Building the VMW Time Circuitry Meter

http://www.deater.net/weave/vmwprod/hardware/time_circuit/

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1 Introduction

This is a work in progress. I will update it as I complete more of the project.

2 Red and Green Displays

The red and green displays are separate from the yellow because the 16-segment LEDs I could source had different pinouts, requiring different PCB layout.

2.1 RED/Green LED board Parts List

Part No	Description	Quantity	Source
TIME-RGLED-MK1	VMW Red/Green PCB Board	2	VMW/OSH Park
DC56-11EWA	Dual Red 7-segment 0.56" CC	5	Kingbright
DC56-11GWA	Dual Green 7-segment 0.56" CC	5	Kingbright
PSC05-11EWA	16-segment alphanum 0.5" CC	3	Kingbright
PSC05-11GWA	16-segment alphanum 0.5" CC	3	Kingbright
LED-1	Red T 1 3/4 LED	4	All Electronics
LED-2	Green T 1 3/4 LED	4	All Electronics
1427	HT16K33 Breakout	2	Adafruit
SIP-30	30-pin SIP header	10	All Electronics
	28-pin DIP socket	2	??

2.2 Building the Red/Green LED Board

Note, this assumes you want to socket everything (I typically do). You can leave out all of the sockets if you're confident in your abilities.

1. Take the 28-pin DIP socket and cut it into two pieces. The breakout board is too wide for a regular socket. Solder both halves on the back of the board. (I don't use SIP socket here as the breakout's pins are too wide to fit into it).

2. Cut the SIPs into the following pieces:

   - 19 + 9 + 2
   - 19 + 4 + 4 + 2
   - 9 + 9 + 9 + 2
   - 9 + 9 + 9 + 2
   - 9 + 9

3. Solder the two 4-length SIP to the back of the board for the i2c sockets

4. Solder the 9-length SIPs to the front of the board for LED sockets. This is easier if the LEDs are in the sockets to hold them parallel.

5. Take the two 19-length SIPs and trim off the middle pin (measure twice cut once). Solder these in the year spot

6. Solder the 4 2-length SIPs where the colon and AM/PM LEDs go

7. Put the various displays in the proper sockets

8. Trim the LED legs and put in the LED spots (the MK1 board the polarity is shown as reversed, so insert them backward)

9. Assemble the HT16K33 breakout and put in place in back. Solder the i2c address pins so red has address 0x74 (addr2 soldered) and green has address 0x75 (addr0 and addr2 soldered).

You should be assembled! Hook up to the i2c bus. From above the signals are ground, 5V, SDA, SCL.

3 Yellow Display

The red and green displays are separate from the yellow because the 16-segment LEDs I could source had different pinouts, requiring different PCB layout.

The yellow display is on the bottom so unlike the red/green we hook up the keypad socket.

3.1 Yellow LED board Parts List

Part No	Description	Quantity	Source
TIME-YELLOW-MK1	VMW Yellow PCB Board	2	VMW/OSH Park
DC56-11YWA	Dual Yellow 7-segment 0.56" CC	5	Kingbright
PSC05-12YWA	16-segment alphanum 0.5" CC	3	Kingbright
LED-3	Yellow T 1 3/4 LED	4	All Electronics
1427	HT16K33 Breakout	1	Adafruit
SIP-30	30-pin SIP header	5	All Electronics
	28-pin DIP socket	1	??
	20-pin DIP socket	1	??

3.2 Building the Yellow LED Board

Note, this assumes you want to socket everything (I typically do). You can leave out all of the sockets if you're confident in your abilities.

1. Take the 28-pin DIP socket and cut it into two pieces. The breakout board is too wide for a regular socket. Solder both halves on the back of the board. (I don't use SIP socket here as the breakout's pins are too wide to fit into it).

2. Solder the 20-pin DIP socket on the bottom for the keypad cable.

3. Cut the SIPs into the following pieces:

   - 19 + 9 + 2
   - 19 + 4 + 4 + 2
   - 9 + 9 + 9 + 2
   - 9 + 9 + 9 + 2
   - 9 + 9

4. Solder the two 4-length SIP to the back of the board for the i2c sockets

5. Solder the 9-length SIPs to the front of the board for LED sockets. This is easier if the LEDs are in the sockets to hold them parallel.

6. Take the two 19-length SIPs and trim off the middle pin (measure twice cut once). Solder these in the year spot

7. Solder the 4 2-length SIPs where the colon and AM/PM LEDs go

8. Put the various displays in the proper sockets

9. Trim the LED legs and put in the LED spots

10. Assemble the HT16K33 breakout and put in place in back Solder so it has i2c address 0x76 (addr2 and addr1).

You should be assembled! Hook up to the i2c bus. From above the signals are ground, 5V, SDA, SCL.

4 Amplifier/Speakers

4.1 Parts List

Part No	Description	Quantity	Source
	3.5mm audio cable	1	Mouser
	Dual 8 ohm speakers	1	Jameco
987	Stereo 3.7W Class D Audio Amplifier	1	Adafruit

4.2 Building

1. Build the amplifier board
2. Hook 5V and ground to main power and ground
3. Hook up the audio cable ground to L- and R-, the left channel to L+ and right channel to R+
4. Hook up the speakers. Left and left ground, Right and right ground
5. Plug into the pi and test. Note you might have to be root for sound to play.

5 Power Converter

This provides 3.3V to 5V i2c conversion, allows powering from a wall-wart, and optionally (maybe) a USB connector to provide power to a pi so you don't need two power outlets. Also an optional power-on LED.

5.1 Parts List

Part No	Description	Quantity	Source
	Power converter board	1	VMW/OSHPark
	USB-A connector	1	Mouser
	26-pin shrouded male connector	1	Jameco
	5V 2A wall power supply	1	????
	470 Ohm resistor	1	????
	LED	1	????
	Power jack	1	????
757	4-channel i2c bi-directional logic level converter	1	Adafruit
	sockets/header pins	???	????

5.2 Building

- Get the PCB
- Put together the logic level converter
- Solder the 26-pin socket, the power-jack, and the usb-connector into place.
- If you want a power-on indicator, solder the LED and the resistor into place. *Note* on the Mark1 board the LED silkscreen is backwards. Optionally you can socket the LED.
- Solder a 4-pin header into the i2c out socket
- Solder the logic level converter to the board
- We are always going to wall-power the device, so solder a jumper wire to indicate this. *NOTE* the silkscreen is backwards on the Mark-1 board, solder from the pi-power pin to the center pin.

6 Real Time Clock

This is useful to have if you ever plan to disconnect the pi from the network. It will keep the current time, even if you're doing crazy things like installing time circuits into a car.

6.1 Parts List

Part No	Description	Quantity	Source
264	DS1307 Real Time Clock breakout	1	Adafruit

6.2 Building

1. Build the clock kit
2. Hook to the i2c bus
3. Configure Linux on the pi to use it (TODO)

7 Keypad

The keypad is not really like in the movie. For example it has star and pound buttons.

7.1 Parts List

Part No	Description	Quantity	Source
	3x4 keypad	1	All Electronics
	Signal Diode	2	Jameco
	39k Resistors	12	???
	Light up Switches	5	Adafruit
	Waterproof Case	1	Jameco
	#4-40 x 1/2 in screws	4	Home Depot
TC-KEYPAD-MK1	PCB	1	VMW/OSH Park
	20-pin DIP socket	1	Jameco
	34 pins SIP socket	1	???

7.2 Building

1. Cut the SIP into a 14-pin piece and 10 2-pin pieces. Solder them in place on the PCB.

2. Solder the 20-pin DIP socket in place

3. Solder the resistors in place.

4. Solder the Diodes in place. Note! The Mark1 board has pin holes that are too small. I had to sort of surface-mount solder the diodes in place, which isn't optimal.

5. Prepare the case. Drill the 5 holes for the lighted switches and the rectangular opening/4 holdes for the keypad. This is tricky! Provided is a drilling template but it moves around if you aren't careful.

6. Cut a notch in the bottom of the case for the ribbon cable to get out.

7. Put the 5 lit LED buttons in place.

8. Cut wire for the buttons/keypad. The way I did it was 13 3-inch wires for the keypad, and then for the five buttons 3 inch x 1, 2.5 inch x2, 2 inch x 2. Soldered the wires in place (tricky to do). Then plugged all

the wires into the right socket. There are probably better ways to do this.

9. Once all wires are in place, test things. Then squeeze it in the case and close it up. There are holes for screwing into the base, but in the end things are wedged tight enough I didn't need to (even if I could get a screwdriver in place).

8 Flux Capacitor

Only vaguely like the movie version and much smaller. Also I wanted the right-angle sockets to be functional rather than ornamental, which complicates things a bit.

8.1 Parts List

Part No	Description	Quantity	Source
	Waterpoof case	1	Adafruit
FLUX-CAP-MK-1	Circuit Board	1	VMW / OSH Park
	20-pin socket	1	Jameco
	30-pin SIP header	1	
	Off-white LEDs	15	SuperBrightLEDs
	Transparent Heat-shrink Tubing	1	Adafruit
	1/2" standoffs	2	Jameco
	Screws	2	Jameco
	Banana Jack Sockets	3	Jameco
	Right-angle probe leads	3	Jameco

8.2 Building

1. Get the circuit board. MK1 version has an issue where the banana jack holes are not drilled out properly so you will need to drill them out to the right size.

2. Break up the SIP socket into 15 2-wide pieces. Solder those on for the LED sockets.

3. Solder in the 20-pin socket.

4. Place the banana jacks in place. Bend the lug at a right angle so it fits better. Solder a bit of wire from the lug to the position on the circuit board.

5. Insert and cut the teast leads with 1.5 inches of wire. Strip and solder the wire in place.

6. Cut the LED leads to 1cm. Place the LEDs inside the shrink wrap (haven't done this step yet, need more details).

7. Cut a notch on the case so the ribbon cable can get out. Roughly 3cm wide. I used a flush cutter to make the notch for lack of better tools.

8. Optionally get an embossing label maker and make a “shield your eyes” label.

9. Permanently mount the board into the case. The screw holes are some odd metric size which I didn’t have screws for. Instead I took the standoffs (which had threaded screws coming off of the bottom) and super-glued them into the larger metric screw holes. Not ideal, but worked.

9 Power Meters / Speedomoter

Todo...

9.1 Parts List

Part No	Description	Quantity	Source

9.2 Building