This is the Revision A verion of the Digital8 module. The status of this project is finished.

# Digital8 Module (Revision B)

## Table of Contents

This document is also available in PDF format.



## 1. Introduction

The Digital8 module provides the ability to input and output 8 bits of digital data. The direction of each bit can be changed under program control.

## 2. Programming

The programmer can download a complement mask to cause any of the bits to be complemented prior to reading.

The Digital8 module supports the Interrupt Protocol. The interrupt pending bit is set whenever the the formula:

L&(~I) | H&I | R&(~P)&I | F&P&(~I)]

is non−zero, where:

- I is the current input bits XOR'ed with the complement mask (C)
- P is the previous value of I
- L is the low mask
- H is the high mask
- R is the raising mask
- F is the falling mask

and

- ~ is bit−wise complement
- | is bit−wise OR
- & is bit−wise AND

Once the interrupt pending bit is set, it must be explicitly cleared by the user.

The Digital8 module supports both the standard shared commands and the shared interrupt commands in addition to the following commands:

| Command | Send/ Receive | Byte Value | | | | | | | | Discussion |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| Read Inputs | Send | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Return 8−bits of input *iiii iiii* (after XOR'ing with complement mask) |
| | Receive | *i* | *i* | *i* | *i* | *i* | *i* | *i* | *i* | |
| Read Outputs | Send | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Return 8−bits of the outputs *oooo oooo* (after XOR'ing with complement mask.) |
| | Receive | *o* | *o* | *o* | *o* | *o* | *o* | *o* | *o* | |
| Read Complement Mask | Send | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | Return 8−bits of complement mask *cccc cccc* |
| | Receive | *c* | *c* | *c* | *c* | *c* | *c* | *c* | *c* | |
| Read Direction Mask | Send | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | Return 8−bits of direction mask *dddd dddd* |
| | Receive | *d* | *d* | *d* | *d* | *d* | *d* | *d* | *d* | |
| Read Low Mask | Send | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Return 8−bits of low mask *llll llll* |
| | Receive | *l* | *l* | *l* | *l* | *l* | *l* | *l* | *l* | |
| Read High Mask | Send | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | Return 8−bits of the high mask *hhhh hhhh* |
| | Receive | *h* | *h* | *h* | *h* | *h* | *h* | *h* | *h* | |
| Read Rising Mask | Send | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | Return 8−bits of the rising mask *rrrr rrrr* |
| | Receive | *r* | *r* | *r* | *r* | *r* | *r* | *r* | *r* | |
| Read Falling Mask | Send | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | Return 8−bits of the falling mask *ffff ffff* |
| | Receive | *f* | *f* | *f* | *f* | *f* | *f* | *f* | *f* | |
| Read Raw | Send | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | Return 8−bits of raw input data *rrrr rrrr* (without XOR'ing with complement mask) |
| | Receive | r | r | r | *r* | *r* | *r* | *r* | *r* | |
| Reset Outputs | Send | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | Set all 8 bits of outputs to 0 (then XOR with complement mask). |
| Set Outputs | Send | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | Set output bits to *oooo oooo*. |
| | Send | *o* | *o* | *o* | *o* | *o* | *o* | *o* | *o* | |
| Set Complement Mask | Send | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | Set 8−bits of complement mask to *cccc cccc* |
| | Send | *c* | *c* | *c* | *c* | *c* | *c* | *c* | *c* | |
| Set Direction Mask | Send | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | Set 8−bits of direction mask to *dddd dddd* 1=input; 0=output |
| | Send | *d* | *d* | *d* | *d* | *d* | *d* | *d* | *d* | |
| Set Low Mask | Send | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | Set 8−bits of low mask to *llll llll* |
| | Send | *l* | *l* | *l* | *l* | *l* | *l* | *l* | *l* | |
| Set High Mask | Send | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | Set 8−bits of the high mask to *hhhh hhhh* |
| | Send | *h* | *h* | *h* | *h* | *h* | *h* | *h* | *h* | |
| Set Rising Mask | Send | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | Set 8−bits of the rising mask to *rrrr rrrr* |
| | Send | *r* | *r* | *r* | *r* | *r* | *r* | *r* | *r* | |
| Set Falling Mask | Send | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | Set 8−bits of the falling mask to *ffff ffff* |
| | Send | *f* | *f* | *f* | *f* | *f* | *f* | *f* | *f* | |
| Set Outputs Raw | Send | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | Set 8−bits to *oooo oooo* with no complement mask. |
| | Send | *o* | *o* | *o* | *o* | *o* | *o* | *o* | *o* | |

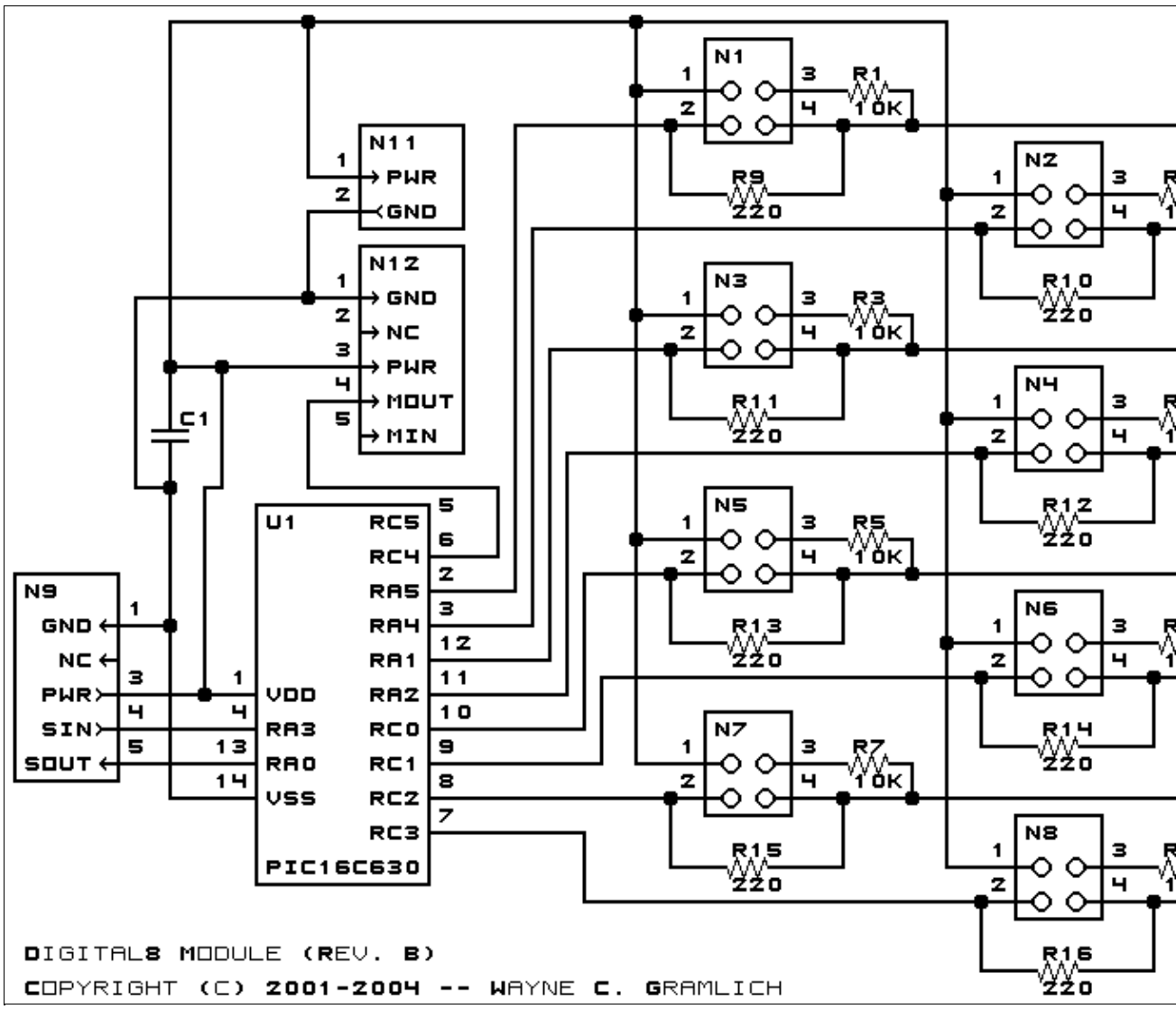
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Reset Everything | Send | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Reset all registers to 0 and set direction bits to 1 (input) |
| Set Output Bit | Send | 0 | 0 | 1 | 0 | *v* | *b* | *b* | *b* | Set output bit *bbbb* to *v* |
| Set Outputs Low | Send | 0 | 1 | 0 | 0 | *l* | *l* | *l* | *l* | Set low order 4−bits of Outputs to *llll* and then XOR complement mask |
| Set Outputs High | Send | 0 | 1 | 0 | 1 | *h* | *h* | *h* | *h* | Set high order 4−bits of Outputs to *hhhh* and and then XOR complement mask |
| Set Direction Low | Send | 0 | 1 | 1 | 0 | *l* | *l* | *l* | *l* | Set low order 4−bits of direction to *llll*. |
| Set Direction High | Send | 0 | 1 | 1 | 1 | *h* | *h* | *h* | *h* | Set high order 4−bits of direction to *hhhh*. |
| Set Interrupt Commands | Send | 1 | 1 | 1 | 1 | 0 | *c* | *c* | *c* | Set Interrupt Command *ccc*. |
| Shared Commands | Send | 1 | 1 | 1 | 1 | 1 | *c* | *c* | *c* | Execute Shared Command *ccc* |

# 3. Hardware

The hardware consists of a circuit schematic and a printed circuit board.

## 3.1 Circuit Schematic

The schematic for the Digital8 module is shown below:




The parts list kept in a separate file −− digital8.ptl.

## 3.2 Printed Circuit Board

The printed circuit files are listed below:

*digital8_back.png*
: The solder side layer.

*digital8_front.png*
: The component side layer.

*digital8_artwork.png*
: The artwork layer.

*digital8.gbl*
: The RS−274X "Gerber" back (solder side) layer.

*digital8.gtl*
: The RS−274X "Gerber" top (component side) layer.

*digital8.gal*
: The RS−274X "Gerber" artwork layer.

*digital8.drl*
: The "Excellon" NC drill file.

*digital8.tol*
: The "Excellon" tool rack file.

### 3.3 Construction Instructions

The construction Instructions are located in a separate file to be a little more printer friendly.

## 4. Software

The Digital8 software is available as one of:

*digital8.ucl*
: The µCL source file.

*digital8.asm*
: The resulting human readable PIC assembly file.

*digital8.lst*
: The resulting human readable PIC listing file.

*digital8.hex*
: The resulting Intel® Hex file.

## 5. Issues

Any fabrication issues will be listed here.

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