N5ESE's QRP Dummy Load

(click on any picture to see larger version)

NOTE: 'N5FC' is my former call.
This project was constructed while that call was valid, and you may observe references to it.

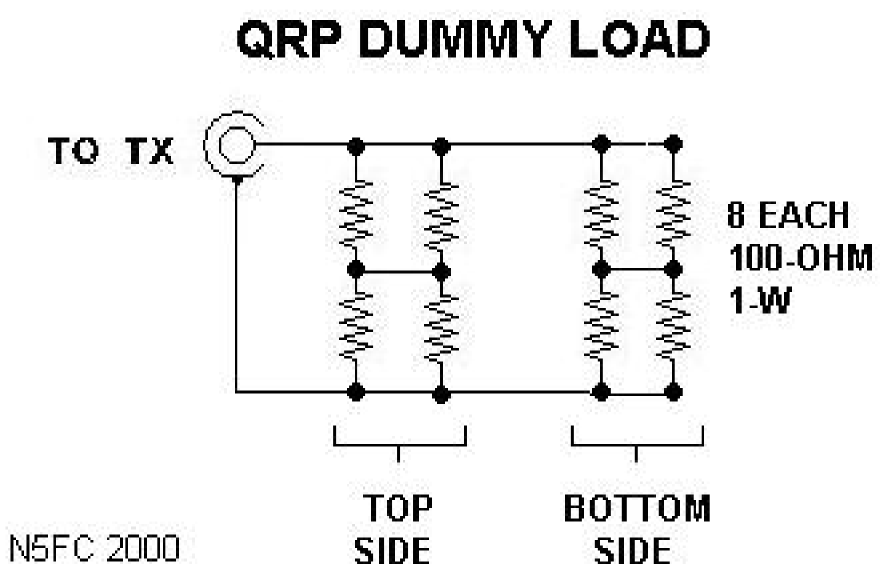
This is another variation on the "parallel resistor" dummy load. [Go -here- for a discussion on dummy load theory]. This is one I built during my infatuation with copper pipe. It's perfect for QRP HF operation of 5-watts or less average power, and should be adequate for continuous operation at that level. It's light and compact, about 2-1/2" in length overall.

WARNING!

Dummy loads dissipate energy by generating heat. Heat generated in a small space translates to temperature rise, and temperatures can be hot enough (under the right circumstances) to burn people and ignite adjacent materials. Because of the thermal mass of the dummy load and its enclosure, that heat can stay around for a long time. Always locate your dummy load in a safe place, where there is no chance that it will burn people or catch something on fire.

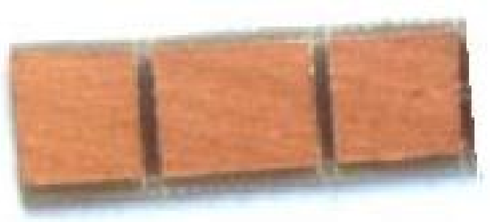
The 1/2" copper pipe provides a convenient, compact form factor, is an excellent shield, and helps to dissipate heat to the outside world. Copper end-caps, available at most any hardware or plumbing supplier, provide a means of mounting the UG-1094 BNC jack and closing the unit.

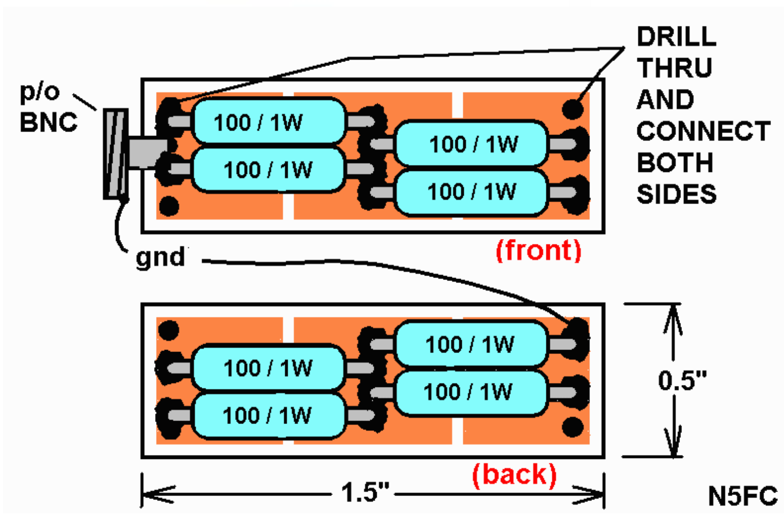
This version uses 8 each 100-ohm 1-watt 5% metal-oxide resistors. Available from Radio Shack for a mere 25-cents each (RS 271-152), you'll invest all of $2 for the parts. The resistors are good through the HF range, but don't do particularly well at VHF. Here's a schematic:



We'll fabricate a printed-circuyit board from scrap double-sided copper board, cut to 1/2 x 1-1/2-inches, and grooved to form 3 pads on each side. On the top side, we'll mount 4 of the 8 resistors, and on the bottom side we mount the remainder. Simply tack-solder the resistors to the board. At the pads on the ends, we drill a small hole through the board, and solder a wire in place top-to-bottom. On the top side, we end up with a 100-ohm, 4-watt equivalent resistor (a pair of parallel 100 ohm resistors makes 50 ohms, and two pairs in series make 100-ohms). When we join the top and bottom in parallel, our equivalent resistance is 50-ohms (two 100-ohm quads in parallel).

Here's a sketch of the pc-board layout:





(click on the above picture to see larger version)

Mount the UG-1094 BNC Jack in one of the copper end-caps. then, connect the pc board assembly directly to the center post of the BNC connector, soldering same. Connect the far end of the board to the BNC ground post, via a short piece of bare wire. Wrap the entire pc board assembly liberally with plumber's teflon tape (available for a buck in the plumbing section of any hardware store). Then run the bare wire outside the teflon tape. DO NOT use other types of tape (they *will* melt!). Next, we slide a short piece of 1/2-inch copper tubing over the assembly, slipping it into the BNC/end-cap. At this point, an ohmmeter should verify 50-ohms. Finally, mount the other end-cap to close and shield the unit. Drill and tap a screw into both end caps to connect the shield both electrically and mechanically.

When supplied RF power for an extended time, this dummy load can get quite warm, even with just 5 watts. Be aware, and plan for it. (Read the "WARNING!" above). My version has an SWR of 1:1 throughout the HF range (DC to 30 MHz). Another variation of this, that includes an rf detector for measuring power, can be viewed -here-.

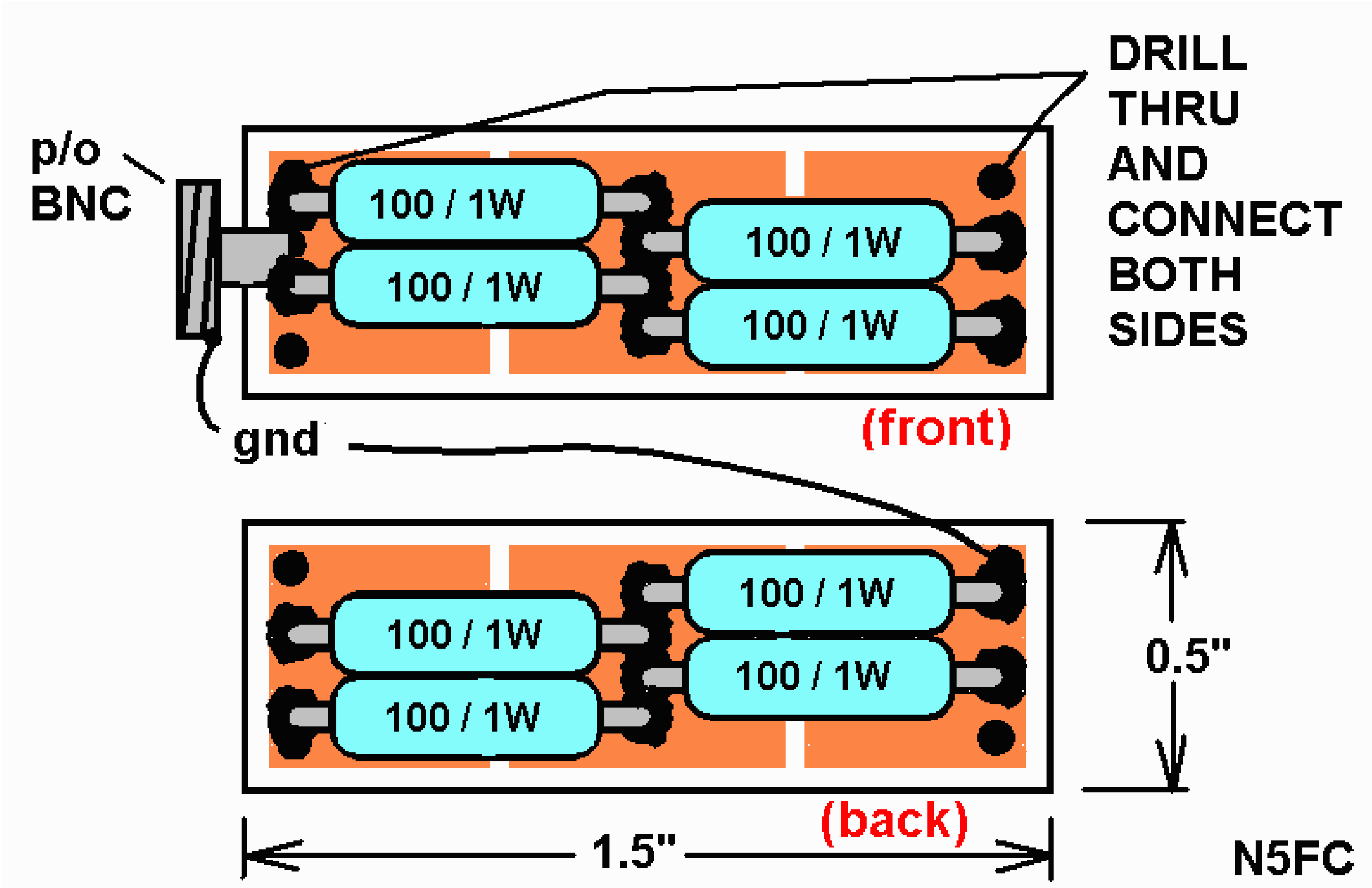
73,
monty N5ESE

Return to N5ESE home page

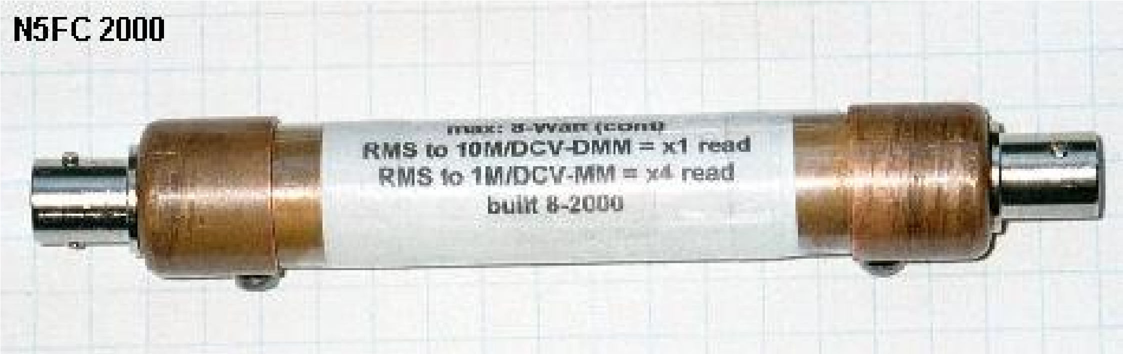
Overseer: Monty Northrup ... ... leave e-mail ...

Visit our regular (non-ham, but very popular) homepage


N5FC
QRP DUMMY LOAD
max: 8-Watt (cont)
N5FC 2000


p/o
BNC
100 / 1W
100 / 1W
100 / 1W
100 / 1W
DRILL
THRU
AND
CONNECT
BOTH
SIDES
gnd
(front)
100 / 1W
100 / 1W
100 / 1W
100 / 1W
0.5"
(back)
1.5"
N5FC

N5ESE's QRP Dummy Load With Built-in RF Detector



(click on any picture to see larger version)

NOTE: 'N5FC' is my former call.
This project was constructed while that call was valid, and you may observe references to it.

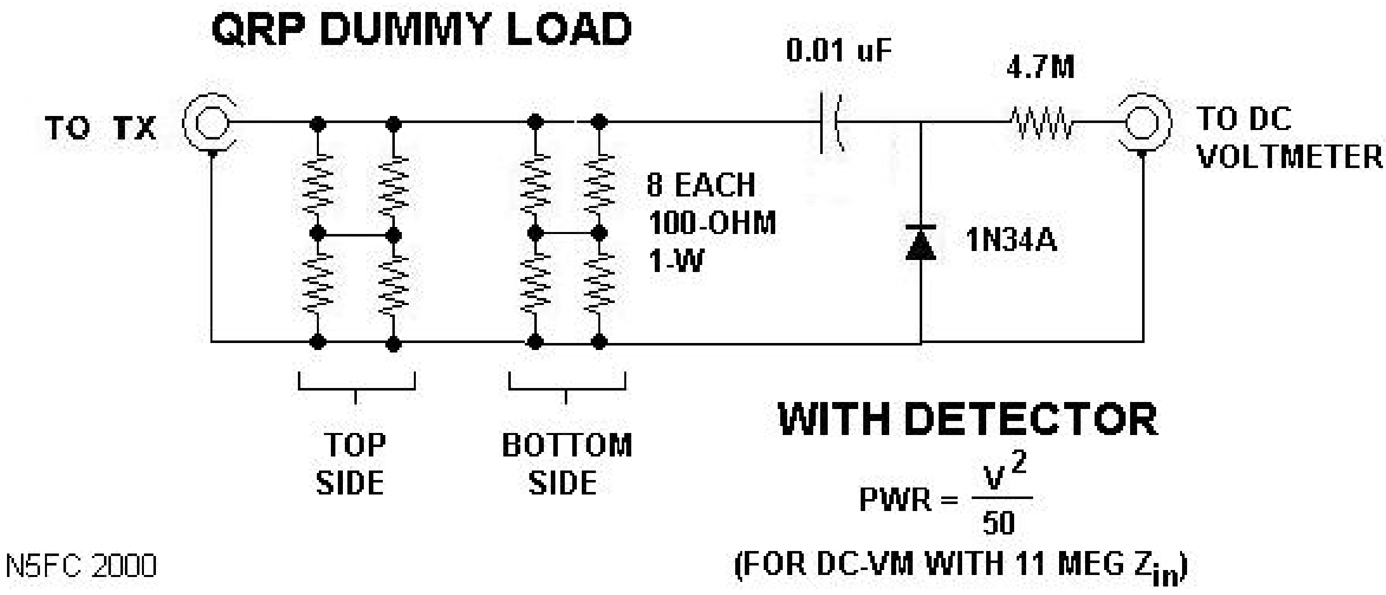
This is yet another variation on the "parallel resistor" dummy load. [Go -here- for a discussion on dummy load theory]. This is another one I built during my infatuation with copper pipe. It's suitable for QRP HF operation of 5-watts or less average power, and should be adequate for continuous operation at that level. It's light and compact, about 5-inches in length overall. This one is unique in that it has a built-in RF detector, with scaling, that may be used with your DC Voltmeter to measure power.

WARNING!

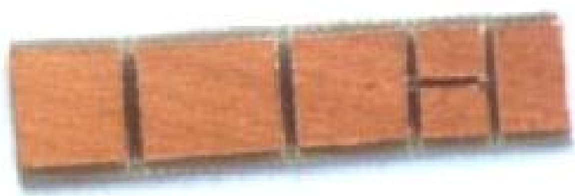
Dummy loads dissipate energy by generating heat. Heat generated in a small space translates to temperature rise, and temperatures can be hot enough (under the right circumstances) to burn people and ignite adjacent materials. Because of the thermal mass of the dummy load and its enclosure, that heat can stay around for a long time. Always locate your dummy load in a safe place, where there is no chance that it will burn people or catch something on fire.

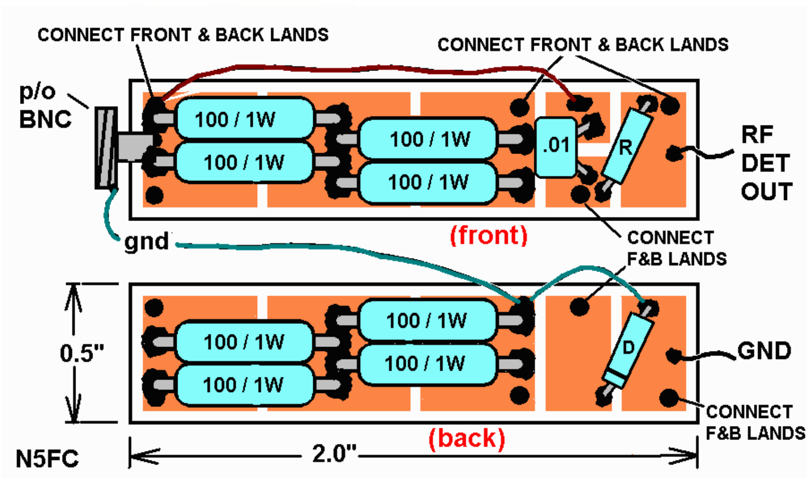
The 1/2" copper pipe provides a convenient, compact form factor, is an excellent shield, and helps to dissipate heat to the outside world. Copper end-caps, available at most any hardware or plumbing supplier, provide a means of mounting the two UG-1094 BNC jacks and closing the unit.

This version uses 8 each 100-ohm 1-watt 5% metal-oxide resistors, available from Radio Shack for a mere 25-cents each (RS 271-152). All the detector parts (yes, all three of them, a 0.01 capacitor, a 4.7-Meg resistor, and a 1N34A diode) are also available at Radio Shack. You would be hard-pressed to spend much more than $5-6 dollars on this project. The resistors are good through the HF range, but don't do particularly well at VHF. Here's a schematic:



We'll fabricate a printed-circuit board from scrap double-sided copper board, cut to 1/2 x 2-inches, and grooved to form pads on each side, as shown in the layout below. On the top side, we'll mount 4 of the 8 resistors, and on the bottom side we mount the remainder. Simply tack-solder the resistors to the board. Where required to connect the resistors, we drill a small hole through the board, and solder a wire in place top-to-bottom. On the top side, we end up with a 100-ohm, 4-watt equivalent resistor (a pair of parallel 100 ohm resistors makes 50 ohms, and two pairs in series make 100-ohms). When we join the top and bottom in parallel, our equivalent resistance is 50-ohms (two 100-ohm quads in parallel).





(click on the above picture to see larger version)

Mount a UG-1094 BNC Jack in each of the two copper end-caps. then, connect the pc board assembly directly to the center post of the BNC connector, soldering same. Make all other interconnections with teflon-insulated wire. DON'T SUBSTITUTE OTHER INSULATIONS! Sorry, I know teflon wire is tough to find, but other insulation types will almost certainly fail when the resistors get hot. Wrap the entire pc-board assembly in teflon tape (often called plumber's tape, available at any hardware store. DO NOT use other types of tape (they *will* melt!). Next, we slide a short piece of 1/2-inch copper tubing over the assembly, slipping it into the BNC/end-cap. At this point, an ohmmeter should verify 50-ohms.

Finally, solder the detector output wires to the second BNC, and mount the other end-cap to close and shield the unit. Drill and tap a screw into both end caps to connect the shield both electrically and mechanically.

When supplied RF power for an extended time, this dummy load can get quite warm, even with just 5 watts. Be aware, and plan for it. (Read the "WARNING!" above). My version has an SWR of 1:1 throughout the HF range (DC to 30 MHz). Measuring power is easy, and accurate if the detector's resistor is sized to work with your DC Voltmeter's input impedance. Read the DC Voltage, square it, and divide by 50. Example: we read 10 Volts, which is 10 * 10 / 50 = 2 watts.

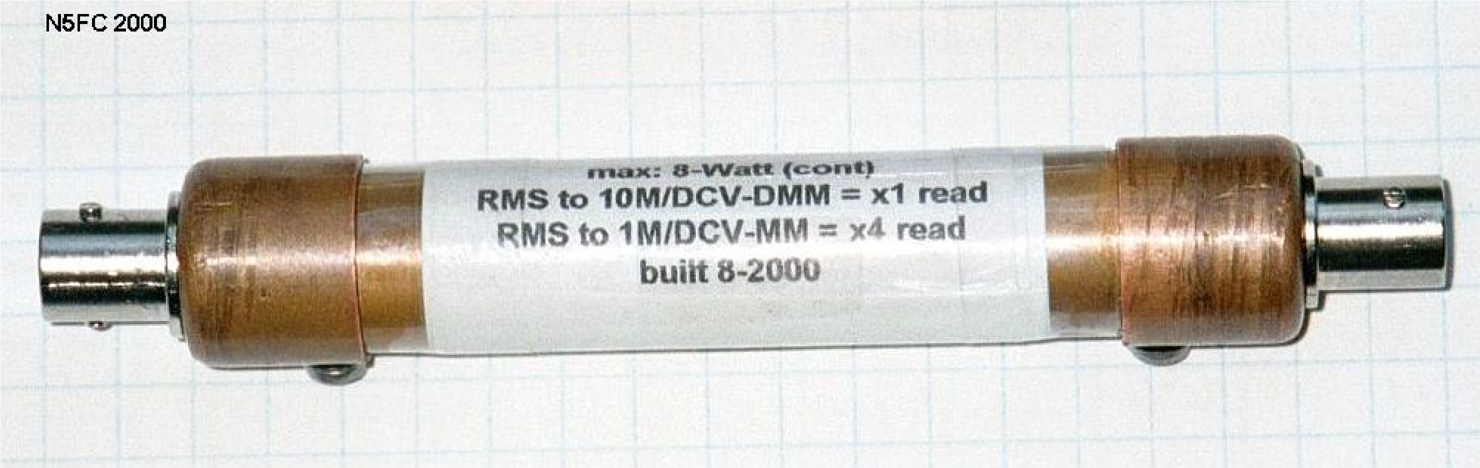
For a more complete discussion on the detector and it's accuracy, and sizing the resistor for your voltmeter, see our page on RF probes.

73,
monty N5ESE

Return to N5ESE home page

Overseer: Monty Northrup ... ... leave e-mail ...

Visit our regular (non-ham, but very popular) homepage


N5FC 2000
max: 8-Watt (cont)
RMS to 10M/DCV-DMM = x1 read
RMS to 1M/DCV-MM = x4 read
built 8-2000

N5ESE's 25 Watt Dummy Load

(click on any picture to see larger version)

NOTE: 'N5FC' is my former call.
This project was constructed while that call was valid, and you may observe references to it.

The "dummy load" is an indespensible accessory for any radio amateur. Using a dummy load, transmitter adjustments can be made "off-the-air" so that no unnecessary interference is generated on the ham bands. And dummy loads are an easy useful project that just about anyone with moderate soldering skills can build.

The one described here can be used for up to 35 watts for short transmissions, and up to 25 watts for longer periods. It presents a 50-ohm load (or something very close to it) from DC to well over 30 MHz. Because it is rated for low-power operation, it makes an ideal dummy load for the QRP operator.

WARNING!

Dummy loads dissipate energy by generating heat. Heat generated in a small space translates to temperature rise, and temperatures can be hot enough (under the right circumstances) to burn people and ignite adjacent materials. Because of the thermal mass of the dummy load and its enclosure, that heat can stay around for a long time. Always locate your dummy load in a safe place, where there is no chance that it will burn people or catch something on fire.

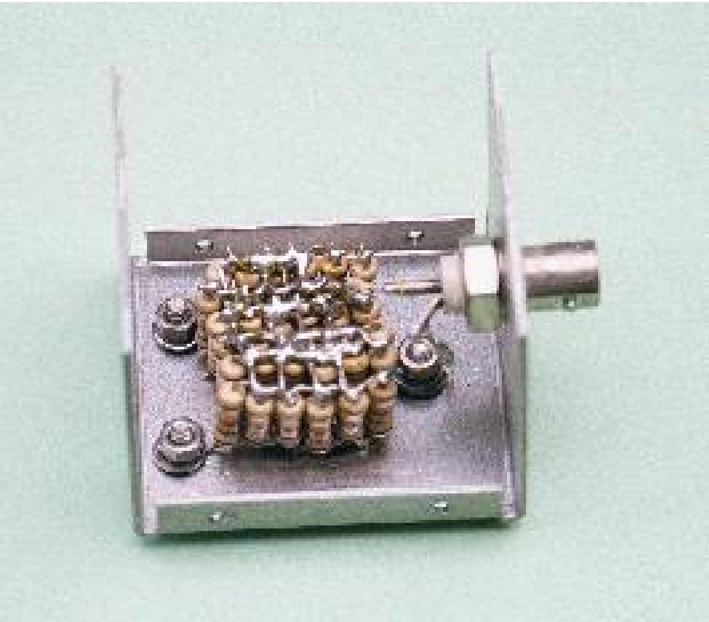
A dummy load is basicly a resistor, designed specifically to dissipate RF energy that would normally go to an antenna. Dummy loads are usually 50-ohms, although there is no reason why you can't build one at 75-ohms, or 300-ohms using the same techniques. Not just any resistor will do; a wire-wound resistor will have way too much inductance for use at HF frequencies (even the "non-inductive" kind). Metal-film, thick-film, carbon-composition, metal-oxide film and carbon-film resistors are generally good candiadtes for HF dummy loads. You can buy resistors specifically made for high power and RF, but they are very expensive. Or you can take the approach shown here, and use LOTS of commonly available resistors in parallel to form a single resistor functionally

When you join equal-value resistors in parallel, two beneficial things happen:

1. the overall resistance decreases by a factor of "n", that is the final resistance R = R/n
2. the overall power dissipating ability goes up (but not necessarily by a factor of "n")

Knowing this, I went a-hunting at my local electronics outlet. I went looking for 1 or 2-watt carbon resistors, which are usually dirt-cheap. I had a big selection to choose from, and I ended up picking up 36 each 1800-ohm 1-watt 5% carbon-film resistors, at 5-cents each (oh, wow... almost $2). Using our formula, 1800 / 36 = 50-ohms... perfect! When constructed, these resistors will dissipate 36 watts safely for a short period of time (say 10-30 seconds), but will need a long cooling-off period after that. If I limit the power to half of that (i.e., 17 watts or less), I can probably key-down for much longer periods (but read the "WARNING!", above). At QRP levels of 5-watts or less, I can leave this keyed continually, with plenty of margin.

While I was at the candy store, I picked up a UG-1094 panel-mounted BNC jack, and a small aluminum project box, 2 x 2 x 2-inches. WARNING! plastic is NOT suitable as a construction material for dummy loads, and may even be dangerous, should it melt or ignite!



Click on the image above to see a larger, more readable image

As you can see from the image above, I arranged six resistors in a row, routing the lead of the first to the second, and soldering it, and the second to the thrird, etc... on both ends. I ended up with 6 rows of 6 resistors, and soldered those in parallel, too. I left 3 leads on one side, which I formed into a "ring" terminal, which (in conjunction with 3 screws and 3 nuts) served to mount the resistor assembly to the inside of the enclosure. The other side gets wired to the center conductor of the BNC jack. Grabbing my trusty ohmmeter, I measured 49.7-ohms (plenty close-enough).

How well did it work? Well, on the HF bands, with 25-watts of RF, I read a 1:1 SWR, even on 10-meters (30-MHz). On 2-meters (146 MHz), it reads about 1.3:1.

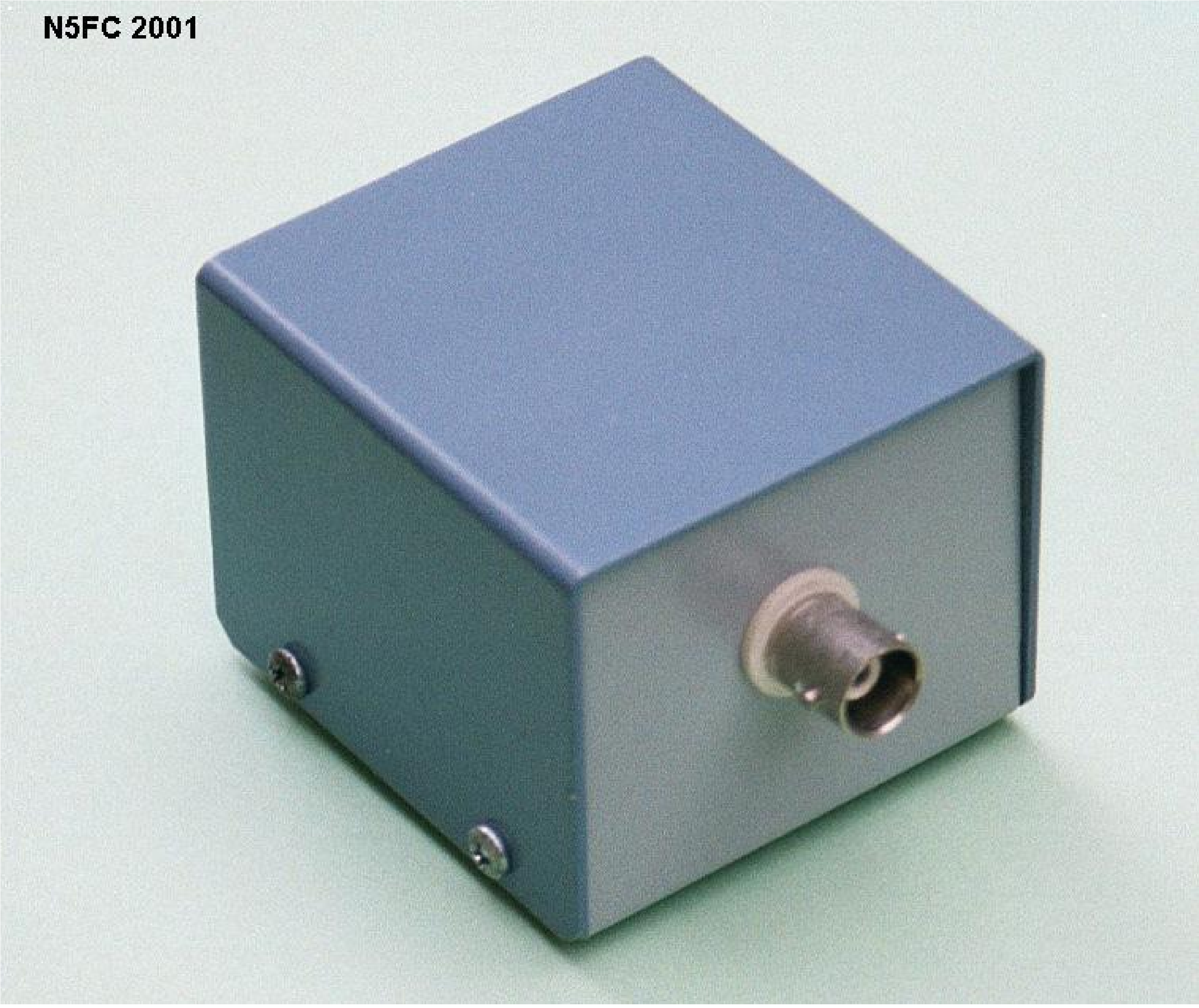
Don't be afraid to substitute different value resistors. Using the right number of EQUAL-VALUE resistors, you should be able to build a usable dummy load at any impedance from 25 ohms to 1000 ohms, and 5 watts to 100 watts (or more). Keep the peak voltages to less than 200 volts (Voltage = square-root of Power * Resistance). Use a shielded enclosure, possibly ventilated with holes to release heat. Be aware of heat dissipation (ever touch a 25-watt bulb?), and plan for it. The amount of power applied must never exceed the aggregate ratings of the resistors, and probably should be kept to something much less, depending on your enclosure and how well heat is released.

73,
monty N5ESE

[Return to N5ESE home page]

Overseer: Monty Northrup ... e-mail ... leave e-mail ...

maddog homepage [Visit our regular (non-ham, but very popular) homepage]


N5FC 2001