RF 303 Manual Update

P/N 3031000, Rev. A5

This manual update contains information pertaining to the operation of the RF303 and the interpretation of its results, and includes revisions to the Operator's Manual. Bio-Tek feels that understanding this information will ensure efficient and effective use of the RF303, allowing the user to achieve the full benefit of our product.

The following topics are discussed in this manual update:

1. RF303 Load Issues (how readings are affected due to frequency and measurement technique)
2. Interpretation of RF303 Fluctuating Readings
3. The Signal Averaging Mode (SAM)
4. Description of the RS-232 Function
5. Revisions to the RF303 Operator's Manual

1. RF303 Load Issues

The load resistors typically used in ESU analyzers are not "ideal"; they possess some reactive components that are frequency dependent. The RF303 derives applied power by measuring the voltage across the set load and calculating the power (V^2/R). Most other ESU analyzers on the market derive the applied power by measuring the current flowing through a set load and calculating the power (I^2*R). At fundamental frequencies below 500 kHz and regardless of the load setting, the two methods of measurement are comparable. Above 500 kHz, and at the extremes of the loads, the readings displayed by the two methods will differ on opposite sides of the expected value.

As an example, when testing the Conmed™ Excalibur™ Electrosurgical Unit in the monopolar output with the RF303 load set to 50 ohms, the set value on the Conmed will correlate with the displayed value on the RF303. When in the Bipolar mode, the RF303 will display higher than expected values – up to 35% higher. The same test performed on some current measuring analyzers will produce lower than expected values. This is due to the difference in fundamental frequencies between the monopolar and bipolar modes. In this case, the Conmed operates at 500 kHz in monopolar mode and 1 MHz in bipolar mode. When comparing readings measured with a V^2/R device to readings measured with an I^2*R device, total measurement difference will likely be larger than 35%, due to different methods of deriving power.

This does not mean that the RF303 is malfunctioning or in error. Rather, it reflects the different results the two measurement techniques will produce when the load deviates from the nominal value used in the power calculations. It should be noted that most ESU manufacturers use the current measuring technique to calibrate production units.

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2. Interpretation of RF303 Fluctuating Readings

The RF303 incorporates an accurate digital measurement system that operates in three modes. The first measurement mode (default mode) utilizes a relatively short sampling time and does not filter or average ESU output. The two selectable measurement modes utilize longer sampling times that average ESU output. When using the default measurement mode, the user may observe some electrosurgery unit (ESU) output readings that fluctuate plus or minus 10% or more depending on the unit under test. ***This is normal operation and is not indicative of a problem with the RF303.***

When fluctuating readings are observed with the RF303, the technician should take note and determine if this is normal behavior for the ESU under test, or if this behavior is a sign of a problem.

- Older ESUs may have unstable output due to old technology or design. This is typical and is acceptable based on the manufacturer's limits.
- Many newer-generation ESUs utilize instantaneous feedback loops, which constantly adjust the output and can cause an oscillating effect. This is also satisfactory and is considered normal for these devices.
- In some cases, fluctuating ESU power output is evidence of a problem. Fluctuating output on some ESUs may indicate the weakening of output from power transistors or other ESU ailments and is not acceptable.

If an ESU normally has fluctuating output, then operating the RF303 in one of the Signal Averaging Modes (SAM) may be desirable. SAM significantly reduces fluctuating readings on the display of the RF303 making it easy for the technician to read an average value.

3. The Signal Averaging Mode (SAM)

Upon power-up, the RF303 defaults to the instantaneous algorithm for power output measurement, which will show fluctuating ESU output if it exists. The user can select the desired SAM by depressing the ***"mode select"*** and ***"- ohm select"*** keys simultaneously; each time the user initiates this key sequence, the RF303 will increment to the next mode. Starting at the default mode ("F 0"), the next mode entered is the ***one-second*** signal-averaging mode ("F 1" will appear on the display). Initiating the key sequence again will select the ***two-second*** signal averaging mode ("F 2" will appear on the display). Initiating the key sequence again brings the unit back to the default instantaneous mode ("F 0" will appear on the display), and so on.

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4. Description of the RS-232 Function

The user can operate the RF303 locally or remotely. Local mode is the default, by which the user manually controls the analyzer by pressing the buttons on the front panel. The user sets the desired test load, and then indicates whether to measure in watts or current. All test load and measurement values appear on the display. Two remote modes are also available: Simplex Mode (unidirectional communication) and Duplex Mode (bi-directional communication).

Simplex Mode: In this mode, the user controls operation of the RF303 from the front panel. By pressing the *"Mode Select"* key, the user can transmit a fixed data string to a host device that includes the ESU readings (in watts), HF current (in milliamps), and test load value (in ohms). Data is sent to a host device at a fixed baud rate. The RF303 cannot receive commands from a remote terminal or computer.

To set up and operate the RF303 in Simplex Mode:

1. Connect the RF303 to the computer with a serial interface cable, BTI P/N 75034.
2. Set the computer to receive data at a baud rate of 2400 with 8 data bits, no parity, and 1 stop bit.
3. With the RF303 power turned off, press and hold both the *"+Ohms Select"* and "- *Ohms Select"* keys located on the front panel.
4. Power on the RF303, and then release both keys when the double beep is heard.
5. Set up the RF303 to conduct the desired ESU measurement.
6. Press and release the *"Mode Select"* key to transmit the data while a measurement is displayed.
7. Data is then transferred in the format:

   Watts =XXXX, I=YYYY, Load =ZZZ.

8. To exit Simplex Mode, power off the RF303.

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7. Data is then transferred in the format:

   Watts =XXXX, I=YYYY, Load =ZZZ.

8. To exit Simplex Mode, power off the RF303.

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Duplex Mode: In this mode, the user controls operation of the RF303 from a remote terminal or computer by issuing specific remote commands that control all features of the RF303. The user can view test data received as a result of sending a remote command on the host controller's display. In Duplex Mode, all front panel keys are "locked out" to allow all functions to be under full direction of the host controller.

To set up and operate the RF303 in Duplex Mode:

1. Connect the RF303 to the computer with a serial interface cable, BTI P/N 75034.
2. Set the computer to communicate with a baud rate of 2400 with 8 data bits, no parity, and 1 stop bit. **Note:** Serial port flow control does not use either XON/XOFF signals or hardware flow control (RTS/CTS).
3. Power on the RF303 without pressing any keys.
4. To set the RF303 in Remote Mode, send the GOTOREMOTE command. After the command is received by the RF303, four horizontal bars appear on the display. Since the controlling computer always receives a return value, a response, the asterisk will be displayed on the monitor.
5. Control the RF303 with the desired commands.
6. To exit Remote Mode and return to Local Mode, send the GOTOLOCAL command.

Note: Observe the following while operating in Duplex Modes:

1. Commands must be terminated by a carriage return/ line feed (CR) (LF).
2. Setup commands always end with the colon character and a parameter: (plus the parameter)

   For example, the setup command *SETLOAD* requires the colon followed by the load value (in ohms): *SETLOAD: 50*
3. Multiple commands (or parameters) are separated by commas. All possible command (parameter) choices are shown. Unless otherwise stated, the default parameters are listed first.
4. As mentioned earlier, every command returns a value as a response. The return value may be a string of alphanumeric characters. Commands that do not require any special return value will show the star character * simply to indicate that the command has been executed.

Duplex Mode: In this mode, the user controls operation of the RF303 from a remote terminal or computer by issuing specific remote commands that control all features of the RF303. The user can view test data received as a result of sending a remote command on the host controller's display. In Duplex Mode, all front panel keys are "locked out" to allow all functions to be under full direction of the host controller.

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4. As mentioned earlier, every command returns a value as a response. The return value may be a string of alphanumeric characters. Commands that do not require any special return value will show the star character * simply to indicate that the command has been executed.

5. After the RF303 receives a command, it will ignore all other commands until after it has responded to the first command.
6. If the user does not enter a command and just presses the **Enter** key (carriage return) on the computer keyboard, the RF303 will return the ? (question mark) character.
7. All responses are uppercase and are followed by CR and LF.
8. Measurement readings from the RF303 are returned identically as they would appear on the analyzer's display; that is, as numbers, with or without a decimal point, and followed by any appropriate unit of measurement.
9. Errors always return a response beginning with:

   ?ERR=XX (plus the description)

The following table lists each of the error responses.

ERROR RESPONSE	EXPLANATION
?ERR=01,BAD OR MISSING PARAMETERS)	The received command requires parameters, and there were none, or they were not recognized.
?ERR=02,ILLEGAL NUMBER OF PARAMETERS	The command did not include the correct number of parameters.
?ERR=03,PARAMETER OUT OF RANGE OR SYNTAX ERROR	One or more of the parameters were out of the correct range, or there was an error in the syntax of the command.
?ERR=04,COMMAND NOT AVAILABLE FROM THIS MODE	The Model RF303 is not in the special sub mode within the remote that is required for the command.
?ERR=05, DEACTIVATE ESU BEFORE ADJUSTING	There is an ESU signal present at the meter inputs that is not allowed for the command to be executed.
?ERR=06,ACCESS DENIED	The command is a calibration command and the calibration jumper is not connected.

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The following table describes various commands available in Duplex Mode.

Command	Description	Parameters Required	Return Value (Response)
GOTOREMOTE	Places the RF303 in the duplex remote mode.	None.	*
GOTOLOCAL	Returns the RF303 to normal (local mode) operation / exits duplex remote mode.	None.	*
IDENT	Identifies the analyzer model and firmware version number.	None.	Model RF303 name and the version of the firmware. Example: MODEL RF303 VERSION X.XX Where X.XX is the version number.
VER	Identifies the firmware version number.	None.	Firmware version number. Example: VERSION X.XX Where: X.XX is the version number.
SETMODE:{parm}	Changes the format of the RF303 response to the RDMETER command. Separate the command from the desired mode (parameter) using a colon. Refer to RDMETER below. Example: SETMODE:OUTPUT	OUTPUT (for measuring generator output). RFLKG (for measuring HF leakage). RARF (for conducting CQM test).	*
RDMODE	Prompts the RF303 to transmit the currently selected mode.	None.	NONE OUTPUT RFLKG RARF
EXITMODE	Prompts the RF303 to exit the currently selected mode. Note: You must exit the current mode before entering another.	None.	*
SETLOAD:{parm}	Sets the measurement test load resistance from 50-750 ohms in 50 ohm increments. Not available in RFLKG mode.	Values of 50-750 in increments of 50	*

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IDENT	Identifies the analyzer model and firmware version number.	None.	Model RF303 name and the version of the firmware. Example: MODEL RF303 VERSION X.XX Where X.XX is the version number.
VER	Identifies the firmware version number.	None.	Firmware version number. Example: VERSION X.XX Where: X.XX is the version number.
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SETLOAD:{parm}	Sets the measurement test load resistance from 50-750 ohms in 50 ohm increments. Not available in RFLKG mode.	Values of 50-750 in increments of 50	*

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Command	Description	Parameters Required	Return Value (Response)
RDLOAD	Resistance value of the selected test load appears in the display.	None.	RRRR (ohms) Where RRRR is the load value in ohms. Formatted to four (4) digits with leading spaces as required.
RDPOWER	Prompts an analyzer power measurement in watts. Not available in RFLKG and RARF modes.	None.	PPP.P (w)
RDCURRENT	Prompts an analyzer current measurement in milliamperes. Not available in RARF mode.	None.	AAAA (mA) Where AAAA is current in milliamperes.
RDMETER	Prompts the RF303 to measure the applied signal of the ESU.	None.	
	Prompts the RF303 to return all 0measurements of the applied signal of the ESU. {MODE=NONE}	None.	I=AAAA(mA), CF=XX.X, KVPP=XXX, PWR=PPP.P(w) Where AAAA is the Current reading in milliAmps, XX.X is the Crest Factor, XXX is the peak-to-peak voltage in kVolts and PPP.P is the power in watts.
	Prompts the RF303 to return all measurements of the applied signal of the ESU. {MODE=OUTPUT}	None.	I=AAAA(mA), CF=XX.X, KVPP=XXX, PWR=PPP.P(w) Where AAAA is the Current reading in milliAmps, XX.X is the Crest Factor, XXX is the peak-to-peak voltage in kVolts and PPP.P is the power in watts.
	Prompts the RF303 to measure the applied signal current of the ESU. {MODE=RFLKG}	None.	I=AAAA(mA) Where AAAA is the Current reading in milliamps.
	Prompts the RF303 to return the current test load. {MODE=RARF}	None.	REM RESISTANCE=RRR Where RRR is the load value in ohms.

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RDCURRENT	Prompts an analyzer current measurement in milliamperes. Not available in RARF mode.	None.	AAAA (mA) Where AAAA is current in milliamperes.
RDMETER	Prompts the RF303 to measure the applied signal of the ESU.	None.	
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	Prompts the RF303 to measure the applied signal current of the ESU. {MODE=RFLKG}	None.	I=AAAA(mA) Where AAAA is the Current reading in milliamps.
	Prompts the RF303 to return the current test load. {MODE=RARF}	None.	REM RESISTANCE=RRR Where RRR is the load value in ohms.

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5. Revisions to the RF303 Operator's Manual

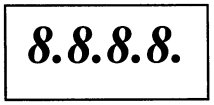
Revised Chapter 3, page 3-3, as follows:

Reference

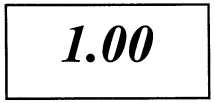
Power-Up Sequence

After plugging the RF303 into a correctly rated earth-ground outlet, locate the power switch on the right panel. Move the switch to the *ON* position (marked with the | symbol). Next you should observe the following power-up sequence:

1. The three front LED indicator lamps illuminate, and you see this information momentarily appear in the display:



2. Next the installed version of the RF303's firmware briefly appears in the display. Here's an example:



3. If the letter *E* followed by a number appears next, this indicates an error condition. See *Power-Up Error Condition Codes* below.

Correction

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After plugging the RF303 into a correctly rated earth-ground outlet, locate the power switch on the right panel. Move the switch to the *ON* position (marked with the | symbol). Next you should observe the following power-up sequence:

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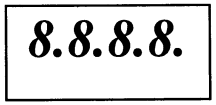

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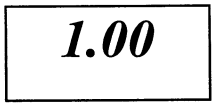

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1. The three front LED indicator lamps illuminate, and you see this information momentarily appear in the display:

8.8.8.8.

2. Next the installed version of the RF303's firmware briefly appears in the display. Here's an example:

1.00

3. If the letter *E* followed by a number appears next, this indicates an error condition. See *Power-Up Error Condition Codes* below.

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1.00

3. If the letter *E* followed by a number appears next, this indicates an error condition. See *Power-Up Error Condition Codes* below.

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Chapter 3, page 3-3 (Continued):

Reference	Correction
4. After the initialization is complete, the display is blank and the analyzer advances to its default test load condition of 300 ohms, ready to measure ESU power in watts.	**4.** The instrument will briefly display several random numbers that are associated with the RMS output offset during initialization. **5.** The display will then revert to a Power Save Mode, where the display is blanked out and the back light is dim. The battery and mode LEDs will remain ON. The analyzer advances to its default test load condition of 300 ohms, ready to measure ESU power in watts.

Insert the following changes before the last paragraph on page 3-5

When the battery nears the end of its discharge cycle, the unit will automatically turn off so as not to damage the battery. This will be preceded by a warning interval of about 5 minutes, indicated by a flashing red light.

Changes to the table on page 3-6

RF303 battery status light

Flashing Green	*(no change to present text)*
Steady Green	*(no change to present text)*
Flashing Red and Green	Automatic shut down is pending, battery is nearly exhausted
Flashing Red	Automatic shut down is imminent

Chapter 3, page 3-3 (Continued):

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4. After the initialization is complete, the display is blank and the analyzer advances to its default test load condition of 300 ohms, ready to measure ESU power in watts.	**4.** The instrument will briefly display several random numbers that are associated with the RMS output offset during initialization. **5.** The display will then revert to a Power Save Mode, where the display is blanked out and the back light is dim. The battery and mode LEDs will remain ON. The analyzer advances to its default test load condition of 300 ohms, ready to measure ESU power in watts.

Insert the following changes before the last paragraph on page 3-5

When the battery nears the end of its discharge cycle, the unit will automatically turn off so as not to damage the battery. This will be preceded by a warning interval of about 5 minutes, indicated by a flashing red light.

Changes to the table on page 3-6

RF303 battery status light

Flashing Green	*(no change to present text)*
Steady Green	*(no change to present text)*
Flashing Red and Green	Automatic shut down is pending, battery is nearly exhausted
Flashing Red	Automatic shut down is imminent

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