300 mA LDO Regulator with the Reverse Current Protection for Automotive Applications

NO.EC-229-220315

OUTLINE

R1191x Series are a low supply current voltage regulator with high output voltage accuracy. The maximum operating voltage is 16V. These ICs can switch to the fast mode and the low power mode by the low power / fast mode changer pin (ECO pin) without changing the output voltage value.

Each of these ICs consists of a voltage reference unit, an error amplifier, a resistor-net for voltage setting, a short current limit circuit, a thermal shutdown circuit and a chip enable circuit.

Moreover, the R1191x Series has the reverse current protection function, which protects the reverse current flow into V_{DD} pin when the output pin voltage becomes higher than the V_{DD} pin voltage. Thus it is suitable for the back-up circuit.

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

FEATURES

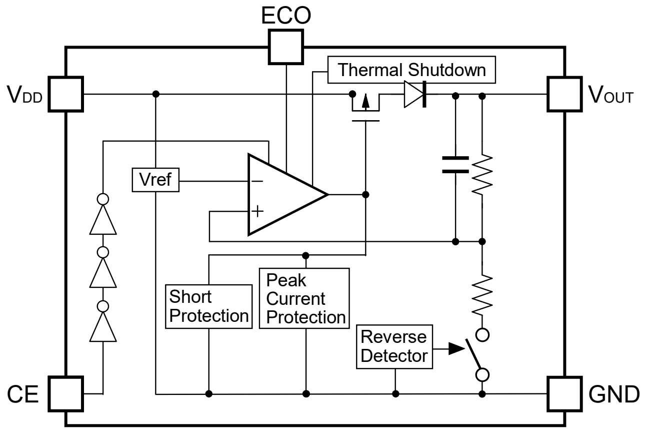
- Input Voltage Range (Maximum Rating).............. 3.5V to 16.0V (18 V)
- Supply Current .... Typ. 50μA (Fast Mode),
  Typ. 6.0μA (Low Power Mode)
- Standby Mode .... Typ. 0.3μA
- Reverse Current.. Max. 0.1μA
- Output Current .... Min. 300mA
- Output Voltage Range.. 2.0V to 15.0V (0.1V steps)
- Output Voltage Accuracy..................................... ±1.5% (Fast Mode)
  ±2.5% (Low Power Mode)
- Temperature-Drift Coefficient of Output Voltage .. Typ. ±80ppm/°C
- Dropout Voltage .... Typ. 0.55V (Fast Mode, I_{OUT}=300mA ,V_{OUT}=5.0V)
  Typ. 0.70V (Low Power Mode, I_{OUT}=300mA,V_{OUT}=5.0V)
- Ripple Rejection .... Typ. 60dB (f=1kHz,V_{OUT}=5.0V, Fast Mode)
- Line Regulation .... Typ. 0.02%/V (Fast Mode)
- Packages SOT-23-5, SOT-89-5
- Built-in fold-back protection circuit .... Typ. 50mA (Current at short mode)
- Built-in Thermal Shutdown Circuit........................ Shutdown Temperature at 150°C
- Ceramic capacitors are recommended to be used with this IC ··· C_{IN}=2.2μF or more, C_{OUT}=4.7μF or more

APPLICATIONS

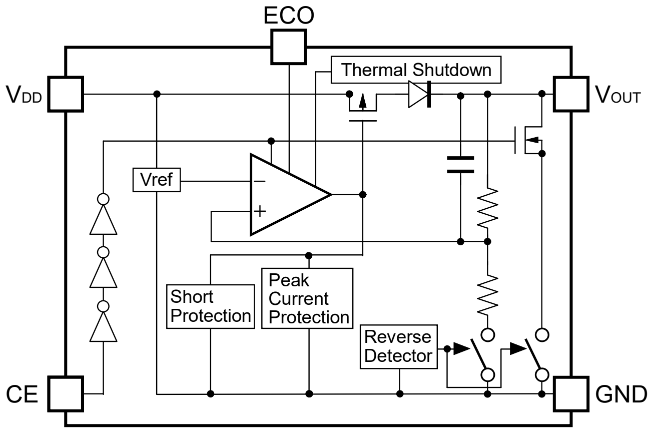
- Power source for accessories such as car audios, car navigation systems, and ETC systems

BLOCK DIAGRAM

R1191xxxxB



R1191xxxxD



SELECTION GUIDE

The output voltage, auto-discharge function, and package, for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1191Nxxx∗-TR-#E	SOT-23-5	3,000 pcs	Yes	Yes
R1191Hxxx∗-T1-#E	SOT-89-5	1,000 pcs	Yes	Yes

xxx : The output voltage can be designated in the range from 2.0V(020) to 15.0V(150) in 0.1V steps.

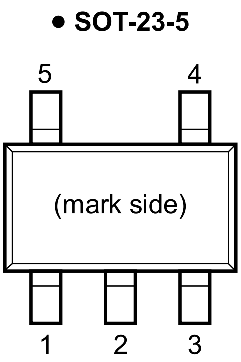
∗ : The auto discharge function at off state options are as follows.
(B) without auto discharge function at off state.
(D) with auto discharge function at off state.

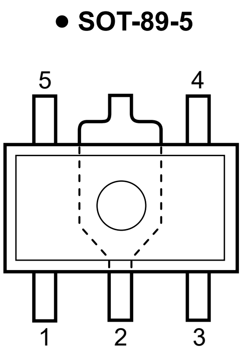
: Specify Automotive Class Code

	Operating Temperature Range	Guaranteed Specs Temperature Range	Screening
A	-40°C to 85°C	25°C	High Temperature

Auto-discharge function quickly lowers the output voltage to 0V, when the chip enable signal is switched from the active mode to the standby mode, by releasing the electrical charge accumulated in the external capacitor.

PIN DISCRIPTIONS





- **SOT-23-5**

Pin No	Symbol	Pin Description
1	ECO	Low Power / Fast Mode Changer Pin ("H": Fast Mode)
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{OUT}	Output pin
5	V_{DD}	Input Pin

- **SOT-89-5**

Pin No	Symbol	Pin Description
1	V_{OUT}	Output pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	ECO	Low Power / Fast Mode Changer Pin ("H": Fast Mode)
5	V_{DD}	Input Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	–0.3 to 18.0	V
V_{CE}	Input Voltage (CE Pin)	–0.3 to 18.0	V
V_{ECO}	Input Voltage (ECO Pin)	–0.3 to V_{IN} + 0.3 ≤ 18.0	V
V_{OUT}	Output Voltage	–0.3 to 18.0	V
I_{OUT}	Output Current	400	mA
P_D	Power Dissipation	Refer to the Power Dissipation in the supplementary item	
Tj	Junction Temperature	–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 RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	3.5 to 16	V
Ta	Operating Temperature Range	−40 to 85	°C

RECOMMENDED OPERATING RATINGS

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

ELECTRICAL CHARACTERISTICS

V_{IN}=V_{CE}=Set V_{OUT}+3.0V (Max.16V), C_{IN}=2.2μF, C_{OUT}=4.7μF I_{OUT}=1mA, unless otherwise noted.
The specifications surrounded by ☐ are guaranteed by Design Engineering at −40°C ≤Ta≤ 85°C.

R1191xxxxB/D

(Ta=25°C)

Symbol	Item		Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Fast Mode	V_{ECO}=V_{IN}	Ta=25°C	×0.985		×1.015	V
				−40°C ≤ Ta ≤ 85°C	×0.970		×1.030	
		Low Power Mode	V_{ECO}=0V	Ta=25°C	×0.975		×1.025	
				−40°C ≤ Ta ≤ 85°C	×0.960		×1.040	
ΔV_{OUT}	Output Voltage Deviation between Fast Mode and Low Power Mode				−1.5	0	1.5	%
I_{OUT}	Output Current				300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	Fast Mode	V_{ECO}=V_{IN}, 1mA ≤ I_{OUT} ≤ 300mA			50	120	mV
		Low Power Mode	V_{ECO}=GND, 1mA ≤ I_{OUT} ≤ 300mA			60	130	
V_{DIF}	Dropout Voltage		Refer to the following table					
I_{SS1}	Supply Current (Fast Mode)		V_{ECO}=V_{IN}, I_{OUT}=0mA			50	100	μA
I_{SS2}	Supply Current (Low Power Mode)		V_{ECO}=GND, I_{OUT}=0mA			6	15	μA
$I_{standby}$	Supply Current (Standby)		V_{IN}=16V, V_{CE}=0V (If V_{OUT} < 3.0V, V_{IN}=14V)			0.3	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation		Set V_{OUT}+0.5V ≤ V_{IN} ≤ 16V (If Set V_{OUT} < 3.0V, 3.5V ≤ V_{IN} ≤ 14V)			0.02	0.10	%/V
I_{SC}	Short Current Limit		V_{OUT}=0V			50		mA
V_{CEH}	CE, ECO Input Voltage "H"				1.6		V_{IN}	V
V_{CEL}	CE, ECO Input Voltage "L"				0		0.6	V
T_{TSD}	Thermal Shutdown Temperature		Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature		Junction Temperature			130		°C
R_{LOW}	Low Output Nch Tr. ON Resistance (of D Version)		V_{IN}=5V, V_{CE}=0V, V_{OUT}=0.3V			150		Ω
I_{REV}	Reverse Current		V_{OUT}> 0.6V, 0V ≤ V_{IN} ≤ 16V			0	0.1	μA

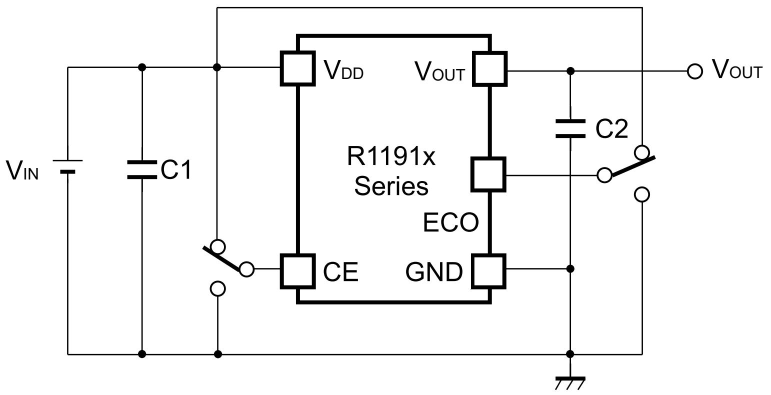
All test items listed under Electrical Characteristics are done under the pulse load condition (Tj≈Ta=25ºC).

The specifications surrounded by ☐ are guaranteed by Design Engineering at −40°C ≤Ta≤ 85°C.

Dropout Voltage (Ta=25°C)

Output Voltage V_{OUT} (V)	Condition	Dropout Voltage V_{DIF} (V)			
		ECO="H"		ECO="L"	
		Typ.	Max.	Typ.	Max.
2.0 ≤ V_{OUT} < 2.5	I_{OUT}=300mA	1.20	1.80	2.5	3.0
2.5 ≤ V_{OUT} < 3.3		1.00	1.50	2.0	2.5
3.3 ≤ V_{OUT} < 5.0		0.75	1.00	1.5	1.8
5.0 ≤ V_{OUT} < 12.0		0.55	0.75	0.7	1.0
12.0 ≤ V_{OUT}		0.40	0.60	0.4	0.6

TYPICAL APPLICATION



(External Components)
Ex. C1: Ceramic Capacitor 2.2µF Murata GRM32RB11E225KC01B
C2: Ceramic Capacitor 4.7µF Murata GCM31CR71E475KA40

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 C2 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 C1 with a capacitance value as much as 2.2μF or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

- **Thermal Shutdown Function**

There is the built-in thermal-shutdown function in R1191x series. It discontinues operation of the IC when the junction temperature becomes over 150°C (Typ.) and IC re-operates when the junction temperature under 130°C (Typ.). If the temperature increasing keeps the IC repeats ON and OFF operating. The output becomes the pulse condition.

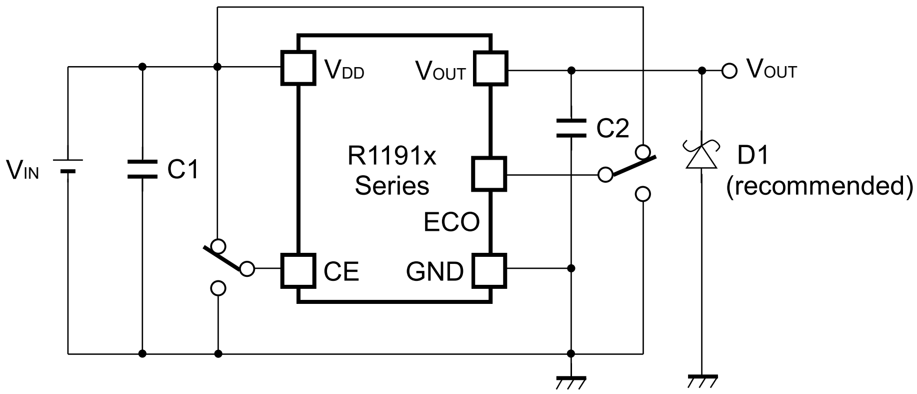
- **Chip Enable (CE) Circuit and High-speed/ Low Supply Current Switching (ECO) Circuit**

To maintain the stability of the output voltage, please do not use the intermediate electric potentials (the voltage values between V_{CEH} and V_{CEL}) for the CE pin and the ECO pin. The use of the intermediate electric potentials increases the supply current and causes the unstable output voltage.

- **Auto-discharge Function**

R1191xxxxD has adopted Auto-discharge function, which decreases the output voltage quickly to 0V by turning on the transistor between V_{OUT} pin and GND pin when switching “Active” to “Standby” and releases the electrical charges accumulated in the external capacitor.

TYPICAL APPLICATION FOR IC CHIP BREAKDOWN PREVENTION



(External Components)

Ex. C1: Ceramic Capacitor 2.2μF Murata GRM32RB11E225KC01B

C2: Ceramic Capacitor 4.7μF Murata GCM31CR71E475KA40

When a sudden surge of electrical current travels along the V_{OUT} pin and GND due to a short-circuit, electrical resonance of a circuit involving an output capacitor (C2) and a short circuit inductor generates a negative voltage and may damage the device or the load devices. To prevent damage to the device or the load devices, it is recommended that a schottky diode (D1) be connected between the V_{OUT} pin and GND.

PACKAGE INFORMATION

POWER DISSIPATION (SOT-23-5)

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

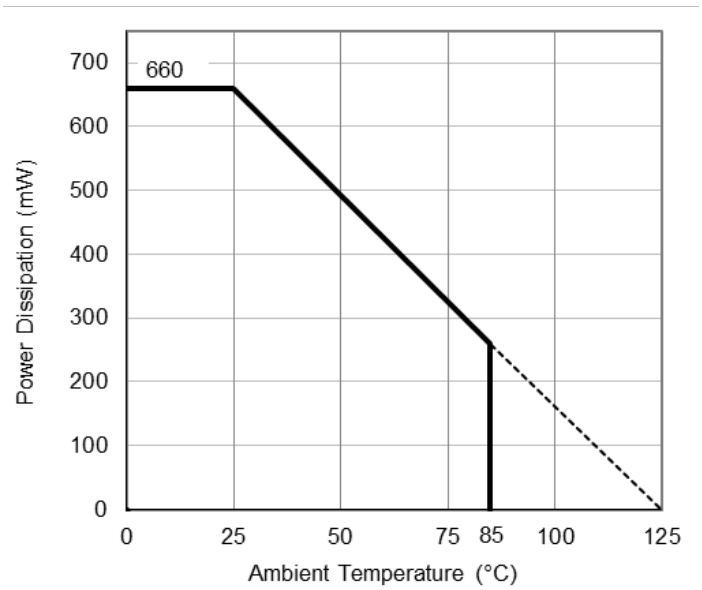
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 7 pcs

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

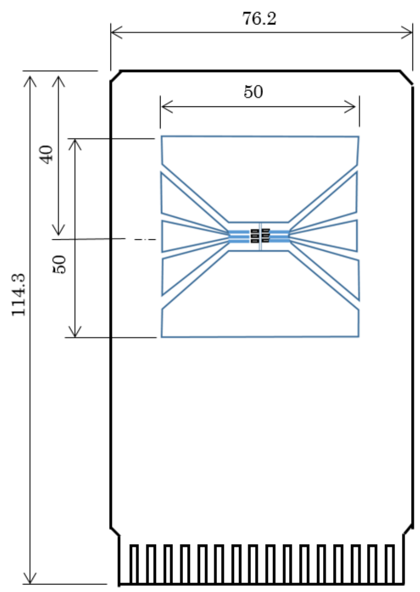
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter

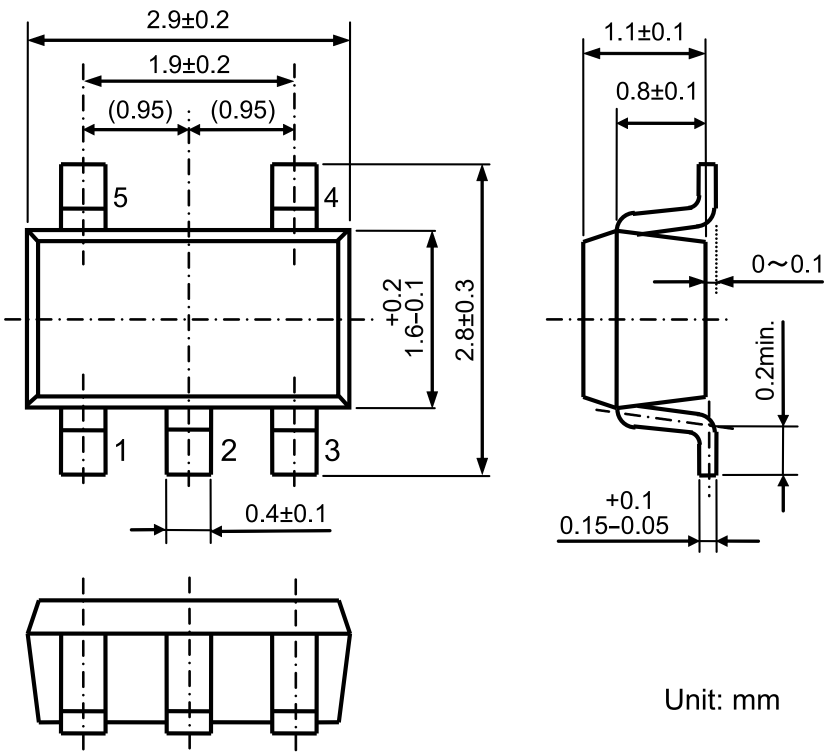


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (SOT-23-5)

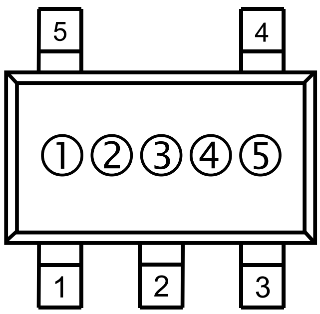


SOT-23-5 Package Dimensions

MARK SPECIFICATION (SOT-23-5)

①②③: Product Code … **Refer to *MARK SPECIFICATION TABLE (SOT-23-5)***

④⑤: Lot Number … Alphanumeric Serial Number



SOT-23-5 Mark Specification

MARK SPECIFICATION TABLE (SOT-23-5)

R1191NxxxB

Product Name	① ② ③	V_{SET}
R1191N020B	4 2 0	2.0 V
R1191N021B	4 2 1	2.1 V
R1191N022B	4 2 2	2.2 V
R1191N023B	4 2 3	2.3 V
R1191N024B	4 2 4	2.4 V
R1191N025B	4 2 5	2.5 V
R1191N026B	4 2 6	2.6 V
R1191N027B	4 2 7	2.7 V
R1191N028B	4 2 8	2.8 V
R1191N029B	4 2 9	2.9 V
R1191N030B	4 3 0	3.0 V
R1191N031B	4 3 1	3.1 V
R1191N032B	4 3 2	3.2 V
R1191N033B	4 3 3	3.3 V
R1191N034B	4 3 4	3.4 V
R1191N035B	4 3 5	3.5 V
R1191N036B	4 3 6	3.6 V
R1191N037B	4 3 7	3.7 V
R1191N038B	4 3 8	3.8 V
R1191N039B	4 3 9	3.9 V
R1191N040B	4 4 0	4.0 V
R1191N041B	4 4 1	4.1 V
R1191N042B	4 4 2	4.2 V
R1191N043B	4 4 3	4.3 V
R1191N044B	4 4 4	4.4 V
R1191N045B	4 4 5	4.5 V
R1191N046B	4 4 6	4.6 V
R1191N047B	4 4 7	4.7 V
R1191N048B	4 4 8	4.8 V
R1191N049B	4 4 9	4.9 V
R1191N050B	4 5 0	5.0 V
R1191N051B	4 5 1	5.1 V
R1191N052B	4 5 2	5.2 V
R1191N053B	4 5 3	5.3 V
R1191N054B	4 5 4	5.4 V
R1191N055B	4 5 5	5.5 V
R1191N056B	4 5 6	5.6 V
R1191N057B	4 5 7	5.7 V
R1191N058B	4 5 8	5.8 V
R1191N059B	4 5 9	5.9 V
R1191N060B	4 6 0	6.0 V
R1191N061B	4 6 1	6.1 V
R1191N062B	4 6 2	6.2 V
R1191N063B	4 6 3	6.3 V
R1191N064B	4 6 4	6.4 V
R1191N065B	4 6 5	6.5 V
R1191N066B	4 6 6	6.6 V
R1191N067B	4 6 7	6.7 V
R1191N068B	4 6 8	6.8 V
R1191N069B	4 6 9	6.9 V
R1191N070B	4 7 0	7.0 V
R1191N071B	4 7 1	7.1 V
R1191N072B	4 7 2	7.2 V
R1191N073B	4 7 3	7.3 V
R1191N074B	4 7 4	7.4 V
R1191N075B	4 7 5	7.5 V
R1191N076B	4 7 6	7.6 V
R1191N077B	4 7 7	7.7 V
R1191N078B	4 7 8	7.8 V
R1191N079B	4 7 9	7.9 V
R1191N080B	4 8 0	8.0 V
R1191N081B	4 8 1	8.1 V
R1191N082B	4 8 2	8.2 V
R1191N083B	4 8 3	8.3 V
R1191N084B	4 8 4	8.4 V
R1191N085B	4 8 5	8.5 V
R1191N086B	4 8 6	8.6 V
R1191N087B	4 8 7	8.7 V
R1191N088B	4 8 8	8.8 V
R1191N089B	4 8 9	8.9 V
R1191N090B	4 9 0	9.0 V
R1191N091B	4 9 1	9.1 V
R1191N092B	4 9 2	9.2 V
R1191N093B	4 9 3	9.3 V
R1191N094B	4 9 4	9.4 V
R1191N095B	4 9 5	9.5 V
R1191N096B	4 9 6	9.6 V
R1191N097B	4 9 7	9.7 V
R1191N098B	4 9 8	9.8 V
R1191N099B	4 9 9	9.9 V
R1191N100B	5 0 0	10.0 V
R1191N101B	5 0 1	10.1 V
R1191N102B	5 0 2	10.2 V
R1191N103B	5 0 3	10.3 V
R1191N104B	5 0 4	10.4 V
R1191N105B	5 0 5	10.5 V
R1191N106B	5 0 6	10.6 V
R1191N107B	5 0 7	10.7 V
R1191N108B	5 0 8	10.8 V
R1191N109B	5 0 9	10.9 V
R1191N110B	5 1 0	11.0 V
R1191N111B	5 1 1	11.1 V
R1191N112B	5 1 2	11.2 V
R1191N113B	5 1 3	11.3 V
R1191N114B	5 1 4	11.4 V
R1191N115B	5 1 5	11.5 V
R1191N116B	5 1 6	11.6 V
R1191N117B	5 1 7	11.7 V
R1191N118B	5 1 8	11.8 V
R1191N119B	5 1 9	11.9 V
R1191N120B	5 2 0	12.0 V
R1191N121B	5 2 1	12.1 V
R1191N122B	5 2 2	12.2 V
R1191N123B	5 2 3	12.3 V
R1191N124B	5 2 4	12.4 V
R1191N125B	5 2 5	12.5 V
R1191N126B	5 2 6	12.6 V
R1191N127B	5 2 7	12.7 V
R1191N128B	5 2 8	12.8 V
R1191N129B	5 2 9	12.9 V
R1191N130B	5 3 0	13.0 V
R1191N131B	5 3 1	13.1 V
R1191N132B	5 3 2	13.2 V
R1191N133B	5 3 3	13.3 V
R1191N134B	5 3 4	13.4 V
R1191N135B	5 3 5	13.5 V
R1191N136B	5 3 6	13.6 V
R1191N137B	5 3 7	13.7 V
R1191N138B	5 3 8	13.8 V
R1191N139B	5 3 9	13.9 V
R1191N140B	5 4 0	14.0 V
R1191N141B	5 4 1	14.1 V
R1191N142B	5 4 2	14.2 V
R1191N143B	5 4 3	14.3 V
R1191N144B	5 4 4	14.4 V
R1191N145B	5 4 5	14.5 V
R1191N146B	5 4 6	14.6 V
R1191N147B	5 4 7	14.7 V
R1191N148B	5 4 8	14.8 V
R1191N149B	5 4 9	14.9 V
R1191N150B	5 5 0	15.0 V

R1191NxxxD

Product Name	① ② ③	V_{SET}
R1191N020D	6 2 0	2.0 V
R1191N021D	6 2 1	2.1 V
R1191N022D	6 2 2	2.2 V
R1191N023D	6 2 3	2.3 V
R1191N024D	6 2 4	2.4 V
R1191N025D	6 2 5	2.5 V
R1191N026D	6 2 6	2.6 V
R1191N027D	6 2 7	2.7 V
R1191N028D	6 2 8	2.8 V
R1191N029D	6 2 9	2.9 V
R1191N030D	6 3 0	3.0 V
R1191N031D	6 3 1	3.1 V
R1191N032D	6 3 2	3.2 V
R1191N033D	6 3 3	3.3 V
R1191N034D	6 3 4	3.4 V
R1191N035D	6 3 5	3.5 V
R1191N036D	6 3 6	3.6 V
R1191N037D	6 3 7	3.7 V
R1191N038D	6 3 8	3.8 V
R1191N039D	6 3 9	3.9 V
R1191N040D	6 4 0	4.0 V
R1191N041D	6 4 1	4.1 V
R1191N042D	6 4 2	4.2 V
R1191N043D	6 4 3	4.3 V
R1191N044D	6 4 4	4.4 V
R1191N045D	6 4 5	4.5 V
R1191N046D	6 4 6	4.6 V
R1191N047D	6 4 7	4.7 V
R1191N048D	6 4 8	4.8 V
R1191N049D	6 4 9	4.9 V
R1191N050D	6 5 0	5.0 V
R1191N051D	6 5 1	5.1 V
R1191N052D	6 5 2	5.2 V
R1191N053D	6 5 3	5.3 V
R1191N054D	6 5 4	5.4 V
R1191N055D	6 5 5	5.5 V
R1191N056D	6 5 6	5.6 V
R1191N057D	6 5 7	5.7 V
R1191N058D	6 5 8	5.8 V
R1191N059D	6 5 9	5.9 V
R1191N060D	6 6 0	6.0 V
R1191N061D	6 6 1	6.1 V
R1191N062D	6 6 2	6.2 V
R1191N063D	6 6 3	6.3 V
R1191N064D	6 6 4	6.4 V
R1191N065D	6 6 5	6.5 V
R1191N066D	6 6 6	6.6 V
R1191N067D	6 6 7	6.7 V
R1191N068D	6 6 8	6.8 V
R1191N069D	6 6 9	6.9 V

Product Name	① ② ③	V_{SET}
R1191N070D	6 7 0	7.0 V
R1191N071D	6 7 1	7.1 V
R1191N072D	6 7 2	7.2 V
R1191N073D	6 7 3	7.3 V
R1191N074D	6 7 4	7.4 V
R1191N075D	6 7 5	7.5 V
R1191N076D	6 7 6	7.6 V
R1191N077D	6 7 7	7.7 V
R1191N078D	6 7 8	7.8 V
R1191N079D	6 7 9	7.9 V
R1191N080D	6 8 0	8.0 V
R1191N081D	6 8 1	8.1 V
R1191N082D	6 8 2	8.2 V
R1191N083D	6 8 3	8.3 V
R1191N084D	6 8 4	8.4 V
R1191N085D	6 8 5	8.5 V
R1191N086D	6 8 6	8.6 V
R1191N087D	6 8 7	8.7 V
R1191N088D	6 8 8	8.8 V
R1191N089D	6 8 9	8.9 V
R1191N090D	6 9 0	9.0 V
R1191N091D	6 9 1	9.1 V
R1191N092D	6 9 2	9.2 V
R1191N093D	6 9 3	9.3 V
R1191N094D	6 9 4	9.4 V
R1191N095D	6 9 5	9.5 V
R1191N096D	6 9 6	9.6 V
R1191N097D	6 9 7	9.7 V
R1191N098D	6 9 8	9.8 V
R1191N099D	6 9 9	9.9 V
R1191N100D	7 0 0	10.0 V
R1191N101D	7 0 1	10.1 V
R1191N102D	7 0 2	10.2 V
R1191N103D	7 0 3	10.3 V
R1191N104D	7 0 4	10.4 V
R1191N105D	7 0 5	10.5 V
R1191N106D	7 0 6	10.6 V
R1191N107D	7 0 7	10.7 V
R1191N108D	7 0 8	10.8 V
R1191N109D	7 0 9	10.9 V
R1191N110D	7 1 0	11.0 V
R1191N111D	7 1 1	11.1 V
R1191N112D	7 1 2	11.2 V
R1191N113D	7 1 3	11.3 V
R1191N114D	7 1 4	11.4 V
R1191N115D	7 1 5	11.5 V
R1191N116D	7 1 6	11.6 V
R1191N117D	7 1 7	11.7 V
R1191N118D	7 1 8	11.8 V
R1191N119D	7 1 9	11.9 V

Product Name	① ② ③	V_{SET}
R1191N120D	7 2 0	12.0 V
R1191N121D	7 2 1	12.1 V
R1191N122D	7 2 2	12.2 V
R1191N123D	7 2 3	12.3 V
R1191N124D	7 2 4	12.4 V
R1191N125D	7 2 5	12.5 V
R1191N126D	7 2 6	12.6 V
R1191N127D	7 2 7	12.7 V
R1191N128D	7 2 8	12.8 V
R1191N129D	7 2 9	12.9 V
R1191N130D	7 3 0	13.0 V
R1191N131D	7 3 1	13.1 V
R1191N132D	7 3 2	13.2 V
R1191N133D	7 3 3	13.3 V
R1191N134D	7 3 4	13.4 V
R1191N135D	7 3 5	13.5 V
R1191N136D	7 3 6	13.6 V
R1191N137D	7 3 7	13.7 V
R1191N138D	7 3 8	13.8 V
R1191N139D	7 3 9	13.9 V
R1191N140D	7 4 0	14.0 V
R1191N141D	7 4 1	14.1 V
R1191N142D	7 4 2	14.2 V
R1191N143D	7 4 3	14.3 V
R1191N144D	7 4 4	14.4 V
R1191N145D	7 4 5	14.5 V
R1191N146D	7 4 6	14.6 V
R1191N147D	7 4 7	14.7 V
R1191N148D	7 4 8	14.8 V
R1191N149D	7 4 9	14.9 V
R1191N150D	7 5 0	15.0 V

POWER DISSIPATION (SOT-89-5)

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

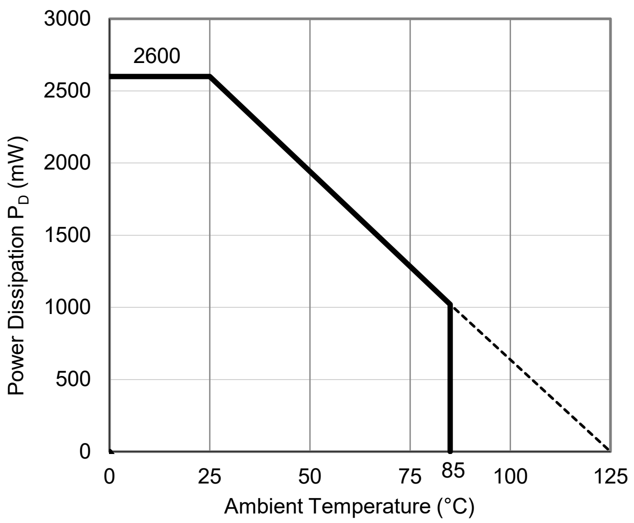
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 13 pcs

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

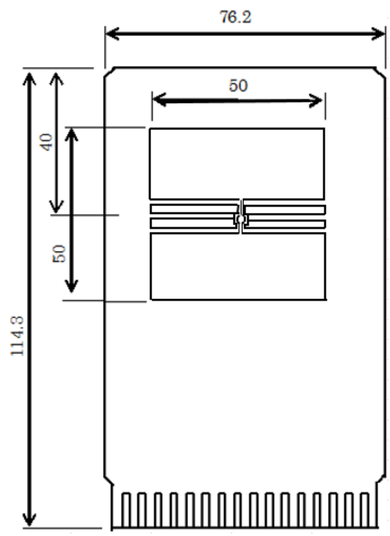
Item	Measurement Result
Power Dissipation	2600 mW
Thermal Resistance (θja)	θja = 38°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 13°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter

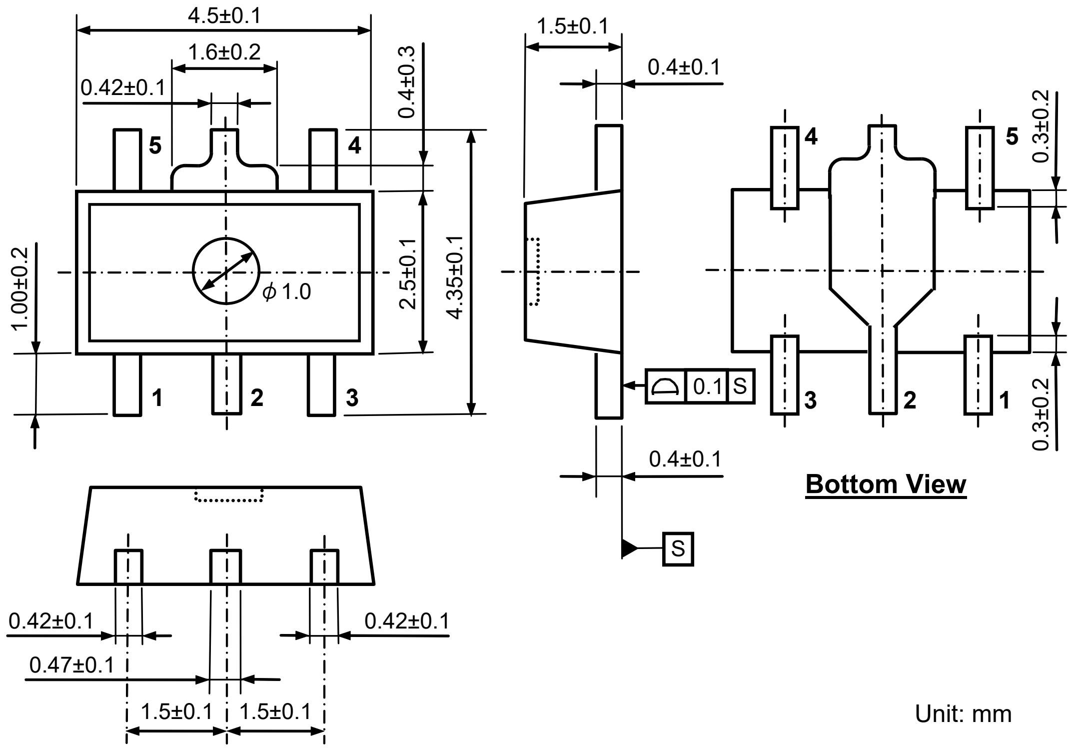


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (SOT-89-5)

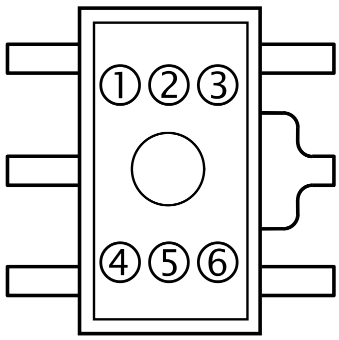


SOT-89-5 Package Dimensions

MARK SPECIFICATION (SOT-89-5)

①②③④: Product Code … **Refer to *MARK SPECIFICATION TABLE (SOT-89-5)***

⑤⑥: Lot Number … Alphanumeric Serial Number



SOT-89-5 Mark Specification

MARK SPECIFICATION TABLE (SOT-89-5)

R1191HxxxB

Product Name	①②③④	V_{SET}
R1191H020B	S 0 2 0	2.0 V
R1191H021B	S 0 2 1	2.1 V
R1191H022B	S 0 2 2	2.2 V
R1191H023B	S 0 2 3	2.3 V
R1191H024B	S 0 2 4	2.4 V
R1191H025B	S 0 2 5	2.5 V
R1191H026B	S 0 2 6	2.6 V
R1191H027B	S 0 2 7	2.7 V
R1191H028B	S 0 2 8	2.8 V
R1191H029B	S 0 2 9	2.9 V
R1191H030B	S 0 3 0	3.0 V
R1191H031B	S 0 3 1	3.1 V
R1191H032B	S 0 3 2	3.2 V
R1191H033B	S 0 3 3	3.3 V
R1191H034B	S 0 3 4	3.4 V
R1191H035B	S 0 3 5	3.5 V
R1191H036B	S 0 3 6	3.6 V
R1191H037B	S 0 3 7	3.7 V
R1191H038B	S 0 3 8	3.8 V
R1191H039B	S 0 3 9	3.9 V
R1191H040B	S 0 4 0	4.0 V
R1191H041B	S 0 4 1	4.1 V
R1191H042B	S 0 4 2	4.2 V
R1191H043B	S 0 4 3	4.3 V
R1191H044B	S 0 4 4	4.4 V
R1191H045B	S 0 4 5	4.5 V
R1191H046B	S 0 4 6	4.6 V
R1191H047B	S 0 4 7	4.7 V
R1191H048B	S 0 4 8	4.8 V
R1191H049B	S 0 4 9	4.9 V
R1191H050B	S 0 5 0	5.0 V
R1191H051B	S 0 5 1	5.1 V
R1191H052B	S 0 5 2	5.2 V
R1191H053B	S 0 5 3	5.3 V
R1191H054B	S 0 5 4	5.4 V
R1191H055B	S 0 5 5	5.5 V
R1191H056B	S 0 5 6	5.6 V
R1191H057B	S 0 5 7	5.7 V
R1191H058B	S 0 5 8	5.8 V
R1191H059B	S 0 5 9	5.9 V
R1191H060B	S 0 6 0	6.0 V
R1191H061B	S 0 6 1	6.1 V
R1191H062B	S 0 6 2	6.2 V
R1191H063B	S 0 6 3	6.3 V
R1191H064B	S 0 6 4	6.4 V
R1191H065B	S 0 6 5	6.5 V
R1191H066B	S 0 6 6	6.6 V
R1191H067B	S 0 6 7	6.7 V
R1191H068B	S 0 6 8	6.8 V
R1191H069B	S 0 6 9	6.9 V

Product Name	①②③④	V_{SET}
R1191H070B	S 0 7 0	7.0 V
R1191H071B	S 0 7 1	7.1 V
R1191H072B	S 0 7 2	7.2 V
R1191H073B	S 0 7 3	7.3 V
R1191H074B	S 0 7 4	7.4 V
R1191H075B	S 0 7 5	7.5 V
R1191H076B	S 0 7 6	7.6 V
R1191H077B	S 0 7 7	7.7 V
R1191H078B	S 0 7 8	7.8 V
R1191H079B	S 0 7 9	7.9 V
R1191H080B	S 0 8 0	8.0 V
R1191H081B	S 0 8 1	8.1 V
R1191H082B	S 0 8 2	8.2 V
R1191H083B	S 0 8 3	8.3 V
R1191H084B	S 0 8 4	8.4 V
R1191H085B	S 0 8 5	8.5 V
R1191H086B	S 0 8 6	8.6 V
R1191H087B	S 0 8 7	8.7 V
R1191H088B	S 0 8 8	8.8 V
R1191H089B	S 0 8 9	8.9 V
R1191H090B	S 0 9 0	9.0 V
R1191H091B	S 0 9 1	9.1 V
R1191H092B	S 0 9 2	9.2 V
R1191H093B	S 0 9 3	9.3 V
R1191H094B	S 0 9 4	9.4 V
R1191H095B	S 0 9 5	9.5 V
R1191H096B	S 0 9 6	9.6 V
R1191H097B	S 0 9 7	9.7 V
R1191H098B	S 0 9 8	9.8 V
R1191H099B	S 0 9 9	9.9 V
R1191H100B	S 1 0 0	10.0 V
R1191H101B	S 1 0 1	10.1 V
R1191H102B	S 1 0 2	10.2 V
R1191H103B	S 1 0 3	10.3 V
R1191H104B	S 1 0 4	10.4 V
R1191H105B	S 1 0 5	10.5 V
R1191H106B	S 1 0 6	10.6 V
R1191H107B	S 1 0 7	10.7 V
R1191H108B	S 1 0 8	10.8 V
R1191H109B	S 1 0 9	10.9 V
R1191H110B	S 1 1 0	11.0 V
R1191H111B	S 1 1 1	11.1 V
R1191H112B	S 1 1 2	11.2 V
R1191H113B	S 1 1 3	11.3 V
R1191H114B	S 1 1 4	11.4 V
R1191H115B	S 1 1 5	11.5 V
R1191H116B	S 1 1 6	11.6 V
R1191H117B	S 1 1 7	11.7 V
R1191H118B	S 1 1 8	11.8 V
R1191H119B	S 1 1 9	11.9 V

Product Name	①②③④	V_{SET}
R1191H120B	S 1 2 0	12.0 V
R1191H121B	S 1 2 1	12.1 V
R1191H122B	S 1 2 2	12.2 V
R1191H123B	S 1 2 3	12.3 V
R1191H124B	S 1 2 4	12.4 V
R1191H125B	S 1 2 5	12.5 V
R1191H126B	S 1 2 6	12.6 V
R1191H127B	S 1 2 7	12.7 V
R1191H128B	S 1 2 8	12.8 V
R1191H129B	S 1 2 9	12.9 V
R1191H130B	S 1 3 0	13.0 V
R1191H131B	S 1 3 1	13.1 V
R1191H132B	S 1 3 2	13.2 V
R1191H133B	S 1 3 3	13.3 V
R1191H134B	S 1 3 4	13.4 V
R1191H135B	S 1 3 5	13.5 V
R1191H136B	S 1 3 6	13.6 V
R1191H137B	S 1 3 7	13.7 V
R1191H138B	S 1 3 8	13.8 V
R1191H139B	S 1 3 9	13.9 V
R1191H140B	S 1 4 0	14.0 V
R1191H141B	S 1 4 1	14.1 V
R1191H142B	S 1 4 2	14.2 V
R1191H143B	S 1 4 3	14.3 V
R1191H144B	S 1 4 4	14.4 V
R1191H145B	S 1 4 5	14.5 V
R1191H146B	S 1 4 6	14.6 V
R1191H147B	S 1 4 7	14.7 V
R1191H148B	S 1 4 8	14.8 V
R1191H149B	S 1 4 9	14.9 V
R1191H150B	S 1 5 0	15.0 V

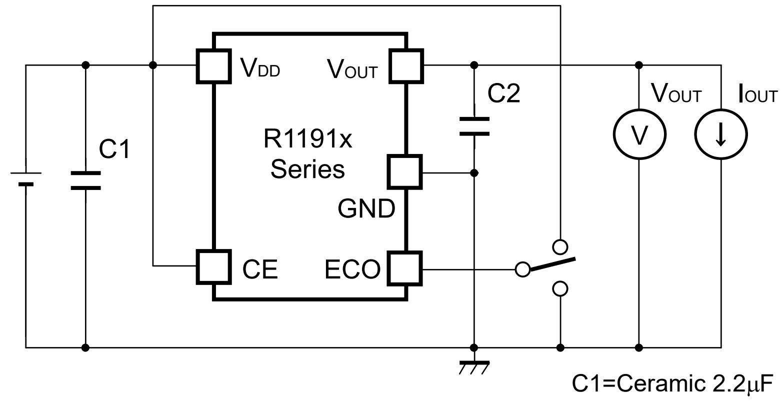
R1191HxxxD

Product Name	①②③④	V_{SET}
R1191H020D	T 0 2 0	2.0 V
R1191H021D	T 0 2 1	2.1 V
R1191H022D	T 0 2 2	2.2 V
R1191H023D	T 0 2 3	2.3 V
R1191H024D	T 0 2 4	2.4 V
R1191H025D	T 0 2 5	2.5 V
R1191H026D	T 0 2 6	2.6 V
R1191H027D	T 0 2 7	2.7 V
R1191H028D	T 0 2 8	2.8 V
R1191H029D	T 0 2 9	2.9 V
R1191H030D	T 0 3 0	3.0 V
R1191H031D	T 0 3 1	3.1 V
R1191H032D	T 0 3 2	3.2 V
R1191H033D	T 0 3 3	3.3 V
R1191H034D	T 0 3 4	3.4 V
R1191H035D	T 0 3 5	3.5 V
R1191H036D	T 0 3 6	3.6 V
R1191H037D	T 0 3 7	3.7 V
R1191H038D	T 0 3 8	3.8 V
R1191H039D	T 0 3 9	3.9 V
R1191H040D	T 0 4 0	4.0 V
R1191H041D	T 0 4 1	4.1 V
R1191H042D	T 0 4 2	4.2 V
R1191H043D	T 0 4 3	4.3 V
R1191H044D	T 0 4 4	4.4 V
R1191H045D	T 0 4 5	4.5 V
R1191H046D	T 0 4 6	4.6 V
R1191H047D	T 0 4 7	4.7 V
R1191H048D	T 0 4 8	4.8 V
R1191H049D	T 0 4 9	4.9 V
R1191H050D	T 0 5 0	5.0 V
R1191H051D	T 0 5 1	5.1 V
R1191H052D	T 0 5 2	5.2 V
R1191H053D	T 0 5 3	5.3 V
R1191H054D	T 0 5 4	5.4 V
R1191H055D	T 0 5 5	5.5 V
R1191H056D	T 0 5 6	5.6 V
R1191H057D	T 0 5 7	5.7 V
R1191H058D	T 0 5 8	5.8 V
R1191H059D	T 0 5 9	5.9 V
R1191H060D	T 0 6 0	6.0 V
R1191H061D	T 0 6 1	6.1 V
R1191H062D	T 0 6 2	6.2 V
R1191H063D	T 0 6 3	6.3 V
R1191H064D	T 0 6 4	6.4 V
R1191H065D	T 0 6 5	6.5 V
R1191H066D	T 0 6 6	6.6 V
R1191H067D	T 0 6 7	6.7 V
R1191H068D	T 0 6 8	6.8 V
R1191H069D	T 0 6 9	6.9 V

Product Name	①②③④	V_{SET}
R1191H070D	T 0 7 0	7.0 V
R1191H071D	T 0 7 1	7.1 V
R1191H072D	T 0 7 2	7.2 V
R1191H073D	T 0 7 3	7.3 V
R1191H074D	T 0 7 4	7.4 V
R1191H075D	T 0 7 5	7.5 V
R1191H076D	T 0 7 6	7.6 V
R1191H077D	T 0 7 7	7.7 V
R1191H078D	T 0 7 8	7.8 V
R1191H079D	T 0 7 9	7.9 V
R1191H080D	T 0 8 0	8.0 V
R1191H081D	T 0 8 1	8.1 V
R1191H082D	T 0 8 2	8.2 V
R1191H083D	T 0 8 3	8.3 V
R1191H084D	T 0 8 4	8.4 V
R1191H085D	T 0 8 5	8.5 V
R1191H086D	T 0 8 6	8.6 V
R1191H087D	T 0 8 7	8.7 V
R1191H088D	T 0 8 8	8.8 V
R1191H089D	T 0 8 9	8.9 V
R1191H090D	T 0 9 0	9.0 V
R1191H091D	T 0 9 1	9.1 V
R1191H092D	T 0 9 2	9.2 V
R1191H093D	T 0 9 3	9.3 V
R1191H094D	T 0 9 4	9.4 V
R1191H095D	T 0 9 5	9.5 V
R1191H096D	T 0 9 6	9.6 V
R1191H097D	T 0 9 7	9.7 V
R1191H098D	T 0 9 8	9.8 V
R1191H099D	T 0 9 9	9.9 V
R1191H100D	T 1 0 0	10.0 V
R1191H101D	T 1 0 1	10.1 V
R1191H102D	T 1 0 2	10.2 V
R1191H103D	T 1 0 3	10.3 V
R1191H104D	T 1 0 4	10.4 V
R1191H105D	T 1 0 5	10.5 V
R1191H106D	T 1 0 6	10.6 V
R1191H107D	T 1 0 7	10.7 V
R1191H108D	T 1 0 8	10.8 V
R1191H109D	T 1 0 9	10.9 V
R1191H110D	T 1 1 0	11.0 V
R1191H111D	T 1 1 1	11.1 V
R1191H112D	T 1 1 2	11.2 V
R1191H113D	T 1 1 3	11.3 V
R1191H114D	T 1 1 4	11.4 V
R1191H115D	T 1 1 5	11.5 V
R1191H116D	T 1 1 6	11.6 V
R1191H117D	T 1 1 7	11.7 V
R1191H118D	T 1 1 8	11.8 V
R1191H119D	T 1 1 9	11.9 V

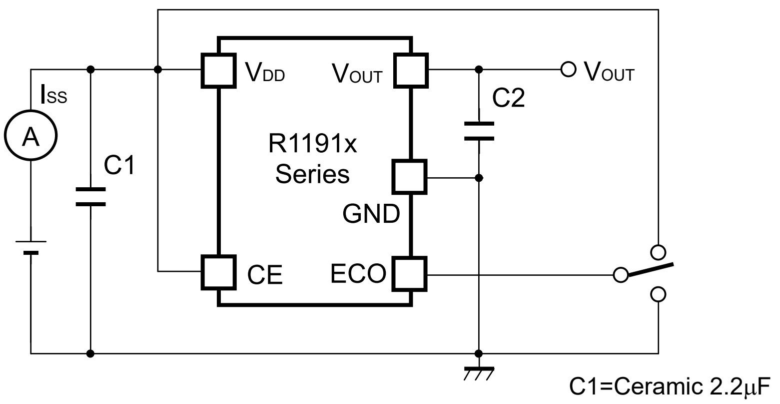
Product Name	①②③④	V_{SET}
R1191H120D	T 1 2 0	12.0 V
R1191H121D	T 1 2 1	12.1 V
R1191H122D	T 1 2 2	12.2 V
R1191H123D	T 1 2 3	12.3 V
R1191H124D	T 1 2 4	12.4 V
R1191H125D	T 1 2 5	12.5 V
R1191H126D	T 1 2 6	12.6 V
R1191H127D	T 1 2 7	12.7 V
R1191H128D	T 1 2 8	12.8 V
R1191H129D	T 1 2 9	12.9 V
R1191H130D	T 1 3 0	13.0 V
R1191H131D	T 1 3 1	13.1 V
R1191H132D	T 1 3 2	13.2 V
R1191H133D	T 1 3 3	13.3 V
R1191H134D	T 1 3 4	13.4 V
R1191H135D	T 1 3 5	13.5 V
R1191H136D	T 1 3 6	13.6 V
R1191H137D	T 1 3 7	13.7 V
R1191H138D	T 1 3 8	13.8 V
R1191H139D	T 1 3 9	13.9 V
R1191H140D	T 1 4 0	14.0 V
R1191H141D	T 1 4 1	14.1 V
R1191H142D	T 1 4 2	14.2 V
R1191H143D	T 1 4 3	14.3 V
R1191H144D	T 1 4 4	14.4 V
R1191H145D	T 1 4 5	14.5 V
R1191H146D	T 1 4 6	14.6 V
R1191H147D	T 1 4 7	14.7 V
R1191H148D	T 1 4 8	14.8 V
R1191H149D	T 1 4 9	14.9 V
R1191H150D	T 1 5 0	15.0 V

TEST CIRCUITS



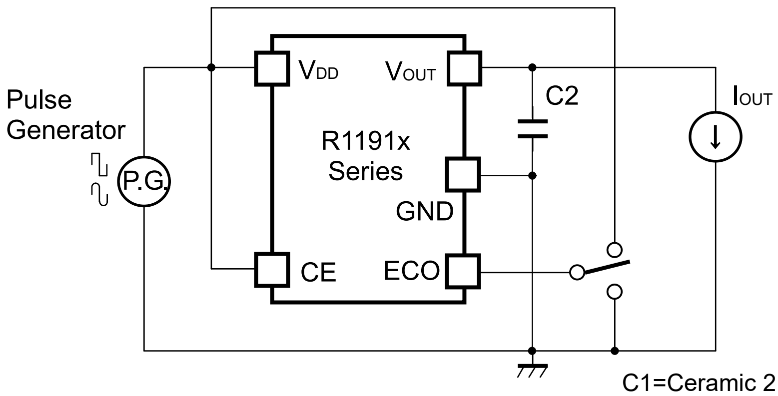
C1=Ceramic 2.2µF
C2=Ceramic 4.7µF

Basic Test Circuit



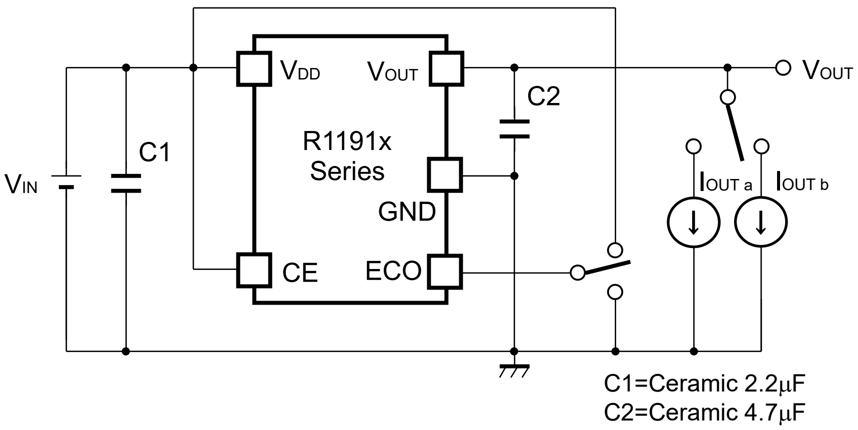
C1=Ceramic 2.2µF
C2=Ceramic 4.7µF

Test Circuit for Supply Current



C1=Ceramic 2.2µF
C2=Ceramic 4.7µF

Test Circuit for Ripple Rejection

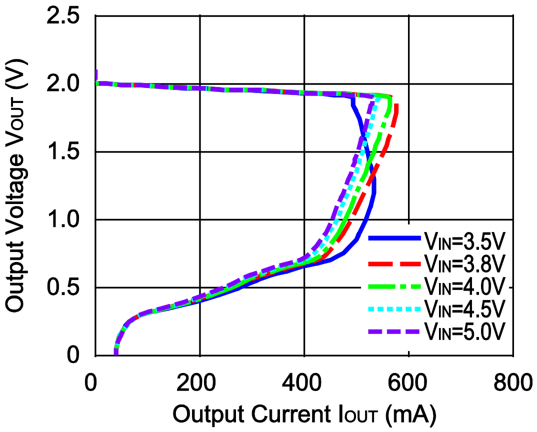


Test Circuit for Load Transient Response

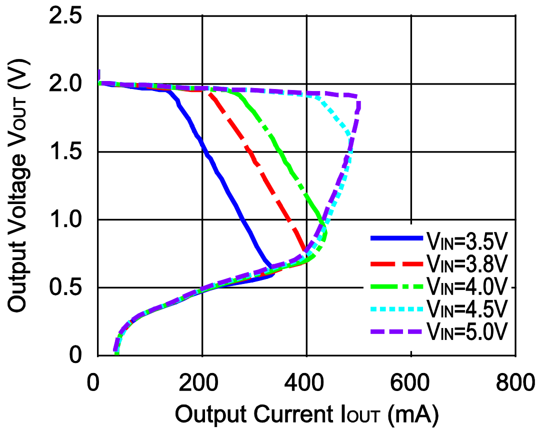
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C1=2.2µF, C2=4.7µF, Ta=25°C)

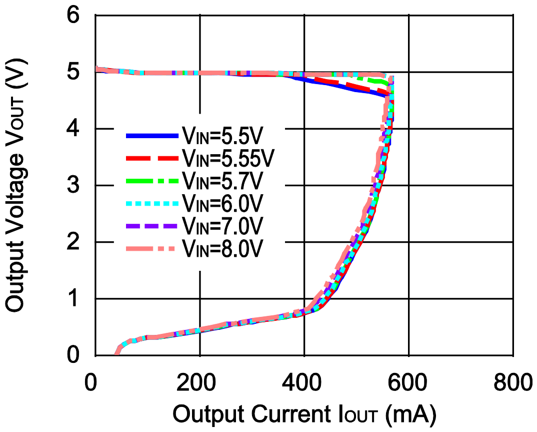
R1191x020x ECO=H



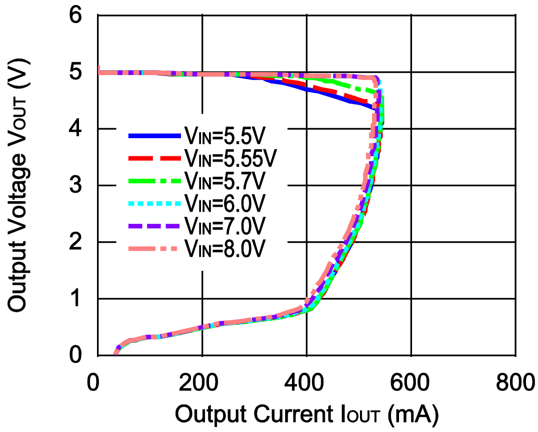
R1191x020x ECO=L



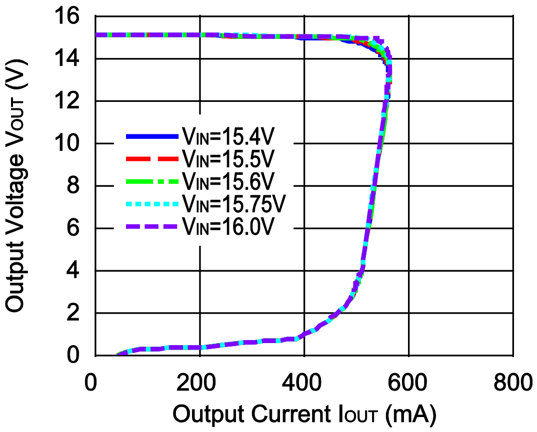
R1191x050x ECO=H



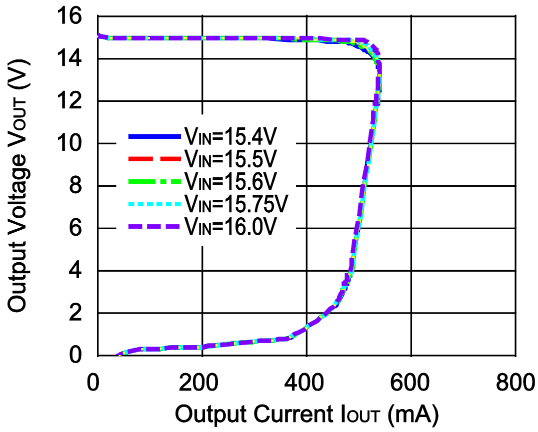
R1191x050x ECO=L



R1191x150x ECO=H

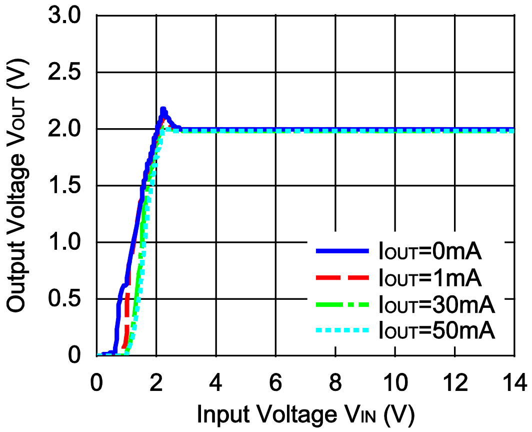


R1191x150x ECO=L

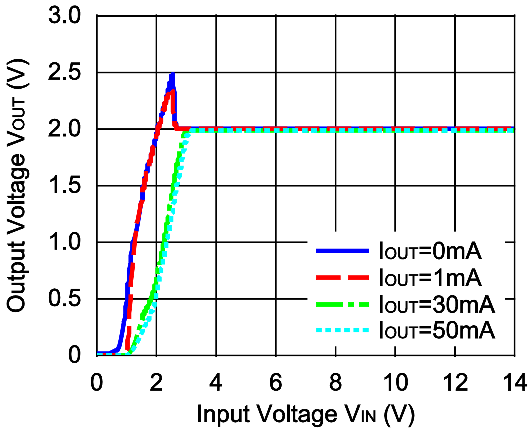


2) Output Voltage vs. Input Voltage (C1=2.2µF, C2=4.7µF, Ta=25°C)

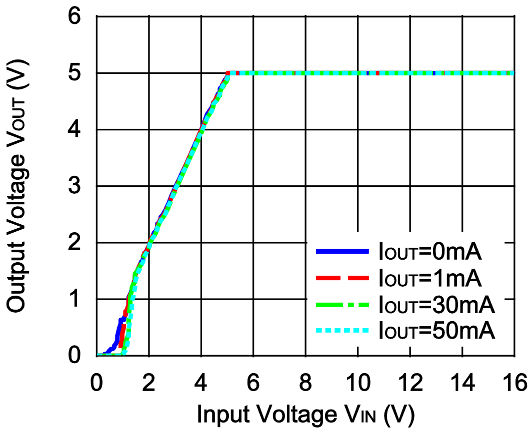
R1191x020x ECO=H



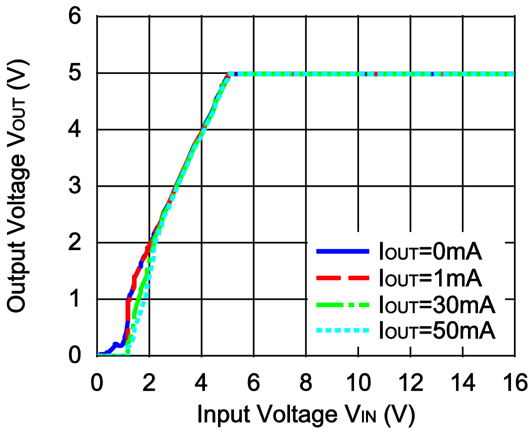
R1191x020x ECO=L



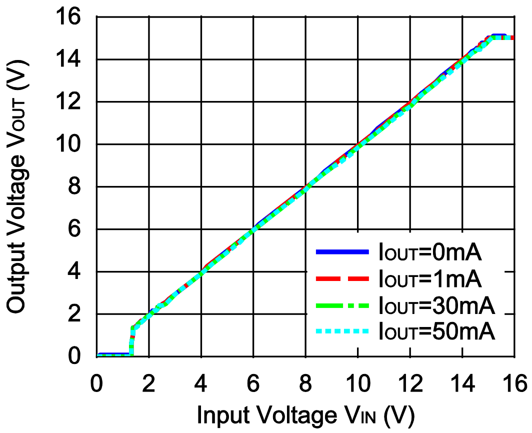
R1191x050x ECO=H



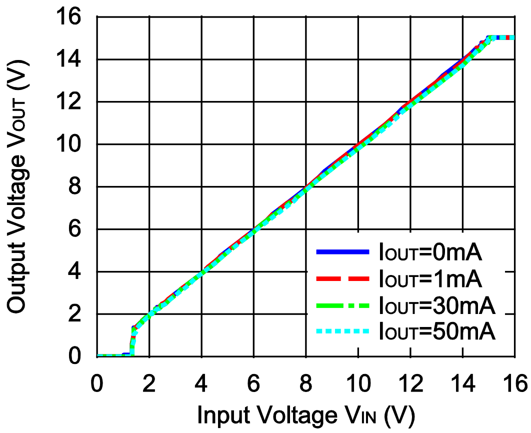
R1191x050x ECO=L



R1191x150x ECO=H

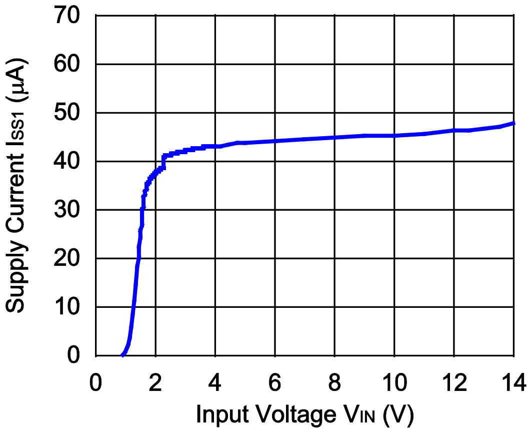


R1191x150x ECO=L

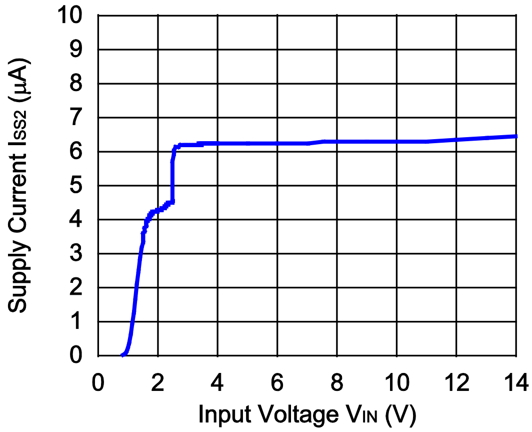


3) Supply Current vs. Input Voltage (C1=2.2µF, C2=4.7µF, Ta=25°C)

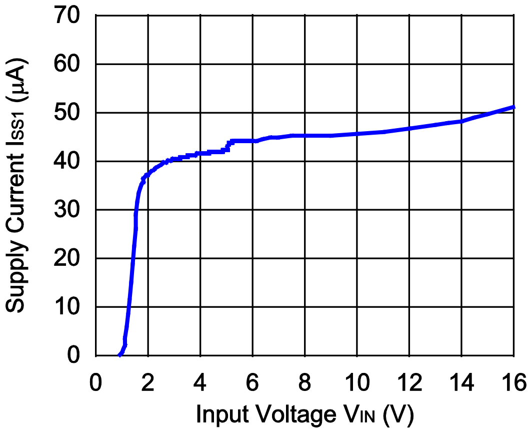
R1191x020x ECO=H



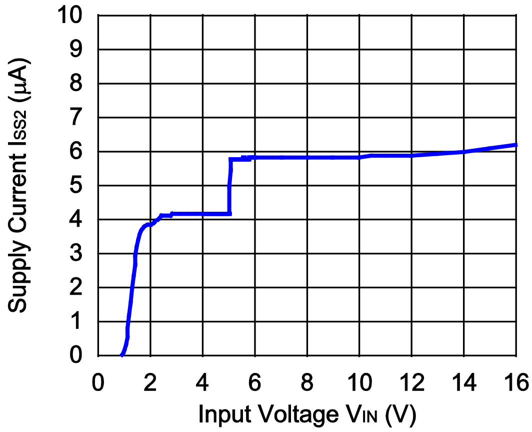
R1191x020x ECO=L



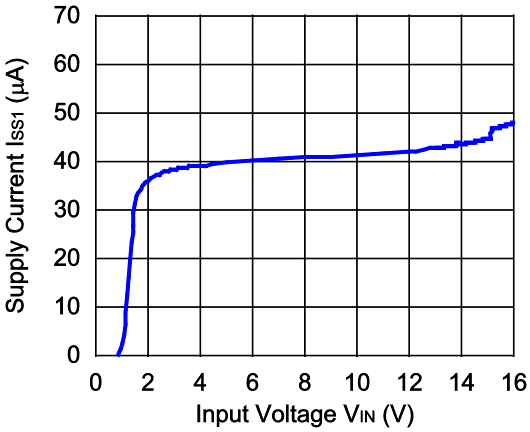
R1191x050x ECO=H



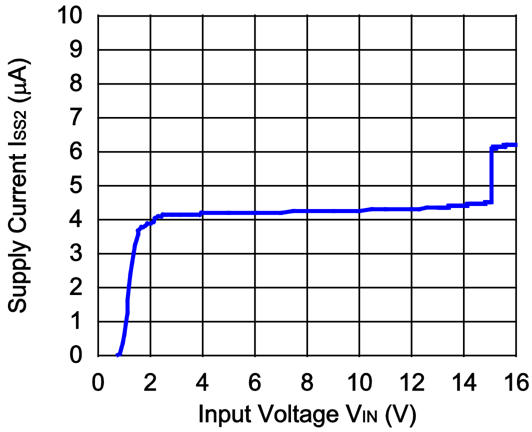
R1191x050x ECO=L



R1191x150x ECO=H

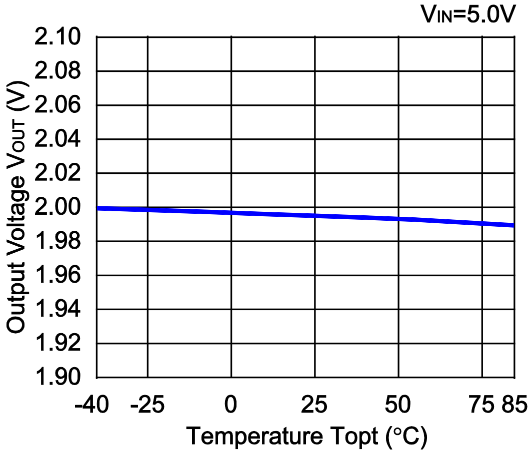


R1191x150x ECO=L

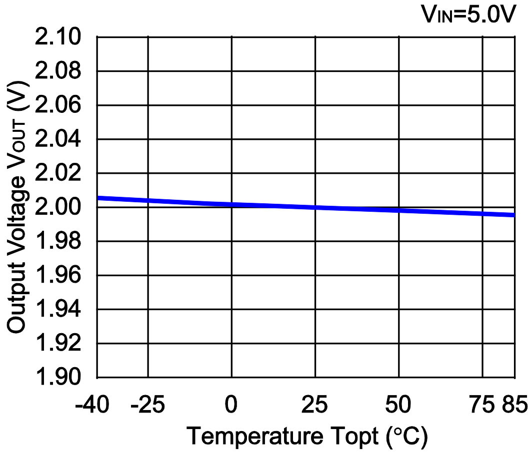


4) Output Voltage vs. Temperature (C1=2.2µF, C2=4.7µF, I_{OUT}=1mA)

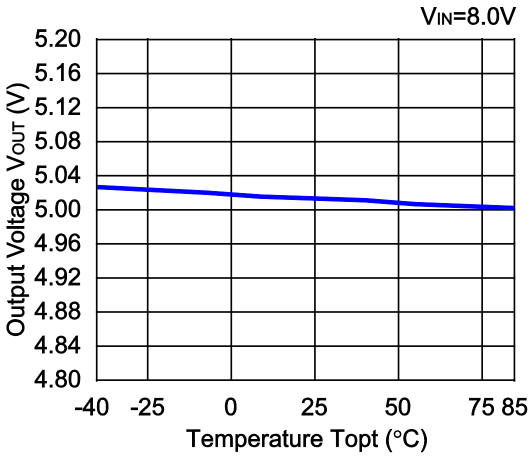
R1191x020x ECO=H



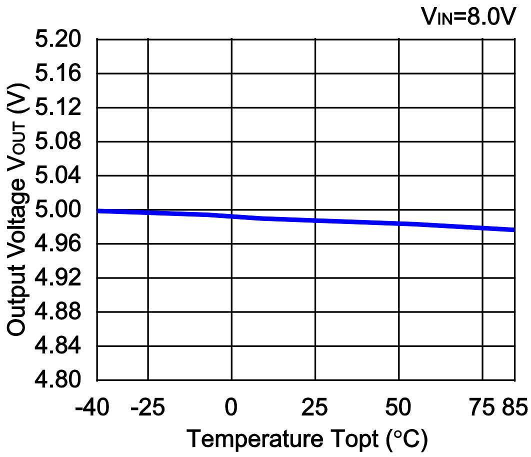
R1191x020x ECO=L



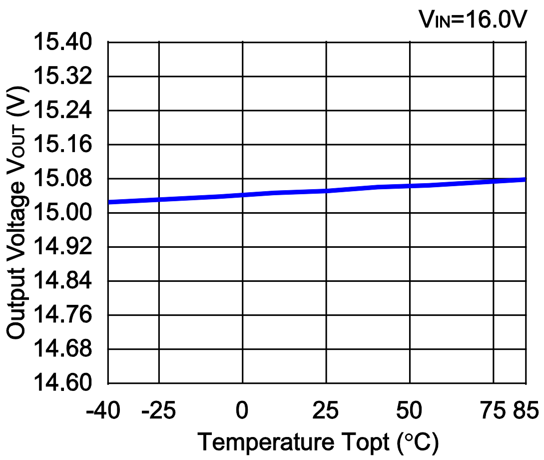
R1191x050x ECO=H



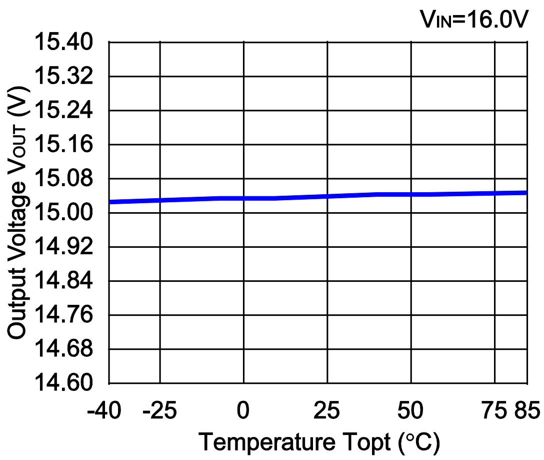
R1191x050x ECO=L



R1191x150x ECO=H

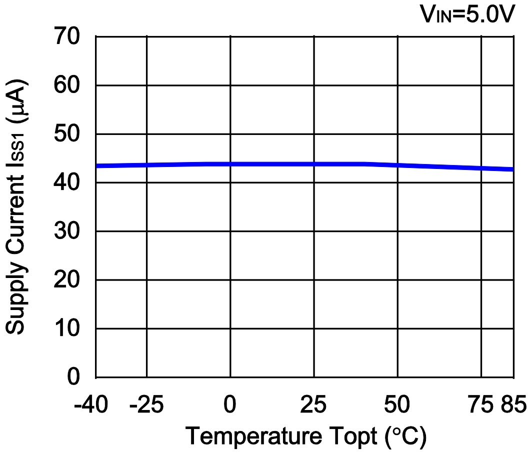


R1191x150x ECO=L

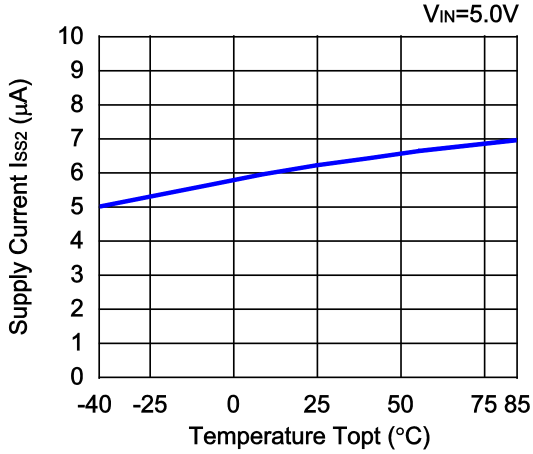


5) Supply Current vs. Temperature (C1=2.2μF, C2=4.7μF)

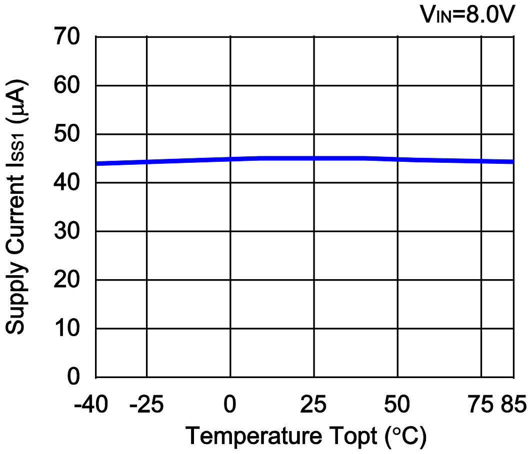
R1191x020x ECO=H



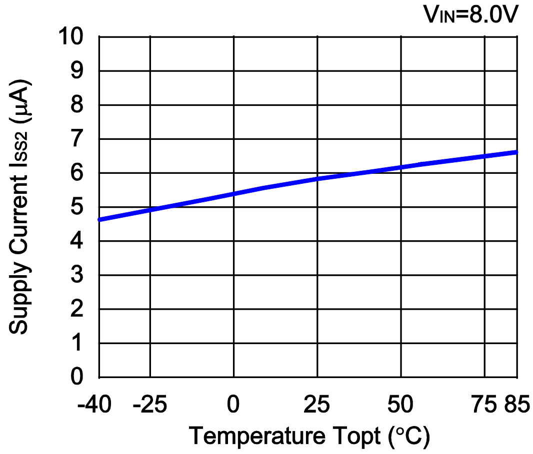
R1191x020x ECO=L



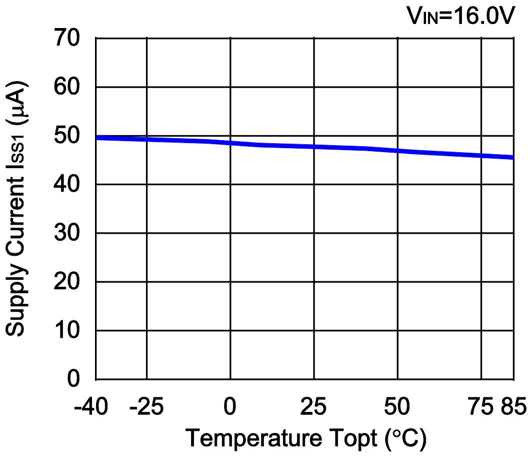
R1191x050x ECO=H



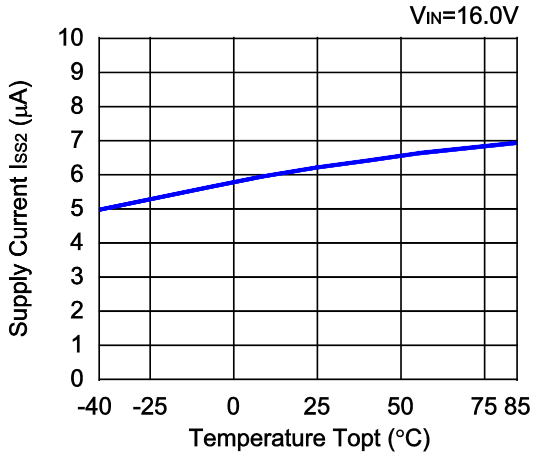
R1191x050x ECO=L



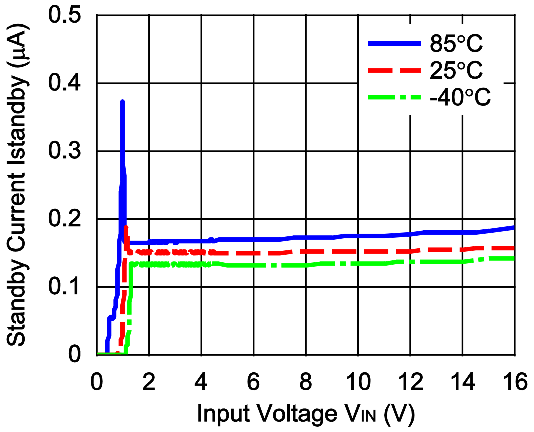
R1191x150x ECO=H



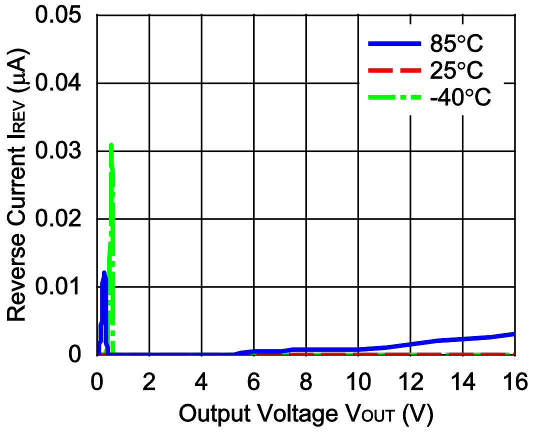
R1191x150x ECO=L



6) Standby Current vs. Input Voltage (C1=2.2µF, C2=4.7µF)

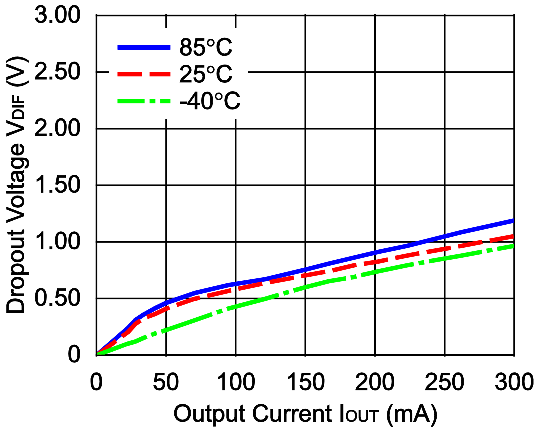


7) Reverse Current vs. Output Voltage (C1=2.2µF, C2=4.7µF, V_{IN}=0V)

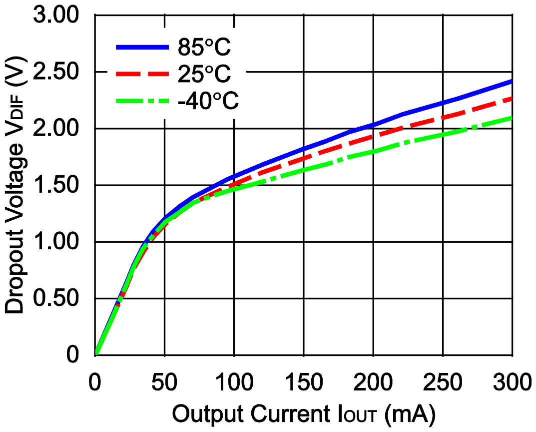


8) Dropout Voltage vs. Output Current (C1=2.2µF, C2=4.7µF)

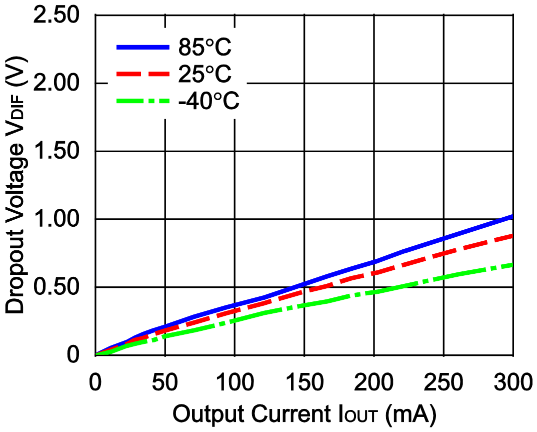
R1191x020x ECO=H



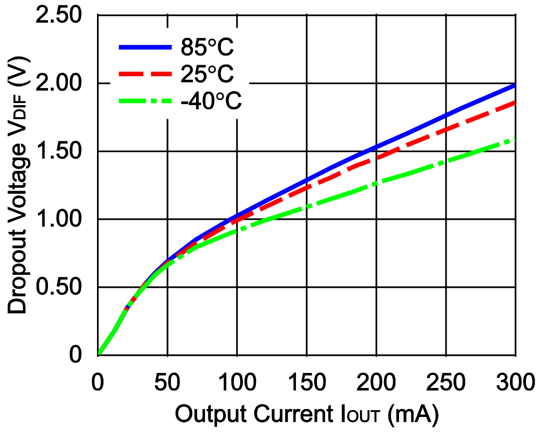
R1191x020x ECO=L



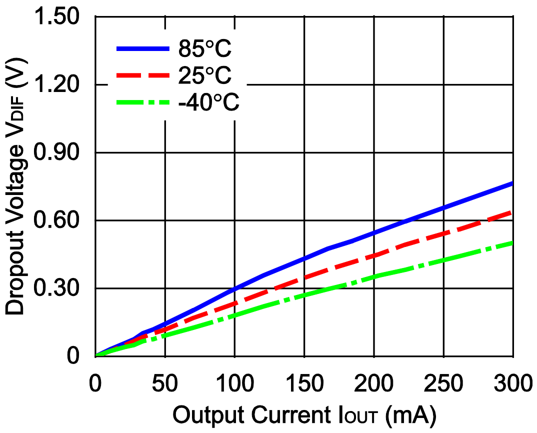
R1191x025x ECO=H



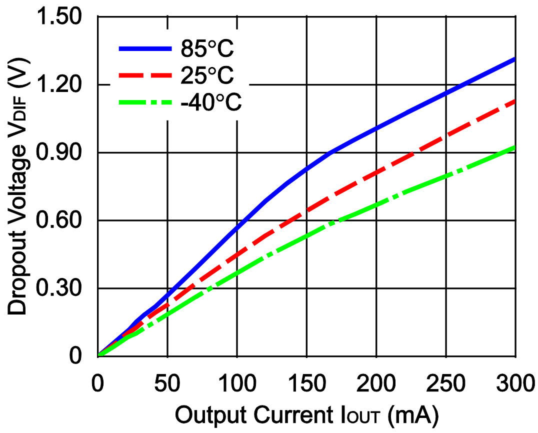
R1191x025x ECO=L



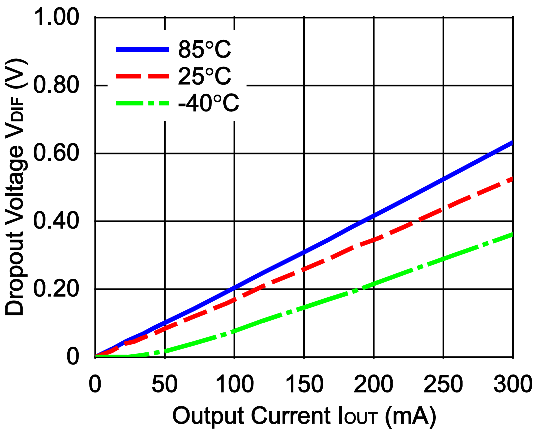
R1191x033x ECO=H



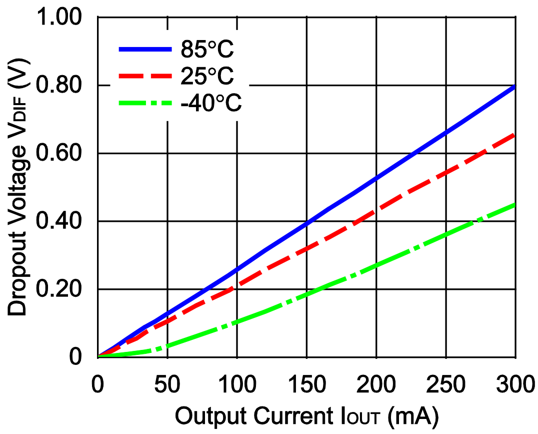
R1191x033x ECO=L



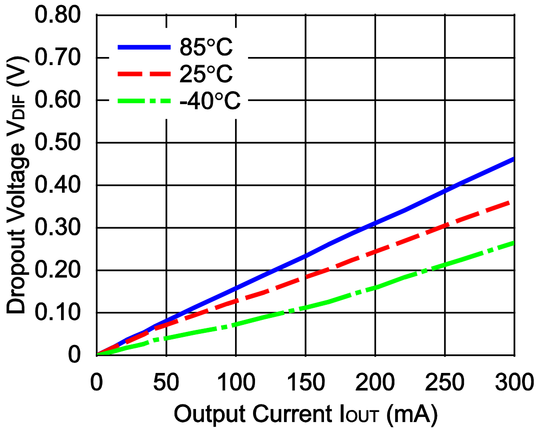
R1191x050x ECO=H



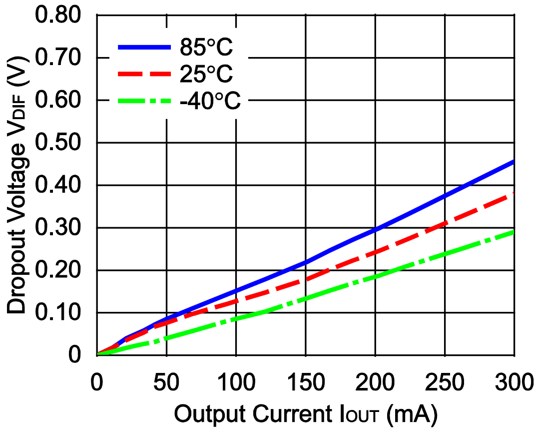
R1191x050x ECO=L



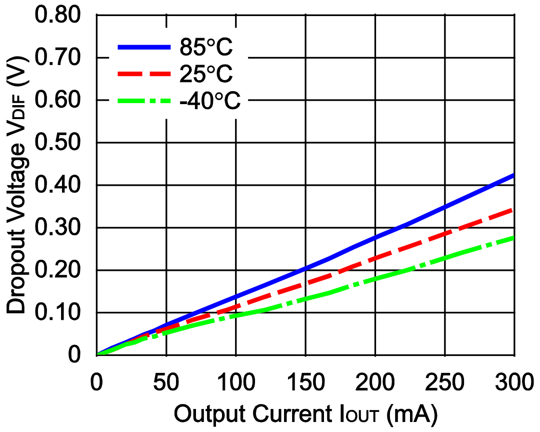
R1191x120x ECO=H



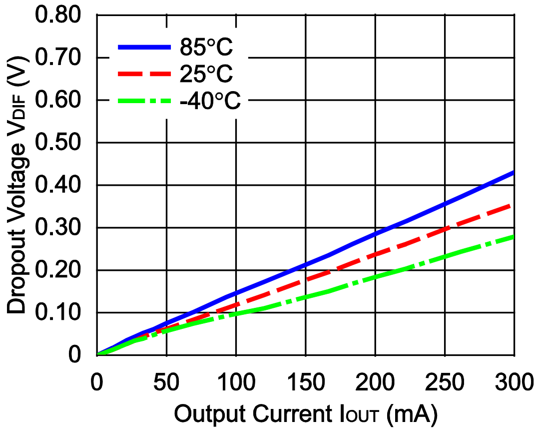
R1191x120x ECO=L



R1191x150x ECO=H

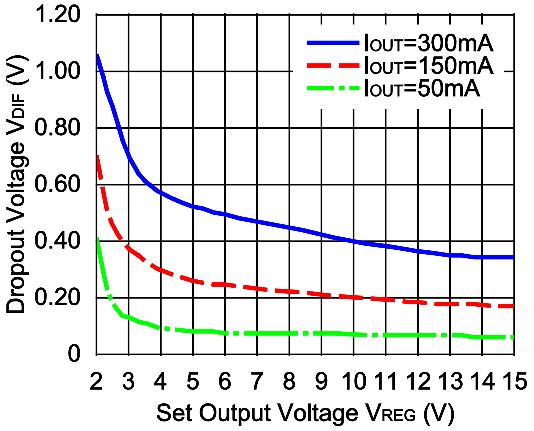


R1191x150x ECO=L

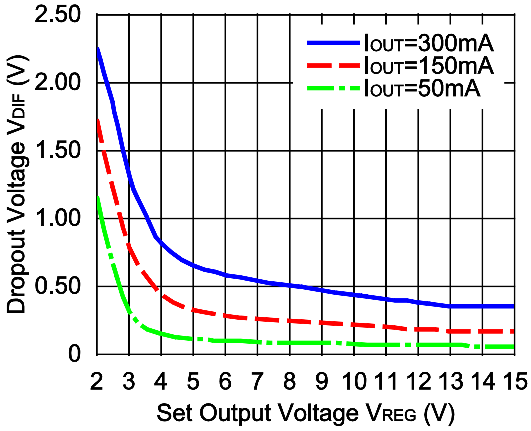


9) Dropout Voltage vs. Set Output Voltage (C1=2.2µF, C2=4.7µF,Ta=25°C)

R1191x ECO=H

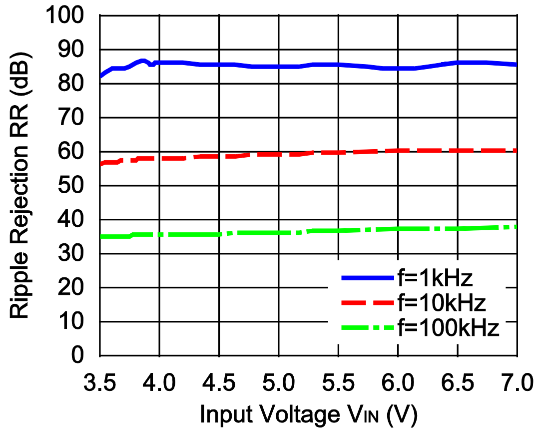


R1191x ECO=L

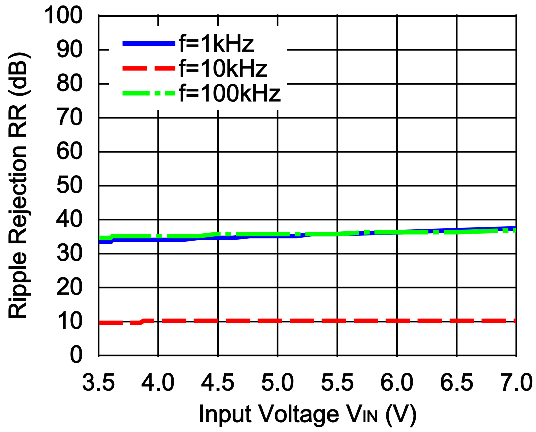


10) Ripple Rejection vs. Input Voltage (C1=none, C2=4.7µF, I_{OUT}=30mA, Ripple=0.5Vp-p, Ta=25°C)

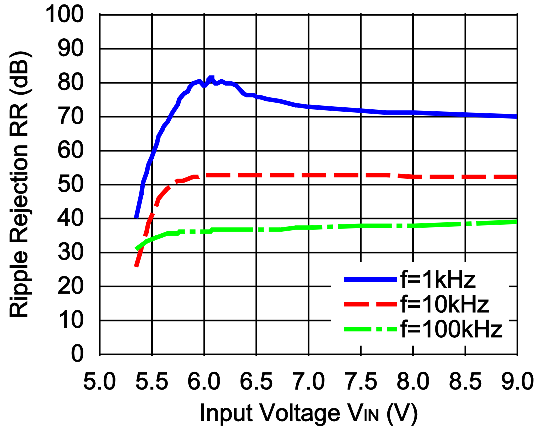
R1191x020x ECO=H



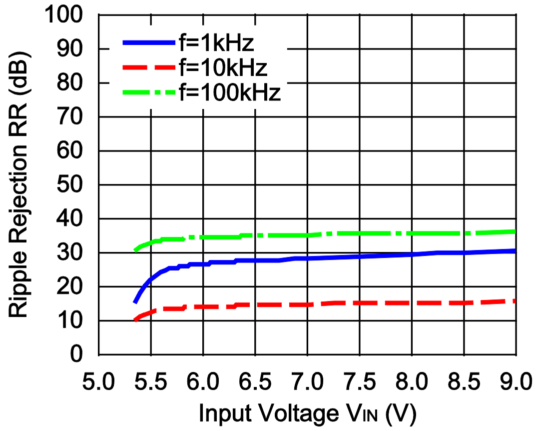
R1191x020x ECO=L



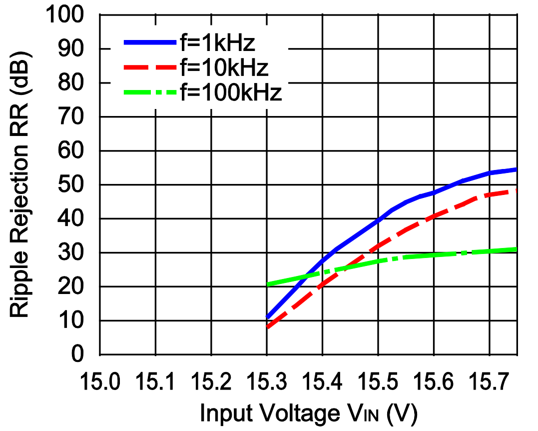
R1191x050x ECO=H



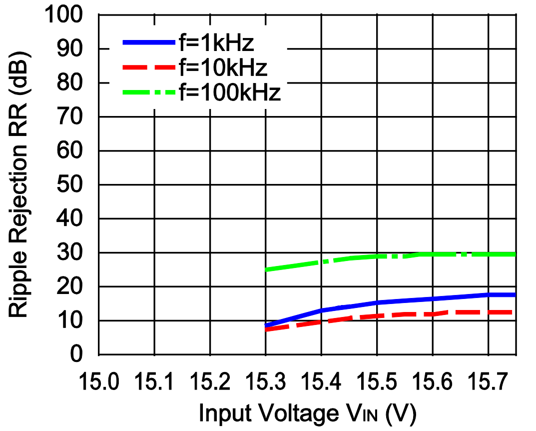
R1191x050x ECO=L



R1191x150x ECO=H

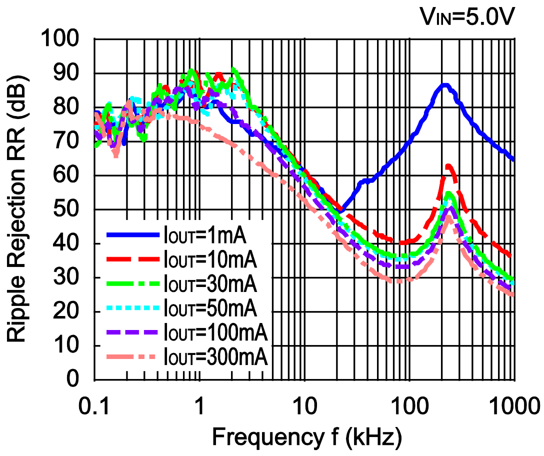


R1191x150x ECO=L

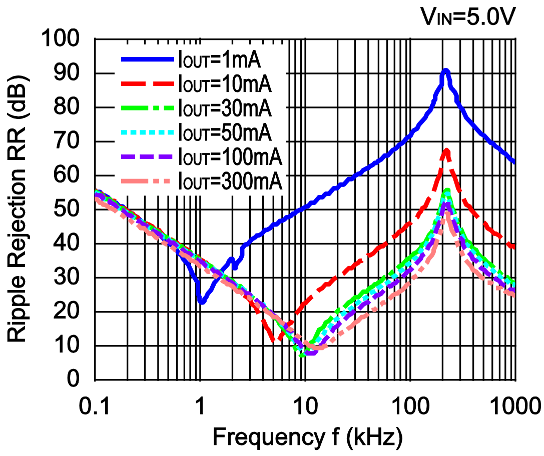


11) Ripple Rejection vs. Frequency (C1= none, C2=4.7µF, Ripple=0.5Vp-p, Ta=25°C)

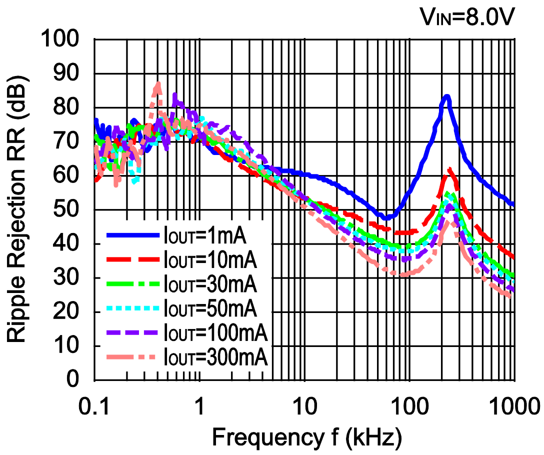
R1191x020x ECO=H



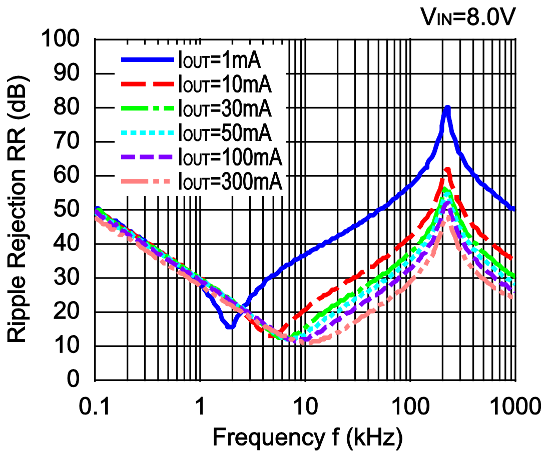
R1191x020x ECO=L



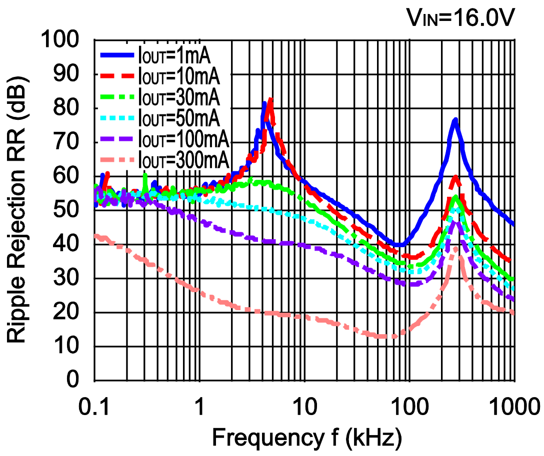
R1191x050x ECO=H



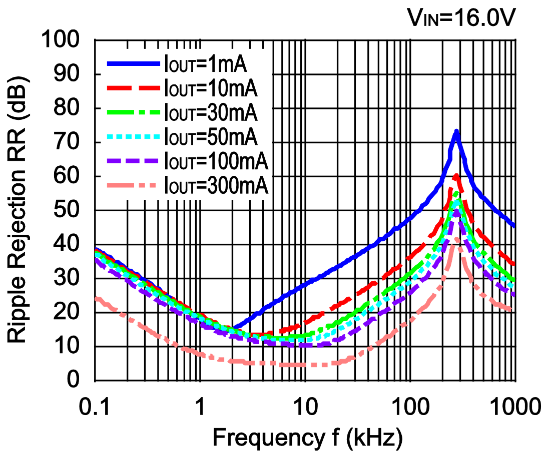
R1191x050x ECO=L



R1191x150x ECO=H

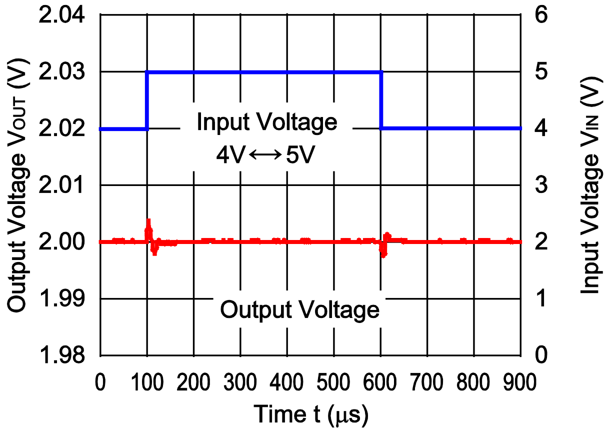


R1191x150x ECO=L

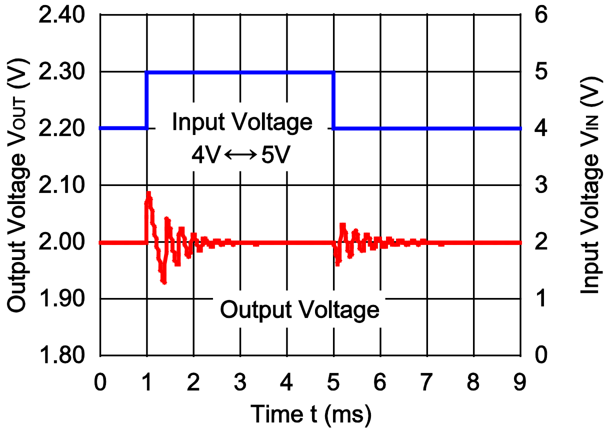


12) Input Transient Response (C1=none, C2=4.7µF, I_{OUT}=1mA, tr=tf=1µs, Ta=25°C)

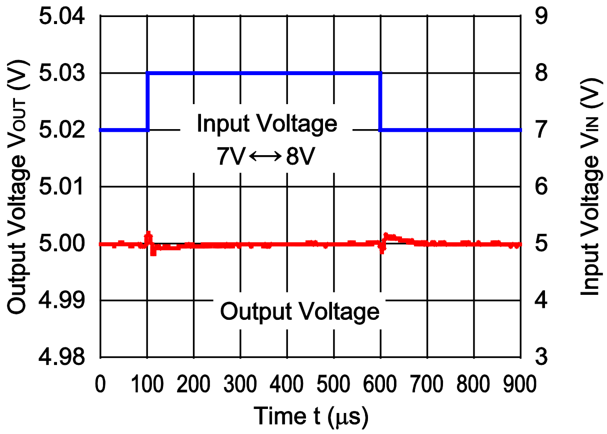
R1191x020x ECO=H



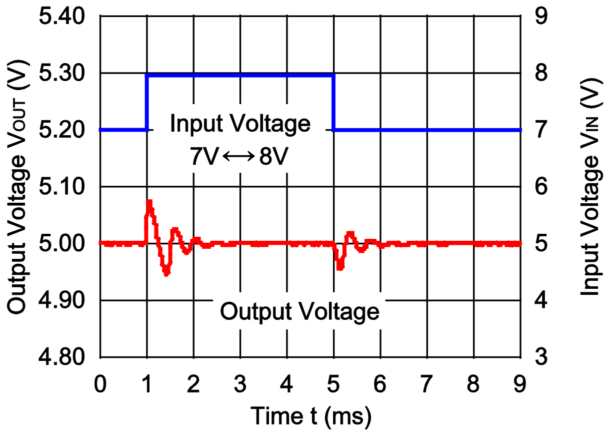
R1191x020x ECO=L



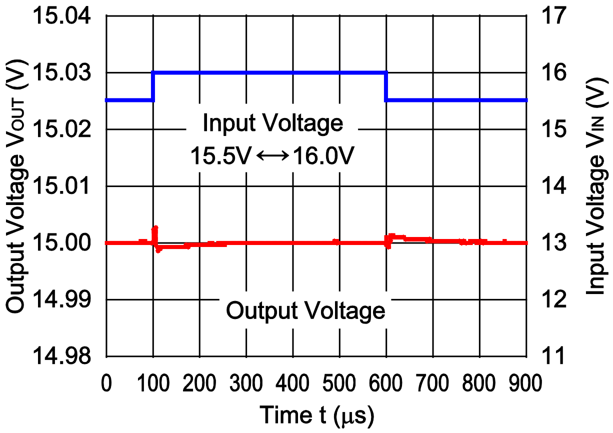
R1191x050x ECO=H



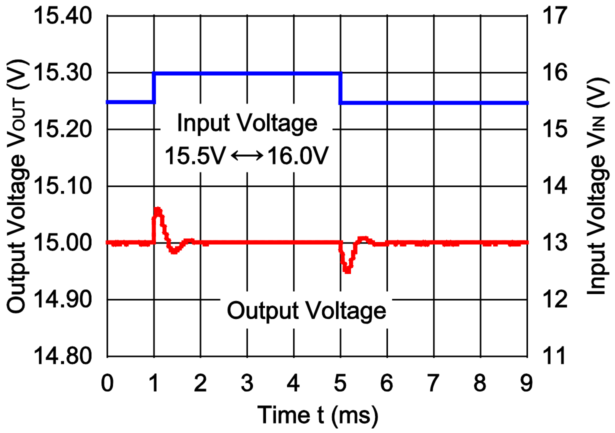
R1191x050x ECO=H



R1191x150x ECO=H

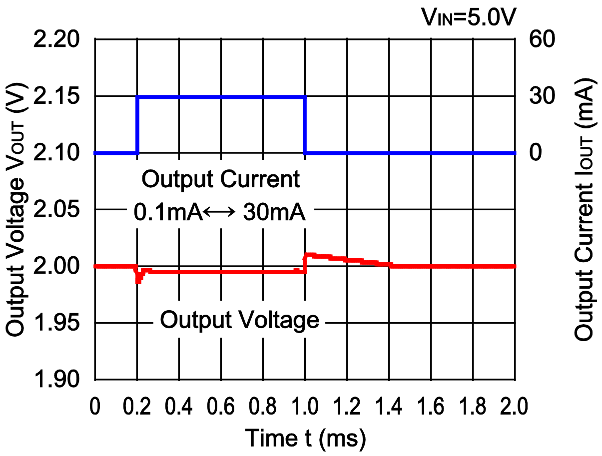


R1191x150x ECO=L

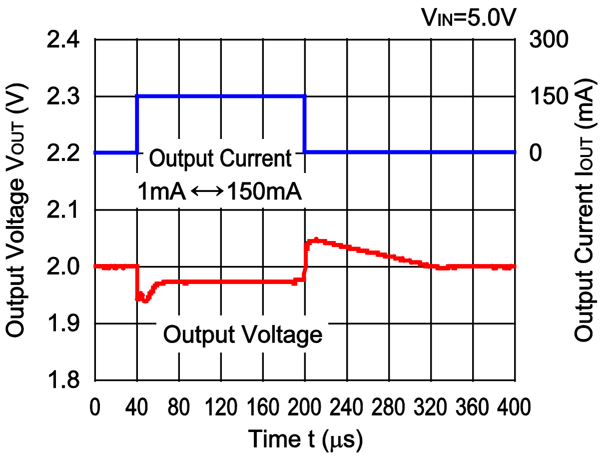


13) Load Transient Response (C1=2.2µF, C2=4.7µF, tr=tf=0.1µs, Ta=25°C)

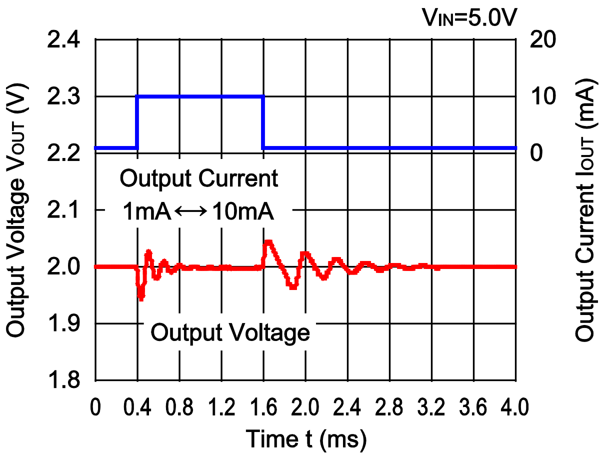
R1191x020x ECO=H



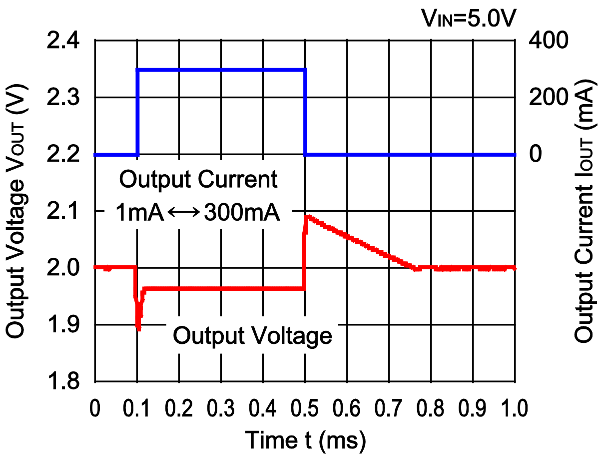
R1191x020x ECO=H



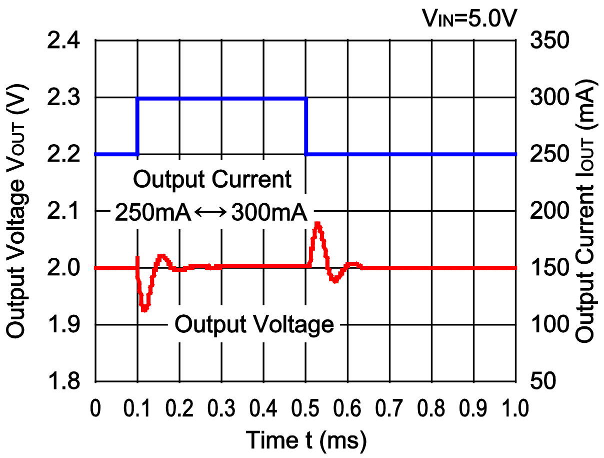
R1191x020x ECO=L



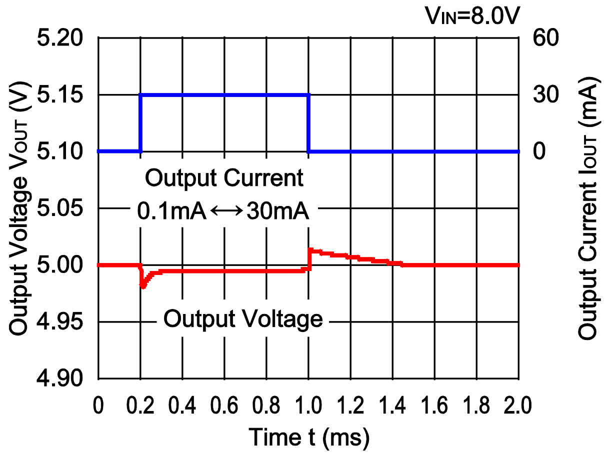
R1191x020x ECO=H



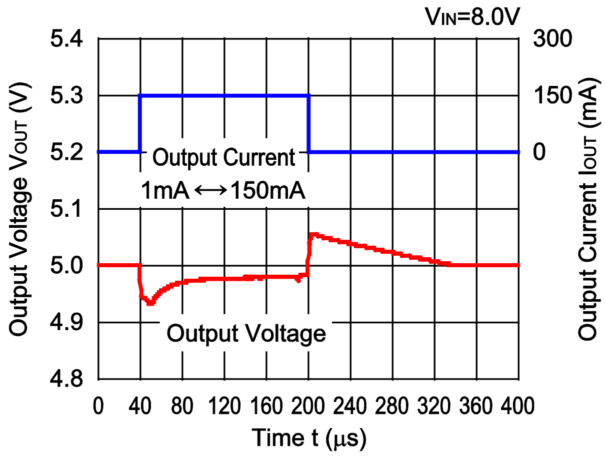
R1191x020x ECO=L



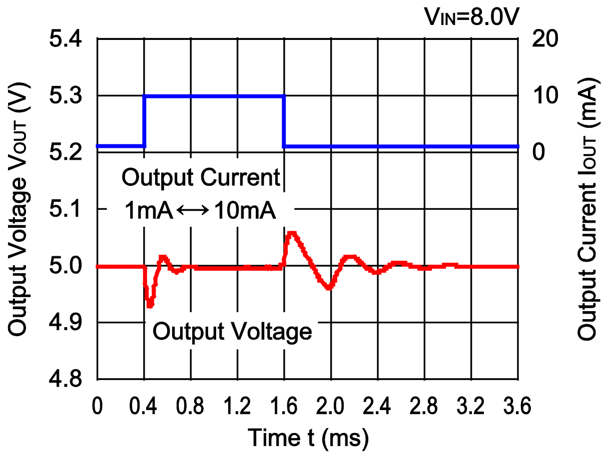
R1191x050x ECO=H



R1191x050x ECO=H



R1191x050x ECO=L



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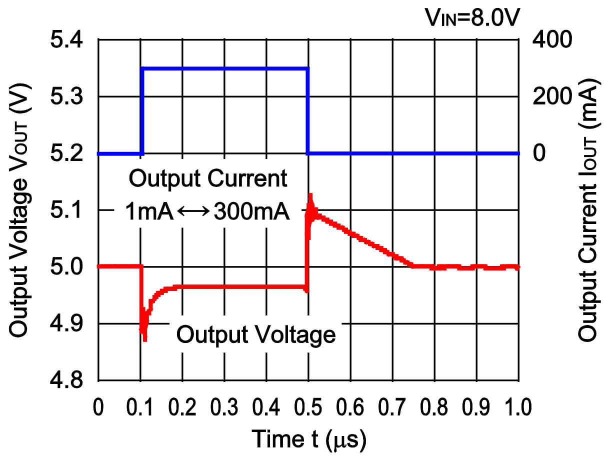

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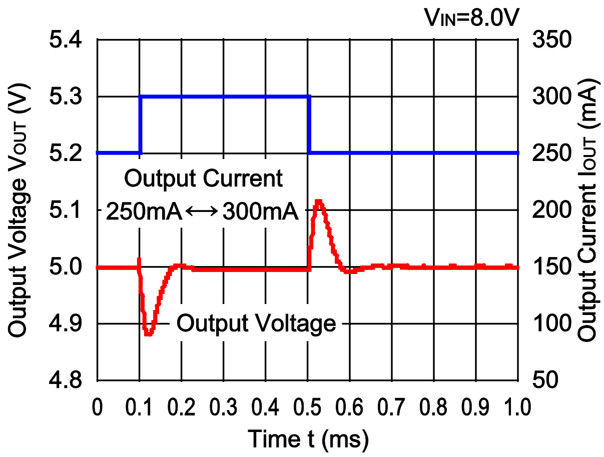

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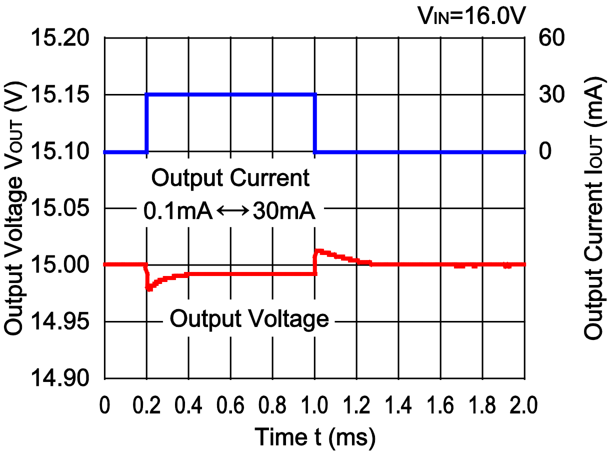

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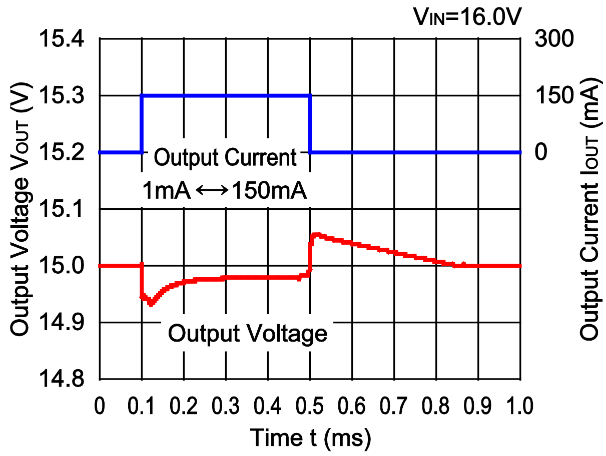

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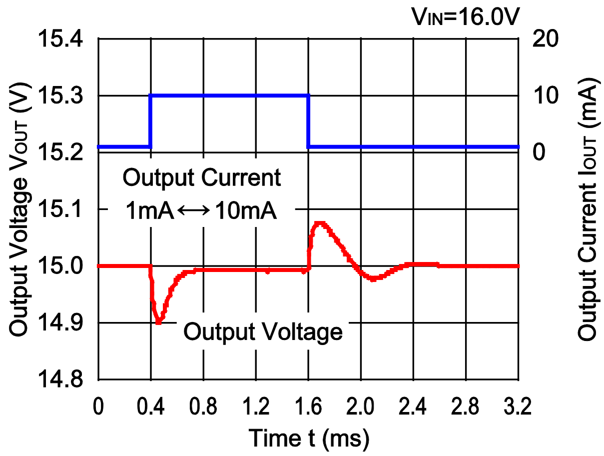

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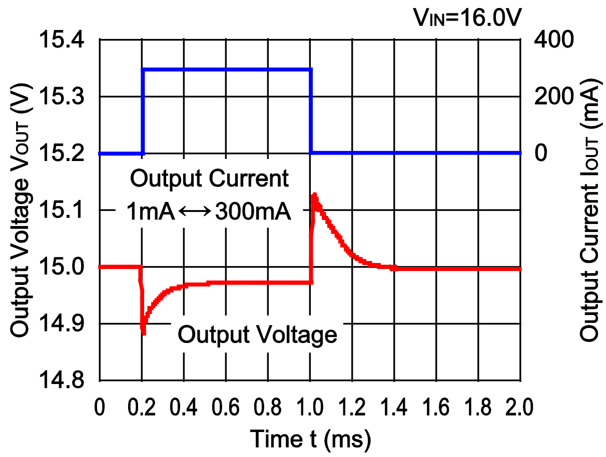

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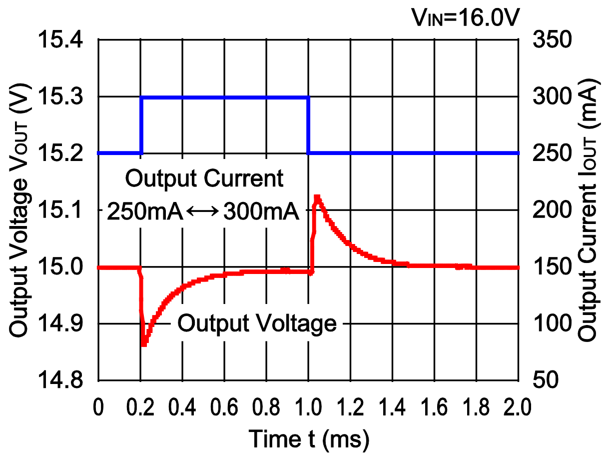
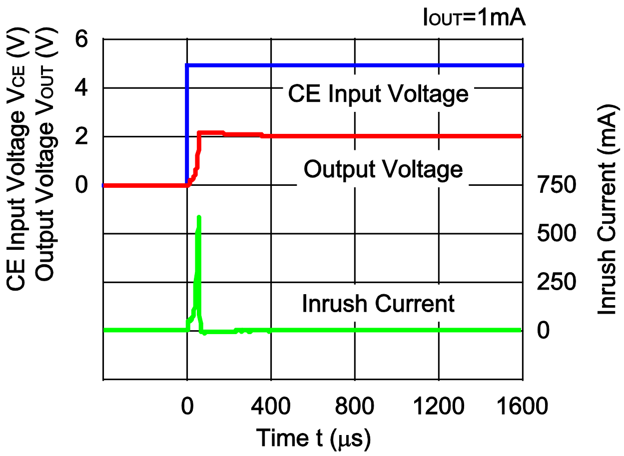


14) Inrush Current at Turn on(C1=2.2µF, C2=4.7µF, tr=0.1µs, Ta=25°C)

R1191x020x ECO=H



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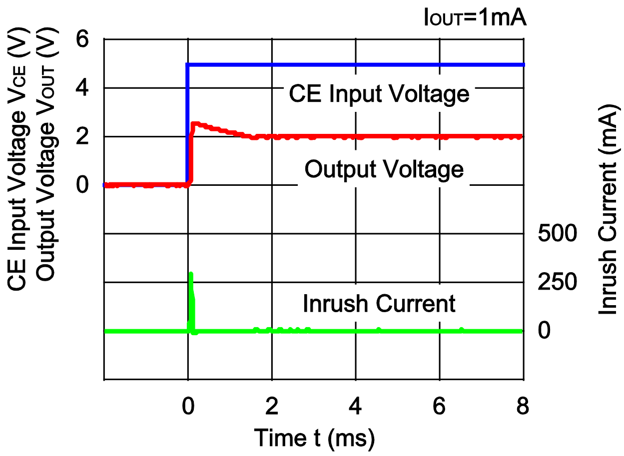

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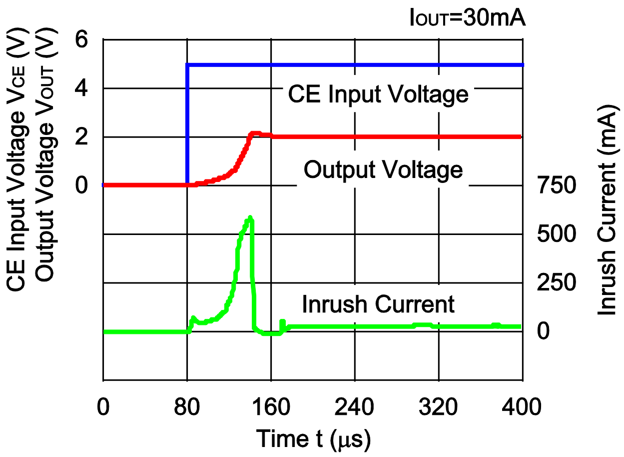

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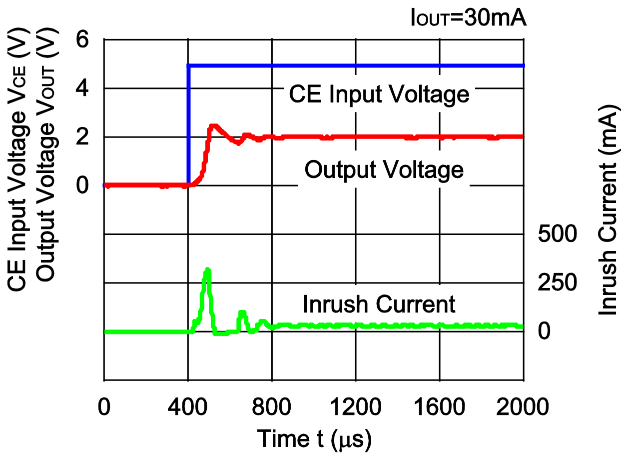

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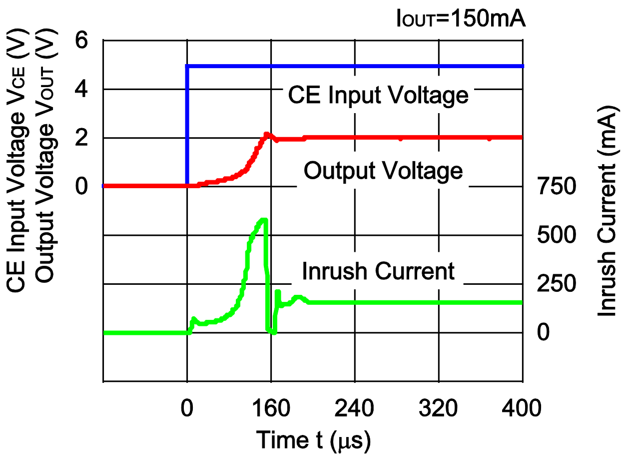

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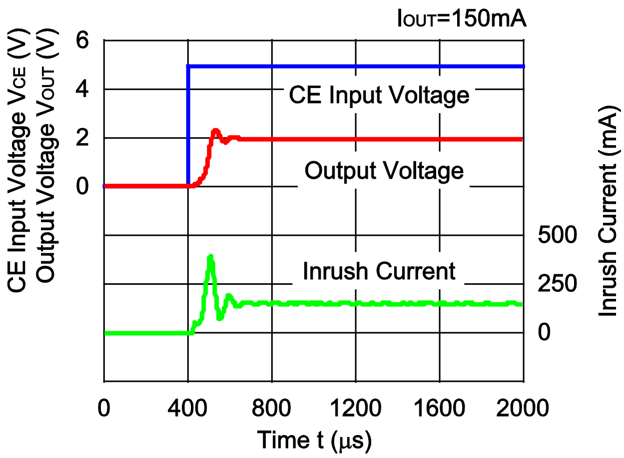

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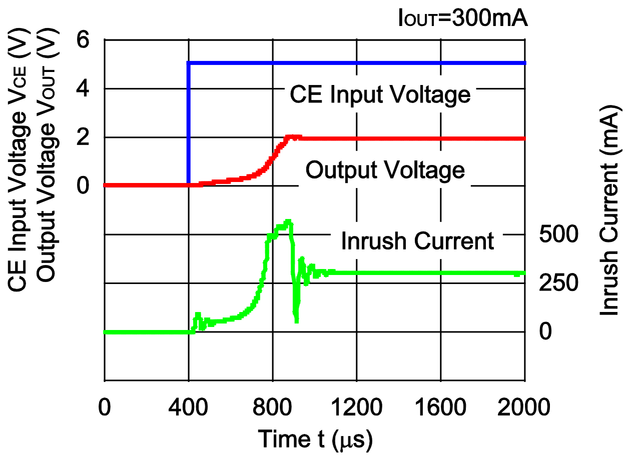

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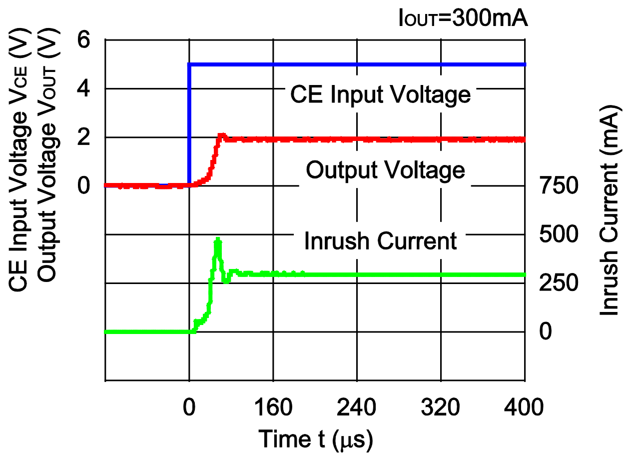
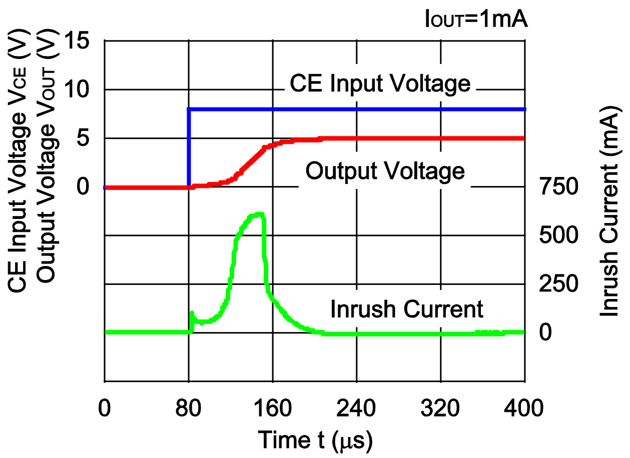


R1191x050x ECO=H



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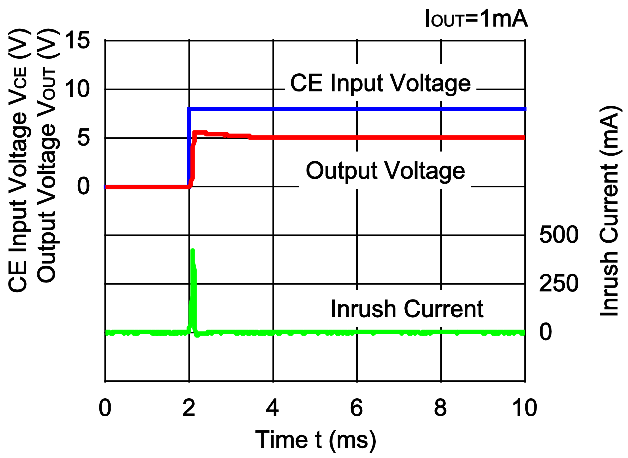

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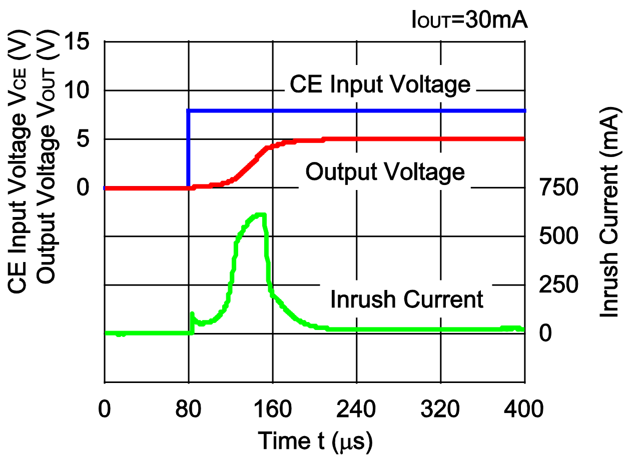

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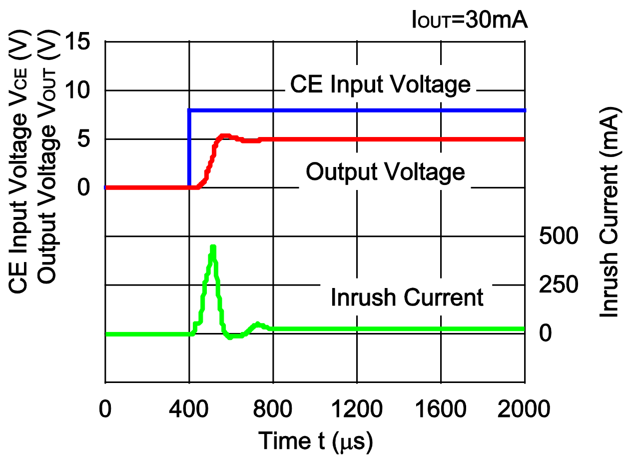

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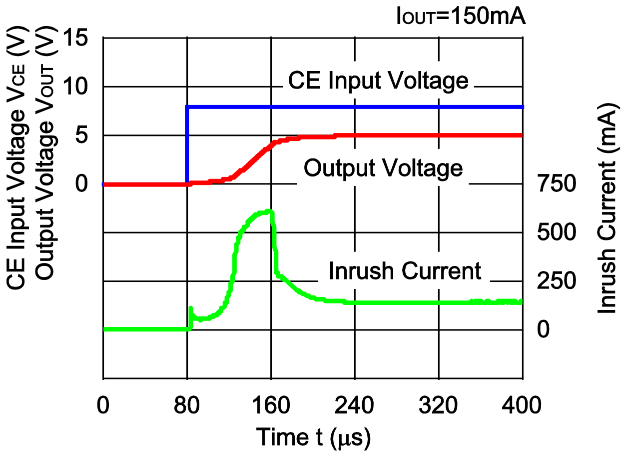

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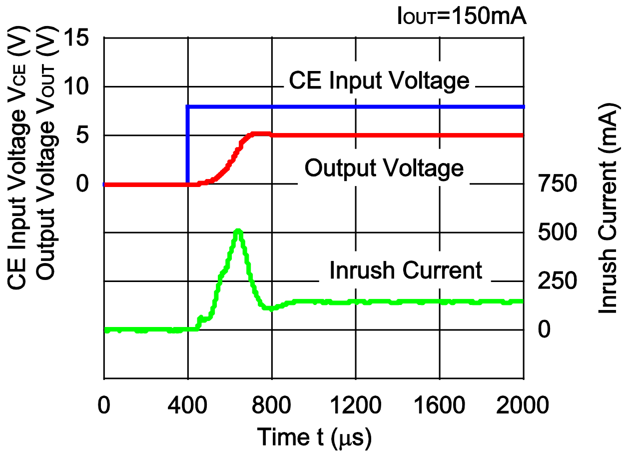

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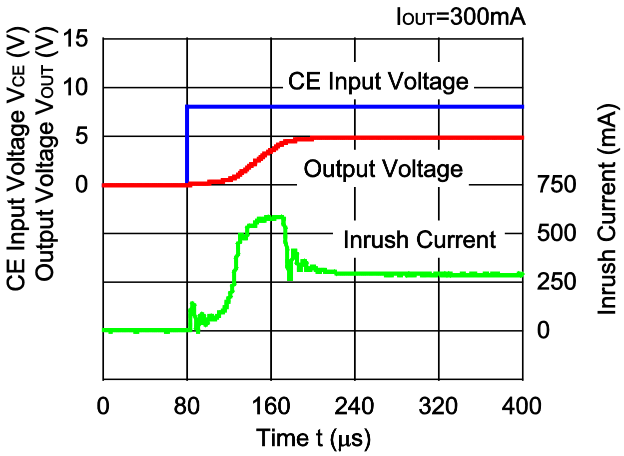

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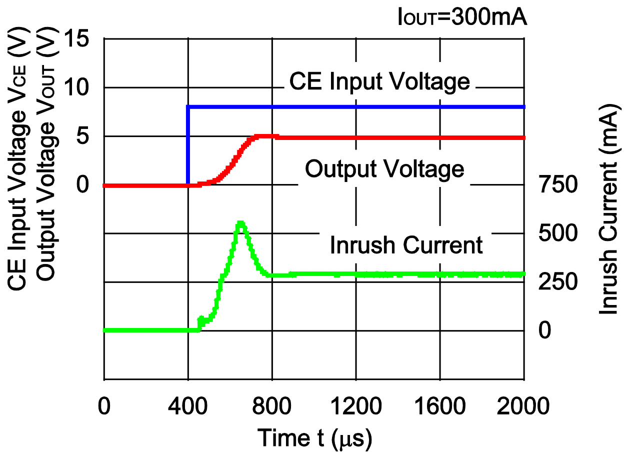

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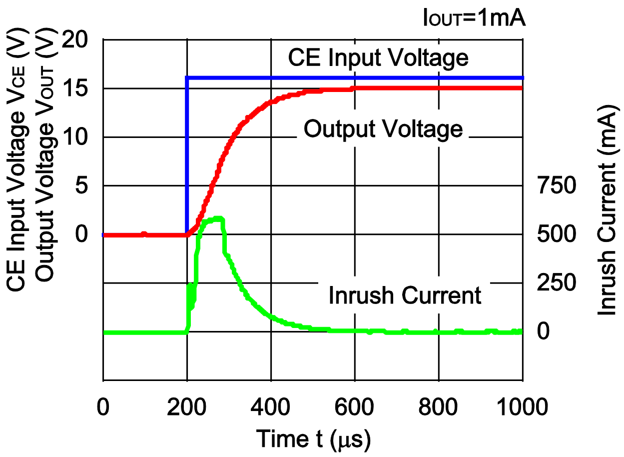

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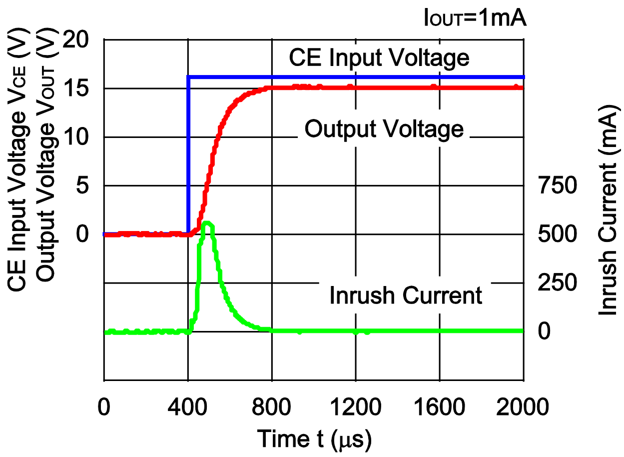

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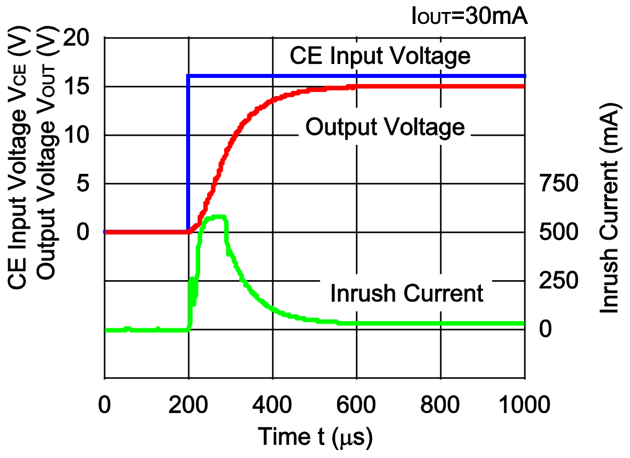

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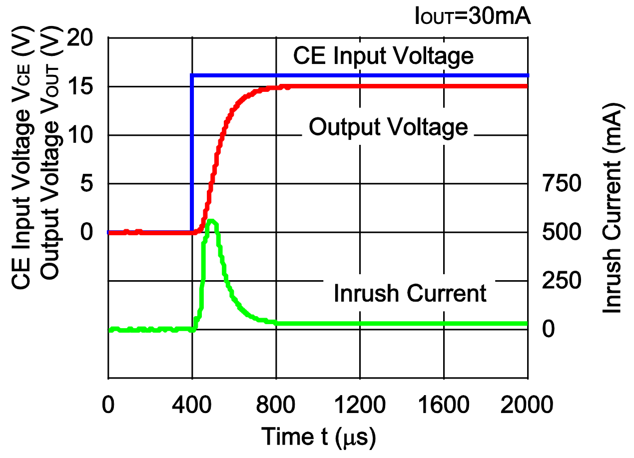

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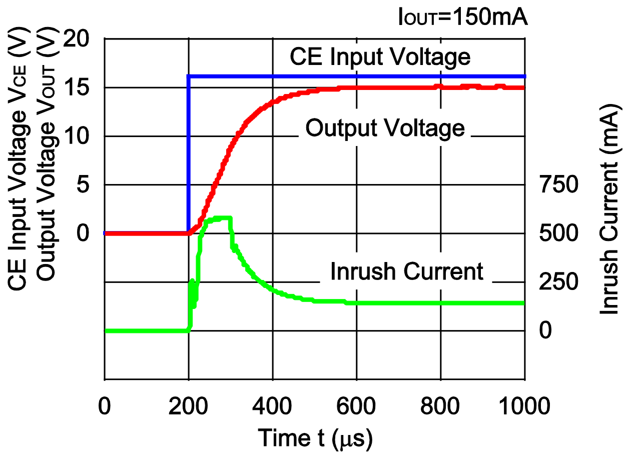

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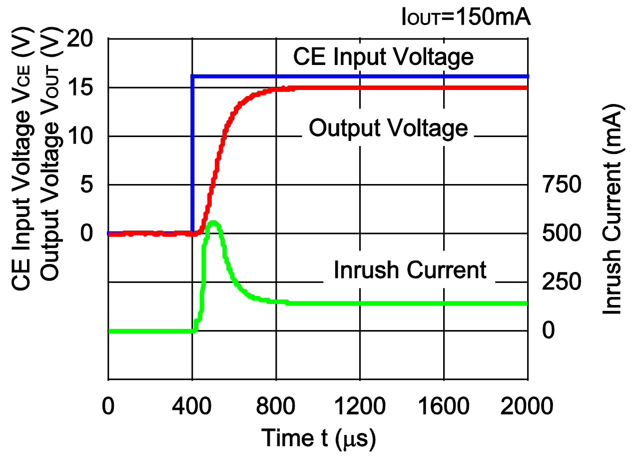

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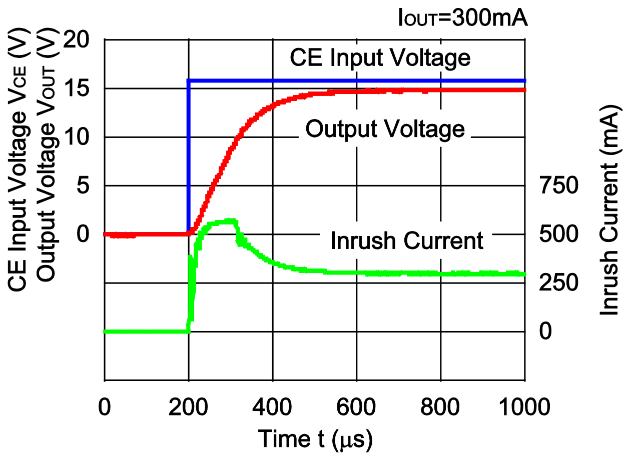

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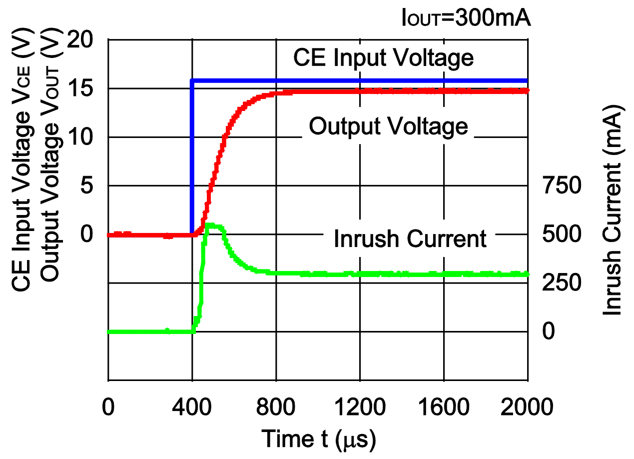
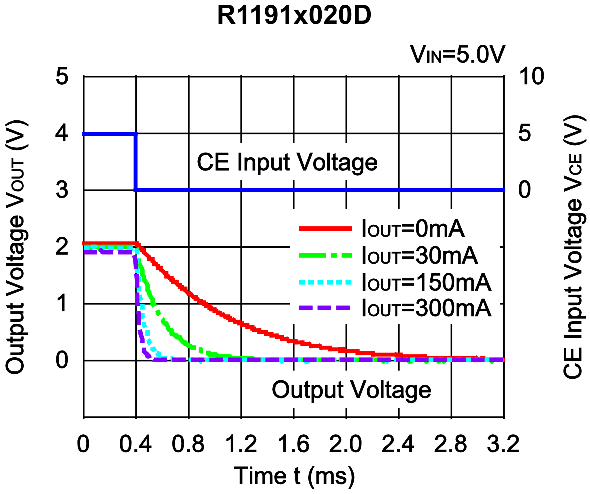
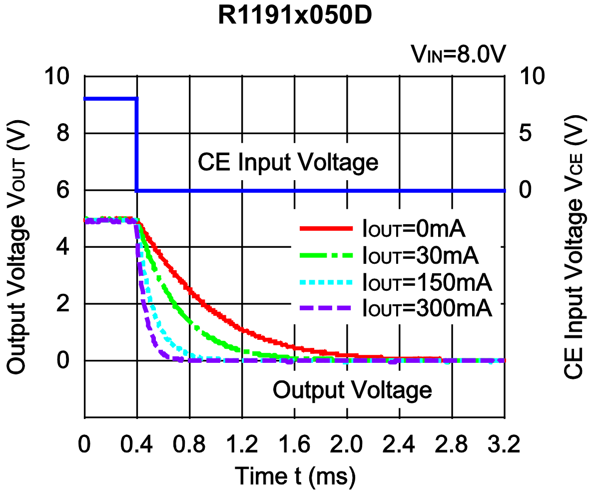
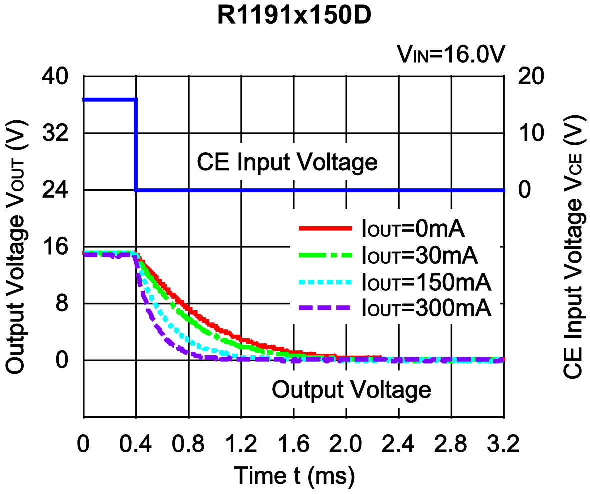


15) Turn Off Speed with CE pin (D Version) (C1=2.2µF, C2=4.7µF, tf=0.1µs, Ta=25°C)

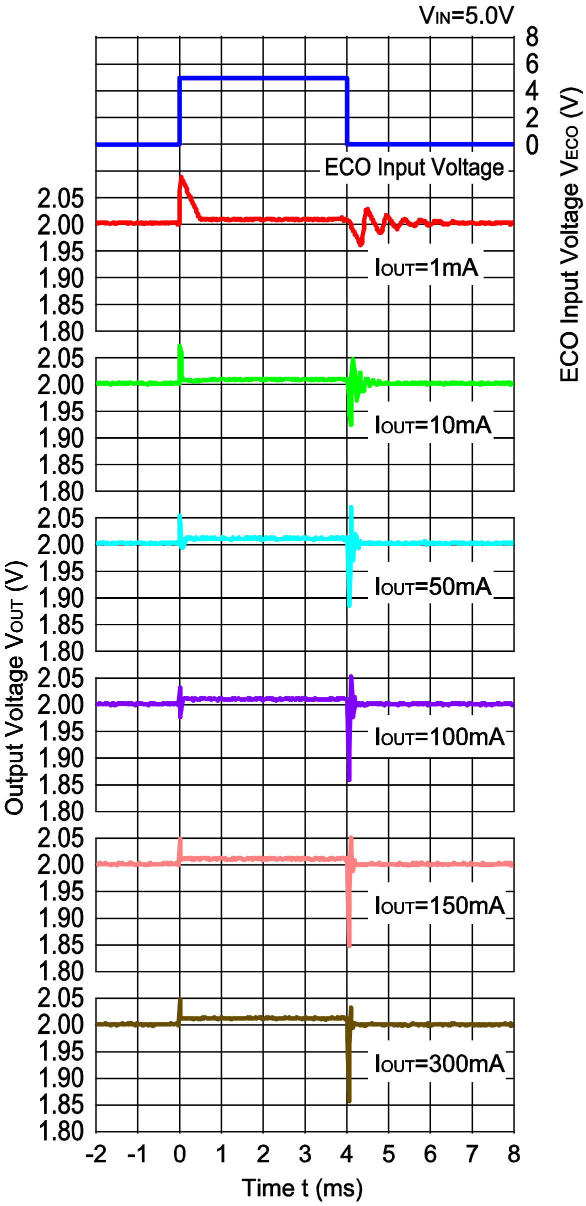




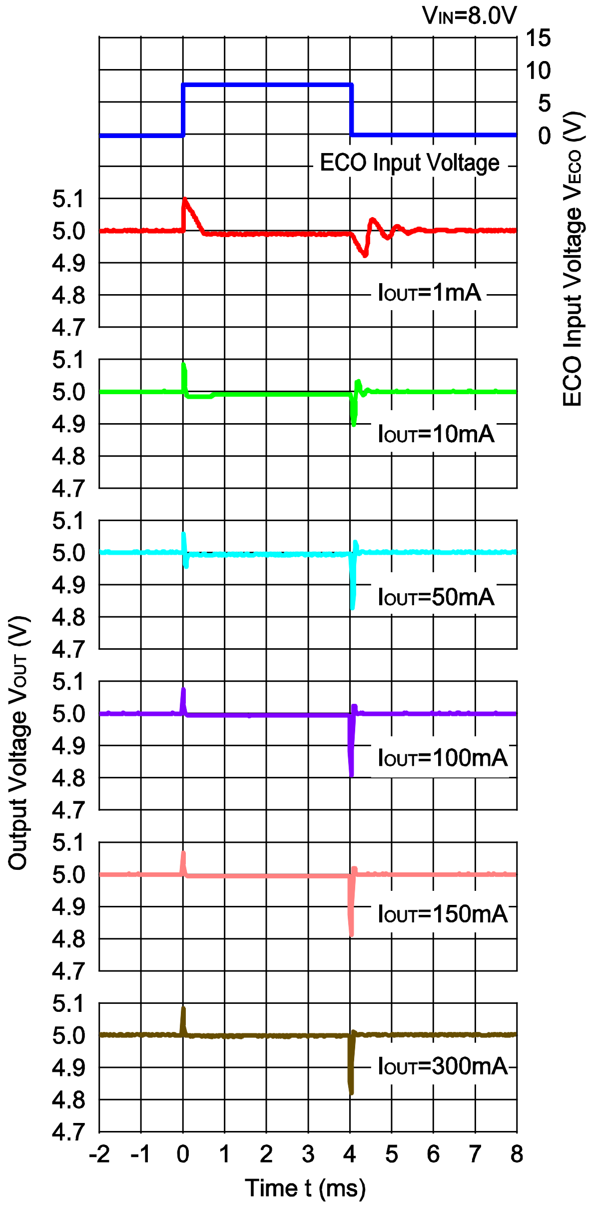


16) Output Voltage at Mode alternative point (C1=2.2μF, C2=4.7μF, tr=tf=0.1μs, Ta=25°C)

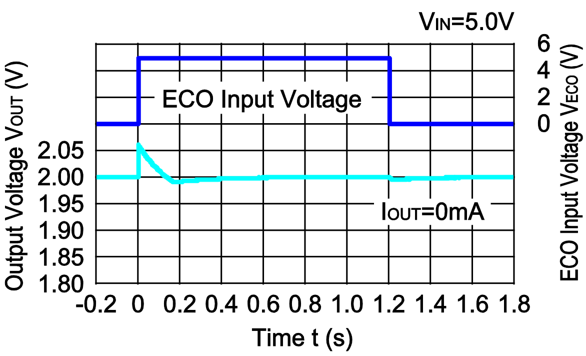
R1191x020x



R1191x050x



R1191x020x



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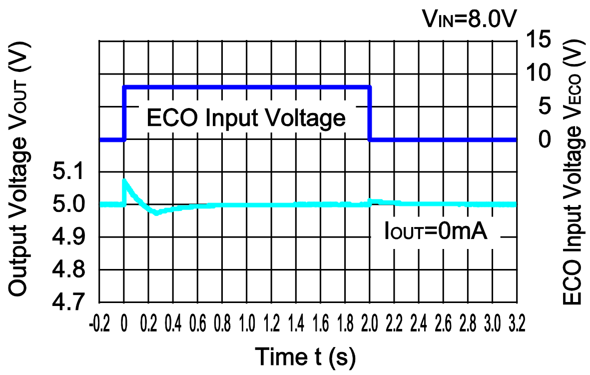

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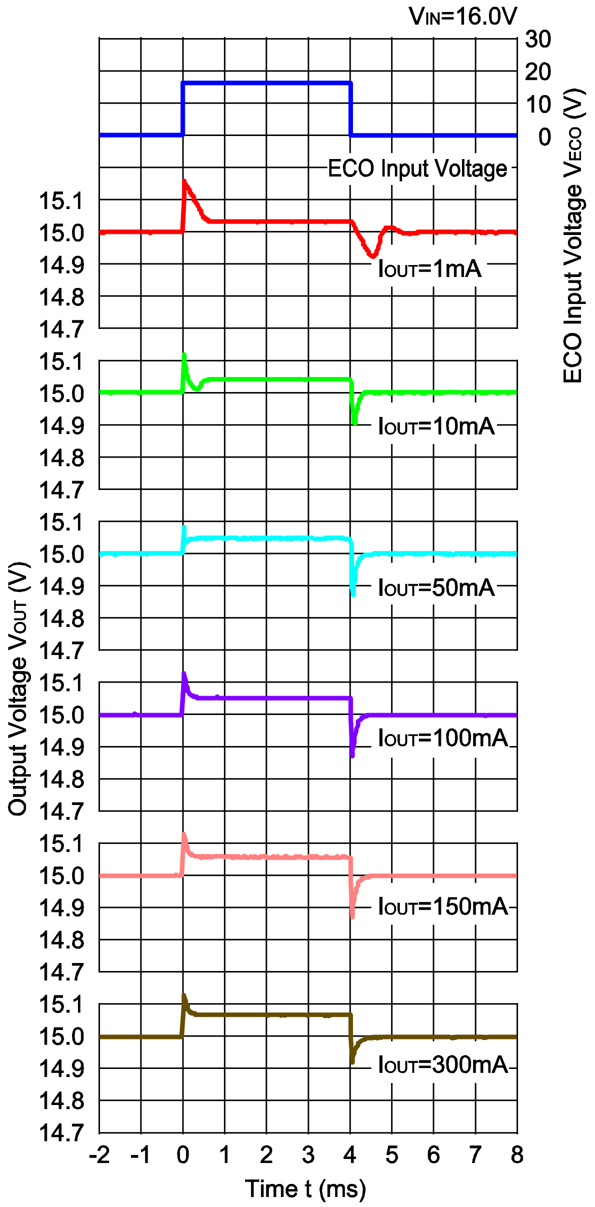

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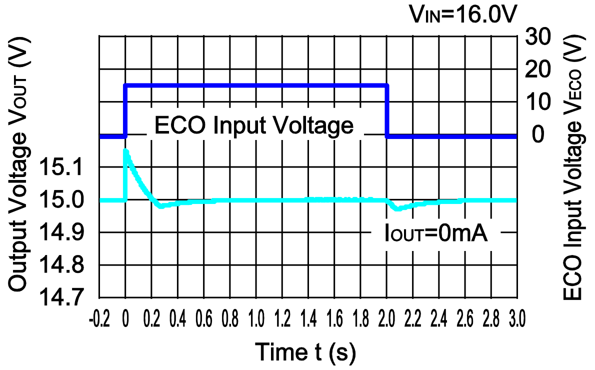
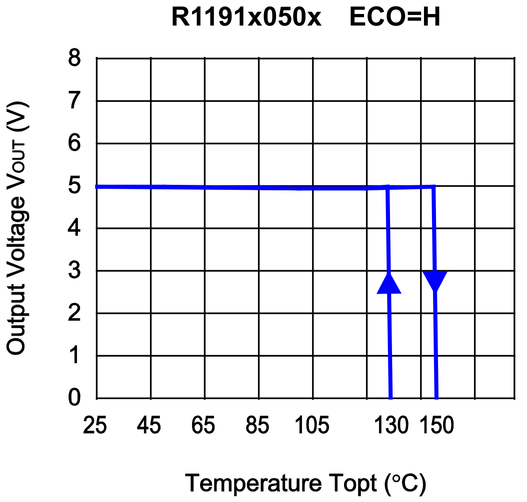
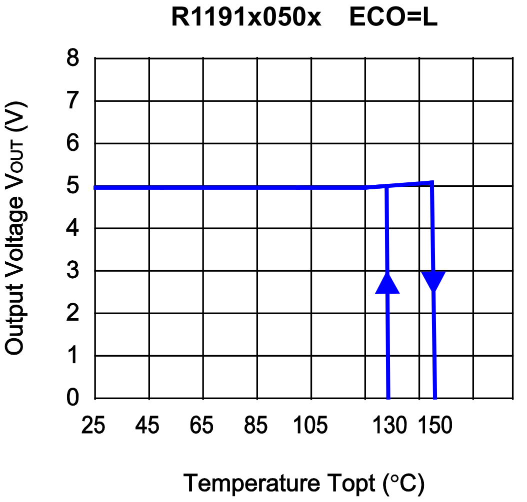


17) Thermal Shutdown Circuit (C1=2.2μF, C2=4.7μF, V_{IN}=16V, R_{LOAD}=1kΩ)





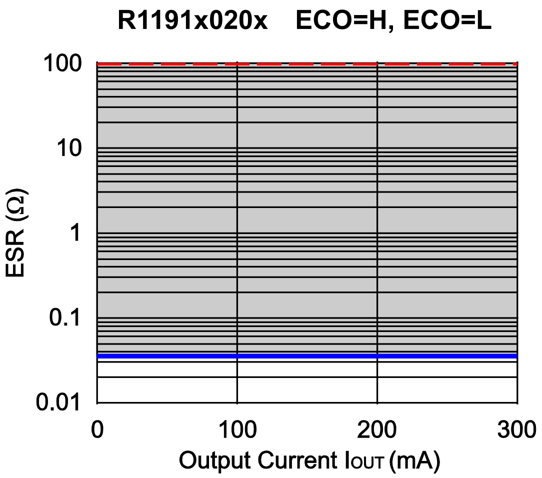
ESR vs. Output Current

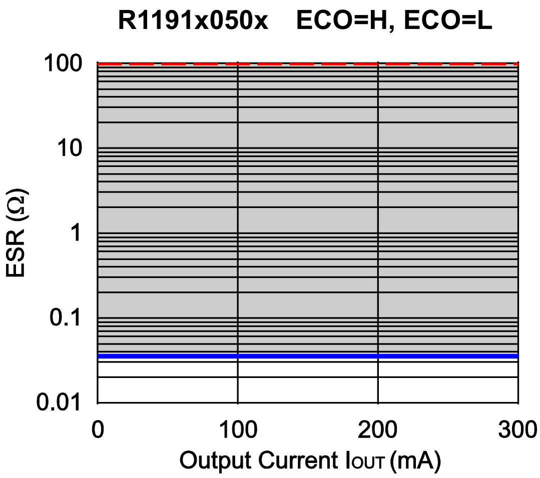
When using these ICs, consider the following points:

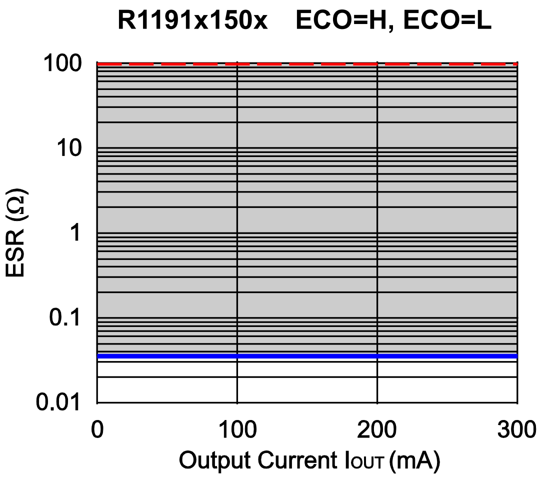
The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below.
The conditions when the white noise level is under 40μV (Avg.) are marked as the hatched area in the graph.

Measurement conditions

Frequency Band : 10Hz to 1MHz
Temperature : –40°C to 85°C
Hatched Area : Noise level is under 40μVms(Avg.)
C_{IN} : 2.2μF Murata (GRM32RB11E225KC01B)
C_{OUT} : 4.7μF Murata (GCM31CR71E475KA40)







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    - Equipment Used in the Deep Sea
    - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
    - Life Maintenance Medical Equipment
    - Fire Alarms / Intruder Detectors
    - Vehicle Control Equipment (airplane, railroad, ship, etc.)
    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

    In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.
6. 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 persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature 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.
7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. Quality Warranty

    8-1. Quality Warranty Period

    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.

    8-2. Quality Warranty Remedies

    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.

    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.

    8-3. Remedies after Quality Warranty Period

    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

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