600mA CMOS LDO REGULATOR WITH ENABLE AP2112

General Description

The AP2112 is CMOS process low dropout linear regulator with enable function, the regulator delivers a guaranteed 600mA (min.) continuous load current.

The AP2112 provides 1.2V, 1.8V, 2.5V, 2.6V and 3.3V regulated output, and provides excellent output accuracy 1.5%, also provides an excellent load regulation, line regulation and excellent load transient performance due to very fast loop response. The AP2112 has built-in auto discharge function.

The regulator features low power consumption, and provides SOT-23-5, SOT-89-5, and SOIC-8 packages.

Features

- Output voltage accuracy: ±1.5%
- Output Current: 600mA (Min.)
- Foldback Short Current Protection: 50mA
- Enable Function to Turn ON/OFF V_{OUT}
- Low Dropout Voltage (3.3V): 250mV (Typ.) @I_{OUT}=600mA
- Excellent Load Regulation: 0.2%/A (Typ.)
- Excellent Line Regulation: 0.02%/V (Typ.)
- Low Quiescent Current: 55μA (Typ.)
- Low Standby Current: 0.01μA (Typ.)
- Low Output Noise: 50μV_{RMS}
- PSRR: 100Hz -65dB, 1k –65dB
- OTSD Protection
- Stable with 1.0μF Flexible Cap: Ceramic, Tantalum and Aluminum Electrolytic
- Operation Temperature Range: -40°C to 85°C
- ESD: MM 400V, HBM 4000V

Applications

- Laptop computer
- Potable DVD
- LCD Monitor

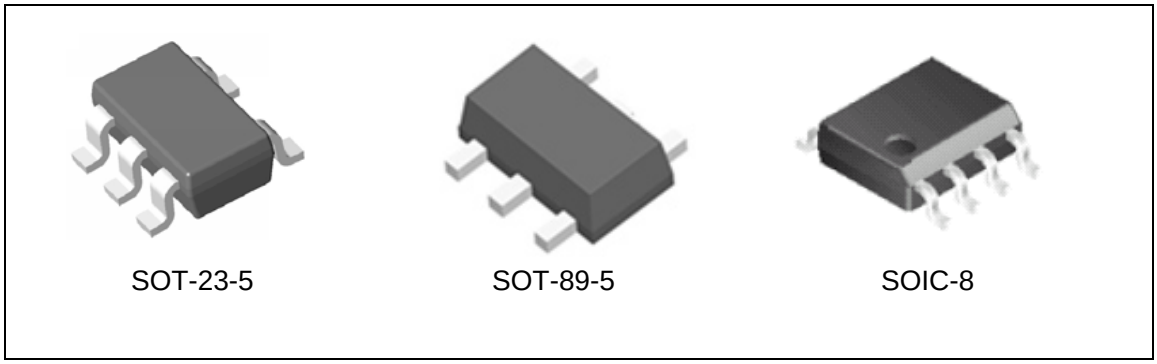


Figure 1. Package Type of AP2112

600mA CMOS LDO REGULATOR WITH ENABLE AP2112

Pin Configuration

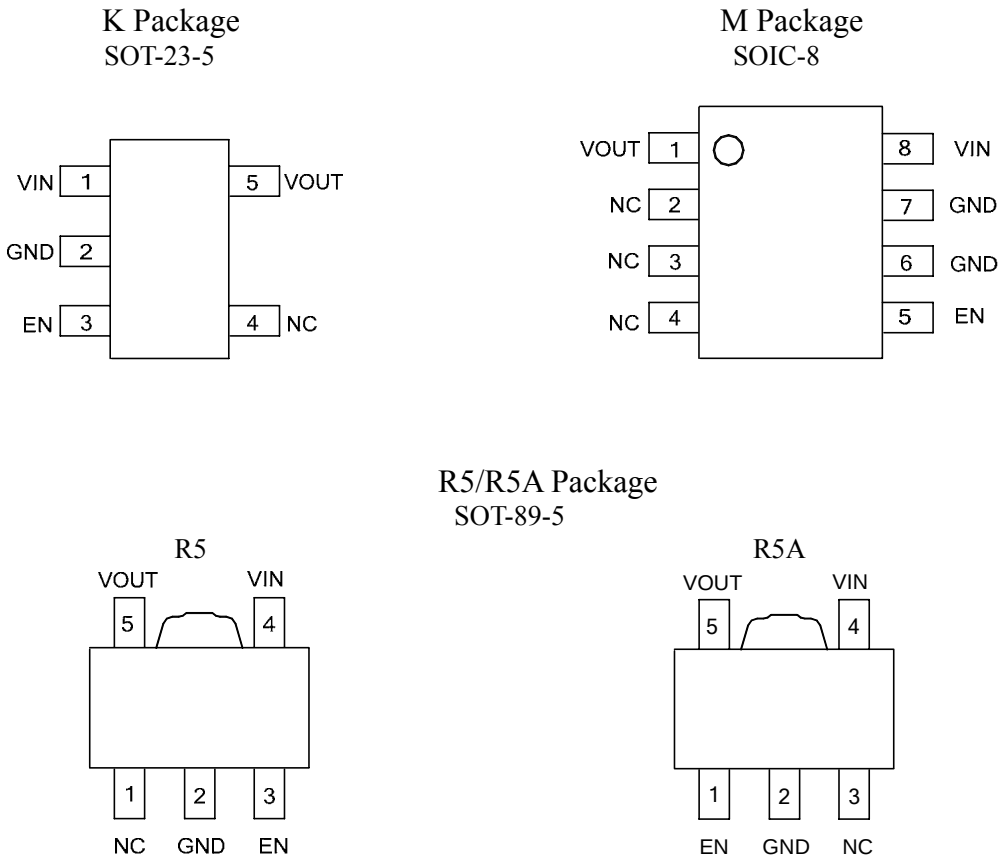


Figure 2. Pin Configuration of AP2112 (Top View)

Pin Descriptions

PIN No.			Name	Descriptions
SOT-23-5	SOT-89-5	SOIC-8		
1	4	8	VIN	Input Voltage
2	2	6, 7	GND	GND
3	3 (R5)	5	EN	Chip Enable, H – normal work, L – shutdown output
	1 (R5A)			
4	1 (R5)	2, 3, 4	NC	No Connection
	3 (R5A)			
5	5	1	VOUT	Output Voltage

Functional Block Diagram

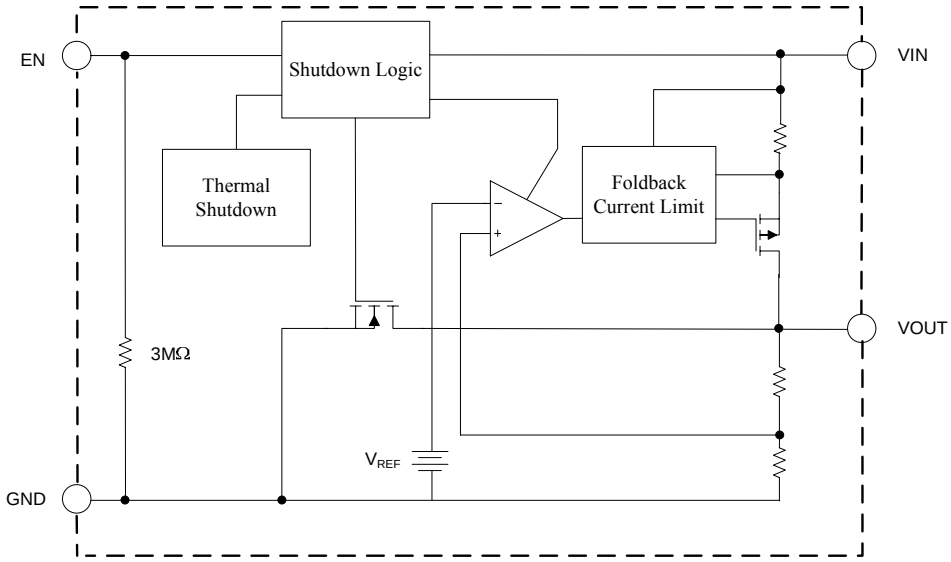
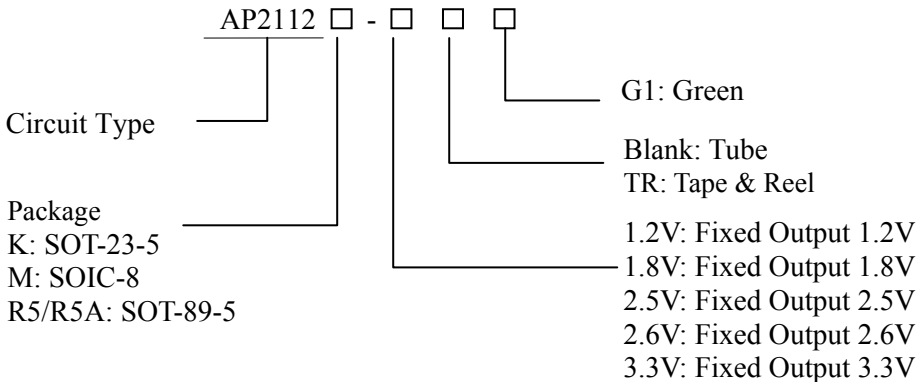


Figure 3. Functional Block Diagram of AP2112

600mA CMOS LDO REGULATOR WITH ENABLE AP2112

Ordering Information



Package	Temperature Range	Condition	Part Number	Marking ID	Packing Type
SOT-23-5	-40 to 85°C	1.2V	AP2112K-1.2TRG1	G3L	Tape & Reel
		1.8V	AP2112K-1.8TRG1	G3M	Tape & Reel
		2.5V	AP2112K-2.5TRG1	G3N	Tape & Reel
		2.6V	AP2112K-2.6TRG1	G5N	Tape & Reel
		3.3V	AP2112K-3.3TRG1	G3P	Tape & Reel
SOIC-8	-40 to 85°C	1.2V	AP2112M-1.2G1	2112M-1.2G1	Tube
			AP2112M-1.2TRG1	2112M-1.2G1	Tape & Reel
		1.8V	AP2112M-1.8G1	2112M-1.8G1	Tube
			AP2112M-1.8TRG1	2112M-1.8G1	Tape & Reel
		2.5V	AP2112M-2.5G1	2112M-2.5G1	Tube
			AP2112M-2.5TRG1	2112M-2.5G1	Tape & Reel
		2.6V	AP2112M-2.6G1	2112M-2.6G1	Tube
			AP2112M-2.6TRG1	2112M-2.6G1	Tape & Reel
		3.3V	AP2112M-3.3G1	2112M-3.3G1	Tube
			AP2112M-3.3TRG1	2112M-3.3G1	Tape & Reel
SOT-89-5	-40 to 85°C	1.2V(R5)	AP2112R5-1.2TRG1	G37D	Tape & Reel
		1.8V(R5)	AP2112R5-1.8TRG1	G37E	Tape & Reel
		2.5V(R5)	AP2112R5-2.5TRG1	G37F	Tape & Reel
		2.6V(R5)	AP2112R5-2.6TRG1	G13F	Tape & Reel
		3.3V(R5)	AP2112R5-3.3TRG1	G37G	Tape & Reel
SOT-89-5	-40 to 85°C	1.2V(R5A)	AP2112R5A-1.2TRG1	G33C	Tape & Reel
		1.8V(R5A)	AP2112R5A-1.8TRG1	G33E	Tape & Reel
		2.5V(R5A)	AP2112R5A-2.5TRG1	G28G	Tape & Reel
		2.6V(R5A)	AP2112R5A-2.6TRG1	G13E	Tape & Reel
		3.3V(R5A)	AP2112R5A-3.3TRG1	G28H	Tape & Reel

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

Absolute Maximum Ratings (Note 1)

Parameter		Symbol	Value		Unit
Power Supply Voltage		V_{CC}	6.5		V
Operating Junction Temperature Range		T_J	150		ºC
Storage temperature Range		T_{STG}	-65 to 150		ºC
Lead Temperature (Soldering,10 Seconds)		T_{LEAD}	260		ºC
Thermal Resistance （Junction to Ambient）(No heatsink)		θ_{JA}	SOT-23-5	184	°C /W
			SOIC-8	114	
			SOT-89-5	120	
ESD	Machine Model		400		V
	Human Body Model		4000		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
Supply Voltage	V_{IN}	2.5	6.0	V
Ambient Operation Temperature Range	T_A	-40	85	°C

Electrical Characteristics

AP2112-1.2 Electrical Characteristic (Note 2)

V_{IN}=2.5V, C_{IN}=1.0μF (Ceramic), C_{OUT}=1.0μF (Ceramic), Typical T_A= 25°C, **Bold** typeface applies over -40°C≤T_J≤85°C ranges, unless otherwise specified (Note 3).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN} =2.5V, 1mA ≤ I_{OUT} ≤ 30mA	V_{OUT} *98.5%	1.2	V_{OUT} *101.5%	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN} =2.5V, V_{OUT}=1.182V to 1.218V	600			mA
Load Regulation	(△V_{OUT}/V_{OUT})/ △I_{OUT}	V_{IN}=2.5V, 1mA ≤ I_{OUT} ≤600mA		0.2	±0.1	%/A
Line Regulation	(△V_{OUT}/V_{OUT})/ △V_{IN}	2.5V≤V_{IN}≤6V, I_{OUT}=30mA		0.02		%/V
Dropout Voltage	V_{DROP}	I_{OUT} =10mA		1000	1300	mV
		I_{OUT} =300mA		1000	1300	
		I_{OUT}=600mA		1000	1300	
Quiescent Current	I_Q	V_{IN}=2.5V, I_{OUT}=0mA		55	80	μA
Standby Current	I_{STD}	V_{IN}=2.5V, V_{EN} in OFF mode		0.01	1.0	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, V_{IN}=2.5V, I_{OUT}=100mA, f=100Hz		65		dB
		Ripple 0.5Vp-p, V_{IN}=2.5V, I_{OUT}=100mA, f=1KHz		65		
Output Voltage Temperature Coefficient	(△VOUT/VOUT)/ △T	I_{OUT}=30mA, T_A =-40°C to 85°C		±100		ppm
Short Current Limit	I_{SHORT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	No Load, 10Hz ≤ f ≤100kHz		50		$μV_{RMS}$
V_{EN} High Voltage	V_{IH}	Enable logic high, regulator on	1.5		6.0	V
V_{EN} Low Voltage	V_{IL}	Enable logic low, regulator off	0		0.4	
Start-up Time	T_S	No Load		20		μs
EN Pull Down Resistor	R_{PD}			3.0		MΩ
V_{OUT} discharge Resistor	R_{DCHG}	Set EN pin at Low		60		Ω
Thermal Shutdown Temperature	T_{OTSD}			160		°C
Thermal Shutdown Hysteresis	T_{HYOTSD}			25		
Thermal Resistance	$θ_{JC}$	SOT-23-5		96		°C /W
		SOIC-8		75		
		SOT-89-5		47		

Note 2: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.
Note 3: Production testing at TA=25°C. Over temperature specifications guaranteed by design only.

Electrical Characteristics (Continued)

AP2112-1.8 Electrical Characteristic (Note 2)

V_{IN}=2.8V, C_{IN}=1μF (Ceramic), C_{OUT}=1μF (Ceramic), Typical T_A = 25°C, **Bold** typeface applies over -40°C≤T_J≤85°C ranges, unless otherwise specified (Note 3).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN} =2.8V, 1mA ≤ I_{OUT} ≤ 30mA	V_{OUT} *98.5%	1.8	V_{OUT} *101.5%	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=2.8V, V_{OUT}=1.773V to 1.827V	600			mA
Load Regulation	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle I_{OUT}$	V_{OUT}=1.8V, V_{IN}=V_{OUT}+1V, 1mA ≤ I_{OUT} ≤600mA		0.2		%/A
Line Regulation	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle V_{IN}$	2.8V≤V_{IN}≤6V, I_{OUT}=30mA		0.02	±0.1	%/V
Dropout Voltage	V_{DROP}	I_{OUT} =10mA		500	700	mV
		I_{OUT} =300mA		500	700	
		I_{OUT}=600mA		500	700	
Quiescent Current	I_Q	V_{IN}=2.8V, I_{OUT}=0mA		55	80	μA
Standby Current	I_{STD}	V_{IN}=2.8V, V_{EN} in OFF mode		0.01	1.0	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=100Hz, V_{IN}=2.8V, I_{OUT}=100mA		65		dB
		Ripple 0.5Vp-p, f=1KHz, V_{IN}=2.8V, I_{OUT}=100mA		65		
Output Voltage Temperature Coefficient	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle T$	I_{OUT}=30mA, T_A =-40°C to 85°C		±100		ppm
Short Current Limit	I_{SHORT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	No Load, 10Hz ≤ f ≤100kHz		50		μV_{RMS}
V_{EN} High Voltage	V_{IH}	Enable logic high, regulator on	1.5		6.0	V
V_{EN} Low Voltage	V_{IL}	Enable logic low, regulator off	0		0.4	
Start-up Time	T_S	No Load		20		μs
EN Pull Down Resistor	R_{PD}			3.0		MΩ
V_{OUT} Discharge Resistor	R_{DCHG}	Set EN pin at Low		60		Ω
Thermal Shutdown Temperature	T_{OTSD}			160		°C
Thermal Shutdown Hysteresis	T_{HYOTSD}			25		
Thermal Resistance	θ_{JC}	SOT-23-5		96		°C /W
		SOIC-8		75		
		SOT-89-5		47		

Note 2: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.
Note 3: Production testing at TA=25°C. Over temperature specifications guaranteed by design only.

Electrical Characteristics (Continued)

AP2112-2.5 Electrical Characteristic (Note 2)

V_{IN}=3.5V, C_{IN}=1μF (Ceramic), C_{OUT}=1μF (Ceramic), Typical T_A = 25°C, **Bold** typeface applies over -40°C≤T_J≤85°C ranges, unless otherwise specified (Note 3).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN} =3.5V, 1mA ≤ I_{OUT} ≤ 30mA	V_{OUT} *98.5%	2.5	V_{OUT} *101.5%	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=3.5V, V_{OUT}=2.463V to 2.537V	600			mA
Load Regulation	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle I_{OUT}$	V_{OUT}=2.5V, V_{IN}=V_{OUT}+1V, 1mA ≤ I_{OUT} ≤600mA		0.2		%/A
Line Regulation	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle V_{IN}$	3.5V≤V_{IN}≤6V, I_{OUT}=30mA		0.02	±0.1	%/V
Dropout Voltage	V_{DROP}	I_{OUT} =10mA		5	8	mV
		I_{OUT} =300mA		125	200	
		I_{OUT}=600mA		250	400	
Quiescent Current	I_Q	V_{IN}=3.5V, I_{OUT}=0mA		55	80	μA
Standby Current	I_{STD}	V_{IN}=3.5V, V_{EN} in OFF mode		0.01	1.0	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p f=100Hz, V_{IN}=3.5V, I_{OUT}=100mA		65		dB
		Ripple 0.5Vp-p f=1KHz, V_{IN}=3.5V, I_{OUT}=100mA		65		
Output Voltage Temperature Coefficient	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle T$	I_{OUT}=30mA T_A =-40°C to 85°C		±100		ppm
Short Current Limit	I_{SHORT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	No Load, 10Hz ≤ f ≤100kHz		50		μV_{RMS}
V_{EN} High Voltage	V_{IH}	Enable logic high, regulator on	1.5		6.0	V
V_{EN} Low Voltage	V_{IL}	Enable logic low, regulator off	0		0.4	
Start-up Time	T_S	No Load		20		μs
EN Pull Down Resistor	R_{PD}			3.0		MΩ
V_{OUT} Discharge Resistor	R_{DCHG}	Set EN pin at Low		60		Ω
Thermal Shutdown Temperature	T_{OTSD}			160		°C
Thermal Shutdown Hysteresis	T_{HYOTSD}			25		
Thermal Resistance	θ_{JC}	SOT-23-5		96		°C /W
		SOIC-8		75		
		SOT-89-5		47		

Note 2: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.
Note 3: Production testing at T_A =25°C. Over temperature specifications guaranteed by design only.

Electrical Characteristics (Continued)

AP2112-2.6 Electrical Characteristic (Note 2)

V_{IN}=3.6V, C_{IN}=1μF (Ceramic), C_{OUT}=1μF (Ceramic), Typical T_A = 25°C, **Bold** typeface applies over -40°C≤T_J≤85°C ranges, unless otherwise specified (Note 3).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN} =3.6V, 1mA ≤ I_{OUT} ≤ 30mA	V_{OUT} *98.5%	2.6	V_{OUT} *101.5%	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=3.6V, V_{OUT}=2.561V to 2.639V	600			mA
Load Regulation	(△V_{OUT}/V_{OUT})/ △I_{OUT}	V_{OUT}=2.6V, V_{IN}=V_{OUT}+1V, 1mA ≤ I_{OUT} ≤600mA		0.2		%/A
Line Regulation	(△V_{OUT}/V_{OUT})/ △V_{IN}	3.6V≤V_{IN}≤6V, I_{OUT}=30mA		0.02	±0.1	%/V
Dropout Voltage	V_{DROP}	I_{OUT} =10mA		5	8	mV
		I_{OUT} =300mA		125	200	
		I_{OUT}=600mA		250	400	
Quiescent Current	I_Q	V_{IN}=3.6V, I_{OUT}=0mA		55	80	μA
Standby Current	I_{STD}	V_{IN}=3.6V, V_{EN} in OFF mode		0.01	1.0	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, V_{IN}=3.6V, I_{OUT}=100mA, f=100Hz		65		dB
		Ripple 0.5Vp-p, V_{IN}=3.6V, I_{OUT}=100mA, f=1KHz		65		
Output Voltage Temperature Coefficient	(△V_{OUT}/V_{OUT})/ △T	I_{OUT}=30mA, T_A =-40°C to 85°C		±100		ppm
Short Current Limit	I_{SHORT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	No Load, 10Hz ≤ f ≤100kHz		50		$μV_{RMS}$
V_{EN} High Voltage	V_{IH}	Enable logic high, regulator on	1.5		6.0	V
V_{EN} Low Voltage	V_{IL}	Enable logic low, regulator off	0		0.4	
Start-up Time	T_S	No Load		20		μs
EN Pull Down Resistor	R_{PD}			3.0		MΩ
V_{OUT} Discharge Resistor	R_{DCHG}	Set EN pin at Low		60		Ω
Thermal Shutdown Temperature	T_{OTSD}			160		°C
Thermal Shutdown Hysteresis	T_{HYOTSD}			25		
Thermal Resistance	$θ_{JC}$	SOT-23-5		96		°C /W
		SOIC-8		75		
		SOT-89-5		47		

Note 2: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.
Note 3: Production testing at T_A =25°C. Over temperature specifications guaranteed by design only.

Electrical Characteristics (Continued)

AP2112-3.3 Electrical Characteristic (Note 2)

V_{IN}=4.3V, C_{IN}=1μF (Ceramic), C_{OUT}=1μF (Ceramic), Typical T_A = 25°C, **Bold** typeface applies over -40°C≤T_J≤85°C ranges, unless otherwise specified (Note 3).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN} =4.3V, 1mA ≤ I_{OUT} ≤ 30mA	V_{OUT} *98.5%	3.3	V_{OUT} *101.5%	V
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=4.3V, V_{OUT}=3.251V to 3.350V	600			mA
Load Regulation	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle I_{OUT}$	V_{IN}=4.3V, 1mA ≤ I_{OUT} ≤600mA		0.2		%/A
Line Regulation	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle V_{IN}$	4.3V≤V_{IN}≤6V, I_{OUT}=30mA		0.02	±0.1	%/V
Dropout Voltage	V_{DROP}	I_{OUT} =10mA		5	8	mV
		I_{OUT} =300mA		125	200	
		I_{OUT}=600mA		250	400	
Quiescent Current	I_Q	V_{IN}=4.3V, I_{OUT}=0mA		55	80	μA
Standby Current	I_{STD}	V_{IN}=4.3V, V_{EN} in OFF mode		0.01	1.0	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p V_{IN}=4.3V, I_{OUT}=100mA, f=100Hz		65		dB
		Ripple 0.5Vp-p V_{IN}=4.3V, I_{OUT}=100mA, f=1KHz		65		
Output Voltage Temperature Coefficient	($\triangle V_{OUT}/V_{OUT}$)/ $\triangle T$	I_{OUT}=30mA T_A =-40°C to 85°C		±100		ppm
Short Current Limit	I_{SHORT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	No Load, 10Hz ≤ f ≤100kHz		50		μV_{RMS}
V_{EN} High Voltage	V_{IH}	Enable logic high, regulator on	1.5		6.0	V
V_{EN} Low Voltage	V_{IL}	Enable logic low, regulator off	0		0.4	
Start-up Time	T_S	No Load		20		μs
EN Pull Down Resistor	R_{PD}			3.0		MΩ
V_{OUT} Discharge Resistor	R_{DCHG}	Set EN pin at Low		60		Ω
Thermal Shutdown Temperature	T_{OTSD}			160		°C
Thermal Shutdown Hysteresis	T_{HYOTSD}			25		
Thermal Resistance	θ_{JC}	SOT-23-5		96		°C /W
		SOIC-8		75		
		SOT-89-5		47		

Note 2: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.
Note 3: Production testing at T_A =25°C. Over temperature specifications guaranteed by design only.

Typical Performance Characteristics

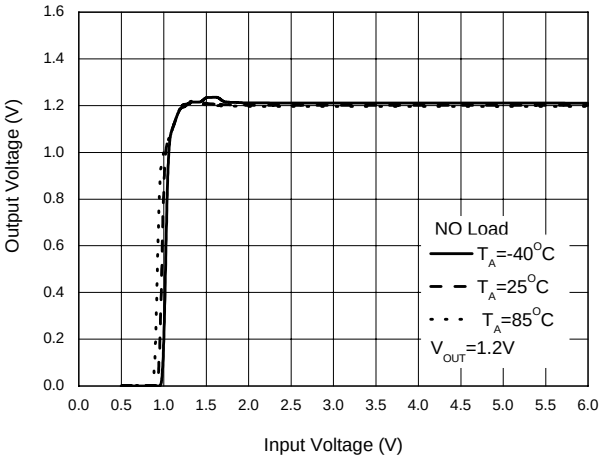


Figure 4. Output Voltage vs. Input Voltage

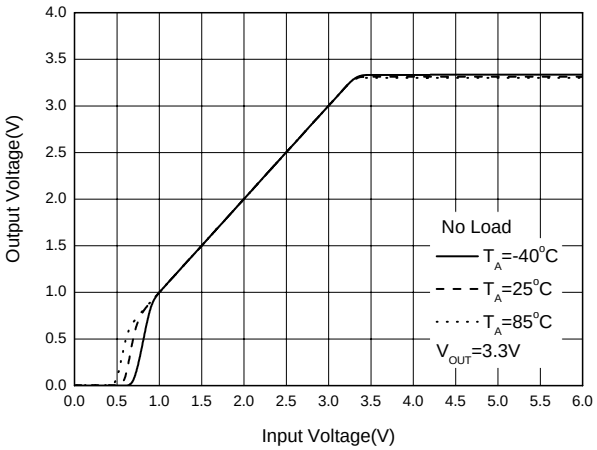


Figure 5. Output Voltage vs. Input Voltage

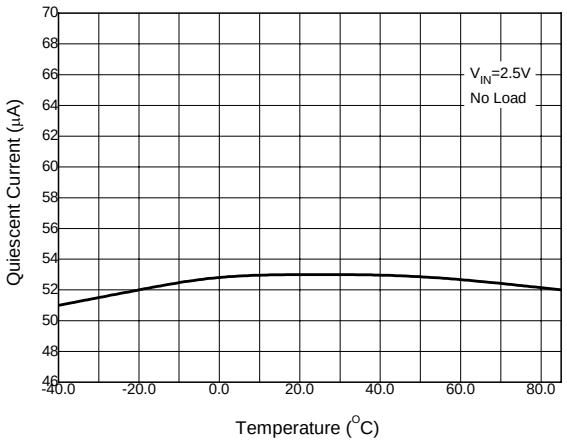


Figure 6. Quiescent Current vs. Temperature

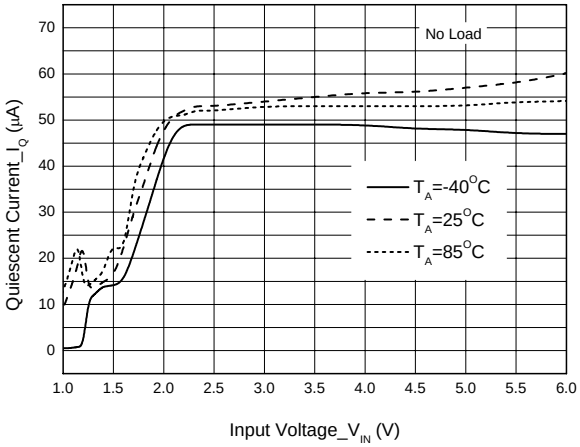


Figure 7. Quiescent Current vs. Input Voltage

Typical Performance Characteristics (Continued)

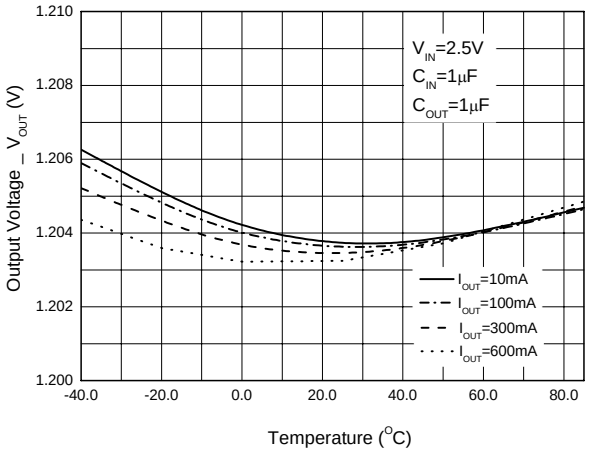


Figure 8. Output Voltage vs. Temperature

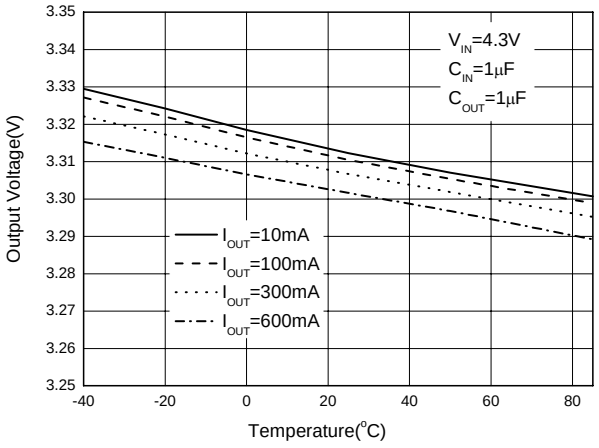


Figure 9. Output Voltage vs. Temperature

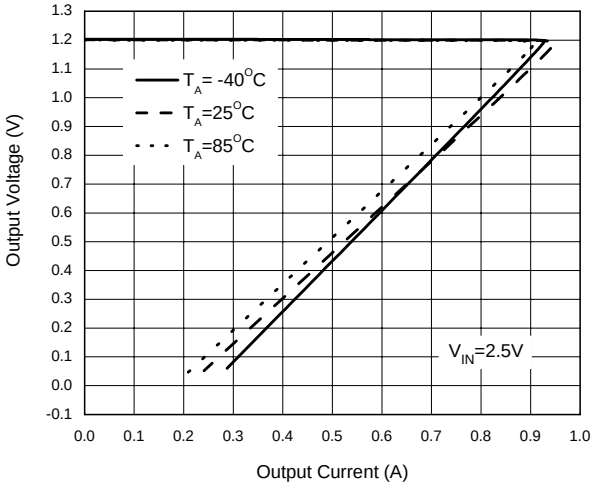


Figure 10. Output Voltage vs. Output Current

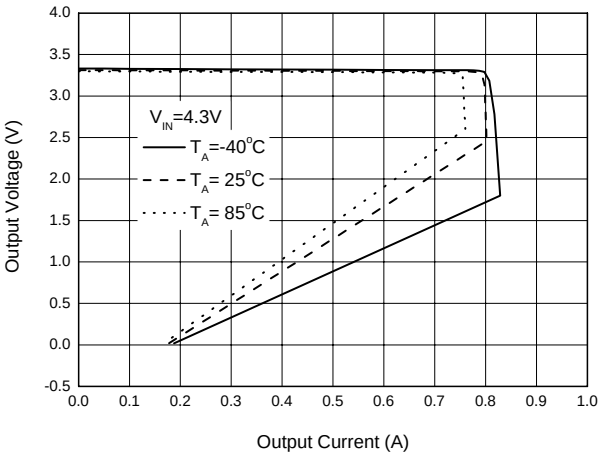


Figure 11. Output Voltage vs. Output Current

Typical Performance Characteristics (Continued)

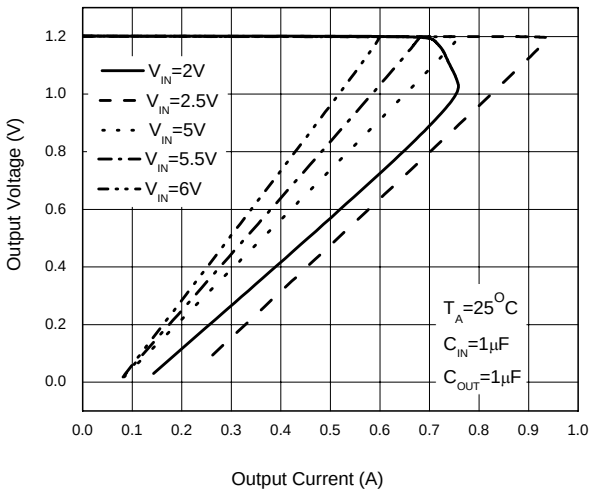


Figure 12. Output Voltage vs. Output Current

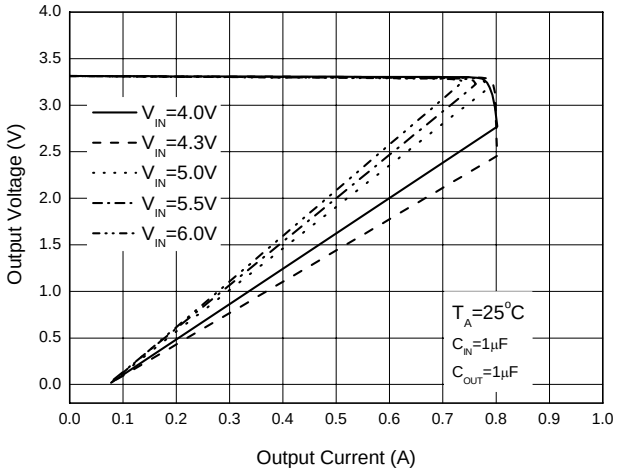


Figure 13. Output Voltage vs. Output Current

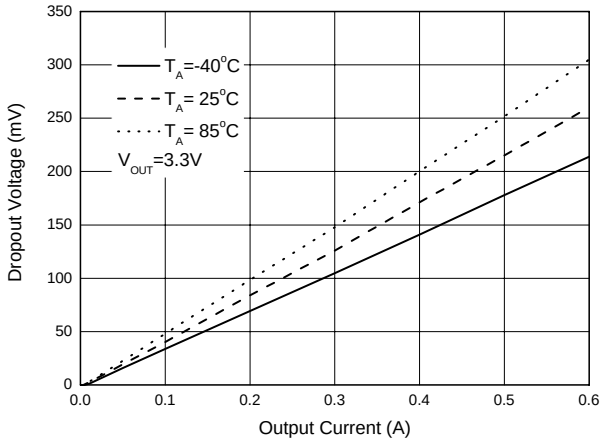


Figure 14. Dropout Voltage vs. Output Current

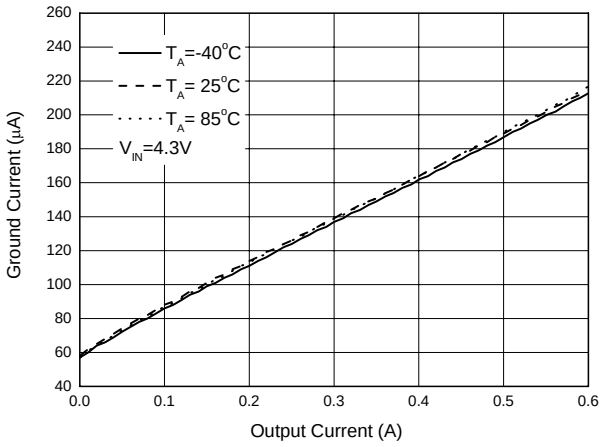


Figure 15. Ground Current vs. Output Current

Typical Performance Characteristics (Continued)

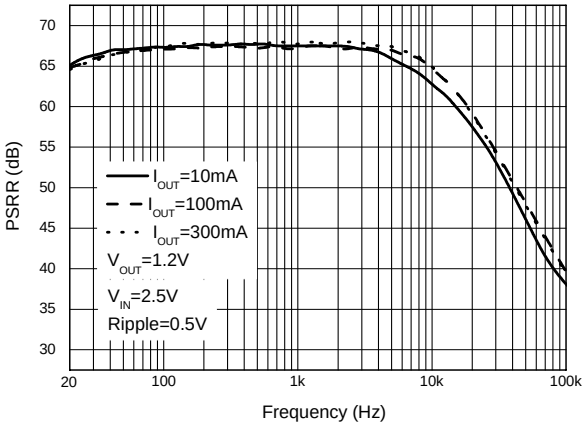


Figure 16. PSRR vs. Frequency

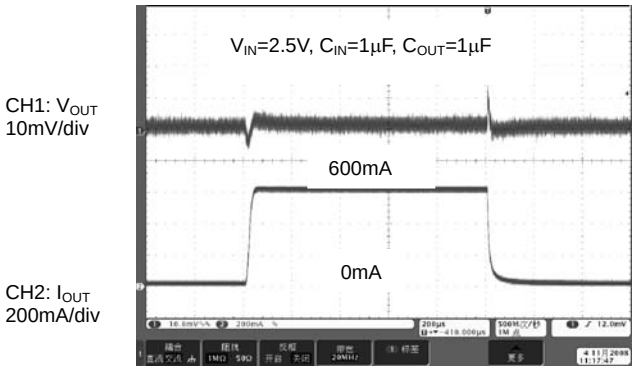


Figure 17. Load Transient

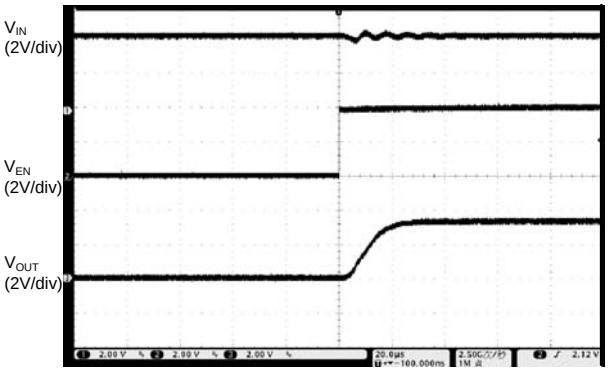


Figure 18. Enable On

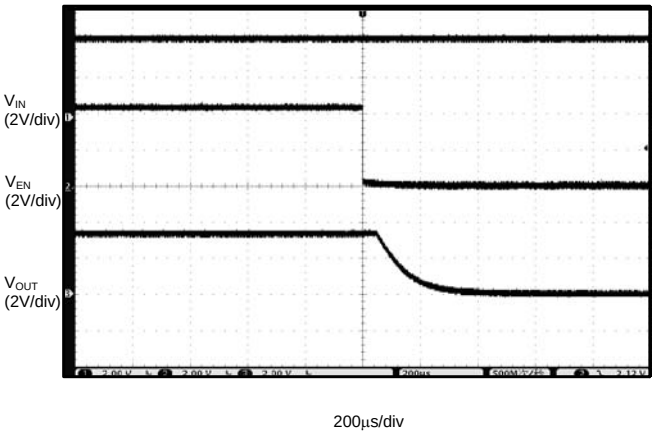
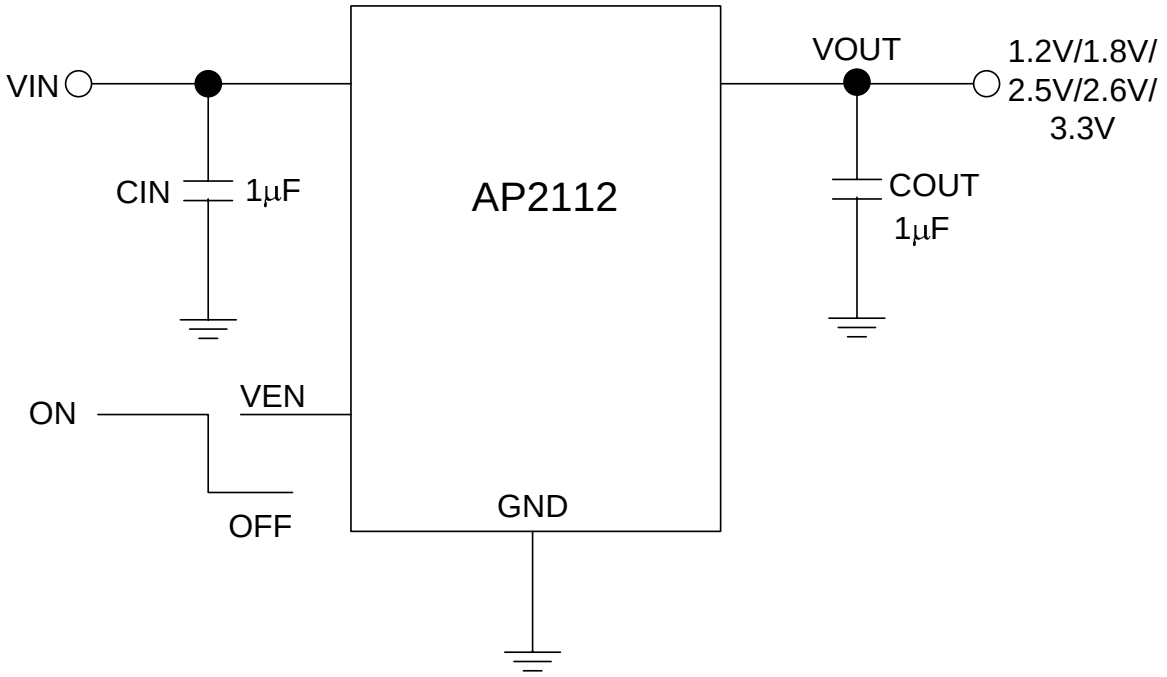


Figure 19. Enable Off

Typical Application (Note 4)

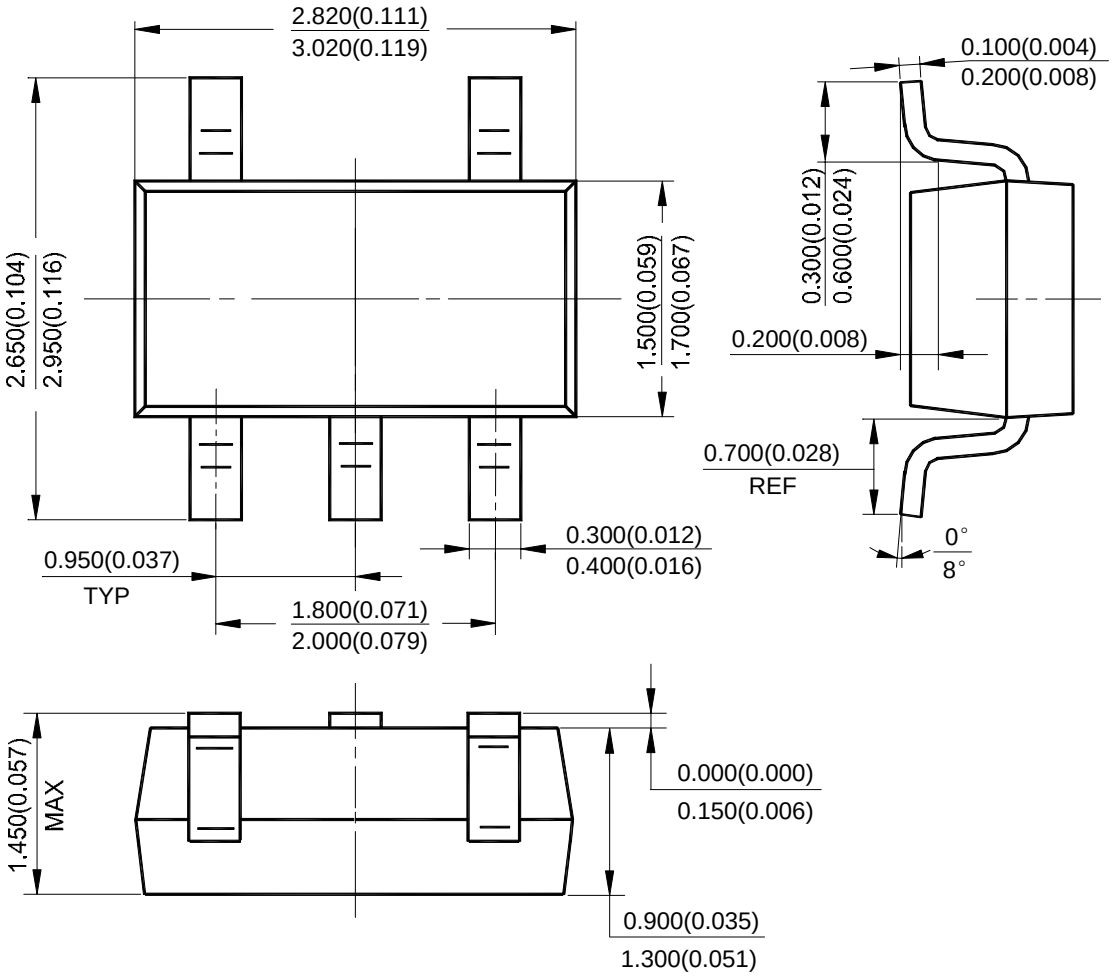


Note 4: It is recommended to use X7R or X5R dielectric capacitor if 1.0μF ceramic capacitor is selected as input/output capacitors.

Figure 20. AP2112 Typical Application

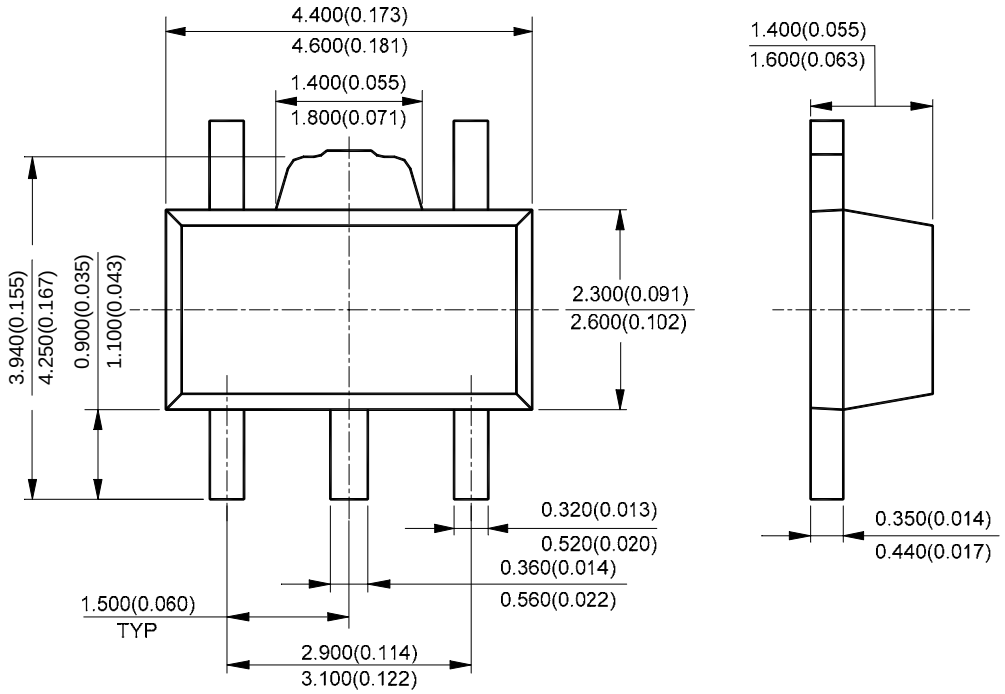
Mechanical Dimensions

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



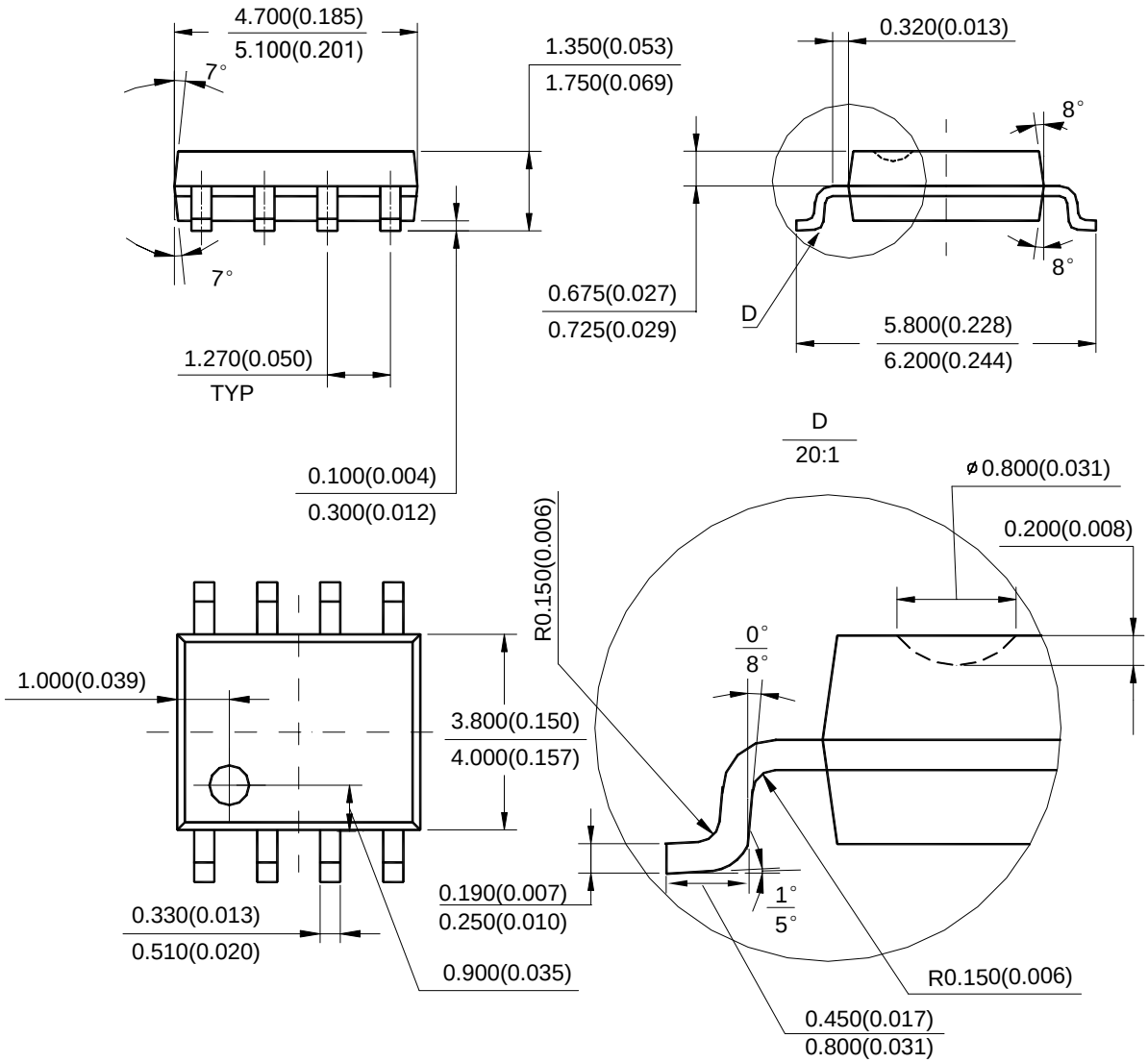
Mechanical Dimensions (Continued)

SOT-89-5 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

SOIC-8 **Unit: mm(inch)**



Note: Eject hole, oriented hole and mold mark is optional.

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