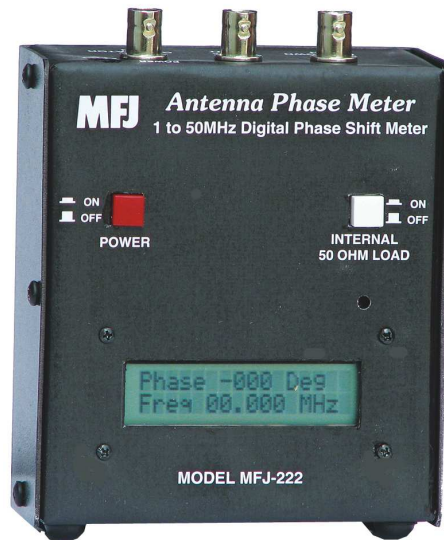


MFJ

Antenna Phase Meter

Model MFJ-222



INSTRUCTION MANUAL

CAUTION: Read All Instructions Before Operating Equipment

MFJ ENTERPRISES, INC.

300 Industrial Park Road
Starkville, MS 39759 USA
Tel: 662-323-5869 Fax: 662-323-6551

Table of Contents

Specifications 1

Front Panel..... 1

Top Panel..... 1

Setup..... 2

 Power Source 2

 Contrast 2

Operation 2

Theory of Operation 3

Calibration 3

Schematic 4

FULL 12-MONTH WARRANTY..... 5

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 8:00 AM-4:30 PM CST.

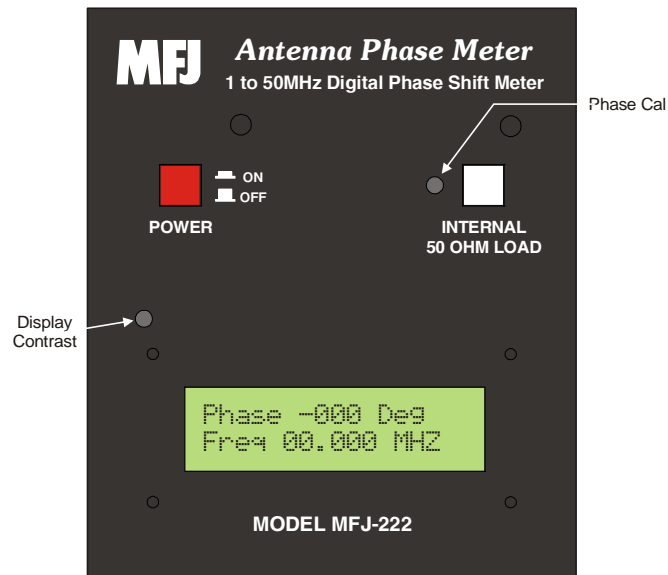
Introduction

The MFJ-222 is an Antenna Phase Meter designed to measure network phase shifts. This could be for antenna phasing networks or any other network that you need to know the phase shift of. The MFJ-222 uses low power high speed devices giving it a large bandwidth for any HF or lower VHF network and long battery life for field use. A built in internal load is featured to reduce the use of adapters and loads in many cases. An easy to read LCD display is used for reading phase measurements to the degree and the frequency to 1KHz.

Specifications

Phase meter	
Frequency Range	1KHz to 55MHz
Phase Range	-180 to 180 degrees
Frequency Counter	300KHz to 50MHz
Input Signal Level	1V to 3.5V with Internal Load 1V to 16V internal load off
Supply Voltage	8 to 16VDC External supply 9V Battery Internal supply

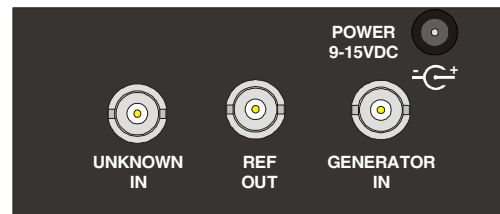
Front Panel



The front panel has only 2 main controls the POWER and the INTERNAL LOAD push button switches. The LCD Display shows the Phase from -180 to 180 degrees and the frequency of the generator being used on the MFJ-222. There are 2 adjustment ports that once set are not normally readjusted which are the Phase Cal and the Display Contrast controls.

Top Panel

The top panel has the signal connections using BNC connectors and the power jack which is a 2.1MM connector.



The GENERATOR IN is the input for the signal generator. The output should be at least 1V and no more than around 3.5V (250mW) if the internal 50 ohm load is used.

The REF OUT is the output to the device under test.

The UNKNOWN IN is from the output of the device under test to the MFJ-222 Phase Meter.

Setup

Power Source

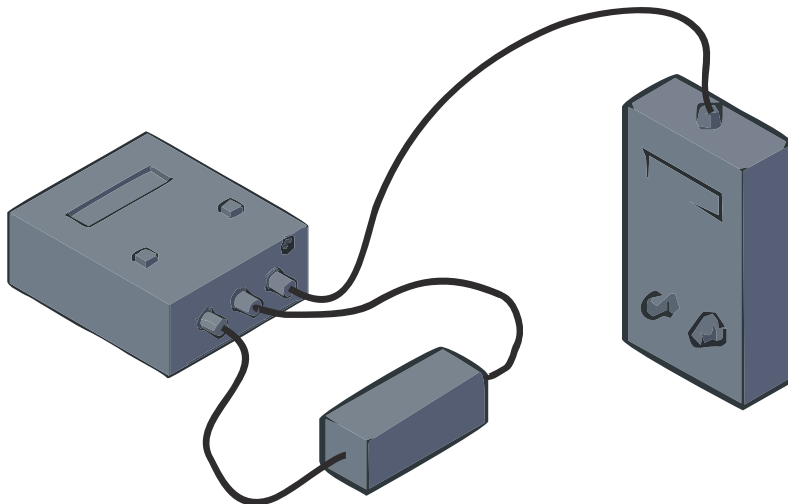
The MFJ-222 can operate on an internal 9 volt battery or an external power source between 8 and 16 volts. To install the battery remove the screws on the sides holding on the back cover and snapping in a 9V battery. Reinstall the cover. Removal of the battery is not required when operating on external power. The MFJ-222 will not recharge a rechargeable 9V battery. If rechargeable batteries are used they will have to be removed and charged in an external charger.

Contrast

The only setup that should have to be done is to adjust the contrast by turning the trim pot in the Display Contrast hole till the contrast is set to your preference using a tuning tool or small screw driver.

Operation

The basic method of operation is to connect a generator such as an MFJ-259B Antenna Analyzer to the GENERATOR INPUT. Connect a short cable from the REF OUT to the device under test input. Then connect a short cable from the device under test output to the UNKNOWN INPUT of the MFJ-222. The phase shift between the REF OUT and the UNKNOWN IN will be measured. Assuming that the device under test is expecting a 50 ohm load, turn on the internal load on the MFJ-222. If the device under test is not expecting a 50 ohm load then a BNC TEE should be connected to the UNKNOWN IN port and the device under test to one leg of the Tee and the expected load on the other side of the Tee.

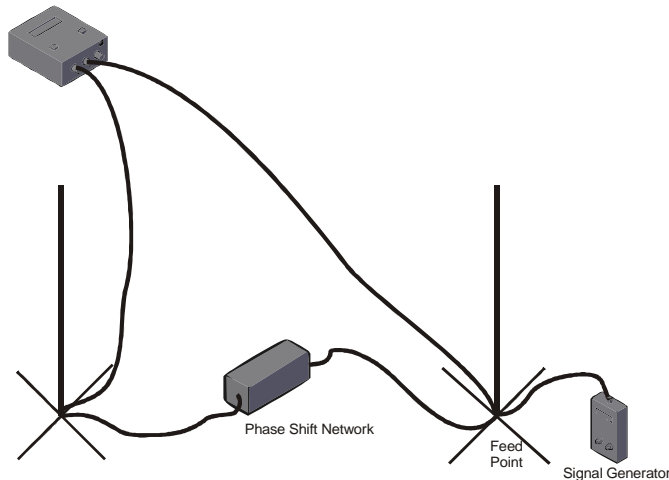


One of the uses of the phase meter is to measure and adjust phasing networks for antenna systems. The system can be as simple as a piece of coax the length needed to shift the phase needed or a complex LC network for a steerable array. When both ends of the network are accessible together setup would be like the figure above with the coax or network as the device under test. Amplifiers and filters can also be tested in this method. The cables should be as short as practical and the phase shift due to the test cables should also be measured to compensate for their phase shift.

CAUTION

Do not transmit into the MFJ-222 Antenna Phase Meter. It is not designed to be used with high power test signals.

A second method of phase shift measurement is where the ends are not easily accessible. In this mode 2 cables of equal phase shift (preferably the same type and length) are needed so they can reach the points to measure. In this case the signal generator should be feeding reference measurement point directly to keep from having to compensate for the long jumper cables used although if the phase shift of



the jumper cables are taken into account then it could be fed at the GEN IN port on the MFJ-222. The diagram shows a two vertical array with a phasing network. In this case the antennas provide the load so the internal load is turned off. T connectors with the proper adapters would be used to tap into the lines at the antennas and the phase between the two would be displayed.

Theory of Operation

The MFJ-222 takes the signal from the generator and sends it to the device to be tested. The signal is passed through the device and brought back in to the MFJ-222. A dual high speed low power comparator is used to square up the signal at the zero crossing point of the sine wave for both the REF OUT and UNKNOWN IN signals. Those signals are fed into a 2 input high speed XOR logic IC and the ratio of the off to on time is integrated and measured with one of the analog inputs of a PIC microprocessor. The voltage is at maximum at a 180 degree phase shift. The outputs of the comparators are also fed to a high speed D Flip-Flop to determine which input is the leading pulse and determine the phase of the signal. A second XOR gate is used to take the reference comparator output and drive one of the PIC counter registers to measure the frequency. The exact voltage levels are not critical. It is recommended that 1V peak to peak be used to reduce the jitter that may be encountered at lower levels. With the internal load enabled the upper limit is with the power dissipation of the load. With the load off higher levels can be used.

Calibration

A simple method of calibration is to use a 10 to 20 foot long piece of 50 ohm cable between the REF OUT and the UNKNOWN IN ports. Sweep the generator frequency to where the phase is shifted 180 degrees. That point is indicated when the plus and minus sign flickers back and fourth. At that point adjust the Phase Cal pot to read 180 degrees. For a 10 ft piece of RG-58 the frequency is around 36 MHz.

FULL 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 provided the product is returned postage prepaid to MFJ Enterprises, Inc. with a personal check, cashiers check, or money order for **\$12.00** covering postage and handling.
3. MFJ Enterprises, Inc. will supply replacement parts free of charge for any MFJ product under warranty upon request. A dated proof of purchase and a **\$8.00** personal check, cashiers check, or money order must be provided to cover postage and handling.
4. This warranty is **NOT** void for owners who attempt to repair defective units. Technical consultation is available by calling (662) 323-5869.
5. This warranty does not apply to kits sold by or manufactured by MFJ Enterprises, Inc.
6. 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 un-repaired.
7. Under no circumstances is MFJ Enterprises, Inc. liable for consequential damages to person or property by the use of any MFJ products.
8. **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.
9. This warranty is given in lieu of any other warranty expressed or implied.
10. 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.
11. All MFJ products to be serviced in-warranty or out-of-warranty should be addressed to **MFJ Enterprises, Inc., 300 Industrial Park Rd, 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 and a telephone number.
12. This warranty gives you specific rights, and you may also have other rights, which vary from state to state.



MFJ ENTERPRISES, INC.
300 Industrial Park Road
Starkville, MS 39759

MFJ-222 Manual
Version 1A
Printed In U.S.A.