

# RangeMaster Trouble-shooting Manual



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## 1. Tools you should have

- Switchable auto/manual range
  - Diode check
  - Continuity buzzer
  - Data hold
  - Relative mold
  - Low battery display
  - Standard test leads included
  - Short test leads also included for accurate capacitance checking
  - 4' opto-coupled RS-232 cable with female DB9 connector
  - Datalogging software
  - Meets 600V CATIII, and 1000V CATII standards
- Specifications: Range**
- DC Voltage: 400mV, 4V, 40V, 400V, 1000V
  - AC Voltage: 4V, 40V, 400V, 750V
  - DC Current: 400 $\mu$ A, 4000 $\mu$ A, 40mA, 400mA, 4A, 10A
  - AC Current: 400 $\mu$ A, 4000 $\mu$ A, 40mA, 400mA, 4A, 10A
  - Resistance : 400 $\Omega$ , 4K $\Omega$ , 40K $\Omega$ , 400K $\Omega$ , 4M $\Omega$ , 40M $\Omega$
  - Capacitance: 40nF, 400nF, 4 $\mu$ F, 40 $\mu$ F, 100 $\mu$ F
  - Frequency: 10Hz~10MHz
  - Duty Cycle: 0.1%~99.9%
  - Input Impedance: 10M $\Omega$
- Dimensions: 6-3/4" (H) x 3-3/8" (W) x 1-1/2" (D)

4,000 Count 3-3/4 Digit Multimeter DMM w/RS-232  
Tenma Part #: 72-7735 | MCM Order #: 72-7735

### Compact Test/Tone Generator

Compact tone generator is great for general test and troubleshooting of virtually any audio installation including automotive, residential and distributed commercial systems. Line level audio output is high enough to drive home theater, autosound and prosound inputs, and speaker level output delivers over 1W signal. Dual frequencies enhance use with all types of speaker systems.

Tenma Part #: 72-815 | MCM Order #: 72-815



Volt Ohm Meter

<http://www.mcmelectronics.com/>

Signal Injector



Signal injector is handy for troubleshooting audio problems. This unit will inject a tone into the circuit where you connect it.

Besides the basics, you want a Voltmeter that has the “frequency” feature, it will help in troubleshooting. However you can buy a separate frequency counter if you wish.

This counter is more precise than a Voltmeter frequency counter

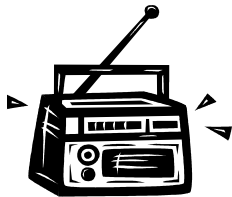
B+K PRECISION counters provide versatility and reliability for a broad spectrum of laboratory and service applications. In addition to frequency measurement, most B+K PRECISION counters also provide period and totalize measurement capabilities.



MCM#73-960

With the above counter you can be sure the transmitter is exactly on frequency. Adjust C28 Frequency trimmer (See page 7) using tune tool. This is an expensive piece of equipment, about \$200.

#21-605 test leads



You should have a good quality test radio with you. This will allow you to tell if you have a signal and/or audio. It would help if the radio has a local/dx switch. When using the radio close to the transmitter place the local/dx switch in the local mode so you won't overload the radio.



## 2. What to do first

When you first realize something is not right, you should turn the power off. An important skill a experienced technician learns is to double and triple check their work. People call us with problems expecting it is a problem with the equipment when it is always something they have done wrong. People somehow think “because I just did it , it must be right” . Experienced technicians know that a portion of what they do will be a mistake, you need to go over all your work, even though it is hard and boring. If you go over your work you will often find something wired wrong, a loose wire, or something else wrong.

### 2.1 Most common problems

We have gotten transmitters back for repair when the only problem was that the power switch was off. Be sure to check for the easy most common problems first before you spend time looking for the hard problems.

- Crystal is not put in, you will notice the volts will not move as you tune. The crystal will not “latch “ in, just place it into the socket pins, it will stay. Also if you connect your VOM (Voltmeter) to any pin on J10 (see page 7) (with the meter set to Hz, freq counter mode) and ground there will be no reading, or an incorrect reading.
- A jumper shunt is out that is needed to work. See page 7 for the (5) needed shunts.
- Is the Antenna installed?
- Measure the voltage coming in, is there at least 12 Volts?
- Is the audio simply turned down somewhere?

### 3. Low Range

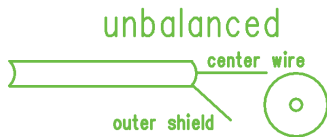
Low range can be the most difficult problem.

#### 3.1 Low Range/ Audio

Low audio can cause low radio range. Either the audio level is not turned up high enough or there may not be enough audio power if the gain is already turned up all the way. Audio is a gate on the radio power, without audio power, you will have no radio power. So always turn the audio power up as high as you can, to the point of distortion. The audio in the radio should be as loud as other stations in the area. If it isn't find out why. If you turn the audio all the way up and the sound doesn't distort, then there isn't enough audio power. If there is not enough audio power you may need a preamp or converter in the audio.

Sometimes the connections may not be right, balanced to unbalanced, wrong impedances or other problems.

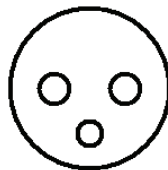
Audio connections need to be balanced to balanced, unbalanced to unbalanced, and the impedance (resistance to alternating current) needs to be approximately matched, input to output. So first follow back the wiring chain from the transmitter, the audio from the transmitter is balanced. Balanced audio is two twisted wires. The signal is the difference in voltage between the two wires, there is no ground, except maybe for



Unbalanced is a center "hot" signal wire with a ground reference outer shield.

You need a converter to convert from balanced to unbalanced, or unbalanced to balanced.

Balanced twisted pair

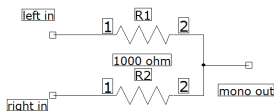


CONNECT TO THE (TIP) AND (RING) (PINS 2&3) OF THE XLR SLEEVE IS THE GROUND (PIN 1) (NO CONNECTION EXCEPT FOR SHIELD)

XLR connector (balanced) wire diagram

#555-8466 <http://www.mcmelectronics.com/>

If you find yourself with stereo and you need mono, below is a sum circuit that should do the job. R1 and R2 are 1/4 watt 1000 ohm resistors you can buy at radio shack. Use this circuit with unbalanced only. Connect all of the grounding together.



MCM electronics #555-8485 Balanced to unbalanced and unbalanced to balanced

Your problem could be impedance mismatch, for example you have a 8 ohm output ( unbalanced) made for a headphone, connected to a high impedance line in. Generally speakers and headphones are low impedance and line in, line out are high impedance. You can connect a high impedance output to a high impedance input, but if you connect a low impedance to a high impedance you will lose range of sound and volume.

## 4. Low Range

Please see the expanded installation manual for hints to get good range. Also see the area on grounding, most of the time low range is an issue with grounding. Below are the common problems that cause low range

- Low voltage to transmitter
- Low audio level
- Bad or no ground
- Transmitter not tuned or tuned wrong
- Power not set right
- Bad transmitter placement
- High noise in the area
- Noisy AM band channel
- Crystal not installed
- Not using tuning tool when tuning
- Audio level in transmitter not turned up

### **Low voltage to the transmitter**

Check the voltage from the wire coming into the transmitter with your Voltmeter, you should read 12 Volts or more.

### **Bad or no ground**

Check quality of ground- After tuning unit, with the tune voltage at about 2-3 volts (rotate PWR) rotate the Cap tune (see page 7) from the extreme counter clockwise position to the clockwise position while watching the meter. Record the minimum and maximum voltage you see, note the difference, less than 1.5 volt, bad or no ground. 1.5-2 volts poor to adequate ground. 2-3 volts, good ground. 3-5volts, great ground. This test will give you an idea where you stand with your ground Quality.

Also be sure that you have connected the ground wire right, connections should be bright and shiny (use steel wool if you need to) and then tightly clamped or soldered with torch and electrical solder. Then weatherproofed with silicone caulk. If weather corrosion gets into these connections the range will suffer. A common call goes like this. We got great range at first, but after a couple months the range seemed to slowly go down. The most likely problem would be ground wire connections going bad as the weather gets into them and causes corrosion.

The ground wire also needs to be mounted so it will not move, this is important for the tuning process. Clamp any ground wire down. Also secure the control wire ( the wire that has the power and audio).

### **Transmitter not tuned or tuned wrong**

Be sure you understand the tuning process, practice it if you need to, watch the video.

If you don't get a reading turn the power up some (see manual diagram). First locate the Cap Tune Variable Capacitor. With the tuning tool supplied (tuning tool not required as the adjust screw is ground, but it is best to use it for peak performance), rotate it to the center of it's tuning range. It is a 10 turn Cap so the center of it's range will be 5 turns in. Then move the Coil Tap Select jumper looking for a peak in voltage. Once you find it turn the Cap tune with supplied tool to increase the voltage as much as you can.

When the voltage is as high as you can get it you are tuned! Remember, look for a peak in voltage. If you don't find a peak the unit isn't tuned. Also if you find more than one peak use the peak towards the middle of the tuning block, positions 4-8. Remember you are looking for a peak! if you turn the Cap tune all the way one way and it keeps going up you are not tuned. You must see a "hill" or a "increase then decrease" as you are turning the screw.

Tuning is critical for good range. The output circuit is very high "Q" and must be tuned to do it's job. A tip for good range: use the coil tap select position that achieves a peak with the cap tune in the most counter clockwise position (least capacitance) position possible. Important: you should see a good voltage rise and fall across the range of the tuning cap, a volt or more. If the voltage barely moves as you turn the tuning cap across it's range then you may have a bad ground (see ground section) or a bad antenna connection, or other problem.

### **Power not set right**

Simply rotate the radio gain (see page 7) until the Green light comes on.

### **Bad transmitter placement**

Again be sure to read the install manual. Make sure the antenna can “look out” over the area, with nothing that would block the radio signal in the way. What would block the radio signal would be building walls, metal, ect. A single power wire or branch, some distance away should not be a problem. But stay away from power wires for safety reasons. Generally the higher the better, but just above the highest thing in the area is fine. If you don’t get good results, you can try another location.

### **High noise in the area**

Listen to your test radio, you will learn how a quiet and noisy band sounds. A quiet band will be a silent “hiss” while a noisy band will be sorts of nasty sounding noise. There is not much you can do if the area is noisy, maybe try another channel.

### **Noisy AM band channel**

I have seen customers not bother to find a clear channel for the transmitter . Remember that the most important rule in Part 15 is NO INTERFERENCE! It says this right in the inside cover of the transmitter. Be very sure to find a quiet channel, this will help your range anyway. You may want to check day and night reception if possible, or have the customer do it.

## **5. Tracing audio problems**

You need the right tools to troubleshoot audio problems. First of all just be sure the audio is turned up as it should be. There are two ways to do this. Start from the end with the signal injector and work your way back, or start from the beginning with a Volt meter and work your way forward.

### **Signal Injector**

You will need the injector pictured to the right or something like it. The tool will inject a audio tone into a circuit for testing. Start with the transmitter on. We are assuming at this point that you have a radio carrier (slight hum) on your test radio, just no audio.

Ground the black lead of the injector (hole marked GND) and connect the “hot” lead or red to TP3 (see page 7) If you have a radio carrier hum in the radio and no tone when you do this, be sure the radio power is up. If still no tone then replace the unit. If you did get a tone then go to the next step



MCM # 72-815 Signal Injector

Next (if you did get a tone) move the red hot lead to TP4. If you do not get a tone then just turn the audio gain up (clockwise). If you get a tone then go to the next step.

Connect the red lead to AF+ or AF- on either terminal block. If no tone then replace the unit. If you get a tone then double check your wiring connections.

Next follow your wire connections all the way to the audio source, injecting the signal as you go, until you find the problem.

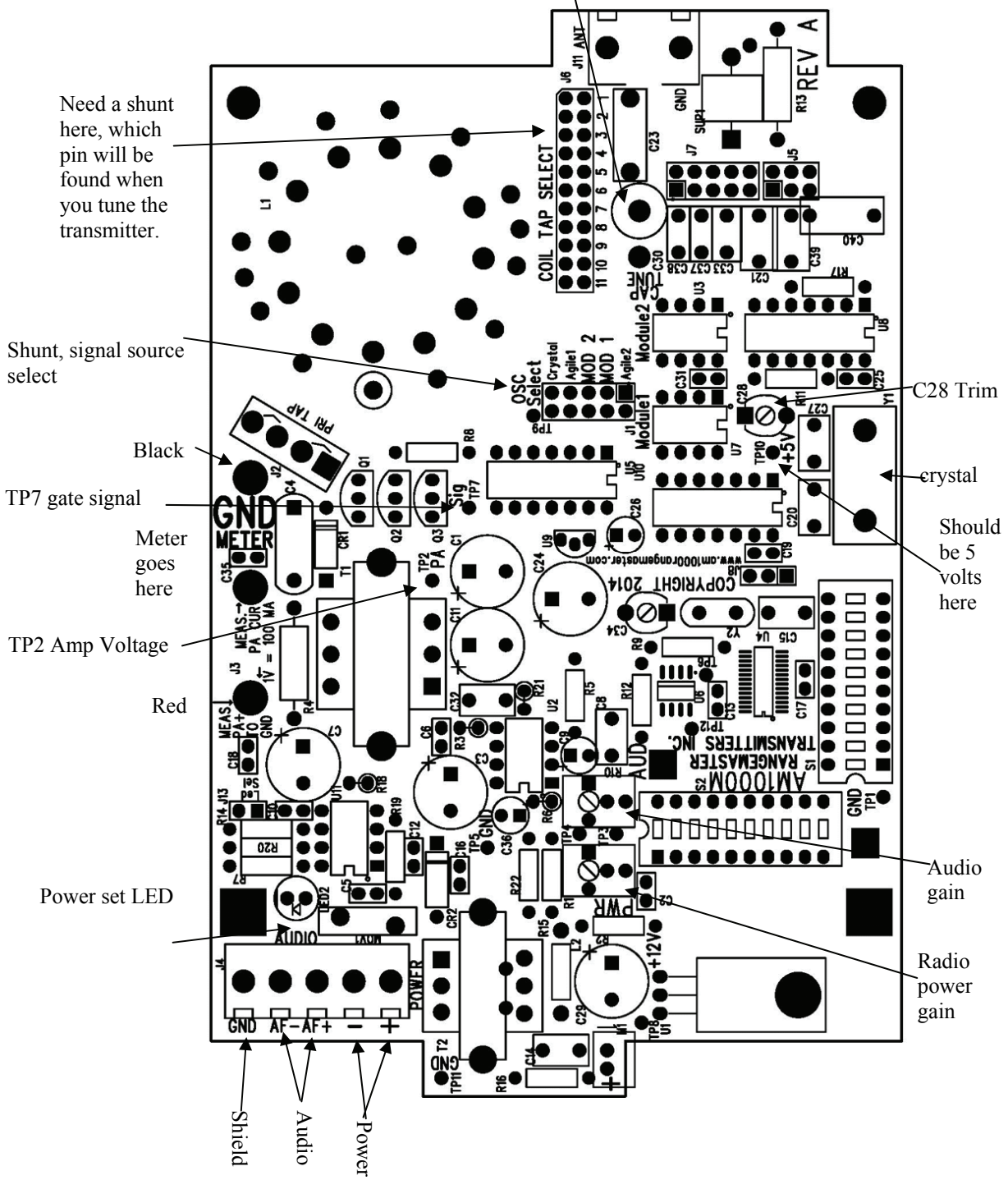
### **Volt meter method**

Place you voltmeter in AC volts. In this mode, ground the black lead (you can use the hole marked GND) and probe the audio connections starting with your audio source. If there is audio you will see a voltage indication. The frequency meter could be used also, audio should give an indication on the meter. Follow the audio to the transmitter terminal block, then to TP4, TP3. If you can follow audio all the way to TP3 and there is no audio in the carrier then replace the unit. It may be possible to try to replace U2 if you have that chip, that is the audio driver. Be sure the power is up high enough.

# 5.1 Transmitter diagram

Cap Tune

Use tuning tool



## 6. Voltage does not move while tuning

This problem usually is a bad ground, but can be caused by the oscillator not running, be sure the crystal is in. If you have another crystal try it.

Here is how to be sure the oscillator is running. Set your Volt meter on frequency read (See Voltmeter section), place black lead in GND hole. Carefully clip the red lead to any of the pins in the phase delay J10 jumper block. Be careful not to short pins together, just connect to one pin. This jumper block is very near the GND hole. You should read the frequency of the crystal channel on your meter, for example if the crystal is 1610 the meter may read 1.61

If you get no reading then the oscillator may not be working, it may be a bad crystal or low power supply voltage. Check at TP10 for 5 Volts DC

## 7. Frequency seems to be off

The crystal frequency has some slight adjustment with C28 but you need a good quality frequency counter to do it. The counter needs to have a 7 digit reading (see page 3) Here is how to set the frequency. Place black lead in GND hole. Carefully clip the red lead to any of the pins in the phase delay J10 jumper block. Be careful not to short pins together, just connect to one pin. This jumper block is very near the GND hole. You should read the frequency of the crystal channel on your meter, for example if the crystal is 1610 the meter may read 1.610000. If it does not then adjust C28 until it does. This adjustment is made at the factory, you should not normally have to make this adjustment. If you are using the module there is no adjustment.

### 7.1 LED comes on when power switch is off

Be sure you wired the power to the + and -, not to the S+ and S-. S+ and S- are not used for power, they are a digital link.

## 8. Hum

Another way to remove hum are to use a grounded power supply (you can get one at Radio Shack) A grounded supply will have a third ground prong on the power cord. The transmitter can operate with a supply rated .5 AMP in the 12-18 volt DC range though it is better to use a supply above 14 volts. Be sure to ground your shielded cable at one end only, don't run the audio cable near any AC power cords.

Good grounding means connecting all grounds together at one point instead of multiple paths.

A hum is either induced into the audio wiring by nearby AC power cords or wiring (move or shield the audio wire), or from improper grounding, or can come in from the power supply (use a shielded grounded supply).

A proper ground system will bring all grounding for all components to one point, then at that point take the connection to the earth. Hum can come from ground not really being true ground, but some potential above ground.

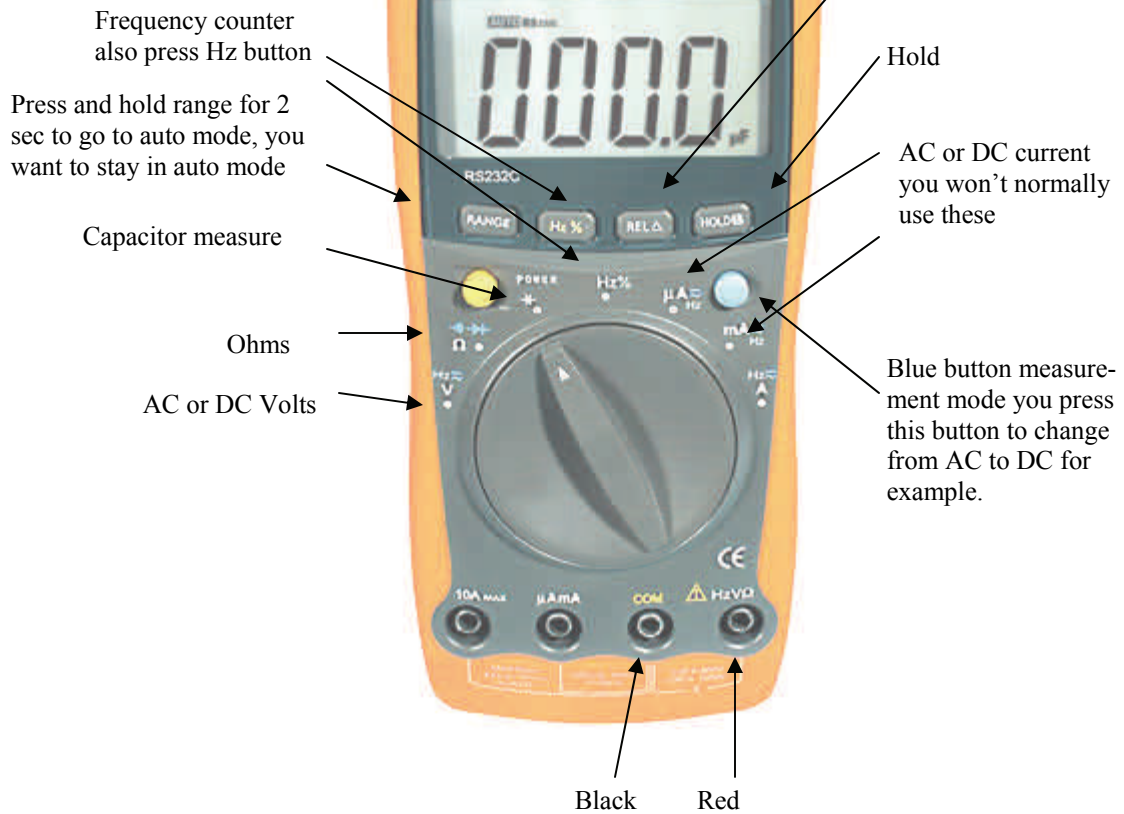
Also don't be fooled thinking you have a hum just because your radio is overloaded. A radio nearby to the transmitter may appear to have a hum, but it may just be a "power hum". Try to move the radio further away, 1/4 mile, and see if the hum is still there.

## 9. Updates

Be sure to check the website for updated versions of the manuals <http://www.am1000rangemaster.com/index.html>



## 10. Voltmeter



This information is for the Tenma 72-7735, other Voltmeters are similar.

## 11. Removing the Circuit board

Removing the circuit board is easy, there is a small catch on each of the (4) nylon mounts. Using a small screw-driver release the catch and pull the board out, nudging each corner out a bit at a time.

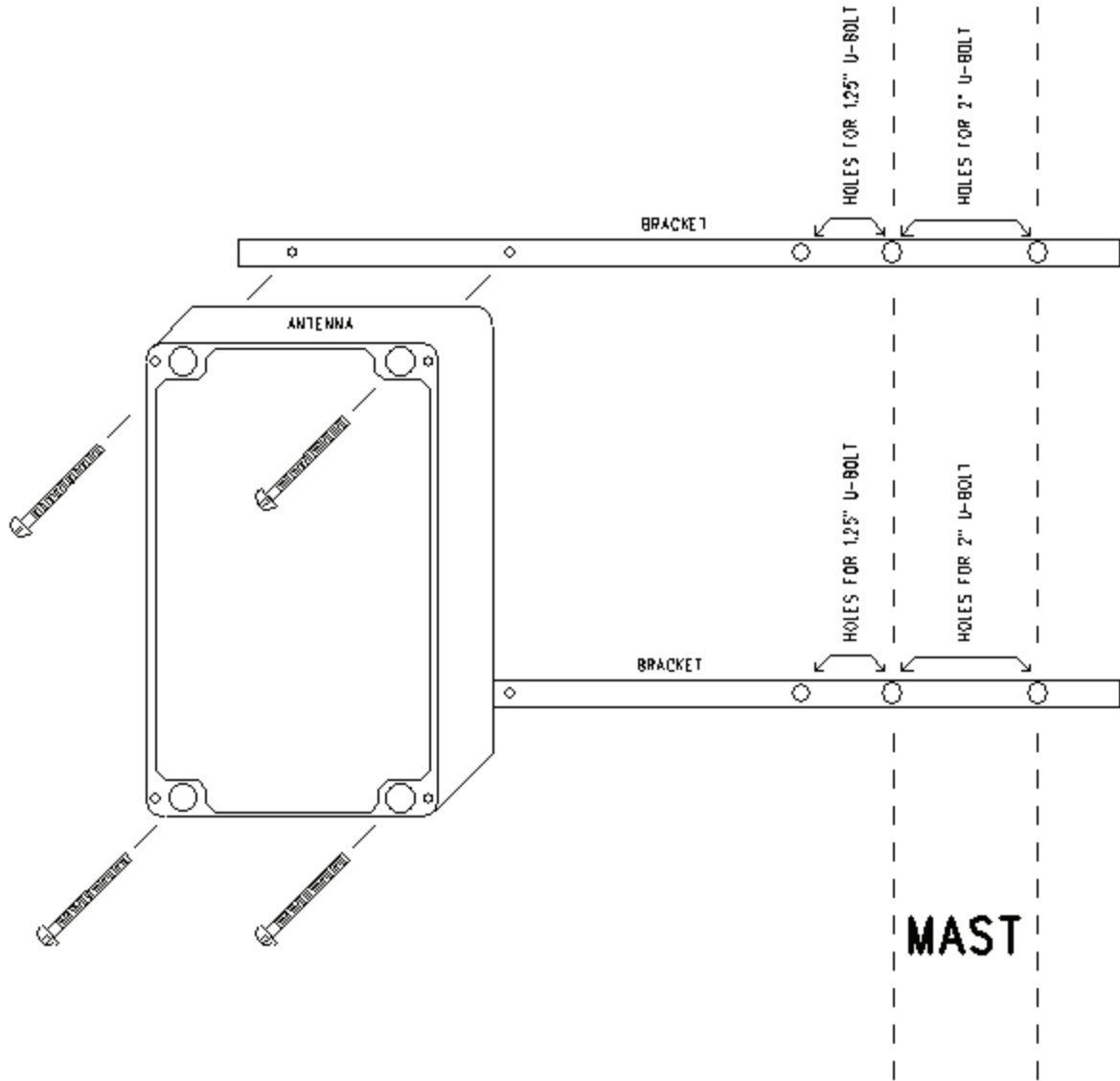
## 12. Outdoor Box

Be sure the rubber gasket is on place in the lid, the inside of the transmitter must be kept dry, away from weather. It is a good idea to place a short piece of wire into the unused cable hole to seal it up. The box is made from fiber-glass and will last many years in the weather. Be sure to tighten the lids screws firmly so you engage the gasket in the lid.

## 13. Radio Check

When the transmitter is working properly it is possible to see a small spark with a pencil lead placed close to the coil (large red round object) pins. You may need to turn the power up for it to do this and it may need to be dark. Or you may feel a slight RF burn (some heat) to your finger if you lightly touch the pins of the coil. If you can get a spark or burn and you hear nothing on your radio you may have the radio on the wrong channel, since there is a spark, burn there is radio energy coming out.

# 14. Mount Bracket diagram



### BRACKET KIT INCLUDES:

- (2) DRILLED ALUMINUM BARS
- (4) 10-24 X 2" BOLTS WITH NUTS
- (2) 1.25" U-BOLTS FOR 1.25" MAST
- (2) 2" U-BOLTS FOR 2" MAST