WEST MOUNTAIN RADIO

The Beacon

QUARTERLY NEWSLETTER

Quarter One - 2015

INSIDE THIS ISSUE:

The Shacktopus Power Beast

by Steven Roberts

These are the voyages of the hand truck, Shacktopus. Her continuing mission… to seek out new loads and strange environments… to boldly blink where no one has blinked before.

On a voyaging sailboat, stable power goes with the territory: a huge battery bank charged by isolated shore cable and solar panels, diesel genset with a ton of fuel, fine-grained distribution, sine wave inverter, clear displays, circuit protection, and reliable design. I have grown used to staring at this console and having an accurate sense of my system's current condition.

I didn't think about this while moving off of Nomadness so she would show well; I just loaded my room in town with computers and electronics — digital piano, mixer, rack amp, video and comm gear, and even a 12-volt power supply for nautical goodies like the stereo. But when I brought home my ham rig to bounce a few APRS packets off the ISS, something started to bother me.

So, I have all this nifty technology for independence and communications, including an insanely dense pack of gizmology that I haul around on my bad back… yet I am ultimately dependent on the power grid. If that fails, I have about two days worth of charged Lithium Ion batteries for personal electronics, but if I want more, then I have to trundle down to the boat and plug in. I realized that I miss owning a floating utility company, and recalled weeks without electricity in Santa Cruz after the epic 1989 quake… depending on the bike's solar power system to run the essentials.

How hard could it be to replicate that in a convenient portable package? I poked around Amazon for a while, assuming that I would just dangle a cheap charger off a deep-cycle battery, shove it under the desk, and clip gadgets to it during power failures. But I realized that unless I wanted to spend big bucks for a serious marine-scale system like the one on Nomadness, I'd be stuck with some-

The Shacktopus Power Beast

thing disappointing. The Amazon reviews of cheapie chargers spoke volumes, and I wanted more capabilities anyway.

From there, well, you know how geek obsession works. I kept refining the specs and began to think of it as the hub of my electrical life: easy mobility, fast charging from the wall, folding solar array with controller, sine wave inverter, AC and DC panels, USB charge ports, AA battery dock, and local displays. Since it would be the one thing in my personal space that is always on, it is a perfect substrate for data collection, a camera, and a server to graphically display history on a browser and push events to my watch.

I didn't find a suitable gadget to buy, or I would have done so and moved on… I am busy enough with the book and other projects. But now that it's done, I find it to be a highly useful power tool, and I'm writing an eBook of plans for folks who want to build one.

Chargér d'affaires

shacktopus SKR sketchLike most of my projects, this avoids wheel-reinvention except where necessary. It's a dense packaging and integration job involving carefully researched products, augmented by a few unusual features and overlaid with computational goodness (like BEHEMOTH).

What started as a way to keep a battery charged took on some related features. Here are the essentials that resulted from a few weeks of refinement:

- AGM Group 24 battery (79 amp-hours)
- 30-amp, 4-state charging from the AC power line
- 10-amp charging from solar panels (PWM controller with display)
- Instant change-over on power fail for reliable UPS service
- Low and high voltage disconnect to protect sensitive loads
- 400-watt sine wave inverter
- Switching between line and inverter for AC distribution
- AC monitoring (voltage, current, and frequency display)
- 6 independently switched AC outlets (and one always on) high-side DC & battery monitoring with display (volts, amps, amp-hours)
- LED indication of all states including blown fuses and high voltage present
- Main battery breaker (40A)
- 12-volt distribution with individual fuses (9 free circuits)
- Utility 12-volt outlets (one cigarette style and 3 spade terminal pairs)
- USB outlet powered by DC source
- USB multi-outlet charger powered by selected AC source
- AA/AAA charger for Eneloop batteries
- Data logging on DC system
- Server for data collection (power, security, camera, and environmental)
- Network connectivity, NFC-triggering of phone app, local control outputs
- LED work light
- Utility pack for cables, fuses, and other accessories
- Collapsible hand-truck substrate

Shacktopus starboard quarter that last item was a key feature for my application, as it fits under my lab/office desk… but the system scales such that one could use a heavy-duty welded industrial cart and carry two Group 27 batteries (220 amp-hours versus my 79). The current mechanical design is adequate for my needs, but I wouldn't want to galumph with it down bumpy roads! More robust folding carts are available.

The white panels are HDPE, an easy-to-machine material that I usually acquire in the form of King Starboard (as in the boat's power console project). For this job, I just picked up a couple of cutting boards from Amazon — not as smooth and uniform as the good marine stuff, but convenient.

As you can see in the photos, I based the DC circuitry on a product family from West Mountain Radio, well-known in the amateur radio community for modules that make it easy to construct an uninterruptible power supply or reliable 12-volt system for home stations and repeaters. I'll go into the various design trade-offs in the eBook about the project, but their approach to RFI minimization seems to be effective (with high-side monitoring and clean change-over between line and battery, since the charge

controller is wrapped around a big Schottky diode-OR architecture). They make good use of Anderson Powerpole® connectors, which integrate well into a wiring harness and are a ham radio standard. All the ones in the photos are rated at 45 amps, and I used a proper crimper to get uniform terminations.

Powercart AC DMM and USB. The solar array I used for this is the Renogy 100-watt "suitcase" model, which folds down to about 20×28 inches and comes in a nice protective case with a strong handle.

To minimize stray power electronics and cables cluttering my life, the machine includes three independent USB charging sources totaling 8 outputs, AC metering, a "cigarette lighter" 12-volt outlet, spade terminals on the battery, a utility board with barrier strips, a cable for charging the network slice of my backpack, and a charger for AA and AAA batteries.

Shacktopus co website. I am now turning my attention to the smart overlay. I had to dust off my old Shacktopus name for this monster (although Datawake was tempting, as it better reflects our vision of a wake of information streaming behind the Microships). The screen capture at right is the 2005 incarnation of Shacktopus… looks like it is about to change!

The intent here is to take advantage of a stable power environment to support a core set of data collection tools. In the planned Nomadness implementation, this involved hundreds of data points reflecting the status of every subsystem from bow to stern… all time-stamped and collected into a database server with various clients including browsers, security and watch code, maintenance schedulers, remote telemetry tuned to available bandwidth, and so on.
Raspberry Pi B+

Raspberry Pi B+

But in the casual environment of a hand truck parked in my workspace, it is a much simpler problem… though still based on the same tools. The micro will slurp data out of the metering systems, log temperatures with DS18B20 sensors (ambient, battery, charger heat sink, and electronics enclosure), keep an eye on the room with the Raspberry Pi camera and a PIR motion sensor, monitor environmental parameters (humidity, pressure, light, gases, radiation), and provide for easy connection of other application-specific devices via slaved Arduinos or simple sensors. The Pi on the cart has WiFi, Bluetooth®, and HDMI, so it feels like another computer; a little NFC tag can tell my phone to connect and turn itself into a convenient console, and before it's all done I expect to push notifications to my Pebble Time watch.
Pi-Plates DAQC

Pi-Plates DAQC for I/O expansion

This should yield a set of tools that scale well to the next boat… or whatever I end up doing in this looming post-Nomadness epoch. It's a development system that doubles as a portable power station covered in blinkies. Is that a good approximation of geek nirvana, or what?

(If you'd like to be notified when the eBook is available, you can sign up. It will be available at Leanpub, with the first release when I am about half done.)

I have been enjoying this project… probably because it is finite in scope, unlike my usual open-ended concepts that evolve more quickly than my ability to keep up with fabrication and coding. More fun ahead!

— Steve

See further articles and blogs at
www. http://microship.com

Morse to Text for Lazy People

by Jon Ficks

I'm a hobbyist who spent many hours in the elementary school library poring through a tattered copy of Alfred Powell Morgan's "The Boy's First Book of Radio and Electronics." I attribute my early thirst for technology to my grandfather. He was the shop foreman in the aviation laboratory at the University of Minnesota and had a few inventions under his belt. Early recollections of childhood include the hours I spent with him in his basement tinkering with all sorts of mechanical and electrical contraptions. He would frequently drive me to ACME Electronics Liquidators in Minneapolis, a true surplus store with junk all over the place. I just couldn't get enough time with my grandfather. That early interest later moved me into a career in the electrical engineering world.

Sometime in the mid 1960's my grandfather gave me his BC-348 shortwave receiver, one whose DM-28 dynamotor had been removed and replaced with an AC power supply. (My grandfather was known to re-purpose war surplus dynamotors into flexible shaft drill tools.) I spent many teenage hours listening

to shortwave broadcasts from all over the world. To bring back memories, there's nothing quite like letting the BC-348 warm up for a half hour and then opening its case and tasting the aroma of hot aluminum, hot oil, and aging electronic components!

Problem and solution

I'm still an electrical engineer but with a wide variety of interests and way too much to do. Over the years I never spent the time to learn code or get a ham ticket. Recently I had the BC-348 open on the bench for tuning and had a brainstorm: while Morse code had been elusive, with my interest in embedded systems and capabilities with PIC® microcontrollers I could develop a Morse-to-text converter. I quickly devised a rather a rather simple circuit consisting of electret microphone, audio amplifier, discriminator, microcontroller, and LCD display. Morse code on the speaker of a shortwave receiver would be picked up by the microphone and converted to text on the display.

How it's done

Two things have to occur to convert tones to text. One is to distinguish tones from silence, or even more realistically, from background noise with which ham operators are so familiar. Secondly, time durations need to be established for a dot, dash, space, and inter-character spacing.

A tone decoder solves the first problem nicely. Its output goes low when the input signal is within its passband. External components set the center frequency, bandwidth, and output delay.

Time durations are calculated by PIC software based on the first twenty code tones encountered after power up. During that period "CALIBRATING" is displayed on the LCD. Some basic definitions have to be adopted in software, for instance, the duration of a dash compared to a dot. Resulting calculated thresholds are based on the ham operator's speed and style. Software then goes into "listen" mode where dots and dashes are distinguished, interpreted, and displayed as text characters on the scrolling LCD display. Recalibration can be done at any time by pressing the RESET button, and that's necessary for each different ham operator.

Adjustment

The volume and signal-to-noise ratio must be reasonable but are not critical. The pitch of the incoming code must match the center frequency of the LM567 tone decoder. When properly adjusted, incoming tones will illuminate the LED. Adjustment is accomplished in two ways.

Morse to Text for Lazy People

For unmodulated carriers, tune your receiver's BFO to the pitch that activates the LED.
For modulated carriers, tune the PITCH control (R2) to illuminate the LED.

Results

The hardware nicely discriminates code at the adjusted pitch and ignores tones at any other pitch as well as static noise, but correct text output depends on how time-stable (dot/dash ratio) the ham operator is with the key. It also depends on the defined relationships written into the software. Some operators are easy to interpret while others are more difficult. The software needs refining to make it smarter and more adaptable to a wider spectrum of ham "fists."

Tech Reference

The circuit runs on 5V because that's what the LCD requires. Everything else in the circuit will run on 3.3 or 5 volts.

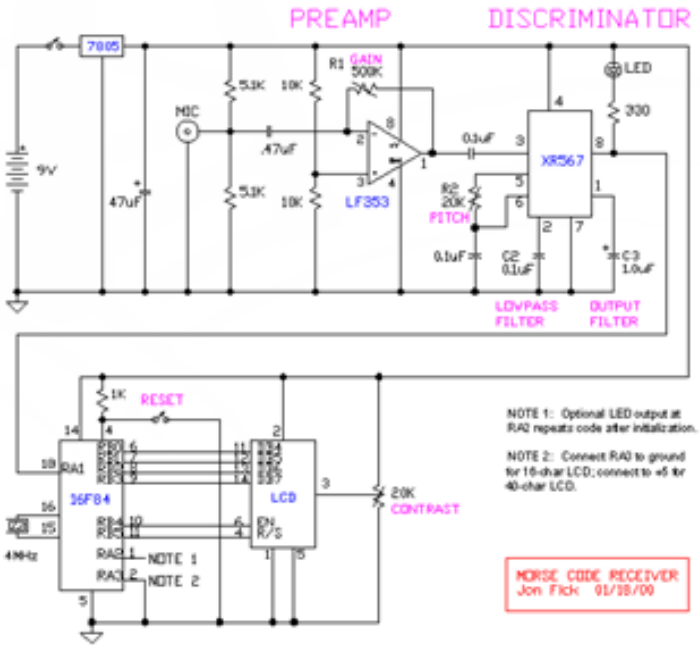
The microphone is a standard two-terminal electret condenser type that is easily available from junk computers or telephones or electronics suppliers. For direct connection to the shortwave receiver the microphone could be eliminated and the audio preamp modified if necessary.

The audio preamp is an LF351, an old standby and garden variety op amp. Its circuit gain is approximately 80 and is adjusted with R1 to provide approximately one volt of signal at the input of the LM567. Although the tone decoder will respond to much lower input voltages, its bandwidth will be reduced. Overall gain does not seem critical and the volume of the shortwave receiver may be varied to suit.

The LM567 tone decoder center frequency is adjustable from 500-5000Hz. 1000Hz seems to be a good target. There are two filter capacitors that need to be calculated. C2 is a low pass filter that has an effect on the 100Hz bandwidth (higher C2 means lower bandwidth.) If the bandwidth seems too low to accommodate unstable BFO's, the value of C2 may need to be reduced. C3 is an output filter that eliminates spurious out-of-band signals. It's typically greater than C2. If too low it may respond to spurious noise. If too high, output response time is slowed and the silence between dots and dashes will not be noticed. This capacitance value seems to be somewhat critical.

The character LCD display is an industry standard 2x16 display with HD44780-compatible controller. It has an 8-bit bus that is initialized for a 4-wire operation to save microcontroller I/O pins. A contrast voltage is required for these LCD displays to make them viewable. The circuit includes a pot for that adjustment.

The PIC software includes two commented-out lines that send serial characters to a 9600-baud terminal or terminal emulator such as PuTTY (http://www.putty.org). The serial stream at pin 2 (RA3) is at TTL levels, of course. Conversion to real RS232 levels is done with a transceiver chip such as the MAX3232 which needs only a 3.3 or 5 volt supply. A modern day alternative to RS232 conversion is to send the serial stream into a computer through a USB-to-UART bridge such as the CP2104 (it comes up as a COM port.) A 2x40 display may be used instead of the 2x16 by connecting PIC pin 1 (RA2) to +5V instead of GND.



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Test pin 18 (RA1) drives an LED. After the initial "learn" mode it should keep step with the LM567 LED which indicates that the software is in "listen" mode.

Program development is accomplished using the PCWH IDE Compiler for Microchip. This is provided by CCS, Inc. CCS has been a mainstay of my PIC programming efforts for some 17 years. Not only did they develop their line of PIC C compilers, they also use them in their consulting business. These practical tools are routinely updated. I use the microEngineering Labs, Inc., U2 Programmer for PIC flash programming. The U2 Programmer interface runs under Windows, has a clean appearance, and integrates nicely into the CCS user interface as a post-build step. The flash process uses Microchips In-Circuit Serial Programming™ (ICSP™) protocol which utilizes three PIC pins (MCLR, RB6, and RB7). I also use those pins for application purposes but it's acceptable because the application doesn't unduly load them.

Conclusion

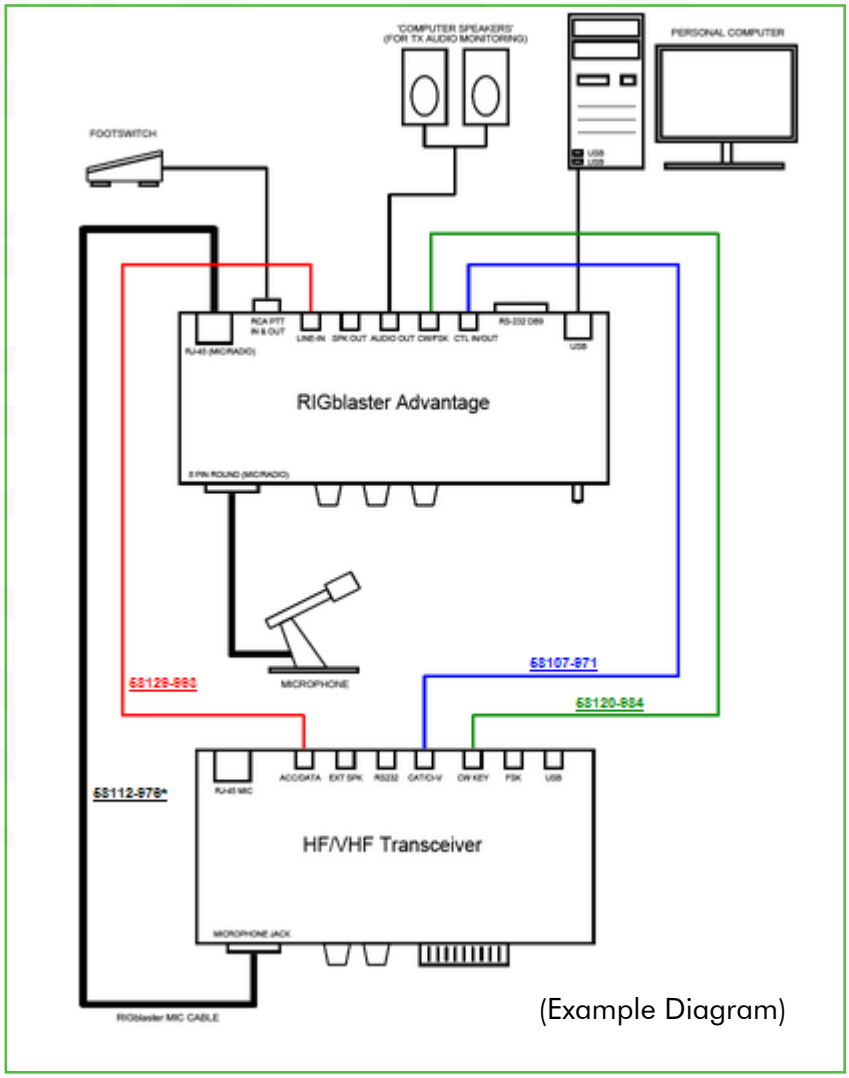
Schematic pdf and C software are available for download at http://westfordmicrosystems.com.

Software

To view the code, link to:
www.westmountainradio.com/fickscode

Interested in microcontrollers?
Click here for more info:
www.westmountainradio.com/pic_resources

Want to Learn C programming for microcontrollers?
Click here for details of a NEW book that includes a FREE compiler:
www.ccsinfo.com/e3book



(Example Diagram)

50 to 1500
by Ted Willett, W9NHE

Hi, I'm Ted, W9NHE. I have been a Ham since the early 50's, I started on VHF and later on HF and have made thousands of contacts. I've worked DX along with loads of contests using 160 meters and up, I even did SSTV and satellites, and I still have my radio controlled gas power boat, which operates on 50 MHz.

I've worked just about everything Amateur Radio had to offer. But as newer radios, antennas and accessories improved and new technology came to light I wanted to do more.

When I started out radios and modes where all analog, and operating on VHF unless there was some unique propagation happening, contacts were pretty much considered local (within 100 miles). In an effort to make regular longer distance contacts I became aware that every year during the various seasons, there were major meteor shower events that could extended communications ranges. It was pretty new so I had to do a little research into astronomy to figure it all out.

If you would tell someone you're reflecting signals off of meteorites or the moon they looked at you kind of funny. To be successful with meteors usually required getting up in the wee hours of the morning when the earth was in a most favorable position to sweep up the maximum amount of the space debris which gave the best chance for reflections between distant stations. We used an activity net on 3.825 MHz to set up schedule times, sequences and duration. Modes were CW or SSB, and in the early days, even AM. In the early morning hours while yawning and blurry-eyed we would start sending a sequence of 15 seconds, timed with WWV, either transmitting the first or third quarter of the minute and listening on the second and fourth. This allowed for precise timing as when to transmit and when to listen for the other station and vice versa. We would usually schedule for an hour or more to see how many bursts ("pings") we could hear, hoping for a burst long enough to be able to complete an exchange of both call signs and signal reports. Seemingly impossible, but over the years I did very well in completing many of these late hour contacts.

There are approximately 43 meteor showers per year (some major, some minor) but actually smaller numbers of these “rocks” from outer space are plunging into earth's atmosphere constantly; an estimated 100,000 tons per year. They enter the atmosphere and streak across the sky at an altitude of 60-100 miles while traveling at 1000's of miles per hour. Most of the time the debris is very small like a grain of sand (and even smaller). However from time to time larger pieces create a spectacular burn trail which can be easily seen, especially during one of the major shower periods.

When a meteor enters our atmosphere at such a great speed it compresses the air molecules so fast that the air is trapped in front of it, creating a super-heated plasma. This white hot plasma usually completely destroys the meteor leaving a stream of ionized gas behind it. With small debris the ionization may only last a fraction of a second, while bigger chunks will burn a few seconds or more, I have actually witnessed many reflections supporting communications up to 30 seconds and sometimes a minute or more.

The ionized gas trail can act as a reflector for radio signals in the VHF range. When that happens you can make brief contact with other stations out of a maximum of about 1,500 miles.

Where does *"*15 for 1500" come into play? Well, historically meteor scatter required a substantial station. You needed high power, a good receiver and a big antenna system. But now days its routine to exchange with other stations using 15 watts or less, and an antenna as simple as a dipole. You can easily do it with most of today's radios interfaced with your computer using available software and the new digital modes.

The selection of West Mountain Radio's RIGblasters (the *Plug & Play*, *Pro*, *Advantage*, *Plus II* and *Blue) make it easy to get going with simple connections and a supplied software suite. You can check them out at www.westmountainradio.com.
Just connect, load and GO! The instructions manuals are detailed and well written but if you happen to have difficulty, friendly, no cost telephone or internet support is readily available.

Much has already been written

about this but this weak signal communications method was developed by Joe Taylor, K1JT who besides a ham is a scientist and a Nobel Prize winner in physics.

Joe was interested in computer technology in 1990's and found that computer sound cards where rapidly evolving into sophisticated digital signal processors. Joe determined that an inexpensive sound card could become a sensitive two-way analog/digital converter. It can convert an analog signal to digital data within the computer processing, and also create analog audio with various modulation schemes for amateur transmissions.

All you need is a transceiver, antenna, and a computer, with a interface device like one of the West Mountain Radio RIGblasters. Included with each is a DVD loaded with free soundcard software to get you on the air quickly and inexpensively. and your digital station is on the air. With the programs it almost endless what you can do, like work PSK31 a digital mode for weak HF signals. Even try to bounce a VHF signal off the moon for a contact on the other side of the globe. With the increasingly popular JT65 mode you can detect a signal so weak that its below the noise floor and not even audible on the station speaker. We use WSJT441 mode for meteor scatter. This, and a lot of other programs are already to supplied on the CD that comes with RIGblasters or they are free to download from http://www.vhfdx.de/wsjt/.

For real time information and scheduling it is normal to use Ping jockey Central by N0UK, Just log in at http://www.pingjockey.net/cgi-bin/pingtalk and get on the chat page, its free.

The action frequencies are:

50.185- 50.195MHz . . . Moonbounce (EME)

50.255- 50.285MHz . . . FSK441 and JT6M Meteor Scatter (MS)

50.260MHz . . . FSK441 and JT6M MS calling frequency

144.155- 144.135. . . JT65 EME calling frequency

144.140 . . . FSK441 calling frequency

222.085 . . . FSK441 calling frequency

432.060-432.070 . . . JT65 EME

1296.060-1296.070. . . JT65 EME

Have Fun!

RIGrunner 4007U

Sholto Fisher
K7TMG

Features

- 40 amp 12 VDC continuous duty with 7 fused outlets.
- Automatic supply voltage and load current measurement shown on a 3 x 7 segment display.
- Automatic shut off on high (HVD) or low voltage condition (LVD).
- Intelligent USB port for charging iPhone, Android and other USB devices.
- Adjustable 7 segment display brightness.
- External input for use with electrical/mechanical interlocks.
- Internal RF bypass capacitors on all inputs and outputs.

I was very excited to get my hands on the new "Emcomm" RIGrunner 4007U from West Mountain Radio. For many years I have used the RIGrunner 4008 in my shack and have appreciated the very sensible power distribution scheme it provides using Anderson Powerpole® connectors, ATC fusing on each outlet and the visual and audible voltage alert. Although (in the interests of full disclosure) I work for West Mountain Radio, I am an active ham and reliable shack power distribution is something many of us overlook.

While the RIGrunner 4008 is a great solution for many, the 4007U introduces some very nice features which make it the perfect choice for the home shack or in "Emcomm" use.

Looking at the unit the first new feature you'll notice is the 3 x 7 segment display. This gives a continuous readout of supply voltage and load current. This is a great way to keep an eye on things without having to break out the DMM. The display also has adjustable brightness (ten steps) so finding the right illumination under various ambient lighting conditions is easy.

Another obvious addition is the USB charging jack on the right. This is an intelligent USB charger capable of delivering up to 2A at 5V. Being "intelligent" means it will negotiate the current demands with different devices such as tablets and smart phones to provide the correct amount of charging current. It's very useful being able to plug the cellphone into my RIGrunner instead of hunting for the wall-wart USB charger! In an emergency situation, having the ability to charge a cellphone from your shack supply or 12V backup batteries speaks for itself.

A less obvious feature of the 4007U is the integrated HVD (high voltage disconnect) and LVD (low voltage disconnect) circuitry. This RIGrunner effectively isolates your connected equipment should the supply voltage go lower than approximately 11V or higher than 15V. It will automatically reset when the voltage level returns to normal.

This is a great safety feature which can protect expensive radio equipment from a dangerously high voltage which can occur (for instance) from a power supply losing regulation. The LVD can protect batteries from being discharged too much. Either way, you know you're covered!

Unless you dig into the manual you might be unaware the 4007U also has a safety interlock feature. This is an external "sense" input which is uncovered by removing a panel knock-out. The idea of this input is to provide a way of controlling the outputs via some other circuit (mechanical or electrical). It could be as simple as a key-switch lockout (which certainly gives me peace-of-mind when attending to antenna repairs!) or perhaps a mechanical interlock in an amplifier cabinet?

As with all RIGrunners, each outlet is RF bypassed and protected by a removable ATC style blade fuse.

If you are considering a RIGrunner why not check out the 4007U? It might be just the thing you need!

Upcoming Events

Visit Our Booth

Dayton Hamvention
May 15-17, 2015

Ham-Com
June 12-13, 2015

So. Milwaukee Amateur Radio Club
July 11, 2015

Huntsville Hamfest
August 15-16, 2015

If you would like to submit an article for consideration in future newsletters please contact marketing@westmountainradio.com.

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