GENERAL DESCRIPTION

The AP8855A is a low-dropout linear regulator that operations in the input voltage range from +2.5V to +9.0V and delivers 500mA output current.

The output voltages range of the adjustable type is from 1.22V to 5.0V.

The AP8855A consists of a 1.22V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection. The AP8855A devices are available in SOT89 packages

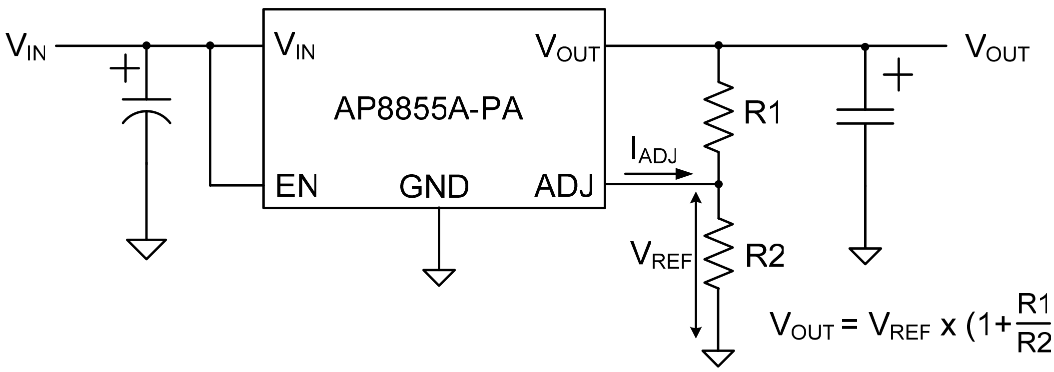
FEATURES

- Low dropout voltage 600mV at 500mA (Typ.)
- Low 40μA current consumption (Typ.) at Vin=5V
- Small output capacitor
- Output current limit
- Short circuit current limit protection
- Thermal overload shutdown protection
- ON/OFF Control Function
- SOT-89 Package
- RoHS Compliant and 100% Lead (Pb)-Free

APPLICATION

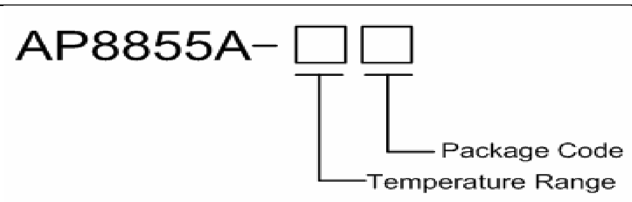
- Battery-Powered Devices
- Personal Communication Devices
- Home Electric/Electronic Appliances

TYPICAL APPLICATION



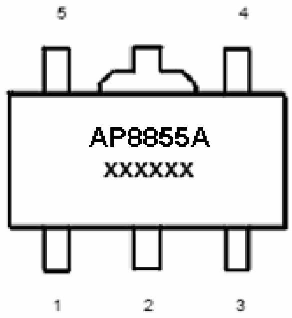
$$V_{OUT} = V_{REF} \times (1+\frac{R1}{R2}) + I_{ADJ} \times R2$$

ORDERING INFORMATION

	**Temperature Range**： **P**：Commercial Standard, Lead (Pb) Free and Phosphorous (P) Free Package **Package Code**： **A**：SOT-89-5

PIN CONFIGURATIONS

Part No.	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
AP8855A -xA	ADJ	GND	EN	IN	OUT



PACKAGE MARKING INFORMATION

SOT-89-5

EX：AP8855A-PA

AP8855A
PAxxxx

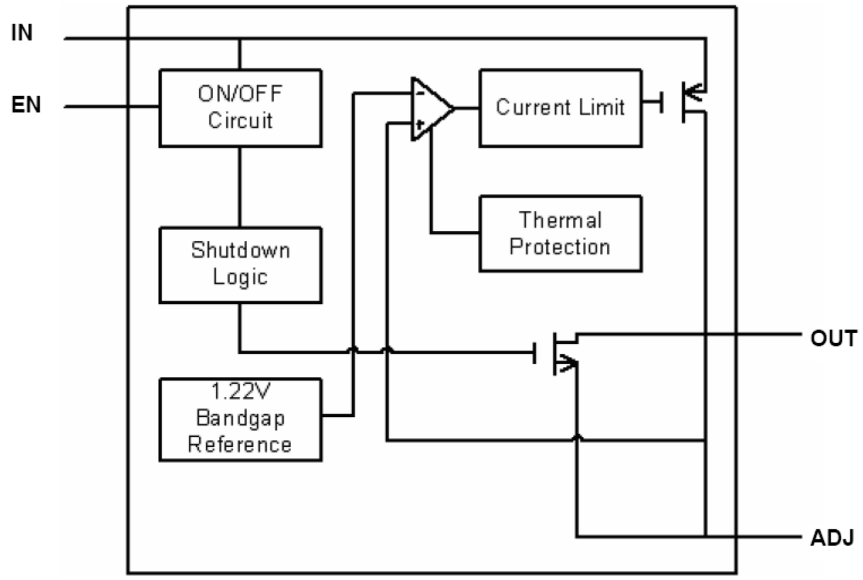
xxxx：Date Code

PIN DESCRIPTION

Part NO.	Symbol	Description
AP8855A-PA	GND	Ground pin.
	IN	Regulator input pin.
	OUT	Regulator output pin.
	ADJ	Adjust terminal pin,
	EN	Chip enable pin.

IN is the regulator input pin. Supply voltage can range from 2.5V to 9.0V. Bypass with a 1μF capacitor to GND.
OUT is the output voltage pin. Sources up to 300mA. Bypass with a 3.3μF capacitor to GND.
GND provides the reference for all voltages.
ADJ provides V_{REF}=1.22V（Typ.）for adjustable output voltage.
EN is output voltage ON/OFF control pin. EN pin input voltage must be less than the input voltage at IN pin.

FUNCTIONAL BLOCK DIAGRAM



Adjustable Voltage

ABSOLUTE MAXIMUM RATINGS

Input voltage V_{IN} to GND ---10V
Output current limit, $I_{(LIMIT)}$ --- 0.8A
Continuous power dissipation, P_D ($\Delta T = T_J - T_A = 100°C$)
SOT-89-5 --- 0.95W
* The power dissipation values are based on the condition that junction temperature T_J and ambient temperature T_A difference is 100°C.
Junction Temperature, T_J --- +155°C
Storage temperature range, T_{STG} --- -55°C to +150°C
Operating junction temperature range --- -40°C to +125°C
Lead temperature (soldering, 10sec) --- 260°C

* Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and function operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(T_A=25℃, unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage		2.5		9.0	V
V_{OUT}	Output Voltage	Adjustable Voltage Type $V_{IN}=V_{OUT}+1.5V$, $I_{OUT}=1mA$	-2%	V_{OUT}	+2%	V
I_{MAX}	Output Current (*1)	$V_{OUT}+1.5 \leqq V_{IN} \leqq 9V$	500			mA
V_{DROP}	Dropout Voltage	I_{OUT}=500mA		600	800	mV
ΔV_{LINE}	Line Regulation	$V_{OUT}+1.5V \leqq V_{IN} \leqq 9V$, $I_{OUT}=1mA$		0.2	0.3	%/V
ΔV_{LOAD}	Load Regulation	$V_{IN}=V_{OUT}+1.5V$, $10\mu A \leqq I_{OUT} \leqq 500mA$		0.02	0.03	%/mA
I_Q	Ground Pin Current	V_{IN}=5V, ON/OFF Pin=ON, No Load		40	60	μA
		V_{IN}=9V, ON/OFF Pin=ON, No Load		60	100	μA
I_{SD}	Shutdown Current	$V_{IN}=V_{OUT}+1V$, EN Pin=OFF, No Load		0.1	1.0	μA
V_{IH}	EN Pin Input Voltage “H”	(see note *2)	2.0			V
V_{IL}	EN Pin Input Voltage “L”	(see note *2)			0.5	V
R_{EN}	EN Pin Pull Low Resistance	V_{EN} <0.5V		100	300	KΩ
I_{SC}	Short Current Limit			350		mA
PSRR	Ripple Rejection	V_{IN}=VOUT+1V, F=100Hz, Vripple=1Vp-p, I_{OUT}=30mA		60		dB
T_{SD}	Thermal Shutdown Temperature			155		°C
T_{HYS}	Thermal Shutdown Hysteresis			20		°C
θ_{JA}	Thermal Resistance	SOT-89-5			150	°C/W

Note：

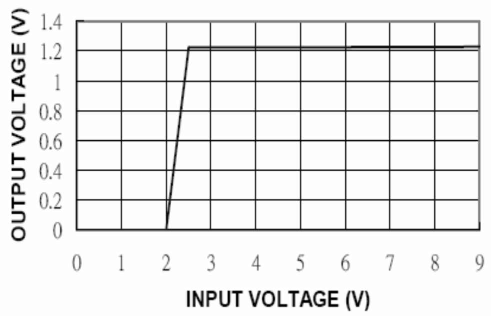
(*1) Measured using a double sided board with 1” x 2” square inches of copper area connected to the GND pins for “heat spreading”.

(*2)EN pin input voltage must be always less than or equal to input voltage.

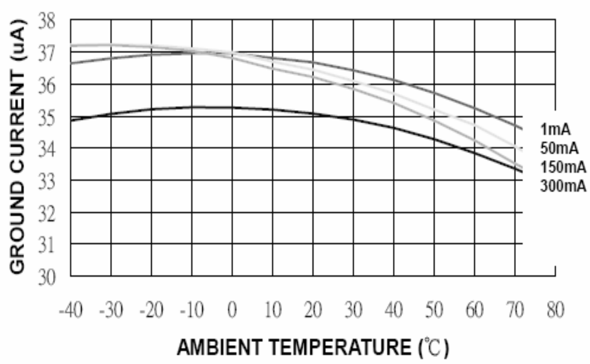
TYPICAL OPERATING CHARACTERISTICS

(C_{IN}=1μF , C_{OUT}=3.3μF, TA=+25℃, unless otherwise noted.)

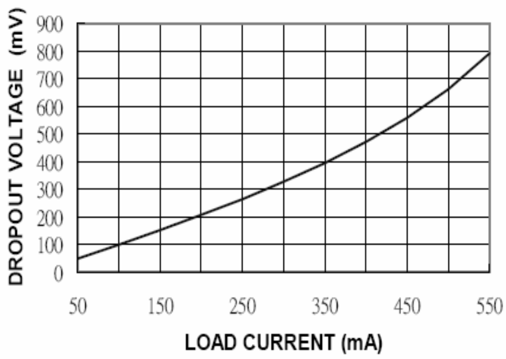
OUTPUT VOLTAGE vs. INPUT VOLTAGE



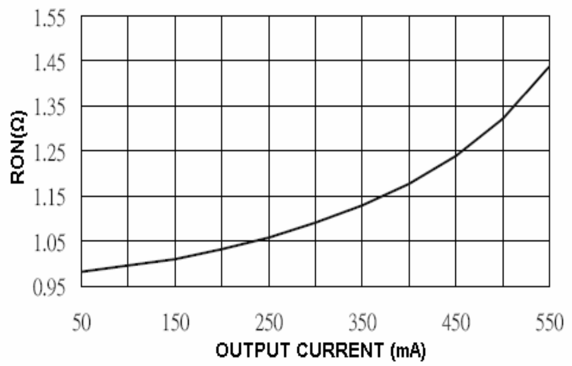
GROUND CURRENT vs. AMBIENT TEMPERATURE



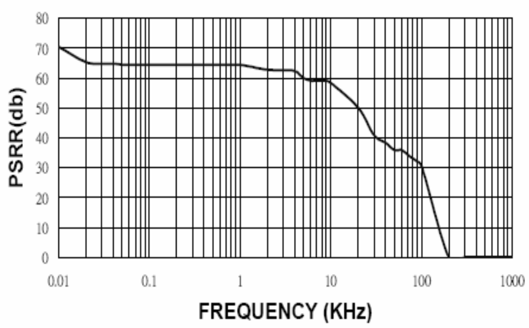
DROPOUT VOLTAGE v.s LOAD CURRENT



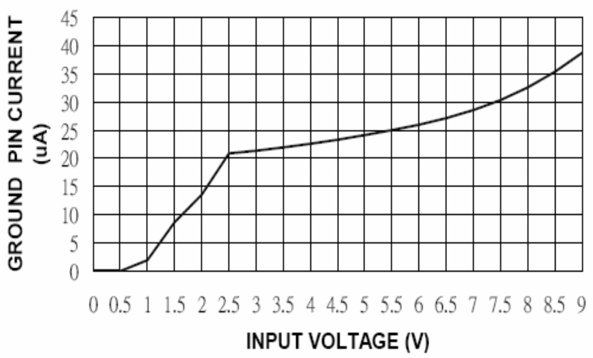
OUTPUT CURRENT v.s RON



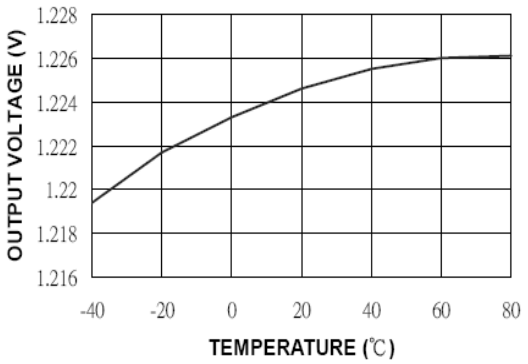
POWER SUPPLY REJECTION RATIO vs FREQUENCY



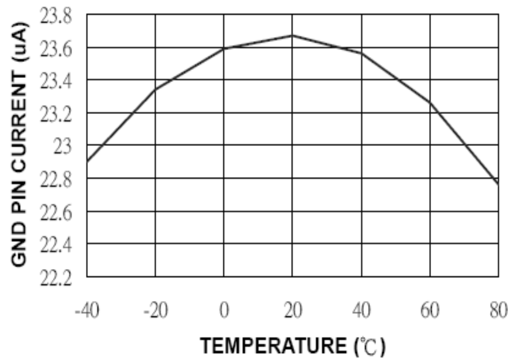
GROUND PIN CURRENT vs INPUT VOLTAGE



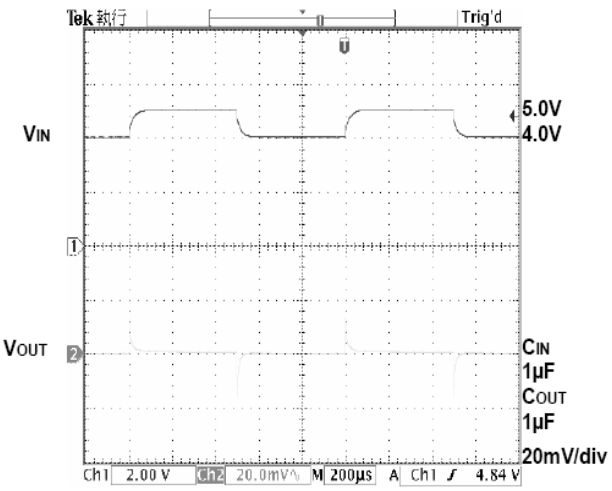
OUTPUT VOLTAGE vs. TEMPERATURE



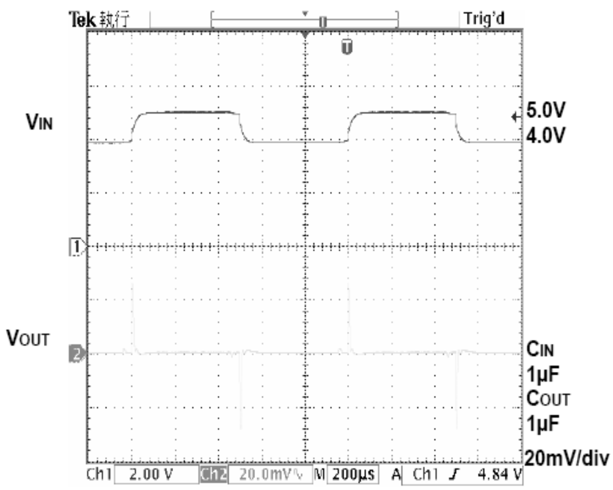
GND PIN CURRENT vs. TEMPERATURE



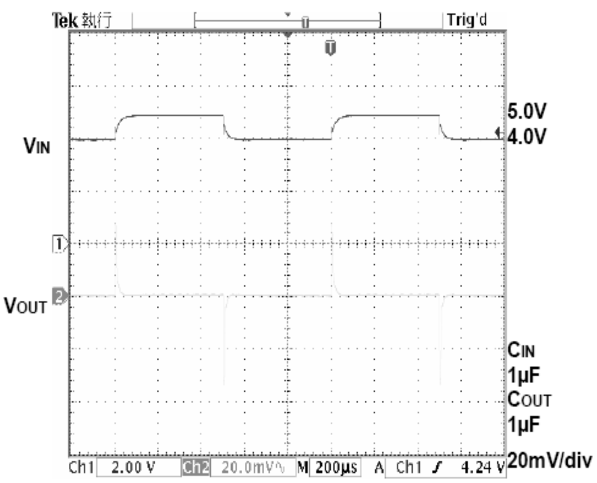
LINE TRANSIENT (I_{OUT}=0mA)



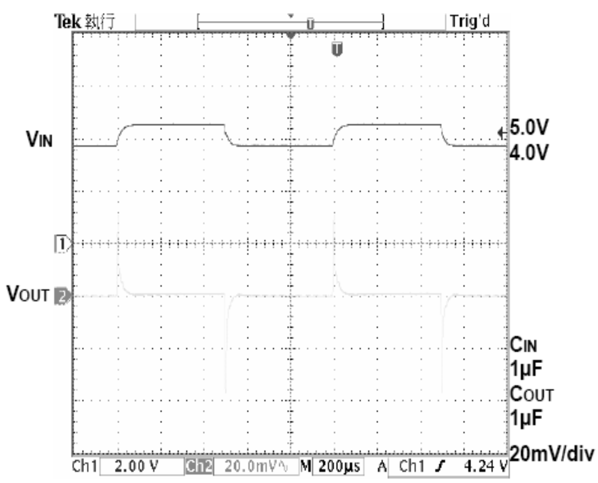
LINE TRANSIENT (I_{OUT}=10mA)

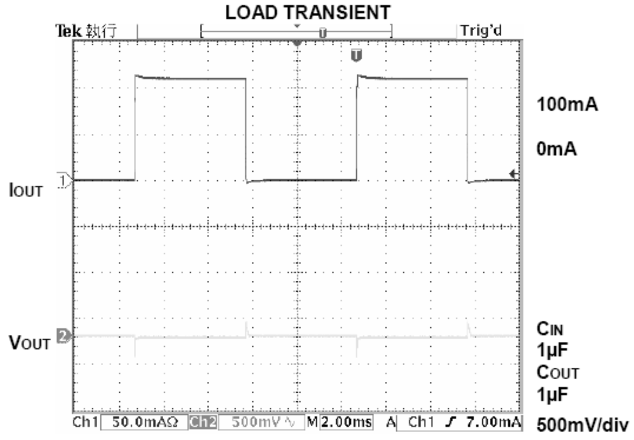


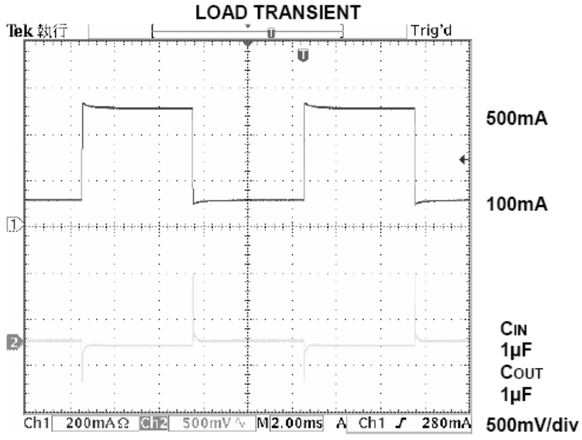
LINE TRANSIENT (I_{OUT}=100mA)

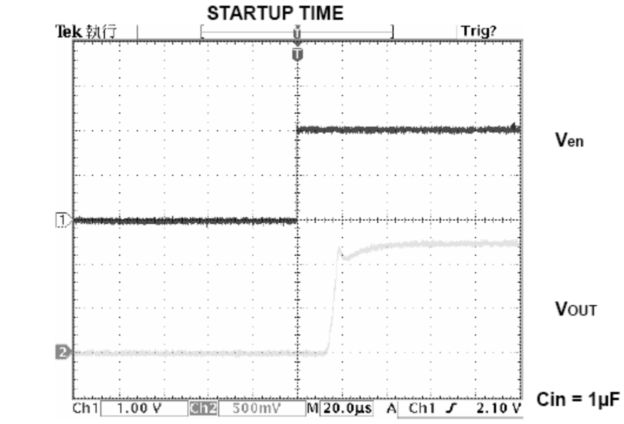


LINE TRANSIENT (I_{OUT}=300mA)




LOAD TRANSIENT
Tek 執行
Trig'd
IOUT
VOUT
100mA
0mA
CIN
1µF
COUT
1µF
Ch1 50.0mAΩ
Ch2 500mV
M 2.00ms
A Ch1 7.00mA
500mV/div


LOAD TRANSIENT
Tek 執行
Trig'd
500mA
100mA
CIN
1µF
COUT
1µF
Ch1 200mAΩ
Ch2 500mV
M 2.00ms
A Ch1 280mA
500mV/div


STARTUP TIME
Tek 執行
Trig?
Ven
VOUT
Ch1 1.00 V
Ch2 500mV
M 20.0µs
A Ch1 2.10 V
Cin = 1µF

DETAIL DESCRIPTION

The AP8855A is a low-dropout linear regulator. As illustrated in function block diagram, it consists of a 1.22V reference, error amplifier, a P-channel pass transistor, an ON/OFF control logic, and an internal feedback voltage divider.

The 1.22V bandgap reference is connected to the error amplifier, which compares this reference with the feedback voltage and amplifies the voltage difference. If the feedback voltage is lower than the reference voltage, the pass-transistor gate is pulled lower, which allows more current to pass to the output pin and increases the output voltage. If the feedback voltage is too high, the pass-transistor gate is pulled up to decrease the output voltage.

The output voltage is feed back through an external resistive divider connected to OUT pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

Internal P-channel Pass Transistor

The AP8855A features a P-channel MOSFET pass transistor. Unlike similar designs using PNP pass transistors, P-channel MOSFETs require no base drive, which reduces quiescent current. PNP-based regulators also waste considerable current in dropout when the pass transistor saturates, and use high base-drive currents under large loads. The AP8855A does not suffer from these problems and consumes only 40μA (Typ.) of current consumption under heavy loads as well as in dropout conditions.

Enable Function

EN pin starts and stops the regulator. When the EN pin is switched to the power off level, the operation of all internal circuit stops, the build-in P-channel MOSFET output transistor between pins V_{IN} and V_{OUT} is switched off, allowing current consumption to be drastically reduced. The V_{OUT} pin enters the GND level due to the several MΩ resistance of the feedback voltage divider between V_{OUT} and GND pins.

Current Limit

The AP8855A also includes a fold back current limiter. It monitors and controls the pass transistor's gate voltage, estimates the output current, and limits the output current within 0.6A.

Thermal Overload Protection

Thermal overload protection limits total power dissipation in the AP8855A. When the junction temperature exceeds T_J = +155°C, a thermal sensor turns off the pass transistor, allowing the IC to cool down. The thermal sensor turns the pass transistor on again after the junction temperature cools down by 20°C, resulting in a pulsed output during continuous thermal overload conditions.

Thermal overload protection is designed to protect the AP8855A in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of T_J = +155°C should not be exceeded.

Operating Region and Power Dissipation

Maximum power dissipation of the AP8855A depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The power dissipation across the devices is P = I_{OUT} x (V_{IN}-V_{OUT}). The resulting maximum power dissipation is:

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(T_J - T_A)}{\theta_{JA}}$$

Where (T_J-T_A) is the temperature difference between the AP8855A die junction and the surrounding air, θ_{JC} is the thermal resistance of the package chosen, and θ_{CA} is the thermal resistance through the printed circuit board, copper traces and other materials to the surrounding air. For better heat-sinking, the copper area should be equally shared between the IN, OUT, and GND pins.

The thermal resistance θ_{JA} of AP8855A SOT-89-5 package is 150°C/W. Based on a maximum operating junction temperature 155°C with an ambient of 25°C, the maximum power dissipation will be:

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(155 - 25)}{150} = 0.8667W$$

Thermal characteristics were measured using a double sided board with 1” x 2” square inches of copper area connected to the GND pin for “heat spreading”.

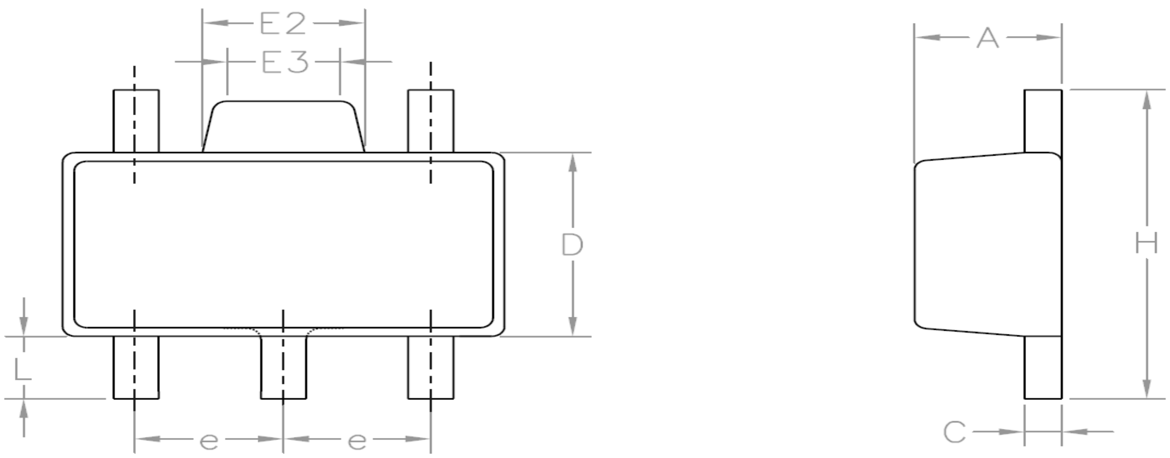
Input-Output Voltage

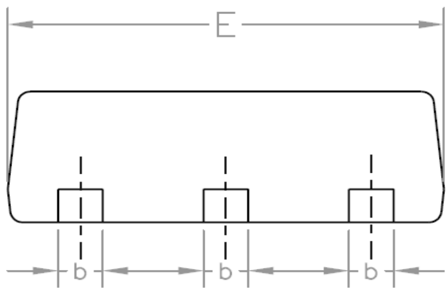
A regulator’s minimum input-output voltage differential, or dropout voltage, determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. The AP8855A uses a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on-resistance ($R_{DS(ON)}$) multiplied by the load current.

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

PACKAGE OUTLINE

A) SOT-89-5





SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.450	1.550	0.057	0.061
b	0.440	0.480	0.017	0.019
C	0.360	0.400	0.014	0.016
D	2.450	2.550	0.096	0.100
E	4.450	4.550	0.175	0.179
E2	1.500	1.700	0.059	0.067
E3	1.400	Ref	0.055	Ref
e	1.500	BSC	0.059	BSC
H	4.150	4.250	0.163	0.167
L	0.800	0.950	0.032	0.038