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

The HT2007x 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 HT2007x 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 HT2007x 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 HT2007x 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/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

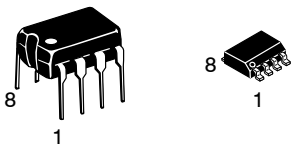
Applications

- Current Sensing
- Signal Conditioning
- Automotive

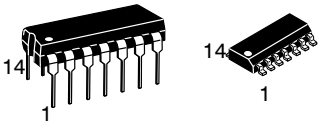
End Products

- Notebook Computers
- Portable Instruments
- Power Supplies

DUAL



QUAD

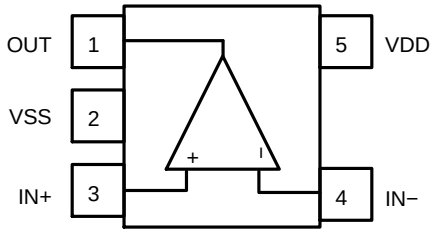


ORDERING INFORMATION

HT20072ANZ	DIP8
HT20072ARZ	SOP8
HT20074ANZ	DIP14
HT20074ARZ	SOP14

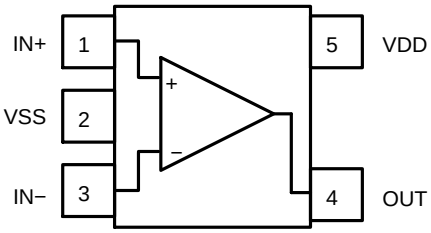
T_A = -40° to 125°C for all packages.

Single Channel Configuration HT20071A



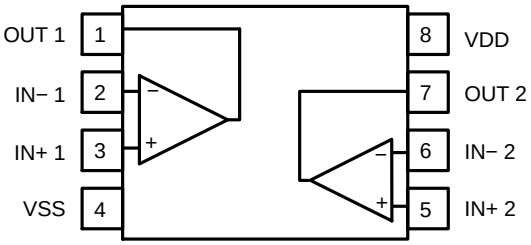
SOT23−5
(TSOP−5)

Single Channel Configuration HT20071B

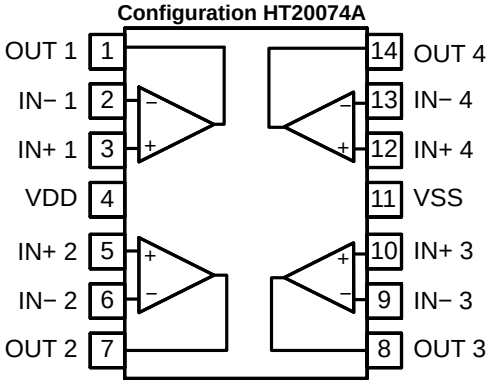


SOT553−5

Dual Channel Configuration HT20072A



Quadruple Channel Configuration HT20074A



ABSOLUTE MAXIMUM RATINGS (Note 1)

Rating	Symbol	Limit	Unit
Supply Voltage (V_{DD} – V_{SS}) (Note 4)	V_S	40	V
Input Voltage	V_{CM}	V_{SS} − 0.2 to V_{DD} + 0.2	V
Differential Input Voltage (Note 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 Dissipation (Note 4)	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 5) Human Body Model	HBM	2000	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
Junction−to−Ambient	θ_{JA}	SOT23−5 / TSOP5	265	195	°C/W
		SOT553−5	325	244	
		Micro8 / MSOP8	236	167	
		SOIC−8	190	131	
		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 mm^2 copper area
9. Values based on a 1S2P standard PCB according to JEDEC51−7 with 1.0 oz copper and a 100 mm^2 copper area

OPERATING RANGES

Parameter	Symbol	Min	Max	Unit
Operating Supply Voltage (Single Supply)	V_S	2.7	36	V
Operating Supply Voltage (Split Supply)	V_S	±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°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 11, 12)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	HT20071			1.3	±3.5	mV
						±4.5	
		HT20072, HT20074			1.3	±3	
						±4	
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	T_A = 25°C to 125°C			2		µV/°C
Input Bias Current (Note 12)	I_{IB}				5	200	pA
						1500	
Input Offset Current (Note 12)	I_{OS}	HT20071, HT20072			2	75	pA
						500	
		HT20074			2	75	
						200	
Channel Separation	XTLK	DC	HT20072		100		dB
			HT20074		115		
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		dB
				69			
OUTPUT CHARACTERISTICS							
Open Loop Voltage Gain	A_{VOL}			96	118		dB
				86			
Output Current Capability (Note 13)	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, R_L = 2 kΩ			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		

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°C; R_L ≥ 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 11, 12)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
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			90		fA/√Hz
SUPPLY CHARACTERISTICS							
Power Supply Rejection Ratio	PSRR	No Load		114	135		dB
				100			
Power Supply Quiescent Current	I_{DD}	HT20071	No load		420	625	μA
						765	
		HT20072,HT20074	Per channel, no load		405	525	
						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°C; R_L ≥ 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 14, 15)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	HT20071			1.3	±3.5	mV
						±4.5	
		HT20072, HT20074			1.3	±3	
						±4	
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	T_A = 25°C to 125 °C			2		μV/°C
Input Bias Current (Note 15)	I_{IB}				5	200	pA
						1500	
Input Offset Current (Note 15)	I_{OS}	HT20071, HT20072			2	75	pA
						500	
		HT20074			2	75	
						200	
Channel Separation	XTLK	DC	HT20072		100		dB
			HT20074		115		
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°C; R_L ≥ 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 14, 15)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
INPUT CHARACTERISTICS							
Common Mode Rejection Ratio	CMRR	V_{CM} = V_{SS} + 0.2 V to V_{DD} − 1.35 V		102	125		dB
				80			
OUTPUT CHARACTERISTICS							
Open Loop Voltage Gain	A_{VOL}			96	120		dB
				86			
Output Current Capability (Note 16)	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	
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 kΩ			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			90		fA/√Hz
SUPPLY CHARACTERISTICS							
Power Supply Rejection Ratio	PSRR	No Load		114	135		dB
				100			
Power Supply Quiescent Current	I_{DD}	HT20071	No load		430	635	μA
						775	
		HT20072, HT20074	Per channel, no load		410	530	
						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.

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 V

T_A = 25°C; R_L ≥ 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 17, 18)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	HT20071			1.3	±3.5	mV
						±4.5	**mV**
Input Offset Voltage	V_{OS}	HT20072, HT20074			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 (Note 18)	I_{IB}				5	200	pA
						1500	
Input Offset Current (Note 18)	I_{OS}	HT20071, HT20072			2	75	pA
						500	
		HT20074			2	75	
						200	
Channel Separation	XTLK	DC	HT20072		100		dB
			HT20074		115		
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		110	130		dB
				87			
OUTPUT CHARACTERISTICS							
Open Loop Voltage Gain	A_{VOL}			98	120		dB
				88			
Output Current Capability (Note 19)	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		MHz
Slew Rate at Unity Gain	SR	C_L = 20 pF, R_L = 2 kΩ			2.6		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		

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°C; R_L ≥ 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 17, 18)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
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			90		fA/√Hz
SUPPLY CHARACTERISTICS							
Power Supply Rejection Ratio	PSRR	No Load		114	135		dB
				100			
Power Supply Quiescent Current	I_{DD}	HT20071	No load		430	645	µA
						785	
		HT20072, HT20074	Per channel, no load		416	540	
						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°C; R_L ≥ 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 20, 21)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	HT20071			1.3	±3.5	mV
						±4.5	**mV**
		HT20072, HT20074			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 (Note 21)	I_{IB}				5	200	pA
		HT20071, HT20072				**2000**	
		HT20074				**1500**	
Input Offset Current (Note 21)	I_{OS}	HT20071, HT20072			2	75	pA
						1000	
		HT20074			2	75	
						200	
Channel Separation	XTLK	DC	HT20072		100		dB
			HT20074		115		
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°C; R_L ≥ 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 20, 21)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
INPUT CHARACTERISTICS							
Differential Input Capacitance	C_{ID}				1.5		pF
Common Mode Input Capacitance	C_{CM}				3.5		pF
Common Mode Rejection Ratio	CMRR			118	135		dB
				95			
				120	145		
				95			
				120	145		
				85			
OUTPUT CHARACTERISTICS							
Open Loop Voltage Gain	A_{VOL}			98	120		dB
				88			
Output Current Capability (Note 22)	I_O	Op amp sinking current			50		mA
		Op amp sourcing current			65		
Output Voltage High	V_{OH}	Voltage output swing from positive rail	HT20071		0.074	0.15	V
						0.22	
			HT20072		0.074	0.10	
						0.15	
			HT20074		0.074	0.10	
						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		MHz
Slew Rate at Unity Gain	SR	C_L = 20 pF, R_L = 2 kΩ			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
			Settling time to 0.01%		7		
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			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°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 20, 21)

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}	HT20071	No load		480	700	μA
						840	
		HT20072	Per channel, no load		465	570	
						700	
		HT20074	Per channel, no load		465	600	
						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.

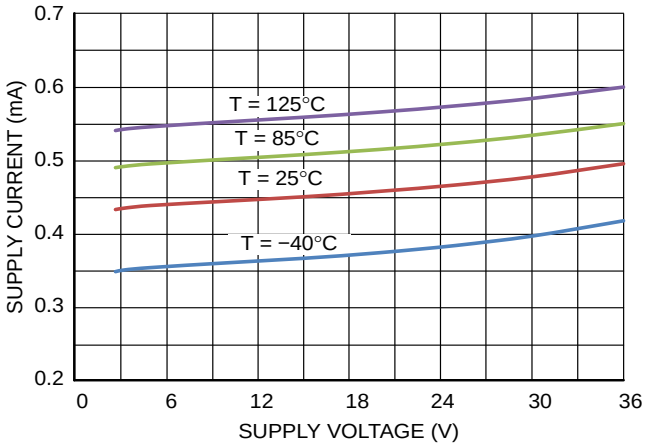


Figure 2. Quiescent Current Per Channel vs. Supply Voltage

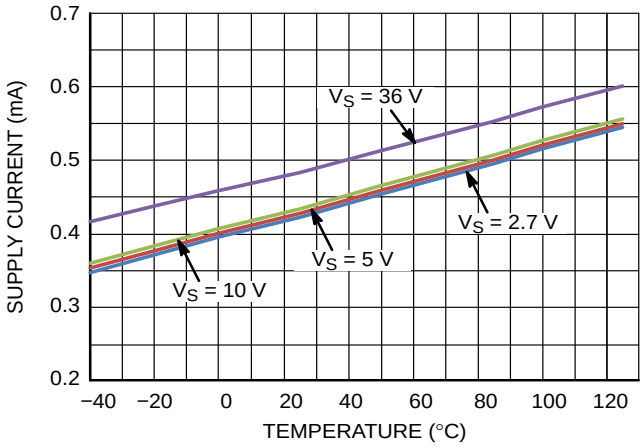


Figure 3. Quiescent Current vs. Temperature

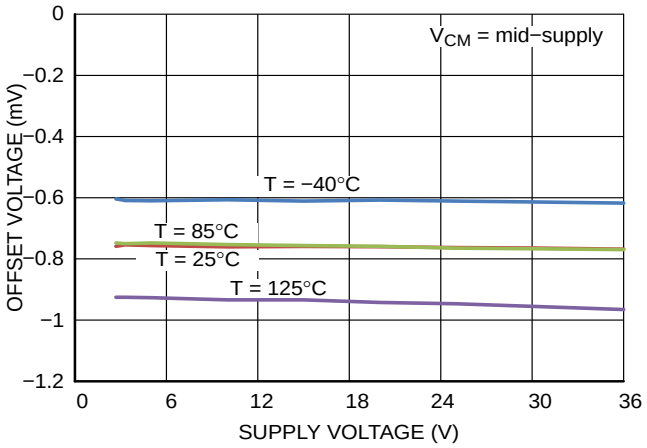


Figure 4. Offset Voltage vs. Supply Voltage

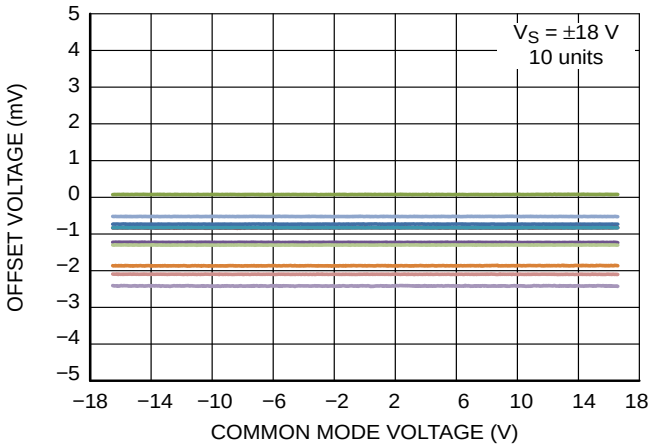


Figure 5. Input Offset Voltage vs. Common Mode Voltage

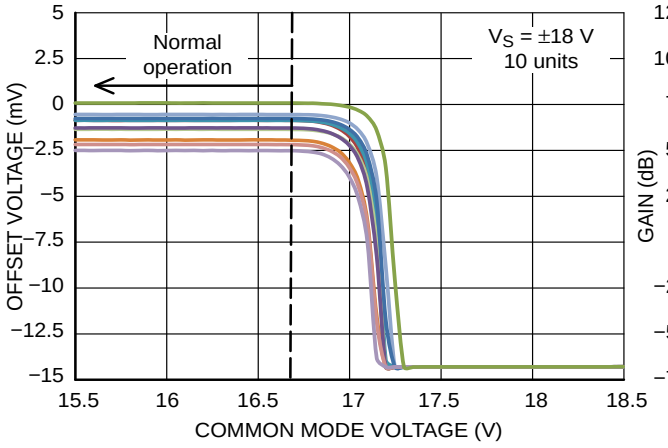


Figure 6. Input Offset Voltage vs. Common Mode Voltage

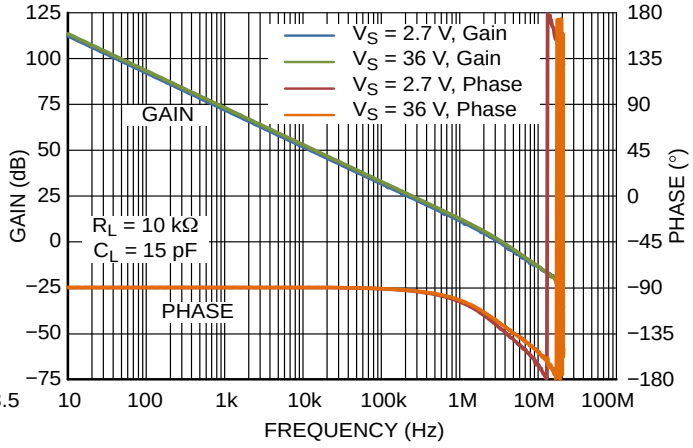


Figure 7. Gain and Phase vs. Frequency

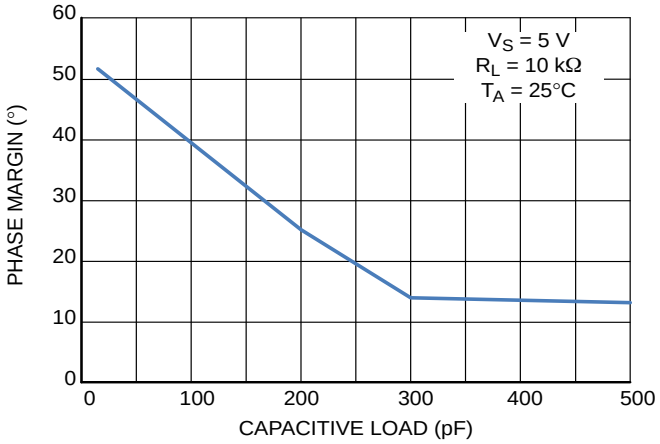


Figure 8. Phase Margin vs. Capacitive Load

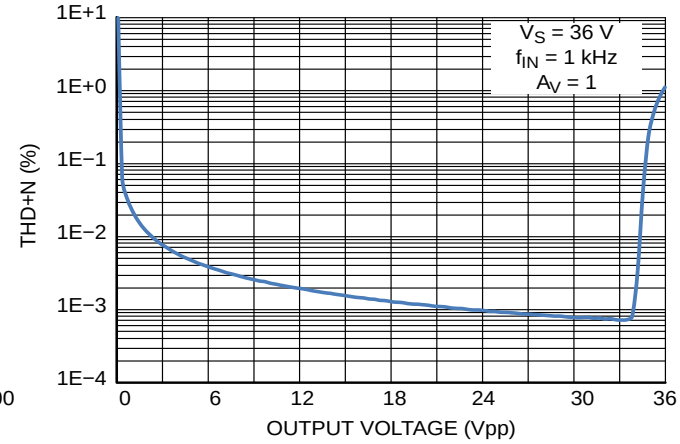


Figure 9. THD+N vs. Output Voltage

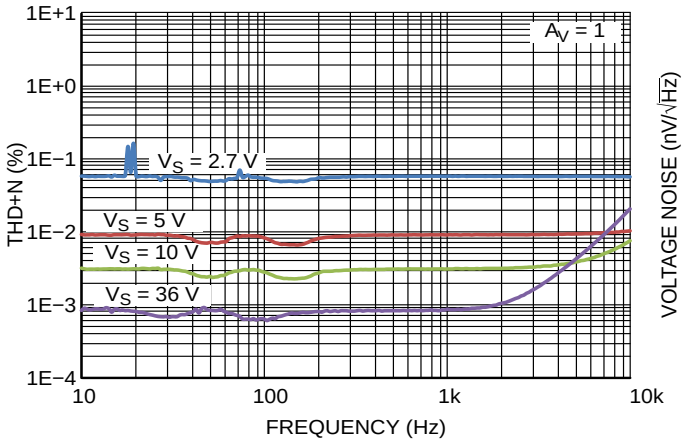


Figure 10. THD+N vs. Frequency

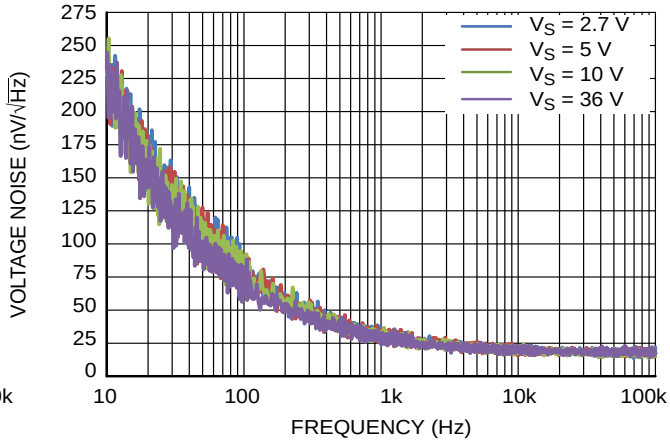


Figure 11. Input Voltage Noise vs. Frequency

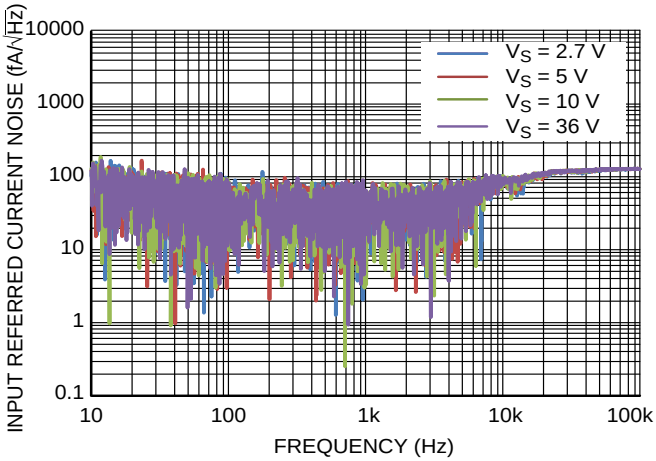


Figure 12. Input Current Noise vs. Frequency

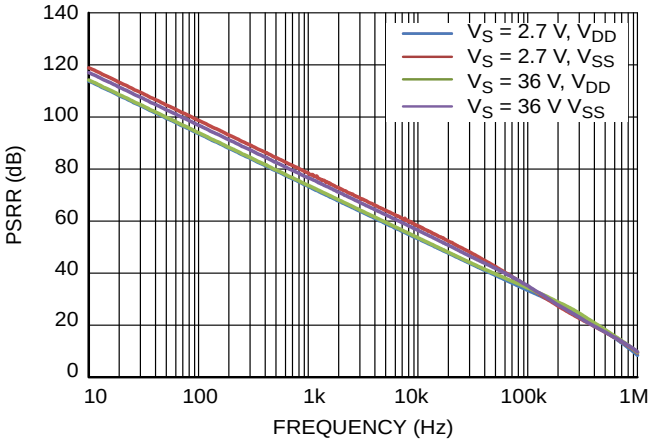


Figure 13. PSRR vs. Frequency

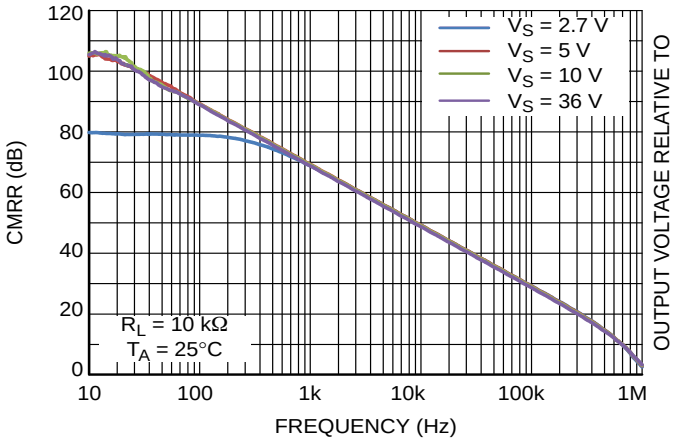


Figure 14. CMRR vs. Frequency

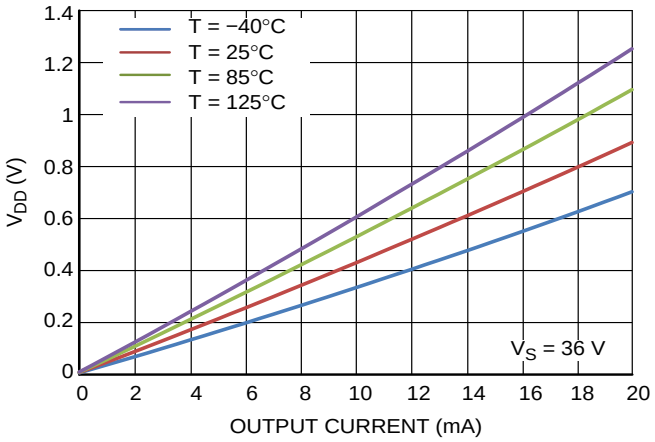


Figure 15. High Level Output vs. Output Current

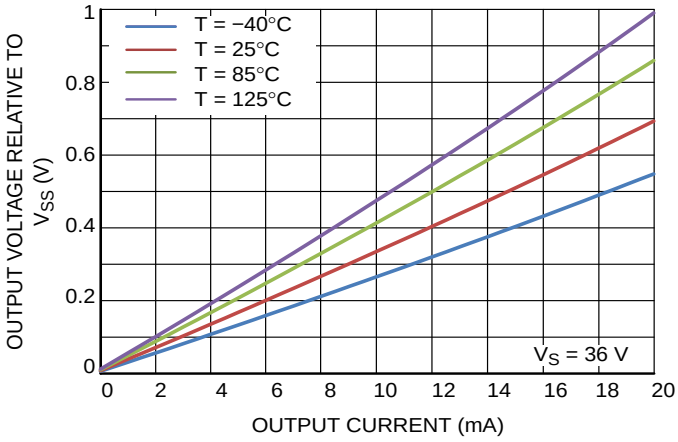


Figure 16. Low Level Output vs. Output Current

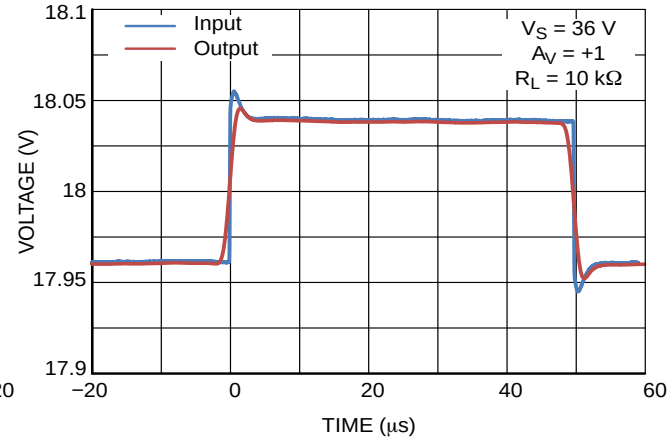


Figure 17. Non−inverting Small Signal Transient Response

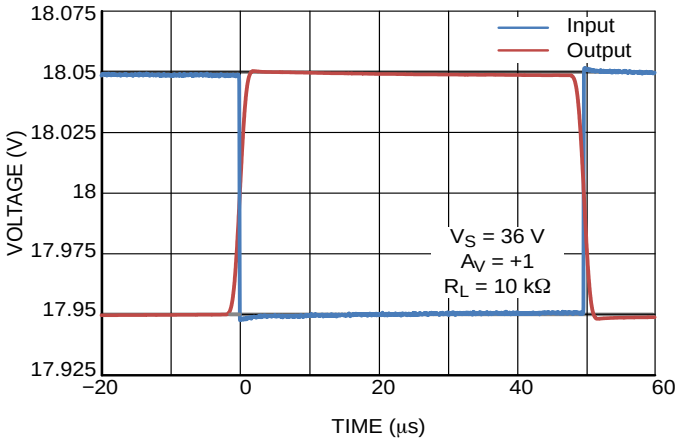


Figure 18. Inverting Small Signal Transient Response

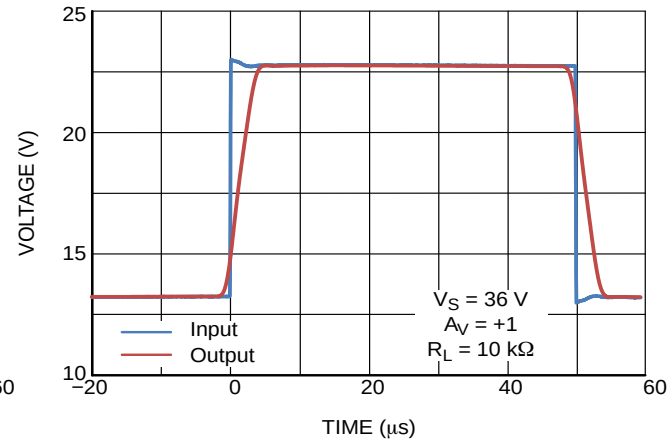


Figure 19. Non−inverting Large Signal Transient Response

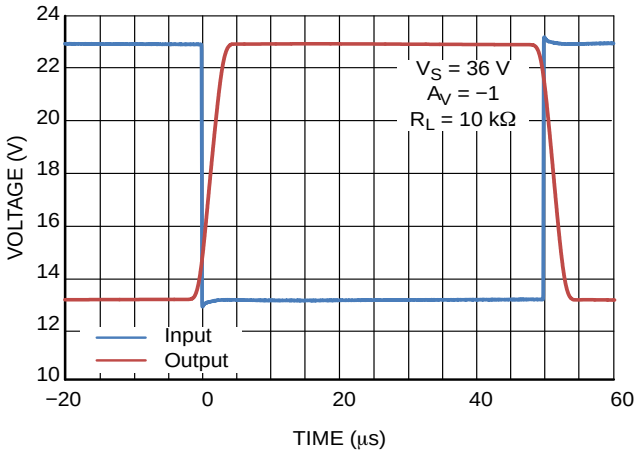


Figure 20. Inverting Large Signal Transient Response

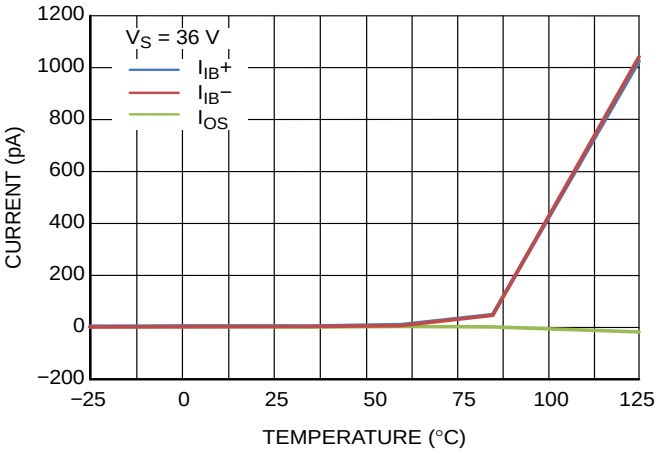


Figure 21. Input Bias and Offset Current vs. Temperature

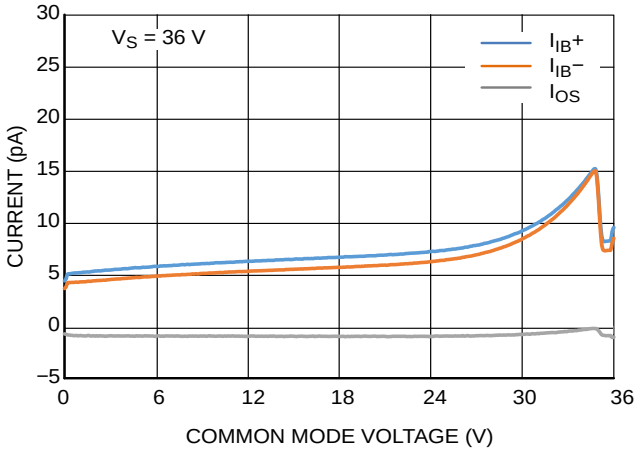


Figure 22. Input Bias Current vs. Common Mode Voltage

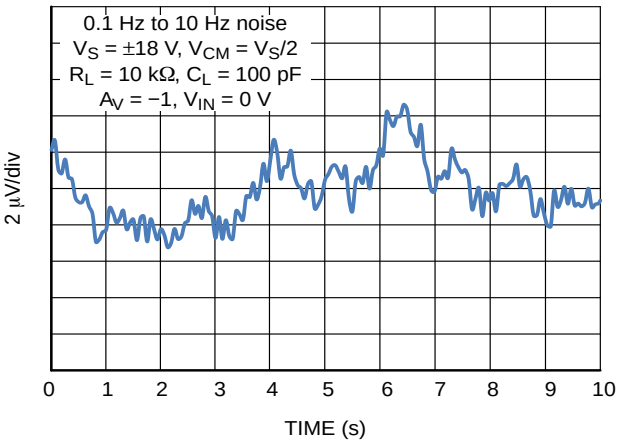


Figure 23. 0.1 Hz to 10 Hz Noise

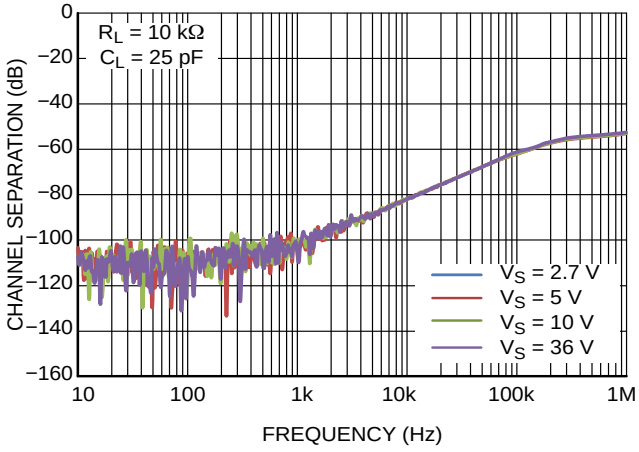


Figure 24. Channel Separation vs. Frequency

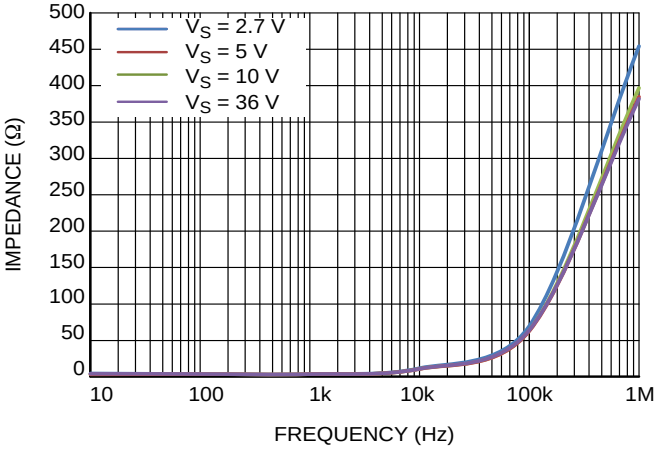


Figure 25. Open Loop Output Impedance

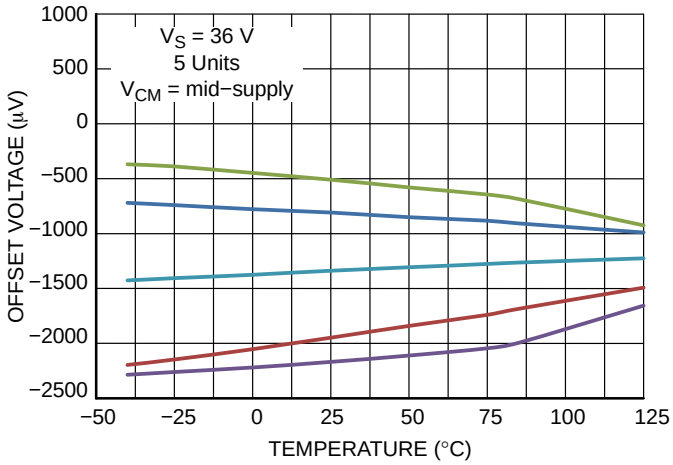


Figure 26. Offset Voltage vs. Temperature

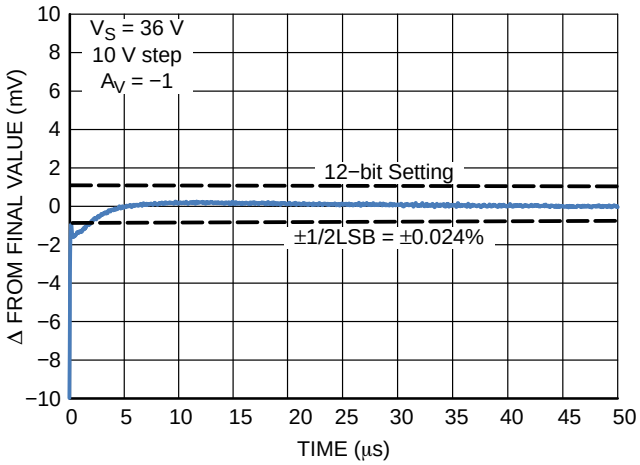


Figure 27. Large Signal Settling Time

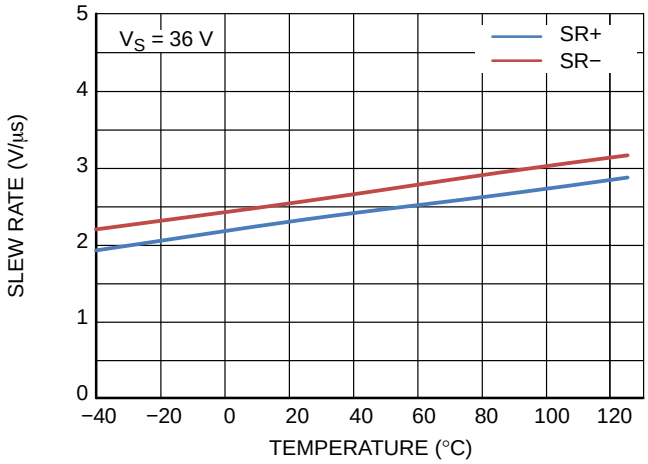


Figure 28. Slew Rate vs. Temperature

APPLICATIONS INFORMATION

Input Circuit

The HTS2007x 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 HTS2007x 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.

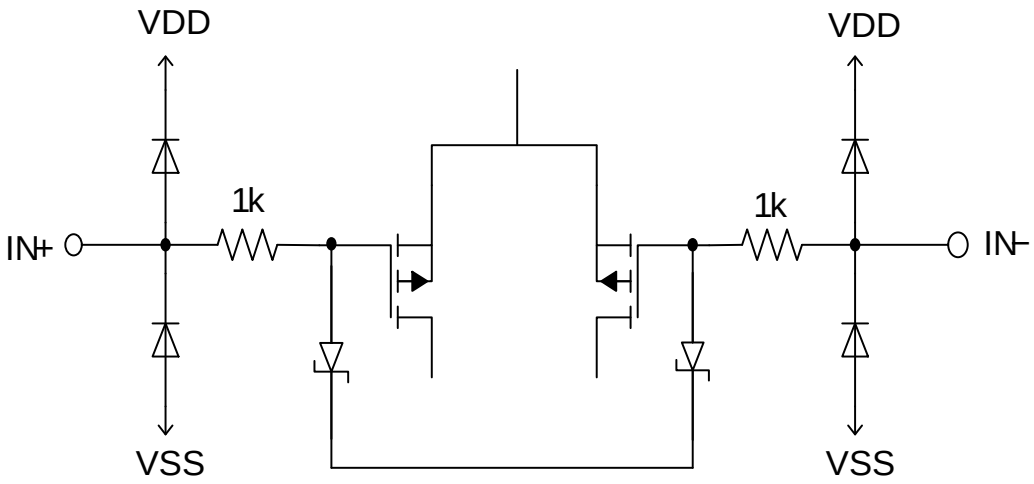


Figure 29. Differential Input Pair

Output

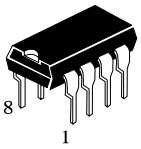
The HTS2007x has a class AB output stage with rail−to−rail output swing.

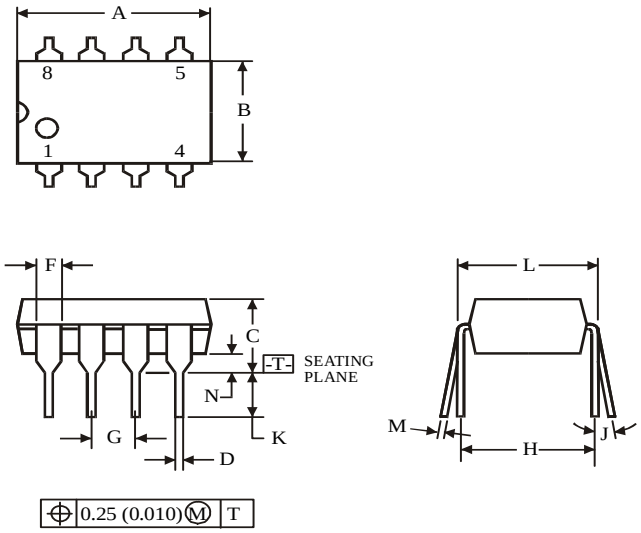
High output currents can cause the junction temperature to exceed the 150°C absolute maximum rating. In the case of a short circuit where the output is connected to either supply rail, the amount of current the op amp can source and sink is described by the output current capability parameter listed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

N SUFFIX PLASTIC DIP
(MS – 001BA)



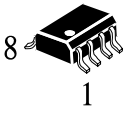


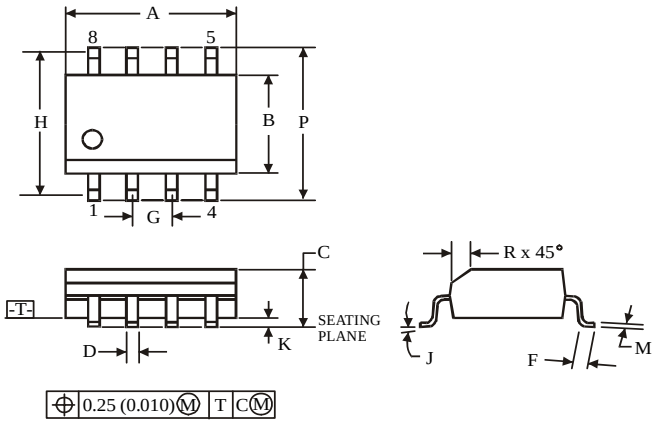
	Dimension, mm	
Symbol	**MIN**	**MAX**
A	8.51	10.16
B	6.1	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.2	0.36
N	0.38	

NOTES:

1. Dimensions “A”, “B” do not include mold flash or protrusions.
   Maximum mold flash or protrusions 0.25 mm (0.010) per side.

D SUFFIX SOIC
(MS - 012AA)



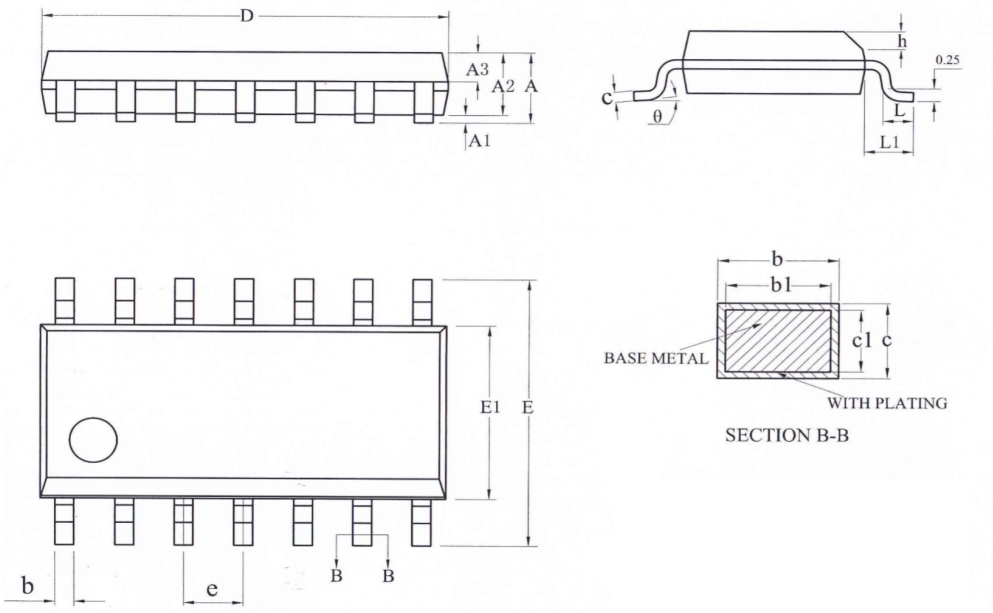


	Dimension, mm	
Symbol	**MIN**	**MAX**
A	4.8	5
B	3.8	4
C	1.35	1.75
D	0.33	0.51
F	0.4	1.27
G	1.27	
H	5.72	
J	0°	8°
K	0.1	0.25
M	0.19	0.25
P	5.8	6.2
R	0.25	0.5

NOTES:

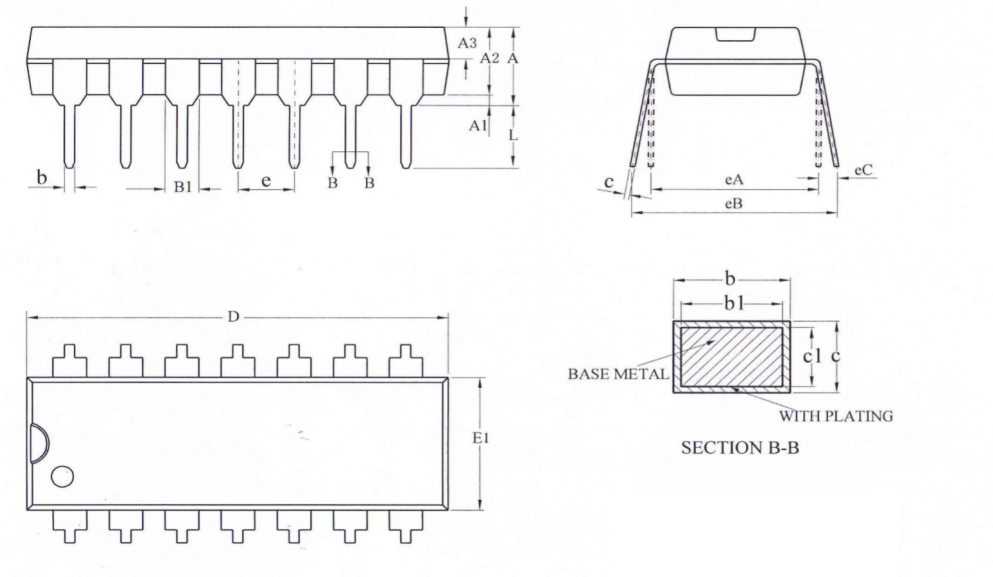
1. Dimensions A and B do not include mold flash or protrusion.
2. Maximum mold flash or protrusion 0.15 mm (0.006) per side
   for A; for B – 0.25 mm (0.010) per side.

SOP14



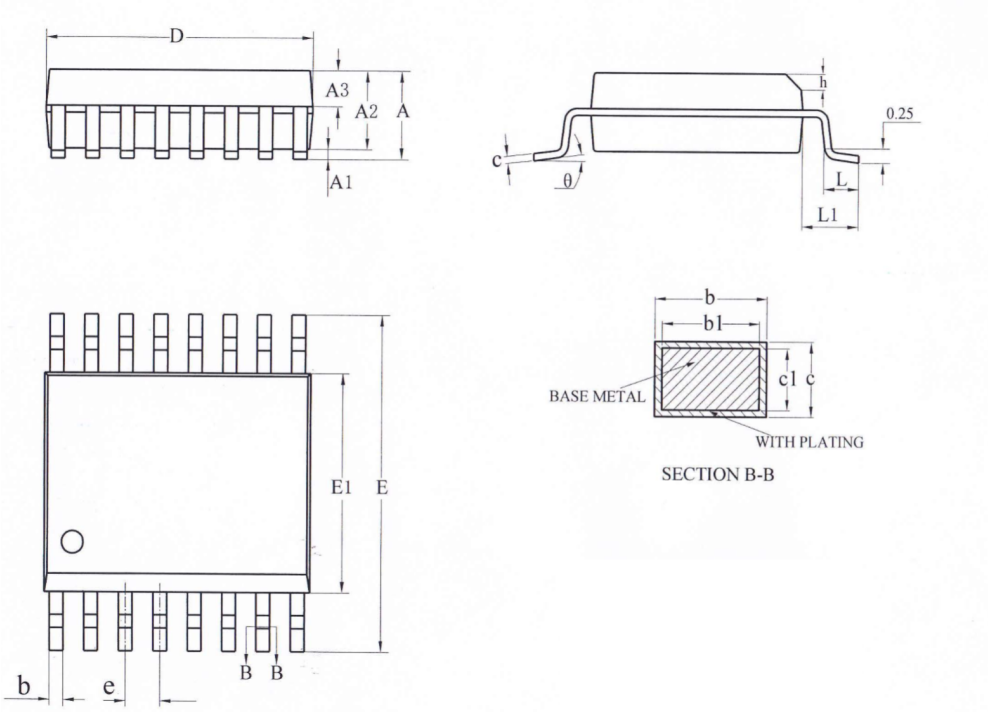
	SYMBOL	MILLIMETER		
		MIN	NOM	MAX
	A	—	—	1.75
	A1	0.05	—	0.225
	A2	1.30	1.40	1.50
	A3	0.60	0.65	0.70
⚠	b	0.39	—	0.47
⚠	b1	0.38	0.41	0.44
⚠	c	0.20	—	0.24
	c1	0.19	0.20	0.21
⚠	D	8.55	8.65	8.75
	E	5.80	6.00	6.20
⚠	E1	3.80	3.90	4.00
	e	1.27BSC		
	h	0.25	—	0.50
	L	0.50	—	0.80
	L1	1.05REF		
	θ	0	—	8°

DIP14



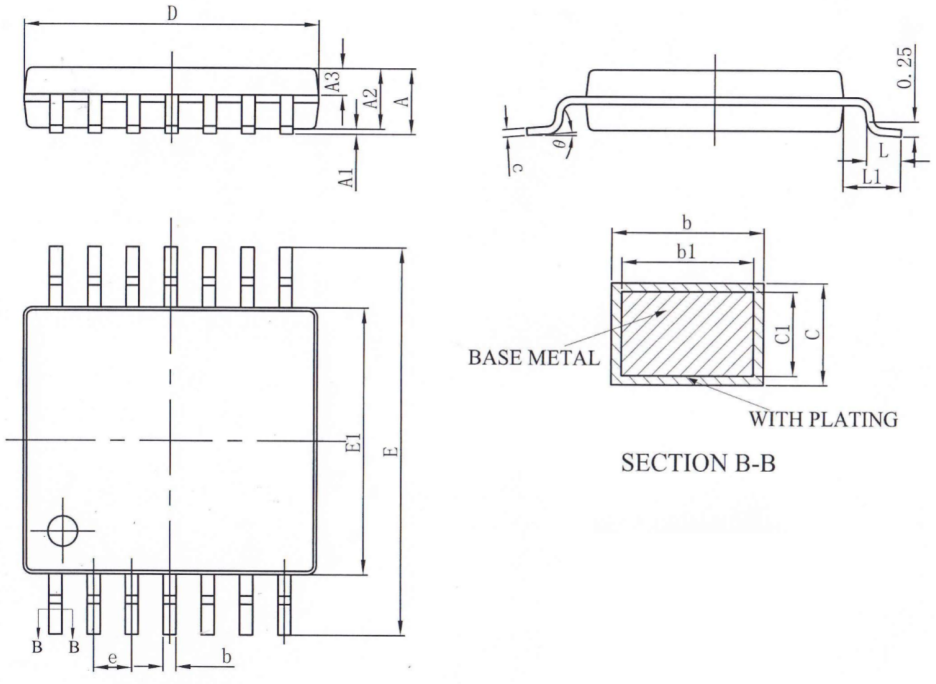
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	3.60	3.80	4.00
A1	0.51	—	—
A2	3.20	3.30	3.40
A3	1.47	1.52	1.57
b	0.44	—	0.52
b1	0.43	0.46	0.49
B1	1.52REF		
c	0.25	—	0.29
c1	0.24	0.25	0.26
D	19.00	19.10	19.20
E1	6.25	6.35	6.45
e	2.54BSC		
eA	7.62REF		
eB	7.62	—	9.30
eC	0	—	0.84
L	3.00	—	—

SSOP14



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.55	0.60	0.65
b	0.23	—	0.31
b1	0.22	0.25	0.28
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	0.635BSC		
h	0.25	—	0.50
L	0.50	0.65	0.80
L1	1.05REF		
θ	0	—	8°

TSSOP14



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	4.90	5.00	5.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
θ	0	—	8°