

Modular Backplane For RC2014 User Guide

For module: SC112 version 1.0

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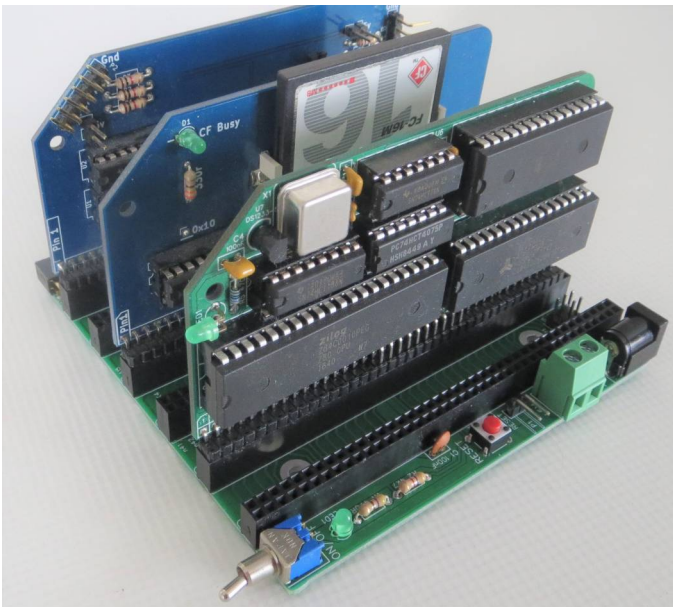
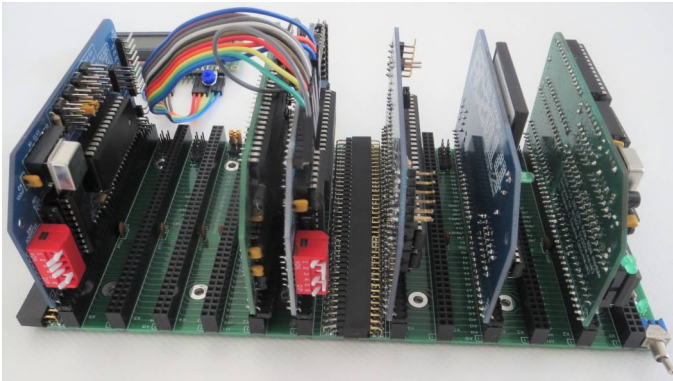
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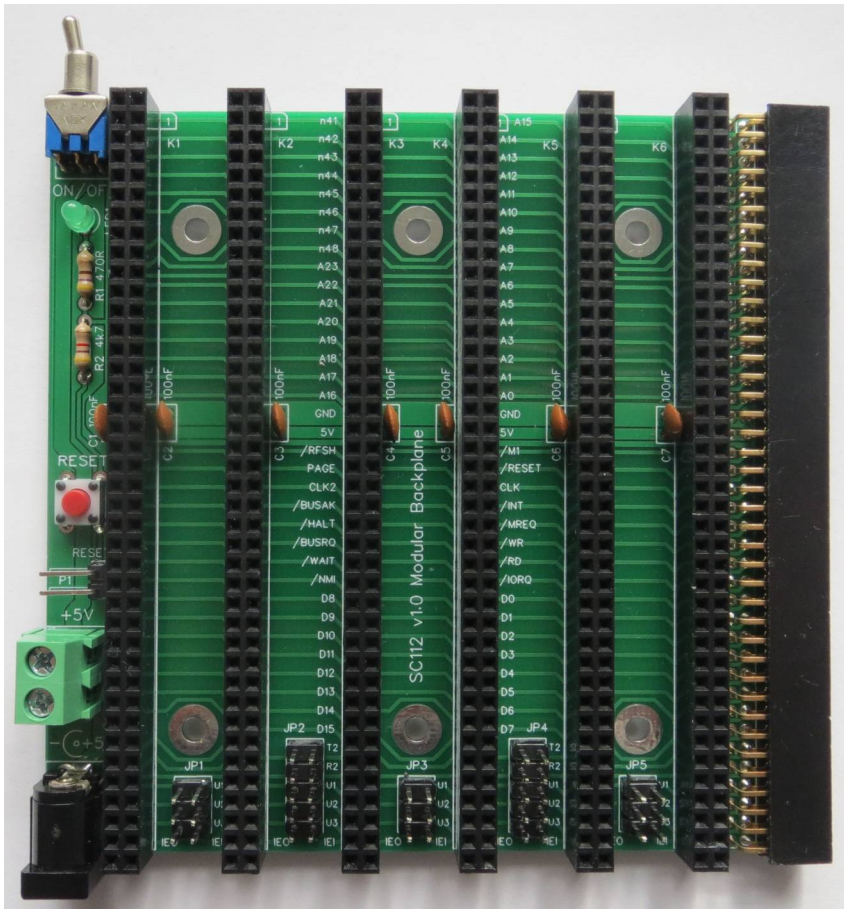
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Overview

My goal is to produce a number of backplane **sections** which can be joined together to form a larger backplane, or used individually for small systems. Not only can the backplane be of variable length, but it can be made of sections that have any special features required. It could even allow cards with different types of bus connector to be used together.



This backplane section has six RC2014 (80 pin) card sockets, a power supply input and an 80 pin expansion socket. Jumpers allow some signals to be isolated or connected between module sockets.

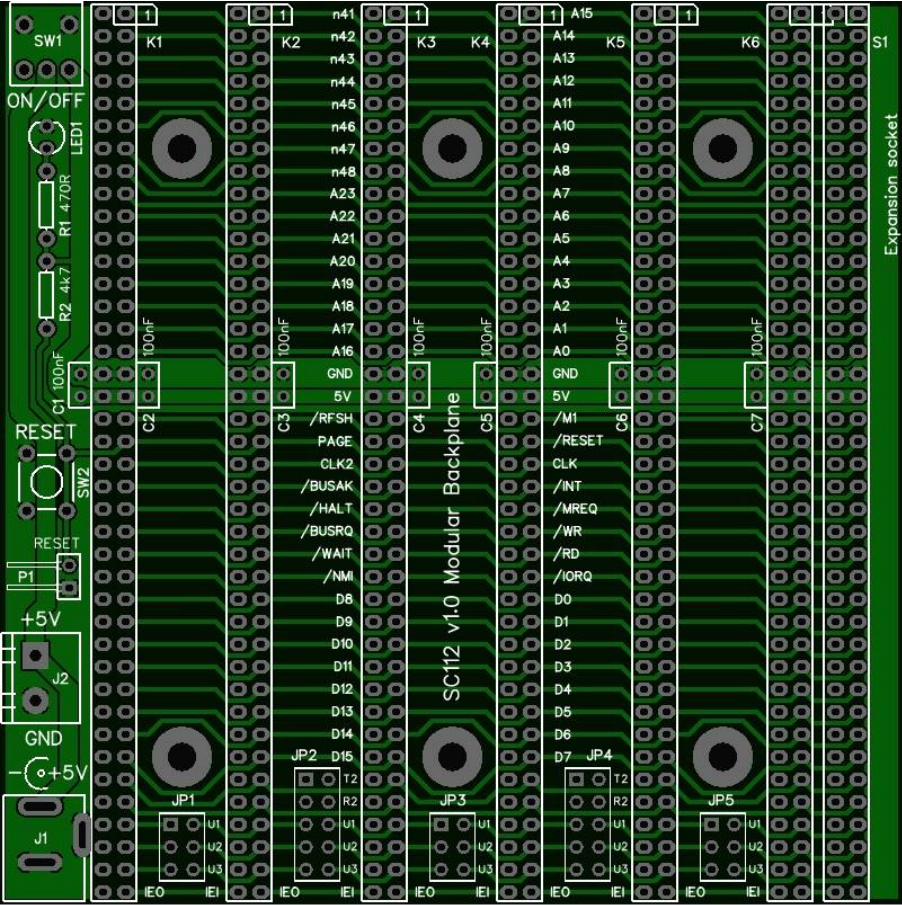


Pin 40 of the standard RC2014 bus is used for the Z80 interrupt daisy chain signal IEO, with the 40th pin of the enhanced bus, sometimes called pin 80, being used for the IEI signal. These two pins therefore do not connect to all 6 sockets in parallel, but instead link pin 40 of one socket to pin 80 of the next, forming a chain.

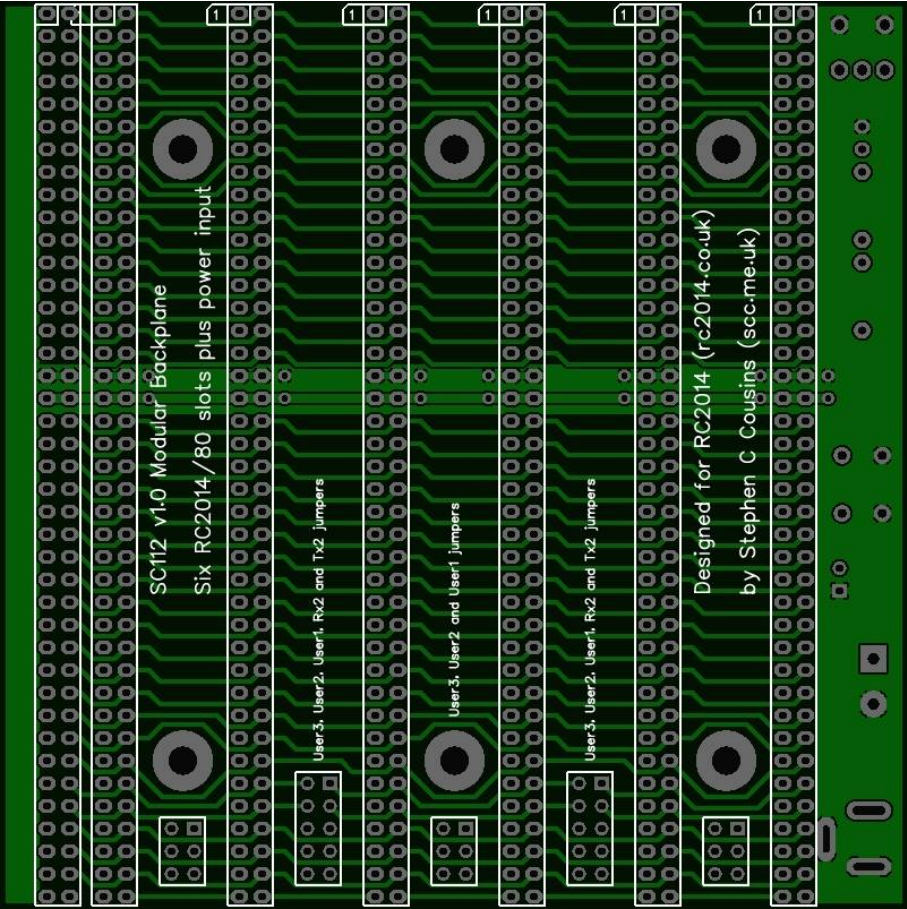
Printed Circuit Board

The printed circuit board is 4 inches by 4 inches (101.6 mm by 101.6 mm).

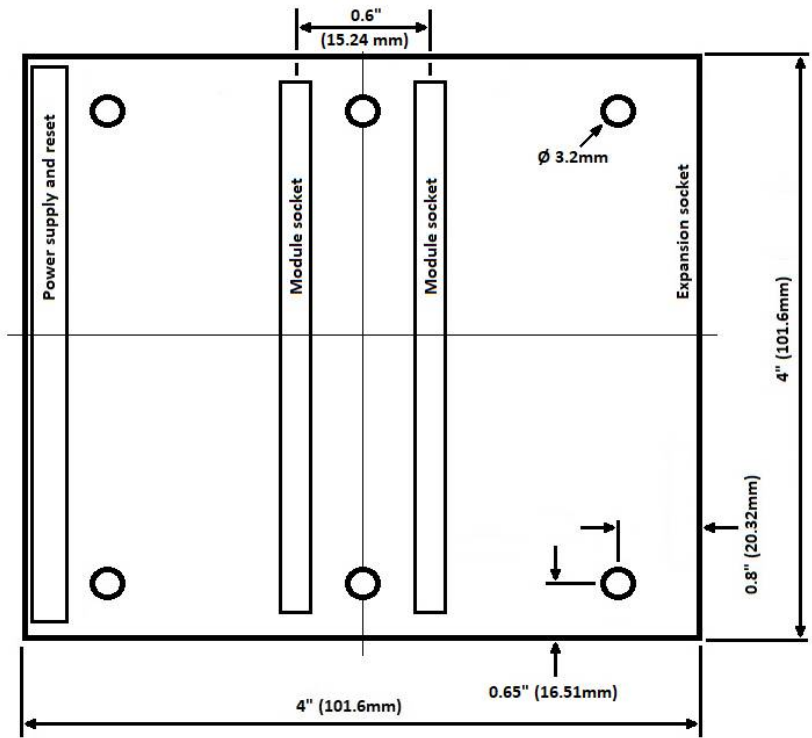
Printed circuit board, top/component side:



Printed circuit board, bottom/solder side:



The circuit board's layout and dimensions are shown below.

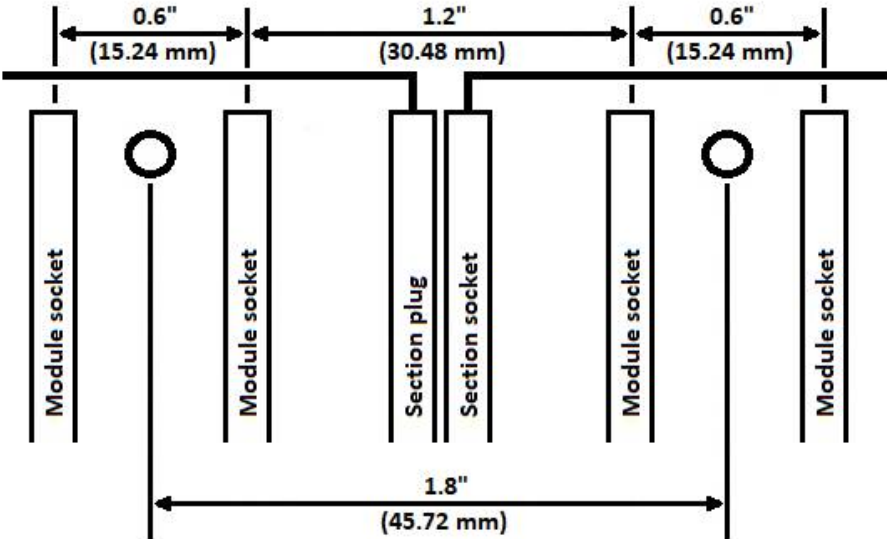


There are six fixing holes, symmetrically placed.

This backplane section has six RC2014/80 module sockets, 0.6" apart, and centred on the circuit board.

Jumpers are provided to enable some bus signals to be isolated or connected to adjacent module sockets.

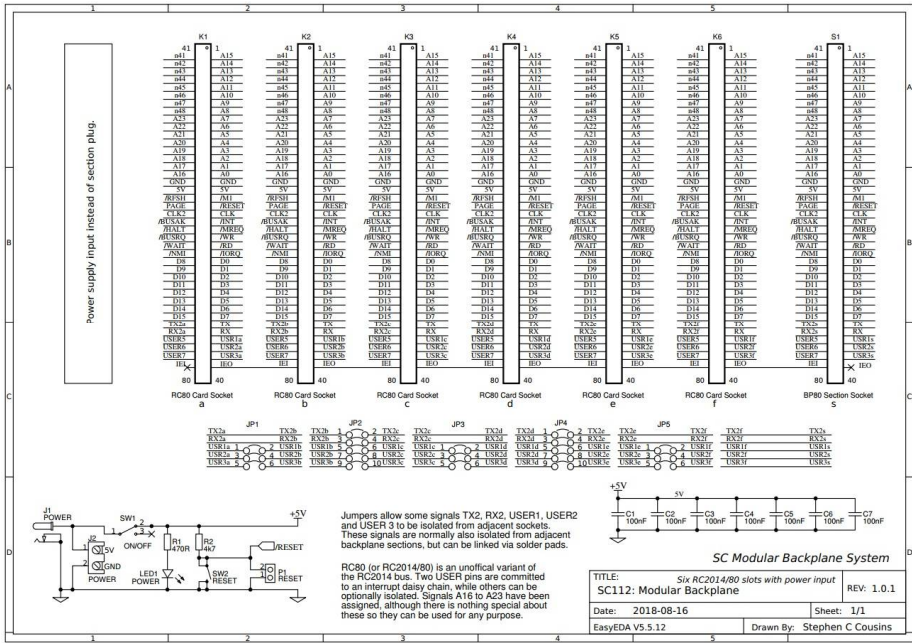
The spacing between two joined sections is shown below.



This spacing is for modular backplane sections that are connected with through hole connectors, such as SC113, not the alternative design using edge mounted connectors.

For further information about the Modular Backplane system consult the document "Modular Backplane Specification" at www.scc.me.uk

Schematic



A high quality version of the schematic is available as a separate PDF.




Errata

None yet.

What You Need

The following components are required to assemble the module with its full functionality and jumper options. Header pins JP1 to JP5, and P1, may need to be cut from longer strips.

Image	Qty	Reference	Description
	1	PCB	Printed circuit board SC112 Backplane with PSU
	7	C1 to C7	Capacitor 100nF, ceramic, lead spacing = 2.54mm
	3	JP1, JP3 and JP5	Pin header, male, 2 rows x 3 pins, straight
	2	JP2 and JP4	Pin header, male, 2 rows x 5 pins, straight
	19	JP1 - JP5 shunt	Jumper shunt for pin spacing = 2.54mm (unlikely to need all 19)
	1	P1	Pin header, male, 1 row x 2 pins, angled
	1	S1	Pin header, socket, 2 rows x 40 pins, angled
	6	K1 to K6	Pin header, socket, 2 rows x 40 pins, straight
	1	R1	Resistor 470R, axial, 5%, carbon film, 0.25W or 0.125W
	2	R2	Resistor 4k7, axial, 5%, carbon film, 0.25W or 0.125W
	1	LED1	LED, green, 3mm
	1	SW1	Switch, tactile toggle, sub-miniature, SPDT

	1	SW2	Switch, tactile button
	1	J1	Socket, power, barrel, 2.1mm
	1	J2	Screw terminal, 2 way, 5.08mm pitch


Also required to assemble the module from the above components:

- Long nose pliers
- Side cutters
- Soldering iron
- Solder
- PCB cleaning materials

Components: What They Do & Where To Get Them


Each component is described below. I have listed multiple sources for most components, but have not actually tried all of them, so best treat the specified part numbers as guidance only. Where eBay is listed as a supplier, the part is likely to be cheaper there than the other sources, sometimes considerably cheaper. Further savings are usually possible by ordering parts direct from countries like China.

PCB

Image	Qty	Reference	Description
	1	PCB	Printed circuit board SC112 Backplane with PSU
		Supplier	Part number
		EasyEDA	Search EasyEDA.com for RC2014 Backplane


The PCB is currently only available to be ordered from EasyEDA.com, although you can download the Gerber and send it to your preferred manufacturer.

C1 to C7

Image	Qty	Reference	Description
	7	C1 to C7	Capacitor 100nF, ceramic, lead spacing = 2.54mm
		Supplier	Part number
		Farnell	1100533
		Mouser	75-1C10Z5U104M050R
		RS	699-5027


These capacitors provide power supply decoupling (or bypass). The fast switching in digital circuits creates spikes on the power supply lines which are suppressed with decoupling capacitors placed at key points on the circuit board.

JP1, JP3 and JP5

Image	Qty	Reference	Description
	3	JP1, JP3 and JP5	Pin header, male, 2 rows x 3 pins, straight
		Supplier	Part number
		eBay	200906546562 (2x40 pin to be cut to length)
		Farnell	2356151 (2x40 pin to be cut to length)
		Mouser	710-61308021121 (2x40 pin to be cut to length)
		RS	155-721 (2x40 pin to be cut to length)

These jumpers allow backplane signals USER1, USER2 and USER3 to be either isolated or connected to adjacent sockets.

JP2 and JP4

Image	Qty	Reference	Description
	2	JP2 and JP4	Pin header, male, 2 rows x 5 pins, straight
		Supplier	Part number
		eBay	200906546562 (2x40 pin to be cut to length)
		Farnell	2356151 (2x40 pin to be cut to length)
		Mouser	710-61308021121 (2x40 pin to be cut to length)
		RS	155-721 (2x40 pin to be cut to length)

As with JP1, JP3 and JP5, these jumpers allow backplane signals USER1, USER2 and USER3 to be either isolated or connected to adjacent sockets. The extra two jumper positions allow TX2 and RX2 to be either isolated or connected to adjacent sockets.


Due to the number of modules now using the signals USER1, USER2, USER3, TX2 and RX2, it may be necessary to isolate some modules from others to prevent conflicts.

In addition, some modules use USER pins to create interrupt daisy chains. In such cases the required pins can be linked with jumper wires (eg. Dupont wires) or by soldering links under the board.

To create a simple straight through backplane, fit jumper shunts in all positions.


Warning: If you have modules with single row RC2014 bus pins, the modules sit lower and can hit these jumpers. If this is a problem then solder wire links instead of fitting these jumper header pins.

JP1 - JP5 shunts

Image	Qty	Reference	Description
	19	JP1 - JP5 shunt	Jumper shunt for pin spacing = 2.54mm (unlikely to need all 19)
		Supplier	Part number
		eBay	201261690156
		Farnell	2396303
		Mouser	649-68786-102LF
		RS	674-2397


These shunts (small sockets) connect the required pins on JP1 to JP5.

P1

Image	Qty	Reference	Description
	1	P1	Pin header, male, 1 row x 2 pins, angled
		Supplier	Part number
		eBay	200906546562 (1x40 pin to be cut to length)
		Farnell	2356192 (1x40 pin to be cut to length)
		Mouser	710-61304011021 (1x40 pin to be cut to length)
		RS	156-077 (1x40 pin to be cut to length)


This header allows an external reset switch to be connected to the backplane. Fitting this header is optional.

S1

Image	Qty	Reference	Description
	1	S1	Pin header, socket, 2 rows x 40 pins, angled
		Supplier	Part number
		eBay	382468980400 (from China)
		Farnell	1807736 (very expensive)
		Mouser	Could not find this part
		RS	Could not find this part


This connector provides a means to plug in another modular backplane section. If you only want a single 6 slot backplane then there is no need to fit this socket.

K1 to K6

Image	Qty	Reference	Description
	6	K1 to K6	Pin header, socket, 2 rows x 40 pins, straight
		Supplier	Part number
		eBay	200906546562 (from UK)
		eBay	362278235395 (from Hong Kong)
		Farnell	1807410 (very expensive)
		Mouser	200-BCS140LDTE (very expensive)
		RS	765-5859 (very expensive)


These connectors are the sockets into which RC2014 modules are plugged.

R1

Image	Qty	Reference	Description
	1	R1	Resistor 470R, axial, 5%, carbon film, 0.25W or 0.125W
		Supplier	Part number
		Farnell	9339531
		Mouser	603-CFR-25JR-52470R
		RS	707-7647


This is the current limit resistor for the power LED indicator. The value can be reduced to 330R if you want a really bright light, or increased to about 1k if you'd rather have a very dim light. If in doubt use the suggested value of 470R.

R2

Image	Qty	Reference	Description
	2	R2	Resistor 4k7, axial, 5%, carbon film, 0.25W or 0.125W
		Supplier	Part number
		Farnell	9339540
		Mouser	603-CFR-25JR-524K7
		RS	707-7726


This resistor pulls up the reset line when the reset switch is not being pressed.

LED1

Image	Qty	Reference	Description
	1	LED1	LED, green, 3mm
		Supplier	Part number
		Farnell	1581114
		Mouser	859-LTL-4231N
		RS	127-8401


Power to the backplane is indicated by this LED.

SW1

Image	Qty	Reference	Description
	1	SW1	Switch, tactile toggle, sub-miniature, SPDT
		Supplier	Part number
		eBay	361064456690
		Farnell	9574590
		Mouser	706-34CMSP12B2M6RT
		RS	734-7220


This switch turns on and off power from J1 or J2. It does not control power from other sources, such as FTDI style serial cables.

SW2

Image	Qty	Reference	Description
	1	SW2	Switch, tactile button
		Supplier	Part number
		Farnell	2468761 (red button)
		Mouser	612-TL1105BF100 (black button)
		RS	479-1413 (black button)


This is the reset switch, which pulls down the backplane's RESET signal.

J1 socket

Image	Qty	Reference	Description
	1	J1	Socket, power, barrel, 2.1mm
		Supplier	Part number
		Farnell	Could not find a matching part
		Mouser	163-179PH-EX
		RS	448-382

The barrel connector provides one means of connecting a regulated 5 volt DC supply to the backplane. The centre pin is positive.

J2 terminal

Image	Qty	Reference	Description
	1	J2	Screw terminal, 2 way, 5.08mm pitch
		Supplier	Part number
		Farnell	2859589 (green)
		Mouser	649-220316-H021B01LF (green)
		RS	146-8345 (green)
		RS	425-8720 (black)

The screw terminal connector provides one means of connecting a regulated 5 volt DC supply to the backplane.

The power supply must be regulated 5 volt D.C. ideally in the range of 4.9 to 5.1 volts. The components will tolerate up to 5.5 volts, but the nearer to 5.0 volts the better.

The power supply must be capable of delivering all the current the system requires without the voltage dropping. The current depends on factors such as how many modules are connected, but a modest system will typically use less than 250 mA.

Assembly Guide

This guide assumes you are familiar with assembling circuit boards, soldering and cleaning. If not, it is recommended you read some of the guides on the internet before continuing.

First check you have all the required components, as listed in the section “What You Need”. Header pins JP1 to JP5, and P1, may need to be cut from longer strips.

Step 1



Fit and solder R1 (shown in red below).

Colour code for 470R resistor: Yellow, Violet, Brown

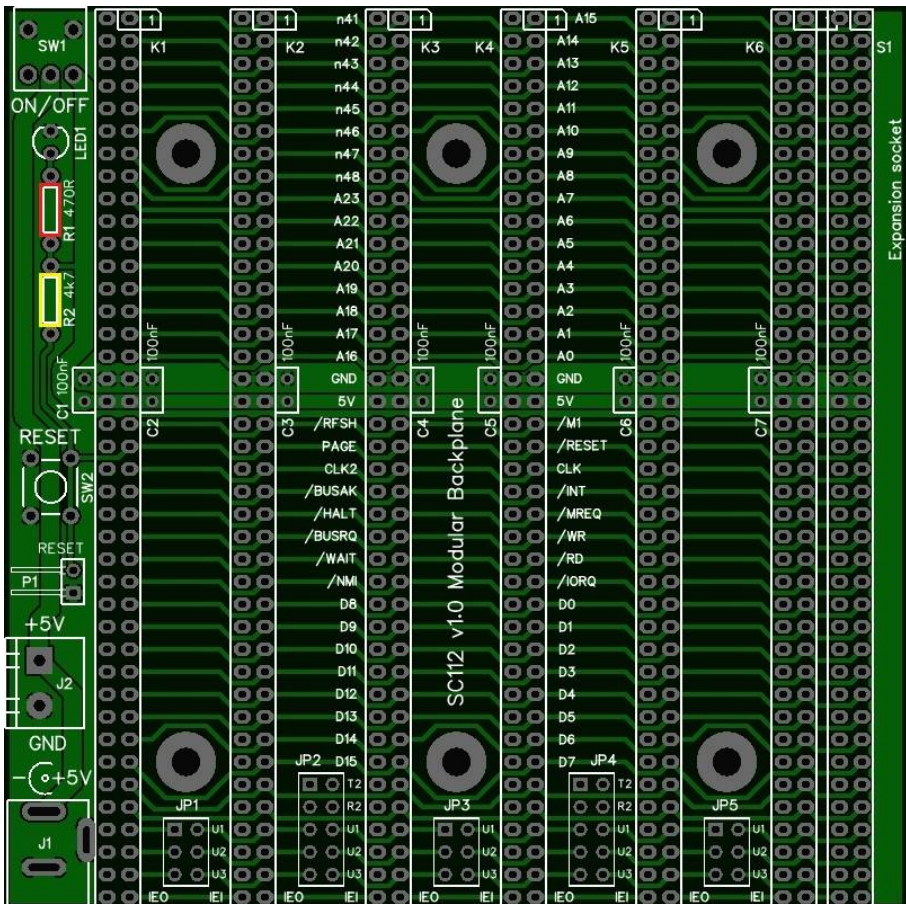


Fit and solder R2 (shown in yellow below).

Colour code for 4k7 resistor: Yellow, Violet, Red



These can be fitted either way round, as they are not polarity dependent.

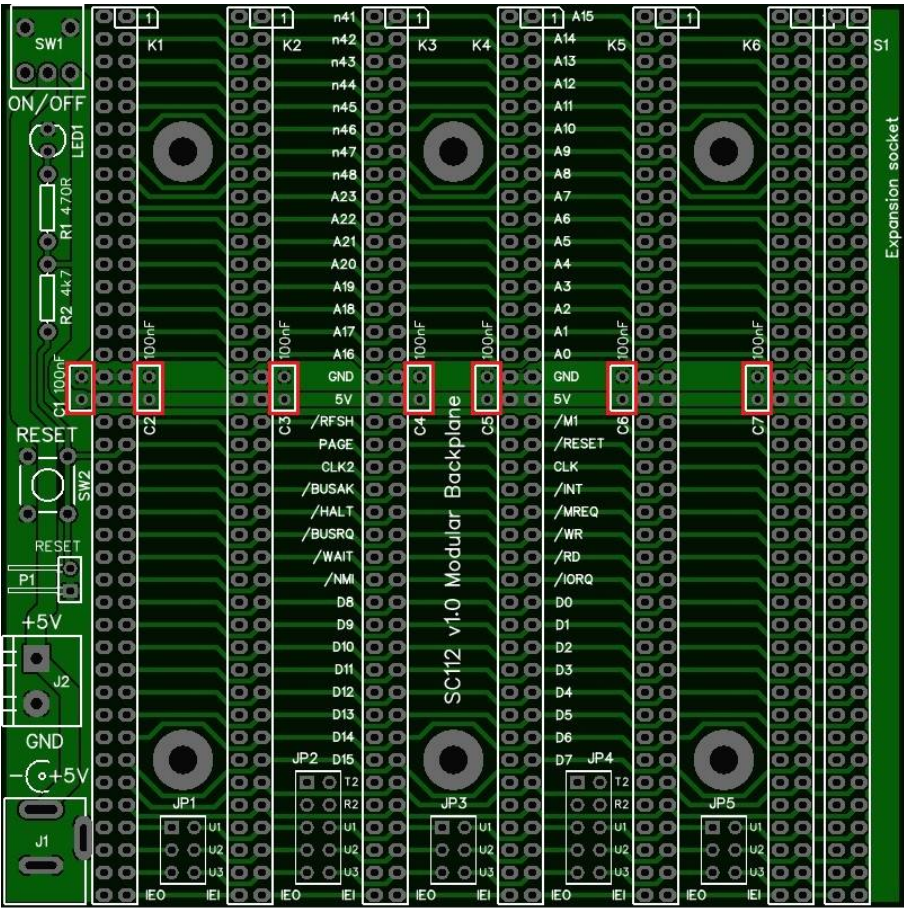


Step 2



Fit and solder capacitors C1 to C7.

These can be fitted either way round, as they are not polarity dependent.



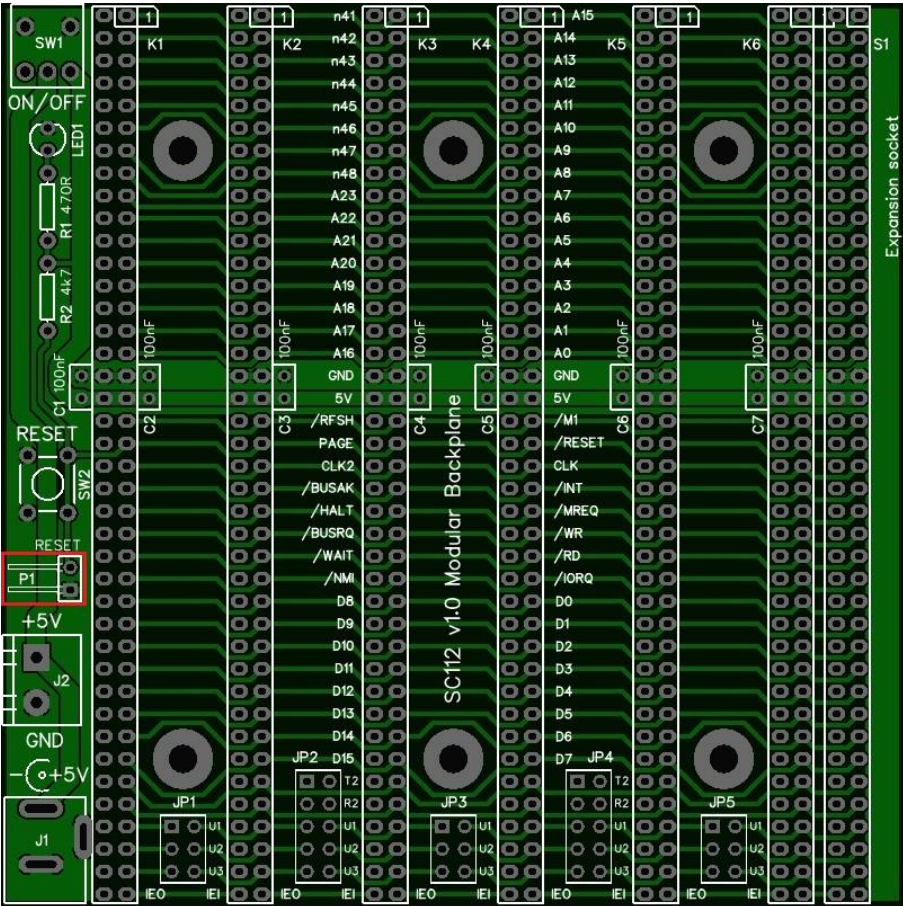
Step 3



Fit and solder P1.

This header allows an external reset switch to be connected to the backplane.

Fitting this header is optional.



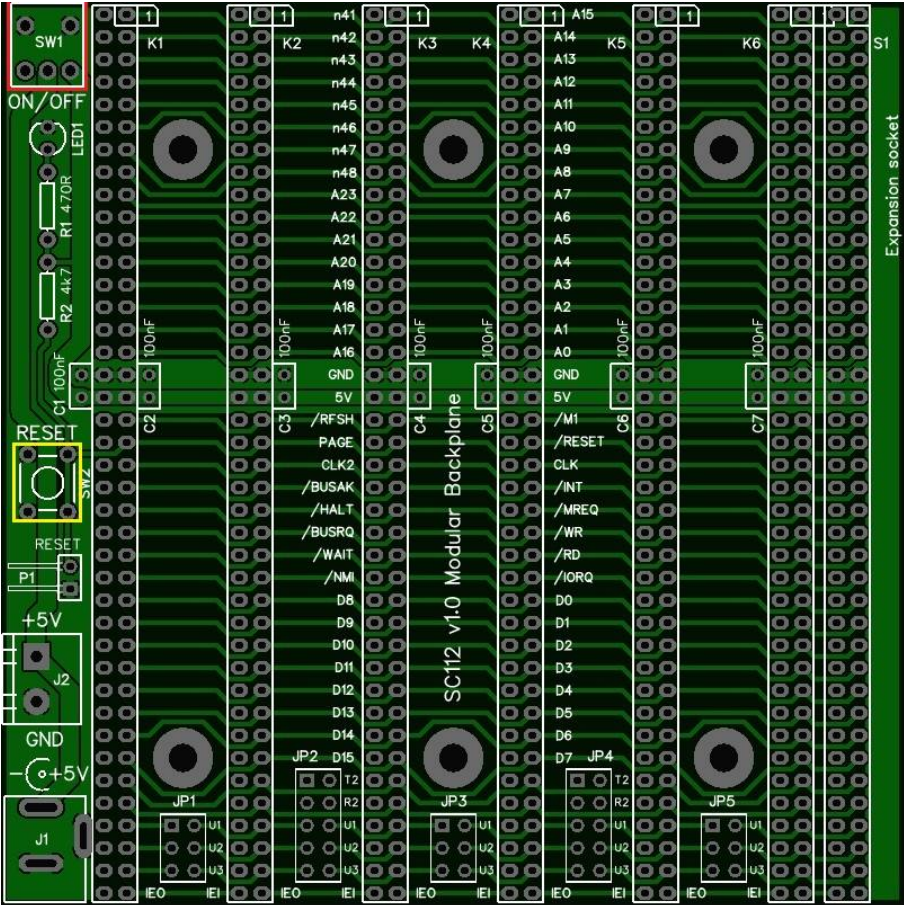
Step 4



Fit and solder SW1 (shown in red below).



Fit and solder SW2 (shown in yellow below).



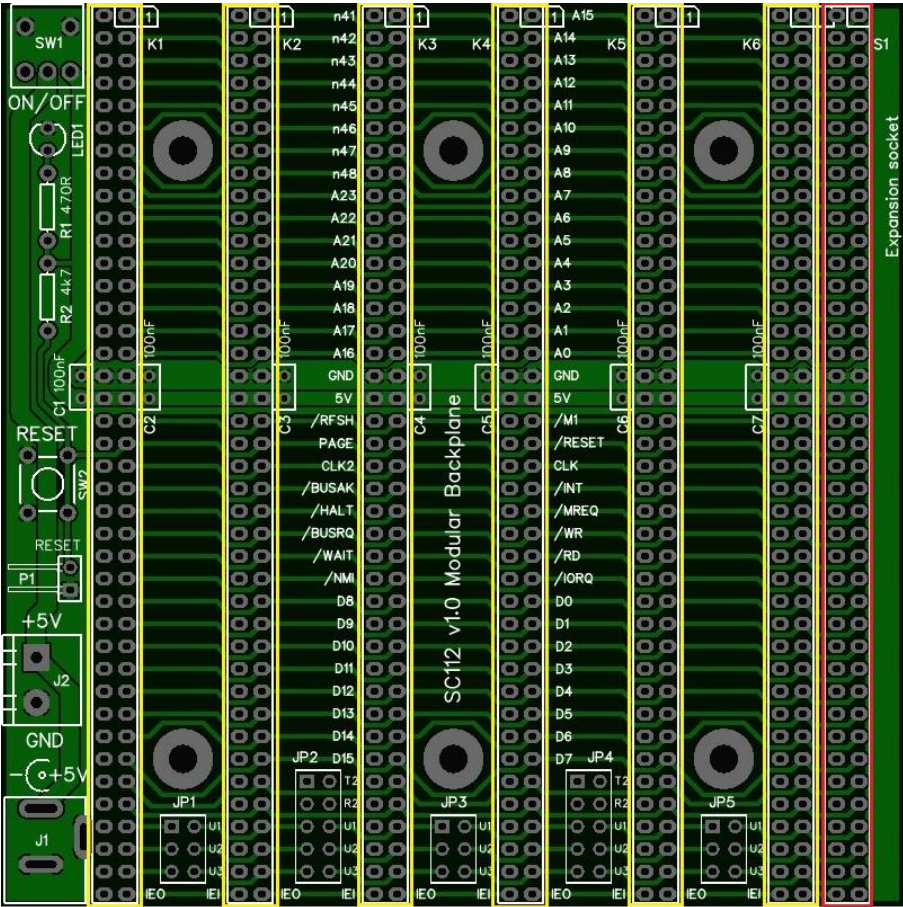
Step 5



Fit and solder S1 (shown in red below).



Fit and solder K1 to K6 (shown in yellow below).



Step 6

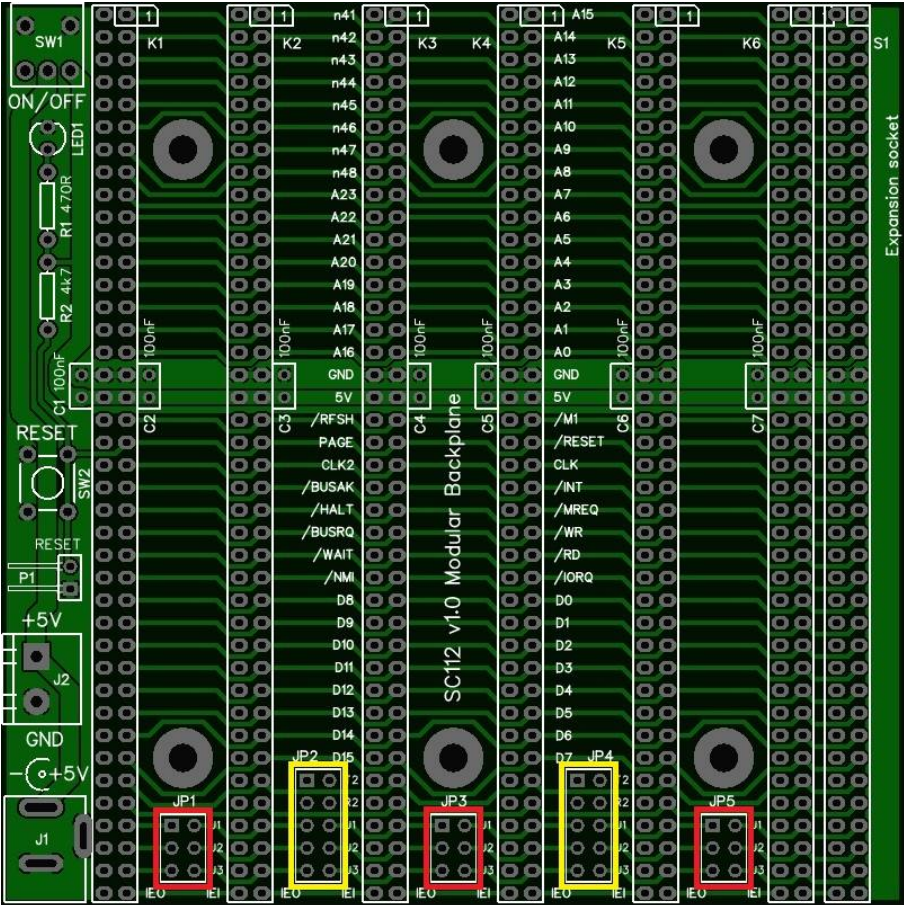


Fit and solder JP1, JP3 and JP5 (shown in red below).



Fit and solder JP2 and JP4 (shown in yellow below).

Warning: If you have modules with single row RC2014 bus pins, the modules sit lower and can hit these jumpers. If this is a problem then solder wire links instead of fitting these jumper header pins.

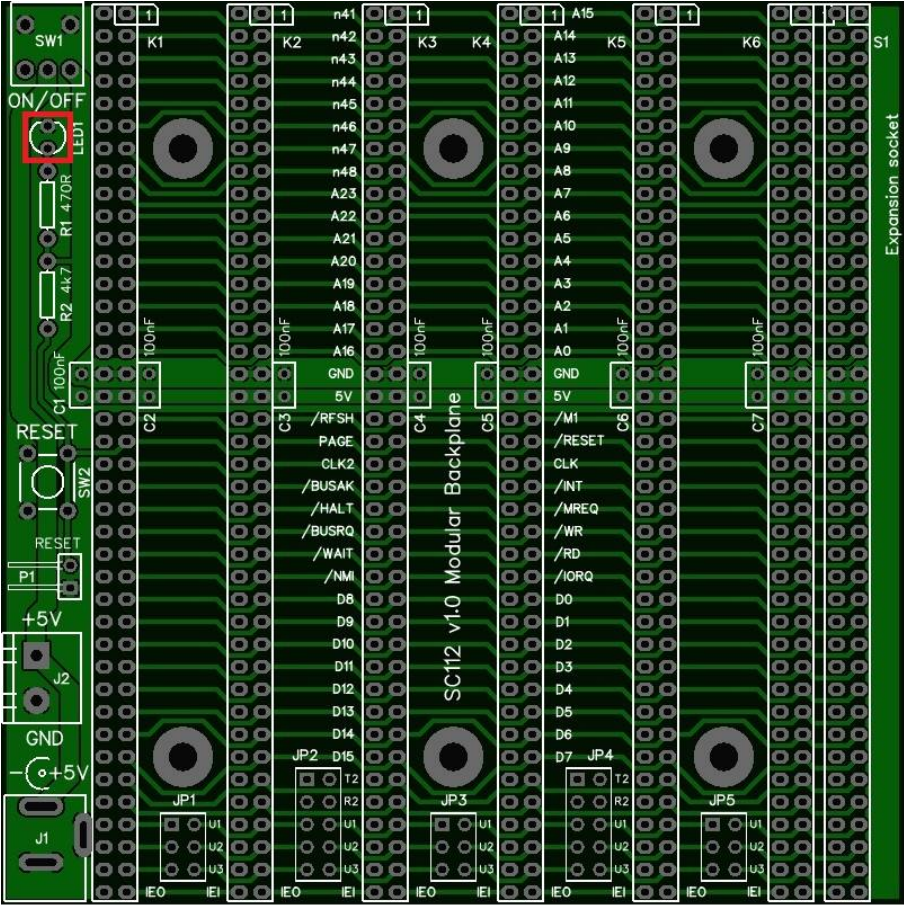


Step 7



Fit and solder LED1.

It is important to fit this component the right way round. The cathode lead is usually shorter than the anode lead, and the cathode side is usually marked with a flat side on the plastic. The cathode is nearest the on/off switch (SW1).



Step 8

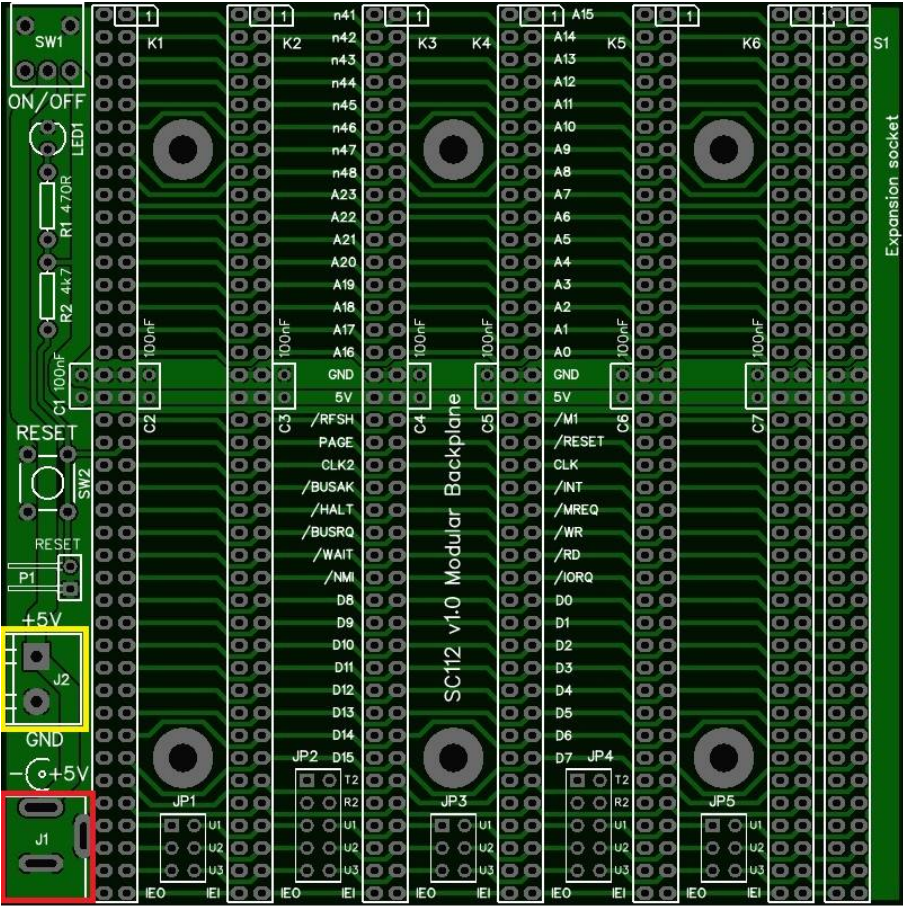


Fit and solder J1 (shown in red below).



Fit and solder J2 (shown in yellow below).

J2 must be fitted with the wire access facing the edge of the board.



Step 9

Remove any solder 'splats' with a brush, such as an old toothbrush.

Visually inspect the soldering for dry joints and shorts.

Clean the flux off with suitable cleaning materials.

Visually inspect again.

Before fitting any RC2014 modules to the backplane, connect a regulated 5 volt DC power supply to either J1 or J2.

- Check the power LED lights when the ON/OFF switch is ON.
- Check the voltage on resistor R2, at the end nearest the reset switch, is at least 4.5 volts when the reset switch is not pressed, and drops to less than 0.4 volts when the reset switch is pressed.

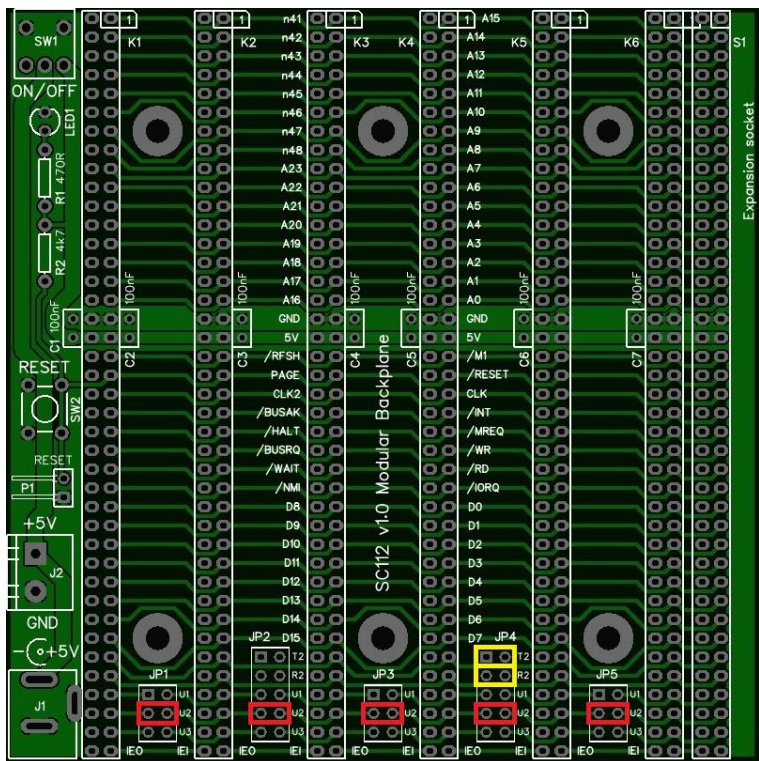
If all is well, power down and plug in some RC2014 modules.

Configuring the Backplane

The only configuration options for the backplane are to connect or isolate adjacent card slots with jumpers on JP1 to JP5.

JP1 to JP5 allow bus signals USER1, USER2 and USER3 to be connected to adjacent sockets, when the jumper shunts are fitted, or isolated from adjacent sockets when the jumper shunts are not fitted. JP2 and JP4 have additional jumper positions for bus signals TX2 and RX2.

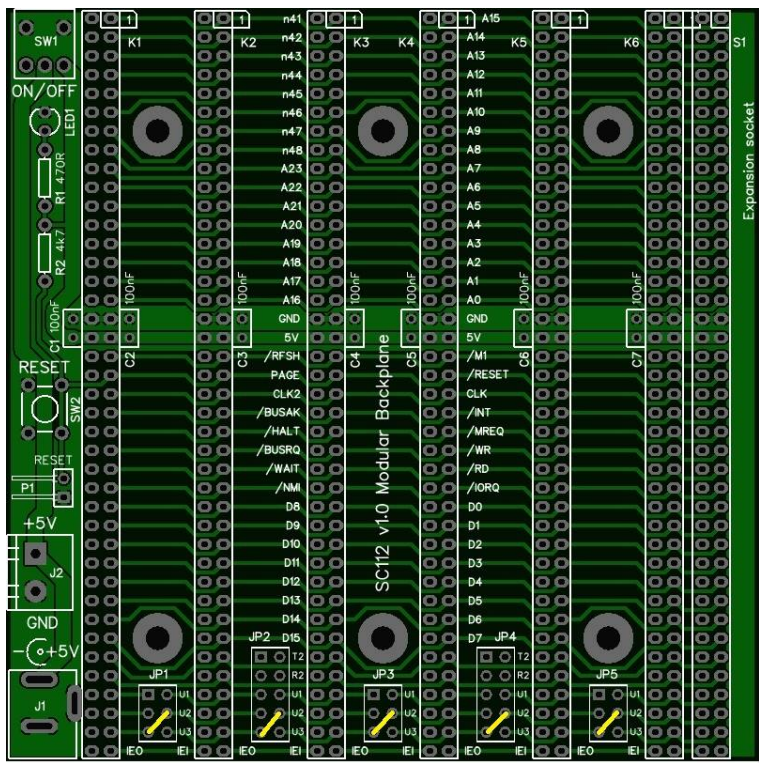
The illustration below shows jumper shunt positions, shown in red, to link signal USER2 to all 6 module sockets. It also shows jumper shunt positions, shown in yellow, to connect TX2 and RX2 between module sockets K4 and K5.



Signals TX2 and RX2 are hard wired between module socket pairs K1 and K2, and K3 and K4, and K5 and K6. Thus with shunts in the positions shown above in yellow, TX2 and RX2 are common to K3, K4, K5 and K6.

Some RC2014 modules use USER2 and USER3 for the interrupt daisy chain signals IEI and IEO.

The illustration below shows links required to implement this daisy chain.



The interrupt daisy chain links the IEO output of one module to the IEI input of the module to its right, as illustrated above. Where USER2 (pin 38) is IEI and USER3 (pin 39) is IEO.

Dupont cables could be used to make these links, although standard cables will likely be rather long. Alternatively wire links could be soldered on the bottom of the boards for a more permanent and tidier solution.

Purchasing the Printed Circuit Board

Currently the circuit board is available from EasyEDA (in China), or more accurately from their production partner JLCPCB.

You can download Gerber files from EasyEDA and send them to your preferred manufacturer, but the following describes the ordering process through EasyEDA.

Browse to [EasyEDA.com](https://www.easyeda.com)

Select the main menu item "Explore"

In the search box, enter "RC2014 SC112" or "sccousins"

Select, from the list shown, the project "SC112 v1.x Backplane with PSU"

The project's details should now be displayed.

Select "Open in Editor" (the button next to the circuit board illustration, not the one next to the schematic).

Select "Generate Fabrication File (Gerber)" to get a summary of the board details.

Select "Generate Gerber" to download the Gerber files or "Order at JLCPCB" to order the boards direct from JLCPCB. Selecting "Order at JLCPCB" requires you to log in (or create an account and log in).

Wait for the progress bar to complete.

You should now be presented with the image of each side of the board and the following options:

Layers	2	
Dimensions	101 x 101 mm	
PCB Qty	10	There is no saving selecting less than 10
PCB Thickness	1.6	
PCB Colour	Green	You may want to change this to Blue
Surface Finish	HASL	
Copper Weight	1 oz	
Gold Fingers	No	
Material Details	FR4-Standard Tg 140C	
Panel By JLCPCB	No	
Different Design	1	

Note, the price increases significantly if you select a colour other than green.

Select "Save to Cart"

Select "Checkout securely"

Enter your details and select your shipping options.

And finally complete the order.

History

2018-08-16	v1.0	First circuit boards yet to be manufactured
2018-09-19	v1.0	First circuit board manufactured and assembled
2018-09-19	e1.0.1	This document updated to edition 1.0.1: Updated photos and minor corrections and additions
2019-03-06	e1.0.2	Revised this user guide General improvements plus corrected some component part numbers

Contact Information

If you wish to contact me regarding this document, or the hardware and software it relates to, use the contact page at www.scc.me.uk

Stephen C Cousins, Chelmsford, Essex, United Kingdom.

Modular backplane information

Information about other compatible modular backplane sections can be found at www.scc.me.uk

RC2014 information

Information about the RC2014 system can be found at www.rc2014.co.uk

RC2014 support

Issues related to the RC2014 can be posted on the google group "RC2014-Z80".

RC2014 supplies

Parts can be purchased through Tindie at www.tindie.com (search "RC2014")

Official RC2014 parts are at:

<https://www.tindie.com/stores/Semachthemonkey/>

Credits

The design of my first modular backplanes (SC105, SC106 and SC107) was inspired by Jon Langseth's Z50Bus 5 slot backplane, which is available to extend the LiNC80 SBC1. Thanks Jon.

This design (SC112) is the result of improvements made from the earlier designs. In addition these earlier backplanes have provided feedback from other RC2014 users. So thanks to those who have provided valuable feedback and comments.

A further influence has been Tom Szolyga. I've recently been discussing many aspects of retro computers with Tom and we have been actively working towards some common designs, including modular backplanes. This design (SC112) is one of the first products to (hopefully) meet the specification we've been working on. Thanks Tom.