300mA HIGH SPEED, EXTREMELY LOW NOISE CMOS LDO REGULATOR AP2128

General Description

The AP2128 series are positive voltage regulator ICs fabricated by CMOS process. The AP2128 provides two kinds of output voltage operation modes for setting the output voltage. Fixed output voltage mode senses the output voltage on V_{OUT}, adjustable output voltage mode needs two resistors as a voltage divider.

The AP2128 series have features of low dropout voltage, low noise, high output voltage accuracy, and low current consumption which make them ideal for use in various battery-powered devices.

AP2128 have 1.0V, 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 3.9V, 4.2V, 4.75V, 5.2V fixed voltage versions and 0.8V to 5.5V adjustable voltage version.

AP2128 series are available in SOT-23-5 package.

Features

- Wide Operating Voltage: 2.5V to 6V
- Low Dropout Voltage:170mV@300mA for V_{OUT}=3.3V, 140mV@300mA for V_{OUT}=5.2V
- High Output Voltage Accuracy: ±2%
- High Ripple Rejection:
  68dB@ f=1kHz, 54dB@ f=10kHz
- Low Standby Current: 0.1μA
- Low Quiescent Current: 60μA Typical
- Low Output Noise: 60μVrms@V_{OUT}=0.8V
- Short Current Limit: 50mA
- Over Temperature Protection
- Compatible with Low ESR Ceramic Capacitor: 1μF for C_{IN} and C_{OUT}
- Excellent Line/Load Regulation
- Soft Start Time: 50μs
- Auto Discharge Resistance: $R_{DS(ON)}$=60Ω

Applications

- Datacom
- Notebook Computers
- Mother Board

SOT-23-5

Figure 1. Package Type of AP2128

Pin Configuration

K Package

(SOT-23-5)

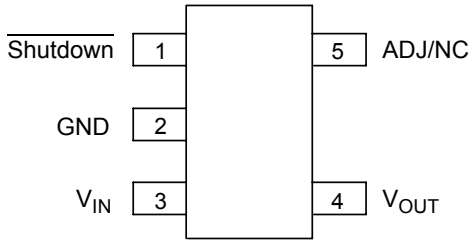
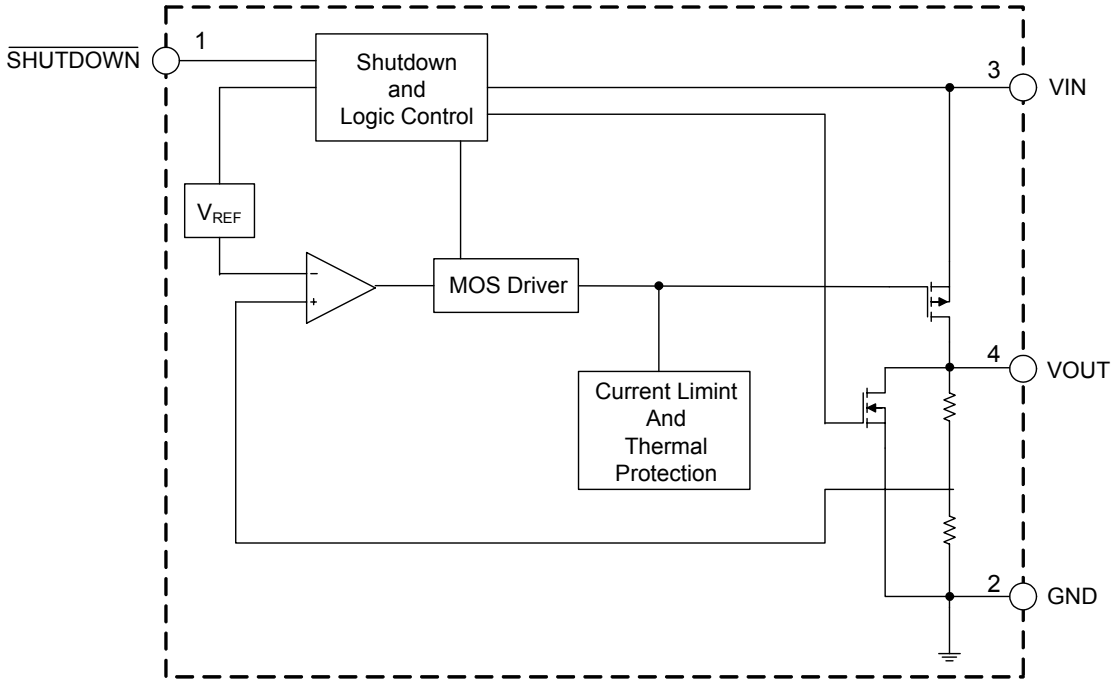


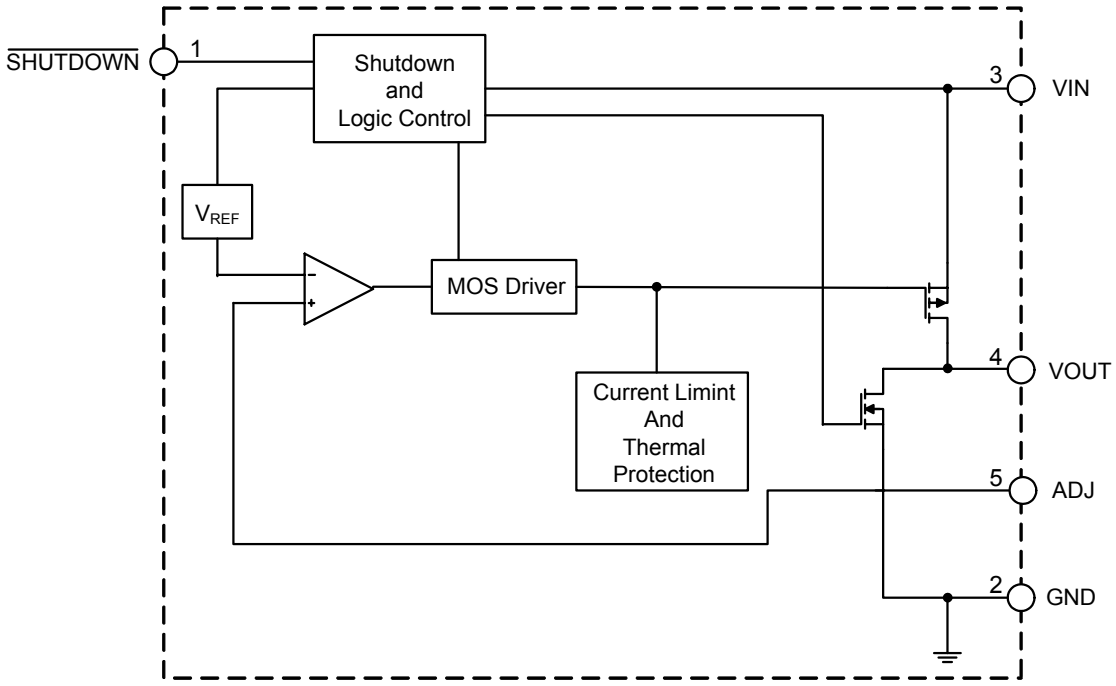
Figure 2. Pin Configuration of AP2128 (Top View)

Functional Block Diagram



Fixed Version

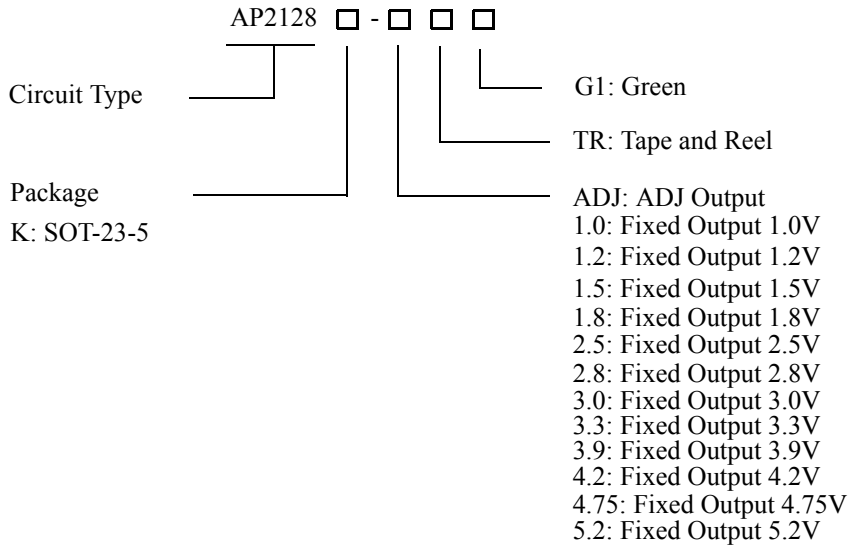
Functional Block Diagram (Continued)



Adjustable Version

Figure 3. Functional Block Diagram of AP2128

Ordering Information



Product	Package	Temperature Range	Part Number	Marking ID	Packing Type
AP2128	SOT-23-5	-40 to 85°C	AP2128K- ADJTRG1	FAD	Tape & Reel
			AP2128K-1.0TRG1	FAJ	Tape & Reel
			AP2128K-1.2TRG1	FAK	Tape & Reel
			AP2128K-1.5TRG1	GAN	Tape & Reel
			AP2128K-1.8TRG1	GAP	Tape & Reel
			AP2128K-2.5TRG1	GAQ	Tape & Reel
			AP2128K-2.8TRG1	GAR	Tape & Reel
			AP2128K-3.0TRG1	GAW	Tape & Reel
			AP2128K-3.3TRG1	FAL	Tape & Reel
			AP2128K-3.9TRG1	GBU	Tape & Reel
			AP2128K-4.2TRG1	GAZ	Tape & Reel
			AP2128K-4.75TRG1	GFZ	Tape & Reel
			AP2128K-5.2TRG1	GAV	Tape & Reel

BCD Semiconductor's products, as designated with "G1" suffix in the part number, are RoHS compliant and Green.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	6.5	V
Shutdown Input Voltage	V_{CE}	-0.3 to V_{IN}+0.3	V
Output Current	I_{OUT}	450	mA
Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
Lead Temperature (Soldering, 10sec)	T_{LEAD}	260	°C
Thermal Resistance	θ_{JA}	250	°C/W
ESD (Human Body Model)	ESD	6000	V
ESD (Machine Model)	ESD	200	V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_{IN}	2.5	6	V
Operating Ambient Temperature Range	T_A	-40	85	°C

Electrical Characteristics

(AP2128-ADJ, V_{IN} min=2.5V, C_{IN}=1μF, C_{OUT}=1μF, Bold typeface applies over -40°C≤T_A≤85°C, unless otherwise specified.)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Reference Voltage	V_{REF}	V_{IN}=2.5V 1mA≤I_{OUT}≤300mA		0.784	0.8	0.816	V
Input Voltage	V_{IN}			2.5		6	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=2.5V, V_{OUT}=98%×V_{OUT}		300	400		mA
Current Limit	I_{LIMIT}	V_{IN}=2.5V			450		mA
Load Regulation	ΔV_{OUT} /(ΔI_{OUT}*V_{OUT})	V_{IN}=2.5V, 1mA≤I_{OUT}≤300mA				0.6	%/A
Line Regulation	ΔV_{OUT} /(ΔV_{IN}*V_{OUT})	V_{IN}=2.5V to 6V I_{OUT}=30mA				0.06	%/V
Quiescent Current	I_Q	V_{IN}=2.5V, I_{OUT}=0mA			60	90	μA
Standby Current	I_{STD}	V_{IN}=2.5V, $V_{\overline{SHUTDOWN}}$ in off mode			0.1	1.0	μA
Power Supply Rejection Ratio	PSRR	Ripple 1Vp-p V_{IN}=3V	f=100Hz		68		dB
			f=1KHz		68		dB
			f=10KHz		54		dB
Output Voltage Temperature Coefficient	(ΔV_{OUT}/V_{OUT}) /ΔT	I_{OUT}=30mA, -40°C≤T_A≤85°C			±100		ppm/°C
Short Current Limit	I_{SHORT}	V_{OUT}=0V			50		mA
Soft Start Time	t_{UP}				50		μs
RMS Output Noise	V_{NOISE}	T_A=25°C, 10Hz ≤f≤100kHz, V_{OUT}=0.8V			60		μVrms
$\overline{\text{Shutdown}}$ "High" Voltage		$\overline{\text{Shutdown}}$ input voltage "High"		1.5		6	V
$\overline{\text{Shutdown}}$ "Low" Voltage		$\overline{\text{Shutdown}}$ input voltage "Low"		0		0.4	V
V_{OUT} Discharge MOSFET $R_{DS(ON)}$		$\overline{\text{Shutdown}}$ input voltage "Low"			60		Ω
$\overline{\text{Shutdown}}$ Pull Down Resistance					3		MΩ
Thermal Shutdown					165		°C
Thermal Shutdown Hysteresis					30		°C
Thermal Resistance	θ_{JC}	SOT-23-5			150		°C/W

Electrical Characteristics (Continued)

(AP2128-1.0V/1.2V/1.5V/1.8V, V_{IN}min.=2.5V, C_{IN}=1μF, C_{OUT}=1μF, Bold typeface applies over -40°C≤T_A≤85°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=2.5V 1mA≤I_{OUT}≤300mA	98%×V_{OUT}		102%×V_{OUT}	V
Input Voltage	V_{IN}		2.5		6	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=2.5V, V_{OUT}=98%×V_{OUT}	300	400		mA
Current Limit	I_{LIMIT}	V_{IN}=2.5V		450		mA
Load Regulation	ΔV_{OUT} /(ΔI_{OUT}*V_{OUT})	V_{IN}=2.5V, 1mA≤I_{OUT}≤300mA			0.6	%/A
Line Regulation	ΔV_{OUT} /(ΔV_{IN}*V_{OUT})	V_{IN}=2.5V to 6V I_{OUT}=30mA			0.06	%/V
Dropout Voltage	V_{DROP}	V_{OUT}=1.0V, I_{OUT}=300mA		1400	1500	mV
		V_{OUT}=1.2V, I_{OUT}=300mA		1200	1300	
		V_{OUT}=1.5V, I_{OUT}=300mA		900	1000	
		V_{OUT}=1.8V, I_{OUT}=300mA		600	700	
Quiescent Current	I_Q	V_{IN}=2.5V, I_{OUT}=0mA		60	90	μA
Standby Current	I_{STD}	V_{IN}=2.5V, $V_{\overline{SHUTDOWN}}$ in off mode		0.1	1.0	μA
Power Supply Rejection Ratio	PSRR	Ripple 1Vp-p V_{IN}=3V, f=100Hz		68		dB
		Ripple 1Vp-p V_{IN}=3V, f=1KHz		68		dB
		Ripple 1Vp-p V_{IN}=3V, f=10KHz		54		dB
Output Voltage Temperature Coefficient	(ΔV_{OUT}/V_{OUT}) /ΔT	I_{OUT}=30mA, -40°C≤T_A≤85°C		±100		ppm/°C
Short Current Limit	I_{SHORT}	V_{OUT}=0V		50		mA
Soft Start Time	t_{UP}			50		μs
$\overline{\text{Shutdown}}$ "High" Voltage		$\overline{\text{Shutdown}}$ input voltage "High"	1.5		6	V
$\overline{\text{Shutdown}}$ "Low" Voltage		$\overline{\text{Shutdown}}$ input voltage "Low"	0		0.4	V
V_{OUT} Discharge MOSFET $R_{DS(ON)}$		$\overline{\text{Shutdown}}$ input voltage "Low"		60		Ω
$\overline{\text{Shutdown}}$ Pull Down Resistance				3		MΩ
Thermal Shutdown				165		°C
Thermal Shutdown Hysteresis				30		°C
Thermal Resistance	θ_{JC}	SOT-23-5		150		°C/W

Electrical Characteristics (Continued)

(AP2128-2.5V/2.8V/3.0V/3.3V/3.9V/4.2V/4.75V, V_{IN}=V_{OUT}+1V; AP2128-5.2V, V_{IN}=6V, C_{IN}=1μF, C_{OUT}=1μF, Bold type-face applies over -40°C≤T_A≤85°C, unless otherwise specified.)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=V_{OUT}+1V 1mA≤I_{OUT}≤300mA		98%× V_{OUT}		102%× V_{OUT}	V
Input Voltage	V_{IN}			2.5		6	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}-V_{OUT}=1V, V_{OUT}=98%×V_{OUT}		300	400		mA
Current Limit	I_{LIMIT}	V_{IN}-V_{OUT}=1V			450		mA
Load Regulation	ΔV_{OUT} /(ΔI_{OUT}*V_{OUT})	V_{IN}-V_{OUT}=1V, 1mA≤I_{OUT}≤300mA				0.6	%/A
Line Regulation	ΔV_{OUT} /(ΔV_{IN}*V_{OUT})	V_{OUT}+0.5V≤V_{IN}≤6V, I_{OUT}=30mA				0.06	%/V
Dropout Voltage	V_{DROP}	V_{OUT}=2.5V, 2.8V, 3.0V, 3.3V, 3.9V, 4.2V, I_{OUT}=300mA			170	300	mV
		V_{OUT}=4.75V and 5.2V, I_{OUT}=300mA			140	300	
Quiescent Current	I_Q	V_{IN}=V_{OUT}+1V, I_{OUT}=0mA			60	90	μA
Standby Current	I_{STD}	V_{IN}=V_{OUT}+1V, $V_{\overline{SHUTDOWN}}$ in off mode			0.1	1.0	μA
Power Supply Rejection Ratio	PSRR	AP2128-2.5V to 4.2V, Ripple 1Vp-p V_{IN}=V_{OUT}+1V	f=100Hz		68		dB
			f=1KHz		68		
			f=10KHz		54		
		AP2128-4.75V , Ripple 0.5Vp-p V_{IN}=V_{OUT}+1V	f=100Hz		63		
			f=1KHz		63		
			f=10KHz		45		
		AP2128-5.2V , Ripple 0.5Vp-p V_{IN}=6V	f=100Hz		63		
			f=1KHz		63		
			f=10KHz		45		
Output Voltage Temperature Coefficient	(ΔV_{OUT}/V_{OUT}) /ΔT	I_{OUT}=30mA, -40°C≤T_A≤85°C			±100		ppm/°C
Short Current Limit	I_{SHORT}	V_{OUT}=0V			50		mA

Electrical Characteristics (Continued)

(AP2128-2.5V/2.8V/3.0V/3.3V/3.9V/4.2V/4.75V, $V_{IN}=V_{OUT}+1V$; AP2128-5.2V, $V_{IN}=6V$, $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, Bold type-face applies over $-40^oC \le T_A \le 85^oC$, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Soft Start Time	t_{UP}			50		μs
$\overline{\text{Shutdown}}$ "High" Voltage		$\overline{\text{Shutdown}}$ input voltage "High"	1.5		6	V
$\overline{\text{Shutdown}}$ "Low" Voltage		$\overline{\text{Shutdown}}$ input voltage "Low"	0		0.4	V
V_{OUT} Discharge MOSFET $R_{DS(ON)}$		$\overline{\text{Shutdown}}$ input voltage "Low"		60		Ω
$\overline{\text{Shutdown}}$ Pull Down Resistance				3		MΩ
Thermal Shutdown				165		^oC
Thermal Shutdown Hysteresis				30		^oC
Thermal Resistance	θ_{JC}	SOT-23-5		150		$^oC/W$

Typical Performance Characteristics

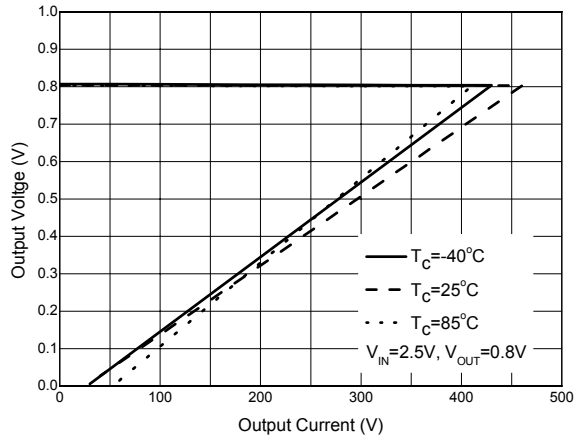


Figure 4. Output Voltage vs. Output Current

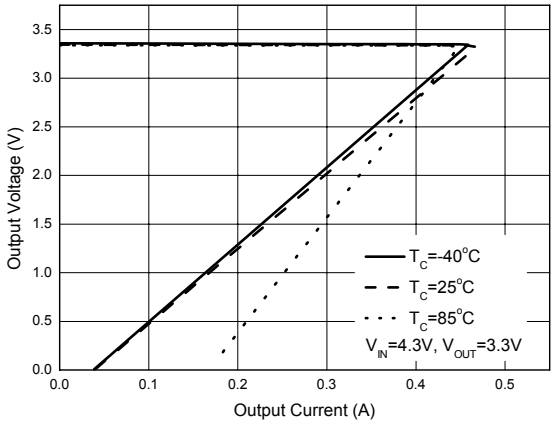


Figure 5. Output Voltage vs. Output Current

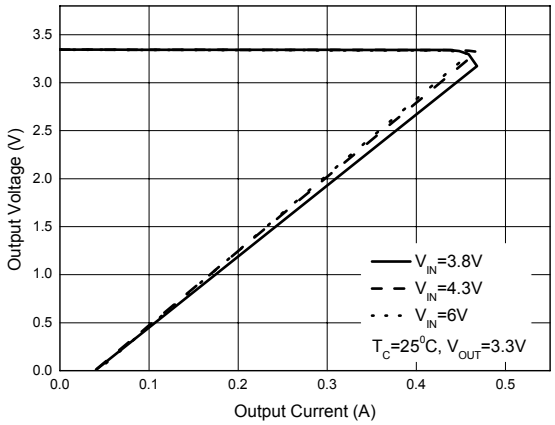


Figure 6. Output Voltage vs. Output Current

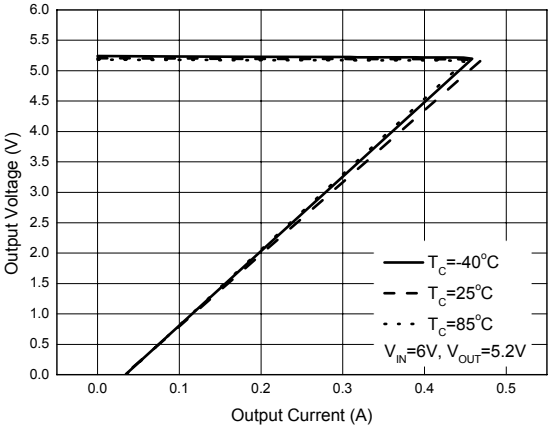


Figure 7. Output Voltage vs. Output Current

Typical Performance Characteristics (Continued)

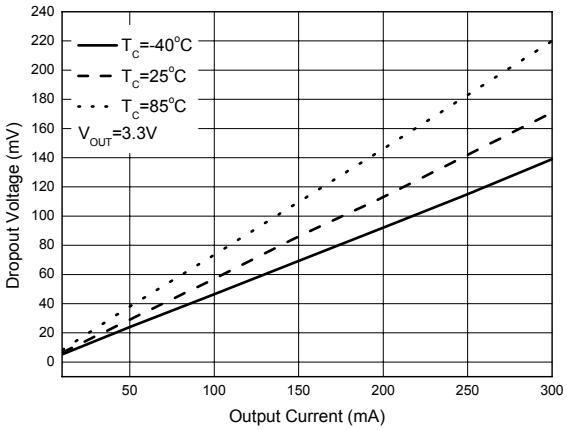


Figure 8. Dropout Voltage vs. Output Current

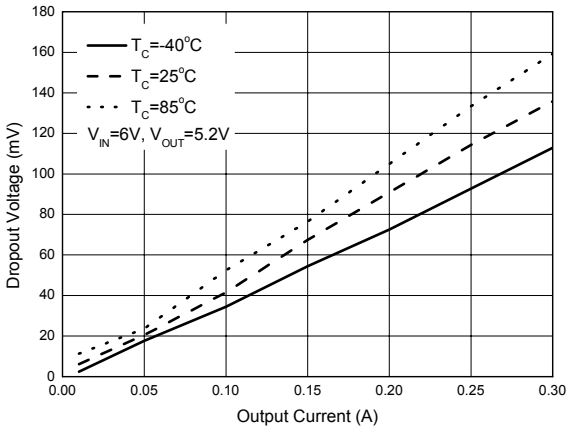


Figure 9. Dropout Voltage vs. Output Current

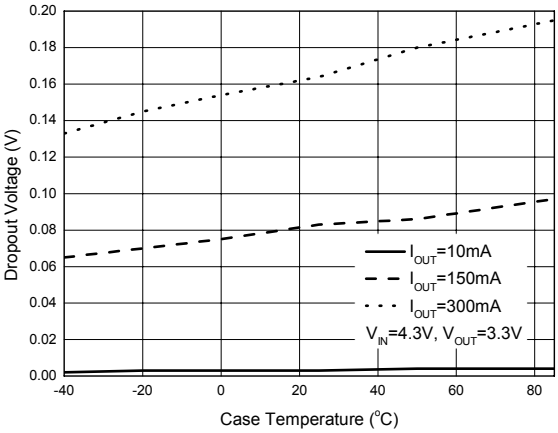


Figure 10. Dropout Voltage vs. Case Temperature

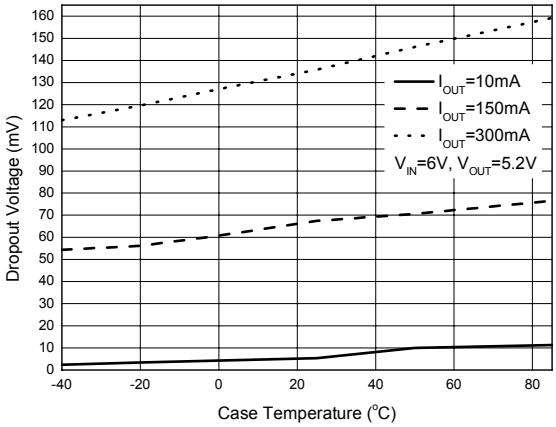


Figure 11. Dropout Voltage vs. Case Temperature

Typical Performance Characteristics (Continued)

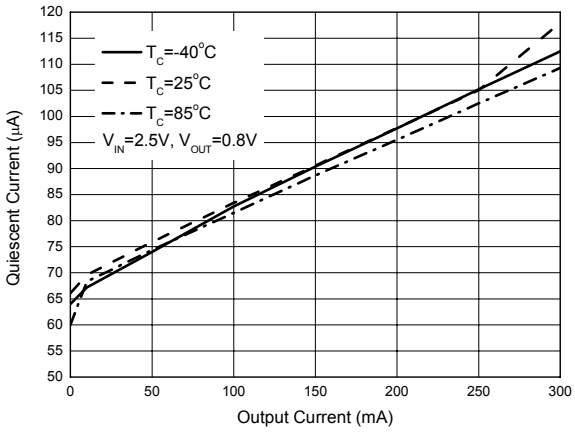


Figure 12. Quiescent Current vs. Output Current

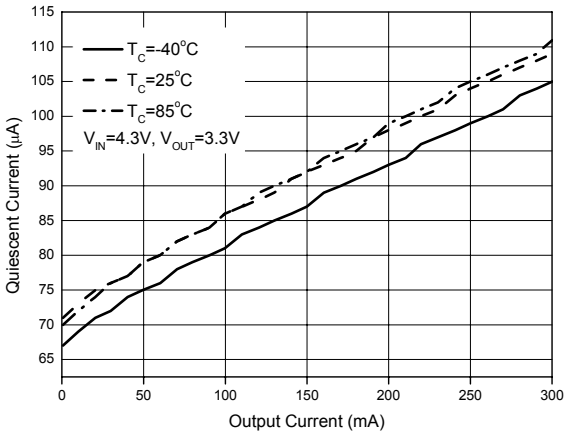


Figure 13. Quiescent Current vs. Output Current

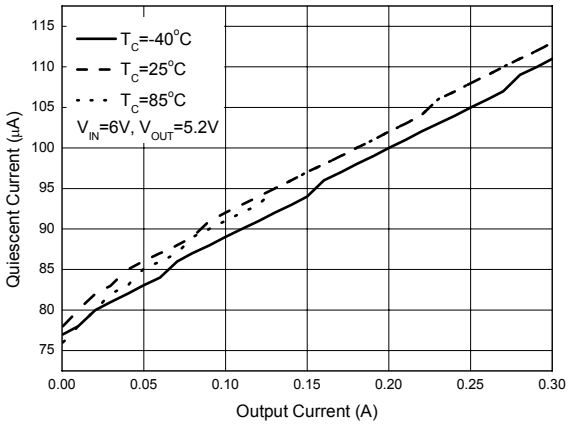


Figure 14. Quiescent Current vs. Output Current

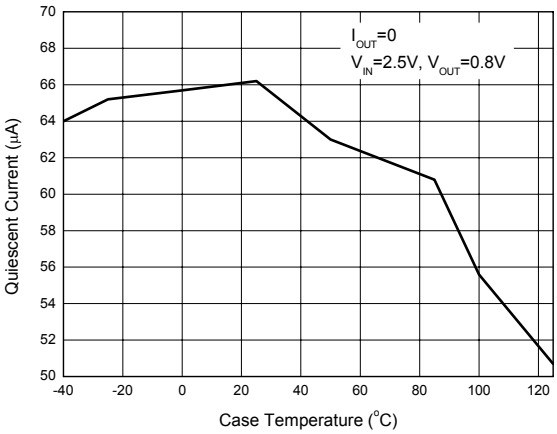


Figure 15. Quiescent Current vs. Case Temperature

Typical Performance Characteristics (Continued)

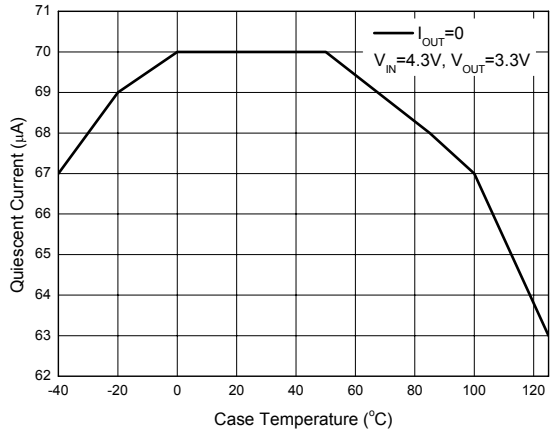


Figure 16. Quiescent Current vs. Case Temperature

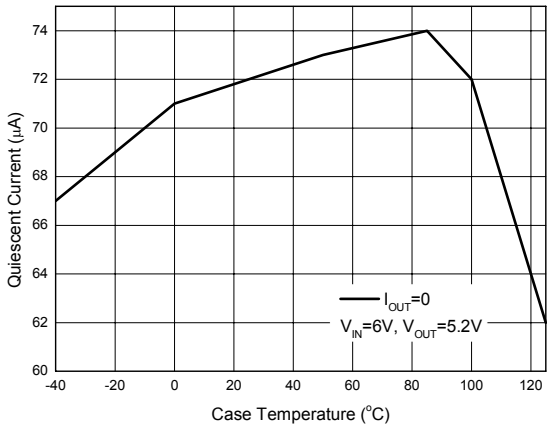


Figure 17. Quiescent Current vs. Case Temperature

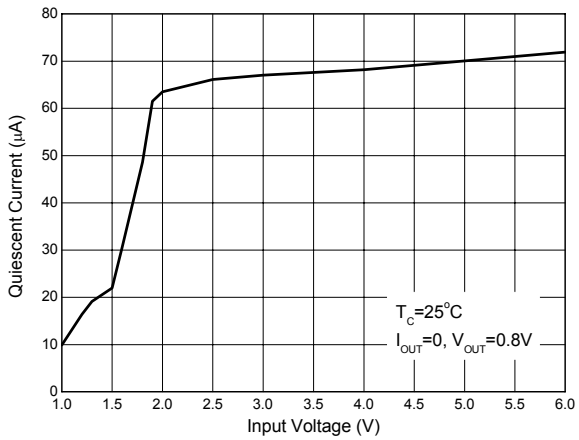


Figure 18. Quiescent Current vs. Input Voltage

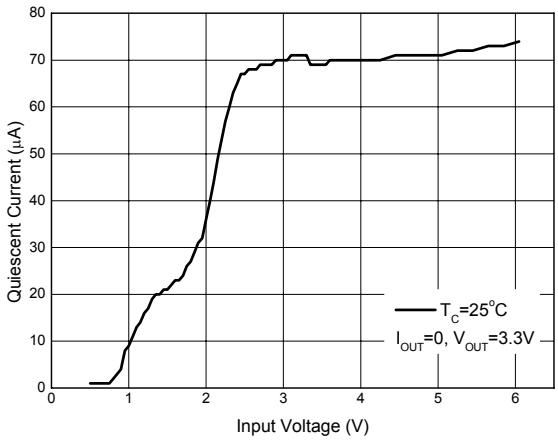


Figure 19. Quiescent Current vs. Input Voltage

Typical Performance Characteristics (Continued)

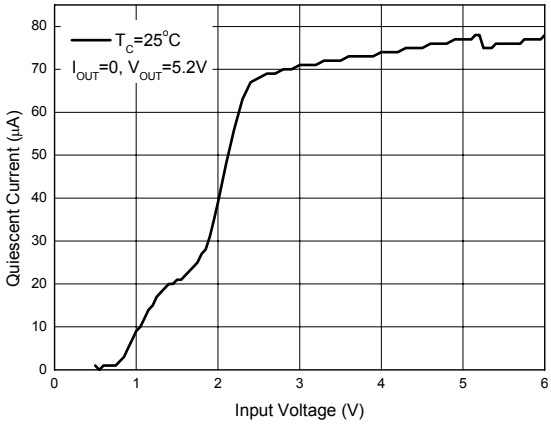


Figure 20. Quiescent Current vs. Input Voltage

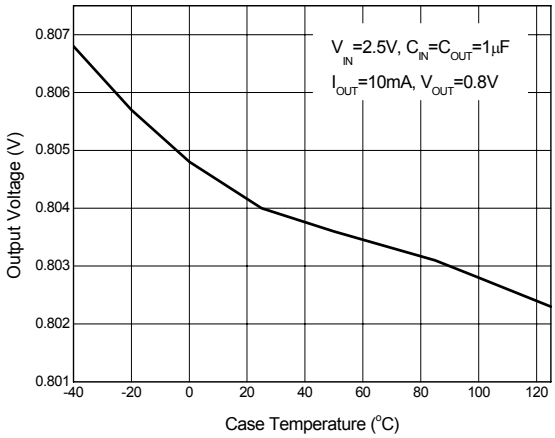


Figure 21. Output Voltage vs. Case Temperature

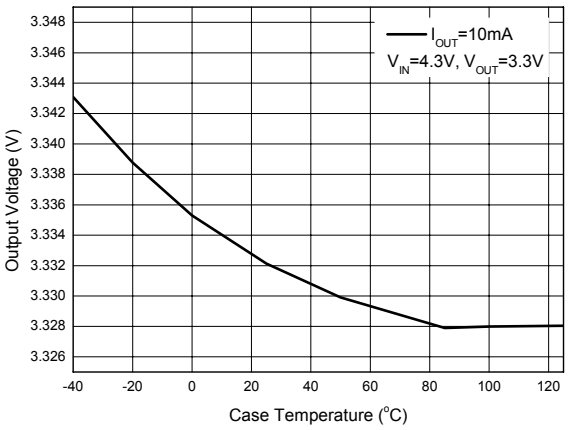


Figure 22. Output Voltage vs. Case Temperature

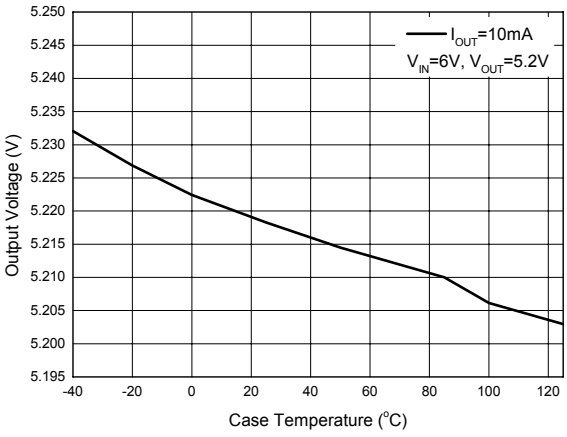


Figure 23. Output Voltage vs. Case Temperature

Typical Performance Characteristics (Continued)

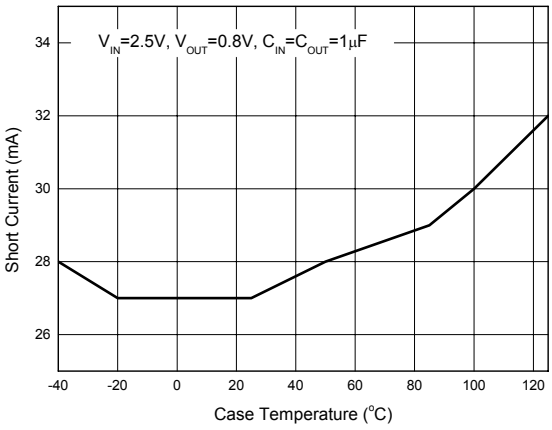


Figure 24. Short Current vs. Case Temperature

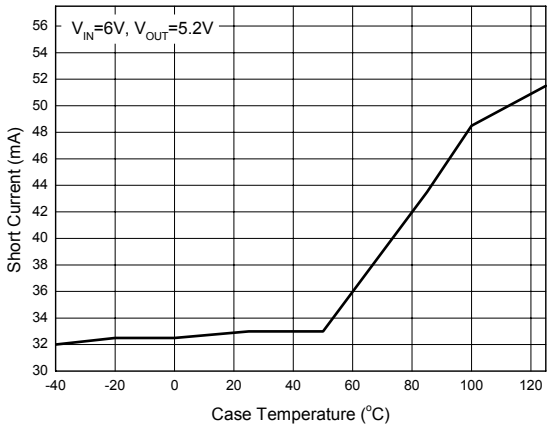


Figure 25. Short Current vs. Case Temperature

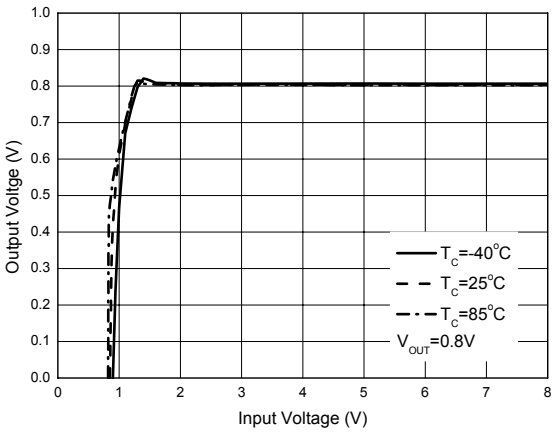


Figure 26. Output Voltage vs. Input Voltage (I_{OUT}=0mA)

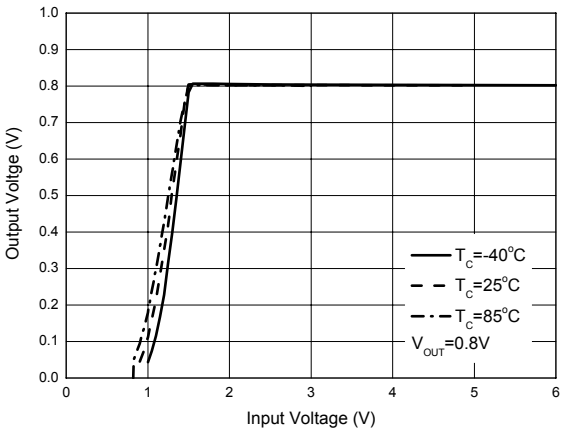


Figure 27. Output Voltage vs. Input Voltage (I_{OUT}=300mA)

Typical Performance Characteristics (Continued)

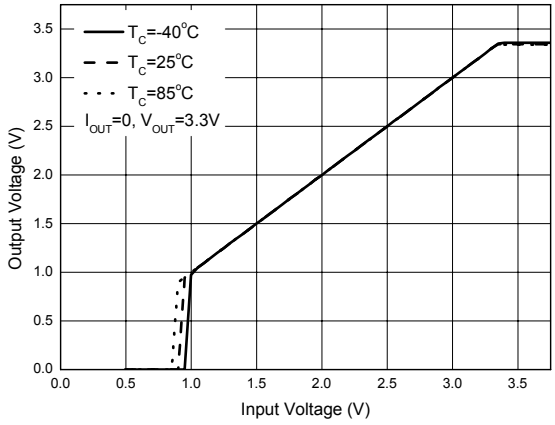


Figure 28. Output Voltage vs. Input Voltage

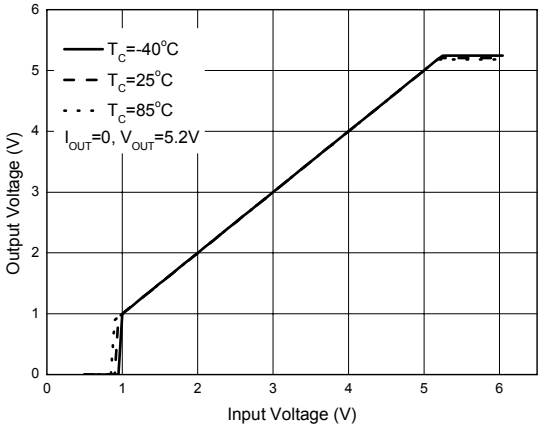


Figure 29. Output Voltage vs. Input Voltage

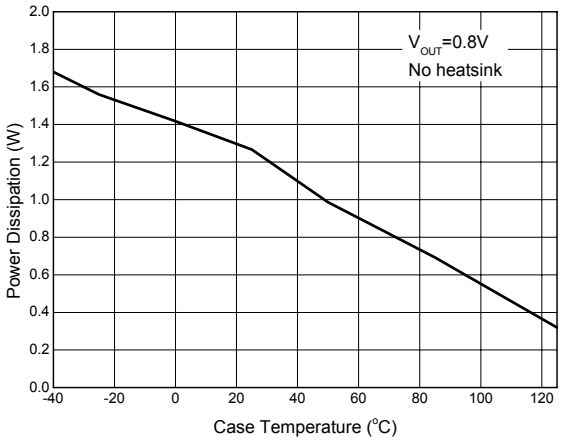


Figure 30. Power Dissipation vs. Case Temperature

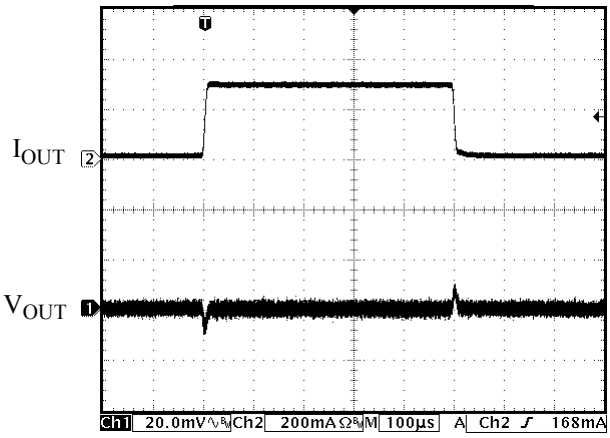


Figure 31. Load Transient

(Conditions: C_{IN}=C_{OUT}=1µF, V_{IN}=2.5V, V_{OUT}=0.8V, I_{OUT}=10mA to 300mA)

Typical Performance Characteristics (Continued)

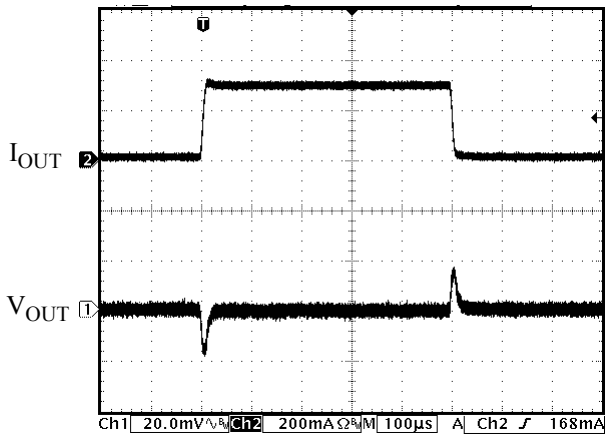


Figure 32. Load Transient

(Conditions: C_{IN}=C_{OUT}=1µF, V_{IN}=4.4V, V_{OUT}=3.3V I_{OUT}=10mA to 300mA)

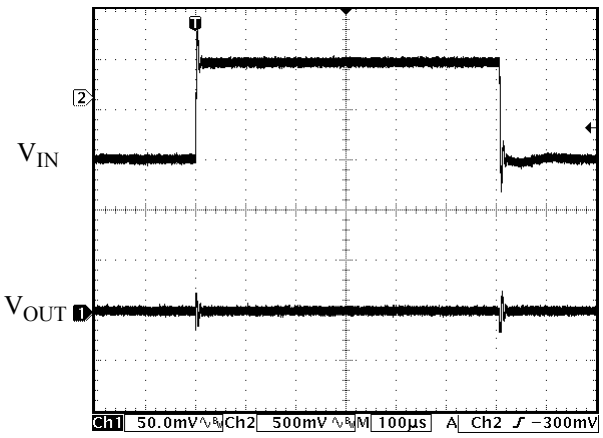


Figure 33. Line Transient

(Conditions: I_{OUT}=30mA, C_{IN}=C_{OUT}=1µF, V_{IN}=2.5 to 3.5V, V_{OUT}=0.8V)

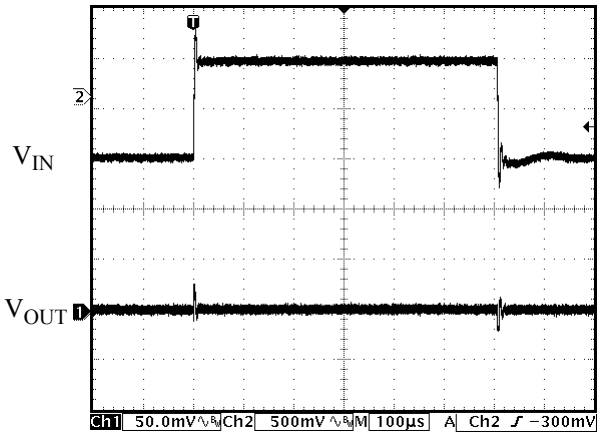


Figure 34. Line Transient

(Conditions: I_{OUT}=30mA, C_{IN}=C_{OUT}=1µF, V_{IN}=4 to 5V, V_{OUT}=3.3V)

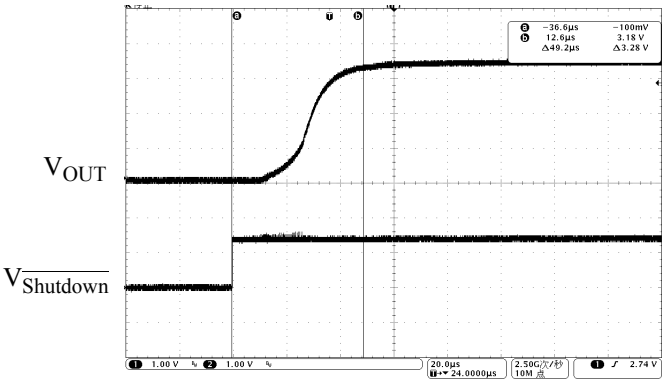


Figure 35. Soft Start Time

(Conditions: I_{OUT}=0mA, C_{IN}=C_{OUT}=1µF, $V_{\overline{Shutdown}}$=0 to 2V, V_{OUT}=3.3V)

Typical Performance Characteristics (Continued)

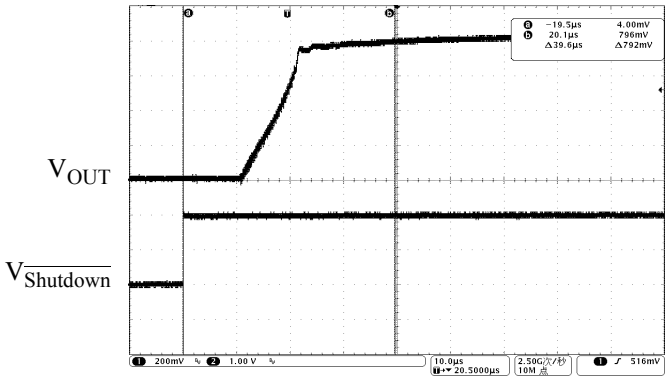


Figure 36. Soft Start Time
(Conditions: I_{OUT}=0mA, C_{IN}=C_{OUT}=1μF, $V_{\overline{Shutdown}}$=0 to 2V, V_{OUT}=0.8V)

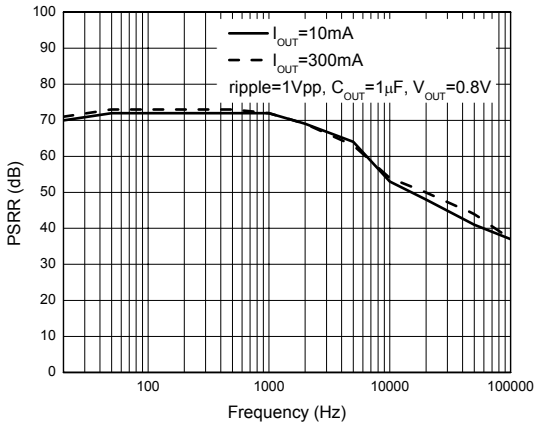


Figure 37. PSRR vs. Frequency

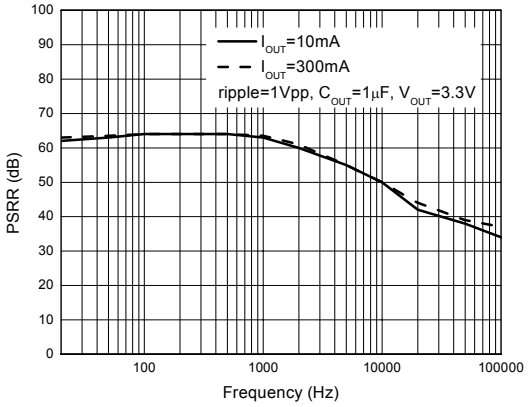


Figure 38. PSRR vs. Frequency

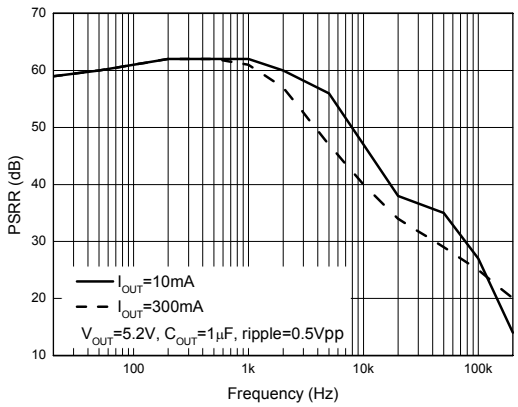
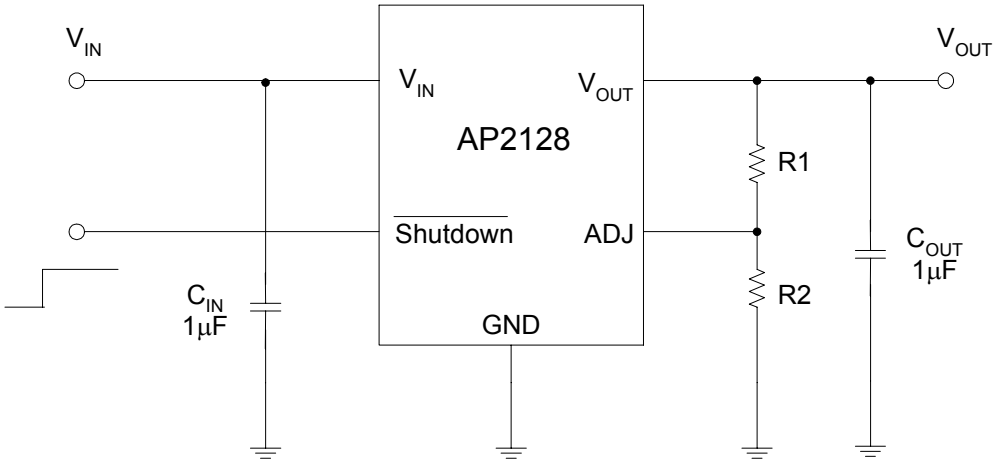
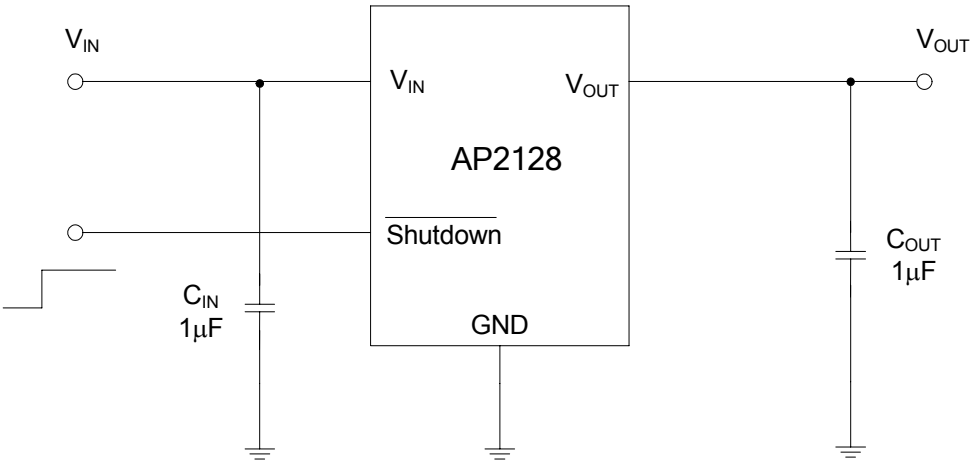


Figure 39. PSRR vs. Frequency

Typical Application



V_{OUT}=0.8(1+R1/R2) V

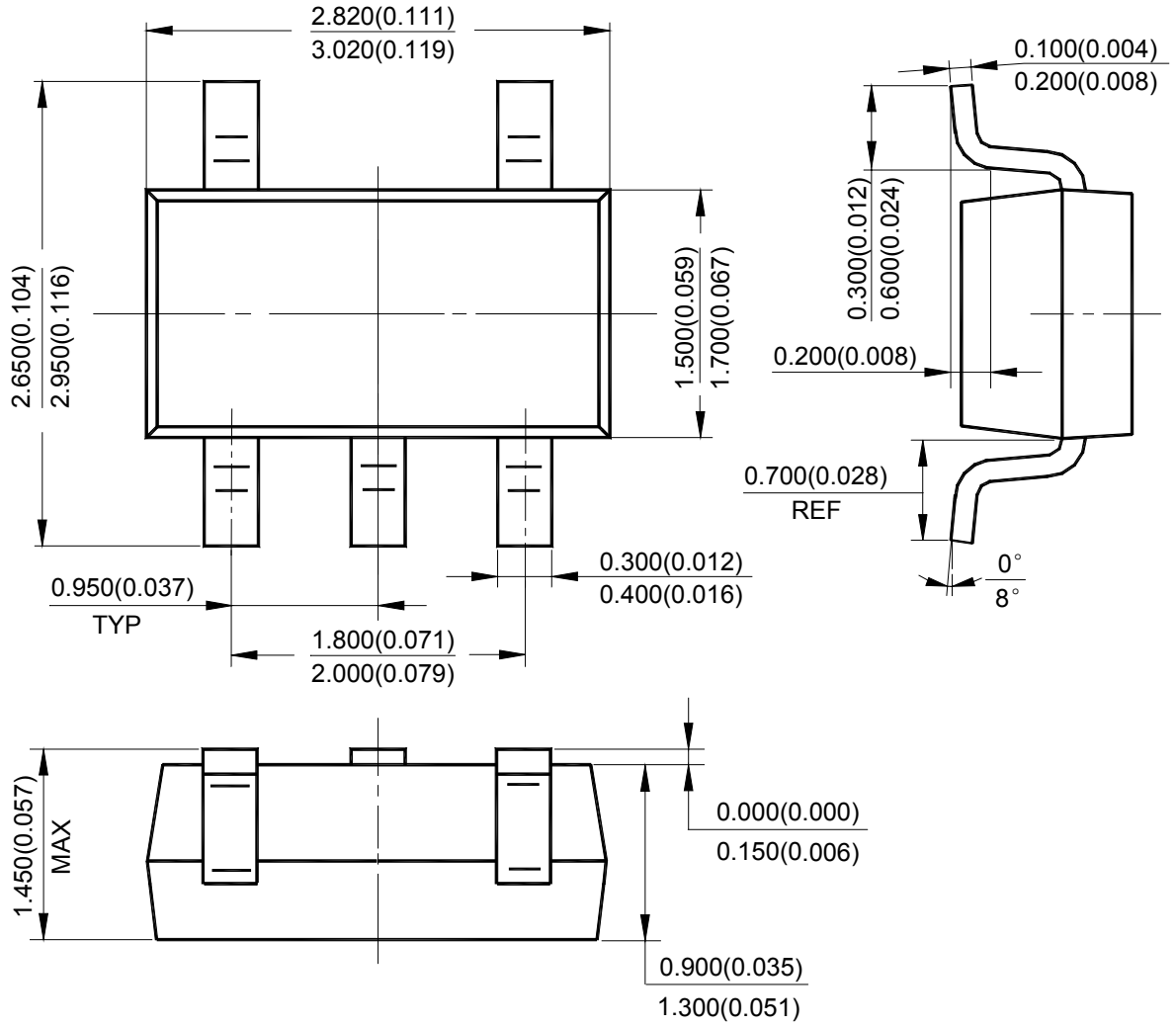


V_{OUT}=1.0V to 5.2V

Figure 40. Typical Application of AP2128

Mechanical Dimensions

SOT-23-5 **Unit: mm(inch)**



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