RICOH

LDO REGULATOR with RESET

R5511x SERIES

NO. EA-111-0407

OUTLINE

The R5511x Series are CMOS-based voltage regulator(LDO) ICs equipped with a voltage detector(VD). LDO function of the R5511x has features of high ripple rejection, low dropout voltage, high output voltage accuracy, and low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a current limit circuit, a voltage detector, and a chip enable circuit. The output of built-in voltage detector is Nch open drain type. (With the mask option CMOS output type is also available.)

The output voltage and the detector threshold voltage are fixed in the IC. Low supply current by the merit of CMOS process and the built-in transistor with low ON-resistance make low dropout voltage. These regulators in the R5511x Series are remarkable improvement on the current regulators in terms of ripple rejection, input transient response, and load transient response. Furthermore, the R5511x series can supervise input voltage (the input voltage means the input level for V_{DD} or V_{SEN} pin) with built-in detector. Thus, the R5511x series are suitable not only for cellular handsets but also for power supply for CD-drives, DVD-drives, and so forth.

Since the packages for these ICs are the SON-6, SOT-23-5, SOT-89-5 package, high density mounting of the ICs on boards is possible.

FEATURES

- Low Supply Current ..... Typ. 50μA (VR)
- Low Standby Current ..... Typ. 0.1μA (VR)
- High Ripple Rejection ..... Typ. 75dB (f=1kHz) (VR)
- Output Current ..... Min. 300mA
- High Output Voltage Accuracy .....±1.5% (V_{OUT} ≧ 2.0V), 30mV(2.0V>V_{OUT}>1.5V), 2.0%(1.5V ≧ V_{OUT})
  ±1.5% (V_{DET} ≧ 2.0V), 30mV(2.0V>V_{DET}>1.5V), 2.0%(1.5V ≧ V_{DET})
- Low Dropout Voltage..... Typ. 0.1V (V_{OUT}=3.0V, I_{OUT}=100mA) (VR)
- Built-in Current Limit Circuits (VR)
- Low Temperature-drift Coefficient of Output Voltage ..... Typ. ±100ppm/°C
- Absolute Maximum Voltage 6.5V
- Small Packages SON-6,SOT-23-5, SOT-89-5
- Built-in Reset Delay Circuits ..... A: (Delay time=1ms, Hysteresis5%)
  B: (Delay time=20ms, Hysteresis5%)
  C: (Delay time; 60ms, Hysteresis5%)
  D: (Delay time; 240ms, no Hysteresis)

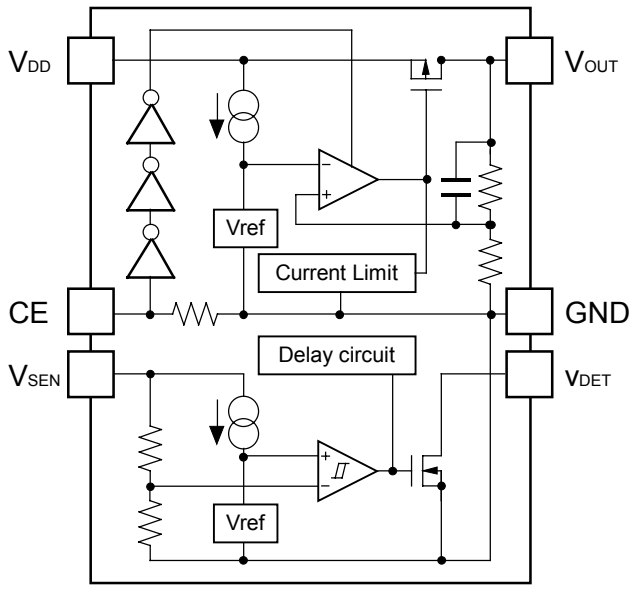
∗Delay time:120ms/ With or without hysteresis can be designated with user's request

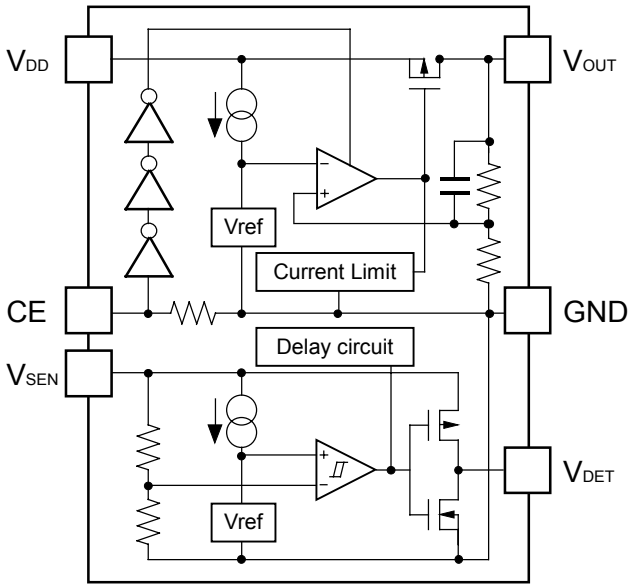
- Ceramic Capacitor Recommendation..... C_{IN}=C_{OUT}=Ceramic Capacitor 1.0μF or more.

APPLICATIONS

- CD-drives and DVD-drives
- Power source for Cellular Phone

BLOCK DIAGRAMS





∗In case 5-pin package is selected, V_{SEN} is connected to V_{DD} or V_{OUT} inside the chip.

SELECTION GUIDE

The output voltage setting code number, hysteresis, output delay time, V_{SENSE} connection option, the detector output type, the taping type can be selected at the user's request.

The selection can be made by designating the part number as follows;

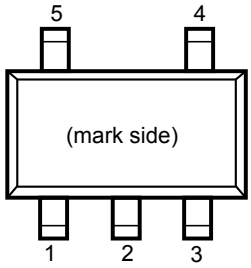
R5511xxxxxx-xx ←Part Number
↑ ↑ ↑↑ ↑
a b cd e

Code	Contents
a	Designation of the package: H: SOT-89-5, D: SON-6, N: SOT23-5
b	Designation of option; Serial number code of Output voltage and Detector Threshold setting, with/without hysteresis
c	Designation of Output Delay Time; A: 1ms, B: 20ms, C: 60ms, D: 240ms
d	Designation of Supervised pin, Detector Output type A: V_{DD} monitor Nch Open drain (5-pin package) B: V_{OUT} monitor Nch Open drain (5-pin package) C: V_{SEN} monitor Nch Open drain (6-pin package) D: V_{SEN} monitor CMOS Output (6-pin package)
e	Designation of Taping Type

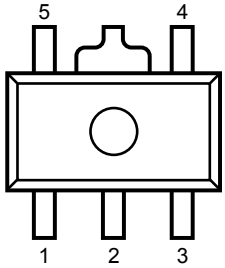
∗With Hysteresis / No delay time version can be designated.

PIN CONFIGURATION

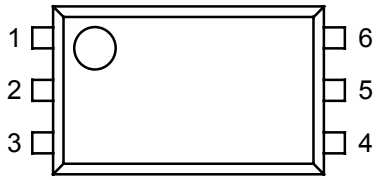
● **SOT-23-5**



● **SOT-89-5**



● **SON-6**



PIN DESCRIPTIONS

● **SOT-23-5**

Pin No	Symbol
1	CE
2	GND
3	V_{DET}
4	V_{DD}
5	V_{OUT}

● **SOT-89-5**

Pin No	Symbol
1	V_{DET}
2	GND
3	CE
4	V_{OUT}
5	V_{DD}

● **SON-6**

Pin No	Symbol
1	CE
2	GND
3	V_{OUT}
4	V_{DD}
5	V_{SEN}
6	V_{DET}

Symbol	Description
V_{OUT}	Voltage Regulator Output Pin
V_{DD}	Input and SENSE Pin of Voltage Detector
GND	Ground Pin
V_{DET}	Voltage Detector Output Pin (When the voltage detector detects the lowering voltage than setting threshold level, the output voltage level is “L”. While V_{DD} Input Level at reset detection or before crossing threshold level from higher voltage than it, the output voltage level is “H”.)
CE	Chip Enable Pin
V_{SEN}	V_{DET} SENSE Pin (In case of 5-lead packages, V_{SEN} is connected V_{DD} or V_{OUT} inside the package.)

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage (CE Input Pin) *Note	6.5	V
V_{SEN}	Input Voltage (V_{SEN} Pin)	6.5	V
V_{DET}	Output Voltage (V_{DET} Output pin)	CMOS Output : −0.3~ V_{IN} + 0.3 Ncn Open Drain : −0.3~ 6.5	V
V_{OUT}	Output Voltage	−0.3~ V_{IN} + 0.3	V
I_{OUT}	Output Current	400	mA
P_D	Power Dissipation (SON-6)	150	mW
	Power Dissipation (SOT-23-5)	250	
	Power Dissipation (SOT-89-5)	500	
Topt	Operating Temperature	−40~ 85	°C
Tstg	Storage Temperature	−55~ 125	°C

ELECTRICAL CHARACTERISTICS

- **R5511**

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage				6.0	V
I_{SS1}	Quiescent Current 1	V_{IN}−V_{OUT}=1.0V		50	80	μA
I_{SS2}	Quiescent Current 2	V_{IN}=−V_{DET}−0.1V, V_{CE}=0V		1.5	3.0	μA
I_{SS3}	Quiescent Current 3	V_{IN}=−V_{DET}+1.0V, V_{CE}=0V		1.5	3.0	μA

• VR Part

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output voltage	$V_{IN}-V_{OUT}$=1.0V I_{OUT}=30mA *Note1	×0.985 (−30mV) ×0.980		×1.015 (+30mV) ×1.020	V
I_{OUT}	Output Current	$V_{IN}-V_{OUT}$ = 1.0V	300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	$V_{IN}-V_{OUT}$ = 1.0V 1mA ≦ I_{OUT} ≦ 100mA *Note2		5	15	mV
V_{DIF}	Dropout Voltage	Refer to the Electrical Characteristics by Output Voltage				V
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	I_{OUT}=30mA V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V		0.05	0.15	%/V
RR	Ripple Rejection	f=1kHz,Ripple 0.5Vp−p $V_{IN}-V_{REG1}$=1.0V		75		dB
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT}=30mA −40°C ≦ Topt ≦ 85°C		±100		ppm /°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V		50		mA
R_{PD}	Pull-down resistance for CE pin		2	5	14	MΩ
V_{CEH}	CE Input Voltage “H”		1.1		V_{IN}	V
V_{CEL}	CE Input Voltage “L”		0.0		0.3	V

∗Note1: ±1.5% (V_{OUT} ≧ 2.0V), 30mV(2.0V>V_{OUT}>1.5V), 2.0%(1.5V ≧ V_{OUT})
∗Note2: Guaranteed by Design.

• VD Part

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	*Note3	×0.985 (−30mV) ×0.980		×1.015 (+30mV) ×1.020	V
V_{HYS}	Detector Threshold Hysteresis	Delay Time: 0ms, 20ms, 60ms	$-V_{DET}$ ×0.03	$-V_{DET}$ ×0.05	$-V_{DET}$ ×0.07	V
IOL IOH (CMOS Output)	Output Current	Refer to Electrical Characteristics by Detector Threshold				mA
V_{DDL}	Minimum Operating Voltage			0.65	0.80	V
$\Delta-V_{DET}/\Delta T$	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm /°C
t_{PLH}	Output Delay Time	Delay time=1ms	0.5	1.0	2.8	ms
		Delay time=20ms	16	20	24	
		Delay time=60ms	50	60	70	
		Delay time=240ms	200	240	280	

∗Note3: ±1.5% (V_{OUT} ≧ 2.0V), 30mV(2.0V>V_{OUT}>1.5V), 2.0%(1.5V ≧ V_{OUT})

• Electrical Characteristics by Output Voltage

Output Voltage V_{OUT} (V)	Dropout Voltage (mV)		
	Condition	V_{DIF}	
		Typ.	Max.
1.2V ≦ V_{SET}<1.5V	I_{OUT} = 100mA	180	280
1.5V ≦ V_{SET}<1.8V		160	220
1.8V ≦ V_{SET}<2.2V		140	200
2.2V ≦ V_{SET}<2.8V		120	170
2.8V ≦ V_{SET} ≦ 4.0V		100	150

• Electrical Characteristics by Detector Threshold

Nch Open Drain Type

Detector Threshold $-V_{DET}$ (V)	Output Current (mA)				
	Condition		IOL		
			Min.	Typ.	Max.
1.2V ≦ V_{DSET}<1.6V	V_{DD}=1.1V	V_{DS}=0.5V	1.1	2.8	5.0
1.6V ≦ V_{DSET}<3.1V	V_{DD}=1.5V		3.0	6.0	10.0
3.1V ≦ V_{DSET} ≦ 5.0V	V_{DD}=3.0V		8.0	11.0	15.0

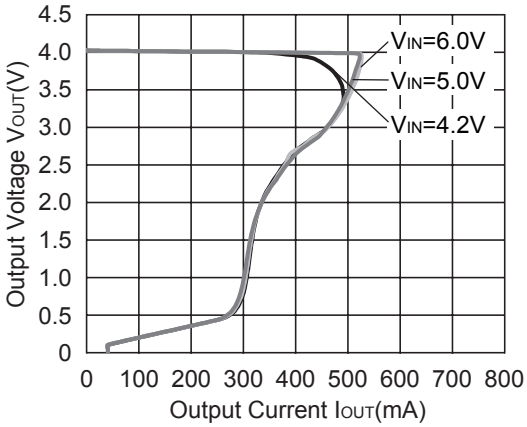
CMOS Output Type

Detector Threshold $-V_{DET}$ (V)	Output Current (mA)			
	Condition	IOH		
		Min.	Typ.	Max.
1.2V ≦ V_{DSET}<1.6V, VS=1.7V	V_{DD}=VS V_{DS}=VS×0.8	0.10	0.20	0.35
1.6V ≦ V_{DSET}<3.1V, VS=3.3V		0.55	0.90	1.40
3.1V ≦ V_{DSET} ≦ 5.0V, VS=5.4V		1.50	2.10	2.90

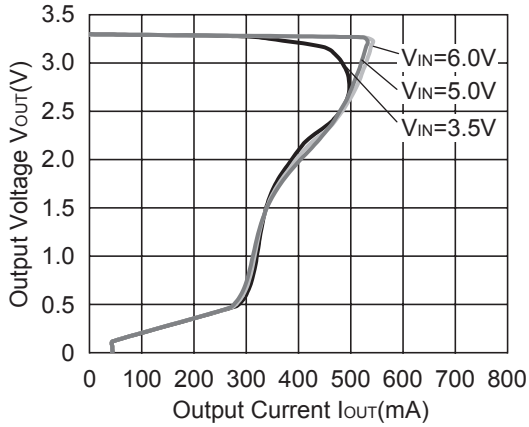
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25°C)

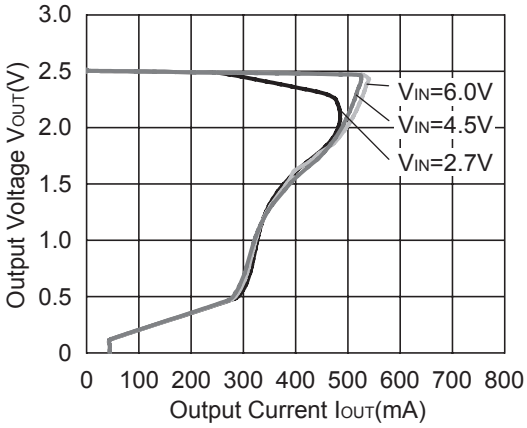
R5511x (VR=4.0V)



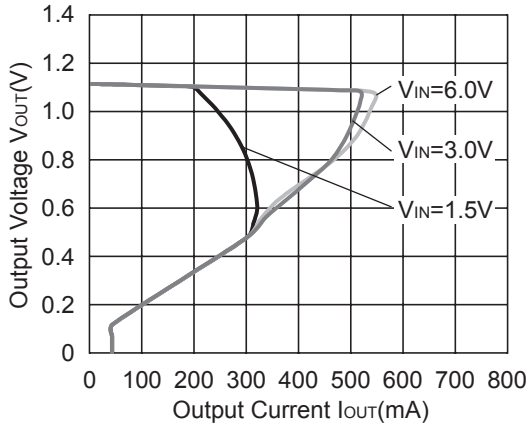
R5511x (VR=3.3V)



R5511x (VR=2.5V)

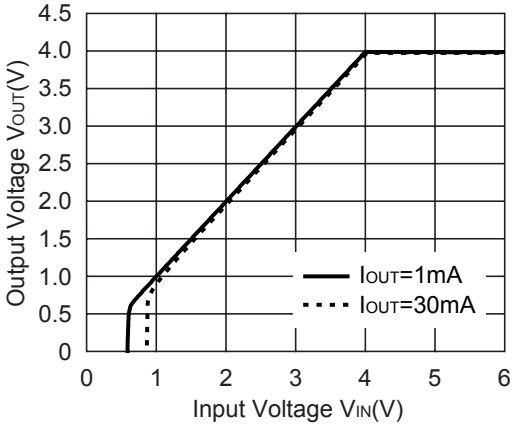


R5511x (VR=1.2V)

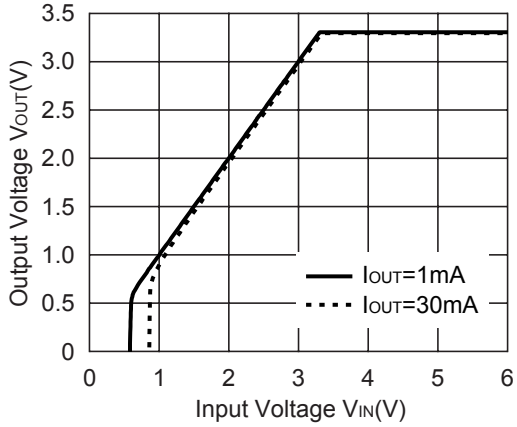


2) Input Voltage vs. Output Voltage (Topt=25°C)

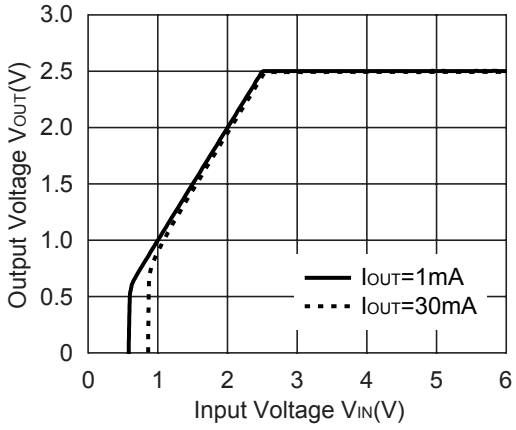
R5511x (VR=4.0V)



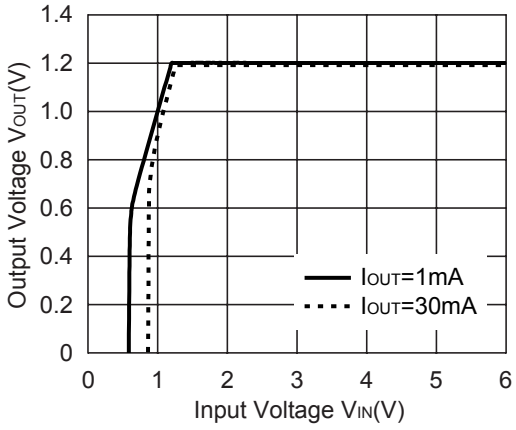
R5511x (VR=3.3V)



R5511x (VR=2.5V)

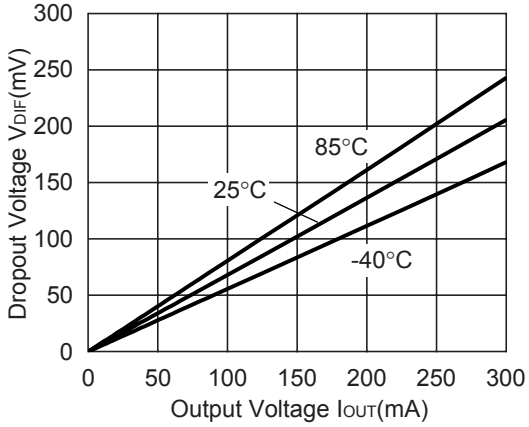


R5511x (VR=1.2V)

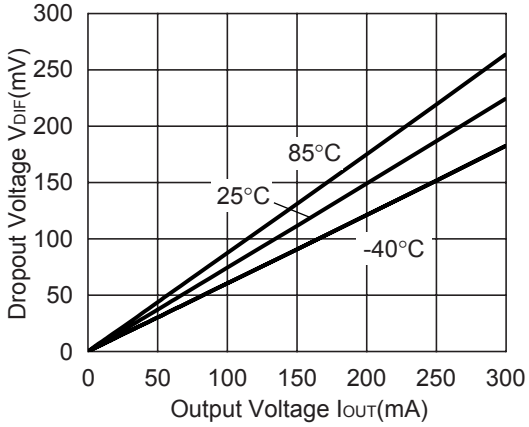


3) Dropout Voltage vs. Output Current

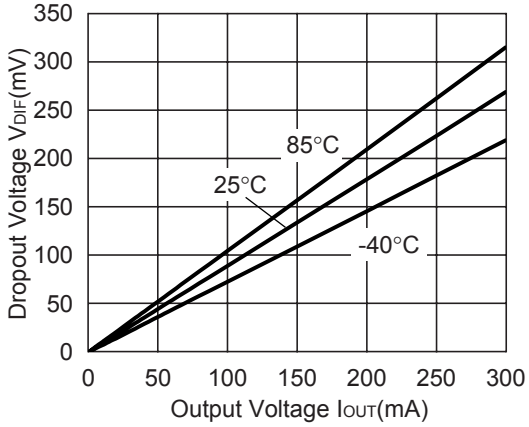
R5511x (VR=4.0V)



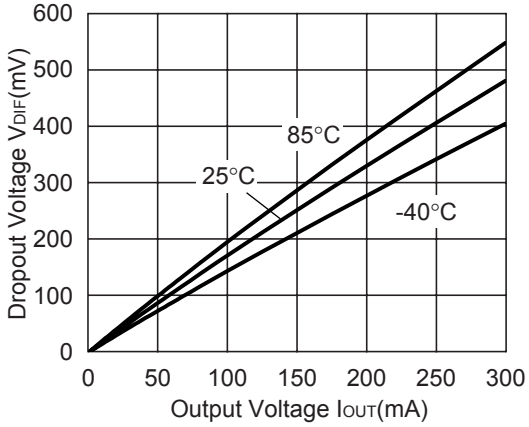
R5511x (VR=3.3V)



R5511x (VR=2.5V)

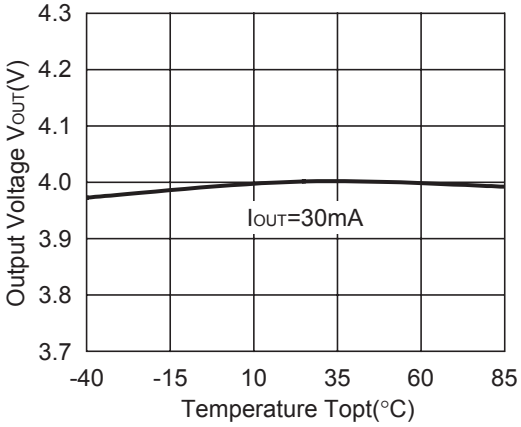


R5511x (VR=1.2V)

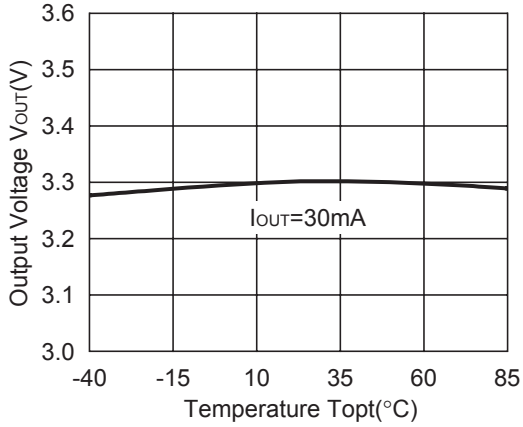


4) Output Voltage vs. Temperature

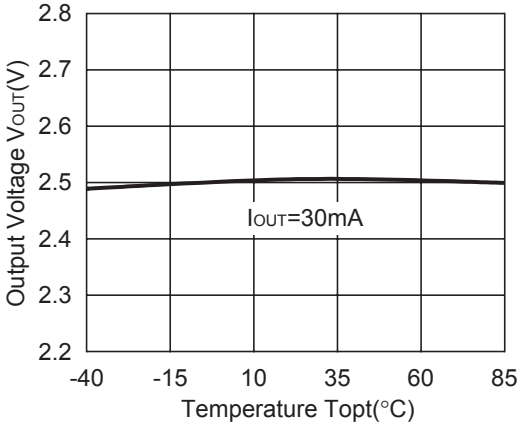
R5511x (VR=4.0V)



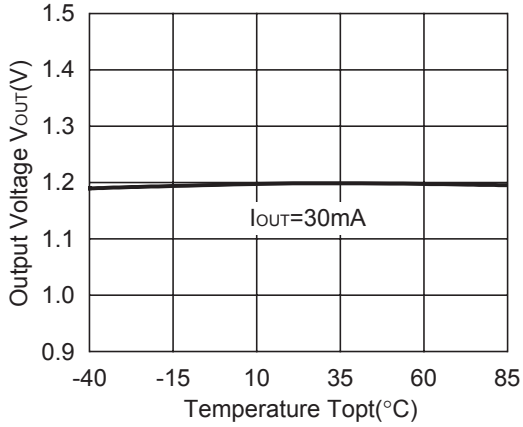
R5511x (VR=3.3V)



R5511x (VR=2.5V)

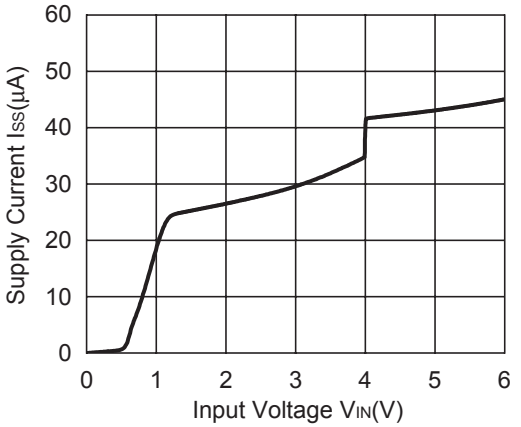


R5511x (VR=1.2V)

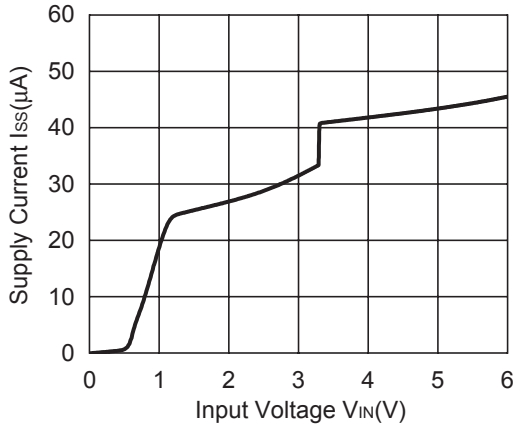


5) Supply Current vs. Input Voltage (Topt=25°C)

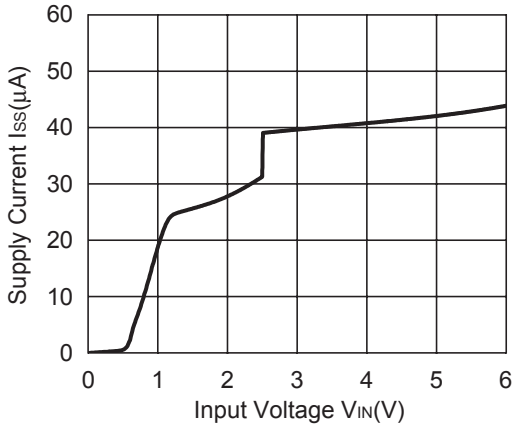
R5511x (VR=4.0V)



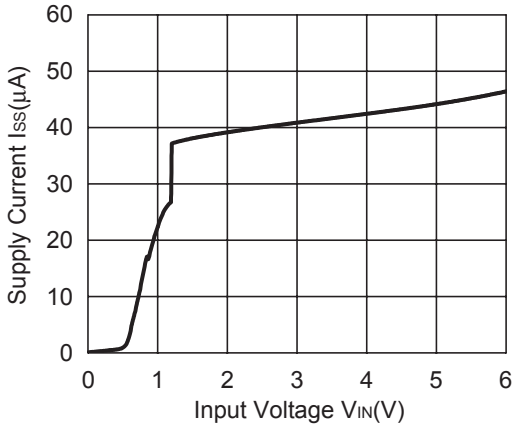
R5511x (VR=3.3V)



R5511x (VR=2.5V)

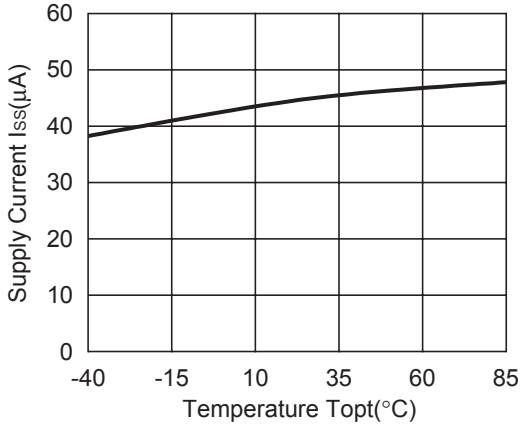


R5511x (VR=1.2V)

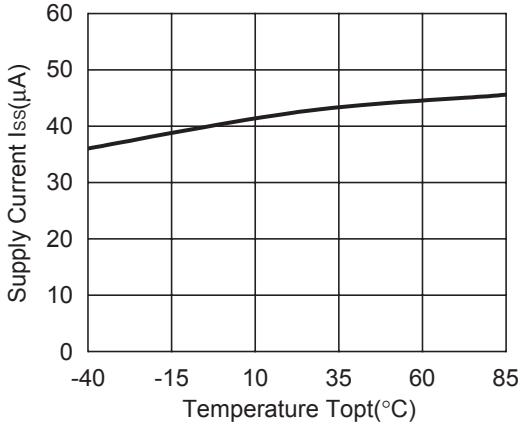


6) Supply Current vs. Temperature

R5511x (VR=4.0V)

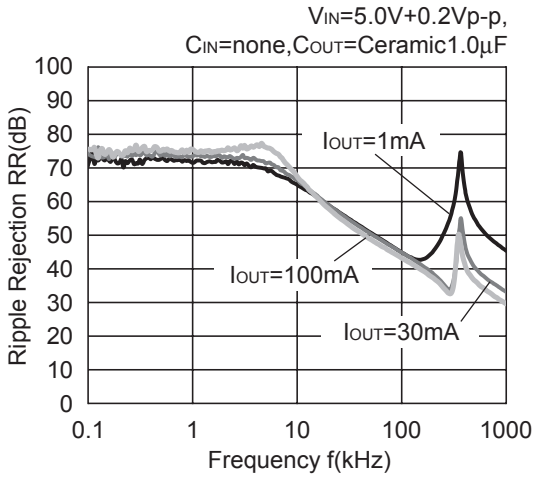


R5511x (VR=1.2V)

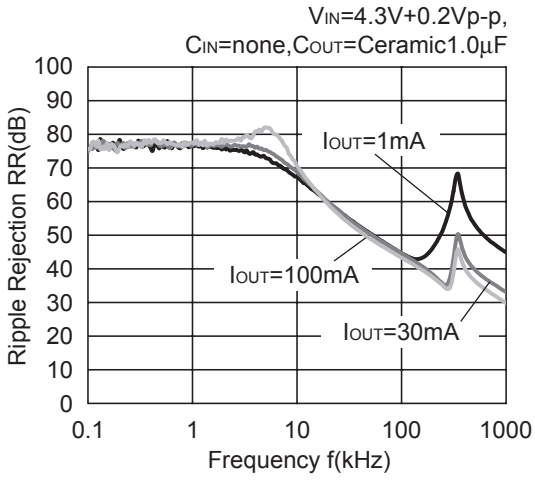


7) Ripple Rejection vs. Temperature (Topt=25°C)

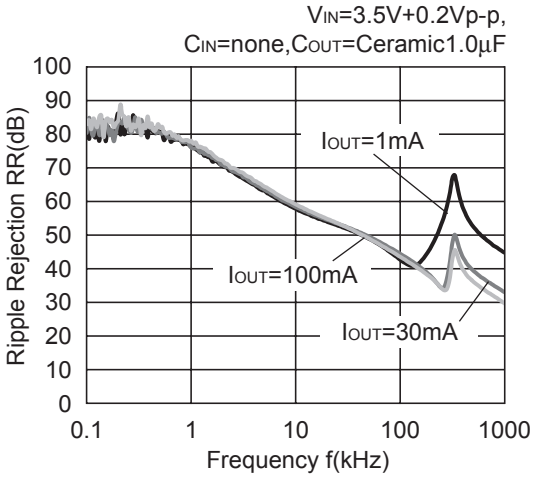
R5511x (VR=4.0V)



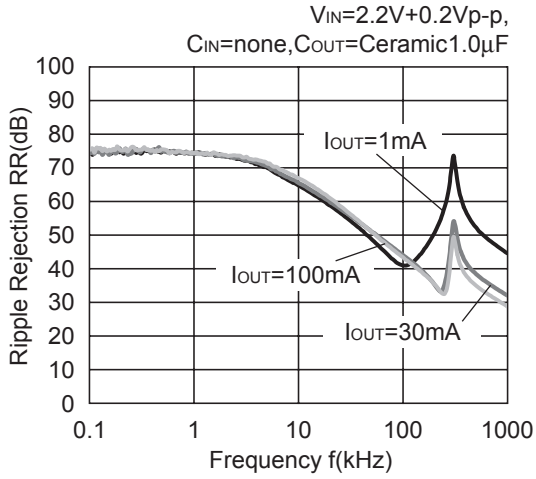
R5511x (VR=3.3V)



R5511x (VR=2.5V)

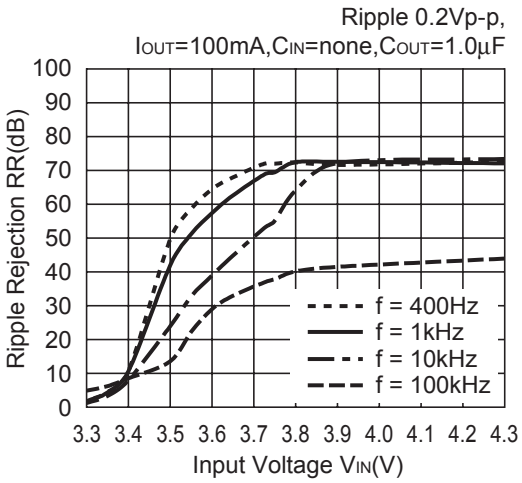


R5511x (VR=1.2V)

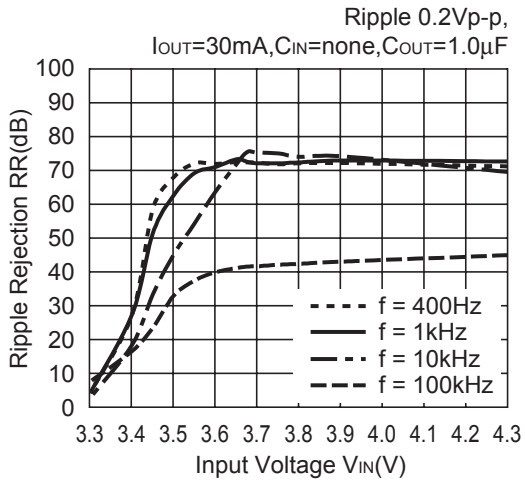


8) Ripple Rejection vs. Input Bias Voltage

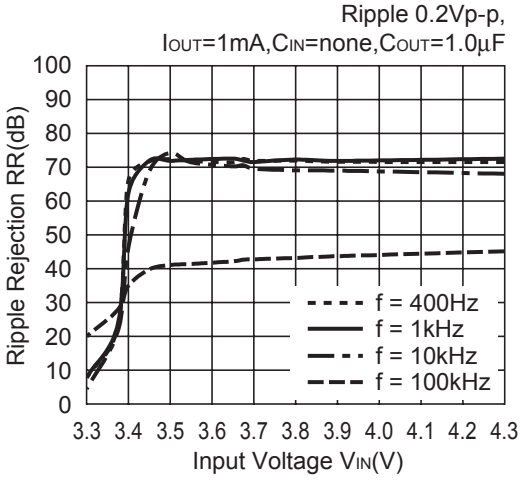
R5511x (VR=3.3V)



R5511x (VR=2.5V)

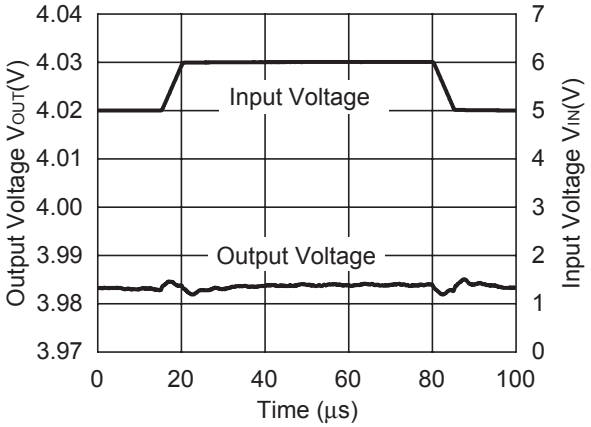


R5511x (VR=3.3V)

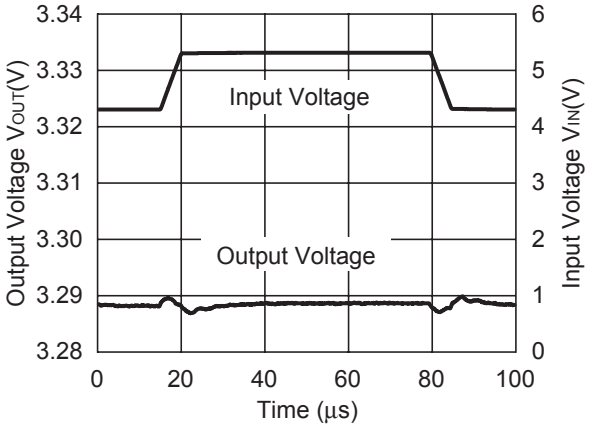


9) Input Transient Response

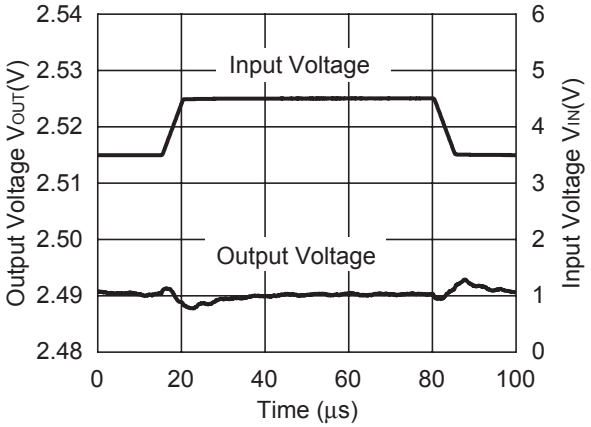
R5511x (VR=4.0V)



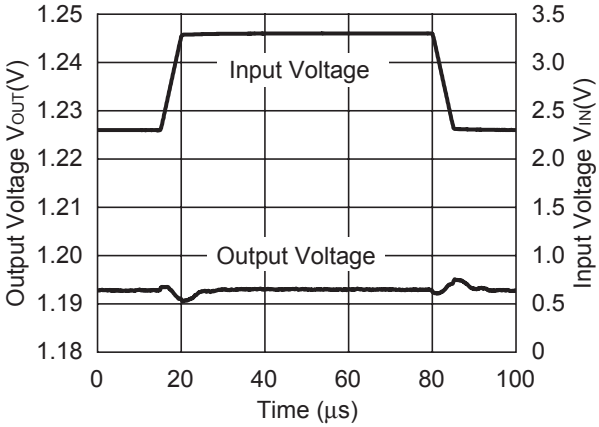
R5511x (VR=3.3V)



R5511x (VR=2.5V)

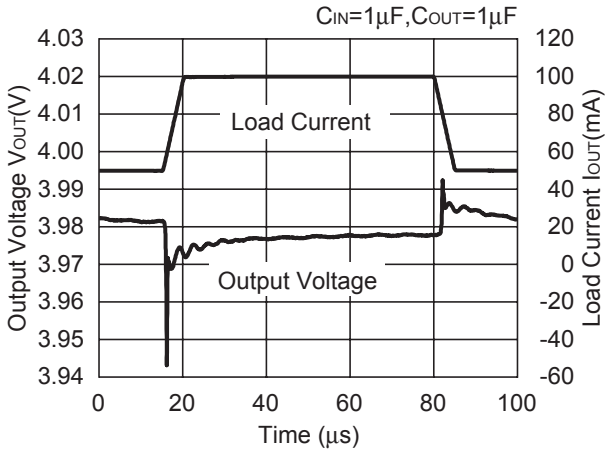


R5511x (VR=1.2V)

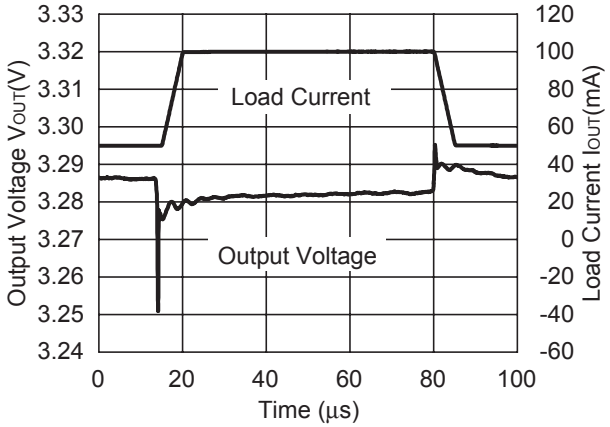


10) Load Transient Response

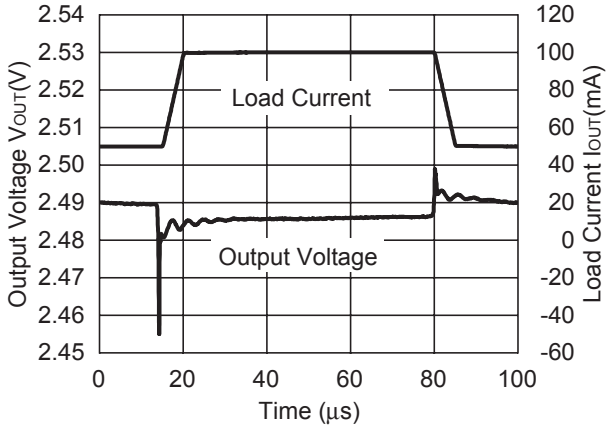
R5511x (VR=4.0V)



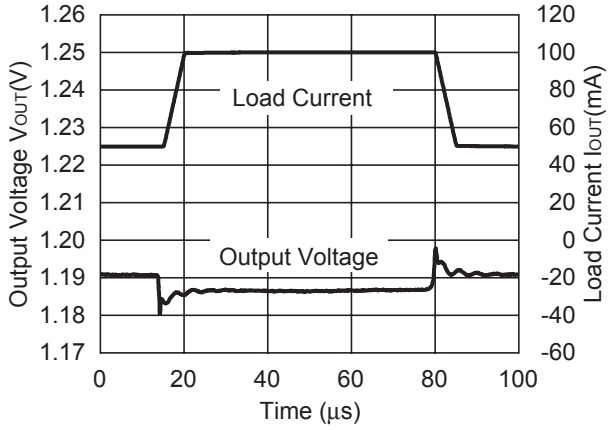
R5511x (VR=3.3V)



R5511x (VR=2.5V)

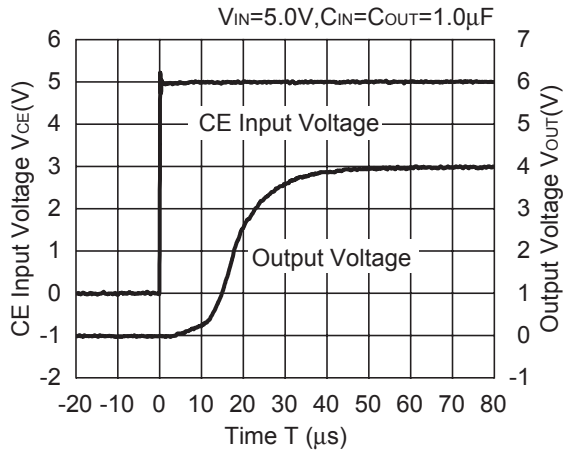


R5511x (VR=1.2V)

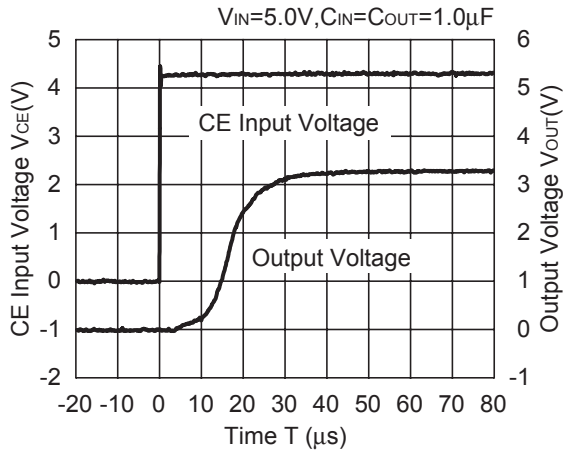


11) Turn-on Speed with CE

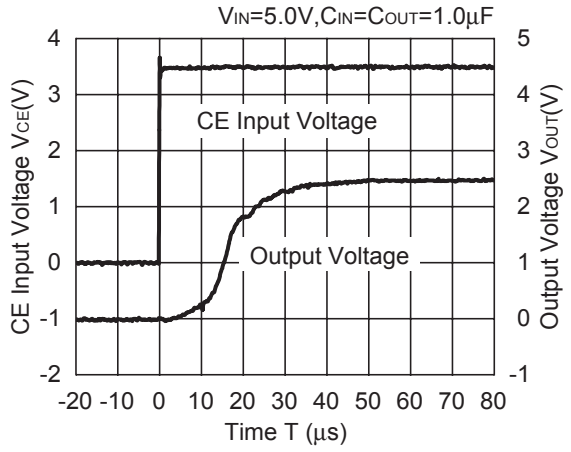
R5511x (VR=4.0V)



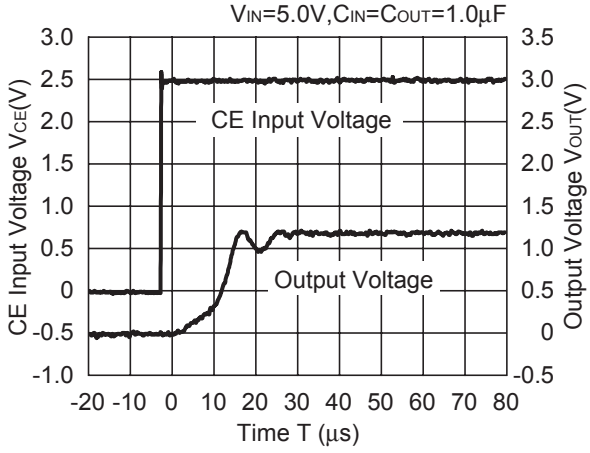
R5511x (VR=3.3V)



R5511x (VR=2.5V)

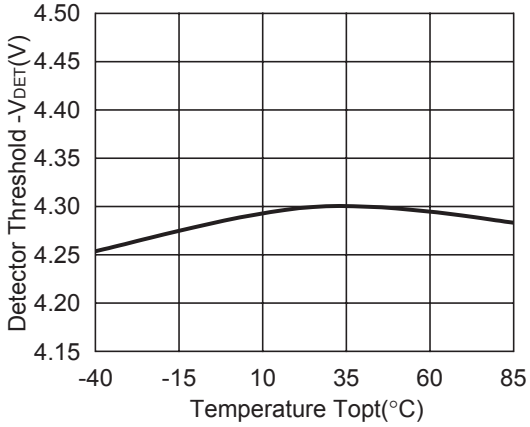


R5511x (VR=1.2V)

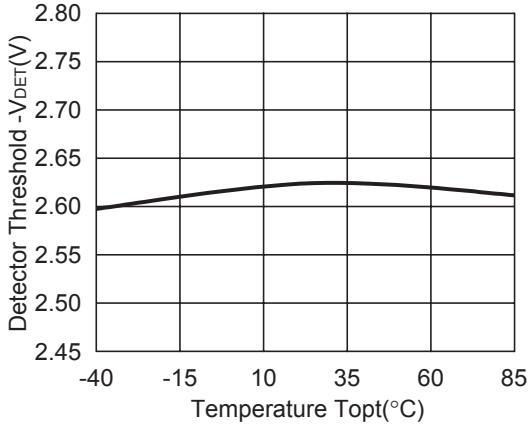


12) Detector Threshold vs. Temperature

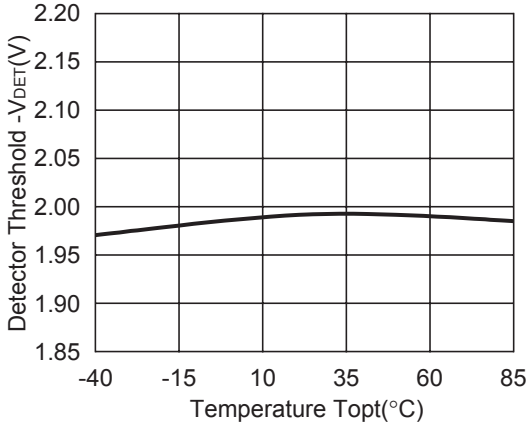
R5511x (–V_{DET}=4.3V)



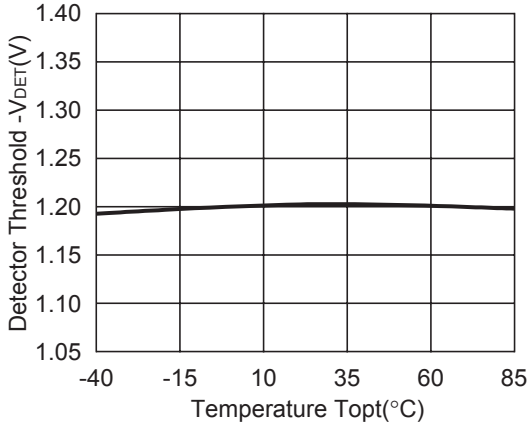
R5511x (–V_{DET}=2.63V)



R5511x (–V_{DET}=2.0V)

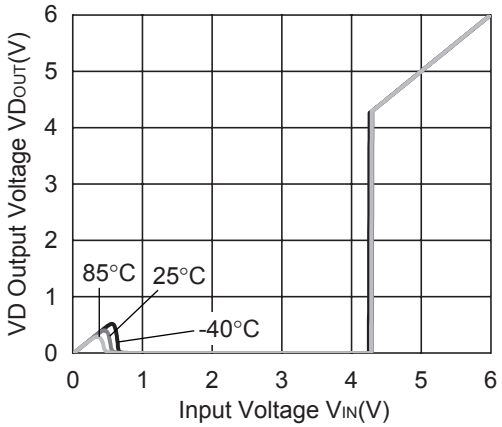


R5511x (–V_{DET}=1.2V)

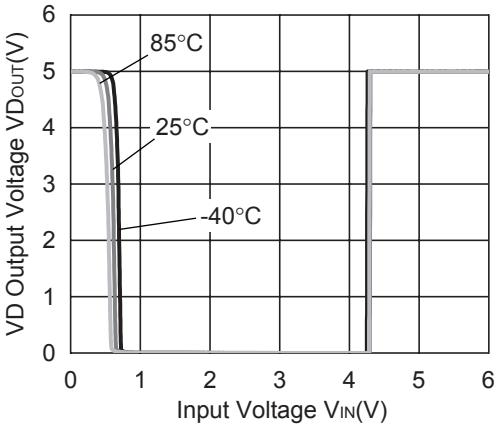


13) Detector Output Voltage vs. Input Voltage

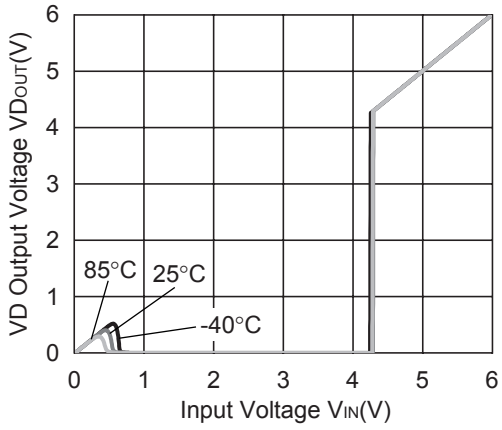
R5511x (–V_{DET}=4.3V V_{DD} pull-up)



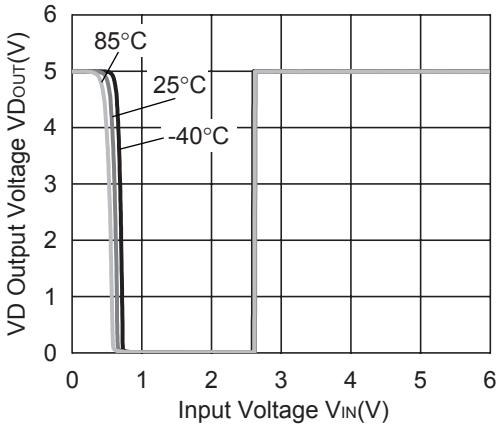
R5511x (–V_{DET}=4.3V 5.0V pull-up)



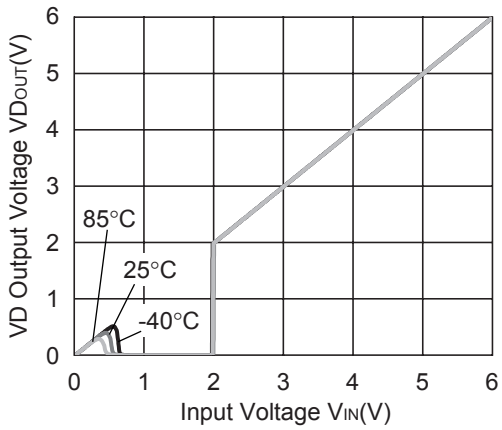
R5511x (–V_{DET}=2.63V V_{DD} pull-up)



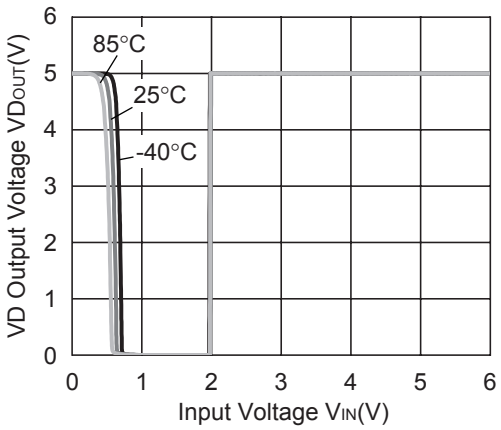
R5511x (–V_{DET}=2.63V 5.0V pull-up)



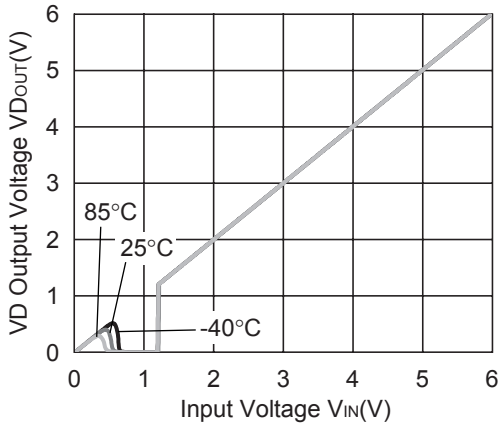
R5511x (–V_{DET}=2.0V V_{DD} pull-up)



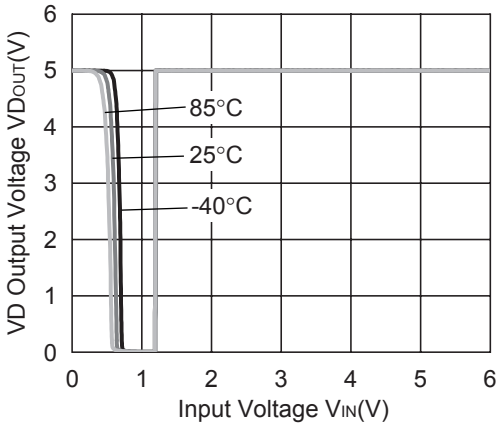
R5511x (–V_{DET}=2.0V 5.0V pull-up)



R5511x (–V_{DET}=1.2V V_{DD} pull-up)

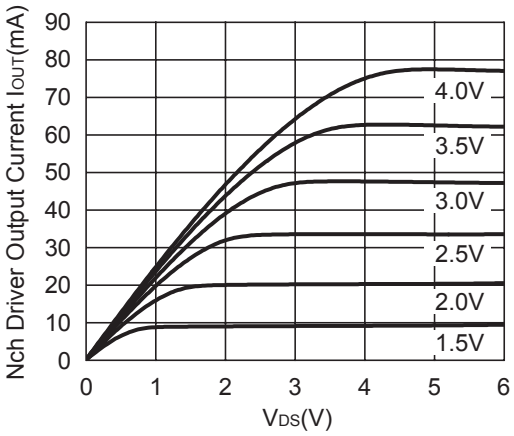


R5511x (–V_{DET}=1.2V 5.0V pull-up)

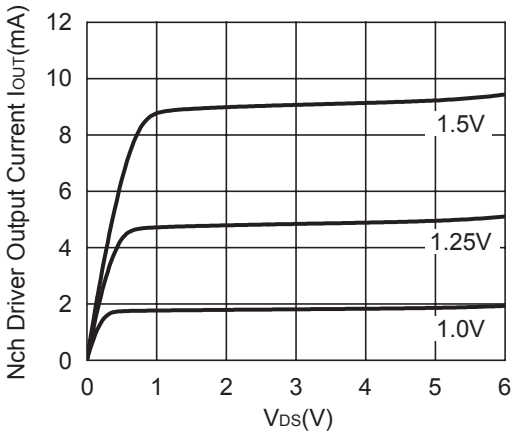


14) Nch Driver Output Current vs. V_{DS}

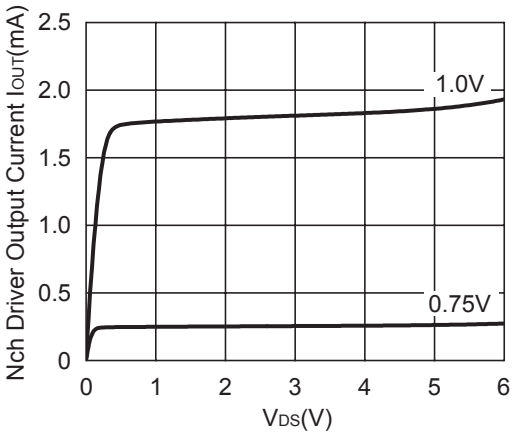
R5511x (–V_{DET}=4.3V)



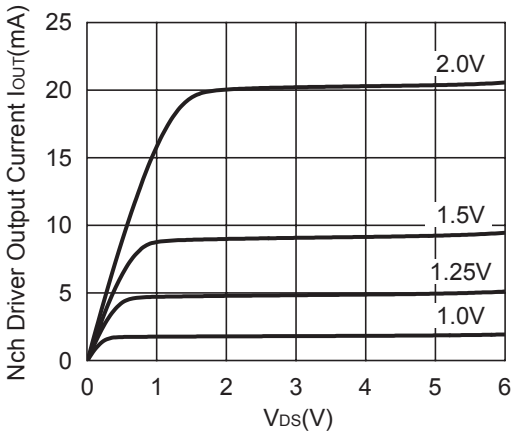
R5511x (–V_{DET}=2.0V)



R5511x (–V_{DET}=1.2V)

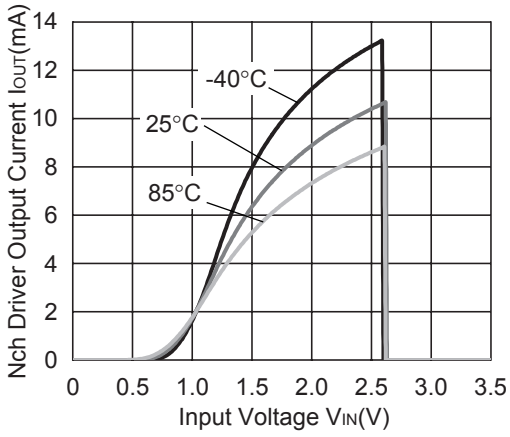


R5511x (–V_{DET}=2.63V)

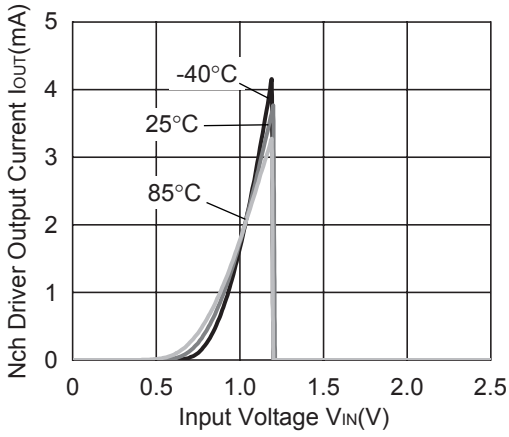


15) Nch Driver Output Current vs. Input Voltage

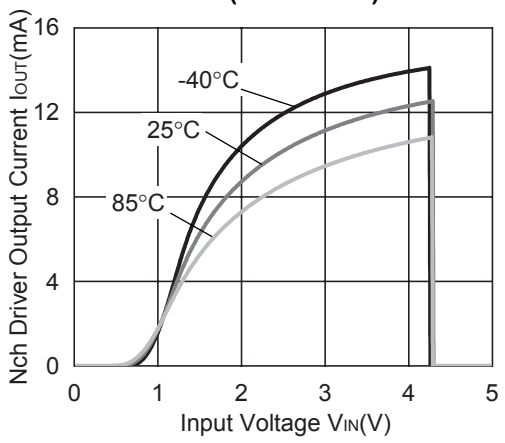
R5511x (–V_{DET}=2.63V)



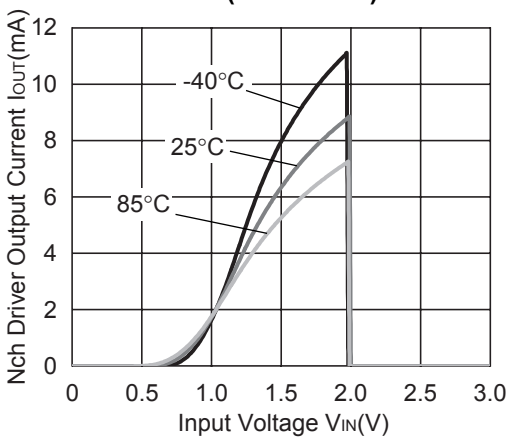
R5511x (–V_{DET}=1.2V)



R5511x (–V_{DET}=4.3V)

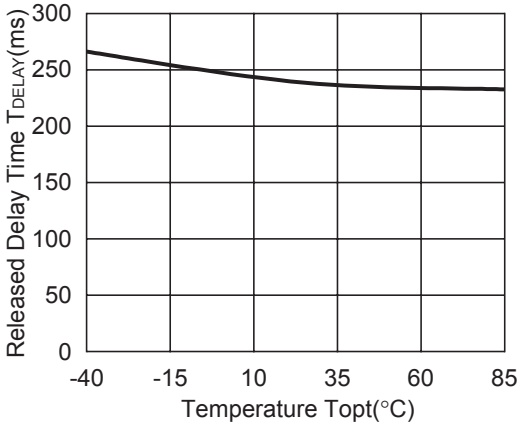


R5511x (–V_{DET}=2.0V)

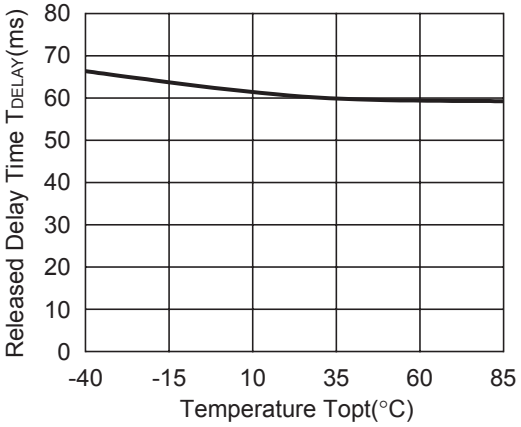


16) Released Delay Time vs. Temperature

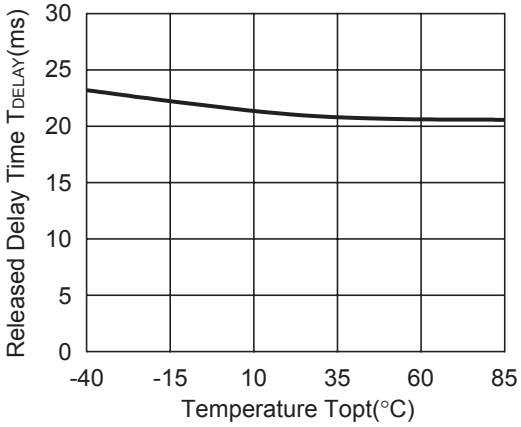
R5511x (T_{DELAY}=240ms)



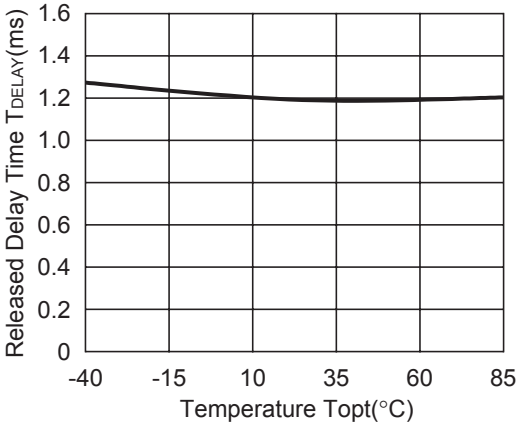
R5511x (T_{DELAY}=60ms)



R5511x (T_{DELAY}=20ms)



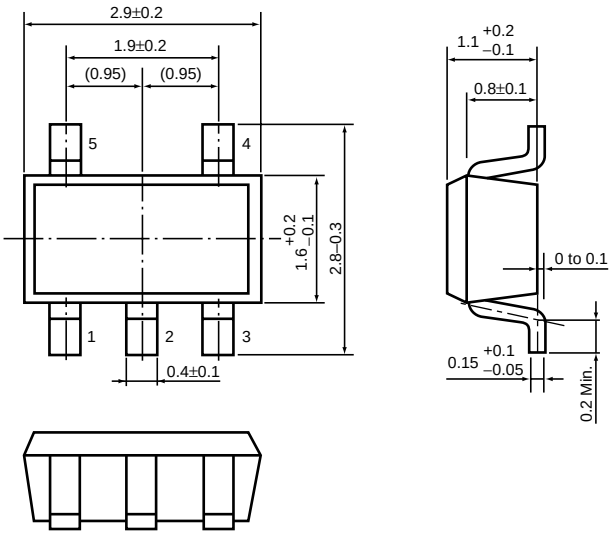
R5511x (T_{DELAY}=0ms)



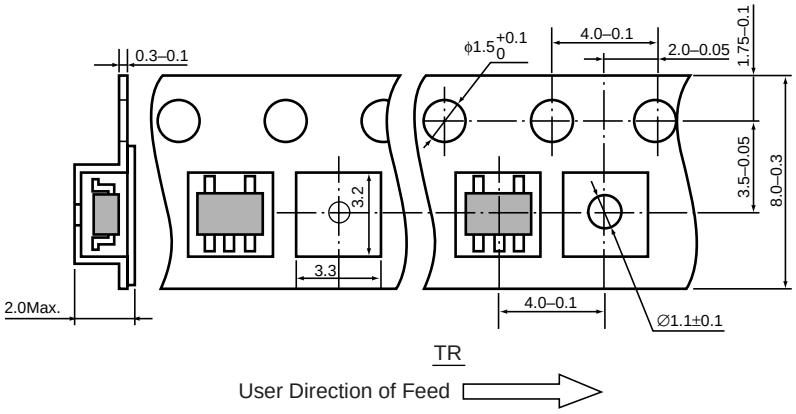
- **SOT-23-5 (SC-74A)**

Unit: mm

PACKAGE DIMENSIONS

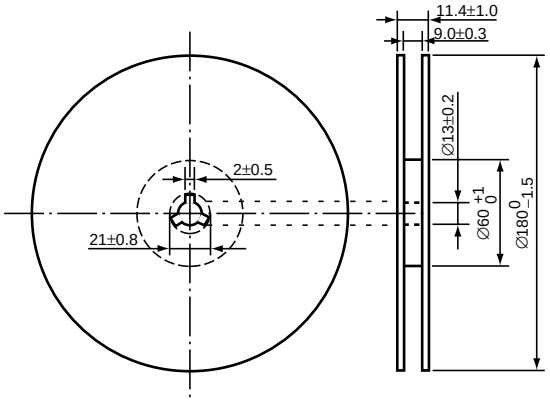


TAPING SPECIFICATION



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-08Bc)

(1reel=3000pcs)



POWER DISSIPATION (SOT-23-5)

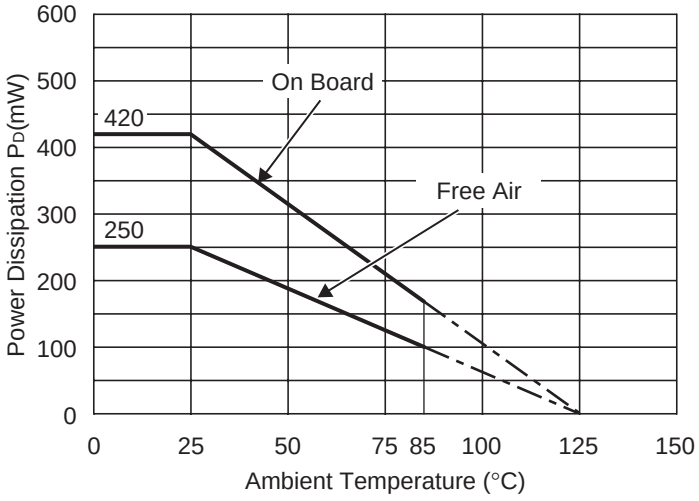
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

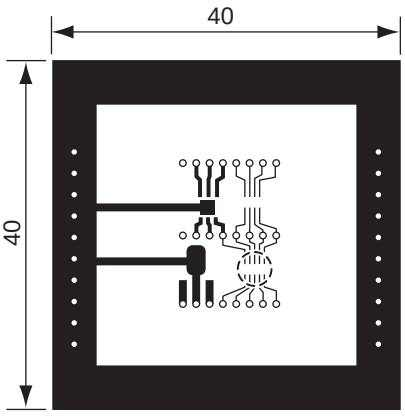
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.5mm × 44pcs

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

	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	θja=(125−25°C)/0.42W=238°C/W	400°C/W



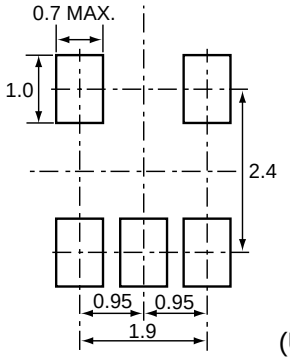
Power Dissipation



Measurement Board Pattern

IC Mount Area Unit : mm

RECOMMENDED LAND PATTERN

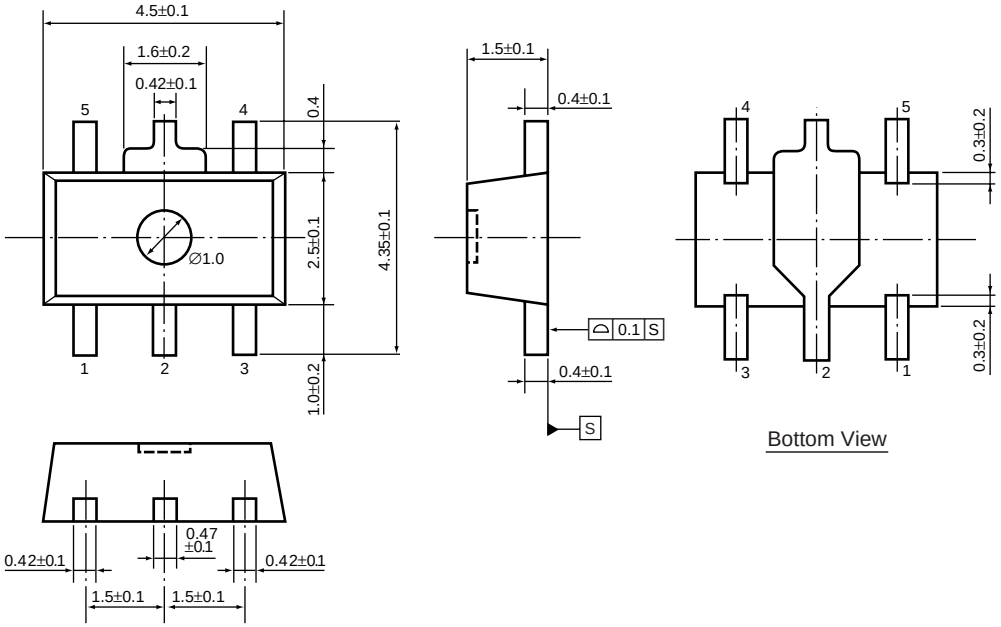


(Unit: mm)

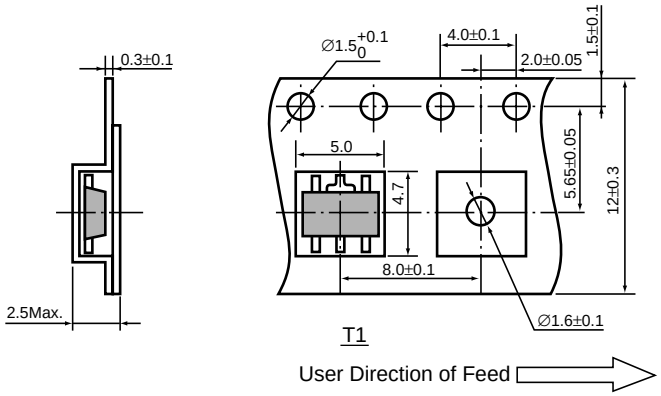
- **SOT-89-5**

Unit: mm

PACKAGE DIMENSIONS

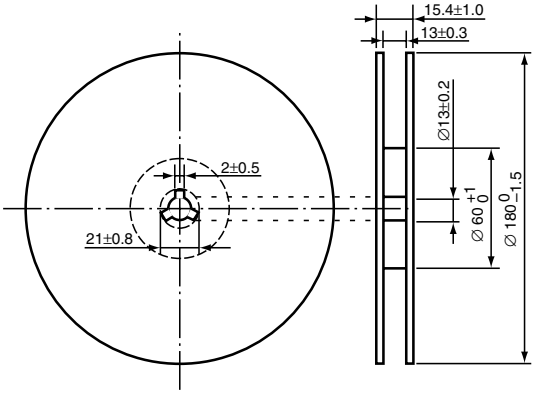


TAPING SPECIFICATION (T1: Standard Type)



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-12Bc)

(1reel=1000pcs)



POWER DISSIPATION (SOT-89-5)

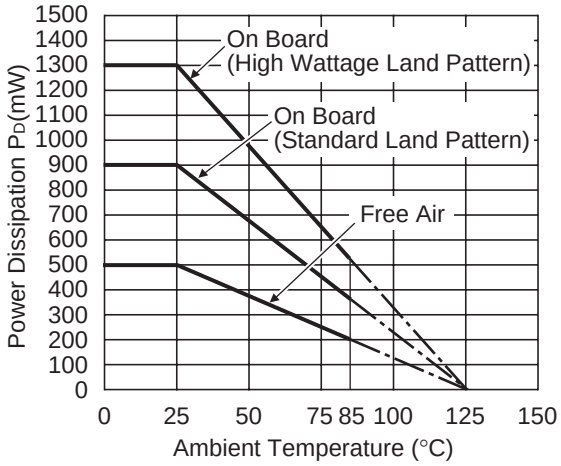
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

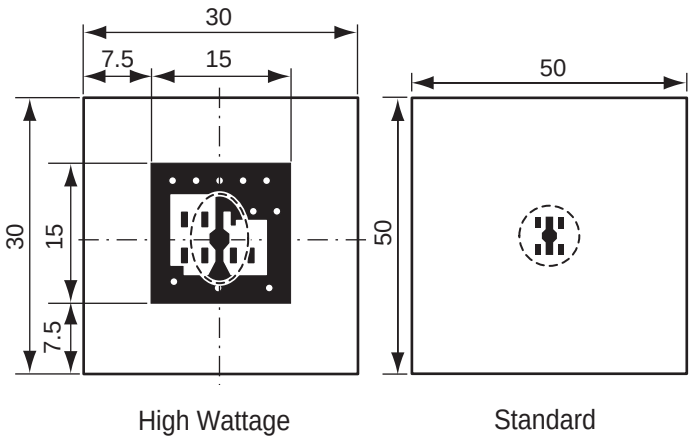
	High Wattage Land Pattern	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)	Glass cloth epoxy plastic (Double sided)
Board Dimensions	30mm × 30mm × 1.6mm	50mm × 50mm × 1.6mm
Copper Ratio	Top side : Approx. 20% , Back side : Approx. 100%	Top side : Approx. 10% , Back side : Approx. 100%
Through-hole	ϕ0.85mm × 10pcs	-

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

	High Wattage Land Pattern	Standard Land Pattern	Free Air
Power Dissipation	1300mW	900mW	500mW
Thermal Resistance	77°C/W	111°C/W	200°C/W



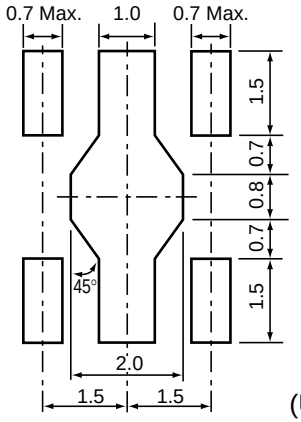
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

RECOMMENDED LAND PATTERN (SOT-89-5)

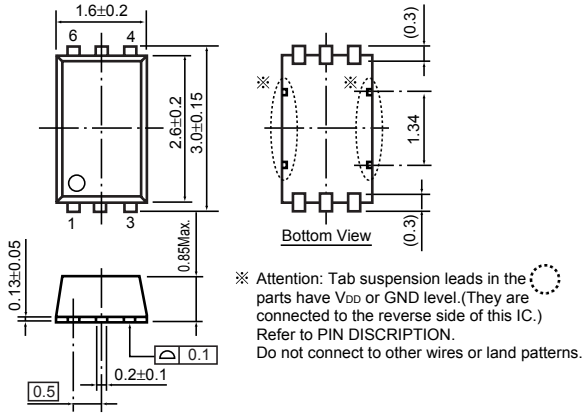


(Unit : mm)

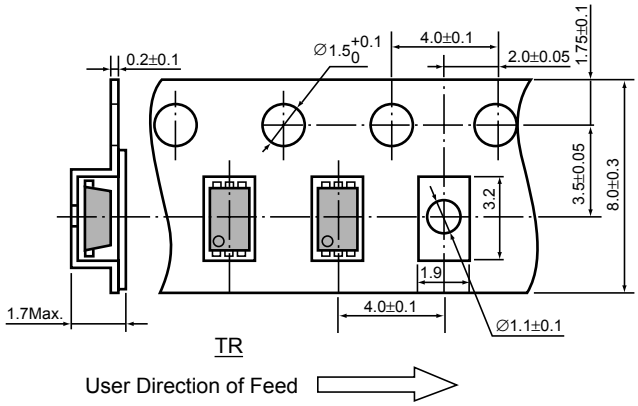
- **SON-6**

Unit: mm

PACKAGE DIMENSIONS

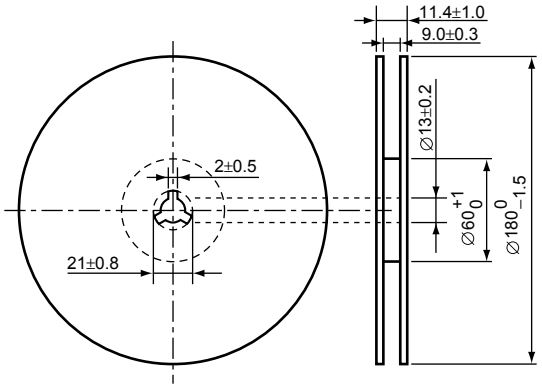


TAPING SPECIFICATION



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-08Bc)

(1reel=3000pcs)



POWER DISSIPATION (SON-6)

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:

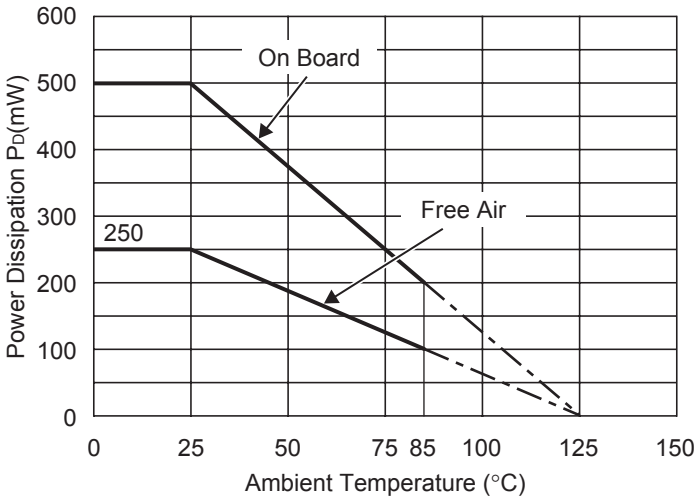
Measurement Conditions

	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	ϕ0.5mm × 44pcs

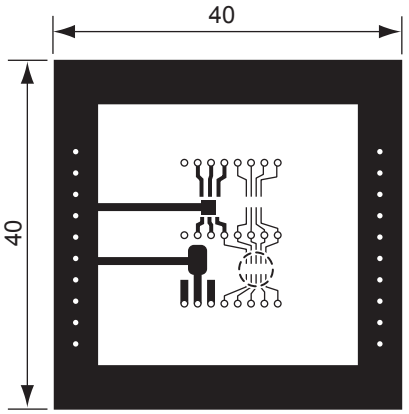
Measurement Result

(Topt=25°C,Tjmax=125°C)

	Standard Land Pattern	Free Air
Power Dissipation	500mW	250mW
Thermal Resistance	θja=(125−25°C)/0.5W=200°C/W	-



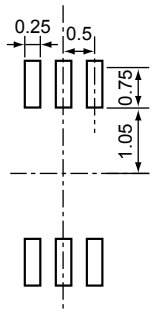
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

RECOMMENDED LAND PATTERN



(Unit: mm)