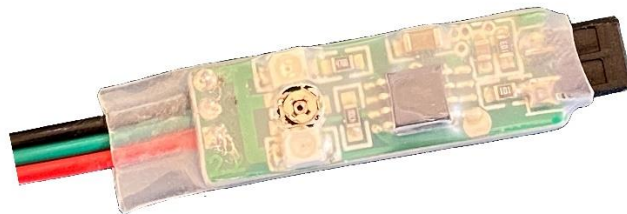# JTElectronics
Infrared Locomotive Detector
Model: JTEILD

The Infrared Locomotive Detector (JTEILD) device uses an infrared beam sent out and reflected back to detect the presence of a passing locomotive, rolling stock, or other nearby object. You can use this detection signal to possibly operate crossing lights, turnouts, track power, auto-reverse loops, sound an alarm etc. Or you can connect it to the JTECFx crossing flasher modules for grade crossing signals.

In the past you may have used reed switches but the locomotive would need modification by adding a magnet to the bottom of it. This attracts unwanted metal or dirt build-up, and can get caught on the track causing a derail.

Using this JTEILD module for train detection requires <u>no</u> modification to the locomotive or other rolling stock!

There are a lot of simple circuits published, and infrared detector boards available, that use a similar infrared sensor mechanism to detect the proximity of passing objects but most of these are very poor at handling changes in ambient light, and sunlight, and will give false detections making them practically useless. This JTEILD module uses advanced circuitry and microcontroller algorithms to ignore changes in ambient light from affecting the infrared sensor detection and sensitivity. The JTEILD module detects passing objects very reliably and needs no "sensitivity" or "level" adjustments. It does have an adjustment to extend the output activation time.

The JTEILD is usually mounted below the track, with the sensor in between the sleepers, but can also be mounted at the side of the track near to where the train will pass by. The detection range using a very good reflector – the "Corner Cube Retroreflector" – is about 1.5 meters so you could use this module for other detection purposes like across a doorway to detect people etc.

WARNING: You must NEVER connect the green output wire directly to a power supply (the red wire) as this could instantly destroy the sensor's output transistor. Always connect a load (lamp or relay etc) between the green output wire and the power supply. We are now (April 2022) shipping the "v2.2" model which has a much larger output transistor and a thermal fuse so the JTEILD will now handle short circuits or wiring issues without failure.

NOTE: The JTEILD is supplied wrapped in a protective clear heatshrink sleeve. You can easily see the green and red LED indicators through it and adjust the output on-delay. Please do NOT remove this heatshrink sleeve as it protects the delicate circuitry inside. Any applicable warranty will be voided by opening the protective heatshrink sleeve or operating the JTEILD module outside the specifications detailed in this document.

HOW IT WORKS

Infra-Red light (IR) is sent out of the IR emitter part of the sensor and a small amount of IR light is reflected off the passing object in all directions. The sensor's IR detector sees some of this reflected light and passes this signal into a microcontroller for further processing. The microcontroller "looks" for passing objects by sampling the IR detector signal approximately 10 times per second and if it detects an object for more than two consecutive samples the "Detect" output is activated. The green "Detect" LED is also turned on to indicate detection of a nearby object.

The JTEILD board would usually be mounted under the track with the IR sensor's emitter and detector visible in the gap between the sleepers. An unmodified locomotive is easily detected as it will only be about 10mm above the end of the IR sensor. If a significantly longer detection range is really needed, you could put something more reflective on the bottom of the locomotive like white paint, tin foil etc.

To assist in correctly positioning the JTEILD under the track and between the ties/sleepers, **the JTEILD will warn you of an unusual amount of unwanted reflected IR light by flashing the orange "Near" LED very quickly**. This means something is near the JTEILD IR sensor and causing a fair amount of reflected IR light, but not enough to be considered a detected passing object. **You will want to realign the sensor so nothing is interfering with it by reflecting back too much unwanted IR light. For reliable operation the orange LED must be flashing slowly and of course the green "Output" LED should be off.**
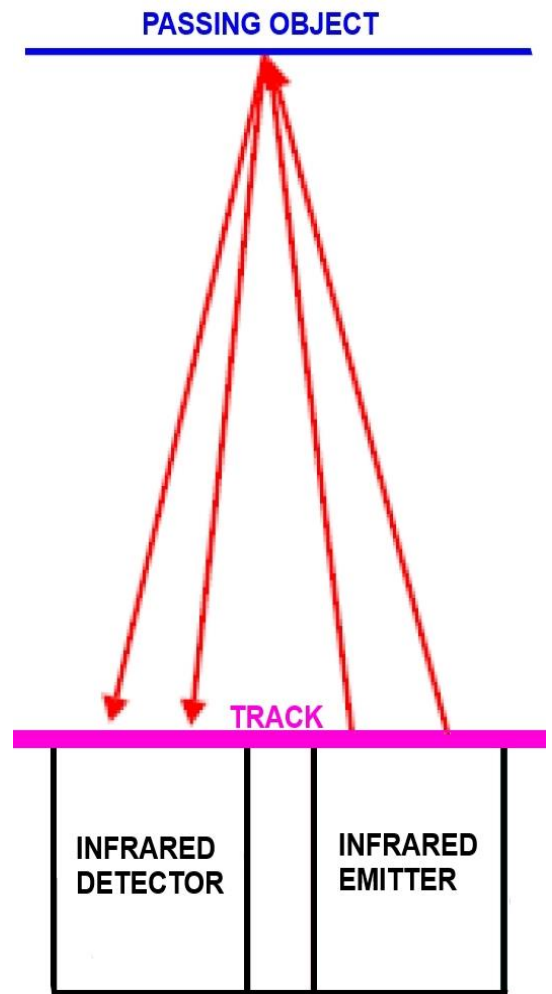
NOTE: All Infra-Red sensors are affected by sunlight, and this JTEILD module is no different. Direct sunlight will cause the JTEILD to turn on the orange LED (a steady "on" and not flashing) to indicate this situation. Fortunately, detection of rolling stock will not usually be affected because as your locomotive passes over the JTEILD sensor, it is most likely to temporarily block the sunlight and the JTEILD will recover very quickly and detect the passing locomotive as it normally would!

JTEILD DIAGRAMS

DETECT / OUTPUT LED
(GREEN)

INFRA-RED
SENSOR

OUTPUT DELAY
ADJUSTMENT

NEAR / STATUS LED
(ORANGE)
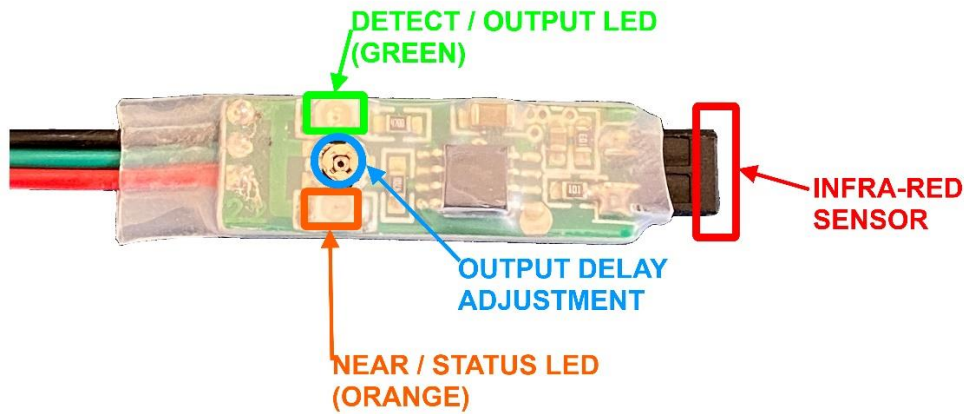
INSTALLATION INSTRUCTIONS

1. If required, adjust the "Output Delay" to the desired setting before mounting the JTEILD as it will be quite a bit more difficult to adjust the output delay once the JTEILD is mounted below your track

2. Temporarily lay your track and mark the centre of the desired sensor position between the sleepers

3. Remove track and drill a 13mm hole all the way through the roadbed using a "spade bit" for a nice clean hole. **13mm (or ½ inch) mounting hole size is only a guide – We recommend you drill a hole into a spare piece of wood and test-fit the JTEILD sensor to see exactly what size you will need, and slowly enlarge the hole until you get a good snug fit.** Then drill the required hole size into your roadbed...
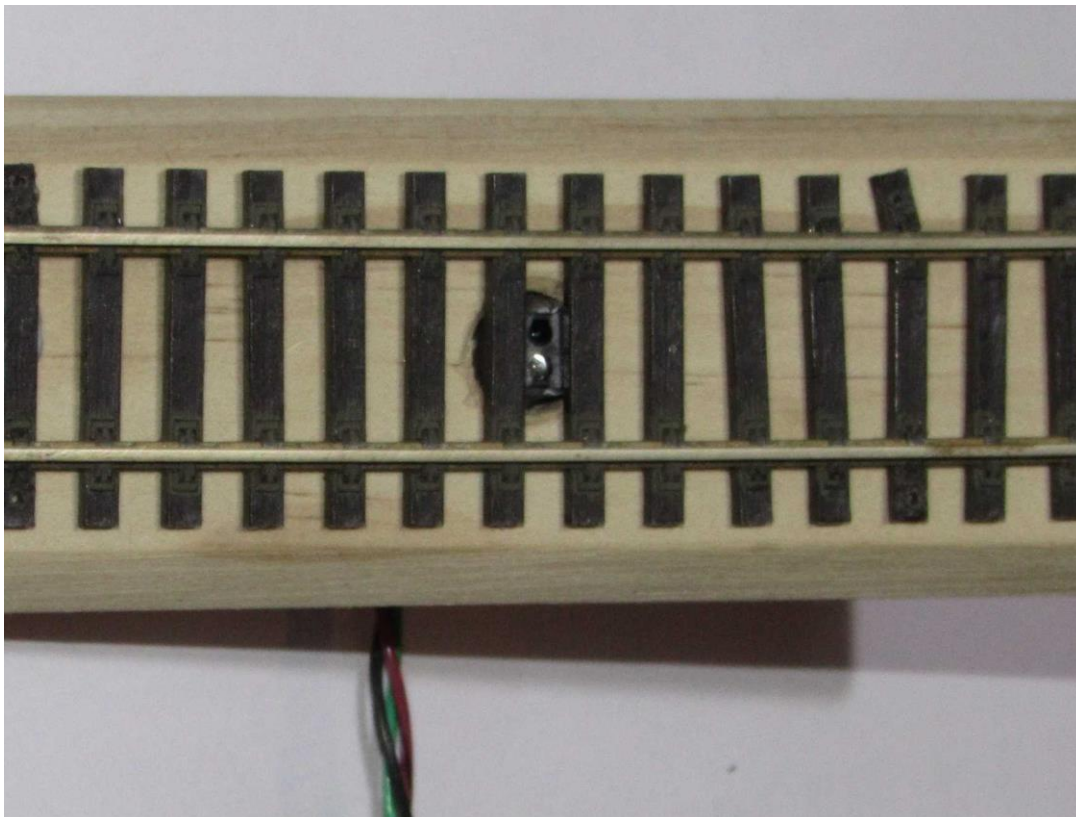

4. Insert the JTEILD from the underside of the roadbed. It will be a snug fit and you may need to enlarge the hole slightly with a file.

5. The JTEILD infrared sensor must be flush with the top of the roadbed (or track).

NEAR and DETECT
LED's still visible

6. The two infrared sensor LED's must be perpendicular to the direction of the track so BOTH sensor LED's will end up being visible between the track ties / sleepers.
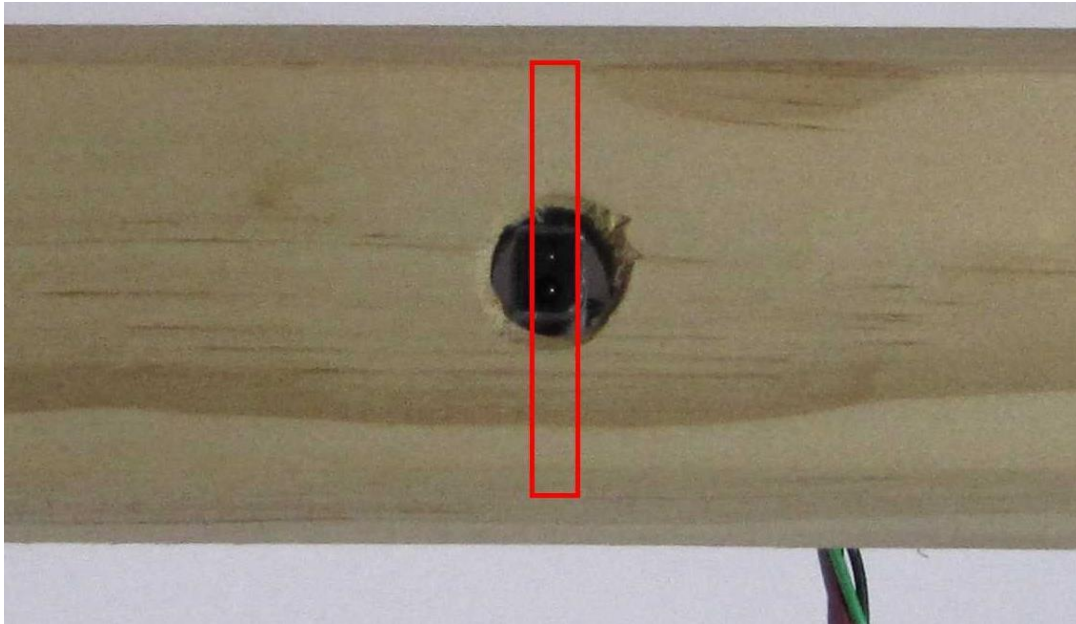
7. Lay your track over the JTEILD sensor making sure the sensor is just touching the bottom of the ties / sleepers and the JTEILD sensor LED's are both visible between ties / the sleepers


8. The JTEILD should be a tight fit into the 13mm hole but, if required, use a small amount of silicone sealant or "blu-tack" on the underside of the roadbed to hold the JTEILD sensor board in the desired position (once you are happy with the installation, proper functionality, and all adjustments have been made).

9. Power up and test operation of the JTEILD. The orange "NEAR/STATUS" LED should be flashing slowly and the green "DETECT" LED should turn on when you roll a locomotive over the sensor

OUTPUT ON-DELAY FUNCTION

The "Detect" output signal activates soon after an object is detected and normally turns off very soon after the object moves away from the sensor. You have the option of enabling an output on-delay where the output is activated normally, but will be held on (for up to the maximum of approximately 30 seconds) after the object moves away from the sensor. This can assist when the output pulses on/off/on/off/on/off in-between carriages, but with crossing lights you may want the Detect output to stay on for a few seconds, even when the train has passed by…

To the right is a diagram of the delay adjustment potentiometer. It is very small and **rough or careless adjustment will certainly damage it**. To turn it the adjustment wheel, you will need a flat screwdriver with 2.0mm x 0.4mm blade, or a cross screwdriver of similar size. The actual delay adjuster on your JTEILD will not look exactly like this diagram but will be very close. The adjustment wheel is a silver/grey colour. In this diagram, I have coloured some of the areas of interest and they are as follows:

GREY   The almost-circular adjustment wheel
BLACK   The adjustment screwdriver slots
RED   The rounded "pointer" of the adjustment wheel
BLUE   The "flat" side of the adjustment wheel. The red "pointer" of the adjustment wheel is directly opposite this flat side.
YELLOW   The "zero" delay setting position (as when supplied to you)
GREEN   The "maximum" delay setting position
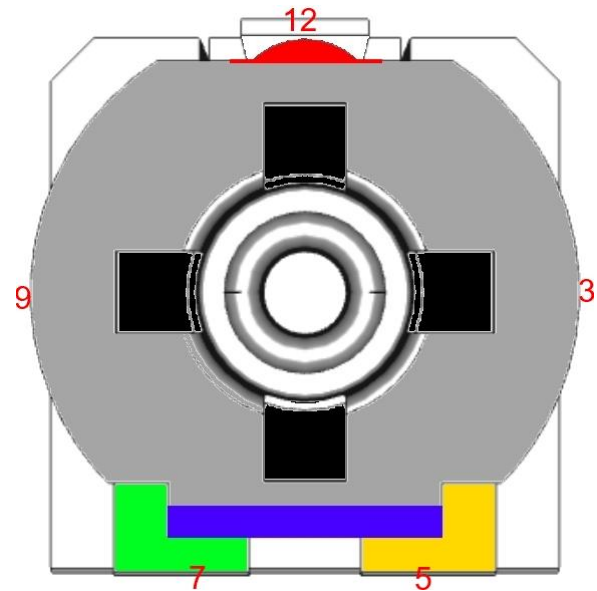
This diagram shows the red adjustment pointer set to the 12 o'clock position at the top, which is midway between the green "maximum" delay setting and the yellow "zero" delay setting. This would give approximately 10 seconds of on-delay.

The JTEILD is supplied to you with the output on-delay set to zero so the red "pointer" side of the adjustment wheel will be turned clockwise so it's facing the yellow "zero" delay setting position. As you move the red "pointer" anti-clockwise toward the green "maximum" delay setting, the output on-delay will increase according to the table below:

5 o'clock position (Yellow)   Zero delay
3 o'clock position   Approx. 1 second on-delay
12 o'clock position   Approx. 10 seconds on-delay
9 o'clock position   Approx. 20 seconds on-delay
7 o'clock position (Green)   Approx. 30 seconds on-delay

LED INDICATORS

| GREEN	Off	Locomotive not detected
GREEN	On	Locomotive Detected
ORANGE	Slow Flash	Idle heartbeat ON/OFF once per second, no problemo…
ORANGE	Fast Flash	Object is "near" detection, something is too near to sensor
ORANGE	Always On	Sensor is flooded by sunlight or a very bright light
ORANGE	Always Off	Very unusual, the JTEILD is likely to be not working. Check your power wiring…

WIRING DETAILS

RED   Supply Voltage 7V to 20 Volts DC

BLACK   Ground

GREEN   Detect Output

IR LOCOMOTIVE DETECTOR (JTEILD) SPECIFICATIONS:

|		
Supply Voltage	7 Volts to 20 Volts DC	
Supply Current	35mA maximum	
DETECT Output	Switches to Ground (effectively an Open Collector / Open Drain)	
DETECT Output Current	500mA maximum	
Object Detection Range	White 80GSM Paper	approx. 80mm
Locomotive Detection Range	Unmodified locomotive	approx. 15 to 25mm
Doorway Beam Detection	Using Corner Retroreflector	approx. 1 meter
Adjustable Output Delay	Zero to approx. 30 seconds	
Mounting hole size	Approx. 13mm	
Board Dimensions	Approx. 38mm x 13mm	
Wire Length	The JTEILD will be supplied with about 1.2 meters of wire like in the picture below	
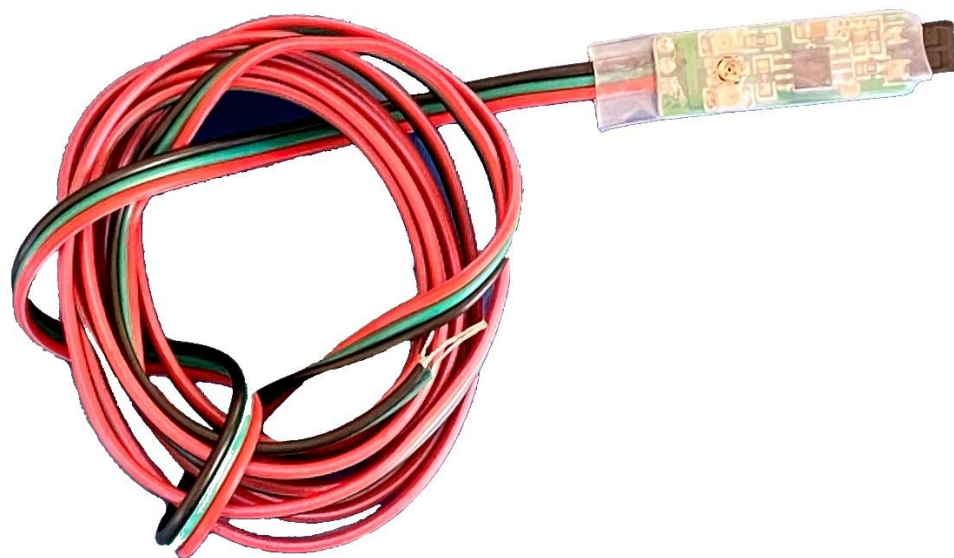
HOW TO WIRE UP THE JTEILD

WARNING: You must NEVER connect the green output wire directly to a power supply (the red wire) as this could destroy the sensor's output transistor. Always connect a load (lamp, relay etc) between the green output wire and the power supply. We are now (April 2022) shipping the "v2.x" model which has a much larger output transistor and a thermal fuse so the JTEILD will now handle short circuits or wiring issues without failure

NOTE: The JTEILD is supplied wrapped in a protective clear heatshrink sleeve. You can easily see the green and red LED indicators through it and adjust the output on-delay. Please do NOT remove this heatshrink sleeve as it protects the delicate circuitry inside. Any applicable warranty will be voided by opening the protective heatshrink sleeve or operating the JTEILD module outside the specifications detailed in this document.

The JTEILD has an "open collector" output, using an NPN transistor, as shown in the simplified diagram to the right. The green "Output" wire will switch to ground when an object is detected and be basically open-circuit when no object is detected. You would use the Output signal to provide a ground connection to control the required external circuitry.
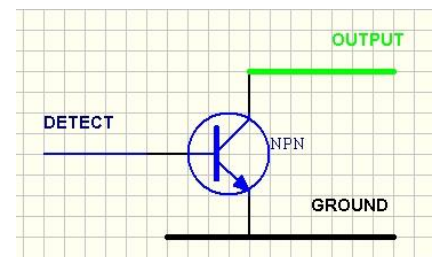

For example, when connecting a JTECF1 or JTECF2 flasher unit you could use wiring like in the picture below:

1. Connect the JTEILD Power and Ground wires to your power supply + and -
2. Connect the flasher unit Power and Ground wire to your power supply + and -
3. Connect the JTEILD Output wire to the flasher Control wire
4. When the JTEILD detects an object, the JTEILD's output activate the flasher unit
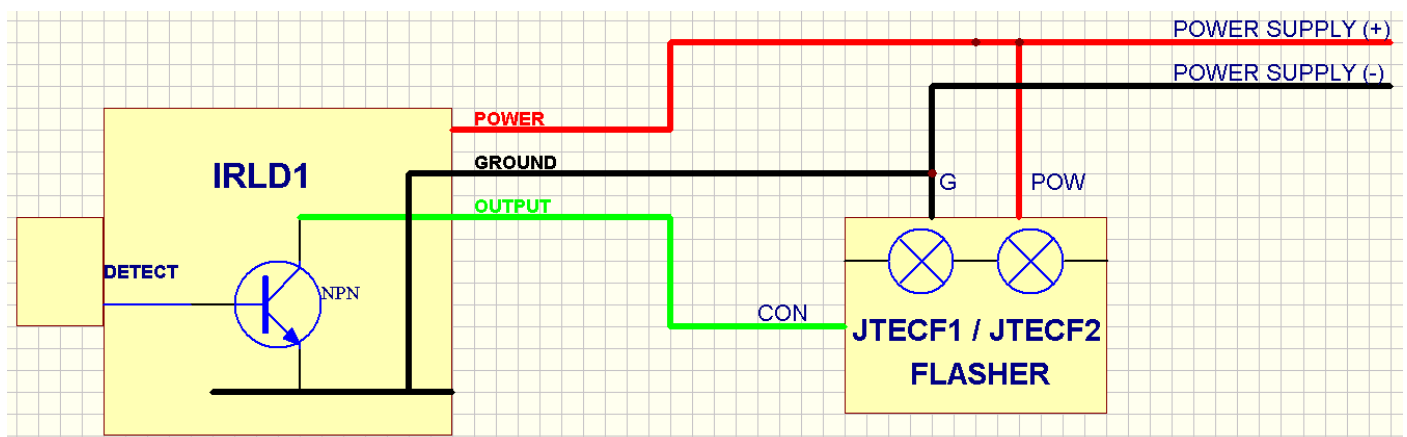
# WIRING MULTIPLE JTEILD SENSORS TO A COMMON CIRCUIT

If needed, you can wire multiple JTEILD sensor outputs in parallel to trigger a common circuit. For example you could wire two sensors in parallel and put each sensor on either side of a crossing to detect your train approaching the crossing from either direction.
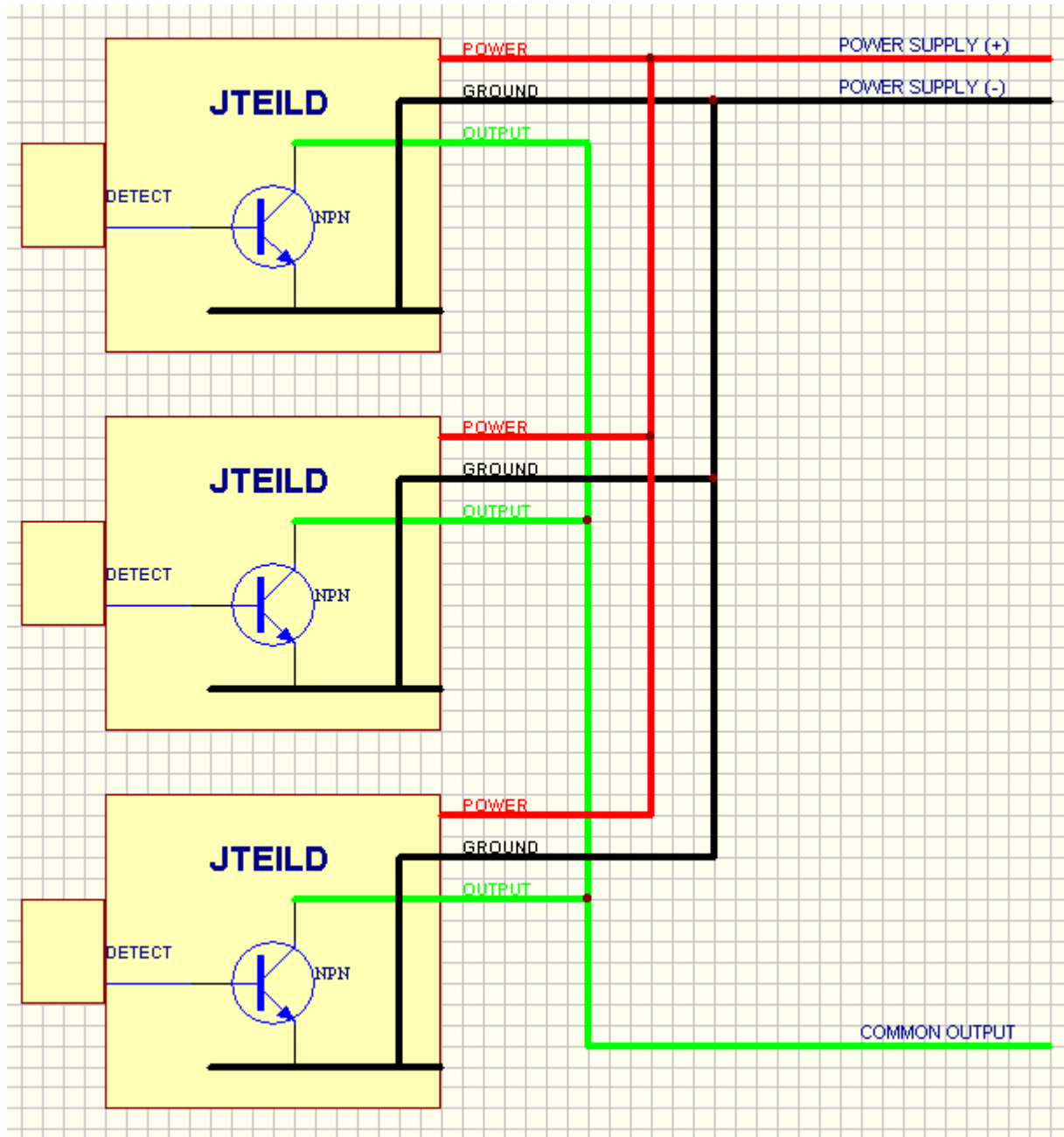
WIRING UP THE JTEILD TO A RELAY LIKE THE "JTELR1" LATCHING RELAY

You can easily connect two JTEILD detectors to a latching relay as shown in the diagram below. This will allow you to use the relay board to switch higher currents and a wide variety of signals.

When an object passes by the top JTEILD sensor, the relay is energised into its "SET" position. When an object passes by the bottom JTEILD sensor, the relay is energised into its "RESET" position.
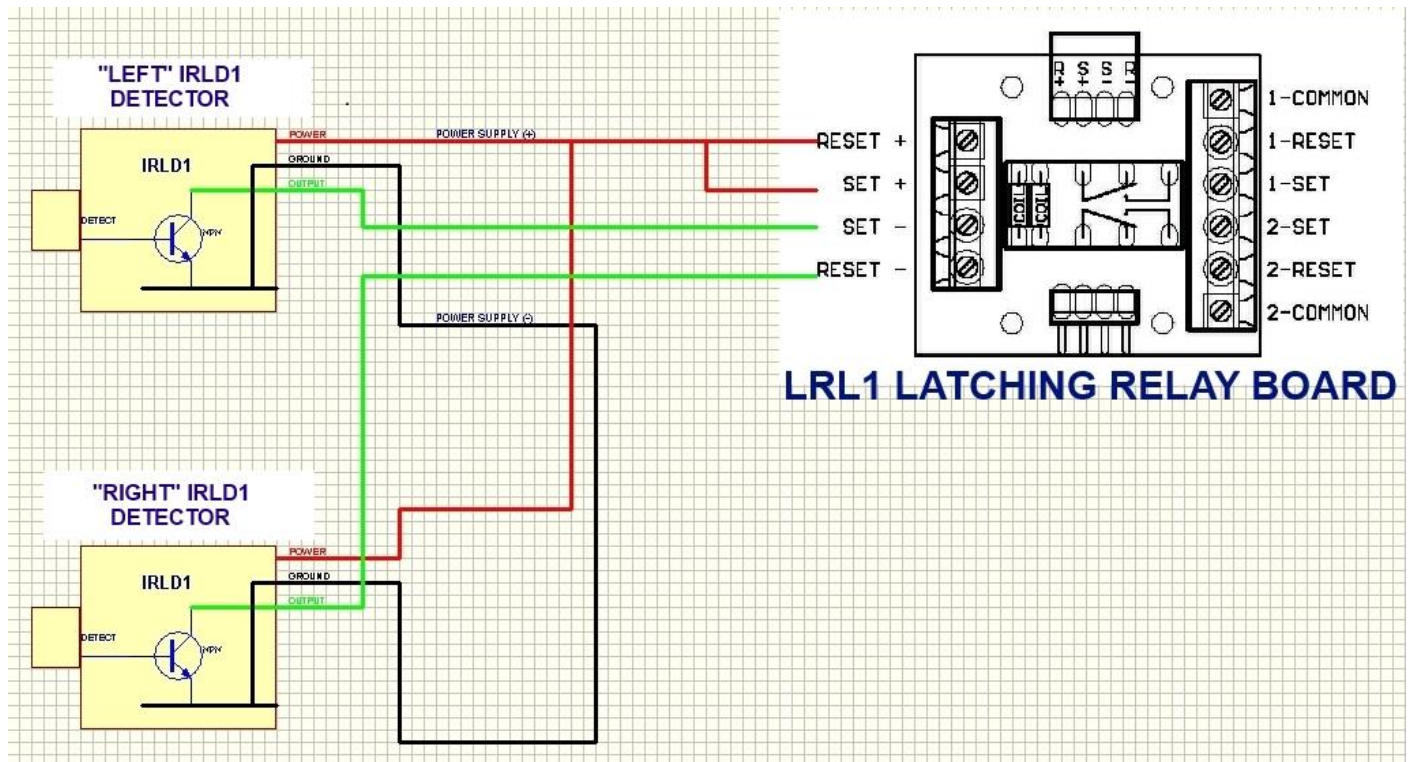

You then can use the six relay connections on the right side of the JTELR1 board for your required purpose.

For a Left/Right auto-reverse straight track (like shown in the JTELR1 datasheet) you would wire the relay contacts as follows:

Controller Power #1   ->   1-COMMON
Controller Power #2   ->   2-COMMON
Track #1   ->   1-RESET and 2-SET
Track #2   ->   2-RESET and 1-SET

WIRING UP THE JTEILD TO A 12 VOLT LAMP
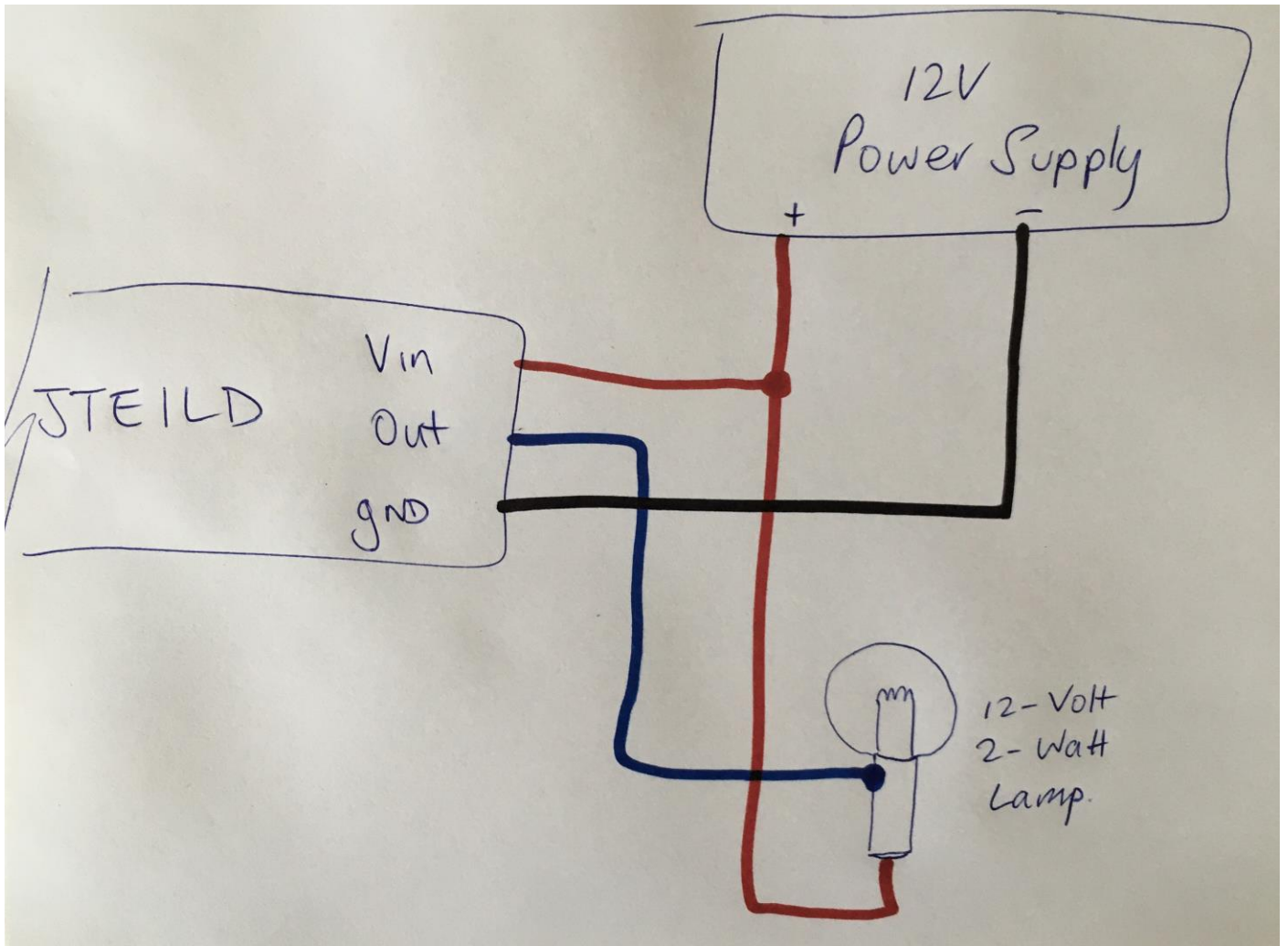
OUTPUT DOESN'T WORK

Newer models of the JTEILD have a resettable fuse and much larger transistor on the output making them able to handle a lot of abuse. Older models may fail due to incorrect wiring as below:

Older models of the JTEIILD could be destroyed easily by incorrect wiring. If you have applied power directly to the green "Output" wire (without a load to limit the current) chances are the JTEILD sensor would have been instantly damaged and will no longer work properly. Usually the green "Output" LED will turn on as normal but the output wire will not switch to ground like it should.

Below are some repair instructions that deal with soldering small surface mount components and should only be attempted by someone familiar with soldering surface mount components. You will need a fine tip soldering iron, desoldering braid, a magnifying headset, and fine tip tweezers.

1. Remove the protective heatshrink by running a sharp craft knife down the <u>thin edge</u> of the circuit board as shown by the pink line being careful to not cut any copper tracks or components
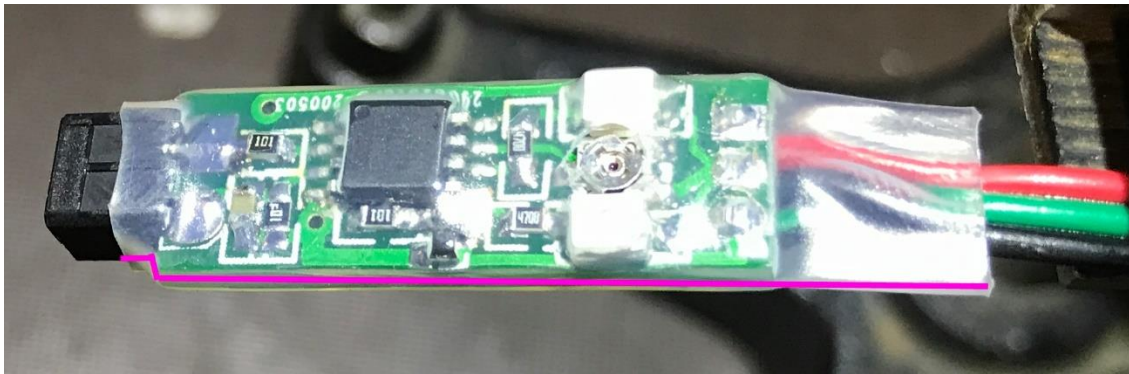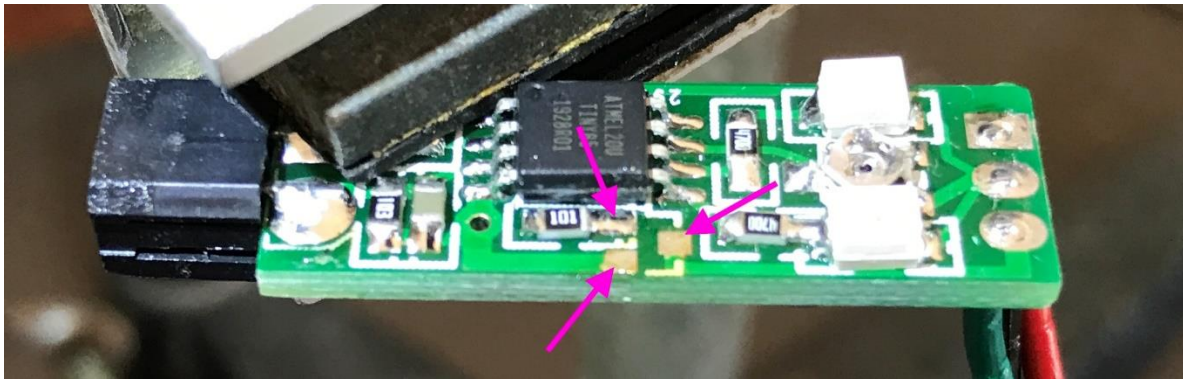

2. Locate the output transistor, circled in pink. It will probably look OK but will have failed
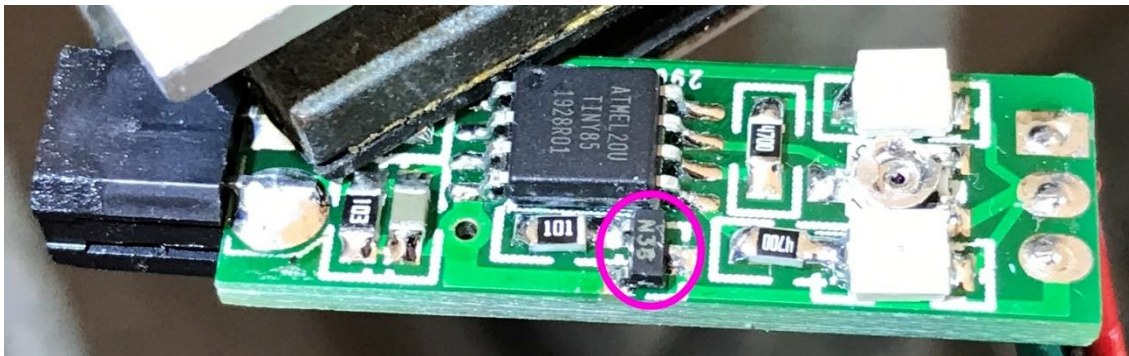

3. Apply a fine tip soldering to the left-hand leg and lift up the left hand side of the transistor
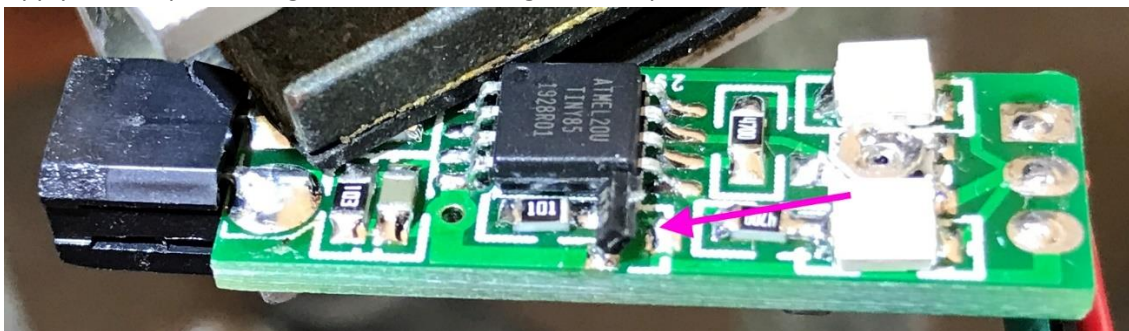
4. Apply a fine tip soldering to the other two legs and remove the transistor. Clean solder off the three solder pads using "desoldering wick"

5. There is also a diode across the output to supress voltage spikes from inductive loads. It can also fail with incorrectly applied power to the output wire. With the output transistor removed, use a multimeter with "diode test" function to test the diode between the green Output wire and the black Ground wire. If this diode is shorted or open circuit, replace it. The diode is type 1N4148 and is available from Digikey, Mouser or RS Components. The orientation of the diode is important, and it is very difficult to see the "cathode" orientation marking which is a thin stripe that the pink arrow is pointing to…
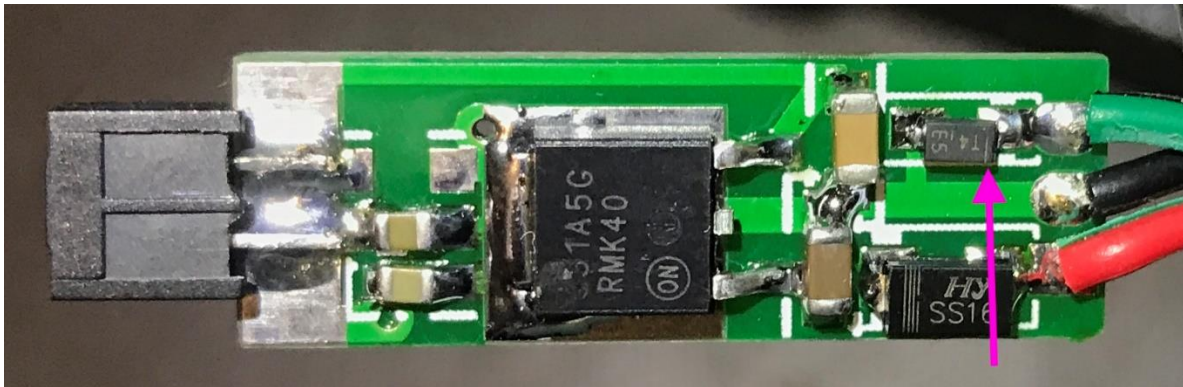
6. Now you can solder the new transistor onto the three solder pads. The transistor is type ZXTN25100 which you can get from Digikey, Mouser or RS Components

7. Great, all fixed but you should carefully examine the soldering before you test the sensor