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E-Cigarette Reference Software Guidance for LC709301F

3.5 W Solution

Overview

LC709301F is a Lithium ion switching charge/discharge controller for 1-Cell Li-Ion Battery (LiB). This guidance describes about reference software of LC709301F for E-Cigarette application. This device has mainly functions for E-Cigarette including battery charge, heating and LED indicating. Our solution provides the following values.

Features

- Advanced Safety
- Heating High Accuracy
- System Flexibility

Characteristic

- 3.0 W to 4.0 W Heating Solution
- Real Time Feedback Heating with Monitoring Voltage and Current of Heater
- Multiple Safety Using Controller (LC709301F) and LiB Protection IC
- Low Power Consumption at Standby

Applications

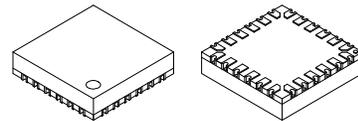
- E-Cigarette
- Charging/Discharging Application used Li-Ion Battery



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APPLICATION NOTE



VCT24 3.5x3.5, 0.5P
CASE 601AD

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SOFTWARE SPEC. E-CIGARETTE BASE PROGRAM

Table 1.

Characteristic	Description
MCU	LC709301F @ Internal 8 MHz
Developer	ON Semiconductor
Circuit	See page 3
Development Environment	Tasking C Compiler Ver.dlc87 3.2.r2 TCB87-Type C (On Chip Debugger)
Document	Main Flow See page 7 Port assign See page 5 Mode transition See page 6
Use Battery	Maker: Joysun New Energy Model: Joysun08450 Type: Li-ion polymer
Charging and Discharging Specification	Charging voltage upper limit: 4.17 V Full-charge detection voltage: 4.0 V – 4.2 V Full-charge detection current: Less than 40 mA (2 s) Charging current: 190 mA 10-bit PWM 39 kHz Base cycle Charging time-out: 180 min Pre-charge voltage threshold: Less than 3.0 V Pre-charge current: 6 mA 15 min Abnormal temperature detection 58°C Discharge current: 3.5 W 10-bit PWM 7.8 kHz Discharge voltage: 3.27 V and over Discharge time-out: 5 s
LED Indicator Specification	See Table 2
USB (+5 V) Detection	When 4.5 V to 5.5 V is input to the USB terminal, the USB connection is detected.

Table 2. LED INDICATOR SPECIFICATION

P12 BLUE	P05 GREEN	P06 RED	Function	Puff Count
0	0	0		
0	0	1	Heater	
0	1	0	Charging	150
0	1	1		100
1	0	0		250 over
1	0	1		50
1	1	0		200
1	1	1		

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REFERENCE BOARD CIRCUIT DIAGRAM

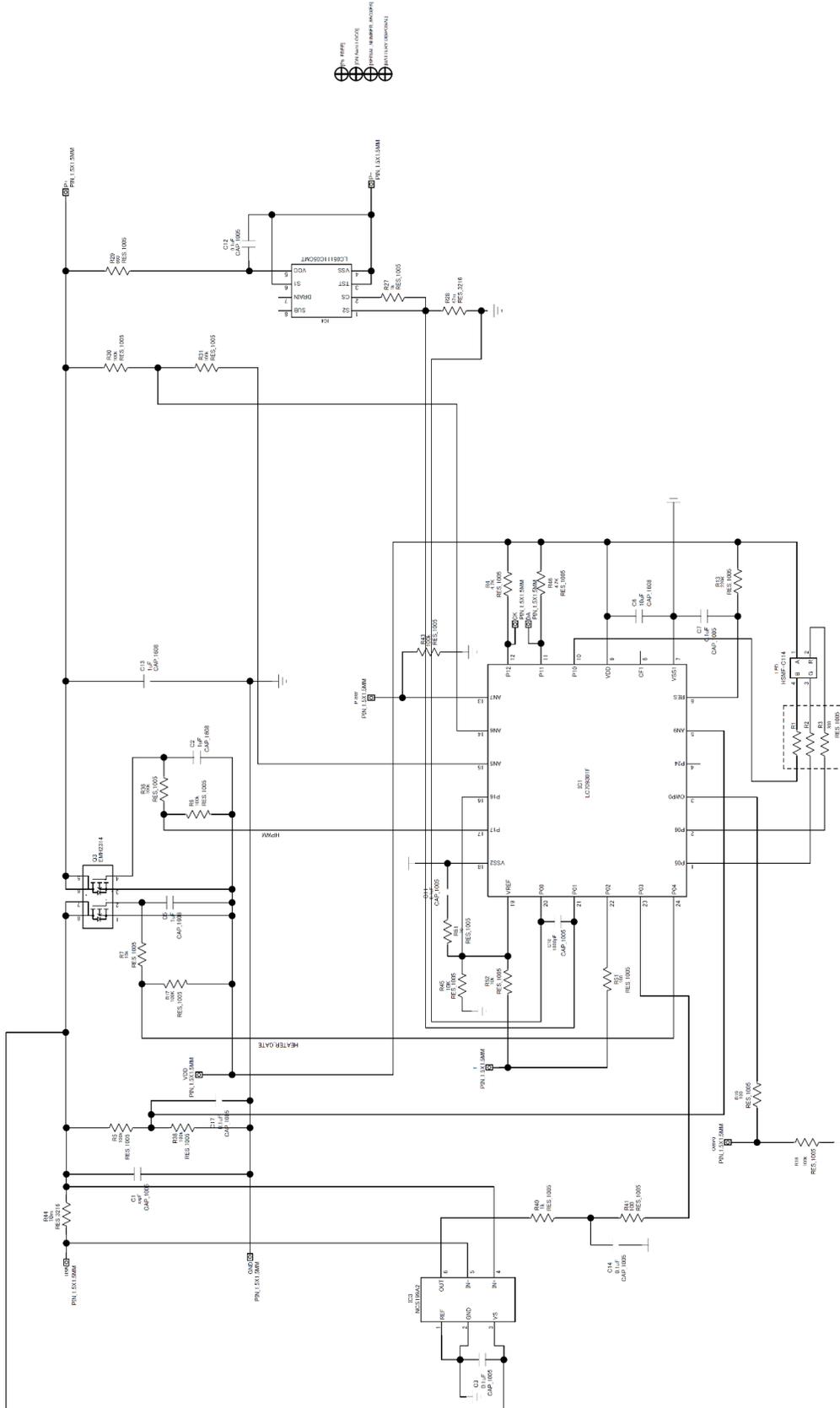


Figure 1. Reference Board Circuit Diagram

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SOFTWARE BLOCK

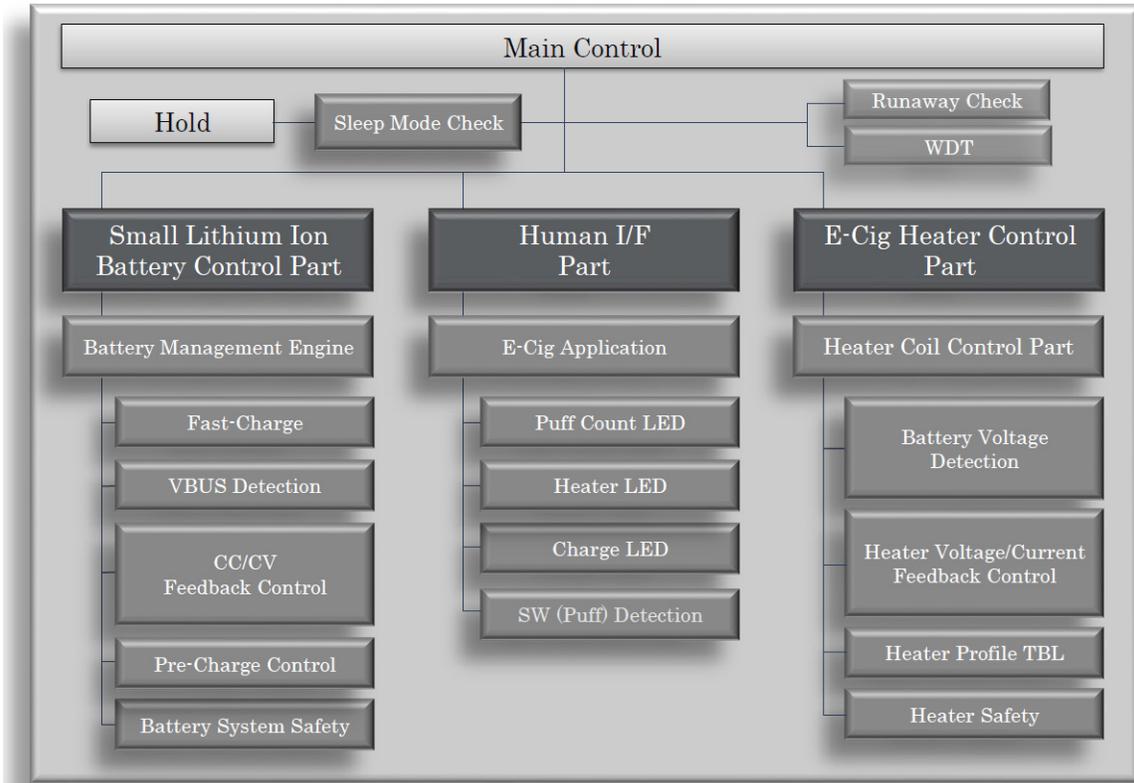


Figure 2. Software Block

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Table 3. PORT ASSIGN

E-Cigarette LC709301F (Package:VCT) Heater Current IC Correspondence										IN/ OUT	Latch	IN/ OUT	Latch	IN/ OUT	Latch	IN/ OUT	Latch	IN/ OUT	Latch
No.	Terminal Name		I/O	Function	Port name	Summary	Active	Internal PullUp	Initial	HOLD	Cigarette Connect Operation Mode	Cigarette Smoking Operation Mode	USB Connect Operation Mode						
1	P05/T1PWML/CK0	CMOS	O	T0PW ML	LED	GREEN (Charging)	Low		O	H	O	H	O	H	O	H	O		
2	P06/T1PWH	CMOS	O	T1PW MH	LED	RED	Low		O	H	O	H	O	H	O	PWM	O	H	
3	OWP0			OWP	Debugger														
4	P24	CMOS	O		NC				O	L	O	L	O	L	O	L	O	L	
5	P70/INT0/T0LCP/AN9	Nch	I	INT0, AN9	Power	USB Detection	High		I	-	I	-	I	-	I	-	I	-	
6	RES#																		
7	VSS1																		
8	CF1/XT1	Nch	O		NC				O	L	O	L	O	L	O	L	O	L	
9	VDD1																		
10	P10/SO1	CMOS	O		LED	BLUE (Full Charge)	Low		O	H	O	H	O	H	O	H	O		
11	P11/SI1/SB1	Nch	O	I2C SDA					O	H	O	H	O	L	O	L	O	L	
12	P12/SCK1	Nch	O	I2C SCL					O	H	O	H	O	L	O	L	O	L	
13	P13/INT4/T1IN/AN7	Nch	I	INT4	Puff	Air Sensor (Key)	High		I	L	I	-	I	-	I	-	I	-	
14	P14/INT4/T1IN/AN6	Nch	I	AN6	FB1	Batt. Vol.			I	-	I	-	I	-	I	-	I	-	
15	P15/INT3/T0IN/AN5	Nch	O		FB1_CN T	Vatt. Partial pressure	Low		O	L	I	-	O	L	O	L	O	L	
16	P16/INT2/T0IN/CPOUT/H PWM2	Nch	O		DisCharge	Vref. Load	Low		O	H	O	H	O	-	O	-	O	-	
17	P17/BUZ/INT1/T0HCP/H PWM2	CMOS	O	HPWM	Charge Control	Q2 FET	Low		O	H	O	H	O	H	O	L	O	PWM	
18	VSS2					AVSS													
19	VREF		O		Ref. Vol.	2V,4V							2V		2V			4V	
20	P00/APIM	Nch	I	APIM	Charge current				I	-	I	-	I	-	I	-	I	-	
21	P01/APIP	Nch	I	APIP	Charge current				I	-	I	-	I	-	I	-	I	-	
22	P02/AN2/CPIM	Nch	I	AN2	Thermistor				I	-	I	-	I	-	I	-	I	-	
23	P03/AN3/VCPWM0	Nch	I	AN3	Heater current	Heater current IC Output (AD)			I	-	I	-	I	-	I	-	I	-	
24	P04/AN4/VCPWM1	CMOS	O	VCPWM1	Heater	Smoking Q1 FET	Low		O	H	O	H	O	H	O	PWM	O	L	

Table 4. CONTROL LOGIC OF FET

Mode	Q1 FET (Heater Side)	Q2 FET (Batt. Side)
USB Charge	ON (Low)	PWM
Heater On	PWM	ON (Low)
Wait, Hold	OFF (High)	OFF (High)

MODE TRANSITION

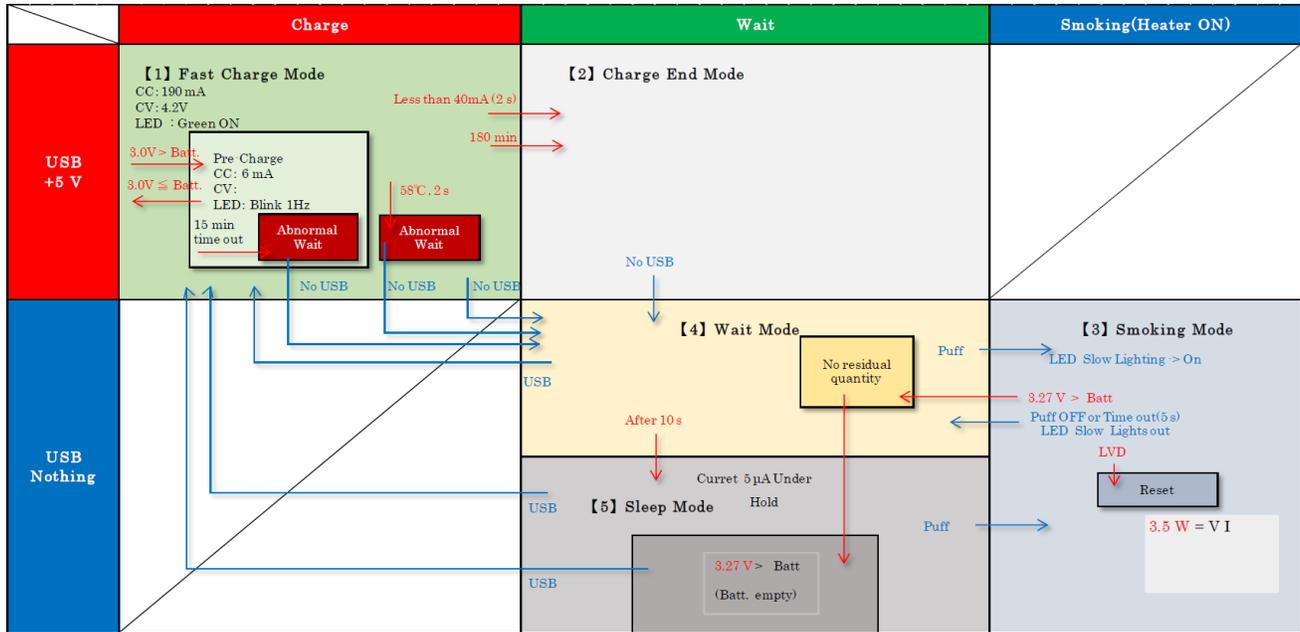
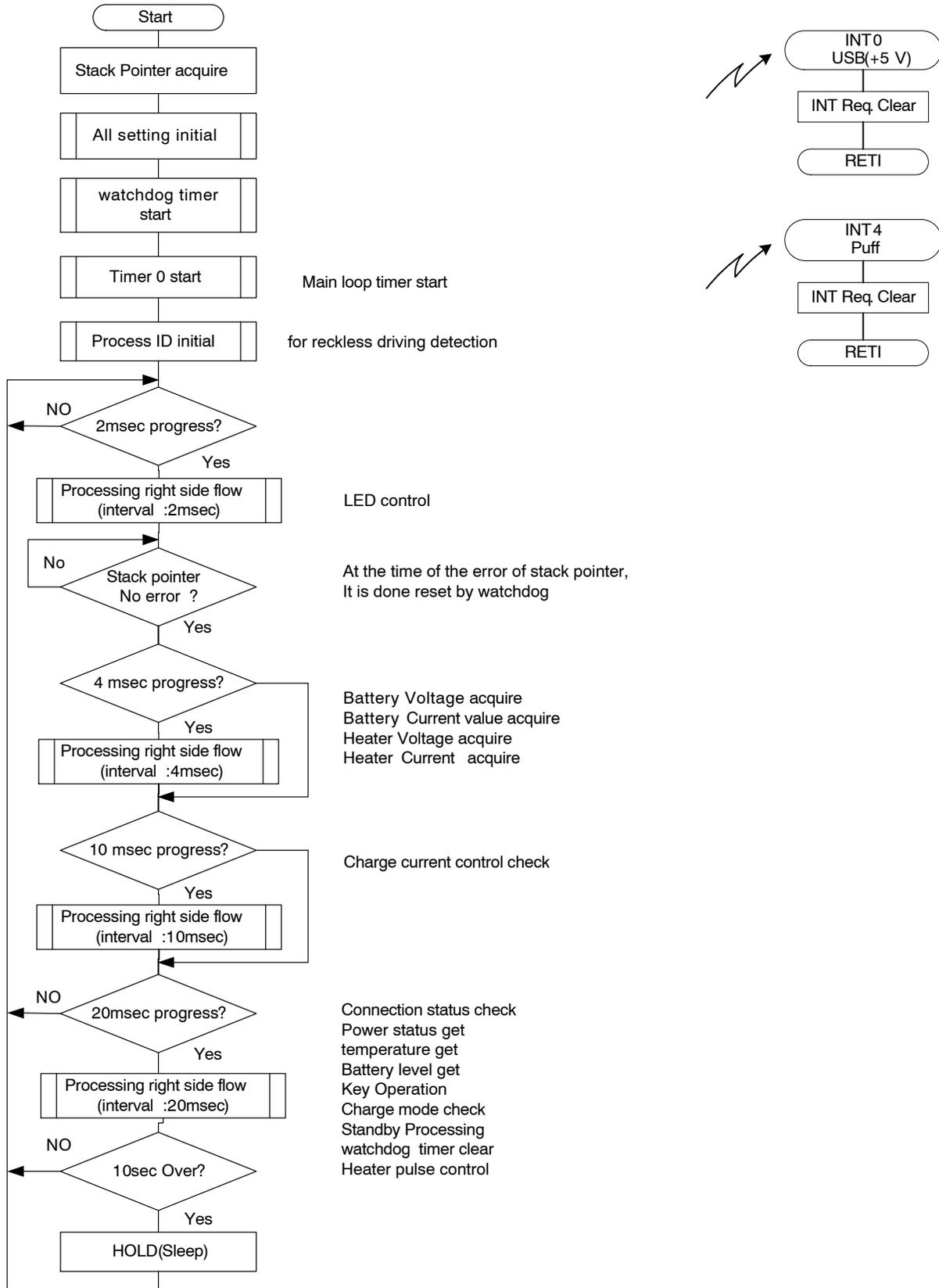


Figure 3. Mode Transition

Table 5.

Detection State	P70(INT0)	P13(Puff)	MODE		
Batt. Only	Low	Low	[4] Wait Mode	[5] Sleep Mode	
Batt. + Cigarette	Low (High at puff)	Low/High	[3] Smoking Mode	[4] Wait Mode	[5] Sleep Mode
Batt. + USB	High	Low	[1] Fast Charge Mode	[2] Charge End Mode	

FLOW



HOLD release = Interrupt : USB or Puff

Figure 4. Flow

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DESCRIPTION OF EVALUATION BOARD

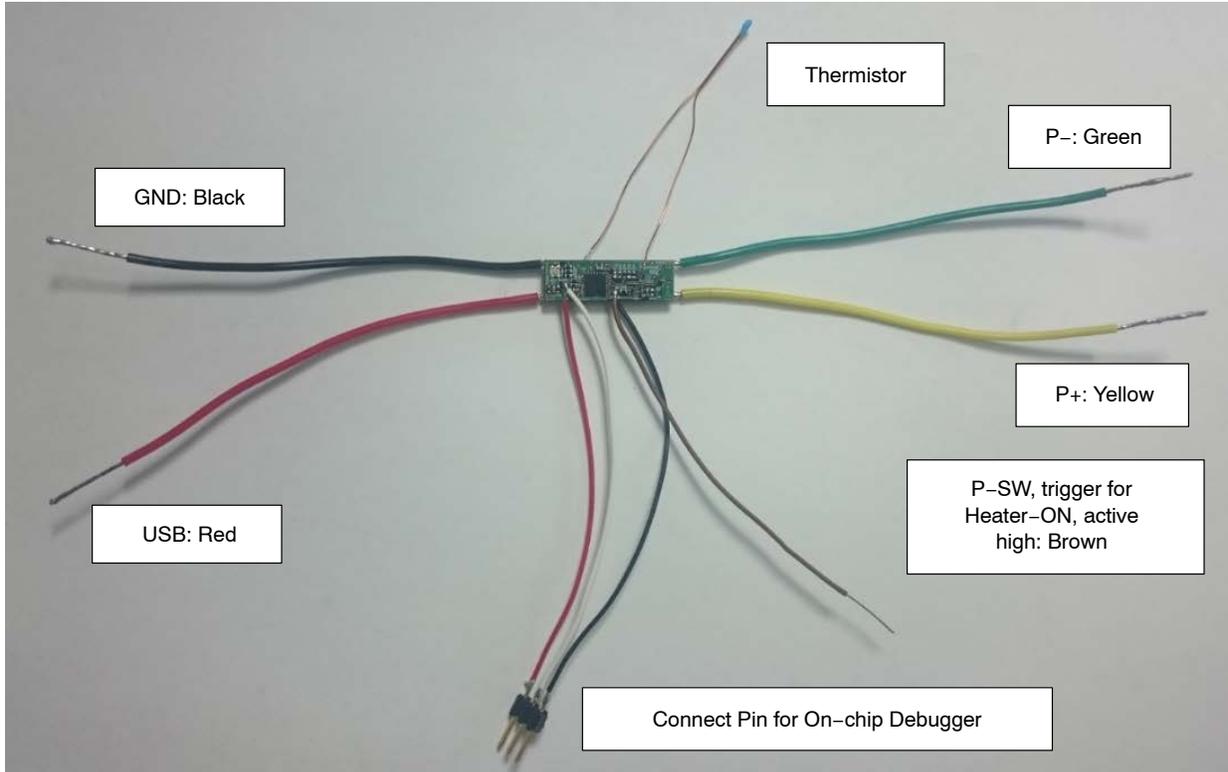


Figure 5. Description of Evaluation Board

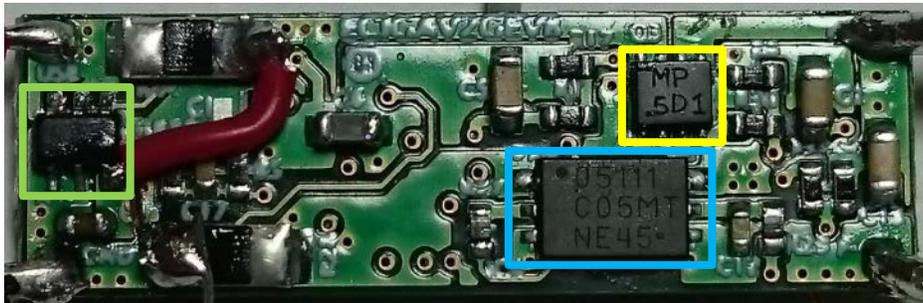


Figure 6. Top View



Figure 7. Top View

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HOW TO CONNECT

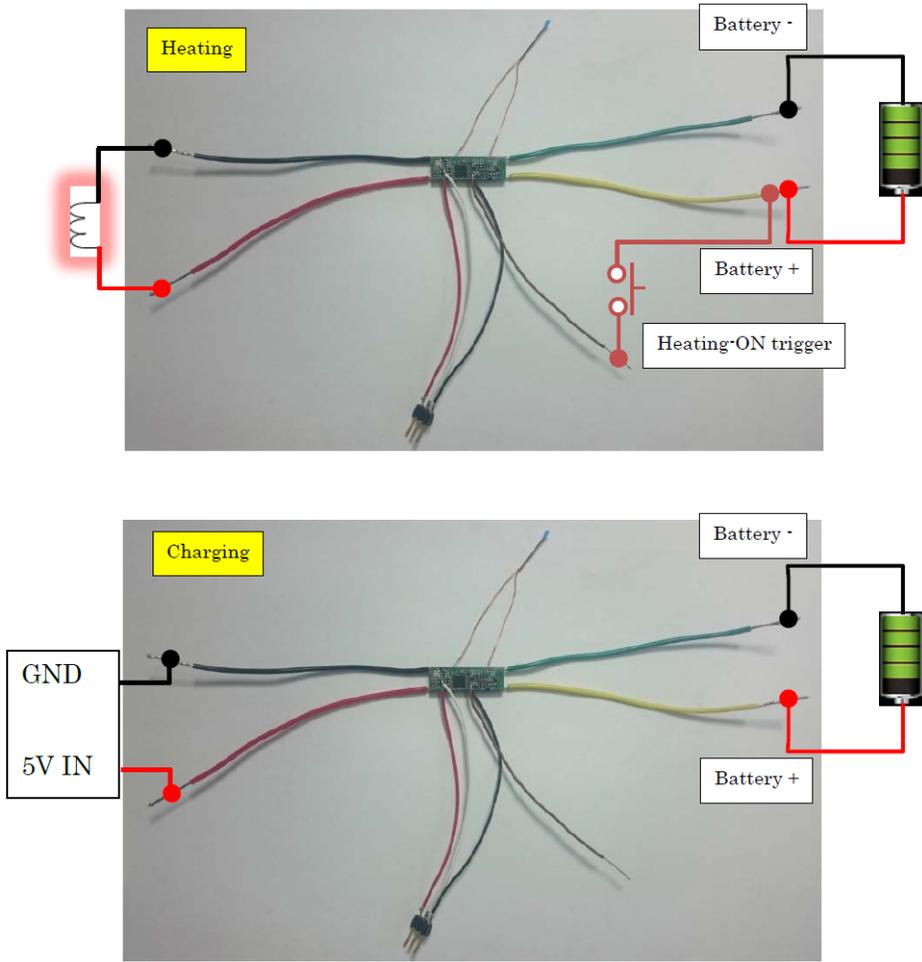
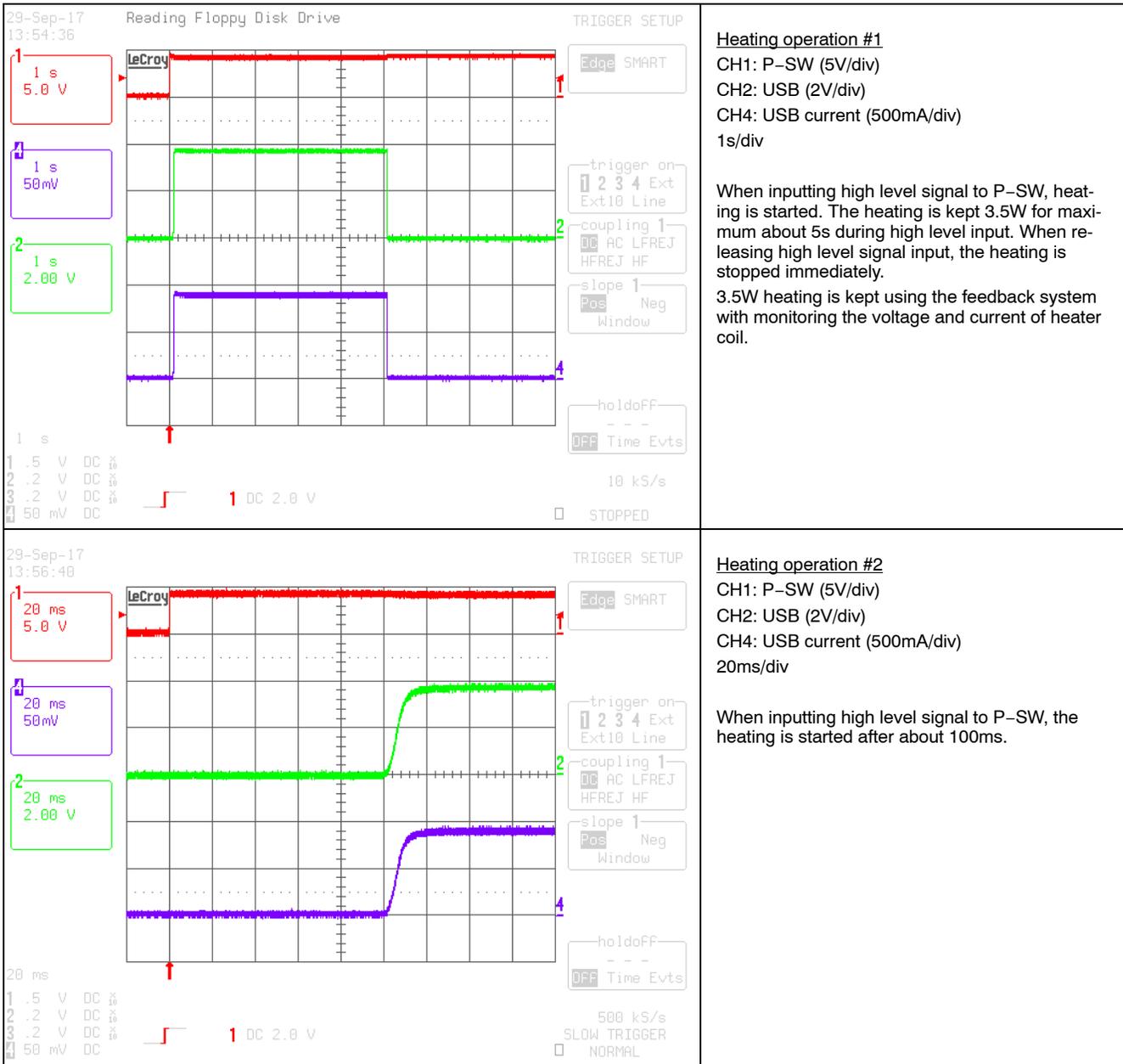


Figure 8. How to Connect

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OPERATION WAVEFORM

Table 6. HEATING



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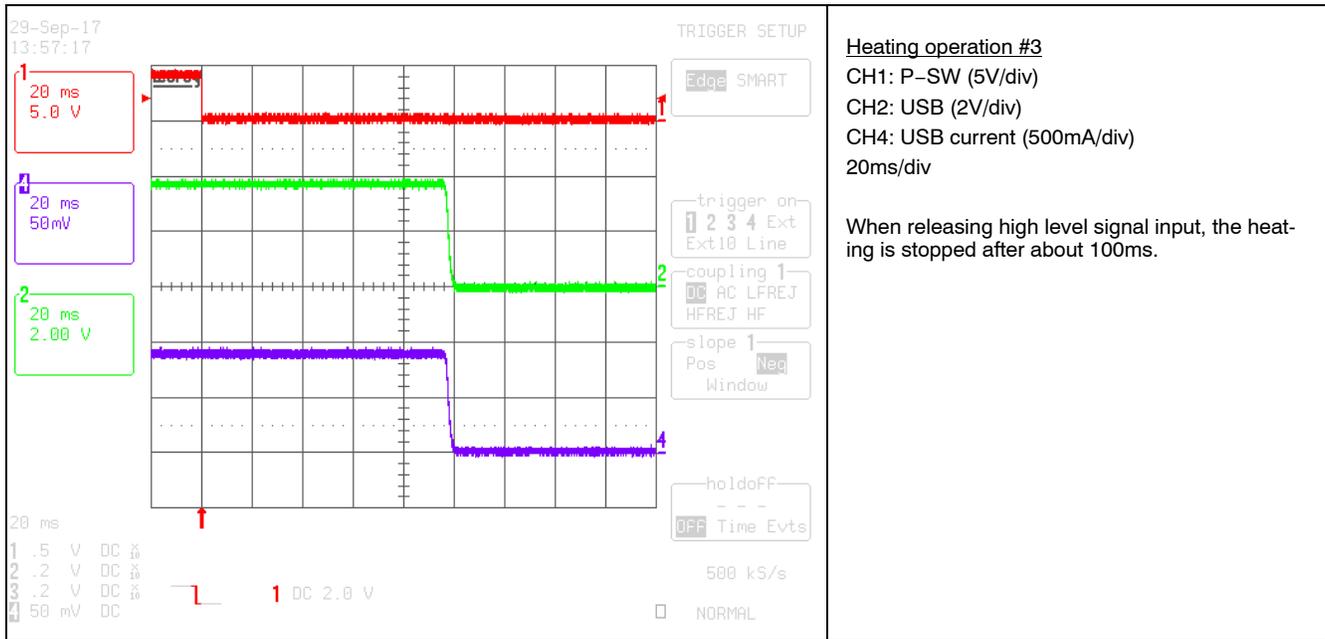
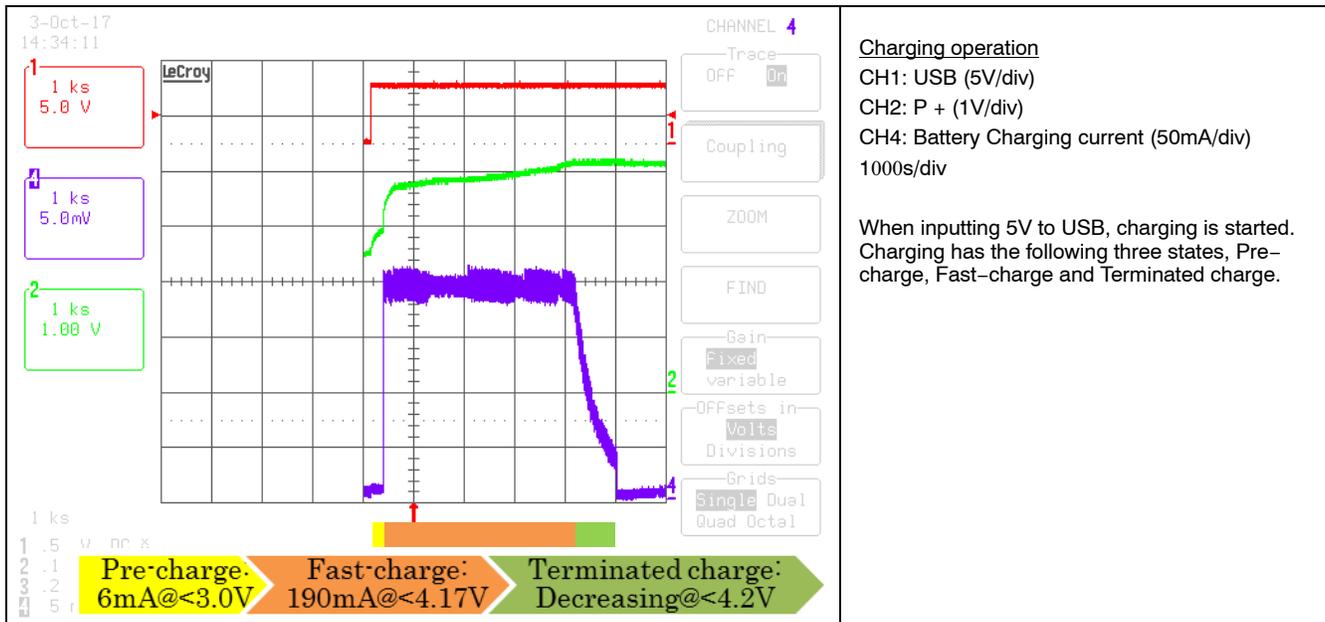


Table 7. CHARGING



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