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 $V_S = 2.7 V$
- 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 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



SOIC-14 NB CASE 751A

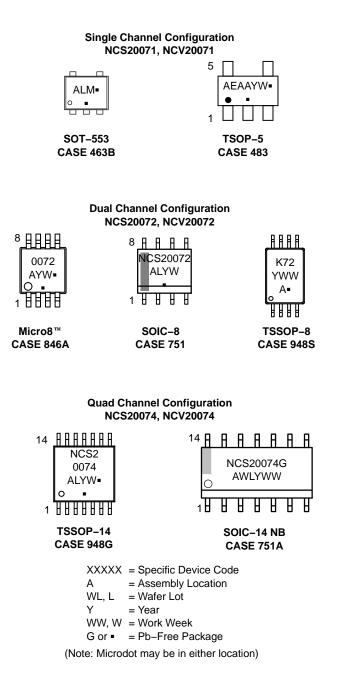
DEVICE MARKING INFORMATION

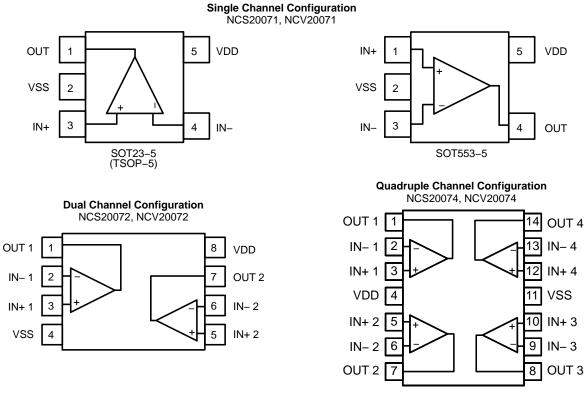
See general marking information in the device marking section on page 2 of this data sheet.

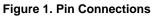
ORDERING INFORMATION

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

MARKING DIAGRAMS







ORDERING INFORMATION

Device	Configuration	Automotive	Marking	Package	Shipping [†]
NCS20071SN2T1G			AEA	TSOP-5 (Pb-Free)	3000 / Tape and Reel
NCS20071XV53T2G	Obsela	No	AL	SOT553–5 (Pb–Free)	4000 / Tape and Reel
NCV20071SN2T1G*	- Single	No. 5	AEA	TSOP-5 (Pb-Free)	3000 / Tape and Reel
NCV20071XV53T2G*		Yes	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	Durk		K72	TSSOP-8 (Pb-Free)	2500 / Tape and Reel
NCV20072DMR2G*	— Dual	Yes	0072	Micro8 (MSOP8) (Pb–Free)	4000 / Tape and Reel
NCV20072DR2G*			NCS20072	SOIC-8 (Pb-Free)	2500 / Tape and Reel
NCV20072DTBR2G*			K72	TSSOP-8 (Pb-Free)	2500 / Tape and Reel
NCS20074DR2G		Ne	NCS20074	SOIC-14 (Pb-Free)	2500 / Tape and Reel
NCS20074DTBR2G	Quad	No	NCS2 0074	TSSOP-14 (Pb-Free)	2500 / Tape and Reel
NCV20074DR2G*	Quad	No. 1	NCS20074	SOIC-14 (Pb-Free)	2500 / Tape and Reel
NCV20074DTBR2G*	7	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)	te 2) V _{ID} ±V _s		V
Maximum Input Current		I _{IN}	±10	mA
Maximum Output Current (Note 3)	Ι _Ο	±100	mA
Continuous Total Power Dis	ssipation (Note 4)	PD	200 m	
Maximum Junction Temper	ature	TJ	150	°C
Storage Temperature Rang	le	T _{STG}	-65 to 150	°C
Mounting Temperature (Infr	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 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	θ_{JA}	SOIC-8	190	131	°C/W
		TSSOP-8	253	194	
		SOIC-14	142	101	
		TSSOP-14	179	128	

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}		Vs	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 $V_S = 2.7 V$

 $T_A = 25^{\circ}C$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT}$ = 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 11, 12)

Parameter	Symbol	C	onditions	Min	Тур	Max	Unit
INPUT CHARACTERISTICS							
			NCv20071		1.3	±3.5	
Innut Offeet Veltere	N	ľ	NCx20071			±4.5	mV
Input Offset Voltage	V _{OS}		072, NCx20074		1.3	±3	IIIV
		NCX20	072, NCX20074			±4	1
Offset Voltage Drift	$\Delta V_{OS} / \Delta T$	$T_A = 25^{\circ}C$ to $125^{\circ}C$			2		μV/°C
Input Bias Current (Note 12)	lus –				5	200	nA
input bias Current (Note 12)	Ι _{IB}					1500	рА
		NCx20071, NCx20072			2	75	
	I _{OS} —					500	n A
Input Offset Current (Note 12)		NCx20074			2	75	рА
						200	
Channel Separation	XTLK	DC	NCx20072		100		dB
Channel Separation	AILK	DC	NCx20074		115		uв
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	V_{CM} = V_{SS} + 0.2 V to V_{DD} – 1.35 V		90	110		dD
ommon Mode Rejection Ratio	CIVIKK			69			dB

OUTPUT CHARACTERISTICS

Open Loop Voltage Gain	A		96	118		dB
Open Loop Voltage Gain	A _{VOL}		86			uВ
Output Current Capability (Note 13)		Op amp sinking current		70		
	I _O	Op amp sourcing current		50		mA
Output) (oltogo ligh	V	Voltage output output from positive roll		0.006	0.15	V
Output Voltage High	V _{ОН}	Voltage output swing from positive rail			0.22	v
	M	Voltage output output from pagetive roll		0.005	0.15	V
Output Voltage Low	V _{OL}	Voltage output swing 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 pF, R_L = 2 k Ω		2.8	V/μs
Phase Margin	φm	C _L = 25 pF		50	0
Gain Margin	A _m	C _L = 25 pF		14	dB
Cottling Time		V _O = 1 Vpp,	Settling time to 0.1%	0.6	
Settling Time	t _S	$V_O = 1 Vpp,$ Gain = 1, C _L = 20 pF	Settling time to 0.01%	1.2	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.

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.

ELECTRICAL CHARACTERISTICS AT V_S = 2.7 V

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

Parameter	Symbol	Conditions	Min	Тур	Max	Unit
NOISE CHARACTERISTICS						
Total Harmonic Distortion plus Noise	THD+N	$V_{IN} = 0.5 \text{ Vpp}, \text{ f} = 1 \text{ kHz}, \text{ Av} = 1$		0.05		%
han at Data and Malta an Alaba		f = 1 kHz		30		nV/√ Hz
Input Referred Voltage Noise	e _n	f = 10 kHz		20		
Input Referred Current Noise	i _n	f = 1 kHz		90		fA/√Hz
SUPPLY CHARACTERISTICS						

SUPPLY CHARACTERISTICS

Power Supply Rejection Ratio	PSRR	No L	ood	114	135		dB
	FORK		Juan	100			uВ
		NCx20071	No load		420	625	
			NO IOAU			765	
Power Supply Quiescent Current	IDD	NCv20072 NCv20074	Der channel no lood		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

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

Parameter	Symbol	Conditions		Min	Тур	Max	Unit
INPUT CHARACTERISTICS							
			10-00074		1.3	±3.5	
land Offerst Vielterer		NCx20071				±4.5	
Input Offset Voltage	Vos	NO	070 NO.00074		1.3	±3	mV
		NCx20072, NCx20074				±4	
Offset Voltage Drift	$\Delta V_{OS} / \Delta T$	$T_A = 2$	25°C to 125 °C		2		μV/°C
Innut Ding Current (Nate 45)					5	200	- 0
Input Bias Current (Note 15)	I _{IB}					1500	рА
		NCx20071, NCx20072			2	75	рА
land offerst Oursest (Nate 15)						500	
Input Offset Current (Note 15)	los				2	75	
		r	VCx20074			200	1
	VTLK	50	NCx20072		100		10
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.

ELECTRICAL CHARACTERISTICS AT $V_S = 5 V$

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

Parameter	Symbol	Cond	litions	Min	Тур	Max	Unit
INPUT CHARACTERISTICS							
				102	125		
Common Mode Rejection Ratio	CMRR	$V_{CM} = V_{SS} + 0.2$	V to V _{DD} – 1.35 V	80			dB
OUTPUT CHARACTERISTICS						-	-
Onen Leen Valtere Coin	•			96	120		٦D
Open Loop Voltage Gain	A _{VOL}			86			dB
Output Current Conshility (Note 16)	1	Op amp sin	king current		50		
Output Current Capability (Note 16)	lo	Op amp sou	rcing current		60		mA
Output Voltage High	Maria	Voltago output out	na from positivo roil		0.013	0.20	v
Output Voltage High	V _{OH}	voltage output swil	ng from positive rail			0.25	V
Output Voltage Low	V.		ng from negative rail		0.01	0.10	v
Oulput voltage Low	V _{OL}	voltage output swir	ig nom 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 pF	$R_L = 2 k\Omega$		2.7		V/μs
Phase Margin	ϕ_{m}	C _L =	25 pF		50		0
Gain Margin	A _m	C _L =	25 pF		14		dB
Settling Time	+	V _O = 3 Vpp,	Settling time to 0.1%		1.2		
Setting Time	t _S	Gain = 1, C_L = 20 pF	Settling time to 0.01%		5.6		μs
NOISE CHARACTERISTICS							
Total Harmonic Distortion plus Noise	THD+N	V _{IN} = 2.5 Vpp, f	ⁱ = 1 kHz, Av = 1		0.009		%
Input Referred Voltage Noise		f = 1	kHz		30		nV/√Hz
input Referred voltage Noise	e _n	f = 10	0 kHz		20		
Input Referred Current Noise	i _n	f = 1	kHz		90		fA/√Hz
SUPPLY CHARACTERISTICS							
Dowor Supply Poinction Potic	PSRR	No	Load	114	135		dB
Power Supply Rejection Ratio	PORK		Luau	100			uВ
		NCv20071	No load		430	635	
Power Supply Quiescont Current		NCx20071	100 1080			775	
Power Supply Quiescent Current	I _{DD}				410	530	μA

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.

Per channel, no load

NCx20072, NCx20074

630

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.

ELECTRICAL CHARACTERISTICS AT $V_S = 10 V$

 $T_A = 25^{\circ}C$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT}$ = 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 17, 18)

Parameter	Symbol	C	onditions	Min	Тур	Max	Unit
INPUT CHARACTERISTICS							
Input Offeet Veltage	V	N	10,20071		1.3	±3.5	mV
Input Offset Voltage	V _{OS} NCx20071				±4.5	mV	
Input Offset Voltage	Vaa		072, NCx20074		1.3	±3	mV
input Onset voltage	V _{OS}	NCX20	072, NCX20074			±4	mV
Offset Voltage Drift	$\Delta V_{OS} / \Delta T$	$T_A = 25^{\circ}C$ to $125^{\circ}C$			2		μV/°C
Input Bias Current (Note 18)	l				5	200	pА
input bias current (Note 18)	I _{IB}	3				1500	рд
and Officer Coursest (Nate 40)		NCx20071, NCx20072			2	75	рА
						500	
Input Offset Current (Note 18)	los	NCx20074			2	75	
						200	
Channel Separation	XTLK	DC	NCx20072		100		dB
Channel Separation	AILK	DC	NCx20074		115		uБ
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
	01400			110	130		dB
Common Mode Rejection Ratio	CMRR	$v_{CM} = v_{SS} +$	$I = V_{SS} + 0.2 \text{ V to } V_{DD} - 1.35 \text{ V}$				uВ

OUTPUT CHARACTERISTICS

Open Loop Voltage Gain	٨		98	120		dB
Open Loop voltage Gain	A _{VOL}		88			uБ
Output Current Capability (Note 19)	1	Op amp sinking current		50		mA
Output Current Capability (Note 19)	IO	Op amp sourcing current		65		ША
Output Valtage Ligh	M	Voltage output output from positive roll		0.023	0.08	V
Output Voltage High	V _{OH}	Voltage output swing from positive rail			0.10	v
	M			0.022	0.3	V
Output Voltage Low	V _{OL}	Voltage output swing from negative rail			0.35	v

AC CHARACTERISTICS

Unity Gain Bandwidth	UGBW	C _L = 25 pF		3	MHz
Slew Rate at Unity Gain	SR	$C_L = 20 \text{ pF}, R_L = 2 \text{ k}\Omega$		2.6	V/μs
Phase Margin	φm	C _L = 25 pF		50	0
Gain Margin	A _m	C _L =	25 pF	14	dB
Cottling Time		V _O = 8.5 Vpp,	Settling time to 0.1%	3.4	
Settling Time	t _S	$V_O = 8.5 Vpp,$ Gain = 1, C _L = 20 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.

ELECTRICAL CHARACTERISTICS AT V_S = 10 V

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

Parameter	Symbol	Conditions		Тур	Max	Unit
NOISE CHARACTERISTICS						
Total Harmonic Distortion plus Noise	THD+N	V _{IN} = 7.5 Vpp, f = 1 kHz, Av = 1		0.004		%
Input Deferred Veltage Naise		f = 1 kHz		30		nV/√ Hz
Input Referred Voltage Noise	e _n	f = 10 kHz		20		
Input Referred Current Noise	i _n	f = 1 kHz		90		fA/√Hz
SUPPLY CHARACTERISTICS						

SUPPLY CHARACTERISTICS

Power Supply Rejection Ratio	PSRR	No.	and	114	135		dB
	FORK	No Load		100			uВ
		NCv20071	No load		430	645	
Devers Querch, Quieses et Quercet		NCx20071	INO IOAU			785	
Power Supply Quiescent Current	IDD	NCv20072 NCv20074	Den eksende en land		416	540	μΑ
		NCx20072, NCx20074	Per channel, no load			640	

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

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

Parameter	Symbol	C	onditions	Min	Тур	Max	Unit
INPUT CHARACTERISTICS							
			10.00074		1.3	±3.5	mV
Innut Offert Veltere	N	ľ	NCx20071			±4.5	mV
Input Offset Voltage	Vos	NCv20072 NCv20074			1.3	±3	mV
		NCX2U	NCx20072, NCx20074			±4	mV
Offset Voltage Drift	$\Delta V_{OS} / \Delta T$	$T_A =$	25°C to 125°C		2		μV/°C
					5	200	
Input Bias Current (Note 21)	I _{IB}	NCx20	071, NCx20072			2000	pА
		NCx20074				1500	
		NOute	074 NO:00070		2	75	
lanut Offerst Comment (Nister 24)		NCX2U	071, NCx20072			1000	- 0
Input Offset Current (Note 21)	l _{os}		10.00074		2	75	рА
		ľ	NCx20074			200	
	VTLK	DC NCx20072 NCx20074			100		JD
Channel Separation	XTLK				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.

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

Parameter	Symbol	Conditions		Min	Тур	Max	Unit
INPUT CHARACTERISTICS							
Differential Input Capacitance	C _{ID}				1.5		pF
Common Mode Input Capacitance	C _{CM}				3.5		pF
NCx20071 V _{CM} = V _{SS} + 0.2 V to V _{DD} - 1.35 V	118	135					
		NCX20071	V _{DD} – 1.35 V	95			
Common Made Dejection Datio	CMRR	NCx20072	$V_{CM} = V_{SS} + 0.2 \text{ V to}$	120	145		dB
Common Mode Rejection Ratio	CIVIRR	NCX20072	V _{DD} – 1.35 V	95			αв
		NCx20074	$V_{CM} = V_{SS} + 0.2 \text{ V to}$ $V_{DD} - 1.35 \text{ V}$	120	145		
		NGX20074	V _{DD} – 1.35 V	85			

OUTPUT CHARACTERISTICS

	٨			98	120		dB
Open Loop Voltage Gain	A _{VOL}			88			uБ
Output Current Capability (Note 22)	1	Op amp sir	king current		50		m۸
Supur Current Capability (Note 22)	Ι _Ο	Op amp sourcing current			65		mA
		Voltage output swing from positive rail	NCx20071		0.074	0.15	
						0.22	
Output Valtage Ligh			NCx20072		0.074	0.10	N
Output Voltage High	V _{OH}					0.15	V
			NC::00074		0.074	0.10	
		NCx20074				0.12	
	M	Voltage output swing from negative rail			0.065	0.3	V
Output Voltage Low	V _{OL}	voltage output swif	ig nom negative fall			0.35	v

AC CHARACTERISTICS

Unity Gain Bandwidth	UGBW	C _L = 25 pF		3	MHz
Slew Rate at Unity Gain	SR	$C_L = 20 \text{ pF}, R_L = 2 \text{ k}\Omega$		2.4	V/μs
Phase Margin	φm	C _L = 25 pF		50	0
Gain Margin	A _m	C _L =	25 pF	14	dB
Cottling Time		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 0.1% 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 Referred Voltage Noise	<u>^</u>	f = 1 kHz	30	nV/√ Hz
Input Referred Voltage Noise	e _n	f = 10 kHz	20	
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.

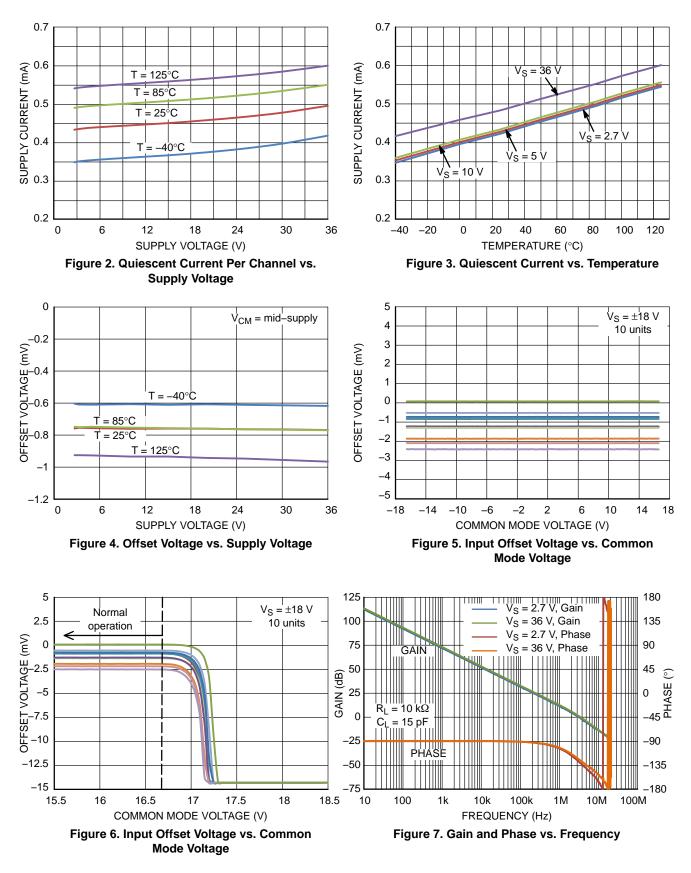
ELECTRICAL CHARACTERISTICS AT V_S = 36 V $T_A = 25^{\circ}C$; $R_L \ge 10 \text{ k}\Omega$; $V_{CM} = V_{OUT} = \text{mid-supply unless otherwise noted}$. All limits are guaranteed by testing or statistical analysis. Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}C$ to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

Parameter	Symbol	Conditions		Min	Тур	Max	Unit
SUPPLY CHARACTERISTICS							
Dower Supply Dejection Datio	PSRR	No.Lond		114	135		dB
Power Supply Rejection Ratio	PORK	INO	No Load				uБ
NO 00074			480	700			
		NCx20071	No load			840	
Device Complex Outlease at Compart		NCx20072	Der ekennel ne leed		465	570	
Power Supply Quiescent Current	I _{DD}	NCX20072	Per channel, no load			700	μΑ
		NO:00074	Der ekennel ne leed		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.



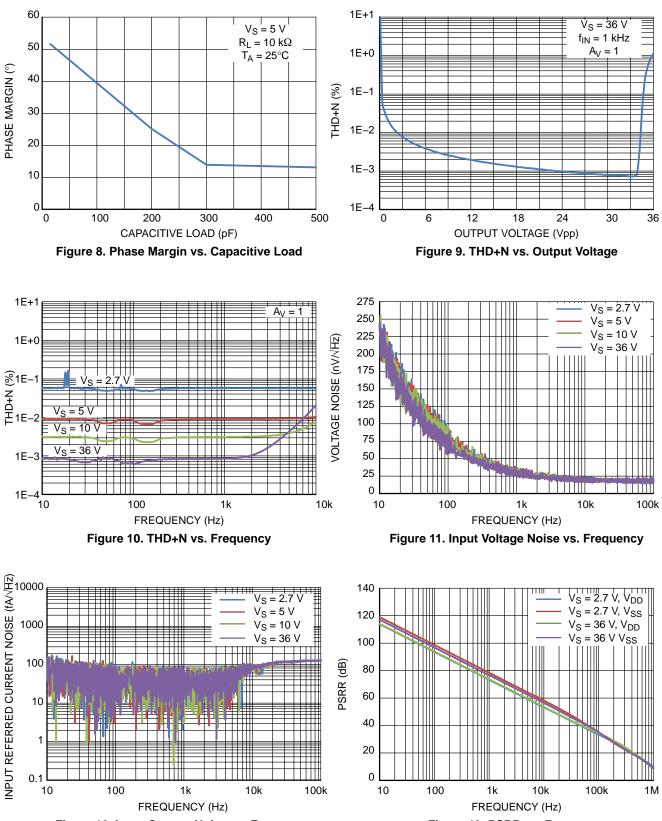
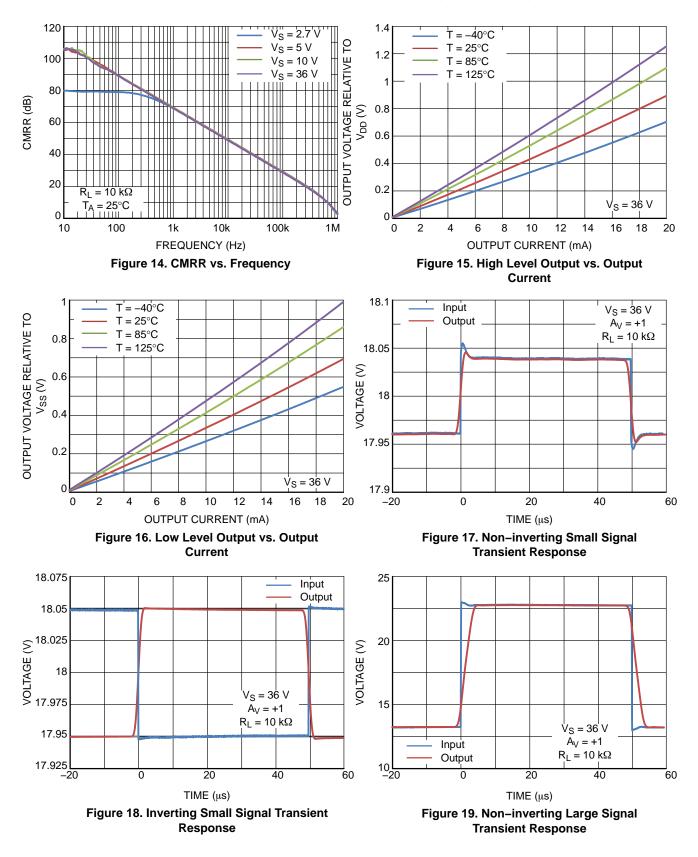
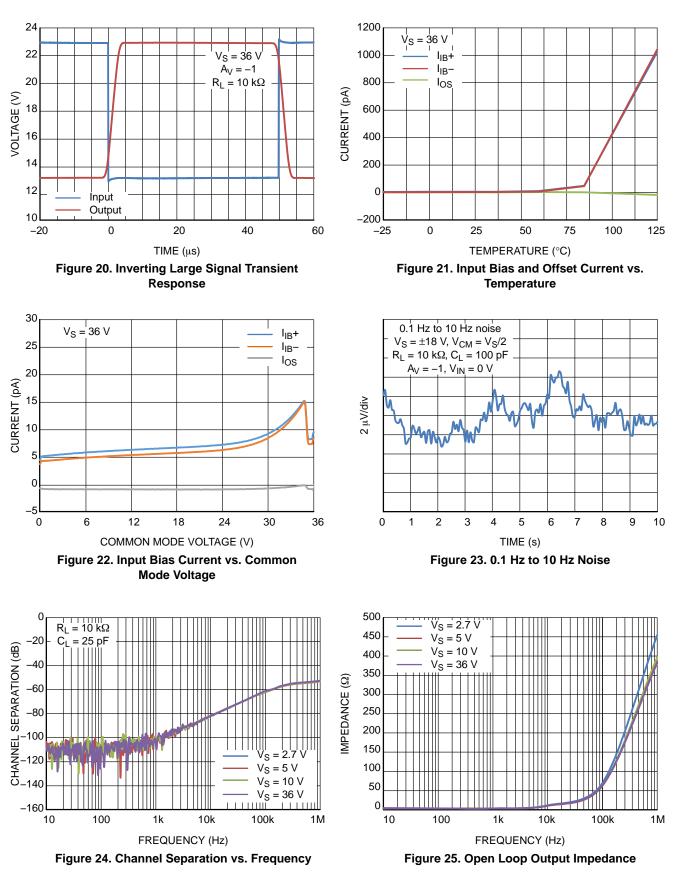


Figure 12. Input Current Noise vs. Frequency

Figure 13. PSRR vs. Frequency





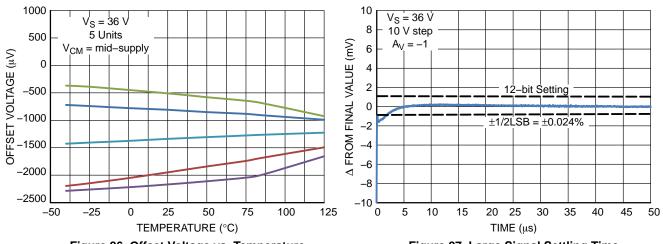
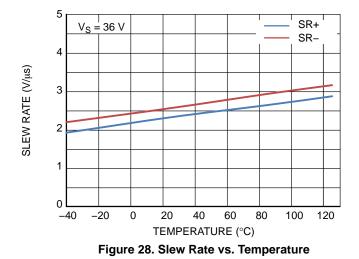


Figure 26. Offset Voltage vs. Temperature

Figure 27. Large Signal Settling Time



<u>www.onsemi.com</u> 17

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.

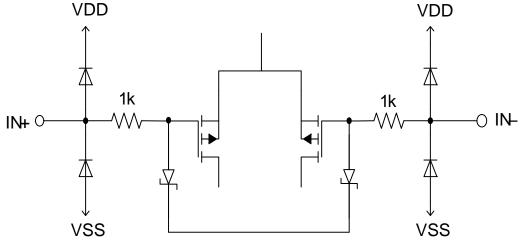


Figure 29. Differential Input Pair

Output

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

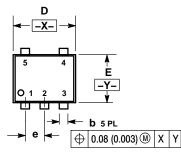
High output currents can cause the junction temperature to exceed the 150°C absolute maximum rating. In the case of a short circuit where the output is connected to either supply rail, the amount of current the op amp can source and sink is described by the output current capability parameter listed in the Electrical Characteristics. The junction temperature at a given power dissipation, P, can be calculated using the following formula:

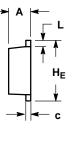
 $T_J = T_A + P \ x \ \theta_{JA}$

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

PACKAGE DIMENSIONS

SOT-553, 5 LEAD CASE 463B ISSUE C

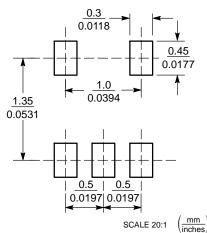




NOTES: 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. 2. CONTROLLING DIMENSION: MILLIMETERS 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL. INCHES

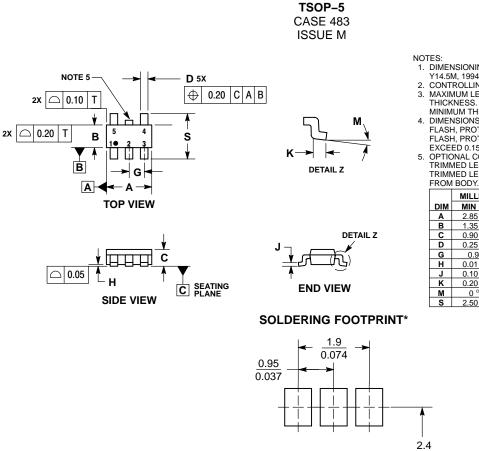
	м	MILLIMETERS			INCHES			
DIM	MIN	NOM	MAX	MIN	NOM	MAX		
Α	0.50	0.55	0.60	0.020	0.022	0.024		
b	0.17	0.22	0.27	0.007	0.009	0.011		
С	0.08	0.13	0.18	0.003	0.005	0.007		
D	1.55	1.60	1.65	0.061	0.063	0.065		
Е	1.15	1.20	1.25	0.045	0.047	0.049		
е	0.50 BSC				0.020 BSC)		
L	0.10	0.20	0.30	0.004	0.008	0.012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

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



1.0 0.039 1

1. DIMENSIONING AND TOLERANCING PER ASME

- Y14.5M, 1994. 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
- DIMENSIONS A AND & 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 IN TO EXTEND MODE THAN 6.2
- TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2

	MILLIN	IETERS				
DIM	MIN	MAX				
Α	2.85	3.15				
В	1.35	1.65				
С	0.90	1.10				
D	0.25	0.50				
G	0.95	BSC				
н	0.01	0.10				
J	0.10	0.26				
к	0.20	0.60				
м	0 °	10 °				
S	2.50	3.00				

0.094

SCALE 10:1

 $\left(\frac{mm}{inches}\right)$

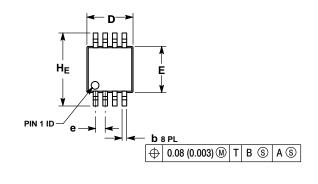
*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

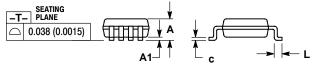
0.7

0.028

PACKAGE DIMENSIONS

Micro8[™] CASE 846A-02 **ISSUE J**





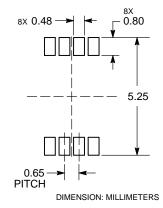
NOTES: 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

1. 2.

- 2. CONTROLLING DIMENSION: MILLIMETER. 3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE
- DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS ON GATE BURRS. MOLD FLASH, PROTRUSIONS 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.
 846A-01 OBSOLETE, NEW STANDARD 846A-02.

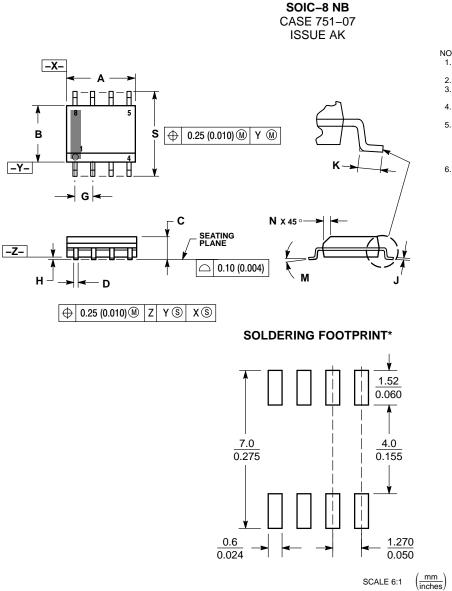
	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
Α	1		1.10			0.043
A1	0.05	0.08	0.15	0.002	0.003	0.006
b	0.25	0.33	0.40	0.010	0.013	0.016
С	0.13	0.18	0.23	0.005	0.007	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
Е	2.90	3.00	3.10	0.114	0.118	0.122
е	0.65 BSC			0.026 BSC		
L	0.40	0.55	0.70	0.016	0.021	0.028
HE	4.75	4.90	5.05	0.187	0.193	0.199

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



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

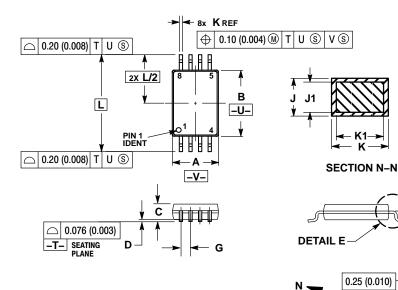
NOTES:

- NOTES:
 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
 DIMENSION A AND B DO NOT INCLUDE MOLEON DEOTRICON
- MOLD PROTRUSION. MAXIMUM MOLD PROTRUSION 0.15 (0.006)
- PER SIDE.
- 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.

	MILLIN	IETERS	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	7 BSC	0.05	0 BSC
н	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
ĸ	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

PACKAGE DIMENSIONS





-W-

N

F DETAIL E

Ν

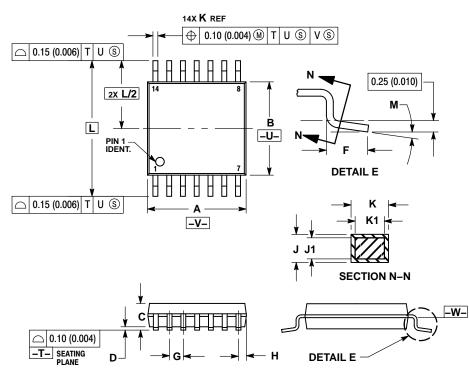
- NOTES: 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. 2. CONTROLLING DIMENSION: MILLIMETER. 3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH. OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
- UNENSION B DOES NOT INCLUDE INTERLEAD
 FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010)
- PER SIDE. 5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY. 6. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

	MILLIN	IETERS	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		
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	0°	8°	0°	8 °	

www.onsemi.com

PACKAGE DIMENSIONS

TSSOP-14 CASE 948G ISSUE C

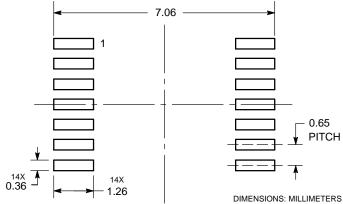


NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
- CONTROLLING DIMENSION: MILLIMETER.
 DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT DUCTOR DATE DOWN TO A DOWNT TO A DOWN TO A
- 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.
- 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.
- DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIN	IETERS	INCHES		
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	
κ	0.19	0.30	0.007	0.012	
K1	0.19	0.25	0.007	0.010	
L	6.40 BSC		0.252 BSC		
Μ	0 °	8 °	0 °	8 °	

SOLDERING FOOTPRINT*



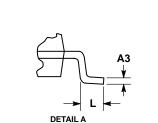
*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

SOIC-14 NB CASE 751A-03 **ISSUE L**

h

м

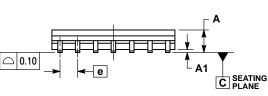


NOTES:

DETAIL A

- 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.

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	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	
Ε	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	
М	0 °	7 °	0 °	7 °	



D

Н

С

BM

⊕ 0.25 M

Δ

В

F

0.25 M C A S B S

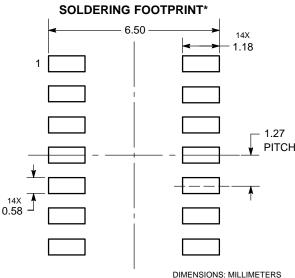
Н

Н

 \oplus

7 13X b

Н



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

ON Semiconductor and ware trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typical" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT

Literature Distribution Center for ON Semiconductor 19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free USA/Canada Europe, Middle East and Africa Technical Support:

Phone: 421 33 790 2910 Japan Customer Focus Center Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative