Crossties

JAMES RIVER DIVISION, NATIONAL MODEL RAILROAD ASSOCIATION FEBRUARY 2019

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VIEW FROM THE WORKBENCH:
CAP that Decoder

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ALL PHOTOS BY MIKE GARBER

There are few things more frustrating while operating our trains than when the engine stalls or the headlights flicker as you pull a cut of cars out of a siding, as above, and cross a dead frog or dirty piece of track. The engine stalls, the lights flicker and, if sound equipped, the sound spits or sputters. It reminds me of the old days when my trains would stall on the four-by-eight DC layout and I'd bump the train board to get the train running again. Remember those days? Bet you do!

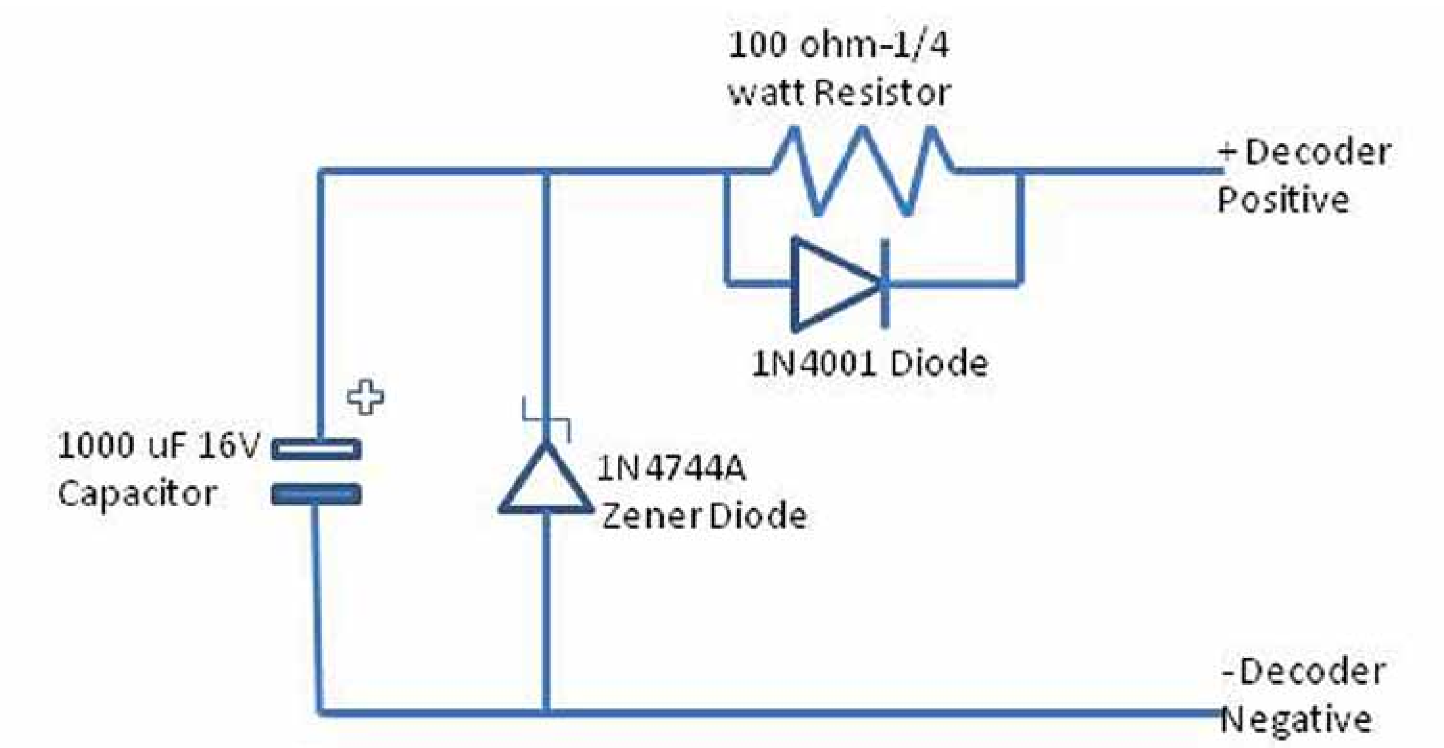
Fast forward to today's world of DCC-controlled layouts and the wonderful experiences to be enjoyed operating our layouts in a prototypical manner with lights, bells, horns, coupler sounds, and more. However, there still exists the possibility of our trains stalling and sputtering just like in those formative years. In some ways, DCC seems more susceptible to these spits and starts than in the DC days. Perhaps it is because our sound decoder equipped engines are so robust and realistic, and can be remotely controlled with a handheld throttle. Also, so much is expected to work and work well. My, how spoiled we have become!

Some of the decoder manufacturers listened to our complaints of these spits and sputters and developed what is referred to as a "keep alive" component or module. These modules can be added to the decoder in our engines and they can greatly reduce or eliminate the stalling and spitting when traveling over dead frogs, dirty track, or across incorrectly thrown turnouts. In some cases a keep alive module can continue to run an engine for several feet after it loses its track power. This is good news, bad news, however. Imagine your train derails and keeps right on chugging along the roadbed and right off the layout as you frantically keep trying to stop the engine with your throttle! Yes, it can and has happened! Equipped with a keep alive module, the engine will continue to run at whatever speed signal it last received. Not being in contact with the rails, it cannot receive speed signals to stop! Too much of a good thing perhaps? There is also the precious space these modules consume (often they are the size of a decoder) inside our already crowded engines, not to mention the cost of purchase, which can be $30 or so. What to do, what to do …

A number of modelers have these same concerns and derived an alternative (other than completely bullet-proof track!) to improve the performance of our engines and reduce the spits and sputters caused by occasional dirty spots on troublesome turnouts. The commercially available keep alive modules are actually DC storage devices (think battery) that hold a small amount of stored energy (electricity). When our engine loses rail contact, the decoder automatically begins to draw on the stored energy inside the keep alive module, which keeps the engine running along until the stored energy is used up or rail contact returns. Again, when the engine is running on this stored energy without contact to the rails, the decoder cannot receive or respond to any signals sent from the throttle, so no control, but the engine keeps running … hopefully on the rails!

So, what stores energy in the commercial keep alive modules? Capacitors! Radial capacitors are charged up on startup and store the energy until needed. The commercial keep alive modules are made up of several capacitors wired in series along with other components, all wrapped into a package ready to be connected to the decoder. Good stuff, but again, these take up a fair amount of space and are a bit costly. This brings us to what alternatives are available.

Glad you asked. Some modelers have resorted to designing and making homemade keep alive devices that have loosely become known as "Poor-Man Keep-Alives"! The poor-man KA device can be made from a single capacitor and associated components for less than $2 and a little time. These are quite small and more easily fit inside of a crowded engine shell. Admittedly, these homemade devices are not as robust as the commercially available products, but they are very effective in eliminating over 90% of the spits and sputters occurring on our layouts.



Shown here is a basic schematic for a simple keep alive circuit or device. Using this schematic and readily available electronic parts, I will show you how to construct a simple poor man keep alive in the following steps. It isn't difficult or tedious, but the schematic must be followed precisely with close attention to the polarity orientation of each component to insure a properly functioning keep alive device. Now, let's get started.

Step 1: Begin Construction

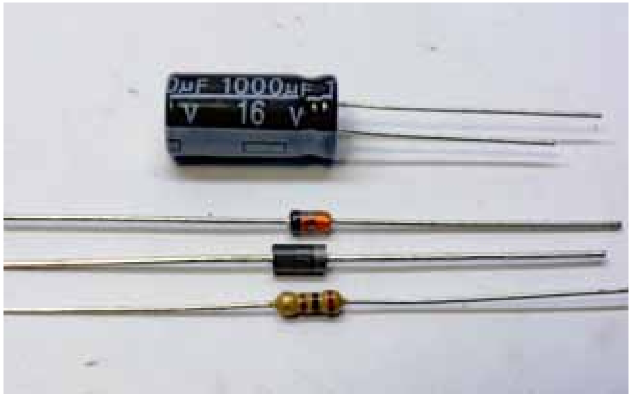


Figure 1

Figure 2

The basic components to make the device are shown in Figure 1. These consist of (top to bottom):

1000 uF 16V Capacitor
1N4744A Zener Diode (15V)
1N4001 Diode
100-ohm 1/4-watt Resistor

Additional items needed are solder, soldering iron, wire, shrink tube (various sizes), patience, and attention to detail.

I began by folding the two leads from the capacitor at 90-degree angles, as shown in Figure 2. Note the white stripe with the "-" on the side of the capacitor. This denotes the negative side of the capacitor; it is very important to keep positive and negative orientation throughout the construction. Follow the wiring schematic closely!

Figure 3

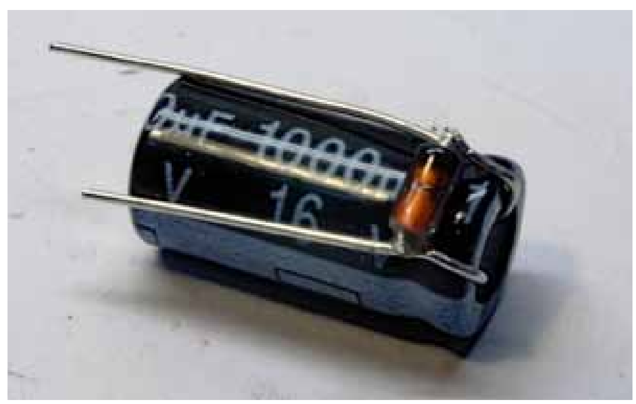


Figure 4

Next, I soldered the 100-ohm Resistor and the 1N4001 Diode in parallel, as shown in Figure 3. I made this as compact as possible to save space in the final product. The leads from the resistor are wrapped tightly around the leads from the diode, soldered, and excess lead cut off short as shown.

As seen in Figure 4, I bent the two leads from the capacitor back over the sides of the capacitor and soldered the Zener Diode in parallel across the two capacitor leads. It is very important to make sure the lead near the "band" on the Zener Diode is soldered to the ***positive*** lead of the capacitor for the diode to work properly.

Step 2: Putting it all together

Figure 5

Figure 6

With the Zener Diode soldered in place, I clipped short the negative lead. A black wire will be soldered to this lead denoting the negative side of the KA. I also clipped short the positive lead on the capacitor. One lead of the resistor/diode components previously soldered together (as shown in Figure 3) is clipped short. I soldered these components to the positive lead from the capacitor. In Figure 5, note that the band on the 1N4001 Diode (indicating the positive end of the1N4001 Diode) faces AWAY from the 1000uF Capacitor lead. This keeps the positive and negative relationship of these components in the proper working orientation.

As shown in Figure 6, I soldered a red wire to the positive lead and a black wire to the negative lead. No mystery to the wire coloring; I just think of red as being hot and black as being cold. Goofy for sure, but works for me.

Step 3: Final and Installation

Figure 7

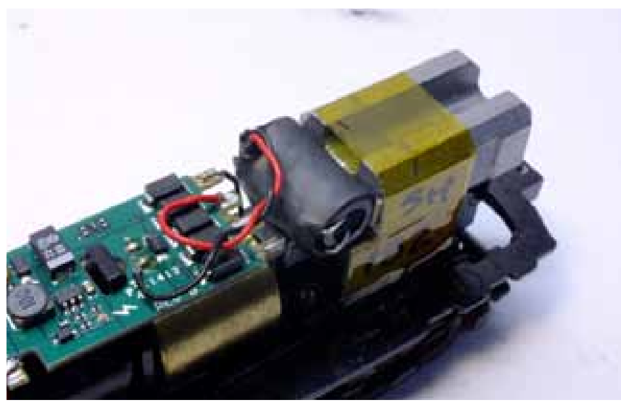


Figure 8

With the basic construction of the KA together, I twisted the red and black wires together for neatness and covered the entire KA with black shrink tube, as shown in Figure 7. Adding the shrink tube isn't completely necessary; I've just used Kapton tape on some devices. However, adding the shrink tube sure makes the KA look finished and semi-pro at least … ha.

This particular poor-man's KA was built to go into an HO-scale Atlas Classic RS3. With its narrow hood, it was very difficult to find a location even for this small device. In Figure 8, see how the weight has been milled to make room for the KA. The black wire was connected to the "-" pad on the decoder where the original Tsunami decoder had a small capacitor installed. The red wire was connected to the common positive lighting pad on the decoder.

A small KA like this can provide about 1/2 second of power, which isn't spectacular but you'd be amazed at how that fraction of a second cures most spits and sputters, allowing an engine to glide over small dirty spots and cranky turnouts. Also, these little KAs will not get you in any trouble with runaway engines and such. With such a small amount of stored energy available, the loco will stop with a derailment or if running through a misaligned turnout. No fear of impending disasters.

Figure 9 shows the completed installation in the RS3 chassis.

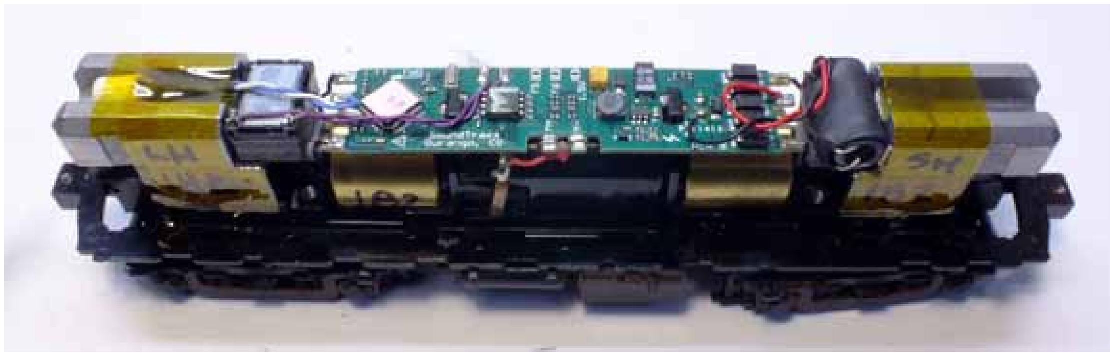


Figure 9

For the curiously minded, a little theory. The 1000uF Capacitor does all the work of storing the necessary energy, but the smaller components do a job as well. The Zener Diode wired in parallel to the 1000uF 16V Capacitor is a voltage limiter. Rated at about 15V, it protects the 16V 1000uF Capacitor from damage in the event of a power spike on the rails exceeding the typical 13 or so volts on the rails. The 1N4001 Diode and 100-ohm Resistor wired in parallel and placed on the positive lead of the 1000uF Capacitor is optional, but its purpose is to protect the DCC system from possibly shutting down due to excessive "in-rush" current issues when the layout is first powered up or when placing an engine back on the tracks following a derailment. This is usually only a problem with larger capacitors, which is why the commercial units have these parts in their devices.

It is very important to determine how and where to attach a keep alive device to a decoder. Many SoundTraxx and TCS sound decoders provide a small female plug for attaching a keep alive. Other decoders do not, but the 12V positive and negative points can be determined on all decoders with a little trial and error using a volt meter. An excellent reference can be found at this web site: http://www.members.optusnet.com.au/mainnorth/alive.htm

Final thoughts. It is very important to keep the polarity of all components correct. The first one of these that I built, even checking and rechecking myself, I got the polarity mixed up. Five seconds after putting the engine on powered track, BANG – the 1000uF Capacitor exploded! It didn't break anything other than the capacitor, but it left a mess inside the engine shell that I had to clean up. SO, BE CAREFUL. Give this little keep alive circuit a try and see for yourself how much it can help. Plus, you can say, *"I did it myself!"*

Additional photographs on next page:

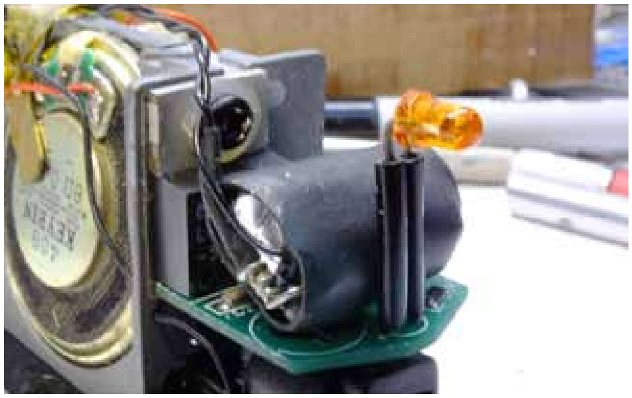


Figure 10: KA made with 2000uF Capacitor in P2K GP9.

Figures 11 and 12: KA made with two 1000uF Capacitors in series for Stewart F7A, located in rear of chassis.

UPDATE:

After this article was posted, I received an email from Bruce Wolff, a member of Division 6 of the North Central Region regarding the circuit design. Here's what Bruce had to say, followed by article author Mike Garber's reply.

Jim Zinser, MMR
Division Business Car Columnist

Bruce Wolff:

Mike Garber's "CAP that Decoder" / "Keep Alives on a Budget" from the James River Division, MER's "Crossties" caught my interest. He's got a great way of sourcing effective but inexpensive components, and assembling them in a way that will work very well while remaining very compact.

There's just one problem: Most of his article talks about assembling a system with a single capacitor, which he says can provide about 1/2 second of power in a typical HO locomotive. But then at the very end, Figures 11 and 12 show a larger KA made with two capacitors in series, in a Stewart F7A. The photo looks very much like it matches the text: He's connected the capacitors in series. If just one capacitor would power the locomotive for 1/2 second, these two capacitors together should power it for... 1/4 second!

Capacitors are the opposite of resistors when you connect two or more in a circuit. When two capacitors are in series, the total capacitance is half that of each individual capacitor. That's because the applied voltage is divided between the two capacitors, so each one stores only half the charge.

On the other hand, if he'd connected the capacitors in parallel, each would be exposed to the full voltage, and each would store the full charge, making twice as much stored charge available, and powering the locomotive for up to one second.

Mike Garber:

As Mr. Wolff noted, my goal in the article was to share an inexpensive and compact stay alive project most anyone can build and fit into their HO scale locomotive. It has worked very well for my purposes. I admit, however, that I am not an electronics guru and Mr. Wolff is correct about wiring capacitors in series. I typically use single capacitors, but as he pointed out, if you indeed want to extend the length of time for the stay alive effect by using two capacitors, they should be wired in parallel. Ah, the fun of continuous learning! Thanks for pointing this out.