350mA High Speed Low Power LDO

Features

- Input Voltage Range: 2V to 5.5V
- Output Voltage Range: 1.1V to 4.5V
- Output Voltage Tolerance: ±2%
- Low Shutdown Current: 0.1μA (Typ.)
- Low Quiescent Current: 28μA (Typ.)
- Thermal Shutdown Protection
- High PSRR: 70dB@1KHz (Typ.)
- Over Current Protection
- Short Circuit Protection
- –40°C to 125°C Operating Junction Temperature
- SOT23-5/ SOT23-3/DFN4-1×1 Package

Applications

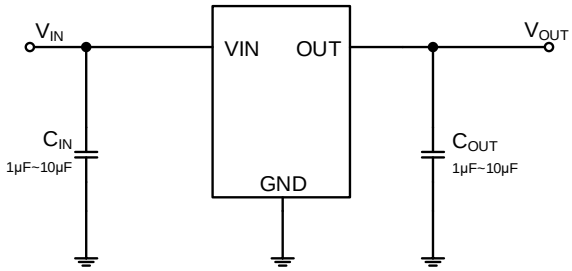
- Cellular Handsets
- Battery-Powered Equipment
- Wi-Fi Router
- Hand-Held Instruments
- Portable Information Application
- General power supply

General Description

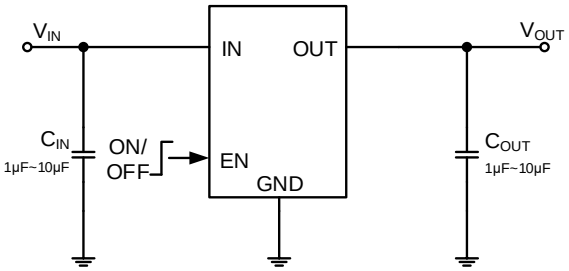
The RY6212 series are highly accurate, low noise, CMOS LDO Voltage Regulators. Offering low output noise, high ripple rejection ratio, low dropout, and very fast turn-on times. The RY6212's current limiters' feedback circuit also operates as a short protect for the output current limiter and the output pin. The output voltage is set by current trimming. Voltages are selectable in 50mV steps within a range of 1.1V to 4.5V.

The RY6212 series is also fully compatible with low ESR ceramic capacitors, reducing cost and improving output stability. This high level of 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 frequencies. The EN function allows the output of regulator to be turned off, resulting in greatly reduced power consumption. The RY6212 series are available in SOT23-3, SOT23-5, DFN4-1×1 package.

Typical Application Circuit



SOT23-3 Typical Application Circuit



SOT23-5/DFN1×1-4 Typical Application Circuit

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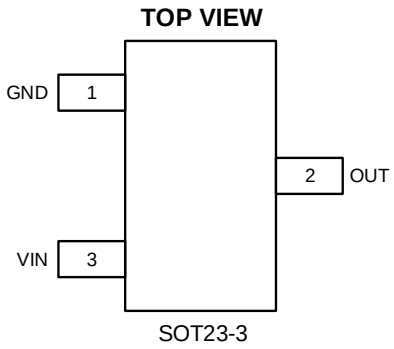
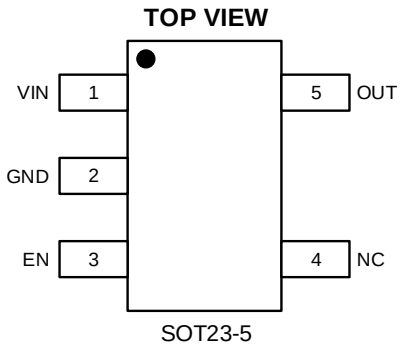
Pin Description

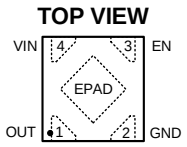
Pin Configuration



SOT23-3



SOT23-5



DFN1×1-4

Pin Description

SOT23-3 Pin No.	SOT23-5 Pin No.	DFN1×1-4 Pin No.	Pin Name	Function
3	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 1V turns on the regulator. Driving EN below 0.5 V puts the regulator into shutdown mode.
-	4	-	NC	Not Connected.
2	5	1	OUT	Output voltage pin for the regulator.
-	-	EPAD	EPAD	Exposed pad should be connected directly to the GND pin.

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Order Information (1)

RY6212-①②③④

Designator	Symbol	Description		
①②	Integer	Output Voltage		
③	M3	SOT23-3		
	M5	SOT23-5		
	D4	DFN1×1-4		
④	R	RoHS / Pb Free		
Part No.	**Model**	**Description**	**Package**	**T/R Qty**
70607000	RY6212-11M5R	RY6212-11M5R High PSRR LDO, 1.1V, SOT23-5	SOT23-5	3000PCS
70607001	RY6212-12M5R	RY6212-12M5R High PSRR LDO, 1.2V, SOT23-5	SOT23-5	3000PCS
70607009	RY6212-13M5R	RY6212-13M5R High PSRR LDO, 1.3V, SOT23-5	SOT23-5	3000PCS
70607002	RY6212-15M5R	RY6212-15M5R High PSRR LDO, 1.5V, SOT23-5	SOT23-5	3000PCS
70607003	RY6212-18M5R	RY6212-18M5R High PSRR LDO, 1.8V, SOT23-5	SOT23-5	3000PCS
70607010	RY6212-22M5R	RY6212-22M5R High PSRR LDO, 2.2V, SOT23-5	SOT23-5	3000PCS
70607004	RY6212-25M5R	RY6212-25M5R High PSRR LDO, 2.5V, SOT23-5	SOT23-5	3000PCS
70607005	RY6212-28M5R	RY6212-28M5R High PSRR LDO, 2.8V, SOT23-5	SOT23-5	3000PCS
70607006	RY6212-30M5R	RY6212-30M5R High PSRR LDO, 3.0V, SOT23-5	SOT23-5	3000PCS
70607007	RY6212-33M5R	RY6212-33M5R High PSRR LDO, 3.3V, SOT23-5	SOT23-5	3000PCS
70607008	RY6212-36M5R	RY6212-36M5R High PSRR LDO, 3.6V, SOT23-5	SOT23-5	3000PCS
70607011	RY6212-38M5R	RY6212-38M5R High PSRR LDO, 3.8V, SOT23-5	SOT23-5	3000PCS
70607012	RY6212-40M5R	RY6212-40M5R High PSRR LDO, 4.0V, SOT23-5	SOT23-5	3000PCS
70607013	RY6212-42M5R	RY6212-42M5R High PSRR LDO, 4.2V, SOT23-5	SOT23-5	3000PCS
70607040	RY6212-11M3R	RY6212-11M3R High PSRR LDO, 1.1V,	SOT23-3	3000PCS

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		SOT23-3		
70607041	RY6212-12M3R	RY6212-12M3R High PSRR LDO, 1.2V, SOT23-3	SOT23-3	3000PCS
70607049	RY6212-13M3R	RY6212-13M3R High PSRR LDO, 1.3V, SOT23-3	SOT23-3	3000PCS
70607042	RY6212-15M3R	RY6212-15M3R High PSRR LDO, 1.5V, SOT23-3	SOT23-3	3000PCS
70607043	RY6212-18M3R	RY6212-18M3R High PSRR LDO, 1.8V, SOT23-3	SOT23-3	3000PCS
70607050	RY6212-22M3R	RY6212-22M3R High PSRR LDO, 2.2V, SOT23-3	SOT23-3	3000PCS
70607044	RY6212-25M3R	RY6212-25M3R High PSRR LDO, 2.5V, SOT23-3	SOT23-3	3000PCS
70607045	RY6212-28M3R	RY6212-28M3R High PSRR LDO, 2.8V, SOT23-3	SOT23-3	3000PCS
70607046	RY6212-30M3R	RY6212-30M3R High PSRR LDO, 3.0V, SOT23-3	SOT23-3	3000PCS
70607047	RY6212-33M3R	RY6212-33M3R High PSRR LDO, 3.3V, SOT23-3	SOT23-3	3000PCS
70607048	RY6212-36M3R	RY6212-36M3R High PSRR LDO, 3.6V, SOT23-3	SOT23-3	3000PCS
70607051	RY6212-38M3R	RY6212-36M3R High PSRR LDO, 3.8V, SOT23-3	SOT23-3	3000PCS
70607052	RY6212-40M3R	RY6212-40M3R High PSRR LDO, 4.0V, SOT23-3	SOT23-3	3000PCS
70607053	RY6212-42M3R	RY6212-42M3R High PSRR LDO, 4.2V, SOT23-3	SOT23-3	3000PCS
70607080	RY6212-11D4R	RY6212-11D4R High PSRR LDO, 1.1V, DFN1×1-4	DFN1×1-4	10000PCS
70607081	RY6212-12D4R	RY6212-12D4R High PSRR LDO, 1.2V, DFN1×1-4	DFN1×1-4	10000PCS
70607090	RY6212-13D4R	RY6212-13D4R High PSRR LDO, 1.3V, DFN1×1-4	DFN1×1-4	10000PCS
70607092	RY6212-1BD4R	RY6212-1BD4R High PSRR LDO, 1.35V, DFN1×1-4	DFN1×1-4	10000PCS
70607082	RY6212-15D4R	RY6212-15D4R High PSRR LDO, 1.5V, DFN1×1-4	DFN1×1-4	10000PCS
70607083	RY6212-18D4R	RY6212-18D4R High PSRR LDO, 1.8V, DFN1×1-4	DFN1×1-4	10000PCS

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70607091	RY6212-22D4R	RY6212-22D4R High PSRR LDO, 2.2V, DFN1×1-4	DFN1×1-4	10000PCS
70607084	RY6212-25D4R	RY6212-25D4R High PSRR LDO, 2.5V, DFN1×1-4	DFN1×1-4	10000PCS
70607085	RY6212-28D4R	RY6212-28D4R High PSRR LDO, 2.8V, DFN1×1-4	DFN1×1-4	10000PCS
70607086	RY6212-2CD4R	RY6212-2CD4R High PSRR LDO, 2.85V, DFN1×1-4	DFN1×1-4	10000PCS
70607087	RY6212-30D4R	RY6212-30D4R High PSRR LDO, 3.0V, DFN1×1-4	DFN1×1-4	10000PCS
70607088	RY6212-33D4R	RY6212-33D4R High PSRR LDO, 3.3V, DFN1×1-4	DFN1×1-4	10000PCS
70607089	RY6212-36D4R	RY6212-36D4R High PSRR LDO, 3.6V, DFN1×1-4	DFN1×1-4	10000PCS
70607093	RY6212-38D4R	RY6212-38D4R High PSRR LDO, 3.8V, DFN1×1-4	DFN1×1-4	10000PCS
70607094	RY6212-40D4R	RY6212-40D4R High PSRR LDO, 4.0V, DFN1×1-4	DFN1×1-4	10000PCS
70607095	RY6212-42D4R	RY6212-42D4R High PSRR LDO, 4.2V, DFN1×1-4	DFN1×1-4	10000PCS

Note (1): All RYCHIP parts are Pb-Free and adhere to the RoHS directive.

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Mark Rule SOT23-5/SOT23-3

Voltage (V)	SOT23-5/SOT23-3/SOT23
1.2	LVBL
1.5	LVEL
1.8	LVKL
2.5	LVTL
2.8	LVXL
3.0	LVZL
3.3	LV2L
3.6	LA2L

Represents product series

Mark	Product Series
L	RY6212

Represents type of regulator

Mark		Product Series
V_{OUT}: 0.1V-3.3V	V_{OUT}: 3.4V-6.0V	RY6212
V	A	

Represents output Voltage

Mark	Output Voltage(V)				Mark	Output Voltage(V)			
0	-	3.1	-	3.15	F	1.6	4.6	1.65	4.65
1	-	3.2	-	3.25	H	1.7	4.7	1.75	4.75
2	-	3.3	-	3.35	K	1.8	4.8	1.85	4.85
3	-	3.4	-	3.45	L	1.9	4.9	1.95	4.95
4	-	3.5	-	3.55	M	2.0	5.0	2.05	-
5	-	3.6	-	3.65	N	2.1	-	2.15	-
6	-	3.7	-	3.75	P	2.2	-	2.25	-
7	-	3.8	-	3.85	R	2.3	-	2.35	--
8	0.9	3.9	0.95	3.95	S	2.4	-	2.45	-
9	1.0	4.0	1.05	4.05	T	2.5	-	2.55	-
A	1.1	4.1	1.15	4.15	U	2.6	-	2.65	-
B	1.2	4.2	1.25	4.25	V	2.7	-	2.75	-
C	1.3	4.3	1.35	4.35	X	2.8	-	2.85	-
D	1.4	4.4	1.45	4.45	Y	2.9	-	2.95	-
E	1.5	4.5	1.55	4.55	Z	3.0	-	3.05	-

Represents production lot number

L: The week of manufacturing. “A” stands for week 1, “Z” stands for week 26, “a” stands for week 27, “z” stands for week 52.

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Mark Rule DFN4-1×1

Voltage (V)	DFN1×1-4/ DFN2×2-6
1.2	LL12
1.5	LL15
1.8	LL18
2.5	LL25
2.8	LL28
2.85	LL2C
3.0	LL30
3.3	LL33
3.6	LL36

Represents product series

Mark	Product Series
L	RY6212

Represents production lot number

Mark	Lot Number
L	The week of manufacturing. "A" stands for week 1, "Z" stands for week 26, "a" stands for week 27, "z" stands for week 52.

Represents output Voltage

Mark	Output Voltage(V)
VV	Output voltage code. Example: 12=1.2V 28=2.8V 2C=2.85V

Mark Rule Update (1)

Marking	Designator	Description
PVVYL	P	Product Code
	VV AD	Fixed Version Output Voltage (1.1~4.5V) Adjustable Version
	Y	Year Code
	L	Lot Number Code

Note (1): More detail information, please check PCN of RY6212 marking update.

350mA High Speed Low Power LDO

Specifications

Absolute Maximum Ratings (1) (2)

Item	Min	Max	Unit
V_{IN} voltage	2	6	V
V_{OUT} voltage	1	5	V
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): The maximum allowable power dissipation is a function of the maximum junction temperature, $T_{J(MAX)}$, the junction-to-ambient thermal resistance, $R_{\theta JA}$, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D\,(MAX)} = (T_{J(MAX)} - T_A)/R_{\theta JA}$. 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= 135°C (typical).

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	350	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
$R_{\theta JA}$	Junction-to-ambient thermal resistance (1)(2)	208	195	216	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	112	102	161	°C/W
$R_{\theta JB}$	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
$R_{\theta JC(bot)}$	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

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Electrical Characteristics

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 350mA		V_{OUT}×0.98		V_{OUT}×1.02	V
Output Current	I_{OUT}	V_{IN}≥$V_{OUT(S)}$+1.0V			350		mA
Dropout Voltage	V_{drop}	V_{OUT}=0.98V_{OUT} (NOM), IOUT=350mA -40°C≤T_J≤125°C	3.3V		230		mV
			2.5V		250		
			1.2V		700		
Line Regulations	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	($V_{OUT(S)}$+1V) ≤V_{IN}≤5.5V I_{OUT}=1mA		-	0.20	0.60	%/V
Load Regulation	$\frac{\Delta V_{OUT}}{V_{OUT}}$	V_{IN}=$V_{OUT(S)}$+1.0 V I_{OUT} = 1mA to 350mA		-	0.50	2	%
Quiescent current	I_{SS1}	V_{IN}=$V_{OUT(S)}$+1.0 V		-	28		μA
Shutdown Current	I_{SD}	V_{EN}=0.3V (Disable)			0.1		μA
Power Supply Rejection Ratio	PSRR	V_{OUT}=2.5V I_{OUT}=20 mA	f = 1KHz	-	70	-	dB
			f = 10kHz		60	-	dB
Output Noise Voltage	V_N	BW=10Hz to 100kHz, C_{OUT} =10μF	I_{OUT}=1mA		40		μV_{RMS}
			I_{OUT}=350mA		30		
Short-Circuit Current Limit	I_{SC}				500		mA
High Input Threshold	V_{ENH}	VEN rising until the output is enabled		1			V
Low Input Threshold	V_{ENL}	VEN falling until the output is disabled				0.5	V
Input Current at EN pin	I_{EN}	V_{EN}=5.5V and V_{IN}=5.5V			0.1		μA
Thermal Shutdown Temperature	T_{SD}	T_J rising			155		°C
Thermal Shutdown Hysteresis	ΔT_{SD}	T_J falling from shutdown			20		°C

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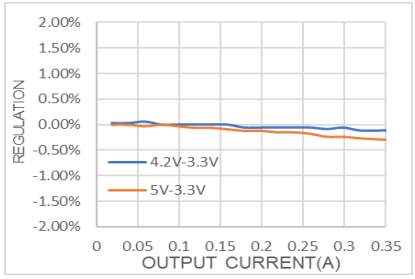
Typical Performance Characteristics (1)

Note (1): Typical performance characteristics below based on T_A = 25°C, unless otherwise noted.

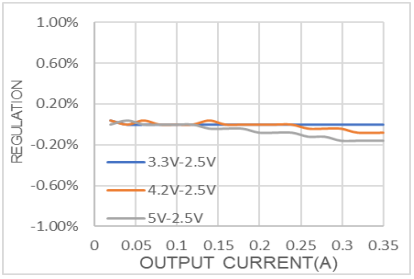
Load Regulation

V_{OUT}=3.3V



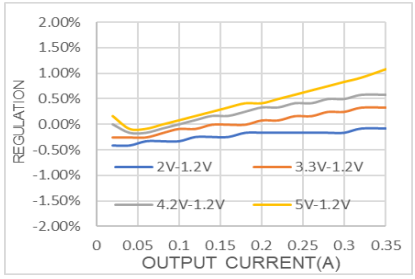
Load Regulation

V_{OUT}= 2.5V



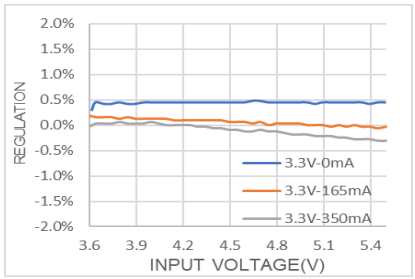
Load Regulation

V_{OUT}=1.2V



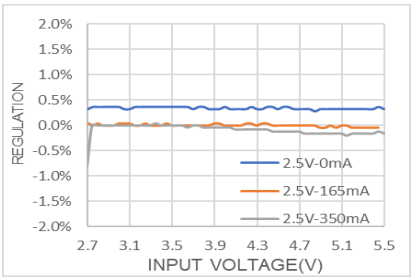
Line Regulation

V_{OUT}=3.3V



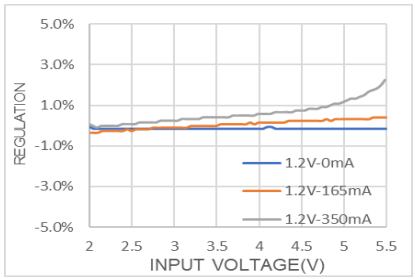
Line Regulation

V_{OUT}=2.5V



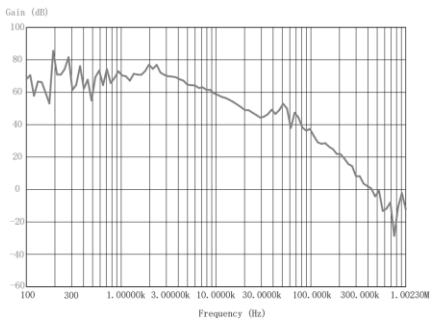
Line Regulation

V_{OUT}=1.2V



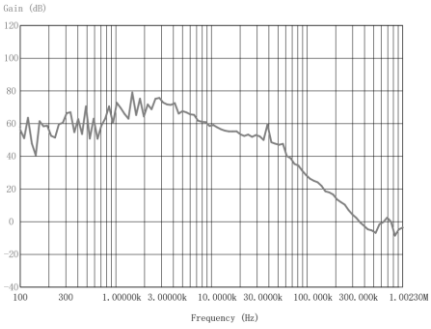
Power Supply Rejection Ration

V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=20mA



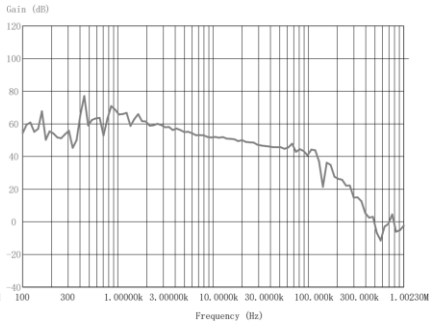
Power Supply Rejection Ration

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=20mA



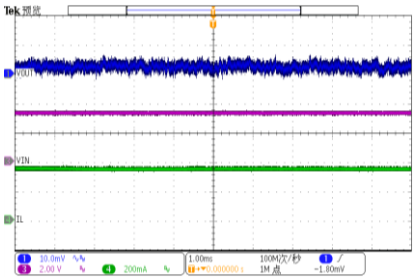
Power Supply Rejection Ration

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



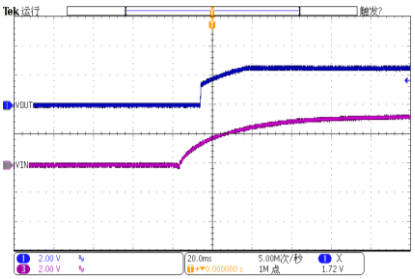
Steady State

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=350mA



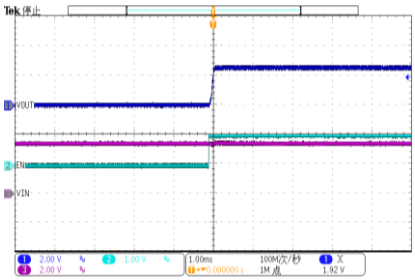
Vin Start Up

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=1mA



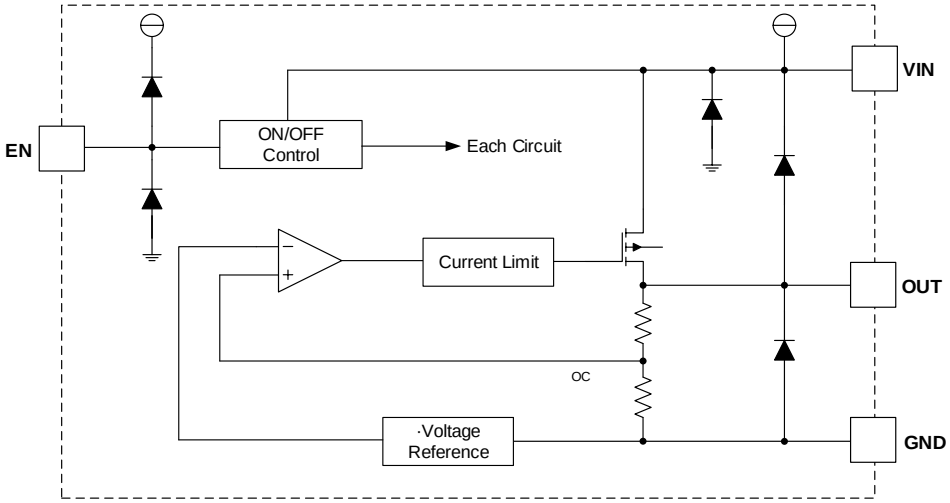
EN Start Up

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=1mA



350mA High PSRR, Low Noise, Low Power LDO

Functional Block Diagram



Functional Block Diagram

Functions Description

The RY6212 low-dropout regulators (LDO) consumes low quiescent current and delivers excellent line and load transient performance. These characteristics, combined with low noise and good PSRR with low dropout voltage, make this device ideal for portable consumer applications.

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.

Dropout Operation

If the input voltage is lower than the nominal output voltage plus the specified dropout voltage, but all other conditions are met for normal operation, the device operates in dropout mode. In this mode, the output voltage tracks the input voltage. During this mode, the transient performance of the device becomes significantly degraded because the pass transistor is in the ohmic or triode region, and acts as a switch. Line or load transients in dropout can result in large output-voltage deviations.

Internal Current Limit and Short-Circuit Protection

The device has an internal current limit circuit that protects the regulator during transient high-load current faults or shorting events. The current limit is a foldback scheme. The scheme limits the output current to the current limit. A foldback current limit activates that scales back the current as the output voltage approaches GND. When the output is shorted, the device supplies a typical current called the short-circuit current limit (I_{SC}). I_{SC} are listed in the Electrical Characteristics table.

Thermal Shutdown Protection (T_{SD})

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Thermal shutdown disables the output when the junction temperature rises to approximately 155°C which allows the device to cool. When the junction temperature cools to approximately 135°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 RY6212 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 RY6212 device into thermal shutdown may degrade device reliability.

Applications Information

Output Voltage

The RY6212's output voltages are selectable in 50mV steps within a range of 1.1V to 4.5V. Customers can select the required output voltage value according to the selection table. Larger power loss occurs when the input and output voltage difference is large and the load current is large.

Input and Output Capacitor Selection

The RY6212 requires an output capacitance of 1-10 μF or larger for stability. Use X5R- and X7R-type ceramic capacitors because these capacitors have minimal variation in value and equivalent series resistance (ESR) over temperature. When choosing a capacitor for a specific application, pay attention to the dc bias characteristics for the capacitor. Higher output voltages cause a significant derating of the capacitor.

The input capacitor reactive input sources and improves transient response, input ripple, and PSRR. If the input supply has a high impedance over a large range of frequencies, several input capacitors can be used in parallel to lower the impedance over frequency. Use a higher-value capacitor if large, fast, rise-time load transients are anticipated, or if the device is located several inches from the input power source. For most application, 1-10 μF is ok.

Reverse Current

Excessive reverse current will damage the device. Reverse current flows through the body diode on the pass element instead of the normal conducting channel. When the output capacitance is too large and the load is small, turning off the input may produce a reverse current from the output to the input. Directly giving the output a bias voltage higher than the input will also produce a reverse current. In either case, a large reverse current will affect the long-term reliability of the device. When a relatively large reverse current is expected in the application, a Schottky diode can be added from the output to the input to prevent damage to the device.

Power Dissipation

Power dissipation in the regulator depends on the input-to-output voltage difference and load conditions.

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

In the case of meeting the output requirements, you can consider using the smallest possible input voltage, which can reduce the power loss caused by the pressure difference and reduce the heat.

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Layout Guidelines

The dynamic performance of the RY6212 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.
4. The PCB area around the regulator must have few or no other heat-generating devices that cause added thermal stress.

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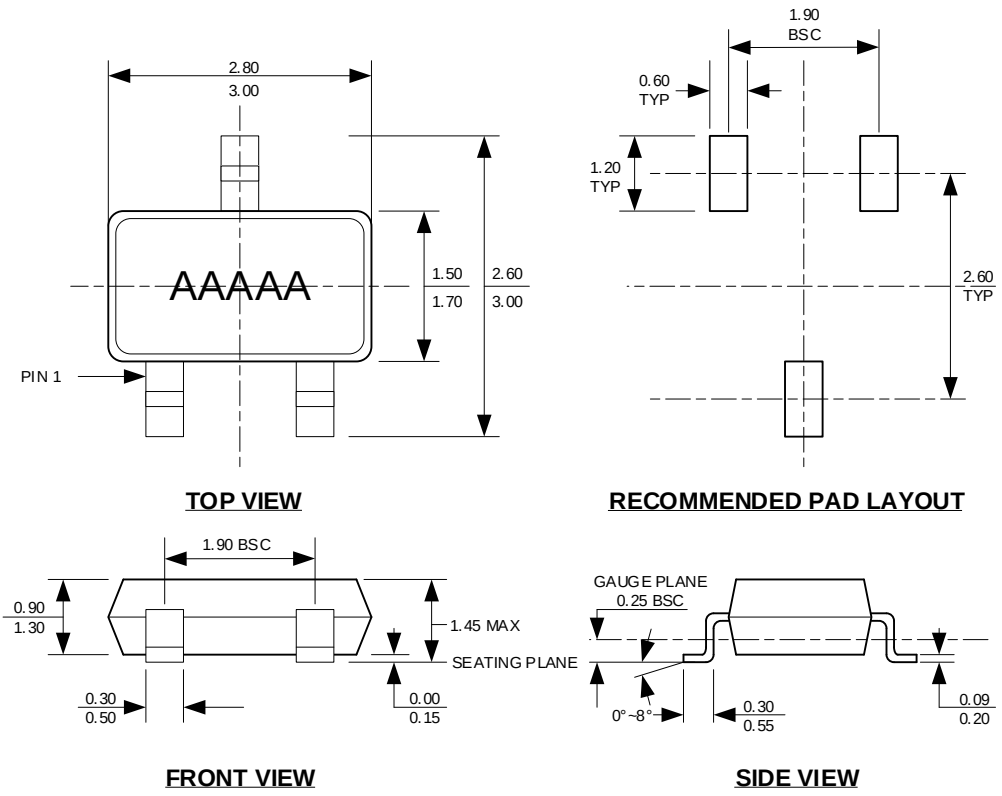
Packaging Information

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.

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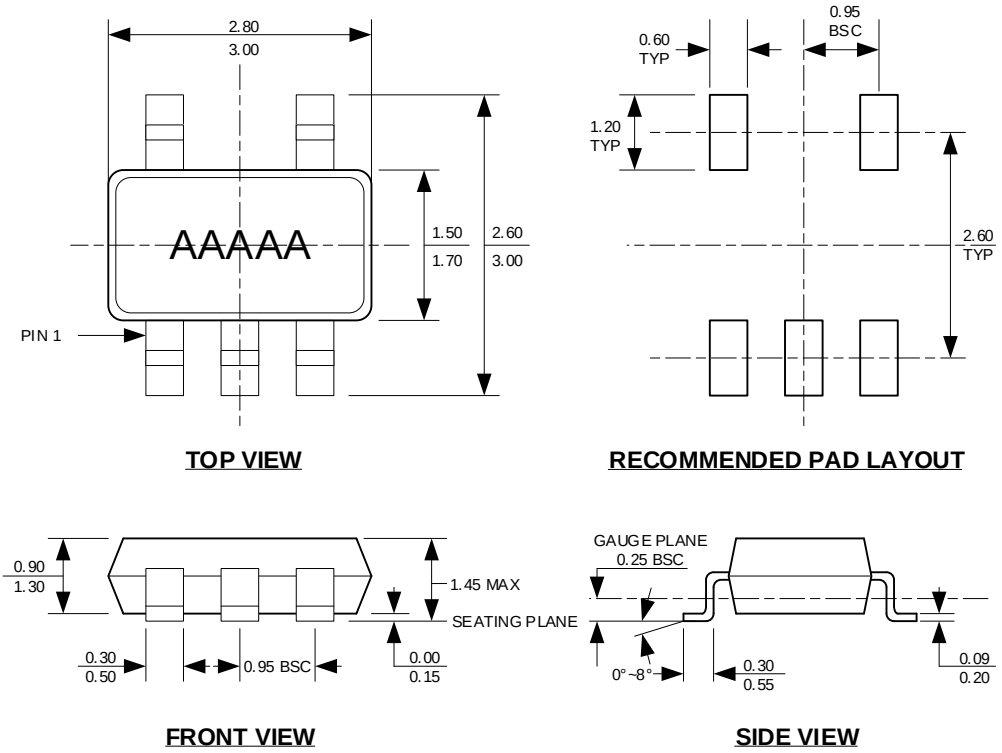
5-Pin SOT23 Packaging Information

SOT23-5



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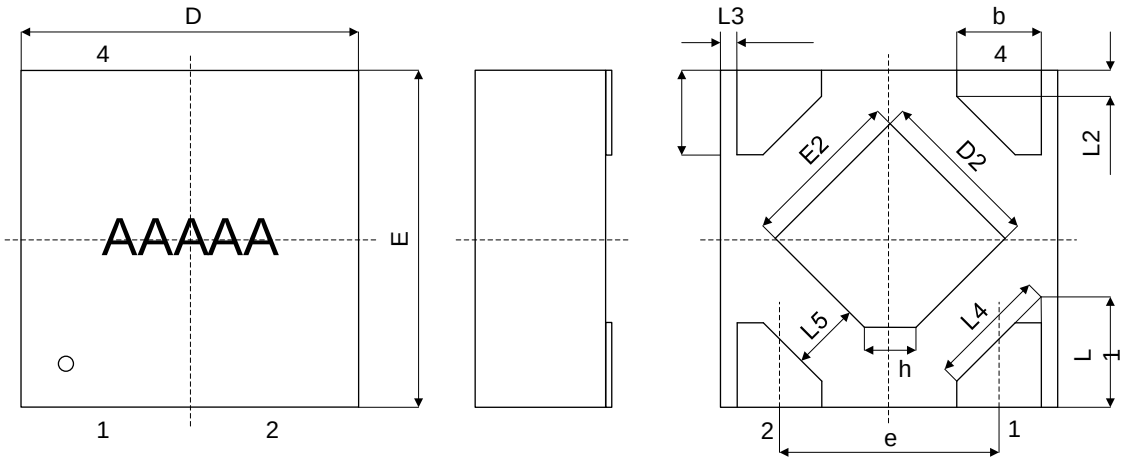
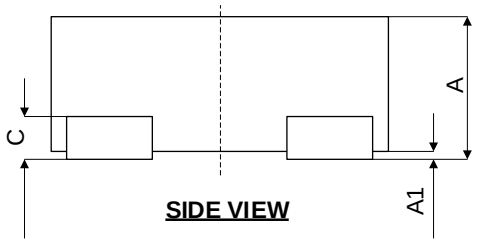
4-Pin DFN1×1 Packaging Information

DFN1x1-4



TOP VIEW

BOTTOM VIEW



SIDE VIEW

Symbol \ DIM	Min (mm)	Nom (mm)	Max (mm)
A	0.35	-	0.40
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		

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