Application note : GPIO and I2C peripherals with the Z80-MBC3

The Z80-MBC3 has a socket for a PCF8574 parallel port circuit and an edge connector to wire the general purpose inputs or outputs (GPIO) to external hardware. The PCF8574 is a lower cost alternative to the MCP23017 circuit that was used on the Z80-MBC2. The I2C bus is an established standard which can interconnect many digital functions using a simple wiring scheme. The MBC3 board has three I2C peripherals on the main board: the GPIO circuit with a PCF8574 and the Real Time Clock module which contains the DS3231 clock circuit and a AT24C32 EEPROM. The I2C needs pull up resistors on the SDA and SCL connections which are present on the Real time Clock Module. Further the MBC3 has an expansion connector on the edge of the card to utilise the I2C bus for external interfaces such as sensors and displays or expansion of the GPIO capabilities.

This chapter focusses on the application of the on board PCF8574 for GPIO. It is very easy to use since it only has a single register which be read from or written to. Applications requiring more port pins, can extend with up to 7 external PCF8574 circuits connected to the I2C bus for up to 64 channels. Each PCF8574 has 3 pins with which the bus address is defined. The onboard circuit uses address 0x40 and additional PCF8574s can occupy addresses 0x42, 0x44, 0x46, 0x48, 0x4A, 0x4C, and 0x4E. The pins are so called quasi bidirectional variants that have internal pull-up current sources. To use them as inputs, you simply connect switches or buttons between the port pins to ground without the need for any resistors. When used for output, the pins can sink more current than they can source. These properties are documented in the data sheet.

The method to perform input and output follows the same procedure as with other I/O:

To write execute :   OUT   1, function
                            OUT   0, data

And to read execute :   OUT   1, function
                            result = INP (0)

And the function codes have a logical relation to the GPIO circuit's address. To write use function code = address divided by 2 (0x20, 0x21, 0x22, 0x23, 0x24, 0x25, 0x26, 0x27) and to read inputs the function code is the same as the output address with 0x80 added (0xA0, 0xA1, 0xA2, 0xA3, 0xA4, 0xA5, 0xA6, 0xA7). The on board GPIO IC has the address pins wired to ground, so that IC uses function codes 0x20 (32 decimal) for output and 0xA0 (160 decimal) for input.

The IOS firmware has provisions for other external peripherals connected to the I2C bus. The Z80 applications can read from or write to an arbitrary I2C slave one byte per command. Where the I2C bus address is embedded in the function code for PCF8574 peripheral IC's, others require an additional step to set the target bus address prior to executing the input / output instruction. The function code to set the target bus address is : 0x29 (41 decimal). To write one byte use function 0x28 (40 decimal), and to read one byte use function 0xA8 (168 decimal).

The following addresses are occupied by the on board I2C peripherals :

DS3231 Real Time Clock   at 0xD0 (208 decimal)

AT24C32 EEPROM on the clock module   at 0xA0 (160 decimal)
        The EEPROM on the clock module is not used by the IOS firmware.