MFJ

MFJ Giant automatic SWR/Wattmeter

Model MFJ-869

INSTRUCTION MANUAL

CAUTION: Read All Instructions Before Operating Equipment

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VERSION 2B

DISCLAIMER

Information in this manual is designed for **user purposes only** and is ***not*** intended to supersede information contained in customer regulations, technical manuals/documents, positional handbooks, or other official publications. The copy of this manual provided to the customer will ***not*** be updated to reflect current data.

Customers using this manual should report errors or omissions, recommendations for improvements, or other comments to MFJ Enterprises, 300 Industrial Park Road, Starkville, MS 39759. Phone: (662) 323-5869; FAX: (662) 323-6551. Business hours: M-F 8-4:30 CST.

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The Basics

Introduction

The MFJ-869 Giant *automatic* SWR/Wattmeter measures up to 1500 watts. It has three high- resolution ranges with accuracy in each range from 1.8 to 54 MHz. True peak or average forward or reflected watts or SWR can be displayed on a huge lighted single-needle SWR/wattmeter.

PeakHold™ feature freezes the highest forward power for one, two or three seconds. These analog displays make it visually easy to tune antenna tuners, amplifiers and transmitters.

There are three high-resolution forward/reflected power ranges that are automatically selected: a QRP range (20 watts full scale), a mid-range (200 watts full scale) and a high-range (1500 watts full scale). *TrueActive*™ peak reading circuit gives *true* peak or average power on all modes.

The MFJ-869 includes MFJ's *Amplifier Bypass Control*™. This exclusive MFJ feature protects your amplifier by taking your amplifier off-line should the SWR increase above a user-defined pre-set limit. There is also a relay connector with normally open and normally closed connections that toggle when the SWR is above the same pre-set limit.

The MFJ-869 enters a "sleep" mode when idle and when no transmit signal is present, turning off the microprocessor clock to avoid the generation of spurious signals.

Features

- Power range of 20, 200 or 1500 watts
- 1.8 to 54 MHz continuous frequency coverage
- Adjustable alarm SWR from 1.5 to 3.0 in 0.5 steps
- *Amplifier Bypass Control*™ automatically protects your amplifier during high SWR events
- Lighted single-needle SWR/wattmeter with fixed or auto ranging
- Peak or average power mode
- Built-in frequency counter
- Built-in bootloader for field upgradeable firmware

Specifications

- RF power range : 20, 200 or 1500 watts
- Frequency range : 1.8 to 54 MHz continuous coverage
- Frequency counter accuracy : ±1 kHz
- A/D conversion resolution : 10-bit
- Memory endurance : 1 million erase/write cycles typical
- Memory data retention : 100 years typical
- Power supply requirement : 12 - 15 volts DC
- Current consumption : 350 milliamps or less
- Dimensions (projections included) : 7 ½ × 3 ¾ × 6 ¾ in; 191 × 95 × 171 mm (w × h × d)
- Analog meter : 6 ½ inches backlit single-needle (diagonally)
- TRANSMITTER connector : SO-239
- ANTENNA connector : SO-239
- POWER connector : 2.1 × 5.5 mm coaxial plug, center pin positive
- RS-232 connector : D-sub 9-pin
- RLY connector : 3.5 mm stereo phone
- AMP ENABLE connectors : Phono (RCA) × 2

† Specifications and design are subject to change without notice or obligation.

Amplifier Protection

The MFJ-869 is unique in that it provides *Amplifier Bypass Control*™ for hands-free protection of your amplifier during high SWR events. This capability is provided by passing the amplifier enable control line to your amplifier through the MFJ-869 **AMP ENABLE IN/OUT** connectors. A normally closed high-speed reed relay interrupts the amplifier enable signal when a user high-SWR pre-set is exceeded. A normally closed relay is used so that your amplifier system works properly when the MFJ-869 is turned off.

> ***Note:*** *MFJ recommends that the amplifier enable control signal be **always** connected through the **AMP ENABLE IN/OUT** connectors on the MFJ-869.*

Front Panel

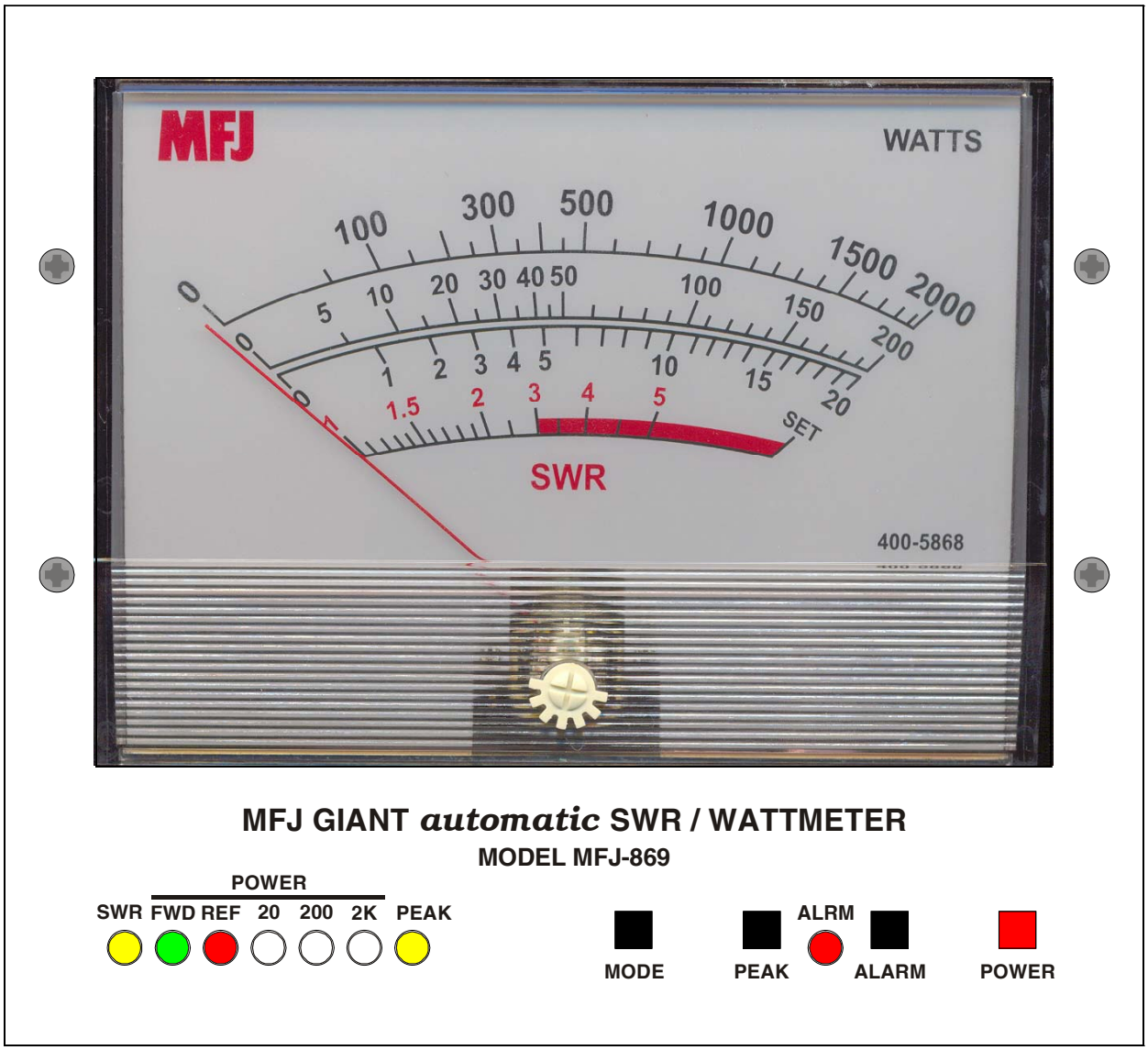

Figure 1. MFJ-869 Front Panel.

- **SWR/Wattmeter:** The single-needle meter measures SWR, forward and reflected power. It operates whenever the unit is powered on. The SWR scale measures standing wave ratio of 1 to infinity. The low power scale measures 0 to 20 watts forward or reflected power. The mid power scale measures 0 to 200 watts forward or reflected power, and the high power scale measures 0 to 2000 watts forward or reflected power.

  The power meter default condition is auto ranging, which automatically sets the meter scales according to the input RF power to the wattmeter. Forward power greater than 20 watts automatically sets the meter to the mid power range; forward power greater than 200 watts automatically sets the meter to the high power range. Forward power less than 150 watts automatically set the meter to the mid power range; forward power less than 15 watts automatically set the meter to the low power range.

Press both [MODE] and [PEAK] buttons simultaneously to show the current power meter range setting, and then hold or press again within half a second to cycle the meter range setting. Default is Auto Ranging.

Meter Range	LEDs	Number of Beeps
Low	20	1
Mid	200	2
High	2K	3
Auto	20 + 200 + 2K	4

- **Wattmeter Zero Scale Adjustment:** A trimmer located below the wattmeter to calibrate the zero scale of the meter needle. There is a trimpot inside the unit for full-scale adjustment. See "Wattmeter Calibration" section for the calibration procedure.

- **SWR LED:** Illuminates when the SWR mode is selected.

- **FWD LED:** Illuminates when the forward power mode is selected.

- **REF LED:** Illuminates when the reflected power mode is selected.

- **20 LED:** Illuminates when the power scale is 0 to 20 watts (red for forward power or green for reflected power).

- **200 LED:** Illuminates when the power scale is 0 to 200 watts (red for forward power or green for reflected power).

- **2K LED:** Illuminates when the power scale is 0 to 2000 watts (red for forward power or green for reflected power).

- **PEAK LED:** Illuminates when the peak power mode is selected.

- **MODE Button:** Used to cycle through the SWR, forward power, and reflected power mode. The selected mode is indicated by the SWR, FWD, and REF LEDs.

- **PEAK Button:** Used to select peak or average power mode. Peak envelope power (PEP) is measured by selecting a peak mode with selectable peak hold time. Press [PEAK] button to show the current power mode setting (only the PEAK LED illuminates when a peak mode is selected), and then hold or press again within half a second to cycle the power mode setting. Default is Average mode.

Mode	2000 Meter Mark	Number of Beeps
Peak 1 sec.	100	1
Peak 2 sec.	200	2
Peak 3 sec.	300	3
Average	2000	4

- **ALRM LED:** Illuminates when the SWR is greater than the selectable alarm SWR.

- **ALARM Button:** Used to toggle the alarm feature on and off and to set the alarm SWR from 1.5 to 3.0. When enabled, the ALRM LED will light and the buzzer will sound when the SWR is above the alarm SWR. Also, the amplifier connected to the Amp Enable connection will bypass and the RLY switch position will toggle when the SWR is above the alarm SWR. Press [ALARM] button to show the current alarm SWR setting (only the SWR LED illuminates), and then hold or press again within half a second to cycle the alarm SWR setting. Default is 3.0.

Alarm	SWR Meter Mark	Number of Beeps
SWR 1.5	1.5	1
SWR 2.0	2.0	2
SWR 2.5	2.5	3
SWR 3.0	3.0	4
OFF	SET	5

  Acknowledgement beep sounds each time a parameter is changed to acknowledge it. This also controls the CW notification of "QRP". If more than 1500 watts is applied to the unit, the unit will send "QRP" (dah-dah-di-dah di-dah-dit di-dah-dah-dit) on CW. Press both [PEAK] and [ALARM] buttons simultaneously to show the current beep setting, and then hold or press again within half a second to toggle this setting on and off. Meter needle bounces to full scale to indicate ON or to 100-watt mark to indicate OFF. Default is ON.

- **POWER Button:** Used to turn the unit on and off. Press to turn power on; press again to turn power off.

> ***WARNING:*** **Do not turn the power on and off rapidly, otherwise the unit's setting memory can be corrupted and the unit will have to be reset to factory defaults.**

Back Panel

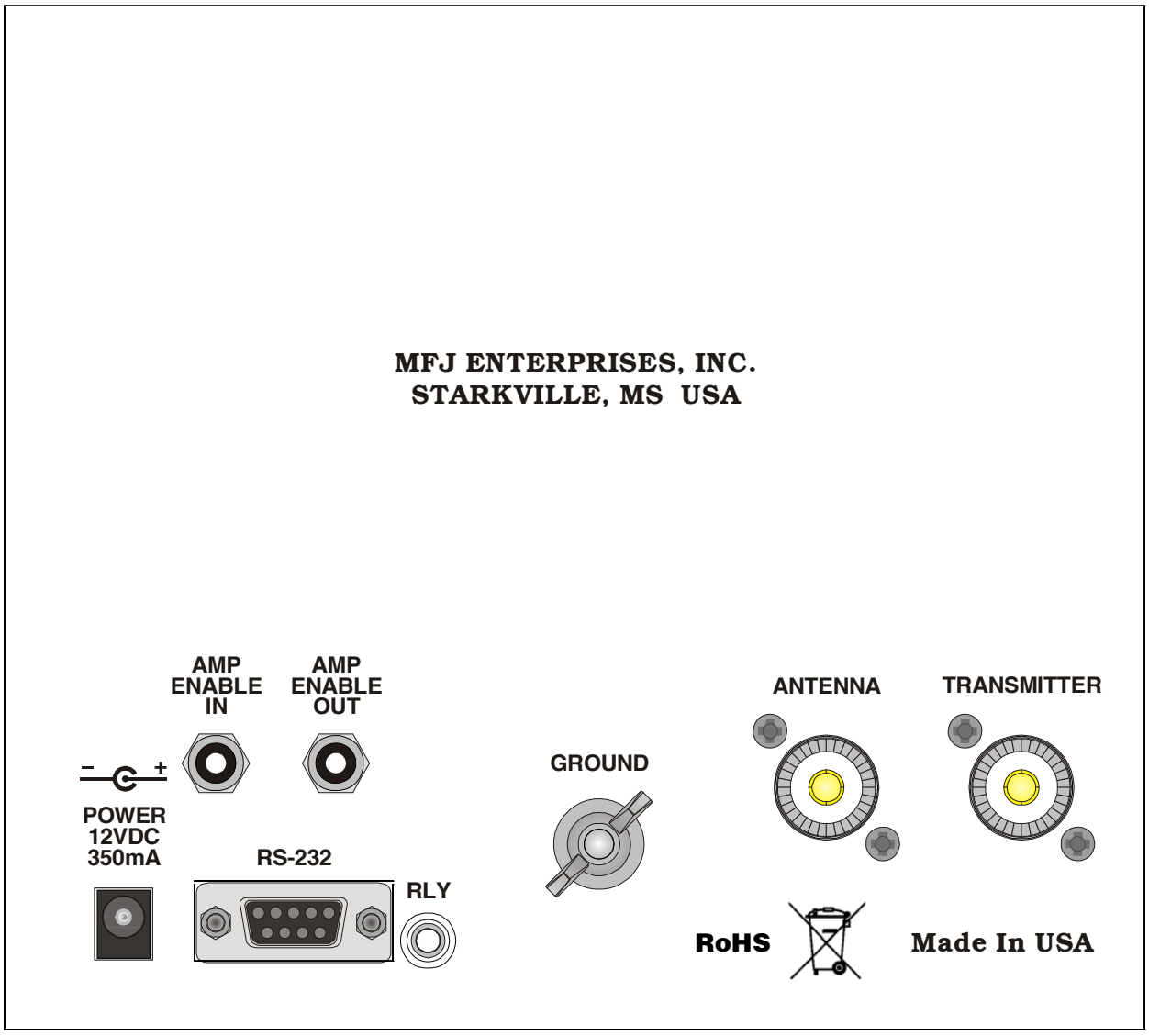

Figure 2. MFJ-869 Back Panel.

- **Amp Enable In:** RCA phono connector for connecting to the radio's amplifier control output.
- **Amp Enable Out:** RCA phono connector for connecting to the amplifier's relay control input.
- **Power:** This jack accepts a standard 2.1 × 5.5 mm coaxial plug with positive center and negative sleeve. The unit requires 12 volts DC at up to 350 milliamps. The use of a regulated supply is not mandatory but is recommended for best performance. An optional 12 volts DC 500 milliamp power supply, the MFJ-1312D, is available from MFJ Enterprises, Inc.

> ***WARNING:*** **Do not apply voltages greater than 18 volts to this unit, or permanent damage to the unit may result.**

- **RS-232:** DB-9 female connector for connecting to the computer's RS-232 serial port to update firmware. Check http://www.mfjenterprises.com/support.php for the latest version of the firmware.

- **RLY:** 3.5 mm stereo phone jack connected to a high-speed reed relay switch with the tip normally closed (NC), the ring normally open (NO), and the sleeve as common (COM). The relay switch toggles position when the SWR is above the alarm SWR.

Connection	Relay Switch
Tip	NC
Ring	NO
Sleeve	COM

- **Ground:** Wing-nut terminal for RF ground wire connection.

- **Antenna:** SO-239 connector for coax cable from antenna or dummy load.

- **Transmitter:** SO-239 connector for coax cable from transmitter or transceiver.

Installation

1. Place the wattmeter in a convenient location at the operating position.
2. Install the wattmeter between the transmitter and the desired antenna. Use good quality coaxial cable (such as RG-8/U) to connect the transmitter (or amplifier) to the rear panel connector marked TRANSMITTER.
3. Connect the antenna to the rear panel connector marked ANTENNA.
4. A GROUND post is provided for an RF ground connection.
5. Connect a 12 to 15 VDC power source capable of 350 milliamps to the rear panel jack marked POWER.

Appendices

Factory Defaults

Each time the wattmeter is powered off, the microprocessor saves all memories and configurations to non-volatile memory ready to be used the next time the unit is turned on. If the unit is not working properly, even on initial power on, try resetting to the factory defaults.

The unit is shipped with the following default settings:

- Mode SWR
- Meter Range Auto
- Alarm SWR 3.0
- Beep On
- Peak Hold Off (Average)
- Alarm On

To reset the unit to these defaults:

1. Turn off the power to the unit.
2. Press and hold *only* the [PEAK] button while turning the power on.
3. Release the button after the unit responds with three beeps and the meter going to full scale.
4. Resume with normal operation.

WARNING:	**If the MFJ-869 is not behaving properly or acting erratic, try resetting the unit to factory defaults.**

Self Test

A self-test routine will check the functions of the MFJ-869. This routine checks the analog meter, the front-panel buttons, the internal memory, the audio circuitry, and the power-down circuitry. During the self-test, you may stop the test by turning off the unit; however, this should NOT be done during the memory test or the memory could be corrupted. The self-test can be completed in approximately 30 seconds.

Note:	*Performing the self-test will reset the unit to its factory default settings.*

Here is the self-test procedure:

1. Turn off the power to the unit.
2. Press and hold *only* the [MODE] button while turning the power on.
3. The test begins by the analog meter needle moving slowly up to full scale and then dropping to zero. At the same time the LEDs indicate the firmware version number X.Y, where X is represented by [SWR:FWD:REF] and Y is represented by [20:200:2K:PEAK]. This tests the analog meter. Release the [MODE] button before the analog meter needle drops to zero. All LEDs are turned off.
4. Press each of the front-panel buttons in the sequence of [MODE], [PEAK] and [ALARM].
5. The unit then tests its non-volatile memory. Notice this step will reset the unit to its factory default settings.

6. If the unit is okay, the ALRM LED will turn on steady and a message PASS will send repetitively as Morse code (di-dah-dah-dit di-dah di-di-dit di-di-dit). If there is a problem, the ALRM LED will blink continuously, a mode LED will turn on steady and a failure message will send repetitively.
7. Once you have confirmed that the audio is okay, turn the unit off.
8. Turn the unit on again to test the power-down detection circuitry.
9. If the power-down detection circuitry is okay, the ALRM LED will turn on steady and a message PASS will send repetitively as Morse code (di-dah-dah-dit di-dah di-di-dit di-di-dit). If there is a problem, the ALRM LED will blink continuously, the 200 LED will turn on steady and a message PD FAIL will send as Morse code repetitively.
10. Turn the power off.

Failure Message	LED	Indicates
ALARM FAIL	SWR	[ALARM] button is shorted or improperly connected.
MEMORY FAIL	20	Non-volatile memory circuitry is improperly connected.
MODE FAIL	FWD	[MODE] button is shorted or improperly connected.
PD FAIL	200	Power-down circuitry problem.
PEAK FAIL	PEAK	[PEAK] button is shorted or improperly connected.
WAKEUP FAIL	2K	Microprocessor wakeup circuitry problem.

Table 1. Failure Messages.

LEDs Test

To test the LEDs and their control circuitry:

1. Turn off the power to the unit.
2. Press and hold *only* the [ALARM] button while turning the power on.
3. All eight LEDs will blink on and off until the buttons are released.
4. Press the [MODE] button to illuminate one LED at a time in the following sequence: SWR, FWD, REF, green 20, red 20, green 200, red 200, green 2K, red 2K, PEAK, and ALRM.
5. Press the [MODE] button to resume normal operation.

SWR Bridge Calibration

To calibrate the SWR Bridge, you will need a transmitter capable of 100 watts output, a precise calibrated wattmeter, a 50-ohm dummy load, three 50-ohm SO-239 coax cables, a Phillips screwdriver, and a tuning tool or small flat blade screwdriver.

WARNING: **Do not touch anything inside the wattmeter during operation! Serious, painful RF burns can result.**

WARNING: **Never operate the MFJ-869 with its cover removed; dangerous voltages and currents can be present during operation. Never exceed wattmeter specifications.**

1. Make sure the analog meter is calibrated. See "Wattmeter Calibration" section for the calibration procedure.
2. Turn off the power to the unit and the transmitter.
3. Remove the cover from the unit (4 screws) with a Phillips screwdriver.
4. Connect the 50-ohm dummy load to the ANTENNA connector; connect the calibrated wattmeter between the transmitter and the TRANSMITTER connector on the unit.
5. Turn on the power to the transmitter. Using a frequency in the middle of the HF band, such as 7.253 MHz, for calibration is recommended.
6. Press and hold *both* the [MODE] and [PEAK] buttons while turning the power on.
7. Release the buttons after the analog meter needle bounces.
8. The REF and 20 LEDs illuminate. Key the transmitter to output 100 watts and adjust trimmer capacitor VC1 (located in front of the coax connectors) for minimum reflected power.
9. Press [MODE] button. The FWD and 200 LEDs illuminate. Key the transmitter to 100 watts output and adjust the FWD trimpot VR1 until the 200-watt scale reads forward power of 100 watts.
10. Press [MODE] button. The FWD and 2000 LEDs illuminate. Key the transmitter to 100 watts output and adjust the trimpot VR3 until the 2000-watt scale reads forward power of 100 watts.
11. Press [MODE] button. The FWD and 20 LEDs illuminate. Key the transmitter to 15 watts output and adjust the trimpot VR5 until the 20-watt scale reads forward power of 15 watts.
12. Turn off the transmitter and reverse the ANTENNA and TRANSMITTER connections; that is, connect the 50-ohm dummy load to the TRANSMITTER connector and connect the transmitter/wattmeter to the ANTENNA connector.
13. Turn on the transmitter's power.
14. Press [MODE] button. The REF and 200 LEDs illuminate. Key the transmitter to 100 watts output and adjust the REF trimpot VR2 until the 200-watt scale reads reflected power of 100 watts.
15. Press [MODE] button. The REF and 2000 LEDs illuminate. Key the transmitter to 100 watts output and adjust the trimpot VR4 until the 2000-watt scale reads reflected power of 100 watts.
16. Press [MODE] button. The REF and 20 LEDs illuminate. Key the transmitter to 15 watts output and adjust the trimpot VR6 until the 20-watt scale reads reflected power of 15 watts.
17. Turn off the power to the unit and the transmitter.
18. Remove the transmitter/wattmeter and the 50-ohm dummy load from the unit.
19. Secure the cover back onto the unit.
20. Connect your transmitter to the TRANSMITTER connector and connect your antenna to the ANTENNA connector on the unit.

Frequency Counter Calibration

To calibrate the frequency counter, you will need a transmitter, a 50-ohm dummy load, two 50-ohm SO-239 coax cables, a Phillips screwdriver, and a tuning tool or small flat blade screwdriver.

WARNING: **Do not touch anything inside the wattmeter during operation! Serious, painful RF burns can result.**

WARNING: **Never operate the MFJ-869 with its cover removed; dangerous voltages and currents can be present during operation. Never exceed wattmeter specifications.**

1. Turn off the power to the unit and the transmitter.
2. Remove the cover from the unit (4 screws) with a Phillips screwdriver.
3. Connect the 50-ohm dummy load to the ANTENNA connector and connect the transmitter to the TRANSMITTER connector on the unit.
4. Turn on the power to the transmitter. Set and lock the frequency to *exactly* 29.000 MHz.
5. Press and hold *both* the [MODE] and [ALARM] buttons while turning the power on. The analog meter needle will go to full scale.
6. Key the transmitter to output about 10 watts. Adjust trimmer capacitor VC2, located next to the big integrated circuit, until the analog meter needle settles at the 0-watt mark. Notice the meter movement is exaggerated for easier calibration. Nominal tolerance of the frequency counter is ±1 kHz.
7. Turn off the power to the unit and the transmitter.
8. Secure the cover back onto the unit.

Wattmeter Calibration

To calibrate the meter needles, you will need a Phillips screwdriver and a tuning tool or small flat blade screwdriver.

1. Turn off the power to the unit and the transmitter.
2. Remove the cover from the unit (4 screws) with a Phillips screwdriver.
3. Press and hold *both* the [PEAK] and [ALARM] buttons while turning the power on. The analog meter needle will bounce. Release the buttons.
4. Use a small flat blade screwdriver and adjust the trimmer, located below the analog meter, to set the analog meter needle to the 0-watt mark.
5. Press the [MODE] button to calibrate the needle to full scale.
6. Adjust trimpot VR8, located to the left of the big integrated circuit, to set the analog meter needle to full scale of 20/200/2000-watt mark.
7. Press the [MODE] button to end calibration and resume normal operation.
8. Secure the cover back onto the unit.

In Case of Difficulty

If the wattmeter acts erratic, reset the wattmeter to factory defaults.

Technical Assistance

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or your problem is not solved by reading the manual, you may call *MFJ Technical Service* at 662-323-0549 or the *MFJ Factory* at 662-323-5869. You will be best helped if you have your unit, manual and all information on your station handy so you can answer any questions the technicians may ask.

You can also send questions by mail to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville, MS 39759; by facsimile (FAX) to 662-323-6551; or by email to techinfo@mfjenterprises.com. Send a complete description of your problem, an explanation of exactly how you are using your unit, and a complete description of your station. Also include the firmware version number of your unit.

Note

Note

LIMITED 12 MONTH WARRANTY

MFJ Enterprises, Inc. warrants to the original owner of this product, if manufactured by MFJ Enterprises, Inc. and purchased from an authorized dealer or directly from MFJ Enterprises, Inc. to be free from defects in material and workmanship for a period of 12 months from date of purchase provided the following terms of this warranty are satisfied.

1. The purchaser must retain the dated proof-of-purchase (bill of sale, canceled check, credit card or money order receipt, etc.) describing the product to establish the validity of the warranty claim and submit the original or machine reproduction of such proof of purchase to MFJ Enterprises, Inc. at the time of warranty service. MFJ Enterprises, Inc. shall have the discretion to deny warranty without dated proof-of-purchase. Any evidence of alteration, erasure, or forgery shall be cause to void any and all warranty terms immediately.

2. MFJ Enterprises, Inc. agrees to repair or replace at MFJ's option without charge to the original owner any defective product under warrantee provided the product is returned postage prepaid to MFJ Enterprises, Inc. with a personal check, cashiers check, or money order for **$10.00** covering postage and handling.

3. This warranty is **NOT** void for owners who attempt to repair defective units. Technical consultation is available by calling the Service Department at 662-323-0549 or the MFJ Factory at 662-323-5869.

4. This warranty does not apply to kits sold by or manufactured by MFJ Enterprises, Inc.

5. Wired and tested PC board products are covered by this warranty provided **only the wired and tested PC board product is returned.** Wired and tested PC boards installed in the owner's cabinet or connected to switches, jacks, or cables, etc. sent to MFJ Enterprises, Inc. will be returned at the owner's expense unrepaired.

6. Under no circumstances is MFJ Enterprises, Inc. liable for consequential damages to person or property by the use of any MFJ products.

7. **Out-of-Warranty Service:** MFJ Enterprises, Inc. will repair any out-of-warranty product provided the unit is shipped prepaid. All repaired units will be shipped COD to the owner. Repair charges will be added to the COD fee unless other arrangements are made.

8. This warranty is given in lieu of any other warranty expressed or implied.

9. MFJ Enterprises, Inc. reserves the right to make changes or improvements in design or manufacture without incurring any obligation to install such changes upon any of the products previously manufactured.

10. All MFJ products to be serviced in-warranty or out-of-warranty should be addressed to:

MFJ Enterprises, Inc.
300 Industrial Park Road
Starkville, Mississippi 39759 USA

and must be accompanied by a letter describing the problem in detail along with a copy of your dated proof-of-purchase.

11. This warranty gives you specific rights, and you may also have other rights which vary from state to state.

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