

RVL020-5 Low-dropout Linear Regulator

20VIN ◇ 0.3A ◇ SOT-89 ◇ 5V

FEATURES

- Maximum input voltage: 20V
- Output voltage accuracy: $\pm 2\%$
- Maximum output current: 300mA
- Dropout voltage: 300mV @ $I_{OUT} = 200\text{mA}$
- No-load current consumption: 25 μ A
- Maximum output current limiting
- Built-in short-circuit protection
- Built-in over-temperature protection
- Supports low-ESR output capacitors
- -40 °C to 125 °C industrial temperature range

APPLICATIONS

- Industrial auxiliary power supply
- Car audio and navigation systems
- Laptops / tablets
- Mobile devices / terminals

DESCRIPTION

RVL020-5 is a low-dropout linear regulator designed using a high-voltage BCD process. It supports a maximum input voltage of 20 V and provides a 5 V output, which is trimmed and calibrated to achieve an accuracy of $\pm 2\%$.

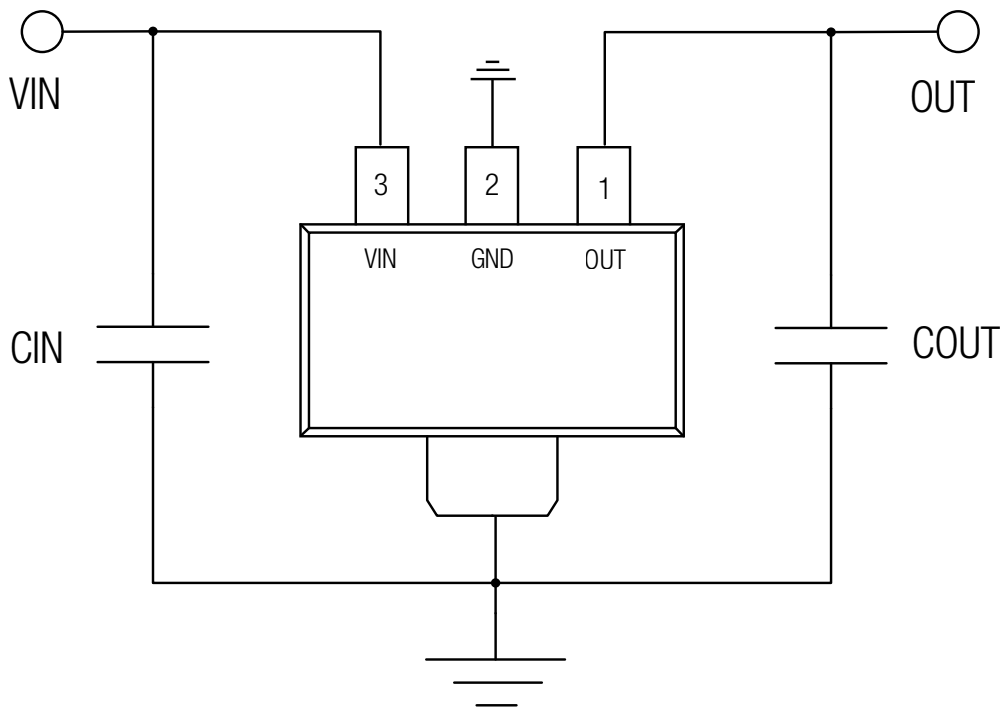
The RVL020-5 uses a PMOS pass transistor to achieve low dropout performance. The dropout voltage is 300 mV at an output current of 200 mA. The internally integrated loop compensation ensures stability even when using low-ESR output capacitors. A larger output capacitor provides greater phase margin, and an output capacitor of at least 2 μ F is recommended.

The RVL020-5 limits current under output short-circuit conditions to provide protection, and also restricts the maximum output current to prevent excessive power dissipation and device damage. Combined with built-in over-temperature protection, these features ensure overall device reliability.

DEVICE INFORMATION

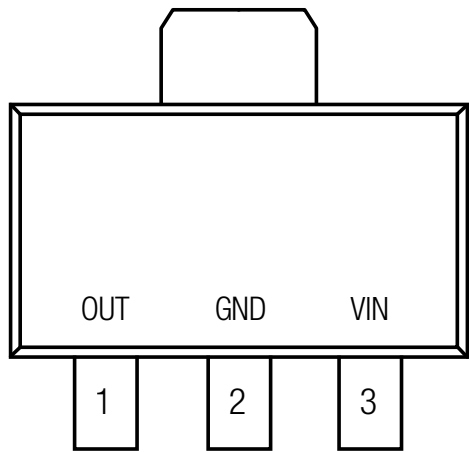
Part number	Package type	Dimension	SPQ
RVL020-5	SOT-89	4.5mm×4.1mm	4000

SIMPLIFIED SCHEMATIC



Reference	Recommended value	Max. value
CIN	1μF	> 1μF
COUT	2.2μF	< 22μF

PIN CONFIGURATION AND FUNCTIONS



SOT-89 Pin No.	Name	Description
1	OUT	Output pin. Place a capacitor between OUT and GND pin.
2	GND	Chip ground.
3	VIN	Input pin. Place a capacitor between OUT and GND pin.
/	EP	Exposed pad, internally connected to GND. Connect EP to a large ground area to improve thermal dissipation. The exposed pad is not used as an electrical connection point.

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TECHNICAL SPECIFICATION**Absolute maximum ratings**

		Min.	Max.	Unit
VIN to GND voltage range	V_{IN}	-0.3	25	V
OUT to GND	V_{OUT}	-0.3	20	V
OUT output current	I_{OUT}	0	600	mA
Maximum operating junction temperature	T_{JMAX}		150	°C
Storage temperature	T_{stg}	-55	150	°C

Stress levels exceeding the absolute maximum ratings may cause permanent damage to the device. These are stress ratings only and do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Prolonged exposure to absolute maximum rating conditions may affect device reliability. All voltages are referenced to ground. Currents are positive into and negative out of the specified terminal.

ESD ratings

			Value	Unit
V _(ESD)	ESD Ratings	Human Body Model (HBM), per ESDA/JEDEC JS-001-2017, (Zap 1 pulse, Interval: ≥ 0.1s) ⁽¹⁾	±2000	V
		Charged Device Model (CDM), per ESDA/JEDEC JS-002-2014 ⁽²⁾	±1000	V

Note (1): JEDEC document JEP155 states that 500-V HBM allows safe manufacturing in standard ESD control processes.

Note (2): JEDEC document JEP157 states that 250-V CDM allows safe manufacturing in standard ESD control processes.

Recommended operating conditions

		Min.	Typ.	Max.	Unit
VIN operating voltage range	V_{IN}			20	V
OUT voltage	V_{OUT}	0		15	V
OUT output current	I_{OUT}	0		300	mA
Operating temperature	T_J	-40		125	°C

Electrical characteristics

(the following parameters are measured under the conditions of $V_{IN} = 7V$ and $T_{AMB} = 25^\circ C$, unless otherwise stated)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{OUT(REG)}$	Output voltage	$I_{OUT} = 10mA$	4.9	5	5.1	V
ΔV_{OUT}	Output voltage variation with load	$10mA \leq I_{OUT} \leq 300mA$		40	100	mV
V_{DO}	Dropout voltage	$I_{OUT} = 100mA$, $V_{OUT} = 0.98 \times V_{OUT(REG)}$		120	300	mV
		$I_{OUT} = 200mA$, $V_{OUT} = 0.98 \times V_{OUT(REG)}$		300	700	mV
$\Delta V_{OUT} / (\Delta V_{IN} \times V_{OUT})$	Line regulation	$7V \leq V_{IN} \leq 20V$, $I_{OUT} = 1mA$		0.01	0.02	%
$\Delta V_{OUT} / (\Delta T_J \times V_{OUT})$	Temperature coefficient	$V_{IN} = 7V$, $I_{OUT} = 1mA$, $-40^\circ C \leq T_J \leq 125^\circ C$		± 80		ppm/°C
I_{GND}	Ground current at no load	OUT no load	15	25	50	μA
I_{SHORT}	Short-circuit current	$V_{OUT} = 0V$, $V_{IN} = 7V$	18	25	60	mA
I_{LIM}	Maximum output current limit	$V_{OUT} = 0.98 \times V_{OUT(REG)}$, $V_{IN} = 7V$	400	550		mA
T_{SHDN}	Over-temperature protection threshold			162		°C
T_{HYS}	Over-temperature protection hysteresis			19		°C

TECHNICAL SPECIFICATION

Typical characteristic curve

Figure 1. $V_{OUT(REG)}$ vs Temperature

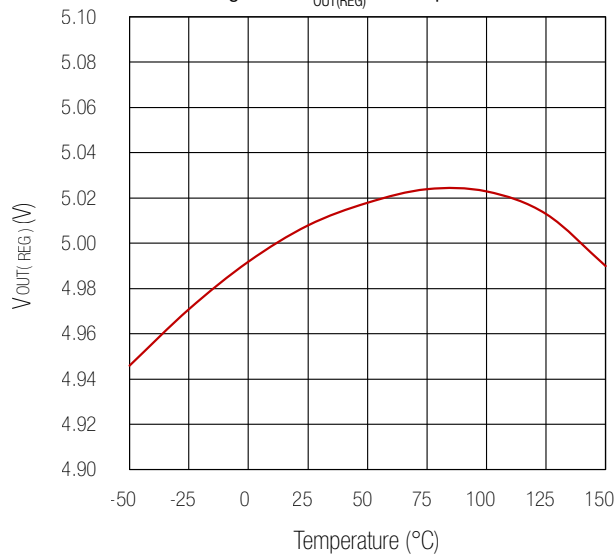


Figure 2. I_{GND} vs Temperature

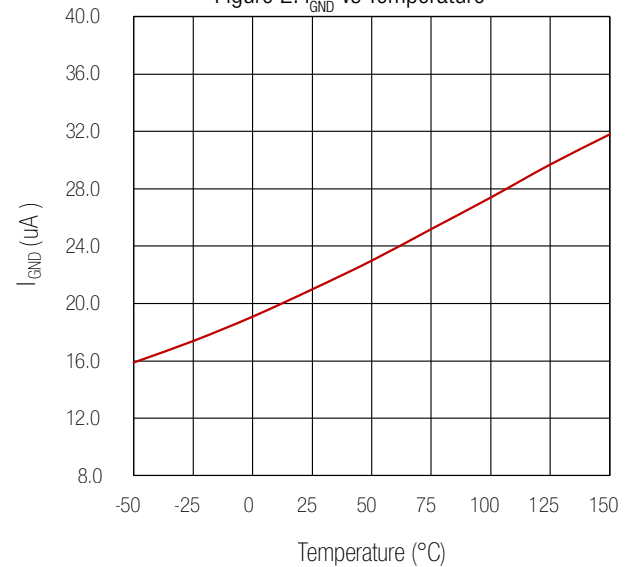


Figure 3. I_{SHORT} vs Temperature

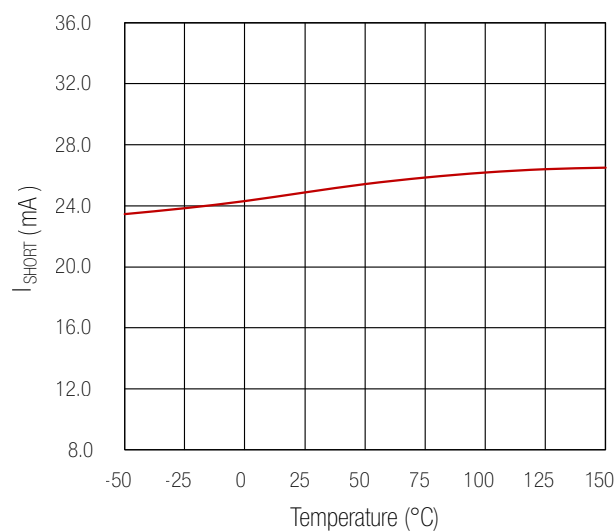


Figure 4. I_{LIM} vs Temperature

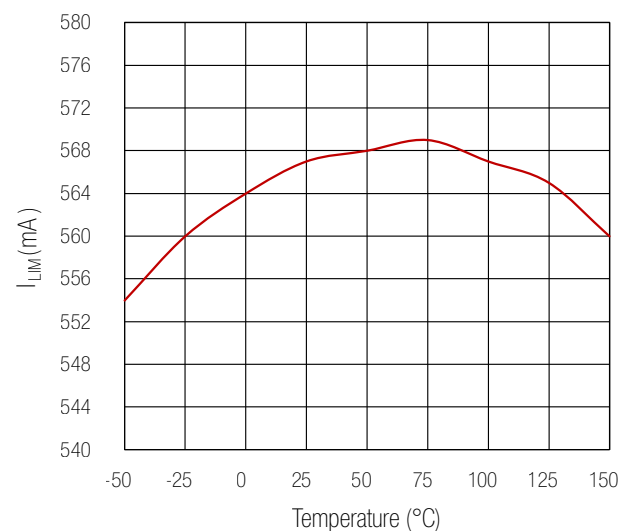


Figure 5. V_{OUT} vs V_{IN}

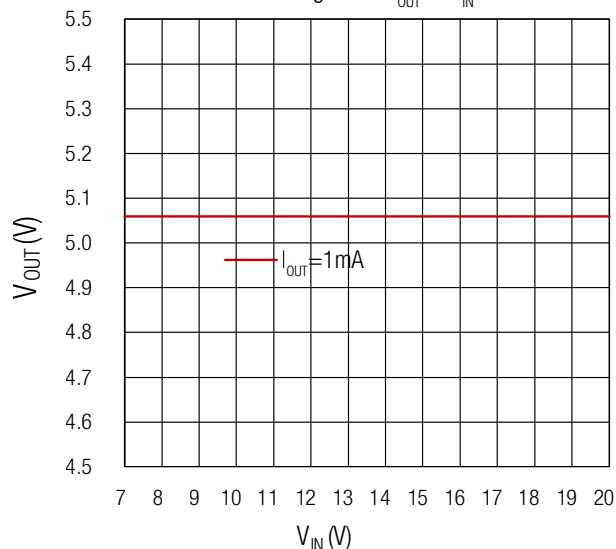
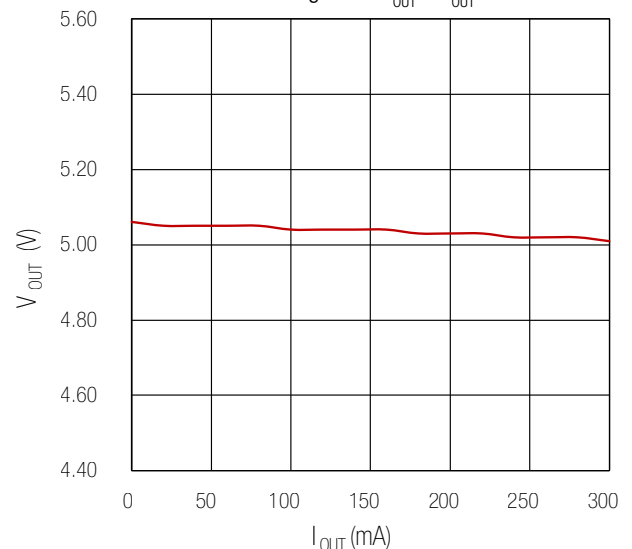
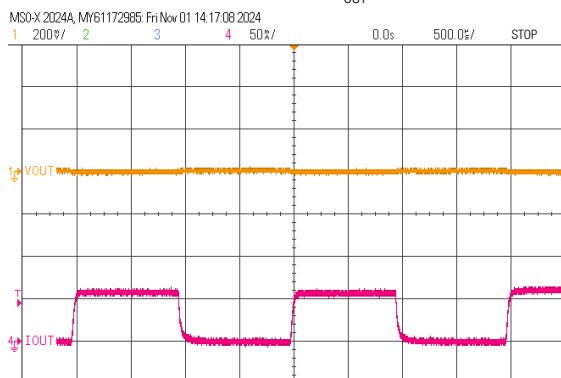
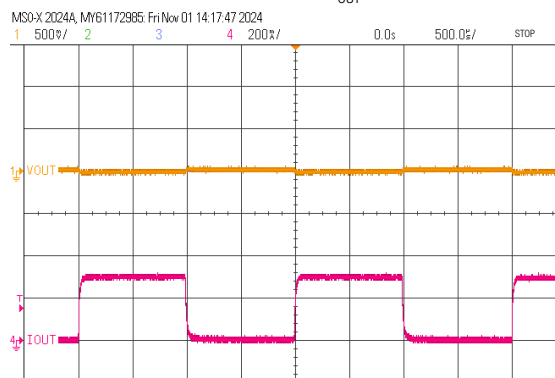
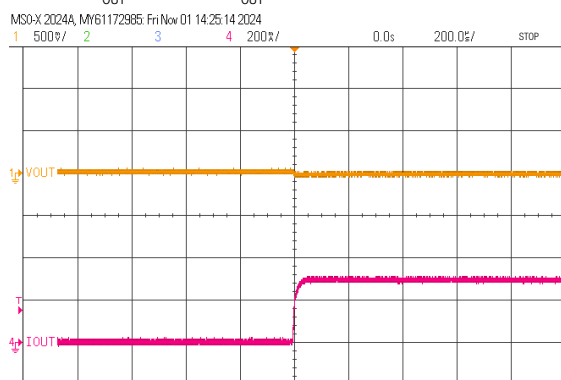
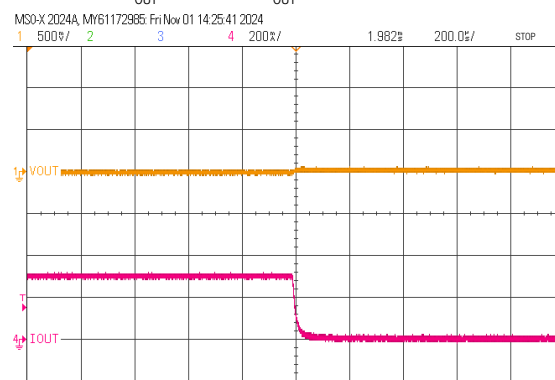
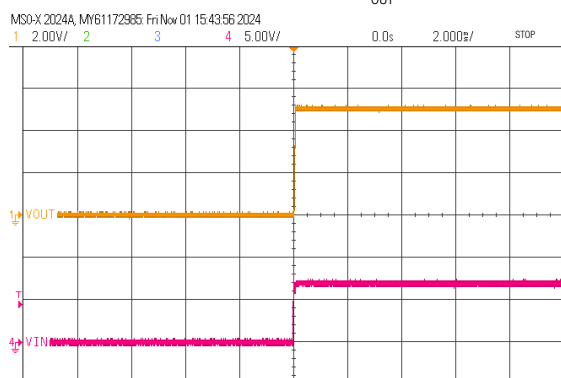
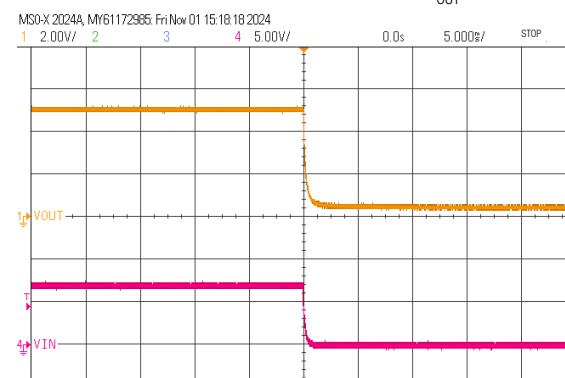
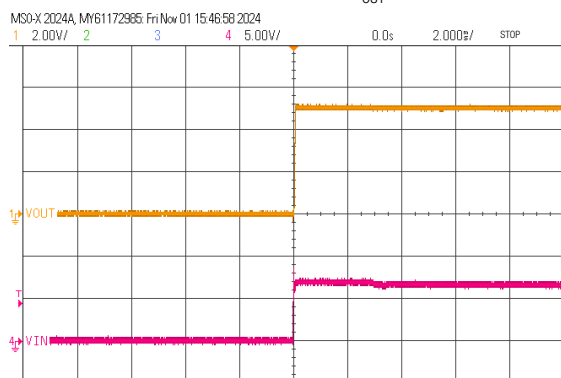
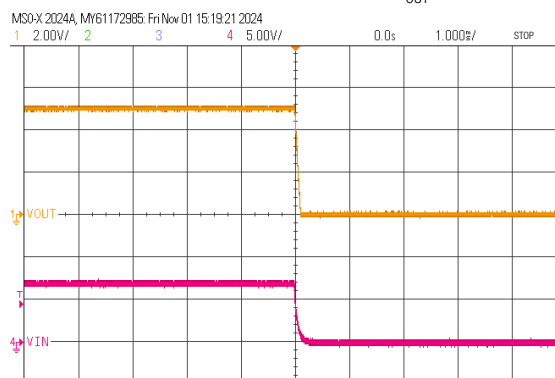


Figure 6. V_{OUT} vs I_{OUT}



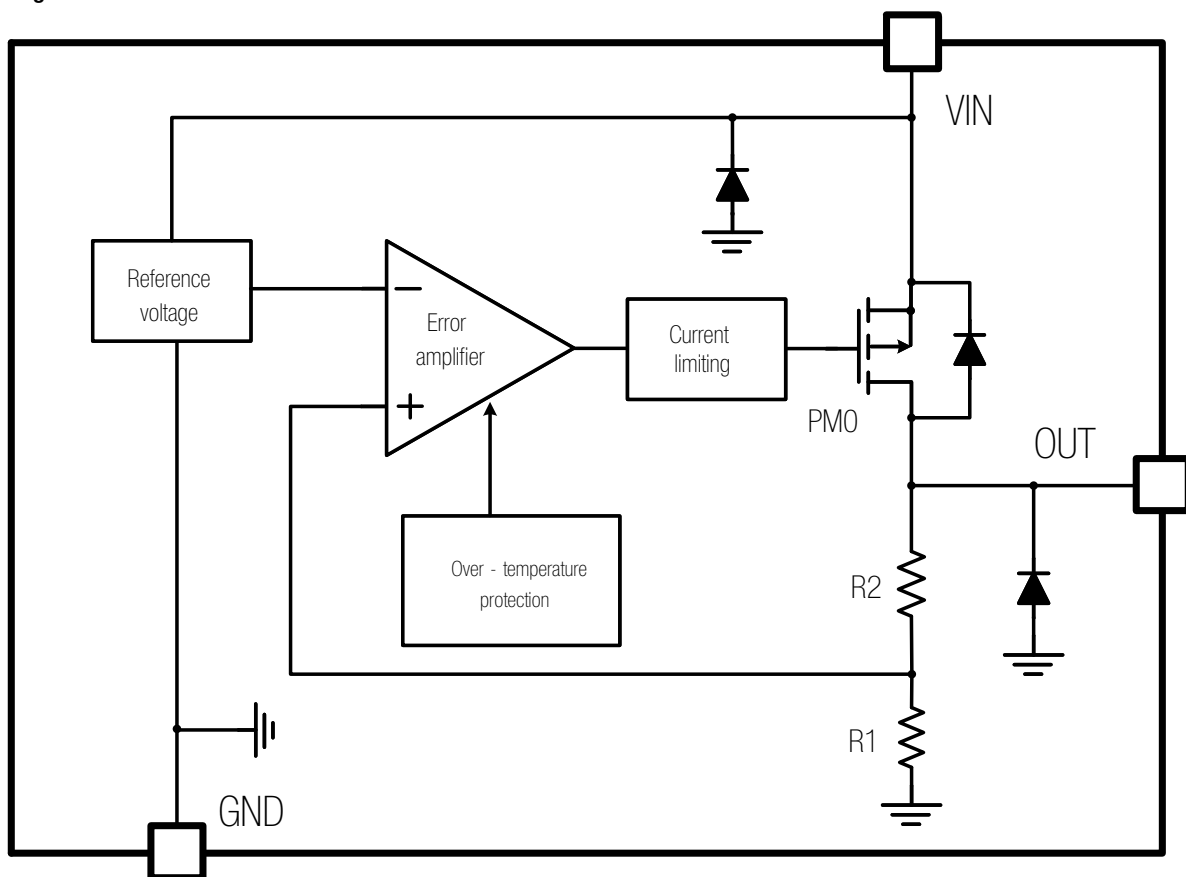
TECHNICAL SPECIFICATION**Typical characteristic curve**Figure 7. Transient response test: $I_{OUT} = 1\text{mA}-60\text{mA}-1\text{mA}$ Figure 8. Transient response test: $I_{OUT} = 1\text{mA}-300\text{mA}-1\text{mA}$ Figure 9. V_{OUT} waveform: I_{OUT} steps from 0 mA to 300 mAFigure 10. V_{OUT} waveform: I_{OUT} steps from 300mA to 0mAFigure 11. Startup waveform at $I_{OUT} = 1\text{mA}$ Figure 12. Shut down waveform at $I_{OUT} = 1\text{mA}$ Figure 13. Startup waveform at $I_{OUT} = 300\text{mA}$ Figure 14. Shut down waveform at $I_{OUT} = 300\text{mA}$ 

RVL020-5 Low-dropout Linear Regulator20VIN $\diamond$ 0.3A $\diamond$ SOT-89 $\diamond$ 5V**FUNCTIONS AND PRINCIPLES****Overview**

RVL020-5 is a low-dropout linear regulator designed using a high-voltage BCD process. It supports a maximum input voltage of 20 V and provides a 5 V output, which is trimmed and calibrated to maintain output accuracy within $\pm 2\%$.

It uses a PMOS pass transistor to achieve low-dropout performance, with a dropout voltage of 300 mV at an output current of 200 mA. The internally integrated loop compensation circuit maintains loop stability even when low-ESR output capacitors are used. Larger output capacitance provides greater phase margin, and an output capacitor greater than 2 μF is recommended.

The RVL020-5 provides current limiting protection under output short-circuit conditions and also limits the maximum output current to prevent excessive power dissipation and device damage. Combined with built-in over-temperature protection, these features ensure overall device reliability.

Functional diagram**Feature descriptions****Output voltage**

The RVL020-5 internally integrates resistor dividers R1 and R2 for sampling the output voltage VOUT. The sampled voltage is compared with the reference voltage and amplified by the error amplifier to regulate the gate voltage of the P-channel MOSFET PMO. When the voltage at the OUT pin is higher than the regulated value (typically 5 V), the error amplifier increases the gate voltage of PMO, causing VOUT to decrease. When the voltage at the OUT pin is lower than the regulated value, the error amplifier decreases the gate voltage of PMO, causing VOUT to increase. Through this negative-feedback closed-loop regulation, the OUT pin voltage is ultimately stabilized at the typical value of 5 V. It is recommended that the capacitor connected to the OUT pin be greater than 2 μF .

Short-circuit current I_{SHORT} and maximum current limit I_{LIM}

The RVL020-5 features short-circuit protection and maximum output current limiting functions. When the OUT pin is shorted to GND, the gate voltage of the power transistor PMO is limited so that the current is restricted to only 25 mA, preventing device damage under abnormal short-circuit conditions at the OUT pin. During normal startup, as the OUT voltage increases, the output current also rises rapidly. Due to the maximum output current limiting function of the RVL020-5, the output current can only increase up to I_{LIM} .

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FUNCTIONS AND PRINCIPLES

Feature descriptions

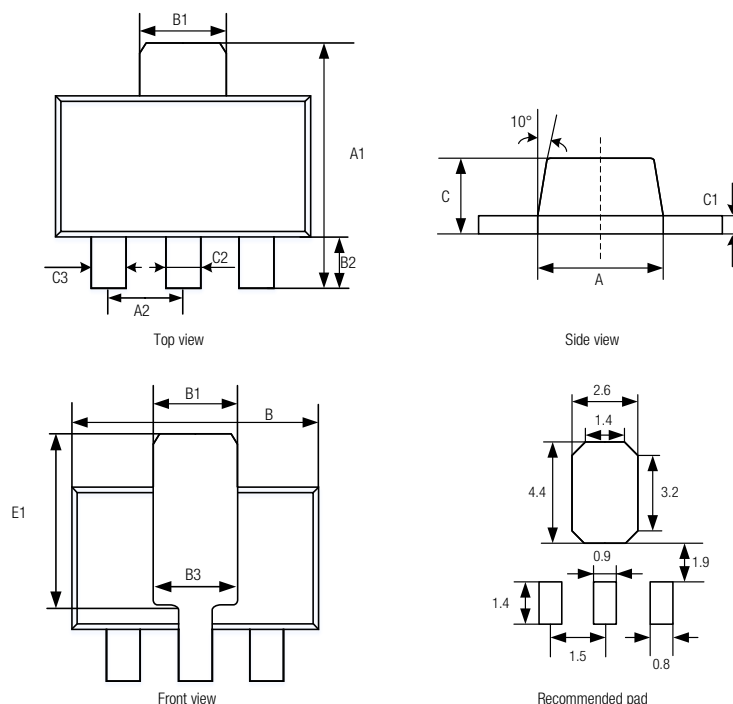
Over-temperature protection

The RVL020-5 incorporates an over-temperature protection function. When the junction temperature exceeds T_{SHDN} , the OUT output is shut down. When the temperature drops below $(T_{SHDN} - T_{HYS})$, the OUT voltage output resumes.

The short-circuit protection and maximum current limiting functions directly prevent device damage caused by excessive current. However, under high input voltage conditions, current limiting alone may not be sufficient, as excessive power dissipation can still lead to overheating and device failure. Therefore, the addition of over-temperature protection provides comprehensive protection to ensure device reliability.

PACKAGING INFORMATION

SOT-89



Dimension table			
Symbol	Millimeter		
	Min.	Nom.	Max.
A	2.35	2.45	2.55
A1	4	4.1	4.2
A2	1.45	1.5	1.55
B	4.4	4.5	4.6
B1	-	1.55 Ref	-
B2	1	1.1	1.2
B3	-	1.63 Ref	-
C	1.45	1.5	1.55
C1	0.39	0.4	0.41
C2	0.4	0.48	0.55
C3	0.35	0.4	0.45
E1	2.65	2.75	2.85

ORDER INFORMATION

Part number	Package	PIN	Package type	SPQ	Marking code*	MSL
RVL020-5-R	SOT-89	3	Tape and reel	4000	RVL0205	MSL-3
RVL020-5-CT	SOT-89	3	Moisture barrier bag	10	RVL0205	MSL-3

*Marking code

RVL0205—— Product code