USB Current Monitor

20131223

Reference;
USB_Current_Monitor_0.3.2.f
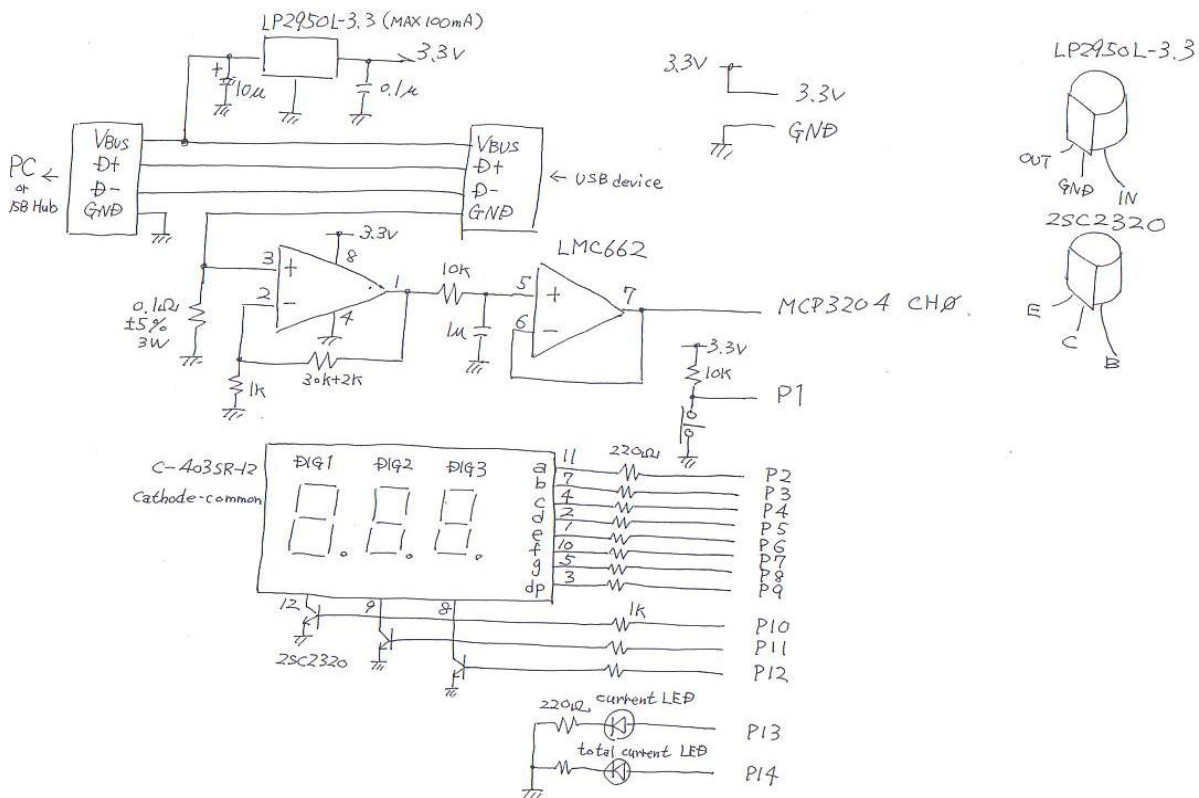

USB Current Monitor display USB-decvices-current(mA) and total-current(Ahour).
Displayment is 1second by 1second.
USB-decvices-current(mA): 0mA – 999mA [– – –]at more than 999mA
USB-total-current(Ahour): 0.00Ahour – 999Ahour [– – –]at more than 999Ahour
Current is an approximate value.

I/F Curcuit
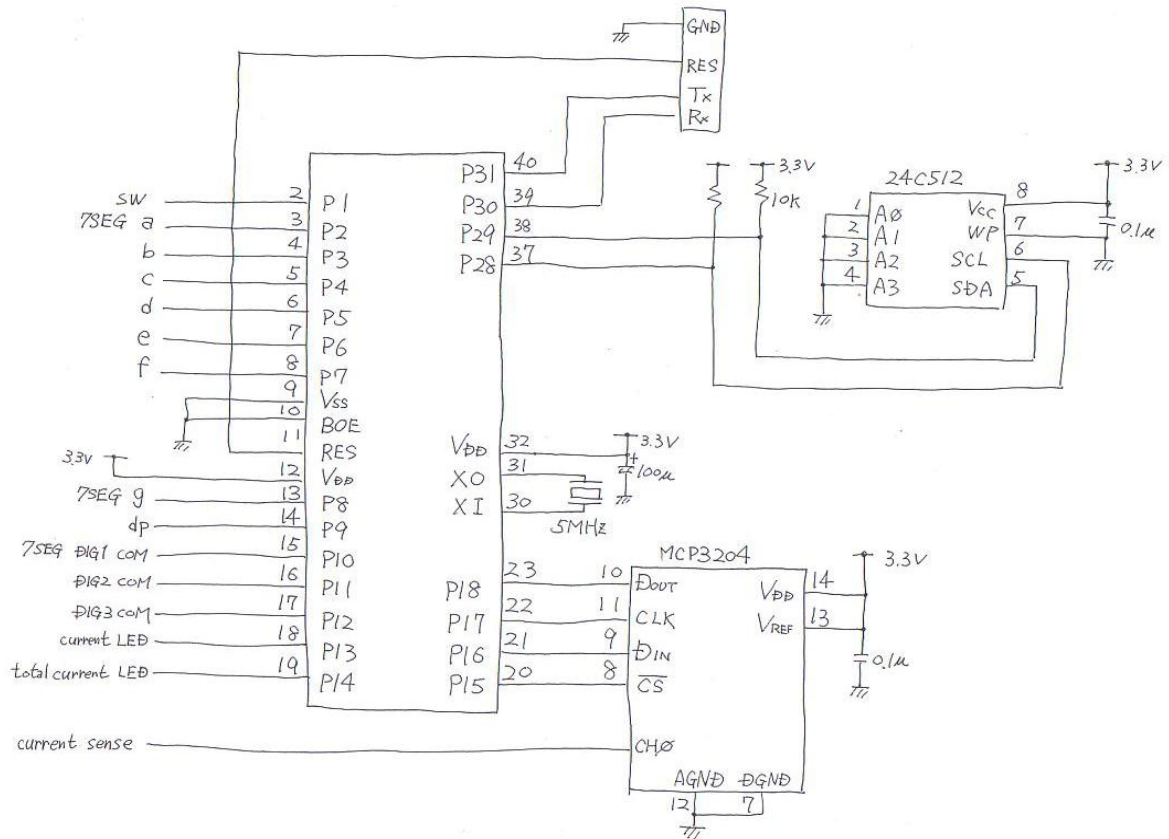

Power(3.3V) is generated by USB-Vbus.
3-digit-7SEG-LED display by Dynamic-drive(400Hz).
USB-device's current is sensed by resistor(0.1ohm).
This resistor has error (max+-5%). Resistor for op-amp is +-5%.
Current-sense-error is max+-5.25%.

CPU Curcuit

	Parts	Description	Quantity
I/F	LMC662	Op-Amp	1
	LP2950L-3.3	3.3V Regurator(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	eeprom 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

Thereis mistake about selection for Ope-Amp.
Power for LMC664 is min5V.
Correct Ope-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 NormalClose-type.
So if using it for NormalOpen-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+-2%).
So, degital-value has max+-2%.

Error for current-sense-resistor and digital-value is +-5.355%.
USB-current's error is max+-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 curcuit, 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
.........................................................................................................................................................4
..............................................
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
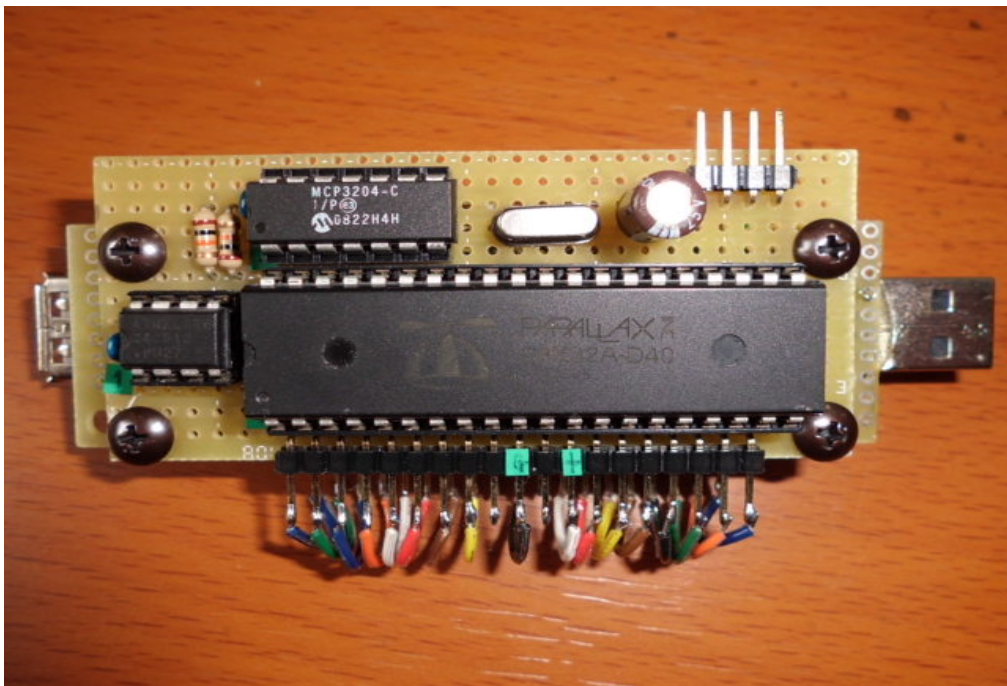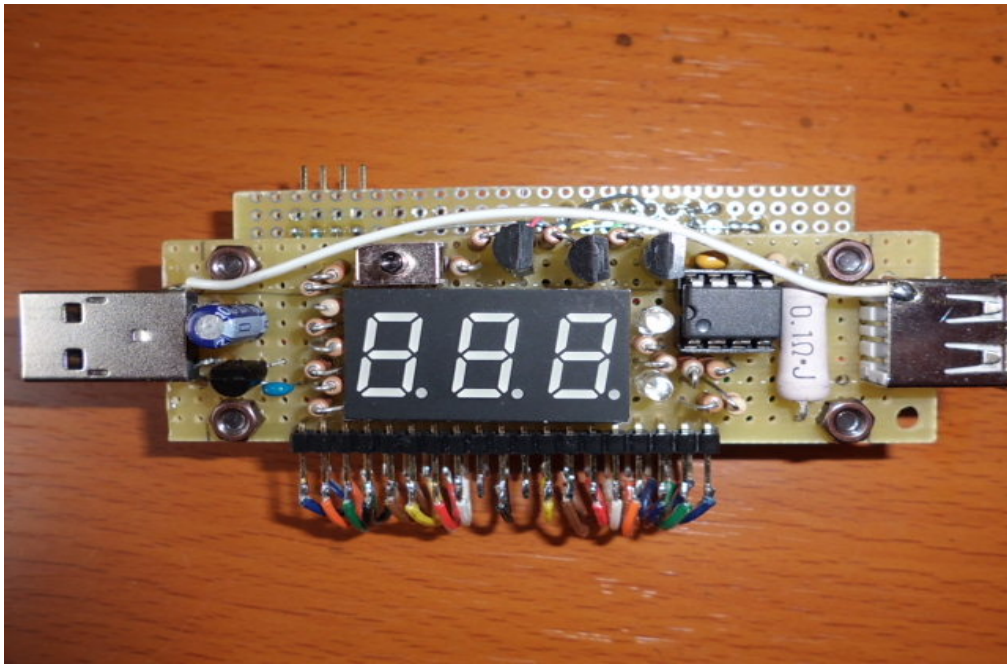
USB Current Monitor II

20140304

Modified USB_Current_Monitor.
Used OLED-LCD and SMD parts.

Reference;
USB_Current_Monitor_II_0.2_1.f
USB_Current_Monitor_II_0.2_2.f
Amp_offset_0.1.f

Curcuit:
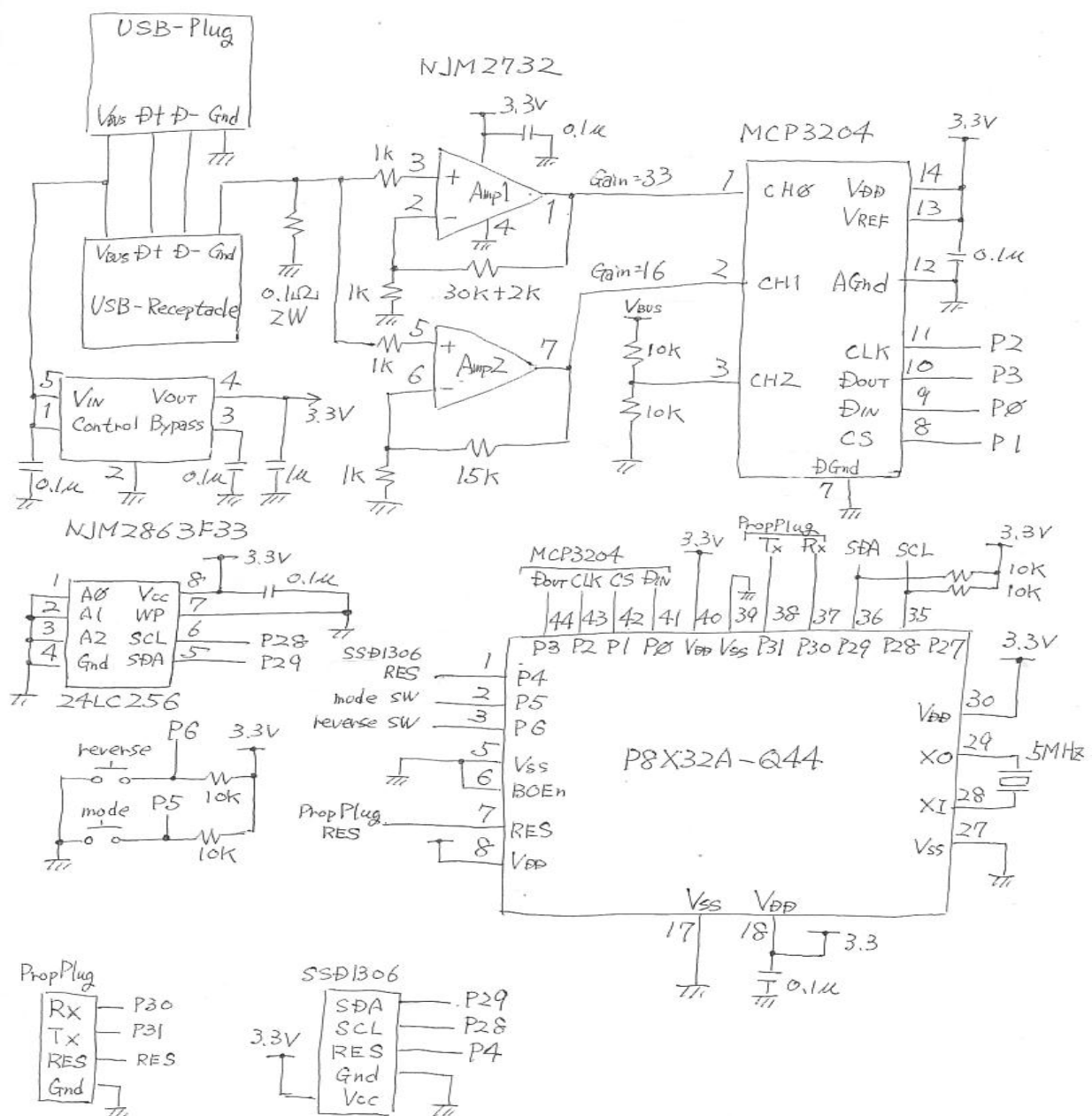
Parts:

Parts	Descroption	Quantity
CPU	P8X32A-Q44	1
Xtal	5MHz	1
OLED-LCD	SSD1306	1
ADC	MCP3204	1
EEPROM	24LC256	1
OpeAmp	NJM2732	1
3.3V Regurator	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_0.2_1.f and
USB_Current_Monitor_II_0.2_2.f
8. Execute "saveforth"
9. Execute "reboot"

Resister for current use 0.1ohm 2W.
Really, 1W resister is ok in case of max current 2A.

Reverse Switch   Xtal 5MHz   SSD1306   0.1Ω 2W

Rx
Tx
RES
GND

Mode Switch

P8X32A-Q44   NJM2732   NJM2863F33

24LC256
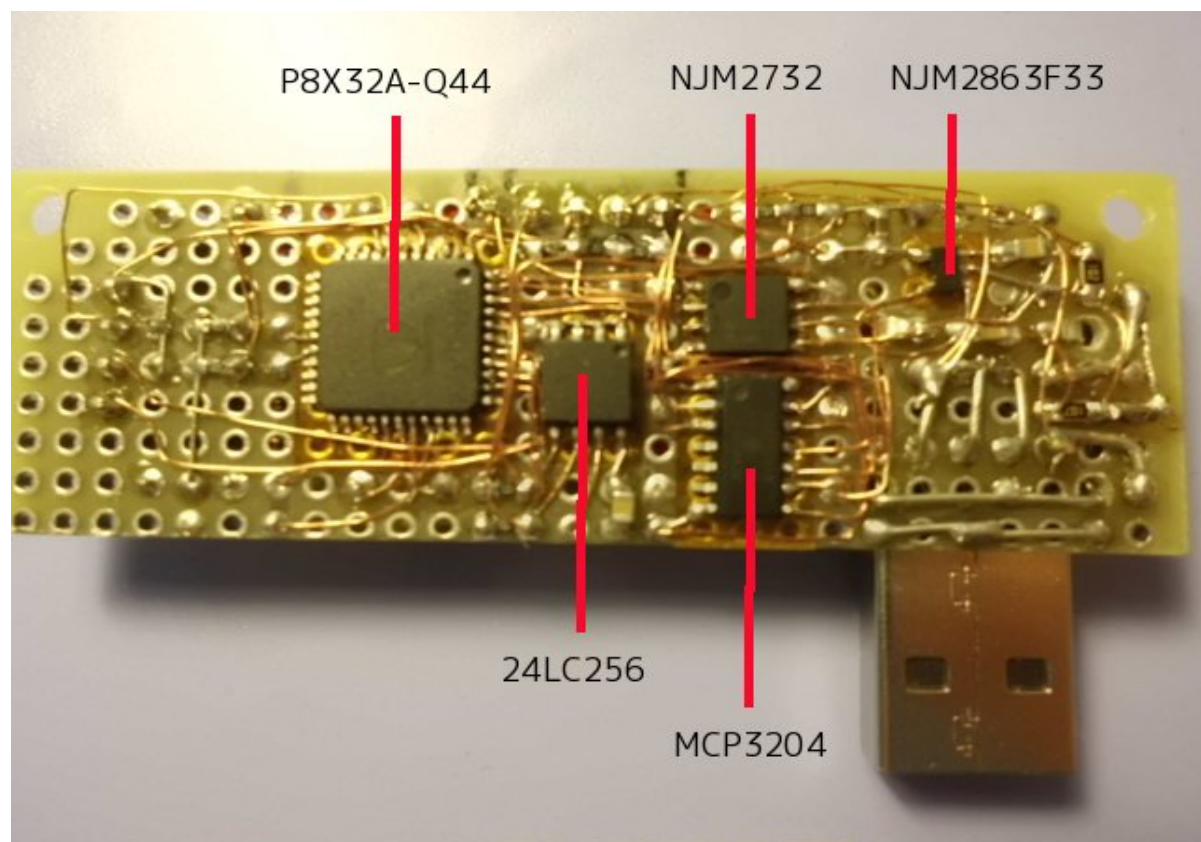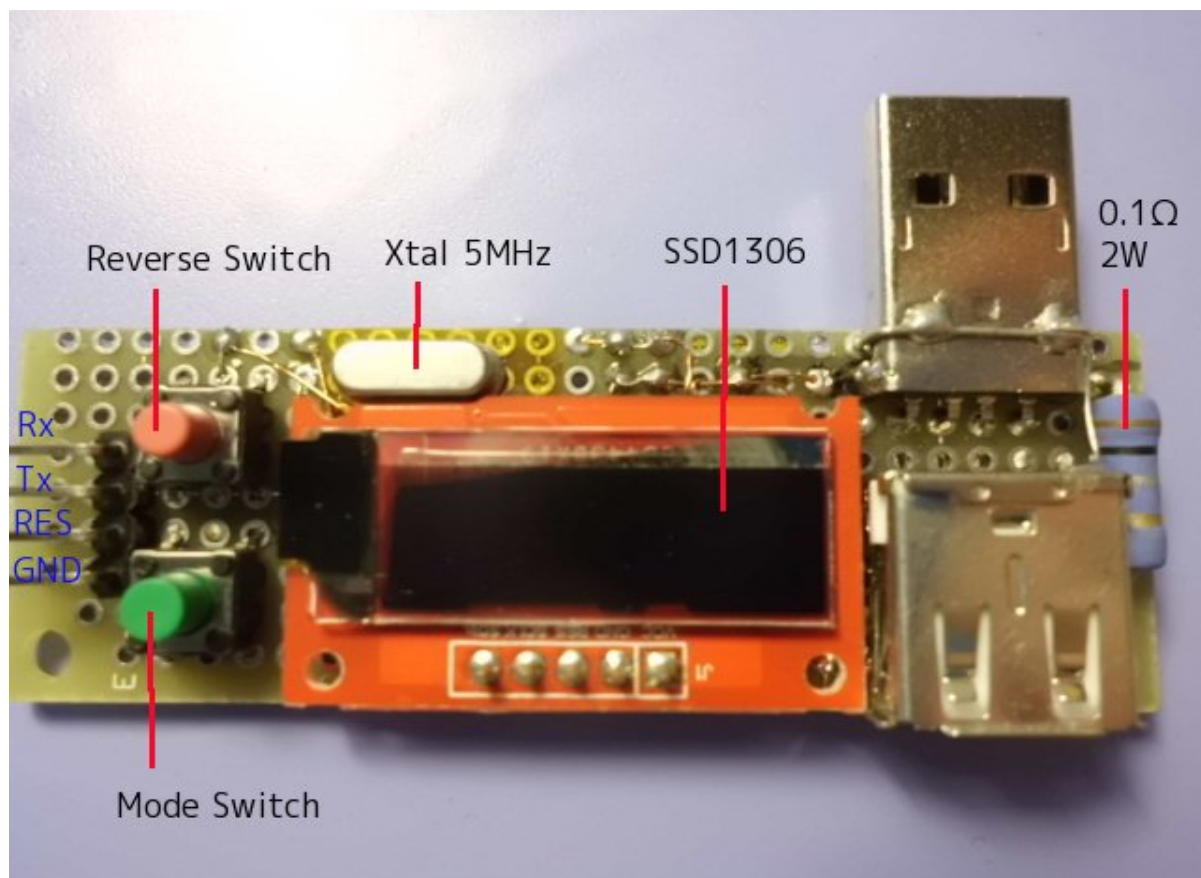
MCP3204

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.

RC-curcuit need at output of Op-amp on USB Current Monitor.
Instead of RC-curcuit, 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.

Delete USB Current Monitor II
  1. forget USB_Current_Monitor
  2. saveforth

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 and Time after USB-device connected
Time 00:00:00 – 99:59:59
0mAs – 3600mAs
0mAh - 1000mAh
0Ah – 99999Ah

Top line Time and current
2nd Line Total-current[mAs]
3rd Line   Total-current[mAh]
4th Line   Total-current[Ah]

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.(display 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.

Detecting i2c-devices

Prop0 Cog6 ok

CON:Prop0 Cog3 RESET - last status: 0 ok
i2c_search
   0 1 2 3 4 5 6 7 8 9 A B C D E F
00: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- 3C -- -- --   h3C is SSD1306
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: 50 -- -- -- -- -- -- -- -- -- -- -- -- -- -- --   h50 is eeprom
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
i2c_device:2

Prop0 Cog6 ok

Displayment 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]
2002	1864	338	0
2002	266	339	0
2002	2268	339	0
2002	670	340	0
2002	2672	340	0
2002	1074	341	0
2002	3076	341	0
2002	1478	342	0
2002	3480	342	0
2001	1881	343	0

Data inside ring-buffer when mouse is connected.

Prop0 Cog6 ok
disp_ADC_buf
101 102 97 99 98 97 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
101 102 97 99 98 97 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 102 97 99 98 97 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 97 99 98 97 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 99 98 97 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 98 97 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 97 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99

96 254 96 96 96 102 98 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 195 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 97 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 244 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 99 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 98 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 98 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 98 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 106 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 98 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 256 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 97 101 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 216 97 101 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 216 97 251 101 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 216 97 251 95 101 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 216 97 251 95 99 102 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 216 97 251 95 99 97 103 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 216 97 251 95 99 97 97 101 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
96 254 96 96 96 102 102 102 104 103 103 103 105 99 98 99 97 216 97 251 95 99 97 97 99 99 101 99 98 98 98 97 236 98 253 98 99 98 98 99
Prop0 Cog6 ok

MP3 Player

Wireless Router

Generally, LCD value is a littel bigger.

TroubleShoot

When connecting to USB-Hub, display is [0mA].
But when connecting PropPlug,, display is [16mV].
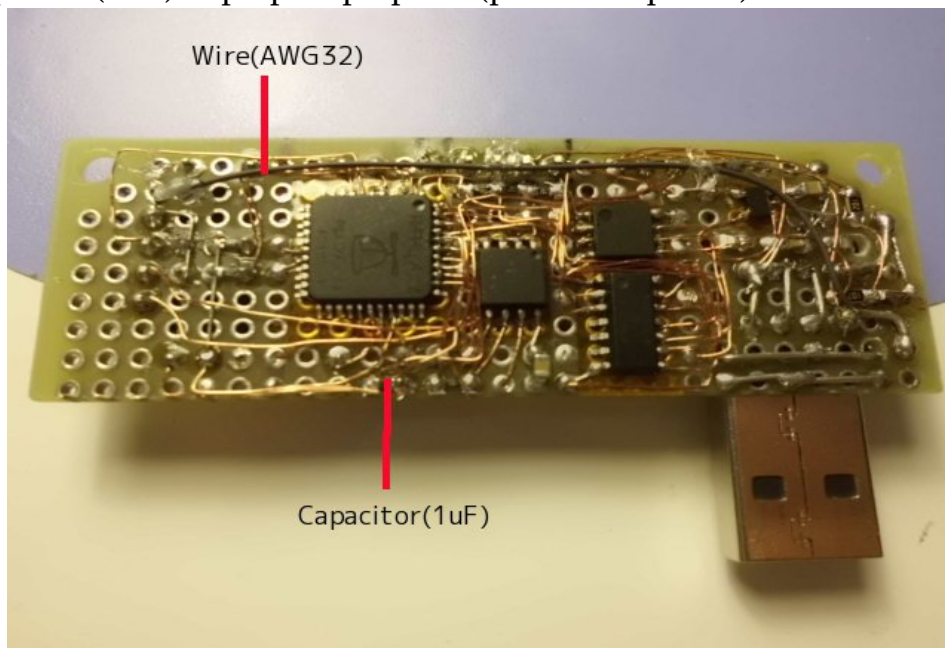GND of PropPlug-connecter connected to Amp1's 1k-ohm(GND-side).
I used wire(UEW polyuretan 0.2mm).
I think maybe GND-line was poor.
So, directly connected PropPlug's GND to USB-plug's GND by black wire(AWG32).

When connecting to PC's USB-port, USB_Current_monitor repeat reboot.
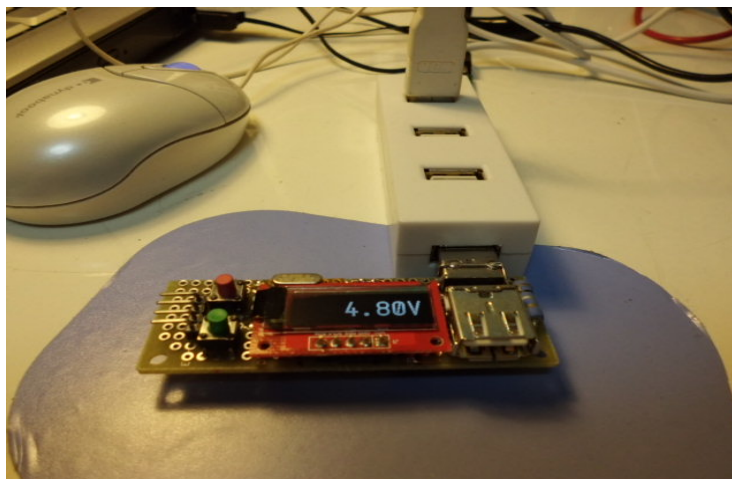I added capacitor(1uF) to prop-chip's power(pin40 and pin 39).

Wire(AWG32)

Capacitor(1uF)

Each USB voltage is different

Camera's USB power supply

USB-Hub

PC's USB port

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