

# **RF Power Meter**

## **USER MANUAL**

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## Introduction

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### RF Power Meter Description

The RF sensor and entire processing unit are packed on a single, small enclosure. It offers the convenience of a display (no computer required) - for bench measurements- and RS-232 or USB connection for automated measurement systems.

The technology is patent pending and covered by intellectual property legislation.

All readings are displayed on the front panel and are also available through a serial communication.

The RF Standard Power Meter can be powered by a wall power plug adapter, USB interface, or internal rechargeable battery.

### Items Supplied

- RF Power Meter
- 90VAC-264VAC wall plug adapter
- USB cable
- Installation USB media containing
  - User Manual (this manual)
  - USB software drivers
  - Virtual Front Panel
  - LabVIEW<sup>®</sup> serial drivers
- Pelican Case<sup>®</sup> with the manufacturer life-time warranty

### Optional Accessories

- Region specific wall plug adapter
- 3-1/8EIA to 1-5/8EIA adapter (for 50kW option)

## Specifications

<b>Nominal Impedance</b>	50Ω
<b>Nominal Power</b>	See the instrument front panel*
<b>Nominal Frequency</b>	See the instrument front panel*
<b>MAX Power Allowable</b>	120% of Nominal Power  LCD will display a message “ <i>Power Overload</i> ” if RF power is in excess of 120% of Nominal Power
<b>Max. Allowable Terminating VSWR</b>	Continuous use: VSWR 3:1
<b>Calibration Technique</b>	Frequency/Power/Temperature/Directivity calibration factors stored in nonvolatile memory
<b>Calibration Cycle, Nominal</b>	12 months
<b>Forward Power Accuracy at nominal frequency into 50Ω</b>	Depends on Calibration Method and Max Power. Refer to your specifications.  a) <b>Standard Calibration:</b> 1% of the reading or 0.1% of Max Power whichever is higher. <b>Generator Calibration Plane</b>  b) <b>Calorimeter Calibration:</b> 0.5% of the reading or 0.5W, whichever is higher <b>Load Calibration Plane</b>  Power and Temperature must be within specification limits. Frequency must be within specification limits and set to the carrier value
<b>Insertion loss</b>	< 0.05dB
<b>Directivity</b>	> 30dB
<b>Frequency Range</b>	See the instrument front panel*
<b>Harmonic rejection</b>	> 20dB **
<b>Pulsing capability</b>	10Hz – x10KHz range***
<b>Gamma</b>	Calculated from $P_r$ – Reflected power and $P_f$ - Forward power  $Gamma = \sqrt{\frac{P_r}{P_f}}$
<b>VSWR</b>	Calculated from Gamma

	$VSWR = \frac{1 + \Gamma}{1 - \Gamma}$
<b>Operating Power</b>	USB power (wall plug or computer) or battery
<b>Connectors</b>	Depends on the max power specification ****
<b>Batteries</b>	Li-Ion
<b>Battery Life</b>	12 Hours minimum
<b>Battery Charge Time</b>	6 hours maximum
<b>Battery Charger</b>	Built in. Power supplied by wall plug adapter or USB port
<b>Display</b>	LCD 4 lines of 16 characters
<b>Interfaces</b>	RS-232 standard, USB 2.0
<b>Output Data Rate, Nominal</b>	15 readings/second
<b>Operating Environmental conditions</b>	
<b>Humidity, Max.</b>	85% (non condensing)
<b>Operating Temperature range</b>	+68° to +95°F (20° to 35°C)
<b>Altitude</b>	78.8kPa to 106kPa (6,562 feet (2,000 m) to -1640ft (-500m)
<b>Case Temperature (imposed from exterior)</b>	<35°C (95°F)
<b>Storage/Transportation Environmental conditions</b>	
<b>Storage Relative Humidity, Max</b>	95% (non condensing)
<b>Altitude</b>	10,000 feet (3,000 m)
<b>Storage Temperature range</b>	-20° to + 70°C (-4° to +158°F)

\* Max Power levels for Forward and Reflected channels and frequency range can be customized (up to 50kW). The instrument displays the maximum power and frequency range upon power up.

\*\* Characteristic for narrow band instruments (with max ±5% frequency range)

\*\*\* The instrument performs hardware and software averaging for pulse (modulated) signals. Please read the [Averaging and Pulsing Signals Operation](#) chapter

\*\*\*\* N female for powers up to 1.5kW, HN female for powers up to 5kW, 7/16EIA and LC female for powers up to 12kW, 3-1/8EIA flange for powers up to 50kW

## Installation

This chapter provides information about preparing the RF Standard Power Meter for use.

### RF Line Connection

 **WARNING**

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is ON!



**CAUTION**

Do not exceed the specified Maximum Power Allowable for the device. Damage to the Power Meter may occur.



**NOTE: FLOATING RF SYSTEMS WARNING:** The RF line ground is connected to the USB and serial communication ground. The meter can be used on floating RF systems (where the RF ground is at a different potential than the USB or serial communication ground) only if a proper isolator is used (ex: an optical isolator). Using the meter without regarding this note can cause permanent damage to the meter and life hazard.

Observe the arrow on the front panel of the Power Meter. The arrow is indicating the direction of the RF power.

No damage will occur if the sensor will be connected in reverse direction but the values for the FWD and REW Power on the LCD display and on the serial communication will be also reversed.

Connect the end of the Power Sensor labeled “RF IN” to the RF source. Connect the end labeled “RF OUT” to the load or antenna.

 **WARNING**

**DO NOT USE MECHANICALLY OR ELECTRICALLY DAMAGED RF CONNECTORS. ANY TRACE OF RESIDUE MUST BE CLEANED BEFORE USING RF CONNECTORS. ENGAGE THE RF CONNECTORS ALL THE WAY IN. FAILING TO DO SO WILL RESULT INTO UNCONSISTENT READINGS AND/OR BURNED CONNECTORS**

Inspect the RF connectors and cables before use for:

- Burned, bent, pushed in or missing central connector. Do not use such cables!
- Residue on the insulators. Try and clean the insulator using Isopropyl alcohol.

Dry the insulator before use!

Torque the RF connectors to the manufacturer specifications. Failure to do so will result in unstable readings, damage of the connector and fire hazard.



**NOTE: SERIAL COMMUNICATION WARNING:** Typical RF systems are controlled by a CPU thru a serial connection (RS232/Devicenet/Profibus). At the same time the RF output is at ground connection. If the instrument is connected to the same CPU a ground loop is created. Depending on the ground leak current this configuration may or may not work.

The instrument may “freeze” if the ground leak current is too high. As a solution use either a serial isolator or use a separate CPU (other than the one used to communicate with the RF generator) to communicate with the instrument. If necessary, use ON/OFF button to reset the instrument.

## AC Line Connection

RF Power Meter is supplied with a universal (90VAC to 264VAC) wall plug adapter. Let us know if you are going to use the RF Power Meter outside U.S. so we can supply the proper wall plug.



**NOTE:** Notify RF Standard if you are going to use the device with non-U.S. voltages. A proper wall plug adapter will be provided.

## Chapter Two

# Operating Instructions

This chapter describes operator controls and indicators on the RF Power Meter. For remote operation using a USB or RS-232 interface, refer to the instructions in following two chapters

## Front Panel

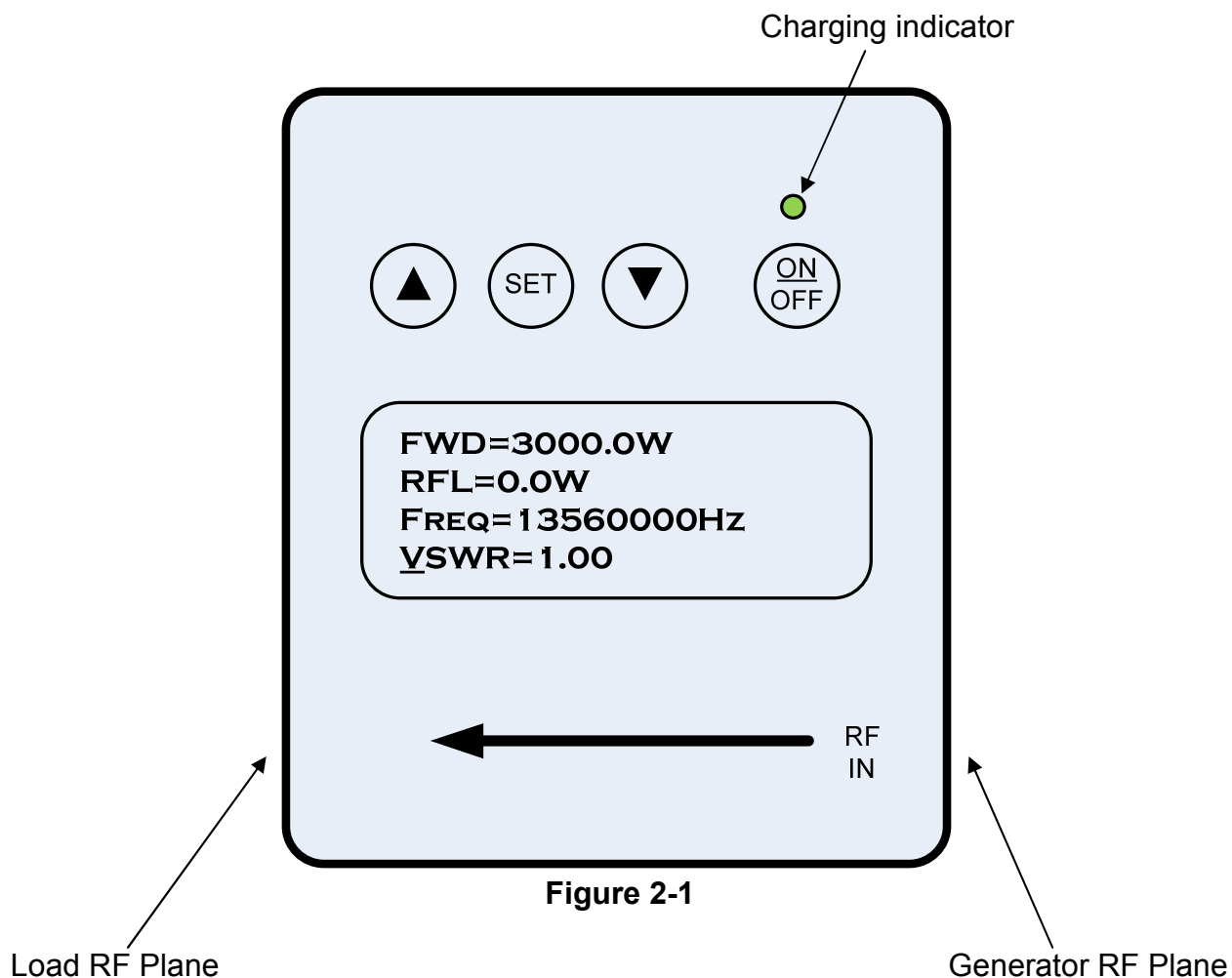






Figure 2-1



<b>Push Button</b>	<b>Description</b>
	Navigational button. Press to increase the set value or to move UP.
	Navigational button. Press to decrease the set value or to move DOWN.
	<p>Press to indicate the value that you want to set. It will change the cursor position between line 3 and 4 on display.</p> <p>If you want to change the frequency, position the cursor on line 3 (where the frequency is displayed) then increase/decrease the frequency value using the arrows.</p> <p>For additional information displayed (VSWR, Gamma, Temperature, #Averages), position the cursor on line 4 and use the arrows to navigate among options.</p>
	Press to turn the Power Meter On or Off. Keep the button pressed for at least 1 second for the command to take effect.

## Charging the battery

The charging LED is going to be ON if the Li-Ion battery is charging (from the USB connection or from the wall plug adapter). The LED will turn OFF when the battery is fully charged (4.2V)

Battery charge is performed either the instrument is ON or OFF.

Charging time to full capacity depends on how much the battery is discharged and the power source. Some computer USB ports are limiting the charging current. A full charge may take up to 6 hours.

Run time on battery is at least 12 hours (typically 16 hours) and decays with the age of the battery. Standard Li-Ion battery has a life of about 500 charging cycles.

Before a complete discharge (below 3.5V) the instrument will display a message to recharge and it shuts down automatically to protect the battery. Upon re-power, the instrument will re-start but if the low battery condition is detected it will shut down.

The instrument has full functionality during re-charging.



**NOTE:** Battery is not user accessible. User cannot replace the battery!

## Performing a High Accuracy Power measurement

There are several simple rules that will help the user perform accurate measurements:

- *Use only good cables and connectors.* Any sign of heating is a result of RF losses; therefore some of your RF power is lost as heat instead of being delivered to your application.
- *Careful grounding.* Ground loops (or lack of proper grounding) will affect the RF propagation, therefore is going to affect your application and the instrument readings.
- *Allow the instrument to stabilize with the temperature.* The instrument compensates for temperature and keeps the accuracy within specifications but during temperature transitions there are gradients that will affect the accuracy.
- *Observe the calibration plane: Generator or Load.* Take into consideration and compensate (if is the case) for the insertion loss of the instrument. The calibration plane is marked on the calibration label.
- *Accuracy degrades with VSWR.* The instrument is guaranteed to be accurate in  $50\Omega$  applications but it works also (with some limitations) into complex loads. Contact us if you need to perform 1% measurements into complex loads.
- *Select the frequency.* The instrument needs to be set to the actual frequency so it can perform adequate compensations.

## Averaging and Pulsing Signals Operation

The standard instrument works in two modes, depending on the number of averages (higher or lower than 32).

Up to 31 averages the firmware will perform an adaptive averaging: if the power level is increasing (or decreasing) with more than 10% the previous value, the averaging is reset and starts with the new power value. This feature is helpful for fast transition signals but it is a drawback when we are measuring pulsing signals. The adaptive averaging is disabled for averages higher than 32.

As a general rule, for pulsing/modulated signals higher averaging will give higher accuracy.

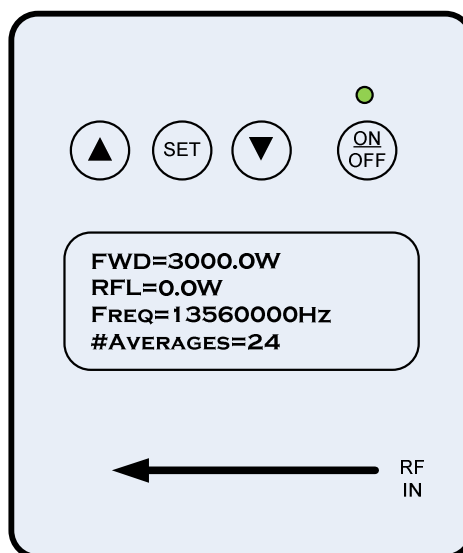
The RF Power Meter contains an internal low pass filter with a cut off frequency of 2 kHz, therefore this filter will average all signals (pulsed or modulated) with a higher frequency than 2 kHz.

For pulsing or modulated frequencies lower than 2 kHz we recommend to increase the number of averages (see serial commands chapter; format of command **rR**).

For very low frequencies (Hz-x10Hz) the averaging must be carefully selected and it must be correlated with the duty factor. Standard instrument takes about 65mS to do a measurement.

Maximum number of averaging elements is limited to 254.

From the front panel display press the set button until the 4<sup>th</sup> line is underlined. After that press either arrow button until the #Averages line is displayed. During normal operation the display will look like Fig 2-1.



**Figure 2-2**

## Chapter Three

**Serial Interface**

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USB communication has a MASTER function over RS232. If both cables (USB and RS232) are connected, the instrument will communicate thru USB. If the USB cable is disconnected from the computer the serial communication is defaulted to RS232.

Refer to USB interface chapter for further details.



**NOTE: SERIAL COMMUNICATION WARNING:** Typical RF systems are controlled by a CPU thru a serial connection (RS232/Devicenet/Profibus). At the same time the RF output is at ground connection. If the instrument is connected to the same CPU a ground loop is created. Depending on the ground leak current this configuration may or may not work.

The instrument may “freeze” if the ground leak current is too high. As a solution use either a serial isolator or use a separate CPU (other than the one used to communicate with the RF generator) to communicate with the instrument. If necessary, use ON/OFF button to reset the instrument.

**Serial Communication Flow Control**

Operators should understand EIA Standard RS-232-C and have basic computer programming skills before attempting serial communication with the device.

The RF Standard RS-232 interface has the communication parameters fixed (factory set) and the user cannot change them.


<b>Baud rate</b>	19200
<b>Data bits</b>	8
<b>Parity</b>	None
<b>Stop bits</b>	1
<b>Flow Control</b>	None



**NOTE:** There is a delay of 65mSec between sending the command and reading or implementing the result. When programming, a delay of at least 65mSec should be implemented between serial write and read commands.



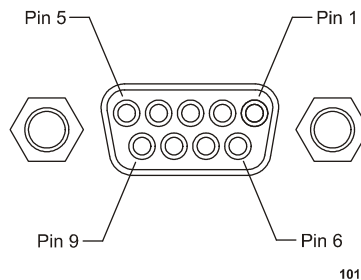
**NOTE:** All the data sent by the device is followed by <CR> (carriage return) character.

 **NOTE:** No termination has to be sent to the device. Sending a termination will either make the instrument to ignore or delay the command.

The device can stream data at a rate of 15 readings/second. This speed can be sustained if all parameters are within specifications (power, frequency) and no key is pressed. Key activation has a higher priority and may delay the serial communication. We recommend sending a **Key Lock** command (to lock the keyboard) in order to preserve the communication rate.

## Serial Cable Connector

The serial RS-232 host port connector is a 9-pin, female, shielded subminiature-D connector. A standard 9-pin serial cable can be used for serial communication.



**Figure 3-1**

## Command Syntax



**NOTE:** All commands are case sensitive.

There are two types of commands: **Read** and **Set**.

**Read** commands are executed by sending 2 characters. No termination has to be sent. Sending a termination will either make the instrument to ignore or delay the command.

**Set** commands are executed by sending 2 characters and <CR> followed by a delay of at least 65mSec followed by 3 or 4 decimal digits.

Read/Write Command	Description
RS	Resets the device. It takes 10 seconds for a full RESET and auto-calibration. Do NOT send any serial commands during this period of time.
PM	Reports the Maximum Power of the FWD Channel
Pm	Reports the Maximum Power of the RFL Channel
FM	Reports the Nominal Maximum Frequency of the device
Fm	Reports the Nominal Minimum Frequency of the device
FS XXXX	Set the current frequency
FR	Reports the current frequency
FV	Reports the Firmware version
CD	Reports the calibration date
SN	Reports the Serial Number

SW	Reports the VSWR
GA	Reports the Gamma
PC	Reports the Forward and Reflected Power
FC	Reports the Forward Power
RC	Reports the Reflected Power
ER	Reports the number of Errors
BT	Reports the voltage of the internal bus
TE	Reports the temperature of the RF sensor
KL	Locks/Unlocks the device keyboard
K?	Reports the status of the keyboard (locked=1,unlocked=0)
rR<CR>xxx	Set the number of averages
A?	Reports the number of averages

Table 3.1




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<b>Re Set</b>	Format	RS
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FUNCTION – will reset the device

 NOTE: Reset takes 10 seconds. Do NOT send any serial commands during this period of time!

IMPLEMENTATION – **RS**

The device will reset. All the settings will go to default values. The LCD will display the device information (serial number, firmware version, power and frequency specifications, last calibration date).

---

<b>Power Max</b>	Format	PM
------------------	--------	----

---

FUNCTION – will return the nominal maximum power supported by the FWD channel of the device

 NOTE: Allow 65mSec between the write and the read commands.

IMPLEMENTATION – **PM**

The device can measure above the nominal maximum power but the accuracy is not guaranteed by the manufacturer

The answer has the following format:

**PFWDMax=xxxxxW**

The answer has a variable length depending on the number of digits to be displayed

---

<b>Power m</b>	Format	Pm
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---

FUNCTION – will return the nominal maximum power supported by the RFL channel of the device

 NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – Pm**

The device can measure below the minimum power but the accuracy is not guaranteed by the manufacturer

The answer has the following format:

**PRFLMax=yyyyyW**

The answer has a variable length depending on the number of digits of the min power.

---

Frequency <b>Max</b>	Format	FM
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FUNCTION – will return the nominal maximum frequency of the RF signal supported by the instrument



NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – FM**

The device will do measurements outside the frequency range but they may not be within the manufacturer accuracy specifications.

The answer has the following format:

**FMax=ccccccHz<CR>**

The answer has a variable length depending on the number of digits of the frequency.

---

Frequency <b>min</b>	Format	Fm
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---

FUNCTION – will return the nominal minimum frequency



NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – Fm**

The device will do measurements outside the frequency range but they will not be within the manufacturer accuracy specifications.

The answer has the following format:

**FMin=cccccccHz<CR>**

The answer has a variable length depending on the number of digits of the frequency.

---

Frequency Read	Format	FR
----------------	--------	----

---

FUNCTION – will return the frequency of the device



NOTE: Allow 65mSec between the write and the read commands.



NOTE: The device cannot measure the frequency. Setting the right frequency is mandatory for accurate power measurement.

IMPLEMENTATION – **FR**

The device will report the value of the frequency set by the user. Nominal frequency is the default frequency. Upon power up or reset the device will start with the nominal frequency.

The answer has the following format:

**Freq=cccccccHz<CR>**

The answer has a variable length depending on the number of digits of the frequency.

---

Firmware Version	Format	FV
------------------	--------	----

---

FUNCTION – will return the firmware version



NOTE: Allow 65mSec between the write and the read commands.

IMPLEMENTATION – **FV**

The answer has the following fixed format:

**FV=cc.cc<CR>**

The answer has a fixed length of 9 bytes (including the Carriage Return).

---

<b>Calibration Date</b>	Format	CD
-------------------------	--------	----

---

FUNCTION – will return the date of the last calibration



NOTE: Allow 65mSec between the write and the read commands.

IMPLEMENTATION – **CD**

The answer has the following fixed format:

**CD=DDMMYY<CR>**

The answer has a fixed length of 10 bytes (including the Carriage Return).  
The format is DDMMYY

---

<b>Serial Number</b>	Format	SN
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---

FUNCTION – will return the serial number of the device



NOTE: Allow 65mSec between the write and the read commands.

IMPLEMENTATION – **SN**

The answer has the following fixed format:

**SN=cccccc<CR>**

The answer has a fixed length of 10 bytes (including the Carriage Return).

---

<b>Standing Wave</b>	Format	SW
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---

FUNCTION – will return the VSWR



NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – SW**

The answer has the following fixed format:

**VSWR=c.cc<CR>**

The answer has a fixed length of 10 bytes (including the Carriage Return).

---

<b>Gamma</b>	Format	GA
--------------	--------	----

---

FUNCTION – will return the Gamma



NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – GA**

The answer has the following fixed format:

**Gamma=c.cc<CR>**

The answer has a fixed length of 11 bytes (including the Carriage Return).

---

<b>Power Carrier</b>	Format	PC
----------------------	--------	----

---

FUNCTION – will return the Forward and Reflected Power



NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – PC**

The answer has the following fixed format:

**Fwd=xxxx.xW Rfl=yyyy.yW<CR>**

The answer has a fixed length of 24 characters (including Carriage Return)  
xxxx.x is the Forward power and yyyy.y is the Reflected power. The format of the power is on 4 digits. If the power level requires less than 6 digits an empty space will be send (the length of the answer will remain 24 characters)

<b>Forward Carrier</b>	<b>Format</b>	<b>FC</b>
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---

FUNCTION – will return the Forward Power Carrier

 NOTE: Allow 65mSec between the write and the read commands.

IMPLEMENTATION – **FC**

The answer has the following fixed format:

**Fwd=xxxx.xW<CR>**

The answer has a fixed length of 12 characters (including Carriage Return) xxxx is the Forward power. The format of the power is on 6 digits. If the power level requires less than 6 digits space character(s) will be sent (the length of the answer will remain 12 characters)

---

<b>Reflected Carrier</b>	<b>Format</b>	<b>RC</b>
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---

FUNCTION – will return the Reflected Power Carrier

 NOTE: Allow 65mSec between the write and the read commands.

IMPLEMENTATION – **RC**

The answer has the following fixed format:

**Rfl=yyyy.yW<CR>**

The answer has a fixed length of 12 characters (including Carriage Return) Yyyy.y is the Reflected power. The format of the power is on 6 digits. If the power level requires less than 6 digits a space character(s) will be sent (the length of the answer will remain 12 characters)

---

<b>ErRors</b>	<b>Format</b>	<b>ER</b>
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---

FUNCTION – will return the Reflected Power

 NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – ER**

The answer has the following fixed format:

**Error=zzz<CR>**

The answer has a variable length depending on the number of errors

---

<b>BaTtery</b>	Format	BT
----------------	--------	----

---

FUNCTION – will return the voltage of the bus



NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – BT**

The answer has a fixed length of 11 characters (including Carriage Return)

**Buss=c.cc<CR>**

If the device is an option with rechargeable battery then the buss voltage is the battery voltage. The device will perform an auto-shutdown when the battery voltage is below 3.3V. Before shutdown a message will be displayed on the screen.

---

<b>TempErature</b>	Format	TE
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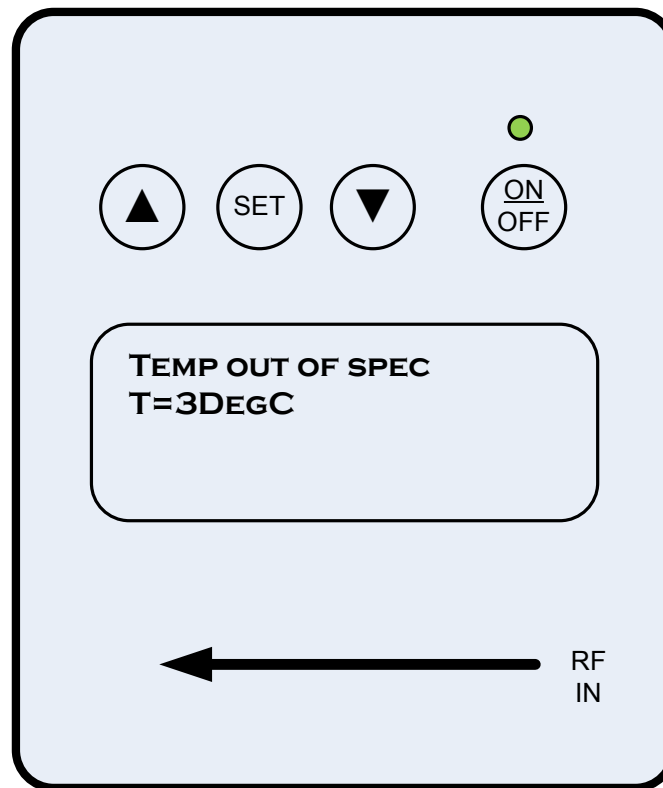
FUNCTION – reports the temperature of the RF sensor



NOTE: Allow 65mSec between the write and the read commands.

**IMPLEMENTATION – TE**

The value of the temperature is used to correct the reported values.

**Figure 3-2**


Extreme temperature values (too high or too low) are not supported (see specifications) and the readings may be out of the accuracy specifications. In these cases the meter will display a specific message (see Fig 3.1). In this case we recommend waiting for the temperature to reach the specifications limits.

---

**KeyLock**                      Format                      KL

---

FUNCTION – locks/unlocks the device keypad

 NOTE: The command is useful when we intend to use the device as a remote monitor and we do not want any unauthorized changes from the keypad. The command will not lock the Power button.

IMPLEMENTATION – **KL**

To confirm the action the device will display the message:

**KeyL**

---



**Key?**            **Format**            **K?**

---

FUNCTION – will return the status of the keyboard



NOTE: Allow 65mSec between the write and read commands.

IMPLEMENTATION – **K?**

The answer has the following fixed format:

**Keyboard=1<CR>** (the keypad is locked)

Or

**Keyboard=0<CR>** (the keypad is not locked)

The answer has a fixed length of 11bytes (including Carriage Return)

---

**Averages?**            **Format**            **A?**

---

FUNCTION – will return the number of averages



NOTE: Allow 65mSec between the write and read commands.

IMPLEMENTATION – **A?**


The answer has the following fixed format:

**#Averages=xxx<CR>**

The answer has a variable length depending on the number of digits to be displayed

When measuring pulsing signals the number of averages is critical. Read also the chapter [Averaging and Pulsing Signals Operation](#).

**Set** commands are executed by sending 2 characters followed by a delay of at least 65mSec followed by 3 or 4 decimal digits. No termination has to be sending. Sending a termination will either make the instrument ignore or delay the command.

 **NOTE:** Set command must be complete. The device will wait for the entire information.


<b>Set Command</b>	<b>Description</b>
FS	Will set the current frequency
rR	Will set the number of Averages

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<b>Frequency Set</b>	<b>Format</b>	FS<CR>XXXX
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---

FUNCTION – will set the carrier frequency.

 **NOTE:** The device cannot measure the frequency. It is important to set the frequency for accurate power measurement. At power up the device will start with the nominal frequency

### IMPLEMENTATION – **FS 1342**

The command has two parts. First send the FS characters followed by enter <carriage return> characters and after a delay of at least 65mSec send the first 4 digits of the frequency.

If the value send is outside the range an error message will be displayed for a second on LCD “*Freq out of spec*” and the frequency will remain unchanged.


If the command was successful the new frequency is displayed on the LCD and it can be read using the command **FR**.

---

<b>rR</b>	<b>Format</b>	rR <CR>XXX
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---

FUNCTION – will set the number of elements for the circular average

 NOTE: The device is performing an adaptive averaging for 31 or less averages. The instrument will restart with the last average settings. Factory default (as shipped) is 24 and cannot be changed from the instrument keyboard (only using serial communication)

If the number of averages is below 32 then the averaging will be restarted every time a 10% change in power is detected. This mode is proper for continuous RF signals.

For averages above 32 (including 32) the instrument will do a continuous averaging. This mode is proper for pulsing or modulated signals.

Read also the [Averaging and Pulsing Signals Operation](#) chapter.

#### IMPLEMENTATION – **rR<CR> 010**

The command has two parts. First send the rR followed by enter <carriage return> characters and after a delay of at least 65mSec send the 3 digits of the average. For example 6 averages should be coded with 3 digits as: 006. The limit of averages is set at 254.

If the command was successful the new average is displayed on the 4<sup>th</sup> line on the LCD (you may have to scroll on the menu of the 4<sup>th</sup> line).

## Chapter Four

# USB Interface

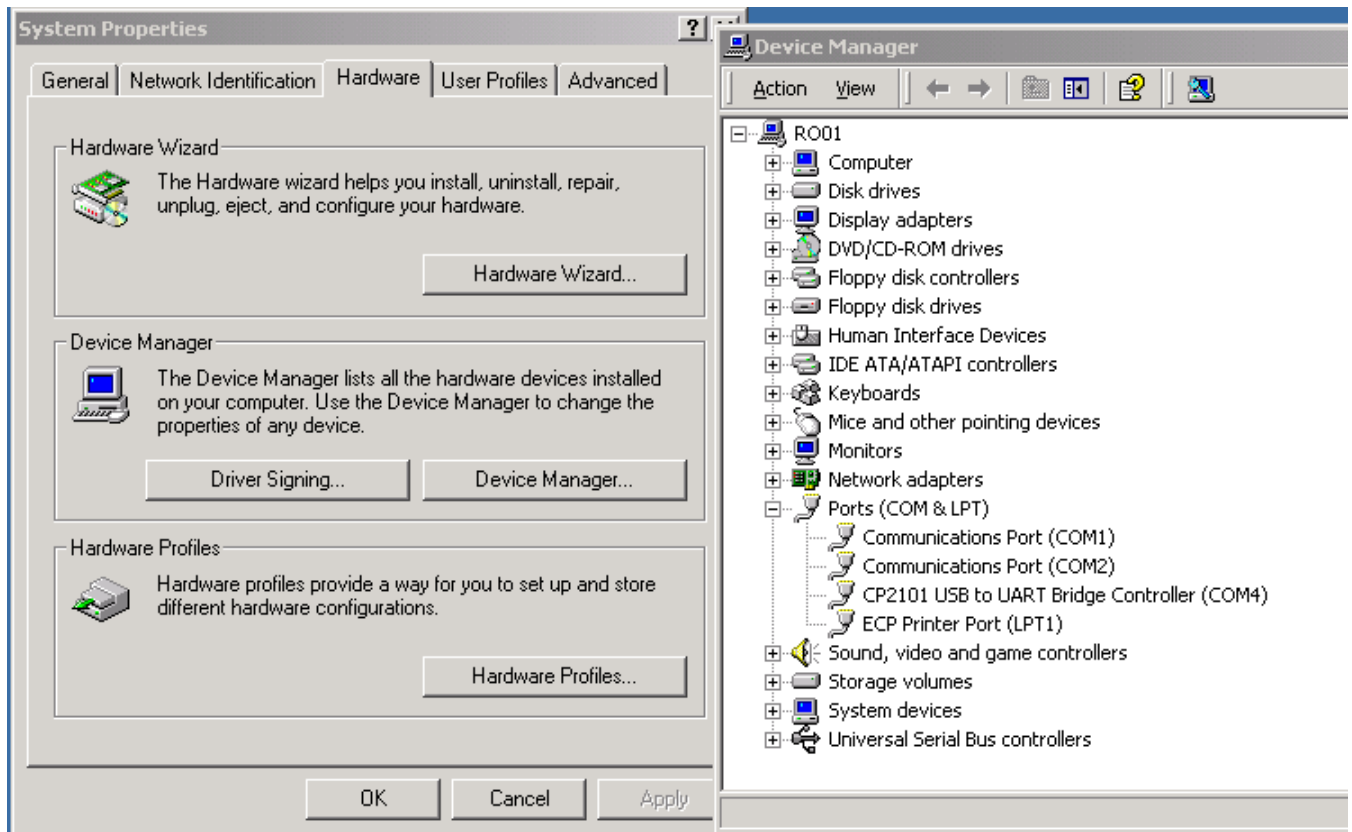


The RF Power Meter interface is USB2.0 Compatible.

USB interface contains a “bridge” that translates the USB communications to a RS232 communication. Practically the software drivers will install first the USB resources and after that will create a virtual RS232 port.


There are two notes **in red** regarding “how to” handle USB that should be followed in order to avoid software errors.


It is a good practice to check under System Properties, HARDWARE tab that a serial port is listed as *CP2102 USB to USART Bridge Controller*



The above window capture is from Windows 2000 Pro

Upon successful installation of the USB drivers one can use serial commands to communicate with the RF Power Meter. See previous chapter for serial commands.

 **NOTE: Always first power ON the RF Power Meter and only then connect USB cable.** Upon USB connection the instrument does a USB initialization that is possible only if it is powered. Not following this instruction does not affect the instrument but it can make the USB communication difficult to establish.

 **NOTE: Always first turn OFF the acquisition software (VFP or any custom software) and only then disconnect USB cable.** Upon USB disconnection of the USB cable the virtual serial port is removed from the computer system. Any software that is exchanging information with the virtual port it will lock or will give an error.

The charging LED is going to be ON if the battery is charging from the USB. The LED will turn OFF once the battery is charged.

Battery charge using USB is performed either the instrument is ON or OFF. The instrument is not affected if both cables (USB and power cable – from the AC adapter) are connected at the same time.

On the following installation instructions we assume that the operator is using the CD (or USB media) provided and the CD (or USB media) is mapped on the computer as D:\. If you downloaded the drivers, use the proper location to refer to the drivers.

USB communication has a MASTER function over RS232. If both cables (USB and RS232) are connected, the instrument will communicate thru USB. If USB cable is disconnected the serial communication is defaulted to RS232.

## Virtual COM Port Driver Installation Windows 2000

Follow these steps to install the Windows 2000 USB driver:

1. Connect the USB cable between the host computer and the RF Power Meter.
2. Windows will open a “Found New Hardware Wizard” window. Press Next to continue
3. Select “Search for a suitable driver for my device (recommended)” and press next.
4. Check “Specify a location” and press Next
5. Press Browse to locate the “slabbus.inf” driver installation file. The default location is the “D:\WIN” directory. Once this file is selected press OK.
6. Verify that the correct path and filename are shown and press “Next”.
7. Press Finish to finish installing the “CP210x USB Composite Device”.

8. Windows will open a second “Found New Hardware Wizard” window. Press Next to continue.
9. Select “Search for a suitable driver for my device (recommended)” and press “Next”.
10. Check “Specify a location” and press Next
11. Press Browse to locate the “slabw2k.inf” driver installation file. The default location is the “D: \WIN” directory. Once this file is selected press OK.
12. Verify that the correct path and filename are shown and press “Next”.
13. Press Finish to finish installing the “CP210x USB to UART Bridge Controller”

## Virtual COM Port Driver Installation Windows XP / 7

Follow these steps to install the Windows XP or Windows 7 USB driver:

1. Connect the USB cable between the host computer and the RF Power Meter.
2. Windows will open a “Found New Hardware Wizard” window.
3. Select “Install from a list of specific locations (Advanced)” and press “Next”.
4. Select “Include this location in the search”
5. Press Browse to locate the “D:\WIN” directory. Once this file is selected press OK.
6. Verify that the correct path and filename are shown and press “Next”.
7. Press Finish to finish installing the “CP210x USB Composite Device”
8. Windows will open a second “Found New Hardware Wizard” window.
9. Select “Install from a list of specific locations (Advanced)” and press “Next”.
10. Select “Include this location in the search”
11. Press Browse to locate the “D: \WIN” directory. Once this file is selected press OK.
12. Verify that the correct path and filename are shown and press “Next”.
13. Press Finish to finish installing the “CP210x USB to UART Bridge Controller”

## Virtual COM Port Driver Installation Macintosh

Follow these steps to install the Macintosh driver:

To install the Macintosh OS-X virtual COM port driver, extract the **cardinal-osx-V1\_00c-release.zip** file located in the D:\MAC directory. Next, run the extracted file **SLAB\_USBtoUART Installer**.

Macintosh OS-9 virtual COM port drivers are currently available by request only.

## Virtual COM Port Driver Installation Linux 2.40

Follow these steps to install the Linux USB driver:

The Linux virtual COM port driver included support Linux versions 2.40 and later. To install the driver, extract the **cardinal-redhat-V0\_81a.tar** file located in the D:\LINUX directory. Next, run the extracted file **load\_mcci\_usb**. To uninstall the driver, run the extracted file **unload\_mcci\_usb**.

## Chapter Five

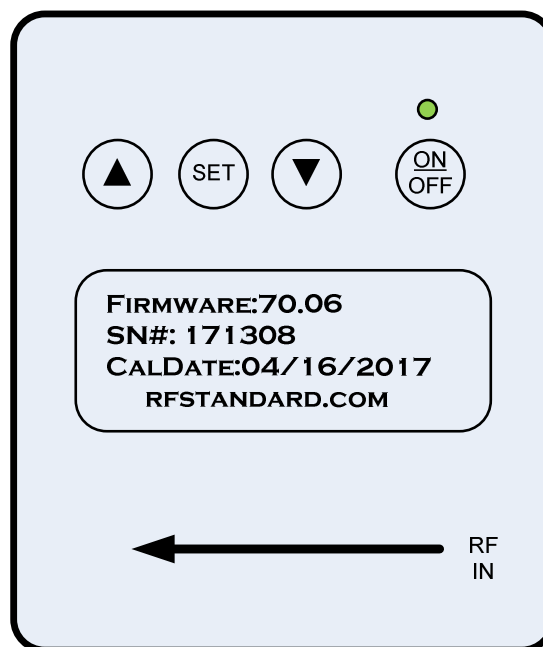
## Maintenance

This chapter describes routine maintenance, along with troubleshooting instructions for the RF power meter.

### Calibration

Recommended calibration time interval for standard instruments is 12 Months. Transfer standards (higher accuracy) or custom standards can have a lower calibration period (typical 6 months).

Upon power up the device will display the last calibration date.



**Figure 5-1**

Schedule a calibration by phone or email. Log on to [www.rfstandard.com](http://www.rfstandard.com) for contact information. Have the SN# and contact information available when contacting us.

### Battery Maintenance

The battery is NOT accessible by user. All the charging discharging cycles are managed by specialized electronics.

Li-Ion batteries can support at least 500 full cycle charges/discharge cycles. This is equivalent to a minimum 2 year lifetime.



## Cleaning

 **WARNING**

**NEVER ATTEMPT TO CONNECT OR DISCONNECT RF EQUIPMENT FROM THE TRANSMISSION LINE WHILE RF POWER IS BEING APPLIED. LEAKING RF ENERGY IS A POTENTIAL HEALTH HAZARD.**

The Power Meter requires simple, routine maintenance.

- Check the RF connectors and cables for damage.
- Clean the connector contacts with pure isopropyl alcohol. Wait until the contacts are properly dried before use!

 **WARNING**

**THE RF POWER METER CONTAINS NO USER-SERVICEABLE PARTS. DO NOT REMOVE ITS COVER.**



**CAUTION**

**Do not use harsh or abrasive detergents for cleaning.**

Clean the RF Power Meter and its display with a soft cloth dampened with mild detergent and water only.

## Troubleshooting

**⚠ CAUTION**

Due to the complexity of the RF Power Meter, field repairs beyond general maintenance should not be attempted. Removal or disturbance of the instrument cover will affect the calibration and will result in cancellation of the warranty.

If a malfunction is not listed or is not corrected by the listed corrective actions, contact the manufacturer

Thermal devices insure internal protection. There are no fuses to change!

Problem	Possible Cause	Correction
Meter has no power	Did you press the ON/OFF button?	Press the ON/OFF button
	Battery is discharged	Connect the USB connection to charge the battery
Display is blank or not updating	Improper serial commands	Reset the device by cycling the power (press the ON/OFF button)
	Battery is discharged	Connect the USB connection to charge the battery
Meter turns off while on battery power	Battery is discharged	Connect the USB connection to charge the battery
Frequency value is not increasing/decreasing when I press UP/DOWN button	You reached the frequency limit of the device	Consult the specifications of the device for frequency range
VSWR and/or Gamma values are unstable	Forward power is very low	Repeat the measurement at high power or use a device with higher accuracy at low RF power
Push buttons do not respond	Random serial commands/improper serial commands	Reset the device by cycling the power (press ON/OFF button)
	The keyboard was locked using a serial command. <b>KeyL</b> message on the upper right corner of display?	Use serial command <b>KB</b> to unlock the keyboard

Meter displays "Temp out of range" message	Temperature of the ambient is out of specifications	Wait until the meter reaches a temperature within specifications	
Meter does not respond to serial commands	Serial/USB cable connected?	Connect the serial cable	
	Serial cable too long or routed thru un-compliant ports/cards	Standard serial cable should be 6 ft. Some hubs and laptops use un-compliant 100% chip-set. Use a different computer	
	Serial/USB cable OK?	Use the cable provided with the meter	
	Serial port –hardware- is listed under computer resources?	Check the computer hardware resources	Use Hyper-terminal program to check communication
		Check that the proper COM port is assigned	
Check that no other software is using the same COM port			
	Cycle the power to the meter		

## Chapter Six

**Warranty**

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**Limited Warranty**

The products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be -at his discretion- to either: issue credit (up to the invoice value), repair or replace any item or part thereof which is proved to be other than as warranted. No allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repair, or any other work.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation charges paid by Buyer).

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by the Buyer or acquired from others at the Buyer's request and/or Buyer's specifications.

The warranty does not cover mechanical damages, bent, pushed in or burned connectors.

For the warranty to apply, the Power Meter must be used according to the user manual, the maximum power rating must not be exceeded, the Power Meter circuit must be properly terminated and not subjected to physical abuse and the manufacturer warranty sticker must be intact.

The warranty is lost if the instrument is altered or modified by the customer.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages.

**SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.**