DESCRIPTION

The A7115B is a 2MHz high-efficiency, PWM step-down converter with integrated main switch and synchronous rectifier that is ideal for powering portable equipment that runs from a single Li-on or Li-Polymer battery.

The A7115B can supply up to up to 1.5A load current from a 2.6V to 5.5V input voltage. The output voltage can be as low as 0.6V.

The A7115B features include <1uA shutdown current, small external components, such as ceramic input and output caps, as well as small inductors, while still providing low output ripples. This low noise output along with its excellent efficiency achieved by the internal synchronous rectifier, making A7115B an ideal replacement for large power consuming linear regulators. Internal soft-start control circuitry reduces inrush current. Short-circuit and thermal shutdown protection improves design reliability.

The A7115B is available in SOT-25 and DFN6 (2x2) packages.

FEATURES

- High efficiency: up to 97%
- 2MHz switching frequency
- Up to 1.5A Load current
- 2.6V to 5.5V input Voltage Rage
- Current mode control
- Low dropout 100% duty operation
- Internal compensation and soft-start
- Reference 0.6V
- Logic control shutdown (I_Q<1uA)
- Thermal shutdown, UVLO
- Available in SOT-25 and DFN6 (2x2) packages

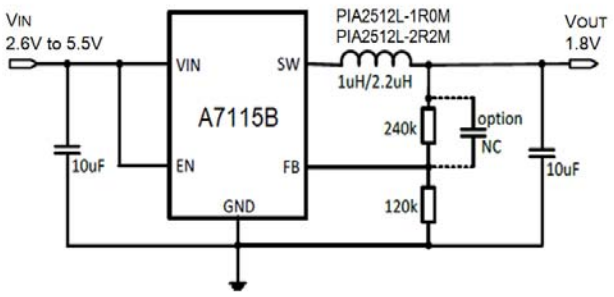
APPLICATION

- Cellular phones
- Microprocessors and DSP Core Supplies
- PDA and Smart Phones
- MP3 and Portable Media Players
- Digital Still and Video Cameras
- Portable Instruments
- Set Top Box
- Wireless and DSL modems
- USB supplied devices in notebooks

ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000pcs/Reel	E5	A7115BE5R
		A7115BE5VR
DFN6 SPQ: 3,000pcs/Reel	J6	A7115BJ6R
		A7115BJ6VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

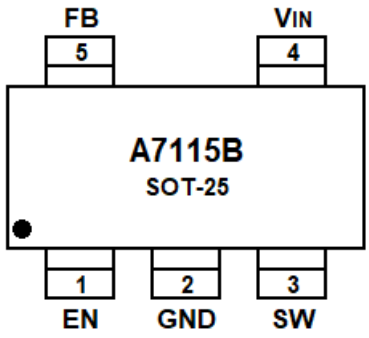
TYPICAL APPLICATION



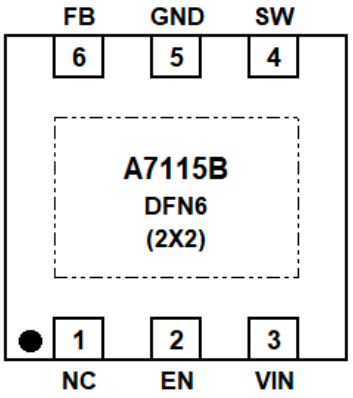
A7115B external Inductor suggest

AiT Semi's PIA2512L-1R0M & PIA2512L-2R2M

PIN DESCRIPTION



Top View



Top View

Pin #		Symbol	Function
SOT-25	DFN6 (2x2)		
1	2	EN	Enable pin for the IC. Drive the pin to high to enable the part, and low to disable
2	5	GND	Ground.
3	4	SW	Inductor connection. Connect an inductor between SW and the regulator output.
4	3	V_{IN}	Supply voltage.
5	6	FB	Feedback input. Connect an external resistor divider from the output to FB and GND to set the output to a voltage between 0.6V and V_{IN}
-	1	NC	No Connection

ABSOLUTE MAXIMUM RATINGS

Max Input Voltage		8V
T_J, Max Operating Junction Temperature		125°C
T_A, Ambient Temperature		-40°C~85°C
Maximum Power Dissipation	SOT-25	400mW
	DFN6 (2x2)	600mW
T_S, Storage Temperature		-40°C~150°C
Lead Temperature & Time		260°C, 10sec.
ESD (HBM)		>2kV

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

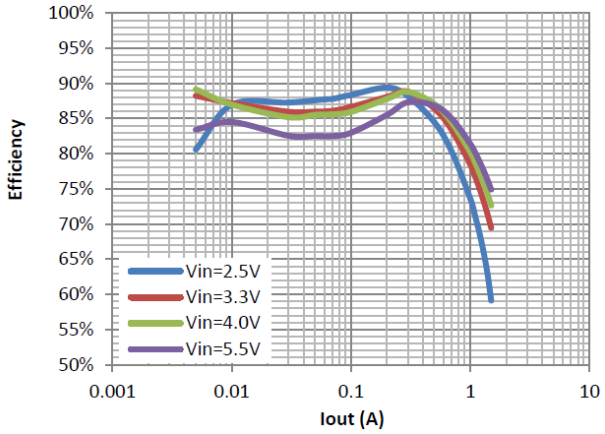
V_{IN}=5V, T_A=25°C, unless otherwise specified.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Voltage Range	V_{IN}		2.6	-	5.5	V
Input Overvoltage Threshold	V_{OVP}		-	6.1	-	V
Feedback Voltage	V_{REF}	V_{IN}=5V	0.588	0.6	0.612	V
Feedback Leakage Current	I_{FB}		-	0.1	1	μA
Quiescent Current	I_Q	Active, V_{FB}=0.65V, No Switching	-	80	-	μA
		Shutdown EN=0V	-	-	1	μA
Line Regulation	LNR	V_{IN}=2.6V to 6V	-	0.1	0.2	%/V
Load Regulation	LDR	I_{OUT}=0.01A to 1A	-	0.1	0.2	%/A
Switching Frequency	f_{SOC}		1.6	2	2.4	MHz
PMOS R_{DSON}	R_{DSONP}		-	250	350	mΩ
NMOS R_{DSON}	R_{DSONN}		-	150	250	mΩ
Under Voltage Lockout	V_{UVLO}		1.9	2.1	2.3	V
UVLO Hysteresis	V_{UVLO_HY}		-	100	-	mV
Peak Current Limit	I_{LIMIT}		1.8	2.3	2.8	A
	I_{NOLOAD}	V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=0A	-	80	-	μA
SW Leakage Current	I_{SWLK}	V_{IN}=6V, V_{SW}=0V or 6V, EN=0V	-	-	1	μA
EN Leakage Current	I_{ENLK}		-	-	1	μA
EN Input High Voltage	V_{H_EN}		1.2	-	-	V
EN Input Low Voltage	V_{L_EN}		-	-	0.5	V
Thermal Shutdown Temp	T_{SD}		-	160	-	°C
Thermal Shutdown Hysteresis	T_{SH}		-	15	-	°C

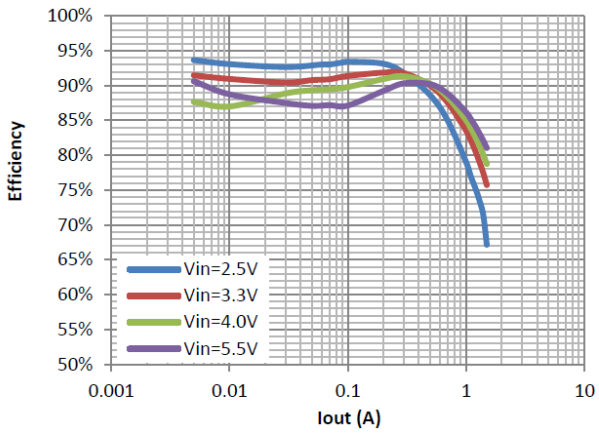
TYPICAL PERFORMANCE CHARACTERISTICS

Tested under T_A=25°C, unless otherwise specified

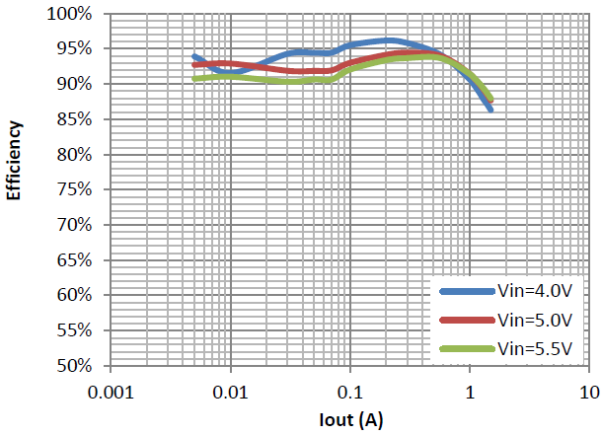
1. Efficiency vs. Output Current (V_{OUT}=1.2V)



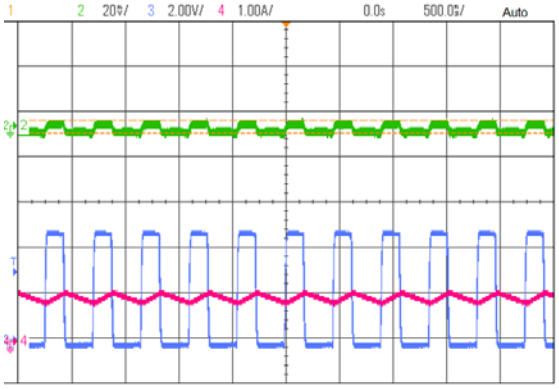
2. Efficiency vs. Output Current (V_{OUT}=1.8V)



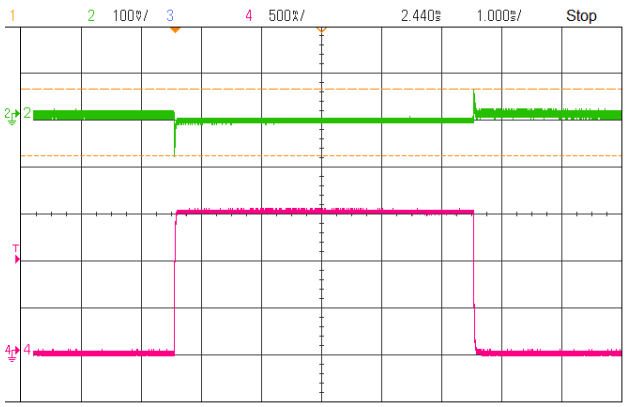
3. Efficiency vs. Output Current (V_{OUT}=3.3V)



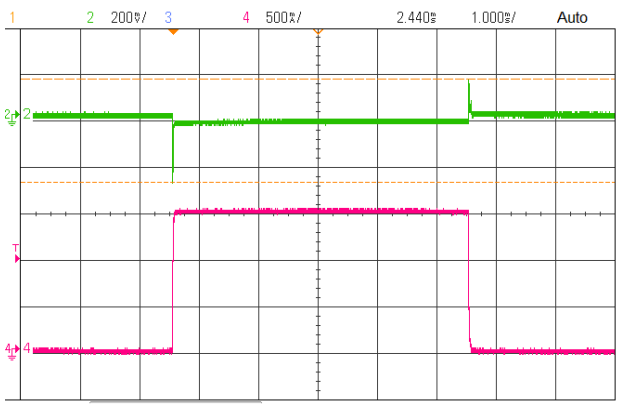
4. Output Ripple and SW at 1A load
V_{IN}=5V / V_{OUT}=1.8V
Ch2—V_{OUT} ripple, Ch3—V_{SW}, Ch4—I_{SW}



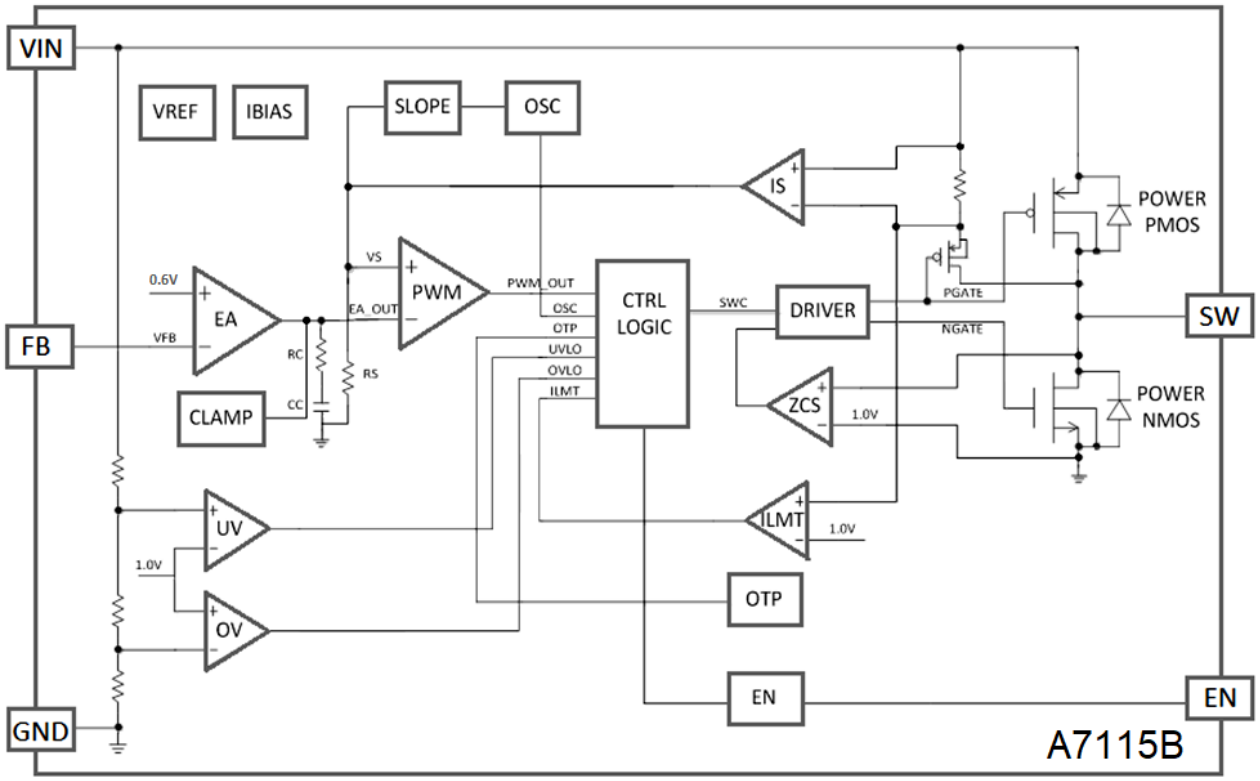
5. Load Transient
V_{IN}=5V / V_{OUT}=1.2V / I_{OUT}=0.01~1.5A
Ch2—V_{OUT} ripple, Ch4—I_{OUT}



6. Load Transient
V_{IN}=5V / V_{OUT}=3.3V / I_{OUT}=0.01~1.5A
Ch2—V_{OUT} ripple, Ch4—I_{OUT}



BLOCK DIAGRAM



DETAILED INFORMATION

The A7115B high-efficiency switching regulator is a small, simple, DC-to-DC step-down converter capable of delivering up to 1.5A of output current. The device operates in pulse-width modulation (PWM) at 2MHz from a 2.6V to 5.5V input voltage and provides an output voltage from 0.6V to V_{IN}, making the A7115B ideal for on-board post-regulation applications. An internal synchronous rectifier improves efficiency and eliminates the typical Schottky free-wheeling diode. Using the on resistance of the internal high-side MOSFET to sense switching currents eliminates current-sense resistors, further improving efficiency and cost.

Loop Operation

A7115B uses a PWM current-mode control scheme. An open-loop comparator compares the integrated voltage-feedback signal against the sum of the amplified current-sense signal and the slope compensation ramp. At each rising edge of the internal clock, the internal high-side MOSFET turns on until the PWM comparator terminates the on cycle. During this on-time, current ramps up through the inductor, sourcing current to the output and storing energy in the inductor. The current mode feedback system regulates the peak inductor current as a function of the output voltage error signal. During the off cycle, the internal high-side P-channel MOSFET turns off, and the internal low-side N-channel MOSFET turns on. The inductor (AiT Semi's PIA2512L-1R0M or PIA2512L-2R2M) releases the stored energy as its current ramps down while still providing current to the output.

Current Sense

An internal current-sense amplifier senses the current through the high-side MOSFET during on time and produces a proportional current signal, which is used to sum with the slope compensation signal. The summed signal then is compared with the error amplifier output by the PWM comparator to terminate the on cycle.

Current Limit

There is a cycle-by-cycle current limit on the high-side MOSFET of 2.3A (typ). When the current flowing out of SW exceeds this limit, the high-side MOSFET turns off and the synchronous rectifier turns on. A7115B utilizes a frequency fold-back mode to prevent overheating during short-circuit output conditions. The device enters frequency fold-back mode when the FB voltage drops below 100mV, limiting the current to 2.3A (typ) and reducing power dissipation. Normal operation resumes upon removal of the short-circuit condition.

Soft-start

A7115B has an internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO), shutdown mode, or restarts following a thermal shutdown event, the soft-start circuitry slowly ramps up current available at SW.

UVLO

If V_{IN} drops below 2.1V, the UVLO circuit inhibits switching. Once V_{IN} rises above 2.2V, the UVLO clears, and the soft-start sequence activates.

Thermal Shutdown

Thermal shutdown protection limits total power dissipation in the device. When the junction temperature exceeds T_J= +160°C, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal sensor turns the device on again after the junction temperature cools by 15°C, resulting in a pulsed output during continuous overload conditions. Following a thermal-shutdown condition, the soft-start sequence begins.

Setting Output Voltages

Output voltages are set by external resistors. The FB threshold is 0.6V.

$$R_{TOP} = R_{BOTTOM}\,[(V_{OUT} / 0.6) - 1]$$

Input Capacitor Selection

The input capacitor in a DC-to-DC converter reduces current peaks drawn from the battery or other input power source and reduces switching noise in the controller. The impedance of the input capacitor at the switching frequency should be less than that of the input source so high-frequency switching currents do not pass through the input source. The output capacitor keeps output ripple small and ensures control-loop stability. The output capacitor must also have low impedance at the switching frequency. Ceramic, polymer, and tantalum capacitors are suitable, with ceramic exhibiting the lowest ESR and high-frequency impedance. Output ripple with a ceramic output capacitor is approximately as follows:

$$\Delta I_L = \frac{V_{OUT}}{L \times fs} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

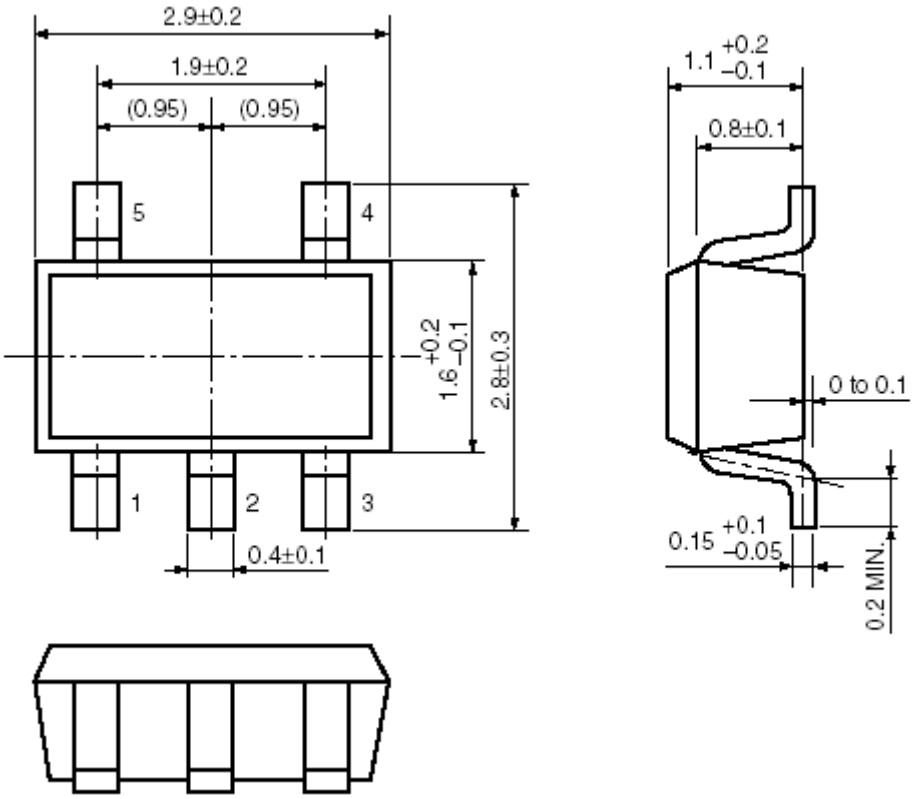
$$\Delta V_{OUT} = \frac{V_{OUT}}{8 \times f_S^2 \times L \times C_{OUT}} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

If the capacitor has significant ESR, the output ripple component due to capacitor ESR is as follows:

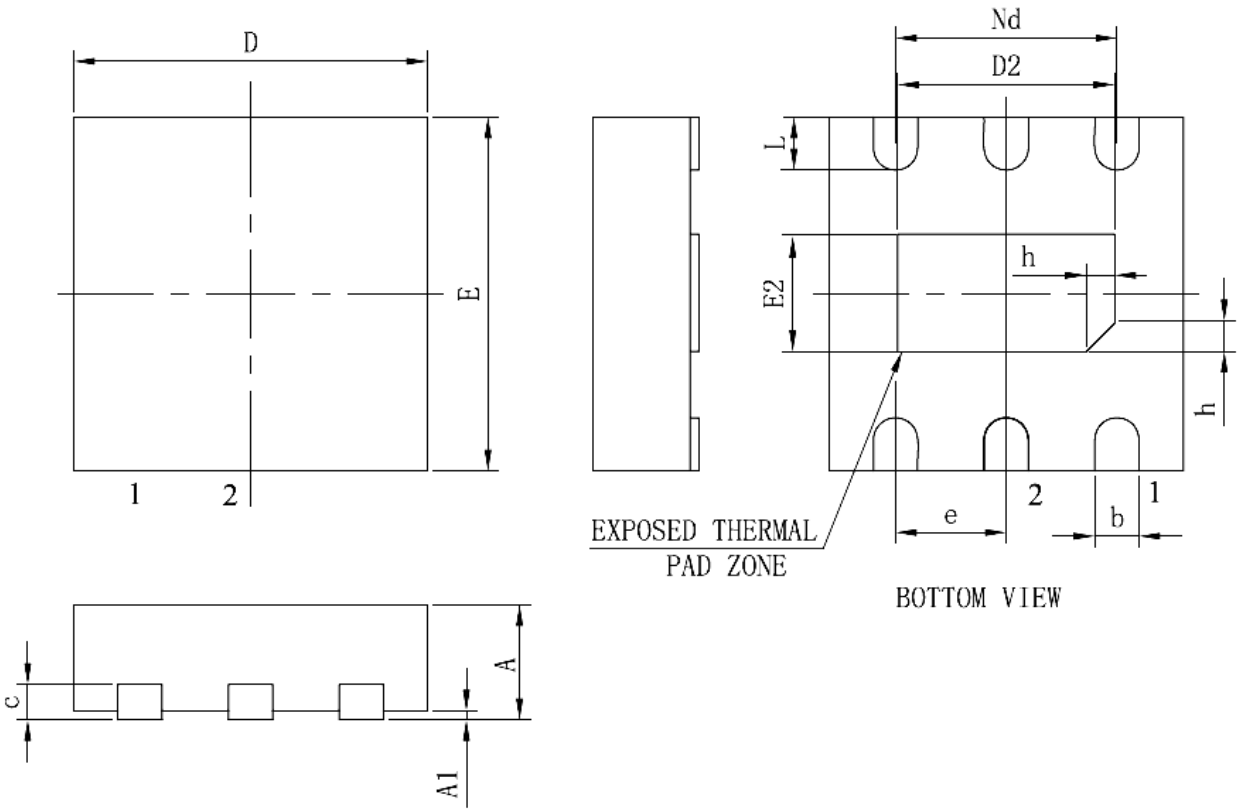
$$\Delta V_{OUT} = \frac{V_{OUT}}{L \times fs} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right) \times R_{ESR}$$

PACKAGE INFORMATION

Dimension in SOT-25 (Unit: mm)



Dimension in DFN6(2x2) (Unit: mm)



Symbol	Min	Max
A	0.70	0.80
A1	-	0.05
b	0.25	0.35
c	0.18	0.25
D	1.95	2.05
D2	1.00	1.45
e	0.65BSC	
Nd	1.30BSC	
E	1.95	2.05
E2	0.50	0.85
L	0.25	0.40
h	0.10	0.20

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