

Welcome to HRU-2005!



Test Equipment Forum

Neil, KC2KY

A New Project, Built and Ready to Test



It Doesn't Work . . .



What Do I Do NOW???

This doesn't help...



Agenda

Digital and Analog Multimeters

Frequency Counters

SWR / Wattmeters

Your Transceiver as a Test Instrument

Oscilloscopes

Signal Generators

Digital and Analog Multimeters

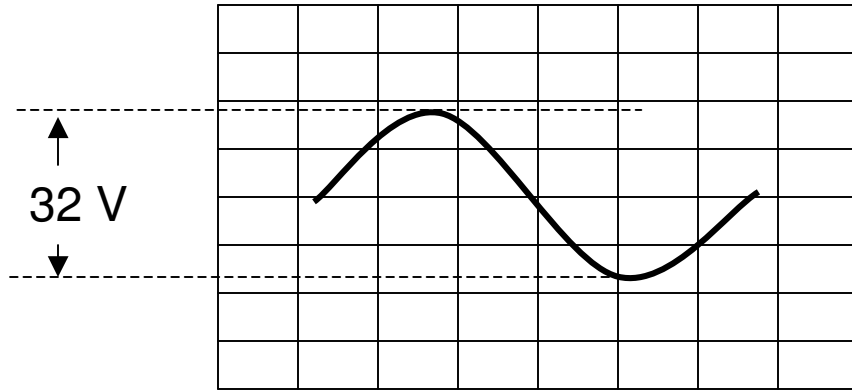


Digital and Analog Multimeters

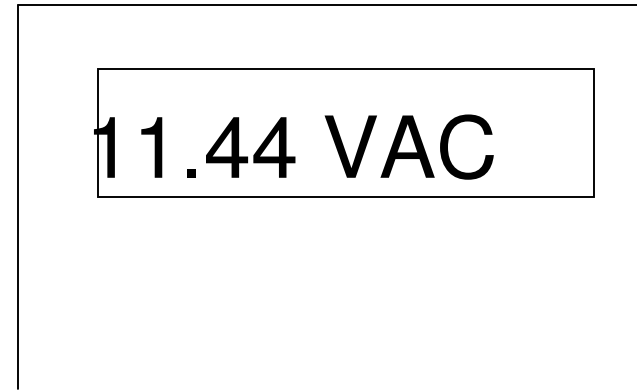
- Power Supply Voltage Checks
- Verify Resistor Values
- Battery Checking
- “Buzz” Out Cables
- Analog Meters Work Better for “Peaking” Things
- Many kit manuals provide voltage points for troubleshooting

Sidebar on AC Voltage Measurements

Peak-to-Peak vs. RMS



Scopes show
Peak to Peak Voltage



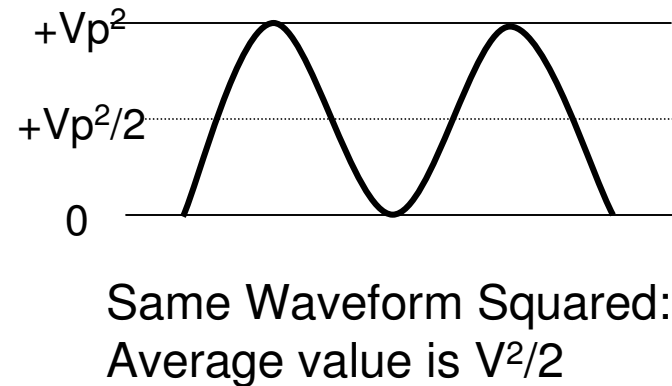
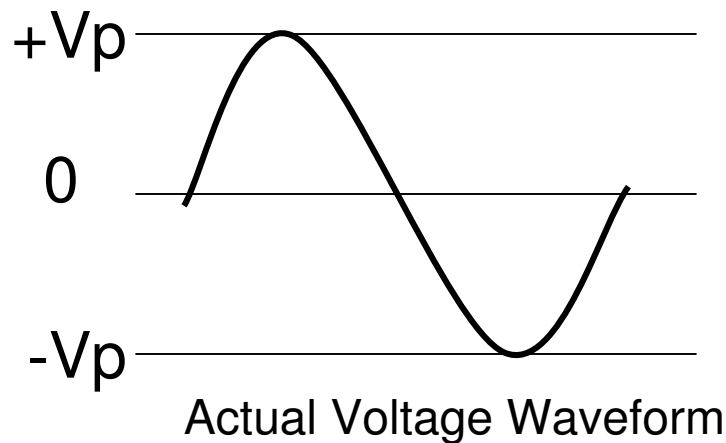
Multimeters show
RMS Voltage

Why is there a Difference??

Sidebar on AC Voltage Measurements (Continued)

$$\text{Power} = V^2/R$$

But What do I Use for V??



$$V_{\text{rms}} = \frac{V_p}{\sqrt{2}} \cong .707 * V_p$$

So, RMS is the voltage value that gives you **AVERAGE POWER** when you plug it into the Power formula*.

*only true for sine waves

Frequency Counters



Frequency Counters

Check your TX frequency

Some kits need a frequency counter for aligning local oscillators and VFO

Very useful for aligning mixers in some receiver kits

“Ham Quality” counters are usually good to about 1 PPM

This means frequency is accurate to about 440 Hz when looking at a 440 MHz HT output

SWR and RF Power Meters



SWR and RF Power Meters

No Shack is Complete Without One

Check / Tune your Antenna

Verify Transmitter Output

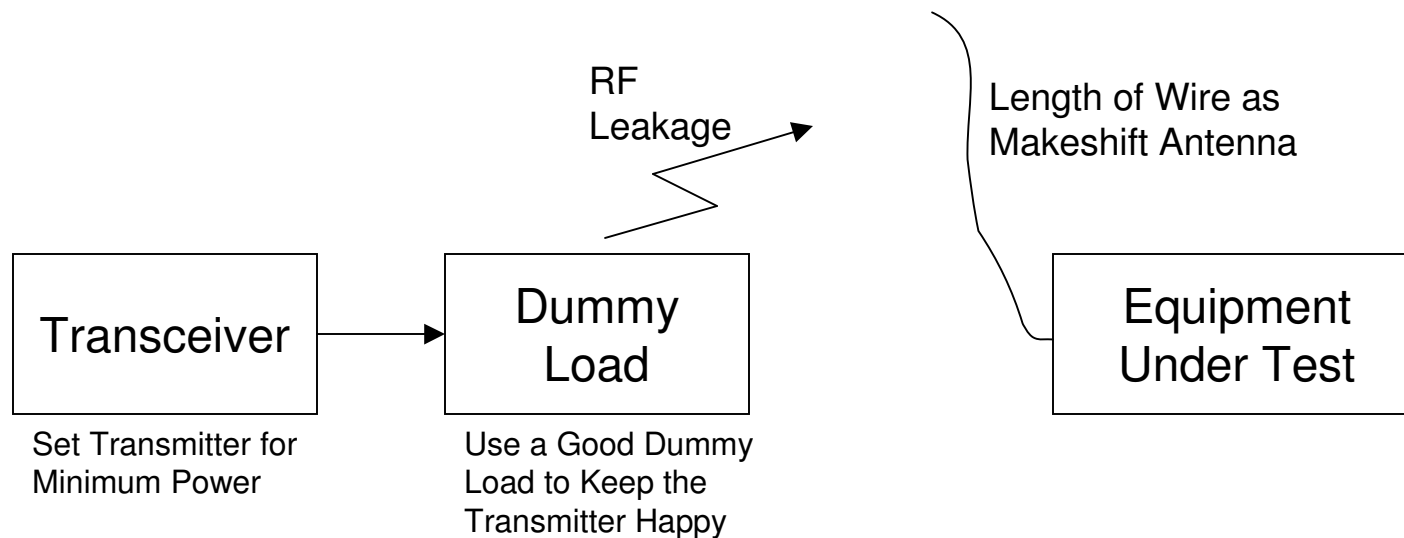
Set Audio Levels in Sound Card Digital Modes

Your Transceiver as a Test Instrument



Using Your Transceiver as a Signal Source

Overall receiver functionality
Frequency accuracy / stability
Relative Sensitivity



Safety Considerations

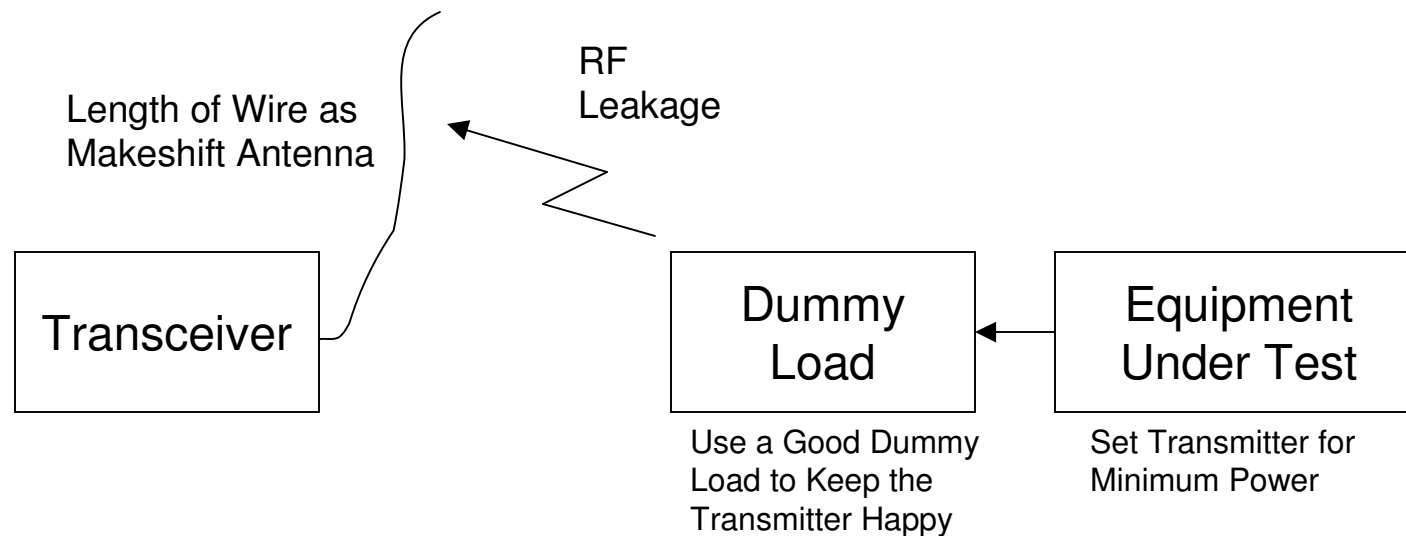
1. You don't want too much RF floating around in the shack
 2. You don't want to burn out the final in your transceiver
 3. You don't want to ruin the front end of the receiver you're testing
- The test setup shown here will provide safe signal levels to work with

Using Your Transceiver as a Reference Receiver

Frequency accuracy / stability

Tone Purity for CW transmitters

Know What the Other Guy will Hear



The Same Safety Considerations Apply As for the Signal Source Setup

1. You don't want too much RF floating around in the shack
2. You don't want to burn out the final in your kit or test radio
3. You don't want to ruin the front end that expensive transceiver!

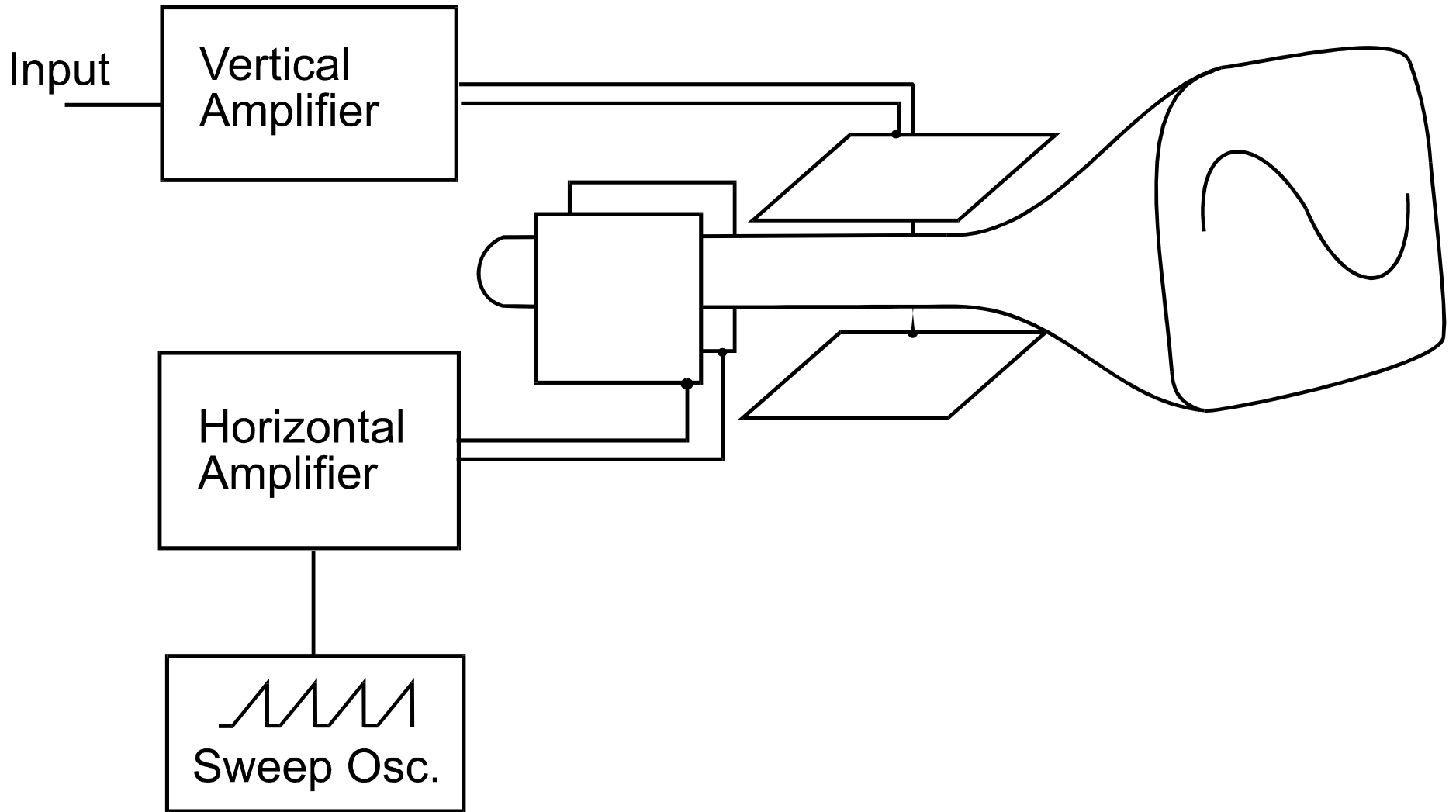
Oscilloscopes



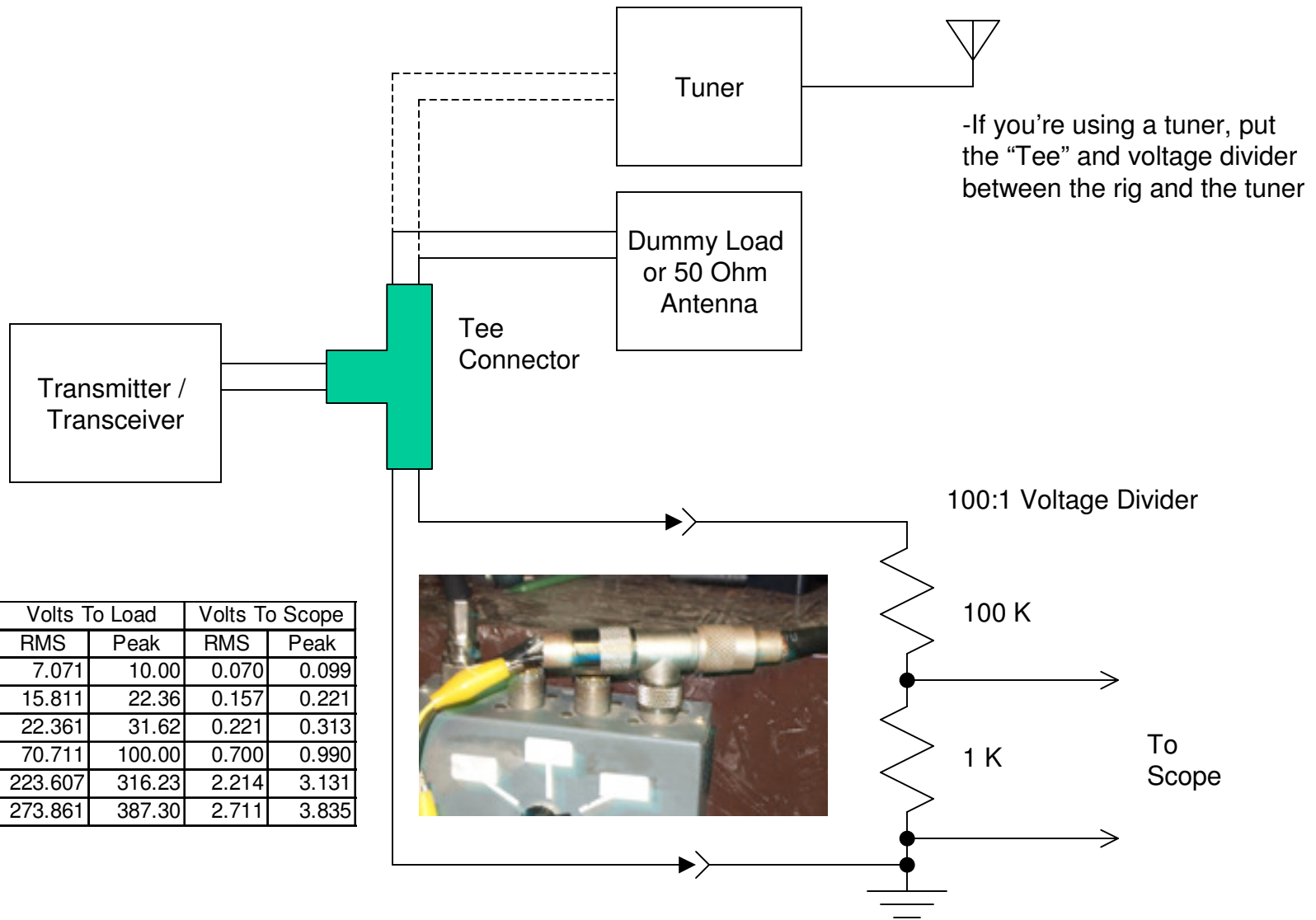
Oscilloscopes

- AC / DC Voltmeter
- Relative Power Indicator
- Frequency Measurement (Approximate)
- Distortion Analyzer

Simplified Block Diagram of an Oscilloscope



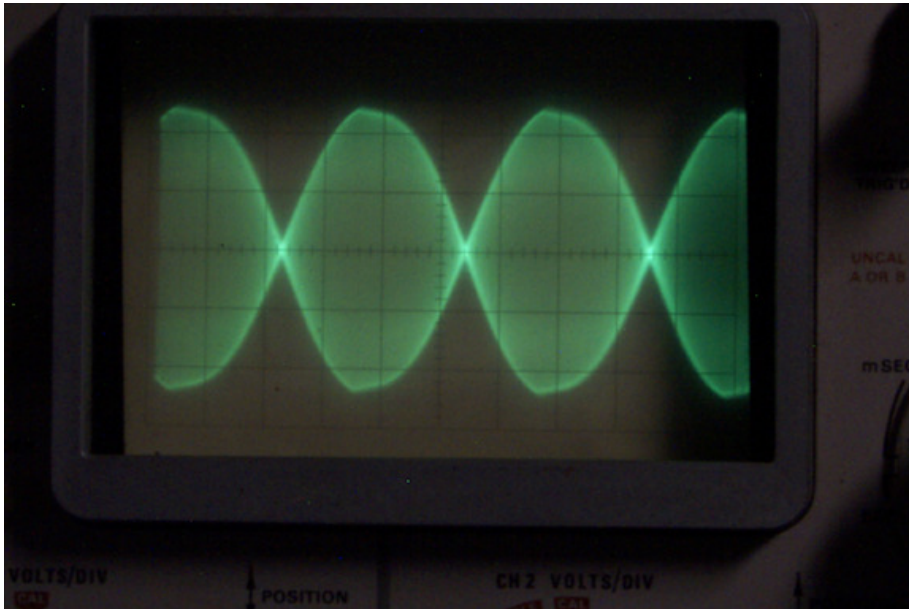
Connecting a Scope Safely to your Transmitter



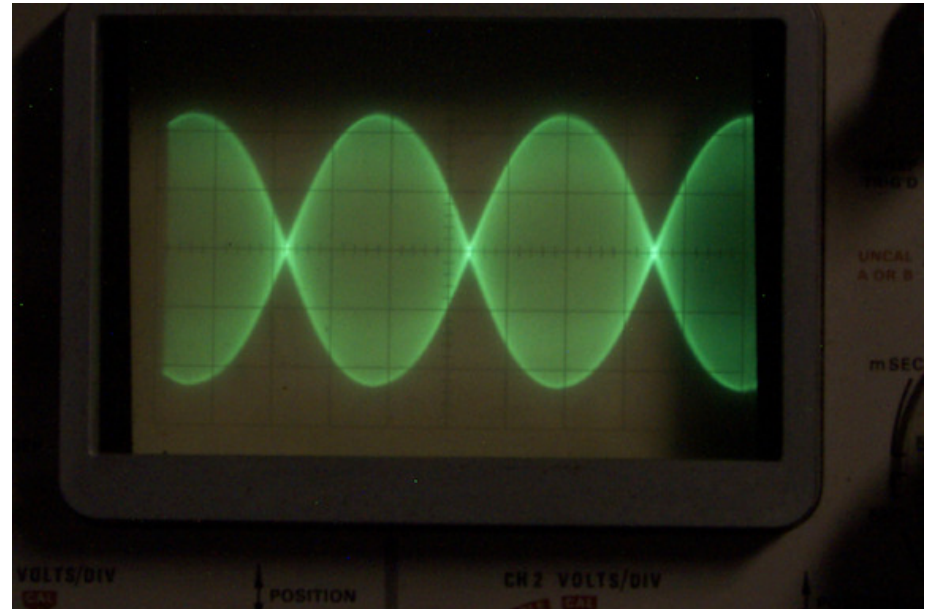
Power Watts	Volts To Load		Volts To Scope	
	RMS	Peak	RMS	Peak
1	7.071	10.00	0.070	0.099
5	15.811	22.36	0.157	0.221
10	22.361	31.62	0.221	0.313
100	70.711	100.00	0.700	0.990
1000	223.607	316.23	2.214	3.131
1500	273.861	387.30	2.711	3.835

Practical Scope Example

Checking TX Audio Levels in PSK-31



Distorted Waveform
Audio Level Set Too High



Good Waveform
Rounded, Symmetric Peaks
Audio Level Set Correctly

Signal Generators



Signal Generators

You can find “antiques” like the one pictured in the previous slide at hamfests at low cost

Create reference signals at a “known” signal strength and frequency

You’ll probably want to use a freq counter to check the frequency out of the signal generator

For most purposes, your main rig will do just as good a job or better (see “Using Your Transceiver as a Test Instrument”)

Have Fun!

Your ham license allows you to do much more than just operate a radio.

You can build, operate, and maintain your own equipment (on ham bands). No other radio service allows you to do this.