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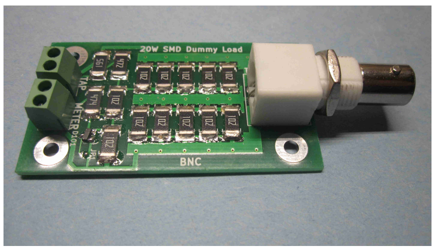
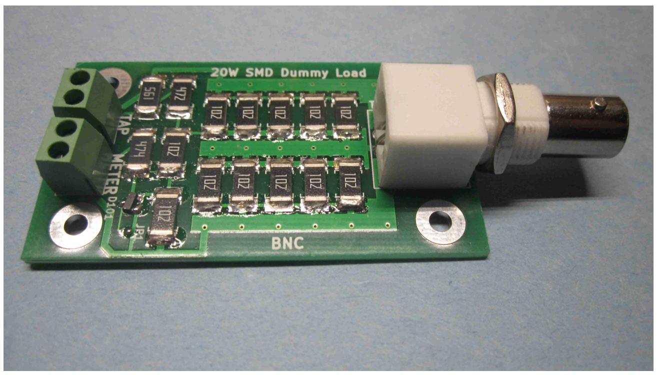
SMD Dummy Load BNC

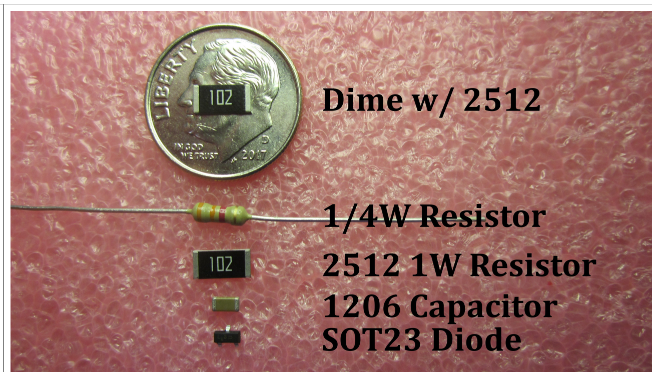


SMD-Dummy-BNC
Assembly Instructions

This small QRP sized dummyload was designed as a learning tool for SMD soldering by using larger 2512 resistors with only 1 small SOT-23 diode. The 50 ohm load will operate from 500KHz to 30MHz with an SWR of less then 1.1:1 at power levels up to 20W under short durations. Usable at up to 225MHz with an SWR of less than 1.3:1. The circuit also includes a small tap for using an oscilloscope and a detector circuit for use with a DMM to monitor your signal.

CAUTION: Dummy loads convert RF energy into heat. **Large power outputs will generate enough heat to cause serious burns**. Very large power outputs at long periods will eventually melt the solder!





Parts List

Qty	Ref	Description	Markings
1	P101	Connector RF BNC PCB RA Female	
1	D101	Diode SMD SOT23 BAT54SLT1G Dual Sereis Schottkey	LD3
1		PCB SMD Dummy BNC	
22	R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R124, R125	Resistor SMD 2512 1W 5% 1K Ohm	102
1	R121	Resistor SMD 2512 1W 5% 4.7K Ohm	472
1	R123	Resistor SMD 2512 1W 5% 470K	474
1	R122	Resistor SMD 2512 1W 5% 560 Ohm	561
2	P102, P103	Terminal Block 2-pin_3.5mm	

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Recommend Tools

Pencil type soldering iron, try to use as fine a tip as possible.
Solder .6mm (.025") preferred but 1mm (.039") will also work.
Solder Flux pen and/or solder paste (optional – if using a heat gun)
Tweezers
Magnifier Glass (if needed)
PCB Holder (or small bench vise)
Digital Multi-Meter (DMM)

Construction notes:

- Familiarize yourself with components using the included parts list.
  TIP: Not sure what part is what? We recommend picking up a copy of the ARRL Handbook. The GQRP web site also has several good articles on component identification.
- Some parts in this kit may have been substituted with parts of a better quality. Alternates will be shown in the parts list with "SUB".
- There are parts mounted on **BOTH** sides of the PCB. The side with silk screeen showing the connectors is regarded as the top side.
- Do not use a hardware store heat gun. The air flow will blow the components off the board.
- There are many different ways to hand solder SMD components. A few excellent YouTube video's are from Colin's Lab and EEVblog. One technique is explained below:
  - Locate a component and it's PCB pads. Wet a pad located next to your soldering iron hand with a little solder.
  - Heat the pad just wetted and with tweezers slide the component into place and adjust as needed. If the component is not placed as you like just re-heat the pad (not the component) and reposition as needed.
  - Solder the opposite, and remaining pads.
  - Re-inspect the first pad and touch up if needed.
- Tip: After soldering in each resistor R101-R120, check your soldering quality by measuring the resistance between the center and one of the ends at P101 after soldering in each resistor. Each resistor will decrease the overall value as follows:

1 @ 1000Ω	2 @ 500Ω	3 @ 333Ω	4 @ 250Ω	5 @ 200Ω
6 @ 167Ω	7 @ 143Ω	8 @ 125Ω	9 @ 111Ω	10 @ 100Ω
11 @ 91Ω	12 @ 83Ω	13 @ 77Ω	14 @ 71Ω	15 @ 67Ω
16 @ 62Ω	17 @ 59Ω	18 @ 56Ω	19 @ 53Ω	20 @ 50Ω

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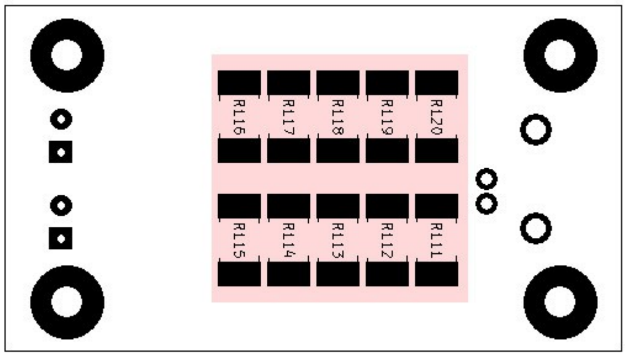
Assembly
Bottom Side

Note: If you want to make a special 2:1 SWR 100 Ohm dummy load (10W) then skip steps 1 & 2.

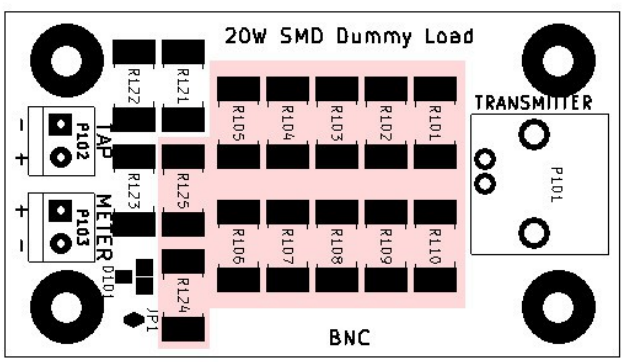
1. ( ) Install 10 1K 2512 SMD resistors, R111-R120, on the BOTTOM side of the PCB. Resistors have the markings of "102".



2. ( ) With an Ohm meter measure the resistance from the center pin of P101 to ground (one of the outer pins). There should be 100 Ohms of resistance when all 10 resistors are soldered. This completes the bottom side.

TOP Side

3. ( ) Install 12 1K 2512 SMD resistors, R101-R110, R124, and R125 on the top side of the PCB. Resistors have the markings "102".



4. ( ) With an Ohm meter measure the resistance from the center pin of P101 to ground (one of the outer pins). There should now be 49-50 Ohms of resistance when all 20 resistors are soldered.

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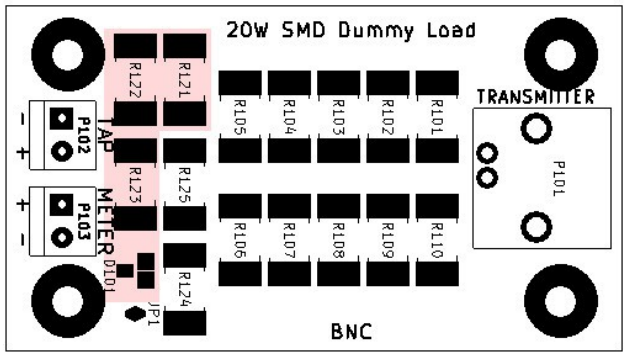
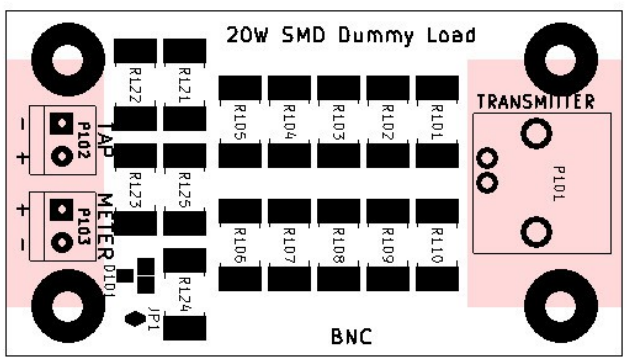
5. ( ) Install the following:

( ) R121	4.7K Ohm 1W 2512 Resistor	472
( ) R122	560 Ohm 1W 2512 Resistor	561
( ) R123	470K Ohm 1W 2512 Resistor	474
( ) D101	BAT54SLT1G SOT23 Dual Diode	LD3



6. ( ) Install the following:

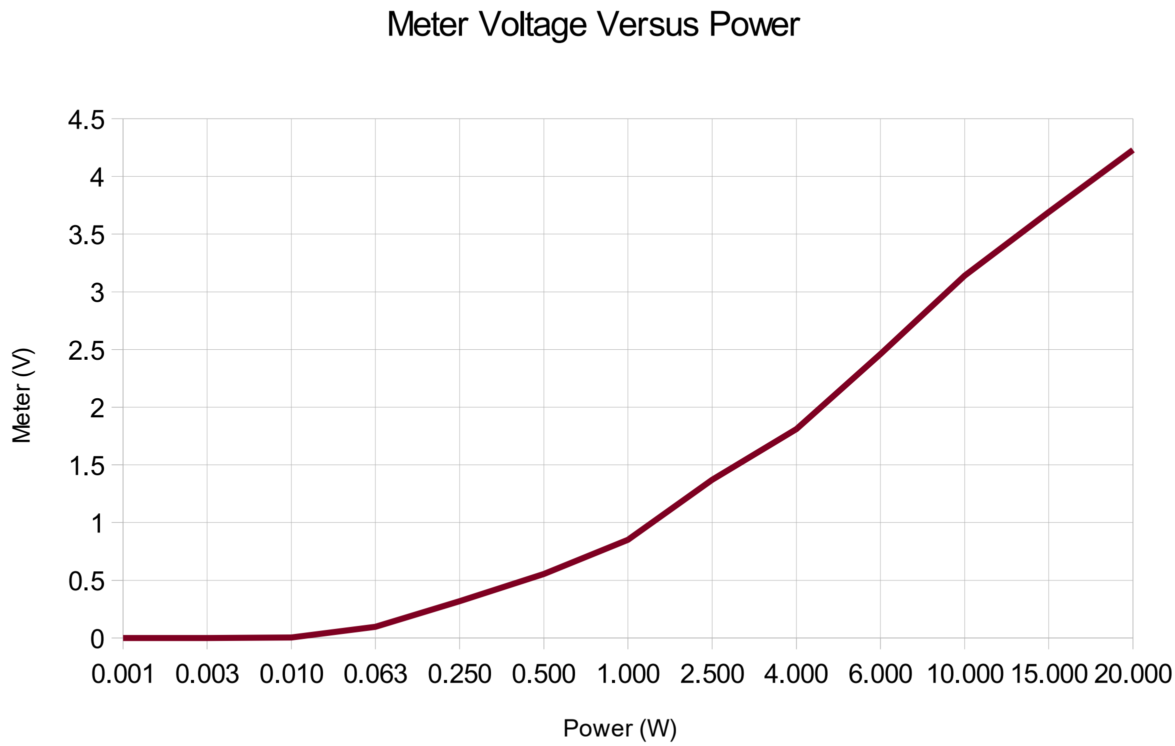
( ) P101	BNC Female PCB Connector	
( ) P102, P103	2 pin terminal block	Position the wires entraces on the block away from the PCB.



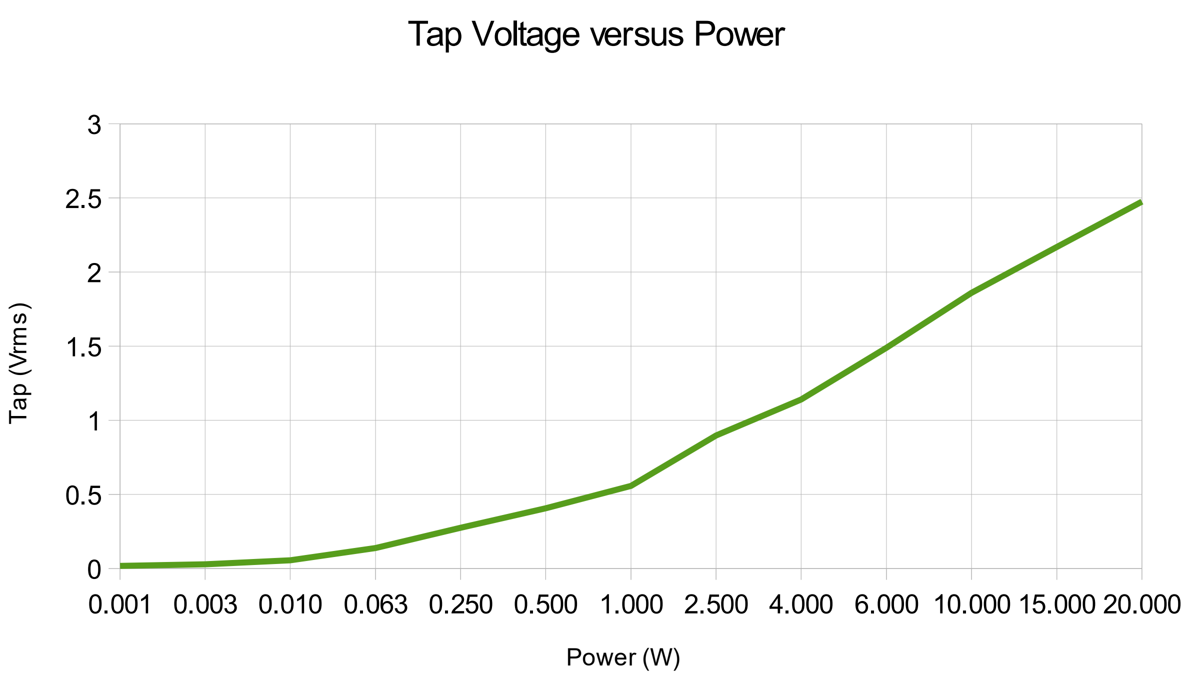
Congradulations! Your dummy load is now ready to use!

Usage: Connect your transmitter to P101. Optionally connect your oscilloscope to P102 (TAP) and a Volt Meter (DMM) to P103 (Meter). The P102 TAP will show approximately 10% of the RF voltage. See Ratings chart for P103 Meter voltages.

At low power levels you may wish to jumper JP1. This will add more sensitivity (increased voltage) to the DMM output. There is risk of damaging the detector diode D101 at high power levels exceeding 20W with JP1 jumpered. See Power to Voltage chart for details.



Meter Voltage Versus Power
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Meter (V)
0.001 0.003 0.010 0.063 0.250 0.500 1.000 2.500 4.000 6.000 10.000 15.000 20.000
Power (W)



Tap Voltage versus Power
3
2.5
2
1.5
1
0.5
0
Tap (Vrms)
0.001 0.003 0.010 0.063 0.250 0.500 1.000 2.500 4.000 6.000 10.000 15.000 20.000
Power (W)

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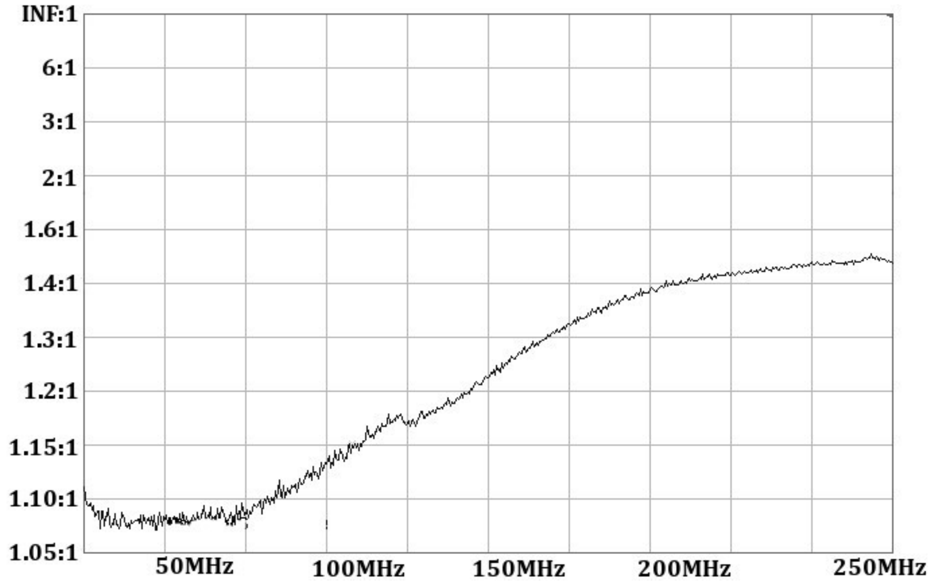
Ratings
(Measured at 10MHz)

Power In(W)	Power Dbm	Power Vrms	Tap(Vrms)	Meter (V) JP1 Open	Meter (V) JP1 Shorted	Max Time(S)	Notes
0.001	0	0.224	0.018	0.0001	0.0003	Unlimited	
0.0025	4	0.355	0.028	0.0002	0.0028	Unlimited	
0.010	10	0.70	0.055	0.005	0.029	Unlimited	
0.063	18	1.58	0.138	0.098	0.158	Unlimited	
0.250	24	3.54	0.275	0.318	0.395	Unlimited	
0.500	27	5.00	0.406	0.555	0.635	Unlimited	
1.000	30	7.07	0.557	0.850	0.950	Unlimited	100F at 30 seconds
2.500	34	11.20	0.898	1.370	1.570	>3 Minutes	HOT 140F at 30 seconds
4.000	36	14.10	1.140	1.810	1.950	>3 Minutes	HOT 160F at 30 seconds
6.000	38	17.50	1.490	2.460	2.560	120	HOT 180F at 30 seconds
10.000	40	22.40	1.860	3.140	3.210	90	Melts solder in 100 seconds
15.000	42	28.00	2.170	3.690	3.820	45	Melts solder in 60 seconds
20.000	43	31.60	2.475	4.230	4.330	20	Melts solder in 30 seconds

SWR & Return Loss

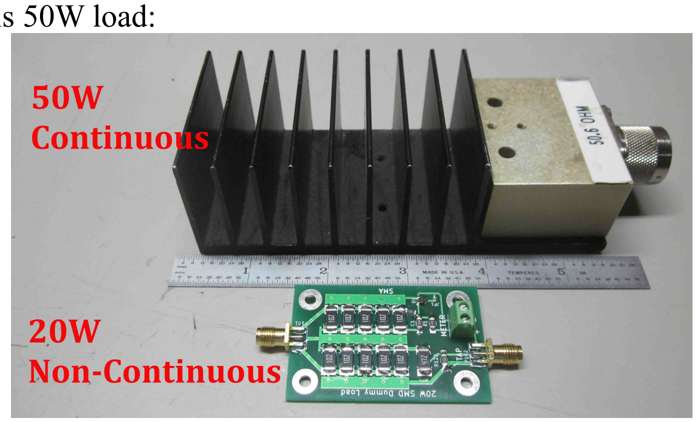
Frequency Mhz	Return Loss Dbm	SWR
1.80	-28.94	1.08:1
10.13	-28.78	1.08:1
18.10	-29.21	1.08:1
29.70	-28.11	1.08:1
52.00	-28.58	1.08:1
70.00	-27.14	1.10:1
148.00	-18.38	1.28:1
225.00	-14.82	1.45:1
450.00	-6.31	2.88:1

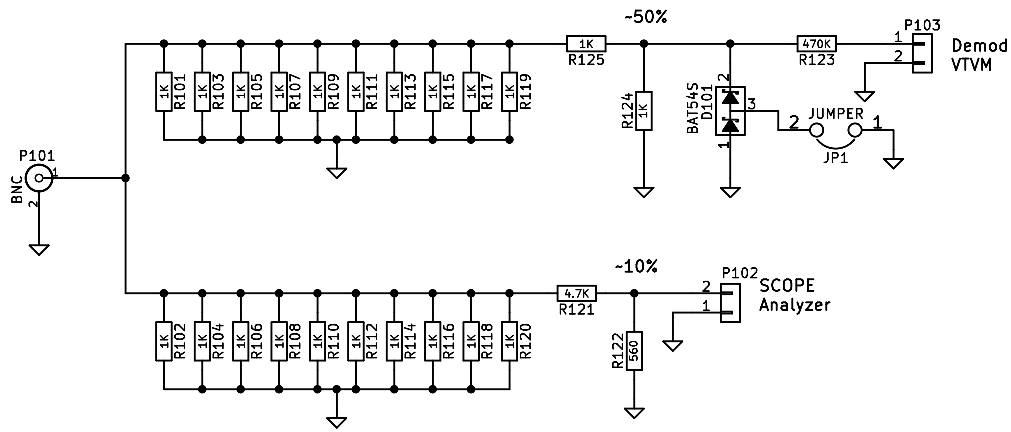


Return Loss from 500KHz to 250MHz

FAQ:

Q: This says it's a 20W load and I do see 20 1W resistors (20x1W=20W) but AT 20w it melts the solder after 30 seconds. What gives?
A: Heat is what gives. As we know a dummy load converts the unwanted RF into heat – the energy has to go somewhere. Although there are 1W resistors on the board the heat has nowhere to go. If we were to find a way to apply a heat sink (or air/oil cooling) to let the heat dissipate then a 20W continuous power source could be applied. For example take a look at the large heat sink on this 50W load:





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Title: SMD-20W-Dummy

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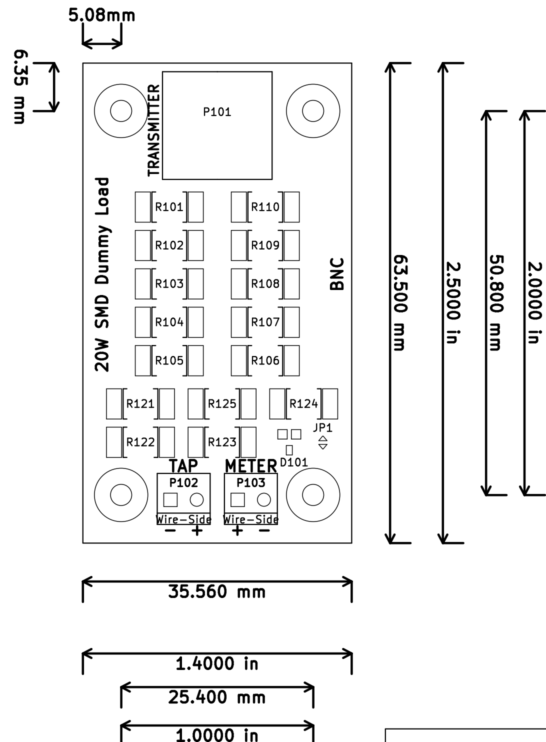

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