DESCRIPTION

The A6110 is a low-dropout regulator that operates the input voltage from 2.5V to 6V and delivers 1 A load current. The A6110 is available in fixed output voltage. The output voltage of the fixed types is preset at an internally trimmed voltage 1V, 1.2V, 1.3V, 1.5V, 1.8V, 2.5V, 2.7V, 2.8V, 2.85V, 3.0V, 3.2V, 3.3V, 5V or can be made with options of the output range from 1V to 5V in 50mV increments.

The A6110 consists of a voltage reference unit, an error amplifier, resistor net for setting output voltage, a current limit circuit for over-current and a thermal-shutdown circuit.

The A6110 is available in TO252-3 and SOT223-3 packages.

ORERING INFORMATION

Package Type	Part Number	
TO252-3 SPQ: 2,500pcs/Reel	D	A6110DR-XXZ
		A6110DVR-XXZ
SOT223-3 SPQ: 2,500pcs/Reel	N	A6110NR-XXZ
		A6110NVR-XXZ
Note	XX: Output Voltage 25=2.5V, 33=3.3V Z: Package Type see pin description V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

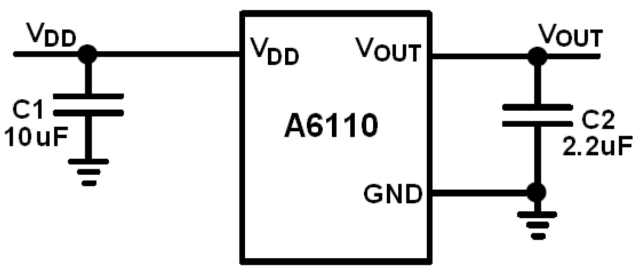
FEATURES

- Up to 1A Output Current
- 70uA Operating Supply Current
- Excellent Line Regulation: 0.05%/V
- Low Dropout: 350mV@1A(V_{OUT}=3.3V)
- High Power Supply Rejection Ratio
- Wide Operating Voltage Range: 2.5V to 6.0V
- 1V to 5V Factory-Preset Output
- High Accuracy:±2%
- Built-in Auto Discharge Function
- 500mA in-rush Current Limit
- Fold-back Current Limit Protection
- Thermal Shutdown Protection
- Available in TO252-3 and SOT223-3 packages.

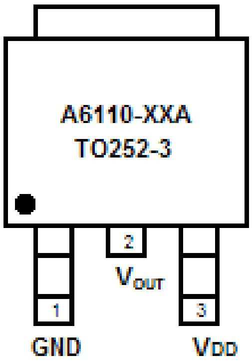
APPLICATION

- Portable Communication Equipment
- Battery-Powered Equipment
- Laptop, Palmtops, Notebook Computers
- Hand-Held Instruments
- PCMCIA Cards and Wireless LAN
- Cameras & VCRs

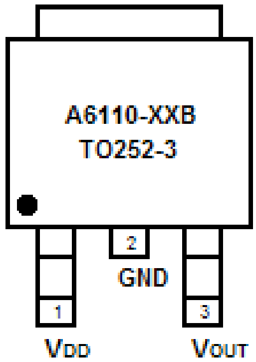
TYPICAL APPLICATION



PIN DESCRIPTION

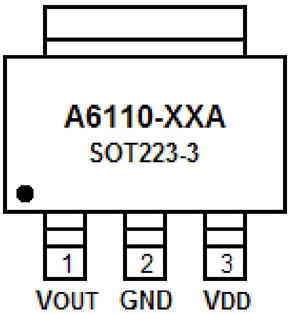


Top View

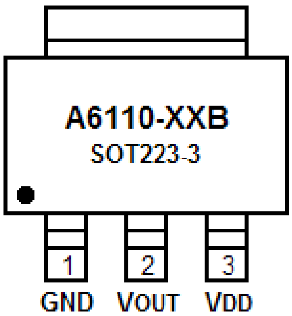


Top View

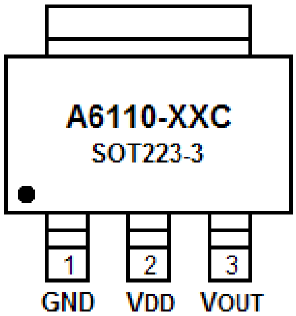
Pin Number		Symbol	Functions
TO252			
A	B		
1	2	GND	Ground Pin
2	3	V_{OUT}	Output Pin
3	1	V_{DD}	Input Pin



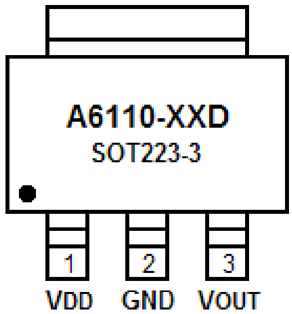
Top View



Top View



Top View



Top View

Pin Number				Symbol	Functions
SOT223-3					
A	B	C	D		
1	2	3	3	V_{OUT}	Output Pin
2	1	1	2	GND	Ground Pin
3	3	2	1	V_{DD}	Input Pin

ABSOLUTE MAXIMUM RATINGS

V_{DD}, Input Supply Voltage	-0.3V ~ +7V
Output Voltage	-0.3V~V_{IN}+0.3V
Output Current	1.4A
Maximum Junction Temperature	125°C
Operating Temperature Range NOTE1	-40°C~85°C
Storage Temperature Range	-65°C~125°C
Lead Temperature (Soldering, 10s)	300°C

Stresses above 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 in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

NOTE1: The A6110 is guaranteed to meet performance specifications from 0°C to 70°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

THERMAL RESISTANCE NOTE2

Package	θ_{JA}	θ_{JC}
TO252-3	90°C/W	10°C/W
SOT223-3	160°C/W	20°C/W

NOTE2: Thermal Resistance is specified with approximately 1 square of 1 oz copper.

ELECTRICAL CHARACTERISTICS NOTE3

V_{DD}= V_{OUT} +1V, and if V_{OUT} < 1.5V, V_{DD}=2.5V, C_{IN}=2.2μF, C_{OUT}=2.2μF, T_A=25°C, unless otherwise specified.

Parameter	Symbol	Conditions		Min	TYP	Max	Units
Input Voltage	V_{DD}			2.5	-	6	V
Output Voltage Accuracy	ΔV_{OUT}	I_{OUT} = 1mA		-2	-	+2	%
Current Limit	I_{LIM}			1.0	1.3	-	A
Short Circuit Current	I_{SCC}	V_{OUT} = 0		-	250	-	mA
Quiescent Current	I_Q	I_{OUT} = 0mA		-	70	120	μA
Dropout Voltage NOTE4	V_{DROP}	I_{OUT} = 300mA	1.2V	-	420	-	mV
			1.5V	-	260	-	
			1.8V	-	180	-	
			2.5V	-	140	-	
			3.3V	-	110	-	
			5.0V	-	100	-	
		I_{OUT} = 1A	1.2V	-	870	-	
			1.5V	-	700	-	
			1.8V	-	570	-	
			2.5V	-	440	-	
			3.3V	-	350	-	
			5.0V	-	340	-	
Line Regulation NOTE5	ΔV_{LINE}	2.5V ≤ V_{DD} ≤ 6V, I_{OUT} = 100mA	1.2V	-	0.05	0.5	%/V
			1.5V				
			1.8V				
		3.0V ≤ V_{DD} ≤ 6V, I_{OUT} = 100mA	2.5V				
		3.8V ≤ V_{DD} ≤ 6V, I_{OUT} = 100mA	3.3V				
		5.5V ≤ V_{DD} ≤ 6V, I_{OUT} = 100mA	5.0V				

Parameter		Symbol	Conditions	Min	TYP	Max	Units
Load Regulation NOTE6		ΔV_{LOAD}	1mA ≤ I_{OUT} ≤ 1A	-	20	-	mV
Output Voltage NOTE7 Temperature Coefficient		TC_{VOUT}	I_{OUT} = 100mA, -40°C ≤ T ≤ 85°C	-	±100	-	ppm/°C
Output Noise Voltage		e_{NO}	10Hz to100kHz, I_{OUT} = 1mA	-	45	-	uV_{RMS}
Power Supply Rejection Ratio	f = 1kHz (V_{OUT} ≤ 3.3V)	PSRR	$0.2V_{P-P}$ Ripple, I_{OUT} = 100mA	-	70	-	dB
	f = 1kHz (V_{OUT} > 3.3V)			-	60	-	
Thermal Shutdown Temperature		T_{SD}	Shutdown, Temp increasing	-	165	-	°C
Thermal Shutdown Hysteresis		T_{SDHY}		-	30	-	°C
Output Discharge Resistance		R_{DSC}		-	50	-	Ω

NOTE3: 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

NOTE4: The required minimum input operating voltage is equal to $V_{OUT} + V_{DROP}$, and if $V_{OUT} + V_{DROP}$ < 2.5V, the required minimum input operating voltage must be set to 2.5V. V_{OUT} is the normal output voltage, e.g. V_{OUT} = 2.8V for 2.8V fixed output version.

NOTE5: Line regulation is calculated by $\Delta V_{LINE} = [(V_{OUT1} - V_{OUT2})/ (\Delta V_{DD} \times V_{OUT})] \times 100$

Where V_{OUT1} is the output voltage when V_{DD1} = 6.0V, and V_{OUT2} is the output voltage when V_{DD2} = max (V_{OUT} + 0.5V, 2.5V).

$\Delta V_{DD} = V_{DD1} - V_{DD2}$.

NOTE6: Load regulation is calculated by $\Delta V_{LOAD} = V_{OUT1} - V_{OUT2}$

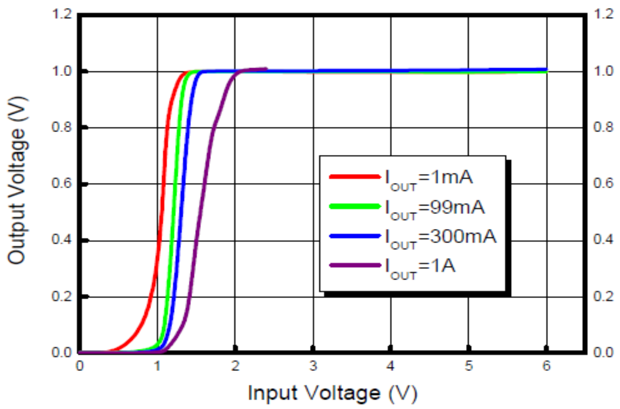
Where V_{OUT1} is the output voltage when I_{OUT1}=1mA, and V_{OUT2} is the output voltage when I_{OUT2} = 1.0A.

NOTE7: The temperature coefficient is calculated by $TC_{VOUT} = \Delta V_{OUT}/ (\Delta T \times V_{OUT})$

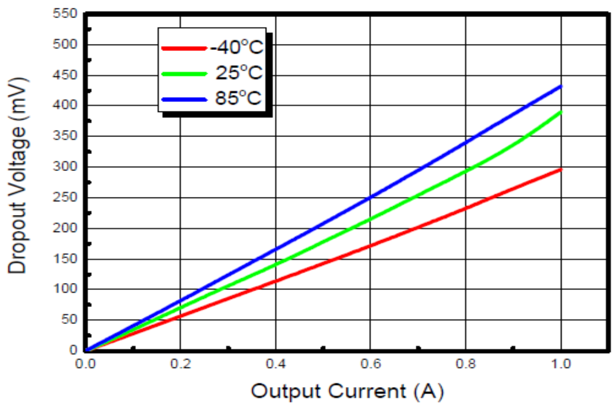
TYPICAL PERFORMANCE CHARACTERISTIC

$V_{DD} = V_{OUT} + 1V$, and if $V_{OUT} < 1.5V$, $V_{DD} = 2.5V$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 2.2\mu F$, $T_A = 25°C$, unless otherwise noted.

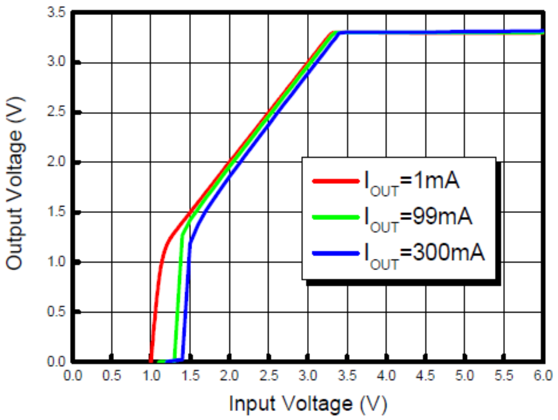
1. Output Voltage vs. Input Voltage (1.0V)



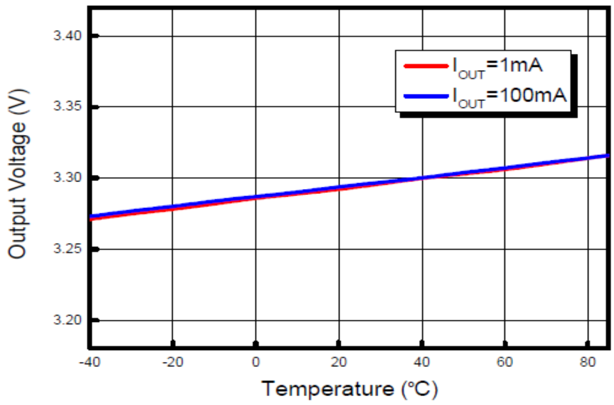
2. Dropout Voltage vs. Output Current (3.3V)



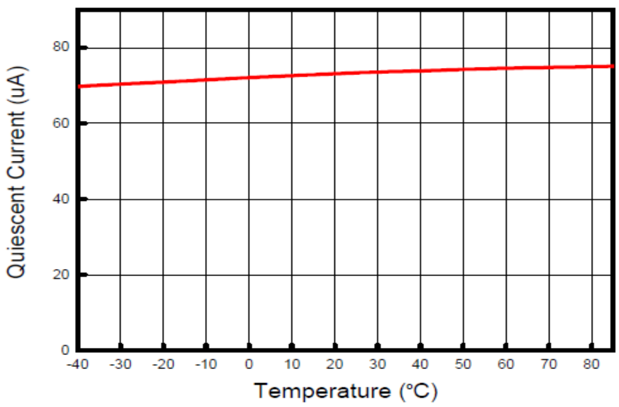
3. Output Voltage vs. Input Voltage (3.3V)



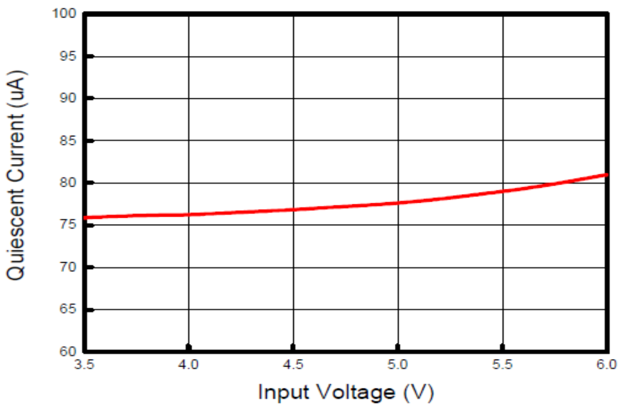
4. Output Voltage vs. Temperature (3.3V)



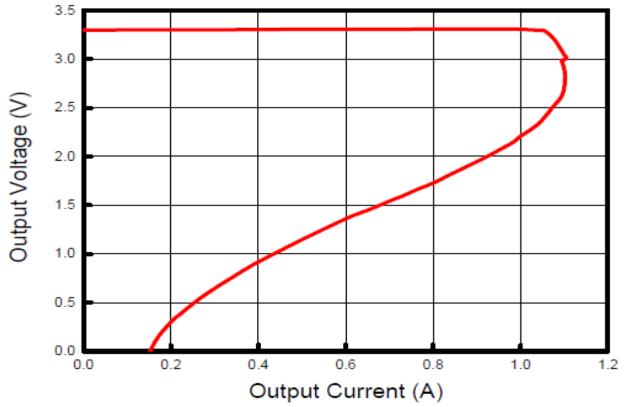
5. Quiescent Current vs. Temperature (3.3V)



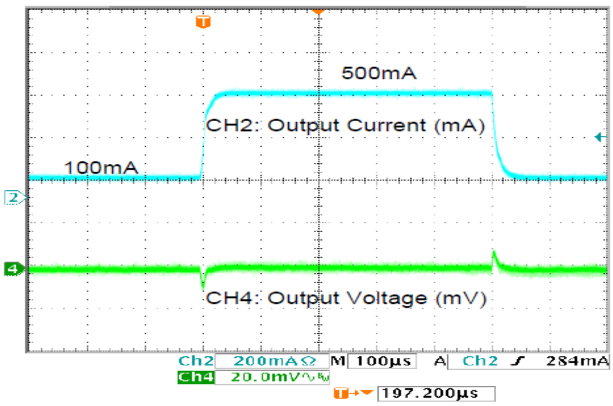
6. Quiescent Current vs. Input Voltage (3.3V)



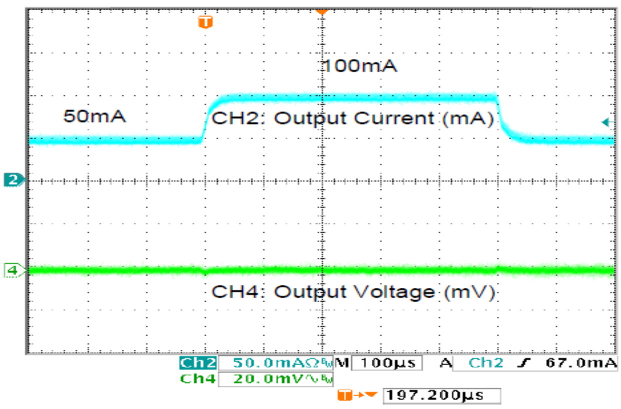
7. Output Voltage vs. Output Current (3.3V)



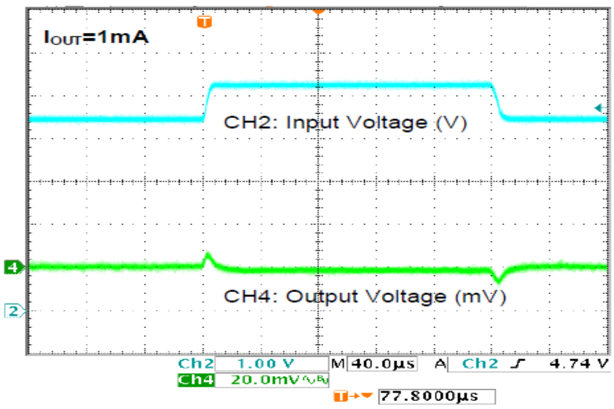
8. Load Transient Response (3.3V)



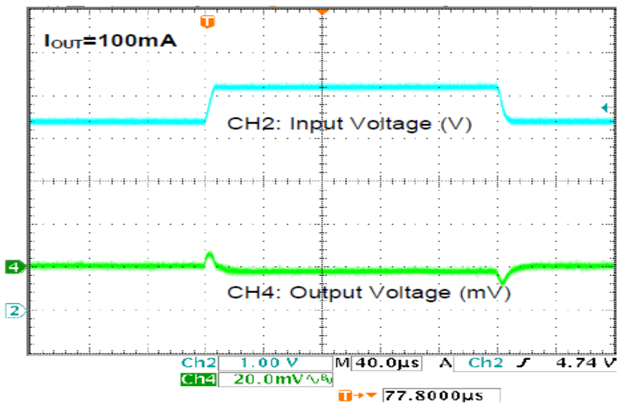
9. Load Transient Response (3.3V)



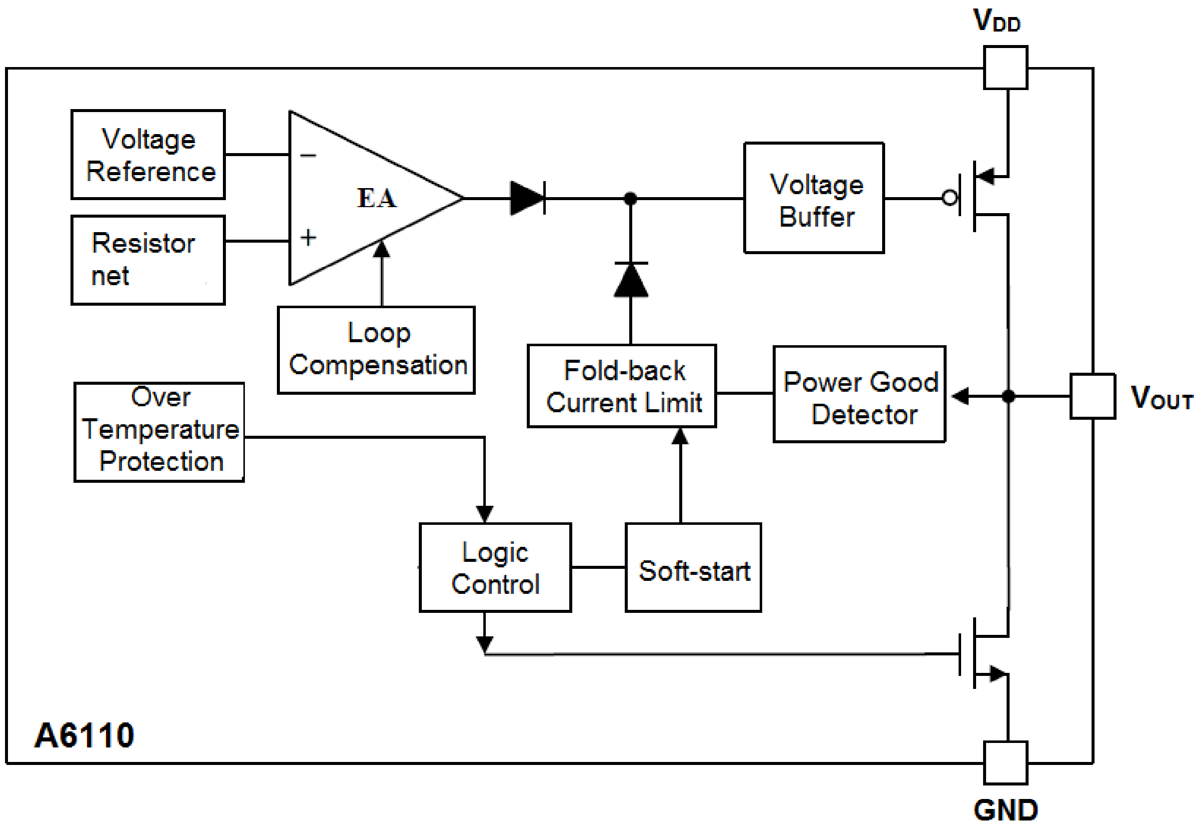
10. Line Transient Response (3.3V)



11. Line Transient Response (3.3V)



BLOCK DIAGRAM



DETAILED INFORMATION

The A6110 is a low dropout CMOS-based positive voltage regulator that operates the input voltage from +2.5V to 6.0V. Output voltages are optional ranging from 1.0V to 5.0V, and can supply current up to 1.0 A.

Thermal Protection

Thermal overload protection limits total power dissipation in the A6110. When the junction temperature exceeds T_J=165°C, the OTP circuit starts the thermal shutdown function and turns the pass element off allowing the IC to cool. The OTP circuit turns on the pass element again after IC's junction temperature cool by 30°C, result in a pulsed output during continuous thermal overload conditions. Thermal-overloaded protection is designed to protect the A6110 in the event of fault conditions. Do not exceed the absolute maximum junction temperature rating of T_J=125°C for continuous operation. The build-in fold-back current limit protection circuit will reduce current value as output voltage drops. When output is shorted to ground, current limit is reduced to 250mA, avoiding damaging the device.

Operating Region and Power Dissipation

The maximum power dissipation of A6110 depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The power dissipation across the device is

$$P_D = (V_{DD} - V_{OUT}) \times I_{OUT} + V_{DD} \times I_Q$$

The maximum power dissipation is

$$P_D\,(MAX) = (T_J\,(MAX) - T_A) / \theta_{JA}$$

Where T_J (MAX) is the maximum operation junction temperature 125°C, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. The GND pin of the A6110 performs the dual function of providing an electrical connection to ground and channeling heat away. Connect the GND pin to ground using a large pad or ground plane.

Capacitor Selection and Regulator Stability

Like any low-dropout regulator, the external capacitors used with the A6110 must be carefully selected for regulator stability and performance. The A6110 requires an output capacitor between the V_{OUT} and GND pins for phase compensation. Using a capacitor whose value is ≥1μF on the A6110 input and the amount of capacitance can be increased without limit. The input capacitor must be located a distance of not more than 0.5 inch from the input pin of the IC and returned to a clean analog ground. Any good quality ceramic or tantalum can be used for this capacitor. The capacitor with larger value and lower ESR (equivalent series resistance) provides better PSRR and line-transient response. The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDO applications. The A6110 is designed specifically to work with low ESR ceramic output capacitor in space-saving and performance consideration. In the A6110, phase compensation is made with the output capacitor for securing stable operation even if the load current is varied. For this purpose, use a 2.2uF capacitor between V_{OUT} pin and GND pin as close as possible.

Load-Transient Considerations

The A6110 load-transient response graphs show two components of the output response: a DC shift from the output impedance due to the load current change, and the transient response. The DC shift is quite small due to the excellent load regulation of the IC. Typical output voltage transient spike for a step change in the load current from 0mA to 50mA is tens of mV, depending on the ESR of the output capacitor. Increasing the output capacitor's value and decreasing the ESR attenuates the overshoot.

Input-Output (Dropout) Voltage

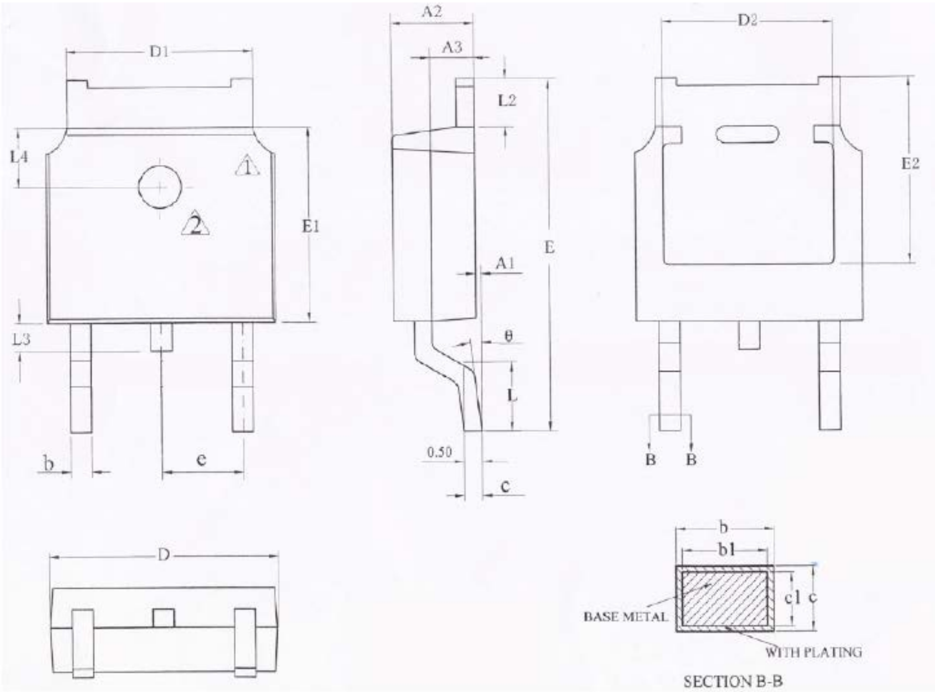
A regulator's minimum input-output voltage differential (or dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. Because the A6110 uses a P-Channel MOSFET pass transistor, the dropout voltage is a function of drain-to-source on resistance [$R_{DS(ON)}$] multiplied by the load current.

Layout Considerations

To improve AC performance such as PSRR, output noise, and transient response, it is recommended that the PCB be designed with separate ground planes for V_{DD} and V_{OUT}, with each ground plane connected only at the GND pin of the device. Make V_{DD} and GND lines sufficiently wide. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 between V_{DD} and GND pin, as close as possible to the pins. Set external components, especially the output capacitor C2, as close as possible to the IC, and make wiring as short as possible.

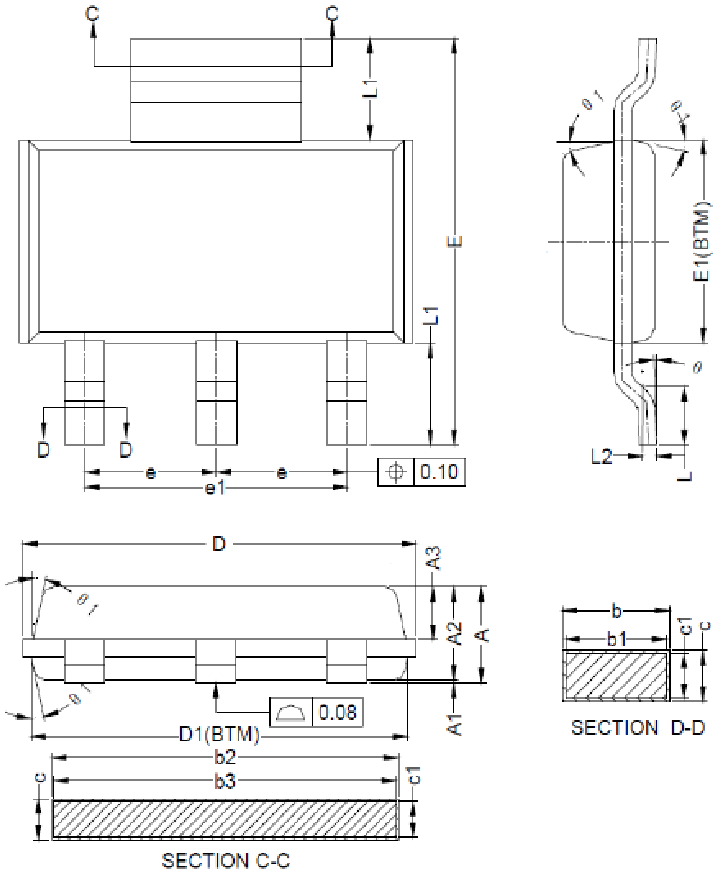
PACKAGE INFORMATION

Dimension in TO252-3 (Unit: mm)



Symbol	Min	Max
A1	0	0.10
A2	2.20	2.40
A3	1.02	1.12
b	0.75	0.84
b1	0.74	0.79
c	0.49	0.57
c1	0.48	0.52
D	6.50	6.70
D1	5.334 REF	
D2	4.70	4.92
E	9.90	10.30
E1	6.00	6.20
E2	5.30 REF	
e	2.286 BSC	
L	1.40	1.60
L2	0.90	1.25
L3	0.60	1.00
L4	1.70	1.90
θ	0°	8°

Dimension in SOT223-3 (Unit: mm)



Symbol	Min	Max
A	1.50	1.80
A1	0.02	0.10
A2	1.45	1.75
A3	0.80	1.00
b	0.67	0.80
b1	0.66	0.75
b2	2.96	3.09
b3	2.95	3.05
c	0.30	0.35
c1	0.29	0.31
D	6.35	7.05
D1	6.30	6.70
E	6.80	7.20
E1	3.40	3.60
e	2.30 BSC	
e1	4.60 BSC	
L	0.80	1.20
L1	1.75 REF	
L2	0.25 BSC	
θ	0°	8°
θ1	10°	14°

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