RICOH R5480x Series

1-Cell Li-Ion Battery Protection IC

NO.EA-308-170516

OUTLINE

The R5480x is a protection IC for over-charge of rechargeable Lithium-ion (Li+)/Lithium polymer battery. The R5480x can detect over-charge, over-discharge, excess-discharge current, and excess-charge current of one-cell Lithium-ion (Li+)/Lithium polymer battery. The external resistor of RSENSE pin allows a high-accuracy detection for excess current. The supply current after detecting over-discharge is suppressed as much as possible by stopping the internal circuit.

FEATURES

- High Voltage Tolerant Process
  Absolute Maximum Ratings ..... 30 V
- Low supply current
  Supply current (At normal mode) ..... Typ. 4.0 μA
  Standby current ..... Max. 0.1 μA
- High accuracy detector threshold
  Over-charge detector ..... ±20 mV
  Over-discharge detector ..... ±35 mV
  Excess discharge-current detector ..... ±15%
  Excess charge-current detector ..... ±15%
- Variety of detector threshold
  Over-charge detector threshold ..... 4.1 V to 4.5 V step of 0.005 V
  Over-discharge detector threshold ..... 2.1 V to 3.0 V step of 0.005 V
  Excess discharge-current threshold ..... 0.030 V to 0.048 V step of 0.001 V
  Excess charge-current threshold ..... −0.030V to −0.020 V step of 0.001 V
- Internal fixed Output delay time
  Over-charge detector Output Delay ..... 1.0 s
  Over-discharge detector Output Delay ..... 20 ms/132 ms
  Excess discharge-current detector Output Delay ..... 12 ms
  Excess charge-current detector Output Delay ..... 16 ms/8 ms
  Short Circuit detector Output Delay ..... 250 μs
- Output Delay Time Shortening Function
  At C_{OUT} is “H”, if V- level is set at −2.0 V, the Output Delay time of detect the over-charge and over-discharge can be reduced (Delay Time for over-charge becomes about 1/100 of normal state).
- Conditions for release over-charge detector ..... Latch type
- Conditions for release over-discharge detector ..... Latch type
- 0 V-battery charge option ..... Unacceptable
- Small package ..... DFN(PLP)1414-6, DFN1814-6C

NO.EA-308-170516

APPLICATIONS

- Li+/Li Polymer protector of over-charge, over-discharge, excess-current for battery pack
- High precision protectors for smart-phones and any other gadgets using on board Li+/Li Polymer battery

SELECTION GUIDE

The over-charge and the delay time are user-selectable options.

Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R5480Kxxx$∗-TR	DFN(PLP)1414-6	5,000 pcs	Yes	Yes
R5480Lxxx$∗-TR	DFN1814-6C	5,000 pcs	Yes	Yes

xxx: Set voltage version

$: Delay time version

Version	t_{VDET1} (s)	t_{VDET2} (ms)	t_{VDET3} (ms)	t_{VDET4} (ms)	t_{SHORT} (µs)
C	1	20	12	16	250
U	1	132	12	8	250

∗: Function version

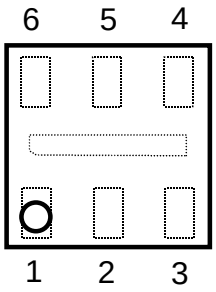
Version	Return from Over-charge	Return from Over-discharge	0-V Charge	V_{SHORT}
G	Latch	Latch	NG	0.500 V
L	Latch	Latch	NG	0.180 V
M	Latch	Latch	NG	0.140 V

Product Code List

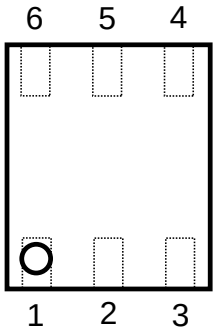
Product Code Table

Code	V_{DET1} (V)	V_{REL1} (V)	V_{DET2} (V)	V_{REL2} (V)	V_{DET3} (V)	V_{DET4} (V)	V_{SHORT} (V)	t_{VDET1} (s)	t_{VDET2} (ms)	t_{VDET3} (ms)	t_{VDET4} (ms)	t_{SHORT} (µs)	0-V Charge
R5480x228CG	4.405	-	2.400	-	0.032	-0.020	0.500	1	20	12	16	250	NG
R5480x240CG	4.280	-	2.800	-	0.032	-0.020	0.500	1	20	12	16	250	NG
R5480x241CG	4.405	-	2.400	-	0.042	-0.020	0.500	1	20	12	16	250	NG
R5480x247CG	4.425	-	2.400	-	0.032	-0.020	0.500	1	20	12	16	250	NG
R5480x257CL	4.425	-	2.400	-	0.034	-0.022	0.180	1	20	12	16	250	NG
R5480x260CL	4.280	-	2.400	-	0.032	-0.030	0.180	1	20	12	16	250	NG
R5480x261CL	4.280	-	2.700	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x262CL	4.405	-	2.400	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x266CL	4.475	-	2.800	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x267CL	4.475	-	2.400	-	0.034	-0.022	0.180	1	20	12	16	250	NG
R5480x228CL	4.405	-	2.400	-	0.032	-0.022	0.180	1	20	12	16	250	NG
R5480x275CL	4.230	-	2.800	-	0.048	-0.030	0.180	1	20	12	16	250	NG
R5480x277CL	4.425	-	2.800	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x278CL	4.425	-	2.800	-	0.034	-0.022	0.180	1	20	12	16	250	NG
R5480x283CL	4.280	-	2.800	-	0.030	-0.020	0.180	1	20	12	16	250	NG
R5480x284CL	4.425	-	2.400	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x285CL	4.280	-	2.400	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x286CL	4.405	-	2.800	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x287CL	4.280	-	2.600	-	0.048	-0.030	0.180	1	20	12	16	250	NG
R5480x324CL	4.425	-	2.500	-	0.030	-0.030	0.180	1	20	12	16	250	NG
R5480x326CL	4.280	-	2.800	-	0.048	-0.030	0.180	1	20	12	16	250	NG
R5480x348CL	4.475	-	2.600	-	0.040	-0.030	0.180	1	20	12	16	250	NG
R5480x342UM	4.425	-	2.800	-	0.030	-0.023	0.140	1	132	12	8	250	NG
R5480x349CL	4.475	-	2.600	-	0.048	-0.030	0.180	1	20	12	16	250	NG

PIN DESCRIPTION



DFN(PLP)1414-6 Pin Configuration



DFN1814-6C Pin Configuration

DFN(PLP)1414-6 Pin Description

Pin No.	Symbol	Description
1	VSS	VSS pin. Ground pin for the IC
2	VDD	Power supply pin, the substrate voltage level of the IC
3	RSENSE	Input of overcurrent detection
4	V−	Pin for charger negative input
5	COUT	Output of over-charge detection, CMOS output
6	DOUT	Output of over-discharge detection, CMOS output

DFN1814-6C Pin Description

Pin No.	Symbol	Description
1	V−	Pin for charger negative input
2	COUT	Output of over-charge detection, CMOS output
3	DOUT	Output of over-discharge detection, CMOS output
4	VSS	VSS pin. Ground pin for the IC
5	VDD	Power supply pin, the substrate voltage level of the IC
6	RSENSE	Input of overcurrent detection

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings (Ta = 25°C, V_{SS} = 0 V)

Symbol	Item	Rating	Unit
V_{DD}	Supply Voltage	30	V
V−	V− Pin Voltage	V_{DD} - 30 to V_{DD} + 0.3	V
R_{SENSE}	RSENSE Pin Voltage	V_{SS} - 0.3 to V_{DD} + 0.3	V
V_{COUT}	COUT Pin Voltage	V_{DD} - 30 to V_{DD} + 0.3	V
V_{DOUT}	DOUT Pin Voltage	V_{SS} - 0.3 to V_{DD} + 0.3	V
P_D	Power Dissipation (Standard Land Pattern)	150	mW
Tj	Junction Temperature Range	−40 to 125	°C
Tstg	Storage Temperature Range	−55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{DD}	Operating Input Voltage	−0.3 to 12	V
Ta	Operating Temperature Range	−40 to 85	°C

RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

R5480x Electrical Characteristics (Unless otherwise specified, Ta = 25°C)

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DD1}	Operating Input Voltage	V_{DD} - V_{SS}	1.5		5.0	V
V_{NOCHG}	Maximum Operating Voltage for Inhibition of Charger	Voltage Defined as V_{DD} - V_{SS}, V_{DD} - V− = 4 V	0.4	0.7	1.0	V
V_{DET1}	Over-charge Threshold Voltage	R1 = 330 Ω	V_{DET1} −0.020	V_{DET1}	V_{DET1} +0.020	V
t_{VDET1}	Output Delay of Over-charge	V_{DD} = 3.6 V→4.5 V	0.7	1.0	1.3	s
t_{VREL1}	Release Delay for VD1	V_{DD} = 4 V, V− = 0 V→1 V	11	16	21	ms
V_{DET2}	Over-discharge Threshold	Detect falling edge of supply voltage	V_{DET2} −0.035	V_{DET2}	V_{DET2} +0.035	V
t_{VDET2}	Output Delay of Over-discharge	V_{DD} = 3.6 V→2.0 V	14	20	26	ms
t_{VREL2}	Release Delay for VD2	V_{DD} = 3 V, V− = 3 V→0 V	0.7	1.2	1.7	ms
V_{DET3}	Excess discharge-current threshold	Detect rising edge of 'RSENSE' pin voltage, V− = V_{RSENSE}	V_{DET3} x0.85	V_{DET3}	V_{DET3} x1.15	V
t_{VDET3}	Output delay of excess discharge-current	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to 0.4 V, V− = V_{RSENSE}	8	12	16	ms
t_{VREL3}	Output delay of release from excess discharge-current	V_{DD} = 3.0 V, V- = 3 V to 0 V V− = V_{RSENSE}	0.7	1.2	1.7	ms
V_{SHORT}	Short protection voltage (R5480xxxxCG)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.41	0.50	0.59	V
	Short protection voltage (R5480xxxxCL)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.135	0.18	0.225	V
	Short protection voltage (R5480xxxxUM)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.095	0.14	0.185	V
t_{SHORT}	Output Delay of Short protection	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to 3 V, V− = V_{RSENSE}	180	250	425	µs
R_{SHORT}	Reset resistance for excess discharge-current protection	V_{DD} = 3.6 V, V− = 1.0 V	20	45	70	kΩ
V_{DET4}	Excess charge-current threshold	Detect falling edge of 'R_{SENSE}' pin voltage, V− = V_{RSENSE}	V_{DET4} x1.15	V_{DET4}	V_{DET4} x0.85	V
t_{VDET4}	Output delay of excess charge-current	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to −0.3 V, V− = V_{RSENSE}	11	16	21	ms
t_{VREL4}	Output delay of release from excess charge-current	V_{DD} = 3.0 V, V− = −1 V to 0 V V− = V_{RSENSE}	0.7	1.2	1.7	ms
V_{DS}	Delay Time Shortening Mode Voltage	V_{DD} = 3.6 V	−2.6	−2.0	−1.4	V
V_{OL1}	Nch ON-Voltage of C_{OUT}	I_{OL} = 50 µA, V_{DD} = 4.5 V		0.4	0.5	V
V_{OH1}	Pch ON-Voltage of C_{OUT}	I_{OH} = −50 µA, V_{DD} = 3.9 V	3.4	3.7		V
V_{OL2}	Nch ON-Voltage of D_{OUT}	I_{OL} = 50 µA, V_{DD} = 2.0 V		0.2	0.5	V
V_{OH2}	Pch ON-Voltage of D_{OUT}	I_{OH} = −50 µA, V_{DD} = 3.9 V	3.4	3.7		V
I_{DD}	Supply Current	V_{DD} = 3.9 V, V− =0 V		4.0	8.0	µA
$I_{STANDBY}$	Standby Current	V_{DD} = 2.0 V			0.1	µA

Considering of variation in process parameters, we compensate for this characteristic related to temperature by laser-trim, however, this specification is guaranteed by design, not mass production tested.

ELECTRICAL CHARACTERISTICS (continued)

R5480x Electrical Characteristics (Ta = −20°C to 60°C)

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DD1}	Operating Input Voltage	V_{DD} - V_{SS}	1.5		5.0	V
V_{NOCHG}	Maximum Operating Voltage for Inhibition of Charger	Voltage Defined as V_{DD} - V_{SS}, V_{DD} - V− = 4 V	0.27	0.7	1.1	V
V_{DET1}	Over-charge Threshold Voltage	R1 = 330 Ω	V_{DET1} −0.025	V_{DET1}	V_{DET1} +0.025	V
t_{VDET1}	Output Delay of Over-charge	V_{DD} = 3.6 V→4.5 V	0.67	1.0	1.55	s
t_{VREL1}	Release Delay for VD1	V_{DD} = 4 V, V− = 0 V→1 V	10.7	16	24.8	ms
V_{DET2}	Over-discharge Threshold	Detect falling edge of supply voltage	V_{DET2} −0.040	V_{DET2}	V_{DET2} +0.040	V
t_{VDET2}	Output Delay of Over-discharge	V_{DD} = 3.6 V→2.0 V	13.4	20	31	ms
t_{VREL2}	Release Delay for VD2	V_{DD} = 3 V, V− = 3 V→0 V	0.65	1.2	1.86	ms
V_{DET3}	Excess discharge-current threshold	Detect rising edge of 'R_{SENSE}' pin voltage, V− = V_{RSENSE}	V_{DET3} x0.83	V_{DET3}	V_{DET3} x1.17	V
t_{VDET3}	Output delay of excess discharge-current	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to 0.4 V, V− = V_{RSENSE}	7.5	12	18.6	ms
t_{VREL3}	Output delay of release from excess discharge-current	V_{DD} = 3.0 V, V- = 3 V to 0 V V− = V_{RSENSE}	0.65	1.2	1.86	ms
V_{SHORT}	Short protection voltage (R5480xxxxCG)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.40	0.50	0.60	V
	Short protection voltage (R5480xxxxCL)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.130	0.18	0.230	V
	Short protection voltage (R5480xxxxUM)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.085	0.14	0.195	V
t_{SHORT}	Output Delay of Short protection	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to 3 V, V− = V_{RSENSE}	160	250	490	µs
R_{SHORT}	Reset resistance for excess discharge-current protection	V_{DD} = 3.6 V, V− = 1.0 V	17.3	45	73.3	kΩ
V_{DET4}	Excess charge-current threshold	Detect falling edge of 'R_{SENSE}' pin voltage, V− = V_{RSENSE}	V_{DET4} x1.17	V_{DET4}	V_{DET4} x0.83	V
t_{VDET4}	Output delay of excess charge-current	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to −0.3 V, V− = V_{RSENSE}	10.7	16	24.8	ms
t_{VREL4}	Output delay of release from excess charge-current	V_{DD} = 3.0 V, V− = −1 V to 0 V V− = V_{RSENSE}	0.65	1.2	1.86	ms
V_{DS}	Delay Time Shortening Mode Voltage	V_{DD} = 3.6 V	−2.7	−2.0	−1.2	V
V_{OL1}	Nch ON-Voltage of C_{OUT}	I_{OL} = 50 µA, V_{DD} = 4.5 V		0.4	0.5	V
V_{OH1}	Pch ON-Voltage of C_{OUT}	I_{OH} = −50 µA, V_{DD} = 3.9 V	3.4	3.7		V
V_{OL2}	Nch ON-Voltage of D_{OUT}	I_{OL} = 50 µA, V_{DD} = 2.0 V		0.2	0.5	V
V_{OH2}	Pch ON-Voltage of D_{OUT}	I_{OH} = −50 µA, V_{DD} = 3.9 V	3.4	3.7		V
I_{DD}	Supply Current	V_{DD} = 3.9 V, V− =0 V		4.0	8.7	µA
$I_{STANDBY}$	Standby Current	V_{DD} = 2.0 V			0.12	µA

All of these specifications are guaranteed by design, not tested in mass production.

ELECTRICAL CHARACTERISTICS (continued)

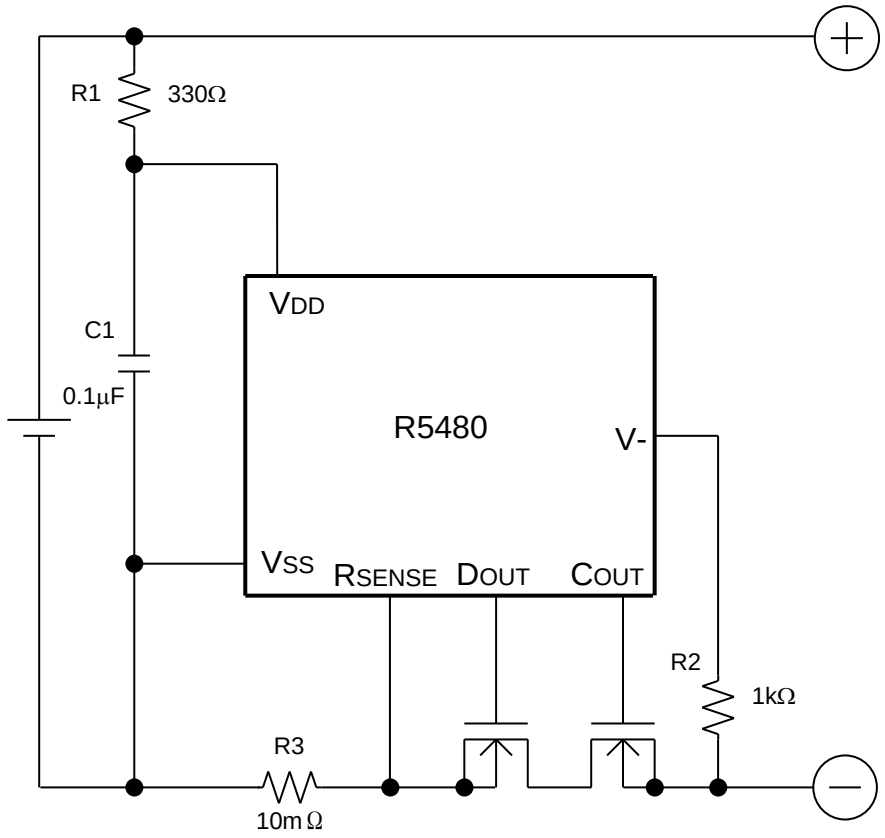
R5480x Electrical Characteristics (Ta = −40°C to 85°C)

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DD1}	Operating Input Voltage	V_{DD} - V_{SS}	1.5		5.0	V
V_{NOCHG}	Maximum Operating Voltage for Inhibition of Charger	Voltage Defined as V_{DD} - V_{SS}, V_{DD} - V− = 4 V	0.27	0.7	1.15	V
V_{DET1}	Over-charge Threshold Voltage	R1 = 330 Ω	V_{DET1} −0.036	V_{DET1}	V_{DET1} +0.035	V
t_{VDET1}	Output Delay of Over-charge	V_{DD} = 3.6 V→4.5 V	0.67	1.0	1.57	s
t_{VREL1}	Release Delay for VD1	V_{DD} = 4 V, V− = 0 V→1 V	10.51	16	26.51	ms
V_{DET2}	Over-discharge Threshold	Detect falling edge of supply voltage	V_{DET2} −0.043	V_{DET2}	V_{DET2} +0.040	V
t_{VDET2}	Output Delay of Over-discharge	V_{DD} = 3.6 V→2.0 V	13.28	20	33.29	ms
t_{VREL2}	Release Delay for VD2	V_{DD} = 3 V, V− = 3 V→0 V	0.65	1.2	2.056	ms
V_{DET3}	Excess discharge-current threshold	Detect rising edge of 'R_{SENSE}' pin voltage, V− = V_{RSENSE}	V_{DET3} x0.8	V_{DET3}	V_{DET3} x1.2	V
t_{VDET3}	Output delay of excess discharge-current	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to 0.4 V, V− = V_{RSENSE}	7.5	12	20.15	ms
t_{VREL3}	Output delay of release from excess discharge-current	V_{DD} = 3.0 V, V- = 3 V to 0 V V− = V_{RSENSE}	0.65	1.2	2.067	ms
V_{SHORT}	Short protection voltage (R5480xxxxCG)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.40	0.50	0.60	V
	Short protection voltage (R5480xxxxCL)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.130	0.18	0.230	V
	Short protection voltage (R5480xxxxUM)	V_{DD} = 3.0 V, V_{RSENSE} = V−	0.085	0.14	0.195	V
t_{SHORT}	Output Delay of Short protection	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to 3 V, V− = V_{RSENSE}	160	250	506.7	µs
R_{SHORT}	Reset resistance for excess discharge-current protection	V_{DD} = 3.6 V, V− = 1.0 V	17.3	45	77.6	kΩ
V_{DET4}	Excess charge-current threshold	Detect falling edge of 'R_{SENSE}' pin voltage, V− = V_{RSENSE}	V_{DET4} x1.17	V_{DET4}	V_{DET4} x0.83	V
t_{VDET4}	Output delay of excess charge-current	V_{DD} = 3.0 V, V_{RSENSE} = 0 V to −0.3 V, V− = V_{RSENSE}	10.38	16	26.57	ms
t_{VREL4}	Output delay of release from excess charge-current	V_{DD} = 3.0 V, V− = −1 V to 0 V V− = V_{RSENSE}	0.65	1.2	2.068	ms
V_{DS}	Delay Time Shortening Mode Voltage	V_{DD} = 3.6 V	−2.7	−2.0	−1.2	V
V_{OL1}	Nch ON-Voltage of C_{OUT}	I_{OL} = 50 µA, V_{DD} = 4.5 V		0.4	0.552	V
V_{OH1}	Pch ON-Voltage of C_{OUT}	I_{OH} = −50 µA, V_{DD} = 3.9 V	3.318	3.7		V
V_{OL2}	Nch ON-Voltage of D_{OUT}	I_{OL} = 50 µA, V_{DD} = 2.0 V		0.2	0.515	V
V_{OH2}	Pch ON-Voltage of D_{OUT}	I_{OH} = −50 µA, V_{DD} = 3.9 V	3.389	3.7		V
I_{DD}	Supply Current	V_{DD} = 3.9 V, V− =0 V		4.0	9.25	µA
$I_{STANDBY}$	Standby Current	V_{DD} = 2.0 V			0.12	µA

All of these specifications are guaranteed by design, not tested in mass production.

APPLICATION INFORMATION

Typical Application Circuit



R1 and C1 stabilize a supply voltage to the R5480. A recommended R1 value is equal or less than 1kΩ. A large value of R1 makes detection voltage shift higher because of the conduction current flowed in the R5480x. Further, to stabilize the operation of R5480x, use the C1 with the value of 0.01μF or more.

R1 and R2 can operate also as parts for current limit circuit against reverse charge or applying a charger with excess charging voltage to the R5480x, battery pack. While small value of R1 and R2 may cause over power dissipation rating of the R5480x, therefore a total of "R1+R2" should be 1kΩ or more. Besides, if a large value of R2 is set, release from over-discharge by connecting a charger might not be possible. Recommended R2 value is equal or less than 10kΩ.

R3 is a resistor for sensing an excess current. If the resistance value is too large, power loss becomes also large. By the excess current, if the R3 is not appropriate, the power loss may be beyond the power dissipation of R3. Choose an appropriate R3 according to the cell specification.

The typical application circuit diagram is just an example. This circuit performance largely depends on the PCB layout and external components. In the actual application, fully evaluation is necessary.

Over-voltage and the over current beyond the absolute maximum rating should not be forced to the protection IC and external components. Although the short protection circuit is built in the IC, if the positive terminal and the negative terminal of the battery pack are short, during the delay time of short limit detector, large current flows through the FET. Select an appropriate FET with large enough current capacity to prevent the IC from burning damage.

We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to humans or damages to property resulting from such failure, users should be careful enough to incorporate safe measures in design, such as redundancy, fire-containment, and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
If the positive terminal and the negative terminal of the battery pack are short, even though the short protection circuit is built in the IC, during the delay time until detecting the short circuit, a large current may flow through the FET. Select an FET with large enough current capacity in order to endure the large current during the delay time.

Sense Resistance and On-resistance of the MOSFET Selection Guideline

Short mode is detected by the current base or the relation between VDD at short and total on-resistance of external MOSFETs for COUT and DOUT.

If short must be detected by the current base determined by V_{SHORT} and R3, the next formula must be true, otherwise, the short current limit becomes (VDD - 0.9)/(R3 + R_{SS} (on))

$$\frac{VDD - 0.9}{R3 + RSS\,(on)} \geq \frac{VSHORT}{R3}$$

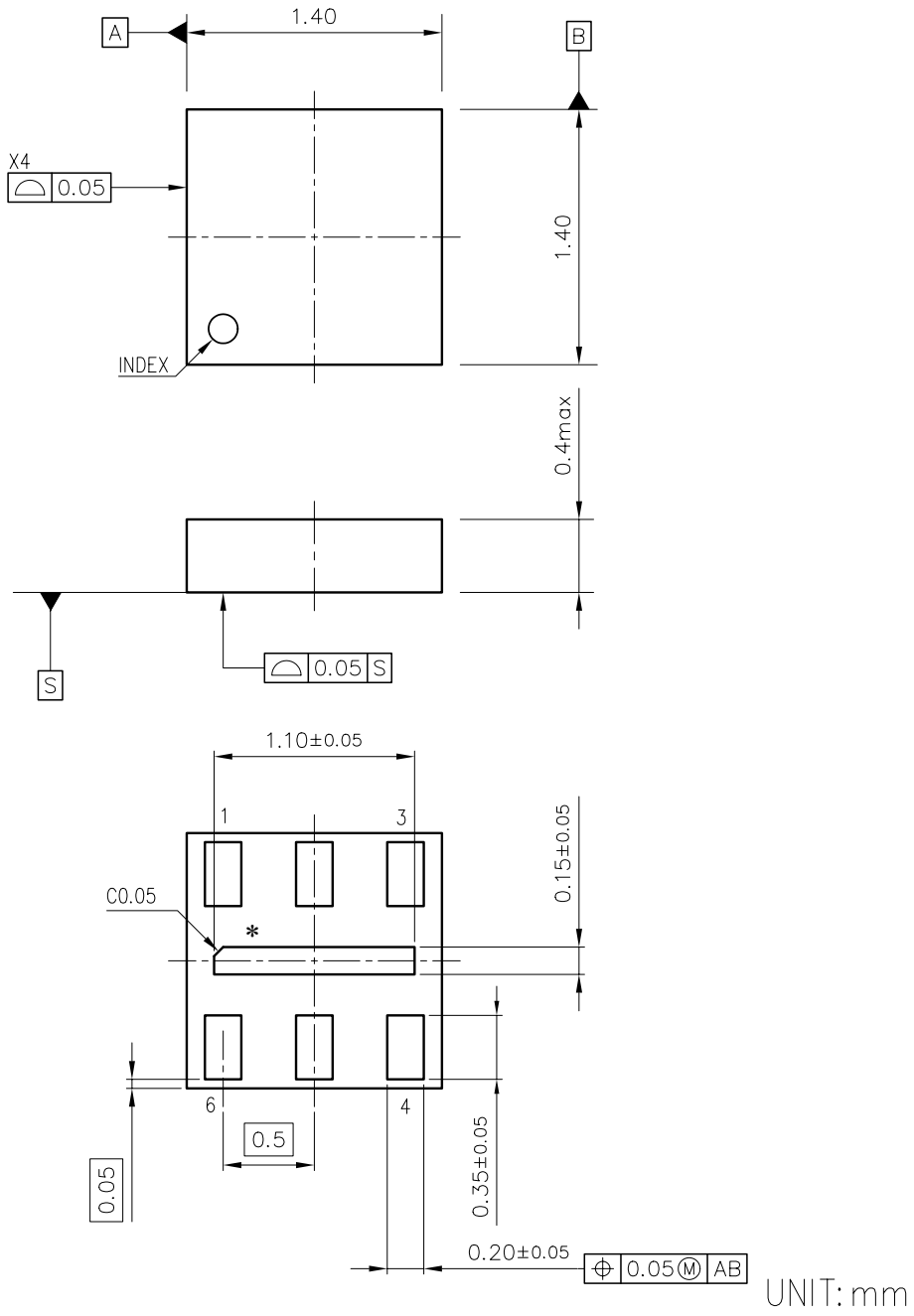
V_{SHORT} = 0.5 V (R5480xxxxCG), 0.18 V (R5480xxxxCL), 0.14 V (R5480xxxxUM)
R3 = External current sense resistance (Ω)
R_{SS} (on) = external MOSFETs' total on-resistance (Ω)
V_{DD} = V_{DD} level at short mode. If V_{DD} goes down by the short current, the lowest level is V_{DD}.

Ex. 1
As the R_{SENSE}, in case that the 10 mΩ is selected as R3 and if the V_{DD} becomes 3.0 V, to detect short at 50 A with V_{SHORT} = 0.5 V, the R_{SS} (on) must be 32 mΩ or lower.

Ex. 2
As the R_{SENSE}, in case the 20 mΩ is selected as R3 and if the V_{DD} becomes 3.0 V, to detect short at 25 A with V_{SHORT} = 0.5 V, the R_{SS} (on) must be 64 mΩ or lower.

If the R_{SS} (on) value is higher than the value calculated by this formula, the short current limit will be less than the desired value.

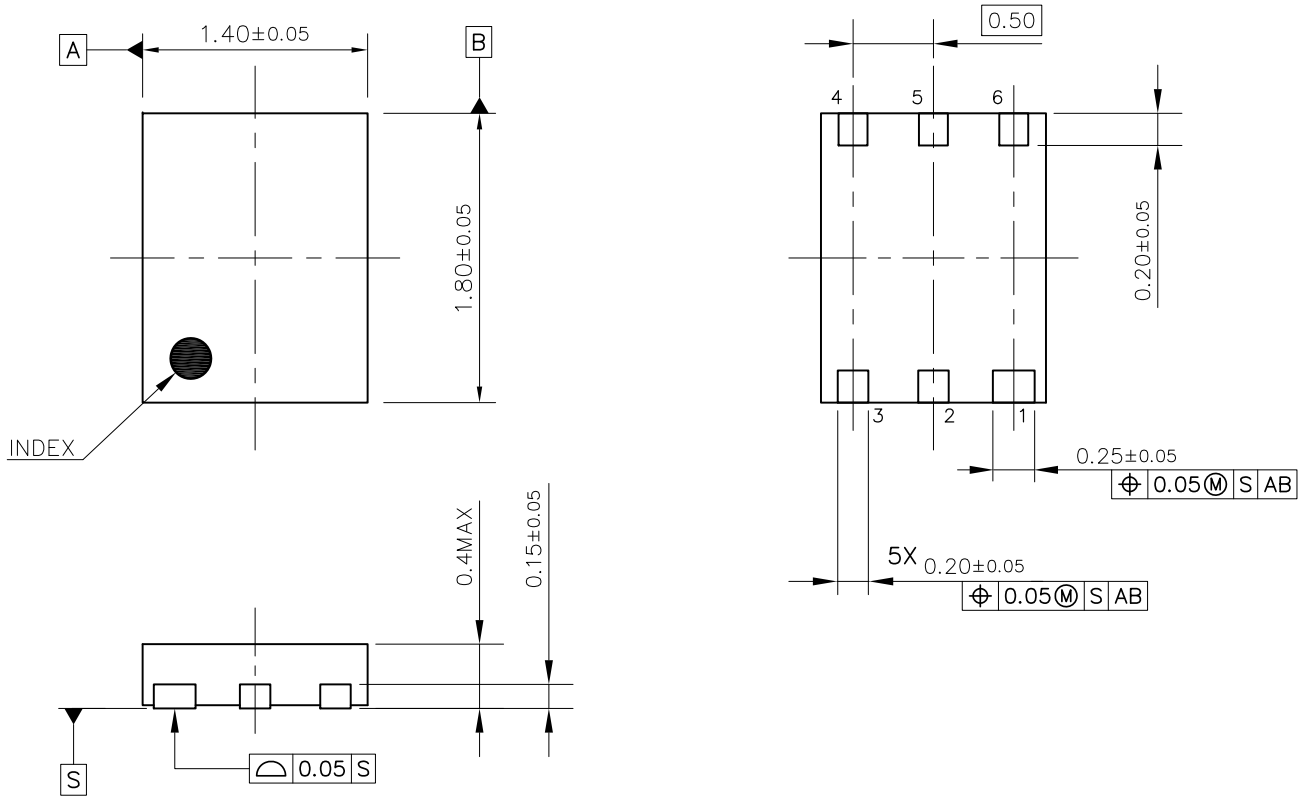
Ver. A



DFN(PLP)1414-6 Package Dimensions

H.IMAI

* The tab on the bottom of the package shown by blue circle is No Connection.



DFN1814-6C Package Dimensions (Unit: mm)

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