DESCRIPTION

The A7112 is a current mode monolithic buck switching regulator. Operating with an input range of 2.5V-5.5V, the A7112 delivers 1.2A of continuous output current with integrated P-Channel and N-Channel MOSFETs. The internal synchronous power switches provide high efficiency. At light loads, the regulator operate in low frequency to maintain high efficiency and low output ripples. Current mode control provides tight load transient response and cycle-by-cycle current limit.

The A7112 guarantees robustness with hiccup output Short-circuit protection, FB short-circuit protection, start-up current run-away protection, input under voltage lockout protection, hot-plug in protection, and thermal protection.

The A7112 is available in SOT-25 package.

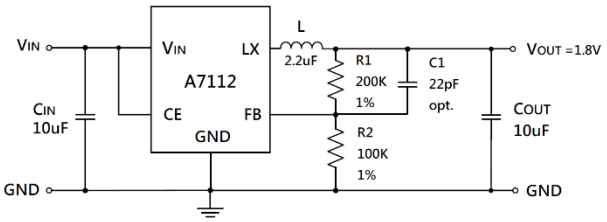
FEATURES

- 1.5MHz switching frequency
- Up to 1.2A output current
- Up to 95% peak efficiency
- 2.5V to 5.5V operating input range
- Can reach 100% duty cycle
- PWM automatic/PFM switching duty cycle adjustable to maintain a large load range of high efficiency, low ripple
- Short circuit protection

APPLICATION

- Set Top Boxes
- Telecom/Networking Systems
- Cameras, Video Equipment, Communications Equipment, Regulated Power Supply
- GPU/DDR Power Supply

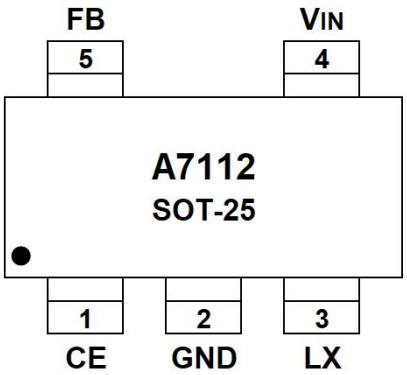
TYPICAL APPLICATION



ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000psc/Reel	E5	A7112E5R
		A7112E5VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

PIN DESCRIPTION



SOT-25, E5

Top View

Pin #	Symbol	Function
1	CE	Drive EN Pin, High to Turn On the Regulator
2	GND	Ground
3	LX	Internal Power Switch Output Port
4	V_{IN}	Power Input
5	FB	Output Feedback

ABSOLUTE MAXIMUM RATINGS

V_{IN}, Input Voltage		-0.3V ~ +7.5V
V_{FB}, Output Voltage		-0.3V ~ +6.5V
V_{LX}, Output Voltage		-0.3V ~V_{IN} +0.3V
V_{CE}, Voltage of the CE		-0.3V ~V_{IN} +0.3V
I_{LX}, LX Side Current		±2A
P_D, Power Dissipation	SOT-25	250mW
T_{OPR}, Operating Ambient Temperature		-40°C ~ +85°C
T_{STG}, Storage Temperature Range		-55°C ~ +125°C

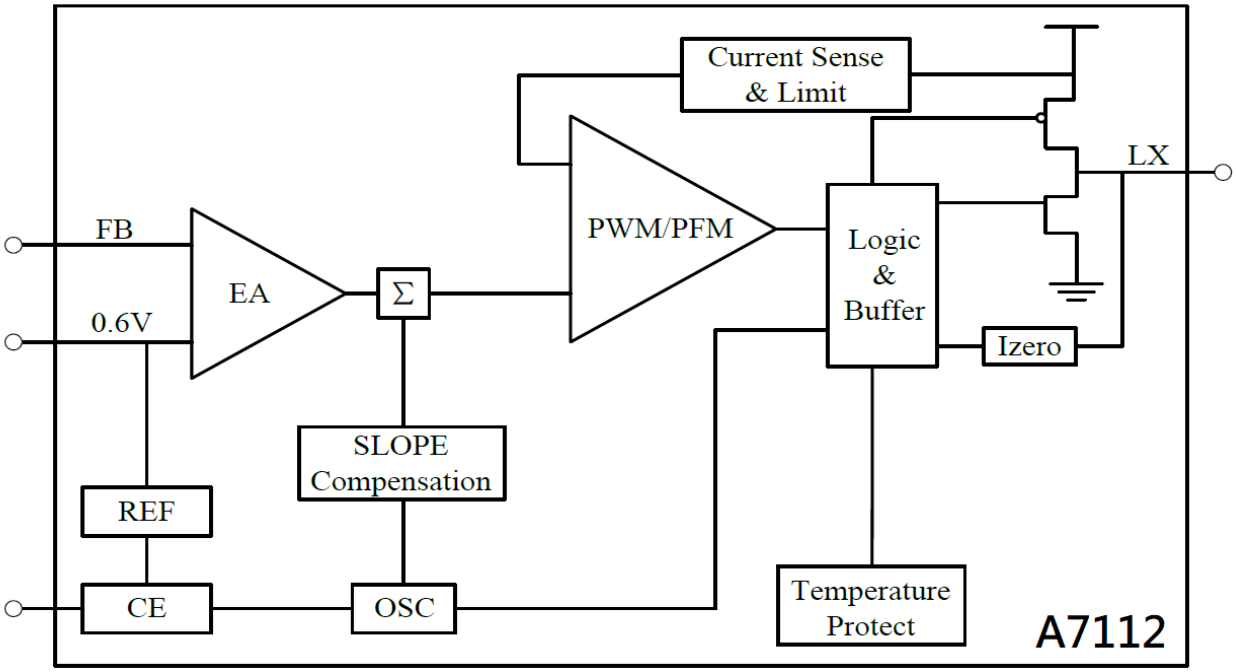
Stresses above may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

C_{IN}=10uF, C_{OUT}=10uF, L=2.2uH ,T_A=25℃ ,unless otherwise noted

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Voltage	V_{IN}	-	2.5	-	5.5	V
V_{IN} Under Voltage Lockout Threshold	U_{VLO}	-	-	2.5	-	V
V_{IN} Under Voltage Lockout Threshold Delay	U_{VLO_HYS}	-	-	500	-	mV
OVP	O_{VP}	-	-	6.2	-	V
OVP Delay	O_{VP_HYS}	-	-	300	-	mV
Regulated Feedback Voltage	V_{FB}	T_A=25℃	0.588	0.600	0.612	V
Standby Current	I_{STB}	V_{CE}=0V, V_{IN}=5V	0	-	1	μA
Quiescent Current	I_Q	V_{FB}=110%, I_{LOAD}=0	-	40	-	μA
Supply Current	I_{ACT}	V_{IN}=5V	-	350	500	μA
Peak Current Limit	I_{LIM}	V_{FB}=90%, V_{IN}=5V	1.70	-	-	A
Load Regulation	ΔV_{OUT}	I_{LOAD}=10mA to 1.0A	-	0.5	-	%
Line Regulations	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{IN}=2.5V to 6V	-	0.04	0.40	%
PFM Switch Point	I_{LOAD}	V_{IN}=3.6V, V_{OUT}=1.8V	-	60	-	mA
Switch Frequency	F_{OSC}	V_{OUT}=100%	-	1.5	-	MHz
Maximum Duty Cycle	D_{MAX}	-	100	-	-	%
PFET On Resistance	R_{DSON_P}	I_{LX}=100mA	-	0.3	-	Ω
NFET On Resistance	R_{DSON_N}	I_{LX}=100mA	-	0.2	-	Ω
LX Side Leakage Current	I_{LEAK_LX}	V_{CE}=0V, V_{IN}=5V	-	±0.01	±1.00	μA
CE “High” Voltage	V_{CEH}	V_{IN}=5V	1.2	-	-	V
CE “Low” Voltage	V_{CEL}	V_{IN}=5V	-	-	0.7	V
Output Short	$I_{\_OS}$	FB<0.2V	-	0.2	-	A
Thermal Shutdown	T_{SHD}	-	-	160	-	℃
Thermal Shutdown Delay	$T_{\_HYS}$	-	-	25	-	℃

BLOCK DIAGRAM



TYPICAL PERFORMANCE CHARACTERISTICS

Fig1. Steady State Test
V_{IN}=5.0V, V_{OUT}=3.3V, I_L=1.0A

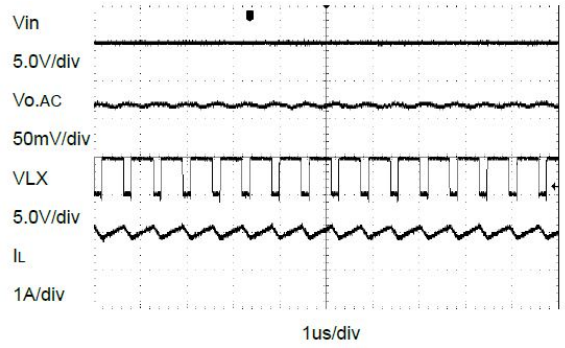


Fig2. CE Open
V_{IN}=5.0V, V_{OUT}=3.3V, I_L=1.0A

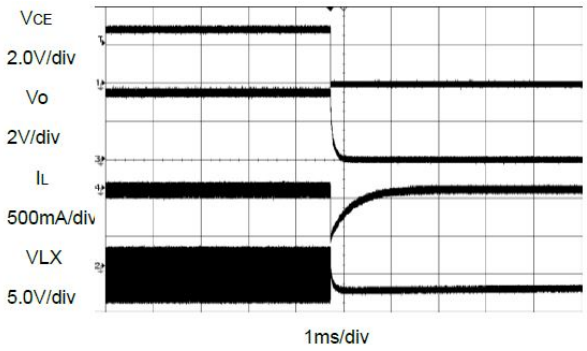


Fig3. CE Shut Off
V_{IN}=5.0V, V_{OUT}=3.3V, I_L=1.0A

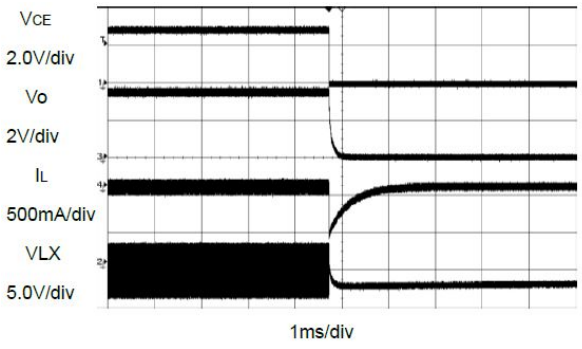


Fig4. Light Load Operation
V_{IN}=5.0V, V_{OUT}=3.3V, I_L=1mA

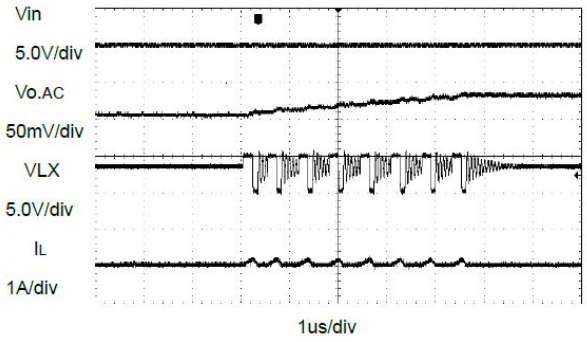


Fig5. Medium Load Operation
V_{IN}=5.0V, V_{OUT}=3.3V, I_L=0.6A

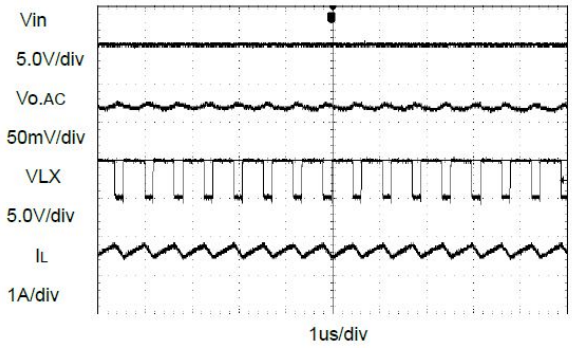


Fig6. Heavy Load Operation
V_{IN}=5.0V, V_{OUT}=3.3V, I_L=1.2A

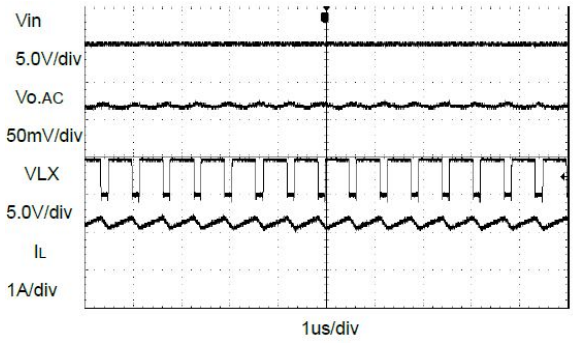


Fig7. Quiescent Current vs. Temperature

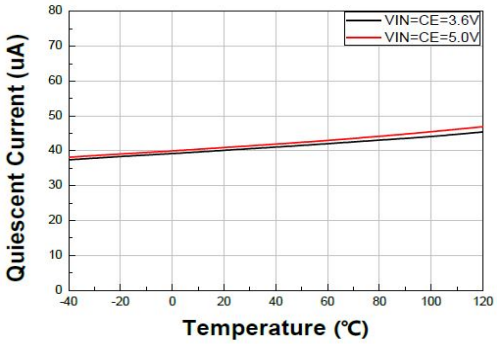


Fig8. Frequency vs. Temperature

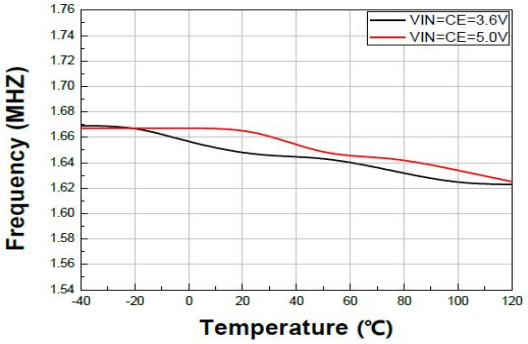


Fig9. Output Voltage vs. Temperature

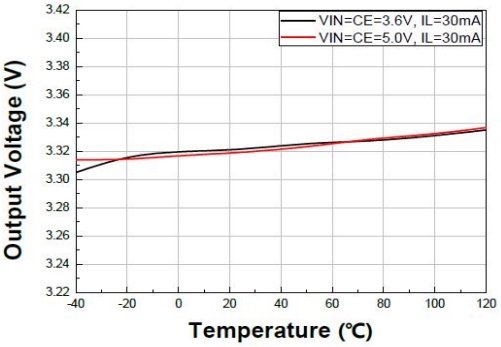


Fig10. Reverse Output Current vs. Temperature

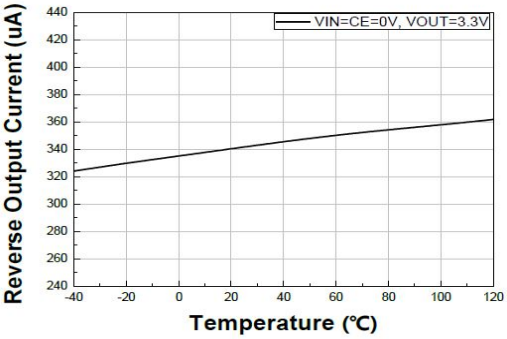


Fig11. Efficiency vs. Temperature

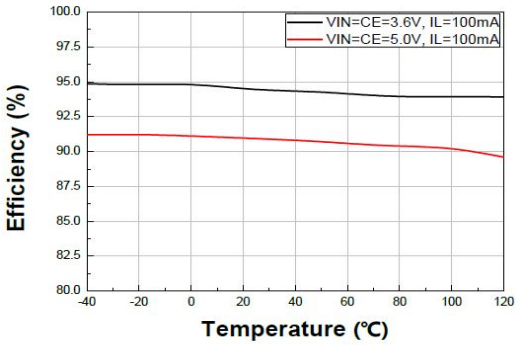


Fig12. Efficiency @ V_{OUT}=3.3V

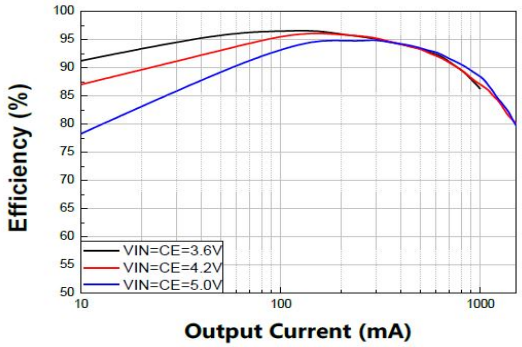


Fig13. Efficiency @ V_{OUT}=1.8V

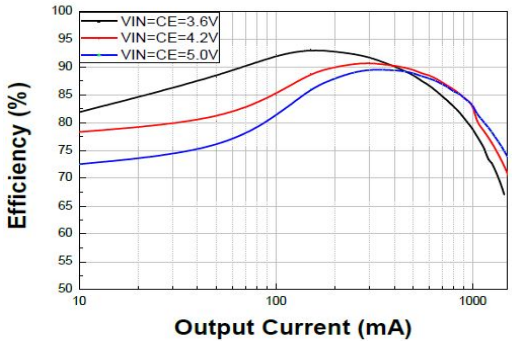


Fig14. Efficiency @ V_{OUT}=1.2V

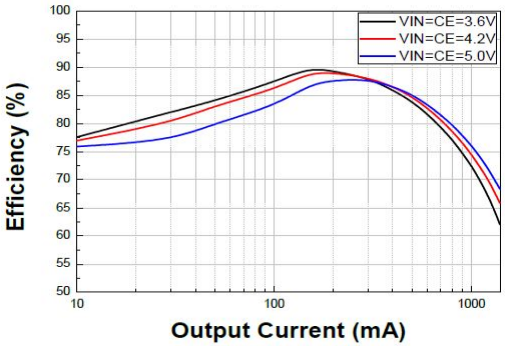


Fig15. Quiescent Current vs. Input Voltage

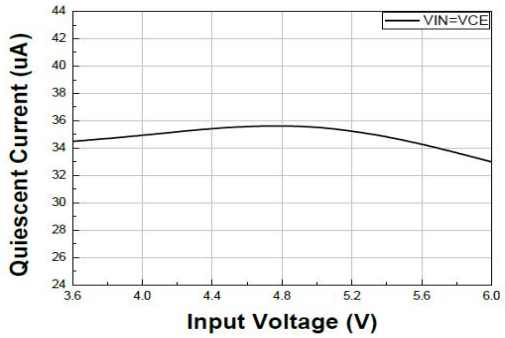
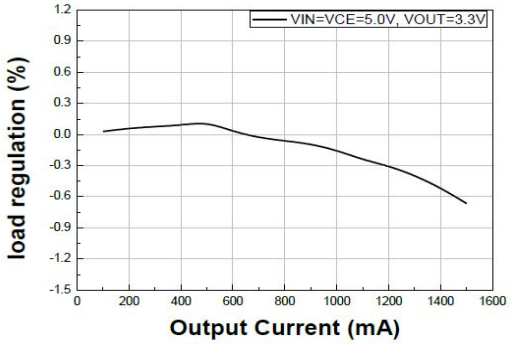


Fig16. Load Regulation @ V_{OUT}=3.3V



DETAILED INFORMATION

The A7112 is a synchronous, current-mode step-down regulator. It regulates input voltages from 2.5V~5.5V down to an output voltage as low as 0.6V, and is capable of supplying up to 1.2A of load current.

PFM Mode

The A7112 operates in PFM mode at light load. In PFM mode, switch frequency is continuously controlled in proportion to the load current, i.e. switch frequency decreases when load current drops to boost power efficiency at light load by reducing switch-loss, while switch frequency increases when load current rises, minimizing output voltage ripples.

Shut-Down Mode

The A7112 operates in shut-down mode when voltage at CE pin is driven below 0.7V. In shut-down mode, the entire regulator is off and the supply current consumed by the A7112 drops below 1uA.

Hot-Plug In Protection

If the Vin voltage exceeds 6.2V, IC will turn off power switch, entering over-voltage protection. It will remain in this state until Vin voltage is less than 6V.

Short Circuit Protection

When output is shorted to ground, the switching frequency is reduced to prevent the inductor current from increasing beyond PFET current limit.

Thermal Protection

When the temperature of the A7112 rises above 160°C, it is forced into thermal shut-down. Only when core temperature drops below 135°C can the regulator becomes active again.

APPLICATIONS INFORMATION

Output Voltage Set

The output voltage is determined by the resistor divider connected at the FB pin, and the voltage can be calculated by:

$$V_{OUT} = 0.6X(1 + \frac{R1}{R2})$$

The recommended value of R2 is KΩ.

Input Capacitor

The input capacitor is used to supply the AC input current to the step-down converter and maintaining the DC input voltage. The input capacitor can be calculated by the following equation when the input ripple voltage is determined.

$$C_{IN}=\frac{I_{LOAD}}{f_{s\times\triangle V_{IN}}} \times \frac{V_{OUT}}{V_{IN}}\left[1-\frac{V_{OUT}}{V_{IN}}\right]$$

where fs is the switching frequency, ΔV_{IN} is the input ripple current.

The input capacitor can be electrolytic, tantalum or ceramic. To minimizing the potential noise, a small X5R or X7R ceramic capacitor, i.e. 0.1uF, should be placed as close to the IC as possible when using electrolytic capacitors.

A 10uF ceramic capacitor is recommended in typical application.

Output Capacitor

The output capacitor is required to maintain the DC output voltage, and the capacitance value determines the output ripple voltage. The output voltage ripple can be calculated by:

$$\triangle V_{OUT} = \frac{V_{OUT}}{f_{s\times L}} X \left(1-\frac{V_{OUT}}{V_{IN}}\right) X \left[PESR + \frac{1}{8 \times f_s \times C_{OUT}}\right]$$

where C_{OUT} is the output capacitance value and RESR is the equivalent series resistance value of the output capacitor.

The output capacitor can be low ESR electrolytic, tantalum or ceramic, which lower ESR capacitors get lower output ripple voltage.

The output capacitors also affect the system stability and transient response, and a 10uF ceramic capacitor is recommended in typical application.

Inductor

The inductor is used to supply constant current to the output load, and the value determines the ripple current which affect the efficiency and the output voltage ripple.

The ripple current is typically allowed to be 40% of the maximum switch current limit, thus the inductance value can be calculated by:

$$L=\frac{V_{OUT}}{f_s \times \Delta I_L} \times \left[1-\frac{V_{OUT}}{V_{IN}}\right]$$

where V_{IN} is the input voltage, VOU_T is the output voltage, fs is the switching frequency, and ΔI_L is the peak-to-peak inductor ripple current.

A 2.2uH inductor is recommended in typical application

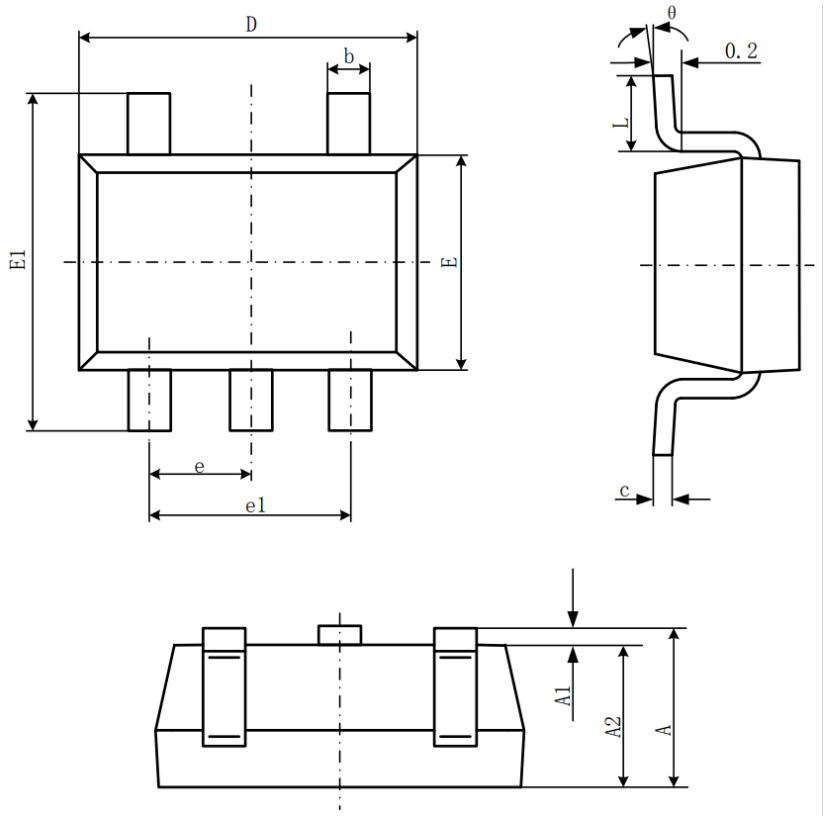
PCB Layout Note

For minimum noise problem and best operating performance, the PCB is preferred to following the guidelines as reference.

1. Place the input decoupling capacitor as close to A7112 (VIN pin and PGND) as possible to eliminate noise at the input pin.
2. The loop area formed by input capacitor and GND must be minimized.
3. Put the feedback trace as far away from the inductor and noisy power traces as possible.
4. The ground plane on the PCB should be as large as possible for better heat dissipation.

PACKAGE INFORMATION

Dimension in SOT-25(Unit: mm)



Symbol	Min.	Max.
A	1.050	1.250
A1	0.000	0.100
A2	1.050	1.150
b	0.300	0.500
c	0.100	0.200
D	2.820	3.020
E	1.500	1.700
E1	2.650	2.950
e	0.950 BSC	
e1	1.800	2.000
L	0.300	0.600
θ	0°	8°

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