

# **MFJ**

## *Dip Meter Adapter Kit*

*Model MFJ-66C*

### **INSTRUCTION MANUAL**

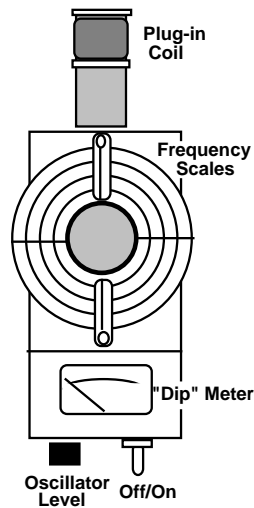
CAUTION: Read All Instructions Before Operating Equipment

# **MFJ ENTERPRISES, INC.**

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**Introduction:** Thank you for purchasing the MFJ-66C Dip-Meter Adapter kit. This coil-set converts your handheld Antenna Analyzer into a sensitive resonance detector covering 1.8 to 230 MHz.

**GDO History:** The tube-style grid-dip oscillator (GDO) of yesterday used a L/C-tuned oscillator and came with a set of plug-in tank coils that install on top of the case to select the band. A meter wired into the oscillator tube's grid circuit monitored grid current. Any time the RF field surrounding the plug-in coil coupled to a nearby resonant circuit, the resulting energy transfer loaded the oscillator and caused a measurable drop in grid current (hence the term "grid-dipper").



More recent versions of the dipper substitute a tunnel diode, bipolar transistor, or FET for the tube and replace grid metering with a diode-type RF-voltage detector. Most simple dip meters tune with a variable capacitor coupled directly to a printed dial scale. Although useful for many applications, poor dial accuracy and the oscillator's tendency to pull off frequency can make these simple meters touchy to tune and difficult to interpret.

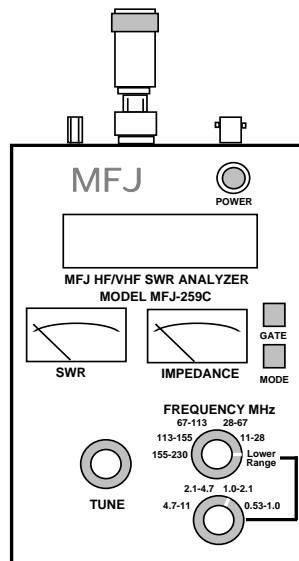
**The MFJ-66C:** With the MFJ-66C dip-meter kit, your antenna analyzer performs the same function as a GDO, but the operating principle is somewhat different. Here's how it works:

1. Unlike poorly stabilized GDOs, most antenna analyzers generate a high-level (0-dBm or stronger) test signal that is heavily buffered. As a result, changes in loading caused by the sense coil's proximity to another circuit can't perturb the oscillator and pull it off frequency.
2. Unlike a GDO with its printed mechanical dial, most analyzers feature a reduction-drive or electronic tuning plus a built-in digital frequency counter that

measures operating frequency very accurately -- often to within 100 Hz. Some analyzers even offer swept-frequency coverage with a graphic display.

3. The GDO coil functions as a large resonant transformer primary when coupled to an external circuit. MFJ-66C coils act like small non-resonant coupling links that are less likely to introduce stray capacitance and perturb the test circuit.

4. The GDO relies on a gross reduction in grid current (or tank-circuit voltage) to produce a visible dip on an electro-mechanical meter movement. The MFJ-66C coils take advantage of your antenna analyzer's directional coupler and highly sensitive digital display to detect very subtle changes in impedance, reactance, and SWR.



**Measuring Technique:** When using the MFJ-66C kit, the best way to detect resonance is by observing changes in resistance (**R**), reactance (**X**), and **SWR** that appear on the analyzer's LCD screen. Normally, in free space, the impedance of the test link will be very low -- often approaching zero. As a result, the SWR it presents to the analyzer will be extremely high. In fact, the SWR of the link often exceeds the top end of the analyzer's measurement range. Note that the SWR measurement range for analyzers in the MFJ-259 family extends all the way up to 25:1 or 31:1, depending on the model. A typical out-of-range screen is shown below:

10.140 MHz	>25
R(Z>650)	SWR

When the MFJ-66C link is moved close to a circuit under test, it becomes positioned to "stimulate" or induce RF energy in that circuit. As the analyzer frequency approaches the circuit's resonant frequency, inductive coupling begins

to transfer energy, causing the link's **SWR** to decrease. Concurrently, *Reactance (X)* drops and *Resistance (R)* increases (see below):

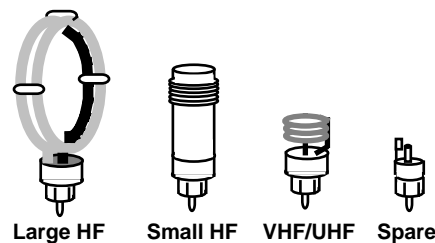
10.120 MHz	22
R= 3	X=23 SWR

All three of these parameter changes appear on the analyzer's sensitive LCD readout well before any visible "dip" can be seen on the analog SWR meter -- and well before any deflection would be seen on a conventional dipper.

**Spurious Response Check:** Some analyzers display one or more minor "dips" in SWR over their frequency range that are unrelated to the sense coil or your test circuit. To confirm you are monitoring a "real" dip, simply remove the test coil or grasp it firmly with your fingers to load it. If the analyzer display shows a change, then you are measuring a response to the test circuit. If they don't change, it's an internally generated spurious response.

**Meter Indications:** With tight coupling, it's common to see a very pronounced dip on the analyzer's analog meter at resonance. However, it's not necessary to obtain a strong meter dip in order to reach a result. In fact, it's always better to make your final measurements with the least amount of coupling possible.

**MFJ-66C Detection Coils:** To ensure sensitive coupling to the widest range of circuits, the MFJ-66C kit comes with a choice of 3 prefabricated links:



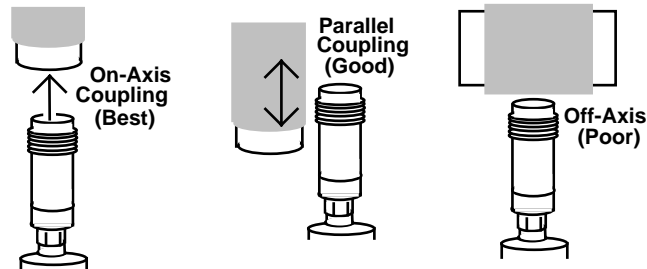
[ ] *Large HF Link:* Especially suited for stimulating air-wound or large form-wrapped coils such as those used in traps, loading coils, tuners, and amplifiers.

[ ] *Small-HF Link:* Suited for coupling to low-power inductors such as those used in band-pass filters, low-power RF stages, etc.

[ ] *VHF/UHF-Link:* Has a very high self-resonant frequency -- is best for coupling to VHF and UHF circuits (up to 230 MHz).

[ ] *Spare Connector:* Extra RCA plug may be used for special applications such as forming a detachable link around a toroid coil.

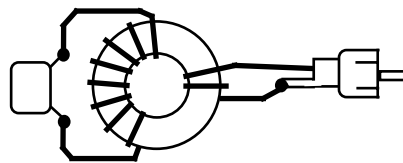
**Coil Placement:** For best coupling, place the link in direct alignment with the coil under test. If on-axis positioning with the coil isn't possible, place the link beside it in parallel. Even though the coils are displaced laterally, the flux alignment between the two inductors is still sufficient to permit coupling. Avoid positioning the link off-axis where flux lines are crossed and little coupling can occur.



Always keep in mind that mutual coupling is a two-way street. If you position the test link too close to a coil in an operating transmitter, high levels of RF may be coupled into the analyzer, destroying the bridge circuit. Never attempt to "dip" a coil if it might be energized with RF, AC, DC, or static buildup voltages.

***Important Warning:*** *The detector diodes in most analyzers connect directly to the antenna port and may be destroyed by high-level RF, AC, DC, or static voltages. Never allow the test link to contact an energized circuit element or to be placed near an inductor in a operating transmitter!*

**Toroids:** These circular coil forms are self-shielding, so placing an external coupling link in close proximity with the windings yields little interaction. To obtain coupling, use the space RCA plug supplied with the kit and wind a one or two turn link around the core (see below).



When checking toroid circuits, you won't be able to control the amount of coupling by adjusting link proximity. Instead, use the minimum number of turns it takes to provide a useable response on the antenna analyzer.

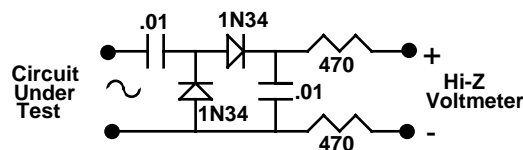
**Shielded Coils:** To detect resonance, the sense coil must stimulate a response in the test circuit through induction. Unfortunately, in most cases, a metallic shield-can or a metallic sleeve encasing a trap will block induction and make testing difficult-to-impossible. It goes without saying that you should never un-install a shield in order to make a measurement -- removing the shield will severely detune the coil inside.

### Step-By-Step Testing for Resonance:

- [ ] Select the appropriate MFJ-66C test link for the circuit under test.
- [ ] Install it and tune the analyzer to the approximate test-circuit frequency.
- [ ] Position the link on-axis and in close proximity to the test-circuit coil.
- [ ] Tune the VFO until a change is observed on the **R**, **X**, and **SWR** readouts.
- [ ] Slowly move the sense coil away while sweeping the frequency.
- [ ] Find a point of minimum detectable change on the LCD display.
- [ ] Record the frequency from the analyzer's digital readout.

**Testing Circuit Q:** This "figure of merit" characterizes the electrical quality of a resonant circuit. High-Q circuits tend to retain RF energy more efficiently and also tend to exhibit narrow bandwidth. Low-Q circuits typically dissipate more energy through various forms of loss and exhibit broader frequency response. Truly accurate Q measurements can be difficult to make and often require specialized test equipment such as a HP4342A Q-Meter. However, it's possible to estimate Q by measuring the circuit's -3 dB response points.

You may use your MFJ-66C and antenna analyzer as part of a test setup to make rough Q measurements. The procedure involves connecting the circuit under test to a high-impedance RF-voltage detector like the circuit shown below:



To "energize" or "stimulate" the test circuit, you'll use the analyzer and test link. A FET voltmeter or oscilloscope connects to the detector to read voltage. The circuit's -3dB response points roughly coincide with a 30% drop in the peak voltage measured across the test circuit at resonance ( $V_R \times 0.7$ ).

### Step-By-Step Q Measurement:

- [ ] Connect the input side of the RF detector circuit across your test circuit.
- [ ] Connect the output side to a Hi-Z meter or scope (measuring DC voltage).
- [ ] Tune the analyzer to the approximate test frequency.
- [ ] Watching the analyzer display, find the test-circuit's resonant frequency.
- [ ] Adjust coupling to induce a measurable voltage on the scope or meter.
- [ ] Once established, don't disturb the setup. Coupling must remain constant.
- [ ] Tune analyzer for peak voltage. Record frequency as **F<sub>R</sub>** and voltage as **V<sub>R</sub>**.
- [ ] Tune down-frequency to the -3dB point ( $.7V_R$ ). Record frequency as **F<sub>1</sub>**.
- [ ] Tune up-frequency to the other -3dB point. Record as **F<sub>2</sub>**.

- [ ] Calculate frequency span between the -3 dB points ( $F_2 - F_1$ ). Record as ( $F_{span}$ ).
- [ ] Divide the resonant frequency by the frequency span ( $F_R / F_{span}$ ) to obtain Q.

Example: If your resonant frequency is 14.100 MHz and the -3dB points fall 200 kHz apart, the Q will be around 70 ( $14.1/0.2 = 70.5$ ). Note that this value represents the approximate loaded Q for the whole circuit including the inductor, capacitor, appended circuit elements, plus any loading caused by the detector.

### **In Case Of Difficulty:**

If you have any problem with your kit, 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 this manual plus any other pertinent information handy so you can answer any questions the technician may ask. You may 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](mailto:techinfo@mfjenterprises.com). Be sure to include a complete description of the difficulty plus a description of how you are using your kit.

## 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 **\$7.00** 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.