600mA LDO with Fast Enable And Fast Discharge Function

Description

The EC49121 series is a Low dropout linear regulator with ON/OFF control and EC49121 can discharge output capacitor charge fast. The device operates in the input voltage range from +2.4V to +7.0V and delivers 600mA output current.

The EC49121 is available in two types, fixed output voltage type and adjustable output voltage type. The fixed output voltage type is preset at an internally trimmed voltage 1.8V, 2.5V, or 3.3V. Other options 1.2V, 1.5V, 2.85V, 3.0V and 3.6V are available by special order only. The output voltage range of the adjustable type is from 1.2V to 5V.

The EC49121 (ADJ type) consists of a 1.175V band gap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection

The EC49121 (Fixed type) consists of a 0.95V band gap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection, the fixed type version has fast respond and discharge feature.

The EC49121 series devices are available in SOT-23-5L,TSOT-23-5L, SC-70-5L packages.

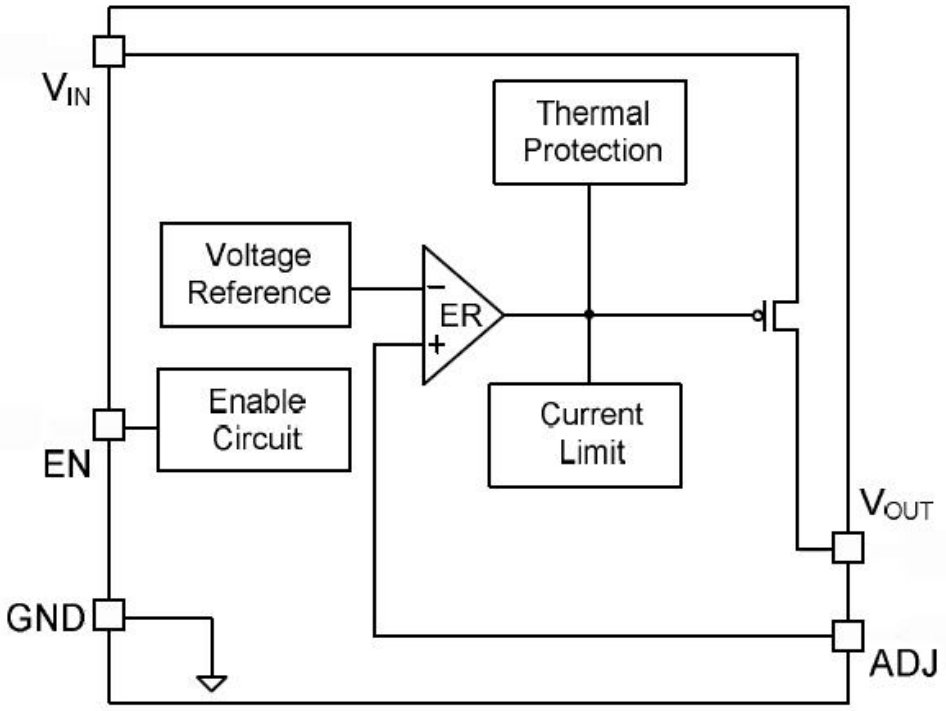
Features

- Operating Voltage Range：+2.4V to +7.0V
- Output Voltages：+1.0V to +5.0V (0.1V Step)(Fixed), +1.2V to +5.0V(ADJ Type)
- Dropout Voltage：500mV @ 600mA(Fixed)
- Fast Response in Turn-on Transient: 35μS (Type.)
- Low Current Consumption 60μA (Type.)
- Shutdown Current：0.7μA (Type.)
- ±2% Output Voltage Accuracy (special ±1% highly accurate)
- Low ESR Capacitor Compatible
- High Ripple Rejection：65 dB (Type.)
- Output Current Limit Protection 1.0A (Type.)
- Short Circuit Protection: 200mA (Type).
- Thermal Overload Shutdown Protection
- Control Output ON/OFF Function
- SOT23-5L ‘TSOT23-5L and SC-70-5L Packages
- 100% Lead (Pb)-Free and Green (Halogen Free With Commercial Standard)

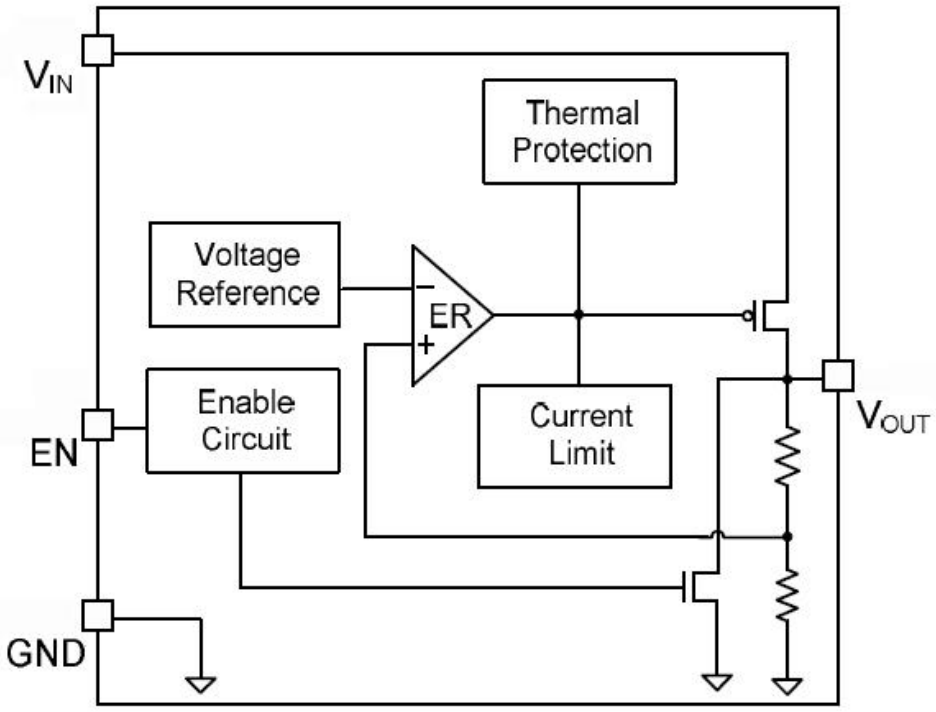
Application

- Battery-Powered Equipments
- Graphic Card.
- Peripheral Card.
- PCMCIA & New Card
- Mini PCI & PCI-Express Cards.
- Digital Still Camera
- CDMA/GSM Cellular Handsets.
- Laptop, Palmtops, Notebook Computers
- Portable Information Application.

Block Diagram



Adjustable Voltage Type

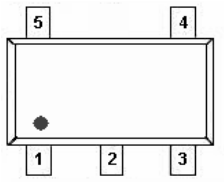


Fixed Voltage Type

600mA LDO with Fast Enable And Fast Discharge Function

Pin Assignment

SOT23-5L/TSOT23-5L /SC-70-5L (Top View)



Pin Descriptions

Pin# SOT23-5L	Pin# SC-70-5L	Symbol	Function
1	1	V_{IN}	Regulator Input Pin.
2	2	GND	Ground Pin.
3	3	EN	Enable Pin.
4	4	NC/ADJ	No Connection for Fixed Voltage or ADJ Terminal Pin for Adjustable Voltage.
5	5	V_{OUT}	Regulator Output Pin.

Ordering Information

EC49121-XX X X X XX X X

- Vout Code: 18=1.8V, 25=2.5V, 33=3.3V, Adjustable Output
- EN Pin Type Code1: N: None Function, U: Pull High Function, D: Pull Low Function
- F: Lead Free, G: Green Mode
- Output voltage Accuracy: 1= ± 1%, 2= ± 2%
- Package Type: B2: SOT23-5L, T2: TSOT23-5L, C5: SC-70-5L
- Discharge Code: F: Fast Discharge
- EN Pin Type Code2: H: High Active Option Function, L: Low Active Option Function

Package	Part Number	Information
SOT23-5L	EC49121-XXNHFB21G	The XX character represents Output Voltage. Example: 18=1.8V, 25=2.5V, 33=3.3V, Default: Adjustable Output... The N character represents EN Pin type code 1: Example: N: None Function, U: Pull High Function, D: Pull Low Function The H character represents EN Pin type code 2 Example: H: High Active Option Function, L:Low Active Option Function The F character represents discharge code. Example: F: Fast discharge. The B2 or C character represents package type. Example: B2: SOT23-5L, C: SC-70-5L. The 1 character represents Output Voltage accuracy. Example:1:±1%, 2 :±2% . The last character" F" or "G" represents Lead Free code: Example: F: Lead Free, G: Green mode.
TSOT23-5L	EC49121-XXNHFT21G	
SC-70-5L	EC49121-XXNHFC1G	

Marking Information

Package	Part Number	Marking	Marking Information
SOT23-5L	EC49121-XXNHFB21G	6VFXX	The 1st character represents the products series Example: Part no:EC49121=6 The 2nd character represents the Output Voltage code. Please refer the table1 for Output Voltage Code information. The 3rd character represents the Function code. Please refer the table2 for Function Code information. The XX character represents the Date Code. There is an under-line on 1st digit for A type package. There is an under-line on 5th digit for Pb-Free package. There are two under-lines on 4th & 5th digit for Green package. There is a top-line on 1 st digit for ±1% Output voltage accuracy.
TSOT23-5L	EC49121-XXNHFT21G		
SC-70-5L	EC49121-XXNHFC1G		

Table1

Mark code vs. Output Voltage code

Mark	Voltage	Mark	Voltage
4	1.0V	M	3.0V
5	1.2V	N	3.1V
8	1.5V	Q	3.3V
A	1.8V	V	3.6V
G	2.5V	Z	5.0V
L	2.85V	O	Adjustable Type

Table2

Mark code vs. Function code

Mark	Code	EN Type		Discharge	Mark	Code	EN Type		Discharge
		Type	Type				Type	Type	
		Code 1	Code 2				Code 1	Code 2	
A	NHF	None	High	Fast	G	UHN	Pull High	High Active	Normal
B	NLF	None	Low	Fast	H	ULN	Pull High	Low Active	Normal
C	NHN	None	High	Normal	J	DHF	Pull Low	High Active	Fast
D	NLN	None	Low	Normal	K	DLF	Pull Low	Low Active	Fast
E	UHF	Pull	High	Fast	L	DHN	Pull Low	High Active	Normal
F	ULF	Pull	Low	Fast	M	DLN	Pull Low	Low Active	Normal

Absolute Maximum Ratings

Parameter		Symbol	Value	Units
Input Voltage V_{IN} to GND		V_{IN}	9.0	V
Output Current Limit, $I_{(LIMIT)}$		I_{OUT}	1.0	A
Junction Temperature		T_J	+155	°C
Thermal Resistance	SOT23-5L	Θ_{JA}	155	°C/W
	SC-70-5L		333	
Power Dissipation	SOT23-5L	P_D	400	mW
	SC-70-5L		250	
Operating Ambient Temperature		T_{OPR}	-40 to +85	°C
Storage Temperature		T_{STG}	-55 to +150	°C
Lead Temperature (Soldering, 10sec.)		—	+260	°C
ESD Voltage			1K	V

Note:

*The power dissipation of values are based on the condition that junction temperature T_J and ambient temperature T_A difference is 100℃

*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 to 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

(V_{IN}=5V, TA=25℃, unless otherwise noted.)

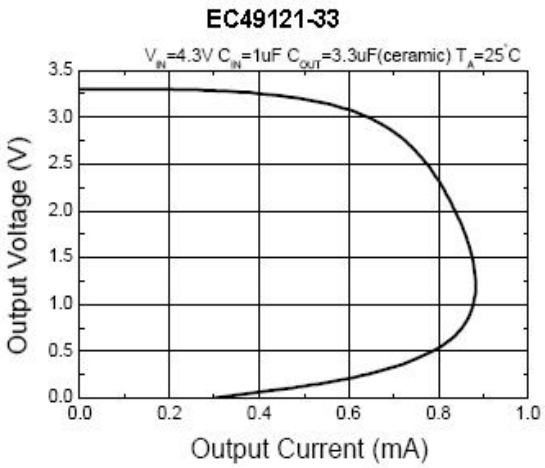
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage	—	2.4	—	7.0	V
V_{OUT}	Output Voltage	Fixed Voltage Type $V_{IN}=V_{OUT}$+1.0,V I_{OUT} =1mA	-1% -2%	V_{OUT}	+1% +2%	V
		Adjustable Voltage Type $V_{IN}=V_{OUT}$+1.2,V I_{OUT} =1mA	-1% -2%		+1% +2%	
I_{MAX}	Output Current (see note *1)	V_{OUT} +1.0V≦V_{IN}≦7.0V, V_{IN}≧2.4V	0.6	—	—	A
I_{LIMIT}	Current Limit	—	—	1.0	—	A
V_{REF}	ADJ Pin Reference Voltage	For Adjustable Voltage Type	—	1.175	—	V
V_{DROP}	Dropout Voltage (For Fixed Voltage Type)	I_{OUT}=100mA,V_{OUT}>3.0V	—	50	—	mV
		I_{OUT}=600mA,V_{OUT}>3.0V	—	500	—	
	Dropout Voltage (For ADJ Voltage Type)	I_{OUT}=600mA,V_{OUT}>3.0V	—	800	—	
ΔV_{LINE}	Line Regulation	V_{OUT} +1.0V≦V_{IN}≦7.0V, I_{OUT} =1mA For Fixed Voltage Type	—	0.2	0.3	%/V
		V_{OUT}+1.2V≦V_{IN}≦7.0V,I_{OUT} 1mA, VIN≧2.8V, For ADJ Voltage Type	—	—	0.2	
ΔV_{LOAD}	Load Regulation	V_{IN} = V_{OUT} +1V, 1mA≦I_{OUT}≦100mA	—	0.01	0.02	%/mA
I_Q	Ground Pin Current	I_{LOAD} =0mA to 1A,V_{IN}= V_{OUT}+1.0V	—	60	—	μA
I_{SD}	Shutdown Current	VIN = V_{OUT}+1V, EN=0V, No Load	—	0.7	—	μA
I_{ADJ}	ADJ Pin Current	I_{LOAD} =0mA to 600mA,V_{IN}= V_{OUT}+1.0V	—	0.1	—	μA
I_{SC}	Short Circuit Current	—	—	200	—	mA
PSRR	Ripple Rejection Rate	I_{OUT} =30mA, F=1KHz, C_{OUT}=3.3μF	—	65	—	dB
e_N	Output Noise	I_{OUT} =100mA, F=1KHz, C_{OUT}=3.3μF	—	40	—	μV (rms)
V_{IH}	EN Pin Input Voltage “H”	V_{IN}≦5.0V	1.6	—	—	V
V_{IL}	EN Pin Input Voltage “L”	V_{IN}≦5.0V	—	—	0.3	V
R_{DIS}	Discharge Resistor	V_{EN}=0V, For Fixed Voltage Type	—	30	100	Ω
T_{DIS}	Discharge Time	V_{OUT}=3.3V to 0V, C_{OUT}=1μF For Fixed Voltage Type	—	70	100	μS
T_{SD}	Thermal Shutdown Temperature	—	—	155	—	°C
T_{HYS}	Thermal Shutdown Hysteresis	—	—	20	—	°C

Note:

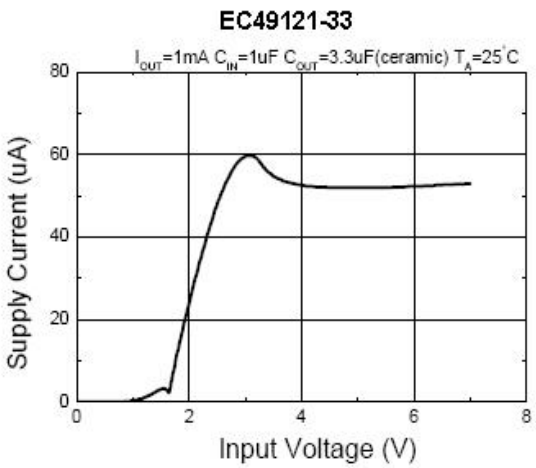
*1) Measured using a double sided board with 1”x2” square inches of copper area connected to the GND pins for “heat spreading”.

Typical Performance Characteristics

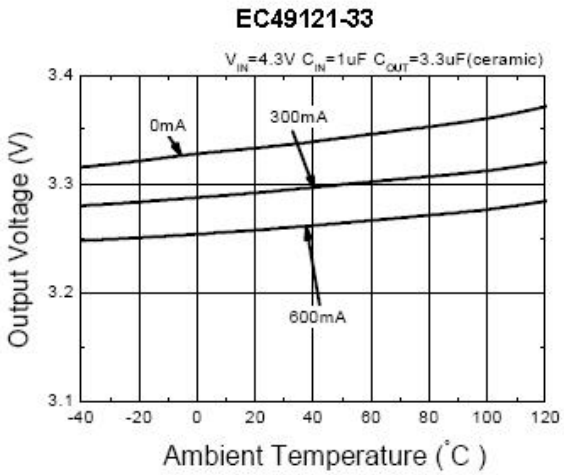
(1) Output Voltage vs. Output Current



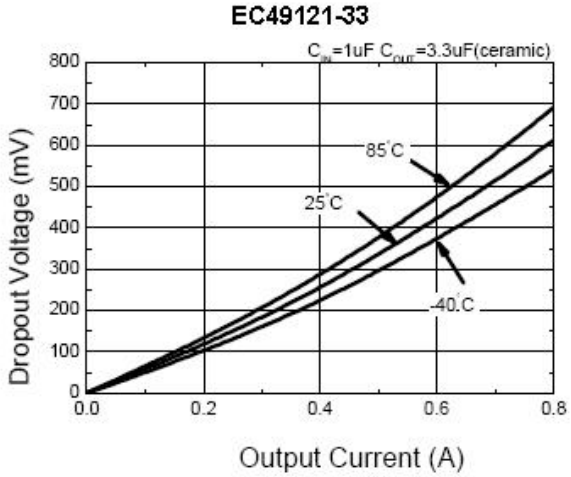
(2) Supply Current vs. Input Voltage



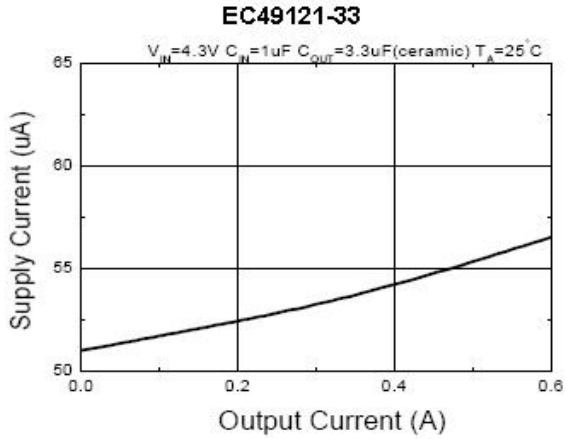
(3) Output Voltage vs. Ambient Temperature



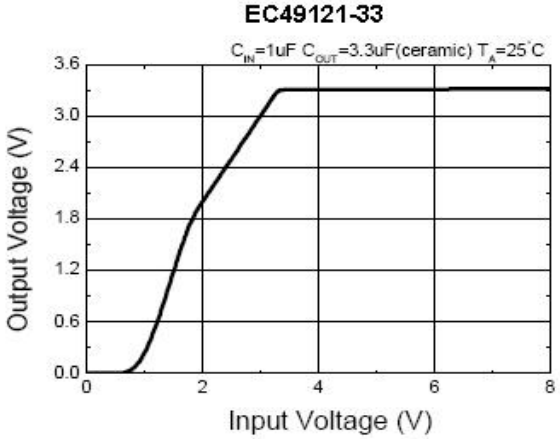
(4) Dropout Voltage vs. Output Current



(5) Supply Current vs. Output Current

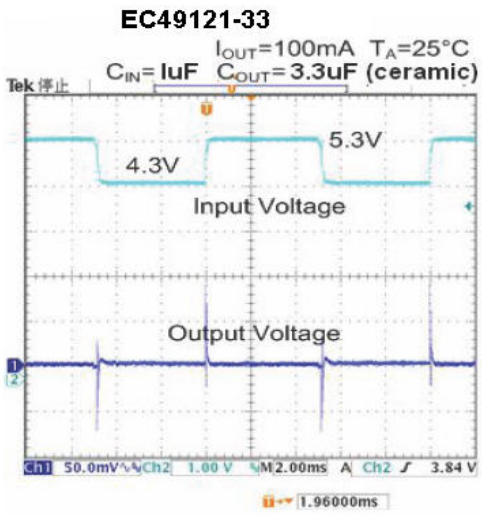


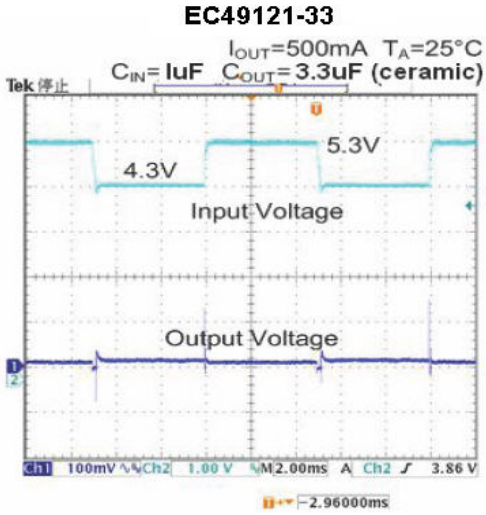
(6) Output Voltage vs. Input Voltage



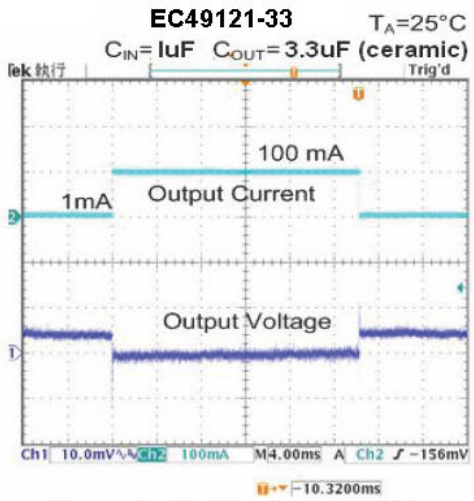
Typical Performance Characteristics (Continued)

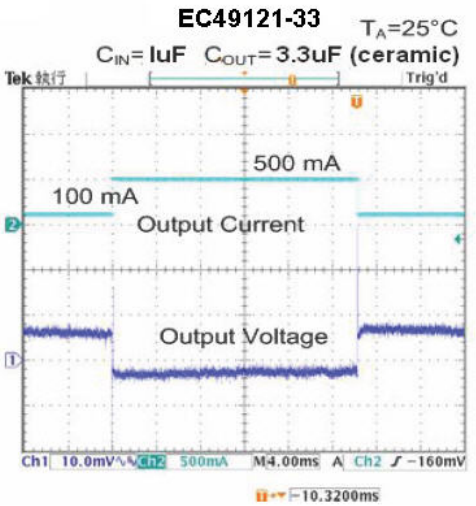
(7) Input Transient Response



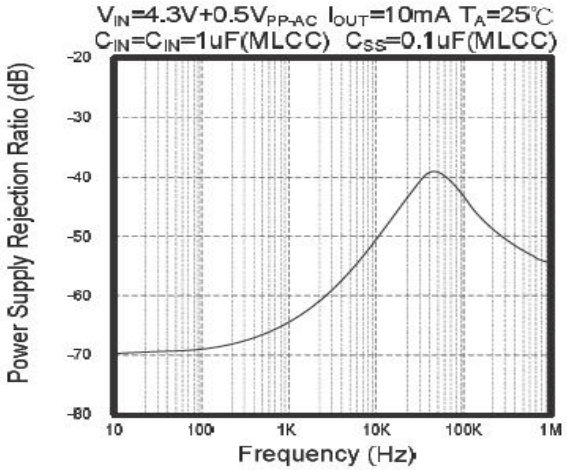


(8) Load Transient Response

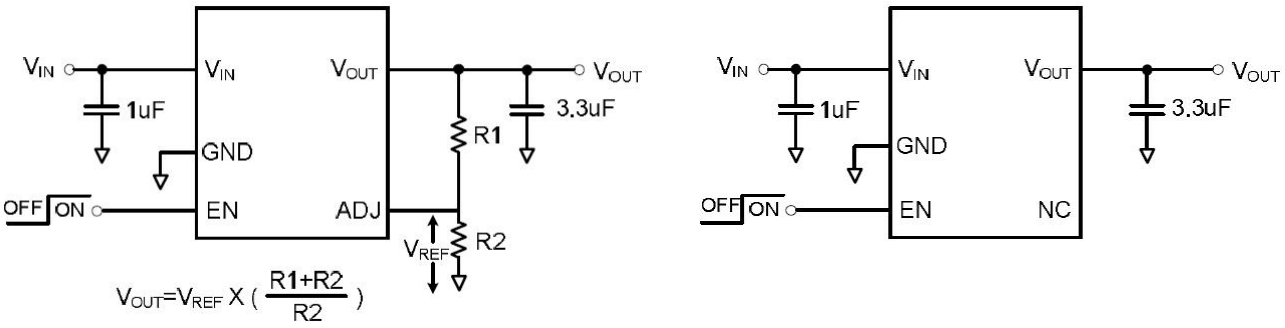




(9) Power Supply Rejection Ratio



Simplified Application Circuit



Detail Description

The EC49121 is a low-dropout linear regulator. The device provides preset 1.8V, 2.5V and 3.3V output voltages for output current up to 600mA. Adjustable output voltage and other mask options for special output voltages are also available. As illustrated in function block diagram, it consists of a 1.175V band gap (Fixed voltage type is 0.95V) reference, an error amplifier, a P-channel pass transistor and an internal feedback voltage divider.

The band gap reference for fixed voltage types 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 internal resistive divider (or external resistive divider for adjustable output voltage type) connected to OUT pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

Internal P-Channel Pass Transistor

The EC49121 features a P-channel MOSFET pass transistor. Unlike similar designs using PNP pass transistors, P-channel MOSFET 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 EC49121 does not suffer from these problems and consumes only 60μA (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 through the internal discharge path between V_{OUT} and GND pins.

Fast Discharge Function

The EC49121 fixed type has fast discharge Function on EN pin disable. When user turns off the device, its internal pull low resistor will discharge output capacitor charge. It'll avoid other device to arise wrong motions.

Output Voltage Selection

For fixed voltage type of EC49121, the output voltage is preset at an internally trimmed voltage. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example; the EC49121-33 has a preset 3.3V output voltage.

For adjustable voltage type of EC49121, the output voltage is set by comparing the feedback voltage at adjust terminal to the internal band gap reference voltage. The reference voltage V_{REF} is1.175V.The out put voltage is given by the equation:

$$V_{OUT} = V_{REF} x\left(1+\frac{R2}{R1}\right) + I_{ADJ} xR2$$

(See Typical Application Schematic)

Current Limit

The EC49121 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 1.0A.

Thermal Overload Protection

Thermal overload protection limits total power dissipation of EC49121. When the junction temperature exceeds T_J = +150°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 EC49121 in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of T_J = +125°C should not be exceeded.

Operating Region and Power Dissipation

Maximum power dissipation of the EC49121 depends on the thermal resistance of the case and printed 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 EC49121 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 V_{IN}, V_{OUT}, and GND pins.

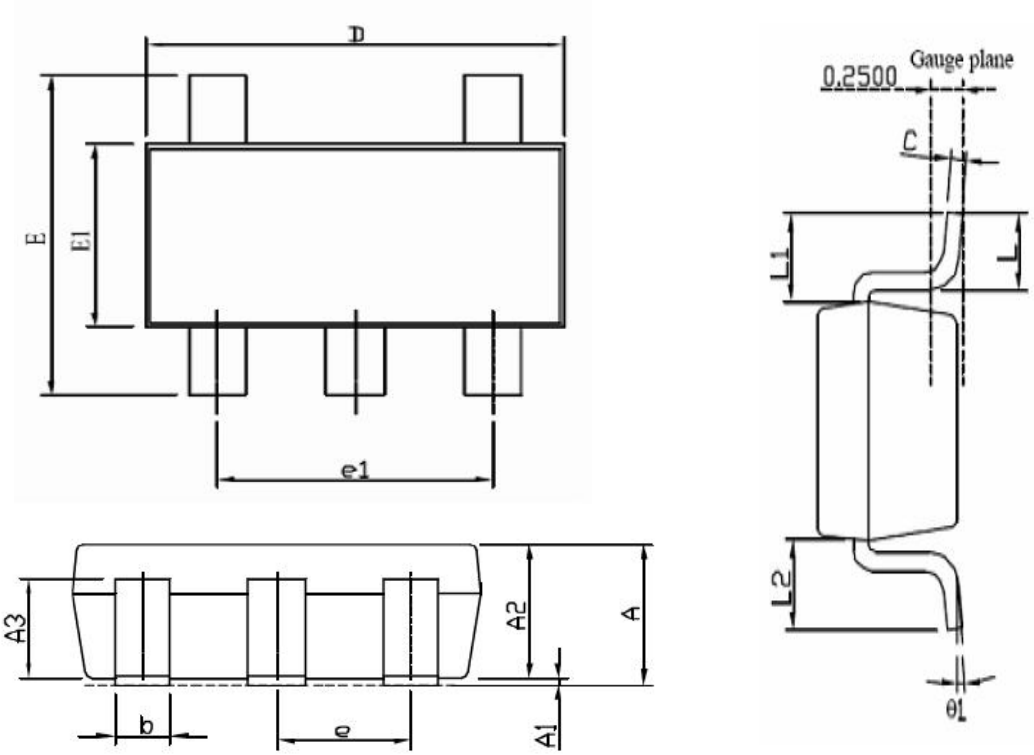
Dropout Voltage

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 EC49121 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.

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} xI_{out}$$

Mechanical Dimensions

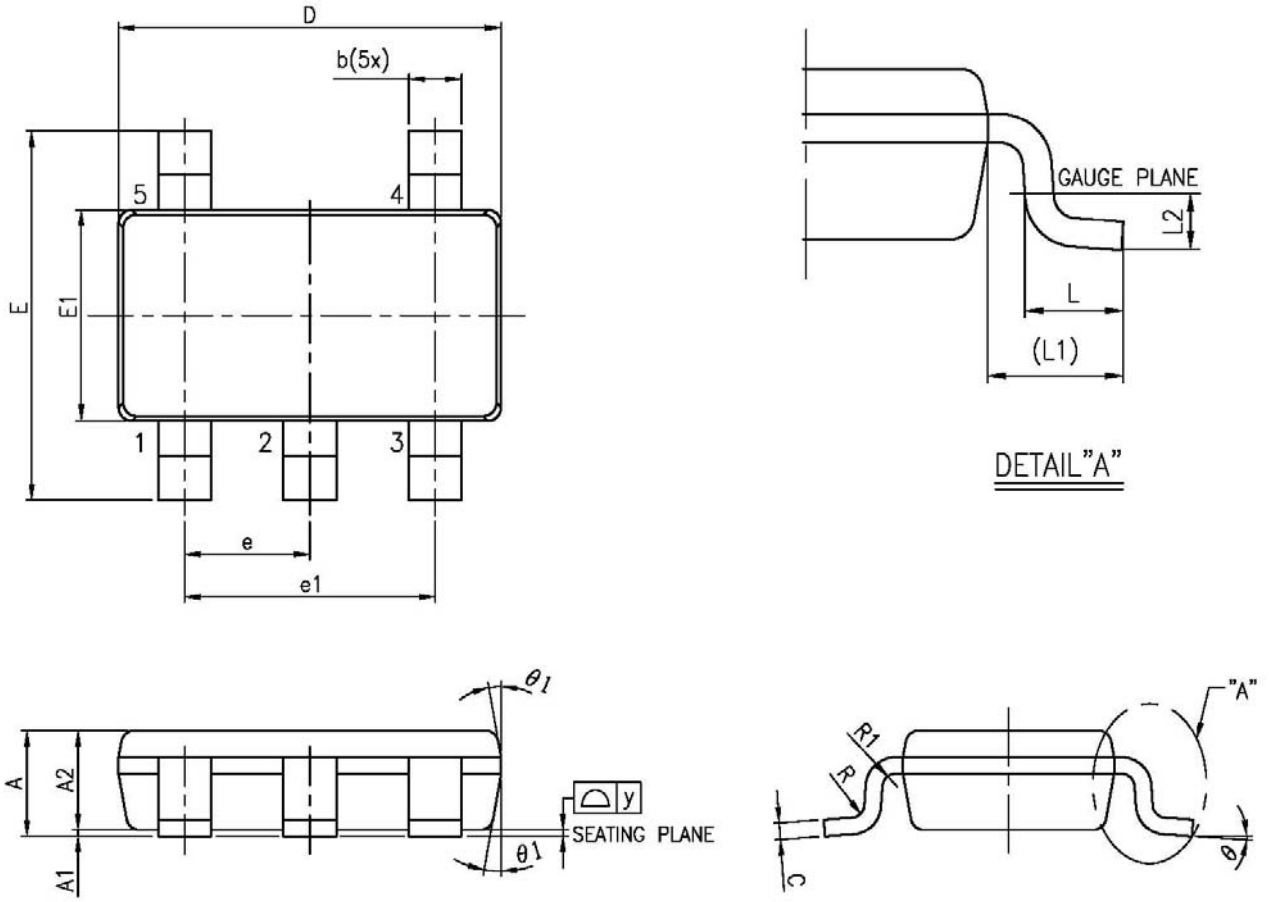
OUTLINE DRAWING SOT23-5L



Symbols	Dimensions in Millimeters		
	Min	Nom	Max
A	1.00	1.10	1.40
A1	0.00	---	0.10
A2	1.00	1.10	1.30
A3	0.70	0.80	0.90
b	0.35	0.40	0.50
C	0.12	0.125	0.225
D	2.70	2.90	3.10
E1	1.40	1.60	1.80
e1	---	1.90(TYP)	---
E	2.60	2.80	3.00
L	0.37	---	---
θ1	1°	5°	9°
e	---	0.95(TYP)	---
L1	---	0.6(REF)	---
LI-L2	---	---	0.12

Mechanical Dimensions

OUTLINE DRAWING TSOT23-5L



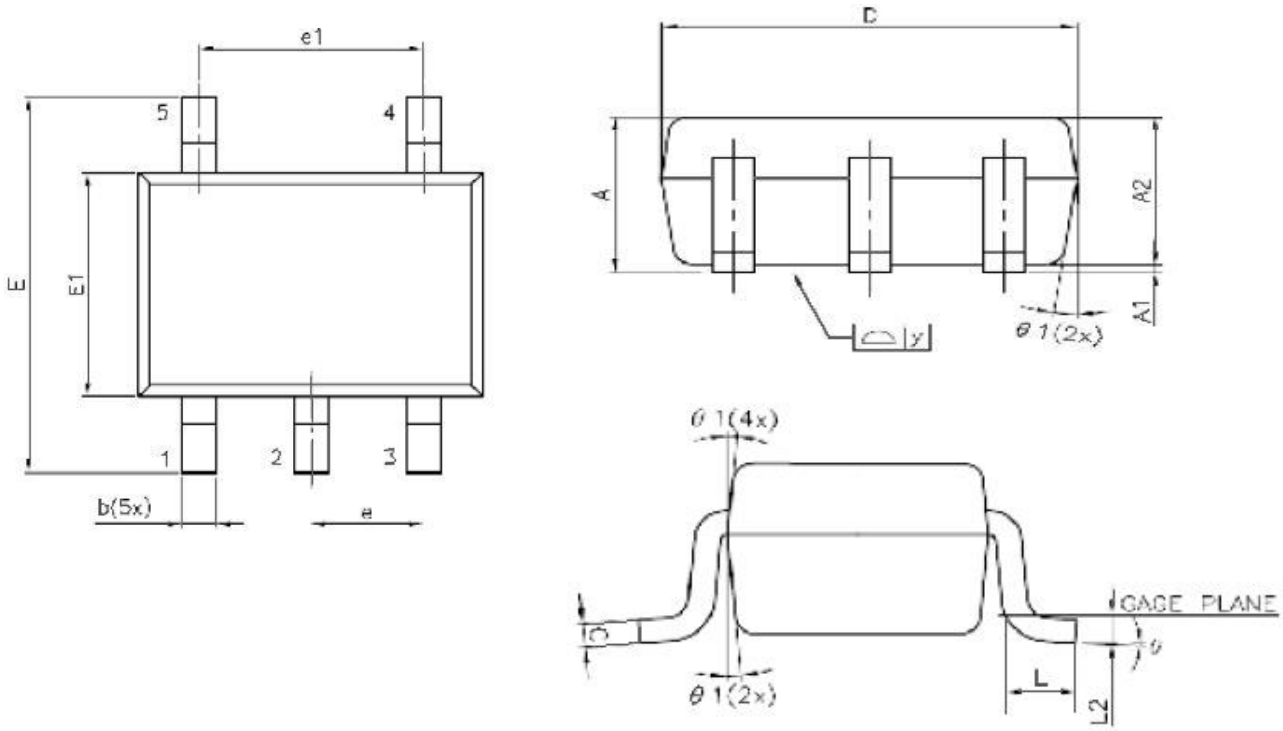
NOTE :

1. All dimensions are in millimeters.
2. Dimension D does not include mold flash, protrusion or gate burrs. Mold flash protrusions or gate burrs shall not exceed 0.15mm per end. Dimension E1 does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.15mm per side.
3. The package top may be smaller then the package bottom. Dimensions D and E1 are determined at outermost extremes of the plastic body exclusive of mold flash, Tie bar burrs, Gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.
4. Dimension “b” does not include dambar protrusion. Allowable dambar protrusion shall be 0.08mm total in excess of the “b” dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot. Minimum space between protrusion and an adjacent lead shall not be less than 0.07mm

SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.75	----------	0.90
A1	0.00	----------	0.10
A2	0.70	0.75	0.80
B	0.30	----------	0.50
c	0.08	----------	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e		0.95 BSC	
e1		1.90 BSC	
L	0.30	0.45	0.60
L1		0.60 REF	
L2		0.25 BSC	
R	0.10	----------	----------
R1	0.10	----------	0.25
θ	0°	4°	8°
θ 1	4°	10°	12°
y	----------	----------	0.10

Mechanical Dimensions

OUTLINE DRAWING SC-70-5L



Symbols	Millimeters			Inches		
	Min	Nom	Max	Min	Nom	Max
A	0.80	---	1.10	0.031	---	0.043
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.90	1.00	0.028	0.035	0.039
b	0.15	---	0.30	0.006	---	0.012
C	0.08	---	0.22	0.003	---	0.009
D	1.80	2.00	2.20	0.071	0.079	0.087
E	1.80	2.10	2.40	0.071	0.083	0.094
E1	1.15	1.25	1.35	0.045	0.049	0.053
e	---	0.65	---	---	0.026	---
e1	---	1.30	---	---	0.051	---
L	0.26	0.36	0.46	0.010	0.014	0.018
L2	---	0.15	---	---	0.006	---
y	---	---	0.10	---	---	0.004
θ	0°	4°	8°	0°	4°	8°
θ1	4°	---	12°	4°	---	12°