Dual Channel LDO Regulator With Enable Function

Description

The EC49222 series are highly accurate, dual, low noise, CMOS LDO voltage regulators with enable function. The EN function allows the output of each regulator to be turned off independently, resulting in greatly reduced power consumption.

The EC49222 series have the soft start function to suppress the inrush current. The current limiters' fold back circuit (it happens when over 350mA per channel) also operates as a short protection for the output current limiter. The output voltage for each regulator is set independently by metal trimming. It's also available to offer the honors other types of V_{OUT} between +1.2V~+3.9V except the options shown on ordering information.

This series are fully com compatible with low ESR ceramic capacitors, reducing cost and improving output stability. This high level output stability is maintained even during frequent load fluctuations, due to the excellent transient response performance and high PSRR achieved across a broad range of frequency. It is available in the SOT23-6L, UFN-6 and DFN-6 ‘chip-scaled' package.

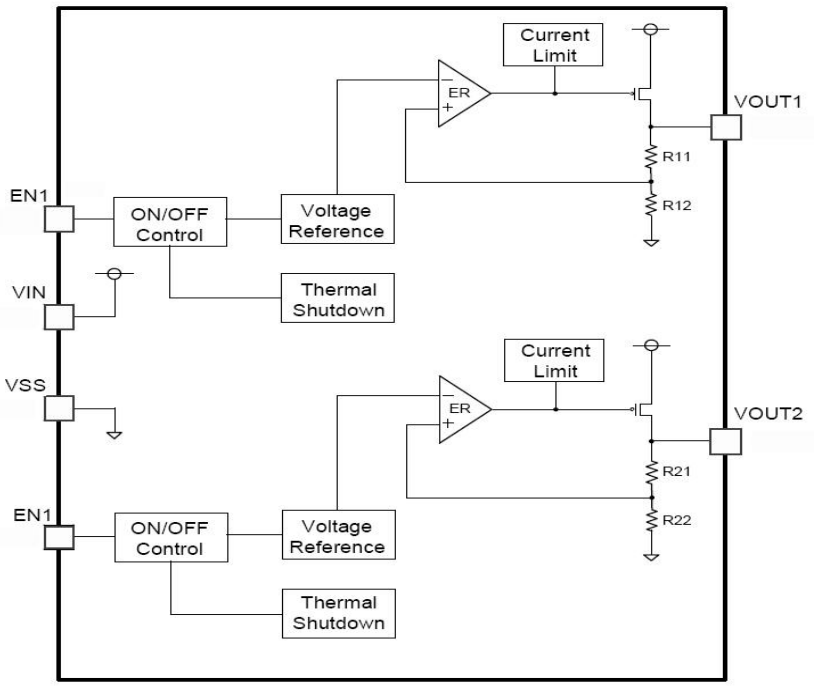
Features

- Dropout:150mV @ 100mA (VOUT≧2.8V)
- Operating Voltage Range: +2.7V to +7.0V
- Output Voltage Range: +1.2V to +3.9V
- Output Current: 250 mA / Channel (Typ.)
- Low Power Consumption: 8μA (Typ.) / Channel
- Standby Current: 0.01pA (Typ.)
- Highly Accurate:±2% (VOUT≧2.0V)
- High Ripple Rejection Rate: 70 dB
- Output Current Limit Protection: 350mA/Channel
- Short Circuit Protection (150mA)
- Output ON/OFF Control Function
- Low ESR Capacitor Compatible
- SOT23-6L, UFN-6 Packages
- ROHS Compliant and 100% Lead (Pb)-Free and Green (Halogen Free with Commercial Standard)

Application

- Mobile Phones (PDC, GSM, CDMA, IMT2000 etc.) and Cordless phones.
- Radio Communication equipment.
- Portable games.
- Cameras, Video recorders.
- Portable AV equipment.

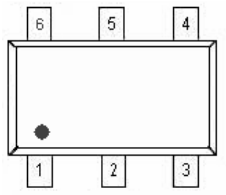
Block Diagram



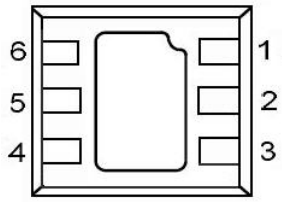
Dual Channel LDO Regulator With Enable Function

Pin Assignment

SOT23-6L (Top View)



UFN-6 (Bottom View)



Pin Descriptions

Pin# SOT23-6L	Pin# UFN-6	Symbol	Function
1	3	EN1	V_{OUT1} Enable Control Pin
2	2	V_{IN}	Power Input.
3	1	EN2	V_{OUT2} Enable Control Pin
4	6	V_{OUT2}	Voltage Output 2
5	4	GND	Ground
6	5	V_{OUT1}	Voltage Output 2

Ordering Information

EC49222-X -XX X

- F: Lead Free
- G: Green Mode
- Package Type: B3= SOT23-6L, F= UFN-6
- Output Type Code: (V_{OUT}+V_{OUT})

A: 3.3V+3.3V
B: 2.8V+3.3V
C: 2.5V+3.3V
D: 1.8V+3.3V
E: 1.5V+3.3V
F: 1.2V+3.3V
G: 2.8V+2.8V
H: 2.5V+2.8V
J: 1.8V+2.8V
K: 1.5V+2.8V
L: 1.2V+2.8V
M: 2.5V+2.5V
N: 1.8V+2.5V
P: 1.5V+2.5V
Q: 1.2V+2.5V
R: 1.8V+1.8V
S: 1.5V+1.8V
T: 1.2V+1.8V
U: 1.5V+1.5V
V: 1.2V+1.5V
W: 2.85V+2.85V
1: 3.0V+3.3V
2: 1.8V+3.0V
3: 3.0V+3.0V
4: 1.3V+2.8V

Marking Information

Package	Part Number	Marking	Marking Information
SOT23-6L	EC49222-X-B3F	01VXX	The 1st to 2nd character represents the Product part. Example: EC49222=01. The 3rd character represents the Output Voltage code. Please refer the table for Output Voltage Code. Please refer the Output Type Code: ex. A=3.3V+3.3V, B=2.8V+3.3V... 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 4th and 5th character for Lead Free package.
	EC49222-X-B3G		
UFN-6	EC49222-X-FF	01V XX	The 1st to 2nd character represents the Product part. Example: EC49222=01. The 3rd character represents the Output Voltage code. Please refer the Output Type Code: ex. A=3.3V+3.3V, B=2.8V+3.3V... The XX characters represents the Date Code There are under-lines on second lines 1st and 2nd characters for Green package. There are no under-lines on second lines 1st and 2nd characters for Lead Free package.
	EC49222-X-FG		

Absolute Maximum Ratings

Parameter		Symbol	Value	Units
Input Voltage		V_{IN}	7.0	V
Output Current		$I_{OUT}1+ I_{OUT}2$	700	mA
Output Voltage		V_{OUT}	V_{SS}-0.3~V_{IN}+0.3	V
Enable Pin Voltage		V_{EN}	V_{SS}-0.3~V_{IN}+0.3	V
Junction Temperature		T_J	-40 to +150	°C
Thermal Resistance (SOT23-6L)		Θ_{JA}	250	°C/W
Power Dissipation	SOT23-6L	P_D	400	mW
	UFN-6		500	
Operating Ambient Temperature		T_{OPR}	-40 to +85	°C
Storage Temperature		T_{STG}	-55 to +125	°C
Lead Temperature (Soldering, 10sec.)		—	+260	°C

Note:

The power dissipation of UFN-6 would be 500mW normally with the 0.5x0.5 square inches cooper area connected to the botton pad. However, it could be up to 1000mW with larger cooper area.

Electrical Charateristics

(TA=25℃, for each channel)

Symbol	Parameter	Test Conditions	MIn	Typ	Max	UnIt
V_{IN}	Input Voltage	—	2.7	—	7.0	V
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+1.0V$, $I_{OUT}=30mA$, V_{OUT} >2.0V	-2%	V_{OUT}	+2%	V
		$V_{IN}=V_{OUT}+1.0V$, $I_{OUT}=30mA$, V_{OUT} >2.0V	-0.04	V_{OUT}	+0.04	V
I_{MAX}	Output Current	V_{OUT} +1.0V≦V_{IN}≦6V (see note *1)	—	250	—	mA
V_{DROP}	Dropout Voltage	I_{OUT}=100mA	—	150	250	mV
I_{SS}	Supply Current	V_{IN} =V_{EN}= V_{OUT} +1.0V, I_{OUT} =0mA	—	8	15	μA
I_{STB}	Standby Current	V_{IN} =V_{EN}= V_{OUT} +1.0V, V_{EN} =Vss	—	0.01	1	μA
ΔV_{LINE}	Line Regulation	V_{OUT} +1.0V≦V_{IN}≦6.0V, I_{OUT} =0mA	—	0.2	0.3	%/V
ΔV_{LOAD}	Load Regulation	V_{IN} = V_{OUT} +1.0V, 1mA≦I_{OUT}≦100mA	—	0.02	0.03	%/mA
T_C	Temperature Characteristics	I_{OUT} =30mA, -25°C≤T_{OPR}≤+85°C	—	±100	—	ppm/°C
I_{LIM}	Current Limiter	V_{IN} = V_{OUT} +1.0V, V_{IN} = V_{EN}	—	350	—	mA
I_{SHORT}	Short-Circuit Current	V_{IN} =V_{OUT}+1.0V, V_{IN} = V_{EN}	—	150	—	mA
PSRR	Ripple Rejection Rate	I_{OUT} =30mA, F=1KHz	—	70	—	dB
V_{IH}	EN Pin Input Voltage “H”	(see note *2)	0.6 V_{IN}	—	—	V
V_{IL}	EN Pin Input Voltage “L”	(see note *2)	—	—	0.3 V_{IN}	V
T_{TST}	Thermal Shutdown Temperature	—	—	150	—	°C
T_{TSH}	Thermal Shutdown Hysteresis	—	—	40	—	°C

Note:

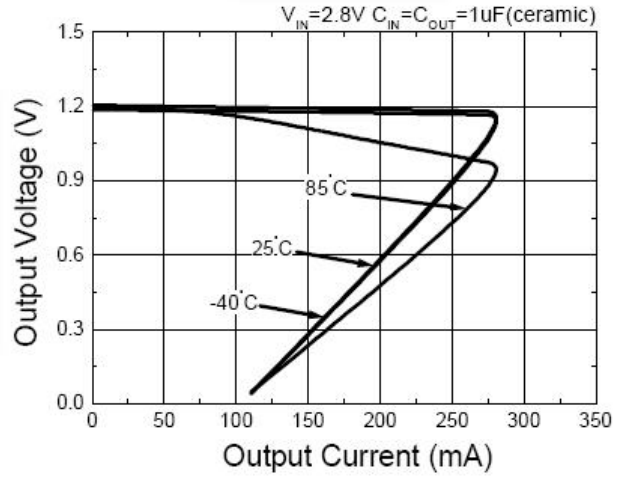
*1) Measured using a double sided board with 1”x2” square inches of copper area connected to the GND pins for “heat spreading”.

*2) EN pin input voltage must be always less than or equal to input voltage.

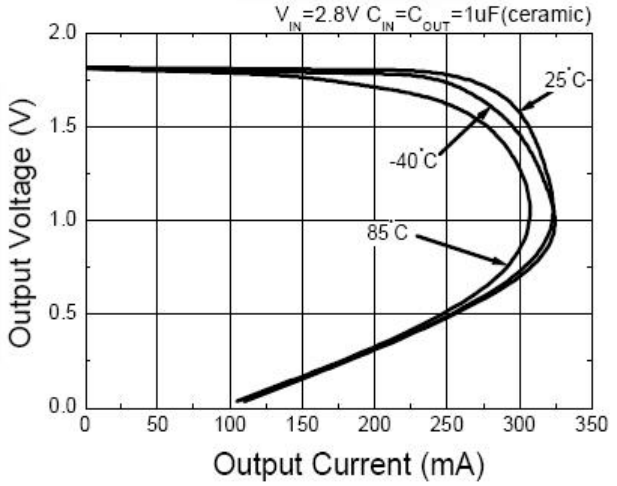
Typical Performance Characteristics

(1) Output Voltage vs. Output Current

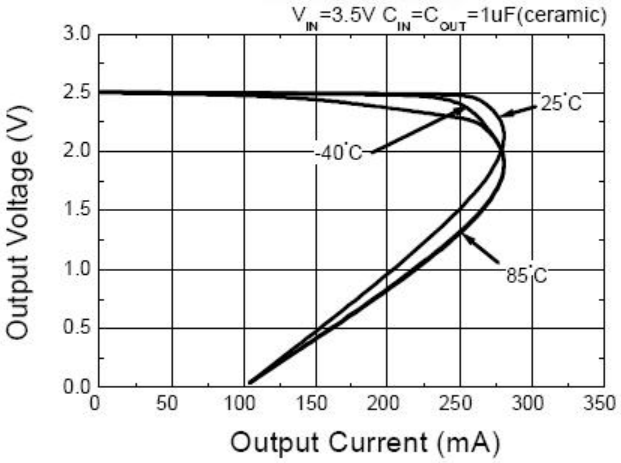
EC49222(1.2V)



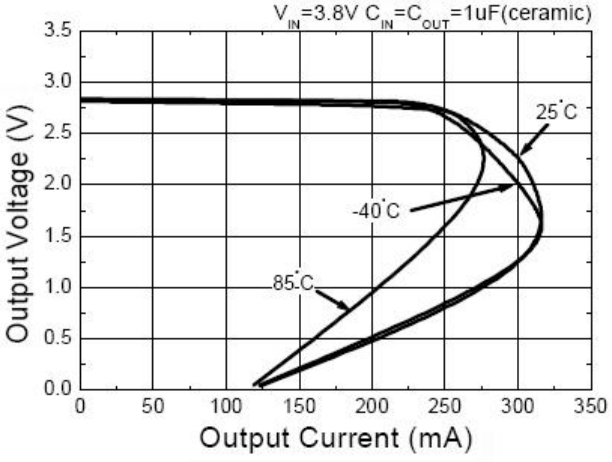
EC49222(1.8V)



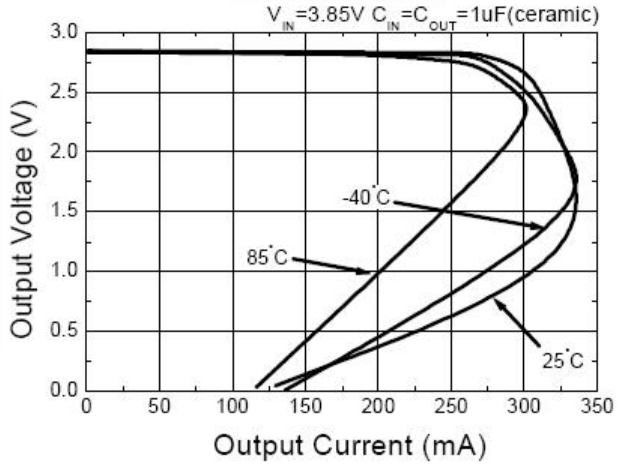
EC49222(2.5V)



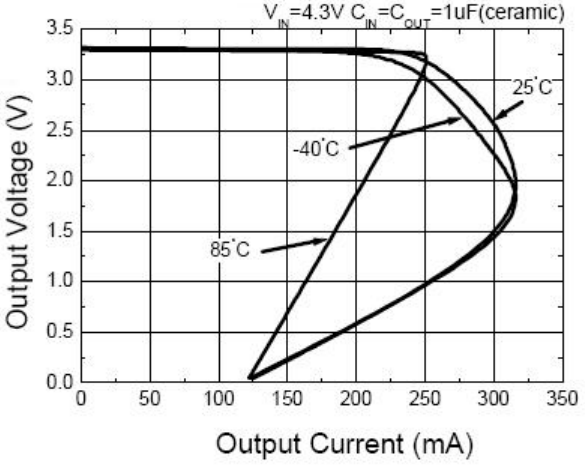
EC49222(2.8V)



EC49222(2.8V)

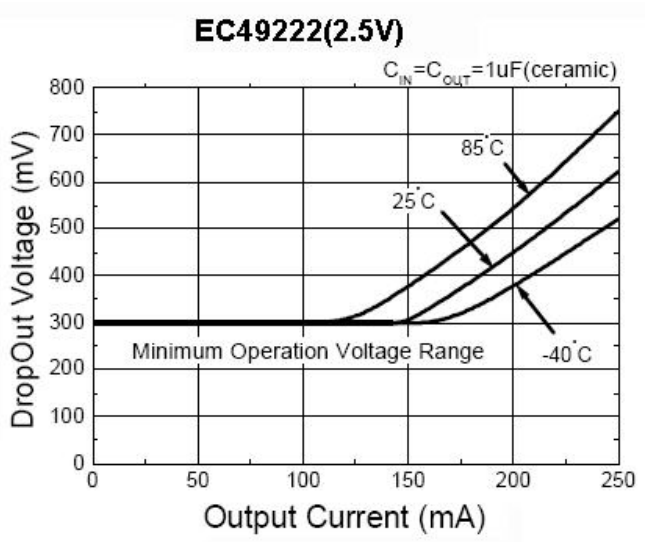


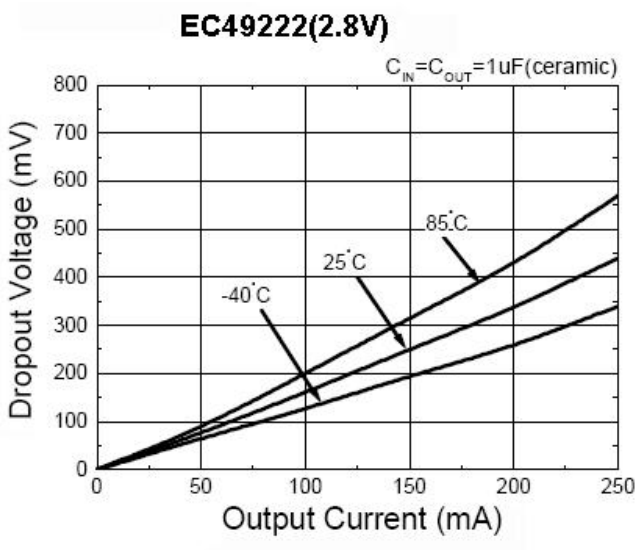
EC49222(3.3V)

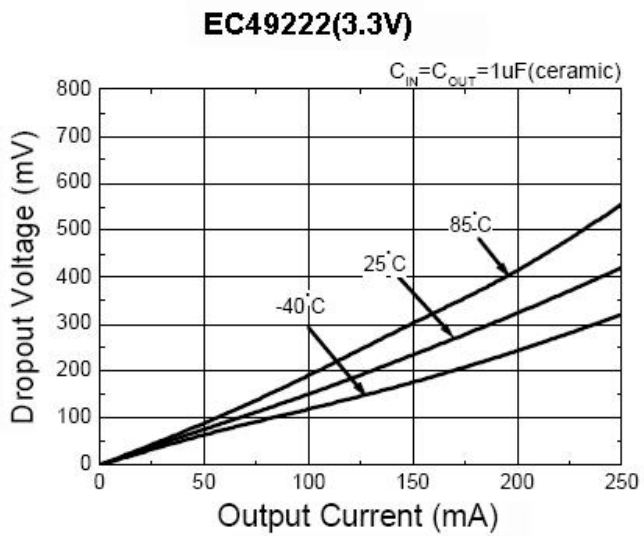


Typical Performance Characteristics (Continued)

(2) Dropout Voltage vs. Output Current

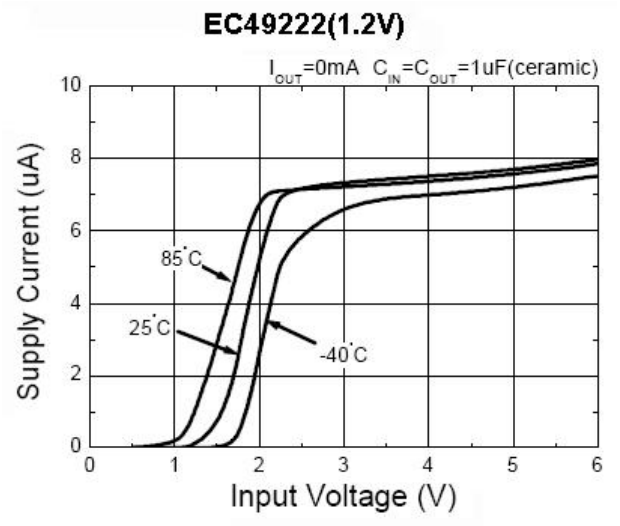


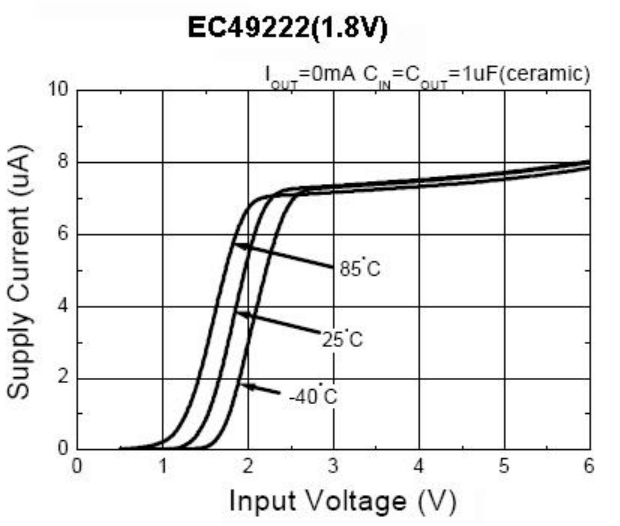


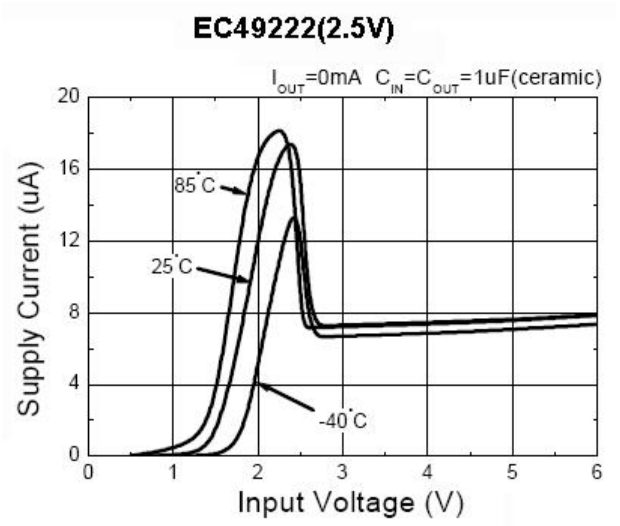


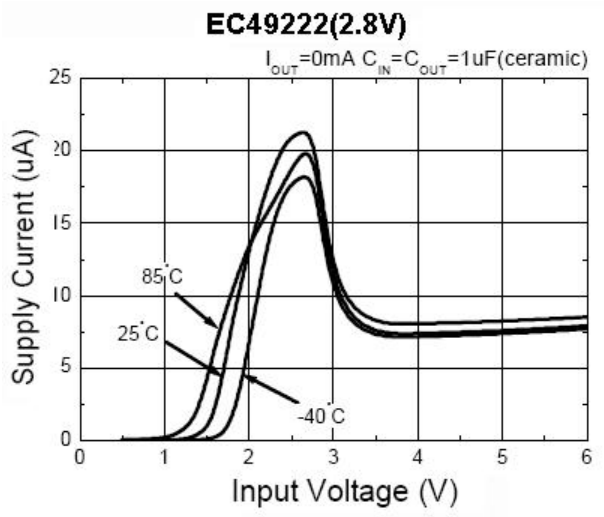
Typical Performance Characteristics (Continued)

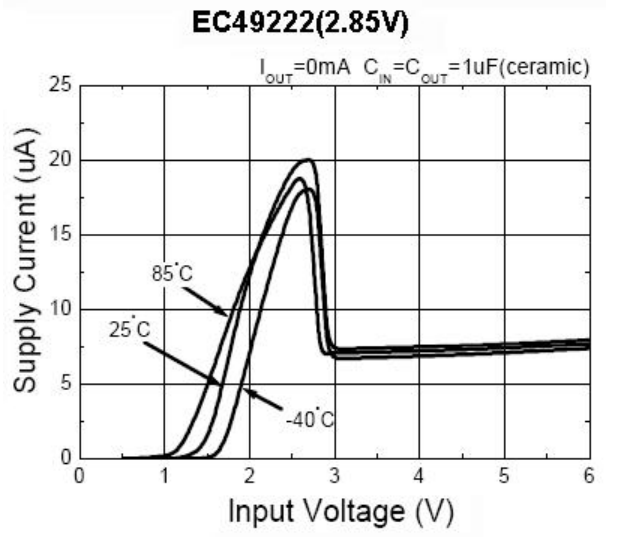
(3) Supply Current vs. Input Voltage

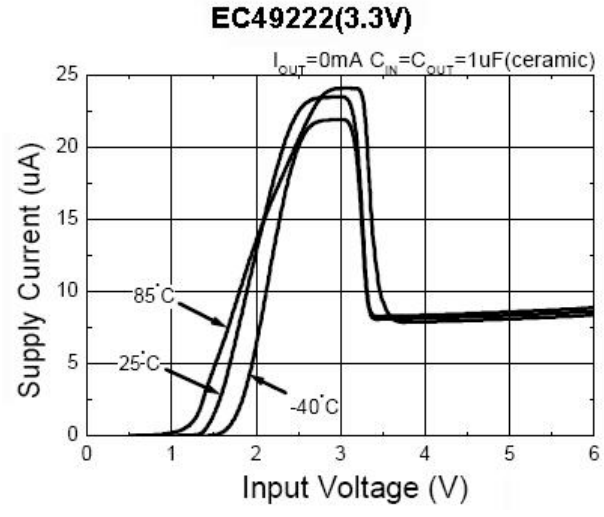








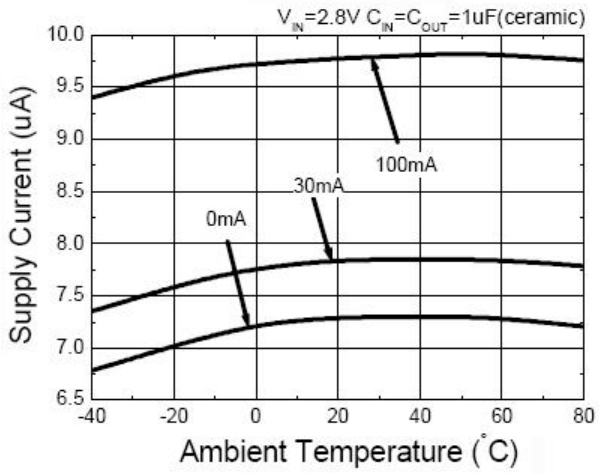




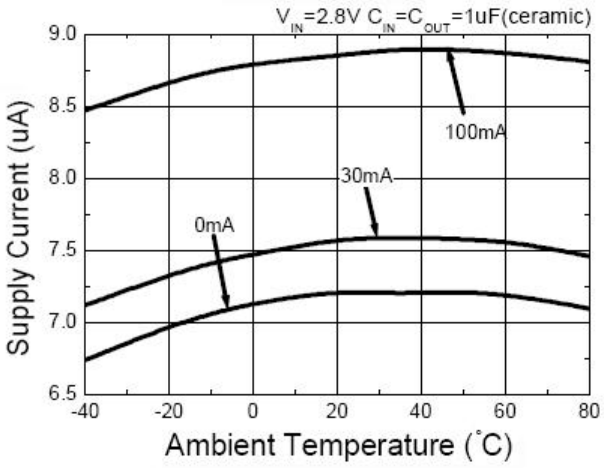
Typical Performance Characteristics (Continued)

(4) Supply Current vs. Ambient Temperature

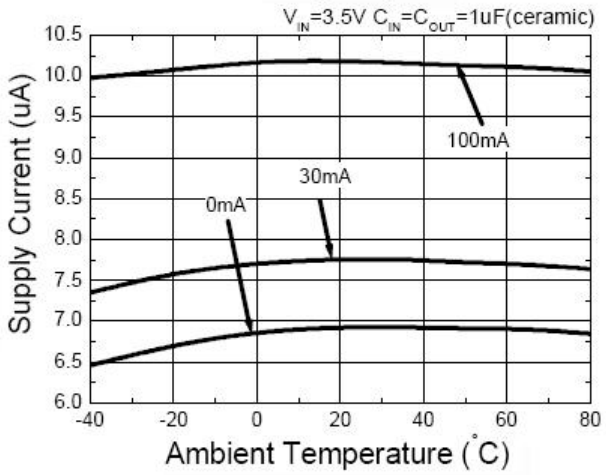
EC49222(1.2V)



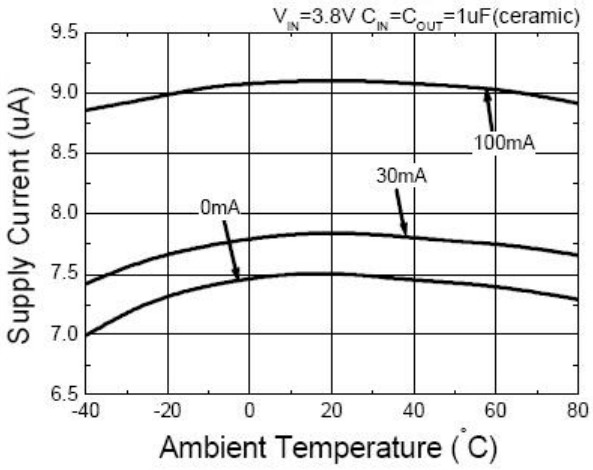
EC49222(1.8V)



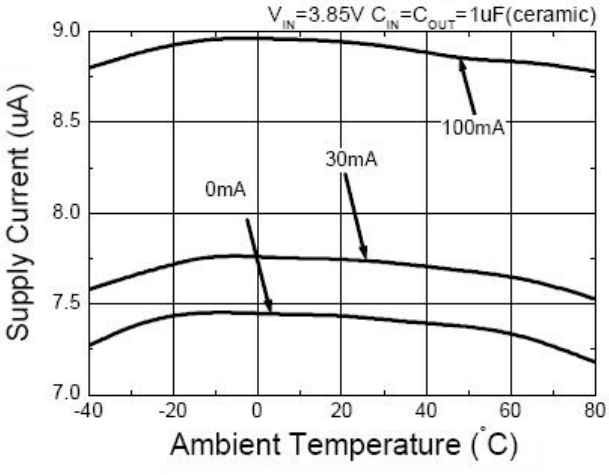
EC49222(2.5V)



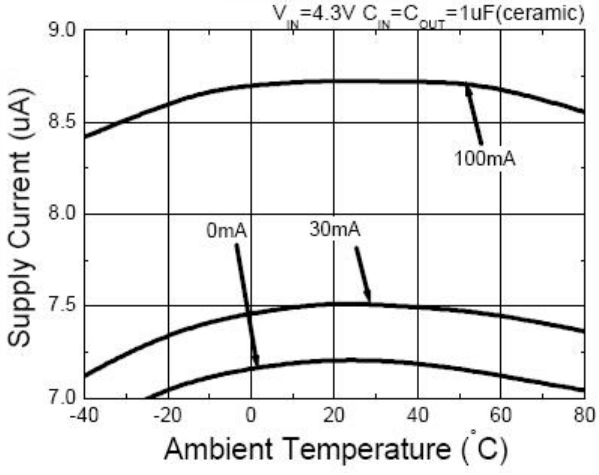
EC49222(2.8V)



EC49222(2.85V)

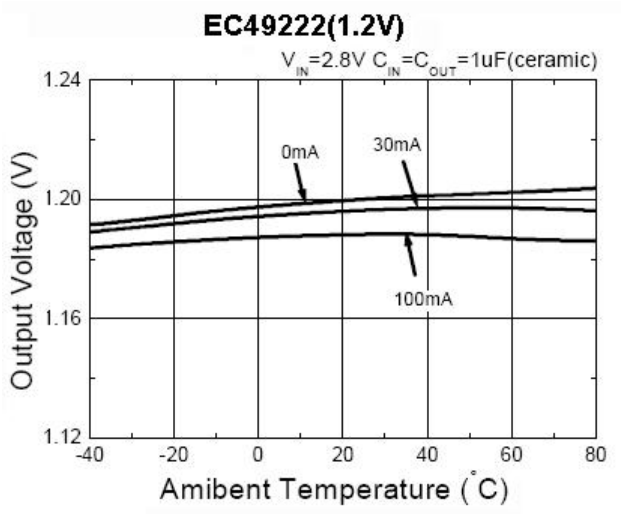


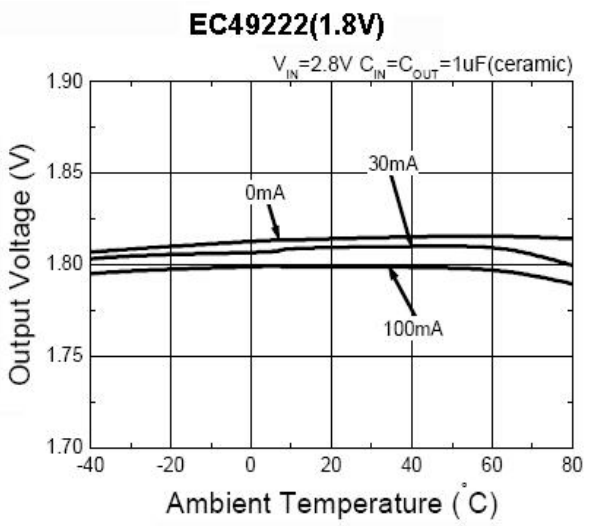
EC49222(3.3V)

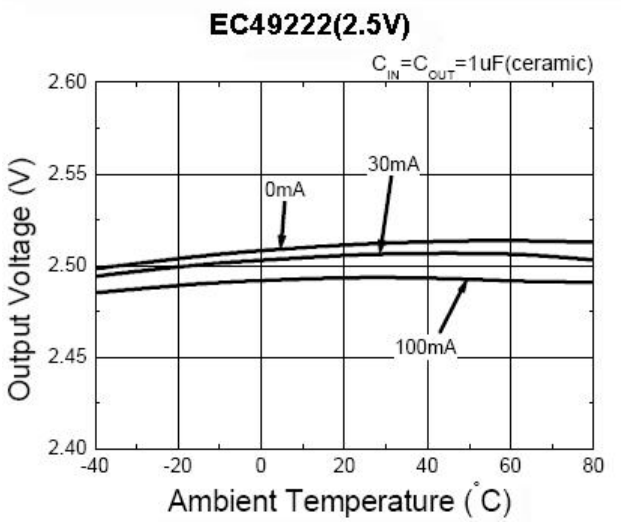


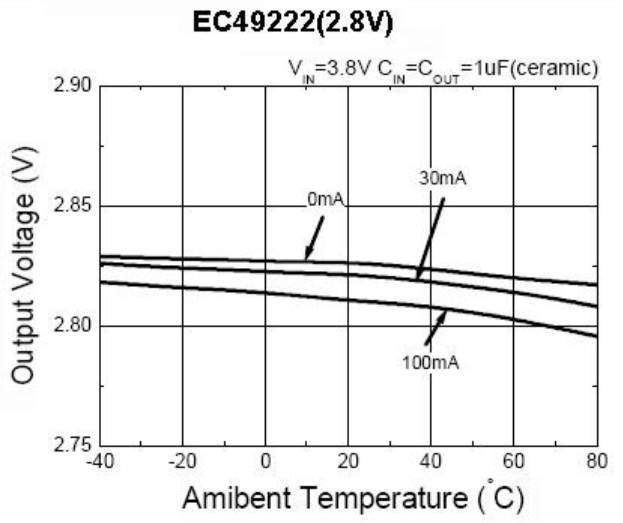
Typical Performance Characteristics (Continued)

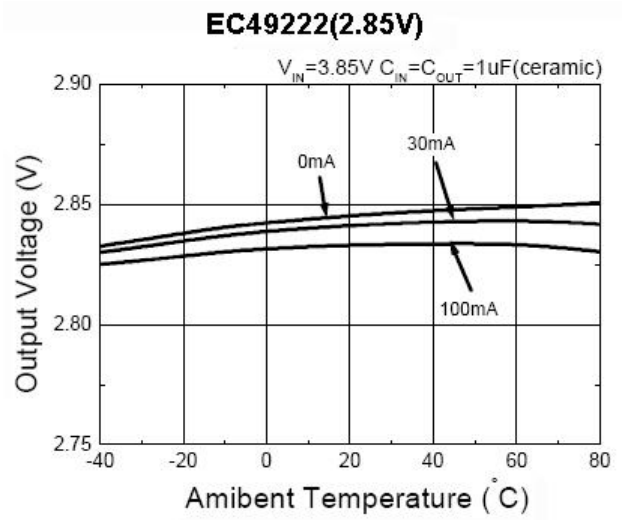
(5) Output Voltage vs. Ambient Temperature

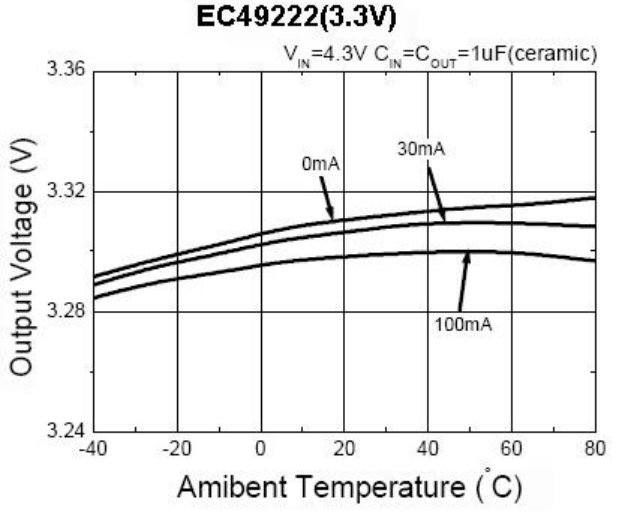






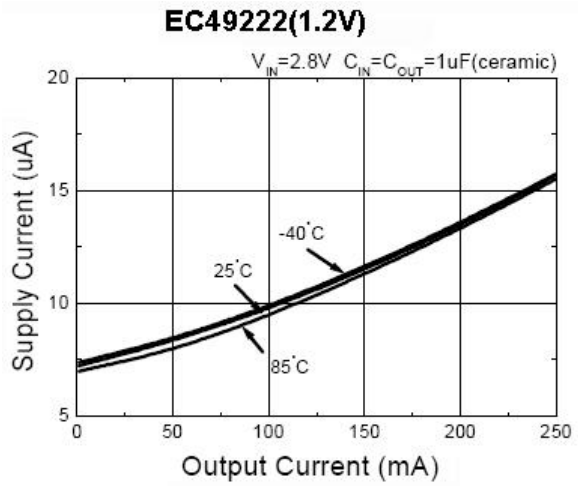


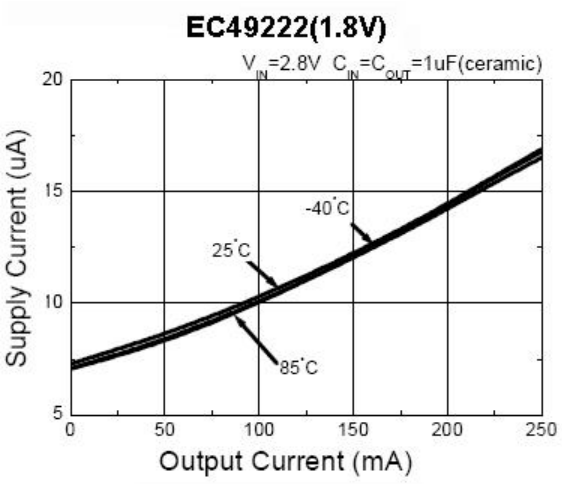


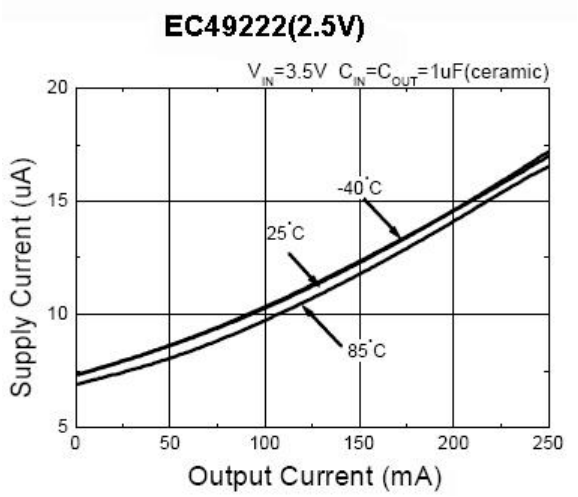


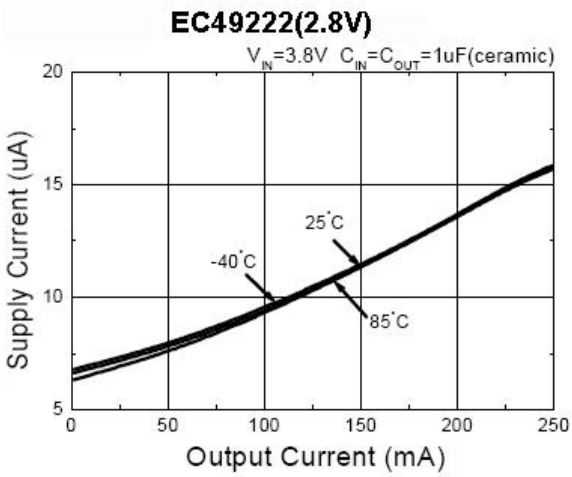
Typical Performance Characteristics (Continued)

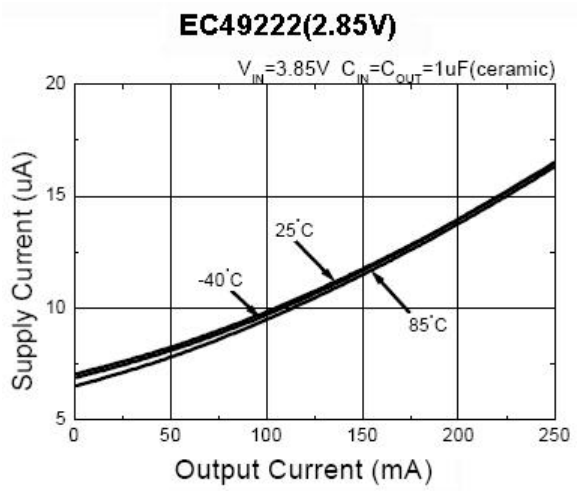
(6) Supply Current vs. Output Current

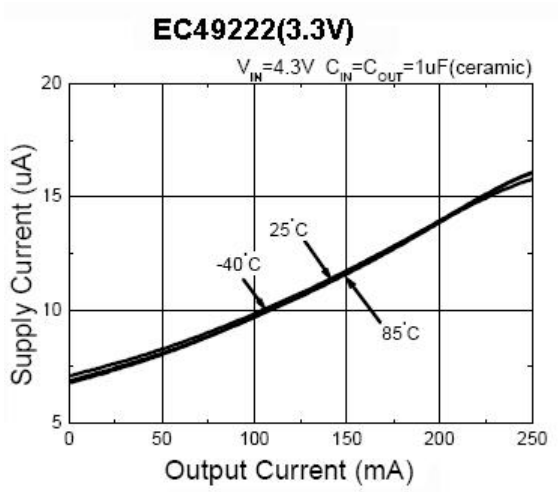






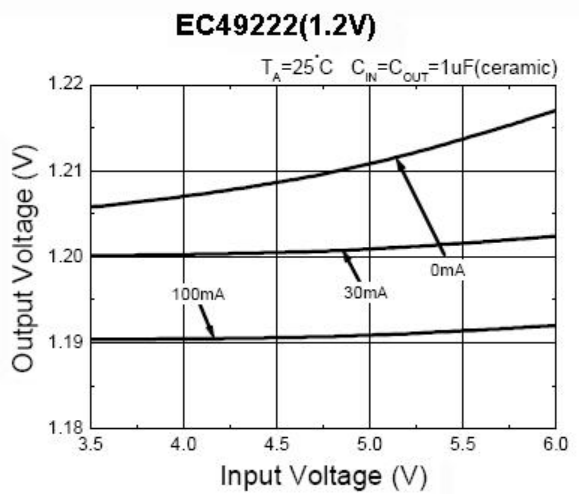


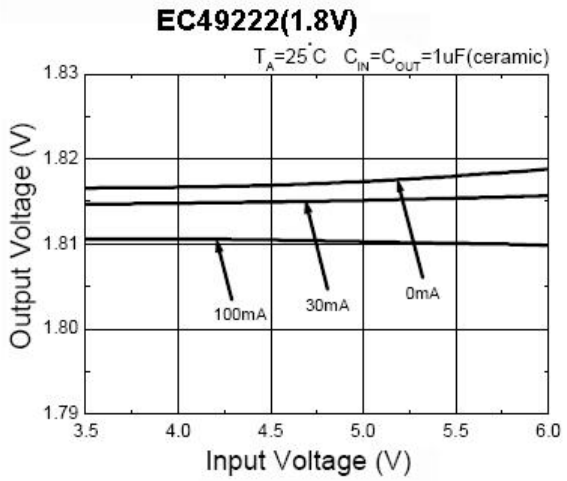


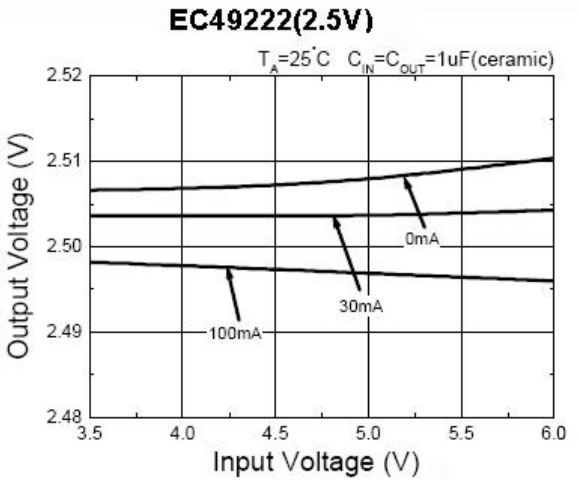


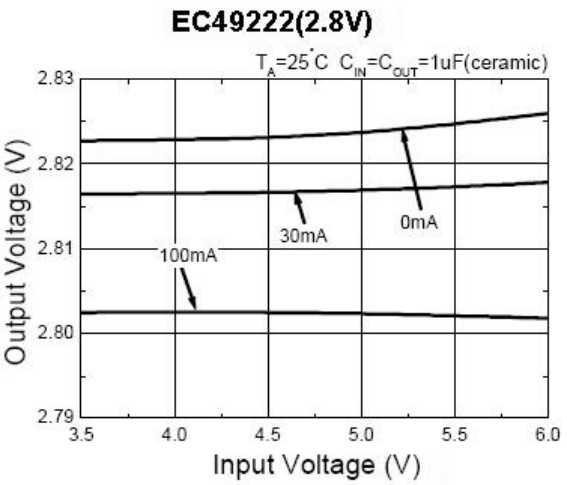
Typical Performance Characteristics (Continued)

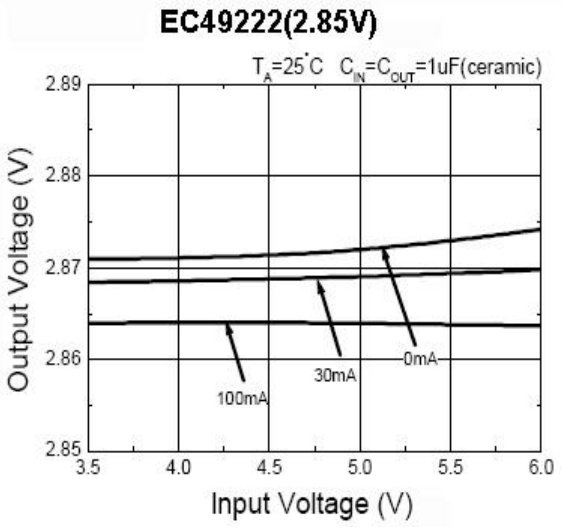
(7) Output Voltage vs. Input Voltage

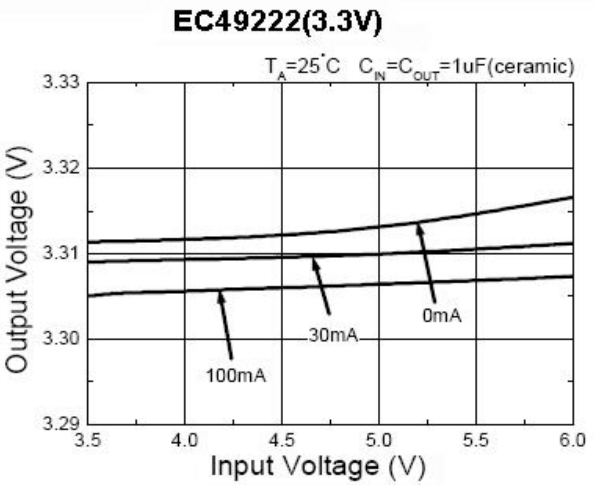






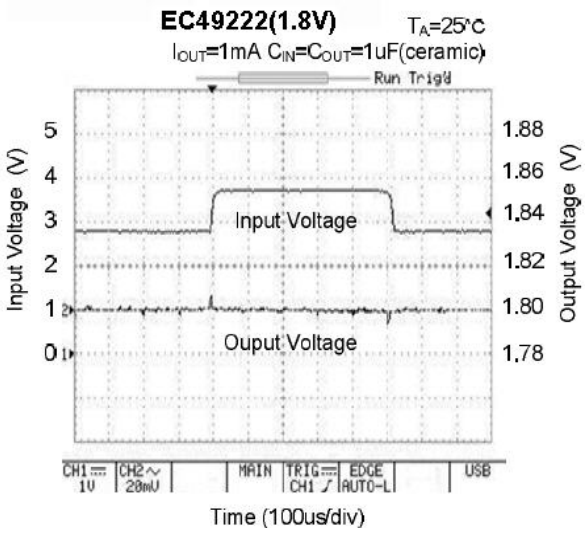


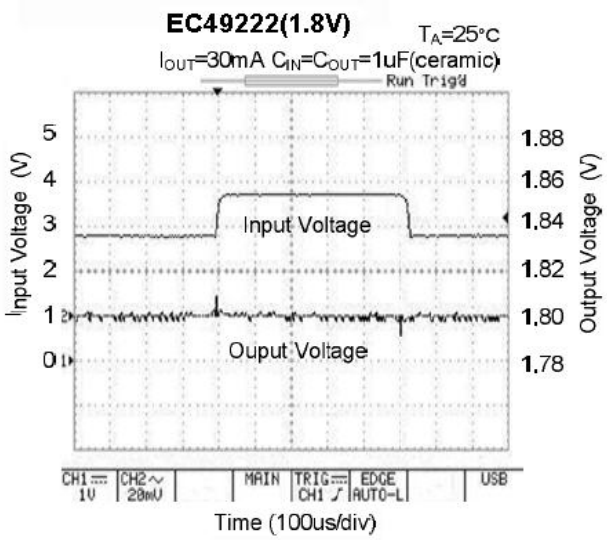


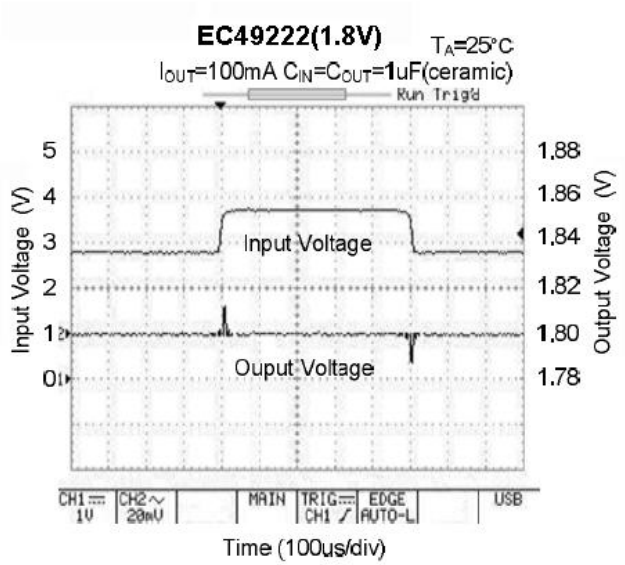


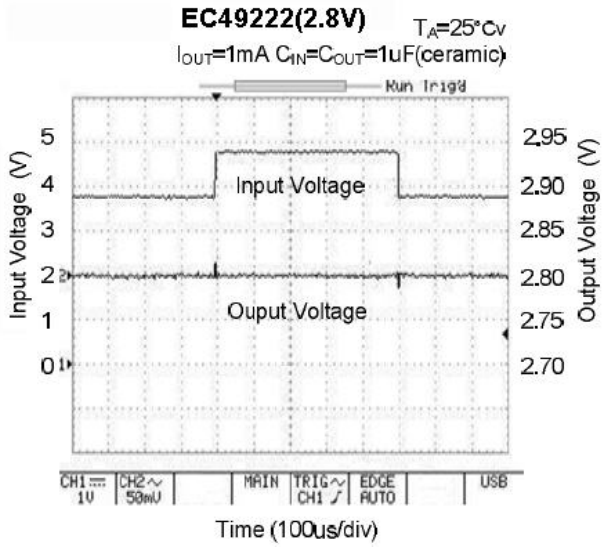
Typical Performance Characteristics (Continued)

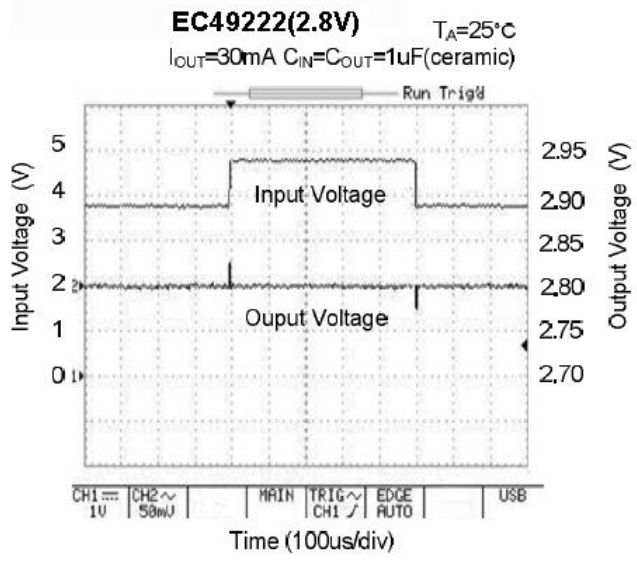
(8) Input Transient Response

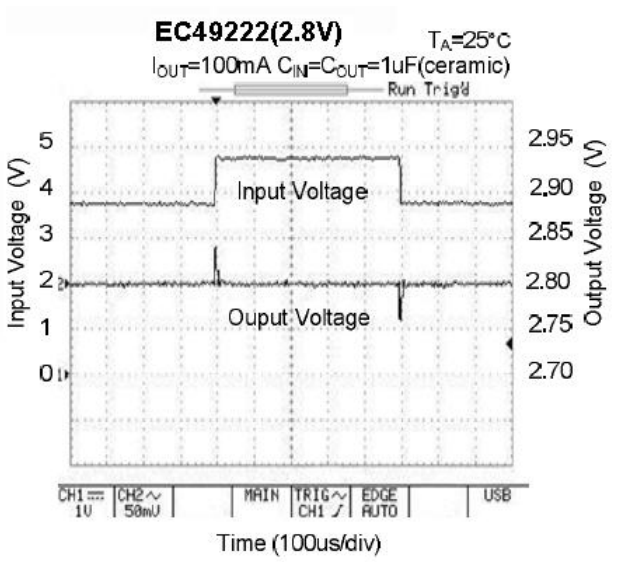






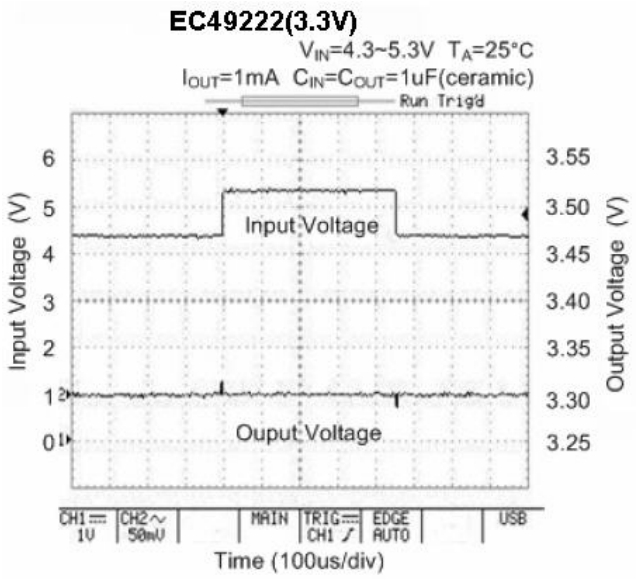


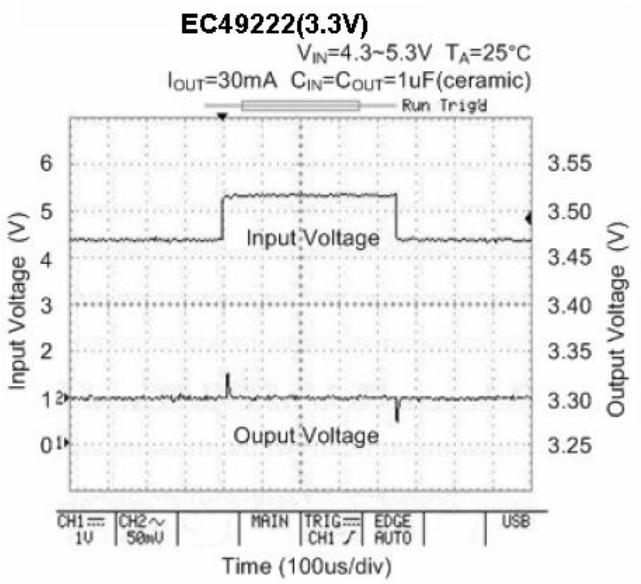


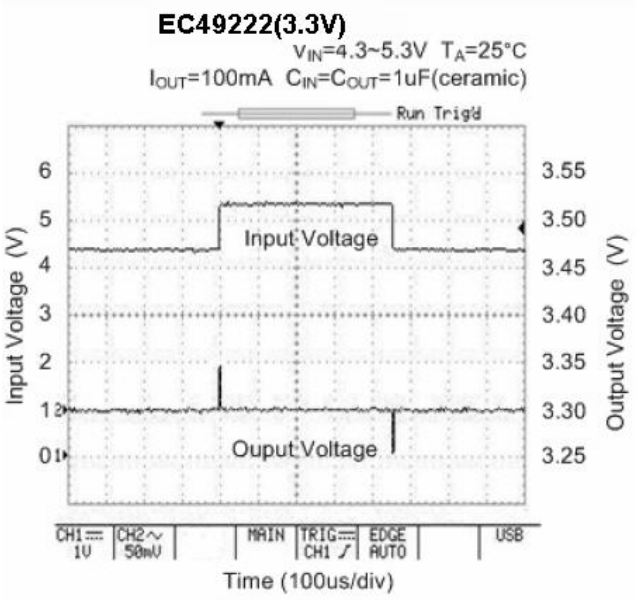


Typical Performance Characteristics (Continued)

(8) Input Transient Response (Continued)

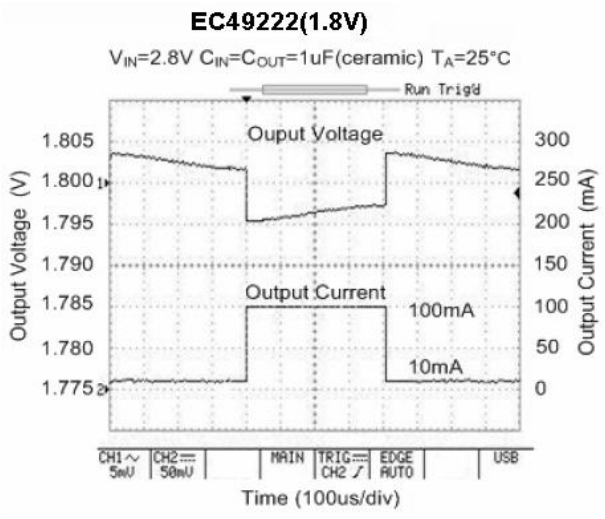


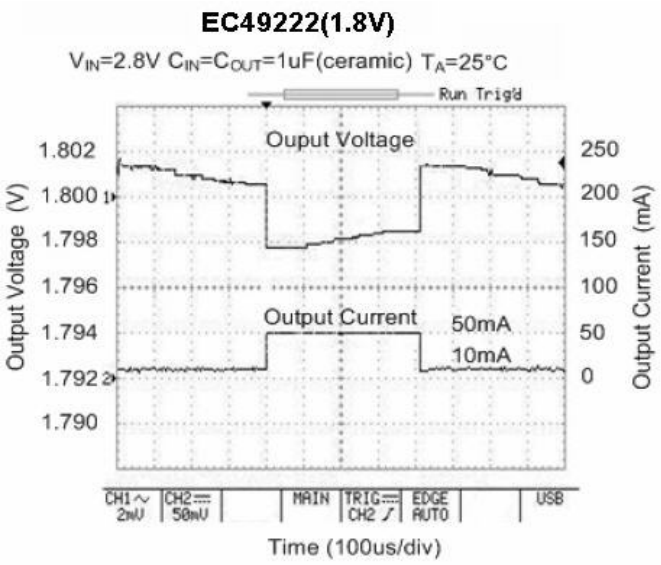


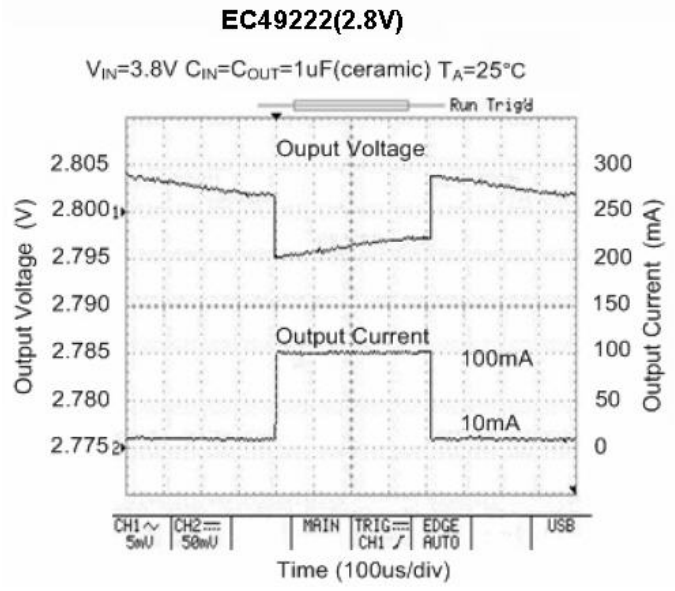


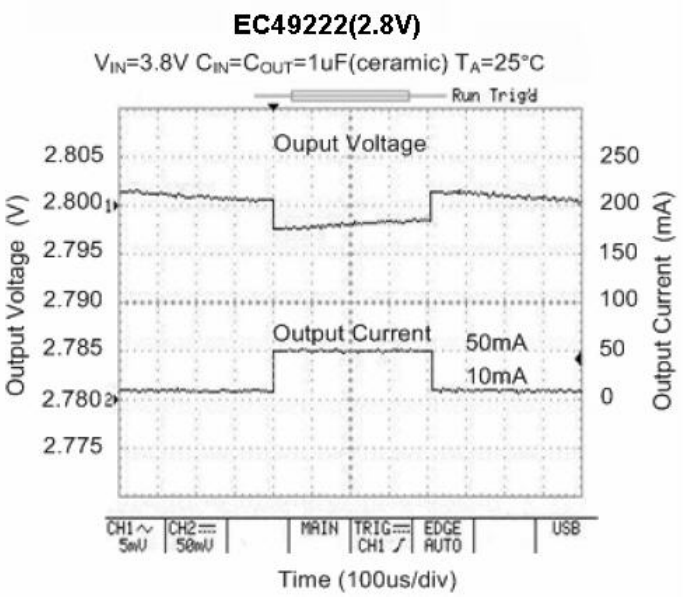
Typical Performance Characteristics (Continued)

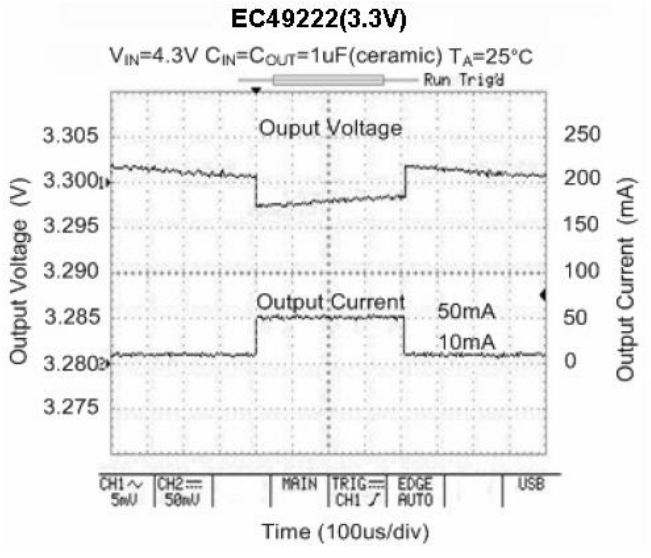
(9) Load Transient Response

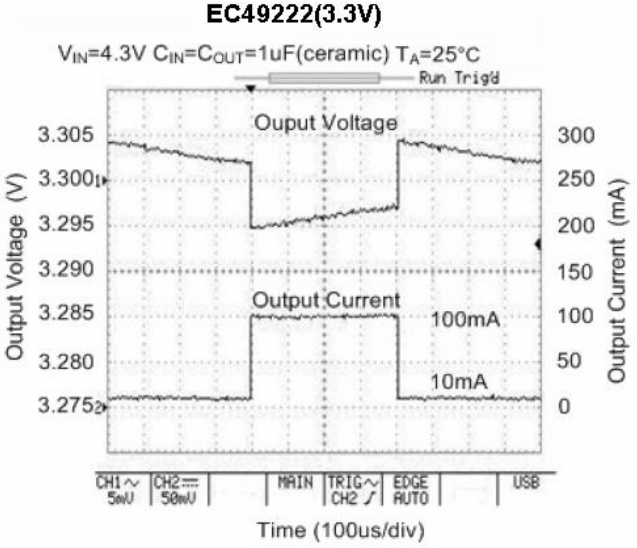






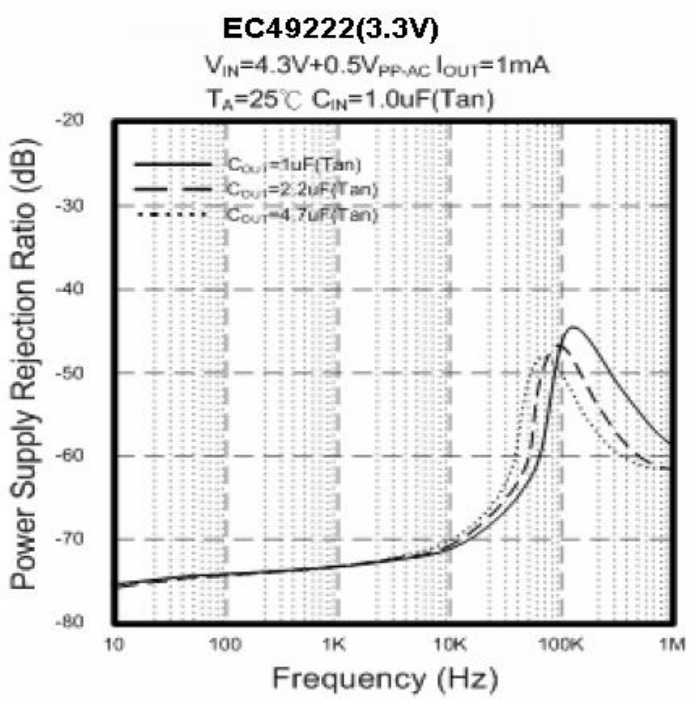


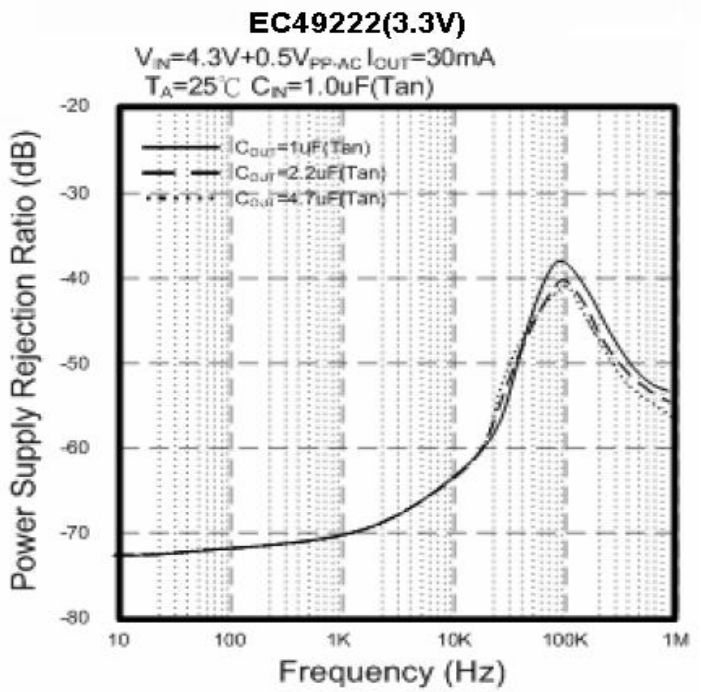




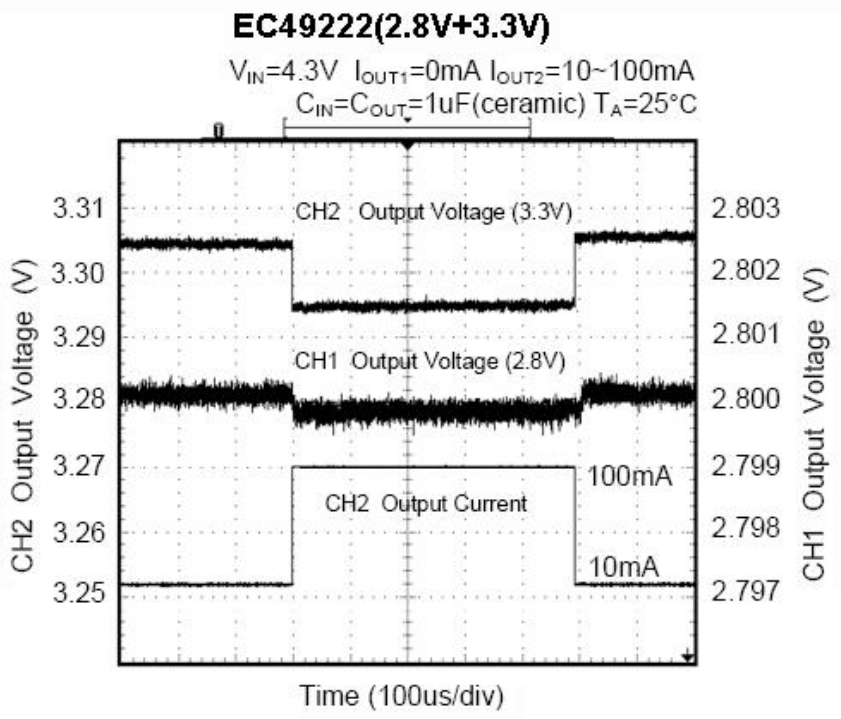
Typical Performance Characteristics (Continued)

(10) Power Supply Rejection

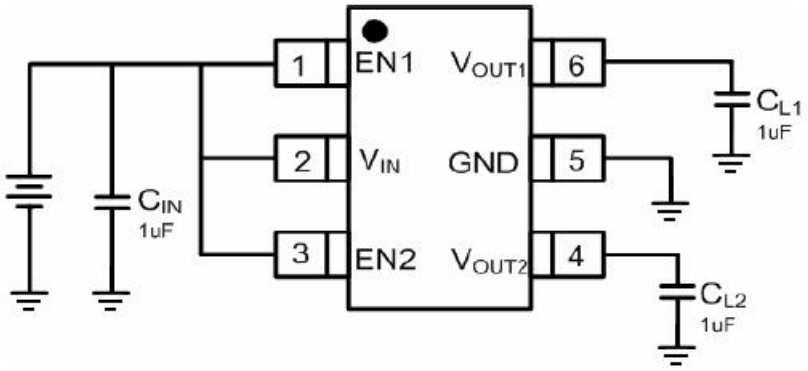




(11) Cross Talk



Simplified Application Circuit



Detail Description

The EC49222 series are highly accurate, dual, low noise, CMOS LDO voltage regulators with enable function. The output voltage for each regulator is set independently by metal trimming. It's also available to offer other types of V_{OUT} between +1.2V~+3.9V except the options shown on ordering information. As illustrated in function block diagram, it consists of a reference, error amplifier, a P-channel pass transistor, an ON/OFF control logic and an internal feedback voltage divider.

The band gap reference is connected to the error amplifier, which compares the 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 VOUT 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 VOUT pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

Internal P-channel Pass Transistor

Each channel of EC49222 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 EC49222 does not suffer from these problems and consumes only 8μA (Typ.) per channel of current consumption under heavy loads as well a in dropout conditions.

Enable Function

EN1 and EN2 pin start and stop the corresponding outputs independently. 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.

Current Limit

Each channel of EC49222 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 with in 350 mA.

Thermal Overload Protection

Thermal overload protection limits total power dissipation of EC49222. 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 40°C, resulting in a pulsed output during continuous thermal overload conditions.

Thermal overload protection is designed to protect the EC49222 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 EC49222 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 EC49222 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 SOT23-6L package of EC49222 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”.

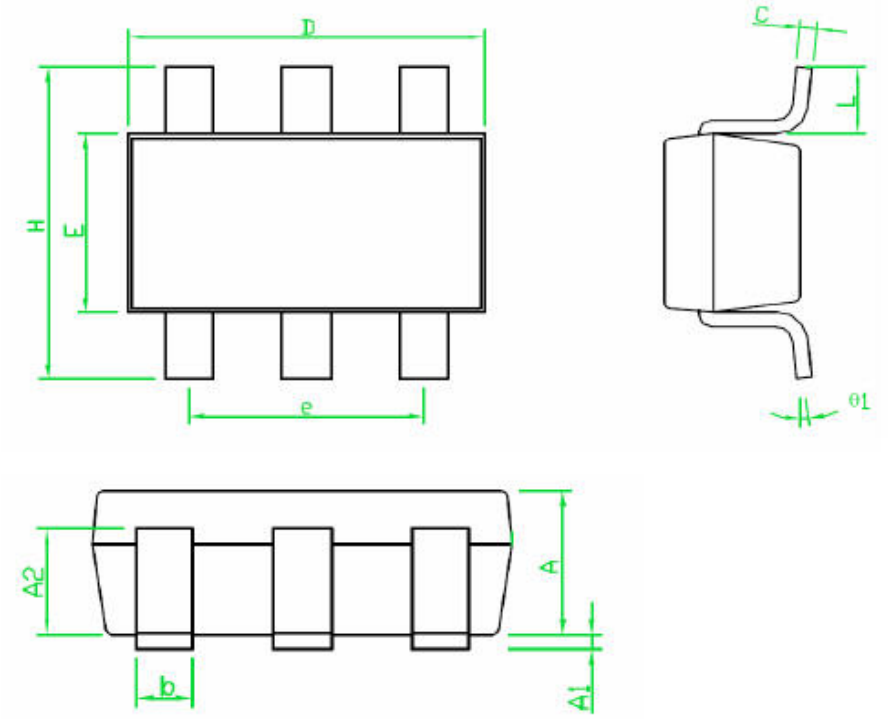
Dropout Voltage

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 EC49222 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

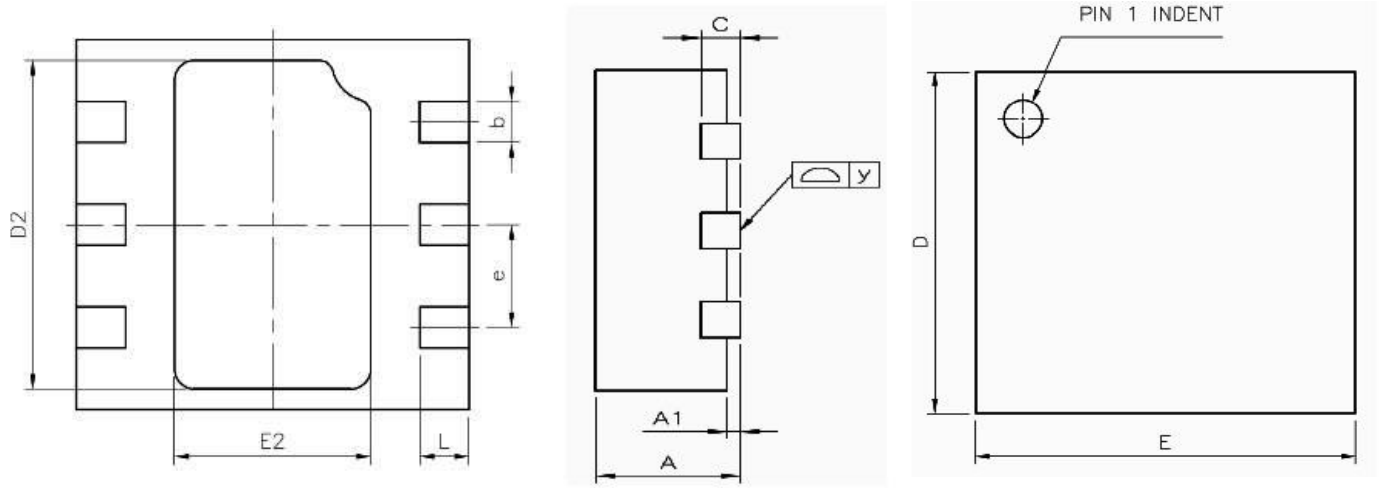
OUTLINE DRAWING SOT23-6L



SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	1.00	1.10	1.30
A1	0.00	---	0.10
A2	0.70	0.80	0.90
b	0.35	0.40	0.50
C	0.10	0.15	0.25
D	2.70	2.90	3.10
E	1.40	1.60	1.80
e	---	1.90(TYP)	---
H	2.60	2.80	3.00
L	0.37	---	---
θ1	1°	5°	9°

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