HIGH SPEED, EXTREMELY LOW NOISE LDO REGULATOR AP2121

General Description

The AP2121 series are positive voltage regulator ICs fabricated by CMOS process. Each of these ICs consists of a voltage reference, an error amplifier, a resistor network for setting output voltage, a current limit circuit for current protection and a chip enable circuit (5-pin products only).

The AP2121 series feature high ripple rejection, low dropout voltage, low noise, high output voltage accuracy, and low current consumption which make them ideal for use in various battery-powered devices.

The AP2121 series have 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.2V and 3.3V versions.

The AP2121 are available in standard SOT-23-3 and SOT-23-5 packages.

Features

- Low Dropout Voltage at I_{OUT}=100mA: 150mV Typical (Except 1.5V Version)
- Low Standby Current: 0.1μA Typical
- Low Quiescent Current: 25μA Typical
- High Ripple Rejection: 70dB Typical（f=10kHz）
- Maximum Output Current: More Than 150mA (300mA Limit)
- Extremely Low Noise: 30μVrms (10Hz to 100kHz)
- Excellent Line Regulation: 4mV Typical
- Excellent Load Regulation: 12mV Typical
- High Output Voltage Accuracy: ±2%
- Excellent Line Transient Response and Load Transient Response
- Compatible with Low ESR Ceramic Capacitor (as Low as 1μF)

Applications

- Mobile Phones, Cordless Phones
- Wireless Communication Equipment
- Portable Games
- Cameras, Video Recorders
- Sub-board Power Supplies for Telecom Equipment
- Battery Powered Equipment

SOT-23-3

SOT-23-5

Figure 1. Package Types of AP2121

Pin Configuration

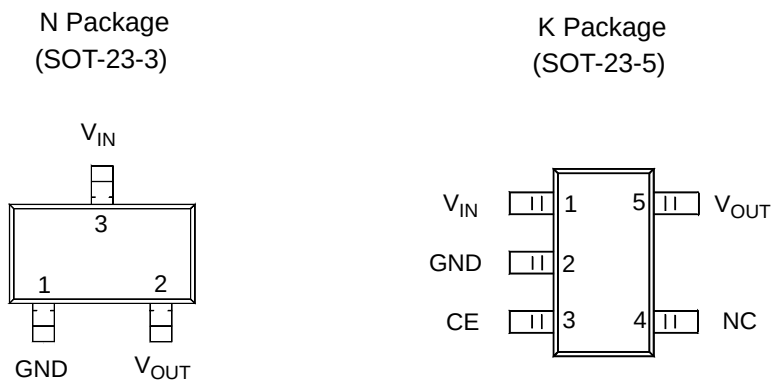
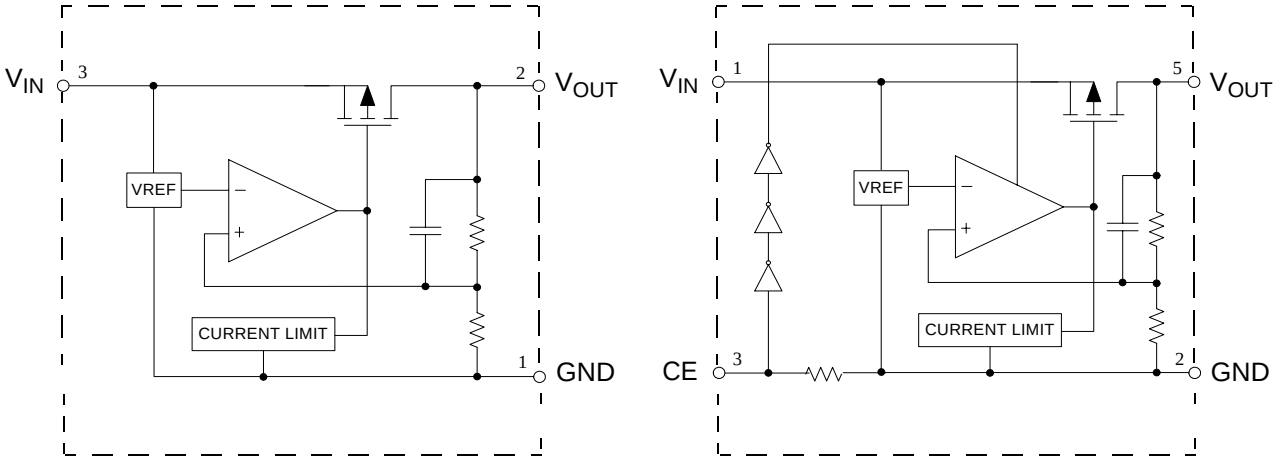


Figure 2. Pin Configuration of AP2121 (Top View)

Pin Description

Pin Number		Pin Name	Function
SOT-23-3	SOT-23-5		
3	1	V_{IN}	Input voltage
1	2	GND	Ground
	3	CE	Active high enable input pin. Logic high=enable, logic low=shutdown
	4	NC	No connection
2	5	V_{OUT}	Regulated output voltage

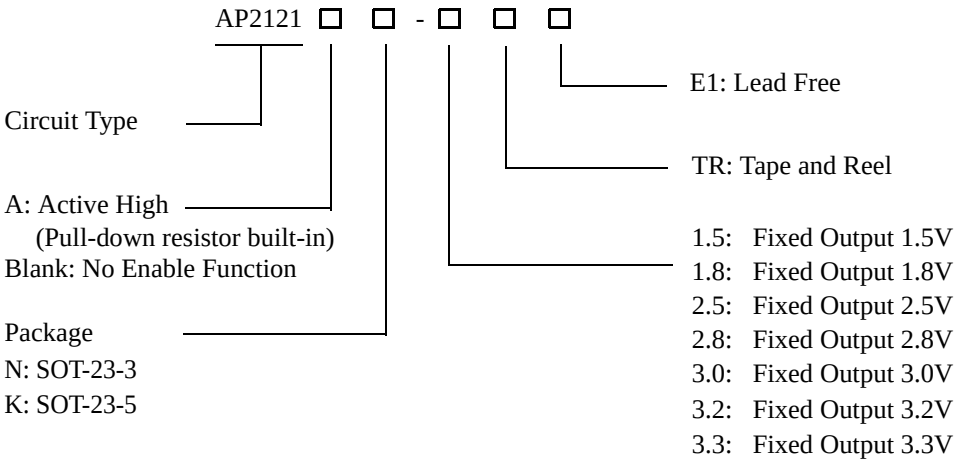
Functional Block Diagram



SOT-23-3 SOT-23-5

Figure 3. Functional Block Diagram of AP2121

Ordering Information



Package	Temperature Range	Condition	Part Number	Marking ID	Packing Type
SOT-23-3	-40 to 85°C		AP2121N-1.5TRE1	EF1	Tape & Reel
			AP2121N-1.8TRE1	EF3	Tape & Reel
			AP2121N-2.5TRE1	EF4	Tape & Reel
			AP2121N-2.8TRE1	EF5	Tape & Reel
			AP2121N-3.0TRE1	EF6	Tape & Reel
			AP2121N-3.2TRE1	EF7	Tape & Reel
			AP2121N-3.3TRE1	EF8	Tape & Reel
SOT-23-5	-40 to 85°C	Active High (Pull-down resistor built-in)	AP2121AK-1.5TRE1	E1Z	Tape & Reel
		Active High (Pull-down resistor built-in)	AP2121AK-1.8TRE1	E1U	Tape & Reel
		Active High (Pull-down resistor built-in)	AP2121AK-2.5TRE1	E1V	Tape & Reel
		Active High (Pull-down resistor built-in)	AP2121AK-2.8TRE1	E1W	Tape & Reel
		Active High (Pull-down resistor built-in)	AP2121AK-3.0TRE1	E1X	Tape & Reel
		Active High (Pull-down resistor built-in)	AP2121AK-3.2TRE1	E3Z	Tape & Reel
		Active High (Pull-down resistor built-in)	AP2121AK-3.3TRE1	E1Y	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value		Unit
Input Voltage	V_{IN}	6.5		V
Enable Input Voltage	V_{CE}	-0.3 to V_{IN}+0.3		V
Output Current	I_{OUT}	300		mA
Junction Temperature	T_J	150		^oC
Storage Temperature Range	T_{STG}	-65 to 150		^oC
Lead Temperature (Soldering, 10sec)	T_{LEAD}	260		^oC
Thermal Resistance (Note 2)	θ_{JA}	SOT-23-3	250	$^oC/W$
		SOT-23-5	250	
ESD (Human Body Model)	ESD	2000		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.

Note 2: Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its operating ratings. The maximum allowable power dissipation is a function of the maximum junction temperature, $T_{J(max)}$, the junction-to-ambient thermal resistance, θ_{JA}, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D(max)}=(T_{J(max)} - T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_{IN}	2	6	V
Operating Junction Temperature Range	T_J	-40	85	^oC

Electrical Characteristics

AP2121-1.5 Electrical Characteristics

(V_{IN}=2.5V, T_J=25°C, C_{IN}=1μF, C_{OUT}=1μF, **Bold** typeface applies over -40°C≤T_J≤85°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=2.5V 1mA≤I_{OUT}≤30mA	1.47	1.5	1.53	V
Input Voltage	V_{IN}				6	V
Output Current	I_{OUT}	V_{IN}-V_{OUT}=1V	150			mA
Load Regulation	V_{RLOAD}	V_{IN}=2.5V 1mA≤I_{OUT}≤80mA		12	40	mV
Line Regulation	V_{RLINE}	2.3V≤V_{IN}≤6V I_{OUT}=30mA		4	16	mV
Dropout Voltage	V_{DROP}	I_{OUT}=10mA		400	600	mV
		I_{OUT}=100mA		400	600	
		I_{OUT}=150mA		400	600	
Quiescent Current	I_Q	V_{IN}=2.5V, I_{OUT}=0mA		25	50	μA
Standby Current	I_{STD}	V_{IN}=2.5V V_{CE} in OFF mode		0.1	1	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=10kHz V_{IN}=2.5V		70		dB
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=30mA		**±150**		μV/°C
	$(\Delta V_{OUT}/V_{OUT})/\Delta T$			**±100**		ppm/°C
Short Current Limit	I_{LIMIT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	T_A=25°C 10Hz ≤f≤100kHz		30		μVrms
CE "High" Voltage		CE input voltage "High"	1.5			V
CE "Low" Voltage		CE input voltage "Low"			0.25	V
CE Pull-down Resistance	R_{PD}		2.5	5	10	MΩ

Electrical Characteristics (Continued)

AP2121-1.8 Electrical Characteristics

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=2.8V 1mA≤I_{OUT}≤30mA	1.764	1.8	1.836	V
Input Voltage	V_{IN}				6	V
Output Current	I_{OUT}	V_{IN}-V_{OUT}=1V	150			mA
Load Regulation	V_{RLOAD}	V_{IN}=2.8V 1mA≤I_{OUT}≤80mA		12	40	mV
Line Regulation	V_{RLINE}	2.3V≤V_{IN}≤6V I_{OUT}=30mA		4	16	mV
Dropout Voltage	V_{DROP}	I_{OUT}=10mA		20	40	mV
		I_{OUT}=100mA		150	300	
		I_{OUT}=150mA		200	400	
Quiescent Current	I_Q	V_{IN}=2.8V, I_{OUT}=0mA		25	50	μA
Standby Current	I_{STD}	V_{IN}=2.8V V_{CE} in OFF mode		0.1	1	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=10kHz V_{IN}=2.8V		70		dB
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=30mA		**±180**		μV/°C
	$(\Delta V_{OUT}/V_{OUT})/\Delta T$			**±100**		ppm/°C
Short Current Limit	I_{LIMIT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	T_A=25°C 10Hz ≤f≤100kHz		30		μVrms
CE "High" Voltage		CE input voltage "High"	1.5			V
CE "Low" Voltage		CE input voltage "Low"			0.25	V
CE Pull-down Resistance	R_{PD}		2.5	5	10	MΩ

Electrical Characteristics (Continued)

AP2121-2.5 Electrical Characteristics

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=3.5V 1mA≤I_{OUT}≤30mA	2.45	2.5	2.55	V
Input Voltage	V_{IN}				6	V
Output Current	I_{OUT}	V_{IN}-V_{OUT}=1V	150			mA
Load Regulation	V_{RLOAD}	V_{IN}=3.5V 1mA≤I_{OUT}≤80mA		12	40	mV
Line Regulation	V_{RLINE}	3V≤V_{IN}≤6V I_{OUT}=30mA		4	16	mV
Dropout Voltage	V_{DROP}	I_{OUT}=10mA		20	40	mV
		I_{OUT}=100mA		150	300	
		I_{OUT}=150mA		200	400	
Quiescent Current	I_Q	V_{IN}=3.5V, I_{OUT}=0mA		25	50	μA
Standby Current	I_{STD}	V_{IN}=3.5V V_{CE} in OFF mode		0.1	1	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=10kHz V_{IN}=3.5V		70		dB
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=30mA		**±250**		μV/°C
	$(\Delta V_{OUT}/V_{OUT})/\Delta T$			**±100**		ppm/°C
Short Current Limit	I_{LIMIT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	T_A=25°C 10Hz ≤f≤100kHz		30		μVrms
CE "High" Voltage		CE input voltage "High"	1.5			V
CE "Low" Voltage		CE input voltage "Low"			0.25	V
CE Pull-down Resistance	R_{PD}		2.5	5	10	MΩ

Electrical Characteristics (Continued)

AP2121-2.8 Electrical Characteristics

(V_{IN}=3.8V, T_J=25°C, C_{IN}=1μF, C_{OUT}=1μF, **Bold** typeface applies over -40°C≤T_J≤85°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=3.8V 1mA≤I_{OUT}≤30mA	2.744	2.8	2.856	V
Input Voltage	V_{IN}				6	V
Output Current	I_{OUT}	V_{IN}-V_{OUT}=1V	150			mA
Load Regulation	V_{RLOAD}	V_{IN}=3.8V 1mA≤I_{OUT}≤80mA		12	40	mV
Line Regulation	V_{RLINE}	3.3V≤V_{IN}≤6V I_{OUT}=30mA		4	16	mV
Dropout Voltage	V_{DROP}	I_{OUT}=10mA		20	40	mV
		I_{OUT}=100mA		150	300	
		I_{OUT}=150mA		200	400	
Quiescent Current	I_Q	V_{IN}=3.8V, I_{OUT}=0mA		25	50	μA
Standby Current	I_{STD}	V_{IN}=3.8V V_{CE} in OFF mode		0.1	1	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=10kHz V_{IN}=3.8V		70		dB
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=30mA		**±280**		μV/°C
	$(\Delta V_{OUT}/V_{OUT})/\Delta T$			**±100**		ppm/°C
Short Current Limit	I_{LIMIT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	T_A=25°C 10Hz ≤f≤100kHz		30		μVrms
CE "High" Voltage		CE input voltage "High"	1.5			V
CE "Low" Voltage		CE input voltage "Low"			0.25	V
CE Pull-down Resistance	R_{PD}		2.5	5	10	MΩ

Electrical Characteristics (Continued)

AP2121-3.0 Electrical Characteristics

(V_{IN}=4V, T_J=25°C, C_{IN}=1μF, C_{OUT}=1μF, **Bold** typeface applies over -40°C≤T_J≤85°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=4V 1mA≤I_{OUT}≤30mA	2.94	3.0	3.06	V
Input Voltage	V_{IN}				6	V
Output Current	I_{OUT}	V_{IN}-V_{OUT}=1V	150			mA
Load Regulation	V_{RLOAD}	V_{IN}=4V 1mA≤I_{OUT}≤80mA		12	40	mV
Line Regulation	V_{RLINE}	3.5V≤V_{IN}≤6V I_{OUT}=30mA		4	16	mV
Dropout Voltage	V_{DROP}	I_{OUT}=10mA		20	40	mV
		I_{OUT}=100mA		150	300	
		I_{OUT}=150mA		200	400	
Quiescent Current	I_Q	V_{IN}=4V, I_{OUT}=0mA		25	50	μA
Standby Current	I_{STD}	V_{IN}=4V V_{CE} in OFF mode		0.1	1	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=10kHz V_{IN}=4V		70		dB
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=30mA		**±300**		μV/°C
	$(\Delta V_{OUT}/V_{OUT})/\Delta T$			**±100**		ppm/°C
Short Current Limit	I_{LIMIT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	T_A=25°C 10Hz ≤f≤100kHz		30		μVrms
CE "High" Voltage		CE input voltage "High"	1.5			V
CE "Low" Voltage		CE input voltage "Low"			0.25	V
CE Pull-down Resistance	R_{PD}		2.5	5	10	MΩ

Electrical Characteristics (Continued)

AP2121-3.2 Electrical Characteristics

(V_{IN}=4.2V, T_J=25°C, C_{IN}=1μF, C_{OUT}=1μF, **Bold** typeface applies over -40°C≤T_J≤85°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=4.2V 1mA≤I_{OUT}≤30mA	3.136	3.2	3.264	V
Input Voltage	V_{IN}				6	V
Output Current	I_{OUT}	V_{IN}-V_{OUT}=1V	150			mA
Load Regulation	V_{RLOAD}	V_{IN}=4.2V 1mA≤ I_{OUT}≤ 80mA		12	40	mV
Line Regulation	V_{RLINE}	3.7V≤V_{IN}≤6V I_{OUT}=30mA		4	16	mV
Dropout Voltage	V_{DROP}	I_{OUT}=10mA		20	40	mV
		I_{OUT}=100mA		150	300	
		I_{OUT}=150mA		200	400	
Quiescent Current	I_Q	V_{IN}=4.2V, I_{OUT}=0mA		25	50	μA
Standby Current	I_{STD}	V_{IN}=4.2V V_{CE} in OFF mode		0.1	1	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=10kHz V_{IN}=4.2V		70		dB
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=30mA		**±320**		μV/°C
	$(\Delta V_{OUT}/V_{OUT})/\Delta T$			**±100**		ppm/°C
Short Current Limit	I_{LIMIT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	T_A=25°C 10Hz ≤f≤100kHz		30		μVrms
CE "High" Voltage		CE input voltage "High"	1.5			V
CE "Low" Voltage		CE input voltage "Low"			0.25	V
CE Pull-down Resistance	R_{PD}		2.5	5	10	MΩ

Electrical Characteristics (Continued)

AP2121-3.3 Electrical Characteristics

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_{OUT}	V_{IN}=4.3V 1mA≤I_{OUT}≤30mA	3.234	3.3	3.366	V
Input Voltage	V_{IN}				6	V
Output Current	I_{OUT}	V_{IN}-V_{OUT}=1V	150			mA
Load Regulation	V_{RLOAD}	V_{IN}=4.3V 1mA≤ I_{OUT}≤ 80mA		12	40	mV
Line Regulation	V_{RLINE}	3.8V≤V_{IN}≤6V I_{OUT}=30mA		4	16	mV
Dropout Voltage	V_{DROP}	I_{OUT}=10mA		20	40	mV
		I_{OUT}=100mA		150	300	
		I_{OUT}=150mA		200	400	
Quiescent Current	I_Q	V_{IN}=4.3V, I_{OUT}=0mA		25	50	μA
Standby Current	I_{STD}	V_{IN}=4.3V V_{CE} in OFF mode		0.1	1	μA
Power Supply Rejection Ratio	PSRR	Ripple 0.5Vp-p, f=10kHz V_{IN}=4.3V		70		dB
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=30mA		**±330**		μV/°C
	$(\Delta V_{OUT}/V_{OUT})/\Delta T$			**±100**		ppm/°C
Short Current Limit	I_{LIMIT}	V_{OUT}=0V		50		mA
RMS Output Noise	V_{NOISE}	T_A=25°C 10Hz ≤f≤100kHz		30		μVrms
CE "High" Voltage		CE input voltage "High"	1.5			V
CE "Low" Voltage		CE input voltage "Low"			0.25	V
CE Pull-down Resistance	R_{PD}		2.5	5	10	MΩ

Typical Performance Characteristics

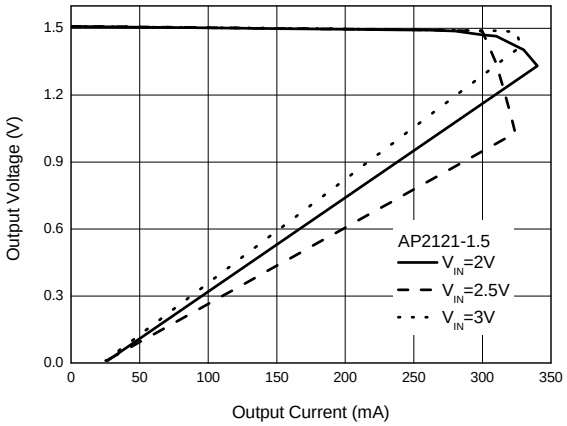


Figure 4. Output Voltage vs. Output Current

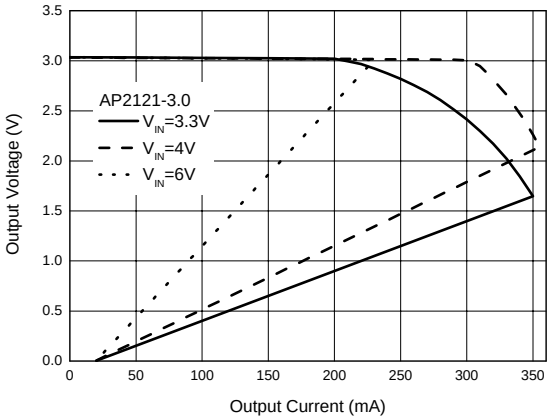


Figure 5. Output Voltage vs. Output Current

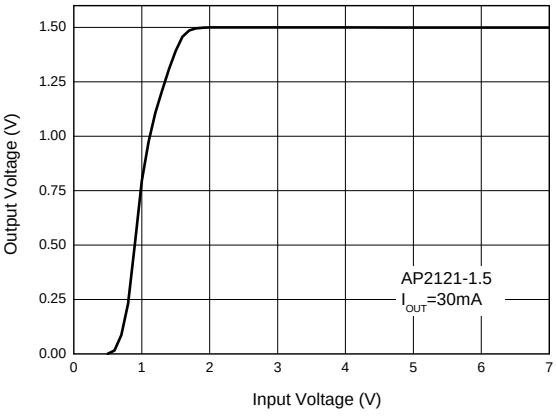


Figure 6. Output Voltage vs. Input Voltage

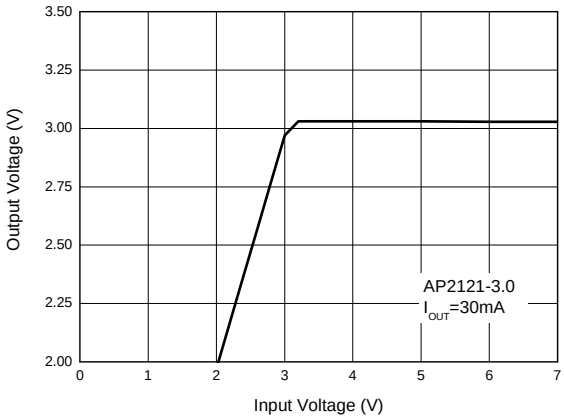


Figure 7. Output Voltage vs. Input Voltage

Typical Performance Characteristics (Continued)

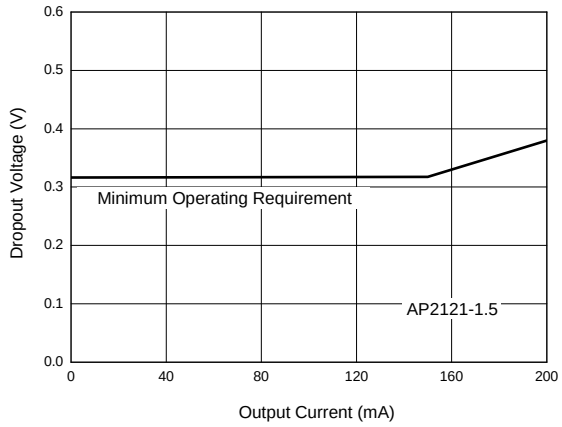


Figure 8. Dropout Voltage vs. Output Current

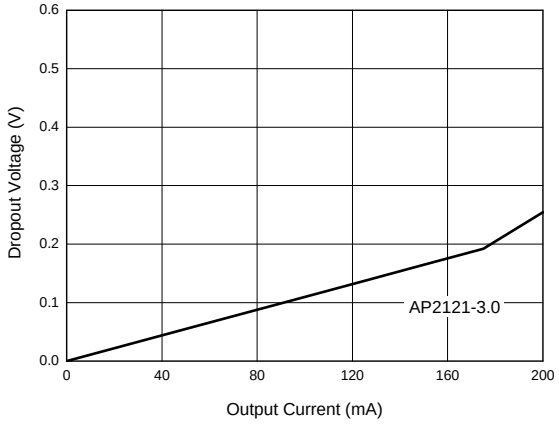


Figure 9. Dropout Voltage vs. Output Current

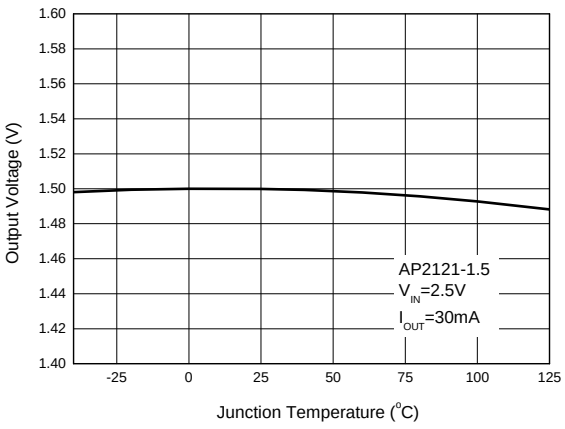


Figure 10. Output Voltage vs. Junction Temperature

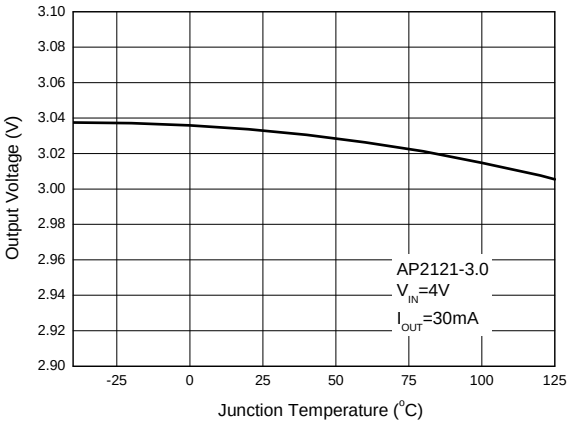


Figure 11. Output Voltage vs. Junction Temperature

Typical Performance Characteristics (Continued)

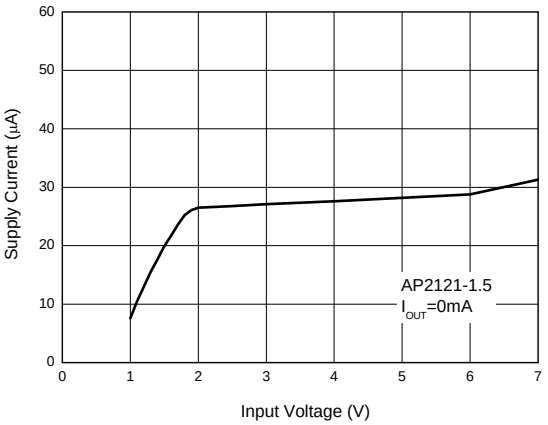


Figure 12. Supply Current vs. Input Voltage

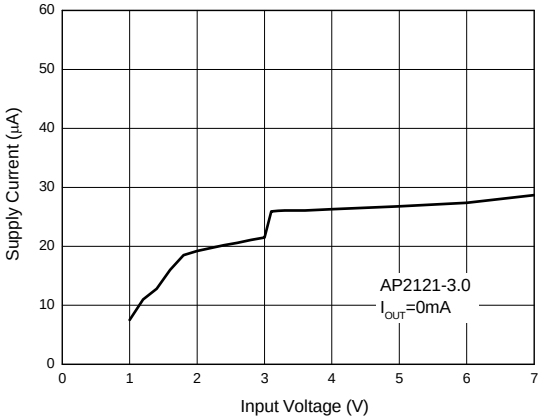


Figure 13. Supply Current vs. Input Voltage

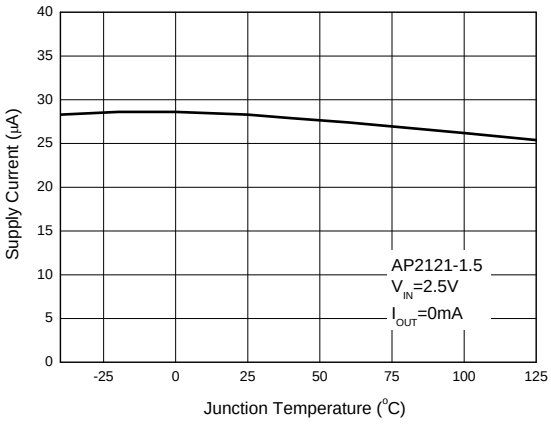


Figure 14. Supply Current vs. Junction Temperature

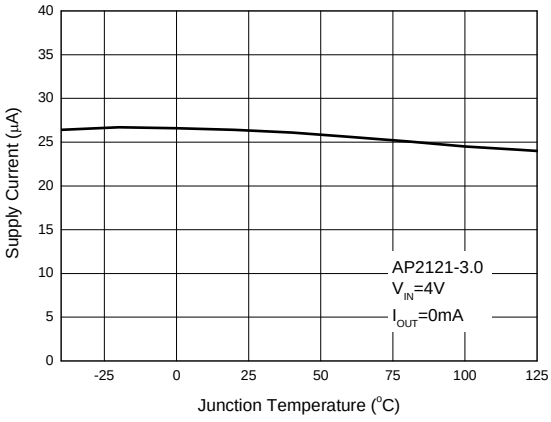


Figure 15. Supply Current vs. Junction Temperature

Typical Performance Characteristics (Continued)

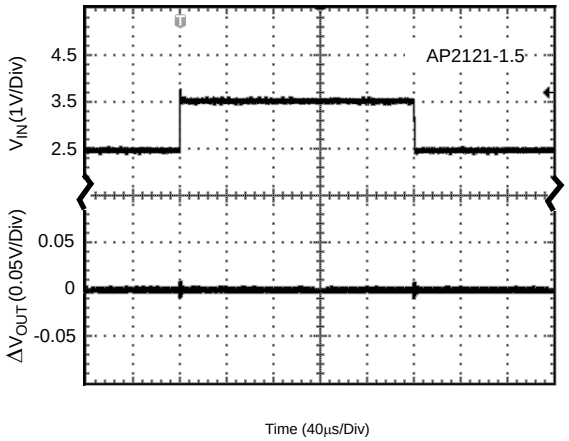


Figure 16. Line Transient
(Conditions: I_{OUT}=30mA, C_{IN}=1μF, C_{OUT}=1μF)

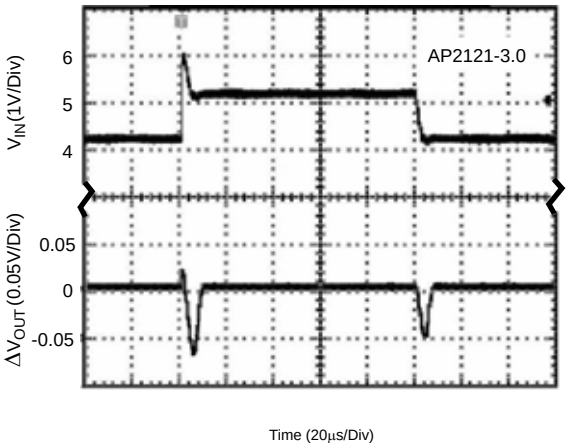


Figure 17. Line Transient
(Conditions: I_{OUT}=30mA, C_{IN}=1μF, C_{OUT}=1μF)

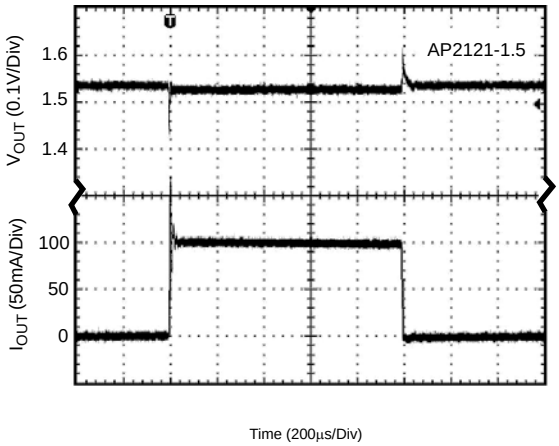


Figure 18. Load Transient
(Conditions: V_{IN}=2.5V, C_{IN}=1μF, C_{OUT}=1μF)

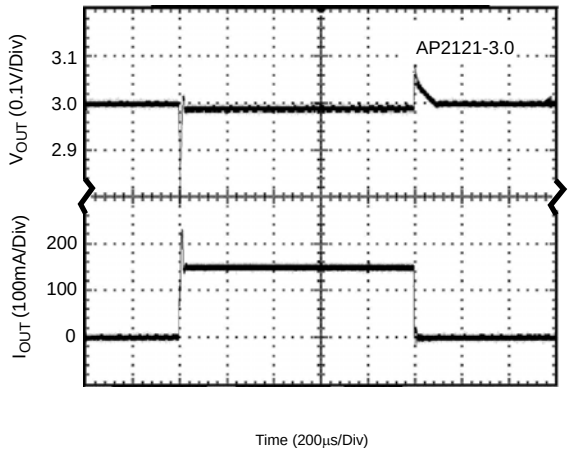


Figure 19. Load Transient
(Conditions: V_{IN}=4V, C_{IN}=1μF, C_{OUT}=1μF)

Typical Performance Characteristics (Continued)

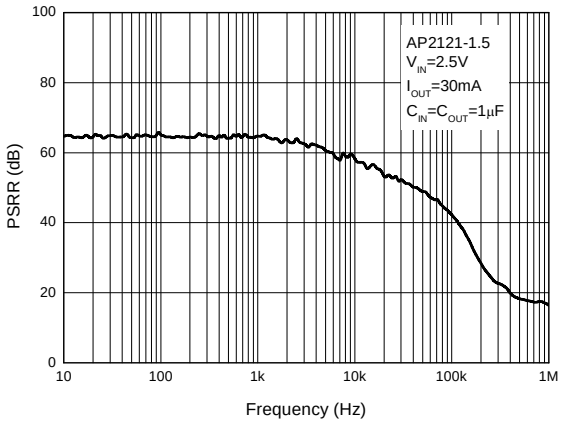


Figure 20. PSRR vs. Frequency

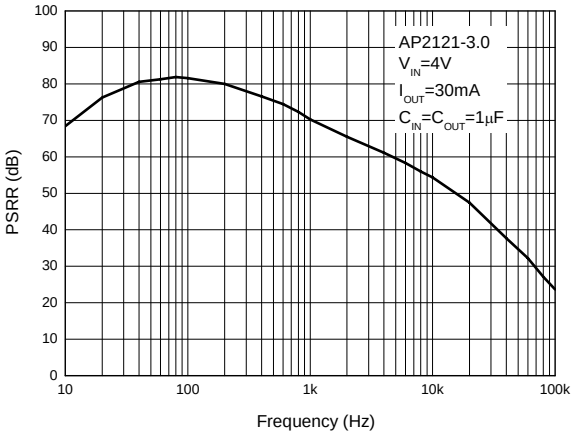
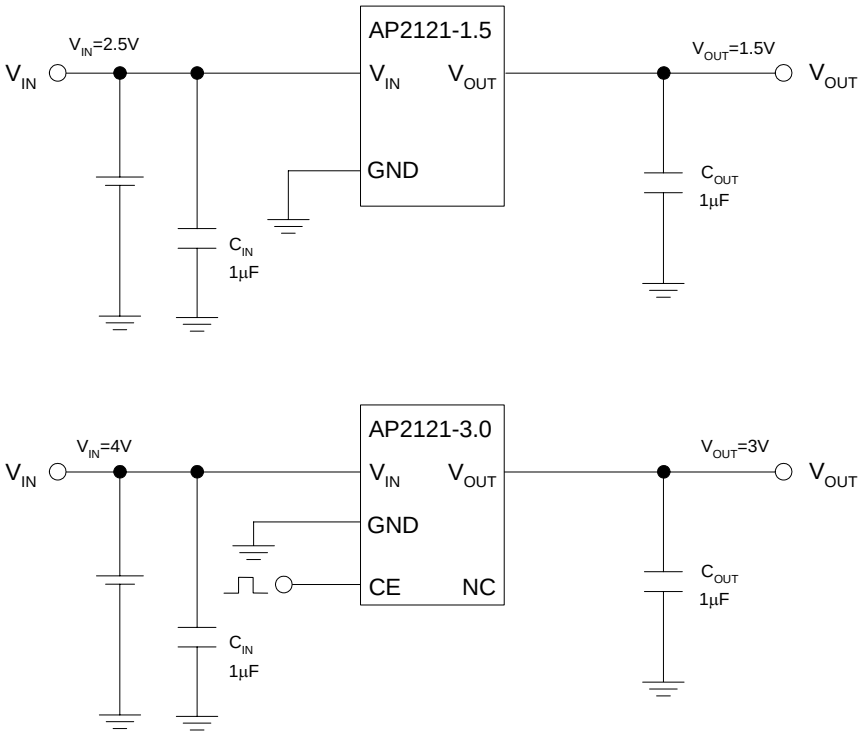


Figure 21. PSRR vs. Frequency

Typical Application

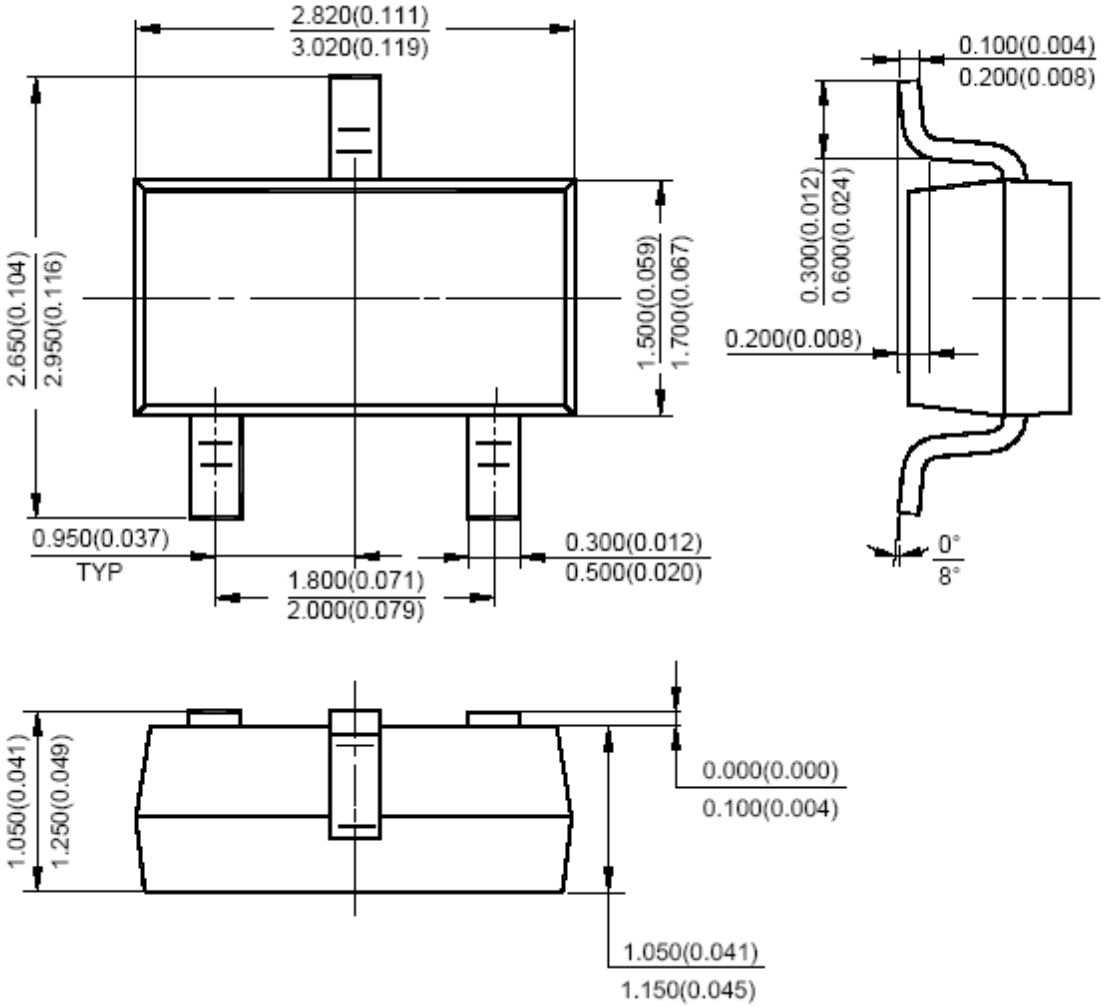


Note: Filter capacitors are required at the AP2121's input and output. 1μF capacitor is required at the input. The minimum output capacitance required for stability should be more than 1μF with ESR from 0.01Ω to 100Ω. Ceramic capacitors are recommended.

Figure 22. Typical Application of AP2121

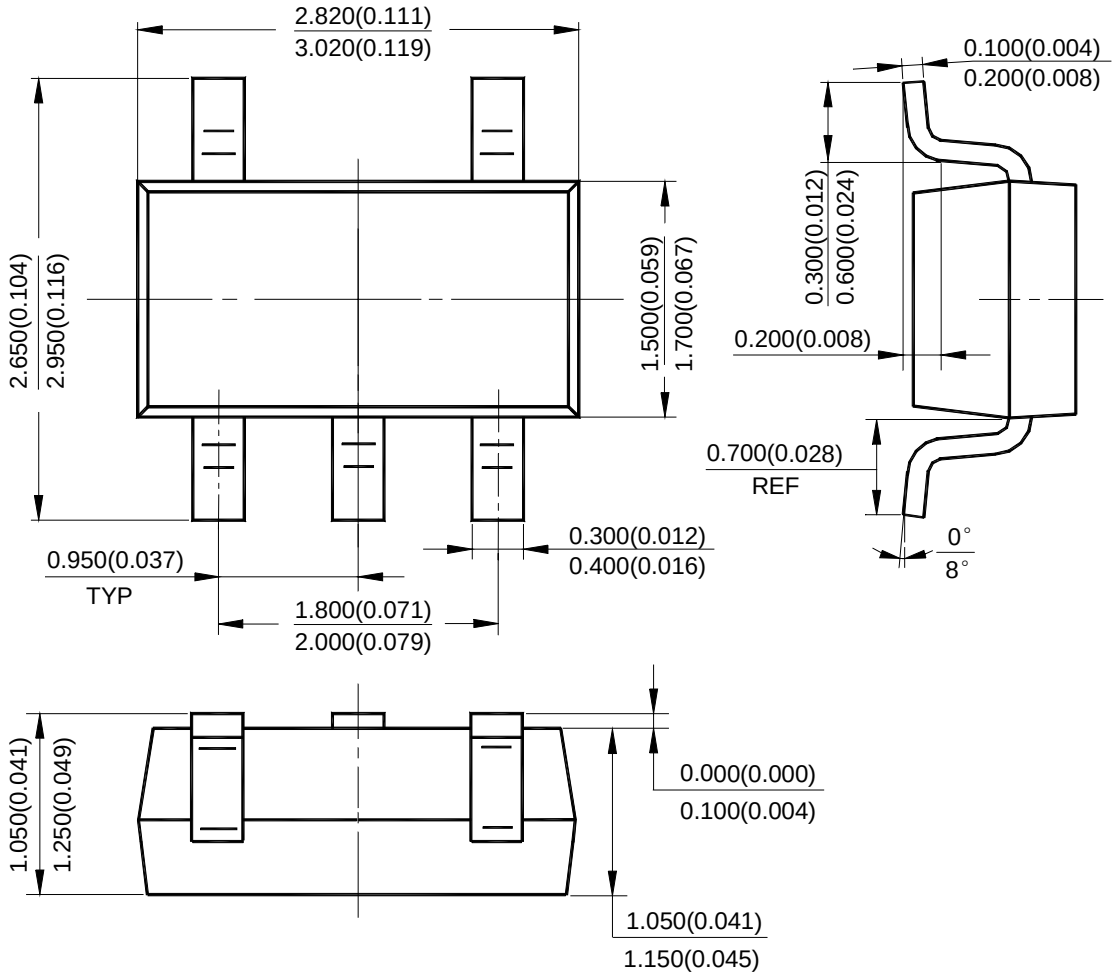
Mechanical Dimensions

SOT-23-3 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

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



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