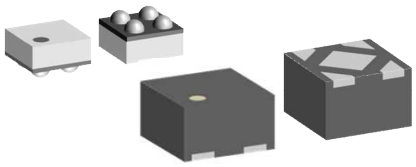
MITSUMI

PRELIMINARY

Ultra Low Noise, High PSRR, fast transient response 450mA LDO

MM4047 Series



Overview

The MM4047 is ultra low noise LDO capable of supplying 450mA output current. Designed to meet the requirements of RF circuits, Image sensor and high resolution audio codec, the MM4047 device provides low noise, High PSRR. It is available in WLCSP (0.65 mm×0.65 mm max.) and PLP-4 (1.0mm×1.0mm), which are suitable for smartphones, wireless earphones and wearable devices.

Features

- Low noise
- High ripple rejection
- High speed transient response
- Low dropout voltage
- Small packagwe

Main specifications

- Maximum rating supply voltage : -0.3V to 6V
- Operating voltage range : 2.2V to 5.5V
- Operating ambient temperature : -40℃ to 85℃
- Output current : 450mA
- Input current (OFF) : Typ. 0.2uA
- No-load input current : Typ. 14uA
- Output voltage range : 1.8V / 2.8V / 3.0V / 3.3V / 4.5V
- Output voltage accuracy : ±2% (1.8V≦V_{OUT}(Typ.), V_{DD}=V_{OUT}+1V to 5.5V, I_{OUT}=1mA to 450mA)
  ±3% (V_{OUT}(Typ.)<1.8V, V_{DD}=V_{OUT}+1V to 5.5V, I_{OUT}=1mA to 450mA)
- Line regulation : Typ. 0.02%/V (V_{DD}=V_{OUT}(Typ.)+1V to 5.5V)
- Load regulation : Typ. 0.001%/mA (I_{OUT}=1mA to 450mA)
- Dropout voltage : Typ. 0.160V (I_{OUT}=450mA, V_{OUT}(Typ.)=2.8V, WLCSP-4)
  Typ. 0.195V (I_{OUT}=450mA, VOUT(Typ.)=2.8V, SSON-4)
- PSRR : Typ. 80dB (f=1kHz)
- Output noise voltage : Typ. 8uVrms (f_{BW}=10 to 100kHz, I_{OUT}=1mA)
  Typ. 6uVrms (f_{BW}=10 to 100kHz, I_{OUT}=450mA)
- Output capacitor : 2.2uF (Ceramic capacitor)
- Protection function : Over current protection, TSD
- Additional function : ON/OFF control, Auto discharge

パッケージ

- WLCSP-4E
- SSON-4D

用途

- Portable communication device
- Photographing / Imaging device
- Wearable device
- Power supply for high-sensitivity image sensor
- Power supply for ADC / DAC
- Power supply for RF circuit

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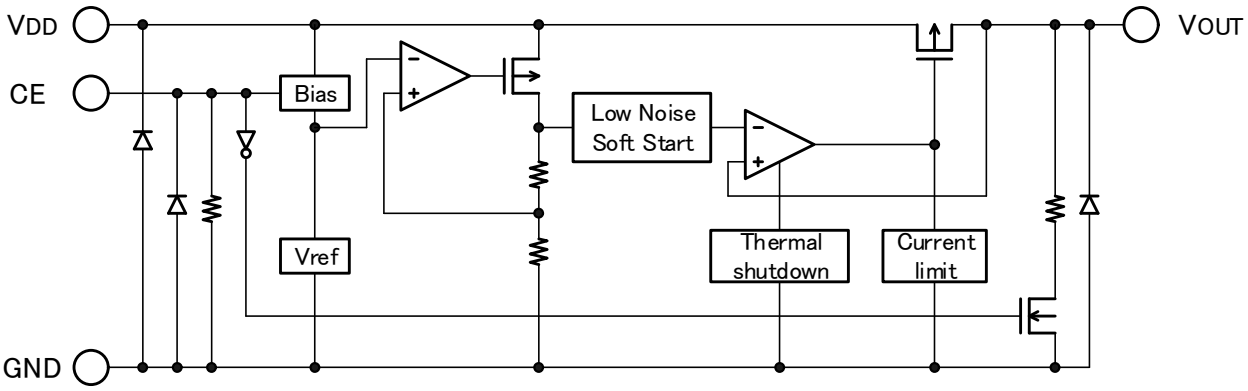
Model Name

M M 4 0 4 7 X X X X X X

Series name (A) (B) (C) (D) (E)

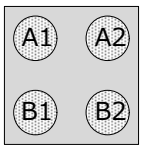
(A)	Function Type	A	CE=H active, with discharge function	
		Z		
(B)	Output voltage rank	18	1.8V	Output voltage other than those listed on the left, Please contact us.
		28	2.8V	
		30	3.0V	
		33	3.3V	
		45	4.5V	
(C)	Package	L	WLCSP-4E	
		R	SSON-4D	
(D)	Packing specifications1	C	B housing (WLCSP-4E standard)	
		R	R housing (SSON-4D standard)	
(E)	Packing specifications2	E	Emboss tape / Halogen free	

Block Diagram



Pin Configuration

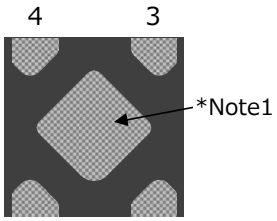
- WLCSP-4E



Top view

Pin No.	Pin name	Function
A1	V_{DD}	Voltage supply pin
A2	V_{OUT}	Output pin
B1	CE	ON/OFF-control pin Connect CE pin with VDD pin, when it is not used.
B2	GND	GND pin

- SSON-4D



Top view

Pin No.	Pin name	Function
1	V_{OUT}	Output pin
2	GND	GND pin
3	CE	ON/OFF-control pin Connect CE pin with VDD pin, when it is not used.
4	V_{DD}	Voltage supply pin

*Note1:Heat spreader bottom with GND.

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Absolute Maximum Ratings

Item		Symbol	Min.	Max.	Unit
Storage temperature		Tstg	-55	150	℃
Junction temperature		Tj_{MAX}	-	150	℃
Supply voltage		V_{DD}	-0.3	6.0	V
Output voltage		V_{OUT}	-	V_{DD}+0.3	V
CE input voltage		V_{CE}	-	6.0	V
Output current		I_{OUT}	450	-	mA
Power dissipation	WLCSP-4E	Pd	-	TBD	mW
*Note2,3	SSON-4D		-	TBD	mW

*Note2:In consideration of product life, please examine the use in less than 80%.

*Note3:JEDEC51-7 standard

Recommended Operating Conditions

Item	Symbol	Min.	Max.	Unit
Operating ambient temperature	Taopr	-40	85	℃
Operating voltage	V_{DDop}	2.2	5.5	V
CE Operating voltage	V_{DDop}	0	5.5	V
Output current	V_{CEop}	0	450	mA

Electrical Characteristics

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=1.2V,I_{OUT}=1mA, Cin=1μA, Co=2.2μA, Ta=25℃ unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input voltage	VD		2.2	-	5.5	V
Standby current	I_{DDOff}	V_{CE}=0.3V (Disabled)	-	0.2	1	μA
Quiescent current	I_{DD1}	V_{CE}=1.2V, I_{OUT}=0mA	-	14	25	μA
	I_{DD2}	VCE=1.2V, IOUT=450mA	-	250	425	μA
Output voltage tolerance	V_{OUT}	V_{DD}=V_{OUT}+1V to 5.5V I_{OUT}=1mA to 450mA 1.8V≦V_{OUT}	-2	-	2	%
		V_{DD}=V_{OUT}+1V to 5.5V I_{OUT}=1mA to 450mA V_{OUT}<1.8V	-3	-	3	%
Line regulation	V_{LINE}	V_{DD}=V_{OUT}+1V to 5.5V I_{OUT}=1mA	-	0.02	-	%/V
Load regulation	V_{LOAD}	I_{OUT}=1mA to 450mA	-	0.001	-	%/mA

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Electrical Characteristics

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=1.2V,I_{OUT}=1mA, Cin=1μA, Co=2.2μA, Ta=25℃ unless otherwise specified)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit
Dropout voltage	WLCSP-4E	V_{DO1}	V_{OUT}=1.8V, I_{OUT}=450mA	-	TBD	TBD	mV
		V_{DO2}	V_{OUT}=2.8V, I_{OUT}=450mA	-	160	TBD	mV
		V_{DO3}	V_{OUT}=4.5V, I_{OUT}=450mA	-	110	TBD	mV
	SSON-4D	V_{DO1}	V_{OUT}=1.8V, I_{OUT}=450mA	-	TBD	TBD	mV
		V_{DO2}	V_{OUT}=2.8V, I_{OUT}=450mA	-	195	TBD	mV
		V_{DO3}	V_{OUT}=4.5V, I_{OUT}=450mA	-	165	TBD	mV
Power supply rejection ratio *Note4		$PSRR_1$	f=1kHz, I_{OUT}=20mA	-	80	-	dB
		$PSRR_2$	f=10kHz, I_{OUT}=20mA	-	70	-	dB
		$PSRR_3$	f=100kHz, I_{OUT}=20mA	-	60	-	dB
Output noise voltage *Note4		V_{n1}	f_{BW}=10Hz to 100kHz I_{OUT}=1mA	-	8	-	μV_{RMS}
		V_{n2}	f_{BW}=10Hz to 100kHz IOUT=450mA	-	6	-	μV_{RMS}
Load current		I_{LOAD}		0	-	450	mA
Maximum output current		I_{OUT_MAX}		450	-	-	mA
Short circuit current		I_{SC}		450	700	-	mA
CE High input threshold		V_{CEH}	V_{DD}=2.2V to 5.5V	1.2	-	-	V
CE Low input threshold		V_{CEL}	V_{DD}=2.2V to 5.5V	-	-	0.4	V
CE Input current		I_{CEH}	V_{CE}=5.5, V_{DD}=5.5V	-	5.5	-	μA

*Note4:The parameter is guaranteed by design

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Electrical Characteristics

(V_{DD}=V_{OUT}(Typ.)+1V, V_{CE}=1.2V,I_{OUT}=1mA, Cin=1μA, Co=2.2μA, Ta=25℃ unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Turn-on time	t_{ON}	From V_{CE} > V_{CEH} to V_{OUT}*95%	-	80	150	μs
Overshoot on start-up *Note4	V_{OS}		-	-	5	%
Line transient 1 *Note4	$V_{LINE-T1}$	V_{DD}=V_{OUT}+1V to V_{OUT}+1.6V tr=30μs	-1	-	-	mV
Line transient 2 *Note4	$V_{LINE-T2}$	V_{DD}=V_{OUT}+1.6V to V_{OUT}+1V tr=30μs	-	-	1	mV
Load transient 1 *Note4	$V_{LOAD-T1}$	I_{OUT}=1mA to 450mA tr=10μs	-50	-	-	mV
Load transient 2 *Note4	$V_{LOAD-T2}$	I_{OUT}=450mA to 1mA tr=10μs	-	-	50	mV
Thermal shutdown *Note4	TSD	T_j rising	-	160	-	℃
Thermal shutdown hysteresis *Note4	TSD_{HYS}	T_j falling from shutdown	-	15	-	℃
Output discharge resistance	R_{DC}	V_{CE}<V_{CEL}	-	230	-	Ω

*Note4:The parameter is guaranteed by design

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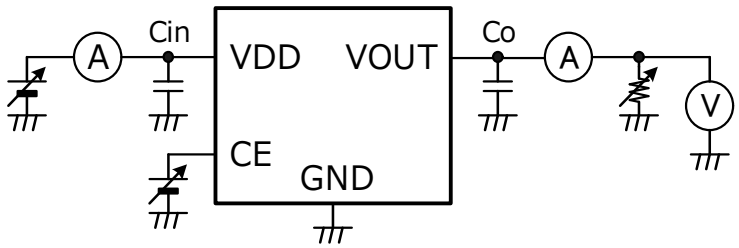
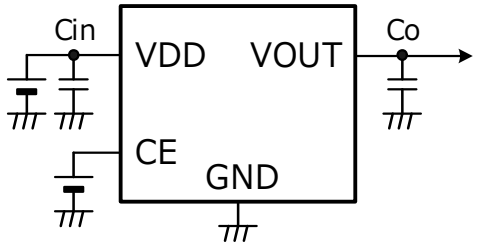
Test Circuit



Application Circuit



(Example of external parts)

- Output capacitor Ceramic capacitor 2.2μF
- Input capacitor Ceramic capacitor 1.0μF *Temperature characteristics : B

- In the event a problem which may affect industrial property or any other rights of us or a third party is encountered during the use of information described in these circuit, we shall not be liable for any such problem, nor grant a license therefore.

Note

1. There is risk that deterioration and destruction of IC when using it exceeding the absolute maximum rating.
   The absolute maximum rating, Never exceed it. The functional operation is not assured.

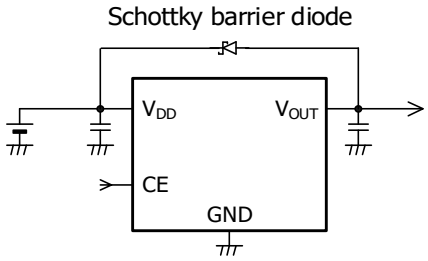
2. There is a risk that it becomes impossible to maintain this performance and reliability IC original
   when using exceeding recommended operation voltage.
   Please use it in recommended operation voltage.

3. Due to restrictions on the package power dissipation, the output current value may not be satisfied.
   Attention should be paid to the power dissipation of the package
   when the output current is large or the voltage between Input and Output is high.
4. The output capacitor is required between output and GND, to prevent oscillation.

5. The ESR of output capacitor must be stable area, defined in ESR stability area.
   In case of using ceramic capacitor, no additional ESR resistance needed.
   The ceramic capacitor must be used more than 2.2μF and X5R temperature characteristics.
   To ensure the actual capacitance is never less than 1.7μF, consider initial tolerance, applied voltage derating,
   and temperature coefficient.
6. For noise and stability, VDD and GND pattern is required to low impedance.

7. The input capacitor must be connected a distance of less than 1cm from input pin.

8. In case output voltage is higher than input voltage, the overcurrent flow from output pin to input pin,
   by internal parasitic diode. In such application, the external bypass diode must be connected
   between output pin and input pin.



9. When overcurrent or output short-circuit, this IC will limit output current by overcurrent protection circuit.
   However, there is a risk of destroying that IC generates heat and exceeding package power dissipation.
   The characteristic depending on the board and use condition. Please evaluate IC in the set.

10. The over current protection circuit of the vertical type is built into this IC.

11. There is a possibility that IC generates heat when the output terminal is short-circuited.
    However, the thermal shutdown circuit operates, and it will do operation that protects IC.
    The thermal shutdown circuit is designed only to shut the IC off to prevent thermal runaway.
    Do not continue to use the IC in an environment where the operation of this circuit is assumed.
    The characteristic changes depending on the substrate condition.
    Please evaluate IC in the set.

12. It returns automatically in temperature returned after it shuts down by self-generation of heat.
    After it returns, it shuts down again by self-generation of heat.
    It is necessary to change the environment used (IC consumption, temperature)
    if it operates in upper cycle.

Note

13. If VDD rise time is longer than soft start time inside IC, it is possibility that output overshoot or chattering. Turn on by CE or VDD rise time within 500μs.

14. If the condition is 0.3V≦VCE≦VDD-0.3V,input current increase for shoot through current. To reduce current consumption, please use except above condition (no shoot through current).

15. It is possible to increase output voltage, if the condition is low output current and high temperature. To add load current to provide it.