CMOS LDO Regulators for Automotive

1ch 200mA
CMOS LDO Regulators

BUxxJA2VG-C series

●General Description
BUxxJA2VG-C series are high-performance CMOS LDO regulators with output current ability of up to 200-mA. These devices have excellent noise and load response characteristics despite of its low circuit current consumption of 33µA. They are most appropriate for various applications such as power supplies for radar modules and camera modules.

●Key Specifications
- Input Power Supply Voltage Range: 1.7V to 6.0V
- Output Current Range: 0 to 200mA
- Operating Temperature Range: -40℃ to +125℃
- Output Voltage Lineup: 1.8V,3.3V
- Output Voltage Accuracy: ±2.0%
- Circuit Current: 33µA(Typ.)
- Standby Current: 0µA (Typ.)

●Package
	W(Typ.) x D(Typ.) x H(Max.)
SSOP5	2.90mm x 2.80mm x 1.25mm

●Features
- AEC-Q100 qualified(Note 1)
- High Output Voltage Accuracy: ±2.0% (In all recommended conditions)
- High Ripple Rejection: 68 dB (Typ, 1 kHz,)
- Compatible with small ceramic capacitor (Cin=Cout=0.47 µF)
- Low Current Consumption: 33 µA
- Output Voltage ON/OFF control
- Built-in Over Current Protection Circuit (OCP)
- Built-in Thermal Shutdown Circuit (TSD)
- Package SSOP5 is similar to SOT23-5(JEDEC)

(Note1:Grade1)

●Applications
- Automotive equipments.
- Radar modules
- Camera modules

●Typical Application Circuit

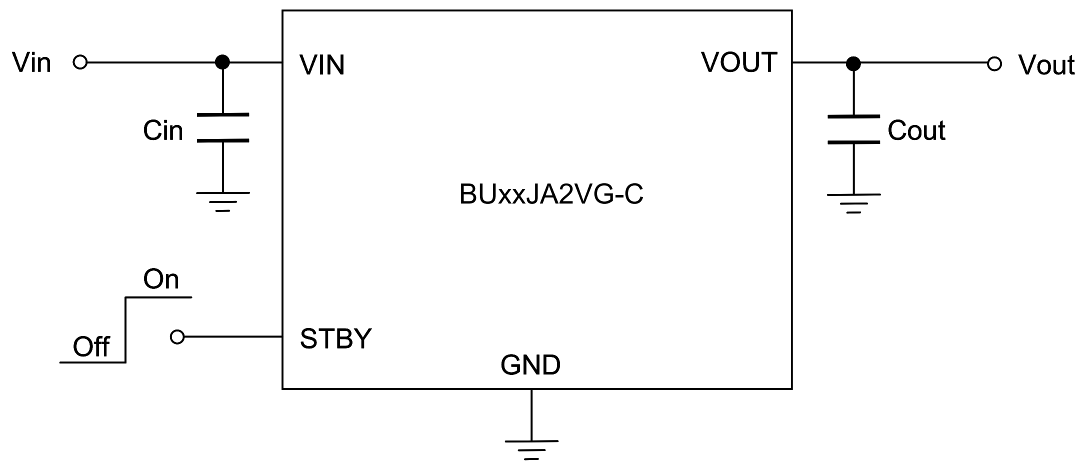
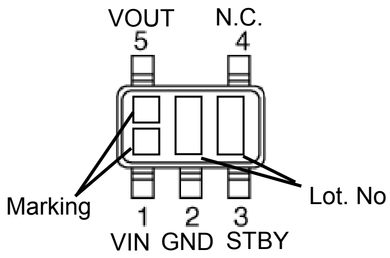


Figure 1. Typical Application Circuit

○Product structure：Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays

●**Pin Configuration**



●**Pin Description**

Pin No.	Symbol	Function
1	VIN	Input Pin
2	GND	GND Pin
3	STBY	Output Control Pin (High:ON, Low:OFF)
4	N.C.	No Connect
5	VOUT	Output Pin

●**Block Diagram**

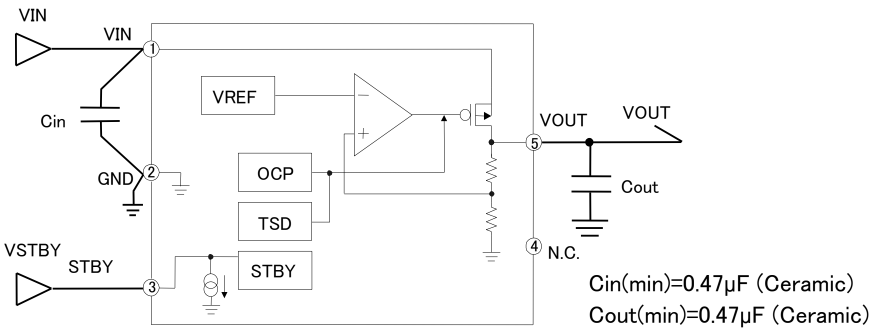


Figure 2. Block diagram

●Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Maximum Power Supply Voltage Range	V_{MAX}	-0.3 to +6.5	V
Power Dissipation	Pd	675(*1)	mW
Maximum Junction Temperature	Tjmax	+150	℃
Operating Temperature Range	Topr	-40 to +125	℃
Storage Temperature Range	Tstg	-55 to +150	℃

(*1) Derate by 5.6mW/℃ when operating above Ta=25℃.(When mounted on a board 70mm×70mm×1.6mm glass-epoxy board, two layer)

●Recommended Operating Ratings

Parameter	Symbol	Limit	Unit
Input Power Supply Voltage Range	V_{IN}	1.7 to 6.0	V
Maximum Output Current	I_{MAX}	200	mA

●Recommended Operating Conditions

Parameter	Symbol	Rating			Unit	Conditions
		Min.	Typ.	Max.		
Input capacitor	Cin	0.47(*2)	1.0	—	μF	A ceramic capacitor is recommended.
Output capacitor	Cout	0.47(*2)	1.0	—	μF	A ceramic capacitor is recommended.

(*2) Set the value of the capacitor so that it does not fall below the minimum value. Take into consideration the temperature characteristics, DC device characteristics, and degradation with time.

●Thermal Characteristics (Note 1)

Parameter	Symbol	Typ.	Unit	Conditions
SSOP5				
Junction to Ambient	θ_{JA}	376.5	°C / W	1s (Note 2)
		185.4	°C / W	2s2p (Note 3)
Junction to Top Center of Case (Note 4)	Ψ_{JT}	40	°C / W	1s (Note 2)
		30	°C / W	2s2p (Note 3)

(Note 1) The thermal impedance is based on JESD51 - 2A (Still-Air) standard.
(Note 2) JESD51 - 3 standard FR4 114.3 mm × 76.2 mm × 1.6 mm 1-layer (1s)
(Top copper foil: ROHM recommended footprint + wiring to measure, 2 oz. copper.)
(Note 3) JESD51 -5 / -7 standard FR4 114.3 mm × 76.2 mm × 1.6 mm 4-layer（2s2p）
(Top copper foil: ROHM recommended footprint + wiring to measure
/ 2 inner layers copper foil area of PCB, copper foil area on the reverse side of PCB : 74.2 mm × 74.2 mm,
copper (top & reverse side / inner layers) 2oz. / 1oz.)
(Note 4) T_T : Top center of case's (mold) temperature

●Electrical Characteristics

(Unless otherwise noted, Ta=-40 to 125℃, $V_{IN}=V_{OUT}+1.0V$ (*3), V_{STBY}=1.5V, Cin=1μF, Cout=1μF.)

PARAMETER	Symbol	Limit MIN.	Limit TYP.	Limit MAX.	Unit	Conditions
Output Voltage	V_{OUT}	V_{OUT} ×0.98	V_{OUT}	V_{OUT} ×1.02	V	I_{OUT}=0 to 200mA, V_{OUT}≧2.5V, $V_{IN}=V_{OUT}$+0.5 to 6.0V V_{OUT}<2.5V, V_{IN}=3.0 to 6.0V Ta=-40 to +125℃ (*4,5,6)
Line Regulation	V_{DLI}	-	4	15	mV	I_{OUT}=10mA V_{OUT}≦2.5V, V_{IN}=3.0 to 6.0V
		-	6	20	mV	I_{OUT}=10mA V_{OUT}>2.5V, $V_{IN}=V_{OUT}$+0.5 to 6.0V
Load Regulation1	V_{DLO1}	-	0.5	5	mV	I_{OUT}=1 to 100mA
Load Regulation2	V_{DLO2}	-	1	10	mV	I_{OUT}=1 to 200mA
Dropout Voltage	V_{DROP}	-	160	315	mV	V_{OUT}=1.8V, I_{OUT}=100mA
		-	85	155	mV	V_{OUT}=3.3V, I_{OUT}=100mA
Maximum Output Current	I_{OMAX}	200	-	-	mA	$V_{IN}=V_{OUT}$+1.0V (*3)
Limit Current	I_{LMAX}	250	400	-	mA	Vo=V_{OUT}×0.98, Ta=25℃
Short Current	I_{SHORT}	-	100	200	mA	Vo=0V, Ta=25℃
Circuit Current	I_{GND}	-	33	80	μA	I_{OUT}=0mA
Circuit Current (STBY)	I_{CCST}	-	-	2.0	μA	V_{STBY}=0V
Ripple Rejection Ratio	R.R.	-	68	-	dB	V_{RR}=-20dBv,f_{RR}=1kHz, I_{OUT}=10mA,Ta=25℃
Load Transient Response	V_{LOT}	-	±65	-	mV	I_{OUT}=1 to 150mA,Trise=Tfall=1μs, $V_{IN}=V_{OUT}$+1.0V,Ta=25℃
Line Transient Response	V_{LIT}	-	±5	-	mV	$V_{IN}=V_{OUT}$+0.5 to V_{OUT}+1.0V, Trise=Tfall =10μs,Ta=25℃
Output Noise Voltage	V_{NOIS}	-	30	-	μVrms	Bandwidth 10 to 100kHz,Ta=25℃
Startup Time	T_{ST}	-	100	300	μsec	Output Voltage settled within tolerances (*7),Ta=25℃
STBY Control Voltage ON	V_{STBH}	1.1	-	V_{IN}	V	Ta=25℃
STBY Control Voltage OFF	V_{STBL}	-0.2	-	0.5	V	Ta=25℃
STBY Pin Current		-	-	4.0	μA	Ta=25℃

(*3) V_{IN}=3.5V for V_{OUT}<2.5V.

(*4) Operating Conditions are limited by Pd.

(*5) Typical values apply for Ta=25℃.

(*6) V_{IN}=3.0V to 6.0V for V_{OUT}<2.5V.

(*7) Startup time=time from EN assertion to V_{OUT}×0.98

●**Reference data BU18JA2VG- (Unless otherwise specified, Ta=25℃.)**

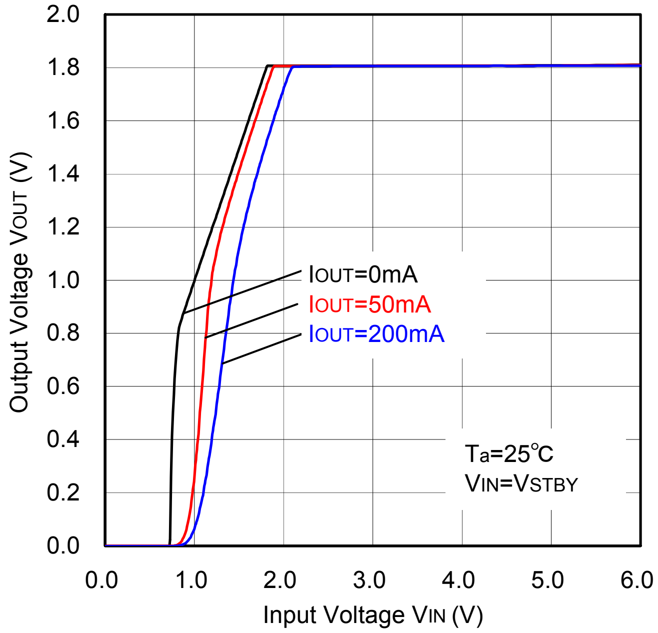


Figure 3. Output Voltage vs. Input Voltage

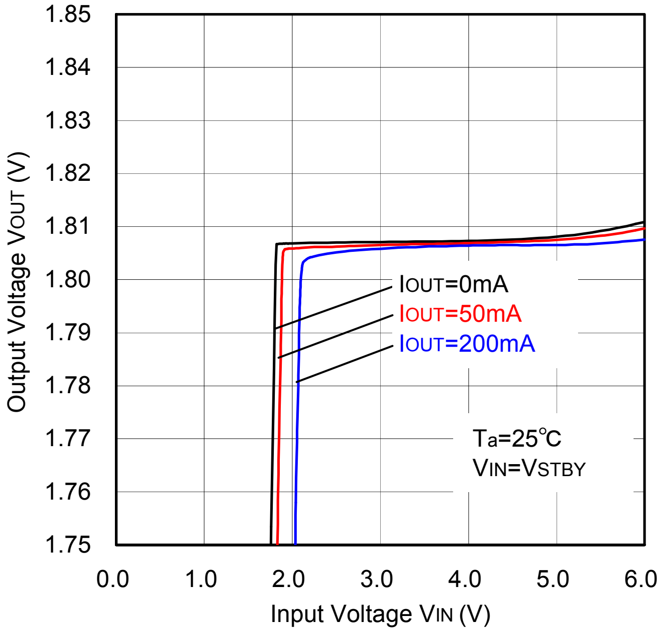


Figure 4. Line Regulation

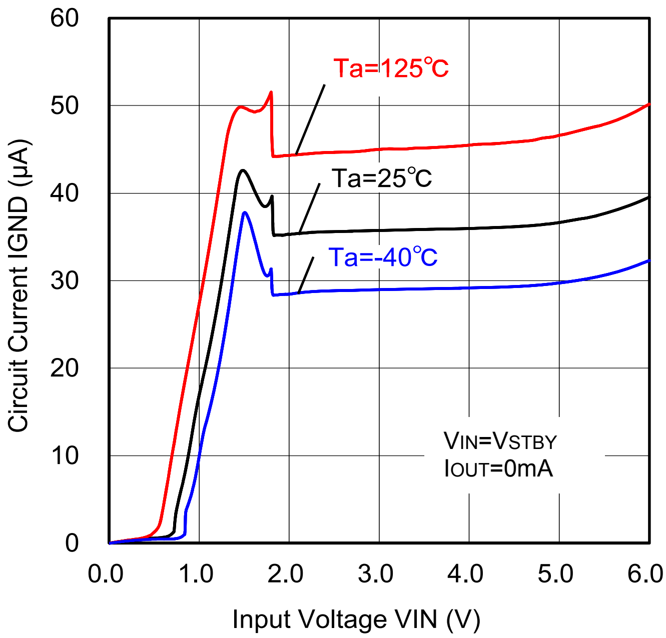


Figure 5. Circuit Current vs. Input Voltage

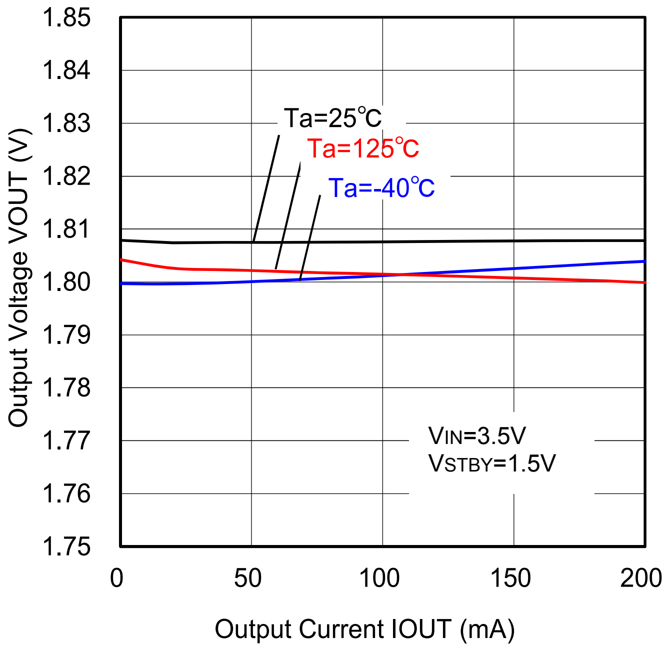


Figure 6. Load Regulation

●Reference data BU18JA2VG-C (Unless otherwise specified, Ta=25℃.)

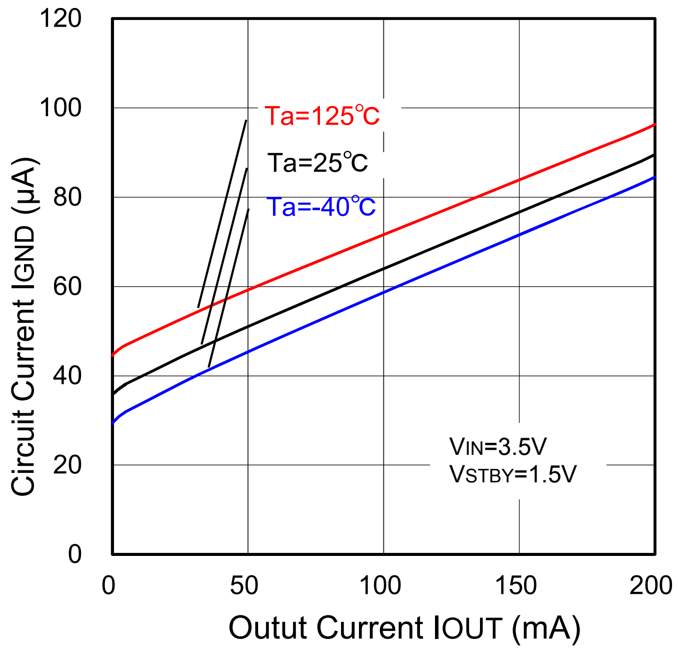


Figure 7. Circuit Current vs. Output Current

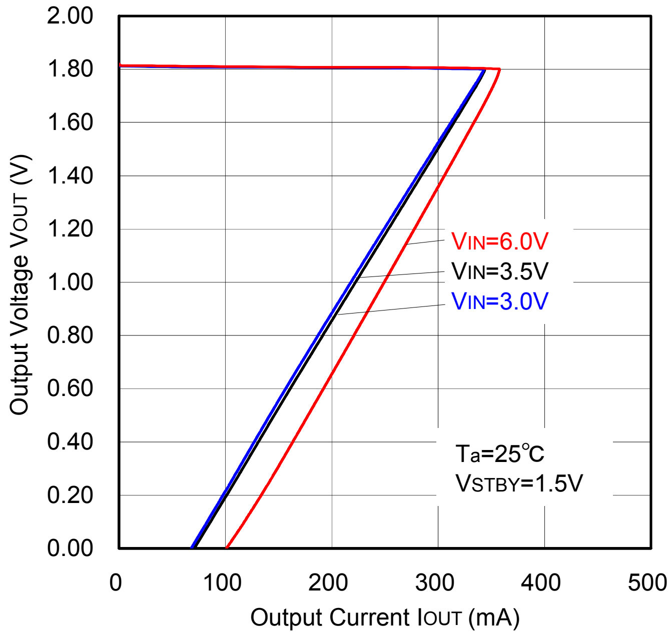


Figure 8. OCP Threshold

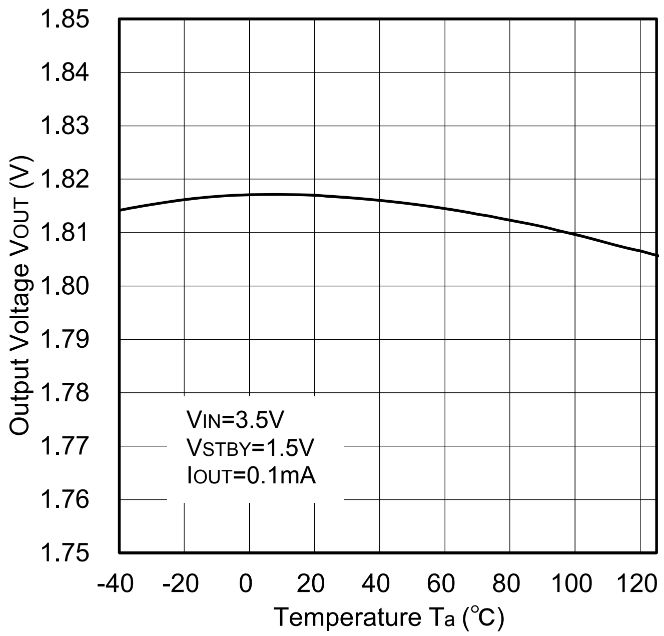


Figure 9. Output Voltage vs. Temperature

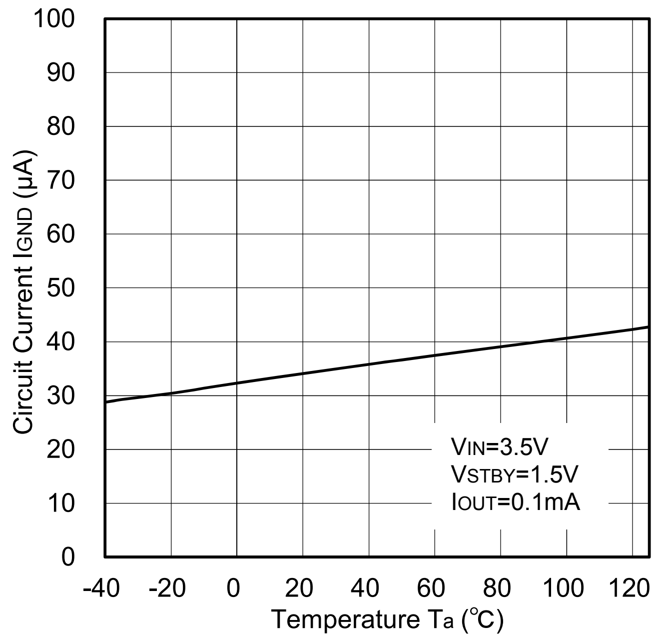


Figure 10. Circuit Current vs. Temperature

●**Reference data BU18JA2VG-C (Unless otherwise specified, Ta=25℃.)**

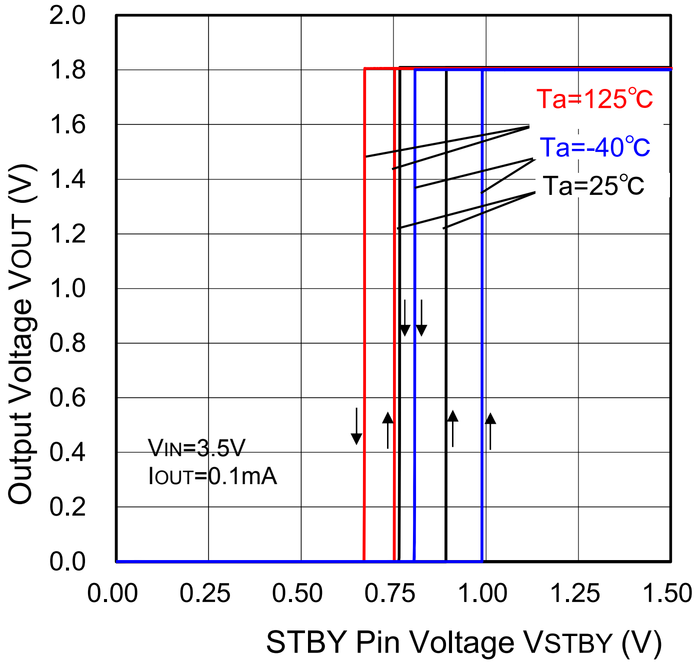


Figure 11. STBY Threshold

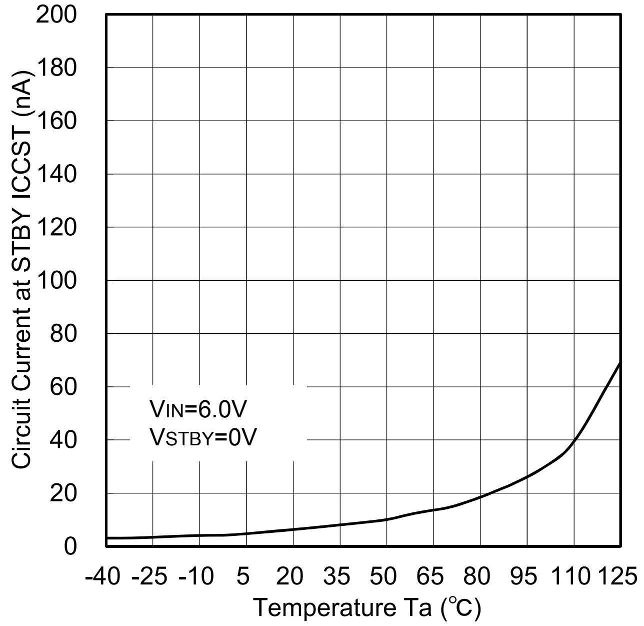


Figure 12. Circuit Current (at STBY) vs. Temperature

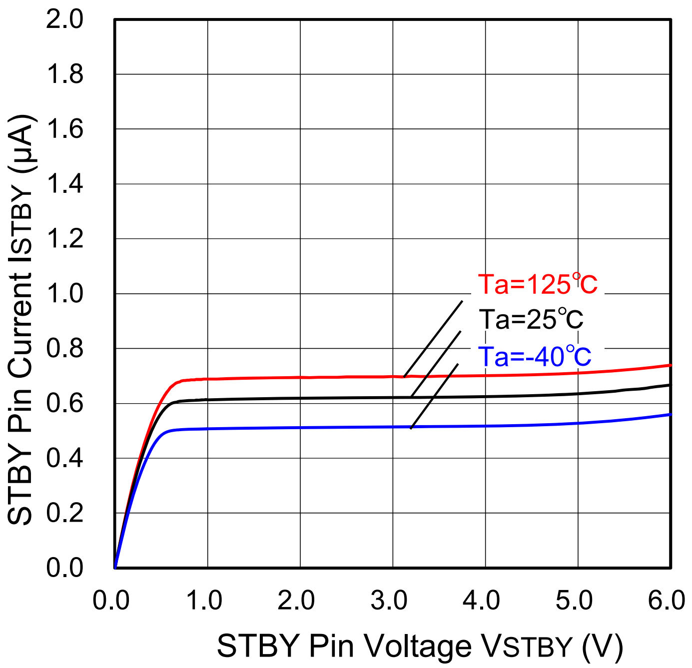


Figure 13. STBY Pin Current vs. STBY Pin Voltage

●**Reference data BU18JA2VG-C (Unless otherwise specified, Ta=25℃.)**

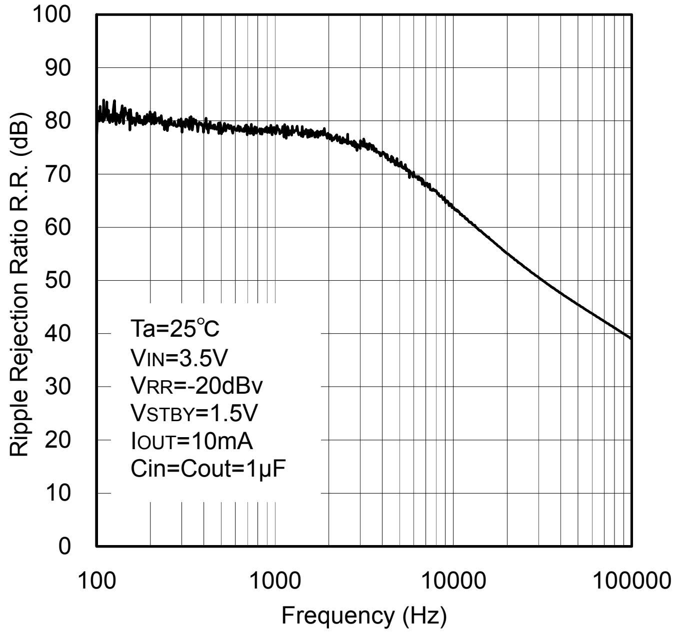


Figure 14. Ripple Rejection Ratio vs. Frequency

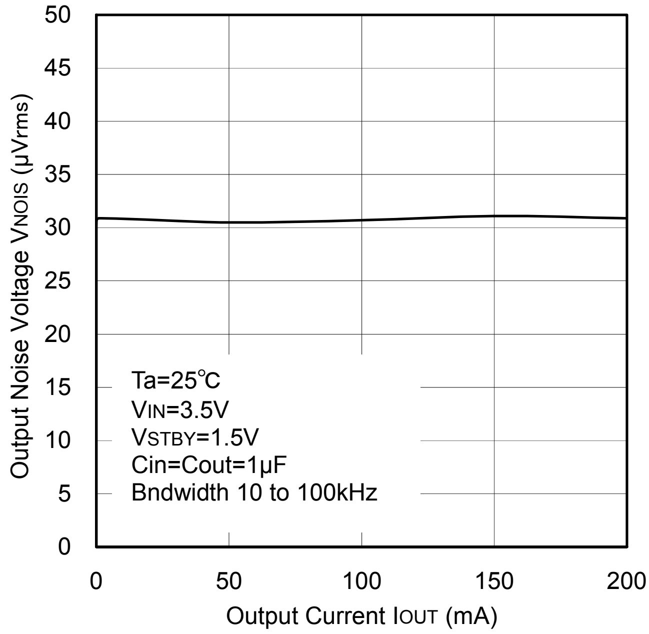


Figure 15. Output Noise Voltage vs. Output Current

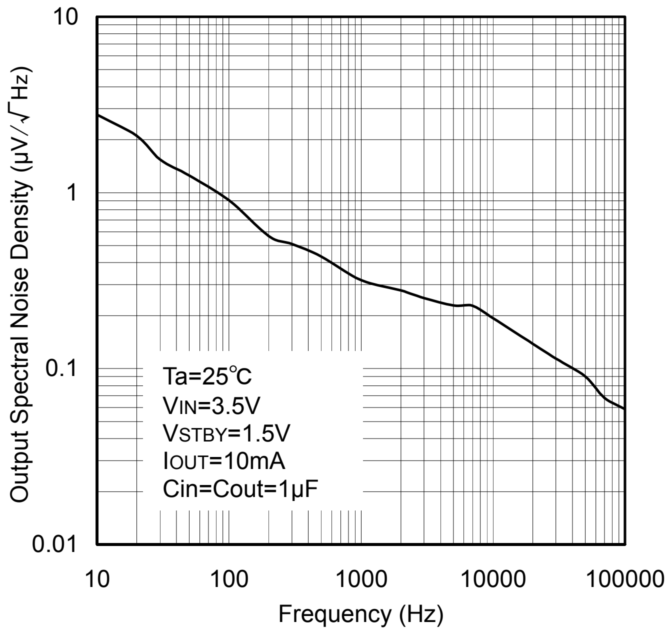


Figure 16.Output Spectral Noise Density vs. Frequency

●**Reference data BU18JA2VG-C (Unless otherwise specified, Ta=25℃.)**

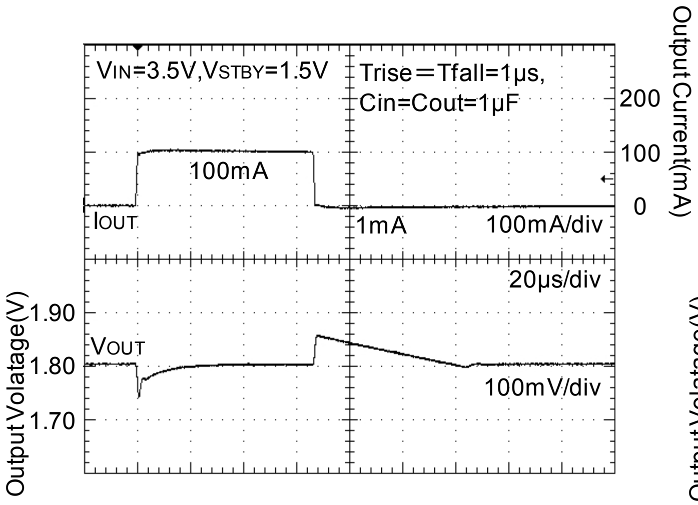


Figure 17. Load Response
(1mA to 100mA)

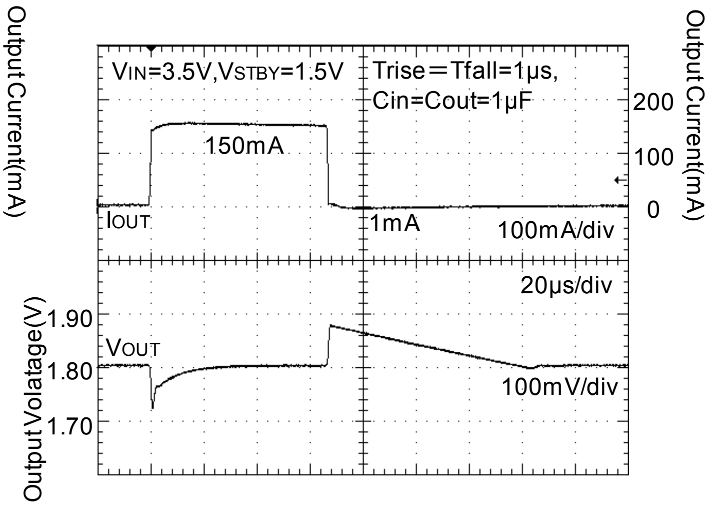


Figure 18. Load Response
(1mA to 150mA)

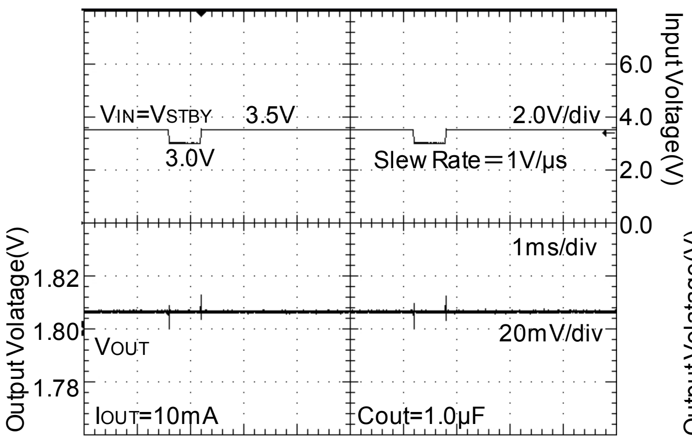


Figure 19. Line Transient Response
(3.0 to 3.5V)

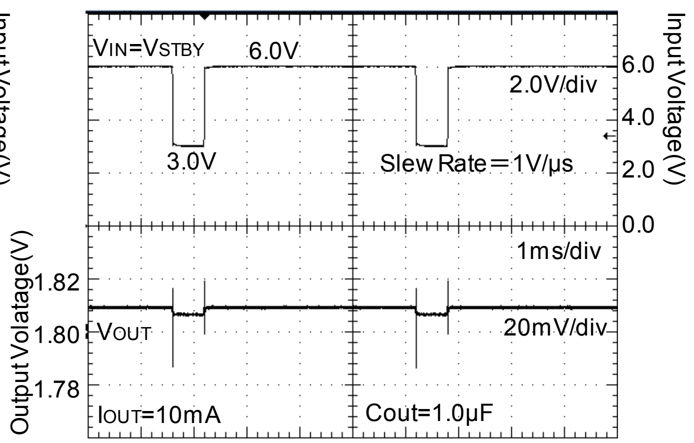


Figure 20. Line Transient Response
(3.0 to 6.0V)

●**Reference data BU18JA2VG-C (Unless otherwise specified, Ta=25℃.)**

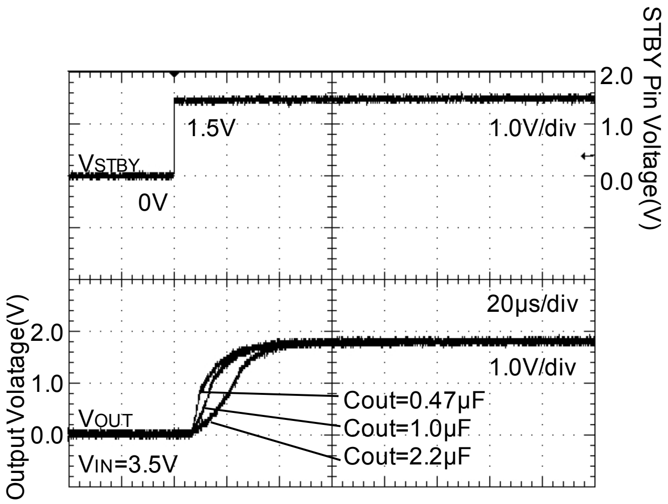


Figure 21. Startup Time
(ROUT=none)

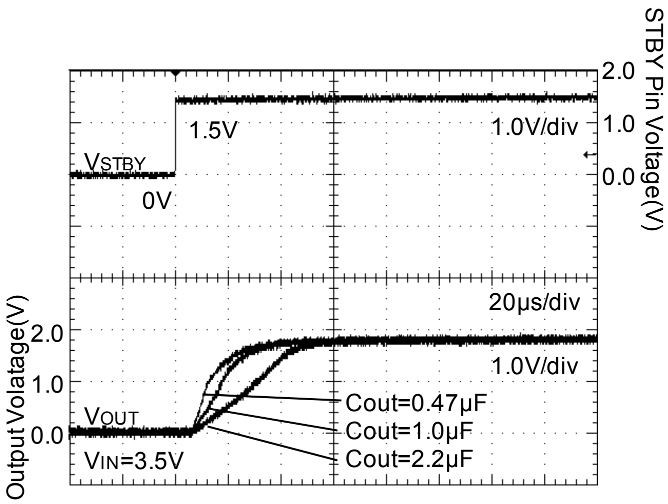


Figure 22. Startup Time
(ROUT=9Ω)

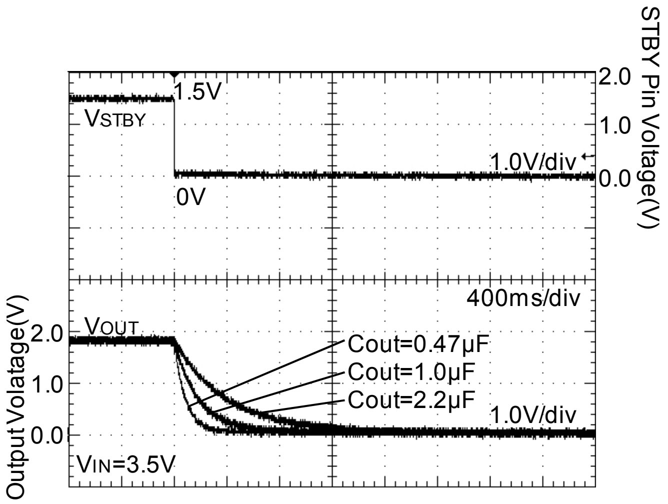


Figure 23. Discharge Time
(ROUT=none)

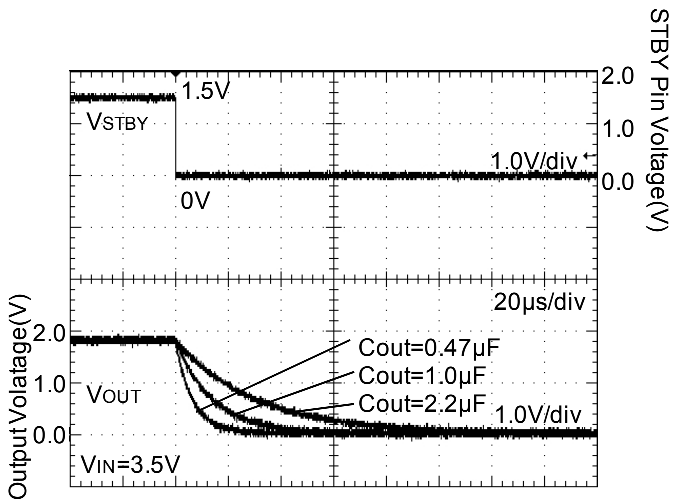


Figure 24. Discharge Time
(ROUT=9Ω)

●**Reference data BU33JA2VG-C (Unless otherwise specified, Ta=25℃.)**

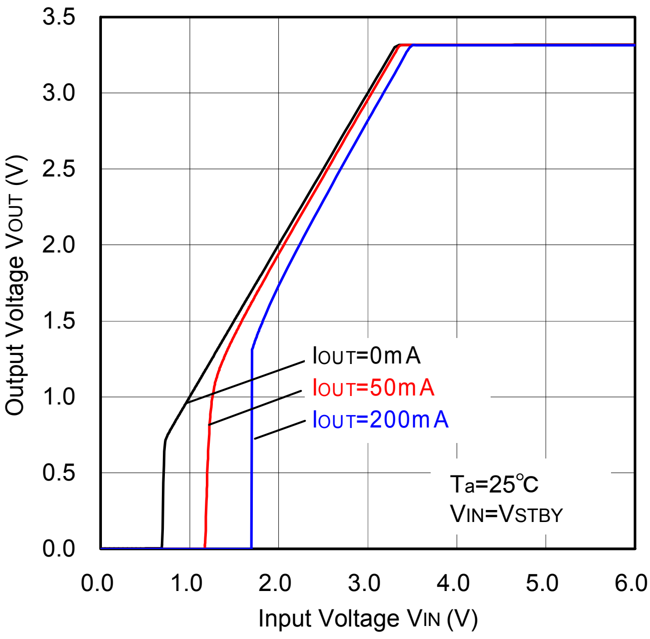


Figure 25. Output Voltage vs. Input Voltage

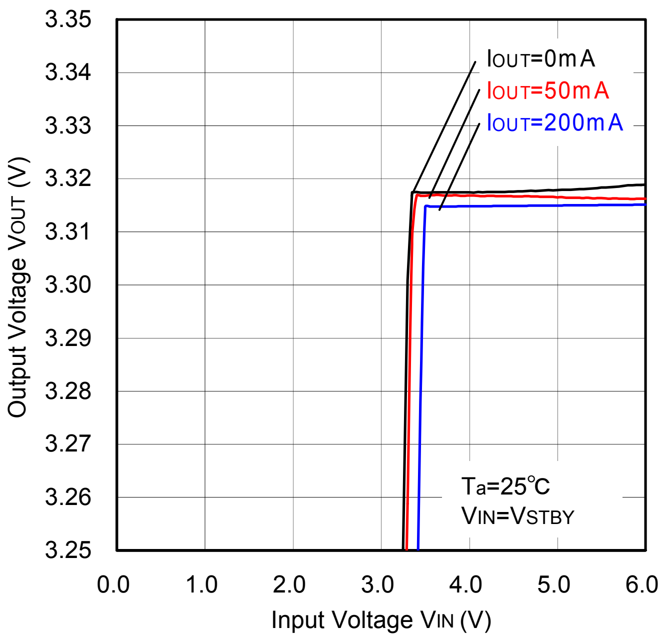


Figure 26. Line Regulation

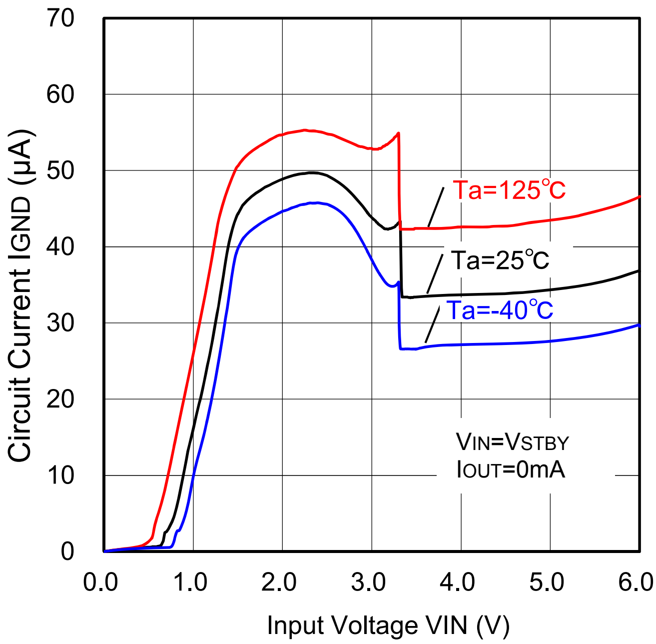


Figure 27. Circuit Current vs. Input Voltage

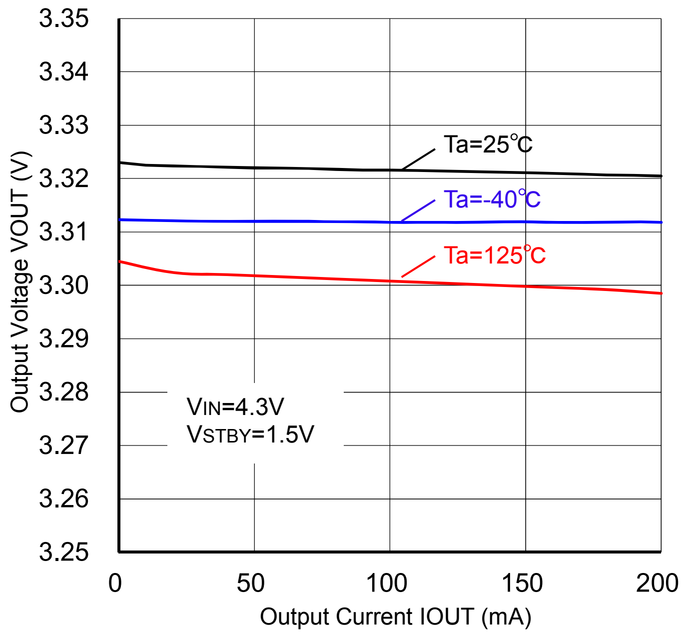


Figure 28. Load Regulation

●**Reference data BU33JA2VG-C (Unless otherwise specified, Ta=25℃.)**

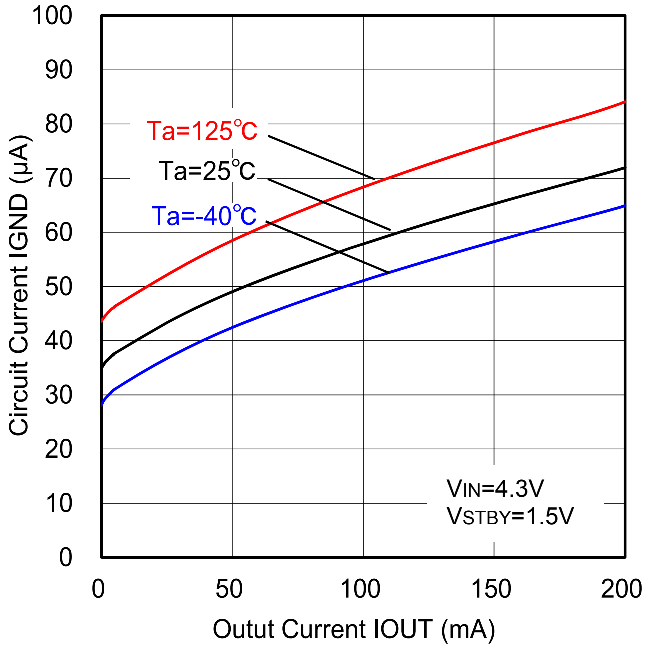


Figure 29. Circuit Current vs. Output Current

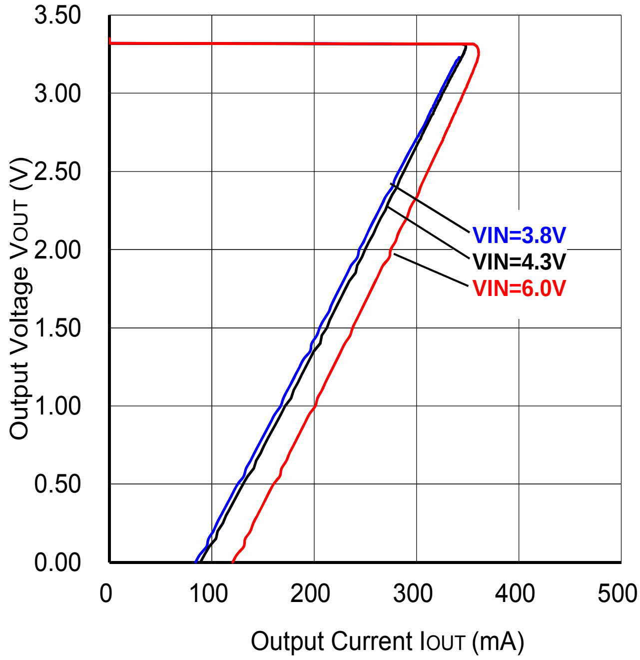


Figure 30. OCP Threshold

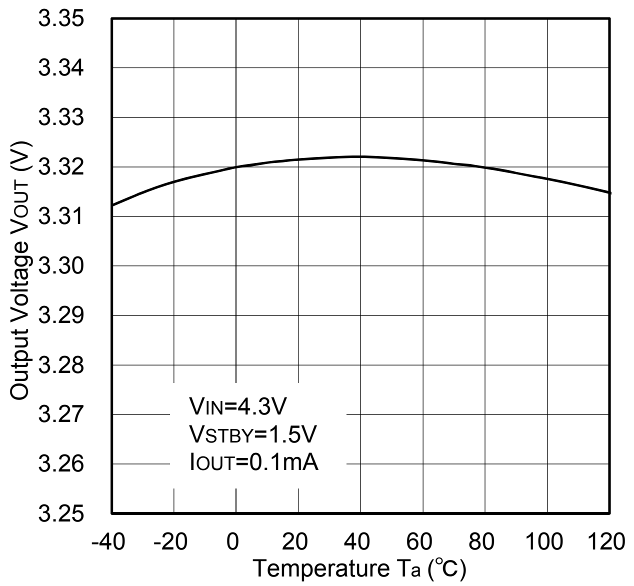


Figure 31. Output Voltage vs. Temperature

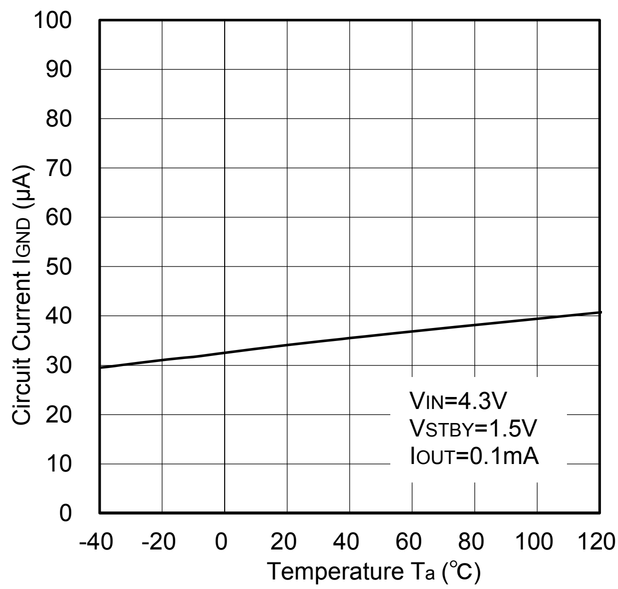


Figure 32. Circuit Current vs. Temperature

●**Reference data BU33JA2VG-C (Unless otherwise specified, Ta=25℃.)**

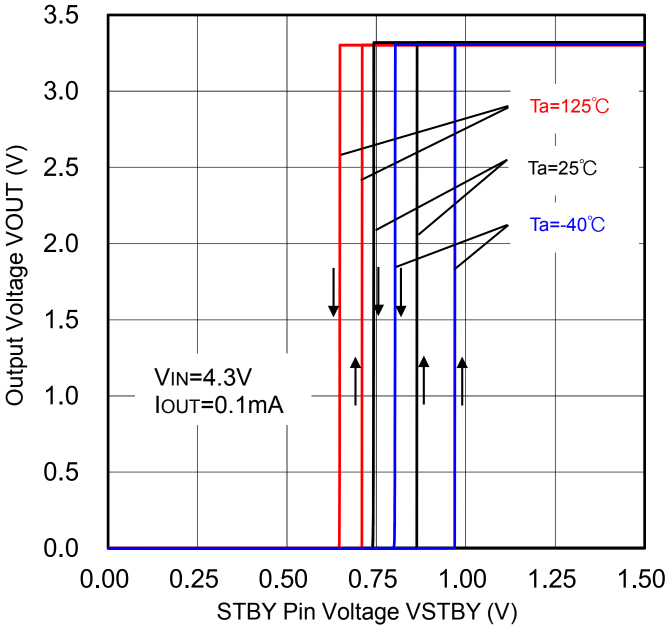


Figure 33. STBY Threshold

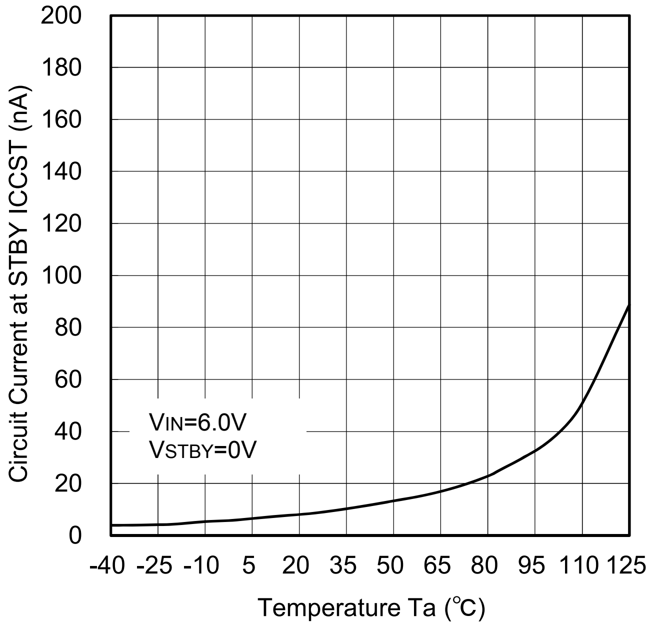


Figure 34. Circuit Current (at STBY) vs. Temperature

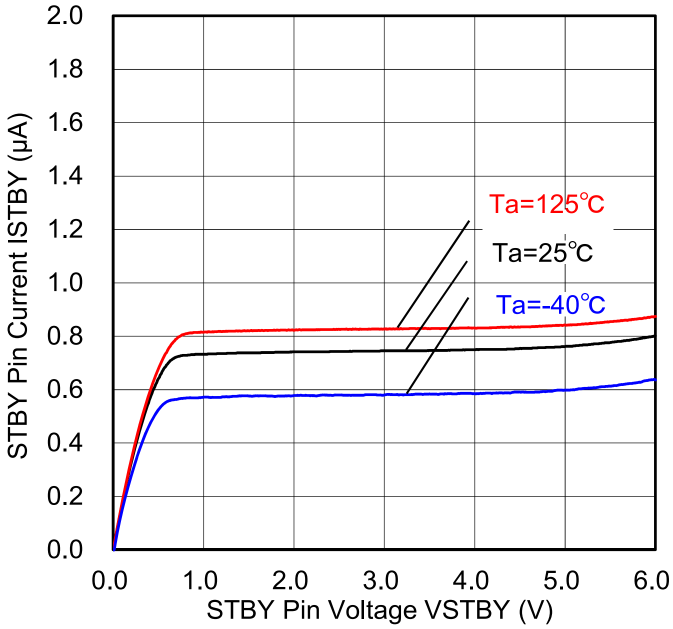


Figure 35. STBY Pin Current vs. STBY Pin Voltage

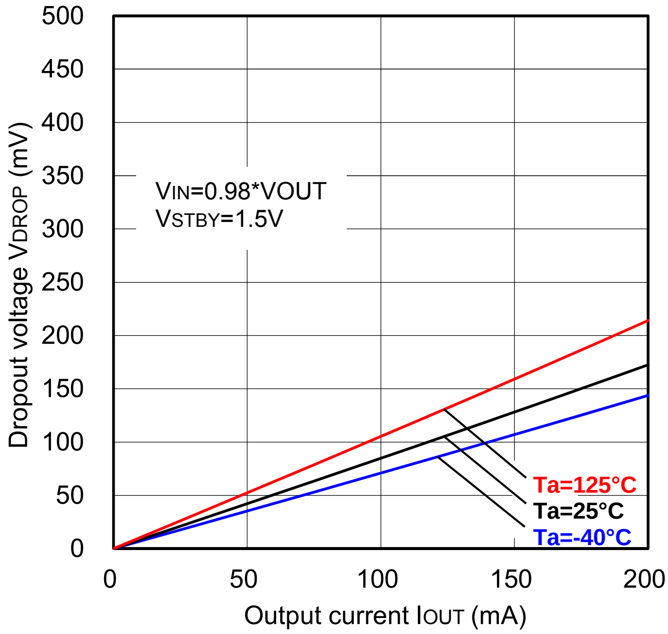


Figure 36. Dropout Voltage vs. Output Current

●**Reference data BU33JA2VG-C (Unless otherwise specified, Ta=25℃.)**

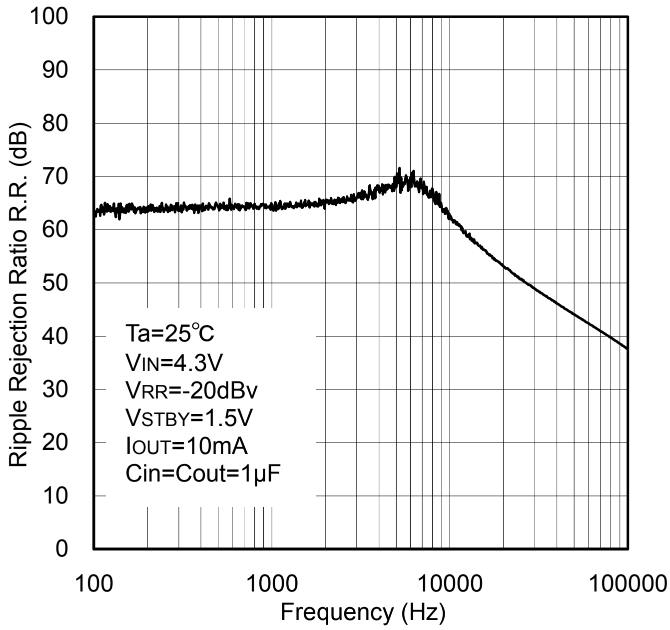


Figure 37. Ripple Rejection Ratio vs. Frequency

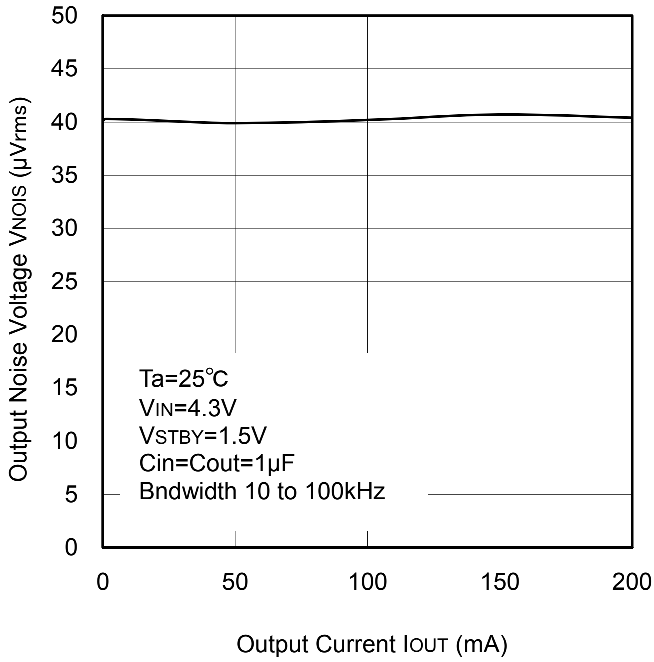


Figure 38. Output Noise Voltage vs. Output Current

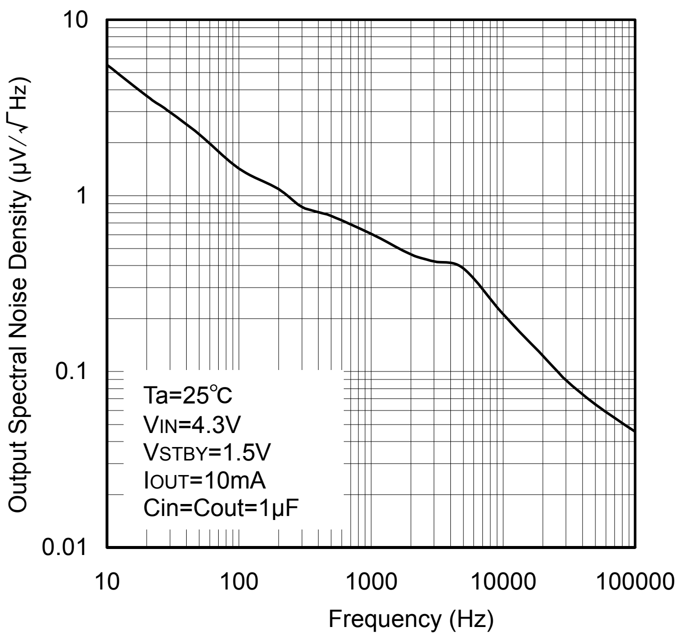


Figure 39.Output Spectral Noise Density vs. Frequency

●Reference data BU33JA2VG-C (Unless otherwise specified, Ta=25℃.)

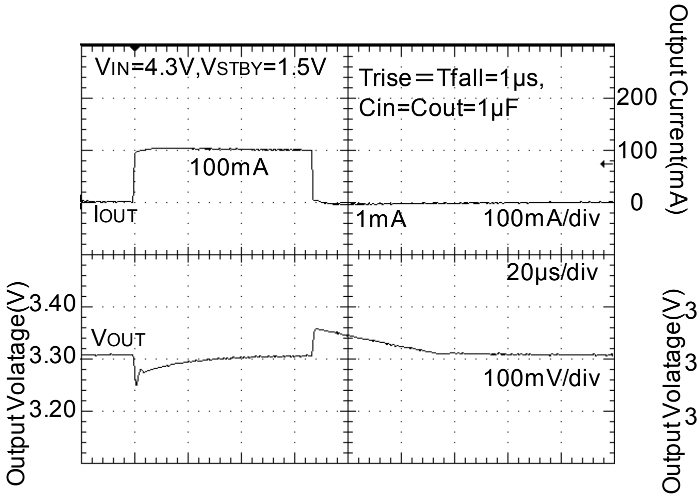


Figure 40. Load Response
(1mA to 100mA)

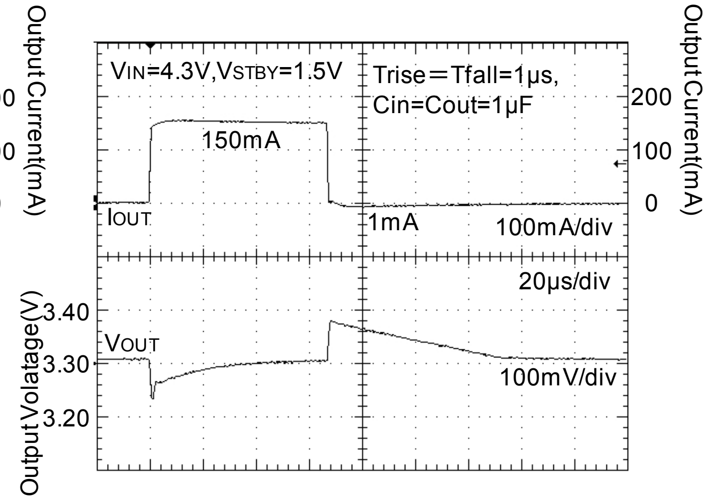


Figure 41. Load Response
(1mA to 150mA)

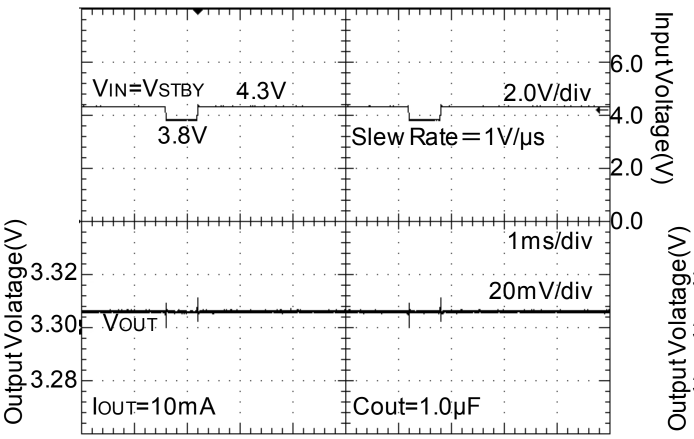


Figure 42. Line Transient Response
(3.8 to 4.3V)

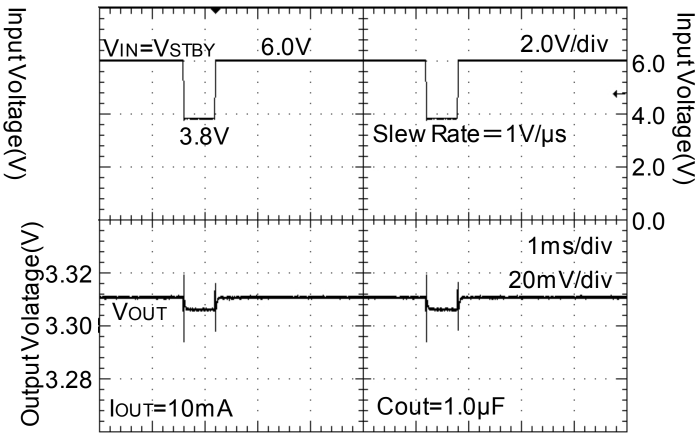


Figure 43. Line Transient Response
(3.8 to 6.0V)

●**Reference data BU33JA2VG-C (Unless otherwise specified, Ta=25℃.)**

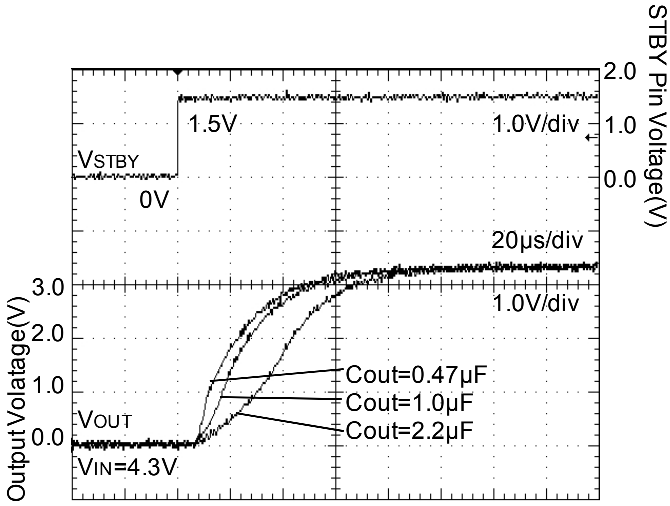


Figure 44. Startup Time
(ROUT=none)

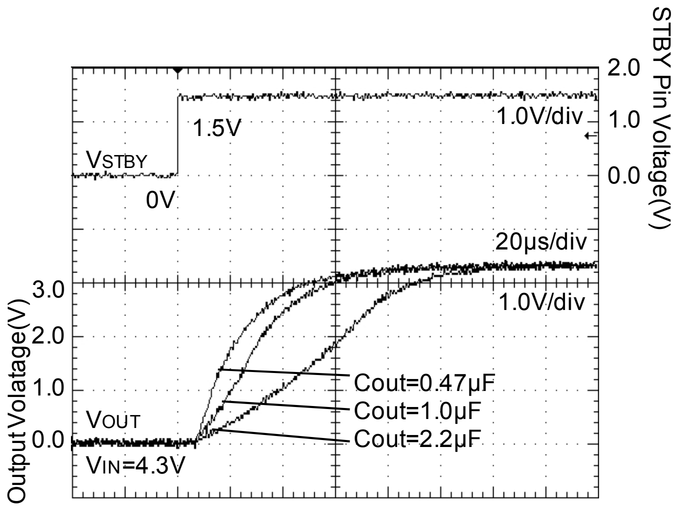


Figure 45. Startup Time
(ROUT=16.5Ω)

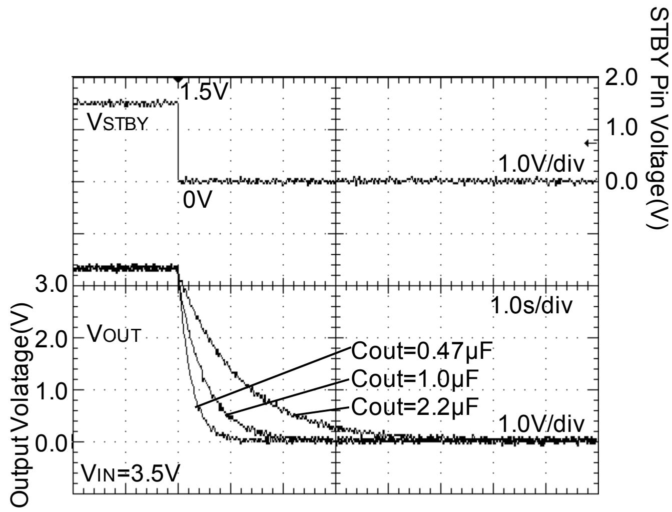


Figure 46. Discharge Time
(ROUT=none)

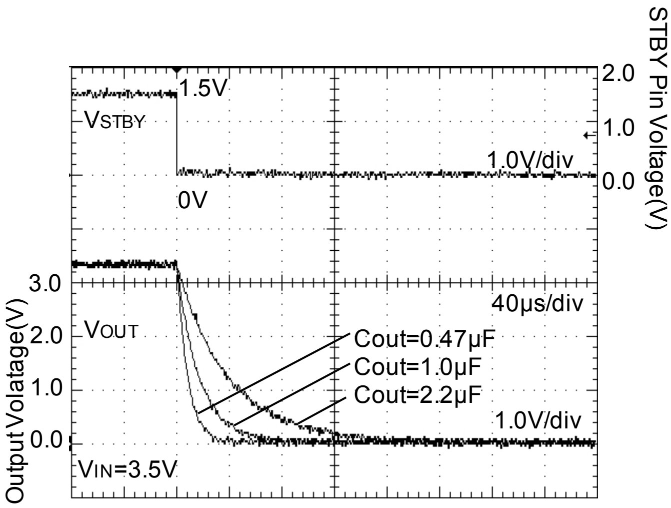


Figure 47. Discharge Time
(ROUT=16.5Ω)

●Input/Output Capacitor

It is recommended that an input capacitor is placed near pins between the VCC pin and GND as well as an output capacitor between the output pin and GND. The input is valid when the power supply impedance is high or when the PCB trace has significant length. For the output capacitor, the greater the capacitance, the more stable the output will be depending on the load and line voltage variations. However, please check the actual functionality of this capacitor by mounting it on a board for the actual application. Ceramic capacitors usually have different, thermal and equivalent series resistance characteristics, and may degrade gradually over continued use.
For additional details, please check with the manufacturer, and select the best ceramic capacitor for your application

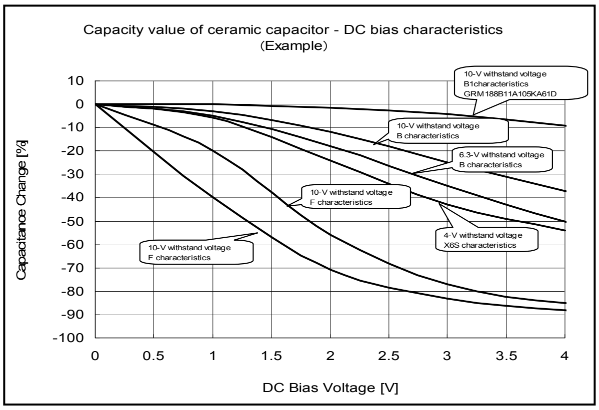


Figure 48. Capacity-bias characteristics

●Equivalent Series Resistance (ESR) of a Ceramic Capacitor

Capacitors generally have ESR (equivalent series resistance) and it operates stably in the ESR-IOUT area shown on the right. Since ceramic capacitors, tantalum capacitors, electrolytic capacitors, etc. generally have different ESR, please check the ESR of the capacitor to be used and use it within the stability area range shown in the right graph for evaluation of the actual application.

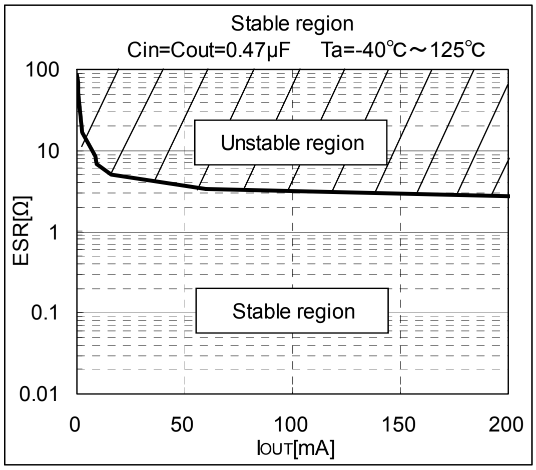


Figure 49. Stability area characteristics
(Example)

Power Dissipation

■SSOP5

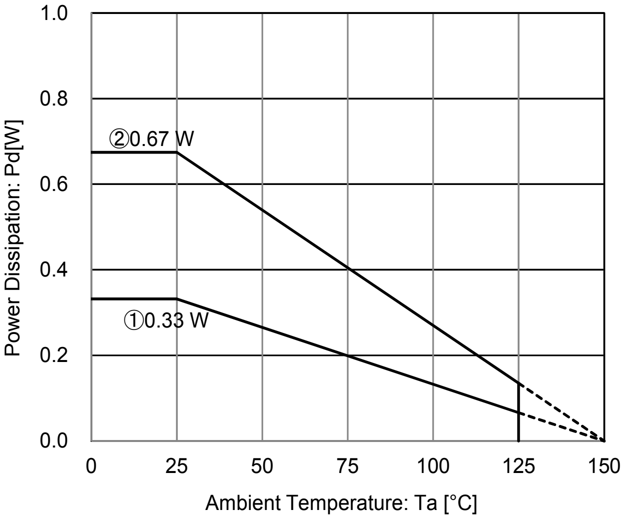


Figure 50. SSOP5 Package Data
(Reference Data)

IC mounted on ROHM standard board based on JEDEC.

① : 1-layer PCB
(Copper foil area on the reverse side of PCB: 0 mm × 0 mm)
Board material: FR4
Board size: 114.3 mm × 76.2 mm × 1.6 mmt
Mount condition: PCB and exposed pad are soldered.
Top copper foil: ROHM recommended
footprint + wiring to measure, 2 oz. copper.

② : 4-layer PCB
(2 inner layers copper foil area of PCB, copper foil area on the reverse side of PCB: 74.2 mm × 74.2 mm)
Board material: FR4
Board size: 114.3 mm × 76.2 mm × 1.6 mmt
Mount condition: PCB and exposed pad are soldered.
Top copper foil: ROHM recommended
footprint + wiring to measure, 2 oz. copper.
2 inner layers copper foil area of PCB
: 74.2 mm × 74.2 mm, 1 oz. copper.
Copper foil area on the reverse side of PCB
: 74.2 mm × 74.2 mm, 2 oz. copper.

Condition①: θ_{JA} = 376.5 °C/W, Ψ_{JT} (top center) = 40 °C/W
Condition②: θ_{JA} = 185.4 °C/W, Ψ_{JT} (top center) = 30 °C/W

●Thermal Design

This product exposes a frame on the back side of the package for thermal efficiency improvement.
Within this IC, the power consumption is decided by the dropout voltage condition, the load current and the circuit current. Refer to power dissipation curves illustrated in Figure 21, 22 when using the IC in an environment of Ta ≥ 25 °C. Even if the ambient temperature Ta is at 25 °C, depending on the input voltage and the load current, chip junction temperature can be very high. Consider the design to be Tj ≤ Tjmax = 150 °C in all possible operating temperature range.
Should by any condition the maximum junction temperature Tjmax = 150 °C rating be exceeded by the temperature increase of the chip, it may result in deterioration of the properties of the chip. The thermal impedance in this specification is based on recommended PCB and measurement condition by JEDEC standard. Verify the application and allow sufficient margins in the thermal design by the following method is used to calculate the junction temperature Tj.
Tj can be calculated by either of the two following methods.

1. The following method is used to calculate the junction temperature Tj.

$$Tj = Ta + P_C \times \theta_{JA}$$

Where:

Tj	: Junction Temperature
Ta	: Ambient Temperature
P_C	: Power Consumption
θ_{JA}	: Thermal Impedance (Junction to Ambient)

2. The following method is also used to calculate the junction temperature Tj.

$$Tj = T_T + P_C \times \Psi_{JT}$$

Where:

Tj	: Junction Temperature
T_T	: Top Center of Case's (mold) Temperature
P_C	: Power consumption
Ψ_{JT}	: Thermal Impedance (Junction to Top Center of Case)

The following method is used to calculate the power consumption Pc (W).

$$Pc = (VIN - VOUT) \times I_O + VIN \times IGND$$

Where:

P_C	: Power Consumption
VIN	: Input Voltage
$VOUT$	: Output Voltage
I_O	: Load Current
$IGND$	: Circuit Current

・Calculation Example (SOP-J8)

If VIN = 3.0 V, VOUT = 1.8 V, I_O = 50 mA, IGND = 33 μA, the power consumption Pc can be calculated as follows:

$$
\begin{aligned}
P_C &= (VIN - VOUT) \times I_O + VIN \times IGND \\
&= (3.0\ V - 1.8\ V) \times 50\ mA + 3.0\ V \times 33\ \mu A \\
&= 0.06\ W
\end{aligned}
$$

At the ambient temperature Tamax = 125°C, the thermal Impedance (Junction to Ambient)θ_{JA} = 185.4 °C / W (4-layer PCB),

$$
\begin{aligned}
Tj &= Tamax + P_C \times \theta_{JA} \\
&= 125\ ℃ + 0.06\ W \times 185.4\ ℃ / W \\
&= 136.1\ ℃
\end{aligned}
$$

When operating the IC, the top center of case's (mold) temperature T_T = 100 °C、Ψ_{JT} = 40 °C / W (1-layer PCB),

$$
\begin{aligned}
Tj &= T_T + P_C \times \Psi_{JT} \\
&= 100\ ℃ + 0.06\ W \times 40\ ℃ / W \\
&= 102.4\ ℃
\end{aligned}
$$

For optimum thermal performance, it is recommended to expand the copper foil area of the board, increasing the layer and thermal via between thermal land pad.

●I/O Equivalence Circuits

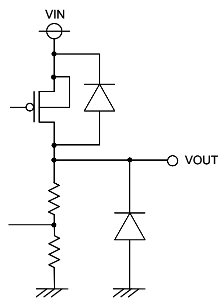
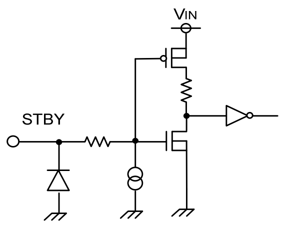
5pin (VOUT)	3pin (STBY)
	

Figure 51. Input / Output equivalent circuit

●Operational Notes

1) Absolute maximum ratings

This product is produced with strict quality control, however it may be destroyed if operated beyond its absolute maximum ratings. In addition, it is impossible to predict all destructive situations such as short-circuit modes, open circuit modes, etc. Therefore, it is important to consider circuit protection measures, like adding a fuse, in case the IC is operated in a special mode exceeding the absolute maximum ratings.

2) GND Potential

GND potential must be the lowest potential of all pins of the IC at all operating conditions. Ensure that no pins are at a voltage below the ground pin at any time, even during transient condition.

3) Setting of Heat

Carry out the heat design that have adequate margin considering Pd of actual working states.

4) Pin Short and Mistake Fitting

When mounting the IC on the PCB, pay attention to the orientation of the IC. If there is mistake in the placement, the IC may be burned up.

5) Mutual Impedance

Use short and wide wiring tracks for the power supply and ground to keep the mutual impedance as small as possible. Use a capacitor to keep ripple to a minimum.

6) STBY Pin Voltage

To enable standby mode for all channels, set the STBY pin to 0.5 V or less, and for normal operation, to 1.1 V or more. Setting STBY to a voltage between 0.5 and 1.1 V may cause malfunction and should be avoided. Keep transition time between high and low (or vice versa) to a minimum.

Additionally, if STBY is shorted to VIN, the IC will switch to standby mode and disable the output discharge circuit, causing a temporary voltage to remain on the output pin. If the IC is switched on again while this voltage is present, overshoot may occur on the output. Therefore, in applications where these pins are shorted, the output should always be completely discharged before turning the IC on.

7) Over Current Protection Circuit

Over current and short circuit protection is built-in at the output, and IC destruction is prevented at the time of load short circuit. These protection circuits are effective in the destructive prevention by sudden accidents, please avoid applications to where the over current protection circuit operates continuously.

8) Thermal Shutdown

This IC has Thermal Shutdown Circuit (TSD Circuit). When the temperature of IC Chip is higher than 180℃(typ), the output is turned off by TSD Circuit. TSD Circuit is only designed for protecting IC from thermal over load. Therefore it is not recommended that you design application where TSD will work in normal condition.

9) Actions under Strong light

A strong light like a halogen lamp may be caused malfunction. In our testing, fluorescence light and white LED causes little effects for the IC, but infrared light causes strong effects on the IC. The IC should be shielded from light like sunrays or halogen lamps.

10) Output capacitor

To prevent oscillation at output, it is recommended that the IC be operated at the stable region shown in Figure 49. It operates at the capacitance of more than 0.47µF. As capacitance is larger, stability becomes more stable and characteristic of output load fluctuation is also improved.

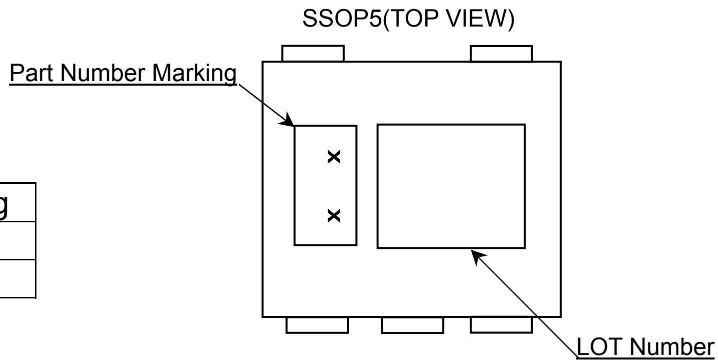
●Ordering Information

B	U	X	X	J	A	2	V	G	-	C	T	R

- **Part Number**
- **Output Voltage**: 18 : 1.8V, 33 : 3.3V
- **Series name**: Maximum Output Current : 200mA; Maximum Power Supply Voltage Range : 6.5V; High-speed load response, Low noise, Shutdown SW
- **Package**: G : SSOP5
- **Product Rank**: C :for Automotive
- **Packageing and forming specification**: Embossed tape and reel; TR : The pin number 1 is the upper right

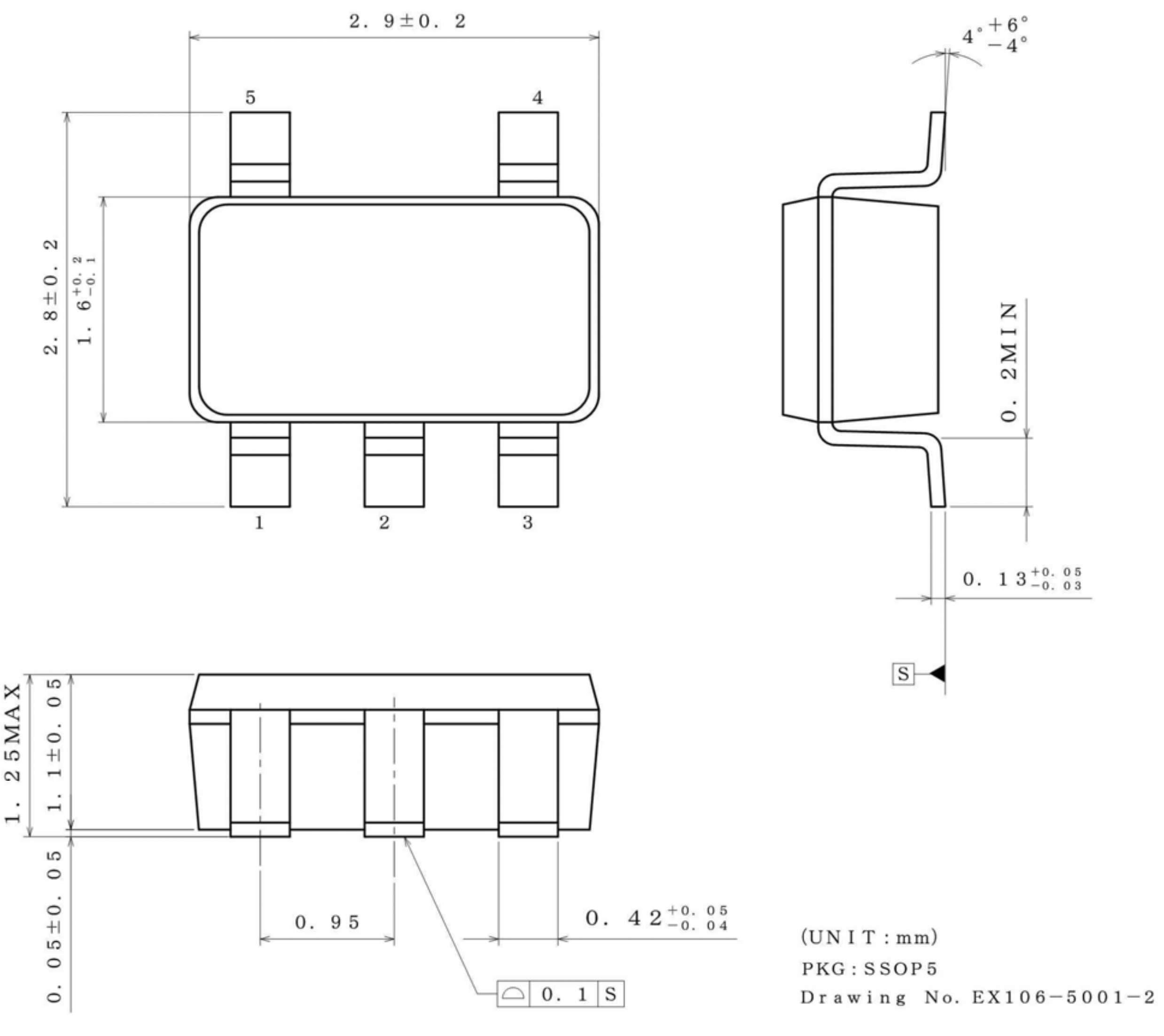
●Marking Diagram

xx	Output Voltage	Marking
18	1.8V typ.	XM
33	3.3V typ.	XN



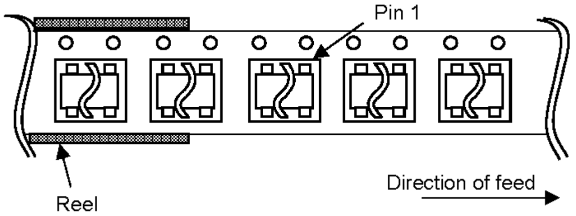
●Physical Dimension Tape and Reel Information

Package Name	SSOP5



< Tape and Reel Information >

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)



Revision History

Date	Revision	Changes
10.Dec.2014	001	New Release
20.Mar.2015	002	Thermal Characteristics is changed.

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:

2. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the information contained in this document.

Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.