



Bi-Comm Electronics

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YOU AND YOUR MOBILE ANTENNA

Three main components comprise a typical Two-Way Radio installation. They are: your transceiver, an antenna, and the coaxial cable that connect the antenna to the transceiver. It is important that all three pieces are installed correctly to give the best possible range and reliable performance. We hope this pamphlet will be helpful for you to realize the maximum performance from your radio installation.

ANTENNA

For several reasons, it is impossible to exactly PRE-TUNE an antenna at the factory. A general range of tuning is done which may suffice, but for best performance, an antenna should be tuned after it is installed. Most antennas have some form of tuning capability. Usually, this involves the whip section sliding into a coil, spring, or metal section. Failing this, the manufacturer will normally supply the antenna tuned to the lowest advertised frequency.

This allows for trimming the "active radiating element", antenna rod or whip, by adjusting or cutting it to the correct resonant length. This works on the same principal as a tuning fork, used by piano tuners. The shorter the fork, the higher the frequency it will radiate, and visa versa.

When the antenna is adjusted for the centre frequency of operation, channel 20 for CB, they should perform well from the lowest to the highest frequency. An untuned antenna robs you of communication distance and could cause, after a period, substantial deterioration of performance, or even destruction of an RF output transistor. We cannot stress enough the importance of tuning your antenna. The measure of an antenna's performance is called its "SWR" (Standing Wave Ratio).

"COAX" CABLE

Coaxial cable is used in almost all radio installations. This cable transfers the power from the transceiver to the antenna. The output impedance of a two way radio transceiver is designed to be 50-ohm. Communication antennas are designed with an input impedance of 50-ohm. Therefore, RG-58 or RG-213 coaxial cable is well suited because it also has 50-ohm impedance, and will perfectly match the transceiver to the antenna. The resonating frequency of the antenna is very important, because a mistuned antenna can disrupt the system balance. If this balance is disrupted, standing waves are generated on the coaxial cable, which results in a loss of power delivered by the transceiver.

UNDERSTANDING SWR (Standing Wave Ratio)

With the transceiver having a 50-ohm output, and a properly tuned antenna a 50-ohm input, by using a 50-ohm cable (such as RG-58 or RG-213), all the power (ignoring coaxial cable losses), from the transceiver will be transferred via the coaxial cable and radiated by the antenna.

Under these conditions, the SWR (standing wave ratio) of the antenna system would be 1:1. This condition seldom exists and standing waves are set up on the cable. A high SWR robs you of power and range. While 1:1 is not always possible to attain, you should tune your antenna system so the SWR does not exceed 1.5:1 or at maximum 2:1. Here are some examples of the power losses for various SWR ratios:

SWR		Power Losses
1:1	=	0
1.3:1	=	2%
1.5:1	=	3%
1.7:1	=	6%
2:1	=	11%
3:1	=	25%
4:1	=	38%
5:1	=	48%
6:1	=	55%
10:1	=	70%

TUNING YOUR ANTENNA

For optimum performance, use an SWR meter to tune the antenna. However, since these meters are becoming more and more costly now a days, not everyone may want to invest in such an instrument.

If possible, borrow one. If you are unable to borrow one, you can use the RF output meter on your transceiver if it is equipped with one, as a GUIDE to antenna tuning. While it is not very accurate, it is generally better than no tuning at all. Always tune your antenna in an open area. Wires, metal and copper tubing if nearby can affect the tuning. Never tune an antenna inside a garage, under a metal car port, next to a metal truck, etc.

A. USING YOUR TRANSCEIVER OUTPUT METER AS A TUNING GUIDE

WARNING: DO NOT CUT THE WHIP USING THE "POWER OUTPUT METER TUNING METHOD". YOU MUST USE AN SWR METER TO ACCURATELY DETERMINE THE SWR. After installing your antenna system, place the whip halfway into its receptacle and turn your transceiver to its centre frequency, channel 20 on CB. (NB! For AM/SSB radios, switch the radio to AM). Depress the switch, also called the "Press To Talk or PTT", on the transceiver microphone, and make note of the reading on your RF output meter. Loosen the adjustable whip section and lengthen the antenna 1 to 2 cm. If the antenna has no adjustment, use a piece of solder or thin copper wire to increase the whip length by wrapping it around the top of the whip. Again depress the PTT, if the reading is the same or lower continue increasing the length until the **LOWEST** reading is obtained on the RF meter. If the reading is higher, shorten the whip 1 to 2 cm at a time until the **LOWEST** reading is obtained on the RF meter. I do not suggest cutting the whip unless you have a proper 'SWR' meter at hand.

THE LOWEST READING.

Your RF output meter is a voltage sensing device. It is installed in the RF output circuit and senses the voltage near the antenna terminal. In a perfectly tuned system all the voltage is transferred from the output transistor and passed to the antenna. As an example, let's use the figure 10. If there is SWR on the line, the forward voltage is 10 and a reverse voltage appears (let's say it's 2). The meter circuit now sees 20 and shows a higher reading. You can see that because of the way most RF output meters work, the **LOWER** your RF output meter reads the better the tuning of the antenna. Of course, if the meter reads less than 1/2 scale, it may indicate a problem in your set and should be checked.

Similarly, an extremely high reading may indicate a problem in your antenna. An RF output meter can tell you much.....especially if you know how to use it.

B. TUNING YOUR ANTENNA WITH AN SWR METER

Using an SWR meter is the most accurate way to tune an antenna. Connect the SWR meter as close as possible to the back of the transceiver. Use a double male-connector or a very short piece of RG-58 with connectors on each end.

Place the adjustable whip halfway into its receptacle. Turn your transceiver to its centre frequency, channel 20 on CB. (NB! For AM/SSB radios, switch the radio to AM). Measure the SWR following the instructions supplied with the meter. Make a note of the meter reading. Loosen the adjustable whip section and lengthen the antenna 1 to 2 cm. If the antenna has no adjustment, use a piece of solder or thin copper wire to increase the whip length by wrapping it around the top of the whip. Key the transmitter and read the SWR again. If the SWR is lower, continue the process lengthening the whip once more until the lowest reading is obtained. If the SWR is higher, lower the whip 1 cm at a time, until the lowest SWR is obtained. Note, if the reading continues falling but you have reached as far down as you can go with the whip, the whip may be too long. To verify this, switch the transceiver to the lowest frequency (Channel 1 on CB) and measure the SWR. Next, switch the transceiver to its highest frequency (Channel 40 on CB) and measure the SWR. **IF THE SWR WAS LOWEST ON THE LOWEST FREQUENCY, AND HIGHEST ON THE HIGHEST FREQUENCY, THE WHIP SECTION IS TOO LONG.** Carefully cut 1/2 cm at a time from the whip section and re-measure the SWR on the lowest, middle and highest frequency (Channels 1, 20, and 40 on CB). If the SWR is still lower on the low frequency compared to the high frequency, continue trimming the whip a little at a time. If the SWR is the same on both lowest and highest frequency, the antenna has reached its optimum length across the frequencies used. **DO NOT GET OVERANXIOUS. YOU CANNOT REPLACE A SECTION ONCE IT IS CUT OFF.** If you are unsure, first lengthen the whip a little with a piece of solder, then re-check the SWR reading.

Every six months or so, recheck the SWR. Car washes, road grime, and chemicals can affect the mechanical connections of an antenna and corrode them. This corrosion can cause poor electrical connections and lead to high SWR. The correction of this problem is usually accomplished by cleaning of the metal connection parts with a wire brush.

HELPFUL HINTS

1. High SWR robs you of range and puts a strain on your output transistor.
ALWAYS TUNE A NEW ANTENNA.
2. Never tune your antenna in a closed area (garage, under a metal car port, etc.) as incorrect tuning may result.
3. MAKE SURE ALL MECHANICAL CONNECTIONS ARE CLEAN & TIGHT.
4. DO NOT SMASH OR SHARPLY BEND THE COAX CABLE – it should not be bent with a radius sharper than six times its own diameter. Sharp bends will effect the characteristics of the coaxial cable.
5. TIGHTEN YOUR PL-259 CONNECTOR OCCASIONALLY - road vibration has a tendency to loosen it which can cause output transistor failure.
6. PERIODICALLY (every 6 months) recheck your SWR. Corrosion and road grime may rob you of performance.
7. PERIODICALLY check your coax cable for wear. A broken or loose wire could cause output transistor failure.

This information was produced to help you understand the installation and maintenance of your antenna and cable feed system. Many field problems have been traced to problems such as the above. They lead to eventual failure of the RF output transistor or module in your transceiver which is may be costly to repair. Careful installation and maintenance can prevent these problems.