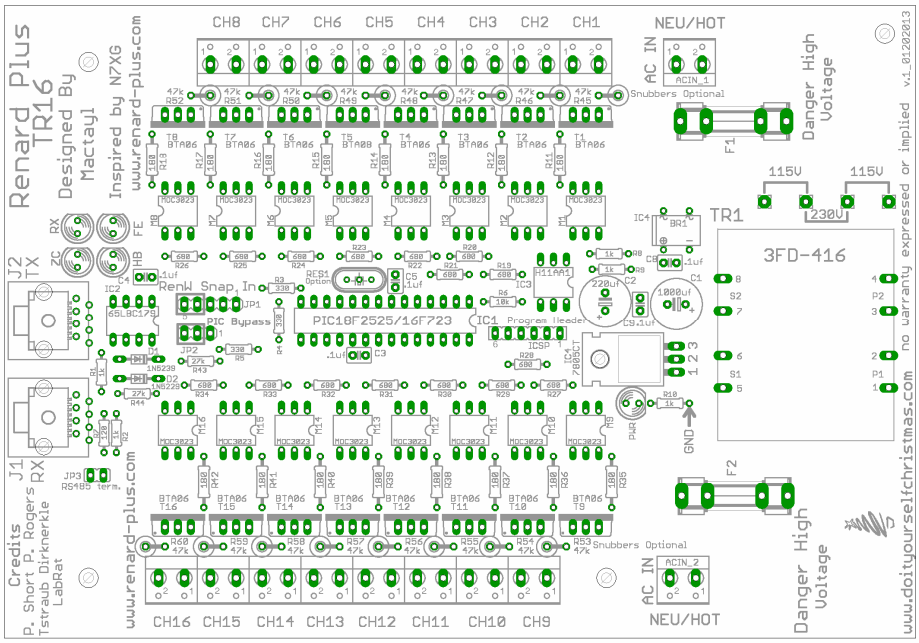
Renard Plus

TR16 Controller



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Overview

Renard is the name of a computer-controlled, PIC-based dimmer scheme, and also refers to dimming controllers that people have built based on this scheme. The designs all use mid-range PIC micro-controllers, are generally modular in units of eight channels (dimmable circuits), and use medium-speed, daisy-chainable, one-direction serial communications for input. Renard controllers do not have stand-alone show sequencing capabilities, and rely on a separate computer (usually a PC) to send it real-time sequences of dimmer commands.

This design was originally described in the Simple PIC-Based 8-Port Dimmer 'How-To' on the http://computerchristmas.com website in a generic form. Since then various people have designed and built controllers based on this hardware, and there are likely to be coop buys of one or more of these designs. Renard is strictly a DIY, hobbyist effort at this time, with no commercial products available (either software or hardware).

Construction

This section covers the construction Renard PlusTR16 controller board. It approaches these tasks as a learning exercise for new builders, so that they can develop proficiency and self-confidence. The project itself is quite simple and if you follow the steps you will have a working controller..

Basic Tools

To build this board requires a few basic electronic hand tools. The tools listed below are recommended for anyone building these types of DIY boards.

Soldering Iron

The first is a suitable soldering iron. Anything between 25 and 40 watts is useable, with at least a 1/16-inch wide chisel tip. However, tips that are closer to 1/8-inch will provide better heating of the joint being soldered. While a temperature controlled soldering station is very nice, one can get by nicely with a much more modest solder iron setup. The iron shown in figure 1 is an inexpensive, adjustable 25-40 watt unit, and quite suitable for constructing this type of kit.

Figure 1: Soldering Iron

If you have never soldered any electronic parts, a little practice before starting on your kit might be in order. Go to your local Radio Shack, or other parts store, and buy a few small resistors and capacitors. If they have any sort of perforated PC board material available, get some of that too. You can practice putting the parts through the holes, bending the leads slightly, and soldering them in. Do not clip off the leads; the parts can be unsoldered and reused for more practice. If you can’t find any perforated PC board material, buy a piece of blank PC board material, and drill several holes in it spaced the lead width of the parts you have available, and use that for practice. Another approach might be to take apart an old wireless telephone and remove the existing parts by heating the PC board with a small torch and rapping it on a solid surface to knock them out. Wear eye protection when using this method for parts removal!

Another alternative is the **Elenco Practical Soldering Project Kit** This kit can be purchased from Amazon for less than 10 dollars and has a well written set of instructions on learning to solder. Soldering a part requires placing the tip of the soldering iron against the component lead and the PC board surface, heating it for a few seconds, and then adding a little bit of solder. If the joint is hot, the solder will flow quickly. Once the solder has flowed, remove the soldering iron and the solder, and let the joint cool. If the job was done correctly, the solder will have flowed smoothly, and the joint will look shiny. Later in this article are many examples of correctly soldered joints.

Solder

Solder plays a key role in electronics construction. The right kind will work well, and is easy to use. The wrong kind can be hellish! A suitable solder for electronics work will contain approximately 37% tin, and 63% lead. Anything around those two values, with a rosin flux core is suitable. Do not use "no lead" solders intended for plumbing; they will not work well. Nor will solders with acid flux cores. Also, stay away from solders with water-soluble (organic) fluxes. While they seem to work well while building, failure to remove all of the flux later will lead to corrosion where the flux remains. This is also true of any acid flux core solders.

The best solders also contain about 2% silver. This improves conductivity of the joint, and keeps it bright looking. Figure 2 shows a small roll of solder containing 2% silver, and readily available from Radio Shack. Kester also makes a similar product that is available from Mouser and DigiKey.

Figure 2 - Solder available from Radio Shack

Side Cutters (also called Diagonal cutters or “dikes”)

The other basic tool that one needs, especially when soldering a PC board, is a pair of side cutters. A favorite is shown in figure 3. These are made by Xcelite, and are available from Mouser, DigiKey, and others supply sources. These cutters are used to clip off the excess lead length of parts soldered into the PC board.

Figure 3 - Side cutters are very useful in clipping off excess lead length

Third Hand Apparatus

Another tool that is very handy to have, but not a necessity, is a "third hand" apparatus of some kind. A commercial version is shown in figure 4. One of these will hold the PC board while parts are being soldered, or hold parts while leads are being attached. One could make the equivalent of this unit with a pair of "pincher" clothespins, a small block of wood, and a bit of fabricating.

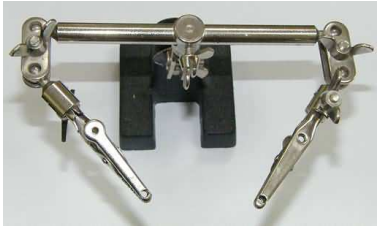


Figure 4: "Third Hand" holds PC board during assembly

Solder Braid

Solder Braid or solder wick is good to have on hand for those occasional mistakes. It is made of a braided copper wire that is impregnated with a rosin flux. If you bridge two solder points when soldering the PCB this can remove the excess solder. This is available Radio Shack, Mouser, DigiKey, and others supply sources

Figure 1 Solder Braid

Needle Nose Pliers

Although though not as vital as the above component, needle nose pliers will be invaluable in forming component leads and in helping straighten bent pins on ICs, This is available Radio Shack, Mouser, DigiKey, and others supply sources.

Figure 6 Needle Nose Pliers

Solder Iron Tip Cleaner

A clean solder iron tip is essential to good solder joints. The tip must be kept clean to ensure the best heat transfer between the iron the part and the solder. The dirt build up on a soldering iron is mostly due to rosin residue. The traditional method of cleaning the tip is with a damp sponge. This will clean off burnt rosin residue on the tip of the iron but will eventually lead to the tip corroding. The item pictured below is a much better method of cleaning the iron and doesn't require any water. Just plunge the tip into the metal mesh and withdraw it and the tip will be clean. This particular cleaner is available from Amazon for about 10 dollars and is well worth the investment.

Figure 7 Hakko Tip Cleaner

Digital Volt Meter (DVM)

This device is used as a diagnostic tool and can be used to troubleshoot as well as test for proper operation. You will need this item when powering the board up for the first time. There will be further instructions later in this manual.

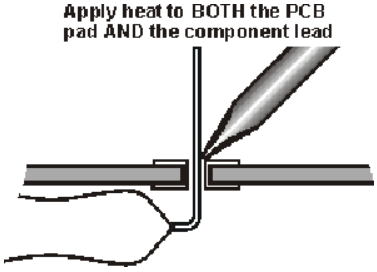
Digital Volt Meter (DVM)

PIC Programmer

The PIC chip on the PCB is used to control all the functions to create blinky flashy. When you order the part from the supplier (Typically Mouser) it will come in un-programmed. You will need a PIC programmer and the software for the board. There are several manufactures out there supplying PIC programmers. The one shown below is made by the original designer of the PIC chip, Microchip. The programming instructions are included later in this manual.

Soldering

Proper positioning of the soldering iron tip and solder are essential in obtaining a well-made soldered joint. The tip must be in contact with both the lead to be soldered and the PC board pad.

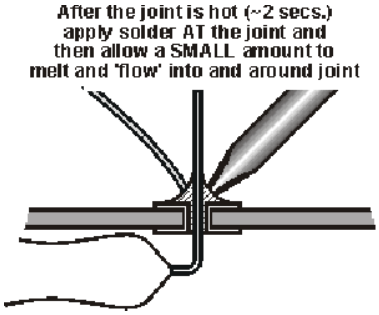


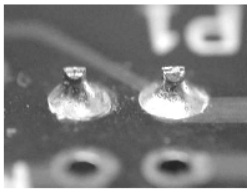
Important!

A clean soldering iron tip is essential to heat transfer.

Be aware that it is possible to damage the board and the component if they are heated for too long.

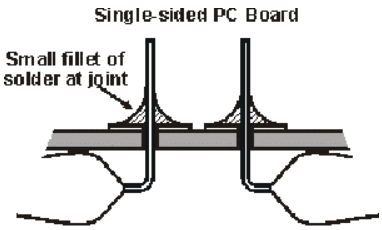
Once the tip has heated the pad and lead apply solder to the **OPPOSITE** side of the joint. The solder should flow evenly around the pad and the lead. Remove the solder iron and give the joint a minute to cool.



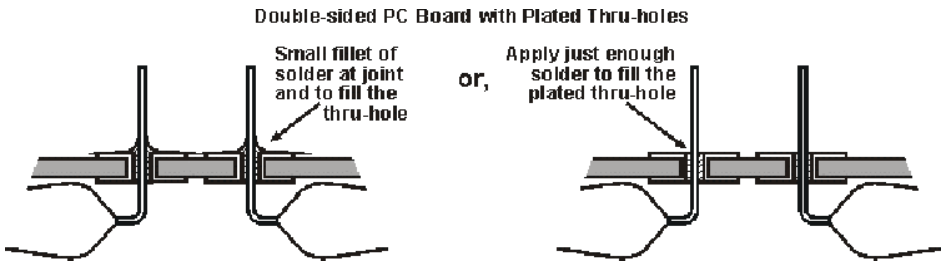


DO NOT blow on the joint or move the component as this can cause a poor solder joint (called a cold solder joint). A cold solder joint will not conduct electricity properly and will cause problems during operation.

This shows a well-made connection to a single-sided PC board. A small amount of solder has been melted by the heat from the component lead and the PC board pad. A small additional amount of solder has been added to the joint to form a small rising *fillet* around the lead



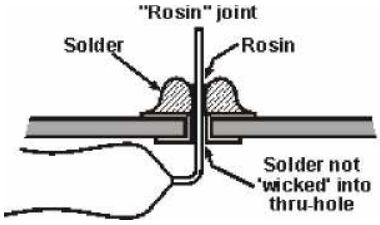
If the PC board was of the plated-thru hole type, capillary action of the lead in the *plated-through hole* has drawn the solder down into the hole. (**left**)

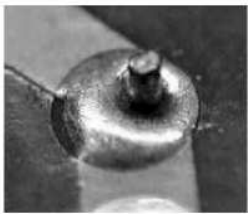


Note that some soldering requirements may dictate that *no fillet* be created when soldering to plated-thru holes. (**right**) In this instance, apply only enough solder to *fill* the plated thru hole. Use of .020" diameter solder greatly enhances your ability to perform this operation. Use of .03" or larger diameter solders will generally cause more solder than required to be applied the instant the solder is applied to the joint.

When soldering plated-thru holed which are to only be filled, apply a small amount of solder and allow your iron to remain a short while longer. This will ensure that the solder is 'wicked' down into the hole. You will be able to *see* the solder as it flows into the hole.

These figures show what can happen if the component lead is not heated along with the PC board pad. A rosin joint will result. The solder flows onto the PC board pad, but since the component lead is not hot enough to melt solder, rosin accumulates around the wire. The solder then forms around the rosin coating on the component lead, and there is no connection. Generally, joints of this type can be corrected by reheating the joint.





Similarly, a poor joint will result if you do not properly strip and tin the enameled wire leads of inductors *before* the lead is inserted into the PC board for soldering. Enamel coating allowed to remain on the inductor lead can create a joint similar to the rosin joint, preventing the lead from being adequately heated by the soldering iron. Such a joint *cannot* normally be restored by reheating. Remove the lead from the PC board, strip it of all enamel and tin it. Then resolder the joint.

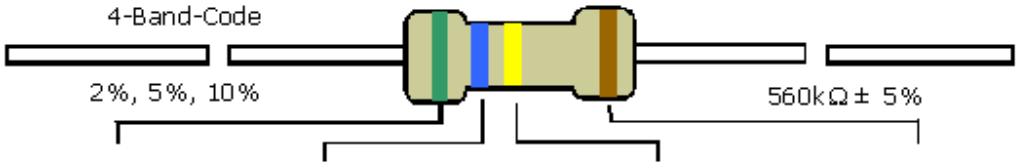
Identifying Components Used in Construction

There are many different types of components used in construction of this board. Below is a list of the types of components and how to identify them.

Resistors

Resistors are small tubular shaped components with wire leads coming out each end. Resistors will have different values depending on where they are used in the circuit. The values are defined by a color code marked on the resistors. The table below can be used as a reference to determine the resistor value.

Resistor Color Code



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)

Capacitors

Capacitors come in various forms and makes. The ones in this kit include electrolytic and MLCC (multilayer ceramic capacitor. These are radial style which means both leads come out the same end of the component.

The electrolytic caps are polarized, which means that have to be installed in the correct orientation. The side of the cap will have a minus sign and must be installed in the board with the unmarked side in the hole with the plus indication on the board. The cap will be labeled with the value and voltage rating.

Electrolytic Capacitor

The MLCC caps will simply have a number on it. For example 102 this stands for a 1000pf capacitor. The 10 is the first 2 numbers of the value and the 2 represents the number of following zeros. Thus 10 with 2 zeros equals 1000.

Radial MLCC Capacitor (value 47000pf)

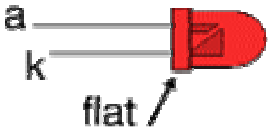
Diodes

Both conventional diodes and light emitting diodes are used in this project.

Conventional diodes are similar in shape to resistors small tubular shaped components with wire leads coming out each end. Diodes are polarized and must be installed in the correct direction. The diode will have a stripe on one end and this must be oriented to the stripe on the printed circuit board. Failure todo so will damage the diode and possibly other components when power is applied.

Conventional Diode

Light Emitting Diodes or LEDs are diodes that emit light. These diodes are typically radial in design and look like small light bulbs. As with all diodes LEDs must be oriented properly. Typically the diode will have a flat side cut into the plastic bulb indicating its polarity. This flat will be indicated on the PCB.



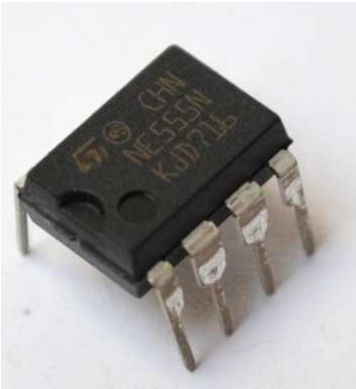
Light Emitting Diode

Integrated Circuits

There are several different types of ICs used in this project. ICs also require proper orientation when installing them on the PCB. They are usually marked with either a notch or a dot at the end nearest pin one. In addition to orientation it is important to remember that ICs are sensitive to heat and are easily damaged. Limiting the the time your soldering iron is used to solder the connections reduces the likelihood that the part will be damaged. In this kit it is recommended that sockets be used for the ICs so they can be easily replaced in the event of a failure.

Pin 1 of the IC socket is on the end, closest to the notch.

:ket

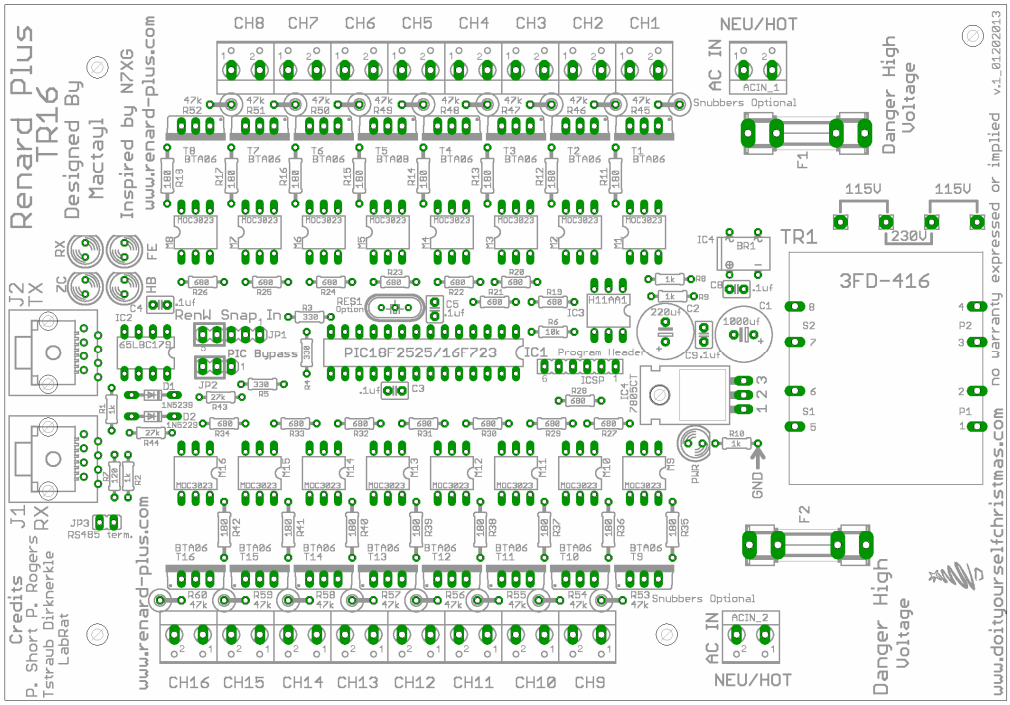


8 Pin IC (Note notch on left side of chip indicating the end with pin one.)

Assembly

Assembling the circuit board should be fairly east for most hobbyists. Start by checking the PCB over for any production faults. Ensure that none of the copper tracks are shorted or open and that the holes are clear of obstructions. Also this is a good time to inventory your parts and get them organized for easy installation

You will need a fine tip soldering iron and a high quality solder (tin/lead mix or Lead free). I use a temperature controlled soldering station and a 0.8mm solder with a rosin core.



Install the resistors:

- ☐ Install the 1K ohm resistors (brown-black-red) at locations R1, R2, R8, R9, R10,
- ☐ Install the 680 ohm resistors (blue-gray-brown) at locations R19-R34.
- ☐ Install the 330 ohm resistors (orange-orange-brown) at locations R3, R4, R5.
- ☐ Install the 10k ohm resistors (brown-black-orange) at locations R6.

☐ Install the 120 ohm resistors (brown-red-brown) at locations R7.

☐ Install the 27k ohm resistors (red-violet-orange) at locations R43, R44.

☐ Install the 180 ohm resistors (brown-gray-brown) at locations R11-R18, R35-R42.

☐ Optionally install the 47k ohm snubber resistors (yellow-violet-orange) at locations R19-R45-R52, R53-R60. .

Install Capacitors and Diodes

☐ Install the .1uf (Marked 104) capacitors at locations C3, C4, C5, C8, C9.

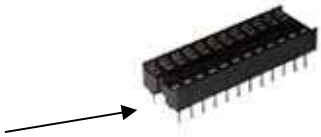
☐ Install the small glass diode 1N5229 at locations D2. The diode has a band on one end and should be installed matching the silkscreen on the board (band should point to the center of the board).

☐ Install the small glass diode 1N5239 at locations D1. The diode has a band on one end and should be installed matching the silkscreen on the board (band should point to the center of the board).

Install IC Sockets

Even though these parts are optional we strongly recommend that sockets be used on all of the IC's. Pin 1 of the IC aligns to the square solder pad on the PCB.

Pin 1 of the IC socket is on the end, closest to the notch.



☐ Install the 6 pin IC sockets at locations M1-M16, and IC3

☐ Install the 8 pin IC socket at location IC2

☐ Install the 28 pin IC socket at location IC1

Install IC Headers

You may have purchased either a single 16 pin header or headers cut according to the board specifications.

☐ Install 6 pin header at location ICSP

☐ Install 3 pin header at location JP2 and PIC Bypass

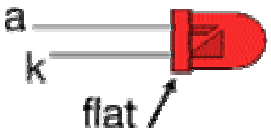
☐ Install 5 pin header at location JP1 RenW

☐ Install 2 pin header at location JP3 RS485 term.

☐ Install XXXXXXXXX above transformer -- Mac need help here

Install Misc. Parts (group 1)

LED's (light emitting diodes) must be installed according to the silk screen pattern on the board. In looking at an LED you will notice a flat spot on one side of the LED:



☐ Install the yellow LED at location FE

☐ Install the 3 red LED's at location Power, HB, ZC

☐ Install the green LED at location RX

☐ Install the bridge rectifier at location IC4. Notice that one pin on this device has s small + on it and this corresponds to the plus on the board. This in the lower left hand side.

☐ Install the voltage regular LM7805CT at location IC4. You will need to bend the leads on the regulator that matches the screw hole in the board. Do not solder yet. Once you have aligned the holes, apply a small amount to terminal compound to the back of the regulator, install it into the board, and use the 440 hardware to secure it. Once secure you may solder.

☐ Install the 1000uv 25V electrolytic capacitor at location C1. Be sure that the (+) lead is installed in the hole marked with a "+" symbol. The (+) lead is usually longer than the (-) lead, and the (-) lead is identified by a black stripe on the capacitor.

☐ Install the 220uf 25V electrolytic capacitor at location C2. Note it's orientation.

☐ Install the 4 fuse clips at location F1, and F2

☐ Install the 10 amp fuses at locations F1 and F2

☐ Install 2 terminal blocks at locations ACIN_1 and ACIN_2. ***The terminal blocks must be oriented facing outward.***

☐ Install the Transformer at location TR1 ***Note: Line up pins 1/1, 2/2, 3/3, and 4/4 according to the silkscreen layout. Be careful as the transformer can be installed backwards.***

Initial Testing

At this point enough parts have been installed to perform some simple voltage tests to insure that the board is being powered correctly, and the DC power supply is working correctly. Connect a power source to the AC IN terminal block at the top of the board. Place the board on a non-conductive surface such as glass and connect the board to an AC outlet. Once connected the Red Power LED should be lit. Perform the following voltage checks using a digital voltmeter with the ground test lead connected to ??????:

+5v	With the positive lead connected to the ??? pin of the voltage regulator (IC4) output from voltage regulator should be +5 ± 0.1 VDC
	Pin ??? of the PIC18f2525 ??????? IC1
	Pin ??? of the PIC18f2525 ???????

Once you have verified that the DC components are working correctly you can proceed to installing the remaining components.

Install Misc. Parts (group 2)

☐ Install the RJ45 modular jacks at location J1 and J2. Be careful as the pins are somewhat close together.

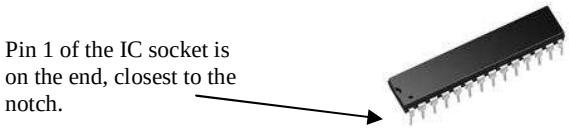
☐ Install the remaining terminal blocks at locations CH1 – CH16. ***The terminal blocks must be oriented facing outward.***

☐ Install the 16 Triacs in locations M1 – M16. The tab side of the Triac should be towards the center of the board as illustrated in the silk screen.

Install IC's

Before handling any IC, touch the bottom of the board or use a conductive wrist-strap attached to the board.

IC's pins are numbered from 1 to the number of pins counter clockwise with pin 1 being just to the right of either a notch or dimple on the IC.



☐ Install IC2 RS-485 Interface (8 pin device) 65LBC179.

☐ Install IC3 Output 0ptocoupler (6 pin device) H11AA!

☐ Install IC1 microcontroller PIC18F2525 (28 pin device)

☐ Install M1 – M16 Triac output optocouplers (6 pin device) MOC3023

Final Testing

At this point you will have now completed the installation of all of the parts to the controller. Before you go ahead and insert the PIC18F2525 into their sockets, I would suggest you visually inspect the board and check to make sure there are no solder bridges between the solder pads, and that the solder joints are all a good quality. I would also recommend cleaning the copper side (bottom) of the PCB with a quality board cleaner to remove and resin residue after soldering.

Programming the PIC18F2525

The Renard Plus TR-16 does not use the default Renard firmware used on other Renard devices. You must program the Renard Plus TR-16 with the special firmware listed on our website, www.renard-plus.com. You can plug your PICKIT programmer directly on the ICSP header making sure to align Pin1 on the ICSP header with Pin 1 of the PICKIT, or you may use a cable.

Jumper Settings / Headers

JP1 XBee Header

This header is used to connect a XBee Wireless module directly to the Renard Plus TR-16. If you are not using a XBee Wireless module, the default jumper position is a jumper across pins 4/5.

Pin Layout
1 = +5V DC
2 = N/C
3 = GND
4 = RX from 485 chip
5 = RX in to PIC

JP2 PIC Bypass

If you are using Start Address Programming, you can use the PIC bypass to allow the data to flow thru the Renard Plus TR-16 without the usual Renard "address eating". If you use a jumper across pins 1/2 then the data stream that comes into the device goes out exactly as it came in with no addresses consumed by the Renard Plus TR-16. The default position is a jumper across pins 2/3.

Pin Layout
1 = Data In From RS485 IC
2 = Data Out to RS485 IC
3 = Data Out from PIC

JP3 RS485 Terminator

??

ICSP

This header allows the PIC to be programmed or reprogrammed while still plugged into the circuit board. To use the ICSP header plug your PICKIT programmer directly onto the header, making note to align pin 1 of the header with pin1 of the PICKIT.

Pin Layout
Pin 1 = MCLR
Pin 2 = +5 volts
Pin 3 = GND
Pin 4 = PGD
Pin 5 = PGC
Pin 6 = PGM/RB5

Final Testing

The Renard Plus TR16 has 5 diagnostic LED status lights:

Diagnostic LED Status Lights

ZC	**Zero Cross** - will blink ON/OFF to indicate that the Zero Cross signal is getting to the PIC correctly
RX	**Receive Data** – Active when sequence is running
HB	**Heart Beat** – Will blink every few seconds to indicate the microprocessor is active
FE	**Frame Error** – wrong baud rate selected or data cable problem
PWR	**Power** - Will be on when power is applied

The design is fairly straight-forward and as long as you are sure of the voltage inputs and the PIC is flashed properly you should not have any issues if your soldering is good.

The data wiring of the Renard Plus TR-16 is the same as other Renard boards including the RenardSS series so you can follow the cabling requirements for that.

Connect the Renard Plus TR-16 to your PC using standard wiring practices listed below for other Renard controllers. Develop a Vixen sequence to turn on/off each channel in groups of four using the appropriate Renard plug-in. Channels 1, 5, 9, etc should have the same programming but only have 1 channel in the group (1,2,3,4) on at a time. This helps ensure you have unique channel addressing from each RJ45 output.

Connect a set of dimmable lights to channel 1 on the controller. Once that is complete you change the on/off to ramp up/downs to verify dimming operation. Finally, you can perform a full load test with 16 sets of lights installed.

Connecting the Renard to your PC

This board contains 2 RJ45 connectors that are used to receive data and pass data to the next controller.

J1 RX	RS485 incoming data from either a RS485 converter or another controller
J2 TX	RS485 outgoing data to next controller

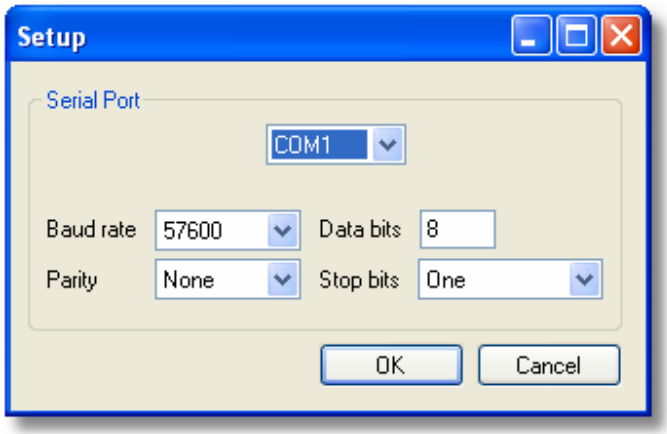
There are many options to connect your computer to the Simple Renard 32. Below is a picture of the Hexim HXSP-2018F USB to RS485 adapter:

When selecting an adapter look for ones that have an easy to use screw terminal like this one.

Computer Setup

VIXEN Settings the Simple Renard 32 Combo requires the Renard Dimmer [Vixen 1.1.*] or Renard Dimmer (modified) [Vixen 2.*] Plug-In.

Renard Dimmer Plug-In Settings:

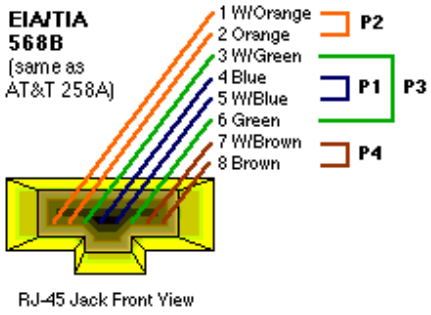


If you are using Xbees the baud rate must be 57600.

RJ45 Wiring

A standard RJ 45 networking cable can be used to connect the TR16 to your RS485 signal source. Just check and make sure that the pins on one end of the cable connect to the same pin on the other end of the cable.

Here is an example of a data cable wired to the EIA-568B standard. There are eight pins, numbered from left to right, looking at the jack. While you only need six wires in your in SSR interface cable, it is just easier to wire up all eight as per the cabling standard.

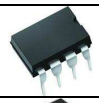
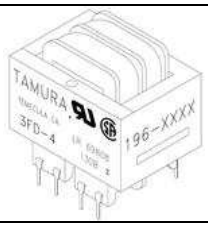


EIA-568B RJ45 Socket

Option 2 Xbee using Snapin Board

Renard Plus TR16 Parts List

Picture	Designators	Description	Qty	Mouser P/N
	R1, R2, R8, R9, R10	1k ohm resistor 1/8 watt	5	299-1k-RC
	R19 – R34	680 ohm resistor 1/8 watt	16	299-680-RC
	R3,R4,R5	330 ohm resistor 1/8 watt	3	299-330-RC
	R6	10k ohm resistor 1/8 watt	1	299-10k-RC
	R7	120 ohm resistor 1/8 watt	1	299-120-RC
	R43, R44	27k ohm resistor 1/8 watt	2	299-27k-RC
	R11-18, R35-42	180 ohm resistor 1/8 watt	16	299-180-RC
	R45-52,R53-60	47K 1/2 watt (Optional) Snubber	16	293-47k-RC
	D2	1N5229 (4.3v) zener diode	1	78-1N5229B
	D1	1N5239 (9.1v) zener diode	1	78-1N5239B
	C1	1000uf 25V Electrolytic Cap	1	647-UVZ1E102MPD
	C2	220uf 25V Electrolytic Cap	1	647-UVZ1E221MPD
		T Blocks 5.08MM PCB PC1-C16,AC/NEU	18	571-7969492
	C3, C4, C5, C8,C9	.1uf cap	5	81-RPEF51104Z2S2A03A
		Terminal Blocks, 5.08mm PCB	18	571-2828372
	J1-J2	Modular Jacks 8 PCB TOP ENTRY	2	571-5556416-1
		IC Sockets 6P ECONOMY TIN (Optional)	17	571-1-390261-1
		8 pin IC socket (optional)	1	517-4808-3004-CP
	IC1	IC & Component Sockets 28P	1	571-1-390261-9
		16 pin header cut to fit: ICSP, JP2 PIC Bypass, JP1 RenW, JP3 RS485	1	571-16404526

		term.		
		Shunts for XBheader and Bypass	3	737-MSC-G
	IC4	LM7805CT voltage regulator	1	512-LM7805CT
		T1-T16 Triac 6AMP snubberless	16	511-BTA06-600CW
	IC2	65LBC179	1	595-SN65LBC179P
	IC3	H11AA1	1	782-H11AA1
	M1-M16	Triac Output Optocouplers MOC3023	16	859-MOC3023
		BR1 4 pin Bridge rectifier 1amp dip	1	625-DF02MA-E3
	IC1	PIC Microcontrollers (MCU) 48KB 3968	1	579-PIC18F2525-I/SP
	FE	yellow 5 MM LED		78-TLHY5405
	Power, HB, ZC	Red 5 MM LED	3	78-TLHR5401
	RX	Green 5 MM LED	1	78-TLHG5401
		5mm x 20mm Medium Time Delay Fuse 125VAC 12Amp	2	504-GMC-12
		Fuse Clips and Holders PC FUSE CLIP 5 MM	4	576-05200001N
		Fuse Cover (Optional)	2	534-3527C
		Transformer pri.115/230volts sec.8volts 800ma.	1	3FD-416
		RES1 resonator 16mhz (Optional)	1	81-CSTLS16M0X53-B0

Parts Placement Diagram