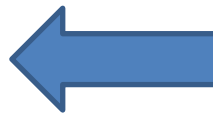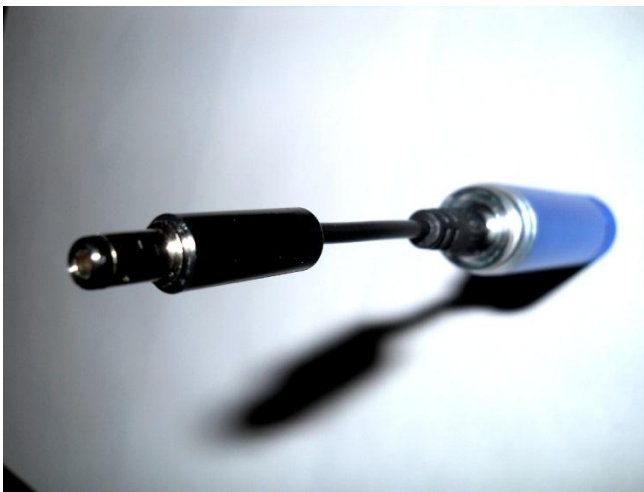# Introducing the...

Mini-Power Stick 2.0!

A 1.5vdc to 5.5vdc power supply for your hobbyist needs.

> The Mini-Power Stick 2.0 is capable of producing up to 100 milliamps* of power at 5.5 vdc. This is more than enough to power most PIC, Basic Stamp, PICAXE, or Arduino projects. Never before has it been so easy to add switch mode DC/DC technology to your project!
>
> *The unit is capable of supplying more than 100milliamps of power, but we recommend staying below this level.

In the beginning...

there was the 7805 and all was well in the hobbyist world. Then people started wondering... "Can we power our devices and projects to last longer with a cheaper power source than a 9 volt transistor battery?" From that simple question came the Dinam Technologies Mini-Power (MP) Stick 2.0, a miniature switch mode power solution within reach of the electronic hobbyist and experimenter.

Our Mission

To become the leader in low voltage DC to DC power supplies for the small volume and hobby market. We are dedicated to the innovator and his creations. In other words... We are here for the purpose of, "bringing power to your ideas!"

So, how does this little marvel of electronic engineering work? We take a 1.5 volt AA battery, we connect it to a fast switching circuit that charges a coil and that produces a step-up voltage that results in a 5.5 volt output. That the basics. Obviously, there is a little more involved than that, but all you really need to know to make this work in your device is to stay within the limits. What are the limits?

1. The input limit is 1.5 vdc. This shouldn't be a problem because the device is only large enough for 1 AA battery. We're sure someone will figure a way around this, but please don't.
2. The recommended output current limit is 100 milliamps. Even if you could get more than that out of the device you would probably need to buy stock in a battery company or use rechargeable batteries, because the resulting current demand on the battery will start to approach 1 amp and will completely discharge your battery in short order!
3. Obviously, this device is not intended for underwater projects and is not covered under the manufacturer's warranty for such defects. Even though it does have a sleek cylindrical body, it's not a submarine so don't treat it like one.
4. That's about it. As customers come up with creative ways to stretch the limits of this device, we'll undoubtedly have to list more things you shouldn't do with your MP Stick 2.0. Until then, just keep the previously mentioned limits in mind when using the Mini-Power Stick 2.0.

Here is a basic diagram of the Mini-Power Stick 2.0.

1.5vdc AA   Converter DC/DC   OutPut Voltage 5.5vdc

The circuit can determine how much power is required by monitoring the output voltage and current levels. It will respond by demanding more current from the input as its voltage level starts to go down to maintain constant power. The unit will continue to supply current at a level of 5.5vdc on the output until the battery is completely exhausted or the output current limits are exceeded.

How does it work on the inside?
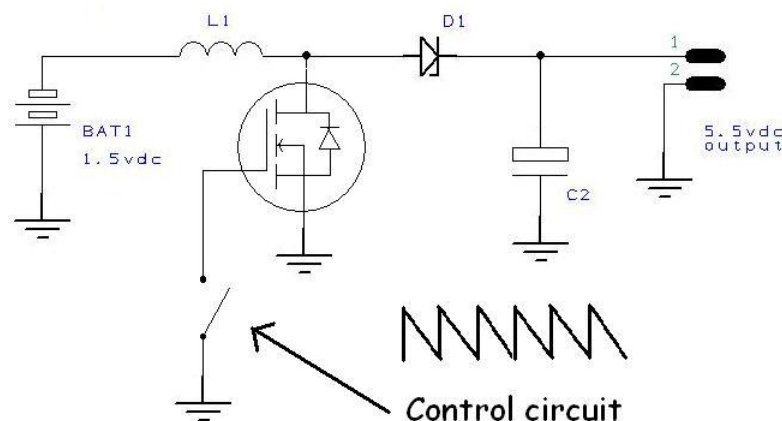
For the purpose of this explanation, Q1and its sensing/feedback circuit is not shown. When C2 is discharged, then Q2 is off. This causes the current to flow throw D1 until the capacitor is charged. Once charged a sensing circuit tells Q2 to turn on. This stops the flow of power from L1 to C2. The current now flows through Q2 to ground (for a very short period of time) at max current fully saturating the coil. C2 cannot discharge through Q2 because of D1, so all its voltage and current is available for the load (your project). When the load on the MP Stick 2.0 discharges C2 a little, then

the sensing circuit will turn Q2 off. When this happens, the field in the coil collapses and higher voltage current flows through D1 to C2 and charges it to 5.5 vdc. After that, the cycle begins again.

So you might be thinking, "Doesn't the oscillator produce DC with a noise on the output? Well, um…uh… The short answer is "yes." As with all things, there is usually a trade-off. However, for most projects that aren't audio or RF based, it shouldn't be a problem. For some projects that are audio or RF based it shouldn't be a big deal either. This is why…

In the first picture, you see an oscilloscope reading of the 5.5 volt DC voltage. It looks fairly clean without any defects.
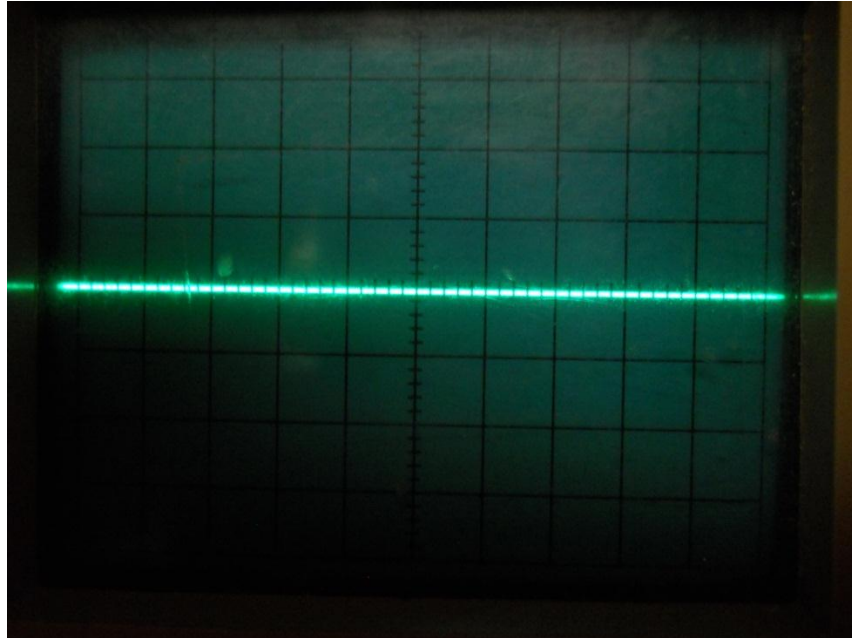
NOTE: The ground level was moved to the bottom of the display.

Now let's look at the DC noise by switching the scope to AC input and to the 50 millivolt scale.
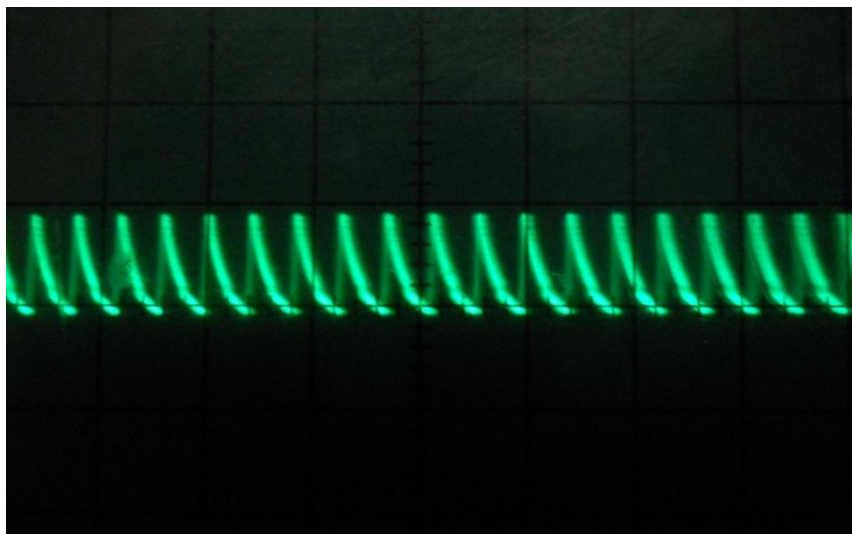
As you can see, the noise is now visible, is an AC saw tooth signal, an is approximately 50 millivolts riding on top of the 5.5 volt DC output. That represents a noise component of only 0.9%. Not bad. However the noise (AC saw tooth ripple) level and frequency does change as the current changes (in this example, it was 100 kHz) with respect to the load changes.

You can eliminate the noise with filtering and by using a low dropout regulator on the input to your project. A SchmartBoard Power Module will work nicely for this and can costs less than $10.00. However, the SchmartBoard Power Module does draw 6.5milliamps of power from the MP Stick 2.0 to power the LED on the module. Fortunately, most PIC/PICAXE/Basic Stamp/Arduino projects won't require much, if any, filtering except in the most noise sensitive applications.

We also mentioned that using the MP Stick 2.0 with audio projects shouldn't matter in most cases. This is because the frequency is so high that no normal person could possibly hear the noise that is generated. If you know someone that can hear this high a frequency, it's time to start looking for some silver bullets or a wooden stake. There is a possibility of low frequency harmonics being generated from the high frequency noise on the DC output from the MP Stick 2.0, so some experimentation would be needed to see if this would be an issue with your project. However, in most cases, adding a Low dropout linear regulator, like the 78L05 or any of the SchmartBoard Power Modules (except the 9vdc version) will eliminate the offending 50millivolt ripple and give you a clean regulated 5vdc output.
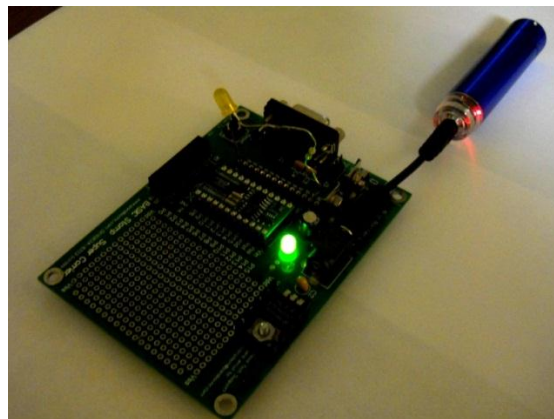
Here we see a Mini-Power Stick 2.0 being used with a Basic Stamp blinking LED project.
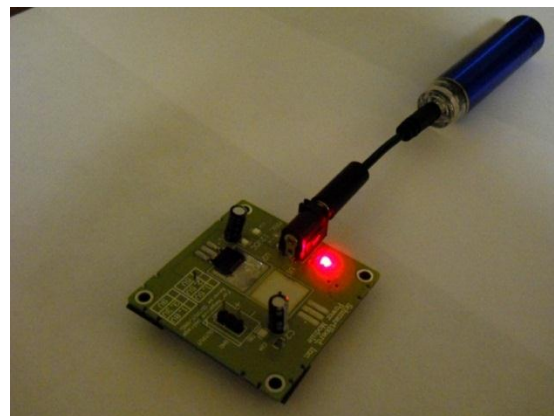
Here we have a Mini-Power Stick 2.0 connected to a Schmitt-Board Power Module.

Notice that the LED on the MP Stick 2.0 is on with the Basic Stamp experimenter's board and not with the SchmartBoard. Why is this? The SchmartBoard is only drawing 6.5 milliamps (.0065 amps) from the MP Stick 2.0 and the Basic Stamp Experimenter's board is running a blinking LED program and is drawing 40 milliamps. The LED on the MP Stick 2.0 indicates a lower switching efficiency. With the 6.5 milliamp load the efficiency of the unit is around 97%. However, at 40 milliamp loads the efficiency drops to around 81%. As long as the LED on the MP Stick 2.0 is not on, unless you overloaded the unit, then you are enjoying the most efficient use of the Mini-Power Stick 2.0 and the best possible battery life from the AA battery.

Voltage in	Input current in amps	voltage out	Output current in amps	Circuit Resistance	Efficiency	Status LED
1.5 vdc	0.0037	5.5 vdc	0.001	5500	99%	no
1.5 vdc	0.0075	5.5 vdc	0.002	2750	98%	no
1.5 vdc	0.0112	5.5 vdc	0.003	1833	98%	no
1.5 vdc	0.0149	5.5 vdc	0.004	1375	98%	no
1.5 vdc	0.0199	5.5 vdc	0.005	1038	98%	no
1.5 vdc	0.0400	5.5 vdc	0.010	550	92%	no
1.5 vdc	0.0600	5.5 vdc	0.015	367	92%	no
1.5 vdc	0.0900	5.5 vdc	0.020	275	86%	no
1.5 vdc	0.1100	5.5 vdc	0.025	220	85%	no
1.5 vdc	0.1300	5.5 vdc	0.030	183	85%	no
1.5 vdc	0.1500	5.5 vdc	0.035	157	83%	no
1.5 vdc	0.1800	5.5 vdc	0.040	138	81%	no/dim/yes

In the above chart it shows the efficiency and the input/output currents that can be expected. For a more complete chart, please refer to Reference Material section at the end of this user guide.

NOTE: *We did do the crazy thing for you that we all know you want to do with your MP Stick 2.0. We connected an MP Stick 2.0 to a BoeBot Tank robot with a resulting current drain of 385 milliamps on the output! We sort of cheated, as we substituted an MP350 (no longer available) for the LDO Linear Regulator they use on the board of education and rewired the servos so they fed directly off the MP Stick 2.0's output. IT RAN!! Well, it did manage to run it for a few minutes before the battery went completely flat. The estimated battery current was at 2.5 amps! You can watch the video on this CD or check it out on our webpage at www.dinam-tech.com/Tank_demo and see for yourself a boebot tank running off one AA battery!*

Well, that's about it except that you might be wondering, "How do you turn off the Mini-Power Stick 2.0?" It's easy. All you have to do is unplug the power cable from the power jack on the clear plastic cover. It couldn't be simpler. The unit goes to sleep and current drain on the battery while not being used is negligible. We recommend if you plan on storing it for an extended period of time, that you remove the battery to prevent battery leakage and damage to the unit.

REFERENCE SECTION

Voltage in	Input current in amps	voltage out	Output current in amps	Circuit Resistance	Efficiency	Status LED
1.5 vdc	0.0037	5.5 vdc	0.001	5500	99%	no
1.5 vdc	0.0075	5.5 vdc	0.002	2750	98%	no
1.5 vdc	0.0112	5.5 vdc	0.003	1833	98%	no
1.5 vdc	0.0149	5.5 vdc	0.004	1375	98%	no
1.5 vdc	0.0199	5.5 vdc	0.005	1038	98%	no
1.5 vdc	0.0400	5.5 vdc	0.010	550	92%	no
1.5 vdc	0.0600	5.5 vdc	0.015	367	92%	no
1.5 vdc	0.0900	5.5 vdc	0.020	275	86%	no
1.5 vdc	0.1100	5.5 vdc	0.025	220	85%	no
1.5 vdc	0.1300	5.5 vdc	0.030	183	85%	no
1.5 vdc	0.1500	5.5 vdc	0.035	157	83%	no
1.5 vdc	0.1800	5.5 vdc	0.040	138	81%	no/dim/yes
1.5 vdc	0.2350	5.5 vdc	0.050	110	78%	dim/yes
1.5 vdc	0.2950	5.5 vdc	0.060	92	75%	yes
1.5 vdc	0.3400	5.5 vdc	0.070	79	75%	yes
1.5 vdc	0.3900	5.5 vdc	0.080	69	75%	yes
1.5 vdc	0.4400	5.5 vdc	0.090	61	75%	yes
1.5 vdc	0.4900	5.5 vdc	0.100	55	75%	yes
1.5 vdc	0.5400	5.5 vdc	0.110	50	75%	yes
1.5 vdc	0.5900	5.5 vdc	0.120	46	75%	yes
1.5 vdc	0.6450	5.5 vdc	0.130	42	74%	yes
1.5 vdc	0.7000	5.5 vdc	0.140	39	73%	yes
1.5 vdc	0.7900	5.5 vdc	0.150	37	70%	dim/yes

NOTE: Readings were taken at 40%RH and at 23.2C with a fresh 1.5vdc AAA Kirkland Battery. Input current will go up as the input voltage drops off. Output current should not exceed 150ma as this may result in damage to the unit. You probably won't want to go above 100ma as this will discharge your AA battery in short order.

Basic Description:

1. Power your 5vdc projects with a 1.5vdc AA Alkaline or NiMH battery!

2. High efficiency 100-180mins. of run time from the MP Stick 2.0 from a single AA to your project (much longer if efficiency kept at amounts greater than 90%).

3. Slick design. Fashionable, because it's a tiny (only slightly bigger than AA battery) power source for your entire 5vdc project needs (those projects requiring less than 100ma of current).

4. Uses only one AA alkaline battery or NI-MH rechargeable battery. Could also be used for charging a mobile phone with a Mini-USB port (with the supplied Mini-USB cable) in those emergency situations.

5. Safe to use. Unit has over voltage protection to protect the circuitry of the unit and your project or your mobile phone (if you are using the included Mini-USB adaptor cable).

Specifications:

Maximum Output Current	150mA (100mA max continuous - recommended)
Output Voltage	5.7V+5% (5.42V to 5.99V)
Typical Efficiency	92%-99% (Range of operation for best battery performance)
	73%-99% (Full recommended range of operation)
Converter frequency range	1400Hz to 156KHz (.1 to 100 milliamps @ 5.7vdc)
Applications	PIC, BASIC Stamp, PICAXE, or Ardiuno projects + Mobile phone, digital camera, PDA, MP3, MP4, etc. (as a standby charger or power backup unit)
Power source	1 X AA Battery
Device compatibility	All devices using a 2.5mm x 9mm DC jack or Mini/Micro-USB port with a power requirement <100ma @ 5.7vdc (5.0-5.7vdc) should be able to use the MP Stick 2.0 (within the range of most microcontrollers)
Concurrent operation	If you use this as a charger, you can use your mobile phone, mpMp4 player while charging. Ultimate convenience with no interruptions to service.
NET Weight of Unit	20g

Package Includes:

- 1 X Mini-Power Stick 2.0
- 3 X connection cable (3 DC Barrel connectors (1 is a 2.5mm x9mm with screw connectors) cables + 1 Mini-USB cable
- 1 x Micro USB adaptor)
- 1 x female 2.5mm x9mm connector with screw connectors
- 1 X User Guide (CD Disk and CD Case)

NOTE:
- Requires 1 AA Alkaline or NI-MH (Nickel Metal Hydride) battery.
- Battery not included

Warranty

Our warranty is not like a lot of the warranties that software companies (and some hardware companies for that matter) give you. We don't charge you an arm and a leg for something that sort of works, then tell you that if anything goes wrong, it's your fault. Our warranty is simple.

1. If the unit does not function when you receive it.
   Or…
2. If the unit quits functioning after you've owned it for less than 90 days.
   Or…
3. If you don't like the color (okay, maybe that's a stretch… forget that one)

We will repair or replace, at our option, the unit as long as it's returned to us at one of the addresses listed below within 90 days from date of purchase. You will need to pay the shipping to us, but we'll pay the shipping back to the address from where it was sent.

Where to send it (Pick the address that is closest to you):

West Coast	Midwest	East Coast
Dinam-Technologies	Dinam-Technologies	Dinam-Technologies
Attn: RMA Department	Attn: RMA Department	Attn: Warranty Department
1680 Hidden Valley Rd.	1680 Hidden Valley Rd	3327 Back Creek Church Road
Sandy Utah 84092	Sandy Utah 84092	Charlotte NC 28213

Please send us an email at sales@dinam-tech.com before sending the defective unit to receive an RMA number that you will need to place on the box when you send the unit. This helps us to keep things in the proper order and not lose your product. In some cases, we may elect to just send you a new replacement circuit board (especially if we determine at some future point in time that there is a common issue among customers with this product), so please send an email before sending it in to determine if you need to do so. Thanks in advance for your cooperation in this matter.

Warranty Disclaimer: Caveat emptor (*not really*)

This should be obvious to most, but we have to state it anyway…

If you drive over this with a car, or you figure out a way to connect it to an outlet in your home (Which we definitely don't recommend), or you try to use it as a defibrillator on your wife's favorite cat that you accidently fried with that really cool project idea that you had, then we'll probably not replace it for you. We put a lot of work into bringing you a great product that should give you many years of service, so it should be treated with respect. In other words, if you abuse it, then we don't feel that we should have to fix it for you. Fair is fair.

Although this unit was designed to power electronic devices and such, we don't guarantee that it will power your electronic device, nor do we guarantee that it will be suitable for any situation or purpose that you dream up. Let's face it, the way some home brewed electronic projects are designed a car battery would have a hard time supplying enough power. Even though it has protective circuitry to prevent catastrophic failure of the device, your project, or your phone (if you elect to charge your phone with this device), we don't guarantee that this feature it will work every time. For example, if you do something not wise like shorting the output for an extended period of time, it probably will fail.

If you elect to modify the unit in any way, we will elect not to repair it. You can of course modify it if you wish, but don't expect us to repair something that you changed and now fails to work as a result. We suggest that you wait until the warranty has expired and then modify the unit if you wish. If it fails to function after your modifications, then you can send it to us to fix for a fee (not free). That way, you will have at least received 90 days of service out of the device before it was rendered inoperable. At this time, we don't have extra circuit boards to sell if a customer caused malady should result. We'll probably have some in the near future, because you can never tell how many people will need to be rescued from themselves.

LEGAL STUFF:

Our Moto: Ut imperdiet odio et

The silly things that lawyers make us say, so we won't get sued:

Even though the Mini-Power Stick 2.0 is a product of Dinam Technologies, we do have to state that the basic unit and all components are made in China and assembled, modified, and tested in the USA. We also have to pay our respects to the people at Revolution Education Ltd, Parallax®, The Arduino Foundation®, and MicroChip® because the names, PICAXE™, BASIC Stamp™, Arduino™, and PIC™ are the trademarks of these companies and they would probably get mad at us if we forgot to mention their names. SchmartBoard Power Modules™ and boards are really cool and you should try these out sometime in the future, but once again, they are also the trademark of their owners (in this case SchmartBoard® Inc.). Everything in this User Guide is copyrighted by Dinam-Technologies and all rights are reserved. However, if you want to use something in this User's Guide in your documentation (unless it's copyrighted by one of those other companies mentioned earlier) for an article that you want to write on the web or in a magazine, then feel free to do so as long as you give credit to Dave Lawson and the crew at Dinam Technologies.

Oh yeah, we almost forgot. We reserve the right to make changes to the design, what is offered in the package and the specifications without notice. That should make obvious sense to most people, as we would like to make improvements from time to time. However, our lawyer is afraid that there is that one person out there that just doesn't like change and probably has a lawyer that needs to pay off his gambling debts and is willing to sue anyone that has more money than he does. If you're that person, then we're sorry. However, you have been notified.

Our lawyer was on vacation when we wrote this legal disclaimer, so that's why you can actually understand it. He'll probably make us change it when he gets back, but until then this is all we have to say on the subject of "Legal Stuff."

*Note: The phrase "**Ut imperdiet odio et**" is Latin for "**We hate lawyers too**." It was translated using Google Translator™ (a product of Google Inc.) as none of us here speak Latin. So, if you know Latin, and know that this phrase is not a correct translation, then send us an email at sales@dinam-tech.com and we'll fix it. Also, there might be something in it for you (a very small something) for helping us out. Thank you for reading all this and we do appreciate it. However, shouldn't you be playing with your MiniPower Stick 2.0? After all, that is why we built it and why you bought it. – The team at Dinam Technologies.*