1.4uA I$_Q$, High Accuracy, High PSRR LDO Regulators

Description

FME6232 series is a 1.4uA I$_Q$, high accuracy, high PSRR, low dropout linear regulator manufactured by CMOS process. FME6232 series voltage regulator has built-in fixed voltage reference, temperature protection, current limiting circuit, phase compensation circuit and low internal resistance MOSFET to achieve ultra-low power consumption, high ripple suppression and low voltage difference.

FME6232 series is compatible with ceramic capacitors smaller than tantalum capacitors, and not required by-pass capacitor, which can save more space.

The high-speed response characteristics of FME6232 series can cope with the fluctuation of load current, so it is especially suitable for handheld and RF products. By controlling the CE pin on the chip, the output can be turned off, and the power consumption after turning off is only 0μA。

Feature

- Maximum Output Current: 400mA

  （V_{IN} = 4.3V,V_{OUT} = 3.3V）

- Dropout Voltage:110mV@ I_{OUT} =100mA

  （FME6232C33）

- Operating Voltage Range: 1.8V~6.0V

- Output Voltage Range：1.2V~5.0V

- High Accuracy：±1%

- Low Quiescent current:1.4uA（TYP.）

- Standby Current: 0 uA（TYP.）

- High Ripple Rejection:70dB@1KHz（FME6232C33）

- Built-in temperature protection and current limiting protection

Applications

- Mobile phones

- Cordless telephone equipment

- Cameras, Video cameras

- Bluetooth and other radio frequency products

- Reference voltage sources

Package

- 3-pin　SOT89-3，SOT23-3

- 4-pin　FBP4L(1.0*1.0*0.37-0.65)

  　　　DFN4L(1.0*1.0*0.37-0.65)

- 5-pin：SOT89-5，SOT23-5

Typical Application Circuit

Selection Guide

FME 62 32 X XX X G
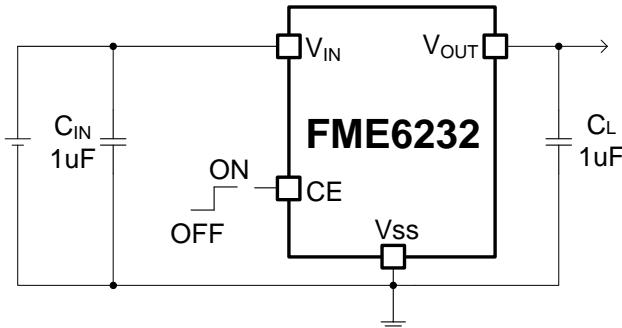
- Environment mark
- Package
  - M3：SOT23-3
  - M5：SOT23-5
  - P：SOT89-3
  - U4：FBP4L(1.0*1.0*0.37-0.65)
  - P5：SOT89-5
- Output Voltage
  - 12：1.2V
  - 15：1.5V
  - 18：1.8V
  - 25：2.5V
  - ……
- Version or Function
- Product Type
- Product Series
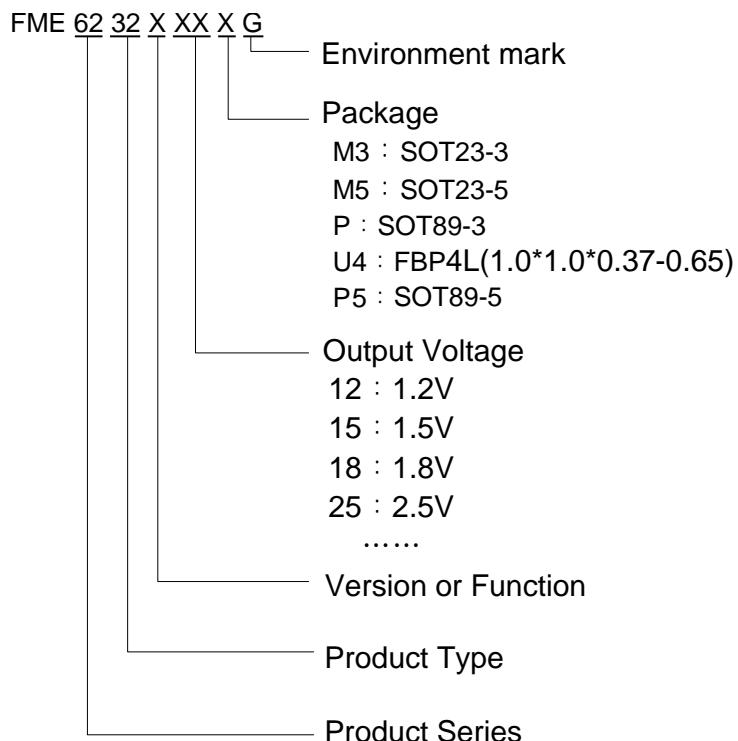
| product series	product description
FME6232A12M3G	V_{OUT}=1.2V；package：SOT23-3
FME6232C12M5G	V_{OUT}=1.2V；package：SOT23-5
FME6232C12U4AG	V_{OUT}=1.2V；package：FBP4L(1.0*1.0*0.37-0.65)
FME6232A15M3G	V_{OUT}=1.5V；package：SOT23-3
FME6232A18M3G	V_{OUT}=1.8V；package：SOT23-3
FME6232C18M5G	V_{OUT}=1.8V；package：SOT23-5
FME6232C18U4AG	V_{OUT} =1.8V；package：FBP4L(1.0*1.0*0.37-0.65)
FME6232C33P5G	V_{OUT} =3.3V；Package：SOT89-5

FME6232C25M5G	V_{OUT}=2.5V；package：SOT23-5
FME6232A28M3G	V_{OUT}=2.8V；package：SOT23-3
FME6232C28M5G	V_{OUT}=2.8V；package：SOT23-5
FME6232C28U4AG	V_{OUT}=2.8V；package：FBP4L(1.0*1.0*0.37-0.65)
FME6232A30M3G	V_{OUT}=3.0V；package：SOT23-3
FME6232C30M5G	V_{OUT}=3.0V；package：SOT23-5
FME6232C30U4AG	V_{OUT}=3.0V；package：FBP4L(1.0*1.0*0.37-0.65)
FME6232A33PG	V_{OUT}=3.3V；package：SOT89-3
FME6232A33M3G	V_{OUT}=3.3V；package：SOT23-3
FME6232C33M5G	V_{OUT}=3.3V；package：SOT23-5
FME6232C33U4AG	V_{OUT}=3.3V；package：FBP4L(1.0*1.0*0.37-0.65)
FME6232C33N4AG	V_{OUT} =3.3V；package：DFN4L(1.0*1.0*0.37-0.65)
FME6232C50M5G	V_{OUT}=5.0V；package：SOT23-5

**NOTE:** If you need other voltage and package, please contact our sales staff。

Pin Configuration（Top View）
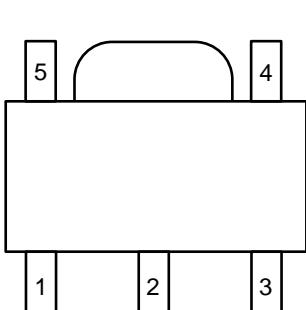
SOT89-5
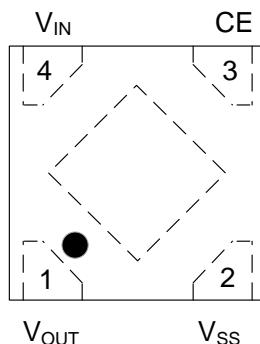
FBP4L(1.0*1.0*0.37-0.65)
DFN4L(1.0*1.0*0.37-0.65)
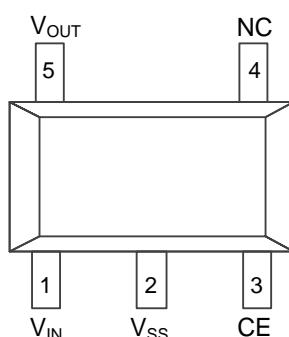
SOT23-5
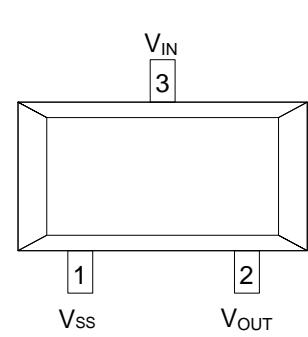
SOT23-3

Pin Assignment

PIN Number（SOT89-3）	PIN Number（FBP4L/DFN4L）	PIN Number（SOT23-5）	PIN Number（SOT23-5）	symbol	Function
2	4	1	3	V_{IN}	Power Input
1	2	2	1	Vss	Ground
-	3	3	-	CE	ON/OFF Control
-	-	4	-	NC	No Connect
3	1	5	2	V_{OUT}	Output

Block Diagram
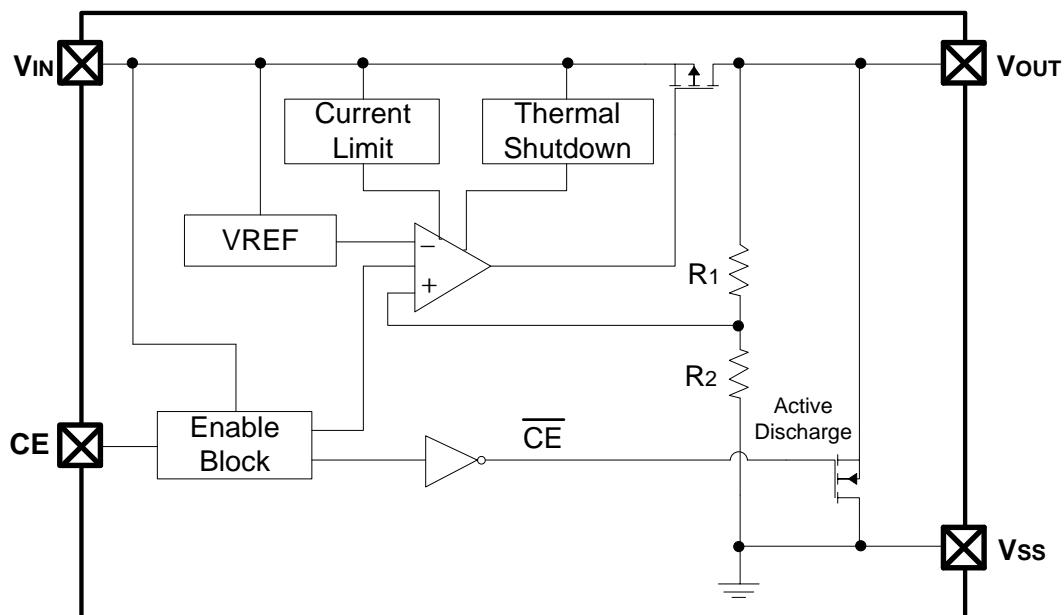
Absolute Maximum Ratings

Parameter			Symbol	Ratings	Units
Input Voltage			V_{IN}	-0.3~6.5	V
CE Pin Voltage			V_{CE}	V_{IN} -0.3~ V_{IN}+0.3	V
V_{OUT} Voltage			V_{OUT}	V_{IN} -0.3~ V_{IN}+0.3	V
V_{OUT} Current			I_{OUT}	600	mA
Internal Power Dissipation		SOT23-3	Pd	0.54	W
		SOT23-5	Pd	0.6	
		FBP4L(1.0*1.0*0.37-0.65) DFN4L(1.0*1.0*0.37-0.65)	Pd	0.5	
		SOT89-3	Pd	1.25	
Thermal resistance (Junction to air)		SOT23-3	Θ_{JA}	230	℃/W
		SOT23-5	Θ_{JA}	210	
		FBP4L(1.0*1.0*0.37-0.65) DFN4L(1.0*1.0*0.37-0.65)	Θ_{JA}	250	
		SOT89-3	Θ_{JA}	100	
Operating Ambient Temperature Range			T_{Opr}	-40~+85	℃
Storage Temperature Range			T_{stg}	-55~+150	℃
Maximum junction temperature			T_J	-40~+150	℃

Electrical Characteristic

FME6232A12/15($V_{IN}=V_{OUT}+1.2V$, V_{CE}=IN, C_{IN}=CL=1uF, Ta=25℃ , unless otherwise noted)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Units
Operating Input Voltage	V_{IN}			1.8	-	6.0	V
Output Voltage	V_{OUT}(E) (Note 2)	I_{OUT}=10mA		X 0.99	V_{OUT}(T) (Note 1)	X 1.01	V
Maximum Output Current	I_{OUTMAX}	$V_{IN}= V_{OUT}$+1.2V		-	400	-	mA
Load Regulation	ΔV_{OUT}	$V_{IN}= V_{OUT}$+1.2V, 1mA≤I_{OUT}≤100mA		-	9	20	mV
Dropout Voltage (Note 3)	VDIF	V_{OUT} =1.2V	I_{OUT} =100mA	-	350	700	mV
			I_{OUT} =200mA	-	600	1200	
		V_{OUT} =1.5V	I_{OUT} =100mA	-	250	500	
			I_{OUT} =200mA	-	500	1000	
Quiescent curren	I_Q	$V_{IN}= V_{OUT}$+1.2V		-	1.4	3	μA
Line Regulation	$\dfrac{\Delta V_{OUT}}{\Delta V_N \cdot V_{OUT}}$	I_{OUT} =30mA V_{OUT}+1V ≤VlN≤6V		-	0.06	0.1	%/V
Output Current Limit	I_{LIM}	Peak Output Current		-	550	-	mA
Ripple Rejection Rate(Note 4)	PSRR	V_N=(V_{OUT}+0.5)V+0.2VppAC, I_{OUT}=10mA	f=1kHz	-	70	-	dB
			f=10kHz	-	50	-	
Thermal Shutdown Temperature(Note 4)	T_{SD}	Temperature increasing, I_{OUT}=15mA		-	160	-	℃
Thermal Shutdown Hysteresis(Note 4)	ΔT_{SD}	Temperature falling		-	20	-	℃
Output noise	V_N	f = 10Hz to 100kHz, IOUT=10mA		-	130	-	uV$_{RMS}$

FME6232A18/28/30/33 ($V_{IN}= V_{OUT}$+1V, $V_{CE} = V_{IN}$, $C_{IN=}C_L$=1uF, Ta=25℃, unless otherwise noted)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Units
Operating Input Voltage	V_{IN}			1.8	-	6.0	V
Output Voltage	V_{OUT}(E) (Note 2)	I_{OUT}=10mA,$V_{IN}= V_{OUT}$+1V		X 0.99	V_{OUT}(T) (Note 1)	X 1.01	V
Maximum Output Current	I_{OUTMAX}	$V_{IN}= V_{OUT}$+1V		-	400	-	mA
Load Regulation	ΔV_{OUT}	$V_{IN}= V_{OUT}$+1V, 1mA≤I_{OUT}≤100mA		-	9	20	mV
Dropout Voltage (Note 3)	VDIF	V_{OUT} =1.8V	I_{OUT} =100mA	-	200	400	mV
			I_{OUT} =200mA	-	400	800	
		V_{OUT}=2.8V/3.0V	I_{OUT} =100SemA	-	120	240	
			I_{OUT} =200mA	-	240	480	
		$V_{OUT} \geq 3.3V$	I_{OUT} =100mA	-	110	220	
			I_{OUT} =200mA	-	220	440	

Quiescent curren	I_Q	$V_{IN}= V_{OUT}+1V$	-	1.4	3	μA
Line Regulation	$\dfrac{\Delta V_{OUT}}{\Delta V_N \cdot V_{OUT}}$	$I_{OUT} =30mA$ $V_{OUT}+1V \leq VIN \leq 6V$	-	0.02	0.1	%/V
Output Current Limit	I_{LIM}	Peak Output Current	-	550	-	mA
Ripple Rejection Rate(Note 4)	PSRR	$V_N=(V_{OUT}+0.5)V+0.2VppAC$, $I_{OUT}=10mA$ — f=1kHz	-	70	-	dB
		f=10kHz	-	50	-	
Thermal Shutdown Temperature(Note 4)	T_{SD}	Temperature increasing, $I_{OUT}=15mA$	-	160	-	℃
Thermal Shutdown Hysteresis(Note 4)	ΔT_{SD}	Temperature falling	-	20	-	℃
Output noise	V_N	f = 10Hz to 100kHz, $I_{OUT}=10mA$	-	130	-	uV$_{RMS}$

FME6232C12($V_{IN}=V_{OUT}+1.2V$, $V_{CE}=IN$, $C_{IN}=CL=1uF$, Ta=25℃, unless otherwise noted)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Units
Operating Input Voltage	V_{IN}			1.8	-	6.0	V
Output Voltage	V_{OUT}(E) (Note 2)	$I_{OUT}=10mA$		X 0.99	V_{OUT}(T) (Note 1)	X 1.01	V
Maximum Output Current	I_{OUTMAX}	$V_{IN}= V_{OUT}+1.2V$		-	400	-	mA
Load Regulation	ΔV_{OUT}	$V_{IN}= V_{OUT}+1.2V$, $1mA \leq I_{OUT} \leq 100mA$		-	9	20	mV
Dropout Voltage (Note 3)	VDIF	$V_{OUT} =1.2V$	$I_{OUT} =100mA$	-	350	700	mV
			$I_{OUT} =200mA$	-	600	1200	
Quiescent curren	I_Q	$V_{IN}= V_{OUT}+1.2V$		-	1.4	3	μA
Stand-by Current	I_{CEL}	$V_{CE} = 0V$		-	0	0.2	μA
Line Regulation	$\dfrac{\Delta V_{OUT}}{\Delta V_N \cdot V_{OUT}}$	$I_{OUT} =30mA$ $V_{OUT}+1V \leq VIN \leq 6V$		-	0.06	0.1	%/V
Output Current Limit	I_{LIM}	Peak Output Current		-	550	-	mA
CE "High" Voltage	V_{CEH}	Start up		1.2	-	-	V
CE "Low" Voltage	V_{CEL}	Shut down		-	-	0.4	V
Ripple Rejection Rate(Note 4)	PSRR	$V_N=(V_{OUT}+0.5)V+0.2VppAC$, $I_{OUT}=10mA$	f=1kHz	-	70	-	dB
			f=10kHz	-	50	-	
Thermal Shutdown Temperature(Note 4)	T_{SD}	Temperature increasing, $I_{OUT}=15mA$		-	160	-	℃
Thermal Shutdown Hysteresis(Note 4)	ΔT_{SD}	Temperature falling		-	20	-	℃
Output noise	V_N	f = 10Hz to 100kHz, IOUT=10mA		-	130	-	uV$_{RMS}$

FME6232C18/25/28/30/33/50($V_{IN}= V_{OUT}+1V$, $V_{CE} = V_{IN}$, $C_{IN=}C_L=1uF$, Ta=25℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Input Voltage	V_{IN}		1.8	-	6.0	V

Output Voltage	$V_{OUT}(E)$ (Note 2)	I_{OUT}=10mA,V_{IN}= V_{OUT}+1V	X 0.99	$V_{OUT}(T)$ (Note 1)	X 1.01	V
Maximum Output Current	I_{OUTMAX}	V_{IN}= V_{OUT}+1V	-	400	-	mA
Load Regulation	ΔV_{OUT}	V_{IN}= V_{OUT}+1V, 1mA≤I_{OUT}≤100mA	-	9	20	mV
Dropout Voltage (Note 3)	VDIF	V_{OUT}=1.8V, I_{OUT}=100mA	-	200	400	mV
		V_{OUT}=1.8V, I_{OUT}=200mA	-	400	800	
		V_{OUT}=2.5V, I_{OUT}=100mA	-	140	280	
		V_{OUT}=2.5V, I_{OUT}=200mA	-	280	560	
		V_{OUT}=2.8V/3.0V, I_{OUT}=100mA	-	120	240	
		V_{OUT}=2.8V/3.0V, I_{OUT}=200mA	-	240	480	
		$V_{OUT} \geq$ 3.3V, I_{OUT}=100mA	-	110	220	
		$V_{OUT} \geq$ 3.3V, I_{OUT}=200mA	-	220	440	
Quiescent curren	I_Q	V_{IN}= V_{OUT}+1V	-	1.4	3	μA
Stand-by Current	I_{CEL}	V_{CE} = 0V	-	0	0.2	μA
Line Regulation	$\dfrac{\Delta V_{OUT}}{\Delta V_N \cdot V_{OUT}}$	I_{OUT} =30mA V_{OUT}+1V ≤VIN≤6V	-	0.02	0.1	%/V
Output Current Limit	I_{LIM}	Peak Output Current	-	550	-	mA
CE "High" Voltage	V_{CEH}	Start up	1.2	-	-	V
CE "Low" Voltage	V_{CEL}	Shut down	-	-	0.4	V
Ripple Rejection Rate(Note 4)	PSRR	V_N=(V_{OUT}+0.5)V+0.2VppAC, I_{OUT}=10mA, f=1kHz	-	70	-	dB
		f=10kHz	-	50	-	
Thermal Shutdown Temperature(Note 4)	T_{SD}	Temperature increasing, I_{OUT}=15mA	-	160	-	℃
Thermal Shutdown Hysteresis(Note 4)	ΔT_{SD}	Temperature falling	-	20	-	℃
Output noise	V_N	f = 10Hz to 100kHz, I_{OUT}=10mA	-	130	-	uV$_{RMS}$

NOTES：

1. V_{OUT} (T)：Specified Output Voltage

2.V_{OUT} (E)：Effective Output Voltage (Ie. The output voltage when "V_{OUT}(T)+1.0V"is provided at the Vin pin while maintaining a certain Iout value.)

3.V_{DIF}： V_{IN1} −V_{OUT} (E)'

  V_{IN1} ：The input voltage when V_{OUT}(E)' appears as input voltage is gradually decreased.

  V_{OUT} (E)'=A voltage equal to 98% of the output voltage whenever an amply stabilized Iout {V_{OUT}(T)+1.0V} is input.

4. guaranteed by design.

Typical Performance Characteristics

FME6232C33M5G （$V_{CE} = V_{IN} = 4.3V$, Ta=25℃, unless otherwise noted.）
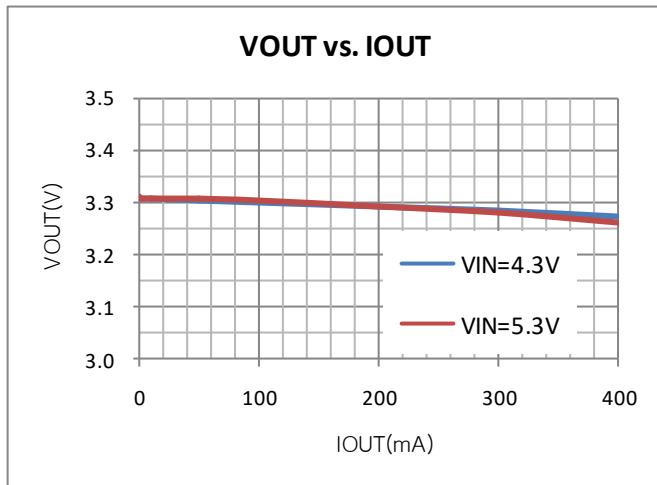

Figure 1. Output Voltage vs. Output Current
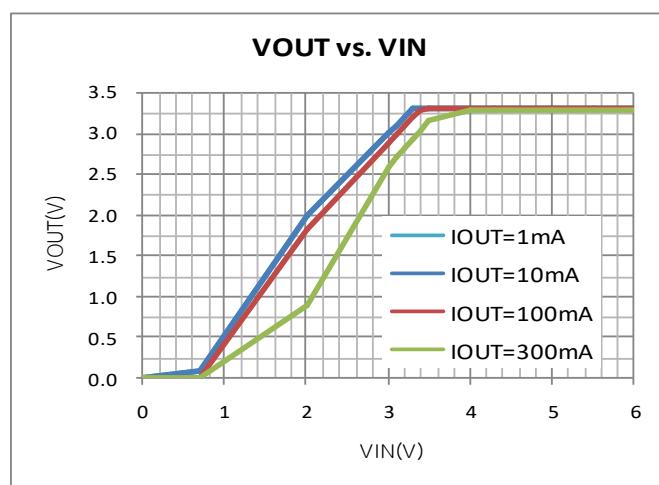
Figure 2. Output Voltage vs. Input Voltage
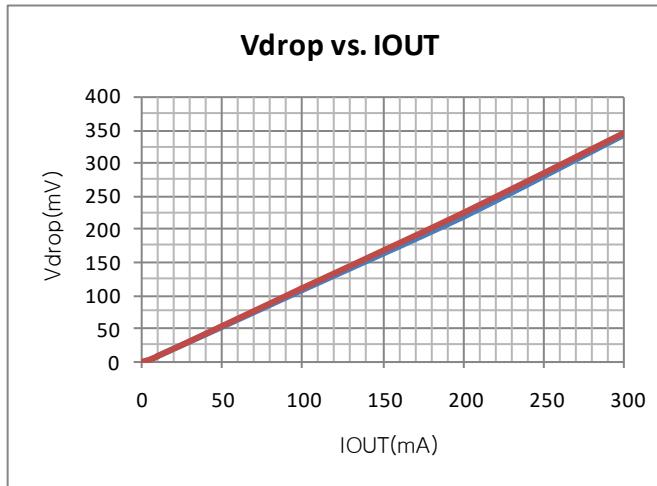


Figure 3. Dropout Voltage vs. Output Current
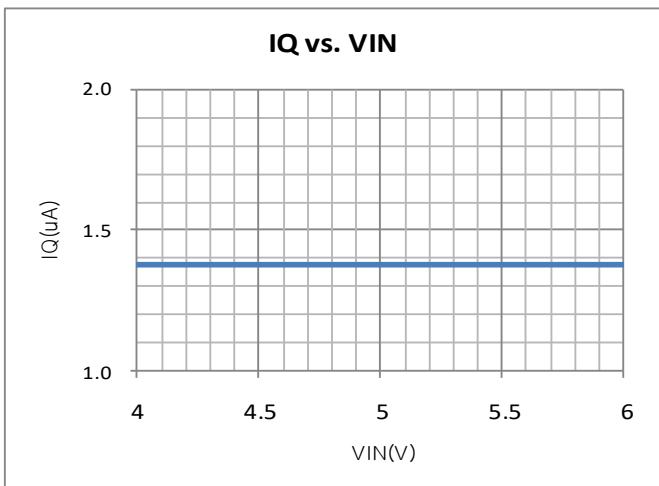

Figure 4.Quiescent Current vs. Input Voltage
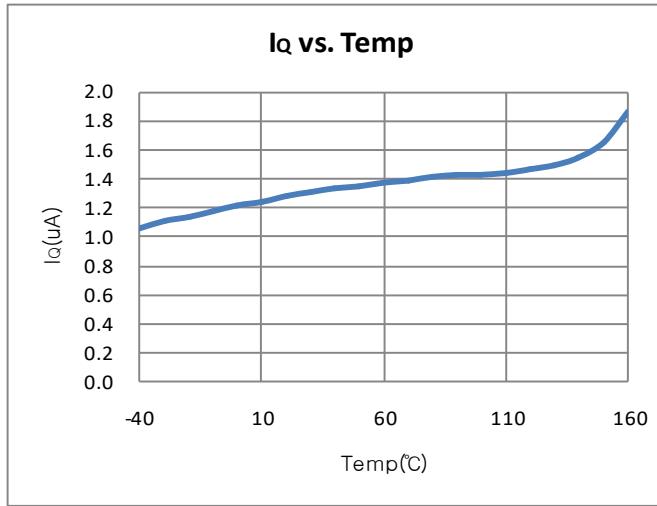
Figure 5. Quiescent Current vs. Temperature
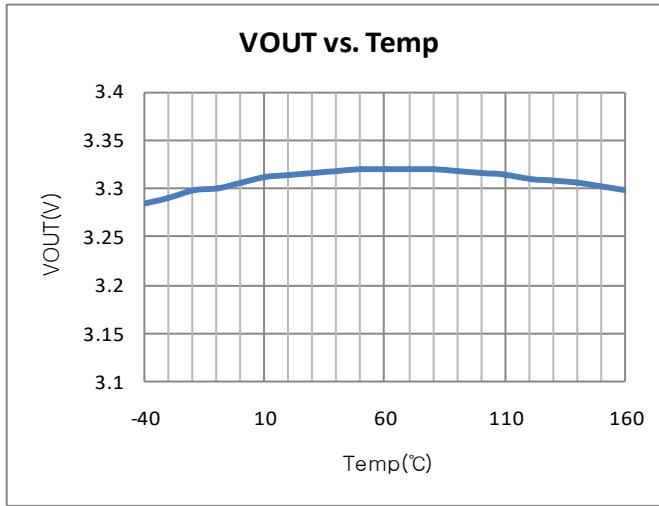
Figure 6. Output Voltage vs. Temperature
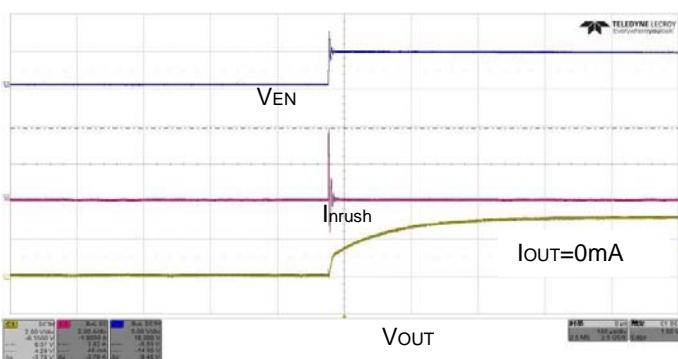
Figure 7. Enable Turn-on Response
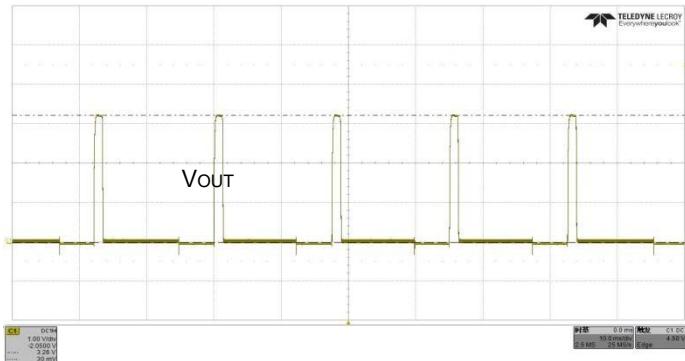
Figure 8. Thermal Shutdown
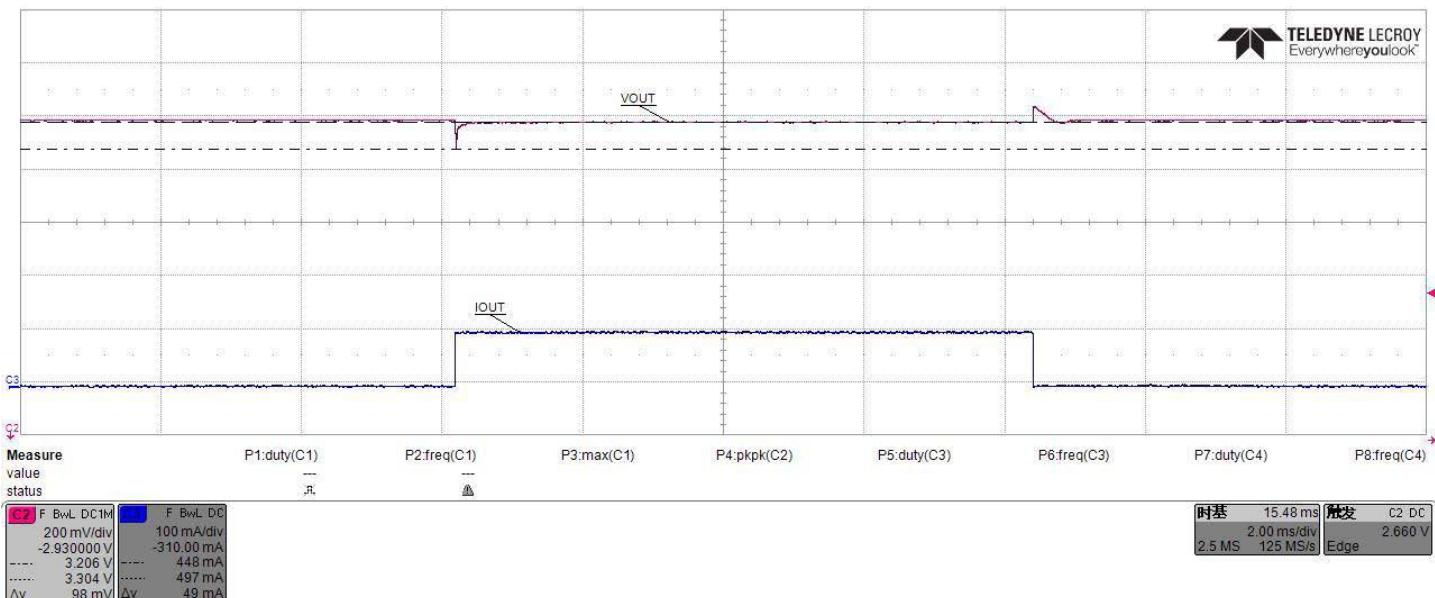
Figure 9. Load Transient Response 1-100mA
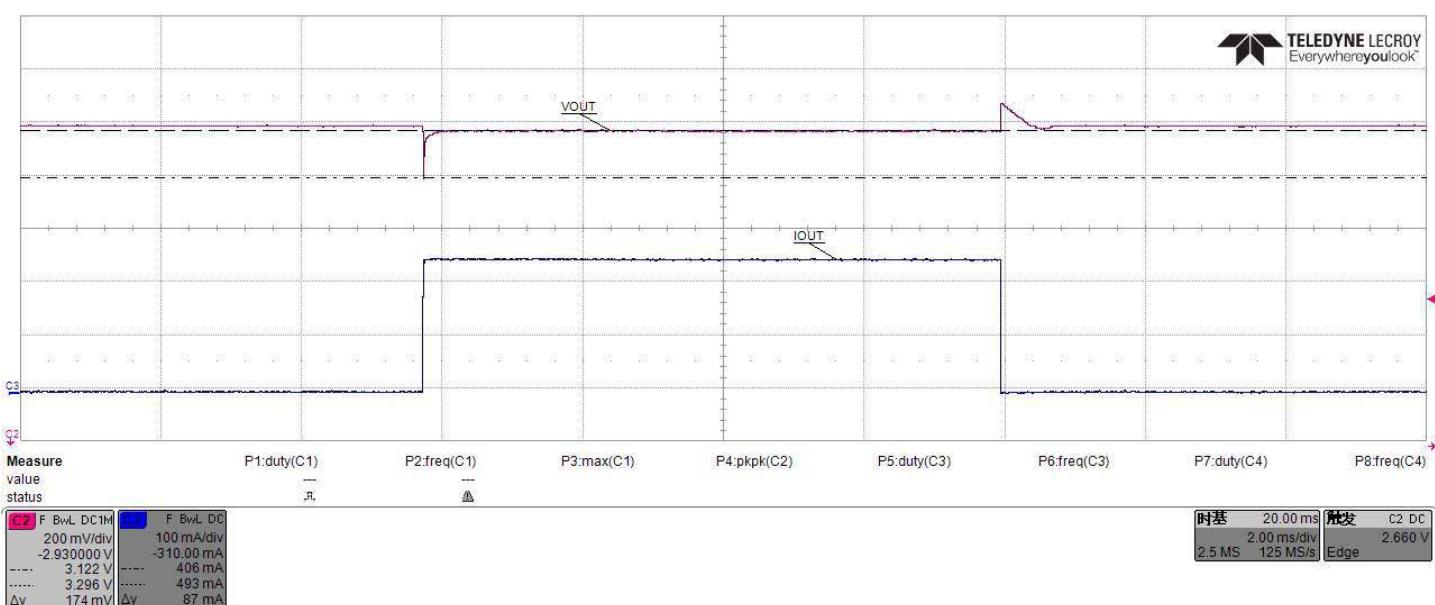
Figure 10. Load Transient Response 1-250mA
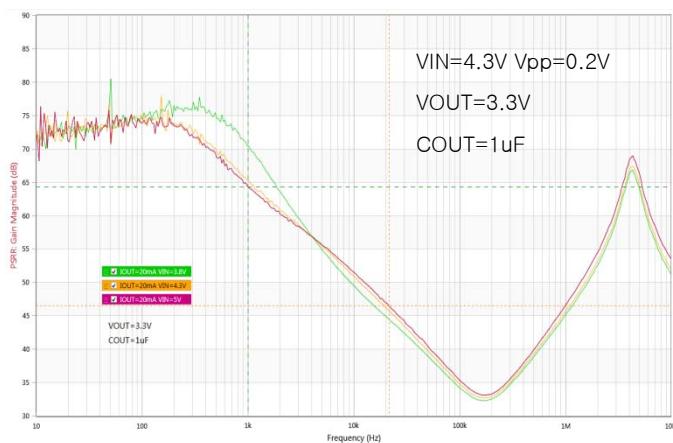
Figure 11. PSRR vs. Frequency
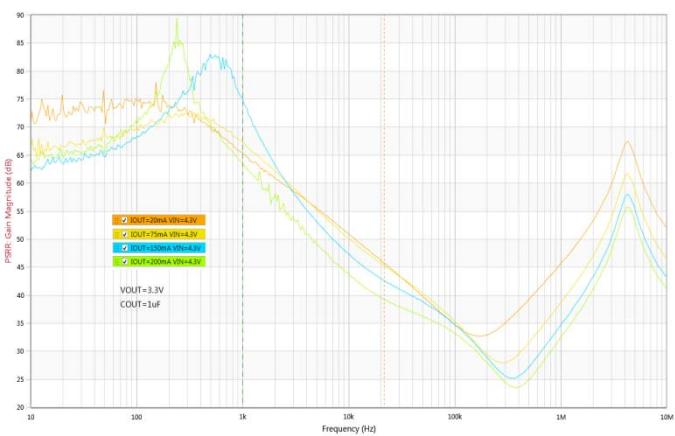
Figure 12. PSRR vs. Frequency
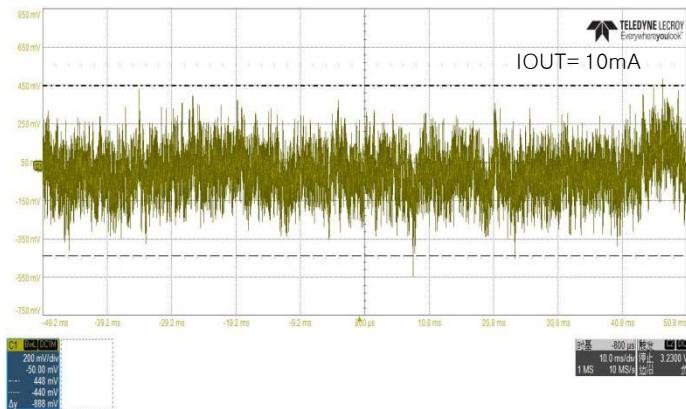
Figure 13. 10Hz-100kHz noise

Package Quantity

Package Type	Minimum Packing QTY	UNITS	Small Box	Large BOX
SOT23-3	3000	Tape & Reel	30K	120K
SOT23-5	3000	Tape & Reel	30K	120K
SOT89-5	1000	Tape & Reel	10K	40K
DFN4L(1.0*1.0*0.37-0.65)	10000	Tape & Reel	100K	400K
FBP4L(1.0*1.0*0.37-0.65)	10000	Tape & Reel	100K	400K

Packaging Information

● **Package Type:SOT89-3**
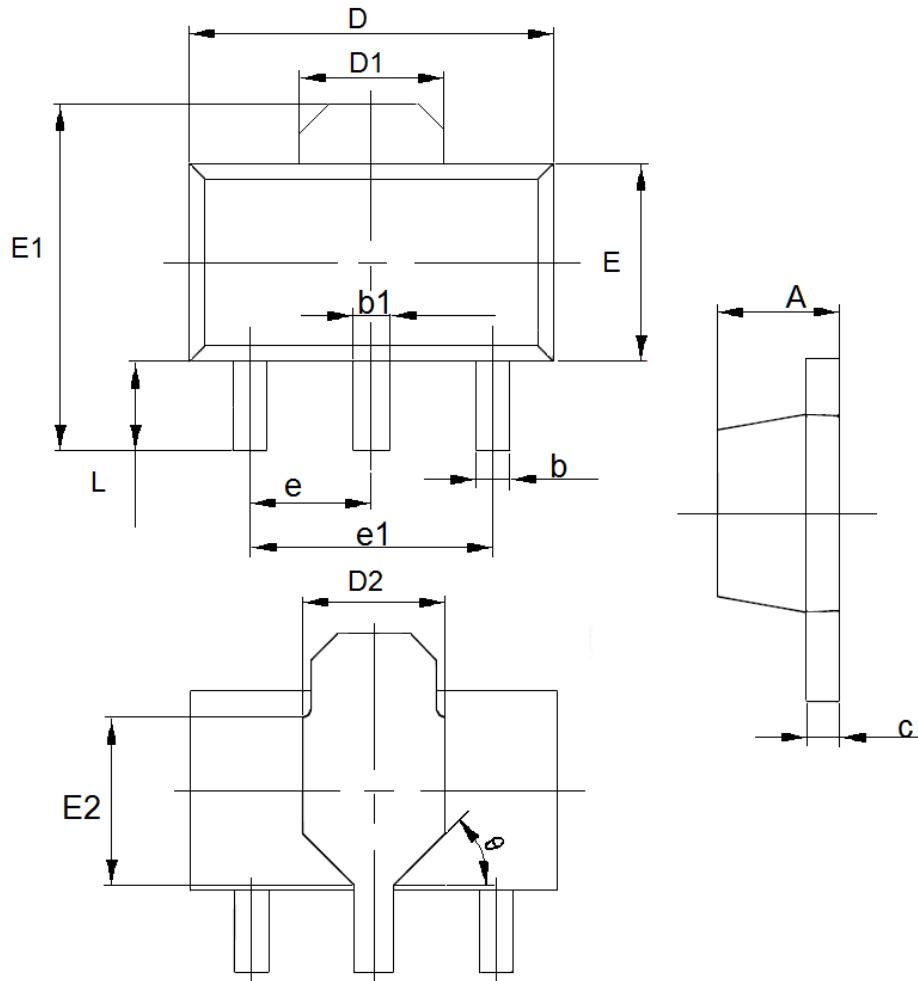
DIM	Millimeters		Inches	
	Min	**Max**	**Min**	**Max**
A	1.4	1.6	0.0551	0.0630
b	0.32	0.52	0.0126	0.0205
b1	0.4	0.58	0.0157	0.0228
c	0.35	0.45	0.0138	0.0177
D	4.4	4.6	0.1732	0.1811
D1	1.55(TYP)		0.061(TYP)	
D2	1.75(TYP)		0.0689(TYP)	
e1	3.0(TYP)		0.1181(TYP)	
E	2.3	2.6	0.0906	0.1023
E1	3.94	4.4	0.1551	0.1732
E2	1.9(TYP)		0.0748(TYP)	
e	1.5(TYP)		0.0591(TYP)	
L	0.8	1.2	0.0315	0.0472
θ	45°		45°	

- **Package Type:FBP4L(1.0*1.0*0.37-0.65)**
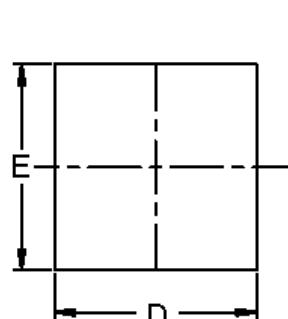
TOP VIEW

BOTTOM VIEW

PIN 1
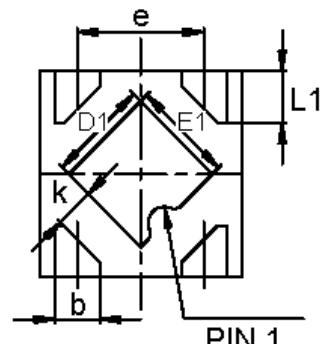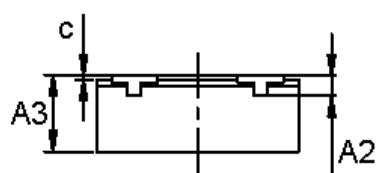
SIDE VIEW

DIM	Millimeters		Inches	
	Min	Max	Min	Max
A2	0.1REF		0.004REF	
A3	0.335	0.405	0.013	0.016
D	0.950	1.050	0.037	0.041
E	0.950	1.050	0.037	0.041
D1	0.450	0.550	0.018	0.022
E1	0.450	0.550	0.018	0.022
k	0.195REF		0.008REF	
b	0.175	0.275	0.007	0.011
C	0.000	0.050	0.000	0.002
e	0.575	0.675	0.023	0.027
L1	0.200	0.300	0.008	0.012

● **Package Type:DFN4L(1.0*1.0*0.37-0.65)**

TOP VIEW

SIDE VIEW

BOTTOM VIEW
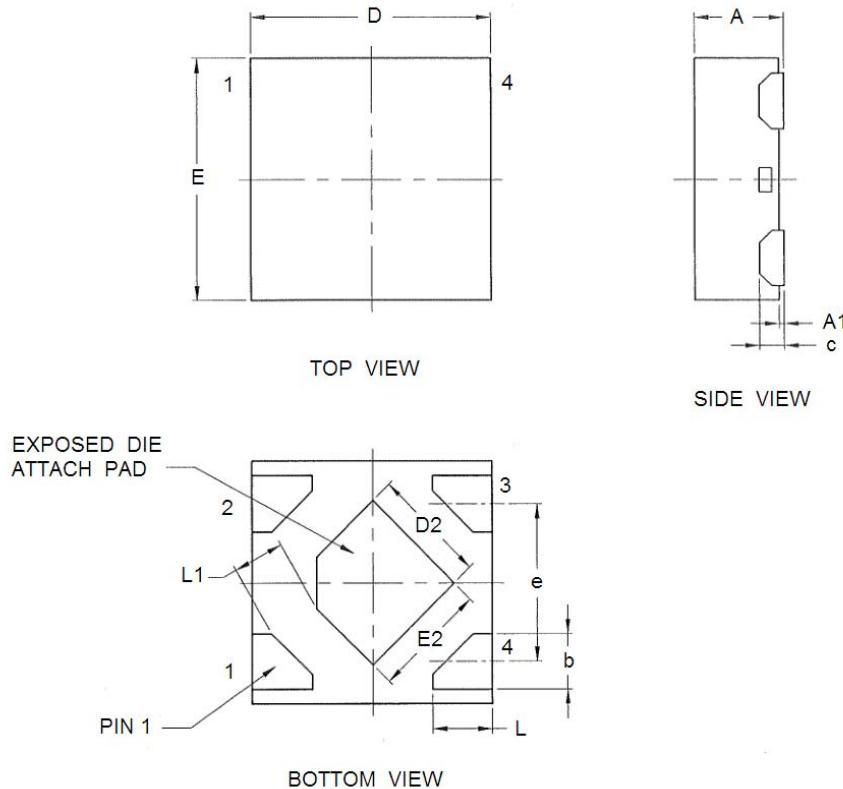
DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	0.32	0.4	0.0126	0.0157
A1	0	0.05	0	0.0020
b	0.18	0.28	0.0071	0.0110
c	0.102		0.0040	
D	0.95	1.05	0.0374	0.0413
D2	0.43	0.53	0.0169	0.0209
e	0.65 (TYP)		0.0256 (TYP)	
E	0.95	1.05	0.0374	0.0413
E2	0.43	0.53	0.0169	0.0209
L	0.2	0.3	0.0079	0.0118
L1	0.205 (TYP)		0.0081 (TYP)	

● **Package Type:SOT23-5**
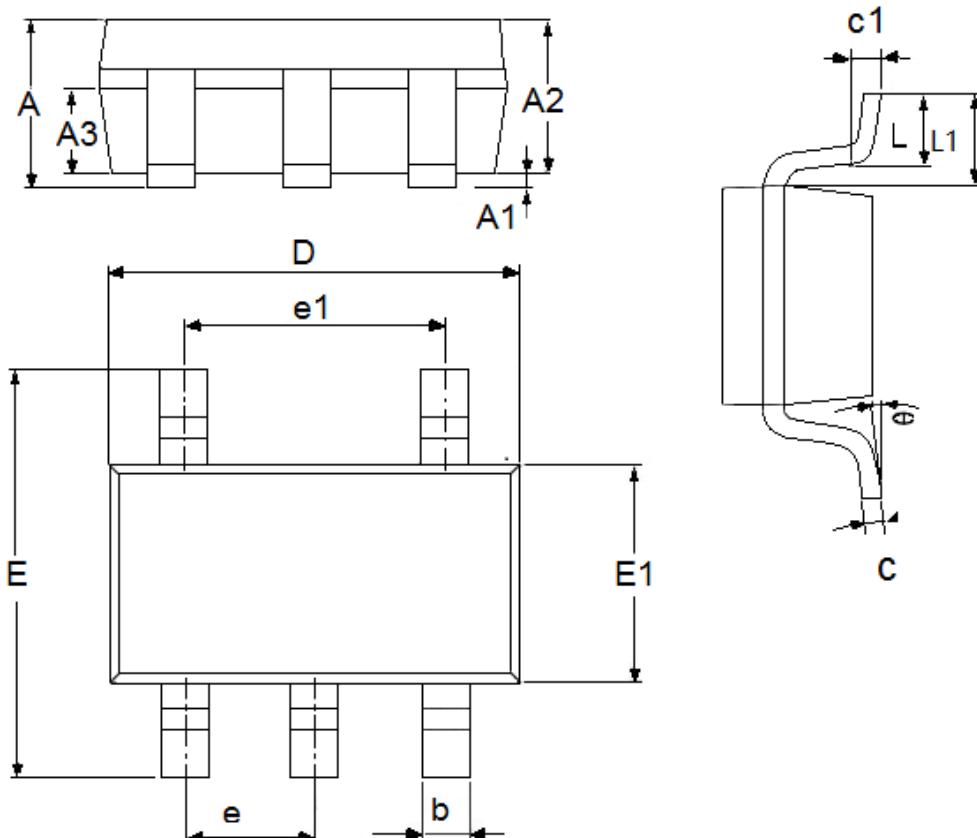
DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.6	0.7	0.0236	0.0276
b	0.25	0.5	0.0098	0.0197
c	0.1	0.23	0.0039	0.0091
D	2.82	3.05	0.1110	0.1201
e1	1.9(TYP)		0.0748(TYP)	
E	2.6	3.05	0.1024	0.1201
E1	1.5	1.75	0.0512	0.0689
e	0.95(TYP)		0.0374(TYP)	
L	0.3	0.6	0.0118	0.0236
L1	0.59(TYP)		0.0232(TYP)	
Θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	

● **Package Type:SOT23-3**
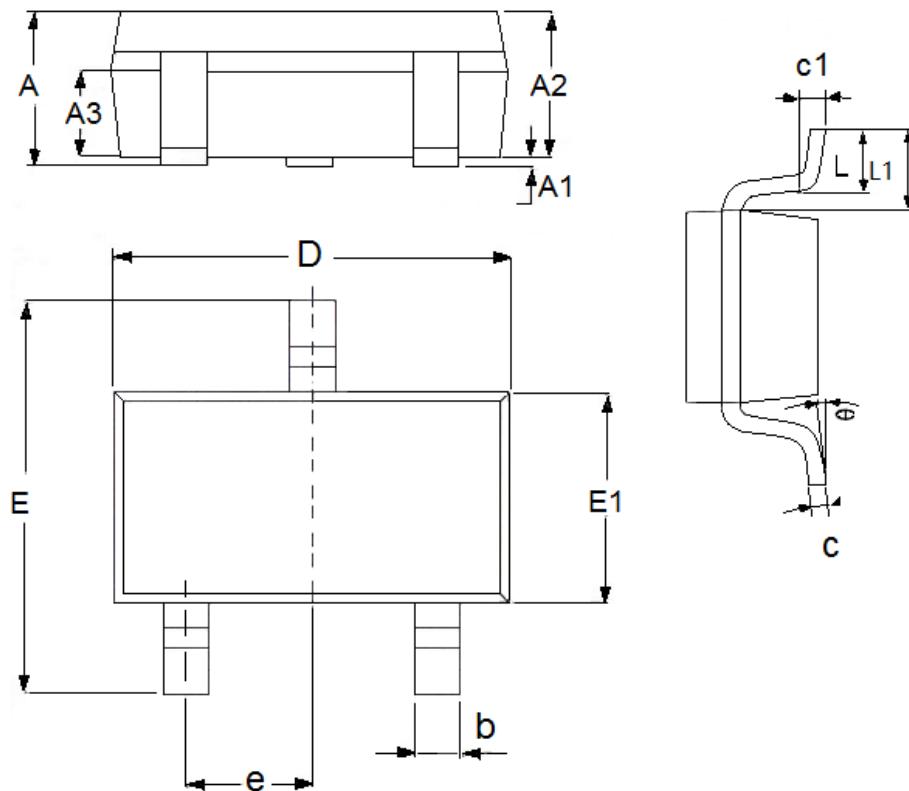
DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.6	0.7	0.0236	0.0276
b	0.25	0.5	0.0098	0.0197
c	0.1	0.25	0.0039	0.0098
D	2.8	3.1	0.1102	0.1220
E	2.6	3.1	0.1023	0.1220
E1	1.5	1.8	0.0591	0.0709
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
L1	0.59(TYP)		0.0232(TYP)	
Θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	

● **Packaging Type: SOT89-5**
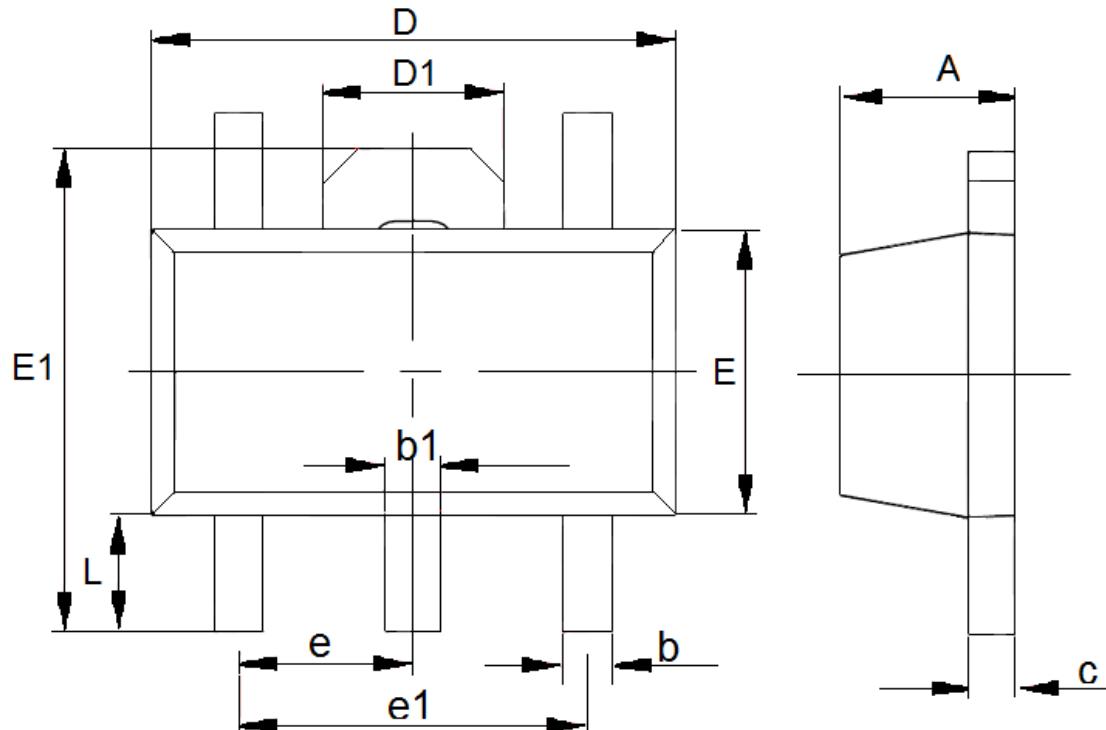
DIM	Millimeters		Inches	
	Min	**Max**	**Min**	**Max**
A	1.4	1.6	0.0551	0.0630
b	0.32	0.52	0.0126	0.0205
b1	0.38	0.58	0.0150	0.0228
c	0.35	0.47	0.0138	0.0185
D	4.4	4.6	0.1732	0.1811
D1	1.55(TYP)		0.061(TYP)	
e1	3(TYP)		0.1181(TYP)	
E	2.3	2.6	0.0906	0.1023
E1	3.94	4.4	0.1551	0.1732
e	1.5(TYP)		0.0591(TYP)	
L	0.8	1.2	0.0315	0.0472