National Semiconductor

LM3411
Precision Secondary Regulator/Driver

General Description

The LM3411 is a low power fixed-voltage (3.3V or 5.0V) precision shunt regulator designed specifically for driving an optoisolator to provide feedback isolation in a switching regulator.

The LM3411 circuitry includes an internally compensated op amp, a bandgap reference, NPN output transistor, and voltage setting resistors.

A trimmed precision bandgap reference with temperature drift curvature correction, provides a guaranteed 1% precision over the operating temperature range (A grade version). The amplifier's inverting input is externally accessible for loop frequency compensation when used as part of a larger servo system. The output is an open-emitter NPN transistor capable of driving up to 15 mA of load current.

Because of its small die size, the LM3411 has been made available in the sub-miniature 5-lead SOT23-5 surface mount package. This package is ideal for use in space critical applications.

Although its main application is to provide a precision output voltage (no trimming required) and maintain very good regulation in isolated DC/DC converters, it can also be used with other types of voltage regulators or power semiconductors to provide a precision output voltage without precision resistors or trimming.

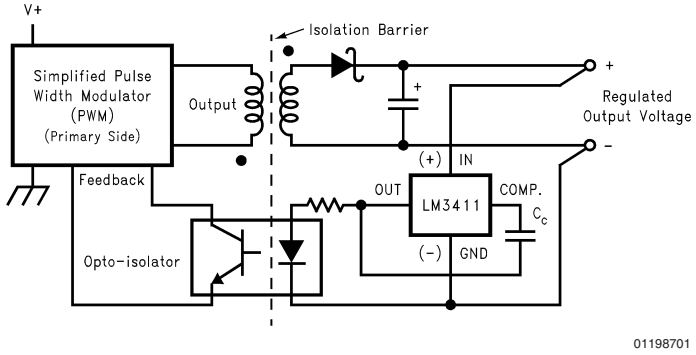
Features

- Fixed voltages of 3.3V and 5.0V with initial tolerance of ±1% for standard grade and ±0.5% for A grade
- Custom voltages available (3V–17V)
- Wide output current range, 20 µA–15 mA
- Low temperature coefficient
- Available in 5-lead SOT23-5 surface mount package (tape and reel)

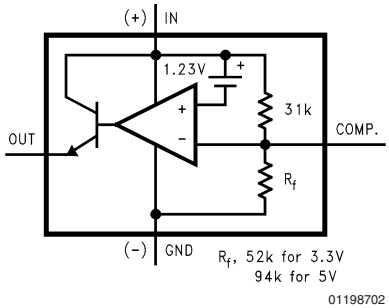
Applications

- Secondary controller for isolated DC/DC PWM switching regulators systems
- Use with LDO regulator for high-precision fixed output regulators
- Precision monitoring applications
- Use with many types of regulators to increase precision and improve performance

Typical Application and Functional Diagram



Basic Isolated DC/DC Converter



LM3411 Functional Diagram

Connection Diagrams and Order Information

Actual Size

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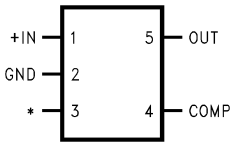
5-Lead Small Outline Package (M5)



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*No internal connection, but should be soldered to PC board for best heat transfer.

Top View

For Ordering Information
See *Figure 1* in this Data Sheet
See NS Package Number MF05A

Five Lead Surface Mount Package Marking and Order Information (SOT23-5)

The small SOT23-5 package allows only 4 alphanumeric characters to identify the product. The table below contains the field information marked on the package.

	Grade	Order Information	Package Marking	Supplied as
3.3V	A (Prime)	LM3411AM5-3.3	D00A	1000 unit increments on tape and reel
3.3V	A (Prime)	LM3411AM5X-3.3	D00A	3000 unit increments on tape and reel
3.3V	B (Standard)	LM3411M5-3.3	D00B	1000 unit increments on tape and reel
3.3V	B (Standard)	LM3411M5X-3.3	D00B	3000 unit increments on tape and reel
5.0V	A (Prime)	LM3411AM5-5.0	D01A	1000 unit increments on tape and reel
5.0V	A (Prime)	LM3411AM5X-5.0	D01A	3000 unit increments on tape and reel
5.0V	B (Standard)	LM3411M5-5.0	D01B	1000 unit increments on tape and reel
5.0V	B (Standard)	LM3411M5X-5.0	D01B	3000 unit increments on tape and reel

FIGURE 1. SOT23-5 Marking and Order Information

The first letter “D” identifies the part as a Driver, the next two numbers indicate the voltage, “00” for 3.3V part and “01” for a 5V part. The fourth letter indicates the grade, “B” for standard grade, “A” for the prime grade.

The SOT23-5 surface mount package is only available on tape in quantities increments of 250 on tape and reel (indicated by the letters “M5” in the part number), or in quantities increments of 3000 on tape and reel (indicated by the letters “M5X” in the part number).

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Input Voltage V(IN)	20V
Output Current	20 mA
Junction Temperature	150˚C
Storage Temperature	−65˚C to +150˚C
Lead Temperature	
Vapor Phase (60 sec.)	+215˚C
Infrared (15 sec.)	+220˚C
Power Dissipation (T_A = 25˚C) (Note 2)	300 mW
ESD Susceptibility (Note 3)	
Human Body Model	1500V

See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for methods on soldering surface-mount devices.

Operating Ratings (Notes 1, 2)

Ambient Temperature Range	$-40˚C \le T_A \le +85˚C$
Junction Temperature Range	$-40˚C \le T_J \le +125˚C$
Output Current	15 mA

LM3411-3.3 Electrical Characteristics

Specifications with standard type face are for T_J = 25˚C, and those with **boldface type** apply over **full Operating Temperature Range**. Unless otherwise specified, V(IN) = V_{REG}, V_{OUT} = 1.5V.

Symbol	Parameter	Conditions	Typical (Note 4)	LM3411A-3.3 Limit (Note 5)	LM3411-3.3 Limit (Note 5)	Units (Limits)
V_{REG}	Regulation Voltage	I_{OUT} = 5 mA	3.3	3.317/**3.333** 3.284/**3.267**	3.333/**3.366** 3.267/**3.234**	V V(max) V(min)
	Regulation Voltage Tolerance	I_{OUT} = 5 mA		±0.5/**±1**	±1/**±2**	%(max)
I_q	Quiescent Current	I_{OUT} = 5 mA	85	110/**115**	125/**150**	µA µA(max)
G_m	Transconductance $\Delta I_{OUT}/\Delta V_{REG}$	20 µA ≤ I_{OUT} ≤ 1 mA	3.3	1.5/**0.75**	1/**0.50**	mA/mV mA/mV(min)
		1 mA ≤ I_{OUT} ≤ 15 mA	6.0	3.3/**2.0**	2.5/**1.7**	mA/mV mA/mV(min)
A_V	Voltage Gain $\Delta V_{OUT}/\Delta V_{REG}$	1V ≤ V_{OUT} ≤ V_{REG} − 1.2V **(−1.3)** R_L = 140Ω (Note 6)	1000	550/**250**	450/**200**	V/V V/V(min)
		1V ≤ V_{OUT} ≤ V_{REG} − 1.2V **(−1.3)** R_L = 2 kΩ	3500	1500/**900**	1000/**700**	V/V V/V(min)
V_{SAT}	Output Saturation (Note 7)	V(IN) = V_{REG} +100 mV I_{OUT} = 15 mA	1.0	1.2/**1.3**	1.2/**1.3**	V V(max)
I_L	Output Leakage Current	V(IN) = V_{REG} −100 mV V_{OUT} = 0V	0.1	0.5/**1.0**	0.5/**1.0**	µA µA(max)
R_f	Internal Feedback Resistor (Note 8)		52	65 39	65 39	kΩ kΩ(max) kΩ(min)
E_n	Output Noise Voltage	I_{OUT} = 1 mA, 10 Hz ≤ f ≤ 10 kHz	50			μV_{RMS}

LM3411-5.0 Electrical Characteristics

Specifications with standard type face are for T_J = 25˚C, and those with **boldface type** apply over **full Operating Temperature Range**. Unless otherwise specified, V(IN) = V_{REG}, V_{OUT} = 1.5V.

Symbol	Parameter	Conditions	Typical (Note 4)	LM3411A-5.0 Limit (Note 5)	LM3411-5.0 Limit (Note 5)	Units (Limits)
V_{REG}	Regulation Voltage	I_{OUT} = 5 mA	5	5.025/**5.050** 4.975/**4.950**	5.050/**5.100** 4.950/**4.900**	V V(max) V(min)
	Regulation Voltage Tolerance	I_{OUT} = 5 mA		±0.5/**±1**	±1/**±2**	%(max)
I_q	Quiescent Current	I_{OUT} = 5 mA	85	110/**115**	125/**150**	µA µA(max)
G_m	Transconductance $\Delta I_{OUT}/\Delta V_{REG}$	20 µA ≤ I_{OUT} ≤ 1 mA	3.3	1.5/**0.75**	1.0/**0.5**	mA/mV mA/mV(min)
		1 mA ≤ I_{OUT} ≤ 15 mA	6.0	3.3/**2.0**	2.5/**1.7**	mA/mV mA/mV(min)
A_V	Voltage Gain $\Delta V_{OUT}/\Delta V_{REG}$	1V ≤ V_{OUT} ≤ V_{REG} − 1.2V **(−1.3)** R_L = 250Ω (Note 6)	1000	750/**350**	650/**300**	V/V V/V(min)
		1V ≤ V_{OUT} ≤ V_{REG} − 1.2V **(−1.3)** R_L = 2 kΩ	3500	1500/**900**	1000/**700**	V/V V/V(min)
V_{SAT}	Output Saturation (Note 7)	V(IN) = V_{REG} +100 mV I_{OUT} = 15 mA	1.0	1.2/**1.3**	1.2/**1.3**	V V(max)
I_L	Output Leakage Current	V(IN) = V_{REG} −100 mV V_{OUT} = 0V	0.1	0.5/**1.0**	0.5/**1.0**	µA µA(max)
R_f	Internal Feedback Resistor (Note 8)		94	118 70	118 70	kΩ kΩ(max) kΩ(min)
E_n	Output Noise Voltage	I_{OUT} = 1 mA, 10 Hz ≤ f ≤ 10 kHz	80			μV_{RMS}

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 2: The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $(P_{Dmax} = T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower. The typical thermal resistance (θ_{JA}) when soldered to a printed circuit board is approximately 306˚C/W for the M5 package.

Note 3: The human body model is a 100 pF capacitor discharged through a 1.5 kΩ resistor into each pin.

Note 4: Typical numbers are at 25˚C and represent the most likely parametric norm.

Note 5: Limits are 100% production tested at 25˚C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate National's Averaging Outgoing Level (AOQL).

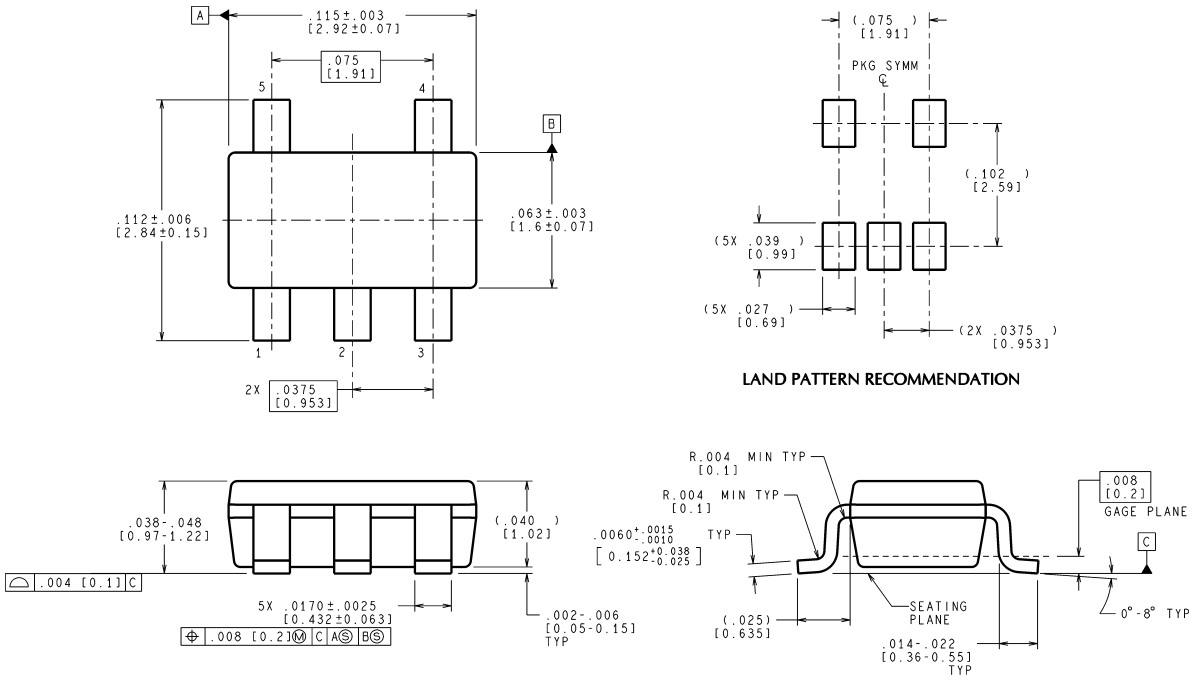
Note 6: Actual test is done using equivalent current sink instead of a resistor load.

Note 7: V_{SAT} = V(IN) − V_{OUT}, when the voltage at the IN pin is forced 100 mV above the nominal regulating voltage (V_{REG}).

Note 8: See Applications and Curves sections for information on this resistor.

Physical Dimensions inches (millimeters)

unless otherwise noted



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VALUES IN [ ] ARE MILLIMETERS

MF05A (Rev B)

5-Lead Small Outline Package (M5)
Order Number LM3411M5-3.3, LM3411AM5-3.3,
LM3411M5-5.0 or LM3411AM5-5.0
NS Package Number MF05A