

## **MFJ VERSA TUNER II**

### **GENERAL INFORMATION**

The **MFJ-941E** is designed to match virtually any transmitter to any antenna, including dipoles, inverted-vees, verticals, mobile whips, beams, random wires, and others fed by coax lines, balanced lines or a single wire. An eight-position antenna-selector switch provides versatile antenna selection. The **MFJ-941E** will handle up to 300 Watts of transmitter RF output power. The **MFJ-941E** employs a cross-needle meter so forward power, reflected power and SWR may be read simultaneously.

### **CROSS-NEEDLE SWR/WATTMETER**

The meter on the **MFJ-941E** may be used alone or with the tuner. Set the **ANTENNA SELECTOR** to **COAX 1 DIRECT** or **COAX 2 DIRECT** to use the meter without the tuner. The **MFJ-941E** utilizes a cross-needle meter so **FORWARD** power, **REFLECTED** power and **SWR** may be read *simultaneously* in two ranges. **FORWARD** power may be read by setting the power range switch to **HI (300 Watts)** or **LO (30 Watts)**. Next read the power level on the **FORWARD SCALE**. **REFLECTED** power is shown simultaneously on the **REFLECTED SCALE**. **SWR** is determined by observing the intersection point of the two needles. No **SWR** sensitivity adjustment is needed to read **SWR**. The **HI** range is **300 Watts FORWARD** and **60 Watts REFLECTED**. The **LO** range is **30 Watts FORWARD** and **6 Watts REFLECTED**. The difference between the **HI** and **LO** scales readings is a factor of **10**.

The meter lamp can be powered by a 12 Vdc source, such as the optional **MFJ-1312B** power supply. Use a 2.1mm coaxial plug with the center conductor of the plug connected to the positive and the sleeve connected to ground. The **METER LAMP ON/OFF** switch will activate the meter lamp.

### **ANTENNA SELECTOR**

The **ANTENNA SELECTOR** switch utilizes eight positions. They are **DUMMY LOAD**, **BALANCE LINE**, **COAX 1**, and **COAX 2** positions for both **BYPASS** (direct) and **TUNED** (through) the tuner operation. An external 50 Ohm dummy load can be connected to the **EXT LOAD** connector located at the rear of the tuner. Do not continuously key into the dummy load for more than 2 minutes at a time.

<p><b>CAUTION:</b> Never use the <b>MFJ-941E</b> for <b>OVER 300 Watts</b> of RF output power, even in the <b>DIRECT</b> or <b>DUMMY LOAD</b> positions.</p>
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### **INSTALLATION:**

1. The tuner should be placed in a location where operation will be convenient. The ceramic feed through insulators will have high RF voltages if random wire or balanced line operation is used. These voltages can cause serious RF burns if touched when transmitting.

**NOTE:** Locate the tuner so the rear is not accessible during operation.

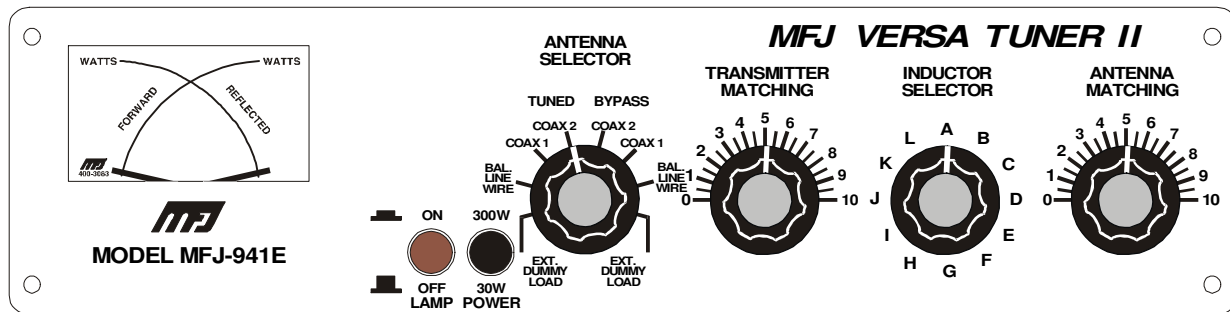
2. The **MFJ-941E** should be installed between the transmitter and antenna. A coaxial line should be connected to the transmitter and the SO-239 coax **TRANSMITTER** connector on the back of the tuner.
3. One or two coax-fed antennas may be connected to the SO-239 coax connectors marked **COAX 1** or **COAX 2**. Coax 1 and Coax 2 antennas may be connected directly to the transmitter, bypassing the tuner, by setting the **ANTENNA SELECTOR** switch to **COAX 1 DIRECT** or **COAX 2 DIRECT**, respectively.

4. A random wire antenna may be connected to the five-way binding post marked **WIRE**. The random length wire should be long, high, and as clear of surrounding objects as possible. For optimum operation, the wire antenna should be a quarter wave-length or longer at the operating frequency. Do NOT ground the random wire antenna. The tuner should be well-grounded to the transmitter. A binding post marked **GROUND** is provided for ground connections.
5. A balanced line-fed antenna may be connected to the two five-way binding posts marked **BALANCED LINE**. A jumper wire from the **WIRE** binding post, as indicated by a dotted line on the *MFJ-941E*, should be connected to one of the posts of the **BALANCE LINE**. This couples the *MFJ-941E* to the balanced line through a 4:1 balun.

**NOTE:** Either a balanced line or a random wire antenna may be connected to the *MFJ-941E* at one time. If a random length wire is used, care should be taken to assure that no jumper wire is between the **WIRE** binding post and the **BALANCED LINE**.

6. An external 50 Ohm dummy load may be connected to the **EXT. DUMMY LOAD** connector located at the rear of the tuner.

### MFJ-941E FRONT PANEL



### USING THE MFJ-941E

The **INDUCTOR** switch on the *MFJ-941E* represents *maximum inductance* at position "A" and the *minimum inductance* at position "L". Lower inductance is needed at higher frequencies than at low frequencies for the same impedance. The **TRANSMITTER** and **ANTENNA** controls represent *maximum capacitance* at position 10. For optimum operation of the *MFJ-941E*, the transmitter must be tuned to a 50 Ohm output impedance at the frequency of operation. The **ANTENNA SELECTOR** switch should be set to **DUMMY LOAD** for tuning up the transmitter.

**NOTE:** The transmitter should always be tuned at a *low output power*.

After the transmitter is properly tuned, the **ANTENNA SELECTOR** should be set to the desired antenna and the tuner adjusted for a minimum SWR as described below. **DO NOT** readjust the transmitter loading control setting after loading it to 50 Ohms.

**NOTE:** When using the *MFJ-941E* for receiving only, tune as described in *Steps 1* and *2*.

### TUNER ADJUSTMENT

1. Set the **TRANSMITTER** and **ANTENNA** controls to 5. In this position the capacitors are half-open.
2. Rotate the **INDUCTOR** control until maximum noise is obtained with the transceiver in the receiving mode.

**CAUTION:** Do not operate the **ANTENNA** selector switch while transmitting!.

3. While transmitting a steady state carrier (CW) alternately adjust **TRANSMITTER** and **ANTENNA** controls for minimum SWR. Since both controls interact, the two controls can best be adjusted by turning the **TRANSMITTER** control one small increment at a time, then rotating the **ANTENNA** control for minimum SWR. Repeat this process until minimum SWR is obtained.
4. If a SWR of **1:1** is not achieved, the **INDUCTOR** control should be increased or decreased and *Step 3* repeated. If arcing should occur between capacitor plates, the **INDUCTOR** control should be increased or decreased by one position, and *Step 3* repeated. If SWR of **1:1** cannot be achieved, *Step 3* should be repeated for each **INDUCTOR** control position.
5. After a minimum SWR is achieved, transmitter power may be increased to 300 Watts. The **VERSA TUNER II** will reduce the SWR of most feed systems to **1:1**. In some cases, a **1:1** SWR is not achievable. In such cases, the length of the antenna may be increased or decreased to improve SWR.
6. SWR of **1:1** may occur at more than one set of control settings on the **MFJ-941E**. When an SWR of **1:1** is obtained, make sure that the transmitter power is relatively high. If transmitter power has decreased substantially, try another **INDUCTOR** control setting and repeat *Step 3*.

## TROUBLESHOOTING

If this tuner **fails to tune**, please **double check all connections** and follow the tuning procedures again. Be sure you are using *enough inductance* (lowest letter usable for band) and have the *capacitors open far enough* (highest front panel number).

If this tuner **arcs** at the rated power levels, please **double check all connections** and follow the tuning procedures again. Be sure you are using the *least amount of inductance* and the *greatest capacitance* possible to match the load on the operating frequency. If you are still unsuccessful, please read the **Antenna Matching Problems** text below.

**NOTE:** If this tuner **arcs** when operating on the **160 meter** band, it may be necessary to *reduce transmitter output power*.

## MATCHING ANTENNAS

Most matching problems occur when the antenna system presents an *extremely high impedance to the tuner*. When the antenna impedance is much **lower** than the feedline impedance, an *odd quarter-wavelength* feedline converts the low antenna impedance to a **very high impedance at the tuner**. A similar problem occurs if the antenna has an extremely high impedance and the transmission line is a multiple of a half-wavelength. The half-wavelength line *repeats* the very high antenna impedance at the tuner. **Incorrect feedline and antenna lengths can make an antenna system very difficult or impossible to tune.**

This problem often occurs on 80 meters if an odd quarter-wave (60 to 70 foot) open wire line is used to feed a half-wave (100 to 140 foot) dipole. The odd quarter-wave line transforms the dipole's low impedance to over **three thousand Ohms at the tuner**. This is because the mismatched feedline is an *odd multiple* of 1/4 wavelength long. The line *inverts* (or teeter-totters) the antenna impedance.

A problem also occurs on 40 meters with this antenna example. The feedline is now a multiple of a half-wave (60 to 70 foot) and connects to a full-wave high impedance antenna (100 to 140 foot). The half-wave line repeats the high antenna impedance at the tuner. The antenna system looks like **several thousand Ohms at the tuner** on 40 meters. The following suggestions will reduce the difficulty in matching an antenna with a tuner:

1. Never center feed a half-wave multi-band antenna with a high impedance feedline that is close to an odd multiple of a quarter-wave long.
2. Never center feed a full-wave antenna with any feedline close to a multiple of a half-wave long.
3. If a tuner will not tune a multi-band antenna, add or subtract 1/8 wave of feedline (for the band that won't tune) and try again.
4. Never try to load a G5RV or center fed dipole on a band below the half-wave design frequency. If you want to operate an 80 meter antenna on 160 meters, feed either or both conductors as a longwire against the station ground.

To avoid problems matching or feeding any dipole antenna with high impedance lines, keep the lines around these lengths [ The *worst possible* line lengths are shown in brackets ]:

<b>160 meter dipole:</b>	35-60, 170-195 or 210-235 feet.	[ Avoid 130, 260 ft ]
<b>80 meter dipole:</b>	34-40, 90-102 or 160-172 feet.	[ Avoid 66, 135, 190 ft ]
<b>40 meter dipole:</b>	42-52, 73-83, 112-123 or 145-155 feet.	[ Avoid 32, 64, 96, 128 ft ]

**NOTE:** Some trimming or adding of line may be necessary to accommodate higher bands.

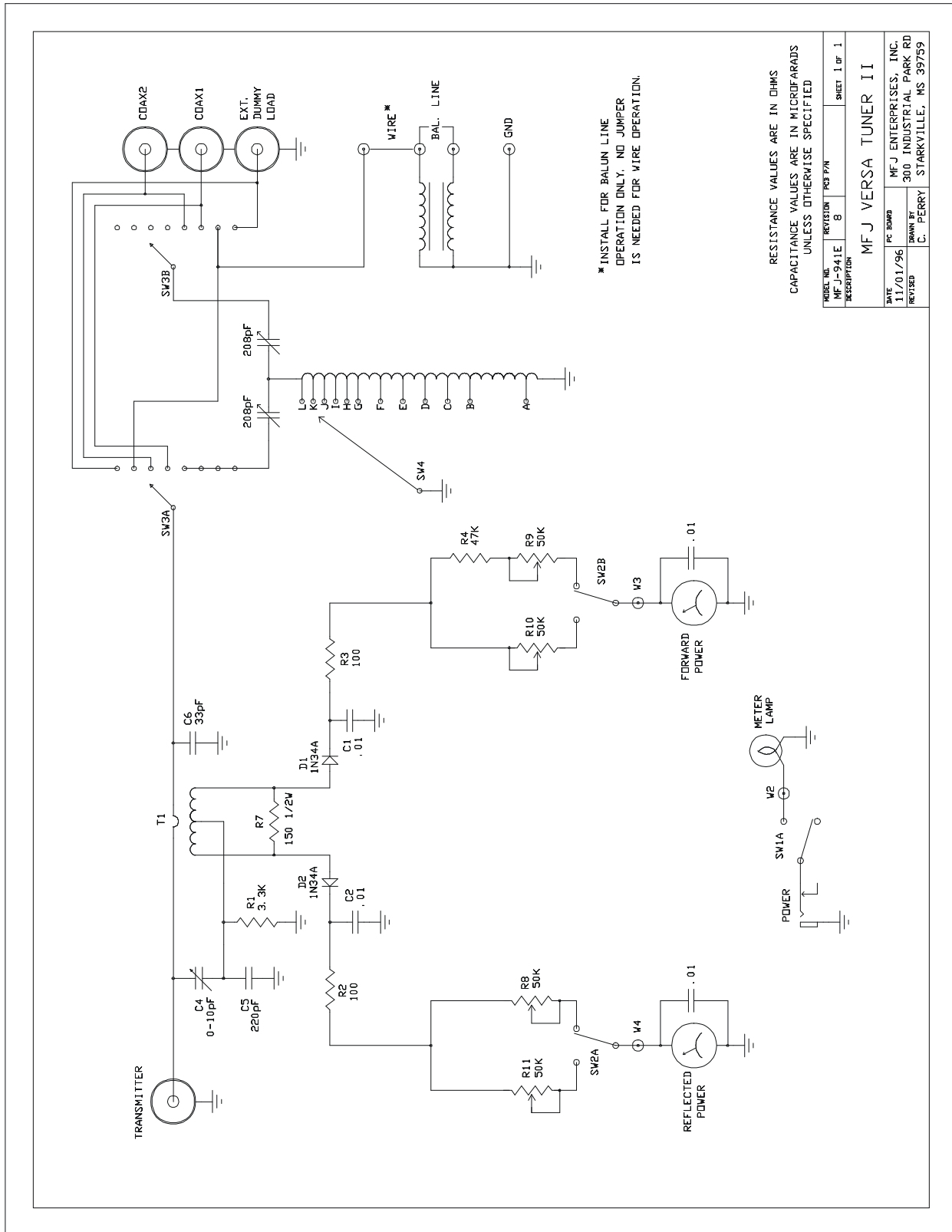
**WARNING:** To avoid problems, a dipole antenna should be a full half-wave on the lowest band. On 160 meters, an 80 or 40 meter antenna fed the normal way will be extremely reactive with only a few Ohms of feedpoint resistance. Trying to load an 80 meter (or higher frequency) antenna on 160 meters can be a disaster for both your signal and the tuner. The best way to operate 160 with an 80 or 40 meter antenna is to load either or both feedline wires (in parallel) as a longwire. The antenna will act like a "T" antenna worked against the station ground.

## 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 to 662-323-6551; or by email to [techinfo@mfjenterprises.com](mailto: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.

**SCHEMATIC:**



RESISTANCE VALUES ARE IN OHMS  
CAPACITANCE VALUES ARE IN MICROFARADS  
UNLESS OTHERWISE SPECIFIED

MODEL NO.	REVISION	PCB P/N	SHEET	OF
MFJ-941E	B		1	1
<b>MFJ VERSA TUNER II</b>				
DATE	PC BOARD	MFJ ENTERPRISES, INC.		
11/01/96		300 INDUSTRIAL PARK RD		
DESIGNED	DRAWN BY	STARKVILLE, MS 39759		
	C. PERRY			