Small Computer Central

SC126, v1.0, Circuit Explained

The SC126, Z180 SBC/motherboard includes the following:

- Z180 CPU (rated at 33 MHz)
- One 512k byte static RAM chip
- Two 512k byte Flash ROM chips
- Two 5 volt FTDI style asynchronous serial ports
- Two 5 volt SPI / SD Card ports
- One 5 volt bit-bang I2C bus port
- Clock oscillator (18.432 MHz)
- Power supply supervisor and a reset circuit
- Battery backed real time clock
- Three expansion sockets
- Power input (5 volt, typically 100 mA)

The two Flash ROM sockets allow easy selection of two separate firmware programs. Currently these are the Small Computer Monitor (SCM) and RomWBW.

B1

Battery (B1) is a 3 volt lithium button cells, type CR2032. This is only used to power the real time clock chip (DS1302) when the main power supply is off. The motherboard can be safely run without this battery fitted, but the time will be lost if the main power supply is off.

C1 to C14

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.

The exact value of this component is not critical. The use of very cheap capacitors within the range of about 50 to 100 nF is acceptable.

C15

This capacitor provides additional support for transient current demands.

C16

This capacitor is required by the Voltage Supervisor and Reset device (DS1233-5+, U2) when an external reset switch and pull-up resistor are connected to the reset line. See DS1233-5+ datasheet for more details.

The exact value of this component is not critical. The datasheet for the DS1233 specifies a value from 0.5 to 10 nF, thus a very low cost component with a wide tolerance is acceptable.

J1

Barrel style, 5 volt power input socket. Power connected here is supplied before the ON/OFF socket.

J2

Screw terminal, 5 volt power input. Power connected here is supplied before the ON/OFF socket.

JP1 and JP2

Jumper 1 allows Flash chip U1's write enable input to be connected to either Vcc (5 volts) or the CPU's write output (/WR). Jumper 2 provides the same function for Flash U2.

When the Flash chip's write enable input is connected to Vcc, the Flash chip will never get a write enable signal and thus the memory is protected against being changed. When connected to the CPU's write output, it is possible to write to the Flash chip.

Writing to the Flash chip is unlikely to happen by accident due to the software requirements. However, for peace of mind it is generally best to disable writing with this jumper.

JP3

This jumper selects which Flash ROM is mapped into memory. This can be either U1, U2, or enable software selection. The software selection option does not have the necessary support yet, so avoid this setting for now. The jumper shunt options are:

- Position 1, select U1
- Position 2, enable software selection
- No fitted, select U2

With the jumper shunt not fitted, P9 can be used for a shunt or an external switch. When closed, U1 is selected. When open U2 is selected.

JP4

The Z180 CPU signals DCD0 and DREQ1 are pulled up by RP1. JP4 enables one or other to be pulled to ground. Alternatively it can be used as a header to access these signals.

JP5

The I2C signals, SCL and SDA, can be connected to the expansion bus signals, USER6 and USER7, by fitting jumper shunts to these pins.

LED1

This LED indicates the 5 volt supply is powering the motherboard.

LED2 to LED9

The output port, address 0x0D, provides control of these 8 LEDs. They are used to display the Small Computer Monitor's self-test status, but are otherwise free for any required use.

P1 and P11

These connectors provide access to the 5 volt bit-bang I2C bus.

Pin	Function
1	Ground (GND)
2	Vcc (5v)
3	Clock (SCL)
4	Data (SDA)
5	Vcc (5V)
6	Ground (GND)

P2 and P12, and P3 and P13

These connectors give access to the 5 volt SPI ports. These ports share common serial clock and data signals, but have unique chip enable signals. They use the Z180's hardware clocked serial I/O for high speed interfacing.

Pin	Function
1	Chip select (active low)
2	Clock
3	Master out, slave in
4	Master in, slave out
5	Vcc (5V)

6	Ground (GND)

P4 and P7

These enable the motherboard's Vcc (5 V) to be connected to serial ports A and B power pins. Typically, this allows the motherboard to be powered from an FTDI style serial adapter.

WARNING: You should normally only connect one power source to the system, at any time.

As power can flow either way, these jumpers (or switches) also enable serial devices to be powered from the motherboard. If such devices are used, fit a jumper shunt in the appropriate position.

P5 and P15, and P6 and P16

Serial ports A and B are connected via P5 and P15, and P6 and P16. These are FTDI style 5 volt serial ports. Port A includes RTS/CTS flow control signals, while port B does not.

Pin	**Function**
1	Ground (GND)
2	Request To Send (RTS) output from Z180
3	Vcc (5V)
4	Recieve Data (RxD) input to Z180
5	Transmit Data (TxD) output from Z180
6	Clear To Send (CTS) input to Z180

P8

This enables connection of an external reset switch.

P9

An external ROM select switch can be connected here. When using an external switch, do not fit a jumper to JP3.

P10

This gives access to the 5 volt supply 'before' the ON/OFF switch. It can be used to supply the motherboard or to take power from the motherboard.

R1 to R6

These provide current limiting between the Z180 system and the serial devices on serial ports A and B, providing protection for when one is powered and the other is not.

R7 to R9

The resistors provide pull up and pull down for the serial port inputs, thus holding them in known states when no device is connected.

R10

This resistor pulls the reset signal up. When pulled low the motherboard is reset.

R11 to R19

These re the current limiting resistors for the LEDs. 470 ohms should give reasonable brightness, but higher or lower values can be used if required.

R20 to R22

These provide pull ups for the I2C SDS signal (R20), the SPI master in signal (R21), and the ROM select signal (R22)

RP1

This resistor pack/network pulls up CPU signals, such as the interrupt line.

S1

This is an 80-pin bus socket, mounted horizontally to allow a module backplane extension board, such as SC113, to be fitted. It can also be used to connect an expansion module horizontally.

S2 and S3

These are 80-pin bus sockets, mounted vertically to allow expansion modules to be fitted. The bus is based on the RC2014 but has extra pins.

SW1

Power ON/OFF toggle switch. This only switches the power from sources J1, J2 and P10. Power supplied from the serial ports is not controlled by this switch.

SW2

This tactile button ground the reset signal, resetting the motherboard.

U1 and U2

These are 512k byte Flash memory chips. Only one can be mapped into memory at a time. See JP3 and P9.

U3

This is a 512k byte static RAM chip.

U4

The 74AHCT139 is the addresses decoder, providing chip enable signals for the three memory chips. It is a dual 2-to-4 line decoder. One decoder is used for the RAM, the other for the two Flash chips. Inputs are memory request (MREQ), A19, and the ROM chip selection signal (low for U1, high for U2).

U5

This is a 68-pin PLCC packaged Z8S180 CPU. It must be rated at a frequency at least as high as the clock signal PHI.

PHI is initially the on-board oscillator (X1) frequency divided by 2, as the Z180 turns on its clock divider on at reset. However, current firmware turns this off, so PHI is then equal to the on-board oscillator (X1) frequency. It is possible for software to enable the Z180's clock multiplier, so that PHI is twice the on-board oscillator (X1) frequency.

SC126 is typically fitted with an 18.432 MHz oscillator, so a 20 MHz Z180 is required. With a 33 MHz Z180, it may be possible to run the system with the clock multiplier on, thus overclocking the Z180 to 36.864 MHz. But only may be!

U6 and U7

These are 74HCT273, 8-bit registers. They are mapped to I/O addresses 0x0C and 0x0D. Address 0x0C latch provides output to control the real time clock, the SPI ports and the I2C bus. Address 0x0D latch provides control of 8 LEDs.

U8

This is a DS1302 real time clock chip. It is powered by the motherboards main supply or by the lithium battery (B1). It provides the time and date to any compatible software.

U9 and U10

These are a pair of 74HCT138, 3-to-8 line decoders. Together these provide address decoding for the I/O devices on the motherboard. U10 decodes the binary address 00001x0x, which is then refined by U9 to provide chip enable signals for a write to 0x0C, read from 0x0C, and write to 0x0D.

U11

The 74HCT125, quad tri-state buffer, provides gating of signals to and from both the I2C and real time clock's data signals.

U12

This is a DS1233-5+ voltage supervisor and reset device. It provides a clean, reliable reset for the Z180 system. The device pulls the system's reset signal low when the supply voltage is less than about 4.5 volts. If your system does not run, check the supply voltage and the reset signal.

The reset line can also be pulled down by a reset button. The DS1233 senses this and pulls its own output low to provide a clean reset pulse. This eliminates the typical switch bounce that could lead to reliability problems.

X1

This oscillator provides the CPU's main clock. With existing firmware this oscillator is also used as a clock source for the serial ports. Typically this oscillator is 18.432 MHz. This is the frequency required when running the motherboard with the Small Computer Monitor configuration S6 and with RomWBW RCZ180_sc126.

X2

This is a 32.768 kHz crystal used by the real time clock (U8).