Build a Simple Handheld Throttle For the Digitrax Zephyr

by
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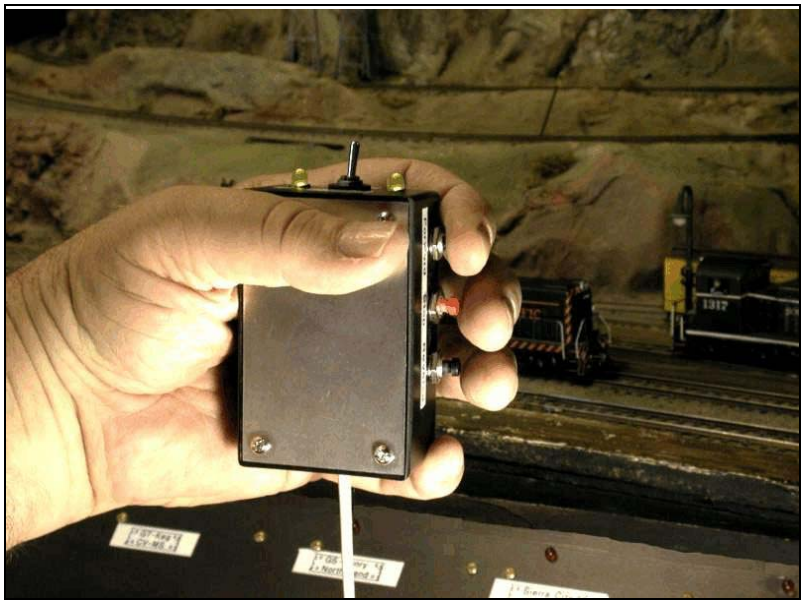
Here is a way to build a simple three button throttle for use with the Digitrax popular Zephyr. This handheld throttle is designed work with the innovative "JUMP" port on the Zephyr. (This throttle will only work with the Zephyr JUMP Port.)

What got me started on this project was a someone that asked why can't we have a simple two button throttle for DCC. One button for GO and one for STOP. Building a DCC throttle to interface any of the normal cab buses would be beyond the scope of a simple home project. On the other hand the Digitrax Zephyr has a novel feature of two input ports called *JUMP ports*. These JUMP ports are designed as a bridge between the old d.c. and new DCC systems. The JUMP port can use a standard d.c. power pack as an input. The Zephyr converts the power pack (analog) inputs to DCC (digital) command packets. The Zephyr can also control one non-decoder equipped locomotive on the layout.



The biggest advantage of DCC is the ability to have walk-around control. But the Zephyr is a low cost all-in-one stationary system. You can add one of the Digitrax throttles to the Loconet on the Zephyr, but this can cost almost as much as the Zephyr itself. A low cost solution would be a simple handheld throttle that uses the JUMP port. The JUMP port is an analog input and requires all most no current and just a voltage for speed and directions. The Zephyr converts the voltage to DCC command packets. Any locomotive address can be assigned to the JUMP port. Even a locomotive without a decoder can be assigned to one of the JUMP ports using address 00.

Back in the analog days I designed the SWAC/2 walk-around throttle that had a couple of simple two and three button handheld throttles. These were very popular because they were easy to get use to and operate. The advantage of a two or three button handheld control is all of the speed and direction can be controlled with one hand without looking at the throttle. This leaves the other hand free to do uncoupling and operate turnouts. Very useful when doing switching, or if you need a spare hand to hold a cup of coffee or adult beverage.

Throttle Design

The JUMP port has an input resistance of about 1k ohm. To use push buttons some way is needed to retain speed and direction when none of the buttons are pushed. A capacitor can hold the speed and direction, but the input resistance of the Zephyr would drain the capacitor and the locomotive will slow to a stop in a few seconds. An Op-Amp used as a buffer can hold the capacitor voltage and still feed a steady voltage to the JUMP input. To retain the speed and direction two 100uF capacitors connected back to back together to form a single 100uF non-polarized capacitor. This allows the output of the throttle to go plus and minus for direction and different voltages for speed control. A resistance is used to control the rate of charge. A couple of diodes and capacitors make up the plus and minus power supply to feed the Op-Amp. Three buttons and a switch are used for control. The top button is for forward and the bottom button for reverse. The middle button is for a quick stop. All three switches can be operated with the three fingers of one hand. With the switches laid out the as shown in the picture it can be operated with either the left or right hand. A toggle switch on the top allows two acceleration/deceleration rates. A quick rate for switching and a slow rate for mainline. Either of these two rates are added to the rates set by the decoder in CV 3 and 4. I found there is also a very short delay while the Zephyr converts the JUMP input into a DCC digital packet. I did some testing with both HO and N scale locomotive and found that 22K resistors set a good rate of change. These values can be changed if you would like different rates. Higher values make reactions slower.

The circuits can be installed on the small circuit board that comes with the Radio Shack enclosure. When you start to drill the enclosure for the switches, be sure the switches will not hit each other or the circuit board on the inside when installed. The push button switches should be spaced so all three fingers can be positioned over the switches. The LEDs and toggle switch are on top of the enclosure. The LEDs are held in place after they were wired with ACC. The 741

Op-amp diagram shows **a top view**, remember this when you wire it from the bottom!

A separate transformer is required to power the throttle. A small plug-in-the-wall type power adapter will supply plenty of power. The throttle requires an **a.c.** transformer. (Many of these small transformers put out d.c.) The first one I used was salvaged from an old scraped battery powered vacuum cleaner. I have collected a bunch of these over the years from other dispose of devices. Most of these transformers have the ratings molded into their cases or printed on them. I started with a 12 volt transformer and then switch to a 9 volt one. Any **a.c.** voltage from 8 to 12 volts will work. The best was the 9 volt transformer. Due to the nature of a.c. the throttle will put out a top voltage of about 12 volts even with a 9 volts transformer. The transformer should not exceed 12 volts a.c. If you build two of these, each throttle should have a separate transformer.

Transformer and Handheld unit

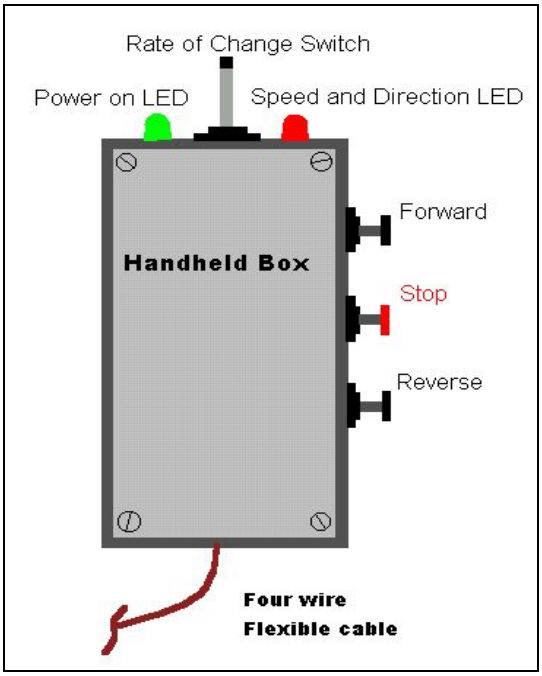
The power and signal cable between the Zephyr and the throttle can be 4 conductor stranded telephone wire(don't use solid wire) and long enough to reach around a small layout or switching area like a yard. You could also use telephone type plugs to be able to move the throttle. When this throttle is unplugged the locomotive will come to a stop.

The throttle can be tested without connecting it to the Zephyr. Plug the transformer in and the power on LED should come on. Pressing the top push button should slowly turn on the Speed and Direction LED to green. When the bottom push button is press the LED should turn off then come up in red. If the colors are backwards, reverse the connections to the LED. The middle button should turn the bicolor LED off from either direction.

Some 741s have a slight leakage current that can cause the output voltage to slowly change after setting unused for a few minutes. A cure for this is to either try another 741 or to replace the 741 with a JFET input op-amp like the TL081 which is a direct replacement. You can test this leakage by tapping the stop button leaving the throttle on for 15 minutes or more. Then check to see if the speed/direction LED comes **on**. If is does ***not*** come on your probably OK.

Throttle Operation

Assigning a locomotive to either JUMP port is done with the Zephyr. Once assigned, the locomotive is under control of the throttle (power pack) connected to the JUMP port. Since the throttle does not have any function keys, functions can be operated with the Zephyr key pad. If the locomotive direction is opposite of the switches and LED color, reverse the two leads to the Zephyr JUMP port.



There are a number of program option switches listed in the back of the Zephyr manual. Switch 01 will set the Zephyr for 1 or 2 JUMP Ports. Best to set the system for 1 JUMP port if you are not going to use both ports. See the Zephyr manual for instructions.

Push the FORWARD button and locomotive should start forward. Small speed adjustments can be made with a tap of either the FORWARD for faster or REVERSE to slow down.

When switching directions there is a dead zone that takes a short time to go though. If you tap the STOP switch when the locomotive just stops or is almost stopped it will speedup the transition of directions. Pushing both the FORWARD and REVERSE buttons will stop a locomotive at a rate slower than the STOP button.

After I had used it for a while I found that the sharp edges of the plastic box next to the aluminum bottom plate were more comfortable when rounded with a file.

I use the Zephyr as an alternate system on my home layout and for my portable layouts. The two portable layouts, N and HO, are used for DCC demos and clinics. The portable layouts use hand throw turnouts and the one hand throttle operation makes running a lot easier and quicker to operate. This also makes using a hand operated uncoupler easier.

My experience with two and three button handheld controls in the past shows that they are quick to get use to.

To test the ergonomic's of the throttle I had a number of people operate the throttle. In a few minutes with very little instruction they are up and running.

The ability to concentrate on the train and not the controls does a lot in speeding up operation. I hope that the ease of use of this type throttle will encourage other DCC systems to make similar cab and throttle products.

All parts can be obtained from Radio Shack. The only exception is the substitute TL081 that can be used in place of the 741 Op-amp. The LT081 is a common JFET input Op-amp.

THROTTLE PARTS LIST

Note "RS" is Radio Shack Part Number

Diodes	1N4001 (4) RS # 276-1101 Pkg of 2
IC Op-amp	741 8 pin dip RS # 276-007 or TL081(not an RS part) See text
Socket for Op-amp	8 Pin RS # 276-1995 Pkg or 2
Transformer	Adjustable unit (See Text)
Plug-in-the-wall	9,10.2,12,13 volt AC RS # 273-1631
Capacitors	100uF 25 volt (4) RS # 272-1016 (35volt) 0.1uF 50 volt (2) RS # 272-135
Resistors	1K 1/4 watt (3) RS # 271-1321 Pkg of 5 22K (2) (See Text)
Switches	
Push Button	RS #275-1547 Pkg of 4
Toggle	RS # 275-645
Project Enclosure with PC Board	RS #270-283A
LEDs	Green (1) RS # 276-022 Red/Green (1) RS # 276-012

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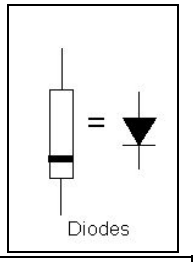

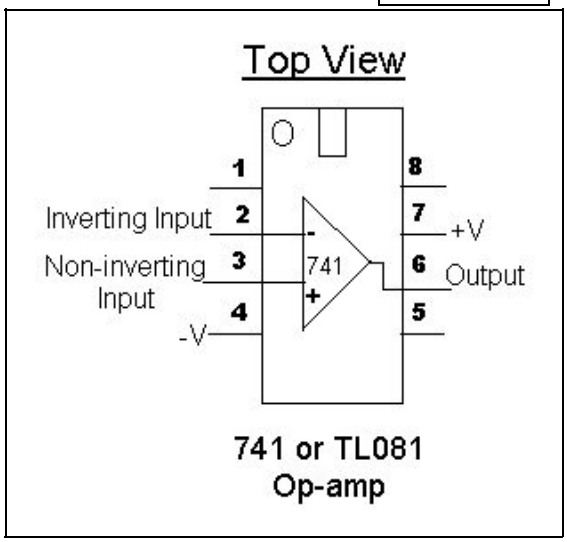

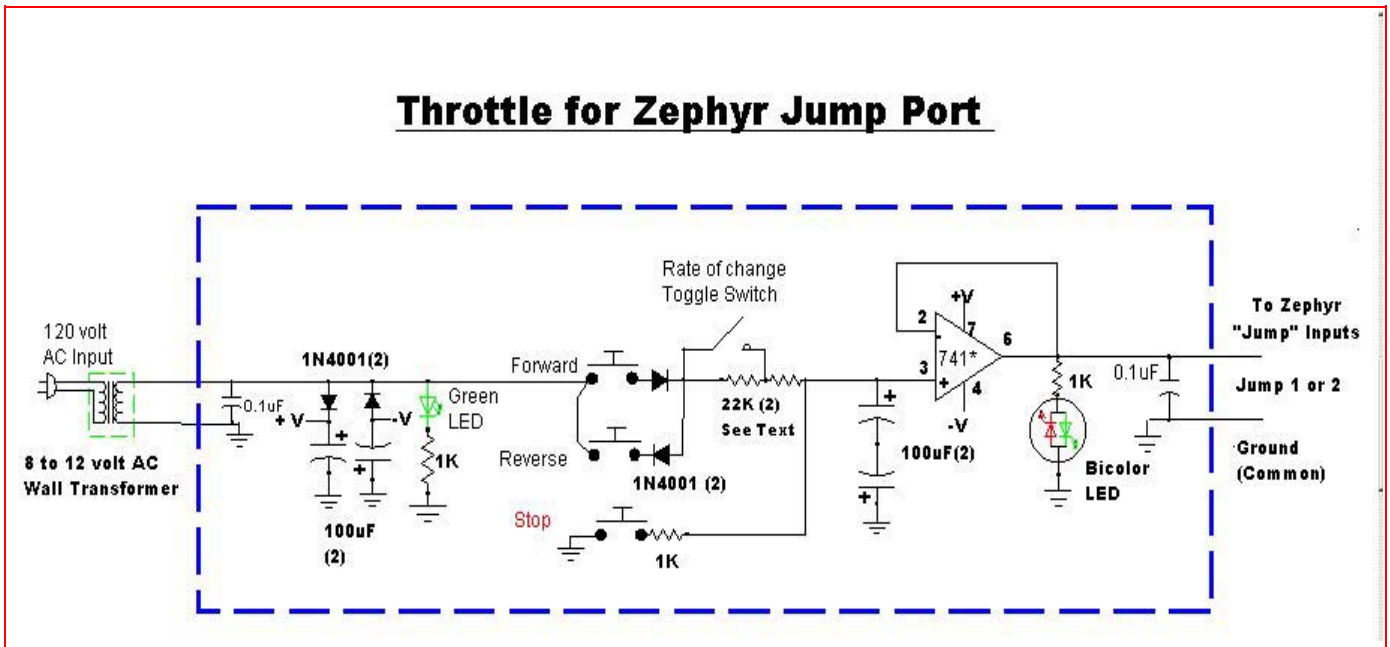

Diagram of the Handheld JUMP throttle for the Zephyr DCC All-In-One. Blue box is the enclosure