

300mA LDO REGULATOR with the Reverse Current Protection

NO.EA-229-230529

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, SOT-23-5 and DFN1616-6, therefore high density mounting of the ICs on boards is possible.

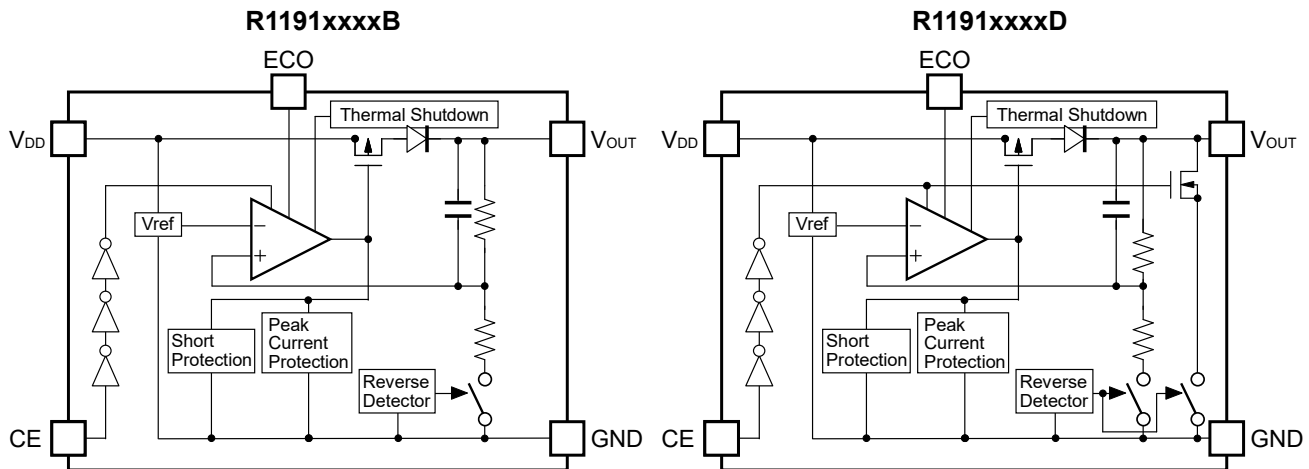
FEATURES

- Supply Current Typ. 50 μ A (Fast Mode),
Typ. 6.0 μ A (Low Power Mode)
- Standby Mode Typ. 0.3 μ A
- Reverse Current Max. 0.1 μ A
- Output Current Min. 300mA
- Input Voltage Range 3.5V to 16.0V
- Output Voltage Range 2.0V to 15.0V (0.1V steps)
(For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy $\pm 1.5\%$ (Fast Mode)
 $\pm 2.5\%$ (Low Power Mode)
- Temperature-Drift Coefficient of Output Voltage .. Typ. ± 80 ppm/ $^{\circ}$ C
- Dropout Voltage Typ. 0.55V (Fast Mode, $I_{OUT}=300$ mA, $V_{OUT}=5.0$ V)
Typ. 0.70V (Low Power Mode, $I_{OUT}=300$ mA, $V_{OUT}=5.0$ V)
- Ripple Rejection Typ. 60dB ($f=1$ kHz, $V_{OUT}=5.0$ V, Fast Mode)
- Line Regulation Typ. 0.02%/V (Fast Mode)
- Packages DFN1616-6, 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 $^{\circ}$ C
- Ceramic capacitors are recommended to be used with this IC $\cdots C_{IN}=2.2\mu$ F or more, $C_{OUT}=4.7\mu$ F or more

APPLICATIONS

- Power source for digital home appliances
- Power source for audio visual equipment

BLOCK DIAGRAM



SELECTION GUIDE

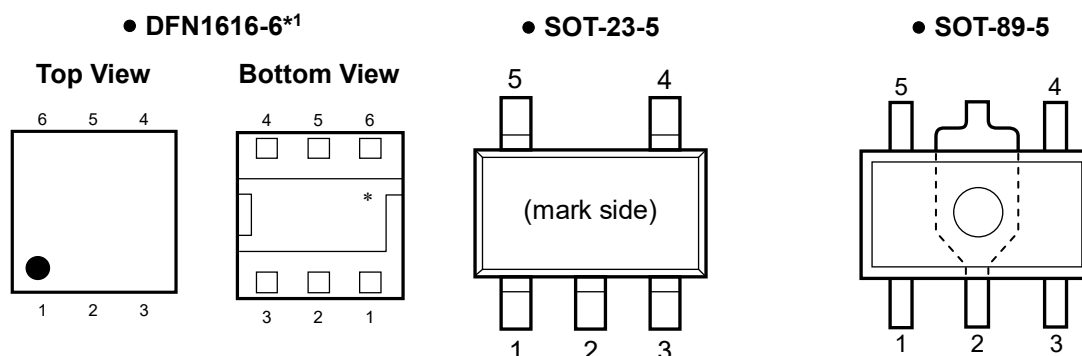
The output voltage, auto-discharge function, and package, for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1191Lxxx*-TR	DFN1616-6	5,000 pcs	Yes	Yes
R1191Nxxx*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
R1191Hxxx*-T1-FE	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.
(For other voltages, please refer to MARK INFORMATIONS.)

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

PIN CONFIGURATIONS



PIN DISCRIPTIONS

• DFN1616-6*1

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

*1) Tab is GND level. (They are connected to the reverse side of this IC.)

The tab is better to be connected to the GND, but leaving it open is also acceptable.

• 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 $V_{IN} + 0.3 \leq 18.0$	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	
T_a	Operating Temperature Range	-40 to +85	°C
T_{stg}	Storage Temperature Range	-55 to +125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.

The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

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

ELECTRICAL CHARACTERISTICS

$V_{IN}=V_{CE}=\text{Set } V_{OUT}+3.0\text{V}$ (Max. 16V), $C_{IN}=2.2\mu\text{F}$, $C_{OUT}=4.7\mu\text{F}$, $I_{OUT}=1\text{mA}$, unless otherwise noted.
The values in are applicable under the condition of $-40^{\circ}\text{C} \leq T_{opt} \leq 85^{\circ}\text{C}$.

R1191xxxxB/D

$T_{opt}=25^{\circ}\text{C}$

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{OUT}	Output Voltage	Fast Mode	$V_{ECO}=V_{IN}$	$T_{opt}=25^{\circ}\text{C}$	$\times 0.985$	$\times 1.015$	V
				$-40^{\circ}\text{C} \leq T_{opt} \leq 85^{\circ}\text{C}$	0.970	1.030	
		Low Power Mode	$V_{ECO}=0\text{V}$	$T_{opt}=25^{\circ}\text{C}$	$\times 0.975$	$\times 1.025$	
				$-40^{\circ}\text{C} \leq T_{opt} \leq 85^{\circ}\text{C}$	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	$V_{ECO}=V_{IN}$, $1\text{mA} \leq I_{OUT} \leq 300\text{mA}$		50	120	mV
		Low Power Mode	$V_{ECO}=\text{GND}$, $1\text{mA} \leq I_{OUT} \leq 300\text{mA}$		60	130	
V_{DIF}	Dropout Voltage		Refer to the following table				
I_{SS1}	Supply Current (Fast Mode)	$V_{ECO}=V_{IN}$, $I_{OUT}=0\text{mA}$		50	100	μA	
I_{SS2}	Supply Current (Low Power Mode)	$V_{ECO}=\text{GND}$, $I_{OUT}=0\text{mA}$		6	15	μA	
$I_{standby}$	Supply Current (Standby)	$V_{IN}=16\text{V}$, $V_{CE}=0\text{V}$ (If $V_{OUT} < 3.0\text{V}$, $V_{IN}=14\text{V}$)		0.3	1.0	μA	
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set $V_{OUT}+0.5\text{V} \leq V_{IN} \leq 16\text{V}$ (If Set $V_{OUT} < 3.0\text{V}$, $3.5\text{V} \leq V_{IN} \leq 14\text{V}$)		0.02	0.10	%/V	
RR	Ripple Rejection	$f=1\text{kHz}$, $I_{OUT}=30\text{mA}$ Ripple 0.2V_{p-p} , $V_{IN}=V_{ECO}=\text{Set } V_{OUT}+1\text{V}$	$2.0\text{V} \leq V_{OUT} < 5.0\text{V}$		70	dB	
			$5.0\text{V} \leq V_{OUT} < 12\text{V}$		60		
			$12\text{V} \leq V_{OUT}$		60		
V_{IN}	Input Voltage	$2.0\text{V} \leq V_{OUT} < 3.0\text{V}$	3.5		14.0	V	
		$3.0\text{V} \leq V_{OUT}$			16.0		
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	$-40^{\circ}\text{C} \leq T_{opt} \leq 85^{\circ}\text{C}$		± 80		ppm/ $^{\circ}\text{C}$	
I_{SC}	Short Current Limit	$V_{OUT}=0\text{V}$		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		$^{\circ}\text{C}$	
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		130		$^{\circ}\text{C}$	
R_{LOW}	Low Output Nch Tr. ON Resistance (of D Version)	$V_{IN}=5\text{V}$, $V_{CE}=0\text{V}$, $V_{OUT}=0.3\text{V}$		150		Ω	
I_{REV}	Reverse Current	$V_{OUT} > 0.6\text{V}$, $0\text{V} \leq V_{IN} \leq 16\text{V}$		0	0.1	μA	

*) The values in have been tested and guaranteed by Design Engineering.

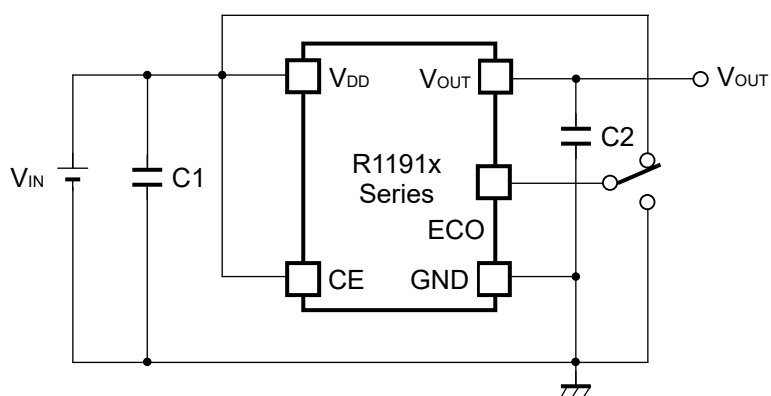
All test categories were tested on the products under the pulse load condition ($T_j \approx T_{opt} = 25^{\circ}\text{C}$) except the following test categories: ripple rejection, output voltage temperature coefficient, and thermal shutdown.

ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

T_{opt}=25°C

Output Voltage V _{OUT} (V)	Dropout Voltage V _{DIF} (V)				
	Condition	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 $2.2\mu\text{F}$ 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.

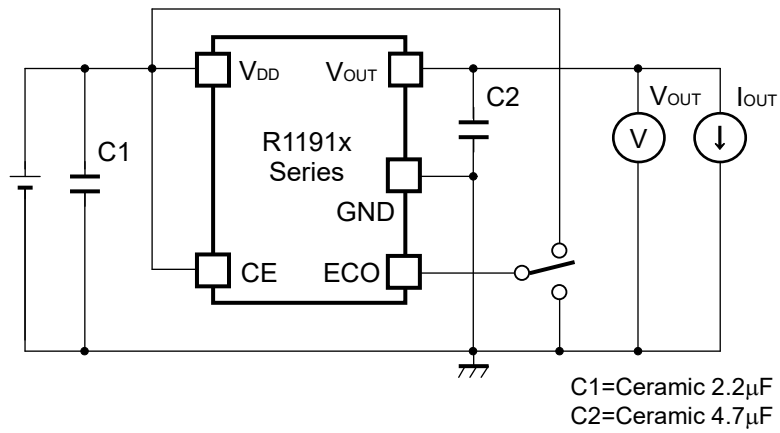
- **Chip Enable (CE) Circuit and High-speed/ Low Supply Current Switching (ECO) Circuit**

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.

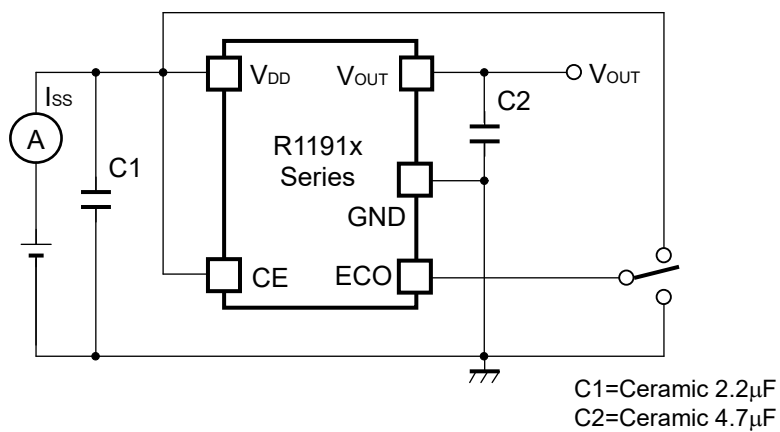
- **Auto-discharge Function**

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.

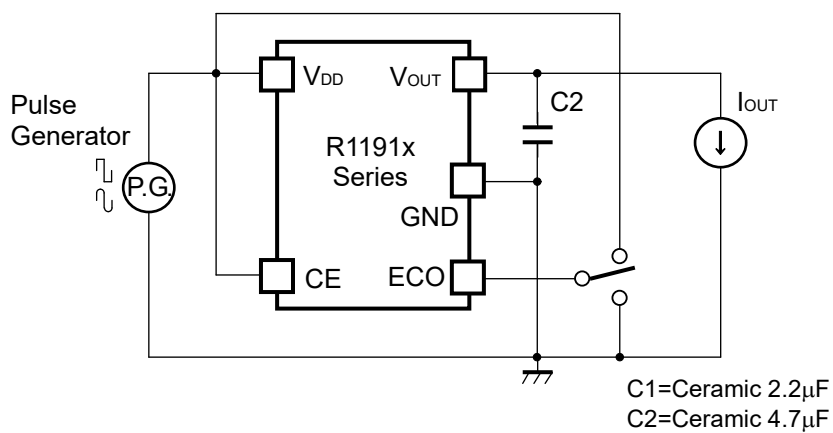
TEST CIRCUITS



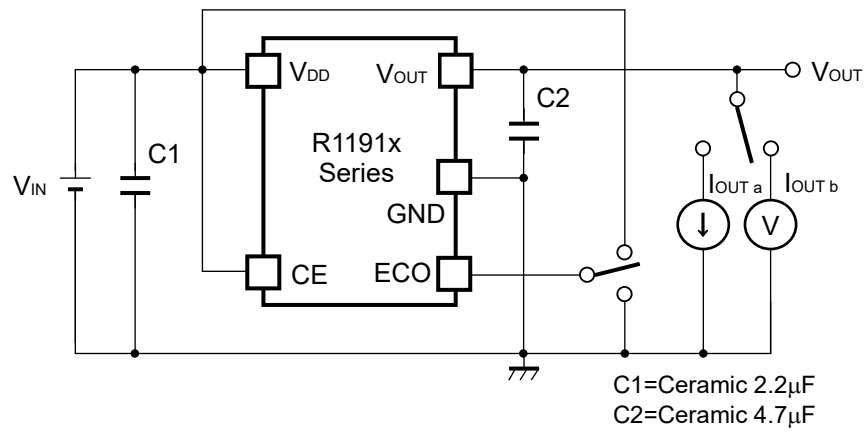
Basic Test Circuit



Test Circuit for Supply Current



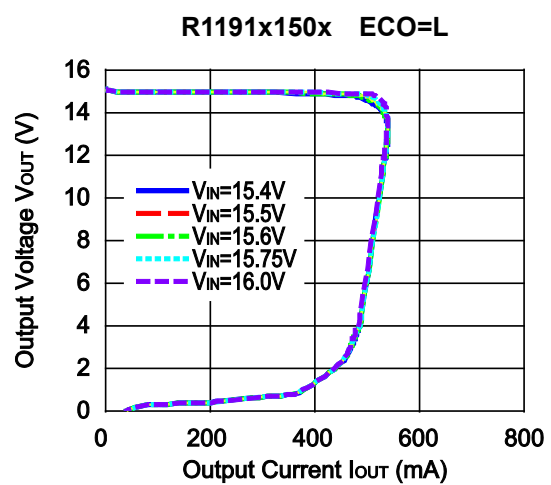
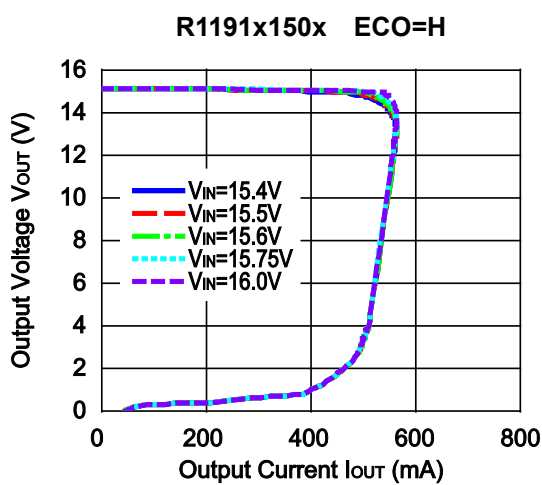
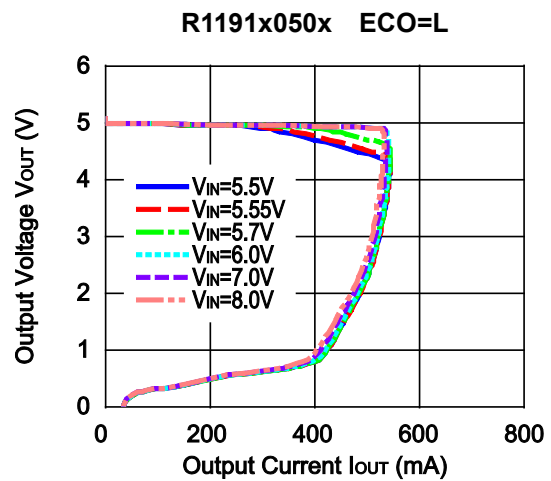
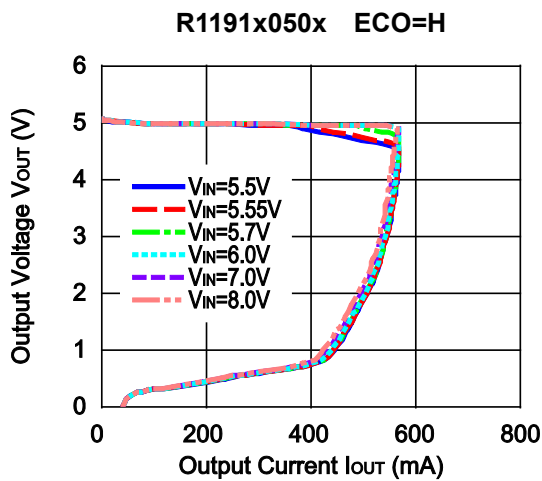
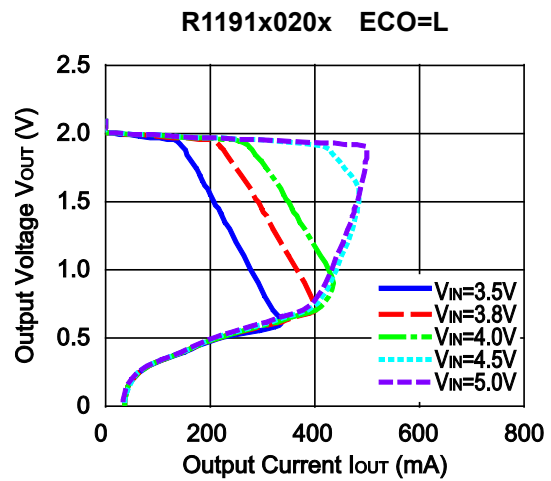
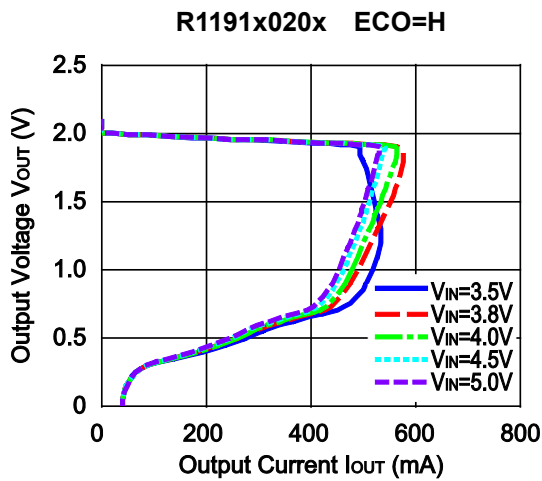
Test Circuit for Ripple Rejection

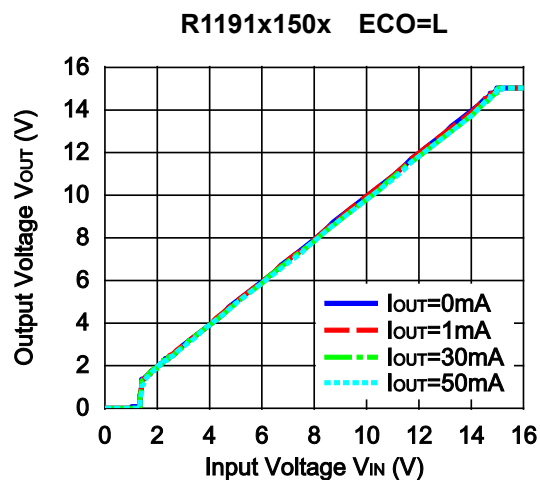
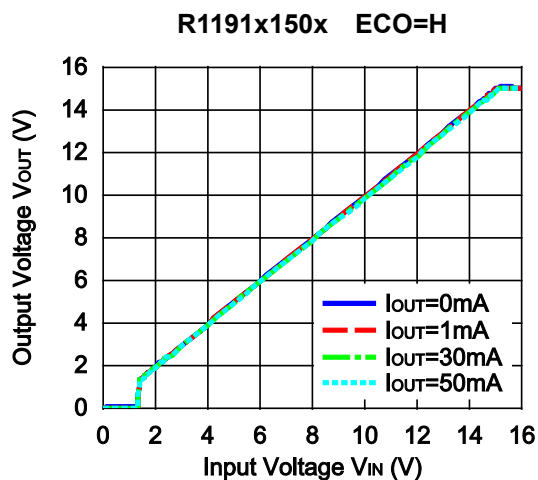
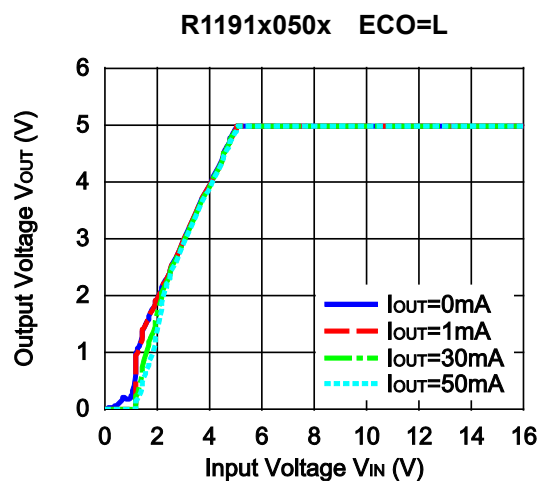
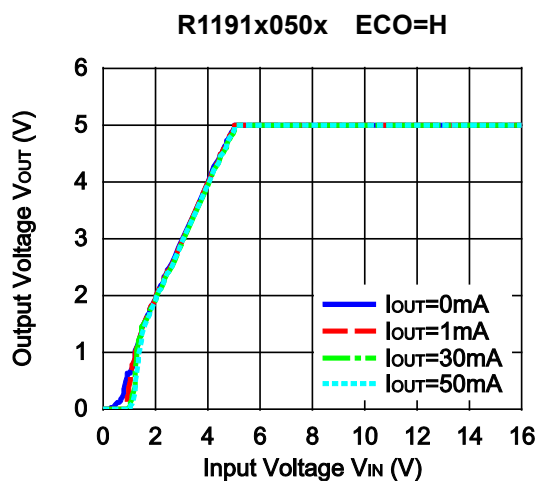
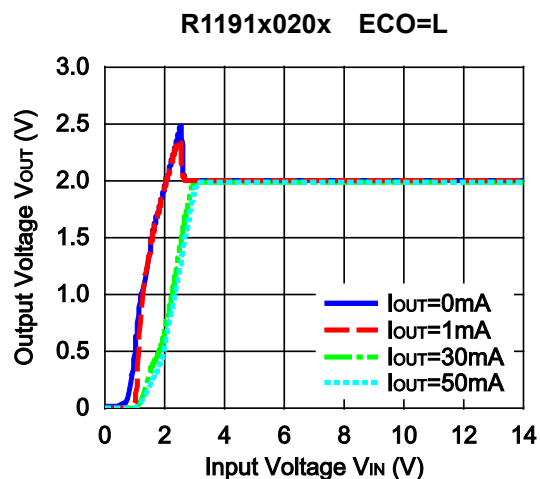
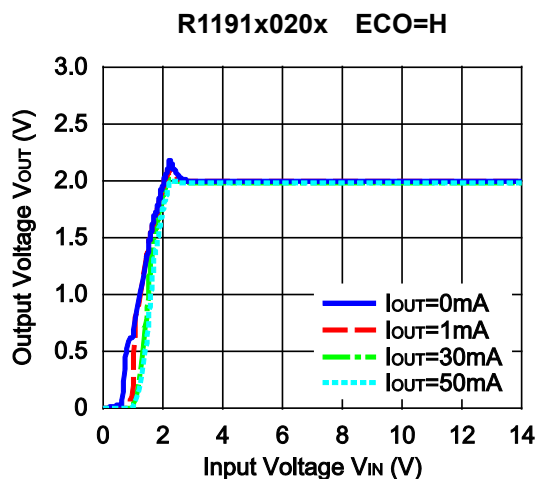


Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

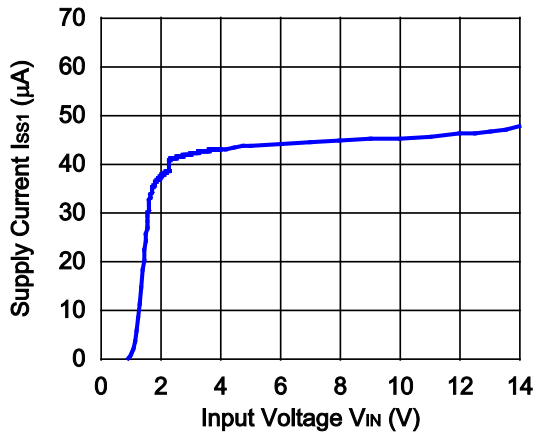
1) Output Voltage vs. Output Current (C1=2.2μF, C2=4.7μF, T_{opt}=25°C)



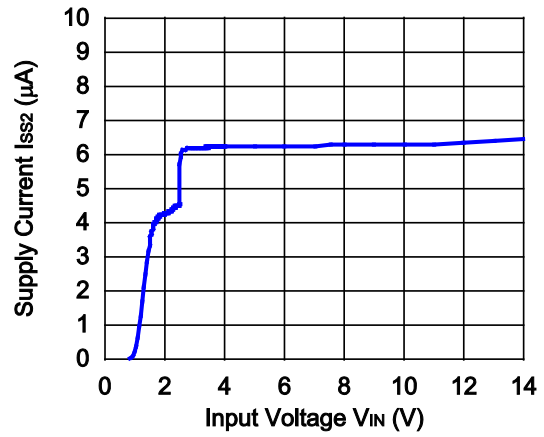
2) Output Voltage vs. Input Voltage ($C_1=2.2\mu\text{F}$, $C_2=4.7\mu\text{F}$, $T_{\text{opt}}=25^\circ\text{C}$)

3) Supply Current vs. Input Voltage (C1=2.2μF, C2=4.7μF, T_{opt}=25°C)

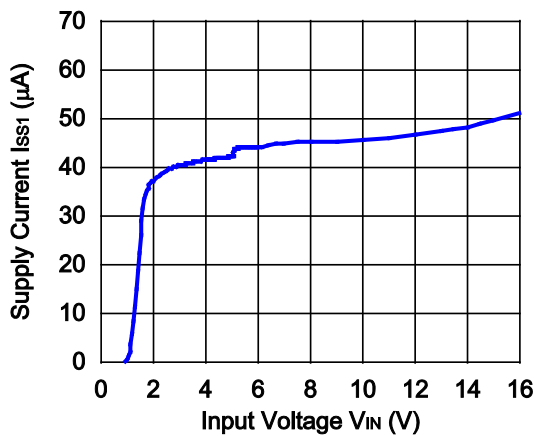
R1191x020x ECO=H



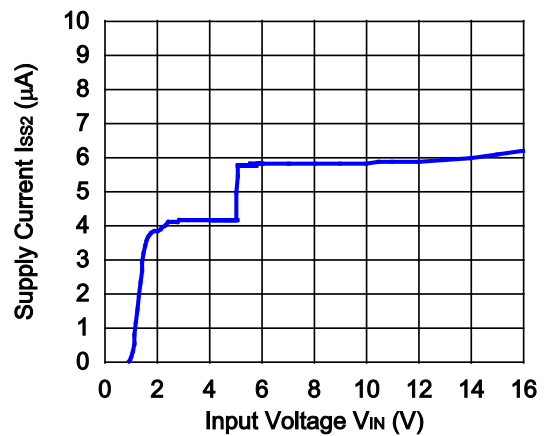
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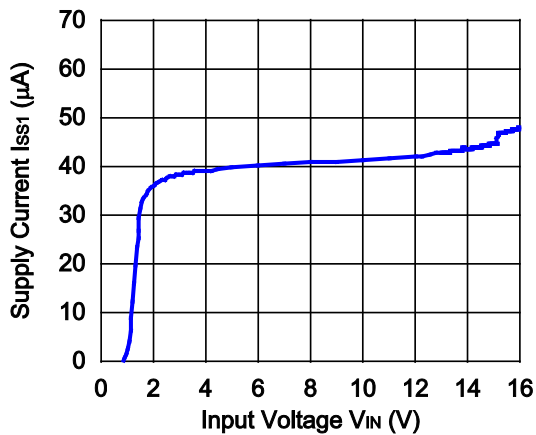
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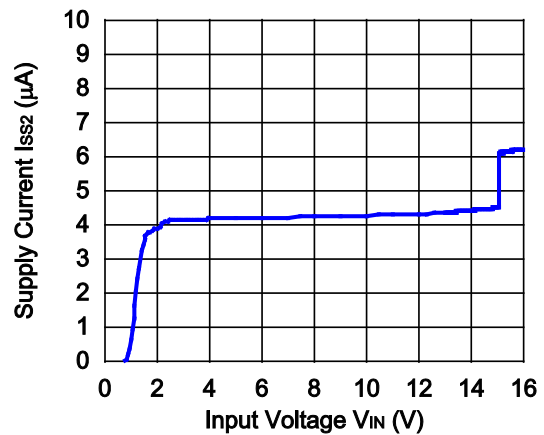
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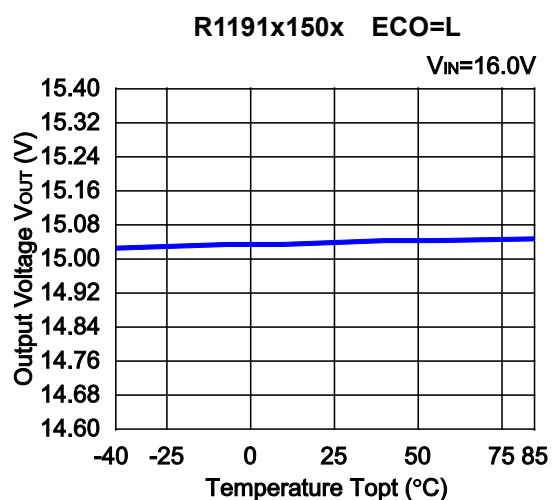
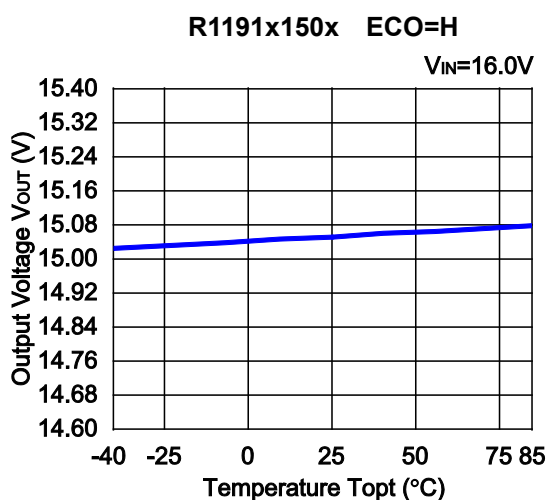
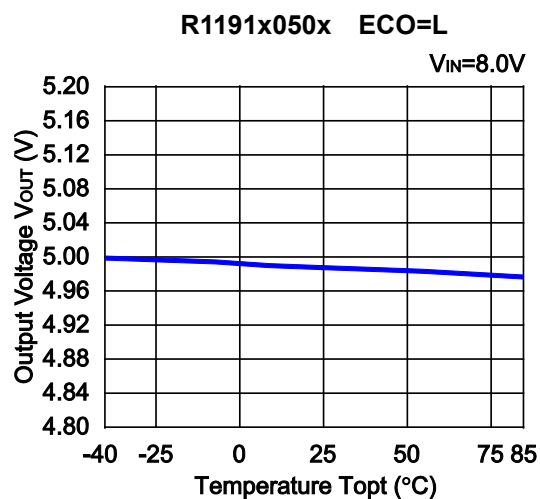
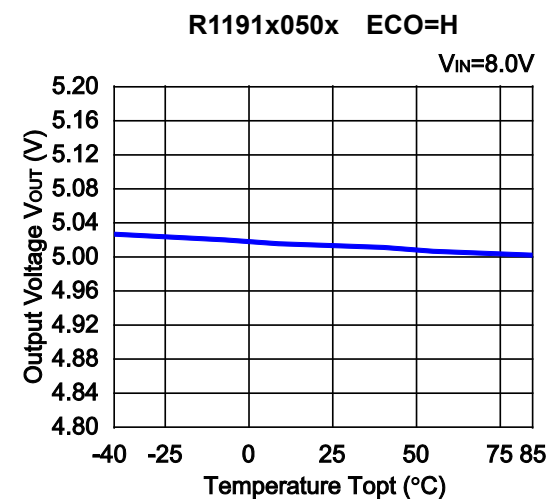
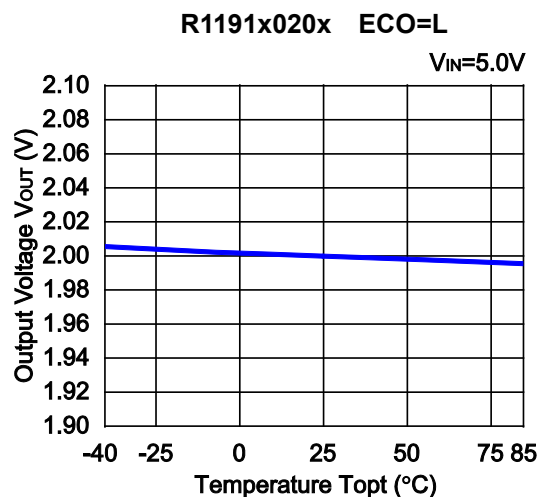
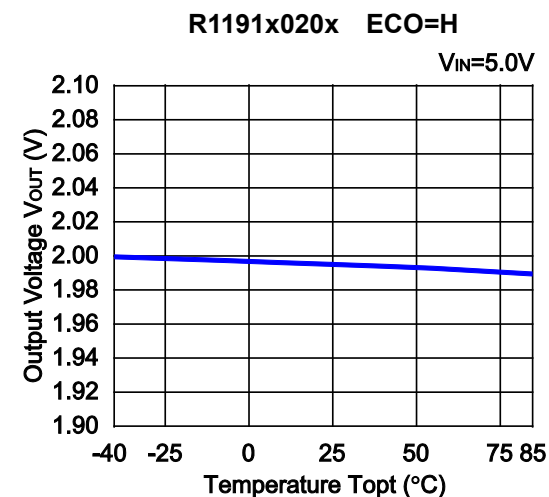


R1191x150x ECO=H

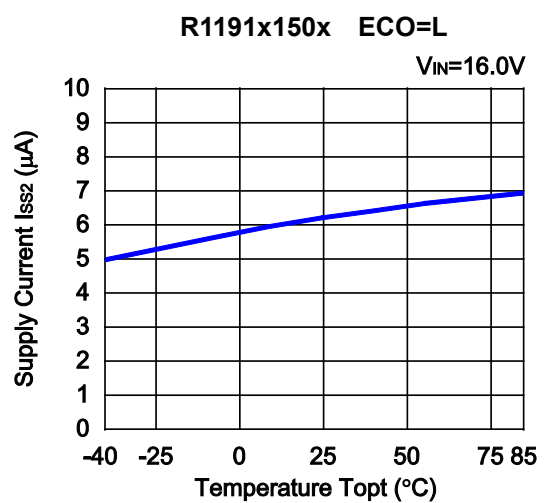
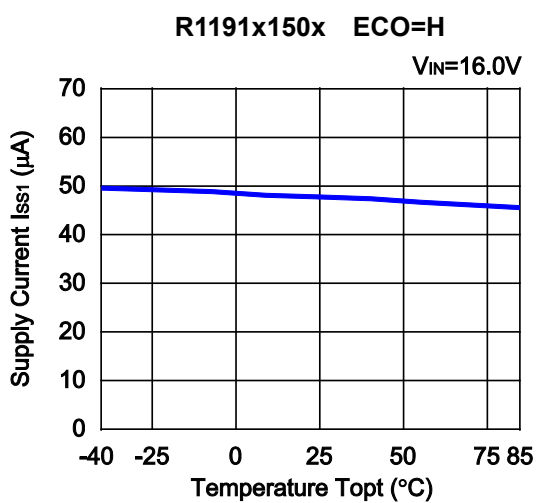
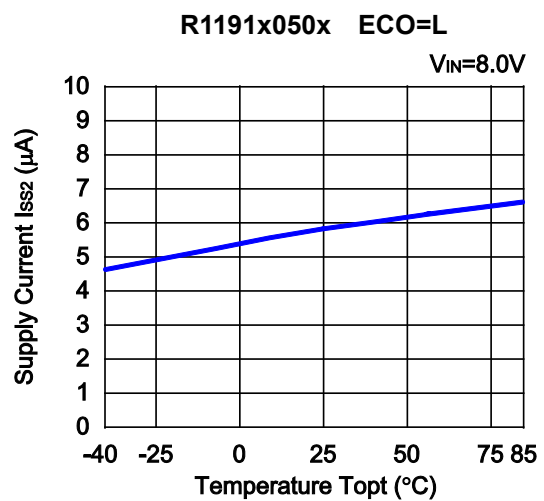
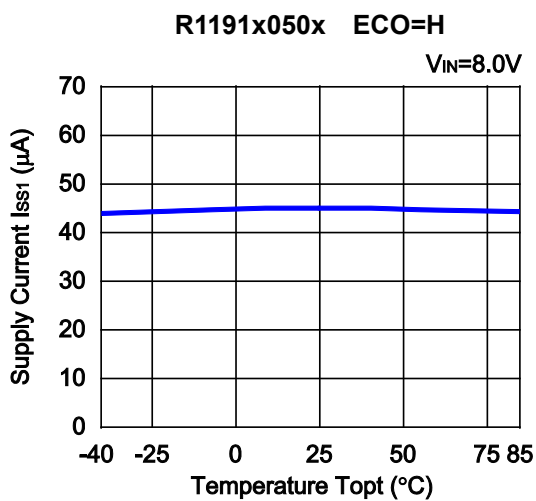
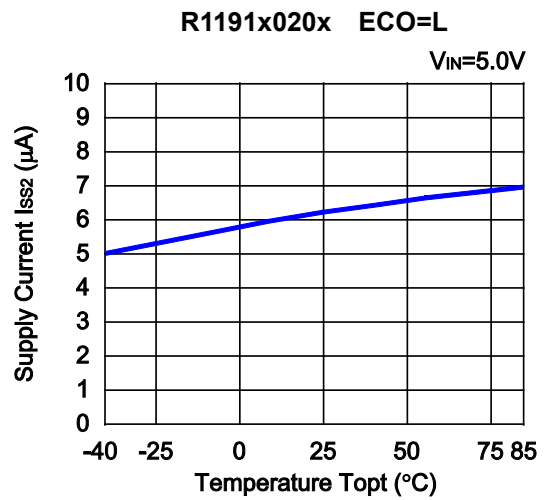
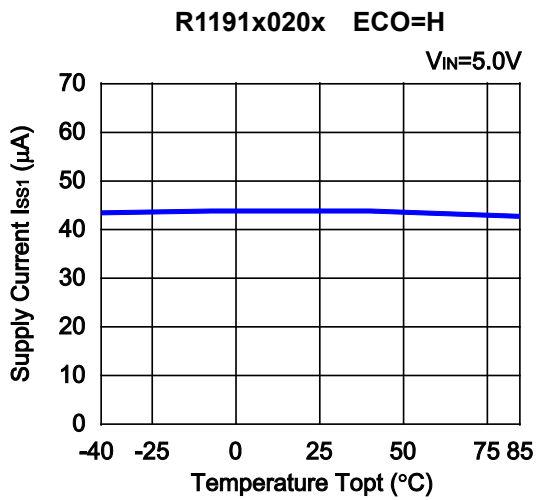


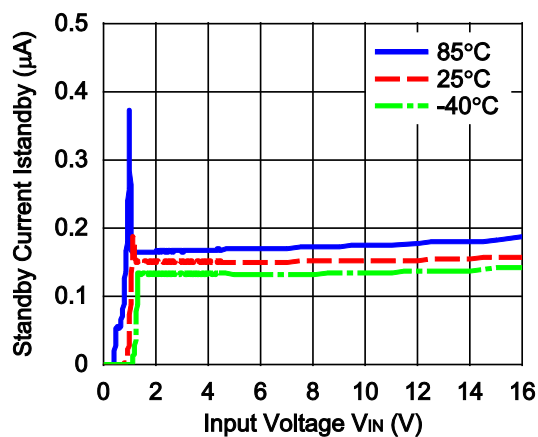
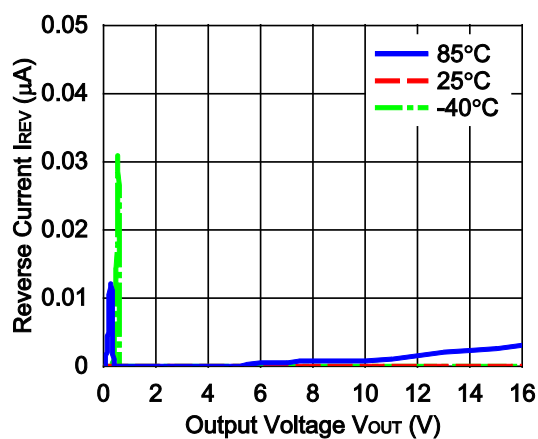
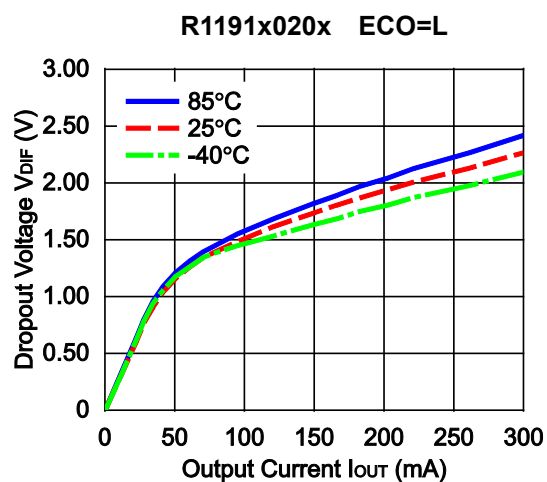
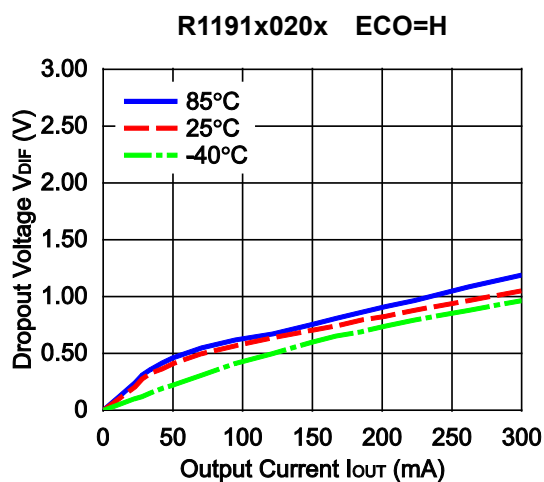
R1191x150x ECO=L



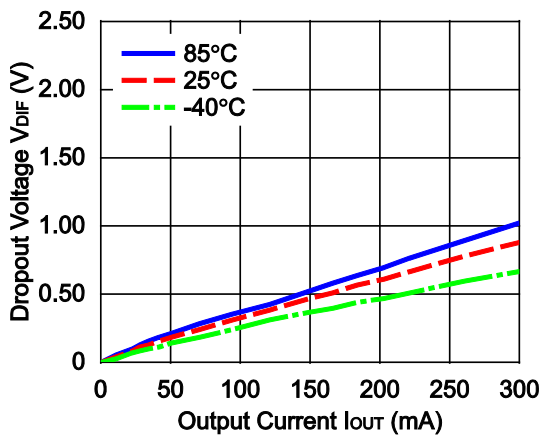
4) Output Voltage vs. Temperature ($C1=2.2\mu\text{F}$, $C2=4.7\mu\text{F}$, $I_{\text{OUT}}=1\text{mA}$)

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

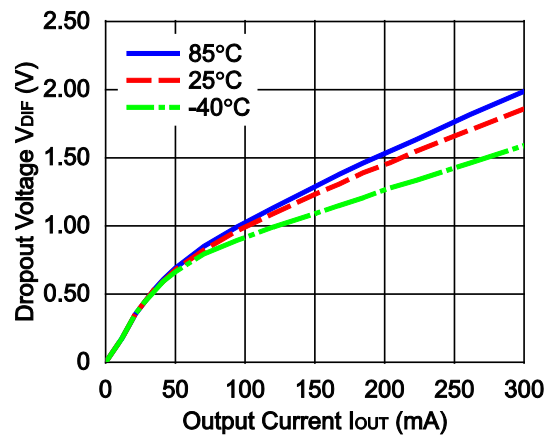


6) Standby Current vs. Input Voltage (C1=2.2 μ F, C2=4.7 μ F)7) Reverse Current vs. Output Voltage (C1=2.2 μ F, C2=4.7 μ F, $V_{IN}=0$ V)8) Dropout Voltage vs. Output Current (C1=2.2 μ F, C2=4.7 μ F)

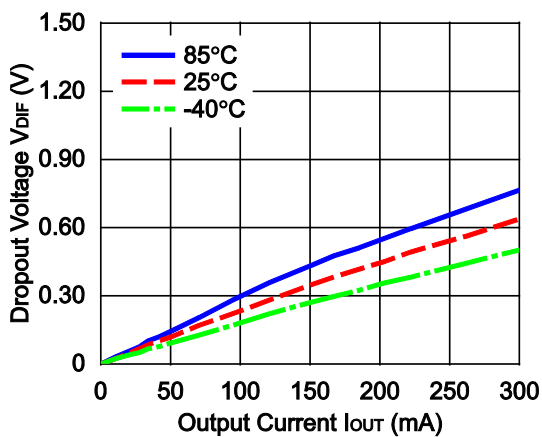
R1191x025x ECO=H



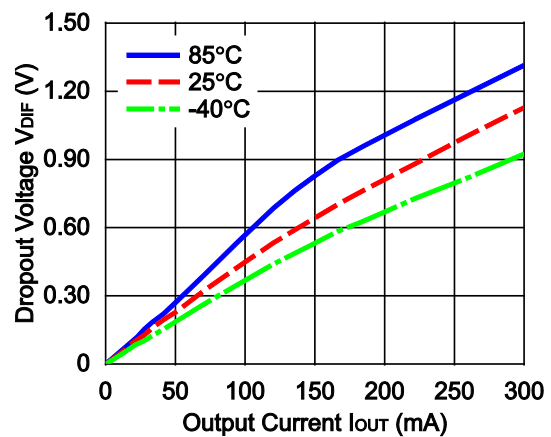
R1191x025x ECO=L



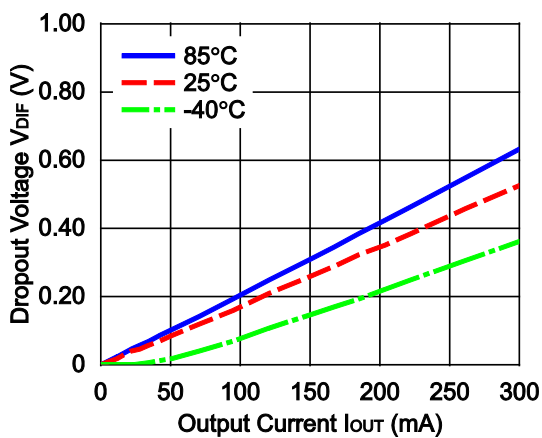
R1191x033x ECO=H



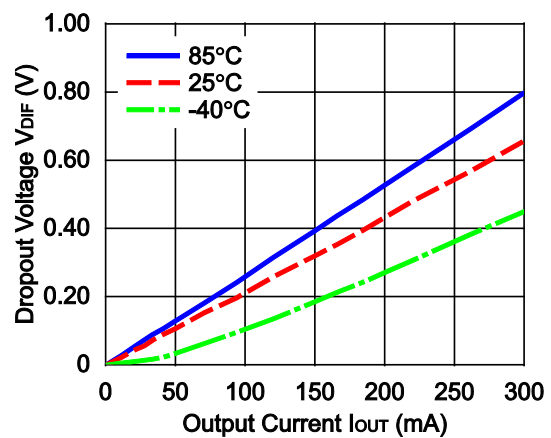
R1191x033x ECO=L

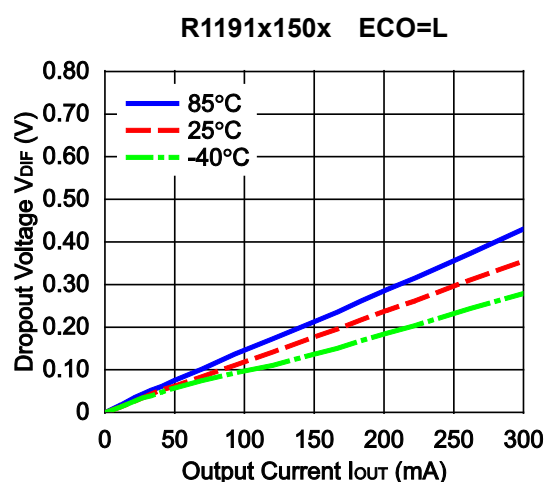
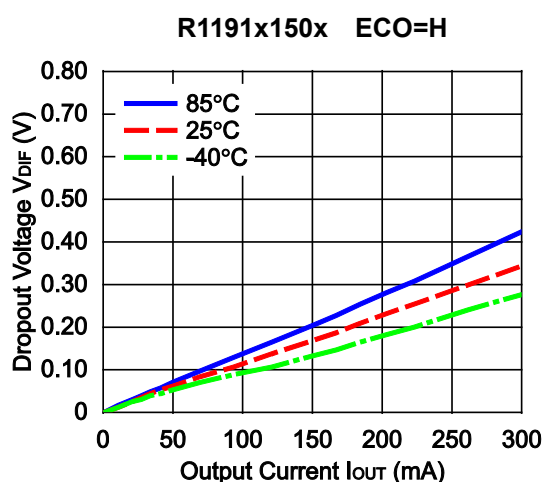
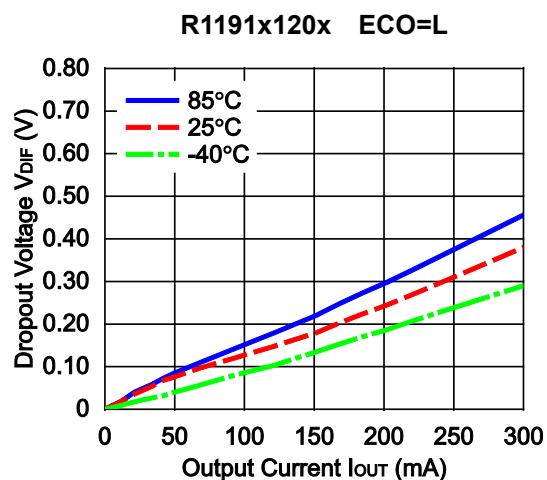
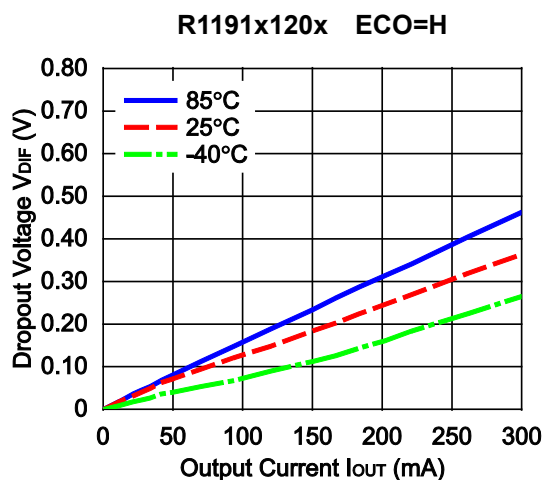


R1191x050x ECO=H

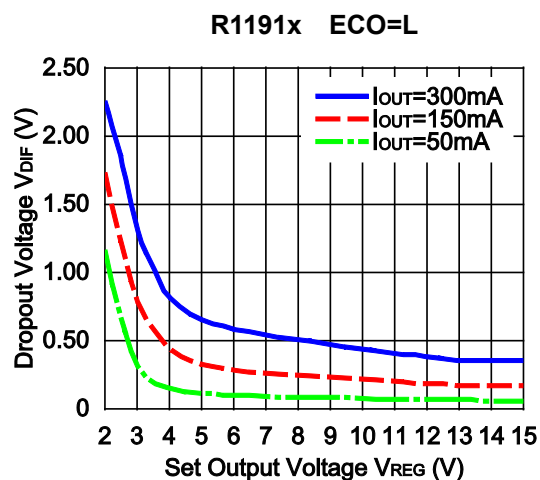
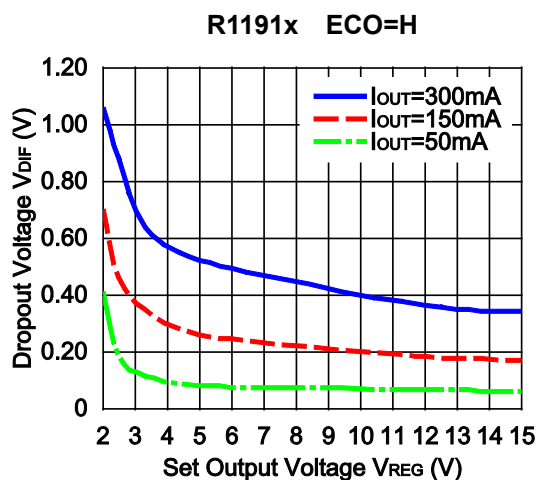


R1191x050x ECO=L



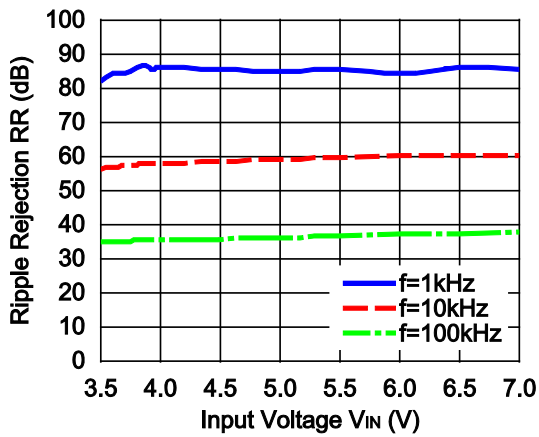


9) Dropout Voltage vs Set Output Voltage ($C1=2.2\mu F$, $C2=4.7\mu F$, $T_{opt}=25^\circ C$)

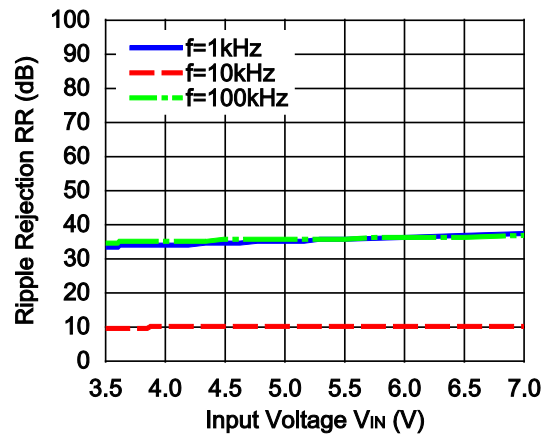


10) Ripple Rejection vs. Input Voltage (C1=none, C2=4.7μF, I_{OUT}=30mA, Ripple=0.5Vp-p, T_{opt}=25°C)

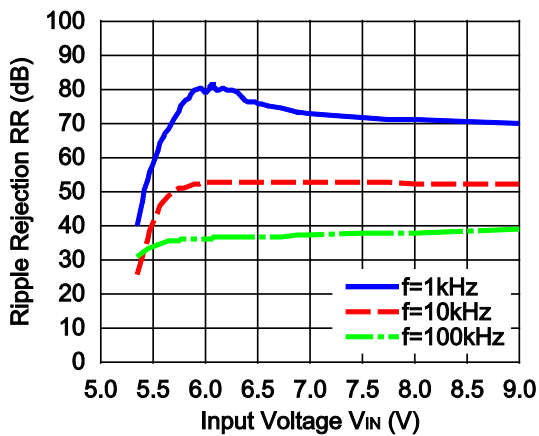
R1191x020x ECO=H



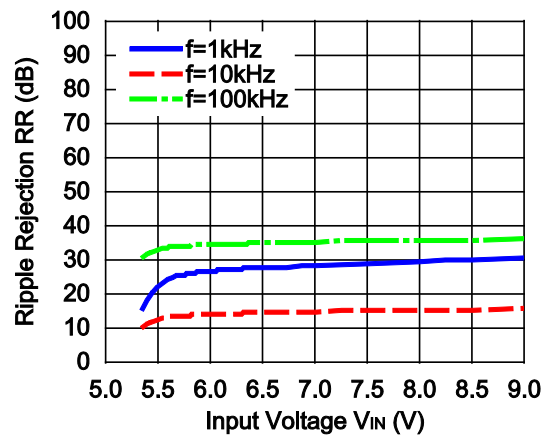
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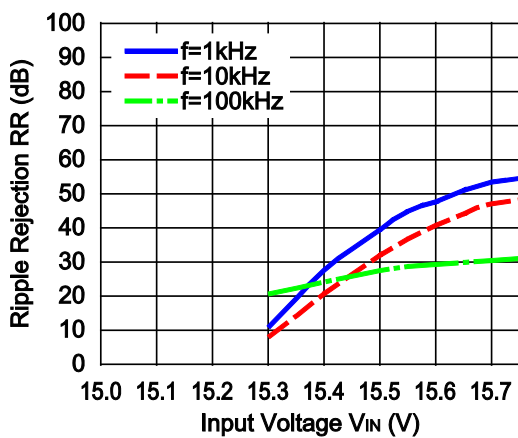
R1191x050x ECO=H



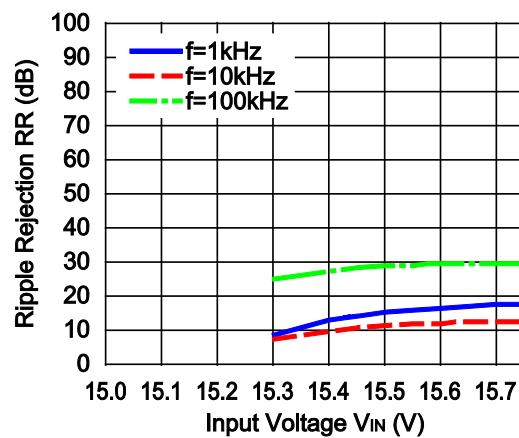
R1191x050x ECO=L



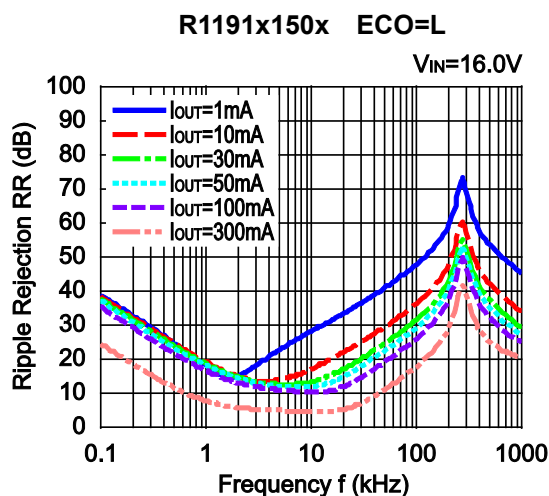
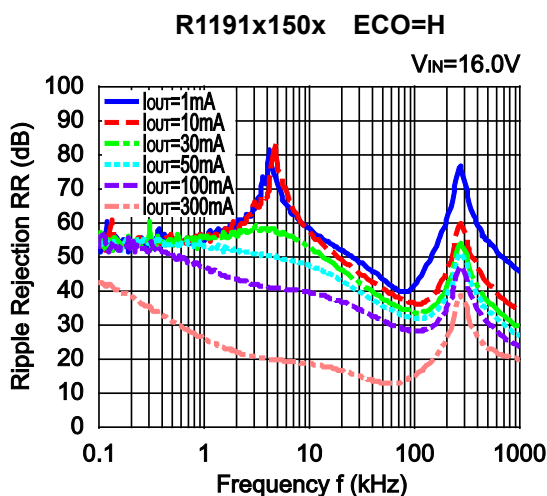
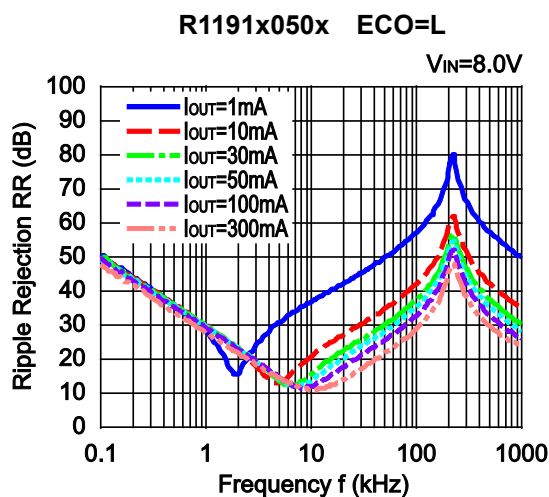
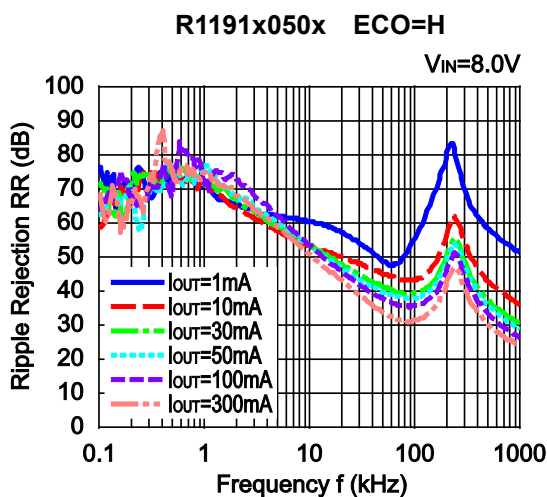
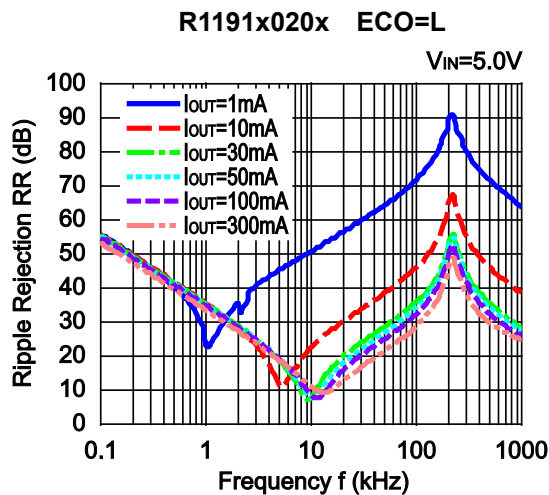
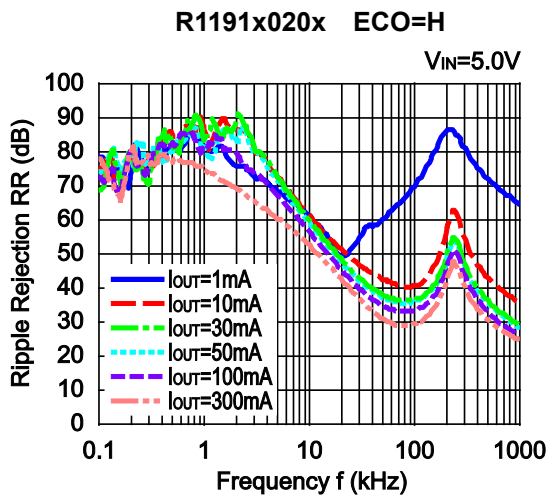
R1191x150x ECO=H



R1191x150x ECO=L

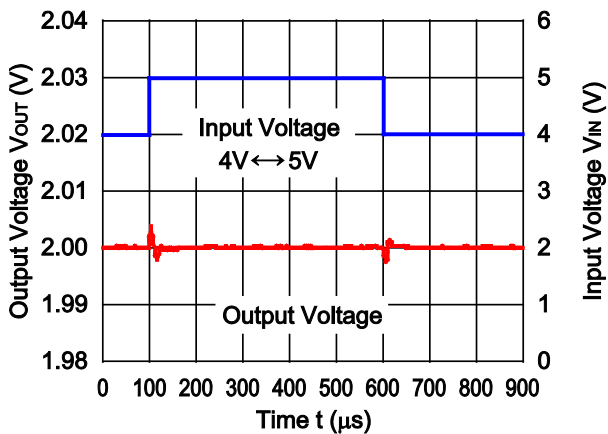


11) Ripple Rejection vs. Frequency (C1= none, C2=4.7μF, Ripple=0.5Vp-p, Topt=25°C)

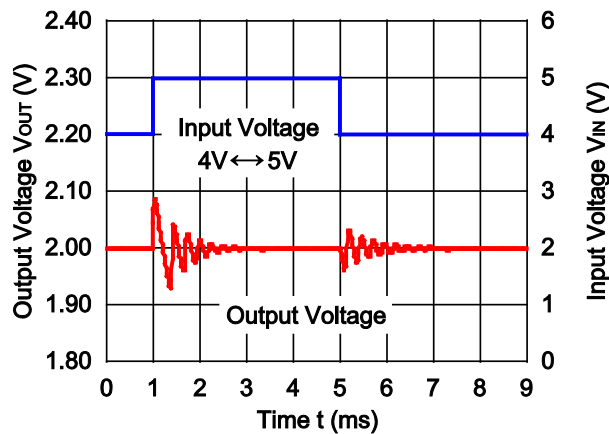


12) Input Transient Response (C1=none, C2=4.7μF, I_{OUT}=1mA, tr=tf=1μs, T_{opt}=25°C)

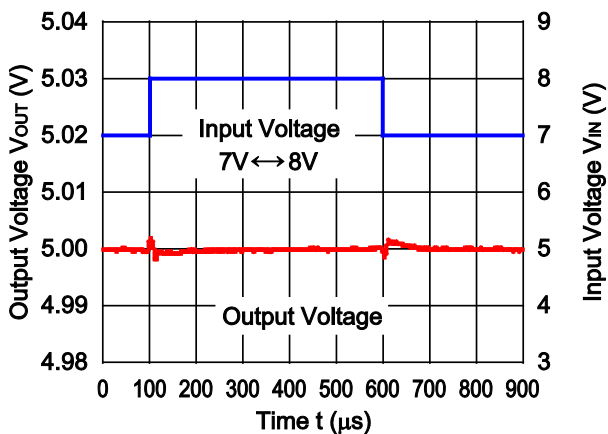
R1191x020x ECO=H



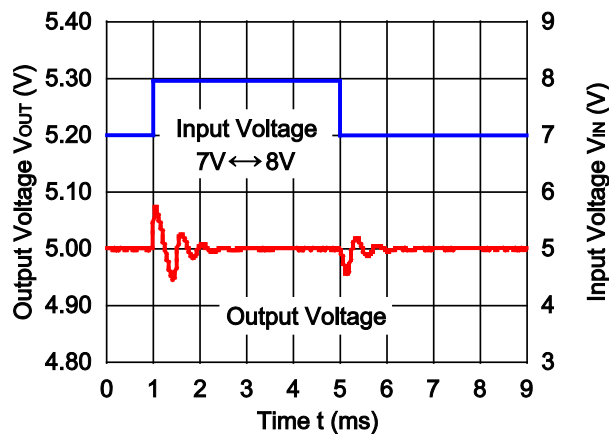
R1191x020x ECO=L



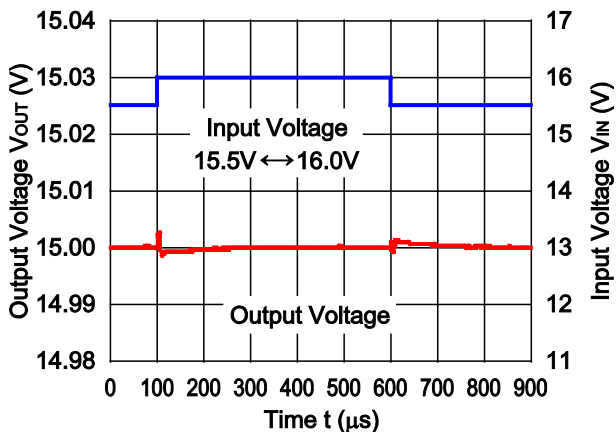
R1191x050x ECO=H



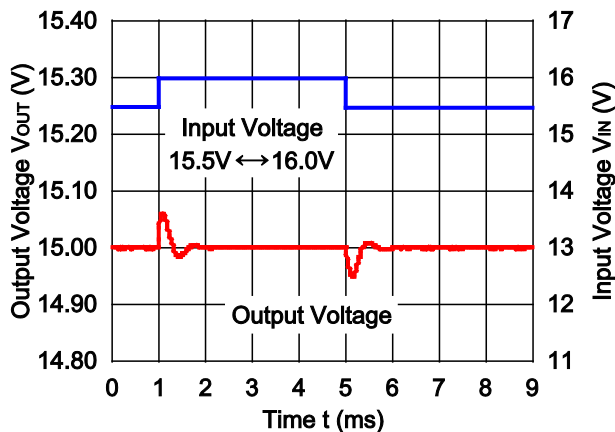
R1191x050x ECO=L



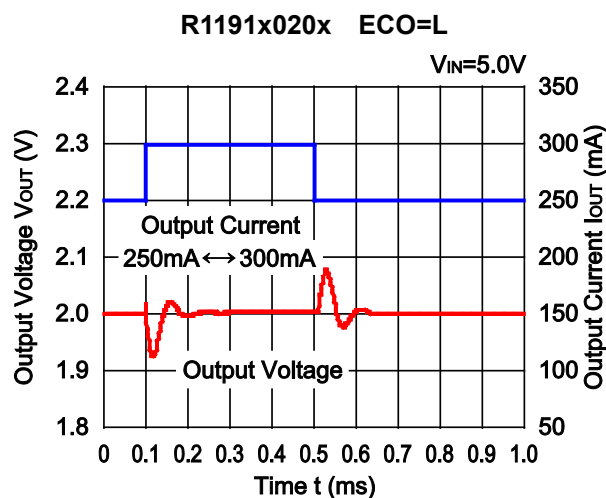
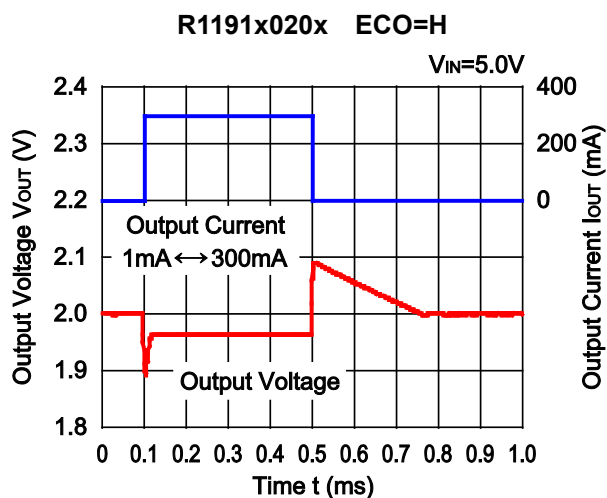
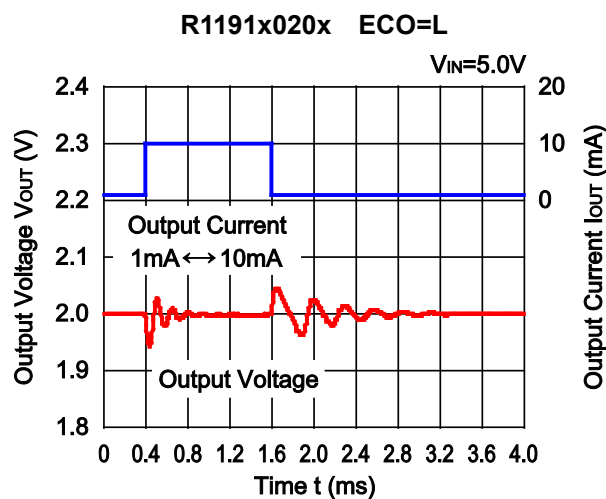
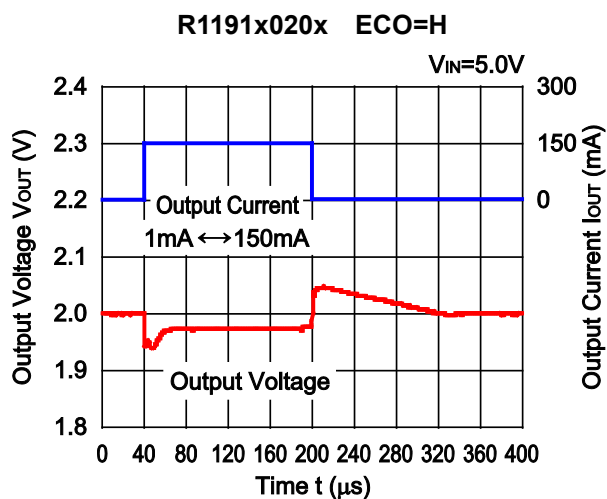
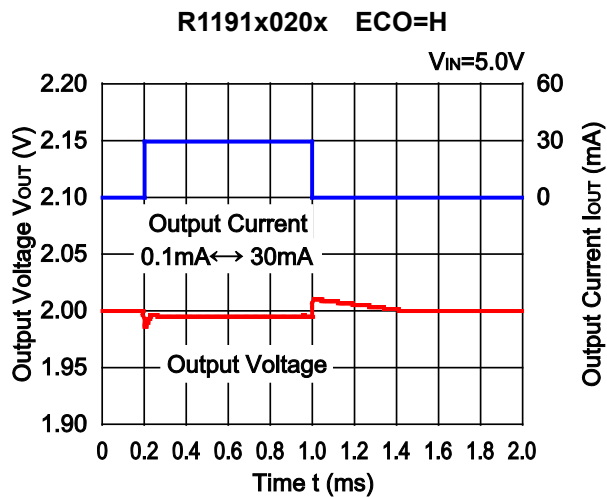
R1191x150x ECO=H



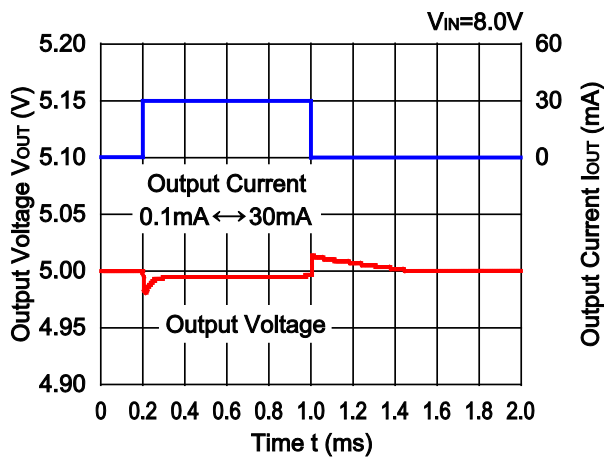
R1191x150x ECO=L



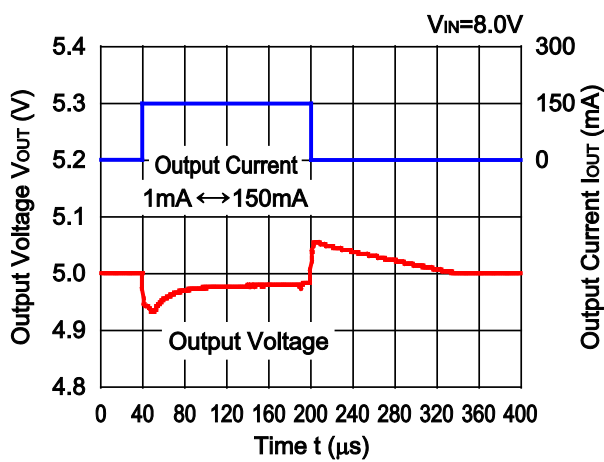
13) Load Transient Response ($C1=2.2\mu\text{F}$, $C2=4.7\mu\text{F}$, $t_r=t_f=0.1\mu\text{s}$, $T_{opt}=25^\circ\text{C}$)



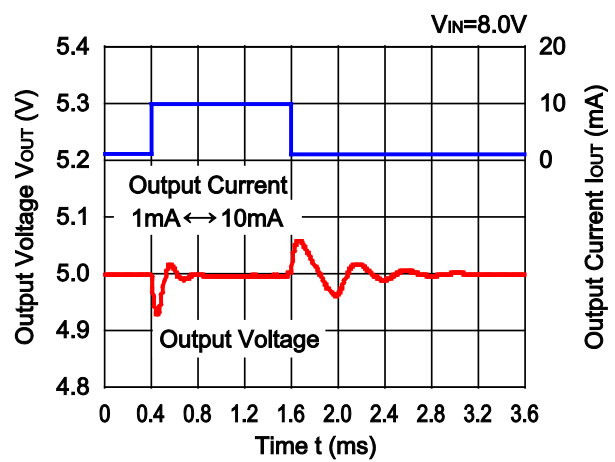
R1191x050x ECO=H



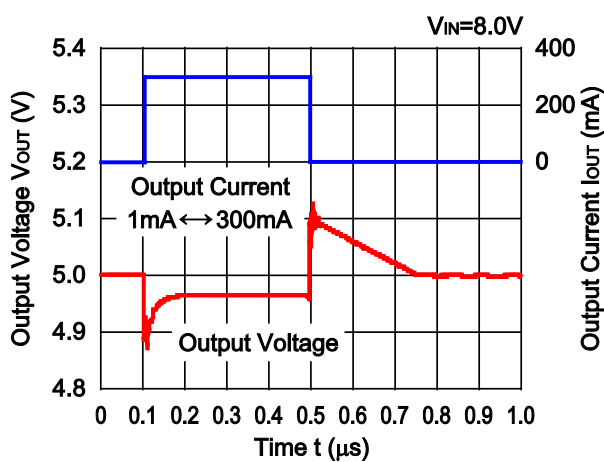
R1191x050x ECO=H



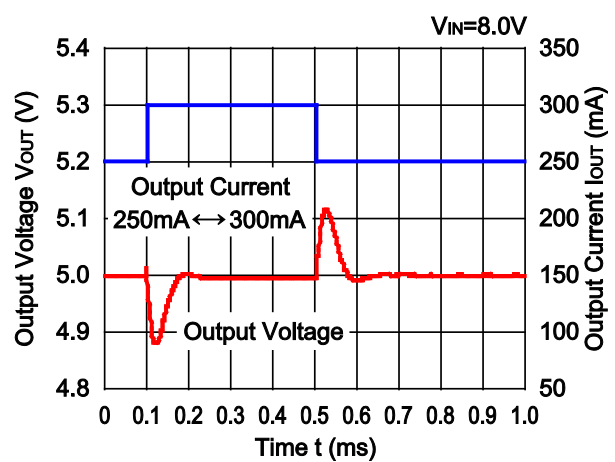
R1191x050x ECO=L

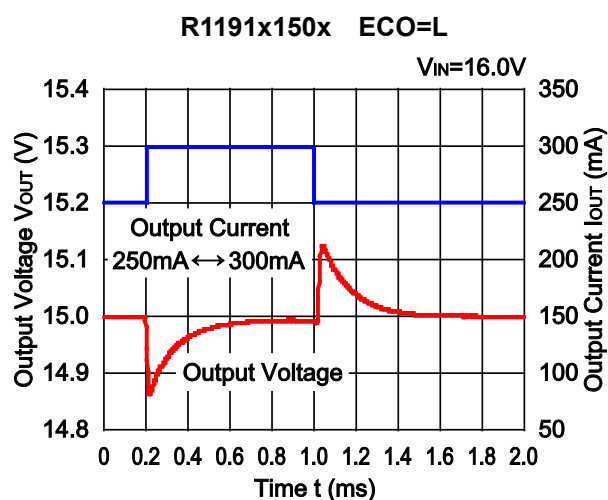
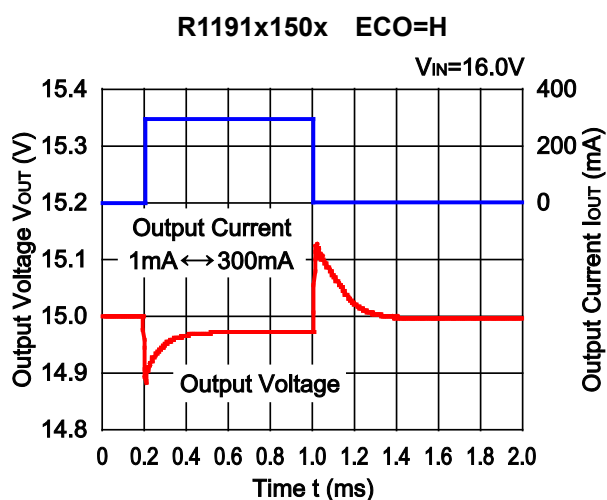
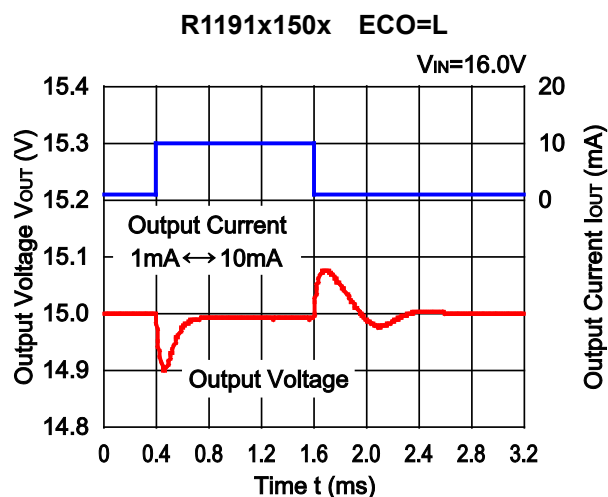
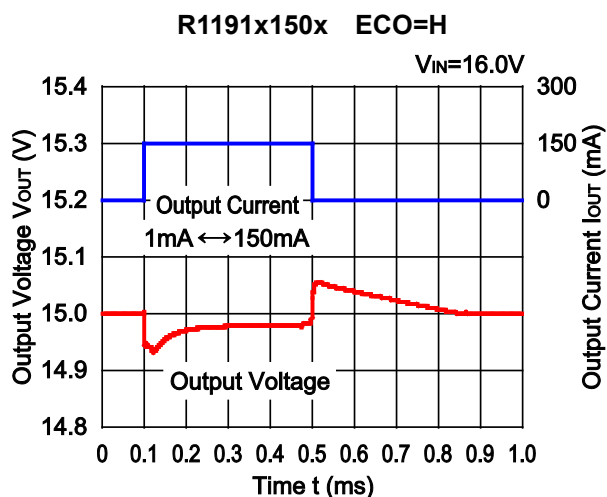
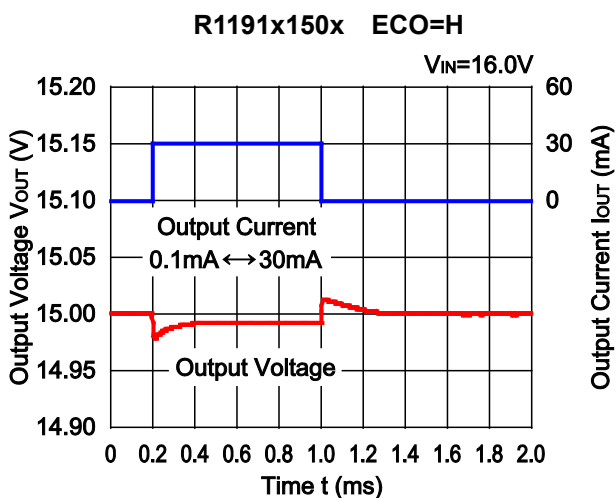


R1191x050x ECO=H

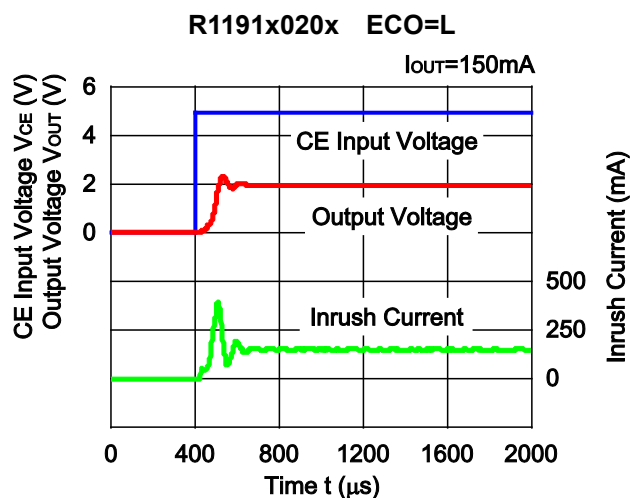
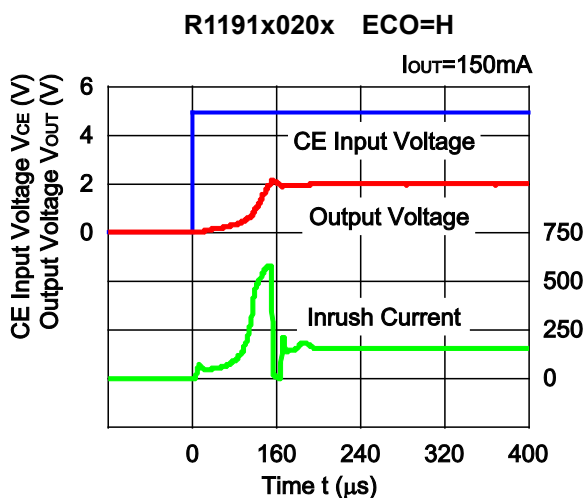
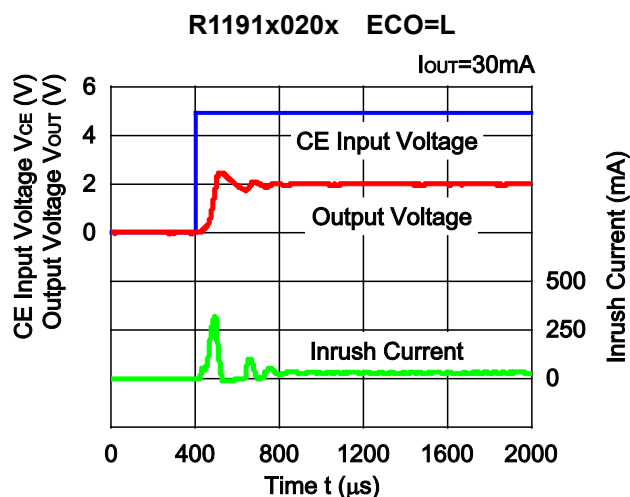
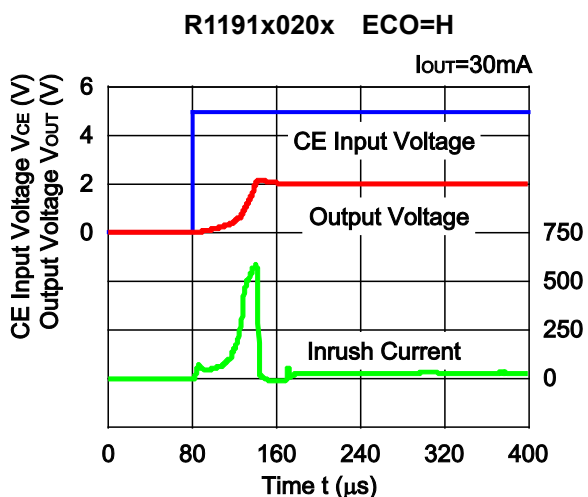
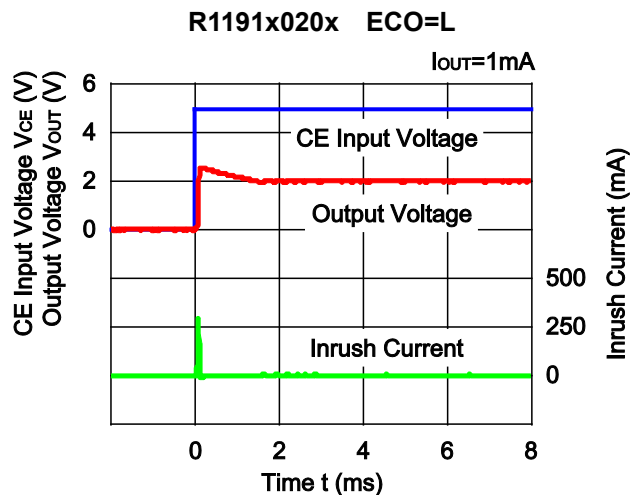
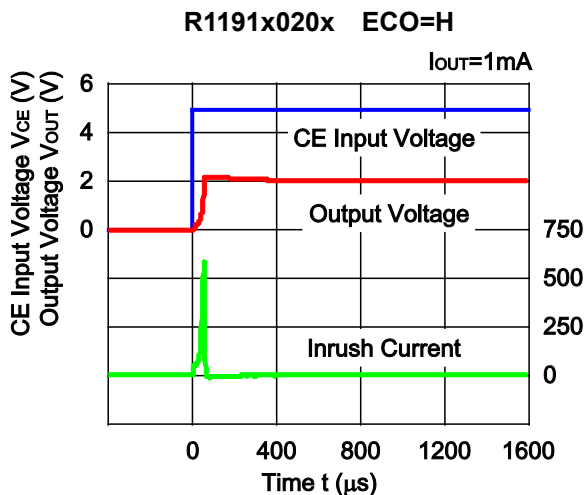


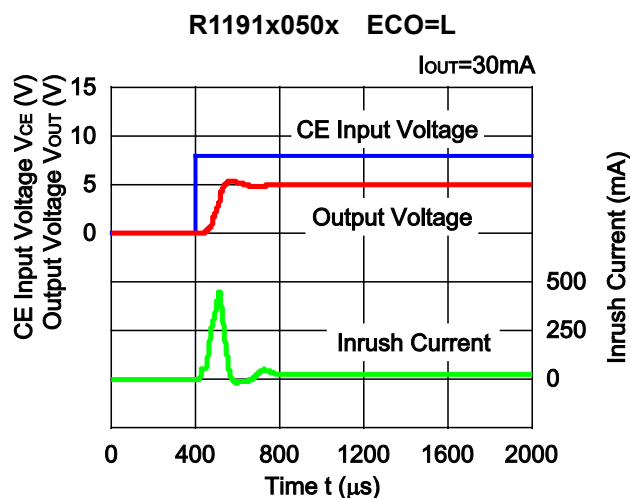
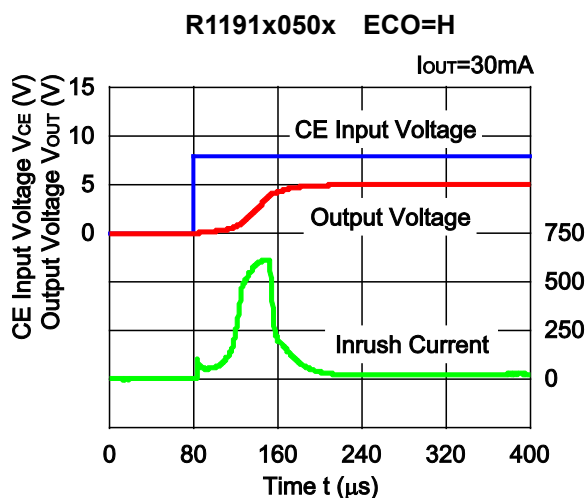
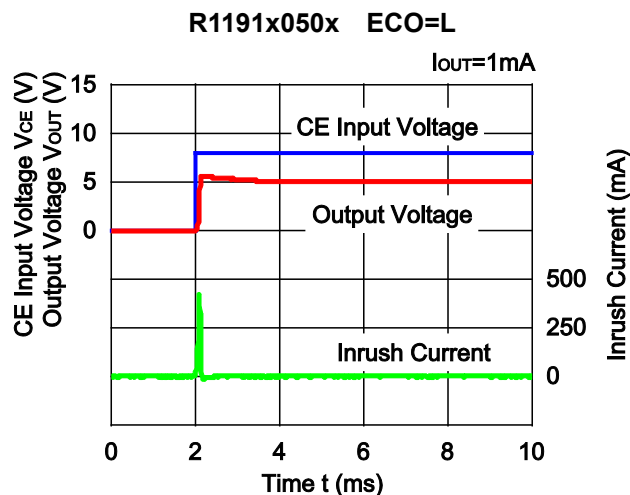
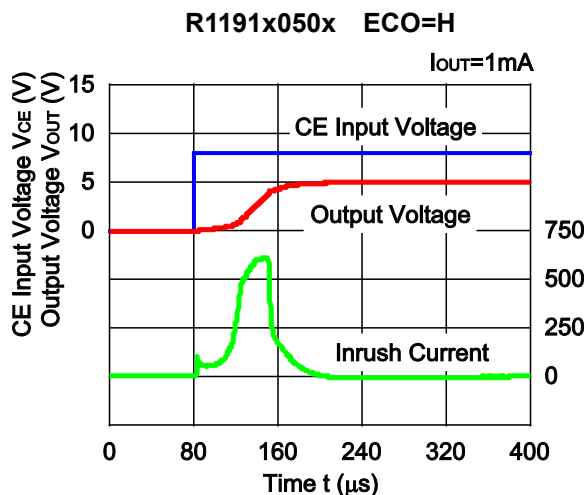
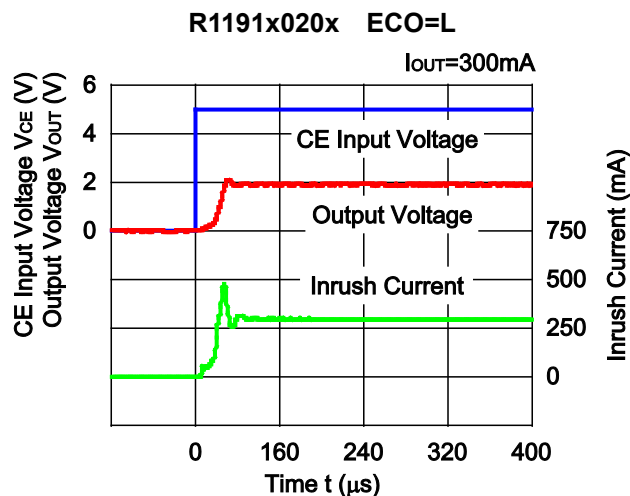
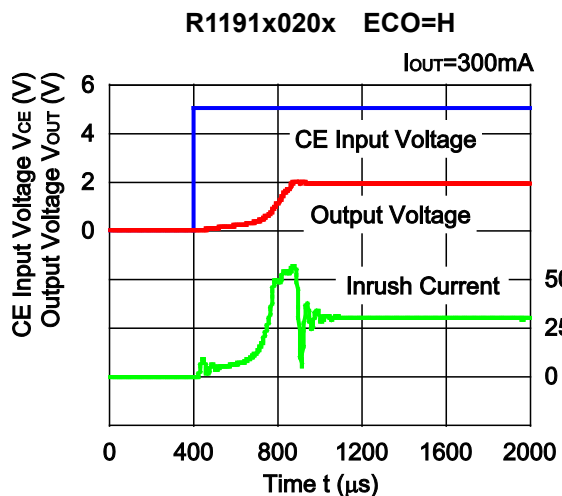
R1191x050x ECO=L



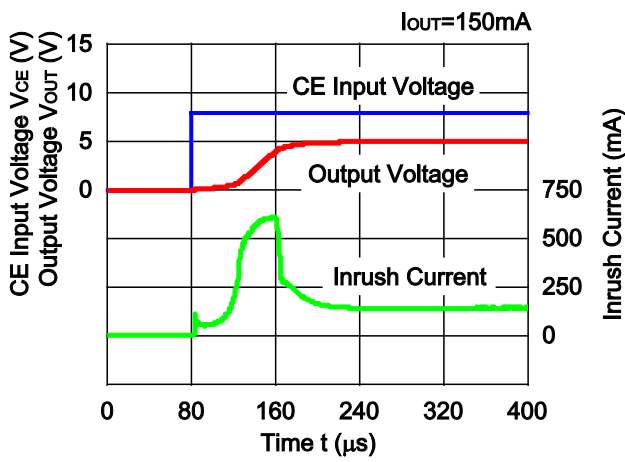


14) Inrush Current at Turn on($C1=2.2\mu\text{F}$, $C2=4.7\mu\text{F}$, $t_r=0.1\mu\text{s}$, $T_{opt}=25^\circ\text{C}$)

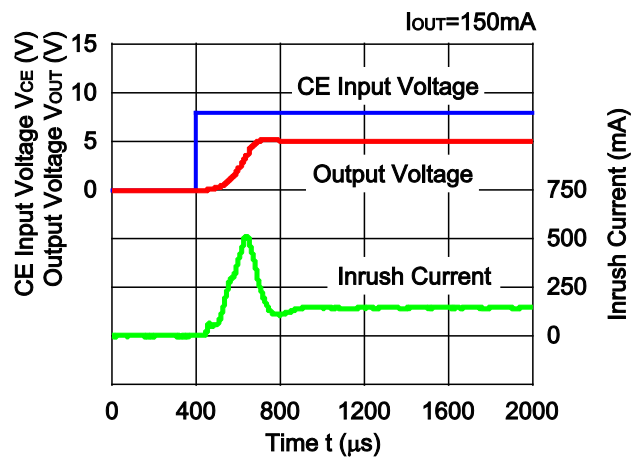




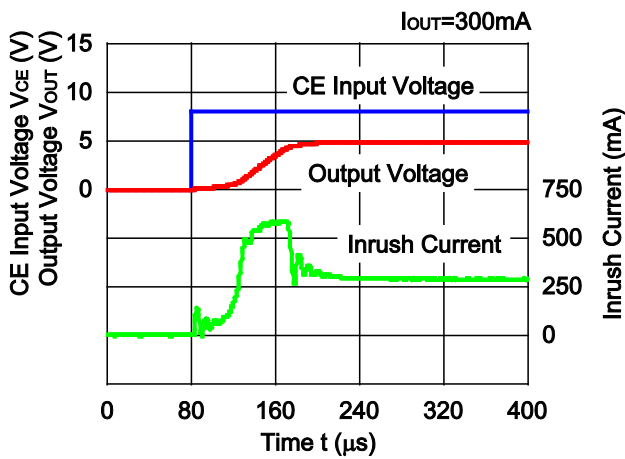
R1191x050x ECO=H



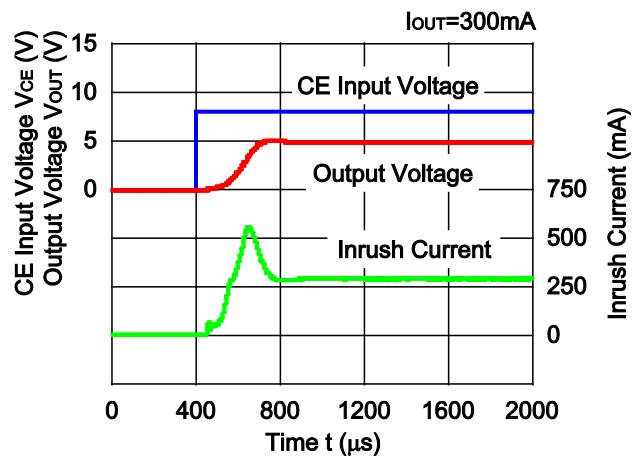
R1191x050x ECO=L



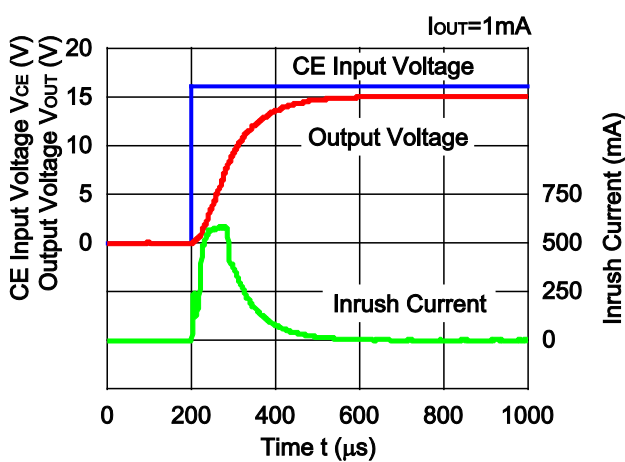
R1191x050x ECO=H



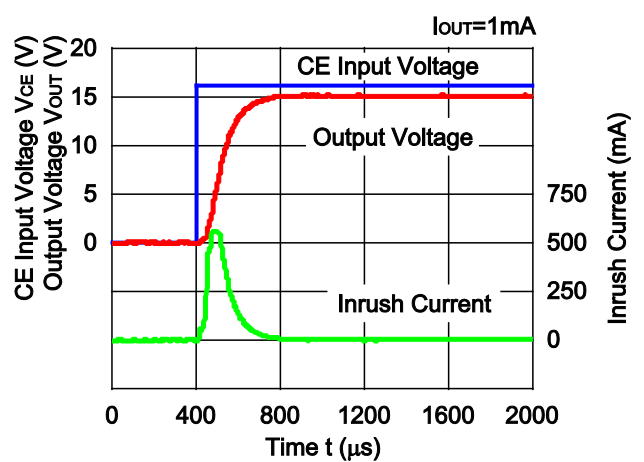
R1191x050x ECO=L

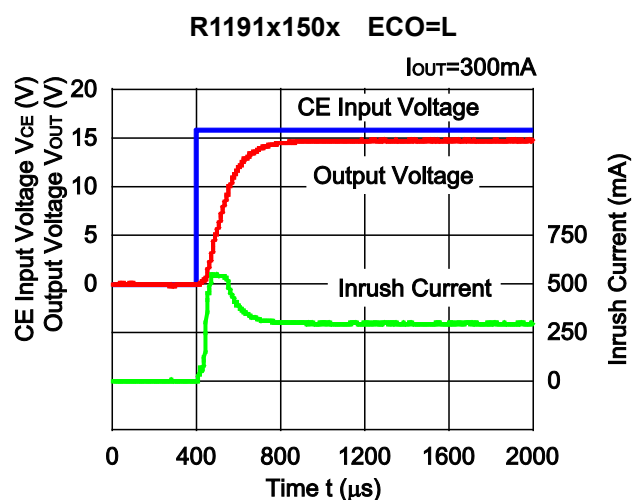
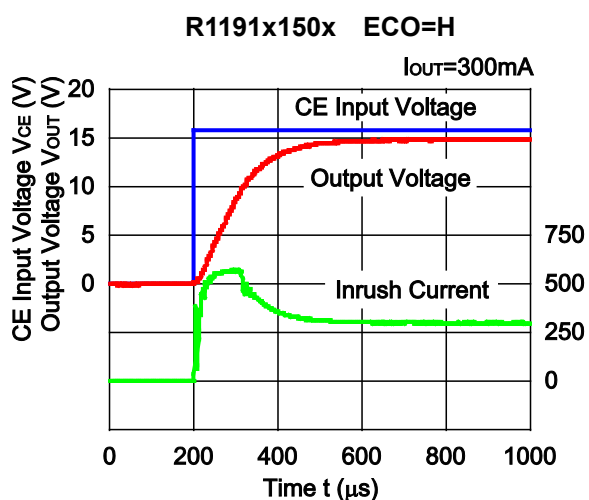
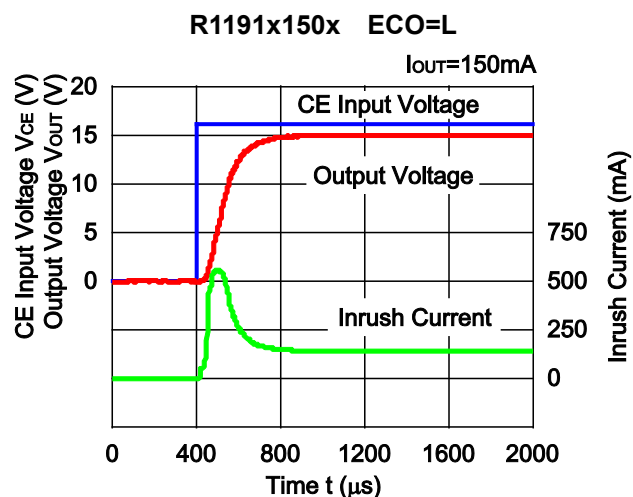
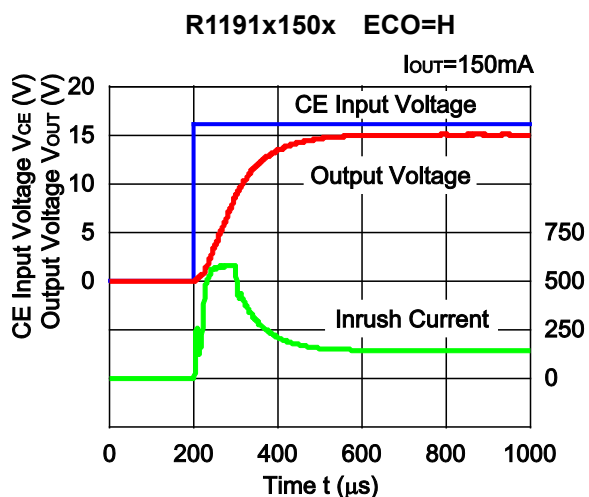
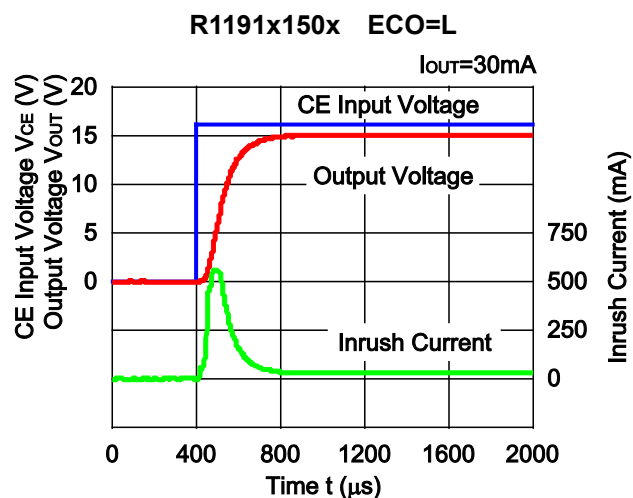
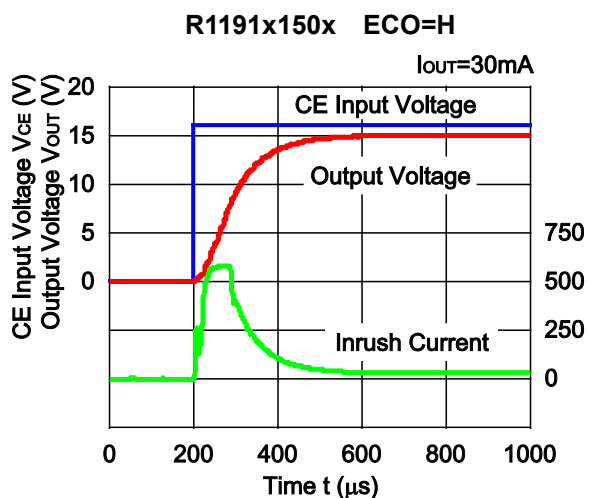


R1191x150x ECO=H

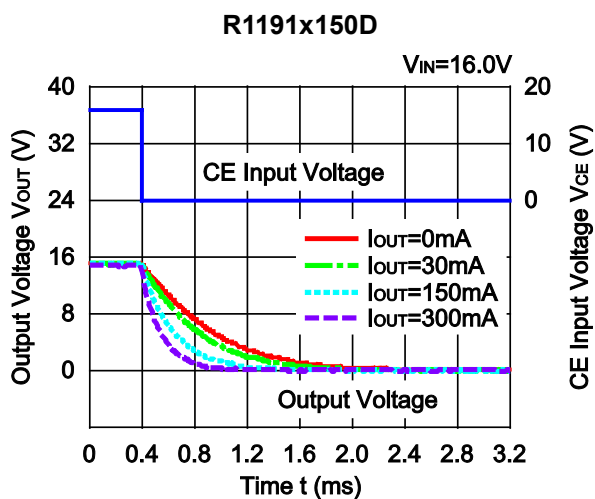
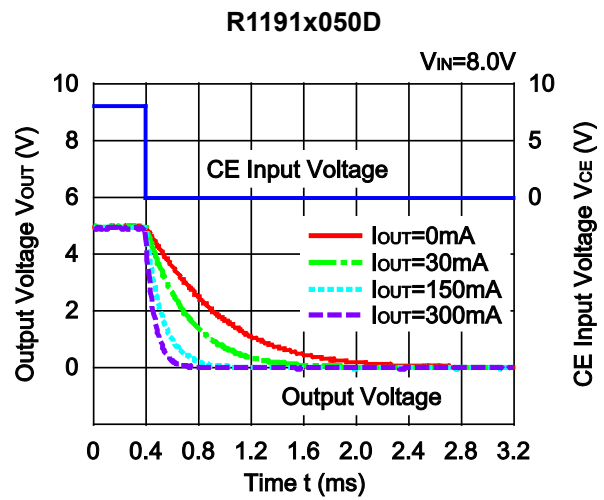
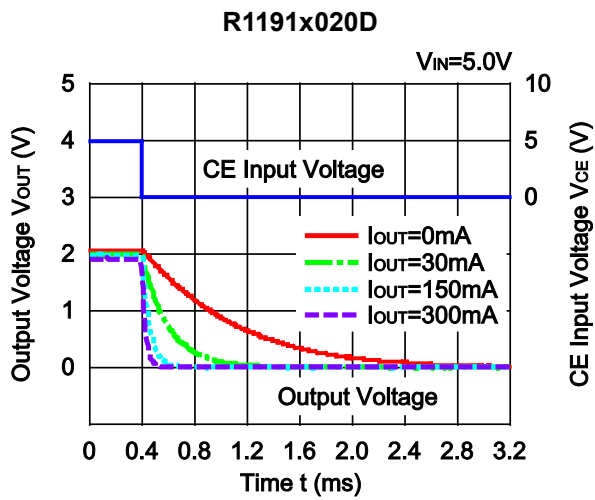


R1191x150x ECO=L

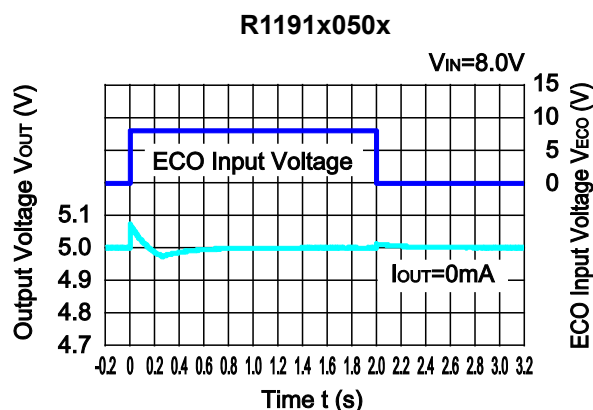
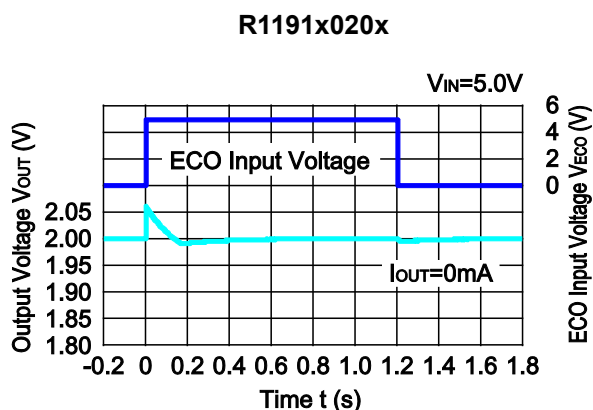
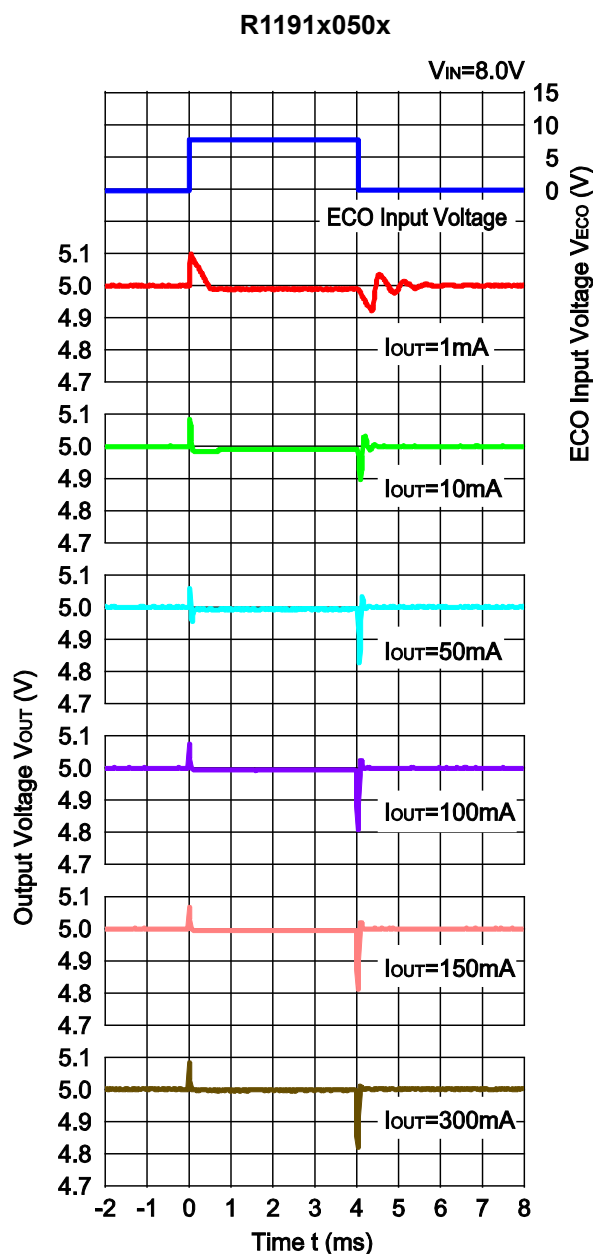
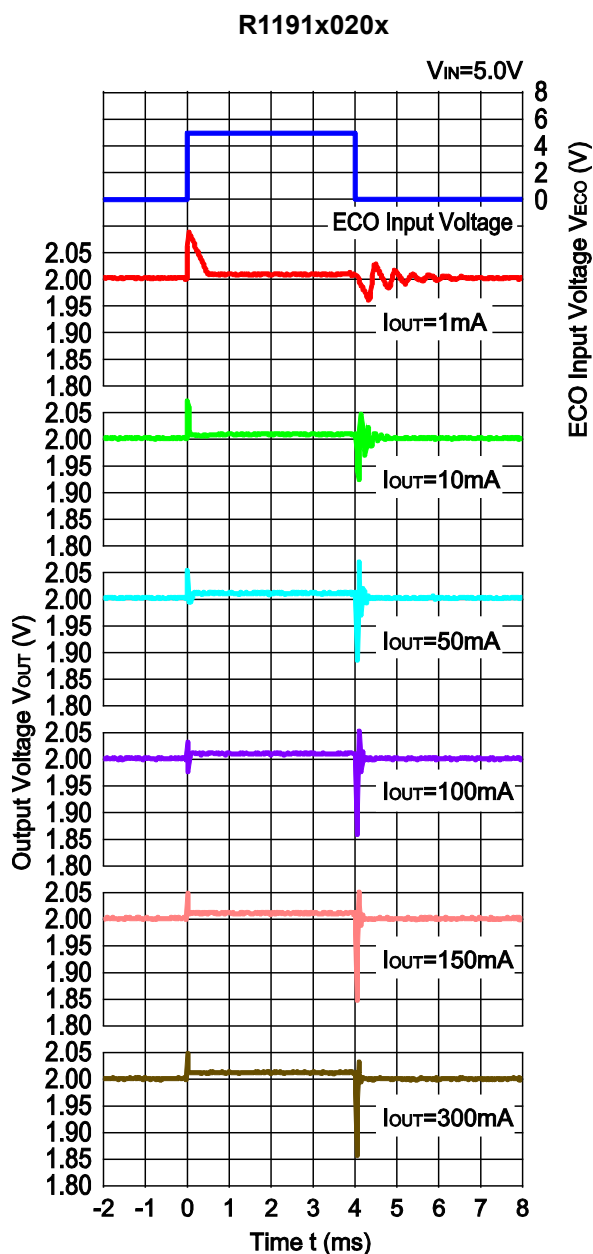




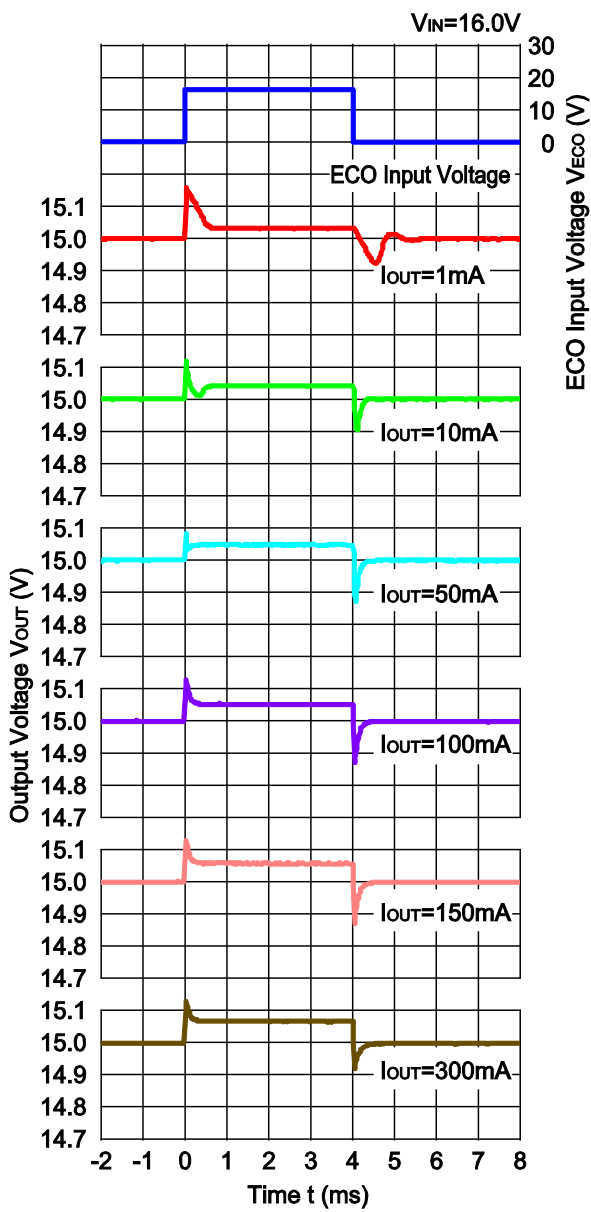
15) Turn Off Speed with CE pin (D Version) ($C_1=2.2\mu\text{F}$, $C_2=4.7\mu\text{F}$, $t_f=0.1\mu\text{s}$, $T_{opt}=25^\circ\text{C}$)



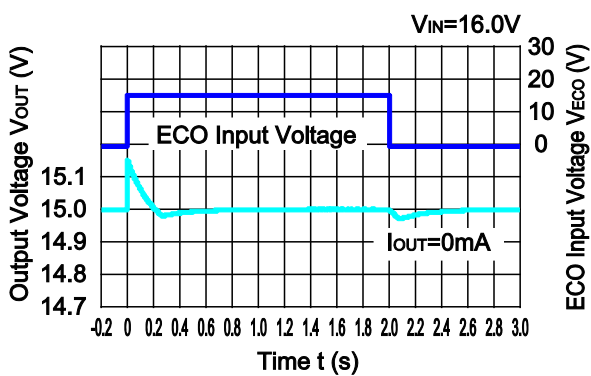
16) Output Voltage at Mode alternative point (C1=2.2μF, C2=4.7μF, tr=tf=0.1μs, Topt=25°C)



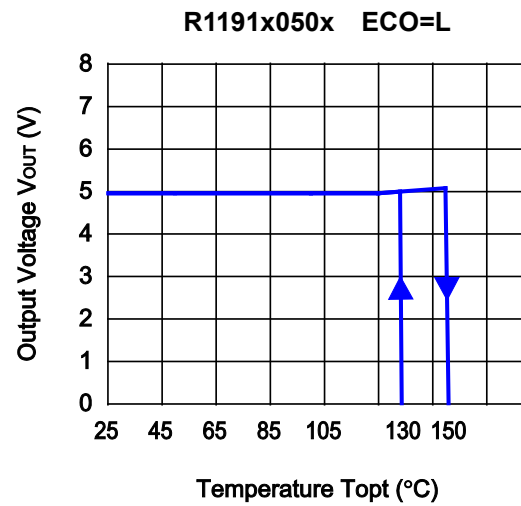
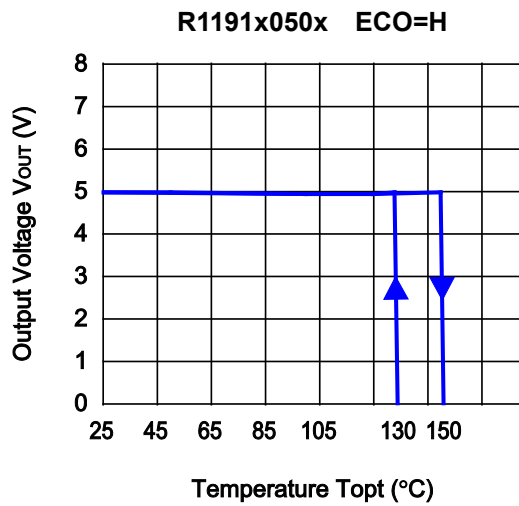
R1191x150x



R1191x150x



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 $40\mu\text{V}$ (Avg.) are marked as the hatched area in the graph.

Measurement conditions

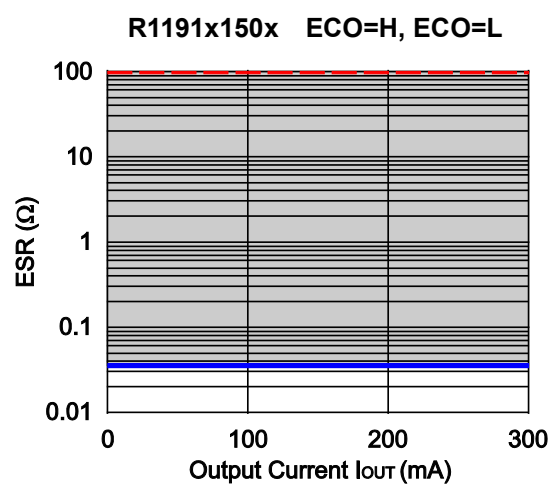
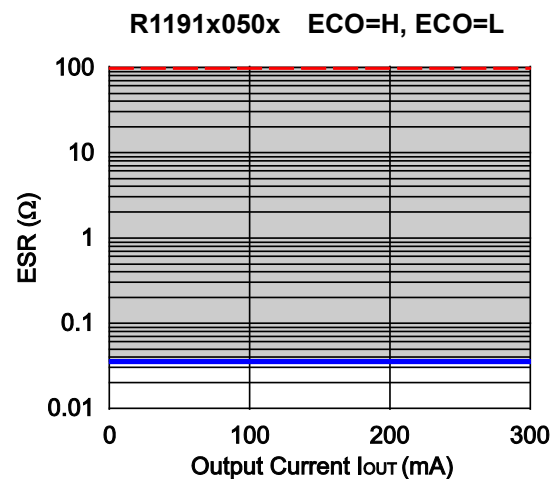
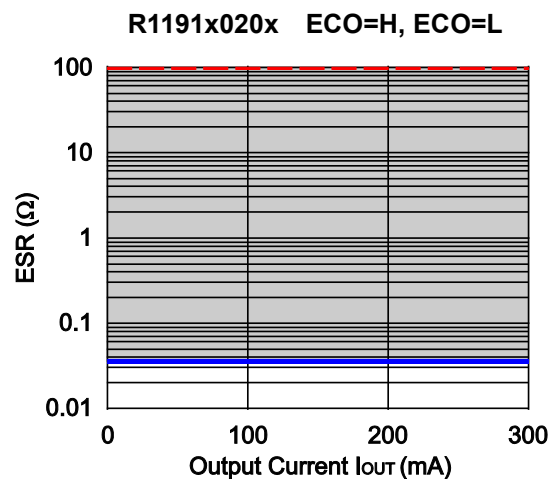
Frequency Band : 10Hz to 1MHz

Temperature : -40°C to 85°C

Hatched Area : Noise level is under $40\mu\text{Vms(Avg.)}$

C_{IN} : $2.2\mu\text{F}$ Murata (GRM32RB11E225KC01B)

C_{OUT} : $4.7\mu\text{F}$ Murata (GCM31CR71E475KA40)



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 0.2 mm × 25 pcs

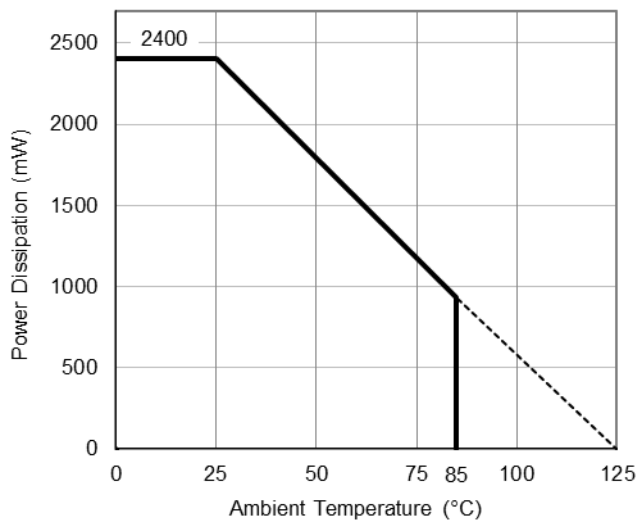
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

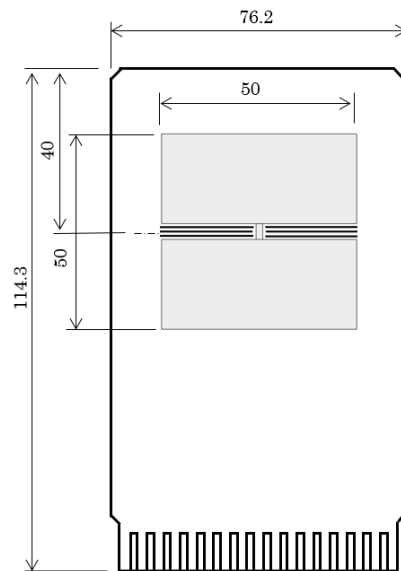
Item	Measurement Result
Power Dissipation	2400 mW
Thermal Resistance (θ_{ja})	$\theta_{ja} = 41^{\circ}\text{C/W}$
Thermal Characterization Parameter (ψ_{jt})	$\psi_{jt} = 11^{\circ}\text{C/W}$

θ_{ja} : Junction-to-Ambient Thermal Resistance

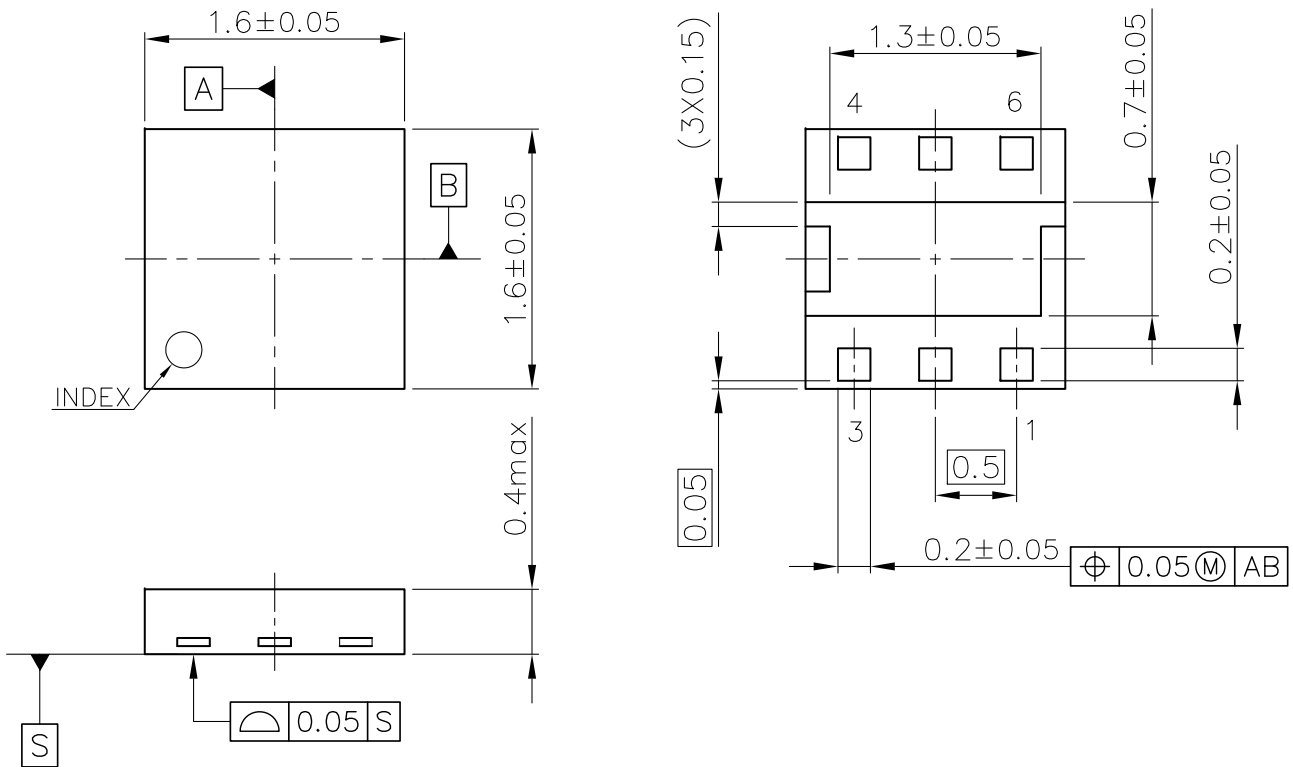
ψ_{jt} : Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern



DFN1616-6 Package Dimensions (Unit: mm)

* The tab on the bottom of the package shown by blue circle is a substrate potential (GND/V_{DD}). It is recommended that this tab be connected to the ground plane/V_{DD} pin on the board but it is possible to leave the tab floating.

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

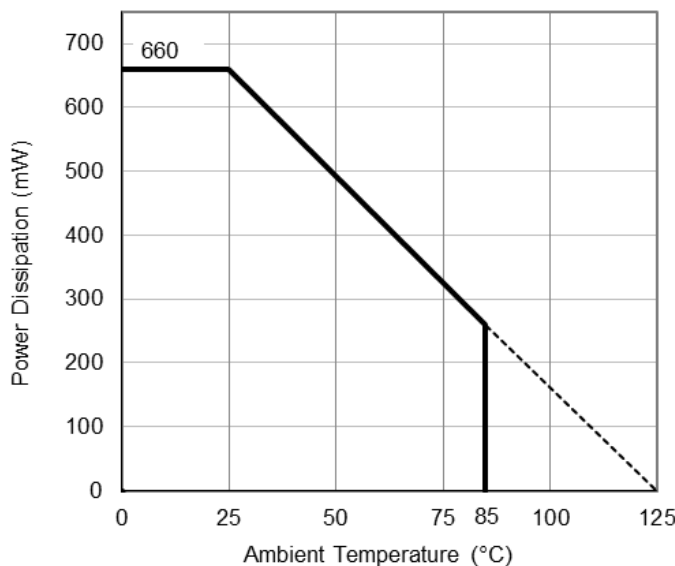
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

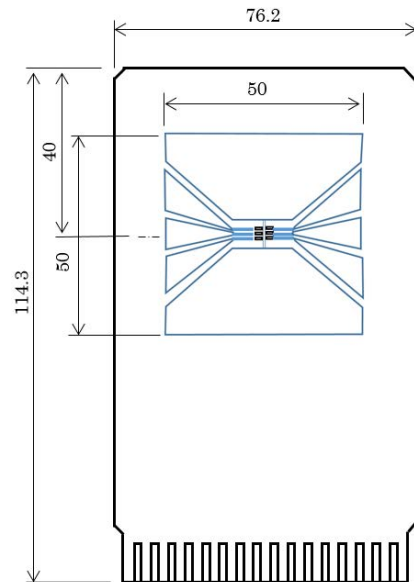
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

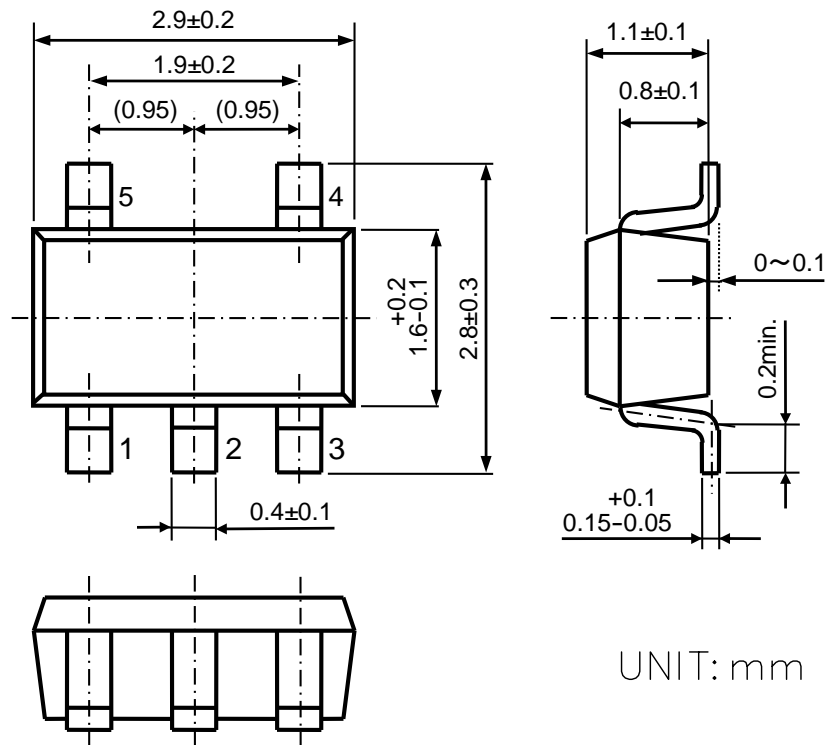
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



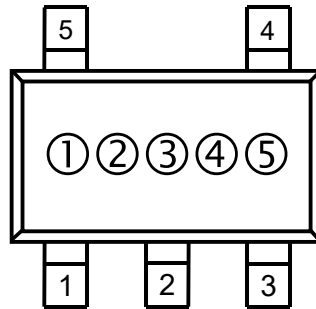
Measurement Board Pattern



SOT-23-5 Package Dimensions

①②③: Product Code ... Refer to *Part Marking List*

④⑤: Lot Number ... Alphanumeric Serial Number



SOT-23-5 Part Markings

NOTICE

There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.

PART MARKINGS

R1191N

MK-R1191N-JE-C

R1191NxxxB Part Marking List

Product Name	① ② ③	SET V _{OUT}
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

Product Name	① ② ③	SET V _{OUT}
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

Product Name	① ② ③	SET V _{OUT}
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

PART MARKINGS

R1191N

MK-R1191N-JE-C

R1191NxxxD Part Marking List

Product Name	① ② ③	SET V _{OUT}
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	SET V _{OUT}
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	SET V _{OUT}
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

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

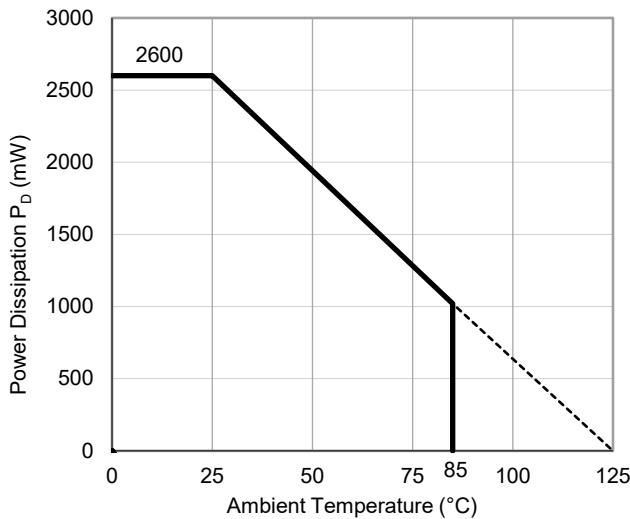
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

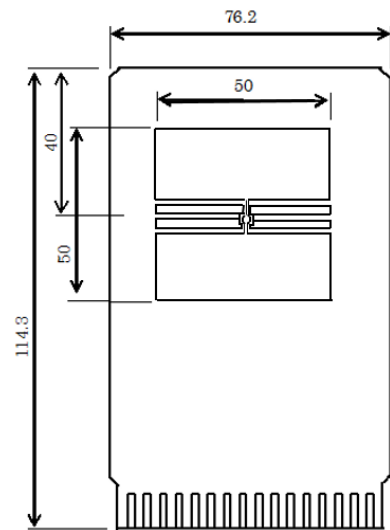
Item	Measurement Result
Power Dissipation	2600 mW
Thermal Resistance (θja)	θja = 38°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 13°C/W

θja: Junction-to-Ambient Thermal Resistance

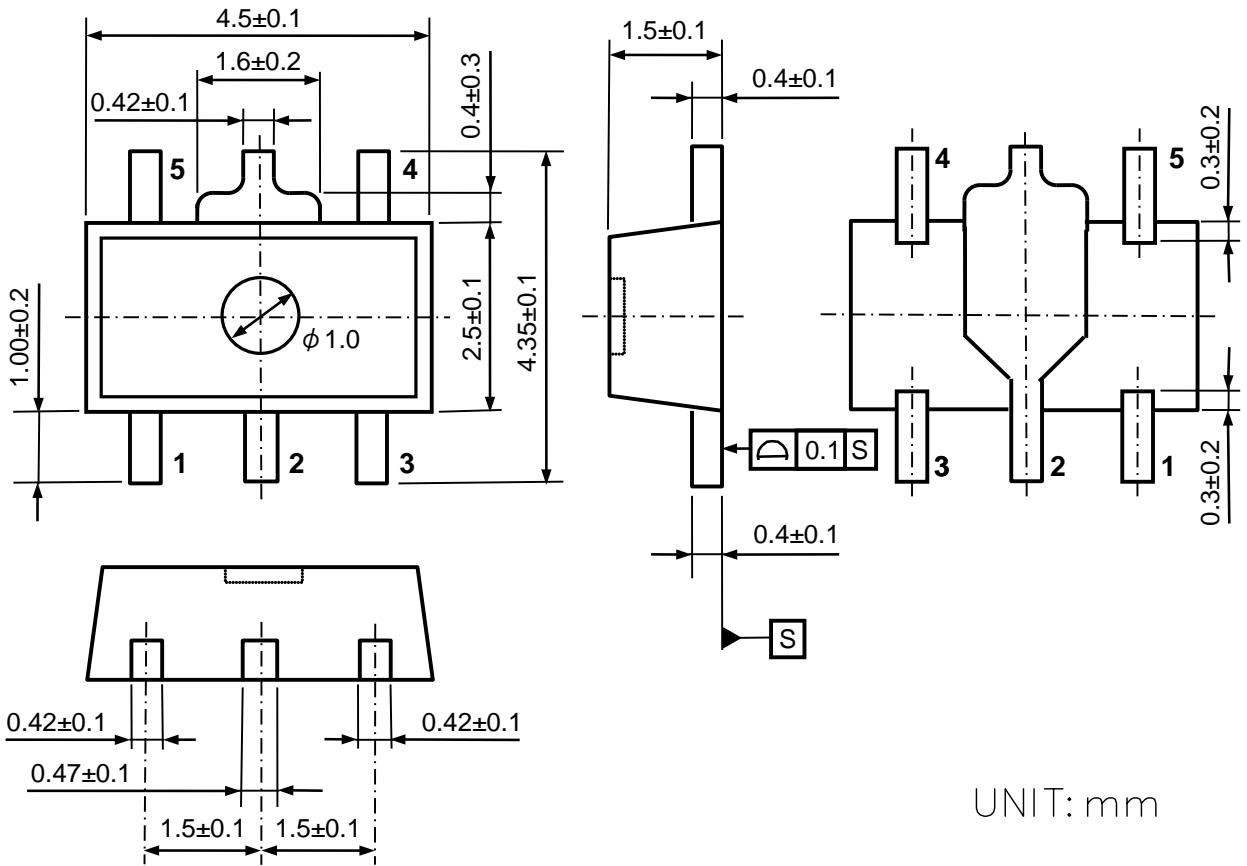
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

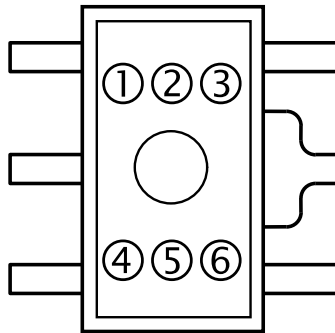


UNIT: mm

SOT-89-5 Package Dimensions

①②③④: Product Code ... Refer to *Part Marking List*

⑤⑥: Lot Number ... Alphanumeric Serial Number



SOT-89-5 Part Markings

NOTICE

There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.

PART MARKINGS

R1191H

MK-R1191H-JE-B

R1191HxxxB Part Marking List

Product Name	①②③④	Set V _{OUT}	Product Name	①②③④	Set V _{OUT}	Product Name	①②③④	Set V _{OUT}
R1191H020B	S 0 2 0	2.0 V	R1191H070B	S 0 7 0	7.0 V	R1191H120B	S 1 2 0	12.0 V
R1191H021B	S 0 2 1	2.1 V	R1191H071B	S 0 7 1	7.1 V	R1191H121B	S 1 2 1	12.1 V
R1191H022B	S 0 2 2	2.2 V	R1191H072B	S 0 7 2	7.2 V	R1191H122B	S 1 2 2	12.2 V
R1191H023B	S 0 2 3	2.3 V	R1191H073B	S 0 7 3	7.3 V	R1191H123B	S 1 2 3	12.3 V
R1191H024B	S 0 2 4	2.4 V	R1191H074B	S 0 7 4	7.4 V	R1191H124B	S 1 2 4	12.4 V
R1191H025B	S 0 2 5	2.5 V	R1191H075B	S 0 7 5	7.5 V	R1191H125B	S 1 2 5	12.5 V
R1191H026B	S 0 2 6	2.6 V	R1191H076B	S 0 7 6	7.6 V	R1191H126B	S 1 2 6	12.6 V
R1191H027B	S 0 2 7	2.7 V	R1191H077B	S 0 7 7	7.7 V	R1191H127B	S 1 2 7	12.7 V
R1191H028B	S 0 2 8	2.8 V	R1191H078B	S 0 7 8	7.8 V	R1191H128B	S 1 2 8	12.8 V
R1191H029B	S 0 2 9	2.9 V	R1191H079B	S 0 7 9	7.9 V	R1191H129B	S 1 2 9	12.9 V
R1191H030B	S 0 3 0	3.0 V	R1191H080B	S 0 8 0	8.0 V	R1191H130B	S 1 3 0	13.0 V
R1191H031B	S 0 3 1	3.1 V	R1191H081B	S 0 8 1	8.1 V	R1191H131B	S 1 3 1	13.1 V
R1191H032B	S 0 3 2	3.2 V	R1191H082B	S 0 8 2	8.2 V	R1191H132B	S 1 3 2	13.2 V
R1191H033B	S 0 3 3	3.3 V	R1191H083B	S 0 8 3	8.3 V	R1191H133B	S 1 3 3	13.3 V
R1191H034B	S 0 3 4	3.4 V	R1191H084B	S 0 8 4	8.4 V	R1191H134B	S 1 3 4	13.4 V
R1191H035B	S 0 3 5	3.5 V	R1191H085B	S 0 8 5	8.5 V	R1191H135B	S 1 3 5	13.5 V
R1191H036B	S 0 3 6	3.6 V	R1191H086B	S 0 8 6	8.6 V	R1191H136B	S 1 3 6	13.6 V
R1191H037B	S 0 3 7	3.7 V	R1191H087B	S 0 8 7	8.7 V	R1191H137B	S 1 3 7	13.7 V
R1191H038B	S 0 3 8	3.8 V	R1191H088B	S 0 8 8	8.8 V	R1191H138B	S 1 3 8	13.8 V
R1191H039B	S 0 3 9	3.9 V	R1191H089B	S 0 8 9	8.9 V	R1191H139B	S 1 3 9	13.9 V
R1191H040B	S 0 4 0	4.0 V	R1191H090B	S 0 9 0	9.0 V	R1191H140B	S 1 4 0	14.0 V
R1191H041B	S 0 4 1	4.1 V	R1191H091B	S 0 9 1	9.1 V	R1191H141B	S 1 4 1	14.1 V
R1191H042B	S 0 4 2	4.2 V	R1191H092B	S 0 9 2	9.2 V	R1191H142B	S 1 4 2	14.2 V
R1191H043B	S 0 4 3	4.3 V	R1191H093B	S 0 9 3	9.3 V	R1191H143B	S 1 4 3	14.3 V
R1191H044B	S 0 4 4	4.4 V	R1191H094B	S 0 9 4	9.4 V	R1191H144B	S 1 4 4	14.4 V
R1191H045B	S 0 4 5	4.5 V	R1191H095B	S 0 9 5	9.5 V	R1191H145B	S 1 4 5	14.5 V
R1191H046B	S 0 4 6	4.6 V	R1191H096B	S 0 9 6	9.6 V	R1191H146B	S 1 4 6	14.6 V
R1191H047B	S 0 4 7	4.7 V	R1191H097B	S 0 9 7	9.7 V	R1191H147B	S 1 4 7	14.7 V
R1191H048B	S 0 4 8	4.8 V	R1191H098B	S 0 9 8	9.8 V	R1191H148B	S 1 4 8	14.8 V
R1191H049B	S 0 4 9	4.9 V	R1191H099B	S 0 9 9	9.9 V	R1191H149B	S 1 4 9	14.9 V
R1191H050B	S 0 5 0	5.0 V	R1191H100B	S 1 0 0	10.0 V	R1191H150B	S 1 5 0	15.0 V
R1191H051B	S 0 5 1	5.1 V	R1191H101B	S 1 0 1	10.1 V			
R1191H052B	S 0 5 2	5.2 V	R1191H102B	S 1 0 2	10.2 V			
R1191H053B	S 0 5 3	5.3 V	R1191H103B	S 1 0 3	10.3 V			
R1191H054B	S 0 5 4	5.4 V	R1191H104B	S 1 0 4	10.4 V			
R1191H055B	S 0 5 5	5.5 V	R1191H105B	S 1 0 5	10.5 V			
R1191H056B	S 0 5 6	5.6 V	R1191H106B	S 1 0 6	10.6 V			
R1191H057B	S 0 5 7	5.7 V	R1191H107B	S 1 0 7	10.7 V			
R1191H058B	S 0 5 8	5.8 V	R1191H108B	S 1 0 8	10.8 V			
R1191H059B	S 0 5 9	5.9 V	R1191H109B	S 1 0 9	10.9 V			
R1191H060B	S 0 6 0	6.0 V	R1191H110B	S 1 1 0	11.0 V			
R1191H061B	S 0 6 1	6.1 V	R1191H111B	S 1 1 1	11.1 V			
R1191H062B	S 0 6 2	6.2 V	R1191H112B	S 1 1 2	11.2 V			
R1191H063B	S 0 6 3	6.3 V	R1191H113B	S 1 1 3	11.3 V			
R1191H064B	S 0 6 4	6.4 V	R1191H114B	S 1 1 4	11.4 V			
R1191H065B	S 0 6 5	6.5 V	R1191H115B	S 1 1 5	11.5 V			
R1191H066B	S 0 6 6	6.6 V	R1191H116B	S 1 1 6	11.6 V			
R1191H067B	S 0 6 7	6.7 V	R1191H117B	S 1 1 7	11.7 V			
R1191H068B	S 0 6 8	6.8 V	R1191H118B	S 1 1 8	11.8 V			
R1191H069B	S 0 6 9	6.9 V	R1191H119B	S 1 1 9	11.9 V			

PART MARKINGS

R1191H

MK-R1191H-JE-B

R1191HxxxD Part Marking List

Product Name	①②③④	Set V _{OUT}	Product Name	①②③④	Set V _{OUT}	Product Name	①②③④	Set V _{OUT}
R1191H020D	T 0 2 0	2.0 V	R1191H070D	T 0 7 0	7.0 V	R1191H120D	T 1 2 0	12.0 V
R1191H021D	T 0 2 1	2.1 V	R1191H071D	T 0 7 1	7.1 V	R1191H121D	T 1 2 1	12.1 V
R1191H022D	T 0 2 2	2.2 V	R1191H072D	T 0 7 2	7.2 V	R1191H122D	T 1 2 2	12.2 V
R1191H023D	T 0 2 3	2.3 V	R1191H073D	T 0 7 3	7.3 V	R1191H123D	T 1 2 3	12.3 V
R1191H024D	T 0 2 4	2.4 V	R1191H074D	T 0 7 4	7.4 V	R1191H124D	T 1 2 4	12.4 V
R1191H025D	T 0 2 5	2.5 V	R1191H075D	T 0 7 5	7.5 V	R1191H125D	T 1 2 5	12.5 V
R1191H026D	T 0 2 6	2.6 V	R1191H076D	T 0 7 6	7.6 V	R1191H126D	T 1 2 6	12.6 V
R1191H027D	T 0 2 7	2.7 V	R1191H077D	T 0 7 7	7.7 V	R1191H127D	T 1 2 7	12.7 V
R1191H028D	T 0 2 8	2.8 V	R1191H078D	T 0 7 8	7.8 V	R1191H128D	T 1 2 8	12.8 V
R1191H029D	T 0 2 9	2.9 V	R1191H079D	T 0 7 9	7.9 V	R1191H129D	T 1 2 9	12.9 V
R1191H030D	T 0 3 0	3.0 V	R1191H080D	T 0 8 0	8.0 V	R1191H130D	T 1 3 0	13.0 V
R1191H031D	T 0 3 1	3.1 V	R1191H081D	T 0 8 1	8.1 V	R1191H131D	T 1 3 1	13.1 V
R1191H032D	T 0 3 2	3.2 V	R1191H082D	T 0 8 2	8.2 V	R1191H132D	T 1 3 2	13.2 V
R1191H033D	T 0 3 3	3.3 V	R1191H083D	T 0 8 3	8.3 V	R1191H133D	T 1 3 3	13.3 V
R1191H034D	T 0 3 4	3.4 V	R1191H084D	T 0 8 4	8.4 V	R1191H134D	T 1 3 4	13.4 V
R1191H035D	T 0 3 5	3.5 V	R1191H085D	T 0 8 5	8.5 V	R1191H135D	T 1 3 5	13.5 V
R1191H036D	T 0 3 6	3.6 V	R1191H086D	T 0 8 6	8.6 V	R1191H136D	T 1 3 6	13.6 V
R1191H037D	T 0 3 7	3.7 V	R1191H087D	T 0 8 7	8.7 V	R1191H137D	T 1 3 7	13.7 V
R1191H038D	T 0 3 8	3.8 V	R1191H088D	T 0 8 8	8.8 V	R1191H138D	T 1 3 8	13.8 V
R1191H039D	T 0 3 9	3.9 V	R1191H089D	T 0 8 9	8.9 V	R1191H139D	T 1 3 9	13.9 V
R1191H040D	T 0 4 0	4.0 V	R1191H090D	T 0 9 0	9.0 V	R1191H140D	T 1 4 0	14.0 V
R1191H041D	T 0 4 1	4.1 V	R1191H091D	T 0 9 1	9.1 V	R1191H141D	T 1 4 1	14.1 V
R1191H042D	T 0 4 2	4.2 V	R1191H092D	T 0 9 2	9.2 V	R1191H142D	T 1 4 2	14.2 V
R1191H043D	T 0 4 3	4.3 V	R1191H093D	T 0 9 3	9.3 V	R1191H143D	T 1 4 3	14.3 V
R1191H044D	T 0 4 4	4.4 V	R1191H094D	T 0 9 4	9.4 V	R1191H144D	T 1 4 4	14.4 V
R1191H045D	T 0 4 5	4.5 V	R1191H095D	T 0 9 5	9.5 V	R1191H145D	T 1 4 5	14.5 V
R1191H046D	T 0 4 6	4.6 V	R1191H096D	T 0 9 6	9.6 V	R1191H146D	T 1 4 6	14.6 V
R1191H047D	T 0 4 7	4.7 V	R1191H097D	T 0 9 7	9.7 V	R1191H147D	T 1 4 7	14.7 V
R1191H048D	T 0 4 8	4.8 V	R1191H098D	T 0 9 8	9.8 V	R1191H148D	T 1 4 8	14.8 V
R1191H049D	T 0 4 9	4.9 V	R1191H099D	T 0 9 9	9.9 V	R1191H149D	T 1 4 9	14.9 V
R1191H050D	T 0 5 0	5.0 V	R1191H100D	T 1 0 0	10.0 V	R1191H150D	T 1 5 0	15.0 V
R1191H051D	T 0 5 1	5.1 V	R1191H101D	T 1 0 1	10.1 V			
R1191H052D	T 0 5 2	5.2 V	R1191H102D	T 1 0 2	10.2 V			
R1191H053D	T 0 5 3	5.3 V	R1191H103D	T 1 0 3	10.3 V			
R1191H054D	T 0 5 4	5.4 V	R1191H104D	T 1 0 4	10.4 V			
R1191H055D	T 0 5 5	5.5 V	R1191H105D	T 1 0 5	10.5 V			
R1191H056D	T 0 5 6	5.6 V	R1191H106D	T 1 0 6	10.6 V			
R1191H057D	T 0 5 7	5.7 V	R1191H107D	T 1 0 7	10.7 V			
R1191H058D	T 0 5 8	5.8 V	R1191H108D	T 1 0 8	10.8 V			
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R1191H060D	T 0 6 0	6.0 V	R1191H110D	T 1 1 0	11.0 V			
R1191H061D	T 0 6 1	6.1 V	R1191H111D	T 1 1 1	11.1 V			
R1191H062D	T 0 6 2	6.2 V	R1191H112D	T 1 1 2	11.2 V			
R1191H063D	T 0 6 3	6.3 V	R1191H113D	T 1 1 3	11.3 V			
R1191H064D	T 0 6 4	6.4 V	R1191H114D	T 1 1 4	11.4 V			
R1191H065D	T 0 6 5	6.5 V	R1191H115D	T 1 1 5	11.5 V			
R1191H066D	T 0 6 6	6.6 V	R1191H116D	T 1 1 6	11.6 V			
R1191H067D	T 0 6 7	6.7 V	R1191H117D	T 1 1 7	11.7 V			
R1191H068D	T 0 6 8	6.8 V	R1191H118D	T 1 1 8	11.8 V			
R1191H069D	T 0 6 9	6.9 V	R1191H119D	T 1 1 9	11.9 V			

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2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
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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 (automotive, airplane, railroad, ship, etc.)
 - Various Safety Devices
 - Traffic control system
 - Combustion equipment

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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.
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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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