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# Software Design Notes



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<https://github.com/miniPCB>

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<https://www.youtube.com/@minipcb>

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## Introduction

### Purpose

The purpose of this document is to record software design notes for the 13A-777 miniPCB.

### Scope

The scope of this document is limited to specifications and requirements, source code, and firmware releases.

### File Locations

FILE NAME	FILE LOCATION
[ALL]	<a href="https://github.com/miniPCB/EAGLE/tree/main/miniPCB/13/A/13A-777">https://github.com/miniPCB/EAGLE/tree/main/miniPCB/13/A/13A-777</a>

### Definitions and Abbreviations

- Convitae, the ratio of a response per stimulus.
- DHM, device histogram matrix, used to organize and access data.
- HPC, histogram program counter, used to track most recent game.
- HVC, histogram vector counter, used to track most recent entry.

## Specification Requirements

### SSR1 – Hardware Abstraction

No text (title)

#### SSR1.1 Target Microcontroller

PIC16LF1789-I/PT

#### SSR1.2 Microcontroller Pinout

PIN	NAME	FUNCTION	DESCRIPTION
1	RC7	GPIO	LCD-D2
2	RD4	GPIO	LCD-D3
3	RD5	GPIO	LCD-D4
4	RD6	GPIO	LCD-D5
5	RD7	GPIO	LCD-D6
6, 29	VSS	Return	Ground
7, 28	VDD	Source	Power
8	RB0	GPIO	LCD-D7
9	RB1	No Connection	
10	RB2	No Connection	
11	RB3	GPIO	LCD-BACKLIGHT-ENABLE
12, 13	NC	No Connection	No pin function
14	RB4	GPIO	LED1, Active Low
15	RB5	GPIO	Button input, Active Low
16	RB6	ICSPCLK	In Circuit Serial Programming
17	RB7	ICSPDAT	In Circuit Serial Programming
18	RE3	MCLR	In Circuit Serial Programming
19	RA0	ADC	Battery voltage
20	RA1	GPIO	Enable battery voltage divider. Active High.
21	RA2	DAC1OUT1	Adjusts LCD contrast.
22	RA3	GPIO	Adjusts LCD contrast, Switches between high and low ranges
23	RA4	GPIO	LCD Enable, Active High
24	RA5	GPIO	Encoder Button Switch, Active Low
25	RE0	GPIO	Encoder Red LED, Active Low
26	RE1	GPIO	Encoder B input
27	RE2	GPIO	Encoder A input
30	RA7	No Connection	
31	RA6	No Connection	
32	RC0	No Connection	
33, 34	NC	No Connection	No pin function
35	RC1	GPIO	Encoder Green LED, Active Low
36	RC2	GPIO	Encoder Blue LED, Active Low

PIN	NAME	FUNCTION	DESCRIPTION
37	RC3	No Connection	
38	RD0	No Connection	
39	RD1	No Connection	
40	RD2	GPIO	LCD-RS
41	RD3	GPIO	LCD-RW
42	RC4	GPIO	LCD-RE
43	RC5	GPIO	LCD-D0
44	RC6	GPIO	LCD-D1

### SSR1.3 – Power

Manage power with these functional modes:

FUNCTION	DESCRIPTION
sleepDeep	Minimal power consumption mode.
sleepActive	Low power consumption mode without sleeping.
activeGame	High power consumption mode.
batteryVoltage	Reads the current battery voltage.

### SSR1.4 – LCD

Control the 2x16 LCD with these functions:

FUNCTION	DESCRIPTION
setContrast	Controls the voltage controlling the LCD contrast.
setBacklight	Controls the voltage controlling the LCD backlight.
refreshScreen	Writes the full screen to the LCD module.

*SSR1.5 – LED*

Control the LED indicator with these functions:

FUNCTION	DESCRIPTION
setLED	Turns an LED indicator on.
clearLED	Turns an LED indicator off.
toggleLED	Toggles an LED indicator from off to on, or on to off.

*SSR1.6 – Primary Select Button*

Interface with the primary select button with this function:

FUNCTION	DESCRIPTION
readSelectButton	Signals include: (1) wake, (2) confirm, (3) select.

*SSR1.7 – Rotary Encoder*

Interface with a rotary encoder with these functions:

FUNCTION	DESCRIPTION
setEncoderRGB	Sets color of the RGB LED on the encoder.
readEncoderButton	Reads the encoder button switch.
readEncoderRotation	Reads the encoder rotation count and direction.

*SSR1.8 – Device Clock*

Maintain a device clock with 1 second resolution with these functions:

FUNCTION	DESCRIPTION
setTimer	Sets value in timer counter.
getTimer	Reads value in timer counter.
incTimer	Increments value in timer counter.
spareTime	Returns with the counts available in the long (8 bytes).
timerRatio	Returns with the ratio of current_count per max_count.



## SSR1.9 – Device Histogram

No text (title)

### SSR1.9.1 – Histogram Programming Interface

Maintain a device histogram with these functions:

FUNCTION	DESCRIPTION
writeHistogram	Adds a new record to the device histogram. Clears user interaction counters: buttonpress, encoderpress, and rotation.
writeHistogramValue	Writes a value to a device histogram.
playHistogram	Moves each value of the device histogram through the working register.
readHistogram	Reads the histogram matrix.
readHistogramValue	Reads a value from the histogram matrix.

### SSR1.9.2 – Game Results

Results from games are saved.

### SSR1.9.3 – Count Ratios

Device count ratios are computed by dividing a count-value by the max-count-value.

### SSR1.9.4 – Rolling Memory

Write over the oldest data in the matrix to accommodate new data.

### SSR1.9.5 – Histogram Program Counter (HPC)

Use a histogram counter to keep track of the most recent histogram entry.

### SSR1.9.6 – Histogram Vector Counter (HVC)

Use a histogram counter to keep track of the most recent vector entry.

### SSR1.9.7 – Histogram Memory

Device histogram is placed in RAM memory from 2A0h (bank 5) to 3EFh (bank 7).

#	HPC	HVC = 0 MEMORY ADDRESS	HVC = 15 MEMORY ADDRESS
0	0	2A0h	2AFh
1	1	2B0h	2BFh
2	2	2C0h	2CFh
3	3	2D0h	2DFh
4	4	2E0h	2EFh
5	5	320h	32Fh
6	6	330h	33Fh
7	7	340h	34Fh
8	8	350h	35Fh
9	9	360h	36Fh
10	10	3A0h	3AFh
11	11	3B0h	3BFh
12	12	3C0h	3CFh
13	13	3D0h	3DFh
14	14	3E0h	3EFh

### SSR1.9.8 – Memory Retention

RAM data is lost when the device loses power.

## *SSR2 – Toy Functionality*

No text (title)

### *SSR2.1 – Sleep*

The device will enter a low power mode when not in use.

### *SSR2.2 – Wakeup*

The device will wake from low power mode when the Primary Select Button is pressed.

### SSR3 – Game Functionality

No text (title)

#### SSR3.1 – PowerBall Lottery

No text (title)

##### SSR3.1.1 – Game Description

Select five (5) numbers from a set of sixty nine (69) numbers, and select one (1) number from a set of twenty six (26).

##### SSR3.1.2 – Histogram Contents

Selected numbers are saved in the device histogram.

##### SSR3.1.2 – Device Histogram Matrix (DHM)

Use the histogram counters to form a matrix.

##### SSR1.9.8 – Histogram Vector

Device histogram for PowerBall lottery is comprised of a matrix of vectors defined below.

#	DATA NAME	TYPE	INTUITIVE FOCUS
0	GAME RESULT 0	char	GAME CONVITAE * USER CONVITAE
1	GAME RESULT 1	char	
2	GAME RESULT 3	char	
3	GAME RESULT 4	char	
4	GAME RESULT 5	char	
5	GAME RESULT 6	char	
6	GAME RESULT 7	char	
7	GAME RESULT 8	char	
8	SECOND COUNT RATIO	char	DEVICE CONVITAE
9	BUTTONPRESS COUNT RATIO	char	
A	ROTATION COUNT RATIO	char	
B	ENCODERPRESS COUNT RATIO	char	
C	BATTERY VOLTAGE RATIO	char	
D	USER SIGNAL 0 (LIVE)	char	DEVICE CONVITAE * USER CONVITAE
E	USER SIGNAL 1 (LOVE)	char	
F	USER SIGNAL 2 (LEARN)	char	

### SSR1.9.9 – Histogram Memory Map

Device histogram will be mapped according to the memory map defined below.

#	HPC	HVC = 0 MEMORY ADDRESS	HVC = 15 MEMORY ADDRESS
0	0	2A0h	2AFh
1	1	2B0h	2BFh
2	2	2C0h	2CFh
3	3	2D0h	2DFh
4	4	2E0h	2EFh
5	5	320h	32Fh
6	6	330h	33Fh
7	7	340h	34Fh
8	8	350h	35Fh
9	9	360h	36Fh
10	10	3A0h	3AFh
11	11	3B0h	3BFh
12	12	3C0h	3CFh
13	13	3D0h	3DFh
14	14	3E0h	3EFh

## Source Code

Table 1 – \FilePath\FileName1.ext

INSERT CODE HERE

Table 2 – \FilePath\FileName2.ext

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Table 3 – \FilePath\FileName3.ext

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Table 4 – \FilePath\FileName4.ext

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## Firmware Release History

Table 5 – Release 000-000-0-NM.DDMMYYYY

File Name	
File Size	
File Location	
Target Hardware	
Maturity Level	
Compiler Notes	

## Revision History

REV	DESCRIPTION	ECO	DATE
A	Initial Release	N/A	DDMMYYYYYY



## Related Content

#	TYPE	DESCRIPTION	LOCATION
1	Sale Posting	eBay	
2	Sale Posting	Mouser	
3	Repository	Engineering Files	<a href="https://github.com/miniPCB/EAGLE/tree/main/miniPCB/13/A/13A-777">https://github.com/miniPCB/EAGLE/tree/main/miniPCB/13/A/13A-777</a>
4	Video	Preparation	<a href="https://youtu.be/YeX36dg0lwk">https://youtu.be/YeX36dg0lwk</a>
5	Video	Design	<a href="https://youtu.be/6YcOx_vTpKk">https://youtu.be/6YcOx_vTpKk</a>
6	Video	Documentation	<a href="https://youtu.be/-dhOiV1X4uM">https://youtu.be/-dhOiV1X4uM</a>
7	Video	Development	
8	Video	Testing	
	Video	Engineering Release	