40V,2.5μA IQ,200mA Low-Dropout Linear Voltage Regulator

Description

The FC6240 series is a high voltage，ultralow-power，low dropout voltage regulator. The device can deliver 200mA output current with a dropout voltage of 450mV@100mA and allows an input voltage as high as 40V. The typical quiescent current is only 2μA. The device is available in fixed output voltages of1.5,1.8,2.5,2.8,3.0,3.3,3.6 and 5.0V.The device features integrated short-circuit and thermal shutdown protection.Although designed primarily as fixed voltage regulators, the device can be used with external components to obtain variable voltages.

Features

- Wide Input Voltage Range: 2.5V to 40V
- Low Power Consumption: 2.5 μA (Typ)
- Maximum Output Current: 200mA
- Low Dropout Voltage:
- V_{DROP} = 450mV @I_{OUT} = 100mA (Typ.)
- High PSRR: 80dB @1kHz
- Output Voltage Accurate: ± 1%
- Excellent Line/Load Regulation
- Good Transient Response
- Integrated Short-Circuit Protection
- Over-Temperature Protection
- Output Current Limit
- Low Temperature Coefficient
- Stable with Ceramic Capacitor
- RoHS Compliant and Lead (Pb) Free
- -40°C to +85°C Operating Temperature Range
- Fixed Output Voltage Versions: 1.5,1.8,2.5,2.8,3.0,3.3,3.6 and 5.0V
- Available in Green SOT23-3, SOT23-5, SOT89-3 Packages

Applications

- Powering MCUs and CAN/LIN transceivers
- Battery-powered equipment
- EV and HEV battery management systems
- Portable, Battery Powered Equipment
- Car Audio/Video Equipmen
- Body control modules

Application Circuits

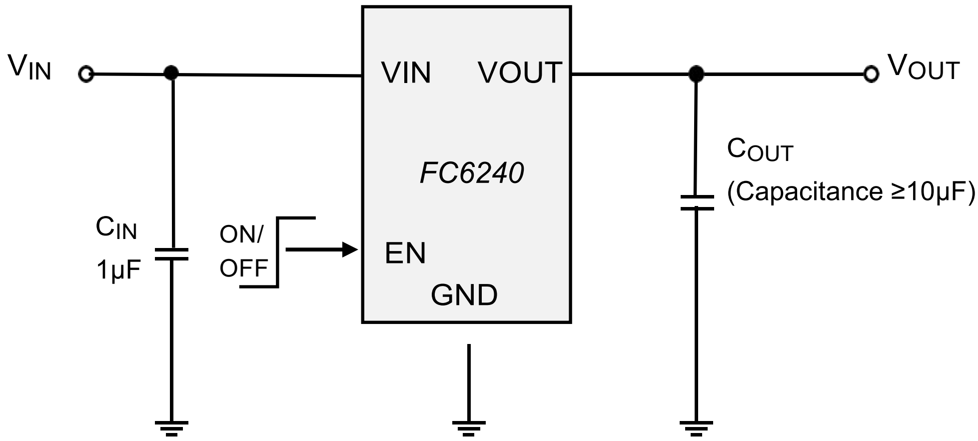
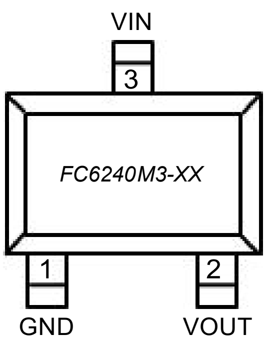
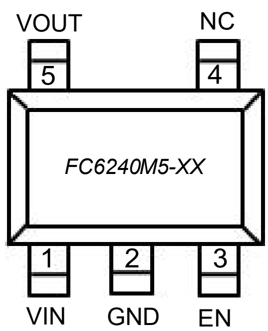


Figure 1. FC6240 Typical Application Circuit

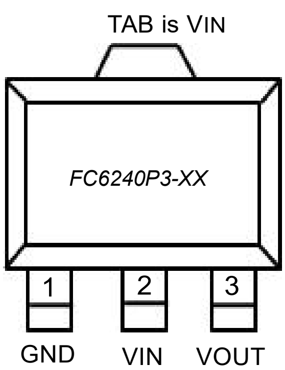
Pin Configuration (TOP VIEW)



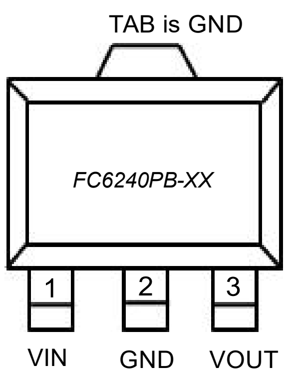
SOT23-3



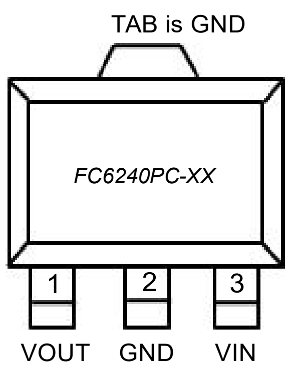
SOT23-5



SOT89-3



SOT89-3(B-Type)



SOT89-3(C-Type)

Pin Description

<table>
<tr><th colspan="5">Pin No.</th><th rowspan="3">Pin Name</th><th rowspan="3">Pin Function</th></tr>
<tr><td>SOT23-3</td><td>SOT23-5</td><td colspan="3">SOT89-3</td></tr>
<tr><td>M3</td><td>M5</td><td>P3</td><td>PB</td><td>PC</td></tr>
<tr><td>1</td><td>2</td><td>1</td><td>2</td><td>2</td><td>GND</td><td>Ground</td></tr>
<tr><td>3</td><td>1</td><td>2</td><td>1</td><td>3</td><td>VIN</td><td>Power Input</td></tr>
<tr><td>2</td><td>5</td><td>3</td><td>3</td><td>1</td><td>VOUT</td><td>Output Voltage</td></tr>
<tr><td>/</td><td>3</td><td>/</td><td>/</td><td>/</td><td>EN</td><td>Chip Enable Control Input</td></tr>
<tr><td>/</td><td>4</td><td>/</td><td>/</td><td>/</td><td>NC</td><td>No Internal Connection.</td></tr>
<tr><td>TAB</td><td colspan="6">In PCB layout, prefer to use large copper area to cover this pad for better thermal dissipation</td></tr>
</table>

Order Information

FC6240①②-③④

Designator	Symbol	Description
①②	M3 , M5 , P3 , PB , PC	SOT23-3, SOT23-5, SOT89-3, SOT89-3B, SOT89-3C
③④	Integer e.g 1.8=18	Output Voltage 1.5,1.8,2.5,2.8,3.0,3.3,3.6 and 5.0V.

<table>
<tr><th>Part NO.</th><th>Description</th><th>Package</th><th>T/R Qty</th></tr>
<tr><td>FC6240M3-XX</td><td rowspan="5">FC6240
40V,2.5μA IQ,200mA Low-Dropout
Linear Voltage Regulator</td><td>SOT23-3</td><td>3,000 PCS</td></tr>
<tr><td>FC6240M5-XX</td><td>SOT23-5</td><td>3,000 PCS</td></tr>
<tr><td>FC6240P3-XX</td><td>SOT89-3</td><td>1,000 PCS</td></tr>
<tr><td>FC6240PB-XX</td><td>SOT89-3(B-Type)</td><td>1,000 PCS</td></tr>
<tr><td>FC6240PC-XX</td><td>SOT89-3(C-Type)</td><td>1,000 PCS</td></tr>
</table>

Marking Information

For marking information, contact our sales representative directly

Absolute Maximum Ratings

Item		Symbol	Rating	Unit
Supply Input Voltage		V_{IN}	-0.3 ~ 45	V
V_{OUT} to V_{IN}		V_{OUT} _ V_{IN}	-15 ~ -0.3	V
EN to GND		V_{EN}	-0.3 ~ 45	V
Regulated Output Voltage		V_{OUT}	-0.3 ~ 6.0	V
Output Current		I_{OUT}	Internally limited	mA
Power Dissipation P_D @T_A=+25℃	SOT23-3	P_D	500	mW
	SOT23-5		500	
	SOT89-3		750	
	SOT89-3(B-Type)		1250	
	SOT89-3(C-Type)		1250	
Thermal Resistance (Junction to air)	SOT23-3	θ_{JA}	250	°C /W
	SOT23-5		250	
	SOT89-3		165	
	SOT89-3(B-Type)		100	
	SOT89-3(C-Type)		100	
Human Body Model (HBM)		±4000		V
Charged Device Mode (CDM)		±2000		V
Machine Mode (MM)		200		V
Storage Temperature Range		T_{STG}	-65 ~ +150	°C
Operating Junction Temperature		T_J	+150	°C
Lead Temperature (Soldering 10s)		T_{LEAD}	+260	°C

Note：

1、Stresses beyond those 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 conditions is not implied. Exposure to absolute-maximum-rated conditions for extended period may affect device reliability.

2、Ratings apply to ambient temperature at +25°C

3、The package thermal impedance is calculated in accordance to JESD 51-7.

Recommended Operating Conditions

Item	Min	Max	Unit
Operating Ambient Temperature	-40	+85	°C
Input Voltage	2.5	40	V
Output Voltage	1.5	5.0	V

Electronic Characteristics

Test Conditions: V_{IN} = V_{OUT} +2V,C_{IN}=1uF,C_{OUT} =10uF,T_A=25℃,unless otherwise specifi

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage	——	2.5	——	40	V
I_Q	Quiescent Current	V_{IN} = 12V, No Load	—	2.5	4	μA
V_{OUT}	Output Voltage	V_{IN} = 12V I_{OUT} = 1mA	V_{OUT} x 0.99	——	V_{OUT} x 1.01	V
I_{OUT}	Output Current	——	——	200	——	mA
V_{DROP}	Dropout Voltage	I_{OUT} = 100mA V_{OUT} =1.8V	——	700	——	mV
		I_{OUT} = 100mA V_{OUT} = 3.3V	——	450	——	mV
		I_{OUT} = 350mA V_{OUT} = 5.0V	——	360	——	mV
ΔV_{LOAD}	Load Regulation	V_{IN} = 12V 1mA ≤ I_{OUT} ≤ 150mA	——	0.02	0.025	%/mA
ΔV_{LINE}	Line Regulation	V_{OUTNOM} + 1V ≤ V_{IN} ≤ 40V I_{OUT} = 1mA	——	0.01	0.02	%/V
I_{LIMIT}	Current Limit	——	——	300	——	mA
T_{OTSD}	Thermal Shutdown Temperature	——	——	+165	——	°C
T_{HYOTSD}	Thermal Shutdown Hysteresis	——	——	+15	——	°C
PSRR	Power Supply Rejection Ratio	V_{IN} = 5V, I_{OUT} = 10mA V_{OUT} = 3.3V @1kHz	——	81	——	dB
Von	Output Noise Voltage	C_{OUT} =10uF, I_{OUT} =30mA BW = 10Hz~100kHz	—	100	—	μVrms

Note : All limits specified at room temperature (TA = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

Functional Block Diagram

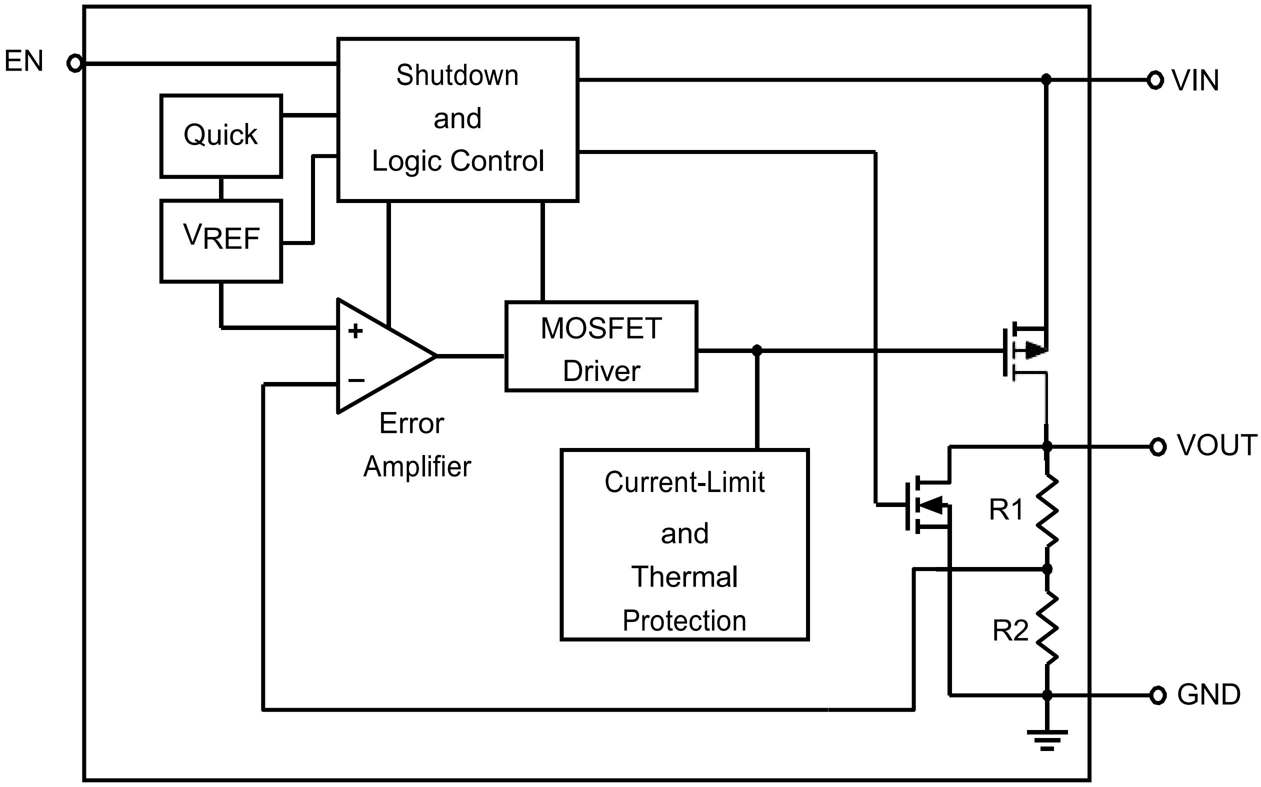


Figure 2. FC6240 Block Diagram

Typical Performance Characteristics

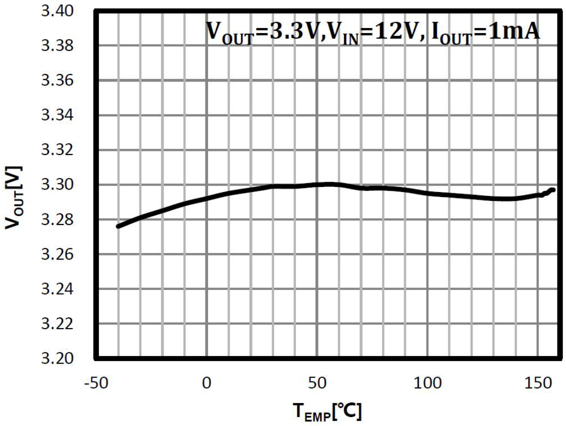


Figure 1. V_{OUT} vs Temperature

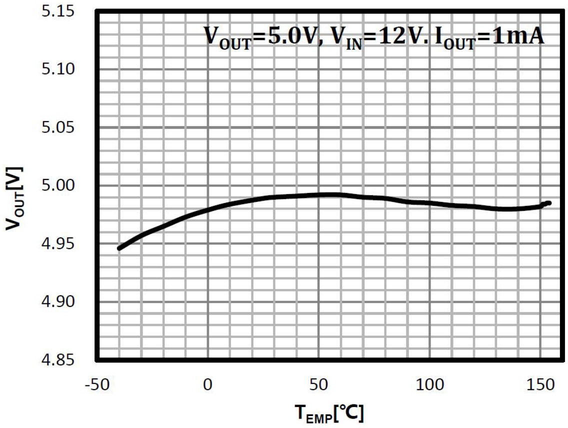


Figure 2. V_{OUT} vs Temperature

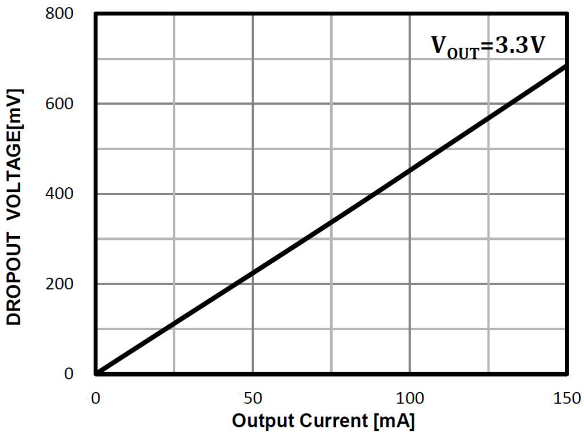


Figure 3. Dropout Voltage vs Output Current

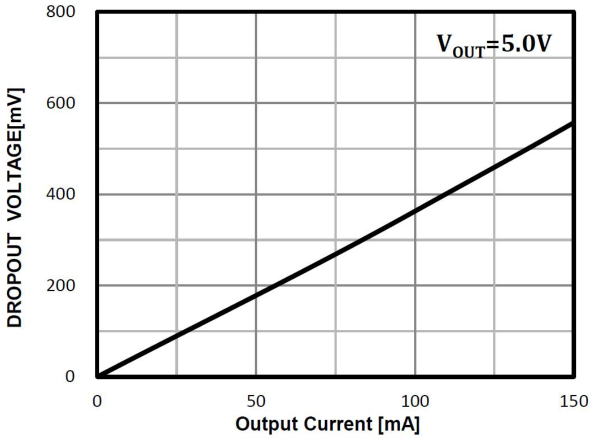


Figure 4. Dropout Voltage vs Output Current

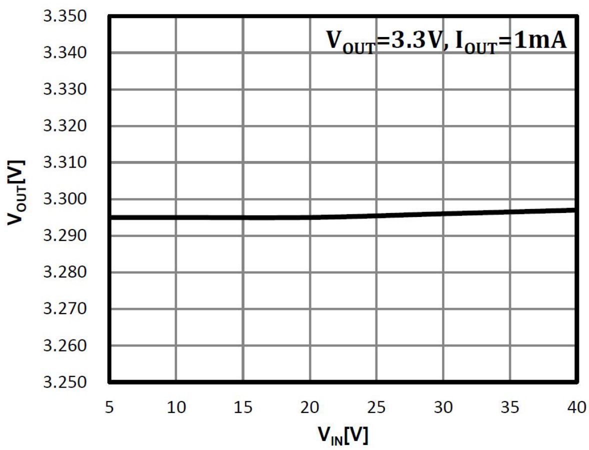


Figure 5. Line Regulation vs V_{IN}

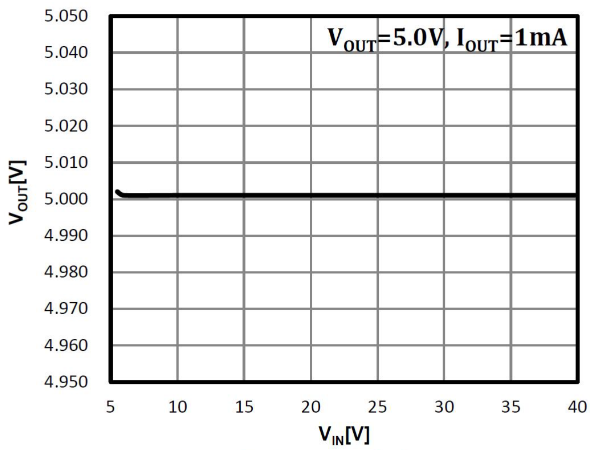


Figure 6. Line Regulation vs V_{IN}

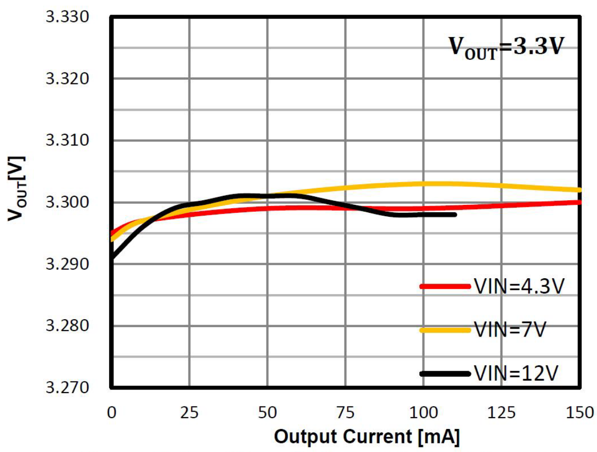


Figure 7. Load Regulation vs Output Current

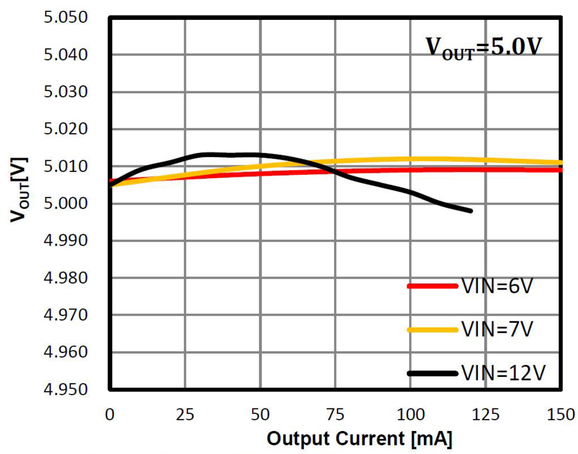
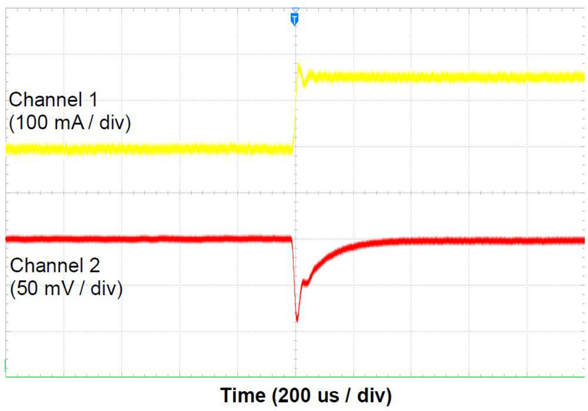
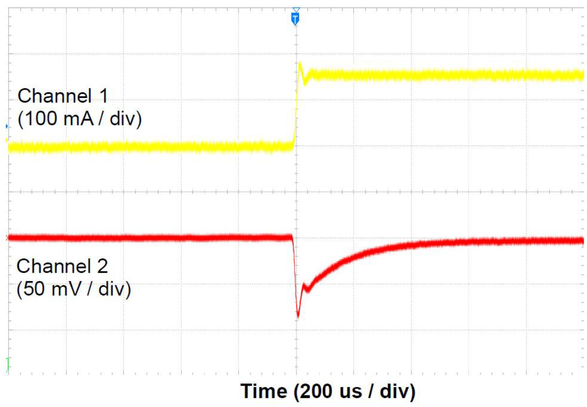


Figure 8. Load Regulation vs Output Current



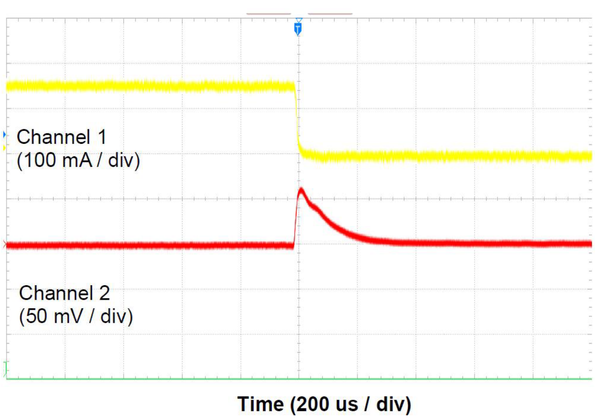
Channel 1 = I_{OUT}, channel 2 =V_{OUT}, V_{IN}=4.3 V, V_{OUT}=3.3V

Figure 9. Load Transient (1 mA to 150 mA)



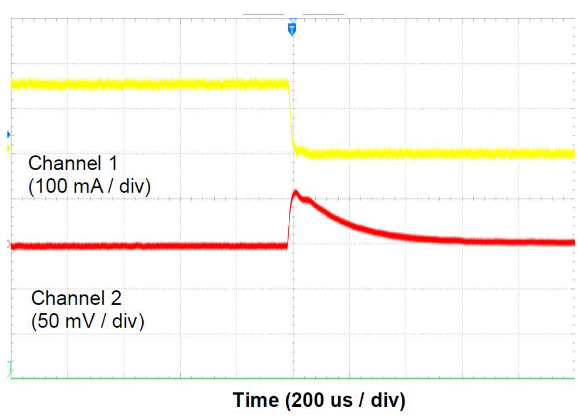
Channel 1 = I_{OUT}, channel 2 =V_{OUT}, V_{IN}=6.0V, V_{OUT}=5.0V

Figure 10. Load Transient (1 mA to 150 mA)



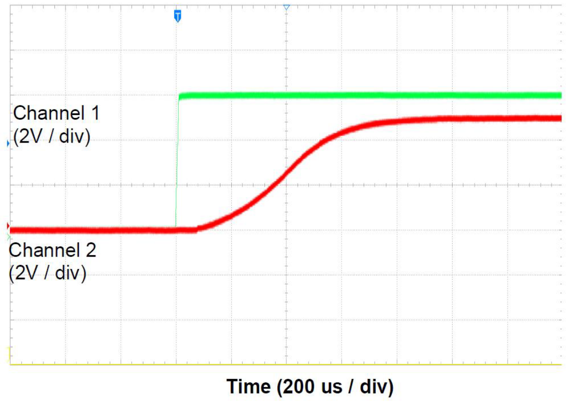
Channel 1 = I_{OUT}, channel 2 =V_{OUT}, V_{IN}=4.3V, V_{OUT}=3.3V

Figure 11. Load Transient (150 mA to 1 mA)



Channel 1 = I_{OUT}, channel 2 =V_{OUT}, V_{IN}=6.0V, V_{OUT}=5.0V

Figure 12. Load Transient (150 mA to 1 mA)



Channel 1 = En, channel 2 = V_{OUT}, V_{IN}=6.0V, V_{OUT}=5.0V, I_{OUT}=10mA

Figure 13. Power-Up with Enable

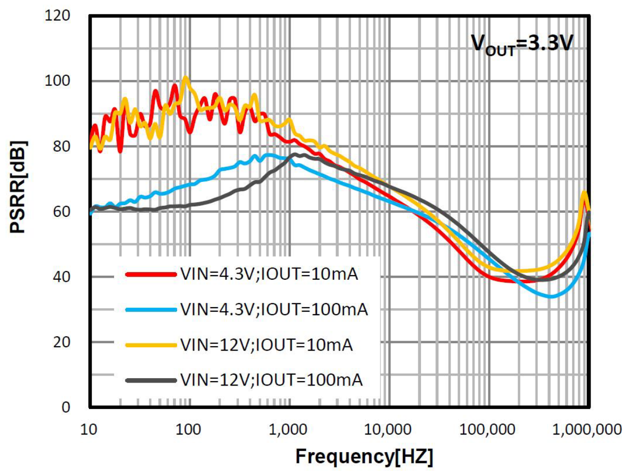


Figure 14. PSRR vs Frequency

Application Guideline

■ Input Capacitor

A ⩾ 1μF ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

■ Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is ⩾10μF, ceramic capacitor is recommended, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to VOUT and GND pins.

■ Dropout Voltage

The dropout voltage refers to the voltage difference between the VIN and VOUT pins while operating at specific output current. The dropout voltage V_{DROP} also can be expressed as the voltage drop on the pass-FET at specific output current (I_{RATED}) while the pass-FET is fully operating at ohmic region and the pass-FET can be characterized asan resistance RDS(ON). Thus the dropout voltage can bedefined as ($V_{DROP} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{RATED}$). Fornormal operation, the suggested LDO operating range is (V_{IN} >

$V_{OUT} + V_{DROP}$) for good transient response and PSRR ability. Vice versa, while operating at the ohmic region will degrade the performance severely.

■ Thermal Application

For continuous operation, do not exceed the absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated as below:

T_A=25°C, DEMO PCB,

The max $P_D = (Tj - T_A) / \theta_{JA}$.

Power dissipation (P_D) is equal to the product of the output current and the voltage drop across the output pass element, as shown in the equation below:

$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$

■ Layout Consideration

By placing input and output capacitors on the same side of the PCB as the LDO, and placing them as close as is practical to the package can achieve the best performance. The ground connections for input and output capacitors must be back to the FC6240 ground pin using as wide and as short of a copper trace as is practical.Connections using long trace lengths, narrow trace widths, and/or connections through via must be avoided. These add parasitic inductances and resistance that results in worse performance especially during transient conditions.