Cruise Control Wiring

By Matt Sandt, Revised 3-28-16

The approach described in this writing applies to solar car motor controls which use a potentiometer connected to a “gas pedal”. The potentiometer is frequently housed in a metal box called the pot box. By putting another potentiometer on a control panel to be adjusted manually by the driver one can eliminate the foot bouncing and frequent adjustments that a driver’s foot makes on the gas pedal. Eliminating this bouncing will significantly increase your efficiency.

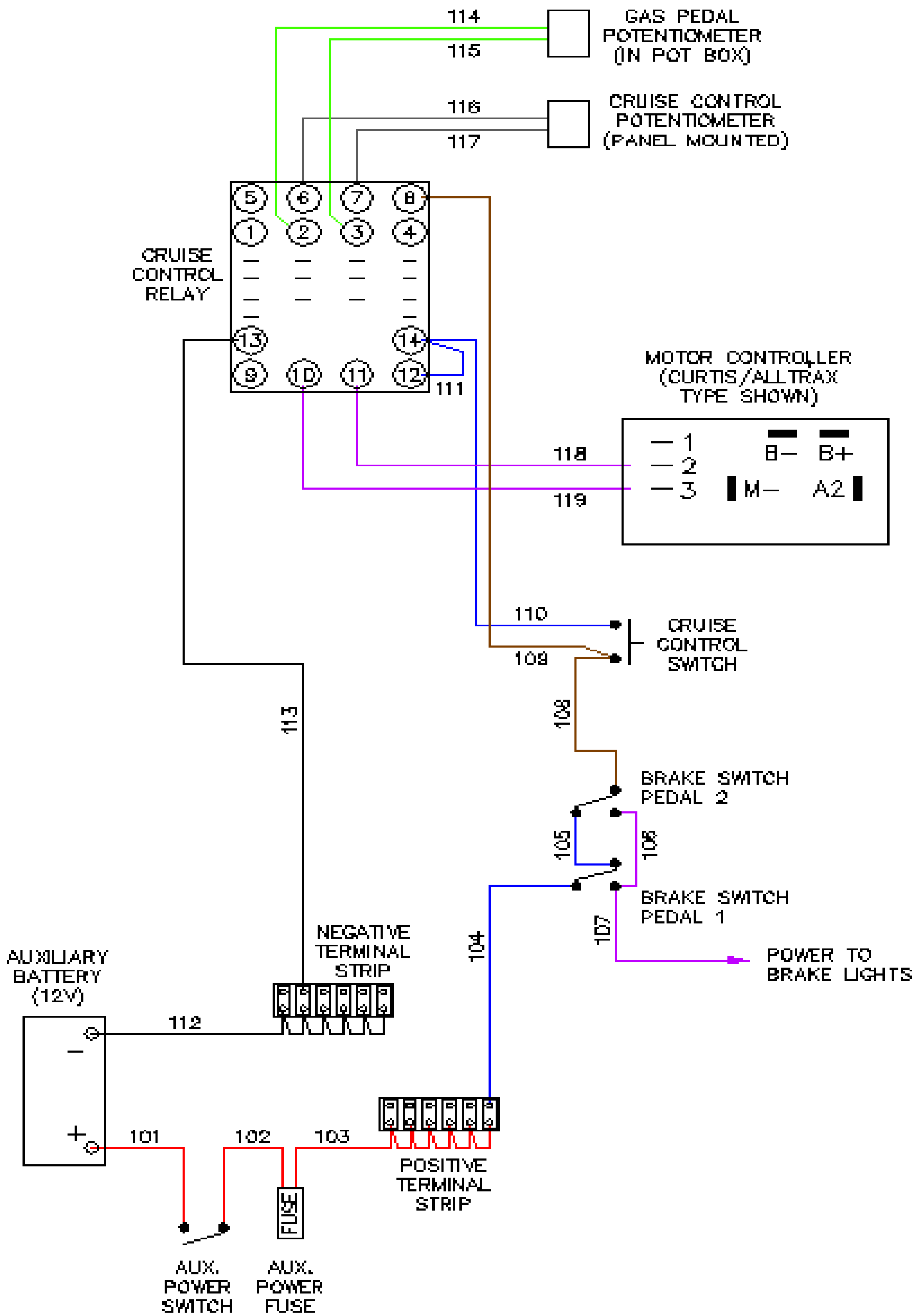
The trick is to be able to make it work so that the throttle control normally operates from the foot pedal, but that the driver can swap the control to the potentiometer on a control panel. This requires more than just a switch because the cruise control must disengage if the brakes are used and should not automatically re-engage which would be dangerous.

Our design uses an electromagnetic relay as shown in the electrical diagram. The relay is a 4 pole relay with a 12 volt coil (NTE Electronics R12-17D3-12). Please note that I am not an electrical engineer so forgive the crude symbology for components. The diagram generally flows from the bottom of the page upward. At the bottom there is an auxiliary battery (what we call the “Ox Bat”), auxiliary power switch and fuse that feed positive and negative terminal strips from which all other auxiliary components are fed.

There is a positive wire (#104) to the Brake Switch on Pedal 1 and then (#105) to the Brake Switch on Pedal 2. I like having two brake pedals, one for each truly independent braking system. For us that means having two brake pedals. If you look at the wiring of the two switches you will see that if either switch is operated it will put power to the brake lights (wire #107). If neither brake switch is actuated then power continues through wire #108 to the Cruise Control Switch.

The Cruise Control Switch is a “momentary” contact push button switch, normally open. This means it’s a spring loaded push button switch that only makes contact as long as the driver is pushing it. As soon as the driver lets go, the switch contacts open and no more power flows through it. Notice that the wire which provides power to this switch also continues through wire #109 to the Cruise Control Relay (relay). If the Cruise Control Switch is depressed then power also flows to the relay through wire #110. The relay is grounded by wire #113. For an understanding of how the relay works see the paragraph labeled “How The Relay Works” below.

Under normal driving conditions (no braking) power always exists through wire #109 to terminal 4. Pay attention. When the driver briefly pushes the Cruise Control Switch power flows through wire #110 to the relay terminal 14 which engages the electromagnetic relay. When this happens wire #109’s power goes from terminal 8 through the relay to terminal 12 which has a short jumper wire (#111) to terminal 14 which just happens be where wire #110 is connected. When the driver stops pushing the Cruise Control Switch the relay <u>STAYS ENGAGED</u> because now power is flowing from wire #109 back through the relay to provide power to the coil terminal 14. When either brake pedal is touched <u>ALL POWER IS CUT TO THE RELAY</u> which disengages the relay. Pretty cool huh?

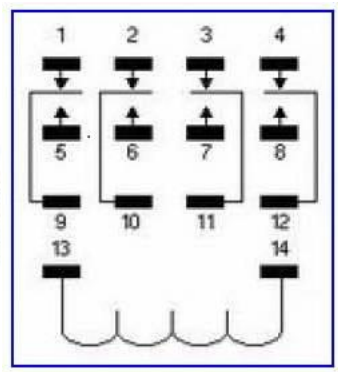


CRUISE CONTROL

So far we've only talked about engaging and disengaging the relay. Before explaining how the two potentiometers are selected it might help to understand how the relay works.

How The Relay Works

The relay has a magnetic coil that is wired between terminals 13 and 14. Power applied to terminal 14 goes through the coil and is grounded through terminal 13, completing a circuit. An electromagnetic plunger in the coil pulls on the 4 contact plates disengaging them from their "normally closed" contacts and connecting them to their "normally open" contacts.



If you look at the relay picture on the left you can see that there are 4 vertical copper plates on the left side. At the bottom of each plate is a pair of small, round contacts, one on each side. This is a 4 pole relay which means it has 4 sets of contacts, just as if it were 4 separate switches placed side-by-side and operated as one switch. The diagram on the right is showing how the relay works. Ignore terminals 13 and 14 as their only function is to energize the coil. Above 13 and 14 are four vertical columns of terminals (1,5,9….2,6,10….3,7,11….4,8,12). These are the four "poles" of the switch.

The horizontal row of terminals 9,10,11,12 are called the "common" terminals. The horizontal row above them 5,6,7,8 are called the "normally open" terminals. The horizontal row at the top 1,2,3,4 are called the "normally closed" terminals. If you look at terminal 9 on the diagram it has a grey line that goes up between terminals 1 and 5, but is closer to 1 (actually touching it). If you look at the relay photo on the left you can see that from terminal 9 there is a white wire arcing up to the top of the vertical copper plate which then extends down between terminals 1 and 5 (Just like the diagram!!!). You can even see that the copper plate is touching the little round contact for terminal 1 and is not touching the contact for terminal 5. It will when power is applied to the coil.

Above is a picture of a 14 pin relay socket (NTE Electronics R95-106A or R95-117). Note that the locations of the terminals look the same as on the relay but they are not. The rows of relay pins 5,6,7,8 and 9,10,11,12 are the inner rows of pins. When plugged into the socket those same groups of pins become the outer rows. It's a bit confusing but trust that the pin numbers share the same connections as the socket terminal numbers. If still confused, just do the wiring per the wiring diagram and it will work just fine.

How the Relay Swaps Potentiometers

The wires from the pot box at the gas pedal, wires #114 and #115 land on terminals 2 and 3, the "normally closed" terminals. When the relay is energized it will disconnect terminals 2 and 3 and instead connect terminals 6 and 7, the ones connected to the potentiometer in the control panel. The normally closed or normally open terminals are connected through the relay to the common terminals 10 and 11 which go to the Motor Controller spade terminals #2 and #3.

And that's about all there is to it. We have never had a relay fail, but I recommend keeping at least one spare. In the event you need to replace the relay you just pull the one out of the socket base and push the new one in.

I'm sure there are more sophisticated ways of achieving cruise control, but this method is what our team came up with and it works so I'm sharing it. This method of cruise control acts like a foot that stays perfectly still in one position on the gas pedal (until you make adjustments on the panel mounted potentiometer). If your car were to come to a hill while on this type of cruise control the amps would change and the driver may want to make adjustments. But it should be noted that the Solar Car Challenge does not allow the use of cruise control on open road events so it doesn't matter.

A Note About Brake Switches

Getting brakes switches to work reliably can be a problem. If the idea is to have the brake pedal or linkage push a switch as it's being depressed the frequent problem is figuring out just how far it will be depressed. Air in the brake line or wear on brake pads can change the "down" position of the pedal. Where do you mount the brake switch?

One solution is to put the brake switch on the driver side of the pedal's arm or linkage so that it depresses the switch when the pedal is in the "up" position but releases the switch when the pedal begins to be depressed. The advantage is that we know exactly where the "up" position of the pedal will be and it is repeatable.

You can use a variety of types of switches. We used to use push buttons. Now we favor the microswitch pictured on the left. It has that long lever which can flex without hurting the switch. And if you don't get the mounting quite right you can bend that lever to make contact where you want it. Regardless what general type of switch is to be used it must be a "double throw", meaning it has three terminals (common, normally closed, normally open). In our wiring diagram the power supply wires #104 & 105 would be connected to the "common" terminals on the switches (normally labelled "COM").