NCP3335

Ultra High Accuracy, Low Iq, 500 mA Low Dropout Regulator

The NCP3335 is a high performance, low dropout regulator. With accuracy of ±0.9% over line and load and ultra−low quiescent current and noise it encompasses all of the necessary features required by today's consumer electronics. This unique device is guaranteed to be stable without a minimum load current requirement and stable with any type of capacitor as small as 1.0 μF. The NCP3335 also comes equipped with sense and noise reduction pins to increase the overall utility of the device.

Features

- **High Accuracy Over Line and Load (±0.9% at 25°C)**
- **Ultra−Low Dropout Voltage at Full Load (260 mV typ.)**
- **No Minimum Output Current Required for Stability**
- **Low Noise (35 μVrms w/ 10 nF C_{nr} and 56 μVrms w/out C_{nr})**
- **Low Shutdown Current (0.07 μA)**
- 2.6 V to 12 V Supply Range
- Thermal Shutdown Protection
- Current Limitation
- Requires Only 1.0 μF Output Capacitance for Stability
- Stable with Any Type of Capacitor (including MLCC)
- Available in 2.5 V, 2.85 V, and 3.3 V Output Voltages
- These are Pb−Free Devices

Applications

- PCMCIA Card
- Cellular Phones
- Camcoders and Cameras
- Networking Systems, DSL/Cable Modems
- Cable Set−Top Box
- MP3/CD Players
- DSP Supply
- Displays and Monitors

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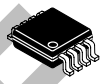
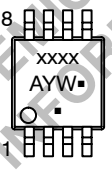


Micro8™
DMR2 SUFFIX
CASE 846A

QFN10
MN SUFFIX
CASE 485C

MARKING DIAGRAM



Pin 1,2. V_{out}
3. Sense
4. GND
5. NR
6. $\overline{SD}$ (Shutdown)
7,8. V_{in}

Pin 1,2. V_{out}
3. Sense
4. GND
5,6. NC
7. NR
8. $\overline{SD}$
9,10. V_{in}

xxx = LHX for 2.5 V
= LHY for 2.85 V
= LHZ for 3.3 V
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

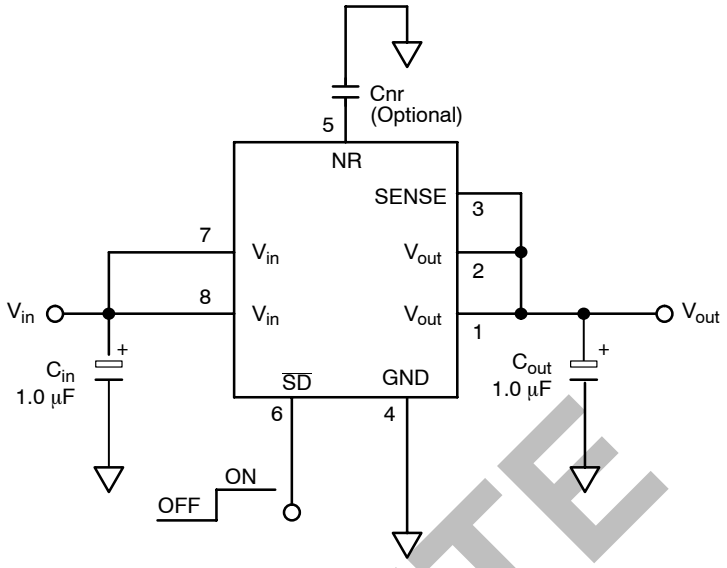


Figure 1. Typical Application Schematic (Micro8 Package)

PIN FUNCTION DESCRIPTION

Pin No. Micro8	Pin No. QFN10	Pin Name	Description
1, 2	1, 2	V_{out}	Regulated output voltage. Bypass to ground with $C_{out} \geq 1.0$ μF.
3	3	SENSE	For output voltage sensing, connect to Pins 1 and 2.
4	4	GND	Power Supply Ground
5	7	NR	Noise Reduction Pin. This is an optional pin used to further reduce noise.
6	8	$\overline{SD}$	Shutdown pin. When not in use, this pin should be connected to the input pin.
7, 8	9, 10	V_{in}	Power Supply Input Voltage
–	5, 6	NC	Not Connected

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage	V_{in}	−0.3 to +16	V
Output Voltage	V_{out}	−0.3 to V_{in} +0.3	V
Shutdown Pin Voltage	V_{sh}	−0.3 to +16	V
Thermal Characteristics Thermal Resistance, Junction−to−Air	$R_{\theta JA}$	238	°C/W
Operating Junction Temperature Range	T_J	−40 to +150	°C
Storage Temperature Range	T_{stg}	−50 to+150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

NOTE: This device series contains ESD protection and exceeds the following tests:
Human Body Model (HBM) JESD 22−A114−B
Machine Model (MM) JESD 22−A115−A

ELECTRICAL CHARACTERISTICS – 2.5 V (V_{out} = 2.5 V typical, V_{in} = 2.9 V, T_A = −40°C to +85°C, unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (Accuracy) V_{in} = 2.9 V to 6.5 V, I_{load} = 0.1 mA to 500 mA, T_J = 25°C	V_{out}	−0.9% 2.477	2.5	+0.9% 2.523	V
Output Voltage (Accuracy) V_{in} = 2.9 V to 6.5 V, I_{load} = 0.1 mA to 500 mA, T_J = 0°C to +85°C	V_{out}	−1.4% 2.465	2.5	+1.4% 2.535	V
Output Voltage (Accuracy), (Note 1) V_{in} = 2.9 V to 6.5 V, I_{load} = 0.1 mA to 500 mA, T_J = −40°C to +150°C	V_{out}	−1.5% 2.462	2.5	+1.5% 2.538	V
Line Regulation V_{in} = 2.9 V to 6.5 V, I_{load} = 0.1 mA	$Line_{Reg}$		0.04		mV/V
Load Regulation V_{in} = 2.9 V, I_{load} = 0.1 mA to 500 mA	$Load_{Reg}$		0.04		mV/mA
Dropout voltage I_{load} = 500 mA (Note 2) I_{load} = 300 mA (Note 2) I_{load} = 50 mA I_{load} = 0.1mA	V_{DO}			 340 230 110 10	mV
Peak Output Current (See Figure 6)	I_{pk}	500	700	800	mA
Short Output Current (See Figure 6)	I_{sc}			900	mA
Thermal Shutdown	T_J		160		°C
Ground Current In Regulation I_{load} = 500 mA (Note 2) I_{load} = 300 mA (Note 2) I_{load} = 50 mA I_{load} = 0.1 mA In Dropout V_{in} = 2.4 V, I_{load} = 0.1 mA In Shutdown S_D = 0 V	I_{GND} I_{GNDsh}		 9.0 4.6 0.8 – 0.07	 14 7.5 2.5 190 500 1.0	 mA µA µA µA
Output Noise C_{nr} = 0 nF, I_{load} = 500 mA, f = 10 Hz to 100 kHz, C_{out} = 10 µF C_{nr} = 10 nF, I_{load} = 500 mA, f = 10 Hz to 100 kHz, C_{out} = 10 µF	V_{noise}		 56 35		 µVrms µVrms
Shutdown Threshold Voltage ON Threshold Voltage OFF		 2.0		 0.4	 V V
$\overline{SD}$ Input Current, V_{SD} = 0 V to 0.4 V or V_{SD} = 2.0 V to V_{in}	I_{SD}		0.07	1.0	µA
Output Current In Shutdown Mode, V_{out} = 0 V	I_{OSD}		0.07	1.0	µA

1. For proper operation below T_J = 0°C, please refer to Figure 8.
2. T_A must be greater than 0°C.

ELECTRICAL CHARACTERISTICS – 2.85 V (V_{out} = 2.85 V typical, V_{in} = 3.25 V, T_A = −40°C to +85°C, unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (Accuracy) V_{in} = 3.25 V to 6.85 V, I_{load} = 0.1 mA to 500 mA, T_J = 25°C	V_{out}	−0.9% 2.824	2.85	+0.9% 2.876	V
Output Voltage (Accuracy) V_{in} = 3.25 V to 6.85 V, I_{load} = 0.1 mA to 500 mA, T_J = 0°C to +85°C	V_{out}	−1.4% 2.810	2.85	+1.4% 2.890	V
Output Voltage (Accuracy) (Note 3) V_{in} = 3.25 V to 6.85 V, I_{load} = 0.1 mA to 500 mA, T_J = −40°C to +150°C	V_{out}	−1.5% 2.807	2.85	+1.5% 2.893	V
Line Regulation V_{in} = 3.25 V to 6.85 V, I_{load} = 0.1 mA	$Line_{Reg}$		0.04		mV/V
Load Regulation V_{in} = 3.25 V, I_{load} = 0.1 mA to 500 mA	$Load_{Reg}$		0.04		mV/mA
Dropout voltage I_{load} = 500 mA I_{load} = 300 mA I_{load} = 50 mA I_{load} = 0.1mA	V_{DO}			 340 230 110 10	mV
Peak Output Current (See Figure 6)	I_{pk}	500	700	800	mA
Short Output Current (See Figure 6)	I_{sc}			900	mA
Thermal Shutdown	T_J		160		°C
Ground Current In Regulation I_{load} = 500 mA (Note 4) I_{load} = 300 mA I_{load} = 50 mA I_{load} = 0.1 mA In Dropout V_{in} = 2.75 V, I_{load} = 0.1 mA In Shutdown SD = 0 V	I_{GND} I_{GNDsh}		 9.0 4.6 0.8 – – 0.07	 14 7.5 2.5 190 500 1.0	 mA µA µA µA
Output Noise C_{nr} = 0 nF, I_{load} = 500 mA, f = 10 Hz to 100 kHz, C_{out} = 10 µF C_{nr} = 10 nF, I_{load} = 500 mA, f = 10 Hz to 100 kHz, C_{out} = 10 µF	V_{noise}		 61 40		 µVrms µVrms
Shutdown Threshold Voltage ON Threshold Voltage OFF		 2.0		 0.4	 V V
S_D Input Current, V_{SD} = 0 V to 0.4 V or V_{SD} = 2.0 V to V_{in}	I_{SD}		0.07	1.0	µA
Output Current In Shutdown Mode, V_{out} = 0 V	I_{OSD}		0.07	1.0	µA

3. For proper operation below T_J = 0°C, please refer to Figure 7.
4. T_A must be greater than 0°C.

ELECTRICAL CHARACTERISTICS – 3.3 V (V_{out} = 3.3 V typical, V_{in} = 3.7 V, T_A = −40°C to +85°C, unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (Accuracy) V_{in} = 3.7 V to 7.3 V, I_{load} = 0.1 mA to 500 mA, T_J = 25°C	V_{out}	−0.9% 3.270	3.3	+0.9% 3.330	V
Output Voltage (Accuracy) V_{in} = 3.7 V to 7.3 V, I_{load} = 0.1 mA to 500 mA, T_J = 0°C to +85°C	V_{out}	−1.4% 3.254	3.3	+1.4% 3.346	V
Output Voltage (Accuracy) V_{in} = 3.7 V to 7.3 V, I_{load} = 0.1 mA to 500 mA, T_J = −40°C to +150°C	V_{out}	−1.5% 3.250	3.3	+1.5% 3.350	V
Line Regulation V_{in} = 3.7 V to 7.3 V, I_{load} = 0.1 mA	$Line_{Reg}$		0.04		mV/V
Load Regulation V_{in} = 3.7 V, I_{load} = 0.1 mA to 500 mA	$Load_{Reg}$		0.04		mV/mA
Dropout Voltage I_{load} = 500 mA I_{load} = 300 mA I_{load} = 50 mA I_{load} = 0.1 mA	V_{DO}			 340 230 110 10	mV
Peak Output Current (See Figure 6)	Ipk	500	700	800	mA
Short Output Current (See Figure 6)	I_{sc}			900	mA
Thermal Shutdown	T_J		160		°C
Ground Current In Regulation I_{load} = 500 mA (Note 5) I_{load} = 300 mA I_{load} = 50 mA I_{load} = 0.1 mA In Dropout V_{in} = 3.2 V, I_{load} = 0.1 mA In Shutdown S_D = 0 V	I_{GND} I_{GNDsh}		 9.0 4.6 0.8 – – 0.07	 14 7.5 2.5 190 500 1.0	 mA µA µA µA
Output Noise C_{nr} = 0 nF, I_{load} = 500 mA, f = 10 Hz to 100 kHz, C_{out} = 10 µF C_{nr} = 10 nF, I_{load} = 500 mA, f = 10 Hz to 100 kHz, C_{out} = 10 µF	V_{noise}		 69 46		 µVrms µVrms
Shutdown Threshold Voltage ON Threshold Voltage OFF		 2.0		 0.4	 V V
S_D Input Current, V_{SD} = 0 V to 0.4 V or V_{SD} = 2.0 V to V_{in}	I_{SD}		0.07	1.0	µA
Output Current In Shutdown Mode, V_{out} = 0 V	I_{OSD}		0.07	1.0	µA

5. T_A must be greater than 0°C.

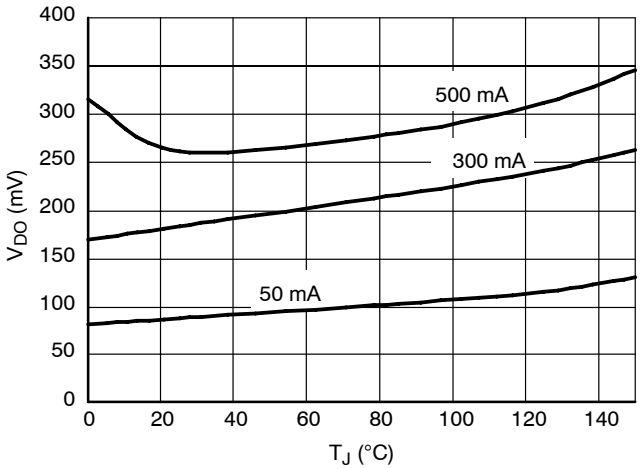


Figure 2. Dropout Voltage vs. Temperature

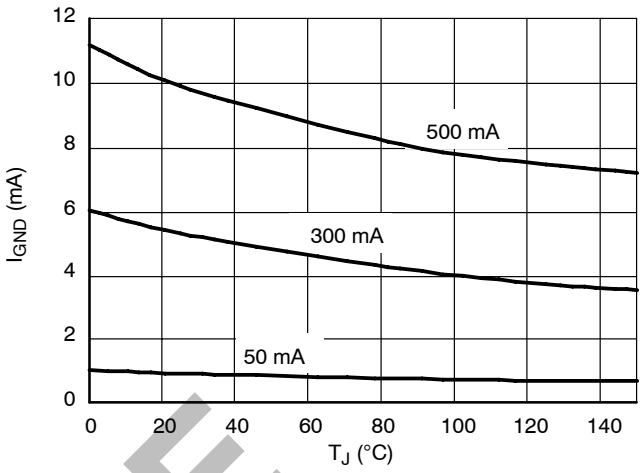


Figure 3. Ground Current vs. Temperature

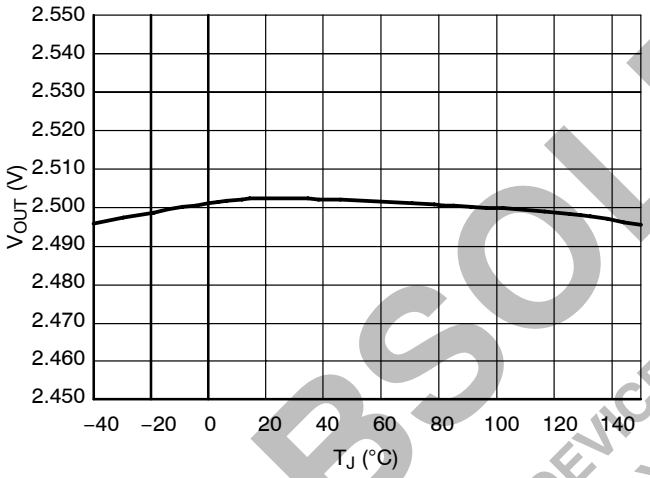


Figure 4. Output Voltage vs. Temperature

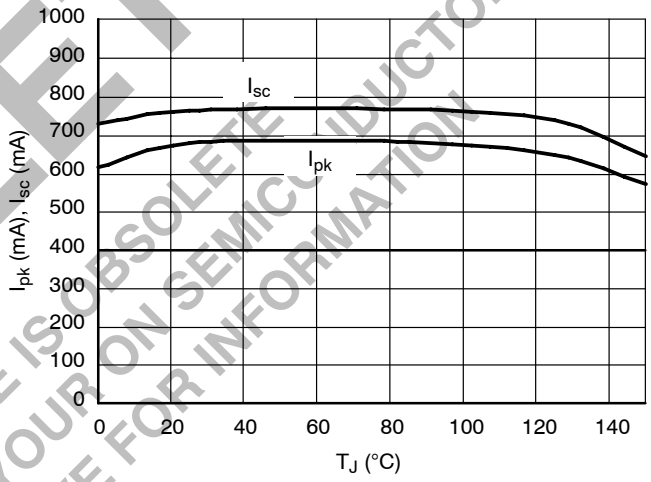
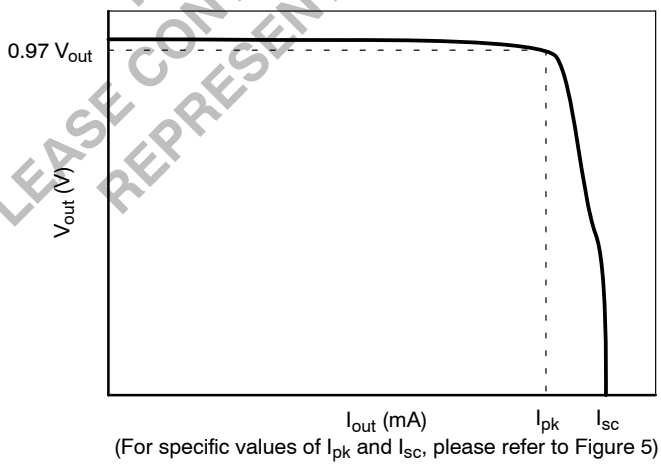


Figure 5. Peak and Short Current vs. Temperature



(For specific values of I_{pk} and I_{sc}, please refer to Figure 5)

Figure 6. Output Voltage vs. Output Current

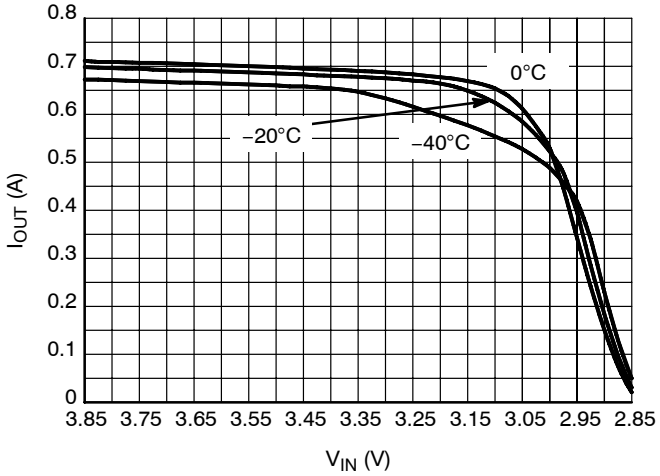


Figure 7. Output Current Capability for the 2.85 V Version

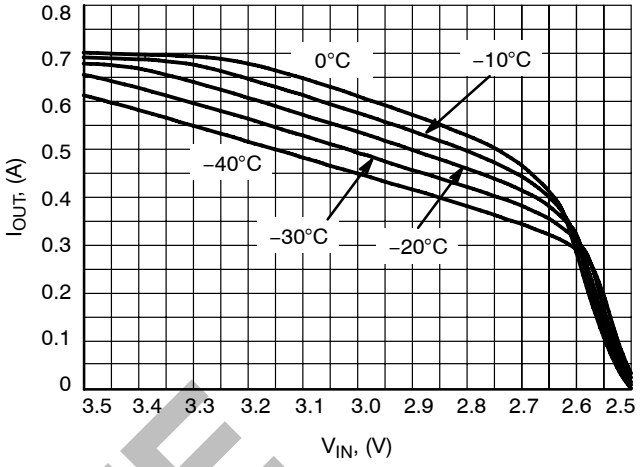


Figure 8. Output Current Capability for the 2.5 V Version

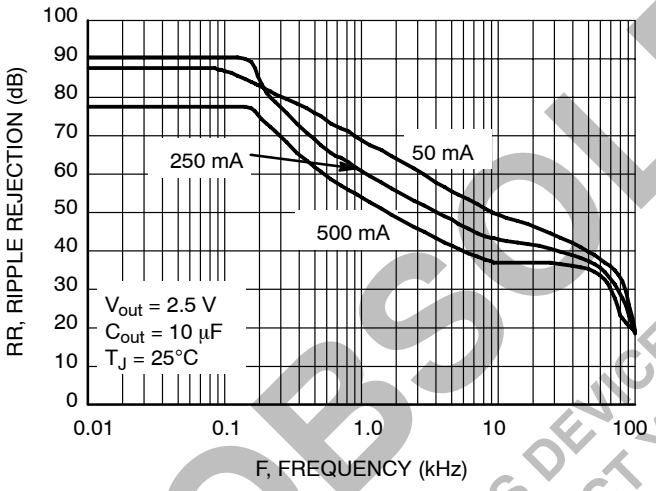


Figure 9. Ripple Rejection vs. Frequency

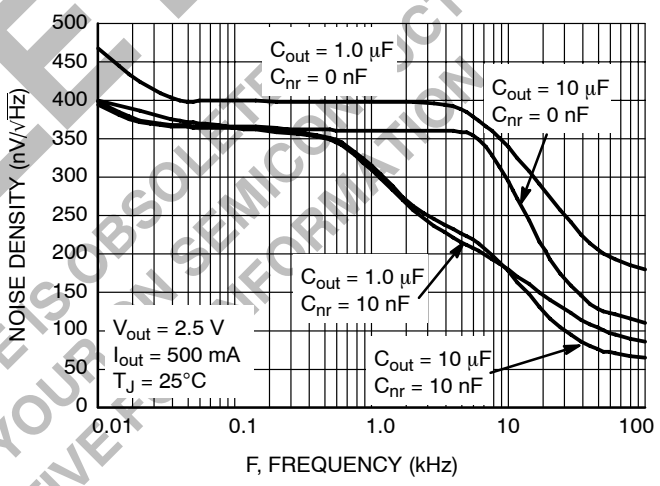


Figure 10. Output Noise Density

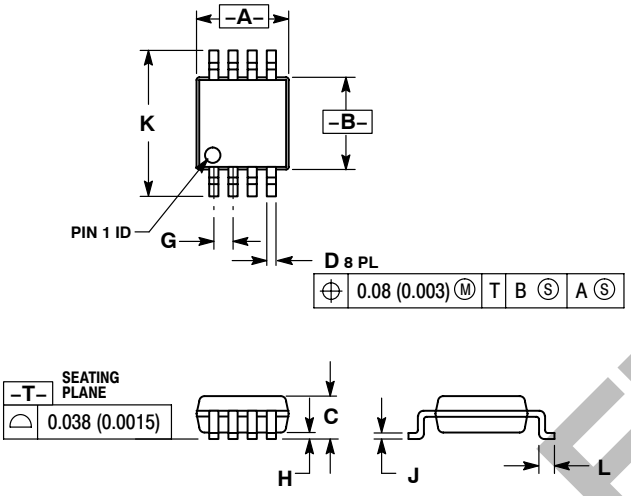
ORDERING INFORMATION

Device	Nominal Output Voltage	Package	Shipping†
NCP3335DMR2250G	2.5 V	Micro8 (Pb−Free)	4000 / Tape & Reel
NCP3335DMR2285G	2.85 V	Micro8 (Pb−Free)	4000 / Tape & Reel
NCP3335DMR2330G	3.3 V	Micro8 (Pb−Free)	4000 / Tape & Reel
NCP3335MN250R2G	2.5 V	QFN10 (Pb−Free)	4000 / Tape & Reel
NCP3335MN330R2G	3.3 V	QFN10 (Pb−Free)	4000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*Please contact factory for other voltage options.

PACKAGE DIMENSIONS

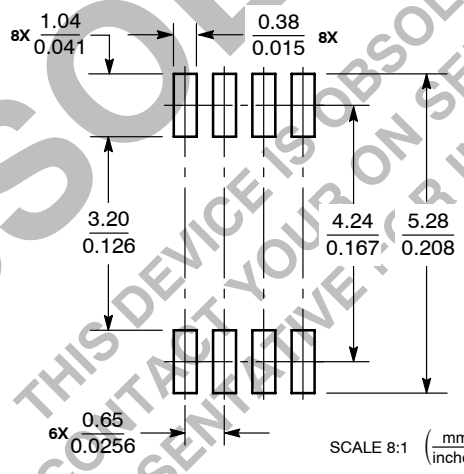
Micro8
CASE 846A–02
ISSUE F



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846A–01 OBSOLETE, NEW STANDARD 846A–02.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	2.90	3.10	0.114	0.122
C	---	1.10	---	0.043
D	0.25	0.40	0.010	0.016
G	0.65 BSC		0.026 BSC	
H	0.05	0.15	0.002	0.006
J	0.13	0.23	0.005	0.009
K	4.75	5.05	0.187	0.199
L	0.40	0.70	0.016	0.028

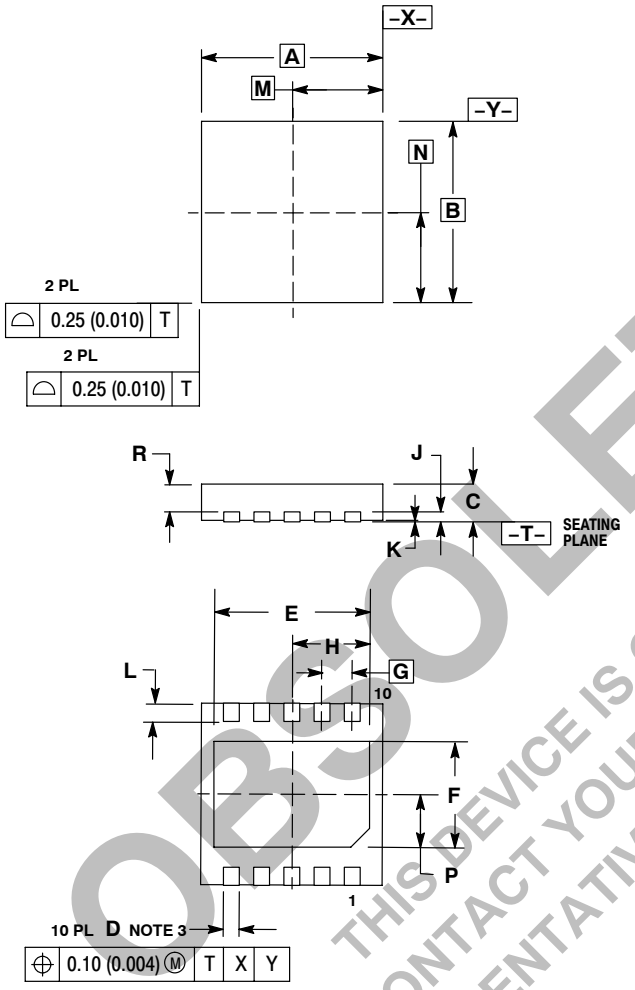
SOLDERING FOOTPRINT*



*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

10 Pin QFN
CASE 8485C−01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION D APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	3.00 BSC		0.118 BSC	
B	3.00 BSC		0.118 BSC	
C	0.80	1.00	0.031	0.039
D	0.20	0.30	0.008	0.012
E	2.45	2.55	0.096	0.100
F	1.75	1.85	0.069	0.073
G	0.50 BSC		0.020 BSC	
H	1.23	1.28	0.048	0.050
J	0.20 REF		0.008 REF	
K	0.00	0.05	0.000	0.002
L	0.35	0.45	0.014	0.018
M	1.50 BSC		0.059 BSC	
N	1.50 BSC		0.059 BSC	
P	0.88	0.93	0.035	0.037
R	0.60	0.80	0.024	0.031

The products described herein NCP3335, may be covered by one or more of the following U.S. patents; 5,920,184, 5,966,004, and 5,834,926. There may be other patents pending.
Micro8 is a trademark of International Rectifier.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
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Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

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ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative

NCP3335/D