1 A 36V Input Low Supply Current LDO for Industrial Application

NO. EY−329−230124

OUTLINE

R1518x is a CMOS-based LDO featuring 1 A output current and 36 V input voltage. In addition to a conventional regulator circuit, R1518x consists of a constant slope circuit as a soft-start function, a fold-back protection circuit, a short current limit circuit, and a thermal shutdown circuit.

R1518x is available in R1518xxx1B/D/E/F with the internally fixed output voltage, and R1518xxx1D/F with the auto-discharge function at standby.

The output voltage of R1518x001C can be set with an external resistor, and the setting range is from 2.5V to Max 20V. R1518xxx1B/C/D internally fixes the soft-start time at 120 μs (Typ). R1518xxx1E/F can adjust the soft-start time with an external capacitor.

R1518x is available in two packages for ultra high wattage: HSOP-6J and TO-252-5-P2.

This is a high-reliability semiconductor device for industrial application (-Y) that has passed both the screening at high temperature and the reliability test with extended hours.

FEATURES

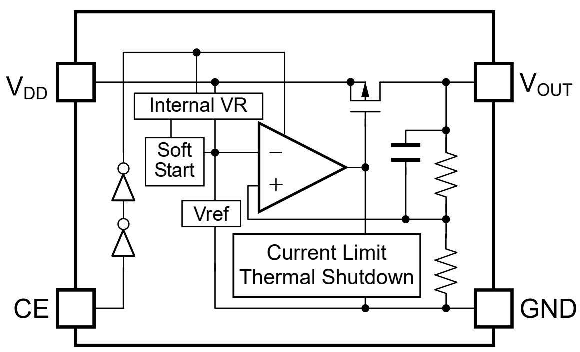
- Input Voltage Range (Maximum Rating) ·············· 3.5 V to 36.0 V (50.0V)
- Operating Temperature range ··························· –40°C to 125°C
- Supply Current ··· Typ. 18 μA
- Standby Current ··· Typ. 0.1 μA
- Dropout Voltage ··· Typ. 0.7 V (I_{OUT} = 1 A, V_{OUT} = 5.0 V)
- Output Voltage Accuracy ································ ±0.8% (V_{OUT} ≤ 5.0 V)
- Temperature-Drift Coefficient of Output Voltage ····· Typ. ±60 ppm/°C (−40°C ≤ Ta ≤ 125°C)
- Line Regulation ·· Typ. 0.01%/V
- Packages ·· HSOP-6J, TO-252-5-P2
- Output Voltage Range ···································· 2.5 V/3.3 V/3.4 V/5.0 V/6.0 V/8.5 V/9.0 V
  R1518x001C: Adjustable from 2.5 V to 20.0 V
  with external resistor
  Feedback Voltage: 2.5 V
- Built-in Short Current Limit Circuit ······················ Typ. 150 mA
- Built-in Fold-Back Protection Circuit ···················· Min. 1.1 A
- Built-in Thermal Shutdown Circuit ······················ Typ. 160°C
- Built-in Soft-start Circuit ·································· R1518xxx1B/C/D: Typ.120 μs
  R1518xxx1E/F: Time adjustable
- Ceramic Capacitors can be used ······················· R1518xxx1B/D/E/F: 0.1 μF or more
  R1518x001C: 1.0 μF or more

APPLICATIONS

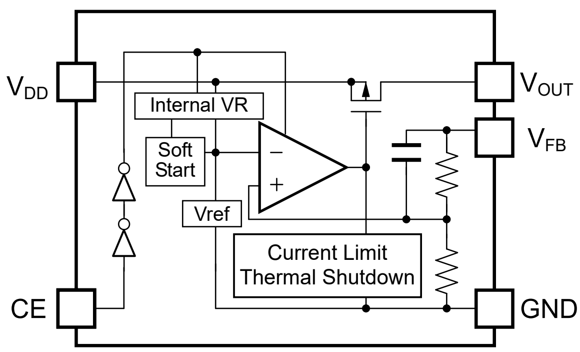
- Industrial equipment such as FAs and smart meters.
- Equipment used under high-temperature conditions such as surveillance camera and vending machine.
- Equipment accompanied by self-heating such as motor and lighting.

BLOCK DIAGRAMS

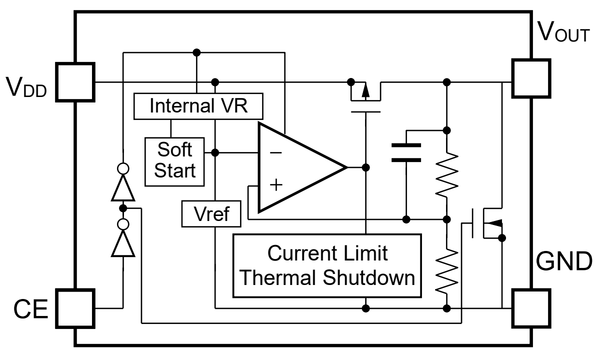
R1518xxx1B



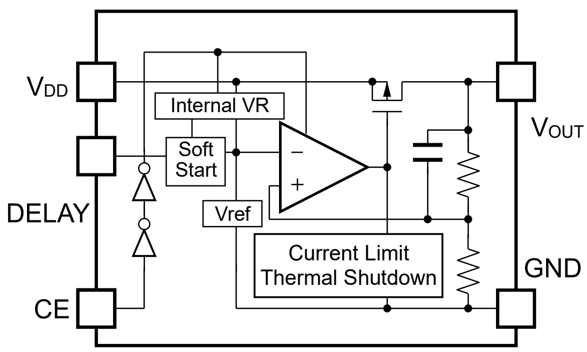
R1518x001C



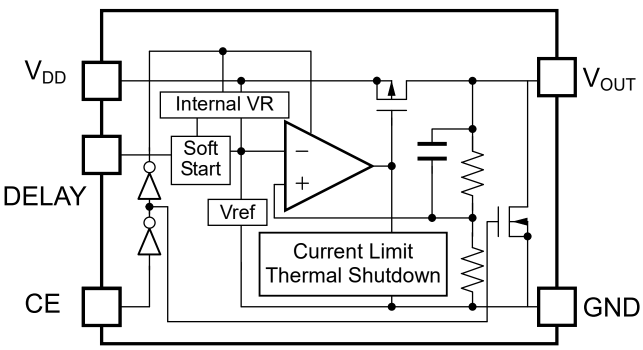
R1518xxx1D



R1518xxx1E



R1518xxx1F



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1518Sxx1∗-E2-YE	HSOP-6J	1,000 pcs	Yes	Yes
R1518S001C-E2-YE				
R1518Jxx1∗-T1-YE	TO-252-5-P2	3,000 pcs	Yes	Yes
R1518J001C-T1-YE				

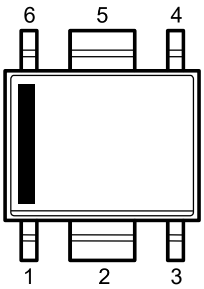
xx: Specify the set output voltage (V_{SET})
2.5 V (25) / 3.3 V (33) / 3.4 V (34) / 5.0 V (50) / 6.0 V (60) / 8.5 V (85) / 9.0 V (90)

Adjustable output voltage setting type is fixed to (00)
Note: For R1518S001C-E2-YE and R1518J001C-T1-YE (No auto-discharge function)

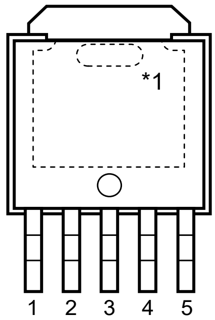
∗ : Specify the version with desired functions
- B: No auto-discharge function
- D: Auto-discharge function
- E: No auto-discharge function / Adjustable soft-start time setting
- F: Auto-discharge function / Adjustable soft-start time setting

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

PIN DESCRIPTION



HSOP-6J



TO-252-5-P2

HSOP-6J

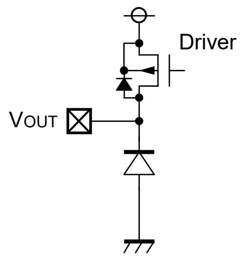
Pin No.	Symbol	Description	
1	VDD	Input Pin	
2	GND	Ground Pin	
3	NC	No Connection	R1518Sxx1B/D
	VFB	Feedback Pin	R1518S001C
	DELAY	Adjustable Soft-start Time Pin	R1518Sxx1E/F
4	CE	Chip Enable Pin, Active-high	
5	GND	Ground Pin	
6	VOUT	Output Pin	

TO-252-5-P2

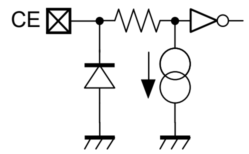
Pin No.	Symbol	Description	
1	V_{DD}	Input Pin	
2	NC	No Connection	R1518Jxx1B/D
	V_{FB}	Feedback Pin	R1518J001C
	DELAY	Adjustable Soft-start Time Pin	R1518Jxx1E/F
3	GND	Ground Pin	
4	CE	Chip Enable Pin, Active-high	
5	V_{OUT}	Output Pin	

[*1] The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). The tab is recommended to connect to the ground plane on the board. Otherwise it may be left floating.

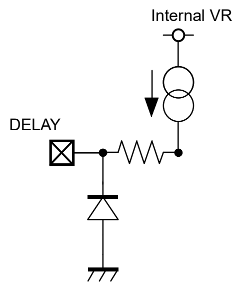
PIN EQUIVALENT CIRCUIT DIAGRAMS



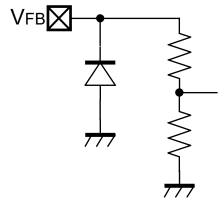
V_{OUT} Pin



CE Pin



DELAY Pin
(R1518xxx1E/F)



V_{FB} Pin
(R1518x001C)

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	−0.3 to 50	V
V_{IN}	Peak Input Voltage[*2]	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
P_D	Power Dissipation	Refer to Appendix *“Power Dissipation”*	
Tj	Junction Temperature	−40 to 150	°C
Tstg	Storage Temperature Range	−55 to 150	°C

[*2] Duration time = 200 ms

ABSOLUTE MAXIMUM RATINGS
Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage 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

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 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

$V_{IN} = V_{SET} + 1.0$ V, $I_{OUT} = 1$ mA, $C_{IN} = C_{OUT} = 0.1$ μF, unless otherwise noted.

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

R1518xxx1B/D (Ta = 25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Ta = 25°C	V_{SET} ≤ 5.0 V	×0.992		×1.008	V
			V_{SET} > 5.0 V	×0.99		×1.01	V
		−40°C ≤ Ta ≤ 125°C	V_{SET} ≤ 5.0 V	×0.982		×1.018	V
			V_{SET} > 5.0 V	×0.98		×1.02	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN} = V_{SET} + 2.0$ V 1 mA ≤ I_{OUT} ≤ 250 mA		−15	3	25	mV
		$V_{IN} = V_{SET} + 2.0$ V 1 mA ≤ I_{OUT} ≤ 1 A		−60	10	60	mV
V_{DIF}	Dropout Voltage	$I_{OUT} = 1$ A		Refer to the *Product-specific Electrical Characteristics*			
I_{SS}	Supply Current	$I_{OUT} = 0$ mA			18	36	μA
Istandby	Standby Current	$V_{CE} = 0$ V			0.1	2.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{SET} + 0.5 V ≤ V_{IN} ≤ 36 V, Under the condition of V_{IN} ≥ 3.5 V			0.01	0.02	%/V
I_{LIM}	Output Current Limit	$V_{IN} = V_{SET} + 2.0$ V		1.1	1.8	2.5	A
I_{SC}	Short Current Limit	V_{IN} =5.0 V, V_{OUT} = 0 V		110	180	250	mA
I_{PD}	CE Pull-down Current	$V_{CE} = 5.0$ V			0.2	0.6	μA
		$V_{CE} = 36$ V			0.5	1.3	μA
t_{D1}	Soft-start Time 1				120		μs
V_{CEH}	CE Input Voltage "H"			2.2		36	V
V_{CEL}	CE Input Voltage "L"			0		1.0	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		150	160		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		125	135		°C
R_{LOW}	Low Output Nch Tr. ON Resistance (R1518xxx1D)	$V_{IN} = 14.0$ V, $V_{CE} = 0$ V		1.0	3.2	5.0	kΩ

All test items listed under Electrical Characteristics are done under the pulse load condition (Tj ≈ Ta = 25°C) except for Soft-start Time 1.

V_{IN} = V_{FB} (= 2.5 V) + 1.0 V = 3.5 V, I_{OUT} = 1 mA, C_{IN} = 0.1 μF, C_{OUT} = 1.0 μF, unless otherwise noted.
The specifications surrounded by [ ] are guaranteed by design engineering at -40°C ≤ Ta ≤ 125°C.

R1518x001C (Ta = 25°C)

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{FB}	Feedback Voltage	Ta = 25°C	2.480		2.520	V
		−40°C ≤ Ta ≤ 125°C	2.455		2.545	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = 4.5V 1 mA ≤ I_{OUT} ≤ 250 mA	−10	3	10	mV
		V_{IN} = 4.5V 1 mA ≤ I_{OUT} ≤ 1 A	−25	5	35	mV
V_{DIF}	Dropout Voltage	I_{OUT} = 1 A		1.0	1.8	V
I_{SS}	Supply Current	I_{OUT} = 0 mA		18	36	μA
Istandby	Standby Current	V_{CE} = 0 V		0.1	2.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	3.5 V ≤ V_{IN} ≤ 36 V		0.01	0.02	%/V
I_{LIM}	Output Current Limit	V_{IN} = 4.5 V	1.1	1.8	2.5	A
I_{SC}	Short Current Limit	V_{IN} = 5.0 V, V_{OUT} = V_{FB} = 0 V	110	180	250	mA
I_{PD}	CE Pull-down Current	V_{CE} = 5.0 V		0.2	0.6	μA
		V_{CE} = 36 V		0.5	1.3	μA
t_{D1}	Soft-start Time 1			120		μs
V_{CEH}	CE Input Voltage "H"		2.2		36	V
V_{CEL}	CE Input Voltage "L"		0		1.0	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature	150	160		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature	125	135		°C

V_{OUT} = V_{FB} = 2.5 V (excluding short circuit current)
All test items listed under Electrical Characteristics are done under the pulse load condition (Tj ≈ Ta = 25°C) except for Soft-start Time 1.

V_{IN} = V_{SET} + 1.0 V, I_{OUT} = 1 mA, C_{IN} = C_{OUT} = 0.1 μF, unless otherwise noted.

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

R1518xxx1E/F (Ta = 25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Ta = 25°C	V_{SET} ≤ 5.0 V	×0.992		×1.008	V
			V_{SET} > 5.0 V	×0.99		×1.01	V
		−40°C ≤ Ta ≤ 125°C	V_{SET} ≤ 5.0 V	[×0.982]		[×1.018]	V
			V_{SET} > 5.0 V	[×0.98]		[×1.02]	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = V_{SET} + 2.0 V 1 mA ≤ I_{OUT} ≤ 250 mA		[−15]	3	[25]	mV
		V_{IN} = V_{SET} + 2.0 V 1 mA ≤ I_{OUT} ≤ 1 A		[−60]	10	[60]	mV
V_{DIF}	Dropout Voltage	I_{OUT} = 1 A		Refer to the *Product-specific Electrical Characteristics*			
I_{SS}	Supply Current	I_{OUT} = 0 mA			18	[36]	μA
Istandby	Standby Current	V_{CE} = 0 V			0.1	[2.0]	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{SET} + 0.5 V ≤ V_{IN} ≤ 36 V, Under the condition of V_{IN} ≥ 3.5 V			0.01	[0.02]	%/V
I_{LIM}	Output Current Limit	V_{IN} = V_{SET} + 2.0 V		[1.1]	1.8	[2.5]	A
I_{SC}	Short Current Limit	V_{IN} = 5.0 V, V_{OUT} = 0 V		[110]	180	[250]	mA
I_{PD}	CE Pull-down Current	V_{CE} = 5.0 V			0.2	[0.6]	μA
		V_{CE} = 36 V			0.5	[1.3]	μA
I_{DELAY}	DELAY Current	DELAY = GND		[1.5]	2.5	[3.5]	μA
t_{D1}	Soft-start Time 1	DELAY = OPEN			26		μs
t_{D2}	Soft-start Time 2	DELAY = 0.001 μF		210	290	415	μs
V_{CEH}	CE Input Voltage "H"			[2.2]		[36]	V
V_{CEL}	CE Input Voltage "L"			[0]		[1.0]	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature		[150]	160		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature		[125]	135		°C
R_{LOW}	Low Output Nch Tr. ON Resistance (R1518xxx1F)	V_{IN} = 14.0 V, V_{CE} = 0 V		[1.0]	3.2	[5.0]	kΩ

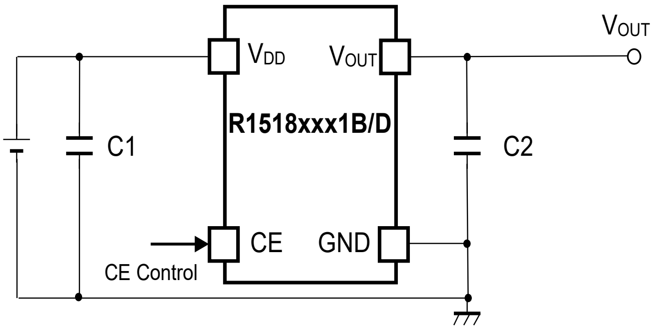
All test items listed under Electrical Characteristics are done under the pulse load condition (Tj ≈ Ta = 25°C) except for Soft-start Time 1 and Soft-start Time 2.

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

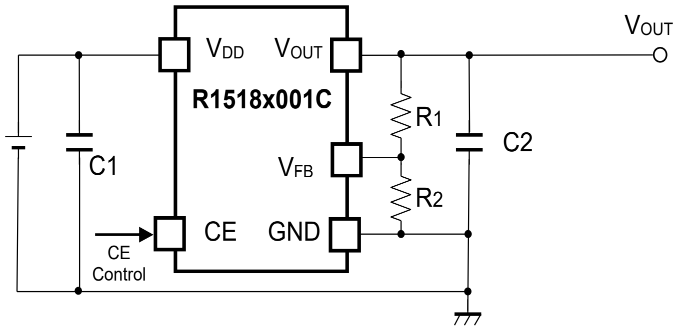
R1518xxx1B/D/E/F Product-specific Electrical Characteristics (Ta = 25°C)

Product Name	V_{OUT} [V] (Ta = 25°C)			V_{OUT} [V] (−40°C ≤ Ta ≤ 125°C)			V_{DIF} [V]	
	Min.	Typ.	Max.	Min.	Typ.	Max.	Typ.	Max.
R1518x251x	2.480	2.500	2.520	2.455	2.500	2.545	1.00	1.80
R1518x331x	3.274	3.300	3.326	3.241	3.300	3.359	0.90	1.60
R1518x341x	3.373	3.400	3.427	3.339	3.400	3.461		
R1518x501x	4.960	5.000	5.040	4.910	5.000	5.090	0.70	1.30
R1518x601x	5.940	6.000	6.060	5.880	6.000	6.120		
R1518x851x	8.415	8.500	8.585	8.330	8.500	8.670	0.65	1.10
R1518x901x	8.910	9.000	9.090	8.820	9.000	9.180		

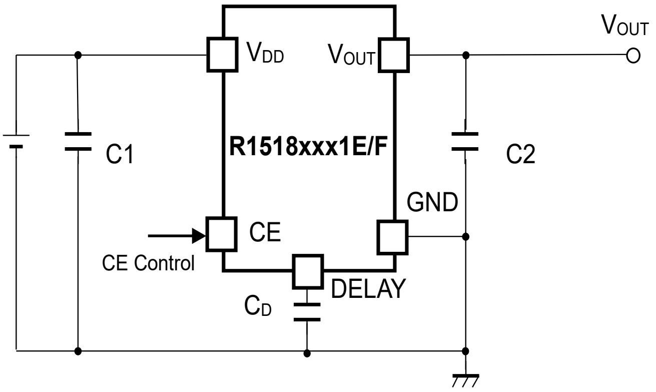
TYPICAL APPLICATION



R1518xxx1B/D Typical Application



R1518x001C Typical Application



R1518xxx1E/F Typical Application

External Components :

Symbol	Description
R1518xxx1B/D/E/F	
C1	0.1 μF (Ceramic)
C2	0.1 μF (Ceramic)
R1518x001C	
C1	0.1 μF (Ceramic)
C2	1.0 μF (Ceramic)

TECHNICAL NOTES

Phase Compensation

In LDO regulators, phase compensation is provided to secure stable operation even when the load current is varied. For this purpose, use 0.1 μF or more (R1518xxx1B/D/E/F), 1.0 μF or more (R1518x001C) of the capacitor C2. When using a tantalum type capacitor and the ESR (Equivalent Series Resistance) value is large, the output might be unstable. Evaluate the circuit including consideration of frequency characteristics.

For the externally adjustable output voltage type (R1518x001C), use 10 kΩ or lower resistance R2.

PCB Layout

Ensure the V_{DD} and GND lines are sufficiently robust. If their impedance is too high, noise pickup or unstable operation may result. Connect 0.1 μF or more of the capacitor C1 between the V_{DD} and GND, and as close as possible to the pins.

In addition, connect the capacitor C2 between V_{OUT} and GND, and as close as possible to the pins.

OPERATION DESCRIPTION

Thermal Shutdown Function

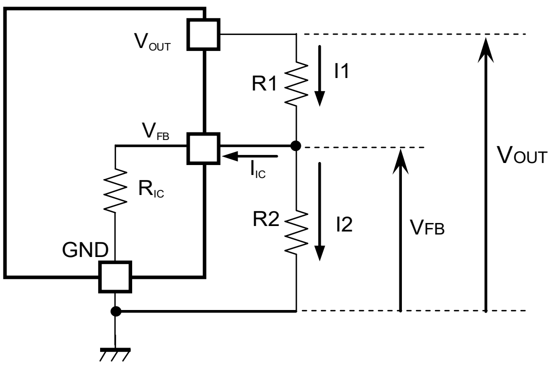
Thermal shutdown function is included in this device. If the junction temperature is more than or equal to 160°C (Typ.), the operation of the regulator would stop. After that, when the junction temperature is less than or equal to 135°C (Typ.), the operation of the regulator would restart. Unless the cause of rising temperature is removed, the regulator repeats on and off, and output waveform would be like consecutive pulses.

Adjustable Output Voltage Setting (R1518x001C)

The output voltage of R1518x001C 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: $2.5\ V \leq V_{OUT} \leq 20.0\ V$
$V_{FB} = 2.5\ V$



Output Voltage Adjustment Using External Divider Resistors (R1, R2)

R_{IC} of the R1518x001C is approximately Typ. 1.35 MΩ (Ta=25°C, guaranteed by design engineering). For better accuracy, setting R1 << R_{IC} reduces errors. The resistance value for R2 should be set to 10 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.

Soft-start Function

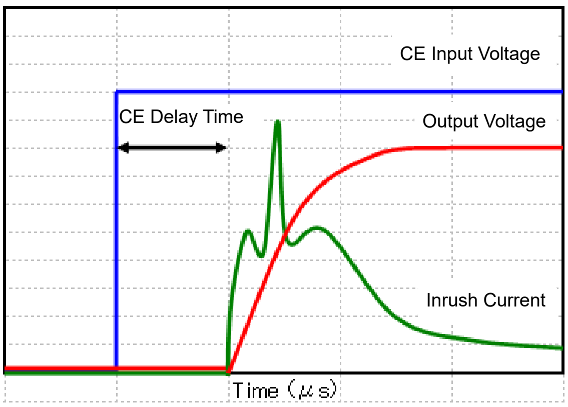
R1518x is equipped with a constant slope circuit, which achieves a soft-start function. This circuit allows the output voltage to start up gradually when the CE is turned on. The constant slope circuit minimizes the inrush current at the start-up and also prevents the overshoot of the output voltage. For R1518xxx1B/C/D, the capacitor to create the start-up slope is built in this device that does not require any external components. The start-up time and the start-up slope angle are fixed inside the device. As for R1518xxx1E/F, the soft-start time is adjustable by inserting the external capacitor to DELAY pin. By using the following equation, the relation between the soft-start time t_D [s] and DELAY pin capacitor C_D [F] is determined.

$$t_D = ((C_D + 90 \times 10^{-12}) / I_{DELAY}) \times 0.73$$

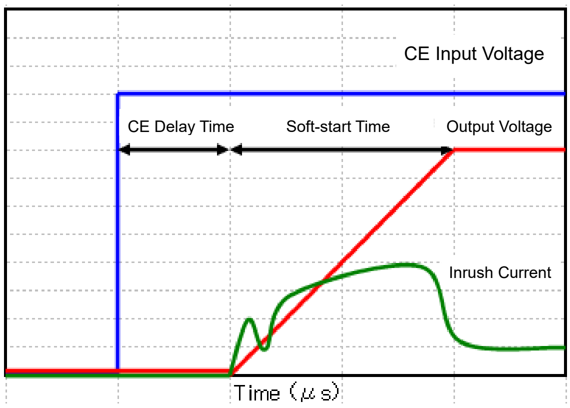
When the capacitor C_D of R1518xxx1E/F is not used, use the DELAY pin as OPEN. At that time, $C_D = 0$ in the above equation, therefore the start-up time is about 26 μs. However, be sure to consider approximately 50 μs of CE delay time.

The capacity (C_D) of the DELAY pin is discharged when V_{IN} is input and CE = L. If the C_D is restarted without being discharged, the soft start time may be shorter than the set time.

Conventional Inrush Current Limit Circuit
(Diagrammatic sketch)



Constant Slope Circuit
(Diagrammatic sketch)

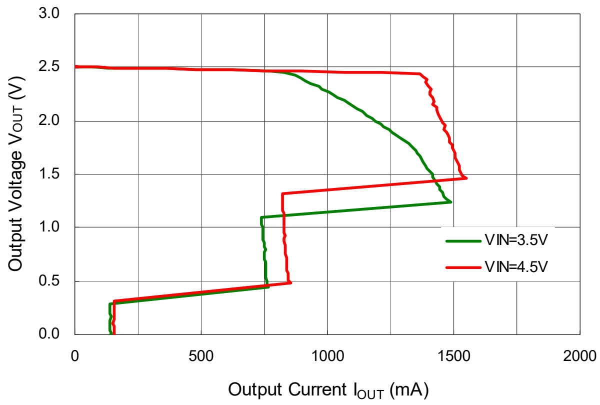


TYPICAL CHARACTERISTICS

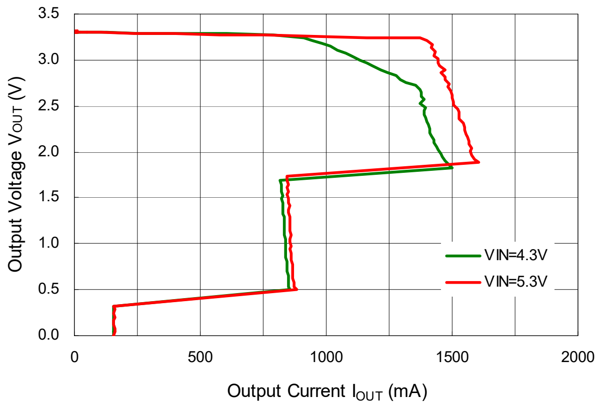
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

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

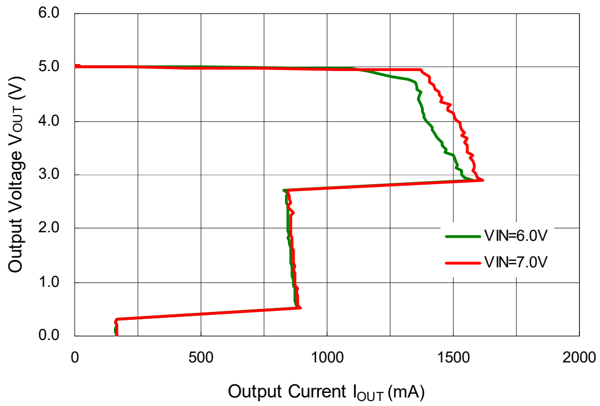
R1518x25xx, R1518x001C



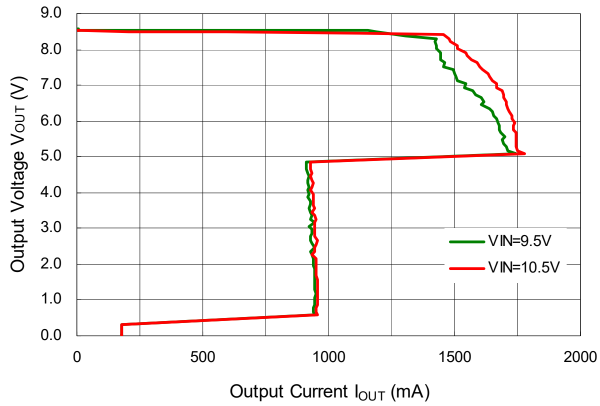
R1518x33xx



R1518x50xx

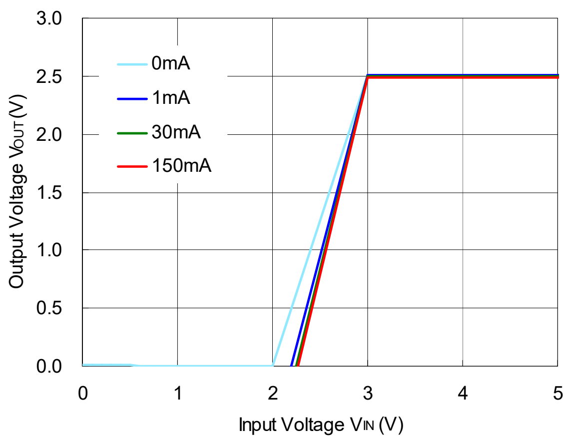


R1518x85xx

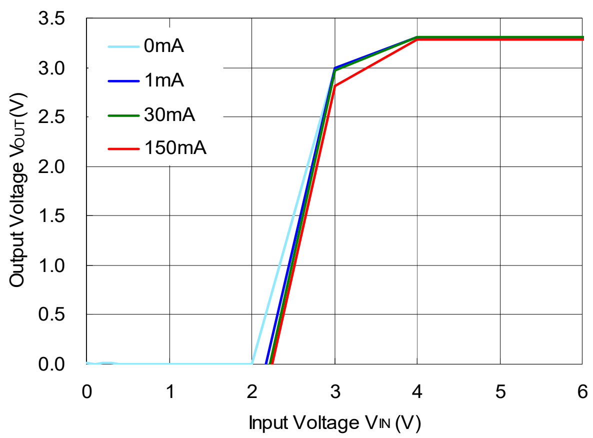


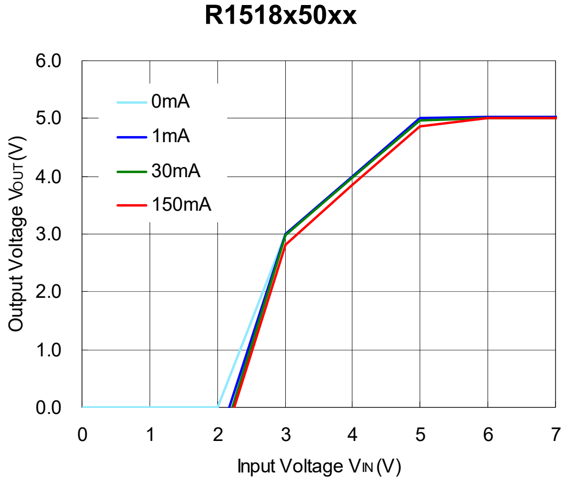
2) Output Voltage vs. Input Voltage (Ta = 25°C)

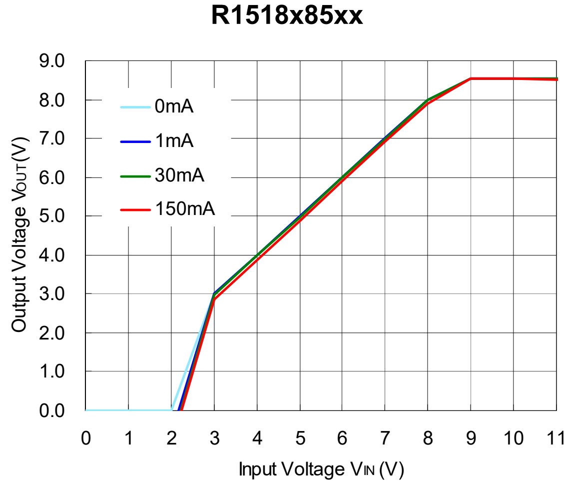
R1518x25xx



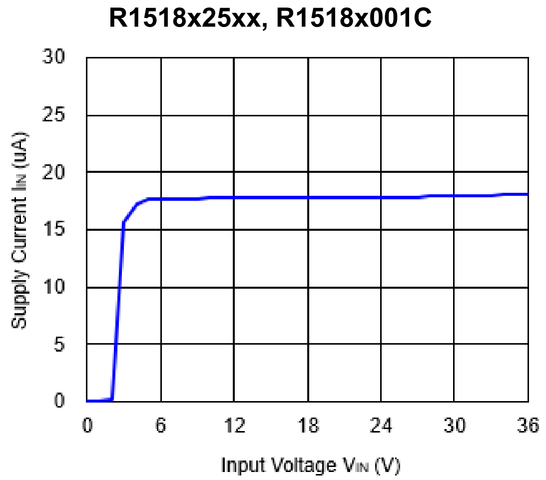
R1518x33xx

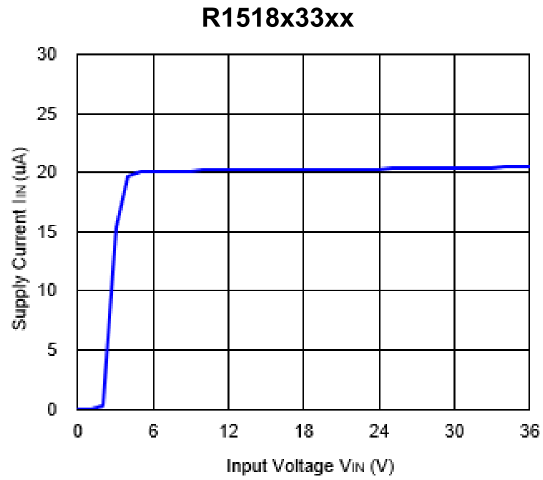


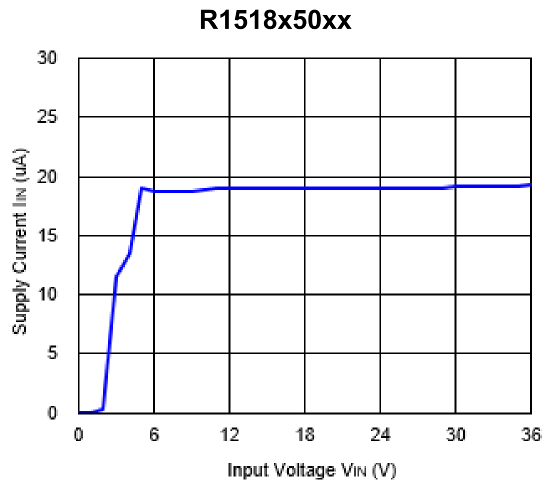


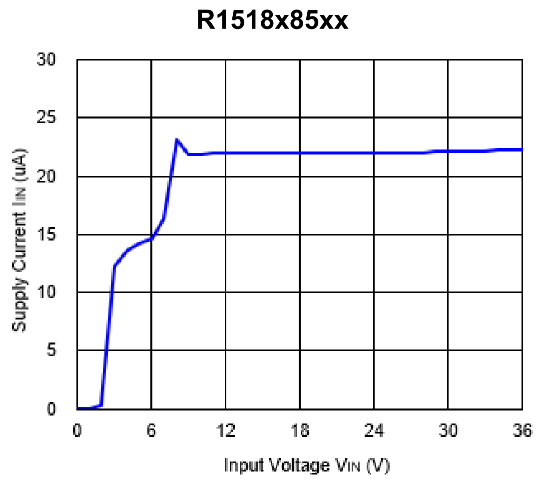


3) Supply Current vs. Input Voltage （ I_{OUT} = 0 mA ）



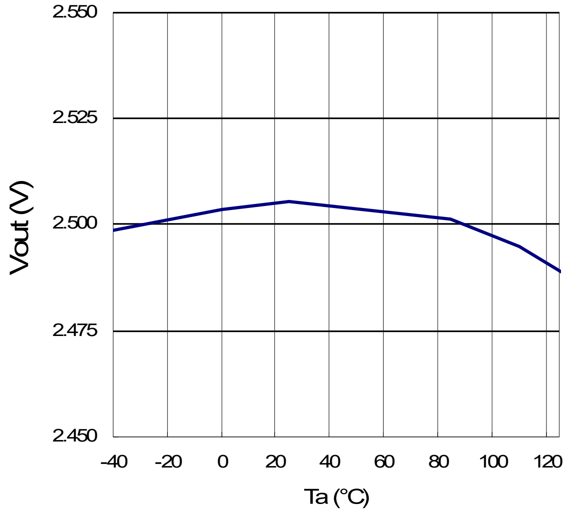




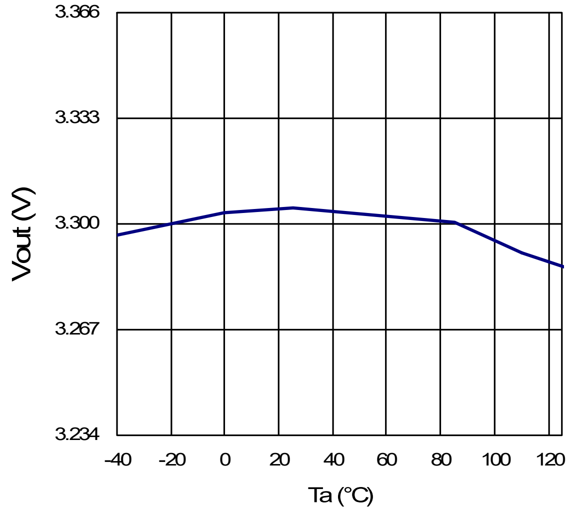


4) Output Voltage vs. Operating Temperature

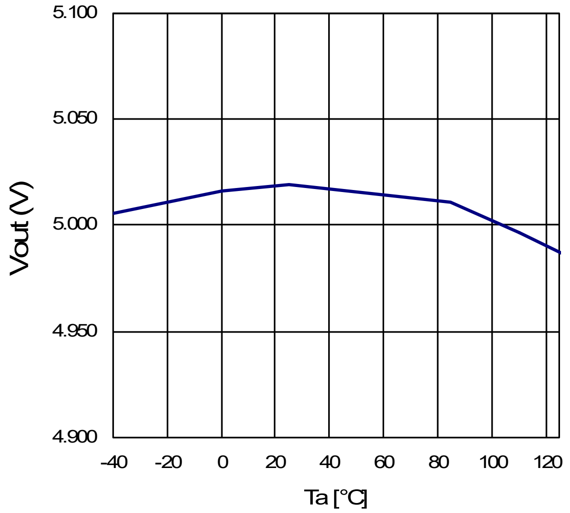
R1518x25xx, R1518x001C



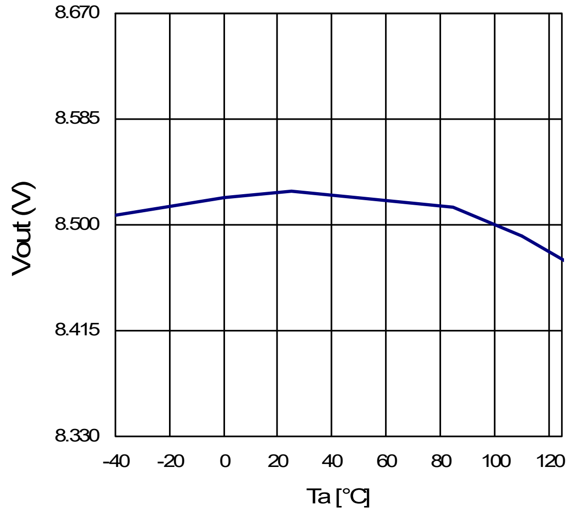
R1518x33xx



R1518x50xx

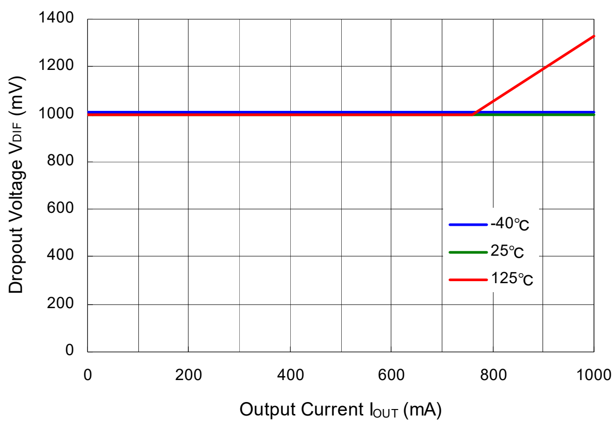


R1518x85xx

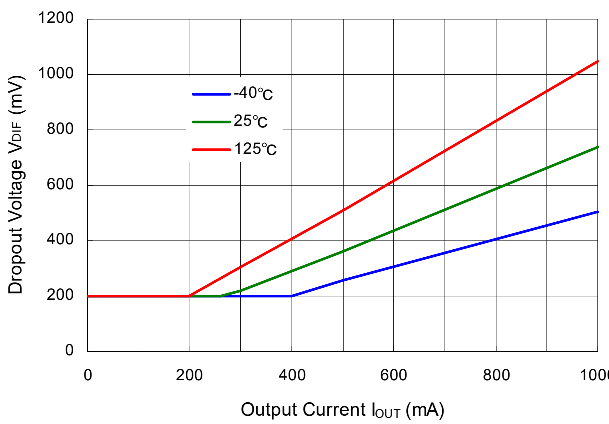


5) Dropout Voltage vs. Output Current

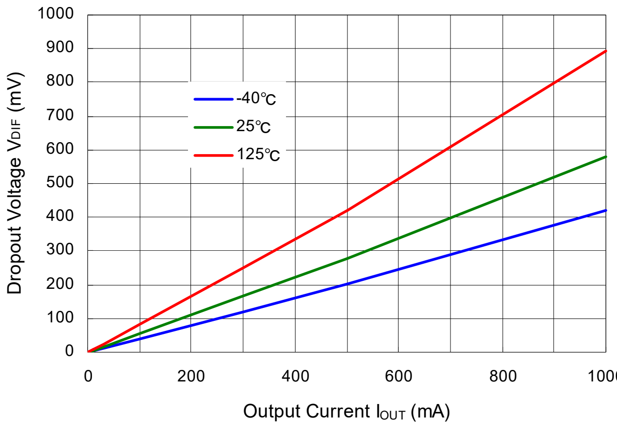
R1518x25xx, R1518x001C



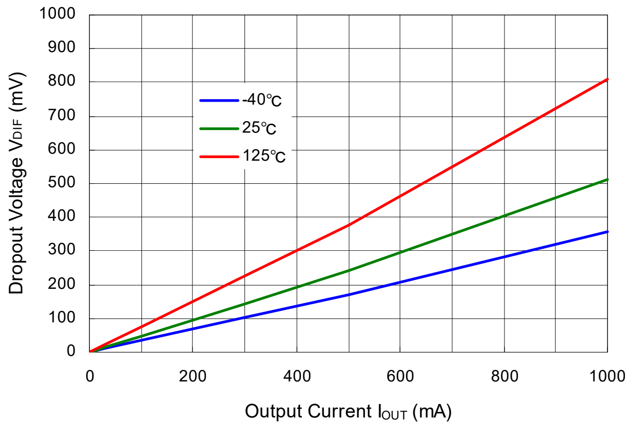
R1518x33xx



R1518x50xx

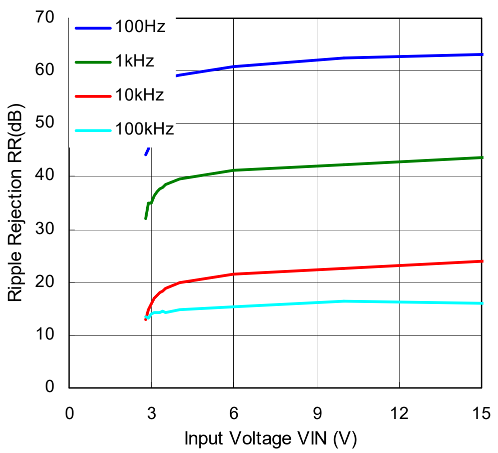


R1518x85xx

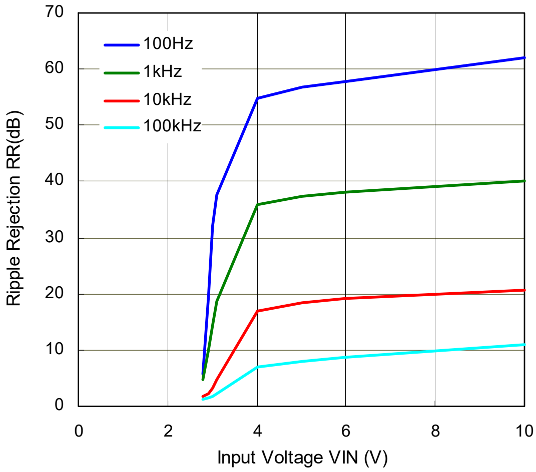


6) Ripple Rejection vs. Input Voltage (Ta = 25°C, Ripple = 0.2 Vpp)

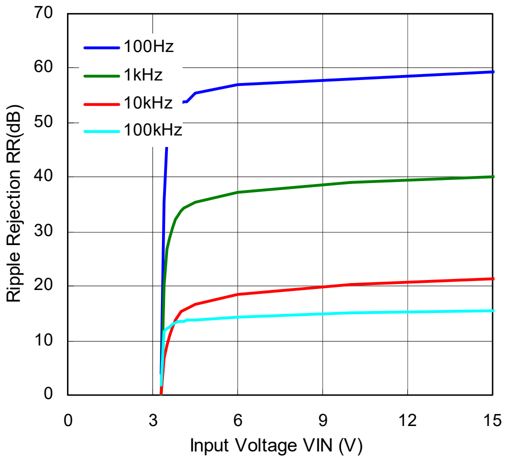
R1518x25xx, R1518x001C (I_{OUT} = 1 mA)



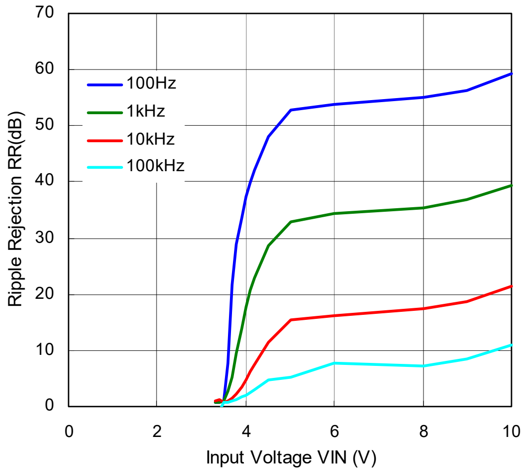
R1518x25xx, R1518x001C (I_{OUT} = 300 mA)



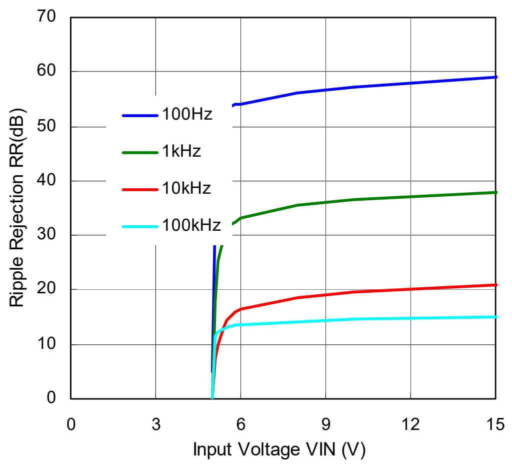
R1518x33xx (I_{OUT} = 1 mA)



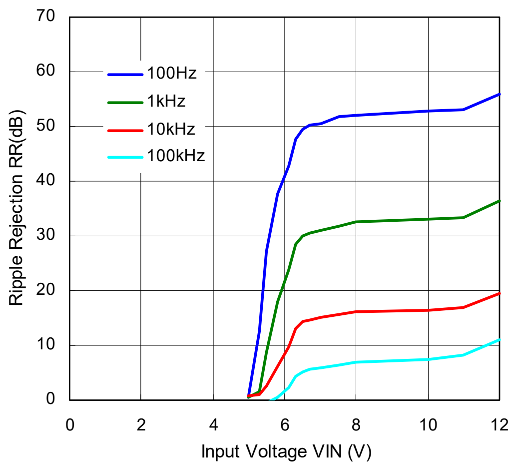
R1518x33xx (I_{OUT} = 300 mA)



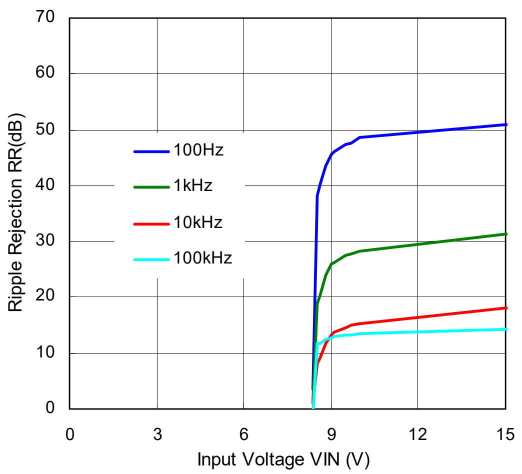
R1518x50xx (I_{OUT} = 1 mA)



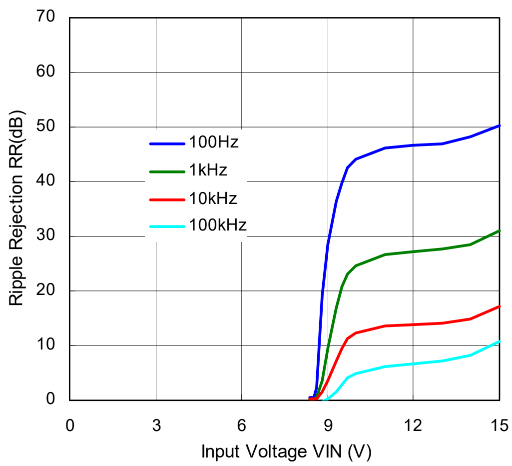
R1518x50xx (I_{OUT} = 300 mA)



R1518x85xx (I_{OUT} = 1 mA)

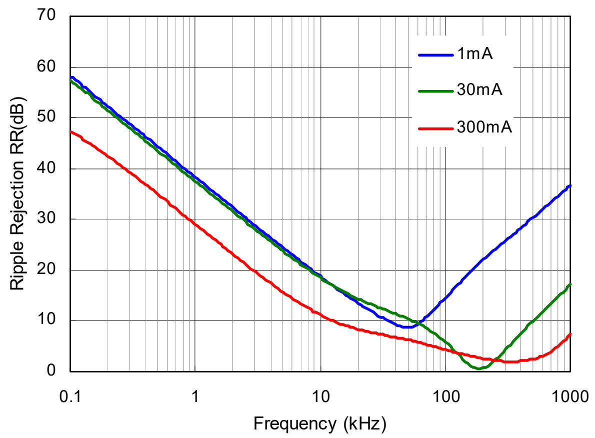


R1518x85xx (I_{OUT} = 300 mA)

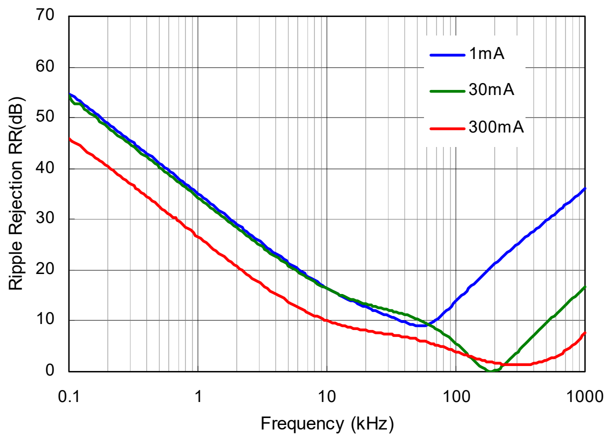


7) Ripple Rejection vs. Frequency (Ta = 25°C, Ripple = 0.2 Vpp)

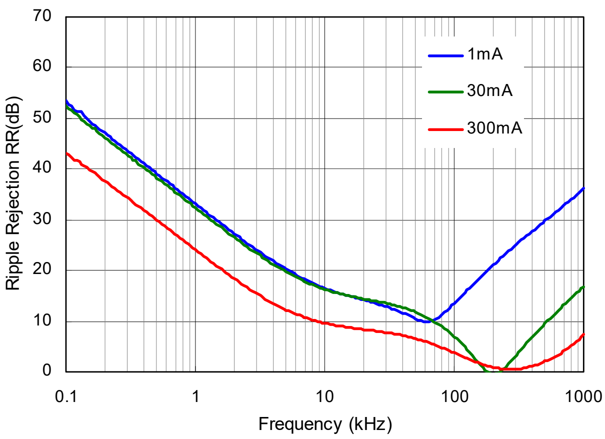
R1518x25xx, R1518x001C



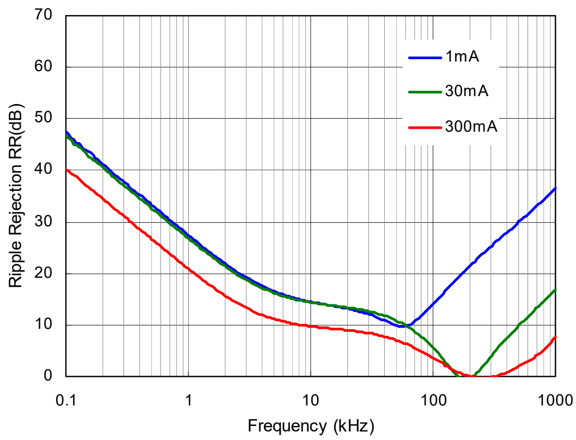
R1518x33xx



R1518x50xx

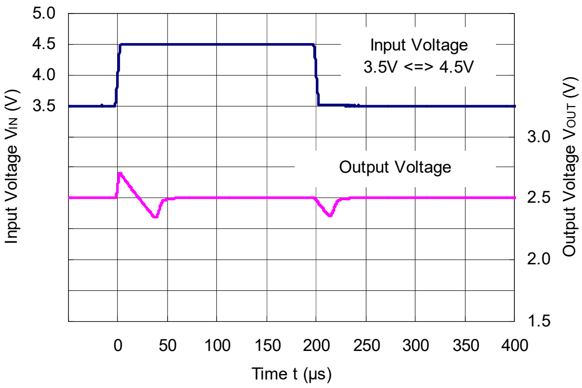


R1518x85xx

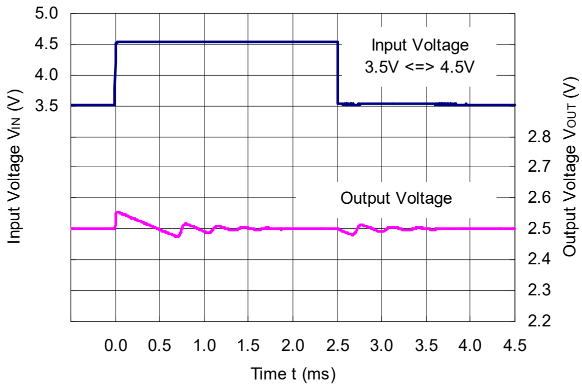


8) Input Transient Response (Ta = 25°C, I_{OUT} = 1 mA, tr = tf = 5 μs)

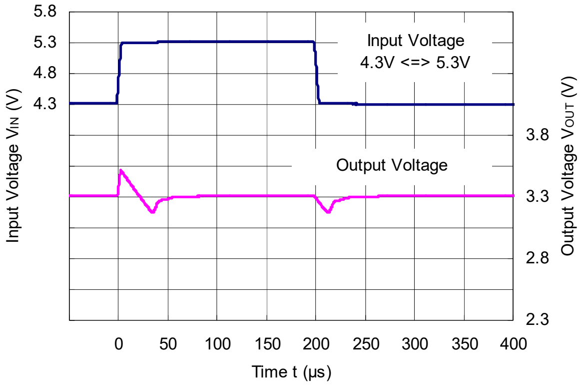
R1518x25xx, R1518x001C (C2 = 0.1 μF)



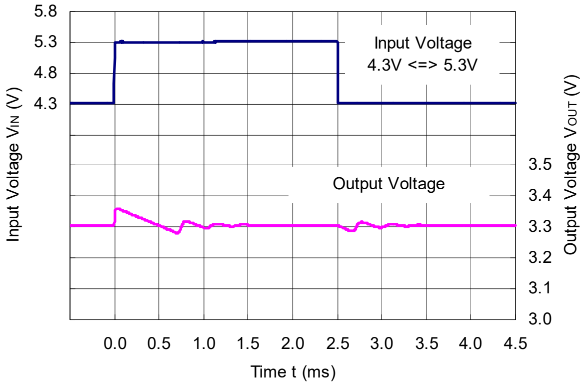
R1518x25xx, R1518x001C (C2 = 10 μF)



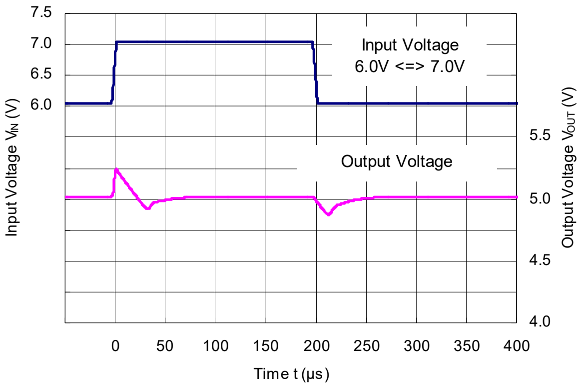
R1518x33xx (C2 = 0.1 μF)



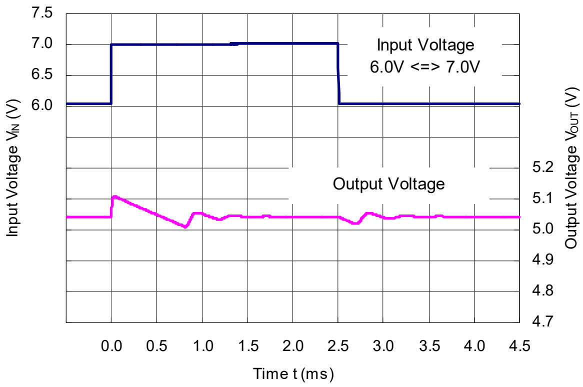
R1518x33xx (C2 = 10 μF)



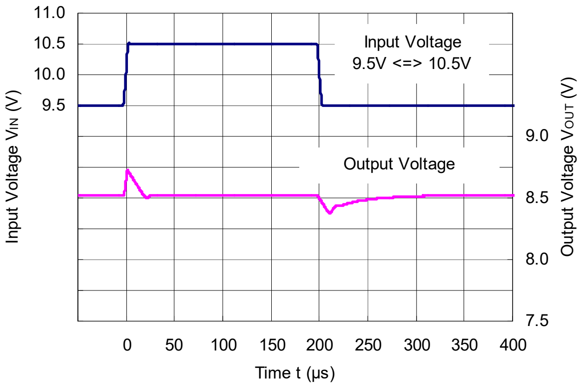
R1518x50xx (C2 = 0.1 μF)



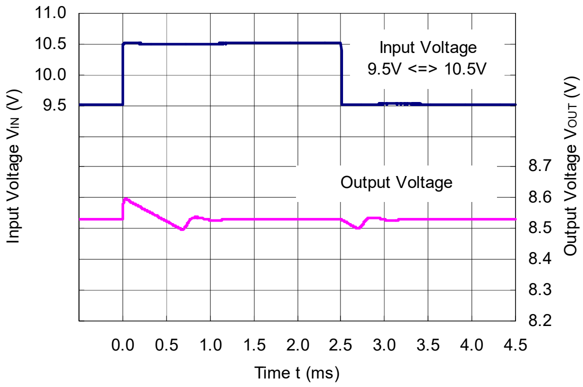
R1518x50xx (C2 = 10 μF)



R1518x85xx (C2 = 0.1 μF)

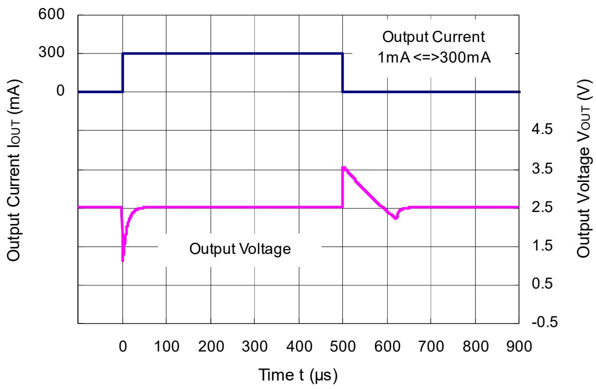


R1518x85xx (C2 = 10 μF)

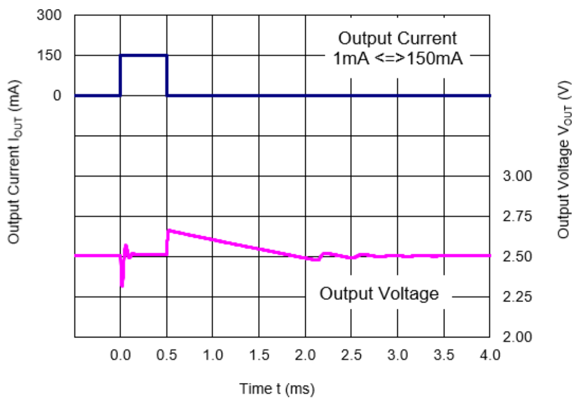


9) Load Transient Response (Ta = 25°C, $V_{IN} = V_{OUT} + 1.0$ V, tr = tf = 0.5 μs)

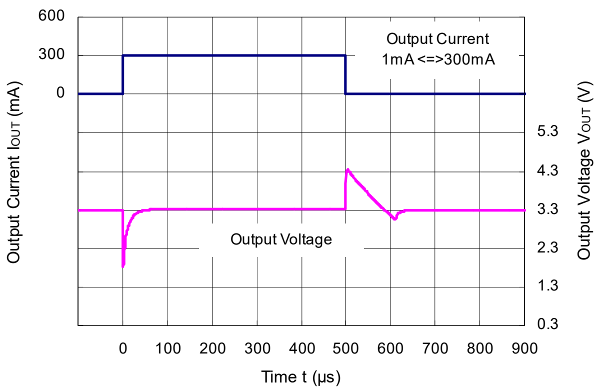
R1518x25xx, R1518x001C (C2 = 0.1 μF)



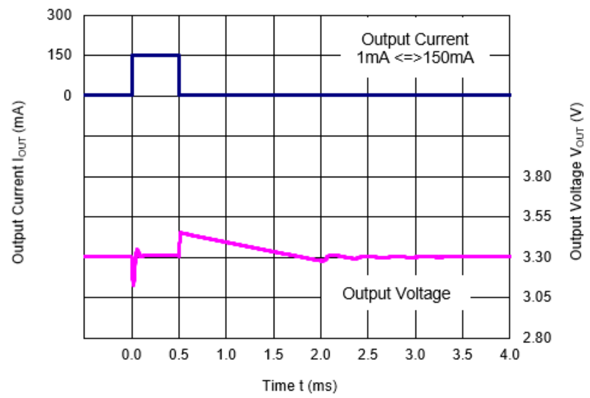
R1518x25xx, R1518x001C (C2 = 10 μF)



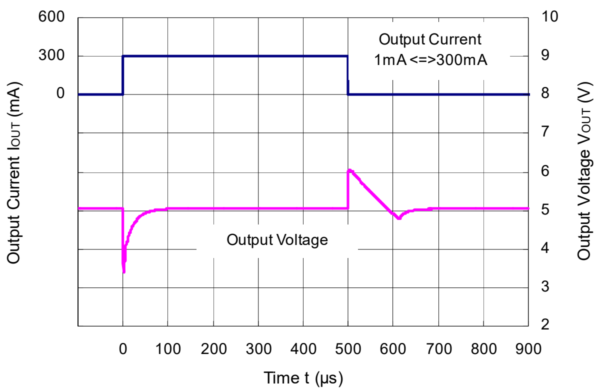
R1518x33xx (C2 = 0.1 µF)



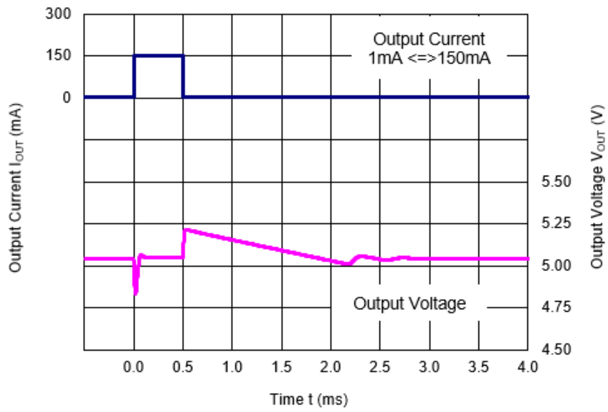
R1518x33xx (C2 = 10 µF)



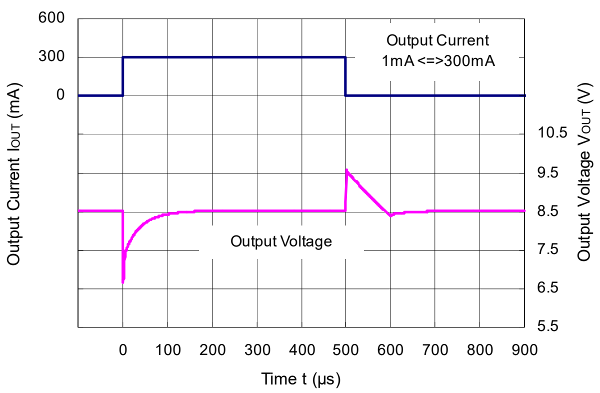
R1518x50xx (C2 = 0.1 µF)



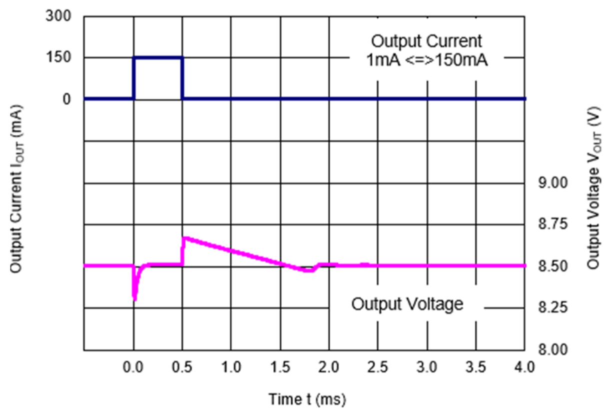
R1518x50xx (C2 = 10 µF)



R1518x85xx (C2 = 0.1 µF)

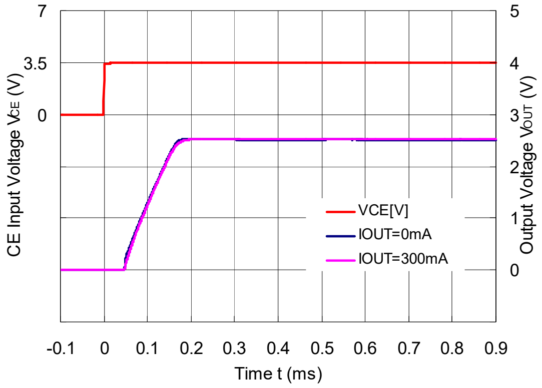


R1518x85xx (C2 = 10 µF)

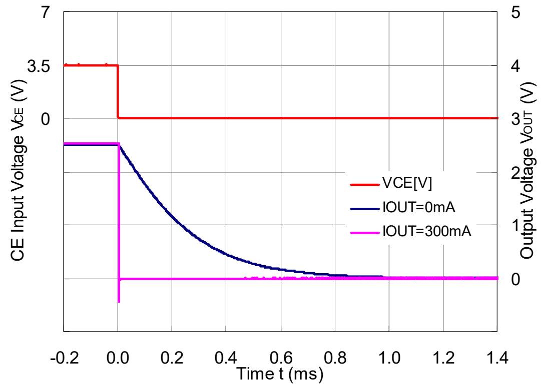


10) CE Transient Response (Ta = 25°C)

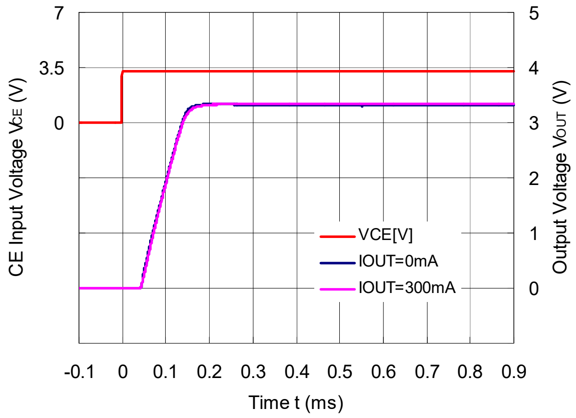
R1518x25xB/D, R1518x001C (C2 = 0.1 μF)



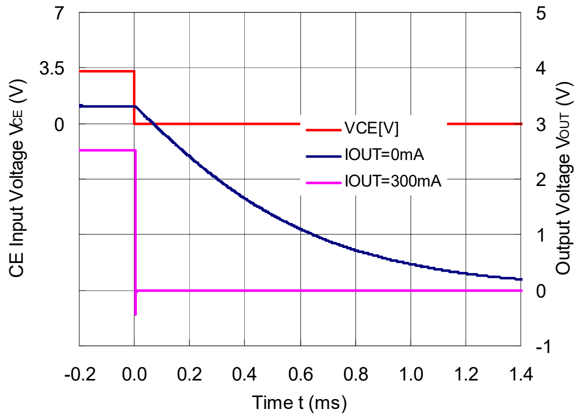
R1518x25xD (C2 = 0.1 μF)



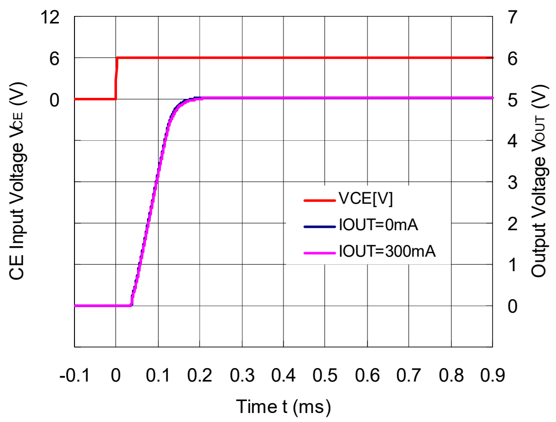
R1518x33xB/D (C2 = 0.1 μF)



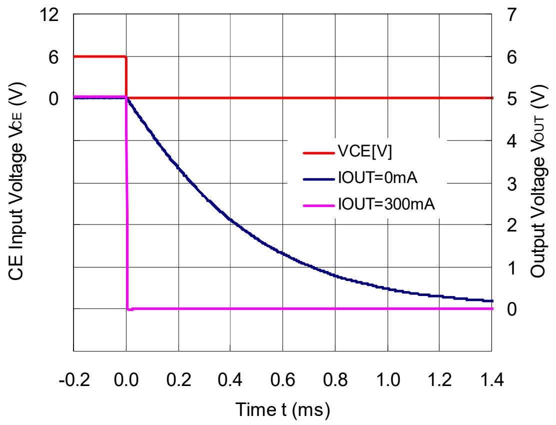
R1518x33xD (C2 = 0.1 μF)



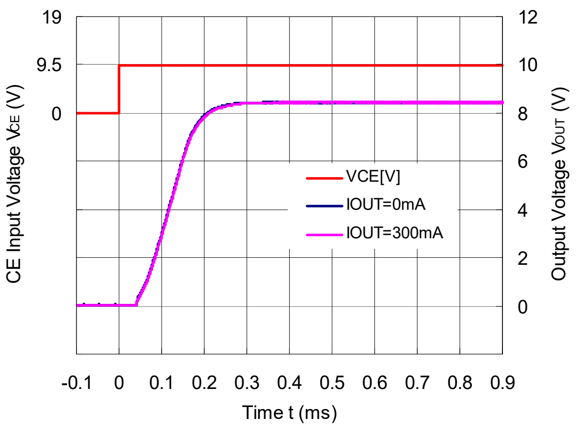
R1518x50xB/D (C2 = 0.1 μF)



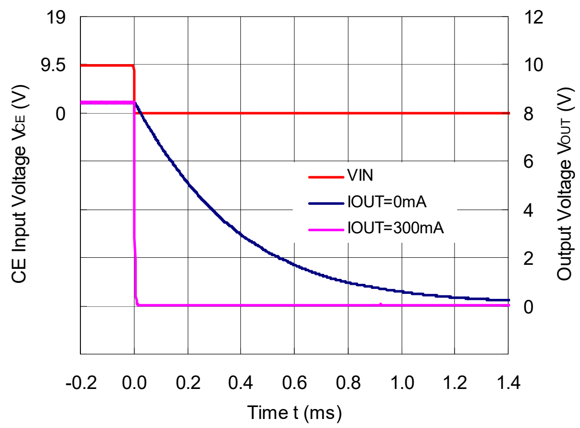
R1518x50xD (C2 = 0.1 μF)



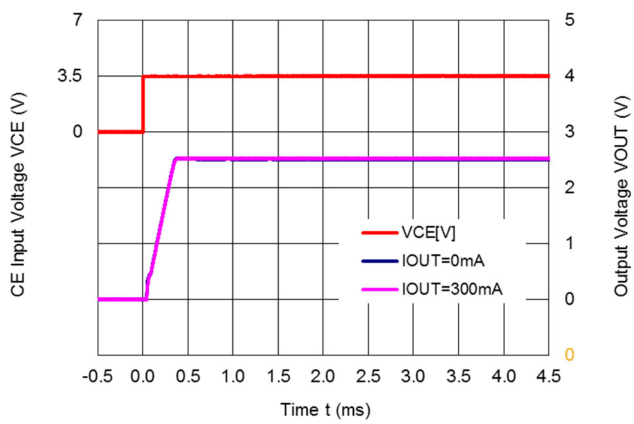
R1518x85xB/D (C2 = 0.1 μF)



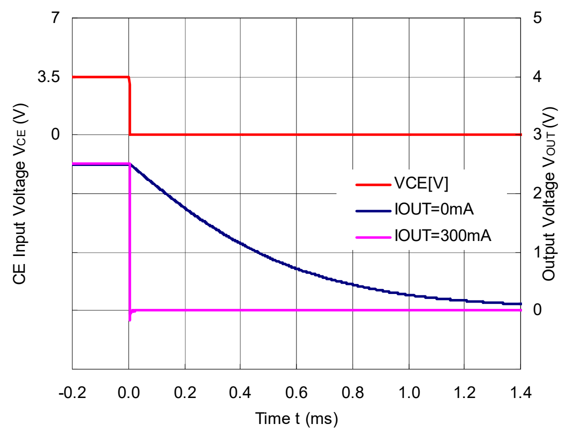
R1518x85xD (C2 = 0.1 μF)



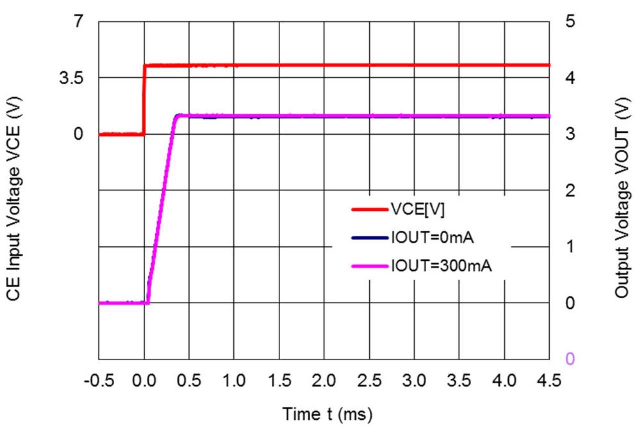
R1518x251E/F (C2 = 0.1 μF, C_D = 1 nF)



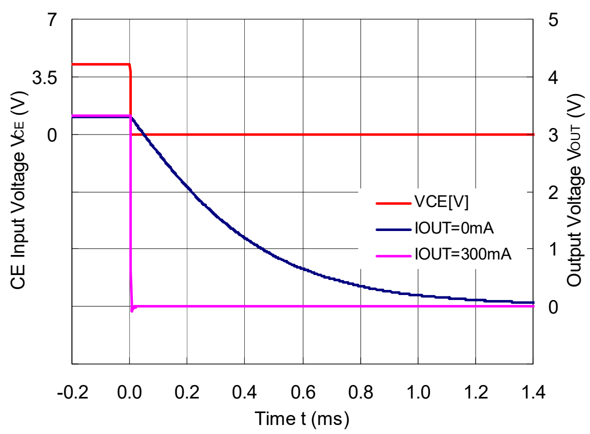
R1518x25xF (C2 = 0.1 μF, C_D = 1 nF)



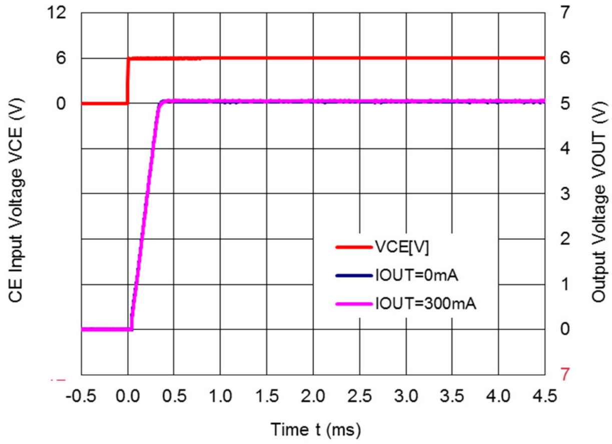
R1518x331E/F (C2 = 0.1 μF, C_D = 1 nF)



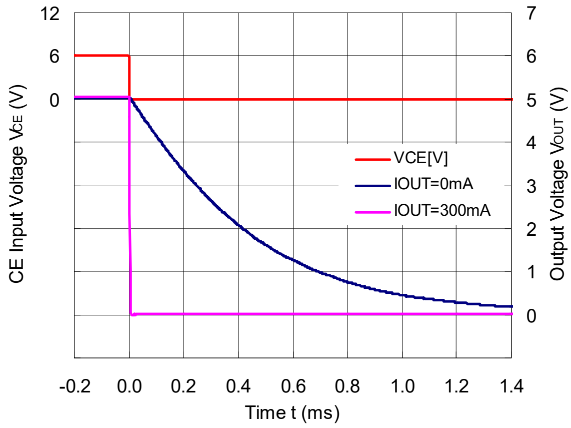
R1518x33xF (C2 = 0.1 μF, C_D = 1 nF)



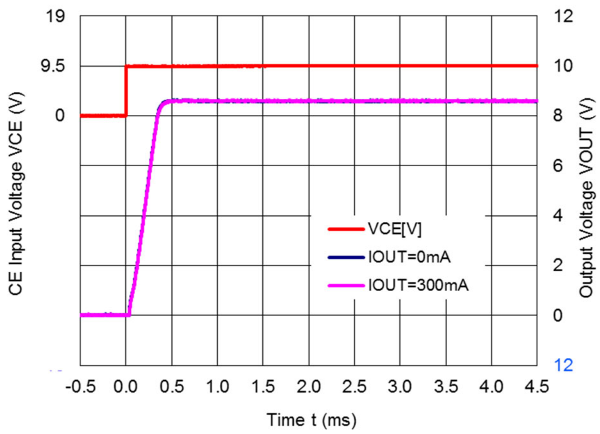
R1518x501E/F (C2 = 0.1 μF, CD = 1 nF)



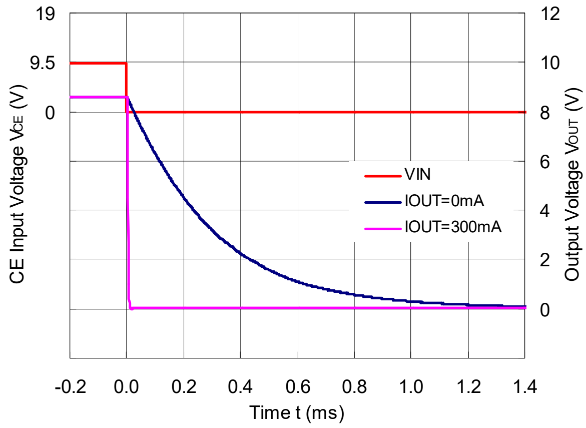
R1518x50xF (C2 = 0.1 μF, CD = 1 nF)



R1518x851E/F (C2 = 0.1 μF, CD = 1 nF)

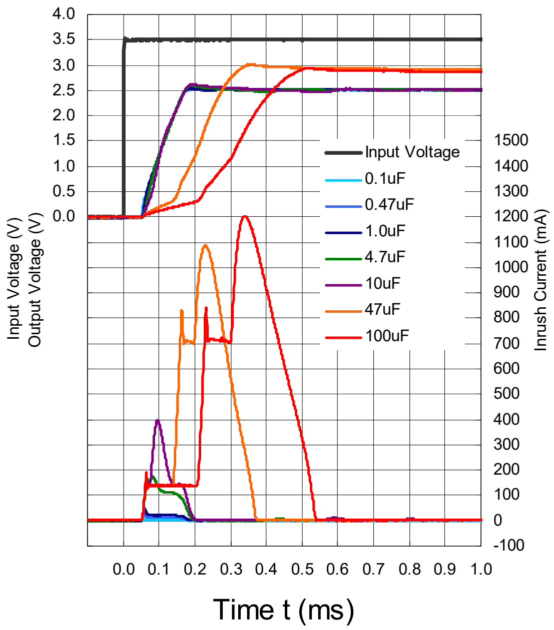


R1518x85xF (C2 = 0.1 μF, CD = 1 nF)

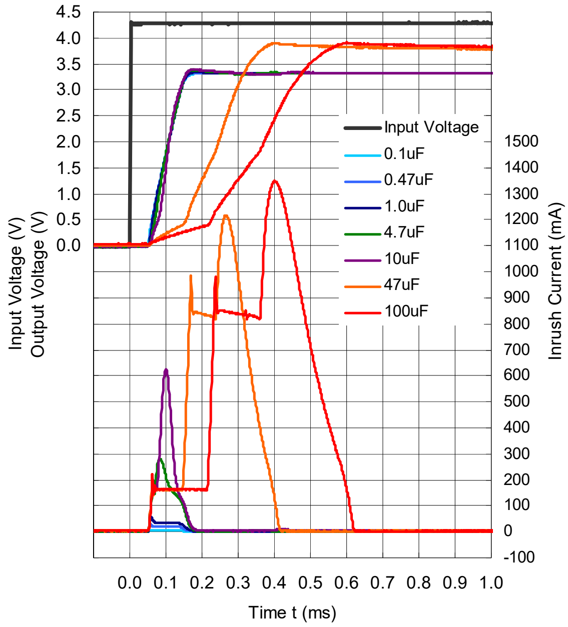


11) Inrush Current Prevention Circuit (Ta = 25°C, I_{OUT} = 1 mA)

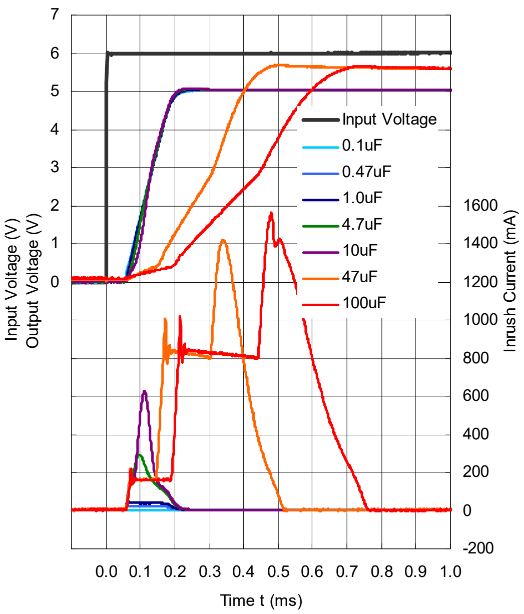
R1518x25xB/D, R1518x001C



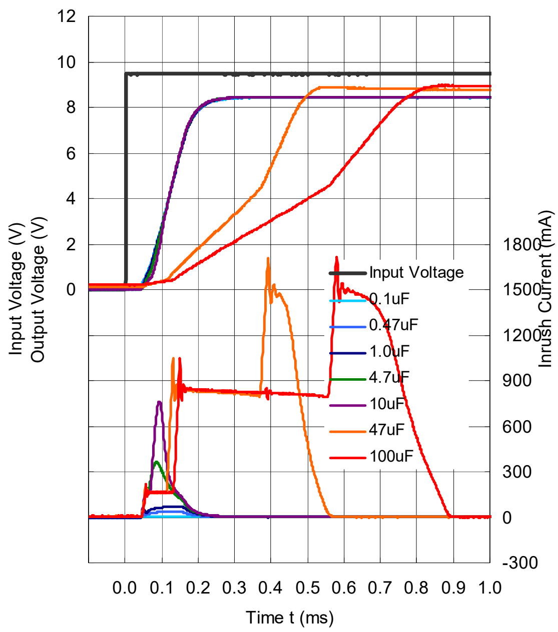
R1518x33xB/D



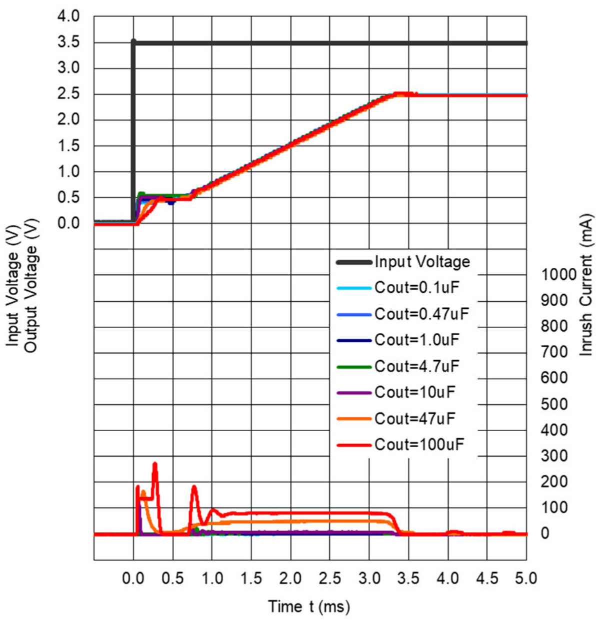
R1518x50xB/D



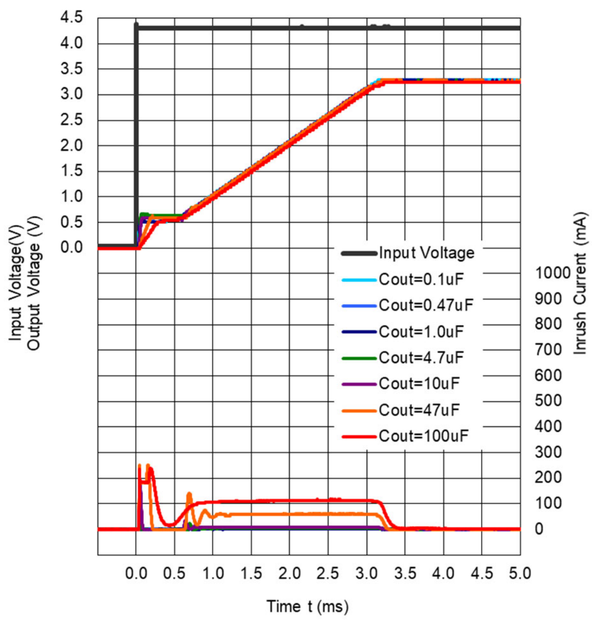
R1518x85xB/D



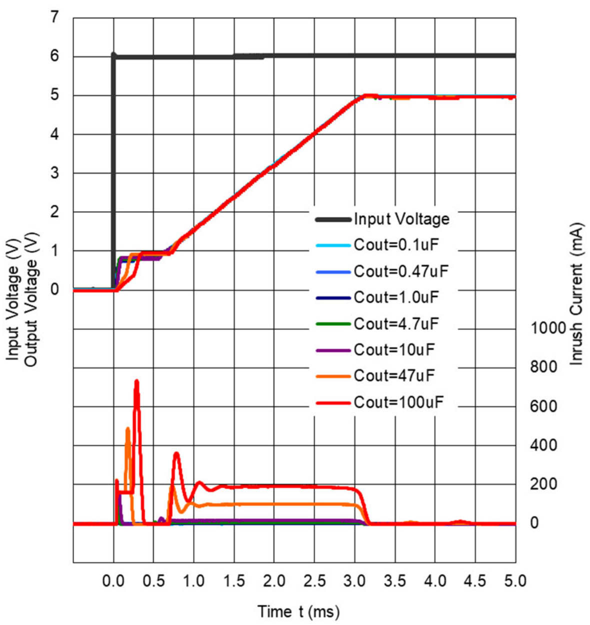
R1518x251E/F (C_D = 10 nF)



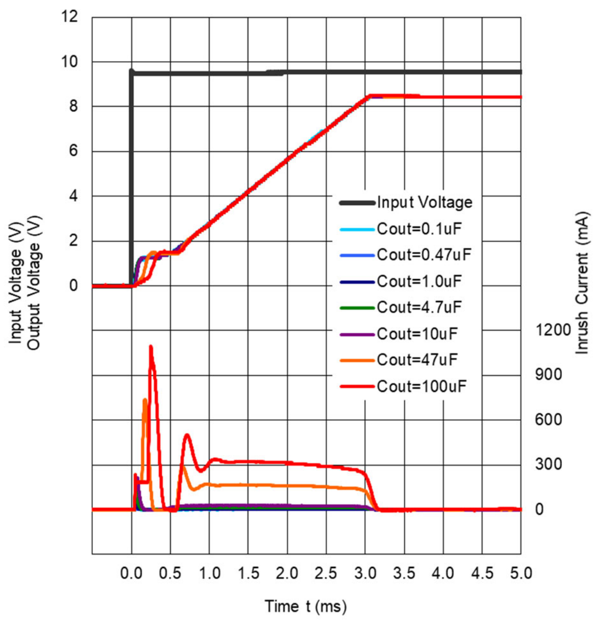
R1518x331E/F (C_D = 10 nF)



R1518x501E/F (C_D = 10 nF)



R1518x851E/F (C_D = 10 nF)

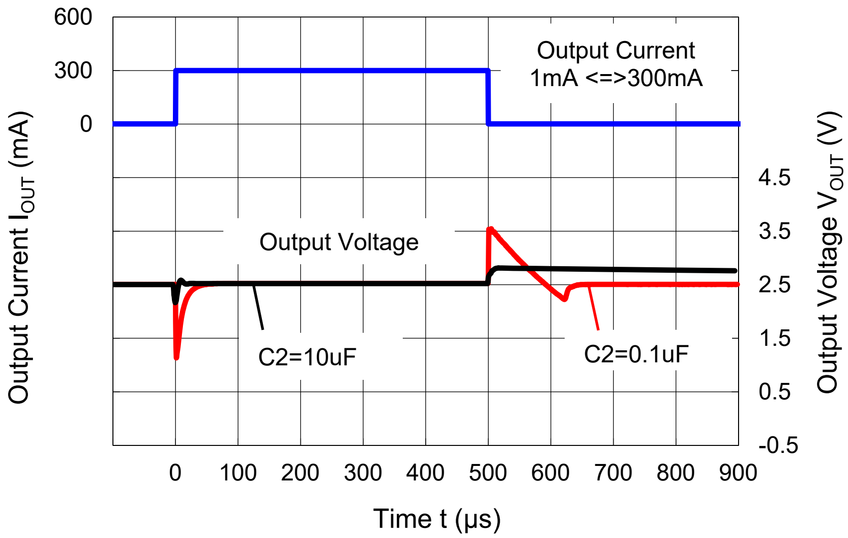


Load Transient vs. Output Capacity (C2)

R1518 performs a stable operation by using 0.1 μF of ceramic capacitor as the output capacitor. However, the variation of output voltage may not meet the demand of the system when input voltage and load current vary. In such cases, the variation of output voltage can be minimized significantly by using 10 μF or higher ceramic capacitor. When using a high-capacity electrolytic capacitor for the output line, place the electrolytic capacitor a few centimeters apart from the IC after arranging the ceramic capacitor close to the IC.

Load Transient Response

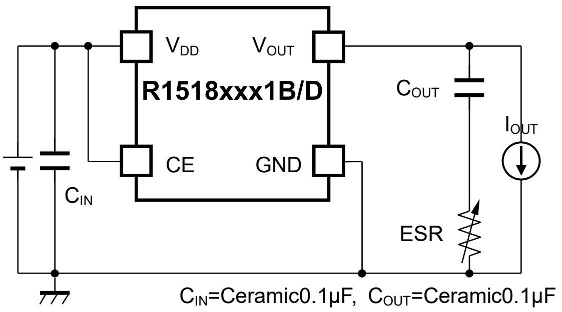
R1518x25xx



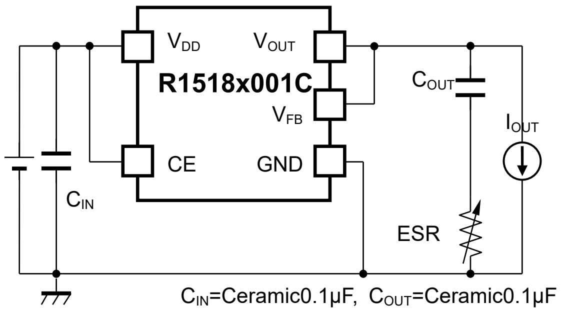
ESR vs. Output Current

It is recommended that a ceramic type capacitor be used for this device. However, other types of capacitors having lower ESR can also be used. The relation between the output current (I_{OUT}) and the ESR of output capacitor is shown below.

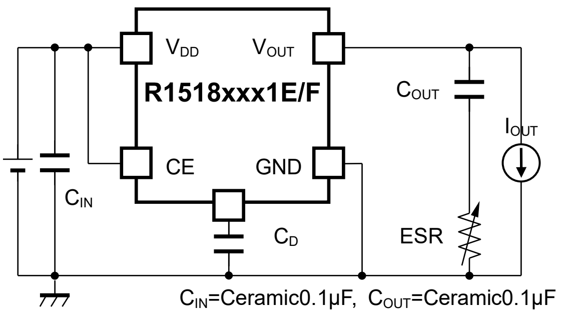
R1518xxx1B/D Test Circuit



R1518x001C Test Circuit



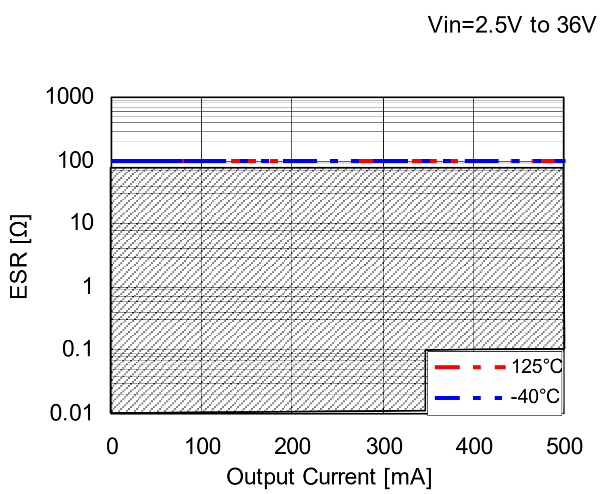
R1518xxx1E/F Test Circuit



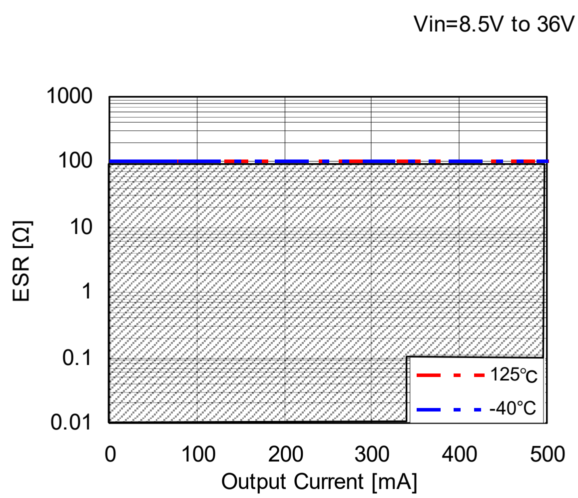
Measurement conditions

Frequency Band: 10 Hz to 2 MHz
Measurement Temperature: −40°C to 125°C
Hatched area: Noise level is 40 μV (average) or below
Capacitor: C1 = Ceramic 0.1 μF, C2 = 0.1 μF

R1518x25xx Output Current I_{OUT} vs. ESR



R1518x85xx Output Current I_{OUT} vs. ESR



PACKAGE INFORMATION

POWER DISSIPATION (HSOP-6J)

Ver. A

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.

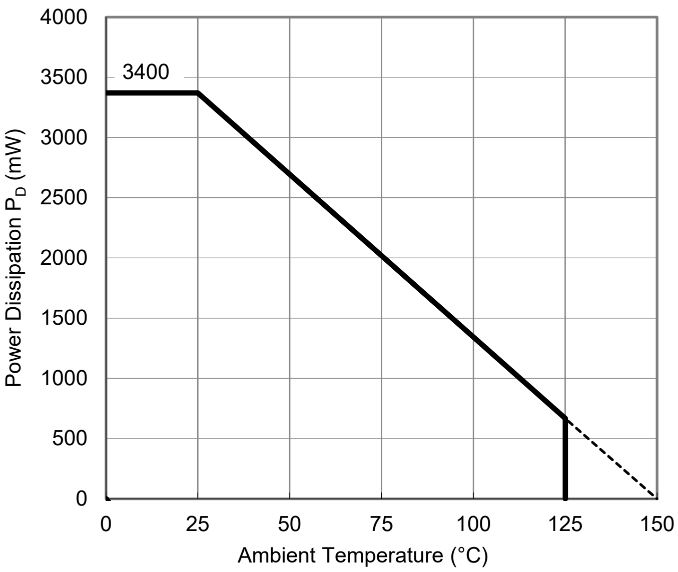
Measurement Conditions

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 × 28 pcs

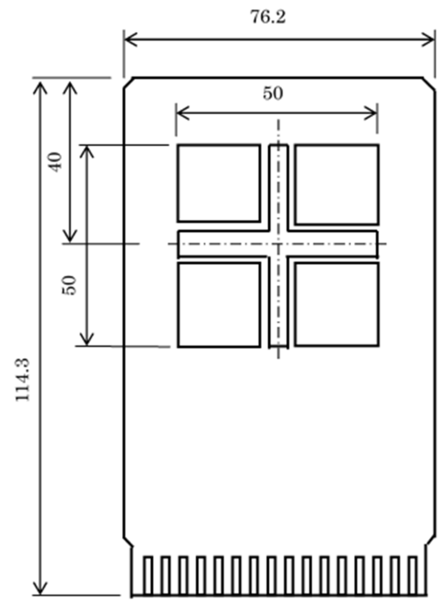
Measurement Result (Ta = 25°C, Tjmax = 150°C)

Item	Measurement Result
Power Dissipation	3400 mW
Thermal Resistance (θja)	θja = 37°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 7°C/W

θja: Junction-to-Ambient Thermal Resistance
ψjt: Junction-to-Top Thermal Characterization Parameter

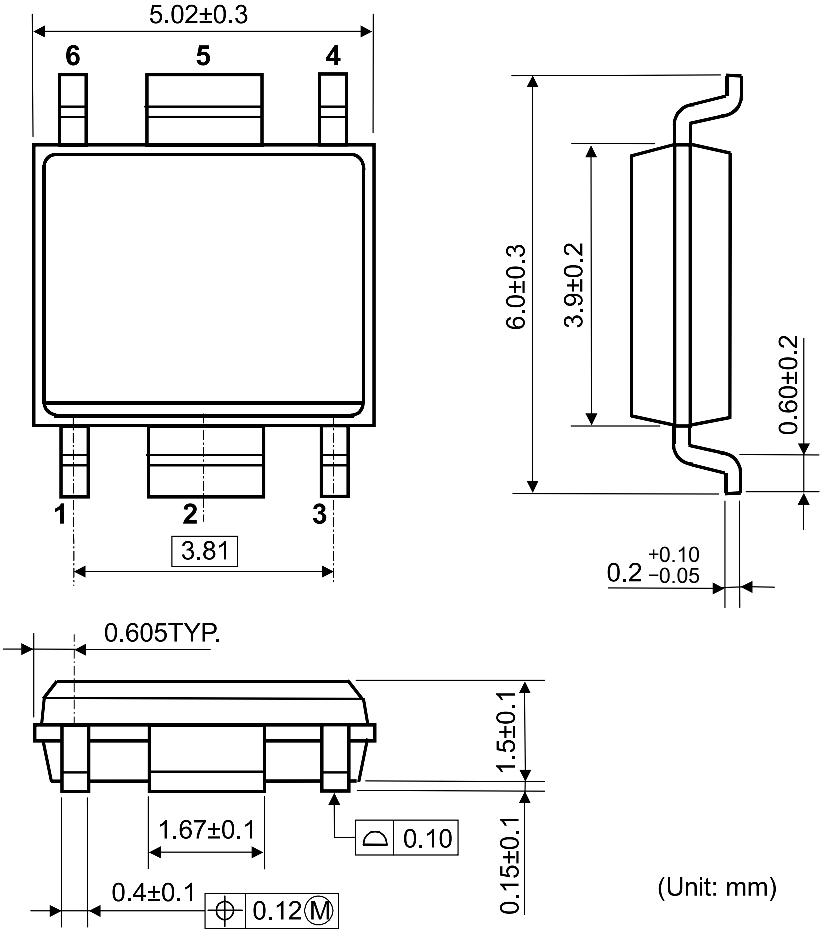


Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (HSOP-6J)

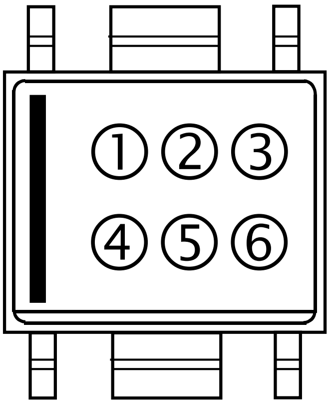


HSOP-6J Package Dimensions

MK-R1518S-JYEY-B

①②③④: Product Code … **Refer to "*R1518S MARK SPECIFICATION TABLE (HSOP-6J)*"**

⑤⑥: Lot Number … Alphanumeric Serial Number



HSOP-6J 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.

MK-R1518S-JYEY-B

R1518S MARK SPECIFICATION TABLE (HSOP-6J)

R1518Sxx1B

Product Name	①②③④	V_{SET}
R1518S251B	**W 1 2 5**	2.5 V
R1518S331B	**W 1 3 3**	3.3 V
R1518S341B	**W 1 3 4**	3.4 V
R1518S501B	**W 1 5 0**	5.0 V
R1518S601B	**W 1 6 0**	6.0 V
R1518S851B	**W 1 8 5**	8.5 V
R1518S901B	**W 1 9 0**	9.0 V

R1518S001C

Product Name	①②③④	V_{SET}
R1518S001C	**W 2 0 1**	-

R1518Sxx1D

Product Name	①②③④	V_{SET}
R1518S251D	**W 3 2 5**	2.5 V
R1518S331D	**W 3 3 3**	3.3 V
R1518S341D	**W 3 3 4**	3.4 V
R1518S501D	**W 3 5 0**	5.0 V
R1518S601D	**W 3 6 0**	6.0 V
R1518S851D	**W 3 8 5**	8.5 V
R1518S901D	**W 3 9 0**	9.0 V

R1518Sxx1E

Product Name	①②③④	V_{SET}
R1518S251E	**W 4 2 5**	2.5 V
R1518S331E	**W 4 3 3**	3.3 V
R1518S341E	**W 4 3 4**	3.4 V
R1518S501E	**W 4 5 0**	5.0 V
R1518S601E	**W 4 6 0**	6.0 V
R1518S851E	**W 4 8 5**	8.5 V
R1518S901E	**W 4 9 0**	9.0 V

R1518Sxx1F

Product Name	①②③④	V_{SET}
R1518S251F	**W 5 2 5**	2.5 V
R1518S331F	**W 5 3 3**	3.3 V
R1518S341F	**W 5 3 4**	3.4 V
R1518S501F	**W 5 5 0**	5.0 V
R1518S601F	**W 5 6 0**	6.0 V
R1518S851F	**W 5 8 5**	8.5 V
R1518S901F	**W 5 9 0**	9.0 V

POWER DISSIPATION (TO-252-5-P2)

Ver. A

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 × 21 pcs

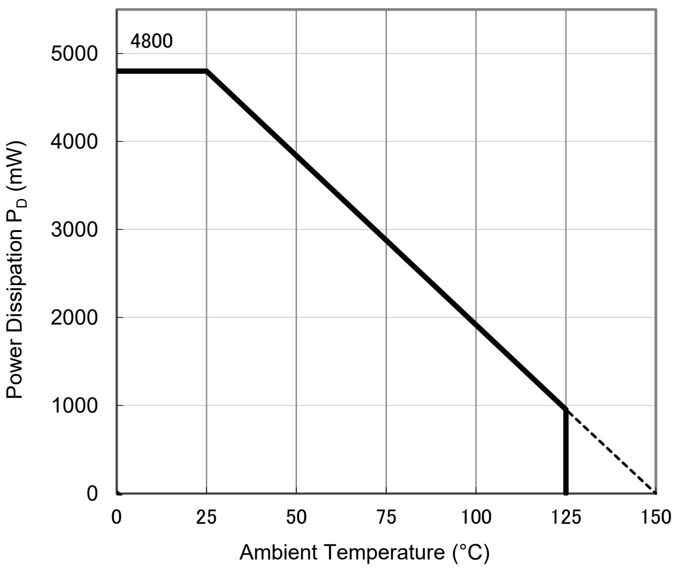
Measurement Result

(Ta = 25°C, Tjmax = 150°C)

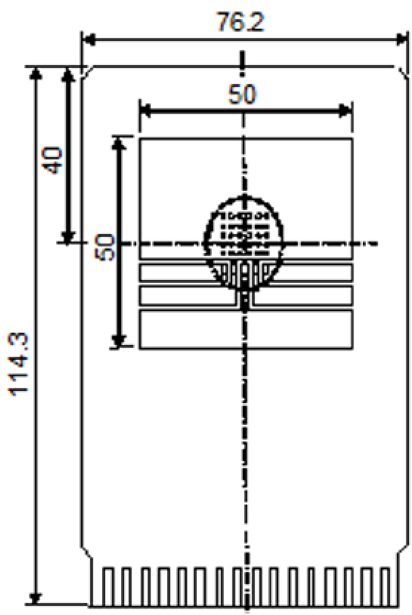
Item	Measurement Result
Power Dissipation	4800 mW
Thermal Resistance (θja)	θja = 26°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 7°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



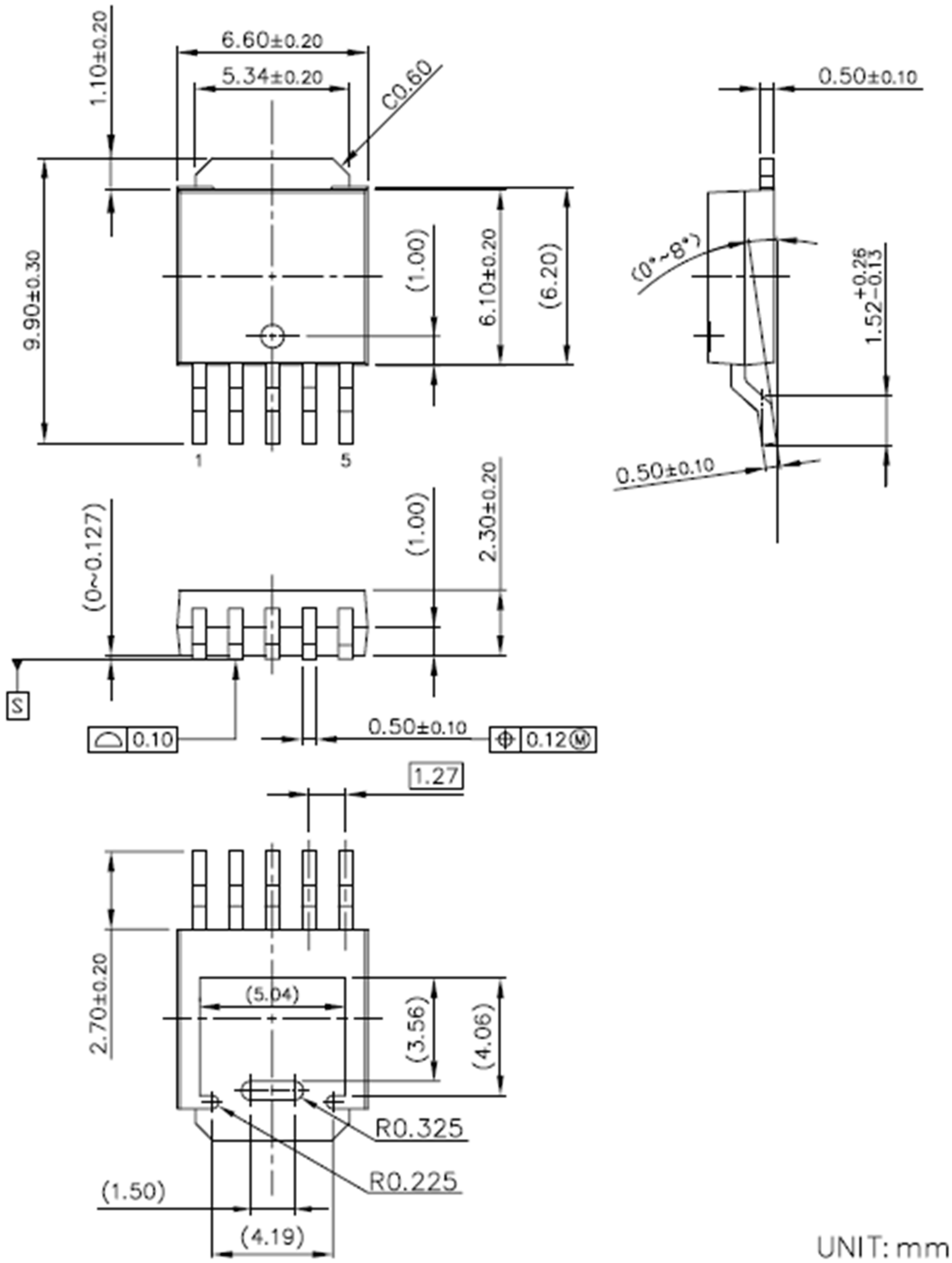
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

PACKAGE DIMENSIONS (TO-252-5-P2)

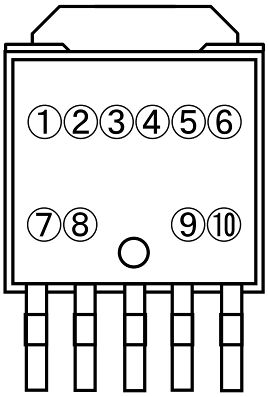
Ver. A



TO-252-5-P2 Package Dimensions

MK-R1518J-JYEY-B

①②③④⑤⑥⑦⑧: Product Code … Refer to “R1518J MARK SPECIFICATION TABLE (TO-252-5-P2)”
⑨⑩: Lot Number … Alphanumeric Serial Number



TO-252-5-P2 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.

MK-R1518J-JYEY-B

R1518J MARK SPECIFICATION TABLE (TO-252-5-P2)

Note: ⑧Underbar indicates a blank

R1518Jxx1B

Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1518J251B	**L 1 J 2 5 1 B _**	2.5 V
R1518J331B	**L 1 J 3 3 1 B _**	3.3 V
R1518J341B	**L 1 J 3 4 1 B _**	3.4 V
R1518J501B	**L 1 J 5 0 1 B _**	5.0 V
R1518J601B	**L 1 J 6 0 1 B _**	6.0 V
R1518J851B	**L 1 J 8 5 1 B _**	8.5 V
R1518J901B	**L 1 J 9 0 1 B _**	9.0 V

R1518J001C

Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1518J001C	**L 2 J 0 0 1 C _**	-

R1518Jxx1D

Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1518J251D	**L 3 J 2 5 1 D _**	2.5 V
R1518J331D	**L 3 J 3 3 1 D _**	3.3 V
R1518J341D	**L 3 J 3 4 1 D _**	3.4 V
R1518J501D	**L 3 J 5 0 1 D _**	5.0 V
R1518J601D	**L 3 J 6 0 1 D _**	6.0 V
R1518J851D	**L 3 J 8 5 1 D _**	8.5 V
R1518J901D	**L 3 J 9 0 1 D _**	9.0 V

R1518Jxx1E

Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1518J251E	**L 4 J 2 5 1 E _**	2.5 V
R1518J331E	**L 4 J 3 3 1 E _**	3.3 V
R1518J341E	**L 4 J 3 4 1 E _**	3.4 V
R1518J501E	**L 4 J 5 0 1 E _**	5.0 V
R1518J601E	**L 4 J 6 0 1 E _**	6.0 V
R1518J851E	**L 4 J 8 5 1 E _**	8.5 V
R1518J901E	**L 4 J 9 0 1 E _**	9.0 V

R1518Jxx1F

Product Name	①②③④⑤⑥⑦⑧	V_{SET}
R1518J251F	**L 5 J 2 5 1 F _**	2.5 V
R1518J331F	**L 5 J 3 3 1 F _**	3.3 V
R1518J341F	**L 5 J 3 4 1 F _**	3.4 V
R1518J501F	**L 5 J 5 0 1 F _**	5.0 V
R1518J601F	**L 5 J 6 0 1 F _**	6.0 V
R1518J851F	**L 5 J 8 5 1 F _**	8.5 V
R1518J901F	**L 5 J 9 0 1 F _**	9.0 V

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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.