DESCRIPTION

The A7232A is a monolithic integrated circuit designed for step-down (buck) DC/DC converter applications. It features a low EMI signature, making it ideal for noise-sensitive environments. The device supports up to 3A continuous output current with excellent load and line regulation, ensuring stable performance across varying conditions.

Key performance features include the ability to operate at up to 93% duty cycle, allowing for low dropout operation, which is critical for maximizing output voltage in low-input voltage scenarios. An internal soft start minimizes inrush current during startup, helping to extend battery life in portable applications.

Protection Features are Cycle-by-cycle peak current limit, Short-circuit protection, Thermal shutdown, and Under-voltage lockout (UVLO)

The A7232A is offered in a 6pins SOT-26 package, providing a compact, thermally efficient solution for a variety of power management.

ORDERING INFORMATION

Package Type	Part Number	
SOT-26 SPQ:3,000pcs/Reel	E6	A7232AE6VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

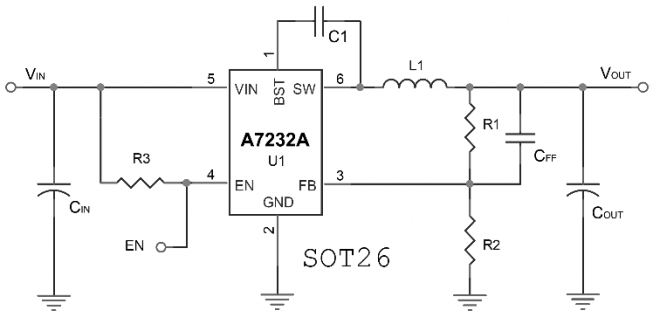
FEATURES

- Wide input voltage Range: 4.0V~18V
- Adjustable Output Voltage: 0.6V to V_{IN}
- 3A Continuous Output Current
- Low $R_{DS(ON)}$ Switches: 70mΩ/ 50mΩ
- Switching Frequency: 600KHz
- High Duty Cycle Operation: up to 93%
- Short Circuit Protection
- Over Current Protection
- Internal Soft Startup
- Thermal Shutdown Protection

APPLICATION

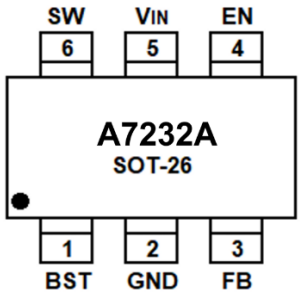
- LCD Monitor and LCD TVs
- Battery-powered Equipment
- Entertainment Devices
- Digital Home Appliances (e.g., Digital TVs)
- ADSL Modem and Portable Instruments

TYPICAL APPLICATION



L1: See Table 1

PIN DESCRIPTION



SOT-26, E6

Top View

PIN#	Symbol	Function
1	BST	Bootstrap: A capacitor must be connected between the BST and SW pins to create a floating voltage supply that drives the high-side MOSFET gate.
2	GND	Ground pin.
3	FB	Feedback: Provides input to the internal control loop. Connect this pin to an external resistor divider from the output to set the regulated output voltage.
4	EN	Enable: Logic input for device enable control. A logic high enables the device, while a logic low disables it and places it into shutdown mode.
5	V_{IN}	Power supply voltage input
6	SW	Switch: The SW pin contains the internal FET switches and connects to the inductor of the output filter for the output stage.

ABSOLUTE MAXIMUM RATINGS

Over operating temperature range(25°C) (unless otherwise noted)

Voltage (1)	V_{IN}	-0.3V ~ +20V
	EN	-0.3V ~ +20V
	BST	V_{SW}+5V
	SW (less than 10ns) (2)	-0.3V ~ +V_{IN}+0.5V
	FB	-0.3V ~ +6.0V
T_J, Operating Junction Temperature		-40°C ~ +150°C
T_{STG}, Storage Temperature		-65°C ~ +150°C
$R_{\theta JA}$, Junction-to-Ambient Thermal Resistance		240 °C/W
$R_{\theta JC(top)}$, Junction-to-Case (top) Thermal Resistance		140 °C/W

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.

(1) All voltage values are with respect to network ground terminal.

(2) While switching

RECOMMENDED OPERATING CONDITIONS

	MIN.	MAX.	Units
Operating Junction Temperature (1)	-40	125	℃/W
Operating Temperature Range	-40	85	℃/W
V_{IN}, Input Voltage	4.5	18	V
V_{OUT}, Output Voltage	0.8	30	V
Output Current	0	3.0	A

(1) All limits specified at room temperature (T_A = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

ELECTRICAL CHARACTERISTICS

V_{IN}=12V, T_A=25°C, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input Voltage Range	V_{IN}		4.0	-	18	V
Non Switching Quiescent Current	I_Q	V_{OUT}=5V, I_{LOAD}=0A			20	mA
Shut Down Current	I_{OFF}	EN = GND	-	-	3	μA
Regulated Feedback Voltage	V_{FB}		590	600	610	mV
V_{IN} Under Voltage Lockout	$V_{IN(UVLO)}$		-	3.8	-	V
V_{IN} Under Voltage Lockout Hysteresis			-	200	-	mV
ENABLE (EN PIN)						
Enable Threshold	$V_{(EN\_RISING)}$	Rising	1.5	-	-	V
	$V_{(EN\_FALLING)}$	Falling	-		0.4	V
Threshold Hysteresis	$V_{(EN\_HYS)}$		-	200	-	mV
POWER STAGE						
High-Side FET on Resistance	$R_{(HSD)}$	I_{SW}= 1000mA	-	70	-	mΩ
Low-Side FET on Resistance	$R_{(LSD)}$		-	50	-	mΩ
CURRENT LIMIT						
High side FET Current Limit	$I_{(LIM\_HS)}$	FB=90%	-	-	4	A
Low side FET Current Limit	$I_{(LIM\_HS)}$		-	-	3.5	A
OSCILLATOR						
Centre Switching Frequency	F_{SW}		460	600	760	kHz
OVER TEMPERATURE PROTECTION						
Rising Temperature	Thermal Shutdown		-	160	-	℃
Hysteresis			-	20	-	℃
Soft Start			1	1.2	1.5	ms

TYPICAL PERFORMANCE CHARACTERISTICS

Fig.1 Power-on sequence: ~=3mS
C_{IN}=22uF, C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5.0V, EN=5V. I_{OUT}= 1A

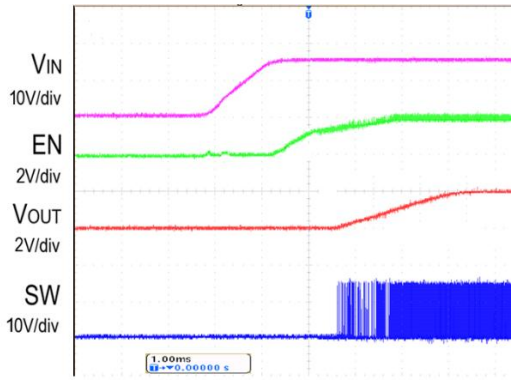


Fig.2 Power Off: ~=16mS
C_{IN}=22uF C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5.0V, EN=5V. I_{OUT}=1A

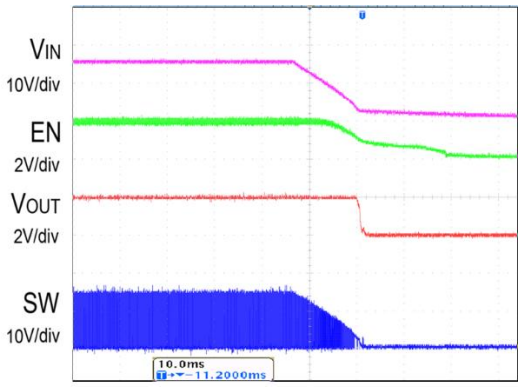


Fig.3 Power Disable by EN: ~=500μS
C_{IN}=22uF, C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5V, EN=5V. I_{OUT}= 1A

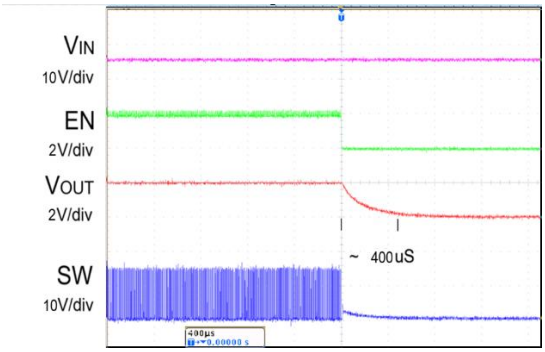


Fig.4 Steady State Test: ~= ±6mV
C_{IN}=22uF, C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5V, EN=5V. I_{OUT}= 1A

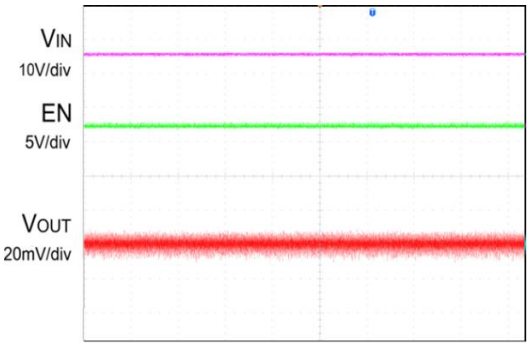


Fig.5 Light Load Transient Response:
C_{IN}=22uF, C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5V, EN=5V. I_{OUT}=0. 1A

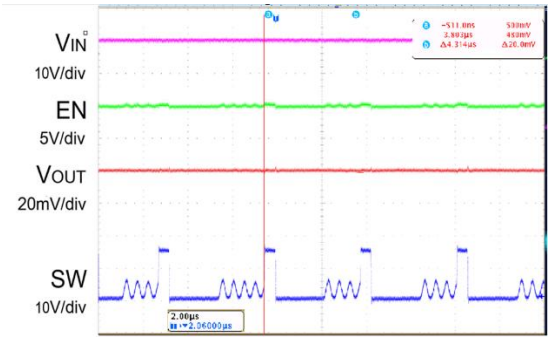


Fig.6 Load Transient Response:
C_{IN}=22uF, C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5V, EN=5V. I_{OUT}=1A

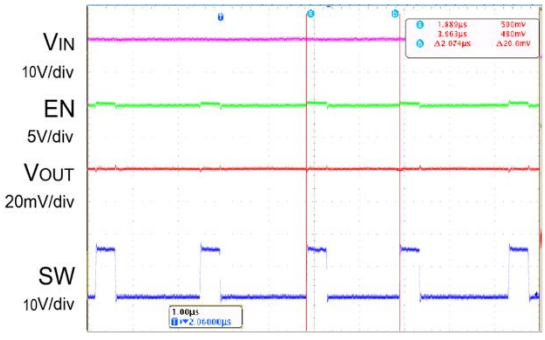


Fig.5 Short Circuit Entry:
C_{IN}=22uF, C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5V, EN=5V. I_{OUT}=0. 1A

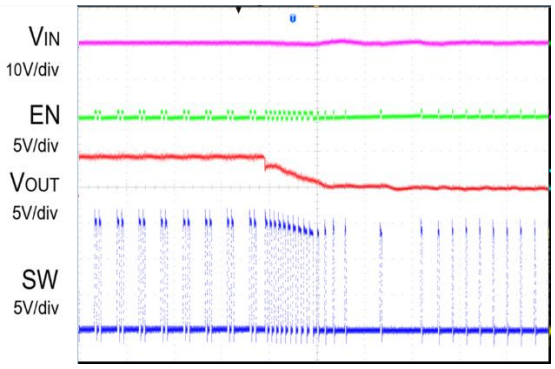


Fig.6 Short Circuit Exit :
C_{IN}=22uF, C_{OUT}=47uF, L=6.8uH, T_A=+25℃
V_{IN} =15V, V_{OUT}= 5V, EN=5V. I_{OUT}=1A

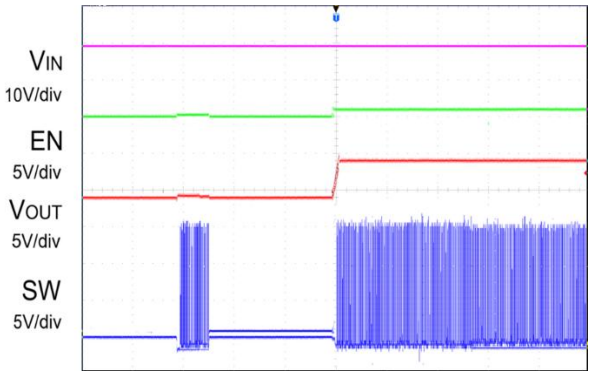
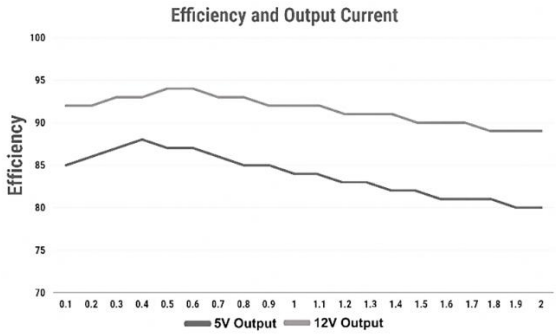
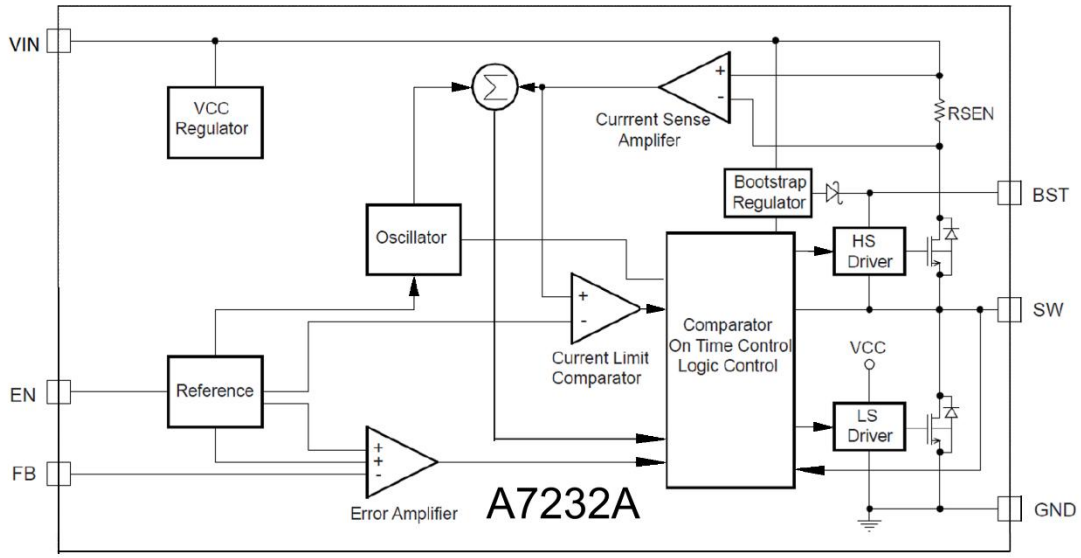


Fig.9 Efficiency & Output Current
Vout=5V vs Vout =12V



BLOCK DIAGRAM



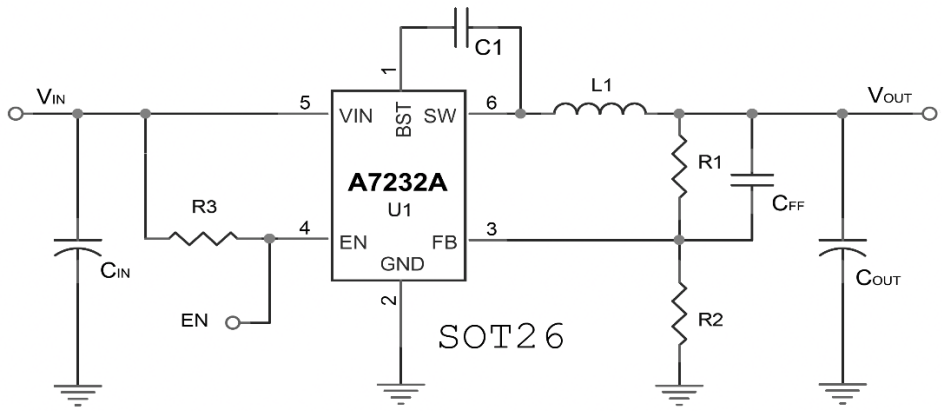
DETAILED INFORMATION

Operation Overview

The A7232A is a high-performance monolithic switch-mode step-down (buck) DC-DC converter capable of delivering up to 3A continuous output current from a wide input voltage range of 4.5V to 18V.
It features a fixed 600KHz high-frequency operation and is built on a slope-compensated current-mode control architecture, ensuring fast transient response and stable regulation. The internal feedback compensation provides excellent line and load regulation without the need for external components.
An external shutdown pin allows logic-level control for enabling or disabling the device, placing it into low-power standby mode when not in use.
Protection Features:

- Thermal shutdown prevents damage during high-temperature operation.
- Cycle-by-cycle current limiting protects the internal power switch during overcurrent conditions.
- If the feedback voltage V_{FB} drops below 0.6V due to a fault or overload, the switching frequency is automatically reduced, improving system stability and reducing thermal stress.

Application information



The A7232A is a high-performance step-down DC/DC converter. It requires minimal external components—just input and output capacitors (C_{IN}, C_{OUT}) and an inductor (L1)—making it ideal for space-constrained designs. The output voltage is adjustable via an external feedback network, allowing it to be set from 0.6V up to the input voltage, providing flexibility for a wide range of applications.

$$V_{OUT} = 0.6 \times \left(1 + \frac{R1+R2}{R2}\right)$$

V_{OUT}(V)@ 3A	L1 (μH)	C1 (μF)	C_{IN} (μF)	C_{OUT}(μF)	C_{FF}.(pF)	R1 (kΩ)	R2 (kΩ)
3.3	PIA6045-4R7M PIA8065-5R6M	0.1	22	22~68	10~100	45	10
5	PIA8065-6R8M	0.1	22	22~68	10~100	73.3	10
12	PIA8065-7R8M WSL06030-8R2M	0.1	22	22~68	10~100	43	2.2

Table 1. Recommended Component Values

The R3 is fixed by design at 10 kΩ to 100 kΩ depended on circuit design requirement. If the EN pin is not used for device enable/disable control, it connects a pull up resistance to V_{IN}.

Output Capacitor

The output capacitor (C_{OUT}) is critical for achieving a stable and low-ripple output voltage. Improper selection may result in abnormal system operation and excessive current ripple.

The equivalent series resistance (ESR) of the output capacitor must be within an appropriate range to ensure loop stability and proper feedback operation.

During the switching transition of the power MOSFET from ON to OFF, the feedback voltage (V_{FB}) may exhibit a slight increase. To maintain a stable feedback voltage and ensure proper charge transfer, a certain ESR and inductor current are required. Therefore, a feedforward capacitor (C_{FF}) is necessary.

Taking V_{OUT} = 5V as an example, when the feedforward capacitor is 0.1 μF, the recommended ESR range for the output capacitor is 100 mΩ to 250 mΩ.

It is recommended to use tantalum or aluminum electrolytic capacitors, optionally in parallel with a small ceramic capacitor (C_{FF}) to improve high-frequency performance.

If the output capacitor and its ESR cannot be adjusted, a feedforward capacitor (C_{FF}) can be connected in parallel with R1 to set the desired frequency response. The feedforward capacitor also helps reduce output voltage ripple.

Feed-Forward Capacitor (C_{FF}) Selection

In Constant On-Time (COT) control of A7232A architecture, the feedforward capacitor (C_{FF}) is typically connected in parallel with the upper feedback resistor (R1). The purpose of C_{FF} is to improve loop stability, enhance transient response, and provide sufficient ripple injections to the FB pin for stable switching operation. For applications using low-ESR ceramic (Ex: MLCC) output capacitors, the output ripple voltage may become too small for proper COT operation. In this condition, an appropriate C_{FF} capacitor is recommended to prevent switching jitter and unstable frequency behavior.

The initial C_{FF} value can be estimated by: $$C_{FF} \approx \frac{1}{2\pi \times R_1 \times f_{SW}}$$

Where:

- R1 = Upper feedback resistor
- f_{SW} = Switching frequency

The final C_{FF} value should be optimized according to PCB layout, output capacitor characteristics, ripple amplitude, and load transient performance.

Power Supply Recommendations

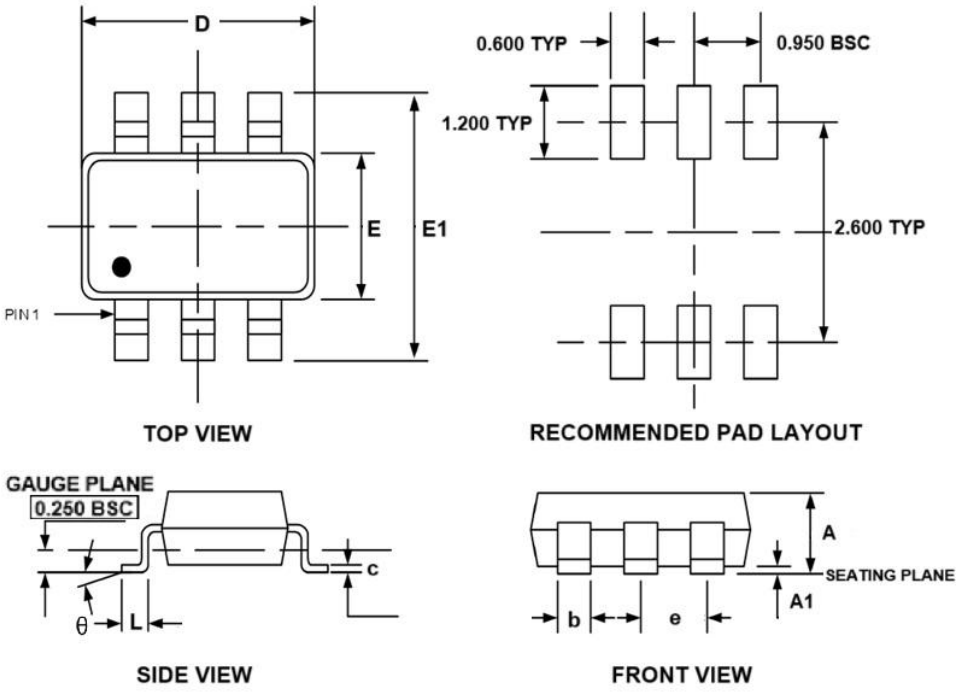
The devices are designed to operate from an input voltage supply range of 4.5V to 18V. For optimal performance, the input supply must be well regulated. If the power source is located more than a few inches away from the device or converter, additional bulk capacitance is recommended to compensate for voltage drops and ensure stable operation. In such cases, an electrolytic capacitor with a typical value of 47~68 µF can be used alongside ceramic bypass capacitors to maintain input stability.

PCB Layout Guidelines

- V_{IN} and GND traces should be as wide as possible to reduce impedance and improve thermal dissipation.
- Input and output capacitors should be placed as close to the device as possible to minimize trace inductance and impedance.
- Provide adequate vias for both input and output capacitors to ensure solid grounding and current flow.
- Keep the SW (switching) trace as short and wide as possible to minimize radiated EMI.
- Avoid routing switching current beneath the IC to reduce potential noise and ground bounce.
- Use a dedicated V_{OUT} trace to connect to the upper feedback resistor for accurate regulation.
- Implement a Kelvin connection from the feedback path to the GND pin for precise voltage sensing.
- Keep the voltage feedback loop away from high voltage switching traces, and shield it with a ground plane if possible.
- Minimize the trace area of the V_{FB} node to reduce susceptibility to noise coupling.
- The GND trace between the output capacitor and the IC’s GND pin should be as wide as possible to reduce voltage drop and ensure solid grounding.

PACKAGE INFORMATION

Dimension in SOT-26 (Unit: mm)



Symbol	Millimeters	
	Min	Max
A	-	1.450
A1	0.000	0.150
b	0.250	0.500
c	0.090	0.200
D	2.800	3.000
E	1.500	1.700
E1	2.600	3.100
e	0.950 BSC	
L	0.300	0.550
θ	0°	8°

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