

20V/500mA, 0.8uA Ultra-Low Power High Precision Linear Regulator

1 Description

The AL99XX is an ultra-low quiescent power, low dropout linear regulator fabricated in CMOS process. The regulator consumes about 0.8uA and 0.01uA (typical) after enable/shutdown. Built-in enable control, output discharge, short circuit protection, and thermal shutdown are available in SOT89-3, SOT23-5, and SOT23-3 packages.

2 Features

- Ultra-low Quiescent Current: 0.8uA(VIN=12V)
- Shutdown Current: 0.01uA
- Input Range: 2.5V-20V
- Output Range: 1.8V-5V (0.1V interval)
- High Precision: $\pm 2\%$
- Maximum Output Current: 500mA
- Enabling Control
- Output Discharge
- Output Short Circuit Protection
- Thermal Shutdown

3 Applications

- Smart Meter
- Battery powered equipment
- Camera Recorder
- Portable Audio-Visual Equipment
- PDA (Personal Digital Assistant)

4 Ordering Information

Product Number	Package	Quantity/Tape
AL99XXGR	SOT89-3	1000/Tape
AL99XXAGR	SOT89-3	1000/Tape
AL99XXTCR	SOT23-5	3000/Tape
AL99XXTGR	SOT23-3	3000/Tape
AL99XXTCRA	SOT23-5	3000/Tape

5 Marking

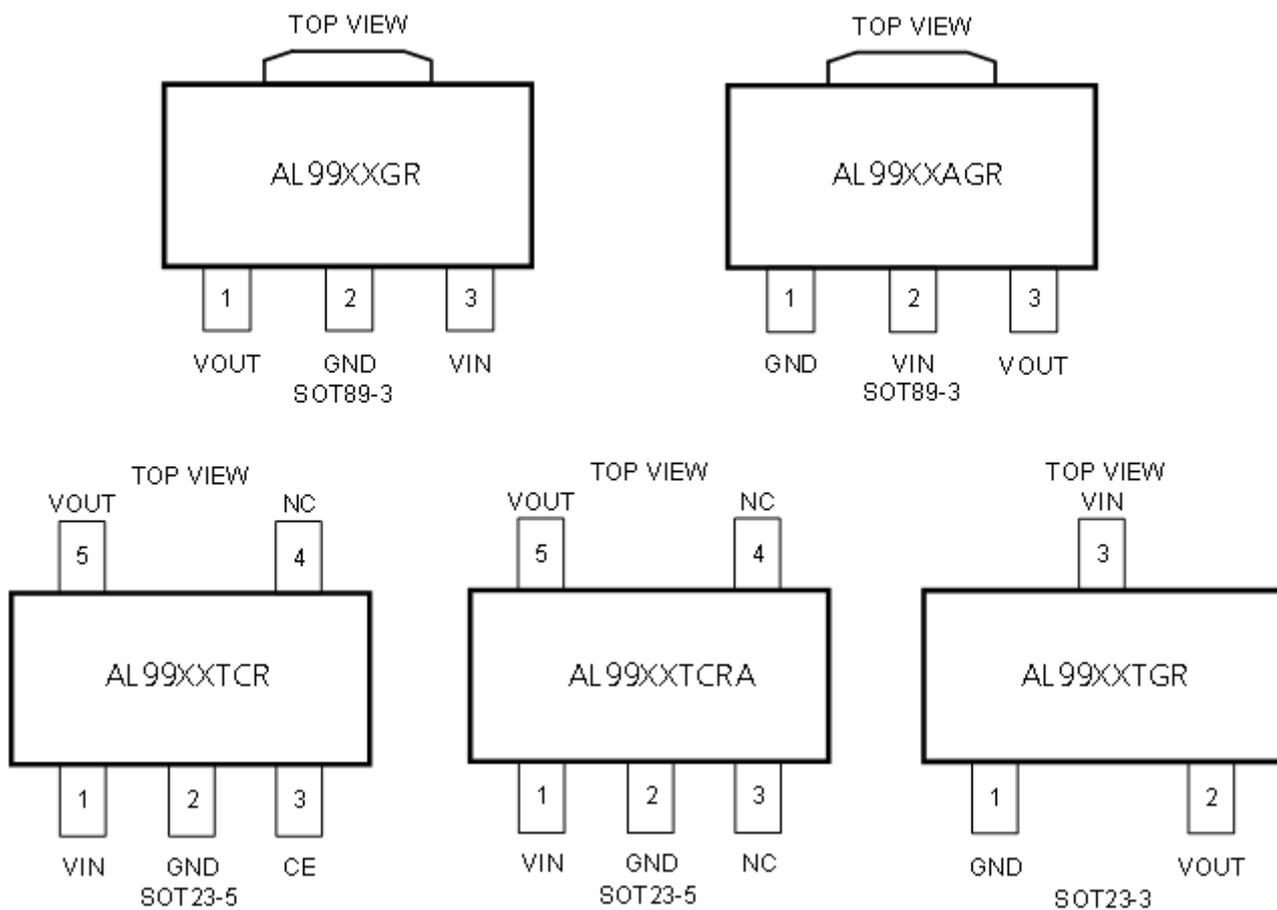
Product Number	Marking*
AL99XXAGR	AL99XXA YYWW
AL99XXGR	AL99XX YYWW
AL99XXTCR	99XX
AL99XXTGR	99XX
AL99XXTCRA	99XX

Note: YY=Year WW=Week; 99XX=Product Name, XX= Output Voltage

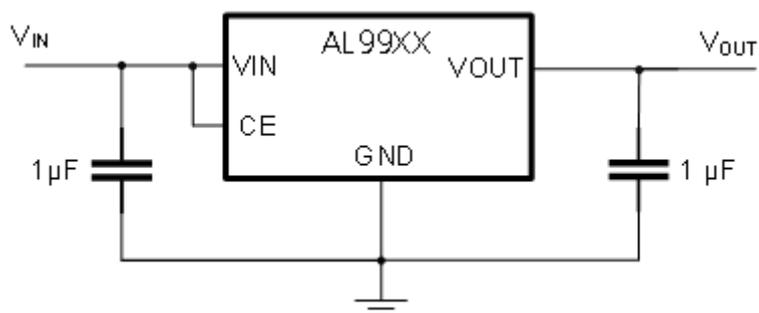
Green (RoHS & HF): ALONG defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your ALONG representative directly.

Moisture sensitivity level(MSL):3

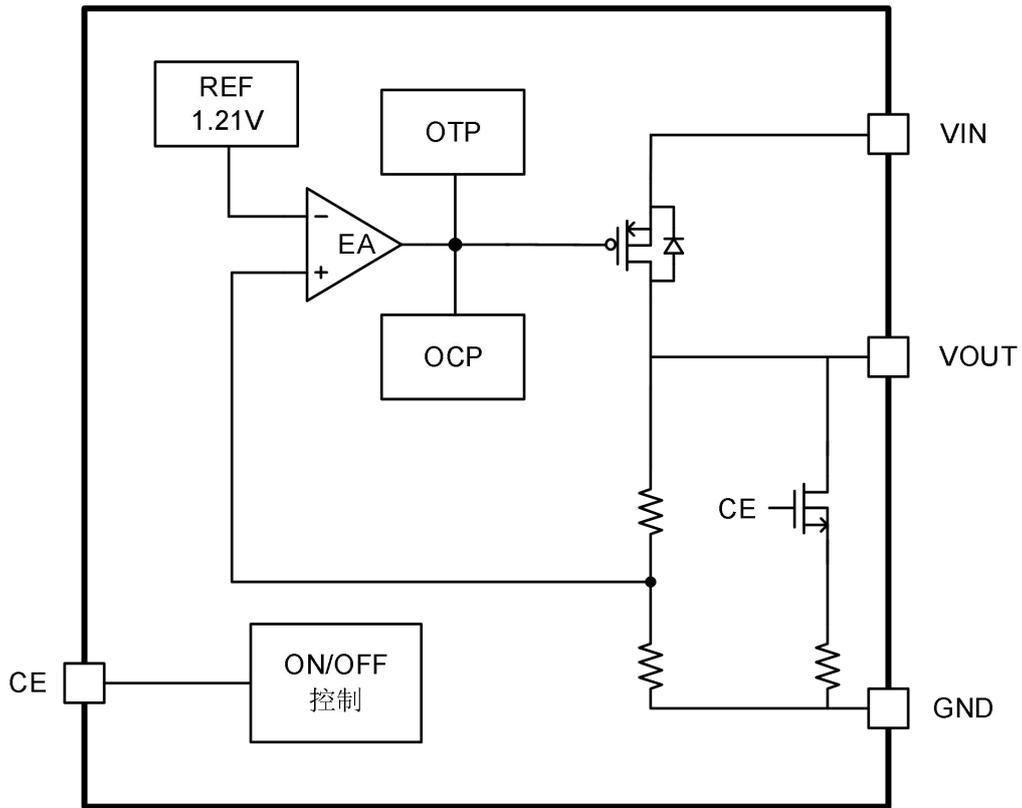
6 Pinout



7 Typical Application



8 Block Diagram



9 Pin Descriptions

AL99XXGR	AL99XXAGR	AL99XXTCR	AL99XXTCRA	AL99XXTGR	Pin Name	Descriptions
SOT89-3	SOT89-3	SOT23-5	SOT23-5	SOT23-3		
/	/	3	/	/	CE	Enable pin
2	1	2	2	1	GND	Ground
		4	3、4		NC	No Connection
3	2	1	1	3	VIN	Power supply input
1	3	5	5	2	VOUT	Voltage output

10 Specifications

10.1 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Supply Input Voltage	V_{IN}	28	V
Output Voltage	V_{OUT}	-0.3 ~ 7	V
CE Voltage	V_{CE}	-0.3 ~ 28	V
Operating Junction Temperature Range	T_{OPR}	-40 ~ 150	°C
Soldering Temperature	T_{LEAD}	260(soldering, 10s)	°C
Storage Temperature Range	T_{STG}	-55 ~ 150	°C

Note1: Stress exceeds these ratings listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Expose to absolute-maximum-rated conditions for extended periods may affect device reliability.

10.2 ESD Ratings

Discharge mode	Standardize	Value	Units
HBM	ESDA/JEDEC JS-001-2017	±4000	V
CDM	ESDA/JEDEC JS-002-2018	±2000	V

10.3 Recommended Operating Range

Parameter	Symbol	Min.	Max.	Units
Input Voltage Range	V_{IN}	$V_{OUT}+1$	20	V
Output Voltage Range	V_{OUT}	1.8	5	V
Operating Ambient Temperature Range	T_A	-40	85	°C
Output Current	I_{OUT}	0	500	mA
Input Capacitor	C_{IN}	1		μF
Output Capacitor	C_{OUT}	1		μF

10.4 Thermal Information

Parameter		AL99XX					Units
		GR [SOT89-3]	AGR [SOT89-3]	TCR [SOT23-5]	TCRA [SOT23-5]	TGR [SOT23-3]	
$R_{\theta JA}$	Junction to ambient	72.5	131.7	195.7	195.7	297.3	°C/W
$R_{\theta JC(top)}$	Junction to case(top)	121.4	65.8	88.2	88.2	128.5	°C/W
$R_{\theta JB}$	Junction to Board	37.3	32.4	40.7	40.7	91.7	°C/W

10.5 Electrical Characteristics

AL99XX

(VIN=VOUT+1V, CIN=1μF, COUT=1μF, TA=25°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V _{OUT}	I _{OUT} = 30mA	4.9	5	5.1	V
Maximum Output Current	I _{OUTMAX}	V _{IN} = V _{OUT} + 1V	500			mA
Load regulation	ΔV _{OUT}	1mA ≤ I _{OUT} ≤ 500mA		15	23	mV
Dropout voltage	V _{DIF1}	I _{OUT} = 100mA		100	203	mV
Input Quiescent Current	I _Q	V _{IN} = 6V		0.5	1	μA
Shutdown Current	I _{SD}	V _{CE} = 0V		0.01		μA
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} * V_{OUT}}$	I _{OUT} = 0mA ΔV _{OUT} +1V ≤ ΔV _{IN} ≤ 18V		0.003	0.36	%/V
CE Rising Threshold	V _{CEH}	On, output voltage stabilized	1.3			V
CE Falling Threshold	V _{CEL}	Off, output voltage is 0			0.4	V
Short-Circuit Current	I _{SHORT}	V _{IN} = V _{OUT} + 1V, V _{CE} = V _{IN} V _{OUT} = 0V		50		mA
Current Limiting	I _{limit}	V _{OUT} = V _{OUT(E)} X 0.95 V _{IN} = V _{OUT} + 2V	500	800		mA
Load Capacitor Discharge Resistance	R _{DCHG}	V _{CE} = V _{SS} , V _{OUT} = V _{OUT}		500		Ω
Thermal Shutdown Temperature	OTP			160		°C
Thermal Shutdown Hysteresis	OTP_HYS			30		°C

AL99XX

(VIN=VOUT+1V, CIN=1μF, COUT=1μF, TA=25°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V _{OUT}	I _{OUT} = 30mA	3.92	4	4.08	V
Maximum Output Current	I _{OUTMAX}	V _{IN} = V _{OUT} + 1V	500			mA
Load regulation	ΔV _{OUT}	1mA ≤ I _{OUT} ≤ 500mA		10	23	mV
Dropout voltage	V _{DIF1}	I _{OUT} = 100mA		110	203	mV
Input Quiescent Current	I _Q	V _{IN} = 5V		0.5	0.8	μA
		V _{IN} = 7.5V		0.7	1	μA
Shutdown Current	I _{SD}	V _{CE} = 0V		0.01		μA
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} * V_{OUT}}$	I _{OUT} = 0mA ΔV _{OUT} +1V ≤ ΔV _{IN} ≤ 18V		0.01	0.55	%/V
CE Rising Threshold	V _{CEH}	On, output voltage stabilized	1.3			V
CE Falling Threshold	V _{CEL}	Off, output voltage is 0			0.4	V
Short-Circuit Current	I _{SHORT}	V _{IN} = V _{OUT} + 1V, V _{CE} = V _{IN} V _{OUT} = 0V		50		mA
Current Limiting	I _{limit}	V _{OUT} = V _{OUT(E)} × 0.95 V _{IN} = V _{OUT} + 2V	500	800		mA
Load Capacitor Discharge Resistance	R _{DCHG}	V _{CE} = V _{SS} , V _{OUT} = V _{OUT}		500		Ω
Thermal Shutdown Temperature	OTP			160		°C
Thermal Shutdown Hysteresis	OTP_HYS			30		°C

AL9933

(VIN=VOUT+1V, CIN=1μF, COU=1μF, TA=25°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V _{OUT}	I _{OUT} = 30mA	3.234	3.3	3.366	V
Maximum Output Current	I _{OUTMAX}	V _{IN} = V _{OUT} +1V	500			mA
Load regulation	ΔV _{OUT}	1mA ≤ I _{OUT} ≤ 500mA		10	23	mV
Dropout voltage	V _{DIF1}	I _{OUT} = 100mA		120	203	mV
Input Quiescent Current	I _Q	V _{IN} = 5V		0.5	0.8	μA
Shutdown Current	I _{SD}	V _{CE} = 0V		0.01		μA
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} * V_{OUT}}$	I _{OUT} = 10mA ΔV _{OUT} +1V ≤ ΔV _{IN} ≤ 18V		0.01	0.55	%/V
CE Rising Threshold	V _{CEH}	On, output voltage stabilized	1.3			V
CE Falling Threshold	V _{CEL}	Off, output voltage is 0			0.4	V
Short-Circuit Current	I _{SHORT}	V _{IN} = V _{OUT} +1V, V _{CE} = V _{IN} V _{OUT} = 0V		50		mA
Current Limiting	I _{limit}	V _{OUT} = V _{OUT(E)} X 0.95 V _{IN} = V _{OUT} +2V	500	800		mA
Load Capacitor Discharge Resistance	R _{DCHG}	V _{CE} = V _{SS} , V _{OUT} = V _{OUT}		500		Ω
Thermal Shutdown Temperature	OTP			160		°C
Thermal Shutdown Hysteresis	OTP_HYS			30		°C

Notes:

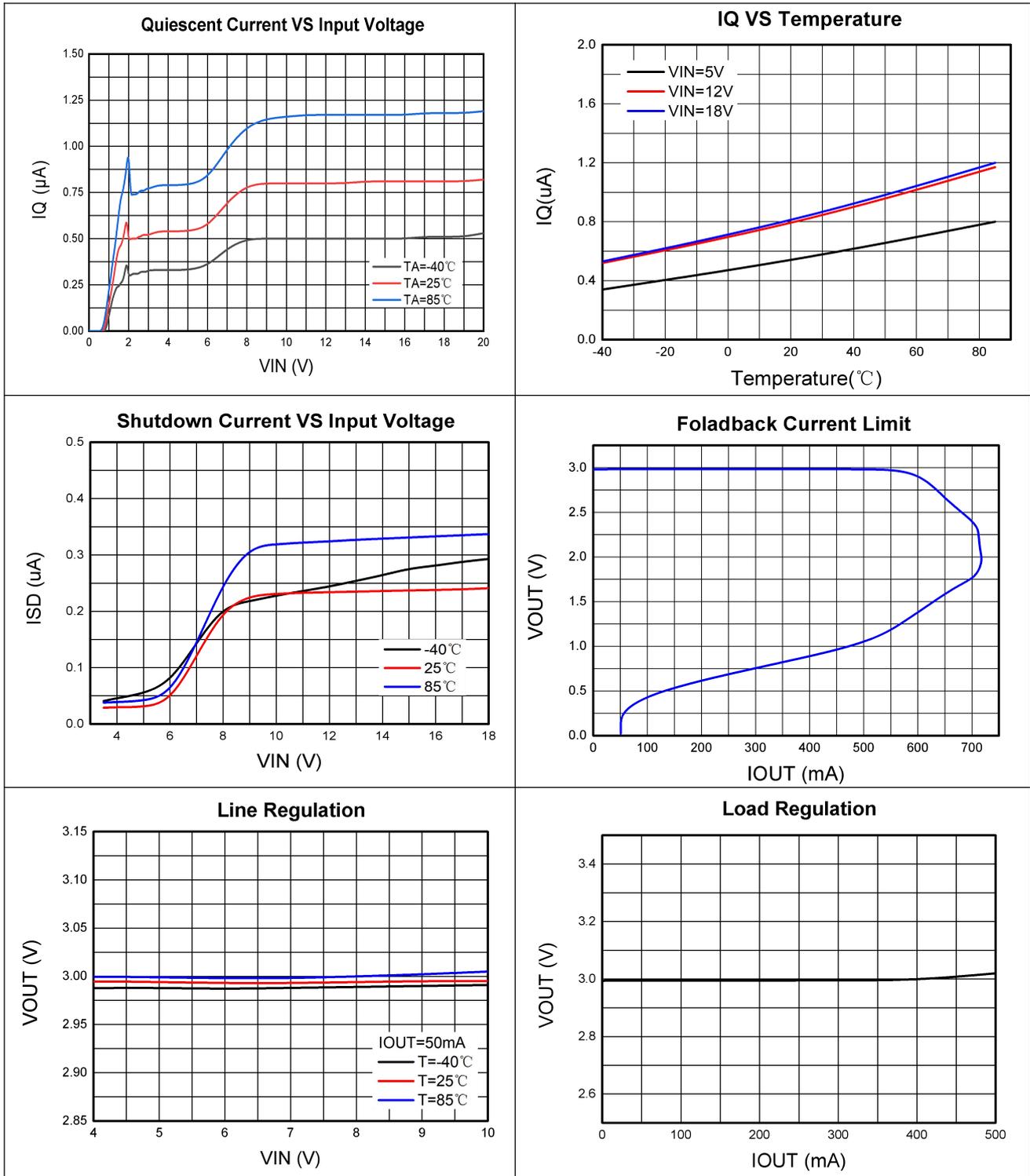
*1. V_{OUT(E)}: output voltage when V_{IN} = V_{OUT} + 1V, I_{OUT} = 1mA.

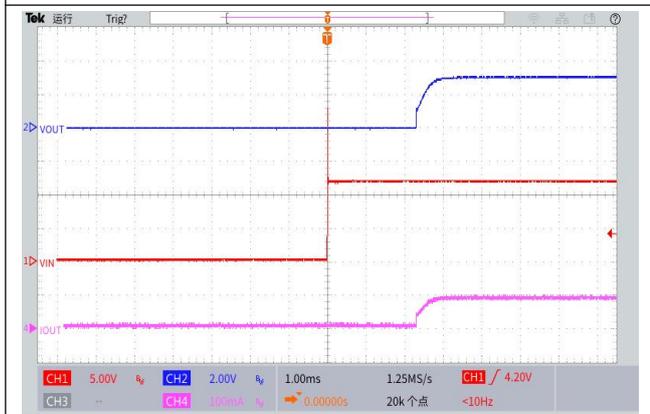
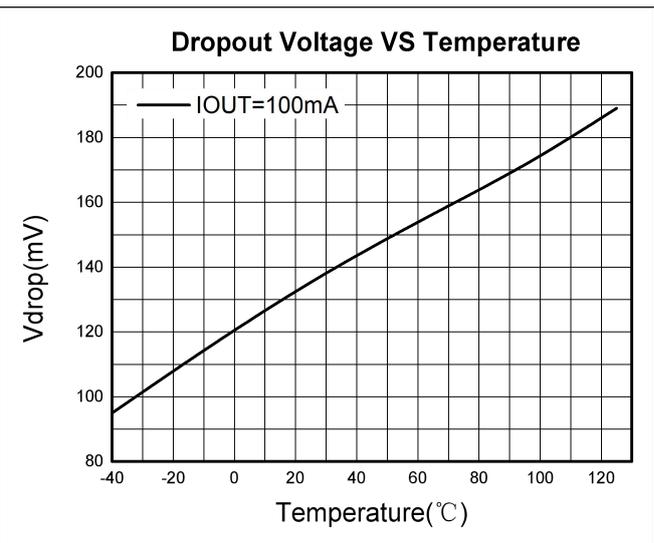
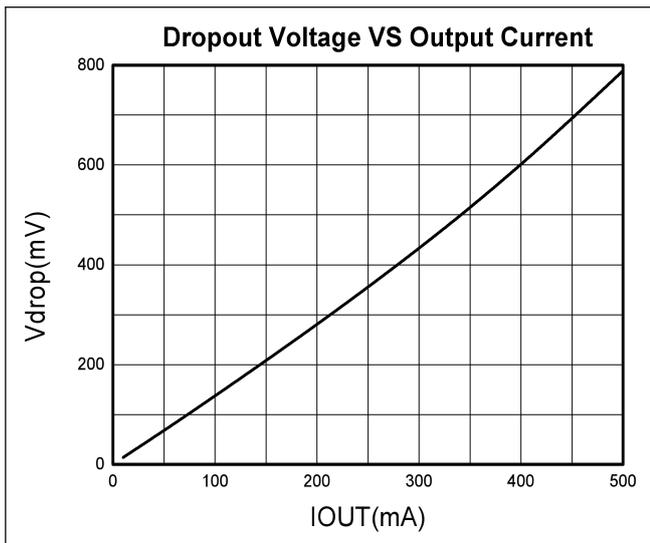
*2. V_{DROP}=V_{IN}-(V_{OUT_REG}*0.98), V_{OUT_REG} is the output voltage when V_{IN} = V_{OUT} + 1.0V and I_{OUT} = 100mA. V_{IN} is the input voltage, and when the input voltage is gradually reduced, the output voltage becomes 98% of V_{OUT_REG}.

*3. I_{LIMIT}: Output current when V_{IN} = V_{OUT} + 1V and V_{OUT} = 0.95 X V_{OUT(E)}.

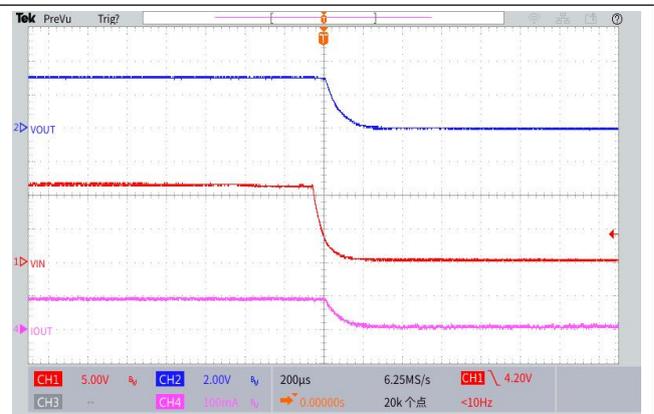
10.6 Characteristics Curve

(VIN=12V, CIN=1uF, COUT= 1uF, TA=25°C, unless otherwise specified.)

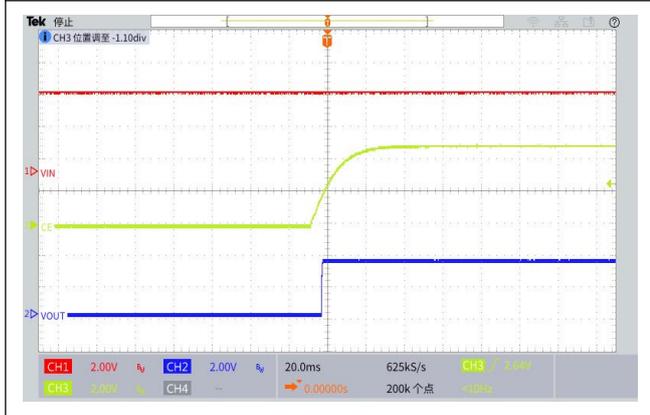




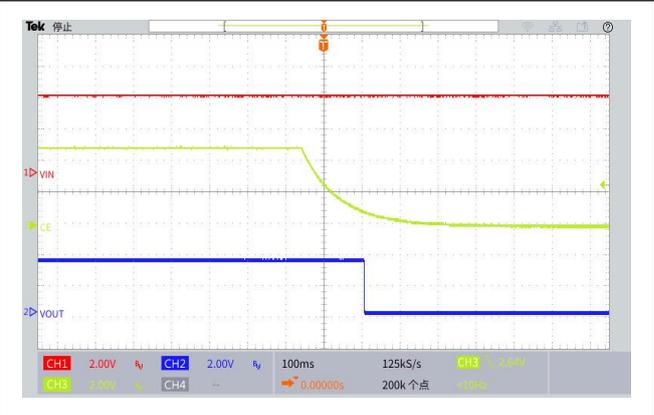
Power on



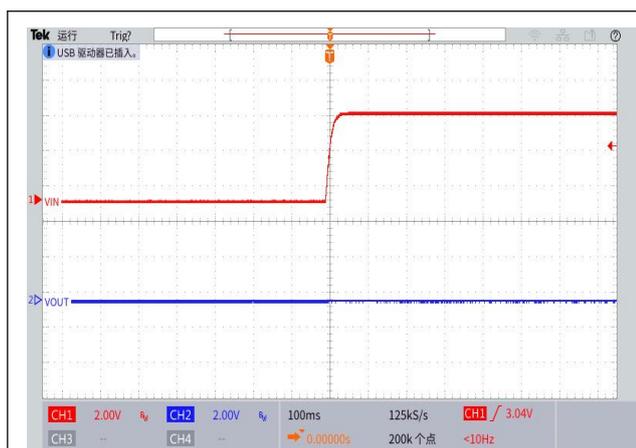
Power down



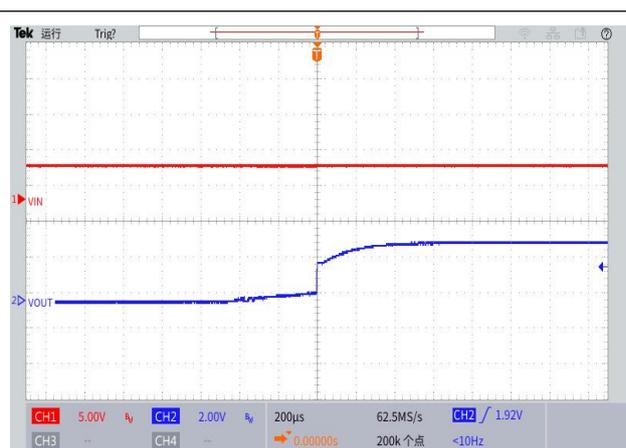
Enable on



Enable down



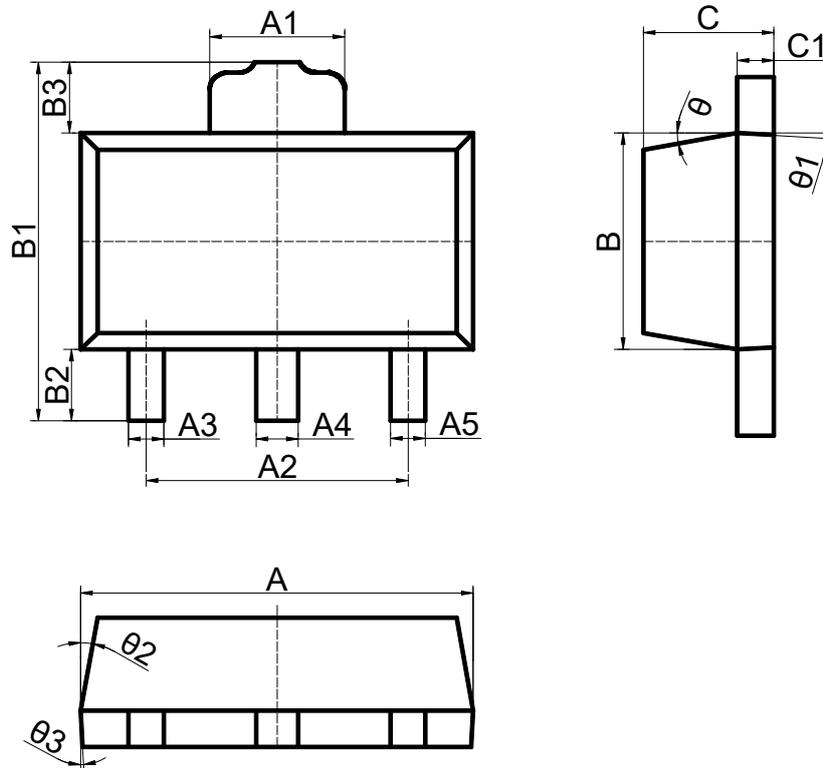
Short circuit protection



Short circuit recovery

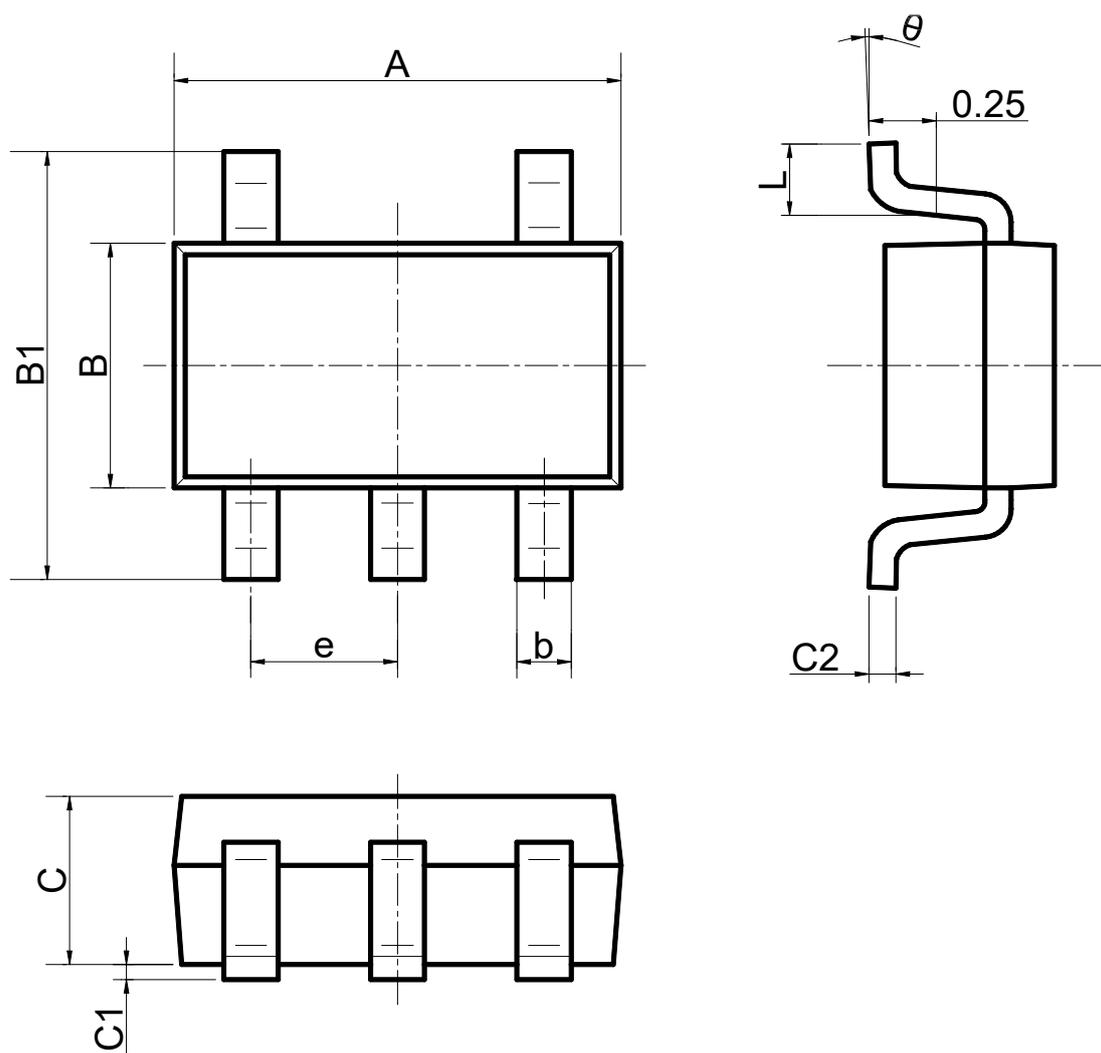
11 Package Information

SOT89-3



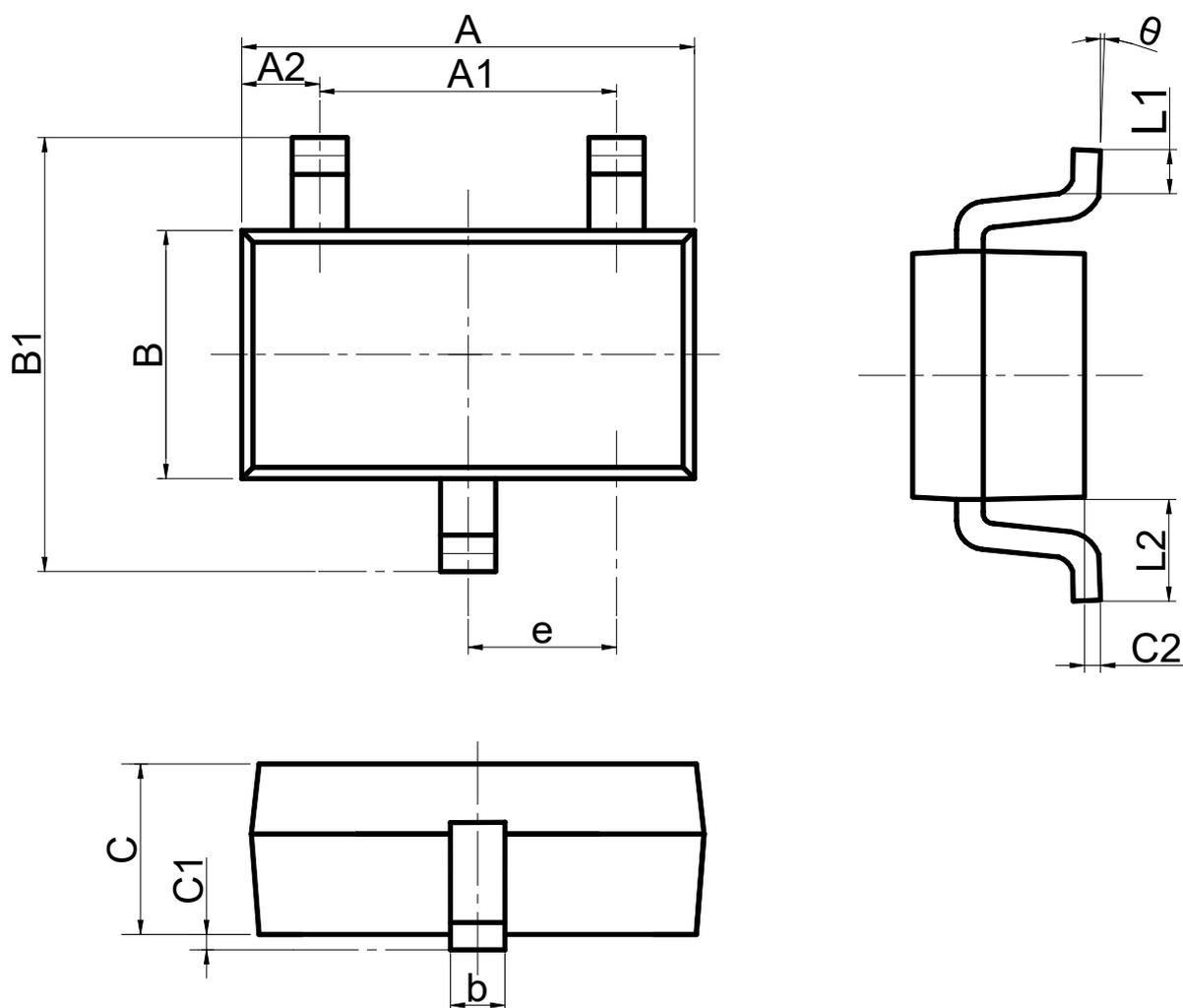
Symbol \ Size	Min(mm)	Max(mm)
A	4.40	4.60
A1	1.65	1.75
A2	2.95	3.05
A3	0.35	0.45
A4	0.43	0.53
A5	0.35	0.45
B	2.40	2.60
B1	4.05	4.25
B2	0.82	0.83
B3	0.82	0.83
C	1.40	1.60
C1	0.35	0.45
θ	6°TYP4	
θ1	3°TYP4	
θ2	6°TYP4	
θ3	3°TYP4	

SOT23-5



Symbol \ Size	Min(mm)	Max(mm)
A	2.82	3.02
e	0.95(BSC)	
b	0.27	0.35
B	1.50	1.70
B1	2.60	3.00
C	1.05	1.15
C1	0.03	0.15
C2	0.135	0.23
L	0.35	0.55
θ	0°	8°

SOT23-3



Symbol \ Size	Min(mm)	Typ(mm)	Max(mm)
A	2.70	2.90	3.10
A1	1.70	1.90	2.10
A2			0.60
e	0.85	0.95	1.05
b	0.30	0.40	0.50
B	1.50	1.60	1.80
B1	2.60	2.80	3.00
C	1.00	1.10	1.20
C1			0.10
C2	0.02		0.08
L1	0.20		0.55
L2		0.60	
θ	0°		15°