FMLDC0604A1V2AXH Thru FMLDC0604A3V3AXH

List

FMLDC0604A1V2AXH Thru FMLDC0604A3V3AXH

400mA Low Voltage Difference CMOS Voltage Regulators

Features

- Input voltage range : 1.0V ~ 6.0V.
- Fixed output voltage : Available from 0.6V to 5.5V.
- Output voltage tolerance : ±15mV for V_{OUT} < 1.2V ±1% for V_{OUT} ≥ 1.2V.
- Output current : Up to 400mA for V_{OUT} > 1.0V.
- Low quiescent current : 5.0μA (Typ.).
- Dropout voltage : 100mV@100mA (V_{OUT} = 3.0V).
- Power supply rejection ratio : 65dB@1kHz
- Excellent transient response
- Anti-overshoot during hot-swap
- Integrated fault protection : Fold-back current limit short-circuit protection.

Applications

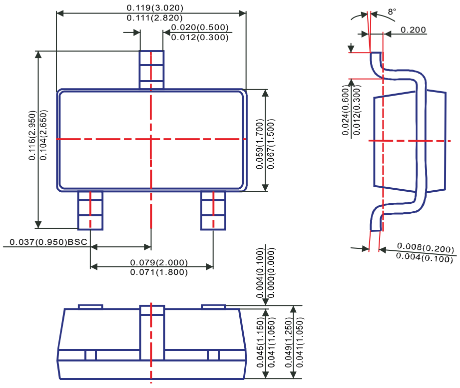
- Battery-powered equipments.
- Cellular and Smart Phones.
- Digital Still and Video Cameras.
- Laptop, Palmtop and PDA.
- MP3, MP4 Player.
- Radio control systems.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant.
- Case : SOT-23-3.
- Weight : Approximated 10mg.

Package outline

SOT-23-3



Dimensions in inches and (millimeters)

Maximum ratings (T_A=25℃, unless otherwise specified) (Note 1)

Parameter	Symbol	Ratings	Unit
Input voltage (Note2)	V_{IN}	-0.3 ~ 7.0	V
Enable input voltage range (Note2)	V_{EN}	-0.3 ~ V_{IN} + 0.3	V
Output voltage (Note2)	V_{OUT}	-0.3 ~ V_{IN}+0.3	V
Reference Power dissipation (Note3)	P_D	380	mW
Electrostatic discharge (Note 4)	$V_{ESD-HBM}$	2	KV
Thermal resistance, junction to ambient (Note5)	$R_{\theta JA}$	260	℃/W
Thermal resistance, junction to case (Note5)	$R_{\theta JC}$	65	℃/W
Operating junction temperature range	T_J	-40 to +125	℃
Storage temperature range	T_{STG}	-40 to +150	℃
Soldering temperature and time (10s)	T_{Solder}	+260	℃

Note:
(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to network ground terminal.
(3) Refer to Thermal Information for details.
(4)ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body model (HBM) electrostatic discharge test is based on the JESD22-A114D test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5kΩ.
(5)Thermal metric is measured in still air with T_A = 25°C and installed on a 1 in^2 FR-4 board covered with 2 ounces of copper.

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Electrical characteristics (V_{IN} = 2V or V_{OUT} +1V, which is better, C_{IN} = 1μF, C_{OUT} = 1μF, T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Input voltage	V_{IN}	T_A=25℃		1.0		6.0	V
DC Output voltage tolerance	$V_{OUT-TOL}$	I_{OUT}=1mA	V_{OUT}<1.2V	-15		15	mV
			V_{OUT}≥1.2V	-1		1	%
Output Current (Note 7)	I_{OUT}	V_{IN}=2V	V_{OUT}<1.0V	250			mA
		V_{IN}=V_{OUT}+1V	V_{OUT}≥1.0V	400			
Quiescent current	I_Q	I_{OUT}=0mA			5.0	10	μA
Dropout voltage (Note 8)	V_{DO}	V_{OUT}<1.0V	I_{OUT} =100mA		550		mV
		V_{OUT}>2.8V			100		
Line regulation (Note 9)	LNR	I_{OUT} =10mA, V_{IN} = V_{OUT} +1V to 6V			0.05	0.1	%/V
Load regulation	ΔV_{LOAD}	V_{IN}=2V, I_{OUT}=10 to 250mA	V_{OUT}<1.0 V		35		mV
		V_{IN}=V_{OUT}+1V, I_{OUT}=10 to 400mA	V_{OUT}≥1.0 V		35		
Temperature characteristics (Note 10)	TR	I_{OUT}=1mA, T_A=-40 to 85°C			65		ppm/°C
Output current limit	I_{Limit}	V_{IN}=2V	V_{OUT}<1.0V	320	380		mA
		V_{IN}=V_{OUT}+1V	V_{OUT}≥1.0V	450	600		
Short current	Ishort	OUT short to GND			40		mA
Power supply rejection ratio (Note 11)	PSRR	V_{OUT}=0.75V, V_{IN}=1.75V, I_{OUT}=50mA	f=100Hz		80		dB
			f=1kHz		80		
		V_{OUT}=3.0V, V_{IN}=4.3V, I_{OUT}=50mA	f=100Hz		65		
			f=1kHz		65		
Output noise voltage (Note 11)	V_N	I_{OUT}=10mA, BW= 10 to 100k Hz	V_{OUT}=0.75V		45		μV_{RMS}
			V_{OUT}=3.0V		100		
EN high	$V_{EN H}$			1.0		V_{IN}	V
EN low	$V_{EN Low}$					0.4	V
EN pin current	I_{EN}	V_{EN}=5V			0.04		μA
Standby current	I_{STBY}	EN=GND			0.02	0.6	μA
C_{OUT} auto-discharge resistance	$R_{Discharge}$	V_{IN}=5.0V, V_{OUT}=1.5V, EN=GND			480		Ω
Load transient (Note 11)	ΔV_{OUT}	I_{OUT}=1 to 400mA in 1μs, V_{OUT}=3.0V			-60		mV
		I_{OUT}=400 to 1mA in 1μs, V_{OUT}=3.0V			50		

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Note :

(6)Typical numbers are at 25°C and represent the most likely norm.

(7)Maximum output current is affected by the PCB layout, metal trace width, number of layers, ambient temperature and other environmental factors. Thermal limitations of the system must be carefully considered.

(8)Test the difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 98% of $_{VOUT}$ Normal.

(9)The line regulation is calculated by the following formula :

$$LNR = \frac{\Delta V_{OUT}}{V_{OUT} \times \Delta V_{IN}}$$

where, ΔV_{OUT} is the variation of the output voltage, ΔV_{IN} is the variation of the input voltage.

(10)The output voltage temperature characteristics (TR) is calculated by the following formula:

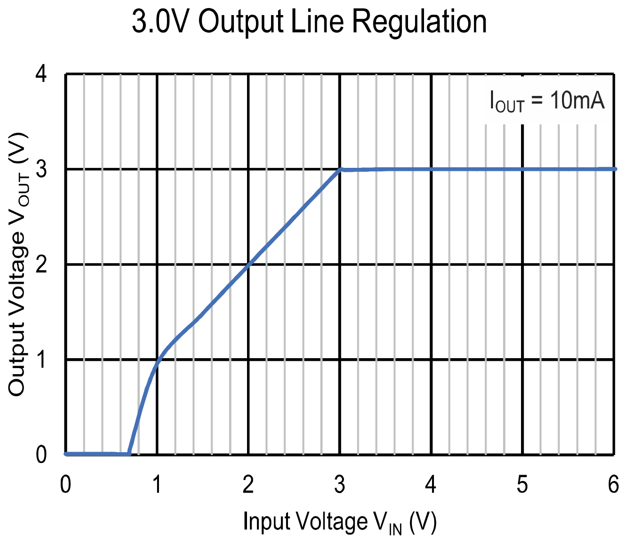
$$TR = \frac{\Delta V_{OUT}}{V_{OUT} \times \Delta T}$$

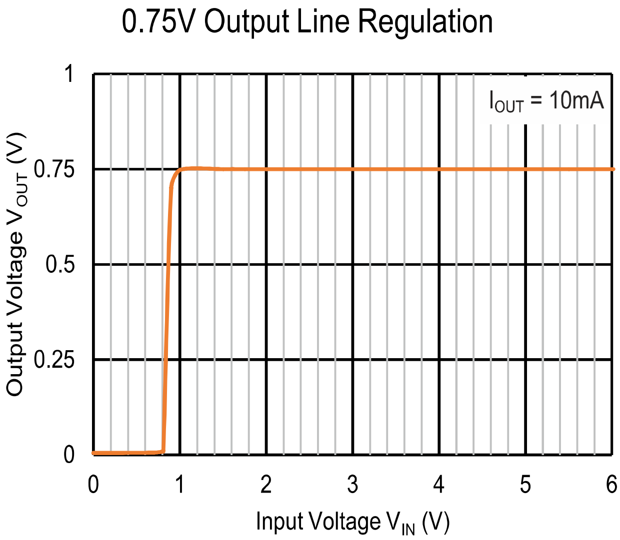
where, ΔV_{OUT} is the variation of the output voltage, ΔT is the variation of the ambient temperature.

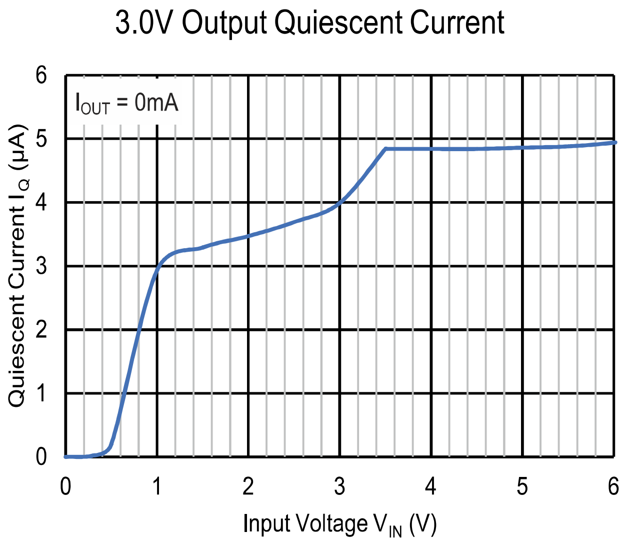
(11) Guaranteed by design, not subject to production testing.

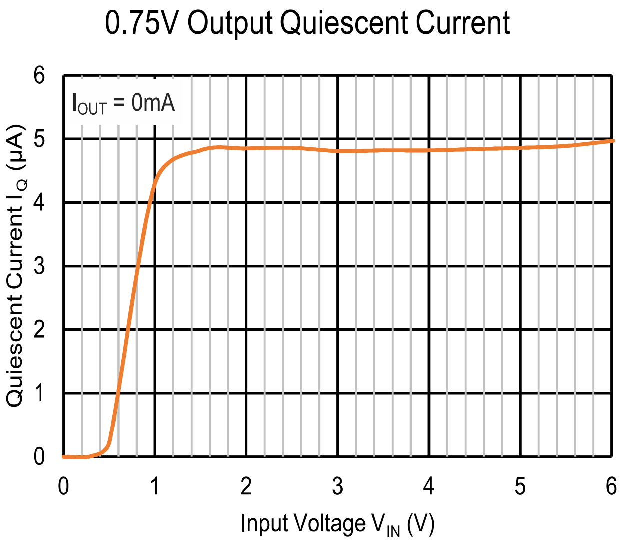
Typical characteristics

(V_{IN} = 2V or V_{OUT} +1V, which is better, C_{IN} = 1μF, C_{OUT} = 1μF, T_A = 25°C, unless otherwise specified)









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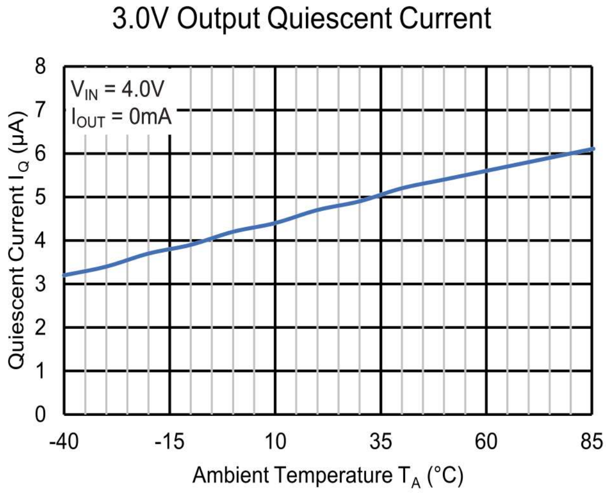
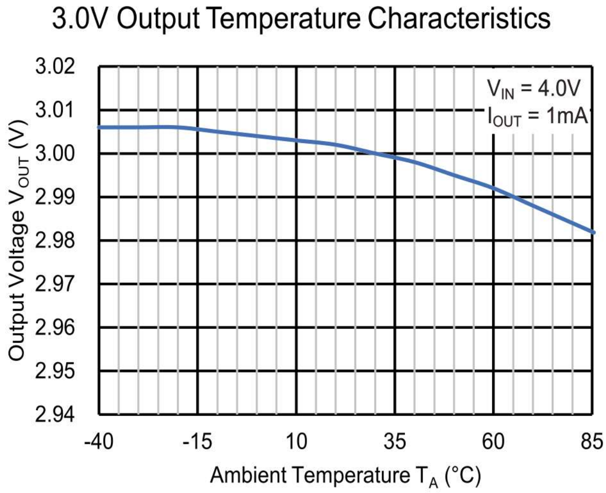
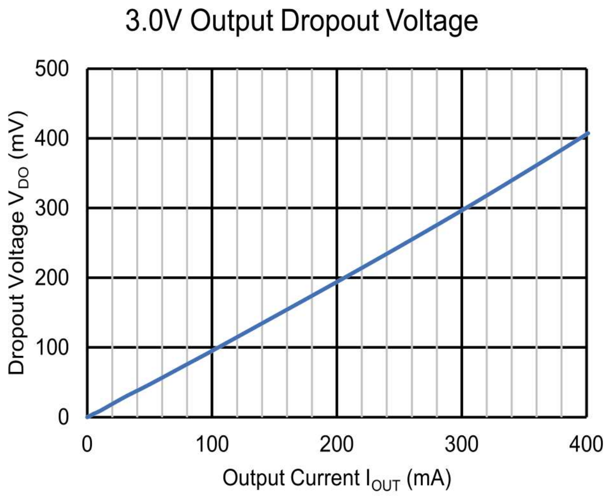
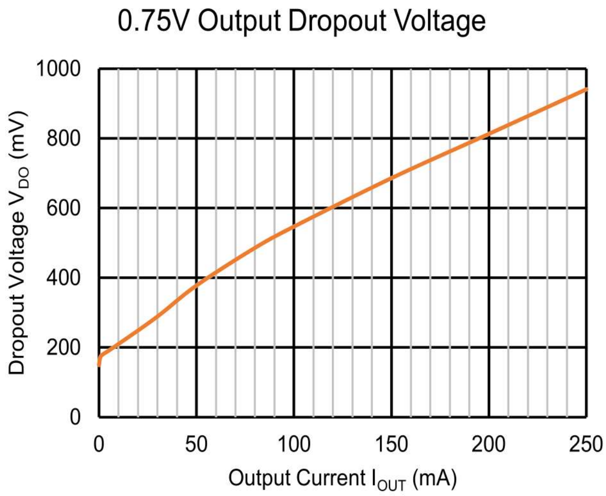
Typical characteristics (Continued)

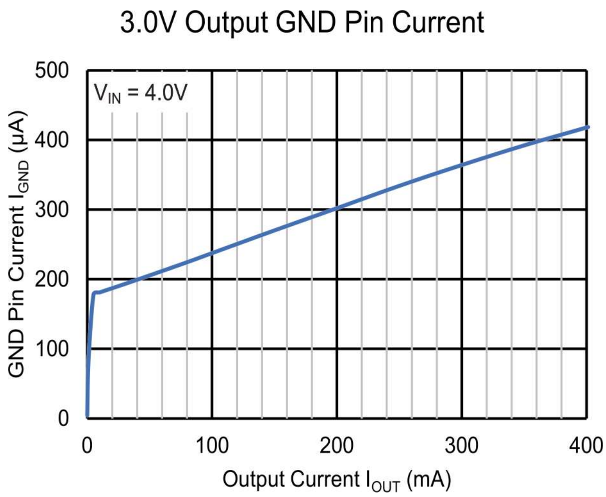
(V_{IN} = 2V or V_{OUT} +1V, which is better, C_{IN} = 1μF, C_{OUT} = 1μF, T_A = 25°C, unless otherwise specified)

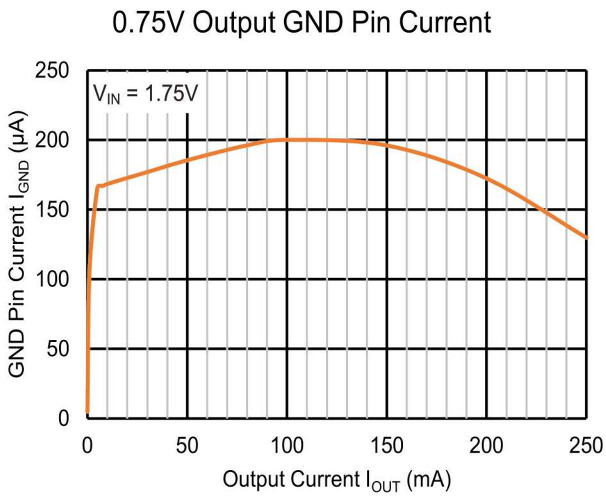












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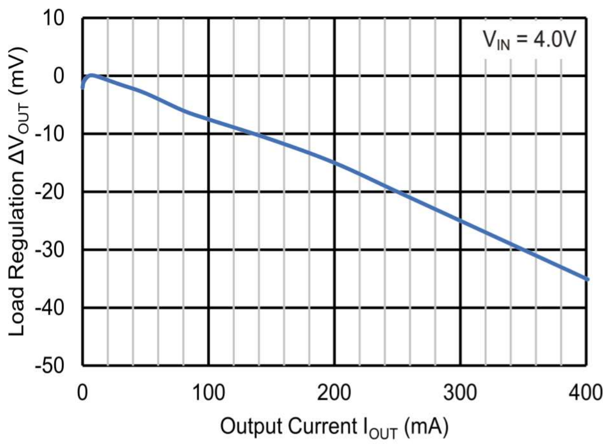
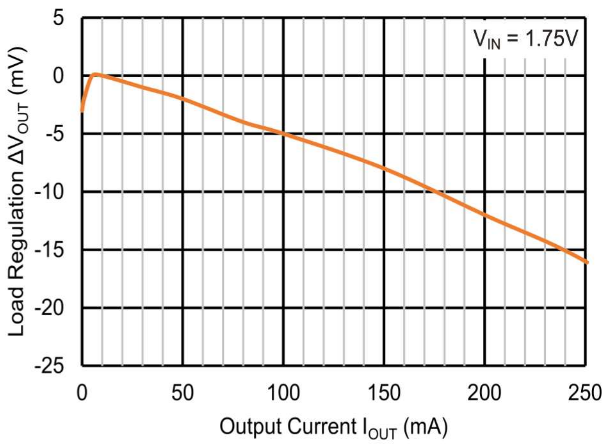
Typical characteristics (Continued)

(V_{IN} = 2V or V_{OUT} +1V, which is better, C_{IN} = 1µF, C_{OUT} = 1µF, T_A = 25°C, unless otherwise specified)

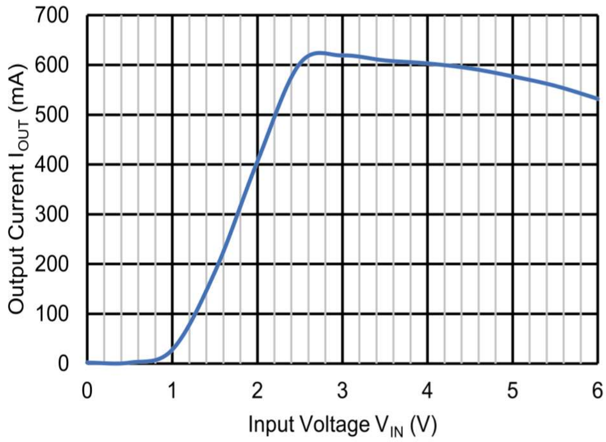
3.0V Output Load Regulation



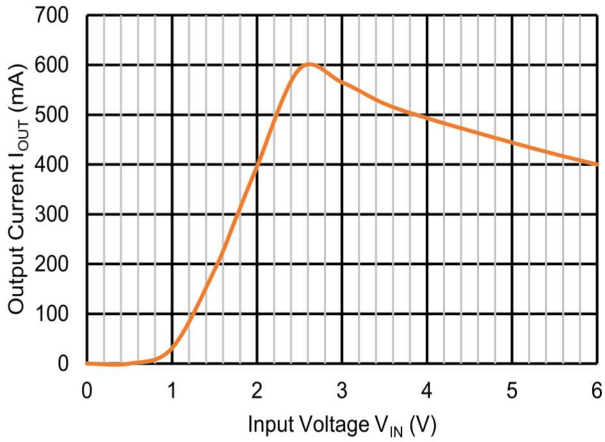
0.75V Output Load Regulation



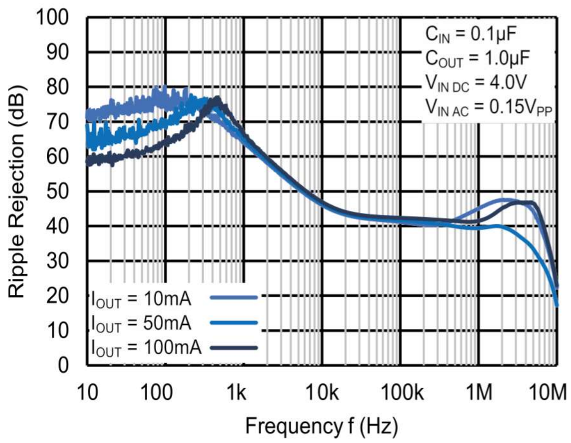
3.0V Output Current Limit



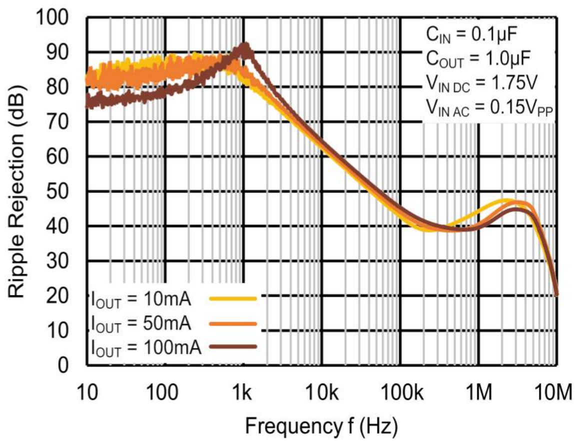
0.75V Output Current Limit



3.0V Output Ripple Rejection



0.75V Output Ripple Rejection



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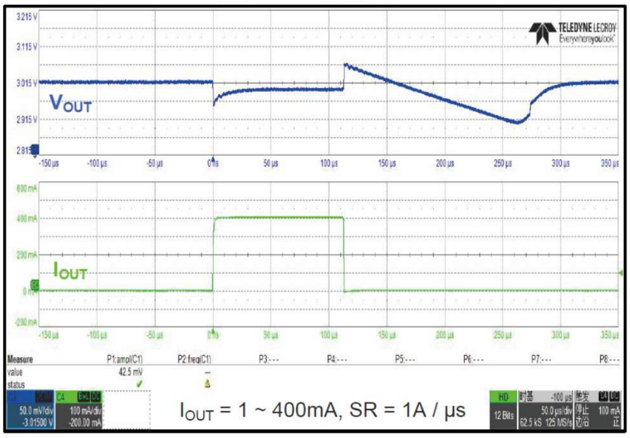
Typical characteristics (continued)

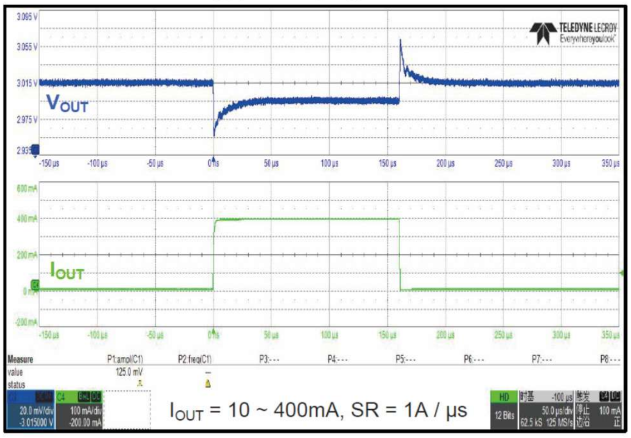
(V_{IN} = 2V or V_{OUT} +1V, which is better, C_{IN} = 1μF, C_{OUT} = 1μF, T_A = 25°C , unless otherwise specified)

Load Transient (V_{EN} = V_{IN})

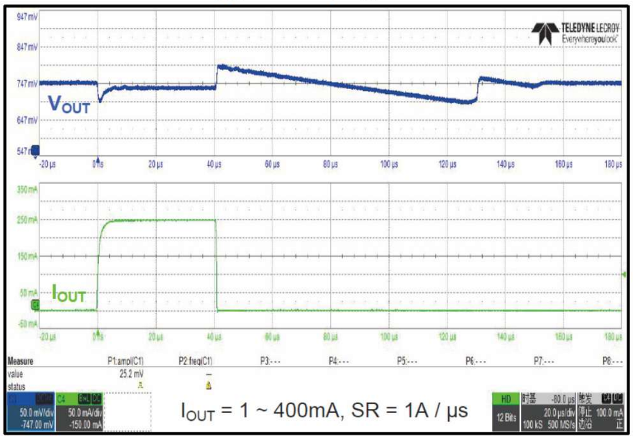
V_{OUT} = 3.0V, V_{IN} = 4.0V



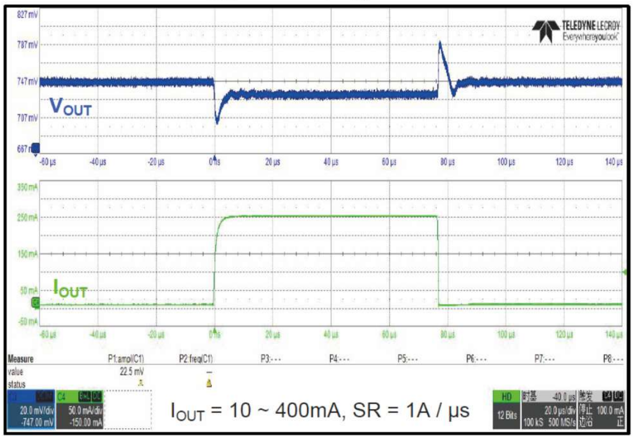
V_{OUT} = 3.0V, V_{IN} = 4.0V



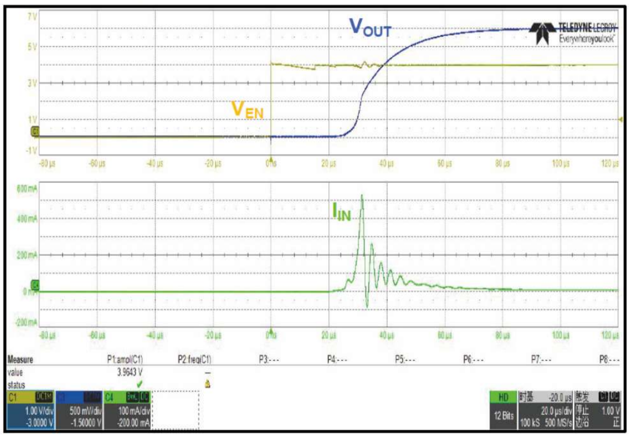
V_{OUT} = 0.75V, V_{IN} = 1.8V



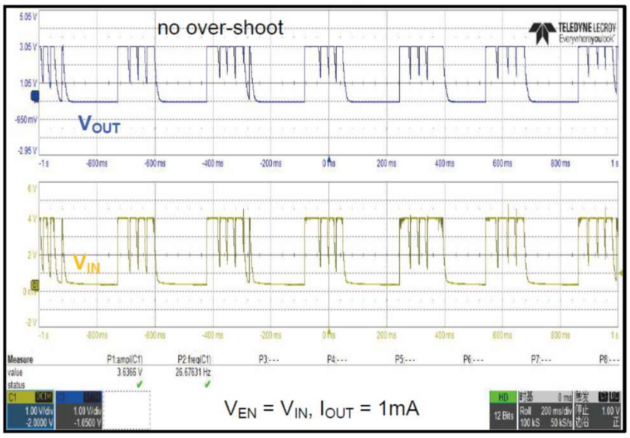
V_{OUT} = 0.75V, V_{IN} = 1.8V



EN High (V_{OUT} = 3.0V, V_{IN} = 4.0V, V_{EN} = 0 ~ 4.0V)



Continuous Power-up Response

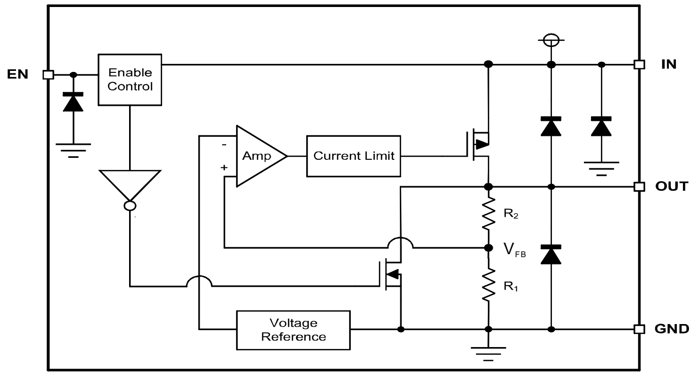


Detailed Description

1. Description

The FMLDC0604A series is a group of 6V, low-power consumption, low-dropout linear regulators (LDOs). The FMLDC0604A series supports a fixed voltage output of 0.6V to 5.5V, which allows it to use fewer external components to provide better accuracy. The CJ6206E series has low quiescent current, low output noise, and fast response. It integrates current limiting, short circuit protection internally. Therefore, the CJ6206E series is an ideal choice for battery power or line power applications.

2. Functional block diagram



The internal feedback resistors R_1 and R_2 form a voltage divider circuit to compare the V_{FB} input error amplifier with the efference voltage. The internal regulator tube (PMOS) will control its conduction degree through the grid voltage provided by the error amplifier output, which will make the output voltage V_{OUT} not affected by temperature changes or input voltage changes to a certain extent, thus maintaining the stability of the device output voltage.

Power Supply Input

When the input voltage is lower than the rated range of the data sheet, the device will lose the regulation function of stabilizing the output voltage, that is, it is unable to maintain the output voltage within the rated range. At this time, compared with normal operation, the transient response performance may be seriously degraded. When the input voltage is higher than the rated range of the data sheet, the device may cause irreversible damage or failure due to exceeding the maximum rated range of electrical stress. For the rated input voltage of the device, see Recommended Operating Conditions and Dropout Voltage.

Output Current

When the circuit design is appropriate, the FMLDC0604A series can reach the maximum load capacity of at least 400mA ($V_{OUT} \geq$ 1.0V). According to the power dissipation of the package and the effective connection thermal resistance with the environment, selecting the appropriate package for the circuit design can make the device emit more heat energy.

Output Current Limit & Short Circuit Protection

The FMLDC0604A series has an internal current limiting circuit, which can protect the device by limiting the load current value in case of instantaneous high load current. When the current limiting is triggered, the output voltage is not regulated. If the out pin of the regulator is short circuited, the internal current limiting circuit will be triggered, the output current of the device will maintain at a relatively small value to protect the device. The typical value of short current I_{Short} can be found in Electrical Characteristics. The current limiting state will continue until the load current drops to the normal range. When the load current of the device is large, the device will generate more heat due to the increase of power consumption. In order to ensure the normal operation of current limit, the inductance of input and load shall be minimized. Continuous operation under current limit is not recommended. The current limit mode of the FMLDC0604A series is fold-back current limit. Please refer to the Fold-back Current Limit for more details.

Dropout Voltage

Dropout voltage V_{DO} refers to the minimum voltage difference between input and output V_{IN} - V_{OUT} to make the device output voltage reach the rated range at rated current. When the dropout voltage condition required by the device is reached, the internal MOSFET will be fully turned on, at this time, the MOSFET is equivalent to a switch for regulation. The V_{DO} increases with the increase of load current. Since V_{IN} - V_{OUT} must be no less than the V_{DO}, the V_{DO} indirectly specifies the minimum input voltage of devices under different load current conditions. If the V_{IN} - V_{OUT} is less than the V_{DO}, the performance of the device may deteriorate (see Operation in Dropout Mode for details).

Detailed Description (Continued)

Enable Control

The enable pin of the device EN is active at high level. When the voltage of the EN is greater than the EN logic high voltage V_{ENH}, the device will be enabled and maintain the normal output. When the voltage of the EN is lower than the EN logic low voltage V_{ENL}, the internal circuit of the device will be disabled and the output will be turned off, the device will be in the standby mode until EN is turned to high level again. The V_{ENH} and V_{ENL} can be found in the Electrical Characteristics.Normal startup waveform and startup slope rate control can be ensured when the device starts from any low voltage lower than V_{ENL}, but the discharge time of output capacitor must be taken into account. EN can be float, when the EN is floating, it will be pulled down to ground internally. If EN is not required to control the output voltage independently, it's recommend to connect EN to IN.

Auto-discharge Function

The device with enable control has an auto-discharge circuit. When the enable control is turned off, the device will be disabled. An internally integrated pull-down MOSFET (see Functional Block Diagram) will connect a resistor $R_{Discharge}$ to the ground to release the charge in the output capacitor, thus closing the entire device circuit. The value of $R_{Discharge}$ can be found in the Electrical Characteristics. The discharge time of the output capacitor after the device is disabled is determined by the output capacitance C_{OUT} and load resistance R_L in parallel with the $R_{Discharge}$. The time constant τ can be calculated by the following formula:

$$\tau = C \times R_{Discharge} \quad (R_L = 0)$$

$$\tau = C \times \left(\frac{R_L \times R_{Discharge}}{R_L + R_{Discharge}}\right) \ (R_L \neq 0)$$

The output voltage after discharging through pull-down MOSFET can be calculated by the following formula:

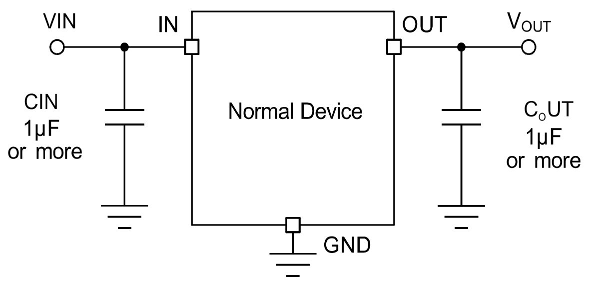
$$V = V_{OUT} \times e^{-\frac{t}{\tau}}$$

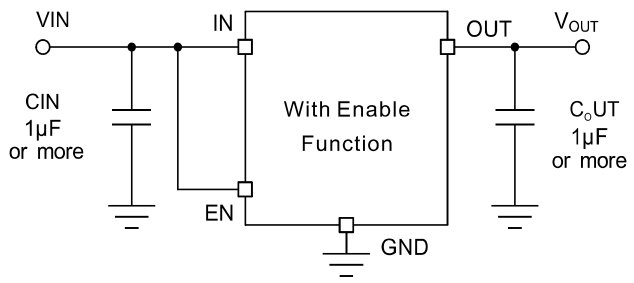
$$t = \tau \times \ln(\frac{V}{V_{OUT}})$$

Where, V is the output voltage after discharge, V_{OUT} is the output voltage, t is the discharge time, τ is the discharge time constant. Do not rely on the active discharge circuit to release a large amount of output capacitance after the input power supply crashes, because the reverse current can flow from the output to the input. This reverse current may damage the device. The limiting reverse current shall not exceed 5% of the rated current of the device.

Application and Implementation

1. Typical application circuits





2. Application information

Selection of Bypass Capacitances

For the FMLDC0604A series, it is recommended to use 1μF input C_{IN} and output C_{OUT} ceramic capacitors.

Type of Capacitors:

Since any leakage of the capacitor will increase the quiescent power consumption of the whole circuit, attention should be paid to selecting capacitors with low leakage. When designing the circuit of portable equipment including CJ6206E series, due to the shortage of tantalum capacitors, it is a good choice to use small size, low equivalent series resistance (ESR) and high RMS current capacity multilayer ceramic capacitors (MLCC) in the DC to DC voltage conversion. The designer must choose the appropriate capacitor type for circuit design: X7R- Ceramic capacitors of X5R- and COG- rated dielectric materials can provide relatively good capacitance stability within the temperature range, Y5V- type capacitors are not recommended because of large changes in capacitance values. However, no matter which type of ceramic capacitor is selected, the effective capacitance may vary with the operating voltage and temperature. The designer must consider the influence of the change of the effective value of capacitance according to the circuit design and application conditions.

Application and Implementation (Continued)

2. Application information (Continued)

Selection of Bypass Capacitances (Continued)

Input Capacitors C_{IN}:

It is recommended to use a 1μF capacitor at the input pin of the device, and the position of the input capacitor should be as close to the device input pin as possible. For the FMLDC0604A series, the input capacitor is not necessary to maintain the output stability, but it can offset the reactive input source and improve the transient response, input ripple and PSRR performance of the device. It should be noted that although many types of capacitors can be used for input bypass, using ceramic capacitors for input filtering may cause problems. Due to the self-resonance and high Q characteristics of some types of ceramic capacitors, under certain starting conditions, applying voltage steps to ceramic capacitors may lead to large current surges (such as directly connecting the input pin of LDO to the power supply), which may cause some energy stored in the parasitic inductance of the power lead. When the stored energy is transferred from these inductors to ceramic capacitors, large voltage spikes may occur in the circuit. These voltage spikes are easily twice the step amplitude of the input voltage, and are likely to bring potential risks to the normal operation and reliability of the device. Therefore, the selection of ceramic capacitors as input capacitors must be careful. Adding 3Ω resistors and X5R- type ceramic capacitors will minimize voltage transients during startup. A higher value capacitor may be necessary if large, fast rise time load or line transients are anticipated or if the device is located several inches from the input power source.

Output Capacitors C_{OUT} :

Recommended 1μF output ceramic capacitor to keep the device output stable, and the capacitor position should be as close to the device pin as possible. For FMLDC0604A series, the device needs an output capacitor to achieve loop stability. As with any regulator, a larger output capacitance reduces the peaks during a load transient but slows down the response time of the device. The proper capacitor can help to obtain better dynamic performance.

Transient response :

Transient response refers to the change of system output from initial state to stable state under the action of typical signal input. For LDO, the designer should pay attention to the possible impact of linear transient response and load transient response on the system: linear transient response refers to the transient response of output to change when the input voltage changes, while load transient response refers to the transient response of output to change when the output current changes. The specific phenomenon is that the output voltage of the device will have a short spike, especially when the input voltage or output current changes greatly in a short time. This change is not only related to the performance of the chip itself, but also related to the change of output current, change rate and output capacitance:

1. When the output current increases, the output voltage of the device will decrease to a certain extent, and the larger output current will provide a higher current discharge path for the output capacitor, which will affect the peak value generated by the transient spike and reduce the peak value;
2. The output current or input voltage changes relatively slowly, and the output change of the device is relatively small, affecting the spike caused by the change;
3. The use of large input and output capacitors can reduce the spike caused by transient response to a certain extent to improve the transient performance, but large output capacitors can also affect the response time of devices.

For the selection of bypass capacitance value, refer to the Section of Bypass Capacitances selection.

Operation in Dropout Mode

The FMLDC05503A series is internally integrated with a P-MOSFET to achieve low dropout voltage. The voltage difference between the input and the output V_{IN} - V_{OUT} of the device must not be lower than the corresponding dropout voltage V_{DO} to ensure that the output voltage tolerance is within the rated range of the data sheet. The dropout voltage will increase with the increase of load current. When the V_{IN} - V_{OUT} is less than the V_{DO}, the P-MOSFET inside the device is in a linear state, the resistance from the input pin to the output pin is equal to the resistance from the drain to the source of the P-MOSFET, and the device functions like a resistor. When operating in this state, the response time of the error amplifier inside the device will be limited, which will seriously degrade the transient performance of the device, when the external circuit has a transient change, the deviation of the output voltage will become larger than the normal operating state. In addition, the PSRR and noise performance of the device will be worse than that under normal operating conditions.

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Application and Implementation (Continued)

Application Information (continued)

Fold-back Current Limit

The FMLDC05503A series adopts the fold-back current limit. The following is some application information of the fold-back current limit.

Current Limit Type:

Current limit can impose certain restrictions on the current value provided by the device. Compared with the so- called "brick-wall" current limiting mode, the significant difference of the fold-back current limit is that overload and short circuit are obviously different. Figure 9-1 and Figure 9-2 show the typical operating characteristics of these two current limiting mechanisms.

1. Operating characteristic curve R1 represents the curve of linear resistance as load under normal working condition;
2. When the linear resistance as the load gradually decreases and causes the device to enter the overload state, the operating characteristic curve is shown in R2;
3. When the linear resistance decreases to 0Ω, the device will enter the short-circuit state, and the operating characteristic curve is shown in R3.

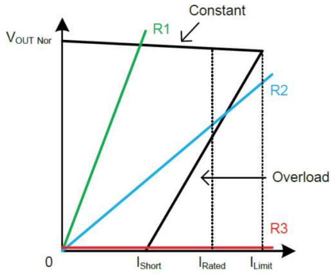


Figure 9-1. Fold-back Current Limit

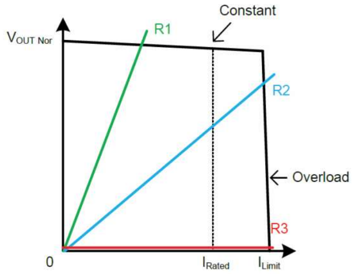


Figure 9-2. Brick-wall Current Limit

After entering the short circuit state, the short-circuit current of the "brick-wall" type current limiting mechanism is limited to I_{Limit}, and the reliability and stability of the voltage regulator may be affected due to the large amount of heat generated during the short circuit, while the I_{Short} of fold-back current limit in the short circuit state is far lower than I_{Limit}, which can reduce the heat energy generated due to power dissipation during the device short circuit. The fold-back current limit allows the device to limit the short circuit current to a small current value without losing the rated range of output current. This is very important if continuous short circuit faults need to be solved. The current limiting mechanism limits the maximum load current of the device, and the internal transmission transistor of the device will not move outside its safe operation area (SOA) during operation. See Recommended Continuous Operating Areas for details.

Fold-back Current Limit (continued)

Usage and Precautions: When using the voltage regulator with the fold-back current limit, it should be noted that the device cannot be started normally under certain loads because the short-circuit current of the fold-back current limit is obviously different from the maximum load current. As shown in the curves S1 and S2 in Figure 9-3, the nonlinear load S1 is distributed in the range of the load curve region where the device can work, because the current provided by the device is always greater than the requirements of the load under all voltage conditions, the device can start normally, and the output will reach the ideal operating point P1; The situation of nonlinear load S2 is different, during actual startup, when the voltage and current are gradually rising, the output of S2 will be limited at P_2, because the device cannot provide more current under the voltage at P_2, which will make the output stuck at the intersection and maintain at this level, and the device cannot reach the ideal operating point P_3 for normal startup.

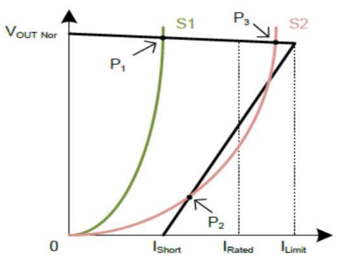


Figure 9-3. Nonlinear Load Example

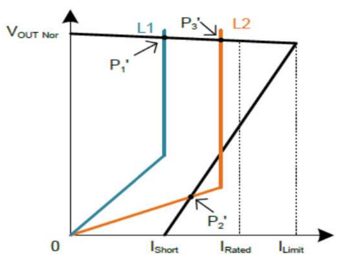


Figure 9-4. Active Load Profile

Application and Implementation (Continued)

In addition, many typical cases of actual loads have operating characteristics as shown in L1 and L2 curves in Figure 9-4. When the device starts from zero with L1 and L2 as loads, the load will behave as a linear resistance, and the load current will change to a constant value after reaching the inflection point voltage. Like nonlinear loads S1 and S2, when L1 is used as the load, the device can start normally and reach the ideal working point P_1', while when L2 is used as the load, the device cannot start normally, and the output will be stuck at P_2' and cannot reach the ideal working point P_3'. As an active load, the electronic load has the same operating characteristics as L1 and L2. Some problems may occur when using the electronic load to test the voltage regulator with a fold-back current limit. See Test Current Limit for more details. For the load with specific operating characteristics as shown in S2 and L2 curves, it is necessary to use a fold-back current limiting device with a higher I_{Short}, or a voltage stabilizing device with a "brick-wall" type current limiting.

Test Current Limit

The FMLDC0604A series uses the fold-back current limit. When testing this kind of linear voltage regulator with the fold- back current limit, it should be noted that using the electronic load that is very common in the laboratory as the load of the voltage regulator may cause some problems:

1. When the constant current mode (CC) is used for testing, when the load current is higher than the short circuit current (I_{short}), the device may not be able to start normally from 0V, because the CC mode of the electronic load has similar operating characteristics as the L2 curve described in the fold-back current limit. Moreover, in the CC mode, the internal circuit of the electronic load will try to pull down the output voltage below the ground. A feasible method is to start the device with no load first, and then switch to the required steady state current. A constant resistance (CR) load mode using an electronic load may help, but this may lead to the following other problems.
2. When using the CC mode of the electronic load to test the current limiting behavior, the negative feedback loop with constant internal control current of the electronic load will conflict with the current limiting loop of the device and may cause faults. When the CR mode is used for testing, the complex control loop inside the electronic load that keeps the load resistance constant will interact with the regulator and may oscillate at the output.

The above are some problems that may occur when using electronic load to test the voltage regulator. Using actual resistance as the load is a good solution. When testing the I_{Limit}, the variable resistor can be used as the load. First, set the resistance value of the variable resistor to be large enough so that the output current of the device under test at this time is significantly less than the current at full load, then gradually reduce the load resistance until the output voltage exceeds the specified range, and the load current at this time is the maximum load current. The specified range of output voltage depends on the range that the user thinks can be accepted and the current regulation rate of the voltage regulator. When some voltage regulators are in the fold-back current limit state, the output voltage drops rapidly. For these devices, the load current before the output voltage drops should be considered as the maximum load current. The measurement of short circuit current can be realized by shorting the output or connecting the load resistance of 0Ω. Compared with the electronic load, the variable resistor may not be so convenient, but the use of variable resistor for current limiting measurement is the only way to ensure that there is no bad interaction between the load and the voltage regulator. If it is necessary to measure the starting characteristics of the device, a variable resistor must be used.

Recommended Continuous Operating Areas

As an LDO, the working area of FMLDC0604A series is limited by dropout voltage, output current, junction temperature and input voltage under continuous working condition. The recommended areas for continuous operation are shown in Figure 9-5:

A. The LDO input and output voltage difference V_{IN} - V_{OUT} must meet the dropout voltage V_{DO} conditions. See Dropout Voltage for more details.

B. Rated output current range I_{Rated}.

C. The actual junction temperature T_J of LDO shall not exceed the rated junction temperature. The product of voltage difference and current at both ends of LDO is power consumption, which determines the actual working junction temperature of LDO, so the curve is not linear.

Application and Implementation (Continued)

Recommended Continuous Operating Areas (Continued)

In addition, the working area of FMLDC0604A series is limited by the rated $VI_{N\,MIN}$ and $V_{IN\,MAX}$.

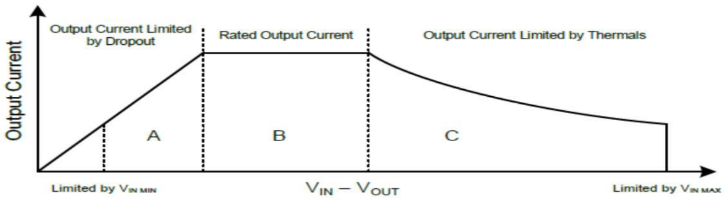


Figure 9-5. Region Description for Continuous Operation

Power Supply Recommendation

The FMLDC0604A series is designed to operate within the input power supply voltage range of 1.0V to 6.0V. The input power supply should be well adjusted and have low noise. If the input power supply has high noise, it is recommended to use an additional bypass capacitor at the input to improve the output noise performance of the device. It is recommended to use an input capacitor of 1μF or higher to reduce the impedance of the input power supply, especially during transients.

Layout Guidelines

When designing the circuit including FMLDC0604A series, the following matters should be noted:

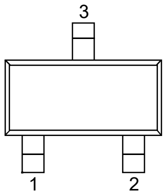
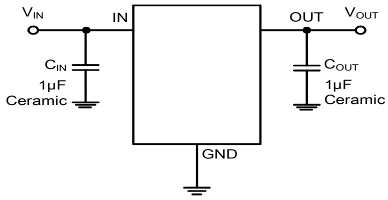
1. Place the input and output capacitors as close to the pins of the device as possible;
2. The device is connected by copper plane and the heat sink (or back pad) of the device is fully welded with PCB to obtain better heat dissipation performance and lower on resistance;
3. Heat sink holes are placed around the device to help the circuit dissipate more heat energy. However, attention should be paid to the position of the heat sink holes to prevent the solder (or solder paste) on the IC pad from being absorbed by the heat sink holes and being damaged during welding.

Orderable information

Part No.	Output voltage (V)
FMLDC0604A1V2AXH	1.2
FMLDC0604A1V8AXH	1.8
FMLDC0604A2V5AXH	2.5
FMLDC0604A2V8AXH	2.8
FMLDC0604A3V0AXH	3.0
FMLDC0604A3V3AXH	3.3

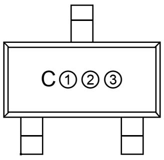
FMLDC0604A1V2AXH Thru FMLDC0604A3V3AXH

Pinning information

Pin	Simplified outline	Symbol
Pin 1 GND Pin 2 OUT Pin 3 IN		

1. GND : Regulator ground.
2. OUT : Output of the regulator. An output capacitor is required for stability and help device obtain the best transient response. Use the capacitor with the recommended value and place it as close as possible to the output.
3. IN : Input to the device. Use the recommended value of the input capacitor and place it as close to the input of the device as possible to reduce the impedance of the input supply.

Marking

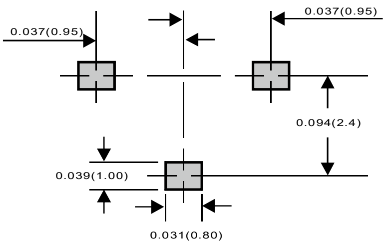


	Marking code	Description
①	B D E F G I	FMLDC0604A1V2AXH FMLDC0604A1V8AXH FMLDC0604A2V5AXH FMLDC0604A2V8AXH FMLDC0604A3V0AXH FMLDC0604A3V3AXH
②③	XX	Code, indicates weekly record information of wafer lot code

X : Represents any character.

Suggested solder pad layout

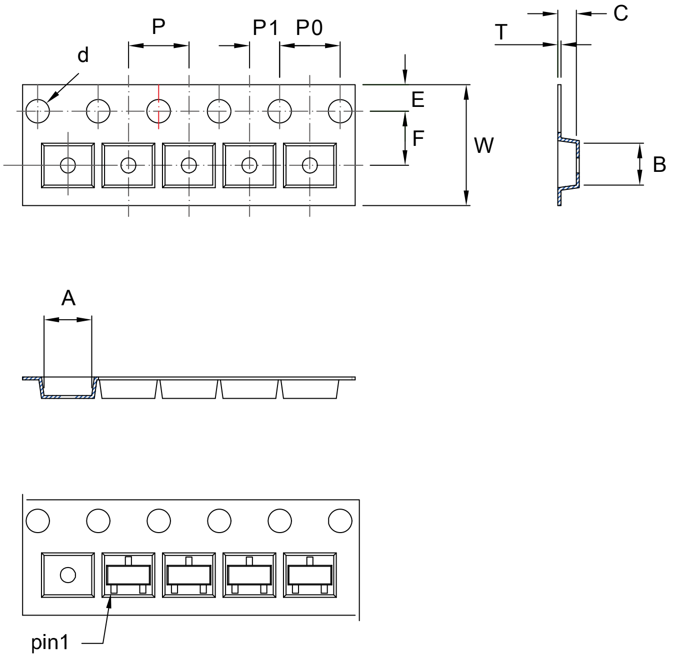
SOT-23-3

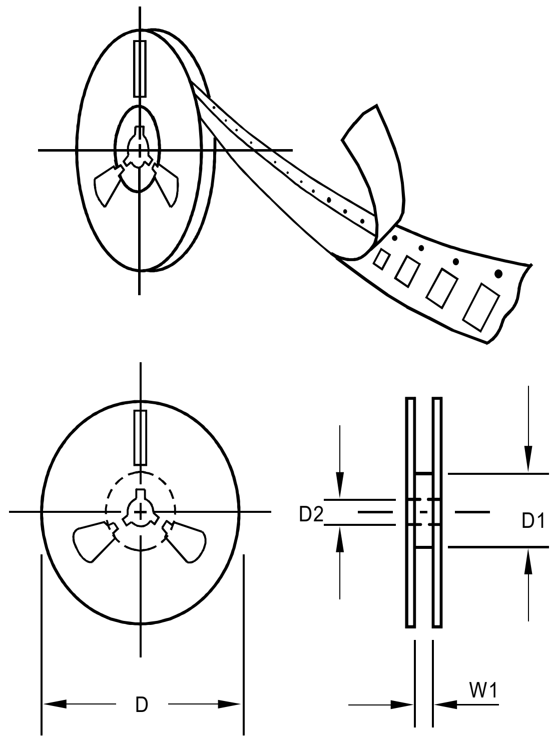


Dimensions in inches and (millimeters)

FMLDC0604A1V2AXH Thru FMLDC0604A3V3AXH

Packing information





Unit : mm

Item	Symbol	Tolerance	SOT-23-3
Carrier width	A	±0.1	3.18
Carrier length	B	±0.1	3.28
Carrier depth	C	±0.1	1.32
Sprocket hole	d	±0.1	1.50
7" Reel outside diameter	D	±1.0	180.0
7" Reel inner diameter	D1	±0.5	60.0
Feed hole diameter	D2	±0.3	13.0
Sprocket hole position	E	±0.1	1.75
Punch hole position	F	±0.1	3.50
Punch hole pitch	P	±0.1	4.00
Sprocket hole pitch	P0	±0.1	4.00
Embossment center	P1	±0.1	2.00
Over all tape thinkness	T	±0.1	0.20
Tape width	W	±0.2	8.10
Reel width	W1	±0.2	9.50

Note : Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

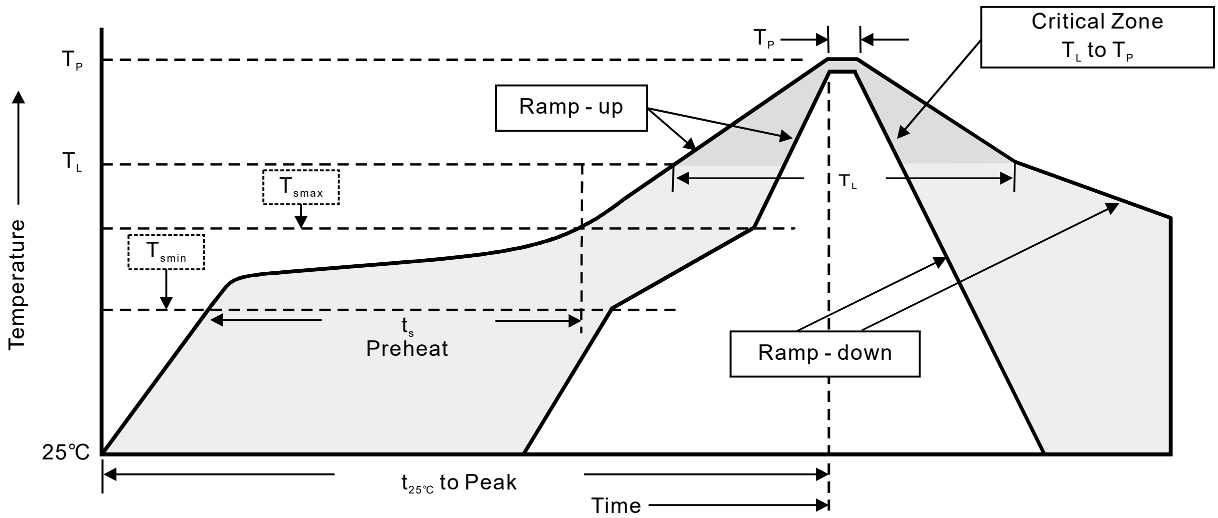
FMLDC0604A1V2AXH Thru FMLDC0604A3V3AXH

Reel packing

Package	Units (pcs)			Dimension (Unit : mm[3])		
	Reel	Inner Box	Outer Box	Reel DIA,	Inner Box	Outer Box
SOT-23-3	3,000	30,000	120,000	180 (7")	203 x 203 x 195	438 x 438 x 220

Suggested thermal profiles for soldering processes

1. Storage environment : Temperature = 5℃ ~ 40℃, Humidity = 55%, ±25%.
2. Reflow soldering of surface - Mount devices.



3.Reflow soldering

Profile feature	Soldering condition
Average ramp-up rate (T_L to T_P)	< 3 ℃/sec
Preheat - Temperature Min (T_{smin}) - Temperature Max (T_{smax}) - Time (Min to Max) (t_s)	150℃ 200℃ 60 ~ 120 sec
T_{smax} to T_L - Ramp-up rate	< 3 ℃ / sec
Time maintained above : - Temperature (T_L) - Time (T_L)	217℃ 60 ~ 260 sec
Peak temperature (T_P)	255 ℃ -0 / +5℃
Time with 5℃ of actual peak temperature (T_P)	10 ~ 30 sec
Ramp-down rate	< 6℃ / sec
Time 25℃ to peak temperature	< 6 minutes