Lithium-Ion Battery Charge Control IC
Monolithic IC MM3439

Outline

This IC is a Mitsumi has developed an IC that monitors 3 power supplies constituted by an AC adaptor, the USB port, and lithium ion secondary battery and controls the system drive power supply and the charging.
The charging control is adapted to the battery temperature profile.
The IC is equipped with safe and highly efficient switch mode charging control to realize optimal power management for the mobile device.

Features

1. Built-in power switch for switching between AC adaptor/USB, and built-in charging control function.
   The IC controls the power supply from the AC adaptor, USB and lithium ion secondary battery.
2. The power supply is controlled to fit the charging temperature profile for safe and highly efficient charging.
   Thanks to control using I^2C, the charging temperature profile can be altered.
3. The switch mode charge control format allows a large charging current (Max 2A) to be supported.
   The I^2C control also allows changes to be made in 100 mA steps.

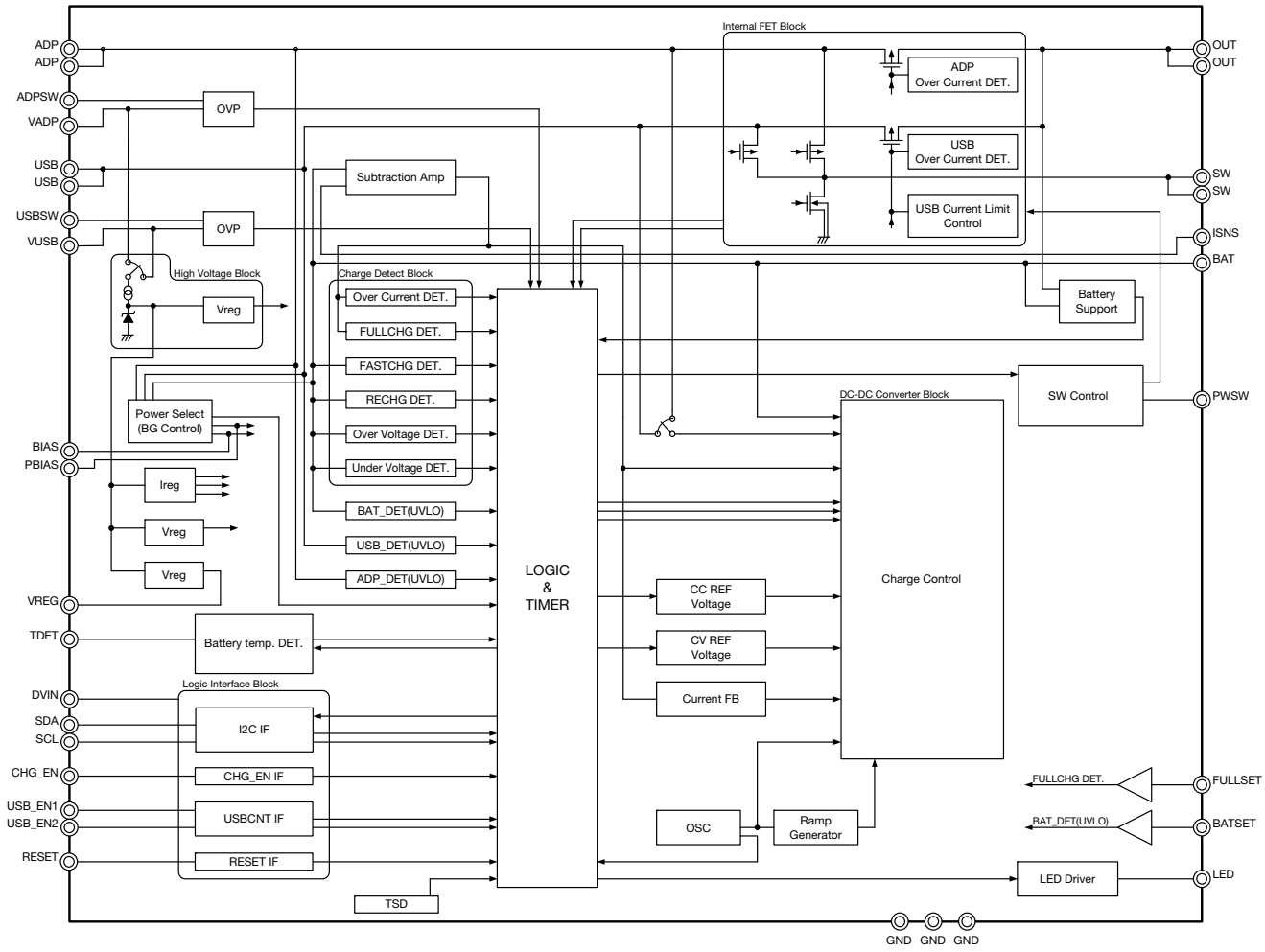
Package

SQFN-32A

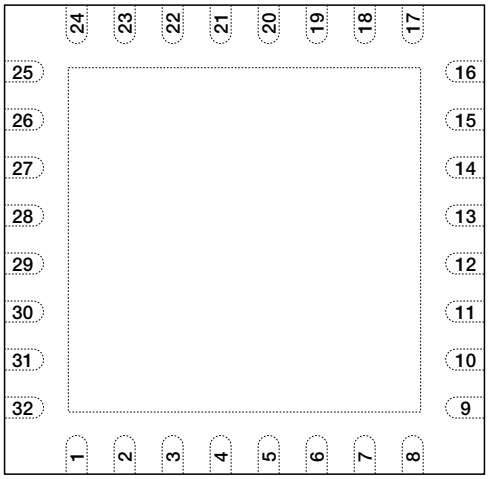
Applications

1. Mobile phones
2. PDAs
3. Digital still cameras
4. Digital video cameras
5. Portable games
6. Portable music players

Block Diagram



Pin Assignment



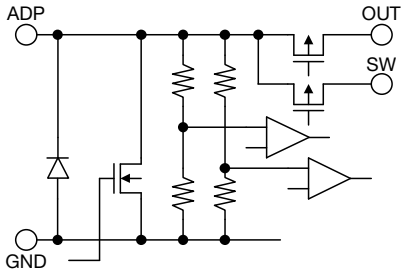
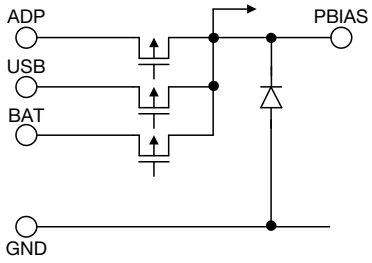
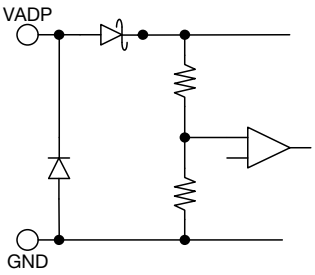
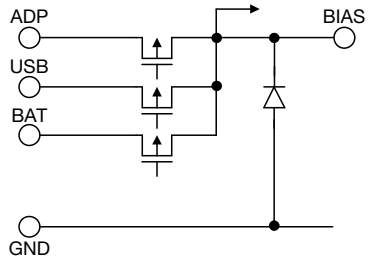
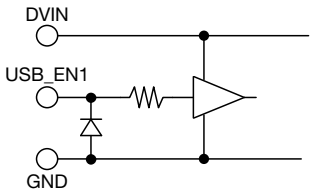
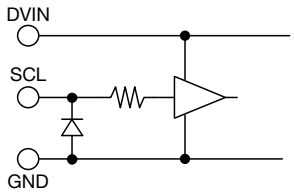
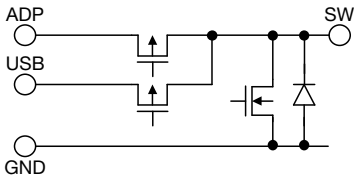
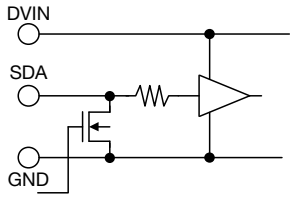
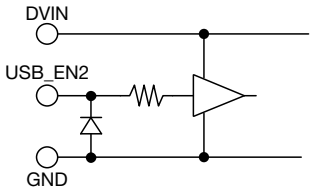
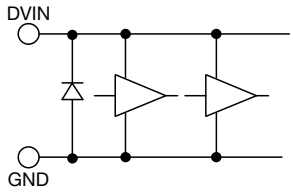
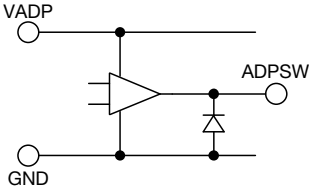
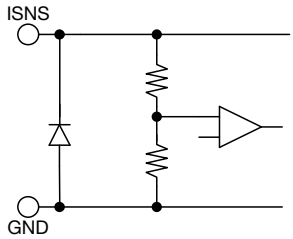
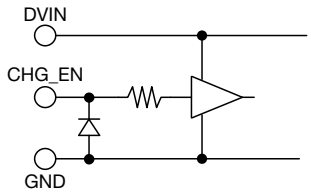
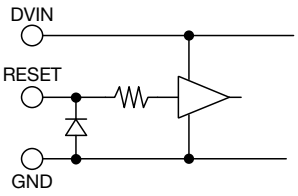
SQFN-32A
(TOP VIEW)

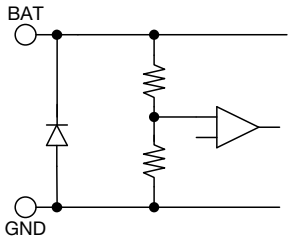
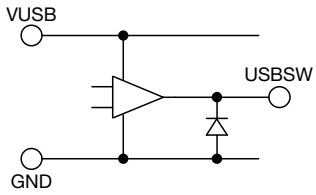
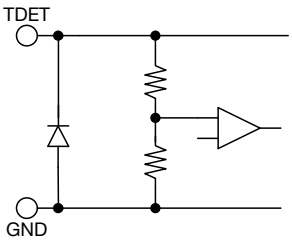
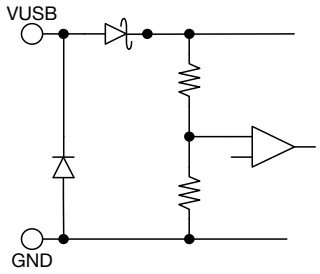
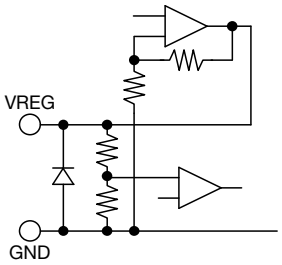
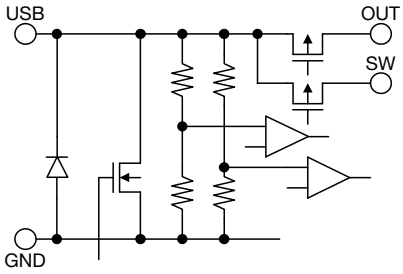
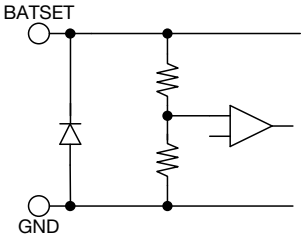
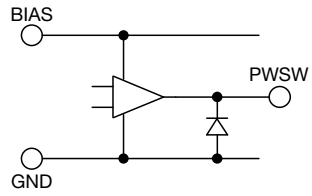
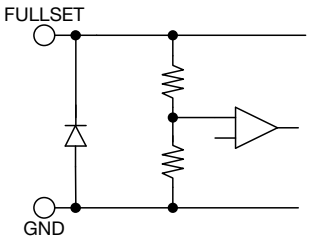
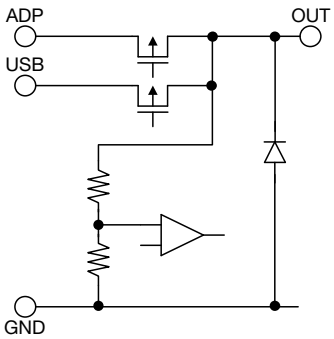
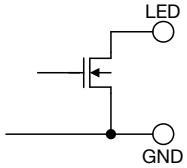
1	ADP	17	ISNS
2	ADP	18	RESET
3	VADP	19	BAT
4	USB_EN1	20	TDET
5	SW	21	VREG
6	SW	22	BATSET
7	USB_EN2	23	FULLSET
8	ADPSW	24	GND
9	GND	25	LED
10	GND	26	USBSW
11	CHG_EN	27	VUSB
12	PBIAS	28	USB
13	BIAS	29	USB
14	SCL	30	PWSW
15	SDA	31	OUT
16	DVIN	32	OUT

Pin Description

Pin No.	Symbol	I/O	Function
1	ADP	I	Power supply input terminal that connects AC adaptor.
2			
3	VADP	I	Terminal for overvoltage protection (>5.7V) detection at the AC adaptor input.
4	USB_EN1	I	Current limitation control terminal of USB power SW. It controls with USB_EN2.
5	SW	O	Output terminal that connects inductor for charge buck DCDC converter.
6			
7	USB_EN2	I	Current limitation control terminal of USB power SW. It controls with USB_EN1.
8	ADPSW	O	FET-drive terminal of AC adaptor external switch (Pch-MOSFET).
9	GND		Ground terminal.
10			
11	CHG_EN	I	Charging enable input terminal.
12	PBIAS		Internal power supply stabilization terminal. The bypass capacitor is connected.
13	BIAS		Internal power supply stabilization terminal. The bypass capacitor is connected.
14	SCL	I	Clock input terminal for I^2C BUS.
15	SDA	I/O	Data I/O terminal for I^2C BUS.
16	DVIN	I	Power supply input terminal for logic I/F part.
17	ISNS	I	Input terminal for charge current detection. The high potential side of the sense resistance is connected.
18	RESET	I	Reset input terminal
19	BAT	I	Input terminal for detection of voltage of battery. Charge current detection input and using combinedly. The low potential side of the detection resistance is connected.
20	TDET	I	Input terminal for detection of battery temperature. The thermistor is connected.
21	VREG	O	Reference voltage output terminal for detection of battery temperature. 3.5Vtyp. is output.
22	BATSET	I	Set terminal of battery power that permits battery use. The voltage value is set by the breeder resistance between VREG-GND.
23	FULLSET	I	Set terminal of charge completion current. The voltage value is set by the breeder resistance between VREG-GND.
24	GND		Ground terminal.
25	LED	O	LED-drive terminal (Nch open drain output).
26	USBSW	O	FET-drive terminal of USB external switch (Pch-MOSFET).
27	VUSB	I	Terminal for input overvoltage protection detection (>5.7V) of USB.
28	USB	I	Power supply input terminal that connects USB.
29			
30	PWSW	O	FET-drive terminal of external power switch (Pch-MOSFET).
31	OUT	O	Power supply output terminal for system.
32			

Pin Description

Pin No.	Pin name	Equivalent circuit diagram	Pin No.	Pin name	Equivalent circuit diagram
1 2	ADP		12	PBIAS	
3	VADP		13	BIAS	
4	USB_EN1		14	SCL	
5 6	SW		15	SDA	
7	USB_EN2		16	DVIN	
8	ADPSW		17	ISNS	
11	CHG_EN		18	RESET	

Pin No.	Pin name	Equivalent circuit diagram	Pin No.	Pin name	Equivalent circuit diagram
19	BAT		26	USBSW	
20	TDET		27	VUSB	
21	VREG		28 29	USB	
22	BATSET		30	PWSW	
23	FULLSET		31 32	OUT	
25	LED				

Absolute Maximum Ratings (Except where noted otherwise Ta=25°C)

Item		Symbol	Ratings	Units
Storage temperature		T_{STG}	−55~+150	°C
Operating temperature		T_{OPRMAX}	−35~+85	°C
VADP, ADPSW, VUSB, USBSW pin input voltage		$VHin_{MAX}$	−0.3~+30	V
Other pin input voltage		Vin_{MAX}	−0.3~+6	V
ADP, USB pin input current		IIN_{MAX}	1.5	A
LED pin sink current		$ILED_{MAX}$	20	mA
Power dissipation	IC unit	Pd1	0.35	W
	Substrate mounting(*1)	Pd2	2.5 2.0 (*2)	W

note : *1 Board size : 90 × 90 × 1.6mm Material : grass epoxy Layer : double side Wire rate : 90%

note : *2 When the back heat spreader unmounting.

Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating temperature	T_{OPR}	−20~+75	°C
ADP, USB Operating voltage	VDD	4.5~5.5	V
BAT Operating voltage	BAT	1.05~4.25	V
DVIN Operating voltage	DVIN	1.5~5.5	V
Logic I/F block pin input voltage (*3)	LOGICIF	0~DVIN	V
BATSET pin input voltage	BATSET	1.0~2.0	V
FULLSET pin input voltage	FULLSET	0.6~1.2	V
ADP, USB pin input current	IIN	0~2.0	A

note : *3 SDA, SCL, CHG_EN, USB_EN1, USB_EN2, RESET pin

Electrical Characteristics 1 (Except where noted otherwise Ta=25°C, ADP=USB=5.0V)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Consumption current 1	ICC	ADP mode, USB mode		1.5	3.0	mA
Consumption current 2	ICCBTM	BAT mode		30	50	µA
VREG pin output voltage	VREG		3.4	3.5	3.6	V
VREG pin output current ability	IREG		2			mA
ADP/USB UVLO (V_{UVLO}<PSM)	V_{UVLO}	ADP/USB=H→L	4.1	4.2	4.3	V
ADP/USB UVLO hysteresis voltage width (*4)	V_{UVLOW}	ADP/USB=L→H	50	100	150	mV
ADP/USB supply voltage control (V_{UVLO}<PSM)	PSM	ADP/USB=H→L	4.2	4.3	4.4	V
BAT UVLO	BAT_{UVLO}	BAT=H→L BATSET=1.5V	TYP −0.1	BATSET ×2	TYP +0.1	V
BAT UVLO hysteresis voltage width (*4)	BAT_{UVLOW}	BAT=L→H BATSET=1.5V	30	85	140	mV
VADP/VUSB OVP	V_{VDDH}	VADP/VUSB=L→H	5.5	5.7	5.9	V
VADP/VUSB OVP hysteresis voltage width (*4)	V_{VDDHW}	VADP/VUSB=H→L	50	100	150	mV
Current limit of USB pass	$I_{USB}1$	USB_EN1=H, USB_EN2=L OUT=3.6V	60	80	100	mA
	$I_{USB}2$	USB_EN1=L, USB_EN2=H OUT=3.6V	420	460	500	
	$I_{USB}2$	USB_EN1=H, USB_EN2=H Only I^2C mode, OUT=3.6V	800	850	900	
ADP overcurrent detection (*4)	I_{ADPMAX}			2.5		A

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
USB overcurrent detection (*4)	I_{USBMAX}			2.5		A
Forced charge current range	I_{FRCCHG}	RSNS=0.2Ω(*6)	100		200	mA
Forced charge current accuracy	A_{FRCCHG}	RSNS=0.2Ω IFRCCHG=180mA(*6)	–40		+40	%
Pre-charge current range	I_{PRECHG}	RSNS=0.2Ω(*6)	100		200	mA
Pre-charge current accuracy	A_{PRECHG}	RSNS=0.2Ω IPRECHG=180mA(*6)	–30		+30	%
Fast charge current range	I_{FSTCHG}	RSNS=0.2Ω(*6)	100		2000	mA
Fast charge current accuracy	A_{FSTCHG}	RSNS=0.2Ω IFSTCHG=1800mA(*6)	–5		+5	%
Detect full charge current range	$I_{DETFULL}$	RSNS=0.2Ω, I^2C bus default	120		240	mA
Detect full charge current accuracy1	$A_{DETFULL}$	RSNS=0.2Ω, I^2C bus default FULLSET=0.6V IDETFULL=120mA	–30		+30	%
Detect full charge current accuracy2	$A_{DETFULL}$	RSNS=0.2Ω, at I^2C bus control FULLSET=0.6V IDETFULL=60mA, 240mA	–50		+50	%
BAT pin current of overcurrent detection	I_{HC}	RSNS=0.2Ω		2.5		A
BAT pin over discharge voltage detection	V_{LV}	BAT=H→L	0.95	1.05	1.15	V
BAT pin voltage of precharge detection	V_P	BAT=L→H	2.8	2.9	3.0	V
Hysteresis voltage width of pre-charge detection (*4)	V_{PW}		25	50	100	mV

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
BAT pin voltage for CV control ($V_{BAT}1>V_{BAT}2>V_{BAT}3$)	$V_{BAT}1$	$VT_2<TDET\leqq VT_5$	4.17	4.20	4.23	V
	$V_{BAT}2$	$VT_5<TDET\leqq VT_6$	4.05	4.10	4.15	
	$V_{BAT}3$	$VT_5<TDET\leqq VT_6$	4.00	4.05	4.10	
BAT pin voltage of re-charge detection	V_R	BAT=H→L	3.85	3.90	3.95	V
BAT pin voltage of overvoltage detection	V_{OV}	BAT=L→H	4.30	4.35	4.40	V
Battery temperature detection TDET pin voltage (*5)	V_{T1}	TDET=L→H −30°C±6°C detection	VREG ×0.893	VREG ×0.919	VREG ×0.940	V
	V_{T2}	TDET=L→H 2°C±2°C detection	VREG ×0.697	VREG ×0.714	VREG ×0.731	V
	V_{T3}	TDET=L→H 12°C±2°C detection	VREG ×0.604	VREG ×0.623	VREG ×0.642	V
	V_{T4}	TDET=H→L 43°C±2°C detection	VREG ×0.330	VREG ×0.345	VREG ×0.360	V
	V_{T5}	TDET=H→L 48°C±2°C detection	VREG ×0.294	VREG ×0.308	VREG ×0.322	V
	V_{T6}	TDET=H→L 58°C±2°C detection	VREG ×0.232	VREG ×0.243	VREG ×0.255	V
	V_{T7}	TDET=H→L 80°C±6°C detection	VREG ×0.124	VREG ×0.143	VREG ×0.165	V
Hysteresis voltage width of battery temp. detection (*4)	V_{VTHW}	VT2, VT3, VT4, VT5, VT6	1	3	5	°C
LED pin output voltage	V_{LED}	I_{LED}=10mA			0.4	V
LED pin sink current	I_{LED}		10			mA
ADP power SW ON resistance (*4)	$ADPR_{ON}$	ADP=5.0V			0.3	Ω
USB power SW ON resistance (*4)	$USBR_{ON}$	USB=5.0V			0.3	Ω

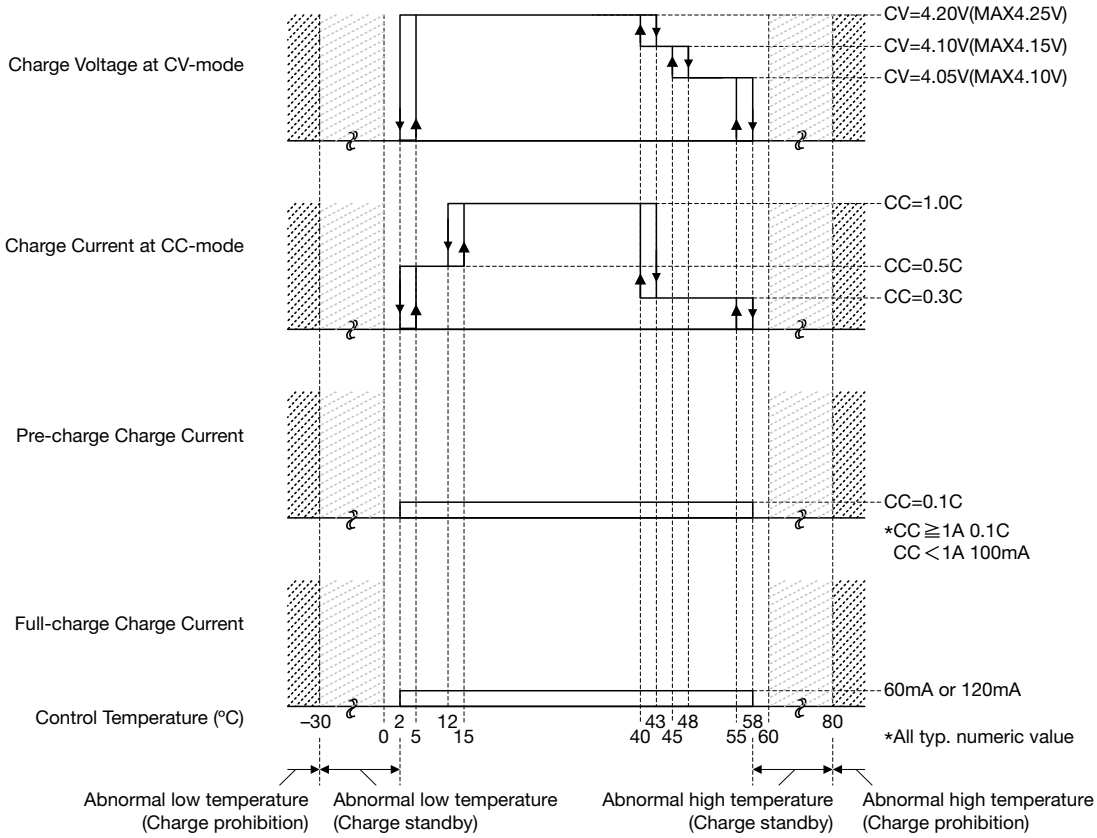
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Oscillator frequency	fosc		0.8	1.0	1.2	MHz
First time delay	T_{1STINT}		102.4	128.0	153.6	ms
BAT pull time	$T_{DISTCHG}$		102.4	128.0	153.6	ms
Forced charge time	T_{1STCHG}		204.8	256.0	307.2	ms
Voltage detection delay	$T_{Vdetect}$		102.4	128.0	153.6	ms
Pre-charge safety timer	T_{PRECHG}	I^2C bus default	5760	7200	8640	s
Fast charge safety timer	T_{FSTCHG}	I^2C bus default	37440	46800	56160	s
Full charge detection delay time	$T_{DETFULL}$		336.0	448.0	560.0	ms
Re-charge detection delay time	T_R		42.0	56.0	70.0	ms
BAT pin current of overcurrent detection delay time	I_{HC}		42.0	56.0	70.0	ms
BAT pin over discharge voltage detection delay time	V_{LV}		42.0	56.0	70.0	ms
BAT pin overvoltage detection delay time	T_{OV}		42.0	56.0	70.0	ms
ADP/USB overcurrent detection delay time (*4)	T_{OC}		42.0	56.0	70.0	ms
ADP/USB/BAT under voltage lockout delay time	T_{UV}		84.0	112.0	140.0	ms
Temp. detection delay time	T_{TDET}		42.0	56.0	70.0	ms

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
LED blinking cycle	T_{BL1}	When blinking (0.25Hz) is set	0.200	0.250	0.300	Hz
	T_{BL2}	When blinking (0.5Hz) is set	0.400	0.500	0.600	
	T_{BL3}	When blinking (1Hz) is set	0.800	1.000	1.200	
	T_{BL4}	When blinking (2Hz) is set	1.600	2.000	2.400	
	T_{BL5}	When blinking (4Hz) is set	3.200	4.000	4.800	
	T_{BL6}	When blinking (8Hz) is set	6.400	8.000	9.600	
CHG_EN "L"-level input voltage	V_{CEL}		0		0.3	V
CHG_EN "H"-level input voltage	V_{CEH}		DVIN −0.3		DVIN	V
CHG_EN pin input current	I_{CE}	DVIN=1.8V H input			2.5	µA
USB_EN1 "L"-level input voltage	V_{USB1L}		0		0.3	V
USB_EN1 "H"-level input voltage	V_{USB1H}		DVIN −0.3		DVIN	V
USB_EN1 pin input current	I_{USB1}	DVIN=1.8V H input			2.5	µA
USB_EN2 "L"-level input voltage	V_{USB2L}		0		0.3	V
USB_EN2 "H"-level input voltage	V_{USB2H}		DVIN −0.3		DVIN	V
USB_EN2 pin input current	I_{USB2}	DVIN=1.8V H input			2.5	µA
RESET "L"-level input voltage	V_{RSTL}		0		0.3	V
RESET "H"-level input voltage	V_{RSTH}		DVIN −0.3		DVIN	V
RESET pin input current	I_{RST}	DVIN=1.8V H input			2.5	µA

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Temperature of chip temperature limiting1 (*4)	TCL1	at I^2C bus control	75	85	95	°C
Temperature of chip temperature limiting2 (*4)	TCL2	I^2C bus default	125	135	145	°C
Temperature of thermal shutdown (*4)	TSD		140	150	160	°C
Hystereisis temperature of thermal shutdown (*4)	TSDh			25		°C

note : *4 guaranteed by design

note : *5 Temperature detection is the setting value at B-Value 3380K (25/50°C)(NCP15XH103F03RC made by MURATA MANUFACTURING).
The battery temperature profile (I^2Cbus is default) when this thermistor use is a figure below.



note : *6 About the range and accuracy to be able to set the charging current.

When RSNS is 0.2Ω, the Forced charge current, the pre-charge current, and the fast charge current are the relations of the table below. It is possible to select No. according to the I2C control. Accuracy excluding No.18 becomes a design certification.

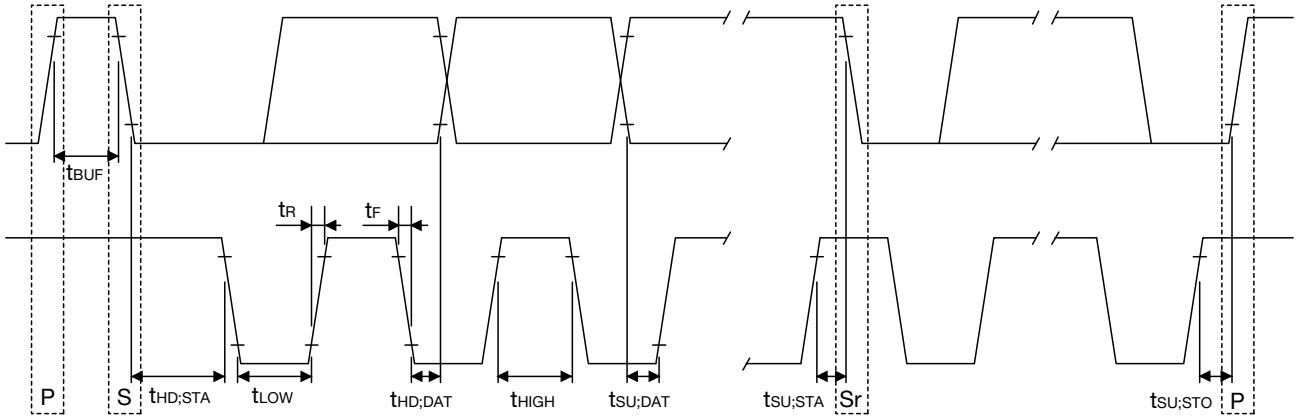
No.	Forced charge current	Pre-charge current	Fast charge current
1	100mA ± 40%	100mA ± 40%	100mA ± 40%
2	100mA ± 40%	100mA ± 40%	200mA ± 30%
3	100mA ± 40%	100mA ± 40%	300mA ± 20%
4	100mA ± 40%	100mA ± 40%	400mA ± 15%
5	100mA ± 40%	100mA ± 40%	500mA ± 15%
6	100mA ± 40%	100mA ± 40%	600mA ± 10%
7	100mA ± 40%	100mA ± 40%	700mA ± 10%
8	100mA ± 40%	100mA ± 40%	800mA ± 10%
9	100mA ± 40%	100mA ± 40%	900mA ± 7.5%
10	100mA ± 40%	100mA ± 40%	1000mA ± 7.5%
11	110mA ± 40%	110mA ± 30%	1100mA ± 7.5%
12	120mA ± 40%	120mA ± 30%	1200mA ± 7.5%
13	130mA ± 40%	130mA ± 30%	1300mA ± 5%
14	140mA ± 40%	140mA ± 30%	1400mA ± 5%
15	150mA ± 40%	150mA ± 30%	1500mA ± 5%
16	160mA ± 40%	160mA ± 30%	1600mA ± 5%
17	170mA ± 40%	170mA ± 30%	1700mA ± 5%
18	180mA ± 40%	180mA ± 30%	1800mA ± 5%
19	190mA ± 40%	190mA ± 30%	1900mA ± 5%
20	200mA ± 40%	200mA ± 30%	2000mA ± 5%

note : If the IC is damaged and control is no longer possible, its safety can not be guaranteed. Please protect with something other than this IC.

note : If adjacent terminals are shorted or each terminal is short with VDD or GND, there is a possibility that the IC malfunctions.

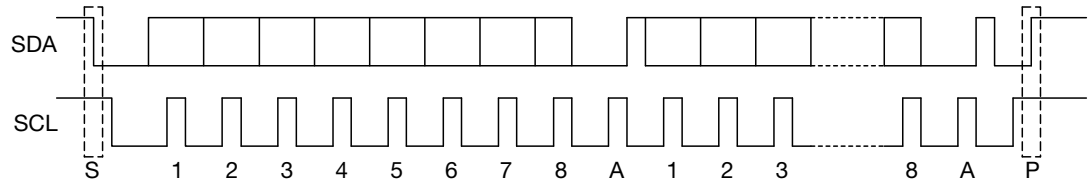
Electrical Characteristics 2 (Except where noted otherwise Ta=25°C, ADP=USB=5.0V)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
[I²C condition]						
Input voltage L	V_{IL}		0		DVIN ×0.3	V
Input voltage H	V_{IH}		DVIN ×0.7		DVIN	V
SDA low level output voltage	V_{OL}	SDA sink 3mA	0		0.4	V
High level input current	I_{IH}	SDA, SCL=4.5V	–10		10	µA
Low level input current	I_{IL}	SDA, SCL=0.4V	–10		10	µA
Clock frequency	f_{SCL}				400	kHz
Data transfer wait time	t_{BUF}		1.3			µs
SCL start hold time	$t_{HD;STA}$		0.6			µs
SCL low level hold time	t_{LOW}		1.3			µs
SCL high level hold time	t_{high}		0.6			µs
Start condition setup	$t_{SU;STA}$		0.6			µs
SDA data hold time	$t_{HD;DAT}$		0			µs
SDA data setup time	$t_{SU;DAT}$		100			ns
SDA,SCL rise time	t_R				300	ns
SDA,SCL fall time	t_F				300	ns
Stop condition setup time	$t_{SU;STO}$		0.6			µs



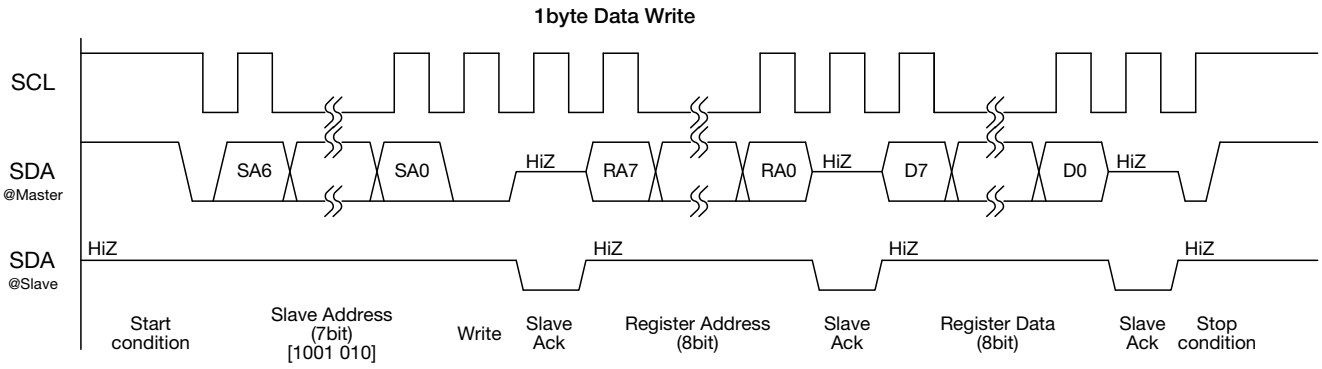
I²C BUS

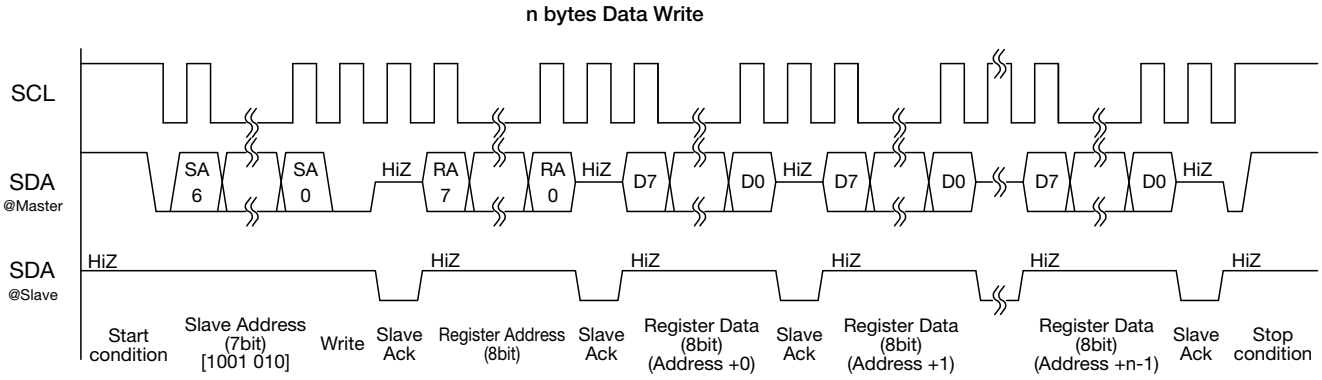
[About I²C BUS]



I²C BUS is inter bus system controlled by 2 lines (SDA,SCL).
Data are transmitted and received in the units of byte and Acknowledge.
It is transmitted by MSB first from the Start condition.

[Control registers]
Control registers are data sent from the master for determining the conditions.
The data format is set as shown in the following figure.

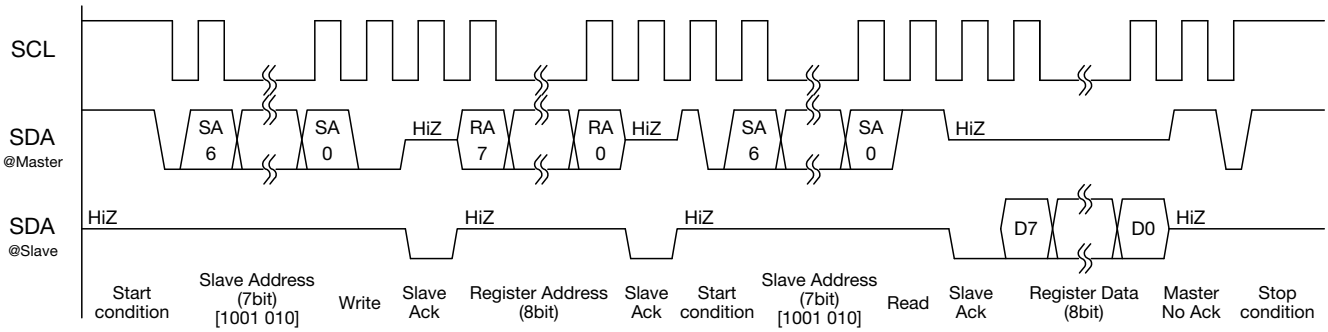




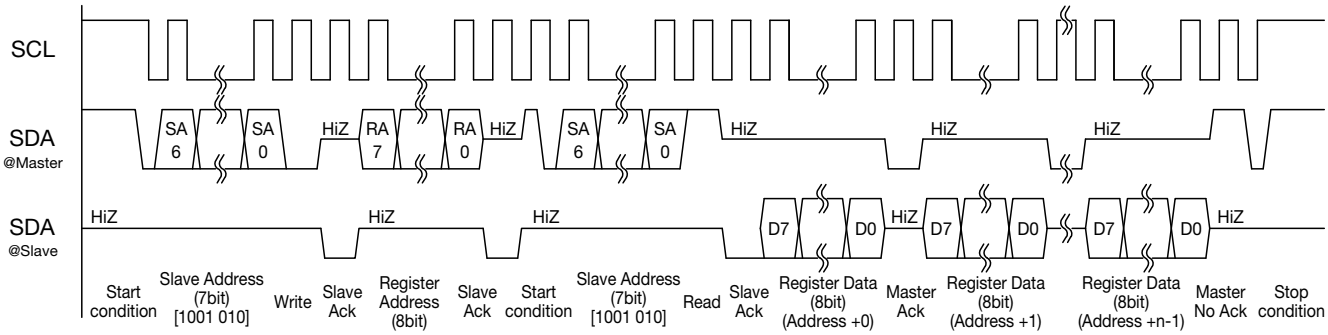
Out of the Address byte, first 7 bit are assigned to the slave address, while the residual 1 bit is assigned to the R/W bit. Set the R/W bit to 0 when data are used control registers.
The address of this IC is 94H. Please refer to "Register map" for the control contents of control registers and switches.

[Status registers]
Status registers are data to inform the master of the IC status.
The data format is set as shown in the following figure.

1byte Data Read



n bytes Data Read



Out of the Address byte, first 7 bit are assigned to the slave address, while the residual 1 bit is assigned to the R/W bit. Set the R/W bit to 1 when data are used status registers. The address of MM3439 is 95H.
Please refer to "Register map" for the control contents of control registers and switches.

[About the control terminal]
CHG_EN(11pin), USB_EN1(4pin), USB_EN2(7pin) and RESET(18pin) are terminals that input H signal (DVIN) or L signal (GND) to decide the state of MM3439. As for the content controlled with these control terminals, the thing controlled by using I^2C BUS is possible.
Please refer to "Control table" for the relation between the control terminal and I^2C BUS.

[Register map]

		b07	b06	b05	b04	b03	b02	b01	b00	Remarks
Slave Address		1	0	0	1	0	1	0	R/W	R=1 W=0
Register Address	00h		Charging status				Charge error			Read only
	01h		Mode distinction				Temperature of battery			
	02h	State of each terminal connection						State of power pass SW		
	03h		Full charge detection		ADP/USB charge existence		Each mode transition prohibition			
	04h	CHG_EN	USB_EN			Control of chip temp.	Internal timer setting			Read/Write
	05h	ADP/USB Priority	2~12°C CV setting	2~12°C CC setting (ADP charge)						
	06h	RESET	12~43°C CV setting	12~43°C CC setting (ADP charge)						
	07h	Re-charge	43~48°C CV setting	43~48°C CC setting (ADP charge)						
	08h	Supply voltage control	48~58°C CV setting	48~58°C CC setting (ADP charge)						
	09h	LED display when charging		2~12°C CC setting (USB charge)						
	0Ah	LED display when temp. stands by		12~43°C CC setting (USB charge)						
	0Bh	LED display when battery abnormal		43~48°C CC setting (USB charge)						
	0Ch	LED display when full charged		48~58°C CC setting (USB charge)						
	F0h	Test mode								Use prohibition usually
	F1h	Test mode								
	F2h	Test mode								

Control table

Register Address : 00H

b06	b05	b04	Charging status
0	0	0	Charge OFF
0	0	1	Battery connection judging
0	1	0	Pre-charge
0	1	1	Fast charge
1	0	0	Full charge
1	0	1	Re-charge

Register Address : 00H

b02	b01	b00	Charge error
0	0	0	No error
0	0	1	Pre-charge time-out
0	1	0	Fast charge time-out
0	1	1	Overvoltage of battery
1	0	0	Battery overdischarge
1	0	1	Battery overcurrent
1	1	0	The battery temp. is abnormal
1	1	1	Thermal shutdown

Register Address : 01H

b06	b05	b04	Mode distinction
0	0	0	Standby
0	0	1	ADP mode
0	1	0	USB mode
0	1	1	BAT mode
1	0	0	ADP charge mode
1	0	1	USB charge mode
1	1	0	USB-BAT common mode

Register Address : 01H

b02	b01	b00	Temperature of battery
0	0	0	~ –30°C
0	0	1	–30~2°C
0	1	0	2~12°C
0	1	1	12~43°C
1	0	0	43~48°C
1	0	1	48~58°C
1	1	0	58~80°C
1	1	1	80°C ~

Register Address : 02H – State of each terminal connection

b07	ADP connection
0	None
1	Connects

b06	USB connection
0	None
1	Connects

b05	Battery B+
0	None
1	Connects

b04	Battery TH
0	None
1	Connects

Register Address : 02H – State of power SW

b01	ADP voltage
0	No error
1	Overvoltage

b00	USB voltage
0	No error
1	Overvoltage

Register Address : 03H – Full charge detection setting

b06	b05	Setting of full charge detect
0	0	1time FULLSET
0	1	* **Two time FULLSET**
1	0	Four time FULLSET
1	1	Prepositive holding

Register Address : 03H – ADP/USB charge existence

b04	ADP charge Presence
0	ADP non-charge
1	ADP charge

b03	USB charge Presence
0	USB non-charge
1	USB charge

* Bold-faced type under line of read/write resistor is default.

Register Address : 03H – Each mode transition prohibition

b02	Battery use mode
0	Transition permission
1	Transition prohibition

b01	ADP use mode
0	Transition permission
1	Transition prohibition

b00	USB use mode
0	Transition permission
1	Transition prohibition

Register Address : 04H

b07	CHG_EN
0	* **Charge prohibition**
1	Charge permission

Register Address : 04H

b06	b05	b04	USB_EN
0	0	0	* **USB use prohibition**
0	0	1	100mA limitation
0	1	0	500mA limitation
0	1	1	900mA limitation
1	0	0	Unrestricted (overcurrent protection)
1	0	1	Prepositive holding
1	1	0	Prepositive holding
1	1	1	Prepositive holding

* Bold-faced type under line of read/write resistor is default.

Register Address : 04H

b03	b02	Chip temperature limiting
0	0	No control
0	1	85°C
1	0	* **135°C**
1	1	Prepositive holding

Register Address : 04H

b01	b00	Setting of internal timer
0	0	0.25 times
0	1	0.5 times
1	0	* **one times**
1	1	Timer reset

Register Address : 05H – 2 ~ 12°C CV Setting
Register Address : 06H – 12 ~ 43°C CV Setting
Register Address : 07H – 43 ~ 48°C CV Setting
Register Address : 08H – 48 ~ 58°C CV Setting

b06	b05	CV Setting
0	0	4.20V
0	1	4.10V
1	0	4.05V
1	1	Prepositive holding

Register Address : 05H

b07	ADP/USB priority
0	USB priority
1	* **ADP priority**

* Refer to the profile of temperature of battery for the default value of CV setting.

Register Address : 06H

b07	RESET
0	* **Release RESET**
1	RESET

Register Address : 07H

b07	Re-charge
0	Re-charge permission
1	* **Re-charge prohibition**

Register Address : 08H

b07	Supply voltage control
0	No control
1	* **Supply voltage control**

* Bold-faced type under line of read/write resistor is default.

Register Address : 05H – 2 ~ 12°C CC setting (ADP charge)
Register Address : 06H – 12 ~ 43°C CC setting (ADP charge)
Register Address : 07H – 43 ~ 48°C CC setting (ADP charge)
Register Address : 08H – 48 ~ 58°C CC setting (ADP charge)

Register Address : 09H – 2 ~ 12°C CC setting (USB charge)
Register Address : 0AH – 12 ~ 43°C CC setting (USB charge)
Register Address : 0BH – 43 ~ 48°C CC setting (USB charge)
Register Address : 0CH – 48 ~ 58°C CC setting (USB charge)

b04	b03	b02	b01	b00	CC setting
0	0	0	0	0	0mA (Charge OFF)
0	0	0	0	1	100mA
0	0	0	1	0	200mA
0	0	0	1	1	300mA
0	0	1	0	0	400mA
0	0	1	0	1	500mA
0	0	1	1	0	600mA
0	0	1	1	1	700mA
0	1	0	0	0	800mA
0	1	0	0	1	900mA
0	1	0	1	0	1000mA
0	1	0	1	1	1100mA
0	1	1	0	0	1200mA
0	1	1	0	1	1300mA
0	1	1	1	0	1400mA
0	1	1	1	1	1500mA
1	0	0	0	0	1600mA
1	0	0	0	1	1700mA
1	0	0	1	0	1800mA
1	0	0	1	1	1900mA
1	0	1	0	0	2000mA
1	0	1	0	1	0.5times setting of 12~43°C
1	0	1	1	0	0.3times setting of 12~43°C
1	0	1	1	1	0.1times setting of 12~43°C
1	1	0	0	0	Prepositive holding
1	1	0	0	1	Prepositive holding
1	1	0	1	0	Prepositive holding
1	1	0	1	1	Prepositive holding
1	1	1	0	0	Prepositive holding
1	1	1	0	1	Prepositive holding
1	1	1	1	0	Prepositive holding
1	1	1	1	1	Prepositive holding

* Register Address 06H/0AH is prepositive holding.

* Refer to the profile of temperature of battery for the default value of CC setting.
* The value of the current of the above table is a value at the sense resistance 0.2Ω.

Register Address : 09H

b07	b06	b05	LED display when charging
0	0	0	Turning off
0	0	1	Blinking (0.25Hz)
0	1	0	∗ **Blinking (0.5Hz)**
0	1	1	Blinking (1Hz)
1	0	0	Blinking (2Hz)
1	0	1	Blinking (4Hz)
1	1	0	Blinking (8Hz)
1	1	1	Lighting

Register Address : 0AH

b07	b06	b05	LED display temperature standby
0	0	0	Turning off
0	0	1	∗ **Blinking (0.25Hz)**
0	1	0	Blinking (0.5Hz)
0	1	1	Blinking (1Hz)
1	0	0	Blinking (2Hz)
1	0	1	Blinking (4Hz)
1	1	0	Blinking (8Hz)
1	1	1	Lighting

Register Address : 0BH

b07	b06	b05	LED display when abnormal battery
0	0	0	Turning off
0	0	1	Blinking (0.25Hz)
0	1	0	Blinking (0.5Hz)
0	1	1	Blinking (1Hz)
1	0	0	∗ **Blinking (2Hz)**
1	0	1	Blinking (4Hz)
1	1	0	Blinking (8Hz)
1	1	1	Lighting

Register Address : 0CH

b07	b06	b05	LED display when full charge
0	0	0	∗ **Turning off**
0	0	1	Blinking (0.25Hz)
0	1	0	Blinking (0.5Hz)
0	1	1	Blinking (1Hz)
1	0	0	Blinking (2Hz)
1	0	1	Blinking (4Hz)
1	1	0	Blinking (8Hz)
1	1	1	Lighting

∗ Bold-faced type under line of read/write resistor is default.

Control table of control terminal and I²C control using together

Control terminal	I²C Control	Charge permission control
CHG_EN (11pin)	CHG_EN (04h_b07)	
L	0	Charge prohibition
H	*	Charge permission
*	1	Charge permission

(* : Don't care)

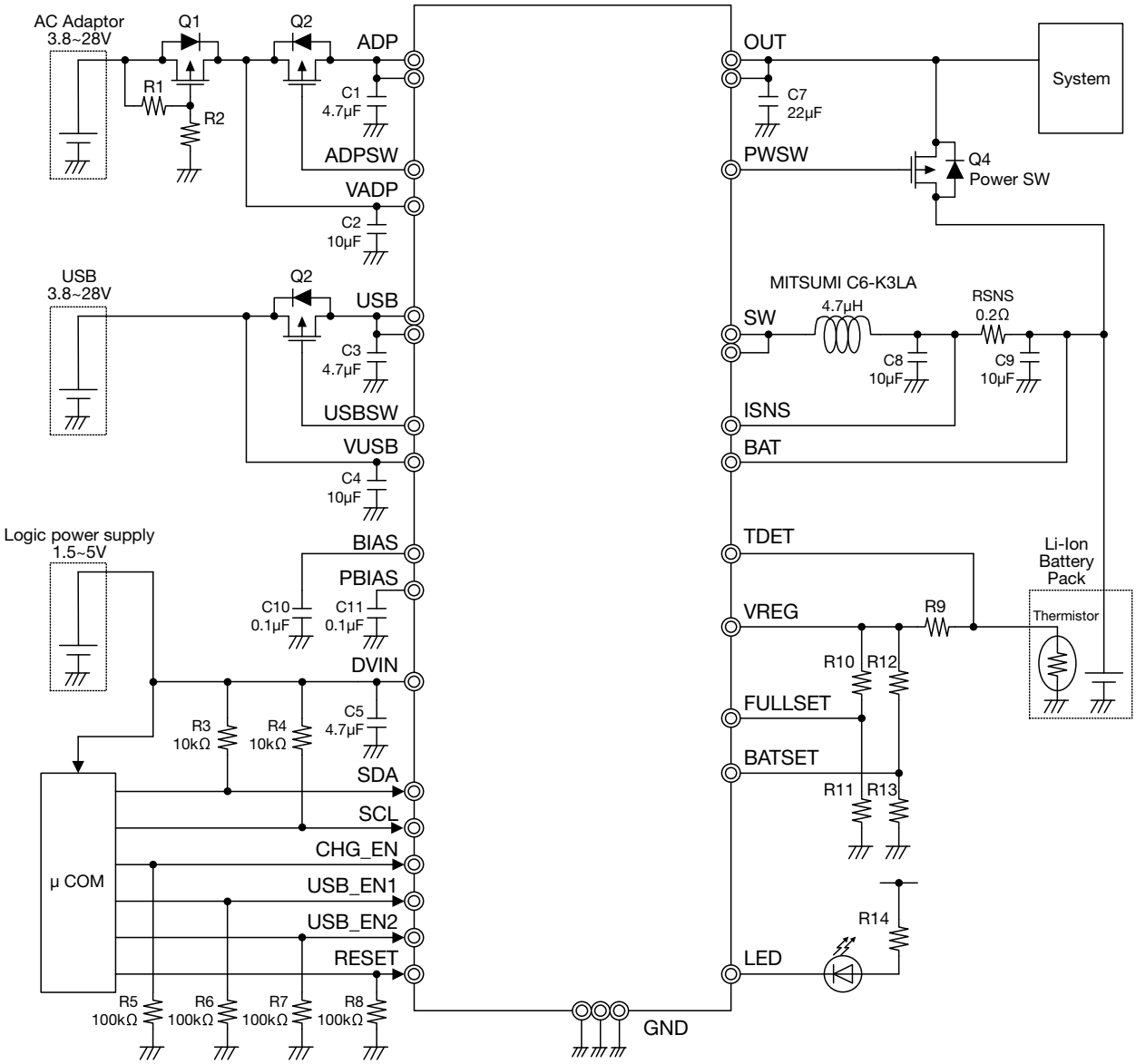
Control terminal		I²C Control USB_EN (04h_b06~b04)
USB_EN1 (4pin)	USB_EN2 (7pin)	
L	L	USB use prohibition. I²C Control is invalid.
H	L	USB current limitation value is 100mA. I²C Control is invalid.
L	H	USB current limitation value is 500mA. I²C Control is invalid.
H	H	I²C Control is effective. USB current limitation automatic operation change is effective.

Control terminal	I²C Control	Reset control
RESET (18pin)	RESET (06h_b07)	
L	0	Reset release
H	*	Reset
*	1	Reset

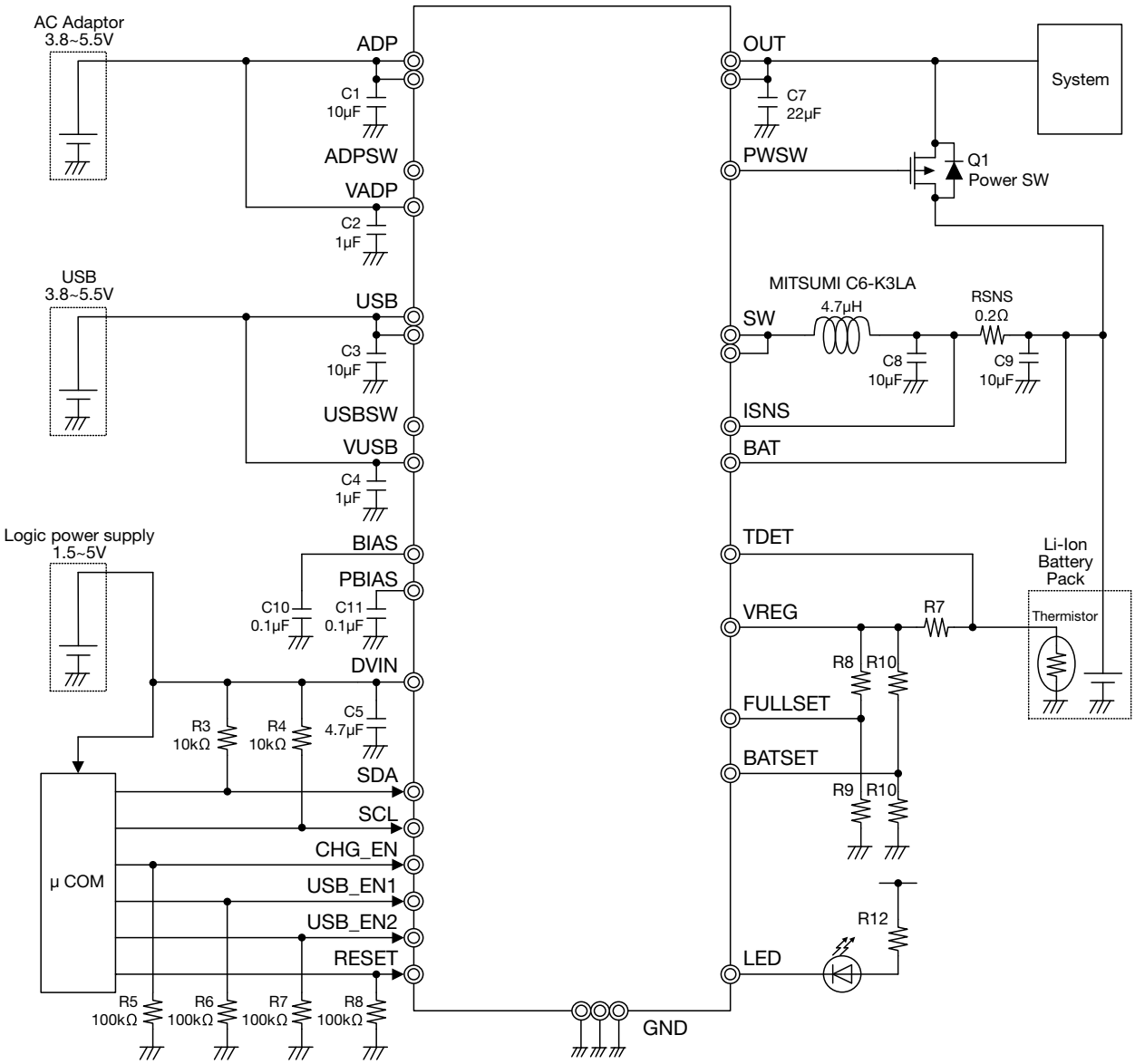
(* : Don't care)

Application Circuit

(1) When use input OVP and the reverse-connected prevention circuit.



(2) Input OVP and the prevention circuit of reverse-connection for unused.



· These circuits are typical examples provided for reference purposes, so in actual applications, the circuit constants, conditions and operations should be thoroughly studied.

· Mitsumi Electric Co., Ltd. assumes no responsibility for any trouble or damage as a result of the use of these circuits.

· Mitsumi Electric Co., Ltd. assumes no responsibility for any infringement of industrial property or any other right of a third party or us, as a result of the use of these circuits.