AME

AME8902A

5.5V 1A, High PSRR, Low Output Noise, Ultra-Low Dropout Voltage Regulator

■ General Description

The AME8902A device is a CMOS-based positive voltage regulator featuring 1A that provides high ripple rejection, low dropout voltage, high output voltage accuracy and low supply current. Internally, it consists of voltage reference unit, an error amplifier, a resistor-net for output voltage setting, a current limit circuit, a thermal shutdown circuit and reverse current protection circuit.

AME8902A is available in the DFN-6D(2x2x0.75mm) & DFN-8C(3x3x0.75mm) packages.

■ Features

● 1.32V to 5.5V Wide Input Voltage Range
● Output Voltage Range:
  Fixed Version_from 0.9V to 4.3V
  ADJ Version_from 0.85V to 5.0V
● Output Voltage Tolerance: $\pm$1%
● Dropout Voltage: 156mV @1A
● Maximum Output Current: 1A
● High PSRR: 80dB @1kHz
● Output Noise: 10μVrms
● Shutdown Current: 0.1μA (typical)
● Internal Over Temperature Protection
● Internal Over Current Protection
● Built-in Soft-Start and Inrush Current Limit
● Fast Auto Discharge Function for Power Down

■ Applications

● Portable Device, Tablet and Smartphone
● Camera, VCR and Car Dashboard Camera
● Low Light and Low Noise Cam Application
● Communications and Infrastructure
● AR and VR Application
● Motors and Lightings that are accompanied by Self-Heating
● FA Equipment, Smart Meter
● Vending Machines that are used under High Temperature Conditions

■ Typical Applications

A. Fixed Mode
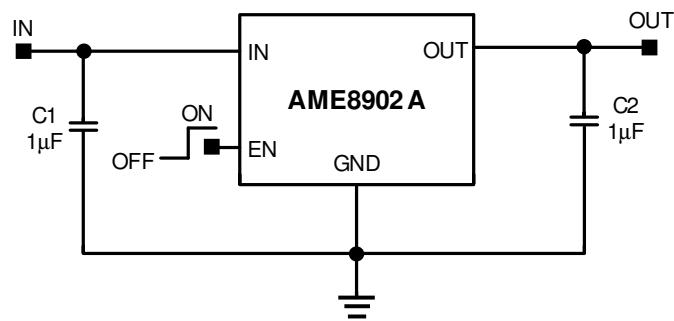
B. ADJ Mode
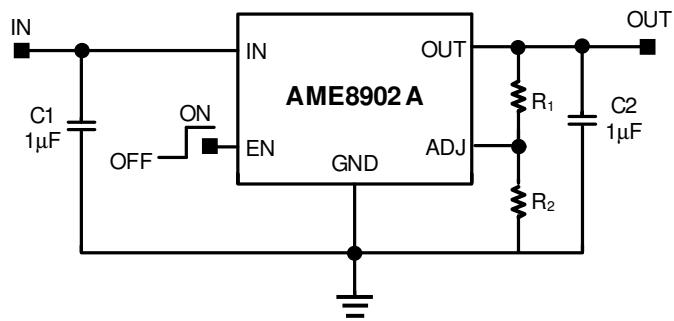
■ Functional Block Diagram

Fixed Version

ADJ Version

■ Pin Configuration

**DFN-6D
(2x2x0.75mm)
Top View**
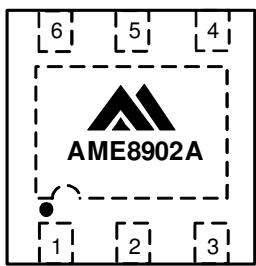
AME 8902A-AVYxxx

1. OUT
2. NC
3. GND
4. EN
5. NC
6. IN

* **Die Attach:
Conductive Epoxy**

**DFN-6D
(2x2x0.75mm)
Top View**
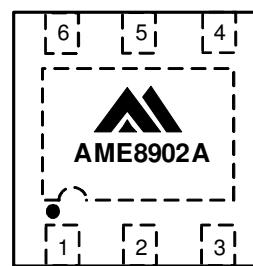
AME 8902A-BVYADJ

1. OUT
2. ADJ
3. GND
4. EN
5. NC
6. IN

* **Die Attach:
Conductive Epoxy**

**DFN-8C
(3x3x0.75mm)
Top View**
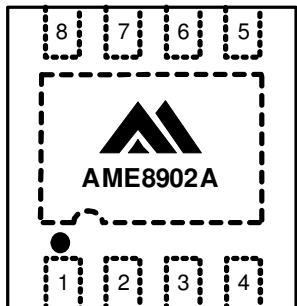
AME 8902A-AVAADJ

1. IN
2. IN
3. OUT
4. OUT
5. ADJ
6. GND
7. NC
8. EN

* **Die Attach:
Conductive Epoxy**

Note: Connect exposed pad (heat sink on the back) to GND.

■ Pin Description

Pin Name	Pin Description	Pin Number		
		DFN-6D (2x2x0.75mm)		DFN-8C (3x3x0.75mm)
		A	B	A
IN	Input Voltage pin	6	6	1, 2
GND	Ground pin	3	3	6
OUT	Output Voltage pin	1	1	3, 4
EN	Enable pin	4	4	8
ADJ	ADJ pin	NA	2	5
NC	No connection	2/5	5	7

■ Ordering Information

AME8902 A - x x x xxx

- Output Voltage
- Number of Pins
- Package Type
- Pin Configuration
- Version

Version	Pin Configuration		Package Type	Number of Pins	Output Voltage
AME8902A 1. V_{ADJ} = 0.85V	A (DFN-6D)	1. OUT 2. NC 3. GND 4. EN 5. NC 6. IN	V: DFN	A: 8 Y: 6	100: 1.0V 120: 1.2V 150: 1.5V 180: 1.8V 250: 2.5V 280: 2.8V 300: 3.0V 330: 3.3V ADJ: ADJ
	B (DFN-6D) (ADJ Version)	1. OUT 2. ADJ 3. GND 4. EN 5. NC 6. IN			
	A (DFN-8C) (ADJ Version)	1. IN 2. IN 3. OUT 4. OUT 5. ADJ 6. GND 7. NC 8. EN			

■ Absolute Maximum Ratings

Parameter		Maximum	Unit
Input Voltage		-0.3 to 6	V
Enable Voltage		-0.3 to 6	V
Output Voltage		-0.3 to 6	V
ESD Classification	HBM	± 4	kV
	MM	± 200	V
	CDM	± 1000	V

■ Recommended Operating Conditions

Parameter	Symbol	Rating	Unit
Input Voltage	V_{IN}	1.32 to 5.5	V
Ambient Temperature Range	T_A	-40 to +85	^{o}C
Junction Temperature Range	T_J	-40 to +125	
Storage Temperaturen Range	T_{STG}	-55 to +150	

■ Thermal Information

Parameter	Package	Die Attach	Symbol	Maximum	Unit
Thermal Resistance* (Junction to Case)	DFN-6D (2x2x0.75mm)	Conductive Epoxy	θ_{JC}	16	^{o}C / W
	DFN-8C (3x3x0.75mm)			8	
Thermal Resistance (Junction to Ambient)	DFN-6D (2x2x0.75mm)	Conductive Epoxy	θ_{JA}	66	^{o}C / W
	DFN-8C (3x3x0.75mm)			41	
Internal Power Dissipation	DFN-6D (2x2x0.75mm)	Conductive Epoxy	P_{D}	1515	mW
	DFN-8C (3x3x0.75mm)			2420	
Lead Temperature (soldering 10 sec)**				300	^{o}C

 * Measure θ_{JC} on backside center of Exposed Pad.
** MIL-STD-202G210F

■ Electrical Specifications

$V_{IN} = V_{OUT}+1V$, $I_{OUT} = 1mA$, $C_{IN} = C_{OUT} = 1.0\mu F$, $T_A = 25^oC$ unless otherwise noted.

Parameter	Symbol	Test Condition		Min	Typ	Max	Units
Input Voltage	V_{IN}			1.32		5.5	V
Output Voltage Accuracy	$V_{OUT,ACC}$	$V_{OUT} < 1.8V$		-20		+20	mV
		$V_{OUT} \geqq 1.8V$		-1.0		+1.0	%
Output Voltage Range	V_{OUT}	Fix	AME8902A	0.9		4.3	V
		ADJ		0.85		5.0	V
ADJ Referenca Voltage	V_{REF}	AME8902A		0.8415	0.85	0.8585	V
Dropout Voltage *Note1	V_{DROP}	$I_{OUT} = 1A$	$V_{OUT(NOM)} \leqq 1.1V$		*Note2		mV
			$1.1V < V_{OUT(NOM)} \leqq 1.8V$		220	285	
			$1.8V < V_{OUT(NOM)} \leqq 2.5V$		185	250	
			$2.5V < V_{OUT(NOM)} \leqq 3.3V$		165	230	
			$3.3V < V_{OUT(NOM)} \leqq 5.0V$		140	200	
Output Current	I_{OUT}	$V_{OUT} > 0.8V$		1			A
Current Limit	I_{LIM}	$V_{OUT} > 0.8V$		1.3	1.56		A
Short Circuit Current	I_{SC}	$V_{OUT} = 0V$				186	mA
Quiescent Current	I_Q	$I_{OUT} = 0mA$, $V_{EN} = V_{IN}$			85	130	μA
Shutdown Current	I_{SHDN}	$V_{IN} = 5V$, $V_{OUT} = 0V$, $V_{EN} = 0V$			0.1	2	μA
Line Regulation	REG_{LINE}				0.01		%/V
Load Regulation	REG_{LOAD}	$I_{OUT} = 10mA$ to $1000mA$			1	50	mV
EN Input Threshold	$V_{EN(LO)}$	$V_{IN(MIN)} \leqq V_{IN} \leqq 5.5V$				0.4	V
	$V_{EN(HI)}$	$V_{IN(MIN)} \leqq V_{IN} \leqq 5.5V$		1		V_{IN}	V
Output Voltage Noise	eN				10		μV_{RMS}
Power Supply Ripple Rejection	PSRR	$I_{OUT} = 1mA$, $f = 1kHz$			80		dB
Under Voltage Lockout	V_{UVLO}	Rising Edge			1.3		V
Under Voltage Lockout Hystereis	$V_{UVLO,HY}$				0.3		V
Over Temperature Shutdown	OTS				165		^oC
Over Temperature Hysteresis	OTH				35		^oC

*Note1: Dropout Voltage is measure at $V_{OUT} = V_{OUT(NOM)}$ x 99%.

*Note2: For V_{OUT} below 1.1V, Dropout Voltage is the $V_{IN(MIN)}$ to Output Differential.

■ Detailed Description

Overview

The AME8902A is a low-dropout linear regulator (LDO) featuring low quiescent current with excellent line and load transient performance.

This LDO is designated for power-sensitive applications. The precision of band gap and error amplifier provides over-all 1% accuracy together with low-output noise, high power supply rejection ratio(PSRR) and low-dropout voltage.

Enable Pin

The function of enable pin is activated in Active-High mode. During pulled-low mode, the MOS pass transistor is shut-off and all of internal circuits are powered down. When the EN pin is floating, the internal mode is pulled-down.

Adjustable Version

The output voltage of regulator is determind by external resistor dividers. While the external resistor divider is connected to ADJ pin, the output voltage is calculated by the following equation:

$$V_{OUT} = V_{ADJ} \times (1 + \frac{R1}{R2})$$

For AME8902A, the range of output voltage is from 0.85V to 5V.

The value of R1 and R2 should be high enough to keep low quiescent current but the exceeding value of R1+R2 will reduce stability. In general, when the value of R1 and R2 is above 10KΩ, LDO will reach adequate stability and generate reasonable layout precautions. To improve stability characteristics, keep parasitics on the ADJ pin to a minimum and lower R1 and R2 values.

Under-Voltage Lockout(UVLO)

The AME8902A uses an undervoltage lockout circuit to keep the output shut-off until the internal circuitry is operating properly.

Input and Output Capacitor Selection

The AME8902A regulator is designed to stabilize a wide range of output capacitors. The ESR of output capacitor affects stability. Larger ESR value of the output capacitor decreases the peak deviations and improves transient response during large changes of current.

The different types of capacitor(aluminum, ceramic and tantalum) are with different characterizations, such as temperature and voltage coefficients. All of ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior across temperature and applications. Commom dielectrics used are X5R, X7R and Y5V. It is recommended to use 1μF to 10μF X5R or X7R dielectric ceramic capacitors with 30mΩ to 50mΩ ESR range between device outputs and ground for stability. The AME8902A is designed to stabilize with low ESR ceramic capacitors and higher values of cpacitors and ESR could improve output stability. The ESR of output capacitor is very important because it generates a zero to provide phase lead for loop stability.

There is no requirement for the ESR on the input capacitor but it is voltage and temperature coefficient must be considered for the environment of device application.

Auto Discharge

The auto discharge function of AME8902A could quickly force the output voltage to zero. When the LDO is disabled, the auto discharge function quickly discharges the output capacitor, thereby reducing the output voltage to nearly zero. This function is very useful for the applications with quick ON/OFF function.

■ Detailed Description(Contd.)

Thermal Consideration

The power handling capability of device will be limited by allowable operation junction temperature(125°C).

The maximum output power of AME8902A is limited by the package's maximum power dissipation. The calculation of package's power dissipation is related to input voltage, output voltage and output current. The maximum of power dissipation should not exceed the package's maximum power rating.

$$P_{MAX} = (V_{IN\text{-}MAX} - V_{OUT}) \times I_{OUT}$$

Where:
$V_{IN\text{-}MAX}$ = maximum input voltage
P_{MAX} = maximum power dissipation of the package

■ Characterization Curve

Output Voltage

$V_{IN} = 2.2V$
$V_{OUT} = 1.2V$
$I_{OUT} = 1mA$

Output Voltage

$V_{IN} = 2.8V$
$V_{OUT} = 1.8V$
$I_{OUT} = 1mA$

Quiescent Current

$V_{IN} = 2.8V$
$V_{OUT} = 1.8V$

Quiescent Current

$V_{OUT} = 1.2V$

Rev. C.01
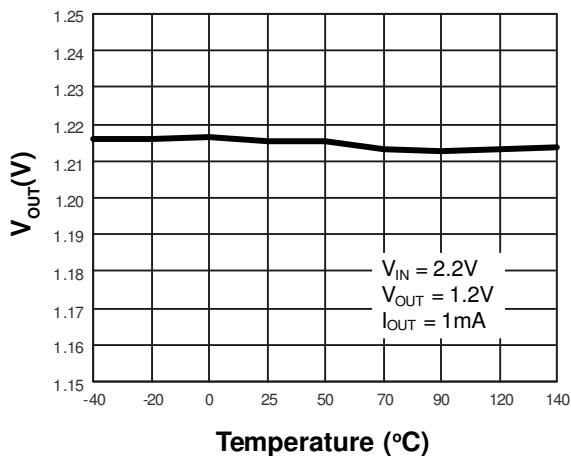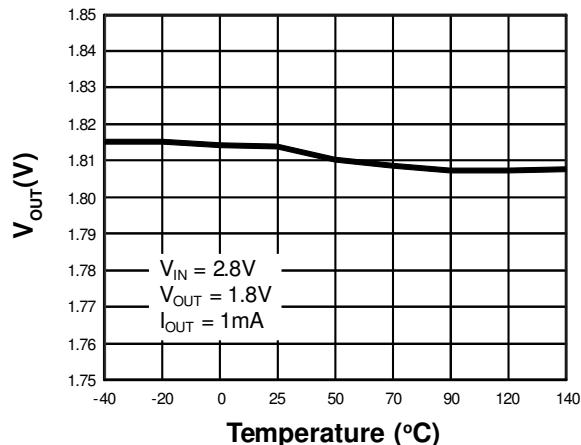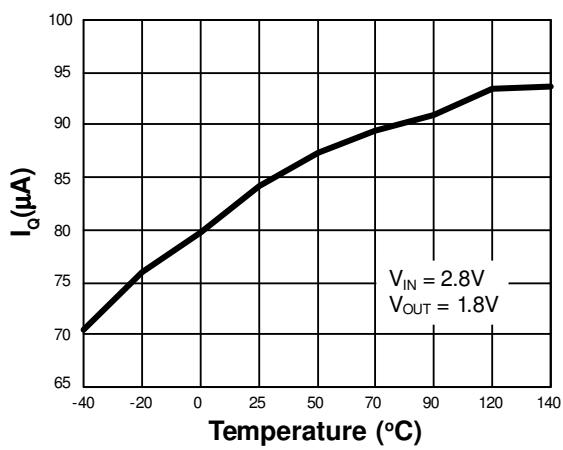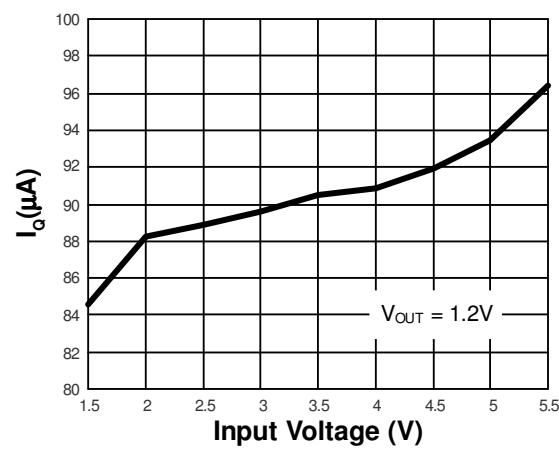
■ Characterization Curve(Contd.)

PSRR vs Frequency

$V_{IN} = 2.8V$
$V_{OUT} = 1.8V$
$I_{OUT} = 10mA$

PSRR vs Frequency

$V_{IN} = 2.8V$
$V_{OUT} = 1.8V$
$I_{OUT} = 300mA$

PSRR vs Frequency

$V_{IN} = 2.8V$
$V_{OUT} = 1.8V$
$I_{OUT} = 500mA$

PSRR vs Frequency

$V_{IN} = 2.8V$
$V_{OUT} = 1.8V$
$I_{OUT} = 1A$
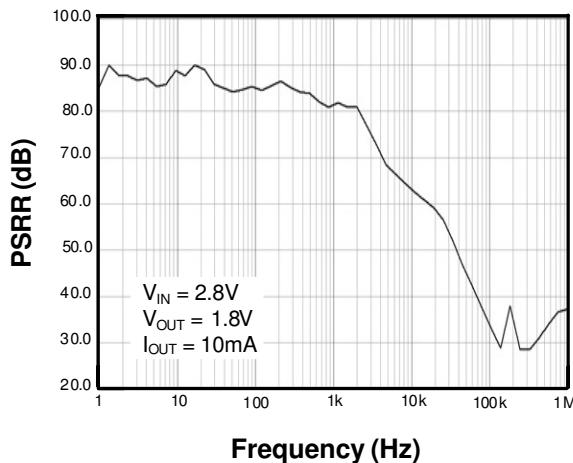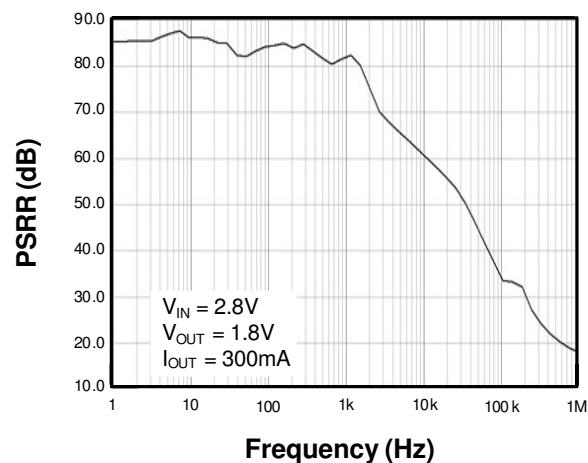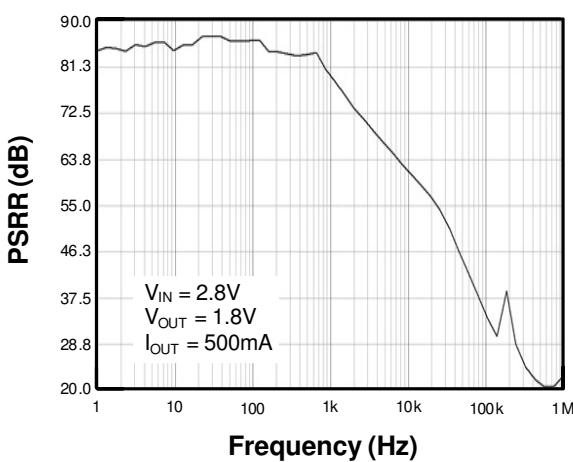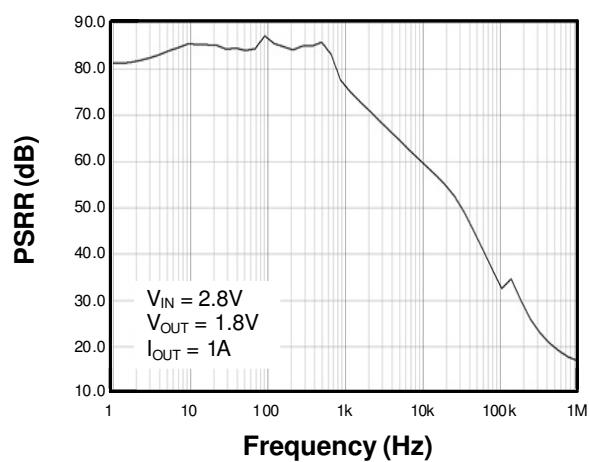
■ Characterization Curve(Contd.)

Load Transient Response
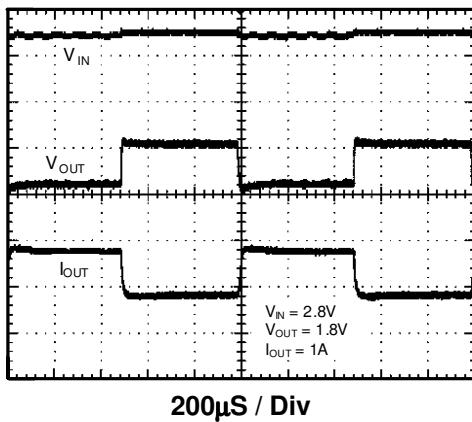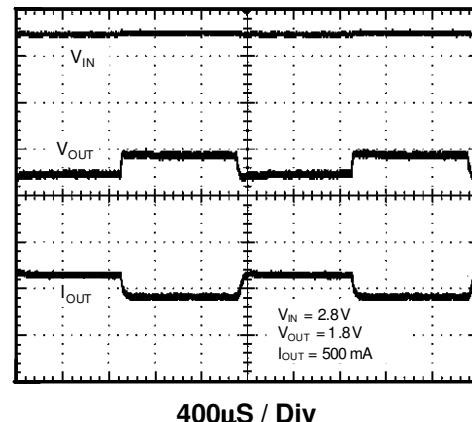
200μS / Div

1. V_{IN} = 2V/Div
2. V_{OUT} = 20mV/Div
3. I_{OUT} = 1A/Div

V_{IN} = 2.8V
V_{OUT} = 1.8V
I_{OUT} = 1A

Load Transient Response

400μS / Div

1. V_{IN} = 2V/Div
2. V_{OUT} = 20mV/Div
3. I_{OUT} = 1A/Div

V_{IN} = 2.8V
V_{OUT} = 1.8V
I_{OUT} = 500 mA

Chip Enable Transient Response

2mS / Div

1. V_{IN} = 1V/Div
2. V_{OUT} = 20mV/Div
   (V_{OUT} = 0.85V/I_{OUT} = 1A)
3. EN = 1V/Div
3. I_{OUT} = 1A/Div

V_{IN} = 1.8V
V_{OUT} = 0.85V
EN = 1.8V
I_{OUT} = 1A

Chip Enable Transient Response

2mS / Div

1. V_{IN} = 1V/Div
2. V_{OUT} = 20mV/Div
   (V_{OUT} = 0.85V/I_{OUT} = 1A)
3. EN = 1V/Div
3. I_{OUT} = 1A/Div

V_{IN} = 1.8V
V_{OUT} = 0.85V
EN = 1.8V
I_{OUT} = 1A
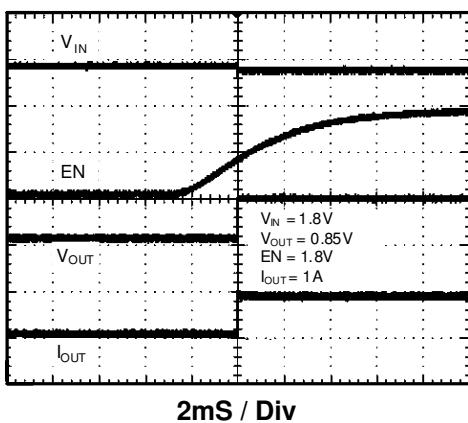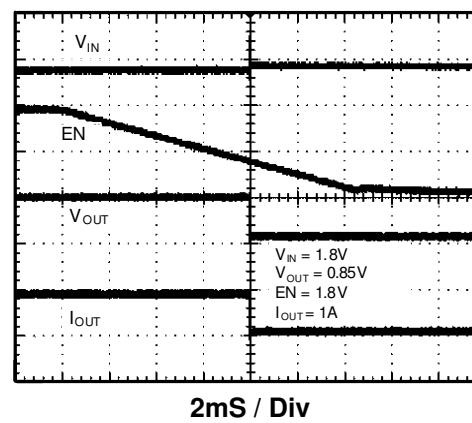
■ Tape and Reel Dimension

**DFN-6D
(2x2x0.75mm)**
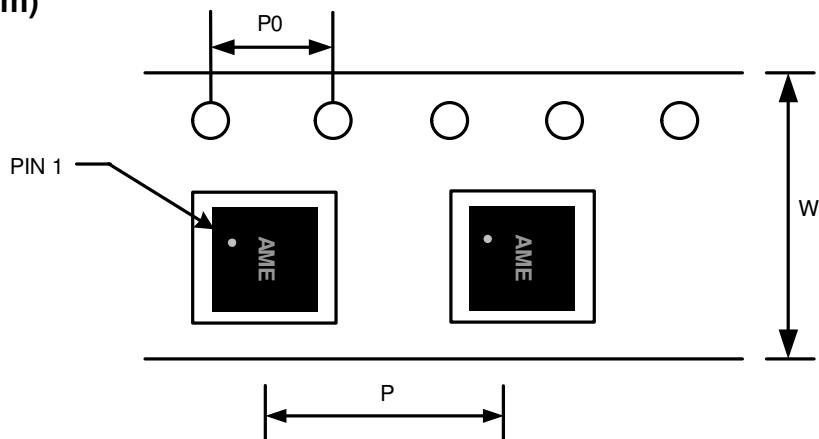
**Carrier Tape, Number of Components Per Reel and Reel Size**

Package	Carrier Width (W)	Pitch (P)	Pitch (P0)	Part Per Full Reel	Reel Size
DFN-6D (2x2x0.75mm)	8.0±0.1 mm	4.0±0.1 mm	4.0±0.1 mm	3000pcs	180±1 mm

■ Tape and Reel Dimension(Contd.)

**DFN-8C
(3x3x0.75mm)**
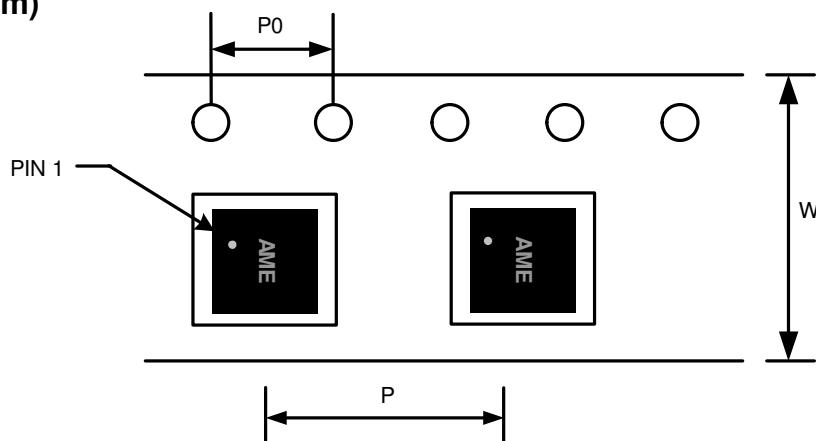
Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Pitch (P0)	Part Per Full Reel	Reel Size
DFN-8C (3x3x0.75mm)	12.0±0.1 mm	8.0±0.1 mm	4.0±0.1 mm	3000pcs	330±1 mm

■ **Package Dimension**

**DFN-6D
(2x2x0.75mm)**

TOP VIEW

BOTTOM VIEW

PIN 1 IDENTIFICATION

REAR VIEW
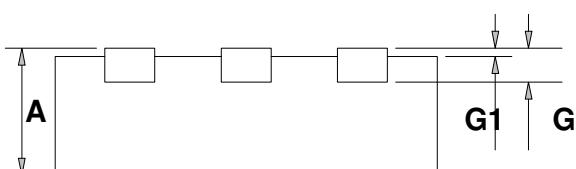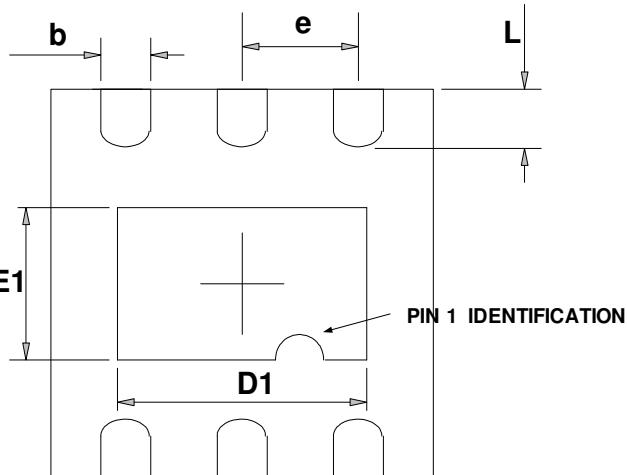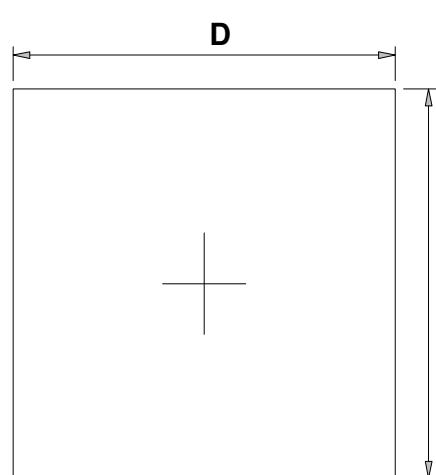
| SYMBOLS	MILLIMETERS		INCHES	
	MIN	**MAX**	**MIN**	**MAX**
A	0.700	0.800	0.028	0.031
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
e	0.650 TYP		0.026 TYP	
D1	1.100	1.650	0.043	0.065
E1	0.600	1.050	0.024	0.041
b	0.180	0.350	0.007	0.014
L	0.200	0.450	0.008	0.018
G	0.178	0.228	0.007	0.009
G1	0.000	0.050	0.000	0.002

■ Lead Pattern Drawing(Contd.)

**DFN-6D
(2x2x0.75mm)**
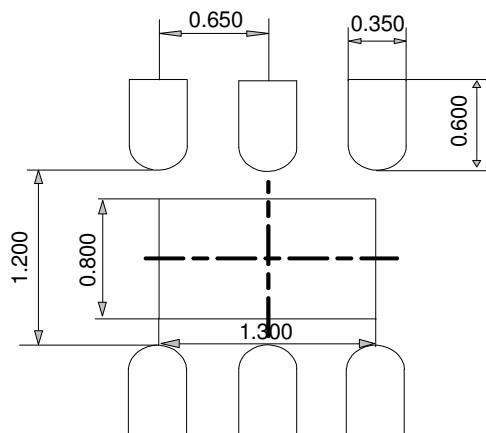
Note:

1. Dimensions in Millimeters.

**2. General tolerance $\pm$0.05mm unless otherwise specified.**

■ Package Dimension(Contd.)

**DFN-8C
(3x3x0.75mm)**

TOP VIEW

BOTTOM VIEW

PIN 1 IDENTIFICATION

REAR VIEW
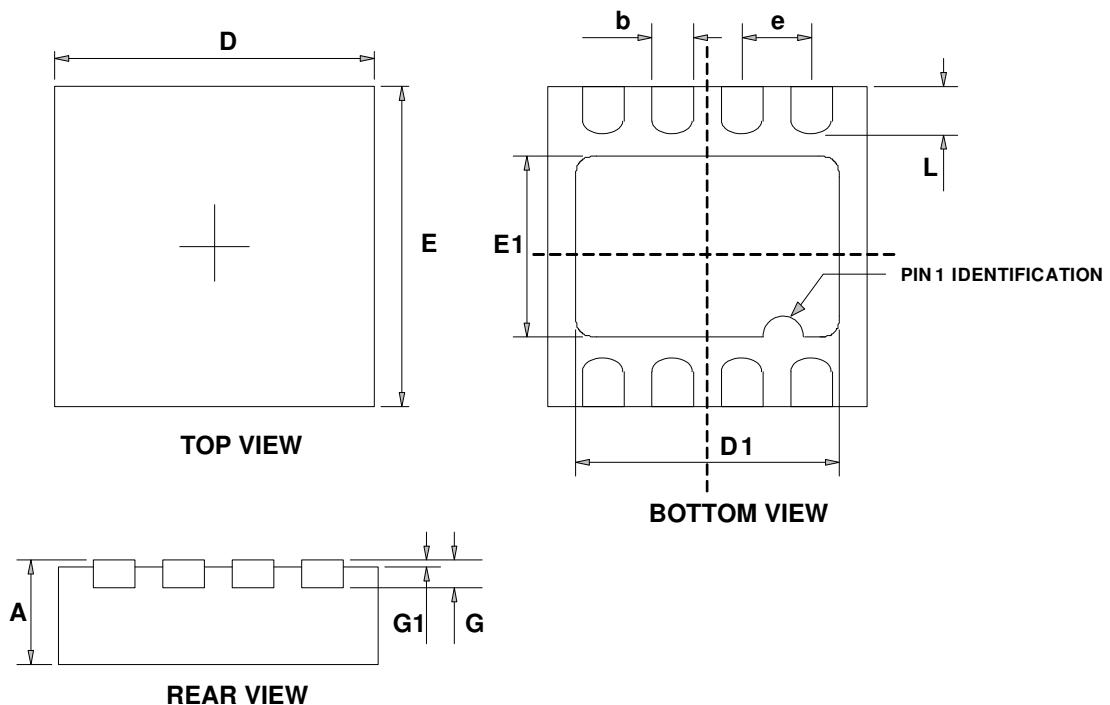
SYMBOLS	MILLIMETERS		INCHES	
	MIN	**MAX**	**MIN**	**MAX**
A	0.700	0.800	0.028	0.031
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
e	0.600	0.700	0.024	0.028
D1	2.200	2.400	0.087	0.094
E1	1.400	1.600	0.055	0.063
b	0.180	0.320	0.007	0.013
L	0.375	0.575	0.015	0.023
G	0.153	0.253	0.006	0.010
G1	0.000	0.050	0.000	0.002

■ Lead Pattern Drawing(Contd.)

**DFN-8C
(3x3x0.75mm)**
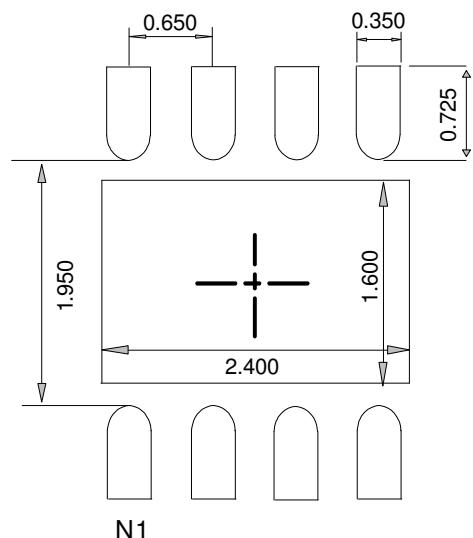
Note:

1. Dimensions in Millimeters.

2. General tolerance +0.05mm unless otherwise specified.

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

Corporate Headquarter
AME, Inc.

8F-1, 12, WenHu St., Nei-Hu
Taipei 114, Taiwan .
Tel: 886 2 2627-8687
Fax: 886 2 2659-2989