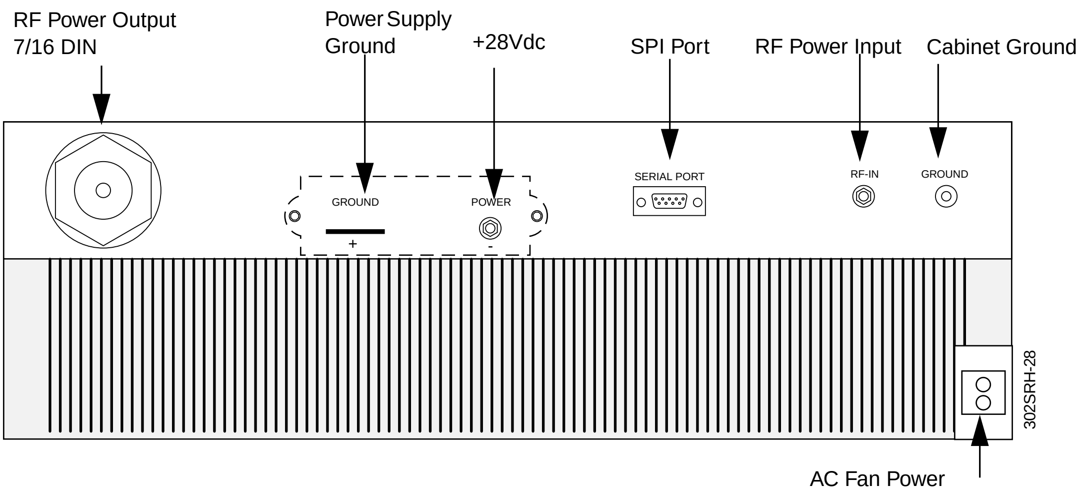



*Figure 6-11: Power Amplifier—Rear View*

4. Use a 5.5-mm hex head driver to remove the two screws holding the interconnect cover over the power supply connections, and set aside.

5. Disconnect the RED PA-to-PS cable from the +28Vdc connection.

6. Disconnect the BLACK PA-to-PS cable from the GROUND (–) connection.

7. Disconnect the AC fan cable from the AC fan connector.

8. Disconnect the SMA cable from the RF power input connector.

9. Use a 7/8-inch wrench to disconnect the RF cable from the RF power output connector.

10. Disconnect the cabinet ground wire from the PA using a #T30 TORX® driver

11. From the front of the cabinet, use a #T30 TORX® driver to remove and retain the four TORX screws securing the power amplifier (see Figure 6-12).

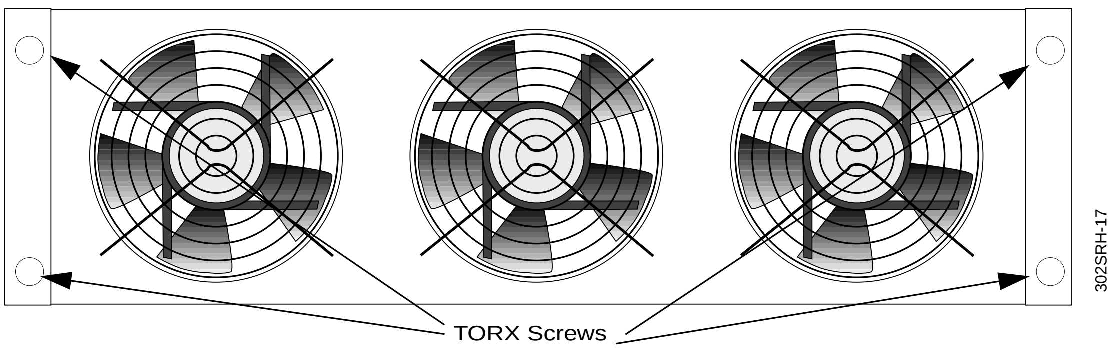



*Figure 6-12: Power Amplifier—Front View*

12. Using both hands, carefully remove the power amplifier module from the cabinet.

CAUTION

*The power amplifier is heavy. Exercise caution when lifting it from the cabinet.*

## Power Amplifier Installation

Perform the following procedure to install the power amplifier module:

1. From the front of the cabinet, slide the new power amplifier unit into the cabinet. Align the mounting holes on the cabinet frame with the mounting holes on the power amplifier unit.

2. Secure the power amplifier using the four #T30 TORX screws removed in paragraph, "Power Amplifier Removal", Step 11 (see Figure 6-12).

3. From the rear of the cabinet, connect the cabinet ground wire to the PA using a #T30 TORX screw.

4. Connect the AC fan cable to the AC fan connector (see Figure 6-11).

5. Using a 5.5-mm hex head driver, remove the two screws holding the interconnect cover, and set it aside.

6. Connect the BLACK PA-to-PS cable to the GROUND (-) connection.

7. Connect the RED PA-to-PS cable to the +28 Vdc connection.

8. Replace the interconnect cover by screwing in the two screws removed in Step 5.

9. Connect the SPI cable to the DB9 connector.

10. Connect the SMA cable to the RF input power connector.

11. Connect the RF cable to the RF output connector. Use a 7/8-inch torque wrench to tighten the connector to 105 in-lb.

12. If necessary, install the cabinet door (see paragraph, "Cabinet Doors Replacement").

13. Switch on all equipment located in the cabinet.

## Power Supply Removal

Perform the following procedure to remove the power supply:

*Note: There are two power supplies housed in the power supply chassis. The removal and replacement procedure is the same for either power supply.*

1. From the front of the cabinet, power down all equipment located in the cabinet.

2. From the rear of the cabinet, disconnect the AC line cord from the AC input connector (see Figure 6-13).

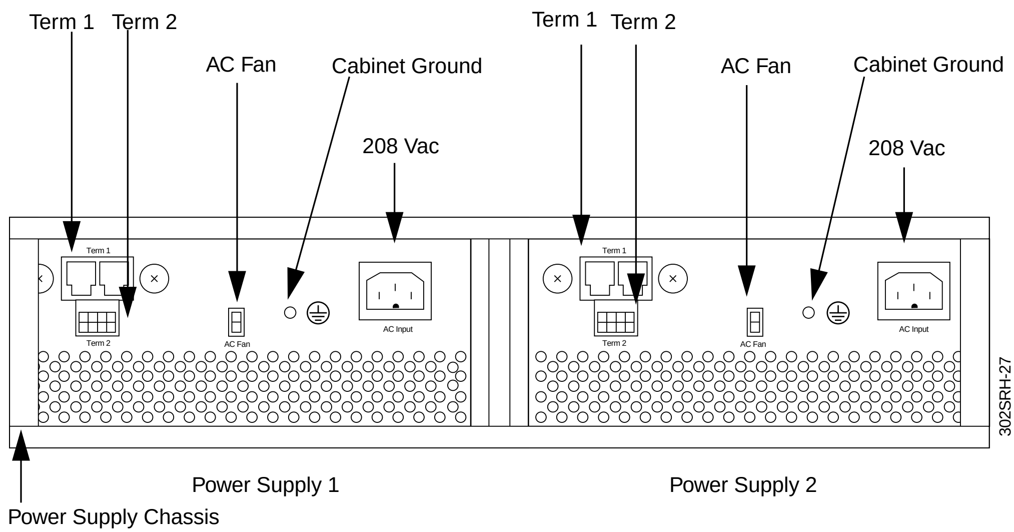



*Figure 6-13: Power Supply—Rear View*

3. Disconnect the DC cable from the Term 2 connector.

4. Disconnect the red PA-to-PS cable from the Term 1 connector.

5. Disconnect the AC fan cable from the AC Fan connector.

6. Disconnect the cabinet ground wire.

7. From the front of the cabinet, remove and retain the two #T15 TORX® screws that secure the power supply to the chassis (see Figure 6-14).

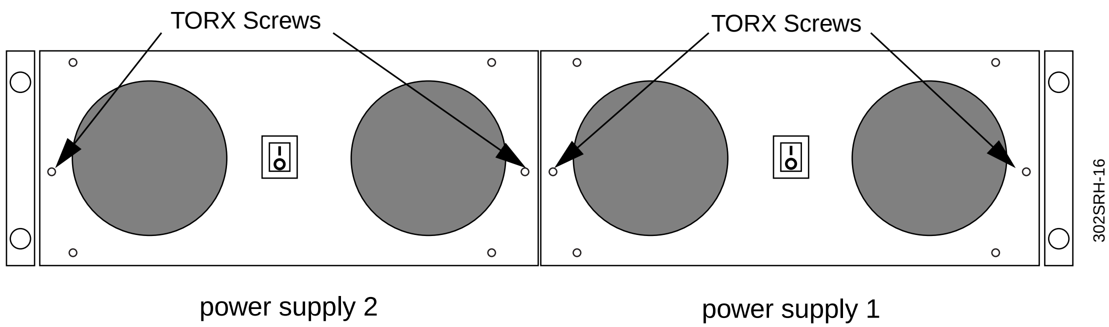



*Figure 6-14: Front View: Location of Torx Screws Connecting Power Supplies to Chassis*

8. From the cabinet front, use both hands to carefully pull the power supply away from the power supply chassis.

## Power Supply Installation

Perform the following procedure to install the power supply unit:

1. Verify the component received is an AC power supply field replaceable unit (FRU), number PTPN1013A.

2. Visually inspect the new AC power supply.

3. From the front of the cabinet, slide the new power supply unit into the power supply chassis and align the mounting holes on the power supply chassis with the mounting holes on the power supply (see Figure 6-14).

4. Secure the power supply unit using the two #T15 TORX screws removed in paragraph, "Power Supply Removal", Step 7.

5. From the rear of the cabinet, connect the AC fan cable to the AC fan connector (see Figure 6-13).

6. Connect the RED PA-to-PS cable to the Term 1 connector.

7. Connect the DC cable to the Term 2 connector.

8. Connect the AC line cord to the AC input connector.

9. Connect cabinet grounding wire.

10. Switch on all equipment located in the cabinet.

## Wattmeter (Power Detector) Removal

Perform the following procedure to remove the external or internal wattmeter power detector:

1. Using a straight blade screwdriver, loosen the two screws and disconnect the DB9 connector (see Figure 6-15).

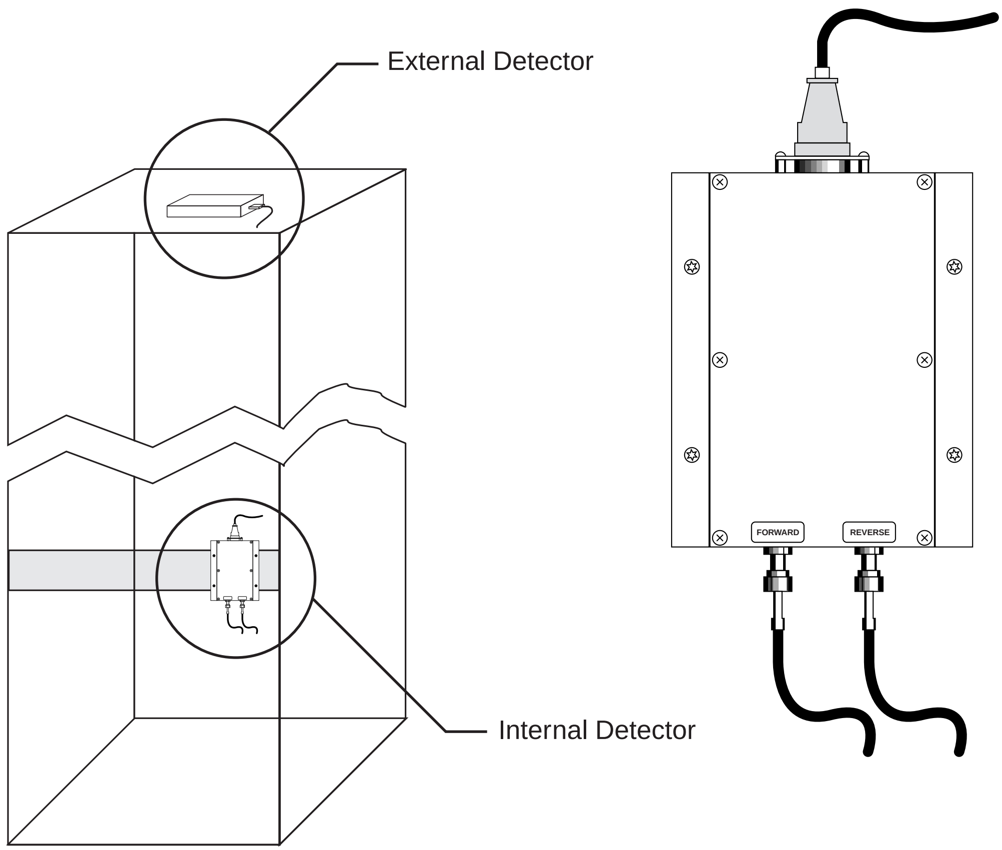



*Figure 6-15: Detector Locations*

2. Label and disconnect the two SMA connectors (use a 5/16-inch wrench).

*Note: You may need a short-handled screwdriver or ratchet to remove the external detector.*

3. While supporting the detector, remove and save the four #T15 TORX® mounting screws.

4. Remove the detector.

## Wattmeter (Power Detector) Installation

Perform the following procedure to install the external or internal wattmeter power detector:

1. Verify the kit received is model PTLN1445A RFO DETECTOR and contains the following parts:
   – (1) DETECTOR AMP RF NUC-O, Motorola part number 0180503R06
   – (4) SCRTPG TT3.5X0.6X8, Motorola part number 0310943J15

2. Visually inspect the new detector.

3. Align the detector mounting holes with the chassis holes and install the four mounting screws (see paragraph, "Wattmeter (Power Detector) Removal", Step 3).

4. Attach the two SMA connectors as labeled and tighten them with a 5/16-inch wrench.

5. Attach the DB9 connector and tighten the two screws.

*Note: After replacement of a power detector, Wattmeter Calibration must be performed.*

## Battery Removal

CAUTION

*The 6-hour battery assembly weighs 40 lbs. One person must support the battery assembly while the another person removes the screws to prevent injury to personnel and/or damage to the equipment.*

Perform the following procedure to remove the 6-hour battery:

1. From the front of the cabinet, set the AC distribution power switches to the OFF position (see Figure 6-16).

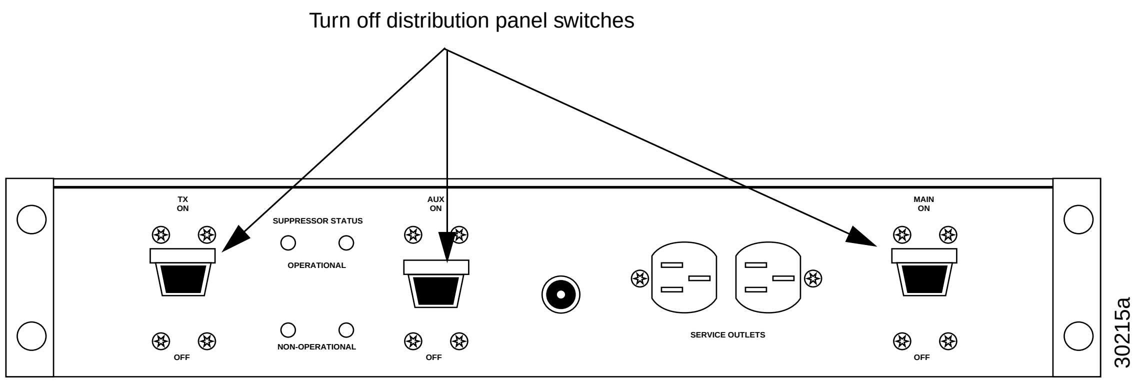



*Figure 6-16: Front View: Location of AC Distribution Panel Power Switches*

2. If the rear cabinet door does not open at least 90 degrees, remove the rear cabinet door (see paragraph, "Cabinet Doors Removal").

3. From the rear of the cabinet, loosen the two screws securing the connector to J14 on the RF-B! transmitter controller backplane (see Figure 6-17) and disconnect the connector.

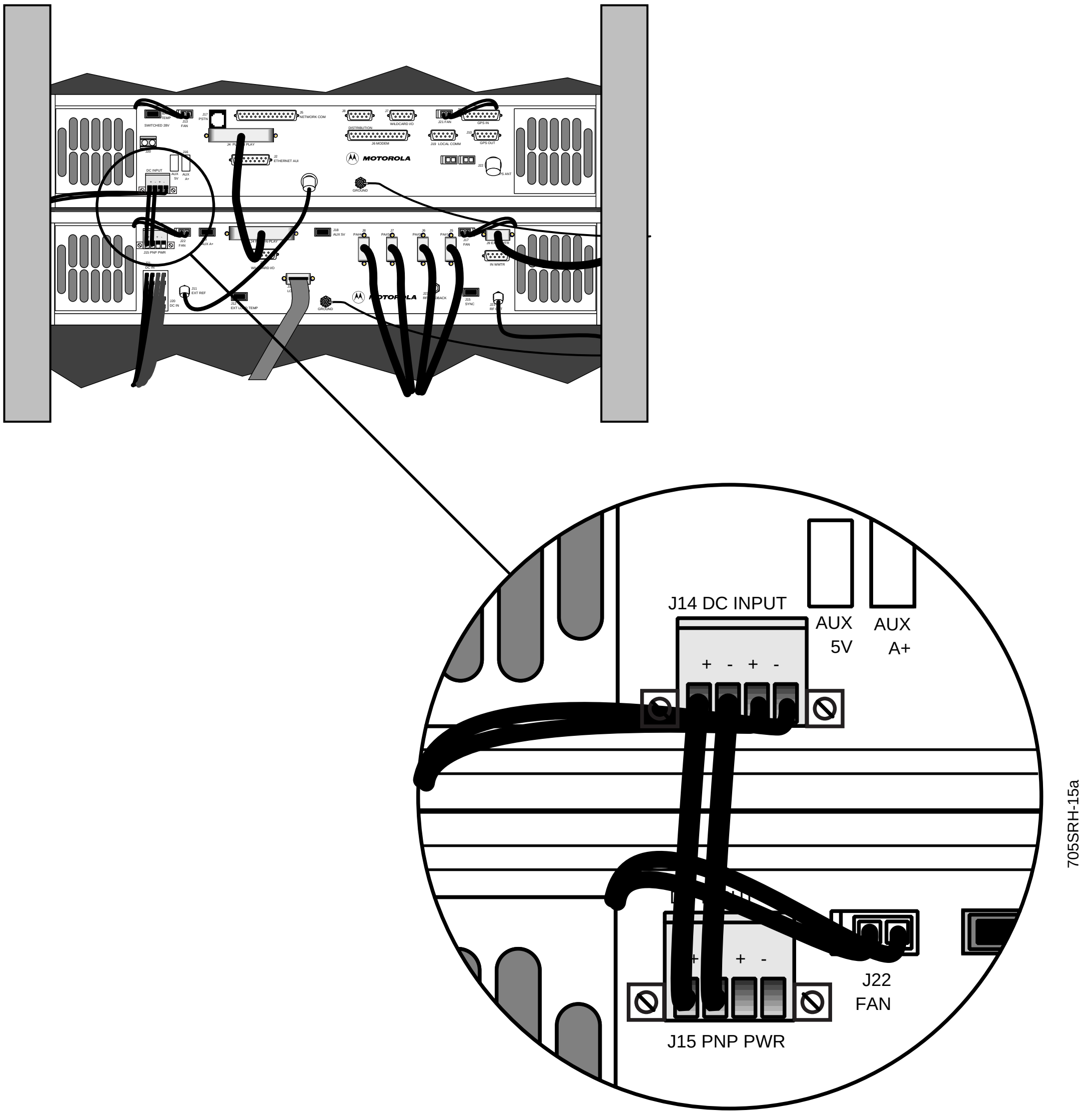



*Figure 6-17: Rear View of RF-B! Transmitter Controller and RF-O! Transmitter Backplane*

4. Loosen the two screws securing the connector to J15 on the RF-O! transmitter backplane (see Figure 6-17) and disconnect the connector.

5. Remove the wire tie that secures the wires to the chassis (see Figure 6-18).

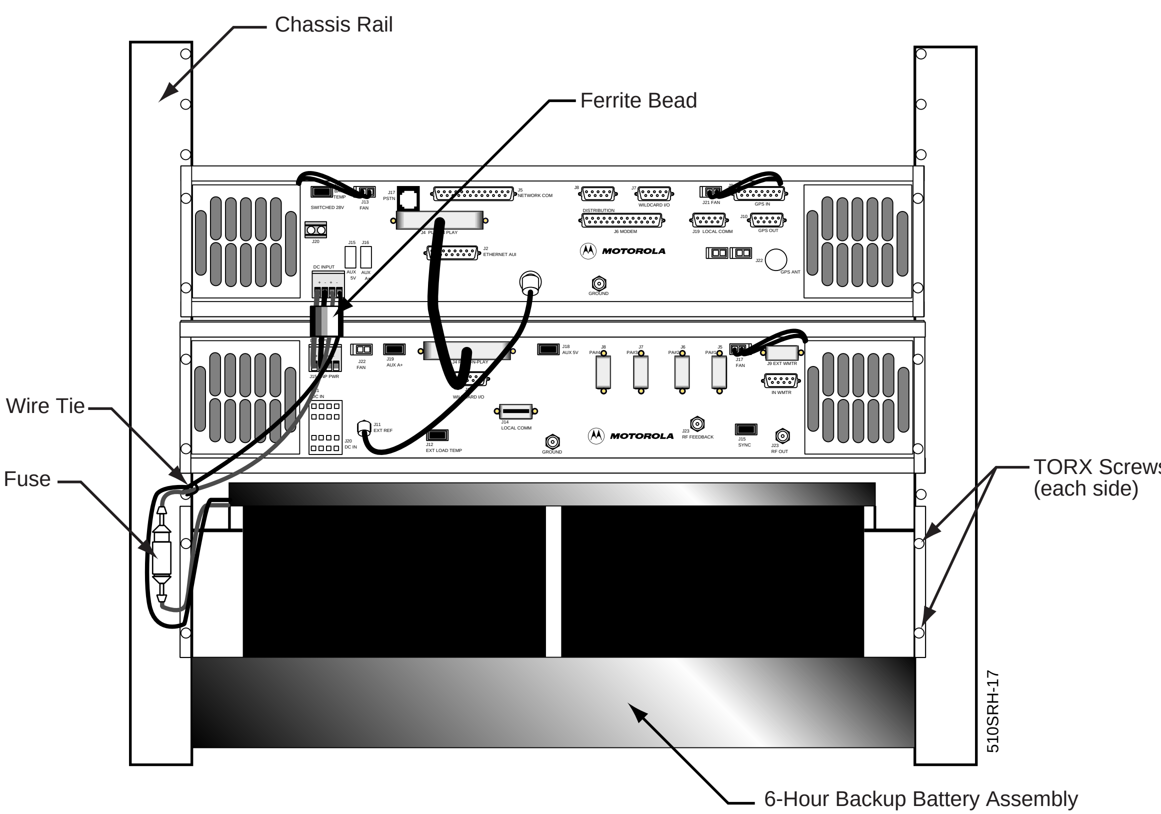



*Figure 6-18: Battery Backup Assembly*

6. While one person supports the battery assembly, another person should remove and save the four #30 TORX screws to remove the battery assembly.

## Battery Installation

Perform the following procedure to install the 6-hour battery assembly:

**DANGER**

*If incorrectly replaced, the battery can become explosive. Replace only with the same or equivalent type recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.*

1. Verify the kit received is PTNN1001A BATTERY 6 HR RF-O! transmitter and contains the following part:

   PTNN4001A, BATTERY 6-HOUR, including
   – Two batteries
   – Mounting brackets
   – Wiring harness with a fuse, fuse holder, 2 connectors, and a ferrite bead

2. Visually inspect the new 6-hour battery assembly.

3. Position the 6-hour battery assembly with the wires on the left (while facing station from rear).

4. Align the bracket holes on the battery assembly with the chassis holes and install the four screws removed in paragraph, "Battery Removal", Step 6 (see Figure 6-18).

5. Attach the connector with two wires to J15 on the RF-O! transmitter backplane and tighten the screws (see Figure 6-17).

6. Attach the connector with four wires to J14 on the RF-B! transmitter controller backplane and tighten the screws.

7. Anchor the wires to the chassis rail using a wire tie (see Figure 6-18).

8. Install the fuse.

9. If necessary, install the cabinet door (see paragraph, "Cabinet Doors Replacement").

10. At the front of the cabinet, set the AC distribution power switches to the ON position (see Figure 6-16).

## AC Distribution Panel Removal

**DANGER**

*Before servicing the RF-O! transmitter, all AC power to the RF-O! transmitter power supplies must be shut off.*

Perform the following procedure to remove the AC Distribution Panel:

*Note: Removing AC power from the RF-O! transmitter eliminates all DC voltages in the transmitter and removes the DC input into the RF-B! transmitter controller. If supplied with optional battery backup, ensure that the RF-Baton! (RF-B!) transmitter controller DC-DC converter switch(es) are placed to the OFF position.*

1. From the front of the cabinet, set the AC distribution power switches to the OFF position (see Figure 6-16).

2. Unplug the 208Vac from the power bus and route the power cord from the top of the cabinet, cutting cable ties, if necessary.

3. Unplug all power cords from the rear of the AC distribution panel.

4. Remove four Torx #30 screws from the AC distribution front panel.

5. Gently slide the AC distribution panel from the front of the cabinet.

## AC Distribution Panel Installation

Perform the following procedure to install the AC Distribution Panel:

1. Verify the component received is an AC Distribution Panel FRU kit, PTTN1016A, and contains the following parts:
   – PTTN1016A, FRU: AC Dist Subchnl 30 Amp
   – (1) AC Dist subchnl 20 amp, Motorola part number 0180576P02

2. Visually inspect the new distribution panel.

3. Gently slide the AC distribution panel into the front of the cabinet.

4. Install four Torx #30 screws to the front panel so as to secure the AC distribution front panel.

5. Plug all power cords to the rear of the AC distribution panel.

6. Route the power cord along the inside of the cabinet to the access hole through the top of the cabinet, adding cable ties, if necessary.

7. Plug the 208Vac to the power bus.

8. From the front of the cabinet, set the AC distribution power switches to the ON position (see Figure 6-16).

## RF-O! Transmitter Backplane Removal

Perform the following procedure to remove the RF-O! transmitter backplane:

1. From the front of the cabinet, set the AC distribution power switches to the OFF position (see Figure 6-16).

2. Remove RF-O! transmitter boards (DC-DC converter, OCB, exciter) from the station. See paragraph, "DC-DC Converter Removal", paragraph, "Orchestra Control Board Removal", and paragraph, "Exciter Removal" in this chapter.

3. Accessing the cabinet from the rear, disconnect the following cables from the RF-O! transmitter backplane:
   a. J4 Plug and Play cable
   b. J5 (and J6) PA SPI cable(s)
   c. J7 and J8 power supply cables
   d. J9 internal wattmeter SPI cable
   e. J10 external wattmeter SPI cable
   f. J11 10 MHz reference cable
   g. J12 external circulator load temperature cable

h. J15 Plug and Play cable

i. J17 and J22 DC fan power

j. J20 +28Vdc from both power supplies

k. J23 RF output cable

l. J24 RF input cable

m. cabinet grounding strap

4. Remove 16 Torx #15 screws around the outside edges of the backplane cover (see Figure 6-19).

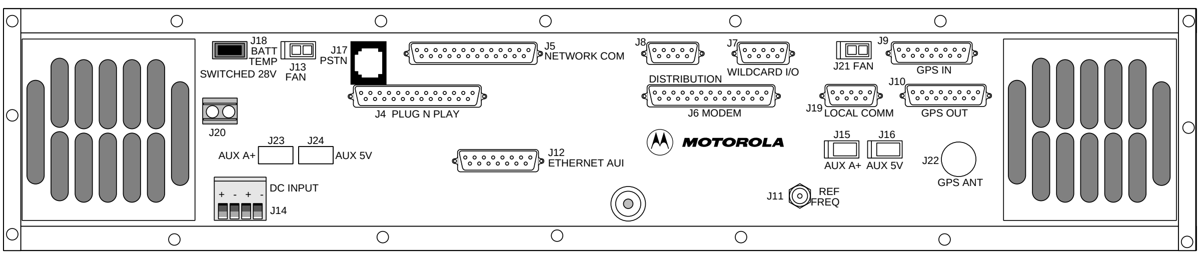



*Figure 6-19: Location of RF-O! Transmitter Backplane Chassis Fastening Torx Screws*

5. Remove backplane cover.

6. Remove the backplane.

## RF-O! Transmitter Backplane Installation

Perform the following procedure to install the RF-O! transmitter backplane:

1. Verify the component received is a RF-O! transmitter backplane kit PTTN4003, and contains the following parts:
   – PTTN4003, RFO Backplane
     - (1) RFO Backplane, Motorola part number 0180619P02
     - (16) SCRMCH M3.5X0.6X10 INTSTARPAN, Motorola part number 0310907A28
     - (1) REAR PNL RFO, Motorola part number 6486340G01

2. Visually inspect the new backplane.

3. Place the backplane in position to the OCM chassis and line up the mounting holes.

4. Place the backplane cover in position over the backplane and line up the mounting holes.

5. Install 16 Torx #15 screws around the outside edges of the backplane cover (see Figure 6-19).

6. Accessing the cabinet from the rear, connect the following cables to the RF-O! transmitter backplane:
   a. J4 Plug-and-Play cable
   b. J5 (and J6) PA SPI cable(s)
   c. J7 and J8 power supply cables
   d. J9 internal wattmeter SPI cable
   e. J10 external wattmeter SPI cable
   f. J11 10 MHz reference cable
   g. J12 external circulator load temperature cable
   h. J15 Plug and Play cable
   i. J17 and J22 DC fan power
   j. J20 +28Vdc from both power supplies
   k. J23 RF output cable

l. J24 RF input cable

m. cabinet grounding strap

7. Install RF-O! transmitter boards (DC-DC converter, OCB, Exciter). See paragraph, "DC-DC Converter Installation", paragraph, "Orchestra Control Board Installation", and paragraph, "Exciter Installation" in this chapter.

8. From the front of the cabinet, set the AC distribution power switches to the ON position (see Figure 6-16).

## RF-A! Receiver Removal and Replacement

*Refer to RF-Audience!™ Receiver Installation and Operation,* Publication 6880493G04 for removal and replacement of the RF-A! Receiver and the associated FRUs.

## RF-B! Transmitter Controller Removal and Replacement

Refer to *RF-Baton!™ Transmitter Controller System Installation and Operation*, Publication 6880497G01 for removal and replacement of the RF-B! Transmitter Controller and the associated FRUs.

## Resetting the Parameter Database

The RF-O! transmitter parameter database information is stored on an electrically erasable programmable read-only memory (EEPROM) on the OCM. Occasionally, new parameters are added to support a new feature of the RF-O! transmitter software. When new parameters are added it is sometimes necessary to reset the parameter database.

In certain cases, the user may wish to have certain parameters in the RF-O! transmitter parameter database set back to default. The use of DIP switch (SW500 on OCB) settings and a reboot allow the user to selectively reset parameters. There are four different combinations available to the user, and one special case.

*Table 6-7: DIP Switch Settings*

| Setting | Description |
|---|---|
| **1. No DIP setting (DIP1 and 2 OFF)** | ALL parameters in the EEPROM are preserved during reboot. |
| **2. DIP2 ON only (DIP1 OFF)** | Restores default settings. Protects both Factory Presets and Site Critical Parameters, such as the user password. |
| **3. Cutover (DIP switches off)** | A cutover changes which flash bank becomes active AND emulates a DIP2-only setting WITH OR WITHOUT the DIP switch itself being active. This is performed immediately after a software download. |
| **4. DIP1 and DIP 2 ON** | Restores default settings to all parameters except Factory Presets (Which should be the same list of parameters set and stored in the RF-O! transmitter after the factory calibrates the station). If these parameters are lost, the station cannot function. |
| **5. EEPROM reset** | This option is NOT selectable by the user. If the RF-O! transmitter software detects a new (blank) EEPROM, a corrupted parameter database, or a software version prior to 1.1.1, the ENTIRE parameter database will be set to defaults. |

The **a 117** command can be used to reset DIP switches remotely. Refer to Appendix D for additional information.

During power up, the user will see the normal RF-O! transmitter banner along with a message of what has happened to the parameter database. The five possibilities are:

1. No DIP switches are ON, and it is not a cutover. The parameter database is unchanged. The user will see:

```
>>>>>>>     MOTOROLA RF-ORCHESTRA!              <<<<<<<
>>>>>>>     WIRELESS MESSAGING SYSTEM (WMS)     <<<<<<<
>>>>>>>     (c) Copyright 1999 Motorola, Inc.   <<<<<<<
>>>>>>>     All Rights Reserved.                <<<<<<<
>>>>>>>     PARAMETER DATABASE UNCHANGED        <<<<<<<
```

2. The user has set the DIP2 switch ON and reset the station.

```
>>>>>>>     WIRELESS MESSAGING SYSTEM (WMS)     <<<<<<<
>>>>>>>     (c) Copyright 1999 Motorola, Inc.   <<<<<<<
>>>>>>>     All Rights Reserved.                <<<<<<<

>>>>>>>     SITE CRITICAL PARAMETERS PRESERVED      <<<<<<<
>>>>>>>     --FACTORY PRESETS PRESERVED--           <<<<<<<
>>>>>>>     ALL OTHER PARAMETERS SET TO DEFAULTS    <<<<<<<
```

3. The user has installed new software (post-RFO_1.1.3) and an automatic cutover is being performed. The user can also perform a cutover manually. The manual cutover steps are:
   a. Write the Active Flash Bank Parameter (901) to the opposite bank.
   b. Write the Active Flash Bank Mirror (709) to the opposite bank.
   c. Write the Cutover Requested Parameter (940) to request cutover.
   d. Clear alarms.
   e. Clear error logs.
   f. Reset the station.

   Example:

   RFO FIPS: **w 901 x** (x = 1 for Bank A, 2 for Bank B)

   RFO FIPS: **w 709 x** (x = 1 for Bank A, 2 for Bank B)

   RFO FIPS: **w 940 0** (0 = cutover requested)

   RFO FIPS: **a 103** (clear alarms)

RFO FIPS: **a 111** (clear 104 error log)

RFO FIPS: **a 113** (clear 110 sware log)

RFO FIPS: **a 117** (reset the station)

An automatic or manual cutover will reset the parameter database the same as if the DIP2 switch was ON, as in #2 above.

4. The user has set the DIP1 and DIP2 switch ON and reset the station.

```
>>>>>>>        MOTOROLA RF-ORCHESTRA!                <<<<<<<
>>>>>>>      WIRELESS MESSAGING SYSTEM (WMS)         <<<<<<<
>>>>>>>     (c) Copyright 1999 Motorola, Inc.        <<<<<<<
>>>>>>>         All Rights Reserved.                 <<<<<<<

>>>>>>>   CRITICAL PARAMETERS SET TO DEFAULTS       <<<<<<<
>>>>>>>      --FACTORY PRESETS PRESERVED--          <<<<<<<
>>>>>>>   ALL OTHER PARAMETERS SET TO DEFAULTS      <<<<<<<
```

5. The RF-O! transmitter software has detected a new (blank) EEPROM, the EEPROM has failed, or the EEPROM has a database from pre-RFO_1.1.3 software. The entire EEPROM will be reprogrammed.

```
>>>>>>>        MOTOROLA RF-ORCHESTRA!                <<<<<<<
>>>>>>>      WIRELESS MESSAGING SYSTEM (WMS)         <<<<<<<
>>>>>>>     (c) Copyright 1999 Motorola, Inc.        <<<<<<<
>>>>>>>         All Rights Reserved.                 <<<<<<<

>>>>>>>  ENTIRE PARAMETER DATABASE SET TO DEFAULT   <<<<<<<
>>>>>>>      --FACTORY PRESETS DESTROYED--          <<<<<<<
>>>>>>>    -- -- REPROGRAMMING EEPROM  -- --        <<<<<<<
```

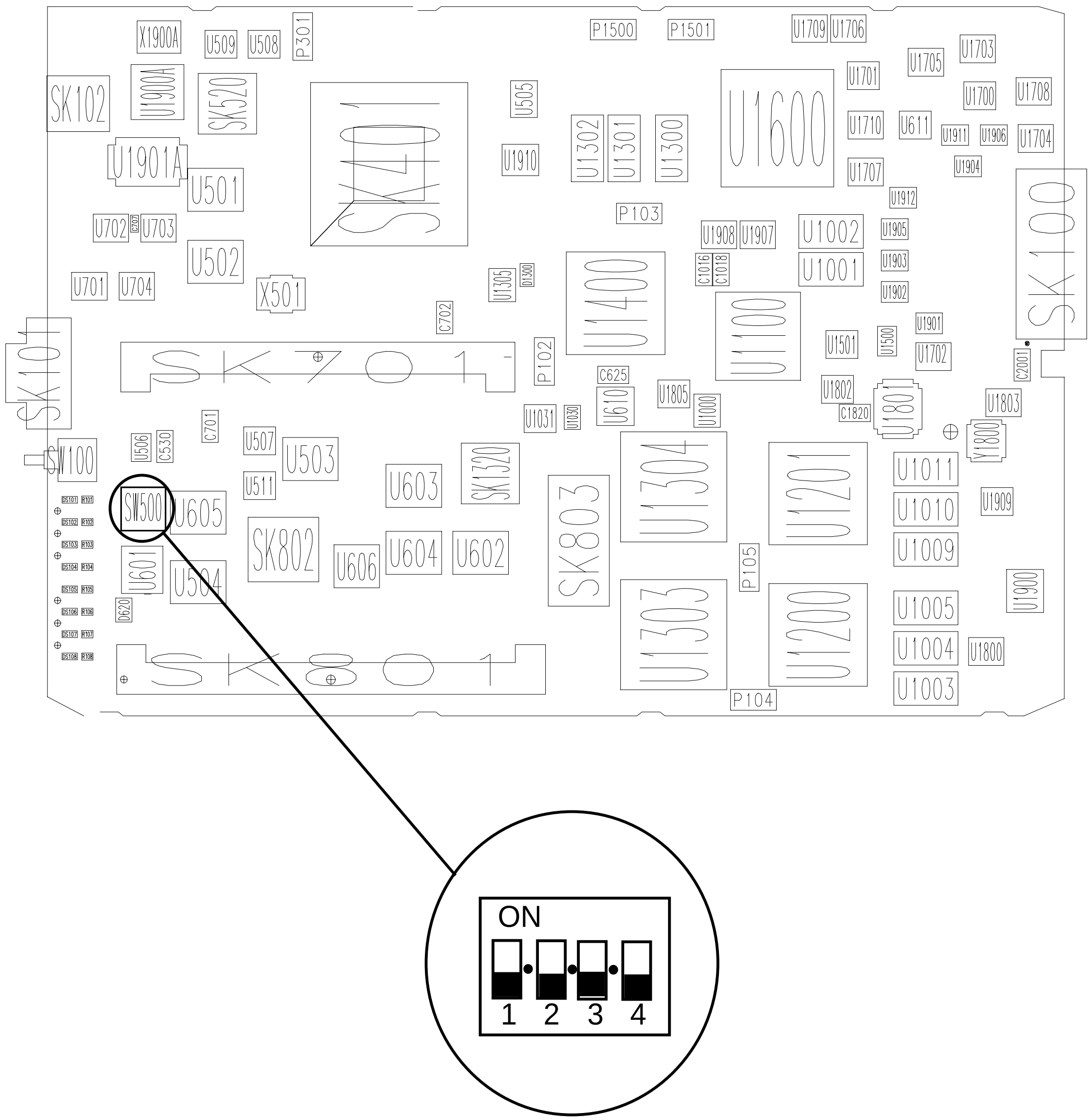



*Figure 6-20: SW500 Location on the RF-Orchestra! Control Board*

# Paging Station Alignment

This section contains alignment requirement and maintenance procedures for the RF-O!™ paging station.

For the purposes of these procedures, the following assumptions are made:

- All required test equipment and tools are available at the RF-O! transmitter.
- All site and RF-O! transmitter access requirements are established.
- Access to any special or non-default passwords that may be required is enabled.
- Log in to the FIPS sessions on the RF-O! transmitter as directed in the procedures.
- The RF-O! transmitter is connected to a network which is already in service.

## Required Tools & Equipment

- Torx wrench with T30 and T15 bits
- 5/16 in. open end crescent wrench for SMA connectors
- 105 in./lb torque wrench with 1 1/4 inch and 1 1/16 inch crows feet
- Ladder - two to four feet tall to access top of station
- Calculator
- Anti-static wrist strap
- Flat-head screw driver
- Needle-nose pliers
- Flashlight
- Inspection mirror with 6 in. handle or longer
- Laptop computer with communications software (two serial ports recommended)
- HP 8560E spectrum analyzer or equivalent with tracking generator
- HP 8482 power sensor or equivalent
- HP 437B power meter or HP 438A power meter (reference power meter)
- 500-Watt, 50-ohm RF load
- High power jumper with male 7/16 DIN connectors on each end

- Connector, as needed, to connect high power jumper to load
- Multimeter

## RF-O! Transmitter Preparation for Alignment

1. Configure your FIPS terminal session:
   a. Disconnect the remote FIPS cables from the 9-pin D-type connectors on the front panel of both the RF-O! transmitter and RF-B! transmitter controller.
   b. Connect your FIPS terminal serial port(s) to the RF-O! transmitter front panel FIPS ports. The setup should be 9600 bps, eight data bits, no parity, 1-stop bit.

2. Verify and record all items in the Appendix G (optional).

   *Note: Use the inspection mirror to see the serial numbers if necessary.*

3. Access the RF-O! transmitter:

```
ENTER PROTOCOL
fips
ENTER PASSWORD
6000 ("6000" is the default password)
RFO FIPS:
```

4. Verify and record the station configuration parameters shown in the checklist.

5. Disconnect the network on the RF-B! transmitter controller, the network can be disconnected by unplugging the coaxial T-connector at the transceiver.

   *Note: Observe safety and static precautions while adjusting cabling within the station. Always use the proper torque wrench to tighten and loosen the RF cables on the station.*

6. Confirm that the RF-O! transmitter is dekeyed:
   a. Confirm front panel *PA Keyed* LED is off
   b. Confirm zero PA module current with RFO FIPS: **a 68 1 c 0 1 0** (and **a 68 2 c 0 1 0,** if two PAs.)

7. Terminate the RF-O! transmitter RF output, located on the top of the cabinet, into a 500-Watt, 50-ohm load.

DANGER

*Before disconnecting the paging station from antenna RF output cable, ensure there is no transmission.*

## Carrier Feedthrough Nulling

The carrier feedthrough (CFT) signal is an undesired by-product of the I/Q modulator circuit of the exciter. This procedure is followed to minimize the CFT component, which may cause degraded voice quality (pops and fades) in InFLEXion paging systems.

Perform this procedure whenever you replace a wattmeter power detector, an RF coupler, a power amplifier, an OCM, an exciter, and during periodic maintenance routines:

CAUTION

*The RF-O! transmitter must warm up (transmit) for a minimum of five minutes before starting this procedure.*

1. Reaccess the RF-O! transmitter, if necessary:

   `ENTER PROTOCOL`

   **`fips`**

   `ENTER PASSWORD`

   **`6000`**

2. Null the CFT using the RFO FIPS command: **a 74**

```
RFO FIPS: a 74
Please wait. Command in process...
RA   74
Carrier Null Complete.

<<< CARRIER NULL TABLE >>>
 ----------    (Table Valid)    ---------
                Txlin Register $12
         Init   0x0c   0x04   0x08  Final
 ---------------------------------------
  979    -175    -50   -175    -50   -175
  980   -1034  -1500  -1500  -1031  -1031
  Vif   -----   0.18   0.18   0.18  -----

  Nulling Ambient Temperature:  25 Deg C
=============================================
```

## Calibrate Paging Station Wattmeters

This procedure aligns the paging station wattmeters to a reference power meter. The reference power meter must be at least 3 percent accurate and traceable to the standards set forth by the National Bureau of Standards. Any error in the reference is passed to the paging station wattmeters.

Perform this procedure whenever you replace a wattmeter, an RF coupler, an exciter, and during periodic maintenance routines.

The internal wattmeter measures paging station RF power at the output of the PA(s). The external wattmeter measures paging station RF power after the cavity filter.

CAUTION

*The RF-O! transmitter must warm up (transmit) for a minimum of five minutes before starting this procedure.*

### Internal Wattmeter Calibration

This procedure will align the RF-O! transmitter internal power meter to a reference power meter. The Reference meter must be at least 3% accurate and traceable to the National Bureau of Standards. Any error in the Reference will be passed to the RF-O! transmitter power meter.

1. Ensure the Tx output is connected to the 500 watt 50 ohm load, and the network is disconnected at the BCM.

2. For a single PA system, disconnect the PA output cable (at the PA) and connect the characterized coupler to the output of the PA. Connect the RF cable to the coupler output port. For multiple PA systems, connect the characterized coupler to the output of the combiner.

3. Connect the reference power meter to FORWARD tap on the characterized coupler. Set the offset of the power meter with attenuation written on the characterized coupler.

4. Initialize the internal cal factor on the OCM with the RFO FIPS command: **a 72 2 0 0 0 0**

```
RFO FIPS: a 72 2 0 0 0 0
RFO FIPS: RA   72
<<< WRITE EXCITER EEPROM >>>

Exciter EEPROM Cell 0x02 = 0x00 0x00 0x00 0x00
RFO FIPS:
```

5. Reset the OCM with the RFO FIPS command: **a 117**

```
RFO FIPS: a 117
 >>>>>>>           MOTOROLA RF-ORCHESTRA!          <<<<<<<
 >>>>>>>        WIRELESS MESSAGING SYSTEM (WMS)    <<<<<<<
 >>>>>>>      (c) Copyright 1998 Motorola, Inc.    <<<<<<<
 >>>>>>>            All Rights Reserved.           <<<<<<<

 >>>>>>>        PARAMETER DATABASE UNCHANGED       <<<<<<<

ENTER PROTOCOL
fips
ENTER PASSWORD
```

```
6000
```

6. Turn off power-control with the FIPS command: **w 992 0**

```
RFO FIPS: w 992 0
RFO FIPS: RW  992 0
```

7. Initialize amplitude alignment parameters with the FIPS command: **a 75**

```
RFO FIPS: a 75
RFO FIPS: RA   75
<<< ALIGNMENT PARAMETER DEFAULT VALUES >>>
  K-Factor       990 = 0.408269
  Fdback Atten   996 =      255
  Phase Trng     982 =   -10000
  Txlin Reg2     954 =       84
  Txlin Reg1     953 =       14
  Txlin Atten    974 =        0
  Mod Dev       2053 =     4800
  FM Power Lvl  2054 =    28000
  AM Pilot Pwr  2055 =     1600
  AM Sdbd Pwr   2056 =    12426
=============================================
```

8. Key the transmitter in test mode with following FIPS command: **a 176 0 8 0 0 0 1 10 5 1**

```
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>
Using Default Frequency Offsets of 1 15 2 14.
Where:
13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz
 0 =   0.00 kHz
 1 =   6.25 kHz,  2 =  12.50 kHz,  3 = 18.75 kHz
(Use Command "A 195" to modify the Frequency Offsets).
Using Default Channel Setting of 0.
(Use Command "A 196" to modify the Channel Setting).
```

```
The Station is Keyed in Test Mode.
```

9. Increase the power (read on the power meter) to 200 watts by adjusting the OCM parameter 990 starting with initial value of 0.4 (i.e. FIPS: **w 990 0.4**). Note that the range of parameter 990 is 0.0 to 1.0. Make initial steps of 0.1. The power must be between 195 and 205 watts ± 5 watts in order for the calibration to take place.

```
RFO FIPS: w 990 0.40
RFO FIPS: RW  990 0.400000
RFO FIPS: w 990 0.5
RFO FIPS: RW  990 0.500000
RFO FIPS: w 990 .46
RFO FIPS: RW  990 0.460000
RFO FIPS: w 990 .465
RFO FIPS: RW  990 0.465000
RFO FIPS: w 990 .467
RFO FIPS: RW  990 0.467000
```

10. Wait about two minutes for transmitter to key up at least 60 times. Verify that the internal calibration factor is 1.00000 by typing the RFO FIPS command **a 79 0**. Also verify that the uncalibrated internal wattmeter reading is within 20% of the reading on the reference power meter. Use the “Power Per Subchannel” reading from the **a 79 0** response as the external wattmeter reading.

```
RFO FIPS: a 79 0
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  INTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:         84 Watts
   Total Wattmeter Voltage:  +1.08 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:        84 Watts  <----------------Use this reading

Calibration Factor: 1.000000
```

```
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

11. Align the internal power meter to the reference power meter by sending the RFO FIPS command: **a 71 0 xxx**; where "xxx" is the reading of the reference power meter and "0" indicates the <u>internal</u> power meter. Calibration may take up to two minutes to complete.

```
RFO FIPS: a 71 0 200
Please wait. Command in process...
RA   71
<<< CALIBRATE DETECTORS >>>
========= Detector 0 Calibration =========
 0x00:  0x44 0x45 0x54 0x30  "DET0"
 0x01:  0x30 0x32 0x30 0x30  "0200"
 0x02:  0x32 0x2e 0x31 0x35  "2.15"
 0x03:  0x37 0x39 0x38 0x35  "7985"
 0x04:  0x44 0x45 0x54 0x30  "DET0"
 0x05:  0x44 0x45 0x54 0x30  "DET0"
 0x06:  0x44 0x45 0x54 0x30  "DET0"
 0x07:  0x44 0x45 0x54 0x30  "DET0"
 0x08:  0x44 0x45 0x54 0x30  "DET0"
 0x09:  0x44 0x45 0x54 0x30  "DET0"
 0x0a:  0x44 0x45 0x54 0x30  "DET0"
 0x0b:  0x44 0x45 0x54 0x30  "DET0"
 0x0c:  0x31 0x2e 0x32 0x2e  "1.2."
 0x0d:  0x33 0x20 0x00 0x00  "3 .."
 0x0e:  0x30 0x30 0x30 0x30  "0000"
 0x0f:  0x43 0x48 0x4b 0xac  "CHK."
 0x3f:  0x43 0x48 0x4b 0xea  "CHK."
Calibration Factor = 1.188193
=============================================
```

*Note: If the calibration factor is not within the range of 0.8 and 1.2 or the system didn't calibrate (no table returned), repeat Step 11 up to three times. If the system still does not calibrate or the cal factor is still out of range, replace the detector or coupler as needed. (In the example given, the difference between the average value read and the reference power meter was greater than 20% and the system was not able to compensate.)*

12. Turn off the OCM test mode (dekey) using the FIPS command: **a 177**

```
RFO FIPS: a 177
RFO FIPS: RA  177
The Station is Dekeyed.
RFO FIPS:
```

13. The RF-O! internal power meter calibration will take effect on return from reset. Reset the OCM to have calibration take effect using the RFO FIPS command: **a 117**

```
RFO FIPS: a 117
 >>>>>>>           MOTOROLA RF-ORCHESTRA!            <<<<<<<
 >>>>>>>        WIRELESS MESSAGING SYSTEM (WMS)      <<<<<<<
 >>>>>>>      (c) Copyright 1998 Motorola, Inc.      <<<<<<<
 >>>>>>>            All Rights Reserved.             <<<<<<<

 >>>>>>>        PARAMETER DATABASE UNCHANGED         <<<<<<<

ENTER PROTOCOL
fips
ENTER PASSWORD
6000
```

14. Turn off power-control with the RFO FIPS command: **w 992 0**

```
RFO FIPS: w 992 0
RFO FIPS: RW  992 0
```

15. Initialize amplitude alignment parameters with the FIPS command: **a 75**

```
RFO FIPS: a 75
RFO FIPS: RA   75
<<< ALIGNMENT PARAMETER DEFAULT VALUES >>>
  K-Factor       990 = 0.408269
  Fdback Atten   996 =      255
  Phase Trng     982 =   -10000
  Txlin Reg2     954 =       84
  Txlin Reg1     953 =       14
  Txlin Atten    974 =        0
  Mod Dev       2053 =     4800
  FM Power Lvl  2054 =    28000
  AM Pilot Pwr  2055 =     1600
  AM Sdbd Pwr   2056 =    12426
=============================================
```

16. Key the transmitter in test mode with following FIPS command: **a 176 0 8 0 0 0 1 10 5 1**

```
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>
Using Default Frequency Offsets of 1 15 2 14.
Where:
13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz
 0 =   0.00 kHz
 1 =   6.25 kHz,  2 =  12.50 kHz,  3 = 18.75 kHz
(Use Command "A 195" to modify the Frequency Offsets).
Using Default Channel Setting of 0.
(Use Command "A 196" to modify the Channel Setting).

The Station is Keyed in Test Mode.
```

17. Wait <u>two minutes</u> for the transmitter to key up at least 60 times. Read internal wattmeter readings using the RFO FIPS commands: **a 79 0** and **a 79 1**. Verify that the reference power meter and the internal forward power meter are within 10% of each other

```
RFO FIPS: a 79 0
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  INTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:        101 Watts
   Total Wattmeter Voltage:  +1.09 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:       100 Watts

Calibration Factor: 1.188193
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
RFO FIPS: a 79 1
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

========= INTERNAL REFLECTED WATTMETER =========
Last Keyed FM Readings:
   Total Station Power:          0 Watts
   Total Wattmeter Voltage:  +0.00 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:         0 Watts

Calibration Factor: 1.188193
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

18. Turn off the OCM test mode (dekey) using the RFO FIPS command: **a 177**

```
RFO FIPS: a 177
RFO FIPS: RA  177
The Station is Dekeyed.
```

19. Disconnect the Characterized Coupler and reconnect PA output cable back on the PA.

### External Wattmeter Calibration

This procedure will verify cavity losses and align the RF-O! transmitter external power meter to a reference power meter. The Reference meter must be at least 3% accurate and traceable to the National Bureau of Standards. Any error in the Reference will be passed to the RF-O! transmitter power meter.

1. Ensure the network is disconnected at the RFB.

2. Ensure the characterized coupler is connected to the top of the cabinet and the output of the characterized coupler is terminated into a 500 Watt 50 Ohm load. Torque the connections to 105 in. lb.

3. Connect the reference power meter to the FORWARD tap on the Characterized Coupler. Set the offset of the power meter with attenuation written on the Characterized Coupler.

4. Initialize the external cal factor with the RFO FIPS command: **a 72 12 0 0 0 0**

```
RFO FIPS: a 72 12 0 0 0 0
RFO FIPS: RA   72
<<< WRITE EXCITER EEPROM >>>
Exciter EEPROM Cell 0x12 = 0x00 0x00 0x00 0x00
RFO FIPS:
```

5. Reset the OCM with the RFO FIPS command: **a 117**

```
RFO FIPS: a 117
 >>>>>>>           MOTOROLA RF-ORCHESTRA!           <<<<<<<
 >>>>>>>        WIRELESS MESSAGING SYSTEM (WMS)     <<<<<<<
 >>>>>>>      (c) Copyright 1998 Motorola, Inc.     <<<<<<<
 >>>>>>>            All Rights Reserved.            <<<<<<<

 >>>>>>>        PARAMETER DATABASE UNCHANGED        <<<<<<<
fips
ENTER PASSWORD
6000
RFO FIPS:
```

6. Turn off power-control with the RFO FIPS command: **w 992 0**

```
RFO FIPS: w 992 0
RFO FIPS: RW  992 0
```

7. Initialize amplitude alignment parameters with the RFO FIPS command: **a 75**

```
RFO FIPS: a 75
RFO FIPS: RA   75
<<< ALIGNMENT PARAMETER DEFAULT VALUES >>>
  K-Factor      990 = 0.408269
  Fdback Atten  996 =      255
  Phase Trng    982 =   -10000
  Txlin Reg2    954 =       84
  Txlin Reg1    953 =       14
  Txlin Atten   974 =        0
  Mod Dev      2053 =     4800
  FM Power Lvl 2054 =    28000
  AM Pilot Pwr 2055 =     1600
  AM Sdbd Pwr  2056 =    12426
=============================================
```

8. Key the transmitter in test mode with following FIPS command: **a 176 0 8 0 0 0 1 10 5 1**

```
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>
Using Default Frequency Offsets of 1 15 2 14.
Where:
13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz
 0 =   0.00 kHz
 1 =   6.25 kHz,  2 =  12.50 kHz,  3 = 18.75 kHz
(Use Command "A 195" to modify the Frequency Offsets).
Using Default Channel Setting of 0.
(Use Command "A 196" to modify the Channel Setting).

The Station is Keyed in Test Mode.
```

9. Increase post-cavity power to 200 Watts by adjusting the OCM parameter 990 starting with initial value of 0.5 (i.e. FIPS: **w 990 0.5**). Note that the range of parameter 990 is 0.0 to 1.0. Make initial steps of 0.1. The external power meter must be calibrated between 195 and 205 watts ± 5 watts.

```
RFO FIPS: r 990
RFO FIPS: RR  990 0.408269
RFO FIPS: w 990 0.50
RFO FIPS: RW  990 0.500000
RFO FIPS: w 990 0.55
RFO FIPS: RW  990 0.550000
RFO FIPS: w 990 .56
RFO FIPS: RW  990 0.560000
RFO FIPS: w 990 .561
RFO FIPS: RW  990 0.561000
```

10. Wait <u>two minutes</u> for transmitter to key up 60 times, and stabilize at the new power setting. Verify that the external calibration factor is 1.00000 by typing the RFO FIPS command: **a 79 2**. Also verify that the uncalibrated external wattmeter reading is within 20% of the reading on the reference power meter. Use the "Power Per Subchannel" reading from the **a 79 2** response as the external wattmeter reading.

```
RFO FIPS: a 79 2
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  EXTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:        201 Watts
   Total Wattmeter Voltage:  +2.51 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:       201 Watts  <----------------Use this reading

Calibration Factor: 1.000000
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

11. Align the external power meter to the reference power meter by typing the OCM FIPS command: **a 71 1 xxx**; where “xxx” is the reading of the reference power meter and “1” indicates the <u>external</u> power meter. Calibration may take up to two minutes to complete.

```
RFO FIPS: a 71 1 201
Please wait. Command in process...
RA   71
<<< CALIBRATE DETECTORS >>>
========= Detector 1 Calibration =========
 0x10:  0x44 0x45 0x54 0x31  "DET1"
 0x11:  0x30 0x32 0x30 0x31  "0201"
 0x12:  0x32 0x2e 0x34 0x39  "2.49"
 0x13:  0x36 0x36 0x39 0x32  "6692"
 0x14:  0x44 0x45 0x54 0x31  "DET1"
 0x15:  0x44 0x45 0x54 0x31  "DET1"
 0x16:  0x44 0x45 0x54 0x31  "DET1"
 0x17:  0x44 0x45 0x54 0x31  "DET1"
 0x18:  0x44 0x45 0x54 0x31  "DET1"
 0x19:  0x44 0x45 0x54 0x31  "DET1"
 0x1a:  0x44 0x45 0x54 0x31  "DET1"
 0x1b:  0x44 0x45 0x54 0x31  "DET1"
 0x1c:  0x31 0x2e 0x32 0x2e  "1.2."
 0x1d:  0x33 0x20 0x00 0x00  "3 .."
 0x1e:  0x30 0x30 0x30 0x30  "0000"
 0x1f:  0x43 0x48 0x4b 0xb7  "CHK."
 0x3f:  0x43 0x48 0x4b 0xf8  "CHK."
Calibration Factor = 0.936122
=============================================
```

*Note: If the calibration factor is not within the range of 0.8 and 1.2 or the system didn’t calibrate, repeat this step up to three times. If the system still doesn’t calibrate or the cal factor is still out of range, replace the detector or coupler as needed. (The difference between the average value read and the reference power meter was greater than 20% and the system was not able to compensate.)*

12. Turn off the OCM test mode (dekey) using the RFO FIPS command: **a 177**

```
RFO FIPS: a 177
RFO FIPS: RA  177
The Station is Dekeyed.
```

13. Reset OCM to have calibration take effect using the RFO FIPS command: **a 117**

```
RFO FIPS: a 117
 >>>>>>>           MOTOROLA RF-ORCHESTRA!            <<<<<<<
 >>>>>>>        WIRELESS MESSAGING SYSTEM (WMS)      <<<<<<<
 >>>>>>>      (c) Copyright 1998 Motorola, Inc.      <<<<<<<
 >>>>>>>            All Rights Reserved.             <<<<<<<

 >>>>>>>        PARAMETER DATABASE UNCHANGED         <<<<<<<

ENTER PROTOCOL
fips
ENTER PASSWORD
6000
```

14. Turn off power-control with the RFO FIPS command: **w 992 0**

```
RFO FIPS: w 992 0
RFO FIPS: RW  992 0
```

15. Initialize amplitude alignment parameters with the RFO FIPS command: **a 75**

```
RFO FIPS: a 75
RFO FIPS: RA   75
<<< ALIGNMENT PARAMETER DEFAULT VALUES >>>
  K-Factor       990 = 0.408269
  Fdback Atten   996 =      255
  Phase Trng     982 =   -10000
  Txlin Reg2     954 =       84
  Txlin Reg1     953 =       14
  Txlin Atten    974 =        0
  Mod Dev       2053 =     4800
  FM Power Lvl  2054 =    28000
  AM Pilot Pwr  2055 =     1600
  AM Sdbd Pwr   2056 =    12426
=============================================
```

16. Key the transmitter in test mode with following RFO FIPS command: **a 176 0 8 0 0 0 1 10 5 1**

```
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>
Using Default Frequency Offsets of 1 15 2 14.
Where:
13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz
 0 =   0.00 kHz
 1 =   6.25 kHz,  2 =  12.50 kHz,  3 = 18.75 kHz
(Use Command "A 195" to modify the Frequency Offsets).
Using Default Channel Setting of 0.
(Use Command "A 196" to modify the Channel Setting).

The Station is Keyed in Test Mode.
```

17. Wait <u>two minutes</u> for transmitter to key up 60 times. Reread the RFO FIPS commands: **a 79 2** and **a 79 3** and verify that the reference power meter and the external forward power meter are within   10% of each other

```
RFO FIPS: a 79 2
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  EXTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:         77 Watts
   Total Wattmeter Voltage:  +0.96 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:        77 Watts

Calibration Factor: 0.936122
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================


RFO FIPS: a 79 3
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

========= EXTERNAL REFLECTED WATTMETER =========
Last Keyed FM Readings:
   Total Station Power:          0 Watts
   Total Wattmeter Voltage:  +0.01 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:         0 Watts

Calibration Factor: 0.936122
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
================================================
```

18. Turn off the OCM test mode (dekey) using the FIPS command: **a 177**

```
RFO FIPS: a 177
RFO FIPS: RA  177
The Station is Dekeyed.

RFO FIPS:
```

19. Disconnect the characterized coupler from the top of the cabinet and connect the Tx output to the 500 watt 50 ohm load.

## Transmitter Power Alignment

This procedure assumes that the wattmeters were previously calibrated. The factory sets this value at 75 Watts, but the value is user-configurable.

1. Ensure that the RF-O! transmitter is terminated into a 500-Watt, 50-ohm load.

2. Confirm that the RF-O! transmitter is disconnected from the network.

3. Reaccess the RF-O! transmitter, if necessary:

```
ENTER PROTOCOL
fips
ENTER PASSWORD
6000
RFO FIPS:
```

4. Ensure power-control is turned off with the RFO FIPS command: **w 992 0**

```
RFO FIPS: w 992 0
RFO FIPS: RW  992 0
```

5. Initialize amplitude alignment parameters with the RFO FIPS command: **a 75**

```
RFO FIPS: a 75
RFO FIPS: RA   75
<<< ALIGNMENT PARAMETER DEFAULT VALUES >>>
  K-Factor       990 = 0.408269
  Fdback Atten   996 =      255
  Phase Trng     982 =   -10000
  Txlin Reg2     954 =       84
  Txlin Reg1     953 =       14
  Txlin Atten    974 =        0
  Mod Dev       2053 =     4800
  FM Power Lvl  2054 =    28000
  AM Pilot Pwr  2055 =     1600
  AM Sdbd Pwr   2056 =    12426
=============================================
```

6. Key the transmitter in test mode with following RFO FIPS command: **a 176 0 8 0 0 0 1 10 5 1**

```
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>
The Station is Keyed in Test Mode.
```

7. Wait two minutes for the transmitter to key up at least 60 times. Read the internal forward wattmeter by typing the RFO FIPS command: **a 79 0**. Power should be somewhere between 50 and 175W. Record the average power reading (Pmeas).

```
RFO FIPS: a 79 0
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  INTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:        105 Watts
   Total Wattmeter Voltage:  +1.14 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:       104 Watts  <-------------This is Pmeas

Calibration Factor: 1.188193
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

8. Al the value obtained from Step 7.

```
RFO FIPS: a 76 104    <----- Insert your value Pmeas here.
RFO FIPS: RA   76
<<< ALIGNMENT PARAMETER VALUES >>>
  K-Factor      990 = 0.408269
  Fdback Atten  996 =      255
  Phase Trng    982 =   -10000
  Txlin Reg2    954 =       84
  Txlin Reg1    953 =       14
  Txlin Atten   974 =        0
  Mod Dev      2053 =     4800
  FM Power Lvl 2054 =    28000
  AM Pilot Pwr 2055 =     1600
  AM Sdbd Pwr  2056 =    12426
=============================================
```

9. Turn off the OCM test mode (dekey) using the RFO FIPS command: **a 177**

```
RFO FIPS: a 177
RFO FIPS: RA  177
The Station is Dekeyed.
```

10. Reset the OCM with the RFO FIPS command: **a 117**

```
RFO FIPS: a 117
 >>>>>>>           MOTOROLA RF-ORCHESTRA!           <<<<<<<
 >>>>>>>        WIRELESS MESSAGING SYSTEM (WMS)      <<<<<<<
 >>>>>>>      (c) Copyright 1998 Motorola, Inc.      <<<<<<<
 >>>>>>>            All Rights Reserved.             <<<<<<<

 >>>>>>>        PARAMETER DATABASE UNCHANGED         <<<<<<<

ENTER PROTOCOL
fips
ENTER PASSWORD
6000
```

11. Set FM power by entering the RFO FIPS command: **a 88 0 x** (where x is the desired FM power per subchannel).

```
RFO FIPS: a 88 0 75
RFO FIPS: RA   88
<<< SET FM POWER OUTPUT >>>

 2 PA Deck(s) Detected
 FM Modulation
 FM Power Level = 75 Watt(s) per Subchannel
 Subchannel(s)  Minimum  Maximum
 -------------------------------
       1          040      290
       2          040      145
       3          025      095
---------------------------------------------
```

```
NOTE: This Configuration Will Allow The Transmitter to Key With
1 thru 3 FM Subchannels. All Other FM Key Requests Will Be
Ignored.
=============================================
```

12. Set AM power by entering the RFO FIPS command: **a 88 1 y** (where y is the desired AM power per subchannel).

```
RFO FIPS: a 88 1 75
RFO FIPS: RA   88
<<< SET AM POWER OUTPUT >>>

 2 PA Deck(s) Detected
 AM Modulation
 AM Power Level = 75 Watt(s) per Subchannel
 Subchannel(s)  Minimum  Maximum
 -------------------------------
       1          065      150
       2          040      075
---------------------------------------------
NOTE: This Configuration Will Allow The Transmitter to Key With
1 thru 2 AM Subchannels. All Other AM Key Requests Will Be
Ignored.
=============================================
Key the transmitter in test mode with following FIPS command: a
176 0 8 0 0 0 1 10 5 1
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>
Using Default Frequency Offsets of 1 15 2 14.
Where:
13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz
 0 =   0.00 kHz
 1 =   6.25 kHz,  2 =  12.50 kHz,  3 = 18.75 kHz
(Use Command "A 195" to modify the Frequency Offsets).
Using Default Channel Setting of 0.
```

```
(Use Command "A 196" to modify the Channel Setting).

The Station is Keyed in Test Mode.
```

13. Wait <u>two minutes</u> for the transmitter to key up at least 60 times. Verify that the internal forward power reading is within 10% of the value entered in the "Set FM Power" by entering the RFO FIPS command: **a 79 0**

```
RFO FIPS: a 79 0
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  INTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:         74 Watts
   Total Wattmeter Voltage:  +0.81 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:        74 Watts  <----------------Use this reading
                                                           for next 3 steps.
Calibration Factor: 1.188193
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

14. Set the Internal Wattmeter Forward Power Minimum Limit to 50% of the Internal forward power reading (Power Per Subchannel) using the FIPS command: **w 141** *x* (for a setting of 75 watts *x* is 37).

15. Set the Internal Wattmeter Forward Power Maximum Limit to two times that of the Internal forward power reading (Power Per Subchannel) using the FIPS command: **w 142** *x* (for a setting of 75 watts *x* is 150).

16. Set the Internal Wattmeter Reflected Power Limit to 10% of the Internal forward power reading (Power Per Subchannel) using the FIPS command: **w 143** *x* (for a setting of 75 watts *x* is 7).

17. Read the external Forward Wattmeter using the RFO FIPS command: **a 79 2**

```
RFO FIPS: a 79 2
RFO FIPS: RA   79
<<< FM POWER OUTPUT READINGS >>>

=========  EXTERNAL FORWARD WATTMETER  =========
Last Keyed FM Readings:
   Total Station Power:         60 Watts
   Total Wattmeter Voltage:  +0.96 Volts
Average FM Keyed Readings (over last 20 keyups):
   Power Per Subchannel:        60 Watts  <----------------Use this reading
                                                           for next 3 steps.
Calibration Factor: 0.936122
---------------------------------------------
The Accuracy of This Meter is +- 10 %.
=============================================
```

18. Set the External Wattmeter Forward Power Minimum Limit to 50% of the external forward power reading (Power Per Subchannel) using the FIPS command: **w 144** *x* (for a reading of 60 watts *x* is 30).

19. Set the External Wattmeter Forward Power Maximum Limit to two times that of the external forward power reading (Power Per Subchannel) using the FIPS command: **w 145** *x* (for a reading of 60 watts *x* is 120).

20. Set the External Wattmeter Reflected Power Limit to 10% of the external forward power reading (Power Per Subchannel) using the FIPS command: **w 146** *x* (for a reading of 60 watts *x* is 6).

## PA Functionality Check

This procedures assumes that the wattmeters were calibrated prior to proceeding with the station alignment.

1. The station should still be keying in test mode from the last section. If not, key the transmitter in test mode with following RFO FIPS command: **a 176 0 8 0 0 0 1 10 5 1**

```
RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>
Using Default Frequency Offsets of 1 15 2 14.
Where:
13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz
 0 =   0.00 kHz
 1 =   6.25 kHz,  2 =  12.50 kHz,  3 = 18.75 kHz
(Use Command "A 195" to modify the Frequency Offsets).
Using Default Channel Setting of 0.
(Use Command "A 196" to modify the Channel Setting).

The Station is Keyed in Test Mode.
```

2. If you have a single-PA configuration, Type OCM command: **a 68 1 c 1 1 0**. Verify the following values are in the given range.
   a. Register 02 should be 032 $\pm 6$ (for 75W FM power)
   b. Register 09 should be 067 $\pm 8$ (for 75W FM power)
   c. If the station is set for 75W FM power, verify that the power displayed next to the Register 09 value is within $\pm$ 15% of the reading from the internal forward wattmeter (75W $\pm$ 11W).
   d. Verify that Register 3 through Register 8 are drawing more than 1.0 Amps. If not, the PA is not functioning properly and must be replaced.

```
RFO FIPS: a 68 1 c 1 1 0
RFO FIPS: RA   68
<<< READ PA DECK 01 A/D 01 >>>
Reg 00: PDPA     = 091 =>  0.11 Amp(s)
Reg 01: DPA      = 092 =>  2.30 Amp(s)
```

```
Reg 02: OD       = 030 =>  7.68 Watt(s)  <--- Should be 026 to 038 (if 75W)
Reg 03: FPA 1 A  = 093 =>  2.13 Amp(s)
Reg 04: FPA 1 B  = 098 =>  2.48 Amp(s)
Reg 05: FPA 2 A  = 084 =>  2.13 Amp(s)
Reg 06: FPA 2 B  = 100 =>  2.30 Amp(s)
Reg 07: FPA 3 A  = 089 =>  2.13 Amp(s)
Reg 08: FPA 3 B  = 094 =>  2.66 Amp(s)
Reg 09: Fwd      = 066 => 78.51 Watt(s)  <--- Should be 059 to 075(if 75 W)
Reg 0A: Rfltd    = 001 =>  0.37 Watt(s)
Reg 0B: A/D Test = 128 => PASS (> 126)
=============================================
```

3. If you have a two-PA configuration, Type OCM command: **a 68 1 c 1 1 0** (to read PA #1) and **a 68 2 c 1 1 0** (to read PA #2). If the station is set for 75W FM power, verify the following values are in the given range for BOTH PAs.
   a. Register 02 should be 021 ± 6 (for 75W FM power)
   b. Register 09 should be 044 ± 8 (for 75W FM power)

```
RFO FIPS: a 68 1 c 1 1 0
RFO FIPS: RA   68
<<< READ PA DECK 01 A/D 01 >>>
Reg 00: PDPA     = 091 =>  0.11 Amp(s)
Reg 01: DPA      = 097 =>  2.48 Amp(s)
Reg 02: OD       = 021 =>  9.04 Watt(s)  <--- Should be 015 to 027(if 75W)
Reg 03: FPA 1 A  = 095 =>  1.42 Amp(s)
Reg 04: FPA 1 B  = 090 =>  1.59 Amp(s)
Reg 05: FPA 2 A  = 085 =>  1.24 Amp(s)
Reg 06: FPA 2 B  = 096 =>  1.59 Amp(s)
Reg 07: FPA 3 A  = 095 =>  1.42 Amp(s)
Reg 08: FPA 3 B  = 088 =>  1.59 Amp(s)
Reg 09: Fwd      = 047 => 39.03 Watt(s)  <--- Should be 036 to 052(if 75W)
Reg 0A: Rfltd    = 002 =>  0.51 Watt(s)
Reg 0B: A/D Test = 128 => PASS (> 126)
=============================================
RFO FIPS:
```

```
RFO FIPS: a 68 2 c 1 1 0
RFO FIPS: RA   68
<<< READ PA DECK 02 A/D 01 >>>
Reg 00: PDPA      = 078 =>  0.11 Amp(s)
Reg 01: DPA       = 090 =>  2.48 Amp(s)
Reg 02: OD        = 025 =>  8.45 Watt(s) <--- Should be 015 to 027(if 75W)
Reg 03: FPA 1 A   = 088 =>  1.42 Amp(s)
Reg 04: FPA 1 B   = 087 =>  1.77 Amp(s)
Reg 05: FPA 2 A   = 084 =>  1.42 Amp(s)
Reg 06: FPA 2 B   = 102 =>  1.77 Amp(s)
Reg 07: FPA 3 A   = 086 =>  1.42 Amp(s)
Reg 08: FPA 3 B   = 080 =>  1.77 Amp(s)
Reg 09: Fwd       = 046 => 38.14 Watt(s) <--- Should be 036 to 052(if 75W)
Reg 0A: Rfltd     = 000 =>  0.25 Watt(s)
Reg 0B: A/D Test = 128 => PASS (> 126)
=============================================
RFO FIPS:
```

*Note:* *If the PA does not read within the above parameters, review setup and calibration. If setup and calibration were done correctly, and readings are out of range, the PA deck may need to be replaced. Contact One-Call Support™.*

4. Turn off the OCM test mode (dekey) using the RFO FIPS command: **a 177**

```
RFO FIPS: a 177
RFO FIPS: RA  177
The Station is Dekeyed.
```

## Final Checkout/Restore Station Service

1. Clear the error logs with the RFO FIPS commands: **a 111, a 113,** and **a 103**

```
RFO FIPS: a 111
RFO FIPS: a 113
RFO FIPS: a 103
```

2. Confirm that the RF-O! transmitter is dekeyed
   a. Confirm front panel LED PA Keyed is OFF.
   b. Turn OFF RFO Power at DC-DC board.

**DANGER**

*Before disconnecting the transmitter from antenna RF output cable, ensure that the transmitter is not transmitting.*

3. Terminate the station into the normal antenna system.
   a. Remove 500-Watt, 50-ohm RF load and jumper cable from the transmitter RF output connector located at the cabinet top.
   b. Reconnect the antenna RF cable to the transmitter RF output connector.

*Note: Observe safety and static precautions while adjusting cabling within the station. Always use the proper torque wrench to tighten and loosen the RF cables on the station.*

4. Turn ON the RF-O! transmitter at the DC-DC board.

5. Reconnect the network by plugging the coaxial T-connector at the transceiver on the RF-B! transmitter controller.

   If the RF-O! transmitter does not resume transmitting paging data within one minute, reset the RF-B! transmitter controller using either the front panel reset switch or by typing the RFB FIPS command:

   RFB FIPS: **a 117** (data terminal must be connected to the RF-B! FIPS port)

   The RF-B! transmitter controller must acquire GPS lock, and can take as long as 15 minutes to do so before it transmits in test mode.

6. If the station is on a live system, verify that a page can be received before leaving the station.

7. Once the transmitter keys 60 times with network data, recheck power out using the RFO FIPS command: **a 80** and verify that they are still within specifications.

*Note: For a station set at 75W FM power, the following are expected values:*
*Internal Forward Wattmeter = 75W*
*Internal Reflected Wattmeter = 0-2W*
*External Forward Wattmeter = not less than 45W*
*External Reflected Wattmeter = 0-2W*

```
RFO FIPS: a 80
RFO FIPS: RA   80
<<< READ FM POWER OUTPUT >>>
 ========= RFO WATTMETER READINGS =========
 Last Keyed FM Power Readings:
   Internal Forward:        75 watts
   Internal Reflected:       0 watts
   External Forward:        61 watts
   External Reflected:       0 watts
   Number of Subchannels:    1
---------------------------------------------
The Accuracy of Each Meter is +- 10 %.
=============================================
```

8. Reconnect the remote FIPS cabling.

# Temperature Calibration Procedure

The temperature sensor must be calibrated in order for the readings to accurately reflect ambient temperature. The ambient temperature sensor is used to determine the maximum allowable output power (RF-O! derates power output from 0 to 3dB, between +45 and +60 degrees Celsius). Ambient temperature versus PA temperature is also monitored, cutting back power when the PA temperature exceeds the ambient temperature by a certain amount (30 degrees Celsius, by default).

The following procedure calibrates the ambient temperature sensor of the paging station. Perform this procedure when replacing the OCM or when performing the station alignment.

## Required Equipment

- Laptop computer with communications or terminal emulation software and a FIPS cable.
- Digital thermometer (units must be in Celsius).

## Temperature Sensor Calibration

1. Enable the Temperature Sensor Trace mode on the OCM using the command: **a 192 SHMI 2**.

```
RFO FIPS: a 192 SHMI 2
RFO FIPS: RA 192
RFO FIPS:
Ambient Temp- A/D: 9c, Volt: 3.06VDC, Curr: 032C, Filt: 032C,
Thresh: 062C
Ambient Temp- A/D: 9c, Volt: 3.06VDC, Curr: 032C, Filt: 032C,
Thresh: 062C
```

2. Place the digital thermometer next to the LED’s on the OCM.

CAUTION

***When placing the independent thermometer, be careful not to touch any of the ICs, possibly creating a short circuit.***

3. Write the "Volt" value read on the Temperature Sensor Trace to Parameter 1028 (Ambient Temperature Sensor Voltage Calibration).

   RFO FIPS: **w 1028 <value>**

   Where <value> is the "Volt" reading from the trace command (usually about 2.9 at 23 C)

4. Write the current ambient temperature, as read on the digital thermometer, to Parameter 1029 (Ambient Temperature Sensor Temperature Calibration):

   RFO FIPS: **w 1029 <value>**

   Where <value> is the temperature (in degrees Celsius) read at the digital thermometer.

*Note: If your thermometer only gives readings in degrees Fahrenheit, use the following equation to convert degrees F to degrees C.*

**degreesC = (degreesF - 32) * 5 / 9**

5. Wait for the next temperature reading trace to be displayed. Verify that the temperature in the "Curr:" field is within +/- 1 degree C of the thermometer reading. If not, repeat calibration procedure.

6. Disable the Temperature Trace with FIPS command:

   RFO FIPS: **a 193 SHMI 2**

7. Read the Current Ambient Temperature from the parameter database (**r 1026**). Verify that it is within +/- 1 degree C of the thermometer reading. If not, repeat calibration procedure.

   RFO FIPS: **r 1026**

   The temperature calibration procedure is complete. The calibration will remain valid unless a “double DIP” reset is performed, or the OCM board is replaced. (A “double DIP” reset is performed by placing both DIP switches 1 and 2 on SW500 in the ON position, then resetting the OCM.)

8. Replace the OCM front panel (Four T15 Torx screws) and remote access FIPS cable.

# Software Download

The RF-O! transmitter downloads the new image from the remote TFTP server to the RAM storage of the RF-B! transmitter controller. The image is then transferred to the RF-O! transmitter record by record through the Plug-n-Play Maintenance Path. The image is stored in the dormant FLASH memory bank of the RF-O! transmitter. In compliance with the Plug-n-Play specifications, the RF-O! transmitter will automatically switch (cutover) to the new software upon completion of a successful software download.

## Software Download Compatibility

There are compatibility limitations associated with the RF-O! transmitter software download. Some of the known limitations are listed below.

- **Previous RF-O! Software Releases Limitation**: Prior to RF-O! software version 1.2.1, software download on the RF-O! transmitter is unreliable.
- **RF-B!/RF-O! Software Compatibility Limitation**: The appropriate version of RF-B! software is needed to properly communicate with the current version of RF-O! software during a software download.
- **RF-O! Hardware/Software Compatibility Limitation**: The RF-O! software versions 1.2.3 and later use the AM29F040 Flash Memory SIMM.

*Note: All compatibility issues are outlined in the latest release document in the "Hardware/Software Compatibility" section. Refer to the "RF-Orchestra! 1.2.5 Release Overview" or later release document if appropriate for current compatibility matrices. Contact Motorola for a copy of the latest release document.*

## Software Download Equipment

- **FIPS Session to RF-B!**: The download to the RF-O! transmitter is done entirely through the RF-B! FIPS interface. The user must have some remote means to establish a FIPS session with the RF-B! transmitter controller. The RF-B! transmitter controller will act as the proxy for the RF-O! transmitter and download to the RF-O! transmitter through the Plug-n-Play Maintenance Path. RF-B! FIPS commands are shown in the procedure. The commands the user should enter at the FIPS session are shown in **bold** text, and the expected response is shown on the following line. A value of *xxx* may be shown with user commands, and the appropriate data or parameter value should be entered instead of the *xxx* shown in the procedure. This is explained at each section where the *xxx* is used for system specific data or parameter values.

- **Downloadable RF-O! File**: A downloadable file with the new software must be loaded onto the TFTP server into the proper directory. The file name may contain the "dl" designation and the release version number (i.e. rfo125dl), or may be stored as only the release version number (i.e. rfo125). The file name must be entered into the RF-B! transmitter controller exactly as it is stored on the TFTP server.

*Note: For RFB_1.3.1 software and previous, the file to download to the RF-B! transmitter controller is identified by an 8 character file name, and the file name MUST be exactly 8 characters. If the RF-B! software is version 1.4.0 or later, the file name MUST be 5-7 characters.*

- **TFTP Server/RF-Conductor**: A TFTP server must be set up to act as the host that downloads the file to the RF-B! transmitter controller. The TFTP server is identified by a unique IP address that is used by the RF-B! transmitter controller to retrieve the file.
- **FIPS Session on RF-O!**: Confirmation of download bank and progress of the download can be monitored with a FIPS session on the RF-O! transmitter. If a FIPS session with the RF-O! transmitter is not possible, the software download can still be accomplished. RF-O! FIPS commands are shown in the procedure. The commands the user should enter at the FIPS session are shown in **bold** text, and the expected response is shown on the following line. A value of *xxx* may be shown with user commands, and the appropriate data or parameter value should be entered instead of the *xxx* shown in the procedure. This is explained at each section where the *xxx* is used for system specific data or parameter values.

## Software Download Procedure

*Note: It is recommended that the download be performed during off-peak load times for highest reliability and fastest completion. This also avoids high network congestion which can lead to lower reliability.*

A software-initiated reset (DIP 2) is done during the cutover to the new software version at the end of a software download. Several parameters will be reset to their default values during the reset. Some of these parameters may need to be preserved and will have to be reset to their non-default values after a cutover has been successfully performed. It is recommended that a minimum set of values be recorded prior to initiating a software download. The first few steps will outline how to read these values using the RF-B! and RF-O! transmitter FIPS sessions.

1. Initiate a FIPS session on the RF-B! transmitter controller.

2. (OPTIONAL) If the station is not being used for actual paging traffic, paging traffic can be turned off (disabled) at the RFB FIPS session. This is not necessary for a proper download to occur, but the completion time for the software download may vary depending on the amount of active paging traffic at that station during the time of the download. To disable the RF-B! paging traffic in RF-B! software versions 1.5.2 or later:

   At the RFB FIPS prompt, type:

   ```
   RFB FIPS: w 99 1
   RFB FIPS: RR 99
   ```

3. Initiate a FIPS session on the RF-O! transmitter.

4. Record the minimum set of parameter values that will be reset to defaults after the software download is complete (See Table 6-8). The values will be shown on the RF-O! transmitter FIPS session instead of the *xxx* shown in the responses below.

   ```
   RFO FIPS: r 141
   RFO FIPS: RR  141 xxx
   RFO FIPS: r 142
   RFO FIPS: RR  142 xxx
   RFO FIPS: r 143
   RFO FIPS: RR  143 xxx
   RFO FIPS: r 144
   RFO FIPS: RR  144 xxx
   RFO FIPS: r 145
   RFO FIPS: RR  145 xxx
   RFO FIPS: r 146
   RFO FIPS: RR  146 xxx
   RFO FIPS: r 997
   RFO FIPS: RR  997 xxx
   ```

```
RFO FIPS: r 1023
RFO FIPS: RR 1023 xxx
RFO FIPS: r 1024
RFO FIPS: RR 1024 xxx
```

*Table 6-8: Minimum Parameter List*

| FIPS Command | Parameter Name | Value |
|---|---|---|
| **r 141** | Internal Wattmeter Forward Power Minimum Limit | |
| **r 142** | Internal Wattmeter Forward Power Maximum Limit | |
| **r 143** | Internal Wattmeter Reflected Power Limit | |
| **r 144** | External Wattmeter Forward Power Minimum Limit | |
| **r 145** | External Wattmeter Forward Power Maximum Limit | |
| **r 146** | External Wattmeter Reflected Power Limit | |
| **r 997** | Power Leveling Enable | |
| **r 1023** | Number of Power Amplifiers Installed in Station | |
| **r 1024** | PA vs. Ambient Temp Shutdown Offset | |

5. (OPTIONAL) Record any additional parameters that will be reset with a *DIP 2 reset* and that are currently using nondefault values by typing the appropriate **r xxx** FIPS command, where **xxx** is the parameter value. Record these values in Table 6-9: Additional Parameter List.

*Table 6-9: Additional Parameter List*

| FIPS Command | Parameter Name | Value |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

6. Check the error logs of the RF-B! transmitter controller.

   At the RFB FIPS prompt, type:

   RFB FIPS: **a 99**

   RFB FIPS: **a 104**

   RFB FIPS: **a 110**

   Note any station performance errors and correct them before proceeding with the download.

7. Check the error logs of the RF-O! transmitter.

   At the RFO FIPS prompt, type:

   RFO FIPS: **a 99**

   RFO FIPS: **a 104**

   RFO FIPS: **a 110**

   Note any station performance errors and correct them before proceeding with the download.

8. Determine the active bank of the RF-O! transmitter with the following command:

   At the RFO FIPS prompt, type:

   RFO FIPS: **r 901**

   RFO FIPS: RR 901 1

*Note: 1 - indicates active bank is Bank A and 2 - indicates active bank is Bank B.*

9. Verify the active bank software version of the RF-O! transmitter. The active bank software version will be displayed instead of the *xx.xx.xx* shown below.

   At the RFO FIPS prompt, type:

   RFO FIPS: **r 148**

   RFO FIPS: RR 148 xx.xx.xx

10. Verify the dormant bank software version of the RF-O! transmitter. The dormant bank software version will be displayed instead of the *xx.xx.xx* shown below.

    At the RFO FIPS prompt, type:

    RFO FIPS: **r 152**

    RFO FIPS: RR 152 xx.xx.xx

11. Verify that a software download is needed. Compare the results returned from the **r 148** and **r 152** commands (Step 10) with the version of software that is about to be downloaded. If the version numbers for the dormant bank (**r 152**) and the desired software are identical, no download is needed. If this is the case, switch to the dormant bank as described in Step 12 and Step 13.

12. **It is strongly recommended to start the download with Bank A being active.** Type the following commands at the RFO FIPS prompt to switch to Bank A:

    RFO FIPS: **w 901 1**

    RFO FIPS: RR 901 1

    RFO FIPS: **a 117**

13. (OPTIONAL) New software can optionally be downloaded to Bank A. However, the RF-O! transmitter must have Bank B as the active bank. Type the following commands at the RFO FIPS prompt to switch to Bank B:

    RFO FIPS: **w 901 2**

    RFO FIPS: RR 901 2

    RFO FIPS: **a 117**

14. Verify the RF-O! transmitter has completed the reset process before proceeding to the next step. The following banner should appear on the RFO FIPS session:

```
>>>>>>>          MOTOROLA RF-ORCHESTRA!           <<<<<<<
>>>>>>>       WIRELESS MESSAGING SYSTEM (WMS)      <<<<<<<
>>>>>>>     (c) Copyright 1998 Motorola, Inc.      <<<<<<<
>>>>>>>           All Rights Reserved.             <<<<<<<



>>>>>>>       PARAMETER DATABASE UNCHANGED         <<<<<<<
```

15. Set up the download on the RFB FIPS session by typing the command RFB FIPS: **a 300**. Verify one of the following menus appear. The TFTP server IP address and the remote file name may be different than what is shown in the menus below.

    For RFB_1.3.1 and previous versions:

    FIPS: **a 300**

```
Current tftp parameter configuration:
TFTP server IP address: 123.13.123.51
remote file name      : rfo100dl
Commands to proceed further:
a 310              to start download to RFB
a 312              to switch over to dormant bank
a 301 xx.xx.xx.xx  to set TFTP Server IP address
a 302 file name    to set TFTP download file
                   NOTE: 8 characters MAXimum
```

For RFB_1.4.0+ versions:

```
RFB FIPS: a 300
RFB FIPS:
 Current tftp parameter configuration:

  TFTP server IP address: 123.13.123.51
  remote file name      : rfo125
 Commands to proceed further:
 a 310              to start download to RFB
 a 311              to start download(and automatic cutover)
                    to RFO(OCM)
 a 312              to switch over to dormant bank
 a 301 xx.xx.xx.xx  to set TFTP Server IP address
 a 302 file name    to set TFTP download file
                    NOTE: 5 to 7 characters long
```

16. Change the file name in the RFB FIPS session to the image file (product dl file) of the RF-O! transmitter software version that is kept in the /tftpboot directory. This directory can be located on the TFTP server by typing the command: **a 302**. For example, if the file name is *rfo125* then type:

```
RFB FIPS: a 302 rfo125
RFB FIPS:
  remote file name      : rfo125
```

17. If the TFTP server IP address is not correct then modify it by typing the RFB FIPS command: **a 301.** For example, the TFTP server IP address can be set to 123.4.53.16 by entering:

```
RFB FIPS: a 301 123.4.53.16
RFB FIPS:
  TFTP server IP address: 123.4.53.16
```

18. Verify that the IP address and file name are correctly accepted by typing the RFB FIPS command: **a 300** and reviewing the information returned. The correct IP address and downloadable filename should appear instead of the IP address of **123.13.123.51** and filename of **rfo125** shown in this example.

```
RFB FIPS: a 300
RFB FIPS:
 Current tftp parameter configuration:

  TFTP server IP address: 123.13.123.51

  remote file name      : rfo125

 Commands to proceed further:
 a 310              to start download to RFB
 a 311              to start download(and automatic cutover)
                    to RFO(OCM)
 a 312              to switch over to dormant bank
 a 301 xx.xx.xx.xx  to set TFTP Server IP address
 a 302 file name    to set TFTP download file
                    NOTE: 5 to 7 characters long
```

19. Clear the RF-B! transmitter controller error logs in the RFB FIPS session with the following commands:

```
RFB FIPS: a 103
RFB FIPS: a 111
RFB FIPS: a 113
```

20. Clear the RF-O! transmitter error logs in the RFO FIPS session with the following commands:

```
RFO FIPS: a 103
RFO FIPS: a 111
RFO FIPS: a 113
```

21. Turn on the Maintenance Path Software Download trace in the RFO FIPS session by entering the following command:

    RFO FIPS: **a 192 MPCM 16**

    RFO FIPS: RA 192

22. Start the RF-O! transmitter download in the RFB FIPS session by entering the following command:

    RFB FIPS: **a 311**

23. The RF-B! transmitter controller receives the image in about 5 to 20 minutes depending on network traffic. The RF-B! transmitter controller transfers the image to the RF-O! transmitter through the Maintenance Path.

    Verify the RF-B! transmitter controller is receiving packets from the TFTP server by entering a command on the RFB FIPS session of **r 432** several times.

    The value given by *xxx* should start with a value of 100 and increase in increments of 100 once the download from the TFTP server to the RF-B! transmitter controller begins. The *xxx* returned by the **r 432** command is the number of TFTP packets transferred to the RF-B! transmitter controller. It may take a few seconds after the **a 311** command is entered before the value in the **r 432** command is reset to 0 and the download from the TFTP server begins.

    The number of TFTP packets to download is release dependent. This information should be provided in future release notes. For example, the number of TFTP packets for the *rfo113* image is around 2000+ packets for a complete RF-O! transmitter software image.

    RFB FIPS: **r 432**

    RFB FIPS: RR 432 2100

    RFB FIPS: **r 432**

    RFB FIPS: RR 432 2100

    RFB FIPS: **r 432**

    RFB FIPS: RR 432 2100

    RFB FIPS: **r 432**

    RFB FIPS: RR 432 2100

    RFB FIPS: **r 432**

    RFB FIPS: RR 432 2100

    RFB FIPS: **r 432**

    RFB FIPS: RR 432 100

```
RFB FIPS: r 432
RFB FIPS: RR  432 200
```

24. After about 5 to 15 minutes the following trace should appear on the RFO FIPS session:

```
<MPCM  16> SFWR DNLD: Status: 100 Software Records Downloaded
<MPCM  16> SFWR DNLD: Status: 200 Software Records Downloaded
<MPCM  16> SFWR DNLD: Status: 300 Software Records Downloaded
```

25. The number of packets written should keep increasing during a successful download. For example, the **rfo113** image will continue increasing up to 8200 records downloaded before an automatic cutover occurs. The number of records to download is release dependent, and should be provided in future release notes. The software download will take approximately 25 to 30 minutes.

26. On the RFO FIPS session, if the Software Records Downloaded does not appear to be increasing, verify that no SWDNLD or TFTP errors are logged in the **a 110** or **a 104** error logs on the RF-B! transmitter controller. This is verified by typing **a 110** and **a 104** on the RFB FIPS session and reviewing any error messages returned. If there are any Maintenance Path error messages in the log and the download packet message does not appear to be incrementing on the RFO FIPS session, then the download process has been disrupted.

```
RFB FIPS: a 104
RFB FIPS: a 110
```

CAUTION

*DO NOT RESET THE RF-O! transmitter. Resetting the RF-O! transmitter in this state could cause the paging station to disable. This would require a site visit to replace the RF-O! Flash Memory SIMM.*

27. Once the download completes, the RF-O! transmitter will execute an automatic cutover. If the RFO FIPS session cutover was successful, the startup banner should appear as follows:

```
>>>>>>>          MOTOROLA RF-ORCHESTRA!          <<<<<<<
>>>>>>>       WIRELESS MESSAGING SYSTEM (WMS)    <<<<<<<
>>>>>>>     (c) Copyright 1998 Motorola, Inc.    <<<<<<<
>>>>>>>           All Rights Reserved.           <<<<<<<
```

```
 >>>>>>>  CRITICAL PARAMETERS PRESERVED ON CUTOVER   <<<<<<<
>>>>>>>       --FACTORY PRESETS PRESERVED--         <<<<<<<
>>>>>>>    ALL OTHER PARAMETERS SET TO DEFAULTS     <<<<<<<
```

28. Once the startup banner appears on the RFO FIPS session after the cutover has occurred, check the active bank and software version number with the following commands.

    RFO FIPS: **r 901**

    RFO FIPS: RR 901 2

    RFO FIPS: **r 148**

    RFO FIPS: RR 148 1.2.5

*Note: In this example, the active bank is now Bank B, and the active software version is 1.2.5.*

29. After the cutover has occurred, the parameters changed by a DIP 2 will be reset to their default values. The previous operational values can be found in Table 6-8 and Table 6-9: Additional Parameter List. On the RFO FIPS session, read the minimum set of parameter values to determine the current value of each parameter. The values read will be shown on the RFO FIPS session instead of the *xxx* shown in the responses below.

    RFO FIPS: **r 141**

    RFO FIPS: RR  141 xxx

    RFO FIPS: **r 142**

    RFO FIPS: RR  142 xxx

    RFO FIPS: **r 143**

    RFO FIPS: RR  143 xxx

    RFO FIPS: **r 144**

    RFO FIPS: RR  144 xxx

    RFO FIPS: **r 145**

    RFO FIPS: RR  145 xxx

    RFO FIPS: **r 146**

    RFO FIPS: RR  146 xxx

    RFO FIPS: **r 997**

    RFO FIPS: RR  997 xxx

    RFO FIPS: **r 1023**

    RFO FIPS: RR 1023 xxx

```
RFO FIPS: r 1024
RFO FIPS: RR 1024 xxx
```

30. Compare the values in Step 29 with the values stored in Table 6-8. If the previous operational values are desired instead of the default values now stored for each parameter, update the parameter value using the appropriate **w yyy xxx** command from the RFO FIPS session.

    The *yyy* in the command is the parameter number, and the *xxx* in the command is the updated value. Examples are shown below for each parameter, but the values stored in Table 6-8 should be used instead of the *xxx* shown below.

*Note: These commands only have to be executed if the default values now loaded in these parameters (see* Step 29*) are not the desired values. For any parameter that uses the default parameter values, the associated FIPS write command (w yyy xxx, where yyy is the parameter number and xxx is the parameter value) shown below is not necessary.*

```
RFO FIPS: w 141 xxx
RFO FIPS: RR  141 xxx
RFO FIPS: w 142 xxx
RFO FIPS: RR  142 xxx
RFO FIPS: w 143 xxx
RFO FIPS: RR  143 xxx
RFO FIPS: w 144 xxx
RFO FIPS: RR  144 xxx
RFO FIPS: w 145 xxx
RFO FIPS: RR  145 xxx
RFO FIPS: w 146 xxx
RFO FIPS: RR  146 xxx
RFO FIPS: w 997 xxx
RFO FIPS: RR  997 xxx
RFO FIPS: w 1023 xxx
RFO FIPS: RR 1023 xxx
RFO FIPS: w 1024 xxx
RFO FIPS: RR 1024 xxx
```

31. Repeat the previous two steps for any additional parameters stored in Table 6-9: Additional Parameter List. Use the appropriate FIPS read command (**r xxx**, where *xxx* is the parameter number) to read the new default value and update this parameter using the appropriate FIPS write command (**w yyy xxx**, where *yyy* is the parameter number and *xxx* is the parameter value) if necessary.

32. The software download is complete.

# Abbreviations and Acronyms

For a detailed list of abbreviations and acronyms, see *Abbreviations for Terms Used in Electronics*, published by the Standards Council of the Society for Technical Communications.

*Table A-1: Acronyms and Definitions List (Sheet 1 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **A** | ampere(s) |
| **Ah** | Ampere-hours |
| **A/D** | Analog-to-Digital |
| **ac/AC** | Alternating Current |
| **ADA** | Americans with Disabilities Act |
| **af** | audio frequency |
| **afc** | audio frequency control |
| **agc** | automatic gain control |
| **alc** | automatic level control |
| **AM** | Amplitude Modulation |
| **ANSI** | American National Standards Institute |
| **APM** | Augmented Phase Modulation |
| **ARP** | Address Resolution Protocol |
| **ASC** | Advanced Simulcast Controller |
| **ASCII** | American Standard Code for Information Interchange |
| **ASIC** | Application Specific Integrated Circuit |
| **assy** | assembly |
| **AUI** | Attachment/Autonomous Unit Interface |
| **aux** | auxiliary |

*Table A-1: Acronyms and Definitions List (Sheet 2 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **avc** | automatic volume control |
| **AWG** | American Wire Gage |
| **bps** | bits per second |
| **BTU** | British Thermal Unit |
| **CFT** | Carrier Feed-Through. Refers to the undesired frequency component present on the carrier frequency on an RF-O! transmitter. |
| **CIR** | Router Committed Information Rate |
| **CIU** | Channel Interface Unit |
| **cm** | centimeter |
| **CMOS** | Complementary Metal-Oxide Semiconductor |
| **CP/IOP** | Central Processor/Input Output Processor |
| **CPU** | Central Processing Unit |
| **CSU** | Channel Service Unit |
| **Cu** | Copper |
| **cutback** | An intentional decrease in the transmitter's output power in response to some abnormal operating condition. A cutback allows the transmitter to operate, but at a diminished output level. |
| **DAC** | Digital-to-Analog Converter |
| **DACS** | Digital Access and Cross-connect System |
| **dB** | decibel(s) |
| **dBc** | decibels in reference to the carrier frequency |
| **DC** | Direct Current |
| **DDS** | Digital Data Service |
| **DEMUX** | Demultiplexer |
| **DIOP** | Digital Input/Output Processor |
| **DIN** | Deutsche Industrie Normenausschuss (German Standards Institute) |
| **DM** | Direct Messaging |

*Table A-1: Acronyms and Definitions List (Sheet 3 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **DMA** | Direct Memory Access |
| **DOP** | Dilution of Precision |
| **DOS** | Disk Operating System |
| **DPA** | Driver Power Amplifier |
| **DPL** | Digital Private Line |
| **DRAM** | Dynamic Random Access Memory |
| **DRC** | Digital Remote Control |
| **DSP** | Digital Signal Processor |
| **DSU** | Data Service Unit |
| **DTE** | Data Terminal Equipment |
| **DTMF** | Dual Tone Modulated Frequency. Touch tones. |
| **DVP** | Digital Voice Protection |
| **EEPOT** | Electrically Erasable Potentiometer |
| **EEPROM** | Electrically Erasable Programmable Read-Only Memory |
| **EIA** | Electronics Industries Association |
| **EMI** | Electromagnetic Interference |
| **FCC** | Federal Communications Commission |
| **FIPS** | Friendly Integrated Paging System. The terminal interface used in communicating with the RF-O! transmitter. |
| **FLEX** | One-Way Data over-the-air paging protocol. |
| **FM** | Frequency Modulation |
| **FNE** | Fixed Network Equipment |
| **FPA** | Final Power Amplifier |
| **FPGA** | Field Programmable Gate Array. The XILINX on the OCM is a brand of FPGA. |
| **FRU** | Field Replaceable Unit |

*Table A-1: Acronyms and Definitions List (Sheet 4 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **FSK** | Frequency Shift Keying |
| **GND** | Ground |
| **GPS** | Global Positioning System |
| **host** | The 68360 controller on the OCB. There is host, as well as DSP and FPGA software on the OCM. |
| **HVAC** | Heating, Ventilation, and Air Conditioning |
| **I/O** | Input/Output |
| **I/Q** | Inphase and Quadrature (digital modulation) |
| **IC** | Integrated Circuit |
| **IF** | Intermediate Frequency |
| **IM** | Intermodulation |
| **in** | inch |
| **InFLEXion** | AM voice modulation protocols in the FLEX family of over-the-air protocols. |
| **IP** | Internet Protocol |
| **IPA** | Intermediate Power Amplifier |
| **IPS** | Integrated Paging System |
| **ISDN** | Integrated Services Digital Network |
| **kHz** | kiloHertz |
| **LAN** | Local Area Network |
| **lbs** | pounds |
| **LCD** | Liquid Crystal Display |
| **LED** | Light-Emitting Diode |
| **LLGT** | Low Level Guard Tone |
| **LO** | Local Oscillator |
| **mm** | millimeter |

*Table A-1: Acronyms and Definitions List (Sheet 5 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **MS** | Messaging Switch |
| **MUX** | Multiplexer |
| **NCU** | Nucleus Control Unit |
| **NEC** | National Electrical Code |
| **NEMA** | National Electronics Manufacturers Association |
| **NPCS** | Narrowband Personal Communications System |
| **NRZ** | No Return to Zero |
| **NVM** | Nonvolatile Memory |
| **OCB** | Orchestra Control Board |
| **OCM** | Orchestra Control Module comprising the OCB, exciter, and an ac-dc converter. |
| **OPPM** | Outbound Paging Protocol Manager. An RF-B! software task name. |
| **OTA** | Over-the-Air |
| **P-LAN** | PURC Local Area Network |
| **PA** | Power Amplifier |
| **PC** | Personal Computer |
| **PCD** | Personal Communicator Device or communicator |
| **PCLM** | Page Control Launch Manager. An RF-B! transmitter controller software task name |
| **PCRM** | Page Control Receive Manager. An RF-B! transmitter controller software task name |
| **PCS** | Personal Communications System |
| **PDOP** | Position Dilution of Precision |
| **PMU** | Personal Messaging Unit (Pager) |
| **PnP** | Plug and Play. Refers to the interface between the RF-O! transmitter and the RF-B! transmitter controller. |
| **PPA** | Predriver Power Amplifier |

*Table A-1: Acronyms and Definitions List (Sheet 6 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **ppb** | parts per billion |
| **PPS** | Pulse Per Second |
| **PS** | power supply |
| **pSOS** | Real-time operating system used in the operation of the RF-O! transmitter host software. |
| **PSTN** | Public Switched Telephone Network |
| **PVC** | Permanent Virtual Circuit or Polyvinylchloride |
| **RAM** | Random Access Memory |
| **ReFLEX25** | Two-way FM data modulation protocol in the FLEX family of over-the-air protocols. Typically used to transmit data to and from a two-way paging device. |
| **RFCC** | Radio Frequency Channel Controller. A pSOS task in the RF-O! transmitter host software which is responsible for synthesizer programming and relaying the number of subchannels and modulation type from the distributor DSP to the collector DSP and other host pSOS tasks. |
| **RF-A!** | RF-Audience! receiver |
| **RF-B!** | RF-Baton! transmitter controller |
| **RF-C!** | RF-Conductor! controller. Responsible for routing messages to the transmitter controllers (RF-B!) and from the receivers (RF-Audience!). |
| **RF-O!** | RF-Orchestra! paging station |
| **RPM** | revolutions per minute |
| **RPS** | revolutions per second |
| **RF** | Radio Frequency |
| **RISC** | Reduced Instruction Set Computer |
| **RIP** | Router Information Protocol |
| **RU** | Rack units |
| **Rx** | Receiver |
| **SCI** | Simulcast Control Information |

*Table A-1: Acronyms and Definitions List (Sheet 7 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **SCM** | Station Control Module |
| **shutdown** | Transmitter completely ceases paging or keying, resulting in no RF power output. |
| **SNMP** | Simple Network Management Protocol |
| **SNR** | Signal to Noise Ratio |
| **SPCM** | Station Power Control Manager. RF-O! transmitter software task controlling station power output |
| **SPI** | Serial/Parallel Interface OR Serial Peripheral Interface |
| **SQC** | Signal Quality Calibration |
| **SS7** | Signalling System 7 |
| **station** | Usually refers to the paging base station, comprising the RF-O! transmitter, RF-B! transmitter controller, and RF-A! receiver. |
| **TCP/IP** | Transmission Control Protocol/Internet Protocol |
| **TCU** | Transmitter Control Unit |
| **TDM** | Time Division Multiplexer |
| **TDSS** | Triple Drive Support Subsystem |
| **TELCO** | Telephone Company |
| **TIPP** | Telocator Internetworking Paging Protocol |
| **TNPP** | Telocator Networking Paging Protocol |
| **TRC** | Tone Remote Control |
| **Tx** | Transmitter |
| **UHSO** | Ultra High Stability Oscillator. 10 MHz Reference on RF-B! transmitter controller. |
| **UL** | Underwriters Laboratories |
| **us/μs** | microsecond |
| **Vac/VAC** | Voltage Alternating Current |
| **VCO** | Voltage Controlled Oscillator |

*Table A-1: Acronyms and Definitions List (Sheet 8 of 8)*

| Abbreviation/Term/Acronym | Definition |
|---|---|
| **Vdc/VDC** | Voltage Direct Current |
| **VDT** | Video Display Terminal |
| **VOX** | Voice-Operated Transmitter |
| **VSAT** | Very Small Aperture Terminal |
| **VSWR** | Voltage Standing Wave Ratio |
| **WAN** | Wide Area Network |
| **WASP** | Wide Area Signaling Protocol |
| **WM** | Wattmeter |
| **WMG** | Wireless Messaging Gateway |
| **WMS** | Wireless Messaging System. The Motorola InFLEXion voice paging system. |
| **WRU** | Where aRe yoU. ReFLEX message requesting the location (color code) of the pager. |

# Backplane Connectors

## RF-O! Transmitter Backplane Connectors

The RF-O! transmitter backplane, located at the rear of OCM, provides the connections necessary to interface the RF-O! transmitter to phone lines, peripheral RF equipment, and other communications and maintenance equipment (see Figure B-1).

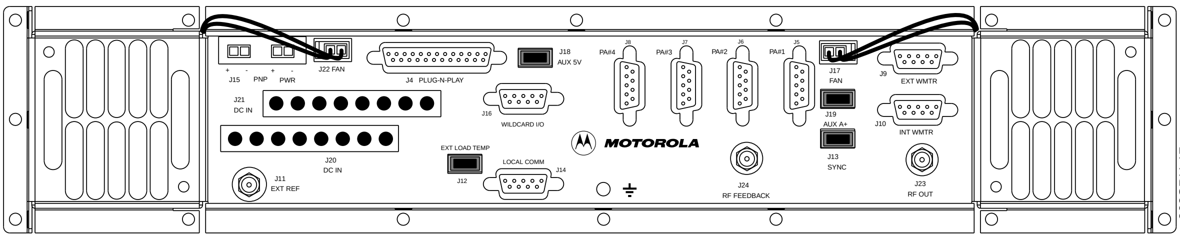



*Figure B-1: RF-O! Transmitter Backplane Connectors*

The following tables provide descriptions, signal names, and pin configuration for each connector in numerical order (see Table B-1).

*Table B-1: RF-O! Transmitter Backplane Connectors*

| Connectors | Name | Description |
|---|---|---|
| Connectors numbered J1, 2, and 3 are internal module connections | | |
| J4 | PLUG-N-PLAY | Transmitter controller interface protocol standard |
| J5, J6 | PA#1 and #2 | Power amplifiers control and diagnostic SPI interface |
| J7, J8 | PS Current Monitor (PA#3 and PA#$) | Only used in model PT1052 (single PA) for measuring power supply current |
| J9 | INT WMTR | Internal RF wattmeter SPI interface |
| J10 | EXT WMTR | External RF wattmeter SPI interface |
| J11 | EXT REF | 10 MHz input must meet the minimum paging station interface protocol requirements for amplitude and frequency stability |
| J12 | EXT_LOAD_TEMP | External circulator load temperature input monitor signal |
| J13 | SYNC PORT | Factory use only |
| J14 | LOCAL COMM | Factory use only |
| J15 | PLUG-N-PLAY POWER | +28 V source for RF-Baton! (RF-B!) transmitter controller power as defined by paging station interface protocol |
| J16 | WILDCARD I/O | Interfaces to external input/output circuits or module interfaces |
| J17 | DC FAN POWER | RF-O! transmitter chassis fan connection +12 V operation |
| J18 | AUX 5 V | +5 V source limited to 50 mA maximum current |
| J19 | AUX A+ | +12 V source limited to 50 mA maximum current |
| J20-J21 | DC INPUT | + 28 V input from each AC power supply |
| J22 | DC FAN POWER | RF-O! transmitter chassis fan connection +12 V operation |
| J23 | RF OUT | RF output from exciter circuits for direct connection to a single PA deck or the RF splitter with multiple PA decks |
| J24 | RF FEEDBACK | RF input from internal RF coupler at the RF output |

## Connector Pinouts

The following tables provide the OCM connector pinouts (see Table B-2 through Table B-6).

*Table B-2: Plug-and-Play -- Connector J4*

| Pin | Function |
|---|---|
| **1** | GND |
| **2** | RFCMAINTA |
| **3** | TXMAINTA |
| **4** | RFCREQ |
| **5** | TXOK |
| **6** | OPEN |
| **7** | GND |
| **8** | OPEN |
| **9** | PTFRAMEA |
| **10** | PTDATAA |
| 11 | PTCLOCKA |
| 12 | MARKA |
| 13 | OPEN |
| 14 | OPEN |
| 15 | OPEN |
| 16 | RFCMAINTB |
| 17 | TXMAINTB |
| 18 | OPEN |
| 19 | OPEN |
| 20 | OPEN |
| 21 | OPEN |
| 22 | PTFRAMEB |
| 23 | PTDATAB |
| 24 | PTCLOCKB |
| 25 | MARKB |

*Table B-3: Power Amplifier Signaling Connectors—J5 through J6*

| Pin | J5 PA#1 SPI | J6 PA#2 SPI |
|---|---|---|
| **1** | GND | GND |
| **2** | DECK_SEL_1 | DECK_SEL_2 |
| **3** | SPI_A2 | SPI_A2 |
| **4** | SPI_A1 | SPI_A1 |
| **5** | SPI_A0 | SPI_A0 |
| **6** | SPI_CLK | SPI_CLK |
| **7** | SPI_MOSI | SPI_MOSI |
| **8** | SPI_MISO | SPI_MISO |
| **9** | PWR_SENS_1 | PWR_SENS_2 |

*Table B-4: Connectors—J9 through J12*

| Pin | J9 Ext Wattmeter | J10 Int Wattmeter | J11 Ext Reference | J12 Ext_Load_Temp |
|---|---|---|---|---|
| **1** | VRI | VRE | 10_MHz_REF | EXT_LOAD_TEMP |
| **2** | A+ | A+ | GND | SPARE |
| **3** | GND | GND | GND | GND |
| **4** | INTGND | EXTGND | GND | |
| **5** | VFI | VFE | GND | |
| **6** | OPEN | OPEN | | |
| **7** | OPEN | OPEN | | |
| **8** | OPEN | OPEN | | |
| **9** | OPEN | OPEN | | |

*Table B-5: Connectors—J13 through J16*

| Pin | J13 Sync | J14 Local Comm | J15 PNP Power | J16 Wildcard I/O |
|---|---|---|---|---|
| **1** | FACTORY USE ONLY | FACTORY USE ONLY | 28 V | GND |
| **2** | | | GND | 5 V |
| **3** | | | 28 V | A+ |
| **4** | | | GND | GND |
| **5** | | | | AUX_IN1 |
| **6** | | | | AUX_IN2 |
| **7** | | | | AUX_OUT1 |
| **8** | | | | AUX_OUT2 |
| **9** | | | | GND |

*Table B-6: Connectors—J17 through J22*

| Pin | J17 & J22 Fan | J18 Aux 5 V | J19 Aux A+ | J20 DC In | J21 DC In |
|---|---|---|---|---|---|
| **1** | FAN A+ | 5 V | A+ | 28 V | 28 V |
| **2** | FAN GND | OPEN | OPEN | 28 V | 28 V |
| **3** | | GND | GND | GND | GND |
| **4** | | | | GND | GND |
| **5** | | | | 28 V | 28 V |
| **6** | | | | 28 V | 28 V |
| **7** | | | | GND | GND |
| **8** | | | | GND | GND |

# Other Backplane Connectors

## RF-B! Backplane Connectors

*See RF-Baton!™ Transmitter Controller System Installation and Operation*, Publication 6880497G01

## RF-A! Receiver Backplane Connectors

*See RF-Audience!™ Receiver Installation and Operation*, Publication 6880493G04

# Model and Options Charts

## Standard Models

Two models are offered for operation over the 929–941 MHz frequency range. The maximum capabilities of power in each model are offered (see Table C-1).

*Table C-1: RF-O! Linear Transmitter Model/Maximum Power Chart*

| Model Number | Configuration | | Average Power/Channel (Watts) ReFLEX25/FLEX | | | InFLEXion Channels | |
|---|---|---|---|---|---|---|---|
| | PA | PS | One | Two | Three | One | Two |
| **PT1052** | 1 | 2 | 400 | 125 | 55 | 75 | — |
| **PT1054** | 2 | 2 | 280 | 145 | 95 | 150 | 75 |

## Model Option Chart

Table C-2 shows the standard kits available with each RF-O! transmitter model.

*Table C-2: RF-O! Transmitter Model Chart (Sheet 1 of 2)*

| Kit No. | Description | Model PT1052 | Model PT1054 |
|---|---|---|---|
| **PTLF1001** | Power Amplifier Kit includes: | 1 | 2 |
| **PTLF4001** | Pre-Driver Kit | 1 | 1 |
| **PTLF4002** | Driver | 1 | 1 |
| **PTLF4003** | Splitter Kit | 1 | 1 |
| **PTLF4004** | Dual Device Module Kit | 1 | 1 |
| **PTLF4005** | Combiner Kit | 1 | 1 |
| **PTTN4001** | PA RF Board | 1 | 1 |
| **PTTN4014** | PA Hardware Kit | 1 | 1 |
| **PTPN4033** | AC Power Supply Kit | 2 | 2 |
| **PTTF1002** | Standard Peripheral Kit includes: | 1 | 1 |
| **PTGN4007** | Peripheral Kit | 1 | 1 |
| **PTKN4105** | Peripheral Cable Kit | 1 | 1 |
| **PTTN1024** | Control Chassis Kit includes: | 1 | 1 |
| **PTLF4006** | Exciter | 1 | 1 |
| **PTTN4002** | Control Chassis Kit | 1 | 1 |
| **PTTN4003** | Control Backplane Kit | 1 | 1 |
| **PTTN4013** | Control Module | 1 | 1 |

*Table C-2: RF-O! Transmitter Model Chart (Sheet 2 of 2)*

| Kit No. | Description | Model PT1052 | Model PT1054 |
|---|---|---|---|
| **PTTF1003** | 2-Way Combiner Kit includes: | | |
| **PTTF4007** | 2-Way Splitter Kit | | 1 |
| **PTTF4012A** | 2-Way Combiner | | 1 |

## Option Chart

Table C-3 shows the options available with the RF-O! transmitter.

*Table C-3: RF-O! Transmitter Options (Sheet 1 of 2)*

| Option No. | Description |
|---|---|
| **X496** | Software License - Combo InFLEXion™ Voice/ReFLEX™ |
| **X128** | 83 in. Cabinet |
| **X179** | RF-Baton!™ Transmitter Controller with GPS Receiver (no antenna) |
| **X594** | RF-Baton!™ Transmitter Controller without GPS Receiver |
| **X649** | Battery Revert; 4 hours |
| **X780** | Battery Revert; 8 hours |
| **X349** | Single RF-Audience!™ Receiver |
| **X351** | Two RF-Audience!™ Receivers |
| **X352** | Three RF-Audience!™ Receivers |
| **X353** | Four RF-Audience!™ Receivers |
| **X263AB** | Tx Peripheral Package (Bandpass/Hi Q) |
| **X263AC** | Tx Peripheral Package (Narrowband Cavity) |
| **X88AA** | Single RF-A! Receiver Peripheral Package w/o GPS |
| **X88AB** | Single RF-A! Receiver Peripheral Package w/GPS |
| **X89** | Multi RF-A! Receivers Peripheral Package w/o GPS |
| **X267AB** | Single Subchannel Peripheral Package |

*Table C-3: RF-O! Transmitter Options (Sheet 2 of 2)*

| Option No. | Description |
|---|---|
| **X267AC** | Multiple Subchannel Peripheral Package |
| **X967** | Single Subchannel ISDN Backup |

## Field Replaceable Units (FRU)

Table C-4 shows the FRU kits available with the RF-O! transmitter.

*Table C-4: Field Replacement Unit (FRUs) Modules*

| Model No. | Description |
|---|---|
| **PTPN1013** | AC Power Supply |
| **PTLF1005** | Exciter |
| **PTLF1006** | Power Amplifier |
| **PTTN1003** | Orchestra Control Module |
| **PTLN1445** | Detector |
| **PTPN1014** | DC-to-DC Converter |
| **PTLF1006** | Power Amplifier |
| **PTTN1016A** | AC Distribution Box |

# FIPS Action Commands (ver 2.0.0)

This appendix lists all of the Friendly Integrated Paging System (FIPS) action commands used to control the RF-Orchestra! transmitter.

DIP switches: #1 OFF #2 OFF #3 OFF #4 OFF

*Table 4-1: RF-O! Transmitter Parameters -- Action Commands*

| Name and Command | Description | Example |
| --- | --- | --- |
| **Limited Self Diagnostics**<br><br>**a 62** | Performs a Limited Set of Tests on the RF-Orchestra. Will return a Pass or Fail result for each of the Tests. The Station must be reset immediately following the execution of this action command. | `RA   62`<br>`RFO FIPS: a 62`<br>`RFO FIPS:`<br><br>`BEGINNING RFO SELF-DIAGNOSTIC:`<br><br>`Hardware Version ID = 6`<br>`DIP switches: #1 OFF  #2 OFF  #3 OFF  #4 OFF`<br><br>`10MHz input connected...................PASSED`<br>`16.8MHz Pendulum detected...............PASSED`<br>`Pendulum Locked to UHSO.................PASSED`<br>`Pendulum temperature = 29C..............NORMAL`<br>`Exciter A+ = 13.60V.....................PASSED`<br>`Exciter 10V source = 10.11V.............PASSED`<br>`Exciter Analog 5V = 5.06V...............PASSED`<br>`Exciter Synthesizer 1 Lock..............PASSED`<br>`Exciter Synthesizer 2 Lock..............PASSED`<br>`Distributor Memory......................PASSED`<br>`Modulator 1 Memory......................PASSED`<br>`Modulator 2 Memory......................PASSED`<br>`Collector Memory........................PASSED`<br><br>`RFO SELF-DIAGNOSTIC.....................PASSED`<br><br>`The station will require a RESET (A 117) after use of this command`<br><br>`RA 62`<br>`RFO FIPS:` |

| Name and Command | Description | Example |
| --- | --- | --- |
| **PA EEPROM Read**<br><br>**a 66 x y** | Reads the 4 byte segment specified by argument 'y' Serial EEPROM from the P/A specified in argument 'x'<br><br>x = P/A Number (range 1..2)<br>y = EEPROM Region to be read in hex. | RFO FIPS: a 66 1 0x00<br>RFO FIPS: RA 66<br><<< READ PA EEPROM >>><br><br>PA 1 EEPRM Cell 0x00 = 0x05 0x06 0x07 0x08 |
| **PA EEPOT Write**<br><br>**a 67 x y ss aw pw** | Writes to the EEPOTs of the P/A's.<br><br>x = PA number (range 1..4)<br>y = phase/attenuation cell (range 0..3)<br>ss = Stack Select (range 0..1)<br>aw = Attenuation Wiper (range 0..FF hex)<br>pw = Phase Wiper (range 0..FF hex)<br><br>**Note:** To reset the PA to the EEPROM settings tenter RFO FIP: **a 67 x 0** where **x** is the PA number.<br><br>**WARNING:** This command intended for Lab/ Development use only! | RFO FIPS: a 67 ?<br>RFO FIPS: RA 67<br><<< PA EEPOT WRITE >>><br>Usage: A 67 x y ss aw pw<br>x = PA Number (Maximum 4 for Current Configuration)<br>y = Phase/Attenuation Cell (0..3)<br>ss = Stack Select (0..1)<br>aw = Attenuation Wiper (0..ff hex)<br>pw = Phase Wiper (0..ff hex)<br><br>RFO FIPS: a 67 1 0 0 AF 2F |

| Name and Command | Description | Example |
|---|---|---|
| **Read PA A/D 01**<br><br>**a 68 v w x y z** | This action command reads the first of two A/Ds (analog/digital) on the PA specified by argument v. Will read the A/D channel specified by argument w; will read during x modulation type, y number of times after a delay of z seconds.<br><br>v = P/A number (range 1...2)<br>w = A/D channel (0x00-0x0B or 0x0C to return all channels)<br>x = Modulation type<br>0 = None<br>1 = FM only<br>2 = FM and AM<br>3 = AM only<br>y = Repetition Rate<br>z = Delay (seconds) | `RFO FIPS: a 68 1 c 0 1 0`<br>`RFO FIPS: RA 68`<br>`<<< READ PA DECK 01 A/D 01 >>>`<br>`Reg 00: PDPA = 077 => 0.11 Amp(s)`<br>`Reg 01: DPA = 096 => 2.73 Amp(s)`<br>`Reg 02: OD = 032 => 14.50 Watt(s)`<br>`Reg 03: FPA 1 A = 099 => 2.53 Amp(s)`<br>`Reg 04: FPA 1 B = 097 => 2.92 Amp(s)`<br>`Reg 05: FPA 2 A = 088 => 2.14 Amp(s)`<br>`Reg 06: FPA 2 B = 093 => 2.53 Amp(s)`<br>`Reg 07: FPA 3 A = 091 => 2.53 Amp(s)`<br>`Reg 08: FPA 3 B = 095 => 2.92 Amp(s)`<br>`Reg 09: Fwd = 068 => 78.6 Watt(s)`<br>`Reg 0A: Rfltd = 003 => 0.43 Watt(s)`<br>`Reg 0B: A/D Test = 128 => PASS (> 127)`<br>`==========================================` |

| Name and Command | Description | Example |
|---|---|---|
| **Read PA A/D 02**<br><br>**a 69 v w x y z** | This action command reads the second of two A/Ds (analog/digital) on the PA specified by argument v. Will read the A/D channel specified by argument w; will read during x modulation type, y number of times after a delay of z seconds.<br><br>v = P/A number (range 1...2)<br>w = A/D channel (0x00-0x0B or 0x0C to Return all channels)<br>x = Modulation type<br>0 = None<br>1 = FM only<br>2 = FM and AM<br>3 = AM only<br>y = Repetition Rate<br>z = Delay (seconds) | `RFO FIPS: a 69 1 c 1 1 0`<br>`RFO FIPS: RA   69`<br>`<<< READ PA DECK 01 A/D 02 >>>`<br>`Reg 00: 28 Vref   = 195 => 28.60 Volt(s)`<br>`Reg 01: 15 Vref   = 196 => 14.98 Volt(s)`<br>`Reg 02: PA Temp   = 210 => 26.44 Deg(s) C`<br>`Reg 03: Phase     = 077 =>  1.50 Volt(s)`<br>`Reg 04: Atten     = 173 =>  3.37 Volt(s)`<br>`Reg 05: N/A       = 000`<br>`Reg 06: N/A       = 000`<br>`Reg 07: N/A       = 000`<br>`Reg 08: N/A       = 000`<br>`Reg 09: N/A       = 000`<br>`Reg 0A: N/A       = 000`<br>`Reg 0B: A/D Test  = 128 => PASS (> 126)`<br>`=============================================` |

| Name and Command | Description | Example |
|---|---|---|
| **Calibrate Detector(s)**<br><br>**a 71 x y** | Calibrate the Internal/External detector(s)<br>x = detector<br>0 = internal<br>1 = external<br>y = power value from Wattmeter (in watts)<br><br>**Note:** This command is normally executed following the RFO FIPS: **a 75** (Initialize Amplitude Alignment Parameters) command execution.<br><br>Power Control must be DISABLED for this command to function (RFO FIPS: **w 992 0**). See Chapter 6, "Maintenance".<br><br>**Note:** This command can take up to 2 minutes to fully execute. The printing of the Output Report, shown in the example, will indicate completion of the command. Do not type any other FIPS commands while calibration is occurring. | RFO FIPS: a 71 0 210<br>Please wait. Command in process...<br>RA 71<br><<< CALIBRATE DETECTORS >>><br><br>========= Detector 0 Calibration =========<br><br>0x00: 0x44 0x45 0x54 0x30 "DET0"<br>0x01: 0x30 0x32 0x31 0x30 "0210"<br>0x02: 0x32 0x2e 0x36 0x36 "2.66"<br>0x03: 0x32 0x30 0x35 0x34 "2054"<br>0x04: 0x44 0x45 0x54 0x30 "DET0"<br>0x05: 0x44 0x45 0x54 0x30 "DET0"<br>0x06: 0x44 0x45 0x54 0x30 "DET0"<br>0x07: 0x44 0x45 0x54 0x30 "DET0"<br>0x08: 0x44 0x45 0x54 0x30 "DET0"<br>0x09: 0x44 0x45 0x54 0x30 "DET0"<br>0x0a: 0x44 0x45 0x54 0x30 "DET0"<br>0x0b: 0x44 0x45 0x54 0x30 "DET0"<br>0x0c: 0x31 0x2e 0x30 0x2e "1.0."<br>0x0d: 0x31 0x20 0x00 0x00 "1 .."<br>0x0e: 0x30 0x30 0x30 0x31 "0001"<br>0x0f: 0x43 0x48 0x4b 0x9e "CHK."<br>0x3f: 0x43 0x48 0x4b 0x26 "CHK&"<br>Calibration Factor = 1.011365<br>========================================== |

| Name and Command | Description | Example |
|---|---|---|
| **Exciter EEPROM Write**<br><br>**a 72 y z1 z2 z3 z4** | Writes to the Serial EEPROM on the Exciter. Write the 4 byte region, using arguments 'z', specified in argument 'y'.<br><br>y = EEPROM Region to be written in hex.<br>z1,z2,z3,z4 = bytes to be written to the EEPROM in hex.<br><br>**WARNING:** This command intended for Lab/ Development use only! | RFO FIPS: a 72 0 44 45 54 30<br>RFO FIPS: RA 72<br><<< WRITE EXCITER EEPROM >>><br><br>Exciter EEPROM Cell 0x00 = 0x44 0x45 0x54 0x30 |
| **Exciter EEPROM Read**<br><br>**a 73 y** | Reads the 4 byte segment of Exciter Serial EEPROM specified by argument 'y'.<br><br>y = EEPROM Region to be read in hex (range 0..3f hex) | RFO FIPS: a 73 0<br>RFO FIPS: RA 73<br><<< READ EXCITER EEPROM >>><br><br>Exciter EEPROM Cell 0x00 = 0x44 0x45 0x54 0x30 |
| **Txlin Carrier Null**<br><br>**a 74 [x]** | Null the carrier feedthru component of the center channel frequency, where x = 0, 1, 2, 3<br>Usage:<br>**a 74** - Performs a Long Null if there is no table, or Medium Null if a valid table exists.<br>**a 74 0** - Long Null (Over complete range)<br>**a 74 1** - Medium Null (Uses existing table)<br>**a 74 2** - Short Null (Smaller range)<br>**a 74 3** - Half (very short) Null (finds 979 or 980)<br><br>**Note:** Parameters (0,1,2, and 3)were added for testing purposes. Typically RFO FIPS: **a 74** is used with no parameters. | RFO FIPS: a 74<br>RFO FIPS: RA 74<br><<< CARRIER NULL TABLE >>><br>------- (Table Valid) --------<br>$12 0x0c 0x04 0x08 0x00<br>-------------------------------------<br>979 0 -200 0 -200<br>980 0 0 900 900<br>Vif 0.16 0.16 0.16 4.21<br>========================================== |

| Name and Command | Description | Example |
|---|---|---|
| **Initialize Amplitude Alignment Parameters**<br><br>**a 75** | Initialize the Amplitude Alignment parameters to default values.<br><br>This command must be performed prior to Amplitude Alignment (RFO FIPS: **a 76**) or Wattmeter Calibration (RFO FIPS: **a 71**).<br><br>**Note**: AM Amplitude alignment is derived from the FM alignment automatically by the software. Previous software had a parameter to specify AM vs. FM. | `RFO FIPS: a 75`<br>`RFO FIPS: RA   75`<br>`<<< ALIGNMENT PARAMETER DEFAULT VALUES >>>`<br>`  K-Factor      990 = 0.408269`<br>`  Fdback Atten  996 =      255`<br>`  Phase Trng    982 =       -1`<br>`  Txlin Reg2    954 =       84`<br>`  Txlin Reg1    953 =       14`<br>`  Txlin Atten   974 =        0`<br>`  Mod Dev      2053 =     4800`<br>`  FM Power Lvl 2054 =    28000`<br>`  AM Pilot Pwr 2055 =     1600`<br>`  AM Sdbd Pwr  2056 =    12426`<br>`==========================================` |

| Name and Command | Description | Example |
|---|---|---|
| **Align the Station Power Amplitude**<br><br>**a 76 x** | Align the station power using the power meter as a reference.<br>Key the station prior to running this command, with a single channel of FM modulation. (Use RFO FIPS: **a 176 0 8 0 0 0 1 10 5 1**).<br>x = Current Power Reading (in watts)<br><br>**Note:** Power Control (Parameter 992) must be DISABLED prior to running this command.<br><br>**Note:** It is important that RFO FIPS: **a 75** (Initialize Amplitude Alignment) be performed immediately prior to this command.<br><br>**Note:** Previous software (prior to 1.2.0) had a parameter to specify AM vs. FM. AM power output is derived from FM alignment.<br><br>See Chapter 6, "Maintenance",paragraph, "Transmitter Power Alignment" | `RFO FIPS: a 76 82`<br>`RFO FIPS: RA   76`<br>`<<< ALIGNMENT PARAMETER VALUES >>>`<br>`  K-Factor      990 = 0.408269`<br>`  Fdback Atten  996 =      255`<br>`  Phase Trng    982 =       -1`<br>`  Txlin Reg2    954 =        0`<br>`  Txlin Reg1    953 =       14`<br>`  Txlin Atten   974 =        0`<br>`  Mod Dev      2053 =     4800`<br>`  FM Power Lvl 2054 =    28000`<br>`  AM Pilot Pwr 2055 =     1600`<br>`  AM Sdbd Pwr  2056 =    12426`<br>`==========================================` |

| Name and Command | Description | Example |
|---|---|---|
| **Subchannel Delay**<br><br>**a 77 x** | Set the subchannel simulcast delay.<br><br>x = Subchannel Delay (0..9F hex - 125 microsecond increments) | `(if station is dekeyed)`<br>`RFO FIPS: a 77 80`<br>`RFO FIPS: RA   77`<br>`<<< SUBCHANNEL DELAY >>>`<br>`The Subchannel Delay is Set to 0x80.`<br>`(if station is keyed)`<br>`RFO FIPS: a 77 80`<br>`RFO FIPS: RA   77`<br>`<<< SUBCHANNEL DELAY >>>`<br>`The Station Must be Dekeyed to Change the Subchannel Delay.`<br>**(request format)**<br>`RFO FIPS: a 77 ?`<br>`RFO FIPS: RA   77`<br>`<<< SUBCHANNEL DELAY >>>`<br>` Usage: A 77 x`<br>` x = Subchannel Delay (0..9F hex - in 125 Microsecond Increments)` |
| **Read Station Power**<br><br>**a 79 x** | Reads the FM Power Level at the selected wattmeter/detector:<br>x = Detector Selected<br>0 = Internal Forward<br>1 = Internal Reflected<br>2 = External Forward<br>3 = External Reflected<br><br>y = Power Reading (optional)<br>no arg = full power - zero reference<br>0 = zero reference reading<br>1 = full power reading<br>**Note:** Due to the nature of AM modulation, the RFO does not monitor AM power output. The AM power output amplitude is determined by an algorithm based on the FM power output. | `RFO FIPS: a 79 0`<br>`RFO FIPS: RA   79`<br>`<<< FM POWER OUTPUT READINGS >>>`<br><br>`=========  INTERNAL FORWARD WATTMETER  =========`<br>`Last Keyed FM Readings:`<br>`   Total Station Power:        105 Watts`<br>`   Total Wattmeter Voltage:  +1.34 Volts`<br>`Average FM Keyed Readings (over last 20 keyups):`<br>`   Power Per Subchannel:       101 Watts`<br><br>`Calibration Factor: 1.009681`<br>`---------------------------------------------`<br>`The Accuracy of This Meter is +- 10 %.`<br>`=============================================` |

| Name and Command | Description | Example |
|---|---|---|
| **Read All Wattmeters**<br><br>**a 80** | Displays the latest keyed FM power readings of all four wattmeter ports, as well as the number of subchannels active during the last key. | `RFO FIPS: a 80`<br>`RFO FIPS: RA   80`<br>`<<< READ FM POWER OUTPUT >>>`<br>` ========= RFO WATTMETER READINGS =========`<br>` Last Keyed FM Power Readings:`<br>`   Internal Forward:        95 watts`<br>`   Internal Reflected:       0 watts`<br>`   External Forward:         0 watts`<br>`   External Reflected:      92 watts`<br>`   Number of Subchannels:    1`<br>`---------------------------------------------`<br>`The Accuracy of Each Meter is +- 10 %.`<br>`==========================================` |
| **Read Exciter Temperature**<br><br>**a 81** | Displays the station temperature, at the exciter, in degrees Celsius.<br><br>**Note:** Read parameter 1026 to determine the temperature at the OCM temperature sensor (Ambient Temperature). | `RFO FIPS: a 81`<br>`RFO FIPS: RA   81`<br>`<<< EXCITER TEMPERATURE DATA >>>`<br>`---- One-Second Sample(s) ----`<br>`00:  0x66 0x66 0x66 0x66 0x66`<br>`05:  0x66 0x66 0x66 0x66 0x66`<br>`10:  0x66 0x66 0x66 0x66 0x66`<br>`15:  0x66 0x66 0x66 0x66 0x66`<br>`20:  0x66 0x66 0x66 0x66 0x66`<br>`25:  0x66 0x66 0x66 0x66 0x66`<br>`30:  0x66 0x66 0x66 0x66 0x66`<br>`35:  0x66 0x66 0x66 0x66 0x66`<br>`40:  0x66 0x66 0x66 0x66 0x66`<br>`45:  0x66 0x66 0x66 0x66 0x66`<br>`50:  0x66 0x66 0x66 0x66 0x66`<br>`55:  0x66 0x66 0x66 0x66 0x66`<br>`---------------------------------------------`<br>`Count = 34`<br>`---- One-Minute Average(s) ----`<br>`00:  0x66 0x66 0x66 0x66 0x66`<br>`---------------------------------------------`<br>`Count = 01`<br>`Exciter Avg Temperature = 0x66  => 34.54 Degrees C`<br>`============================================` |

<table>
<tr><th>Name and Command</th><th>Description</th><th>Example</th></tr>
<tr>
<td>Station Status<br>a 83</td>
<td>Display the current status of the station.<br><br>This command displays the current status of Power Control, Amplitude Alignment, Internal and External Wattmeter Calibration, Power Cutback State, Paging Disabled Status, and Power Leveling.<br><br>Note: If any of the Alignments or Calibrations are INVALID, the RFO should be aligned or calibrated.<br><br>Note: If the Power Leveling amount is greater than 0.5 dB or less than -0.5 dB, this tends to signal that the Amplitude Alignment is not accurate. If the Amplitude Alignment is accurate, then the Internal Wattmeter needs to be re-calibrated.<br><br>Note: If any of the Disable Sources are ACTIVE, the transmitter will not key until the cause of the disable is cleared. Check the Alarm and Error Log (RFO FIPS: a 99 and a 104) for details on any active Disable Source.</td>
<td><pre>RFO FIPS: a 83
RFO FIPS: RA   83
<<< STATION STATUS/MODE >>>
Power Control (R 992)........ENABLED Power Leveling (R 2999)........ 0.00dB
Int Wattmeter Calibration....VALID Ext Wattmeter Calibration......VALID
Amplitude Alignment..........VALID CFT Nulling...................VALID

POWER CUTBACK STATE.......FULL_POWER
PA Temperature............FULL_POWER    Ambient Temperature.......FULL_POWER
PA Deck/Power Supply......FULL_POWER    Disabled Status...........FULL_POWER

PAGING DISABLED STATUS (R 100 = 0 = 0h)
Paging Access Disabled (R 99)..OK       Power Supply A/D Read..........OK
OCM Ambient Temperature........OK       Exciter Synthesizer Lock.......OK
Txlin Local Oscillator Lock....OK       AM Clipping....................OK
FM Clipping....................OK       PA A/D SPI Read................OK
PA Current.....................OK       28 Volt Reference..............OK
14 Volt Reference..............OK       UHSO Present/Operating.........OK
Pendulum Lock..................OK       Pendulum Present...............OK
Exciter SPI Read...............OK       Circulator Load Thermal Limit..OK
PA Failure.....................OK       PA Temperature.................OK
Amplitude Alignment............OK       Power Leveling Failure.........OK
Internal Wattmeter VSWR........OK       High Int WM Reflected Power....OK
External Wattmeter VSWR........OK       High Ext WM Reflected Power....OK
External 1PPS Signal...........OK       RFB REQ Line Down..............OK
PNP Error......................OK       PNP Check Error................OK
Internal Service Mode..........OK

RFO FIPS:</pre></td>
</tr>
</table>

| Name and Command | Description | Example |
|---|---|---|
| **P/A EEPROM Dump**<br><br>**a 84 v** | Reads and displays the values stored in the Power Amplifier Serial EEPROM specified by the parameter ‘v’.<br><br>v = P/A Number (range 1..2) | See example below |

```
RFO FIPS: a 84 2
Please wait. Command in process...
RA   84
<<< READ ENTIRE PA EEPROM >>>

-------------------- PA 02 EEPROM Cell(s) ------------------
 0x00:  0x00 0x90 0x4d 0x00  0x00 0x00 0x00 0x00   "..M. ...."
 0x02:  0x00 0x00 0x00 0x00  0x00 0x00 0x00 0x00   ".... ...."
 0x04:  0x30 0x30 0x30 0x30  0x30 0x00 0x00 0x00   "0000 0..."
 0x06:  0x31 0x30 0x2e 0x30  0x30 0x00 0x00 0x00   "10.0 0..."
 0x08:  0x31 0x33 0x2e 0x39  0x30 0x00 0x00 0x00   "13.9 0..."
 0x0a:  0x30 0x30 0x30 0x30  0x30 0x00 0x00 0x00   "0000 0..."
 0x0c:  0x30 0x2e 0x36 0x30  0x30 0x00 0x00 0x00   "0.60 0..."
 0x0e:  0x31 0x31 0x2e 0x33  0x30 0x00 0x00 0x00   "11.3 0..."
 0x10:  0x2d 0x2e 0x30 0x33  0x34 0x00 0x00 0x00   "-.03 4..."
 0x12:  0x31 0x30 0x2e 0x39  0x38 0x00 0x00 0x00   "10.9 8..."
 0x14:  0x33 0x38 0x2e 0x31  0x36 0x00 0x00 0x00   "38.1 6..."
 0x16:  0x2e 0x30 0x35 0x37  0x34 0x00 0x00 0x00   ".057 4..."
 0x18:  0x35 0x2e 0x32 0x35  0x38 0x00 0x00 0x00   "5.25 8..."
 0x1a:  0x33 0x34 0x2e 0x34  0x34 0x00 0x00 0x00   "34.4 4..."
 0x1c:  0x2e 0x32 0x34 0x37  0x31 0x00 0x00 0x00   ".247 1..."
 0x1e:  0x35 0x2e 0x34 0x31  0x34 0x00 0x00 0x00   "5.41 4..."
 0x20:  0x33 0x33 0x2e 0x37  0x35 0x00 0x00 0x00   "33.7 5..."
 0x22:  0x31 0x2e 0x31 0x36  0x31 0x00 0x00 0x00   "1.16 1..."
 0x24:  0x2d 0x32 0x2e 0x31  0x39 0x00 0x00 0x00   "-2.1 9..."
 0x26:  0x33 0x31 0x2e 0x39  0x34 0x00 0x00 0x00   "31.9 4..."
 0x28:  0x31 0x37 0x32 0x2e  0x36 0x00 0x00 0x00   "172. 6..."
 0x2a:  0x2d 0x38 0x37 0x2e  0x32 0x00 0x00 0x00   "-87. 2..."
 0x2c:  0x32 0x35 0x2e 0x33  0x35 0x00 0x00 0x00   "25.3 5..."
 0x2e:  0x2d 0x33 0x2e 0x31  0x32 0x00 0x00 0x00   "-3.1 2..."
 0x30:  0x00 0x00 0x00 0x00  0x00 0x00 0x00 0x00   ".... ...."
 0x32:  0x00 0x00 0x00 0x00  0x00 0x00 0x00 0x00   ".... ...."
 0x34:  0x30 0x31 0x34 0x31  0x32 0x32 0x36 0x2d   "0141 226-"
 0x36:  0x56 0x30 0x31 0x2e  0x30 0x31 0x00 0x00   "V01. 01.."
 0x38:  0x43 0x4f 0x50 0x59  0x52 0x49 0x47 0x48   "COPY RIGH"
 0x3a:  0x54 0x2c 0x4d 0x4f  0x54 0x4f 0x52 0x4f   "T,MO TORO"
 0x3c:  0x4c 0x41 0x2c 0x49  0x4e 0x43 0x2e 0x2c   "LA,I NC.,"
 0x3e:  0x31 0x39 0x39 0x36  0x00 0x00 0x00 0x3c   "1996 ...<"
Calculated Checksum = 0xa8, Actual Checksum = 0x3c
=============================================
```

| Name and Command | Description | Example |
|---|---|---|
| **Exciter EEPROM Dump**<br><br>**a 85** | Reads and displays the values stored in the Exciter Serial EEPROM.<br><br>**Note:** The matching calculated and actual checksum verifies that at least one of the three alignments (Amplitude Alignment, Internal Wattmeter Calibration, External Wattmeter Calibration) has been completed successfully. It **does not** indicate that ALL have been completed successfully. Use RFO FIPS: **a 83** to verify validity of alignment/calibrations. | See below |

```
RFO FIPS: a 85
Please wait. Command in process...
RFO FIPS: RA   85
<<< READ ENTIRE EXCITER EEPROM >>>
------------------- Exciter EEPROM Cell(s) -------------------

 0x00:  0x44 0x45 0x54 0x30  0x30 0x32 0x31 0x30   "DET0 0210"
 0x02:  0x32 0x2e 0x36 0x36  0x36 0x34 0x39 0x34   "2.66 6494"
 0x04:  0x44 0x45 0x54 0x30  0x44 0x45 0x54 0x30   "DET0 DET0"
 0x06:  0x44 0x45 0x54 0x30  0x44 0x45 0x54 0x30   "DET0 DET0"
 0x08:  0x44 0x45 0x54 0x30  0x44 0x45 0x54 0x30   "DET0 DET0"
 0x0a:  0x44 0x45 0x54 0x30  0x44 0x45 0x54 0x30   "DET0 DET0"
 0x0c:  0x31 0x2e 0x30 0x2e  0x31 0x20 0x00 0x00   "1.0. 1 .."
 0x0e:  0x30 0x30 0x30 0x31  0x43 0x48 0x4b 0xaa   "0001 CHK."
 0x10:  0x44 0x45 0x54 0x31  0x30 0x32 0x30 0x30   "DET1 0200"
 0x12:  0x32 0x2e 0x32 0x33  0x36 0x30 0x37 0x33   "2.23 6073"
 0x14:  0x44 0x45 0x54 0x31  0x44 0x45 0x54 0x31   "DET1 DET1"
 0x16:  0x01 0x02 0x03 0x04  0x44 0x45 0x54 0x31   ".... DET1"
 0x18:  0x44 0x45 0x54 0x31  0x44 0x45 0x54 0x31   "DET1 DET1"
 0x1a:  0x44 0x45 0x54 0x31  0x44 0x45 0x54 0x31   "DET1 DET1"
 0x1c:  0x39 0x37 0x30 0x38  0x31 0x31 0x00 0x00   "9708 11.."
 0x1e:  0x30 0x30 0x30 0x31  0x43 0x48 0x4b 0xd0   "0001 CHK."
 0x20:  0x41 0x47 0x4e 0x46  0x30 0x30 0x38 0x32   "AGNF 0082"
 0x22:  0x30 0x30 0x30 0x45  0x30 0x30 0x30 0x30   "000E 0000"
 0x24:  0x30 0x2e 0x34 0x30  0x38 0x32 0x36 0x39   "0.40 8269"
 0x26:  0x30 0x30 0x46 0x46  0x31 0x32 0x43 0x30   "00FF 12C0"
 0x28:  0x36 0x44 0x36 0x30  0x30 0x36 0x34 0x30   "6D60 0640"
 0x2a:  0x33 0x30 0x38 0x41  0x30 0x30 0x30 0x30   "308A 0000"
 0x2c:  0x31 0x2e 0x30 0x2e  0x31 0x20 0x00 0x00   "1.0. 1 .."
 0x2e:  0x30 0x30 0x31 0x35  0x43 0x48 0x4b 0xc8   "0015 CHK."
 0x30:  0x00 0x00 0x00 0x00  0x00 0x00 0x00 0x00   ".... ...."
 0x32:  0x30 0x30 0x30 0x45  0x30 0x30 0x30 0x30   "000E 0000"
 0x34:  0x30 0x2e 0x37 0x35  0x30 0x30 0x30 0x30   "0.75 0000"
 0x36:  0x30 0x30 0x39 0x42  0x31 0x32 0x43 0x30   "009B 12C0"
 0x38:  0x36 0x31 0x41 0x38  0x30 0x36 0x34 0x30   "61A8 0640"
 0x3a:  0x33 0x30 0x38 0x41  0x41 0x47 0x4e 0x41   "308A AGNA"
 0x3c:  0x31 0x2e 0x30 0x2e  0x31 0x20 0x00 0x00   "1.0. 1 .."
 0x3e:  0x30 0x30 0x30 0x31  0x43 0x48 0x4b 0x3e   "0001 CHK>"
Calculated Checksum = 0x3e, Actual Checksum = 0x3e
=============================================
```

| Name and Command | Description | Example |
|---|---|---|
| **Display the Set Power Level**<br><br>**a 87 x** | Read AM or FM Power Amplitude Alignment based on the current power setting and PA/Power Supply configuration.<br>x = Modulation Type<br>0 = FM<br>1 = AM<br><br>**Note:** These tables are only used by the RFO when Power Control is Enabled (RFO FIPS: **w 992 1**). When power control is disabled the values stored in parameters 990, 996, 982, 954, 953, 974, 2053, 2054, 2055, and 2056 are used to control the power output. By default, Power Control is Enabled upon reset (starting with RFO 1.2.0). | See below |

```
 RFO FIPS: a 87 1
RFO FIPS: RA   87
<<< AM AMPLITUDE CONTROL PARAMETERS >>>

                                             Number of Subchannels
                      Align         1          2          3          4
                     ------------------------------------------------
  Power              150         69         69         0          0
  K-Factor      990 1.000000   0.678233   0.959166   0.000000
    0.000000
  Fdback Atten  996     255        229        229          0          0
  Phase Trng    982   -10000     -14000     -14000         0          0
  Txlin Reg2    954      84         84         20          0          0
  Txlin Reg1    953      14         14         14          0          0
  Txlin Atten   974       0          0          0          0          0
  Mod Dev      2053    4800       4800       4800          0          0
  FM Power Lvl 2054   28000      28000      28000          0          0
  AM Pilot Pwr 2055    1600       1600       1600          0          0
  AM Sdbd Pwr  2056   12426      12426      12426          0          0
                      ------------------------------------------------
=============================================
RFO FIPS: a 87 0
RFO FIPS: RA   87
<<< FM AMPLITUDE CONTROL PARAMETERS >>>

                                             Number of Subchannels
                      Align         1          2          3          4
                     ------------------------------------------------
  Power              150         50         50         50         0
  K-Factor      990 0.408269   0.235714   0.471428   0.707168
    0.000000
  Fdback Atten  996     255        255        255        255          0
  Phase Trng    982   -10000     -14000     -14000     -14000
    0
  Txlin Reg2    954      84         84         20         20          0
  Txlin Reg1    953      14         14         14         14          0
  Txlin Atten   974       0          0          0          0          0
  Mod Dev      2053    4800       4800       4800       4800          0
  FM Power Lvl 2054   28000      28000      14000       9333          0
  AM Pilot Pwr 2055    1600       1600       1600       1600          0
  AM Sdbd Pwr  2056   12426      12426      12426      12426          0
                      ------------------------------------------------
=============================================
```

| Name and Command | Description | Example |
|---|---|---|
| **Set Output Power**<br><br>**a 88 x y** | Set AM or FM Output Power. For a single PA, 2 Power Supply Configuration, the Maximum AM Power Setting is 75 Watts. See the RFO! Linear Transmitter Power Chart for Maximum and Minimum settings for your particular configuration.<br>x = Modulation Type<br>0 = FM (ReFLEX)<br>1 = AM (InFLEXion)<br>y = User Requested Power Setting (watts) | |

```
RFO FIPS: a 88 ?
RFO FIPS: RA   88
<<< SET POWER OUTPUT LEVEL >>>
 Usage: A 88 x y
 x = Modulation Type. 0=FM, 1=AM
 y = Desired Power Level Per Subchannel (watts).
     Valid FM Range for Current 2 PA Configuration is 25 - 290 Watts.
     Valid AM Range is 40 - 150 Watts.
RFO FIPS: a 88 0 100
RFO FIPS: RA   88
<<< SET FM POWER OUTPUT >>>

 2 PA Deck(s) Detected
 FM Modulation
 FM Power Level = 100 Watt(s) per Subchannel
 Subchannel(s)  Minimum  Maximum
 ------------------------------
       1          040      290
       2          040      145
---------------------------------------------
NOTE: This Configuration Will Allow The Transmitter to Key With 1
    thru 2 FM Subchannels. All Other FM Key Requests Will Be Ignored.
=============================================
RFO FIPS: a 88 1 65
RFO FIPS: RA   88
<<< SET AM POWER OUTPUT >>>

 2 PA Deck(s) Detected
 AM Modulation
 AM Power Level = 65 Watt(s) per Subchannel
 Subchannel(s)  Minimum  Maximum
 ------------------------------
       1          065      150
       2          040      075
---------------------------------------------
NOTE: This Configuration Will Allow The Transmitter to Key With 1
    thru 2 AM Subchannels. All Other AM Key Requests Will Be Ignored.
=============================================
```

| Name and Command | Description | Example |
| --- | --- | --- |
| **Display Carrier Null Results**<br><br>**a 89** | Display the carrier null results.<br><br>**Note:** Carrier Nulling must be performed via RFO FIPS: **a 74** prior to using this command, for table value to be valid. | <pre>RFO FIPS: a 89<br>RFO FIPS: RA   89<br><<< CARRIER NULL TABLE >>><br> -------     (Table Valid)    --------<br>           Txlin Register $12<br>  $12    0x0c   0x04   0x08   0x00<br>  ------------------------------------<br>  979    -551   -410   -551   -410<br>  980    -301   -301   -710   -710<br>  Vif    0.16   0.16   0.16   0.16<br>=============================================</pre> |

| Name and Command | Description | Example |
|---|---|---|
| **Carrier Null Characterization**<br><br>**a 90 x y z t u** | Null the Carrier Feedthrough Component of the signal.<br>x = parameter id (979 = i offset; 980 = q offset)<br>y = Txlin register $12 value (0 ... 255)<br>z = step count (minimum of 10)<br>t = beginning offset (-3000 ... 3000)<br>u = ending offset (-3000 ... 3000)<br><br>**Note:** This was the original command used to null the carrier. Use command RFO FIPS: **a 74** instead. | `RFO FIPS: A 90 ?`<br>`Please wait. Command in process...`<br>`RA 90`<br>`<<< CARRIER NULL CHARACTERIZATION >>>`<br>`Usage: A 90 x y z t u`<br>`x = parameter ID: 979 for i offset, 980 for q offset.`<br>`y = Txlin reg $12 value: 00 to ff.`<br>`z = Step count: minimum 10.`<br>`t = Beginning offset: -3000 to 3000.`<br>`u = Ending offset: -3000 to 3000.`<br>`Ending offset must be greater than beginning offset.`<br>`See FIPS document for more information.`<br>`=============================================`<br>`RFO FIPS: a 90 979 4 200 0 3000`<br>`Please wait. Command in process...`<br>`RA 90`<br>`200 0 92`<br>`200 200 118`<br>`200 400 145`<br>`200 600 172`<br>`200 800 200`<br>`200 1000 217`<br>`200 1200 218`<br>`200 1400 218`<br>`200 1600 218`<br>`200 1800 218`<br>`200 2000 218`<br>`200 2200 218`<br>`200 2400 218`<br>`200 2600 218`<br>`200 2800 218`<br>`200 3000 218`<br>`RFO FIPS:` |

| Name and Command | Description | Example |
|---|---|---|
| **Read All Alarms**<br><br>**a 99** | Read all Alarms currently logged.<br>The alarms logged here are a subset of those logged in the error log (RFO FIPS: **a 104**). This Alarm log is typically reserved for alarms that immediately impact the operation of the station.<br><br>This log is cleared by entering the RFO FIPS: **a 103** command.<br>**AL001** - Indicates that the Alarm is active and has been logged 001 time(s) since the last time the log was cleared.<br>**OK000** - Indicates that an alarm was logged, but was cleared by the RFO software. The condition causing the alarm no longer exists. | `RFO FIPS: a 99`<br>`RFO FIPS: RA   99`<br><br>`Reported Alarms`<br>`---------------`<br>`AL001 - Alarm Occurred Due to OCM Reset.`<br>`OK000 - Transmitter Disabled Due To High OCM Ambient Temperature.`<br>`OK000 - Transmitter Disabled - (Check Disabled Status via FIPS: A 83).` |
| **Clear All Alarms**<br><br>**a 103** | Clear all logged Alarms.<br>Clears all alarms displayed by the RFO FIPS: **a 99** command. | `RFO FIPS: a 103`<br>`RFO FIPS:` |

| Name and Command | Description | Example |
|---|---|---|
| **Read Error Log**<br><br>**a 104** | Returns the Error Log.<br>Each error is returned in the format:<br><**Type**><**Action**><**Error Code**><**Caller**><**Line Num**><**Timestamp**><**Occurrences**><br>**Type** - helps determine which subsystem within the module is responsible for the error condition. The Type can take on values such as NVM, DSP,STATION_ERROR,GPS, etc.<br>**Action** - tells what action the error logging mechanism took when the error occurred. Action can be either RESET_STATION (fatal error, station was reset) or LOG_ERROR (non-fatal, error was logged, but station was not reset.)<br>**Error Code** - used to identify individual errors. The tables in this document contain descriptions of each of the possible error codes.<br>**Caller** - Used for software debugging. The Caller represents the software source code module which logged the error<br>**Line Num** - Used for software debugging. The Line Num is the physical line number of the calling software source code module from where the error was logged.<br>**Timestamp** - The time when the latest occurrence of the error was logged. During a reset and/or until the BCM locks GPS, the timestamp will contain the current value of the onboard clock, which starts timing from 1996/04/02.12:00:00 upon reset. If there is a BCM present and it locks GPS, the onboard clock will be set to the GPS Date/Time, which is GMT.<br>**Occurrences** - the number of times the current combination of Type, Action, Error Code, Caller, and Line Num have occurred since the log was last cleared. Note that different Callers can log the same Error Code, in which case separate log entries will be made.<br>Use RFO FIPS: **a 111** to clear this log. | `RFO FIPS: a 104`<br>`RFO FIPS:`<br>`<STATION_ERROR><LOG_ERROR><S_RSR_SOFTWARE_WATCHDOG_RESET> <ROOT>`<br>`<653><1996/04/09.12:30:30> <1>` |

| Name and Command | Description | Example |
|---|---|---|
| **Read Sware Log**<br><br>**a 110** | Returns the Software Error Log.<br>These errors are usually directly related to the RFO's software operating system.<br>Use RFO FIPS: **a 113** to clear this log. | `RFO FIPS: a 110`<br>`RFO FIPS: <SWARE> <LOG_ERROR> <E_SRAM_READ_FAULT> <ERROR_LOG_HANDLER> <848>` |
| **Clear Error Log**<br><br>**a 111** | Clears the Error Log.<br>Clears the errors displayed by the RFO FIPS: **a 104** command. | |
| **Clear Sware Log**<br><br>**a 113** | Clears the Software Error Log.<br>Clears the errors displayed by the RFO FIPS: **a 110** command | |
| **Station Reset**<br><br>**a 117** | This action command performs a software reset of the station. | |
| **Read Pendulum Warp Value**<br><br>**a 154** | Reads the Pendulum Warp Value directly from the Pendulum IC. Value is changed by modifying parameter 185. | `RFO FIPS: a 154`<br>`RFO FIPS: RA 154 110` |
| **Read Exciter Synthesizer 1**<br><br>**a 166** | Returns the frequency last manually programmed into the First Synthesizer. | `RFO FIPS: a 166`<br>`RFO FIPS: RA  166`<br>`<<< READ SYNTHESIZER FREQUENCY >>>`<br>`Synthesizer 1 Frequency is Set at 929000.000 kHz` |
| **Read Exciter Synthesizer 2**<br><br>**a 168** | Returns the frequency last manually programmed into the Second Synthesizer. | `RFO FIPS: a 168`<br>`RFO FIPS: RA  168`<br>`<<< READ SYNTHESIZER FREQUENCY >>>`<br>`Synthesizer 2 Frequency is Set at 929000.000 kHz` |

<table>
<tr><th>Name and Command</th><th>Description</th><th>Example</th></tr>
<tr><td>Read Tranlin<br><br>a 172</td><td>This action command returns the current register settings in the Tranlin IC.</td><td><pre>
RFO FIPS: a 172
RFO FIPS: RA  172
<<< READ TXLIN IC >>>
Reg 0x00: Invert I/Q  = 0x16
Reg 0x01: ASW/PWRC    = 0x0e
Reg 0x02: LOA         = 0x54
Reg 0x03: LON         = 0x31
Reg 0x04: LOR         = 0xf1
Reg 0x05: Interval A  = 0x14 =>  125.00 usec
Reg 0x06: Interval B  = 0x27 =>  243.75 usec
Reg 0x07: Interval C  = 0x00 =>    0.00 usec
Reg 0x08: Interval D  = 0xca => 1262.50 usec
Reg 0x09: Interval E  = 0xcc => 1275.00 usec
Reg 0x0A: Interval F  = 0x51 =>  506.25 usec
Reg 0x0B: Interval G  = 0x7e =>  787.50 usec
Reg 0x0C: Interval H  = 0xcb => 1268.75 usec
Reg 0x0D: Interval I  = 0x40 =>  400.00 usec
Reg 0x0E: Interval J  = 0x20 =>  200.00 usec
Reg 0x0F: Interval K  = 0xff => 1593.75 usec
Reg 0x10: Interval L  = 0x36 =>  337.50 usec
Reg 0x11: Interval M  = 0x4d =>  481.25 usec
Reg 0x12: IQ Slew     = 0x00
Reg 0x13: Pmode/DAC   = 0x1f
Reg 0x14: PDAC        = 0x7f
Reg 0x15: Ph/Lvl/Loop = 0x13
Reg 0x16: Attenuator  = 0x00
Reg 0x17: Manual Sin  = 0x00
Reg 0x18: Manual Cos  = 0x00
Reg 0x19: Interval N  = 0x10 =>  100.00 usec
Calculated Checksum   = 0x07a8
Actual Checksum       = 0x07a8
Information           = 0x02
Attenuation           = 0xff
Sine                  = 0xfe
Cosine                = 0x96
==========================================
</pre></td></tr>
</table>

<table>
<tr><th>Name and Command</th><th>Description</th><th>Example</th></tr>
<tr><td>Test Mode Start<br><br>a 176 m p1 p2 p3 p4 1 b 5 1</td><td>Key the station in test mode<br>m = modulation type<br>0 = FM<br>1 = AM<br>p = pattern (where p1 is for subchannel 1, p2 for subchannel 2, p3 for subchannel 3, and p4 for subchannel 4)<br>0 - No Pattern<br>1 - FM Big Comma<br>2 - FM Little comma<br>3 - FM Staircase 4-level<br>4 - FM Symbol A (10)<br>5 - FM Symbol B (11)<br>6 - FM Symbol C (01)<br>7 - FM Symbol D (00)<br>8 - FM Random<br>9 - FM Reserved<br>10 - AM 2-tone (400 Hz + 1 kHz)<br>11 - AM 1-tone (1.7 kHz)<br>12 - AM Female voice<br>13 - AM Male voice<br>b = Number of Blocks per Frame (0..11) 11 Represents a Full Frame.</td><td><pre>RFO FIPS: a 176 0 8 0 0 0 1 10 5 1
RFO FIPS: RA  176
<<< RFO TEST MODES >>>

The Station is Keyed in Test Mode ...

RFO FIPS:
RFO FIPS: a 176 ?
RFO FIPS: RA  176
<<< RFO TEST MODES >>>

OCM Test Mode command syntax:
A 176 m  p  p  p  p  1  b  5  1
      |  |  |  |  |  |  |  |  |
      |  |  |  |  |  |  |  |  +- fsk level - 3200 sym/sec
      |  |  |  |  |  |  |  +---- bit speed - 6400 bits/sec
      |  |  |  |  |  |  +------- # forward blocks (1 - 11)
      |  |  |  |  |  +---------- frame frequency
      |  |  |  |  +------------- subchannel 4 pattern (1-13)
      |  |  |  +---------------- subchannel 3 pattern (1-13)
      |  |  +------------------- subchannel 2 pattern (1-13)
      |  +---------------------- subchannel 1 pattern (1-13)
      +------------------------- modulation mode (0 = FM, 1 = AM)

Pattern options:
 1  - FM Big Comma
 2  - FM Little comma
 3  - FM Staircase 4-level
 4  - FM Symbol A (10)
 5  - FM Symbol B (11)
 6  - FM Symbol C (01)
 7  - FM Symbol D (00)
 8  - FM Random
 9  - FM Reserved
 10 - AM 2-Tone (400 Hz + 1 kHz)
 11 - AM 1-Tone (1.7 kHz)
 12 - AM Female Voice
 13 - AM Male Voice</pre></td></tr>
<tr><td>Test Mode Stop<br><br>a 177</td><td>Exit Test Mode. Used to dekey the station, after keying with the RFO FIPS: a 176 command.</td><td><pre>RFO FIPS: a 177
RFO FIPS: RA  177
The Station is Dekeyed.</pre></td></tr>
</table>

| Name and Command | Description | Example |
|---|---|---|
| **Exciter A/D Read**<br><br>**a 188 y** | This action command reads the Exciter A/D channel specified by argument, y.<br><br>y = A/D channel (0x00-0x0B or 0x0C to return all channels). | `RFO FIPS: a 188 c`<br>`RFO FIPS: RA  188`<br>`<<< READ EXCITER A/D >>>`<br>`Reg 00: A+ (14V)   = 108 => 14.20 Volt(s)`<br>`Reg 01: Rect IF    = 036 =>  0.70 Volt(s)`<br>`Reg 02: 10 V       = 167 => 10.18 Volt(s)`<br>`Reg 03: CHG Freq 1 = 003 => PASS (> 0)`<br>`Reg 04: 5V Analog  = 128 =>  4.99 Volt(s)`<br>`Reg 05: LO2 Lock 2 = 252 => PASS (> 200)`<br>`Reg 06: LO2 Lock 1 = 252 => PASS (> 200)`<br>`Reg 07: EX Temp    = 113 => 40.48 Deg(s) C`<br>`Reg 08: A/D Ref    = 125 =>  2.44 Volt(s)`<br>`Reg 09: CHG Freq 2 = 003 => PASS (> 0)`<br>`Reg 0A: Epot Wiper = 253 =>  4.93 Volt(s)`<br>`Reg 0B: A/D Test   = 128 => PASS (> 127)`<br>`==========================================`<br>Note: The example shown is assuming a of current ±10; volt ±5; and power at ±10 . |

| Name and Command | Description | Example |
|---|---|---|
| **Enable Trace Mode**<br><br>**a 192 NNNN x**<br><br>**Note: NNNN syntax is case sensitive**<br><br>**Note: Enabling traces CAN affect station performance... use traces with caution. Be sure to turn off all unused traces.** | Enables a mode which will output the occurrence of certain events to the FIPS session. The arguments are:<br>NNNN x (Trace Enabled)<br>DIAG 1 - Diagnostic Error Log Trace<br>SPIQ 1 - SPI Activity<br>SHMI 1 - Power Supply Status<br>SHMI 2 - Ambient Temperature Status<br>SHMI 4 - P/A Temperature Status<br>SHMI 8- Reserved<br>SHMI 16 - USHO Present Debug<br>SHMI 32- Pendulum Locked Debug<br>SHMI 64 - Pendulum Present Debug<br>SHMI 128 - Exciter Synth 1 Locked Debug<br>SHMI 256 - Exciter Synth 2 Locked Debug<br>DIDQ 1 - Start Time Error<br>DIDQ 2 - Incomplete Frame Error<br>DIDQ 4 - Modulation Type Error<br>DIDQ 8 - Frequency Offset Error<br>DIDQ 16 - Invalid Command Type<br>DIDQ 32 - Control Command Format Error<br>DIDQ 64 - Unexpected Symbol Command Error<br>DIDQ 126 - Symbol Data Command Format Error<br>DIDQ 256 - End of Command Error<br>DIDQ 512 - Workahead Window Error<br>DIDQ 1024 - Check Command Format Error<br>DIDQ 2048 - Invalid Symbol Duration<br>MPCM 16 - Remote Software Download Trace<br>ITCM 1 - K Factor Trace<br>ITCM 2 - Attenuation Level Trace<br>ITCM 4 - Cutback Mode Trace<br>ITCM 8 - PA Deck Trace<br>ITCM 16 - Power Supply Trace<br>ITCM 32 - Carrier Null Trace<br>SPCQ 1 - Protocol Trace<br>SPCQ 2 - Reserved<br>SPCQ 4 - Reserved<br>SPCQ 8 - DSP Flush Frame State Trace<br>SPCQ 16 - Power Leveling Trace<br>SPCQ 32 - VSWR Checking Trace<br>RFCQ 1 - Control Command Trace | RFO FIPS: a 192 SPCQ 16<br>RFO FIPS: RA 192<br>RFO FIPS: a 192 SHMI 1<br>RFO FIPS: RA 192<br>RFO FIPS:<br><SHMI 1> PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.22 Volt(s)<br><br><SPCQ 16> LEVELING: Set=100 W Act=103 W<br>Lvl Chg=-0.13 dB Total= 1.57 dB<br><br><SHMI 1> PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.24 Volt(s)<br><br><SHMI 1> PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.24 Volt(s)<br><br><SHMI 1> PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.22 Volt(s)<br><br><SHMI 1> PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.24 Volt(s)<br><br><SHMI 1> PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.24 Volt(s) |

| Name and Command | Description | Example |
|---|---|---|
| **Disable Trace Mode**<br><br>**a 193 NNNN x**<br><br>**Note: NNNN syntax is case sensitive** | Use above arguments to disable traces previously enabled with the RFO FIPS: **a 192** command. | `RFO FIPS: a 193 RFCQ 1`<br>`RFO FIPS: RA  193`<br>`RFO FIPS:` |
| **Set Subchannel Frequency Offsets**<br><br>**a 195 x x x x** | Set the subchannel frequency offsets for Test Modes.<br>x = 0..3, 13..15<br>0 = 0 khz<br>1 = 6.25 khz,   13 = -18.75 khz<br>2 = 12.50 khz, 14 = -12.50 khz<br>3 = 18.75 khz, 15 = - 6.25 khz | `RFO FIPS: a 195 1 2 3 1`<br>`RFO FIPS: RA  195`<br>`<<< SET SUBCHANNEL FREQUENCY OFFSETS >>>`<br>`Subchannel Frequency Offsets Set to: 1, 2, 3, 1`<br>`For Subchannels 1 Through 4, Respectively.`<br>`Where:`<br>`13 = -18.75 kHz, 14 = -12.50 kHz, 15 = -6.25 kHz`<br>`0 =   0.00 kHz`<br>`1 =   6.25 kHz,   2 =  12.50 kHz,   3 = 18.75 kHz` |
| **Set RF channel**<br><br>**a 196 x** | Set the RF Channel to use when keying in Test Modes.<br>x = channel (range: 0..15)<br><br>**Note:** RF Channels 0 through 15, are set to the Center Frequencies programmed in parameter 2000 through 2015, respectively. | `RFO FIPS: a 196 1`<br>`RFO FIPS: RA  196`<br>`RFO FIPS: RA  196`<br>`<<< SET TEST CHANNEL >>>`<br>`Test Channel Set to 1.`<br><br>`RFO FIPS: a 196 ?`<br>`RFO FIPS: RA  196`<br>`<<< SET TEST CHANNEL >>>`<br>`Usage: A 196 x`<br>`x = RF Channel (0..15)` |

# FIPS Read/Write Commands (ver. 2.0.0)

This appendix summarizes the Friendly Integrated Paging System (FIPS) read and write commands for the RF-Orchestra! transmitter. These commands are used to display or modify the values of the parameters stored in the RF-O! transmitter parameter database.

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 1 of 27)*

| Name and Command | Description | Ranges Upper | Ranges Lower | Default |
|---|---|---|---|---|
| **Paging Access Disabled**<br><br>**r 99**<br>**w 99 <arg>** | Paging Access Disable is used to locally disable the transmitter. If the transmitter is not already disabled, writing this parameter to ‘1’ will cause the transmitter to cease transmission. The DISABLE LED will light, the PWR CTBK LED will start blinking, and the TX_OK output to the RFB will change to the “Not OK” state. To re-enable paging access, and there are no other disables active, write this parameter to ‘0’.(See also, a 83, or parameter 100) | 1 | 0 | 0 |
| **Paging Disabled Status**<br><br>**r 100** | Gives the current disabled status of the station. If the transmitter is disabled by the software, the value read will be a number other than 0. | 0xFFFFFFFF | 0 | 0 |
| **FIPS Inactivity Timer**<br><br>**r 136**<br>**w 136 <arg>** | Return/Set the Inactivity Timer which will cause the host to exit FIPS if no keystrokes are recorded during the elapsed time in this parameter. | 3600 s | 60 s | 300 s |
| **FIPS Baud Rate**<br><br>**r 140**<br>**w 140 <arg>** | This command returns/sets the communications data rate of the FIPS port. The following arguments apply:<br><br>1 = 1200 bps 5 = 19200 bps<br>2 = 2400 bps 6 = 38400 bps<br>3 = 4800 bps 7 = 57600 bps<br>4 = 9600 bps 8 = 115200 bps | 8 | 1 | 4 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 2 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Internal Wattmeter Forward Power Minimum Limit**<br><br>**r 141**<br>**w 141 <arg>** | This command returns/sets the internal wattmeter forward power minimum limit. If the internal wattmeter forward power per-subchannel power goes below this amount, an error will be logged. This value should be set to one-half of the normal internal forward power reading. | 600 W | 0 W | 0 W |
| **Internal Wattmeter Forward Power Maximum Limit**<br><br>**r 142**<br>**w 142 <arg>** | This command returns/sets the internal wattmeter forward power maximum limit. If the internal wattmeter forward power goes above this amount, an error will be logged. This values should be set to two times that of the normal internal forward power reading. | 600 W | 0 W | 600 W |
| **Internal Wattmeter Reflected Power Maximum Limit**<br><br>**r 143**<br>**w 143 <arg>** | This command returns/sets the external wattmeter reflected power maximum limit. If the internal wattmeter per-subchannel reflected power goes above this amount, an error is logged, and the transmitter is disabled (shutdown). This value should be 10% (one-tenth) of the normal internal forward power reading. | 600 W | 0 W | 600 W |
| **External Wattmeter Forward Power Minimum Limit**<br><br>**r 144**<br>**w 144 <arg>** | This command returns/sets the external wattmeter forward power minimum limit. If the external wattmeter per-subchannel forward power goes below this amount an error will be logged. This value should be set to one-half of the normal external forward power reading. | 600 W | 0 W | 0 W |
| **External Wattmeter Forward Power Maximum Limit**<br><br>**r 145**<br>**w 145 <arg>** | This command returns/sets the external wattmeter forward power. If the external wattmeter per-subchannel forward power goes above this amount an error is logged. This values should be set to two times that of the normal external forward power reading. | 600 W | 0 W | 600 W |
| **External Wattmeter Reflected Power Limit**<br><br>**r 146**<br>**w 146 <arg>** | This command returns/sets the external reflected power. If the external wattmeter per-subchannel reflected power goes above this amount, an error is logged, and the transmitter is disabled (shutdown). This value should be 10% (one-tenth) of the normal external forward power reading. | 600 W | 0 W | 600 W |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 3 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Active Application Software Version**<br><br>**r 148** | This command return the active application software version. | N/A | N/A | N/A |
| **Dormant Application Software Version**<br><br>**r 152** | This command returns the software version (if any) of the bank which is currently in the inactive bank of FLASH memory. | N/A | N/A | N/A |
| **Hardware Serial Number**<br><br>**r 155**<br>**w 155** | Storage String for serial number. Eight alphanumeric characters maximum length. | N/A | N/A | None |
| **Pendulum Warp**<br><br>**r 185**<br>**w 185 <arg>** | Programs the Pendulum IC with the Warping value specified in this parameter on power-up.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 215 | 0 | 110 |
| **Maintenance Path Baud Rate**<br><br>**r 213**<br>**w 213** | Return/Set the Communication Data Rate of the PnP Maintenance Path. The following arguments apply:<br>1 = 1200 bps<br>2 = 2400 bps<br>3 = 4800 bps<br>4 = 9600 bps<br>5 = 19200 bps<br>6 = 38400 bps<br>7 = 57600 bps<br>8 = 115200 bps<br>**Note:** This parameter not fully implemented.<br>**WARNING:** This parameter intended for Lab/ Development use only! | 8 | 1 | 4 |
| **User Password**<br><br>**r 707**<br>**w 707** | This command returns/sets the password used to enter the FIPS program. | N/A | N/A | ‘6000’ |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 4 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Xilinx Type**<br><br>**r 710** | Return/Set the model of the FPLD on the RFO.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 4 | 1 | 4 |
| **Active Flash Bank**<br><br>**r 901**<br>**w 901** | This command returns/sets the application bank which currently used (read). Writing to this parameter will take effect on the next station reset. | 2 | 1 | 1 |
| **One Pulse Per Second Window Size**<br><br>**r 902** | Return the 1 PPS Simulcast Window Size.<br><br>Arg Window Size(nanosec)<br>1 480<br>2 950<br>3 1900<br>4 3810<br>5 7620<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 5 | 1 | 5 |
| **IF Frequency**<br><br>**r 951** | Return the IF Frequency used in programming the Exciter Synthesizers.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 22500 | 70000 | 107400 |
| **Exciter Attenuator (Txlin Register 00)**<br><br>**r 952**<br>**w 952 <arg>** | Return/Set the value of Exciter IC Attenuator level. Used for enabling/disabling DC Offset Training.<br><br>**WARNING:** This parameter should only be modified if DC Offset Training (parameter 998) is enabled.<br><br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED. | 255 | 0 | 22 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 5 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Txlin 6 dB Attenuator (Txlin Register 02)**<br><br>**r 954**<br>**w 954 x** | This is the value to be store in the Txlin 6dB Attenuator (Register 2) when Power Control is DISABLED. This value should be set to one of two values; hex 10 or hex 54.<br><br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED. | 255 (0xFF) | 0 | 84 (0x54) |
| **Attenuator Level**<br><br>**r 974**<br>**w 974** | This command returns/sets the value of Tranlin Register 22 (also referred to as 10 dB attenuator). This parameter is used to control station power output. A high value results in a lower power output. A low value results is a higher power output.<br><br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED. | 255 | 0 | 255 |
| **I Offset**<br><br>**r 979**<br>**w 979 <arg>** | Return/Set the parameter used by the Collector DSP to modify the IQ data stream.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 3000 | -3000 | 0 |
| **Q Offset**<br><br>**r 980**<br>**w 980 <arg>** | Return/Set the parameter used by the Collector DSP to modify the IQ data stream.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 3000 | -3000 | 0 |
| **IQ Balance**<br><br>**r 981**<br>**w 981 <arg>** | Return/Set the parameter used by the Collector DSP to modify the IQ data stream.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 5.0 | -5.0 | 0 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 6 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Phase Training Scale**<br><br>**r 982**<br>**w 982 <arg>** | Return/Set the parameter used by the Collector DSP to scale the amplitude of the training waveform sent to the Txlin on the Exciter.<br>This parameter should be set according to the number of PA's installed in the transmitter:<br>Single PA: Param 982 = -10000<br>Two PA's: Param 982 = -14000<br><br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED.<br>**WARNING:** This parameter intended for Lab/ Development use only! | -5000 | -32767 | -10000 (single PA)<br>-14000 (dual PA) |
| **K Factor**<br><br>**r 990**<br>**w 990 <arg>** | Return/Set the parameter used as a fine power level scaling in the Collector DSP.<br><br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED.<br>**WARNING:** This parameter intended for Lab/ Development use only! | 1.0 | 0.0 | 1.0 |
| **Spectrum Invert**<br><br>**r 991**<br>**w 991 <arg>** | Return/Set the parameter used by the Collector DSP to modify the IQ data stream.<br>1 = Inverted<br>0 = Non-Inverted<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 1 | 0 | 1 |
| **Power Control Enable**<br><br>**r 992**<br>**w 992 <arg>** | Return/Set the value of Power Control Enable=1/ Disable=0.<br>**Note:** This Parameter is ENABLED upon reset.<br>Note: If Power Control is ENABLED, changes to certain parameters will NOT take effect until Power Control is DISABLED. These parameters include 953, 954, 974, 982, 990, 996, 2053, 2054, 2055, 2056.<br>**WARNING:** This parameter intended for Lab/ Development use only! | 1 | 0 | 1 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 7 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Power Amplifier Deck Configured**<br><br>**r 993** | Number of operational PA decks detected by the RFO software. | 2 | 0 | N/A |
| **FM Power Output**<br><br>**r 994** | Returns the current FM Power Output setting. This value is modified using the RFO FIPS: **a 88 0 x** command. (Actual Min/Max range of values depends upon number of PA's installed). | 500 | 32 | 75 |
| **AM Power Output**<br><br>**r 995** | Returns the current AM Power Output setting. This value is modified using the RFO FIPS: **a 88 1 x** command. (Actual Min/Max range of values depends upon number of PA's installed). | 300 | 32 | 75 |
| **Exciter Feedback Attenuation**<br><br>**r 996**<br>**w 996 <arg>** | Power Output Control Parameter<br><br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED.<br>**WARNING:** Do not set below 36 to avoid PA damage. This parameter intended for Lab/ Development use only! | 255 | 0<br>(Do not set below 36!) | 255 |
| **Power Leveling Enable**<br><br>**r 997**<br>**w 997** | Return/Set the value of Power Leveling. Enable=1/Disable=0.<br><br>**Note:** Power Control (parameter 992) must also be enabled for Power Leveling to be performed | 1 | 0 | 1 |
| **Carrier Feedthrough Nulling Type**<br><br>**r 998**<br>**w 998 <arg>** | Nulling Type Parameter. Specifies what type of nulling will be performed.<br>0 = Disabled (Nulling must be done manually periodically via RFO FIPS: **a 74** command)<br>1 = Auto Null (during empty InFLEXion frames or due to ambient temp change)<br>2 = DC Offset Training (for FLEX/ReFLEX only) | 2 | 0 | 0 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 8 of 27)*

| Name and Command | Description | Ranges Upper | Ranges Lower | Default |
|---|---|---|---|---|
| **Number of Power Amplifiers Installed**<br><br>**r 1023**<br>**w 1023 <arg>** | This number must match the number of PA's installed in the RF-O!. This number is used by the RF-O! software to determine the power cutback based on number of operational PA decks.<br><br>Model PT1052 = 1 PA<br>Model PT1054 = 2 PA's | 2 | 0 | 1 |
| **PA vs. Ambient Temp Shutdown Offset**<br><br>**r 1024**<br>**w 1024 <arg>** | This parameter defines the number of degrees over the current Ambient temperature at which the transmitter will be shutdown.<br><br>Units are in Degrees Celsius. | 45 | 10 | 45 |
| **PA vs. Ambient Temp 3 dB Cutback Offset**<br><br>**r 1025**<br>**w 1025 <arg>** | If a Power Amplifier's operating temperature exceeds the ambient temperature plus this amount, a Power Amplifier Overtemperature Alarm and Error will be issued and the transmitter will cutback by 3 dB.<br><br>Units are in Degrees Celsius. | 30 | 10 | 30 |
| **Current Ambient Temperature**<br><br>**r 1026** | This is the current ambient temperature at the front of the RF-Orchestra!.<br><br>(See Chapter 5, "Operation" for instructions on calibrating the Ambient Temperature Sensor) | 140 C | -50 C | N/A |
| **1PA/2PS Acceptable Current Difference**<br><br>**r 1027**<br>**w 1027 <arg>** | Used to determine a Power Supply failure on a 1PA/2PS configured station. this is the measured current difference threshold between Power Supplies before a failure alarm is issued. | 50 Amps | 0 Amps | 10 Amps |
| **Ambient Temperature Sensor Voltage Calibration**<br><br>**r 1028**<br>**w 1028 <arg>** | This is the voltage value used in calibrating the station ambient temperature sensor.<br><br>(See Chapter 5, "Operation" for instructions on calibrating the Ambient Temperature Sensor) | 5 VDC | 0 VDC | 2.98 VDC |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 9 of 27)*

| Name and Command | Description | Ranges Upper | Ranges Lower | Default |
|---|---|---|---|---|
| **Ambient Temperature Sensor Temperature Calibration**<br><br>**r 1029**<br>**w 1029 <arg>** | This is the temperature value used in calibrating the station ambient temperature sensor.<br><br>(See Chapter 5, "Operation" for instructions on calibrating the Ambient Temperature Sensor) | 70 C | -30 C | 25 C |
| **Check Circulator Load Thermal Switch**<br><br>**r 1030**<br>**w 1030 x** | This parameter allows enabling/disabling the check of the circulator load thermal limit. By default checking is enabled (1). In certain instances in the field an RF-O! may not have a circulator load thermal switch installed, in which case, this parameter should be set to disabled (0). | 1 | 0 | 1 |
| **Peak-to-Average High Soft Threshold 1 Subchannels**<br><br>**r 1100**<br>**w 1100 <arg>** | Return/Set the value of Peak-to-Average High Soft Threshold 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 739 |
| **Peak-to-Average Soft Threshold Constant 1 Subchannel**<br><br>**r 1101**<br>**w 1101 <arg>** | Peak-to-Average Soft Threshold Constant 1 Subchannel<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 82 |
| **Peak-to-Average Low Soft Threshold 1 Subchannel**<br><br>**r 1102**<br>**w 1102 <arg>** | Return/Set the value of Peak-to-Average Low Soft Threshold 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 32767 |
| **Peak-to-Average High Control Signal 1 Subchannel**<br><br>**r 1103**<br>**w 1103 <arg>** | Return/Set the value of Peak-to-Average High Control Signal 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | -3277 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 10 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Peak-to-Average Low Control Signal 1 Subchannel**<br><br>**r 1104**<br>**w 1104 <arg>** | Return/Set the value of Peak-to-Average Low Control Signal 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 821 |
| **Peak-to-Average Hard Fold Level 1 Subchannel**<br><br>**r 1105**<br>**w 1105 <arg>** | Return/Set the value of Peak-to-Average Hard Fold Level 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 1277 |
| **Peak-to-Average Feedback Constant 1 Subchannel**<br><br>**r 1106**<br>**w 1106 <arg>** | Return/Set the value of Peak-to-Average Feedback Constant 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 3277 |
| **Peak-to-Average Nominal Average to Peak 1 Subchannel**<br><br>**r 1107**<br>**w 1107 <arg>** | Return/Set the value of Peak-to-Average Nominal Average to Peak 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 5193 |
| **Peak-to-Average Average to Peak Scale 1 Subchannel**<br><br>**r 1108**<br>**w 1108 <arg>** | Return/Set the value of Peak-to-Average Average to Peak Scale 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2554 |
| **Peak-to-Average Output Scale 1 Subchannel**<br><br>**r 1109**<br>**w 1109 <arg>** | Return/Set the value of Peak-to-Average Output Scale 1 Subchannel.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 11 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Peak-to-Average High Soft Threshold 2 Subchannels**<br><br>**r 1110**<br>**w 1110 <arg>** | Return/Set the value of Peak-to-Average High Soft Threshold 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 739 |
| **Peak-to-Average Soft Threshold Constant 2 Subchannels**<br><br>**r 1111**<br>**w 1111 <arg>** | Peak-to-Average Soft Threshold Constant 2 Subchannels<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 82 |
| **Peak-to-Average Low Soft Threshold 2 Subchannels**<br><br>**r 1112**<br>**w 1112 <arg>** | Return/Set the value of Peak-to-Average Low Soft Threshold 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 32767 |
| **Peak-to-Average High Control Signal 2 Subchannels**<br><br>**r 1113**<br>**w 1113 <arg>** | Return/Set the value of Peak-to-Average High Control Signal 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | -3277 |
| **Peak-to-Average Low Control Signal 2 Subchannels**<br><br>**r 1114**<br>**w 1114 <arg>** | Return/Set the value of Peak-to-Average Low Control Signal 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 821 |
| **Peak-to-Average Hard Fold Level 2 Subchannels**<br><br>**r 1115**<br>**w 1115 <arg>** | Return/Set the value of Peak-to-Average Hard Fold Level 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 1277 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 12 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Peak-to-Average Feedback Constant 2 Subchannel**<br><br>**r 1116**<br>**w 1116 <arg>** | Return/Set the value of Peak-to-Average Feedback Constant 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 3277 |
| **Peak-to-Average Nominal Average to Peak 2 Subchannels**<br><br>**r 1117**<br>**w 1117 <arg>** | Return/Set the value of Peak-to-Average Nominal Average to Peak 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 5193 |
| **Peak-to-Average Average to Peak Scale 2 Subchannels**<br><br>**r 1118**<br>**w 1118 <arg>** | Return/Set the value of Peak-to-Average Average to Peak Scale 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2554 |
| **Peak-to-Average Output Scale 2 Subchannels**<br><br>**r 1119**<br>**w 1119 <arg>** | Return/Set the value of Peak-to-Average Output Scale 2 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2 |
| **Peak-to-Average High Soft Threshold 3 Subchannels**<br><br>**r 1120**<br>**w 1120 <arg>** | Return/Set the value of Peak-to-Average High Soft Threshold 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 739 |
| **Peak-to-Average Soft Threshold Constant 3 Subchannels**<br><br>**r 1121**<br>**w 1121 <arg>** | Peak-to-Average Soft Threshold Constant 3 Subchannels<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 82 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 13 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Peak-to-Average Low Soft Threshold 3 Subchannels**<br><br>**r 1122**<br>**w 1122 <arg>** | Return/Set the value of Peak-to-Average Low Soft Threshold 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 32767 |
| **Peak-to-Average High Control Signal 3 Subchannels**<br><br>**r 1123**<br>**w 1123 <arg>** | Return/Set the value of Peak-to-Average High Control Signal 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | -3277 |
| **Peak-to-Average Low Control Signal 3 Subchannels**<br><br>**r 1124**<br>**w 1124 <arg>** | Return/Set the value of Peak-to-Average Low Control Signal 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 821 |
| **Peak-to-Average Hard Fold Level 3 Subchannels**<br><br>**r 1125**<br>**w 1125 <arg>** | Return/Set the value of Peak-to-Average Hard Fold Level 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 1277 |
| **Peak-to-Average Feedback Constant 3 Subchannel**<br><br>**r 1126**<br>**w 1126 <arg>** | Return/Set the value of Peak-to-Average Feedback Constant 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 3277 |
| **Peak-to-Average Nominal Average to Peak 3 Subchannels**<br><br>**r 1127**<br>**w 1127 <arg>** | Return/Set the value of Peak-to-Average Nominal Average to Peak 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 5193 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 14 of 27)*

| Name and Command | Description | Ranges Upper | Ranges Lower | Default |
|---|---|---|---|---|
| **Peak-to-Average Average to Peak Scale 3 Subchannels**<br><br>**r 1128**<br>**w 1128 <arg>** | Return/Set the value of Peak-to-Average Average to Peak Scale 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2554 |
| **Peak-to-Average Output Scale 3 Subchannels**<br><br>**r 1129**<br>**w 1129 <arg>** | Return/Set the value of Peak-to-Average Output Scale 3 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2 |
| **Peak-to-Average High Soft Threshold 4 Subchannels**<br><br>**r 1130**<br>**w 1130 <arg>** | Return/Set the value of Peak-to-Average High Soft Threshold 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 739 |
| **Peak-to-Average Soft Threshold Constant 4 Subchannels**<br><br>**r 1131**<br>**w 1131 <arg>** | Peak-to-Average Soft Threshold Constant 4 Subchannels<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 82 |
| **Peak-to-Average Low Soft Threshold 4 Subchannels**<br><br>**r 1132**<br>**w 1132 <arg>** | Return/Set the value of Peak-to-Average Low Soft Threshold 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 32767 |
| **Peak-to-Average High Control Signal 4 Subchannels**<br><br>**r 1133**<br>**w 1133 <arg>** | Return/Set the value of Peak-to-Average High Control Signal 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | -3277 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 15 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Peak-to-Average Low Control Signal 4 Subchannels**<br><br>**r 1134**<br>**w 1134 <arg>** | Return/Set the value of Peak-to-Average Low Control Signal 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 821 |
| **Peak-to-Average Hard Fold Level 4 Subchannels**<br><br>**r 1135**<br>**w 1135 <arg>** | Return/Set the value of Peak-to-Average Hard Fold Level 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 1277 |
| **Peak-to-Average Feedback Constant 4 Subchannel**<br><br>**r 1136**<br>**w 1136 <arg>** | Return/Set the value of Peak-to-Average Feedback Constant 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 3277 |
| **Peak-to-Average Nominal Average to Peak 4 Subchannels**<br><br>**r 1127**<br>**w 1127 <arg>** | Return/Set the value of Peak-to-Average Nominal Average to Peak 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 5193 |
| **Peak-to-Average Average to Peak Scale 4 Subchannels**<br><br>**r 1138**<br>**w 1138 <arg>** | Return/Set the value of Peak-to-Average Average to Peak Scale 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2554 |
| **Peak-to-Average Output Scale 4 Subchannels**<br><br>**r 1139**<br>**w 1139 <arg>** | Return/Set the value of Peak-to-Average Output Scale 4 Subchannels.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | -32768 | 2 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 16 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Center Frequency 1**<br><br>**r 2000**<br>**w 2000 <arg>** | This command returns/sets the center frequency for the 1st entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 2**<br><br>**r 2001**<br>**w 2001 <arg>** | This command returns/sets the center frequency for the 2nd entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 3**<br><br>**r 2002**<br>**w 2002 <arg>** | This command returns/sets the center frequency for the 3rd entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 4**<br><br>**r 2003**<br>**w 2003 <arg>** | This command returns/sets the center frequency for the 4th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 5**<br><br>**r 2004**<br>**w 2004 <arg>** | This command returns/sets the center frequency for the 5th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 6**<br><br>**r 2005**<br>**w 2005 <arg>** | This command returns/sets the center frequency for the 6th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 7**<br><br>**r 2006**<br>**w 2006 <arg>** | This command returns/sets the center frequency for the 7th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 17 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Center Frequency 8**<br><br>**r 2007**<br>**w 2007 <arg>** | This command returns/sets the center frequency for the 8th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 9**<br><br>**r 2008**<br>**w 2008 <arg>** | This command returns/sets the center frequency for the 9th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 10**<br><br>**r 2009**<br>**w 2009 <arg>** | This command returns/sets the center frequency for the 10th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 11**<br><br>**r 2010**<br>**w 2010 <arg>** | This command returns/sets the center frequency for the 11th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 12**<br><br>**r 2011**<br>**w 2011 <arg>** | This command returns/sets the center frequency for the 12th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 13**<br><br>**r 2012**<br>**w 2012 <arg>** | This command returns/sets the center frequency for the 13th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 14**<br><br>**r 2013**<br>**w 2013 <arg>** | This command returns/sets the center frequency for the 14th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 18 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Center Frequency 15**<br><br>**r 2014**<br>**w 2014 <arg>** | This command returns/sets the center frequency for the 15th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Center Frequency 16**<br><br>**r 2015**<br>**w 2015 <arg>** | This command returns/sets the center frequency for the 16th entry in the PNP Channel Table.<br><br>**Note:** The parameters may only be multiples of 5 kHz or 6.25 kHz. | 941000.0 kHz | 929000.0 kHz | 929000.0 kHz |
| **Lower Bound 1**<br><br>**r 2016**<br>**w 2016 <arg>** | This command returns/sets the distance from center frequency 1 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 2**<br><br>**r 2017**<br>**w 2017 <arg>** | This command returns/sets the distance from center frequency 2 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 3**<br><br>**r 2018**<br>**w 2018 <arg>** | This command returns/sets the distance from center frequency 3 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 4**<br><br>**r 2019**<br>**w 2019 <arg>** | This command returns/sets the distance from center frequency 4 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 5**<br><br>**r 2020**<br>**w 2020 <arg>** | This command returns/sets the distance from center frequency 5 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 6**<br><br>**r 2021**<br>**w 2021 <arg>** | This command returns/sets the distance from center frequency 6 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 19 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Lower Bound 7**<br><br>**r 2022**<br>**w 2022 <arg>** | This command returns/sets the distance from center frequency 7 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 8**<br><br>**r 2023**<br>**w 2023 <arg>** | This command returns/sets the distance from center frequency 8 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 9**<br><br>**r 2024**<br>**w 2024 <arg>** | This command returns/sets the distance from center frequency 9 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 10**<br><br>**r 2025**<br>**w 2025 <arg>** | This command returns/sets the distance from center frequency 10 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 11**<br><br>**r 2026**<br>**w 2026 <arg>** | This command returns/sets the distance from center frequency 11 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 12**<br><br>**r 2027**<br>**w 2027 <arg>** | This command returns/sets the distance from center frequency 12 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 13**<br><br>**r 2028**<br>**w 2028 <arg>** | This command returns/sets the distance from center frequency 13 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 14**<br><br>**r 2029**<br>**w 2029 <arg>** | This command returns/sets the distance from center frequency 14 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Lower Bound 15**<br><br>**r 2030**<br>**w 2030 <arg>** | This command returns/sets the distance from center frequency 15 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 20 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Lower Bound 16**<br><br>**r 2031**<br>**w 2031 <arg>** | This command returns/sets the distance from center frequency 16 to the lower bound. | 50.0 kHz | 0.0 | 25.0 |
| **Upper Bound 1**<br><br>**r 2032**<br>**w 2032 <arg>** | This command returns/sets the distance from the center frequency 1 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 2**<br><br>**r 2033**<br>**w 2033 <arg>** | This command returns/sets the distance from the center frequency 2 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 3**<br><br>**r 2034**<br>**w 2034 <arg>** | This command returns/sets the distance from the center frequency 3 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 4**<br><br>**r 2035**<br>**w 2035 <arg>** | This command returns/sets the distance from the center frequency 4 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 5**<br><br>**r 2036**<br>**w 2036 <arg>** | This command returns/sets the distance from the center frequency 5 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 6**<br><br>**r 2037**<br>**w 2037 <arg>** | This command returns/sets the distance from the center frequency 6 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 7**<br><br>**r 2038**<br>**w 2038 <arg>** | This command returns/sets the distance from the center frequency 7 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 8**<br><br>**r 2039**<br>**w 2039 <arg>** | This command returns/sets the distance from the center frequency 8 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 21 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Upper Bound 9**<br><br>**r 2040**<br>**w 2040 <arg>** | This command returns/sets the distance from the center frequency 9 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 10**<br><br>**r 2041**<br>**w 2041 <arg>** | This command returns/sets the distance from the center frequency 10 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 11**<br><br>**r 2042**<br>**w 2042 <arg>** | This command returns/sets the distance from the center frequency 11 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 12**<br><br>**r 2043**<br>**w 2043 <arg>** | This command returns/sets the distance from the center frequency 12 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 13**<br><br>**r 2044**<br>**w 2044 <arg>** | This command returns/sets the distance from the center frequency 13 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 14**<br><br>**r 2045**<br>**w 2045 <arg>** | This command returns/sets the distance from the center frequency 14 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 15**<br><br>**r 2046**<br>**w 2046 <arg>** | This command returns/sets the distance from the center frequency 15 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |
| **Upper Bound 16**<br><br>**r 2047**<br>**w 2047 <arg>** | This command returns/sets the distance from the center frequency 16 to the upper bound. | 50.0 kHz | 0.0 kHz | 25.0 kHz |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 22 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Simulcast Launch Delay**<br><br>**r 2049**<br>**w 2049 <arg>** | When simulcasting is enabled, this command adds the simulcast launch delay time to the launch time. | 4800 (1/96ks) | 0 | 0 |
| **Simulcast Frequency Offset**<br><br>**r 2050**<br>**w 2050 <arg>** | When simulcasting is enabled, this value adds simulcast frequency offset to the selected center frequency. | 90 Hz | 0 Hz | 0 Hz |
| **Synthesizer Adapt Time**<br><br>**r 2051**<br>**w 2051 <arg>** | Return/Set the time that the Synthesizer Adapt Line is pulled low after Synthesizer programming to accelerate the lock time.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 100000 us | 0 us | 30000 us |
| **Modulation Angle/ Deviation Multiplier**<br><br>**r 2052** | Return/Set the constant used in calculating Modulation Angle and Deviation. Used by the Modulator DSP's.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 360 degrees | 0 degrees | 349.52533 degrees |
| **Maximum Modulation Deviation**<br><br>**r 2053**<br>**w 2053 <arg>** | This command returns/sets the maximum modulation level allowed.<br><br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED. | 9600 Hz | 0 Hz | 4800 Hz |
| **Modulation FM Power**<br><br>**r 2054**<br>**w 2054 <arg>** | Return/Set the Power Level used in FM modulation. Used by the Modulator DSP's.<br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED.<br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | 11680 | 0 |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 23 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Modulation AM Pilot Power**<br><br>**r 2055**<br>**w 2055 <arg>** | Return/Set the Pilot Power Level used in AM modulation. Used by the Modulator DSP's.<br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED.<br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | 0 | 1600 |
| **Modulation AM Sideband Power**<br><br>**r 2056**<br>**w 2056 <arg>** | Return/Set the Sideband Power Level used in AM modulation. Used by the Modulator DSP's.<br>**Note:** If Power Control is ENABLED, changes to this parameter will NOT take effect until Power Control is DISABLED.<br>**WARNING:** This parameter intended for Lab/ Development use only! | 32767 | 12426 | 0 |
| **Frequency Change Delay**<br><br>**r 2057**<br>**w 2057 <arg>** | The time required to change to another channel center frequency.<br><br>**Note:** If this parameter is changed during normal operation, the RFO will disable and reaquire the 1PPS signal, causing interruption of paging traffic.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 2147483 647 us (0x7fffffff) | 0 us | 0 us |
| **Minimum Workahead Time**<br><br>**r 2058**<br>**w 2058 <arg>** | The minimum time between when a command (control or data) is fully received by the transmitter and its start time.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 100000 us | 0 us | 50000 us |
| **Workahead Window Width**<br><br>**r 2059**<br>**w 2059 <arg>** | The time between the earliest and latest time that the controller may finish sending a command to the transmitter, in microseconds.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 500000 us | 50000 us | 50000 us |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 24 of 27)*

| Name and Command | Description | Ranges Upper | Ranges Lower | Default |
|---|---|---|---|---|
| **Keyup Time**<br><br>**r 2060**<br>**w 2060 <arg>** | This value is read from the Collector DSP on startup. It is stored in parameter memory on startup for fast access and to support the Distributor DSP.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 2147483 647 us (0x7fffffff) | 0 us | 0 us |
| **Mode Mixture Code**<br><br>**r 2061**<br>**w 2061 <arg>** | Bit array that indicates which modulation modes permits simultaneous transmission of additional modes of different type.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 4294967 295 (0xffffffff) | 0 | 0 |
| **Offset From Center Frequency - Index 0**<br><br>**r 2100**<br>**w 2100 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 0.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 0 Hz |
| **Offset From Center Frequency - Index 1**<br><br>**r 2101**<br>**w 2101 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 1.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 6250 Hz |
| **Offset From Center Frequency - Index 2**<br><br>**r 2102**<br>**w 2102 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 2.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 12500 Hz |
| **Offset From Center Frequency - Index 3**<br><br>**r 2103**<br>**w 2103 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 3.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 18750 Hz |
| **Offset From Center Frequency - Index 4**<br><br>**r 2104**<br>**w 2104 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 4.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 25000 Hz |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 25 of 27)*

| Name and Command | Description | Ranges Upper | Ranges Lower | Default |
|---|---|---|---|---|
| **Offset From Center Frequency - Index 5**<br><br>**r 2105**<br>**w 2105 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 5.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 31250 Hz |
| **Offset From Center Frequency - Index 6**<br><br>**r 2106**<br>**w 2106 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 6.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 37500 Hz |
| **Offset From Center Frequency - Index 7**<br><br>**r 2107**<br>**w 2107 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 7.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 43750 Hz |
| **Offset From Center Frequency - Index 8**<br><br>**r 2108**<br>**w 2108 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 8.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | 0 Hz |
| **Offset From Center Frequency - Index 9**<br><br>**r 2109**<br>**w 2109 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 9.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | -43750 Hz |
| **Offset From Center Frequency - Index 10**<br><br>**r 2110**<br>**w 2110 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 10.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | -37500 Hz |
| **Offset From Center Frequency - Index 11**<br><br>**r 2111**<br>**w 2111 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 11.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | -31250 Hz |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 26 of 27)*

| Name and Command | Description | Ranges Upper | Ranges Lower | Default |
|---|---|---|---|---|
| **Offset From Center Frequency - Index 12**<br><br>**r 2112**<br>**w 2112 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 12.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | -25000 Hz |
| **Offset From Center Frequency - Index 13**<br><br>**r 2113**<br>**w 2113 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 13.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | -18750 Hz |
| **Offset From Center Frequency - Index 14**<br><br>**r 2114**<br>**w 2114 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 14.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | -12500 Hz |
| **Offset From Center Frequency - Index 15**<br><br>**r 2115**<br>**w 2115 <arg>** | Plug-and-Play Control Command Offset From Center Frequency Index 15.<br><br>**WARNING:** This parameter intended for Lab/ Development use only! | 50000 Hz | -50000 Hz | -6250 Hz |
| **Power Leveling Cutback**<br><br>**r 2999** | This parameter keeps track of the current power leveling amount. When Power Control is enabled, power leveling is automatically enabled. Typically, this value should remain between -0.5 and 0.5. If this value is outside of this range, possibly the Amplitude Alignment and/or the Internal Wattmeter Calibration is faulty.<br><br>**Note:** This value is set to 0 upon RF-O! reset. | 4.00 dB | -4.00 dB | 0 dB |
| **Power Cutback**<br><br>**r 3000** | This parameter maintains the current cutback amount of the station in dB. If the station is shutdown or disabled, this value is ignored by the RFO software. Use RFO FIPS: **a 83** to see the actual station status.<br><br>**Note:** This value is set to 0 upon RF-O! reset. | 10 dB | 0 dB | 0 dB |

*Table E-1: RF-O! Transmitter Parameters—Read/Write Commands (Sheet 27 of 27)*

| Name and Command | Description | Ranges | | Default |
|---|---|---|---|---|
| | | Upper | Lower | |
| **Ambient Temperature Power Derate Start**<br><br>**r 3001**<br>**w 3001 <arg>** | This defines the ambient temperature of the station at which point the power control software starts to derate (decrease) the power output. | 80 C | 30 C | 45 C |
| **Ambient Temperature Power Shutdown**<br><br>**r 3002**<br>**w 3002 <arg>** | This defines the ambient temperature of the station at which point the power control software disables/ shuts down the station. | 80 C | 30 C | 60 C |
| **Ambient Temperature Derate Maximum Cutback**<br><br>**r 3003**<br>**w 3003 <arg>** | This defines the amount of cutback the station will linearly derate while the ambient temperature is between the values of parameters 3001 and 3002. | 10 dB | 0.0 dB | 3.0 dB |
| **Programmed Synthesizer 1 Frequency**<br><br>**r 3100** | Value of the Synthesizer 1 Frequency that was programmed with the RFO FIPS: **a 165** command. | 941000.0 kHz | 928000.0 kHz | 929000.0 kHz |
| **Programmed Synthesizer 2 Frequency**<br><br>**r 3101** | Value of the Synthesizer 2 Frequency that was programmed with the RFO FIPS: **a 167** command. | 941000.0 kHz | 928000.0 kHz | 929000.0 kHz |

# Alarms and Error Messages

The RF-Orchestra! (RF-O!) paging station component has the ability to relay its current status through a list of error codes. When an error is detected, the error is logged in the RF-O! transmitter error log. The error log is read through the FIPS interface. Some of the errors are also reported as alarms to the Choreographer! network manager through the OCM/BCM Plug-and-Play interface. The Choreographer! network manager receives notification of unsolicited alarms from the RF-B! transmitter controller asynchronously when the error condition occurs.

Because the RF-O! transmitter does not support a network interface between itself and the Choreographer! network manager, the RF-B! transmitter controller relays specific RF-O! transmitter alarms to the Choreographer! network manager. These items identified as "Reported as an SNMP Trap".

## Definitions

The definitions presented in Table F-1 are used with the alarm and error reporting functions of the RF-O! transmitter.

*Table F-1: Alarm and Error Code Terminology*

| Term | Definition |
|---|---|
| **Alarm** | A report of a system performance degradation |
| **Alarm Severity** | There are four categories of alarm severity:<br>**Critical:** Caused paging transmissions to stop indefinitely. Without user interaction, paging may not resume<br>**Major:** Caused a temporary interruption of paging transmissions. Paging will probably resume without user intervention. Repetitive occurrences of these alarms can effectively disable the station.<br>**Minor:** Probably did not cause interruption of paging transmissions.<br>**Informational:** For the user's information only. No interruption of service occurred. |
| **Error** | A report of a diagnosed problem or an information event. Some errors may trigger alarms. |
| **Event** | Report of some OCM action occurring. An event is usually reported for the user's information and **not** because of an adverse OCM operating condition. |

# RF-O! Transmitter Error Logs

The RF-O! transmitter error log is read through the RF-O! FIPS **a 104** command. This command displays all currently logged errors.

## Error Log Description

Each log entry line contains the following information:

<Type><Action><Error Code><Caller><Line Num><Timestamp><Occurrences>

Each item in the entry is defined in Table F-2. The following example shows a typical RF-O! transmitter error log (See Figure F-1).

```
RFO FIPS: a 104
<STATION_ERROR><LOG_ERROR><S_STATION_RESET><ROOT><354><1996/04/02.12:00:00><1>
```

*Figure F-1: Typical RF-O! Transmitter Error Log*

*Table F-2: Log Entry Definitions*

| Information Item | Definition |
|---|---|
| **Type** | Helps determine which subsystem within the module caused the error condition. Type value examples: NVM, DSP,STATION_ERROR,GPS. |
| **Action** | Tells what action the error logging mechanism took when the error occurred. Action can be either RESET_STATION (fatal error, station was reset) or LOG_ERROR (nonfatal error was logged, but station was not reset. |
| **Error Code** | Identifies individual errors. The tables in this appendix contain descriptions of each possible error code. |
| **Caller** | Used for software debugging. The caller represents the software source code module which logged the error. |
| **Line Num** | Used for software debugging. The line num is the physical line number of the calling software source code module from where the error was logged. |
| **Timestamp** | Not currently supported on the RF-O! transmitter. |
| **Occurrences** | Number of times the current combination of Type, Action, Error Code, Caller, and Line Num have occurred since the log was last cleared. Different Callers can log the same Error Code, and separate log entries will be made. |

## Clearing the Error Logs on RF-O! Transmitter

Enter the RF-O! FIPS **a 111** command to clear the RF-O! transmitter error log. Turning off the RF-O! transmitter, resetting the station using RF-O! FIPS **a 117** command, or pushing the RESET button on the front panel will *not* clear the error logs.

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 1 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_1PPS_INITIAL_SEARCH_FAILURE**<br>The Collector DSP has reported to the host that the Xilinx is not detecting a 1 Pulse-Per-Second (1PPS) signal.<br>**NOTE:** It is normal to experience these errors when GPS on RF-B! transmitter controller is not locked (within first 10 minutes of RF-B! transmitter controller reset) | Critical (Minor, if after RF-B! transmitter controller reset) | Check installation of GPS on RF-B! transmitter controller. Verify antenna is properly installed. Verify GPS tracking status on RF-B! transmitter controller with FIPS ‘a 208’ command. Check for recent RF-B! transmitter controller reset.<br>**NOTE:** It is normal to experience these errors when GPS on RF-B! transmitter controller is not locked (within the first few minutes of RF-B! transmitter controller reset). |
| **E_1PPS_WATCHDOG_FIRED**<br>The GPS 1PPS is misaligned or absent. | Critical | See E_1PPS_INITIAL_SEARCH _FAILURE above. |
| **E_AMPLITUDE_NOT_ALIGNED (formerly E_FM_NOT_ALIGNED)**<br>The Amplitude Alignment parameters in the Exciter EEPROM are invalid.<br>Beginning with RF-O! transmitter 1.2.2, if this error condition is detected at startup, the transmitter will be disabled by the RF-O! transmitter software. The transmitter will be re-enabled, once Power Control is Disabled, and the Amplitude Alignment is performed. | Critical | The Power Amplitude Alignment must be performed (RFO FIPS: **a 76**) at the site. Power Control must be disabled (W 992 0), prior to performing the Amplitude Alignment. Use RFO FIPS: **A 83** - Station Status to determine Alignment/Calibration status. |
| **E_BAD_IMAGE_CRC**<br>An application remote software download attempt failed. | Critical | New software has not been downloaded. User must reattempt. See download procedure document for more details. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 2 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_BAD_WATTMETER_INDEX**<br>A wattmeter reading was received from the Distributor DSP with an invalid wattmeter identifier (not one of the valid ID's for internal forward, external forward, internal reflected, or external reflected). The wattmeter reading is ignored. | Minor | If this error persists, please notify Motorola. It may signal a DSP/host Interface problem. |
| **E_BAD_XILINX_PARAMETER**<br>Invalid Xilinx type returned from the EEPROM. | Critical | Verify that Xilinx Type is 4 using RFO FIPS: **r 710**. If it is not, execute RFO FIPS: **w 710 4** and reboot RF-O! transmitter. If the problem persists, contact Motorola. |
| **E_CHECK_COMMAND_FORMAT_ERROR**<br>Sent if the Distribution DSP detects that 1 (or more) of the Check Command fields of a PnP data path message is invalid. | Major | If error persists, save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_CHECK_COMMAND_FREQ_FAIL**<br>The RF-B! transmitter controller and RF-O! transmitter do not agree on the current center channel frequency. This error condition causes the transmitter to become disabled for 2 seconds, and DSP buffers to be flushed. | Major | If error persists, save error log and contact Motorola. |
| **E_CHECK_COMMAND_KEY_FAIL**<br>The RF-B! transmitter controller and RF-O! transmitter do not agree on the keyup state. The RF-O! transmitter is either keyed when it is expected to be dekeyed, or dekeyed when it is supposed to be keyed. This error condition causes the transmitter to become disabled for 2 seconds, and DSP buffers to be flushed. | Major | If error persists, save error log and contact Motorola. |
| **E_CIRC_LOAD_TEMP_EXCEEDED**<br>Indicates thermal switch in the Circulator has triggered, indicating High Circulator temperature. Transmitter is disabled. **NOTE:** Parameter 1030 must be set to 1 for RF-O! transmitter software to check for this condition. | Critical | Reset station. Allow Circulator to cool. Verify proper connection of cable from Circulator to EXT LOAD TEMP connector on back of RF-O! transmitter.Monitor for subsequent errors.<br>If error persists, contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 3 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_CONTROL_COMMAND_FORMAT_ERROR**<br>Sent if the Distribution DSP detects that 1 (or more) of the Control Command fields of a PnP data path message is invalid. | Major | If error persists, save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_CURRENT_STATE_INVALID**<br>An invalid input command is encountered in the key/dekey cycle. | Major | If error persists, save error log and contact Motorola. |
| **E_CUTOVER_FAILED**<br>The cutover to the new flash bank after a remote software download has failed. | Critical | **Do NOT reset the RF-O! transmitter.** Attempt the remote software download again as detailed in the RF-O! Remote Software Download Procedure. |
| **E_DISABLE_PAGING**<br>The transmitter has been disabled (shutdown). There are several disable sources. Each is listed in the RFO FIPS: **a 83** (Station Status) screen. The transmitter can be disabled by the User (W 99 1), or by the Software. Software shutdowns occur due to High VSWR, High Reflected Power, AM/FM Clipping, Synthesizer Out of Lock, High Temperature, Bad Amplitude Alignment, Pendulum Unlock, UHSO Failures, PA Failures, etc. | Critical | Check the alarm log (RFO FIPS: **a 99**), error log, and station status (RFO FIPS: **a 83**) to determine the source of the disable. The alarm and error logs should describe the reason for the shutdown in greater detail. Take action based on the specific error causing the shutdown. (Specific error can be determined by matching timestamps with the E_DISABLE_PAGING error log entry) |
| **E_DSP1_STARTUP_FAILURE**<br>**E_DSP2_STARTUP_FAILURE**<br>**E_DSP3_STARTUP_FAILURE**<br>**E_DSP4_STARTUP_FAILURE**<br>An attempt to download code the one of the 4 DSPs failed. Occurs after reset. | Critical | Reset RF-O! transmitter. If problem persists, contact Motorola. Possible DSP or OCM board failure. |
| **E_DSP_TIMEOUT_ON_OUTPUT**<br>The DSP did not respond to a host request within a designated time-out period. | Critical | Reset RF-O! transmitter. If problem persists, contact Motorola. Possible DSP or OCM board failure. |
| **E_DSP_TX_MODE_INVALID_MESSAGE_TYPE**<br>RF-O! transmitter sends a flush request to a DSP, but receives an invalid reply. | Minor | If error persists, save error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 4 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_DSP_TX_MODE_INVALID_SOURCE_TASK**<br>RF-O! transmitter host receives a DSP reply from a source other than Distributor, Modulator, or Collector DSP. | Minor | If error persists, save error log and contact Motorola. |
| **E_DSP_TX_MODE_INVALID_STATE**<br>The DSP flush mode is in an invalid state. | Minor | If error persists, save error log and contact Motorola. |
| **E_DSP_TX_MODE_REPLIES_MISMATCH**<br>The request mode sent to DSP does not match the mode from the DSP reply. | Minor | If error persists, save error log and contact Motorola. |
| **E_DSP_TX_MODE_REQ_REPLY_OUT_OF_SEQ**<br>RF-O! transmitter host receives invalid reply from DSPs after sending a flush request | Minor | If error persists, save error log and contact Motorola. |
| **E_EEPROM_REPROG_PARMS_TO_DEFAULTS**<br>The RF-O! transmitter software detected a new(blank) or corrupted EEPROM. | Critical | The OCM EEPROM parameter database has been reprogrammed and all parameters have been set to default. |
| **E_END_OF_COMMAND_ERROR**<br>Sent if the Distributor DSP detects that the final word in any PnP command has an invalid termination indicator. Possible RF-O! transmitter/RF-B! transmitter controller PnP incompatibility. | Minor | If error persists, save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_EXCITER_AD_READ_FAIL**<br>RF-O! transmitter was unable to read the Exciter A/D values using the SPI bus. | Critical | Verify proper installation of Exciter and OCM. Reset station. Error could indicate a problem with the Exciter, backplane, or OCM. If error persists, save error log and contact Motorola. |
| **E_EXCITER_EEPROM_READ_FAIL**<br>The OCM was unable to read the data in the Exciter Serial EEPROM using the SPI bus. The Exciter Serial EEPROM contains the Internal and External Wattmeter Calibration, and the Amplitude Alignment data necessary for proper power output and leveling. | Major | Verify proper seating of Exciter and OCM Module within the chassis. Clear error logs, then reset OCM. Error could indicate possible Exciter, backplane, and/or OCM module failure.<br>If error persists, save error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 5 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_EXCITER_EEPROM_WRITE_FAIL**<br>The OCM was unable to write data to the Exciter Serial EEPROM using the SPI bus. The Exciter Serial EEPROM contains the Internal and External Wattmeter Calibration, and the Amplitude Alignment data necessary for proper power output and leveling. This error would only occur during Write to Exciter EEPROM (RFO FIPS: **a 72**), Amplitude Alignment (**a 76**), or Internal or External Wattmeter/Detector Calibration (**a 71**). | Major | Verify proper seating of Exciter and OCM Module within the chassis. Clear error logs, then reset OCM. Perform RFO FIPS command which caused the error to occur (**a 72**, **a 76**, or **a 71**). Error could indicate possible Exciter, backplane, and/or OCM module failure. If error persists, save error log and contact Motorola. |
| **E_EXCITER_FRU_FAIL_ALARM**<br>Catastrophic Exciter Failure Detected. This error is currently logged when the OCM repeatedly fails to lock one or both of the synthesizers on the Exciter. | Critical | Check for proper installation of Exciter. If problem persists, Exciter module should be replaced. |
| **E_EXTERNAL_DETECTOR_NOT_CALIBRATED**<br>The external power detector has not been calibrated. This check is performed when RF-O! boots. | Major | ON SITE: Calibrate the detectors using RFO FIPS: **a 71 x yyy** and a reference wattmeter. |
| **E_EXTERNAL_FORWARD_POWER_LOW**<br>Power Output is below the limit on the external forward power meter during an FM transmission. The limit is set by writing to Parameter 144. If you do not care to monitor this alarm, set Parameter 144 to its maximum value of 600 (Watts). | Major | Check station output power level using RFO FIPS: **a 80**. Verify that all RF connections are secure.<br>If condition persists, this error could indicate a faulty external detector. Contact Motorola. |
| **E_EXTERNAL_REFLECTED_POWER_HIGH**<br>Power Output is above the limit on the external reflected power meter during an FM transmission. The limit is set by writing Parameter 146 to the desired level (less than one-fourth the FM Power Output setting of Parameter 994).Beginning with RF-O! transmitter 1.2.2, when this error is logged, and Power Control is Enabled, the transmitter will become disabled. The RF-O! transmitter must be reset to re-enable the transmitter. | Major | This error normally indicates a possible short or open circuit between the External Detector and the antenna. Check all connections.<br>Check station output power level using RFO FIPS: **a 80**.<br>Error could possibly indicate a faulty External Detector.<br>If condition persists, contact Motorola. |
| **E_FFDS_INVALID_TX_MODE_REQUESTED**<br>A DSP received an invalid DSP flush request. | Minor | If error persists, save error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 6 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_FM_NOT_ALIGNED**<br>**(See “E_AMPLITUDE_NOT_ALIGNED” )**<br>The amplitude alignment parameters stored in the Exciter EEPROM are invalid. | Major | The Power Amplitude Alignment must be performed (RFO FIPS: **a 76**) at the site. Power Control must be disabled (RFO FIPS; **w 992 0**), prior to performing the Amplitude Alignment.<br>Use RFO FIPS: **a 83** (Station Status) to determine Alignment/Calibration status. |
| **E_FREQ_OFFSET_ERROR**<br>An invalid/unsupported Sub-channel was received in the Plug-and-Play Control Command | Major | If errors persist, save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_HIGH_AMBIENT_TEMP_CUTBACK_ALARM**<br>The transmitter ambient temperature has exceeded the Ambient Temperature Cutback Threshold (Parameter 3001). By default, this value is 45 (degrees C). Ambient temperature is measured at the temperature sensor on OCM. | Major | Verify proper calibration of OCM temperature sensor. Read current ambient temperature (RFO FIPS: **r 1026**). If ambient temperature reading differs by more than 3 degrees from the transmitter site room temperature, the sensor is not calibrated correctly, and should be calibrated. If site temperature is above 45 degrees C (113 degrees F), station is operating properly. If errors persist, save error log and contact Motorola. |
| **E_HIGH_AMBIENT_TEMP_SHUTDOWN_ALARM**<br>The transmitter ambient temperature has exceeded the Ambient Temperature Shutdown Threshold (Parameter 3002). By default, this value is 60 (degrees C). Ambient temperature is measured at the temperature sensor on OCM. | Major | See E_HIGH_AMBIENT_TEMP_CUTBACK_ALARM.<br>If transmitter site room temperature exceeds 60 degrees C (140 degrees F), RF-O! is operating properly. If errors persist, save error log and contact Motorola. |
| **E_HIGH_EXT_WM_VSWR_ALARM**<br>RF-O! transmitter disabled the transmitter due to a VSWR (Voltage Standing Wave Ratio) reading of greater than 3.0 (Reflected Power is greater than one-fourth of the Forward Power) at the External Detector. | Critical | See “E_EXTERNAL_REFLECTED_POWER_HIGH” |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 7 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_HIGH_INT_WM_VSWR_ALARM**<br>RF-O! transmitter disabled the transmitter due to a VSWR reading of greater than 3.0 (Reflected Power is greater than one-fourth the Forward Power) at the Internal Detector. | Critical | See "E_INTERNAL_REFLECTED_POWER_HIGH" |
| **E_HIGH_STABILITY_REFERENCE_FAILURE**<br>The OCM lost contact with the Ultra High Stability Reference Oscillator (UHSO). | Critical | Verify RF-B! transmitter controller has power. Verify reference module is properly installed in RF-B! transmitter controller. Verify 10 MHz BNC cable is properly connected to both RF-O! transmitter and RF-B! transmitter controller on backplanes. Check that 10 MHz is signal is present on backplane. If error persists, contact Motorola. |
| **E_ILLEGAL_IPS_COMMAND**<br>An invalid FIPS command was entered. The command was ignored | Informational | If command was entered correctly, verify that command is compatible with software version. See FIPS document for correct command formats. |
| **E_ILLEGAL_PARAMETER_WRITE**<br>The user tried to write a Parameter which can only be written to by RF-O! transmitter software (Application Write Only). Command was ignored. | Informational | Only attempt to write to writable parameter ID's. See FIPS document for details. |
| **E_ILLTICKS**<br>OS Error: Ticks input out of range. | Minor | If error persists, save error log and contact Motorola. |
| **E_ILLTIME**<br>OS Error: Time of day input out of range. | Minor | If error persists, save error log and contact Motorola. |
| **E_INCOMPLETE_FRAME_ERROR**<br>The Distribution DSP has detected that a partial Frame fragment was received. Possibly due to error in PnP interface/protocol. | Major | If error persists, save error log and contact Motorola.<br>**NOTE:** This is a Plug-and-Play Error**.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |

*Table F-3:  RF-O! Transmitter Error/Alarm Code Definitions (Sheet 8 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_INTERNAL_DETECTOR_NOT_CALIBRATED**<br>The Internal Power Detector has not been calibrated. The RF-O! transmitter validates detector calibration at startup, or when Power Control is changed from Disabled to Enabled. Internal and External Detector Calibration values are stored in the Exciter Serial EEPROM. | Major | ON SITE: Calibrate Internal Detector using the proper calibration procedure.(RFO FIPS: **a 71**). |
| **E_INTERNAL_FOWARD_POWER_LOW**<br>Power Output is below the limit on the Internal Forward Power Meter during an FM transmission. The limit is set by writing to Parameter 141. If you do not care to monitor this alarm, set Parameter 141 to its maximum value of 600 (Watts).<br>**NOTE:** When running RF-O! transmitter 1.2.2, it is normal to log this error while running the Automatic Carrier Null procedure (RFO FIPS: **a 74**), which operates at a power output between 0 and 5 watts. | Major | Check station output power level using RFO FIPS: **a 80**.<br>If condition persists, contact Motorola. |
| **E_INTERNAL_REFLECTED_POWER_HIGH**<br>Power Output is above the limit on the Internal Reflected power meter. The limit is set by writing Parameter 143 (RFO FIPS: **w 143 x**) to the desired level (less than one-fourth the FM Power Output setting of Parameter 994).<br>Beginning with RF-O! transmitter 1.2.2, when this error is logged, and Power Control is Enabled, the transmitter will become disabled. The RF-O! transmitter must be reset to re-enable the transmitter. | Critical | This error normally indicates a possible short or open circuit between the Internal Detector and the antenna. Check all connections. Check station output power level using RFO FIPS: **a 80**. Error could possibly indicate a faulty Internal Detector. If condition persists, contact Motorola. |
| **E_INVALID_AM_CONFIGURATION**<br>This error occur during Power Control initialization, during startup. There are two possible causes: (1) There are no PA decks detected; (2) The current power level was set out of range per the Power Chart. | Critical | Check PA configuration using RFO FIPS: **r 993**. Set output power using RFO FIPS: **a 88 x y**. If condition persists, contact Motorola. |
| **E_INVALID_CHAN_OFFSET**<br>**(formerly E_RFCC_INVALID_CHAN_OFFSET)**<br>An invalid sub-channel offset was received from the Plug-and-Play Control Command. | Major | If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 9 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_INVALID_COMMAND_TYPE_ERROR**<br>PnP Error: Error occurs if Plug-and-Play message does not match any possible Plug-and-Play commands. | Major | If error persists, contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_INVALID_FM_CONFIGURATION**<br>This error occur during Power Control initialization, during startup. There are two possible causes: (1) There are no PA decks detected; (2) The current power level was set out of range per the Power Chart.<br>NOTE: A software defect in RF-O! transmitter 1.2.2, caused this error (along with E_INVALID_AM_CONFIGURATION) to be logged upon every reset. Ignore these errors in RF-O! transmitter 1.2.2. | Major | Check PA configuration using RFO FIPS: **r 993**. Set output power using RFO FIPS: **a 88 x y**. If condition persists, contact Motorola. |
| **E_INVALID_FRAME_FLUSH_DSP_INDEX_ERROR**<br>An illegal DSP designator was encountered by the DSP Flush entire frame cycle. | Major | If error persists, save error log and contact Motorola. |
| **E_INVALID_IDLE_DSP_INDEX_ERROR**<br>An illegal DSP designator was encountered by the DSP Flush to IDLE cycle. | Major | If error persists, save error log and contact Motorola. |
| **E_INVALID_INFLEXION_DSP_INDEX_ERROR**<br>An illegal DSP designator was encountered by the DSP Flush to INFLEXION cycle. | Major | If error persists, save error log and contact Motorola. |
| **E_INVALID_INPUT_RECEIVED**<br>An invalid input command is encountered in the key/dekey cycle. | Major | If error persists, save error log and contact Motorola. |
| **E_INVALID_IPS_PORT**<br>Host application attempted to connect to an invalid communications port. | Informational | Debug message only. Ignore. |
| **E_INVALID_LAUNCH_TIME**<br>An invalid Plug-and-Play launch time was received by the host from the Distributor DSP. | Major | If the error persists, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 10 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_INVALID_MOD_TYPE**<br>**(formerly E_RFCC_INVALID_MOD_TYPE)**<br>An invalid Modulation Type was received from the Plug-and-Play Control Command. | Major | If the error persists, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_INVALID_MODULATION_TYPE**<br>An invalid modulation type (not AM or FM) is received in the Plug-and-Play message. | Minor | This error appears once when the RF-O! keys up the first time after reboot. Ignore. If the error persists, save the error log and contact Motorola. |
| **E_INVALID_NEXT_MODULATION_TYPE**<br>An invalid modulation type is received for the next transmission in the Plug-and-Play message. | Major | If the error persists, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_INVALID_NEXT_NUMBER_OF_SUBCHANNELS**<br>An invalid number of subchannels is received for the next transmission in the Plug-and-Play message. | Major | If the error persists, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_INVALID_NUMBER_OF_SUBCHANNELS**<br>The number of subchannels received for the transmission is out of range. | Major | If the error persists, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_INVALID_OPCODE**<br>The DSP received an invalid/unsupported command from the host. | Informational | Debug message only. Ignore. |
| **E_INVALID_SYMBOL_DURATION_ERROR**<br>An invalid/unsupported symbol rate was received in the Symbol Data Command. | Major | If the error persists, save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 11 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_MOD1_INPUT_OVERFLOW_ERROR**<br>Both Modulator DSPs did not receive the same amount of data for each logical subchannel. Interruption of the input stream to the modulator is caused by other Plug-and-Play Errors. In a multiple channel operation any Plug and Play error has the potential to cause a Mod1 or Mod2 Input Overflow error. | Major | If the error persists (more than 10 occurrences per day), save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_MOD2_INPUT_OVERFLOW_ERROR**<br>Both Modulator DSP's did not receive the same amount of data for each logical subchannel. Interruption of the input stream to the modulator is caused by other Plug-and-Play Errors. In a multiple channel operation any Plug and Play error has the potential to cause a Mod1 or Mod2 Input Overflow error. | Major | If the error persists (more than 10 occurrences per day), save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_MODULATION_TYPE_ERROR**<br>An invalid/unsupported Modulation Type was received in the Plug-and-Play Control Command. | Major | If the error persists, save error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_MP_BAD_CHECKSUM**<br>Received packet did not match calculated checksum. Data is invalid and packet is discarded. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_BAD_FORMAT**<br>Base error used for all invalid messages received on the Maintenance Path. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_EVENT_OVERFLOW**<br>There were too many Events that occurred within the last 3 seconds for the PnP Maintenance Path to transmit all of them to the Controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_INVALID_COMMAND**<br>The command received from the BCM is not recognized.Possible maintenance path incompatibility between RF-O! transmitter and RF-B!. | Minor | If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 12 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_MP_INVALID_EVENT_ID**<br>Event ID requested does not have an associated entry in the event table. Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_INVALID_EVENT_LENGTH**<br>The error string exceeds the maximum number of characters allowed. Error in table entry. Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_INVALID_VALUE_DESC_ENUM_LENGTH**<br>The enumeration length of an enumerated type exceeds the maximum size allowed. Error in table entry. Possible maintenance path incompatibility between RF-O! transmitter and RF-B!. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_INVALID_VALUE_DESC_ID**<br>Value ID requested does not have an associated description in the value table. Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_INVALID_VALUE_ID**<br>Value ID requested does not have an associated entry in the value table Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_INVALID_VALUE_LENGTH**<br>The value length does not match the associated value format. Error in table entry. Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_NO_LAST_RESPONSE**<br>There is no last response to return when the OCM receives a request to send the last response. Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 13 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_MP_OUT_OF_SYNC_REPLY**<br>Received sequence number is incorrect. BCM and OCM are out of sync. Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | Reset RF-B! transmitter controller to resynchronize the interface. If error persists, contact Motorola. |
| **E_MP_SOURCE_TASK_ID_NOT_FOUND**<br>Source task ID received does not exist. Possible maintenance path incompatibility between RF-O! transmitter and RF-B! transmitter controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_UNEXPECTED_REPLY_OPCODE**<br>The opcode received from the BCM is not recognized. Possible maintenance path incompatibility between RF-O! transmitter and RF-B!. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_MP_VALUE_OVERFLOW**<br>There were too many Parameter changes (values) that occurred within the last 3 seconds for the PnP Maintenance Path to transmit all of them to the Controller. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_NOBUF**<br>OS Error: Operating System is unable to obtain free memory buffers for some form of messaging. There are many locations in the RF-O! transmitter software where this error may occur. Depending upon the location, the severity of this error may vary. | Minor/Critical | If the error persists, save the error log and contact Motorola. |
| **E_NOT_ENOUGH_MEMORY**<br>An attempt to allocate additional dynamic memory for a FIPS reply message failed. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_OVERWRITING_MOD_MODE_PARAMETERS**<br>This error occurs when a new modulation type is received by the RF-O! transmitter, while another modulation type is pending transmission. | Major | If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 14 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_PA_HS_TEMPERATURE_FAIL_DECK_1**<br>Power amplifier 1 heat sink temperature exceeded the ambient temperature of the OCM by more than the amount specified by Parameter 1024 or 1025. Beginning with RF-O! transmitter 1.2.2, when Power Control is Enabled, exceeding parameter 1024 (PA vs. Ambient Temp Shutdown Offset), the transmitter will become disabled (shutdown) until the temperature of the PA deck lowers sufficiently. | Major | Verify all fans are operational. Verify proper settings of parameters 1024 and 1025. Verify proper calibration of Ambient Temperature Sensor on OCM. (Check current Ambient Temperature by reading parameter Contact Motorola. |
| **E_PA_HS_TEMPERATURE_FAIL_DECK_2**<br>Power Amplifier 2 Heat Sink Temperature Has Exceeded the Ambient Temperature of the OCM by more than the amount specified by Parameter 1024 or 1025. See “PA_HS_TEMPERATURE_FAIL_DECK_1” | Major | See “PA_HS_TEMPERATURE_FAIL_ DECK_1” |
| **E_PA_INITIALIZATION_FAILED**<br>During startup, or when enabling Power Control, the RF-O! transmitter software was unable to read the PA EEPROM(s), and/or Analog to Digital Converters. | Major | Verify proper installation of PA deck(s) and wiring. Verify all power supplies are turned on and functioning. Verify PA SPI cable is properly connected. |
| **E_PA_TEMP_CUTBACK_ALARM**<br>The temperature of a PA exceeded the Ambient Temperature at the OCM temperature sensor, by more than the configured 3 dB Cutback amount (See Parameter 1025). | Major | Verify Ambient Temperature Sensor is properly calibrated. Read Parameter 1026 to see current ambient temperature reading (if it appears too low, shutdown may not be warranted). Use RFO FIPS: **a 192 SHMI 4** trace to see PA and Ambient Temperature readings. Verify fans are working properly. |
| **E_PA_TEMP_SHUTDOWN_ALARM**<br>The temperature of a PA exceeded the Ambient Temperature at the OCM temperature sensor, by more than the configured Shutdown amount (See Parameter 1024). | Major | Verify Ambient Temperature Sensor is properly calibrated. Read Parameter 1026 to see current ambient temperature reading (if it appears too low, shutdown may not be warranted). Use RFO FIPS: **a 192 SHMI 4** trace to see PA and Ambient Temperature readings.<br>Verify fans are working properly. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 15 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_PARAMETER_MANAGER_BAD_ STATUS**<br>Returned when an error is encountered reading from or writing to Parameter NVM.<br>The EEPROM may have failed. | Critical | Reboot station. If error returns, contact Motorola. |
| **E_PASSED_PARAMETER_OUT_OF_RANGE**<br>Parameter passed to a function contained an invalid value. | Informational | Debug message. Ignore. |
| **E_PC_ENABLED_PARAMETER_WRITE_DISABLED (See I_PC_ENABLED_PARAMETER_WRITE_ DISABLED)**<br>A write or read is requested from FIPS to access some power related parameters when the power control is on and a valid amplitude alignment exists. | Informational | The command was ignored. Do not access the parameters below when power control is enabled. The parameters include K factor (990), Tranlin attenuation level (974), exciter level (953), exciter feedback attenuator parameter (996), modulation DSP maximum deviation (2053), modulation DSP FM power (2054), modulation DSP voice pilot power (2055), or modulation DSP voice sideband power (2056). |
| **E_PENDULUM_NOT_LOCKED**<br>The Pendulum has fallen out of phase lock with the 10MHz Reference. This could be due to the absence of a 10MHz Reference, incorrect programming or failure of the RF-O! transmitter synthesizer or incorrect programming or failure of the Pendulum IC. | Major | Verify 10 MHz oscillator is properly installed, and Reference Module board is properly installed in RF-B! transmitter controller. Verify 10 MHz BNC cable is connected properly between RF-O! transmitter and RF-B! transmitter controller backplanes. Reset RF-B! transmitter controller. If problem persists, contact Motorola. |
| **E_PENDULUM_REFERENCE_FAILURE**<br>The Pendulum Clock is no longer detectable by the host microprocessor. | Major | See E_PENDULUM_NOT_LOCKED above. |
| **E_POWER_CONTROL_SYNCHRONIZATION**<br>Certain software tasks used in power control feature can not be synchronized when RF-O! transmitter is reset. | Minor | Reset RF-O! transmitter. If error persists, contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 16 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_POWER_LEVELING_FAILED**<br>Transmitter is disabled due to Power Leveling attempting to Gain or Attenuate the set power by more than 1.5 dB. Power Leveling, as indicated by parameter 2999, or using RFO FIPS: **a 83** (Station Status), should typically be no more than 0.5 or less than -0.5 dB. OCM needs to be reset to enable transmitter. | Major | Verify Amplitude Alignment is valid (A 83). Use RFO FIPS: **a 192 SPCQ 16** and **a 192 SPCQ 64** debug traces to monitor power leveling and wattmeter readings. If problem persists, Contact Motorola. |
| **E_PS_INPUT_VOLT_ALARM_DECK_1**<br>Power Supply 1 voltage detected has fallen below specified limits, flagging a possible power supply failure. | Major | Replace Power Supply 1. |
| **E_PS_INPUT_VOLT_ALARM_DECK_2**<br>Power Supply 2 voltage detected has fallen below specified limits, flagging a possible power supply failure. | Major | Replace Power Supply 2. |
| **E_QFULL**<br>OS Error: Cannot Send - Message queue full. The severity of this message depends upon where in the RF-O! software this error occurred. | Minor/Critical | May cause the RF-O! transmitter to reset. If error returns, save error log and contact Motorola. |
| **E_RFCC_INVALID_CHAN_OFFSET**<br>**(See “E_INVALID_CHAN_OFFSET” )**<br>An invalid sub-channel offset was received from the Plug-and-Play Control Command. | Major | If the error persists, save the error log and contact Motorola. |
| **E_RFCC_INVALID_MOD_TYPE**<br>**(formerly E_RFCC_INVALID_MOD_TYPE)**<br>An invalid Modulation Type was received from the Plug-and-Play Control Command. | Major | If the error persists, save the error log and contact Motorola. |
| **E_RFCC_SYNTH1_LOCK_FAIL**<br>**(See “E_SYNTH1_LOCK_FAIL” )**<br>The attempt to reprogram the First Exciter Synthesizer failed. | Critical | Reboot RF-O! transmitter. If the error persists, save the error log and contact Motorola. |
| **E_RFCC_SYNTH2_LOCK_FAIL**<br>**(See “E_SYNTH2_LOCK_FAIL” )**<br>The attempt to reprogram the Second Exciter Synthesizer failed. | Critical | Reboot RF-O! transmitter. If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 17 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_SPI_TIMEOUT**<br>An SPI access returned a time-out error. This indicates that the addresses SPI device did not respond within a defined time-out period. | Major | Verify all backplane connections are secure and all boards tightly seated. If error persists, contact Motorola. |
| **E_SRAM_READ_FAULT**<br>Attempt to read from Static RAM failed. | Minor | **NOTE:** It is normal to see these errors after reset in a totally operational RF-O! transmitter. If error occurs after RF-O! transmitter has completed startup, contact Motorola. |
| **E_SRAM_WRITE_FAULT**<br>Attempt to write to Static RAM failed. | Major | Reboot RF-O! transmitter. If the error persists, save the error log and contact Motorola. |
| **E_START_TIME_ERROR**<br>An invalid Start Time was received in the Plug-and-Play Control Command. | Major | If the error persists, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_STATION_AM_CLIPPING_DETECTED (formerly E_EXCITER_AM_CLIPPING_DETECTED)**<br>The Exciter has indicated that it has clipped during an AM (Voice) transmission.<br>Beginning with RF-O! transmitter 1.2.2, when Power Control is Enabled, this error condition will cause the transmitter to be disabled. | Major | Verify that RF-O! transmitter amplitude is properly aligned to the correct FM output power. Verify that Internal and External Wattmeters are calibrated. These can be checked by using the RFO FIPS: **a 83** (Station Status) command. Verify that all RF connections on the RF-O! transmitter are properly connected. If error persists, contact Motorola. |
| **E_STATION_DEKEYED_KEY_STATE_MISMATCH**<br>This error occurs when the transmitter status is in the keyed state, but it should be in a dekeyed state. | Major | If the error persists, save the error log and contact Motorola. |
| **E_STATION_DEKEYED_MOD_MODE_MISMATCH**<br>The modulation type in a key state does not match the modulation type received. | Major | If the error persists, save the error log and contact Motorola. |
| **E_STATION_DEKEYED_MOD_STATE_INVALID**<br>The current modulation type is invalid in the dekey state. | Major | If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 18 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_STATION_FM_CLIPPING_DETECTED (formerly E_EXCITER_FM_CLIPPING_DETECTED)** The Exciter has indicated that it has clipped during an FM transmission. Beginning with RF-O! transmitter 1.2.2, when Power Control is Enabled, this error condition will cause the transmitter to be disabled. | Critical | Verify that RF-O! transmitter amplitude is properly aligned to the correct FM output power. Verify that Internal and External Wattmeters are calibrated. These can be checked by using the RFO FIPS: **a 83** (Station Status) command. Verify that all RF connections on the RF-O! transmitter are properly connected. If condition persists, contact Motorola. |
| **E_STATION_KEYED_KEY_STATE_MISMATCH** This error occurs when the transmitter status is in the inactive state, but it should be in an active state. | Major | If the error persists, save the error log and contact Motorola. |
| **E_STATION_KEYED_MOD_MODE_MISMATCH** The current modulation type is invalid in the keyed state. | Major | If the error persists, save the error log and contact Motorola. |
| **E_STATION_KEYED_NEXT_PROTOCOL_INVALID** The next modulation type has not been received in the key state. | Major | If the error persists, save the error log and contact Motorola. |
| **E_STATION_PA_DECK_FULL_POWER (See "I_STATION_PA__DECK_FULL_POWER")** Set during powerup to indicate that all PA's decks have been initialized correctly. | Informational | Ignore. |
| **E_STATION_TEMP_FULL_POWER (See "I_STATION_TEMP_FULL_POWER")** Set at startup to indicate that the RF-O! transmitter initially detected PA's running within proper temperature range. | Informational | Ignore. |
| **E_SWITCH_DEFAULT** Software Error. The value passed to a software conditional 'switch' statement did not match any of the tested values. **The severity of this error depends upon where in the software this error is logged.** | Informational<br>Minor<br>Major<br>Critical | If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 19 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_SYMBOL_DATA_COMMAND_FORMAT_ERROR**<br>Sent if one or more of the Symbol Data Command fields are invalid. | Major | If the error persists, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |
| **E_SYNTH1_LOCK_FAIL**<br>**(formerly E_RFCC_SYNTH1_LOCK_FAIL)**<br>The attempt to reprogram the First Exciter Synthesizer failed.<br>Beginning with RF-O! transmitter 1.2.2, the transmitter is disabled after several attempts to program both synthesizers has failed. | Critical | Reboot RF-O! transmitter. If the error persists, save the error log and contact Motorola. |
| **E_SYNTH2_LOCK_FAIL**<br>**(formerly E_RFCC_SYNTH2_LOCK_FAIL)**<br>The attempt to reprogram the Second Exciter Synthesizer failed.<br>Beginning with RF-O! transmitter 1.2.2, the transmitter is disabled after several attempts to program both synthesizers has failed. | Critical | Reboot RF-O! transmitter. If the error persists, save the error log and contact Motorola. |
| **E_SYNTHESIZER_INITIALIZATION_FAILED**<br>The two synthesizers on exciter can not be initialized and locked. This check is performed when RF-O! transmitter starts up and initializes the power control. | Critical | Reset RF-O! transmitter. Check synthesizers. If the error persists, save the error log and contact Motorola. |
| **E_TIMER_COUNT_PAST_REFERENCE_ COUNT**<br>The periodic timer which controls time-critical tasks was delayed by a higher priority task, making it impossible to setup the next timer interrupt. The timer controls time-critical functions, such as wattmeter readings. The RFO will self-recover from this error condition.<br>**NOTE:** It is normal for this error to be triggered at the same time as any of the Plug-and-Play Errors, when the DSP's are flushed. | Minor | If a large number of these errors occurs (more occurrences of this error than all of the PnP Errors combined), contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 20 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_TIMER_NOT_MULTIPLE_5_MILLISECOND**<br>The time interval of the timer handler's periodic check is not an even multiples of 5 milliseconds. The interrupt is used to provide delays for sampling the detectors, performing periodic checks while the station is keyed/dekeyed, and enabling the next interrupt. | Minor | If error persists, contact Motorola. |
| **E_TRACE_INVALID_OPCODE**<br>The Trace manager receives an invalid request. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_TRACE_INVALID_SOURCE_TASK**<br>The Trace manager receives message from an invalid source. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_TRACE_INVALID_TRACE_MESSAGE**<br>An unexpected command is received by Trace manager. | Minor | If the error persists, save the error log and contact Motorola. |
| **E_TXLIN_CARRIER_NULL_FAILED**<br>This error occurs when RF-O! fails to null the Txlin carrier feed through component which is unacceptable for InFLEXion transmission. | Major | Attempt to null the carrier feed through component (RFO FIPS: **a 74**) with Power Control Disabled (RFO FIPS: **w 992 0**) several times, prior to notifying Motorola. |
| **E_TXLIN_CHECKSUM_INVALID**<br>The checksum reported by the Txlin (on the Exciter) for its registers, does not match the RF-O! transmitter's calculated value. This operation is performed whenever one of the Txlin registers is written by the RF-O! transmitter software. | Critical | Verify that Exciter and OCM are properly installed in the chassis. Error could indicate problem with Exciter, backplane, and/or OCM. Contact Motorola. |
| **E_TXLIN_CHECKSUM_TEST_REG_READ_FAIL**<br>The RF-O! transmitter software was unable to read the Checksum Test Register from the Txlin on the Exciter. | Critical | Verify that Exciter and OCM are properly installed in the chassis.<br>Error could indicate problem with Exciter, backplane, and/or OCM.<br>Contact Motorola. |
| **E_TXLIN_INITIALIZATION_FAILED**<br>RF-O! transmitter fails to initialize the Transmitter Linearization (Txlin) IC at startup. | Critical | Verify that Exciter and OCM are properly installed in the chassis. Error could indicate problem with Exciter, backplane, and/or OCM. Contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 21 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_TXLIN_NOT_LOCKED**<br>The Oscillator on the Exciter Txlin failed to lock. The transmitter is disabled. | Critical | Verify that Exciter and OCM are properly installed in the chassis. Error could indicate problem with Exciter, backplane, and/or OCM. Contact Motorola. |
| **E_TXLIN_REGISTER_WRITE_FAIL**<br>Indicates that an attempt to write one or more of the Txlin registers using the SPI bus has failed. Failure to properly write the Txlin registers may cause severe transmitter failure. | Critical | Verify that Exciter and OCM are properly installed in the chassis. Error could indicate problem with Exciter, backplane, and/or OCM. Contact Motorola. |
| **E_UNABLE_TO_START_TASKS**<br>OS Error: An attempt to start one of the Station Software Tasks has failed. | Critical | Reset RF-O! transmitter. If the error returns, contact Motorola. |
| **E_UNDEFINED_1PPS_STATUS**<br>The Collector DSP has returned a 1PPS status that does not match any of the statuses known to the host. | Informational | Debug message. If the error persists, save the error log and contact Motorola. |
| **E_UNEXPECTED_ELSE**<br>The software took an undesired branch in a conditional statement. | Informational | Debug message. If the error persists, save the error log and contact Motorola. |
| **E_UNEXPECTED_OPCODE**<br>A command passed to a task was not recognized by that task. | Informational | Debug message. If the error persists, save the error log and contact Motorola. |
| **E_UNEXPECTED_SYMBOL_COMMAND_ERROR**<br>Sent if a symbol data command arrives before a control command on Plug-and-Play data path. | Major | If the error persists, save the error log and contact Motorola. |
| **E_VARIABLE_OUT_OF_RANGE**<br>Variable passed to a routine was outside its allowed limits. | Informational | Debug message. Verify proper format of all FIPS commands. If the error persists, save the error log and contact Motorola. |
| **E_WORK_AHEAD_WINDOW_ERROR**<br>PnP Error: Sent if the arrival of the Plug-and-Play packet is outside the designated arrival window. | Major | A few of these errors per day is normal in a heavy traffic environment.<br>If excessive amounts of these errors are logged, save the error log and contact Motorola.<br>**NOTE:** This is a **Plug-and-Play Error.** Transmitter was Disabled for 2 seconds, and DSP buffers were flushed. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 22 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **E_XILINX_DOWNLOAD_FAILURE** An error occurred while attempting to download a program to the Xilinx FPGA. | Critical | Reset RF-O! transmitter. If error occurs again, contact Motorola. |
| **I_CUTOVER_TO_BANK_1_SUCCESSFULLY** The cutover to flash bank A after a remote software download was performed. | Informational | No action necessary. |
| **I_CUTOVER_TO_BANK_2_SUCCESSFULLY** The cutover to flash bank B after a remote software download was performed. | Informational | No action necessary. |
| **I_DIP1_ACTIVE_BUT_IGNORED** During reboot, the DIP Switch 1 on the RF-O! transmitter module was detected as ON. However, since DIP2 was detected as OFF, the DIP1 was ignored. | Informational | Set the DIP switch to OFF unless performing a parameter database reset. |
| **I_DIP1_IS_ACTIVE** During reboot, the DIP Switch 1 on the RF-O! transmitter module was detected as ON. | Informational | Set the DIP switch to OFF unless performing a parameter database reset. |
| **I_DIP1_NOT_SET** During reboot, the DIP Switch 1 on the RF-O! transmitter module was detected as OFF. | Informational | No action necessary. |
| **I_DIP2_IS_ACTIVE** During reboot, the DIP Switch 2 on the RF-O! transmitter module was detected as ON. | Informational | Set the DIP switch to OFF unless performing a parameter database reset. |
| **I_DIP2_NOT_SET** During reboot, the DIP Switch 2 on the RF-O! transmitter module was detected as OFF. | Informational | No action necessary. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 23 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **I_FFDS_FRAME_FLUSHED**<br>**(Removed after RF-O! transmitter version 1.2.0)**<br>This signals the user that a transmission frame has been flushed by a DSP. It is normal for this message to be logged at startup, and occasionally during normal operation. This message is normally accompanied by one of the following Plug-N-Play error messages:<br>E_START_TIME_ERROR,<br>E_INCOMPLETE_FRAME_ERROR,<br>E_MODULATION_TYPE_ERROR,<br>E_FREQ_OFFSET_ERROR,<br>E_INVALID_COMMAND_TYPE_ERROR,<br>E_UNEXPECTED_SYMBOL_COMMAND_ERROR,<br>E_SYMBOL_DATA_COMMAND_FORMAT_ERROR,<br>E_END_OF_COMMAND_ERROR,<br>E_WORK_AHEAD_WINDOW_ERROR,<br>E_CHECK_COMMAND_FORMAT_ERROR, | Informational | It is normal for occasional occurrences of this Informational Message. If excessive (more than 10 per day) Plug-N-Play errors are received, there may be a network loading/delay issue between the RFC and the RF-B! transmitter controller, or a Plug-N-Play issue between the RF-O! transmitter and RF-B! transmitter controller.<br><br>If excessive occurrences of this message are experienced, contact Motorola. |
| **I_FREQ_CHANGE_DELAY_CHANGED**<br>The Frequency Change Delay parameter (2057) was changed during normal operation after bootup. The RFO will disable paging and reaquire the 1PPS signal. | Informational | No action required.<br>Note: Paging will resume after 1PPS signal is reaquired (usually around ten seconds). |
| **I_PAGING_ACCESS_DISABLED**<br>The transmitter was disabled by a User (RFO FIPS: **w 99 1**). | Informational | If the transmitter is still disabled (see RFO FIPS: **a 83** - Station Status), and this is not the desired state, enable the transmitter by writing parameter 99 to 0. (RFO FIPS: **w 99 0**). |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 24 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **I_PC_ENABLED_PARAMETER_WRITE_DISABLED)**<br>An attempt to write to one or more of the Power Amplitude Parameters was made while Power Control (PC) was Enabled. This log entry is intended to inform the user, that the values entered will not be recognized by the RF-O! software while Power Control is Enabled, but will be used by the station once/if Power Control is Disabled.<br>**NOTE**: This error log entry will occur approximately 6 times if the "Initialize Amplitude Alignment" command RFO FIPS: **a 75**) is entered while Power Control is Enabled. | Informational | No Action Required.<br>It is important to note that while Power Control is enabled, the RF-O! transmitter uses calculated values for power amplitude settings, not the values stored in the Parameter Database. The calculated values can be found using the RFO FIPS: **a 87 x** command.<br>Attempting to write any of the following parameters while Power Control is Enabled will cause this message to be logged:<br>Phase Training Scale (982), K-Factor (990), Tranlin Attenuation Level (974), Exciter Attenuator Level (953), Txlin Attenuator (954), Exciter Feedback Attenuator (996), Maximum Deviation (2053),Modulation FM power (2054), Modulation Voice Pilot Power (2055), or Modulation Voice Sideband Power (2056). |
| **I_SIMULCAST_LAUNCH_DELAY_CHANGED**<br>The Simulcast Launch Delay parameter (2049) was changed during normal operation after bootup. The RFO will disable paging and reaquire the 1PPS signal. | Informational | No action required.<br>Note: Paging will resume after 1PPS signal is reaquired (usually around ten seconds). |
| **I_STATION_PA_DECK_FULL_POWER (formerly E_STATION_PA_DECK_FULL_POWER)**<br>Set when RF-O! transmitter goes from a cutback or shutdown state to full power operation, due to recovery from a PA failure. | Informational | If error occurs excessively, along with E_STATION_PA_DECK_CUTBACK, or E_STATION_PA_DECK_SHUT_DOWN, this situation could indicate PA failures. Verify proper PA and power supply installation.Contact Motorola. |
| **I_STATION_TEMP_FULL_POWER (formerly E_STATION_TEMP_FULL_POWER)**<br>Set when one or more PA's has gone from a cutback state, due to high temperature, back to full power operation (temperature of PA decreased sufficiently to allow full power operation to continue) | Informational | Excessive logging of this message with E_STATION_PA_DECK_CUTBACK, or E_STATION_PA_DECK_SHUT_DOWN errors indicates PA operating temperature problems. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 25 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **S_OCM_TX_CONTROL_ERROR**<br>A PnP Control Command was invalid.<br>**Reported as an SNMP Trap.** | Critical | Verify proper PnP interface connections. If the error persists, save the error log and contact Motorola. |
| **S_OCM_TX_DATA_ERROR**<br>A PnP Symbol Data Command was invalid.<br>**Reported as an SNMP Trap.** | Major | Verify proper PnP interface connections. If the error persists, save the error log and contact Motorola. |
| **S_OCM_TX_PAGING_DISABLED**<br>This error is **logged on the RFB**, but sourced by the RFO. An error occurred on the RFO which caused the RFO to become disabled. When disabled, the TX_OK line between the RFO and RFB is de-asserted, notifying the RFB to stop sending PnP data. The following errors on the RF-O! currently disable the transmitter:<br>E_AMPLITUDE_NOT_ALIGNED<br>E_CIRC_LOAD_TEMP_EXCEEDED<br>E_DISABLE_PAGING<br>E_EXCITER_AD_READ_FAIL<br>E_EXCITER_FRU_FAIL_ALARM<br>E_EXTERNAL_REFLECTED_POWER_HIGH<br>E_HIGH_AMBIENT_TEMP_SHUTDOWN_ALARM<br>E_HIGH_EXT_WM_VSWR_ALARM<br>E_HIGH_INT_WM_VSWR_ALARM<br>E_HIGH_STABILITY_REFERENCE_FAILURE<br>E_INTERNAL_REFLECTED_POWER_HIGH<br>E_PA_AD_2_TEST_VOLTAGE_FAIL_DECK_1<br>E_PA_AD_2_TEST_VOLTAGE_FAIL_DECK_2<br>E_PA_AD_1_TEST_VOLTAGE_FAIL_DECK_1<br>E_PA_AD_1_TEST_VOLTAGE_FAIL_DECK_2<br>E_PA_FAIL_SHUTDOWN_ALARM<br>E_PA_TEMP_SHUTDOWN_ALARM<br>E_PA1_PS_AD_SPI_READ_FAIL<br>E_PA2_PS_AD_SPI_READ_FAIL<br>E_PENDULUM_NOT_LOCKED E_PENDULUM_REFERENCE_FAILURE<br>E_POWER_LEVELING_FAILED<br>E_STATION_AM_CLIPPING_DETECTED<br>E_STATION_FM_CLIPPING_DETECTED<br>E_SYNTH1_LOCK_FAIL E_SYNTH2_LOCK_FAIL<br>E_TXLIN_NOT_LOCKED<br>I_PAGING_ACCESS_DISABLED<br><br>**Reported as an SNMP Trap**. | Critical | Check for related error messages through RF-O! FIPS. If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 26 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **S_OCM_TX_POWER_CUTBACK**<br>This error is logged on the RFB, but originates from the RFO. Caused by an intentional power cutback on the OCM due to: power supply failure, PA high temperature, or power clip. The following RF-O! transmitter error codes cause this error to appear on the RF-B! transmitter controller:<br>`E_EXTERNAL_FORWARD_POWER_LOW`<br>`E_INTERNAL_FORWARD_POWER_LOW`<br>`E_HIGH_AMBIENT_TEMP_CUTBACK_ALARM`<br>`E_PA_TEMP_CUTBACK_ALARM`<br>`E_PA_FAIL_CUTBACK_ALARM`<br><br>**Reported as an SNMP Trap.** | Major | Check for related error messages in RF-O! transmitter error log through RF-O! FIPS. Take appropriate action based on the error causing the problem. If the error persists, save the error log and contact Motorola. |
| **S_OCM_TX_POWER_OUTPUT**<br>This error is logged on the RF-B! transmitter controller, but originates from the RF-O! transmitter. This error signals that there is a problem on the RF-O! transmitter, but the transmitter continues to key at full power (no cutback or disable). The following RF-O! transmitter errors cause this alarm to appear on the RF-B! transmitter controller:<br>`E_PS_INPUT_VOLT_ALARM_DECK_1`<br>`E_PS_INPUT_VOLT_ALARM_DECK_2`<br>`E_PA_HS_TEMPERATURE_FAIL_DECK_1`<br>`E_PA_HS_TEMPERATURE_FAIL_DECK_2`<br><br>**Reported as an SNMP Trap**. | Major | Determine reason for this error in the RFO logs. Take appropriate action based on the error causing the problem. |
| **S_OCM_TX_TRANSMITTER_RESET**<br>OCM software reset occurred.<br>**Reported as an SNMP Trap.** | Major | Determine reason for OCM reset.<br>If reset occurs frequently, save the error log and contact Motorola. |
| **S_RSR_DOUBLE_FAULT_MON_RESET**<br>The last reset was caused by the double bus fault monitor. | Major | If the error persists, save the error log and contact Motorola. |
| **S_RSR_EXTERNAL_TOTAL_SYSTEM_RESET (Removed after RFO 1.3.0)**<br>The last reset was caused by an external signal driving `RESET_H`. | Informational | Ignore. If the error persists, save the error log and contact Motorola. |

*Table F-3: RF-O! Transmitter Error/Alarm Code Definitions (Sheet 27 of 27)*

| Error and Description | Alarm Severity | Action |
|---|---|---|
| **S_RSR_LOSS_OF_CLOCK_RESET**<br>The last reset was caused by a loss of frequency reference to the clock sub-module. | Major | If the error persists, save the error log and contact Motorola. |
| **S_RSR_POWER_UP_RESET**<br>The last reset was caused by the power-up reset circuit. | Informational | Ignore. If the error persists, save the error log and contact Motorola. |
| **S_RSR_SOFT_RESET_PIN_RESET**<br>**(Removed after RFO 1.3.0)**<br>The last reset was caused by an external signal driving RESET_S. (Reset button on RF-O! was pushed) | Informational | Ignore. If the error persists, save the error log and contact Motorola. |
| **S_RSR_SOFTWARE_RESET**<br>**(Removed after RFO 1.3.0)**<br>The last reset was caused by the CPU32+ executing a RESET instruction. | Informational | Ignore. If the error persists, save the error log and contact Motorola. |
| **S_RSR_SOFTWARE_WATCHDOG_RESET**<br>The last reset was caused by a software watchdog time-out. | Informational | Ignore. If the error persists, save the error log and contact Motorola. |
| **S_RSR_SW_RESET_CNTRLER_REQ_LINE_LOSS**<br>The RF-O! transmitter performed a software reset due to loss of RFC_REQ line from the transmitter controller (RF-B!). | Informational | No action required. |
| **S_RSR_SW_RESET_FIPS_A_117**<br>The RF-O! transmitter performed a software reset due to user execution of RFO FIPS: **a 117**. | Informational | No action required. |
| **S_RSR_SW_RESET_SWDL_CUTOVER**<br>The R-FO! performed a software reset due to a cutover following a successful software download. | Informational | No action required. |
| **S_RSR_SW_RESET_UNDEFINED_CAUSE**<br>The R-FO! performed a software reset due to an undefined cause. | Major | If the error persists, save the error log and contact Motorola. |
| **S_STATION_RESET_x.x.x**<br>Issued upon any Station Reset or Station Power-up. “x.x.x” is the software version number. | Informational | No action required. |

# RF-O! Alarms

## Reading the Alarm Logs on the RF-O! (RFO FIPS: a 99)

The Alarm Log is used to hold error / alarm conditions that are relayed to the RF-B! transmitter controller using the Maintenance Path. All Alarm Log entries have a corresponding Error Log entry, but not all Error Log Entries appear in the Alarm Log. Alarm Logs are primarily reserved for RF-O! transmitter conditions that warrant immediate attention, signalling a module failure, or some other interruption of messaging traffic.

Alarm Logs can be read on the RF-O! transmitter using the RFO FIPS: **a 99** command. Entering RFO FIPS: **a 99** causes all currently logged alarms to be displayed.

When the RFO FIPS: **a 99** command is issued, all currently logged alarms are returned to the terminal. The example below shows a typical alarm log on the RF-O! transmitter.

```
RFO FIPS: a 99
RFO FIPS: RA   99

  Reported Alarms
  ---------------
  AL001 - Alarm Occurred Due to OCM Reset.
  OK000 - Transmitter Disabled Due To High OCM Ambient Temperature.
  OK000 - Transmitter Disabled - (Check Disabled Status via FIPS: A 83).
```

*Figure F-2: Typical RF-O! Transmitter Alarm Log*

Each log entry line contains the following information:

**XXYYY - <Description>**

**XX -** (Alarm Status). Either **AL** or **OK**. **AL** indicates that the alarm is still active. **OK** indicates that the alarm occurred, but is now cleared.

**YYY -** (Alarm Count). If **XX** is **AL**, these three digits will indicate the number of occurrences of this alarm since the alarm log was last cleared. The alarm count goes to a maximum of 999, then stops counting. The count is set to 000 whenever the cause of the Alarm is no longer present, and the Alarm Status changes from **AL** to **OK**.

**<Description> -** A brief textual explanation of the alarm.

## Clearing the Error Logs on OCM (RFO FIPS: a 103)

Enter the RFO FIPS: **a 103** command to clear the OCM Alarm Log. Turning off the RF-O! transmitter, resetting the station using RFO FIPS: **a 117** command, or pushing the RESET button on the RF-O! transmitter will **not** clear the alarm logs.

## RF-O! Error Code/Alarm Code Cross-Reference

The table below shows all of the currently supported RF-O! transmitter Alarms along with the corresponding Error Log entry.

*Table F-4: RF-O! Error Code / Alarm Code Cross Reference*

| Alarm Text (RFO FIPS: a 99) | Corresponding Error Code (RFO FIPS: a 104) |
|---|---|
| 16.8MHz Pendulum Reference Not Phase Locked. | E_PENDULUM_NOT_LOCKED |
| 16.8MHz Pendulum Reference Not Detected. | E_PENDULUM_REFERENCE_FAILURE |
| Alarm Occurred Due to OCM Reset. | S_STATION_RESET |
| Catastrophic Exciter Failure Detected. | E_EXCITER_FRU_FAIL_ALARM |
| Circulator Load Temperature Limit Exceeded. | E_CIRC_LOAD_TEMP_EXCEEDED |
| Clipping Detected by the Tranlin During FM Transmission. | E_STATION_FM_CLIPPING_DETECTED |
| Clipping Detected by the Tranlin During Voice Transmission. | E_STATION_AM_CLIPPING_DETECTED |
| Exciter Synthesizer 1 Has Failed to Lock. | E_SYNTH1_LOCK_FAIL |
| Exciter Synthesizer 2 Has Failed to Lock. | E_SYNTH2_LOCK_FAIL |
| Exciter Tranlin IC 236 MHz Oscillator Failed to Lock. | E_TXLIN_NOT_LOCKED |
| Failed to Read A to D Converter using SPI on PA 1 Power Supply. | E_PA1_PS_AD_SPI_READ_FAIL |
| Failed to Read A to D Converter using SPI on PA 2 Power Supply. | E_PA2_PS_AD_SPI_READ_FAIL |
| Failed to Read the Exciter A to D Converter. | E_EXCITER_AD_READ_FAIL |

*Table F-4: RF-O! Error Code / Alarm Code Cross Reference*

| Alarm Text (RFO FIPS: a 99) | Corresponding Error Code (RFO FIPS: a 104) |
|---|---|
| High External Wattmeter VSWR (Greater than 3.0). | E_HIGH_EXT_WM_VSWR_ALARM |
| High Internal Wattmeter VSWR (Greater than 3.0). | E_HIGH_INT_WM_VSWR_ALARM |
| PA 1 A to D Converter 1 Test Voltage Failure. | E_PA_AD_1_TEST_VOLTAGE_FAIL_DECK_1 |
| PA 2 A to D Converter 1 Test Voltage Failure. | E_PA_AD_1_TEST_VOLTAGE_FAIL_DECK_2 |
| PA 1 Power Supply A to D Converter Test Voltage Failure. | E_PA_AD_2_TEST_VOLTAGE_FAIL_DECK_1 |
| PA 2 Power Supply A to D Converter Test Voltage Failure. | E_PA_AD_2_TEST_VOLTAGE_FAIL_DECK_2 |
| PA Failure. Transmitter Shutdown. (See FIPS: A 83) | E_PA_FAIL_SHUTDOWN_ALARM |
| PA or PS Failure. Transmitter Cutback. (See FIPS: A 83) | E_PA_FAIL_CUTBACK_ALARM |
| PnP Check Command Frequency Mismatch. | E_CHECK_COMMAND_FREQ_FAIL |
| PnP Check Command Station Key State Mismatch. | E_CHECK_COMMAND_KEY_FAIL |
| Power Amplifier 1 Operating Temperature Has Exceeded Specification. | E_PA_HS_TEMPERATURE_FAIL_DECK_1 |
| Power Amplifier 2 Operating Temperature Has Exceeded Specification. | E_PA_HS_TEMPERATURE_FAIL_DECK_2 |
| Power Amplitude Not Aligned. Transmitter Shutdown. | E_AMPLITUDE_NOT_ALIGNED |
| Power Output is Above the Limit on the External Reflected Power Meter | E_EXTERNAL_REFLECTED_POWER_HIGH |
| Power Output is Above the Limit on the Internal Reflected Power Meter | E_INTERNAL_REFLECTED_POWER_HIGH |
| Power Output is Below the Limit on the External Forward Power Meter | E_EXTERNAL_FORWARD_POWER_LOW |
| Power Output is Below the Limit on the Internal Forward Power Meter | E_INTERNAL_FORWARD_POWER_LOW |
| Power Output Too High/Low to Auto Level. Check Wattmeter Calibration. | E_POWER_LEVELING_FAILED |

*Table F-4: RF-O! Error Code / Alarm Code Cross Reference*

| Alarm Text (RFO FIPS: a 99) | Corresponding Error Code (RFO FIPS: a 104) |
|---|---|
| Power Supply 1 Current Detected Has Fallen Below Specified Limits. | E_PS_INPUT_VOLT_ALARM_DECK_1 |
| Power Supply 2 Current Detected Has Fallen Below Specified Limits. | E_PS_INPUT_VOLT_ALARM_DECK_2 |
| Transmitter Cutback Due To High PA Temperature. | E_PA_TEMP_CUTBACK_ALARM |
| Transmitter Disabled - (Check Disabled Status using FIPS: A 83). | E_DISABLE_PAGING |
| Transmitter Disabled By User (FIPS: W 99 1). | I_PAGING_ACCESS_DISABLED |
| Transmitter Disabled Due To High OCM Ambient Temperature. | E_HIGH_AMBIENT_TEMP_SHUTDOWN_ALARM |
| Transmitter Disabled Due To High PA Temperature. | E_PA_TEMP_SHUTDOWN_ALARM |
| Ultra-High Stability Reference Oscillator Not Detected. | E_HIGH_STABILITY_REFERENCE_FAILURE |

# Transmitter Alignment Checklist

## Station Identification

*Table G-1: RF-O! Transmitter Service Information*

| | | | |
|---|---|---|---|
| Station S/N | | Date | |
| Customer | | FTR Name | |
| Log File | | System | |
| Site Name | | Site ID | |

Was the station in service when you arrived? Yes / No ________

Did you verify the station was in service by sending a page? Yes / No _________

Comments: (What was the condition of the station when you arrived?)

# Station Configuration Parameters

*Table G-2: Station Configuration Parameters*

| RF-B! Configuration Parameters | | Recorded Values | RF-O! Configuration Parameters | | Recorded Values |
|---|---|---|---|---|---|
| Active S/W Version | **r 148** | | Active S/W Version | **r 148** | |
| Dormant Bank Version | **r 152** | | Dormant Bank Version | **r 152** | |
| Color Code | **r 704** | | Active Bank | **r 901** | |
| IP Address | **r 705** | | CFT Nulling | **4 998** | |
| Gateway IP Address | **r 708** | | Frequency 1 | **r 2000** | |
| SNMP Address | **r 500** | | Frequency 2 | **r 2001** | |
| Active Bank | **r 901** | | Frequency 3 | **r 2002** | |
| | | | Frequency 4 | **r 2003** | |
| | | | Frequency 5 | **r 2004** | |
| | | | Frequency 6 | **r 2005** | |
| | | | Frequency 7 | **r 2006** | |
| | | | Frequency 8 | **r 2007** | |
| | | | Frequency 9 | **r 2008** | |
| | | | Frequency 10 | **r 2009** | |
| | | | Frequency 11 | **r 2010** | |
| | | | Frequency 12 | **r 2011** | |
| | | | Frequency 13 | **r 2012** | |
| | | | Frequency 14 | **r 2013** | |
| | | | Frequency 15 | **r 2014** | |

# Final Check

## PA Functionality Check

*Table G-3: PA Information*

| | Power Amplivier # 1 (a 68 1 c 0 1 0) | | | Power Amplifier #2 (a 68 2 c 0 1 0) | | |
|---|---|---|---|---|---|---|
| **Register** | **Register Output** | **Register Output (Decoded)** | **Type** | **Register Output** | **Register Output (Decoded)** | **Type** |
| **00** | | | **00** | | | |
| **01** | | | **01** | | | |
| **02** | | | **02** | | | |
| **03** | | | Amps | | | Amps |
| **04** | | | **04** | | | |
| **05** | | | Amps | | | Amps |
| **06** | | | Amps | | | Amps |
| **07** | | | Amps | | | Amps |
| **08** | | | Amps | | | Amps |
| **09** | | | Watts | | | Watts |
| **10** | | | Watts | | | Watts |

## Wattmeter Check

*Table G-4: Wattmeter Readings*

| | | |
|---|---|---|
| Internal Forward Wattmeter | **a 79 0** | |
| Internal Reflected Wattmeter | **a 79 1** | |
| External Forward Wattmeter | **a 79 2** | |
| External Reflected Wattmeter | **a 79 3** | |

Did you verify a page? Yes / No __________

Comments: (What is the condition of the station now?)

# Debug Traces

Debug traces in the RF-O! transmitter software allow monitoring of certain paging station functionality. The debug traces are implemented to minimize interference with normal paging operation. The traces require additional processor loading, which may slow down or hamper other processing. Disable the traces when they are not in use.

## Enabling Debug Traces

To enable RF-O! debug traces use a FIPS session through the RFO FIPS port. Type the following command:

RFO FIPS: **a 192 <TASK> <FLAG>**

**<TASK>** is a 4-letter acronym that describes the software task responsible for creating the debug trace output. The current tasks available on the RF-O! transmitter are described in the Table H-1.

*Note:* **<TASK>** *identifiers are case-sensitive (Use all capital letters).*

**<FLAG>** is a decimal number that defines the individual debug traces to be enabled for the specified trace. Each debug trace is uniquely identified by a single bit set within a particular trace. Several traces can be enabled with one command by adding **<FLAG>** values as shown in the following example:

RFO FIPS: **A 192 SPCQ 10**

This command turns on both SPCQ 2 and SPCQ 8 traces.

The debug traces are described in Table H-2.

*Table H-1: RF-O! Transmitter Debug Trace TASK Identifiers*

| TASK | Software Task Description |
|---|---|
| COHQ | Collector DSP task. Responsible for communications between the host processor and the Collector DSP. |
| DIAG | Diagnostics task. |
| DIDQ | Distributor DSP Communications Task. Responsible for sending/receiving messages to/from the Distributor DSP. |
| ITCM | Internal Transmitter Controller Manager Task. Responsible for executing most FIPS action commands. |
| M1HQ | Modulator 1 DSP Task. Responsible for communications between the host processor (MC68360) and the Modulator 1 DSP. |
| M2HQ | Modulator 2 DSP Task. Responsible for communications between the host processor (MC68360) and the Modulator 2 DSP. |
| MPCM | Maintenance Path Control Manager Task. Controls the communications between the RF-O! transmitter and the plug and play interface (RF-B! or other transmitter controller). |
| RFCQ | Radio Frequency Channel Control Task. Responsible for assuring that the DSPs and Exciter are programmed to the correct frequency prior to keyup. |
| SHMI | Station Hardware Manager Task. Responsible for monitoring station hardware peripherals such as Pendulum, UHSO, and Ambient Temperature Sensor. |
| SPCQ | Station Power Control Manager Task. Responsible for controlling the transmitter power output based on number of subchannels, modulation type, power cutbacks, and power leveling. |
| SPIQ | Serial Peripheral Interface Task. Responsible for communications with devices on the SPI bus. |

## Disabling Debug Traces

To turn off traces that are enabled, type the following:

`RFO FIPS:` **`A 193 <TASK> <FLAG>`**

**<TASK>** is the same debug trace identifier as described in the Table H-1.

**<FLAG>** is a decimal number defining the individual debug traces to be disabled for the specified Trace. That is, each debug trace is uniquely identified by a single bit (1,2,4,8,16,...) being set within a particular TRACE. To disable one or more traces, specify the trace(s) with the <FLAG>. For example:

`RFO FIPS: `**`a 193 ITCM 65`**

This command turns off two ITCM traces, 64 and 1.

*Note: All debug traces are disabled upon station reset.*

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| COHQ | 1 | 1.4.0+ | Launch Time and Synthesizer Trace. Displays data being sent to the collector DSP based on the control command just received from the distributor DSP.<br>***Synth***: Synthesizer to be used (0 or 1)<br>***Coarse***: Coarse Launch Time<br>***Fine***: Fine Launch Time<br>***ChanlFilter***: Channel splatter filter to be used (000 - 50 kHz, 001- 25 kHz). | <COHQ 1>LAUNCH TIME: Synth:0x0 Coarse:0x0000b7c0 Fine:0x01 ChanlFilter:0x000<br><COHQ 1>LAUNCH TIME: Synth:0x0 Coarse:0x00005dc0 Fine:0x01 ChanlFilter:0x000 |
| COHQ | 2 | | Reserved. | |
| DIAG | 1 | 1.4.0+ | Diagnostics Error Log Trace<br>Displays errors to the FIPS port as they are logged in the A 104 or A 110 log. Useful for monitoring the order and time at which errors are logged. | Currently not functional. |
| DIDQ | 1 | 1.4.0+ | Start Time Error. Information useful in debugging the cause of E_START_TIME_ERROR. Only displays data when error occurs. | |
| DIDQ | 2 | 1.4.0+ | Incomplete Frame Error. Information useful in debugging the cause of E_INCOMPLETE_FRAME_ERROR. Only displays data when error occurs. | |
| DIDQ | 4 | 1.4.0+ | Modulation Type Error. Information useful in debugging the cause of E_MODULATION_TYPE_ERROR. Only displays data when error occurs. | |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| DIDQ | 8 | 1.4.0+ | Frequency Offset Error. Information useful in debugging the cause of E_FREQ_OFFSET_ERROR error. Only displays data when error occurs. | |
| DIDQ | 16 | 1.4.0+ | Invalid Command Type. Information useful in debugging the cause of E_INVALID_COMMAND_TYPE_ERROR. Only displays data when error occurs. | |
| DIDQ | 32 | 1.4.0+ | Control Command Format Error. Information useful in debugging the cause of E_CONTROL_COMMAND_FORMAT_ERROR error. Only displays data when error occurs. | |
| DIDQ | 64 | 1.4.0+ | Unexpected Symbol Command Error. Information useful in debugging the cause of E_UNEXPECTED_SYMBOL_COMMAND_ERROR. Only displays data when error occurs. | |
| DIDQ | 128 | 1.4.0+ | Symbol Data Command Format Error. Information useful in debugging the cause of E_SYMBOL_DATA_COMMAND_FORMAT_ERROR. Only displays data when error occurs. | |
| DIDQ | 256 | 1.4.0+ | End of Command Error. Information useful in debugging the cause of E_END_OF_COMMAND_ERROR. Only displays data when error occurs. | |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| DIDQ | 512 | 1.4.0+ | Workahead Window Error<br>Information useful in debugging the cause of E_WORK_AHEAD_WINDOW_ERROR error. Only displays data when error occurs. | |
| DIDQ | 1024 | 1.4.0+ | Check Command Format Error<br>Information useful in debugging the cause of E_CHECK_COMMAND_FORMAT_ERROR error. Only displays data when error occurs. | |
| DIDQ | 2048 | 1.4.0+ | Invalid Symbol Duration. Information useful in debugging the cause of E_INVALID_SYMBOL_DURATION_ERR OROnly displays data when error occurs. | |
| ITCM | 1 | | Reserved | |
| ITCM | 2 | | Reserved | |
| ITCM | 4 | | Reserved | |
| ITCM | 8 | | Reserved | |
| ITCM | 16 | | Reserved | |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| ITCM | 32 | 1.4.0+ | **Carrier Null Trace.** Displays data as CFT nulling procedure is performed. This data is displayed during Auto (w 998 1) or Semiauto CFT nulling (A 74). CFT nulling involves finding the point at which the rectified IF voltage (Rect IF Volt A/D) is at a minimum.<br>***Step***: Indicates the current offset (I or Q) difference between subsequent readings. Step size becomes smaller as RF-O! transmitter narrows in on best null point.<br>***IOffset***: Current setting of the inphase offset<br>***QOffset:*** Current setting of the quadrature offset.<br>***Rect IF Volt A/D***: Analog-to-digital reading of the rectified IF voltage. The lower this value is, the lower the CFT feedthrough is.<br>*******: Indicates when the reading was made, this combination of I and Q offsets produced an IF voltage reading less than or equal to the current lowest value (possible minimum point). | <ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -700 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -710 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -690 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -720 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -680 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -730 Rect IF Volt A/D= 9<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -670 Rect IF Volt A/D= 9<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -740 Rect IF Volt A/D= 13<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -660 Rect IF Volt A/D= 9<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -750 Rect IF Volt A/D= 26<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -650 Rect IF Volt A/D= 18<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -760 Rect IF Volt A/D= 38<br><ITCM 32>NULLING: Step= 10 IOffset= -600 QOffset= -640 Rect IF Volt A/D= 29<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -700 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -702 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -698 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -704 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -696 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -706 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -694 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -708 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -692 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -710 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 2 IOffset= -600 QOffset= -690 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 1 IOffset= -600 QOffset= -700 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 1 IOffset= -600 QOffset= -701 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 1 IOffset= -600 QOffset= -699 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 1 IOffset= -600 QOffset= -702 Rect IF Volt A/D= 8 *<br><ITCM 32>NULLING: Step= 1 IOffset= -600 QOffset= -698 Rect IF Volt A/D= 8 * |

*Table H-2:  Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| M1HQ | 1 | 1.4.0+ | **Modulator 1 DSP Modulation Parameters**<br>Display information being sent to the Modulator 1 DSP. FM Parameters:<br>***Invert***: 1 = Invert, 0 = Noninvert<br>***Activate***: 0 - upon next launch<br>1 - immediately<br>***SplatterFilt***: 000 - 50 kHz chan or 001 - 25 kHz chan<br>***Word1***:First word sent to DSP. Bits define Invert, Activate, and Splatter Filter.<br>***Ang0***: Modulator 0 FreqInteger<br>***Dev0***: Modulator 0 Deviation<br>***Pwr0***: Modulator 0 Magnitude (default: 0x6d60)<br>***Ang1***: Modulator 1 FreqInteger<br>***Dev1***: Modulator 1 Deviation<br>***Pwr1***: Modulator 1 Magnitude (default: 0x6d60)<br>AM PARAMS:<br>***Invert***: 0 - Do not invert 1 - Invert spectrum<br>***Activate***: 0 - activation of new params at next launch<br>1 - immediate activation<br>***Angle0***: Mod 0 subchan freq<br>***Pilot0***: Mod 0 Pilot Magnitude<br>***Upper0***: Mod 0 Upper Sideband Magn.<br>***Lower0***: Mod 0 Lower Sideband Magn.<br>***Angle1***: Mod 1 subchan freq<br>***Pilot1***: Mod 1 Pilot Magnitude<br>***Upper1***: Mod 1 Upper Sideband Magn.<br>***Lower1***: Mod 1 Lower Sideband Magn. | <M1HQ 1>MOD1 FM PARMS: Invert:1, Activate:0, SplatterFilt:000, (Word1: 0x0002)<br>Ang0:0xffdeaaab, Dev0:0x00199999, Pwr0:0x006d60<br>Ang1:0x00000000, Dev1:0x00199999, Pwr1:0x000000<br><M1HQ 1>MOD1 AM PARMS: Invert:1, Activate:0<br>Angle0:42aaaa, Pilot0:640, Upper0:308a, Lower0:308a<br>Angle1:0, Pilot1:0, Upper1:0, Lower1:0<br><M1HQ 1>MOD1 FM PARMS: Invert:1, Activate:0, SplatterFilt:000, (Word1: 0x0002)<br>Ang0:0xffdeaaab, Dev0:0x00199999, Pwr0:0x006d60<br>Ang1:0x00000000, Dev1:0x00199999, Pwr1:0x000000<br><M1HQ 1>MOD1 AM PARMS: Invert:1, Activate:0<br>Angle0:42aaaa, Pilot0:640, Upper0:308a, Lower0:308a<br>Angle1:0, Pilot1:0, Upper1:0, Lower1:0 |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| M2HQ | 1 | 1.4.0+ | **Modulator 2 DSP Modulation Parameters** (See Modulator 1 DSP Modulation Parameters) | <M2HQ 1>MOD2 FM PARMS: Invert:1, Activate:0, SplatterFilt:000, (Word1: 0x0002)<br>Ang0:0x00000000, Dev0:0x00199999, Pwr0:0x000000<br>Ang1:0x00000000, Dev1:0x00199999, Pwr1:0x000000<br><M2HQ 1>MOD2 AM PARMS: Invert:1, Activate:0<br>Angle0:0, Pilot0:0, Upper0:0, Lower0:0<br>Angle1:0, Pilot1:0, Upper1:0, Lower1:0<br><M2HQ 1>MOD2 FM PARMS: Invert:1, Activate:0, SplatterFilt:000, (Word1: 0x0002)<br>Ang0:0x00000000, Dev0:0x00199999, Pwr0:0x000000<br>Ang1:0x00000000, Dev1:0x00199999, Pwr1:0x000000<br><M2HQ 1>MOD2 AM PARMS: Invert:1, Activate:0<br>Angle0:0, Pilot0:0, Upper0:0, Lower0:0<br>Angle1:0, Pilot1:0, Upper1:0, Lower1:0<br>a<M2HQ 1>MOD2 FM PARMS: Invert:1, Activate:0, SplatterFilt:000, (Word1: 0x0002)<br>Ang0:0x00000000, Dev0:0x00199999, Pwr0:0x000000<br>Ang1:0x00000000, Dev1:0x00199999, Pwr1:0x000000 |
| MPCM | 1 | 1.4.0+ | **Maintenance Path Inbound Message Trace**<br>Incoming MP message from communications port with framing stripped off. The msg is translated into APDU formats and displayed with content headers.<br>***Cmd***:<br>D- Get value command<br>N - Get event or changed value command<br>W - Write value command<br>S - Software download command<br>Z- Repeat last response command<br>***Select***: N-Next, F-First (Only with N or D command)<br>***Seq***: One byte sequence code repeated from the Get Event or Changed Value Command | <MPCM 1> IN MSG-GET EVT: Cmd: N Seq: 112 Select: N<br><MPCM 1> IN MSG-GET EVT: Cmd: N Seq: 113 Select: N<br><MPCM 1> IN MSG-GET EVT: Cmd: N Seq: 114 Select: N<br><MPCM 1> IN MSG-GET EVT: Cmd: N Seq: 115 Select: N<br><MPCM 1> IN MSG-GET EVT: Cmd: N Seq: 116 Select: N |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| MPCM | 2 | 1.4.0+ | **Maintenance Path Inbound Data Trace** Displays incoming message as is, i.e., in hex bytes with all framing present. This message should be exactly what was received over the MP from the controller | <MPCM 2> INPUT DATA (Hex): 10 02 4E 83 4E 22 10 03<br><MPCM 2> INPUT DATA (Hex): 10 02 4E 84 4E 23 10 03<br><MPCM 2> INPUT DATA (Hex): 10 02 4E 85 4E 24 10 03<br><MPCM 2> INPUT DATA (Hex): 10 02 4E 86 4E 25 10 03<br><MPCM 2> INPUT DATA (Hex): 10 02 4E 87 4E 26 10 03 |
| MPCM | 4 | 1.4.0+ | **Maintenance Path Control Line Status** Displays the control line status (TX OK and RFC Request) whenever it changes, as reported to the MPCM task by the Station Hardware Manager Interface (SHMI) Task. | <MPCM 4> CONTROL LINE: Status: TX OK Line Up<br><MPCM 4> CONTROL LINE: Status: TX OK Line Down<br><MPCM 4> CONTROL LINE: Status: TX OK Line Up<br><MPCM 4> CONTROL LINE: Status: TX OK Line Down<br><MPCM 4> CONTROL LINE: Status: TX OK Line Up |
| MPCM | 8 | 1.4.0+ | **Maintenance Path Event or Parameter Update Trace.** Displays each queue message to the MPCM with a parameter update or an event. **ParamId:** (hex) Parameter Manager ID (0x64 = 100**)**<br>***Value***:<br>Event Report<br>***EventId***:<br>***Alarm Status***:<br>***Event Desc***: Description of event being reported. | <MPCM 8> EV/PARAM UPDT: ParamId: 0x64 Value: Unknown Parameter<br><MPCM 8> EV/PARAM UPDT: ParamId: 0x63 Value: Unknown Parameter<br><MPCM 8> EV/PARAM UPDT: EventId: 0x12 Alarm Status: F<br>Event Desc: Paging Disabled Alarm<br><MPCM 8> EV/PARAM UPDT: EventId: 0x12 Alarm Status: F<br>Event Desc: Paging Disabled Alarm |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| MPCM | 16 | 1.4.0+ | **Remote Software Download Trace** Displays progress of the software download as the copy to the FLASH bank is completed. Displays a message at the completion of the download before booting on the new bank (Attempting Cutover).<br>***Software Records Downloaded***: Updates after each 100 records (lines) are downloaded. | <MPCM 16> SFWR DNLD: Status: 100 Software Records Downloaded<br><MPCM 16> SFWR DNLD: Status: 200 Software Records Downloaded<br><MPCM 16> SFWR DNLD: Status: 300 Software Records Downloaded<br><MPCM 16> SFWR DNLD: Status: 400 Software Records Downloaded<br><MPCM 16> SFWR DNLD: Status: 500 Software Records Downloaded<br>:<br>:<br><MPCM 16> SFWR DNLD: Status: 8400 Software Records Downloaded<br><MPCM 16> SFWR DNLD: Status: 8500 Software Records Downloaded<br><MPCM 16> SFWR DNLD: Status: 8600 Software Records Downloaded<br><MPCM 16> SFWR DNLD: Status: Attempting Cutover |
| MPCM | 32 | 1.4.0+ | **Maintenance Path Outbound Message Trace** Displays outgoing message to communications port with framing stripped off. The msg is translated into APDU formats and displayed with content headers.<br>***Cmd***:<br>d- Get Value Reply<br>n - Get Event or Changed Value Reply<br>w - Write Value Reply<br>s - Software Download Reply<br>z- Repeat Last Response Reply<br>***Select***: N-Next, F-First (Only with N or D command)<br>***Seq***: One byte sequence code repeated from the Get Event or Changed Value Command | w 99 1<br>RFO FIPS: RW 99 1<br>RFO FIPS: w<br><MPCM 32> OUT MSG-GET EVT: Cmd: n Seq: 242 Status: E ID: 12 Alarm: F<br>Data: Paging Disabled Alarm<br>99 0<br>RFO FIPS: RW 99 0<br>RFO FIPS:<br><MPCM 32> OUT MSG-GET EVT: Cmd: n Seq: 243 Status: E ID: 12 Alarm: O<br>Data: Paging Disabled Alarm<br><MPCM 32> OUT MSG-GET EVT: Cmd: n Seq: 244 Status: N<br><MPCM 32> OUT MSG-GET EVT: Cmd: n Seq: 245 Status: N<br><MPCM 32> OUT MSG-GET EVT: Cmd: n Seq: 246 Status: N |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| MPCM | 64 | 1.4.0+ | **Maintenance Path Outbound Data Trace** Displays outgoing message as is in hex bytes with all framing present. This message should be exactly what is sent over the MP to the controller. | RFO FIPS: RW 99 1<br>RFO FIPS:<br><MPCM 64> OUTPUT DATA (Hex): 10 02 6E 0A 45 12 46 50 61 67 69 6E 67 20 44 69 73 61 62 6C 65 64 20 41 6C 61 72 6D 00 CB 10 03<br>w 99 0<br>RFO FIPS: RW 99 0<br>RFO FIPS:<br><MPCM 64> OUTPUT DATA (Hex): 10 02 6E 0B 45 12 4F 50 61 67 69 6E 67 20 44 69 73 61 62 6C 65 64 20 41 6C 61 72 6D 00 D5 10 03 |
| MPCM | 128 | | (Reserved for **Maintenance Path Errors**) This message **will** display informational or debugging errors for the RF-O! transmitter software development team use only. | Not implemented. |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| RFCQ | 1 | 1.4.0+ | **Control Command Trace** Used to verify plug and play control command information. Control commands are received by the Distributor DSP whenever the transmitter needs to dekey and/or keyup. Note: In a FLEX/ ReFLEX system it is possible to go several minutes or hours without the need for a control command, due to the fact that the transmitter remains keyed for long periods of time.<br>***f***: (first occurrence): frequency change. 0 - same center frequency as last control command. 1 - different freq.<br>***st***: Start time.<br>***f***: Center Frequency. 0 = Param 2000 frequency, 1=Param 2001.<br>***o3,o2,o1,o0***: Frequency offset for each of 4 possible subchannels.<br>***m3,m2,m1,m0***: Modulation type for each of 4 possible subchannels. 0= None, 1= FM, 2 = AM(Voice) | <RFCQ 1>CTL CMD: f: 0, st: 249f00, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2<br><RFCQ 1>CTL CMD: f: 0, st: 000000, f: 0, o3: 0, o2: 0, o1: 0, o0: 0, m3: 0, m2: 0, m1: 0, m0: 1<br><RFCQ 1>CTL CMD: f: 0, st: 8583b0, f: 0, o3: 0, o2: 0, o1: 0, o0: 0, m3: 0, m2: 0, m1: 0, m0: 1<br><RFCQ 1>CTL CMD: f: 0, st: ffffff, f: 0, o3: e, o2: 2, o1: f, o0: 1, m3: 0, m2: 0, m1: 0, m0: 1<br><RFCQ 1>CTL CMD: f: 0, st: 7270e0, f: 0, o3: 0, o2: 0, o1: 0, o0: f, m3: 0, m2: 0, m1: 0, m0: 1<br><RFCQ 1>CTL CMD: f: 0, st: 83fd10, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2<br><RFCQ 1>CTL CMD: f: 0, st: 5f5e10, f: 0, o3: 0, o2: 0, o1: 0, o0: f, m3: 0, m2: 0, m1: 0, m0: 1<br><RFCQ 1>CTL CMD: f: 0, st: 70ea40, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2<br><RFCQ 1>CTL CMD: f: 0, st: 4c4b40, f: 0, o3: 0, o2: 0, o1: 0, o0: f, m3: 0, m2: 0, m1: 0, m0: 1<br><RFCQ 1>CTL CMD: f: 0, st: 5dd770, f: 0, o3: 0, o2: 0, o1: 0, o0: 2, m3: 0, m2: 0, m1: 0, m0: 2 |
| RFCQ | 2 | 1.4.0+ | **Check Command Trace.** Displays key state (keyed/dekeyed) and center frequency information being reported to the controller in response to a Check command from the controller.<br>***KeyState:*** 1= Keyed, 0 = Dekeyed<br>***Freq:*** Center channel (0 - f hex).0 = Param 2000, 1 = Parm 2001, etc. | <RFCQ 2>CHECK CMD: KeyState: 1 Freq: 0x0<br><RFCQ 2>CHECK CMD: KeyState: 1 Freq: 0x0<br><RFCQ 2>CHECK CMD: KeyState: 1 Freq: 0x0 |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| SASM | 1 | 1.4.0+ | **1 Pulse-Per-Second Status**<br>Reports on status of the 1 PPS being received from the GPS receiver. The transmitter is disabled whenever the report is anything but “1 PPS IS VALID”. | <SASM 1>1PPS STAT: 1PPS STATUS: SIMULCAST ENABLED. PHASE REPORT ENABLED.<br><SASM 1>1PPS STAT: PHASE REPORT: 1PPS IS VALID.<br><SASM 1>1PPS STAT: PHASE REPORT: 1PPS WATCHDOG FIRED. REAQUIRE.<br><SASM 1>1PPS STAT: PHASE REPORT: 1PPS IS VALID.<br><SASM 1>1PPS STAT: PHASE REPORT: 1PPS IS VALID. |
| SHM | 1 | 1.4.0+ | **Power Supply Trace.** Monitors voltage and current draw on each of the power supplies. The power supply readings are taken upon every dekey, every FM keyup, and every 5 seconds while keyed or dekeyed constantly. The information displayed differs between 1-PA and 2-PA configuration.<br>**Single-PA Configuration.** If the current (Amps) difference between PS1 and PS2 is greater than the amount programmed in parameter 1027, the transmitter cuts back 3 dB. If power supplies appear to be fine, and an error occurs, verify that connectors J5, J6, J7, and J8 are properly connected to the OCM backplane.<br>**2-PA Configuration.** Displays only the voltage reading for both power supplies.<br>**Volts(s)**: Represents the 28 V sense-line on the A/D converter (~4.20 V sense line = 28 V)<br>***Amps(s)***: Only displayed on single-PA configuration. Current being drawn by the power supply. | (Single PA Display)<br><SHMI 1>PS: PS1=left: PS2=right<br>PS1=> 4.20 Volt(s), 1.96 Amp(s)<br>PS2=> 4.22 Volt(s), 3.14 Amp(s)<br><SHMI 1>PS: PS1=left: PS2=right<br>PS1=> 4.20 Volt(s), 10.98 Amp(s)<br>PS2=> 4.20 Volt(s), 12.35 Amp(s)<br><br>(2-PA Display)<br><SHMI 1>PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.20 Volt(s)<br><SHMI 1>PS: PS1=left: PS2=right<br>PS1=> 4.20 Volt(s): PS2=> 4.20 Volt(s)<br><SHMI 1>PS: PS1=left: PS2=right<br>PS1=> 4.20 Volt(s): PS2=> 4.22 Volt(s)<br><SHMI 1>PS: PS1=left: PS2=right<br>PS1=> 4.20 Volt(s): PS2=> 4.20 Volt(s)<br><SHMI 1>PS: PS1=left: PS2=right<br>PS1=> 4.22 Volt(s): PS2=> 4.20 Volt(s) |

*Table H-2: Traces*

| Trace | Flag | Version | Description | Example Output |
|---|---|---|---|---|
| SHMI | 2 | 1.4.0+ | **Ambient Temperature Trace**<br>Displays data from ambient temperature sensor located on the OCM module behind the front panel LED's.<br>***A/D***: Analog to Digital reading (0 to 255).<br>***Volt***: Converted A/D reading to a voltage (0 to 5 V DC)<br>***Curr***: Current Temperature. Converted from A/D reading.<br>***Filt***: Running average of all ambient temperature readings.<br>***Thresh***: PA temperature at which the transmitter will begin cutting back. (Param 1025 plus the average ambient temperature reading (**Filt:**)) | Ambient Temp- A/D: 99, Volt: 3.00VDC, Curr: 026C, Filt: 026C, Thresh: 056C<br>Ambient Temp- A/D: 9a, Volt: 3.02VDC, Curr: 028C, Filt: 026C, Thresh: 056C<br>Ambient Temp- A/D: 98, Volt: 2.98VDC, Curr: 025C, Filt: 026C, Thresh: 056C<br>Ambient Temp- A/D: 98, Volt: 2.98VDC, Curr: 025C, Filt: 026C, Thresh: 056C |
| SHMI | 4 | 1.4.0+ | **PA Temperature Trace.** Displays data related to the PA and ambient temperature readings.<br>***A/D***: Analog-to-digital reading from PA thermistor (0 to FF hex).<br>***Temp***: Temperature converted from A/D reading in degrees Centigrade.<br>***Curr***: Current ambient temperature read on OCM board.<br>***Filt***: Running average of all ambient temperature readings.<br>***Thresh***: PA temperature at which the transmitter will begin cutting back. (Param 1025 plus the average ambient temperature reading (**Filt:**)) | (Single PA Display)<br>PA 1 Temp- A/D: cf, Temp: 027C, Curr: 028C, Filt: 026C, Thresh: 056C<br>PA 1 Temp- A/D: cf, Temp: 027C, Curr: 028C, Filt: 026C, Thresh: 056C<br>PA 1 Temp- A/D: cf, Temp: 027C, Curr: 028C, Filt: 026C, Thresh: 056C<br>PA 1 Temp- A/D: cf, Temp: 027C, Curr: 025C, Filt: 026C, Thresh: 056C<br>PA 1 Temp- A/D: ce, Temp: 028C, Curr: 026C, Filt: 026C, Thresh: 056C |