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R5458L Series

1-Cell Li-Ion or Polymer Battery Secondary Protection IC

OUTLINE

The R5458L is a high voltage tolerant CMOS-based overcharge secondary protection IC for 1-Cell Li-ion or Li-polymer battery. The R5458L monitors the cell batteries and protects them from overcharge conditions. Internally, the R5458L consists of a voltage detector, a voltage reference unit, an oscillator, a counter, a delay circuit, and a logic circuit.

The cell is monitored for overcharging condition and triggers an internal counter once the overcharge threshold is exceeded. After the overcharge detection delay time, the output of COUT is transitioned to a high level. The output of COUT goes low if the cell voltage drops below the overcharge release voltage. The output type of the COUT pin is CMOS. The R5458L is offered in a small 6-pin DFN1814-6C package.

FEATURES

- **High Voltage Tolerant Process**
  Absolute Maximum Ratings ....30 V
- **Low Supply Current**
  Operating at 3.9 V Cell Voltage.....................................Typ. 1.5 µA
  Standby Current ....Max. 0.5 µA
- **Output Voltage**
  COUT Pin Output ....VDD Power Supply CMOS Output, Active-high
- **High Accuracy Voltage Detection**
  Overcharge Detector Threshold (V_{DET1}).........................4.0 V to 4.7 V in 0.005 V step
  Overcharge Release Voltage (V_{REL1}) ....V_{DET1}−0 V to V_{DET1}−0.4 V in 0.05 V step
  Overcharge Detector Threshold Accuracy ....±20 mV, Ta = 25°C
  ±25 mV, Ta = 0 to 60°C
  Overcharge Release Type ....Voltage Release Type
- **Overcharge Output Delay Function**
  Overcharge Detection Delay Time ....2 s
  Overcharge Release Delay Time ....16 ms
  Overcharge Detection Delay Time Shortening ....Overcharge detection delay time can be shortened by short-circuiting the VSS pin and the DS pin.
- **Compact Package**
  DFN1814-6C .... 1.4 mm x 1.8 mm

APPLICATIONS

- 1-Cell Li-Ion or Li-Polymer Battery Pack

SELECTION GUIDE

The overcharge detector threshold and overcharge release voltage, the overcharge detection delay time and overcharge release delay time, and the overcharge release type are user-selectable options.

Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R5458Lxxx∗$-TR	DFN1814-6C	5,000 pcs	Yes	Yes

xxx: Specify the combination of overcharge detector threshold (V_{DET1}) and overcharge release voltage (V_{REL1}). Refer to *Product Code Table* for details.

V_{DET1}: 4.0 V to 4.7 V in 5 mV step
V_{REL1}: V_{DET1} −0 V to 0.4 V in 50 mV step

∗: Specify the combination of overcharge detection delay time (t_{VDET1}) and overcharge release delay time (t_{VREL1}). Refer to the table below.

Delay Time Code

Code	t_{VDET1} [s]	t_{VREL1} [ms]
A	2	16

$: Specify the overcharge release type. Refer to the table below.

Overcharge Release Code

Code	Overcharge Release Type
A	Voltage Release Type

Product Code Table

The product code is determined by the combination of set output voltage (overcharge detector threshold: V_{DET1}, overcharge release voltage: V_{REL1}) and delay time (overcharge detection delay time: t_{VDET1}, overcharge release delay time: t_{VREL1}) and overcharge release type.

Product Code Table

Product Name	Set Output Voltage [V]		Delay Time		Overcharge Release Type
	V_{DET1}	V_{REL1}	t_{VDET1} [s]	t_{VREL1} [ms]	
R5458L101AA	4.500	4.150	2	16	Voltage Release Type
R5458L102AA	4.550	4.200	2	16	Voltage Release Type
R5458L103AA	4.650	4.300	2	16	Voltage Release Type
R5458L104AA	4.600	4.300	2	16	Voltage Release Type

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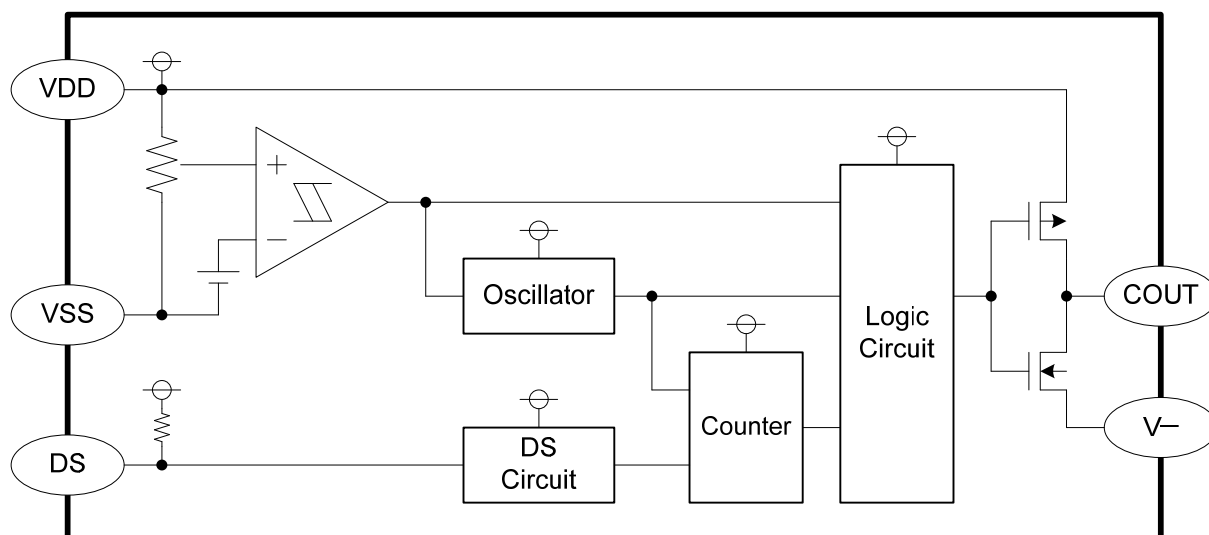
BLOCK DIAGRAMS

R5458L Block Diagram

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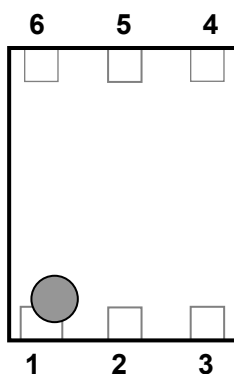
PIN DESCRIPTIONS

DFN1814-6C Pin Configuration

DFN1814-6C Pin Description

Pin No.	Symbol	Description
1	NC	No Connection
2	COUT	Output of Overcharge Detection
3	DS	Delay Shortening
4	VSS	Ground
5	VDD	Power Supply, substrate level of the IC
6	V−	Negative Power Supply of COUT Pin

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ABSOLUTE MAXIMUM RATINGS

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

Symbol	Item	Ratings	Unit
V_{DD}	Power Supply Voltage	−0.3 to 12	V
V−	V− Pin Input Voltage	V_{DD} −30 to V_{DD} +0.3	V
DS	DS Pin Input Voltage	V_{SS} −0.3 to V_{DD} +0.3	V
V_{COUT}	COUT Pin Output Voltage	V− −0.3 to V_{DD} +0.3	V
P_D	Power Dissipation	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	Ratings	Unit
V_{DD}	Operating Input Voltage	1.5 to 5.0	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.

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ELECTRICAL CHARACTERISTICS

Ta = 25°C, unless otherwise specified.

R5458L Electrical Characteristics (Ta = 25°C)

| Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
V_{DET1}	Overcharge Detector Threshold	Detect rising edge of supply voltage (25°C) R1 = 330 Ω	V_{DET1} −0.020	V_{DET1}	V_{DET1} +0.020	V	A
		Detect rising edge of supply voltage (0 to 60°C)[1] R1 = 330 Ω	V_{DET1} −0.025		V_{DET1} +0.025		
V_{REL1}	Overcharge Release Voltage	Detect falling edge of supply voltage R1 = 330 Ω	V_{REL1} −0.050	V_{REL1}	V_{REL1} +0.050	V	A
t_{VDET1}	Output Delay of Overcharge	V_{DD} = 3.5 V to 4.8 V	t_{VDET1} ×0.8	t_{VDET1}	t_{VDET1} ×1.2	s	A
t_{VREL1}	Output Delay of Release from Overcharge	V_{DD} = 4.8 V to 3.5 V	t_{VREL1} ×0.8	t_{VREL1}	t_{VREL1} ×1.2	ms	A
V_{DS}	Delay Time Shortening Mode Voltage	V_{DD} = 4.8 V			0.4	V	B
R_{DS}	DS Pin Pull-up Resistances	V_{DD} = 3.9 V	200	500	1000	kΩ	C
V_{OH}	COUT Pch On Voltage	I_{OH} = −50 μA, V_{DD} = 4.8 V	4.3	4.6		V	D
V_{OL}	COUT Nch On Voltage	I_{OL} = 50 μA, V_{DD} = 3.9 V		0.4	0.5	V	E
Istandby	Standby Current	V_{DD} = 1.9 V		0	0.5	μA	F
I_{SS}	Supply Current	V_{DD} = 3.9 V		1.5	3.0	μA	F

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[1] This specification is guaranteed by design, not tested in mass-production.

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TEST CIRCUITS

A

B

C

D

E

F

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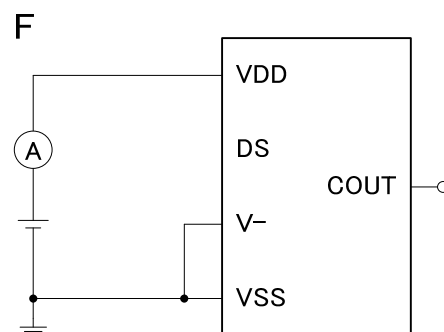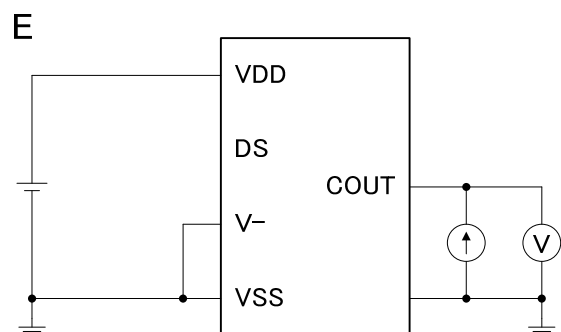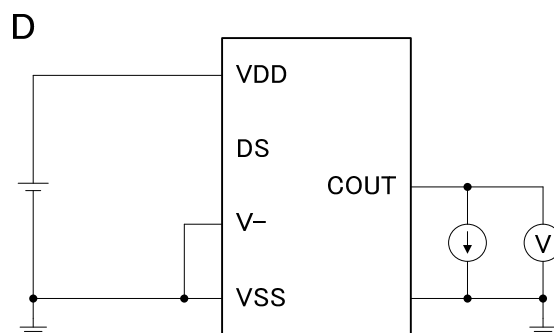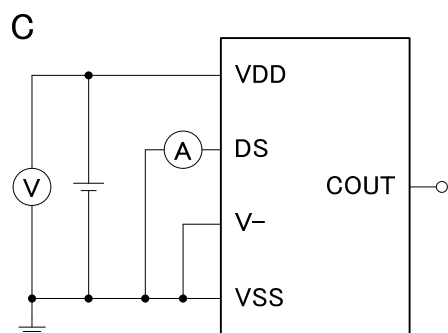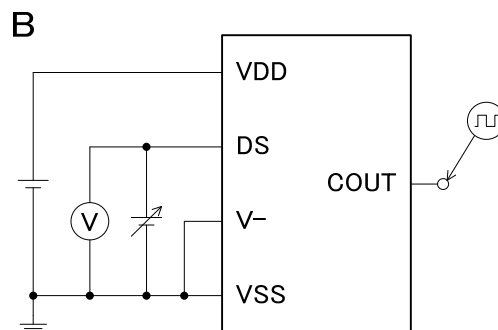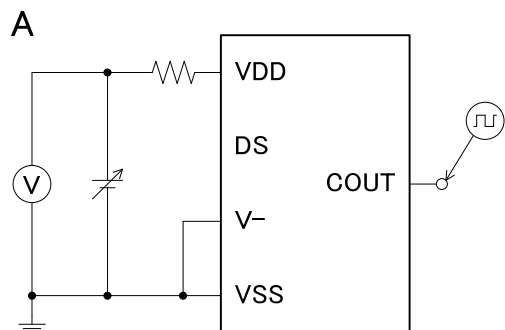
THEORY OF OPERATION

V$_{DET1}$/ Overcharge Detector

The voltage between the VDD pin and the VSS pin is monitored while the cell is charged. The cell is monitored for overcharging condition and triggers an internal counter once the cell voltage exceeds the overcharge detector threshold. After the overcharge detection delay time, an external charging control Nch MOSFET turns on, which means the output of COUT is transitioned to a high level, a fuse on the charger path is cut, and the charging stops. The output of COUT goes low if the cell voltage drops below the overcharge release voltage. During the overcharge detection/ release delay time, the cell voltage needs to be kept more than the overcharge detector threshold/ release voltage level to make the output of COUT high/ low. The output type of the COUT pin is CMOS output between V− and VDD.

Delay Shortening Function

The overcharge detection delay time can be shortened to 8pprox.. 4 ms by short-circuiting the VSS pin and the DS pin (Max. 0.4 V).
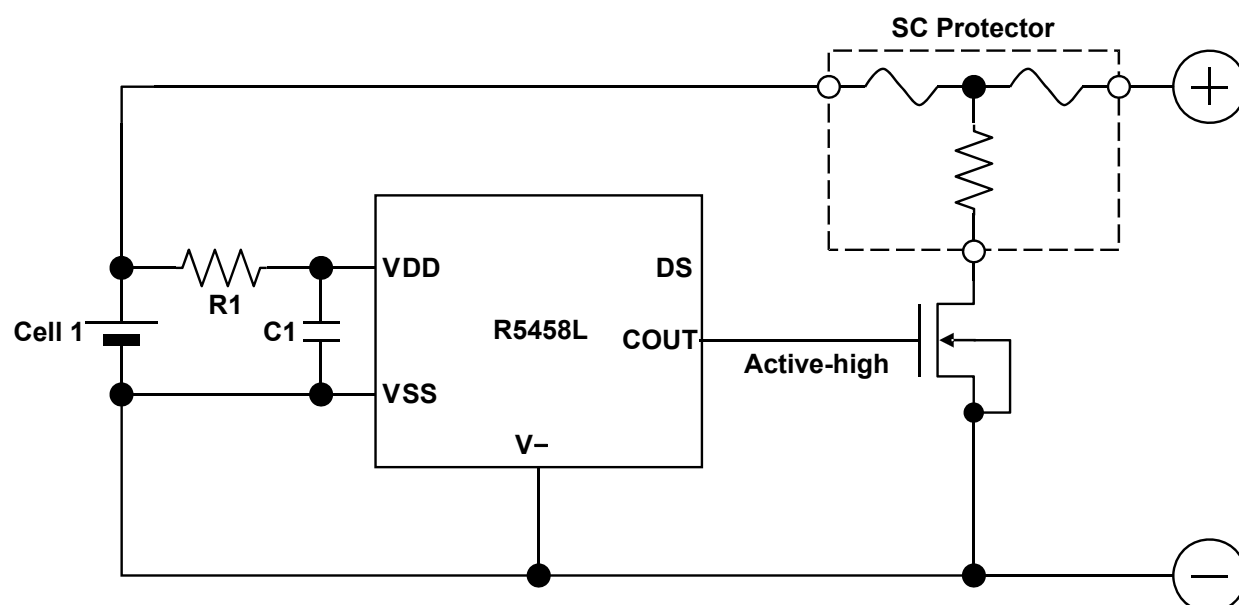
Timing Chart
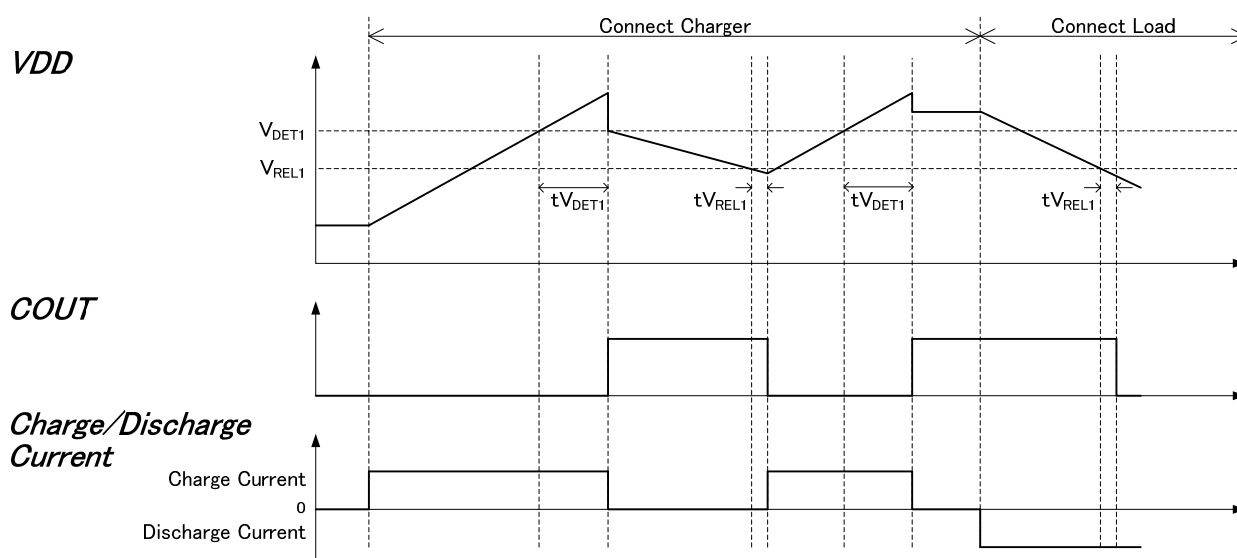
Overcharge Operation Timing Chart

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APPLICATION INFORMATION

R5458L Typical Application Circuit

Recommended External Components

Symbol	Typ.	Unit	Range
R1	330	Ω	330 to 1000
C1	0.1	µF	0.01 to 0.1

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NO.EA-380-181015

Technical Notes on the Selection of Components

- R1 and C1 stabilize a supply voltage to the IC. A recommended R1 value is equal or less than 1 kΩ. A large value of R1 makes detection voltage shift higher because of the conduction current flowed in the IC.
- To stabilize the operation of the IC, use the C1 with the value in the range from 0.01 μF to 0.1 μF. To choose the most suitable value of C1, fully evaluation is necessary.
- The typical application circuit diagrams are just examples. This circuit performance largely depends on the PCB layout and external components. In the actual application, fully evaluation is necessary.
- Overvoltage and the overcurrent beyond the absolute maximum rating should not be forced to the protection IC and external components. During the time until the fuse is open after detecting overcharge, a large current may flow through the FET. Select an FET with large enough current capacity in order to endure the large current.
- Ricoh cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Ricoh product. If technical notes are not complied with the circuit which is used Ricoh product, Ricoh is not responsible for any damages and any accidents.
- To connect the SC protector, connect the SC protector to the cell must be the last.

Contact Information for Inquiries regarding SC Protector

Dexerials Corporation (Sony Chemical & Information Device Company Ltd.)
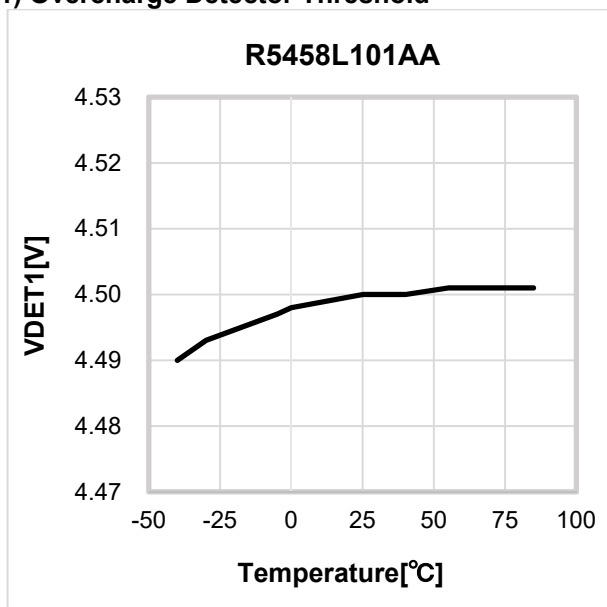Gate-city Osaki East Tower 8F, 1-11-2 Osaki, Shinagawa, Tokyo, 141-0032
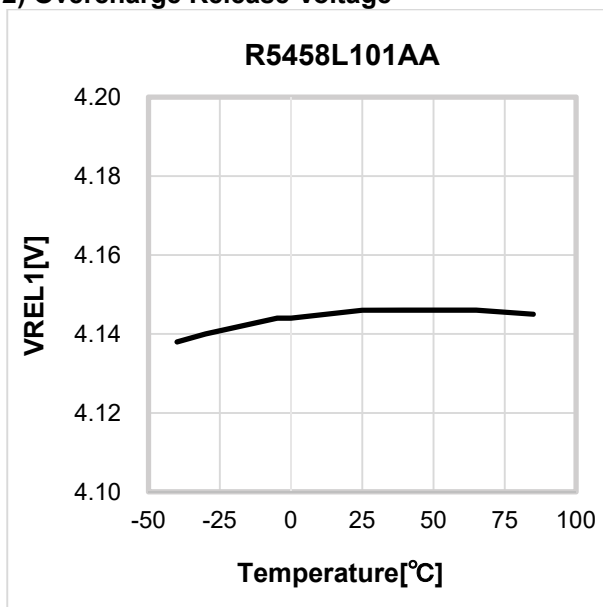TEL: 03-5435-3946
URL: http://www.dexerials.jp

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TYPICAL CHARACTERISTICS (vs. Ambient Temperature)

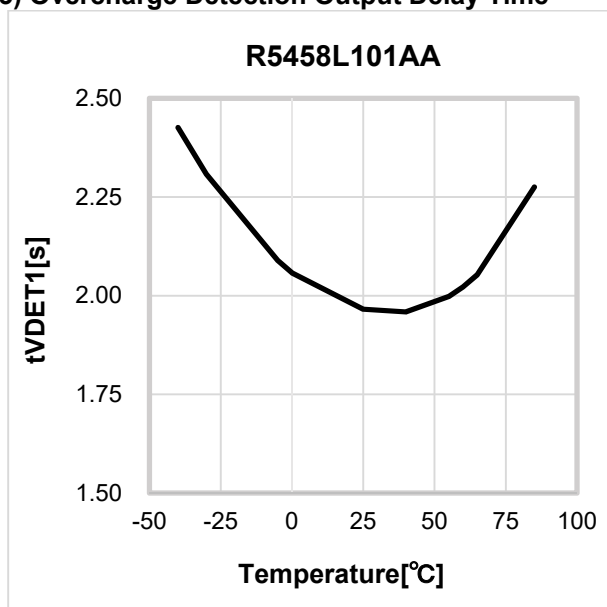Note: Typical Characteristics are intended to be used as reference data, they are not guaranteed.
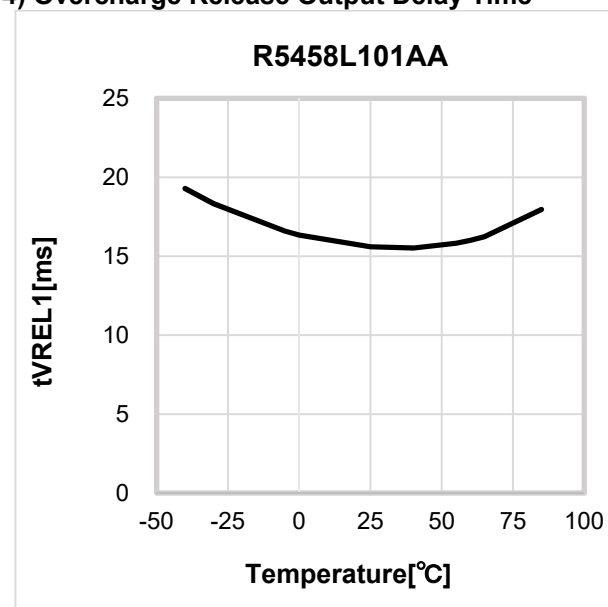
1) Overcharge Detector Threshold
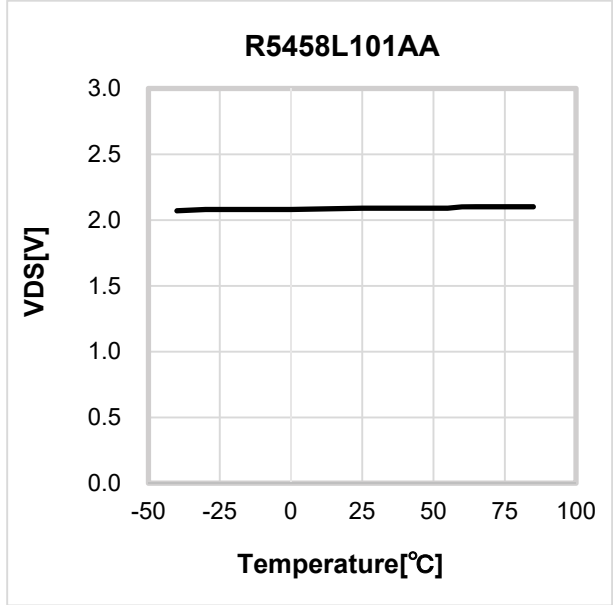
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2) Overcharge Release Voltage

R5458L101AA

3) Overcharge Detection Output Delay Time

R5458L101AA

4) Overcharge Release Output Delay Time

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5) Delay Time Shortening Mode Voltage
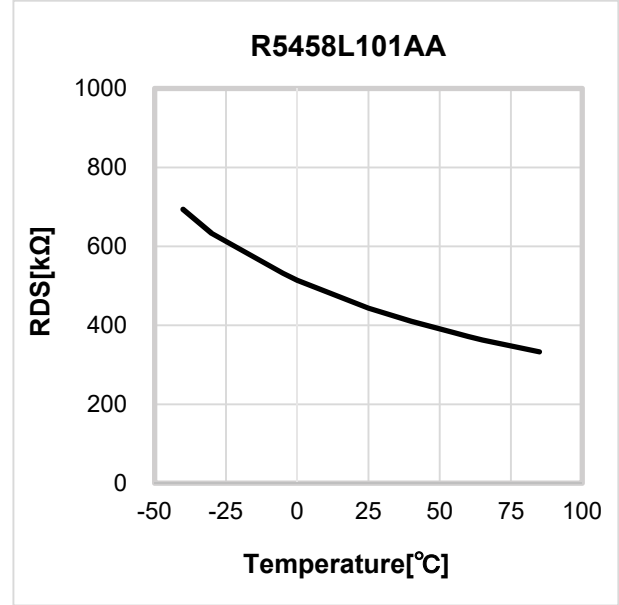
R5458L101AA

6) DS Pin Pull-up Resistance

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7) C$_{OUT}$ Pch ON Voltage

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8) C$_{OUT}$ Nch ON Voltage

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9) Standby Current

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10) Supply Current

R5458L101AA
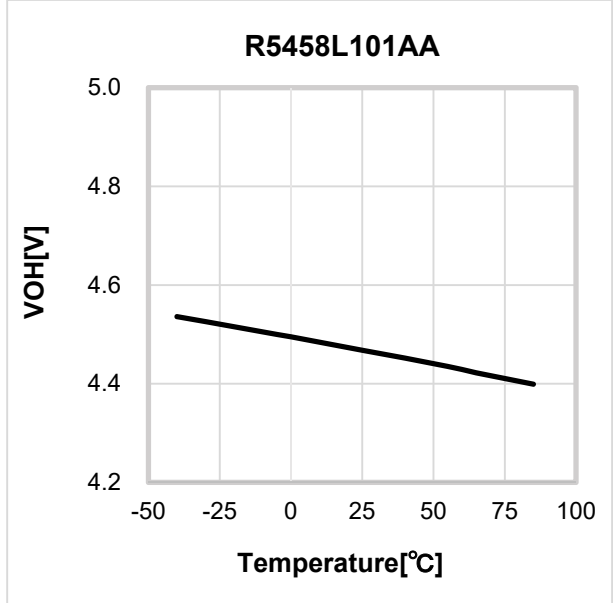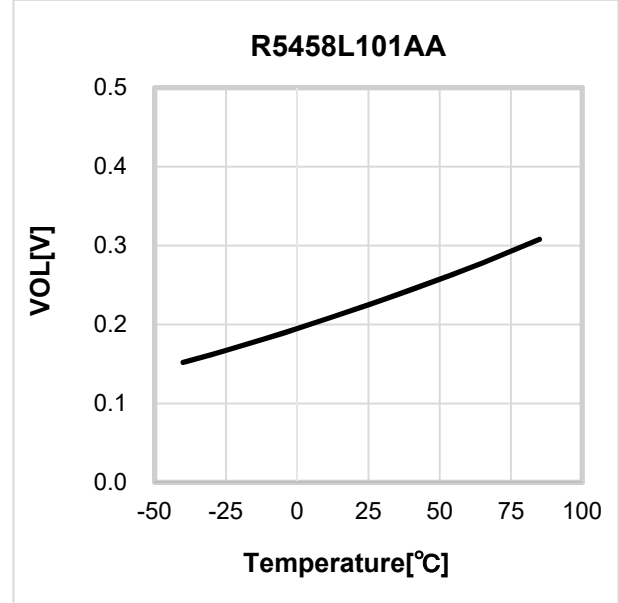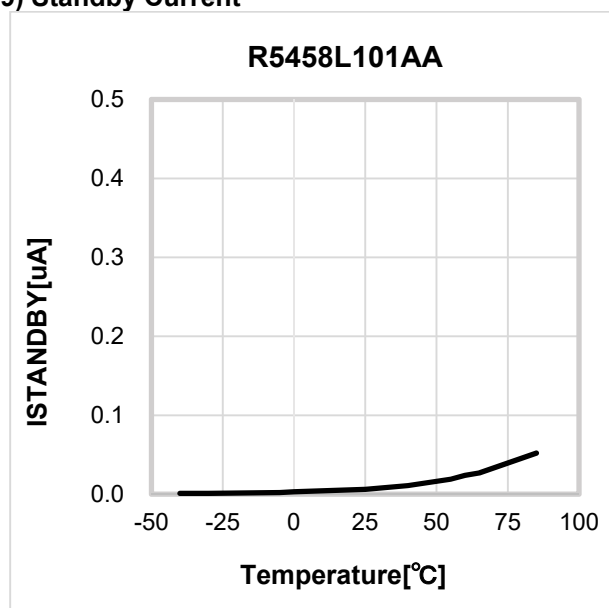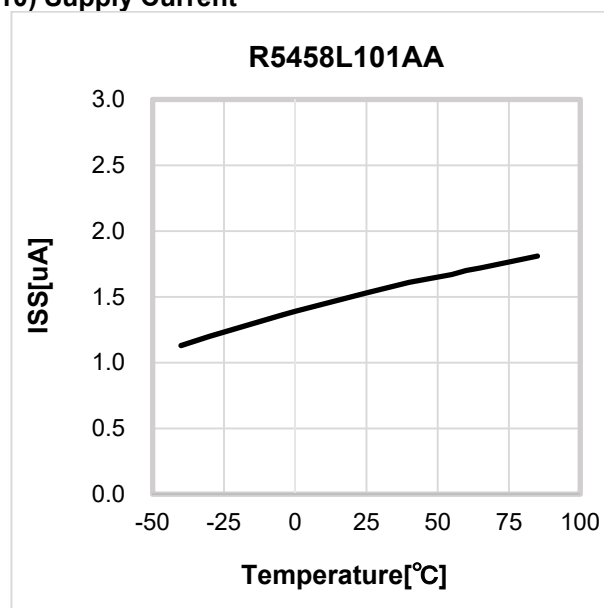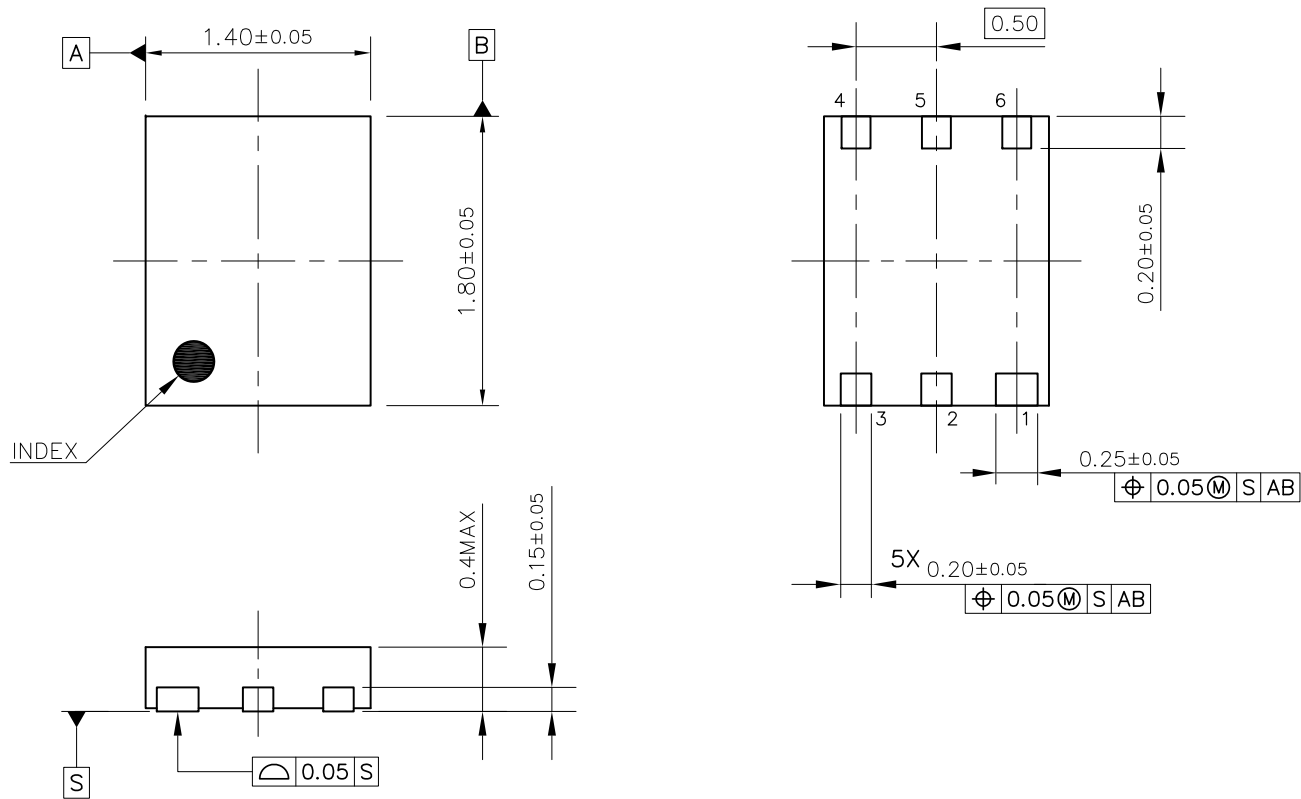
DFN1814-6C Package Dimensions (Unit: mm)

RoHS Compliant
Halogen Free

Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.
Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

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