300mA Linear Regulator with Enable And Fast Discharge Function

Description

The EC49513A/L is a 4-Low (Low dropout, Low quiescent Current, Low noise, Low cost) linear regulator with ON/OFF control and EC49513L can discharge output capacitor charge fast. The device operates in the input voltage range from +2.2V to +7.0V and delivers 300mA output current.

The high accuracy output voltage is preset at an internally trimmed voltage 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V or 3.3V. Other output voltages can be mask optioned from 1.2V to 5.0V with 100mV increment, except the EC49513A/L-285 which has 2.85V output voltage.

The EC49513A/L consists of a 1.0V reference compares amplifier, a P-channel pass transistor, and an enable/disable logic circuit. Other features include soft start function, short circuit protection, and thermal shutdown protection.

The EC49513A/L is also compatible with low ESR ceramic capacitors which give added output stability. This stability can be maintained even during load fluctuations due to the excellent transient response of the chip. The EC49513A/L devices are available in SOT23-5L、UFN-6 and TSOT23-5 packages.

Features

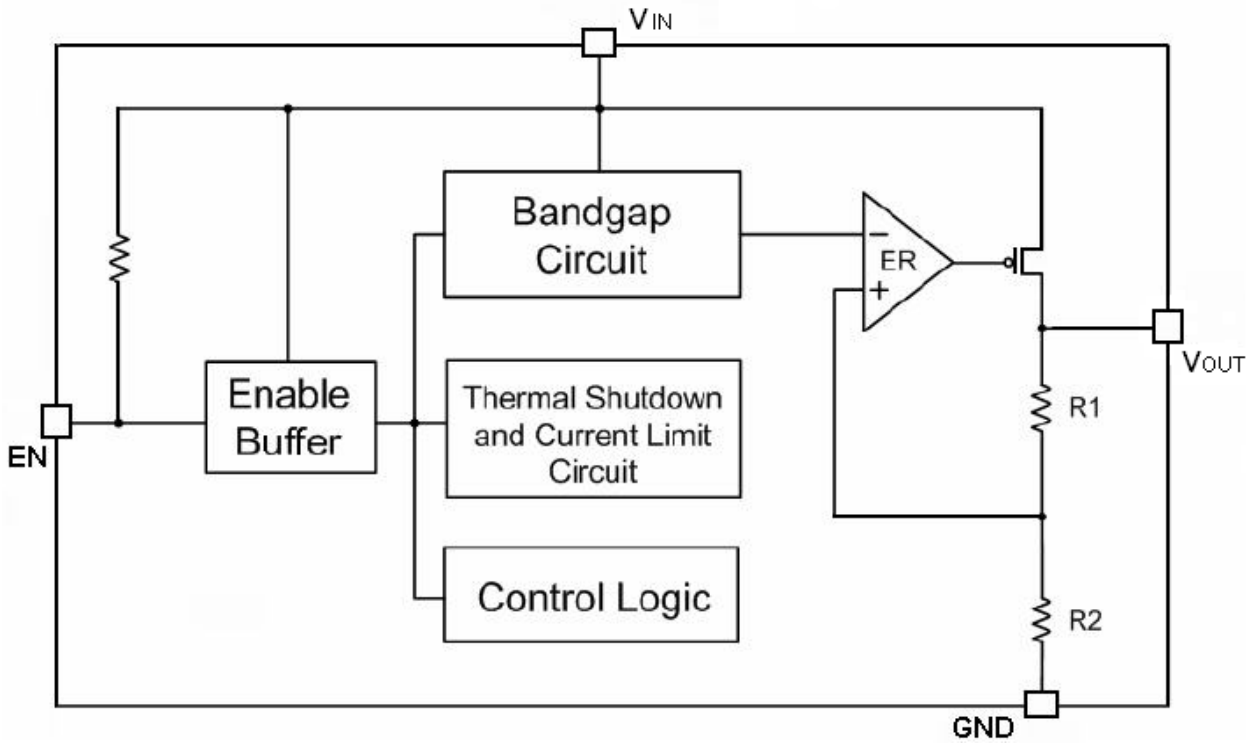
- EC49513A/L Without / With Fast Discharge
- Operating Voltage Range：+2.2V to +7.0V
- Output Voltages：+1.2V to +5.0V with 100mV
- Maximum Output Current：300 mA
- Dropout Voltage：120mV @ 100mA
- Low Current Consumption 15μA (Typ.)
- Shutdown Current：0.1μA (Typ.)
- ±2% Output Voltage Accuracy (special ±1% highly accurate)
- Low ESR Capacitor Compatible
- High Ripple Rejection：70 dB
- Output Current Limit Protection (450mA)
- Short Circuit Protection (150mA)
- Thermal Overload Shutdown Protection
- Control Output ON/OFF Function
- SOT23-5L、UFN-6 and TSOT23-5 packages.
- Green (Halogen Free With Commercial Standard)

Application

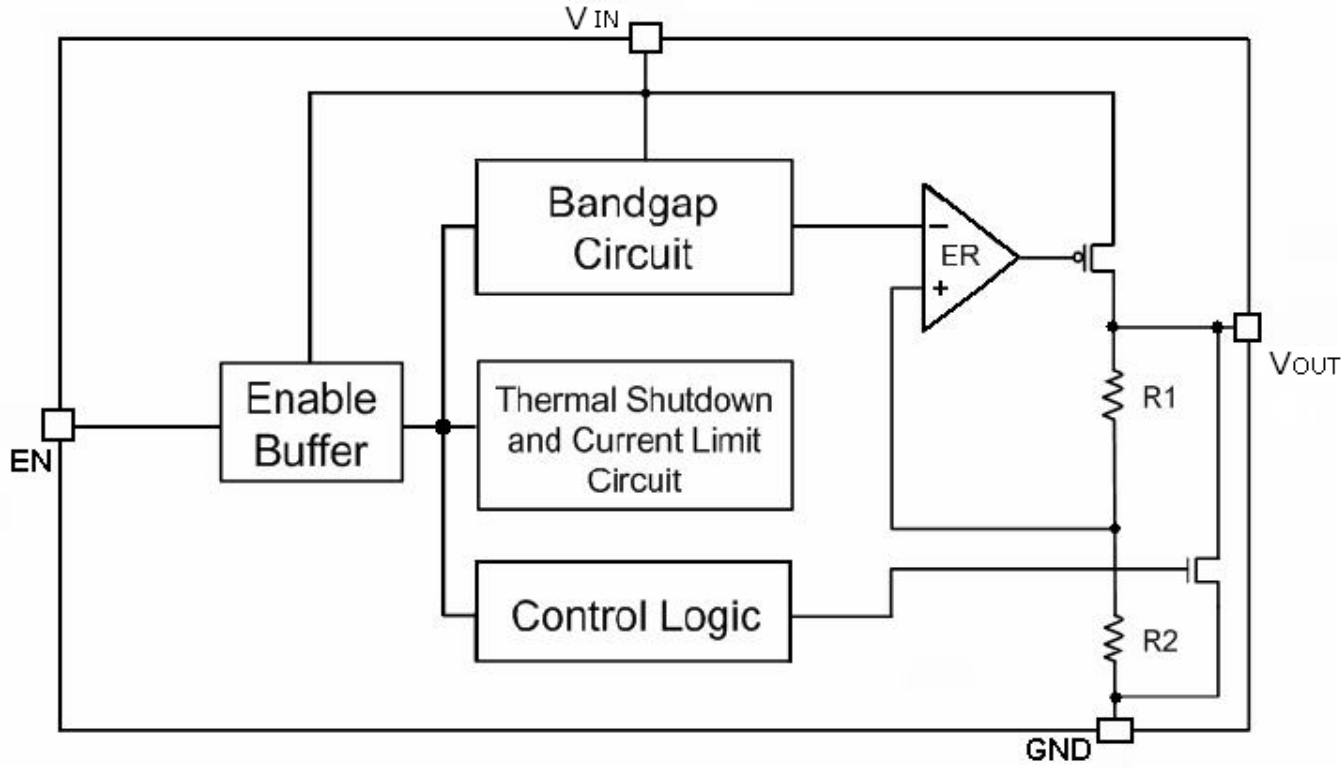
- Battery-Powered Devices.
- Personal Communication Devices.
- Mobile Phones, Cordless Phone.
- Portable Games.
- Portable AV equipment.

Block Diagram

EC49513A Function Block Diagram

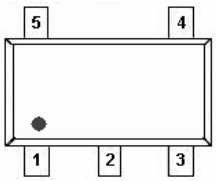


EC49513L Function Block Diagram

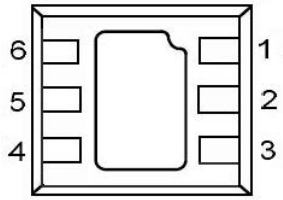


Pin Assignment

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



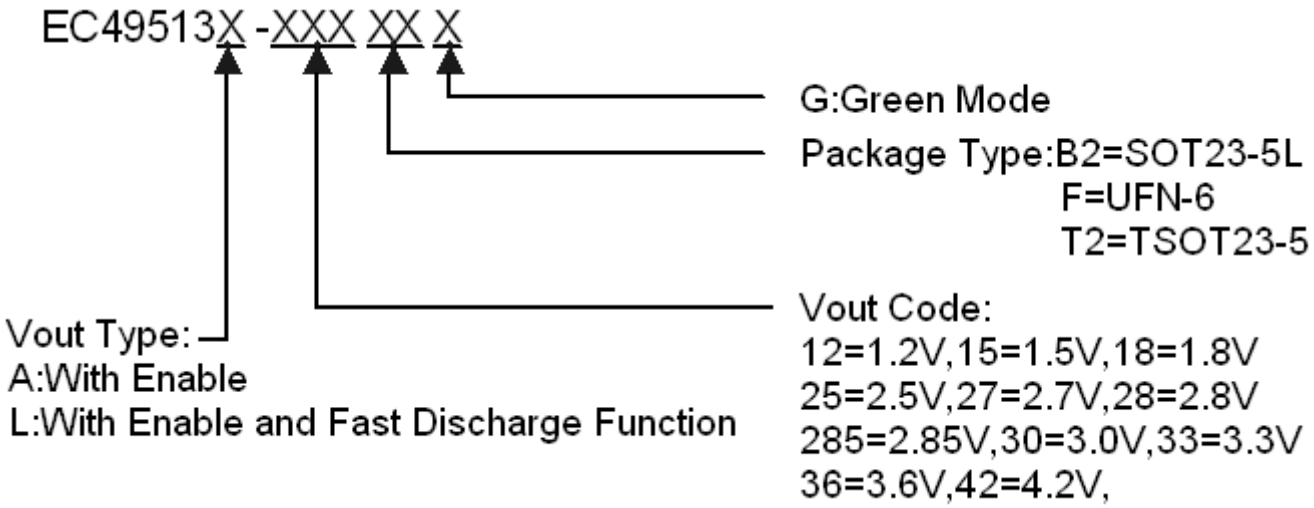
UFN-6
(Bottom View)



Pin Descriptions

Pin# SOT23-5L/TSOT23-5L	Pin# UFN-6	Symbol	Function
1	1	V_{IN}	Power Input.
2	5	GND	Ground Pin.
3	6	EN	Chip Enable Pin.
4	2,4	NC	No Connection.
5	3	V_{OUT}	Voltage Output Pin.

Ordering Information



Package	Part Number	Information
SOT23-5L	EC49513A-XXXB2G	The XXX character represents Output Voltage. Example: 12=1.2V, 15=1.5V...
	EC49513L-XXXB2G	
UFN-6	EC49513A-XXXFG	
	EC49513L-XXXFG	
TSOT23-5	EC49513A-XXXT2G	
	EC49513L-XXXT2G	

Marking Information

Package	Part Number	Marking	Marking Information
SOT23-5L	EC49513A-XXXB2G	3AVXX	The 1st to 2nd character represents the V_{OUT} Type. 3A: With Enable, 3L: With Enable and Fast Discharge Function. The 3rd character represents the Output Voltage code. Please refer the table for Output Voltage Code information. The XX characters represents the Date Code There are under-lines on 4th and 5th character for Green package. There are no under lines on second lines of 1st and 2nd characters for Lead Free package.
	EC49513L-XXXB2G	3LVXX	
UFN-6	EC49513A-XXXFG	3AV XX	The 1st to 2nd character represents the V_{OUT} Type. 3A: With Enable, 3L: With Enable and Fast Discharge Function. The 3rd character represents the Output Voltage code. Please refer the table for Output Voltage Code information. The XX characters represents the Date Code There are under-lines on 4th and 5th character for Green package. There are no under lines on second lines of 1st and 2nd characters for Lead Free package.
	EC49513L-XXXFG	3LV XX	
TSOT23-5	EC49513A-XXXT2G	3AVXX	The 1st to 2nd character represents the V_{OUT} Type. 3A: With Enable, 3L: With Enable and Fast Discharge Function. The 3rd character represents the Output Voltage code. Please refer the table for Output Voltage Code information. The XX characters represents the Date Code. There is an under-line on 1st digit for SOT23-5 package. There is an under-line on 2nd digit for TSOT25 package There are under-lines on 4th and 5th character for Green package. There are no under lines on second lines of 1st and 2nd characters for Lead Free package.
	EC49513L-XXXT2G	3LVXX	

Table1

Mark code vs. Output Voltage code of Products part

Part Number	Mark	Part Number	Mark	Part Number	Mark
EC49513A/L-12B2G	5	EC49513A/L-28B2G	K	EC49513A/L-42B2G	S
EC49513A/L-12FG		EC49513A/L-28FG		EC49513A/L-42FG	
EC49513A/L-12T2G		EC49513A/L-28T2G		EC49513A/L-42T2G	
EC49513A/L-15B2G	8	EC49513A/L-285B2G	L		
EC49513A/L-15FG		EC49513A/L-285FG			
EC49513A/L-15T2G		EC49513A/L-285T2G			
EC49513A/L-18B2G	A	EC49513A/L-30B2G	M		
EC49513A/L-18FG		EC49513A/L-30FG			
EC49513A/L-18T2G		EC49513A/L-30T2G			
EC49513A/L-25B2G	G	EC49513A/L-33B2G	Q		
EC49513A/L-25FG		EC49513A/L-33FG			
EC49513A/L-25T2G		EC49513A/L-33T2G			
EC49513A/L-27B2G	J	EC49513A/L-36B2G	V		
EC49513A/L-27FG		EC49513A/L-36FG			
EC49513A/L-27T2G		EC49513A/L-36T2G			

Absolute Maximum Ratings

Parameter		Symbol	Value	Units
Input Voltage V_{IN} to GND		V_{IN}	7.0	V
Output Current Limit, $I_{(LIMIT)}$		I_{OUT}	0.5	A
Junction Temperature		T_J	+155	°C
Thermal Resistance (SOT23-5L)		Θ_{JA}	250	°C/W
Power Dissipation	SOT23-5L	P_D	400	mW
	UFN-6		500	
Operating Ambient Temperature		T_{OPR}	-40 to +125	°C
Storage Temperature		T_{STG}	-55 to +150	°C
Lead Temperature (Soldering, 10sec.)		—	+260	°C

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.

* The power dissipation of UFN-6 would be 500 mW normally with the 0.5X0.5 square inches cooper area connected to the bottom pad. However, it could be up to 1000mW with larger cooper area.

Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage	—	2.2	—	7.0	V
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+0.8V$	-1% -2%	V_{OUT}	+1% +2%	V
I_{MAX}	Output Current (see note *1)	V_{OUT} +0.8V≦V_{IN}≦7.0V, 2.2V≦V_{IN}	300	—	—	mA
V_{DROP}	Dropout Voltage	I_{OUT}=300mA,2.8V≦V_{IN}, 25°C≦T_A≦80°C	—	550	650	mV
		I_{OUT}=180mA,2.8V≦V_{IN}	—	240	280	
		I_{OUT}=150mA,2.8V≦V_{IN}	—	160	180	
ΔV_{LINE}	Line Regulation	V_{OUT} +0.5V≦V_{IN}≦7.0V, I_{OUT} =1mA	—	0.2	0.3	%/V
		V_{OUT}+0.15V≦V_{IN}≦5.0V,I_{OUT} 1mA, VIN≧2.8V	—	—	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	V_{IN} =5V, EN=5V, No Load	—	15	30	μA
		VIN =5V, EN=5V, I_{OUT} =150mA,	—	30	60	
I_{SD}	Shutdown Current	VIN = V_{OUT}+1V, EN=0V, No Load	—	0.1	1.0	μA
V_{IH}	EN Pin Input Voltage “H”	(See note *2, *4)	2.0	—	—	V
V_{IL}	EN Pin Input Voltage “L”	(See note *2)	—	—	0.3	V
I_{EN}	EN Pin Leakage Current	V_{IN} =(V_{OUT}+0.15V) to 5V, V_{EN}>V_{IH} (See note *3)	—	0.1	0.15	μA
I_{SC}	Short Circuit Current	—	—	150	—	mA
PSRR	Ripple Rejection Rate	I_{OUT} =30mA, F=1KHz	—	70	—	dB
		I_{OUT} =30mA, F=10KHz	—	65	—	
e_N	Output Noise	I_{OUT} =100mA, F=1KHz, C_{OUT}=10μA	—	40	—	μV (rms)
T_{SD}	Thermal Shutdown Temperature	—	—	150	—	°C
T_{HYS}	Thermal Shutdown Hysteresis	—	—	20	—	°C
R_{DIS}	Discharge Resistor	V_{EN}=0V, (See note *3)	—	30	100	Ω
T_{DIS}	Discharge Time	V_{OUT}=3.3V to 0V, C_{OUT}=1μF (See note *3)	—	70	100	μS

Note:

*1) Measured using a double sided board with 1”x2” 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.

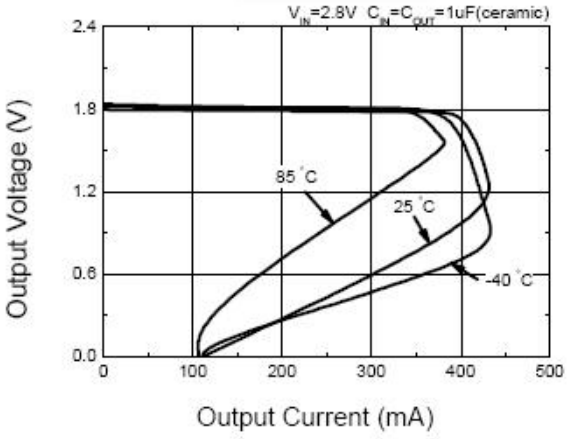
*3) It is for the EC49513L only.

*4) EN Pin with internal pull high resistor is about several hundreds of KΩ for EC49513A only.

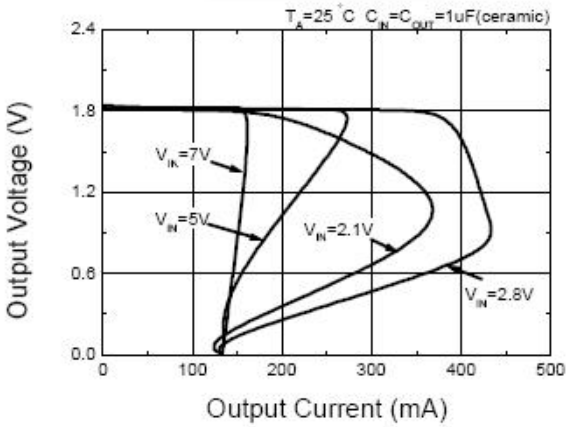
Typical Performance Characteristics

(1) Output Voltage vs. Output Current

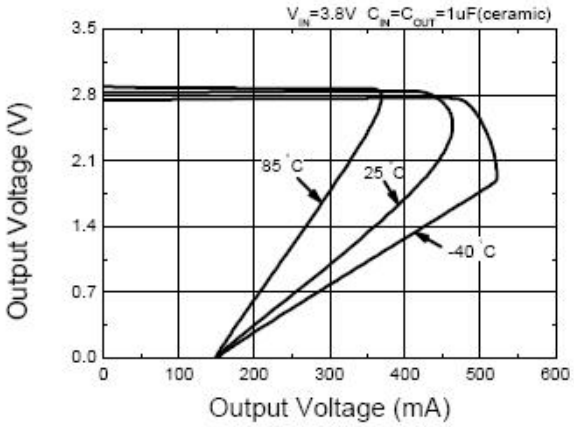
EC49513A/L-18



EC49513A/L-18



EC49513A/L-28



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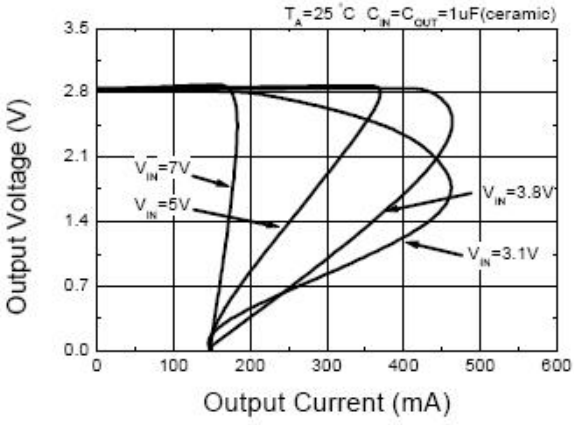
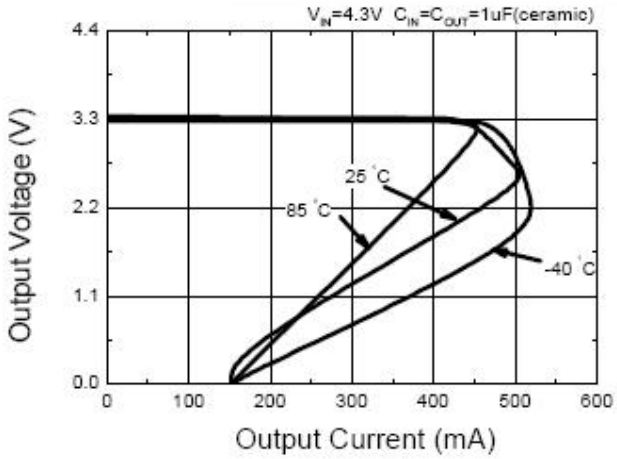


EC49513A/L-33



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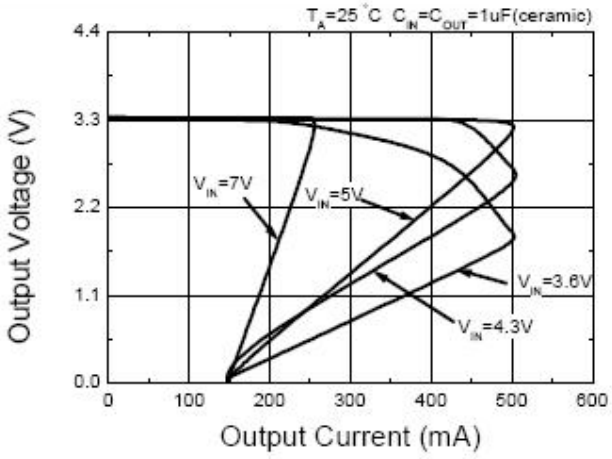
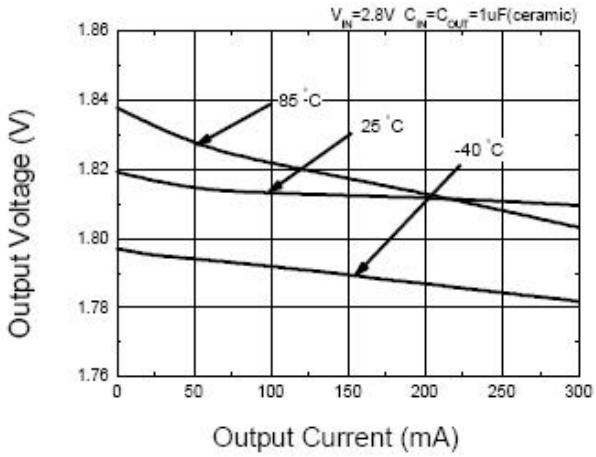


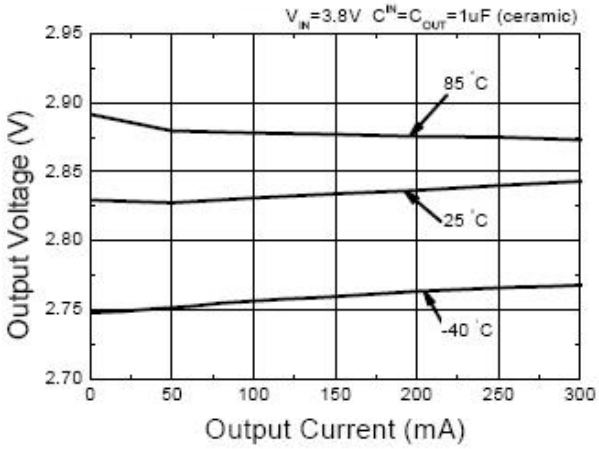
Typical Performance Characteristics

(1) Output Voltage vs. Output Current (Continued)

EC49513A/L-18



EC49513A/L-28



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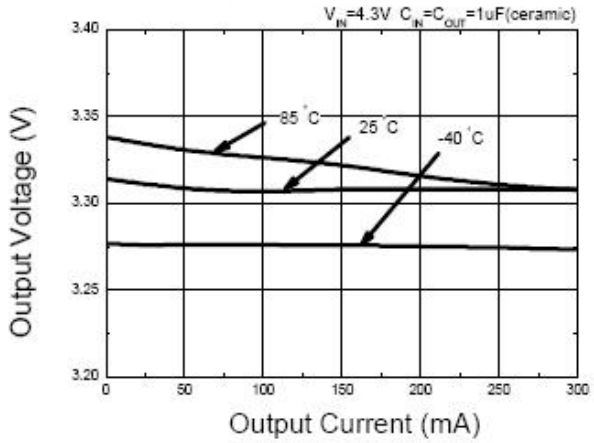
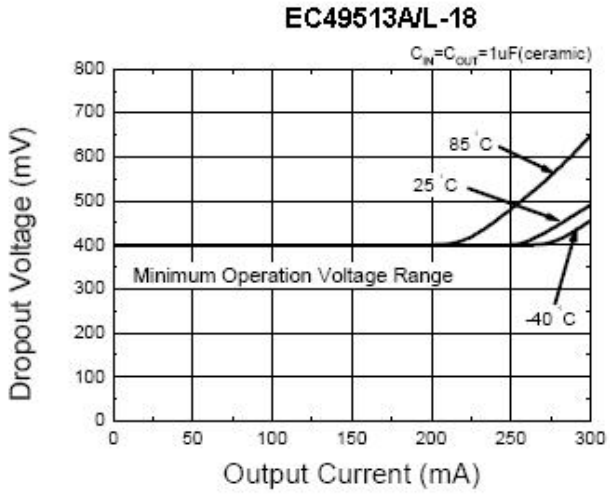
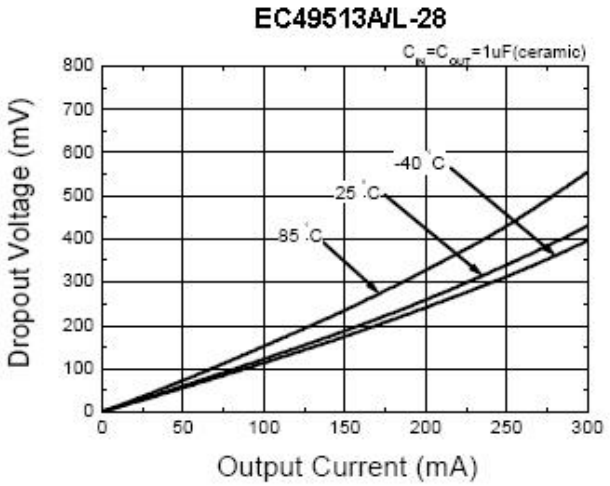
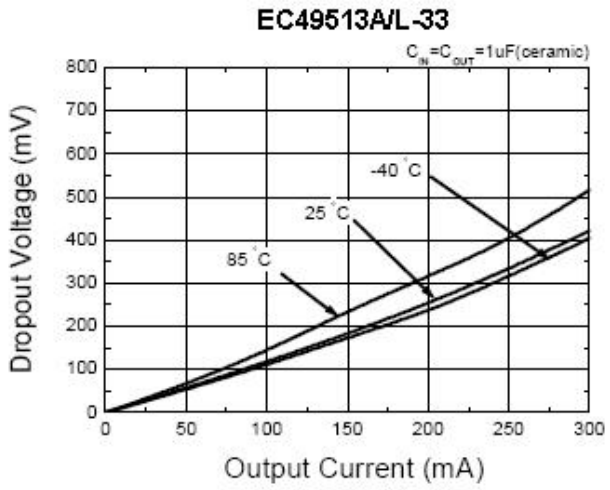


Typical Performance Characteristics (Continued)

(2) Dropout Voltage vs. Output Current



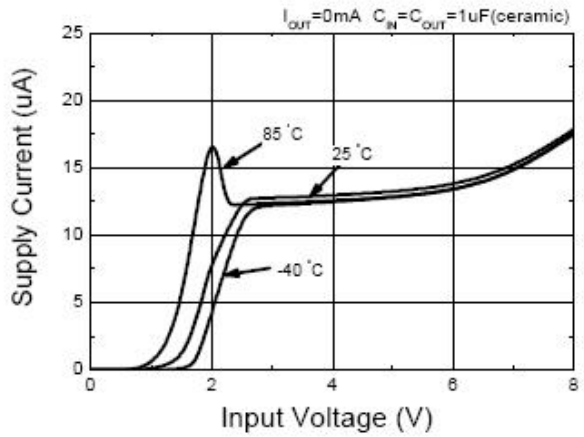




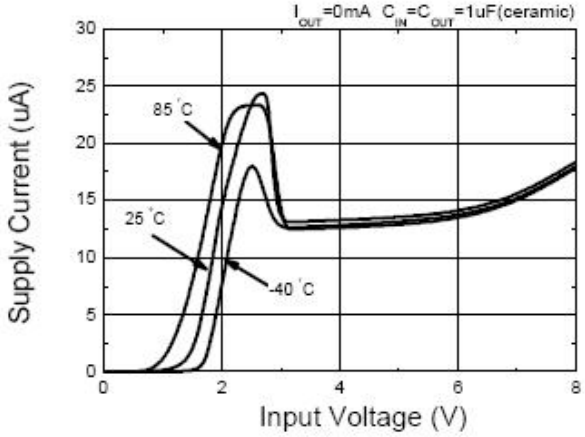
Typical Performance Characteristics (Continued)

(3) Supply Current vs. Input Voltage

EC49513A/L-18



EC49513A/L-28



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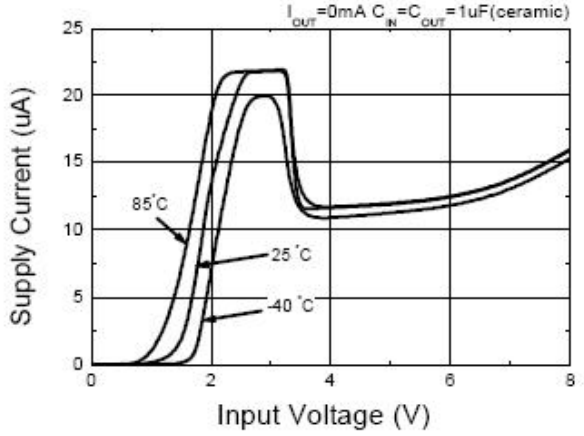
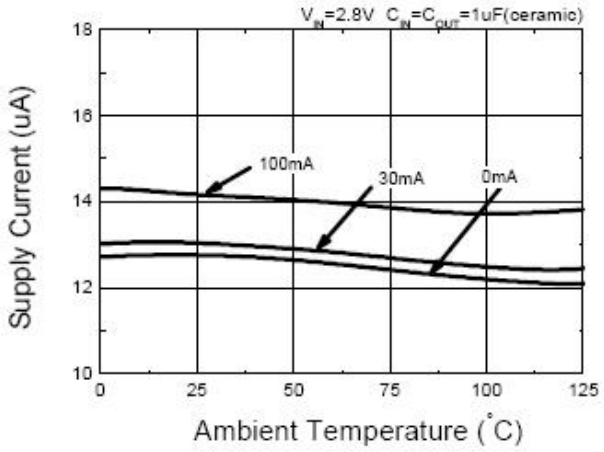


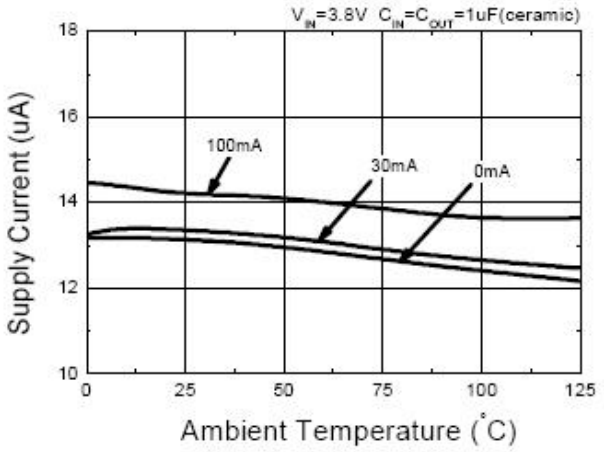
Typical Performance Characteristics (Continued)

(4) Supply Current vs. Ambient Temperature

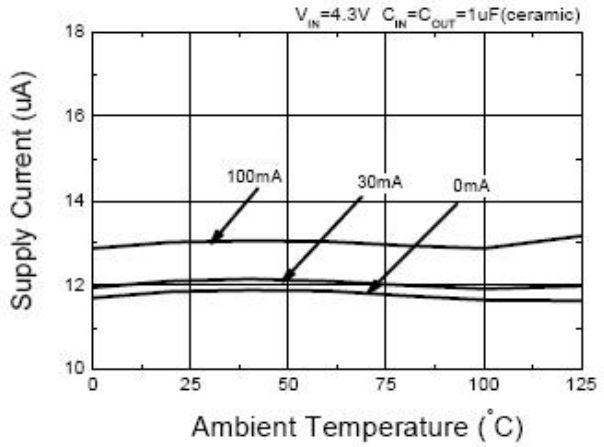
EC49513A/L-18



EC49513A/L-28

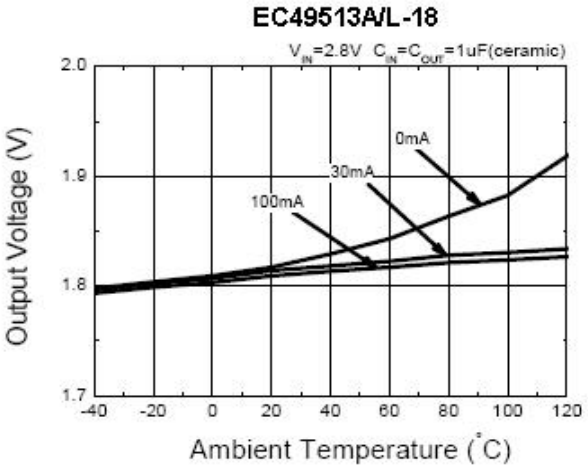


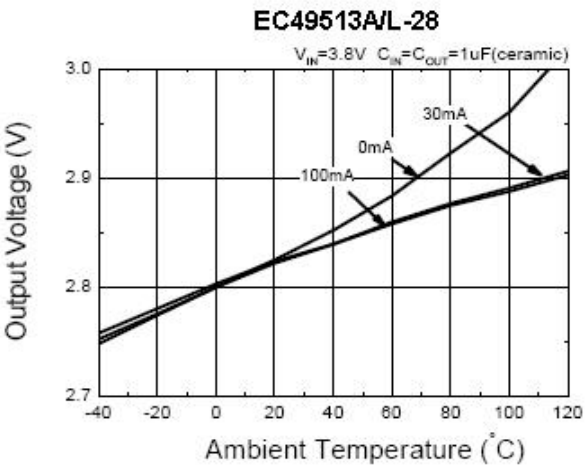
EC49513A/L-33

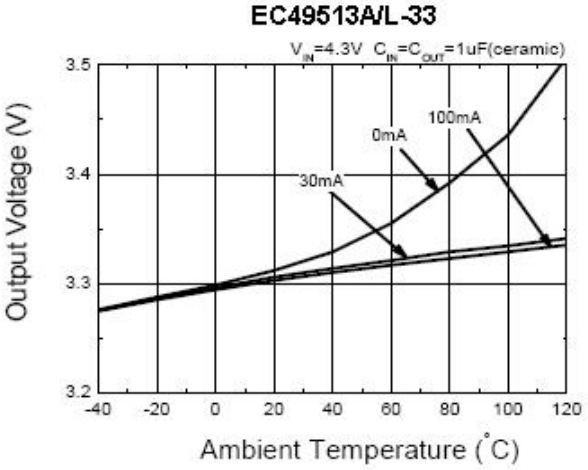


Typical Performance Characteristics (Continued)

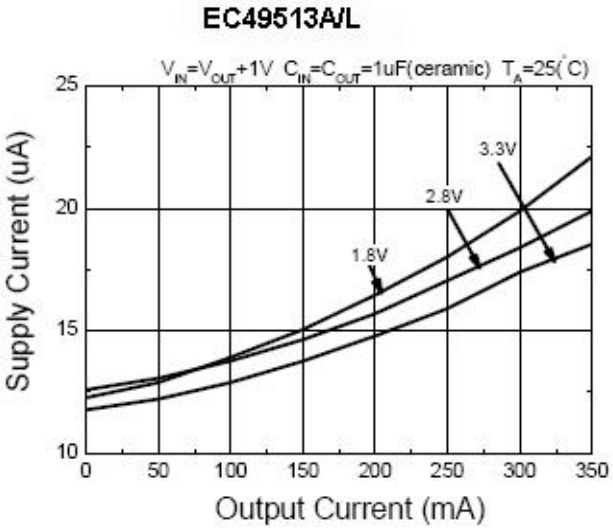
(5) Output Voltage vs. Ambient Temperature







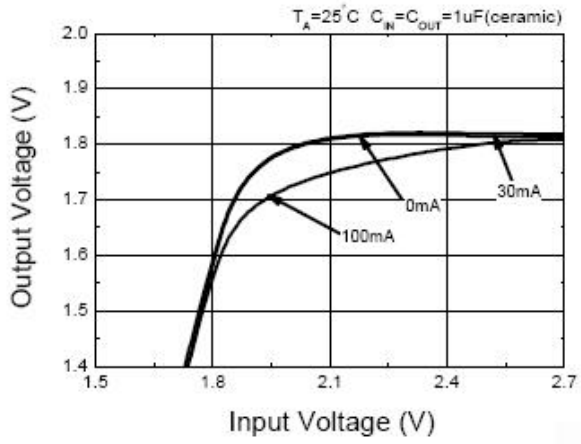
(6) Supply Current vs. Output Current



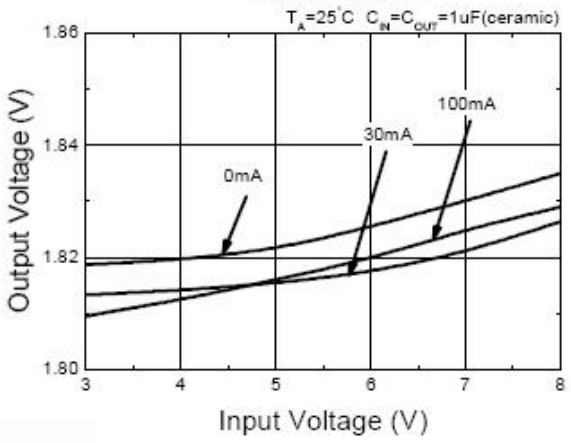
Typical Performance Characteristics

(7) Output Voltage vs. Input Voltage

EC49513A/L-18



EC49513A/L-18



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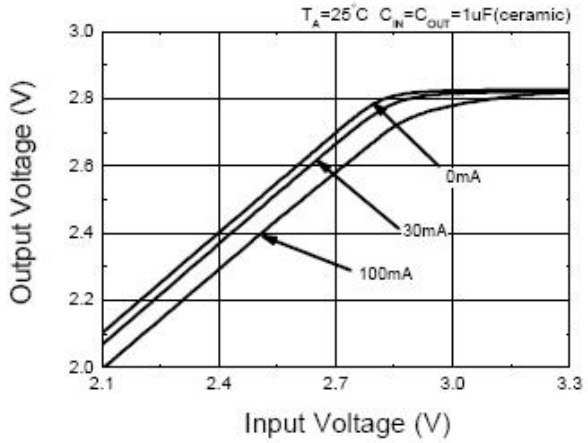

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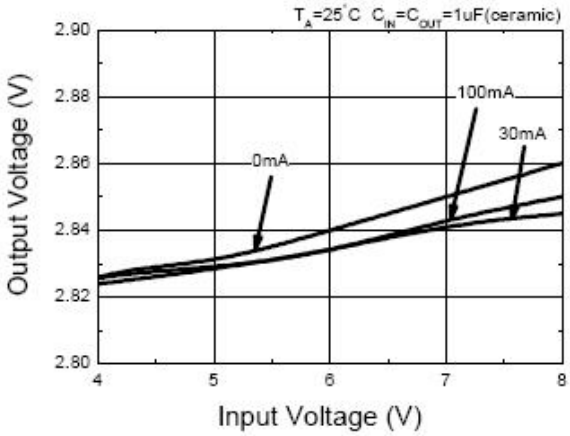

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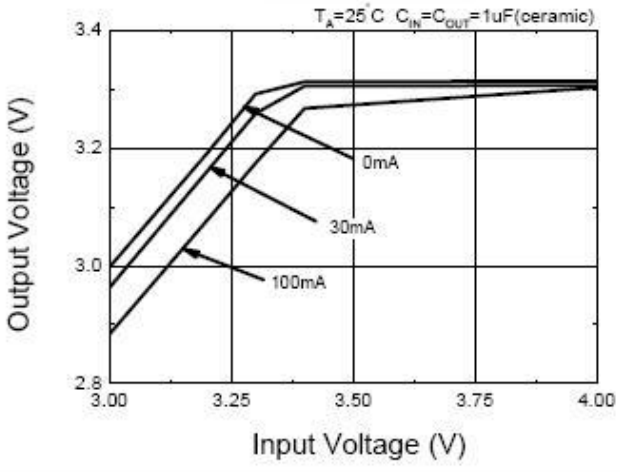

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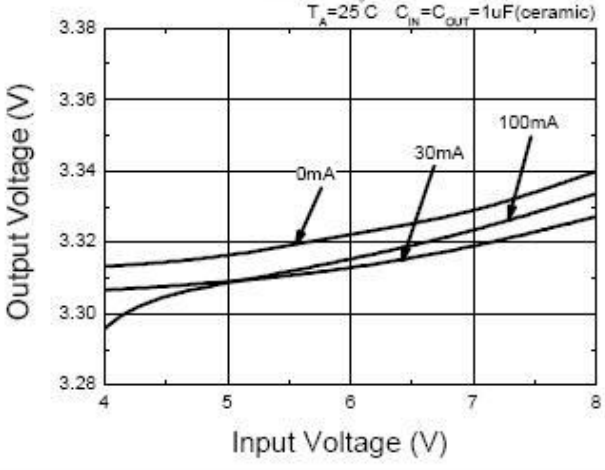
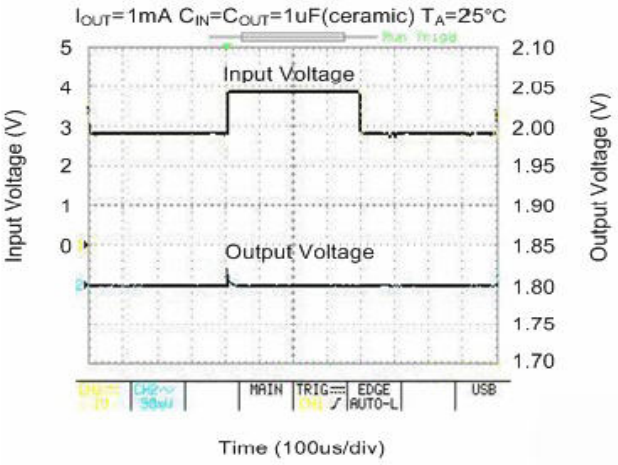


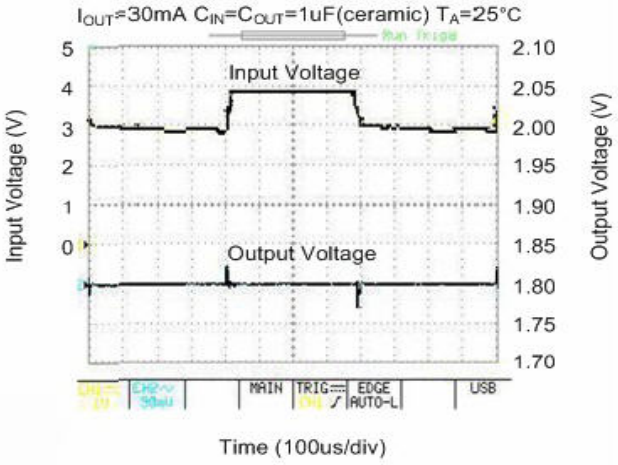
Typical Performance Characteristics (Continued)

(8) Input Transient Response

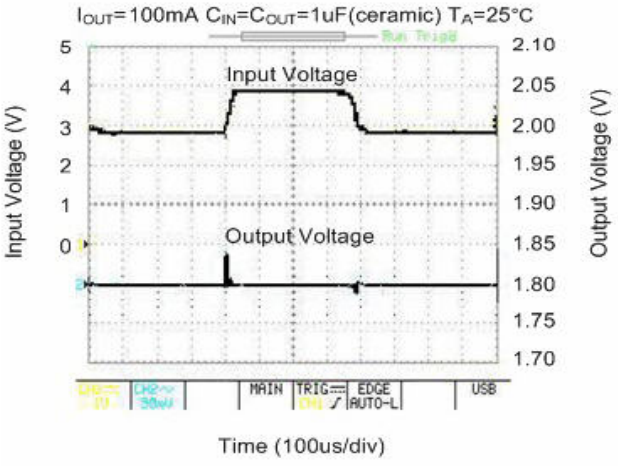
EC49513A/L-18



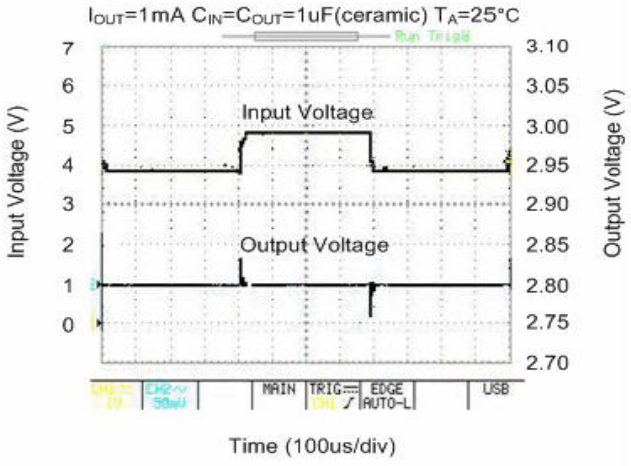
EC49513A/L-18



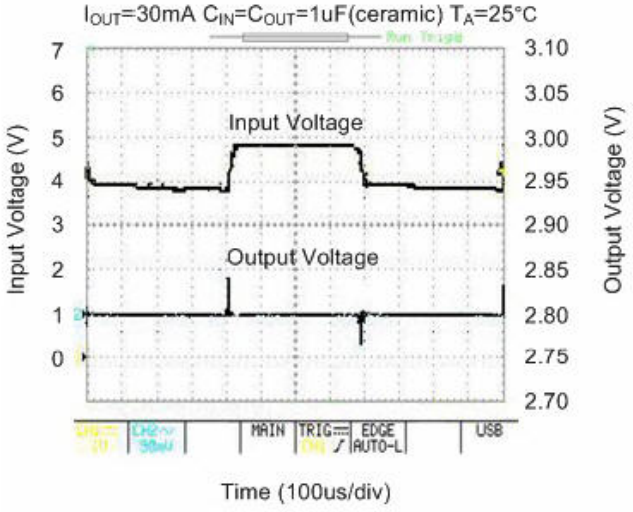
EC49513A/L-18



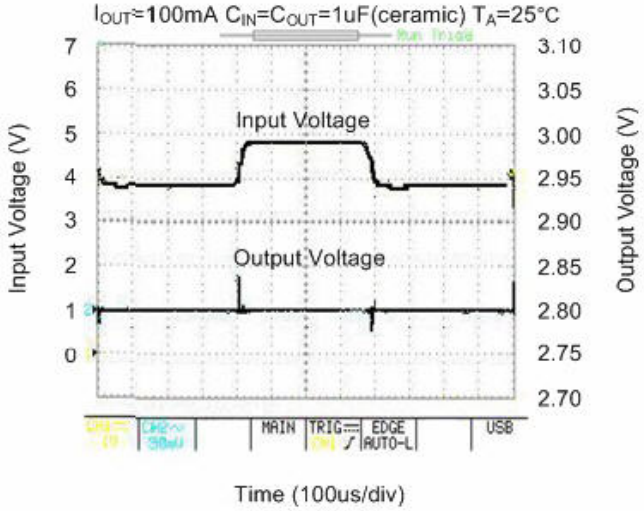
EC49513A/L-28



EC49513A/L-28

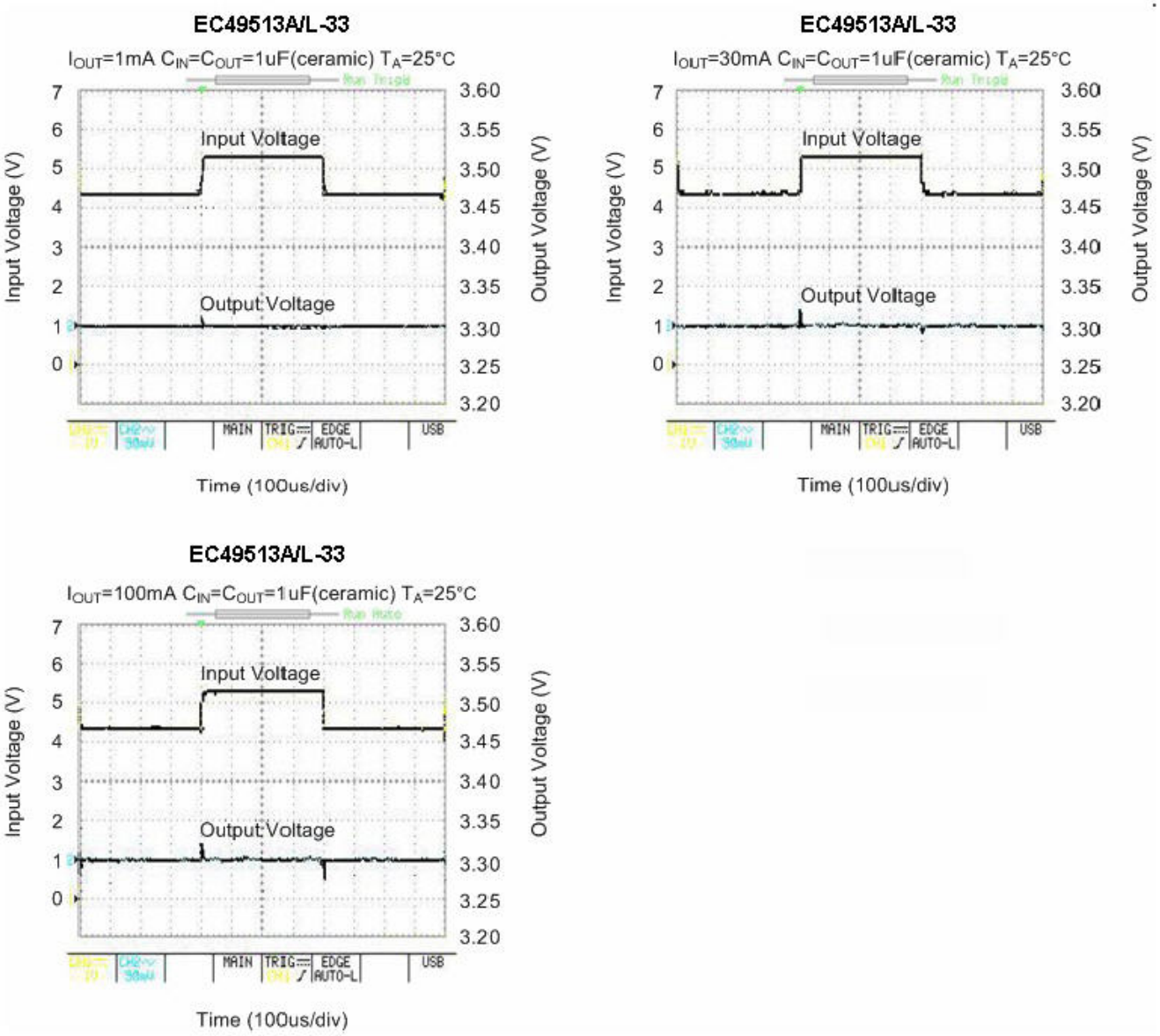


EC49513A/L-28



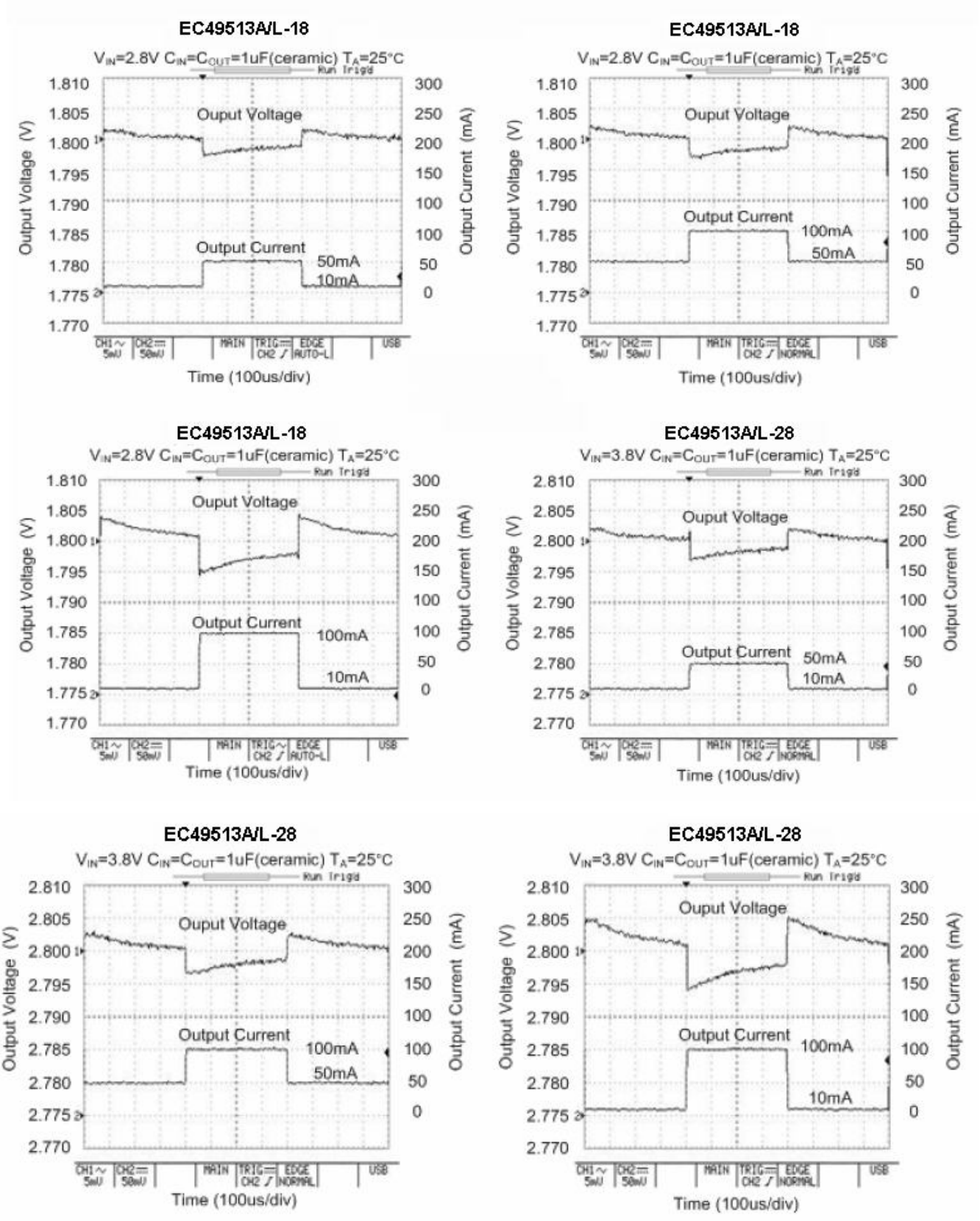
Typical Performance Characteristics (Continued)

(8) Input Transient Response (Continued)



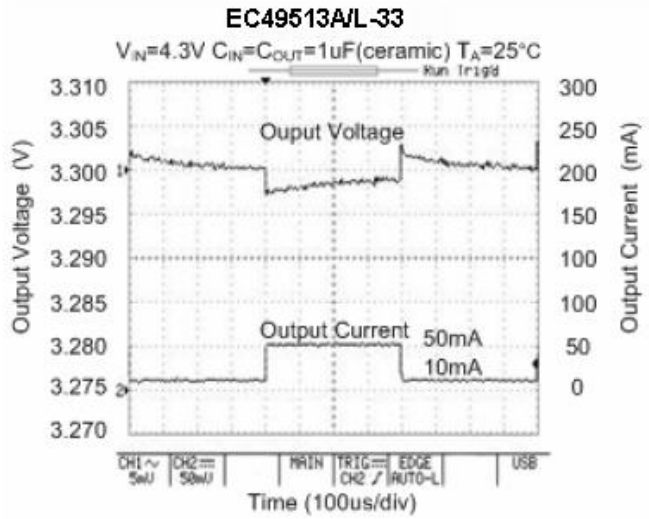
Typical Performance Characteristics (Continued)

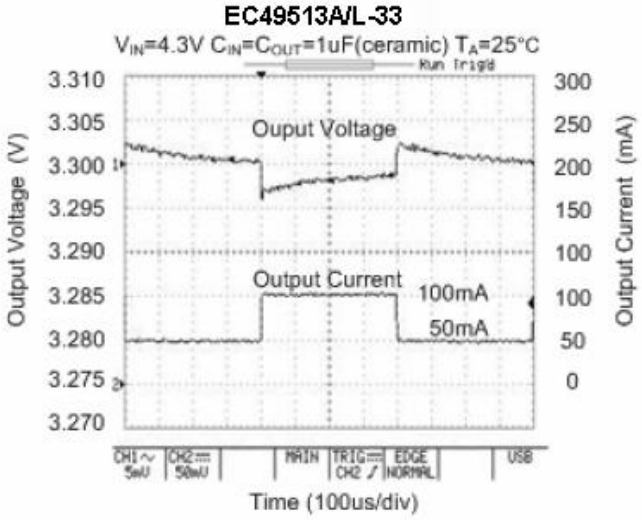
(9) Load Transient Response

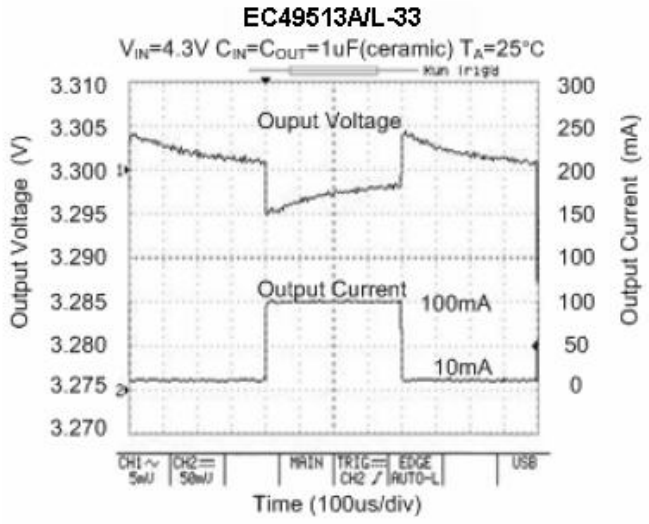


Typical Performance Characteristics (Continued)

(9) Load Transient Response (Continued)

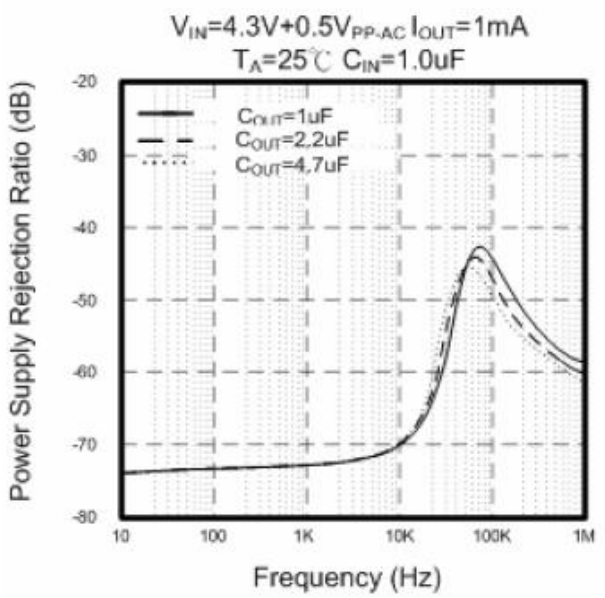


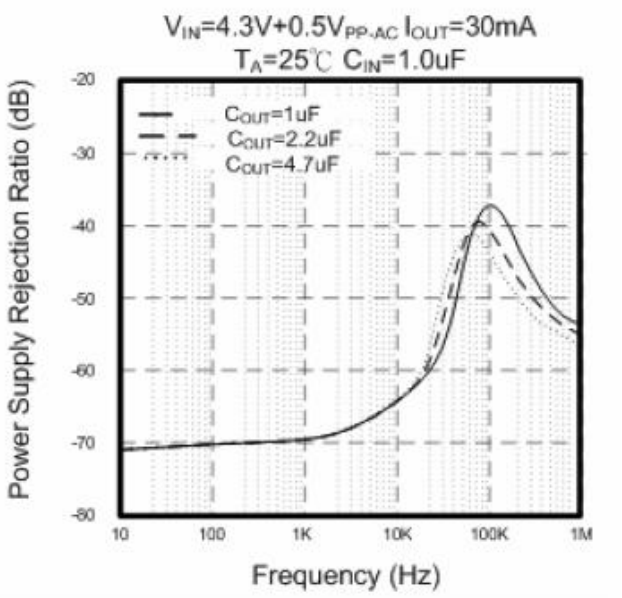




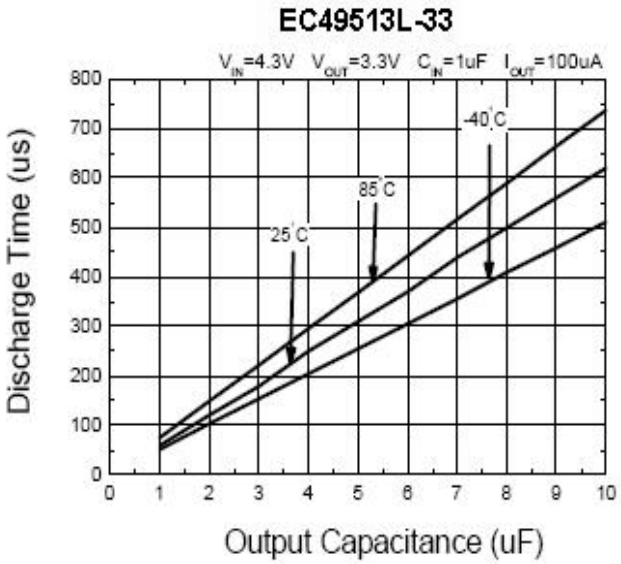
Typical Performance Characteristics (Continued)

(10) Power Supply Rejection Ratio (EC49513A/L)

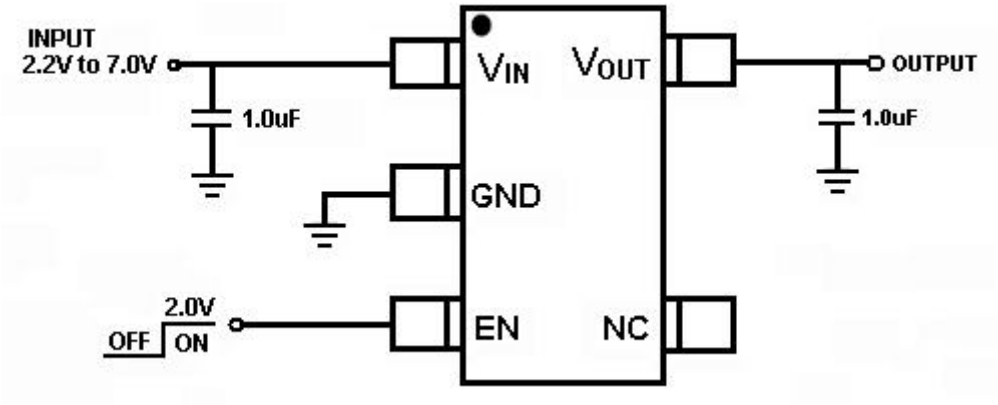




(11) Discharge Time vs. Output Capacitance (EC49513L only)



Simplified Application Circuit



Detail Description

The EC49513A/L is a low dropout linear regulator. The device provides preset 2.5V, 2.85V and 3.3V output voltages for output current up to 300mA. Other mask options for special output voltages from 1.2V to 5.0V with 100mV increment are also available. As illustrated in function block diagram, it consists of a 1.0V reference, error amplifier, a P-channel pass transistor, an ON/OFF control logic and an internal feedback voltage divider.

The 1.0V band gap 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 internal resistive divider connected to V_{OUT} pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

Internal P-Channel Pass Transistor

The EC49513A/L 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 EC49513A/L does not suffer from these problems and consumes only 15μA (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 EC49513L has fast discharge Function on EN pin disable. When user turns off EC49513L, its internal pull low resistor will discharge output capacitor charge. It'll avoid other device to arise wrong motions.

Output Voltage Selection

The EC49513A/L output voltage is preset at an internally trimmed voltage 2.5V, 2.85V or 3.3V. The output voltage also can be mask-optioned from 1.2V to 5.0V with 100mV increment by special order. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example, the EC49513A/L-33 has a preset 3.3V output voltage.

Current Limit

The EC49513A/L 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 0.5A.

Thermal Overload Protection

Thermal overload protection limits total power dissipation of EC49513A/L. 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 EC49513A/L 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 EC49513A/L 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 $P=I_{OUT} \times (V_{IN}-V_{OUT})$. 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 EC49513A/L 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.

The thermal resistance θ_{JA} of SOT23-5L package of EC49513A/L is 250°C/W. based on a maximum operating junction temperature 125°C with an ambient of 25°C, the maximum power dissipation will be:

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(125 - 25)}{250} = 0.40W$$

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".

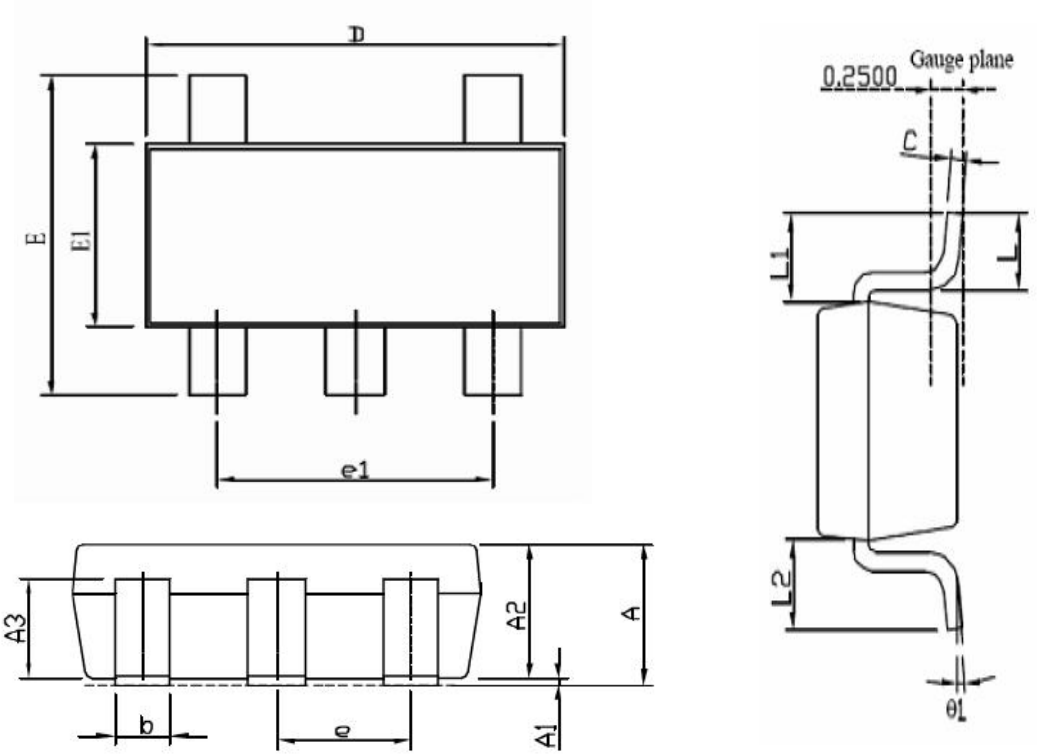
Dropout Voltage

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 EC49513A/L 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.

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

Mechanical Dimensions

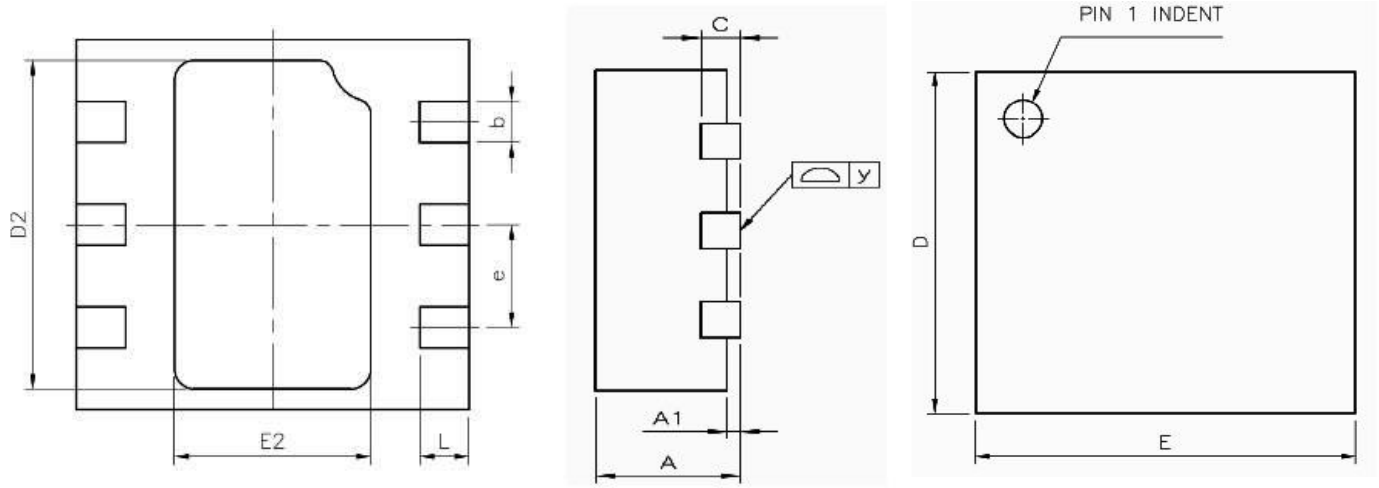
OUTLINE DRAWING SOT23-5L



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	---	---
θ 1	1°	5°	9°
e	---	0.95(TYP)	---
L1	---	0.6(REF)	---
LI-L2	---	---	0.12

Mechanical Dimensions

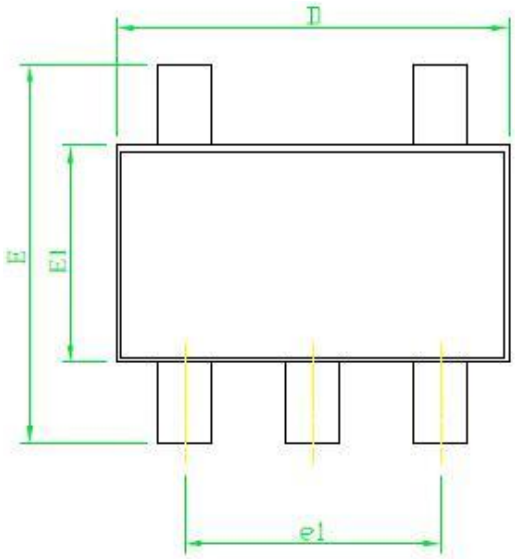
OUTLINE DRAWING UFN-6L

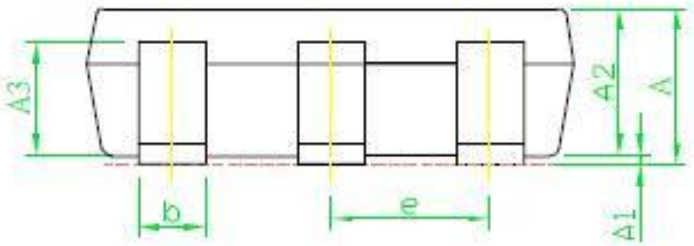


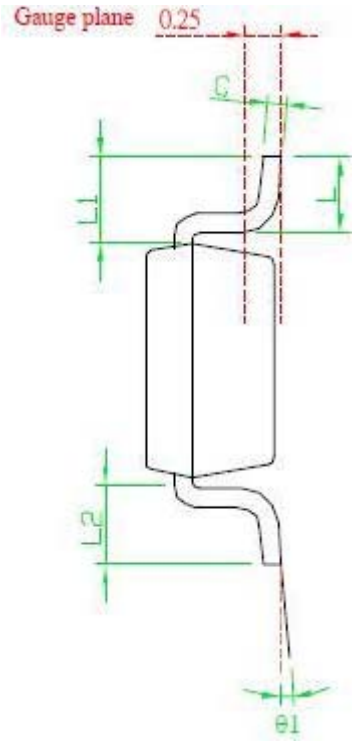
Dimension	mm		
	Min.	Nom.	Max.
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
b	0.15	0.20	0.25
C	---	0.15 REF	---
D	1.60	1.80	1.90
D2	1.55	1.60	1.65
E	1.90	2.00	2.10
E2	0.95	1.00	1.05
e	---	0.50	---
L	0.20	0.25	0.30
y	0.00	---	0.075

Mechanical Dimensions

OUTLINE DRAWING TSOT23-5







SYMBOL	Dimensions in Millimeters		
	MIN	NOM	MAX
A	-		1.00
A1	0.00	0.05	0.10
A2	0.84	0.87	0.90
A3	0.58	0.68	0.78
b	0.35	0.40	0.50
C	0.10	0.125	0.15
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
e	-	0.95(TYP)	-
θ1	1°	5°	9°
L	0.37	-	-
L1	-	0.6REF	-
| L1-L2 |	-	-	0.12