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# RJ45 Inverter

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## Introduction

This document describes the RJ45 Inverter and how to assemble and install it.

## Revision History

v0.1 December 10, 2020 SCN

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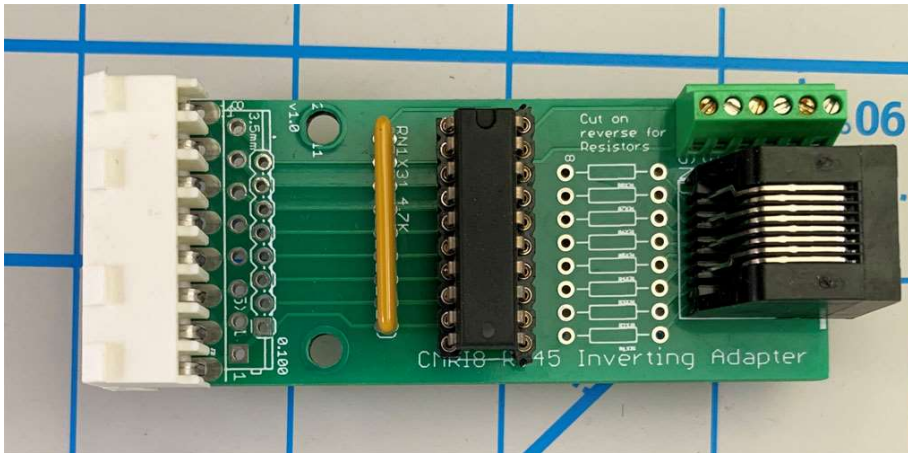
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## 1 INTRODUCTION

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**Figure 1 - RJ45 Inverter in Standard Molex Configuration**

This board is a variation on the CMRI (0.156 Molex) to RJ45 adapter John Plocher developed for Jay Beckham. John has since enhanced it with individual resistor pads. This version is based on a Kris Puccinelli variation which includes a 74HC540 octal inverter which can source ~ 8mA for use with common cathode signals.

- The RJ45 Inverter operates at 5 volts and draws about  $< 1 \text{ mA} + 8 \text{ mA}$  per lamp that's on
- On board pull-up networks condition the open collector outputs of an SMINI or DOUT to logic level
- 3 styles of input connector are supported:
  - 0.156" 8 position female Molex (I expect this to be the standard as the product is aimed at CMRI users and it mates with Dr Chubb's standard output connector
  - 3.5 mm 8 position screw terminal
  - 0.100" (2.54mm) 8 position screw terminal or any other 0.100 connector you'd like to use. All components are through-hole technology for ease of assembly and repair.
- 8 resistor pads are provided for  $\frac{1}{4}W$  axial resistors for current limiting the LEDs in the signal
- A 6 position 0.100" (2.54mm) terminal block is provided for +5 and ground, 2 terminals are bused for +5 to allow easy daisy chaining and 4 are bused to ground for daisy chaining and ground reference connections.
- Available Assembled and tested with your choice of input connector or as a bare board, panel of 3
- If you want an Assembled and Tested variant that we don't stock, send us an email and we'll be happy to quote on orders of 10 or more.

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## 2 IDENTIFICATION AND INFORMATION

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### 2.1 BILL OF MATERIALS

Qty	Value	Device	Package	Parts	Description
1		CONNECTOR-M06LOCK	1X06_LOCK	J4	Header 6 Standard 6-pin 0.1 header"
1		CONNECTOR-M083.5MM-2*	SCREWTERMINAL-3.5MM-8	J2	Header 8
1		CONNECTOR-M08LOCK*	1X08_LOCK	J5	Header 8
1		KK-156-8F*	KK-156-8-F	J3	KK 156 HEADER
8	0	RPTH04	AXIAL-0.4-RES	R1, R2, R3, R4, R5, R6, R7, R8	Resistor
1	4.7K	GE08RP	SIL9	RN1	SIL RESISTOR
1	74HC540N	74HC540N	DIL20	IC1	Inverting Octal BUFFER and LINE DRIVER, 3-state
1	20 Pin DIL Socket	20 Pin DIL Socket	20 Pin DIL Socket	IC1	20 Pin DIL Socket
1	RJ45	CONNECTOR-RJ45-FRONT	RJ45-NO-SHIELD	J1	CORCOM Modular RJ Jacks No Shield
1	Circuit Board	Circuit Board	33 x 74mm		circuit board

**Table 1- Bill of Materials Rev 1.0**

\*Pick only the connector you'll be using, in most cases the KK-156-8F (Molex)

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## 2.3 SCHEMATIC DRAWING

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### 3 THEORY OF OPERATION

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The 74HC540 is an octal inverter, that is each input (low, high) appears in the opposite state at the output. It expects a logic level input, so a 4.7Kohm pull-up is provided for the input to interface with open collector signals such as provided by the Dr. Chubb's DOUT and SMINI. A 9 pin Single Inline Package (SIP) resistor network is used for ease of assembly and to save real estate.

If you want a buffered, non-inverting, logic level output from a DOUT or SMINI you could use this board with a 74HC541 but it might be more straightforward to simply modify the SMINI/DOUT by jumping from the output of the 74HCT537s directly to the pins intended for the collectors of the output transistors. However, the RJ45 Inverter Board solution uses an unmodified SMINI/DOUT.

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## 4 OPTIONS & ASSEMBLY

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### 1.1.CONNECTORS

- Choice of input connectors as indicated in the introduction above. If you are ordering an assembled and tested unit from MRCSS and you would prefer a different connector, please contact us at [sales@modelrailroadcontrolsystems.com](mailto:sales@modelrailroadcontrolsystems.com) and indicate your preference and we'll provide a quotation.
- Input power and ground are on the 6-pin connector next to the RJ45 modular jack.

### 1.2.DETAILED ASSEMBLY

All of the components are through-hole technology with wire leads. The general rule is to install the lowest components first, working towards components that are higher off the board. Start by inserting the lower height components (IC Socket and SIP). This enables you to support the components as you solder them.

#### [ ] Resistors

[ ] If you are inserting **limiting resistors**, cut the corresponding traces on the back and check with an ohmmeter that they are really open. The hole spacing is 0.400. Use a lead bender to form  $\frac{1}{4}$  or  $\frac{1}{8}$  W resistors and install them as needed. You may need to use different values for different colors, especially if mixing green and red to make yellow.

The 74HC540 can only source 8mA, so careful consideration should be given to limiting resistor values. Depending on the forward voltage of the LED (typically 1.5V for red LEDs, 1.8 for yellow and green, and about 3.5 for blue and white) a value between 220 and 470 ohms is likely. A resistance substitution box is a handy tool for determining which resistor to use.

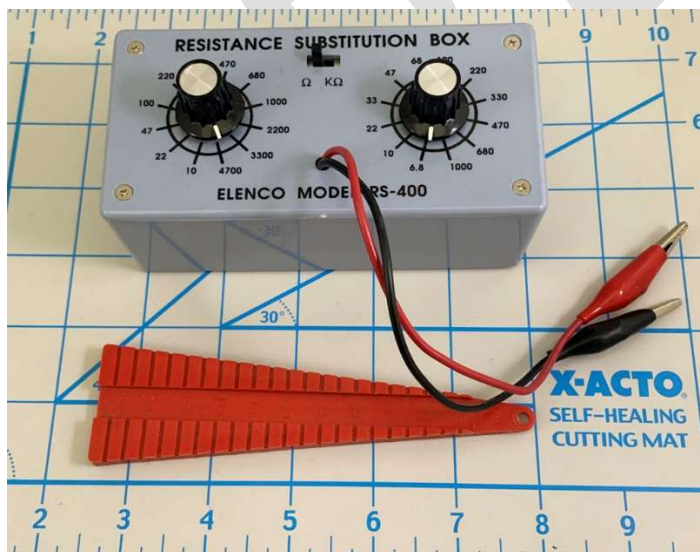
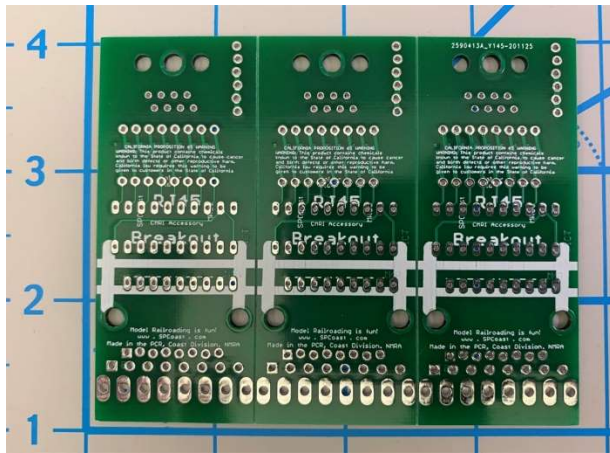


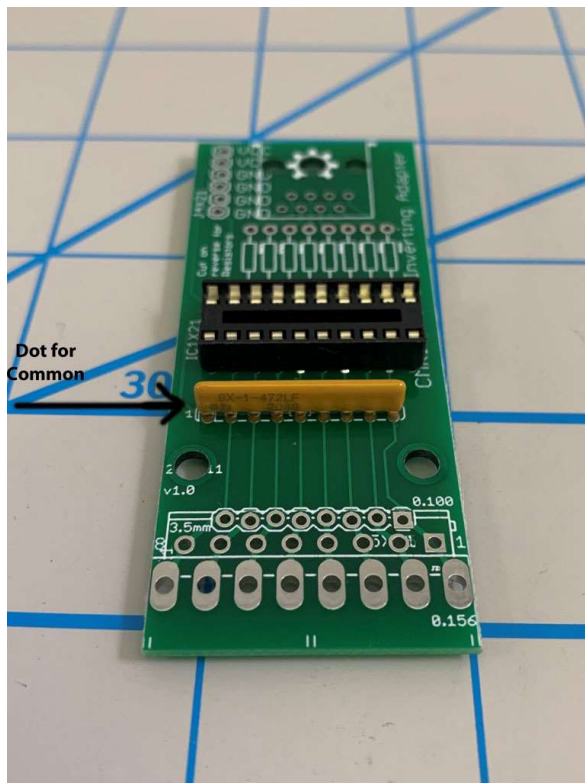
Figure 3 - Handy tools





**Figure 4 - bottom of RJ 45 inverter board - cut traces under the prop 65 warning**

[ ] Install SIP Resistor pack RN1 . The common pin (dark dot on the SIP) goes towards the top of the board, following the text.



**Figure 5 - Aligning the Single in Line Resistor Package**

[ ] IC Socket

[ ] Install U1, notch pointing up , following the text.

**[ ] Connectors**

- ☐ Install your choice of input connector (J5 0.100", J2 3.5mm , J3 - Molex)
- ☐ Install power connector (J4)
- ☐ Install RJ45 output connector (J1)

**[ ] Install IC in socket**

- ☐ Insert U1 74HC540 in socket

**[ ] Clean board with 91% Isopropyl alcohol**

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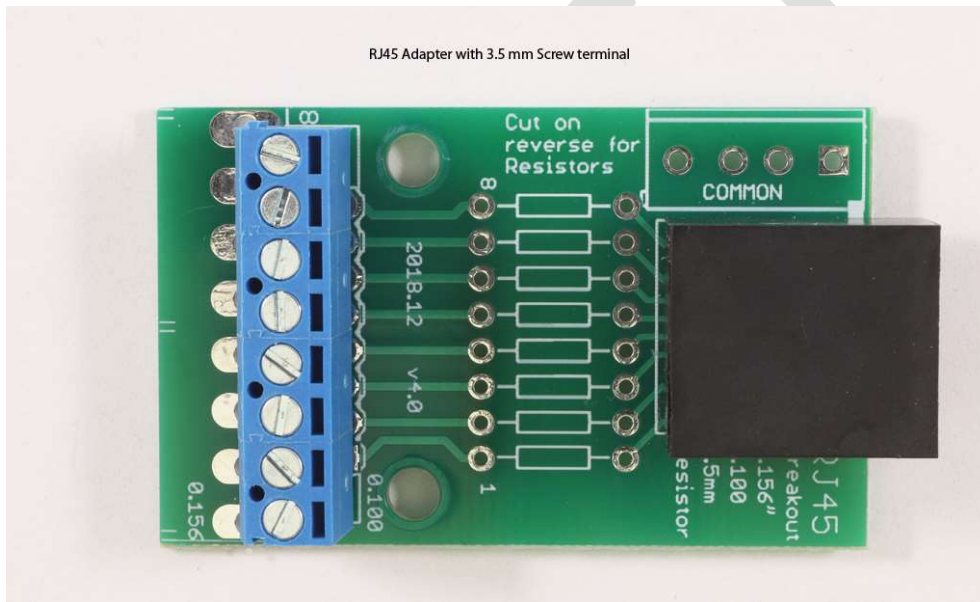
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## 5 TESTING

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Testing your RJ45 Inverter is quick and simple:

1. Apply positive voltage (5 VDC) and ground between on JP4 (note 4 terminals towards the IC are ground, and the 2 away from the IC are +).
2. Connect an LED (observe polarity) in series with a suitable limiting resistor (RED Led, 470 Ohms at 5 Volts), with the Cathode (short lead) to a spare Ground terminal. Connect the resistor to each output terminal in turn. Use a stripped end of an Ethernet cable or a standard Ethernet cable with our standard RJ45 adapter, to get easier access to the outputs. If you've already installed limiting resistors, just use a LED to test.
3. Apply a ground from a spare ground terminal to each input in turn. You should see the LEDs turn on as you ground the input.



**Figure 6 – Standard RJ45 Breakout**

## 6 INSTALLATION AND CONNECTIONS

Plug the Molex on to the SMINI/DOUT, matching component sides. Screw holes are provided if you need to support the RJ45 inverter, but the Molex pins should hold them in place.

Plug an Ethernet Cable into the RJ45 and route it to whatever it's connecting to. We offer the standard version of the RJ45 adapter (which also has resistor pads if you'd prefer to add them at the signal end) as a breakout.

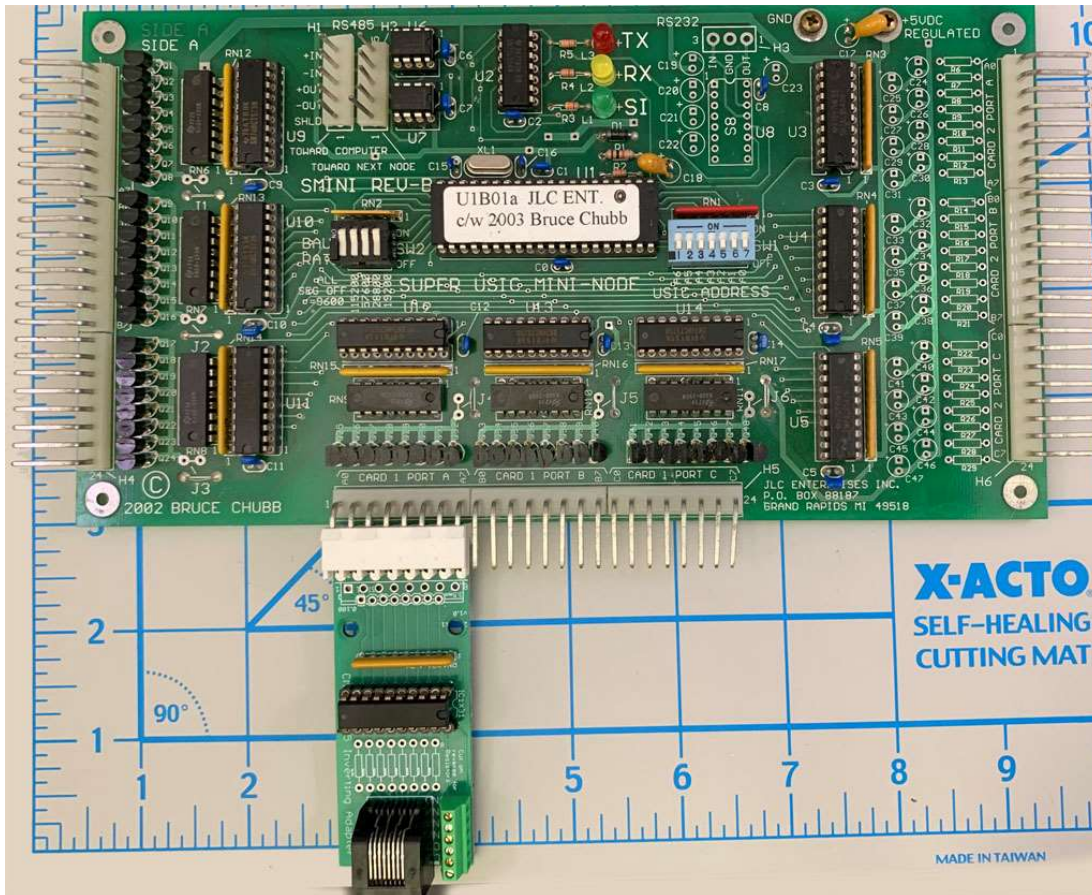


Figure 7 - RJ45 Inverter on SMINI