Majenko Technologies

Micro Pulse Rifle Counter Module

DS3824 Revision 1

Miniature programmable 7 segment display with counter functionality

Contents

Miniature programmable 7 segment display with counter functionality

High-Performance RISC CPU:

- **PIC18F25K20**
- **Internal RC Oscillator at 16MHz**
- **32KB Flash**
- **1.5KB SRAM**
- **256 Bytes EEPROM**
- **UART Interface**

Integrated dual 7-segment LED display

- **Hyper Red™ Technology**
- **44mcd luminous intensity**
- **630nm wavelength**
- **Non-multiplexed operation**

6 dedicated universal IO connections

- **6 General Purpose IO Ports Multiplexed With:**
  - **2 Analog inputs**
  - **UART**
  - **2 Interrupt inputs**
  - **ICSP Programming Port**

1 Overview

The Majenko Technologies Micro Pulse Rifle Counter Module is an incredibly small embedded development board aimed at individuals wishing to add a basic counter display to replica film props and similar projects. The module is designed to be powered from batteries and be simple to wire to external peripherals, such as buttons, switches, LEDs and other suitable devices.

The module is completely programmable using XC8 and MPLAB-X from Microchip, and the open source UECIDE development environment from Majenko Technologies (downloadable from www.uecide.org) and comes preloaded with an example firmware for the popular M41A Pulse Rifle from the Alien series of films.

External connections to the board are made through wires soldered to through-hole solder points around the edge of the board. A number of useful signals are brought directly to these solder points from the main PIC18F25K20 microcontroller, including general purpose IO lines, TTL UART and analog inputs.

The microcontroller is also directly driving a dual digit 7-segment display in a common-cathode arrangement.

The TTL UART connection also provides a simple serial interface menu for adjusting various parameters for the operation of the board.

2 Board Layout

2.1 Rear (components)

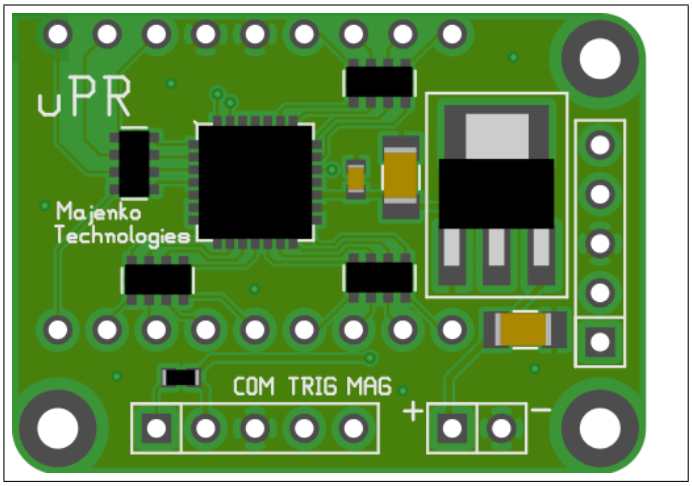

Figure 1: Layout

Connections

There are three main connectors on the Micro Pulse Rifle Board. The bottom row consists of two connectors: The ICSP / GPIO header aimed at connecting to trigger and magazine buttons, and the incoming power connection. The right hand side has a further general purpose communications connector.

ICSP / GPIO

This connector follows the standard ICSP layout used in the PICkit™2 and PICkit™3 hardware PIC programmers.

From left-to-right the connections are:

- $\overline{\text{MCLR}}$ (Reset)
- +3.3V
- Ground
- PGD (RB7, Trigger)
- PGC (RB6, Magazine)

Power

While the board itself runs internally from 3.3V, a linear voltage regulator (LM1117-3.3 compatible) is provided to allow the board to be powered by any voltage between 4.5V and 12V. The power connector allows direct connection (through a power switch) to power sources such as 3xAA, 9V PP3, or multi-cell Lithium-Ion batteries.

Communications / GPIO

The communication port provides a TTL UART connection for configuring some aspects of the board's operation. Two additional GPIO ports, either of which can also be an analog input or interrupt input, are also available. From top to bottom the connections in this port are as follows:

- UART RX
- UART TX
- Ground
- RB1 - Analog or interrupt input
- RB0 - Analog or interrupt input

2.2 Pulse Rifle IO Functions

The default firmware for the board assigns specific functions to the GPIO ports for operating as a Pulse Rifle counter.

Wiring

For basic operation just two buttons (normally open) or similar components are required:

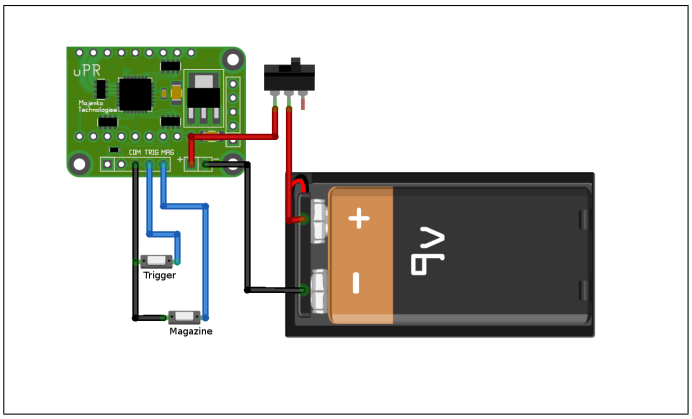

Figure 2: Pulse Rifle Wiring

TRIG

The Trigger (TRIG) connection, port RB7, is an active-low 3.3V input which causes the counter to count down from 95 to 00.

The Magazine (MAG) connection, port RB6, is an active-low 3.3V input which, when active, signals the presence of a magazine. While this input is not active the display will be locked on 00 and no counting can occur. Upon activating this input (connectingto ground) the counter resets to 99 then counts down to 95.

Receive / Transmit

An interactive menu, accessible through the UART interface, is provided for making adjustments and personalizations to the operation of the board. See Appendix C on page 7 for more information about the parameters menu.

Status

Port RB1 is used to indicate the current status of the counter. A HIGH output (3.3V) from this pin indicates that the magazine is inserted, the loading sequence (counting from 99 to 95) has completed, and there is ammunition available (a value of 01 or more on the display). Upon removal of the magazine, or the ammunition counter running out, this output will go to a low state.

Fire pulse

Port RB0 emits a short pulse of 3.3V every time the counter decrements. The length of this pulse is 50ms by default, but the length can be adjusted in the parameters menu.

A Electrical Characteristics

This section provides an overview of the Micro Pulse Rifle Counter Module electrical characteristics. Additional information will be provided in future revisions of this document as it becomes available.

Absolute maximum ratings for the Micro Pulse Rifle Counter Module are listed below. Exposure to these maximum rating conditions for extended periods may affect device reliability. Functional operation of the device at these or any other conditions, above the parameters indicated in the operation listings of this specification, is not implied.

A.1 Absolute Maximum Ratings

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions, above those indicated in the operation listings of this specification, is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Ambient temperature under bias	-40°C to +125°C
Storage temperature	-65°C to +150°C
Voltage on BATTERY with respect to GND	-0.3V to +15.0V
Voltage on any pin IO, with respect to GND	-0.3V to +3.6V
Maximum output current sunk by any I/O pin	25 mA
Maximum output current sourced by any I/O pin	25 mA
Maximum current sunk by all ports	200 mA
Maximum current sourced by all ports	185 mA

A.2 DC Characteristics

Operating voltage (battery)	+4.5V to +12V
Idle current consumption (displaying 95)	108mA
Active current (audio and active display)	115mA

A.3 AC Characteristics

Nominal core frequency	16MHz

B Interfacing a high power LED

The firing pulse output (RB0) can be used to drive a high power LED to create a visual firing effect. A low powered LED can be directly driven (with a suitable current limiting resistor) from the pulse output at up to 20mA, but for higher currents a constant current LED driver is required.

A suitable device is the CAT4101TV available as a small breakout board from Majenko Technologies.

Wiring the CAT4101TV to the Micro Pulse Rifle Counter Board is a very simple operation:

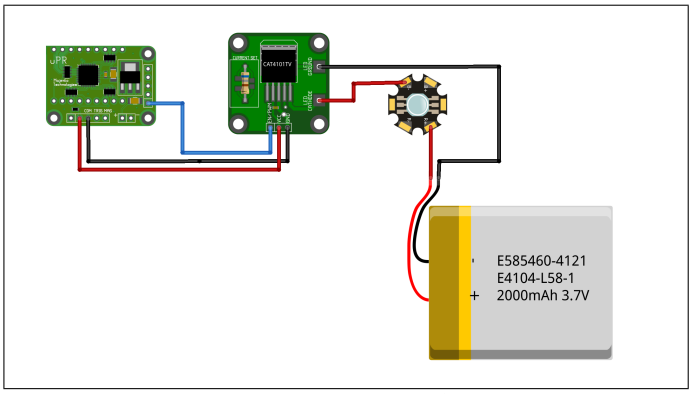

Figure 3: Interfacing a CAT4101TV

In this example a separate power source (Lithium Ion battery) is shown for the high current portion of the circuit. This power source, if the voltage is within the right range, can also be shared with powering the counter board.

C Serial Parameters Menu

The serial parameters menu can be accessed through the R and T pins as a TTL UART interface. The interface is configured to run at 115200 baud, with 8 bits, one stop bit, and no parity (8N1).

To connect to the interface a TTL UART adapter is required. Suitable adapters generally operate on chips such as the FT232R from Future Technologies, the PL2303 from Prolific, or the MCP2200 from Microchip.

Note that the UART connections are 3.3V, not 5V. If your UART adapter isn't 3.3V it is recommended to connect the adapter's TX to the board's RX pins through a small resistor of approximately 220Ω to avoid damage to the board.

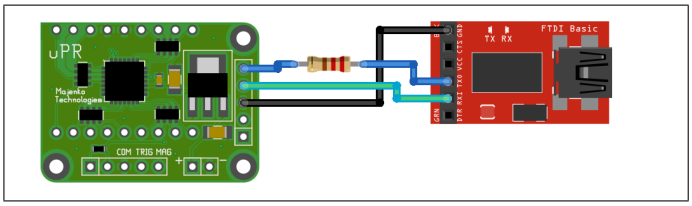

Figure 4: Connecting a Serial Interface

Any ANSI compatible serial terminal software can be used to communicate with the menu.

The structure of the menu is as below:

```
uPR Settings
============

[B/b] Brightness: 10
[L/l] Load speed: 250ms
[F/f] Fire speed: 66ms
[I/i] Initial ammo: 99
[C/c] Countdown ammo: 95
[P/p] Output pulse: 50ms
```

Pressing a letter associated with an entry either increases or decreases the value of that entry by one. Using a capital letter increases the value, and a lower-case letter decreases the value.

Brightness

It is possible to change the brightness of the display through software driven PWM. This can be used if the display is too bright. The range is 0 (off) through 10 (fully on).

Load speed

This is the delay between subsequent numbers during the "loading sequence" when the display is performing the initial count-down of ammunition as you insert a magazine.

Fire speed

This is the delay between subsequent digits during the normal firing count-down. 66ms is approximately 15 rounds per second.

Initial ammo

This is the value the counter starts at immediately you insert a magaine. Normally this is 99.

Countdown ammo

The loading sequence will count down to this value. This is usually 95.

Output pulse

The length, in milliseconds, of the output pulse signal from port RB0. 50ms is a reasonable length for driving an LED for a visual firing effect.

Once values have been changed, after a short pause (about 5 seconds) the changed values will be automatically written to EEPROM.

D Programming

To update or replace the firmware, or to develop your own firmware, the recommended IDE is currently MPLAB-X from Microchip. The compiler needed is Microchip's XC8 compiler. Both are available as a free download from www.microchip.com. XC8 is also available for purchase as a Professional version which produces more highly optimized code.

To install firmware on the board a hardware programmer is required. Recommended is the PICkit™2 or PICkit™3 from Microchip. Connecting the programmer is a simple 1:1 connection between the programmer and the board's ICSP port:

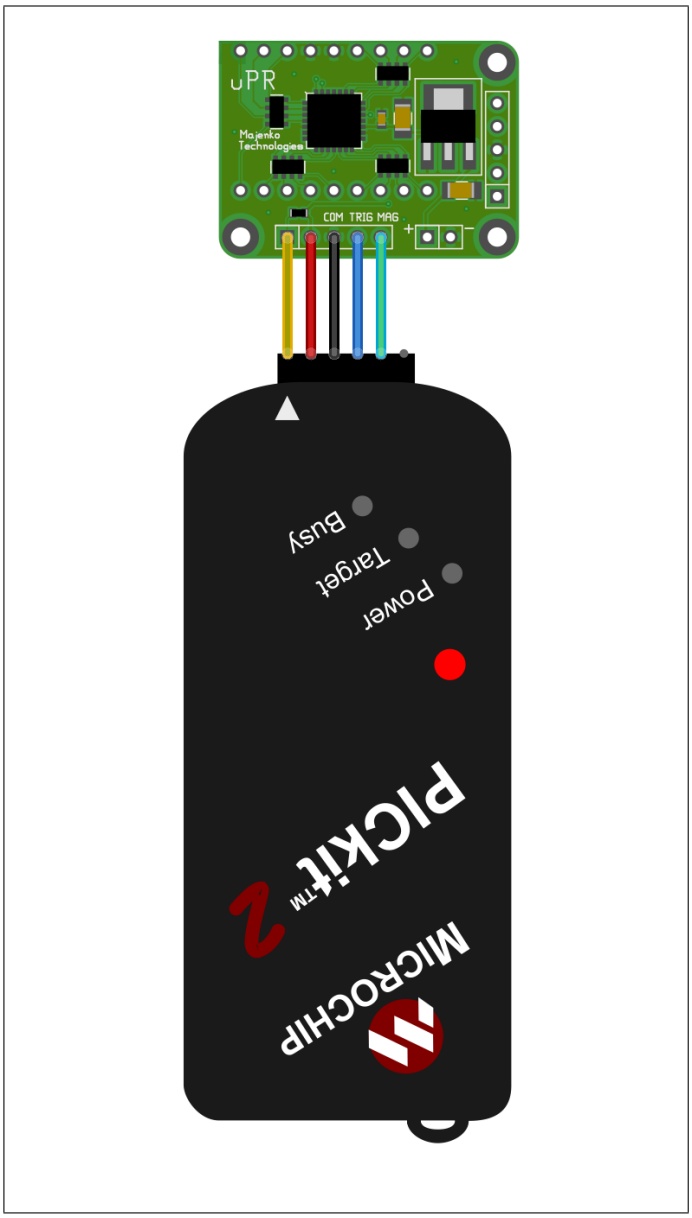

Figure 5: Connecting a PICkit™2

E Schematic

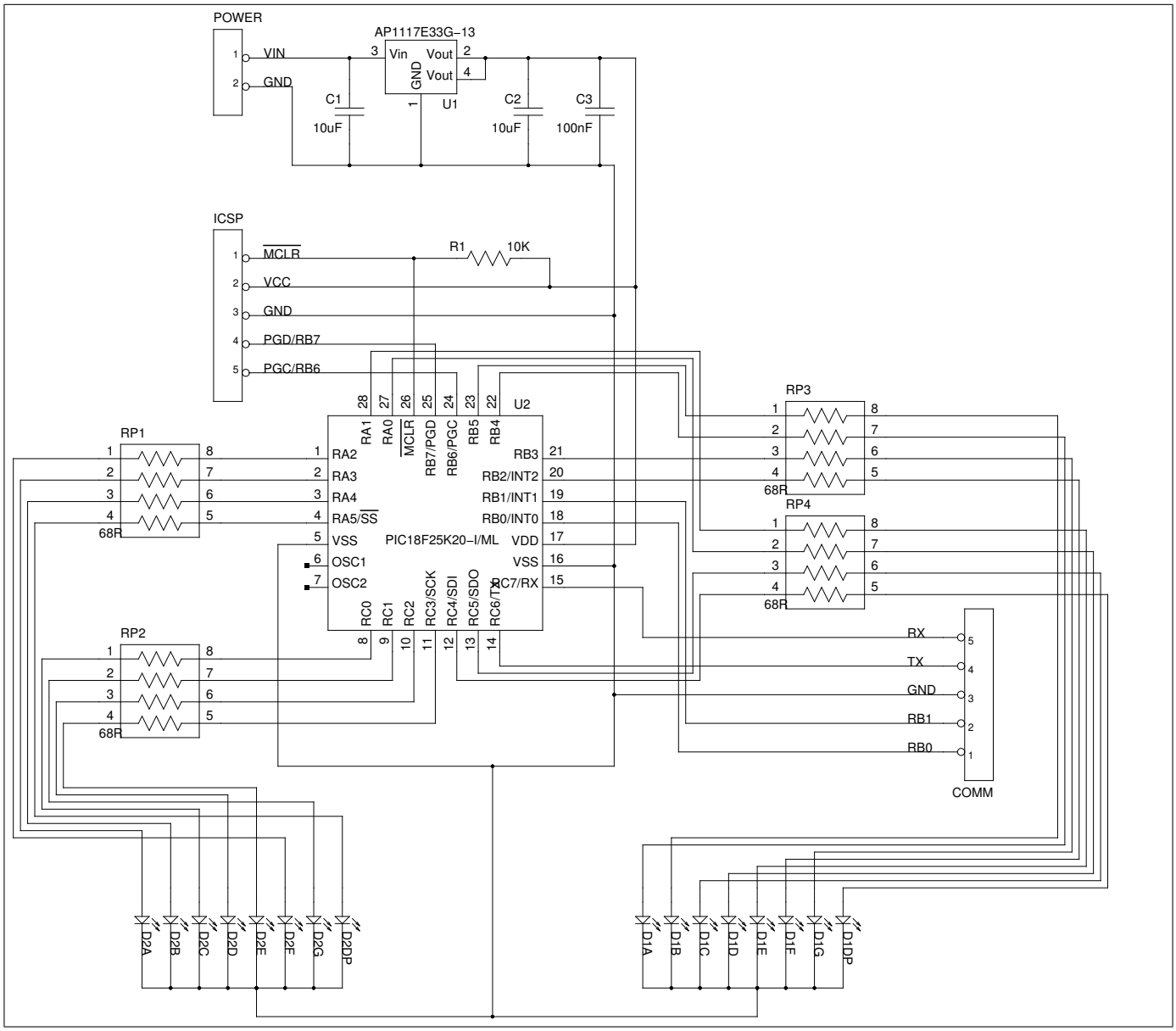

Figure 6: Schematic

F Mechanical Specifications

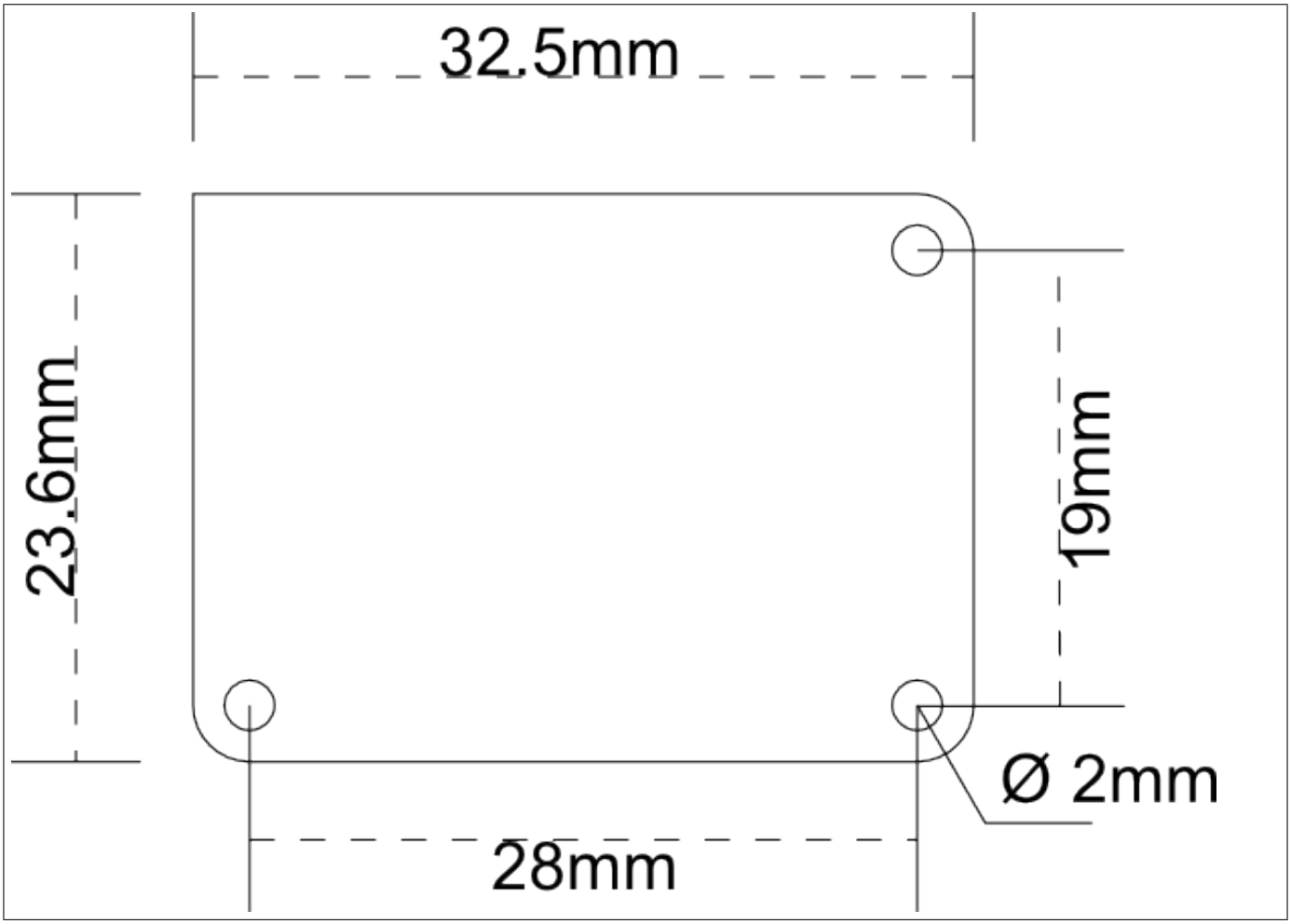

Figure 7: Mounting Dimensions

G Document Revisions

1. MJ ... 16/11/2014 ..... Initial draft