

# NCS1002

## Constant Voltage / Constant Current Secondary-Side Controller

### Description

The NCS1002 is a highly integrated solution for Switching Mode Power Supply (SMPS) applications requiring a dual control loop to perform Constant Voltage (CV) and Constant Current (CC) regulation. The NCS1002 integrates a 2.5 V voltage reference and two precision op amps. The voltage reference, along with Op Amp 1, is the core of the voltage control-loop. Op Amp 2 is an independent, uncommitted amplifier specifically designed for the current control. Key external components needed to complete the two control loops are: (a) A resistor divider that senses the output of the power supply (battery charger) and fixes the voltage regulation set point at the specified value. (b) A sense resistor that feeds the current sensing circuit with a voltage proportional to the DC output current. This resistor determines the current regulation set point and must be adequately rated in terms of power dissipation. The NCS1002 comes in a small 8-pin SOIC package and is ideal for space-shrunk applications such as battery chargers.

### Features

- Low Input Offset Voltage: 0.5 mV, Typ
- Input Common-Mode Range includes Ground
- Low Quiescent Current: 300  $\mu$ A per Op Amp at  $V_{CC} = 5$  V
- Large Output Voltage Swing
- Wide Power Supply Range: 3 V to 32 V
- High ESD Protection: 2 kV
- These are Pb-Free Devices

### Typical Applications

- Battery Chargers
- Switch Mode Power Supplies



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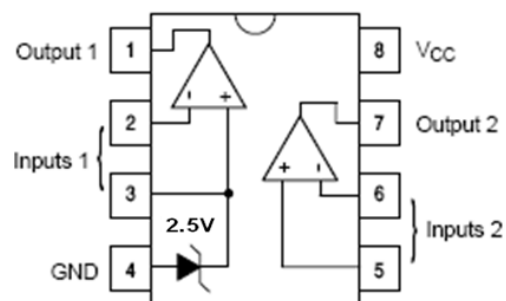
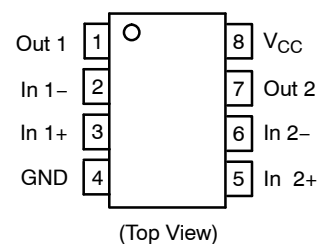
### MARKING DIAGRAMS



- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

### PIN CONNECTIONS



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

# NCS1002

## MAXIMUM RATINGS

| Parameter  | Symbol     | Rating      | Unit |
|--|------------|-------------|------|
| Supply Voltage ( $V_{CC}$ to GND)                          | $V_{CC}$   | 36          | V    |
| Differential Input Voltage                                 | $V_{id}$   | 36          | V    |
| Input Voltage  | $V_i$      | -0.3 to +36 | V    |
| ESD Protection Voltage at Pin<br>Human Body Model          | $V_{ESD}$  | 2000        | V    |
| Maximum Junction Temperature                               | $T_J$      | 150         | °C   |
| Specification Temperature Range ( $T_{min}$ to $T_{max}$ ) | $T_A$      | -40 to +105 | °C   |
| Operating Free-Air Temperature Range                       | $T_{oper}$ | -55 to +125 | °C   |
| Storage Temperature Range                                  | $T_{stg}$  | -55 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.

## THERMAL CHARACTERISTICS

| Parameter                                 | Symbol          | Rating | Unit |
|---|-----------------|--------|------|
| Thermal Resistance<br>Junction-to-Ambient | $R_{\theta JA}$ | 175    | °C/W |

# NCS1002

## ELECTRICAL CHARACTERISTICS

| Symbol   | Characteristics   | Conditions | Min | Typ | Max  | Unit |
|----------|---|------------|-----|-----|------|------|
| $I_{CC}$ | Total Supply Current, excluding current in the Voltage Reference $V_{CC} = 5\text{ V}$ , no load; $-40 \leq T_A \leq +105^\circ\text{C}$  |            |     | 0.3 | 0.4  | mA   |
| $I_{CC}$ | Total Supply Current, excluding Current in the Voltage Reference $V_{CC} = 30\text{ V}$ , no load; $-40 \leq T_A \leq +105^\circ\text{C}$ |            |     |     | 0.75 | mA   |

### OP AMP 1 (OP AMP WITH NONINVERTING INPUT CONNECTED TO THE INTERNAL $V_{ref}$ ) ( $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$ unless otherwise noted)

|              |   |  |     |      |     |                              |
|--------------|---|--|-----|------|-----|------------------------------|
| $V_{IO}$     | Input Offset Voltage  | $T_A = 25^\circ\text{C}$                                       |     |      | 2.0 | mV                           |
|              |   | $-40 \leq T_A \leq +105^\circ\text{C}$                         |     |      | 3.0 | mV                           |
| $DV_{IO}$    | Input Offset Voltage Drift ( $-40 \leq T_A \leq +105^\circ\text{C}$ )   |  |     | 7.0  |     | $\mu\text{V}/^\circ\text{C}$ |
| $I_{IB}$     | Input Bias Current (Inverting Input Only) $T_A = 25^\circ\text{C}$  |  |     | 20   |     | nA                           |
| AVD          | Large Signal Voltage Gain ( $V_{CC} = 15\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $V_{ICM} = 0\text{ V}$ )  |  |     | 100  |     | V/mV                         |
| PSRR         | Power Supply Rejection ( $V_{CC} = 5.0\text{ V}$ to $30\text{ V}$ , $V_{OUT} = 2\text{ V}$ )  |  | 80  | 100  |     | dB                           |
| $I_{SOURCE}$ | Output Source Current ( $V_{CC} = 15\text{ V}$ , $V_{OUT} = 2.0\text{ V}$ , $V_{id} = 1\text{ V}$ )   |  | 20  | 40   |     | mA                           |
| $I_O$        | Short Circuit to GND ( $V_{CC} = 15\text{ V}$ )   |  |     | 40   | 60  | mA                           |
| $I_{SINK}$   | Output Current Sink ( $V_{id} = -1\text{ V}$ )  | $V_{CC} = +15\text{ V}$ , $V_{OUT} = 0.2\text{ V}$<br>(Note 1) | 1   | 10   |     | mA                           |
|              |   | $V_{CC} = +15\text{ V}$ , $V_{OUT} = 2\text{ V}$               | 10  | 20   |     | mA                           |
| $V_{OH}$     | Output Voltage Swing, High ( $V_{CC} = 30\text{ V}$ )   | $R_L = 2\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$            | 26  | 27   |     | V                            |
|              |   | $-40 \leq T_A \leq +105^\circ\text{C}$                         | 26  |      |     |                              |
|              |   | $R_L = 10\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$           | 27  | 28   |     |                              |
|              |   | $-40 \leq T_A \leq +105^\circ\text{C}$                         | 27  |      |     |                              |
| $V_{OL}$     | Output Voltage Swing, Low   | $R_L = 10\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$           |     | 5.0  | 50  | mV                           |
|              |   | $-40 \leq T_A \leq +105^\circ\text{C}$                         |     |      | 50  |                              |
| SR           | Slew Rate ( $AV = +1$ , $V_i = 0.5\text{ V}$ to $2\text{ V}$ , $V_{CC} = 15\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ )                                      |  | 0.2 | 0.4  |     | V/ $\mu\text{s}$             |
| GBP          | Gain Bandwidth Product ( $V_{CC} = 30\text{ V}$ , $AV = +1$ , (Note 1) $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $f = 100\text{ kHz}$ , $V_{IN} = 10\text{ mV}_{PP}$ ) |  | 0.5 | 0.9  |     | MHz                          |
| THD          | Total Harmonic Distortion ( $f = 1\text{ kHz}$ , $AV = 10$ , $R_L = 2\text{ k}\Omega$ , $V_{CC} = 30\text{ V}$ , $V_{OUT} = 2\text{ V}_{PP}$ )                                  |  |     | 0.08 |     | %                            |

### OP AMP 2 (INDEPENDENT OP AMP) ( $V_{CC} = 5.0\text{ V}$ , $T_A = 25^\circ\text{C}$ unless otherwise noted)

|           |   |  |    |     |     |                              |
|-----------|---|--|----|-----|-----|------------------------------|
| $V_{IO}$  | Input Offset Voltage  | $T_A = 25^\circ\text{C}$               |    | 0.5 | 2.0 | mV                           |
|           |   | $-40 \leq T_A \leq +105^\circ\text{C}$ |    |     | 3.0 |                              |
| $DV_{IO}$ | Input Offset Voltage Drift ( $-40 \leq T_A \leq +105^\circ\text{C}$ )   |  |    | 7.0 |     | $\mu\text{V}/^\circ\text{C}$ |
| $I_{IO}$  | Input Offset Current  | $T_A = 25^\circ\text{C}$               |    | 2.0 | 75  | nA                           |
|           |   | $-40 \leq T_A \leq +105^\circ\text{C}$ |    |     | 150 |                              |
| $I_B$     | Input Bias Current  | $T_A = 25^\circ\text{C}$               |    | 20  | 150 | nA                           |
|           |   | $-40 \leq T_A \leq +105^\circ\text{C}$ |    |     | 200 |                              |
| AVD       | Large Signal Voltage Gain ( $V_{CC} = 15\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $V_{OUT} = 1.4\text{ V}$ to $11.4\text{ V}$ ) | $T_A = 25^\circ\text{C}$               | 50 | 100 |     | V/mV                         |
|           |   | $-40 \leq T_A \leq +105^\circ\text{C}$ | 25 |     |     |                              |
| PSRR      | Power Supply Rejection ( $V_{CC} = 5\text{ V}$ to $30\text{ V}$ )   |  | 65 | 100 |     | dB                           |

1. Guaranteed by design and/or characterization.

# NCS1002

## ELECTRICAL CHARACTERISTICS (continued)

| Symbol  | Characteristics  | Conditions   | Min | Typ  | Max            | Unit                   |
|---|--|--|-----|------|----------------|------------------------|
| <b>OP AMP 2 (INDEPENDENT OP AMP) (continued)</b> ( $V_{CC} = 5.0\text{ V}$ , $T_A = 25^\circ\text{C}$ unless otherwise noted) |  |  |     |      |                |                        |
| $V_{ICM}$   | Input Common Mode Voltage Range (Note 2)<br>( $V_{CC} = +30\text{ V}$ )  | $T_A = 25^\circ\text{C}$   | 0   |      | $V_{CC} - 1.5$ | V                      |
|   |  | $-40 \leq T_A \leq +105^\circ\text{C}$                                 | 0   |      | $V_{CC} - 2.0$ |                        |
| CMRR  | Common Mode Rejection Ratio (Note 4)   | 0 to $V_{CC} - 1.7\text{ V}$ ,<br>$T_A = 25^\circ\text{C}$             | 70  | 85   |                | dB                     |
|   |  | 0 to $V_{CC} - 2.2\text{ V}$<br>$-40 \leq T_A \leq +105^\circ\text{C}$ | 60  |      |                |                        |
| $I_{SOURCE}$  | Output Current Source ( $V_{CC} = 15\text{ V}$ , $V_{OUT} = 2\text{ V}$ , $V_{ID} = +1\text{ V}$ )   |  | 20  | 40   |                | mA                     |
| $I_O$   | Short-Circuit to GND ( $V_{CC} = 15\text{ V}$ )  |  |     | 40   | 60             | mA                     |
| $I_{SINK}$  | Output Current Sink ( $V_{ID} = -1\text{ V}$ )   | $V_{CC} = +15\text{ V}$ , $V_{OUT} = 0.2\text{ V}$                     | 1   | 10   |                | mA                     |
|   |  | $V_{CC} = +15\text{ V}$ , $V_{OUT} = 2\text{ V}$                       | 10  | 20   |                | mA                     |
| $V_{OH}$  | Output Voltage Swing, High ( $V_{CC} = 30\text{ V}$ )  | $R_L = 2\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$                    | 26  | 27   |                | V                      |
|   |  | $-40 \leq T_A \leq +105^\circ\text{C}$                                 | 26  |      |                |                        |
|   |  | $R_L = 10\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$                   | 27  | 28   |                |                        |
|   |  | $-40 \leq T_A \leq +105^\circ\text{C}$                                 | 27  |      |                |                        |
| $V_{OL}$  | Output Voltage Swing, Low  | $R_L = 10\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$                   |     | 5.0  | 50             | mV                     |
|   |  | $-40 \leq T_A \leq +105^\circ\text{C}$                                 |     |      | 50             |                        |
| SR  | Slew Rate ( $A_V = +1$ , $V_i = 0.5\text{ V}$ to $3\text{ V}$ , $V_{CC} = 15\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ )                                      |  | 0.2 | 0.4  |                | V/ $\mu\text{s}$       |
| GBP   | Gain Bandwidth Product ( $V_{CC} = 30\text{ V}$ , $A_V = +1$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $f = 100\text{ kHz}$ , $V_{IN} = 10\text{ mV}_{PP}$ ) (Note 4) |  | 0.5 | 0.9  |                | MHz                    |
| THD   | Total Harmonic Distortion ( $f = 1\text{ kHz}$ , $A_V = 10$ , $R_L = 2\text{ k}\Omega$ , $V_{CC} = 30\text{ V}$ , $V_{OUT} = 2\text{ V}_{PP}$ )                                  |  |     | 0.08 |                | %                      |
| $e_{noise}$   | Equivalent Input Noise Voltage ( $f = 1\text{ kHz}$ , $R_S = 100\ \Omega$ , $V_{CC} = 30\text{ V}$ )   |  |     | 50   |                | nV/ $\sqrt{\text{Hz}}$ |

## VOLTAGE REFERENCE

|                  |  |  |       |     |      |               |
|------------------|--|--|-------|-----|------|---------------|
| $I_K$            | Cathode Current  |  | 0.075 |     | 100  | mA            |
| $V_{ref}$        | Reference Voltage ( $I_K = 1\text{ mA}$ )  | $T_A = 25^\circ\text{C}$               | 2.49  | 2.5 | 2.51 | V             |
|                  |  | $-40 \leq T_A \leq +105^\circ\text{C}$ | 2.48  | 2.5 | 2.52 |               |
| $\Delta V_{ref}$ | Reference Deviation over Temperature ( $V_{KA} = V_{ref}$ , $I_K = 10\text{ mA}$ , $-40 \leq T_A \leq +105^\circ\text{C}$ ) (Note 4) |  |       | 7.0 | 30   | mV            |
| $I_{min}$        | Minimum Cathode Current for Regulation ( $V_{KA} \geq 2.45\text{ V}_I$ )   |  |       | 40  | 75   | $\mu\text{A}$ |
| $ Z_{KA} $       | Dynamic Impedance (Note 3)<br>( $V_{KA} = V_{ref}$ , $I_K = 1\text{ mA}$ to $100\text{ mA}$ , $f < 1\text{ kHz}$ )                   |  |       | 0.2 | 0.5  | $\Omega$      |

- The input common-mode voltage of either input signal should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode range is  $V_{CC} - 1.5\text{ V}$ . Both inputs can go to  $V_{CC} + 0.3\text{ V}$  without damage.
- The Dynamic Impedance is defined as  $|Z_{KA}| = \Delta V_{KA} / \Delta I_K$ .
- Guaranteed by design and/or characterization.

# NCS1002

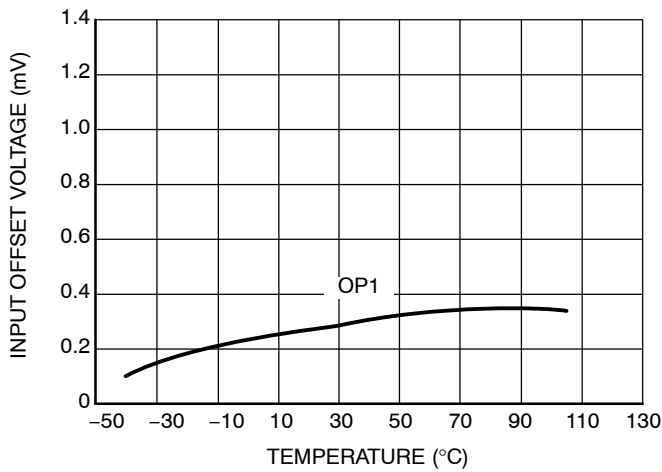


Figure 1. Input Offset Voltage vs. Temperature

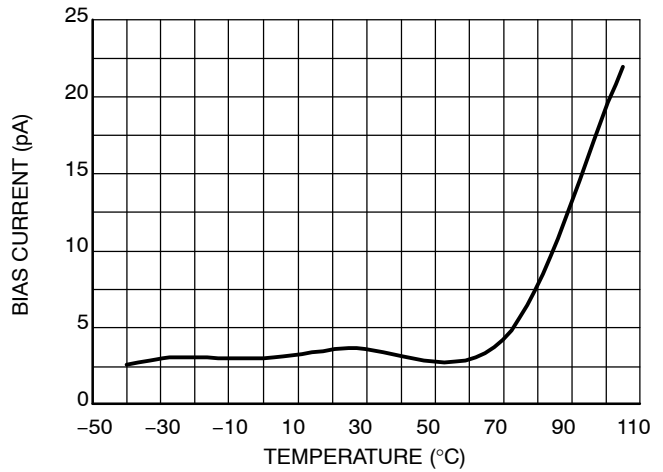


Figure 2. IB vs. Temperature

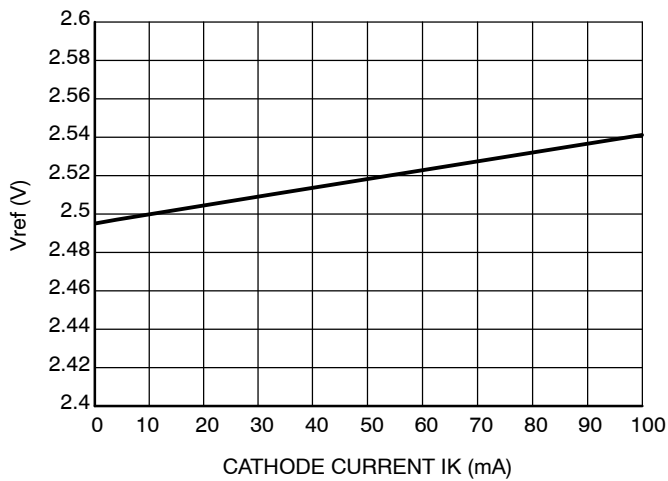


Figure 3. Vref as a Function of IK

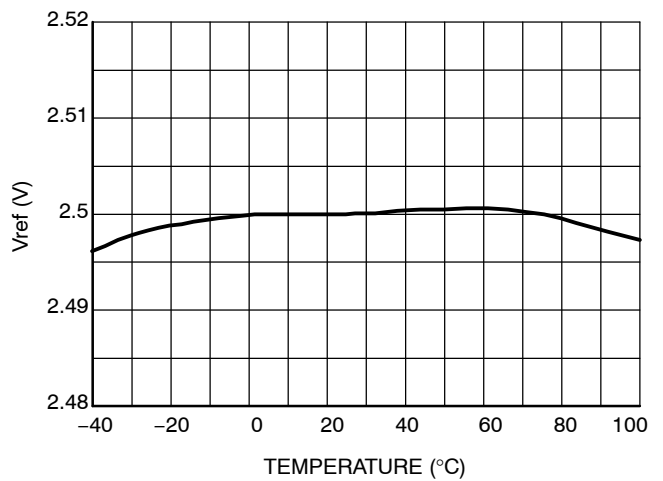


Figure 4. Vref Over Temperature

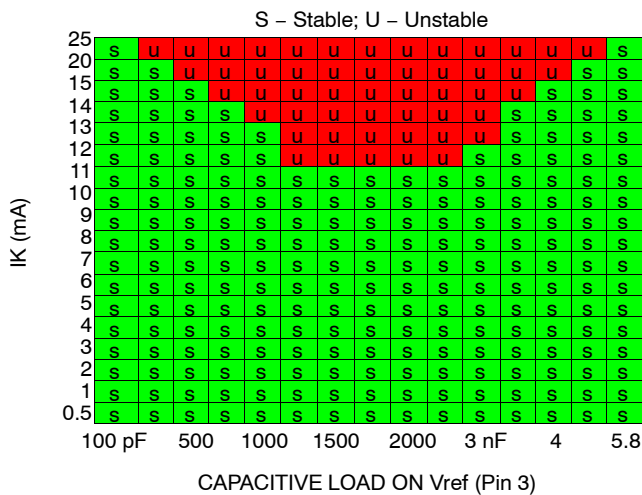


Figure 5. Region of Reference Stability vs. Capacitive Load (Pin 3)

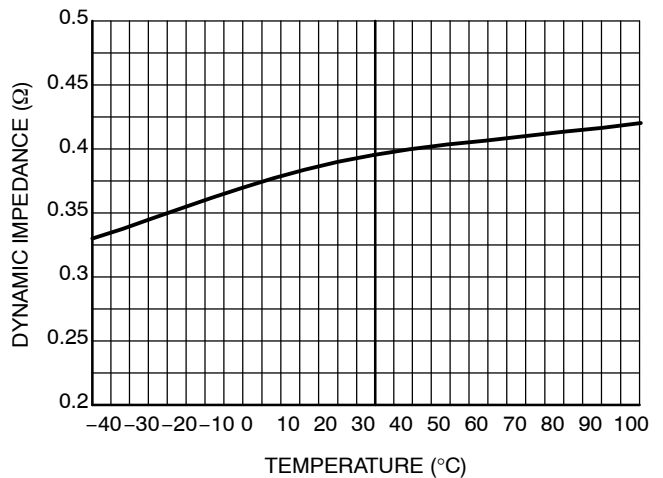


Figure 6. Ref Dynamic Impedance vs. Temperature

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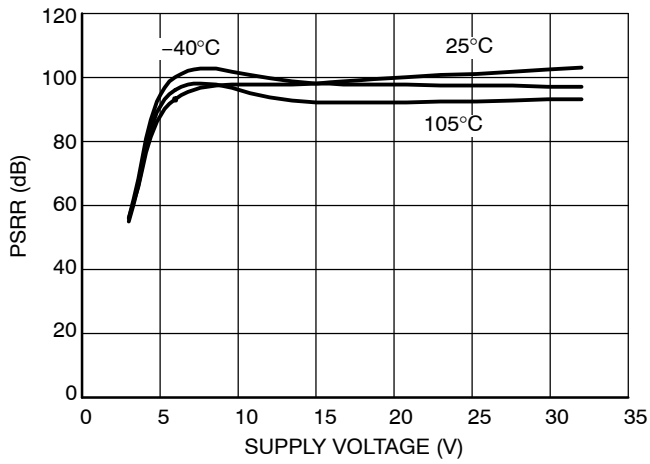


Figure 7. NCS1002 PSRR vs. Supply Voltage

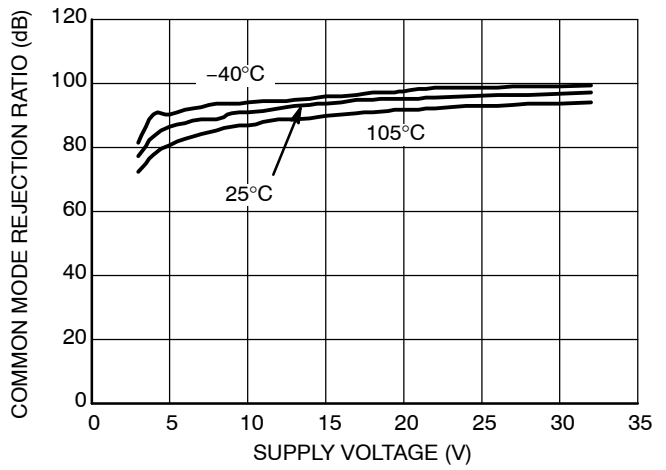


Figure 8. NCS1002 CMRR vs. Supply Voltage

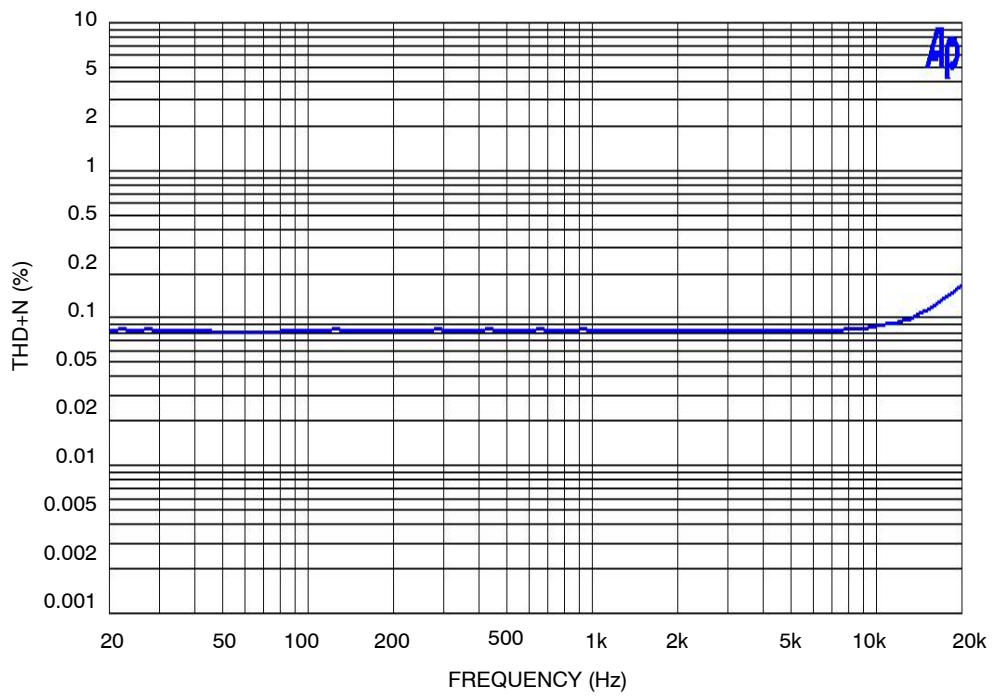


Figure 9. THD+N

# NCS1002

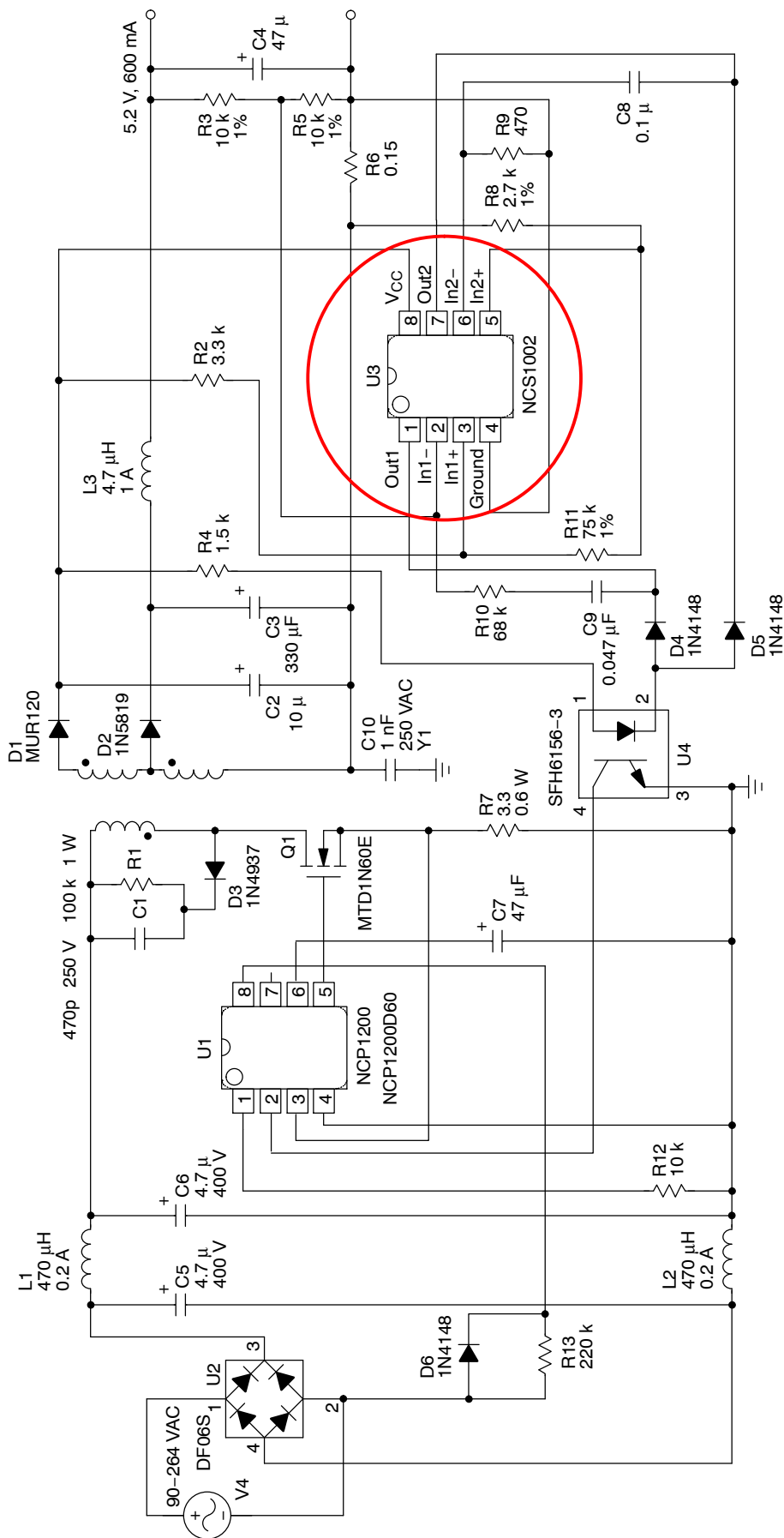


Figure 1. AC Adapter Application

# NCS1002

## ORDERING INFORMATION

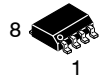
| Device      | Package             | Shipping†          |
|-------------|---------------------|--------------------|
| NCS1002DR2G | SOIC-8<br>(Pb-Free) | 2500 / Tape & Reel |

†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.



# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

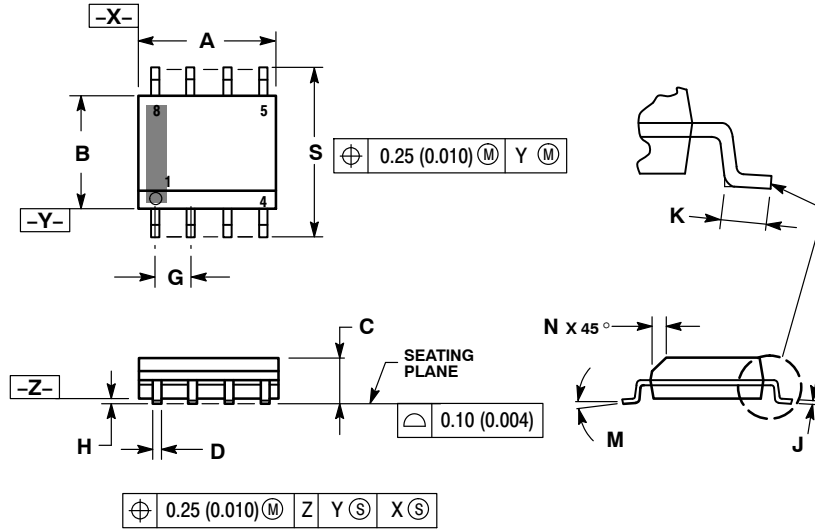
ON Semiconductor®



SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0°          | 8°   | 0°        | 8°    |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |

### 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.

### GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
 A = Assembly Location  
 L = Wafer Lot  
 Y = Year  
 W = Work Week  
 ■ = Pb-Free Package

XXXXXX = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ■ = Pb-Free Package

\*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. Some products may not follow the Generic Marking.

### STYLES ON PAGE 2

|                  |             |  |
|------------------|-------------|--|
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| DESCRIPTION:     | SOIC-8 NB   | PAGE 1 OF 2  |


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**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

DATE 16 FEB 2011

- |  |   |   |   |
|--|---|---|---|
| <p><b>STYLE 1:</b><br/> PIN 1. EMITTER<br/> 2. COLLECTOR<br/> 3. COLLECTOR<br/> 4. EMITTER<br/> 5. EMITTER<br/> 6. BASE<br/> 7. BASE<br/> 8. EMITTER</p>   | <p><b>STYLE 2:</b><br/> PIN 1. COLLECTOR, DIE, #1<br/> 2. COLLECTOR, #1<br/> 3. COLLECTOR, #2<br/> 4. COLLECTOR, #2<br/> 5. BASE, #2<br/> 6. EMITTER, #2<br/> 7. BASE, #1<br/> 8. EMITTER, #1</p>               | <p><b>STYLE 3:</b><br/> PIN 1. DRAIN, DIE #1<br/> 2. DRAIN, #1<br/> 3. DRAIN, #2<br/> 4. DRAIN, #2<br/> 5. GATE, #2<br/> 6. SOURCE, #2<br/> 7. GATE, #1<br/> 8. SOURCE, #1</p>                            | <p><b>STYLE 4:</b><br/> PIN 1. ANODE<br/> 2. ANODE<br/> 3. ANODE<br/> 4. ANODE<br/> 5. ANODE<br/> 6. ANODE<br/> 7. ANODE<br/> 8. COMMON CATHODE</p>   |
| <p><b>STYLE 5:</b><br/> PIN 1. DRAIN<br/> 2. DRAIN<br/> 3. DRAIN<br/> 4. DRAIN<br/> 5. GATE<br/> 6. GATE<br/> 7. SOURCE<br/> 8. SOURCE</p>   | <p><b>STYLE 6:</b><br/> PIN 1. SOURCE<br/> 2. DRAIN<br/> 3. DRAIN<br/> 4. SOURCE<br/> 5. SOURCE<br/> 6. GATE<br/> 7. GATE<br/> 8. SOURCE</p>  | <p><b>STYLE 7:</b><br/> PIN 1. INPUT<br/> 2. EXTERNAL BYPASS<br/> 3. THIRD STAGE SOURCE<br/> 4. GROUND<br/> 5. DRAIN<br/> 6. GATE 3<br/> 7. SECOND STAGE Vd<br/> 8. FIRST STAGE Vd</p>                    | <p><b>STYLE 8:</b><br/> PIN 1. COLLECTOR, DIE #1<br/> 2. BASE, #1<br/> 3. BASE, #2<br/> 4. COLLECTOR, #2<br/> 5. COLLECTOR, #2<br/> 6. EMITTER, #2<br/> 7. EMITTER, #1<br/> 8. COLLECTOR, #1</p>                              |
| <p><b>STYLE 9:</b><br/> PIN 1. EMITTER, COMMON<br/> 2. COLLECTOR, DIE #1<br/> 3. COLLECTOR, DIE #2<br/> 4. EMITTER, COMMON<br/> 5. EMITTER, COMMON<br/> 6. BASE, DIE #2<br/> 7. BASE, DIE #1<br/> 8. EMITTER, COMMON</p> | <p><b>STYLE 10:</b><br/> PIN 1. GROUND<br/> 2. BIAS 1<br/> 3. OUTPUT<br/> 4. GROUND<br/> 5. GROUND<br/> 6. BIAS 2<br/> 7. INPUT<br/> 8. GROUND</p>  | <p><b>STYLE 11:</b><br/> PIN 1. SOURCE 1<br/> 2. GATE 1<br/> 3. SOURCE 2<br/> 4. GATE 2<br/> 5. DRAIN 2<br/> 6. DRAIN 2<br/> 7. DRAIN 1<br/> 8. DRAIN 1</p>   | <p><b>STYLE 12:</b><br/> PIN 1. SOURCE<br/> 2. SOURCE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>   |
| <p><b>STYLE 13:</b><br/> PIN 1. N.C.<br/> 2. SOURCE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>  | <p><b>STYLE 14:</b><br/> PIN 1. N-SOURCE<br/> 2. N-GATE<br/> 3. P-SOURCE<br/> 4. P-GATE<br/> 5. P-DRAIN<br/> 6. P-DRAIN<br/> 7. N-DRAIN<br/> 8. N-DRAIN</p>   | <p><b>STYLE 15:</b><br/> PIN 1. ANODE 1<br/> 2. ANODE 1<br/> 3. ANODE 1<br/> 4. ANODE 1<br/> 5. CATHODE, COMMON<br/> 6. CATHODE, COMMON<br/> 7. CATHODE, COMMON<br/> 8. CATHODE, COMMON</p>               | <p><b>STYLE 16:</b><br/> PIN 1. EMITTER, DIE #1<br/> 2. BASE, DIE #1<br/> 3. EMITTER, DIE #2<br/> 4. BASE, DIE #2<br/> 5. COLLECTOR, DIE #2<br/> 6. COLLECTOR, DIE #2<br/> 7. COLLECTOR, DIE #1<br/> 8. COLLECTOR, DIE #1</p> |
| <p><b>STYLE 17:</b><br/> PIN 1. VCC<br/> 2. V2OUT<br/> 3. V1OUT<br/> 4. TXE<br/> 5. RXE<br/> 6. VEE<br/> 7. GND<br/> 8. ACC</p>  | <p><b>STYLE 18:</b><br/> PIN 1. ANODE<br/> 2. ANODE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. CATHODE<br/> 8. CATHODE</p>   | <p><b>STYLE 19:</b><br/> PIN 1. SOURCE 1<br/> 2. GATE 1<br/> 3. SOURCE 2<br/> 4. GATE 2<br/> 5. DRAIN 2<br/> 6. MIRROR 2<br/> 7. DRAIN 1<br/> 8. MIRROR 1</p>   | <p><b>STYLE 20:</b><br/> PIN 1. SOURCE (N)<br/> 2. GATE (N)<br/> 3. SOURCE (P)<br/> 4. GATE (P)<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>   |
| <p><b>STYLE 21:</b><br/> PIN 1. CATHODE 1<br/> 2. CATHODE 2<br/> 3. CATHODE 3<br/> 4. CATHODE 4<br/> 5. CATHODE 5<br/> 6. COMMON ANODE<br/> 7. COMMON ANODE<br/> 8. CATHODE 6</p>  | <p><b>STYLE 22:</b><br/> PIN 1. I/O LINE 1<br/> 2. COMMON CATHODE/VCC<br/> 3. COMMON CATHODE/VCC<br/> 4. I/O LINE 3<br/> 5. COMMON ANODE/GND<br/> 6. I/O LINE 4<br/> 7. I/O LINE 5<br/> 8. COMMON ANODE/GND</p> | <p><b>STYLE 23:</b><br/> PIN 1. LINE 1 IN<br/> 2. COMMON ANODE/GND<br/> 3. COMMON ANODE/GND<br/> 4. LINE 2 IN<br/> 5. LINE 2 OUT<br/> 6. COMMON ANODE/GND<br/> 7. COMMON ANODE/GND<br/> 8. LINE 1 OUT</p> | <p><b>STYLE 24:</b><br/> PIN 1. BASE<br/> 2. EMITTER<br/> 3. COLLECTOR/ANODE<br/> 4. COLLECTOR/ANODE<br/> 5. CATHODE<br/> 6. CATHODE<br/> 7. COLLECTOR/ANODE<br/> 8. COLLECTOR/ANODE</p>                                      |
| <p><b>STYLE 25:</b><br/> PIN 1. VIN<br/> 2. N/C<br/> 3. REXT<br/> 4. GND<br/> 5. IOUT<br/> 6. IOUT<br/> 7. IOUT<br/> 8. IOUT</p>   | <p><b>STYLE 26:</b><br/> PIN 1. GND<br/> 2. dv/dt<br/> 3. ENABLE<br/> 4. ILIMIT<br/> 5. SOURCE<br/> 6. SOURCE<br/> 7. SOURCE<br/> 8. VCC</p>  | <p><b>STYLE 27:</b><br/> PIN 1. ILIMIT<br/> 2. OVLO<br/> 3. UVLO<br/> 4. INPUT+<br/> 5. SOURCE<br/> 6. SOURCE<br/> 7. SOURCE<br/> 8. DRAIN</p>  | <p><b>STYLE 28:</b><br/> PIN 1. SW_TO_GND<br/> 2. DASIC OFF<br/> 3. DASIC_SW_DET<br/> 4. GND<br/> 5. V_MON<br/> 6. VBULK<br/> 7. VBULK<br/> 8. VIN</p>  |
| <p><b>STYLE 29:</b><br/> PIN 1. BASE, DIE #1<br/> 2. EMITTER, #1<br/> 3. BASE, #2<br/> 4. EMITTER, #2<br/> 5. COLLECTOR, #2<br/> 6. COLLECTOR, #2<br/> 7. COLLECTOR, #1<br/> 8. COLLECTOR, #1</p>                        | <p><b>STYLE 30:</b><br/> PIN 1. DRAIN 1<br/> 2. DRAIN 1<br/> 3. GATE 2<br/> 4. SOURCE 2<br/> 5. SOURCE 1/DRAIN 2<br/> 6. SOURCE 1/DRAIN 2<br/> 7. SOURCE 1/DRAIN 2<br/> 8. GATE 1</p>                           |   |   |

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