Operational Amplifier, Railto-Rail Output, 3 MHz BW

The NCx2007x series operational amplifiers provide rail–to–rail output operation, 3 MHz bandwidth, and are available in single, dual, and quad configurations. Rail–to–rail operation enables the user to make optimal use of the entire supply voltage range while taking advantage of 3 MHz bandwidth. The NCx2007x can operate on supply voltages as low as 2.7 V over the temperature range of –40°C to 125°C. At a 2.7 V supply, the high bandwidth provides a slew rate of 2.8 V/µs while only consuming 405 µA of quiescent current per channel. The wide supply range allows the NCx2007x to run on supply voltages as high as 36 V, making it ideal for a broad range of applications. Since this is a CMOS device, high input impedance and low bias currents make it ideal for interfacing to a wide variety of signal sensors. The NCx2007x devices are available in a variety of compact packages. Automotive qualified options are available under the NCV prefix.

Features

- Rail-To-Rail Output
- Wide Supply Range: 2.7 V to 36 V
- Wide Bandwidth: 3 MHz typical at $V_S = 2.7 \text{ V}$
- High Slew Rate: 2.8 V/ μ s typical at V_S = 2.7 V
- Low Supply Current: 405 μ A per channel at $V_S = 2.7 \text{ V}$
- Low Input Bias Current: 5 pA typical
- Wide Temperature Range: -40°C to 125°C
- Available in a variety of packages
- 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

- Current Sensing
- Signal Conditioning
- Automotive

End Products

- Notebook Computers
- Portable Instruments
- Power Supplies



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SOT-553 CASE 463B TSOP-5 CASE 483





Micro8™ CASE 846A SOIC-8 CASE 751





TSSOP-8 CASE 948S

TSSOP-14 CASE 948G



SOIC-14 NB CASE 751A

DEVICE MARKING INFORMATION

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

ORDERING INFORMATION

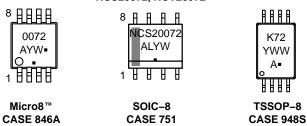
See detailed ordering and shipping information on page 4 of this data sheet.

MARKING DIAGRAMS

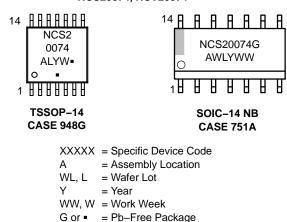
Single Channel Configuration NCS20071, NCV20071



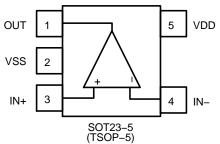
Dual Channel Configuration NCS20072, NCV20072

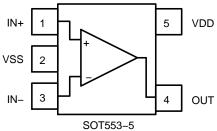


Quad Channel Configuration NCS20074, NCV20074

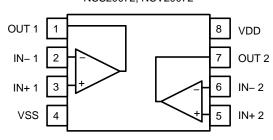


Single Channel Configuration NCS20071, NCV20071





Dual Channel Configuration NCS20072, NCV20072



Quadruple Channel Configuration NCS20074, NCV20074

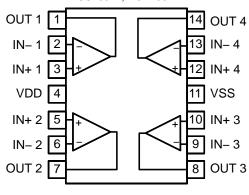


Figure 1. Pin Connections

ORDERING INFORMATION

| Device | Configuration | Automotive | Marking | Package | Shipping [†] |
|------------------|---------------|------------|--------------|-----------------------------|-----------------------|
| NCS20071SN2T1G | | No | AEA | TSOP-5 (Pb-Free) | 3000 / Tape and Reel |
| NCS20071XV53T2G | Single | INO | AL | SOT553-5 (Pb-Free) | 4000 / Tape and Reel |
| NCV20071SN2T1G* | Single | Yes | AEA | TSOP-5 (Pb-Free) | 3000 / Tape and Reel |
| NCV20071XV53T2G* | | 165 | AL | SOT553-5 (Pb-Free) | 4000 / Tape and Reel |
| NCS20072DMR2G | | | 0072 | Micro8 (MSOP8) (Pb-Free) | 4000 / Tape and Reel |
| NCS20072DR2G | | No | NCS20072 | SOIC-8 (Pb-Free) | 2500 / Tape and Reel |
| NCS20072DTBR2G | Post | | K72 | TSSOP-8 (Pb-Free) | 2500 / Tape and Reel |
| NCV20072DMR2G* | Dual | | 0072 | Micro8 (MSOP8) (Pb-Free) | 4000 / Tape and Reel |
| NCV20072DR2G* |] | Yes | NCS20072 | SOIC-8 (Pb-Free) | 2500 / Tape and Reel |
| NCV20072DTBR2G* | | | K72 | TSSOP-8 (Pb-Free) | 2500 / Tape and Reel |
| NCS20074DR2G | | N | NCS20074 | SOIC-14 (Pb-Free) | 2500 / Tape and Reel |
| NCS20074DTBR2G | Outed | No | NCS2 0074 | TSSOP-14 (Pb-Free) | 2500 / Tape and Reel |
| NCV20074DR2G* | Quad | Vo. | NCS20074 | SOIC-14 (Pb-Free) | 2500 / Tape and Reel |
| NCV20074DTBR2G* | | Yes | NCS2 0074 | TSSOP-14 (Pb-Free) | 2500 / Tape and 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.
*NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC–Q100 Qualified and PPAP

Capable.

ABSOLUTE MAXIMUM RATINGS (Note 1)

| | Rating | Symbol | Limit | Unit |
|---|--|-------------------------------|--|------|
| Supply Voltage (V _{DD} – V _{SS} |) (Note 4) | Vs | 40 | V |
| Input Voltage | | V _{CM} | $V_{SS} - 0.2$ to $V_{DD} + 0.2$ | V |
| Differential Input Voltage (N | lote 2) | V_{ID} | ±V _s | V |
| Maximum Input Current | | I _{IN} | ±10 | mA |
| Maximum Output Current (| Note 3) | I _O | ±100 | mA |
| Continuous Total Power Dis | ssipation (Note 4) | P_{D} | 200 | mW |
| Maximum Junction Temper | ature | T_J | 150 | °C |
| Storage Temperature Rang | e | T _{STG} | -65 to 150 | °C |
| Mounting Temperature (Infi | rared or Convection – 20 sec) | T _{mount} | 260 | °C |
| ESD Capability (Note 5) | Human Body Model Machine Model – NCx20071 Machine Model – NCx20072, NCx20074 Charged Device Model – NCx20071, NCx20072 Charged Device Model – NCx20074 | HBM MM MM CDM CDM | 2000 200 150 2000 (C6) 1000 (C6) | V |
| Latch-Up Current (Note 6) | | I _{LU} | 100 | mA |
| Moisture Sensitivity Level (| Note 7) | MSL | Level 1 | |

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. Maximum input current must be limited to ±10 mA. Series connected resistors of at least 500 Ω on both inputs may be used to limit the maximum input current to ±10 mA.
- 3. Total power dissipation must be limited to prevent the junction temperature from exceeding the 150°C limit.
- 4. Continuous short circuit operation to ground at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of the maximum output current rating over the long term may adversely affect reliability. Shorting output to either VDD or VSS will adversely affect reliability.
- 5. This device series incorporates ESD protection and is tested by the following methods:
 - ESD Human Body Model tested per JEDEC standard JS-001 (AEC-Q100-002)
 - ESD Machine Model tested per JEDEC standard JESD22-A115 (AEC-Q100-003)
 - ESD Charged Device Model tested per JEDEC standard JESD22-C101 (AEC-Q100-011)
- 6. Latch-up Current tested per JEDEC standard JESD78 (AEC-Q100-004)
- 7. Moisture Sensitivity Level tested per IPC/JEDEC standard J-STD-020A

THERMAL INFORMATION

| Parameter | Symbol | Package | Single Layer Board (Note 8) | Multi–Layer Board (Note 9) | Unit | |
|---------------------|-------------------|-----------------|--------------------------------|-------------------------------|------|--|
| | | SOT23-5 / TSOP5 | 265 | 195 | | |
| | | SOT553-5 | 325 | 244 | | |
| | | Micro8 / MSOP8 | 236 | 167 | | |
| Junction-to-Ambient | $\theta_{\sf JA}$ | SOIC-8 | 190 | 131 | °C/W | |
| | | TSSOP-8 | 253 | 194 | 1 | |
| | | SOIC-14 | 142 | 101 | | |
| | | TSSOP-14 | 179 | 128 | 1 | |

- 8. Values based on a 1S standard PCB according to JEDEC51-3 with 1.0 oz copper and a 300 mm² copper area
- 9. Values based on a 1S2P standard PCB according to JEDEC51-7 with 1.0 oz copper and a 100 mm² copper area

OPERATING RANGES

| Parameter | Symbol | Min | Max | Unit |
|--|-----------------|-----------------|------------------------|------|
| Operating Supply Voltage (Single Supply) | Vs | 2.7 | 36 | V |
| Operating Supply Voltage (Split Supply) | Vs | ±1.35 | ±18 | V |
| Differential Input Voltage (Note 10) | V_{ID} | | V _S | V |
| Input Common Mode Voltage Range | V _{CM} | V _{SS} | V _{DD} – 1.35 | V |
| Ambient Temperature | T _A | -40 | 125 | °C |

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.

10. Maximum input current must be limited to ± 10 mA. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 2.7 V $T_A = 25^{\circ}\text{C}$; $R_L \ge 10$ kΩ; $V_{CM} = V_{OUT} = \text{mid}$ –supply unless otherwise noted. All limits are guaranteed by testing or statistical analysis. **Boldface** limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 11, 12)

| Parameter | Symbol | Cond | litions | Min | Тур | Max | Unit |
|---|--|--|-------------------------------|-----|-------|------|-------|
| INPUT CHARACTERISTICS | | | | | | | |
| | | NCv | 20071 | | 1.3 | ±3.5 | |
| Input Offset Valtage | V | NCX. | 20071 | | | ±4.5 | m\/ |
| Input Offset Voltage | Vos | NCv20072 | NCx20072, NCx20074 | | 1.3 | ±3 | mV |
| | | NCX20072 | , INCX20074 | | | ±4 | |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | T _A = 25°0 | C to 125°C | | 2 | | μV/°C |
| Input Bias Current (Note 12) | L. | | | | 5 | 200 | nΛ |
| Input Bias Current (Note 12) | I _{IB} | | | | | 1500 | pА |
| | | NCv20071 | NCv20072 | | 2 | 75 | |
| Input Officet Current (Note 42) | | NCX20071 | NCx20071, NCx20072 | | | 500 | рА |
| Input Offset Current (Note 12) | los | NOv | 20074 | | 2 | 75 | рА |
| | | NCX. | NCx20074 | | | 200 | |
| Channel Conserving | VTLK | DC | NCx20072 | | 100 | | dВ |
| Channel Separation | XTLK | DC | DC NCx20074 | | 115 | | dB |
| Differential Input Resistance | R _{ID} | | | | 5 | | GΩ |
| Common Mode Input Resistance | R _{IN} | | | | 5 | | GΩ |
| Differential Input Capacitance | C _{ID} | | | | 1.5 | | pF |
| Common Mode Input Capacitance | C _{CM} | | | | 3.5 | | pF |
| 0 11 5 : 5 | OMBB | ., ., ., | V/ V/ 4.05.V/ | 90 | 110 | | |
| Common Mode Rejection Ratio | CMRR $V_{CM} = V_{SS} + 0.2 \text{ V to } V_{DD} - 1.35 \text{ V}$ | | v to v _{DD} – 1.35 v | 69 | | | - dB |
| OUTPUT CHARACTERISTICS | | | | | | | |
| 0.000 0.000 | ^ | | | 96 | 118 | | -in |
| Open Loop Voltage Gain | A_{VOL} | | Ī | 86 | | | dB |
| 0 0 | | Op amp sir | nking current | | 70 | | |
| Output Current Capability (Note 13) | I _O | Op amp sou | rcing current | | 50 | | mA |
| 0 | | | | | 0.006 | 0.15 | ., |
| Output Voltage High | V _{OH} | Voltage output swi | ng from positive rail | | | 0.22 | V |
| | ., | | | | 0.005 | 0.15 | ., |
| Output Voltage Low | V_{OL} | Voltage output swir | ng from negative rail | | | 0.22 | V |
| AC CHARACTERISTICS | | | | | | | |
| Unity Gain Bandwidth | UGBW | C _L = 25 pF | | | 3 | | MHz |
| Slew Rate at Unity Gain | SR | $C_{L} = 20 \text{ pF}$ | $R_L = 2 k\Omega$ | | 2.8 | | V/μs |
| Phase Margin | φm | C _L = | 25 pF | | 50 | | ٥ |
| Gain Margin | A _m | C _L = | 25 pF | | 14 | | dB |
| 0.48 | Vo = 1 Vpp | | Settling time to 0.1% | | 0.6 | | μs |
| Settling Time | t _S G | Gain = 1, C_L = 20 pF Settling time to 0.01% | | | 1.2 | | |

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.

^{11.} Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.

^{12.} Performance guaranteed over the indicated operating temperature range by design and/or characterization.

^{13.} Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 2.7 V

 $T_A = 25^{\circ}\text{C}$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid}$ –supply unless otherwise noted. All limits are guaranteed by testing or statistical analysis. **Boldface** limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 11, 12)

| Parameter | Symbol | Cond | itions | Min | Тур | Max | Unit |
|--------------------------------------|-----------------|---|-----------------------|-----|------|-----|---------------------|
| NOISE CHARACTERISTICS | | | | | | | |
| Total Harmonic Distortion plus Noise | THD+N | V _{IN} = 0.5 Vpp, f | = 1 kHz, Av = 1 | | 0.05 | | % |
| Inner Deferred Valters Naise | f = 1 kHz | | f = 1 kHz | | 30 | | ->/// |
| Input Referred Voltage Noise | e _n | f = 10 kHz | | | 20 | | nV/√ Hz |
| Input Referred Current Noise | i _n | f = 1 kHz | | | 90 | | fA/√ Hz |
| SUPPLY CHARACTERISTICS | | | | | | | |
| Davisa Comple Daiostica Datia | 2022 | No Load | | 114 | 135 | | -10 |
| Power Supply Rejection Ratio | PSRR | NO L | .oad | 100 | | | dB |
| | | NC20074 | Noteed | | 420 | 625 | |
| D | | NCx20071 | No load | | | 765 | _ |
| Power Supply Quiescent Current | I _{DD} | | Dan dia sanda a dan d | | 405 | 525 | μΑ |
| | | NCx20072, NCx20074 Per channel, no load | | | | 625 | |

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.

- 11. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
- 12. Performance guaranteed over the indicated operating temperature range by design and/or characterization.
- 13. Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 5 V

 $T_A = 25^{\circ}\text{C}$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid-supply}$ unless otherwise noted. All limits are guaranteed by testing or statistical analysis. **Boldface** limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 14, 15)

| Parameter | Symbol | С | onditions | Min | Тур | Max | Unit |
|--------------------------------|--------------------------|--------------------|----------------|-----|-----|------|------------|
| INPUT CHARACTERISTICS | | | | | | | |
| | | NO::00074 | 1000074 | | 1.3 | ±3.5 | |
| Innut Offact Valtage | \/ | r | ICx20071 | | | ±4.5 | >/ |
| Input Offset Voltage | Vos | NC20 | 070 NO. 00074 | | 1.3 | ±3 | mV |
| | | NCx20072, NCx20074 | | | | ±4 | 1 |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | $T_A = 2$ | 25°C to 125 °C | | 2 | | μV/°C |
| Innut Diag Current (Note 45) | | | | | 5 | 200 | π Λ |
| Input Bias Current (Note 15) | I _{IB} | | | | | 1500 | pА |
| | | NCx20071, NCx20072 | | | 2 | 75 | |
| land Offert Comment (Nets 45) | 1 | | | | | 500 | π Λ |
| Input Offset Current (Note 15) | los | | 1000074 | | 2 | 75 | - pA |
| | | r | ICx20074 | | | 200 | |
| Ohana al Oaranatia a | VTLK | D0 | NCx20072 | | 100 | | .ID |
| Channel Separation | XTLK | DC | NCx20074 | | 115 | | dB |
| Differential Input Resistance | R _{ID} | | • | | 5 | | GΩ |
| Common Mode Input Resistance | R _{IN} | | | | 5 | | GΩ |
| Differential Input Capacitance | C _{ID} | | | | 1.5 | | pF |
| Common Mode Input Capacitance | C _{CM} | | | | 3.5 | | pF |

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.

- 14. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
- 15. Performance guaranteed over the indicated operating temperature range by design and/or characterization.
- 16. Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 5 V $T_A = 25^{\circ}C$; $R_L \ge 10$ kΩ; $V_{CM} = V_{OUT} = \text{mid}$ –supply unless otherwise noted. All limits are guaranteed by testing or statistical analysis. **Boldface** limits apply over the specified temperature range, $T_A = -40^{\circ}C$ to 125°C. (Notes 14, 15)

| Parameter | Symbol | Cond | itions | Min | Тур | Max | Unit |
|--------------------------------------|---------------------|--|-------------------------------|-----|-------|------|--------------------|
| INPUT CHARACTERISTICS | | | | | | | |
| 0 11 5 : 5 | OMBB | , , , , , , , , , , , , , , , , , , , | V. V. 4.05.V. | 102 | 125 | | i. |
| Common Mode Rejection Ratio | CMRR | $V_{CM} = V_{SS} + 0.2$ | V to V _{DD} – 1.35 V | 80 | | | - dB |
| OUTPUT CHARACTERISTICS | | • | | | | | |
| On an Loan Voltage Cain | ٨ | | | 96 | 120 | | ٩D |
| Open Loop Voltage Gain | A_{VOL} | | | 86 | | | dB |
| Output Current Conchility (Note 16) | , | Op amp sin | king current | | 50 | | A |
| Output Current Capability (Note 16) | I _O | Op amp sou | rcing current | | 60 | | mA |
| Output Voltage High | V | Voltage output out | a a from positive roil | | 0.013 | 0.20 | V |
| Output Voltage High | V _{OH} | Voltage output swing from positive rail | | | | 0.25 | V |
| Output Voltage Low | V | Voltago output owin | og from pogotivo roil | | 0.01 | 0.10 | V |
| Output Voltage Low | V _{OL} | voltage output swir | ng from negative rail | | | 0.15 | V |
| AC CHARACTERISTICS | | | | | | | |
| Unity Gain Bandwidth | UGBW | C _L = | 25 pF | | 3 | | MHz |
| Slew Rate at Unity Gain | SR | $C_{L} = 20 \text{ pF}$ | $R_L = 2 k\Omega$ | | 2.7 | | V/μs |
| Phase Margin | ϕ_{m} | C _L = | 25 pF | | 50 | | ٥ |
| Gain Margin | A_{m} | C _L = | 25 pF | | 14 | | dB |
| Comilia a Timo o | | $V_{O} = 3 \text{ Vpp},$ Gain = 1, C _L = 20 pF | Settling time to 0.1% | | 1.2 | | |
| Settling Time | t _S | Gain = 1, $C_L = 20 \text{ pF}$ | Settling time to 0.01% | | 5.6 | | μS |
| NOISE CHARACTERISTICS | | | | | | | |
| Total Harmonic Distortion plus Noise | THD+N | V _{IN} = 2.5 Vpp, f | = 1 kHz, Av = 1 | | 0.009 | | % |
| Innuit Defermed Valteria Naina | _ | f = 1 | kHz | | 30 | | nV/√ Hz |
| Input Referred Voltage Noise | e _n | f = 10 |) kHz | | 20 | | 11V/VIIZ |
| Input Referred Current Noise | i _n | f = 1 | kHz | | 90 | | fA/√ Hz |
| SUPPLY CHARACTERISTICS | | | | | | | |
| 5 0 15: " 5" | 2022 | | | 114 | 135 | | i. |
| Power Supply Rejection Ratio | PSRR | No Load | | 100 | | | dB |
| | | NC-20074 | Noteed | | 430 | 635 | |
| Power Supply Quiescent Current | | NCx20071 | No load | | | 775 | |
| | I _{DD} NC. | NCv20072 NCv20074 D | Dan ahannal araba | | 410 | 530 | μΑ |
| | | NCx20072, NCx20074 Per channel, no load | | | | 630 | 1 |

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.

^{14.} Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.

^{15.} Performance guaranteed over the indicated operating temperature range by design and/or characterization.

^{16.} Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT $V_S = 10 \text{ V}$

 $T_A = 25^{\circ}\text{C}$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid}$ –supply unless otherwise noted. All limits are guaranteed by testing or statistical analysis. Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 17, 18)

| Parameter | Symbol | Cond | itions | Min | Тур | Max | Unit | |
|--|--------------------------|---------------------------------|-------------------------------|-----|-------|------|-------|--|
| INPUT CHARACTERISTICS | | | | | | | | |
| Innut Officet Vallege | N/ | NOve | 20074 | | 1.3 | ±3.5 | mV | |
| Input Offset Voltage | V _{OS} | NCX2 | 20071 | | | ±4.5 | mV | |
| Input Offset Voltage | V | NCv20072 | NCx20074 | | 1.3 | ±3 | mV | |
| input Onset voltage | V _{OS} | 110020072 | 110220074 | | | ±4 | mV | |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | T _A = 25°C | to 125°C | | 2 | | μV/°C | |
| Input Bias Current (Note 18) | I _{IB} | | | | 5 | 200 | рA | |
| | .10 | | | | | 1500 | μ, . | |
| | | NCx20071. | NCx20072 | | 2 | 75 | pA | |
| Input Offset Current (Note 18) | I _{OS} | | | | | 500 | | |
| put Gilber Guirein (i tete 16) | .03 | NCx | 20074 | | 2 | 75 | | |
| | | | | | | 200 | | |
| Channel Separation | XTLK | DC | DC NCx20072 | | 100 | | dB | |
| | XILK | 20 | NCx20074 | | 115 | | 4.5 | |
| Differential Input Resistance | R _{ID} | | | | 5 | | GΩ | |
| Common Mode Input Resistance | R _{IN} | | | | 5 | | GΩ | |
| Differential Input Capacitance | C _{ID} | | | | 1.5 | | pF | |
| Common Mode Input Capacitance | C _{CM} | | | | 3.5 | | pF | |
| Common Mode Rejection Ratio | CMRR | Von = Voc + 0.2 | V to V _{DD} – 1.35 V | 110 | 130 | | dB | |
| Common Mode Rejection ratio | Omar | VCIVI — VSS 1 0.2 | * to *DD * 1.00 * | 87 | | | (I) | |
| OUTPUT CHARACTERISTICS | | | | | _ | | | |
| Open Loop Voltage Gain | A _{VOL} | | | 98 | 120 | | dB | |
| | , vol | | | 88 | | | 4.5 | |
| Output Current Capability (Note 19) | I _O | Op amp sin | king current | | 50 | | mA | |
| Catput Carrent Capability (140to 15) | 10 | Op amp sou | rcing current | | 65 | | 1117. | |
| Output Voltage High | V _{OH} | Voltage output swi | ng from positive rail | | 0.023 | 0.08 | V | |
| - Calput Voltage Flight | VОН | voltage output swii | ig irom poolave raii | | | 0.10 | V | |
| Output Voltage Low | V _{OL} | Voltage output swir | ng from negative rail | | 0.022 | 0.3 | V | |
| - Catput Voltage Low | VOL | voltage output swii | ig irom riegative raii | | | 0.35 | · | |
| AC CHARACTERISTICS | | | | | | | | |
| Unity Gain Bandwidth | UGBW | C _L = | 25 pF | | 3 | | MHz | |
| Slew Rate at Unity Gain | SR | $C_{L} = 20 \text{ pF}$ | $R_L = 2 k\Omega$ | | 2.6 | | V/μs | |
| Phase Margin | ϕ_{m} | C _L = | 25 pF | | 50 | | ٥ | |
| Gain Margin | A _m | C _L = | 25 pF | | 14 | | dB | |
| Settling Time | to | $V_{O} = 8.5 \text{ Vpp},$ | Settling time to 0.1% | | 3.4 | | li 6 | |
| Committee of the commit | t _S G | Gain = 1, $C_L = 20 \text{ pF}$ | Settling time to 0.01% | | 6.8 | | μs | |

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.

^{17.} Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.

^{18.} Performance guaranteed over the indicated operating temperature range by design and/or characterization.

^{19.} Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 10 V

 $T_A = 25^{\circ}\text{C}$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid-supply}$ unless otherwise noted. All limits are guaranteed by testing or statistical analysis. Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 17, 18)

| Parameter | Symbol | Cond | itions | Min | Тур | Max | Unit |
|--------------------------------------|-----------------|---|---------------------|-----|-------|-----|----------------------|
| NOISE CHARACTERISTICS | | | | | | | |
| Total Harmonic Distortion plus Noise | THD+N | V _{IN} = 7.5 Vpp, f | = 1 kHz, Av = 1 | | 0.004 | | % |
| Inner Defermed Voltage Naise | f = 1 kHz | | f = 1 kHz | | 30 | | ->/// |
| Input Referred Voltage Noise | e _n | f = 10 kHz | | | 20 | | - nV/√ Hz |
| Input Referred Current Noise | i _n | f = 1 kHz | | | 90 | | fA/√ Hz |
| SUPPLY CHARACTERISTICS | | | | | | | |
| Davisa Comple Daiostica Datia | 2022 | No Load | | 114 | 135 | | -10 |
| Power Supply Rejection Ratio | PSRR | NO L | -oad | 100 | | | dB |
| | | NC20074 | Noteed | | 430 | 645 | |
| D | | NCx20071 | No load | | | 785 | 1 , |
| Power Supply Quiescent Current | I _{DD} | | Day shawasi wa laad | | 416 | 540 | μΑ |
| | | NCx20072, NCx20074 Per channel, no load | | | | 640 | 1 |

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.

- 17. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
- 18. Performance guaranteed over the indicated operating temperature range by design and/or characterization.
- 19. Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 36 V

 $T_A = 25^{\circ}\text{C}$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid-supply}$ unless otherwise noted. All limits are guaranteed by testing or statistical analysis. Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 20, 21)

| Parameter | Symbol | Con | ditions | Min | Тур | Max | Unit |
|--------------------------------|--------------------------|--------------------|--------------------|-----|------|------|-------|
| INPUT CHARACTERISTICS | | | | | | | |
| | | NCx20071 | | | 1.3 | ±3.5 | mV |
| land Office Valtage | V/ | NC) | (20071 | | | ±4.5 | mV |
| Input Offset Voltage | Vos | NCv2007 | 0. NCv20074 | | 1.3 | ±3 | mV |
| | | NCX2007. | 2, NCx20074 | | | ±4 | mV |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | $T_A = 25^{\circ}$ | °C to 125°C | | 2 | | μV/°C |
| | | | | | 5 | 200 | |
| Input Bias Current (Note 21) | I _{IB} | NCx20071, NCx20072 | | | | 2000 | рА |
| | | NC: | | | 1500 | | |
| | | NCv2007 | NCx20071, NCx20072 | | 2 | 75 | |
| Innut Offert Comment (Nata 24) | | NCX2007 | 1, NCX20072 | | | 1000 | - pA |
| Input Offset Current (Note 21) | los | NO | .00074 | | 2 | 75 | |
| | | NC) | k20074 | | | 200 | |
| Channel Consention | VTLK | DC. | NCx20072 | | 100 | | 40 |
| Channel Separation | XTLK | DC | NCx20074 | | 115 | | dB |
| Differential Input Resistance | R _{ID} | | | | 5 | | GΩ |
| Common Mode Input Resistance | R _{IN} | | | | 5 | | GΩ |

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.

- 20. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
- 21. Performance guaranteed over the indicated operating temperature range by design and/or characterization.
- 22. Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 36 V $T_A = 25^{\circ}\text{C}$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid}$ –supply unless otherwise noted. All limits are guaranteed by testing or statistical analysis. Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 20, 21)

| Parameter | Symbol | Cond | litions | Min | Тур | Max | Unit |
|--------------------------------------|--|---------------------------------|---|-----|-------|------|---------------------|
| INPUT CHARACTERISTICS | | • | <u>, , , , , , , , , , , , , , , , , , , </u> | | | | • |
| Differential Input Capacitance | C _{ID} | | | | 1.5 | | pF |
| Common Mode Input Capacitance | C _{CM} | | | | 3.5 | | pF |
| | | | $V_{CM} = V_{CC} + 0.2 \text{ V to}$ | 118 | 135 | | |
| | | NCx20071 | $V_{CM} = V_{SS} + 0.2 \text{ V to}$ $V_{DD} - 1.35 \text{ V}$ | 95 | | | |
| | | | $V_{CM} = V_{SS} + 0.2 \text{ V to}$ $V_{DD} - 1.35 \text{ V}$ | 120 | 145 | | ļ . |
| Common Mode Rejection Ratio | CMRR | NCx20072 | | 95 | | | dB |
| | | NCx20074 | $V_{CM} = V_{SS} + 0.2 \text{ V to}$ | 120 | 145 | | 1 |
| | | | V _{DD} – 1.35 V | 85 | | | 1 |
| OUTPUT CHARACTERISTICS | | | | | | | |
| On an Lean Wallana On's | Δ. | | | 98 | 120 | | JD |
| Open Loop Voltage Gain | A_{VOL} | | | 88 | | | dB |
| 0 0 | | Op amp sinking current | | | 50 | | |
| Output Current Capability (Note 22) | nt Capability (Note 22) I _O Op amp sourcing current | | | 65 | | mA | |
| | | | NO 00074 | | 0.074 | 0.15 | |
| Output Voltage High | | | NCx20071 | | | 0.22 | - - V |
| | | Voltage output swing | NO 00070 | | 0.074 | 0.10 | |
| | V_{OH} | from positive rail | NCx20072 | | | 0.15 | |
| | | | NO 00074 | | 0.074 | 0.10 | |
| | | | NCx20074 | | | 0.12 | |
| 0 | ., | | | | 0.065 | 0.3 | Ţ., |
| Output Voltage Low | V_{OL} | Voltage output swir | ng from negative rail | | | 0.35 | V |
| AC CHARACTERISTICS | | | <u>.</u> | | | | |
| Unity Gain Bandwidth | UGBW | C _L = | 25 pF | | 3 | | MHz |
| Slew Rate at Unity Gain | SR | $C_{L} = 20 \text{ pF}$ | $R_L = 2 k\Omega$ | | 2.4 | | V/μs |
| Phase Margin | ϕ_{m} | C _L = | 25 pF | | 50 | | 0 |
| Gain Margin | A _m | C _L = | 25 pF | | 14 | | dB |
| Cottling Times | | V _O = 10 Vpp, | Settling time to 0.1% | | 3.2 | | |
| Settling Time | t _S | Gain = 1, $C_L = 20 \text{ pF}$ | Settling time to 0.01% | | 7 | | μS |
| NOISE CHARACTERISTICS | | | | | | | |
| Total Harmonic Distortion plus Noise | THD+N | V _{IN} = 28.5 Vpp, | f = 1 kHz, Av = 1 | | 0.001 | | % |
| Input Poforred Voltage Noise | - | f = 1 | kHz | | 30 | | nV/√ H z |
| Input Referred Voltage Noise | e _n | f = 1 | 0 kHz | | 20 | | 11V/ VH2 |
| Input Referred Current Noise | i _n | f = 1 | kHz | | 90 | - | fA/√Hz |

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.

^{20.} Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.

^{21.} Performance guaranteed over the indicated operating temperature range by design and/or characterization.

^{22.} Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

ELECTRICAL CHARACTERISTICS AT V_S = 36 V $T_A = 25^{\circ}\text{C}$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid}$ –supply unless otherwise noted. All limits are guaranteed by testing or statistical analysis. Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to 125°C. (Notes 20, 21)

| Parameter | Symbol | Conditions | | Min | Тур | Max | Unit | |
|--------------------------------|-----------------|------------|----------------------|-----|-----|-----|------|--|
| SUPPLY CHARACTERISTICS | | | | | | | | |
| Dawar Cumply Dejection Datio | | | Lood | 114 | 135 | | ٩D | |
| Power Supply Rejection Ratio | PSRR | No Load | | 100 | | | dB | |
| | | NCx20071 | No load | | 480 | 700 | | |
| | | NCX20071 | No load | | | 840 | | |
| Dower Cumply Ouisesent Current | | NCx20072 | Der channel no load | | 465 | 570 | ^ | |
| Power Supply Quiescent Current | I _{DD} | NCX20072 | Per channel, no load | | | 700 | μΑ | |
| | | NCv20074 | Der channel no load | | 465 | 600 | | |
| | | NCx20074 | Per channel, no load | | | 700 | | |

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.

- 20. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
- 21. Performance guaranteed over the indicated operating temperature range by design and/or characterization.
- 22. Power dissipation must be limited to prevent junction temperature from exceeding 150°C. See Absolute Maximum Ratings for more information.

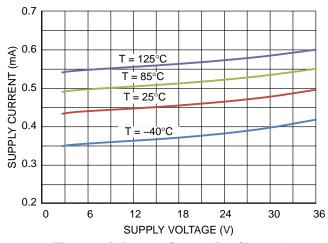


Figure 2. Quiescent Current Per Channel vs. Supply Voltage

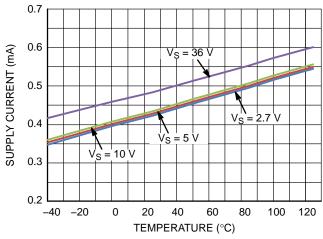


Figure 3. Quiescent Current vs. Temperature

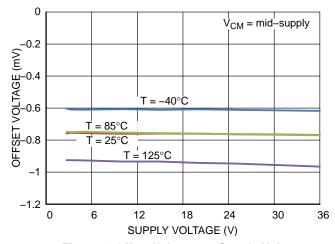


Figure 4. Offset Voltage vs. Supply Voltage

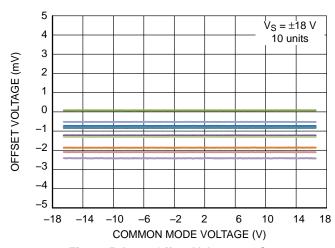


Figure 5. Input Offset Voltage vs. Common Mode Voltage

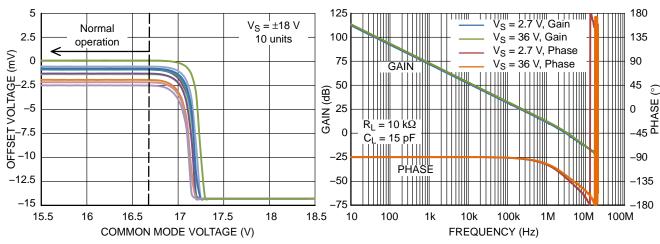


Figure 6. Input Offset Voltage vs. Common Mode Voltage

Figure 7. Gain and Phase vs. Frequency

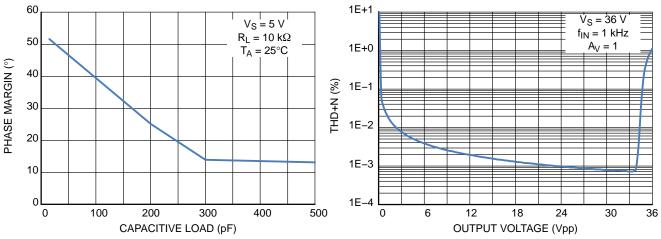


Figure 8. Phase Margin vs. Capacitive Load

Figure 9. THD+N vs. Output Voltage

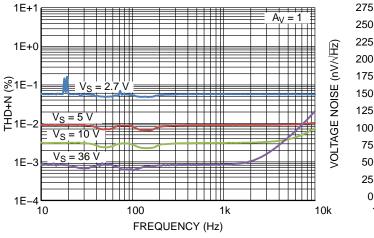


Figure 10. THD+N vs. Frequency

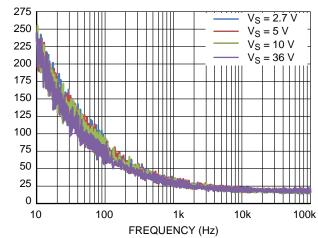


Figure 11. Input Voltage Noise vs. Frequency

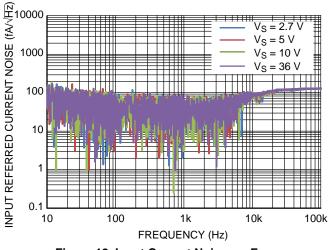


Figure 12. Input Current Noise vs. Frequency

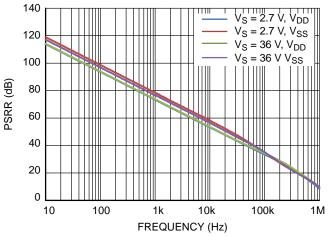
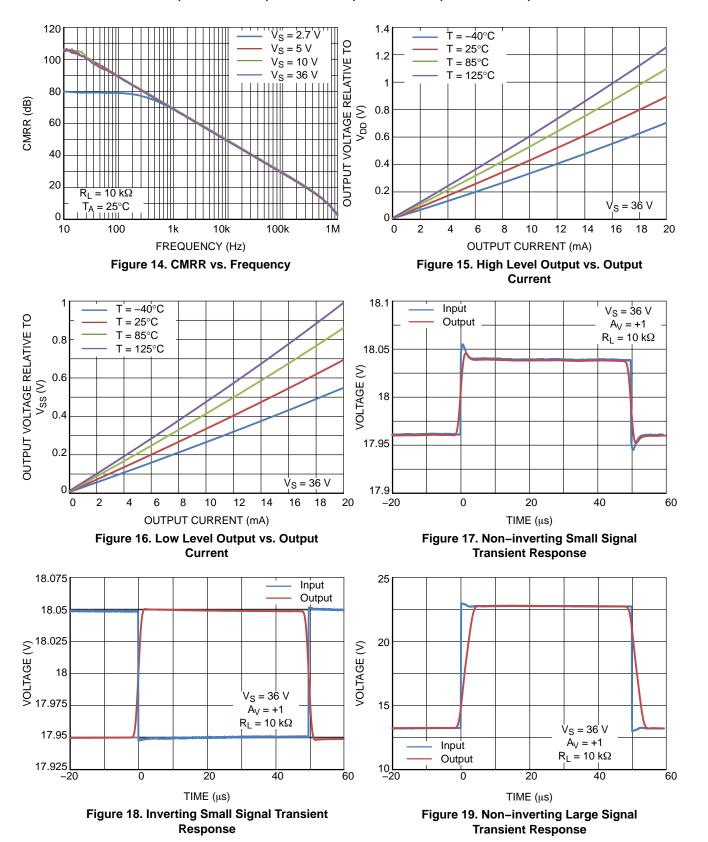


Figure 13. PSRR vs. Frequency



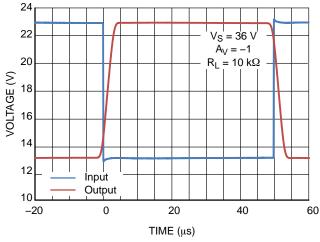


Figure 20. Inverting Large Signal Transient Response

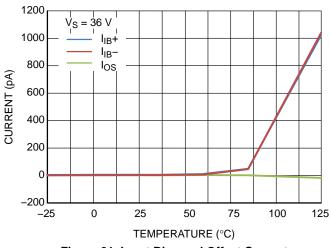


Figure 21. Input Bias and Offset Current vs.
Temperature

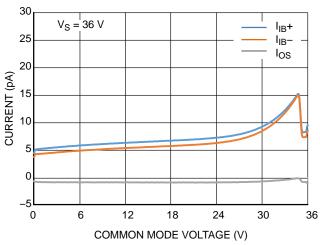


Figure 22. Input Bias Current vs. Common Mode Voltage

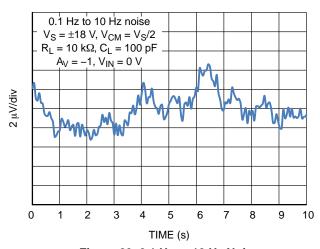


Figure 23. 0.1 Hz to 10 Hz Noise

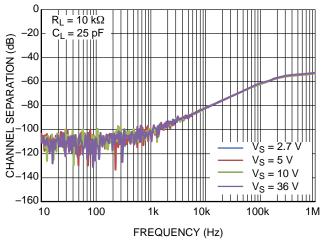


Figure 24. Channel Separation vs. Frequency

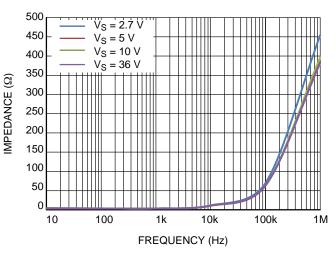
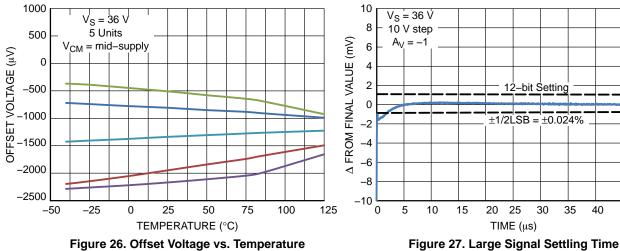


Figure 25. Open Loop Output Impedance



TIME (µs)

 $\pm 1/2$ LSB = $\pm 0.024\%$

Figure 26. Offset Voltage vs. Temperature

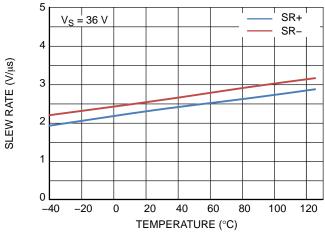


Figure 28. Slew Rate vs. Temperature

APPLICATIONS INFORMATION

Input Circuit

The NCS2007x input stage has a PMOS input pair and ESD protection diodes. The input pair is internally connected by back–to–back Zener diodes with a reverse voltage of 5.5 V. To protect the internal circuitry, the input current must be limited to 10 mA. When operating the

NCS2007x at differential voltages greater than $V_{ID}=26~V$, series resistors can be added externally to limit the input current flowing between the input pins. Adding 500 Ω resistors in series with the input prevents the current from exceeding 10 mA over the entire operating range up to 36 V.

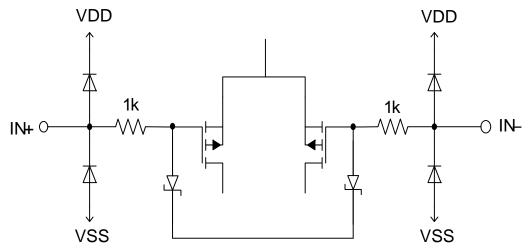


Figure 29. Differential Input Pair

Output

The NCS2007x has a class AB output stage with rail-to-rail output swing.

High output currents can cause the junction temperature to exceed the 150°C absolute maximum rating. In the case of a short circuit where the output is connected to either supply rail, the amount of current the op amp can source and sink is described by the output current capability parameter

listed in the Electrical Characteristics. The junction temperature at a given power dissipation, P, can be calculated using the following formula:

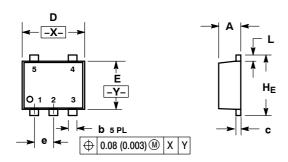
$$T_J = T_A + P \times \theta_{JA}$$

The thermal resistance between junction and ambient, θ_{JA} , is provided in the Thermal Information section of this datasheet.

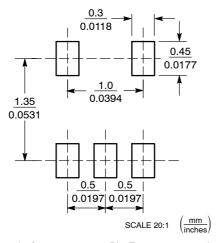


SOT-553, 5 LEAD CASE 463B ISSUE C

DATE 20 MAR 2013



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.

NOTES:

- 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.

| | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-----------|-------|
| DIM | MIN NOM MAX | | MAX | MIN | NOM | MAX |
| Α | 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 |
| С | 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 |
| е | 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 |

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.

| STYLE 1: PIN 1. BASE 2. EMITTER 3. BASE 4. COLLECTOR 5. COLLECTOR | STYLE 2: PIN 1. CATHODE 2. COMMON ANODE 3. CATHODE 2 4. CATHODE 3 5. CATHODE 4 | STYLE 3: PIN 1. ANODE 1 2. N/C 3. ANODE 2 4. CATHODE 2 5. CATHODE 1 | STYLE 4: PIN 1. SOURCE 1 2. DRAIN 1/2 3. SOURCE 1 4. GATE 1 5. GATE 2 | STYLE 5: PIN 1. ANODE 2. EMITTER 3. BASE 4. COLLECTOR 5. CATHODE |
|---|--|--|--|---|
| STYLE 6: PIN 1. EMITTER 2 2. BASE 2 3. EMITTER 1 4. COLLECTOR 1 5. COLLECTOR 2/BASE 1 | STYLE 7: PIN 1. BASE 2. EMITTER 3. BASE 4. COLLECTOR 5. COLLECTOR | STYLE 8: PIN 1. CATHODE 2. COLLECTOR 3. N/C 4. BASE 5. EMITTER | STYLE 9: PIN 1. ANODE 2. CATHODE 3. ANODE 4. ANODE 5. ANODE | |

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| 98AON11127 | D |

PAGE 2 OF 2

| ISSUE | REVISION | DATE | | | |
|-------|---|-------------|--|--|--|
| Α | ADDED STYLES 3-9. REQ. BY D. BARLOW | 11 NOV 2003 | | | |
| В | ADDED NOMINAL VALUES AND UPDATED GENERIC MARKING DIAGRAM. REQ. BY HONG XIAO | 27 MAY 2005 | | | |
| С | UPDATED DIMENSIONS D, E, AND HE. REQ. BY J. LETTERMAN. | 20 MAR 2013 | | | |
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TSOP-5 **CASE 483 ISSUE N**

DATE 12 AUG 2020









NOTES:

- DIMENSIONING AND TOLERANCING PER ASME
- CONTROLLING DIMENSION: MILLIMETERS.
 MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH
 THICKNESS. MINIMUM LEAD THICKNESS IS THE
 MINIMUM THICKNESS OF BASE MATERIAL.
- 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. OPTIONAL CONSTRUCTION: AN ADDITIONAL
- TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

| | MILLIMETERS | | | |
|-----|-------------|----------|--|--|
| DIM | MIN MAX | | | |
| Α | 2.85 | 3.15 | | |
| В | 1.35 | 1.65 | | |
| C | 0.90 | 1.10 | | |
| D | 0.25 | 0.50 | | |
| G | 0.95 | 0.95 BSC | | |
| Н | 0.01 | 0.10 | | |
| J | 0.10 | 0.26 | | |
| K | 0.20 | 0.60 | | |
| М | 0° 10° | | | |
| S | 2 50 | 3.00 | | |

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*





XXX = Specific Device Code XXX = Specific Device Code

= Assembly Location = Date Code = Year = Pb-Free Package

= Work Week W

= 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.

| DOCUMENT NUMBER: | 98ARB18753C | Electronic versions are uncontrolled except when accessed directly from Printed versions are uncontrolled except when stamped "CONTROLLED" | |
|------------------|-------------|--|-------------|
| DESCRIPTION: | TSOP-5 | | PAGE 1 OF 1 |

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

DATE 16 FEB 2011



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER
- ANSI Y14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE
- 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.
- 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| | MILLIMETERS | | INC | HES |
|-----|-------------|------|-----------|-------|
| DIM | MIN | MAX | MIN | MAX |
| Α | 4.80 | 5.00 | 0.189 | 0.197 |
| В | 3.80 | 4.00 | 0.150 | 0.157 |
| С | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| Н | 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 |
| М | 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*



XXXXX = Specific Device Code = Assembly Location = Wafer Lot = Year = Work Week W

= Pb-Free Package

XXXXXX XXXXXX AYWW AYWW Ŧ \mathbb{H} Discrete **Discrete** (Pb-Free)

XXXXXX = Specific Device Code = Assembly Location Α = 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.

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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

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

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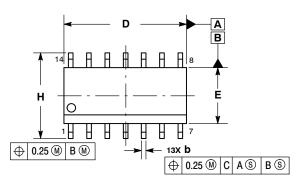




△ 0.10

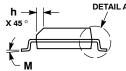
SOIC-14 NB CASE 751A-03 ISSUE L

DATE 03 FEB 2016









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

| | MILLIN | IETERS | INC | HES |
|-----|--------|--------|-----------|-------|
| DIM | MIN | MAX | MIN | MAX |
| Α | 1.35 | 1.75 | 0.054 | 0.068 |
| A1 | 0.10 | 0.25 | 0.004 | 0.010 |
| АЗ | 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 |
| Е | 3.80 | 4.00 | 0.150 | 0.157 |
| е | 1.27 | BSC | 0.050 BSC | |
| Н | 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° |

GENERIC MARKING DIAGRAM*

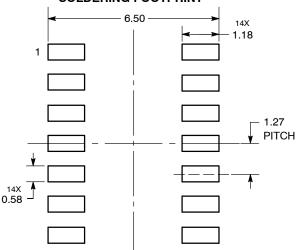


XXXXX = Specific Device Code Α = Assembly Location

WL = Wafer Lot Υ = 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.

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

C SEATING PLANE

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

SOIC-14 CASE 751A-03 ISSUE L

DATE 03 FEB 2016

| STYLE 1: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. NO CONNECTION 5. ANODE/CATHODE 6. NO CONNECTION 7. ANODE/CATHODE 8. ANODE/CATHODE 9. ANODE/CATHODE 10. NO CONNECTION 11. ANODE/CATHODE 12. ANODE/CATHODE 13. NO CONNECTION 14. COMMON ANODE | STYLE 2: CANCELLED | STYLE 3: PIN 1. NO CONNECTION 2. ANODE 3. ANODE 4. NO CONNECTION 5. ANODE 6. NO CONNECTION 7. ANODE 8. ANODE 9. ANODE 10. NO CONNECTION 11. ANODE 12. ANODE 13. NO CONNECTION 14. COMMON CATHODE | STYLE 4: PIN 1. NO CONNECTION 2. CATHODE 3. CATHODE 4. NO CONNECTION 5. CATHODE 6. NO CONNECTION 7. CATHODE 8. CATHODE 9. CATHODE 10. NO CONNECTION 11. CATHODE 12. CATHODE 13. NO CONNECTION 14. COMMON ANODE |
|---|---|---|---|
| STYLE 5: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. ANODE/CATHODE 5. ANODE/CATHODE 6. NO CONNECTION 7. COMMON ANODE 8. COMMON CATHODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. ANODE/CATHODE 12. ANODE/CATHODE 13. NO CONNECTION 14. COMMON ANODE | STYLE 6: PIN 1. CATHODE 2. CATHODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE 7. CATHODE 8. ANODE 9. ANODE 10. ANODE 11. ANODE 12. ANODE 13. ANODE 14. ANODE | STYLE 7: PIN 1. ANODE/CATHODE 2. COMMON ANODE 3. COMMON CATHODE 4. ANODE/CATHODE 5. ANODE/CATHODE 6. ANODE/CATHODE 7. ANODE/CATHODE 8. ANODE/CATHODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. COMMON CATHODE 12. COMMON ANODE 13. ANODE/CATHODE 14. ANODE/CATHODE | STYLE 8: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. NO CONNECTION 5. ANODE/CATHODE 6. ANODE/CATHODE 7. COMMON ANODE 8. COMMON ANODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. NO CONNECTION 12. ANODE/CATHODE 13. ANODE/CATHODE 14. COMMON CATHODE |

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Micro8 CASE 846A-02 ISSUE K

DATE 16 JUL 2020









NOTES:

- 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
- CONTROLLING DIMENSION: MILLIMETERS
- DIMENSION 6 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER SIDE. DIMENSION E DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 mm PER SIDE. DIMENSIONS D AND E ARE DETERMINED AT DATUM F.
- DATUMS A AND B ARE TO BE DETERMINED AT DATUM F.
- A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.



MOUNTING FOOTPRINT

| DIM | MI | LLIMETE | RS | |
|-------|---------------|---------|------|--|
| ויונע | MIN. | N□M. | MAX. | |
| Α | - | - | 1.10 | |
| A1 | 0.05 | 0.08 | 0.15 | |
| b | 0.25 | 0.33 | 0.40 | |
| c | 0.13 | 0.18 | 0.23 | |
| D | 2.90 | 3.00 | 3.10 | |
| E | 2.90 | 3.00 | 3.10 | |
| е | 0.65 BSC | | | |
| HE | 4.75 4.90 5.0 | | | |
| L | 0.40 | 0.55 | 0.70 | |

GENERIC MARKING DIAGRAM*



XXXX = Specific Device Code Α = Assembly Location

Υ = Year W = Work Week = 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. Some products may not follow the Generic Marking.

| STYLE 1: | STYLE 2: | STYLE 3: |
|--------------------------|-----------------|----------------------------|
| PIN 1. SOURCE | PIN 1. SOURCE 1 | PIN 1. N-SOURCE |
| SOURCE | 2. GATE 1 | 2. N-GATE |
| SOURCE | 3. SOURCE 2 | P-SOURCE |
| GATE | 4. GATE 2 | 4. P-GATE |
| DRAIN | 5. DRAIN 2 | 5. P-DRAIN |
| DRAIN | 6. DRAIN 2 | 6. P-DRAIN |
| 7. DRAIN | 7. DRAIN 1 | 7. N-DRAIN |
| 8. DRAIN | 8. DRAIN 1 | 8. N-DRAIN |
| | | |

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DATE 17 FEB 2016

- 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.
 DIMENSION B DOES NOT INCLUDE
- INTERLEAD FLASH OR PROTRUSION.
 INTERLEAD FLASH OR PROTRUSION SHALL
- INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE. 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. TERMINAL NUMBERS ARE SHOWN FOR DEEEDERING ONLY
- REFERENCE ONLY.
 DIMENSION A AND B ARE TO BE
- DETERMINED AT DATUM PLANE -W-.

| | MILLIMETERS | | INC | HES |
|-----|-------------|------|-----------|-------|
| DIM | MIN | MAX | MIN | MAX |
| Α | 4.90 | 5.10 | 0.193 | 0.200 |
| В | 4.30 | 4.50 | 0.169 | 0.177 |
| С | | 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 | |
| Н | 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 | |
| М | o° | 8 ° | 0 ° | 8 ° |

GENERIC MARKING DIAGRAM*



= Assembly Location

= Wafer Lot Υ = Year

= Work Week W

= 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. Some products may not follow the Generic Marking.

| DETAIL E 0.15 (0.006) T U S -V- O.10 (0.004) -T- SEATING PLANE DETAIL E DETAIL E DETAIL E DETAIL E | 4. [1 5. [6. 7 7. [|
|--|---|
| SOLDERING FOOTPRINT 7.06 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | A L Y V |

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DIMENSIONS: MILLIMETERS

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14X

1.26

-T- SEATING

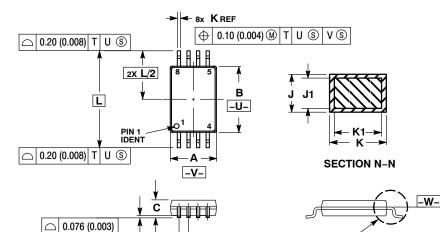
D

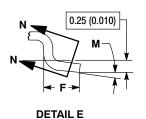




TSSOP-8 CASE 948S **ISSUE C**

DATE 20 JUN 2008





DETAIL E

- IOTES:

 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.
 DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
 TERMINAL NUMBERS ARE SHOWN FOR
- REFERENCE ONLY.
 DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| DIM | MIN | MAX | MIN | MAX |
| Α | 2.90 | 3.10 | 0.114 | 0.122 |
| В | 4.30 | 4.50 | 0.169 | 0.177 |
| C | | 1.10 | | 0.043 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.70 | 0.020 | 0.028 |
| G | 0.65 | BSC | 0.026 BSC | |
| 7 | 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° |

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code = Assembly Location Α

= 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.

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