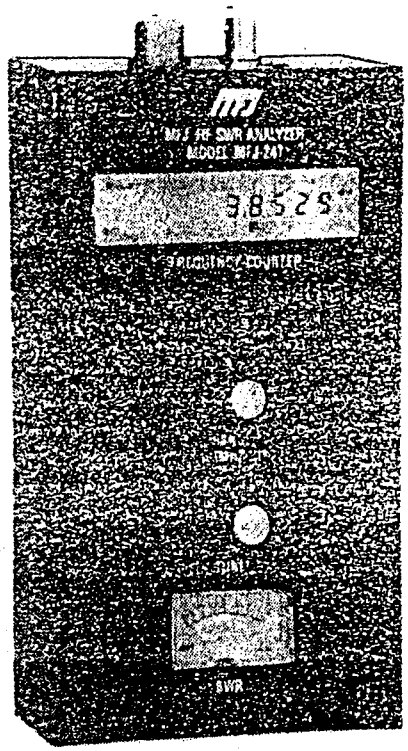
MFJ HF SWR ANALYZER



MODEL MFJ-247
INSTRUCTION MANUAL

CAUTION: Read All Instructions Before Operating Equipment

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Thank you for purchasing the MFJ-247 HF SWR Analyzer. The MFJ-247 gives you a direct readout of your antenna's SWR without the need for formulas or indirect readings. The MFJ-247 can also be used to adjust a tuner to match your antenna without the need for transmitting. The frequency coverage for the MFJ-247 is approximately from 1.75 MHz to 33.5 MHz in five bands. The bands and coverage are:

BAND A	1.75	- 2.9	MHz
BAND B	3.2	- 5.3	MHz
BAND C	6.5	- 11	MHz
BAND D	12	- 21	MHz
BAND E	18	- 33.5	MHz

The MFJ-247 requires the optional MFJ-1312 power supply adapter (12 volts @ 300 mA.) or six AA ALKALINE batteries.

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* NOTE: If you use batteries with the MFJ-247, use *
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* ALKALINE batteries. *
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To install batteries, remove the screws holding the cover onto the case. Insert the batteries into the battery holder. Tuck the battery snap wires out of the way so they do not interfere with the tuning capacitor rotation. Re-install the cover and screws.

USING THE MFJ-247 HF SWR ANALYZER

Your MFJ-247 HF SWR Analyzer has many uses. It can be used to find:

1) The resonant frequency of your antenna.

2) The SWR of your antenna at a particular frequency.

3) The frequency at which your antenna has the lowest SWR.

You can also use the SWR Analyzer to adjust your antenna to a low SWR and to adjust an antenna tuner to match the transmitter to the line.

Measurement of the antenna's SWR is done right at the input to the transmission line. There is no need to climb the tower and measure the SWR at the antenna. Using the

chart in Figure 4, and knowing the line loss for your transmission line and the SWR at the line input, you can determine the SWR at the antenna, regardless of line length.

I. Measure the antenna's SWR at a particular frequency.

1. To check the SWR of your antenna, connect the antenna with a PL-259 connector to the ANTENNA connector on the MFJ-247.

NOTE: If you are using coax as your feedline, connect the coax directly to the SO-239 (UHF) connector marked ANTENNA.
If you are using an open-wire feedline, wire the feedline to a PL-259 connector, then attach it to the ANTENNA connector of the MFJ-247.

2. Set the BAND switch to the appropriate band.

3. Adjust the frequency dial of the SWR ANALYZER to the frequency at which you want to check the SWR.

4. Read the SWR from the meter.
This is the SWR at the INPUT TO THE TRANSMISSION LINE looking toward the load (antenna). To determine the SWR at the antenna, use Figure 4 in APPENDIX D.

NOTE: If the SWR at the transmitter is 1:1, then the SWR at the antenna is 1:1.

5. Using steps 1 through 4, you can make a plot of SWR versus FREQUENCY for your antenna. Just plot the SWR at many different frequencies. APPENDIX B has an SWR vs. FREQUENCY chart (Figure 3). We suggest you make photocopies of this chart so you can use it for several antennas.

NOTE:

It is advisable to take readings on several bands to determine the frequency at which the lowest SWR occurs.

The SWR can be low at several different frequencies, but there should only be one frequency that shows the LOWEST SWR. That frequency will be the natural resonant frequency of the antenna.

II. **Find the frequency at which the antenna has the lowest SWR.**

1. Connect the antenna to the MFJ-247 as in step I.

2. Turn the BAND switch to the appropriate band.

3. Adjust the TUNE control throughout its range until the SWR meter reads its lowest value. Read the frequency on the frequency meter. Read the SWR on the meter.

4. If you do not obtain a low SWR on any frequency, turn the BAND switch to another band and repeat Steps 1-3 above. Don't be surprised if your antenna does not show a 1:1 SWR on any frequency. Many antennas can be tuned to obtain a 1:1 SWR, but will never show a 1:1 SWR without an antenna tuner.

NOTE: The antenna may have a low SWR at more than one frequency. For instance, an antenna that is resonant in the 40 meter band is usually also resonant in the 15 meter band.

III. **Adjust the antenna for 1:1 SWR.**

1. Turn the BAND switch to the appropriate band.

2. Turn the frequency TUNE knob until the pointer is on the freq at which you want to tune the antenna.

3. Read the frequency on the frequency counter.

4. Read the SWR on the meter. If the meter reads other than 1:1 SWR, adjust the antenna until the antenna reads 1:1 SWR (or lowest value obtainable).

NOTE: The MFJ-247 can tell you whether the antenna elements are too short or too long. If you find the antenna's resonant frequency is too low, then the elements are too long. If the resonant frequency is higher than you want then the elements are too short.

If you are adjusting an antenna for the first time, it is recommended you start with elements a little too long, then shorten to resonance. Again, the SWR for your particular antenna may never get as low as 1:1. Adjust for the lowest reading.

IV. Using the MFJ-247 to adjust an antenna tuner.

1. Connect the antenna to the antenna tuner connector marked ANTENNA.

2. Connect a coax cable between the tuner's TRANSMITTER connector and the MFJ-247's ANNTENA connector. (See Figure 1.) This should be a 2-3 foot length of RG-58 or RG-8.

3. Turn the BAND switch to the appropriate band.

4. Set the frequency dial to the desired operating frequency. Adjust the tuner's controls until the meter on the MFJ-247 indicates 1:1 SWR (nulls).

5. Disconnect the MFJ-247 completely and connect the tuner to the transmitter.

6. Turn the Band Switch to OFF when finished .

****
* CAUTION *
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* Never transmit through the MFJ-247. Take the MFJ-247 *
* completely out of line before transmitting! *
* Damage to your MFJ-247 will result if left in line. *
*
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We recommend using the MFJ-1702 coax switch as in the diagram below:

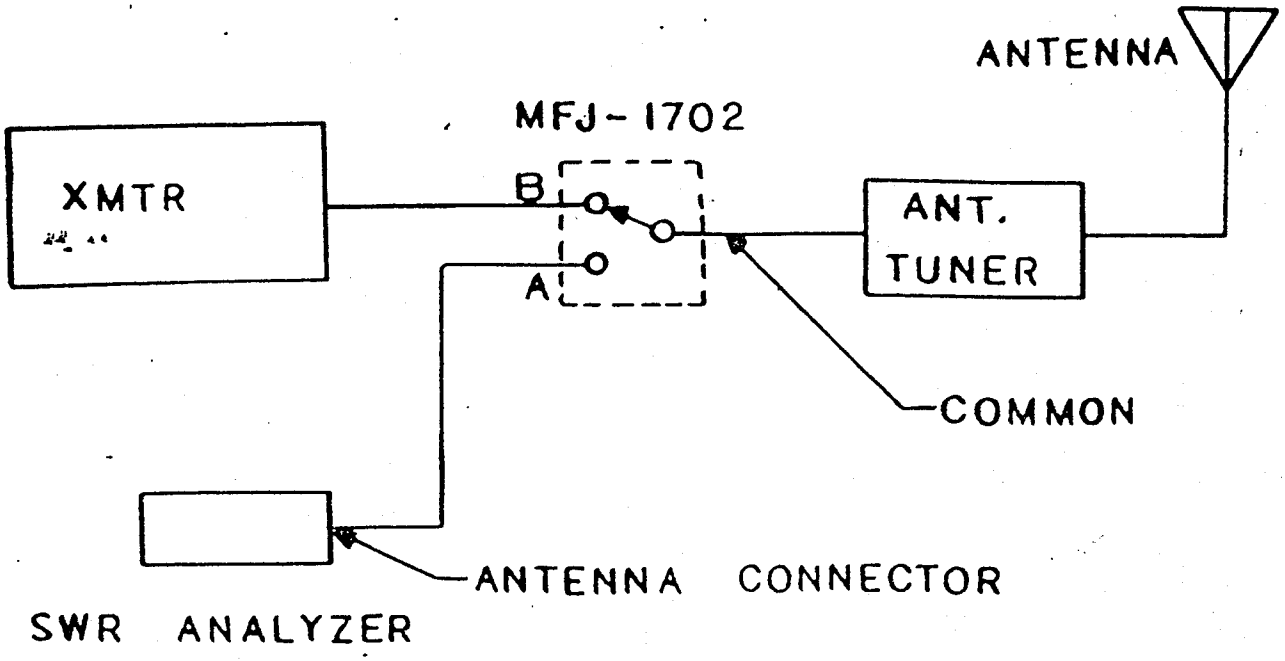


Figure 1 - Hook-up for Using Analyzer to Tune Antenna Tuner.

WARNING - Never transmit while the MFJ-1702 coax switch is switched to A if the XMTR is connected to B.

Damage to your radio can occur.

If the XMTR input is on B, then transmit only when the coax switch is in position B.

If the XMTR input is on A, then transmit only when the coax switch is in position A.

The center conductor of the UNSELECTED coax position is grounded, so transmitting into B while the switch is in position A will cause you to be transmitting into a dead short to ground.

NOTE: MFJ Enterprises, Inc. will NOT be liable for any damage to your radio or other equipment due to improper connection or use of the MFJ-1702 coax switch.

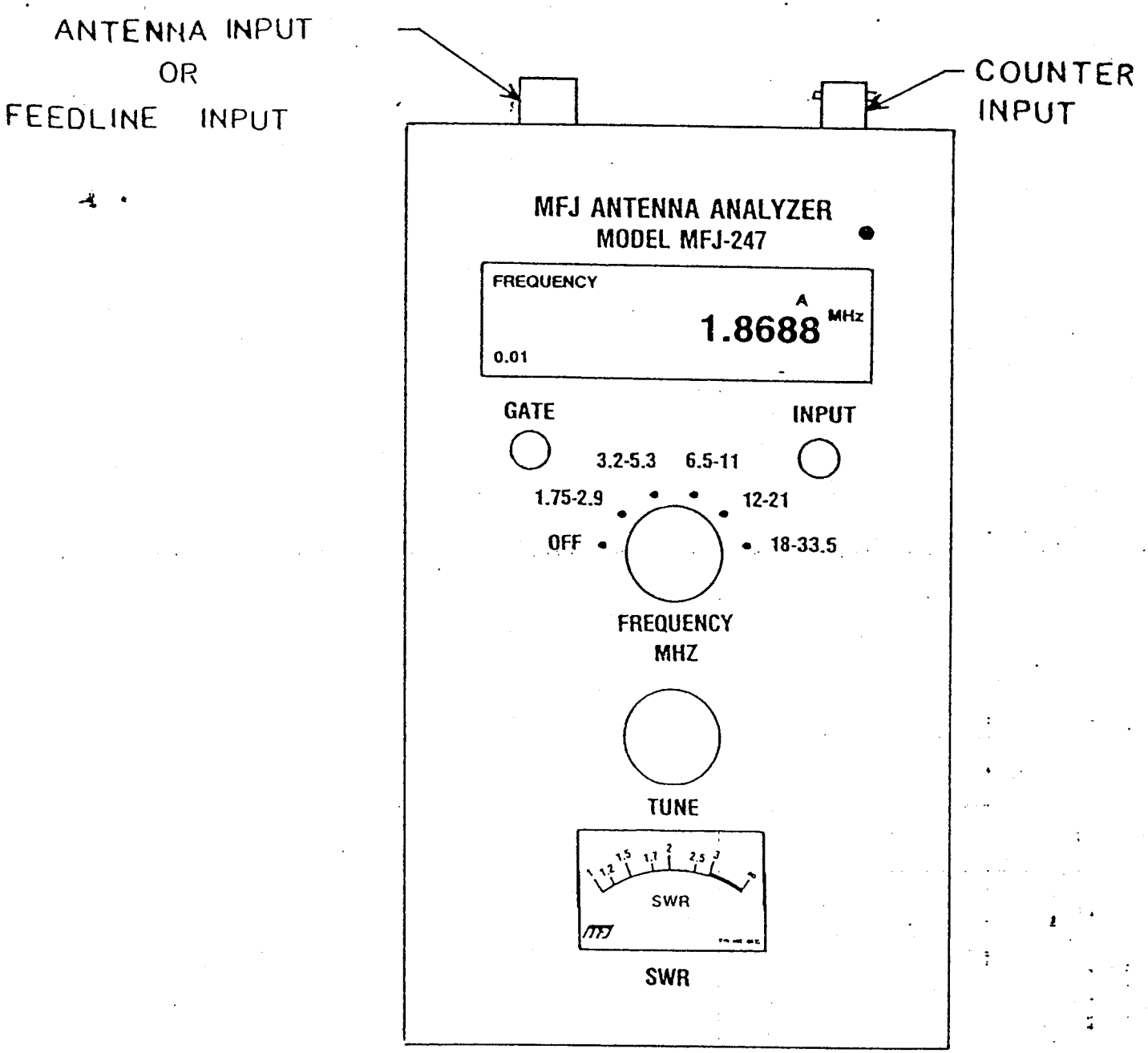


Figure 2 - MFJ-247 Front Panel Layout.

APPENDIX A

FREQUENCY COUNTER

The MFJ-247 has a built-in frequency counter. This frequency counter reads the frequency of the MFJ-247 oscillator or a frequency counter probe can be attached to the female BNC connector at the top right side of the MFJ-247. Refer to Figure 2 on the previous page.

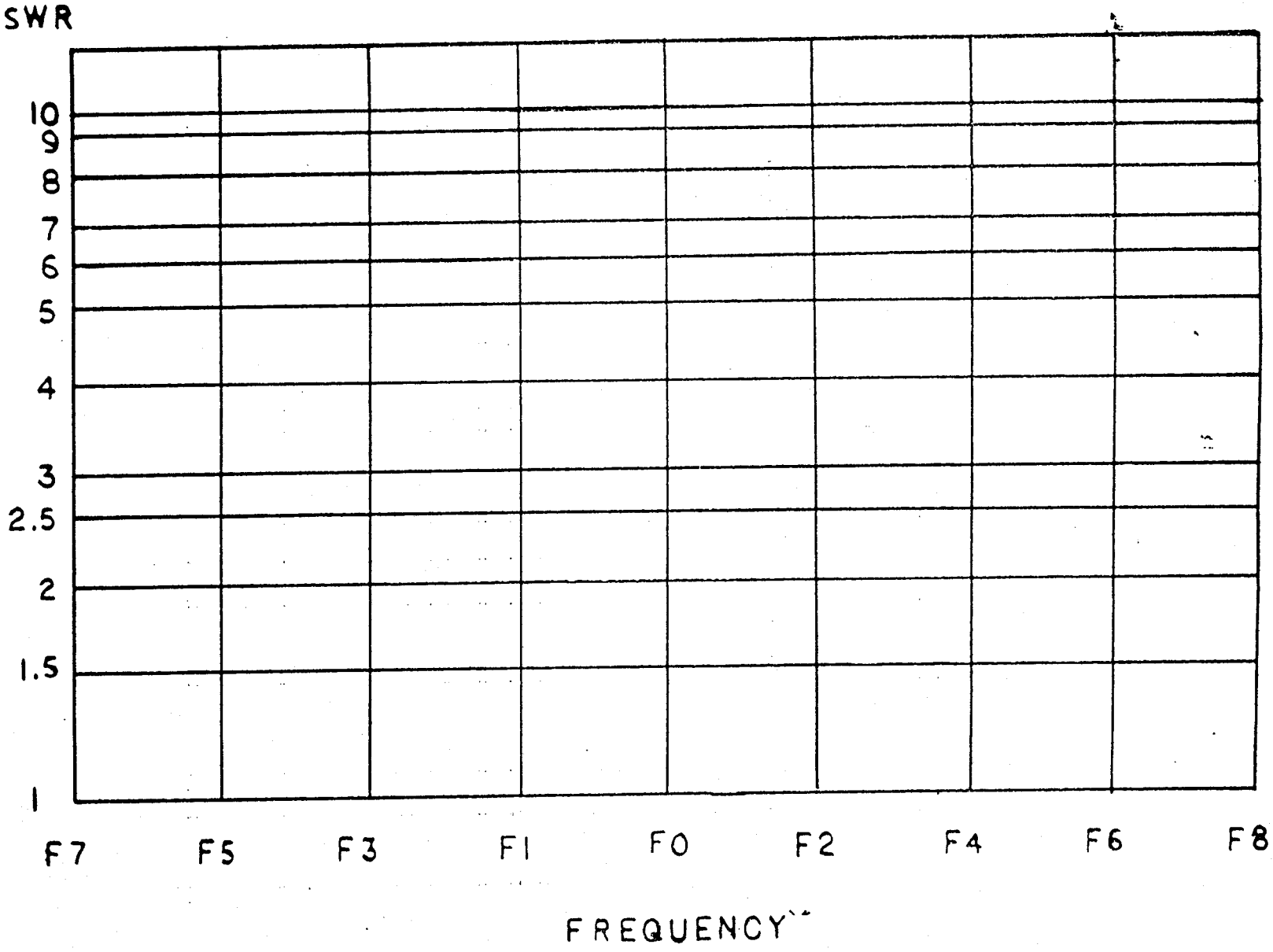
When the unit is first turned on, there is a small "A" between the last two digits at the right of the display. This "A" means the counter is reading the oscillator frequency. On band A the frequency will read between 1.75 and 2.9 MHz.

To switch the counter to read an external frequency, PUSH the red (INPUT) pushbutton on the right once. A small "B" will come up on the display and the "A" will disappear. The counter will now read whatever frequency the probe is picking up.

If you want to use the counter to measure other than the 247's oscillator, attach a counter probe or a piece of wire to the BNC connector at the top right of the case.

NOTE: The sensitivity of the counter is about 600 mV. A "TIMES 1" probe must be used unless you are measuring a very large signal.

FREQUENCY/SWR PLOTTING CHART



APPENDIX C

Facts About Transmission Lines and Line Loss.

The MFJ-247 should be connected to the input to the transmission line looking toward load. You do NOT have to know the length in wavelength of your transmission line, but you do need to know the number of feet (or meters) and the loss (in dB) for the length of the transmission line you are using. Using the SWR/Line loss chart below you can readily determine the SWR at the antenna. The most important consideration for any antenna system is probably the loss in the transmission line. The less loss, the better. Two important points about transmission lines need to be understood:

1. On a LOSSLESS transmission line, the SWR read at the transmitter is the same as the SWR at the antenna. For any line with loss the SWR is greatest at the antenna and minimum at the transmitter.

2. Regardless of the losses in the transmission line, if the SWR at the transmitter is 1:1, then the SWR at the antenna is 1:1, but if there is ANY SWR at the input to the transmission line, there is a higher SWR at the antenna (assuming anything but a lossless line).
Let's go through a practical example:

   Let's say you are using RG-58/U which has a loss of 2.3 dB at 30 MHz per 100 feet. You are using only 50 feet of cable, so your loss when matched at the transmitter is 1.15 dB at 30 MHz.

   Go to Figure 4 in APPENDIX D and find the 1 dB loss line which curves up and to the right.

   Now assume you are using the MFJ-247 and find that the lowest SWR you can get on our antenna is 2.0:1.

   Follow the 1.15 dB line (between the 1 dB line and the 2 dB line) down to the point it reads 2.0:1 on the horizontal axis (SWR at transmitter).

   Looking at the vertical axis we can see that the point corresponds to an SWR of about 2.5:1 on the vertical axis.

   Reading this chart correctly tells us that with 50 feet of RG-58/U that has a loss of 2.3 dB per 100 feet at 30 Mhz and a line input SWR of 2.0:1, the SWR at the antenna is 2.5:1.

   By the way, the 2.0:1 SWR at the load only adds about .225 dB of loss to the already matched 1.4 dB of loss for a total loss of 1.625 dB. (See ARRL Antenna Book.)

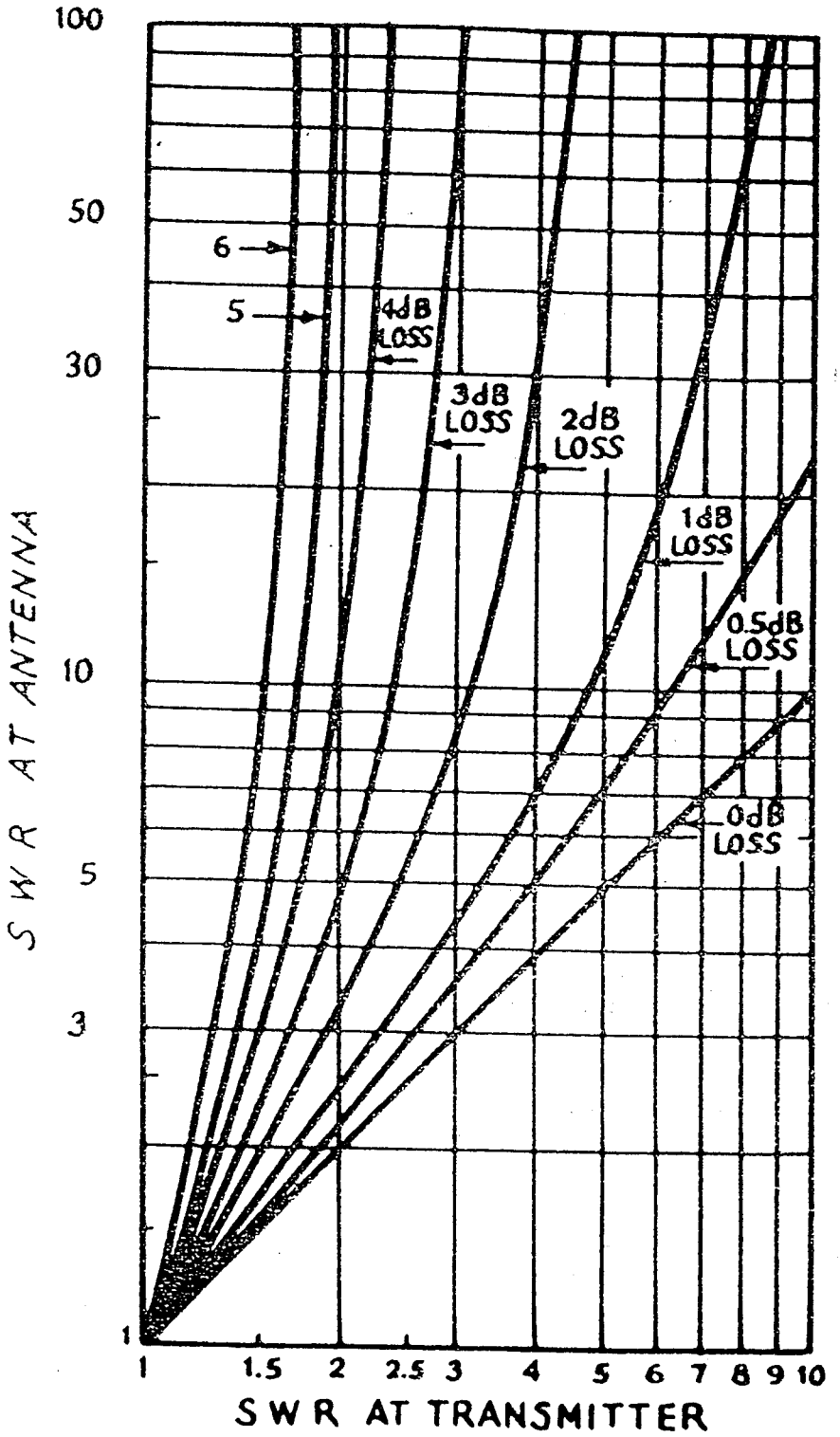
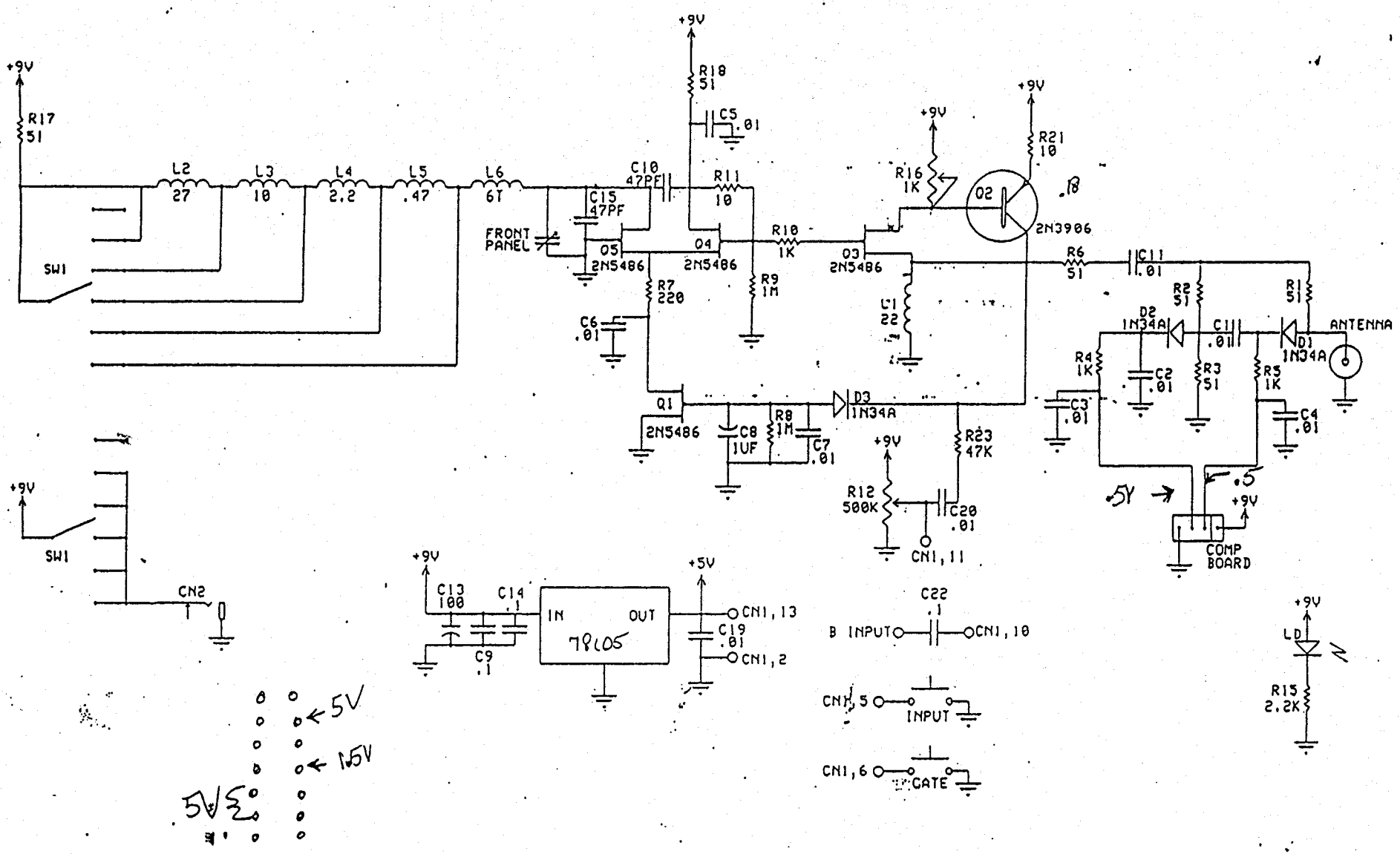


Figure 4 - SWR at Transmitter vs. SWR at Antenna chart.



RESISTANCE VALUES ARE IN OHMS
CAPACITANCE VALUES ARE IN MICROFARADS
INDUCTANCE VALUES ARE IN MICROHENRIES
UNLESS OTHERWISE SPECIFIED

PROJECT NO.	PART NO.	REVISION	SHEET
MFJ-247	XXX-XXXX	1	SHEET 1 OF 2
DESCRIPTION: MFJ HF SWR ANALYZER OSCILLATOR AND BRIDGE BOARD			
DATE: 8/19/90	REVISED: 9/8/92	PC BOARD: M207.2	DRAWN BY: R. HANEY