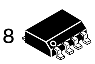
NCS1002A

Constant Voltage / Constant Current Secondary-Side Controller

MARKING DIAGRAMS

8

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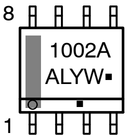
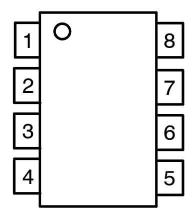
SOIC−8
D SUFFIX
CASE 751



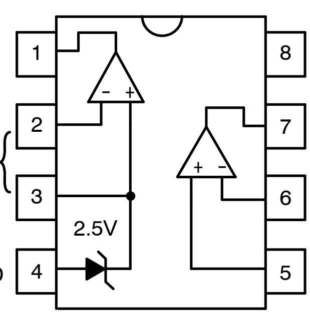
A	= Assembly Location
L	= Wafer Lot
Y	= Year
W	= Work Week
▪	= Pb−Free Package

(Note: Microdot may be in either location)

PIN CONNECTIONS



(Top View)



ORDERING INFORMATION

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

Description

The NCS1002A is a performance upgrade from the NCS1002 focused on reducing power consumption in applications that require more efficient operation. It 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 NCS1002A 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 NCS1002A 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: 150 μA 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

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	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	Junction−to−Ambient	$R_{\theta JA}$	175	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Characteristics	Conditions	Min	Typ	Max	Unit
I_{CC}	Total Supply Current, excluding current in the Voltage Reference V_{CC} = 5 V, no load; −40 ≤ T_A ≤ +105°C			0.15	0.25	mA
I_{CC}	Total Supply Current, excluding Current in the Voltage Reference V_{CC} = 30 V, no load; −40 ≤ T_A ≤ +105°C			0.2	0.3	mA
OP AMP 1 (OP AMP WITH NONINVERTING INPUT CONNECTED TO THE INTERNAL V_{ref}) (V_{CC} = 5 V, T_A = 25°C unless otherwise noted)						
V_{IO}	Input Offset Voltage	T_A = 25°C			2.0	mV
		−40 ≤ T_A ≤ +105°C			3.0	mV
DV_{IO}	Input Offset Voltage Drift (−40 ≤ T_A ≤ +105°C)				7.0	μV/°C
I_{IB}	Input Bias Current (Inverting Input Only)			20	150	nA
AVD	Large Signal Voltage Gain (V_{CC} = 15 V, R_L = 2 kΩ, V_{ICM} = 0 V)			100		V/mV
PSRR	Power Supply Rejection (V_{CC} = 5.0 V to 30 V, V_{OUT} = 2 V)		80	100		dB
I_{SOURCE}	Output Source Current (V_{CC} = 15 V, V_{OUT} = 2.0 V, V_{id} = 1 V)		20	40		mA
I_O	Short Circuit to GND (V_{CC} = 15 V)			40	60	mA
I_{SINK}	Output Current Sink (V_{id} = −1 V)	V_{CC} = +15 V, V_{OUT} = 0.2 V (Note 1)	1	10		mA
		V_{CC} = +15 V, V_{OUT} = 2 V	10	20		mA
V_{OH}	Output Voltage Swing, High (V_{CC} = 30 V)	R_L = 2 kΩ, T_A = 25°C	26	27		V
		−40 ≤ T_A ≤ +105°C	26			
		R_L = 10 kΩ, T_A = 25°C	27	28		
		−40 ≤ T_A ≤ +105°C	27			
V_{OL}	Output Voltage Swing, Low	R_L = 10 kΩ, T_A = 25°C		5.0	50	mV
SR	Slew Rate (AV = +1, V_i = 0.5 V to 2 V, V_{CC} = 15 V, R_L = 2 kΩ, C_L = 100 pF)		0.2	0.4		V/μs
GBP	Gain Bandwidth Product (V_{CC} = 30 V, AV = +1, (Note 1) R_L = 2 kΩ, C_L = 100 pF, f = 100 kHz, V_{IN} = 10 mV_{PP})		0.5	0.9		MHz
THD	Total Harmonic Distortion (f = 1 kHz, AV = 10, R_L = 2 kΩ, V_{CC} = 30 V, V_{OUT} = 2 V_{PP})			0.08		%
OP AMP 2 (INDEPENDENT OP AMP) (V_{CC} = 5.0 V, T_A = 25°C unless otherwise noted)						
V_{IO}	Input Offset Voltage	T_A = 25°C		0.5	2.0	mV
		−40 ≤ T_A ≤ +105°C			3.0	
DV_{IO}	Input Offset Voltage Drift (−40 ≤ T_A ≤ +105°C)				7.0	μV/°C
I_{IO}	Input Offset Current	T_A = 25°C		2.0	75	nA
		−40 ≤ T_A ≤ +105°C			150	
I_B	Input Bias Current	T_A = 25°C		20	150	nA
		−40 ≤ T_A ≤ +105°C			200	
AVD	Large Signal Voltage Gain (V_{CC} = 15 V, R_L = 2 kΩ, V_{OUT} = 1.4 V to 11.4 V)	T_A = 25°C	50	100		V/mV
		−40 ≤ T_A ≤ +105°C	25			
PSRR	Power Supply Rejection (V_{CC} = 5 V to 30 V)		80	100		dB

1. Guaranteed by design and/or characterization.

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Characteristics	Conditions	Min	Typ	Max	Unit
OP AMP 2 (INDEPENDENT OP AMP) (continued) (V_{CC} = 5.0 V, T_A = 25°C unless otherwise noted)						
V_{ICM}	Input Common Mode Voltage Range (Note 2) (V_{CC} = +30 V)	T_A = 25°C	0		V_{CC} − 1.5	V
		−40 ≤ T_A ≤ +105°C	0		V_{CC} − 2.0	
CMRR	Common Mode Rejection Ratio (Note 4)	0 to V_{CC} − 1.7 V, T_A = 25°C	70	85		dB
		0 to V_{CC} − 2.2 V −40 ≤ T_A ≤ +105°C	60			
I_{SOURCE}	Output Current Source (V_{CC} = 15 V, V_{OUT} = 2 V, V_{ID} = +1 V)		20	40		mA
I_O	Short−Circuit to GND (V_{CC} = 15 V)			40	60	mA
I_{SINK}	Output Current Sink (V_{ID} = −1 V)	V_{CC} = +15 V, V_{OUT} = 0.2 V	1	10		mA
		V_{CC} = +15 V, V_{OUT} = 2 V	10	20		mA
V_{OH}	Output Voltage Swing, High (V_{CC} = 30 V)	R_L = 2 kΩ, T_A = 25°C	26	27		V
		−40 ≤ T_A ≤ +105°C	26			
		R_L = 10 kΩ, T_A = 25°C	27	28		
		−40 ≤ T_A ≤ +105°C	27			
V_{OL}	Output Voltage Swing, Low	R_L = 10 kΩ, T_A = 25°C		5.0	50	mV
SR	Slew Rate (AV = +1, V_i = 0.5 V to 3 V, V_{CC} = 15 V, R_L = 2 kΩ, C_L = 100 pF)		0.2	0.4		V/μs
GBP	Gain Bandwidth Product (V_{CC} = 30 V, AV = +1, R_L = 2 kΩ, C_L = 100 pF, f = 100 kHz, V_{IN} = 10 mV_{PP}) (Note 4)		0.5	0.9		MHz
THD	Total Harmonic Distortion (f = 1 kHz, AV = 10, R_L = 2 kΩ, V_{CC} = 30 V, V_{OUT} = 2 V_{PP})			0.08		%
e_{noise}	Equivalent Input Noise Voltage (f = 1 kHz, R_S = 100 Ω, V_{CC} = 30 V)			50		$nV/\sqrt{Hz}$
VOLTAGE REFERENCE						
I_K	Cathode Current		0.05		100	mA
V_{ref}	Reference Voltage (I_K = 1 mA)	T_A = 25°C	2.49	2.5	2.51	V
		−40 ≤ T_A ≤ +105°C	2.48	2.5	2.52	
ΔV_{ref}	Reference Deviation over Temperature (V_{KA} = V_{ref}, I_K = 10 mA, −40 ≤ T_A ≤ +105°C) (Note 4)			7.0	30	mV
I_{min}	Minimum Cathode Current for Regulation (V_{KA} ≥ 2.45 V_f)			10	50	μA
I ZKA I	Dynamic Impedance (Note 3) (V_{KA} = V_{ref}, I_K = 1 mA to 100 mA, f < 1 kHz)			0.2	0.5	Ω

2. 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 V. Both inputs can go to V_{CC} + 0.3 V without damage.
3. The Dynamic Impedance is defined as I ZKA I = ΔV_{KA} / ΔI_K.
4. Guaranteed by design and/or characterization.

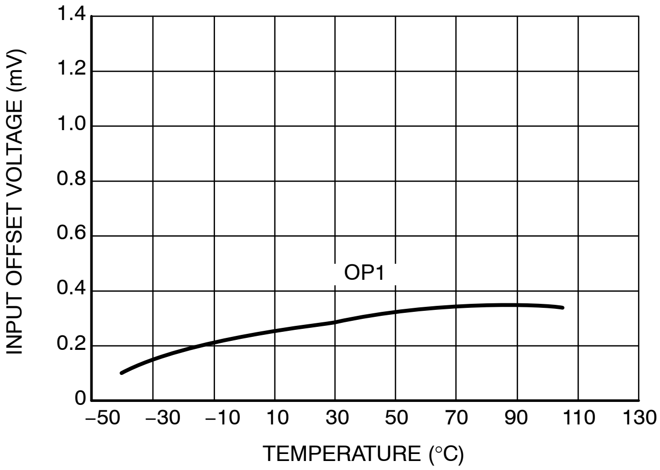


Figure 1. Input Offset Voltage vs. Temperature

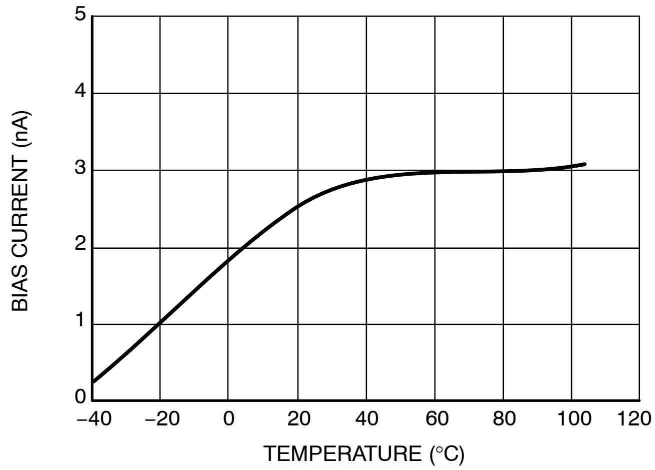


Figure 2. IB vs. Temperature

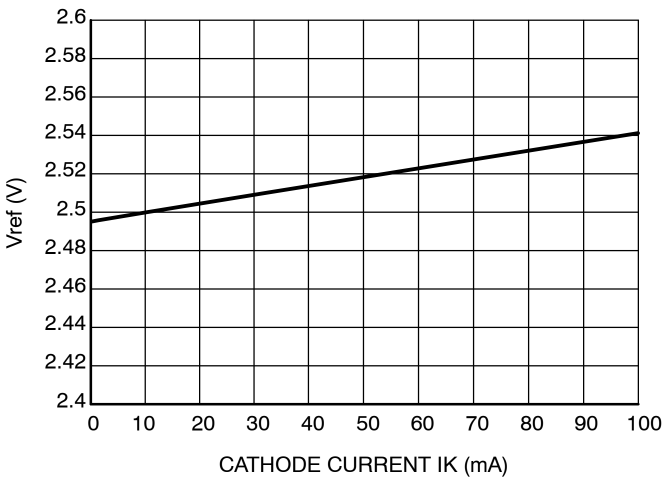


Figure 3. Vref as a Function of IK

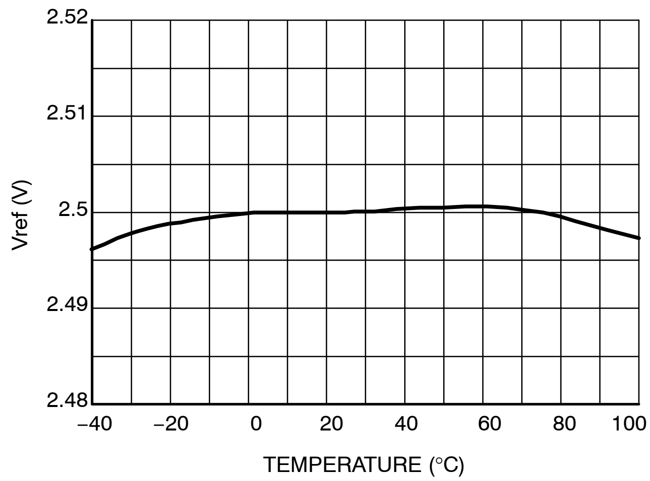


Figure 4. Vref Over Temperature

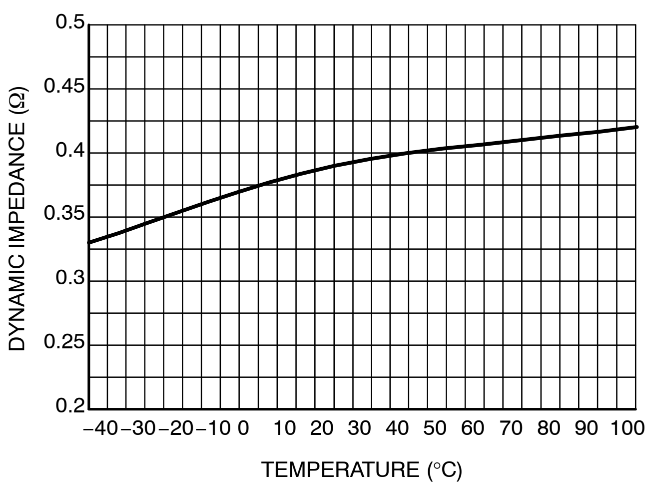


Figure 5. Ref Dynamic Impedance vs. Temperature

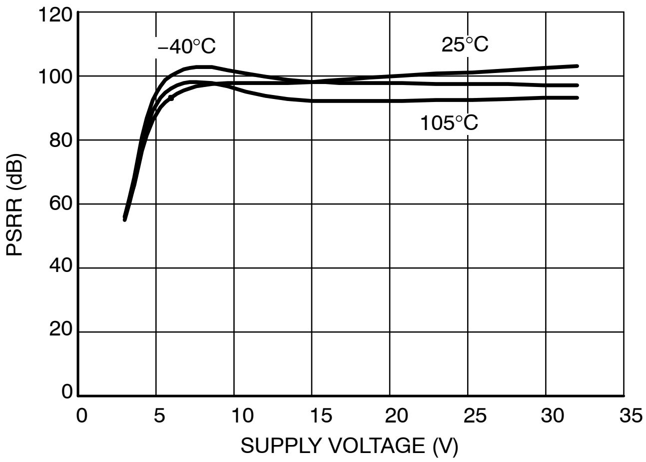


Figure 6. NCS1002A PSRR vs. Supply Voltage

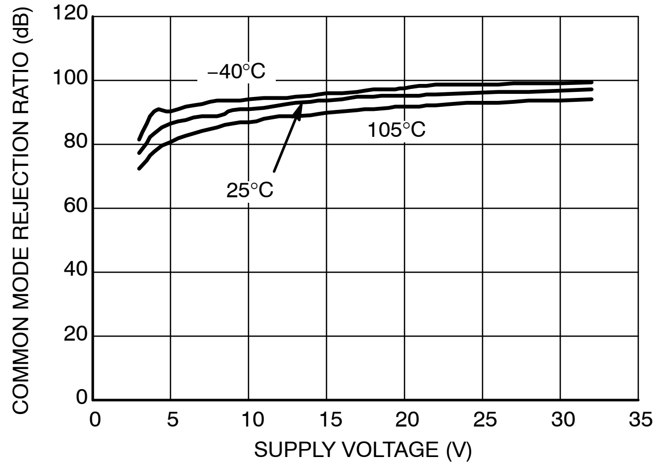


Figure 7. NCS1002A CMRR vs. Supply Voltage

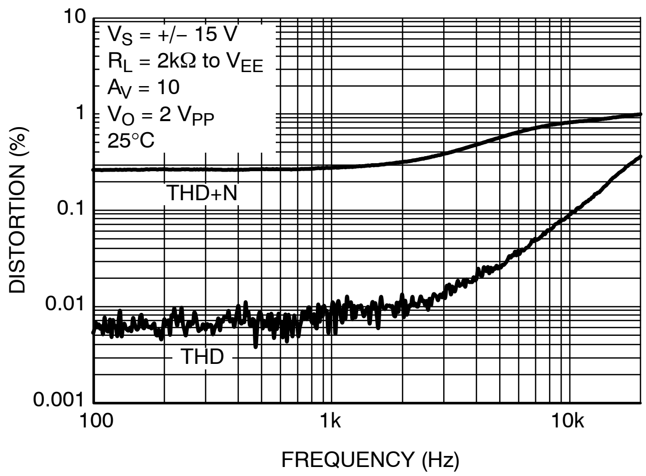


Figure 8. Distortion vs. Frequency

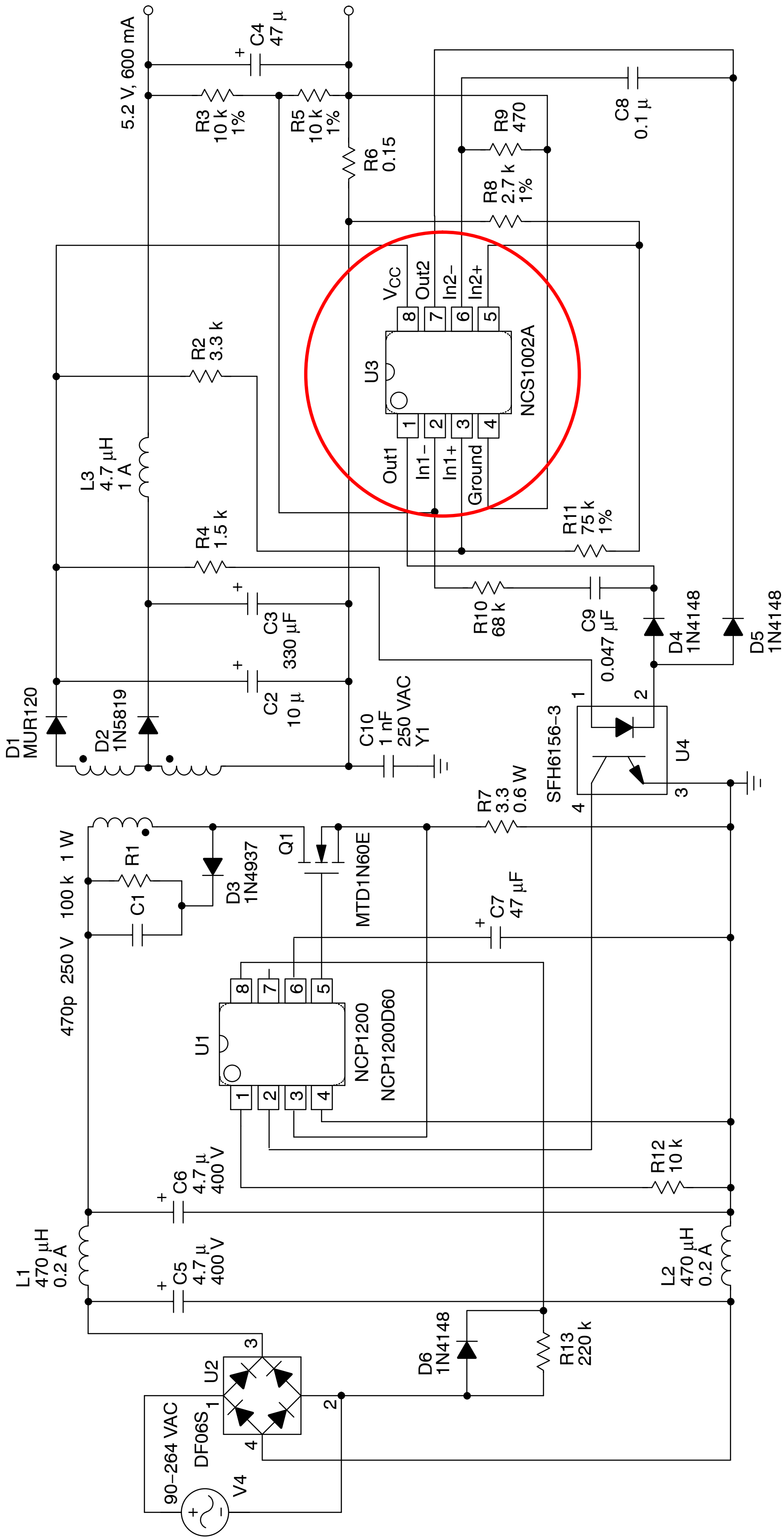


Figure 1. AC Adapter Application

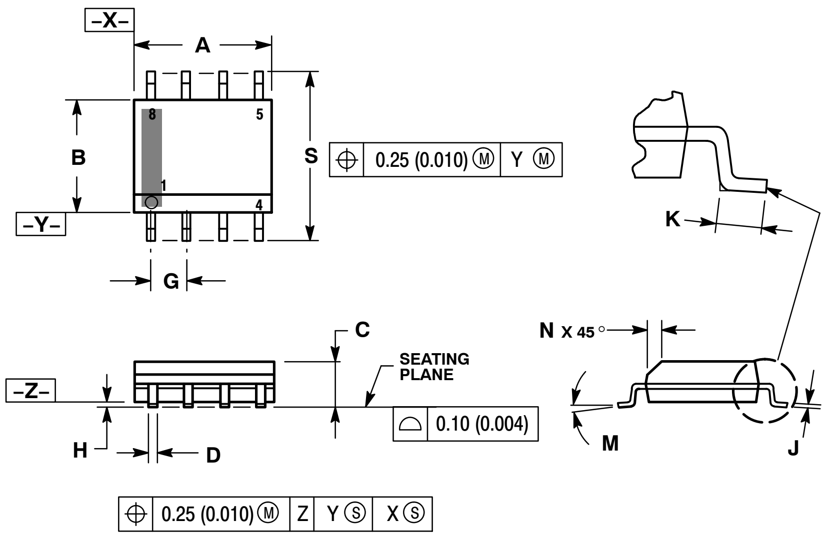
ORDERING INFORMATION

Device	Package	Shipping†
NCS1002ADR2G	SOIC−8 (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.

PACKAGE DIMENSIONS

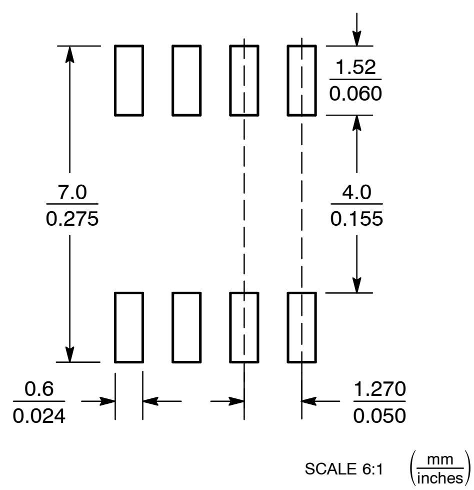
SOIC−8 NB
CASE 751−07
ISSUE AK



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.

	MILLIMETERS		INCHES	
DIM	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.

PUBLICATION ORDERING INFORMATION

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