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CMOS LDO Regulators for Portable Equipments

1ch 200mA CMOS LDO Regulators

BUxxSA4 series

●General Description

BUxxSA4 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 40µA. They are most appropriate for various applications such as power supplies for logic IC, RF, and camera modules.

●Features

- High Output Voltage Accuracy: ±0.6% (±15mV on VOUT<2.5V)
- High Ripple Rejection: 70 dB (Typ, 1 kHz,)
- Compatible with small ceramic capacitor (Cin=Cout=0.47 µF)
- Low Current Consumption: 40 µA
- Output Voltage ON/OFF control
- Built-in Over Current Protection Circuit (OCP)
- Built-in Thermal Shutdown Circuit (TSD)
- Adopting ultra-small WLCSP UCSP50L1

●Key Specifications

- Input Power Supply Voltage Range: 1.7V to 5.5V
- Output Current Range: 0 to 200mA
- Operating Temperature Range: -40℃ to +85℃
- Output Voltage Lineup: 1.8V,2.5V,2.55V 2.8V,3.0V,3.3V
- Output Voltage Accuracy: ±0.6%
- Circuit Current: 40µA(Typ.)
- Standby Current: 0µA (Typ.)

●Package

	W(Typ.) x D(Typ.) x H(Max.)
UCSP50L1(BUXXSA4WGWL)	0.8mm x 0.8mm x 0.5mm

●Applications

- Portable devices
- Camera modules
- Other electronic devices using microcontrollers or logic circuits

●Typical Application Circuit

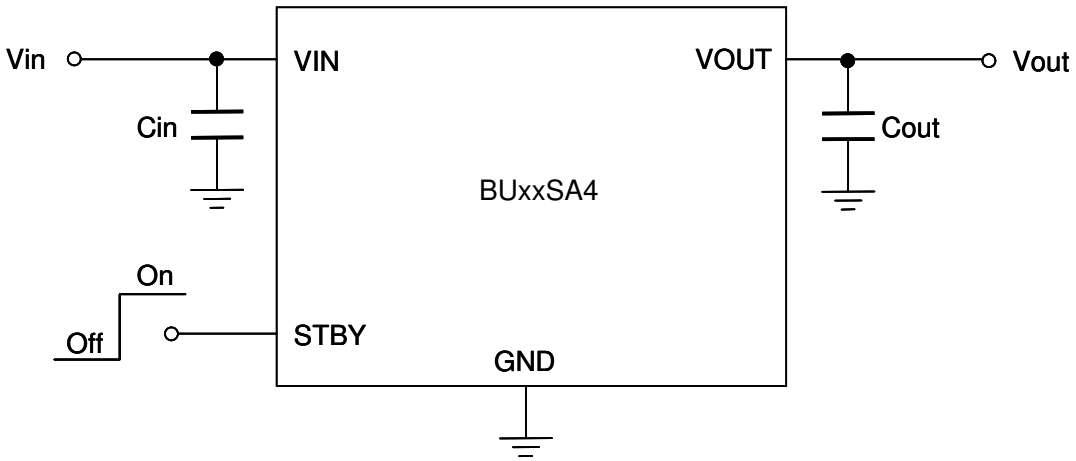
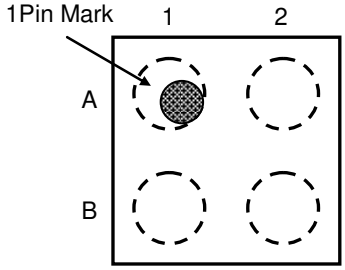


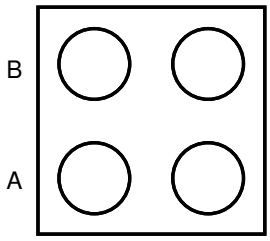
Figure 1. Typical Application Circuit

●Pin Configuration



Top View

(Mark Side)



Bottom View

●Pin Description

Pin No.	Symbol	Function
A1	GND	GND Pin
A2	STBY	Output Control Pin (High:ON, Low:OFF)
B1	VOUT	Output Pin
B2	VIN	Input Pin

●Block Diagram

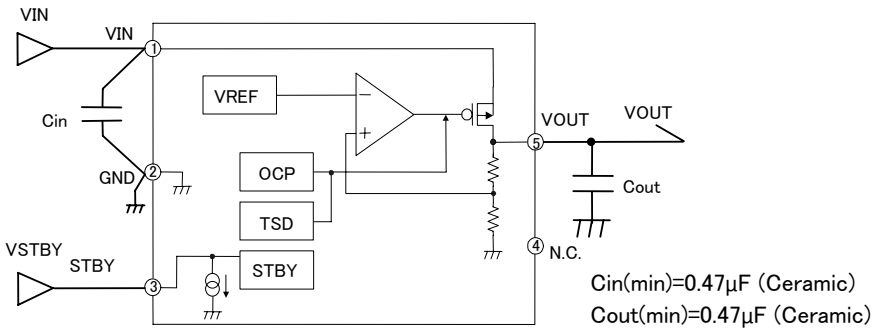


Figure 2. Block diagram

●**Absolute Maximum Ratings**

Parameter	Symbol	Rating	Unit
Power Supply Voltage	VMAX	-0.3 to +6.5	V
Power Dissipation	Pd	410(*1)	mW
Maximum Junction Temperature	Tjmax	+125	℃
Operating Temperature Range	Topr	-40 to +85	℃
Storage Temperature Range	Tstg	-55 to +125	℃

(*1) Derate by 4.1mW/℃ when operating above Ta=25℃.(When mounted on a board 63mm × 55mm × 1.6mm glass-epoxy board, 9 layer)

●**Recommended Operating Ratings**

Parameter	Symbol	Limit	Unit
Input Power Supply Voltage Range	VIN	1.7 to 5.5	V

●**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.

●**Electrical Characteristics**

(Unless otherwise noted, Ta=-25℃, VIN=VOUT+1.0V(*6), VSTBY=1.5V, Cin=1μF, Cout=1μF.)

PARAMETER		Symbol	Limit			Unit	Conditions
			MIN.	TYP.	MAX.		
Output Voltage 1		VOUT1	VOUT ×0.994	VOUT	VOUT ×1.006	V	IOUT = 10μA, VOUT≧2.5V
			VOUT -15mV		VOUT +15mV		IOUT = 10μA, VOUT＜2.5V
Output Voltage 2		VOUT2	VOUT ×0.98	VOUT	VOUT ×1.02	V	IOUT=0 to 200mA, VOUT≧2.5V VIN=VOUT+0.5 to 5.5V Ta=-40 to +85℃(*3,4,5)
			VOUT -50mV		VOUT +50mV		IOUT=0 to 200mA, VOUT＜2.5V VIN=3.0 to 5.5V Ta=-40 to +85℃(*3,4,5)
Circuit Current 1		IGND1	-	40	65	μA	IOUT=0mA
Circuit Current 2		IGND2	-	40	80	μA	Ta=-40 to +85℃(*4), IOUT=0mA
Circuit Current (STBY)		ICCST	-	-	1.0	μA	STBY=0V
Ripple Rejection Ratio1		RR1	-	70	-	dB	VRR=-20dBv,fRR=1kHz,IOUT=10mA
Ripple Rejection Ratio2		RR2	-	55	-	dB	VRR=-20dBv,fRR=10kHz,IOUT=10mA
Ripple Rejection Ratio3		RR3	-	45	-	dB	VRR=-20dBv,fRR=100kHz,IOUT=10mA
Dropout Voltage		VDROP	-	80	150	mV	VIN=0.98×VOUT, IOUT=100mA Ta=-40 to +85℃, VOUT≧2.5V
			-	150	360	mV	VIN=0.98×VOUT, IOUT=100mA Ta=-40 to +85℃, VOUT＜2.5V
Load transient resp.		VLOT	-	±65	-	mV	Io=1 to 150mA,T_{rise}=T_{fall}=1μs, VIN=VOUT+1.0V(*4)
Line Transient resp.		VLIT	-	±5	-	mV	VIN=VOUT+0.5 to VOUT+1.0V, T_{rise}=T_{fall}=10μs
Output noise voltage		VNOIS	-	30	-	μVrms	Bandwidth 10 to 100kHz
Startup time		TST	-	100	300	μsec	Output voltage settled within tolerancies
Line Regulation		VDLI	-	2	8	mV	IOUT=10mA VIN=VOUT+0.5 to 5.5V(*5)
Load Regulation1		VDLO1	-	2	8	mV	IOUT=1 to 100mA
Load Regulation2		VDLO2	-	4	16	mV	IOUT=1 to 200mA
Maximum Output Current		IOMAX	200	-	-	mA	VIN=VOUT+1.0V(*6)
Limit Current		ILMAX	250	400	-	mA	Vo=VOUT×0.98
Short Current		ISHORT	-	100	200	mA	Vo=0V
STBY Pin Current		ISTBY	-	-	4.0	μA	Ta=-40 to +85℃
STBY Control Voltage	ON	VSTBH	1.1	-	VIN	V	
	OFF	VSTBL	-0.2	-	0.5	V	

(*3) Operating conditions are limited by Pd.
(*4) Typical values apply for Ta=25℃.
(*5) VIN=3.0V to 5.0V for VOUT＜2.5V.
(*6) VIN=3.5V for VOUT＜2.5V.

●**Reference data BU18SA4WGWL (Unless otherwise specified, Ta=25℃.)**

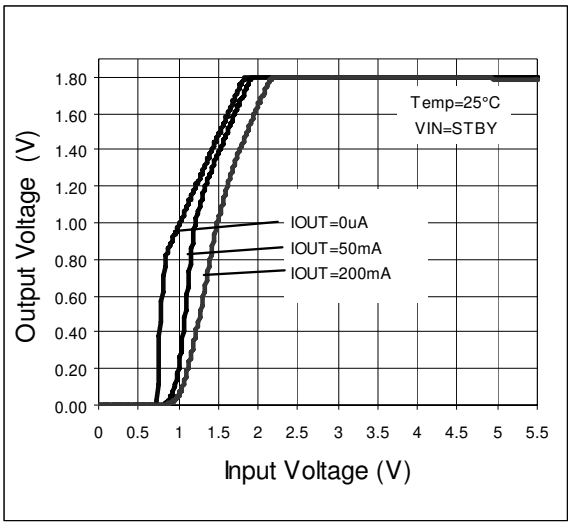


Figure 3. Output Voltage vs. Input Voltage

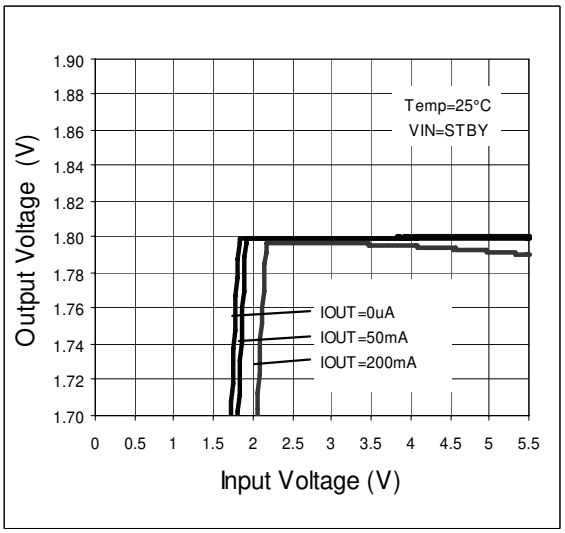


Figure 4. Line Regulation

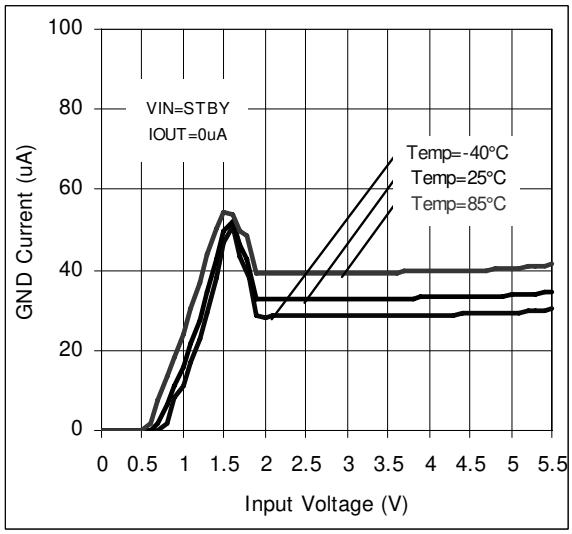


Figure 5. GND Current vs. Input Voltage

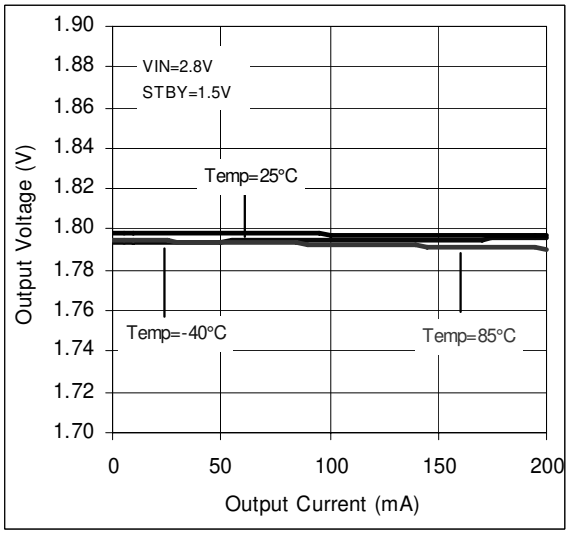


Figure 6. Load Regulation

●**Reference data BU18SA4WGWL (Unless otherwise specified, Ta=25℃.)**

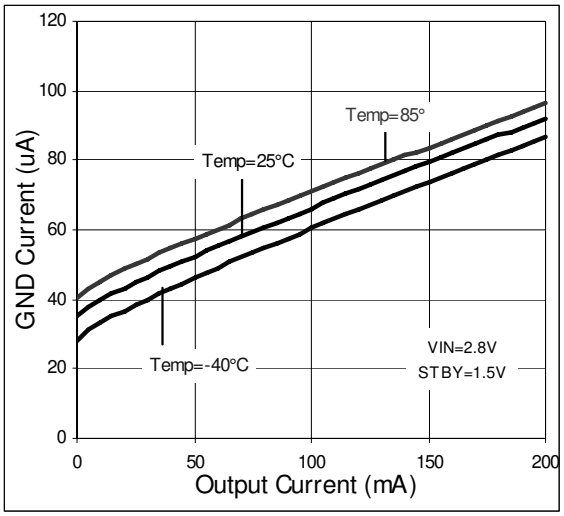


Figure 7. GND Current vs. Output Current

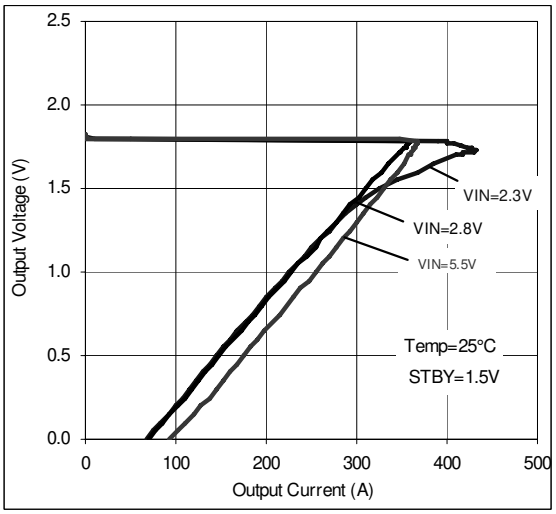


Figure 8. OCP Threshold

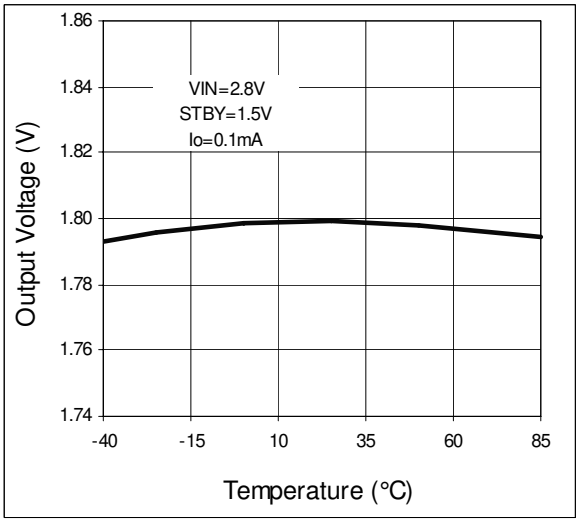


Figure 9. Output Voltage vs. Temperature

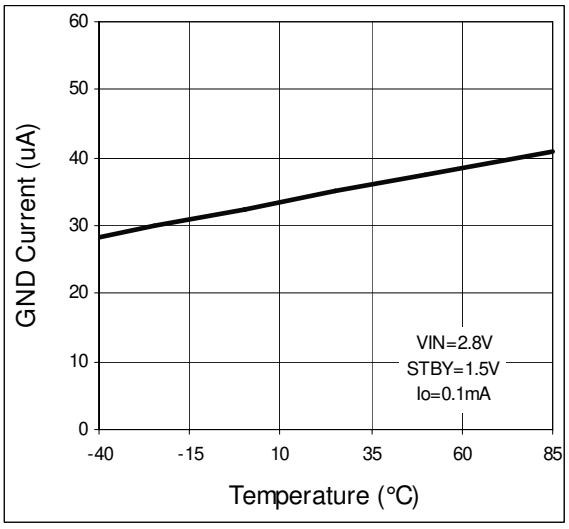


Figure 10. GND Current vs. Temperature

●**Reference data BU18SA4WGWL (Unless otherwise specified, Ta=25℃.)**

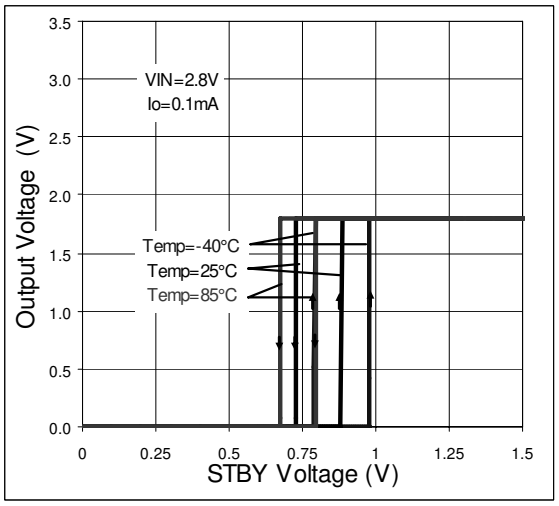


Figure 11. STBY Threshold

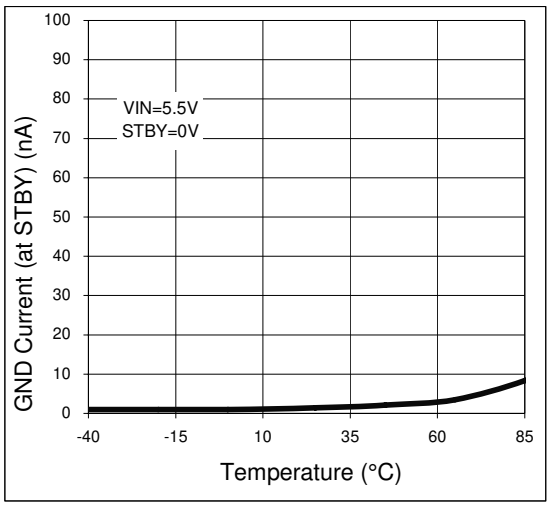


Figure 12. GND Current (at STBY) vs. Temperature

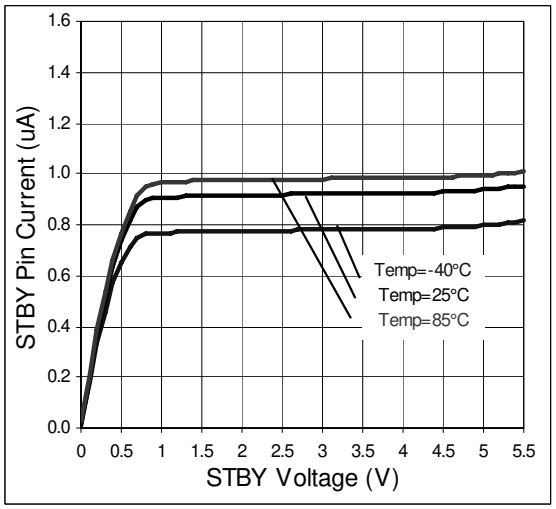


Figure 13. STBY Pin Current vs. STBY Pin Voltage

●**Reference data BU18SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

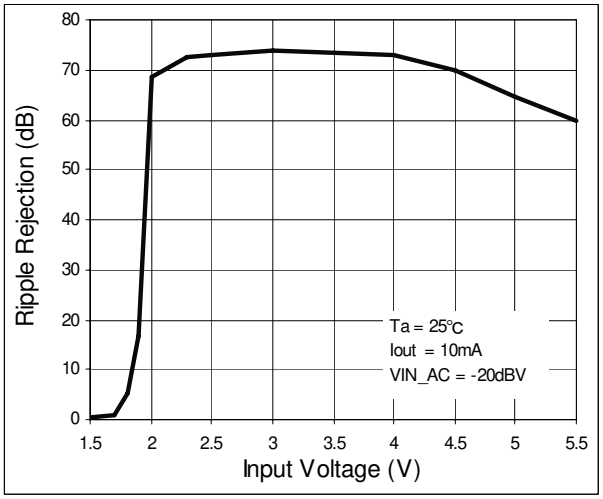


Figure 14. Ripple Rejection vs. Input Voltage

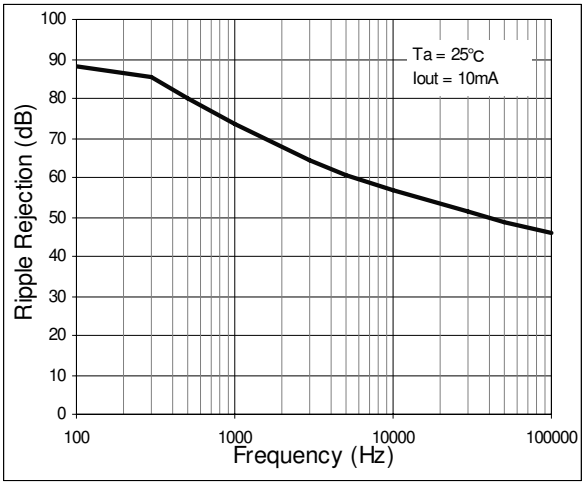


Figure 15. Ripple Rejection vs. Freqency

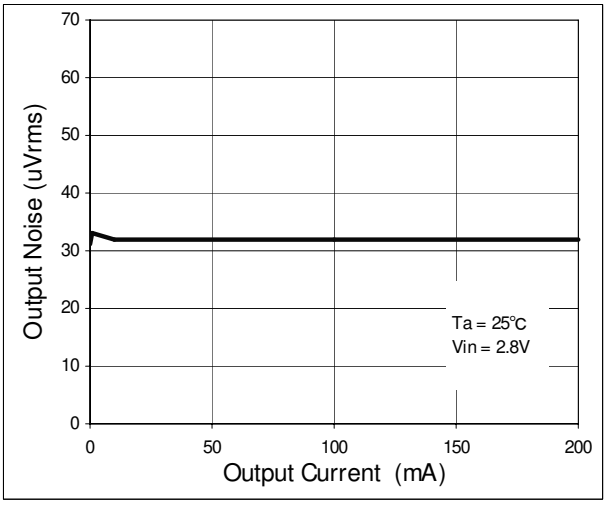


Figure 16. Output Noise vs. Output Current

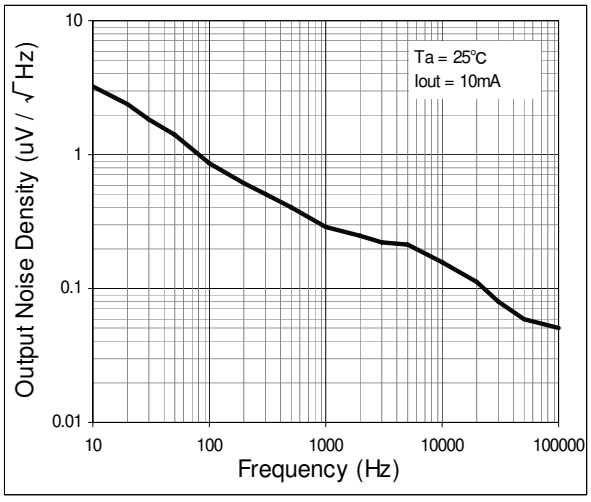


Figure 17. Output Noise Density vs. Frequency

●**Reference data BU18SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

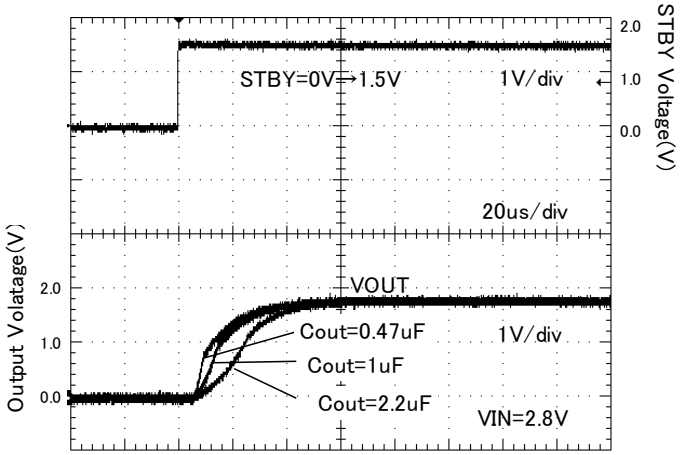


Figure 18. Startup time (Rout = none)

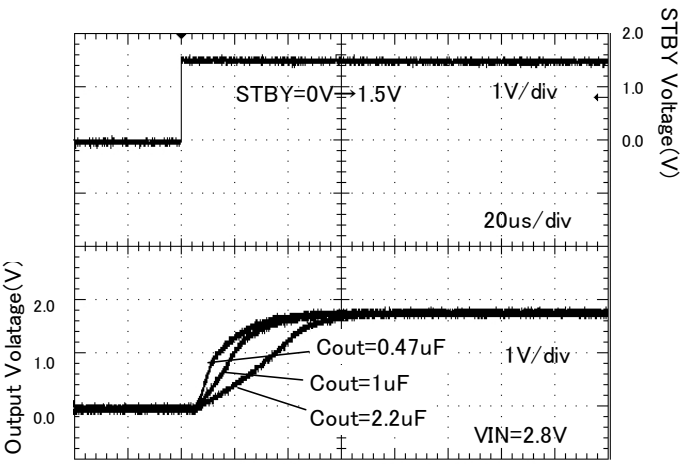


Figure 19. Startup time (Rout = 9 ohm)

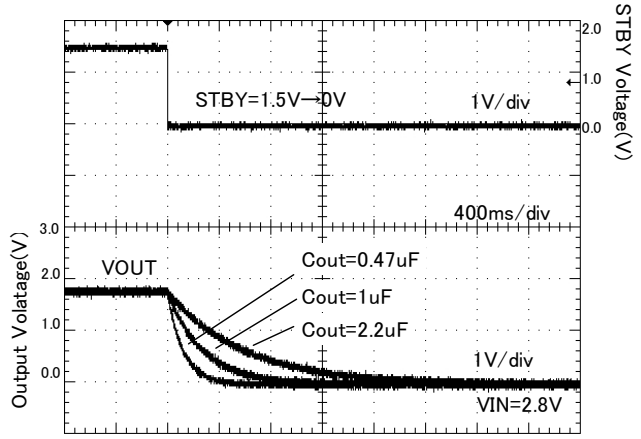


Figure 20. Discharge time (Rout = none)

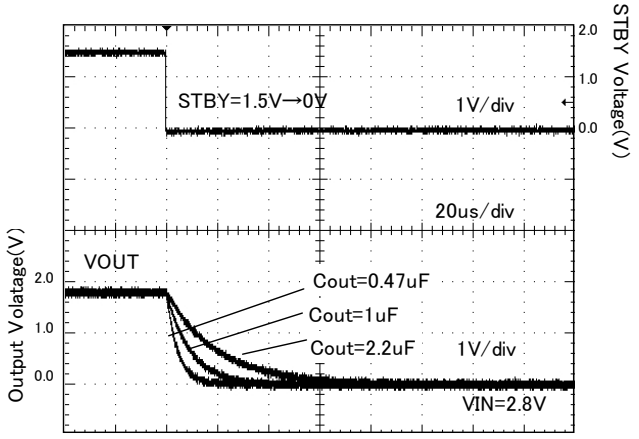


Figure 21. Discharge time (Rout = 9 ohm)

●**Reference data BU18SA4WGWL (Unless otherwise specified, Ta=25℃, Cin = Cout =1μF.)**

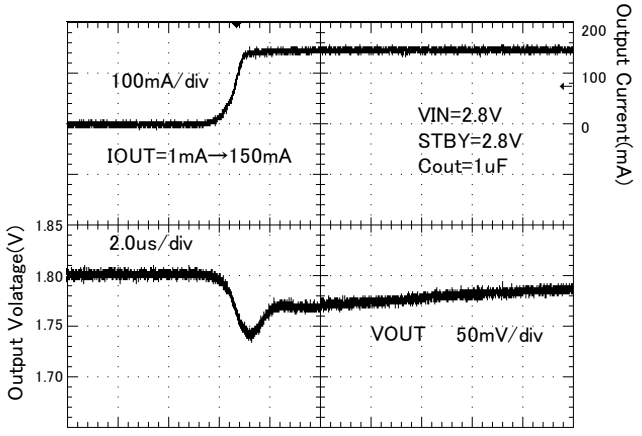


Figure 22. Load response
(Iout = 1mA → 150mA)

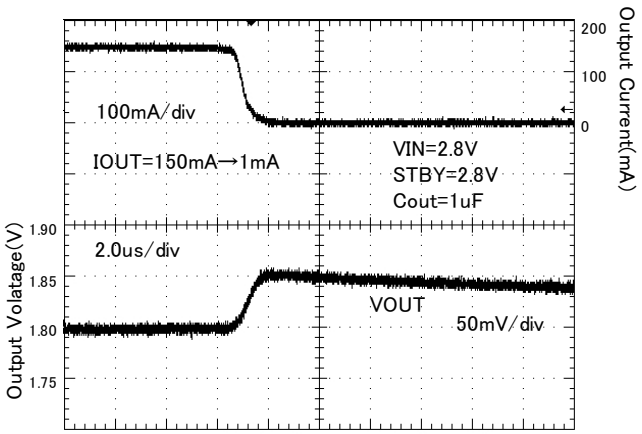


Figure 23. Load response
(Iout = 150mA → 1mA)

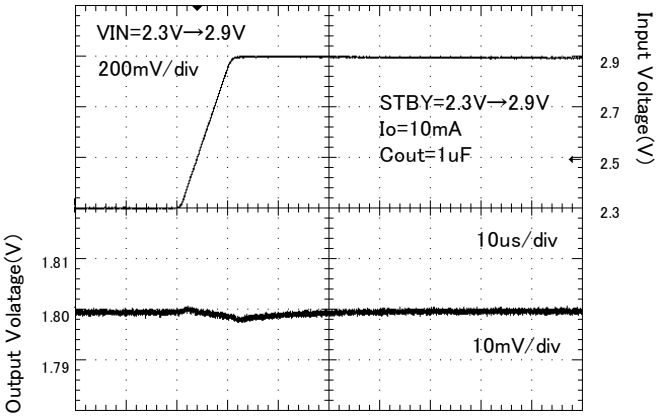


Figure 24. Line response
(Vin= 2.3V → 2.9V)

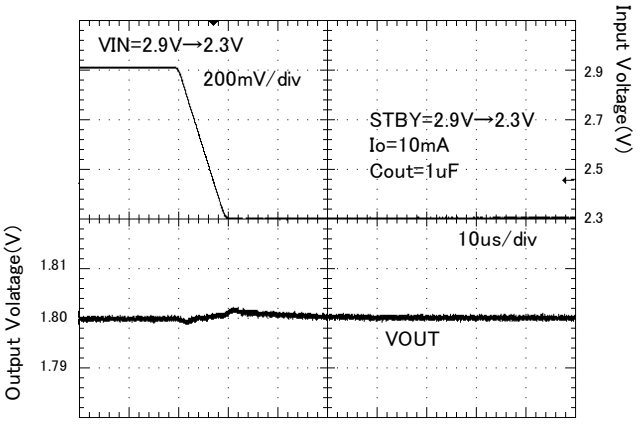


Figure 25. Line response
(Vin= 2.9V → 2.3V)

●**Reference data BU28SA4WGWL (Unless otherwise specified, Ta=25℃.)**

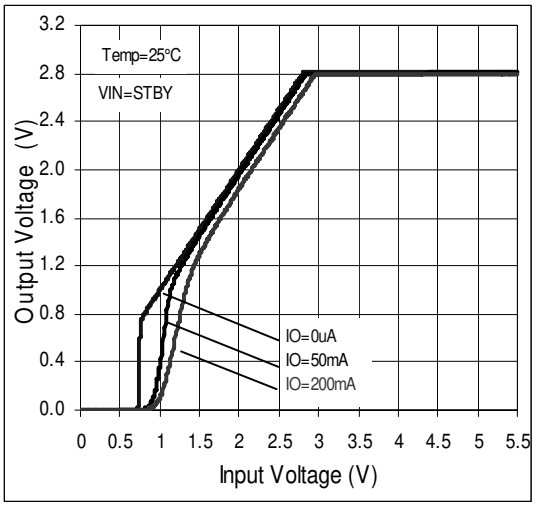


Figure 26. Output Voltage vs. Input Voltage

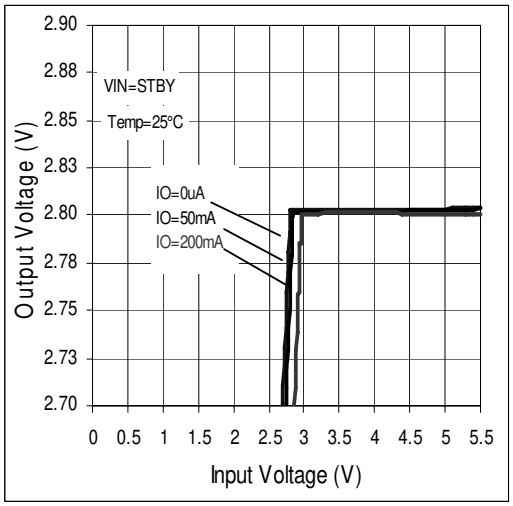


Figure 27. Line Regulation

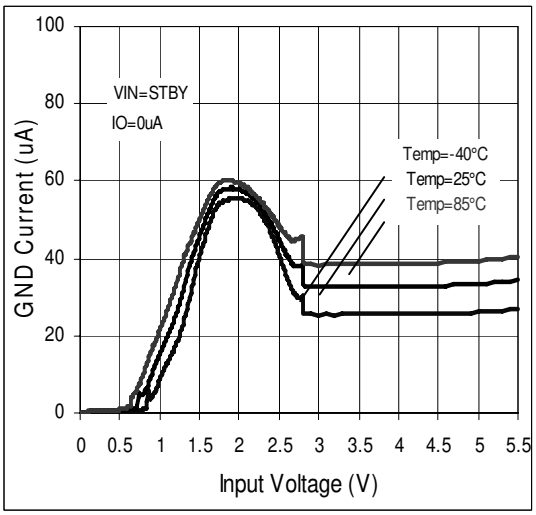


Figure 28. GND Current vs. Input Voltage

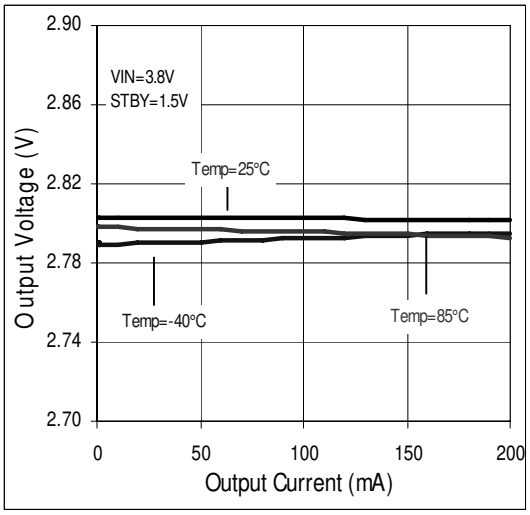


Figure 29. Load Regulation

●**Reference data BU28SA4WGWL (Unless otherwise specified, Ta=25℃.)**

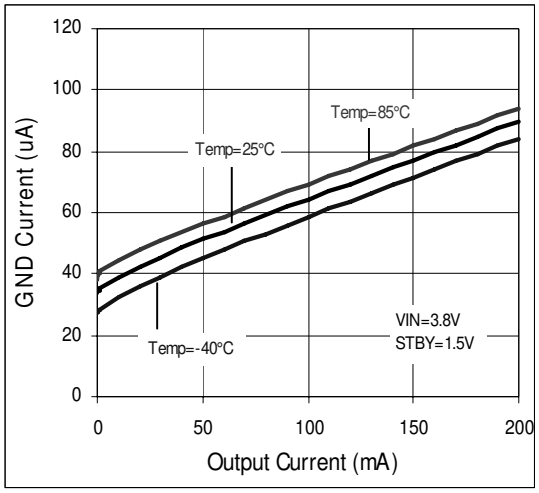


Figure 30. GND Current vs. Output Current

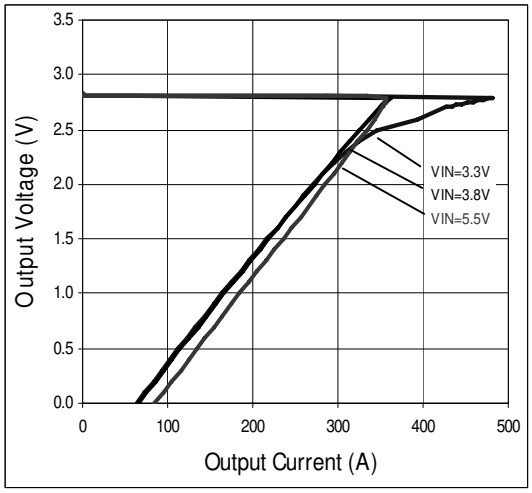


Figure 31. OCP Threshold

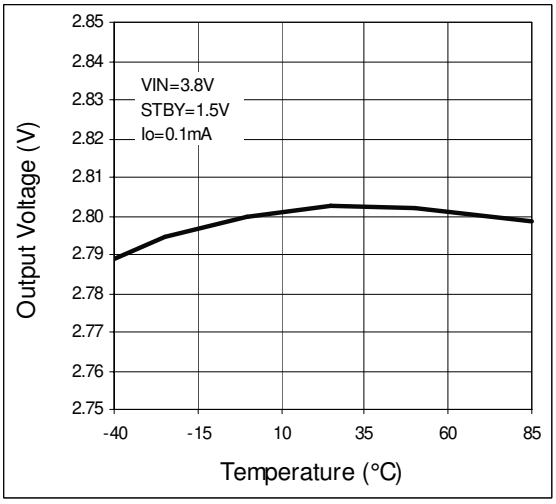


Figure 32. Output Voltage vs. Temperature

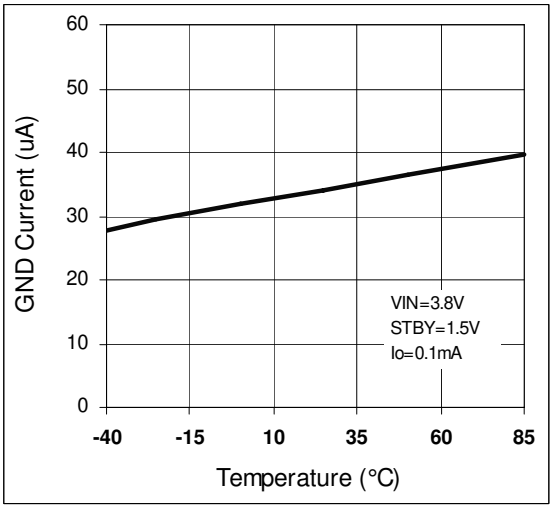


Figure 33. GND Current vs. Temperature

●**Reference data BU28SA4WGWL (Unless otherwise specified, Ta=25℃.)**

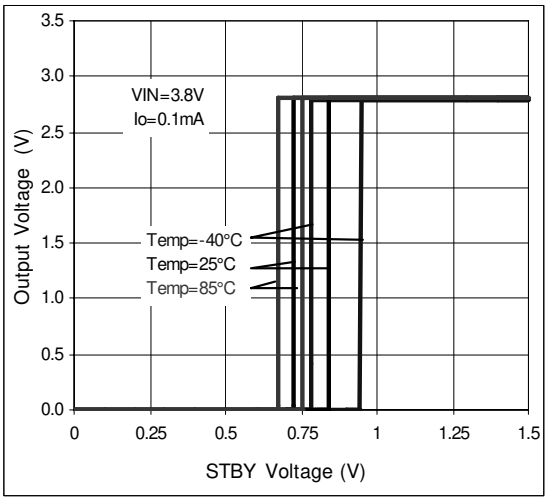


Figure 34. STBY Threshold

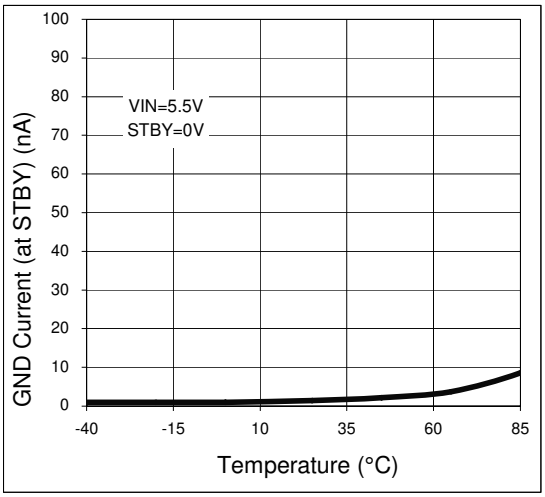


Figure 35. GND Current (at STBY) vs. Temperature

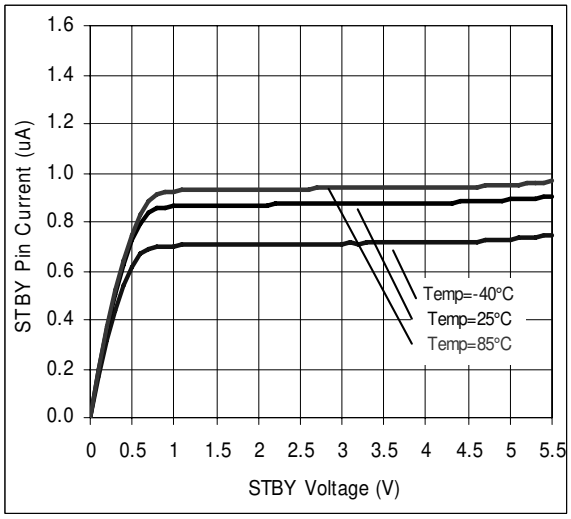


Figure 36. STBY Pin Current vs. STBY Voltage

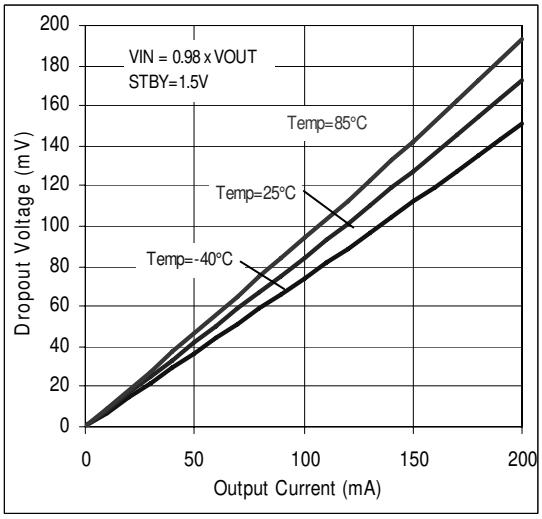


Figure 37. Dropuout Voltage vs. Output Current

●**Reference data BU28SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

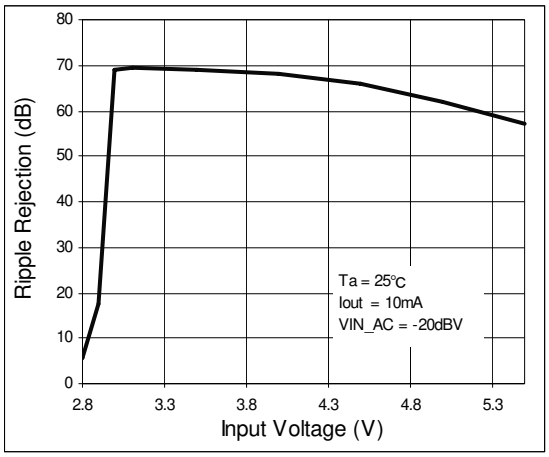


Figure 38. Ripple Rejection vs. Input Voltage

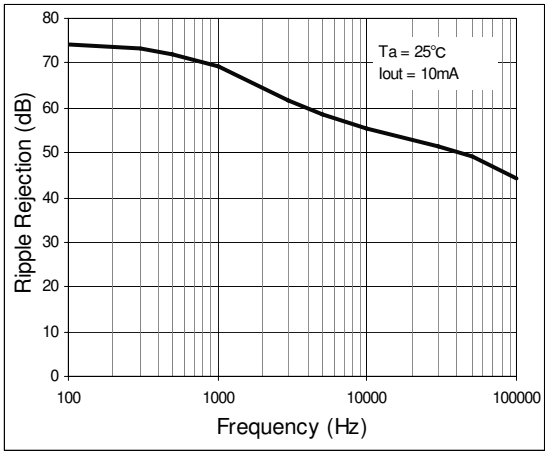


Figure 39. Ripple Rejection vs. Frequency

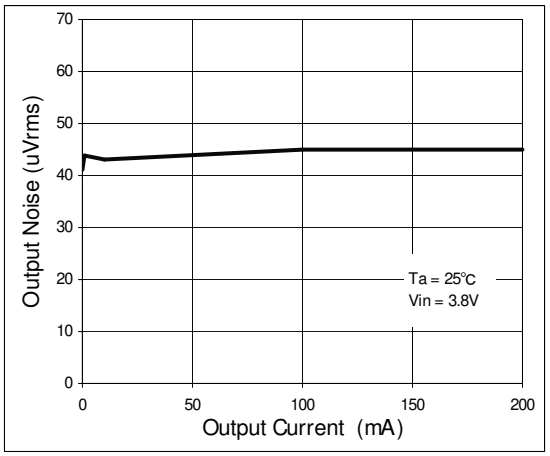


Figure 40. Output Noise vs. Output Current

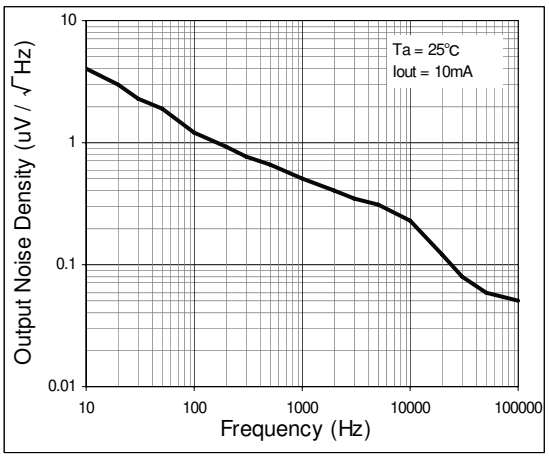


Figure 41. Output Noise Density vs. Frequency

●**Reference data BU28SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

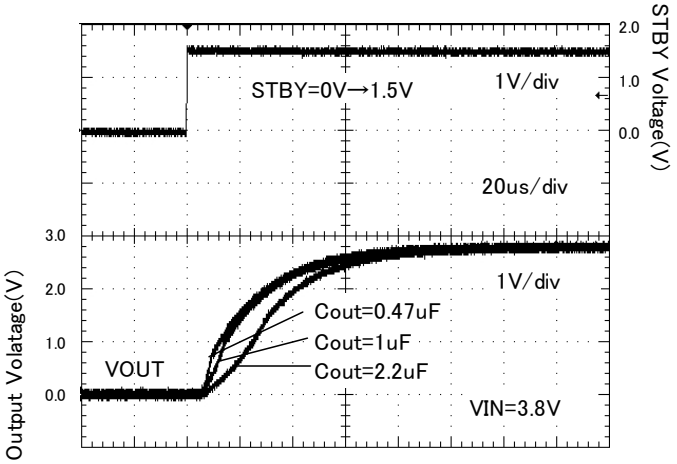


Figure 42. Startup time (Rout = none)

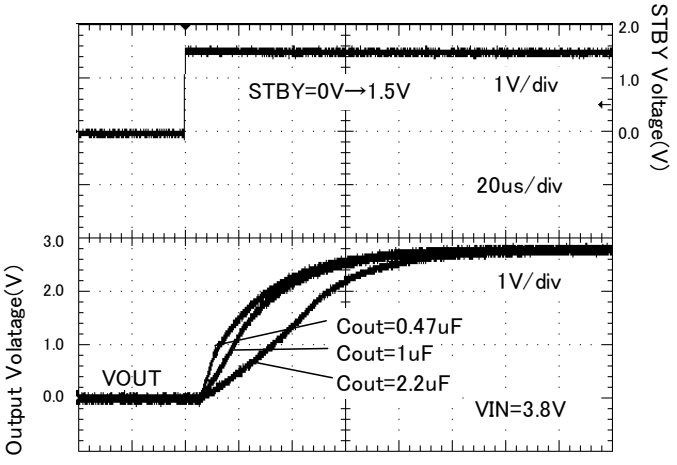


Figure 43. Startup time (Rout = 14 ohm)

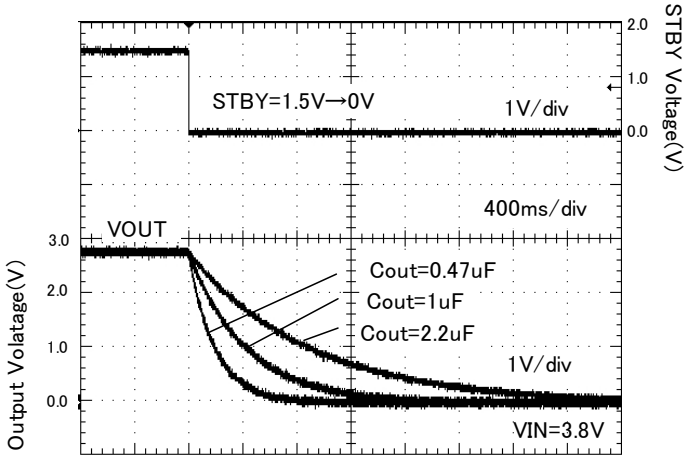


Figure 44. Discharge time (Rout = none)

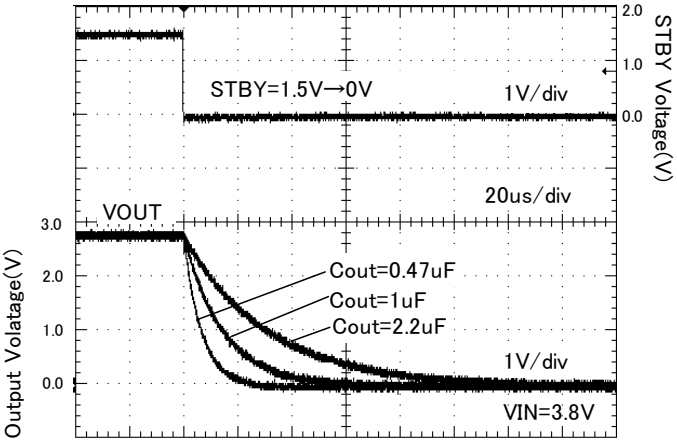


Figure 45. Discharge time (Rout = 14 ohm)

●**Reference data BU28SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

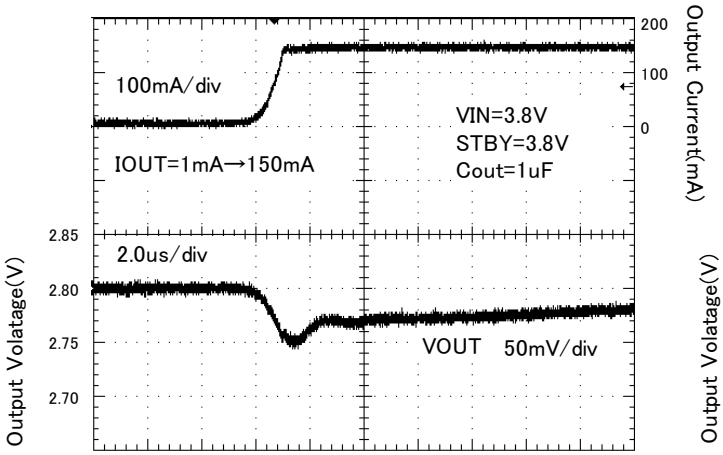


Figure 46. Load response
(Iout = 1mA → 150mA)

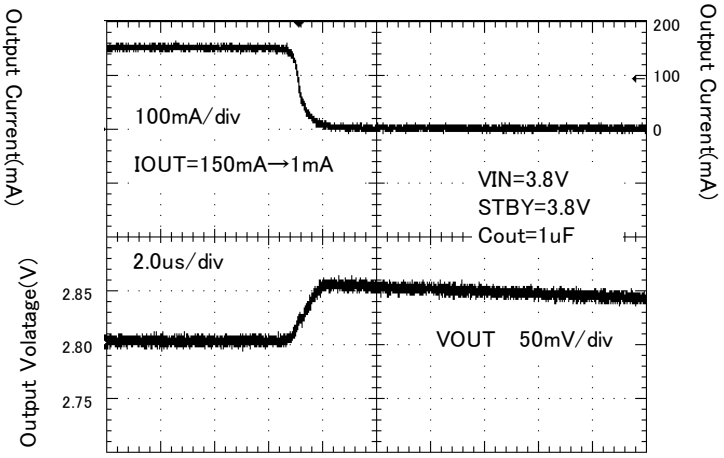


Figure 47. Load response
(Iout = 150mA → 1mA)

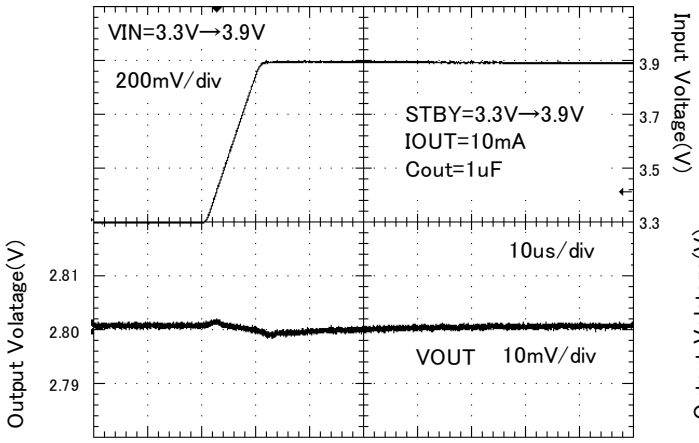


Figure 48. Line response (Vin= 3.3V → 3.9V)

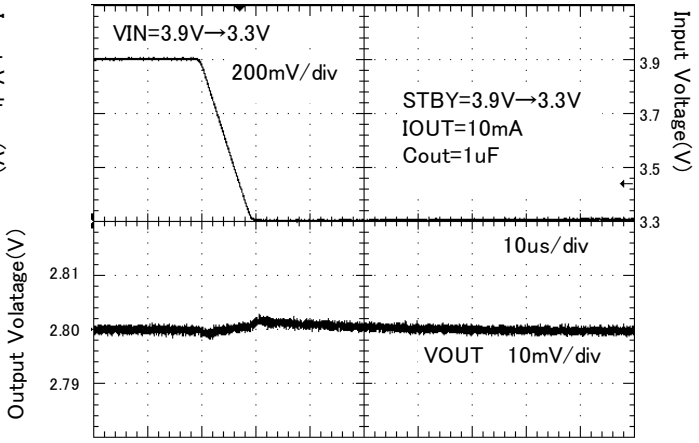


Figure 49. Line response (Vin= 3.9V → 3.3V)

●**Reference data BU30SA4WGWL (Unless otherwise specified, Ta=25℃.)**

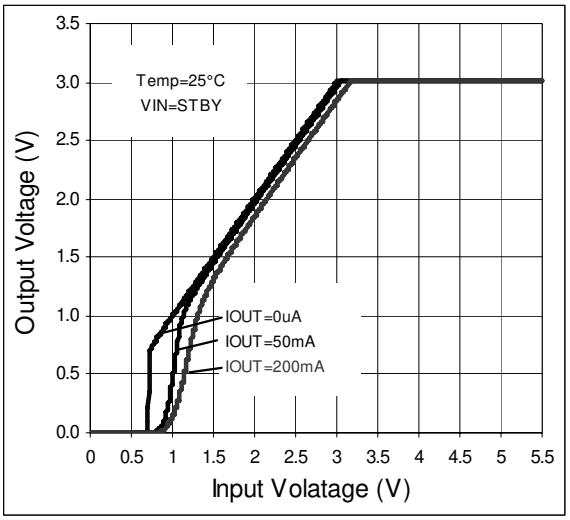


Figure 50. Output Voltage vs. Input Voltage

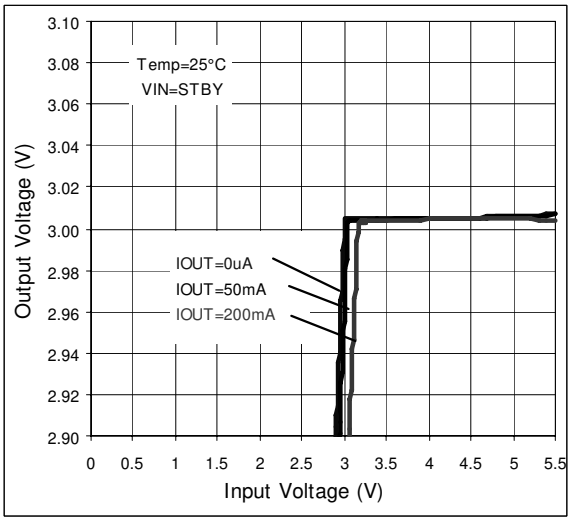


Figure 51. Line Regulation

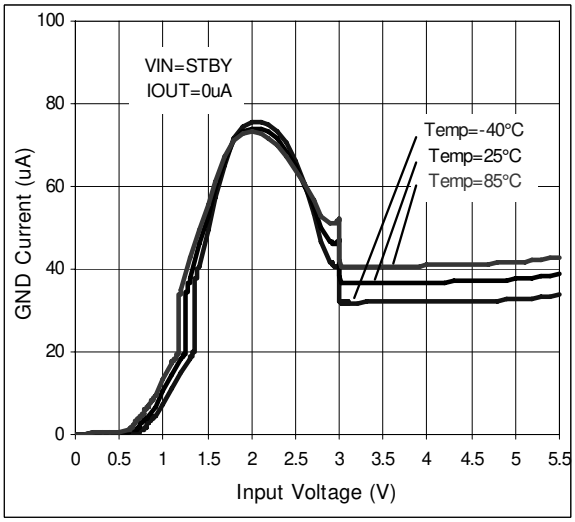


Figure 52. GND Current vs. Input Voltage

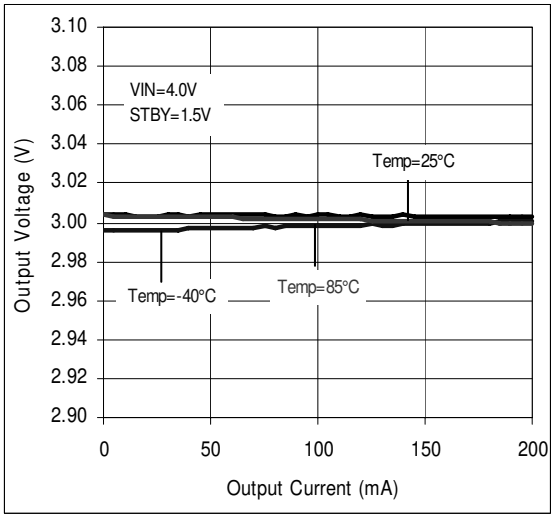


Figure 53. Load Regulation

●**Reference data BU30SA4WGWL (Unless otherwise specified, Ta=25℃.)**

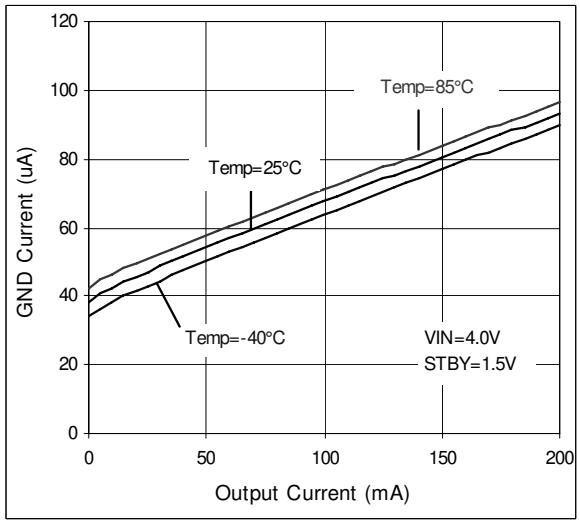


Figure 54. GND Current vs. Output Current

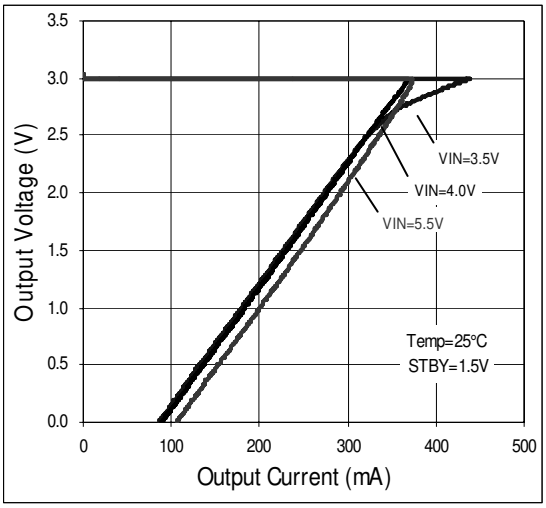


Figure 55. OCP Threshold

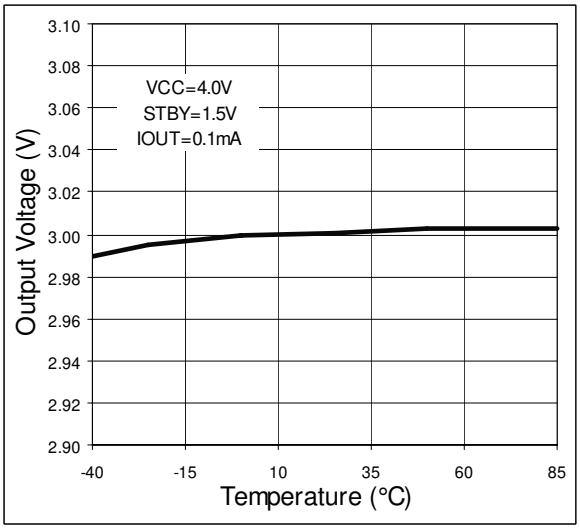


Figure 56. Output Voltage vs. Temperature

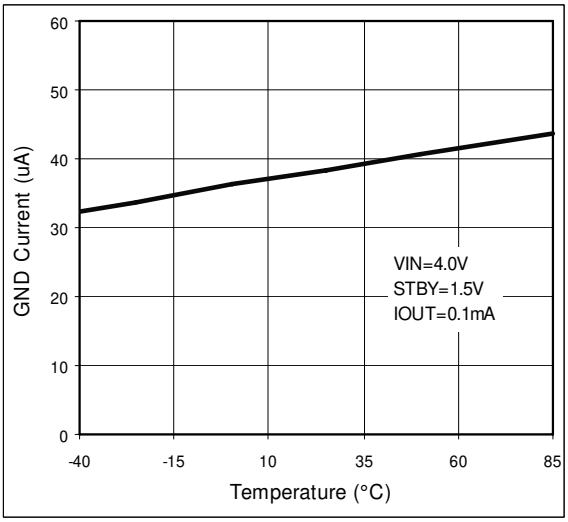


Figure 57. GND Current vs. Temperature

●**Reference data BU30SA4WGWL (Unless otherwise specified, Ta=25℃.)**

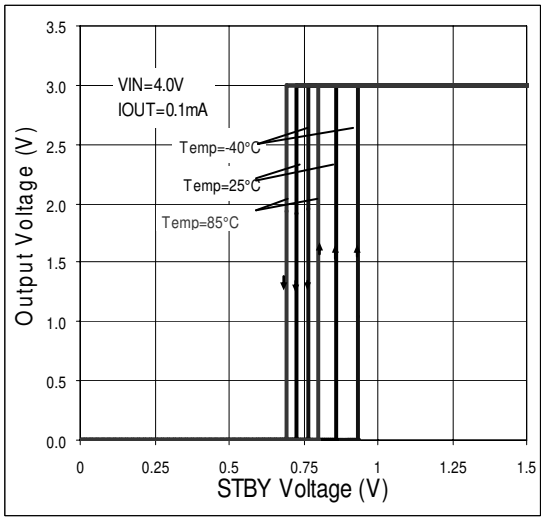


Figure 58. STBY Threshold

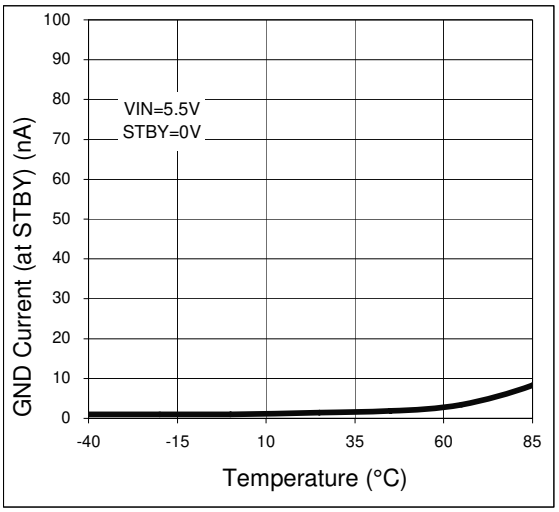


Figure 59. GND Current(at STBY) vs. Temperature

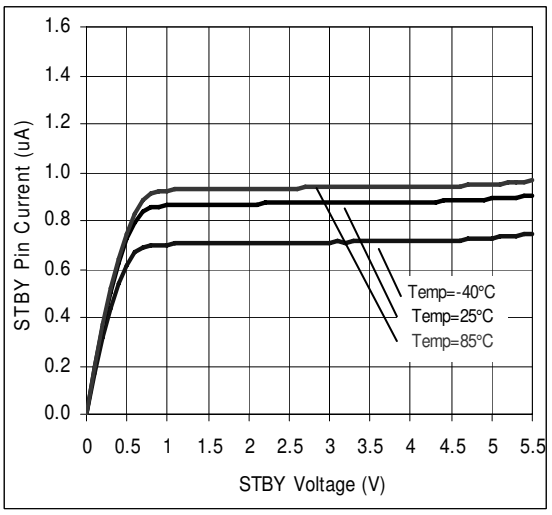


Figure 60. STBY Pin Voltage vs. STBY Pin Current

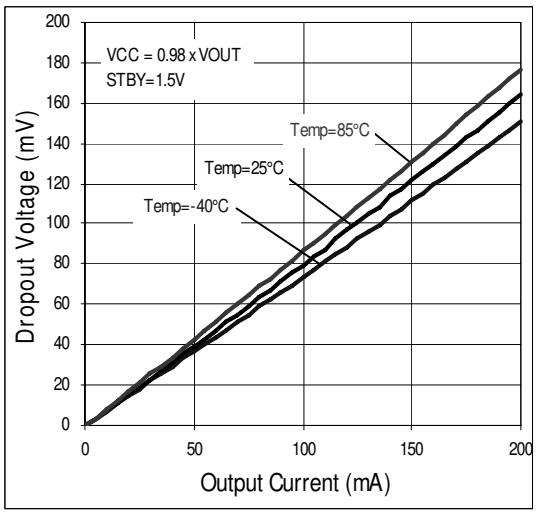


Figure 61. Dropout Voltage vs. Output Current

●**Reference data BU30SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

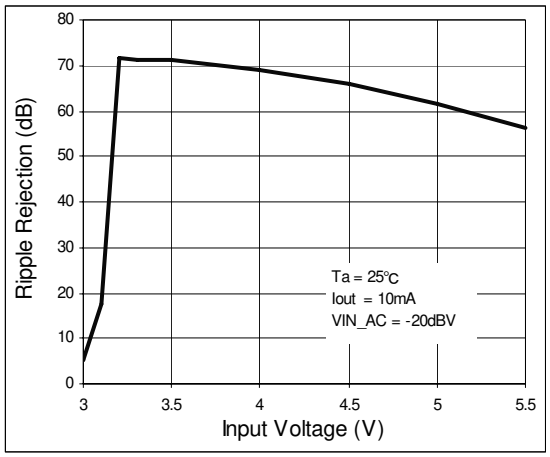


Figure 62. Ripple Rejection vs. Input Voltage

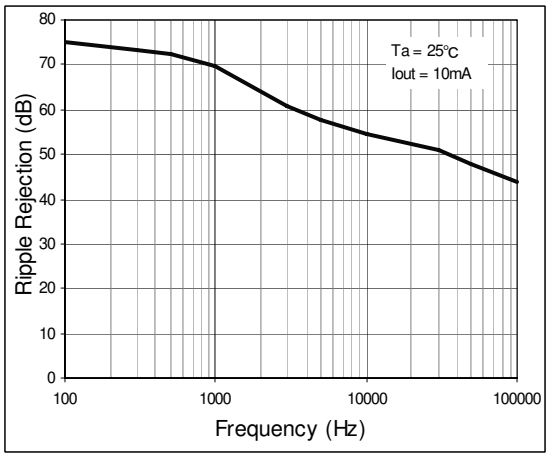


Figure 63. Ripple Rejection vs. Frequency

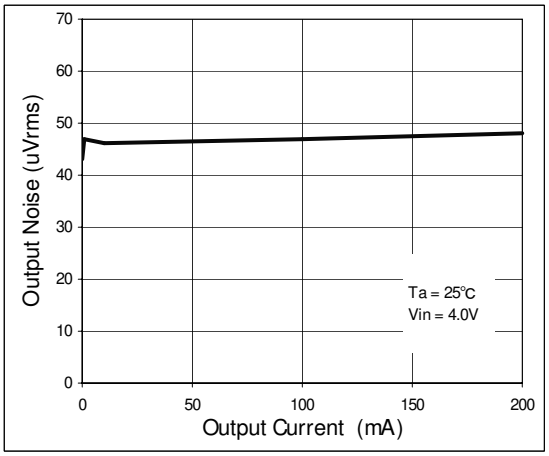


Figure 64. Output Noise vs. Output Current

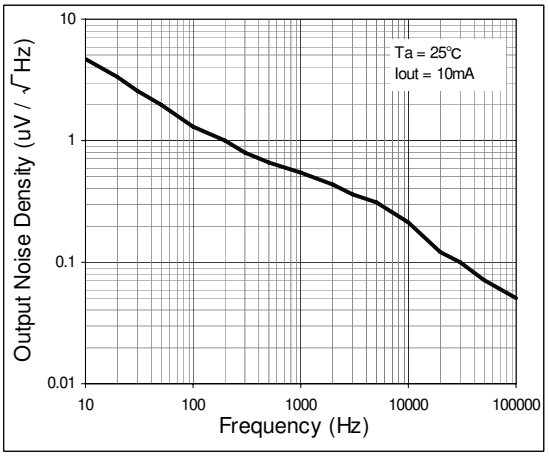


Figure 65. Output Noise Density vs. Frequency

●**Reference data BU30SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

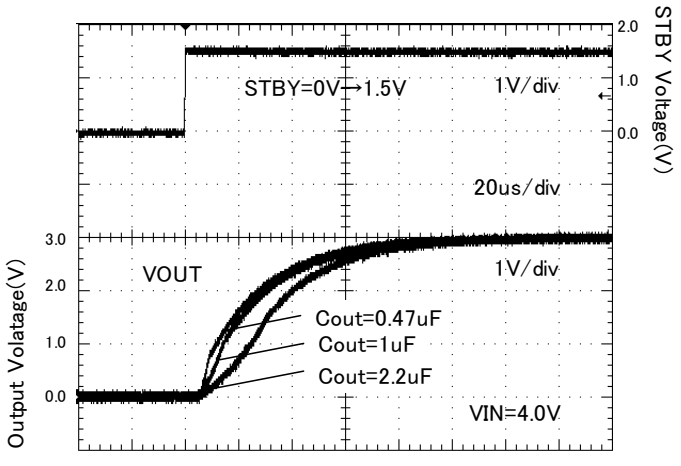


Figure 66. Startup time (Rout = none)

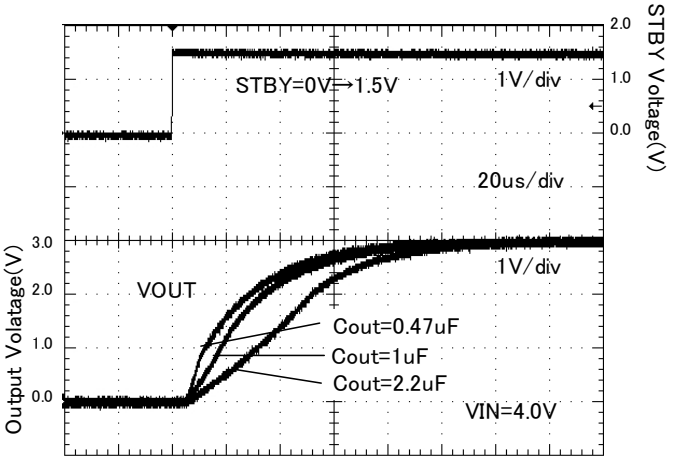


Figure 67. Startup time (Rout = 15 ohm)

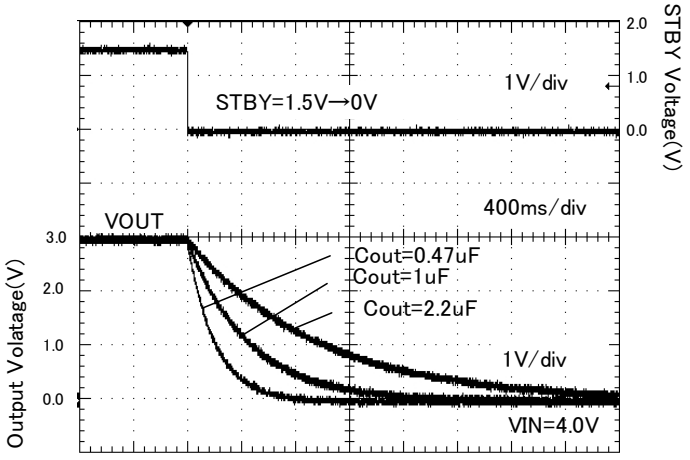


Figure 68. Discharge time (Rout = none)

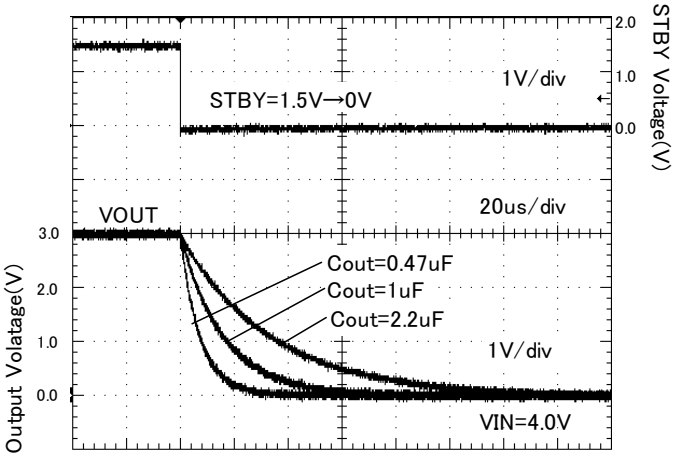


Figure 69. Discharge time (Rout = 15 ohm)

●**Reference data BU30SA4WGWL (Unless otherwise specified, Ta=25℃,Cin = Cout =1μF.)**

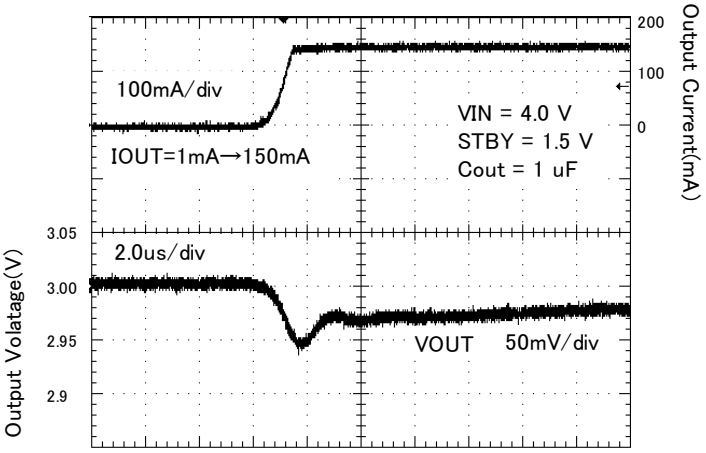


Figure 70. Load response
(Iout = 1mA → 150mA)

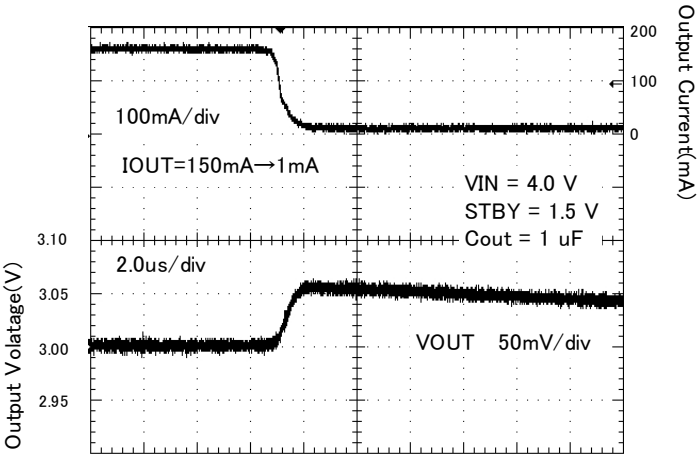


Figure 71. Load response
(Iout = 150mA → 1mA)

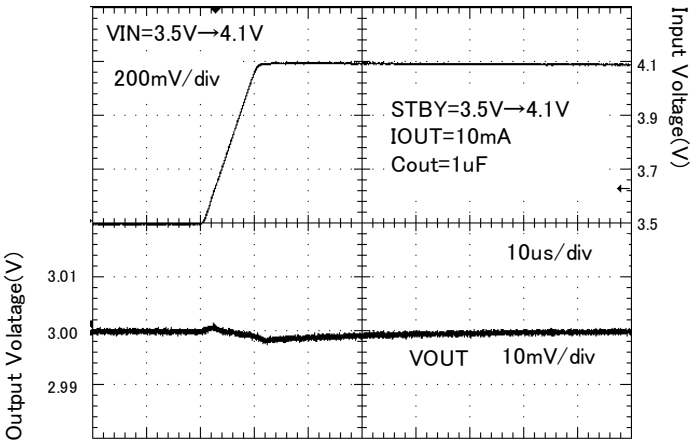


Figure 72. Line response (Vin= 3.5 V → 4.1 V)

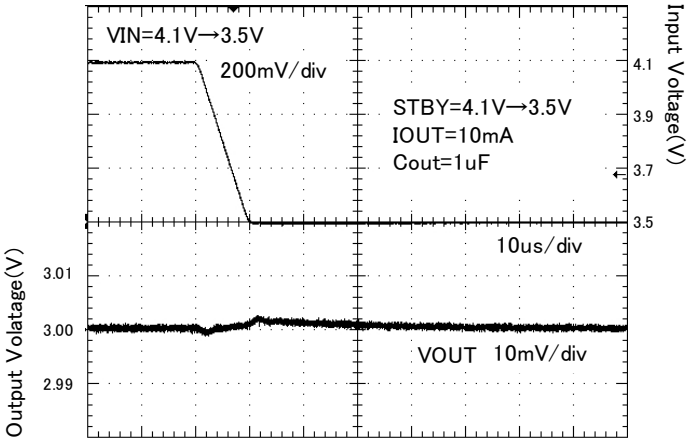


Figure 73. Line response (Vin= 4.1 V → 3.5 V)

●**Reference data BU33SA4WGWL (Unless otherwise specified, Ta=25℃.)**

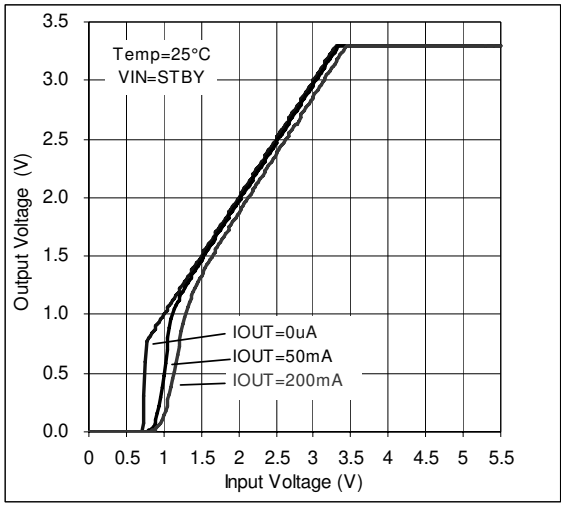


Figure 74. Output Voltage vs. Input Voltage

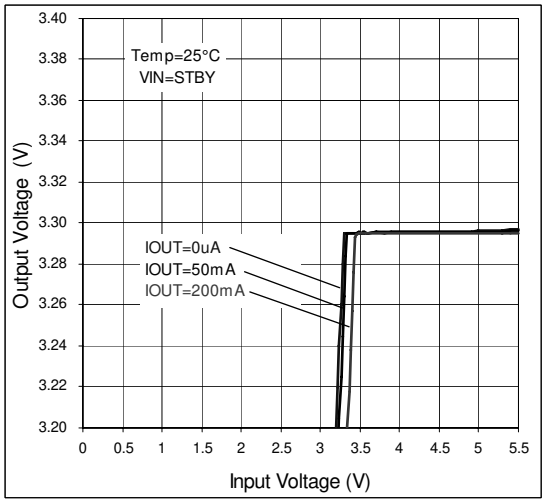


Figure 75. Line Regulation

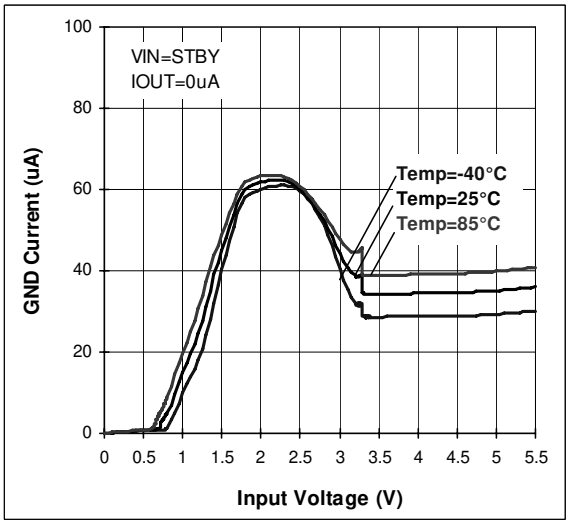


Figure 76. GND Current vs. Input Voltage

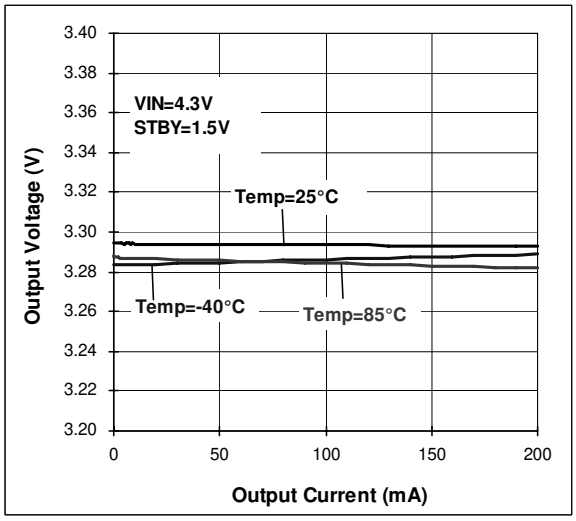


Figure 77. Load Regulation

●**Reference data BU33SA4WGWL (Unless otherwise specified, Ta=25℃.)**

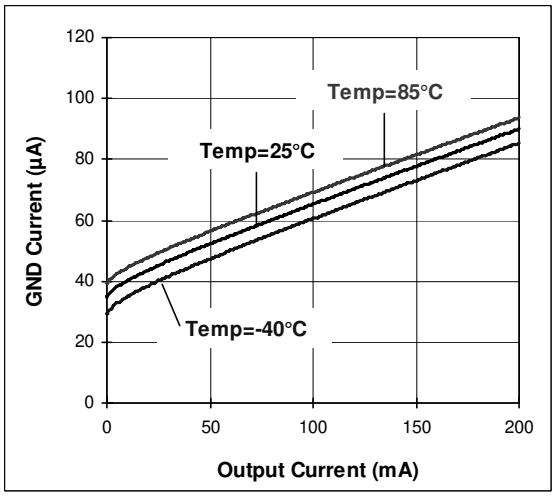


Figure 78. GND Current vs. Output Current

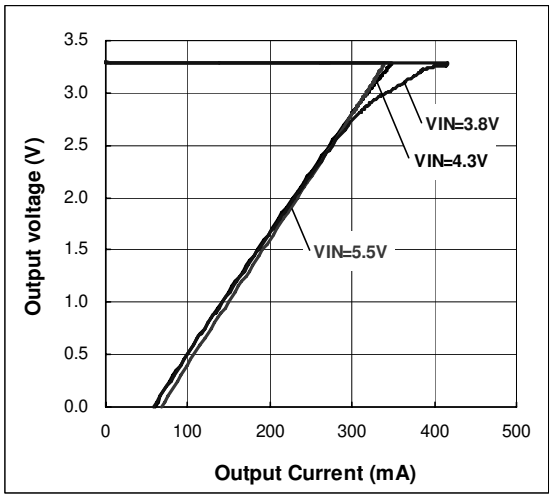


Figure 79. OCP Threshold

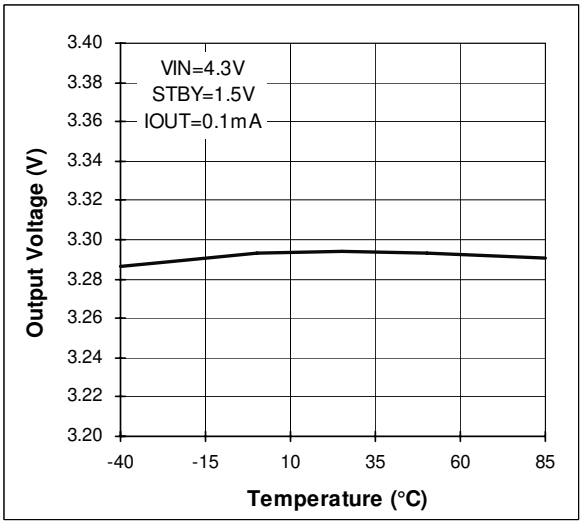


Figure 80. Output Voltage vs. Temperature

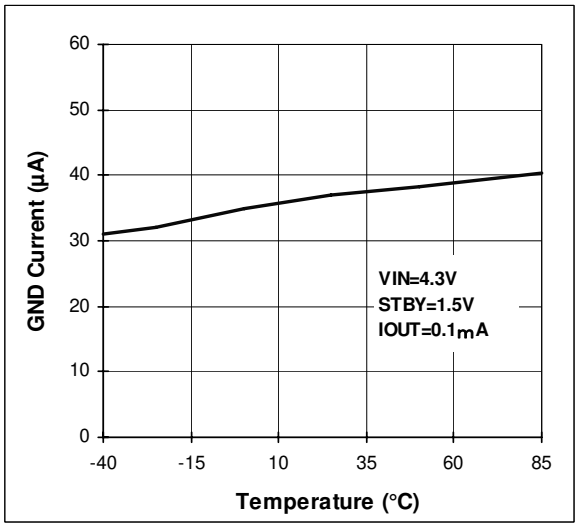


Figure 81. GND Current vs. Temperature

●**Reference data BU33SA4WGWL (Unless otherwise specified, Ta=25℃.)**

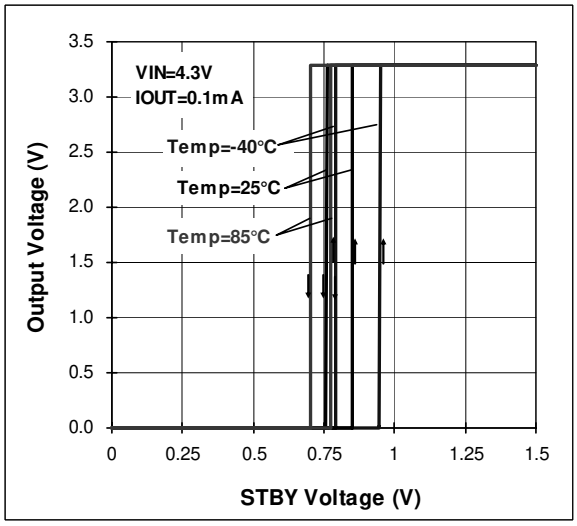


Figure 82. STBY Threshold

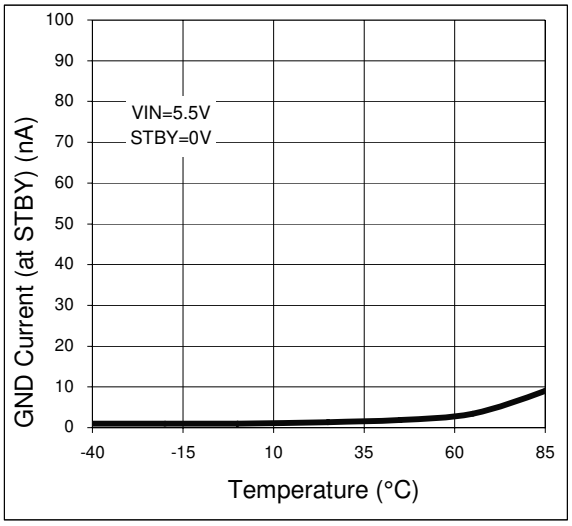


Figure 83. GND Current (at STBY) vs. Temperature

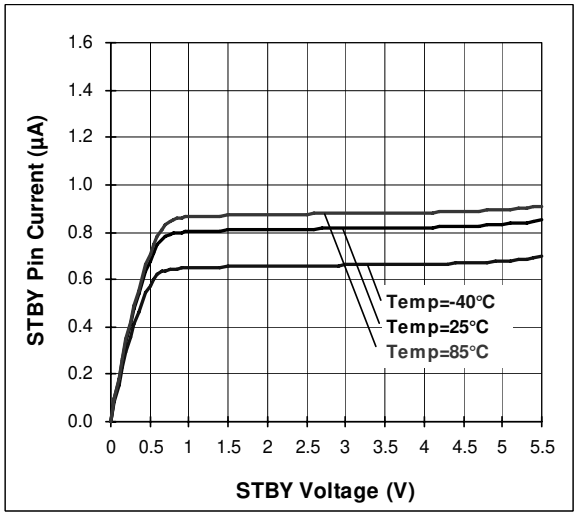


Figure 84. STBY Pin Current vs. STBY Voltage

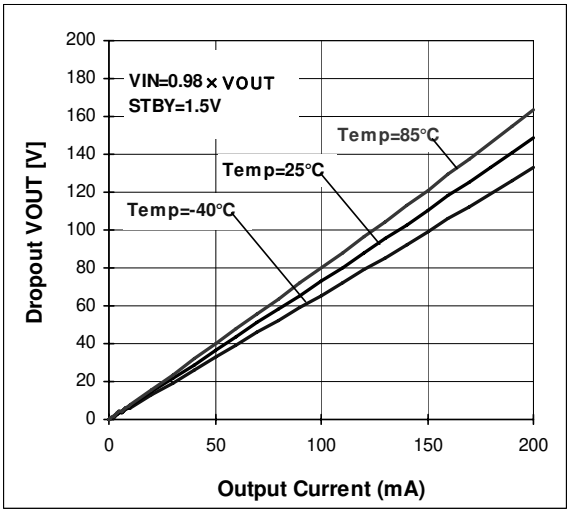


Figure 85. Dropout Voltage vs. Output Current