

# USB Current Monitor

20131223

Reference;

USB\_Current\_Monitor\_0.3.2.f

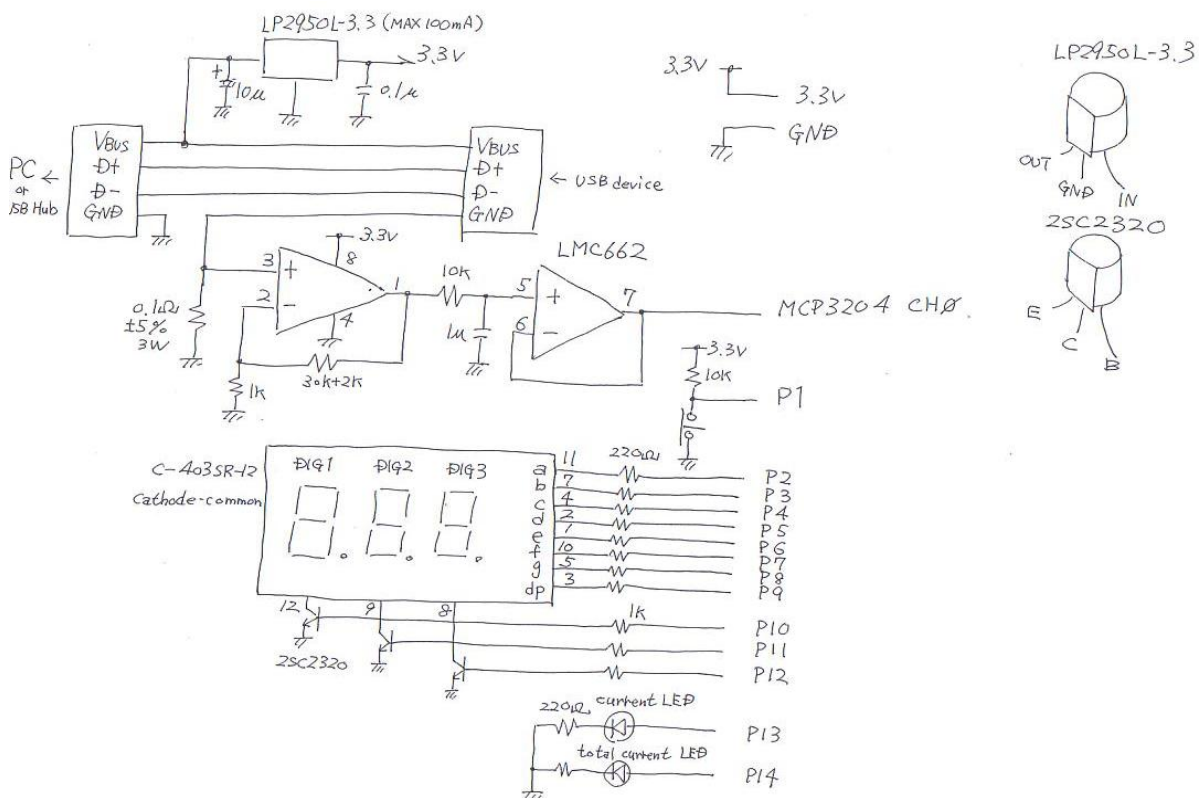
USB Current Monitor display USB-devices-current(mA) and total-current(Ahour).  
Displayment is 1second by 1second.

USB-devices-current(mA): 0mA – 999mA [– – –]at more than 999mA

USB-total-current(Ahour): 0.00Ahour – 999Ahour [– – –]at more than 999Ahour

Current is an approximate value.

## I/F Curcuit



Power(3.3V) is generated by USB-Vbus.

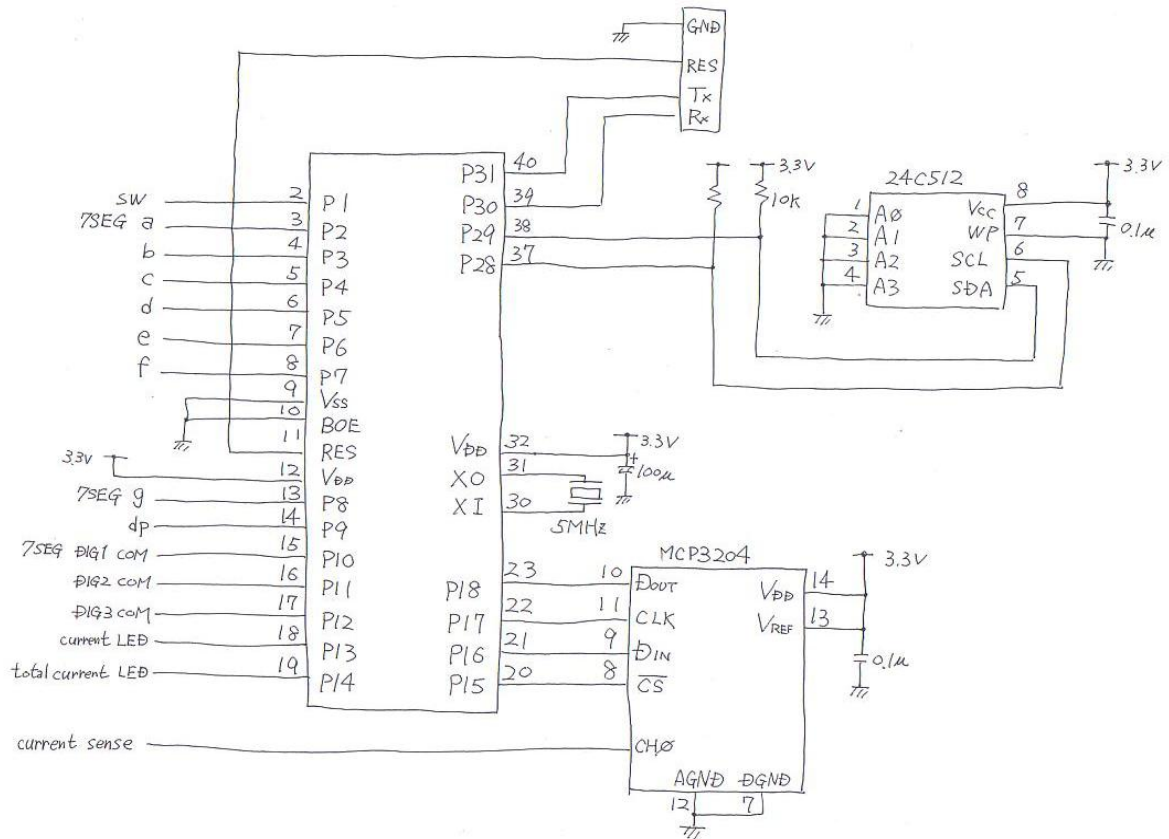
3-digit-7SEG-LED display by Dynamic-drive(400Hz).

USB-device's current is sensed by resistor(0.1ohm).

This resistor has error (max+-5%). Resistor for op-amp is +-5%.

Current-sense-error is max+-5.25%.

## CPU Curcuit



	Parts	Description	Quantity
I/F	LMC662	Op-Amp	1
	LP2950L-3.3	3.3V Regulator(max current 100mA)	1
	2SC2320	NPN Tr	3
	0.1ohm	(+ -5% 3W)	1
	220ohm	(+ -5% 1/4W)	10
	1kohm	(+ -5% 1/4W)	4
	30kohm	(+ -5% 1/4W)	1
	2kohm	(+ -5% 1/4W)	1
	10kohm	(+ -5% 1/4W)	2
	C-403SR-12	3-digit Cathode-common 7SEG	1
	1uF	Ceramic Capacitor	1
	10uF	electrolytic Capacitor	1
	0.1uF	Ceramic Capacitor	1
	Push-Switch	Normal-Close type	1
	LED	3mm yellow	2
	USB connector	Receptacle	1
	USB connector	Plug	1
CPU	P8X32A	40pin DIP	1
	24C512	eeeprom 64kByte	1
	Xtal	5MHz	1
	MCP3204	ADC	1
	100uF	electrolytic Capacitor	1
	0.1uF	Ceramic Capacitor	2
	10kohm	(+ -5% 1/4W)	2
	4-pin	For PropPlug	1
	IC-socket(40pin)	For propeller chip	1
	IC-socket(14pin)	For MCP3204	1
	IC-socket(8pin)	For 24C512	1

There is a mistake about selection for Op-Amp.  
Power for LMC664 is min 5V.  
Correct Op-Amp character is "Rail to Rail" and "Single Power 3.3V".  
I replaced to NJM2732.

Although using 24C512 as eeprom, using 24C256 is ok.  
I use Push-Switch for Normal Close-type.  
So if using it for Normal Open-type, modify word 'read\_sw'.  
ADC(MCP3204) is using because converting current-sense-voltage.  
Vref for MCP3204 use 3.3V (generated by LP2950L-3.3).  
LP2950L-3.3 has error (max  $\pm 2\%$ ).  
So, digital-value has max  $\pm 2\%$ .

Error for current-sense-resistor and digital-value is  $\pm 5.355\%$ .  
USB-current's error is max  $\pm 5.355\%$ .  
But actually display-value is almost correct.

USB-current	Volt for 0.1ohm	Op-Amp Output	ADC-value
1mA	0.1mV	3.3mV	4
10mA	1mV	33mV	40
100mA	10mV	330mV	409
1000mA	100mV	3.3V	4096

Using

1. Inserting USB Current Monitor to USB-port for PC or USB-Hub.
2. After "---" on 7SEG-LED, "0" is displayed on it. (zero-adjustment for op-amp)
3. Inserting USB-device to USB Current Monitor
4. When pushig switch, 7SEG-LED display total-current(Ahour).

Install

After built-up circuit, insert USB Current monitor to USB-port.  
Load DevKernel.spin connecting prop-plug to 4-pin-port.  
Connect to TeraTerm.  
Loading USB\_Current\_Monitor\_0.3.2.f.

```

Prop0 Cog6 ok
saveforth
.....
Prop0 Cog6 ok
reboot

CON:Prop0 Cog0 RESET - last status: 0 ok

CON:Prop0 Cog1 RESET - last status: 0 ok

CON:Prop0 Cog2 RESET - last status: 0 ok

CON:Prop0 Cog3 RESET - last status: 0 ok

CON:Prop0 Cog4 RESET - last status: 0 ok

CON:Prop0 Cog5 RESET - last status: 0 ok

CON:Prop0 Cog6 RESET - last status: 0 ok

Prop0 Cog6 RESET - last status: 0 ok
Prop0 Cog6 ok

-- USB_Current_Monitor should operate ----

cog?
Cog:0 #io chan:1      RUNNING 7SEG_drive
Cog:1 #io chan:1      RUNNING read_sw
Cog:2 #io chan:1      RUNNING USB-current
Cog:3 #io chan:1 PropForth v5.5 2013Feb20 11:30 3
Cog:4 #io chan:1 PropForth v5.5 2013Feb20 11:30 3
Cog:5 #io chan:1 PropForth v5.5 2013Feb20 11:30 3
Cog:6 #io chan:1 PropForth v5.5 2013Feb20 11:30 3 6(0)->7(0)
Cog:7 #io chan:1      SERIAL 7(0)->6(0)
Prop0 Cog6 ok

-- Connected MP3-player ---
monitor
monitor
A/D   Current[mA]   Total Current[mAsec]   Total Current[d100 X Ahour]
0    0           0           0
0    0           0           0
0    0           0           0
0    0           0           0
0    0           0           0
10   2           2           0
29   7           9           0
81   19          28          0
68   16          44          0
67   16          60          0
95   23          83          0
99   24          107         0
100  24          131         0
94   22          153         0
93   22          175         0
98   23          198         0
98   23          221         0
98   23          244         0
98   23          267         0
93   22          289         0

A/D   Current[mA]   Total Current[mA*sec]
93   22          311         0
114  27          338         0
99   24          362         0
99   24          386         0

```

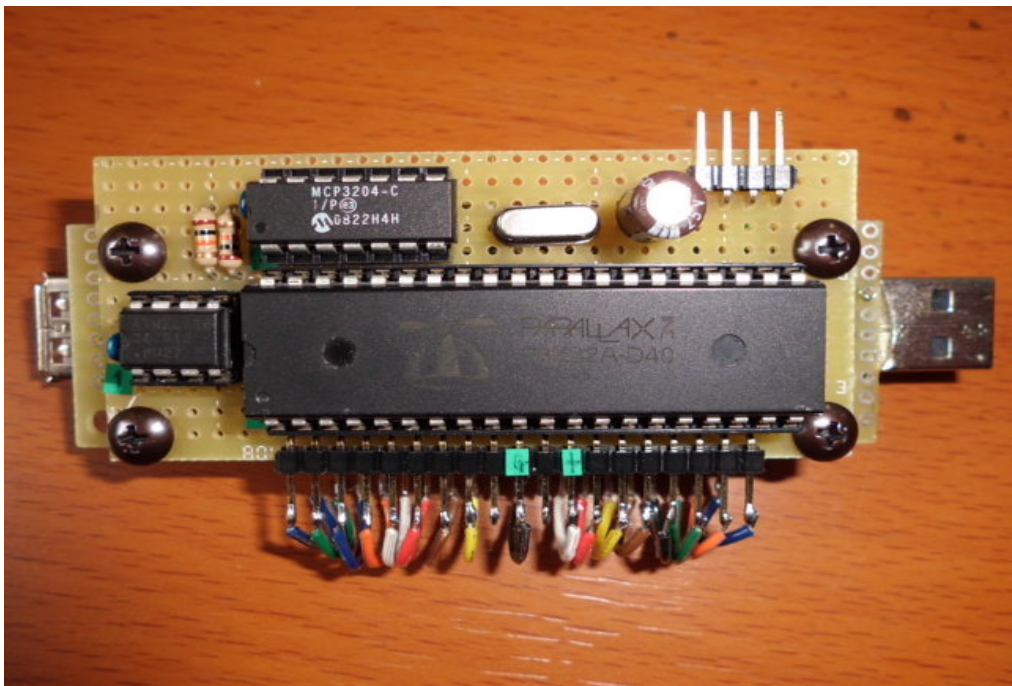
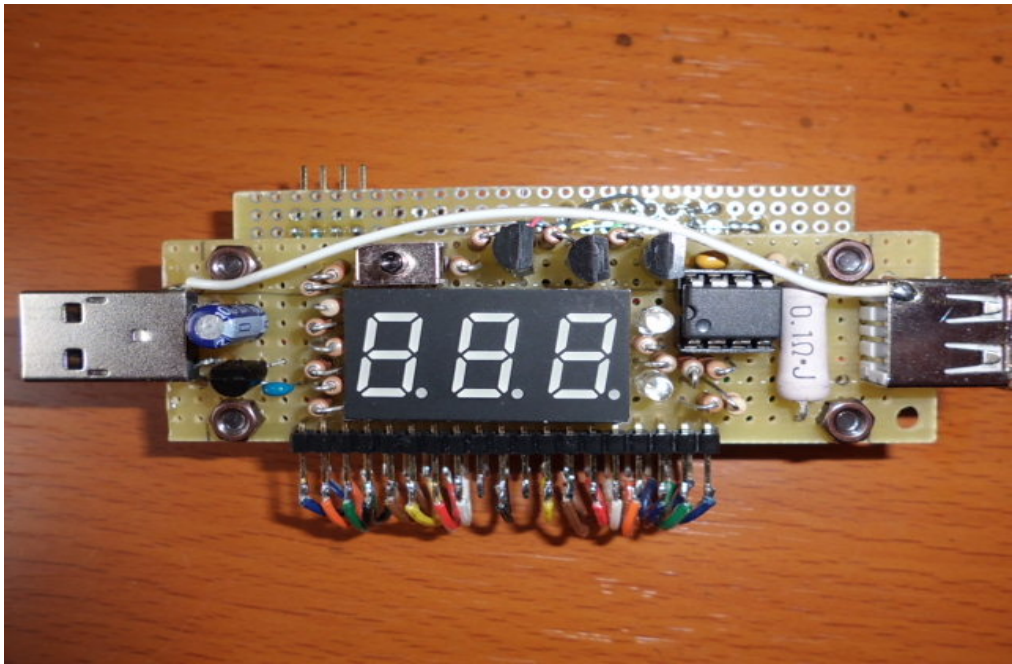
99	24	410	0
99	24	434	0
99	24	458	0
99	24	482	0
99	24	506	0
99	24	530	0
99	24	554	0
99	24	578	0
99	24	602	0
99	24	626	0
99	24	650	0
99	24	674	0
94	22	696	0
93	22	718	0
99	24	742	0
99	24	766	0



Current-measure mode



Total-Current-measure mode





# USB Current Monitor II

20140226

Modified USB\_Current\_Monitor.  
Used OLED-LCD and SMD parts.

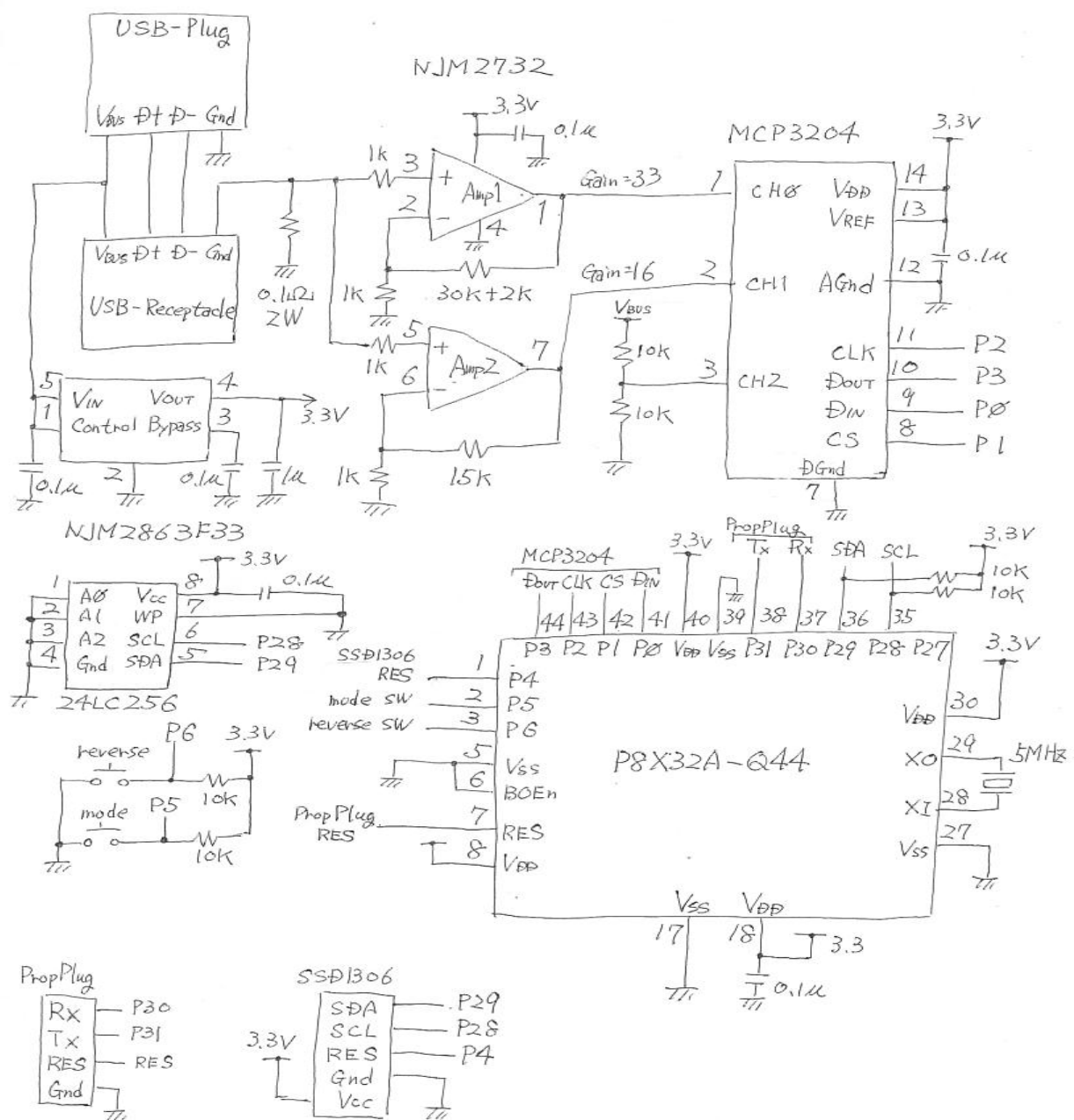
Reference;

USB\_Current\_Monitor\_II\_0.1\_1.f

USB\_Current\_Monitor\_II\_0.1\_2.f

Amp\_offset\_0.1.f

Curcuit:



## Parts:

Parts	Description	Quantity
CPU	P8X32A-Q44	1
Xtal	5MHz	1
OLED-LCD	SSD1306	1
ADC	MCP3204	1
EEPROM	24LC256	1
OpeAmp	NJM2732	1
3.3V Regulator	NJM2863F33	1
Push Switch	Red	1
Push Switch	Green	1
Capacitor	SMD 0.1uF	6
Capacitor	SMD 1uF	1
Resistor	SMD 10k	6
Resistor	SMD 1k	4
Resistor	SMD 15k	1
Resistor	SMD 30k	1
Resistor	SMD 2k	1
USB connector	Plug	1
USB connector	Receptacle	1
PropPlug connect	4pin Angle-pin-connector	1

## Install for Forth code

1. Loading Dev-kernel to eeprom
2. Loading Amp\_offset\_0.1.f
3. Add 10mV to input for Amp1 and Amp2
4.
 

```

Prop0 Cog6 ok
get_offset
ch0_offset:59
ch1_offset:67
Prop0 Cog6 ok
      
```
5. Cop each value of ch0\_offset and ch1\_offset to USB\_Current\_Monitor\_II\_0.1\_1.f
 

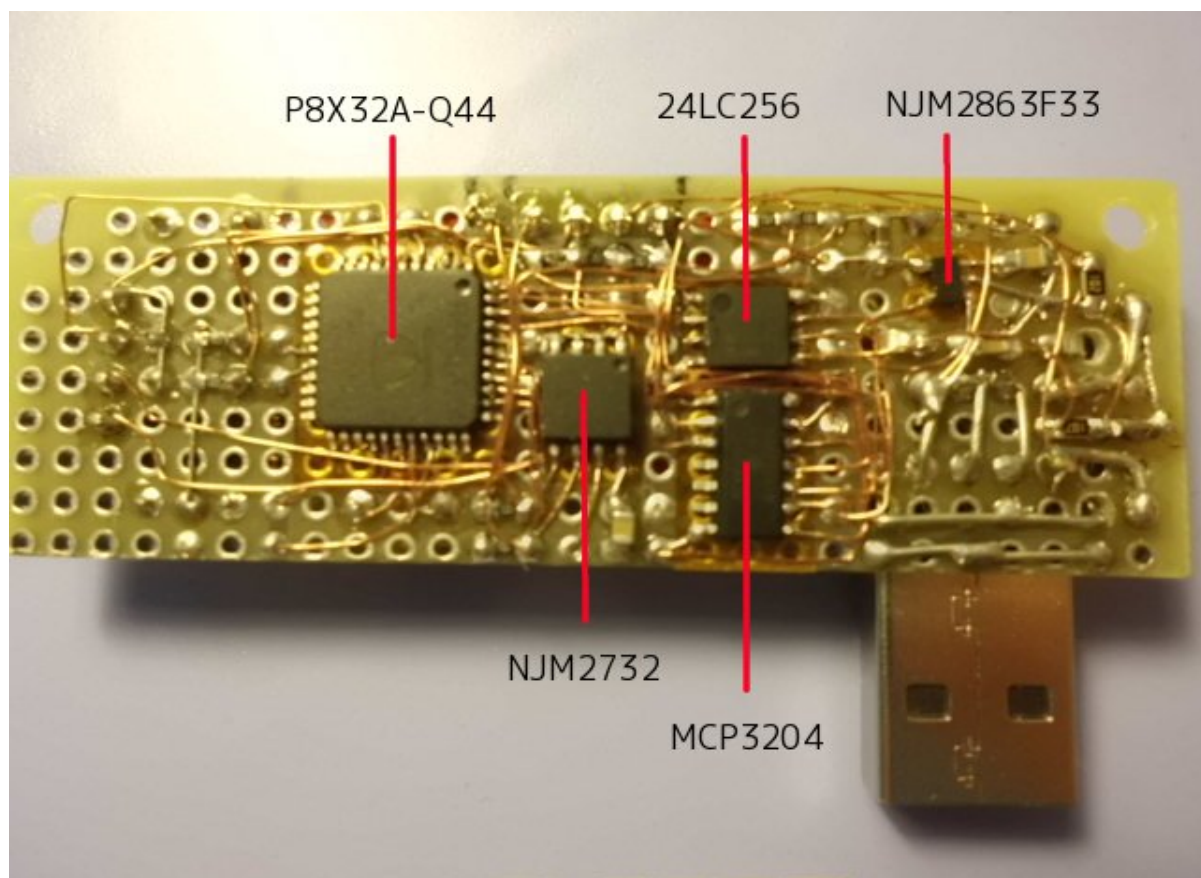
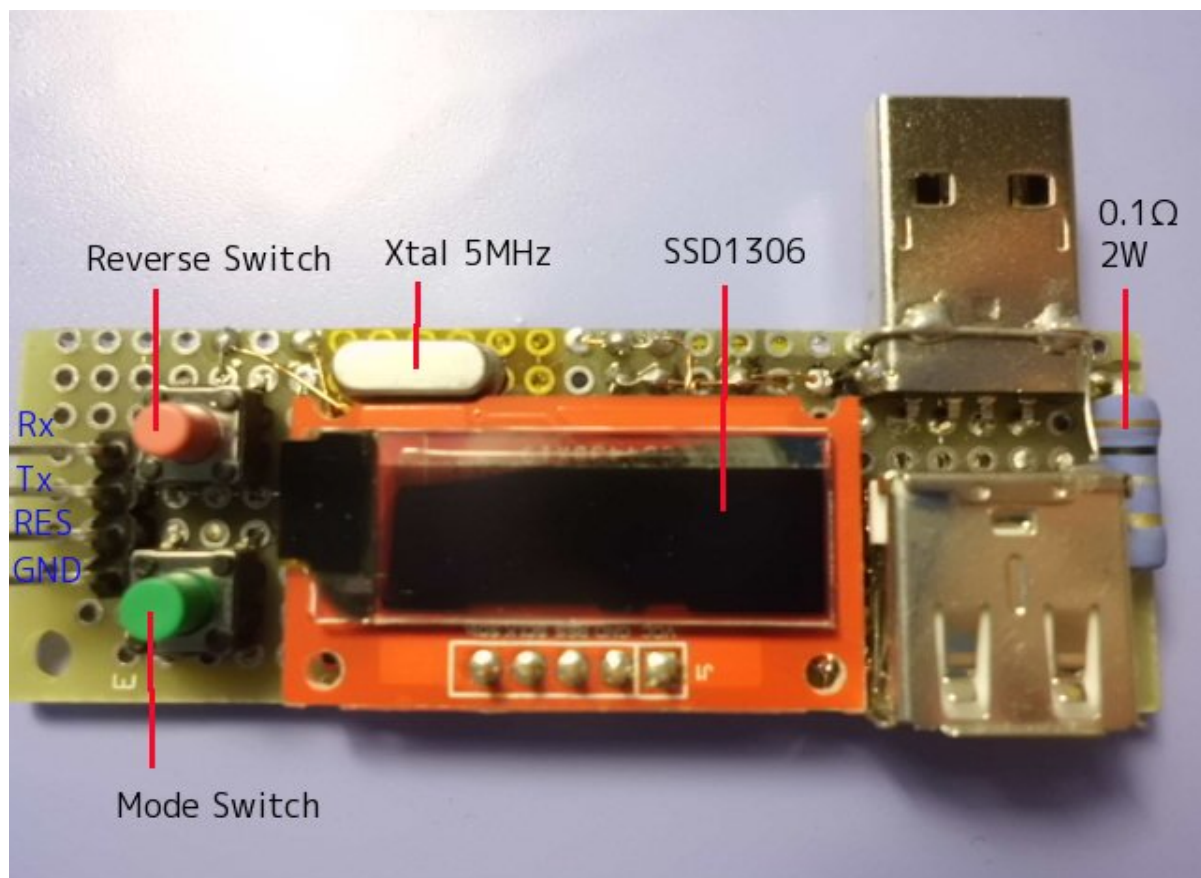
```

\ ch*_offset is plus when amp-offset is negative
Line No.355    d59 constant ch0_offset
Line No.356    d67 constant ch1_offset
      
```
6. Execute "reboot"
7. Loading USB\_Current\_Monitor\_II\_0.1\_1.f and USB\_Current\_Monitor\_II\_0.1\_2f
8. Execute "saveforth"
9. Execute "reboot"

Resister for current use 0.1ohm 2W.

Really, 1W resister is ok in case of max current 2A.





LCD for USBCurrent Monitor II use 32x16\_font and 8x8\_font.  
32x16\_font use vertical mode for SSD1306.  
8x8\_font use horizontal mode for SSD1306.  
At less than 1A, ADC(MCP3204) select Amp1(Gain=33).  
At more than 1A, ADC(MCP3204) select Amp2(Gain=16).

NJM2732 on USBCurrent Monitor has positive offset.  
But NJM2732 on USBCurrent Monitor II has negative offset.  
So, codes for USBCurrent Monitor can't use on USBCurrent Monitor II.

I get offset by using Amp\_offset\_0.1.f.

```
Prop0 Cog6 ok  
get_offset  
ch0_offset:59  
ch1_offset:67  
Prop0 Cog6 ok
```

Added line inside USBCurrent Monitor II\_0.1\_1.f.

```
\ ch*_offset is plus when amp-offset is minus  
d59 constant ch0_offset  
d67 constant ch1_offset
```

RC-circuit need at output of Op-amp on USB Current Monitor.  
Instead of RC-circuit, USBCurrent Monitor II has ring-buffer for ADC-values.  
ADC get ADC-value 50msec by 50msec.  
And average value is got from 40 data inside ring-buffer 50msec by 50msec.

Function:

When connected USB\_Current\_Monitor\_II, it display [0mA] after [-----mA].

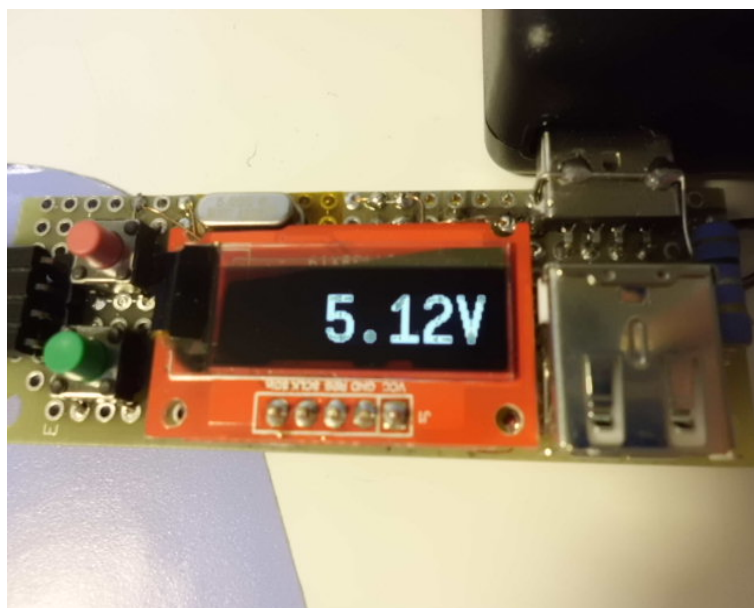


USB-decvices-current(mA) : 0mA – 2000mA

(This is added 200mV to op-amp-input for display-test.)



USB-voltage



Total-current

0mAs – 3600mAs

1mAh - 1000mAh

1Ah – 99999Ah





Total-current and Time after USB-device connected

Time 00:00:00 – 99:59:59



When reverse-sw is pushed, display' direction is chengeed.



When input for Amp1/Amp2 is 0mv(removed USB-device), LCD is off.



After this, LCD screen is off.

Removal for USB\_Current\_Monitor\_II is ready.

If mode-sw is pushed for a while, back to initial status.(diisplay 0mV)

Connecting to TeraTerm, below;

Prop0 Cog6 ok

cog?

Cog:0 #io chan:1 RUNNING ADC

Cog:1 #io chan:1 RUNNING total-current

Cog:2 #io chan:1 RUNNING Time

Cog:3 #io chan:1 RUNNING USB\_Current\_Monitor\_II

Cog:4 #io chan:1 PropForth v5.5 2013Feb20 11:30 3

Cog:5 #io chan:1 PropForth v5.5 2013Feb20 11:30 3

Cog:6 #io chan:1 PropForth v5.5 2013Feb20 11:30 3 6(0)->7(0)

Cog:7 #io chan:1 SERIAL 7(0)->6(0)

Prop0 Cog6 ok

Cog0 convert data from MCP3204 to current and voltage.

Cog1 calculate total-current(mAs,mAH,Ah)

Cog2 measure elapsed time.

Cog3 is main of USB\_Current\_Monitor\_II.

Disolayment for data

Prop0 Cog6 ok

monitor

Current[mA]	Total Current[mAs]	Total Current[mAh]	Total Current[Ah]
2001	1424	327	0
2002	3426	327	0
2002	1828	328	0
2002	230	329	0
2002	2232	329	0
2002	634	330	0
2002	2636	330	0
2002	1038	331	0
2002	3040	331	0
2002	1442	332	0
2002	3444	332	0
2002	1846	333	0
2002	248	334	0
2002	2250	334	0
2002	652	335	0
2002	2654	335	0
2002	1056	336	0
2001	3057	336	0
2002	1459	337	0
2003	3462	337	0

Current[mA]	Total Current[mAs]	Total Current[mAh]	Total Current[Ah]
-------------	--------------------	--------------------	-------------------





MP3 Player



Wireless Router



Generally, LCD value is a littel bigger.

Input voltage	Output for Amp1	Output for Amp2	LCD
4mV	97.0mV	24.5mV	41mV
5mV	128.2mV	38.5mV	51mV
6mV	162.9mV	54.4mV	61mV
7mV	194.3mV	69.0mV	71mV
8mV	227.3mV	84.6mV	81mV
9mV	260.3mV	100.3mV	91mV
10mV	292.3mV	115.6mV	101mV
20mV	0.619V	0.274V	200mV
30mV	0.948V	0.433V	300mV
40mV	1.276V	0.592V	399mV
50mV	1.601V	0.749V	498mV
60mV	1.930V	0.908V	598mV
70mV	2.257V	1.066V	697mV
80mV	2.586V	1.226V	797mV
90mV	2.913V	1.384V	896mV
100mV	3.240V	1.543V	1001mV
110mV	3.283V	1.701V	1101mV
120mV	3.283V	1.860V	1202mV
130mV	3.283V	2.018V	1302mV
140mV	3.283V	2.176V	1401mV
150mV	3.283V	2.335V	1502mV
160mV	3.283V	2.493V	1601mV
170mV	3.283V	2.652V	1701mV
180mV	3.283V	2.810V	1801mV
190mV	3.283V	2.969V	1901mV
200mV	3.283V	3.128V	2002mV