

Operational Amplifier, 36 V, 3 MHz, 0.95 mV Input Offset Voltage, Rail-to-Rail

Product Preview

NCS20231, NCV20231, NCS20232, NCV20232, NCS20234, NCV20234

The NCS2023x series of op amps feature a wide supply range of 2.7 V to 36 V with an input offset voltage as low as ± 0.95 mV max. These op amps are available in single, dual, and quad channel configurations. Automotive qualified options are available under the NCV prefix with an optional extended operating temperature range from -40°C to 150°C . All other versions are specified over the operating temperature range from -40°C to 125°C .

Features

- Supply Voltage Range: 2.7 V to 36 V
- Temperature Range: -40°C to 150°C
- Unity Gain Bandwidth: 3 MHz
- Offset Voltage: ± 1.5 mV max, $T_A = -40$ to 150°C
- Offset Drift: ± 2 $\mu\text{V}/^{\circ}\text{C}$ max
- Common-Mode Input Voltage Range
 - ◆ Optimal: $V_{SS} - 0.1$ to $V_{DD} - 2$ V
 - ◆ Functional: $V_{SS} - 0.1$ to $V_{DD} + 0.1$ V
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Telecom Equipment
- Power Supply Designs
- Diesel Injection Control
- Automotive
- Motor Control

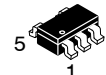


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SC-88A / SC70-5
CASE 419A-02



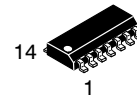
TSOP-5
CASE 483



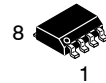
SOT-553, 5 LEAD
CASE 463B



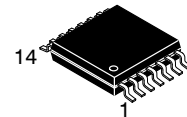
UDFN8
CASE 517AW



SOIC-14 NB
CASE 751A-03



SOIC-8 NB
CASE 751-07



TSSOP-14 WB
CASE 948G

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 2 of this data sheet.

PIN CONNECTIONS

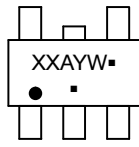
See pin connections on page 3 of this data sheet.

ORDERING INFORMATION

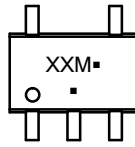
See detailed ordering and shipping information on page 2 of this data sheet.

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

DEVICE MARKING INFORMATION



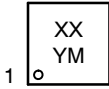
TSOP-5
CASE 483



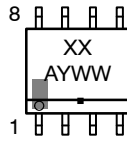
SC-88A / SC70-5
CASE 419A-02



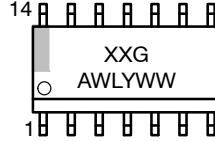
SOT-553, 5 LEAD
CASE 463B



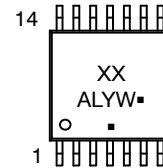
UDFN8, 2x2, 0.5P
CASE 517AW



SOIC-8 NB
CASE 751-07



SOIC-14 NB
CASE 751A-03



TSSOP-14 WB
CASE 948G

- XX = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- M = Date Code
- G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

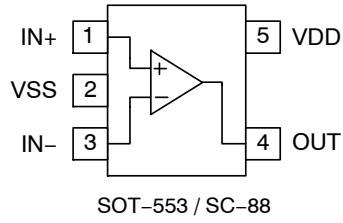
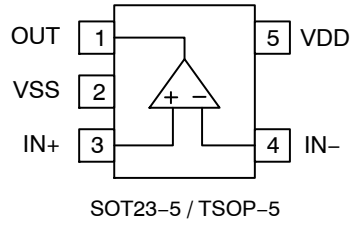
ORDERING INFORMATION

Temperature	Channels	Package	Device Part Number	Marking	Shipping
Industrial and Commercial					
-40°C to 125°C	Single	TSOP-5	NCS20231SN2T1G		
		SC-88	NCS20231SQ3T2G		
		SOT-553	NCS20231		
	Dual	SOIC-8	NCS20232DR2G		
		UDFN-8	NCS20232		
	Quad	SOIC-14	NCS20234DR2G		
TSSOP-14		NCS20234DBR2G			
Automotive Qualified, Grade 1					
-40°C to 150°C	Single	TSOP-5	NCV20231SN2T1G		
		SC-88	NCV20231SQ3T2G		
		SOT-553	NCV20231		
	Dual	SOIC-8	NCV20232DR2G		
	Quad	SOIC-14	NCV20234DR2G		
		TSSOP-14	NCV20234DBR2G		

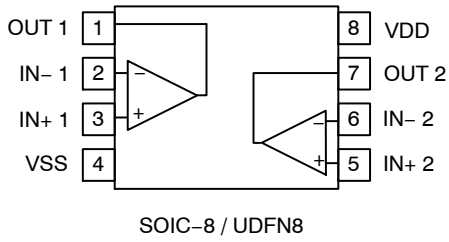
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PIN CONNECTIONS

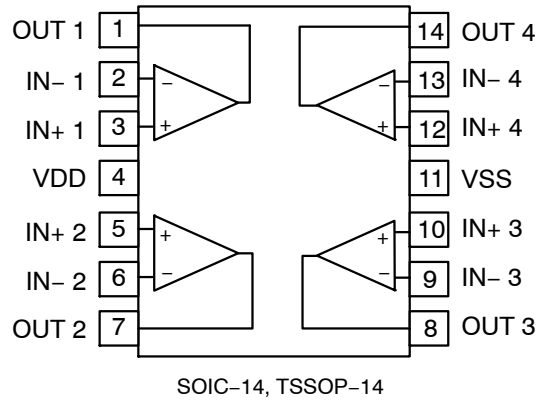
Single Channel



Dual Channel



Quad Channel



ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Symbol	Value	Unit
Supply Voltage Range ($V_{DD} - V_{SS}$)	V_S	-0.3 to 40	V
Input Common-Mode Range	V_{CM}	$V_{SS} - 0.2$ to $V_{DD} + 0.2$	V
Differential Input Voltage	V_{ID}	$\pm V_S$	V
Maximum Input Current	I_I	± 10	mA
Maximum Output Current	I_O	± 100	mA
Continuous Total Power Dissipation	P_D	200	mW
Maximum Junction Temperature	$T_{J(max)}$	150	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
ESD Capability, Human Body Model (Note 2)	HBM	± 2000	V
ESD Capability, Charge Device Model (Note 2)	CDM	± 1000	V
Latch Up Rating (Note 3)		100	mA
Moisture Sensitivity Level	MSL	Level 1	
Lead Temperature Soldering Reflow (SMD Styles Only), Pb-Free Versions (Note 4)	T_{SLD}	260	°C

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 JEDEC standard JS-001-2017 (AEC-Q100-002)
ESD Charged Device Model tested per JEDEC standard JS-002-2014 (AEC-Q100-011)
3. Latch-up Current tested per JEDEC standard JESD78E (AEC-Q100-004)
4. For information, please refer to our Soldering and Mounting Techniques Reference Manual, SOLDERRM/D

THERMAL CHARACTERISTICS

Parameter	Symbol	Package	Value	Unit
Thermal Resistance, Junction-to-Air (Note 5)	θ_{JA}	TSOP-5	TBD	°C/W
		SC88-5	TBD	
		UDFN-8	TBD	
		SOIC-8	TBD	
		SOIC-14	TBD	
		TSSOP-14	TBD	

5. Values based on copper area of 645 mm² (or 1 in²) of 1 oz copper thickness and FR4 PCB substrate

RECOMMENDED OPERATING RANGES (Note 6)

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_S	2.7	36	V
Differential Input Voltage	V_{ID}		$\pm V_S$	V
Input Common-Mode Range	V_{CM}	$V_{SS} - 0.1$	$V_{DD} + 0.1$	V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

6. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area

NCS20231, NCV20231, NCS20232, NCV20232, NCS20234, NCV20234

ELECTRICAL CHARACTERISTICS ($V_S = 2.7\text{ V to }36\text{ V}$)

At $T_A = +25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$ connected to midsupply, $V_{CM} = V_{OUT} = \text{midsupply}$, unless otherwise noted.

Boldface limits apply over the specified temperature range, guaranteed by characterization and/or design.

Parameter	Symbol	Conditions	Supply Voltage (V)	Temp ($^\circ\text{C}$)	Min	Typ	Max	Unit
INPUT CHARACTERISTICS								
Offset Voltage	V_{OS}	$V_{CM} = \text{mid-supply}$	2.7, 5, 10, 36	25		± 0.3	± 0.95	mV
				-40 to 125			± 1.5	
				-40 to 150			± 1.5	
		$V_{CM} = V_{DD} - 2\text{ V to } V_{DD} + 0.1$		25		± 7		
Offset Voltage Drift over temp	dV_{OS}/dT	$V_{CM} = \text{mid-supply}$	2.7, 5, 10, 36	-40 to 125		± 1	± 2	$\mu\text{V}/^\circ\text{C}$
				-40 to 150		± 1	± 5	
		$V_{CM} = V_{DD} - 2\text{ V to } V_{DD} + 0.1$		-40 to 125		± 12		
Input Bias Current	I_{IB}		2.7	25		± 5	± 200	pA
				-40 to 125			± 1500	
				-40 to 150			± 9400	
			5, 10, 36	25		± 1	± 60	
				-40 to 125			± 800	
				-40 to 150			± 9400	
Input Offset Current	I_{OS}		2.7	25		± 2	± 75	pA
				-40 to 125			± 500	
				-40 to 150			± 6000	
			5, 10, 36	25		± 0.5	± 60	
				-40 to 125			± 800	
				-40 to 150			± 6000	
Channel Separation		NCS20232, NCS20234	2.7	25		TBD		dB
			5, 10, 36	25		100		
Input Capacitance	C_{IN}	Common mode	2.7, 36	25		TBD		pF
		Differential	2.7, 36	25		TBD		
Common Mode Rejection Ratio	CMRR	$V_{CM} = V_{SS} - 0.1\text{ V to } V_{DD} - 2\text{ V}$	2.7	25	96	116		dB
				-40 to 125	69			
			-40 to 150	69				
			5, 10, 36	25	102	125		
		-40 to 125		80				
		-40 to 150	80					
		$V_{CM} = V_{DD} - 2\text{ V to } V_{DD} + 0.1\text{ V}$	2.7, 5, 10, 36	25		65		dB
EMI Rejection Ratio	EMIRR	$f = 400\text{ MHz}$	2.7, 36	25		70		dB
		$f = 5\text{ GHz}$	2.7, 36	25		90		

NCS20231, NCV20231, NCS20232, NCV20232, NCS20234, NCV20234

ELECTRICAL CHARACTERISTICS ($V_S = 2.7\text{ V to }36\text{ V}$) (continued)

At $T_A = +25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$ connected to midsupply, $V_{CM} = V_{OUT} = \text{midsupply}$, unless otherwise noted.

Boldface limits apply over the specified temperature range, guaranteed by characterization and/or design.

Parameter	Symbol	Conditions	Supply Voltage (V)	Temp ($^\circ\text{C}$)	Min	Typ	Max	Unit	
OUTPUT CHARACTERISTICS									
Open Loop Voltage Gain	A_{VOL}	$V_{CM} = \text{mid-supply}$	2.7	25	96	120		dB	
				-40 to 125	86				
				-40 to 150	86				
			5	25	96	120			
				-40 to 125	86				
				-40 to 150	86				
			10	25	96	120			
				-40 to 125	86				
				-40 to 150	86				
			36	25	96	120			
-40 to 125	86								
-40 to 150	86								
		$V_{CM} = V_{DD} - 2\text{ V to }V_{DD} + 0.1\text{ V}$	2.7, 5, 10, 36	25		60			
Open Loop Output Impedance	Z_{OUT}					See Figure		Ω	
High Level Output Voltage Swing from V_{DD}	$V_{DD}-V_{OH}$	$R_L = 10\text{ k}\Omega$	2.7, 5, 10, 36	25		13	200	mV	
				-40 to 125			250		
				-40 to 150			250		
		$R_L = 1\text{ mA}$	2.7, 5, 10, 36	25		74	100		
				-40 to 125			150		
				-40 to 150			350		
		$R_L = 5\text{ mA}$	10	25		250	200		
				-40 to 125		350	400		
				-40 to 150			400		
Low Level Output Voltage Swing from V_{SS}	$V_{OL}-V_{SS}$	$R_L = 10\text{ k}\Omega$	2.7, 5, 10	25		10	100	mV	
				-40 to 125			150		
				-40 to 150			150		
			36	2.7, 5, 10, 36	25		10		200
					-40 to 125				250
					-40 to 150				250
		$R_L = 1\text{ mA}$	2.7, 5, 10, 36	25		65	100		
				-40 to 125			300		
				-40 to 150			300		
		$R_L = 5\text{ mA}$	10	25		180	200		
				-40 to 125		250	300		
				-40 to 150			300		

NCS20231, NCV20231, NCS20232, NCV20232, NCS20234, NCV20234

ELECTRICAL CHARACTERISTICS ($V_S = 2.7\text{ V to }36\text{ V}$) (continued)

At $T_A = +25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$ connected to midsupply, $V_{CM} = V_{OUT} = \text{midsupply}$, unless otherwise noted.

Boldface limits apply over the specified temperature range, guaranteed by characterization and/or design.

Parameter	Symbol	Conditions	Supply Voltage (V)	Temp ($^\circ\text{C}$)	Min	Typ	Max	Unit
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OUTPUT CHARACTERISTICS

Output Current Capability	I_{OUT}	Output to V_{DD} rail, sinking current	2.7	25		35		mA	
			5	25		35			
			10	25		35			
			36	25		35			
		Output to V_{SS} rail, sourcing current	2.7	25		35			
			5	25		35			
			10	25		35			
			36	25		35			
Capacitive Load Drive	C_L		2.7 to 36	25		180		pF	

DYNAMIC PERFORMANCE

Gain Bandwidth Product	GWBP	$C_L = 25\text{ pF}$	2.7, 5, 10, 36	25		3		MHz
		$C_L = 25\text{ pF}$, $V_{CM} = V_{DD} - 2\text{ V to }V_{DD} + 0.1\text{ V}$					0.7	
Gain Margin	A_m	$C_L = 25\text{ pF}$	2.7, 5, 10, 36	25		14		dB
Phase Margin	Φ_m	$C_L = 25\text{ pF}$	2.7, 5, 10, 36	25		50		$^\circ$
Slew Rate	SR	Unity gain, $R_L = 2\text{ k}\Omega$	2.7, 5, 10, 36	25		2.7		V/ μs
		Unity gain, $V_{CM} = V_{DD} - 2\text{ V to }V_{DD} + 0.1\text{ V}$					0.7	
Settling Time to 0.1 %	t_s	$V_{IN} = 1\text{ V step}$	2.7	25		1.9		μs
		$V_{IN} = 3\text{ V step}$	5	25		1.2		
		$V_{IN} = 8\text{ V step}$	10	25		3.4		
		$V_{IN} = 10\text{ V step}$	36	25		3.2		
Settling Time to 0.01 %	t_s	$V_{IN} = 1\text{ V step}$	2.7	25		3.2		μs
		$V_{IN} = 3\text{ V step}$	5	25		5.6		
		$V_{IN} = 8\text{ V step}$	10	25		6.8		
		$V_{IN} = 10\text{ V step}$	36	25		7		

NOISE PERFORMANCE

Total Harmonic Distortion + Noise	THD+ N	$V_{IN} = 0.5\text{ V}_{pp}$, $f = 1\text{ kHz}$, $A_V = 1$	2.7	25		0.009		%	
		$V_{IN} = 2.5\text{ V}_{pp}$, $f = 1\text{ kHz}$, $A_V = 1$	5	25		0.009			
		$V_{IN} = 7.5\text{ V}_{pp}$, $f = 1\text{ kHz}$, $A_V = 1$	10	25		0.004			
		$V_{IN} = 28.5\text{ V}_{pp}$, $f = 1\text{ kHz}$, $A_V = 1$	36	25		0.004			
Voltage Noise Density	e_n	$f = 1\text{ kHz}$	2.7, 5, 10, 36	25		30		nV/ $\sqrt{\text{Hz}}$	
		$f = 1\text{ kHz}$, $V_{CM} = V_{DD} - 2\text{ V to }V_{DD} + 0.1\text{ V}$					30		
		$f = 10\text{ kHz}$					20		
Current Noise Density	i_n	$f = 1\text{ kHz}$	2.7, 5, 10, 36	25		90		fA/ $\sqrt{\text{Hz}}$	
Voltage Noise, Peak to Peak	e_{pp}	$f_{IN} = 0.1\text{ Hz to }10\text{ Hz}$	2.7, 5, 10, 36	25		TBD		μV_{pp}	
		$f_{IN} = 0.01\text{ Hz to }1\text{ Hz}$					TBD		

NCS20231, NCV20231, NCS20232, NCV20232, NCS20234, NCV20234

ELECTRICAL CHARACTERISTICS ($V_S = 2.7\text{ V to }36\text{ V}$) (continued)

At $T_A = +25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$ connected to midsupply, $V_{CM} = V_{OUT} = \text{midsupply}$, unless otherwise noted.

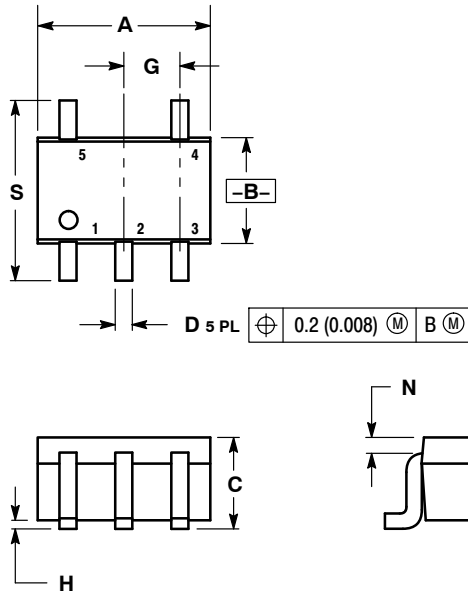
Boldface limits apply over the specified temperature range, guaranteed by characterization and/or design.

Parameter	Symbol	Conditions	Supply Voltage (V)	Temp ($^\circ\text{C}$)	Min	Typ	Max	Unit
POWER SUPPLY								
Power Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to }36\text{ V}$	2.7, 36	25	114	135		dB
				-40 to 125	100			
				-40 to 150	90			
Quiescent Current	I_Q	No load, per channel	2.7, 5	25		0.475	0.595	mA
				-40 to 125			0.650	
				-40 to 150			0.7	
			10	25		0.475	0.595	
				-40 to 125			0.650	
				-40 to 150			0.75	
			36	25		0.475	0.595	
				-40 to 125			0.650	
				-40 to 150			0.8	

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.

PACKAGE DIMENSIONS

SC-88A (SC-70-5/SOT-353)
CASE 419A-02
ISSUE L

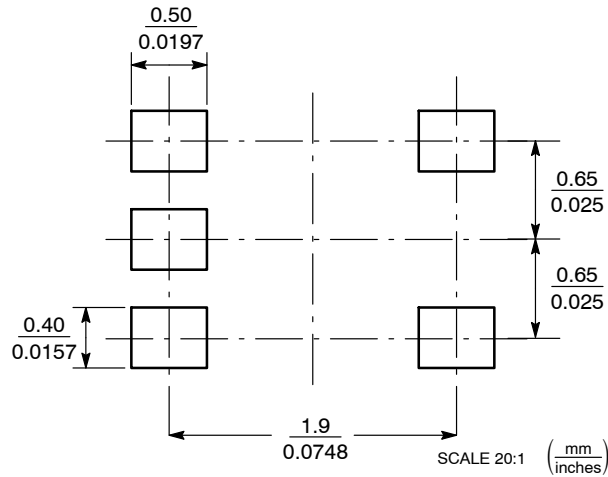


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20

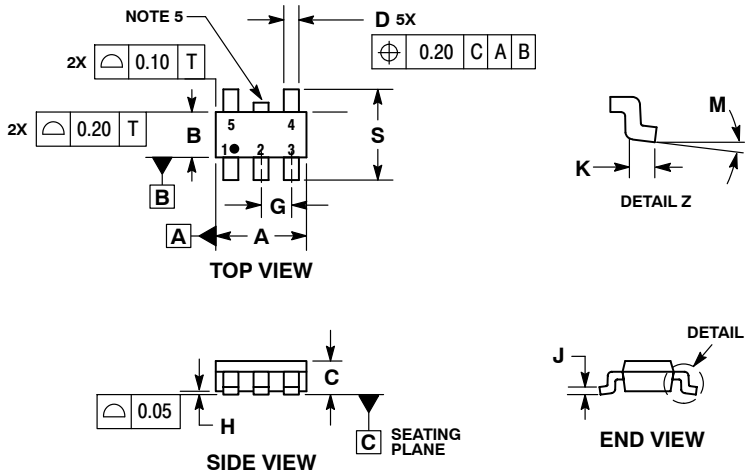
SOLDER FOOTPRINT



*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

TSOP-5
CASE 483
ISSUE M

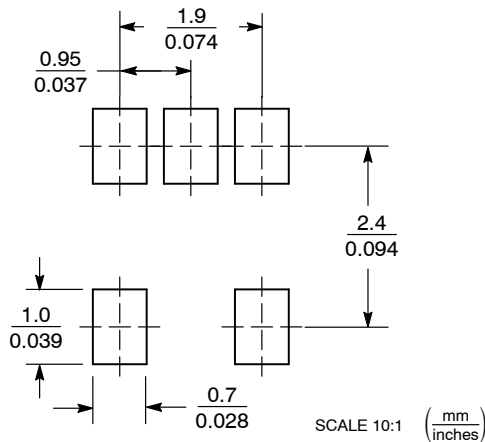


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSION A.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

DIM	MILLIMETERS	
	MIN	MAX
A	2.85	3.15
B	1.35	1.65
C	0.90	1.10
D	0.25	0.50
G	0.95 BSC	
H	0.01	0.10
J	0.10	0.26
K	0.20	0.60
M	0°	10°
S	2.50	3.00

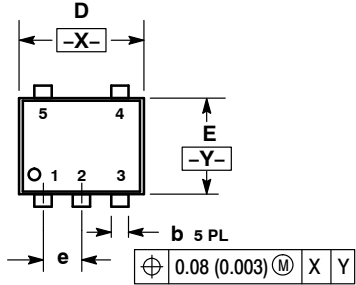
SOLDERING FOOTPRINT*



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PACKAGE DIMENSIONS

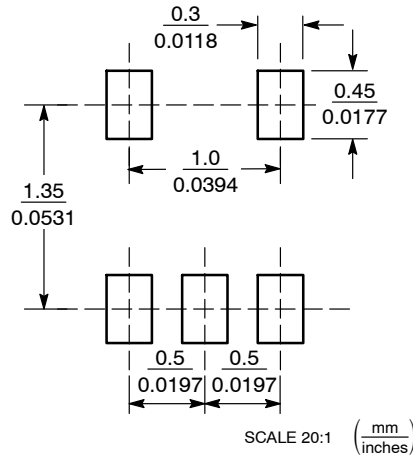
SOT-553, 5 LEAD
CASE 463B
ISSUE C



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETERS
 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.50	0.55	0.60	0.020	0.022	0.024
b	0.17	0.22	0.27	0.007	0.009	0.011
c	0.08	0.13	0.18	0.003	0.005	0.007
D	1.55	1.60	1.65	0.061	0.063	0.065
E	1.15	1.20	1.25	0.045	0.047	0.049
e	0.50 BSC			0.020 BSC		
L	0.10	0.20	0.30	0.004	0.008	0.012
HE	1.55	1.60	1.65	0.061	0.063	0.065

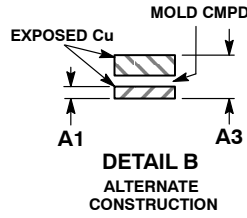
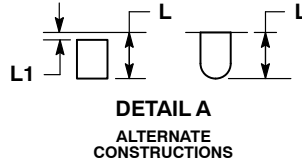
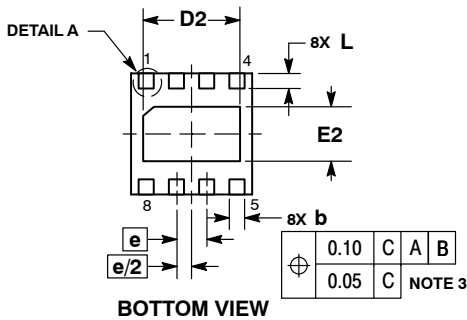
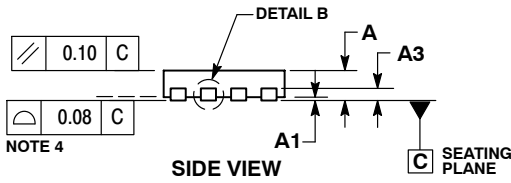
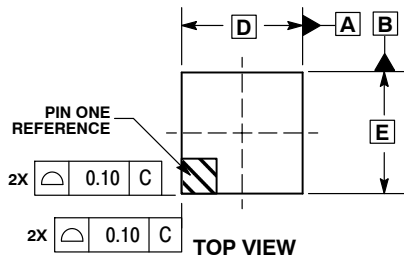
RECOMMENDED
SOLDERING FOOTPRINT*



*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

UDFN8, 2x2
CASE 517AW
ISSUE A

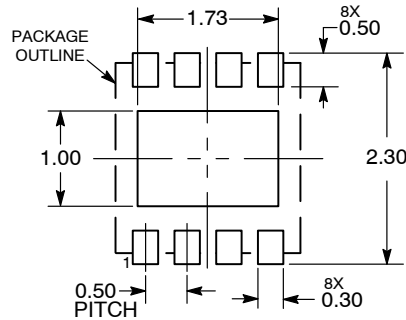


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINALS AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. FOR DEVICE OPN CONTAINING W OPTION, DETAIL B ALTERNATE CONSTRUCTION IS

NOT APPLICABLE		
MILLIMETERS		
DIM	MIN	MAX
A	0.45	0.55
A1	0.00	0.05
A3	0.13	REF
b	0.18	0.30
D	2.00	BSC
D2	1.50	1.70
E	2.00	BSC
E2	0.80	1.00
e	0.50	BSC
L	0.20	0.45
L1	---	0.15

**RECOMMENDED
SOLDERING FOOTPRINT***

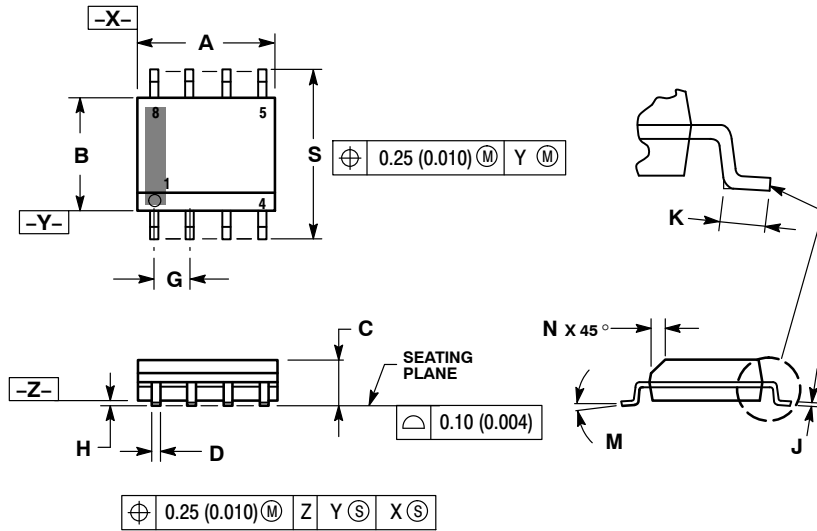


DIMENSIONS: MILLIMETERS

*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

SOIC-8 NB
CASE 751-07
ISSUE AK

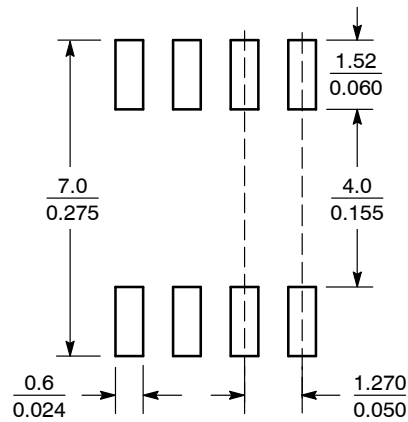


NOTES:

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.

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*

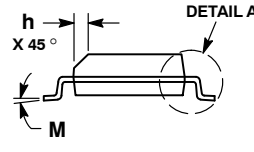
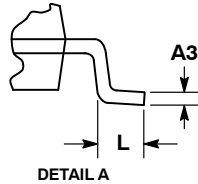
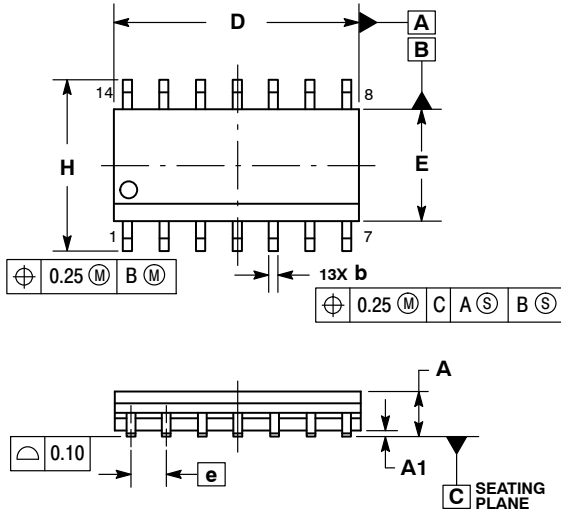


SCALE 6:1 (mm/inches)

*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

SOIC-14 NB
CASE 751A-03
ISSUE L

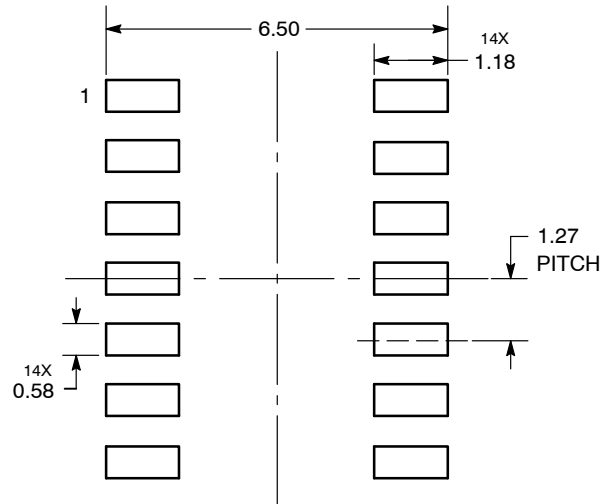


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0°	7°	0°	7°

SOLDERING FOOTPRINT*

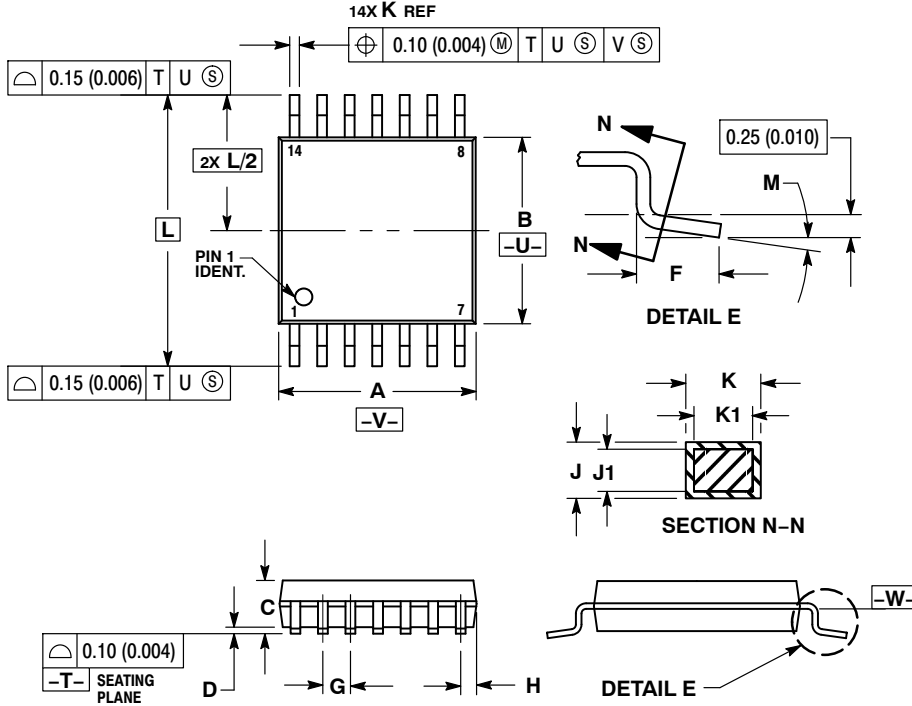


DIMENSIONS: MILLIMETERS

*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

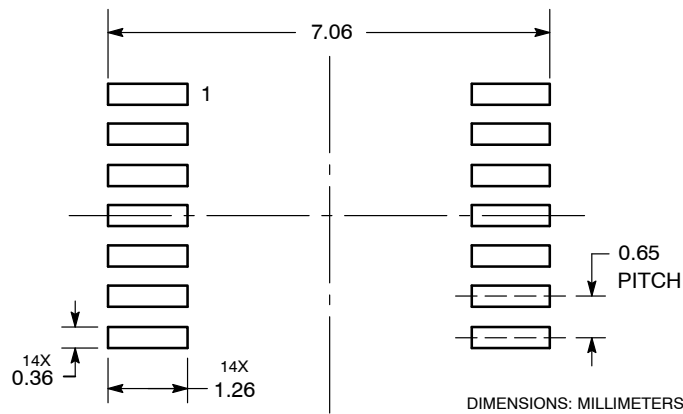
TSSOP-14 WB
CASE 948G
ISSUE C




- 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 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. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
 6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
 7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

SOLDERING FOOTPRINT



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