Z80 SIO/2 Module For RC2014

User Guide

For module: SC104 version 1.0

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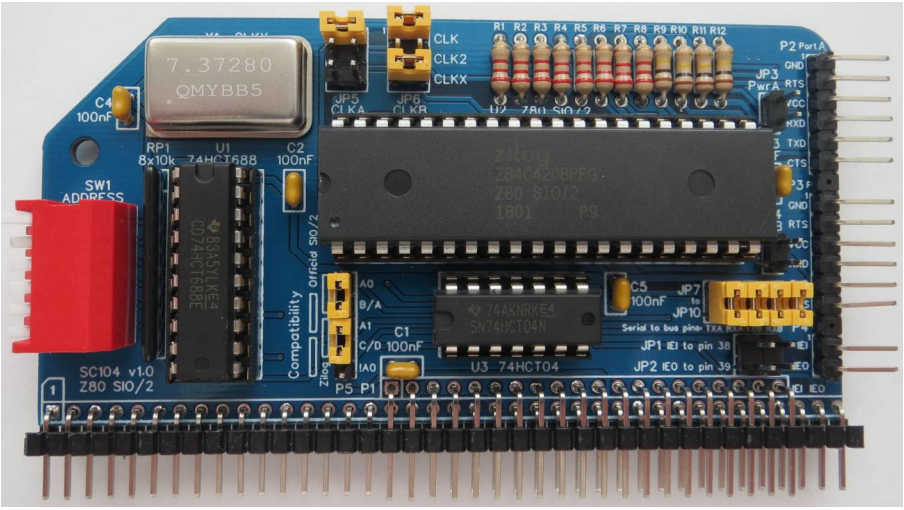
Edition 1.0.1

CONTENTS

Overview

The Z80 SIO/2 module (SC104) provides two TTL serial ports with very flexible input and output connectivity, as well as support for Z80 mode 2 interrupt daisy chaining.



Each port has transmit, receive, request to send and clear to send signals brought out to connectors on the back edge of the module. The transmit and receive signals may also be connected to the standard RC2014 bus pins via jumpers.

Each channel has a jumper to select one of three clock signals:

- RC2014 bus primary clock (CLK)
- RC2014 bus secondary clock (CLK2)
- The module's on-board oscillator output (CLKX)

The RC2014 bus secondary clock can either be generated by the official dual clock module or the SC102 Z80 CTC module. The official clock module sets the baud rate with a jumper, while the CTC allows the baud rate to be set with software.

The module has an on-board oscillator option. If fitted it can be:

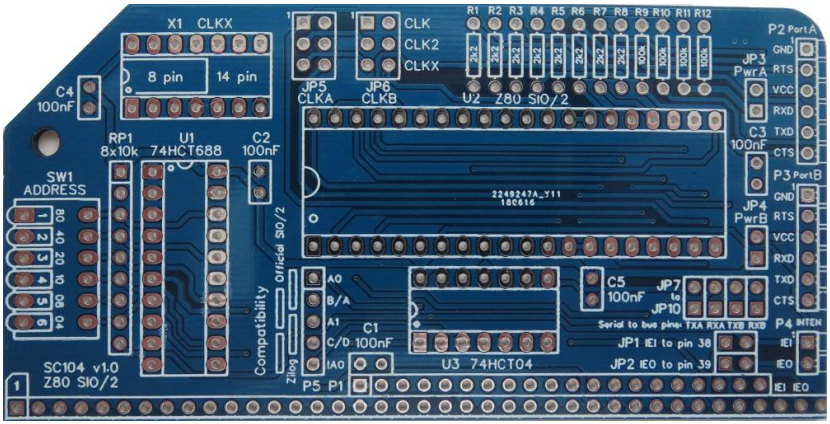
- Source for the RC2014 primary bus clock (CLK)
- Source for the RC2014 secondary bus clock (CLK2)
- Source for one or both of the SIO port's clocks

For full details of the Z80 SIO see the Zilog data sheet.

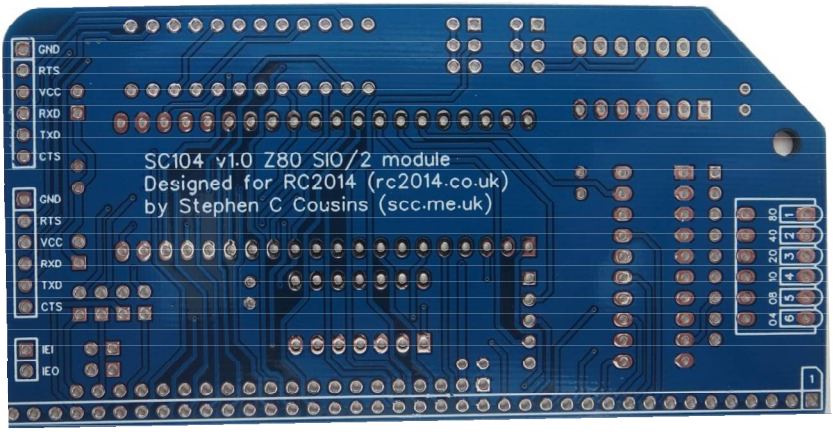
Printed Circuit Board

The printed circuit board is a standard footprint RC2014 board.

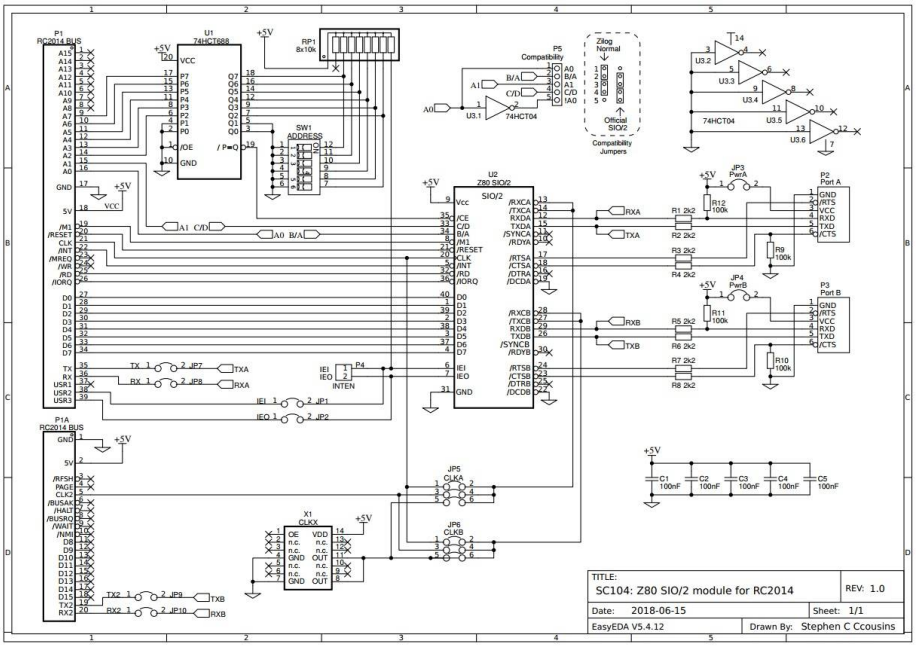
Printed circuit board, top/component side:



Printed circuit board, bottom/solder side:



Schematic



Errata

Version 1.0 of the PCB has the RC2014 IEI (pin 38) and IEO (pin 39) incorrectly labelled. The labels are incorrectly shown next to pins 37 and 38, not 38 and 39.

What You Need

The Z80 SIO/2 module (SC104) is a very flexible board, with many options. It is therefore possible to assemble it in a variety of different configurations, such as not including the on-board oscillator.

The following components are required to assemble the module with its full functionality and jumper options. Header pins JP1 to JP10, and P1 to P5 may need to be cut from longer strips.

Image	Qty	Reference	Description
	1	PCB	Printed circuit board SC104 Z80 SIO/2
	5	C1, 2, 3, 4, 5	Capacitor 100nF, ceramic, lead spacing = 2.54mm
	1	JP1 and JP2	Pin header, male, 2 rows x 2 pins, straight
	2	JP3, 4	Pin header, male, 1 row x 2 pins, straight
	2	JP5, 6	Pin header, male, 2 rows x 3 pins, straight
	1	JP7 and JP8 and JP9 and JP10	Pin header, male, 2 rows x 4 pins, straight
	12	JP1 - JP10 & P5 shunts	Jumper shunt for pin spacing = 2.54mm
	1	P1	Pin header, male, 2 rows x 39 pins, angled (2nd row optional)
	2	P2, 3	Pin header, male, 1 row x 6 pins, angled
	1	P4	Pin header, male, 1 row x 2 pins, angled
	1	P5	Pin header, male, 1 row x 5-pins, straight

	8	R1 to R8	Resistor 2k2, axial, 5%, carbon film, 0.25W
	4	R9 to R12	Resistor 100k, axial, 5%, carbon film, 0.25W
	1	RP1	Resistor pack 8x10k, SIL, 9-pin
	1	SW1	DIP switch, 6 way, piano style
	1	U1	74HCT688, 8-bit identity comparator, PDIP 20
	1	U1 socket	20 pin PDIP IC socket 0.3" wide
	1	U2	Z80 SIO/2, 8MHz, Z84C4208PEG (or Z80 SIO/2, 10MHz, Z84C4210PEG), PDIP 40
	1	U2 socket	40 pin PDIP IC socket 0.6" wide
	1	U3	74HCT04, hex inverter
	1	U3 socket	14 pin PDIP IC socket 0.3" wide
	1	X1	Oscillator module 7.3728MHz, either 8 pin or 14 pin
	1	X1 socket	14 pin PDIP IC socket 0.3" wide

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 SC104 Z80 SIO/2
		Supplier	Part number
		EasyEDA	Search EasyEDA.com for SC104
		Tindie	Search Tindie.com for SC104

The PCB is currently available to be ordered from EasyEDA.com or Tindie.com.

C1, 2, 3, 4

Image	Qty	Reference	Description
	5	C1, 2, 3, 4, 5	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 and JP2

Image	Qty	Reference	Description
	1	JP1 and JP2	Pin header, male, 2 rows x 2 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)

This pair of jumpers allow the interrupt daisy chain signals to be connected to the RC2014 bus signal USER 2 (pin 38) and USER 3 (pin 39). To make use of this feature you must use a backplane that is specifically designed to provide the necessary daisy chain, such as Backplane SC107. The current official RC2014 backplanes do not support this feature.

Alternatively the signals IEI and IEO can be found on connector P2 on the back edge of the board. Dupont wires can be used to daisy chain these signals to other modules.

JP3, 4

Image	Qty	Reference	Description
	2	JP3, 4	Pin header, male, 1 row x 2 pins, straight
		Supplier	Part number
		eBay	200906546562 (1x40 pin to be cut to length)
		Farnell	2356175 (1x40 pin to be cut to length)
		Mouser	855-M20-9774046 (1x40 pin to be cut to length)
		RS	156-049 (1x40 pin to be cut to length)

JP3 and JP4 allow the serial port power pin to be connected to the module's 5 volt supply line. This can either be to power the RC2014 from the serial port, or power the serial port device from the RC2014.

Care needs to be taken when more than one device can be selected to power the RC2014. Only select one power source at a time.

JP5, 6

Image	Qty	Reference	Description
	2	JP5, 6	Pin header male 2x3 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)

JP5 and JP6 enable selection of the clock source for serial ports A and B respectively. The sources are:

- RC2014 bus primary clock (CLK)
- RC2014 bus secondary clock (CLK2)
- This module's on-board oscillator clock signal (CLKX)

JP7 - JP10

Image	Qty	Reference	Description
	1	JP7 and JP8 and JP9 and JP10	Pin header male 2x4 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)

JP7 to JP10 allow the serial transmit and receive lines for port A and port B to be connected to the RC2014 bus TX, RX, TX2 and RX2 pins.

Each of these jumpers should have a shunt fitted, unless your system has more than one serial module. If you have more than one serial module fitted, it is important to isolate all but one serial module by removing the jumper shunts.

JP1 - JP10 and P5 shunts

Image	Qty	Reference	Description
	12	JP1 - JP10 & P5 shunts	Jumper shunt for pin spacing = 2.54mm
		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 JP10 and P5.

P1

Image	Qty	Reference	Description
	1	P1	Pin header, male, angled, 2-row x 39-pin, 2 row (1 row optional)
		Supplier	Part number
		eBay	200906546562 (2x40 pin to be cut to length)
		Farnell	2032912 (2x40 pin to be cut to length)
		Mouser	571-9-103795-0 (2x40 pin to be cut to length)
		RS	155-743 (2x40 pin to be cut to length)

This connector mates with the RC2014 bus backplane. You can fit a single or a double row header, but the full functionality of this module requires the extended RC2014 bus and thus a double row header.

Some pins need to be removed, using a pair of pliers, before fitting.

P2, 3

Image	Qty	Reference	Description
	2	P2, 3	Pin header, male, 1 row x 6-pin, 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)

These two connectors provide TTL serial ports A and B, suitable for connecting FTDI style serial cables. The pin-outs are:

1. GND Common ground / 0 volts
2. RTS Request to send output from SIO/2 module
3. VCC 5 volt in or out via jumper JP3 (port A) or JP4 (port B)
4. RXD Serial receive data input to SIO/2 module
5. TXD Serial transmit data output from SIO/2 module
6. CTS Clear to send input to SIO/2 module

P4

Image	Qty	Reference	Description
	1	P4	Pin header, male, angled, 1-row x 2-pin
		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)

As the official RC2014 backplanes do not provide a Z80 mode 2 interrupt daisy chain (IEI and IEO signals), these have been brought to the back of the board where they can be easily linked to other modules with Dupont wires.

P5

Image	Qty	Reference	Description
	1	JP5	Pin header, male, 1 row x 5 pins, straight
		Supplier	Part number
		eBay	200906546562 (1x40 pin to be cut to length)
		Farnell	2356175 (1x40 pin to be cut to length)
		Mouser	855-M20-9774046 (1x40 pin to be cut to length)
		RS	156-049 (1x40 pin to be cut to length)

This connector is used to select the register address order, allowing compatibility with either the official SIO/2 module or the Zilog default order used by Grant Searle's original design and later Dr Baker and others.

The usual way to use this connector is with a pair of jumper shunts fitted as indicated by the PCB legend.

R1 to R8

Image	Qty	Reference	Description
	8	R1 to R8	Resistor 2k2, axial, 5%, carbon film, 0.25W
		Supplier	Part number
		Farnell	9339302
		Mouser	603-CFR-25JR-522K2
		RS	707-7690

These resistors are connected in series with all serial port input and output signals, to provide current limiting in the event that one side is powered when the other isn't.

There have been reports of some FTDI style serial adapter cables not working with resistors in the 2k range and requiring lower value resistors of 1k or less. The reason for this is not clear, but it might have something to do with the signal voltages used by the cable. When buying FTDI style serial adapter cables for use with the RC2014, make sure you select ones with 5 volt serial signals, not just 5 volt tolerant signals. If you want to reduce the risk of having to change resistors you could fit 1k resistors. The down side is more power leaks through when the cable is powered but the RC2014 is not, causing more chance of circuitry remaining active, such as memory not clearing during 'power down'.

R9 to R12

Image	Qty	Reference	Description
	4	R9 to R12	Resistor 100k, axial, 5%, carbon film, 0.25W
		Supplier	Part number
		Farnell	9339078
		Mouser	603-CFR-25JR-52100K
		RS	707-7824

These resistors pull up or down serial port inputs so that they are in a known state when no cable is connected.

RP1

Image	Qty	Reference	Description
	1	RP1	Resistor pack 8x10k, SIL, 9-pin
		Supplier	Part number
		Farnell	9356819
		Mouser	652-4609X-1LF-10K
		RS	333-864

This is a network of 8 resistors with one end of each resistor common to pin 1. The resistors are used to pull up the address select switch (SW1) outputs and also to pull up the interrupt enable input signal (IEI).

SW1

Image	Qty	Reference	Description
	1	SW1	DIP switch, 6 way, piano style
		Supplier	Part number
		eBay	262361463572
		Farnell	2452331
		Mouser	653-A6FR-6104 (black)
		RS	877-2359

This switch is used to set the I/O address for the module. It sets the required state of address lines A2 to A7, thus allowing the module to occupy a 4 address block on any 4-byte boundary.

In order to provide some certainty for software it is strongly recommended you set the base address of your first SIO module to 0x80, so that the module occupies I/O addresses 0x80 to 0x83. This is done by setting switches 1 to 6, to Off, On, On, On, On, On, where On is the switch closed. In the case of the piano style DIP switch, the On position is the switch lever pushed down towards the circuit board.

Switches in the On position pull down the input of the address comparator U1. Switches in the Off position allow the input of the address comparator to be pulled up by RP1.

U1

Image	Qty	Reference	Description
	1	U1	74HCT688, 8-bit identity comparator, PDIP 20
		Supplier	Part number
		Farnell	2407104
		Mouser	595-CD74HCT688E
		RS	663-0650

This integrated circuit provides the address decoding, by comparing the current address from the CPU with the address set with the DIP switch SW1.

U1 socket

Image	Qty	Reference	Description
	1	U1 socket	20 pin PDIP IC socket 0.3"
		Supplier	Part number
		Farnell	4285608
		Mouser	571-1-2199298-6
		RS	674-2444

U2

Image	Qty	Reference	Description
	1	U2	Z80 SIO/2, 8MHz, Z84C4208PEG (or Z80 SIO/2, 10MHz, Z84C4210PEG), PDIP 40
		Supplier	Part number
		Farnell	6MHz version only
		Mouser	692-Z84C4208PEG (8 MHz version) 692-Z84C4210PEG (10 MHz version)
		RS	6MHz version only

The Z80 SIO/2 provides two TTL serial ports, suitable for use with FTDI style serial adapter cables.

Each port has transmit, receive, request to send and clear to send signals brought out to headers, see P2 and P3 above. The transmit and receive signals may also be connected to the standard RC2014 bus pins via jumpers.

Each channel has a jumper (JP5 and JP6) to select one of three clock signals:

- RC2014 bus primary clock (CLK)
- RC2014 bus secondary clock (CLK2)
- The module's on-board oscillator output (CLKX)

The RC2014 bus secondary clock can either be generated by the official dual clock module or the SC102 Z80 CTC module. The official clock module sets the baud rate with a jumper, while the CTC allows the baud rate to be set with software.

For further details see the Zilog SIO data sheet.

U2 socket

Image	Qty	Reference	Description
	1	U2 socket	40 pin PDIP IC socket 0.6"
		Supplier	Part number
		Farnell	4285669
		Mouser	571-1-2199299-5 or 649-DILB40P223TLF
		RS	674-2466

X1

Image	Qty	Reference	Description
	1	X1	Oscillator module 7.3728MHz, either 8 pin or 14 pin
		Supplier	Part number
		Farnell	2508742 (7.328MHz 8-pin QX8T50B)
		Mouser	774-MXO45HS-3C-7.3 (7.3728MHz 8-pin MXO45HS)
		RS	796-0574 (7.328MHz 8-pin QX8T50B)

This oscillator is optional. If fitted it can perform a number of functions:

- Source for the RC2014 primary bus clock (CLK)
- Source for the RC2014 secondary bus clock (CLK2)
- Source for one or both of the SIO ports

The assumption is that a 7.3728 MHz oscillator is used. By using this value the board will match the frequency expected by software designed for this board. It will also enable the oscillator to be useful as a source for the RC2014 bus clocks CLK and CLK2, which are usually 7.3728 MHz.

If this oscillator is not fitted, the board can be configured with jumpers to use either of the RC2014 bus clocks as a source for one or both of the SIO ports.

X1 socket

Image	Qty	Reference	Description
	1	X1 socket	14 pin PDIP IC socket 0.3"
		Supplier	Part number
		Farnell	2445621
		Mouser	571-1-2199298-3
		RS	674-2438

Oscillator module (X1) is quite large, so if you want to make a low profile board it is best to solder the oscillator directly onto the circuit board rather than fit this socket.

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 JP10, and P1 to P5 may need to be cut from longer strips.

Step 1

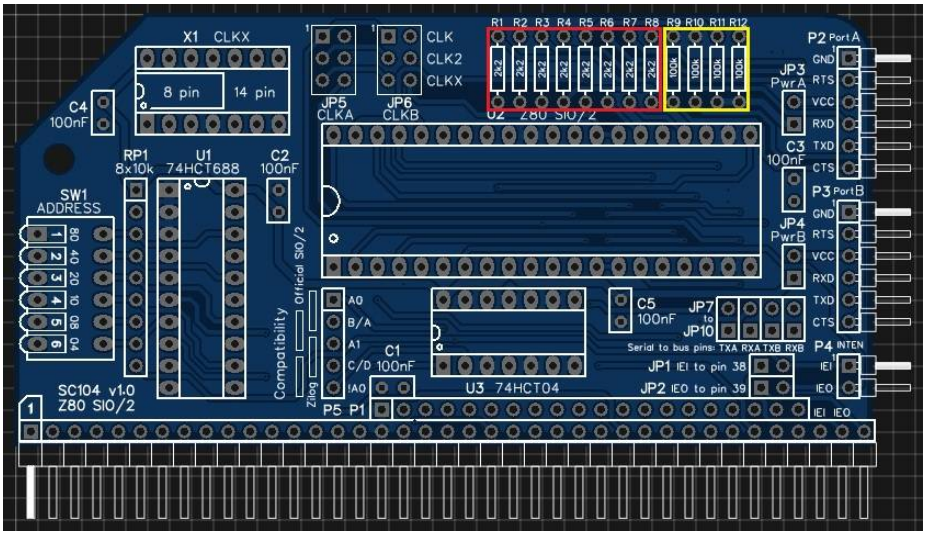
Fit and solder the eight 2k2 resistors R1 to R8 (shown in red below).

Colour code for 2k2 resistor: Red, Red, Red

Fit and solder the four 100k resistors R9 to R12 (shown in yellow below).

Colour code for 100k resistor: Brown, Black, Yellow

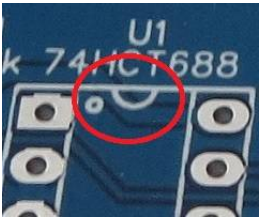
Resistors can be fitted either way round, as they are not polarity dependent.



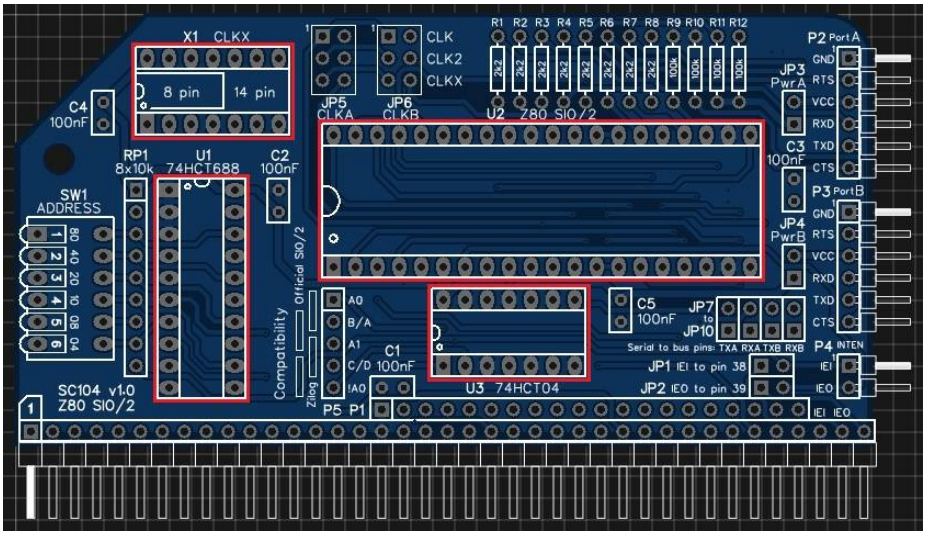
Step 2

Fit and solder IC sockets for U1, U2, U3 and optionally X1.

Be sure to fit them with the notch matching the legend on the circuit board, so you do not end up fitting the IC the wrong way round too.



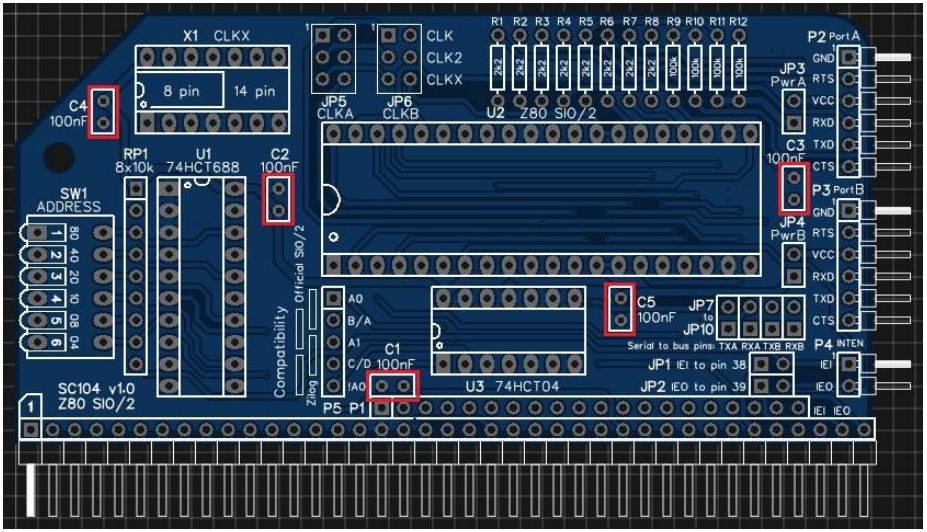
You may wish to solder the oscillator X1 directly to the board, in which case fit the oscillator now instead of the socket.



Step 3

Fit and solder capacitors C1, C2, C3, C4 and C5.

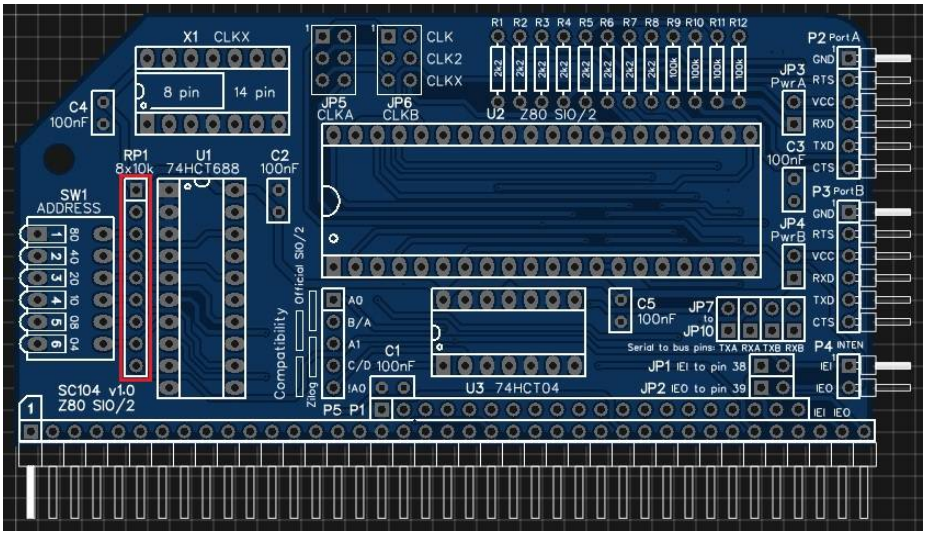
These can be fitted either way round, as they are not polarity dependent.



Step 4

Fit and solder resistor pack RP1.

This must be fitted the correct way round. The component should have pin 1 marked with a dot, as illustrated right.

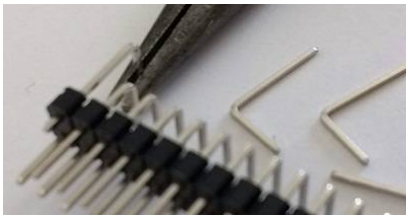


Step 5

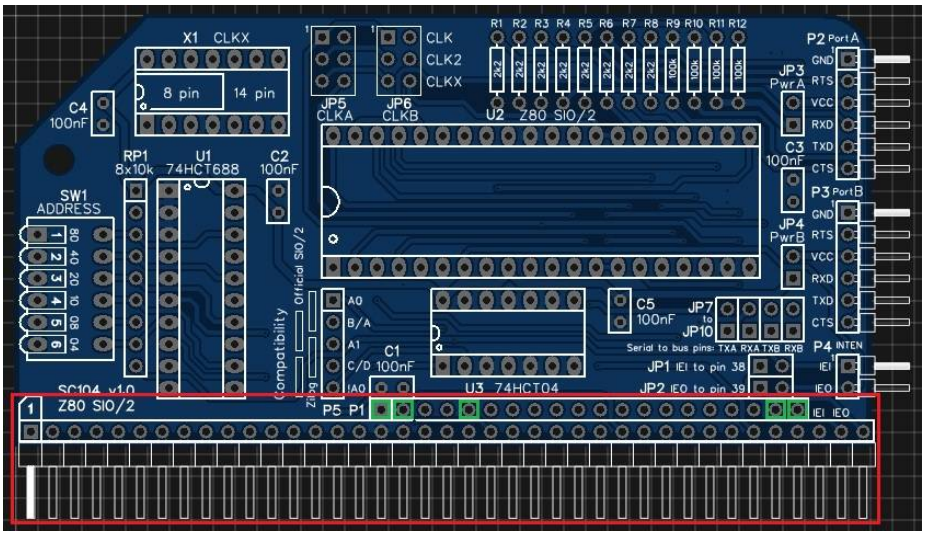
Fit and solder connector P1.

You can fit just a single row header as used by the RC2014 standard bus, but doing so means not all the features of this module can be used. It is best to fit a double row even if the module is initially only used with a standard bus backplane.

To prepare the header, it should first be cut to length (if starting with a strip more than 39 pins long) and then unwanted pins must be removed. If you want to make the board as easy to insert and remove as possible, you can remove all the pins in the second row except those shown on the schematic as used and indicated below in green.



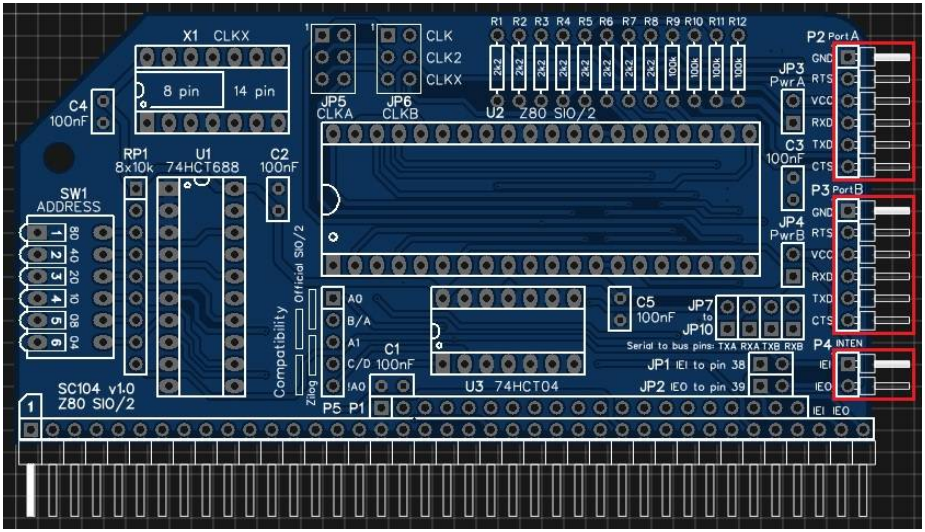
Take care to ensure the pins are parallel to the circuit board so that the board will be vertical when plugged into a backplane.



Step 6

Fit and solder connector P2, P3 and P4.

Take care to ensure the pins are parallel to the circuit board.



P2, P3 and P4 can be fitted as a single strip but with two pins pulled out at the gaps between P2/P3 and P3/P4. The photograph at the beginning of this guide shows the board assembled with the connectors in a single strip.

Step 7

Fit and solder header pins JP1 to JP10, and P5.

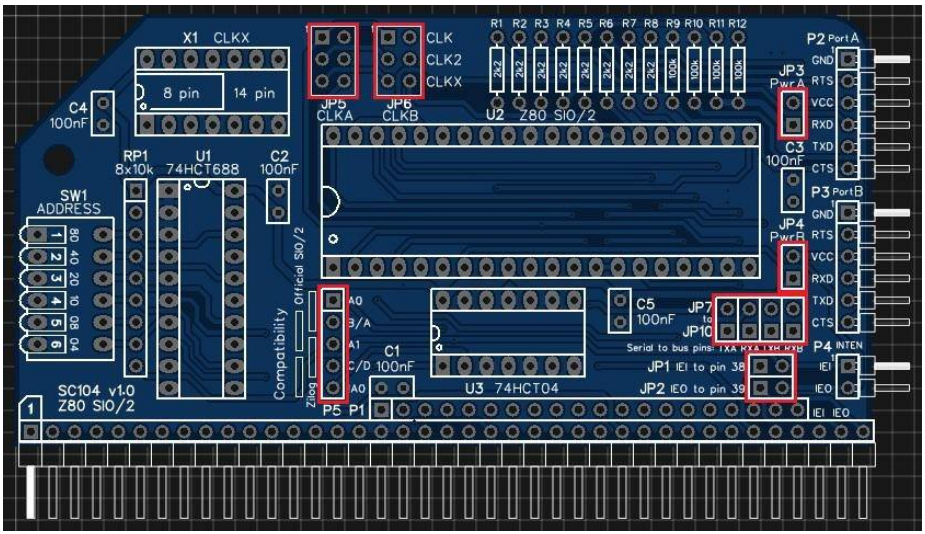
JP1 and JP2 are made up of a single header 2 pins by 2 pins as illustrated right.

JP3 and JP4 are individual headers 1 pin by 2 pins as illustrated right.

JP5 to JP6 are 2 pin by 3 pin headers as illustrated right.

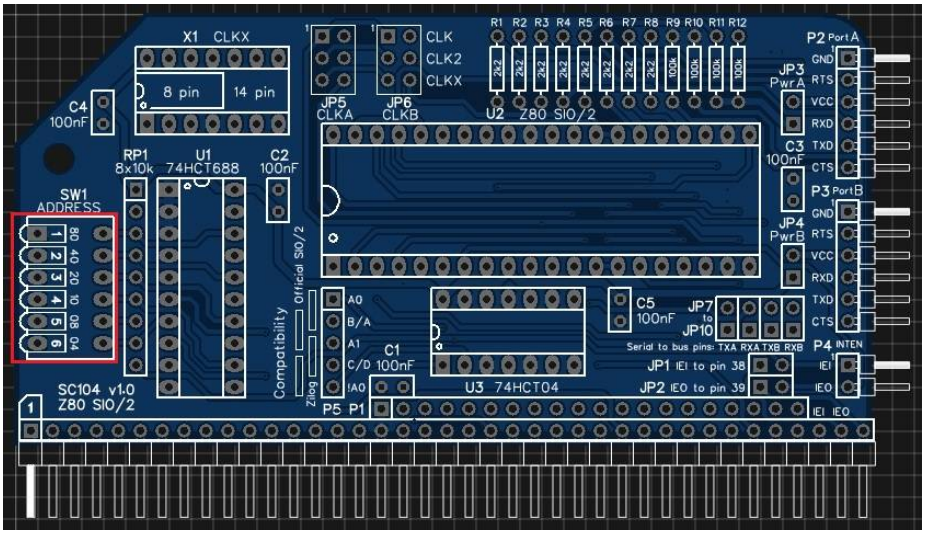
JP7 to JP10 are made up of a single header 2 pins by 4 pins as illustrated right.

P5 is an individual header 1 pin by 5 pins as illustrated right.

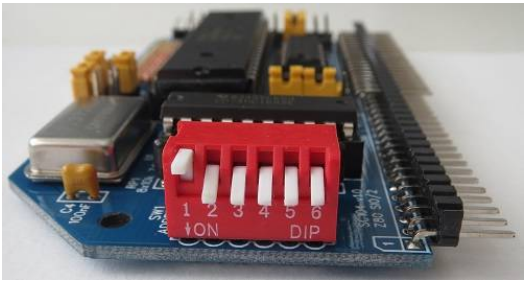


Step 8

Fit and solder the DIP switch SW1.



In order to provide some certainty for software it is strongly recommended you set the base address of your first SIO module to 0x80. The module then occupies I/O addresses 0x80 to 0x83. This is done by setting the switches as illustrated below.



If you have a second SIO module the recommended base address is 0x84.

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 the ICs or jumper shunts, plug the board into an RC2014 backplane with no other boards fitted. Power the backplane and perform the following checks with a volt meter:

- Check the supply voltage on the SIO module, between, say, U1 pin 10 and U1 pin 20. This should be 4.5 to 5.5 volts, preferably 4.75 to 5.25 volts.
- Check RXD on connector P2 and RXD on connector P3 are being pulled up to at least 4.5 volts.
- Check CTS on connector P2 and CTS on connector P3 are being pulled down to least than 0.4 volts.
- Check the interrupt enable input (IEI) on connector P4 is being pulled up to at least 4.5 volts.
- Check each address switch input (Q2 to Q7) on U1 is being pulled up to at least 4.5 volts when the appropriate switch (SW1) is Off (open) and drops to less than 0.4 volts when the appropriate switch (SW1) is On (closed).
- If you have an oscilloscope or logic probe, check the clocks CLK, CLK2 and CLKX (if oscillator X1 is fitted) at jumper header JP6.

If all is well, power down and remove the SIO module.

Step 10

Insert the ICs into their sockets, taking care to insert them the right way round, as illustrated below. Be careful not to bend any legs over.

Fit two jumper shunts to header P5 to select RC2014 compatibility mode.

There is no need to fit any other jumper shunts yet, unless they are specifically needed in your system's configuration.

Now plug the SIO module into the RC2014 backplane together with your normal working set of modules. Power up and check the system is working as usual.

Configuring the SIO Module

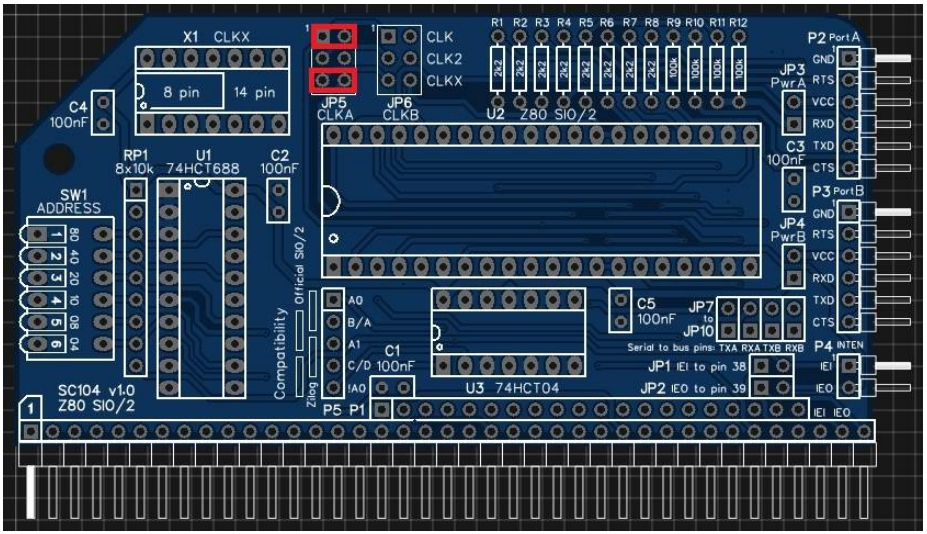
The following are just a few examples of how you can configure and use the SIO module. To realise its full potential it is necessary to study the Zilog Z80 SIO data sheet, which can be found on the internet by searching for "zilog UM0081".

Most of the following examples require software support.

SIO Module as the Primary Clock

The SIO module can provide a clock source for the RC2014 bus primary clock (CLK). This means a separate clock module is not required, potentially saving one backplane slot.

The illustration below shows the jumper shunt positions required to link the output of the on-board oscillator to the RC2014 bus primary clock (CLK). The illustration uses JP5, but JP6 can be used instead.



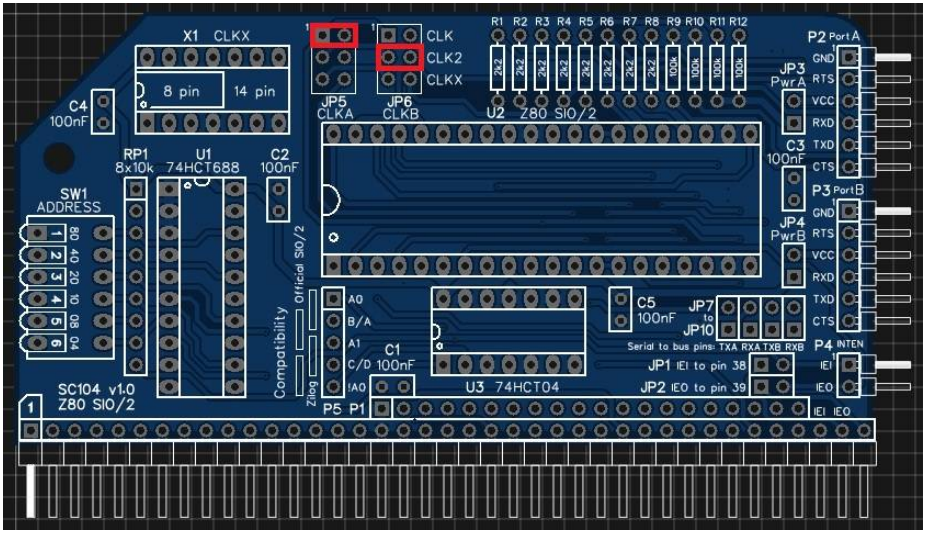
Clock Sources

Each serial port's clock input can be either:

- RC2014 bus primary clock (CLK)
- RC2014 bus secondary clock (CLK2)
- The module's on-board oscillator output (CLKX)

The illustration below shows the jumper shunt positions for:

- Port A to use the RC2014 bus primary clock (CLK) as its input
- Port B to use the RC2014 bus secondary clock (CLK2) as its input

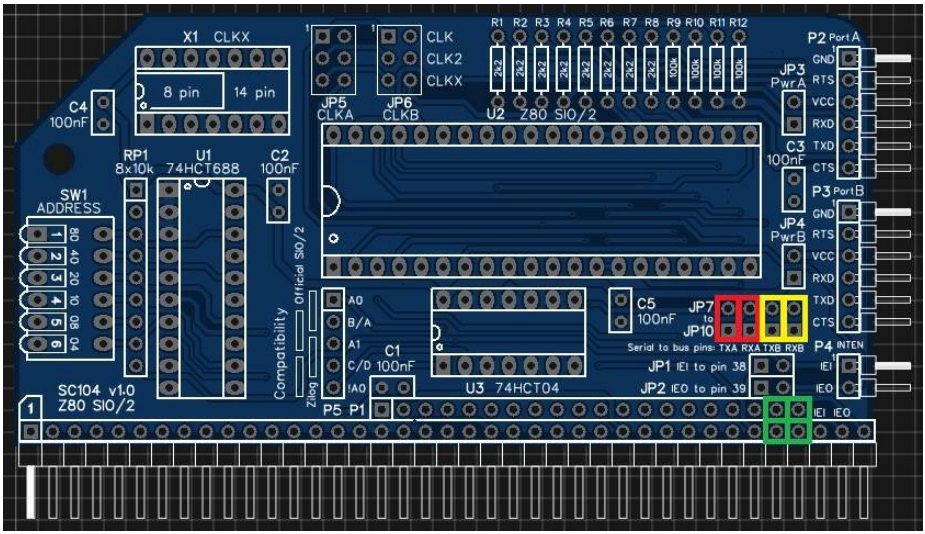


This feature requires software support. This is the standard configuration of clock sources for the RC2014 SIO/2, so most RC2014 software should work.

Bus Signals

The RC2014 bus has provision for two pairs of serial transmit and receive signals, allowing other modules to connect to the serial module.

To allow for the possibility of more than one serial module, these signals are routed via jumpers JP7 to JP10. To connect the required signal to the bus fit a jumper shunt in the positions illustrated below.



The jumpers highlighted in red are for serial port A and those in yellow are for serial port B. The pins used on the RC2014 bus are shown in green.

This feature requires software support. Jumper shunts fitted is the standard configuration for the RC2014 SIO/2, so most RC2014 software and hardware accessories should work.

Compatibility Mode

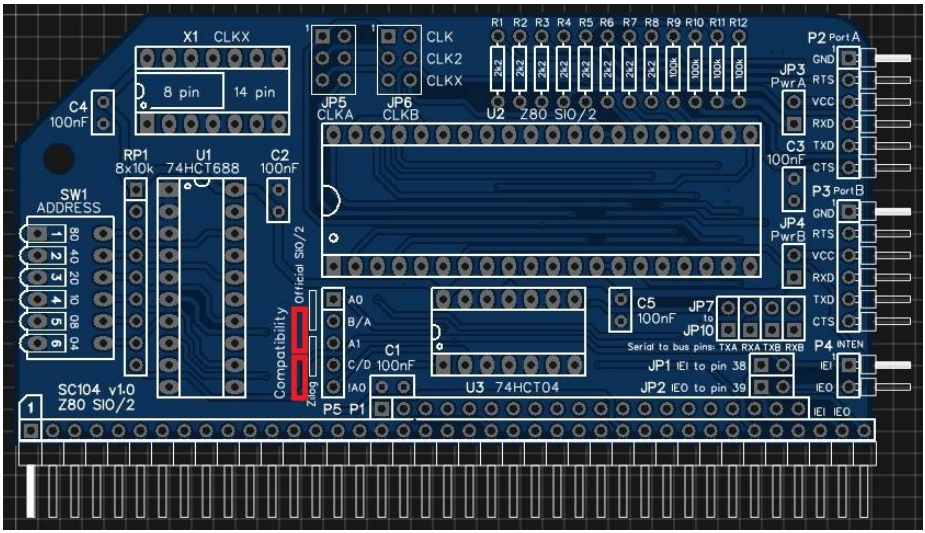
There are two different register orders in use for Z80 SIO modules on the RC2014:

- The Zilog default order, as used by Grant Searle's and later for RC2014 modules by Dr. Baker and others
- The RC2014 default order introduced some time later by the official Z80 SIO/2 module

Header P5 provides a means of selecting which register order in used.

The illustration below shows the two jumper shunt positions required to select the official RC2014 module's register order. By selecting this order the module is compatible with most software written for the RC2014.

Moving the jumper shunts to the alternative position, as illustrated by the PCB's legend, the register order is set to the more generic Zilog default order.



This feature requires software support. By using the RC2014 compatibility setting most RC2014 software should work.

The Small Computer Monitor ROM auto-identifies the order and thus works with both settings.

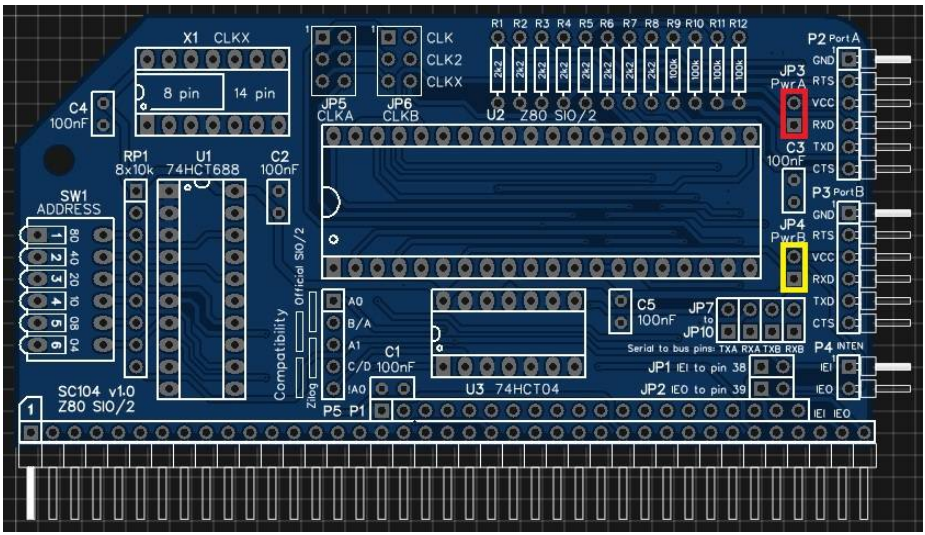
Power Sources

The SIO module provides a means of sourcing power from, or supplying power to, either or both serial ports.

The jumpers JP3 and JP4 connect pin 3 of the serial port connectors to the module's 5 volt supply.

With one of these jumper shunts fitted the R2014 can be powered from an FTDI style serial adapter. Alternatively, with the shunt fitted, the RC2014 can supply power to the serial device.

The illustration below shows the jumper position for port A power in red and port B power in yellow.



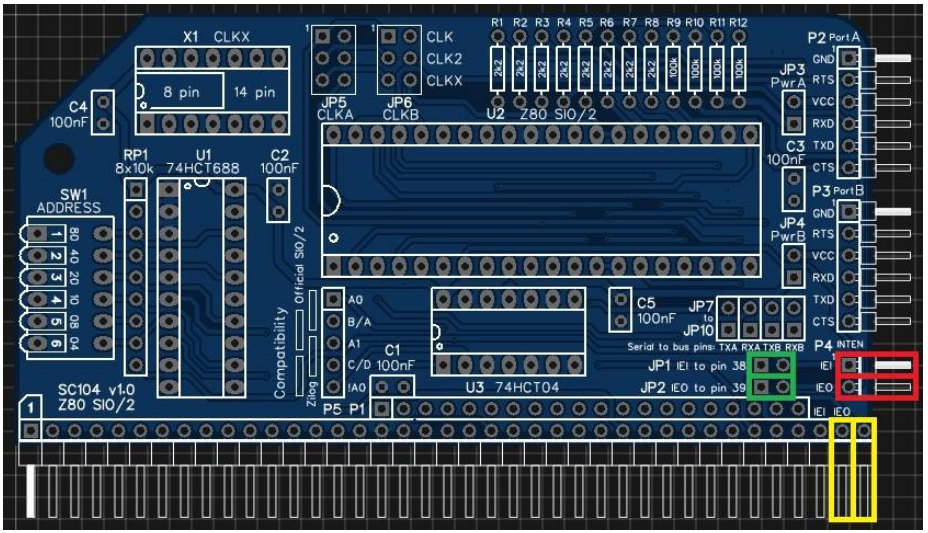
Warning: Do not connect two power sources at the same time.

Interrupt Daisy Chain

If your system has more than one device using interrupt mode 2, it will be necessary to set up an interrupt daisy chain.

This is fully described in the Z80 peripherals data sheet, but essentially it requires linking the output (IEO) of one interrupt generating device to the input (IEI) of the next, and so on. The position in the chain determines the device's interrupt priority.

The illustration shows the connections required when using external Dupont wires on P2 (shown in red) and the RC2014 bus USER pins (shown in yellow). To connect the IEI and IEO signals to the RC2014 bus fit shunts to jumpers J1 and J2 (shown in green).



Note that v1.0 of the PCB has the IEI and IEO bus pins incorrectly labelled. It indicates the use of pins 37 and 38, not 38 and 39.

This feature requires software support.

Setting up a mode 2 interrupt system is not trivial so requires study of the data sheets rather than following any simple example I could write here.

Address Selection

The module's address can be set to any address that is a multiple of 4, such as address 0, 4, 8, 12, 16, ... , 252. This address is known as the base address, with the module occupying this address plus the next three addresses. Thus if the base address is 0, then the module occupies the address range 0 to 3.

The address is set with the 6 way DIP switch SW1.

The six address switches, 1 to 6, represent addresses 128, 64, 32, 16, 8 and 4 respectively. The base address is the sum of all the switches in the Off position. For a piano style DIP switch, as illustrated below, Up is Off and Down is On.

In the illustration below the switches are:

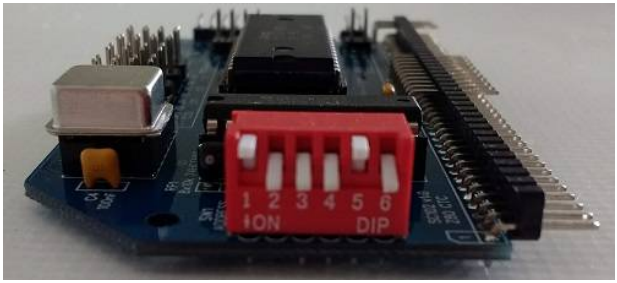
Up Down Down Down Up Down

This represents the address:

128 + 0 + 0 + 0 + 8 + 0

= 128 + 8

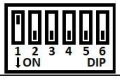
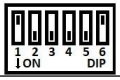
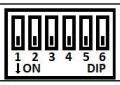
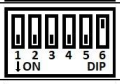
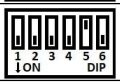
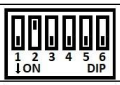
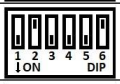
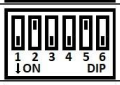
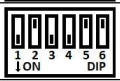
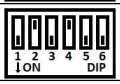
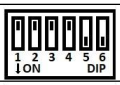
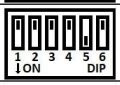
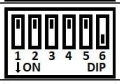
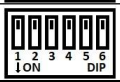
= 136 (or 0x88 in hexadecimal).



In order to be compatible with existing RC2014 software the first SIO module needs the base address 0x80, with the module occupying I/O address range 0x80 to 0x83.

If you have a second SIO module the recommended base address is 0x84. If everybody follows this recommendation then software written for a second SIO module will know where to find the SIO hardware.

The following table shows examples of address switch settings.

Switches	Base Address	Address Range	Recommended
	0x80 hexadecimal (128 decimal)	0x80 to 0x83 hexadecimal (128 to 131 decimal)	1st SIO module address
	0x84 hexadecimal (132 decimal)	0x84 to 0x87 hexadecimal (132 to 135 decimal)	2nd SIO module address
	0x00 hexadecimal (0 decimal)	0x00 to 0x03 hexadecimal (0 to 3 decimal)	
	0x04 hexadecimal (4 decimal)	0x04 to 0x07 hexadecimal (4 to 7 decimal)	
	0x08 hexadecimal (8 decimal)	0x08 to 0x0B hexadecimal (8 to 11 decimal)	
	0x40 hexadecimal (64 decimal)	0x40 to 0x43 hexadecimal (64 to 67 decimal)	
	0x44 hexadecimal (68 decimal)	0x44 to 0x47 hexadecimal (68 to 71 decimal)	
	0x48 hexadecimal (72 decimal)	0x48 to 0x4B hexadecimal (72 to 75 decimal)	
	0x4C hexadecimal (76 decimal)	0x4C to 0x4F hexadecimal (76 to 79 decimal)	
	0x50 hexadecimal (80 decimal)	0x50 to 0x53 hexadecimal (80 to 83 decimal)	
	0xF0 hexadecimal (240 decimal)	0xF0 to 0xF3 hexadecimal (240 to 243 decimal)	
	0xF4 hexadecimal (244 decimal)	0xF4 to 0xF7 hexadecimal (244 to 247 decimal)	
	0xF8 hexadecimal (248 decimal)	0xF8 to 0xFB hexadecimal (248 to 251 decimal)	
	0xFC hexadecimal (252 decimal)	0xFC to 0xFF hexadecimal (252 to 255 decimal)	

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

Select the main menu item “Explore”

In the search box, enter “RC2014 SIO” or “sccousins”

Select, from the list shown, the project “SC104 v1.x Z80 SIO/2 for RC2014”

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	50 x 99 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.

Warning

You may get a warning about design rule violations. There are 2 legitimate warnings that may be reported due to the position of the last pair of holes on the RC2014 bus connector being too close to the edge of the board when using the standard RC2014 board outline. These warnings can be safely ignored, but any others may be a cause for concern.

Fault Finding

Check all links and jumpers, check no chips have bent legs and thus not making contact with their socket, carefully inspect all soldering, check all the chips are inserted the right way round, check all the components are in the right place.

With the SIO module plugged in to the RC2014 backplane with no other boards fitted. Power the backplane and perform the following checks with a volt meter:

- Check the supply voltage on the SIO module, between, say, U1 pin 10 and U1 pin 20. This should be 4.5 to 5.5 volts, preferably 4.75 to 5.25 volts.
- Check RXD on connector P2 and RXD on connector P3 are being pulled up to at least 4.5 volts.
- Check CTS on connector P2 and CTS on connector P3 are being pulled down to least than 0.4 volts.
- Check the interrupt enable input (IEI) on connector P4 is being pulled up to at least 4.5 volts.
- Check each address switch input (Q2 to Q7) on U1 is being pulled up to at least 4.5 volts when the appropriate switch (SW1) is Off (open) and drops to less than 0.4 volts when the appropriate switch (SW1) is On (closed).
- If you have an oscilloscope or logic probe, check the clocks CLK, CLK2 and CLKX at jumper header JP6.

History

2018-06-25	v1.0	First circuit boards
2018-06-25	e1.0.0	First release of this user guide
2019-01-21	e1.0.1	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.

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

Thanks to all those who provided encouragement, feedback and contributed ideas to the design. Specifically: Mark T, Tom S, Steve M, Jon L, Nigel K, Jay C, Karl B, Randy M, Thomas R, Spencer O, and anyone else I forgot!

See RC2014 google group for full details:
https://groups.google.com/forum/#!topic/rc2014-z80/1GZEJAZCdpQ