Mini-HowTo

Home-Made Current Shunts for Measuring Motor Current

Jul 16, 2005, 01:04 AM

LBMiller5
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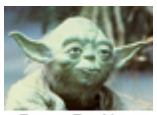


Do or Do Not, There is no Try!

Join Date: Jan 2005
Location: San Marcos, CA
Posts: 2,177

Home-Made Current Shunts for Measuring Motor Current

I have seen many threads in the past asking how to measure current for our motors. It is ea if you have a digital voltmeter that has a high current scale, unfortunately, most of the meters only have a 10 Amp scale. This works well for small CD-ROM type motors, or little 22mm to 24mm outrunners, but they cannot measure the larger currents used in the bigger motors. Plus, if you try to measure currents in the 10-12 amp range, you will probably melt the insulation off your test leads because they are not designed to handle that much current

As an Electrical Engineer, I have needed to measure very large currents in the past. These were in the 50 - 100 Amp range on a 24 volt DC system, so using a DVM was out of the question. In the lab, we use a thing called a precision current shunt to measure high current Basically they are a very low ohm, very high watt resistor, that drops a specific voltage acro itself for every amp of current that passes through it. They typically have ratings such as 1 millivolt per Amp or 10 millivolts per amp with a maximum amperage rating.

To use them, you simply insert one in line with the power lead and turn the equipment on. Then you take a Digital Voltmeter and measure the voltage drop across the shunt. For example, if you were using a 1 millivolt per amp shunt, and the equipment was drawing 58.(

amps of current, the shunt would read 58.6 millivolts when measured with the DVM. Pretty neat huh!

If you were using a 10 millivolt per amp current shunt in the above example, your digital meter would read 586 millivolts in the display. in this case, you simply shift the decimal poir over 1 position to the left and convert your reading to 58.6 amps.

This way, almost no power is lost in the shunt, and you can measure the current with a simp voltmeter. Unfortunately, these precision current shunts are kinda pricey. One made for a Fluke DVM that is a 1 millivolt per amp shunt that has a 30 amp max rating costs $62.00. don't know about you , but paying twice as much as my motor costs to see how much curren it is using seems a bit foolish to me!

So how about a cheap alternative that you can build yourself, from parts you probably alrea have, for a couple bucks, that works as good as the $60+ dollar units?

Do I have your attention?

OK, lets get started.

To make our own current shunt, we can take advantage of one of the fundamental propertie of copper wire. Copper wire, a very good conductor, is not a perfect conductor. Every piece c wire has a finite resistance. Granted it is small, but it is measureable and consistent, and we can use this information to our advantage.

If you look at a wire table, it gives the parameters of the wire such as gauge size, diameter, Resitance in ohms per 1000 feet, current carrying capacity and other measurements. Here is a link to a wire chart that I found on the web.

Wire Gauge Chart

From this chart there are 2 very useful wire sizes for making current shunts, 10 ga wire and 18 ga wire. If you look at the parameters for 10 ga wire you will notice that the resistance o 1000 feet is equal to 0.9989 ohms, which is pretty darn close to exactly 1 ohm (only 1/10 o 1% off to be exact). This means if we cut a piece of 10ga wire that is exactly 12.01 inches long, the resistance will be equal to 0.001 ohms. This humble 12" piece of 10ga solid house wiring is in fact a precision 1 millivolt per amp current shunt! And if you look at the chart it is rated for 55 amps of continuous current, and can take short bursts of 100 amps with no problem!

Likewise, the 18ga wire has a resistance of 6.385 ohms per 1000 feet. based on this, if you take a piece of 18ga wire that is 18.79 inches long, it will have a resistance of exactly 0.01 ohms which makes a precision 10 millivolt per amp current shunt that can carry 16 amps of continous current with short bursts of up to 30 amps.

Based on this info, lets get going with making our current shunts. The first one is a 1 millivo per amp unit. To build it you will need the following:

1 - 13" piece of 10ga solid copper house wiring. (It must be solid, not stranded, since strand wire has a different resistance)

2 - Banana Plugs

1 - Male battery connector

1 - Female battery connector

A soldering iron and some solder.

I use the small mini-banana type battery connectors, so that is what you will see in the phot below. You can use any type connector you choose on yours.

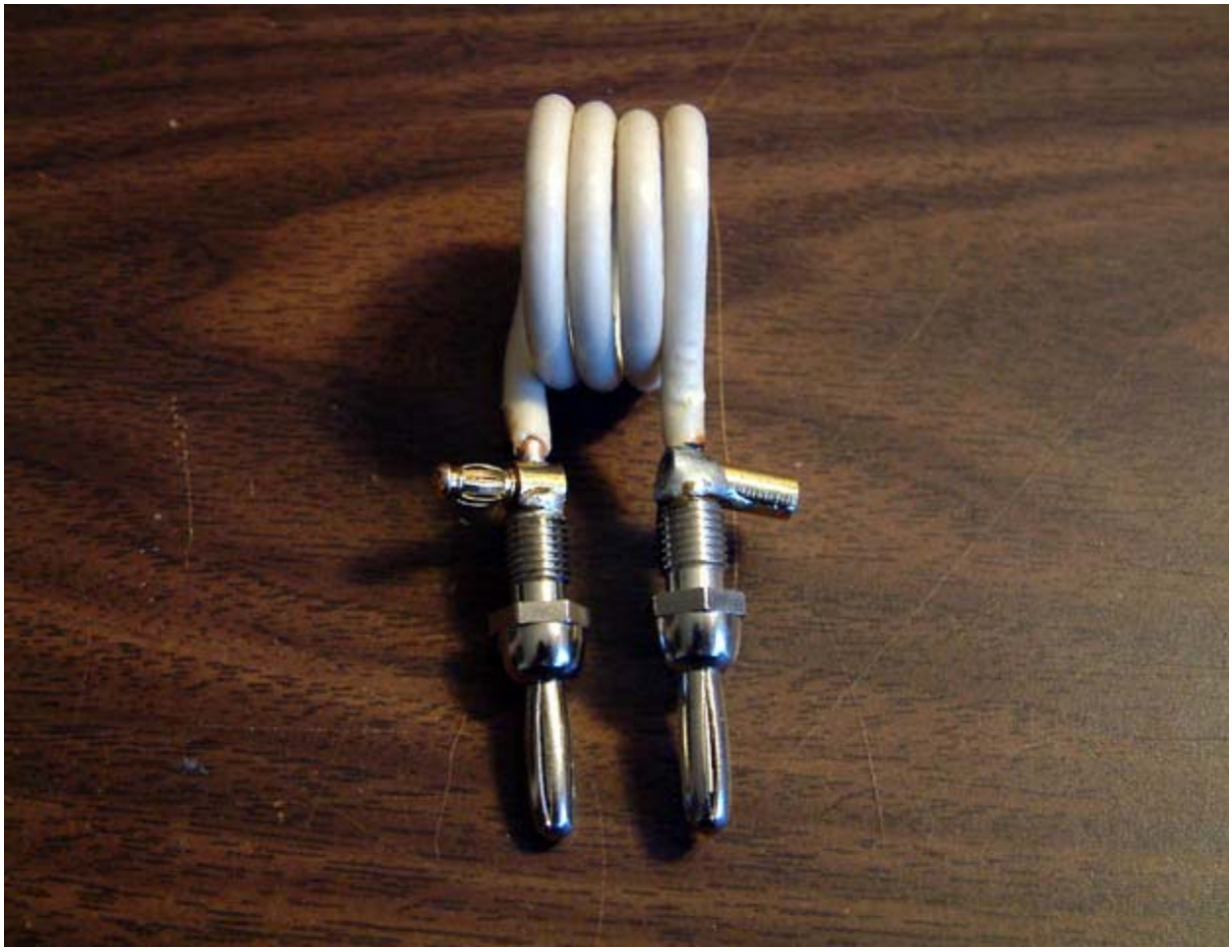
Step 1. Cut the 13" piece of wire to length and trim 1/2" of insulation from each end. You want to leave the insulation exactly 12" long. (Each 1/8 of an inch off in this measurement will introduce a 1% error in the shunt so measure carefully.) See the photo below.

Step 2. Take the wire and wind it around something round about 3/4" in diameter. I used a screwdriver handle. You can also use a piece of dowel rod or broom handle.

Step 3. Solder a banana plug and a male battery connector on one end of the wire, then solder another banana plug and a female battery connector to the other end of the wire.

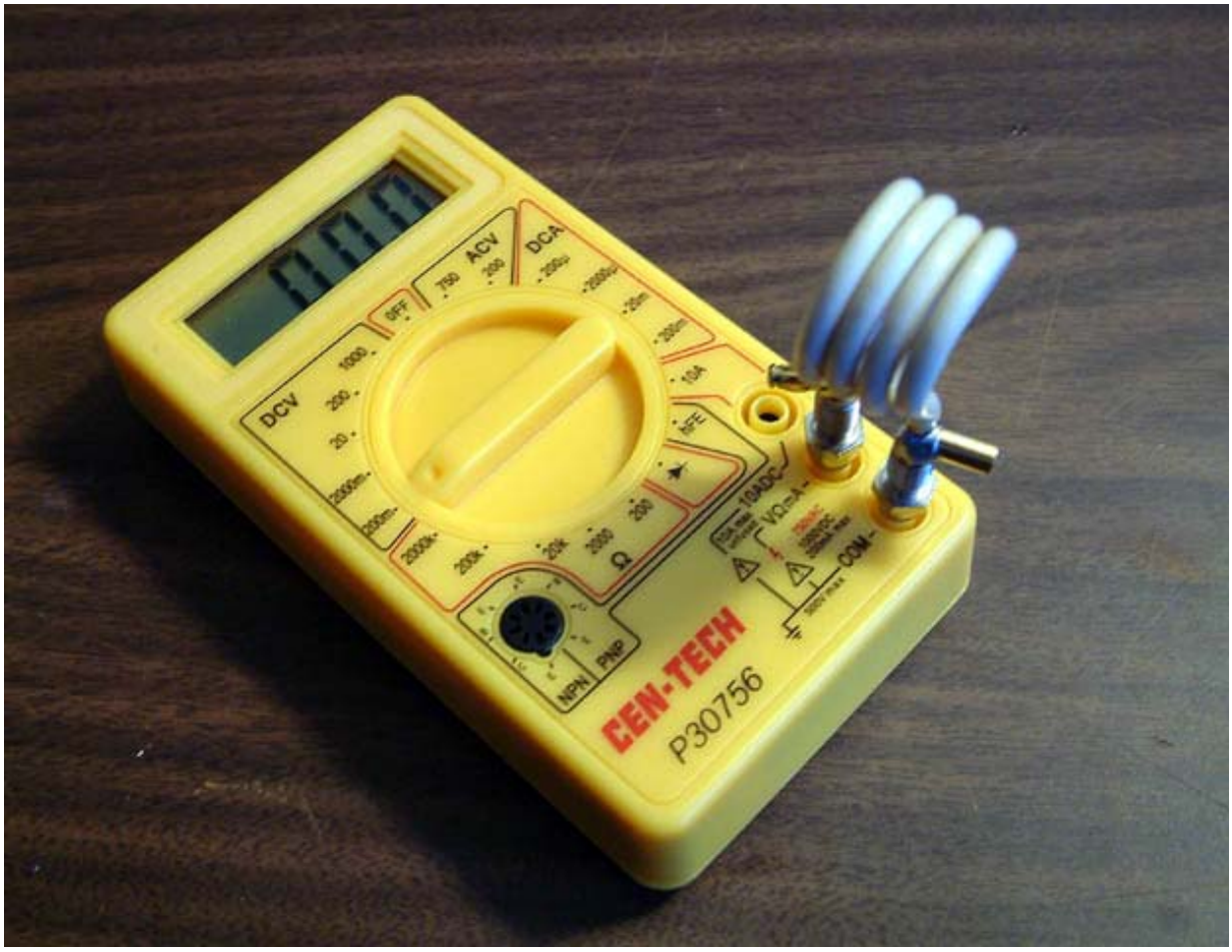
Now you are done! Pretty easy huh! If you want, you can add some short lengths of wire just above the banana plugs and crimp or solder your battery connectors to these leads. The important measurement is that the current must travel through 12 inches of 10ga wire to be accurate, so be sure to atttach your wires right up next to the insulation on the 10ga wire.

Here is a side view of the completed shunt showing the battery connector plugs.



I repeated the process using a piece of solid 18ga wire that was 18.79 inches long. This form
a current shunt that reads 10 millivolts per amp. Here is a photo of this one.

To use the shunt, plug it into the voltage and ground holes on your DVM as shown below. Make sure that the connector that mates into the battery goes into the voltage hole, and the connector that mates with the speed controller goes in the ground hole. (If you get it backwards it will still work, it will just display a negative value) Turn the voltmeter to the lowest voltage scale, usually 200mV or 300mV. The one in the photo below has a 200mV scale.



Set up your test motor and plug the black lead from the battery to the black lead on the Speed Controller. Then plug the red lead from the speed controller to the proper connector o the DVM. Finally, hook the red lead from the battery to the other lead on the shunt. **This w turn the system on, so make sure you have the throttle turned down!**

Now when you run up your motor, you will see the amps of current draw in the meter displa If the meter says 15.3, then you are drawing 15.3 amps. How cool is that!

The other shunt works the same way, but since it is a 10mV per Amp shunt, you have to divide the value in the display by 10. In the above example, the meter will read 153, which you would divide by 10 to get 15.3 amps.

Well there you go, a simple, easy, and best of all, cheap way to convert your DVM into an accurate 100 amp current meter for just a couple bucks worth of parts and a 1/2 hour of you time.

If anybody else tries this technique, please add onto this thread and let us know how it turn out.

Till next time.....

Lucien

Last edited by LBMiller5; Feb 25, 2006 at 04:55 PM.

Quo

Jul 16, 2005, 02:38 AM #2

Low Voltage
Irish Escapement winder

Join Date: Apr 2005
Location: Troy, Michigan
Posts: 40

Cheap and easy is and good....

Lucien, A man after my own heart...

That probably is the neatest trick I've seen in a long time. Especially for those of us who only occasionally have the need to check current draw. For the serious experimenter/hobbyist, a Whatmeter or Medusa is must. But for those of us with our inexpensive Harbor Freight DVM's this solution is certainly welcome.

Mike O'Bryan aka Low Voltage

Quote

Jul 16, 2005, 03:08 AM #3

LBMiller5
Use the Force!
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Join Date: Jan 2005
Location: San Marcos, CA
Posts: 2,177

Hey Mike,

I noticed you are from Troy Michigan. I am originally from Monroe, Michigan, and my mom grew up in Lincoln Park, Michigan. Small world huh!

I'm glad you liked the idea. It's simple, easy to make, and best of all it really works!

Lucien

Quote

Jul 16, 2005, 03:32 AM #4

ExtremeSkyes
Registered User

Join Date: Nov 2004
Posts: 480

Very cool...That's abstract thinking for ya! I'm all for home made hobby gear ...

Ex.

Quote

Jul 16, 2005, 04:25 AM #5

olmod
Good Better Best quest.

Join Date: Apr 2004
Location: Australia, VIC, Cranbourne East

Tip

There is available a dual banana plug that plugs straight into multimeters and can /has been used as a base for these shunts.

Posts: 8,465

Quote

Jul 16, 2005, 08:33 AM #6

powerditto
Former User

Join Date: Oct 2004
Posts: 961

Last edited by powerditto; Oct 22, 2006 at 03:54 AM.

Quote

Jul 16, 2005, 10:17 AM #7

jrb
Member

Join Date: Oct 1999
Location: Edina, MN, USA
Posts: 9,182

I also use a 14ga wire as a shunt; mine plugs into the side of the fuselage so I can measure installed current w/o breaking into the wiring.

Attached Thumbnails

91.3 KB · Views: 2167

Quote

Jul 16, 2005, 11:46 AM #8

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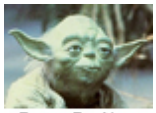

Join Date: Jan 2005
Location: San Marcos, CA
Posts: 2,177

Powerditto,

I guess I forgot to mention that I use this to test motors on my bench, not it a plane. I check my motor/prop combinations on the bench, before I install them, so no additional wire is introduced into the system. I just lay the meter in the path of the battery wiring and break the red line from the battery and insert the shunt.

As for the coil being and inductor, I don't see that as a bad thing, since the coil in series is a low pass filter that absorbs transient voltage spikes.

I guess that the bottom line is that it works, and I have not seen any negative side effects with any of my motors or speed controllers.

Lucien

Quote

Jul 16, 2005, 11:56 AM #9

olmod
Good Better Best quest.

Join Date: Apr 2004
Location: Australia, VIC, Cranbourne East
Posts: 8,465

And if

your not up to the task http://www.halted.com/ccp17261-acce-...30a-emi039.htm

Quote

Jul 16, 2005, 12:14 PM #10

powerditto
Former User

Join Date: Oct 2004
Posts: 961

Last edited by powerditto; Oct 22, 2006 at 03:54 AM.

Quote

Jul 16, 2005, 01:48 PM #11

everydayflyer
Southern Pride

Join Date: Oct 2004
Location: Haralson County GA. USA
Posts: 28,361

My shunt is about 15 years old and I first posted it many months ago here.

Charles

Quote

Jul 16, 2005, 10:38 PM #12

tmenet
Registered User
Site Sponsor

Join Date: Dec 2004
Location: Florida
Posts: 85

You want cheep you and you want non-inductive? Just like the Fluke shunt? How about $1.38 ? Good to about 45 AMPS continuous and short bursts up to 100 AMPS. Lucien. Looks like Fluke has a handsome profit for their $62 - 30AMP shunt!

This design will read 1 milivolt per amp just like Luciens 10ga wire shunt.

Substitute the resistor below in place of Luciens shunt. Actually it is more accurate to do it near your battery/ESC connoector as Powerditto suggests in post #6 to keep the high current lead short. This is true even if you test only on the bench.

http://www.mouser.com/index.cfm?hand..._pcodeid=71070

Albert

Quote

Dec 25, 2005, 01:34 PM #13

z-matrix
just look at it smokin'

Join Date: Dec 2005
Posts: 607

Hello,

sorry to drop in like this,

But you shouldn't wind up your shunt, it will have (N^2*A*u0*ur)/l inductance, it is not good, since your esc is a high đi/đt device, high voltages can be developed on your voltage amplifier/sensor at fly back time, U_i of about L*đi/đt

wind it up bifilar, hold the two ends together, hold the center with your other hand, pull it hard, now its furled in half, now you can wind your shunt up as a single wire, it will have no inductance.

regards.

Quote

Dec 26, 2005, 05:54 AM #14

Cyb
Registered User

Join Date: Sep 2003
Location: Belgium
Posts: 114

Lucien,
Thank you for this tip. I've built one this morning and it seems to work fine. Is there a way to calibrate it ? I mean I just cut the wire with the dimension written in the chart, but how can I really be sure it will show the right value ?

Quote

Dec 28, 2005, 12:13 AM #15

LBMiller5
Use the Force!
Site Sponsor

Do or Do Not,
There is no Try!

Join Date: Jan 2005
Location: San Marcos, CA
Posts: 2,177

One easy way to calibrate it is to put it in series with another Digital Voltmeter that is set to the 10 amp scale. The current drop is a purely linear function, so if they both read the same then it will read correctly at higher currents. Run about 6 or 7 amps of current through the meters and compare the readings.

To calibrate the shunt, there are a couple things you can do. If it is reading a little high, you can do 1 of 2 things. The first is to unsolder one of the ends and shorten the wire a little bit. This is a trial and error thing where you cut a little and measure, cut a little more and measure again until you get it right. The other way is to add a resistor in parallel to the shunt to lower the resistance slightly. If you have a bunch of resistors you can just hold one across the ends of the shunt and see if it is right. If not try another value until you get it right. There is a way of mathematically calculating the exact value needed based on the current reading if you know Ohms Law. But if the reading that you are getting is within 1% or so, it is good enough for our purposes.

If the value you are reading is a little too low, compared to the other meter, then you need to increase the resistance of the shunt a little bit. One way of doing this is to take a pair of diagonal cutting pliers and squeeze the wire in a few places just hard enough to nick the wire but not cut it. This will increase the resistance of the wire slightly and cause the current reading to increase. This method is best used to fine tune the shunt a very small amount. If you are off by more that a couple percent, you are best to cut a new wire a little bit longer and try again.

Hopefully that helps.

Lucien

Quote

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