

AME8816

1.5A CMOS LDO

■ General Description

The AME8816 family of positive, linear regulators feature low quiescent current (45 μ A typ.) with low dropout voltage, making them ideal for battery applications.

Output voltages are set at the factory and trimmed to 1.5% accuracy.

These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" operating conditions.

In applications requiring a low noise, regulated supply, place a 1000pF capacitor between Bypass and Ground.

The AME8816 is stable with an output capacitance of 4.7 μ F or greater.

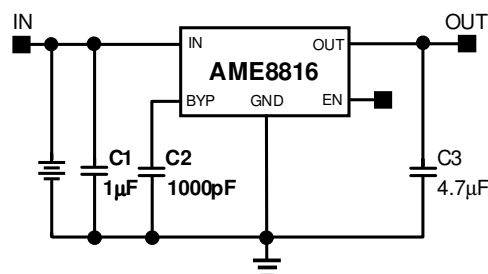
■ Features

- Very Low Dropout Voltage
- Guaranteed 1.5A Output
- Accurate to within 1.5%
- 45 μ A Quiescent Current Typically
- Over-Temperature Shutdown
- Current Limiting
- Short Circuit Current Fold-back
- Noise Reduction Bypass Capacitor (Fixed Versions)
- Power-Saving Shutdown Mode
- Low Temperature Coefficient
- Adjustable Version
- All AME's Lead Free Products Meet RoHS Standards.

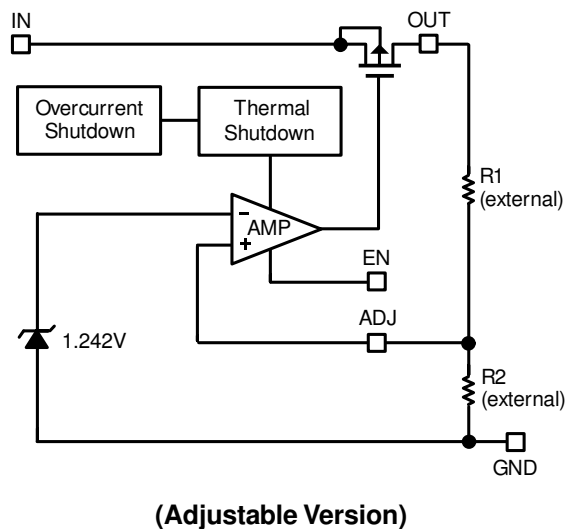
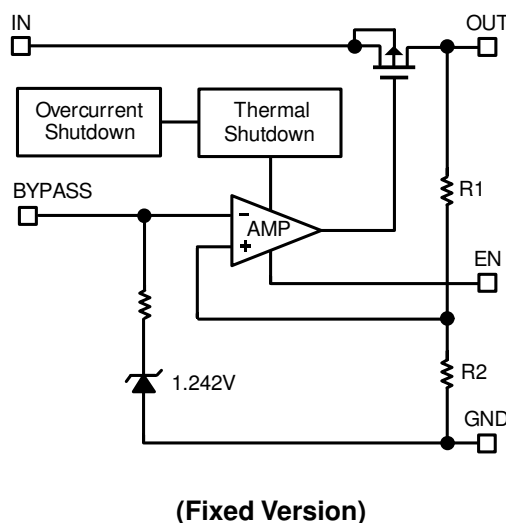
■ Applications

- Instrumentation
- Portable Electronics
- Wireless Devices
- PC Peripherals
- Battery Powered Widgets

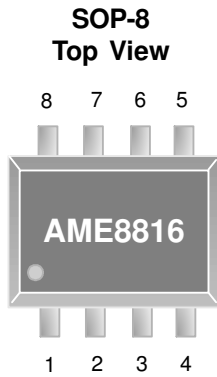
■ Typical Application



■ Functional Block Diagram



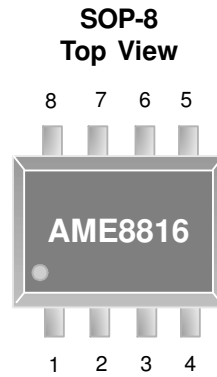
■ Pin Configuration



AME 8816AEHAxxx

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

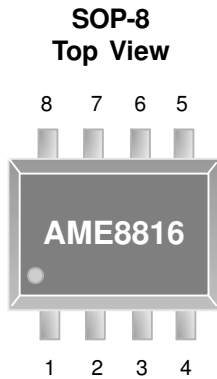
*** Die Attach:
Conductive Epoxy**



AME 8816BEHAADJ

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

*** Die Attach:
Conductive Epoxy**



AME 8816CEHAADJ

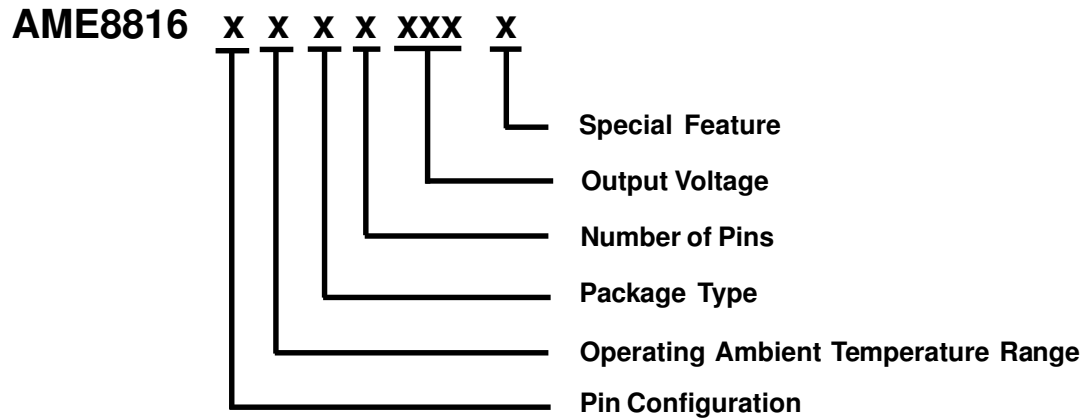
1. EN
2. IN
3. OUT
4. ADJ
5. GND
6. GND
7. GND
8. GND

*** Die Attach:
Conductive Epoxy**

■ Pin Description

Pin Name	Pin Description
IN	Input voltage pin. It should be decoupled with 1 μ F or greater capacitor.
GND	Ground connection pin.
EN	Enable pin. When pulled low, the PMOS pass transistor turns off, current consuming less than 1 μ A.
BYP	Bypass capacitor connection. To improve AC ripple rejection, connect a 1000pF capacitor to GND. This will also provide a soft-start function.
OUT	LDO voltage regulator output pin. It should be decoupled with a 4.7 μ F or greater value low ESR ceramic capacitor.
ADJ	Feedback output voltage for adjustable device.

■ Ordering Information



Pin Configuration	Operating Ambient Temperature Range	Package Type	Number of Pins	Output Voltage	Special Feature
A (SOP-8) 1. BYP 2. GND 3. GND 4. EN 5. IN 6. GND 7. GND 8. OUT	E: -40°C to +85°C	H: SOP	A: 8	ADJ: Adjustable 150: V=1.5V 180: V=1.8V 250: V=2.5V 330: V=3.3V 475: V=4.75V 500: V=5.0V	Z: Lead Free
B (SOP-8) 1. ADJ 2. GND 3. GND 4. EN 5. IN 6. GND 7. GND 8. OUT					
C (SOP-8) 1. EN 2. IN 3. OUT 4. ADJ 5. GND 6. GND 7. GND 8. GND					

■ Ordering Information

Part Number	Marking*	Output Voltage	Package	Operating Ambient Temperature Range
AME8816AEHA150	AME8816 AEHA150 yyww	1.50	SOP-8	- 40°C to +85°C
AME8816AEHA150Z	AME8816 AEHA150 yyww	1.50	SOP-8	- 40°C to +85°C
AME8816AEHA180	AME8816 AEHA180 yyww	1.80	SOP-8	- 40°C to +85°C
AME8816AEHA180Z	AME8816 AEHA180 yyww	1.80	SOP-8	- 40°C to +85°C
AME8816AEHA250	AME8816 AEHA250 yyww	2.50	SOP-8	- 40°C to +85°C
AME8816AEHA250Z	AME8816 AEHA250 yyww	2.50	SOP-8	- 40°C to +85°C
AME8816AEHA330	AME8816 AEHA330 yyww	3.30	SOP-8	- 40°C to +85°C
AME8816AEHA330Z	AME8816 AEHA330 yyww	3.30	SOP-8	- 40°C to +85°C
AME8816AEHA475	AME8816 AEHA475 yyww	4.75	SOP-8	- 40°C to +85°C
AME8816AEHA475Z	AME8816 AEHA475 yyww	4.75	SOP-8	- 40°C to +85°C
AME8816AEHA500	AME8816 AEHA500 yyww	5.00	SOP-8	- 40°C to +85°C
AME8816AEHA500Z	AME8816 AEHA500 yyww	5.00	SOP-8	- 40°C to +85°C

■ Ordering Information (Contd.)

Part Number	Marking*	Output Voltage	Package	Operating Ambient Temperature Range
AME8816BEHAADJ	AME8816 BEHAADJ yyww	ADJ	SOP-8	- 40°C to +85°C
AME8816BEHAADJZ	AME8816 BEHAADJ yyww	ADJ	SOP-8	- 40°C to +85°C
AME8816CEHAADJ	AME8816 CEHAADJ yyww	ADJ	SOP-8	- 40°C to +85°C
AME8816CEHAADJZ	AME8816 CEHAADJ yyww	ADJ	SOP-8	- 40°C to +85°C

Note: yyww represents the date code

* A line on top of the first character represents lead free plating such as $\overline{\text{AME8816}}$

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

■ Absolute Maximum Ratings

Parameter	Maximum	Unit
Input Voltage	-0.3 to +8	V
EN, BYP Voltage	-0.3 to +8	V
Output Voltage	-0.3 to $V_{IN} + 0.3$	V
Output Current	$P_D / (V_{IN} - V_{OUT})$	mA
ESD Classification	B*	

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

* HBM B:2000V~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	°C
Storage Temperature Range	T_{STG}	- 65 to +150	°C

■ Thermal Information

Parameter	Package	Die Attach	Symbol	Maximum	Unit
Thermal Resistance (Junction to Case)	SOP-8**	Conductive Epoxy	θ_{JC}	60	°C / W
Thermal Resistance (Junction to Ambient)	SOP-8		θ_{JA}	150	
Internal Power Dissipation	SOP-8		P_D	810	mW
Maximum Junction Temperature				150	°C
Solder Iron(10 Sec)***				350	°C

* Measure θ_{JC} on backside center of tab.

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

*** MIL-STD-202G210F

■ Electrical Specifications

$V_{IN} = V_{O(NOM)} + 2V$, $V_{EN} = V_{IN}$, $T_A = 25^{\circ}C$ unless otherwise noted

Parameter	Symbol	Test Condition		Min	Typ	Max	Units
Input Voltage	V _{IN}			Note 1		7	V
Output Voltage Accuracy	V _O	V _{EN} = V _{EHmin} , I _O =1mA		-1.5		1.5	%
Dropout Voltage	V _{DROPOUT}	I _O =1.5A V _O =V _{O(NOM)} -2.0%	1.5V<V _{O(NOM)} <=2.0V		See chart	1300	mV
			2.0V<V _{O(NOM)} <=2.8V			800	
			2.8V<V _{O(NOM)}			600	
Output Current	I _O	V _O >1.2V		1500			mA
Current Limit	I _{LIM}	V _O >1.2V		1500	2000		mA
Short Circuit Current	I _{SC}	V _O <0.4V			750		mA
Quiescent Current (For Fixed Output Voltage Options)	I _Q	I _O =0mA			45	70	μA
Minimun Load Current (For ADJ Option)	I _{MIN}			1			mA
Ground Pin Current	I _{GND}	I _O =1mA to 1.5A			45		μA
Line Regulation	REG _{LINE}	I _O =1mA V _{IN} =V _O +1 to V _O +2	V _O < 2.0V	-0.15		0.15	%
			4.0 > V _O >= 2.0V	-0.1	0.02	0.1	%
			4.0V <= V _O	-0.4		0.4	%
Load Regulation	REG _{LOAD}	I _O =1mA to 1.5A		-1	0.2	1	%
Over Temperature Shutdown	OTS				150		°C
Over Temperature Hysterisis	OTH				30		°C
V _O Temperature Coefficient	TC				30		ppm/°C
ADJ Input Bias Current	I _{ADJ}	V _{IN} = 5V , V _{ADJ} = 1.242V			1		μA
ADJ Reference Voltage	V _{REF}			1.223	1.242	1.261	V
Power Supply Rejection	PSRR	I _O =100mA C _O =4.7μF ceramic	f=100Hz				dB
			f=1kHz		50		
			f=10kHz		20		
Power Supply Rejection	PSRR	I _O =100mA C _O =4.7μF ceramic C _{BYP} =0.01μF	f=100Hz				dB
			f=1kHz		75		
			f=10kHz		55		
Output Voltage Noise	eN	f=10Hz to 100kHz I _O =10mA,C _{BYP} =0μF	Co=4.7μF		30		μVrms
Output Voltage Noise	eN	f=10Hz to 100kHz I _O =10mA,C _{BYP} =0.01μF	Co=4.7μF		30		μVrms
EN Input Threshold	V _{EH}			2.0		Vin	V
	V _{EL}			0		0.4	V
EN Input Bias Current	I _{EH}	V _{IN} = 7V				0.1	μA
	I _{EL}	V _{EN} =0V, V _{IN} = 7V				0.5	μA
Shutdown Supply Current	I _{SD}	V _{IN} = 5V , V _O =0V, V _{EN} =0V			0.5	2	μA

Note1: $V_{IN(min)} = V_{OUT} + V_{DROPOUT}$

Note2: $V_{O(nom)}$: nominal output voltage of fixed version

■ Detailed Description

The AME8816 family of CMOS regulators contain a PMOS pass transistor, voltage reference, error amplifier, over-current protection, and thermal shutdown.

The P-channel pass transistor receives data from the error amplifier, over-current shutdown, and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over-current and Thermal shutdown circuits become active when the junction temperature exceeds 140°C, or the current exceeds 2.2A. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120°C.

The AME8816 behaves like a current source when the load reaches 2.2A. However, if the load impedance drops below 0.3 ohms, the current drops back to 600mA to prevent excessive power dissipation. Normal operation is restored when the load resistance exceeds 0.75 ohms.

■ External Capacitors

The AME8816 is stable with an output capacitor to ground of 4.7μF or greater. Ceramic capacitors have the lowest ESR, and will offer the best AC performance. Conversely, Aluminum Electrolytic capacitors exhibit the highest ESR, resulting in the poorest AC response. Unfortunately, large value ceramic capacitors are comparatively expensive. One option is to parallel a 0.1μF ceramic capacitor with a 10μF Aluminum Electrolytic. The benefit is low ESR, high capacitance, and low overall cost.

A second capacitor is recommended between the input and ground to stabilize V_{in} . The input capacitor should be at least 0.1μF to have a beneficial effect.

A third capacitor can be connected between the BY-PASS pin and GND. This capacitor can be a low cost Polyester Film variety between the value of 0.001 ~ 0.01μF. A larger capacitor improves the AC ripple rejection, but also makes the output come up slowly. This "Soft" turn-on is desirable in some applications to limit turn-on surges.

All capacitors should be placed in close proximity to the pins. A "Quiet" ground termination is desirable. This can be achieved with a "Star" connection.

■ Enable

When pulled low, the PMOS pass transistor shuts off, and all internal circuits are powered down. In this state, the quiescent current is less than 1μA. This pin behaves much like an electronic switch.

100Kohm resistor is necessary between V_{EN} source and EN pin when V_{EN} is higher than V_{IN} .

(Note: There is no internal pull-up for EN PIN.)

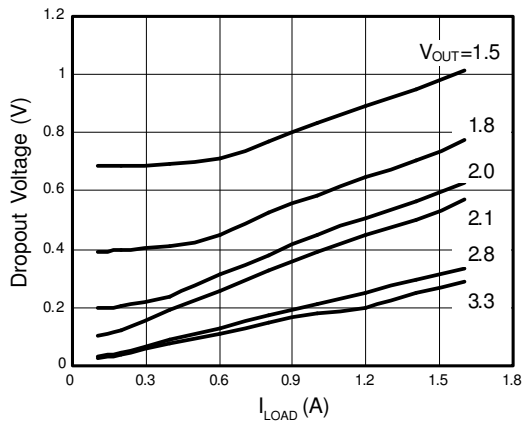
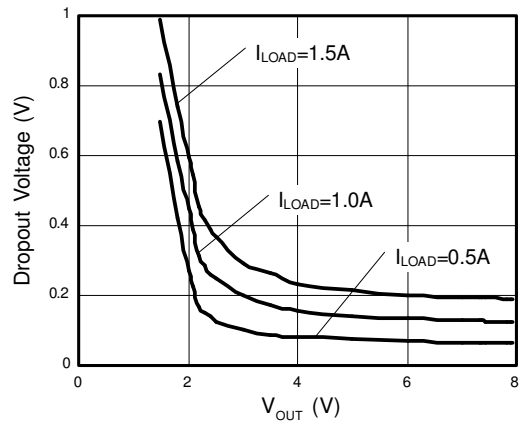
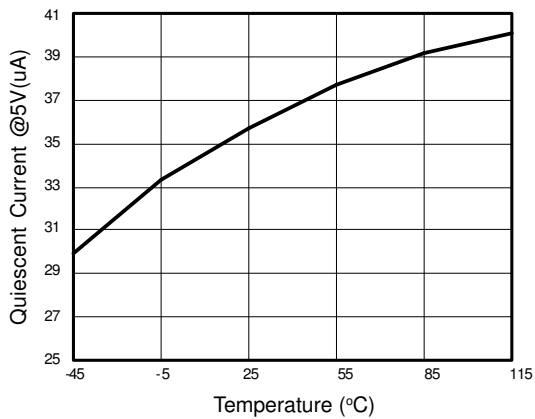
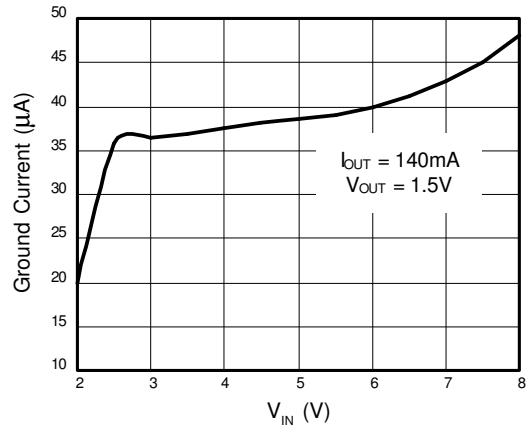
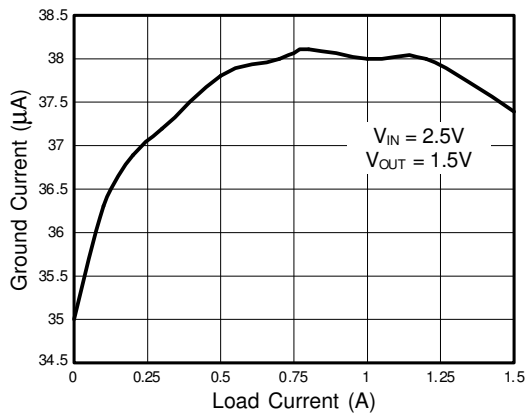
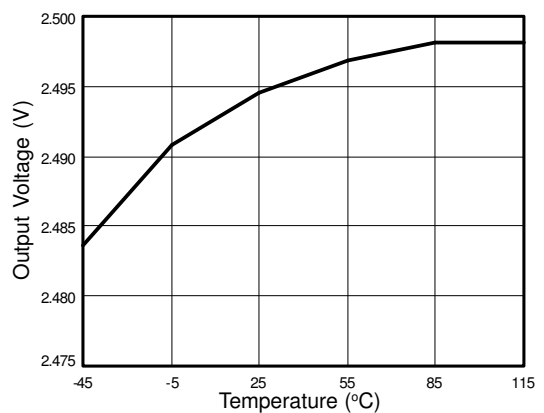
■ Adjustable Version

The adjustable version uses external feedback resistors to generate an output voltage anywhere from 1.5V to 5.0V. V_{adj} is trimmed to 1.242V and V_{OUT} is given by the equation:

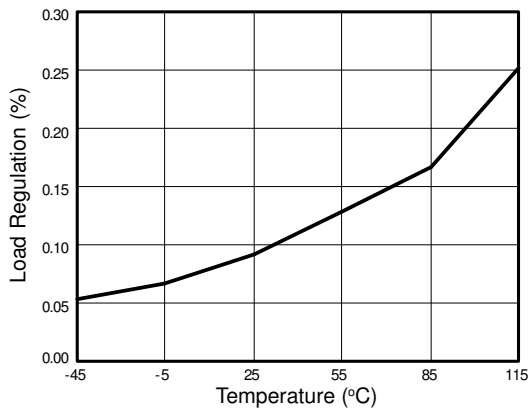
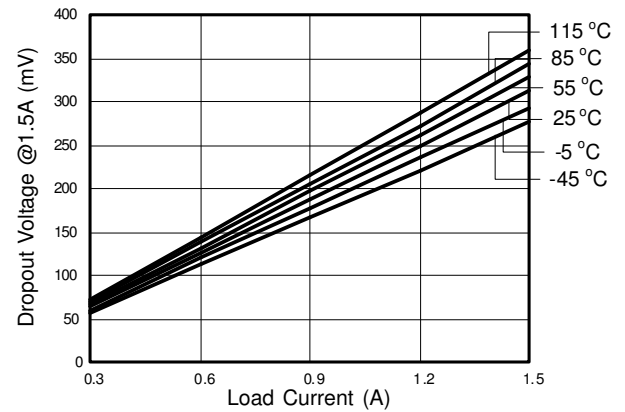
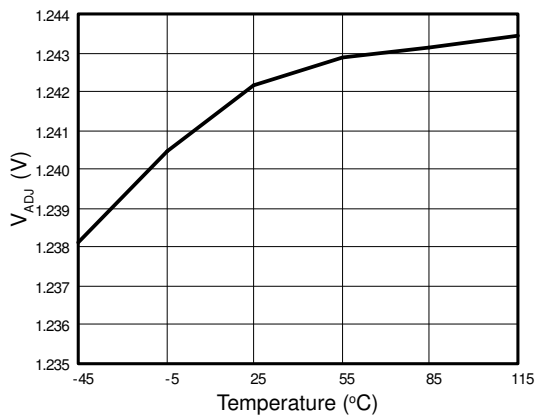
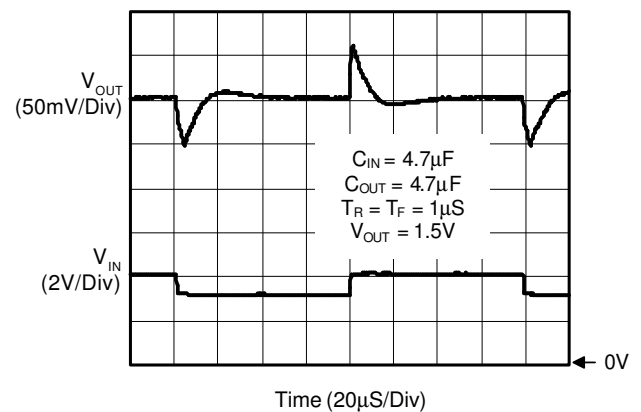
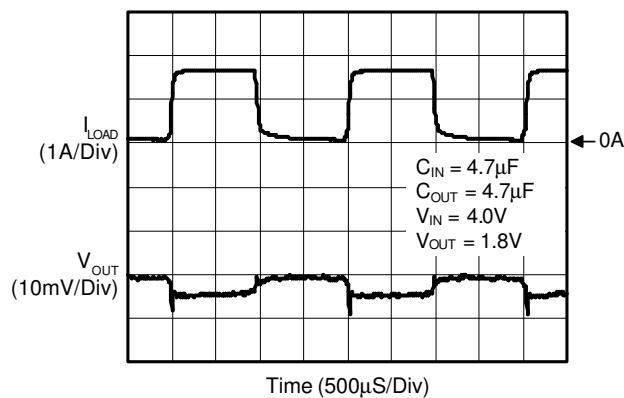
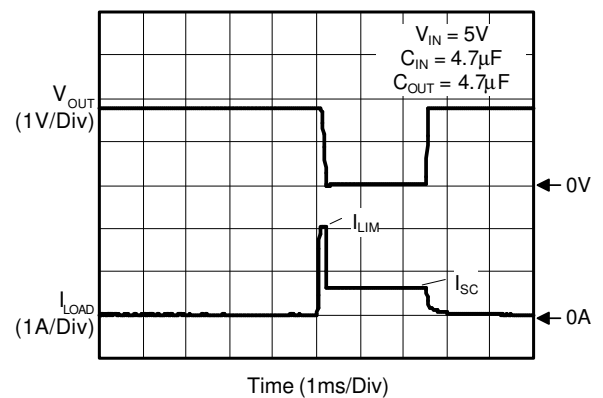
$$V_{OUT} = V_{ADJ} (1 + R1/R2)$$

Feedback resistors R1 and R2 should be high enough to keep quiescent current low, but increasing $R1 + R2$ will reduce stability. In general, R1 and R2 in the 10' s of kΩ will produce adequate stability, given reasonable layout precautions. To improve stability characteristics, keep parasitics on the ADJ pin to a minimum, and lower R1 and R2 values.

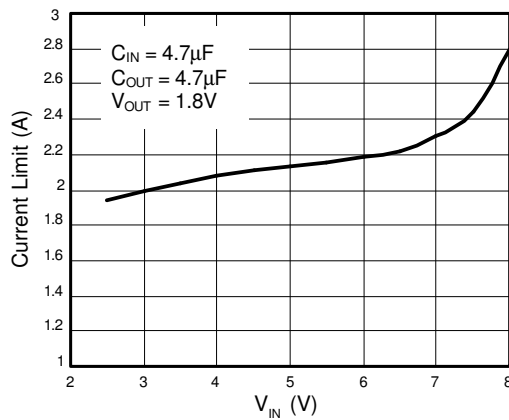
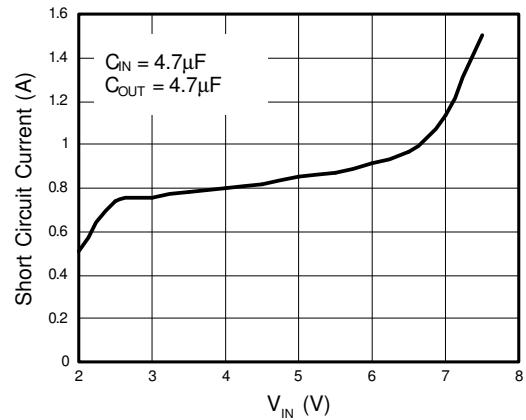
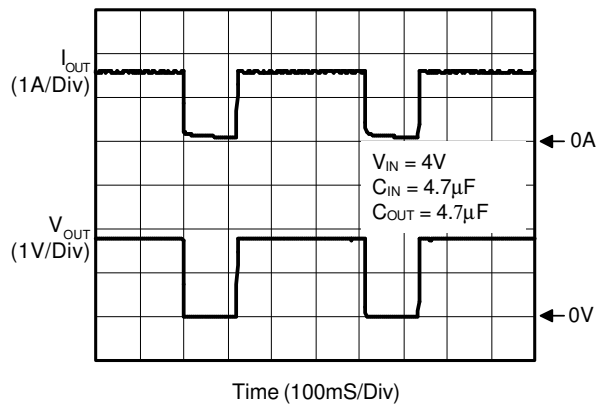
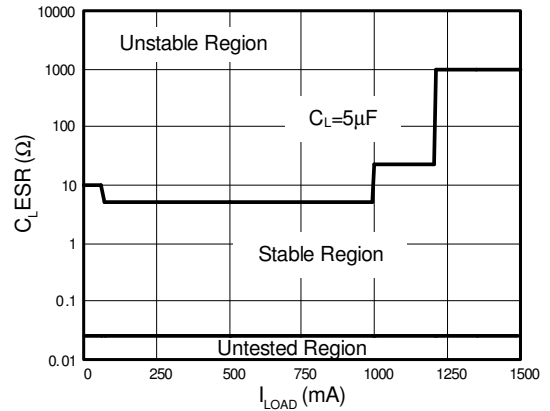
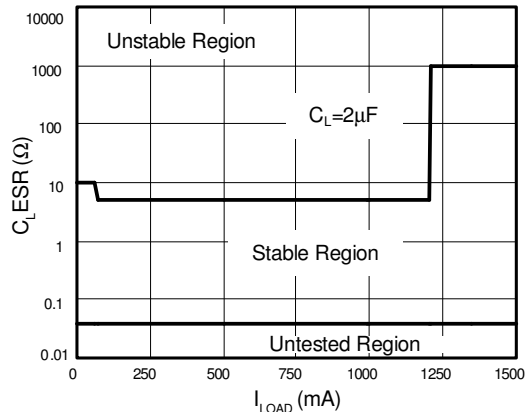
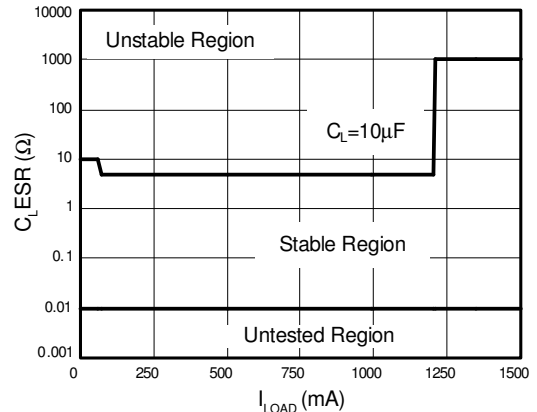
■ Characterization Curve

Dropout Voltage vs. I_{LOAD}

Dropout Voltage vs. V_{OUT}

Quiescent Current vs. Temperature

Ground Current vs. V_{IN}

Ground Current vs. Load Current

 V_{OUT} vs. Temperature(2.5V)


■ Characterization Curve (Contd.)

Load Regulation vs. Temperature

Dropout Voltage vs. Load Current(2.5V)

AME8816BEHA V_{ADJ} vs. Temperature

Line Transient Response

Load Step 40mA to 1.5A

Current Limit Response


■ Characterization Curve (Contd.)

Current Limit vs. V_{IN}

Short Circuit Current vs. V_{IN}

Overtemperature Shutdown

Stability vs. ESR vs. I_{Load}

Stability vs. ESR vs. I_{Load}

Stability vs. ESR vs. I_{Load}


■ External Resistor Divider Table

R1 (K Ohm)	1	2	5	10	20	50	100	200	500	1000
Vout	$R2(kohm)=(1.242 \cdot R1(kohm))/(Vout-1.242)$									
1.30	21.41	42.83	107.07	214.14	428.28	1070.69				
1.35	11.50	23.00	57.50	115.00	230.00	575.00				
1.40	7.86	15.72	39.30	78.61	157.22	393.04				
1.45	5.97	11.94	29.86	59.71	119.42	298.56	597.55			
1.50	4.81	9.63	24.07	48.14	96.28	240.70	481.68	962.79		
1.55	4.03	8.06	20.16	40.32	80.65	201.62	403.44	806.49		
1.60	3.47	6.94	17.35	34.69	69.39	173.46	347.07	693.85		
1.65	3.04	6.09	15.22	30.44	60.88	152.21	304.52	608.82		
1.70	2.71	5.42	13.56	27.12	54.24	135.59	271.27	542.36		
1.75	2.44	4.89	12.22	24.45	48.90	122.24	244.56	488.98		
1.80	2.23	4.45	11.13	22.26	44.52	111.29	222.64	445.16		
1.85	2.04	4.09	10.21	20.43	40.86	102.14	204.33	408.55		
1.90	1.89	3.78	9.44	18.88	37.75	94.38	188.80	377.51		
1.95	1.75	3.51	8.77	17.54	35.08	87.71	175.46	350.85	877.12	
2.00	1.64	3.28	8.19	16.39	32.77	81.93	163.88	327.70	819.26	
2.05	1.54	3.07	7.69	15.37	30.74	76.86	153.74	307.43	768.56	
2.10	1.45	2.90	7.24	14.48	28.95	72.38	144.78	289.51	723.78	
2.15	1.37	2.74	6.84	13.68	27.36	68.39	136.81	273.57	683.92	
2.20	1.30	2.59	6.48	12.96	25.93	64.82	129.67	259.29	648.23	
2.25	1.23	2.46	6.16	12.32	24.64	61.61	123.23	246.43	616.07	
2.30	1.17	2.35	5.87	11.74	23.48	58.70	117.41	234.78	586.96	
2.35	1.12	2.24	5.60	11.21	22.42	56.05	112.11	224.19	560.47	
2.40	1.07	2.15	5.36	10.73	21.45	53.63	107.27	214.51	536.27	
2.45	1.03	2.06	5.14	10.28	20.56	51.41	102.83	205.63	514.07	
2.50	0.99	1.97	4.94	9.87	19.75	49.36	98.74	197.46	493.64	
2.55	0.95	1.90	4.75	9.50	18.99	47.48	94.97	189.91	474.77	
2.60	0.91	1.83	4.57	9.15	18.29	45.73	91.47	182.92	457.29	914.58
2.65	0.88	1.76	4.41	8.82	17.64	44.11	88.22	176.42	441.05	882.10
2.70	0.85	1.70	4.26	8.52	17.04	42.59	85.19	170.37	425.93	851.85
2.75	0.82	1.65	4.12	8.24	16.47	41.18	82.37	164.72	411.80	823.61
2.80	0.80	1.59	3.99	7.97	15.94	39.86	79.73	159.44	398.59	797.18
2.85	0.77	1.54	3.86	7.72	15.45	38.62	77.25	154.48	386.19	772.39
2.90	0.75	1.50	3.75	7.49	14.98	37.45	74.92	149.82	374.55	749.10
2.95	0.73	1.45	3.64	7.27	14.54	36.36	72.72	145.43	363.58	727.17
3.00	0.71	1.41	3.53	7.06	14.13	35.32	70.65	141.30	353.24	706.48
3.05	0.69	1.37	3.43	6.87	13.74	34.35	68.70	137.39	343.47	686.95
3.10	0.67	1.34	3.34	6.68	13.37	33.42	66.85	133.69	334.23	668.46

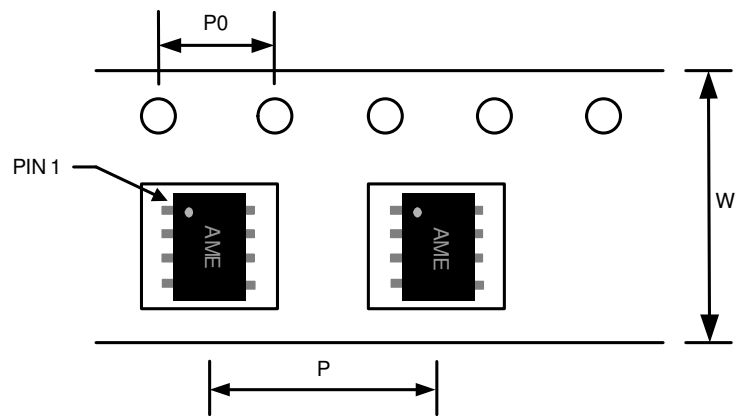
■ External Resistor Divider Table (Contd.)

R1 (K Ohm)	1	2	5	10	20	50	100	200	500	1000
Vout	$R2(kohm)=(1.242 \times R1(kohm))/(Vout-1.242)$									
3.15	0.65	1.30	3.25	6.51	13.02	32.55	65.09	130.19	325.47	650.94
3.20	0.63	1.27	3.17	6.34	12.69	31.72	63.43	126.86	317.16	634.32
3.25	0.62	1.24	3.09	6.19	12.37	30.93	61.85	123.71	309.26	618.53
3.30	0.60	1.21	3.02	6.03	12.07	30.17	60.35	120.70	301.75	603.50
3.35	0.59	1.18	2.95	5.89	11.78	29.46	58.92	117.84	294.59	589.18
3.40	0.58	1.15	2.88	5.76	11.51	28.78	57.55	115.11	287.77	575.53
3.45	0.56	1.13	2.81	5.63	11.25	28.13	56.25	112.50	281.25	562.50
3.50	0.55	1.10	2.75	5.50	11.00	27.50	55.00	110.01	275.02	550.04
3.55	0.54	1.08	2.69	5.38	10.76	26.91	53.81	107.63	269.06	538.13
3.60	0.53	1.05	2.63	5.27	10.53	26.34	52.67	105.34	263.36	526.72
3.65	0.52	1.03	2.58	5.16	10.32	25.79	51.58	103.16	257.89	515.78
3.70	0.51	1.01	2.53	5.05	10.11	25.26	50.53	101.06	252.64	505.29
3.75	0.50	0.99	2.48	4.95	9.90	24.76	49.52	99.04	247.61	495.22
3.80	0.49	0.97	2.43	4.86	9.71	24.28	48.55	97.11	242.77	485.54
3.85	0.48	0.95	2.38	4.76	9.52	23.81	47.62	95.25	238.11	476.23
3.90	0.47	0.93	2.34	4.67	9.35	23.36	46.73	93.45	233.63	467.27
3.95	0.46	0.92	2.29	4.59	9.17	22.93	45.86	91.73	229.32	458.64
4.00	0.45	0.90	2.25	4.50	9.01	22.52	45.03	90.07	225.16	450.33
4.05	0.44	0.88	2.21	4.42	8.85	22.12	44.23	88.46	221.15	442.31
4.10	0.43	0.87	2.17	4.35	8.69	21.73	43.46	86.91	217.28	434.57
4.15	0.43	0.85	2.14	4.27	8.54	21.35	42.71	85.42	213.55	427.10
4.20	0.42	0.84	2.10	4.20	8.40	20.99	41.99	83.98	209.94	419.88
4.25	0.41	0.83	2.06	4.13	8.26	20.64	41.29	82.58	206.45	412.90
4.30	0.41	0.81	2.03	4.06	8.12	20.31	40.61	81.23	203.07	406.15
4.35	0.40	0.80	2.00	4.00	7.99	19.98	39.96	79.92	199.81	399.61
4.40	0.39	0.79	1.97	3.93	7.87	19.66	39.33	78.66	196.64	393.29
4.45	0.39	0.77	1.94	3.87	7.74	19.36	38.72	77.43	193.58	387.16
4.50	0.38	0.76	1.91	3.81	7.62	19.06	38.12	76.24	190.61	381.22
4.55	0.38	0.75	1.88	3.75	7.51	18.77	37.55	75.09	187.73	375.45
4.60	0.37	0.74	1.85	3.70	7.40	18.49	36.99	73.97	184.93	369.86
4.65	0.36	0.73	1.82	3.64	7.29	18.22	36.44	72.89	182.22	364.44
4.70	0.36	0.72	1.80	3.59	7.18	17.96	35.92	71.83	179.58	359.17
4.75	0.35	0.71	1.77	3.54	7.08	17.70	35.40	70.81	177.02	354.05
4.80	0.35	0.70	1.75	3.49	6.98	17.45	34.91	69.81	174.54	349.07
4.85	0.34	0.69	1.72	3.44	6.88	17.21	34.42	68.85	172.12	344.24
4.90	0.34	0.68	1.70	3.40	6.79	16.98	33.95	67.91	169.76	339.53
4.95	0.33	0.67	1.67	3.35	6.70	16.75	33.50	66.99	167.48	334.95
5.00	0.33	0.66	1.65	3.30	6.61	16.52	33.05	66.10	165.25	330.49

Note: Small load(greater than 2 mA) is necessary as R1 or R2 is larger than 50 K Ohm. Otherwise, outputvoltage probably cannot be pulled down to 0 V on disable mode.

■ Tape and Reel Dimension

SOP-8

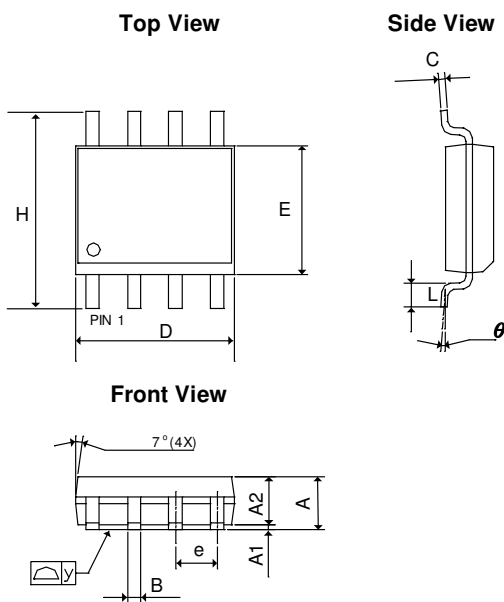


Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Pitch (P0)	Part Per Full Reel	Reel Size
SOP-8	12.0±0.1 mm	8.0±0.1 mm	4.0±0.1 mm	2500pcs	330±1 mm

■ Package Dimension

SOP-8



SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.0531	0.0689
A ₁	0.10	0.30	0.0039	0.0118
A ₂	1.473 REF		0.0580 REF	
B	0.33	0.51	0.0130	0.0201
C	0.17	0.25	0.0067	0.0098
D	4.70	5.33	0.1850	0.2098
E	3.80	4.00	0.1496	0.1575
e	1.27 BSC		0.0500 BSC	
L	0.40	1.27	0.0157	0.0500
H	5.80	6.30	0.2283	0.2480
y	-	0.10	-	0.0039
θ	0°	8°	0°	8°



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