DATA SHEET

NEC

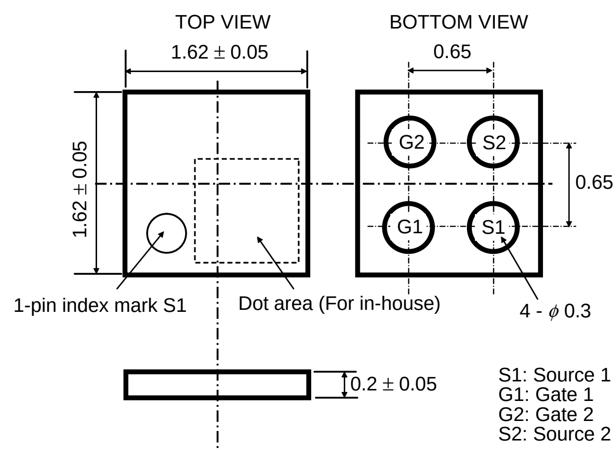
MOS FIELD EFFECT TRANSISTOR
μPA2350T1P

DUAL Nch MOSFET FOR SWITCHING

DESCRIPTION

The μPA2350T1P is a Dual N-channel MOSFET designed for Lithium-Ion battery protection circuit.
Ecologically Flip chip MOSFET for Lithium-Ion battery Protection (EFLIP).

OUTLINE DRAWING (Unit: mm)



FEATURES

- Monolithic Dual MOSFET
  The Drain connection on circuit board is unnecessary, because Drains of 2MOSFET are internally connected.
- 2.5 V drive available and low on-state resistance
  $R_{SS(on)1}$ = 35 mΩ MAX. (V_{GS} = 4.5 V, I_S = 3.0 A)
  $R_{SS(on)2}$ = 37 mΩ MAX. (V_{GS} = 4.0 V, I_S = 3.0 A)
  $R_{SS(on)3}$ = 44 mΩ MAX. (V_{GS} = 3.1 V, I_S = 3.0 A)
  $R_{SS(on)4}$ = 55 mΩ MAX. (V_{GS} = 2.5 V, I_S = 3.0 A)
- Built-in G-S protection diode against ESD
- Pb-free Bump

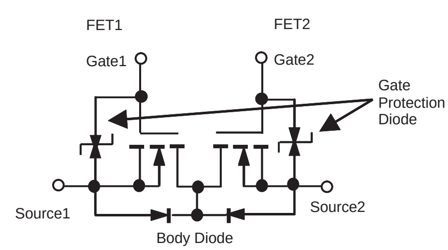
ORDERING INFORMATION

PART NUMBER	PACKAGE
μPA2350T1P-E4-A Note	4-pin EFLIP-LGA

Note Pb-free (This product does not contain Pb in external electrode and other parts.)

Remark "-E4" indicates the unit orientation (E4 only).

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

Source to Source Voltage (V_{GS} = 0 V)	V_{SSS}	20	V
Gate to Source Voltage (V_{SS} = 0 V)	V_{GSS}	±12	V
Source Current (DC) Note1	$I_{S(DC)}$	6.0	A
Source Current (pulse) Note2	$I_{S(pulse)}$	±60	A
Total Power Dissipation Note1	P_T	1.3	W
Channel Temperature	T_{ch}	150	°C
Storage Temperature	T_{stg}	–55 to +150	°C

Notes 1. Mounted on ceramic board of 50 cm^2 x 1.0 mm
2. PW ≤ 100 μs, Single Pulse

Remark The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.

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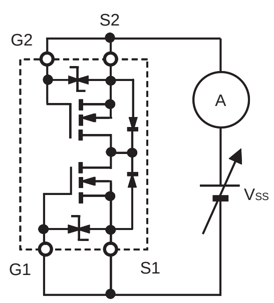
ELECTRICAL CHARACTERISTICS (T_A = 25°C) These are common to FET1 and FET2.

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Source Current	I_{SSS}	V_{SS} = 20 V, V_{GS} = 0 V, TEST CIRCUIT 1			1	μA
Gate Leakage Current	I_{GSS}	V_{GS} = ±12 V, V_{SS} = 0 V, TEST CIRCUIT 2			±10	μA
Gate to Source Cut-off Voltage	$V_{GS(off)}$	V_{SS} = 10 V, I_S = 1.0 mA, TEST CIRCUIT 3	0.5	1.0	1.5	V
Forward Transfer Admittance Note	$\| y_{fs} \|$	V_{SS} = 10 V, I_S = 3.0 A, TEST CIRCUIT 4	2.5	8.0		S
Source to Source On-state Resistance Note	$R_{SS(on)1}$	V_{GS} = 4.5 V, I_S = 3.0 A, TEST CIRCUIT 5	22	28	35	mΩ
	$R_{SS(on)2}$	V_{GS} = 4.0 V, I_S = 3.0 A, TEST CIRCUIT 5	23	29	37	mΩ
	$R_{SS(on)3}$	V_{GS} = 3.1 V, I_S = 3.0 A, TEST CIRCUIT 5	24	33	44	mΩ
	$R_{SS(on)4}$	V_{GS} = 2.5 V, I_S = 3.0 A, TEST CIRCUIT 5	30	41	55	mΩ
Input Capacitance	C_{iss}	V_{SS} = 10 V, V_{GS} = 0 V, f = 1.0 MHz		542		pF
Output Capacitance	C_{oss}	TEST CIRCUIT 7		132		pF
Reverse Transfer Capacitance	C_{rss}			91		pF
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 10 V, I_S = 6.0 A,		24		ns
Rise Time	t_r	V_{GS} = 4.0 V, R_G = 6.0 Ω,		165		ns
Turn-off Delay Time	$t_{d(off)}$	TEST CIRCUIT 8		160		ns
Fall Time	t_f			150		ns
Total Gate Charge	Q_G	V_{DD} = 16 V, V_{G1S1} = 4.0 V, I_S = 6.0 A, TEST CIRCUIT 9		8.6		nC
Body Diode Forward Voltage Note	$V_{F(S-S)}$	I_F = 6.0 A, V_{GS} = 0 V, TEST CIRCUIT 6		0.9		V

Note Pulsed

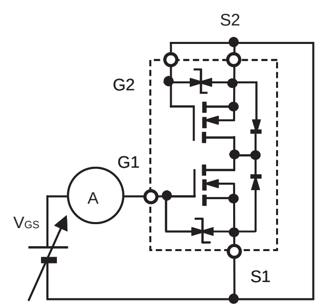
Test circuits are example of measuring the FET1 side.

TEST CIRCUIT 1 **I_{SSS}**



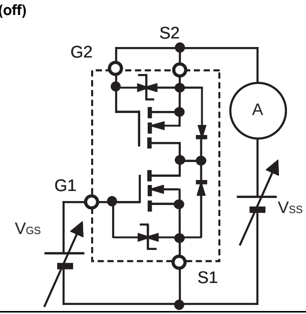
TEST CIRCUIT 2 **I_{GSS}**

When FET1 is measured, between GATE and SOURCE of FET2 are shorted.



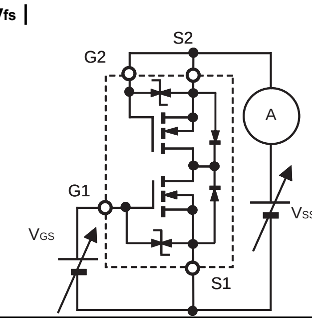
TEST CIRCUIT 3 **$V_{GS(off)}$**

When FET1 is measured, between GATE and SOURCE of FET2 are shorted.



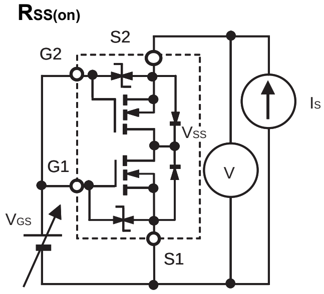
TEST CIRCUIT 4 **$| y_{fs} |$**

$\Delta I_S/\Delta V_{GS}$



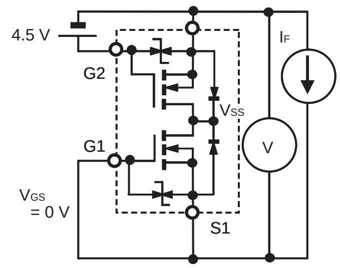
TEST CIRCUIT 5 $R_{SS(on)}$

V_{SS}/I_S

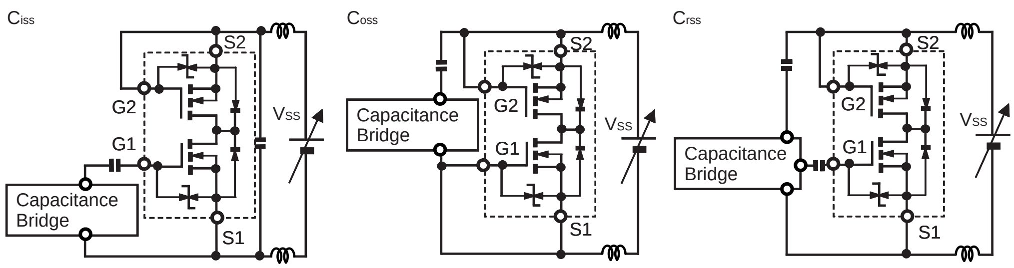


TEST CIRCUIT 6 $V_{F(S-S)}$

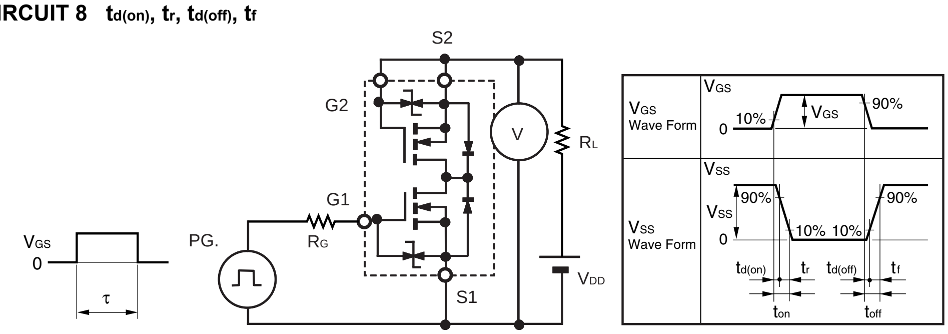
When FET1 is measured,
FET2 is added V_{GS} +4.5 V.



TEST CIRCUIT 7

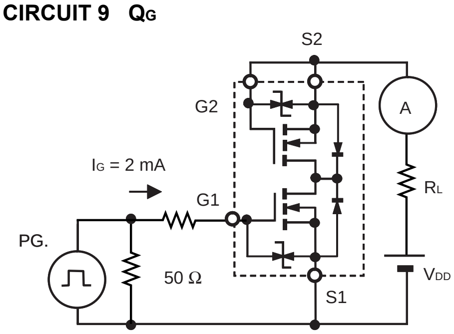


TEST CIRCUIT 8 $t_{d(on)}$, t_r, $t_{d(off)}$, t_f



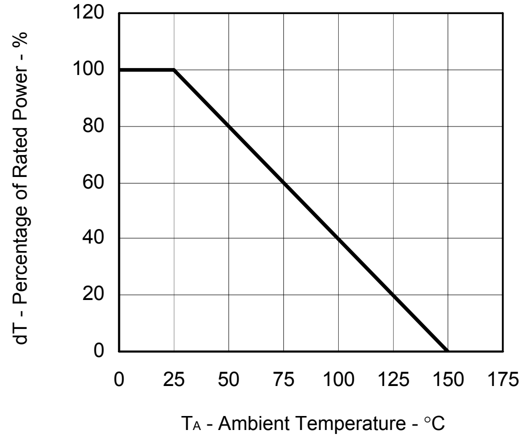
τ = 1 μs
Duty Cycle ≤ 1%

TEST CIRCUIT 9 Q_G

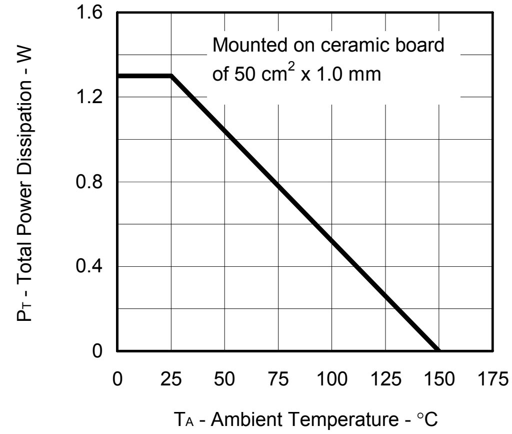


TYPICAL CHARACTERISTICS (T_A = 25°C)

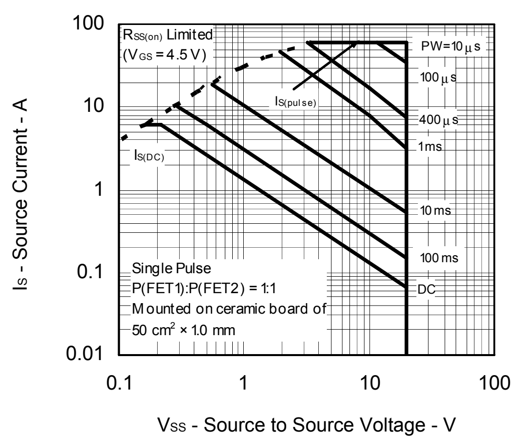
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



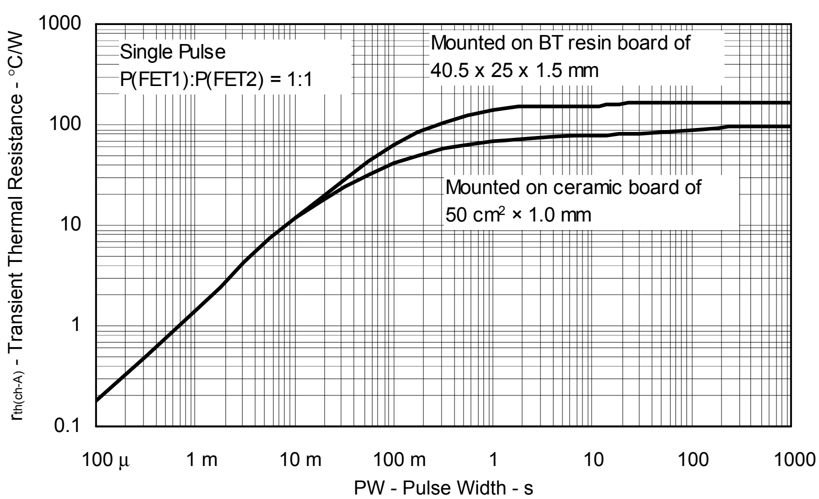
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



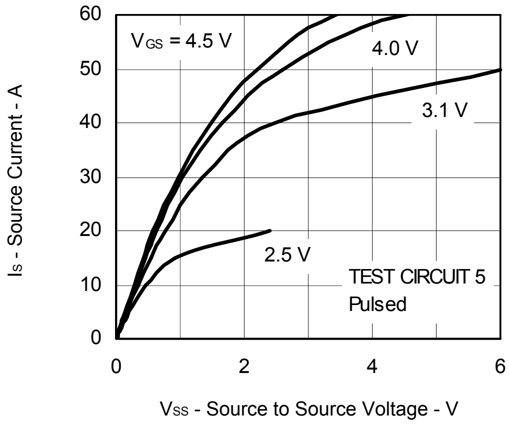
FORWARD BIAS SAFE OPERATING AREA



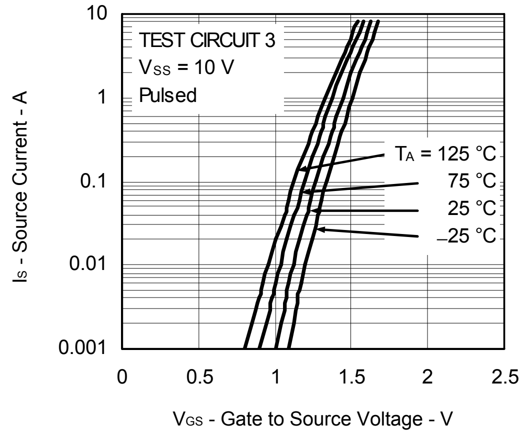
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



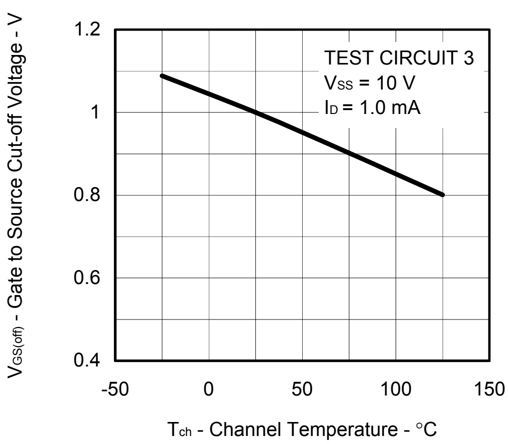
SOURCE CURRENT vs.
SOURCE TO SOURCE VOLTAGE



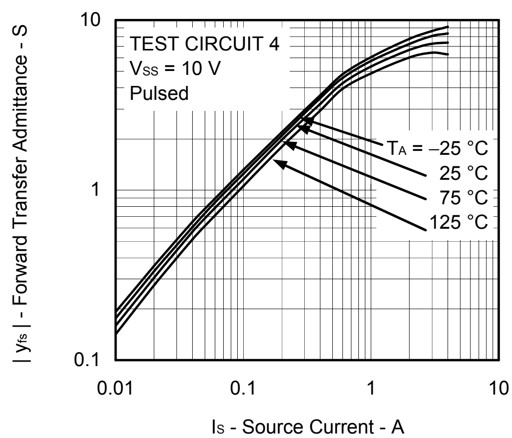
FORWARD TRANSFER CHARACTERISTICS



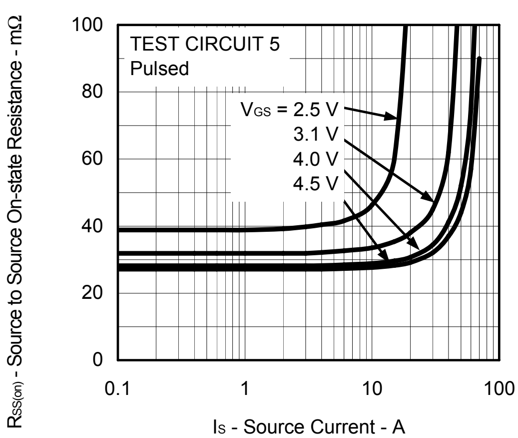
GATE TO SOURCE CUT-OFF VOLTAGE vs.
CHANNEL TEMPERATURE



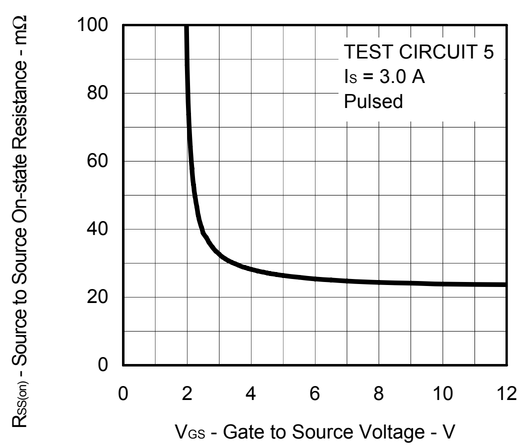
FORWARD TRANSFER ADMITTANCE vs.
SOURCE CURRENT



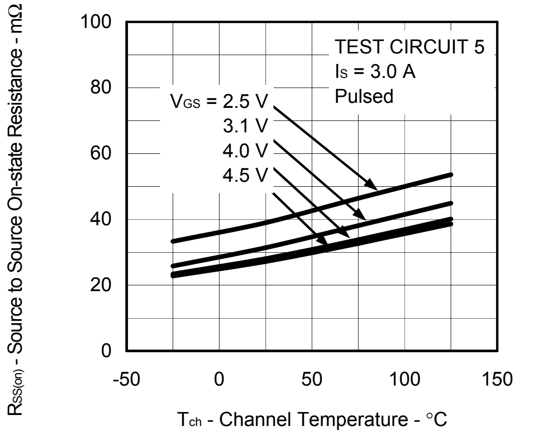
SOURCE TO SOURCE ON-STATE RESISTANCE vs.
SOURCE CURRENT



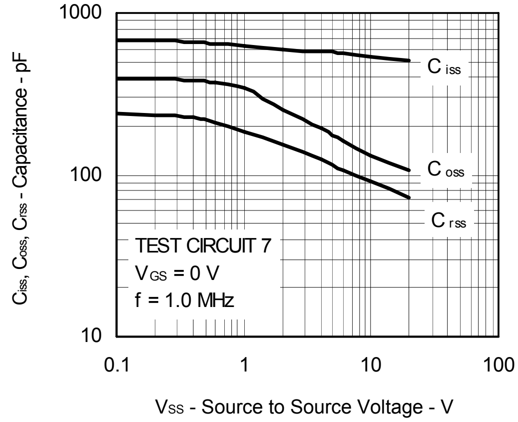
SOURCE TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE



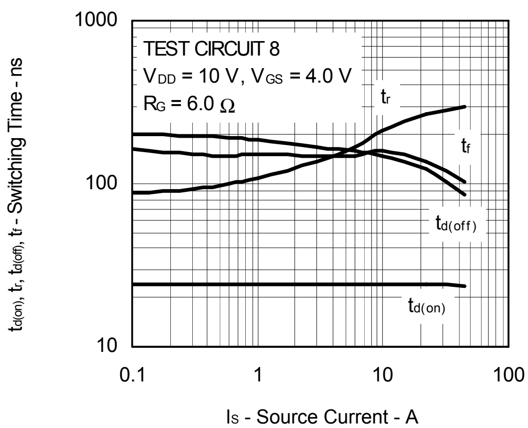
SOURCE TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



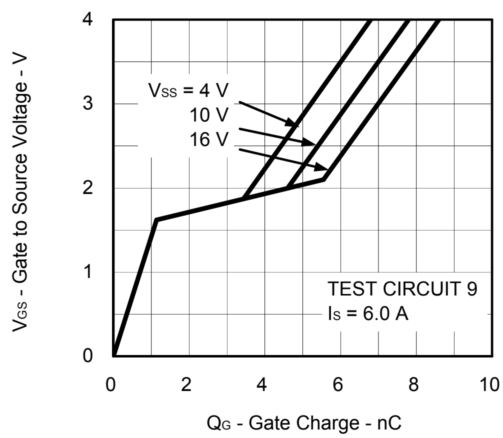
CAPACITANCE vs. SOURCE TO SOURCE VOLTAGE



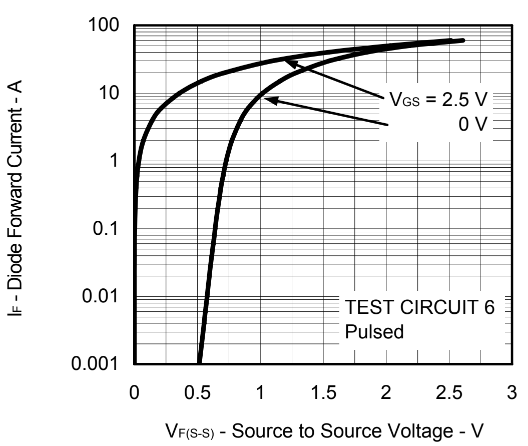
SWITCHING CHARACTERISTICS



DYNAMIC INPUT CHARACTERISTICS

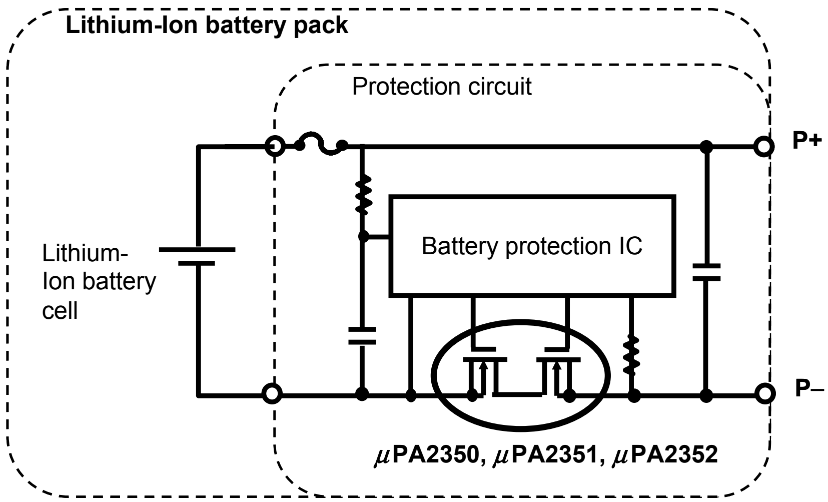


SOURCE TO SOURCE DIODE FORWARD VOLTAGE



< Example of application circuit >

Lithium-Ion battery (1 cell) protection circuit



<Notes for using this device safely>

When you use this device, in order to prevent a customer's hazard and damage, use it with understanding the following contents. If used exceeding recommended conditions, there is a possibility of causing the device and characteristic degradation.

1. This device is very thin device and should be handled with caution for mechanical stress. The distortion applied to the device should become below 2000 × 10^{-6}. If the distortion exceeds 2000 × 10^{-6}, the characteristic of a device may be degraded and it may result in failure.

2. Please do not damage the device when you handle it. The use of metallic tweezers has the possibility of giving the wound. Mounting with the nozzle with clean point is recommended.

3. When you mount the device on a substrate, carry out within our recommended soldering conditions of infrared reflow. If mounted exceeding the conditions, the characteristic of a device may be degraded and it may result failure.

4. When you wash the device mounted the board, carry out within our recommended conditions. If washed exceeding the conditions, the characteristic of a device may be degraded and it may result in failure.

5. When you use ultrasonic wave to substrate after the device mounting, prevent from touching a resonance directly. If it touches, the characteristic of a device may be degraded and it may result in failure.

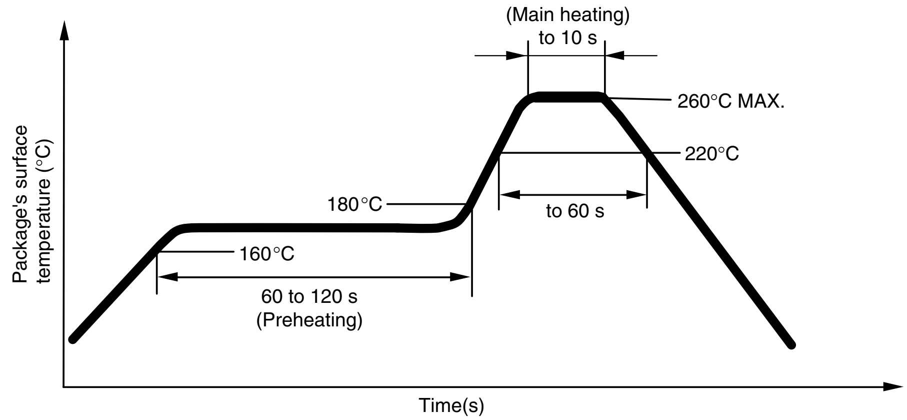
6. When you coat the device after mounted on the board, please consult our company. NEC Electronics recommends the epoxy resin of the semiconductor grade as a coating material.

7. Please refer to Figure 2 as an example of the Mounting Pad. Optimize the land pattern in consideration of density, appearance of solder fillets, common difference, etc in an actual design.

8. The marking side of this device is an internal electrode. Please neither contact with terminals of other parts nor take out the electrode.

Figure 1 Recommended soldering conditions of INFRARED REFLOW

Maximum temperature (Package's surface temperature)	: 260°C or below
Time at maximum temperature	: 10 s or less
Time of temperature higher than 220°C	: 60 s or less
Preheating time at 160 to 180°C	: 60 to 120 s
Maximum number of reflow processes	: 3 times
Maximum chlorine content of rosin flux (Mass percentage)	: 0.2% or less



Infrared Reflow Temperature Profile

Figure 2 The example of the Mounting Pad (Unit : mm)

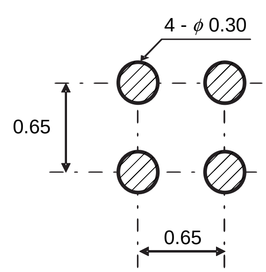


Figure 3 The unit orientation