A few added components make a self-contained controller for 100A load

Steve Hageman, AnalogHome.com, Windsor, CA

The late Jim Williams' last project was a 100A active load (**Reference 1**). That design needed a separate signal generator and other components. This Design Idea makes the load self-contained. It adds potentiometers to control the stepped load levels, a chopper oscillator to switch between the set load levels, and a dual-readout DPM (digital-panel meter) to allow for direct voltage and current readout. In tribute to Williams, it uses three Linear Technology chips.

The heart of the load controller is two potentiometers, Set A and Set B (**Figure 1**). These devices allow you to set A and B load levels anywhere in the 0 to 100A-load-range capability of Williams' design. For instance, assume that Set A is at –0.5V and Set B is at –0.75V. Switching the load between these two levels changes it from 50 to 75A. Timer chip IC_1 controls the stepping rate and duty cycle between the Set A and the Set B levels. This timer IC allows you to control frequency over a decade range. It also allows you to set the duty cycle between 0 and 100%.

The full 0 to 100% duty-cycle control comes in handy when you set up the load. At 100% duty cycle, the voltage between the potentiometers does not switch, and the Set A control is active alone. This situation allows you to adjust Set A and watch the actual dc level on the dual-readout panel meter. Likewise, setting the duty-cycle control to 0% switches to the Set B potentiometer and allows you to adjust its static or dc level.

THE FULL 0 TO 100% DUTY-CYCLE CONTROL COMES IN HANDY WHEN YOU SET UP THE LOAD.

Setting any duty cycle other than 0 or 100% causes the Set A and Set B levels to alternate. You control the chopping frequency by adjusting the fre-

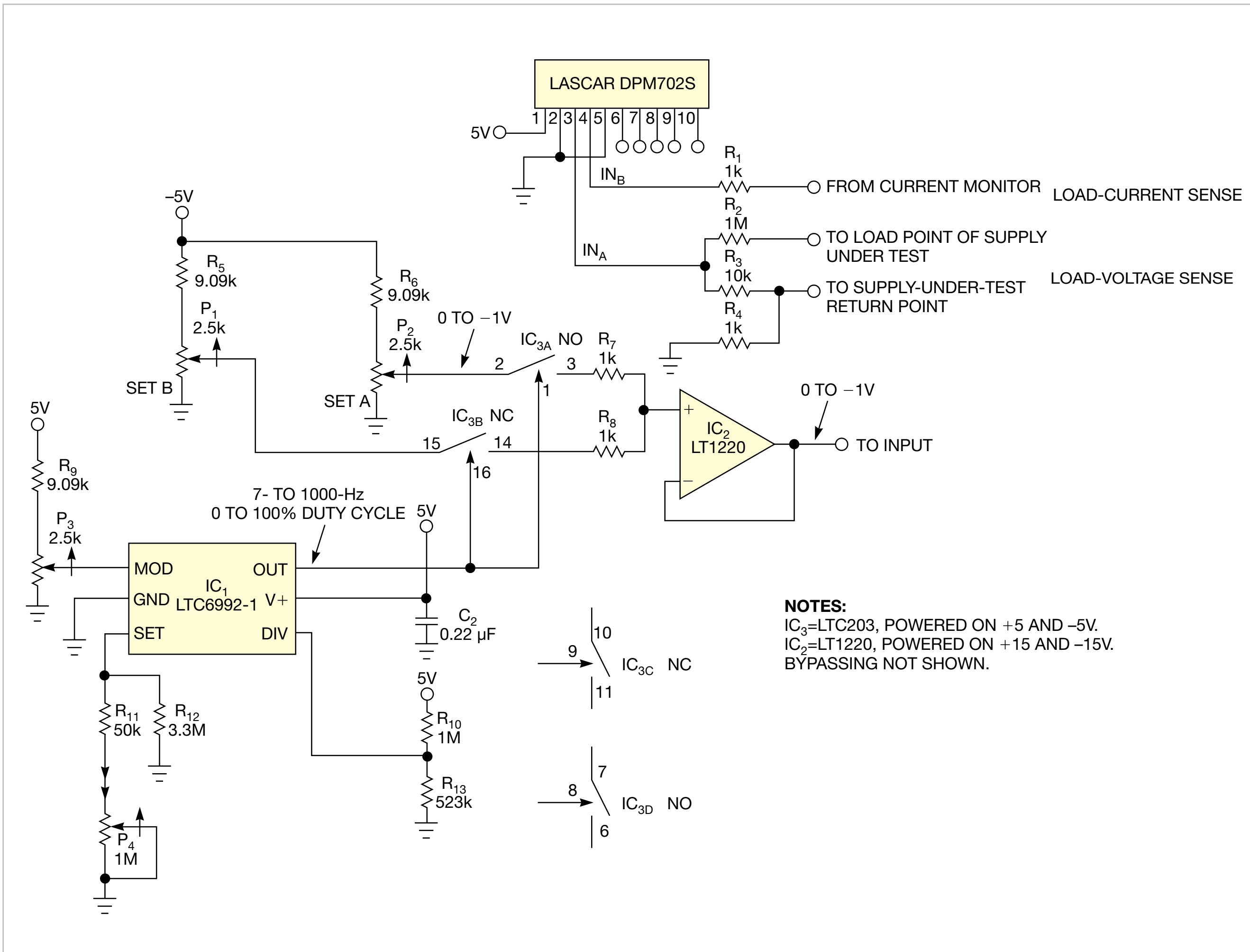


Figure 1 Adding this circuit to a 100A active load makes a stand-alone piece of test equipment.

quency potentiometer, P_4. A frequency of 60 to 1000 Hz best suits use in large power supplies. You can adjust the values of the resistors to get chopping frequencies of 4 Hz to 1 MHz.

Take care with the physical mounting of potentiometer P_4. Any stray capacitance on the Set pin of IC_1 is detrimental to its proper operation. Resistors R_{11} and R_{12} should be placed next to IC_1. You can wire potentiometer P_3 a few inches away for panel mounting.

Connect the labeled points in **Figure 1** directly to the labeled points in Williams' original schematic. You should change the 51Ω resistor at the earlier circuit's Input pin to something on the order of 1 kΩ. IC_2 should be close to the previous design's A_1 amplifier. You can slightly optimize the pulse's shape if necessary by adjusting the 300-pF capacitor at the input to A_1 on the original design.

The dual-readout DPM from Lascar Electronics is handy in active-load applications (**Reference 2**). The dual 3½-digit voltmeter has a ±1.999V input and has built-in annunciations for amperes and volts. Set the decimal place to the proper location by soldering jumper pads on the back of the unit.

This design connects the voltmeter across the load terminals but doesn't compensate for voltage drop on the leads connecting the load to the power supply. At the 100A level, the voltmeter doesn't provide the kind of accuracy that load-regulation testing requires. The voltage indication at the load is useful, however. It provides adequate indication that the power supply under test is still regulating and that the test leads connect properly to the load. If you need a more accurate reading, it is a simple matter to connect a 6½-digit bench DMM (digital multimeter) directly to the power supply under test. EDN

REFERENCES

1 Williams, Jim, "Design a 100A active load to test power supplies," *EDN*, Sept 22, 2011, pg 28, http://bit.ly/sGqlY5.
2 Lascar Electronics, www.lascarelectronics.com.

Simple night-light uses a photoresistor to detect dusk

Chau Tran, Analog Devices, Malden, MA

Streetlights, emergency lights, and security lights must automatically turn on when it gets dark. You base the control circuit on the resistance of a photoresistor or another LDR (light-dependent resistor) that varies with light intensity. An LDR's resistance of several megohms in darkness decreases to a few hundred ohms in bright light (**Figure 1**). This feature allows a circuit to distinguish between one light bulb and two, direct sunlight or total darkness, or anything in between.

You can use an LDR in a circuit that detects darkness and turns on an LED (**Figure 2**). The circuit uses a high-voltage threshold-detector IC that features a current output and operates as a comparator. The LDR and potentiometer R_3 form one side of a Wheatstone bridge. Fixed resistors R_1 and R_2 form the other side. You can operate the circuit from a 5 to 65V battery because the bridge excitation comes from an on-chip 2.4V series regulator that is referenced to the supply voltage. The chip keeps the 2.4V regulation voltage below the supply voltage. Resistors R_1 and R_2 form a fixed reference voltage at the noninverting input of internal comparator A_1. The LDR and R_3 form a variable voltage at the inverting input. When the light level falls, the voltage on the inverting input falls below the reference voltage until the comparator trips, activating the relay and the LED. The total voltage across the resistors is always 2.4V. Choose the values for these resistors based on your desired threshold voltage using the **equation** $V_{TH}=-2.4\times(R_1/(R_1+R_2))=-2.4\times(LDR/(R_3+LDR))$, where V_{TH} is the threshold voltage.

YOU CAN ADJUST THE POTENTIOMETER TO PRESET THE SWITCH TO ANY LIGHT LEVEL, MAKING IT AN IDEAL LIGHT SENSOR.

You can reverse the position of the LDR and potentiometer R_3 to switch on the relay when the light exceeds a preset level. You can adjust the potentiometer to preset the switch to any light level, making it an ideal light sensor. The IC's output current is less than 100 nA when the negative pin's value is greater than that of the positive pin. The output current goes to 1 mA when the positive pin's value is greater than that of the negative pin. This current drives a ground-referenced resistor to develop a logic-level signal at D_{OUT}. The logic signal is buffered with the NPN transistor that then drives relay switch S_1. You should use a latching relay, which uses permanent magnets to hold the armature in place after the drive current is removed.

When you turn on the LED, the resistance of the LDR may decrease dramatically, and the comparator will switch off, cutting back the output current to nanoamps while the latching relay keeps the light on. EDN

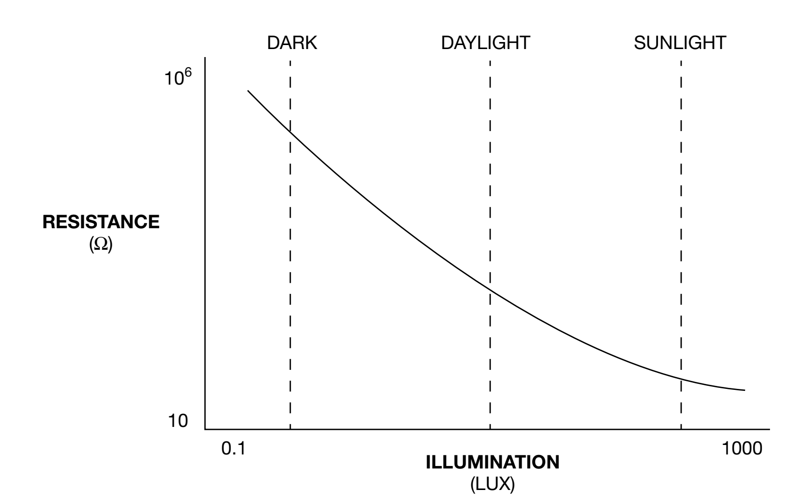


Figure 1 The resistance of a photoresistor falls dramatically as you illuminate it.

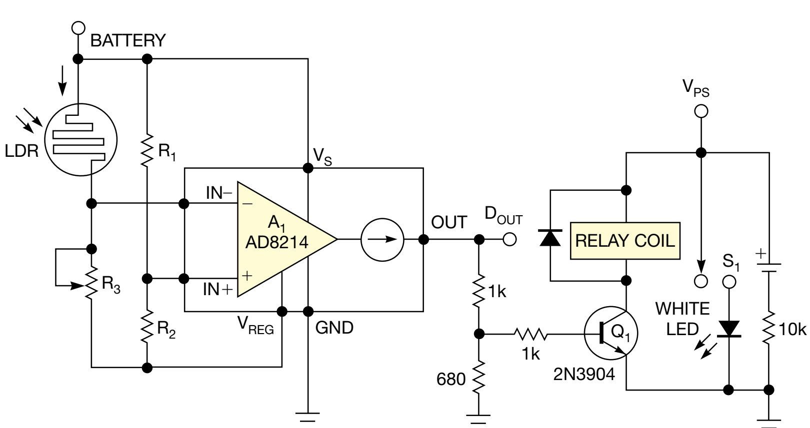


Figure 2 This night-light circuit turns on as the illumination on the photoresistor dims.

Originally published in the December 23, 1999, issue of *EDN*

Simple tester checks Christmas-tree lights

William Dias, Brown & Sharpe, North Kingstown, RI

Why is it that you always test 48 bulbs before you find the bad one in a 50-light string? The simple circuit in **Figure 1** allows you to divide and conquer, greatly reducing the time it takes to find the bad bulb. The circuit uses a pair of NE2 neon bulbs with current-limiting resistors. You can use a pair of Radio Shack 272-1100 bulb-resistor sets. It's convenient to house the tester in a clear piece of plastic tubing, with the probe tip emerging from one end and a light-duty power cord emerging from the other end. You place the bulbs in the tube such that one is close to the probe tip and the other is near the power cord, so it's easy to remember which bulb lit last. The probe tip connects to the common point between the neon bulbs. It consists of thin spring wire with all but the last ¼ in. insulated. You use the bare tip to make contact with the crimp connectors in the base of the bulbs.

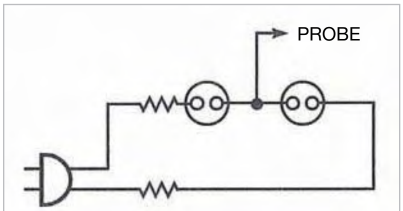


Figure 1 A simple probe set cuts the time you spend troubleshooting a series-string light set.

Series-string Christmas-tree lights come in two types. The first type is the continuous-series string (**Figure 2a**). In this configuration, one wire from the plug goes from bulb to bulb until it reaches the last bulb. A return wire bypasses all the bulbs and returns to the plug. The second type is the alternating-series string (**Figure 2b**). In this connection, one wire from the plug goes to the first bulb, and the other wire from the plug goes to the second bulb. The connections then alternate through the string. To troubleshoot a defective continuous-series string:

- Plug in both the tester and the bulb set.
- Insert the tip of the tester's probe into the wire hole in the base of the first bulb. One of the neon bulbs should light; remember which one.
- Move halfway down the set and insert the probe again. If the same neon bulb lights, then the problem is in the second half of the set. If the other neon bulb lights, then the problem is in the first half of the set. Either way, you are testing 25 of the 50 bulbs without breaking into a sweat.
- If the original neon bulb lights, move halfway down the remaining part of the set and try again. If the other neon bulb lights, you must move back halfway to the last bulb you tested and try again. This process should allow you to find a bad bulb in a set of 50 in only seven steps. You know you have the bad bulb when inserting the probe tip into one side of the bulb lights one neon bulb and placing the tip in the other side lights the other neon bulb.

To troubleshoot a defective set with many bad bulbs, use the same process as above. At some point, you will reach the dead spot between two or more bad bulbs. When you reach this point, neither neon lamp will light. Back up, just as if the other neon bulb had lit. You know you have a bad bulb if the probe lights when you plug it into one side and nothing lights when you plug it into the other side. Replace this bulb and start over.

To troubleshoot an alternating-series string, you must work in pairs. Test the first bulb, and one neon bulb lights. Test the second bulb, and the other neon bulb lights. Now move down the set an even number of lights and test the next pair of lights. When you pass the bad bulb, the same neon lamp lights for both series-string bulbs. EDN

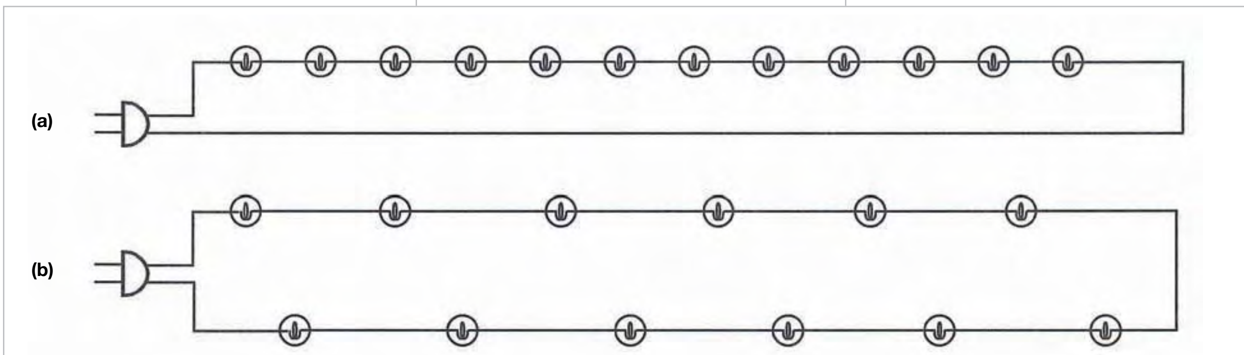


Figure 2 Series-string light sets come in two flavors: a continuous-series string (a) and an alternating-series string (b).

productroundup

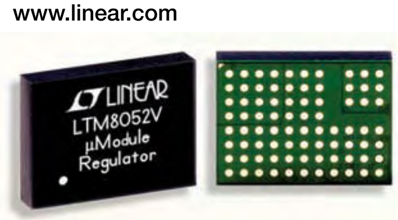
POWER SOURCES

IR's IRS2980 LEDrivIR aims at nonisolated LED-driver applications

The 600V IRS2980 buck-regulator-control IC targets applications in LED-light-bulb replacement, LED-tube lighting, and other nonisolated LED-driver applications. The device uses hysteretic average-current-mode control for precise current regulation. The LED buck driver features low-side MOSFET drive with a high-voltage internal regulator and high-side current sensing. The converter is compatible with electronic PWM dimming, allowing for 0 to 100% current control. The IRS2980 is available in an SO-8 package at prices starting at 60 cents (10,000).
International Rectifier, www.irf.com

Linear LTM8052 µModule has adjustable output-current limit

The 36V-input-voltage, constant-frequency, step-down LTM8052 µModule regulator has an adjustable current limit as high as 5A, helping designers set the maximum power a load receives and minimizing the output rating of the upstream ac/dc- or dc/dc-power supply. The device can source or sink current while regulating an adjustable output voltage. It operates at a constant frequency throughout the entire output-current range. The regulator converts an input voltage of 6 to 36V to an adjustable output voltage of 1.2 to 24V. In a 12V-input to 2.5V-output application, the LTM8052 achieves a peak operating efficiency of 88% at 2A. The device has a ±10% adjustable-current-limit accuracy, can synchronize to an external 100-kHz to 1-MHz clock, and comes in an 11.25×15×2.82-mm LGA package. Prices start at $13.17 (1000).
Linear Technology, www.linear.com



ZMDI announces ZSSC1856 intelligent battery sensor

The ZSSC1856 intelligent battery-sensor IC for fuel-saving start/stop systems measures state of health, state of charge, and state of function of a vehicle's battery. A calibrated on-chip temperature sensor eliminates the need for calibration of external components. The device also features user-controlled wake-up conditions. An ARM core, a 96-kbyte flash/electronically erasable memory with ECC, and an 8-kbyte SRAM are available to execute customer-specific software for calculating the battery states. The ZSSC1856 uses less than 100 µA in sleep mode and operates with 10 to 20 mA in normal mode. The IC can receive voltages of 4.2 to 18V and directly connects to the vehicle's battery. The IC comes in a 5×5-mm, 0.85-mm-high QFN32 package and sells for $5.40 (low volumes).
ZMDI, www.zmdi.com

Infineon unveils ILD series of high-power LED-driver ICs

The ILD series of switch-mode, high-power LED-driver ICs combines an integrated power stage and an external MOSFET to achieve efficiency as high as 98% in MR16 halogen retrofits, residential and commercial lumi-

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naires, architectural lighting, and streetlamps. The ILD2035 finds use in MR16 lamps with 1W LEDs, and a stand-alone LED controller includes the features and protection functions of the ILD4001, which uses an external MOSFET as a power stage. The ILD4001, ILD4035, and ILD2035 come in SC-74 packages, and the ILD4120 comes in a DSO-8 package with an exposed pad. Input voltages range from 4.5 to 42V for the ILD4001 and 4.5 to 40V for the ILD4035 and ILD4120. The ILD4035 sells for 60 cents (10,000).
Infineon Technologies AG,
www.infineon.com

TDK offers splash-proof AL60-100 LED drivers/ supplies

The AL60-100 series of ac/dc power supplies targets use in LED lighting, signs, and displays with output ratings of 60, 80, and 100W. Both constant-voltage and constant-current models are available. The drivers and supplies include PFC and meet IP66 standards for

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splash-proof supplies and operate with universal power inputs of 90 to 305V ac with no derating at low line. The constant-voltage models are available with 12, 24, or 36V outputs; the constant-current units provide 1 to 4A with dc outputs of 6 to 48V. The convection-cooled devices can operate with ambient temperatures of −30 to +70°C and deratings higher than 50°C. Typical output efficiencies are 85 to 90% under full load. The devices come in rugged plastic cases that measure 1.36×1.7×9.49 in. Prices start at $42 (1000).

TDK-Lambda Americas, www.us.tdk-lambda.com

IR's AUIRS2332J targets use in EV, HEV applications

The 600V, three-phase AUIRS2332J MOSFET- and IGBT-gate-driver IC for high-voltage EV (electric-vehicle) and HEV (hybrid-electric-vehicle) applications features three independent high- and low-side-referenced output channels. Proprietary HVIC technology enables ruggedized monolithic construction with logic inputs compatible with CMOS or LSTTL outputs, down to 3.3V logic. The IC comes in a PLCC-44 package, providing higher creepage distances between high-voltage pins and simplifying PCB layout. The device has an offset voltage of 600V, an output voltage of 10 to 20V, an output current of 250 or −500 mA, and on- and off-times of 540 nsec. Matched propagation delays simplify use at high frequencies. Designers can use the floating channel to drive N-channel power MOSFETs or IGBTs in the high-side configuration. Prices begin at $3.34 (10,000).

International Rectifier, www.irf.com

Fairchild's PSW creates flyback-power-supply circuits in minutes

The PSW (Power Supply WebDesigner) online simulation tool allows designers to create a flyback design, including the selection of a controller, a MOSFET, diodes, transformers, snubber circuits, output filters, ac input circuits, resistors, and capacitors. Alternatively, the tool can automatically recommend the design values, providing the vendor's part numbers if applicable. PSW includes steady-state and transient waveforms and loop-gain plots showing stability margins. It also includes a BOM, a distributor parts order, and simulation features that help designers fine-tune their designs without building a bench prototype. The PSW tool is free to registered customers.

Fairchild Semiconductor, www.fairchildsemi.com

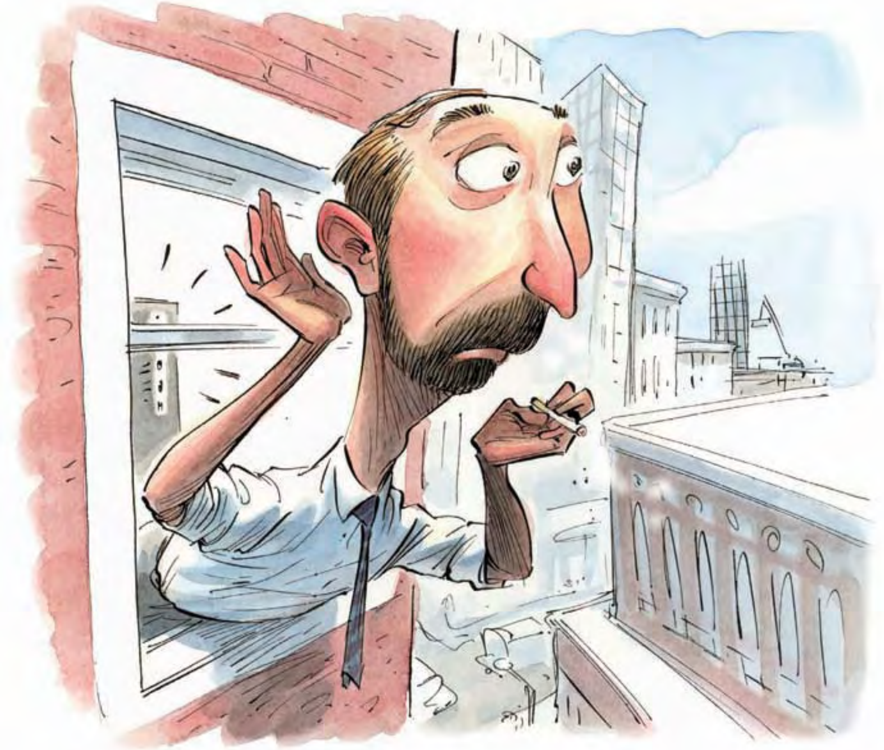
CUI's VSK encapsulated ac/dc modules operate at 5 to 25W

The board-mounted, 5 to 25W VSK encapsulated ac/dc power-supply modules measure 2×1×0.6 in. in the 5W package. Efficiency is 87%, and operating-temperature range is −25 to +70°C. The devices provide continuous output power; a universal input of 85 to 264V ac; and fully regulated dc outputs of 3.3, 5, 9, 12, 15, 24, and 48V dc. The

5 and 10W versions have 4-kV-ac isolation, and the 15, 20, and 25W versions have 3-kV-ac isolation. Prices start at $13.56 (100).

CUI Inc, www.cui.com

It's a bird! It's a crane!



DANIEL VASCONCELLOS

At our corporate offices, we started getting alarms on our microwave terminal, which supplied the communications link for the telephones and data. The chief executive officer was upset over losing his calls at various times, so I was assigned to find the cause of this problem and fix it PDQ! The alarms would start at approximately 9 a.m. and would occur intermittently all day long for a few seconds and then stop at about 4 p.m. I went to the corporate offices, checked the radio equipment, and found no problems. I even looked for a fault in the alarms circuitry. I found the radio equipment to be functioning properly. All levels, power, and voltages were within specifications. I arrived the next day at 7 a.m. and started to monitor this equipment, hoping to find the problem. Sure enough, at 8:53, the alarm lights on the equipment lit up like a Christmas tree. Before I could even begin to check anything, the alarms went out.

I remained at my post, and, in about 20 minutes, the alarms went off and again lasted for only a few seconds. It now became obvious that we were experiencing a path loss. What was blocking the signal path in both directions for just a few seconds? Could it be a flock of birds? Airplanes flying by?

I tried to detect a pattern of this loss by timing the periods between the losses. Whenever I thought I had found a cadence to the failures, however, they would change. The only pattern I did find was that the failures ceased between 12 noon and 12:45 p.m. That discovery was telling me something, but what? Was it telling me that it was lunchtime? If so, I wondered how lunchtime figures into a path loss. I ran through all the options I could think of that could be causing this trouble: a helicopter flight above the path, laser sighting between the dishes, vehicles driving around the path area, and so on.

Pondering these things, I opened a window to have a smoke. While looking at the view from this 10th-floor perch, I noticed a glimmer reflecting from something just as the alarms went off. Was there a connection between the glimmer and the alarms?

I remained at the window, checking the horizon and again saw the glimmer, and the alarms again went off. I tried to identify a landmark where I saw the glimmer and proceeded down to my vehicle and drove to the area of the landmark. As I approached the landmark, I saw a construction site with a huge crane, lifting steel up to a multistory building under construction. I remained at this location, and, as the crane lifted a steel girder, I called the office and had them monitor the alarms while I watched the crane. Sure enough, the office verified a failure. I stayed where I was, and the failures again coincided with the crane lifts. I realized that, when construction was complete, we would have no path at all. This new building—ironically, a communications company—would permanently block our path.

Our only choice was to find another path through the city to the microwave hub—an impossible task. So we came up with a temporary solution: using a passive dish system on top of another building, placing the dishes back to back, turning one dish toward the microwave hub, and turning the other one toward our building. We mounted two new dishes on the roof of an adjacent building, aiming one at the distant hub's location and tying it, through a waveguide, to a dish pointing at our building's dish. Getting enough signal to pass between these two dishes without any amplification was a major challenge. The alignment of the dishes on the buildings proved difficult at these low signal levels. EDN

Earl Schlenk is a retired engineer for Burlington Northern Railroad. He resides in St Louis, MO.

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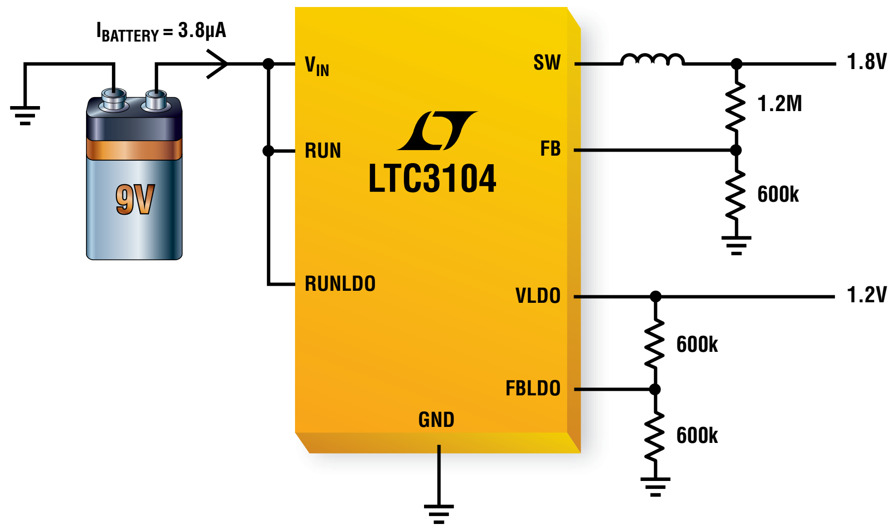
Change Batteries in 2018



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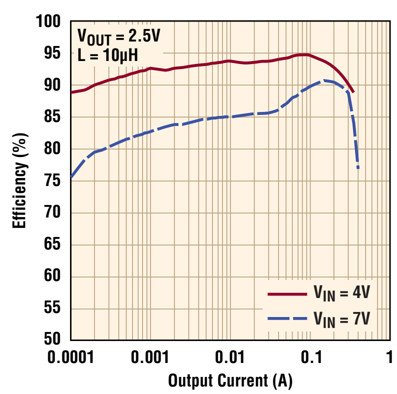

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