

300mA High PSRR, Low Noise, Low Power LDO

Features

- Input Voltage Range: 2V to 5.5V
- Output Voltage Range: 1.1V to 4.5V
- Output Voltage Tolerance: $\pm 2\%$
- Ultra-Low Shutdown Current: 0.1 μ A (Typ.)
- Ultra-Low Quiescent Current: 1.5 μ A (Typ.)
- Low Dropout: 80mV@100mA
- High PSRR: 60dB@1KHz (Typ.)
- Over Current Protection
- Short Circuit Protection
- Thermal Shutdown Protection
- -40°C to 125°C Operating Junction Temperature
- SOT23-5/SOT23-3/DFN4-1 \times 1 Package

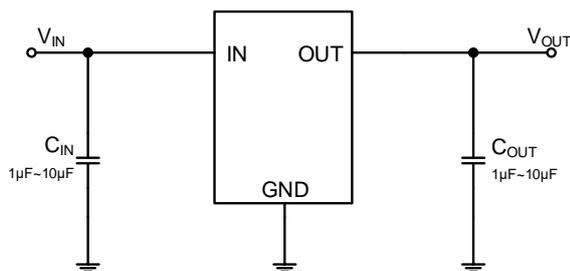
Applications

- Mobile Phones, Tablets
- Portable Medical Equipment
- Smart Meters and Field Transmitters
- IP Cameras
- Digital Cameras and Audio Devices
- Portable and Battery-Powered Equipment
- RF, PLL, VCO, and Clock Power Supplies
- Drones

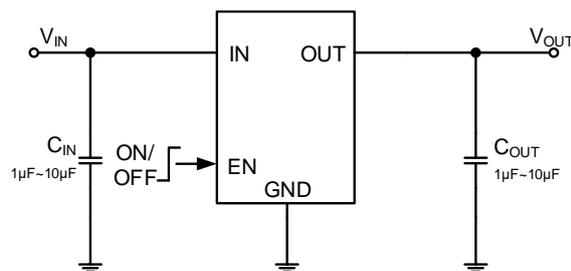
General Description

The RY6031 is a high PSRR, low noise, ultra-low power LDO that can supply up to 300mA output current. Designed to meet the requirements of IOT, wearable and battery powered applications, the RY6031 device provides low noise, high PSRR, ultra-low quiescent current, and low line or load transient response figures. Using new innovative design techniques, the RY6031 offers class-leading noise performance without a noise bypass capacitor. This device is available with fixed output voltages from 1.1 V to 4.5 V in 50-mV steps. The RY6031 series are available in SOT23-3, SOT23-5, DFN4-1 \times 1 package.

Typical Application Circuit



SOT23-3 Typical Application Circuit

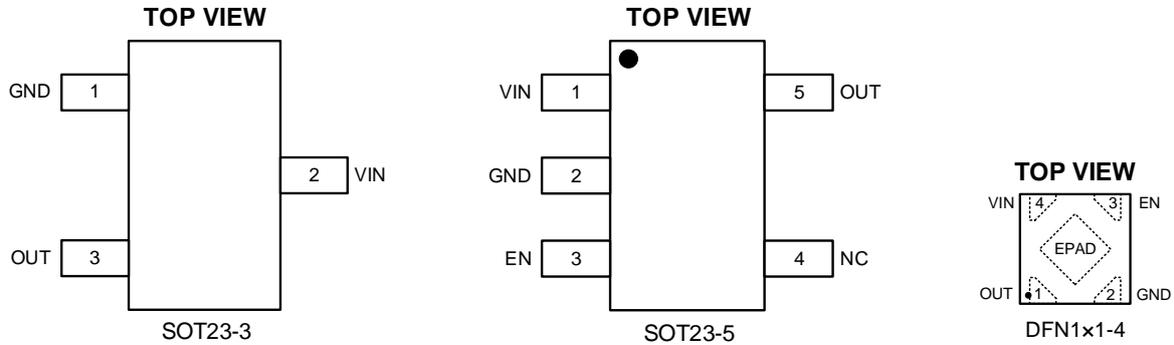


SOT23-5/DFN1 \times 1-4 Typical Application Circuit

300mA High PSRR, Low Noise, Low Power LDO

Pin Description

Pin Configuration



Pin Description

SOT23-3 Pin No.	SOT23-5 Pin No.	DFN1×1-4 Pin No.	Pin Name	Function
2	1	4	VIN	Input voltage pin for the regulator.
1	2	2	GND	Ground pin.
-	3	3	EN	Enable Control (Active high), Driving EN over 0.9 V turns on the regulator. Driving EN below 0.4 V puts the regulator into shutdown mode.
-	4	-	NC	Not Connected.
3	5	1	OUT	Output voltage pin for the regulator.
-	-	EPAD	EPAD	Exposed pad should be connected directly to the GND pin.

Marking Rule

Marking	Designator	Description
QVVYL	Q	Product Code
	VV	Fixed Version Output Voltage (1.1~4.5V)
	Y	Year Code
	L	Lot Number Code

300mA High PSRR, Low Noise, Low Power LDO

Order Information ⁽¹⁾

RY6031-①②③④

Designator	Symbol	Description		
①②	Integer	Output Voltage		
③	T3	SOT23-3		
	T5	SOT23-5		
	D4	DFN1×1-4		
④	R	RoHS / Pb Free		
Part No.	Model	Description	Package	T/R Qty
70606601	RY6031-11T3R	RY6031-11T3R High PSRR, Ultra Low Power LDO, 1.1V, 300mA, SOT23-3	SOT23-3	3000PCS
70606602	RY6031-12T3R	RY6031-12T3R High PSRR, Ultra Low Power LDO, 1.2V, 300mA, SOT23-3	SOT23-3	3000PCS
70606603	RY6031-13T3R	RY6031-13T3R High PSRR, Ultra Low Power LDO, 1.3V, 300mA, SOT23-3	SOT23-3	3000PCS
70606604	RY6031-1BT3R	RY6031-1BT3R High PSRR, Ultra Low Power LDO, 1.35V, 300mA, SOT23-3	SOT23-3	3000PCS
70606605	RY6031-15T3R	RY6031-15T3R High PSRR, Ultra Low Power LDO, 1.5V, 300mA, SOT23-3	SOT23-3	3000PCS
70606606	RY6031-18T3R	RY6031-18T3R High PSRR, Ultra Low Power LDO, 1.8V, 300mA, SOT23-3	SOT23-3	3000PCS
70606607	RY6031-25T3R	RY6031-25T3R High PSRR, Ultra Low Power LDO, 2.5V, 300mA, SOT23-3	SOT23-3	3000PCS
70606608	RY6031-28T3R	RY6031-28T3R High PSRR, Ultra Low Power LDO, 2.8V, 300mA, SOT23-3	SOT23-3	3000PCS
70606609	RY6031-2CT3R	RY6031-2CT3R High PSRR, Ultra Low Power LDO, 2.85V, 300mA, SOT23-3	SOT23-3	3000PCS
70606610	RY6031-29T3R	RY6031-29T3R High PSRR, Ultra Low Power LDO, 2.9V, 300mA, SOT23-3	SOT23-3	3000PCS
70606611	RY6031-2DT3R	RY6031-2DT3R High PSRR, Ultra Low Power LDO, 2.95V, 300mA, SOT23-3	SOT23-3	3000PCS
70606612	RY6031-30T3R	RY6031-30T3R High PSRR, Ultra Low Power LDO, 3.0V, 300mA, SOT23-3	SOT23-3	3000PCS
70606613	RY6031-33T3R	RY6031-33T3R High PSRR, Ultra Low Power LDO, 3.3V, 300mA, SOT23-3	SOT23-3	3000PCS
70606614	RY6031-36T3R	RY6031-36T3R High PSRR, Ultra Low Power LDO, 3.6V, 300mA, SOT23-3	SOT23-3	3000PCS
70606615	RY6031-38T3R	RY6031-38T3R High PSRR, Ultra Low Power LDO, 3.8V, 300mA, SOT23-3	SOT23-3	3000PCS

300mA High PSRR, Low Noise, Low Power LDO

		Power LDO, 3.8V, 300mA, SOT23-3		
70606616	RY6031-40T3R	RY6031-40T3R High PSRR, Ultra Low Power LDO, 4.0V, 300mA, SOT23-3	SOT23-3	3000PCS
70606617	RY6031-42T3R	RY6031-42T3R High PSRR, Ultra Low Power LDO, 4.2V, 300mA, SOT23-3	SOT23-3	3000PCS
70606618	RY6031-45T3R	RY6031-45T3R High PSRR, Ultra Low Power LDO, 4.5V, 300mA, SOT23-3	SOT23-3	3000PCS
70606621	RY6031-11T5R	RY6031-11T5R High PSRR, Ultra Low Power LDO, 1.1V, 300mA, SOT23-5	SOT23-5	3000PCS
70606622	RY6031-12T5R	RY6031-12T5R High PSRR, Ultra Low Power LDO, 1.2V, 300mA, SOT23-5	SOT23-5	3000PCS
70606623	RY6031-13T5R	RY6031-13T5R High PSRR, Ultra Low Power LDO, 1.3V, 300mA, SOT23-5	SOT23-5	3000PCS
70606624	RY6031-1BT5R	RY6031-1BT5R High PSRR, Ultra Low Power LDO, 1.35V, 300mA, SOT23-5	SOT23-5	3000PCS
70606625	RY6031-15T5R	RY6031-15T5R High PSRR, Ultra Low Power LDO, 1.5V, 300mA, SOT23-5	SOT23-5	3000PCS
70606626	RY6031-18T5R	RY6031-18T5R High PSRR, Ultra Low Power LDO, 1.8V, 300mA, SOT23-5	SOT23-5	3000PCS
70606627	RY6031-25T5R	RY6031-25T5R High PSRR, Ultra Low Power LDO, 2.5V, 300mA, SOT23-5	SOT23-5	3000PCS
70606628	RY6031-28T5R	RY6031-28T5R High PSRR, Ultra Low Power LDO, 2.8V, 300mA, SOT23-5	SOT23-5	3000PCS
70606629	RY6031-2CT5R	RY6031-2CT5R High PSRR, Ultra Low Power LDO, 2.85V, 300mA, SOT23-5	SOT23-5	3000PCS
70606630	RY6031-29T5R	RY6031-29T5R High PSRR, Ultra Low Power LDO, 2.9V, 300mA, SOT23-5	SOT23-5	3000PCS
70606631	RY6031-2DT5R	RY6031-2DT5R High PSRR, Ultra Low Power LDO, 2.95V, 300mA, SOT23-5	SOT23-5	3000PCS
70606632	RY6031-30T5R	RY6031-30T5R High PSRR, Ultra Low Power LDO, 3.0V, 300mA, SOT23-5	SOT23-5	3000PCS
70606620	RY6031-33T5R	RY6031-33T5R High PSRR, Ultra Low Power LDO, 3.3V, 300mA, SOT23-5	SOT23-5	3000PCS
70606621	RY6031-36T5R	RY6031-36T5R High PSRR, Ultra Low Power LDO, 3.6V, 300mA, SOT23-5	SOT23-5	3000PCS
70606622	RY6031-38T5R	RY6031-38T5R High PSRR, Ultra Low Power LDO, 3.8V, 300mA, SOT23-5	SOT23-5	3000PCS
70606623	RY6031-40T5R	RY6031-40T5R High PSRR, Ultra Low Power LDO, 4.0V, 300mA, SOT23-5	SOT23-5	3000PCS

300mA High PSRR, Low Noise, Low Power LDO

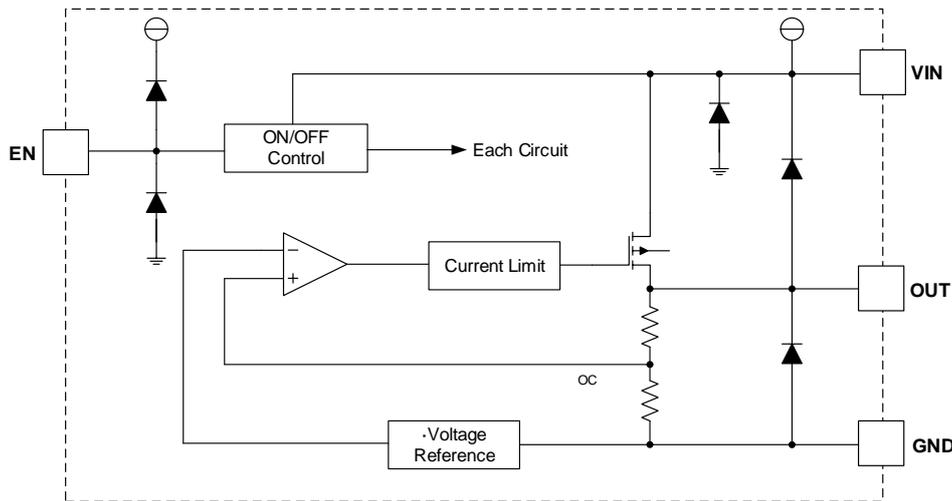
70606624	RY6031-42T5R	RY6031-42T5R High PSRR, Ultra Low Power LDO, 4.2V, 300mA, SOT23-5	SOT23-5	3000PCS
70606625	RY6031-45T5R	RY6031-45T5R High PSRR, Ultra Low Power LDO, 4.5V, 300mA, SOT23-5	SOT23-5	3000PCS
70606628	RY6031-11D4R	RY6031-11D4R High PSRR, Ultra Low Power LDO, 1.1V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606629	RY6031-12D4R	RY6031-12D4R High PSRR, Ultra Low Power LDO, 1.2V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606630	RY6031-13D4R	RY6031-13D4R High PSRR, Ultra Low Power LDO, 1.3V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606631	RY6031-1BD4R	RY6031-1BD4R High PSRR, Ultra Low Power LDO, 1.35V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606632	RY6031-15D4R	RY6031-15D4R High PSRR, Ultra Low Power LDO, 1.5V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606633	RY6031-18D4R	RY6031-18D4R High PSRR, Ultra Low Power LDO, 1.8V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606634	RY6031-25D4R	RY6031-25D4R High PSRR, Ultra Low Power LDO, 2.5V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606635	RY6031-28D4R	RY6031-28D4R High PSRR, Ultra Low Power LDO, 2.8V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606636	RY6031-2CD4R	RY6031-2CD4R High PSRR, Ultra Low Power LDO, 2.85V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606637	RY6031-29D4R	RY6031-29D4R High PSRR, Ultra Low Power LDO, 2.9V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606638	RY6031-2DD4R	RY6031-2DD4R High PSRR, Ultra Low Power LDO, 2.95V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606639	RY6031-30D4R	RY6031-30D4R High PSRR, Ultra Low Power LDO, 3.0V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606640	RY6031-33D4R	RY6031-33D4R High PSRR, Ultra Low Power LDO, 3.3V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606641	RY6031-36D4R	RY6031-36D4R High PSRR, Ultra Low Power LDO, 3.6V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606642	RY6031-38D4R	RY6031-38D4R High PSRR, Ultra Low Power LDO, 3.8V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606643	RY6031-40D4R	RY6031-40D4R High PSRR, Ultra Low Power LDO, 4.0V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606644	RY6031-42D4R	RY6031-42D4R High PSRR, Ultra Low Power LDO, 4.2V, 300mA, DFN4-1×1	DFN1×1-4	10000PCS
70606645	RY6031-45D4R	RY6031-45D4R High PSRR, Ultra Low	DFN1×1-4	10000PCS

300mA High PSRR, Low Noise, Low Power LDO

	Power LDO, 4.5V, 300mA, DFN4-1×1		
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Note (1): All RYCHIP parts are Pb-Free and adhere to the RoHS directive.

Functional Block Diagram



Functional Block Diagram

Specifications

Absolute Maximum Ratings ⁽¹⁾ ⁽²⁾

Item	Min	Max	Unit
V _{IN} voltage	2	6	V
V _{OUT} voltage	1	5	V
Output Current ⁽³⁾	350		mA
Power dissipation ⁽⁴⁾	Internally Limited		
Operating Ambient Temperature	-40	85	°C
Maximum junction temperature		150	°C
Storage temperature, T _{stg}	-50	85	°C
Lead Temperature (Soldering, 10sec.)		260	°C

Note (1): Exceeding these ratings may damage the device.

Note (2): The device is not guaranteed to function outside of its operating conditions.

Note (3): $I_{OUT} = P_D / (V_{IN} - V_{OUT})$

Note (4): The maximum allowable power dissipation is a function of the maximum junction temperature, T_{J(MAX)}, the junction-to-ambient thermal resistance, R_{θJA}, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D(MAX)} = (T_{J(MAX)} - T_A) / R_{θJA}$. Exceeding the maximum allowable power dissipation causes excessive die temperature, and the regulator goes into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage. Thermal shutdown engages at T_J=155°C (typical) and disengages at T_J= 140°C (typical).

300mA High PSRR, 1.5μA Ultra Low Power LDO

Recommended Operating Conditions

Item	Min	Max	Unit
Operating junction temperature ⁽¹⁾	-40	125	°C
Operating temperature range	-40	85	°C
Input voltage V _{IN}	2	5.5	V
Output current	0	300	mA

Note (1): All limits specified at room temperature (T_A = 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).

Thermal Information

Item	Description	SOT23 3 Pin	SOT23 5 Pin	DFN1×1 4 Pin	Unit
R _{θJA}	Junction-to-ambient thermal resistance ⁽¹⁾⁽²⁾	208	195	216	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	112	102	161	°C/W
R _{θJB}	Junction-to-board thermal resistance	56	46	162	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	9.2	8.5	5.1	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	52	45	162	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	N/A	N/A	123	°C/W

Note (1): The package thermal impedance is calculated in accordance to JESD 51-7.

Note (2): Thermal Resistances were simulated on a 4-layer, JEDEC board

300mA High PSRR, 1.5μA Ultra Low Power LDO

Electrical Characteristics ⁽¹⁾

T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Test Conditions	Min	Typ.	Max	Units	
Input Voltage	V _{IN}		2		5.5	V	
Output Voltage	V _{OUT}	V _{IN} =V _{OUT} +1V I _{OUT} =1mA to 300mA	V _{OUT} ×0.98		V _{OUT} ×1.02	V	
Output Current	I _{OUT}	V _{IN} ≥V _{OUT(S)} +0.5V		300		mA	
Dropout Voltage	V _{drop}	I _{OUT} =100 mA	-	80		mV	
		I _{OUT} =250 mA	-		250		
Line Regulations	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	(V _{OUT(S)} +1V) ≤ V _{IN} ≤ 5.5V I _{OUT} =1mA	-	0.10		%/V	
Load Regulation	ΔV _{OUT}	V _{IN} =V _{OUT(S)} +1.0 V I _{OUT} = 1mA to 300mA	-	50	100	mV	
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{T_A \times V_{OUT}}$	V _{IN} =V _{OUT(S)} +1.0V, I _{OUT} =10mA -40°C ≤ T _A ≤ 85°C	-	±100	-	ppm/°C	
Quiescent current	I _{SS1}	V _{IN} =V _{OUT(S)} +1.0 V	-	1.5		μA	
Shutdown Current	I _{SD}	V _{EN} =0.3V (Disable)		0.1	1	μA	
Power Supply Rejection Ratio	PSRR	I _{OUT} =20 mA	f = 100Hz	-	70	-	dB
			f = 1kHz		60	-	dB
Output Noise Voltage	e _N	BW=10Hz to 100kHz, C _{OUT} = 10μF	I _{OUT} =1mA		20		μV _{RMS}
			I _{OUT} =300mA		12		
Short-Circuit Current Limit	I _{SC}			100	-	mA	
High Input Threshold	V _{ENH}	V _{EN} rising until the output is enabled	0.9			V	
Low Input Threshold	V _{ENL}	V _{EN} falling until the output is disabled			0.4	V	
Input Current at EN pin	I _{EN}	V _{EN} =3.3V and V _{IN} =3.3V		0.5		μA	
		V _{EN} =0V and V _{IN} =3.3V		0.001		μA	
Turn On Time	t _{ON}			80	150	μS	
Thermal Shutdown Temperature	T _{SD}	T _J rising		155		°C	
Thermal Shutdown Hysteresis	ΔT _{SD}	T _J falling from shutdown		15		°C	

Note (1): All of specification is verified by design.

300mA High PSRR, 1.5µA Ultra Low Power LDO

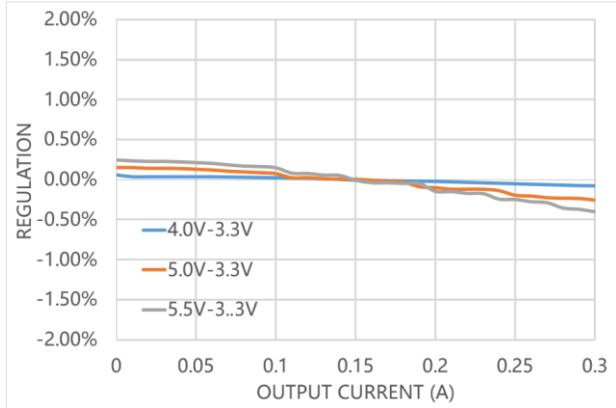
Typical Performance Characteristics

Note (1): Typical performance characteristics below based on $T_A = 25^\circ\text{C}$, unless otherwise noted.

Note (2): $V_{OUT}=3.3\text{V}$, $V_{IN}=V_{OUT}+2\text{V}$, $C_{IN}=10\mu\text{F}$, $C_{OUT}=10\mu\text{F}$, unless otherwise noted

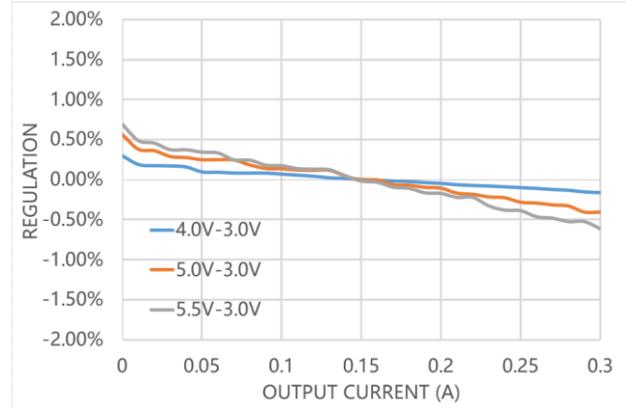
Load Regulation

$V_{OUT}=3.3\text{V}$



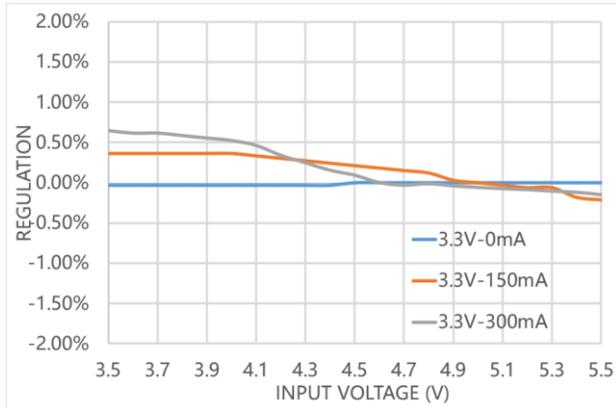
Load Regulation

$V_{out} = 3.0\text{V}$



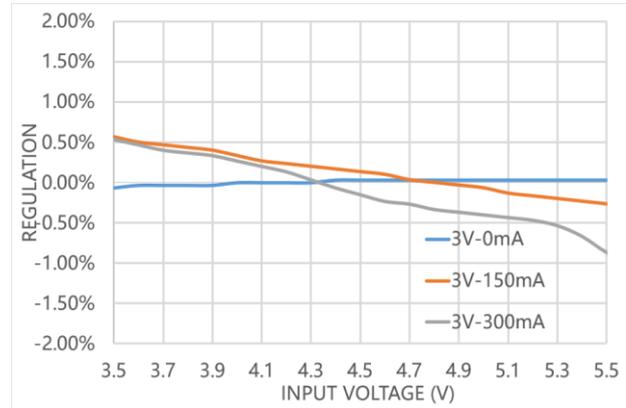
Line Regulation

$V_{OUT}=3.3\text{V}$



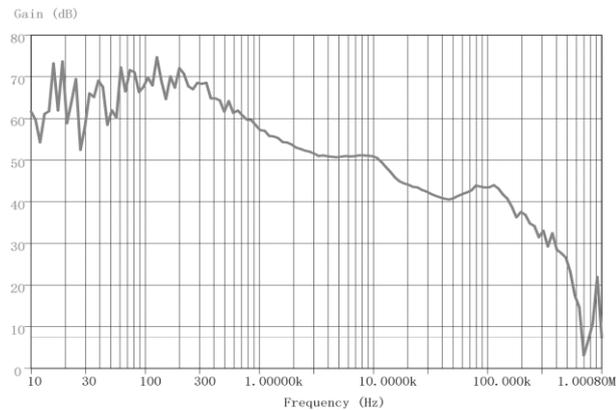
Line Regulation

$V_{out}=3.0\text{V}$



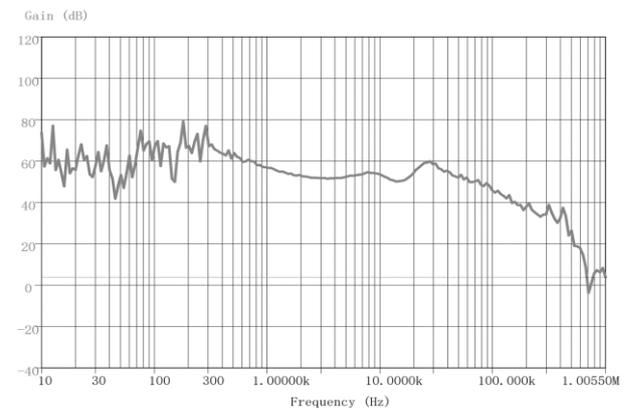
Power Supply Rejection Ratio

$V_{IN}=5\text{V}$, $V_{OUT}=3.3\text{V}$, $I_{OUT}=20\text{mA}$



Power Supply Rejection Ratio

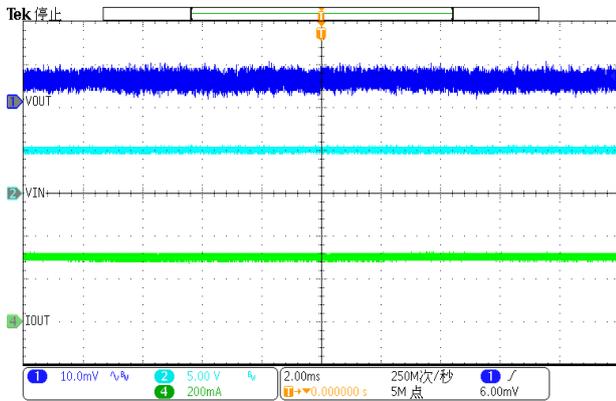
$V_{IN}=5\text{V}$, $V_{OUT}=3.0\text{V}$, $I_{OUT}=20\text{mA}$



300mA High PSRR, 1.5 μ A Ultra Low Power LDO

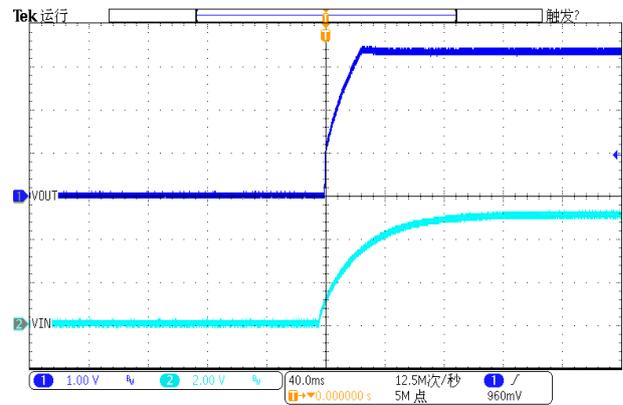
Steady State

V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=300mA



Vin Start Up

V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=1mA



300mA High PSRR, 1.5 μ A Ultra Low Power LDO

Applications Information

Internal Current Limit and Short-Circuit Protection

The RY6031 has an internal foldback current limit that helps to protect the regulator during fault conditions. The current supplied by the device is gradually throttled down as the output voltage decreases. When the output is shorted, the LDO supplies a 30% of typical output current. Output voltage is not regulated when the device is in current limit, and is $V_{OUT} = I_{CL} \times R_{LOAD}$. The advantage of foldback current limit is that the I_{CL} value is less than the fixed current limit. Therefore, the power that the PMOS pass transistor dissipates $[(V_{IN} - V_{OUT}) \times I_{CL}]$ is much less.

Thermal Shutdown Protection (T_{SD})

Thermal shutdown disables the output when the junction temperature rises to approximately 160°C which allows the device to cool. When the junction temperature cools to approximately 145°C, the output circuitry enables. Based on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This thermal cycling limits the dissipation of the regulator and protects it from damage as a result of overheating. The thermal shutdown circuitry of the RY6031 has been designed to protect against temporary thermal overload conditions. The T_{SD} circuitry was not intended to replace proper heat-sinking. Continuously running the RY6031 device into thermal shutdown may degrade device reliability.

Enable (EN pin)

The EN pin voltage must be higher than the V_{ENH} threshold to ensure that the device is fully enabled under all operating conditions. The EN pin voltage must be lower than the V_{ENL} threshold to ensure that the device is fully disabled and the automatic output discharge is activated.

Low Output Noise

Any internal noise at the RY6031 reference voltage is reduced by a first order low-pass RC filter before it is passed to the output buffer stage.

Layout Guidelines

The dynamic performance of the RY6031 is dependent on the layout of the PCB.

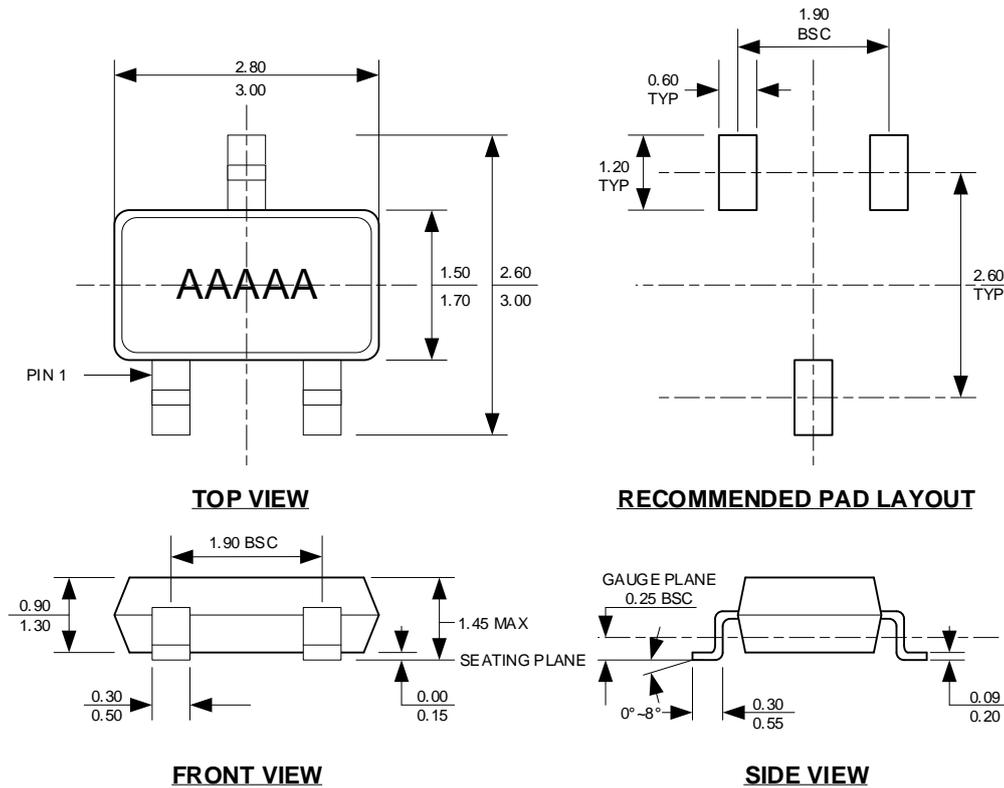
1. Best performance is achieved by placing C_{IN} and C_{OUT} as close to the IC as possible.
2. The ground connections for C_{IN} and C_{OUT} must be back to the IC's GND pin using as wide and short a copper trace as is practical.
3. Connections using long trace lengths, narrow trace widths, and/or connections through vias must be avoided. These add parasitic inductances and resistance that results in inferior performance especially during transient conditions.

300mA High PSRR, 1.5µA Ultra Low Power LDO

Packaging Information

3-Pin SOT23 Outline Dimensions

SOT23-3



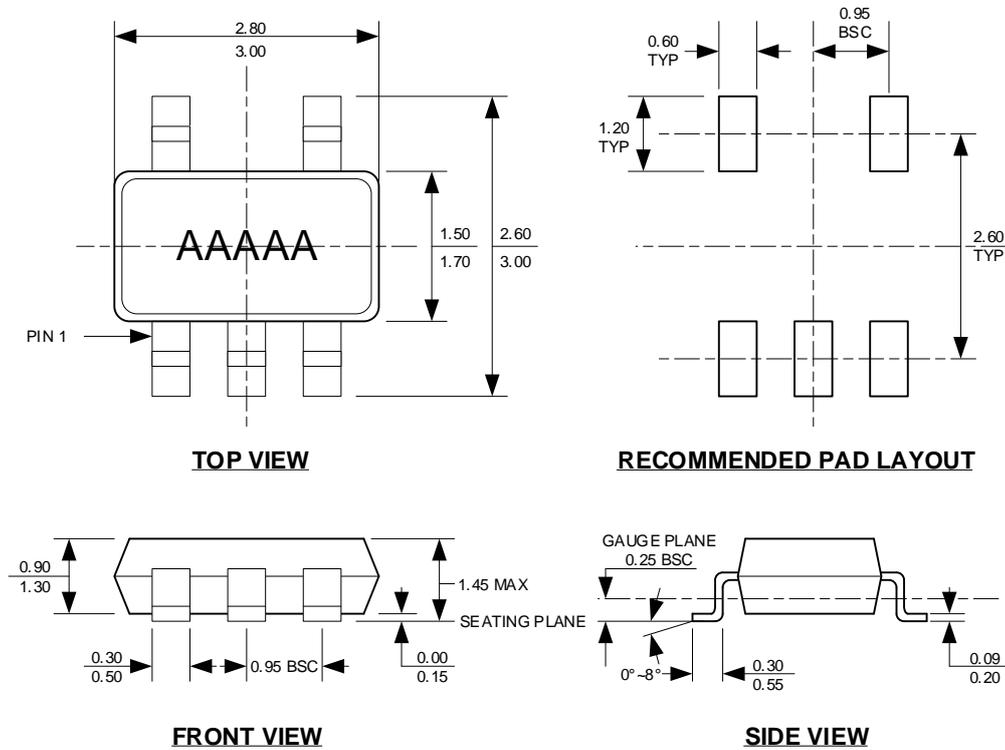
NOTE:

1. CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2. PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3. PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
4. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5. DRAWING CONFORMS TO JEDEC MS-012, VARIATION BA.
6. DRAWING IS NOT TO SCALE.

300mA High PSRR, 1.5µA Ultra Low Power LDO

5-Pin SOT23 Packaging Information

SOT23-5



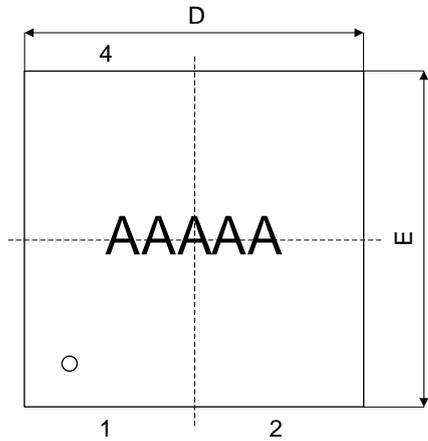
NOTE:

1. CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
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6. DRAWING IS NOT TO SCALE.

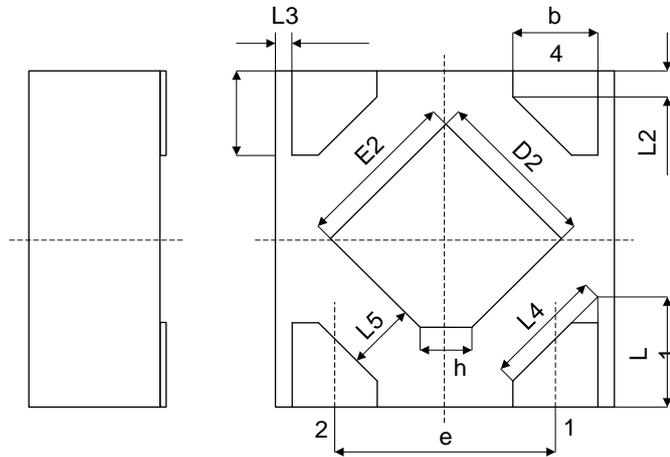
300mA High PSRR, 1.5µA Ultra Low Power LDO

4-Pin DFN1x1 Packaging Information

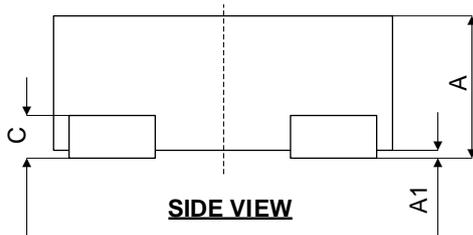
DFN1x1-4



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Symbol	DIM	Min (mm)	Nom (mm)	Max (mm)
A		0.45	-	0.6
A1		0	0.02	0.05
b		0.20	0.25	0.30
c		0.02	0.07	0.17
D		0.95	1.00	1.05
D2		0.38	0.48	0.58
e		0.65BSC		
E		0.95	1.00	1.05
E2		0.38	0.48	0.58
L		0.20	0.25	0.30
L2		0.077REF		
L3		0.05REF		
L4		0.34REF		
L5		0.20REF		
h		0.12REF		

NOTE:

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