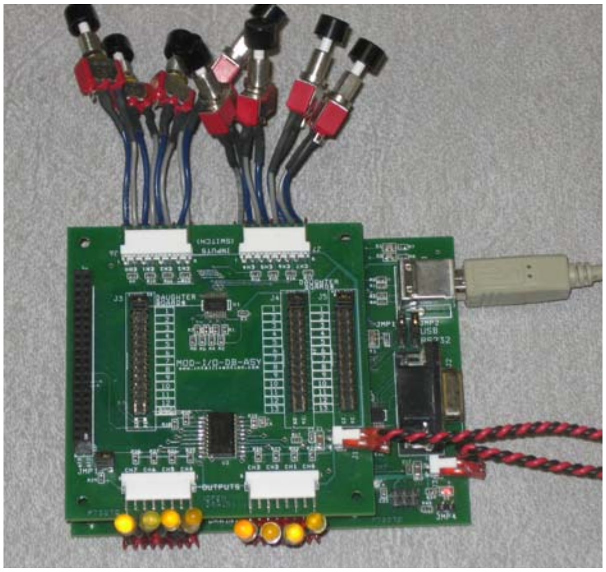
MODULAR I/O BOARD SYSTEM USER MANUAL



Capabilities

The I/O board consists of one motherboard and stackable daughter cards for increasing I/O capabilities. A total of twelve daughter cards can be stacked on the motherboard for up to 104 inputs and 104 outputs. The system is comprised of one motherboard with USB or RS232 interface that has 8 digital outputs and 8 digital inputs.

Additional daughter cards each carrying an additional 8 digital outputs and 8 digital inputs. Each output is an open source/drain that can sink up to 250 mA from up to a 45VDC source. Each input is active low with integrated pull-up resistor. The firmware provides for Software-detectable I/O stack configuration, user control of input debounce scan rate and debounce period, and facilities for read/write functionality to a single board or the entire stack. Additionally, event messages indicating any given input changes logic state.

Motherboard Power and Reset

J3 is the power header and requires a 5 VDC input at up to 4.25A depending on the output loads. Pin one is ground and pin 2 is 5 VDC. Jumper 4, labeled “JMP4” is the reset and when its terminals are shorted together the circuit reboots the board.

Daughterboard Power

J1 is the power header and requires a 5 VDC input at up to 4.25A depending on the outputs. Pin one is ground and pin 2 is 5 VDC.

I/O Port Functionality

There are eight input ports per board as well as eight output ports.

Inputs

The TTL level inputs (with on board 5VDC pull-ups) are on the even pin numbers on the Input Connectors. The odd pin numbers on the input connectors provide a board ground so that a user may simply connect a switch between any odd-even pin pair. It is recommended that switch inputs are paired up in numerical order. I.e. Pins 1,2 to a switch, Pins 3,4 to the next switch, etc.

Outputs

The outputs are open collector/drain and are connected to the even pin numbers on the output connectors. Each output is capable of sinking 250 mA with a maximum collector/drain voltage of 45V.

The output terminals odd pin numbers each have a 1/10 watt 165 Ω resistor to the on board 5V power so that a 3.6 V LED can be connected to the adjacent even pin.

Since the Outputs are open collector/drain a wide variety of loads may be sinked as long as the voltage and current limits are obeyed.

I/O Port Configuration

Each board in a MOD-IO board stack has jumper labeled "LAST BOARD". The "LAST BOARD" jumper is only to be installed on the final (top) board in the stack. If the motherboard is used by itself the "LAST BOARD" jumper is installed on the motherboard. The stack of boards will only function up to the first board in the stack with the "LAST BOARD" jumper installed. On early version of the daughter cards the "LAST BOARD" jumper is labeled JMP1.

Each daughterboard also has 3 more jumper headers J3, J4, & J5. Numbers run along each jumper header that corresponds to the daughterboard position in the stack.
For example the 1st daughterboard in the stack would have all three jumpers: J3, J4, & J5 installed in the "1" position. The 2nd daughterboard would have all three jumpers: J3, J4, & J5 installed in the "2" position.

The "LAST BOARD" jumper on the top or last daughterboard should be installed.

Up to 12 daughterboards may be installed on the stack.

Connectors

The motherboard interfaces with a computer via a standard RS232 DB9-Female Serial port connector configured as a DTE (TX=Pin2, RX = Pin3) or standard USB 1.1 B-Type connector. Digital inputs to the and outputs from the motherboard and daughterboard(s) are via right angle AMP/Tyco MTA type 0.1" 8 position headers. Power is provided over a two position AMP/Tyco MTA type 0.1" header on the Motherboard and each Daughterboard.

Serial Port Settings (Motherboard)

The motherboard interfaces with a computer or other peripheral using a USB port or standard RS232 serial port. Jumpers one and two, labeled "JMP1" and "JMP2", are used to select which port data will be transmitted on. See Figure 1 & Figure 2 below for appropriate settings.

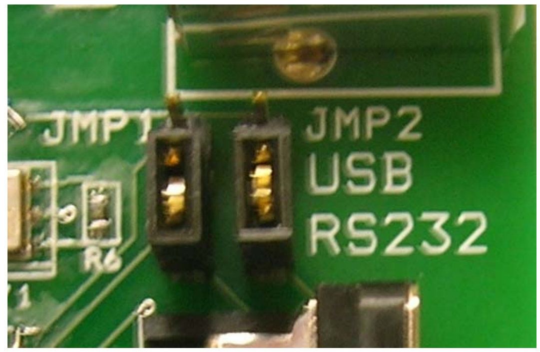
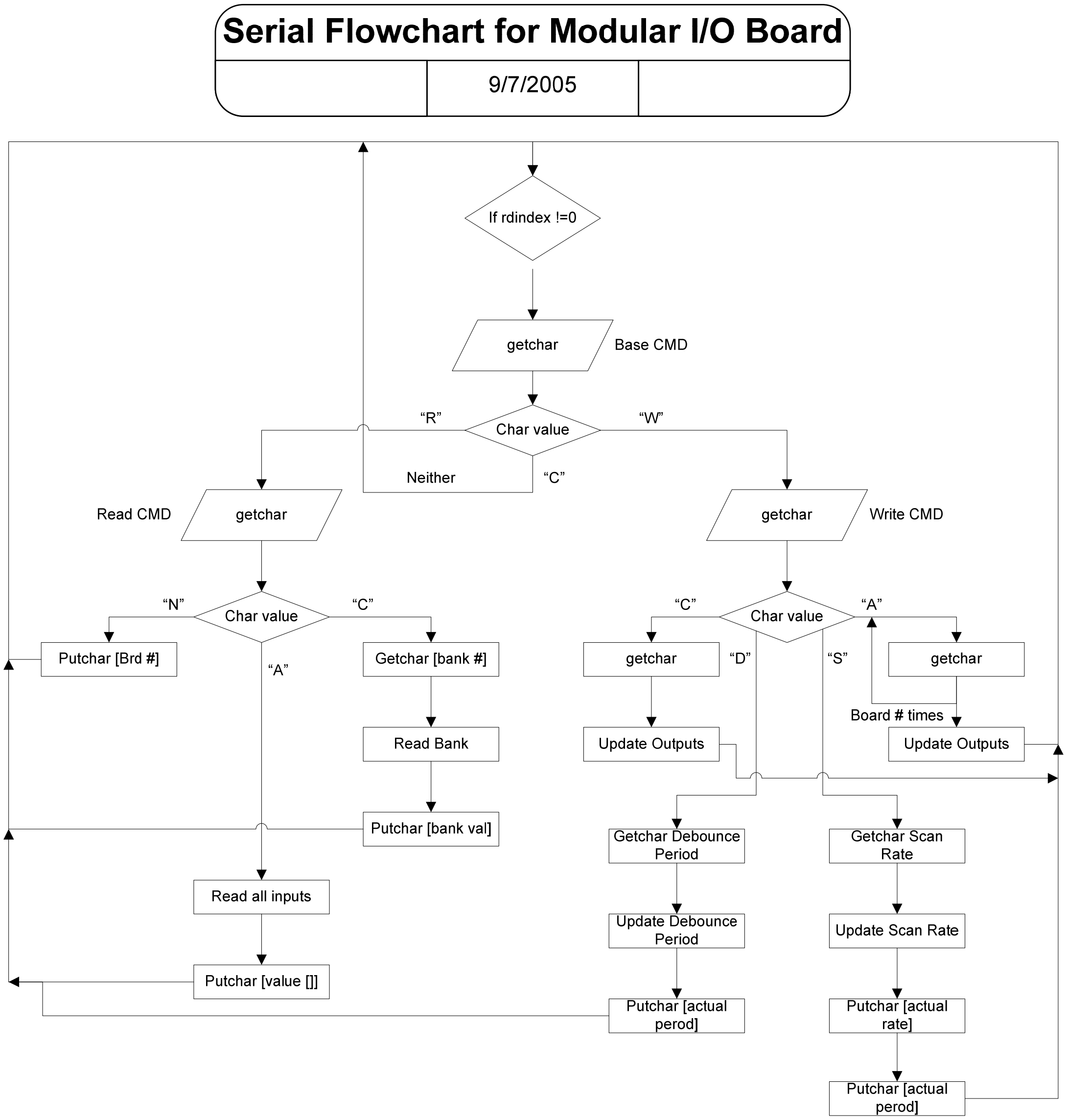


Figure 1 - RS232 Serial Port Setting

Figure 2 – USB Port Setting

Serial Interface



The above flow chart demonstrates the serial command flow for each upload and download. There is a separate interface for the debounce data. When a command is written to the I/O board the timer debounce capability is paused so the command can be completed. Once all data transfers have been completed the timer interrupt resumes at the same debounce period and scan rate. The table below characterizes the format for each of the data transfers in the command structure.

Data Flow of I/O Board

Mode of Operation	First	Second	Third	Fourth etc..
Read All Channels	DL 'R'	DL 'A'	UL 8-bit # of Channels	UL 8-bit input for each channel, UL channels from bottom to top
Read Single Channel	DL 'R'	DL 'C'	DL 8-bit Channel #	UL 8-bit input
Read Number of Boards	DL 'R'	DL 'N'	UL 8-bit # of Channels	
Write All Channels	DL 'W'	DL 'A'	UL 8-bit # of Channels	DL 8-bit output for each channel, DL channels from board 0 to top board in the stack
Write Single Channel	DL 'W'	DL 'C'	DL 8-bit Channel #	DL 8-bit output
Write Debounce Scan Rate	DL 'W'	DL 'S'	DL Desired Scan Rate (float)	UL Actual Scan Rate (float) (4 bytes) and Actual Debounce Period (float) (4 bytes)
Write Debounce Period	DL 'W'	DL 'D'	DL Debounce Period (float)	UL Debounce Counter (float) (4 bytes)
Heart Beat	DL 'H'	UL 'B'		

Variable Name	**Data format**
Channel Number	byte
Number of channels	byte
I/O Data	byte
Scan Rate	float
Debounce Period (ms)	float
Debounce Counter	float

Key

DL = Download from Computer to I/O board
UL = Upload from I/O board to Comuter
Read and Write Floats MSB First
Read and Write I/O Data LSB First

State Change Interface

State changes at any input port cause a four byte message to be sent over the serial port. The first byte is a delimiter, ASCII 'C'. The second byte is the board number (0-12) on the stack in a binary format. The third byte transmitted is the bit number (0-7) that changed on the board # included in the message. The bit number is in a binary format. The fourth and final byte is a binary value containing the state of the input pin # included in the message. The state byte contains a binary 0 for open and a binary 1 for closed. If a state change occurs during command serial communication it will not detect the state change until after the serial communication has completed. If the state changes back to its original value within the serial communication, the state change will be lost.

Debounce Period and Scan Rate Relationship

There is a direct relationship between the debounce period and scan rate. If the scan rate changes it will change the debounce period, but if the debounce period changes it will not change the scan rate. It is characterized by the following formulas:

$$DebounceLimit = ((\text{int})F_{sract} * T_{dbdes})$$
$$T_{dbact} = DebounceLimit / F_{sract}$$

Because of the dependency of the debounce period on the scan rate the actual debounce period is transmitted during the write scan rate command.