

TUNNEL STRETCHER and STATION SIGNAL

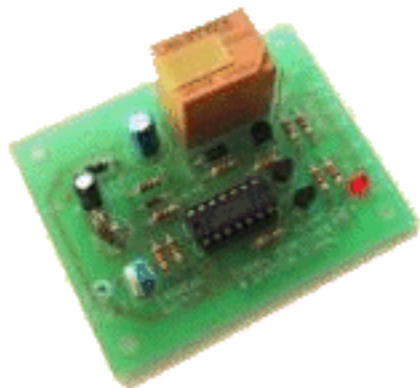
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TUNNEL STRETCHER & STATION SIGNAL

Do you find your tunnels a bit short? Does the train pop out of the far end moments after the last coach disappears from view? This module will automatically add some time to the train's trip through the tunnel. It can also be used to control signals at stations, making a train wait for a predetermined time before letting it continue.

One common problem with model railways is the length of tunnels. Some people will include tunnels just for the sake of it, their tunnels being shorter than their trains! No amount of electronics will make such a train set look any better. Bulldozing is the only solution.

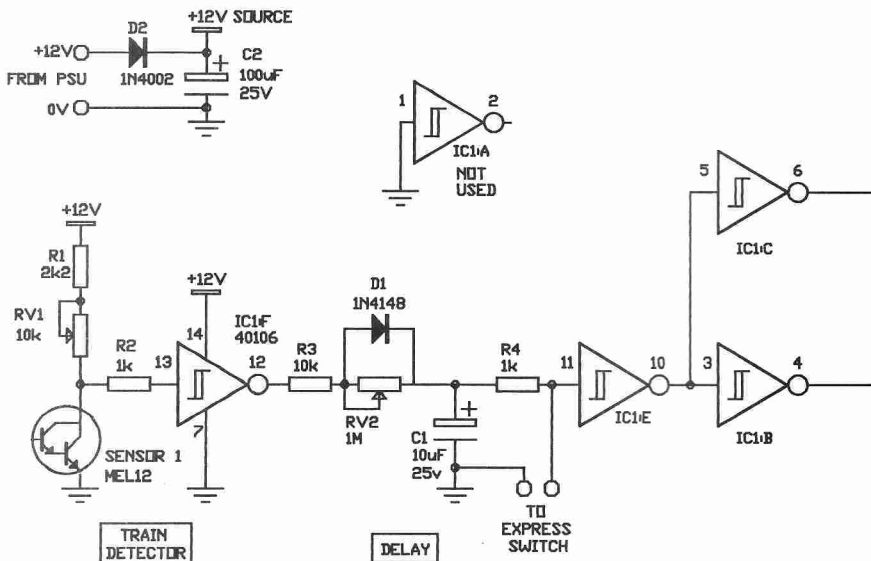
However, if your tunnel is of a reasonable length, you will find this circuit of great use. The train will vanish into the tunnel and wait a predetermined time before emerging again. This delay is great for stretching the scale "distance" between stations.

If we consider N scale as 1/160 scale, one scale kilometre is only 6.25 metres. I would be lucky if my layout has more than 12 metres of track on it. Less than two miles!!

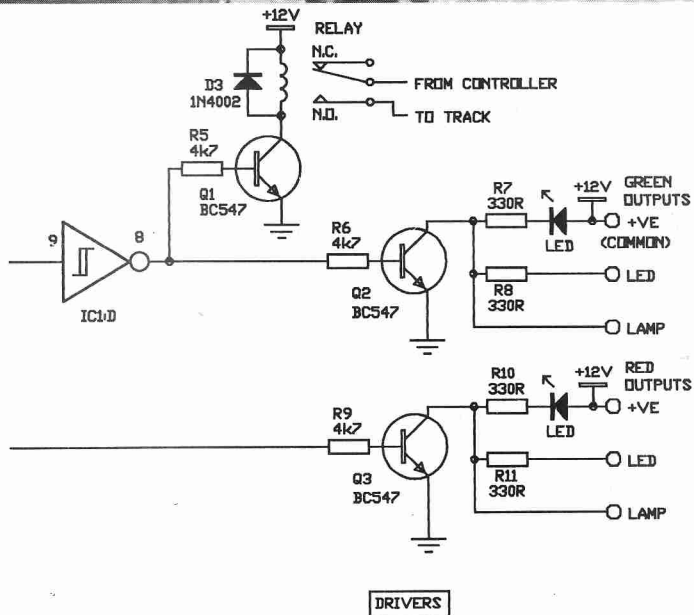
On timetable running days at some clubs, this lack of distance is compensated for by running clocks four times

as fast. However, spectators would not be likely to appreciate this trick, taking things exactly as they appeared. By putting a delay in my 3 metre long tunnel I can stretch the scale journey out. It helps defeat the "train set" image that short runs generate. Another thing that helps is the physical layout of the tunnel itself. The entrance and exit of my tunnel are only about 10cm apart, each in its own cutting. The track actually loops in the tunnel. With the delay, it looks like a train heads south to a station further down the line, returning later on the north bound line.

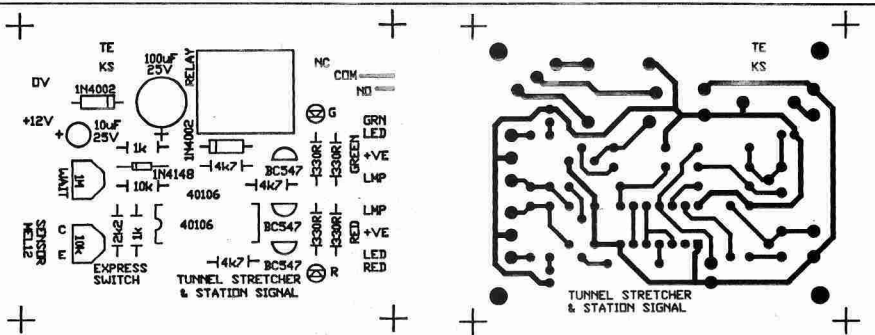
There is also another use to which this handy module can be put. You will notice that it sports LED and lamp drivers so a two aspect signal can be connected to it. If this signal is put at the end of a station platform, along with the sensor and an isolated length of track, it works as a station signal.



The Tunnel Stretcher and Station Signal circuit.



Many of the circuit elements are similar to those used in the Signal Module project. The primary differences are in how the circuit elements are connected together.



The printed circuit artwork for the Tunnel Stretcher and Station Signal. The 10k resistor near the 1M trimpot is the resistor that must be increased if you find the GREEN time of the signal too short. Try 100k or 220k. Remember that this will effect the overall time length too.

The signal will remain on red until a train drives up to it. The train will stop because it has just driven onto the length of isolated track which is currently switched off by the relay in the tunnel stretcher module. The train has also just covered the photo-transistor that is mounted between the rails. This starts the delay. After the predetermined time the signal will go green and the relay will close, switching power to the isolated length of track. The train will then move off again. A short while after it has cleared the photo-transistor, the signal will revert to red and the relay will isolate the length of track again, ready to stop the next train.

Some careful throttle work will be required if you don't want your train to screech to a halt, only to take off like a startled rabbit several seconds later. Of course, if the train

is on a tunnel, it won't matter because no one will be able to see it.

What if the train is a goods train or an express? You don't want that to stop at a station. There is an override switch to allow for such trains. It is appropriately labelled the "Express Switch" and closing it will force the signal to green and hold the relay closed, ensuring that power is switched through to the isolated stretch of track.

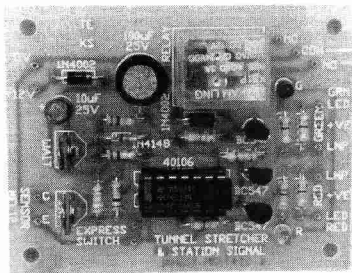
ABOUT THE CIRCUIT

In many ways this circuit is similar to the Signal Module project. It has four similar circuit sections, though their arrangement is a little different. Instead of two track sensors, only one is needed. Also, the delay works backwards to the one in the signal module. The gating is somewhat simpler but the drivers are essentially the same though there is one less of them, as no amber lamp is needed.

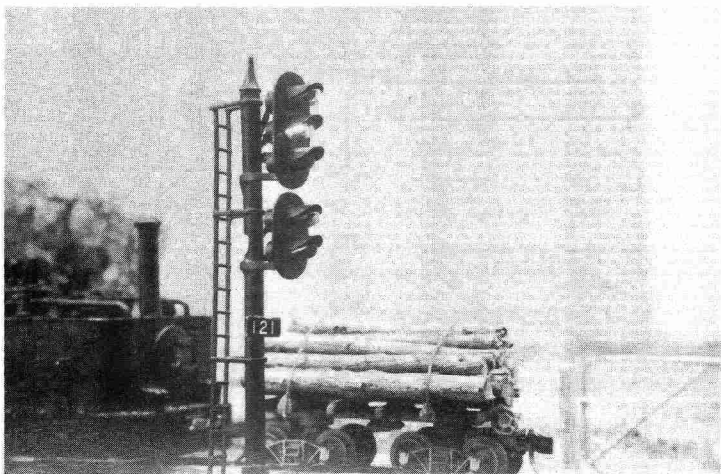
The sensor uses a MEL12 darlington photo-transistor as the active element. Light falling on the junction of the first transistor in the darlington pair has the same effect as applying a voltage to the base of the device. It turns the transistor on. The degree of saturation, or how hard the transistor pair is turned on, depends on the intensity of the light.

Therefore when light is falling on the sensor, it will hold the input of the schmitt inverter IC1:F LOW via R2. The output of IC1:F will be HIGH. When a train casts a shadow over the MEL12, the transistor will not be turned on as hard, allowing its collector to be pulled up by R1 and RV1. When RV1 has been adjusted correctly, the voltage at this point will rise over the input threshold of the schmitt inverter IC1:F and its output will go LOW.

This sensor circuit behaves quite differently under various light conditions. It is very sensitive under fluorescent lights, but under incandescent lamps, it is harder to trip. If you find you have problems, you may need to change R1 and R2. Reduce them if you can't make the signals go GREEN, or increase them if the signals won't return to RED. When you are making the adjustments, the delay can be disabled



All components fit neatly onto the printed circuit board. Again clearances and track thicknesses have been arranged with the beginner in mind.



The five lamp signal is ideal for combining the Station Signal with the three-aspect Signal Module. The circuits are independent of each other, sharing only power connections and the signal itself. The signal still uses lamps for photographic reasons.

by leaving C1 off the board or shortened by winding the 1M trimpot fully clockwise.

In some dark areas on your layout, you may find that you need to mount a street light so that some light falls on the sensor. Experimenters may also like to try hiding infra red LEDs in overhead gantries or in tunnels. Their light is not visible to the human eye.

When the output of IC1:F is high, C1 will be held charged via R3 and D1. The voltage will be above the upper threshold of IC1:E, resulting in a LOW at the output (pin 10) of IC1:E. The signal is then inverted again by IC1:B, resulting in a HIGH being fed via R9 to Q3. This turns on the RED LED. From this we can see that an even number of inverters in series will give a non inverted or "buffered" output. An odd number of inverters in series will give an inverted output. There are three inverters between C1 and the GREEN LED and relay drivers, resulting in an inversion with respect to C1, so both of these will be off any time the RED LED is on, and vice versa.

When a train causes a shadow to fall on the sensor, the output of IC1:F goes LOW. C1 will discharge slowly through the 1M trimpot and R3. When the voltage on C1 falls below the lower threshold of IC1:E, the GREEN LED will be switched on and the relay will close, switching power through to the track. This will allow the train to move off.

As soon as light falls on the sensor again, the output of IC1:F will go HIGH again, charging C1 via R3 and D1, sending the signals back to RED and opening the relay, isolating the track. The charging of C1 is a lot faster than its discharging, making the time before power is removed from the track rather short. Depending on the positioning of the sensor and its light source, you may find that the locomotive does not make it off the isolated section of track

before the relay cuts power to it again. If this happens, the locomotive will be stuck unless you hit the express switch. The solution is to increase the time it takes to charge C1. This is done by increasing R3 to 100k or even higher if you find the time still not long enough. Increasing R3 also stretches the length of time before the signal will turn GREEN when a train arrives.

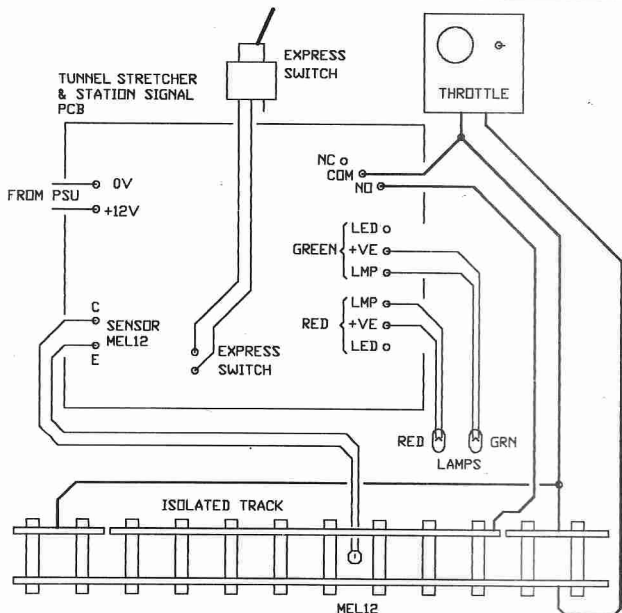
With the component values given, the maximum delay is about 20 seconds. Increasing C1 to 22uF will double this time.

The Express Switch works by shorting the input of IC1:E to the 0V rail. This forces the signal to GREEN and closes the relay. R4 is there to prevent C1 from damaging the switch contacts by rapidly discharging through them.

D2 provides protection for the module, should you accidentally connect it to a supply backwards. C2 provides decoupling for the board. In other words, it helps smooth fluctuations on the module's 12 volt rail caused by parts of the circuit switching on or off.

And while I'm discussing the 12 volt rail, I'll explain the convention I use to show it on circuit diagrams. The +12V symbol labelled "SOURCE" is the common point for all the parts of the circuit that require 12 volts. All other +12V symbols are connected to it. It is really a system much like that used for the 0V or GROUND rail.

In some circuits you will notice that the GROUND symbol has been replaced by a small triangle. This symbol represents a COMMON rail. It is often used where the circuit's 0V rail is relative or in other words, not actually at 0V but offset by another voltage. Such a circuit is the onboard diesel sound generator presented later in this book. Due to a bridge rectifier, it's "0V" rail is not at 0V if compared with the 0V rail of the train tracks.



How to wire the Tunnel Stretcher and Station Signal module to the throttle and track. Refer to the diagram below if your signal uses LEDs instead of lamps.

BUILDING THE MODULE

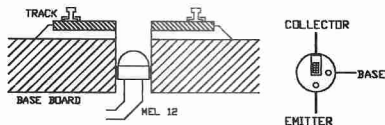
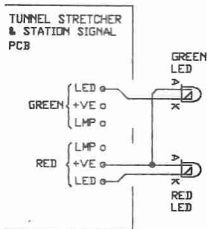
The Tunnel Stretcher and Station Signal project is constructed on a printed circuit board measuring 58mm by 73mm. There is ample space between components, and the track and pad sizes are big enough to make the beginner's job easier.

Start with the lower components first, working your way up to the tallest. Don't mount the MEL12 photo-transistor on the board. It should be connected to short flying leads, and pushed up through a hole between the tracks.

Use a socket for the IC. The IC should be the last thing you install before powering the board. Take care with orientation. If, when you first power the board, you find nothing happens, check to make sure you have remembered to put the chip in the socket. It may sound ridiculous, but it is a very easy mistake to make.

The 10k trimpot is for adjusting the sensitivity of the sensor. It is mounted next to the pads to which the sensor is connected. The 1M trimpot is for adjusting the length of the delay.

Each driver has three outputs. One is for a grain of wheat lamp, one is for a LED. The third is the LED on the PCB itself. These PCB mounted LEDs make trouble shooting much easier. If you are working on the boards under the layout, it saves you having to crawl out every time you need to look at the signal. If the unit is being used in a

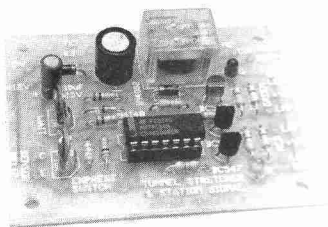


The MEL12 photo-transistor pinout, and how to mount it below the track on your layout. On larger scales, the hole can be drilled between sleepers. With N scale track one sleeper may need to be removed. If you are careful with the positioning of the hole, you may be able to get the active part of the MEL12 lined up with the gap between the sleepers. Be careful that stray ballast does not fall down the hole and cover the MEL12.

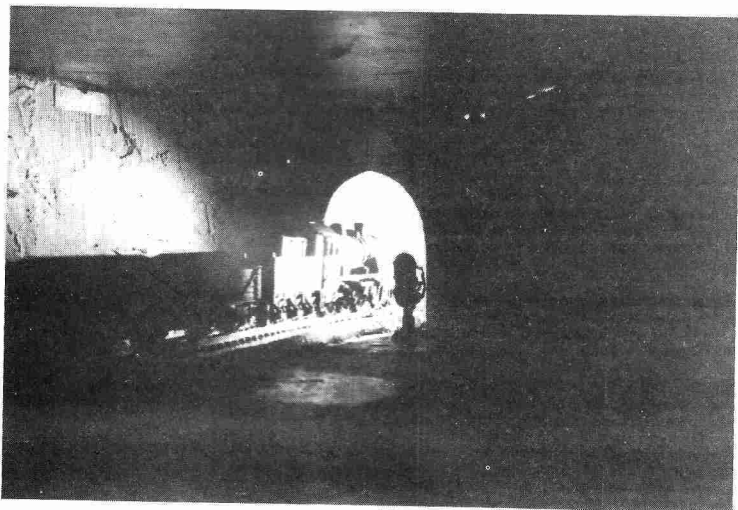
tunnel, it is more than likely that there won't be a signal to look at!

Again it is a good idea to use LEDs instead of lamps for the signals themselves. If you do this, make sure that you connect the anodes of the LEDs (the long leads) and run the cathodes back to the driver outputs. A wiring error to avoid is connecting a signal made with LEDs to the lamp (LMP) output of the module. As there are no resistors in line with these outputs, the LEDs would be destroyed instantly. Refer to the diagrams and photographs in the Signals project.

A tri-colored LED can be easily used with this module. The common cathode wire is connected to the zero volt rail of the PCB. The red and green LEDs that the tri-colored LED houses are connected via 1k resistors to pins 4 and 8 of the IC. The red LED goes to pin 4, the green one to pin 8.



No.46406 escapes into the evening sun.



PARTS LIST

- 4- 330R
- 2- 1k
- 1- 2k2
- 3- 4k7
- 1- 10k
- 1- 100k See Text
- 1- 10k mini trimpot
- 1- 1M mini trimpot

- 1- 10uF 25V electro
- 1- 100uF 25v electro

- 1- 1N4148
- 2- 1N4002
- 3- BC547
- 1- MEL12
- 1- 40106 Hex Schmitt Inverter
- 1- 3mm Green LED
- 1- 3mm Red LED

- 1- 12v SPDT RELAY
- 1- 14 pin IC socket
- 1- SPST toggle switch
- 1- TUNNEL STRETCHER PCB