

AME5150

Micropower Inverting DC/DC Converter

■ General Description

The AME5150 is an inverting DC/DC converter operating from 1.5V to 5.5V input voltage range. It is capable of producing up to -28V of regulated negative output voltage. Built-in current-limit and fixed off-time control scheme of AME5150 provides high efficiency over a wide range of load conditions.

Low supply current, 400ns fixed off-time, small package, and tiny external components makes AME5150 a extremely compact and high efficiency voltage biasing solution for battery-powered application. The AME5150 is available in a small SOT-25/TSOT-25 packages.

■ Typical Application

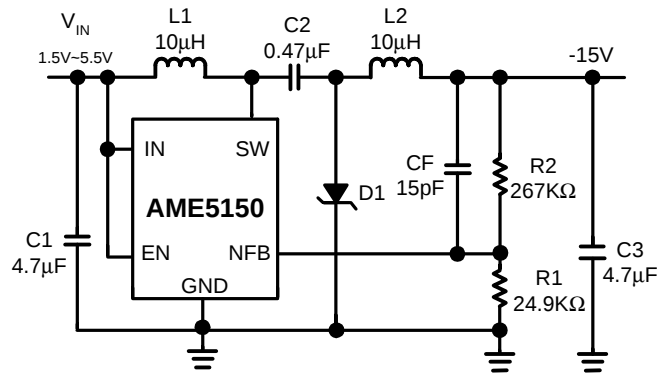


Figure. 1
1-cell Li-Ion to -15V inverting converter

■ Features

- 1Ω Internal Switch
- Use Small Surface Mount Components
- Adjust Output Voltage up to -28V
- 1.5V to 5.5V Input Voltage Range
- Input under Voltage Lockout
- 0.1 µA Shutdown Current
- Internal Soft Star
- All AME's Lead Free Products Meet RoHS Standards

$$R1 = \frac{|V_{OUT}| - |V_{NFB}|}{\frac{|V_{NFB}|}{R2} + I_{NFB}}$$

■ Applications

- Electronic Information Organizers
- Palmtops
- Cellular and Portable Phones
- Portable Audio Systems
- Various Multi-function Power Supplies

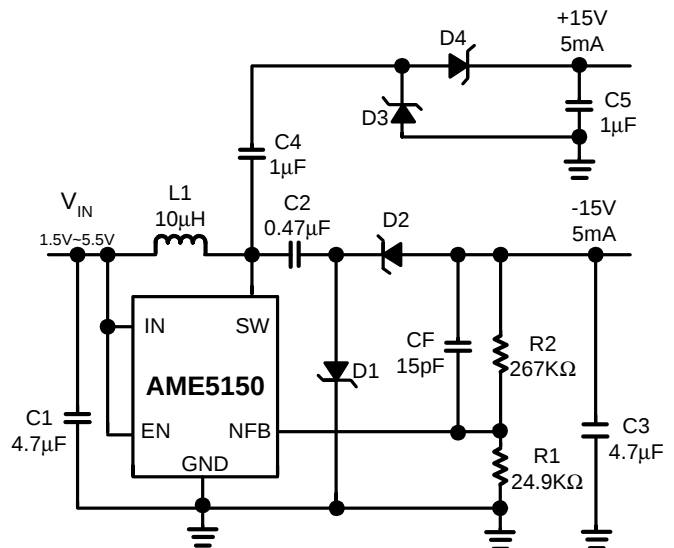


Figure. 2
± 15V Dual output converter



■ Function Block Diagram

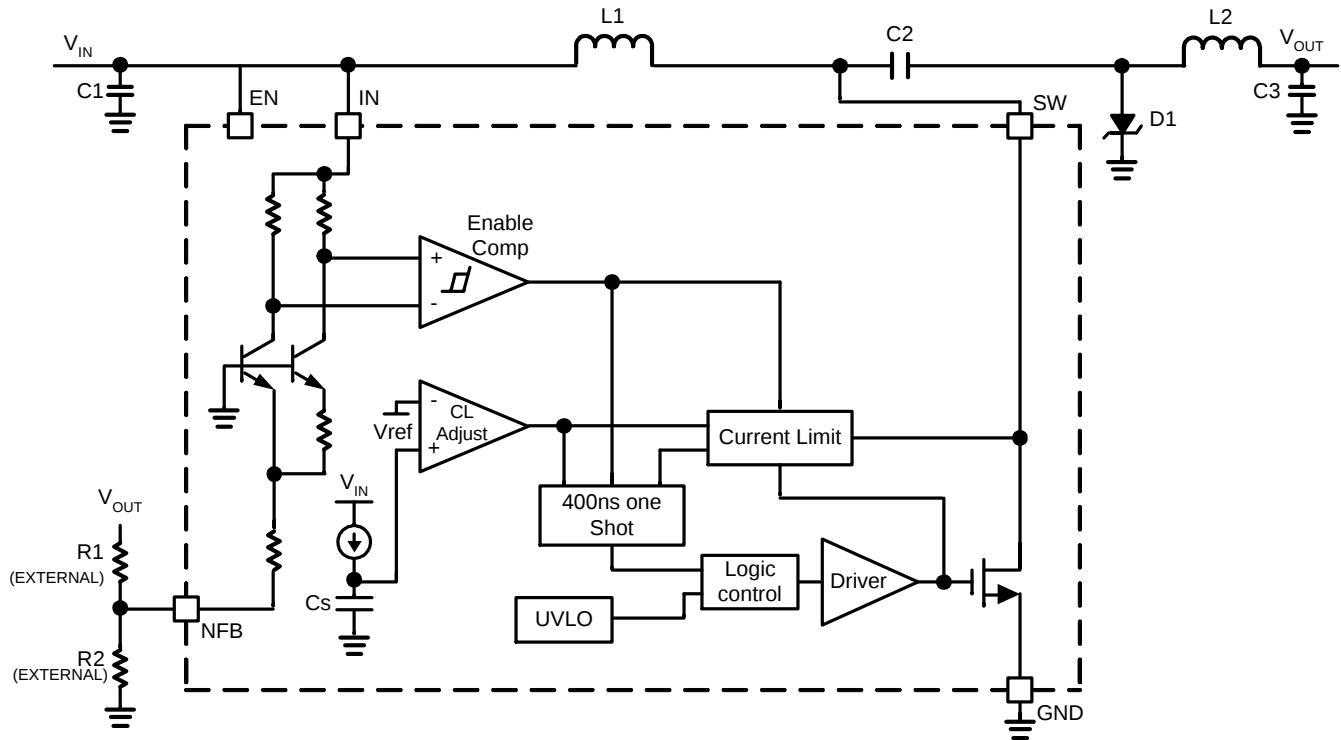
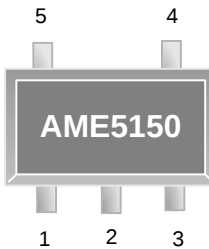


Figure. 3



■ Pin Configuration

SOT-25/TSOT-25
Top View



AME5150AEEV

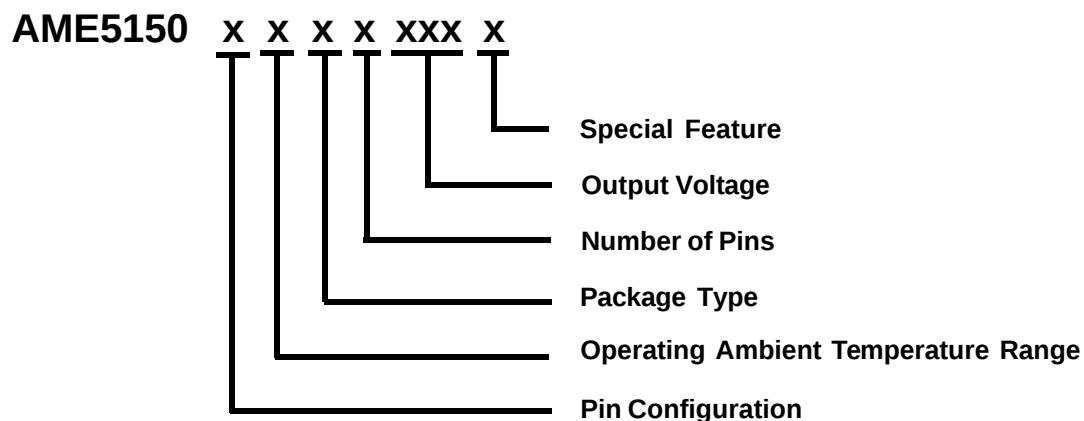
1. SW
2. GND
3. NFB
4. EN
5. IN

Die Attach:
Conductive Epoxy

■ Pin Description

Pin Number	Pin Name	Pin Description
1	SW	Power Switch input. This is the drain of the internal NMOS power switch. Minimize the metal trace area connected to this pin to minimize EMI.
2	GND	Ground. Tie directly to ground plane.
3	NFB	Output voltage feedback input. Set the output voltage by selecting values for R1 and R2 using: $R1 = \frac{ V_{OUT} - V_{NFB} }{\frac{ V_{NFB} }{R2} + I_{NFB}}$
4	EN	Enable control input, active high. The enable pin is an active high control. Tie this pin above 1.5V to enable the device. Tie this pin below 0.4V to turn off the device.
5	IN	Analog and Power input. Input Supply Pin. Bypass this pin with a capacitor as close to the device as possible.

■ Ordering Information



Pin Configuration	Operating Ambient Temperature Range	Package Type	Number of Pins	Output Voltage	Special Feature
A 1. SW (SOT-25) 2. GND (TSOT-25) 3. NFB 4. EN 5. IN	E: -40°C to 85°C	E: SOT-2X	V: 5	ADJ: Adjustable	Z: Lead free Y: Lead free & Low profile

■ Ordering Information

Part Number	Marking*	Output Voltage	Package	Operating Ambient Temperature Range
AME5150AEEVADJZ	BISww	ADJ	SOT-25	-40°C to 85°C
AME5150AEEVADJY	BISww	ADJ	TSOT-25	-40°C to 85°C

Note: ww represents the date code and pls refer to Date Code Rule on Package Dimension.

* A line on top of the first letter represents lead free plating such as BISww.

Please consult AME sales office or authorized Rep./Distributor for the availability of package type.



■ Absolute Maximum Ratings

Parameter	Symbol	Maximum	Unit
Input Supply Voltage	V_{IN}	6	V
EN, NFB Voltages	EN, V_{NFB}	V_{IN}	V
SW Voltage	V_{SW}	$V_{OUT} + 0.3$	V
N-Channel Switch Sink Current	I_{SW}	600	mA
ESD Classification	B*		

Caution: Stress above the listed absolute rating may cause permanent damage to the device.

* HBM B: 2000~3999V

■ Recommended Operating Conditions

Parameter	Symbol	Rating	Unit
Ambient Temperature Range	T_A	- 40 to 85	°C
Junction Temperature Range	T_J	- 40 to 125	
Storage Temperature Range	T_{STG}	- 65 to 150	

■ Thermal Information

Parameter	Package	Die Attach	Symbol	Maximum	Unit
Thermal Resistance* (Junction to Case)	SOT-25 TSOT-25	Conductive Epoxy	θ_{JC}	81	$^{\circ}\text{C} / \text{W}$
Thermal Resistance (Junction to Ambient)			θ_{JA}	260	
Internal Power Dissipation			P_D	400	mW
Solder Iron (10Sec)**				350	$^{\circ}\text{C}$

* Measure θ_{JC} on backside center of molding compound if IC has no tab.

** MIL-STD-202G 210F



■ Electrical Specifications

$V_{IN} = 3.6V$, $EN = V_{IN}$, $T_A = 25^{\circ}C$, $C_{IN} = 4.7\mu F$, $I_L = 0A$, unless otherwise noted.

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Input Voltage	V_{IN}		1.5		5.5	V
Quiescent Current	I_Q	$V_{IN} = 2V$, $V_{NFB} = -1.3V$		65	90	μA
Shutdown Current	I_{SD}	$EN = 0V$		0.1	1	μA
Feedback Trip Point	V_{NFB}		-1.205	-1.23	-1.255	V
Feedback Hysteresis	V_{NFB} Hysteresis			5		mV
Switch Current Limit	I_{CL}		300	375	450	mA
NFB Pin Bias Current	I_{NFB}	$V_{NFB} = -1.23V$		2	2.7	μA
Switch $R_{DS(on)}$	$R_{DS(on)}$		0.6	1	1.4	Ω
Switch Off Time	t_{OFF}			400		nS
Input Undervoltage Lockout	UVLO			1.2	1.4	V
EN Input Threshold (High) (Enable the device)	EN Threshold		1.5			V
EN Input Threshold (Low) (Shutdown)					0.4	



■ Detailed Description

The AME5150 features a constant off-time control scheme. Operation can be best understood by referring to Figure 3. When the voltage at the NFB pin is larger than -1.23V , the Enable Comp in Figure 3 enables the device and the NMOS switch is turned on, pulling the SW pin to ground. When the NMOS switch is on, load current is supplied by the output capacitor C3. Once the current in the inductor reaches the peak current limit, the 400ns One Shot turns off the NMOS switch. During this time the energy stored in the inductor is transferred to C3 and the load. After the 400ns off-time the NMOS switch is turned on and energy is stored in the inductor again. This energy transfer from the inductor to the output causes a stepping effect in the output ripple.

This cycle is continued until the voltage at NFB pin reaches -1.23V . When NFB pin reaches this voltage, the enable comparator then disables the device turning off the NMOS switch and reducing the quiescent current of the device to $65\mu\text{A}$. The load current is then supplied solely by C3 indicated by the gradually decreasing voltage at the output. When the NFB pin drops slightly below -1.23V , the enable comparator enables the device and begins the cycle as described previously. The EN pin can be used to turn off the AME5150 and reduce the quiescent current to $0.1\mu\text{A}$.

■ Typical Application

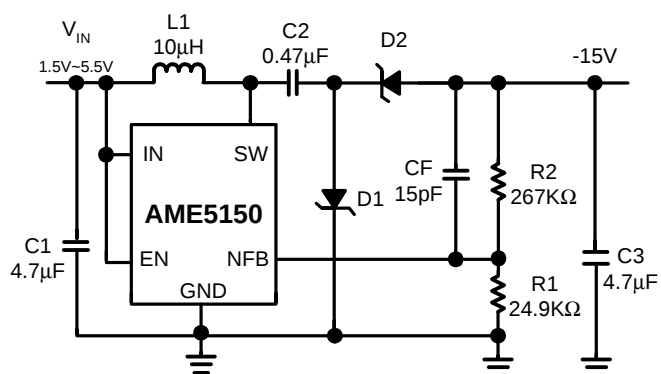
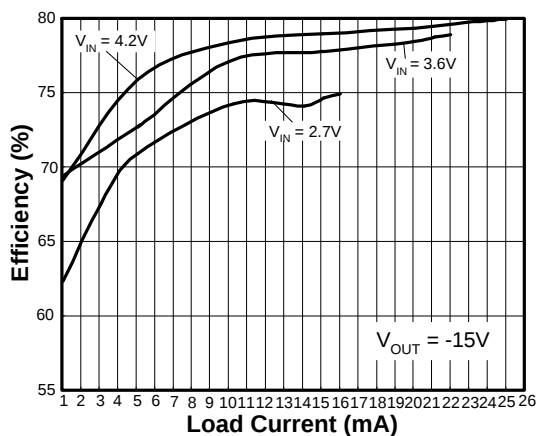


Figure. 4

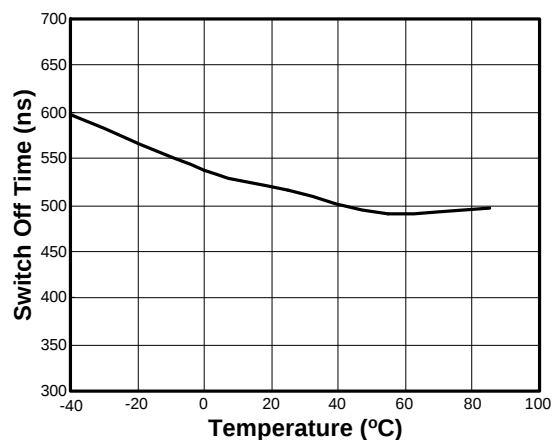
1-cell Li-Ion to -15V inverting charge pump converter



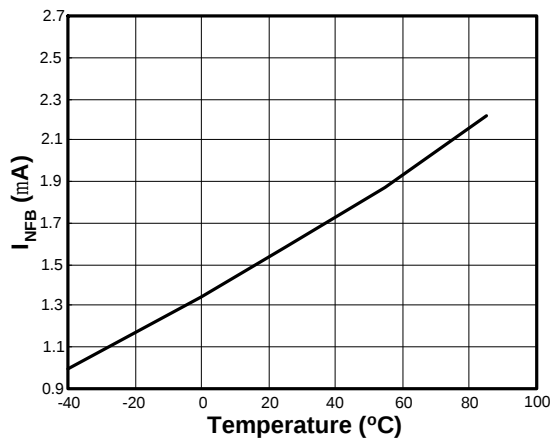
Efficiency vs. Loading



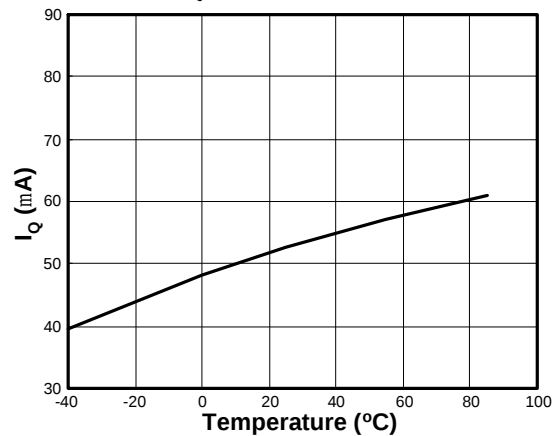
Switch off Time vs. Temperature



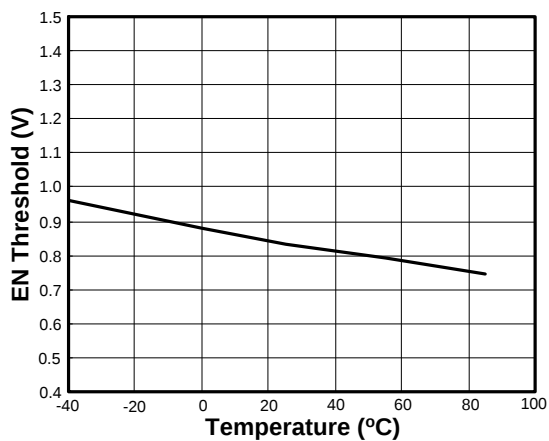
I_{NFB} vs. Temperature



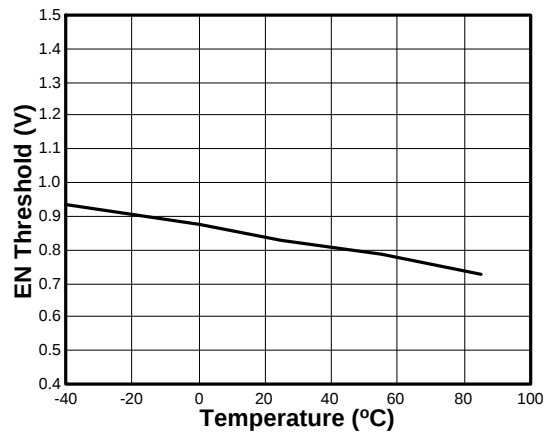
I_Q vs. Temperature



EN Threshold High vs. Temperature

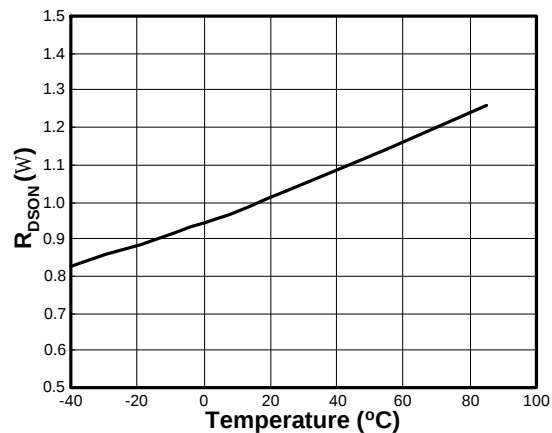


EN Threshold Low vs. Temperature

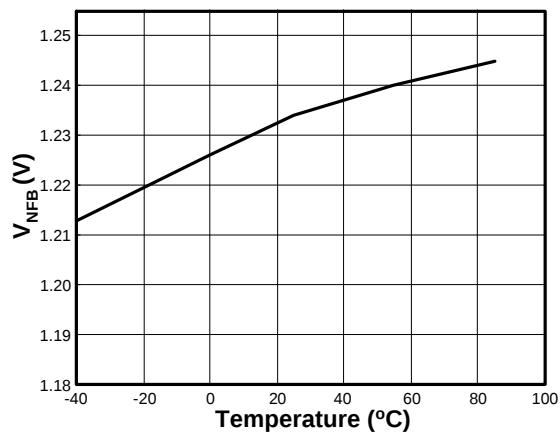




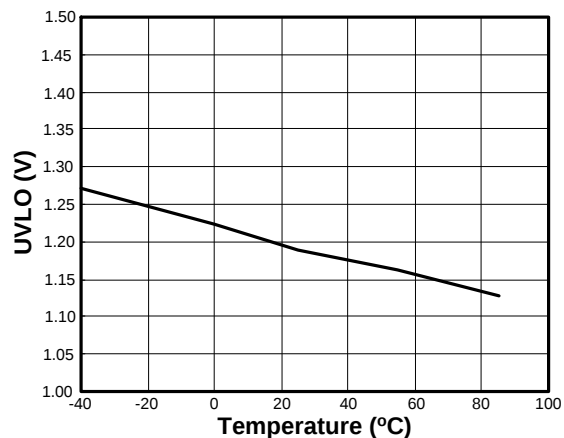
$R_{\text{DS(on)}}$ vs. Temperature



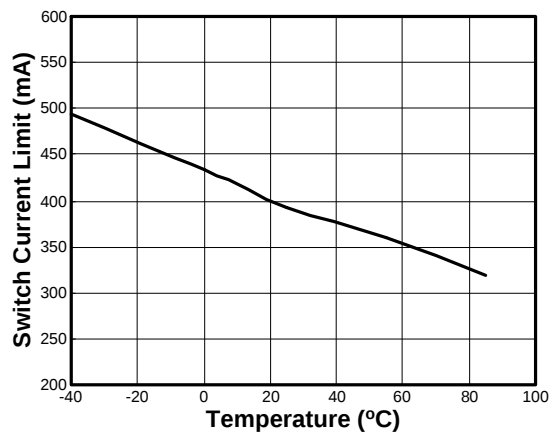
V_{NFB} vs. Temperature



UVLO vs. Temperature



Switch Current Limit vs. Temperature



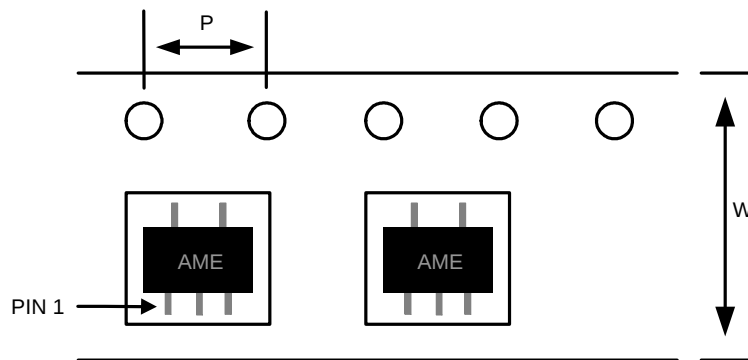


■ Date Code Rule

Marking			Date Code		Year
A	A	A	W	W	xxx0
A	A	A	W	<u>W</u>	xxx1
A	A	A	<u>W</u>	W	xxx2
A	A	A	<u>W</u>	<u>W</u>	xxx3
A	A	<u>A</u>	W	W	xxx4
A	A	<u>A</u>	W	<u>W</u>	xxx5
A	A	<u>A</u>	<u>W</u>	W	xxx6
A	A	<u>A</u>	<u>W</u>	<u>W</u>	xxx7
A	<u>A</u>	A	W	W	xxx8
A	<u>A</u>	A	W	<u>W</u>	xxx9

■ Tape and Reel Dimension

SOT-25

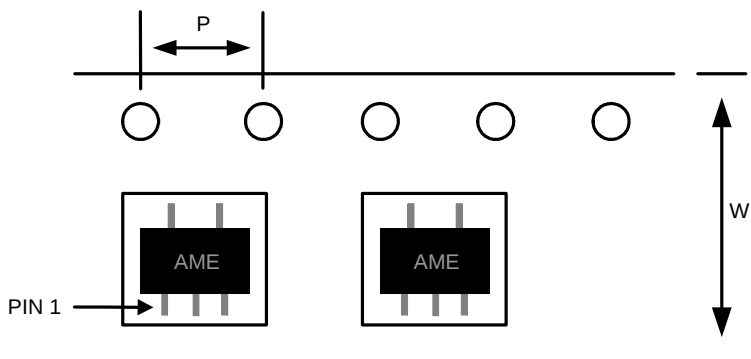


Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
SOT-25	8.0±0.1 mm	4.0±0.1 mm	3000pcs	180±1 mm

■ Tape and Reel Dimension

TSOT-25

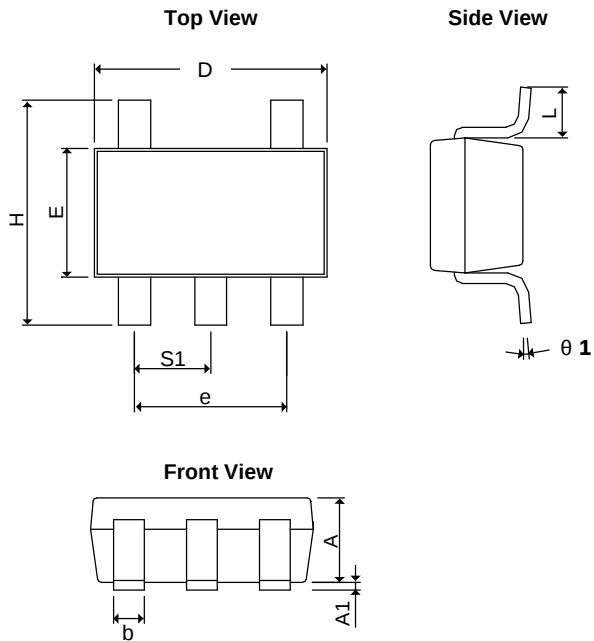


Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
TSOT-25	8.0±0.1 mm	4.0±0.1 mm	3000pcs	180±1 mm

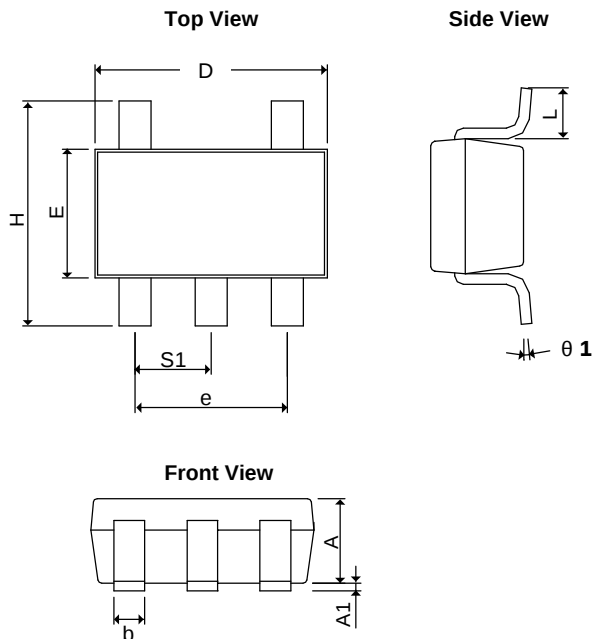
■ Package Dimension

SOT-25



SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.20REF		0.0472REF	
A ₁	0.00	0.15	0.0000	0.0059
b	0.30	0.55	0.0118	0.0217
D	2.70	3.10	0.1063	0.1220
E	1.40	1.80	0.0551	0.0709
e	1.90 BSC		0.07480 BSC	
H	2.60	3.00	0.10236	0.11811
L	0.37BSC		0.0146BSC	
q1	0°	10°	0°	10°
S ₁	0.95BSC		0.0374BSC	

TSOT-25



SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A+A ₁	0.90	1.25	0.0354	0.0492
b	0.30	0.50	0.0118	0.0197
D	2.70	3.10	0.1063	0.1220
E	1.40	1.80	0.0551	0.0709
e	1.90 BSC		0.07480 BSC	
H	2.40	3.00	0.09449	0.11811
L	0.35BSC		0.0138BSC	
q1	0°	10°	0°	10°
S ₁	0.95BSC		0.0374BSC	



www.ame.com.tw
E-Mail: sales@ame.com.tw

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Corporate Headquarter
AME, Inc.

2F, 302 Rui-Guang Road, Nei-Hu District
Taipei 114, Taiwan, R.O.C.
Tel: 886 2 2627-8687
Fax: 886 2 2659-2989

U.S.A.(Subsidiary)
Analog Microelectronics, Inc.

3100 De La Cruz Blvd., Suite 201
Santa Clara, CA. 95054-2438
Tel : (408) 988-2388
Fax: (408) 988-2489