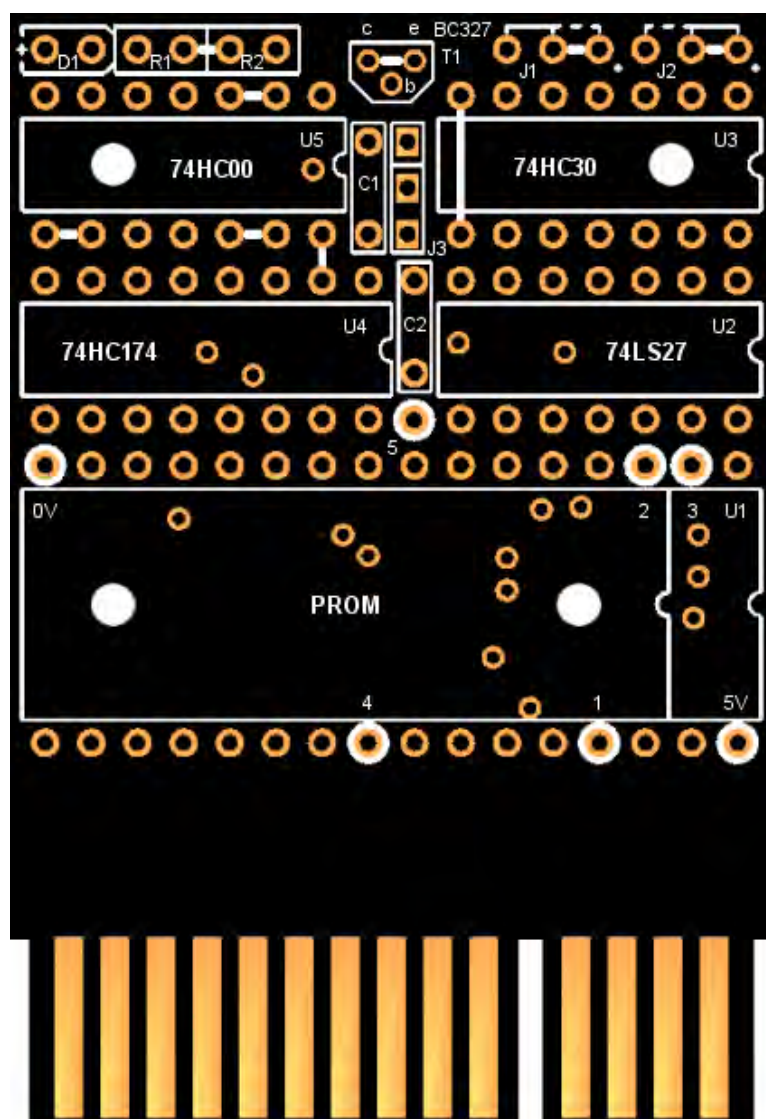


## ZXC3 Interface 2 ROM Cartridge Configurations

The ZXC3 ROM cartridge PCB supports a 29F010 128K FLASH ROM which, when inserted into a ZX Interface 2 (or compatible interface), is user programmable/erasable directly from the ZX Spectrum. The PCB can also support 8K (27C64), 16K (27C128), 32K (27C256), 64K (27C512) and 128K (27C010/1001) EPROMs. It can also support 256K (27C020/2001) EPROMs if a minor modification is made to the PCB. All EPROMs must be pre-programmed via an EPROM programmer. The ZXC3 PCB implements the same bank paging mechanism introduced with the ZXC2 PCB, and hence is backwards compatible. It can also be populated in a standard 8K/16K EPROM configuration. The ZXC3 PCB incorporates reset detection circuitry which allows the Spectrum+/128/+2 reset button to clear the ROM cartridge paging mechanism back to its default settings.

In addition, the PCB can also be used as a 5 channel output controller board. When combined with the 10 input channels available via the joystick ports of the Interface 2, the ZXC3 provides a low cost I/O controller.



The following diagram shows the PCB and indicates the function of the components.

U2 is required for all configurations.

U3, U4 and U5 are required for the software banked configuration.

J1 1-2 shorted for a 27C64/128/256/512 EPROM, omitted (or 2-3 harmless) for a 27C010/1001 EPROM or 29F010 FLASH ROM, 2-3 for a 27C020/2001 EPROM. Pin 1 is denoted by the white dot.

J2 1-2 shorted to enable the cartridge. Pin 1 is denoted by the white dot.

J3 1-2 shorted to enable the paging circuitry. Its use allows full access to the 16K address range even when the paging circuitry has been fitted. A track connects 1-2 so as to enable the paging circuitry by default, and hence this track must be cut before this jumper facility can be used.

T1 and R2 provide optional support for paging the Spectrum ROM in and out of the memory map when using the software banked paging configuration.

C1 and R1 form a start up reset circuit used with the software banked paging configuration.

D1 is required for the automatic reset detection functionality.

C2 is optional and provides smoothing of the power supply to the ICs.

When configured as a 5 channel output controller, the thick white circles surround the 5 connection points to use.

**Note: An error exists on the PCB - the circuitry to allow J2 to disable the cartridge requires an additional diode D2 be connected in series with the collector leg of transistor T1.**

**8K / 16K Configurations**

This configuration mimics a standard ROM cartridge by replacing the Spectrum ROM in the memory map. Not all of the ICs are to be fitted but instead 9 wire links must be installed. These are indicated on the PCB by the thick white lines.

**8K Configuration:**

Omit: U3 (74HC30), U4 (74HC174), U5 (74HC00), T1, C1, R1, R2, D1, J3, D2  
 Required: J1 1-2 shorted, J2 1-2 shorted, U1 (27C64), U2 (74LS27), U3 7-8 shorted, U5 2-3 shorted, U5 8-9 shorted, U5 12-13 shorted, U5 pin 14 shorted to U4 pin 2, T1 c-e shorted, R2-R1 shorted  
 Optional: C2 (100nF)

**16K Configuration:**

Omit: U3 (74HC30), U4 (74HC174), U5 (74HC00), T1, C1, R1, R2, D1, J3, D2  
 Required: J1 1-2 shorted, J2 1-2 shorted, U1 (27C128), U2 (74LS27), U3 7-8 shorted, U5 2-3 shorted, U5 8-9 shorted, U5 12-13 shorted, U5 pin 14 shorted to U4 pin 2, T1 c-e shorted, R2-R1 shorted  
 Optional: C2 (100nF)

**Software Banked FLASH Configurations**

This configuration allows the Spectrum to program and erase the FLASH ROM. It also allows software to select a specific bank of 16K to page into the memory map and can also page the Spectrum ROM in and out.

**128K Configuration:**

Omit: J1, J3  
 Required: U1 (29F010), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), T1 (BC327), D2 (1N4148), R2 (1kΩ), R1 (1MΩ), C1 (100nF), D1 (1N4148), J2 fit 3 pin header with jumper on pins 1-2  
 Optional: C2 (100nF)

**32K – 256K Software Banked EPROM Configurations**

This configuration allows software to select a specific bank of 16K to page into the memory map and can also page the Spectrum ROM in and out.

**32K Configuration without Spectrum ROM Paging:**

Omit: J3, R2, T1, D2  
 Required: U1 (27C256), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), R1 (1MΩ), C1 (100nF), D1 (1N4148), T1 c-e shorted, J1 1-2 shorted, J2 1-2 shorted  
 Optional: C2 (100nF)

**32K Configuration with Spectrum ROM Paging:**

Omit: J3  
 Required: U1 (27C256), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), T1 (BC327), D2 (1N4148), R2 (1kΩ), R1 (1MΩ), C1 (100nF), D1 (1N4148), J1 1-2 shorted, J2 fit 3 pin header with jumper on pins 1-2  
 Optional: C2 (100nF)

**64K Configuration without Spectrum ROM Paging:**

Omit: J3, R2, T1, D2  
 Required: U1 (27C512), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), R1 (1MΩ), C1 (100nF), D1 (1N4148), T1 c-e shorted, J1 1-2 shorted, J2 1-2 shorted  
 Optional: C2 (100nF)

64K Configuration with Spectrum ROM Paging:

Omit: J3  
 Required: U1 (27C512), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), T1 (BC327), D2 (1N4148), R2 (1kΩ), R1 (1MΩ), C1 (100nF), D1 (1N4148), J1 1-2 shorted, J2 fit 3 pin header with jumper on pins 1-2  
 Optional: C2 (100nF)

128K Configuration without Spectrum ROM Paging:

Omit: J1, J3, R2, T1, D2  
 Required: U1 (27C010/1001), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), R1 (1MΩ), C1 (100nF), D1 (1N4148), T1 c-e shorted, J2 1-2 shorted  
 Optional: C2 (100nF)

128K Configuration with Spectrum ROM Paging:

Omit: J1, J3  
 Required: U1 (27C010/1001), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), T1 (BC327), D2 (1N4148), R2 (1kΩ), R1 (1MΩ), C1 (100nF), D1 (1N4148), J2 fit 3 pin header with jumper on pins 1-2  
 Optional: C2 (100nF)

256K Configuration without Spectrum ROM Paging:

Omit: J3, R2, T1, D2  
 Required: U1 (27C020/2001), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), R1 (1MΩ), C1 (100nF), D1 (1N4148), T1 c-e shorted, J1 1-2 shorted, J2 1-2 shorted, add wire connecting U1 pin 24 to U1 pin 22, cut off pin 11 of U5, add wire connecting footprint for U5 pin 11 to footprint for U5 pin 12, cut track to U1 pin 31, add wire connecting U1 pin 31 to U1 pin 32, cut track from U4 pin 7 to U1 pin 24 (see page 5 for details on where to make these modifications)  
 Optional: C2 (100nF)

256K Configuration with Spectrum ROM Paging:

Omit: J3  
 Required: U1 (27C020/2001), U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), T1 (BC327), D2 (1N4148), R2 (1kΩ), R1 (1MΩ), C1 (100nF), D1 (1N4148), J1 1-2 shorted, J2 fit 3 pin header with jumper on pins 1-2, add wire connecting U1 pin 24 to U1 pin 22, cut off pin 11 of U5, add wire connecting footprint for U5 pin 11 to footprint for U5 pin 12, cut track to U1 pin 31, add wire connecting U1 pin 31 to U1 pin 32, cut track from U4 pin 7 to U1 pin 24 (see page 5 for details on where to make these modifications)  
 Optional: C2 (100nF)

**Software Bank Paging Control**

Bank switching is controlled by memory accesses to the top 64 locations within the ROM area: 3FC0h – 3FFFh. This uses 6 address lines: A0 – A5. There is no differentiation between reading and writing to these locations.

A0 – A3	-	Selects EPROM bank (0 – 15), or FLASH bank (0 – 7) where A3 is used as the write select line
A4	-	Page Spectrum ROM in/out (1 = Select Spectrum ROM, 0 = Select EPROM/FLASH bank)
A5	-	Lock paging mechanism (1 = Disable further paging)

When using a FLASH 29F010 ROM, address line A3 is used to control the programming mechanism. It should always be set to 0 when performing bank paging. For details on how to write to the FLASH directly from your own Spectrum programs, please refer to the example software available on [www.fruitcake.plus.com](http://www.fruitcake.plus.com).

Software bank paging examples:

- LD A,(3FC1h) will select bank 1
- LD A,(3FC2h) will select bank 2
- LD A,(3FE5h) will select bank 5 and lock the paging mechanism

- LD A,(3FD0h) will page out the cartridge and enable the Spectrum ROM
- LD A,(3FF0h) will page out the cartridge, enable the Spectrum ROM and lock the paging mechanism

Note that it may be necessary to insert a small delay after paging in the Spectrum's ROM and before accessing it, e.g. to read the first byte of the Spectrum's ROM: LD A,(3FD0h), NOP, LD A,(0000h). A delay is not necessary when switching between EPROM/FLASH banks.

At power up, bank 0 is selected, the Spectrum ROM is disabled and the banking mechanism is unlocked. Once the paging mechanism has been disabled, it cannot be re-enabled by writing a 0 to bit A5. It can only be re-enabled by power cycling the ROM cartridge or by using the reset button of the Spectrum+/128/+2.

### **FLASH Programming**

Address line A3 is used as a 'write select' control line. To program or erase the FLASH ROM, it is necessary to first activate this 'write' line, then output the appropriate sequence of values as defined by the 29F010 datasheet which selects FLASH write/erase mode, then output the data byte value (if writing), and finally de-activate the 'write' line to return the ROM to reading mode. The datasheet for the 29F010, along with an example showing how to write a byte to FLASH, can be found on web page:

[http://www.fruitcake.plus.com/Sinclair/Interface2/Interface2\\_RC\\_Custom.htm#Programmable](http://www.fruitcake.plus.com/Sinclair/Interface2/Interface2_RC_Custom.htm#Programmable)

Reference design software routines for reading, writing and erasing bytes and blocks of the FLASH ROM can be downloaded from the following web page:

[http://www.fruitcake.plus.com/Sinclair/Interface2/Interface2\\_RC\\_ZXC3.htm](http://www.fruitcake.plus.com/Sinclair/Interface2/Interface2_RC_ZXC3.htm)

These routines should be read in conjunction with the datasheet for the 29F010 FLASH ROM.

### **Output Channel Controller Configuration**

The 6 address lines used for the bank switching mechanism can instead be used to turn the PCB into a 5 channel general purpose output controller. These channels are controlled using the top 64 locations within the ROM area: 3FC0h – 3FFFh.

- A0 - Output channel 1 (1 = 5V output, 0 = 0V output)
- A1 - Output channel 2 (1 = 5V output, 0 = 0V output)
- A2 - Output channel 3 (1 = 5V output, 0 = 0V output)
- A3 - Output channel 4 (1 = 5V output, 0 = 0V output)
- A4 - Output channel 5 (1 = 5V output, 0 = 0V output)
- A5 - Lock output channels (1 = Disable further changes to the output channels)

At power up, all output channels are set to 0 and unlocked. Once the output channels have been disabled, they cannot be re-enabled by writing a 0 to bit A5. They can only be re-enabled by power cycling the ROM cartridge.

Omit: U1, T1, R2, J1, J3, D2

Required: L1 2-3 shorted, U2 (74LS27), U3 (74HC30), U4 (74HC174), U5 (74HC00), C1 (100nF), R1 (1MΩ), D1 (1N4148), C2 (100nF), J2 1-2 shorted

The output channels and power are available from:

- Channel 1 - U1 pin 29
- Channel 2 - U1 pin 3
- Channel 3 - U1 pin 2
- Channel 4 - U1 pin 24
- Channel 5 - Connection point situated between U2 pin 8 and U4 pin 16
- 5V - U1 pin 32
- 0V - U1 pin 16

Each output channel is capable of driving a maximum of 20mA.

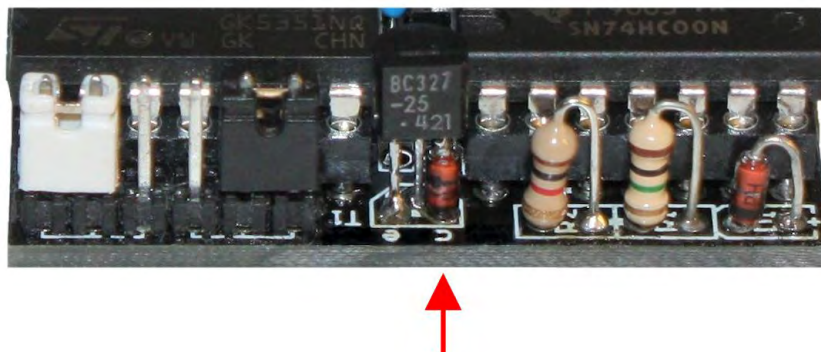
### **Notes**

EPROMs manufactured by Texas Instruments, identified by the designator TMS27Cxxx, appear to be incompatible with the Spectrum.

## Modification Recommendations

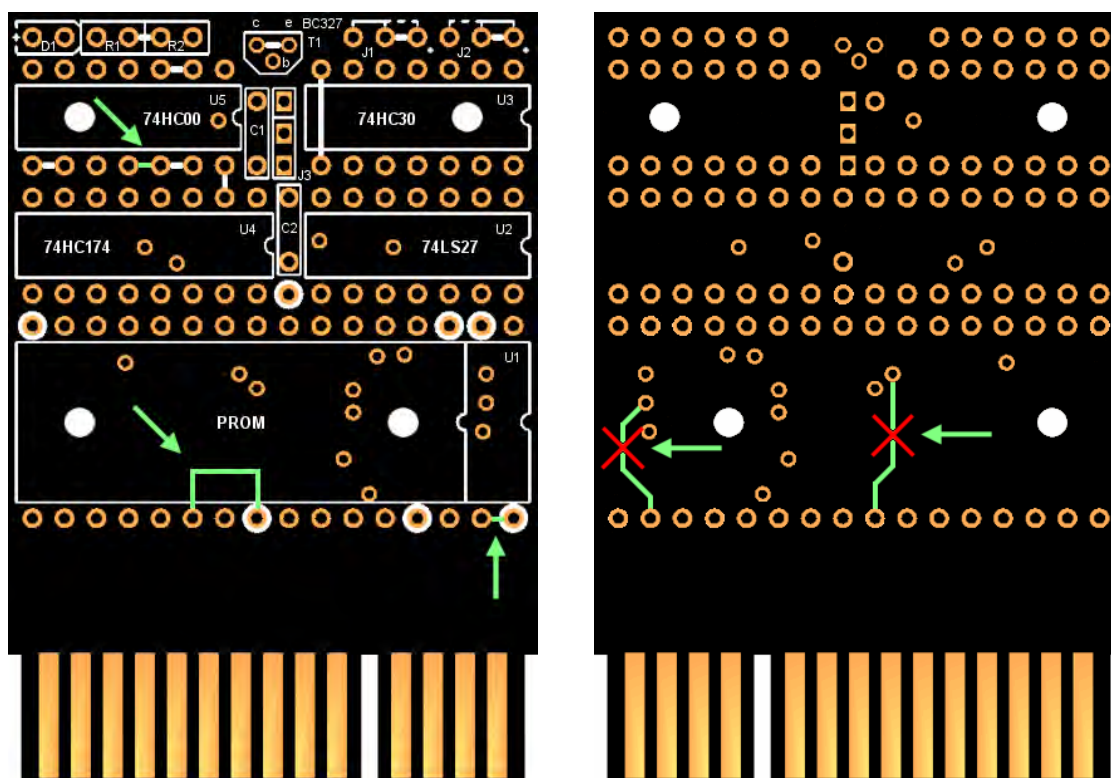
### Location of Diode D2

The following photo shows the recommended location for installing diode D2. The diode replaces the collector leg of transistor T1, and requires the transistor to be raised slightly more from the board than would otherwise have been needed. If diode D2 is not installed then it is not possible to reliably disable the cartridge using jumper J2.



### 256K EPROM Support

The following diagrams show the recommended way of modifying the ZXC3 to support a 256K EPROM. Making the modification will disable the FLASH ROM write facility. Smaller capacity EPROMs can be supported using J1.



Three wire links must be added to the board and two tracks cut. It is recommended to fit the wire links on the front of the board such that they are covered and hence protected when the ICs are fitted.