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Single-Output LDO Regulators

35V Withstand Voltage

1A LDO Regulators

BDxxFC0 series

●Description

The BDxxFC0 series are low-saturation regulators. The series' output voltages are Variable, 3.0V, 3.3V, 5.0V, 6.0V, 7.0V, 8.0V, 9.0V, 10.0V, 12.0V and 15.0V and packages are HTSOP-J8, TO252-3, and TO252-5. This series has a built-in over-current protection circuit that prevents the destruction of the IC due to output short circuits and a thermal shutdown circuit that protects the IC from thermal damage due to overloading.

●Key Specifications

- 1) Output current capability: 1A
- 2) Output voltage: Variable, 3.0V, 3.3V, 5.0V, 6.0V, 7.0V, 8.0V, 9.0V, 10.0V, 12.0V and 15.0V
- 3) High output voltage accuracy (Ta=25°C): ±1%
- 4) Low saturation with PDMOS output
- 5) Built-in over-current protection circuit that prevents the destruction of the IC due to output short circuits
- 6) Built-in thermal shutdown circuit for protecting the IC from thermal damage due to overloading
- 7) Available Ceramic Capacitor to prevent oscillation
- 8) HTSOP-J8, TO252-3 and TO252-5 packages

●Features

- Output Voltage: 1.0V to 15.0V
- Output Voltage Precision(Ta=25°C): ±1%
- Supply Voltage(Vo≥3.0V): Vo+1.0V to 26.5V
- Supply Voltage(Vo<3.0V): 4.0V to 26.5V
- Output Current: 1A
- Operating Temperature Range: -25°C≤Ta≤+85°C

●Packages

HTSOP-J8

(Typ) (Typ) (Max)
4.90mm x 6.00mm x 1.00mm



TO252-3

6.50mm x 9.50mm x 2.50mm



TO252-5

6.50mm x 9.50mm x 2.50mm



●Ordering part number

B D x x F C 0 W x x x						-	E 2
Part Number	Output voltage 00: Variable 30: 3.0V 33: 3.3V 50: 5.0V 60: 6.0V 70: 7.0V 80: 8.0V 90: 9.0V J0: 10.0V J2: 12.0V J5: 15.0V	Input Voltage F:35V	Output Current C0:1.0A	Enable "W": Included Enable None: Without Enable	Package EFJ: HTSOP-J8 FP: TO252-3/5	Packaging and forming specification E2: Emboss tape reel	

○Product structure : Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

●Lineup

Articles	Variable	3.0	3.3	5.0	6.0	7.0	8.0	9.0	10.0	12.0	15.0	パッケージ	
BDxxFC0WEFJ-E2	○	○	○	○	○	○	○	○	○	○	○	HTSOP-J8	Reel of 2500
BDxxFC0FP-E2	-	-	○	○	-	-	-	-	-	-	-	TO252-3	Reel of 2000
BDxxFC0WFP-E2 ^(Note 1)	○	○	○	○	○	○	○	○	○	○	○	TO252-5	Reel of 2000

(Note 1) under development except for Variable

●Typical Application Circuits

〈Output Voltage Variable Type (With Enable)〉

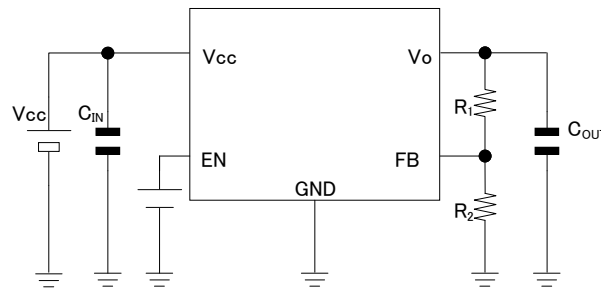


Figure 1. Typical Application Circuit Output Voltage Variable Type (With Enable)

〈Output Voltage Fixed Type (With Enable)〉

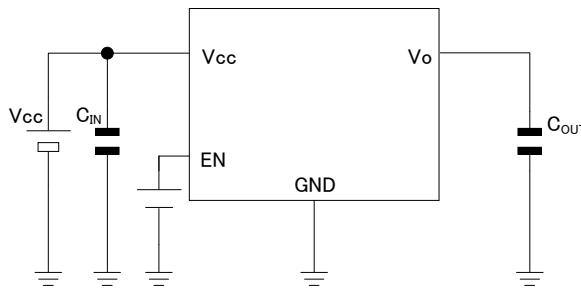


Figure 2. Typical Application Circuit Output Voltage Fixed Type (With Enable)

〈Output Voltage Fixed Type (Without Enable)〉

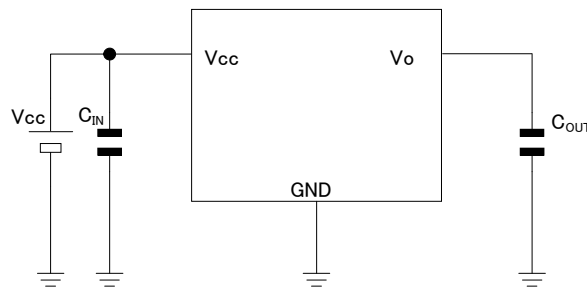


Figure 3. Typical Application Circuit Output Voltage Fixed Type (Without Enable)

●Pin Configuration/Pin Description

<With Enable (HTSOP-J8)>

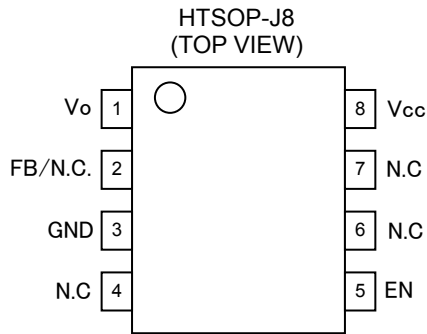


Figure 4. Pin Configuration (With Enable)

Pin No.	Pin name	Pin Function
1	Vo	Output pin
2	FB/N.C. (Note 1)	Feedback pin (Variable Output Type) No Connection (Fixed Output Type)
3	GND	GND pin
4	N.C. (Note 1)	No Connection (Connect to GND or leave OPEN)
5	EN	Enable pin
6	N.C. (Note 1)	No Connection (Connect to GND or leave OPEN)
7	N.C. (Note 1)	No Connection (Connect to GND or leave OPEN)
8	Vcc	Power supply pin
Exposed PAD	GND	Substrate(Connect to GND)

(Note 1) N.C. Pin can be open, because it is not connected to the IC.

<Without Enable (TO252-3)>

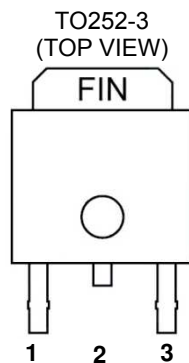


Figure 5. Pin Description (Without Enable)

Pin No.	Pin Name	Pin Function
1	Vcc	Power Supply Pin
2	N.C. (Note 1)	No Connection (leave OPEN)
3	Vo	Output Pin
FIN	GND	GND

(Note 1) N.C.Pin can be open since it is not connected inside of IC.

〈With Enable (TO252-5)〉

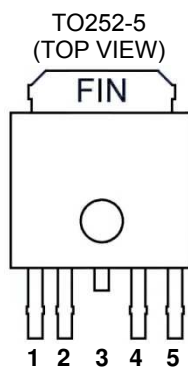


Figure 6. Pin Configuration (With Enable)

Pin No.	Pin Name	Pin Function
1	EN	Enable Pin
2	Vcc	Power Supply Pin
3	N.C. (Note 1)	No Connection (leave OPEN)
4	Vo	Output Pin
5	FB/N.C. (Note 1)	Variable Pin (Variable Output Type) N.C. Pin (Fixed Output Type)
FIN	GND	GND

(Note 1) N.C.Pin can be open since it is not connected inside of IC.

●Block diagrams

■ HTSOP-J8 <BD00FC0WEFJ (Output Voltage Variable Type) with Enable>

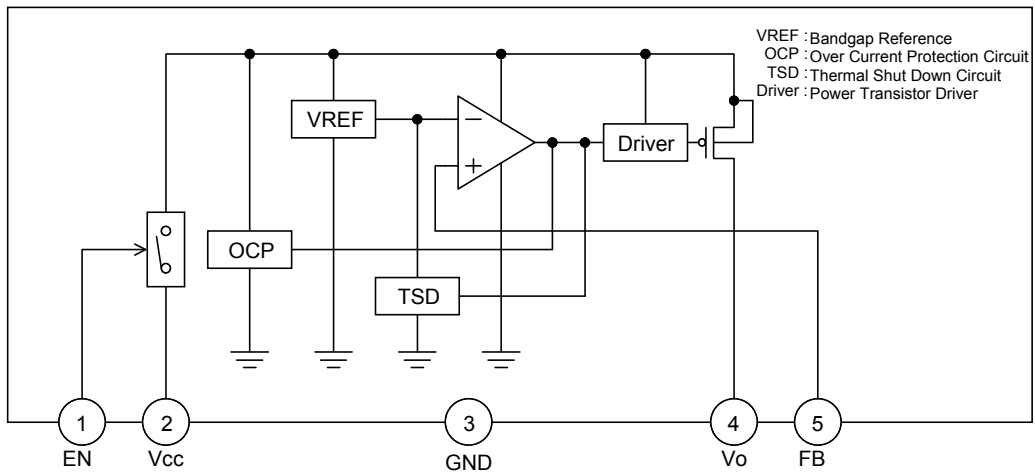


Figure 7. Block diagrams
 BD00FC0WEFJ (Output Voltage Variable Type with Enable)

■ HTSOP-J8 <BDxxFC0WEFJ (Output Voltage Fixed Type) with Enable>

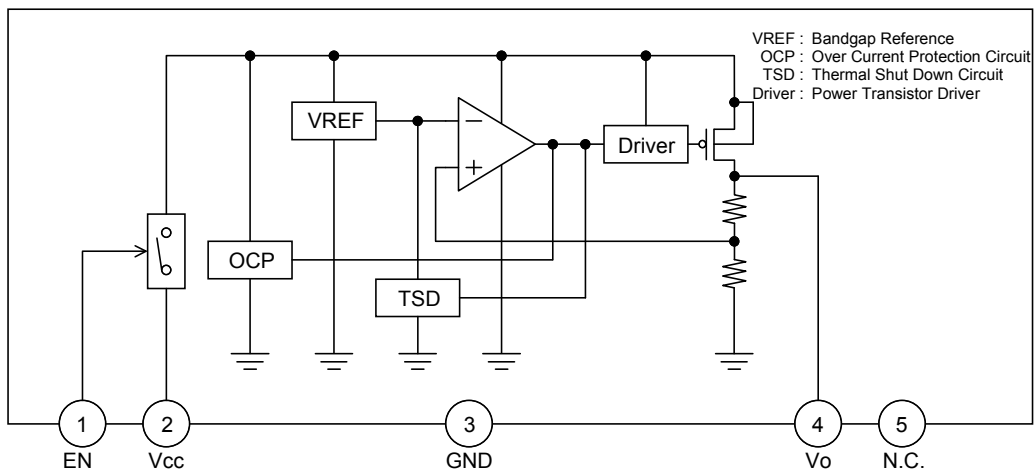


Figure 8. Block diagrams
 BxxFC0WEFJ (Output Voltage Variable Type with Enable)

■ TO252-3 <BDxxFC0FP (Output Voltage Fixed Type) without Enable>

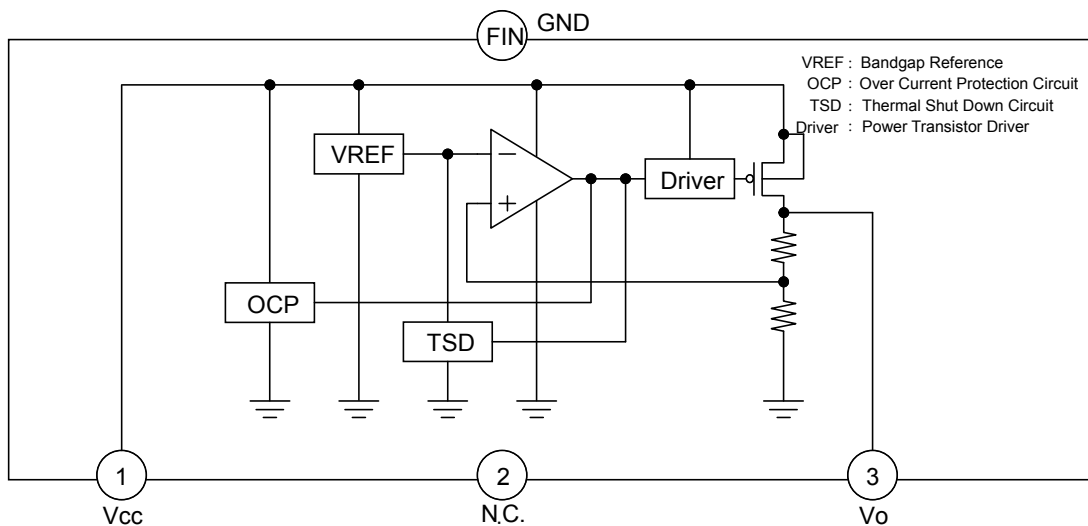


Figure 9. Block diagrams
 BDxxFC0FP (Output Voltage Fixed Type, without Enable)

■ TO252-5 〈BD00FC0WFP (Output Voltage Variable Type) With Enable〉

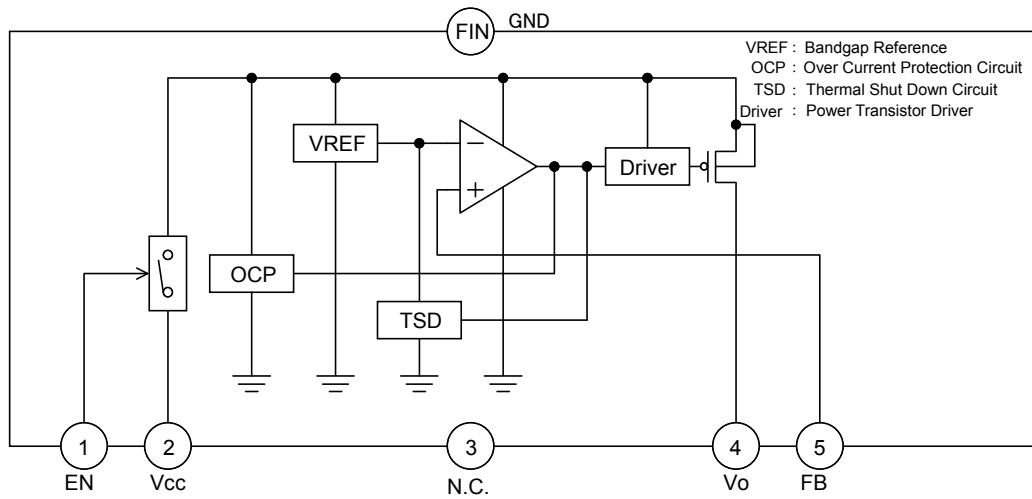


Figure 10. Block diagram
 BD00FC0WFP (Output Voltage Variable Type, with Enable)

■ TO252-5 〈BDxxFC0WFP (Output Voltage Fixed Type) With Enable〉

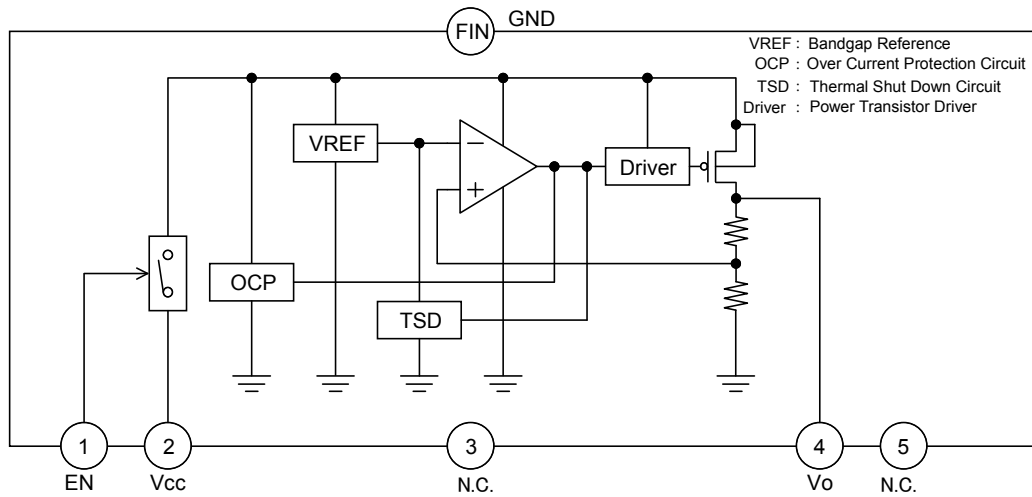


Figure 11. Block diagram
 BDxxFC0WFP (Output Voltage Fixed Type, with Enable)

●Absolute Maximum Ratings (Ta= 25°C)

Parameter	Symbol	Ratings	Unit
Supply Voltage *1	Vcc	-0.3 to +35.0	V
EN Voltage *2	VEN	-0.3 to +35.0	V
Operating Temperature Range	Ta	-25 to +85	°C
Storage Temperature Range	Tstg	-55 to +150	°C
Maximum Junction Temperature	Tjmax	150	°C

*1 Do not exceed Tjmax.

*2 Power Supply (Vcc) and EN pin startup sequence does not matter provided they are operated within the power supply voltage range.

●Operating Conditions (-25°C ≤ Ta ≤ +85°C)

Parameter	Symbol	Min	Max	Unit
Supply Voltage (Vo ≥ 3.0V)	Vcc	Vo+1	26.5	V
Supply Voltage (Vo < 3.0V)	Vcc	4.0	26.5	V
Startup Voltage (Io=0mA)	Vcc	-	3.8	V
EN Voltage (with shutdown ENABLE)	VEN	0	26.5	V
Output Current	Io	0	1.0	A
Output Voltage *3 (BD00FC0)	Vo	1.0	15.0	V

*3 Please refer to Notes when using BD00FC0W at output voltage of 1.0V to 3.0V.

●Electrical Characteristics

Unless otherwise specified, Ta=25°C, Vcc=13.5V, Io=0mA, VEN=5.0V

The resistor between FB and OUT =56.7kΩ, FB and GND =10kΩ (BD00FC0)

Parameter	Symbol	Guaranteed Limit			Unit	Conditions
		Min	Typ	Max		
Circuit Current at shutdown mode	ISD	-	0	5	μA	VEN=0V
Circuit Current	ICC	-	0.5	2.5	mA	
Output Reference Voltage (BD00FC0)	VFB	0.742	0.750	0.758	V	Io =50mA
Output Voltage (BD30/33/50FC0)	Vo	Vo×0.99	Vo	Vo×1.01	V	Io =200mA
Output Voltage (BD60/70/80/90/J0/J2/J5FC0)	Vo	Vo×0.99	Vo	Vo×1.01	V	Io =500mA *4
Minimum dropout voltage	ΔVd	-	0.4	0.7	V	Vcc=4.0V Io =500mA *5
Minimum dropout voltage (BD00/50/60/70/80/90/J0/J2/J5FC0)	ΔVd	-	0.3	0.5	V	Vcc= Vo×0.95, Io =500mA
Line Regulation	Reg.I	-	20	80	mV	Vcc=Vo+1.0V→26.5V
Load Regulation	Reg.Io	-	Vo×0.010	Vo×0.020	V	Io =5mA→1A *4
EN High Voltage (with Enable)	VEN(High)	2.0	-	-	V	ACTIVE MODE
EN Low Voltage (with Enable)	VEN(Low)	-	-	0.8	V	OFF MODE
EN Bias Current (with Enable)	IEN	-	25	50	μA	

*4 In case of J0, J2 and J5, Vcc=Vo+4.5V

*5 In case of Vo ≥ 4.0V

● Thermal Resistance

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s ^(Note 3)	2s2p ^(Note 4)	
HTSOP-J8				
Junction to Ambient	θ_{JA}	206.4	45.2	°C/W
Junction to Top Characterization Parameter ^(Note 2)	Ψ_{JT}	21	13	°C/W
TO252-5 / TO252-3				
Junction to Ambient	θ_{JA}	115.3	20.8	°C/W
Junction to Top Characterization Parameter ^(Note 2)	Ψ_{JT}	14	3	°C/W

(Note 1)Based on JESD51-2A(Still-Air)

(Note 2)The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.

(Note 3)Using a PCB board based on JESD51-3.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3mm x 76.2mm x 1.57mmt
Top		
Copper Pattern	Thickness	
Footprints and Traces	70 μ m	

(Note 4)Using a PCB board based on JESD51-5, 7.

Layer Number of Measurement Board	Material	Board Size	Thermal Via ^(Note 5)		
			Pitch	Diameter	
4 Layers	FR-4	114.3mm x 76.2mm x 1.6mmt	1.20mm	Φ 0.30mm	
Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70 μ m	74.2mm x 74.2mm	35 μ m	74.2mm x 74.2mm	70 μ m

(Note 5) This thermal via connects with the copper pattern of all layers. The placement and dimensions obey a land pattern.

●Reference Data

■BD00FC0 series (5.0V Output Setting)

Unless otherwise specified, $T_a=25^{\circ}\text{C}$, $V_{CC}=13.5\text{V}$, $V_{EN}=5.0\text{V}$, $I_o=0\text{mA}$, $V_o=5.0\text{V}$
 (The resistor between FB and $V_o=56.7\text{k}\Omega$, FB and GND = $10\text{k}\Omega$)

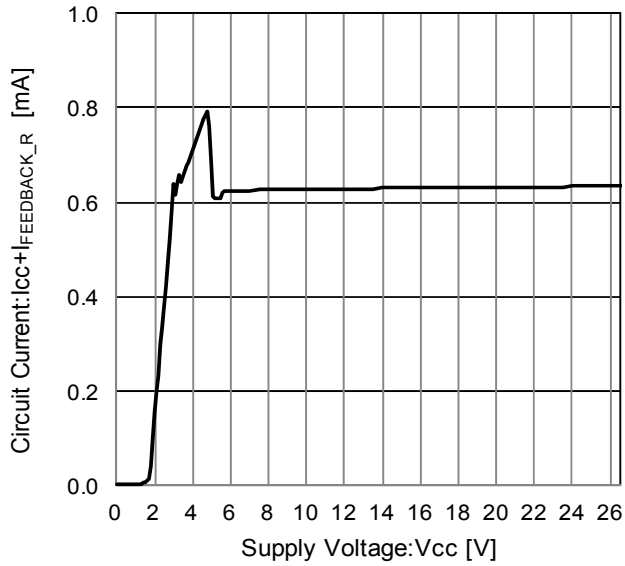


Figure 12. Circuit Current
 ($I_{FEEDBACK_R}(\text{Note 1}) \cong 75\mu\text{A}$)
 (Note 1) $I_{FEEDBACK_R}$ is the current through external Feed Back resistor.

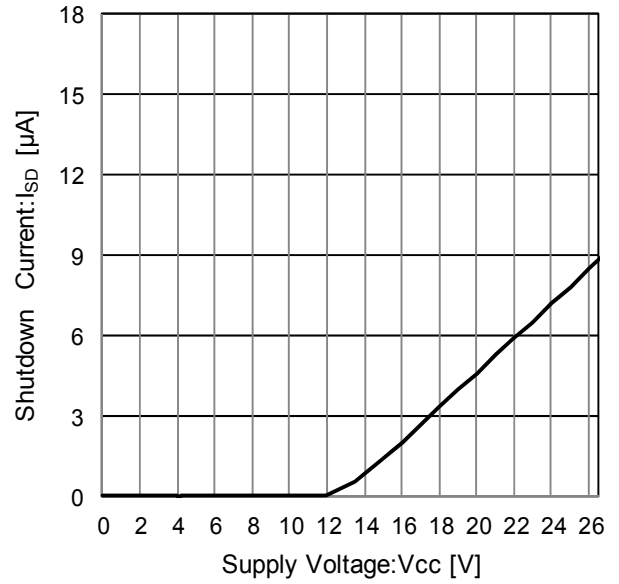


Figure 13. Shutdown Current
 ($V_{EN}=0\text{V}$)

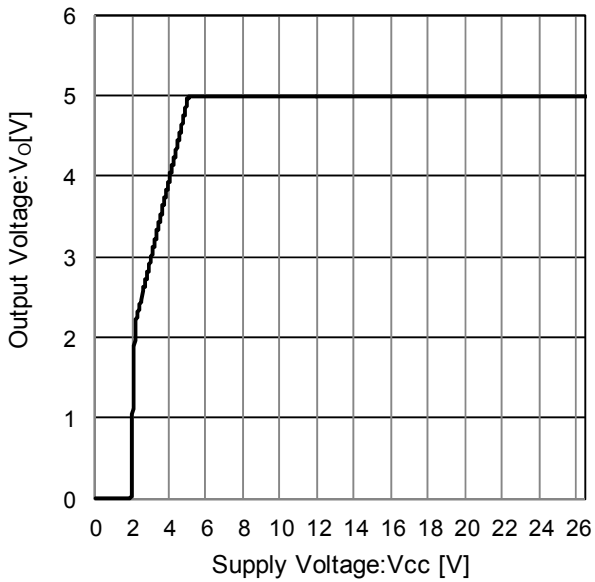


Figure 14. Line Regulation
 ($I_o=0\text{mA}$)

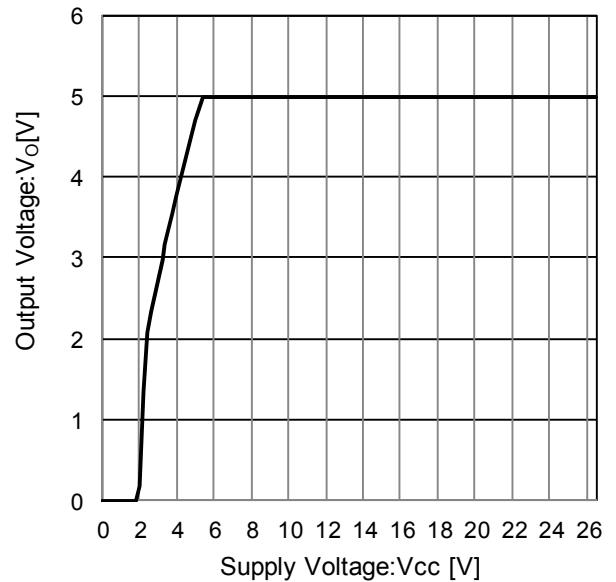


Figure 15. Line Regulation
 ($I_o=500\text{mA}$)

●Reference Data - Continued

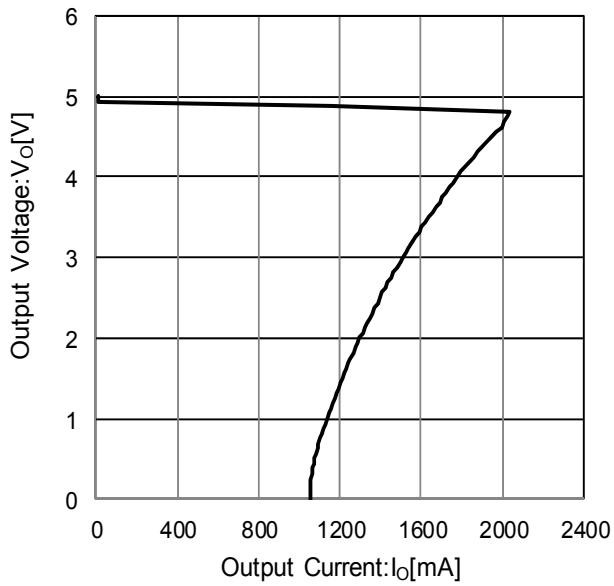


Figure 16. Load Regulation

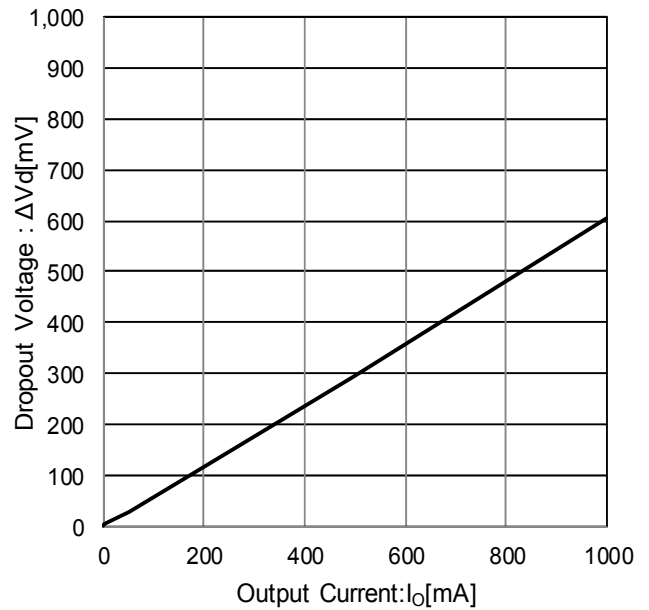


Figure 17. Dropout Voltage
($V_{cc}=4.75V$)
($I_o=0mA \rightarrow 1000mA$)

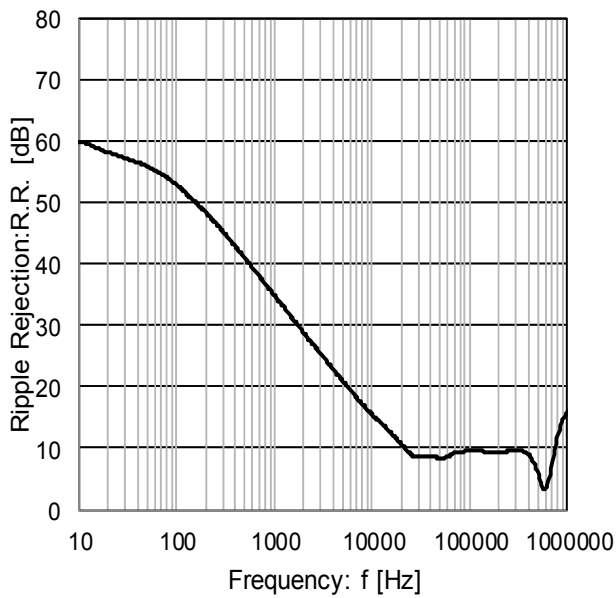


Figure 18. Ripple Rejection
($I_o = 100mA$)

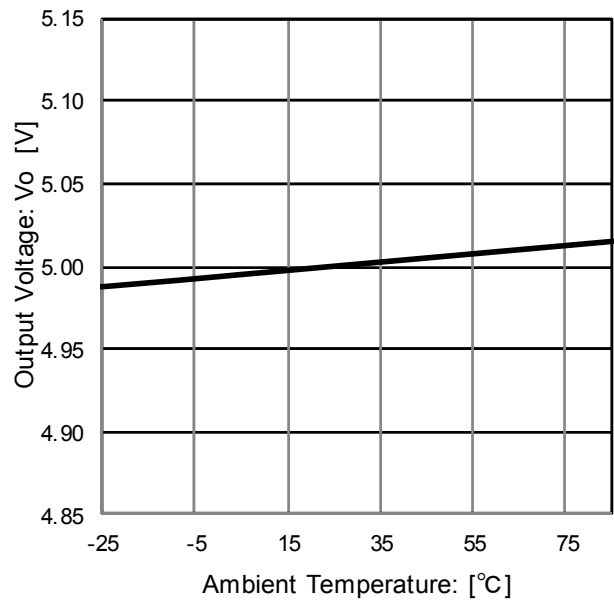


Figure 19. Output Voltage
Temperature Characteristic

●Reference Data - Continued

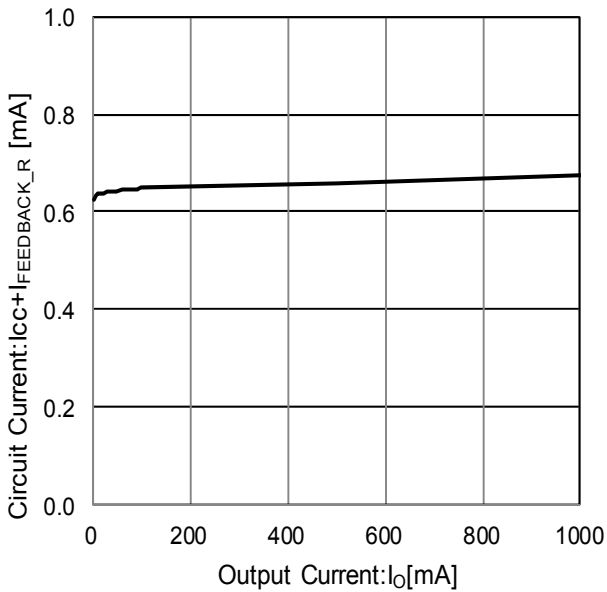


Figure 20. Circuit Current vs Output Current
($I_o = 0\text{mA} \rightarrow 1000\text{ mA}$)
($I_{FEEDBACK_R} \cong 75\mu\text{A}$)

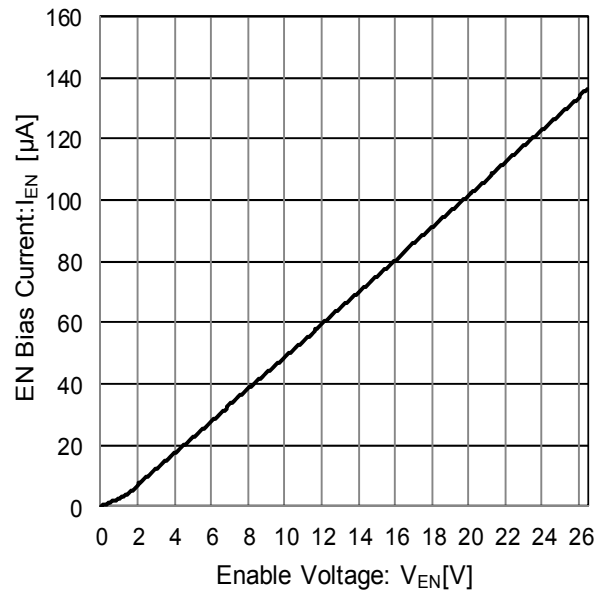


Figure 21. EN Voltage vs EN Current

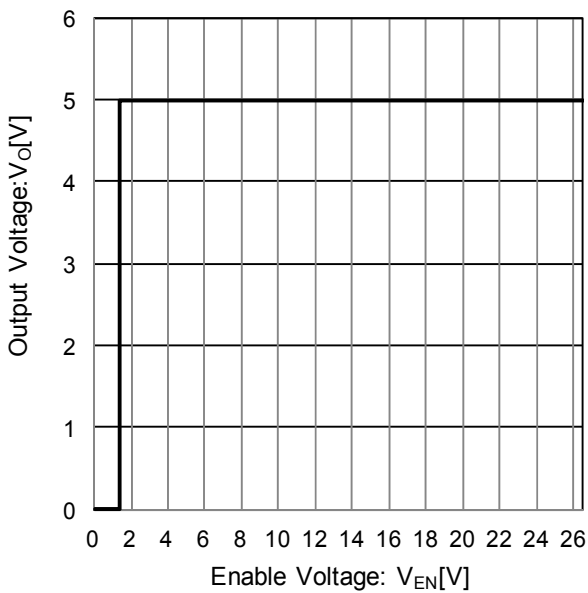


Figure 22. EN Voltage vs Output Voltage

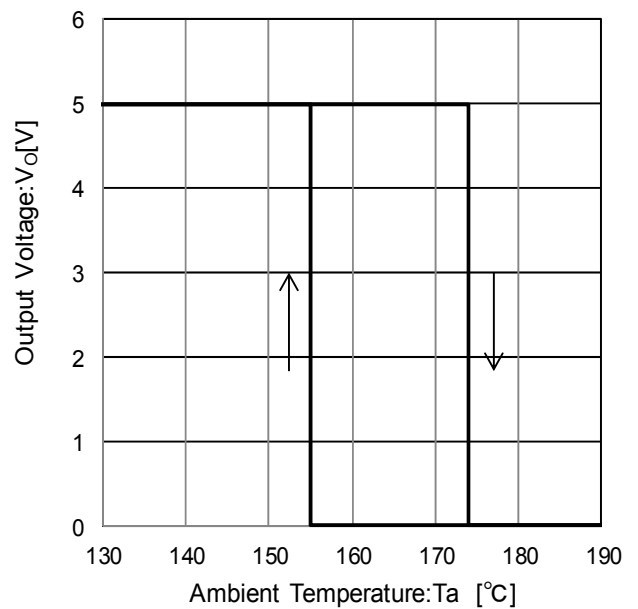
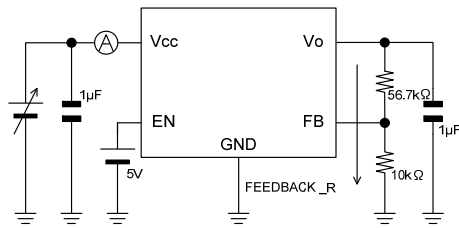


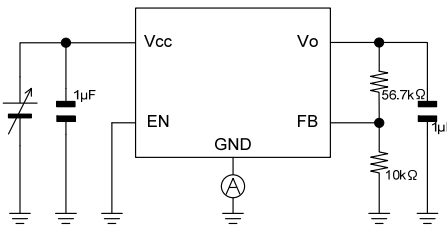
Figure 23. Thermal Shutdown
Circuit Characteristic

● Measurement setup for reference data

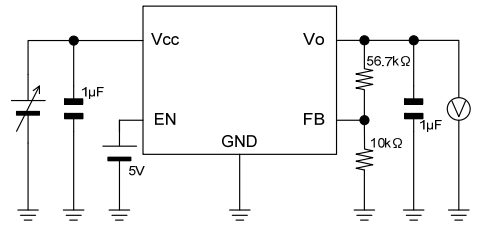
■ BD00FC0 series (5.0V Output Setting)



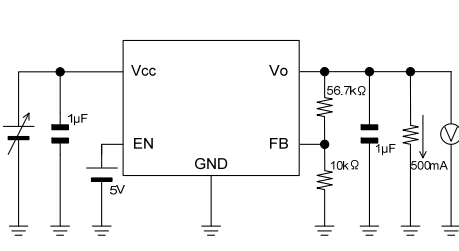
Measurement setup for Figure 12



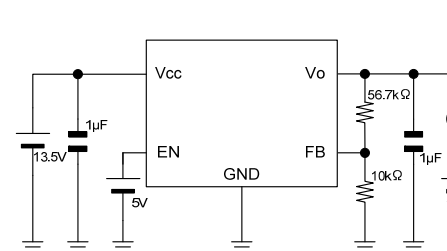
Measurement setup for Figure 13



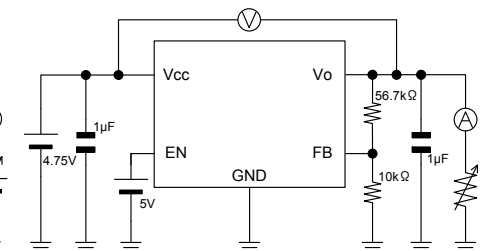
Measurement setup for Figure 14



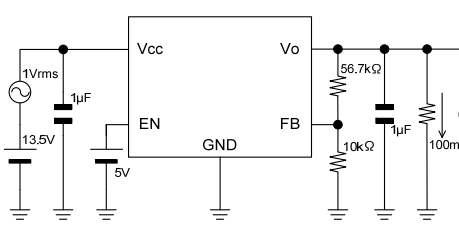
Measurement setup for Figure 15



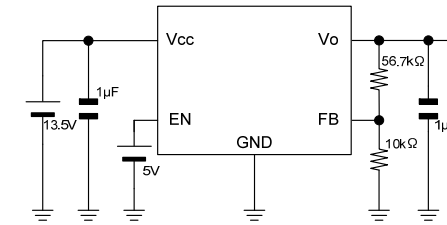
Measurement setup for Figure 16



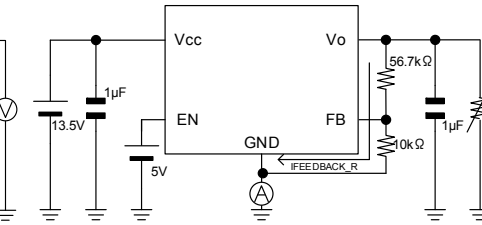
Measurement setup for Figure 17



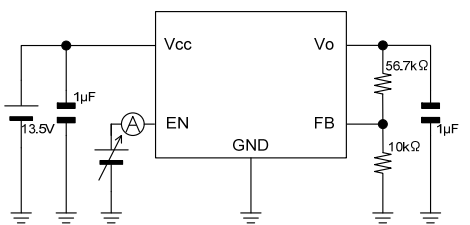
Measurement setup for Figure 18



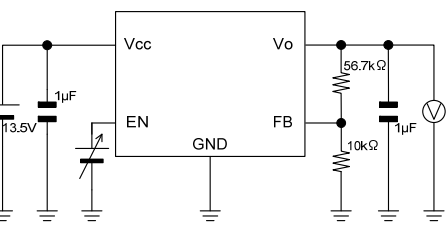
Measurement setup for Figure 19



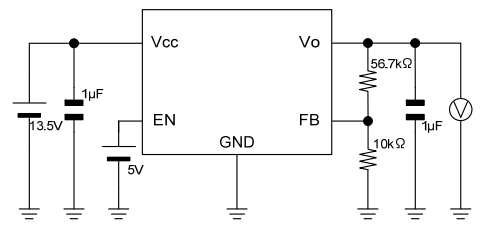
Measurement setup for Figure 20



Measurement setup for Figure 21



Measurement setup for Figure 22



Measurement setup for Figure 23

● Reference Data

■ BD33FC0 series

Unless otherwise specified $T_a = 25^\circ\text{C}$, $V_{CC}=13.5\text{V}$, $V_{EN}=5.0\text{V}$, $I_o=0\text{mA}$

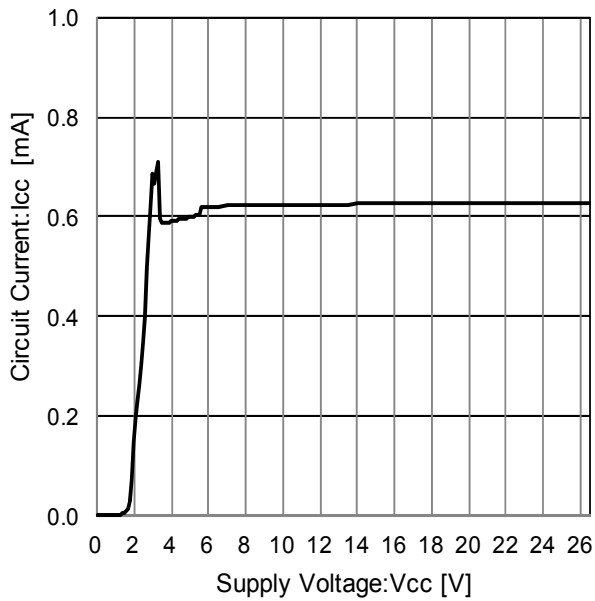


Figure 24. Circuit Current

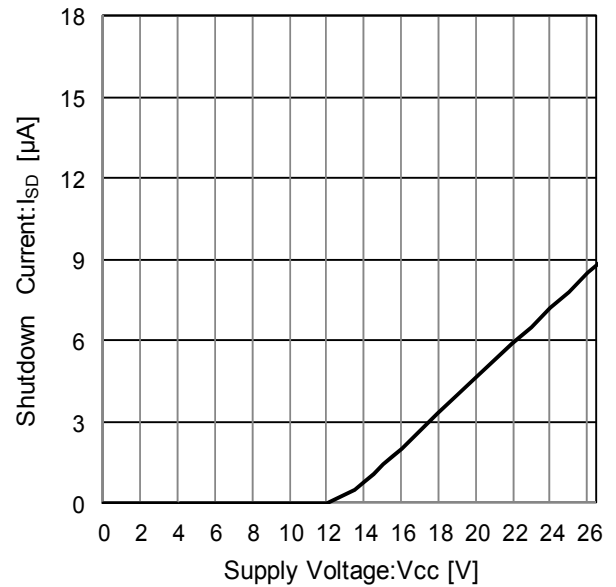


Figure 25. Shutdown Current ($V_{EN}=0\text{V}$)

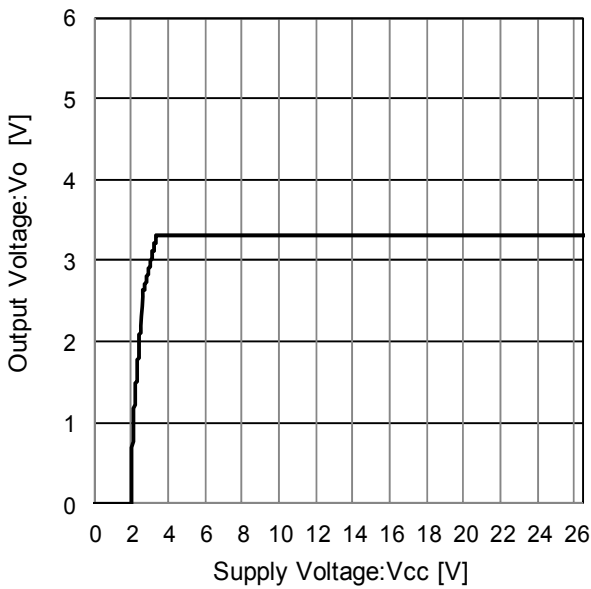


Figure 26. Line Regulation ($I_o=0\text{mA}$)

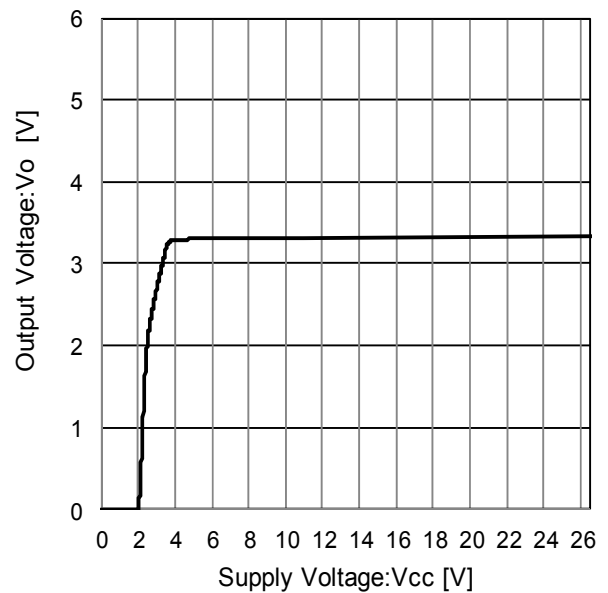


Figure 27. Line Regulation ($I_o=500\text{mA}$)

●Reference Data - Continued

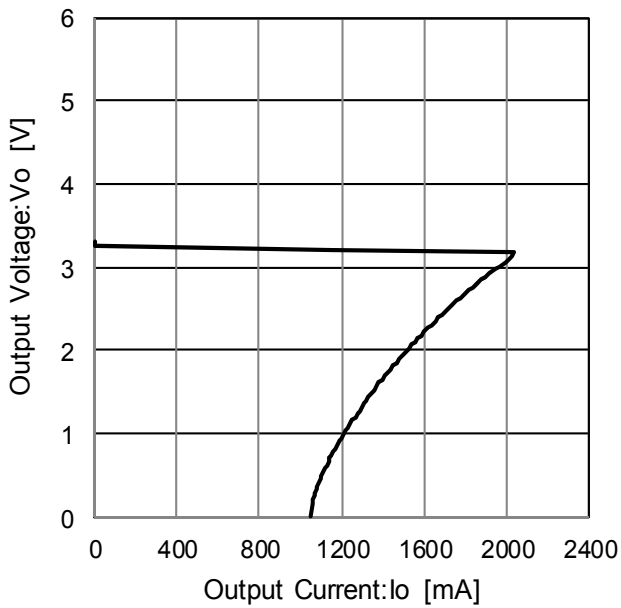


Figure 28. Load Regulation

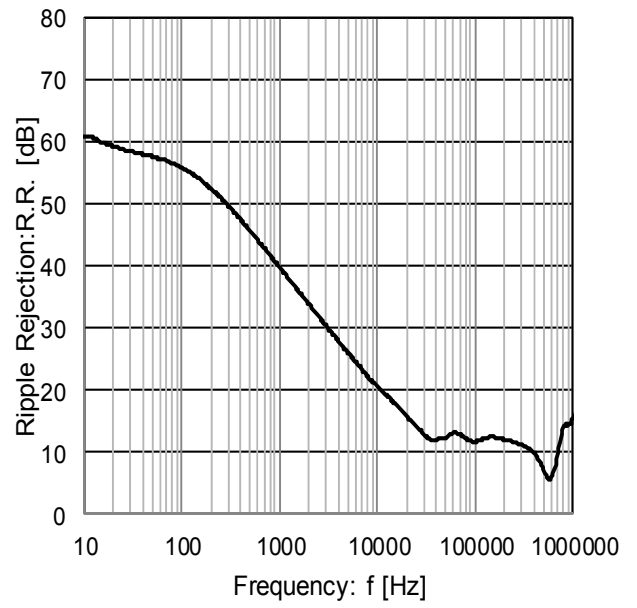


Figure 29. Ripple Rejection ($I_o=100\text{mA}$)

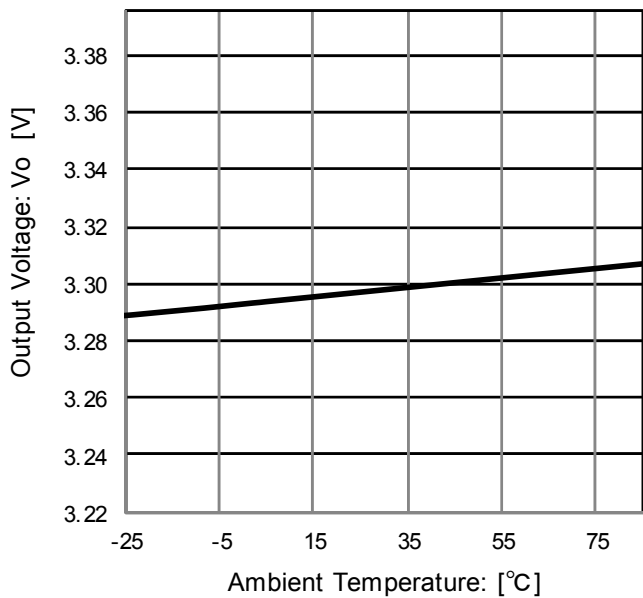


Figure 30. Output Voltage Temperature Characteristic

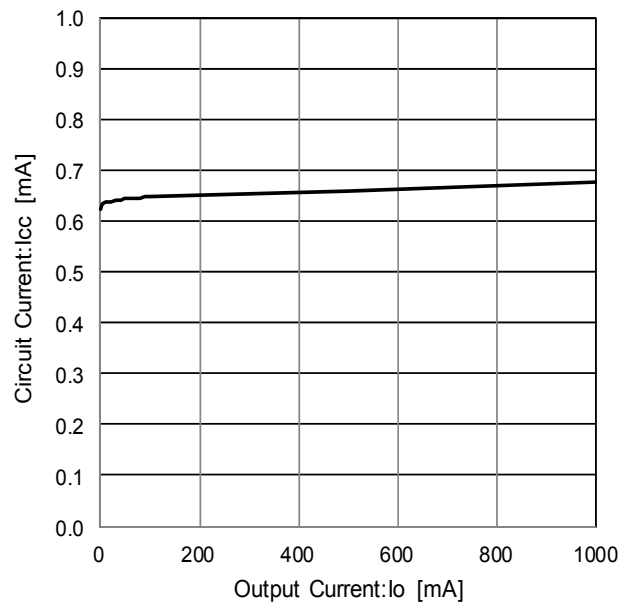


Figure 31. Circuit Current vs Output Current ($I_o = 0\text{mA} \rightarrow 1000\text{mA}$)

●Reference Data - Continued

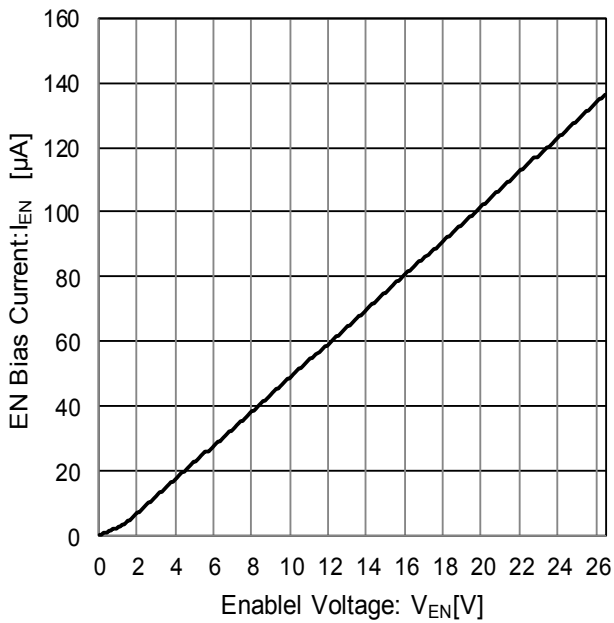


Figure 32. EN Voltage vs EN Current

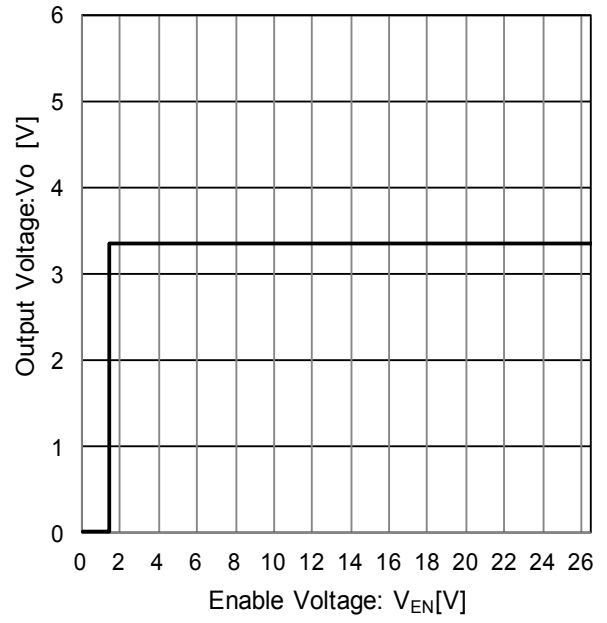


Figure 33. EN Voltage vs Output Voltage

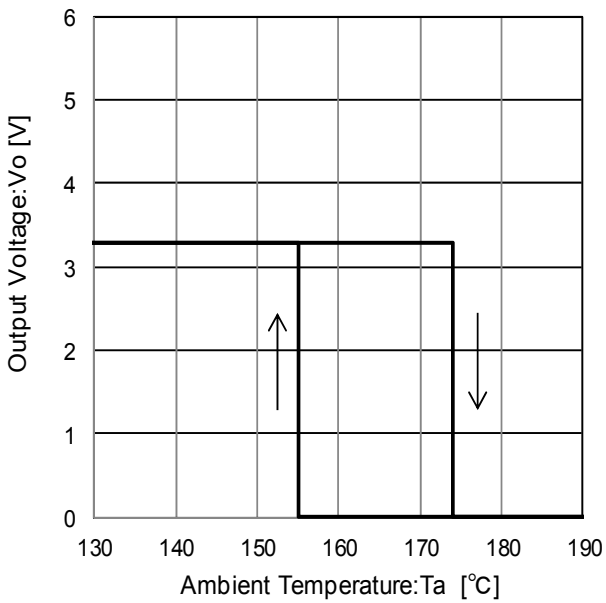


Figure 34. Thermal Shutdown Circuit Characteristic

●Reference Data

■BD50FC0 series

Unless otherwise specified, $T_a = 25^\circ\text{C}$, $V_{cc}=13.5\text{V}$, $V_{EN}=5.0\text{V}$, $I_o=0\text{mA}$

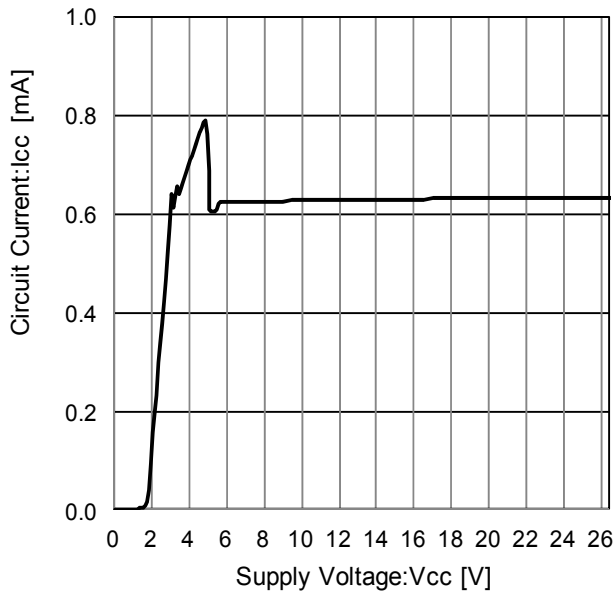


Figure 35. Circuit Current

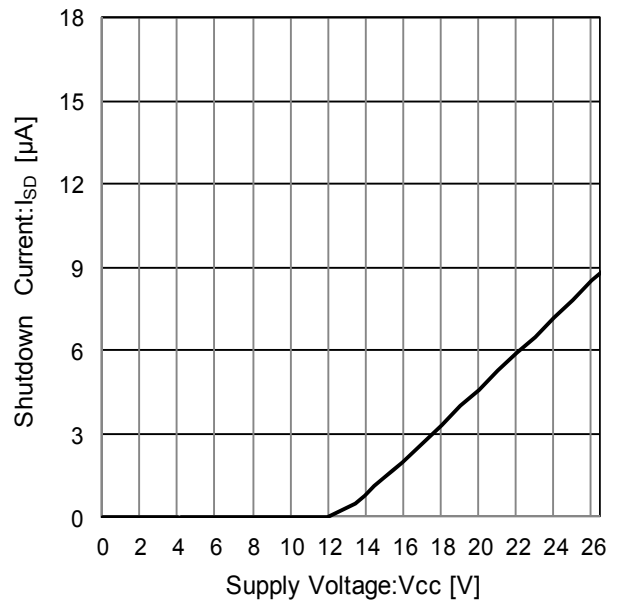


Figure 36. Shutdown Current ($V_{EN}=0\text{V}$)

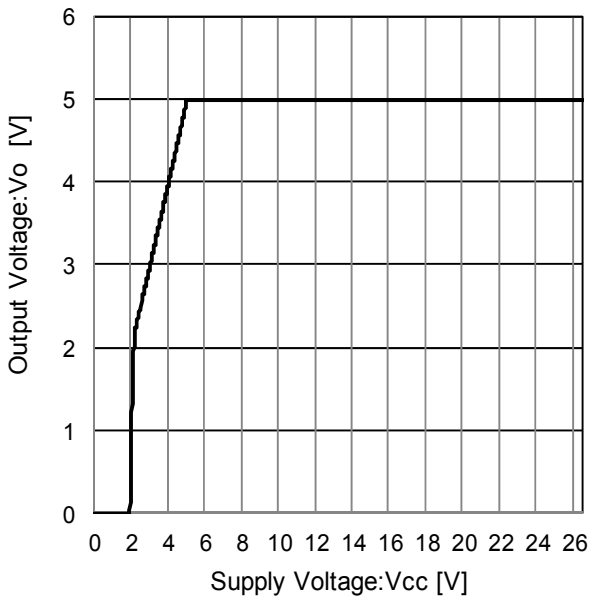


Figure 37. Line Regulation ($I_o=0\text{mA}$)

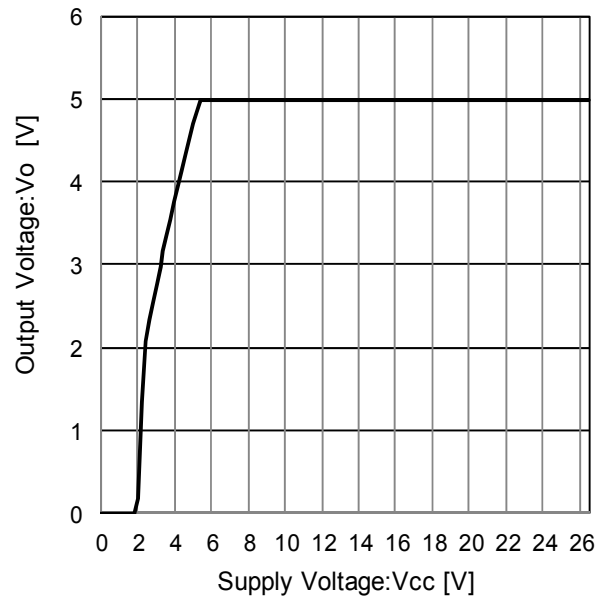


Figure 38. Line Regulation ($I_o=500\text{mA}$)

●Reference Data - Continued

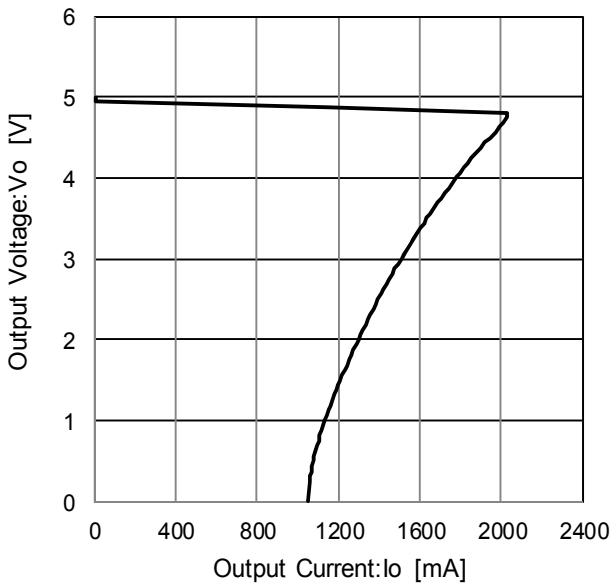


Figure 39. Load Regulation

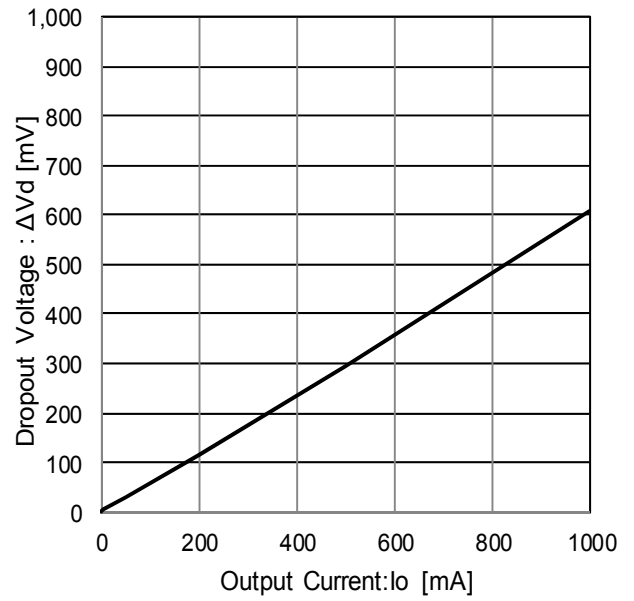


Figure 40. Dropout Voltage
($V_{cc}=V_o \times 0.95=4.75V$)

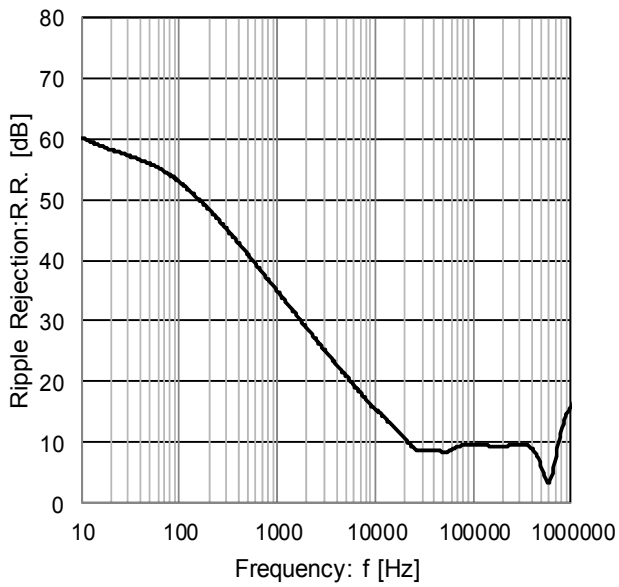


Figure 41. Ripple Rejection
($I_o=100mA$)

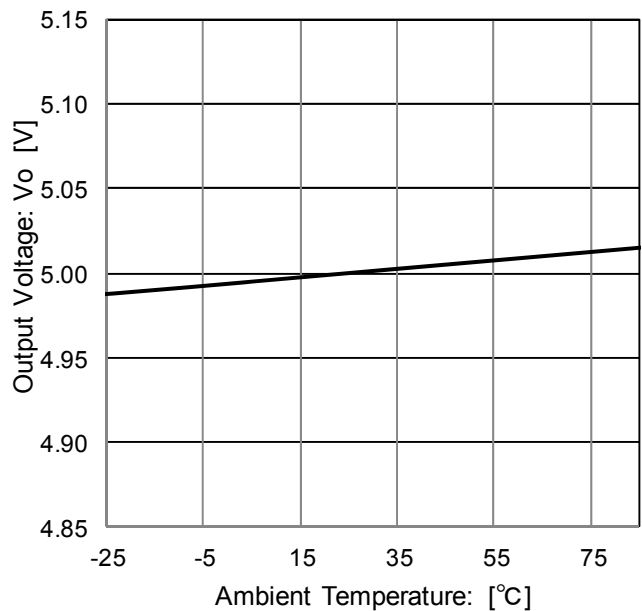


Figure 42. Output Voltage
Temperature Characteristic

●Reference Data - Continued

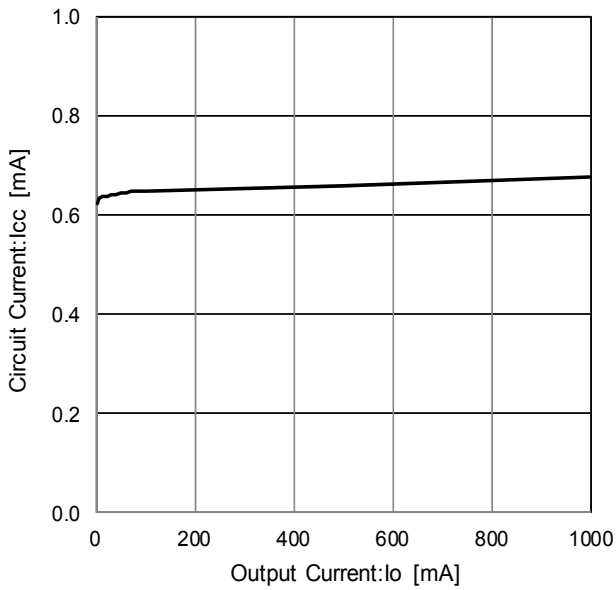


Figure 43. Circuit Current vs Output Current ($I_o = 0\text{mA} \rightarrow 1000\text{ mA}$)

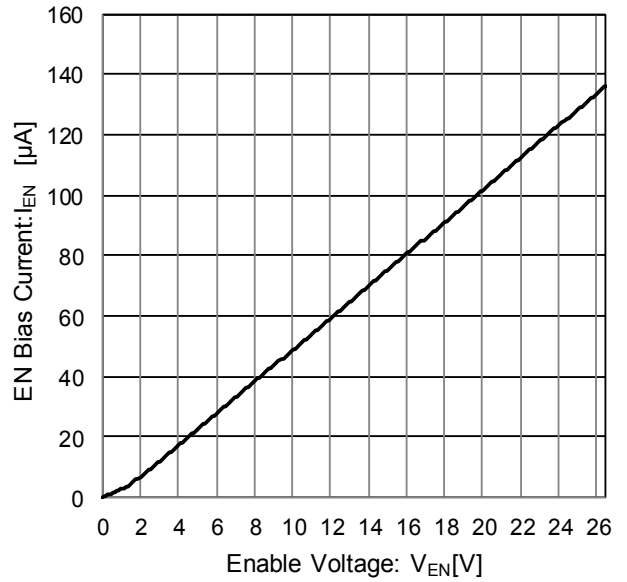


Figure 44. EN Voltage vs EN Current

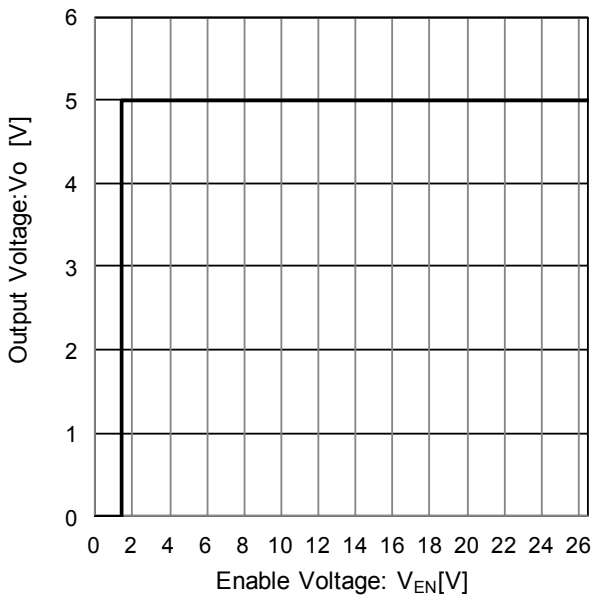


Figure 45. EN Voltage vs Output Voltage

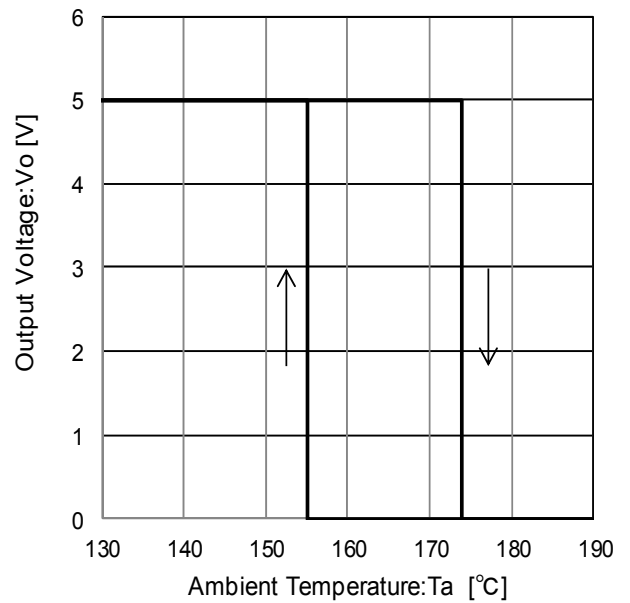


Figure 46. Thermal Shutdown Circuit Characteristic

●Reference Data

■BD80FC0 series

Unless otherwise specified, $T_a = 25^\circ\text{C}$, $V_{cc}=13.5\text{V}$, $V_{EN}=5.0\text{V}$, $I_o=0\text{mA}$

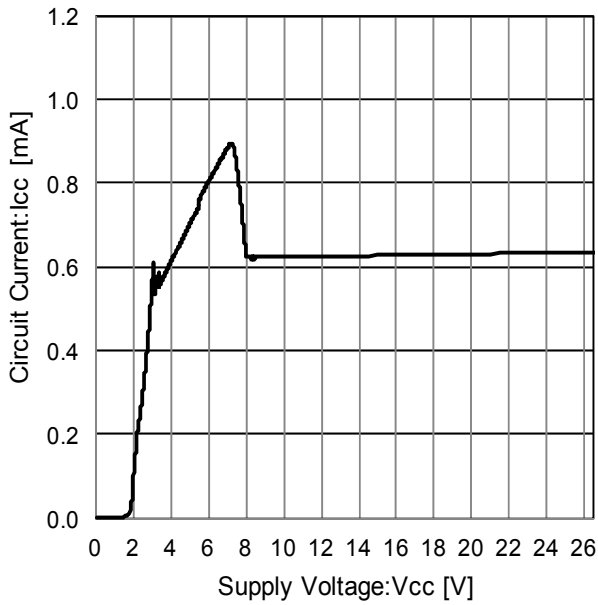


Figure 47. Circuit Current

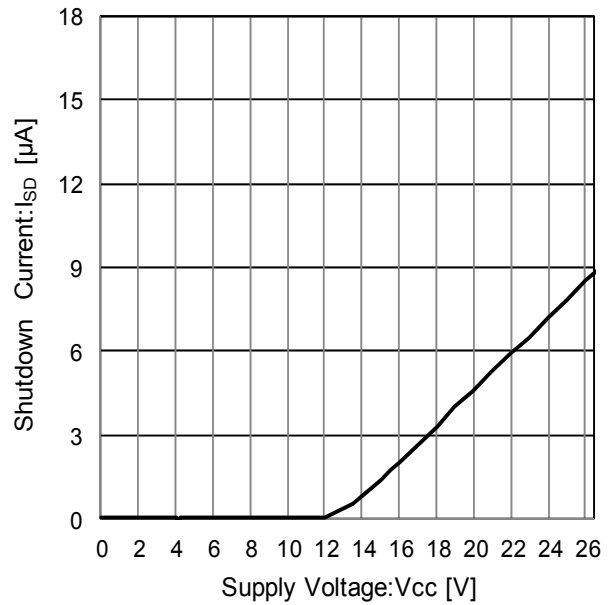


Figure 48. Shutdown Current ($V_{EN}=0\text{V}$)

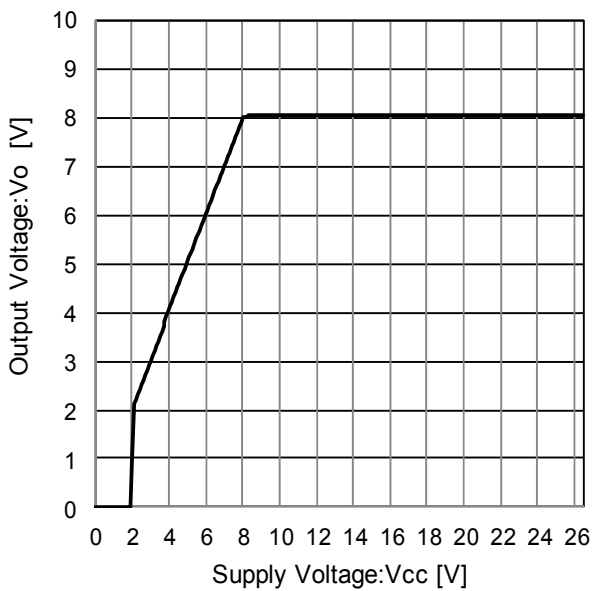


Figure 49. Line Regulation ($I_o=0\text{mA}$)

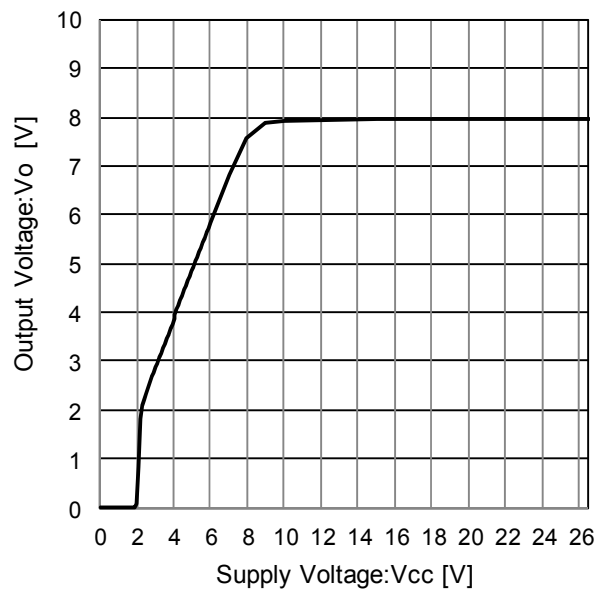


Figure 50. Line Regulation ($I_o=500\text{mA}$)

●Reference Data - Continued

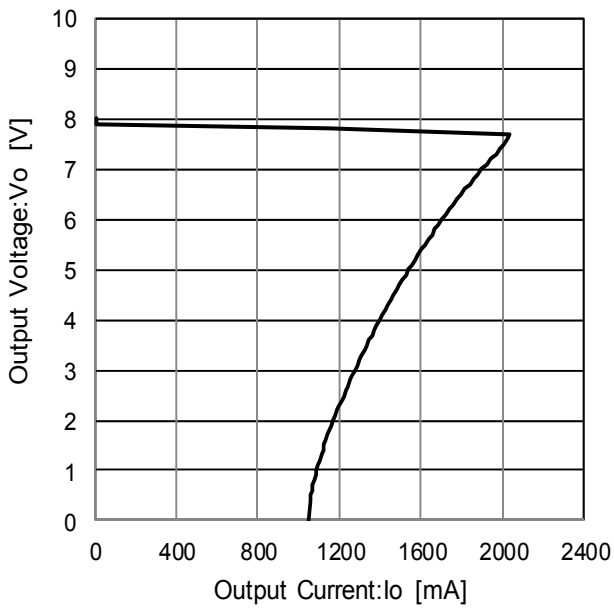


Figure 51. Load Regulation

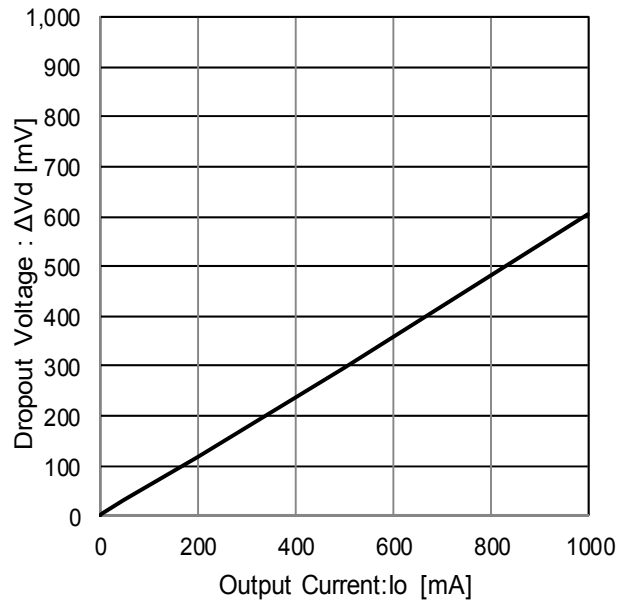


Figure 52. Dropout Voltage
($V_{cc}=V_o \times 0.95=7.6V$)

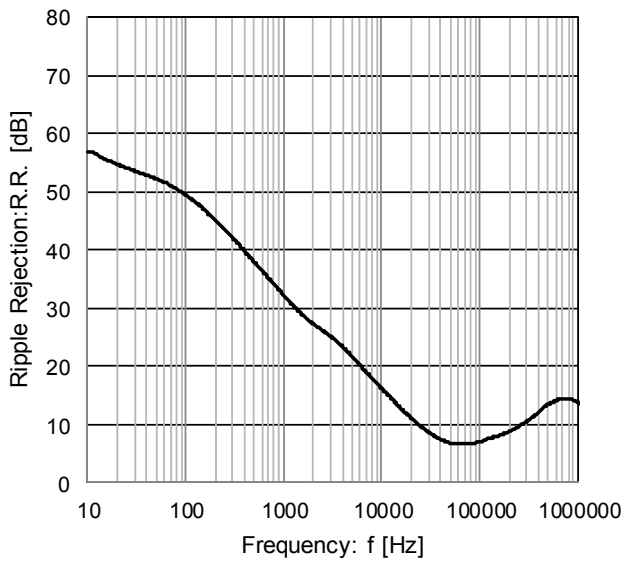


Figure 53. Ripple Rejection
($I_o=100mA$)

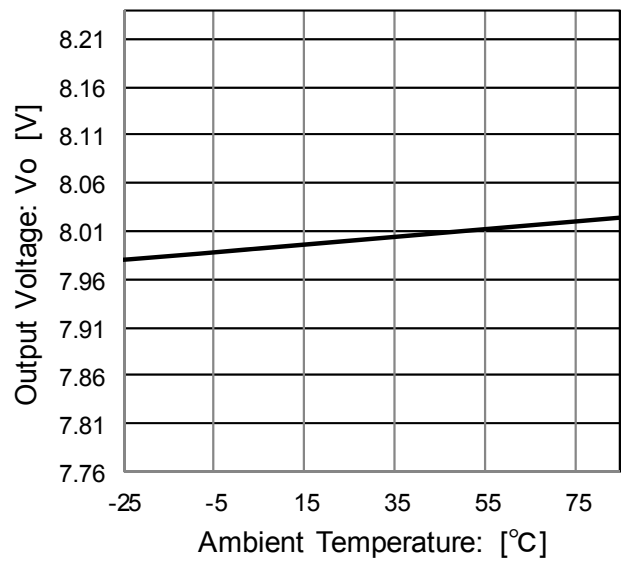


Figure 54. Output Voltage Temperature Characteristic

●Reference Data - Continued

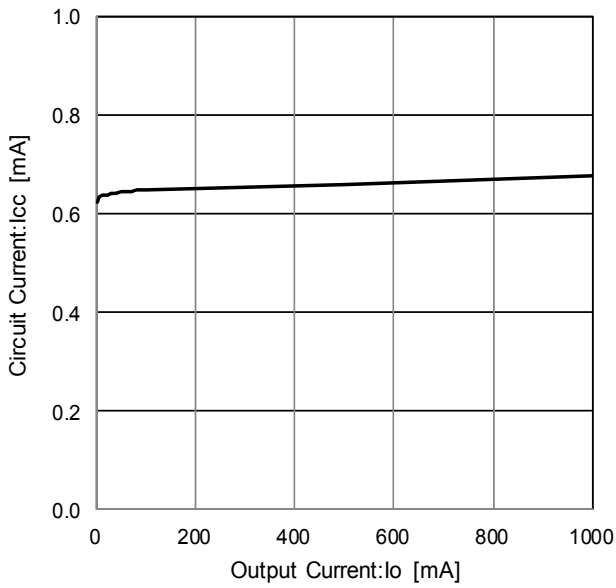


Figure 55. Circuit Current vs Output Current ($I_o = 0\text{mA} \rightarrow 1000\text{ mA}$)

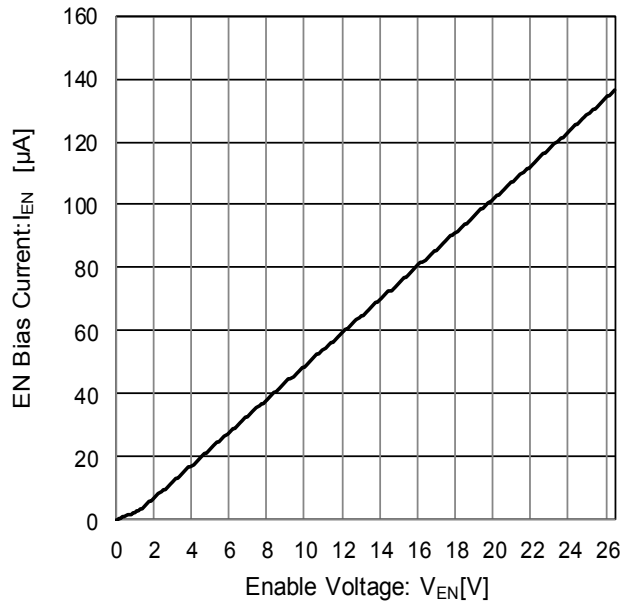


Figure 56. EN Voltage vs EN Current

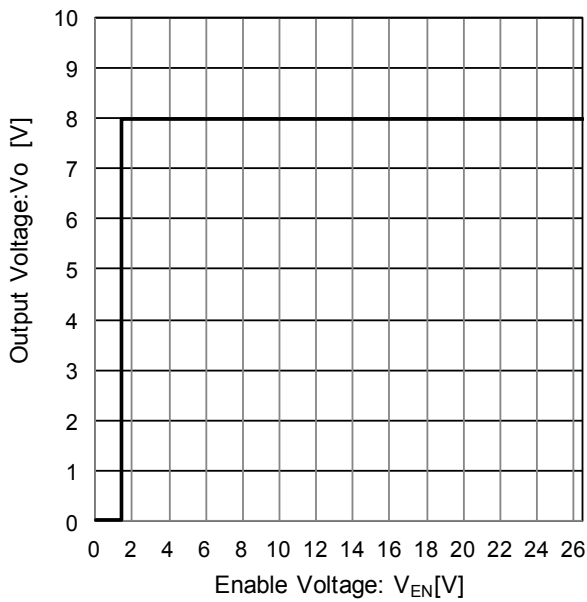


Figure 57. EN Voltage vs Output Voltage

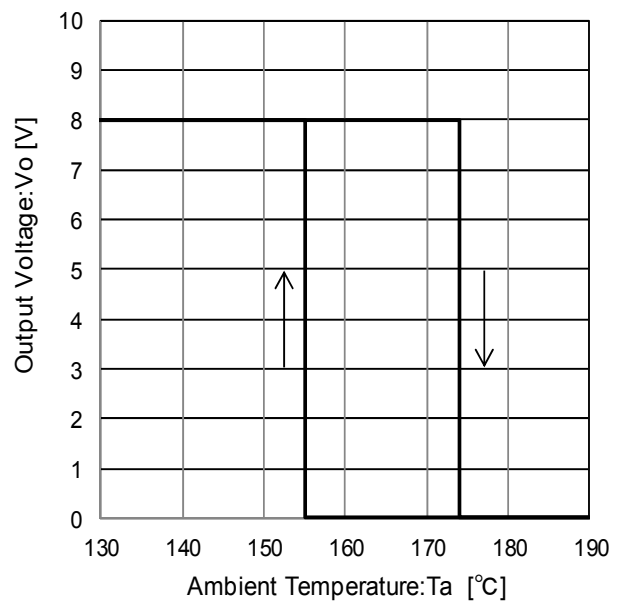


Figure 58. Thermal Shutdown Circuit Characteristic

●Reference Data

■BD90FC0 series

Unless otherwise specified, Ta = 25°C, Vcc=13.5V, VEN=5.0V, Io=0mA

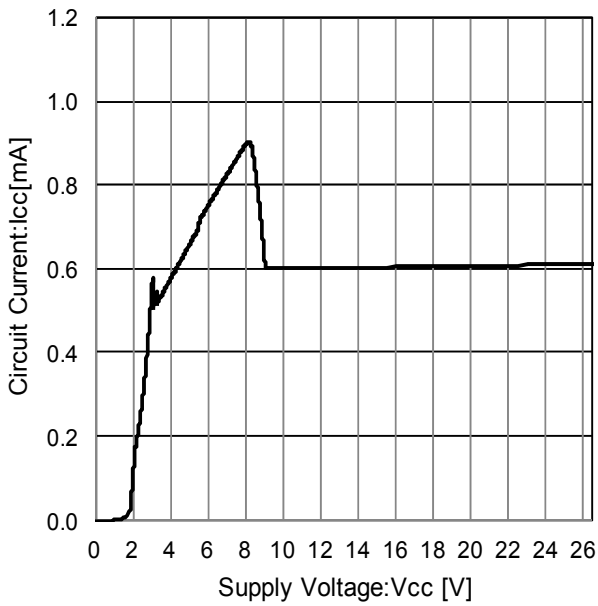


Figure 59. Circuit Current

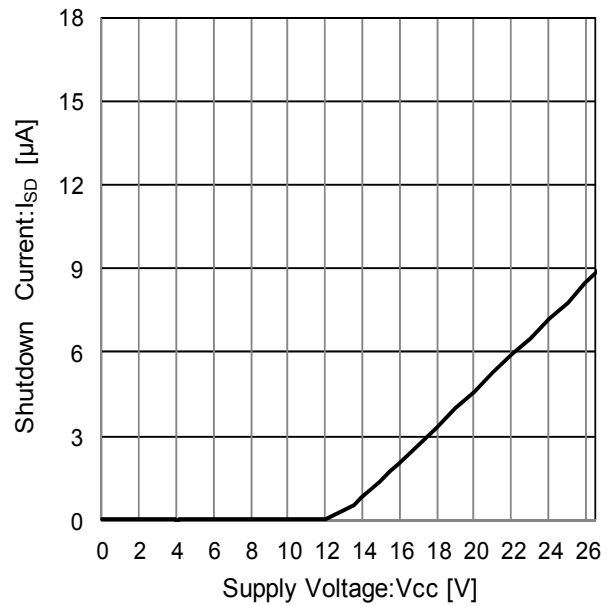


Figure 60. Shutdown Current (VEN=0V)

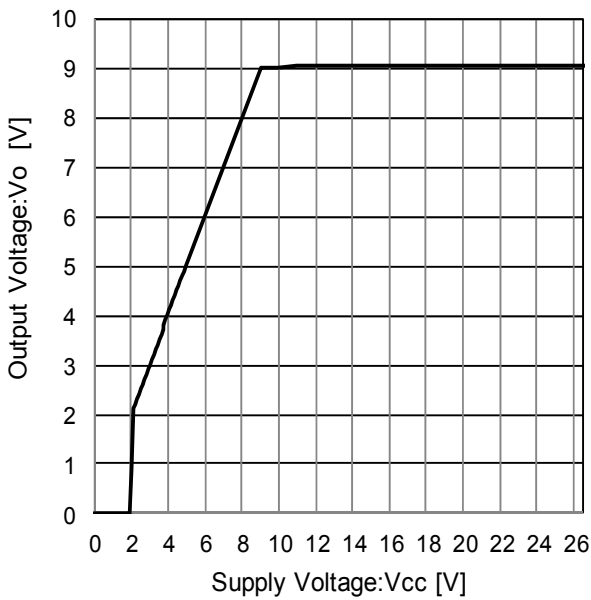


Figure 61. Line Regulation (Io=0mA)

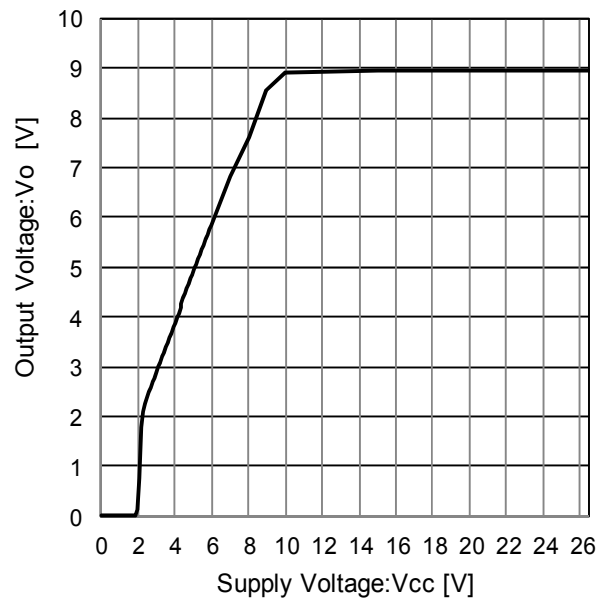


Figure 62. Line Regulation (Io=500mA)

●Reference Data - Continued

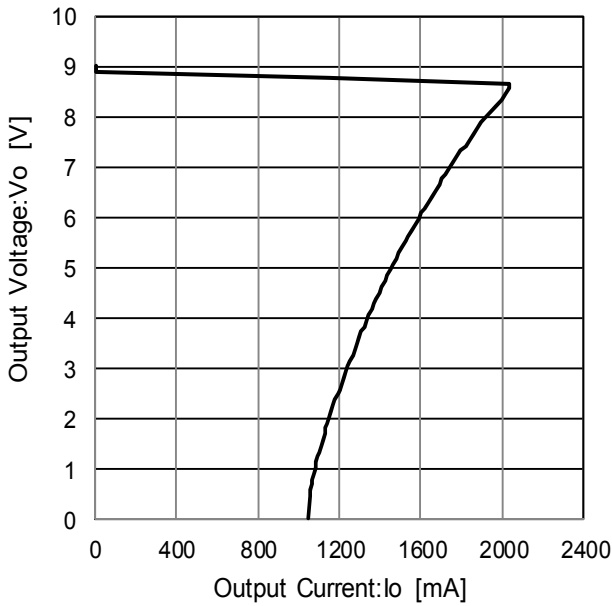


Figure 63. Load Regulation

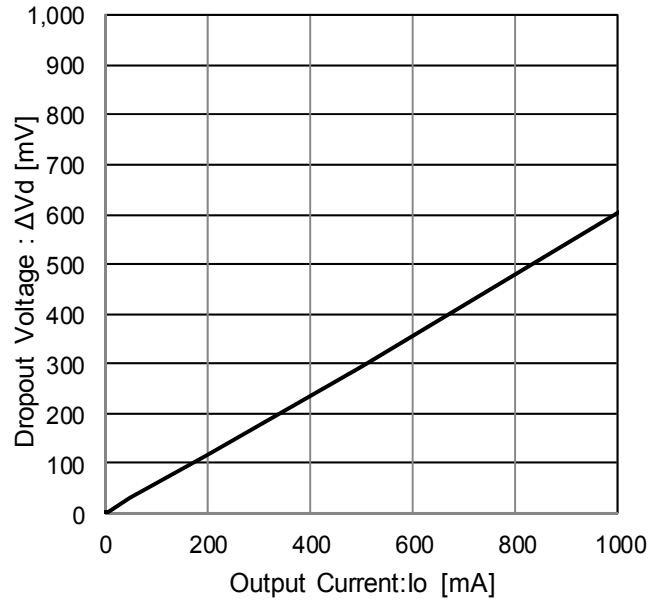


Figure 64. Dropout Voltage
($V_{cc} = V_o \times 0.95 = 8.55V$)

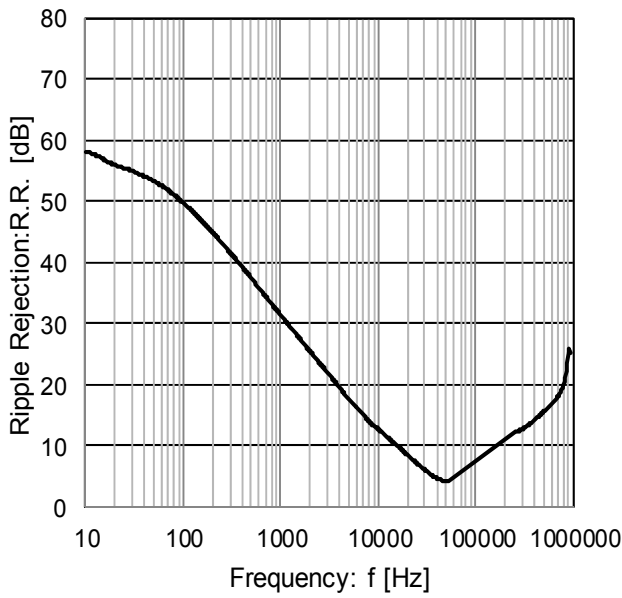


Figure 65. Ripple Rejection
($I_o = 100mA$)

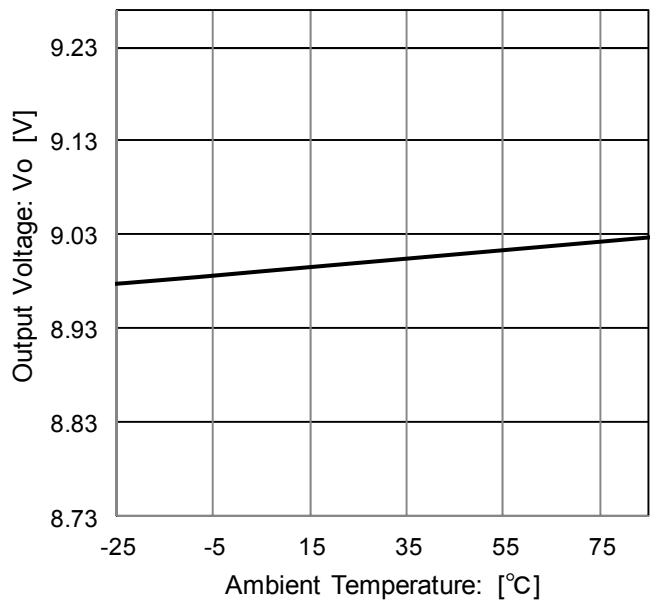


Figure 66. Output Voltage
Temperature Characteristic

●Reference Data - Continued

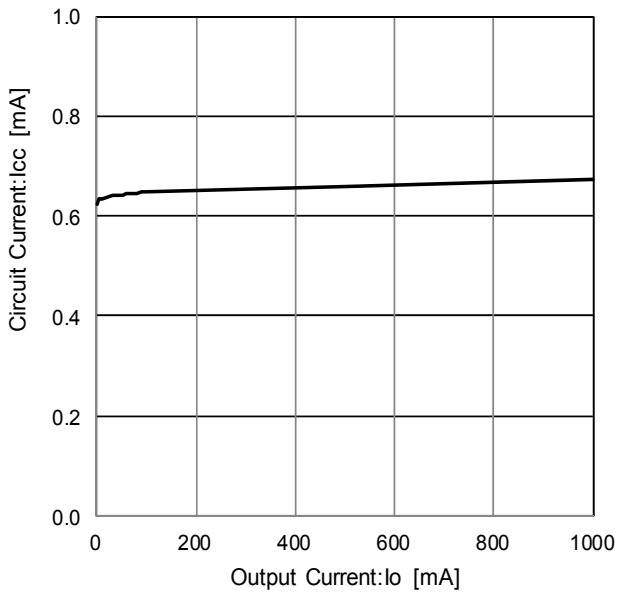


Figure 67. Circuit Current vs Output Current ($I_o = 0\text{mA} \rightarrow 1000\text{ mA}$)

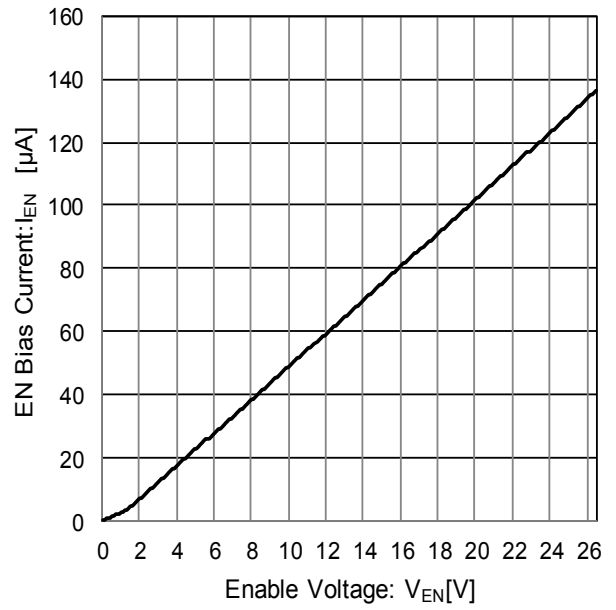


Figure 68. EN Voltage vs EN Current

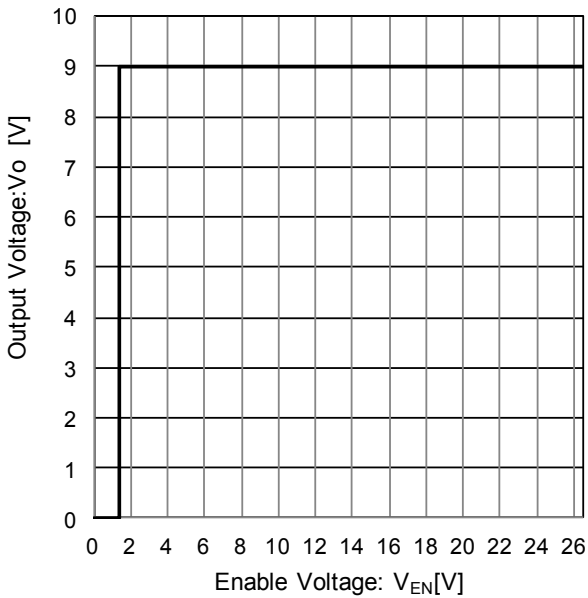


Figure 69. EN Voltage vs Output Voltage

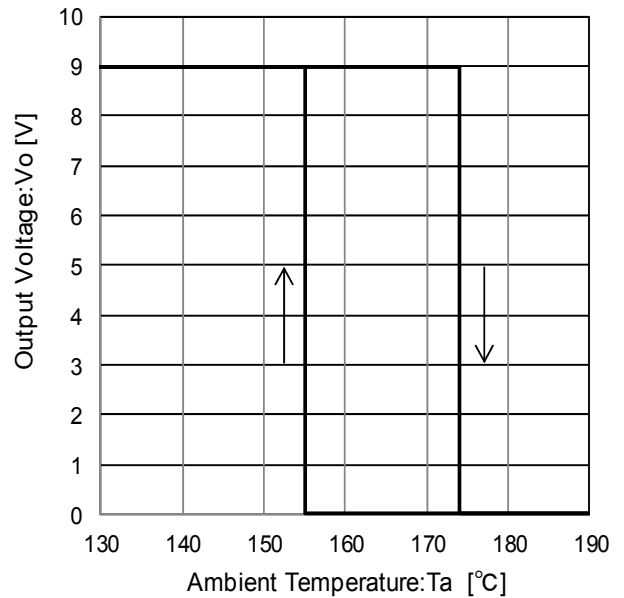


Figure 70. Thermal Shutdown Circuit Characteristic