## MFJ-945E MOBILE TUNER

## General Information:

The *MFJ-945E Mobile Tuner* is a compact tuner designed for mobile operation in cars, trucks, RV's, and boats. Covering **1.8** to **60 MHz**, it will match virtually any transmitter to almost any mobile whip antenna. It will also match almost any antenna for home station operation such as dipoles, inverted-vees, verticals, beams, random wires, and others fed by coax lines or single wire. The *MFJ-945E* employs a cross-needle meter so forward power, reflected power, and SWR may be read simultaneously. The meter lamp can be powered by a 12Vdc, 300mA source, such as the *MFJ-1312B* for home-station operation. The meter lamp **ON/OFF** switch will activate the meter lamp. Use a 2.1mm coaxial plug with the center conductor of the plug connected to the positive and the sleeve connected to ground. Optional mobile mounting bracket (*MFJ-20*) is available.

**Cross-Needle SWR/Wattmeter:**

The *MFJ-945E* utilizes a cross-needle meter to read *FORWARD* power, *REFLECTED* power and *SWR* simultaneously in either **HI** (300 Watts) or **LO** (30 Watts) power ranges. First set the **TUNE/BPS** switch to **BPS** (bypass), then set the power range switch to **HI** or **LO**. Next read the *FORWARD* power on the *Forward Scale*. *REFLECTED* power is shown at the same time on the *Reflected Scale*. *SWR* is read by observing where the two needles cross. No *SWR* sensitivity adjustment 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 *MFJ-945E* is factory calibrated on the **LO** scale at **10** Watts *FORWARD* and **2**Watts *REFLECTED*, and on the **HI** scale at **100** Watts *FORWARD* and **20** Watts *REFLECTED*.

## Installation:

1. Place the tuner in a convenient location at the operating position. Avoid placing the tuner near microphones, speech processors, TNC's or other RF sensitive devices.
2. Install the *MFJ-945E* between your transmitter and antenna. Connect a coax line from your transmitter to the SO-239 connector labeled **TRANSMITTER** on the rear panel of the tuner. Connect your antenna to the SO-239 connector labeled **ANTENNA** on the rear panel of the tuner. A random wire antenna may be connected to the center connection of the **ANTENNA** connector. 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 **1/4-wavelength** or longer at the operating frequency. Do **not** ground the random wire antenna. Ensure that the tuner is well grounded to the transmitter! A post labeled **GROUND** is provided for ground connection(s).

**NOTE:** If random wire operation is desired, position the tuner so that the rear panel terminals can not be contacted by persons or conductors! When transmitting with random wire, the rear panel connectors can operate with high RF voltages. These voltages may cause serious burns and may also damage anything contacting or within 1/2" of the terminals!

## MFJ-945E Front Panel
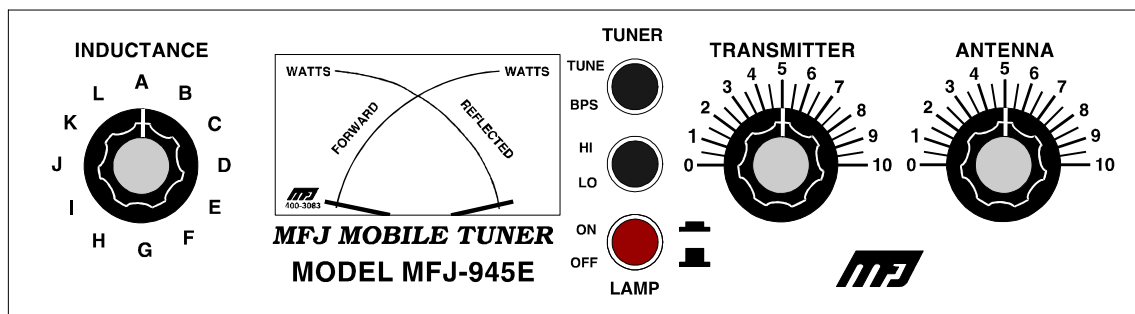
## Using the MFJ-945E:

The **INDUCTOR** switch on the *MFJ-945E* represents *maximum inductance* at position **A** and a *minimum inductance* at position **L**.  Less inductance is needed at higher frequencies than at low frequencies for the same impedance.  The **TRANSMITTER** and **ANTENNA** controls both represent *maximum capacitance* at position **10**.  For optimum operation of the *MFJ-945E*, the transmitter must be tuned to a 50 Ohm output impedance at the operating frequency.  **Always tune the transmitter at a low output power!**  Do **not** readjust the transmitter loading control setting after loading it to a 50 Ohm load!  After properly tuning the transmitter, tune the *MFJ-945E* for a minimum SWR as described below:

**NOTE:**   When using the *MFJ-945E* for receiving only, tune as described in *Steps 1* and *2*.

1.  Set the **TRANSMITTER** and **ANTENNA** controls to position **5**.  The tuning capacitors are half opened at this setting.
2.  Rotate the **INDUCTOR** control until maximum noise is obtained with your tranceiver in the receiving mode.

    **WARNING:**   *Never transmit while changing the INDUCTOR setting!*

3.  While transmitting a steady state carrier (CW), alternately adjust the **ANTENNA** and **TRANSMITTER** controls for minimum SWR.  Since both of these controls interact, the two controls can best be adjusted by turning the **TRANSMITTER** control a small increment at a time, then rotating the **ANTENNA** control for minimum SWR.  Repeat this procedure until minimum SWR is obtained.
4.  If an SWR of **1:1** is not obtained, increase or decrease the **INDUCTOR** control and repeat *Step 3*.  If arcing should occur between the capacitor plates, increase or decrease the **INDUCTOR** control one position, then repeat *Step 3*.  **NOTE:**  If you can't obtain a **1:1** SWR, repeat *Step 3* for each **INDUCTOR** control position.
5.  After minimum SWR is achieved, transmitter power may be increased up to 300 Watts. Your *MFJ-945E* will reduce the SWR of most feed systems to 1:1.  In some cases, a 1:1 SWR is not possible.  Increase or decrease the length of your antenna to improve SWR.
6.  An SWR of 1:1 may occur at more than one set of control settings on your *MFJ-945E*.  When an SWR of 1:1 is obtained, check transmitter power. Ensure that transmitter power is relatively high.  If transmitter power has decreased substantially, try another **INDUCTOR** control setting and repeat *Step 3*.

## In Case Of Difficulty:

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*.

## Antenna Matching Problems:

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 **]**:

| | | |
|---|---|---|
| **160 meter dipole:** | 35-60, 170-195 or 210-235 feet. | **[** *Avoid 130, 260 ft* **]** |
| **80 meter dipole:** | 34-40, 90-102 or 160-172 feet. | **[** *Avoid 66, 135, 190 ft* **]** |
| **40 meter dipole:** | 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.
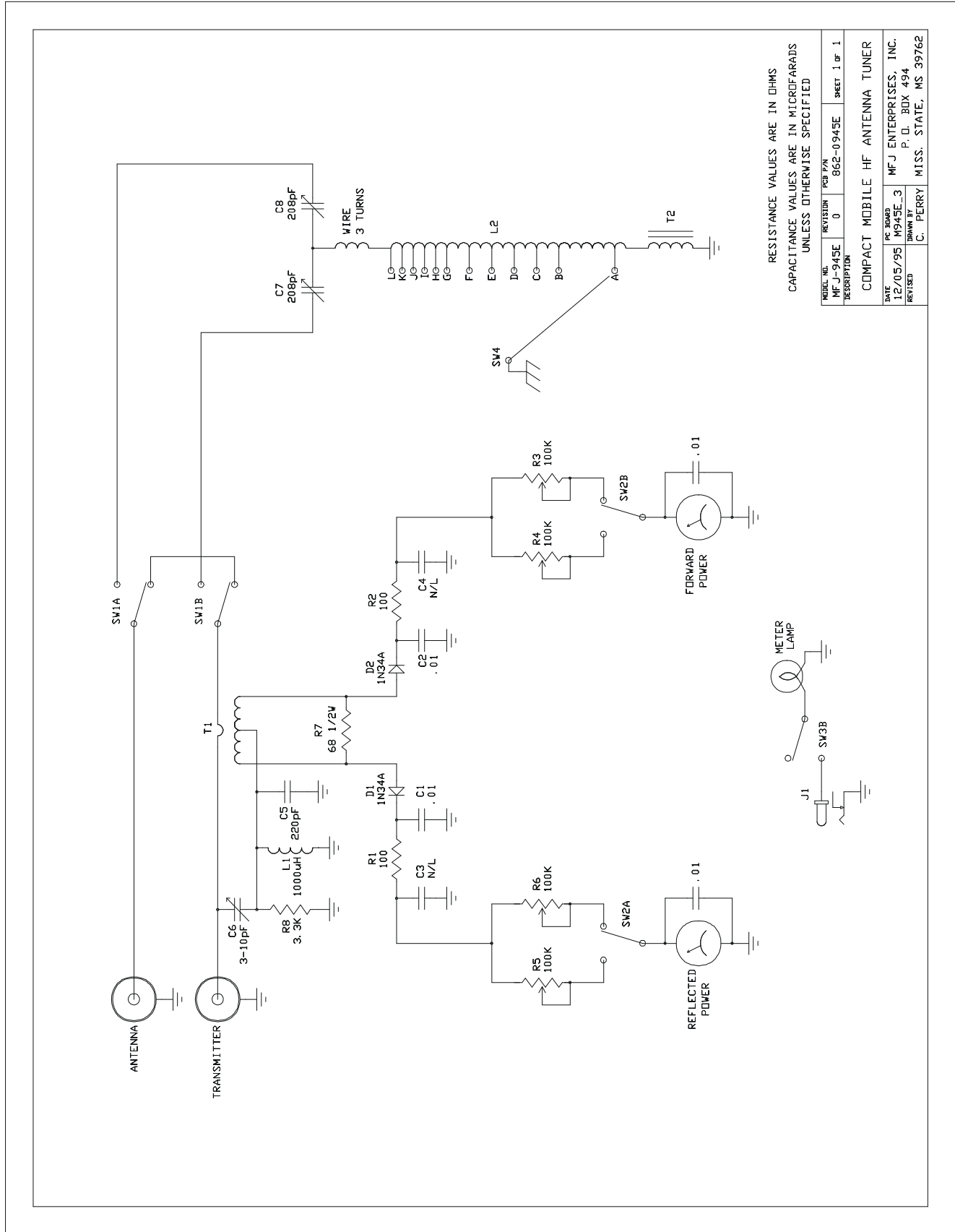
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**WARNING:** To avoid problems, a dipole antenna should be a full half-wave on the lowest band. On 160 meters, an 80 or 40 meter antenna fed the normal way will be extremely reactive with only a few ohms of feedpoint resistance. Trying to load an 80 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.

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## 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, Stakville, MS 39759; by 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.

## Schematic: