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Sharing My Passion for Electronics Engineering and Software Hacking

MAYNUO M9711 DC ELECTRONIC LOAD – UNBOXING, TEARDOWN AND QUICK TEST

BY GERRYSWEENEY ON APRIL 18, 2013 — 31 COMMENTS

I have been working on various power supply projects of late and was finding that my approach to loading PSU with simple incandescent laps was limiting. What I needed was a programmable DC load so I wondered – build or buy? Because I am already working on a PSU I decided that its probably better to buy one if I can find something that was reasonable quality and at a reasonable price. So I searched around and eventually took a chance on a Maynuo M9711 DC Electronic Load. I had not heard of the company before and could not find much out about them on on the internet, what I did see what that other similar devices that cost twice as much and had a reputable brand (BK Precision for example) were so similar in form that I thought its a

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design. I am not sure that is the case because I do not have a BK Precision to compare, but I bought the M9711 brand new from the manufacturer on the basis that this was likely the case. Was I disappointed with the purchase? we shall see…

In this video I unbox and then tear down the Maynuo M9711 DC Electronic Load so we can take a look inside and see how it works and how well its been built. I try to explain how a DC electronic load works and I present a block diagram of the Maynuo M9711 based on my understanding and the cornerstone components that I find.

Maynuo M9711 DC Electronic Load - Unboxing…

The main funcional components found in the device are:

Part Numner	Description
Silicone Labs C8051F304	This is an 8051 based 8-bit flash micro controller, this is the main processor for the device
Texas Instruments ADS8327	This is a 16-bit SAR 500Khz Analog to Digital (ADC) voltage output converter, used to measure voltage and current in the load.

Experience Ever!!! No Seriously Ever…

— TAGS

1999   2110

8663-XS   53131A

AGILENT   ALTIUM

APPLE   ARDUINO

ATMEL   AUTOTRAX

CAD   DAC

DIPTRACE   DIY

DS1821   E3631A

E3634A   EAGLE

FE-5680A   FET

HP   IMAC

IRF540   KEITHLEY

LM358   LT1013

LTC2402   M9711

MAX4080

MCP4822

NOVRAM   OCXO

OSCILLOQUARTZ

PCB

POWER SUPPLY

PROGRAMMABLE

PSU   RACAL

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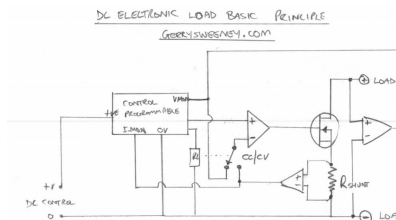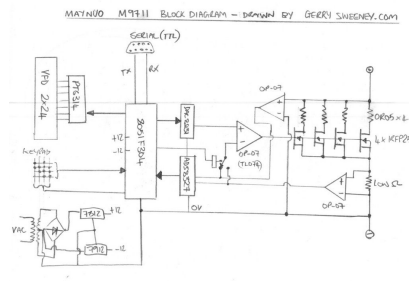|		
Instruments DAC8831	converter, used to generate the programmable reference voltage.	
Princeton Technology Corp. PT6314	This is a vacuum fluorescent display driver chip	
International Rectifier IRFP250	The power MOSFET (x4 in 150W model) used as the main active power device that creates the load load	

Notes and Diagrams

Below are the diagrams I present in the video describing the operation of a DC Load and the basic high-level layout of the M9711. You can browse these images or download a PDF document to print out if you prefer.

Well I hope you find this useful, thank you for reading and watching, catch you next time…

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ADS8327　C4051F304　DAC8831　DIAGRAM　IRFM250

M9711　M9712　MAYNUO　PT6314　TEARDOWN

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MIKE WARREN

APRIL 19, 2013 AT 12:13 AM

The bridge rectifier is used for temperature sensing for the fan control. The TIP41 is the driver for the fan, driven by the LM324.

REPLY

GERRYSWEENEY 👤

APRIL 19, 2013 AT 7:43 AM

Hi Mike, thanks very much for the clarification, that makes perfect sense.

REPLY

GERRY SWEENEY

APRIL 19, 2013 AT 7:45 PM

A comment was posted on the EEVblog forum in response to my video review which I thought was very relevant so I have re-posted the comment here (with the authors permission). The EEVBlog forum post can be viewed here: http://www.eevblog.com/forum/reviews/maynuo-m9711-programmable-dc-electronic-load-photos/

———

On the question of the current equilizing resistors on the parrallel Mosfets ,yes they are required .I know that because I have just finished designing and building my own so had to find answers to the

— META

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mosfet's do not have a positve temp coefficient except at high drives (Vgs > 5V) and high currents (Id >20 A for power devices). At these levels then Rds on dominates and this value has a + temp coeff and increases with temp. At a lower Vgs drives and lower currents then Vgs (Th) will dominate and this has a Negative temp coeff and gets lower with increasing temp ,so a small diff in Vgs(th) between two Mosfets of say 0.5 Vgs can cause a difference of 10A Id at the same applied Vgs .

Check out the transfer characteristics of any power mosfet and notice at some piont the Vgs – Id current at different temps will cross over at some 'inflection' point from being negative to positve temp coeff.

Check out this short onsemi app note on mosfet temp stability . It will explain better than me http://www.onsemi.com/pub_link/Collateral/AND8199-D.PDF

REPLY

RICHARD
APRIL 21, 2013 AT 12:12 AM

Hi Gerry, very interesting teardown. Furrther to the question of the paralleled MOSFET – does the M9711 include a schematic? The current balancing resistors should be in the Source and not the Drain as your diagram shows as they

Q   Search …

have drawn the schematic. It is OK to parallel MOSFETs directly without "ballast" resistors when used in switch mode if driven well. But linear mode is when the resistors are required.

Here is an another article on the topic:

http://www.microsemi.com/document-portal/doc_download/14700-new-500v-linear-mosfets-for-a-120kw-active-load

The idea shown in this app note is very similar to the HP/Agilent Electronic Load. The schematic for the 6060B is available on the Agilent website. I am curious to know if the M9711 actually uses a separate op amp for each MOSFET.

Thanks for the videos!

REPLY

GERRYSWEENEY 👤

APRIL 21, 2013 AT 12:32 AM

Hi Richard, thanks for the correction, you are absolutely right, I should have drawn the resistors in the Source and not the Drain, it was a quick sketch with not too much thought. Unfortunately the M9711 does not have a schematic, nor could I find one. Thanks for the clarification around paralleling MOSFET's it makes sense although I have seen (obviously not very good) designs for audio power amps

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paralleled without ballast resistors, I guess it works when you do nto need to drive the MOSFET anywhere near its inflexion point.

Thanks for the article, I like the idea of driving each MOSFET with its own op-amp and a source resistor for negative feedback, I think if I am to design my own DC load I would take this approach. The Maynuo M9711 does have two TL074's to drive four MOSFET's, I did not reverse engineer to that level but given there are eight available op-amps this could well be exactly what they do – it would make sense.

I will check out the schematic for the 6060B, thanks for the comments and info

Gerry

REPLY

LAURENCE WILKINS
APRIL 24, 2013 AT 8:57 PM

Hello Gerry, i was one of the detailed contributors on the eevblog about my own Maynuo M9712B 500V (yikes!) 300W load. I typed quite a lot of STUFF there, so wont repeat it.

You may have already discovered this? If you set VMAX to 20V or lower, and IMAX to 3A or lower, the load drops into much

Q   Search …

higher resolution displays of voltage and current.

DO NOT be tempted to recalibrate the load! I did, and it took me ages to get it back…

I have a fault with probably the USB serial lead. It is only working one way. How about i sent it to you (with return postage) for you to test out? Not getting much out of Maynuo or the original supplier, now.

REPLY

GERRYSWEENEY 👤
APRIL 24, 2013 AT 9:07 PM

Hi Laurence, I think I did see your article I am sure because I recall the recalibrate warning you put out. I did not know about the increased resolution at lower voltages, thats actually a very nice touch, I should have designed something like that into my PSU project, thanks for making me aware. With regret I have too many other commitments to take on any repairs of other peoples equipment. I would suggest trying to figure out what is at fault, the isolator lead or the actual unit. A scope on a DB9 breakout should tell you pretty quickly. I am pretty sue that what is to/from the unit its self is simple TTL level serial, so scope that out and see if you are getting

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data in/out. If you are its the
isolator lead. Gerry

REPLY

GERRYSWEENEY 👤
APRIL 24, 2013 AT 9:10 PM

Hi Laurence, sorry, I just re-read your request, you was asking if I would try out your isolator cable on my PSU. Yes I would be happy to do that for you if you want to post it. Please e-mail me (see my contact details in about) and I will send you my postal address. I cannot guarantee a fast turn-around but I will certainly try it out for you. Gerry

REPLY

KAUSHLESH CHANDEL
MAY 14, 2013 AT 2:50 PM

Very useful Video Gerry. I am also building an electronic load using 60A Mosfets. The teardown and details on how it works was very useful.

Kaushlesh

REPLY

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GERRYSWEENEY 👤

MAY 14, 2013 AT 5:51 PM

Glad you have found it useful, thank you for watching and good luck with the build.

REPLY

TJERET

MAY 31, 2013 AT 2:35 PM

I ordered M9712, after watching your video teardown
Thank's for explanation how it works (even i did not fully understand)

La Ode

REPLY

GERRYSWEENEY 👤

MAY 31, 2013 AT 2:53 PM

You are welcome, I am glad you found the teardown useful. I have been using the load a fair bit now and so far its proven to be very useful and very reliable. Gerry

REPLY

DENNIS

🔍 Search …

Hi Gerry. Thank you for the teardown. After doing some research for commercial programmable loads, it seems like Itech Electronics (http://www.itech.sh/en) is at least a supplier to BK-Precision, Maynuo and other companies. Itech also sells rackmount power supplies that BK does not offer so it seems that Itech is not a division of BK as much as a vendor. Itech's web site implies it is a BK company. Don't know for sure.

I'm looking to purchase the M9715B or M9716B depending on quotes that come back from my buyer in China. The "B" is the 500V grade product, both support a max of 120A and the 9715/9716 will dissipate 1800W/2400W respectively. I expect my teardown of one of these will be very similar to the M9711 but with additional parallel MOSFET stages and heavier shunts, etc. My job involves designing and testing power supplies and the 150W unit would suffice for most projects but I also want to test and grade solar panels, inverters and storage batteries.

Itech will soon release a single phase AC load with DC load capabilities – the best of both worlds. My future applications will involve developing 208V/3-phase sine wave inverters so the Itech AC load will not be of too much help. I can manage to do quite a bit of development with a larger DC load that is available now.

I am curious how Itech will design the AC load. For single phase use, it would

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neutral at 0V and the hot line swinging 169V p-p about the neutral. To develop a 3-phase load, there are phase-phase currents, both imaginary and real and WYE & delta voltage setups. When I get time I may try to sketch out the load circuitry of a 3-ph electronic load. Off the top of my head there would be (3) phase-phase current shunts but I still need to think about bipolar (below 0V) operation.

I did quite a bit of research in developing electronic loads and am a bit disappointed about the lack of voltage isolation between the load and controls in the Itech product line. I plan to use 2kV high speed opto-isolation between the microcontroller and A/D & D/A converters. This way all USB & serial communications will be grounded with respect to line voltages to safely connect to PCs and the analog side with be floating with the hot load. Most of the sigma-delta converters are SPI based and should work with sufficiently fast opto-isolators.

I look forward to receiving my programmable load, all 32kg of it.

Dennis

REPLY

GERRYSWEENEY 👤
JUNE 30, 2013 AT 11:56 PM

Hi Dennis,

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That sounds like a monster of a load. From what I can tell there is one man behind the design of the BK/Maynou/Itech products, I am not sure which organisation he represents but they all sure seem to be linked in some way.

I imagine an AC load would work much like a DC load with a bridge rectifier on the input terminals (in simple terms), it should not be too hard to make a load responsive to AC currents, and if you think about it that would explain why the AC load has DC capability.

Gerry

REPLY

DENNIS
JULY 3, 2013 AT 3:44 AM

Hi Gerry,

My price for the Maynou M9715B and M9716B are $1550USD and $2350USD respectively so I think I'll go with the M9715B 1800W unit. It seems like a lot of capability until you put it in terms of a practical load like 5.3A at 339Vdc (rectified & filtered P-P voltage for 240VAC input supplies). This can be used for testing of PFC front ends, etc.

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In comparison the list price for the BK-Precision 2400W 500Vdc unit is $6975USD so I don't feel too bad about paying Maynou's prices being about 1/3 of BK's prices.

My buyer in China is packaging a pallet of materials for me this week so I thought it would be a good time to add an electronic load to the shipment. I made sure to specify 120Vac operation for use in the US. I'll post a link to my teardown when I get it. I'm curious how they handle 500Vdc inside the box in terms of increased clearances.

Dennis

REPLY

GERRYSWEENEY 👤
JULY 3, 2013 AT 7:23 AM

Hi Dennis,

Thats a big beast of a DC load, let me know how you get on with it.

Gerry

REPLY

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KATE ZHOU
JULY 3, 2013 AT 3:03 AM

Hi, this is Kate Zhou from Maynuo Electronic. Thanks for all the comments on our products.
Maynuo offers M97 series DC electronic loads from 150W to 200KW and DC power supplies from 150W to 1200W.

REPLY

JOY TORRES
DECEMBER 9, 2015 AT 6:39 PM

Hello Gerry

I thought that was a very interesting and comprehensive video.

We are authorized UK/Ireland distributors for Maynou Electronics.

Thank you. Best wishes for a lovely Christmas!

Joy Torres

REPLY

GERRYSWEENEY 👤
DECEMBER 9, 2015 AT 6:56 PM

Hi Joy,
Thanks for your

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REPLY

JULIAN ROBINSON
JANUARY 26, 2016 AT 11:26 AM

Thanks for this – very useful and the only circuit of any kind I've found. I'm looking because I seem to have blown up my M9711, possibly by inadvertent reverse voltage application. I'm trying to work out what is likely to be damaged but have no experience of MOSFETs (not covered when I went to uni!). Symptom is no current drawn in normal polarity, and near short circuit in reverse polarity. Power-on self-test is ok. I assume I've blown the MOSFETS and will probably just replace them and hope. Would you have any thoughts on this?

REPLY

GERRYSWEENEY 👤
JANUARY 26, 2016 AT 11:51 AM

Hi Julian,
I would suggest based on what you describe that your input protection is working OK, its a diode basically so reverse polarity the diode is kicking in, so its unlikely that you damaged it with reverse polarity otherwise that diode would be either a short because that diode you are seeing would be either short circuit or blown apart. MOSFET's most

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waste of money. I would be inclined to open it up and get your multimeter out, the circuit is quite simple. A MOSFET is nothing to be afraid of, think of it as a voltage controlled transistor, the more volts you apply to the gate/source (up to about 10v or so) then the more it will conduct current drain/source – in this circuit you can simply think of it as a voltage-controlled low value resistor, very similar conceptually to a valve (vacuum tube). Hope that helps.

Gerry

REPLY

JULIAN ROBINSON
JANUARY 28, 2016 AT 11:18 AM

Thanks Gerry. I have received a response from Maynuo, they gave me some useful advice so I'm pleased with their service. Embarrassingly, it all turns out to be finger trouble, combined with not knowing about the reverse body-diode in the MOSFET and a couple of other contributing factors. The only think I had to fix was a loose fuse (external to device). You've probably lost interest in this topic by now, but I can confirm that the device uses one op amp per mosfet.

Overall it's a great piece of kit, I love it, though I can sympathise with your correspondent above who had to

Q   Search ...

Incidentally I'm pretty well up on MOSFETS now, your comparison with valves is ancient but illuminating. Thanks again for the video, it was a great introduction giving me confidence to pull mine apart. Impressed with the construction too – a model of elegant sufficiency.

Cheers
Julian

REPLY

GERRYSWEENEY 👤
FEBRUARY 3, 2016 AT 11:15 PM

Hi Julian,
Glad you got it sorted in the end. I have to say that company does seem quite responsive and helpful. Glad the MOSFET explanation was of some help
Gerry

REPLY

OLIVIER
MARCH 23, 2016 AT 6:38 AM

is there a reason to not put some snuber on the mofset in the dc electronic load?

i believe i understand how it work, you need to evacuate the heat from the Ton period trough the mofset and the ballast

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REPLY

OLIVIER
MARCH 23, 2016 AT 6:40 AM

my bad, there is a diode in the mofset, but is it enough?

REPLY

MATIAS TRONCOSO
OCTOBER 12, 2016 AT 12:39 PM

I do not recommend buying this DC load. I bought a Maynuo M9712C and it has a problem measuring voltage while discharging a current higher than 20 amperes. Here is a video showing the problem: https://youtu.be/ABcOg52YfbY

The worst part is that the company is unable to give any assistance or take any responsability about this issue.

REPLY

GERRYSWEENEY 👤
OCTOBER 28, 2016 AT 9:20 AM

Thanks for your comments/post

REPLY

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VIGNESH DURAIRAJ

OCTOBER 22, 2017 AT 5:00 PM

Hi Gerry,
your tear-down video well explained
everything about electronic load.
I have few question on that.
1. How bridge rectifier used as
temperature sensor?
2.Why mosfet driving op-amp tl084 need
negative 12V power supply? i think
without negative voltage it will work as
same…

REPLY

GERRYSWEENEY 👤

MAY 31, 2018 AT 5:59 PM

1. Uses the silicone diode junction
which has a negative temperature
coefficient.
2. To be able to get to absolute zero
volts, and not just above zero.

Gerry

REPLY

MICHAEL RUNYAN

OCTOBER 9, 2018 AT 5:41 AM

Hi Gerry,
Wow, its been 6 years since your original
post. Wonder if the loads have changed

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Any idea how the Maynuo decides on overpower. Will it take a little over the rated for a few seconds? Specifically, I'd like to use a 300W load (M9712B30) to make MPPT curves for a 325W solar panel. So it might see 325W for a long enough pulse to get a stable reading, 10s of milliseconds? then a long pause then a slightly different current pulse ect. ect.

Mike

REPLY

GERRYSWEENEY 👤
OCTOBER 10, 2018 AT 12:34 AM

I think it will probably handle the small overload ok, but depending on the mode it might limit the power and not actually draw the full 325W
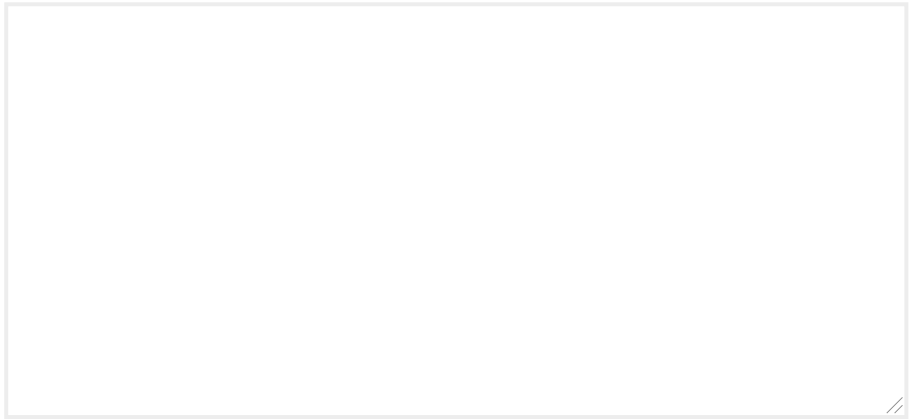
Gerry

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