LOW NOISE 150mA LDO REGULATOR (Preliminary)

NO.EA-173-071220

OUTLINE

The RP130 Series are CMOS-based positive voltage regulator ICs with high ripple rejection, low dropout voltage, high output voltage accuracy and extremely low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, a resistor-net for voltage setting, a short current limit circuit and a chip enable circuit.

These ICs has an excellent low supply current performed by CMOS process, moreover they perform with low dropout voltage due to built-in low ON-resistance. A chip enable function prolongs the battery life.

The line transient response, the load transient response and the ripple rejection have been improved in the RP130 series compared with the conventional products. Besides achieving low supply current (TYP.38μA).

The range of the operation voltage is capable from 1.7V to 6.5V for this product, which is wider range as our conventional product R1114 series.

The output voltage of these ICs is fixed with high accuracy. Since the packages for these ICs are DFN(PLP)1010-4, SOT-23-5 and SC-82AB, therefore high density mounting of the ICs on boards is possible.

FEATURES

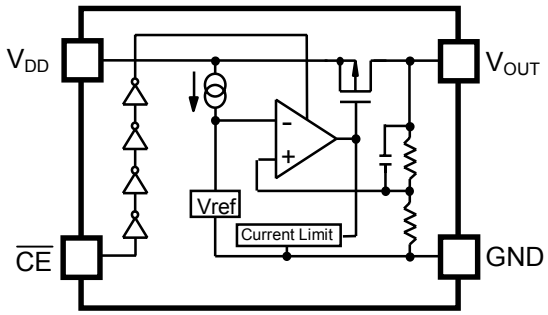
- Low Supply Current ····· Typ.38μA
- Small Packages ····· DFN(PLP)1010-4, SOT23-5, SC-82AB
- High Output Voltage Accuracy ····· ±1.0%
- High Ripple Rejection ····· Typ.80dB (f=1kHz 2.8V Output Type)
- Supply Current (Standby Mode)····· Typ.0.1μA
- Low Dropout Voltage····· Typ.0.3V (I_{OUT}=50mA,V_{OUT}=2.8V)
- Low Temperature-Drift Coefficient of Output Voltage····· Typ.±20ppm/°C
- Excellent Line Regulation ····· Typ.0.02%/V
- Output Voltage ····· Stepwise setting with a step of 0.1V in the range of 1.2V to 5.0V is possible
- Input Voltage ····· 1.7V to 6.5V
- Built-in Fold Back Protection Circuit····· Typ.40mA
- Ceramic capacitors are recommended to be used this IC··· C_{IN}=C_{OUT}=0.47μF or more

APPLICATIONS

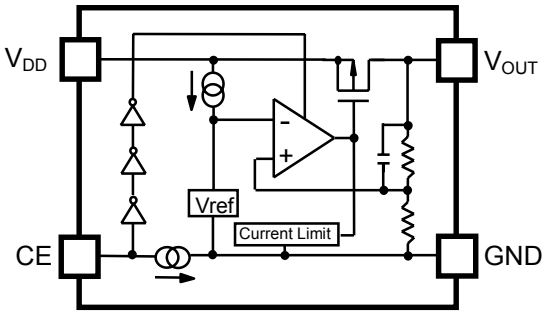
- Power source for battery-powered equipment.
- Power source for portable communication equipment.
- Power source for electrical applications such as cameras, VCRs and camcorders.
- Power source for high stable reference voltage

BLOCK DIAGRAMS

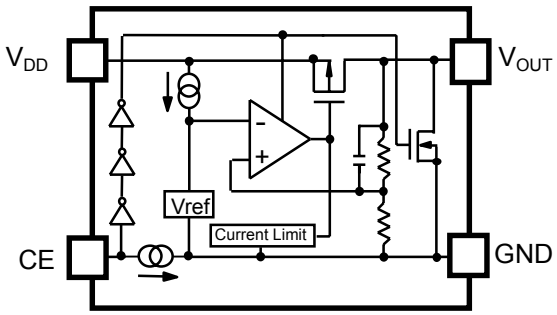
RP130xxx1A



RP130xxx1B



RP130xxx1D



SELECTION GUIDE

The output voltage, version, and the taping type for the ICs can be selected at the user's request.
The selection can be made with designating the part number as shown below;

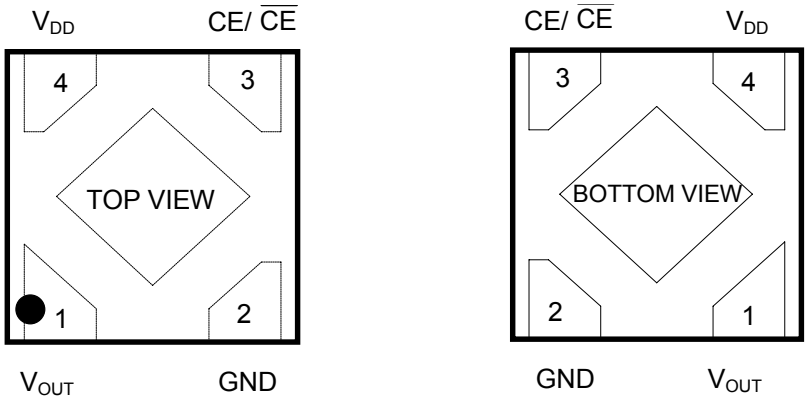
RP130xxx1x-xx ←Part Number
↑↑ ↑ ↑
a b c d

Code	Contents
a	Designation of Package Type: K: DFN(PLP)1010-4 N: SOT23-5 Q: SC-82AB
b	Setting Output Voltage (V_{OUT}) : Fixed Type: 12 to 50 Stepwise setting with 0.1V increment in the range from 1.2V to 5.0V Exception: 1.85V=RP130x181x5-TR, 2.85V=RP130x281x5-TR
c	Designation of Active Type: A: active low type* B: active high type* D: active high type, with auto-discharge*
d	Designation of Taping Type: Ex.TR (refer to Taping Specifications: TR type is the standard direction)

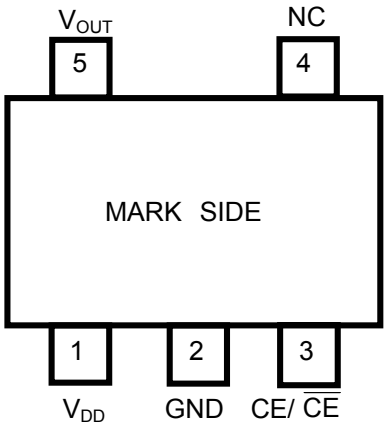
* When the mode is into standby with CE signal, auto-discharge transistor turns on, and it makes the turn-off speed faster than normal type.

PIN CONFIGURATION

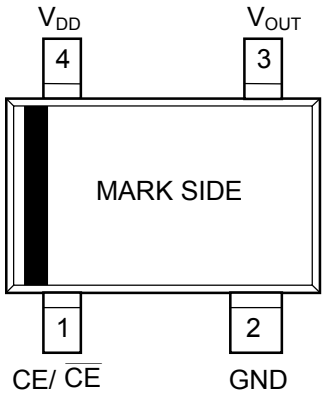
DFN (PLP)1010-4



SOT-23-5



SC-82AB



PIN DESCRIPTIONS

● **RP130K: DFN(PLP)1010-4**

Pin No.	Symbol	Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	$\overline{CE}$ or CE	Chip Enable
4	V_{DD}	Input Pin

Tab is GND level. (They are connected to the reverse side of this IC.)
Do not connected to other wires or land patterns.

● **RP130N: SOT-23-5**

Pin No.	Symbol	Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	$\overline{CE}$ or CE	Chip Enable
4	NC	No Connection
5	V_{OUT}	Output Pin

● **RP130Q: SC-82AB**

Pin No.	Symbol	Description
1	$\overline{CE}$ or CE	Chip Enable
2	GND	Ground Pin
3	V_{OUT}	Output Pin
4	V_{DD}	Input Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Ratings		Unit
V_{IN}	Input Voltage	7.0		V
V_{CE}	Input Voltage (CE Pin)	- 0.3 ~ 7.0		V
V_{OUT}	Output Voltage	- 0.3 ~ V_{IN} + 0.3		V
I_{OUT}	Output Current	200		mA
P_D	Power Dissipation*	DFN(PLP)1010-4	400	mW
		SOT-23-5	420	
		SC-82AB	380	
Ta	Ambience Temperature Range	- 40 ~ + 85		°C
Tstg	Storage Temperature Range	- 55 ~ + 125		°C

* For Power Dissipation, please refer to PACKAGE INFORMATION (p.12~) to be described

ELECTRICAL CHARACTERISTICS

V_{IN}=Set V_{OUT}+1V for V_{OUT} options greater than 1.5V. V_{IN}=2.5V for V_{OUT} ≦ 1.5V.
I_{OUT}=1mA, C_{IN}=C_{OUT}=0.47µF, unless otherwise noted.
☐ **values indicate -40°C ≦ Ta ≦ 85°C, unless otherwise noted.**

RP130xxx1A (Ta=25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Ta=25°C	V_{OUT} > 2.0V	x 0.99		x 1.01	V
			V_{OUT} ≦ 2.0V	-20		+20	mV
		-40°C ≦ Ta ≦ 85°C	V_{OUT} > 2.0V	x 0.985		x 1.015	V
			V_{OUT} ≦ 2.0V	-30		+30	mV
I_{OUT}	Output Current			150			mA
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	1mA ≦ I_{OUT} ≦ 150mA			10	30	mV
V_{DIF}	Dropout Voltage	Please see the data on next page (p.8)					
I_{SS}	Supply Current	I_{OUT}=0mA			38	58	µA
Istandby	Supply Current (Standby)	V_{CE}=V_{IN}			0.1	1.0	µA
ΔV_{OUT} /ΔV_{IN}	Line Regulation	Set V_{OUT}0.5V ≦ V_{IN} ≦ 5.0V			0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V_{IN}=Set V_{OUT}+1V, I_{OUT}=30mA (In case that V_{OUT} ≦ 2.0V, V_{IN}=3.0V)			75		dB
V_{IN}	Input Voltage*			1.7		6.5	V
ΔV_{OUT} /ΔTa	Output Voltage Temperature Coefficient	-40°C ≦ Ta ≦ 85°C			±20		ppm /°C
Ilim	Short Current Limit	V_{OUT}=0V			40		mA
V_{CEH}	$\overline{CE}$ Input Voltage "H"			1.0			µA
V_{CEL}	$\overline{CE}$ Input Voltage "L"					0.4	
en	Output Noise	BW=10Hz to 100kHz I_{OUT}=30mA			30		µVrms

The specification in ☐ is checked and guaranteed by design engineering.
All of unit are tested and specified under load conditions such that Tj ≈ Ta=25°C except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient items.

RP130xxx1B/D

(Ta=25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Ta=25°C	V_{OUT} > 2.0V	x 0.99		x 1.01	V
			V_{OUT} ≦ 2.0V	-20		+20	mV
		-40°C ≦ Ta ≦ 85°C	V_{OUT} > 2.0V	x 0.985		x 1.015	V
			V_{OUT} ≦ 2.0V	-30		+30	mV
I_{OUT}	Output Current			150			mA
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	1mA ≦ I_{OUT} ≦ 150mA			10	30	mV
V_{DIF}	Dropout Voltage	Please see the data below					
I_{SS}	Supply Current	I_{OUT}=0mA			38	58	µA
Istandby	Supply Current (Standby)	V_{CE}=0V			0.1	1.0	µA
ΔV_{OUT} /ΔV_{IN}	Line Regulation	Set V_{OUT},0.5V ≦ V_{IN} ≦ 5.0V			0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V_{IN}=Set V_{OUT}+1V, I_{OUT}=30mA (In case that V_{OUT} ≦ 2.0V, V_{IN}=3.0V)			75		dB
V_{IN}	Input Voltage*			1.7		6.5	V
ΔV_{OUT} /ΔTa	Output Voltage Temperature Coefficient	-40°C ≦ Ta ≦ 85°C			±20		ppm /°C
Ilim	Short Current Limit	V_{OUT}=0V			40		mA
I_{PD}	CE Pull-down Current				0.4		µA
V_{CEH}	CE Input Voltage "H"			1.0			V
V_{CEL}	CE Input Voltage "L"					0.4	V
en	Output Noise	BW=10Hz to 100kHz I_{OUT}=30mA			30		µVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (D version Only)	V_{IN}=4.0V V_{CE}=0V			30		Ω

The specification in ☐ is checked and guaranteed by design engineering.

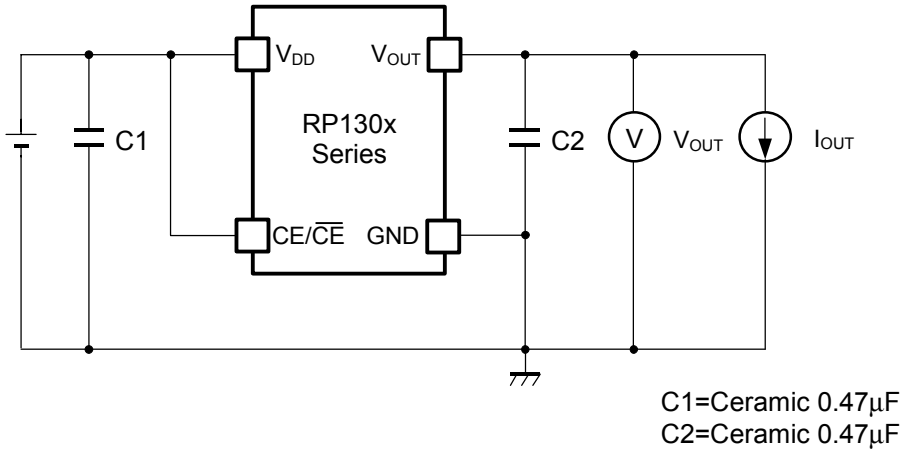
All of unit are tested and specified under load conditions such that Tj ≈ Ta=25°C except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient items.

Dropout Voltage

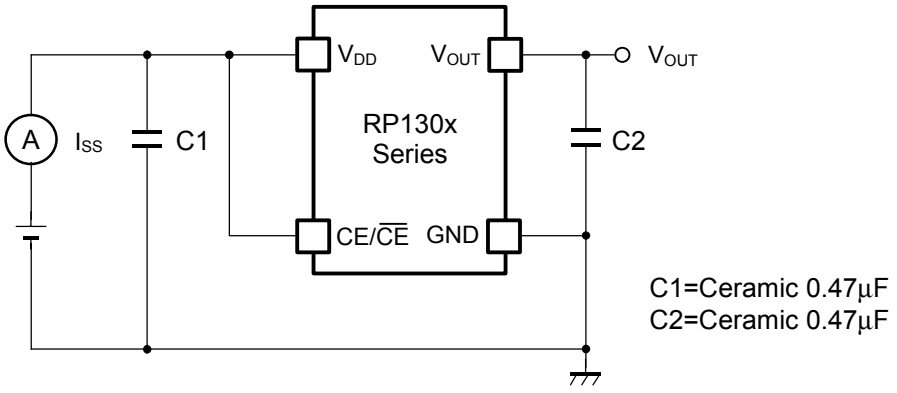
V_{OUT} (V)	Dropout Voltage (V)		
	Condition	TYP.	MAX.
1.2V ≦ V_{OUT} < 1.5V	I_{OUT}=150mA	0.67	1.00
1.5V ≦ V_{OUT} < 1.7V		0.54	0.81
1.7V ≦ V_{OUT} < 2.0V		0.46	0.68
2.0V ≦ V_{OUT} < 2.5V		0.41	0.60
2.5V ≦ V_{OUT} < 4.0V		0.32	0.51
4.0V ≦ V_{OUT}		0.24	0.37

The specification in ☐ is checked and guaranteed by design engineering.

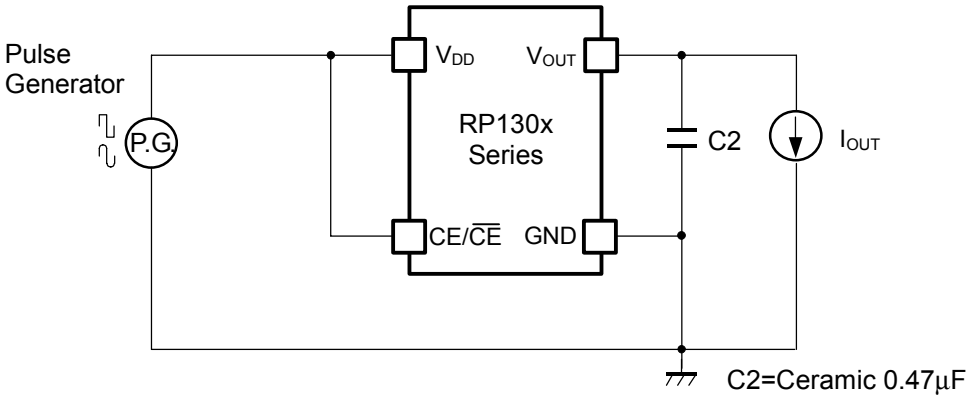
TEST CIRCUITS



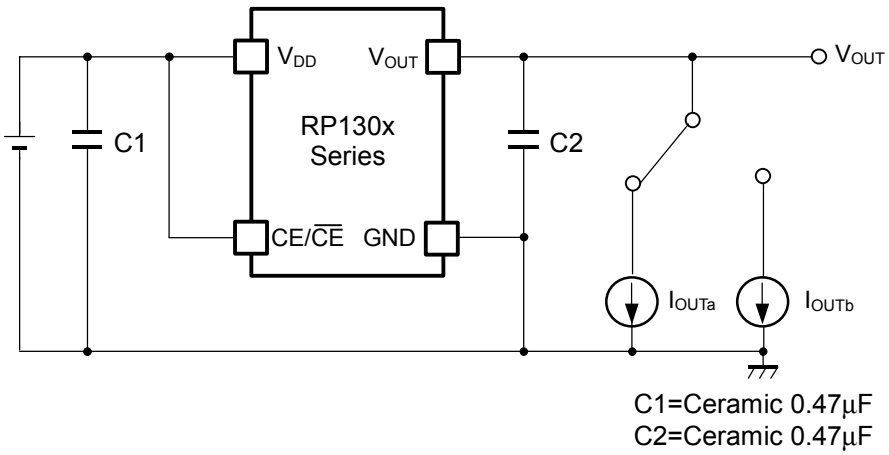
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection



Test Circuit for Load Transient Response

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

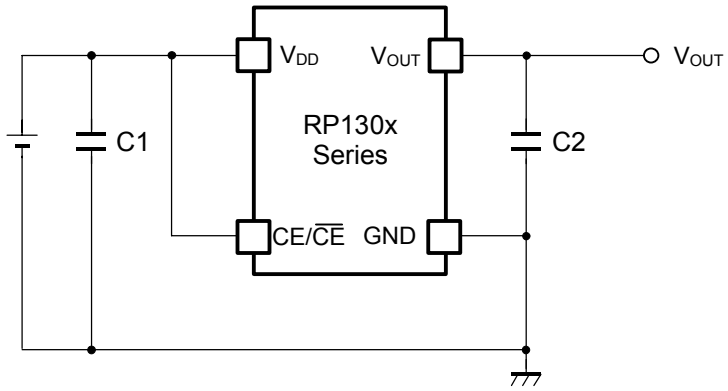
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 0.47µF or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible.

TYPICAL APPLICATION



(External Components)

C2 0.47µF MURATA: GRM155B30J474KE18B

POWER DISSIPATION (DFN(PLP)1010-4)

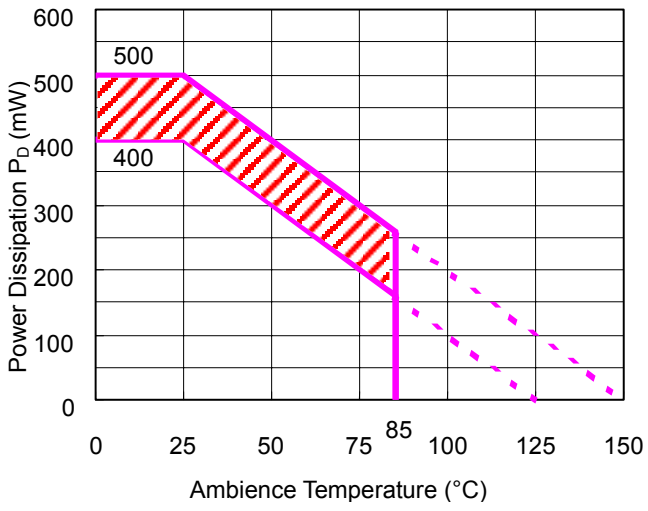
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

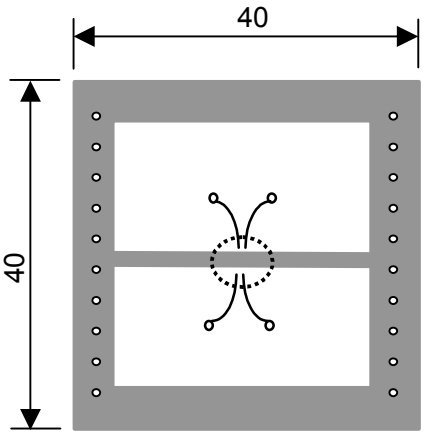
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm * 40mm * 1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.54mm * 24pcs

Measurement Result (Ta=25°C)

	Standard Test Land Pattern
Power Dissipation	400mW(Tjmax=125°C) 500mW(Tjmax=150°C)
Thermal Resistance	θja = (125-25°C)/0.4W= 250°C/W θjc = 67°C/W



Power Dissipation



Measurent Board Pattern

IC Mount Area (Unit:mm)

- Use in the oblique-line-area might be influence the product-life cycle, please suppress by 13,000 hours about use. 13,000 hours will correspond in nine years when using it for four hours a day.

POWER DISSIPATION (SOT-23-5)

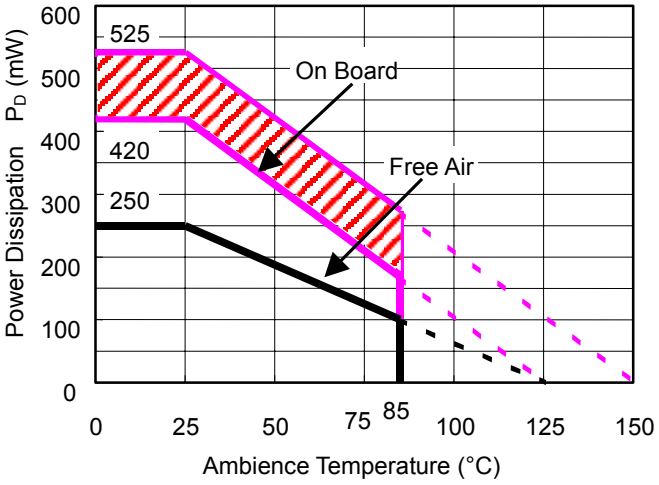
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

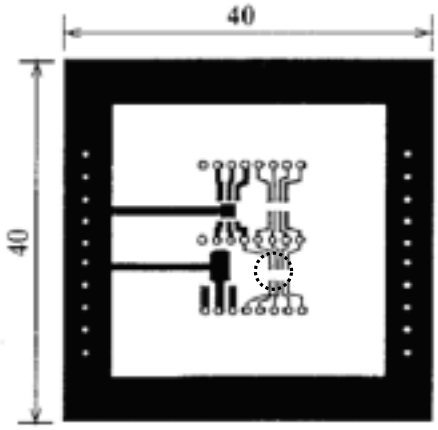
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm * 40mm * 1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.5mm * 44pcs

Measurement Result (Ta=25°C)

	Standard Test Land Pattern	Free Air
Power Dissipation	420mW(Tjmax=125°C) 525mW(Tjmax=150°C)	250mW(Tjmax=125°C)
Thermal Resistance	θja = (125-25°C)/0.42W= 263°C/W	400°C/W



Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit: mm)

- Use in the oblique-line-area might be influence the product-life cycle, please suppress by 9,000 hours about use. 9,000 hours will correspond in six years when using it for four hours a day.

POWER DISSIPATION (SC-82AB)

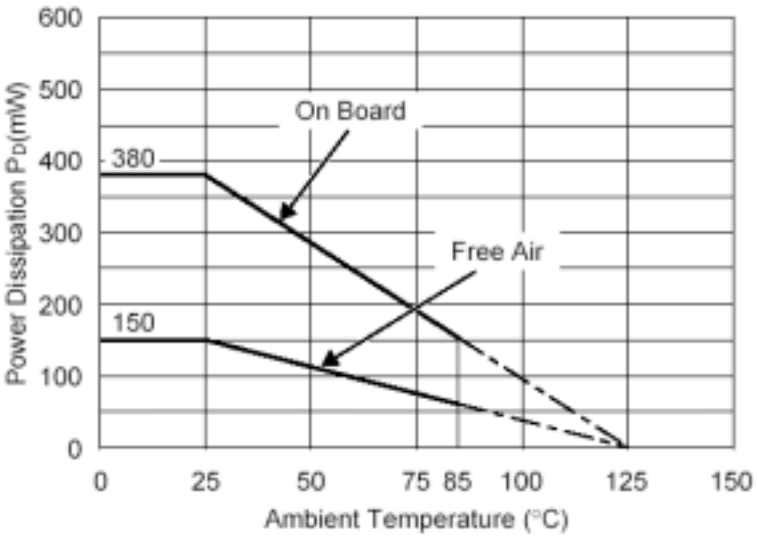
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

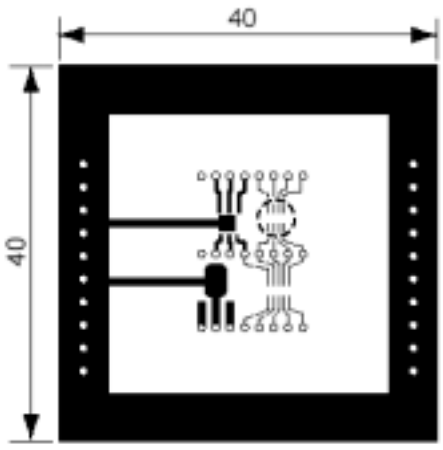
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plactic (Double sided)
Board Dimensions	40mm * 40mm * 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ 0.5mm*44pcs

Measurement Result (Topt=25°C,Tjmax=125°C)

	Standard Land Pattern	**Free Air**
Power Dissipation	380mW	150mW
Thermal Resistance	θja=(125-25°C)/0.38W=263°C/ W	667°C/ W



Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)