RICOH

R1515x SERIES

50mA VOLTAGE REGULATOR (Wide Input Voltage Range)

NO.EA-153-111026

OUTLINE

The R1515x series are CMOS-based positive voltage regulator (VR) ICs featuring 50mA output current. The R1515xxxxB has features of high input voltage and ultra-low supply current. A peak current limit circuit, a short current limit circuit, and a thermal shutdown circuit are built in the R1515x series.

The operating temperature is −40°C to 105°C and the maximum input voltage is 36V, the R1515x series are very suitable for power source of car accessories.

The regulator output voltage is fixed in the R1515xxxxB and can be selected with a step of 0.1V in the range of 2.0V to 12.0V. Output voltage accuracy is ±2%.

The packages for these ICs are the SOT-89-5 for space saving and the HSOP-6J for higher power applications.

FEATURES

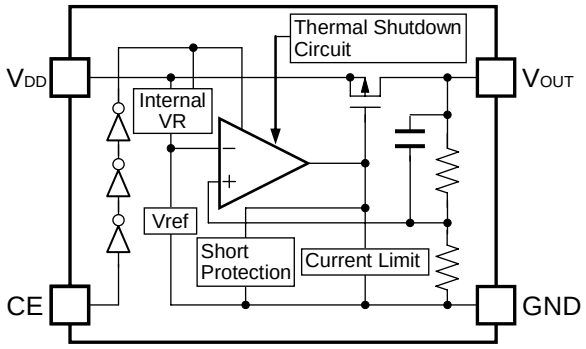
- Input Voltage ..... Max. 36V
- Supply Current ..... Typ. 9μA
- Standby Current ..... Typ. 0.1μA
- Temperature-Drift Coefficient of Output Voltage ... Typ. ±100ppm/°C
- Output Current ..... Min. 50mA (V_{IN}=V_{OUT}+3.0V; R1515x050B)
- Line Regulation ..... Typ. 0.05%/V
- Output Voltage Accuracy ..... ±2%
- Output Voltage Range ..... 2.0V to 12.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Packages SOT-89-5, HSOP-6J
- Built-in Peak Current Limit Circuit
- Built-in Short Current Limit Circuit
- Built-in Thermal Shutdown Circuit
- Operating Temperature ..... −40°C to 105°C

APPLICATIONS

- Power source for home appliances such as refrigerators, rice cookers, electric water warmers, etc.
- Power source for car audio equipment, car navigation system, ETC system, etc.
- Power source for notebook PCs, digital TVs, cordless phones, and private LAN system, etc.
- Power source for office equipment machines such as copiers, printers, facsimiles, scanners, projectors, etc.
- Power source for the backup circuit for keyless entry system, etc.

BLOCK DIAGRAMS

R1515xxxxB



SELECTION GUIDE

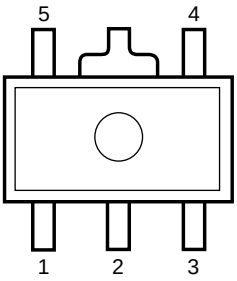
The output voltage, package for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1515HxxxB-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes
R1515SxxxB-E2-FE	HSOP-6J	1,000 pcs	Yes	Yes

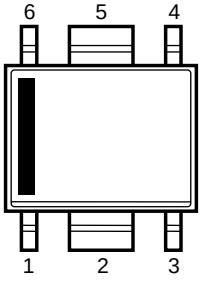
xxx : The output voltage can be designated in the range of 2.0V(020) to 12.0V(120) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

PIN CONFIGURATIONS

● **SOT-89-5**



● **HSOP-6J**



PIN DESCRIPTIONS

● **SOT-89-5**

Pin No.	Symbol	Description
1	V_{OUT}	Output Pin
2	GND*	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	GND*	Ground Pin
5	V_{DD}	Input Pin

∗) The GND pin must be wired together when it is mounted on board.

● **HSOP-6J**

Pin No.	Symbol	Description
1	V_{OUT}	Output Pin
2	GND*	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	GND*	Ground Pin
5	GND*	Ground Pin
6	V_{DD}	Input Pin

∗) The GND pin must be wired together when it is mounted on board.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	−0.3 to 50	V
V_{IN}	Peak Input Voltage[*1]	60	V
V_{CE}	Input Voltage (CE Pin)	−0.3 to V_{IN}+0.3 ≤ 50	V
V_{OUT}	Output Voltage	−0.3 to V_{IN}+0.3 ≤ 50	V
I_{OUT}	Output Current	150	mA
P_D	Power Dissipation (SOT-89-5)[*2]	900	mW
	Power Dissipation (HSOP-6J)[*2]	1700	
Topt	Operating Temperature Range	−40 to 105	°C
Tstg	Storage Temperature Range	−55 to 125	°C

∗1) Duration time=200ms
∗2) For Power Dissipation, please refer to PACKAGE INFORMATION.

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

- **R1515xxxxB**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage		4		36	V
I_{SS}	Supply Current	$V_{IN}=V_{OUT}+3.0V$, $I_{OUT}=0mA$		9	20	μA
$I_{standby}$	Standby Current	$V_{IN}=36V$, $V_{CE}=0V$		0.1	1.0	μA
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+3.0V$, $I_{OUT}=1mA$	×0.98		×1.02	V
I_{OUT}	Output Current	$V_{IN}=V_{OUT}+3.0V$	50			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}=V_{OUT}+3.0V$, $1mA \le I_{OUT} \le 40mA$	Refer to the following table			
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$V_{OUT}+1.5V \le V_{IN} \le 36V$, $I_{OUT}=1mA$		0.05	0.20	%/V
V_{DIF}	Dropout Voltage	$I_{OUT}=20mA$	Refer to the following table			
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	$V_{IN}=V_{OUT}+3.0V$, $I_{OUT}=1mA$, $-40°C \le Topt \le 105°C$		±100		ppm /°C
I_{SC}	Short Current Limit	$V_{OUT}=0V$		50		mA
V_{CEH}	CE Input Voltage "H"		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"		0		0.3	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		125		°C

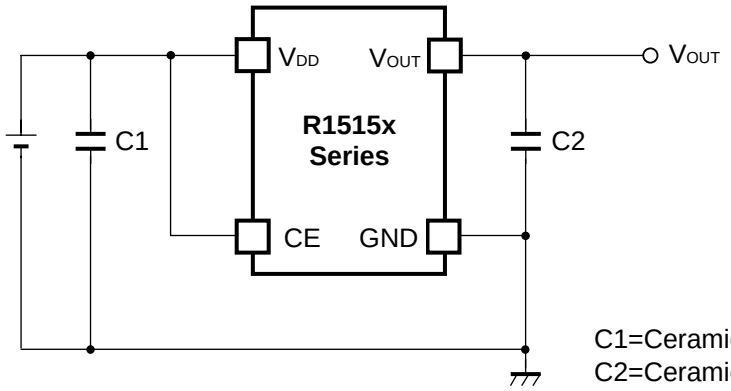
- **Load Regulation by Output Voltage** Topt=25°C

Output Voltage V_{OUT} (V)	Load Regulation $\Delta V_{OUT}/\Delta I_{OUT}$ (mV)		
	Conditions	Typ.	Max.
$2.0 \le V_{OUT} < 5.0$	$V_{IN}=V_{OUT}+3.0V$, $1mA \le I_{OUT} \le 40mA$	10	25
$5.0 \le V_{OUT} \le 12.0$		20	35

- **Dropout Voltage by Output Voltage** Topt=25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Conditions	Typ.	Max.
$V_{OUT}=2.0$	$I_{OUT}=20mA$		2.0
$V_{OUT}=2.1$			1.9
$V_{OUT}=2.2$			1.8
$V_{OUT}=2.3$			1.7
$V_{OUT}=2.4$			1.6
$V_{OUT}=2.5$			1.5
$V_{OUT}=2.6$			1.4
$V_{OUT}=2.7$			1.3
$V_{OUT}=2.8$			1.2
$V_{OUT}=2.9$			1.1
$V_{OUT}=3.0$			1.0
$V_{OUT}=3.1$			0.9
$V_{OUT}=3.2$			0.8
$V_{OUT}=3.3$			0.7
$V_{OUT}=3.4$			0.6
$V_{OUT}=3.5$			0.5
$V_{OUT}=3.6$			0.4
$3.7 \le V_{OUT} < 4.0$		0.35	0.60
$4.0 \le V_{OUT} < 5.0$		0.25	0.40
$5.0 \le V_{OUT} \le 12.0$		0.20	0.35

TYPICAL APPLICATION



TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

Phase Compensation of the R1515x Series has been made internally for stable operation even though the load current would vary. Therefore, without the capacitors, C1 and C2, the output voltage is regulated, however, for more stable operation, use capacitors as C1 and C2. Especially, if the input line is long and impedance is high, C1 is necessary. Moreover, if you use rather large C2, transient response will be improved. Recommended value is in the range from 0.1μF to 10μF. Wiring should be made as short as possible.

Connect the capacitor, C1 between V_{DD} pin and GND pin and C2 between V_{OUT} and GND as close as possible.

GND wiring of mounting on board

No.2 pin and No.4 pin of SOT-89-5 package must be wired to the GND plane. No.2 pin, No.4 pin and No.5 pin of HSOP-6J package must be wired to the GND plane when it is mounted on board.

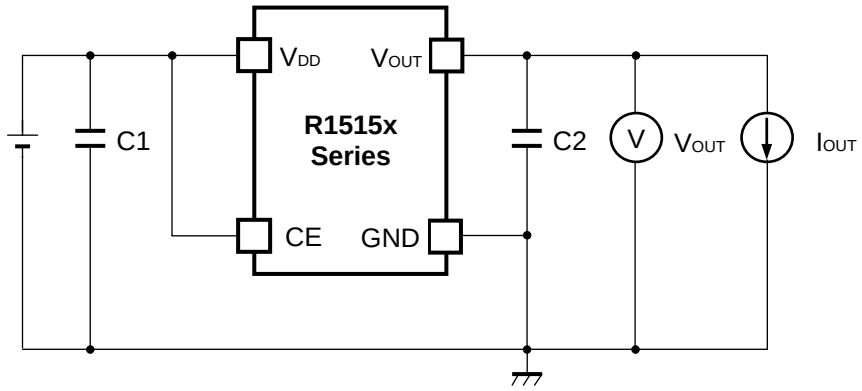
Thermal Shutdown

Thermal shutdown function is included in the R1515x Series, if the junction temperature is equal or more than +150°C (Typ.), the operation of regulator would stop. After that, when the junction temperature is equal or less than +125°C (Typ.), the operation of regulator would restart. Unless the cause of rising temperature would remove, the regulator repeats on and off, and output waveform would be like consecutive pulses.

Chip Enable Circuit

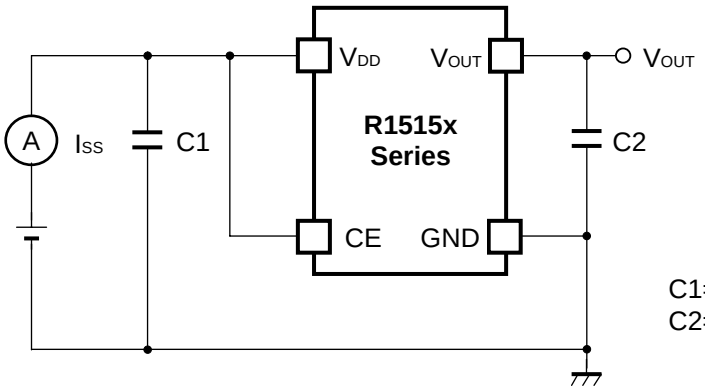
Do not make voltage level of chip enable pin keep floating level, or in between V_{CEH} and V_{CEL}. Otherwise, the output voltage would be unstable or indefinite, or unexpected current would flow internally.

TEST CIRCUITS



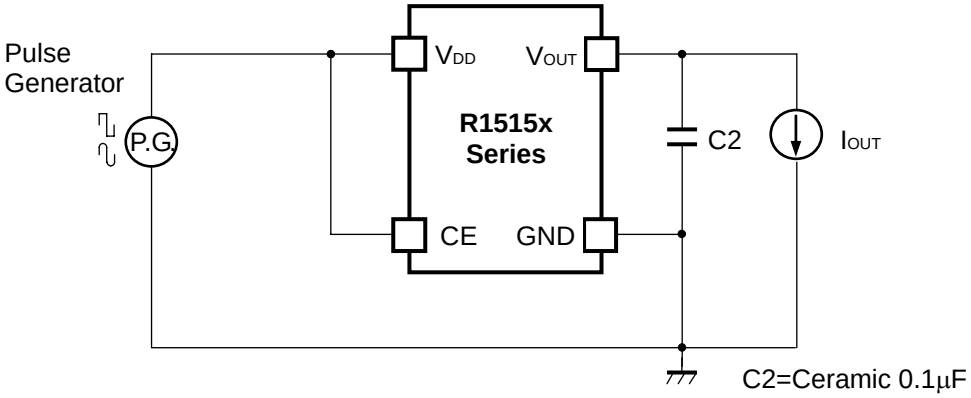
C1=Ceramic 0.1μF
C2=Ceramic 0.1μF

Basic Test Circuit



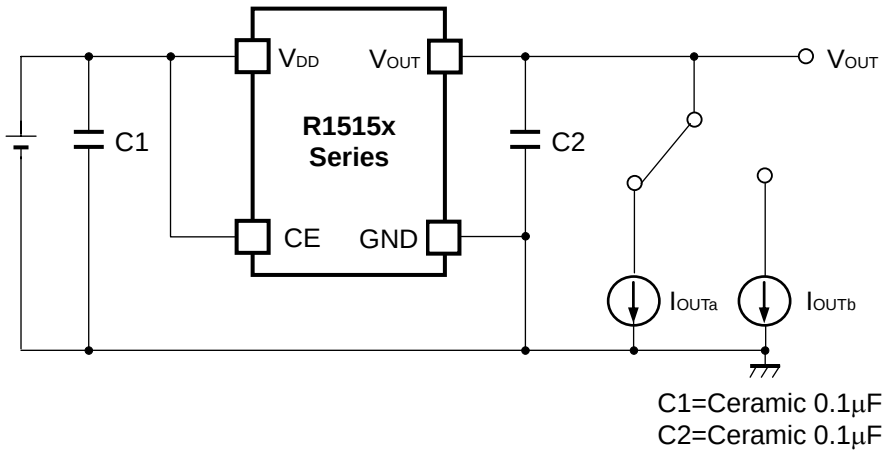
C1=Ceramic 0.1μF
C2=Ceramic 0.1μF

Test Circuit for Supply Current



C2=Ceramic 0.1μF

Test Circuit for Line Transient Response

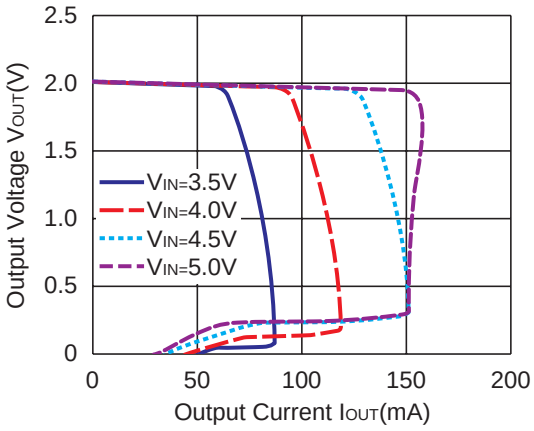


Test Circuit for Load Transient Response

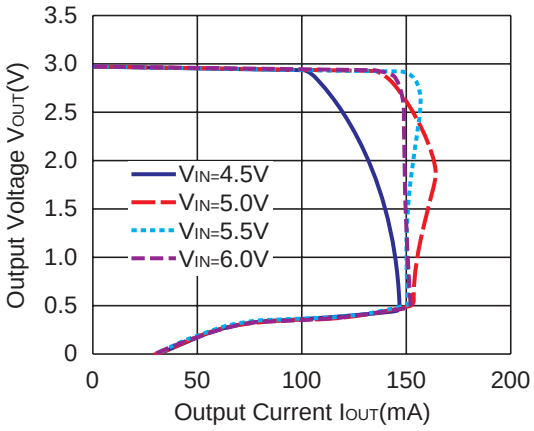
TYPICAL CHARACTERISTICS

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

R1515x020B



R1515x030B



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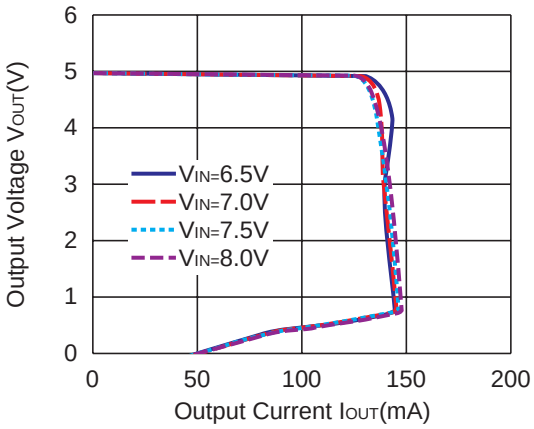
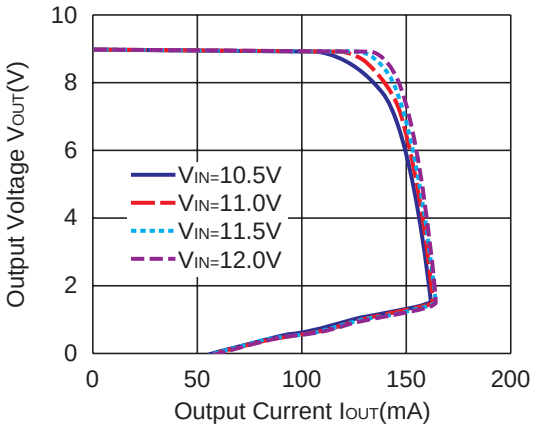
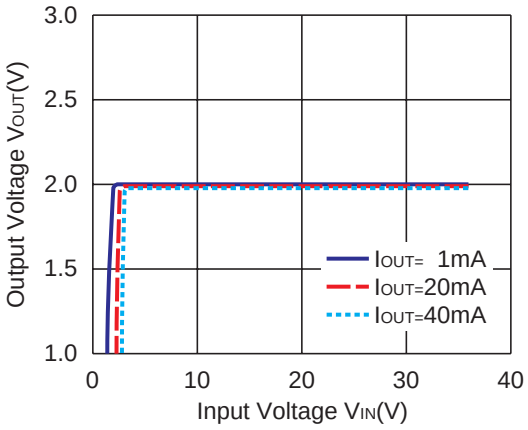


R1515x090B



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

R1515x020B



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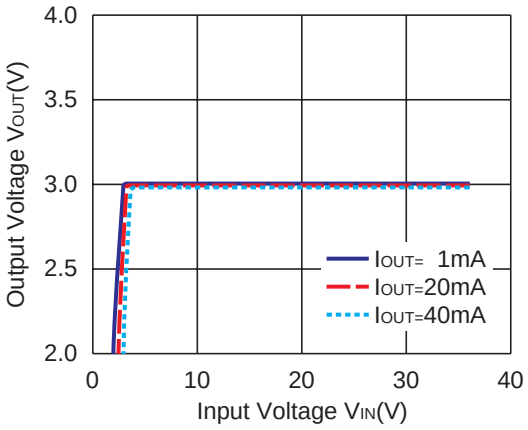

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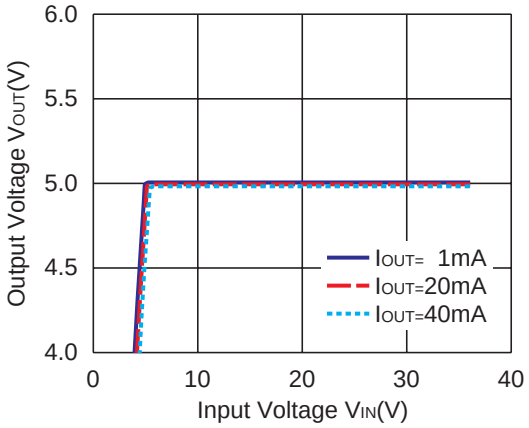

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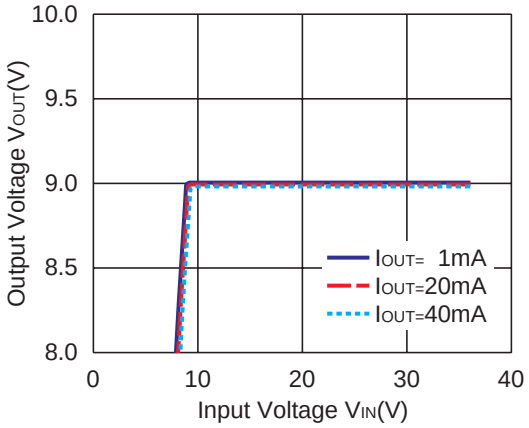
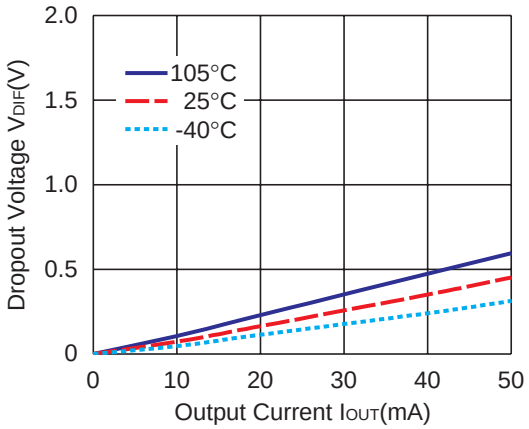


3) Dropout Voltage vs. Output Current

R1515x050B



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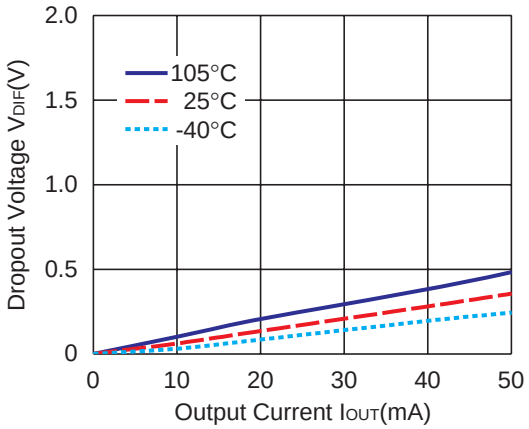
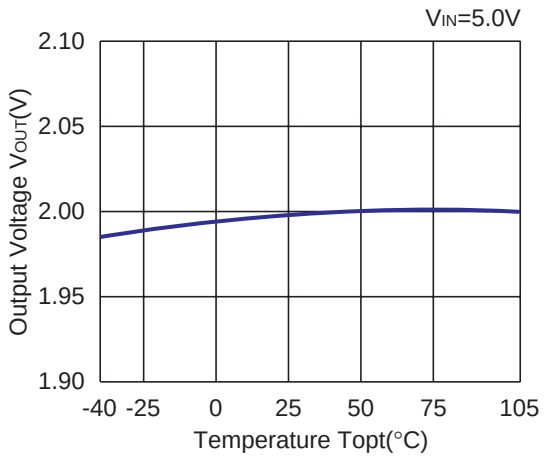


4) Output Voltage vs. Temperature

R1515x020B



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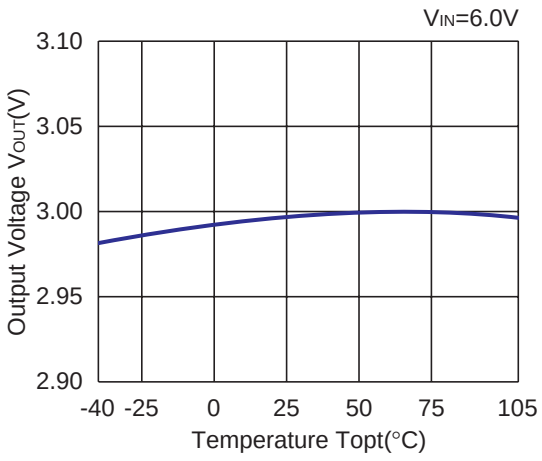

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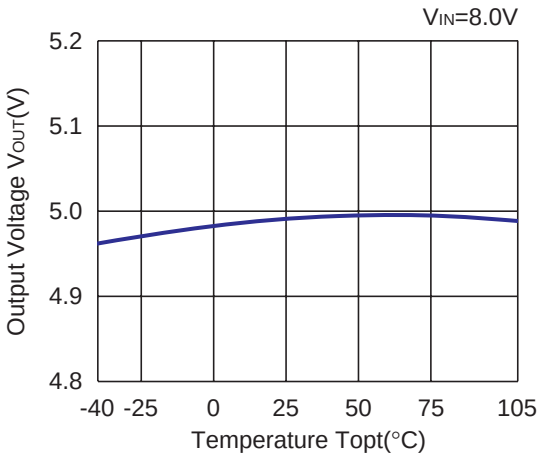

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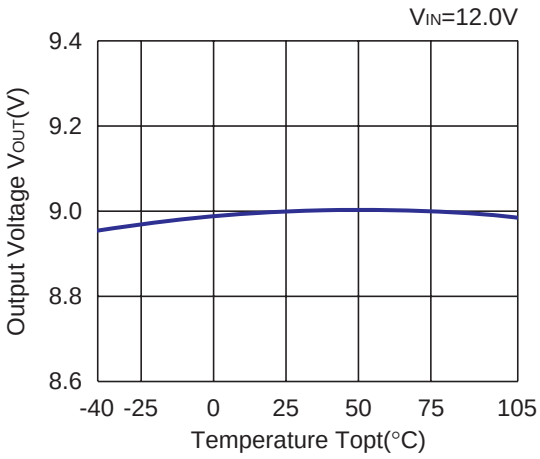
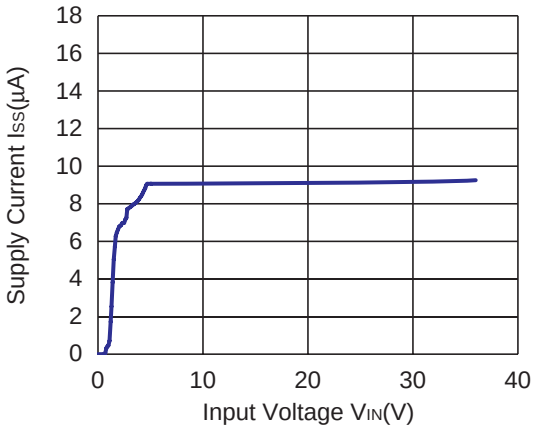


5) Supply Current vs. Input Voltage (Topt=25°C)

R1515x020B



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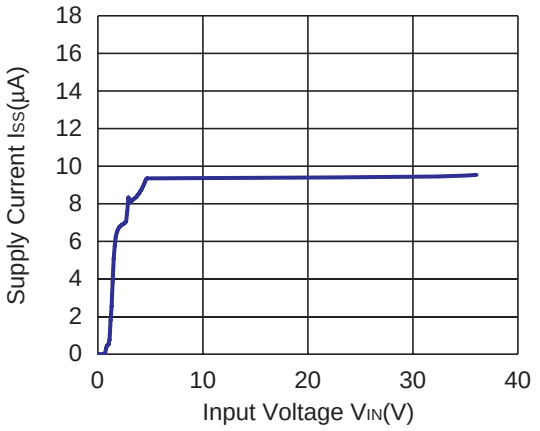

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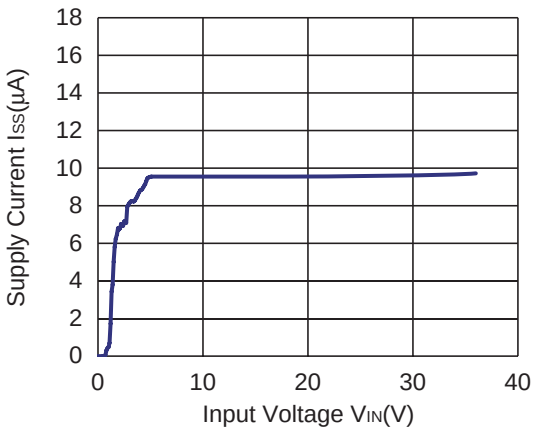

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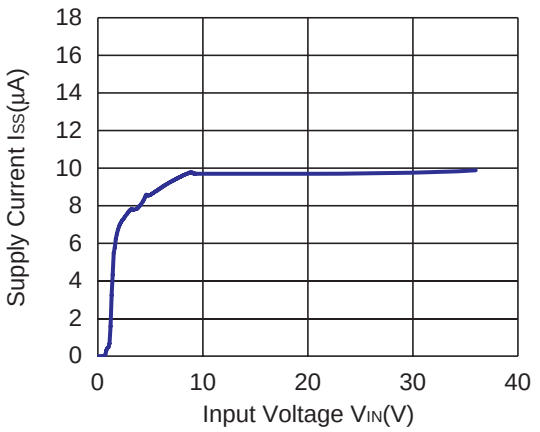
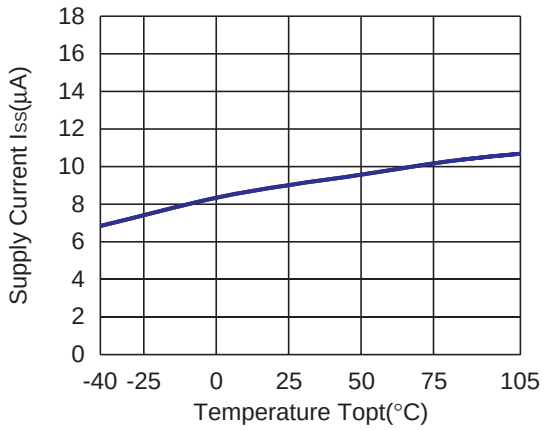


6) Supply Current vs. Temperature

R1515x020B



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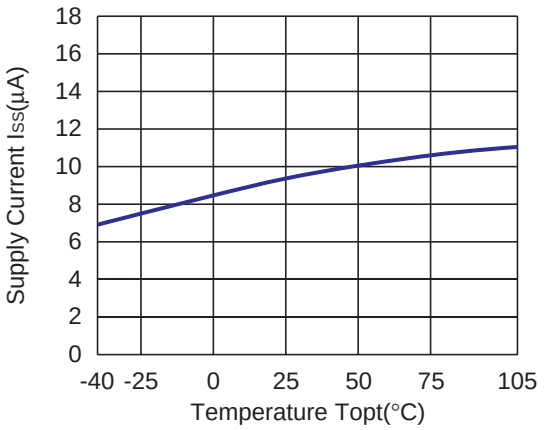

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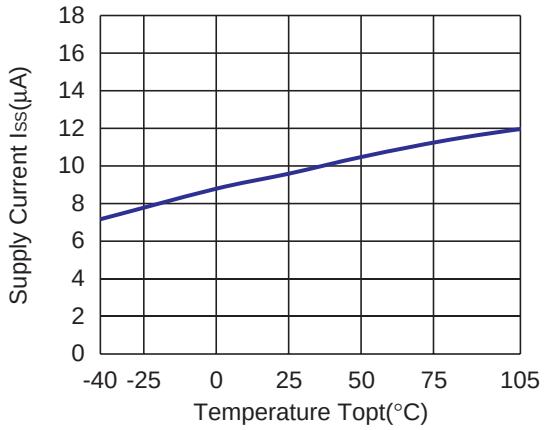

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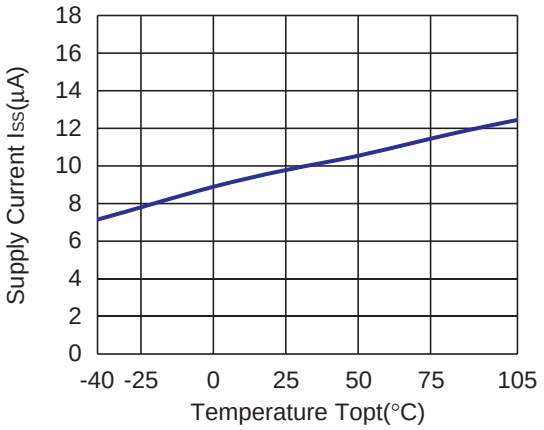
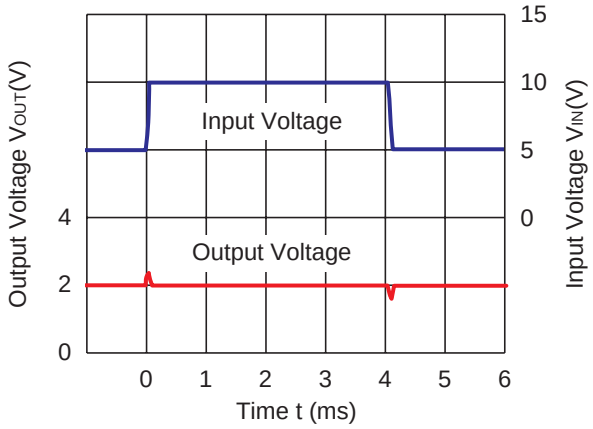


7) Input Transient Response (I_{OUT}=1mA, tr=tf=50µs, C2=Ceramic 0.1µF, Topt=25°C)

R1515x020B



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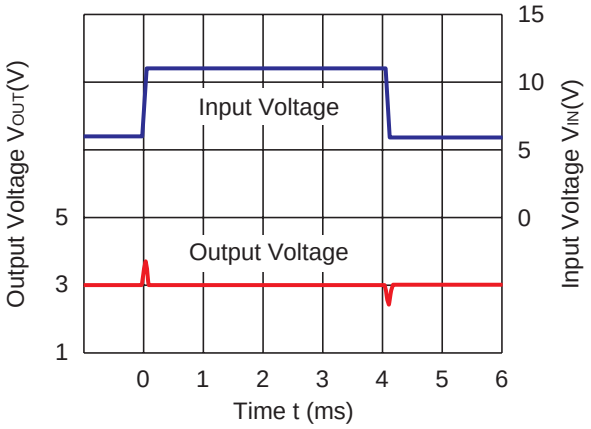

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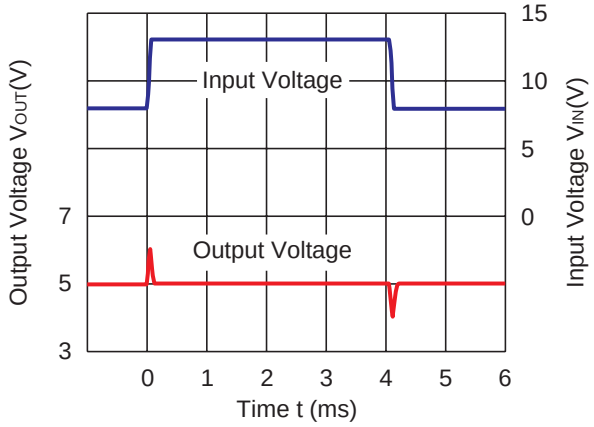

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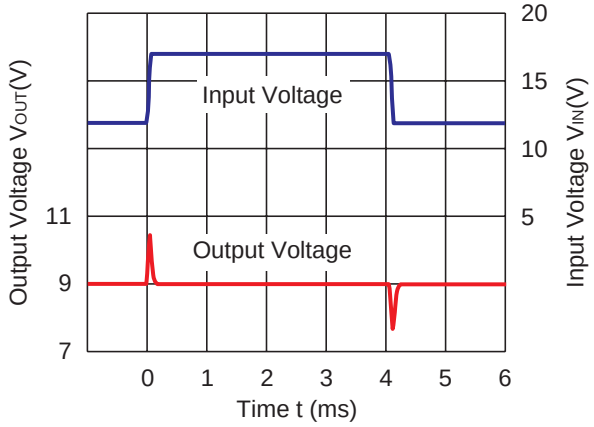
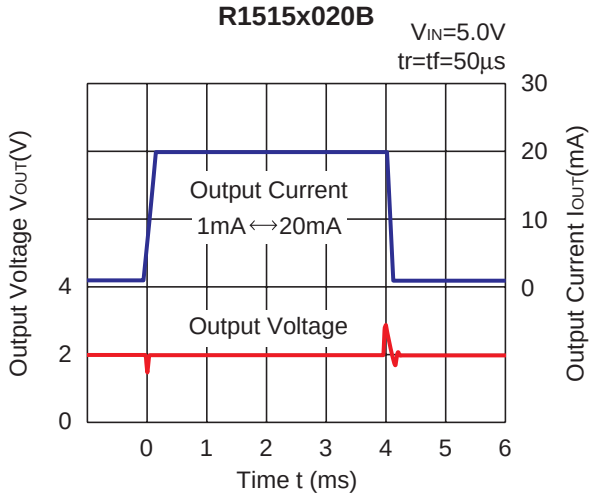


8) Load Transient Response (C2=Ceramic 0.1µF, Topt=25°C)

R1515x020B



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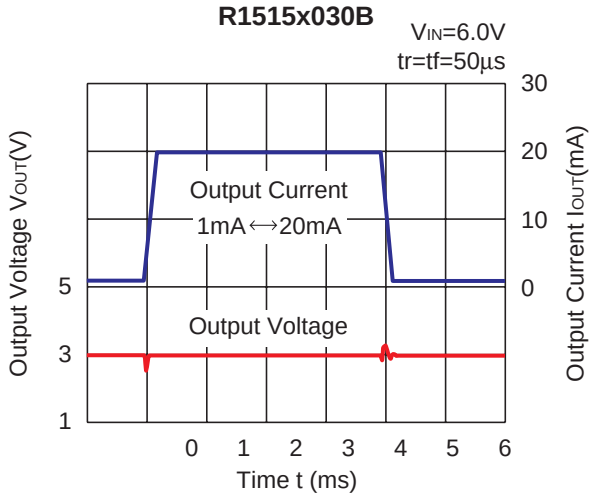

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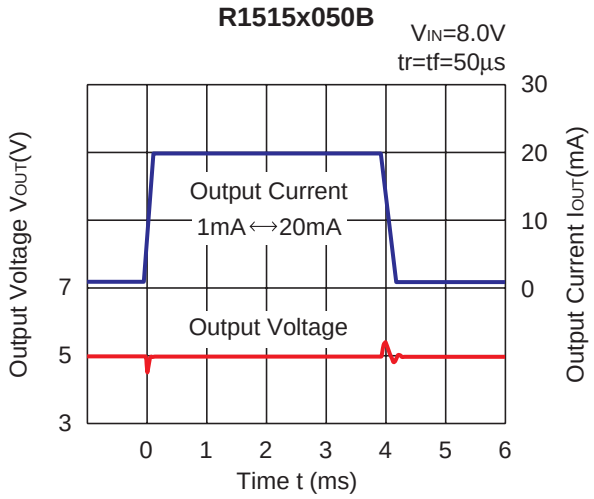

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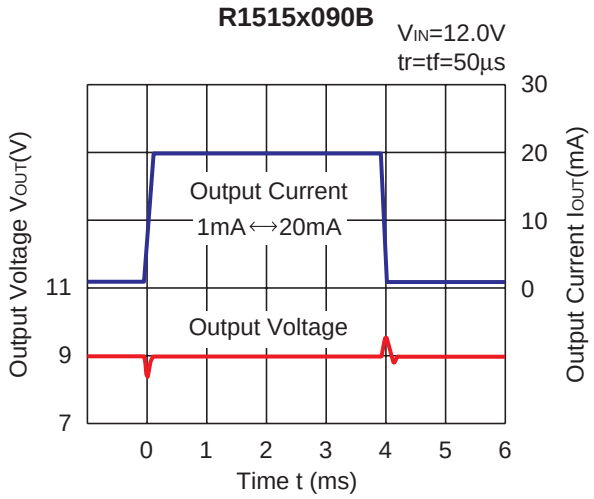

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