

MFJ

MFJ Ultrasonic Receiver

Model MFJ-5008

INSTRUCTION MANUAL

CAUTION: Read All Instructions Before Operating Equipment

MFJ ENTERPRISES, INC.

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MFJ-5008 Ultrasonic Receiver

Introduction

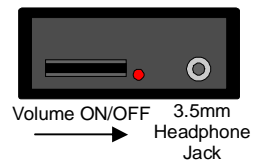
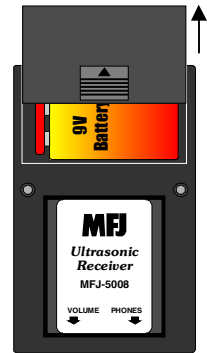
The MFJ-5008 Ultrasonic Receiver is a device designed to receive acoustic sound in the ultrasonic range around 40KHz. The primary purpose of the device is to pinpoint noise generated by faulty power line components in an aid to prompt repair and mitigation of the associated RF noise generated from this source once the offending structure is located. The Ultrasonic Receiver can also detect ultrasonic sounds from machinery, animals and insects.

Power line noise is normally generated by arcing of components in the electromagnetic field of the main lines on the pole. This arcing will cause RF interference and will also generate acoustic noise into the ultrasonic range that can be detected by the MFJ-5008.

Operation

Battery installation and setup

Open the battery cover on the electronics case by sliding it up. Plug a 9V battery to the clip in the electronics case and slide the cover back on. An Alkaline battery should last for many hours of use. If the MFJ-5008 is not to be used for some time remove the battery to prevent damage in case the battery starts to leak.

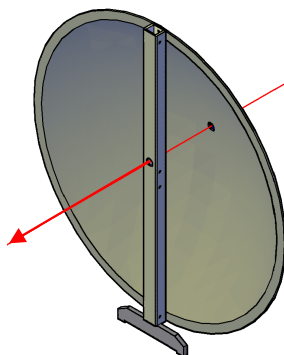


Plug in a set of headphones to the 3.5MM jack on the bottom end of the electronics case. Most any sort of Stereo or Mono headphones or earbuds can be used.

Turn on the MFJ-5008 by turning the thumbwheel on the bottom of the case. Adjust the volume as needed. Turn off when not in use.

Basic Use

Turn on the MFJ-5008 and adjust the volume to where background noise can be heard. Point the dish toward the suspected noise source and point the dish around at the suspect area to locate the maximum power line noise sound as heard in the head set. Adjust the volume as needed.



There are 2 sets of sight holes, that when lined up and viewed through, the object that is generating the sound should be seen. In most cases the source of the ultrasonic sound can be identified within a foot or so at 30 to 50 ft.

Range of the Ultrasonic Receiver is dependant on the level of acoustic noise but usually will hear the noise up to 100 to 200 feet.

Finding Power Line Noise

This section is not a complete coverage of the subject but a quick overview. More complete information is available from a number of sources including the ARRL and other internet sources.

The first rule of thumb is to only search when the noise is present. Trying to find non-existent noise is almost impossible to do. What looks bad may not generate noise and what looks good may make large amounts of noise.

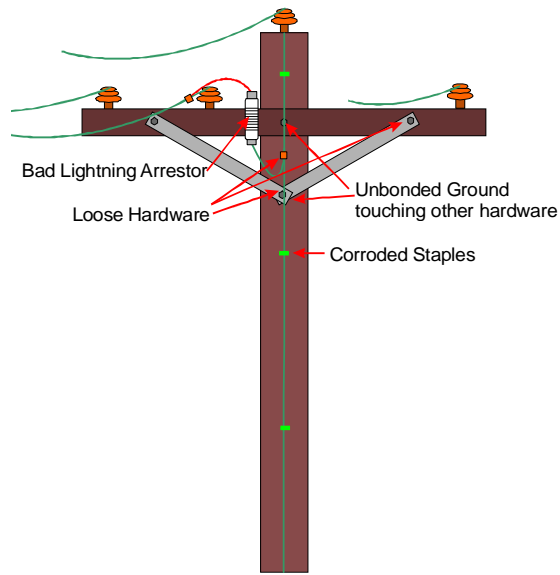
Not all RF Noise is power line noise even though it may sound like power line noise. RFI generated from power line sources are just a few of the sources that can give us trouble. Interference can come from a myriad of items in and outside of the house and many times are not power line related. A proper search would include eliminating sources in the house and around the house that generate noise. A battery powered AM broadcast radio is a good item to start with in the RFI search. Tune in the interference with the radio and then turn off circuit breakers in the house one by one listening to see if the noise goes away, if it does check the rooms that the breaker controls. A few of the things that can generate noise in the house are CFL and LED lamps, which use switching power supplies to operate, computers, cell phone chargers, televisions, VCRs and DVD players, HVAC controls, electric blankets, door bell transformers, fish tank heaters, lamp dimmers, touch lamps, low voltage lamp systems, and electric motors.

Once the house is cleared of interference problems, start checking the neighborhood for similar problems. Non power line RF sources you may run across outside can be outside lighting, swimming pool heaters and pumps, electric fences, and newer cars and trucks including tractor trailer rigs. Work with your neighbors using tact for best results.

Once you have eliminated non power line sources it is time to locate the power line source. If you have an HF radio with a directional antenna you may be able to locate the general direction of the noise. Radios that will detect the noise in the VHF and UHF range are very handy to have. The higher you can tune and find the same noise the closer you are to the noise source in most cases. If the noise is heard on the AM broadcast radio or in the HF bands may be over a mile away. If heard in the UHF region most likely less than a quarter mile away. The MFJ-852 Line Noise Meter which receives in the VHF range is designed to help locate noise. Driving around in the car using an HF radio may help but may also give false readings because the noise can be conducted down the power lines. You may also be hearing multiple sources but until you get rid of each source you will not know for sure.

The RFI from power lines is caused by arcing between conductors on the pole. It is normally not corona discharge. What can be arcing is usually loose hardware or improper grounding. The arc occurs at the peak of the sine wave and will normally make a raspy sound in the receiver buzzing at 60 or 120 Hz. This noise is best detected using a receiver in an AM or SSB mode but may be detected on the S meter of FM radios if the noise is bad enough.

The arcing is normally due to loose connections in the electromagnetic field of the line generating enough voltage to arc across the loose connection. Corrosion in the joints can be an insulator that will break down under voltage and wires rubbing against each other can arc. These issues can normally be fixed by tightening up loose bolts, properly bonding everything that is supposed to be grounded, replacing corroded staples and connections, and putting space between wires and hardware that are not supposed to be touching.



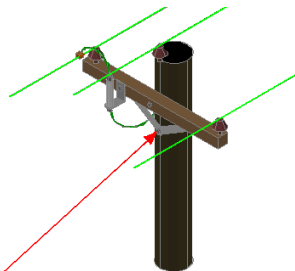
A list of things normally found according to experts are:

- Loose or corroded staples on ground conductor
- Loose pole top pin
- Ground conductor touching nearby hardware
- Corroded slack span insulators
- Guy touching neutral
- Loose hardware
- Old tie wire on the main conductors
- Loose cross arm brace
- Lightning arrestors

Transformers, although possible, are not normally the problem and direct line to ground arcing through cracked insulators are not normally the problem. Those will have more catastrophic failures than minor arcing. Eliminating the noise by replacing a transformer or insulator is usually due to retightening hardware on the pole or wire not the transformer or insulator itself.

Weather can also vary the RFI levels. Moisture may short out the arc making it go away in wet weather. It may also make things worse by making conductive paths that are not there in dry weather. It all depends on the exact problem on the pole.

Locating the problem pole will take some driving and foot work. Do not start with the MFJ-5008 but use a receiver capable of receiving the noise to identify the general noise source. Using an AM broadcast radio may get you within a mile of the source but most likely not to the pole. An HF radio may get you within several poles but probably not the exact pole. The reason is the noise can be conducted along the power lines and is reradiated. The span or the ground line on the pole may be resonant the ham bands making several poles noisy when the source is actually only one. This effect can be seen as you drive down the road and the noise goes up and down rhythmically with a fairly constant spacing of noise peaks. Using a VHF AM receiver such as the MFJ-852 or a mobile that can tune the AIR band, 2M SSB/AM, or 70CM SSB/AM will help locate the source of noise. The MFJ-852 with its Yagi antenna can confirm which pole it is by pointing it toward the pole and looking for the maximum noise.



Once the problem pole is located the MFJ-5008 can be used to locate the problem on the pole. Pointing the dish at the noise source and pointing it around for loudest noise then sighting through the sight holes you should see the culprit. You will need direct line of sight path to the source and you may need to check from several angles.



Check carefully each point that may be a source of noise. The MFJ-5008 should be able to locate the area within a foot or two depending on the distance from the pole and its height. Checking from several angles will also help to verify specific problem spots. Even if you can not tell the exact location, the location found will greatly reduce the repair area for the lineman.

Things to avoid doing when searching for noise:

- Do not hit the pole with a hammer to shake it up. If the pole is in bad shape things may break that can cause lines to come down.
- Do not pull on guy wires or ground wires. Ground wires that are not grounded to the ground below at the pole may have significant voltage on them.
- Do not climb the pole to do it your self. That is the power company job.
- Try to work with the power company, not get mad at them. Most of the time they realize that if noise is generated then there is something loose or bad that can fail or cause bigger problems.
- Point out what you found but do not tell them how to do their job unless they ask for your opinion. (Assuming that is not your job).

Some but not all power companies will have someone on staff that has training in RFI mitigation or the equipment to locate problems, or possess the equipment needed. With this in mind they often will want to help but have no good way to find the problems. If you can reduce their search area, in most cases they will be willing to fix the problem to the best of their ability. They do not want to waste time, but do want everything to work the best it can. The problem may also be due to other equipment on power poles such as CATV and telephone hardware. Those problems may need to be repaired by those companies.

Theory of operation

The basic operation of the MFJ-5008 is that of a direct conversion receiver. The IC2 NE-555P is set up as a local oscillator running at 41 to 42 KHz. The signal is picked up with the ultrasonic transducer around 40KHz and is amplified by Q1 and Q2. The amplified signal and local oscillator are mixed in Q3 where the audio product between 100 and 5000 Hz is sent through the volume control to the audio amplifier and on to the headphones.

The transducer is a narrow band device tuned to around 40 KHz with a 3dB bandwidth of about 2KHz. With the oscillator set to about 42KHz the range from 38 to 42KHz is heard as 0 to 4KHz audio.

The output of the transducer is around -65dBv at maximum sound level. This small signal is amplified by Q1 and Q2 each adding about 30dB of gain. The amplifiers are not linear and will clip at an input of -65dBv. This gives some limiting of loud signals when the volume is set high.

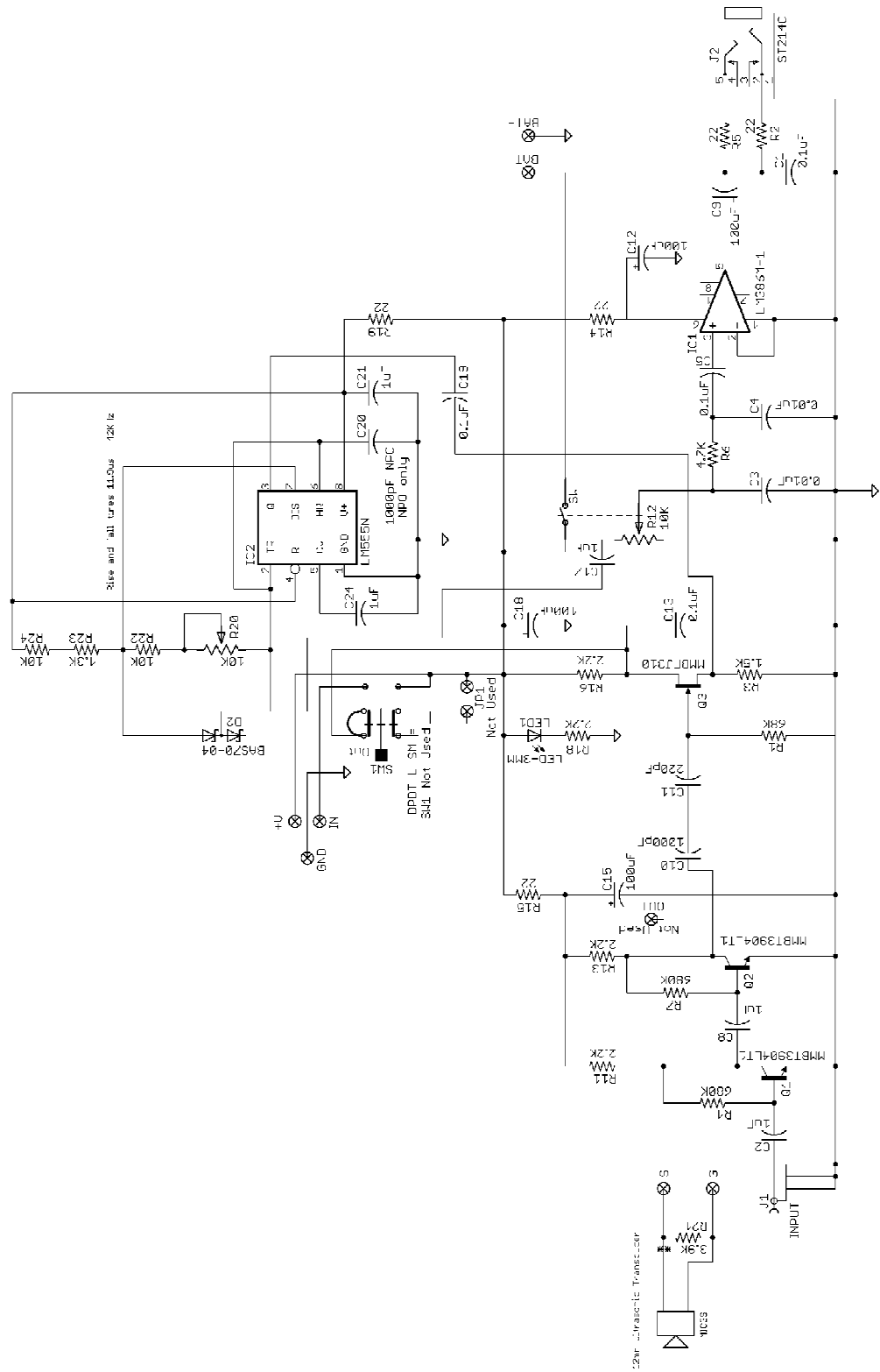
The signal is fed in on the gate of Q3 and the oscillator is fed in on the source of Q3. The resultant products are on the drain of Q3 and only the audio range products are filtered out and used.

The oscillator is set up to give an almost equal on and off period. R23 adjusts the period/frequency so it can be set as close to 42KHz as possible. C20 is an NPO capacitor to reduce temperature related drift to a minimum.

The audio amplifier is an LM386-1. This amplifier is fed from a low pass filter to kill any real high frequency sounds. The amplifier feeds the headphone jack through two 22 ohm resistors so a mono headphone can be used without problems.

Note the PCB has a number of places where components are not placed. Those locations are for possible future modifications. Those unused components are not shown on the schematic diagram.

Schematic Diagram



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 an **\$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.



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