NCS20071, NCS20072, NCS20074

Rail-to-Rail Output, 3 MHz BW Operational Amplifier

The NCS2007 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 NCS2007 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 2.1 V/μs while only consuming 405 μA of quiescent current per channel. The wide supply range allows the NCS2007 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 NCS2007 devices are available in a variety of compact packages.

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/μs typical at V_S = 2.7 V
- Low Supply Current: 405 μA 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

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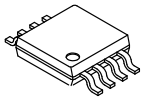
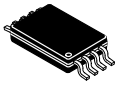
SOT−553
CASE 463B

TSOP−5
CASE 483

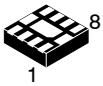


Micro8™
CASE 846AH

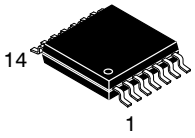
SOIC−8
CASE 751



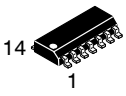
TSSOP−8
CASE 948S



UDFN8
CASE 517AC



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.

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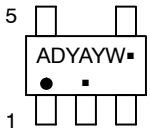
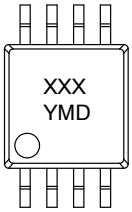
Single Channel Configuration
NCS20071, NCV20071

SOT−553
CASE 463B

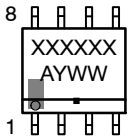


TSOP−5
CASE 483

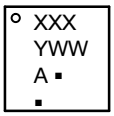
Dual Channel Configuration
NCS20072, NCV20072



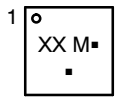
Micro8™
CASE 846AH



SOIC−8
CASE 751

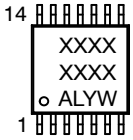


TSSOP−8
CASE 948S

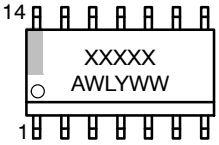


UDFN8
CASE 517AC

Quad Channel Configuration
NCS20074, NCV20074



TSSOP−14
CASE 948G

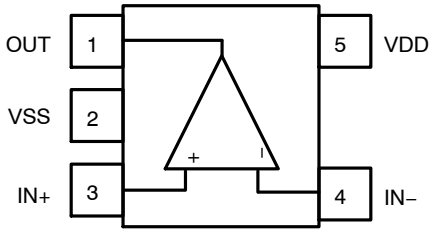


SOIC−14 NB
CASE 751A

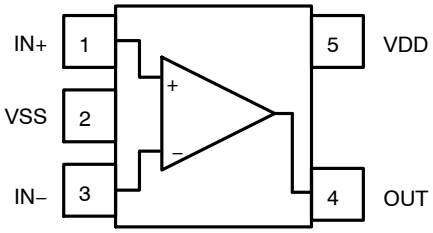
X = Specific Device Code
A, R = Assembly Location
Y = Year
WW, W = Work Week
G or ▪ = Pb−Free Package

Figure 1. Marking Diagrams

Single Channel Configuration
NCS20071, NCV20071

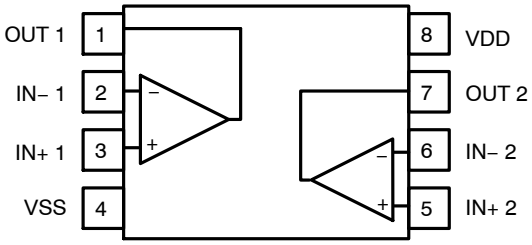


SOT23−5
(TSOP−5)



SOT553−5

Dual Channel Configuration
NCS20072, NCV20072



Quadruple Channel Configuration
NCS20074, NCV20074

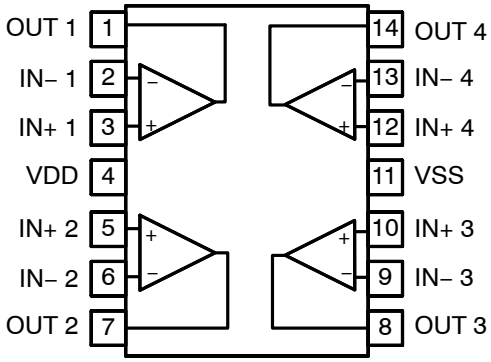


Figure 2. Pin Connections

ORDERING INFORMATION

Device	Configuration	Automotive	Marking	Package	Shipping†
NCS20071SN2T1G*	Single	No	*	SOT23−5 (TSOP−5) (Pb−Free)	3000 / Tape and Reel
NCS20071*			*	SOT553−5 (Pb−Free)	4000 / Tape and Reel
NCV20071SN2T1G*		Yes	*	SOT23−5 (TSOP−5) (Pb−Free)	3000 / Tape and Reel
NCV20071*			*	SOT553−5 (Pb−Free)	4000 / Tape and Reel
NCS20072DMR2G*	Dual	No	*	Micro8 (MSOP8) (Pb−Free)	4000 / Tape and Reel
NCS20072DR2G*			*	SOIC−8 (Pb−Free)	2500 / Tape and Reel
NCS20072DTBR2G*			*	TSSOP−8 (Pb−Free)	3000 / Tape and Reel
NCS20072*			*	UDFN8 (Pb−Free)	3000 / Tape and Reel
NCV20072DMR2G*		Yes	*	Micro8 (MSOP8) (Pb−Free)	4000 / Tape and Reel
NCV20072DR2G*			*	SOIC−8 (Pb−Free)	2500 / Tape and Reel
NCV20072DTBR2G*			*	TSSOP−8 (Pb−Free)	3000 / Tape and Reel
NCV20072*			*	UDFN8 (Pb−Free)	3000 / Tape and Reel
NCS20074DR2G	Quad	No	NCS20074	SOIC−14 (Pb−Free)	3000 / Tape and Reel
NCS20074DTBR2G			NCS2 0074	TSSOP−14 (Pb−Free)	2500 / Tape and Reel
NCV20074DR2G		Yes	NCS20074	SOIC−14 (Pb−Free)	3000 / Tape and Reel
NCV20074DTBR2G			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.
*Contact local sales office for more information

ABSOLUTE MAXIMUM RATINGS (Note 1)

Rating	Symbol	Limit	Unit
Supply Voltage (V_{DD} – V_{SS}) (Note 2)	V_S	40	V
Input Voltage	V_I	V_{SS} – 0.2 to V_{DD} + 0.2	V
Differential Input Voltage	V_{ID}	$\pm V_s$	V
Maximum Input Current	I_I	±10	mA
Maximum Output Current	I_O	±100	mA
Continuous Total Power Dissipation (Note 2)	P_D	200	mW
Maximum Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{STG}	−65 to 150	°C
Mounting Temperature (Infrared or Convection – 20 sec)	T_{mount}	260	°C
ESD Capability (Note 3) Human Body Model Machine Model Charged Device Model	ESD_{HBM} ESD_{MM} ESD_{CDM}	2000 150 1000 (C6)	V
Latch−Up Current (Note 3)	I_{LU}	100	mA
Moisture Sensitivity Level (Note 3)	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. 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.
3. This device series incorporates ESD protection and is tested by the following methods:
   ESD Human Body Model tested per ANSI/ANSI/ESDA/JEDEC JS-001−2010 (AEC−Q100−002)
   ESD Machine Model tested per JESD22−A115 (AEC−Q100−003)
   ESD Charged Device Model tested per ANSI/ESD S5.3.1−2009 (AEC−Q100−011)
4. Latch−up Current tested per JEDEC standard: JESD78 (AEC−Q100−004)
5. Moisture Sensitivity Level tested per IPC/JEDEC standard: J−STD−020A

THERMAL INFORMATION

Parameter	Symbol	Package	Value	Unit
Junction−to−Ambient	θ_{JA}	SOT23−5/ TSOP5	235	°C/W
		SOT553−5	250	
		Micro8/MSOP8	238	
		SOIC−8	190	
		TSSOP−8	140	
		UDFN−8	350	
		SOIC−14	156	
		TSSOP−14	190	

OPERATING RANGES

Parameter	Symbol	Min	Max	Unit
Operating Supply Voltage	V_S	2.7	36	V
Differential Input Voltage	V_{ID}		V_S	V
Input Common Mode Range	V_{ICM}	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.

ELECTRICAL CHARACTERISTICS AT V_S = 2.7 V

T_A = 25°C; $R_L \geq 10$ kΩ; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 6, 7)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}			1.3	±3	mV
					±4	mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	T_A = 25°C to 125°C		2		μV/°C
Input Bias Current	I_{IB}	Note 7		5	200	pA
					1500	pA
Input Offset Current	I_{OS}	Note 7		2	75	pA
					175	pA
Channel Separation	XTLK	DC		115		dB
Differential Input Resistance	R_{ID}			50		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} = 0 V to V_{DD} − 1.35 V	90	110		dB
			69			
OUTPUT CHARACTERISTICS						
Open Loop Voltage Gain	A_{VOL}		96	118		dB
			86			
Output Current Capability	I_O	Op amp sinking current		70		mA
		Op amp sourcing current		50		
Output Voltage High	V_{OH}	Voltage output swing from positive rail		0.006	0.15	V
					0.22	
Output Voltage Low	V_{OL}	Voltage output swing from negative rail		0.005	0.15	V
					0.22	
AC CHARACTERISTICS						
Unity Gain Bandwidth	UGBW	C_L = 25 pF		3		MHz
Slew Rate at Unity Gain	SR	C_L = 20 pF		2.8		V/μs
Phase Margin	φ_m	C_L = 25 pF		50		°
Gain Margin	A_m	C_L = 25 pF		14		dB
Settling Time	t_S	V_O = 1 Vpp, Gain = 1, C_L = 20 pF; Settling time to 0.1%		0.6		μs
		Settling time to 0.01%		1.2		
NOISE CHARACTERISTICS						
Total Harmonic Distortion plus Noise	THD+N	V_{IN} = 0.5 Vpp, f = 1 kHz, Av = 1		0.05		%
Input Referred Voltage Noise	e_n	f = 1 kHz		30		nV/√Hz
		f = 10 kHz		20		
Input Referred Current Noise	i_n	f = 1 kHz		0.25		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.

6. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
7. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

ELECTRICAL CHARACTERISTICS AT V_S = 2.7 V

T_A = 25°C; $R_L \geq 10\ k\Omega$; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 6, 7)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
SUPPLY CHARACTERISTICS						
Power Supply Rejection Ratio	PSRR	No Load	114	135		dB
			100			
Power Supply Quiescent Current	I_{DD}	Per channel, no load		405	525	μA
					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.
6. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
7. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

ELECTRICAL CHARACTERISTICS AT V_S = 5 V

T_A = 25°C; $R_L \geq 10\ k\Omega$; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 8, 9)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}			1.3	±3	mV
					±4	mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	T_A = 25°C to 125 °C		2		μV/°C
Input Bias Current	I_{IB}	Note 9		5	200	pA
					1500	**pA**
Input Offset Current	I_{OS}	Note 9		2	75	pA
					175	pA
Channel Separation	XTLK	DC		115		dB
Differential Input Resistance	R_{ID}			50		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} = 0 V to V_{DD} − 1.35 V	105	125		dB
			80			
OUTPUT CHARACTERISTICS						
Open Loop Voltage Gain	A_{VOL}		96	120		dB
			86			
Output Current Capability	I_O	Op amp sinking current		50		mA
		Op amp sourcing current		60		
Output Voltage High	V_{OH}	Voltage output swing from positive rail		0.013	0.20	V
					0.25	
Output Voltage Low	V_{OL}	Voltage output swing from negative rail		0.01	0.10	V
					0.15	

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.
8. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
9. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

ELECTRICAL CHARACTERISTICS AT V_S = 5 V

T_A = 25°C; $R_L \geq 10\ k\Omega$; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 8, 9)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
AC CHARACTERISTICS							
Unity Gain Bandwidth	UGBW	C_L = 25 pF			3.2		MHz
Slew Rate at Unity Gain	SR	C_L = 20 pF			2.7		V/μs
Phase Margin	φ_m	C_L = 25 pF			50		°
Gain Margin	A_m	C_L = 25 pF			14		dB
Settling Time	t_S	V_O = 3 Vpp, Gain = 1, C_L = 20 pF	Settling time to 0.1%		1.2		μs
			Settling time to 0.01%		5.6		
NOISE CHARACTERISTICS							
Total Harmonic Distortion plus Noise	THD+N	V_{IN} = 2.5 Vpp, f = 1 kHz, Av = 1			0.009		%
Input Referred Voltage Noise	e_n	f = 1 kHz			30		nV/√Hz
		f = 10 kHz			20		
Input Referred Current Noise	i_n	f = 1 kHz			0.25		fA/√Hz
SUPPLY CHARACTERISTICS							
Power Supply Rejection Ratio	PSRR	No Load		114	135		dB
				100			
Power Supply Quiescent Current	I_{DD}	Per channel, no load			410	530	μA
						630	

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.
8. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
9. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

ELECTRICAL CHARACTERISTICS AT V_S = 10 V

T_A = 25°C; $R_L \geq 10\ k\Omega$; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 10, 11)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}			1.3	±3	mV
					±4	**mV**
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	T_A = 25°C to 125°C		2		μV/°C
Input Bias Current	I_{IB}	Note 11		5	200	pA
					1500	**pA**
Input Offset Current	I_{OS}	Note 11		2	75	pA
					175	**pA**
Channel Separation	XTLK	DC		115		dB
Differential Input Resistance	R_{ID}			50		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.
10. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
11. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

ELECTRICAL CHARACTERISTICS AT V_S = 10 V

T_A = 25°C; $R_L \geq 10\ k\Omega$; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 10, 11)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Common Mode Rejection Ratio	CMRR	V_{CM} = 0 V to V_{DD} − 1.35 V	110	130		dB
			87			
OUTPUT CHARACTERISTICS						
Open Loop Voltage Gain	A_{VOL}		98	120		dB
			88			
Output Current Capability	I_O	Op amp sinking current		50		mA
		Op amp sourcing current		65		
Output Voltage High	V_{OH}	Voltage output swing from positive rail		0.023	0.08	V
					0.10	
Output Voltage Low	V_{OL}	Voltage output swing from negative rail		0.022	0.3	V
					0.35	
AC CHARACTERISTICS						
Unity Gain Bandwidth	UGBW	C_L = 25 pF		3.2		MHz
Slew Rate at Unity Gain	SR	C_L = 20 pF		2.2		V/μs
Phase Margin	φ_m	C_L = 25 pF		50		°
Gain Margin	A_m	C_L = 25 pF		14		dB
Settling Time	t_S	V_O = 8.5 Vpp, Gain = 1, C_L = 20 pF; Settling time to 0.1%		3.4		μs
		Settling time to 0.01%		6.8		
NOISE CHARACTERISTICS						
Total Harmonic Distortion plus Noise	THD+N	V_{IN} = 7.5 Vpp, f = 1 kHz, Av = 1		0.004		%
Input Referred Voltage Noise	e_n	f = 1 kHz		30		nV/√Hz
		f = 10 kHz		20		
Input Referred Current Noise	i_n	f = 1 kHz		0.25		fA/√Hz
SUPPLY CHARACTERISTICS						
Power Supply Rejection Ratio	PSRR	No Load	114	135		dB
			100			
Power Supply Quiescent Current	I_{DD}	Per channel, no load		416	540	μA
					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.

10. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
11. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

ELECTRICAL CHARACTERISTICS AT V_S = 36 V

T_A = 25°C; $R_L \geq 10$ kΩ; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 12, 13)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}			1.3	±3	mV
					±4	**mV**
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	T_A = 25°C to 125°C		2		μV/°C
Input Bias Current	I_{IB}	Note 13		5	200	pA
					1500	**pA**
Input Offset Current	I_{OS}	Note 13		2	75	pA
					175	**pA**
Channel Separation	XTLK	DC		115		dB
Differential Input Resistance	R_{ID}			50		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} = 0 V to V_{DD} − 1.35 V	120	145		dB
			95			
OUTPUT CHARACTERISTICS						
Open Loop Voltage Gain	A_{VOL}		98	120		dB
			88			
Output Current Capability	I_O	Op amp sinking current		50		mA
		Op amp sourcing current		65		
Output Voltage High	V_{OH}	Voltage output swing from positive rail		0.074	0.10	V
					0.12	
Output Voltage Low	V_{OL}	Voltage output swing from negative rail		0.065	0.3	V
					0.35	
AC CHARACTERISTICS						
Unity Gain Bandwidth	UGBW	C_L = 25 pF		3.2		MHz
Slew Rate at Unity Gain	SR	C_L = 20 pF		2.4		V/μs
Phase Margin	φ_m	C_L = 25 pF		50		°
Gain Margin	A_m	C_L = 25 pF		14		dB
Settling Time	t_S	V_O = 10 Vpp, Gain = 1, C_L = 20 pF; Settling time to 0.1%		3.2		μs
		V_O = 10 Vpp, Gain = 1, C_L = 20 pF; Settling time to 0.01%		6.8		
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	e_n	f = 1 kHz		30		nV/√Hz
		f = 10 kHz		20		
Input Referred Current Noise	i_n	f = 1 kHz		0.25		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.

12. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
13. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

ELECTRICAL CHARACTERISTICS AT V_S = 36 V

T_A = 25°C; $R_L \geq 10\ k\Omega$; $V_{CM} = V_{OUT}$ = 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°C to 125°C. (Notes 12, 13)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
SUPPLY CHARACTERISTICS						
Power Supply Rejection Ratio	PSRR	No Load	114	135		dB
			100			
Power Supply Quiescent Current	I_{DD}	Per channel, no load		465	600	μA
					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.

12. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
13. Performance guaranteed over the indicated operating temperature range by design and/or characterization.

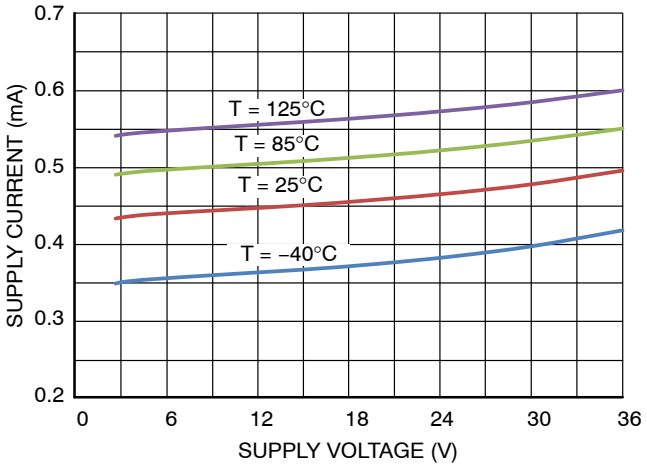


Figure 3. Quiescent Current Per Channel vs. Supply Voltage

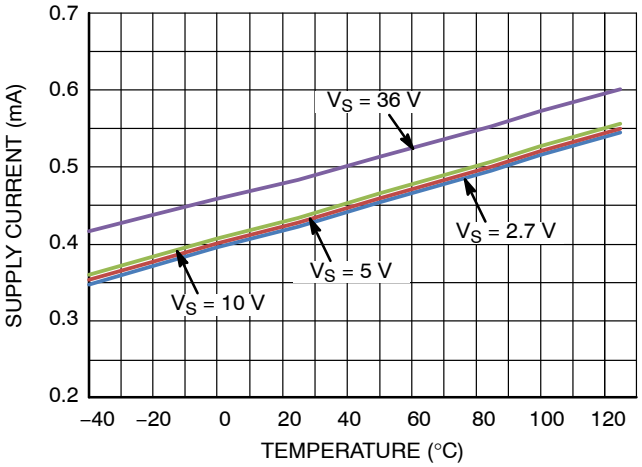


Figure 4. Quiescent Current vs. Temperature

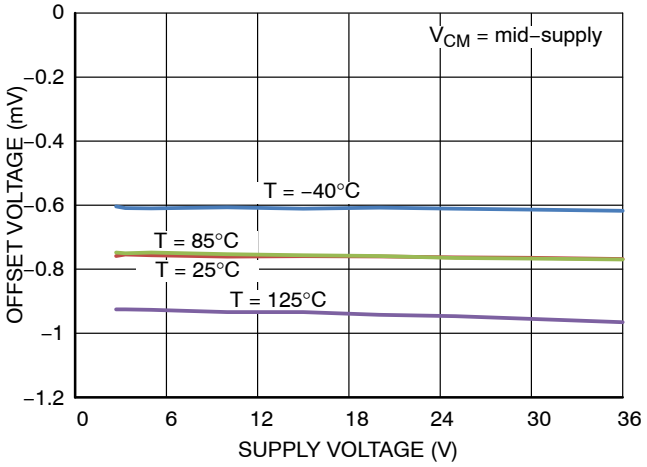


Figure 5. Offset Voltage vs. Supply Voltage

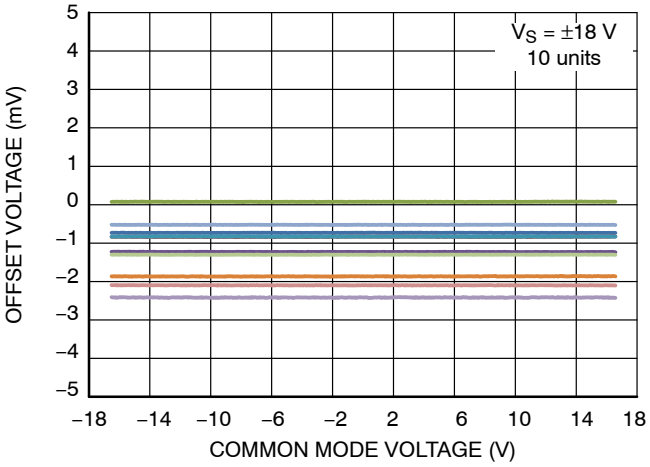


Figure 6. Input Offset Voltage vs. Common Mode Voltage

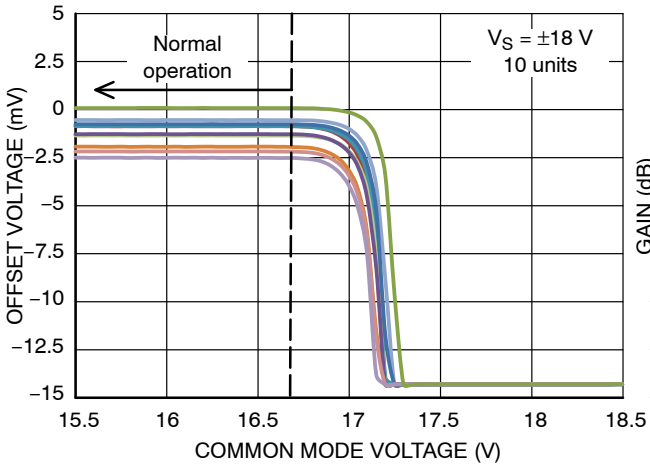


Figure 7. Input Offset Voltage vs. Common Mode Voltage

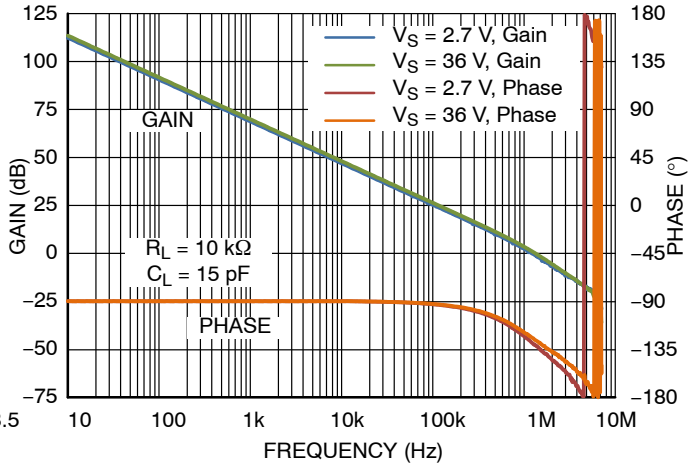


Figure 8. Gain and Phase vs. Frequency

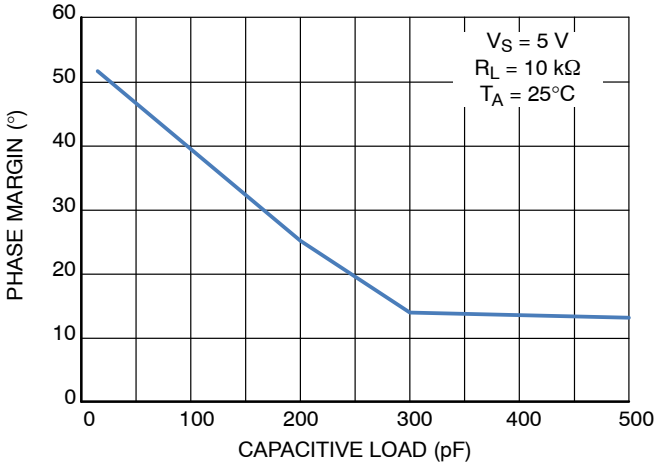


Figure 9. Phase Margin vs. Capacitive Load

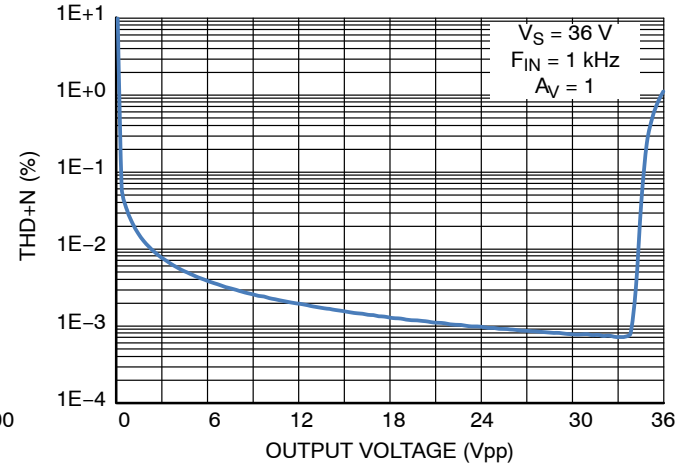


Figure 10. THD+N vs. Output Voltage

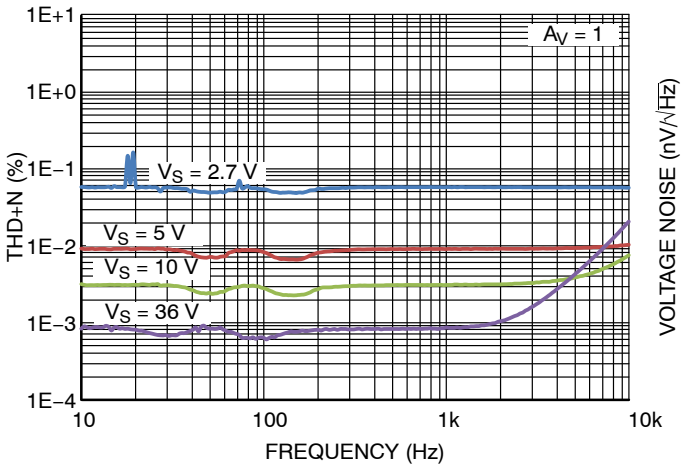


Figure 11. THD+N vs. Frequency

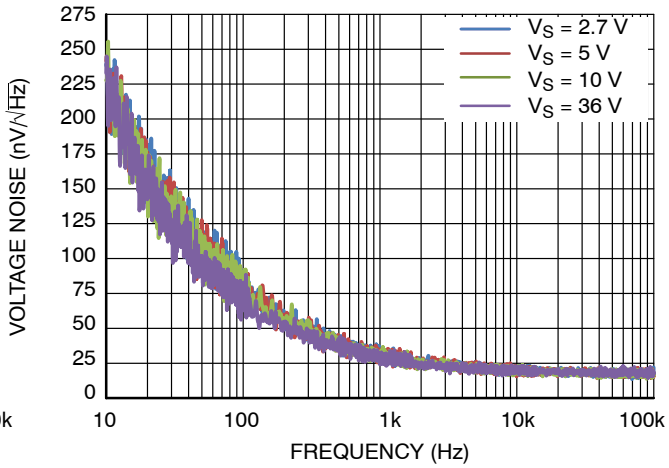


Figure 12. Input Voltage Noise vs. Frequency

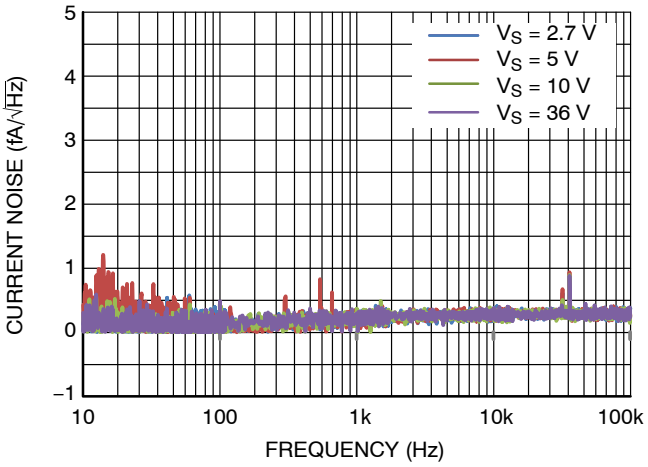


Figure 13. Input Current Noise vs. Frequency

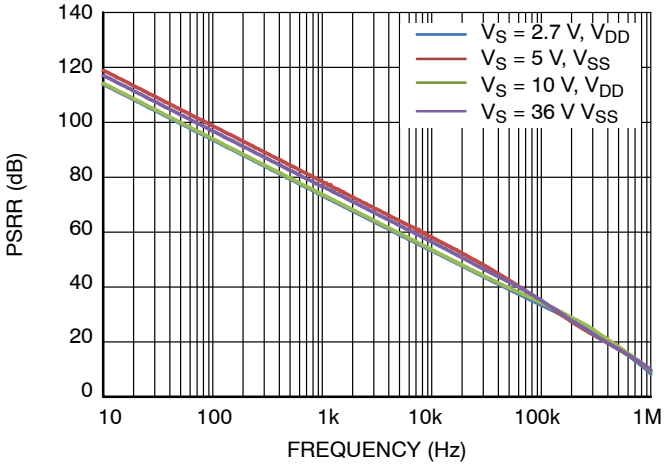


Figure 14. PSRR vs. Frequency

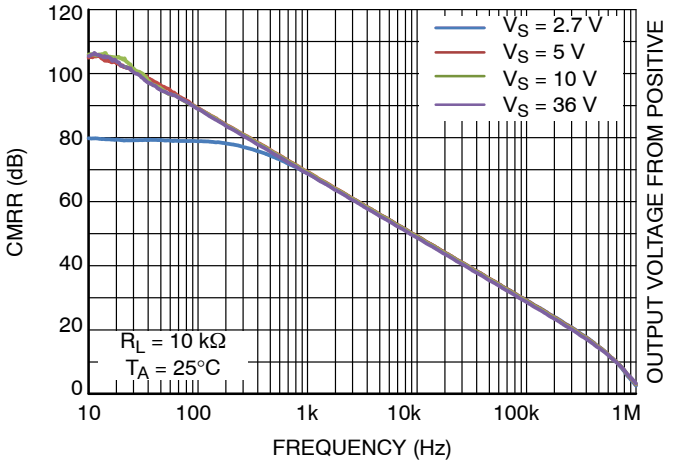


Figure 15. CMRR vs. Frequency

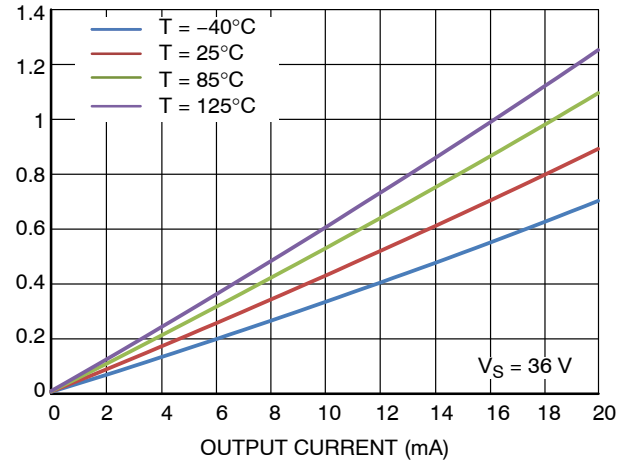


Figure 16. High Level Output vs. Output Current

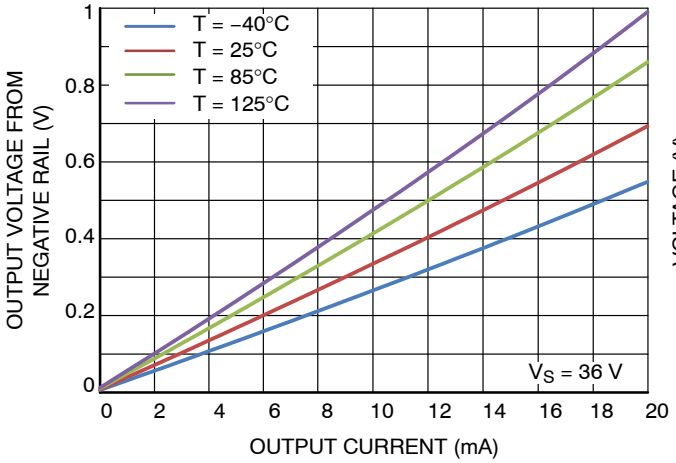


Figure 17. Low Level Output vs. Output Current

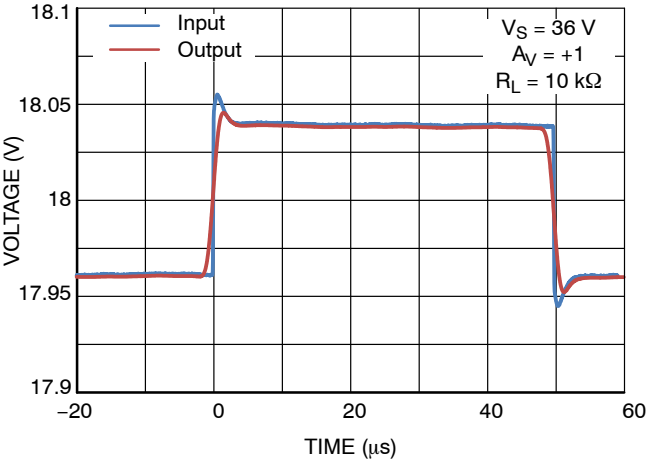


Figure 18. Non−inverting Small Signal Transient Response

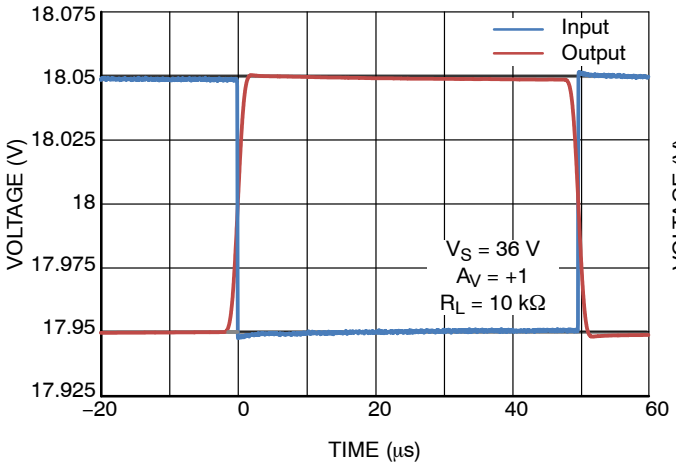


Figure 19. Inverting Small Signal Transient Response

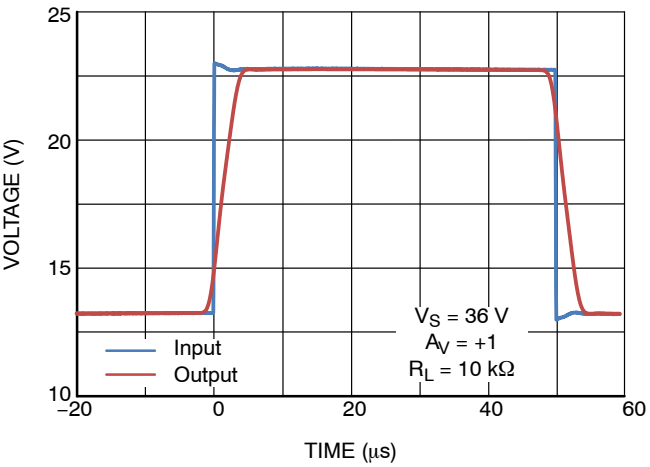


Figure 20. Non−inverting Large Signal Transient Response

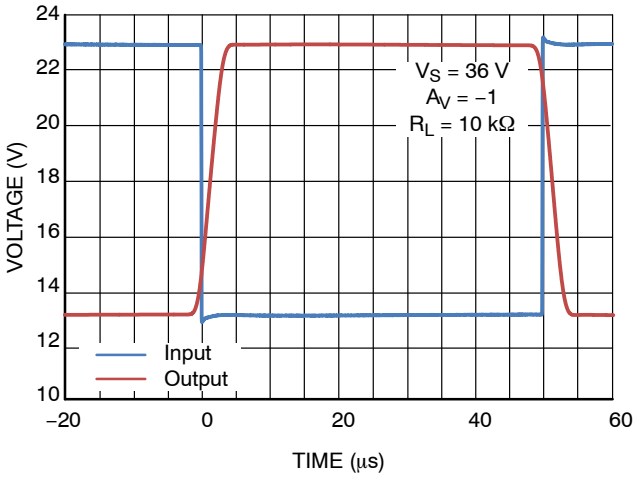


Figure 21. Inverting Large Signal Transient Response

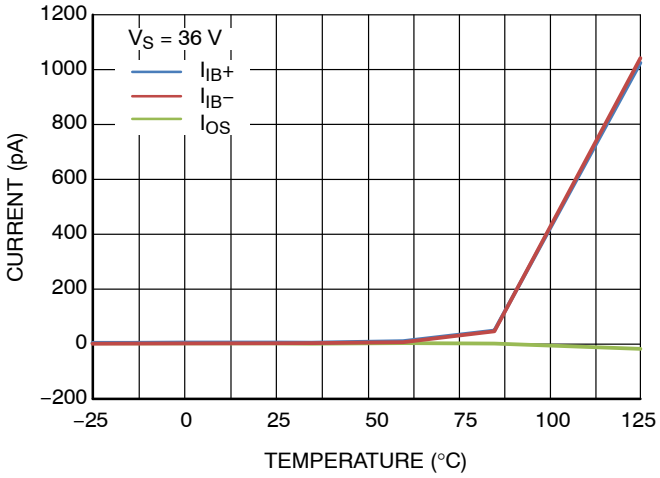


Figure 22. Input Bias and Offset Current vs. Temperature

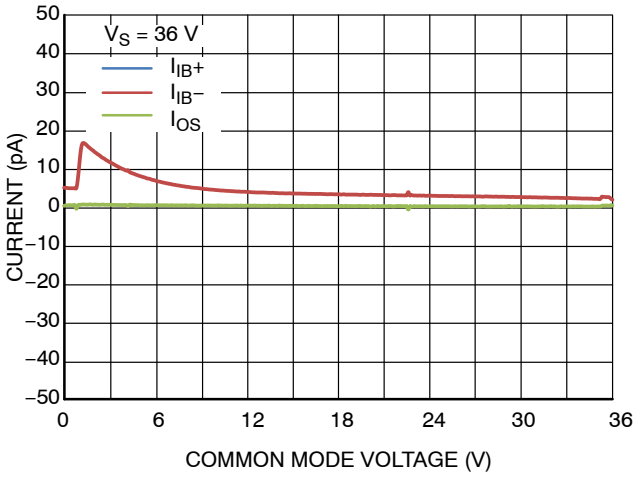


Figure 23. Input Bias Current vs. Common Mode Voltage

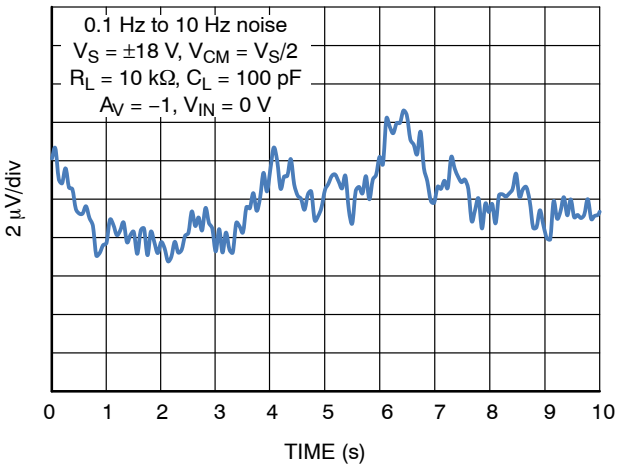


Figure 24. 0.1 Hz to 10 Hz Noise

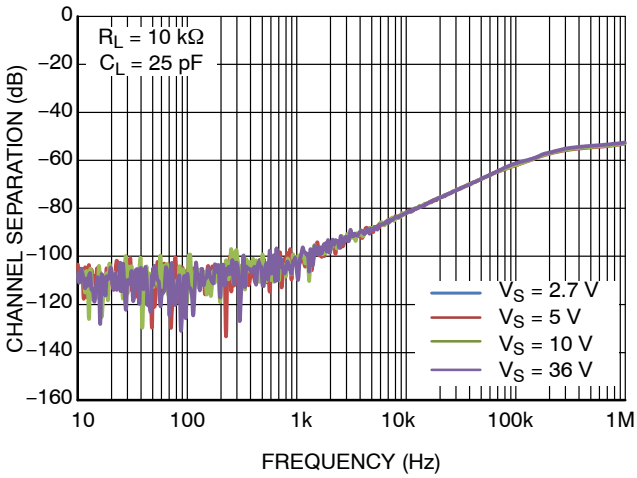


Figure 25. Channel Separation vs. Frequency

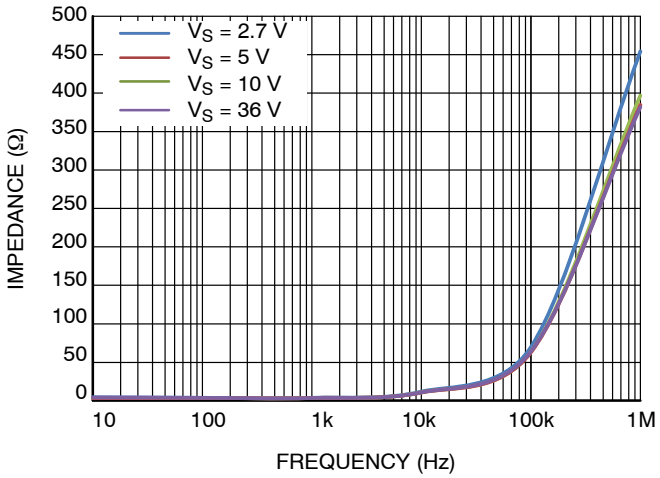


Figure 26. Open Loop Output Impedance

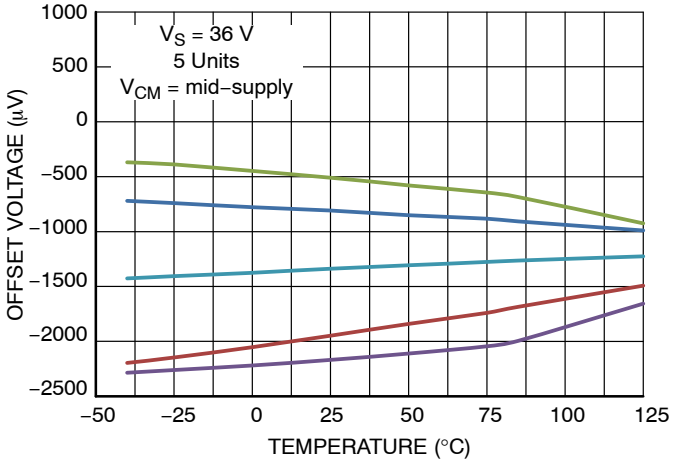


Figure 27. Offset Voltage vs. Temperature

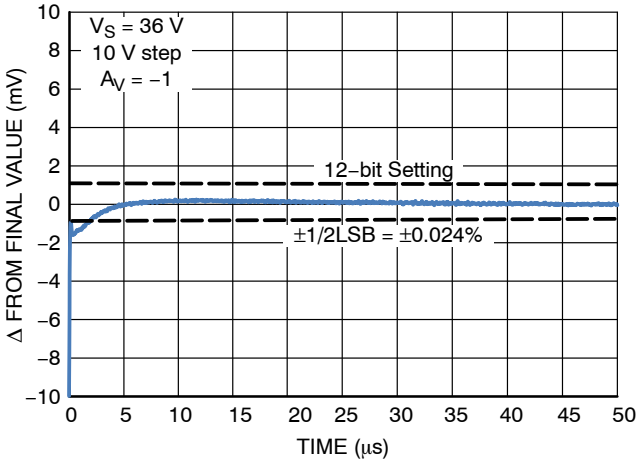


Figure 28. Large Signal Settling Time

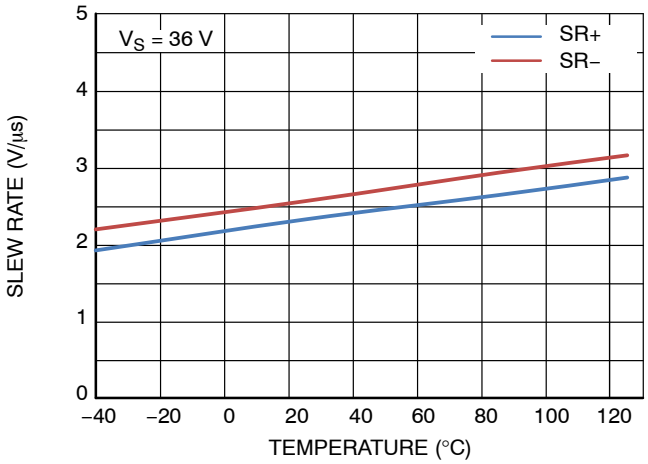
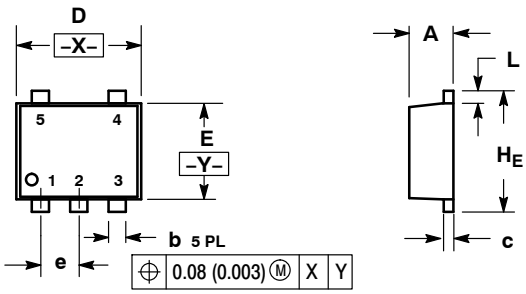


Figure 29. Slew Rate vs. Temperature

PACKAGE DIMENSIONS

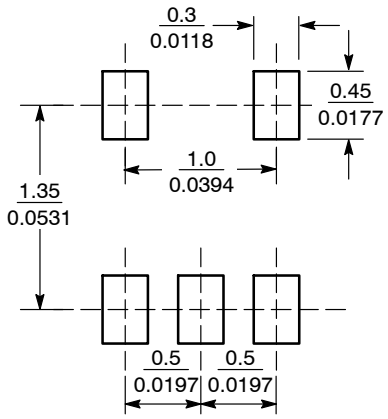
SOT−553, 5 LEAD
CASE 463B
ISSUE C



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.

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

RECOMMENDED SOLDERING FOOTPRINT*

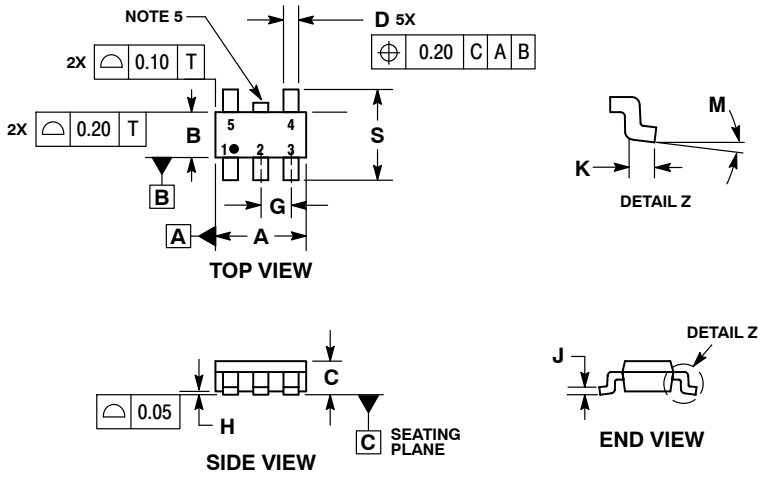


SCALE 20:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

PACKAGE DIMENSIONS

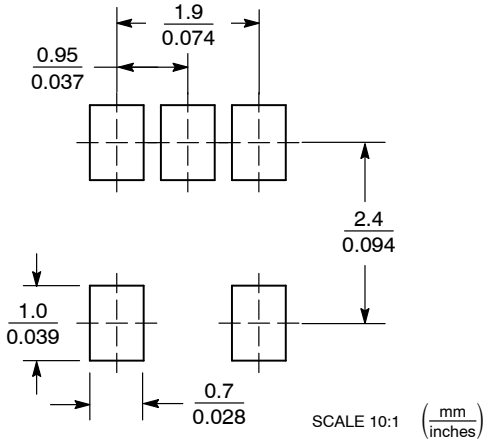
TSOP−5
CASE 483−02
ISSUE K



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

	MILLIMETERS	
DIM	MIN	MAX
A	3.00 BSC	
B	1.50 BSC	
C	0.90	1.10
D	0.25	0.50
G	0.95 BSC	
H	0.01	0.10
J	0.10	0.26
K	0.20	0.60
M	0 °	10 °
S	2.50	3.00

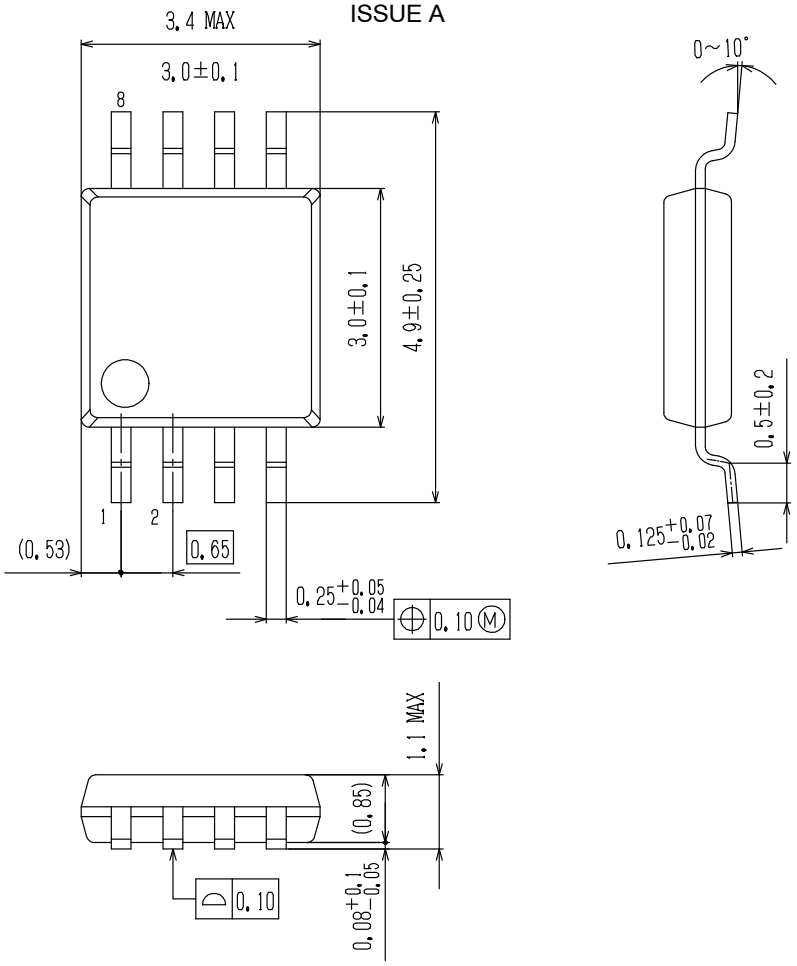
SOLDERING FOOTPRINT*



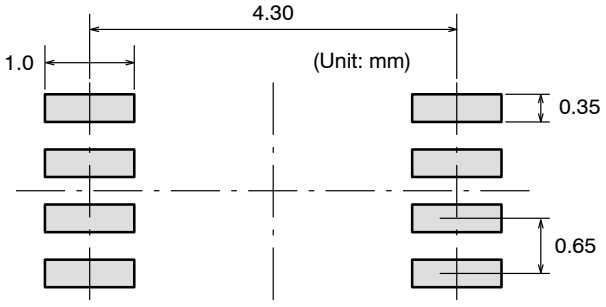
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

Micro8 / MSOP8 (150 mil)
CASE 846AH
ISSUE A



SOLDERING FOOTPRINT*

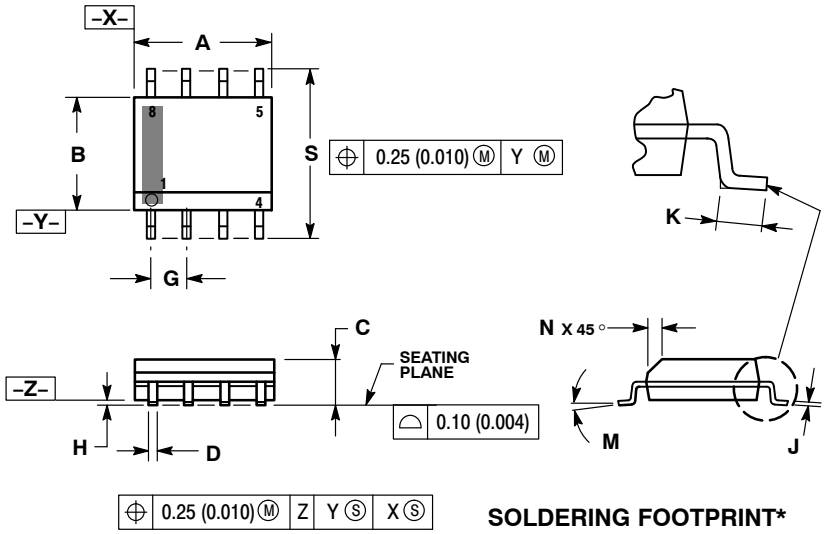


NOTE: The measurements are not to guarantee but for reference only.

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and

PACKAGE DIMENSIONS

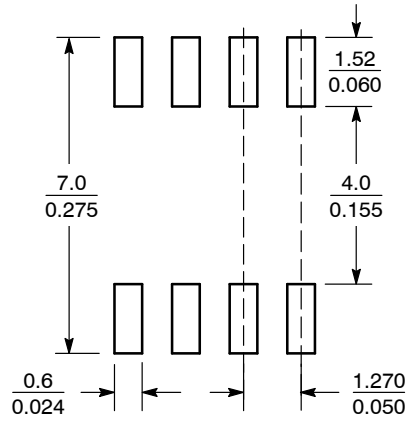
SOIC−8 NB
CASE 751−07
ISSUE AK



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

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

SOLDERING FOOTPRINT*

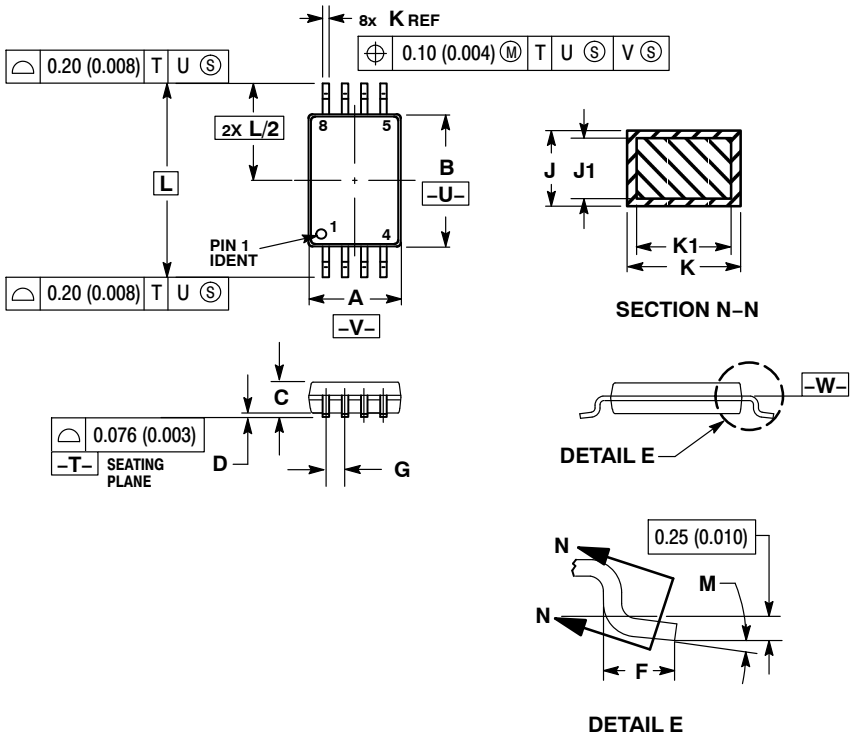


SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

PACKAGE DIMENSIONS

TSSOP−8
CASE 948S−01
ISSUE C

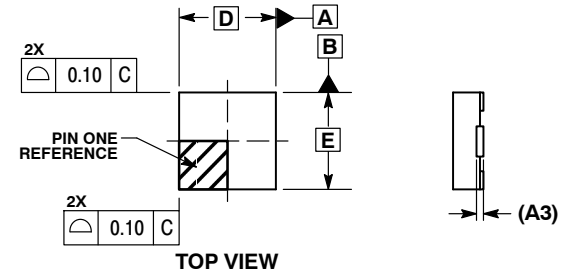


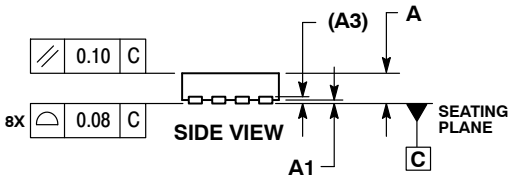
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD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

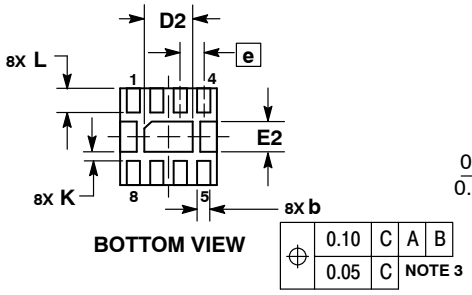
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	4.30	4.50	0.169	0.177
C	---	1.10	---	0.043
D	0.05	0.15	0.002	0.006
F	0.50	0.70	0.020	0.028
G	0.65 BSC		0.026 BSC	
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

PACKAGE DIMENSIONS

UDFN8, 1.6x1.6, 0.4P
CASE 517AC−01
ISSUE A



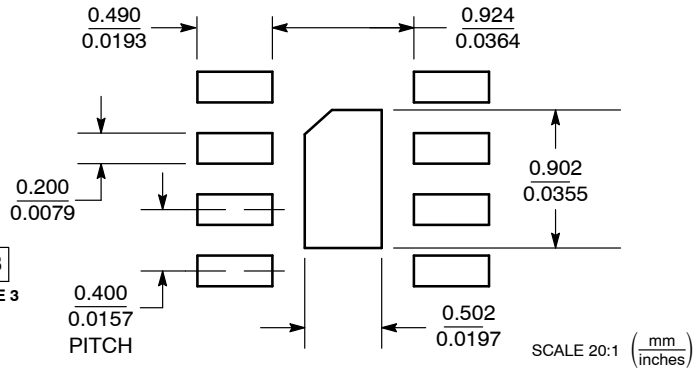




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. EXPOSED PADS CONNECTED TO DIE FLAG. USED AS TEST CONTACTS.

	MILLIMETERS		
DIM	MIN	NOM	MAX
A	0.45	0.50	0.55
A1	0.00	0.03	0.05
A3		0.127 REF	
b	0.15	0.20	0.25
D		1.60 BSC	
D2	0.70	0.80	0.90
E		1.60 BSC	
E2	0.40	0.50	0.60
e		0.40 BSC	
K	0.20	---	---
L	0.20	0.30	0.40

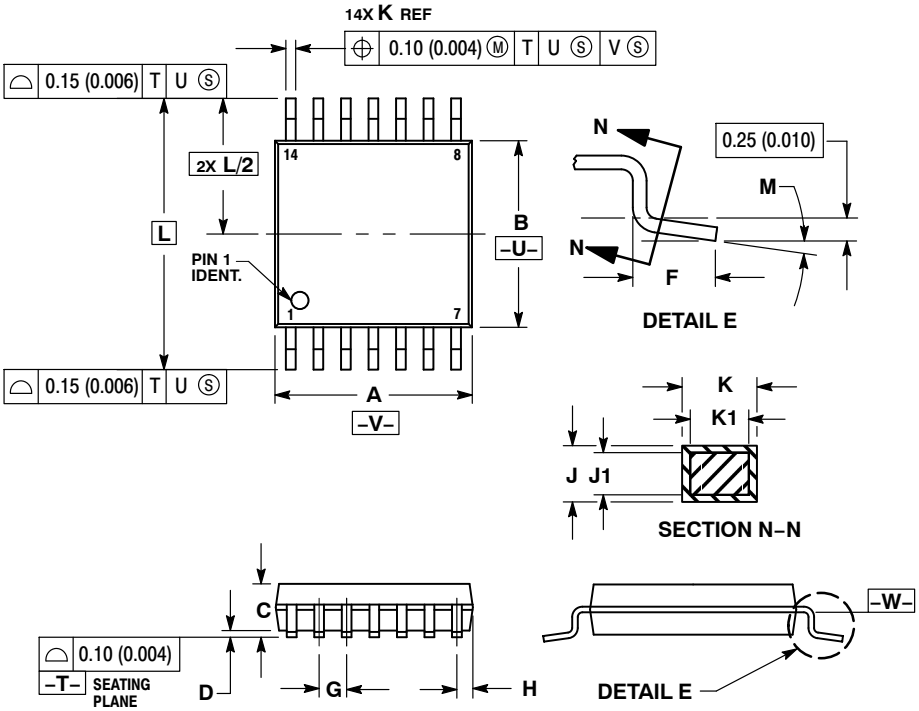
SOLDERING FOOTPRINT*



*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

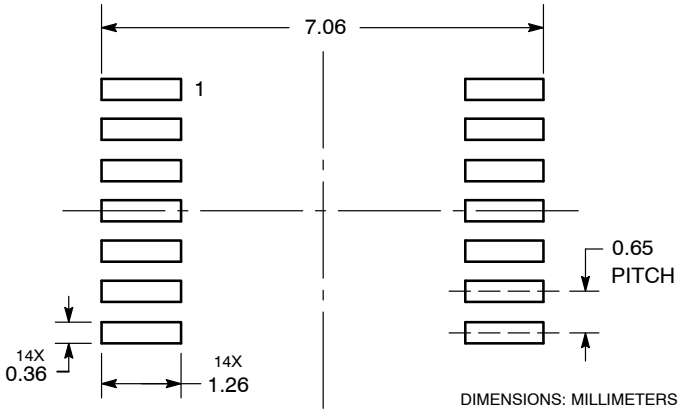
TSSOP−14
CASE 948G−01
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

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

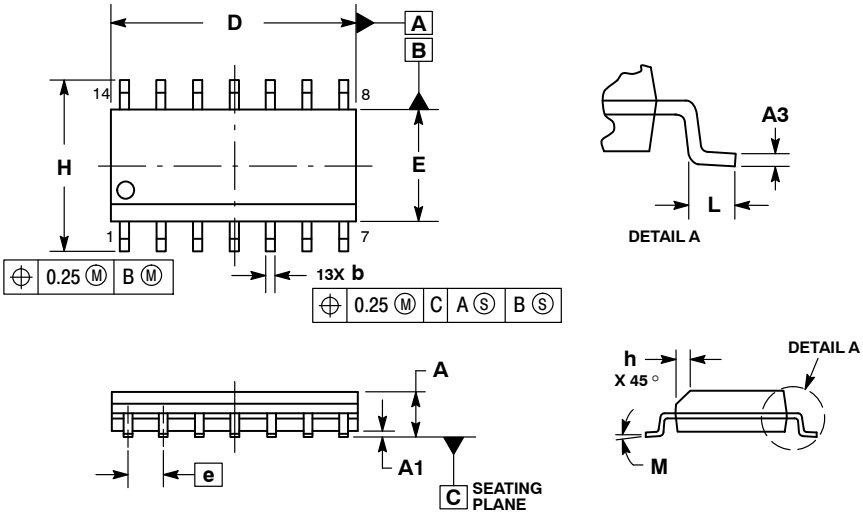
SOLDERING FOOTPRINT*



*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

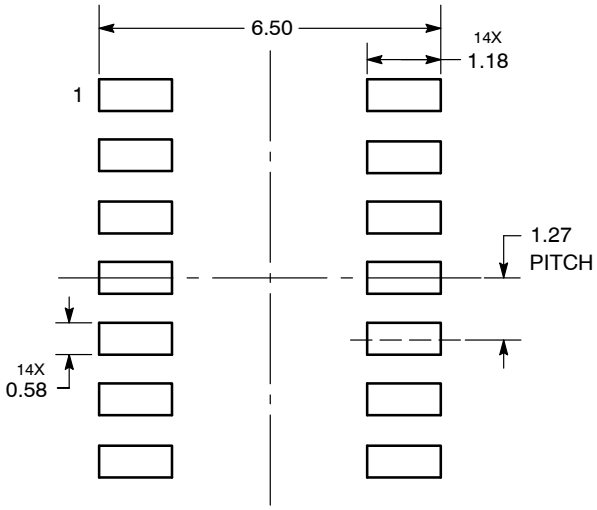
SOIC−14 NB
CASE 751A−03
ISSUE K



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

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

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

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