

# NCP706

## 1 A, 1% Precision Very Low Dropout Voltage Regulator with Enable

The NCP706 is a Very Low Dropout Regulator which provides up to 1 A of load current and maintains excellent output voltage accuracy of 1% including line, load and temperature variations. The operating input voltage range from 2.4 V up to 5.5 V makes this device suitable for Li-ion battery powered products as well as post-regulation applications. The product is available in 2.1 V, 2.2 V, 2.95 V, 3.0 V and 3.3 V fixed output voltage options. NCP706 is fully protected against overheating and output short circuit.

Very small 8-pin XDFN8 1.6 x 1.2, 04P package makes the device especially suitable for space constrained portable applications such as tablets and smartphones.

### Features

- Operating Input Voltage Range: 2.4 V to 5.5 V
- Fixed Output Voltage Options: 2.1 V, 2.2 V, 2.95 V, 3.0 V and 3.3 V  
Other Output Voltage Options Available on Request.
- Low Quiescent Current of Typ. 200  $\mu$ A
- Very Low Dropout: 155 mV Max. at  $I_{OUT} = 1$  A
- $\pm 1\%$  Accuracy Over Load/Line/Temperature
- High PSRR: 60 dB at 1 kHz
- Internal Soft-Start to Limit the Inrush Current
- Thermal Shutdown and Current Limit Protections
- Stable with a 4.7  $\mu$ F Ceramic Output Capacitor
- Available in XDFN8 1.6 x 1.2, 04P 8-pin Package
- These are Pb-Free Devices

### Typical Applications

- Tablets, Smartphones,
- Wireless Handsets, Portable Media Players
- Portable Medical Equipment
- Other Battery Powered Applications

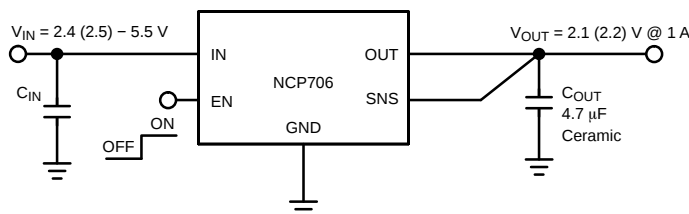


Figure 1. Typical Application Schematic



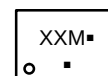
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XDFN8  
CASE 711AS

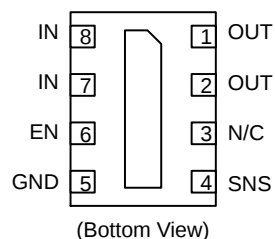
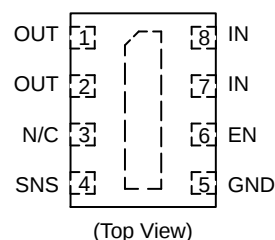
### MARKING DIAGRAM



XX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

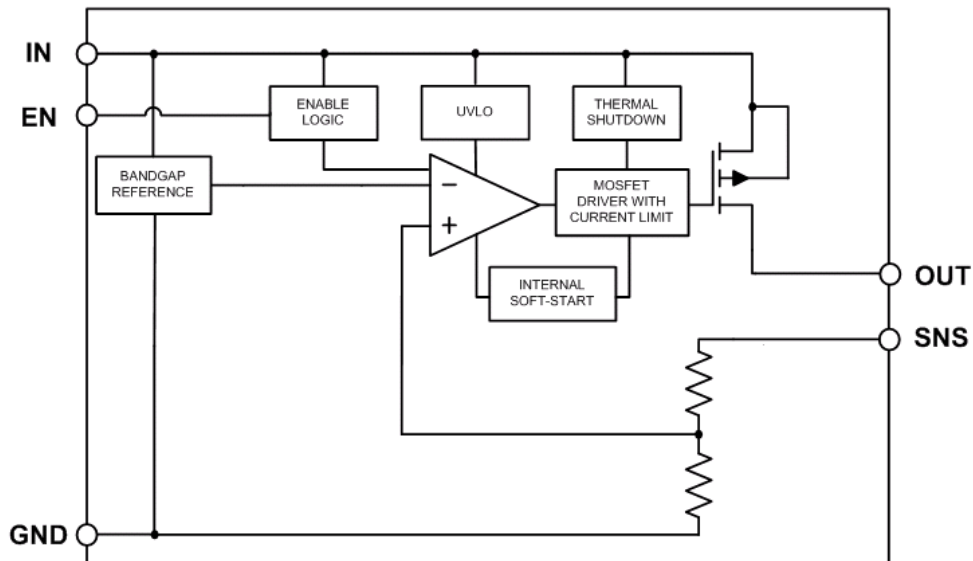
### PIN CONNECTION



### ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 15 of this data sheet.

## NCP706



**Figure 2. Simplified Internal Schematic Block Diagram**

### PIN FUNCTION DESCRIPTION

| Pin No.<br>XDFN8 | Pin Name    | Description                                                                                                                                                                              |
|------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | OUT         | Regulated output voltage. A minimum 4.7 $\mu$ F ceramic capacitor is needed from this pin to ground to assure stability.                                                                 |
| 2                | OUT         |                                                                                                                                                                                          |
| 3                | N/C         | Not connected. This pin can be tied to ground to improve thermal dissipation.                                                                                                            |
| 4                | SNS         | Remote sense connection. This pin should be connected to the output voltage rail.                                                                                                        |
| 5                | GND         | Power supply ground.                                                                                                                                                                     |
| 6                | EN          | Enable pin. Driving EN over 0.9 V turns on the regulator. Driving EN below 0.4 V puts the regulator into shutdown mode.                                                                  |
| 7                | IN          | Input pin. A small capacitor is needed from this pin to ground to assure stability.                                                                                                      |
| 8                | IN          |                                                                                                                                                                                          |
| –                | Exposed Pad | This pad enhances thermal performance and is electrically connected to GND. It is recommended that the exposed pad is connected to the ground plane on the board or otherwise left open. |

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## ABSOLUTE MAXIMUM RATINGS

| Rating                                    | Symbol       | Value                      | Unit |
|-------------------------------------------|--------------|----------------------------|------|
| Input Voltage (Note 1)                    | $V_{IN}$     | -0.3 V to 6 V              | V    |
| Output Voltage                            | $V_{OUT}$    | -0.3 V to $V_{IN} + 0.3$ V | V    |
| Enable Input                              | $V_{EN}$     | -0.3 V to $V_{IN} + 0.3$ V | V    |
| Output Short Circuit Duration             | $t_{SC}$     | Indefinite                 | s    |
| Maximum Junction Temperature              | $T_{J(MAX)}$ | 150                        | °C   |
| Storage Temperature                       | $T_{STG}$    | -55 to 150                 | °C   |
| ESD Capability, Human Body Model (Note 2) | $ESD_{HBM}$  | 2000                       | V    |
| ESD Capability, Machine Model (Note 2)    | $ESD_{MM}$   | 200                        | V    |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
2. This device series incorporates ESD protection and is tested by the following methods:  
 ESD Human Body Model tested per EIA/JESD22-A114  
 Latch-up Current Maximum Rating tested per JEDEC standard: JESD78

## THERMAL CHARACTERISTICS

| Rating                                                                             | Symbol          | Value | Unit |
|------------------------------------------------------------------------------------|-----------------|-------|------|
| Thermal Characteristics, XDFN8 1.6x1.2, 04P<br>Thermal Resistance, Junction-to-Air | $R_{\theta JA}$ | 160   | °C/W |

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## ELECTRICAL CHARACTERISTICS – VOLTAGE VERSION 2.1 V

–40°C ≤ T<sub>J</sub> ≤ 125°C; V<sub>IN</sub> = V<sub>OUT(NOM)</sub> + 0.3 V or 2.4 V, whichever is greater; I<sub>OUT</sub> = 10 mA, C<sub>IN</sub> = C<sub>OUT</sub> = 4.7 μF, V<sub>EN</sub> = 0.9 V, unless otherwise noted. Typical values are at T<sub>J</sub> = +25°C. (Note 3)

| Parameter                           | Test Conditions                                                                                    | Symbol               | Min                                   | Typ            | Max   | Unit              |
|-------------------------------------|----------------------------------------------------------------------------------------------------|----------------------|---------------------------------------|----------------|-------|-------------------|
| Operating Input Voltage             |                                                                                                    | V <sub>IN</sub>      | 2.4                                   |                | 5.5   | V                 |
| Undervoltage lock-out               | V <sub>IN</sub> rising                                                                             | UVLO                 | 1.2                                   | 1.6            | 1.9   | V                 |
| Output Voltage Accuracy             | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 0 – 1 A                     | V <sub>OUT</sub>     | 2.079                                 | 2.10           | 2.121 | V                 |
| Line Regulation                     | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 10 mA                       | Reg <sub>LINE</sub>  |                                       | 2              |       | mV                |
| Load Regulation                     | I <sub>OUT</sub> = 0 mA to 1 A                                                                     | Reg <sub>LOAD</sub>  |                                       | 2              |       | mV                |
| Load Transient                      | I <sub>OUT</sub> = 10 mA to 1A or 10 mA to 1 A in 10 μs, C <sub>OUT</sub> = 10 μF                  | Tran <sub>LOAD</sub> |                                       | ±120           |       | mV                |
| Dropout voltage (Note 4)            | I <sub>OUT</sub> = 1 A, V <sub>OUT(nom)</sub> = 2.1 V                                              | V <sub>DO</sub>      |                                       |                | 300   | mV                |
| Output Current Limit                | V <sub>OUT</sub> = 90% V <sub>OUT(nom)</sub>                                                       | I <sub>CL</sub>      | 1.1                                   |                |       | A                 |
| Quiescent current                   | I <sub>OUT</sub> = 0 mA                                                                            | I <sub>Q</sub>       |                                       | 180            | 230   | μA                |
| Ground current                      | I <sub>OUT</sub> = 1 A                                                                             | I <sub>GND</sub>     |                                       | 200            |       | μA                |
| Shutdown current                    | V <sub>EN</sub> ≤ 0 V, V <sub>IN</sub> = 2.0 to 5.5 V                                              |                      |                                       | 0.1            | 1     | μA                |
| Reverse Leakage Current in Shutdown | V <sub>IN</sub> = 5.5 V, V <sub>OUT</sub> = V <sub>OUT(NOM)</sub> , V <sub>EN</sub> < 0.4 V        | I <sub>REV</sub>     |                                       | 1.5            | 5     | μA                |
| EN Pin High Threshold               | V <sub>EN</sub> Voltage increasing                                                                 | V <sub>EN_HI</sub>   | 0.9                                   |                |       | V                 |
| EN Pin Low Threshold                | V <sub>EN</sub> Voltage decreasing                                                                 | V <sub>EN_LO</sub>   |                                       |                | 0.4   | V                 |
| EN Pin Input Current                | V <sub>EN</sub> = 5.5 V                                                                            | I <sub>EN</sub>      |                                       | 100            | 500   | nA                |
| Turn-on Time                        | C <sub>OUT</sub> = 4.7 μF, from assertion EN pin to 98% V <sub>out(nom)</sub>                      | t <sub>ON</sub>      |                                       | 200            |       | μs                |
| Power Supply Rejection Ratio        | V <sub>IN</sub> = 2.6 V, V <sub>OUT</sub> = 2.1 V, I <sub>OUT</sub> = 0.5 A                        | PSRR                 | f = 100 Hz<br>f = 1 kHz<br>f = 10 kHz | 60<br>60<br>40 |       | dB                |
| Output Noise Voltage                | V <sub>OUT</sub> = 2.1 V, V <sub>IN</sub> = 2.6 V, I <sub>OUT</sub> = 0.5 A, f = 100 Hz to 100 kHz | V <sub>NOISE</sub>   |                                       | 280            |       | μV <sub>rms</sub> |
| Thermal Shutdown Temperature        | Temperature increasing from T <sub>J</sub> = +25°C                                                 | T <sub>SD</sub>      |                                       | 160            |       | °C                |
| Thermal Shutdown Hysteresis         | Temperature falling from T <sub>SD</sub>                                                           | T <sub>SDH</sub>     | –                                     | 20             | –     | °C                |

- Performance guaranteed over the indicated operating temperature range by design and/or characterization production tested at T<sub>J</sub> = T<sub>A</sub> = 25°C. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.
- Characterized when V<sub>OUT</sub> falls 100 mV below the regulated voltage at V<sub>IN</sub> = V<sub>OUT(NOM)</sub> + 0.3 V.

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## ELECTRICAL CHARACTERISTICS – VOLTAGE VERSION 2.2 V

–40°C ≤ T<sub>J</sub> ≤ 125°C; V<sub>IN</sub> = V<sub>OUT(NOM)</sub> + 0.3 V or 2.5 V, whichever is greater; I<sub>OUT</sub> = 10 mA, C<sub>IN</sub> = C<sub>OUT</sub> = 4.7 μF, V<sub>EN</sub> = 0.9 V, unless otherwise noted. Typical values are at T<sub>J</sub> = +25°C. (Note 5)

| Parameter                                     | Test Conditions                                                                                      | Symbol                                   | Min   | Typ  | Max            | Unit              |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------|-------|------|----------------|-------------------|
| Operating Input Voltage                       |                                                                                                      | V <sub>IN</sub>                          | 2.5   |      | 5.5            | V                 |
| Undervoltage lock-out                         | V <sub>IN</sub> rising                                                                               | UVLO                                     | 1.2   | 1.6  | 1.9            | V                 |
| Output Voltage Accuracy                       | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 0 – 1 A                       | V <sub>OUT</sub>                         | 2.178 | 2.2  | 2.222          | V                 |
| Line Regulation                               | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 10 mA                         | Reg <sub>LINE</sub>                      |       | 2    |                | mV                |
| Load Regulation                               | I <sub>OUT</sub> = 0 mA to 1 A                                                                       | Reg <sub>LOAD</sub>                      |       | 2    |                | mV                |
| Load Transient                                | I <sub>OUT</sub> = 10 mA to 1A or 10 mA to 1 A in 10 μs, C <sub>OUT</sub> = 10 μF                    | Tran <sub>LOAD</sub>                     |       | ±120 |                | mV                |
| Dropout voltage (Note 6)                      | I <sub>OUT</sub> = 1 A, V <sub>OUT(nom)</sub> = 2.2 V                                                | V <sub>DO</sub>                          |       |      | 300            | mV                |
| Output Current Limit                          | V <sub>OUT</sub> = 90% V <sub>OUT(nom)</sub>                                                         | I <sub>CL</sub>                          | 1.1   |      |                | A                 |
| Quiescent current                             | I <sub>OUT</sub> = 0 mA                                                                              | I <sub>Q</sub>                           |       | 180  | 230            | μA                |
| Ground current                                | I <sub>OUT</sub> = 1 A                                                                               | I <sub>GND</sub>                         |       | 200  |                | μA                |
| Shutdown current                              | V <sub>EN</sub> ≤ 0 V, V <sub>IN</sub> = 2.0 to 5.5 V                                                |                                          |       | 0.1  | 1              | μA                |
| EN Pin High Threshold<br>EN Pin Low Threshold | V <sub>EN</sub> Voltage increasing<br>V <sub>EN</sub> Voltage decreasing                             | V <sub>EN_HI</sub><br>V <sub>EN_LO</sub> | 0.9   |      | 0.4            | V                 |
| EN Pin Input Current                          | V <sub>EN</sub> = 5.5 V                                                                              | I <sub>EN</sub>                          |       | 100  | 500            | nA                |
| Turn-on Time                                  | C <sub>OUT</sub> = 4.7 μF, from assertion EN pin to 98% V <sub>out(nom)</sub>                        | t <sub>ON</sub>                          |       | 200  |                | μs                |
| Power Supply Rejection Ratio                  | V <sub>IN</sub> = 3.2 V, V <sub>OUT</sub> = 2.2 V<br>I <sub>OUT</sub> = 0.5 A                        | f = 100 Hz<br>f = 1 kHz<br>f = 10 kHz    | PSRR  |      | 55<br>70<br>60 | dB                |
| Output Noise Voltage                          | V <sub>OUT</sub> = 2.2 V, V <sub>IN</sub> = 2.7 V, I <sub>OUT</sub> = 0.5 A<br>f = 100 Hz to 100 kHz | V <sub>NOISE</sub>                       |       | 300  |                | μV <sub>rms</sub> |
| Thermal Shutdown Temperature                  | Temperature increasing from T <sub>J</sub> = +25°C                                                   | T <sub>SD</sub>                          |       | 160  |                | °C                |
| Thermal Shutdown Hysteresis                   | Temperature falling from T <sub>SD</sub>                                                             | T <sub>SDH</sub>                         | –     | 20   | –              | °C                |

5. Performance guaranteed over the indicated operating temperature range by design and/or characterization production tested at T<sub>J</sub> = T<sub>A</sub> = 25°C. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.

6. Characterized when V<sub>OUT</sub> falls 100 mV below the regulated voltage at V<sub>IN</sub> = V<sub>OUT(NOM)</sub> + 0.3 V.

# NCP706

## ELECTRICAL CHARACTERISTICS – VOLTAGE VERSION 2.95 V

–40°C ≤ T<sub>J</sub> ≤ 125°C; V<sub>IN</sub> = V<sub>OUT(NOM)</sub> + 0.3 V or 3.3 V, whichever is greater; I<sub>OUT</sub> = 10 mA, C<sub>IN</sub> = C<sub>OUT</sub> = 4.7 μF, V<sub>EN</sub> = 0.9 V, unless otherwise noted. Typical values are at T<sub>J</sub> = +25°C. (Note 7)

| Parameter                                     | Test Conditions                                                                                                                 | Symbol                                   | Min    | Typ            | Max    | Unit              |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|--------|----------------|--------|-------------------|
| Operating Input Voltage                       |                                                                                                                                 | V <sub>IN</sub>                          | 2.4    |                | 5.5    | V                 |
| Undervoltage lock-out                         | V <sub>IN</sub> rising, I <sub>OUT</sub> = 0                                                                                    | UVLO                                     | 1.2    | 1.6            | 1.9    | V                 |
| Output Voltage Accuracy                       | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 0 – 1 A                                                  | V <sub>OUT</sub>                         | 2.9205 | 2.95           | 2.9795 | V                 |
| Line Regulation                               | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 10 mA                                                    | Reg <sub>LINE</sub>                      |        | 2              |        | mV                |
| Load Regulation                               | I <sub>OUT</sub> = 0 mA to 1 A, V <sub>IN</sub> = 3.3 V                                                                         | Reg <sub>LOAD</sub>                      |        | 2              |        | mV                |
| Load Transient                                | I <sub>OUT</sub> = 10 mA to 1 A in 10 μs, V <sub>IN</sub> = 3.5 V<br>C <sub>OUT</sub> = 10 μF                                   | Tran <sub>LOAD</sub>                     |        | ±120           |        | mV                |
| Dropout voltage (Note 8)                      | I <sub>OUT</sub> = 1 A, V <sub>OUT(nom)</sub> = 3.0 V                                                                           | V <sub>DO</sub>                          |        | 155            | 230    | mV                |
| Output Current Limit                          | V <sub>OUT</sub> = 90% V <sub>OUT(nom)</sub>                                                                                    | I <sub>CL</sub>                          | 1.1    |                |        | A                 |
| Quiescent current                             | I <sub>OUT</sub> = 0 mA                                                                                                         | I <sub>Q</sub>                           |        | 170            | 230    | μA                |
| Ground current                                | I <sub>OUT</sub> = 1 A                                                                                                          | I <sub>GND</sub>                         |        | 200            |        | μA                |
| Shutdown current                              | V <sub>EN</sub> ≤ 0 V, V <sub>IN</sub> = 2.4 to 5.5 V                                                                           |                                          |        | 0.1            | 1      | μA                |
| EN Pin High Threshold<br>EN Pin Low Threshold | V <sub>EN</sub> Voltage increasing<br>V <sub>EN</sub> Voltage decreasing                                                        | V <sub>EN_HI</sub><br>V <sub>EN_LO</sub> | 0.9    |                | 0.4    | V                 |
| EN Pin Input Current                          | V <sub>EN</sub> = 5.5 V                                                                                                         | I <sub>EN</sub>                          |        | 100            | 500    | nA                |
| Turn-on Time                                  | C <sub>OUT</sub> = 4.7 μF, from assertion EN pin to 98%<br>V <sub>out(nom)</sub>                                                | t <sub>ON</sub>                          |        | 150            |        | μs                |
| Power Supply Rejection Ratio                  | V <sub>IN</sub> = 3.5 V + 200 mVpp modulation, V <sub>OUT</sub> = 2.95 V<br>I <sub>OUT</sub> = 0.5 A, C <sub>OUT</sub> = 4.7 μF | PSRR                                     |        | 65<br>58<br>52 |        | dB                |
| Output Noise Voltage                          | V <sub>OUT</sub> = 2.95 V, V <sub>IN</sub> = 4.0 V, I <sub>OUT</sub> = 0.5 A<br>f = 100 Hz to 100 kHz                           | V <sub>NOISE</sub>                       |        | 300            |        | μV <sub>rms</sub> |
| Thermal Shutdown Temperature                  | Temperature increasing from T <sub>J</sub> = +25°C                                                                              | T <sub>SD</sub>                          |        | 160            |        | °C                |
| Thermal Shutdown Hysteresis                   | Temperature falling from T <sub>SD</sub>                                                                                        | T <sub>SDH</sub>                         | –      | 20             | –      | °C                |

7. Performance guaranteed over the indicated operating temperature range by design and/or characterization production tested at T<sub>J</sub> = T<sub>A</sub> = 25°C. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.

8. Characterized when V<sub>OUT</sub> falls 90 mV below the regulated voltage at V<sub>IN</sub> = 3.3 V, I<sub>OUT</sub> = 10 mA.

# NCP706

## ELECTRICAL CHARACTERISTICS – VOLTAGE VERSION 3.0 V

–40°C ≤ T<sub>J</sub> ≤ 125°C; V<sub>IN</sub> = V<sub>OUT(NOM)</sub> + 0.3 V or 3.3 V, whichever is greater; I<sub>OUT</sub> = 10 mA, C<sub>IN</sub> = C<sub>OUT</sub> = 4.7 μF, V<sub>EN</sub> = 0.9 V, unless otherwise noted. Typical values are at T<sub>J</sub> = +25°C. (Note 9)

| Parameter                                     | Test Conditions                                                                                                                | Symbol                                   | Min  | Typ  | Max            | Unit              |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------|------|----------------|-------------------|
| Operating Input Voltage                       |                                                                                                                                | V <sub>IN</sub>                          | 2.4  |      | 5.5            | V                 |
| Undervoltage lock-out                         | V <sub>IN</sub> rising, I <sub>OUT</sub> = 0                                                                                   | UVLO                                     | 1.2  | 1.6  | 1.9            | V                 |
| Output Voltage Accuracy                       | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 0 – 1 A                                                 | V <sub>OUT</sub>                         | 2.97 | 3.0  | 3.03           | V                 |
| Line Regulation                               | V <sub>OUT</sub> + 0.3 V ≤ V <sub>IN</sub> ≤ 4.5 V, I <sub>OUT</sub> = 10 mA                                                   | Reg <sub>LINE</sub>                      |      | 2    |                | mV                |
| Load Regulation                               | I <sub>OUT</sub> = 0 mA to 1 A, V <sub>IN</sub> = 3.3 V                                                                        | Reg <sub>LOAD</sub>                      |      | 2    |                | mV                |
| Load Transient                                | I <sub>OUT</sub> = 10 mA to 1 A in 10 μs, V <sub>IN</sub> = 3.5 V<br>C <sub>OUT</sub> = 10 μF                                  | Tran <sub>LOAD</sub>                     |      | ±120 |                | mV                |
| Dropout voltage (Note 10)                     | I <sub>OUT</sub> = 1 A, V <sub>OUT(nom)</sub> = 3.0 V                                                                          | V <sub>DO</sub>                          |      | 155  | 230            | mV                |
| Output Current Limit                          | V <sub>OUT</sub> = 90% V <sub>OUT(nom)</sub>                                                                                   | I <sub>CL</sub>                          | 1.1  |      |                | A                 |
| Quiescent current                             | I <sub>OUT</sub> = 0 mA                                                                                                        | I <sub>Q</sub>                           |      | 170  | 230            | μA                |
| Ground current                                | I <sub>OUT</sub> = 1 A                                                                                                         | I <sub>GND</sub>                         |      | 200  |                | μA                |
| Shutdown current                              | V <sub>EN</sub> ≤ 0 V, V <sub>IN</sub> = 2.0 to 5.5 V                                                                          |                                          |      | 0.1  | 1              | μA                |
| EN Pin High Threshold<br>EN Pin Low Threshold | V <sub>EN</sub> Voltage increasing<br>V <sub>EN</sub> Voltage decreasing                                                       | V <sub>EN_HI</sub><br>V <sub>EN_LO</sub> | 0.9  |      | 0.4            | V                 |
| EN Pin Input Current                          | V <sub>EN</sub> = 5.5 V                                                                                                        | I <sub>EN</sub>                          |      | 100  | 500            | nA                |
| Turn-on Time                                  | C <sub>OUT</sub> = 4.7 μF, from assertion EN pin to 98%<br>V <sub>out(nom)</sub>                                               | t <sub>ON</sub>                          |      | 150  |                | μs                |
| Power Supply Rejection Ratio                  | V <sub>IN</sub> = 3.5 V + 200 mVpp modulation, V <sub>OUT</sub> = 3.0 V<br>I <sub>OUT</sub> = 0.5 A, C <sub>OUT</sub> = 4.7 μF | f = 100 Hz<br>f = 1 kHz<br>f = 10 kHz    | PSRR |      | 65<br>58<br>52 | dB                |
| Output Noise Voltage                          | V <sub>OUT</sub> = 3.0 V, V <sub>IN</sub> = 4.0 V, I <sub>OUT</sub> = 0.5 A<br>f = 100 Hz to 100 kHz                           | V <sub>NOISE</sub>                       |      | 300  |                | μV <sub>rms</sub> |
| Thermal Shutdown Temperature                  | Temperature increasing from T <sub>J</sub> = +25°C                                                                             | T <sub>SD</sub>                          |      | 160  |                | °C                |
| Thermal Shutdown Hysteresis                   | Temperature falling from T <sub>SD</sub>                                                                                       | T <sub>SDH</sub>                         | –    | 20   | –              | °C                |

9. Performance guaranteed over the indicated operating temperature range by design and/or characterization production tested at T<sub>J</sub> = T<sub>A</sub> = 25°C. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.

10. Characterized when V<sub>OUT</sub> falls 90 mV below the regulated voltage at V<sub>IN</sub> = 3.3 V, I<sub>OUT</sub> = 10 mA.

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS

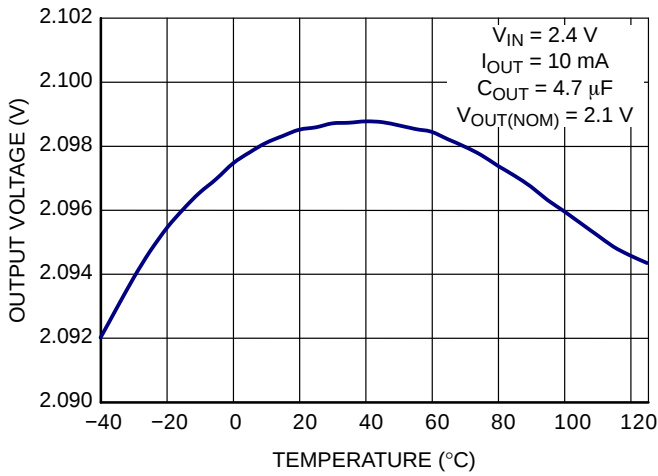


Figure 3. Output Voltage vs. Temperature

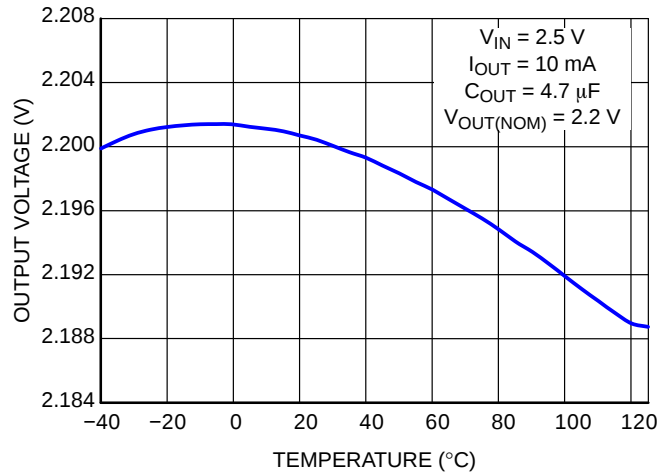


Figure 4. Output Voltage vs. Temperature

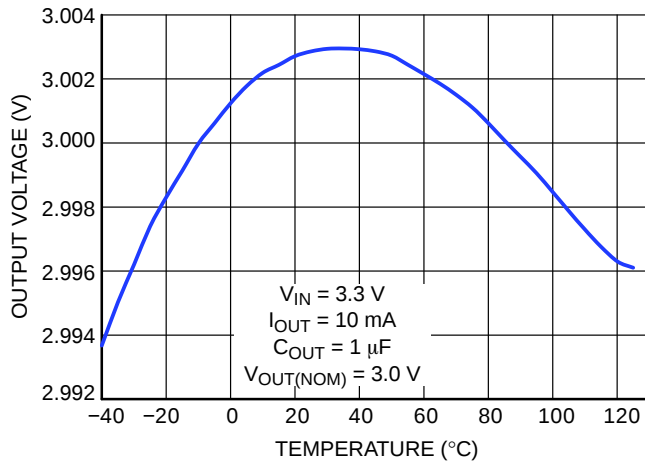


Figure 5. Output Voltage vs. Temperature

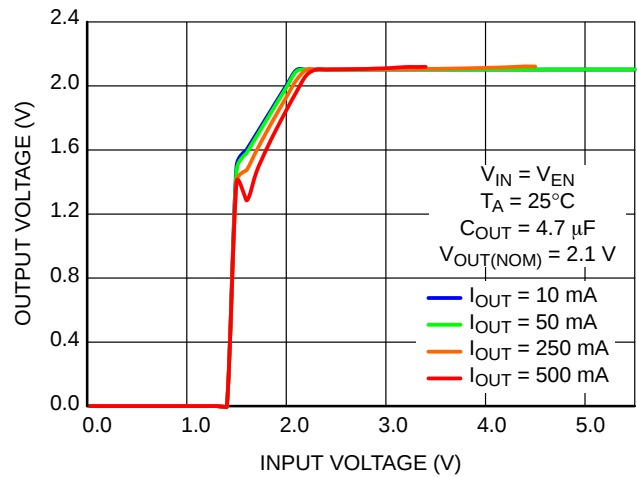


Figure 6. Output Voltage vs. Input Voltage

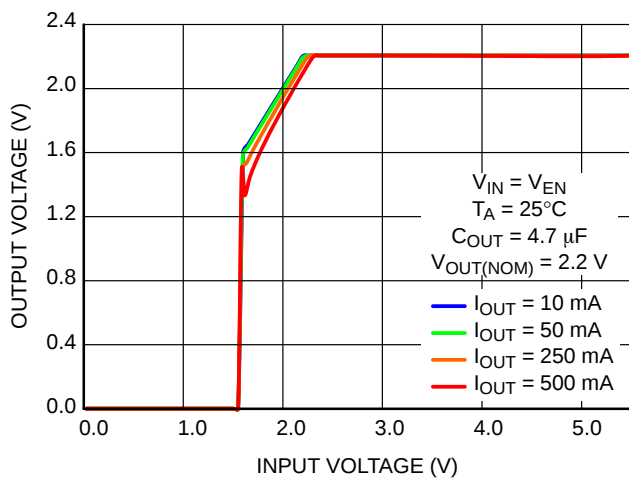


Figure 7. Output Voltage vs. Input Voltage

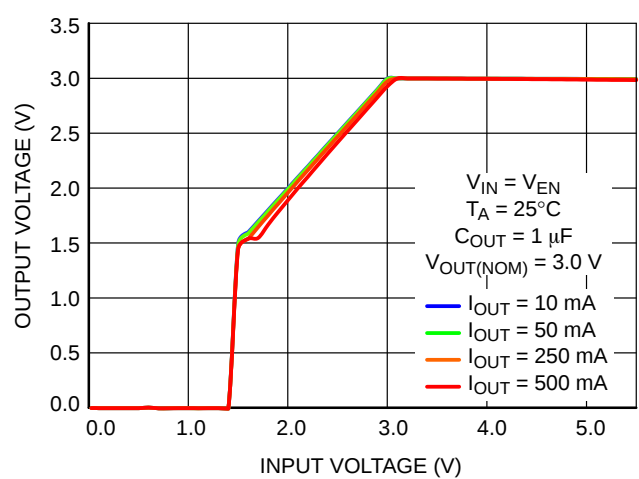


Figure 8. Output Voltage vs. Input Voltage

TYPICAL CHARACTERISTICS

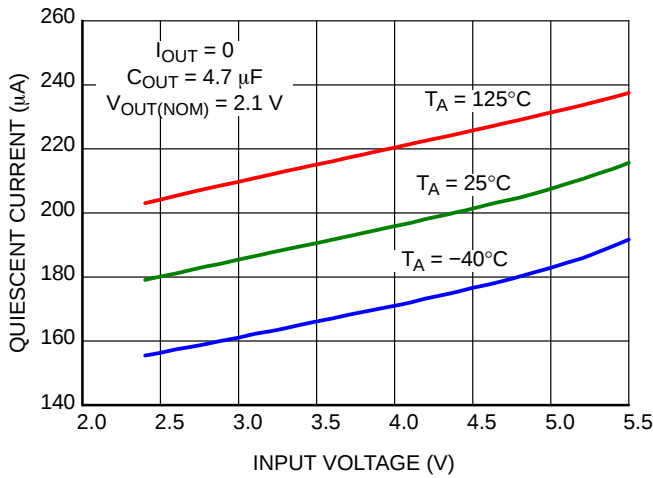


Figure 9. Quiescent Current vs. Input Voltage

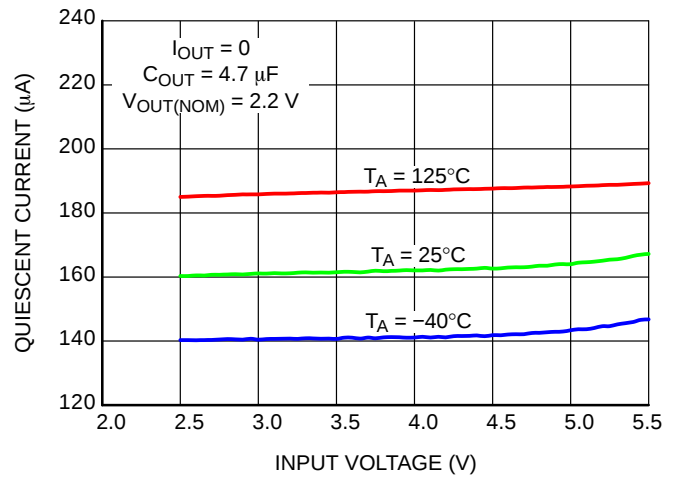


Figure 10. Quiescent Current vs. Input Voltage

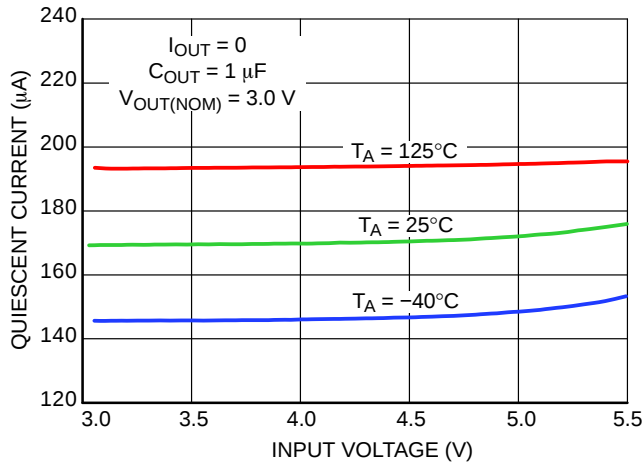


Figure 11. Quiescent Current vs. Input Voltage

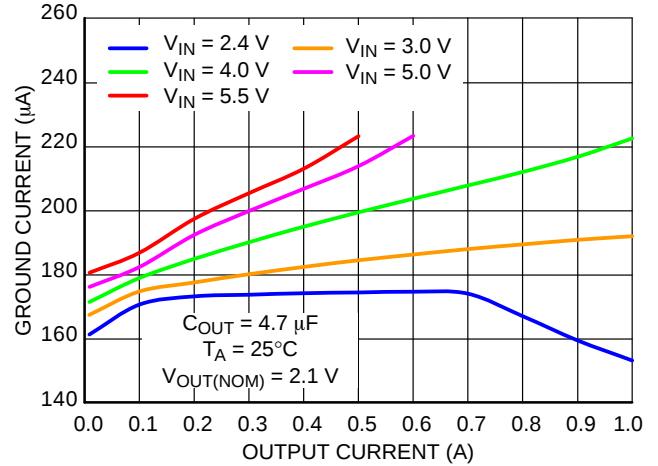


Figure 12. Ground Current vs. Output Current

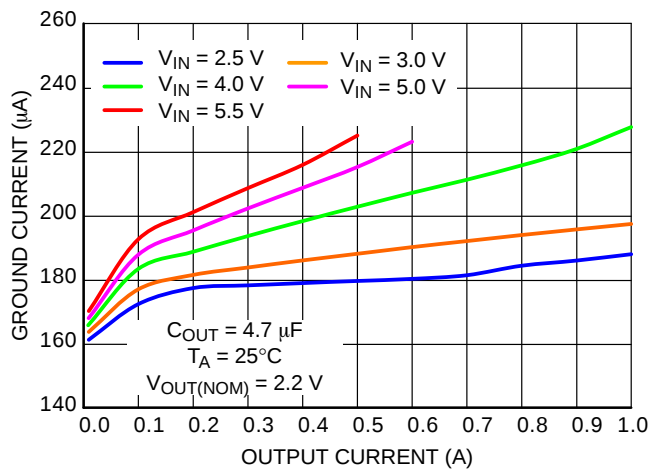


Figure 13. Ground Current vs. Output Current

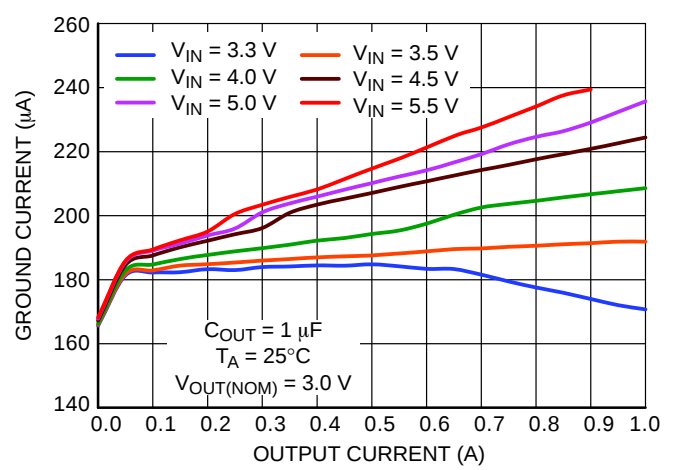


Figure 14. Ground Current vs. Output Current

TYPICAL CHARACTERISTICS

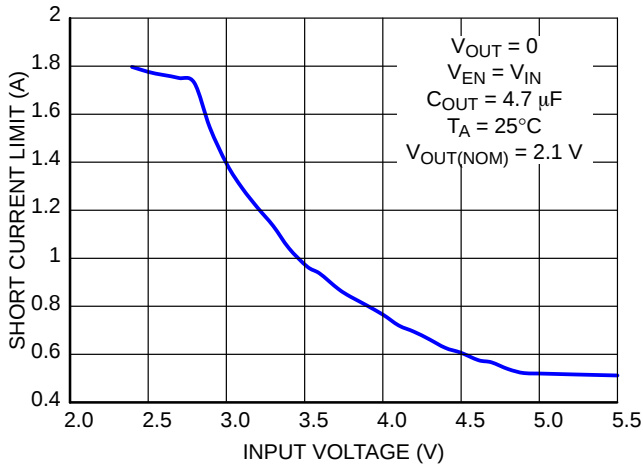


Figure 15. Short Current Limitation vs. Input Voltage

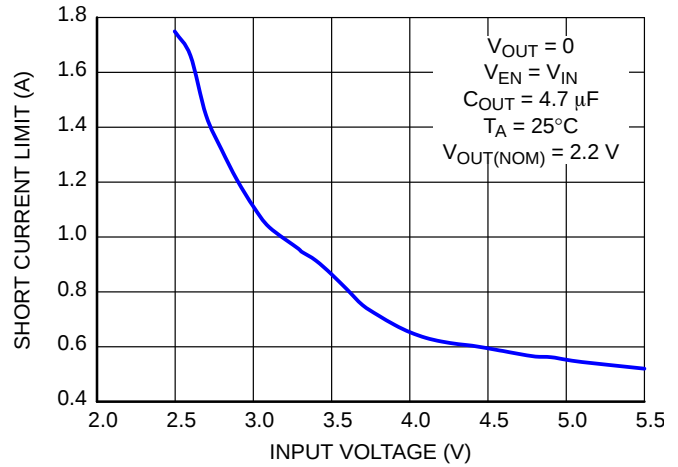


Figure 16. Short Current Limitation vs. Input Voltage

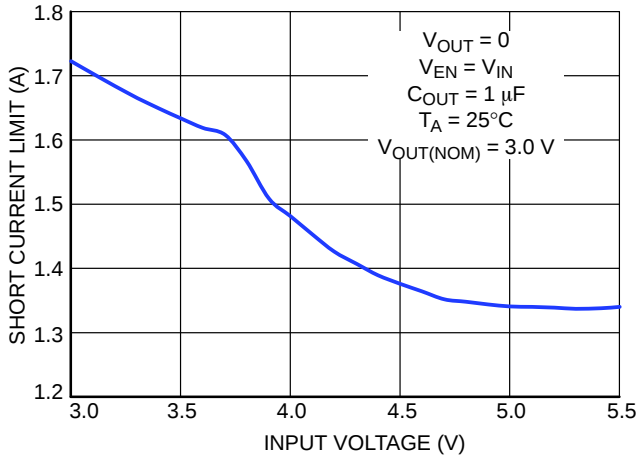


Figure 17. Short Current Limitation vs. Input Voltage

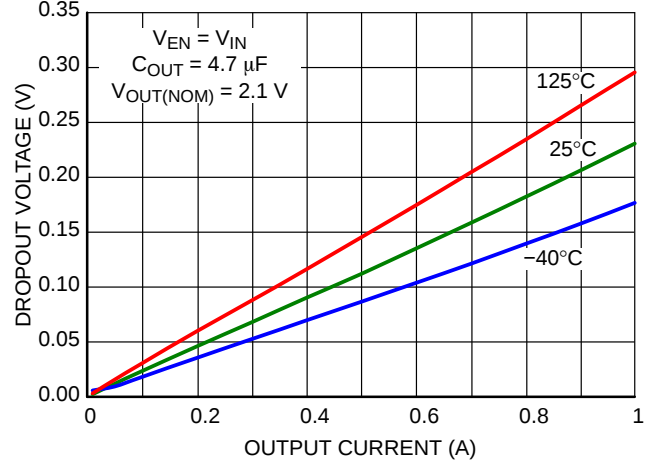


Figure 18. Dropout Voltage vs. Output Current

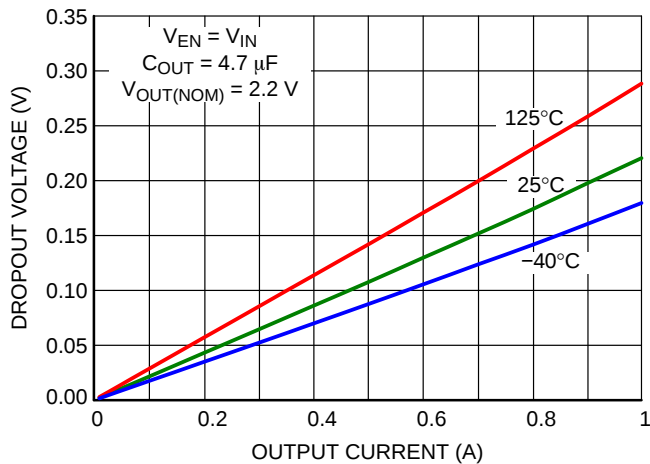


Figure 19. Dropout Voltage vs. Output Current

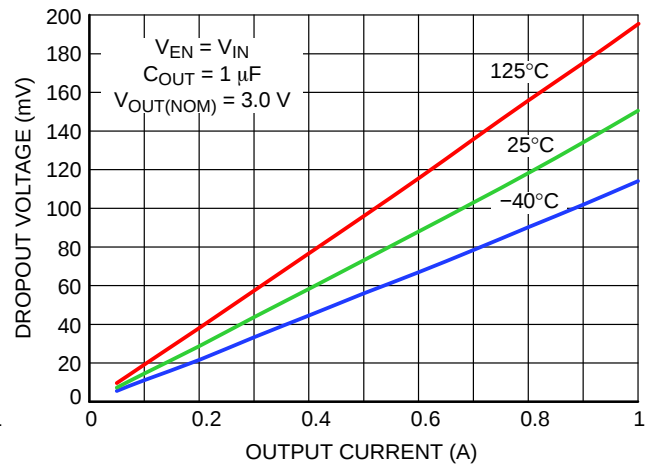


Figure 20. Dropout Voltage vs. Output Current

## TYPICAL CHARACTERISTICS

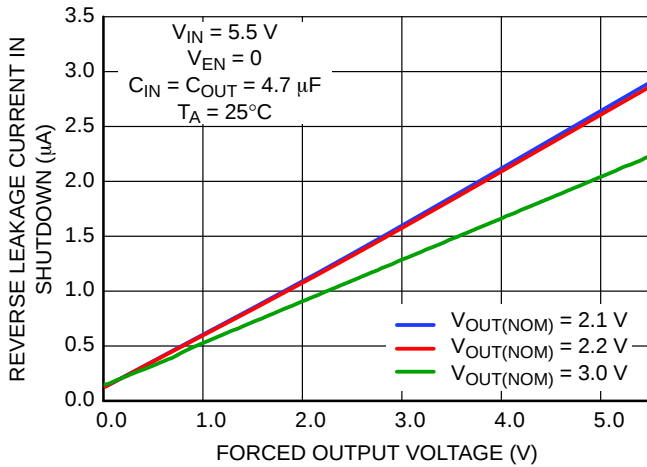


Figure 21. Reverse Leakage Current in Shutdown

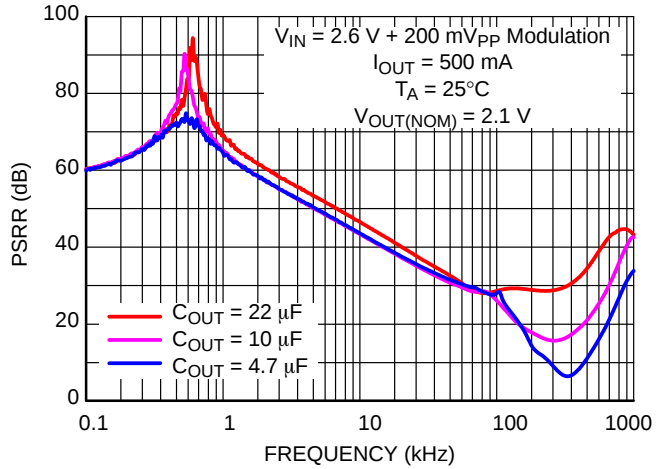


Figure 22. PSRR vs. Frequency & Output Capacitor

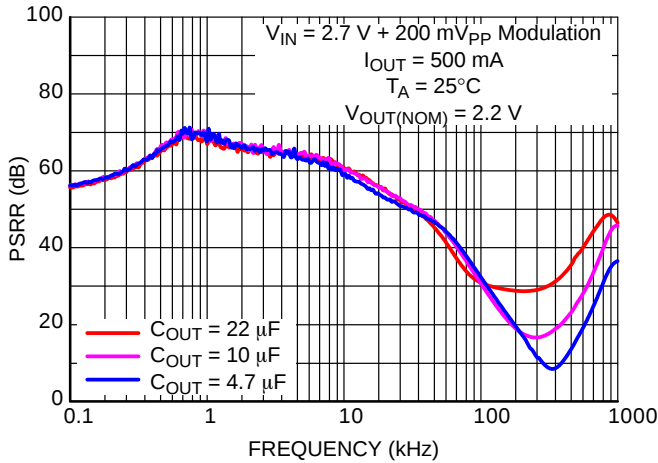


Figure 23. PSRR vs. Frequency & Output Capacitor

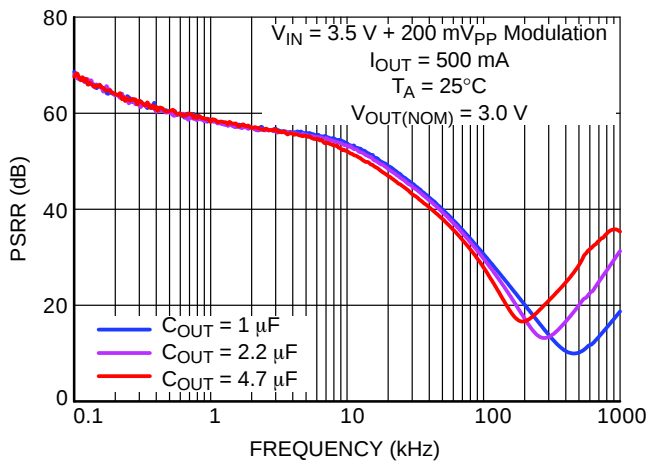


Figure 24. PSRR vs. Frequency & Output Capacitor

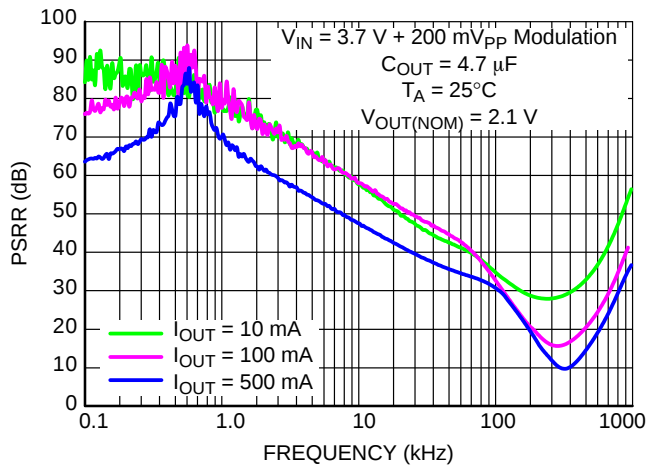


Figure 25. PSRR vs. Frequency & Output Current

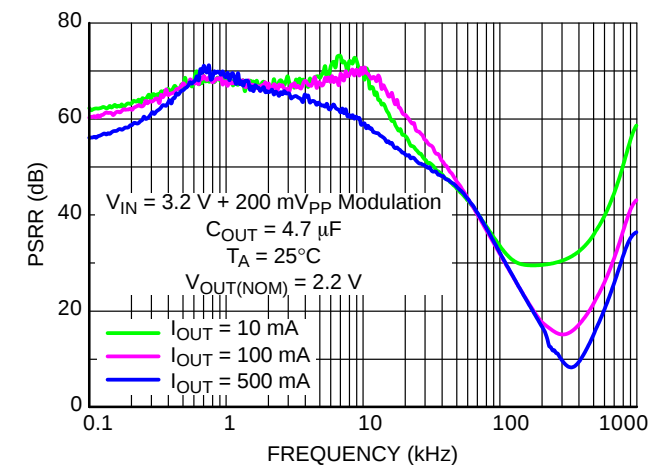
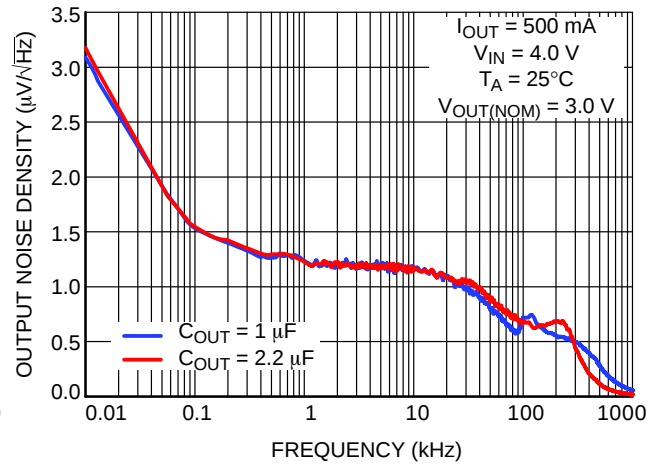
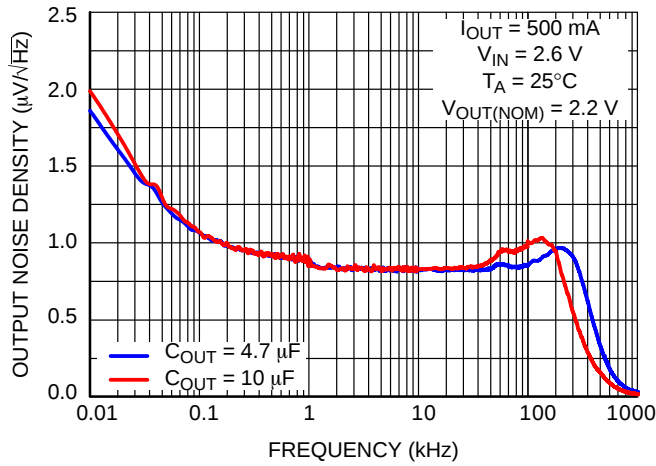
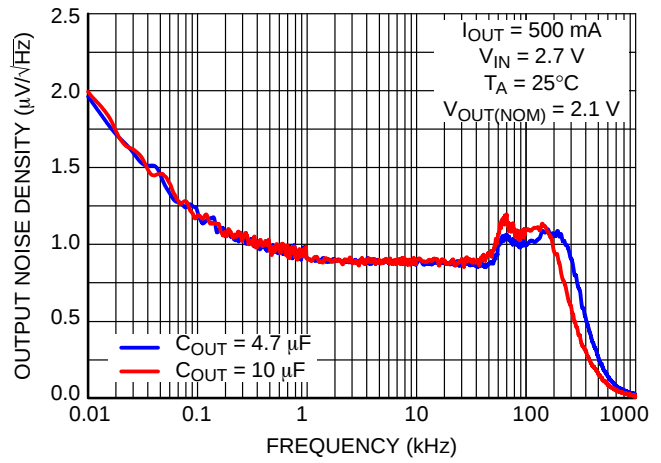
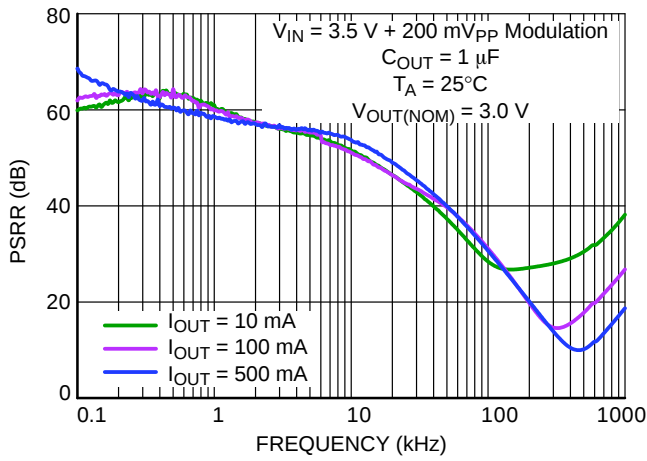


Figure 26. PSRR vs. Frequency & Output Current

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

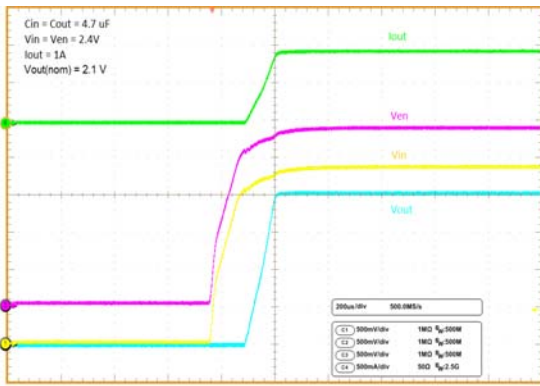


Figure 31. Turn-on by Coupled Input and Enable Pins

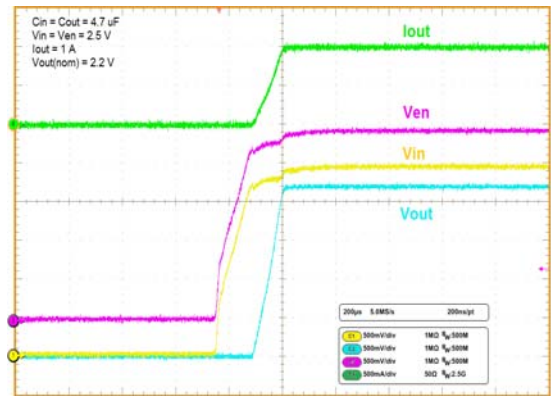


Figure 32. Turn-on by Coupled Input and Enable Pins

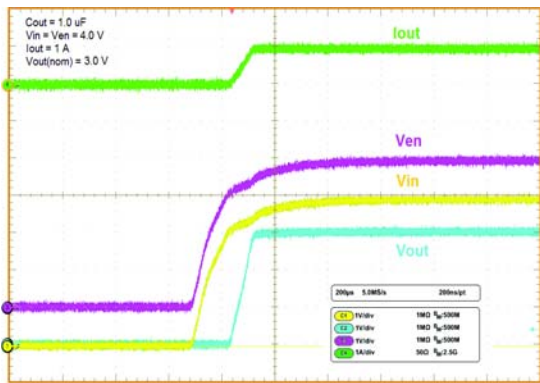


Figure 33. Turn-on by Coupled Input and Enable Pins

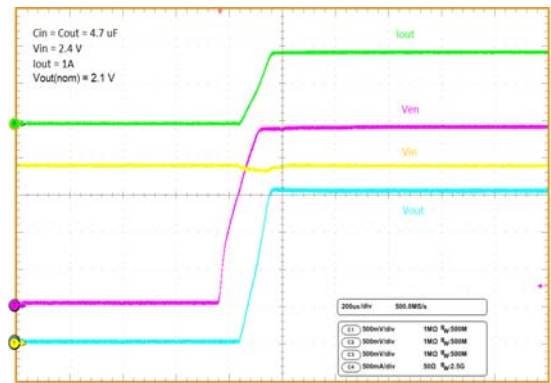


Figure 34. Turn-on by Enable Signal

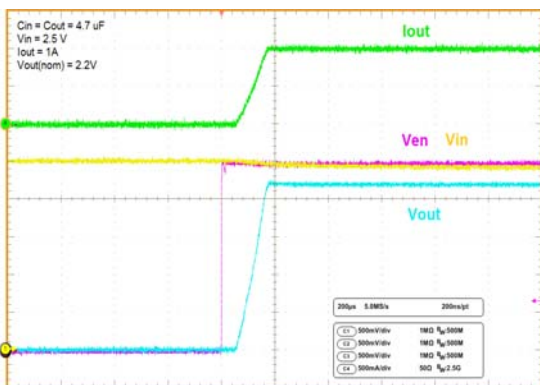


Figure 35. Turn-on by Enable Signal

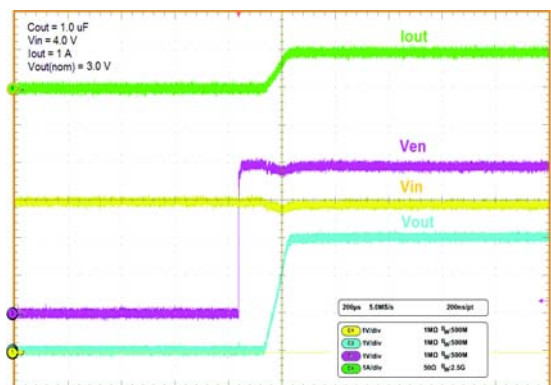


Figure 36. Turn-on by Enable Signal

## TYPICAL CHARACTERISTICS

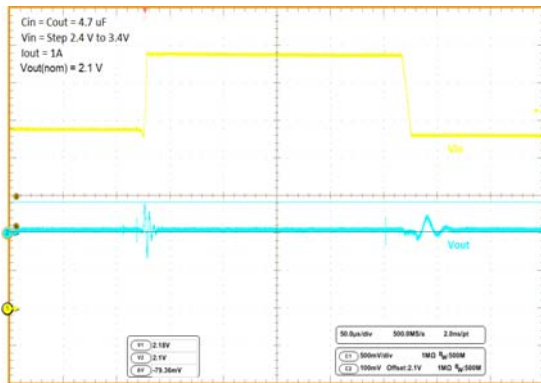


Figure 37. Line Transient Response

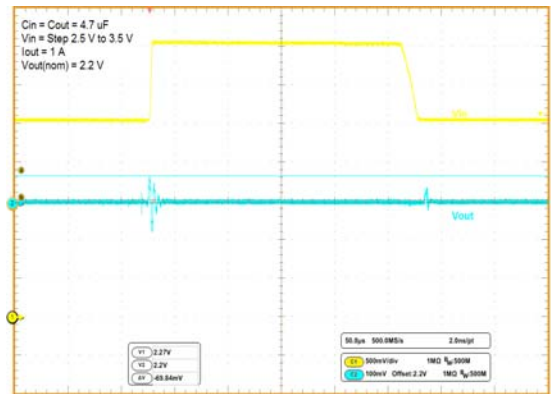


Figure 38. Line Transient Response

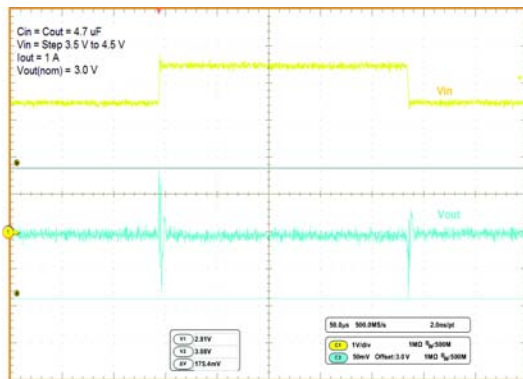


Figure 39. Line Transient Response

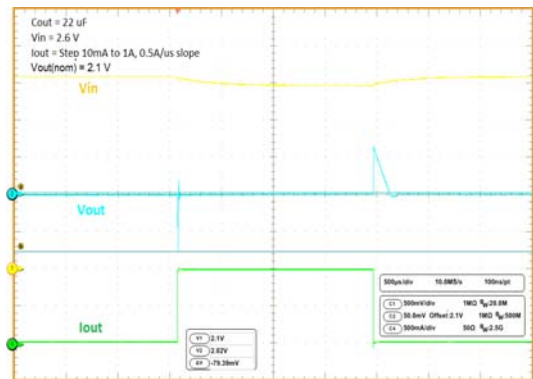


Figure 40. Load Transient Response

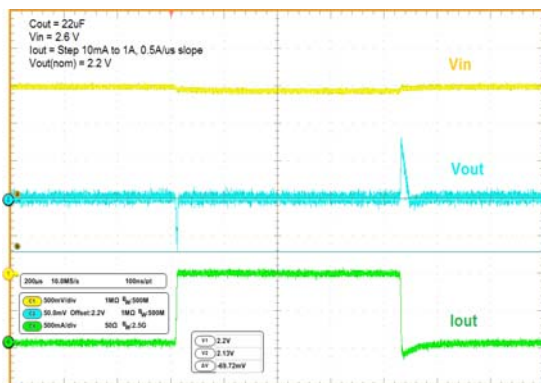


Figure 41. Load Transient Response

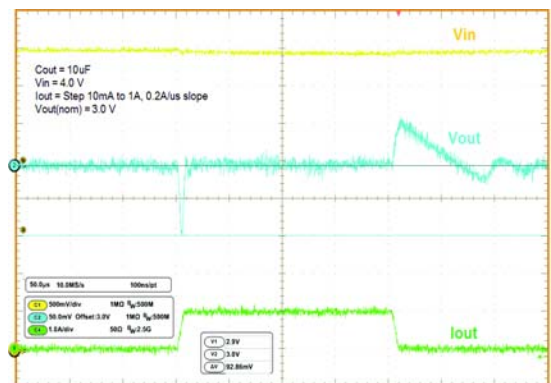


Figure 42. Load Transient Response

## APPLICATIONS INFORMATION

**Input Decoupling (C<sub>in</sub>)**

A 4.7  $\mu\text{F}$  capacitor either ceramic or tantalum is recommended and should be connected as close as possible to the pins of NCP706 device. Higher values and lower ESR will improve the overall line transient response.

**Output Decoupling (C<sub>out</sub>)**

The minimum decoupling value for NCP706MX21TAG and NCP706MX22TAG devices is 4.7  $\mu\text{F}$  and can be augmented to fulfill stringent load transient requirements. The minimum decoupling value for NCP706MX295TAG and NCP706MX706300TAG devices is 1  $\mu\text{F}$ . The regulator accepts ceramic chip capacitors MLCC. If a tantalum capacitor is used, and its ESR is large, the loop oscillation may result. Larger values improve noise rejection and PSRR.

**Enable Operation**

The enable pin EN will turn on or off the regulator. These limits of threshold are covered in the electrical specification section of this data sheet. If the enable is not used then the pin should be connected to V<sub>IN</sub>.

**Hints**

Please be sure the V<sub>IN</sub> and GND lines are sufficiently wide. If their impedance is high, noise pickup or unstable operation may result.

Set external components, especially the output capacitor, as close as possible to the circuit.

The sense pin SNS trace is recommended to be kept as far from noisy power traces as possible and as close to load as possible.

**Thermal**

As power across the NCP706 increases, it might become necessary to provide some thermal relief. The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material, and also the ambient temperature affect the rate of temperature rise for the part. This is stating that when the NCP706 has good thermal conductivity through the PCB, the junction temperature will be relatively low with high power dissipation.

The power dissipation across the device can be roughly represented by the equation:

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} \text{ [W]} \quad (\text{eq. 1})$$

The maximum power dissipation depends on the thermal resistance of the case and circuit board, the temperature differential between the junction and ambient, PCB orientation and the rate of air flow.

The maximum allowable power dissipation can be calculated using the following equation:

$$P_{MAX} = (T_J - T_A) / \theta_{JA} \text{ [W]} \quad (\text{eq. 2})$$

Where (T<sub>J</sub> - T<sub>A</sub>) is the temperature differential between the junction and the surrounding environment and  $\theta_{JA}$  is the thermal resistance from the junction to the ambient.

Connecting the exposed pad and non connected pin 3 to a large ground pad or plane helps to conduct away heat and improves thermal relief.

## ORDERING INFORMATION

| Device                            | Nominal Ooutput Voltage | Marking | Package         | Shipping <sup>†</sup>                  |
|-----------------------------------|-------------------------|---------|-----------------|----------------------------------------|
| NCP706MX21TAG                     | 2.1 V                   | QM      | XDFN8 (Pb-Free) | 3000 / Tape & Reel                     |
| NCP706MX22TAG                     | 2.2 V                   | QR      | XDFN8 (Pb-Free) | 3000 / Tape & Reel                     |
| NCP706MX295TAG                    | 2.95 V                  | A2      | XDFN8 (Pb-Free) | 3000 / Tape & Reel                     |
| NCP706MX300TAG                    | 3.0 V                   | A3      | XDFN8 (Pb-Free) | 3000 / Tape & Reel                     |
| NCP706MX33TAG<br>(In Development) | 3.3 V                   | Q3      | XDFN8 (Pb-Free) | 3000 / Tape & Reel<br>(Available Soon) |

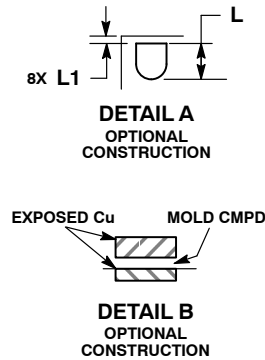
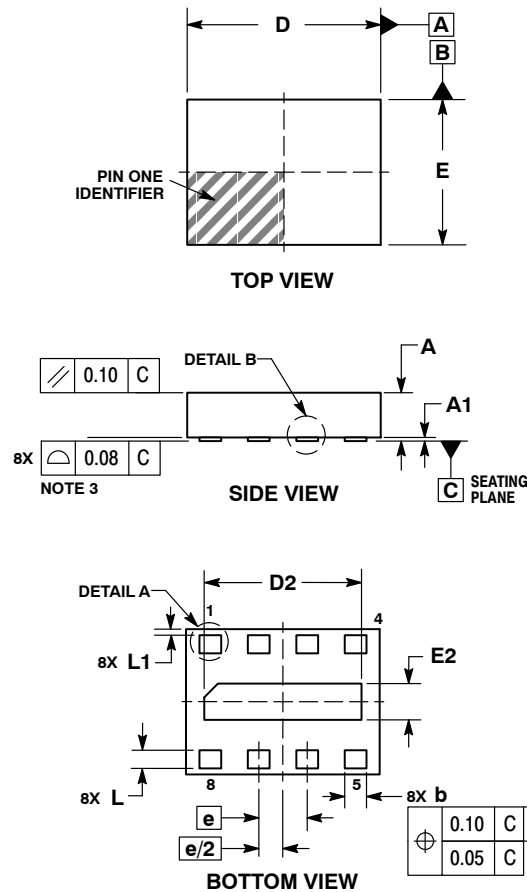
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



SCALE 4:1

**XDFN8 1.6x1.2, 0.4P**  
**CASE 711AS**  
**ISSUE D**

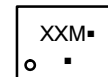
DATE 08 DEC 2015



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

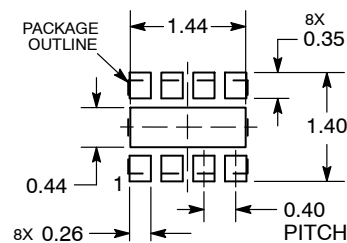
| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN         | NOM   | MAX   |
| A   | 0.300       | 0.375 | 0.450 |
| A1  | 0.000       | 0.025 | 0.050 |
| b   | 0.130       | 0.180 | 0.230 |
| D   | 1.500       | 1.600 | 1.700 |
| D2  | 1.200       | 1.300 | 1.400 |
| E   | 1.100       | 1.200 | 1.300 |
| E2  | 0.200       | 0.300 | 0.400 |
| e   | 0.40 BSC    |       |       |
| L   | 0.150       | 0.200 | 0.250 |
| L1  | 0.000       | 0.050 | 0.100 |

**GENERIC MARKING DIAGRAM\***


- XX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

**RECOMMENDED MOUNTING FOOTPRINT\***


DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, [SOLDERM/D](#).

|                         |                             |                                                                                                                                                                                  |
|-------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>XDFN8, 1.6X1.2, 0.4P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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