Rex McKinnon

0xff@rexploits.com

PowerPIC Calculator Watch

February, 2022

Overview

The PowerPIC calculator watch is a replacement board for the Casio CA-53W. The sleek donor watch boasts a high contrast 221 segment liquid crystal display for viewing even in direct sunlight. Inputs include a 16 button keypad along with two side buttons. A piezo buzzer is available for audible notifications.

The Power comes from a PIC16LF1919x-I/MR with 14-56KB flash and 2-4KB RAM. This microcontroller includes a LCD driver, interrupt on change, ADC, temperature sensor, and PWM. These peripherals allow the wearer to create custom Powerful applications that run on your wrist.

Goals

1. **One Year Battery Life:** Battery life must be comparable to a stock Casio CA-53W which is about a year.
2. **Accurate Timekeeping:** No more than +/- 1 minute drift over a year.
3. **Easy to Update:** Must be easy to update the firmware with minimal dissasembly.

Specifications

Each PowerPIC requires the careful sacrifice of a Casio CA-53W. Every component will be reused except the original PCB. Donor watches are approximately $20 dollars from several online retailers and include the needed CR2016 coin cell battery.

The PowerPIC was designed with low manufacturing costs in mind, so a short run of 3 pieces costs about $30 dollars. After one-time tooling and material costs, the final price per board is just under $5 dollars. A medium run of 30 boards brings the cost per board down about 10 percent.

Summarizing, the PowerPIC enables the wearer to explore the PIC microcontroller family in a fun, usable form factor for under $30 dollars.

Milestones

1. Compile a “Blink” application for a PIC16 microcontroller
2. Upload a “Blink” application to the PowerPIC board
3. Interface with LCD

   All segments functioning and mapped to digit groups.

4. Interface with Buttons

   Keypad scanning with debouncing and side buttons set to interrupt on press.

5. Interface with Buzzer

   Buzzer beeping in various frequencies/tones.

6. Custom Breakout Board

   Custom PCB breakout with pogo pins to easily program the PowerPIC.

Manufacturing Cost Breakdown @ OSHPark / Mouser / OSHStencils Quantity: 3

Item		Cost Per	er (No Shipping)	Order Cost
Components		$4.28	$3.12	$12.84
Tooling		$3.02	$1.67	$9.07
PCB		$1.82	$1.82	$5.45
Total Cost Per	$9.12	**Total Manufacturing Costs**		$27.36

Component Cost Breakdown @ Mouser

Item	Qty	Unit Price	Total
U1	3	$2.720	$8.160
C1, C2, C3	10	$0.007	$0.070
C4	10	$0.011	$0.110
C5, C6, C7	10	$0.084	$0.840
R1	10	$0.007	$0.070
R2	10	$0.010	$0.100
		Sub Total	$9.35
		Shipping and Handling	$3.49
		Total	$12.84

Tooling Cost Breakdown @ OSHStencils

Item	Qty	Unit Price	Total
PolyFilm Stencil	1	$5.00	$5.00
		Sub Total	$5.00
		Shipping and Handling	$4.07
		Total	$9.07

PCB Cost Breakdown @ OSHPark

Item	Qty	Unit Price	Total
(x3) PCB	1	$5.45	$5.45
		Sub Total	$5.45
		Shipping and Handling	$0.00
		Total	$5.45