Datasheet

FS8855

500 mA LDO Linear Regulator

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1. General Description

The FS8855 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 high-accuracy output voltage is preset at an internally trimmed voltage 2.5V or 3.3V. Other output voltages can be mask-optioned from 1.5V to 5.0V with 100mV increment, except FS8855-29Cx which has 2.85V output voltage.
The FS8855 consists of a 1.25V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection. The FS8855 devices are available in TO-92 and SOT-89 packages.

2. Features

- Low dropout voltage 650mV at 500mA (Typ.)
- Up to ±35mV output voltage accuracy (VIN≤7.0V, VOUT≤3.5V)
- Preset at 2.5V, 3.3V
- Mask options from 1.5V to 5.0V
- Quiescent current 30μA at 5V input (Typ.)
- Small output capacitor
- Output current limit
- Thermal overload shutdown protection
- TO-92 and SOT-89 Package

3. Applications

- CD-ROM Drivers
- DVD-ROM Drivers
- Portable Consumer Equipment
- Radio Control Systems
- Wireless Communication Systems

4. Ordering Information

FS8855-xx x x

Package / Pin Out

Package	Pin Out		
E : TO-92	1.GND	2.IN	3.OUT
K : SOT-89	1.IN	2.GND	3.OUT
L : SOT-89	1.GND	2.IN	3.OUT
I : SOT-89	1.OUT	2.GND	3.IN
Y : SOT-89	1.GND	2.OUT	3.IN

Temperature Range

C : Commercial Standard
P : Commercial Standard, Lead(Pb) Free and Phosphorous(P) Free Package

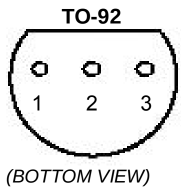
Output Voltage

15 : 1.5V	27 : 2.7V	39 : 3.9V
16 : 1.6V	28 : 2.8V	40 : 4.0V
17 : 1.7V	29 : 2.85V	41 : 4.1V
18 : 1.8V	30 : 3.0V	42 : 4.2V
19 : 1.9V	31 : 3.1V	43 : 4.3V
20 : 2.0V	32 : 3.2V	44 : 4.4V
21 : 2.1V	**33 : 3.3V**	45 : 4.5V
22 : 2.2V	34 : 3.4V	46 : 4.6V
23 : 2.3V	35 : 3.5V	47 : 4.7V
24 : 2.4V	36 : 3.6V	48 : 4.8V
25 : 2.5V	37 : 3.7V	49 : 4.9V
26 : 2.6V	38 : 3.8V	50 : 5.0V

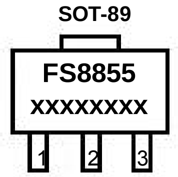
Note : Mask option output types are available by order only

5. Pin Configurations

Part No.	Pin 1	Pin 2	Pin 3
FS8855 -xxxE	GND	IN	OUT

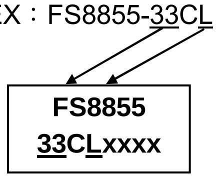


Part No.	Pin 1	Pin 2	Pin 3
FS8855 -xxxK	IN	GND	OUT
FS8855 -xxxL	GND	IN	OUT
FS8855 -xxxI	OUT	GND	IN
FS8855 -xxxY	GND	OUT	IN



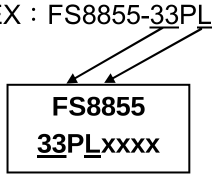
6. Package Marking Information

EX：FS8855-33CL



xxxx：Date Code

EX：FS8855-33PL

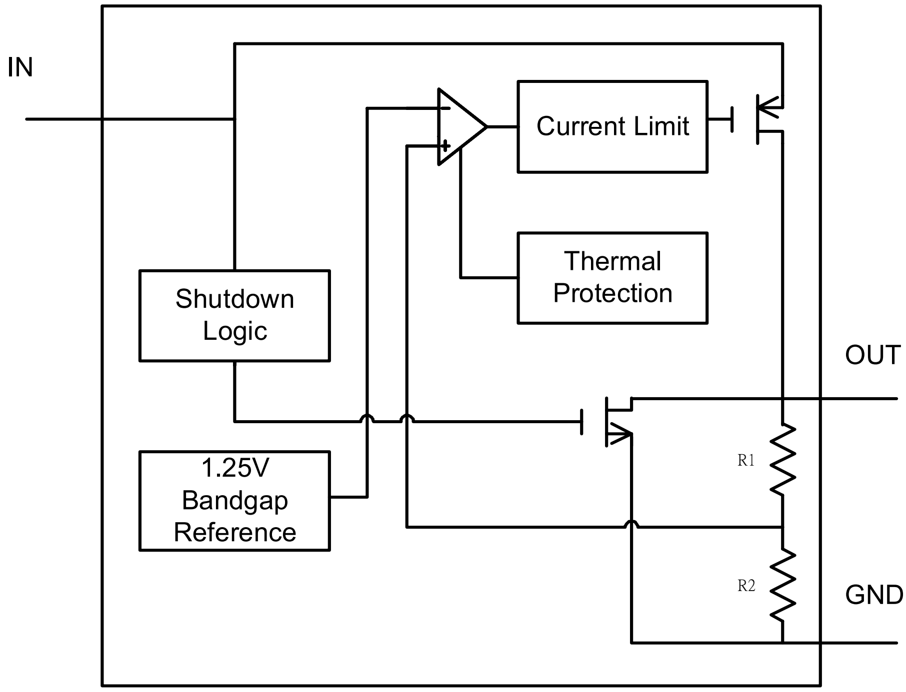


xxxx：Date Code

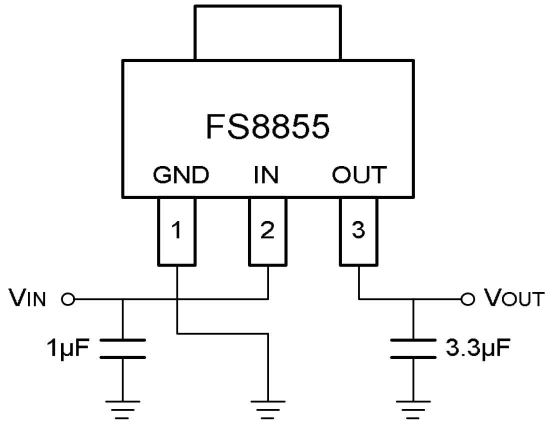
7. Pin Description

Part NO.	Symbol	Description
FS8855-xxxE FS8855-xxxK FS8855-xxxL FS8855-xxxI FS8855-xxxY	GND	Ground pin that provides the reference for all voltages.
	IN	Regulator input pin. Supply voltage can range from 2.5V to 9.0V. Bypass with a 1μF capacitor to GND.
	OUT	Regulator output pin. Sources up to 550mA. Bypass with a 3.3μF capacitor to GND.

8. Functional Block Diagram



9. Typical Application Circuit



10. 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 -- 0.55W
TO-92 -- 0.55W
* 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℃ to +150°C
Operating junction temperature range -- -40℃ 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

11. Electrical Characteristics

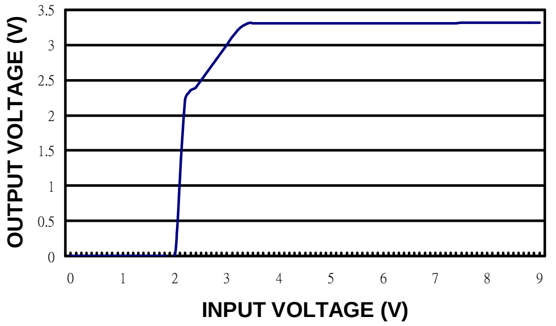
(T_A=25℃, unless otherwise noted.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
VIN	Input Voltage		2.5		9.0	V
∆ VOUT	Output Voltage Accuracy 1.5V ≤ VOUT ≤ 3.5V	VIN>VOUT+0.8V, IOUT=1mA, VIN≤7V	-35		+35	mV
		VIN>VOUT+0.8V, IOUT=1mA, VIN≤9V	-42		+42	mV
∆ VOUT	Output Voltage Accuracy 3.5V < VOUT ≤ 5.0V	VIN>VOUT+0.8V, IOUT=1mA, VIN≤7V	-1.0		+1.0	%
		VIN>VOUT+0.8V, IOUT=1mA, VIN≤9V	-1.5		+1.5	%
IMAX	Maximum Load Current		500			mA
ILIMIT	Current Limit				0.8	A
ISC	Short-Circuit Current	VOUT=0V, VIN=5.0V		350	400	mA
IQ	Ground Pin Current	IOUT=0mA to 500mA, VIN=5.0V		30	50	μA
VDROP	Dropout Voltage	IOUT=1mA		1.1	1.3	mV
		IOUT=100mA		120	145	mV
		IOUT=500mA		650	800	mV
∆VLINE	Line Regulation	VOUT+0.8V<VIN<9V, ILOAD=1mA		0.2	0.3	%/V
∆VLOAD	Load Regulation	IOUT=0mA to 500mA		0.01	0.02	%/mA
eN	Output Noise	F=1Hz to 10KHz, COUT=3.3μF		75		μVRMS
PSRR	Ripple Rejection	F=10KHz, COUT=3.3μF		70		dB
TSD	Thermal Shutdown Temperature			155		°C
THYS	Thermal Shutdown Hysteresis			10		°C
θJA	Thermal Resistance	SOT-89			180	°C/W
		TO-92			180	°C/W

12. Typical Operating Characteristics

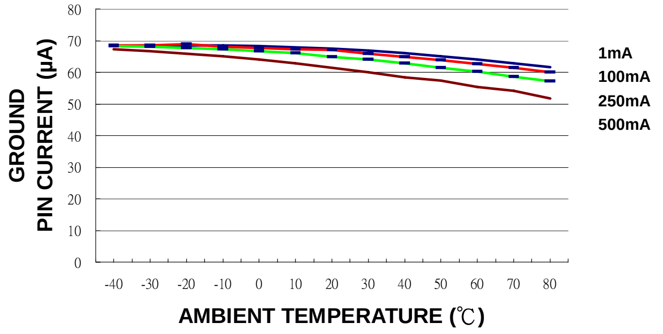
(CIN=1.0μF, COUT=3.3μF, TA=+25℃, unless otherwise noted.)

OUTPUT VOLTAGE vs. INPUT VOLTAGE

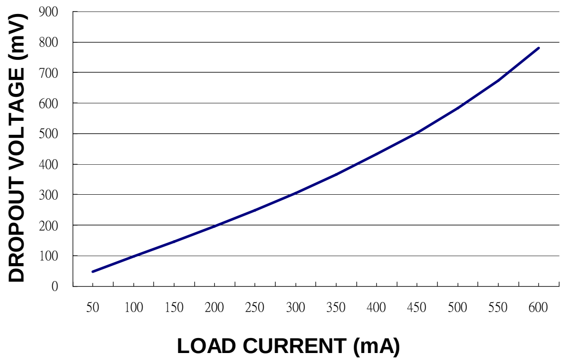


*EX：Model FS8855-33Cx

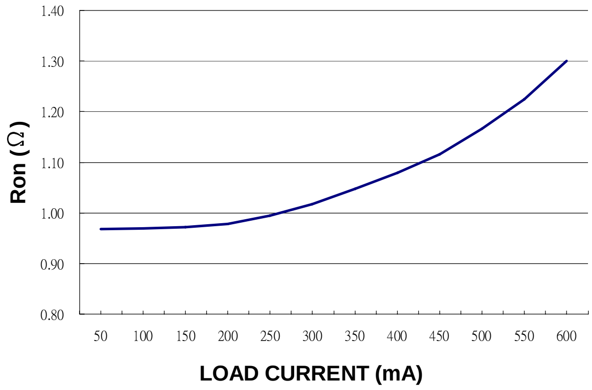
GROUND PIN CURRENT vs. AMBIENT TEMPERATURE



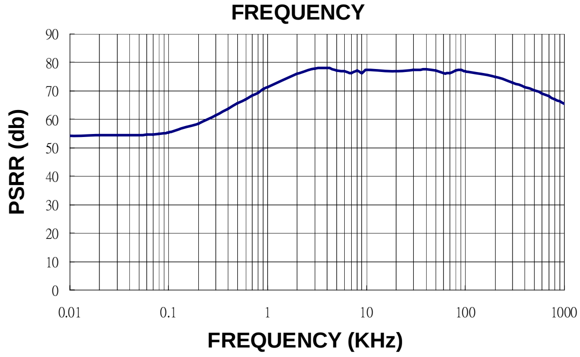
DROPOUT VOLTAGE vs. LOAD CURRENT



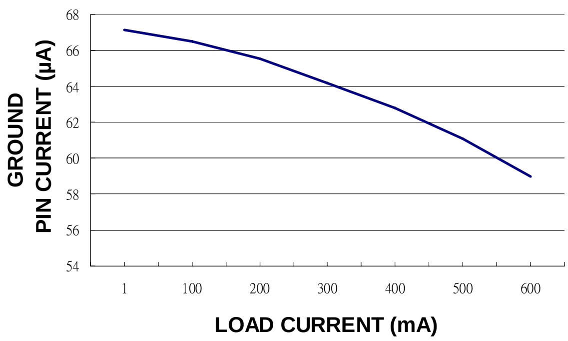
Ron vs. LOAD CURRENT



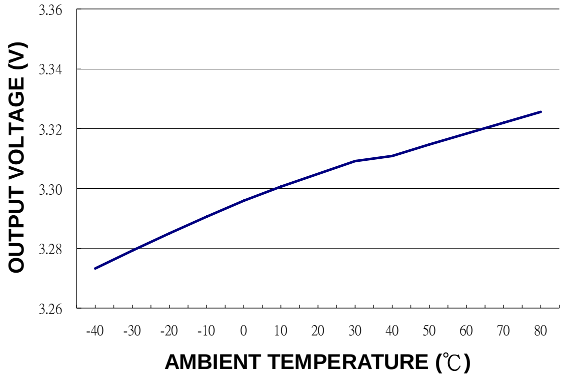
POWER SUPPLY REJECTION RATIO vs. FREQUENCY



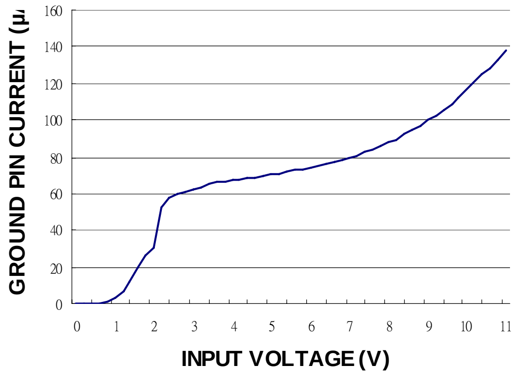
GND PIN CURRENT vs. LOAD CURRENT



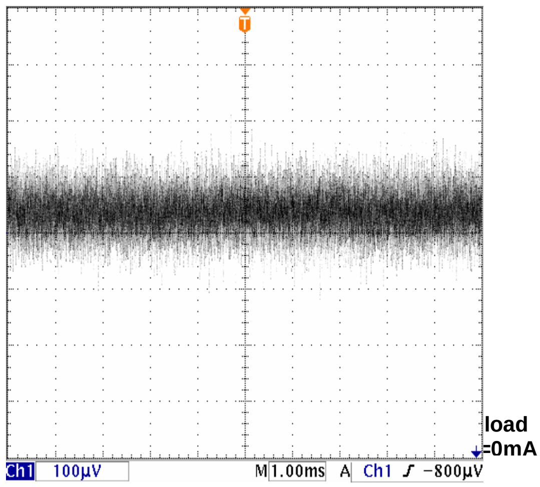
OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



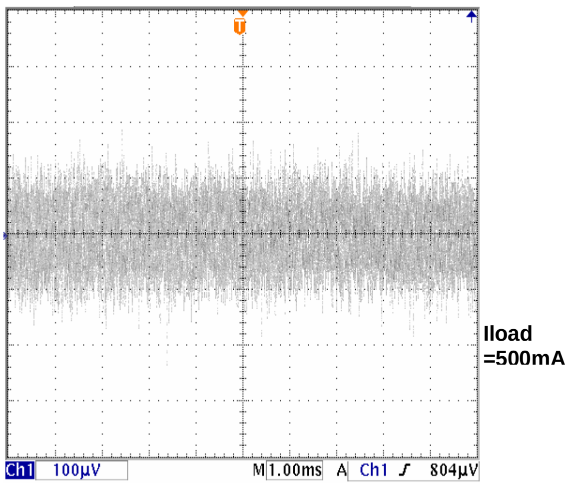
GROUND PIN CURRENT vs. INPUT VOLTAGE



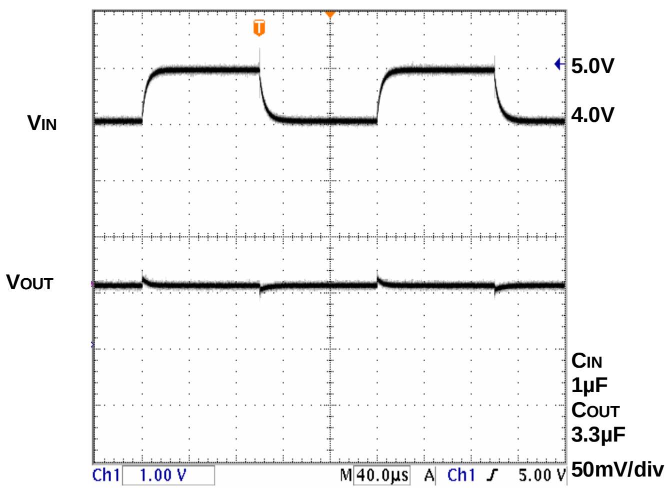
OUTPUT NOISE DC to 1MHz (39uVRMS)



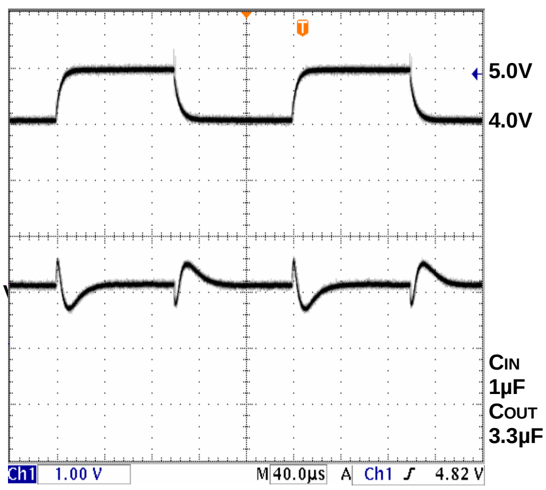
OUTPUT NOISE to 1MHz (74uVRMS)



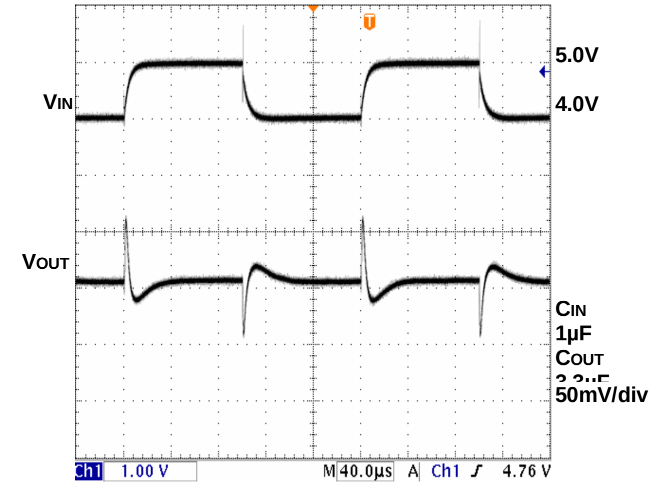
LINE TRANSIENT (I_{OUT}=0mA)



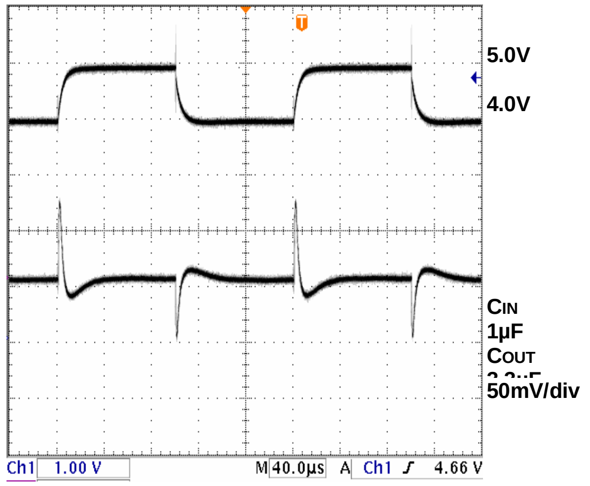
LINE TRANSIENT (I_{OUT}=10mA)



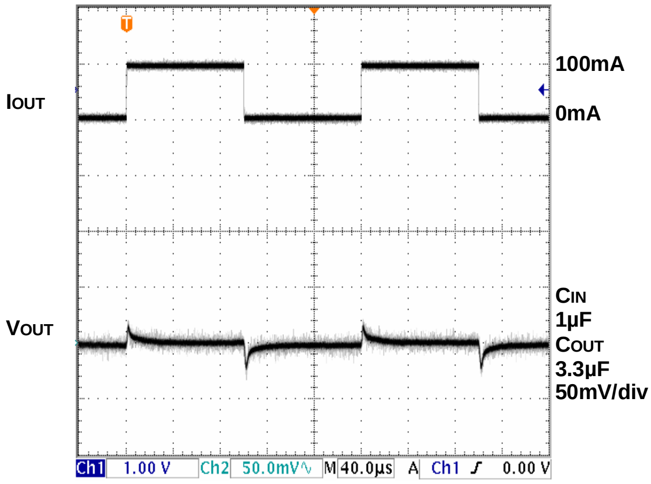
LINE TRANSIENT (IOUT=200mA)



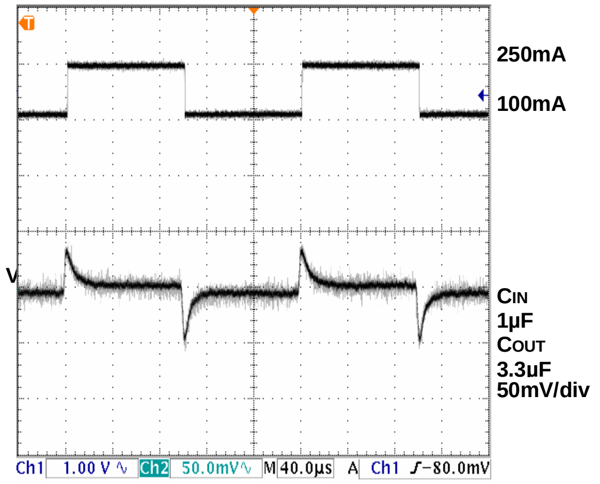
LINE TRANSIENT (IOUT=300mA)



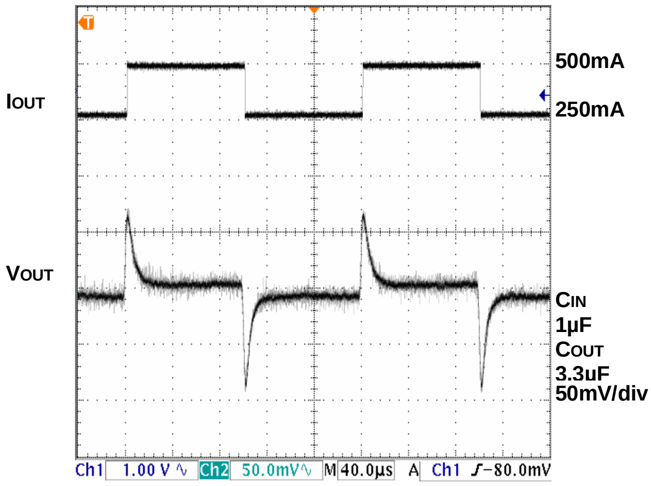
LOAD TRANSIENT



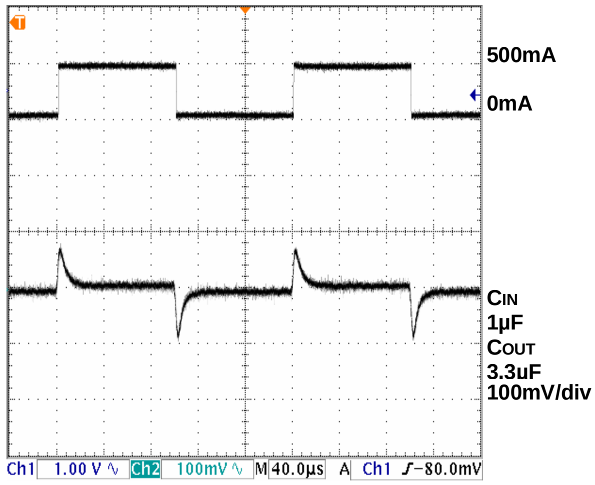
LOAD TRANSIENT



LOAD TRANSIENT



LOAD TRANSIENT



13. Detail Description

The FS8855 is a low-dropout linear regulator. The device provides preset 2.5V and 3.3V output voltages for output current up to 500mA. Other mask options for special output voltages from 1.5V to 5.0V with 100mV increment are also available. As illustrated in function block diagram, it consists of a 1.25V reference, error amplifier, P-channel pass transistor and an internal feedback voltage divider.

The 1.25V 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 feedback through an internal resistive divider connected to OUT pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

13.1 Internal P-channel Pass Transistor

The FS8855 features a P-channel MOSFET pass transistor. Unlike similar designs using PNP pass transistors, P-channel MOSFETs require no base drive, which reduces ground pin 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 FS8855 does not suffer from these problems and consumes only 30µA (Typ.) of ground pin current under heavy loads as well as in dropout conditions.

13.2 Output Voltage Selection

The FS8855 output voltage is preset at an internally trimmed voltage 2.5V, 3.3V or can be mask-optioned from 1.5V to 5.0V with 100mV increment. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example, the FS8855-33CL has a preset 3.3V output voltage.

13.3 Current Limit

The FS8855 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 0.8A.

13.4 Thermal Overload Protection

Thermal overload protection limits total power dissipation in the FS8855. When the junction temperature exceeds TJ = +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 10°C, resulting in a pulsed output during continuous thermal overload conditions.

Thermal overload protection is designed to protect the FS8855 in the event of fault conditions. For continuous operation, the maximum operating junction temperature rating of TJ = +125°C should not be exceeded.

13.5 Operating Region and Power Dissipation

Maximum power dissipation of the FS8855 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 = IOUT x (VIN-VOUT). 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 (TJ-TA) is the temperature difference between the FS8855 die junction and the surrounding air, θJC is the thermal resistance of the package chosen, and θCA 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.

If the FS8855 uses a SOT-89 package and this package is mounted on a double sided printed circuit board with two square inches of copper allocated for “heat spreading”, the resulting θJA is 180°C/W.

Based on a maximum operating junction temperature 125°C with an ambient temperature of 25°C, the maximum power dissipation will be:

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(125 - 25)}{180} = 0.555W$$

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”.

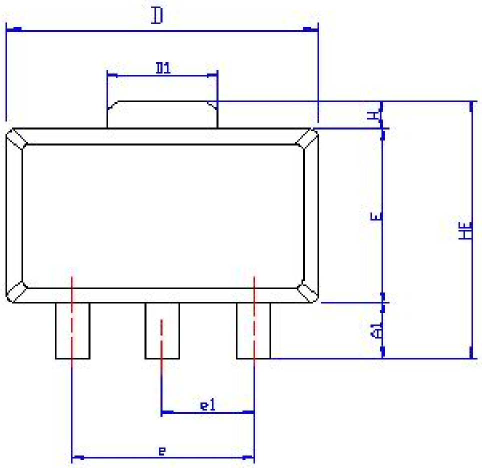
13.6 Input-Output Voltage

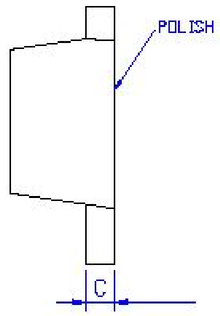
A regulator’s minimum input-output voltage differential, or dropout voltage, determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. The FS8855 uses a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on-resistance (RDS(ON)) multiplied by the load current.

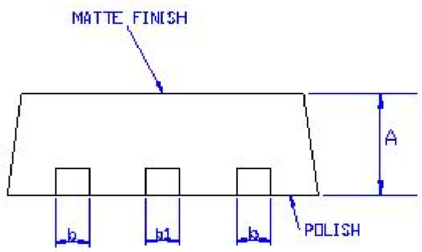
$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

14. Package Outline

14.1 SOT-89

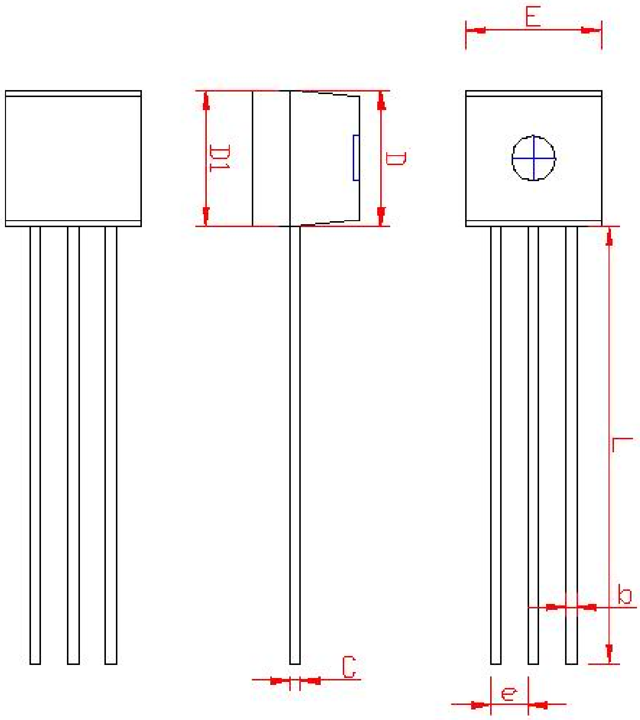






SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.50	1.60	0.055	0.059	0.063
A1	0.80	1.04	—	0.031	0.041	—
b	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.018	0.020
C	0.38	0.40	0.43	0.014	0.015	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.60	1.75	0.055	0.062	0.069
HE	—	—	4.25	—	—	0.167
E	2.40	2.50	2.60	0.094	0.098	0.102
e	2.90	3.00	3.10	0.114	0.118	0.122
H	0.35	0.40	0.45	0.014	0.016	0.018
S	0.65	0.75	0.85	0.026	0.030	0.034
e1	1.40	1.50	1.60	0.054	0.059	0.063

14.2 TO-92



SYMBOL	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	3.35	3.86	0.132	0.152
A1	1.0414	1.55	0.041	0.061
b	0.254	0.508	0.010	0.020
E	4.34	4.85	0.171	0.191
C	0.254	0.508	0.010	0.020
L	14.53	15.04	0.572	0.592
e	1.143	1.397	0.045	0.055
G	3.683	4.191	0.145	0.165
D	4.29	4.80	0.169	0.189
D1	4.34	4.85	0.171	0.191