RICOH

R1511x Series

AEC-Q100 Grade 1 Compliant

300 mA 36 V Input Regulator for Automotive Applications

NO. EC-300-160929

OUTLINE

The R1511x is a CMOS-based high-voltage resistant and fast response voltage regulator that provides the minimum 300mA of output current. Internally, R1511x consists of an Output Short-circuit Protection Circuit, an Over-current Protection Circuit, and a Thermal Shutdown Circuit in addition to the basic regulator circuits. The operating temperature range is between –40ºC to 125ºC, and the maximum input voltage is 36V. All these features allow the R1511x to become an ideal power source for car accessories and ECUs.

R1511x is available in R1511xxxxB with the fixed output voltage type, and R1511x001C with adjustable output voltage type with external resistors. The output voltage accuracy is ±1.0%.

R1511x is available in two types of packages for ultra high wattage: HSOP-6J and TO-252-5-P2.

FEATURES

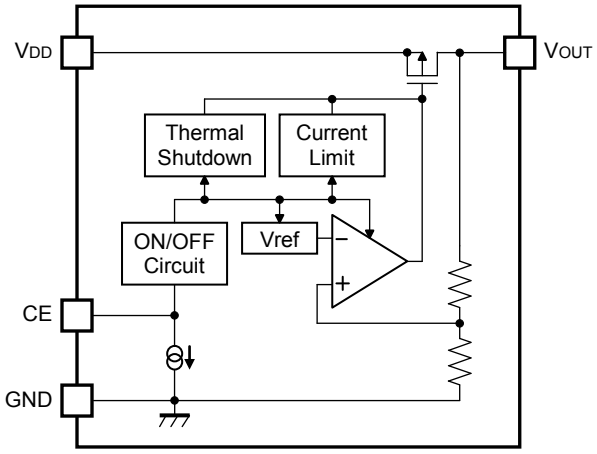
- Input Voltage Range (Maximum Rating) ····· 3.5V to 36V (50 V)
- Supply Current ····· Typ. 100µA
- Standby Current ····· Typ. 0.1µA (R1511xxxxB)
- Output Voltage Range ····· R1511xxxxB: 3.0 V to 9.0 V (0.1 V step)
  R1511x001C: 3.0V to 12.0V (Adjustable with external resistor)
- Output Voltage Accuracy ····· R1511xxxxB: ±1.0% (T_a=25°C)
- Feedback Voltage ····· R1511x001C: 3.0V ±1.0% (T_a=25°C)
- Output Voltage Temperature-Drift Coefficient ····· Typ. ±60ppm/°C
- Line Regulation ····· Typ. 0.01%/V (V_{DD}=V_{OUT}+0.5V to 36V)
- Dropout Voltage ····· Typ. 0.64V (I_{OUT}=300mA, V_{OUT}=5.0V)
- Package Option ····· HSOP-6J, TO-252-5-P2
- Built-in Output Short-circuit Protection Circuit ····· Typ. 50mA
- Built-in Over-current Protection Circuit ····· Typ. 450mA
- Built-in Thermal Shutdown Circuit ····· Thermal Shutdown Temperature: Typ. 160°C
- Operating Temperature Range ····· -40 to 125°C
- Ripple Rejection ····· Typ. 65dB (1kHz)
- Ceramic capacitors are recommended to be used with this IC
  ····· C_{IN}=1.0µF or more, C_{OUT}=6.8µF or more

APPLICATIONS

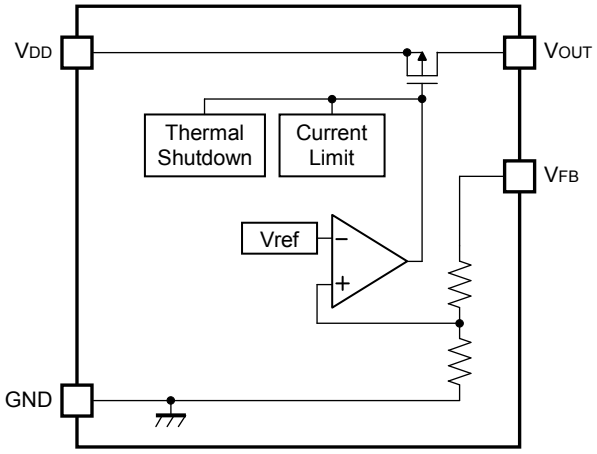
- Power source for accessories such as car audios, car navigation systems, and ETC systems
- Power source for ECUs such as EV inverter and battery charge control unit

BLOCK DIAGRAMS

R1511xxxxB



R1511x001C



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1511Sxxx∗-E2-#E	HSOP-6J	1,000 pcs	Yes	Yes
R1511Jxxx∗-T1-#E	TO-252-5-P2	3,000 pcs	Yes	Yes

xxx : Specify the set output voltage (V_{SET})
R1511xxxxB: 3.0 V (030) to 9.0 V (090) in 0.1 V step
R1511x001C: Only (001)

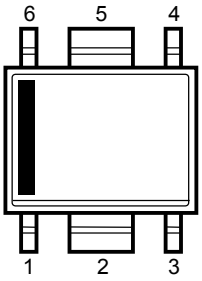
∗ : Specify the version
(B): Fixed output and Built-in Chip Enable (Active-high)
(C): Adjustable output

: Specify Automotive Class Code

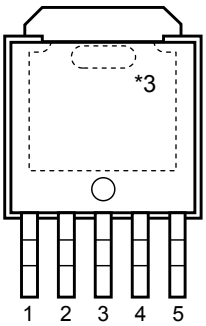
	Operating Temperature Range	Guaranteed Specs Temperature Range	Screening
A	-40°C to 125°C	25°C	High Temperature
K	-40°C to 125°C	-40°C to 125°C	High and Low Temperature

PIN DESCRIPTIONS

● **HSOP-6J**



● **TO-252-5-P2**



HSOP-6J

Pin No.	Symbol	Description	
1	V_{DD}	Input Pin	
2	GND*1	Ground Pin	
3	GND*1	Ground Pin	
4	CE	R1511SxxxB	Chip Enable Pin (Active-high)
	V_{FB}	R1511S001C	Feed Back Pin
5	GND*1	Ground Pin	
6	V_{OUT}	Output Pin	

*1 The GND pin must be wired together when it is mounted on board.

TO-252-5-P2

Pin No.	Symbol	Description	
1	V_{DD}	Input Pin	
2	GND*2	Ground Pin	
3	GND*2	Ground Pin	
4	CE	R1511JxxxB	Chip Enable Pin (Active-high)
	V_{FB}	R1511J001C	Feed Back Pin
5	V_{OUT}	Output Pin	

*2 The GND pin must be wired together when it is mounted on board.
*3 The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). It is recommended that the tab be connected to the ground plane on the board, or otherwise be left open.

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 50		V
V_{FB}	Input Voltage (V_{FB} Pin)	-0.3 to 50		V
V_{OUT}	Output Voltage	-0.3 to V_{IN}+0.3 ≤ 50		V
I_{OUT}	Output Current	450		mA
P_D	Power Dissipation (HSOP-6J)[*2]	Standard Land Pattern	2100	mW
		Ultra High Wattage Land Pattern	3400	
	Power Dissipation (TO-252-5-P2)[*2]	Standard Land Pattern	2350	
		Ultra High Wattage Land Pattern	4800	
Tj	Operating Junction Temperature Range	-40 to 150		°C
Tstg	Storage Temperature Range	-55 to 150		°C

[*1] Duration time: 200ms

[*2] Refer to *PACKAGE INFORMATION* for detailed information.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings are not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	3.5 to 36	V
Ta	Operating Temperature Range	-40 to 125	°C

RECOMMENDED OPERATING CONDITIONS

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

C_{IN}=1.0µF, C_{OUT}=6.8µF, unless otherwise noted.
The specifications surrounded by ☐ are guaranteed by design engineering at -40°C ≤ Ta ≤ 125 °C.

R1511xxxxB-AE (Ta=25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	V_{IN}=V_{SET}+1.0V, I_{OUT}=0mA			100	180	µA
Istandby	Standby Current	V_{IN}=36V, V_{CE}=0V			0.1	2.0	µA
V_{OUT}	Output Voltage	V_{IN}=V_{SET}+2.0V I_{OUT}=1mA	Ta=25°C	×0.99		×1.01	V
			−40°C≤Ta≤125°C	×0.98		×1.02	
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	V_{IN}=V_{SET}+2.0V 1mA≤I_{OUT}≤300mA	V_{SET}≤5.0V	-20		100	mV
			5.0V<V_{SET}	-20		120	
ΔV_{OUT} /ΔV_{IN}	Line Regulation	V_{SET}+0.5V≤V_{IN}≤36V, I_{OUT}=1mA			0.01	0.02	%/V
V_{DIF}	Dropout Voltage	I_{OUT}=300mA		Refer to the *Product-specific Electrical Characteristics*			
I_{LIM}	Output Current Limit	V_{IN}=V_{SET}+2.5V			450		mA
I_{SC}	Short Current Limit	V_{OUT}=0V			50		mA
V_{CEH}	CE Input Voltage “H”			2.2		36	V
V_{CEL}	CE Input Voltage “L”			0		1.0	V
I_{PD}	CE Pull-down Current	V_{CE}=5.0V			0.2	0.6	µA
		V_{CE}=36V			0.5	1.3	
T_{TSD}	Thermal Shutdown Temparature	Junction Temperature			160		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			135		°C

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

Product-specific Electrical Characteristics

The specifications surrounded by ☐ are guaranteed by design engineering at -40°C ≤ Ta ≤ 125 °C.

R1511xxxxB-AE (Ta=25°C)

Product Name	V_{OUT} [V]					V_{DIF} [V]	
	(Ta = 25°C)			(Ta = -40°C to 125°C)			
	MIN.	TYP.	MAX.	MIN.	MAX.	TYP.	MAX.
R1511x030x	2.970	3.000	3.030	2.940	3.060	0.98	1.50
R1511x031x	3.069	3.100	3.131	3.038	3.162		
R1511x032x	3.168	3.200	3.232	3.136	3.264	0.94	1.40
R1511x033x	3.267	3.300	3.333	3.234	3.366		
R1511x034x	3.366	3.400	3.434	3.332	3.468		
R1511x035x	3.465	3.500	3.535	3.430	3.570	0.88	1.30
R1511x036x	3.564	3.600	3.636	3.528	3.672		
R1511x037x	3.663	3.700	3.737	3.626	3.774		
R1511x038x	3.762	3.800	3.838	3.724	3.876		
R1511x039x	3.861	3.900	3.939	3.822	3.978	0.79	1.20
R1511x040x	3.960	4.000	4.040	3.920	4.080		
R1511x041x	4.059	4.100	4.141	4.018	4.182		
R1511x042x	4.158	4.200	4.242	4.116	4.284		
R1511x043x	4.257	4.300	4.343	4.214	4.386		
R1511x044x	4.356	4.400	4.444	4.312	4.488	0.71	1.10
R1511x045x	4.455	4.500	4.545	4.410	4.590		
R1511x046x	4.554	4.600	4.646	4.508	4.692		
R1511x047x	4.653	4.700	4.747	4.606	4.794		
R1511x048x	4.752	4.800	4.848	4.704	4.896		
R1511x049x	4.851	4.900	4.949	4.802	4.998		
R1511x050x	4.950	5.000	5.050	4.900	5.100	0.64	1.00
R1511x051x	5.049	5.100	5.151	4.998	5.202		
R1511x052x	5.148	5.200	5.252	5.096	5.304		
R1511x053x	5.247	5.300	5.353	5.194	5.406		
R1511x054x	5.346	5.400	5.454	5.292	5.508		
R1511x055x	5.445	5.500	5.555	5.390	5.610		
R1511x056x	5.544	5.600	5.656	5.488	5.712		
R1511x057x	5.643	5.700	5.757	5.586	5.814		
R1511x058x	5.742	5.800	5.858	5.684	5.916	0.59	0.90
R1511x059x	5.841	5.900	5.959	5.782	6.018		

R1511xxxxB-AE (Ta=25°C)

Product Name	V_{OUT} [V]					V_{DIF} [V]	
	(Ta = 25°C)			(Ta = -40°C to 125°C)			
	MIN.	TYP.	MAX.	MIN.	MAX.	TYP.	MAX.
R1511x060x	5.940	6.000	6.060	5.880	6.120		
R1511x061x	6.039	6.100	6.161	5.978	6.222		
R1511x062x	6.138	6.200	6.262	6.076	6.324		
R1511x063x	6.237	6.300	6.363	6.174	6.426		
R1511x064x	6.336	6.400	6.464	6.272	6.528	0.59	0.90
R1511x065x	6.435	6.500	6.565	6.370	6.630		
R1511x066x	6.534	6.600	6.666	6.468	6.732		
R1511x067x	6.633	6.700	6.767	6.566	6.834		
R1511x068x	6.732	6.800	6.868	6.664	6.936		
R1511x069x	6.831	6.900	6.969	6.762	7.038		
R1511x070x	6.930	7.000	7.070	6.860	7.140		
R1511x071x	7.029	7.100	7.171	6.958	7.242		
R1511x072x	7.128	7.200	7.272	7.056	7.344		
R1511x073x	7.227	7.300	7.373	7.154	7.446		
R1511x074x	7.326	7.400	7.474	7.252	7.548		
R1511x075x	7.425	7.500	7.575	7.350	7.650		
R1511x076x	7.524	7.600	7.676	7.448	7.752	0.54	0.80
R1511x077x	7.623	7.700	7.777	7.546	7.854		
R1511x078x	7.722	7.800	7.878	7.644	7.956		
R1511x079x	7.821	7.900	7.979	7.742	8.058		
R1511x080x	7.920	8.000	8.080	7.840	8.160		
R1511x081x	8.019	8.100	8.181	7.938	8.262		
R1511x082x	8.118	8.200	8.282	8.036	8.364		
R1511x083x	8.217	8.300	8.383	8.134	8.466		
R1511x084x	8.316	8.400	8.484	8.232	8.568		
R1511x085x	8.415	8.500	8.585	8.330	8.670		
R1511x086x	8.514	8.600	8.686	8.428	8.772		
R1511x087x	8.613	8.700	8.787	8.526	8.874	0.47	0.70
R1511x088x	8.712	8.800	8.888	8.624	8.976		
R1511x089x	8.811	8.900	8.989	8.722	9.078		
R1511x090x	8.910	9.000	9.090	8.820	9.180		

$V_{OUT}=V_{FB}$, C_{IN}=1.0µF, C_{OUT}=6.8µF, unless otherwise noted.
The specifications surrounded by ☐ are guaranteed by design engineering at -40°C ≤ Ta ≤ 125 °C.

R1511x001C-AE (Ta=25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	V_{IN}=4.0V, I_{OUT}=0mA			100	180	µA
V_{OUT}	Output Voltage	V_{IN}=5.0V I_{OUT}=1mA	Ta=25°C	2.97		3.03	V
			−40°C≤Ta≤125°C	2.94		3.06	
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	V_{IN}=5.0V 1mA≤I_{OUT}≤300mA		-20		40	mV
ΔV_{OUT} /ΔV_{IN}	Line Regulation	V_{SET}+0.5V≤V_{IN}≤36V I_{OUT}=1mA			0.01	0.02	%/V
V_{DIF}	Dropout Voltage	I_{OUT}=300mA			0.98	1.5	V
I_{LIM}	Output Current Limit	V_{IN}= V_{SET}+2.5V			450		mA
I_{SC}	Short Current Limit	V_{OUT}=0V			50		mA
R_{FB}	V_{FB} Pin Resistanse			1.0	3.0		MΩ
T_{TSD}	Thermal Shutdown Temparature	Junction Temperature			160		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			135		°C

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

C_{IN}=1.0µF, C_{OUT}=6.8µF, unless otherwise noted.

R1511xxxxB-KE (-40°C ≤ Ta ≤ 125°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	V_{IN}=V_{SET}+1.0V, I_{OUT}=0mA			100	180	µA
Istandby	Standby Current	V_{IN}=36V, V_{CE}=0V			0.1	2.0	µA
V_{OUT}	Output Voltage	V_{IN}=V_{SET}+2.0V I_{OUT}=1mA	Ta=25°C	×0.99		×1.01	V
			−40°C≤Ta≤125°C	×0.98		×1.02	
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	V_{IN}=V_{SET}+2.0V 1mA≤I_{OUT}≤300mA	V_{SET}≤5.0V	-20		100	mV
			5.0V<V_{SET}	-20		120	
ΔV_{OUT} /ΔV_{IN}	Line Regulation	V_{SET}+0.5V≤V_{IN}≤36V, I_{OUT}=1mA		-0.02	0.01	0.02	%/V
V_{DIF}	Dropout Voltage	I_{OUT}=300mA		Refer to the *Product-specific Electrical Characteristics*			
I_{LIM}	Output Current Limit	V_{IN}=V_{SET}+2.5V		300	450	610	mA
I_{SC}	Short Current Limit	V_{IN}=5V, V_{OUT}=0V		35	50	65	mA
V_{CEH}	CE Input Voltage “H”			2.2		36	V
V_{CEL}	CE Input Voltage “L”			0		1.0	V
I_{PD}	CE Pull-down Current	V_{CE}=5.0V			0.2	0.6	µA
		V_{CE}=36V			0.5	1.3	
T_{TSD}	Thermal Shutdown Temparature	Junction Temperature		150	160		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		125	135		°C

Product-specific Electrical Characteristics

R1511xxxxB-KE (-40°C ≤ Ta ≤ 125°C)

Product Name	V_{OUT} [V]					V_{DIF} [V]	
	(Ta = 25°C)			(Ta = -40°C to 125°C)			
	MIN.	TYP.	MAX.	MIN.	MAX.	TYP.	MAX.
R1511x030x	2.970	3.000	3.030	2.940	3.060	0.98	1.50
R1511x031x	3.069	3.100	3.131	3.038	3.162		
R1511x032x	3.168	3.200	3.232	3.136	3.264	0.94	1.40
R1511x033x	3.267	3.300	3.333	3.234	3.366		
R1511x034x	3.366	3.400	3.434	3.332	3.468		
R1511x035x	3.465	3.500	3.535	3.430	3.570	0.88	1.30
R1511x036x	3.564	3.600	3.636	3.528	3.672		
R1511x037x	3.663	3.700	3.737	3.626	3.774		
R1511x038x	3.762	3.800	3.838	3.724	3.876		
R1511x039x	3.861	3.900	3.939	3.822	3.978	0.79	1.20
R1511x040x	3.960	4.000	4.040	3.920	4.080		
R1511x041x	4.059	4.100	4.141	4.018	4.182		
R1511x042x	4.158	4.200	4.242	4.116	4.284		
R1511x043x	4.257	4.300	4.343	4.214	4.386		
R1511x044x	4.356	4.400	4.444	4.312	4.488	0.71	1.10
R1511x045x	4.455	4.500	4.545	4.410	4.590		
R1511x046x	4.554	4.600	4.646	4.508	4.692		
R1511x047x	4.653	4.700	4.747	4.606	4.794		
R1511x048x	4.752	4.800	4.848	4.704	4.896		
R1511x049x	4.851	4.900	4.949	4.802	4.998		
R1511x050x	4.950	5.000	5.050	4.900	5.100	0.64	1.00
R1511x051x	5.049	5.100	5.151	4.998	5.202		
R1511x052x	5.148	5.200	5.252	5.096	5.304		
R1511x053x	5.247	5.300	5.353	5.194	5.406		
R1511x054x	5.346	5.400	5.454	5.292	5.508		
R1511x055x	5.445	5.500	5.555	5.390	5.610		
R1511x056x	5.544	5.600	5.656	5.488	5.712		
R1511x057x	5.643	5.700	5.757	5.586	5.814		
R1511x058x	5.742	5.800	5.858	5.684	5.916	0.59	0.90
R1511x059x	5.841	5.900	5.959	5.782	6.018		
R1511x060x	5.940	6.000	6.060	5.880	6.120		
R1511x061x	6.039	6.100	6.161	5.978	6.222		
R1511x062x	6.138	6.200	6.262	6.076	6.324		
R1511x063x	6.237	6.300	6.363	6.174	6.426		
R1511x064x	6.336	6.400	6.464	6.272	6.528		
R1511x065x	6.435	6.500	6.565	6.370	6.630		
R1511x066x	6.534	6.600	6.666	6.468	6.732		
R1511x067x	6.633	6.700	6.767	6.566	6.834		
R1511x068x	6.732	6.800	6.868	6.664	6.936		
R1511x069x	6.831	6.900	6.969	6.762	7.038	0.54	0.80

R1511xxxxB-KE (-40°C ≤ Ta ≤ 125°C)

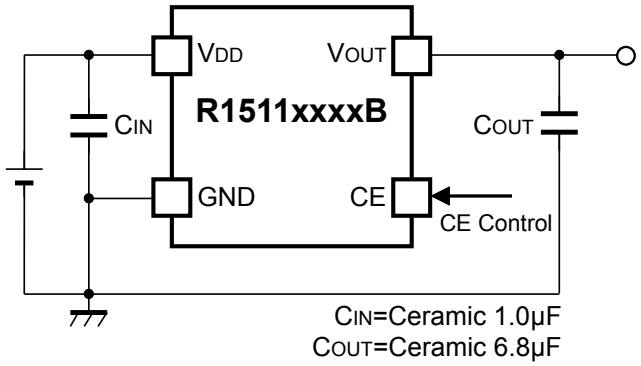
Product Name	V_{OUT} [V]					V_{DIF} [V]	
	(Ta = 25°C)			(Ta = -40°C to 125°C)			
	MIN.	TYP.	MAX.	MIN.	MAX.	TYP.	MAX.
R1511x070x	6.930	7.000	7.070	6.860	7.140	0.54	0.80
R1511x071x	7.029	7.100	7.171	6.958	7.242		
R1511x072x	7.128	7.200	7.272	7.056	7.344		
R1511x073x	7.227	7.300	7.373	7.154	7.446		
R1511x074x	7.326	7.400	7.474	7.252	7.548		
R1511x075x	7.425	7.500	7.575	7.350	7.650		
R1511x076x	7.524	7.600	7.676	7.448	7.752		
R1511x077x	7.623	7.700	7.777	7.546	7.854		
R1511x078x	7.722	7.800	7.878	7.644	7.956		
R1511x079x	7.821	7.900	7.979	7.742	8.058		
R1511x080x	7.920	8.000	8.080	7.840	8.160		
R1511x081x	8.019	8.100	8.181	7.938	8.262		
R1511x082x	8.118	8.200	8.282	8.036	8.364		
R1511x083x	8.217	8.300	8.383	8.134	8.466		
R1511x084x	8.316	8.400	8.484	8.232	8.568	0.47	0.70
R1511x085x	8.415	8.500	8.585	8.330	8.670		
R1511x086x	8.514	8.600	8.686	8.428	8.772		
R1511x087x	8.613	8.700	8.787	8.526	8.874		
R1511x088x	8.712	8.800	8.888	8.624	8.976		
R1511x089x	8.811	8.900	8.989	8.722	9.078		
R1511x090x	8.910	9.000	9.090	8.820	9.180		

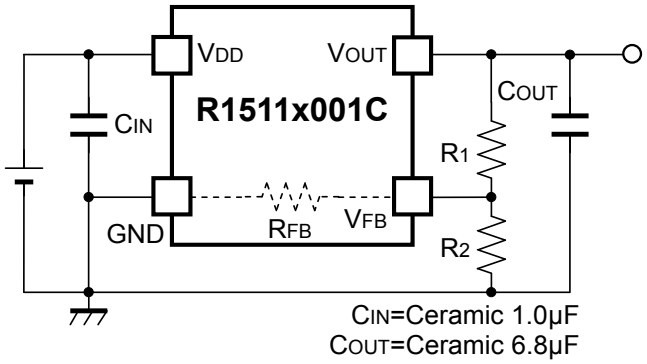
V_{OUT}=V_{FB}, C_{IN}=1.0µF, C_{OUT}=6.8µF, unless otherwise noted.

R1511x001C-KE (-40°C ≤ Ta ≤ 125°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	V_{IN}=4.0V, I_{OUT}=0mA			100	180	µA
V_{OUT}	Output Voltage	V_{IN}=5.0V I_{OUT}=1mA	Ta=25°C	2.97		3.03	V
			−40°C≤Ta≤125°C	2.94		3.06	
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	V_{IN}=5.0V 1mA≤I_{OUT}≤300mA		-20		40	mV
ΔV_{OUT} /ΔV_{IN}	Line Regulation	V_{SET}+0.5V≤V_{IN}≤36V I_{OUT}=1mA		-0.02	0.01	0.02	%/V
V_{DIF}	Dropout Voltage	I_{OUT}=300mA			0.98	1.5	V
I_{LIM}	Output Current Limit	V_{IN}= V_{SET}+2.5V		300	450	610	mA
I_{SC}	Short Current Limit	V_{IN}=5V, V_{OUT}=0V		35	50	65	mA
R_{FB}	V_{FB} Pin Resistanse			1.0	3.0		MΩ
T_{TSD}	Thermal Shutdown Temparature	Junction Temperature		150	160		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		125	135		°C

TYPICAL APPLICATIONS





TECHNICAL NOTES

PCB Layout and GND Wiring

Ensure the V_{DD} and GND lines are sufficiently robust. If their impedance is too high, noise pickup or unstable operation may result. Connect a C_{IN} capacitor with 1.0µF or more value between the V_{DD} and GND pins, and as close as possible to the pins. Likewise, connect a C_{OUT} capacitor with suitable values between the V_{OUT} and GND pins, and as close as possible to the pins (refer to the Typical Application above).

In the case of using HSOP-6J package, make sure to wire No. 2, No. 3, and No. 5 pins to the GND plane. Also, in the case of using TO-252-5-P2 package, make sure to wire No. 2 and No. 3 pins to the GND plane.

Phase Compensation

In the R1511x, phase compensation is provided to secure stable operation even when the load current is varied. For this purpose, make sure to use a C_{OUT} capacitor.

In case of using a tantalum type capacitor and the ESR (Equivalent Series Resistance) value of the capacitor is large, the output might be unstable. Evaluate the circuit including consideration of frequency characteristics.

Depending on the capacitor size, manufacturer, and part number, the bias characteristics and temperature characteristics are different. Evaluate the circuit taking actual characteristics into account.

Thermal Shutdown

R1511x contains a thermal shutdown circuit, which stops regulator operation if the junction temperature of R1511x becomes higher than 160ºC (Typ.). Additionally, if the junction temperature after the regulator being stopped decreases to a level below 135ºC (Typ.), it restarts regulator operation. As a result the operation of the thermal shutdown circuit causes the regulator repeatedly to turn off and on until the causes of overheating are removed. As a consequence a pulse shaped output voltage occurs.

Adjustable Output Voltage Setting (R1511x001C)

The output voltage of R1511x001C can be adjusted by using the external divider resistors (R1, R2). By using the following equation, the output voltage (V_{OUT}) can be determined. The voltage which is fixed inside the IC is described as V_{FB}.

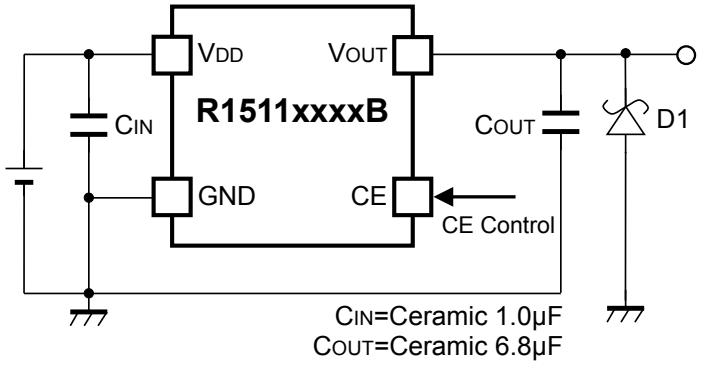
$$V_{OUT} = V_{FB} \times ((R1 + R2) / R2)$$

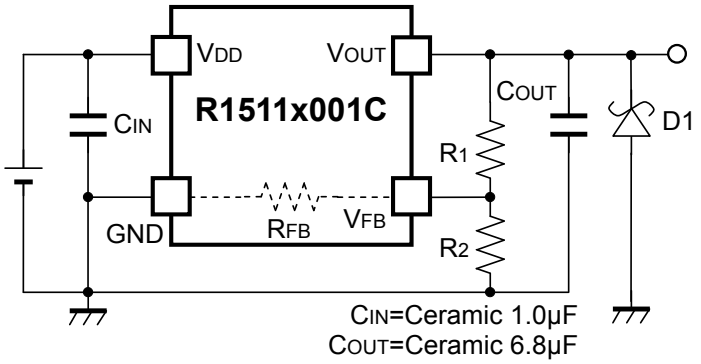
Recommended Range: 3.0 V ≤ V_{OUT} ≤ 12.0 V
V_{FB} = 3.0 V

R_{FB} of the R1511x001C is approximately Min. 1.0 MΩ (guaranteed by design). For better accuracy, setting R1 << R_{FB} reduces errors. The resistance value for R2 should be set to 39 kΩ or lower. It is easily affected by noises when setting the value of R1 and R2 larger, which makes the impedance of V_{FB} pin larger.

R_{IC} could be affected by the temperature, therefore evaluate the circuit taking the actual conditions of use into account when deciding the resistance values for R1 and R2.

TYPICAL APPLICATION FOR IC CHIP BREAKDOWN PREVENTION

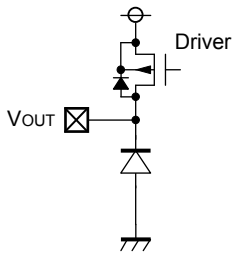




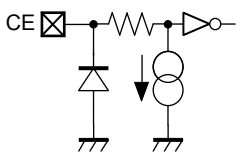
When a sudden surge of electrical current travels along the V_{OUT} pin and GND due to a short-circuit, electrical resonance of a circuit involving an output capacitor (C_{OUT}) and a short circuit inductor generates a negative voltage and may damage the device or the load devices. Connecting a schottky diode (D1) between the V_{OUT} pin and GND has the effect of preventing damage to them.

PIN EQUIVALENT CIRCUIT DIAGRAMS

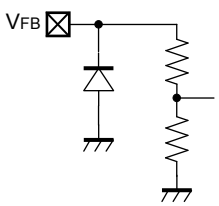
<V_{OUT} Pin>



<CE Pin (R1511xxxxB)>



<V_{FB} Pin (R1511x001C)>



PACKAGE INFORMATION

POWER DISSIPATION (HSOP-6J)

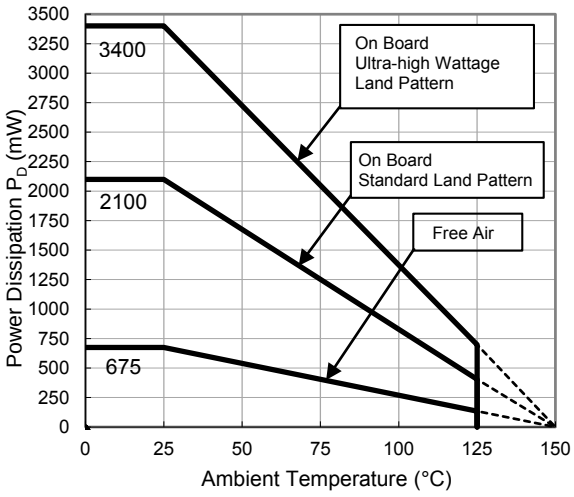
The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

Measurement Conditions

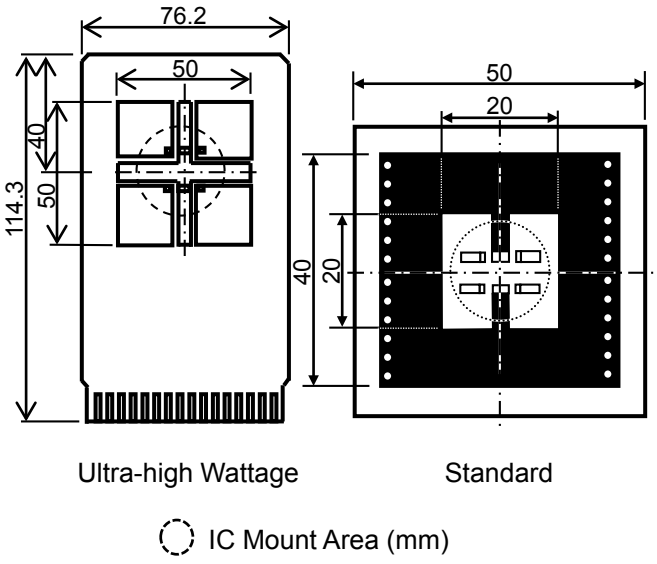
	Ultra-high Wattage Land Pattern	Standard Land Pattern
Environment	Mounting on Board (Wind Velocity = 0 m/s)	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-layer Board)	Glass Cloth Epoxy Plastic (Double-sided Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm	50 mm × 50 mm × 1.6 mm
Copper Ratio	96%	50%
Through-holes	ϕ 0.3 mm × 28 pcs	ϕ 0.5 mm × 24 pcs

Measurement Result (Ta = 25°C, Tjmax = 150°C)

	Ultra-high Wattage Land Pattern	Standard Land Pattern	Free Air
Power Dissipation	3400 mW	2100 mW	675 mW
Thermal Resistance	37°C/W	59°C/W	185°C/W

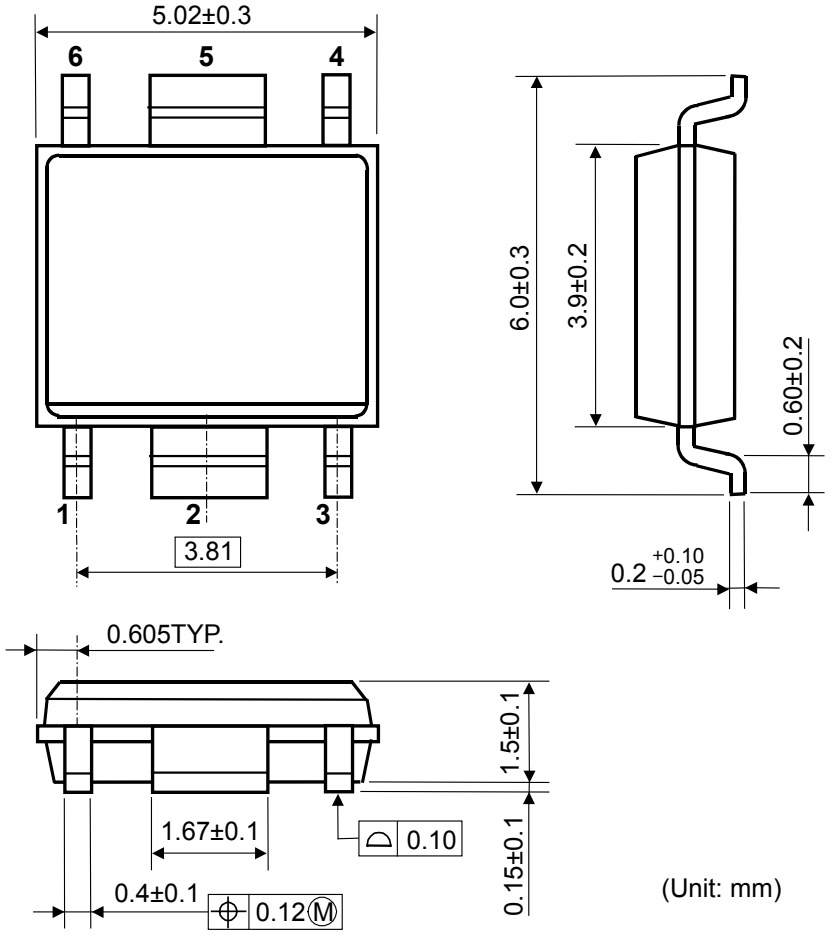


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (HSOP-6J)

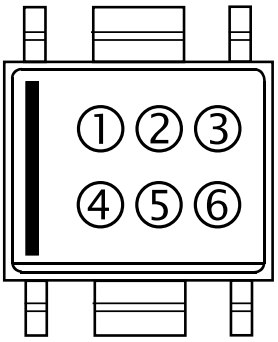


Package Dimensions (HSOP-6J)

MARK SPECIFICATION (HSOP-6J)

①②③④: Product Code … **Refer to *MARK SPECIFICATION TABLE***

⑤⑥: Lot Number … Alphanumeric Serial Number



Mark Specification (HSOP-6J)

MARK SPECIFICATION TABLE (HSOP-6J)

R1511SxxxB

Product Name	① ② ③ ④	V_{SET}
R1511S030B	S 3 0 B	3.0 V
R1511S031B	S 3 1 B	3.1 V
R1511S032B	S 3 2 B	3.2 V
R1511S033B	S 3 3 B	3.3 V
R1511S034B	S 3 4 B	3.4 V
R1511S035B	S 3 5 B	3.5 V
R1511S036B	S 3 6 B	3.6 V
R1511S037B	S 3 7 B	3.7 V
R1511S038B	S 3 8 B	3.8 V
R1511S039B	S 3 9 B	3.9 V
R1511S040B	S 4 0 B	4.0 V
R1511S041B	S 4 1 B	4.1 V
R1511S042B	S 4 2 B	4.2 V
R1511S043B	S 4 3 B	4.3 V
R1511S044B	S 4 4 B	4.4 V
R1511S045B	S 4 5 B	4.5 V
R1511S046B	S 4 6 B	4.6 V
R1511S047B	S 4 7 B	4.7 V
R1511S048B	S 4 8 B	4.8 V
R1511S049B	S 4 9 B	4.9 V
R1511S050B	S 5 0 B	5.0 V
R1511S051B	S 5 1 B	5.1 V
R1511S052B	S 5 2 B	5.2 V
R1511S053B	S 5 3 B	5.3 V
R1511S054B	S 5 4 B	5.4 V
R1511S055B	S 5 5 B	5.5 V
R1511S056B	S 5 6 B	5.6 V
R1511S057B	S 5 7 B	5.7 V
R1511S058B	S 5 8 B	5.8 V
R1511S059B	S 5 9 B	5.9 V
R1511S060B	S 6 0 B	6.0 V
R1511S061B	S 6 1 B	6.1 V
R1511S062B	S 6 2 B	6.2 V
R1511S063B	S 6 3 B	6.3 V
R1511S064B	S 6 4 B	6.4 V
R1511S065B	S 6 5 B	6.5 V
R1511S066B	S 6 6 B	6.6 V
R1511S067B	S 6 7 B	6.7 V
R1511S068B	S 6 8 B	6.8 V
R1511S069B	S 6 9 B	6.9 V

Product Name	① ② ③ ④	V_{SET}
R1511S070B	S 7 0 B	7.0 V
R1511S071B	S 7 1 B	7.1 V
R1511S072B	S 7 2 B	7.2 V
R1511S073B	S 7 3 B	7.3 V
R1511S074B	S 7 4 B	7.4 V
R1511S075B	S 7 5 B	7.5 V
R1511S076B	S 7 6 B	7.6 V
R1511S077B	S 7 7 B	7.7 V
R1511S078B	S 7 8 B	7.8 V
R1511S079B	S 7 9 B	7.9 V
R1511S080B	S 8 0 B	8.0 V
R1511S081B	S 8 1 B	8.1 V
R1511S082B	S 8 2 B	8.2 V
R1511S083B	S 8 3 B	8.3 V
R1511S084B	S 8 4 B	8.4 V
R1511S085B	S 8 5 B	8.5 V
R1511S086B	S 8 6 B	8.6 V
R1511S087B	S 8 7 B	8.7 V
R1511S088B	S 8 8 B	8.8 V
R1511S089B	S 8 9 B	8.9 V
R1511S090B	S 9 0 B	9.0 V

R1511S001C
(Adjustable Output Voltage Setting Type)

Product Name	① ② ③ ④	V_{SET}
R1511S001C	S 0 0 C	—

POWER DISSIPATION (TO-252-5-P2)

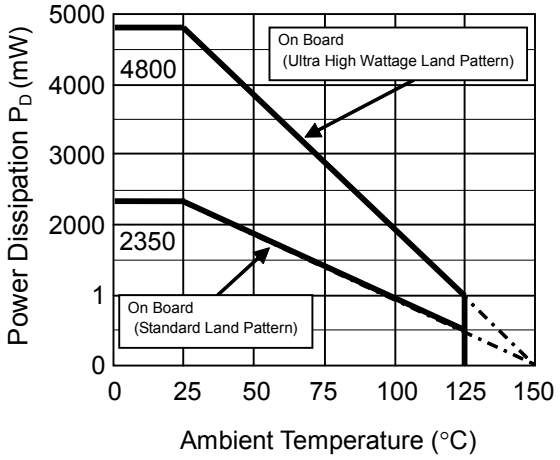
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

	Ultra High Wattage Land Pattern	Standard Land Pattern
Environment	Mounting on board (Wind velocity 0 m/s)	
Board Material	Glass cloth epoxy plastic (Four-layers)	Glass cloth epoxy plastic (Double layers)
Board Dimensions	76.2 mm x 114.3 mm x 0.8 mm	50 mm x 50 mm x 1.6 mm
Copper Ratio	Top, Back side: Approx. 96%, 2nd, 3rd: 100%	Top side: Approx. 50%, Back side: Approx. 50%
Through - hole	ϕ 0.4 mm x 30 pcs	ϕ 0.5 mm x 24 pcs

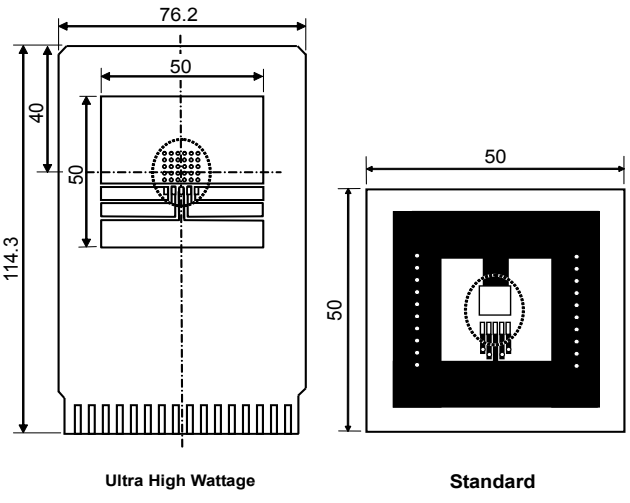
Measurement Result (Ta = 25°C, Tjmax = 150°C)

	Ultra High Wattage Land Pattern	Standard Land Pattern
Power Dissipation	4800 mW	2350 mW
Thermal Resistance	θja = (150-25°C)/4.8 W = 26°C/W	θja = (150-25°C)/2.35 W= 53°C/W
	θjc = 7°C/W	θjc = 17°C/W



Power Dissipation

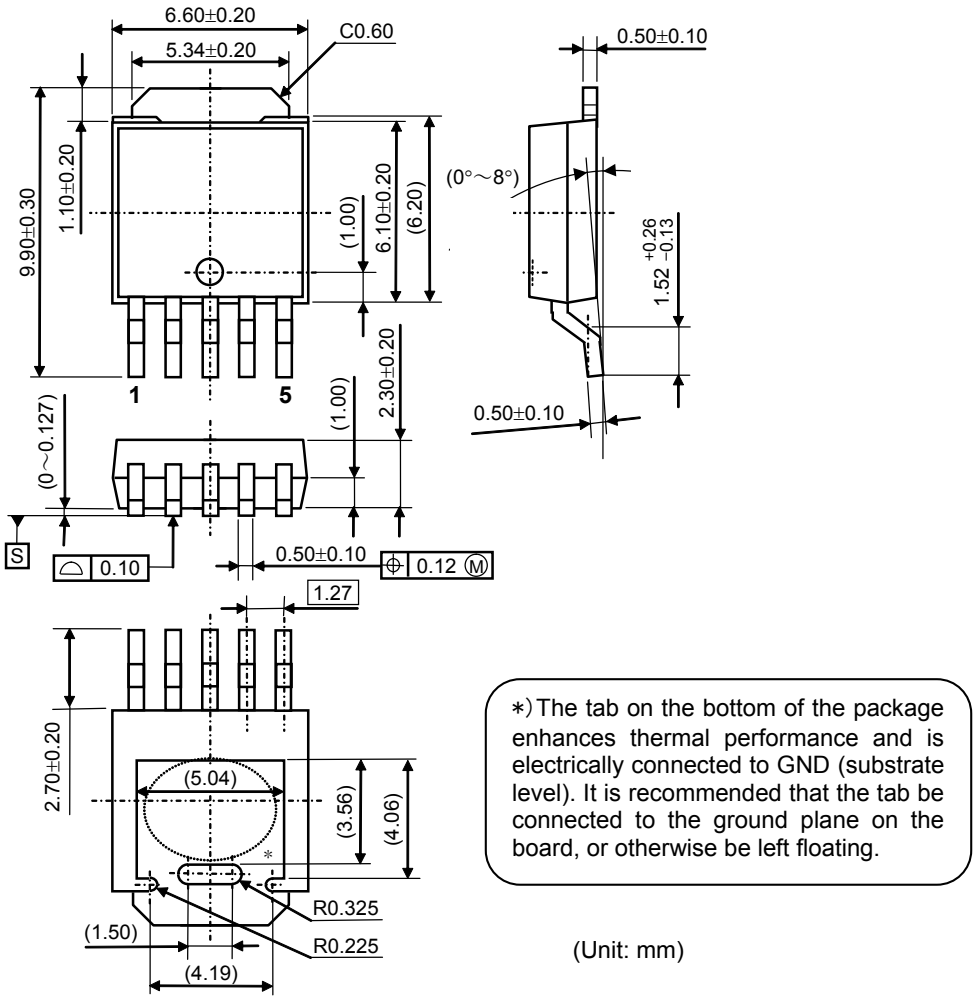
Power Dissipation vs. Ambience Temperature (TO-252-5-P2)



IC Mount Area (Unit: mm)

Measurement Board Pattern (TO-252-5-P2)

PACKAGE DIMENSIONS (TO-252-5-P2)

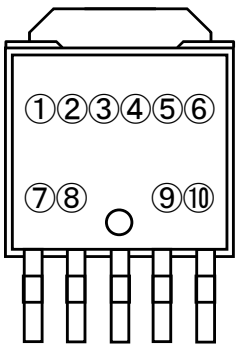


Package Dimensions (TO-252-5-P2)

MARK SPECIFICATION (TO-252-5-P2)

①②③④⑤⑥⑦⑧: Product Code … **Refer to *MARK SPECIFICATION TABLE***

⑨⑩: Lot Number … Alphanumeric Serial Number



Mark Specification (TO-252-5-P2)

MARK SPECIFICATION TABLE (TO-252-5-P2)

R1511JxxxB

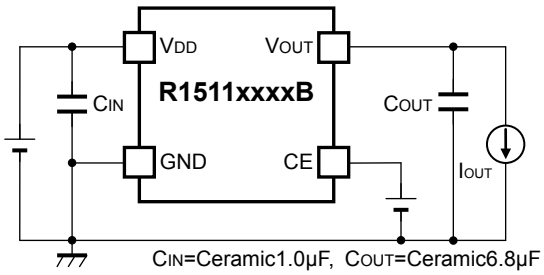
Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1511J030B	H 1 J 0 3 0 B	3.0 V
R1511J031B	H 1 J 0 3 1 B	3.1 V
R1511J032B	H 1 J 0 3 2 B	3.2 V
R1511J033B	H 1 J 0 3 3 B	3.3 V
R1511J034B	H 1 J 0 3 4 B	3.4 V
R1511J035B	H 1 J 0 3 5 B	3.5 V
R1511J036B	H 1 J 0 3 6 B	3.6 V
R1511J037B	H 1 J 0 3 7 B	3.7 V
R1511J038B	H 1 J 0 3 8 B	3.8 V
R1511J039B	H 1 J 0 3 9 B	3.9 V
R1511J040B	H 1 J 0 4 0 B	4.0 V
R1511J041B	H 1 J 0 4 1 B	4.1 V
R1511J042B	H 1 J 0 4 2 B	4.2 V
R1511J043B	H 1 J 0 4 3 B	4.3 V
R1511J044B	H 1 J 0 4 4 B	4.4 V
R1511J045B	H 1 J 0 4 5 B	4.5 V
R1511J046B	H 1 J 0 4 6 B	4.6 V
R1511J047B	H 1 J 0 4 7 B	4.7 V
R1511J048B	H 1 J 0 4 8 B	4.8 V
R1511J049B	H 1 J 0 4 9 B	4.9 V
R1511J050B	H 1 J 0 5 0 B	5.0 V
R1511J051B	H 1 J 0 5 1 B	5.1 V
R1511J052B	H 1 J 0 5 2 B	5.2 V
R1511J053B	H 1 J 0 5 3 B	5.3 V
R1511J054B	H 1 J 0 5 4 B	5.4 V
R1511J055B	H 1 J 0 5 5 B	5.5 V
R1511J056B	H 1 J 0 5 6 B	5.6 V
R1511J057B	H 1 J 0 5 7 B	5.7 V
R1511J058B	H 1 J 0 5 8 B	5.8 V
R1511J059B	H 1 J 0 5 9 B	5.9 V
R1511J060B	H 1 J 0 6 0 B	6.0 V
R1511J061B	H 1 J 0 6 1 B	6.1 V
R1511J062B	H 1 J 0 6 2 B	6.2 V
R1511J063B	H 1 J 0 6 3 B	6.3 V
R1511J064B	H 1 J 0 6 4 B	6.4 V
R1511J065B	H 1 J 0 6 5 B	6.5 V
R1511J066B	H 1 J 0 6 6 B	6.6 V
R1511J067B	H 1 J 0 6 7 B	6.7 V
R1511J068B	H 1 J 0 6 8 B	6.8 V
R1511J069B	H 1 J 0 6 9 B	6.9 V

Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1511J070B	H 1 J 0 7 0 B	7.0 V
R1511J071B	H 1 J 0 7 1 B	7.1 V
R1511J072B	H 1 J 0 7 2 B	7.2 V
R1511J073B	H 1 J 0 7 3 B	7.3 V
R1511J074B	H 1 J 0 7 4 B	7.4 V
R1511J075B	H 1 J 0 7 5 B	7.5 V
R1511J076B	H 1 J 0 7 6 B	7.6 V
R1511J077B	H 1 J 0 7 7 B	7.7 V
R1511J078B	H 1 J 0 7 8 B	7.8 V
R1511J079B	H 1 J 0 7 9 B	7.9 V
R1511J080B	H 1 J 0 8 0 B	8.0 V
R1511J081B	H 1 J 0 8 1 B	8.1 V
R1511J082B	H 1 J 0 8 2 B	8.2 V
R1511J083B	H 1 J 0 8 3 B	8.3 V
R1511J084B	H 1 J 0 8 4 B	8.4 V
R1511J085B	H 1 J 0 8 5 B	8.5 V
R1511J086B	H 1 J 0 8 6 B	8.6 V
R1511J087B	H 1 J 0 8 7 B	8.7 V
R1511J088B	H 1 J 0 8 8 B	8.8 V
R1511J089B	H 1 J 0 8 9 B	8.9 V
R1511J090B	H 1 J 0 9 0 B	9.0 V

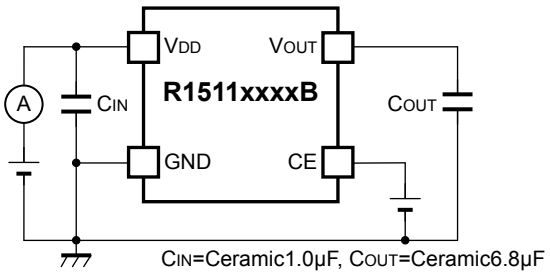
R1511J001C
(Adjustable Output Voltage Setting Type)

Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1511J001C	H 1 J 0 0 1 C	—

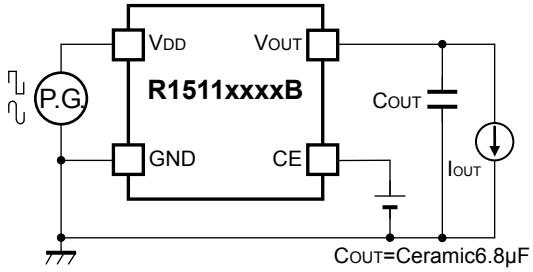
TEST CIRCUITS



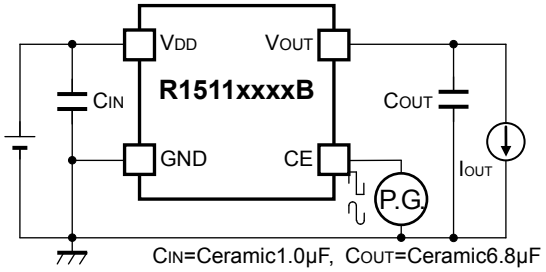
R1511xxxxB Basic Test Circuit



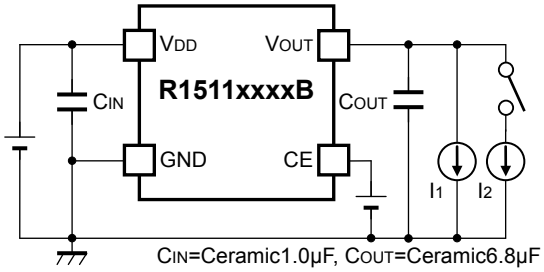
R1511xxxxB Test Circuit for Supply Current



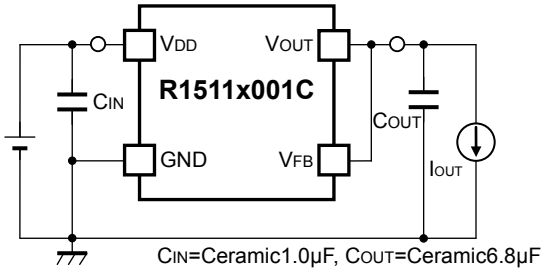
R1511xxxxB Test Circuit for Ripple Rejection and Regulator Input Transient Response



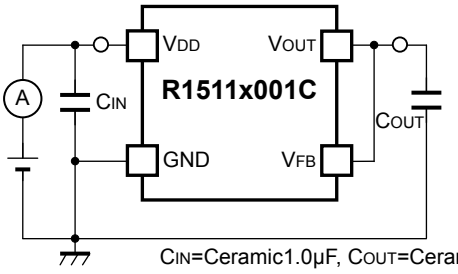
R1511xxxxB Test Circuit for CE Start-up



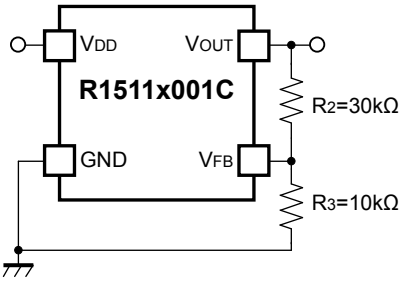
R1511xxxxB Test Circuit for Load Transient Response



R1511x001C Basic Test Circuit



R1511x001C Test Circuit for Supply Current



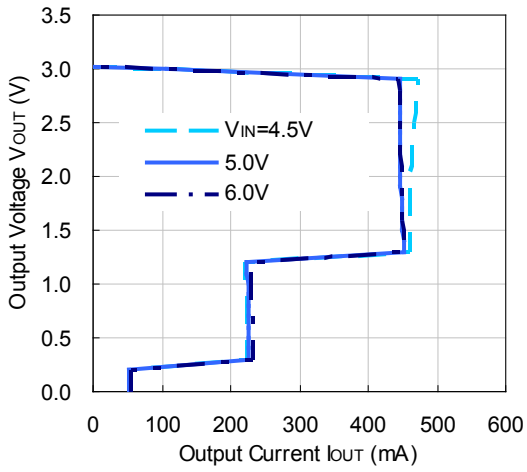
R1511x001C Case of output voltage adjustment by external resistors

TYPICAL CHARACTERISTICS

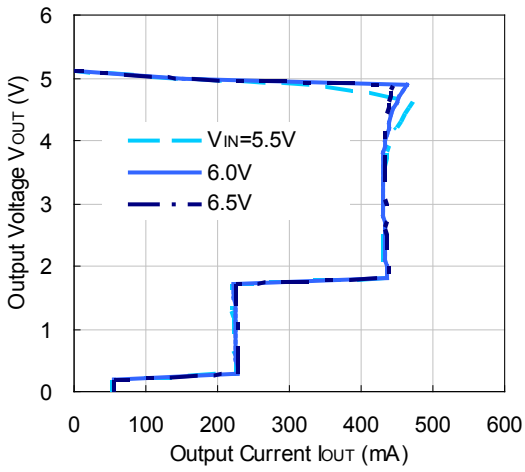
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Output Voltage vs. Output Current (Ta = 25ºC)

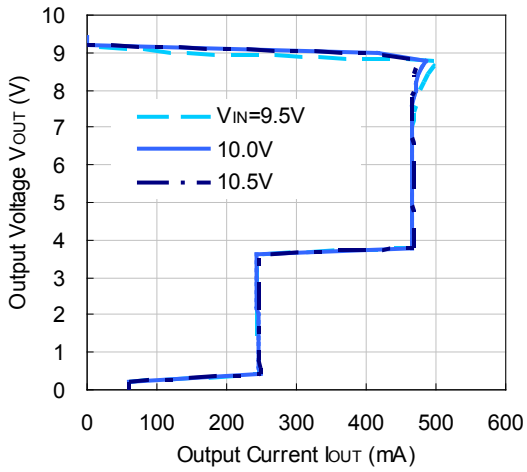
R1511x030B



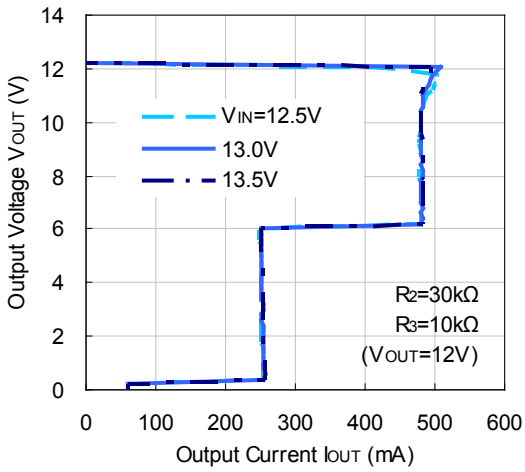
R1511x050B



R1511x090B



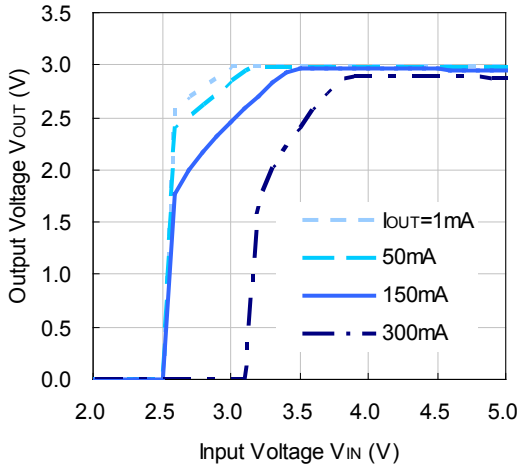
R1511x001C

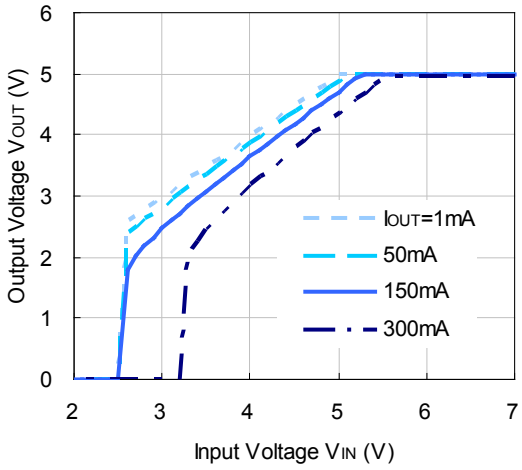


2) Output Voltage vs. Input Voltage (Ta = 25ºC)

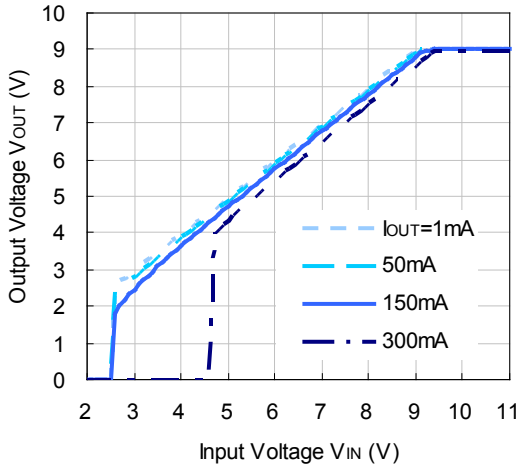
R1511x030B

R1511x050B

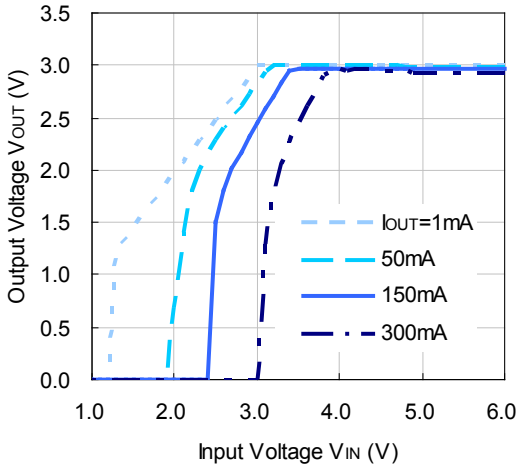

3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Output Voltage VOUT (V)
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Input Voltage VIN (V)
IOUT=1mA
50mA
150mA
300mA


6
5
4
3
2
1
0
Output Voltage VOUT (V)
2
3
4
5
6
7
Input Voltage VIN (V)
IOUT=1mA
50mA
150mA
300mA

R1511x090B

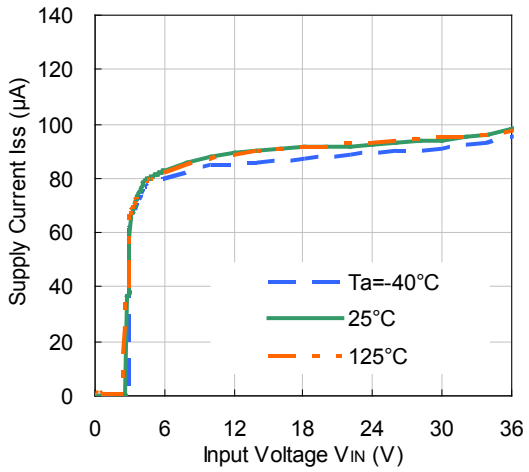


R1511x001C

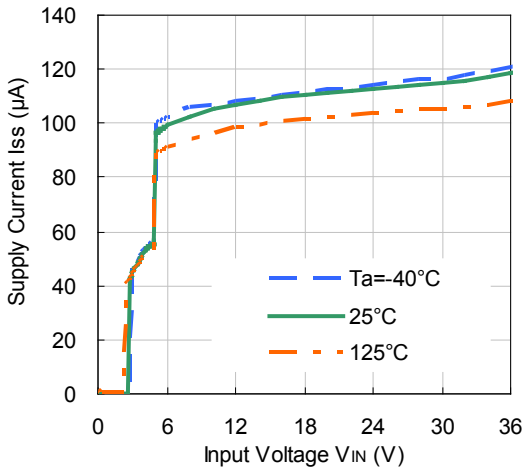


3) Supply Current vs. Input Voltage

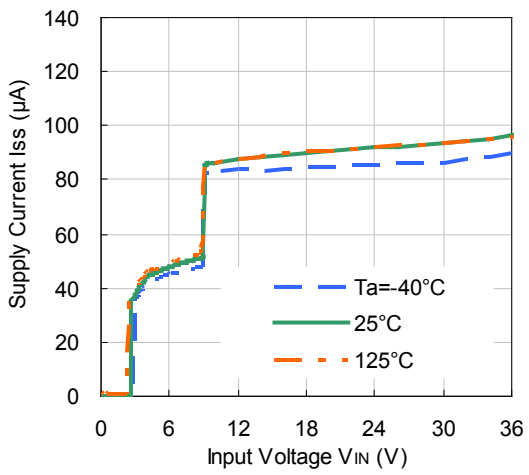
R1511x030B



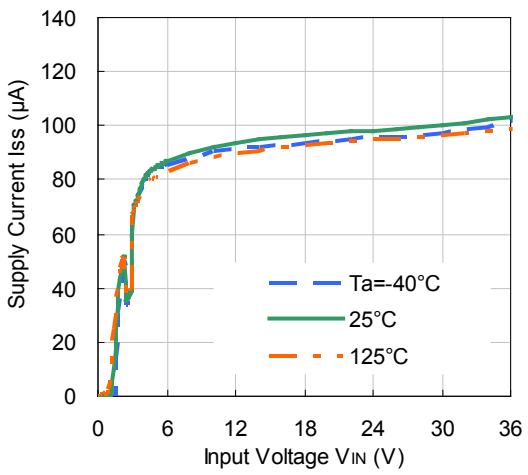
R1511x050B



R1511x090B

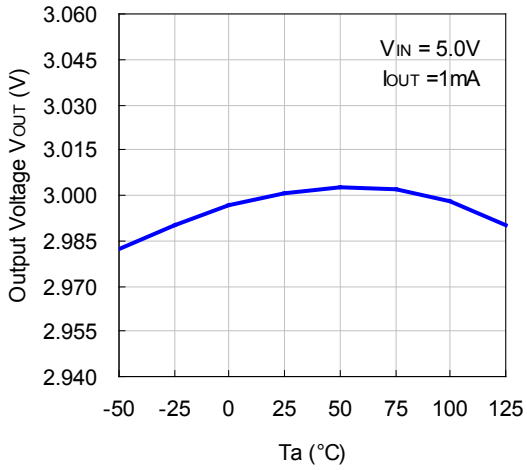


R1511x001C

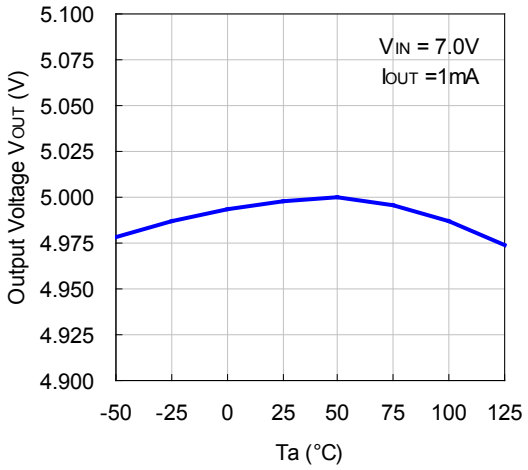


4) Output Voltage vs. Ambient Temperature

R1511x030B



R1511x050B



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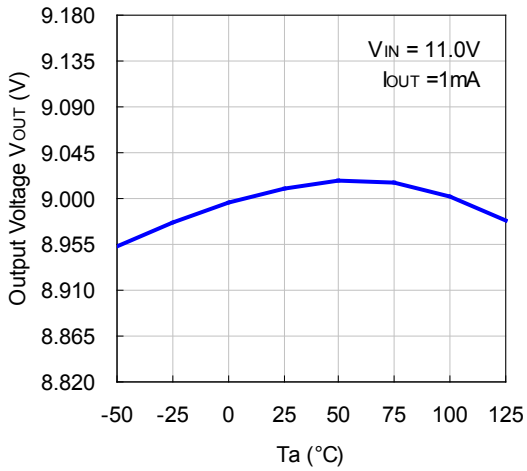
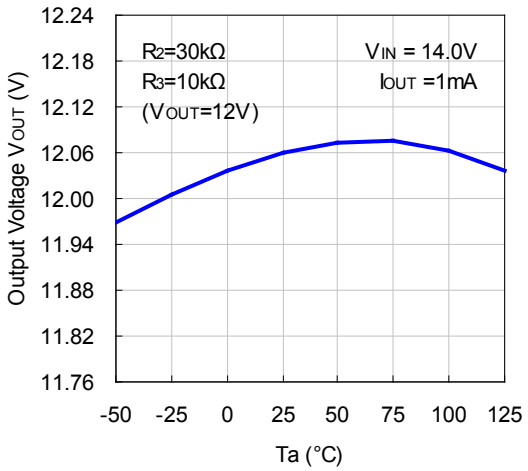
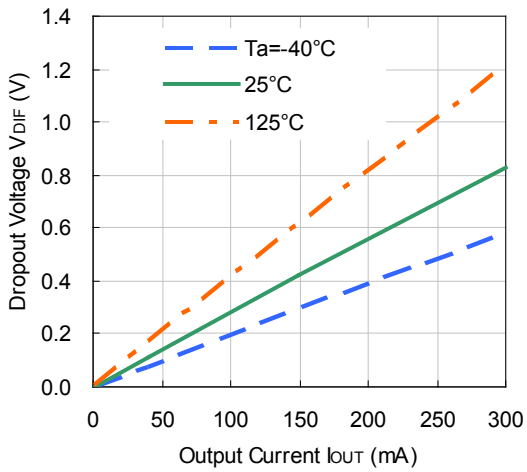


R1511x001C

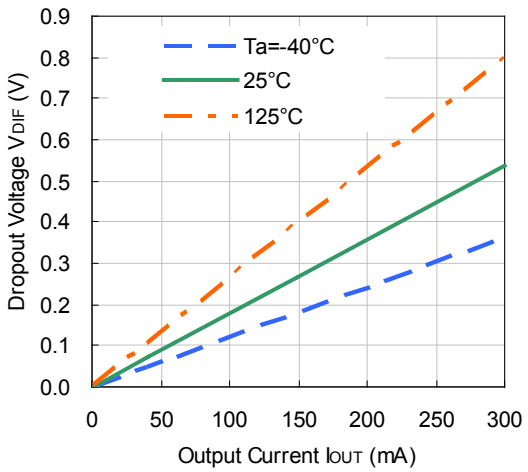


5) Dropout Voltage vs. Output Current

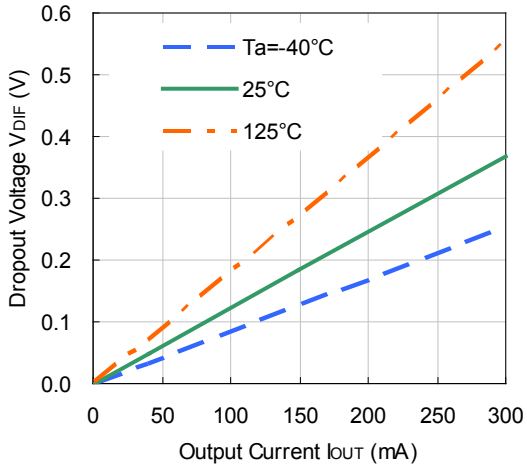
R1511x030B/R1511x001C



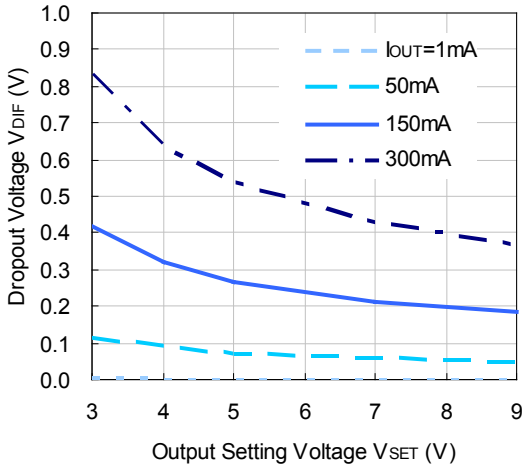
R1511x050B



R1511x090B

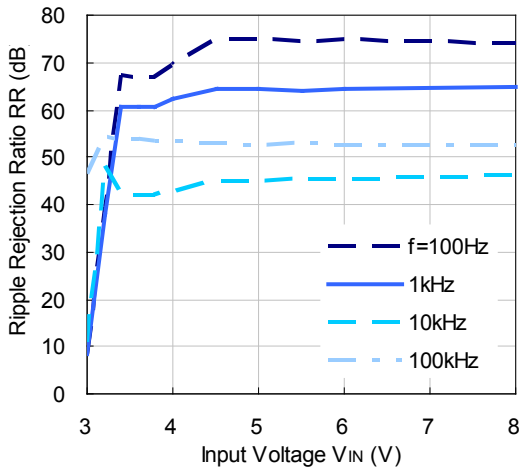


6) Dropout Voltage vs. Setting Voltage (Ta = 25ºC)

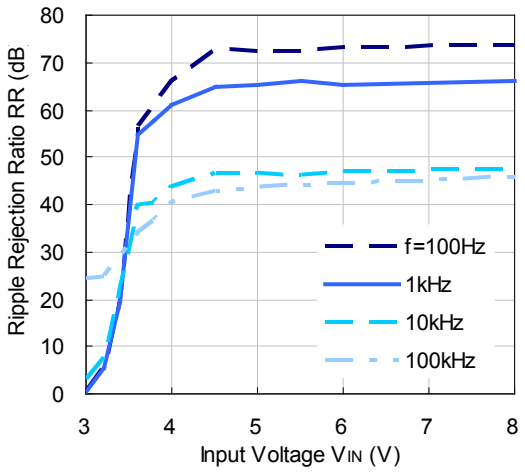


7) Ripple Rejection vs. Input Bias Voltage (Ta = 25°C, Ripple = 0.5 Vpp)

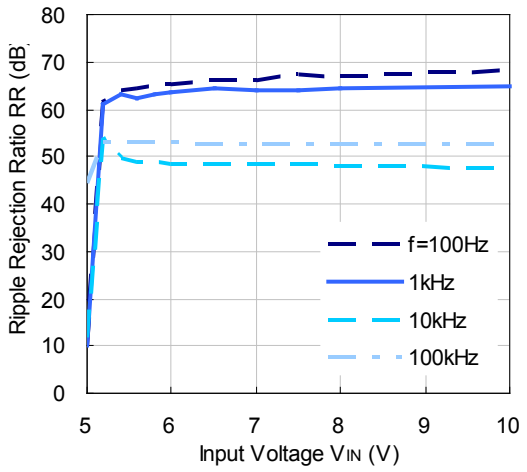
R1511x030B/R1511x001C (IOUT=1mA)



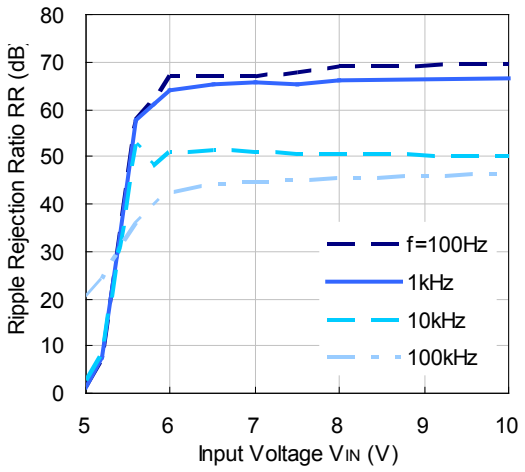
R1511x030B/R1511x001C (IOUT=100mA)



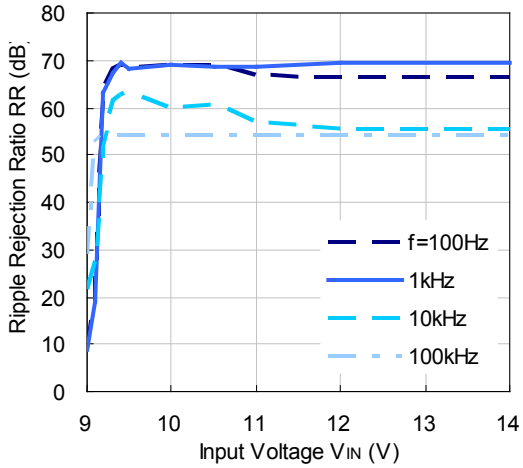
R1511x050B (IOUT=1mA)



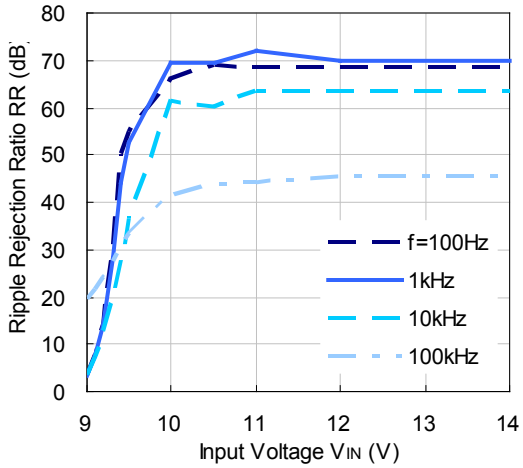
R1511x050B (IOUT=100mA)



R1511x090B (I_{OUT}=1mA)

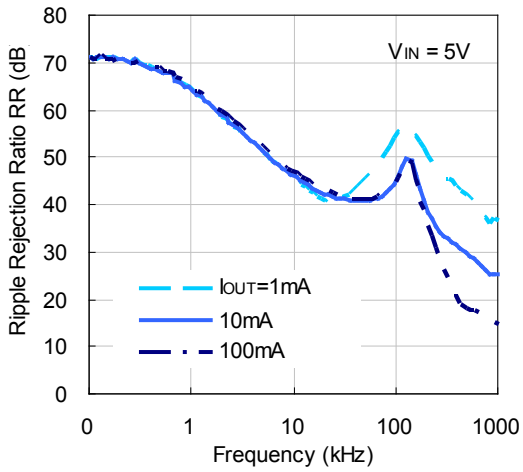


R1511x090B (I_{OUT}=100mA)

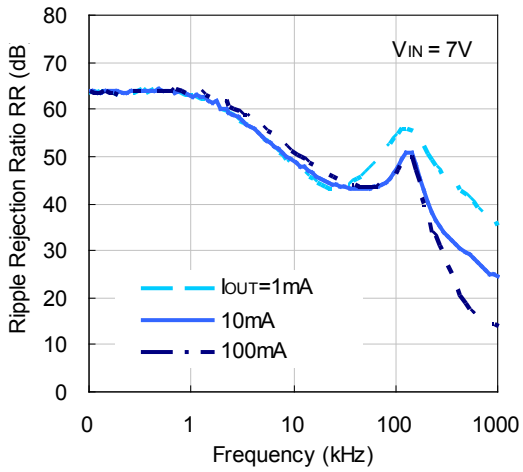


8) Ripple Rejection vs. Frequency (Ta = 25°C, Ripple = 0.5 Vpp)

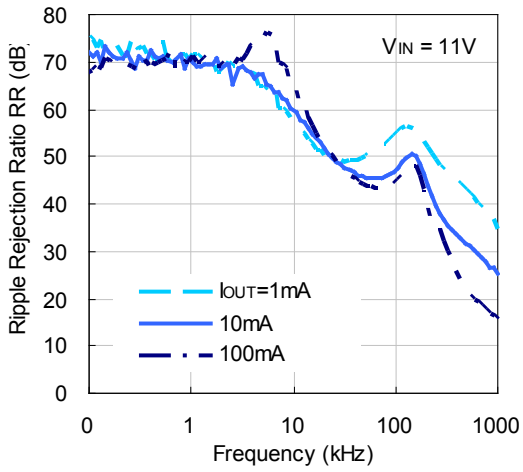
R1511x030B/R1511x001C



R1511x050B

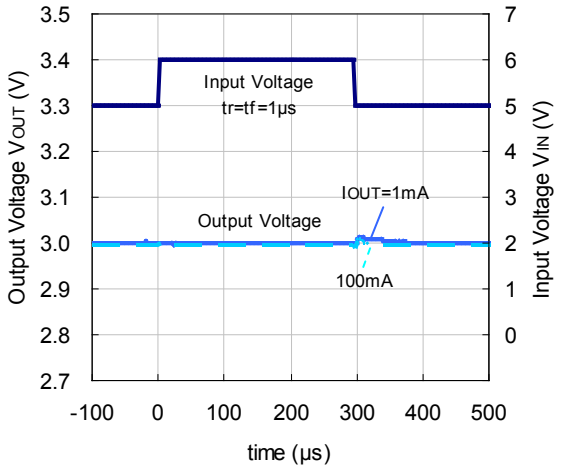


R1511x090B

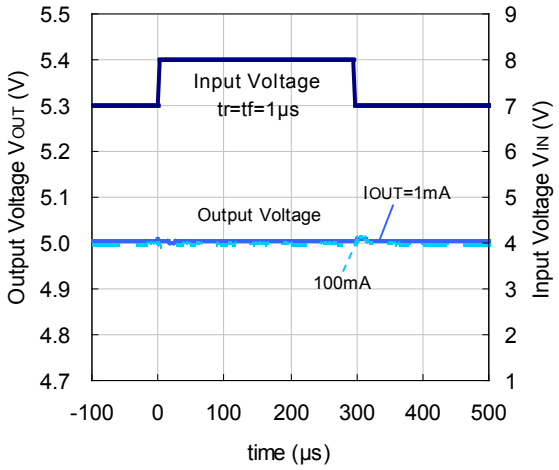


9) Input Transient Response (Ta = 25°C)

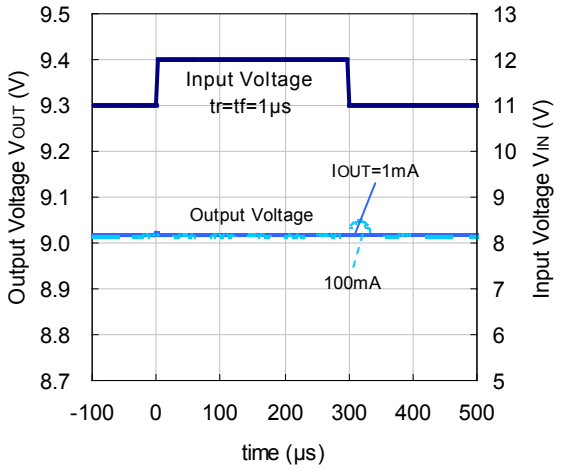
R1511x030B



R1511x050B

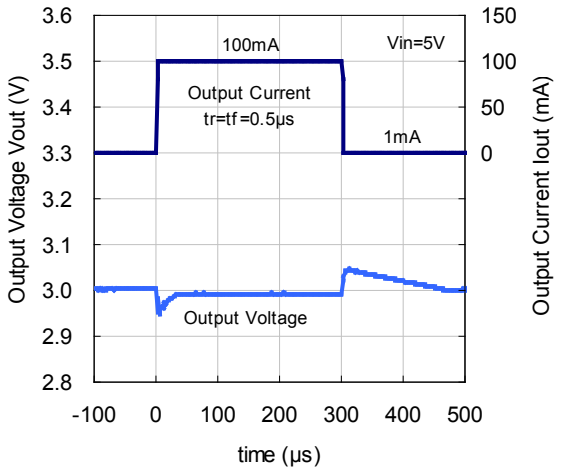


R1511x090B

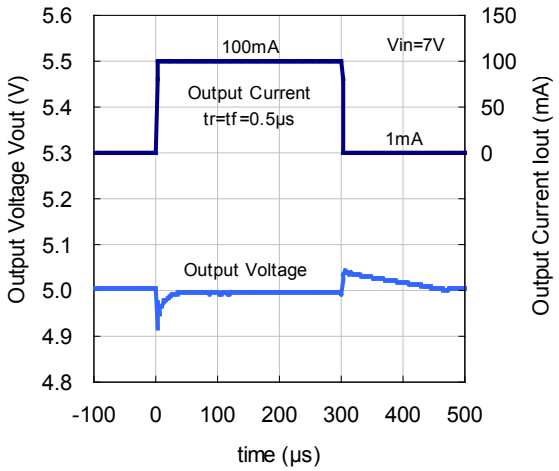


10) Load Transient Response (Ta = 25°C)

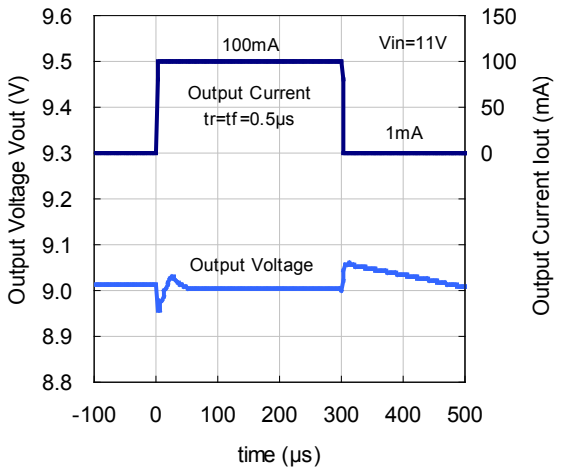
R1511x030B



R1511x050B

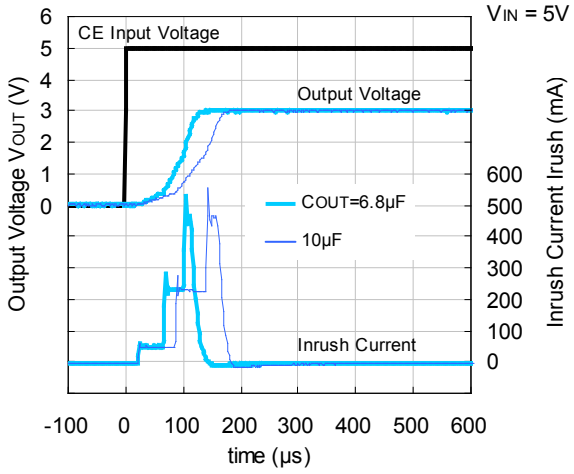


R1511x090B

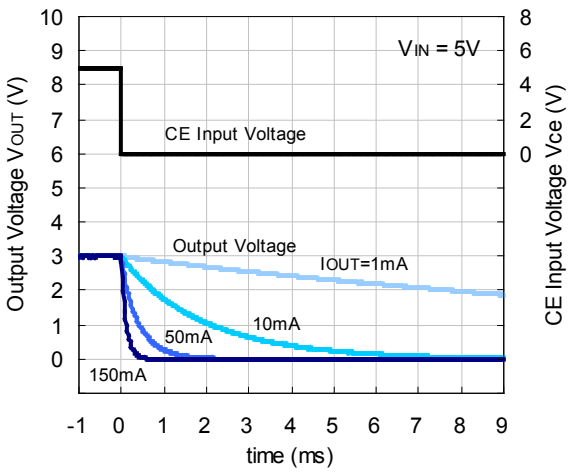


11) CE Response (Ta = 25°C)

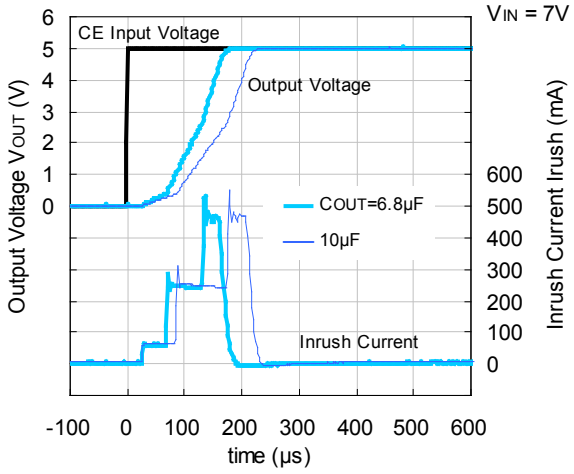
R1511x030B (Turn On)



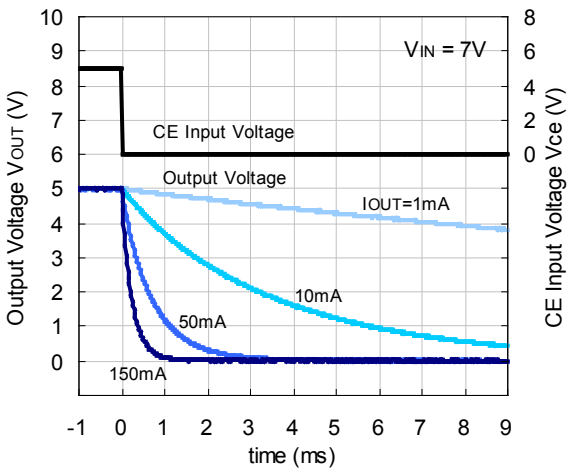
R1511x030B (Turn Off)



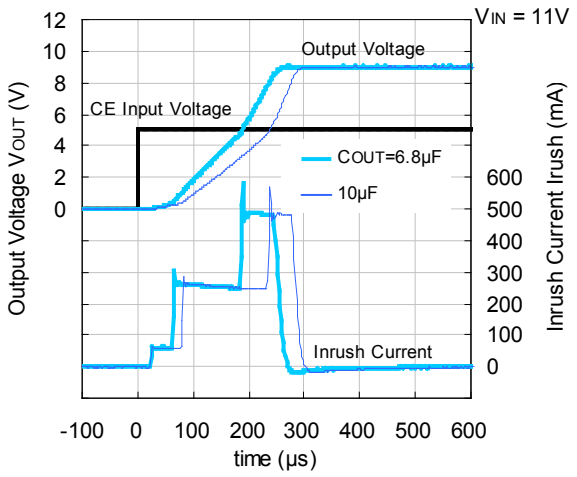
R1511x050B (Turn On)



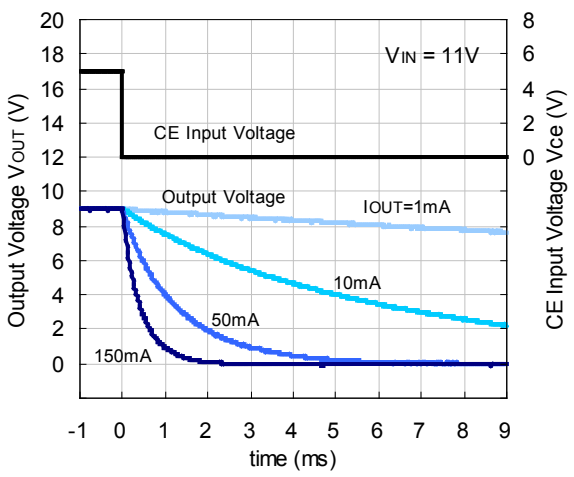
R1511x050B (Turn Off)



R1511x090B (Turn On)

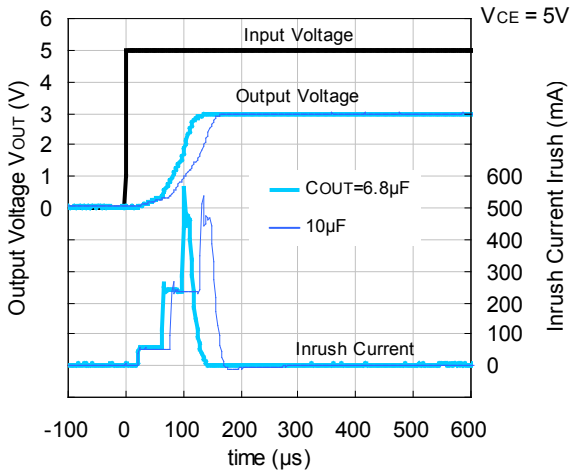


R1511x090B (Turn Off)

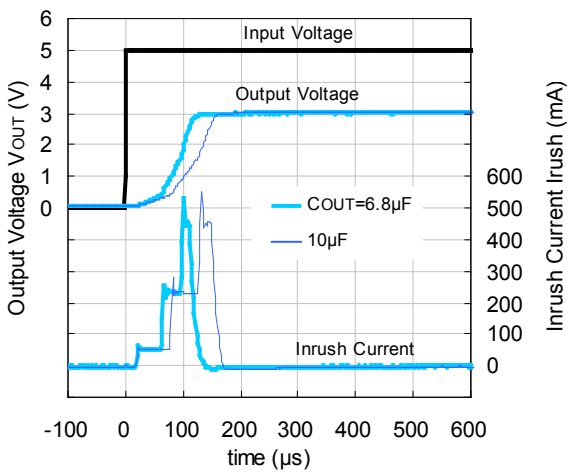


12) Start Up Waveform (Ta = 25°C)

R1511x030B

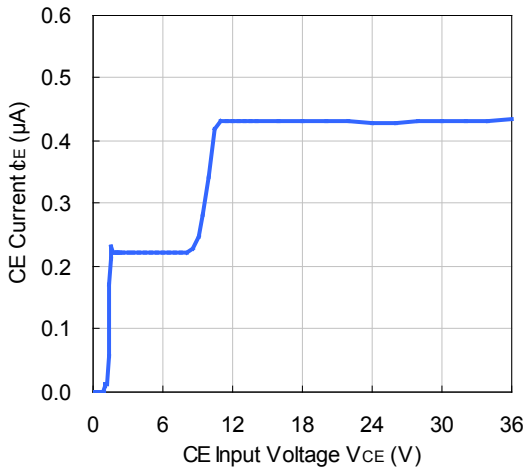


R1511x001C



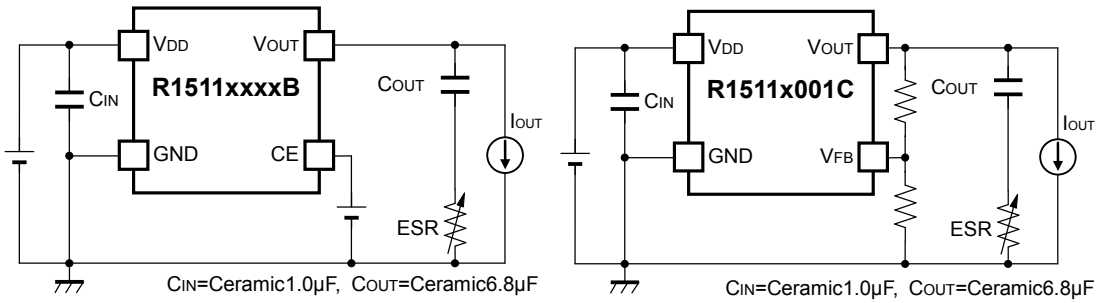
13) CE Pin Current Vs. CE Input Voltage

R1511xxxxB



EQUIVALENT SERIES RESISTANCE (ESR) vs. OUTPUT CURRENT

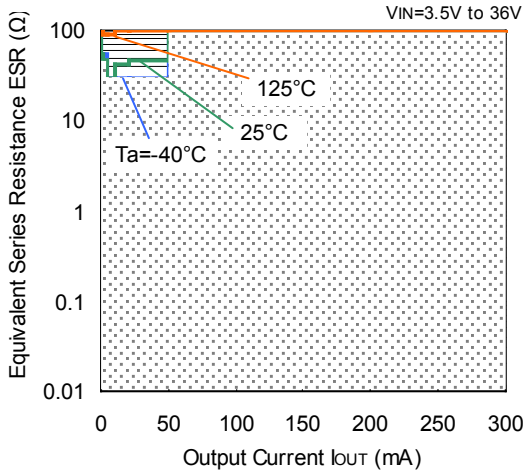
Ceramic type output capacitor is recommended for this device; however, the other output capacitors with low ESR also can be used. As for reference, the below graphs show the relationship between output current (I_{OUT}) and equivalent series resistance (ESR). The noise level of the output current (I_{OUT}) was measured by the test circuit and is lower than the specified value.



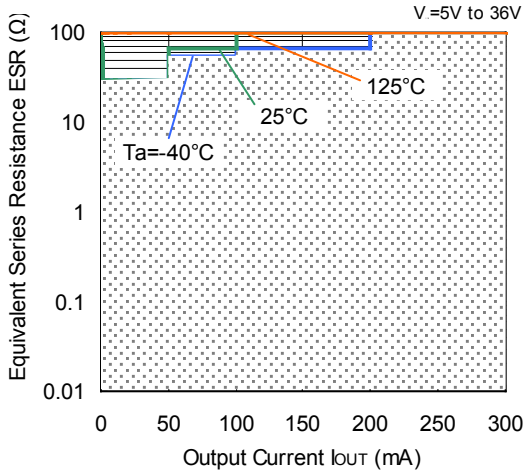
Measurement Conditions

- Noise Frequency Range: 10Hz to 2MHz
- Ambient Temperature: -40ºC to 125ºC
- Shaded Area: Noise level is lower than the specified value (40μV)
- Capacitor: C_{IN}=Ceramic 1.0μF, C_{OUT}=Ceramic 6.8μF (C4532X7S1H685K)

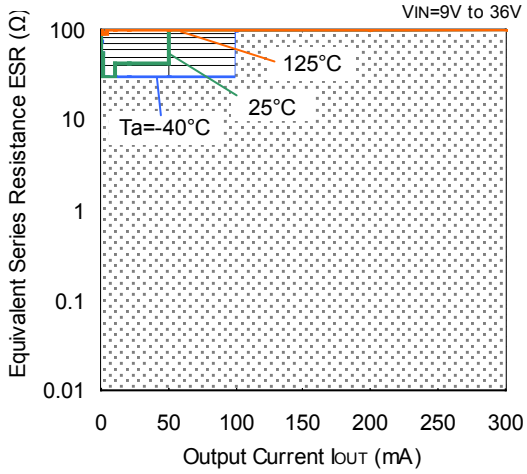
R1511x030B



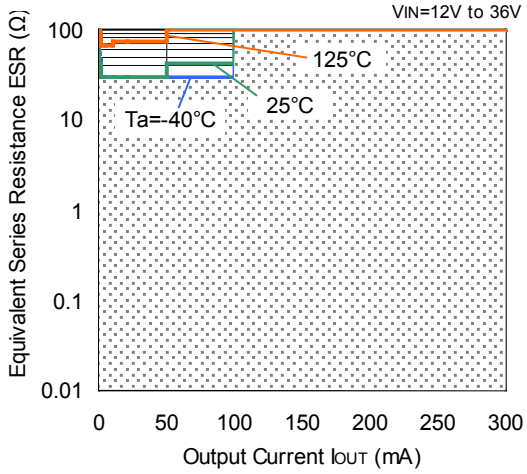
R1511x050B



R1511x090B



R1511x001C (VOUT=12V)



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