MIC2211

Dual µCap LDO in 3mm × 3mm MLF™

General Description

The MIC2211 is a dual µCap, low dropout regulator. The first regulator is capable of sourcing 150mA, while the second regulator can source up to 300mA.

Ideal for battery operated applications, the MIC2211 offers 1% accuracy, extremely low dropout voltage (80mV @ 100mA), and extremely low ground current, only 48µA total. Equipped with TTL logic compatible enable pins, the MIC2211 can be put into a zero-off-mode current state, drawing no current when disabled. Separate enable pins allow individual control of each output voltage.

The MIC2211 is a µCap design, operating with very small ceramic output capacitors for stability, reducing required board space and component cost.

The MIC2211 is available in fixed output voltages in the 10-pin 3mm × 3mm MLF™ leadless package.

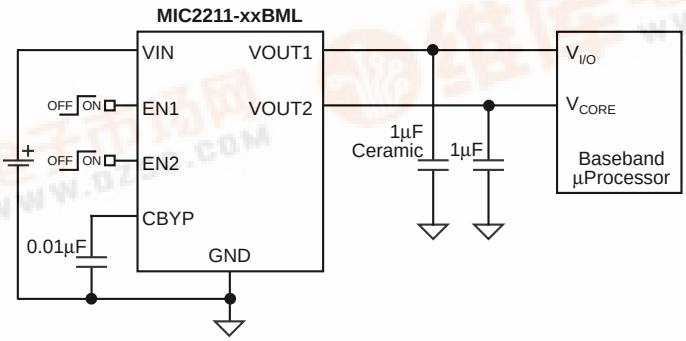
Features

- Input voltage range: 2.25V to 5.5V
- Stable with ceramic output capacitor
- 2 LDO outputs
  - Output 1 - 150mA output current
  - Output 2 - 300mA output current
- Low dropout voltage of 80mV @ 100mA
- **Ultra-low quiescent current of 48µA total (24µA/LDO)**
- High output accuracy:
  - +1.0% initial accuracy
  - +2.0% over temperature
- Thermal shutdown protection
- Current limit protection
- **Tiny 10-pin 3mm × 3mm MLF™ package**

Applications

- Cellular phones
- Wireless modems
- PDAs

Typical Application



MIC2211 Typical Cell Phone Application

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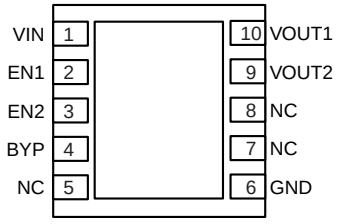
Ordering Information

Manufacturing Number	Part Number Standard	Pb-Free	Voltage*	Temp. Range	Package
MIC2211-ADJ/ADJBML	MIC2211-AA BML	Contact Micrel	ADJ/ADJ	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.5/1.8BML	MIC2211-FGBML	Contact Micrel	1.5V/1.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.5/2.8BML	MIC2211-FMBML	MIC2211-FMYML	1.5V/2.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.5/3.1BML	MIC2211-FQBML	Contact Micrel	1.5V/3.1V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.6/2.8BML	MIC2211-WMBML	Contact Micrel	1.6V/2.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.6/2.9BML	MIC2211-WOBML	Contact Micrel	1.6V/2.9V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.6/3.3BML	MIC2211-WSBML	MIC2211-WSYML	1.6V/3.3V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.8/2.8BML	MIC2211-GMBML	MIC2211-GMYML	1.8V/2.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.8/2.9BML	MIC2211-GOBML	MIC2211-GOYML	1.8V/2.9V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.8/3.0BML	MIC2211-GPBML	MIC2211-GPYML	1.8V/3.0V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.8/3.3BML	MIC2211-GSBML	MIC2211-GSYML	1.8V/3.3V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.9/2.8BML	MIC2211-YMBML	Contact Micrel	1.9V/2.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.5/1.8BML	MIC2211-JGBML	Contact Micrel	2.5V/1.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.5/1.9BML	MIC2211-JYBML	MIC2211-JYYML	2.5V/1.9V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.5/2.8BML	MIC2211-JMBML	MIC2211-JMYML	2.5V/2.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.5/3.0BML	MIC2211-JPBML	MIC2211-JPYML	2.5V/3.0V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.5/3.3BML	MIC2211-JSBML	MIC2211-JSYML	2.5V/3.3V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.8/1.5BML	MIC2211-MFBML	Contact Micrel	2.8V/1.5V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.8/1.8BML	MIC2211-MGBML	Contact Micrel	2.8V/1.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.8/2.5BML	MIC2211-MJBML	Contact Micrel	2.8V/2.5V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.8/3.0BML	MIC2211-MPBML	Contact Micrel	2.8V/3.0V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.8/3.3BML	MIC2211-MSBML	MIC2211-MSYML	2.8V/3.3V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.85/3.3BML	MIC2211-NSBML	Contact Micrel	2.85V/3.3V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.85/2.85BML	MIC2211-NNBML	Contact Micrel	2.85V/2.85V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-2.9/1.5BML	MIC2211-OFBML	Contact Micrel	2.9V/1.5V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-3.0/1.6BML	MIC2211-PWBML	Contact Micrel	3.0V/1.6V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-3.0/2.8BML	MIC2211-PMBML	MIC2211-PMYML	3.0V/2.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-3.0/3.0BML	MIC2211-PPBML	MIC2211-PPYML	3.0V/3.0V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-3.0/3.3BML	MIC2211-PSBML	MIC2211-PSYML	3.0V/3.3V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-3.3/2.8BML	MIC2211-SMBML	Contact Micrel	3.3V/2.8V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-3.3/3.3BML	MIC2211-SSBML	Contact Micrel	3.3V/3.3V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-1.5/3.1BML	MIC2211-FQBML	Contact Micrel	1.5V/3.1V	–40°C to +125°C	10-Pin 3×3 MLF™
MIC2211-3.6/3.6BML	MIC2211-WBML	Contact Micrel	3.6V/3.6V	–40°C to +125°C	10-Pin 3×3 MLF™

*For other output voltage options, contact Micrel marketing.

Pin Configuration



10-Pin 3mm × 3mm MLF™ (ML)
(Top View)

Voltage	Code
Adj.	A
1.5	F
1.6	W
1.8	G
1.85	D
1.9	Y
2.0	H
2.1	E
2.5	J
2.6	K
2.7	L
2.8	M
2.850	N
2.9	O
3.0	P
3.1	Q
3.2	R
3.3	S
3.4	T
3.5	U
3.6	V

Table 1. Voltage Codes

Pin Description

Pin Number	Pin Name	Pin Function
1	VIN	Supply Input: (VIN1 and VIN2 are internally tied together.)
2	EN1	Enable Input to Regulator 1: Enables regulator 1 output. Active high input. High = on, low = off. Do not leave floating.
3	EN2	Enable Input to Regulator 2: Enables regulator 2 output. Active high input. High = on, low = off. Do not leave floating.
4	CBYP	Reference Bypass: Connect external 0.01µF to GND to reduce output noise. May be left open.
5, 7, 8	NC	No Connection.
6	GND	Ground: Connect externally to Exposed Pad.
9	VOUT2	Output of Regulator 2: 300mA output current
10	VOUT1	Output of Regulator 1: 150mA output current
EP	GND	Ground: Internally connected to the Exposed Pad. Connect externally to pin 6.

Absolute Maximum Rating(1)

Supply Input Voltage (V_{IN}) ..... 0V to 7V
Enable Input Voltage (V_{EN}) ..... 0V to 7V
Power Dissipation (P_D) ..... Internally Limited(3)
Junction Temperature ..... –40°C to +125°C
Storage Temperature (T_S) ..... –65°C to 150°C
Lead Temperature (soldering, 5 sec.) ..... 260°C

Operating Ratings(2)

Supply Input Voltage (V_{IN}) ..... 2.25V to 5.5V
Enable Input Voltage (V_{EN}) ..... 0V to Vin
Junction Temperature (T_J) ..... –40°C to +125°C
Package Thermal Resistance
MLF™-10 (θ_{JA}) ..... 60°C/W

Electrical Characteristics(4)

$V_{IN} = V_{OUT}$ +1.0V for higher output of the regulator pair; C_{OUT} = 1.0µF, I_{OUT} = 100µA; T_J = 25°C, **bold** values indicate –40°C ≤ T_J ≤ +125°C; unless noted.

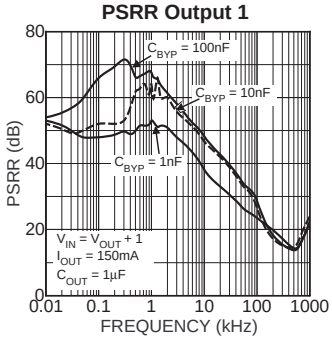
Parameter	Conditions	Min	Typ	Max	Units
Output Voltage Accuracy	Variation from nominal V_{OUT}	–1.0 **–2.0**		+1.0 **+2.0**	% %
Output Voltage Temp. Coefficient			40		ppm/C
Line Regulation(5)	$V_{IN} = V_{OUT}$ +1V to 5.5V	–0.3 **–0.6**	0.02	0.3 **0.6**	%/V
Load Regulation	I_{OUT} = 100µA to 150mA (Regulator 1 and 2)		0.2	1.0	%
	I_{OUT} = 100µA to 300mA (Regulator 2)			1.5	%
Dropout Voltage(6)	I_{OUT} = 150mA (Regulator 1 and 2)		120	190 **250**	mV mV
	I_{OUT} = 300mA (Regulator 2)		240	340 **420**	mV
Ground Pin Current	$I_{OUT1} = I_{OUT2}$ = 0µA		48	65 **80**	µA µA
	I_{OUT1} = 150mA & I_{OUT2} = 300mA		60		µA
Ground Pin Current in Shutdown	$V_{EN} \le 0.4V$			**2.0**	µA
Ripple Rejection	f = 1kHz; C_{OUT} = 1.0µF ceramic; C_{BYP} = 10nF		60		dB
	f = 20kHz; C_{OUT} = 1.0µF ceramic; C_{BYP} = 10nF		40		dB
Current Limit	V_{OUT} = 0V (Regulator 1)	150	280	460	mA
	V_{OUT} = 0V (Regulator 2)	300	450	700	mA
Output Voltage Noise	C_{OUT} =1µF, C_{BYP} =0.01µF, 10Hz to 100kHz		30		µVrms
Enable Input					
Enable Input Voltage	Logic Low (Regulator Shutdown)			**0.6**	V
	Logic High (Regulator Enabled)	**1.8**			V
Enable Input Current	V_{IL} < 0.6V (Regulator Shutdown)	–1	0.01	+1	µA
	V_{IH} > 1.8V (Regulator Enabled)	–1	0.01	+1	µA

Notes:

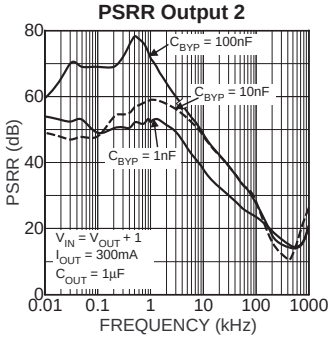
1. Exceeding maximum rating may damage the device.
2. The device is not guaranteed to work outside its operating rating.
3. The maximum allowable power dissipation of any T_A (ambient temperature) is ($P_{D(max)} = T_{J(max)} - T_A$) / θ_{JA}. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.
4. Specification for packaged product only.
5. Minimum input for line regulation test is set to V_{OUT} + 1V relative to the highest output voltage.
6. Dropout voltage is defined as the input-to-output differential at which the output voltage drops 2% below its nominal value measured at 1V differential. For outputs below 2.25V, dropout voltage is the input-to-output voltage differential with the minimum input voltage 2.25V. Minimum input operating voltage is 2.25V.

Typical Characteristics

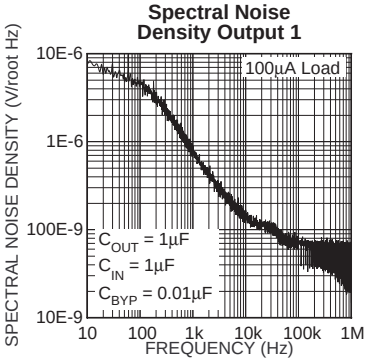
PSRR Output 1



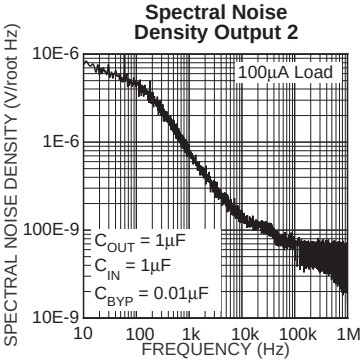
PSRR Output 2



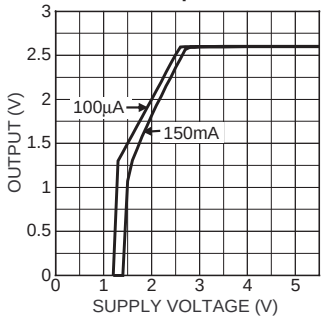
Spectral Noise Density Output 1



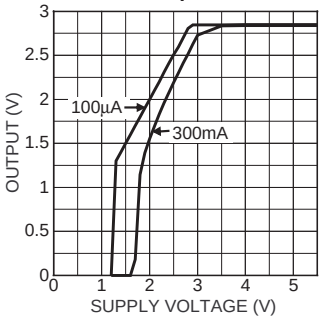
Spectral Noise Density Output 2



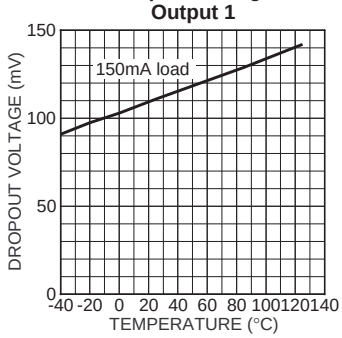
Dropout Characteristics Output 1



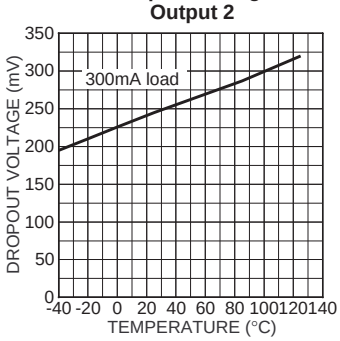
Dropout Characteristics Output 2



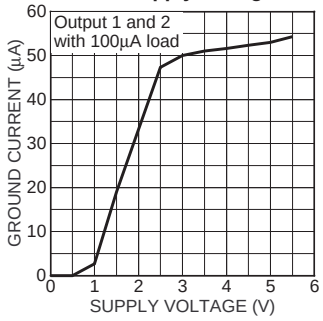
Dropout Voltage Output 1



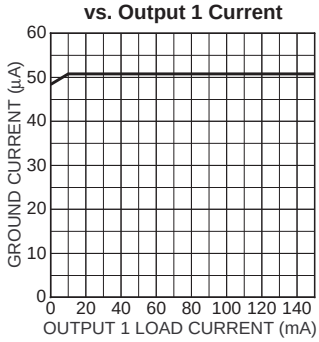
Dropout Voltage Output 2



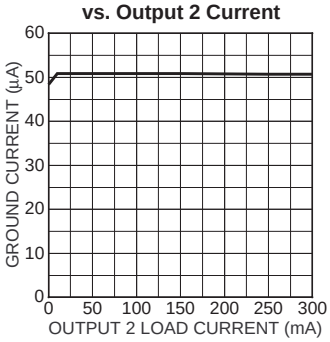
Ground Current vs. Supply Voltage



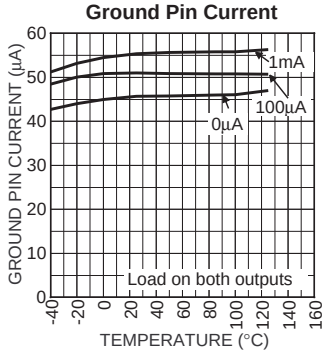
Ground Current vs. Output 1 Current



Ground Current vs. Output 2 Current

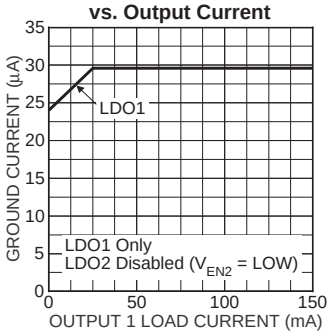


Ground Pin Current

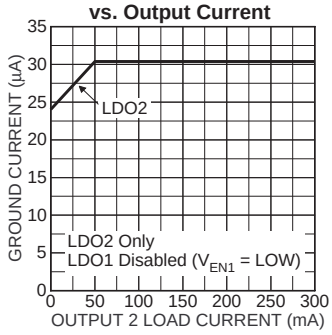


Typical Characteristics (cont.)

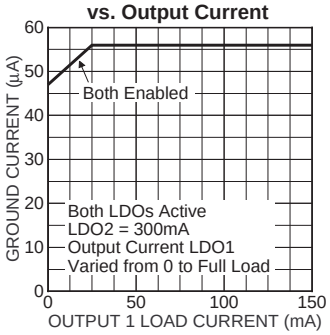
Ground Current vs. Output Current



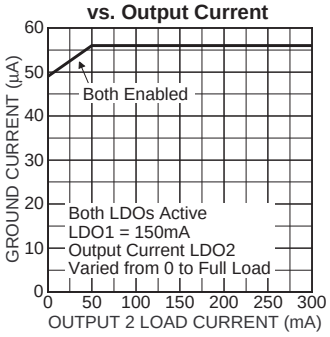
Ground Current vs. Output Current



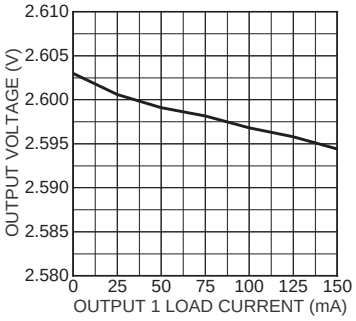
Ground Current vs. Output Current



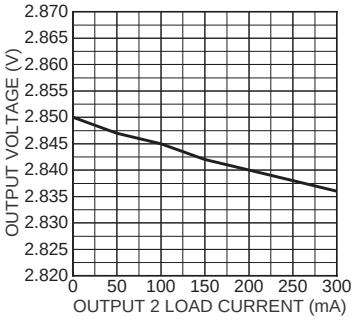
Ground Current vs. Output Current



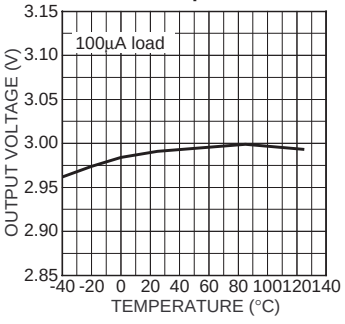
Output Voltage vs. Load Current



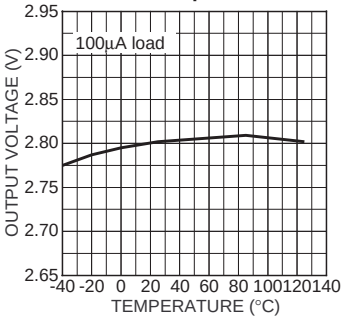
Output Voltage vs. Load Current



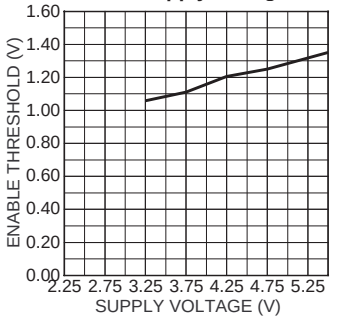
Output Voltage 1 vs. Temperature



Output Voltage 2 vs. Temperature

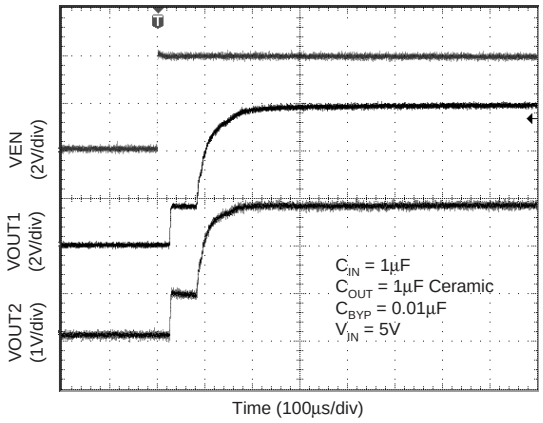


Enable Voltage Threshold vs. Supply Voltage

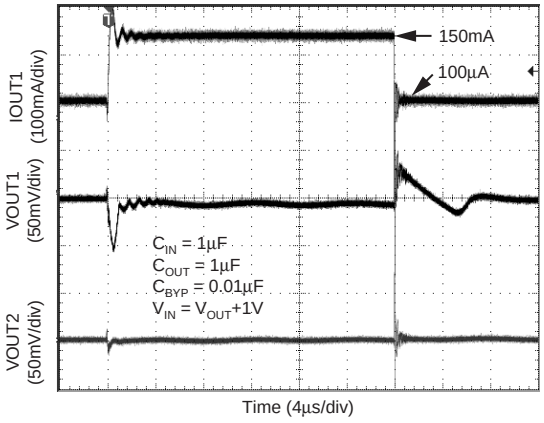


Functional Characteristics

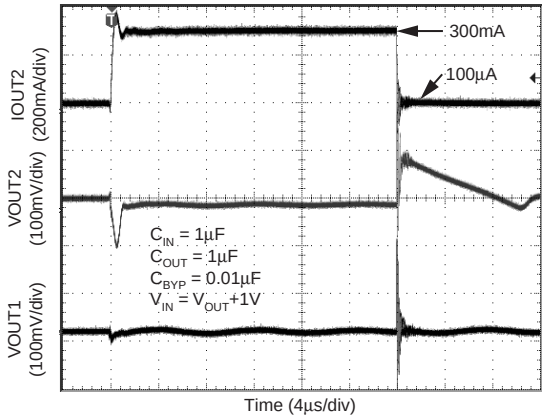
Enable Characteristics



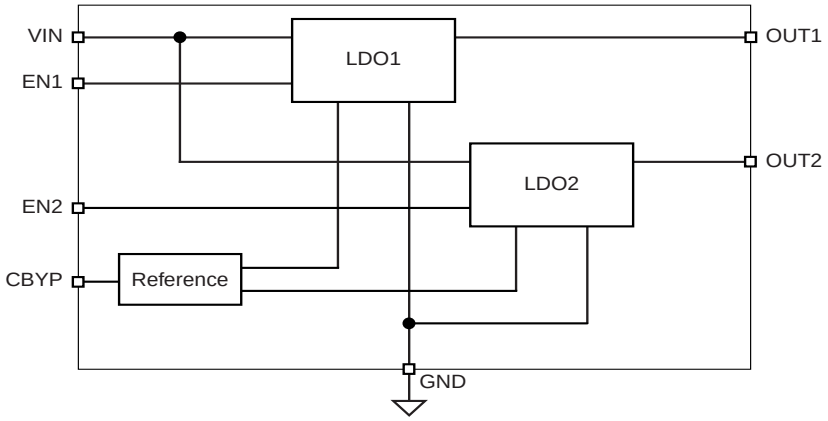
Load Transient Response (LDO 1)



Load Transient Response (LDO 2)



Functional Diagram



MIC2211 Fixed Voltage Block Diagram

Functional Description

The MIC2211 is a high performance, low quiescent current power management IC consisting of two μCap low dropout regulators. The first regulator is capable of sourcing 150mA at output voltages from 1.25V to 5V. The second regulator is capable of sourcing 300mA of current at output voltages from 1.25V to 5V.

Enable 1 and 2

The enable inputs allow for logic control of both output voltages with individual enable inputs. The enable input is active high, requiring 1.8V for guaranteed operation. The enable input is CMOS logic and cannot by left floating.

Input Capacitor

Good bypassing is recommended from input to ground to help improve AC performance. A 1μF capacitor or greater located close to the IC is recommended.

Bypass Capacitor

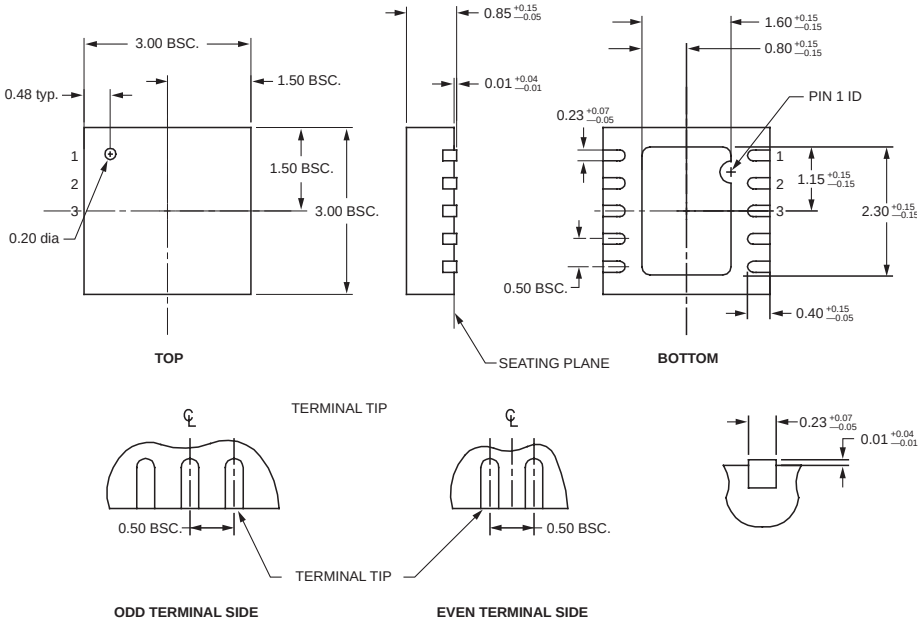
The internal reference voltage of the MIC2211 can be bypassed with a capacitor to ground to reduce output noise and increase power supply rejection (PSRR). A quick-start feature allows for quick turn-on of the output voltage regardless of the size of the capacitor. The recommended nominal bypass capacitor is 0.01μF, but it can be increased without limit.

Output Capacitor

Each regulator output requires a 1μF ceramic output capacitor for stability. The output capacitor value can be increased to improve transient response, but performance has been optimized for a 1μF ceramic type output capacitor.

X7R/X5R dielectric-type ceramic capacitors are recommended because of their temperature performance. X7R-type capacitors change capacitance by 15% over their operating temperature range and are the most stable type of ceramic capacitors. Z5U and Y5V dielectric capacitors change value by as much as 50% and 60% respectively over their operating temperature ranges. To use a ceramic chip capacitor with Y5V dielectric, the value must be much higher than an X7R ceramic capacitor to ensure the same minimum capacitance over the equivalent operating temperature range.

Package Information



10-Lead MLF™ (ML)