RICOH

R1516x SERIES

150mA 36V Input LDO Regulator

NO.EA-258-111025

OUTLINE

The R1516x Series are CMOS-based high-voltage resistant and low supply current voltage regulator ICs that provide the minimum 150mA of output voltage. Internally, the R1516x Series consists of a Foldback Protection Circuit, and a Thermal Shutdown Circuit in addition to the basic regulator circuits. The operating temperature range is between –40ºC to 105ºC, and the maximum input voltage is 36V. All these features allow the R1516x Series to become an ideal power source of electric home appliances.

The R1516x Series are available in fixed output voltage options between 1.8V and 6.2V in 0.1V steps. The output voltage accuracy is ±1%.

The R1516x Series are available in two types of packages: SOT-89-5 that is for high-density mounting and HSOP-6J that is for high wattage.

FEATURES

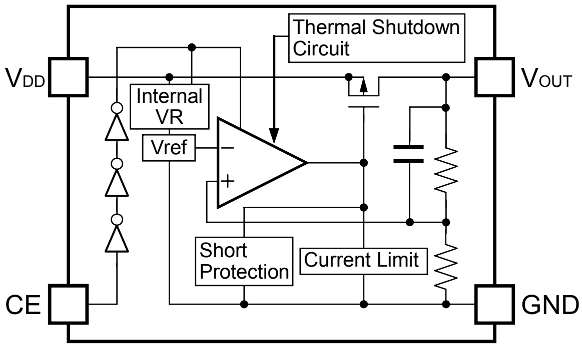
- Input Voltage Range ···································· 4V to 36V
- Supply Current ···································· Typ. 29μA
- Standby Current ···································· Typ. 0.1μA
- Output Voltage Temperature Coefficient ·················· Typ. ±100ppm/ºC
- Output Current ···································· Min. 150mA (V_{OUT}=5.0V, V_{IN}=8.0V)
- Line Regulation ···································· Typ. 0.1%/V
- Output Voltage Accuracy ···································· ±1% (V_{OUT} ≥ 3.2V, Topt=25ºC)
- Packages ···································· SOT-89-5, HSOP-6J
- Output Voltage Range ···································· 1.8V to 6.2V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Built-in Foldback Protection Circuit ························ 50mA (Current at short mode)
- Built-in Thermal Shutdown Circuit ························ Stops at 150°C
- Operating Temperature ···································· –40 to 105ºC

APPLICATIONS

- Power source for home appliances such as refrigerators, rice cookers, electric hot-water pot.
- Power source for notebook PCs, digital TVs, cordless phones, and private LAN system.
- Power source for office equipment machines such as copiers, printers, facsimiles, scanners, projectors.

BLOCK DIAGRAMS

R1516xxxxB



SELECTION GUIDE

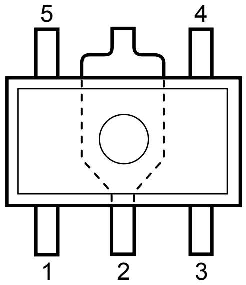
The output voltage and the package for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1516HxxxB-T1-FE	SOT-89-5	1,000pcs	Yes	Yes
R1516SxxxB-E2-FE	HSOP-6J	1,000pcs	Yes	Yes

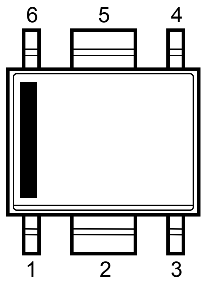
xxx : The output voltage can be designated in the range of 1.8V (018) to 6.2V (062) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

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	−0.3～50	V
V_{IN}	Peak Input Voltage*1	60	V
V_{CE}	Input Voltage (CE Pin)	−0.3～V_{IN}+0.3≦50	V
V_{OUT}	Output Voltage	−0.3～V_{IN}+0.3≦50	V
I_{OUT}	Output Current	250	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.

ELECTRICAL CHARACTERISTICS

The specifications in [ ] are applicable under the condition of -40°C ≤ Topt ≤ 105°C.

● R1516xxxxB

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage			4		36	V
I_{SS}	Supply Current	$V_{IN}=V_{OUT}+3.0V$, $I_{OUT}=0mA$			29	45	µA
$I_{standby}$	Standby Current	$V_{IN}=36V$, $V_{CE}=0V$			0.1	1.0	µA
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+3.0V$, $I_{OUT}=1mA$	$V_{OUT} \geq 3.2V$	×0.99 ×0.98		×1.01 ×1.02	V
			$V_{OUT} < 3.2V$	×0.985 ×0.975		×1.015 ×1.025	
I_{OUT}	Output Current	Please refer to "Output Current by Output Voltage".					
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	Please refer to "Load Regulation by Output Voltage".					
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$I_{OUT}=1mA$	$V_{OUT}+1.5V \leq V_{IN} \leq 36V$, ($V_{OUT} \geq 2.5V$)		0.1	0.7	%/V
			$4V \leq V_{IN} \leq 36V$, ($V_{OUT} < 2.5V$)				
V_{DIF}	Dropout Voltage	Please refer to "Dropout Voltage by Output Voltage".					
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	$V_{IN}=V_{OUT}+3.0V$, $I_{OUT}=1mA$ −40°C ≤ Topt ≤ 105°C			±100		ppm/°C
I_{SC}	Short Current Limit	$V_{OUT}=0V$			50		mA
V_{CEH}	CE Input Voltage "H"			1.3		V_{IN}	V
V_{CEL}	CE Input Voltage "L"			0		0.35	V
T_{TSD}	Thermal Shutdown Temparature	Junction Temeprature			150		°C
T_{TSR}	Thermal Shutdown Released Temparature	Junction Temeprature			125		°C

● Output Current by Output Voltage

Topt=25°C

Output Voltage V_{OUT} (V)	Output Current I_{OUT} (mA)	
	Condition	Min.
$1.8 \leq V_{OUT} < 3.0$	$V_{IN}=V_{OUT}+5.0V$	150
$3.0 \leq V_{OUT} < 5.0$	$V_{IN}=V_{OUT}+4.0V$	
$5.0 \leq V_{OUT} \leq 6.2$	$V_{IN}=V_{OUT}+3.0V$	

● Load Regulation by Output Voltage

Topt=25°C

Output Voltage V_{OUT} (V)	Load Regulation (mV)		
	Condition	Typ.	Max.
$1.8 \leq V_{OUT} \leq 3.0$	$V_{IN}=V_{OUT}+3.0V$ $1mA \leq I_{OUT} \leq 40mA$	30 ($V_{OUT}=3.0V$)	70
$3.0 < V_{OUT} \leq 5.0$		40 ($V_{OUT}=5.0V$)	105
$5.0 < V_{OUT} \leq 6.2$		50 ($V_{OUT}=6.2V$)	125

●Dropout Voltage by Output Voltage

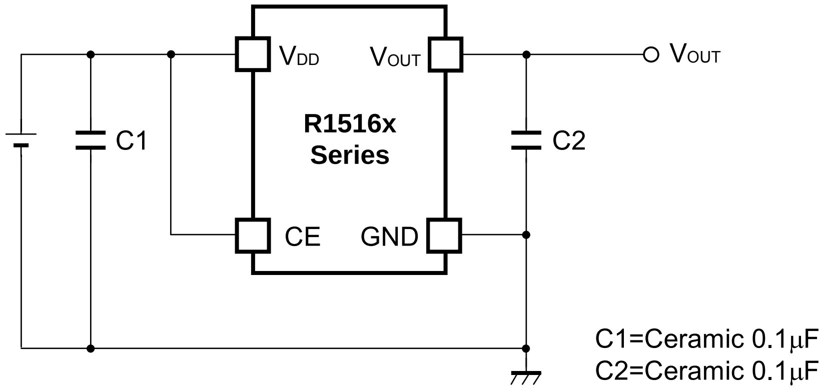
（I_{OUT}=20mA） Topt=25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V) Max.
V_{OUT}=1.8	2.30
V_{OUT}=1.9	2.20
V_{OUT}=2.0	2.10
V_{OUT}=2.1	2.00
V_{OUT}=2.2	1.90
V_{OUT}=2.3	1.80
V_{OUT}=2.4	1.70
V_{OUT}=2.5	1.60
V_{OUT}=2.6	1.50
V_{OUT}=2.7	1.40
V_{OUT}=2.8	1.30
V_{OUT}=2.9	1.20
V_{OUT}=3.0	1.10
V_{OUT}=3.1	1.06
V_{OUT}=3.2	1.02
V_{OUT}=3.3	0.98
V_{OUT}=3.4	0.94
V_{OUT}=3.5	0.90
V_{OUT}=3.6	0.86
V_{OUT}=3.7	0.82
V_{OUT}=3.8	0.78
V_{OUT}=3.9	0.74
V_{OUT}=4.0	0.70
V_{OUT}=4.1	0.69
V_{OUT}=4.2	0.68
V_{OUT}=4.3	0.67
V_{OUT}=4.4	0.66
V_{OUT}=4.5	0.65
V_{OUT}=4.6	0.64
V_{OUT}=4.7	0.63
V_{OUT}=4.8	0.62
V_{OUT}=4.9	0.61
$5.0 \leq V_{OUT} \leq 6.2$	0.60

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.

TYPICAL APPLICATION



TECHNICAL NOTES

When using the R1516x Series, please consider the following points.

Phase Compensation

The R1516x Series provide the constant-voltage without using C1 and C2 capacitors. However, if the input line is too long, C1 should be connected. To minimize the input voltage fluctuation and the transient output voltage fluctuation that is caused by the load fluctuation, C2 size should be increased. Please refer to the Basic Test Circuit below when connecting a 0.1μF to 20μF C1 capacitor from V_{DD} to GND, and also connecting a 0.1μF to 20μF C2 capacitor from V_{OUT} to GND. The C1 and C2 capacitors, V_{DD}, GND and V_{OUT} should be connected as close as possible to each other.

GND Wiring on Boards

For SOT-89-5 package, please connect the No.2 pin and the No.4 pin to the ground plane on the board.

For HSOP-6J package, please connect the No.2 pin, the No.4 pin and the No.5 pin to the ground plane on the board.

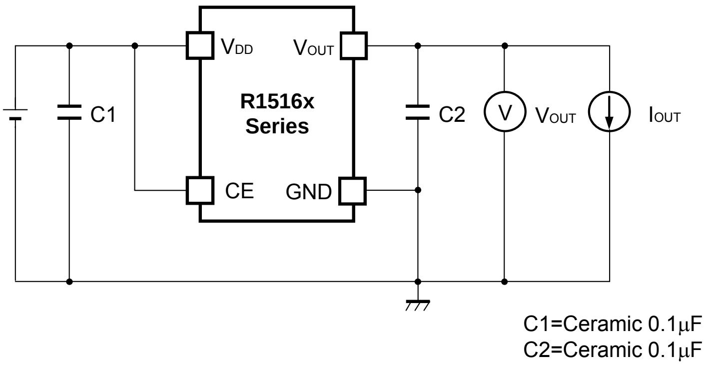
Thermal Shutdown

The thermal shutdown is included, which limits the junction temperature to a maximum 150ºC (Typ.). Under extreme conditions when the junction temperature begins to rise above 150ºC, the output is turned off, reducing the output current to zero. When the junction temperature drops below +125ºC (Typ.), the output is turned on again and the output current is restored to its nominal value. The output repeats turning on and off to form a pulse shaped output unless the causes of the temperature rise are removed.

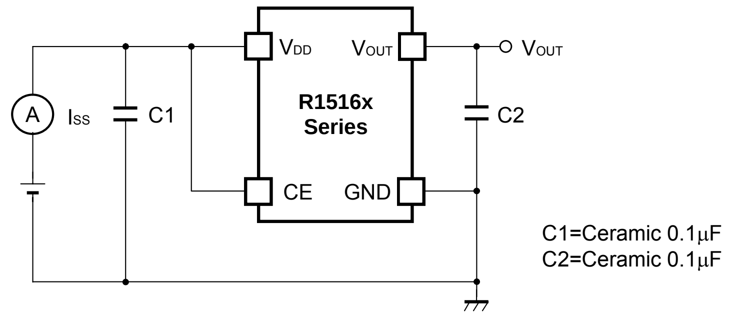
Chip Enable (CE) Circuit

The electrical potential level of chip enable (CE) pin should not be set in between V_{CEH} and V_{CEL}. Using the electrical potentials in between V_{CEH} and V_{CEL} may cause the increase of supply current and may result in unstable output.

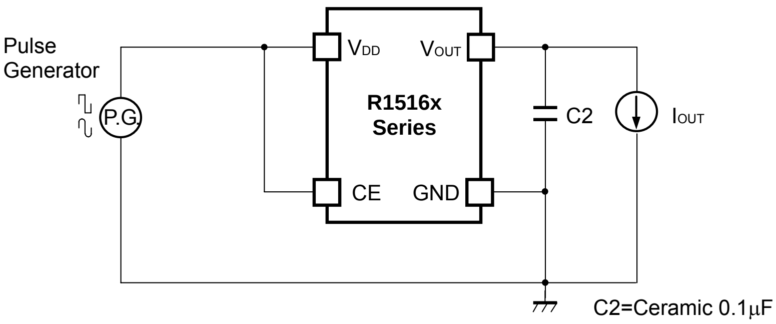
TEST CIRCUITS



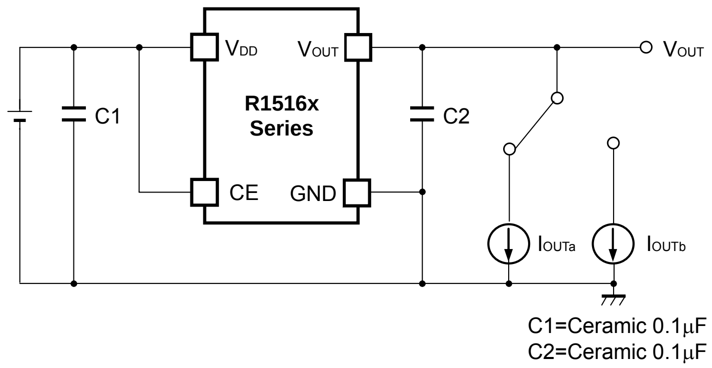
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Line Transient Response

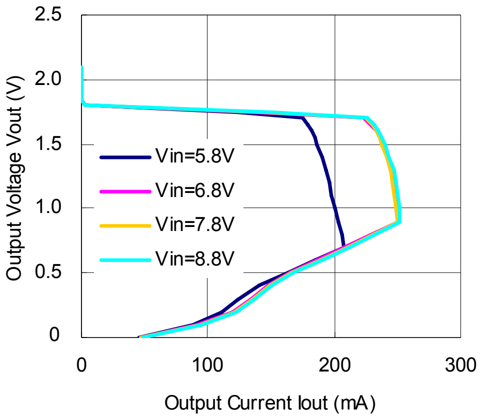


Test Circuit for Load Transient Response

Typical Characteristics

1) Output Voltage vs. Output Current (C1=0.1μF, C2=0.1μF, Topt=25°C)

R1516x018x



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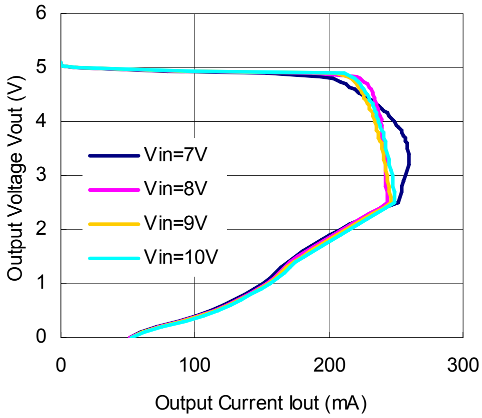
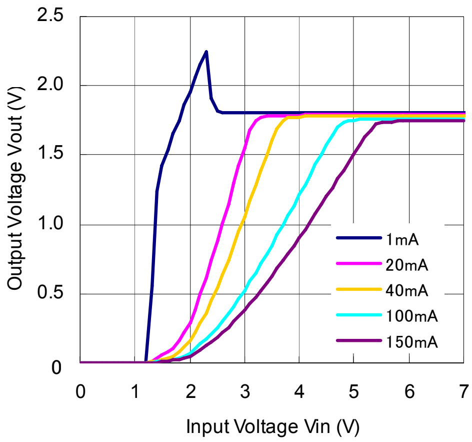
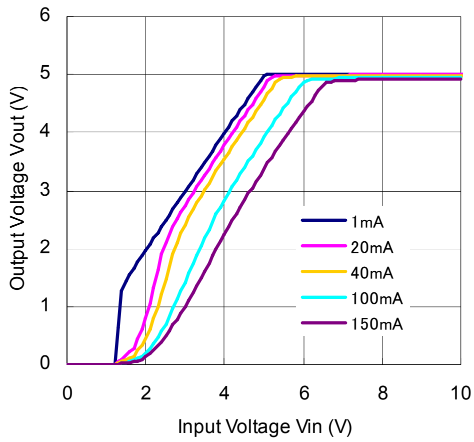


2) Output Voltage vs. Input Voltage (C1=0.1μF, C2=0.1μF, Topt=25°C)

R1516x018x

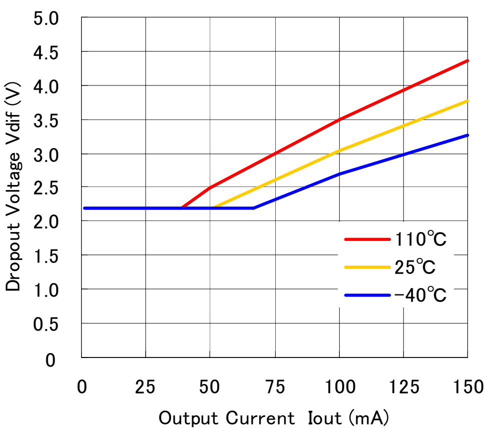


R1516x050x

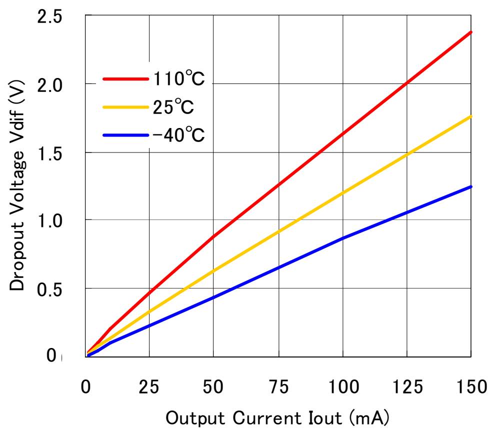


3) Dropout Voltage vs. Output Voltage (C1=0.1μF, C2=0.1μF, Topt=25°C)

R1516x018x

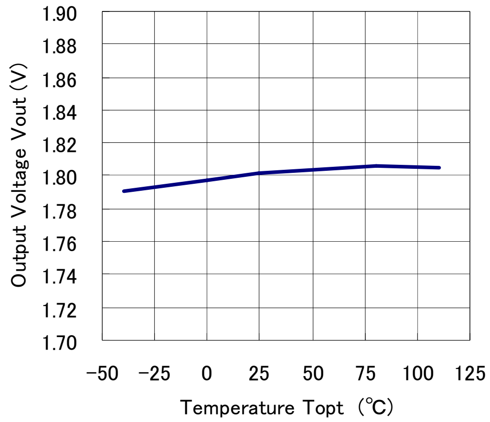


R1516x050x

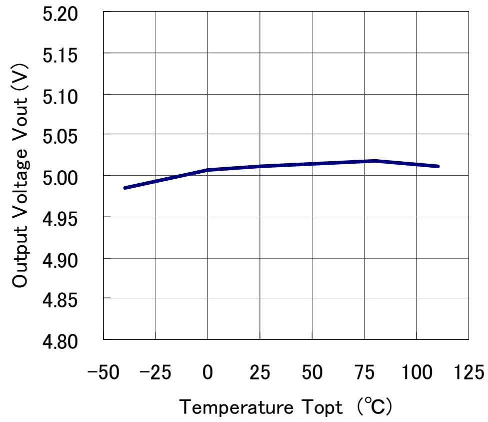


4) Output Voltage vs. Temperature (C1=0.1µF, C2=0.1µF)

R1516x018x

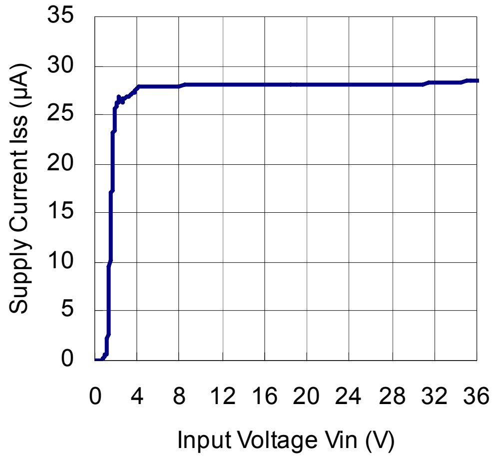


R1516x050x



5) Supply Current vs. Input Votlage (C1=0.1µF, C2=0.1µF, Topt=25°C)

R1516x018x



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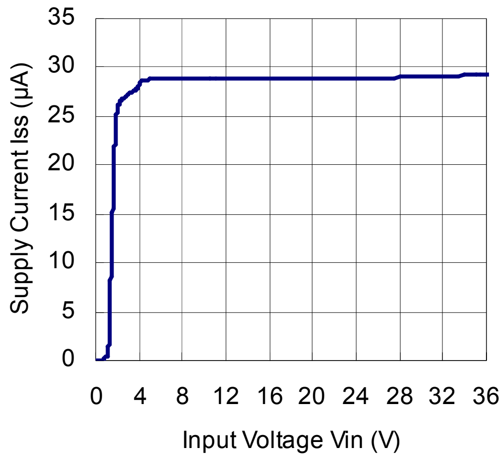
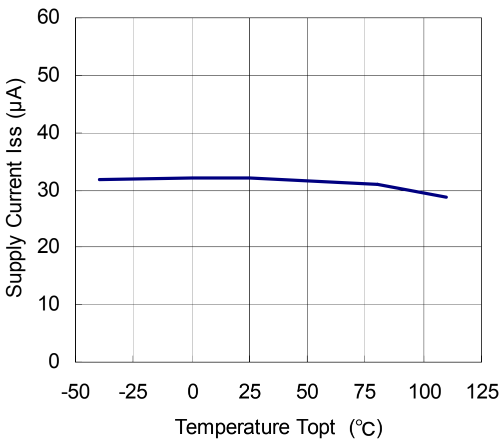


6) Supply Current vs. Temperature (C1=0.1µF, C2=0.1µF)

R1516x018x



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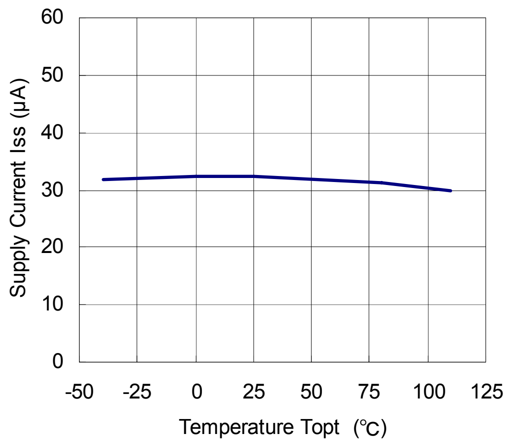
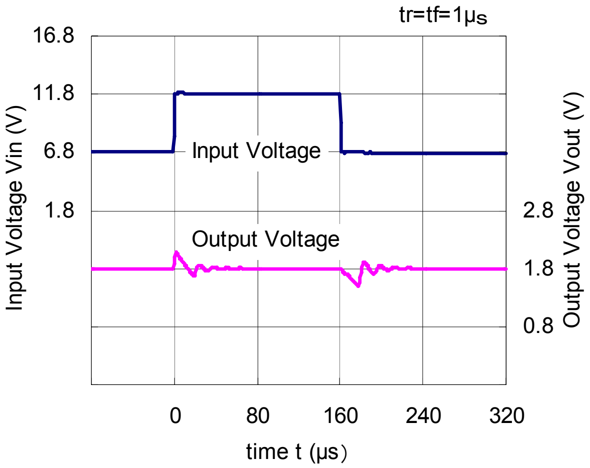


7) Input Transient Response (C1=none, C2=Ceramic 0.1μF, I_{OUT}=1mA, Topt=25°C)

R1516x018x



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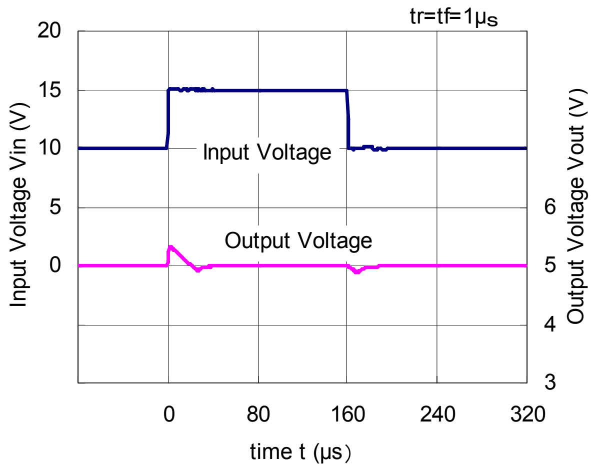

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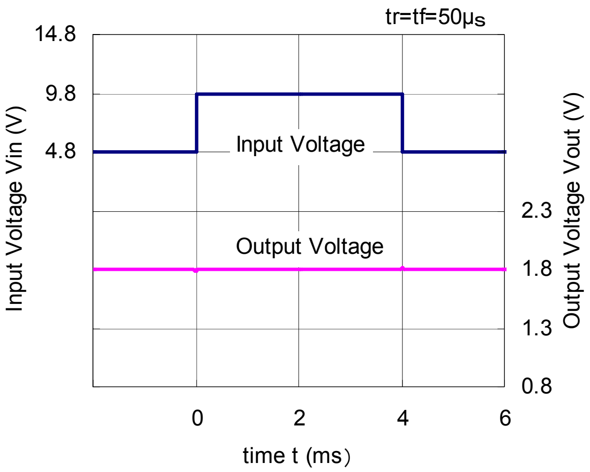

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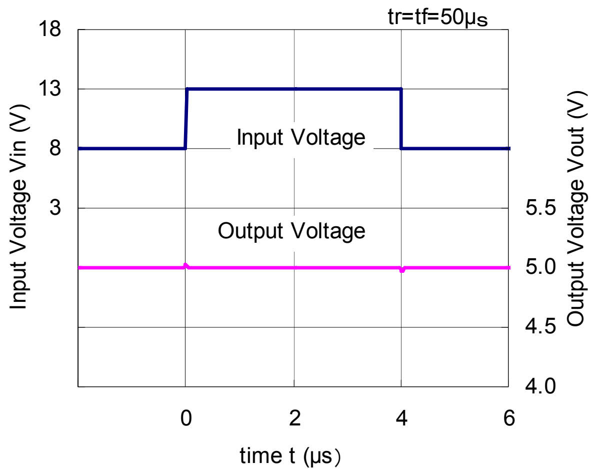
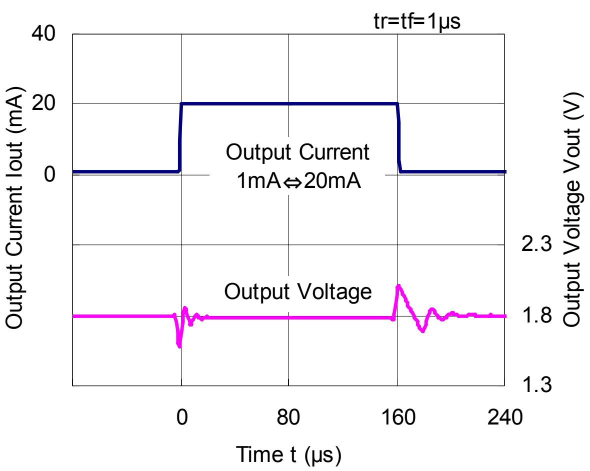
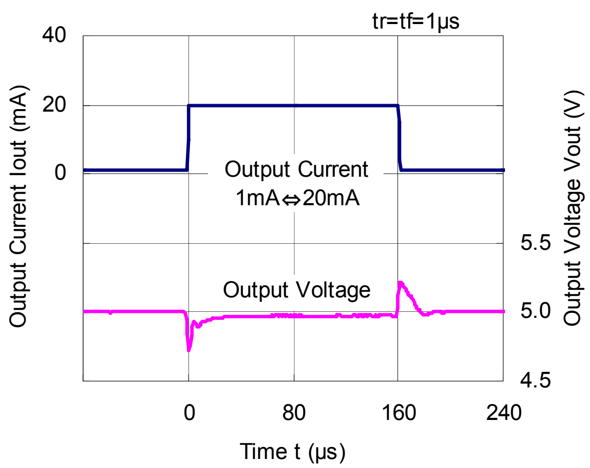


8) Load Transient Response (C_1=Ceramic 0.1μF, C_2=Ceramic 0.1μF, Topt=25°C)

R1516x018x



R1516x050x



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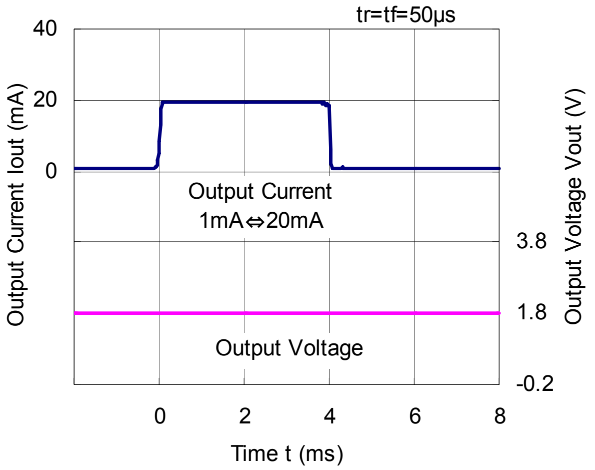

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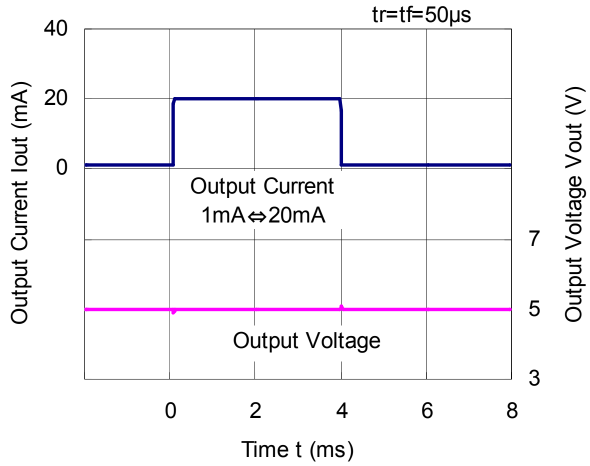

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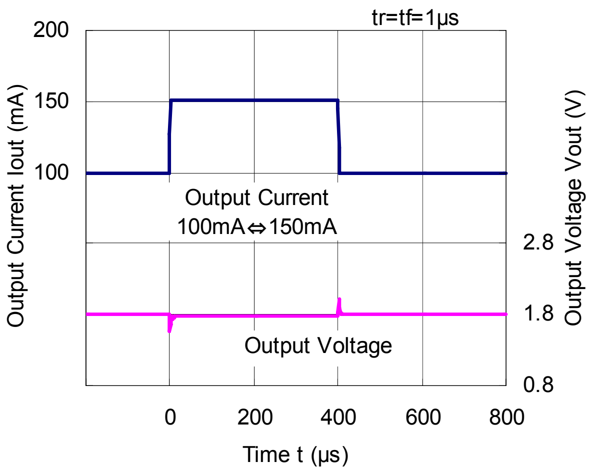

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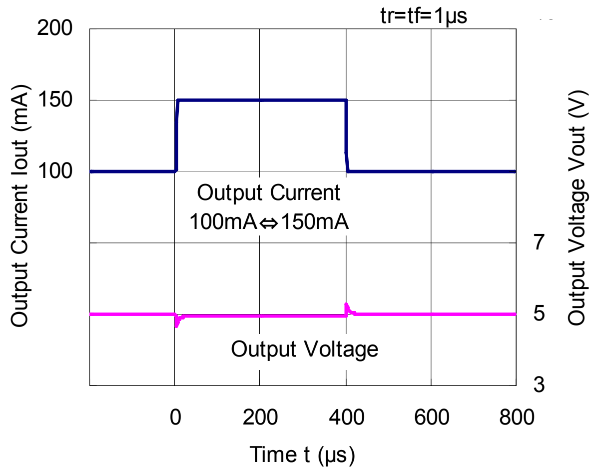
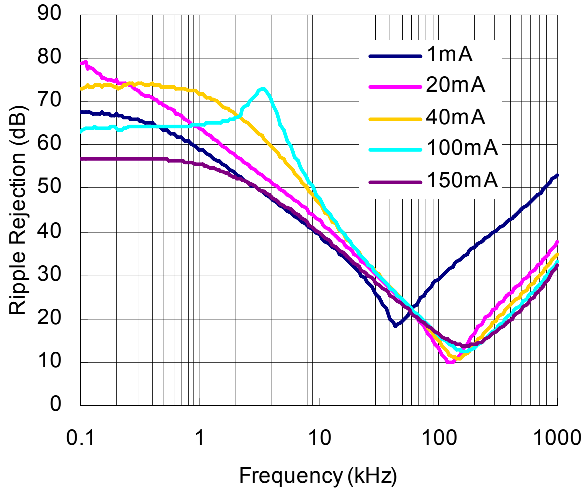


9) Ripple Rejection vs. Frequency (C1=none, C2=Ceramic 0.1μF, Ripple=0.5Vp-p, Topt=25°C)

R1516x018x



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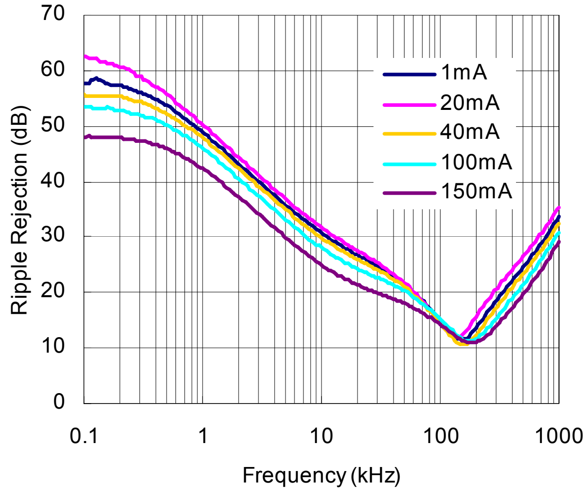
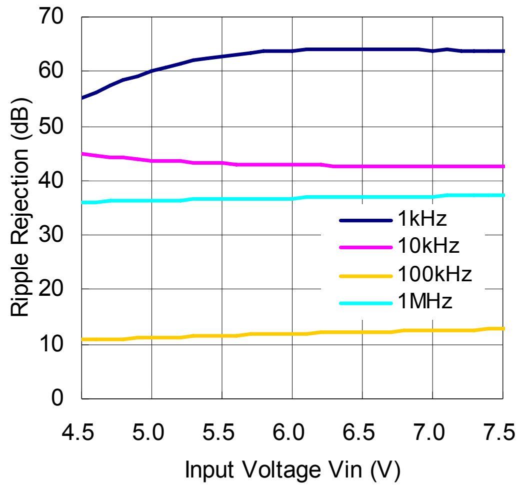
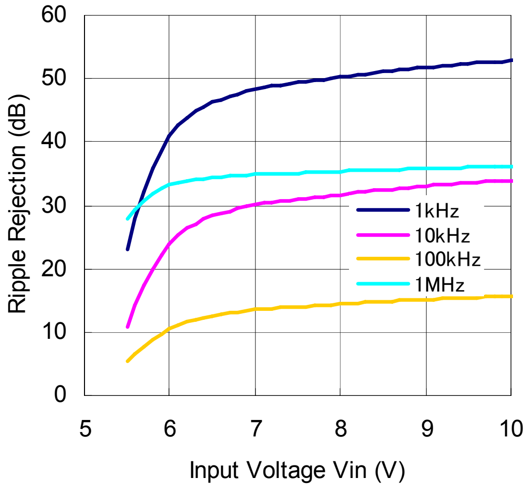


10) Ripple Rejection vs. Input Voltage (C1=none, C2=Ceramic 0.1μF, I_{OUT}=20mA, Ripple=0.5Vp-p, Topt=25°C)

R1516x018x



R1516x050x



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■Ricoh presented with the Japan Management Quality Award for 1999.
Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.

■Ricoh awarded ISO 14001 certification.
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

RoHS Compliant

Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.

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