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- B Grade Is 100% Tested for Noise 30 nV/ $\sqrt{\text{Hz}}$ Max at f = 10 Hz 12 nV/ $\sqrt{\text{Hz}}$ Max at f = 1 kHz
- Low Input Offset Voltage . . . 500 μ V Max
- **Excellent Offset Voltage Stability** With Temperature . . . 0.5 μV/°C Typ
- Rail-to-Rail Output Swing

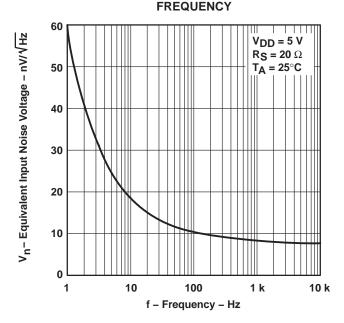
description

The TLC220x, TLC220xA, TLC220xB, and TLC220xY are precision, low-noise operational amplifiers using Texas Instruments Advanced LinCMOS™ process. These devices combine the noise performance of the lowest-noise JFET amplifiers with the dc precision available previously only in bipolar amplifiers. The Advanced LinCMOS™ process uses silicon-gate technology to obtain input offset voltage stability with temperature and time that far exceeds that obtainable using metal-gate technology. In addition, this technology makes possible input impedance levels that meet or exceed levels offered by top-gate JFET and expensive dielectric-isolated devices.

The combination of excellent DC and noise performance with a common-mode input voltage range that includes the negative rail makes these devices an ideal choice for high-impedance, low-level signal-conditioning applications in either single-supply or split-supply configurations.

- **Low Input Bias Current** 1 pA Typ at $T_A = 25^{\circ}C$
- Common-Mode Input Voltage Range Includes the Negative Rail
- Fully Specified For Both Single-Supply and **Split-Supply Operation**

TYPICAL EQUIVALENT INPUT NOISE VOLTAGE VS



The device inputs and outputs are designed to withstand -100-mA surge currents without sustaining latch-up. In addition, internal ESD-protection circuits prevent functional failures at voltages up to 2000 V as tested under MIL-PRF-38535, Method 3015.2; however, care should be exercised in handling these devices as exposure to ESD may result in degradation of the parametric performance.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from -40°C to 85°C. The M-suffix devices are characterized for operation over the full military temperature range of -55°C to 125°C.



PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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TLC2201 AVAILABLE OPTIONS

		V	V	PACKAGED DEVICES						
TA	V _{IO} max AT 25°C	V _n max f = 10 Hz AT 25°C	V _n max f = 1 kHz AT 25°C	SMALL OUTLINE† (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CHIP FORM [‡] (Y)		
	200 μV	35 nV/√Hz	15 nV/√Hz	TLC2201ACD			TLC2201ACP			
0°C to 70°C	200 μV	30 nV/√ Hz	12 nV/√ Hz	TLC2201BCD	_	_	TLC2201BCP	TLC2201Y		
	500 μV	_	_	TLC2201CD			TLC2201CP			
	200 μV	35 nV/√Hz	15 nV/√Hz	TLC2201AID			TLC2201AIP			
-40°C to 85°C	200 μV	30 nV/√ Hz	12 nV/√ Hz	TLC2201BID	_	_	TLC2201BIP	_		
	500 μV	_	_	TLC2201ID			TLC2201IP			
	200 μV	35 nV/√Hz	15 nV/√Hz	TLC2201AMD	TLC2201AMFK	TLC2201AMJG	TLC2201AMP			
-55°C to 125°C	200 μV	30 nV/√Hz	12 nV/√Hz	TLC2201BMD	TLC2201BMFK	TLC2201BMJG	TLC2201BMP	_		
	500 μV	_	_	TLC2201MD	TLC2201MFK	TLC2201MJG	TLC2201MP			

[†]The D packages are available taped and reeled. Add R suffix to device type (e.g. TLC220xBCDR).

TLC2202 AVAILABLE OPTIONS

				I LOZZOZ A		CKAGED DEVICE			
TA	V _{IO} max AT 25°C	V _n max f = 10 Hz AT 25°C	V _n max f = 1 kHz AT 25°C	SMALL OUTLINE† (D)	PLASTIC SMALL OUTLINE (PS)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CHIP FORM [‡] (Y)
	500 μV	30 nV/√ Hz	12 nV/√ Hz	TLC2202BCD	_	_	_	TLC2202BCP	
0°C to 70°C	500 μV	35 nV/√ Hz	15 nV/√ Hz	TLC2202ACD	_	_	_	TLC2202ACP	TLC2202Y
	1 mV	_	_	TLC2202CD	TLC2202CPSR	_	_	TLC2202CP	
	500 μV	30 nV/√Hz	12 nV/√Hz	TLC2202BID	_	_	_	TLC2202BIP	
-40°C to 85°C	500 μV	35 nV/√ Hz	15 nV/√ Hz	TLC2202AID	_	_	_	TLC2202AIP	_
	1 mV	_	_	TLC2202ID	_	_	_	TLC2202IP	
	500 μV	30 nV/√Hz	12 nV/√Hz	TLC2202BMD	_	TLC2202BMFK	TLC2202BMJG	TLC2202BMP	
−55°C to 125°C	500 μV	35 nV/√ Hz	15 nV/√ Hz	TLC2202AMD	_	TLC2202AMFK	TLC2202AMJG	TLC2202AMP	_
	1 mV	_	_	TLC2202MD	_	TLC2202MFK	TLC2202MJG	TLC2202MP	

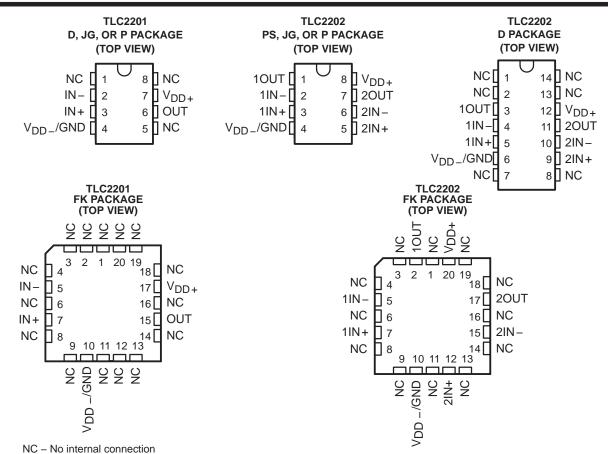
[†] The D packages are available taped and reeled. Add R suffix to device type (e.g. TLC220xBCDR).



[‡] Chip forms are tested at 25°C only.

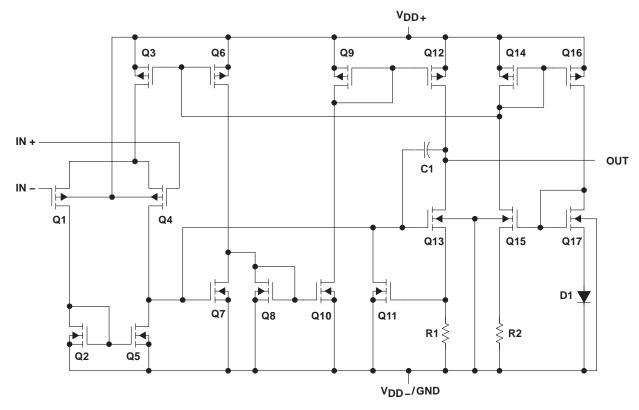
[‡] Chip forms are tested at 25°C only.

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equivalent schematic (each amplifier)

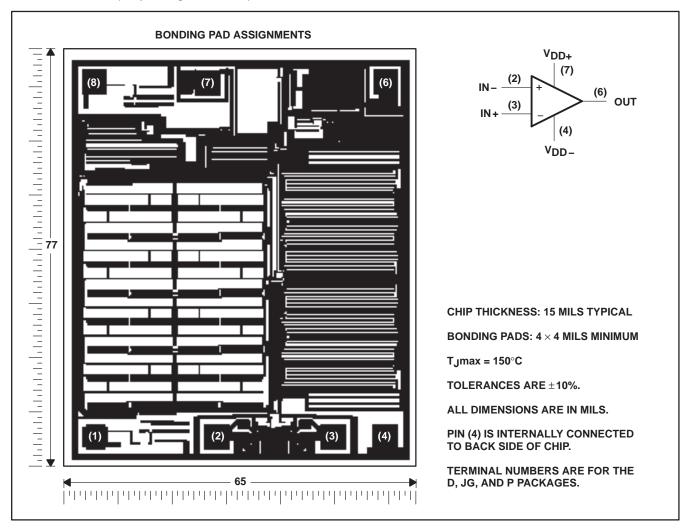


ACTUAL DEVICE COMPONENT COUNT											
COMPONENT TLC2201 TLC2202											
Transistors	17	34									
Resistors	2	2									
Diodes	1	4									
Capacitors	1	2									

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TLC2201Y chip information

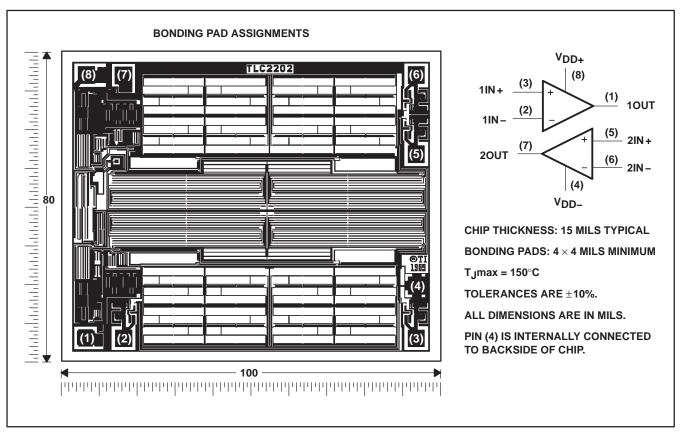
This chip, when properly assembled, displays characteristics similar to the TLC2201C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding path. Chips may be mounted with conductive epoxy or a gold-silicon preform.



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TLC2202Y chip formation

This chip, when properly assembled, displays characteristics similar to the TLC2202C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.



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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V _{DD+} (see Note 1)	
Supply voltage, V _{DD}	8 V
Differential input voltage, V _{ID} (see Note 2)	±16 V
Input voltage, V _I (any input)	±8 V
Input current, I _I (each input)	±5 mA
Output current, I _O (each output)	±50 mA
Duration of short-circuit current at (or below) 25°C (see Note 3)	unlimited
Continuous total dissipation	See Dissipation Rating Table
Operating free-air temperature range, T _A : C suffix	0°C to 70°C
I suffix	–40°C to 85°C
M suffix	–55°C to 125°C
Storage temperature range	–65°C to 150°C
Case temperature for 60 seconds: FK package	
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, PS, or P pa	ackage 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package	300°C

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. All voltage values except differential voltages are with respect to the midpoint between VDD+ and VDD-.
 - 2. Differential voltages are at IN+ with respect to IN-.
 - 3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating in not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_{\mbox{A}} \le 25^{\circ}\mbox{C}$ POWER RATING	DERATING FACTOR ABOVE T _A = 25°C	T _A = 70°C POWER RATING	T _A = 85°C POWER RATING	T _A = 125°C POWER RATING
D-8	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
D-14	950 mW	7.6 mW/°C	608 mW	494 mW	190 mW
PS	770 mW	6.2 mW/°C	496 mW	403 mW	155 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
Р	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW

recommended operating conditions

	C	SUFFIX	1 5	SUFFIX	M		
	MIN	MAX	MIN	MAX	MIN	MAX	UNIT
Supply voltage, V _{DD} ±	±2.3	±8	±2.3	±8	±2.3	±8	V
Common-mode input voltage, V _{IC}	V _{DD} -	V _{DD+} -2.3	V_{DD-}	V _{DD+} -2.3	V_{DD-}	V _{DD+} -2.3	V
Operating free-air temperature, T _A	0	70	-40	85	-55	125	°C



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TLC2201C electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DADAMETED	TEST COL	NDITIONS	- +	TI	LC22010	;	LINIT
	PARAMETER	IESI COI	NDITIONS	T _A †	MIN	TYP	MAX	UNIT
.,				25°C		100	500	.,
VIO	Input offset voltage			Full range			600	μV
ανιο	Temperature coefficient of input offset voltage	1		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	1., .		25°C		0.001	0.005	μV/mo
		$V_{IC} = 0,$	$R_S = 50 \Omega$	25°C		0.5	60	
lio	Input offset current	Fu	Full range			100	рA	
	Land Management	1 🗔		25°C		1	60	A
lВ	Input bias current			Full range			100	pΑ
					-5			
VICR	Common-mode input voltage range	$R_S = 50 \Omega$		Full range	to 2.7			V
				25°C	4.7	4.8		
VOM+	Maximum positive peak output voltage swing			Full range	4.7			V
		$R_L = 10 \text{ k}\Omega$		25°C	-4.7	-4.9		
VOM-	Maximum negative peak output voltage swing			Full range	-4.7			V
				25°C	400	560		
		$V_0 = \pm 4 V$,	$R_L = 500 \text{ k}\Omega$	Full range	300			.,, .,
AVD	Large-signal differential voltage amplification	V 14V	D 4010	25°C	90	100		V/mV
		$V_0 = \pm 4 V$,	$R_L = 10 \text{ k}\Omega$	Full range	70			
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}min$ $R_S = 50 \Omega$	$V_{O} = 0$	Full range	85			dB
				25°C	90	110		
ksvr	Supply voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = \pm 2.3 \text{ V}$	′ to ±8 V	Full range	85			dB
		ļ., .		25°C		1.1	1.5	
IDD	Supply current	$V_O = 0$,	No load	Full range			1.5	mA

[†]Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2201C operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	PARAMETER	TEST COMPITIONS	- +	TL	;		
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
CD	Class mate at smits and	$V_O = \pm 2.3 \text{ V}, R_L = 10 \text{ k}\Omega,$ $C_I = 100 \text{ pF}$	25°C	2	2.7		Miss
SR	Slew rate at unity gain	$C_L = 100 pF$	Full range	1.5			V/μs
.,	Carrie alors in a stance value	f = 10 Hz	25°C		18		nV/√ Hz
V _n	Equivalent input noise voltage	f = 1 kHz	25°C		8		IIV/∀⊓Z
.,	Dealers and a minutest in a minute self-	f = 0.1 to 1 Hz	25°C		0.5		
V _N (PP)	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
In	Equivalent input noise current		25°C		0.6		fA/√ Hz
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		48°		

[†]Full range is 0°C to +70°C.



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TLC2201C electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DADAMETED	TECT OF	NIDITIONS	- +	TL	C2201	/C	TL	C2201E	3C		
	PARAMETER	IESI CC	ONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT	
.,				25°C		80	200		80	200	.,	
VIO	Input offset voltage			Full range			300			300	μV	
ανιο	Temperature coefficient of input offset voltage			Full range		0.5			0.5		μV/°C	
	Input offset voltage long-term drift (see Note 4)	V _{IC} = 0,	$C = 0$, $R_S = 50 \Omega$			0.001	0.005		0.001	0.005	μV/mo	
	lancet affect accomment			25°C		0.5	60		0.5	60	pА	
lio	Input offset current			Full range			100			100	рА	
l.s	Input high ourrent			25°C		1	60		1	60	pA	
IВ	Input bias current			Full range			100			100	рA	
VICR	Common-mode input voltage range	$R_S = 50 \Omega$		Full range	-5 to 2.7			-5 to 2.7			V	
\/a++	Maximum positive peak output			25°C	4.7	4.8		4.7	4.8		V	
VOM+	voltage swing	R _I = 10 kΩ		Full range	4.7			4.7			V	
\/O14	Maximum negative peak output	KL = 10 K22		25°C	-4.7	-4.9		-4.7	-4.9		V	
VOM-	voltage swing			Full range	-4.7			-4.7			V	
		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	R _L = 500 kΩ	25°C	400	560		400	560			
AVD	Large-signal differential voltage	VO = ±4 V,	IVE = 300 K32	Full range	300			300			V/mV	
^VD	amplification	Vo = +4 V	$R_{I} = 10 \text{ k}\Omega$	25°C	90	100		90	100		V/IIIV	
		VO = ± + v,	11 = 10 1122	Full range	70			70				
CMRR	Common-mode rejection ratio	VIC = VICR	min,	25°C	90	115		90	115		dB	
OWNER	Common mode rejection ratio	$V_{O} = 0$,	$R_S = 50 \Omega$	Full range	85			85			GD.	
kovp	Supply voltage rejection ratio	Vpp + - +2	3 \/ to +8 \/	25°C	90	110		90	110		dB	
ksvr	$(\Delta V_{DD\pm}/\Delta V_{IO})$	• DD± - ±2.	$DD \pm = \pm 2.3 \text{ V to } \pm 8 \text{ V}$		85			85			ub	
IDD	Supply current	V _O = 0,	No load	25°C		1.1	1.5		1.1	1.5	mA	
טט.	Cappi, carroin] , ,	110 1000	Full range			1.5			1.5	IIIA	

[†]Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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TLC2201C operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~\text{V}$

	PARAMETER	TEST CONDITIONS	T. †	TLC2201AC			TL	C2201E	C	
	PARAIVIETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
O.D.	Olassa and a state of the section	$V_{O} = \pm 2.3 \text{ V}, R_{L} = 10 \text{ k}\Omega,$	25°C	2	2.7		2	2.7		\// -
SR	Slew rate at unity gain	C _L = 100 pF	Full range	1.5			1.5			V/μs
V	Equivalent input noise volt-	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn age (see Note 5)		f = 1 kHz	25°C		8	15		8	12	nv/√HZ
.,	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		.,
V _{N(PP)}	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.9			1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		48°			48°		

[†] Full range is 0°C to +70°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2201C electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

	DADAMETED	TEST COM	NTIONS	- +	Т	LC22010	2	UNIT
	PARAMETER	TEST CONI	OHIONS	T _A †	MIN	TYP	MAX	UNIT
.,	hand effect college			25°C		100	500	
VIO	Input offset voltage			Full range			600	μV
ανιο	Temperature coefficient of input offset voltage	1		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	1., .		25°C		0.001	0.005	μV/mo
		$V_{IC} = 0$,	$R_S = 50 \Omega$	25°C		0.5	60	
ΙΟ	Input offset current			Full range			100	pA
		1 –		25°C		1	60	
IB	Input bias current			Full range			100	pA
VICR	Common-mode input voltage range	R _S = 50 Ω		Full range	0 to 2.7			V
.,		D 4010		25°C	4.7	4.8		.,
VOH	Maximum high-level output voltage	$R_L = 10 \text{ k}\Omega$		Full range	4.7			V
.,				25°C		0	50	.,
VOL	Maximum low-level output voltage	IO = 0		Full range			50	mV
		$V_{O} = 1 \text{ V to 4 V},$		25°C	150	315		
		$R_L = 500 \text{ k}\Omega$		Full range	100			.,, .,
AVD	Large-signal differential voltage amplification	$V_{O} = 1 \text{ V to 4 V},$		25°C	25	55		V/mV
		$R_L = 10 \text{ k}\Omega$		Full range	15			
01400		V _{IC} = V _{ICR} min,	$V_{O} = 0$,	25°C	90	110		1
CMRR	Common-mode rejection ratio	$R_S = 50 \Omega$		Full range	85			dB
				25°C	90	110		
ksvr	Supply voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD} = 4.6 \text{ V to } 10^{-1}$	b V	Full range	85			dB
1	Cumply current	V- 25V	Nolood	25°C		1	1.5	A
IDD	Supply current	$V_0 = 2.5 V$,	No load	Full range			1.5	mA

[†] Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2201C operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	DADAMETED	TEST COMPITIONS	- +	TL			
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
0.0		$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.8	2.5		.,,
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.3			V/µs
V	Emphysical transfer size well-	f = 10 Hz	25°C		18		nV/√ Hz
Vn	Equivalent input noise voltage	f = 1 kHz	25°C		8	8	
.,	B. I	f = 0.1 to 1 Hz	25°C		0.5		.,
VN(PP)	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
In	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.8		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		45°		

[†] Full range is 0°C to +70°C.



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TLC2201C electrical characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$ (unless otherwise noted)

	DADAMETED	TEST COMPITIONS	- +	TL	C2201	AC	TL	C2201E	3C	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
.,	leavet effect wellows		25°C		80	200		80	200	
V _{IO}	Input offset voltage		Full range			300			300	μV
ανιο	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
1	Input offset surrent		25°C		0.5	60		0.5	60	» ^
liO	Input offset current		Full range			100			100	pА
	Innuit biog gurrant		25°C		1	60		1	60	~ ^
IB	Input bias current		Full range			100			100	рA
VICR	Common-mode input voltage range	R _S = 50 Ω	Full range	0 to 2.7			0 to 2.7			٧
.,	Maximum high-level output	D 4010	25°C	4.7	4.8		4.7	4.8		
VOH	voltage	$R_L = 10 \text{ k}\Omega$	Full range	4.7			4.7			V
V	Maximum low-level output	1 0	25°C		0	50		0	50	mV
VOL	voltage	I _O = 0	Full range			50			50	IIIV
		$V_{O} = 1 \ V \text{ to } 4 \ V,$	25°C	150	315		150	315		
۸	Large-signal differential	$R_L = 500 \text{ k}\Omega$	Full range	100			100			V/mV
AVD	voltage amplification	$V_{O} = 1 \ V \text{ to } 4 \ V,$	25°C	25	55		25	55		V/IIIV
		$R_L = 10 \text{ k}\Omega$	Full range	15			15			
CMRR	Common mode rejection refin	V _{IC} = V _{ICR} min,	25°C	90	110		90	110		dΒ
CIVIKK	Common-mode rejection ratio	$V_O = 0$, $R_S = 50 \Omega$	Full range	85			85			UD
kovo	Supply voltage rejection ratio	V== - 4.6.V to 16.V	25°C	90	110		90	110		dB
ksvr	$(\Delta V_{DD\pm}/\Delta V_{IO})$	$V_{DD} = 4.6 \text{ V to } 16 \text{ V}$	Full range	85			85			UD
loo	Supply current	V _O = 2.5 V, No load	25°C		1	1.5		1	1.5	mA
lDD	Supply Culterit	VO = 2.5 V, NO 10au	Full range			1.5		·	1.5	111/

[†]Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TLC2201C operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	PARAMETER	TEST CONDITIONS	T. †	TL	C2201A	C	TL	C2201B	C	
	PARAIVIETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
CD	Class rate at social	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.8	2.5		1.8	2.5		Miss
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.3			1.3			V/μs
.,	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	110/1112
\/	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		/
V _N (PP)	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√ Hz
	Gain-bandwidth product		25°C		1.8			1.8		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		45°			45°		

[†]Full range is 0°C to +70°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.

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TLC2202C electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise specified)

	DARAMETER	TEOT 6	CHRITICHS	- +	Т	LC22020	C	
	PARAMETER	1551 0	CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
.,				25°C		100	1000	.,
VIO	Input offset voltage			Full range			1150	μV
ανιο	Temperature coefficient of input offset voltage	1		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	1		25°C		0.001	0.005	μV/mo
		$V_{IC} = 0$,	$R_S = 50 \Omega$	25°C		0.5	60	
IIO	Input offset current			Full range			100	
		1		25°C		1	60	рA
I _{IB}	Input bias current			Full range			100	
VICR	Common-mode input voltage range	R _S = 50 Ω		Full range	-5 to 2.7			V
				25°C	4.7	4.8		
VOM+	Maximum positive peak output voltage swing			Full range	4.7			V
		$R_L = 10 \text{ k}\Omega$		25°C	-4.7	-4.9		
VOM-	Maximum negative peak output voltage swing			Full range	-4.7			V
			D 50010	25°C	300	560		
		$V_O = \pm 4 V$	$R_L = 500 \text{ k}\Omega$	Full range	200			.,, .,
AVD	Large-signal differential voltage amplification		D 4010	25°C	50	100		V/mV
		$V_0 = \pm 4 V$	$R_L = 10 \text{ k}\Omega$	Full range	25			
		$V_{O} = 0$,	V _{IC} = V _{ICR} min,	25°C	80	115		
CMRR	Common-mode rejection ratio	$R_S = 50 \Omega$	10 1011	Full range	80			dB
			0.14 0.14	25°C	80	110		
ksvr	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = \pm 2.3$	3 V to ±8 V	Full range	80			dB
1	Complex compact	V- 0	Nolocal	25°C		1.8	2.7	A
IDD	Supply current	$V_O = 0$,	No load	Full range			2.7	mA

[†] Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202C operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	PARAMETER	TEST CON	IDITIONS	T. †	TL	C22020	;	
	PARAMETER	TEST CON	IDITIONS	T _A †	MIN	TYP	MAX	UNIT
0.0	0	$V_0 = \pm 2.3 \text{ V},$	$R_L = 10 \text{ k}\Omega$	25°C	1.8	2.7		\ //
SR	Slew rate at unity gain	C _L = 100 pF		Full range	1.3			V/μs
.,	English land to add a state of the sec	f = 10 Hz		25°C		18		->4/\ -
V _n	Equivalent input noise voltage	f = 1 kHz		25°C		8		nV/√Hz
.,	Park to a select minute of a select man	f = 0.1 to 1 Hz		25°C		0.5		.,
VN(PP)	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz		25°C		0.7		μV
In	Equivalent input noise current			25°C		0.6		fA/√ Hz
	Gain-bandwidth product	f = 10 kHz, C _L = 100 pF	R_L = 10 kΩ,	25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$,	C _L = 100 pF	25°C		48°		

[†] Full range is 0°C to +70°C.



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TLC2202C electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DADAMETED	TEOT OC	NDITIONS	- +	TL	C2202/	AC.	TL	.C2202E	3C	
	PARAMETER	1551 00	NDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
Via	Input offset voltage			25°C		80	500		80	500	μV
VIO	input onset voltage			Full range			650			650	μν
αΝΙΟ	Temperature coefficient of input offset voltage			Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	V _{IC} = 0,	$R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
1	Input offset current	1		25°C		0.5	60		0.5	60	pА
IIO	input onset current			Full range			100			100	pΑ
lin.	Input bias current]		25°C		1	60		1	60	pА
IB	input bias current			Full range			100			100	pΑ
VICR	Common-mode input voltage range	R _S = 50 Ω		Full range	-5 to 2.7			-5 to 2.7			V
.,	Maximum positive peak			25°C	4.7	4.8		4.7	4.8		.,
VOM+	output voltage swing	D: 40 kg		Full range	4.7			4.7			V
V	Maximum negative peak	$R_L = 10 \text{ k}\Omega$		25°C	-4.7	-4.9		-4.7	-4.9		V
VOM-	output voltage swing			Full range	-4.7			-4.7			V
		\/o = +4\/	$R_1 = 500 \text{ k}\Omega$	25°C	300	560		300	560		
AVD	Large-signal differential	VO = ±4 V,	NC = 300 K22	Full range	200			200			V/mV
7VD	voltage amplification	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	$R_1 = 10 \text{ k}\Omega$	25°C	50	100		50	100		V/IIIV
		VO = ±4 V,	NC = 10 K22	Full range	25			25			
CMRR	Common-mode rejection ratio	VIC = VICR		25°C	80	115		80	115		dB
JIVIIXIX	Common mode rejection ratio	$V_{O} = 0,$	$R_S = 50 \Omega$	Full range	80			80			ub_
ksvr	Supply-voltage rejection ratio	$V_{DD+} = \pm 2.3$	3 V to +8 V	25°C	80	110		80	110		dB
"SVK	$(\Delta V_{DD\pm}/\Delta V_{IO})$	**************************************		Full range	80			80			<u> </u>
I _{DD}	Supply current	VO = 0,	No load	25°C		1.8	2.7		1.8	2.7	mA
.טט	Cappi, carroin	10 - 0,	110 1000	Full range			2.7			2.7	111/1

[†]Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202C operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	DADAMETED	TEST SOMBITIONS	- +	TL	C2202A	/C	TL	C2202B	C	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
CD	Class nata at social social	$V_0 = \pm 2.3 \text{ V},$	25°C	1.8	2.7		1.8	2.7		Mina
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.3			1.3			V/μs
V	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	IIV/VIIZ
V	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		\/
V _{N(PP)}	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.9			1.9		MHz
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega$, $C_{I} = 100 \text{ pF}$	25°C		48°			48°		

[†] Full range is 0°C to +70°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2202A and on all devices for the TLC2202B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.



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TLC2202C electrical characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$ (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	- +	Т	LC22020	C	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
.,	land effect will an		25°C		100	1000	.,
VIO	Input offset voltage		Full range			1150	μV
ανιο	Temperature coefficient of input offset voltage	1	Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005	μV/mo
		$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.5	60	pА
ΙΟ	Input offset current		Full range			100	
]	25°C		1	60	pА
lΒ	Input bias current		Full range			100	
				0			
VICR	Common-mode input voltage range	$R_S = 50 \Omega$	Full range	to			V
			2=:0	2.7			
V_{OH}	Maximum high-level output voltage	$R_{I} = 10 \text{ k}\Omega$	25°C	4.7	4.8		٧
		-	Full range	4.7			
Vol	Maximum low-level output voltage	I _O = 0	25°C		0	50	mV
- OL		0 0	Full range			50	
		$V_O = 1 V \text{ to } 4 V,$	25°C	150	315		
AVD	Large-signal differential voltage amplification	$R_L = 500 \text{ k}\Omega$	Full range	100			V/mV
AVD	Large signal differential voltage amplification	$V_O = 1 V \text{ to } 4 V,$	25°C	25	55		V/111V
		$R_L = 10 \text{ k}\Omega$	Full range	15			
CMRR	Common-mode rejection ratio	$V_O = 0$, $V_{IC} = V_{ICR}min$,	25°C	75	110		dB
CIVIKK	Common-mode rejection ratio	$R_S = 50 \Omega$	Full range	75			uБ
	Cumply voltage rejection ratio (AV = 5 /4V =)	\\ 46\\\+0.46\\	25°C	80	110		٩D
ksvr	Supply-voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	V _{DD} = 4.6 V to 16 V	Full range	80			dB
	Complex compact	V O No load	25°C		1.7	2.6	A
lDD	Supply current	$V_O = 0$, No load	Full range			2.6	mA

[†] Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202C operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	DADAMETED	TEST COME	NITIONS	T _A †	TL	C22020	;	
	PARAMETER	TEST CONE	DITIONS		MIN	TYP	MAX	UNIT
CD.	Class note at waits main	$V_0 = 0.5 \text{ V to } 2.5$	V,	25°C	1.6	2.5		1//
SR	Slew rate at unity gain		$C_L = 100 pF$	Full range	1.1			V/μs
,,		f = 10 Hz		25°C		18		->4/15
Vn	Equivalent input noise voltage	f = 1 kHz		25°C		8		nV/√Hz
.,	Back to a select minimum to the contract of the contract of	f = 0.1 to 1 Hz		25°C		0.5		.,
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz		25°C		0.7		μV
In	Equivalent input noise current			25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, C _L = 100 pF	R _L = 10 kΩ,	25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$,	C _L = 100 pF	25°C		47°		

[†] Full range is 0°C to +70°C.



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TLC2202C electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	- +	TL	C2202/	/C	TL	C2202E	3C	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
Vio	Input offset voltage		25°C		80	500		80	500	μV
VIO	input onset voltage		Full range			650			650	μν
αΝΙΟ	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
l. o	Input offset current		25°C		0.5	60		0.5	60	рA
liO	input onset current		Full range			100			100	PΑ
lun.	Input bias current		25°C		1	60		1	60	рA
ΙΒ	input bias current		Full range			100			100	рΑ
VICR	Common-mode input voltage range	RS = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
V	Maximum high-level	D. 401-0	25°C	4.7	4.8		4.7	4.8		V
VOH	output voltage	$R_L = 10 \text{ k}\Omega$	Full range	4.7			4.7			V
VOL	Maximum low-level	I _O = 0	25°C		0	50		0	50	mV
VOL	output voltage	10 = 0	Full range			50			50	IIIV
		$V_O = 1 V \text{ to } 4 V,$	25°C	150	315		150	315		
AVD	Large-signal differential	$R_L = 500 \text{ k}\Omega$	Full range	100			100			V/mV
AVD	voltage amplification	$V_0 = 1 \ V \text{ to } 4 \ V,$	25°C	25	55		25	55		V/111V
		$R_L = 10 \text{ k}\Omega$	Full range	15			15			
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICR} min,	25°C	75	110		75	110		dB
OWNER	Common mode rejection ratio	$V_O = 0$, $R_S = 50 \Omega$	Full range	75			75			uБ
ksvr	Supply-voltage rejection ratio	V _{DD} = 4.6 V to 16 V	25°C	80	110		80	110		dB
"21K	$(\Delta V_{DD\pm}/\Delta V_{IO})$	- 4.0 V 10 10 V	Full range	80			80			ub
I _{DD}	Supply current	V _O = 2.5 V, No load	25°C		1.7	2.6		1.7	2.6	mA
טט.	Cappi, carroin	10 = 2.0 V, 140 load	Full range			2.6			2.6	111// \

[†]Full range is 0°C to +70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202C operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	PARAMETER	TEST CONDITIONS	T. †	TL	C2202/	C	TL	C2202E	C	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
CD	Class nata at social racin	$V_{O} = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.6	2.5		1.6	2.5		\//
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.1			1.1			V/μs
V	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	IIV/VIIZ
V	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		μV
V _{N(PP)}	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μν
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.9			1.9		MHz
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega$, $C_{I} = 100 \text{ pF}$	25°C		47°			47°		

[†] Full range is 0°C to +70°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2202A and on all devices for the TLC2202B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2201I electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DARAMETER	TEGT	CHRITICALO	- +	Т	LC2201	ı	
	PARAMETER	1551 0	CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
.,	harvet effect wells as			25°C		100	500	.,
VIO	Input offset voltage			Full range			650	μV
ανιο	Temperature coefficient of input offset voltage]		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)],, ,		25°C		0.001	0.005	μV/mo
		$V_{IC} = 0$,	$R_S = 50 \Omega$	25°C		0.5	60	
IIO	Input offset current			Full range			150	pA
		1		25°C		1	60	
lΒ	Input bias current			Full range			150	pA
VICR	Common-mode input voltage range	R _S = 50 Ω		Full range	-5 to			V
·ICK	oonmon mode input to lage tange			· u · ugo	2.7			
.,				25°C	4.7	4.8		.,
VOM+	Maximum positive peak output voltage swing			Full range	4.7			V
.,		$R_L = 10 \text{ k}\Omega$		25°C	-4.7	-4.9		
VOM-	Maximum negative peak output voltage swing			Full range	-4.7			V
			D F00. 10	25°C	400	560		
		$V_O = \pm 4 V$,	$R_L = 500 \text{ k}\Omega$	Full range	250			.,, .,
AVD	Large-signal differential voltage amplification		D 4010	25°C	90	100		V/mV
		$V_0 = \pm 4 V$	$R_L = 10 \text{ k}\Omega$	Full range	65			
		V _{IC} = V _{ICR} n	nin,	25°C	90	115		
CMRR	Common-mode rejection ratio	$V_{O} = 0$,	$R_S = 50 \Omega$	Full range	85			dB
				25°C	90	110		
ksvr	Supply voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	$V_{DD\pm} = \pm 2.3$	3 V to ±8 V	Full range	85			dB
1	Complex compact	\/- 0	Nolood	25°C		1.1	1.5	A
IDD	Supply current	$V_O = 0$,	No load	Full range			1.5	mA

[†] Full range is -40°C to +85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150 \, ^{\circ}\text{C}$ extrapolated to $T_{A} = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2201I operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	PARAMETER	TEST CONDITIONS	- .+	TI	LC2201I		LINUT
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
0.0	0	$V_{O} = \pm 2.3 \text{ V}, R_{L} = 10 \text{ k}\Omega,$	25°C	2	2.7		
SR	Slew rate at unity gain	$V_{O} = \pm 2.3 \text{ V}, R_{L} = 10 \text{ k}\Omega,$ $C_{L} = 100 \text{ pF}$	Full range	1.4			V/μs
.,	Envisor land to a decide of the second	f = 10 Hz	25°C		18		->4/\ -
V _n	Equivalent input noise voltage	f = 1 kHz	25°C		8		nV/√ Hz
.,	Back to a select minute in the select in the	f = 0.1 to 1 Hz	25°C		0.5		
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
In	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		48°		

[†] Full range is -40°C to +85°C.



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TLC2201I electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	- +	TL	C2201	Al	TI	C2201	BI	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
VIO	Input offset voltage		25°C		80	200		80	200	μV
۷۱٥	input onset voltage		Full range			350			350	μν
α VIO	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
li o	Input offset current		25°C		0.5	60		0.5	60	рА
lio	input onset current		Full range			150			150	pΑ
lin	Input bias current		25°C		1	60		1	60	рA
lΒ	input bias current		Full range			150			150	PΑ
V _{ICR}	Common-mode input voltage range	$R_S = 50 \Omega$	Full range	-5 to 2.7			-5 to 2.7			V
V _{OM+}	Maximum positive peak output		25°C	4.7	4.8		4.7	4.8		V
VOIVI+	voltage swing	R _I = 10 kΩ	Full range	4.7			4.7			V
V _{OM} -	Maximum negative peak output	17[- 10 1/22	25°C	-4.7	-4.9		-4.7	-4.9		V
VOIVI –	voltage swing		Full range	-4.7			-4.7			V
		$V_{O} = \pm 4 \text{ V}, R_{I} = 500 \text{ k}\Omega$	25°C	400	560		400	560		
A_{VD}	Large-signal differential voltage	VO = = 1 V, TKL = 000 KB2	Full range	250			250			V/mV
7.00	amplification	$V_O = \pm 4 \text{ V}, R_L = 10 \text{ k}\Omega$	25°C	90	100		90	100		.,
		_	Full range	65			65			
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}min,$	25°C	90	115		90	115		dB
		$V_{O} = 0$, $R_{S} = 50 \Omega$	Full range	85			85			
ksvr	Supply voltage rejection ratio	$V_{DD \pm} = \pm 2.3 \text{ V to } \pm 8 \text{ V}$	25°C	90	110		90	110		dB
31K	$(\Delta V_{DD\pm}/\Delta V_{IO})$	-DD = = = 2.0 + 10 ±0 +	Full range	85			85			<u> </u>
I _{DD}	Supply current	$V_{O} = 0$, No load	25°C		1.1	1.5		1.1	1.5	mA
-טט	Capp., canon	10 0, 110 1000	Full range			1.5			1.5	1117

[†]Full range is -40°C to +85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation assuming an activation energy of 0.96 eV.

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TLC2201I operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	PARAMETER	TEST CONDITIONS	T. +	TL	.C2201	ΑI	TL	.C2201I	31	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	$V_0 = \pm 2.3 \text{ V},$	25°C	2	2.7		2	2.7		V/us
SK	Siew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.4			1.4			ν/μ5
V	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	nv/√HZ
V	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		μV
V _{N(PP)}	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μν
In	Equivalent input noise current		25°C		0.6			0.6		fA/√ Hz
	Gain-bandwidth product	$f = 10 \text{ kHz}, \qquad R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.9			1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		48°			48°		

† Full range is -40°C to +85°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2201I electrical characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$ (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	- +	Т	LC2201	I	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
.,	harvet effect wells as		25°C		100	500	
VIO	Input offset voltage		Full range			650	μV
αVIO	Temperature coefficient of input offset voltage		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)],,	25°C		0.001	0.005	μV/mo
		$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.5	60	
IIO	Input offset current		Full range			150	pA
			25°C		1	60	
IB	Input bias current		Full range			150	pA
				0			
VICR	Common-mode input voltage range	$R_S = 50 \Omega$	Full range	to			V
			2-02	2.7			
Vон	Maximum high-level output voltage	$R_{I} = 10 \text{ k}\Omega$	25°C	4.7	4.8		V
	3	_ ·	Full range	4.7			
VOL	Maximum low-level output voltage	I _O = 0	25°C		0	50	mV
VOL	waximum low-level output voltage	10 - 0	Full range			50	111 V
		$V_O = 1 V \text{ to } 4 V,$	25°C	150	315		
	Lanca di santi differenzi del contro de con l'il contro de con l'il contro de contro d	$R_L = 500 \text{ k}\Omega$	Full range	100			\//\/
AVD	Large-signal differential voltage amplification	$V_O = 1 V \text{ to } 4 V,$	25°C	25	55		V/mV
		$R_L = 10 \text{ k}\Omega$	Full range	15			
		V _{IC} = V _{ICR} min,	25°C	90	110		
CMRR	Common-mode rejection ratio	$V_O = 0$, $R_S = 50 \Omega$	Full range	85			dB
			25°C	90	110		
ksvr	Supply voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	$V_{DD} = 4.6 \text{ V to } 16 \text{ V}$	Full range	85			dB
	Owner, comment	V 05V Notes	25°C		1	1.5	4
lDD	Supply current	$V_O = 2.5 \text{ V}$, No load	Full range			1.5	mA

[†] Full range is -40°C to +85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2201I operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	DADAMETED	TEST COMPITIONS	- +	Т	LC2201I		
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
0.0	Olemanta at maite main	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.8	2.5		\// -
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$,, $C_L = 100 \text{ pF}$	Full range	1.2			V/μs
.,	Emphysical transfer size well-	f = 10 Hz	25°C		18		->4/ U -
V _n	Equivalent input noise voltage	f = 1 kHz	25°C		8		nV/√Hz
.,	B. I	f = 0.1 to 1 Hz	25°C		0.5		.,
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
In	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.8		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		45°		

[†]Full range is -40°C to +85°C.



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TLC2201I electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	- +	TL	.C2201	AI	TI	C2201	BI	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V _{IO}	Input offset voltage		25°C		80	200		80	200	μА
۷IO	input onset voltage		Full range			350			350	μΑ
αVIO	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
l. a	Innuit offeet current		25°C		0.5	60		0.5	60	π Λ
lιΟ	Input offset current		Full range			150			150	pΑ
l	Input bigg gurrent]	25°C		1	60		1	60	
I _{IB}	Input bias current		Full range			150			150	pА
VICR	Common-mode input voltage range	R _S = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
.,	Maximum high-level output	D 4010	25°C	4.7	4.8		4.7	4.8		V
VOH	voltage	$R_L = 10 \text{ k}\Omega$	Full range	4.7			4.7			V
\/a:	Maximum low-level output	IO = 0	25°C		0	50		0	50	mV
VOL	voltage	IO = 0	Full range			50			50	IIIV
		$V_0 = 1 \ V \text{ to } 4 \ V,$	25°C	150	315		150	315		
۸۰۰۰	Large-signal differential	$R_L = 500 \text{ k}\Omega$	Full range	100			100			V/mV
AVD	voltage amplification	$V_0 = 1 \ V \text{ to } 4 \ V,$	25°C	25	55		25	55		V/IIIV
		$R_L = 10 \text{ k}\Omega$	Full range	15			15			
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}min,$	25°C	90	110		90	110		dB
CIVILLY	Common-mode rejection ratio	$V_O = 0$, $R_S = 50 \Omega$	Full range	85			85			uБ
kovp	Supply voltage rejection ratio	V _{DD} = 4.6 V to 16 V	25°C	90	110		90	110		dB
ksvr	$(\Delta V_{DD\pm}/\Delta V_{IO})$	VDD = 4.0 V to 10 V	Full range	85			85			uБ
IDD	Supply current	V _O = 2.5 V, No load	25°C		1	1.5		1	1.5	mA
יטט.	Supply Guilett	VO = 2.5 V, 140 load	Full range			1.5			1.5	111/-1

[†] Full range is -40°C to +85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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TLC2201I operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	PARAMETER	TEST CONDITIONS	T. +	TL	.C2201	AI	TL	.C2201E	31	
	PARAIVIETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
CD	Class nata at society main	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.8	2.5		1.8	2.5		Miss
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.2			1.2			V/μs
	Equivalent input noise	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn	voltage (see Note 5)	f = 1 kHz	25°C		8	15		8	12	IIV/√⊓Z
\/	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		
V _N (PP)	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	$f = 10 \text{ kHz}, R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.8			1.8		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		45°			45°		

[†]Full range is -40°C to +85°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2202I electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DADAMETED	TEGT	CONDITIONS	- .+	Т	LC2202		
	PARAMETER	1551 0	CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
.,				25°C		100	1000	.,
VIO	Input offset voltage			Full range			1200	μV
ανιο	Temperature coefficient of input offset voltage	1		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)],,	D 50 0	25°C		0.001	0.005	μV/mo
	hand effect connect	$V_{IC} = 0$,	$R_S = 50 \Omega$	25°C		0.5	60	pА
lo	Input offset current			Full range			150	
	Land Management]		25°C		1	60	pА
lВ	Input bias current			Full range			150	
VICR	Common-mode input voltage range	R _S = 50 Ω		Full range	-5 to			V
					2.7			<u> </u>
V _{OM+}	Maximum positive peak output voltage swing			25°C	4.7	4.8		l
OWIT		R _L = 10 kΩ		Full range	4.7			V
Vom-	Maximum negative peak output voltage swing	110100		25°C	-4.7	-4.9		
VOIVI –	Maximum riegative peak output voltage owing			Full range	-4.7			V
		$V_0 = \pm 4 \text{ V},$	$R_1 = 500 \text{ k}\Omega$	25°C	300	560		1
Δ	Large-signal differential voltage amplification	VO = ± + v,	TYL = 300 K32	Full range	150			V/mV
AVD	Large-signal differential voltage amplification	$V_0 = \pm 4 V$	R _L = 10 kΩ	25°C	50	100		V/111V
		ν _O = ± 4 ν,	NC = 10 K22	Full range	25			
CMDD	Common mode rejection ratio	$V_{O} = 0$,	$V_{IC} = V_{ICR}min,$	25°C	80	115		٩D
CMRR	Common-mode rejection ratio	$R_S = 50 \Omega$		Full range	80			dB
	Owner handle and resident to the state of th		//- : 0 //	25°C	80	110		.15
ksvr	Supply-voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	$V_{DD} = \pm 2.3$	ν το ±8 V	Full range	80			dB
	Owner to comment	., .	Natard	25°C		1.8	2.7	^
IDD	Supply current	$V_{O} = 0,$	No load	Full range			2.7	mA

[†] Full range is -40°C to +85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202I operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	PARAMETER	TEST CON	IDITIONS	T. †	TI	_C2202I		
	PARAMETER	TEST CON	IDITIONS	T _A †	MIN	TYP	MAX	UNIT
0.0	Olever and a strength and a	$V_0 = \pm 2.3 \text{ V},$	$R_L = 10 \text{ k}\Omega$,	25°C	1.8	2.7		\// -
SR	Slew rate at unity gain	$C_L = 100 pF$	_	Full range	1.2			V/μs
.,	Encharter transfer and a selection	f = 10 Hz		25°C		18		nV/√ Hz
V _n	Equivalent input noise voltage	f = 1 kHz		25°C		8		nv/√Hz
.,	Book to a select mission to a select many	f = 0.1 to 1 Hz		25°C		0.5		.,
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz		25°C		0.7		μV
In	Equivalent input noise current			25°C		0.6		fA/√ Hz
	Gain-bandwidth product	f = 10 kHz, C _L = 100 pF	R_L = 10 kΩ,	25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$,	C _L = 100 pF	25°C		48°		

[†] Full range is -40°C to +85°C.



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TLC2202I electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	24244555	TEGT COMPLETIONS	- +	TI	C2202	AI	TI	LC2202	BI	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V	Innut offeet voltege		25°C		80	500		80	500	\/
VIO	Input offset voltage		Full range			700			700	μV
αΛΙΟ	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
1	Input offset current]	25°C		0.5	60		0.5	60	рA
lo	input onset current		Full range			150			150	рΑ
l.a	Input bias current		25°C		1	60		1	60	pА
ΙΒ	input bias current		Full range			150			150	рΑ
VICR	Common-mode input voltage range	R _S = 50 Ω	Full range	-5 to 2.7			-5 to 2.7			V
V	Maximum positive peak		25°C	4.7	4.8		4.7	4.8		V
VOM+	output voltage swing	R _I = 10 kΩ	Full range	4.7			4.7			V
Vou	Maximum negative peak	KL = 10 K22	25°C	-4.7	-4.9		-4.7	-4.9		V
VOM-	output voltage swing		Full range	-4.7			-4.7			V
		$V_O = \pm 4 V$,	25°C	300	560		300	560		
A _{VD}	Large-signal differential	$R_L = 500 \text{ k}\Omega$	Full range	150			150			V/mV
AVD	voltage amplification	$V_O = \pm 4 V$,	25°C	50	100		50	100		V/111V
		$R_L = 10 \text{ k}\Omega$	Full range	25			25			
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICR} min,	25°C	80	115		80	115		dB
OWNER	Common mode rejection ratio	$V_O = 0$, $R_S = 50 \Omega$	Full range	80			80			uВ
ksvr	Supply-voltage rejection ratio	V _{DD±} ±2.3 V to ±8 V	25°C	80	110		80	110		dB
"21K	$(\Delta V_{DD\pm}/\Delta V_{IO})$	*DD± ±2.0 * 10 ±0 *	Full range	80			80			GD.
I _{DD}	Supply current	$V_{O} = 0$, No load	25°C		1.8	2.7		1.8	2.7	mA
טט.	Cuppiy Current	VO = 0, 140 load	Full range			2.7			2.7	111/5

[†] Full range is -40°C to +85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202I operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	DADAMETED	TEST CONDITIONS	T _A †	TL	.C2202/	ΑI	TL	.C2202E	31	
	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	MIN	TYP	MAX	UNIT
CD	Classical at social acids	$V_O = \pm 2.3 \text{ V}, R_L = 10 \text{ k}\Omega,$	25°C	1.8	2.7		1.8	2.7		\// -
SR	Slew rate at unity gain	C _L = 100 pF	Full range	1.2			1.2			V/μs
V	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	110/10
V	Peak-to-peak equivalent	f = 0.1 to 1 Hz	25°C		0.5			0.5		\/
V _{N(PP)}	input noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.9			1.9		MHz
φm	Phase margin at unity gain	$R_{ } = 10 \text{ k}\Omega$, $C_{ } = 100 \text{ pF}$	25°C		48°			48°		

[†]Full range is -40°C to +85°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2202A and on all devices for the TLC2202B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2202I electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	T. †	Т	LC2202	I	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
V	land offeet velters		25°C		100	1000	/
VIO	Input offset voltage		Full range			1200	μV
ανιο	Temperature coefficient of input offset voltage		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	V 0 D- 500	25°C		0.001	0.005	μV/mo
	land offeet coment	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.5	60	pA
ΙO	Input offset current		Full range			150	
I	lanut higa gurrant		25°C		1	60	рΑ
I _{IB}	Input bias current		Full range			150	
VICR	Common-mode input voltage range	R _S = 50 Ω	Full range	0 to 2.7			٧
			25°C	4.7	4.8		
VOH	Maximum high-level output voltage	$R_L = 10 \text{ k}\Omega$	Full range	4.7	7.0		V
			25°C		0	50	
VOL	Maximum low-level output voltage	IO = 0	Full range			50	mV
		V _O =1 V to 4 V,	25°C	150	315		
		$R_L = 500 \text{ k}\Omega$	Full range	100			
AVD	Large-signal differential voltage amplification	$V_O = 1 \text{ V to 4 V},$	25°C	25	55		V/mV
		$R_L = 10 \text{ k}\Omega$	Full range	15			
OMBB	Occurred and anticotics and	$V_O = 0$, $V_{IC} = V_{ICR}min$,	25°C	75	110		JD.
CMRR	Common-mode rejection ratio	$R_S = 50 \Omega$	Full range	75			dB
l	Complex voltage rejection ratio (AVI)	V 4 C V to 4 C V	25°C	80	110		40
ksvr	Supply-voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	V _{DD} = 4.6 V to 16 V	Full range	80			dB
I	Cumply ourrent	V- 25V No lood	25°C		1.7	2.6	A
IDD	Supply current	$V_O = 2.5 \text{ V}$, No load	Full range			2.6	mA

[†] Full range is -40°C to +85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202I operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	DADAMETED	TEST COMPLETIONS	+	Т	LC22021		
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
CD.	Class make at smits main	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.6	2.5		Mhia
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1			V/µs
.,	English at least least a size wellow.	f = 10 Hz	25°C		18		~>//s/I-I=
Vn	Equivalent input noise voltage	f = 1 kHz	25°C		8		nV/√Hz
.,	Back to a select misselect found a fee college	f = 0.1 to 1 Hz	25°C		0.5		
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
In	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	$ f = 10 \text{ kHz}, \qquad \qquad R_L = 10 \text{ k}\Omega, $ $C_L = 100 \text{ pF} $	25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		47°		

[†]Full range is -40°C to +85°C.



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TLC2202I electrical characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$ (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	- +	TI	C2202	AI	TI	C2202	BI	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
Via	Input offset voltage		25°C		80	500		80	500	μV
VIO	input onset voitage		Full range			700			700	μν
αΛΙΟ	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
l. a	Input offset current]	25°C		0.5	60		0.5	60	Aq
IIO	input onset current		Full range			150			150	PΑ
l.n	logut bigg gurrent]	25°C		1	60		1	60	n Λ
IB	Input bias current		Full range			150			150	pA
VICR	Common-mode input voltage range	R _S = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
V	Maximum high-level output	D. 40 kO	25°C	4.7	4.8		4.7	4.8		V
VOH	voltage	$R_L = 10 \text{ k}\Omega$	Full range	4.7			4.7			V
Vai	Maximum low-level output	I _O = 0	25°C		0	50		0	50	mV
VOL	voltage	IQ = 0	Full range			50			50	IIIV
		$V_O = 1 V to 4 V$,	25°C	150	315		150	315		
۸۰۰۰	Large-signal differential	$R_L = 500 \text{ k}\Omega$	Full range	100			100			V/mV
AVD	voltage amplification	$V_O = 1 V \text{ to } 4 V,$	25°C	25	55		25	55		V/IIIV
		$R_L = 10 \text{ k}\Omega$	Full range	15			15			
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICR} min,	25°C	75	110		75	110		dB
CIVIKK	Common-mode rejection ratio	$V_O = 0$, $R_S = 50 \Omega$	Full range	75			75			uБ
ko) (E	Supply-voltage rejection ratio	V _{DD} = 4.6 V to 16 V	25°C	80	110		80	110		dB
ksvr	$(\Delta V_{DD\pm}/\Delta V_{IO})$	VDD = 4.0 V to 10 V	Full range	80			80			uБ
I _{DD}	Supply current	V _O = 2.5 V, No load	25°C		1.7	2.6		1.7	2.6	mA
טטין	i 1000 t 0500	VO = 2.5 V, 140 load	Full range			2.6			2.6	ША

[†]Full range is -40°C to +85°C

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202I operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	PARAMETER	TEST CONDITIONS	т. †	TL	.C2202/	ΔI	TL	.C2202I	BI	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
CD	Class sets at wells seek	$V_{O} = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.6	2.5		1.6	2.5		Miss
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1			1			V/μs
V	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
V _n	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	nv/vHz
\/	Peak-to-peak equivalent	f = 0.1 to 1 Hz	25°C		0.5			0.5		\/
V _{N(PP)}	input noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.9			1.9		MHz
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega$, $C_{I} = 100 \text{ pF}$	25°C		47°			47°		

[†]Full range is -40°C to +85°C

NOTE 5: This parameter is tested on a sample basis for the TLC2202A and on all devices for the TLC2202B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2201M electrical characteristics at specified free-air temperature, $V_{DD\,\pm}$ = ± 5 V (unless otherwise noted)

	DADAMETER	TEOT O	ONDITIONS	_ +	T	LC2201	/	
	PARAMETER	IESI C	ONDITIONS	T _A †	MIN	TYP	MAX	UNIT
,	Land offertuality as			25°C		100	500	.,,
VIO	Input offset voltage			Full range			700	μV
ανιο	Temperature coefficient of input offset voltage			Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)],,	D 50 0	25°C		0.001	0.005	μV/mo
	Land effect comment	$V_{IC} = 0,$	$R_S = 50 \Omega$	25°C		0.5	60	A
IO	Input offset current			Full range			500	рA
	Land Management			25°C		1	60	A
ΙΒ	Input bias current			Full range			500	pA
					-5			
VICR	Common-mode input voltage range	$R_S = 50 \Omega$		Full range	to			V
				0500	2.7	4.0		
V _{OM+}	Maximum positive peak output voltage swing			25°C	4.7	4.8		V
		$R_{\parallel} = 10 \text{ k}\Omega$		Full range	4.7			
V _{OM} _	Maximum negative peak output voltage swing	_		25°C	-4.7	-4.9		V
				Full range	-4.7			
		$V_0 = \pm 4 V$,	$R_1 = 500 \text{ k}\Omega$	25°C	400	560		
A _{VD}	Large-signal differential voltage amplification	,		Full range	200			V/mV
7.00	_a.go o.ga. ao.oa. ronago apoa.o	V0 = +4 V	$R_L = 10 \text{ k}\Omega$	25°C	90	100		.,
				Full range	45			
CMRR	Common-mode rejection ratio	VIC = VICRm	nin,	25°C	90	115		dB
CIVILLIA	Common-mode rejection ratio	$V_{O} = 0$,	$R_S = 50 \Omega$	Full range	85			uБ
kovr	Supply voltage rejection ratio (ΔV _{DD+} /ΔV _{IO})	Vpp +2.3	2 \/ to ± 2 \/	25°C	90	110		dB
ksvr	Supply voltage rejection ratio (\(\D\D\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	$V_{DD\pm} = \pm 2.3$	3 V 10 ± 8 V	Full range	85			uБ
Inn	Supply current	V _O = 0,	No load	25°C		1.1	1.5	mA
IDD	очррту сипепі	v () = 0,	INU IUAU	Full range			1.5	111/4

[†]Full range is –55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2201M operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	DADAMETED	TEST COMPITIONS	- +	TL	C2201N	1	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
0.0		$V_0 = \pm 2.3 \text{ V}, R_L = 10 \text{ k}\Omega,$	25°C	2	2.7		
SR	Slew rate at unity gain	C _L = 100 pF	Full range	1.3			V/μs
V	English at the of section will are	f = 10 Hz	25°C		18		->4/1
V _n	Equivalent input noise voltage	f = 1 kHz	25°C		8		nV/√Hz
.,	B. I	f = 0.1 to 1 Hz	25°C		0.5		
VN(PP)	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
In	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.9		MHz
φm	Phase margin	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		48°		

[†] Full range is -55°C to 125°C.



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TLC2201M electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DADAMETED	TEST COL	IDITIONS	- +	TL	C2201A	M	TL	.C2201B	M	
	PARAMETER	TEST CON	MULLIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V	Innut offeet voltage			25°C		80	200		80	200	/
VIO	Input offset voltage			Full range			400			400	μV
αΛΙΟ	Temperature coefficient of input offset voltage			Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	V _{IC} = 0,	$R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
1	Innut offeet current			25°C		0.5	60		0.5	60	~ A
IIO	Input offset current			Full range			500			500	рA
1	Input bias current			25°C		1	60		1	60	pA
I _{IB}	input bias current			Full range			500			500	pΑ
VICR	Common-mode input voltage range	R _S = 50 Ω		Full range	-5 to 2.7			-5 to 2.7			V
.,	Maximum positive peak			25°C	4.7	4.8		4.7	4.8		.,
V _{OM+}	output voltage swing	D 4010		Full range	4.7			4.7			V
\/ ·	Maximum negative peak	$R_L = 10 \text{ k}\Omega$		25°C	-4.7	-4.9		-4.7	-4.9		V
VOM-	output voltage swing			Full range	-4.7			-4.7			V
		$V_0 = \pm 4 V$,		25°C	400	560		400	560		
۸	Large-signal differential	$R_L = 500 \text{ k}\Omega$		Full range	200			200			V/mV
AVD	voltage amplification	$V_0 = \pm 4 V$,		25°C	90	100		90	100		V/IIIV
		$R_L = 10 \text{ k}\Omega$		Full range	45			45			
CMRR	Common-mode rejection	VIC = VICRm	nin,	25°C	90	115		90	115		dB
CIVIKK	ratio	$V_{O} = 0$,	$R_S = 50 \Omega$	Full range	85			85			uБ
kovrs	Supply voltage rejection	$V_{DD \pm} = \pm 2.3$	2 \/ to ± 2 \/	25°C	90	110		90	110		dB
ksvr	ratio (ΔV _{DD±} /ΔV _{IO})	ν _{DD} ± = ±2.3	ονιυ πον	Full range	85			85			uБ
IDD	Supply current	V _O = 0,	No load	25°C		1.1	1.5		1.1	1.5	mA
טט.	Cuppiy Cultoni	VO = 0,	140 1000	Full range			1.5			1.5	111/5

[†] Full range is -55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observable through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TLC2201M operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	PARAMETER	TEST	T. †	TL	C2201A	M	TL	C2201B	М	
	PARAMETER	CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
0.5	01	$V_0 = \pm 2.3 \text{ V},$	25°C	2	2.7		2	2.7		.,,
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.3			1.3			V/µs
.,	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	nV/√ Hz
Vn	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	nv/√Hz
.,	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		.,
VN(PP)	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√ Hz
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.9			1.9		MHz
фm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		48°			48°		

[†]Full range is -55°C to 125°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2201M electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

	DADAMETED	TEGT COMPLETIONS	_ +	Т	LC2201	М	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
, , , , , , , , , , , , , , , , , , ,	harvet affact walters		25°C		100	500	
VIO	Input offset voltage		Full range			700	μV
ανιο	Temperature coefficient of input offset voltage		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	N 0 5 500	25°C		0.001	0.005*	μV/mo
		$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.5	60	
lio	Input offset current		Full range			500	рA
			25°C		1	60	
IB	Input bias current		Full range			500	рA
				0			
VICR	Common-mode input voltage range	$R_S = 50 \Omega$	Full range	to			V
				2.7			
VOH	Maximum high-level output voltage	$R_{I} = 10 \text{ k}\Omega$	25°C	4.7	4.8		V
		-	Full range	4.7			
VOL	Maximum low-level output voltage	I _O = 0	25°C		0	50	mV
VOL	waximam low level output voltage	10 - 0	Full range			50	111.4
		$V_O = 1 V \text{ to } 4 V,$	25°C	150	315		
۸. ه	Large-signal differential voltage amplification	$R_L = 500 \text{ k}\Omega$	Full range	75			V/mV
AVD	Large-signal differential voltage amplification	$V_O = 1 V \text{ to } 4 V,$	25°C	25	55		V/IIIV
		$R_L = 10 \text{ k}\Omega$	Full range	10			
OMBB	Occurred made minutes at the	V _{IC} = V _{ICR} min,	25°C	90	110		.ID
CMRR	Common-mode rejection ratio	$V_O = 0$, $R_S = 50 \Omega$	Full range	85			dB
	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	V 40V/ 40V/	25°C	90	110		i.
ksvr	Supply voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	V _{DD} = 4.6 V to 16 V	Full range	85			dB
	Complex compact	V- 05V Nolood	25°C		1	1.5	A
lDD	Supply current	$V_O = 2.5 \text{ V}$, No load	Full range			1.5	mA

^{*}On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

TLC2201M operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

DADAMETED	TEST CONDITIONS	- +	TL	C2201N	1	·
PARAMETER	1EST CONDITIONS	'A'	MIN	TYP	MAX	UNIT
Oleverate at anything and	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.8	2.5		\// -
Siew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.1			V/μs
Employed and format made a contract	f = 10 Hz	25°C		18		nV/√ Hz
Equivalent input noise voltage	f = 1 kHz	25°C		8		nv/√Hz
Dool, to most assistant insut soirs values	f = 0.1 to 1 Hz	25°C		0.5		
Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
Equivalent input noise current		25°C		0.6		fA/√Hz
Gain-bandwidth product		25°C		1.8		MHz
Phase margin at unity gain	$R_L = 10 \text{ k}Ω$, $C_L = 100 \text{ pF}$	25°C		45°		
	Gain-bandwidth product	$\begin{tabular}{lll} Slew rate at unity gain & V_O = 0.5 \ V to 2.5 \ V, \\ R_L = 10 \ k\Omega, & C_L = 100 \ pF \end{tabular}$ $\begin{tabular}{lll} Equivalent input noise voltage & f = 10 \ Hz \\ Peak-to-peak equivalent input noise voltage & f = 0.1 to 1 \ Hz \\ \hline Equivalent input noise current & \\ \hline Gain-bandwidth product & f = 10 \ kHz, \\ C_L = 100 \ pF & R_L = 10 \ k\Omega, \\ \hline \end{tabular}$	Slew rate at unity gain $ \begin{array}{c} V_O = 0.5 \ V \ to \ 2.5 \ V, \\ R_L = 10 \ k\Omega, C_L = 100 \ pF \end{array} $ Full range $ \begin{array}{c} F = 10 \ Hz \\ F = 0.1 \ to \ 1 \ Hz \\ F = 0.1 \ to \ 10 \ Hz \\ F = 0.1 \ to \ 10 \ Hz \\ F = 10 \ kHz, \\ C_L = 100 \ pF \end{array} $ Considerable of the product $ \begin{array}{c} F = 10 \ kHz, \\ F = 10 \ kHz, \\ C_L = 100 \ pF \end{array} $ So Considerable of the product $ \begin{array}{c} F = 10 \ kHz, \\ C_L = 100 \ pF \end{array} $ So Considerable of the product $ \begin{array}{c} F = 10 \ kHz, \\ C_L = 100 \ pF \end{array} $	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Slew rate at unity gain $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$

[†] Full range is -55°C to 125°C.



[†] Full range is –55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TLC2201M electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	- +	TL	.C2201A	М	TL	.C2201B	M	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V	Innut offeet voltage		25°C		80	200		80	200	\/
VIO	Input offset voltage		Full range			400			400	μV
ανιο	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005		0.001	0.005	μV/mo
1	Innut offeet current		25°C		0.5	60		0.5	60	n 1
lio	Input offset current		Full range			500			500	pА
1	Input bigg ourrent		25°C		1	60		1	60	n 1
IB	Input bias current		Full range			500			500	pА
VICR	Common-mode input voltage range	R _S = 50 Ω	Full range	0 to 2.7			0 to 2.7			٧
.,	Maximum high-level output	D 4010	25°C	4.7	4.8		4.7	4.8		.,
VOH	voltage	$R_L = 10 \text{ k}\Omega$	Full range	4.7			4.7			V
V	Maximum low-level output	1- 0	25°C		0	50		0	50	V
VOL	voltage	I _O = 0	Full range			50			50	V
		$V_O = 1 V \text{ to } 4 V,$	25°C	150	315		150	315		
A	Large-signal differential	$R_L = 500 \text{ k}\Omega$	Full range	75			75			V/mV
AVD	voltage amplification	$V_0 = 1 \ V \text{ to } 4 \ V,$	25°C	25	55		25	55		V/mv
		$R_L = 10 \text{ k}\Omega$	Full range	10			10			
CMRR	Common-mode rejection	V _{IC} = V _{ICR} min,	25°C	90	110		90	110		dB
CIVIRR	ratio	$V_0 = 0$, $R_S = 50 \Omega$	Full range	85			85			uБ
kove	Supply voltage rejection	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	25°C	90	110		90	110		dB
ksvr	ratio (ΔV _{DD±} /ΔV _{IO})	V _{DD} = 4.6 V to 16 V	Full range	85			85			UD
I _{DD}	Supply current	V _O = 2.5 V, No load	25°C		1.1	1.5		1.1	1.5	mA
יטט.	ouppiy ourion	VU = 2.5 V, 140 10au	Full range			1.5			1.5	ША

[†]Full range is -55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observable through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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TLC2201M operating characteristics at specified free-air temperature, V_{DD} = 5 V

	DADAMETED	TEST CONDITIONS	T. +	TL	C2201A	М	TL	C2201B	M	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
0.0	Q	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.8	2.5		1.8	2.5		
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	1.1			1.1			V/μs
.,	Equivalent input noise voltage	f = 10 Hz	25°C		18	35		18	30	->4/\ -
Vn	(see Note 5)	f = 1 kHz	25°C		8	15		8	12	nV/√Hz
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		
V _{N(PP)}	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.8			1.8		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		45°			45°		

[†]Full range is -55°C to 125°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



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TLC2202M electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

	DARAMETER	TEST COMPITIONS	- +	Т	LC2202I	И	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MMAX 1000 1250 0.005 60 500 600	UNIT
.,	harvet effect wells as		25°C		100	1000	
VIO	Input offset voltage		Full range			1250	μV
ανιο	Temperature coefficient of input offset voltage		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)], , , , , , , , , , , , , , , , , , ,	25°C		0.001	0.005	μV/mo
	harvet effect assert	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.5	60	pА
ΙO	Input offset current		Full range			500	
	Land Management		25°C		1	60	pА
lΒ	Input bias current		Full range			500	
				-5			
VICR	Common-mode input voltage range	$R_S = 50 \Omega$	Full range	to			V
			0.700	2.7			
V _{OM+}	Maximum positive peak output voltage swing		25°C	4.7	4.8		
OWN		R _L = 10 kΩ	Full range	4.7			V
Vom-	Maximum negative peak output voltage swing		25°C	-4.7	-4.9		
- OIVI –			Full range	-4.7			V
		$V_O = 1 V \text{ to } 4 V,$	25°C	300	560		
AVD	Large-signal differential voltage amplification	$R_L = 500 \text{ k}\Omega$	Full range	100			V/mV
AVD	Large-signal differential voltage amplification	$V_O = 1 V \text{ to } 4 V,$	25°C	50	100		V/111V
		$R_L = 10 \text{ k}\Omega$	Full range	25			
CMDD	Common mode unication matic	$V_O = 0$, $V_{IC} = V_{ICR}min$,	25°C	80	115		40
CMRR	Common-mode rejection ratio	$R_S = 50 \Omega$	Full range	80			dB
	Owner handle and resident and the ANA	V 100V/1-10V	25°C	80	110		-ID
ksvr	Supply-voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	$V_{DD} = \pm 2.3 \text{ V to } \pm 8 \text{ V}$	Full range	80			dB
I	Complete company	V- 0 No lood	25°C		1.8	2.7	A
IDD	Supply current	$V_O = 0$, No load	Full range			2.7	mA

^{*}On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

TLC2202M operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

	PARAMETER	TEST CON	IDITIONS	T. †	TL	.C2202N	1	
	PARAMETER	TEST CON	MUITIONS	T _A †	MIN	TYP	MAX	UNIT
CD	Class make at smits main	$V_0 = \pm 2.3 \text{ V},$	$R_L = 10 \text{ k}\Omega$,	25°C	1.8	2.7		Miss
SR	Slew rate at unity gain	$C_L = 100 \text{ pF}$		Full range	1.1			V/μs
.,	Faviral antianut pains valtage	f = 10 Hz		25°C		18		2)//s/II=
Vn	Equivalent input noise voltage	f = 1 kHz		25°C		8		nV/√Hz
.,	Dool, to most, any instant insultant acids weltons	f = 0.1 to 1 Hz		25°C		0.5		
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz		25°C		0.7		μV
In	Equivalent input noise current			25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, C _L = 100 pF	$R_L = 10 \text{ k}\Omega$,	25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$,	C _L = 100 pF	25°C		48°		

[†]Full range is -55°C to 125°C.



[†]Full range is –55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using Arrhenius equation and assuming an activation energy of 0.96 eV.

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TLC2202M electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ± 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T _A †	TLC2202AM			TLC2202BM			
				MIN	TYP	MAX	MIN	TYP	MAX	UNIT
VIO	Input offset voltage	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		80	500		80	500	μV
			Full range			750			750	
αΝΙΟ	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005*		0.001	0.005*	μV/mo
l. a	Input offset current		25°C		0.5	60		0.5	60	pА
liO	input onset current		Full range			500			500	
lin.	Input bias current		25°C		1	60		1	60	pА
IIB			Full range			500			500	
VICR	Common-mode input voltage range	$R_S = 50 \Omega$	Full range	-5 to 2.7			-5 to 2.7			V
	Maximum positive peak		25°C	4.7	4.8		4.7	4.8		V
VOM+	output voltage swing	- R _L = 10 kΩ	Full range	4.7			4.7			
	Maximum negative peak output voltage swing		25°C	-4.7	-4.9		-4.7	-4.9		V
VOM-			Full range	-4.7			-4.7			
AVD	Large-signal differential voltage amplification	$V_O = \pm 4 V$, $R_L = 500 \text{ k}\Omega$	25°C	300	560		300	560		- V/mV
			Full range	100			100			
		$V_O = \pm 4 V$, $R_L = 10 \text{ k}\Omega$	25°C	50	100		50	100		
			Full range	25			25			
CMRR	Common-mode rejection ratio	$V_O = 0$, $V_{IC} = V_{ICR}$ min, $R_S = 50 \Omega$	25°C	80	115		80	115		dB
			Full range	80			80			
ksvr	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = \pm 2.3 \text{ V to } \pm 8 \text{ V}$	25°C	80	110		80	110		dB
			Full range	80			80			
I _{DD}	Supply current	$V_{\Omega} = 0$, No load	25°C		1.8	2.7		1.8	2.7	mA
		VO = 0, 140 load	Full range			2.7			2.7	111/-1

^{*}On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

[†] Full range is –55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TLC2202M operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm5~V$

PARAMETER		TEST CONDITIONS	τ _A †	TLC2202AM			TLC2202BM			
				MIN	TYP	MAX	MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	$V_O = \pm 2.3 \text{ V},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C	1.8	2.7		1.8	2.7		V/μs
			Full range	1.1			1.1			
Vn	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35*		18	30*	nV/√ Hz
		f = 1 kHz	25°C		8	15*		8	12*	
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		.,
		f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.9			1.9		MHz
фm	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		48°			48°		

^{*}On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

NOTE 5: This parameter is tested on a sample basis for the TLC2202A and on all devices for the TLC2202B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



[†] Full range is –55°C to 125°C.

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TLC2202M electrical characteristics at specified free-air temperatures, $V_{DD} = 5 \text{ V}$ (unless otherwise noted)

	DADAMETED	TEST COMPITIONS	t	Т	LC2202	М	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
\/	land offeet velters		25°C		100	1000	\/
VIO	Input offset voltage		Full range			1250	μV
ανιο	Temperature coefficient of input offset voltage		Full range		0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	, a 5 50 0	25°C		0.001	0.005*	μV/mo
		$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.5	60	рА
lio	Input offset current		Full range			500	
	lament bitan assessed		25°C		1	60	pА
IB	Input bias current		Full range			500	
				0			
VICR	Common-mode input voltage range	$R_S = 50 \Omega$	Full range	to			V
			0500	2.7	4.0		
VOH	Maximum high-level output voltage	$R_L = 10 \text{ k}\Omega$	25°C	4.7	4.8		V
<u> </u>		_	Full range	4.7			
VOL	Maximum low-level output voltage	I _O = 0	25°C		0	50	mV
		<u> </u>	Full range			50	
		$V_O = 1 V \text{ to } 4 V,$	25°C	150	315		
AVD	Large-signal differential voltage amplification	$R_L = 500 \text{ k}\Omega$	Full range	75			V/mV
7.00	Large dignar amererniar voltage amplification	$V_O = 1 V \text{ to } 4 V,$	25°C	25	55		V/111V
		$R_L = 10 \text{ k}\Omega$	Full range	10			
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}$ min, $R_S = 50 \Omega$	25°C	75	110		dB
CIVIKK	Common-mode rejection ratio	VIC = VICRIIIII, KS = 30 22	Full range	75			uБ
lea=	Supply-voltage rejection ratio (ΔV _{DD+} /ΔV _{IO})	V _{DD} = 4.6 V to 16 V	25°C	80	110		dB
ksvr	Supply-voltage rejection ratio (AvDD±/AvIO)	VDD= 4.6 V to 16 V	Full range	80			uБ
Inn	Supply current	V _O = 2.5 V, No load	25°C		1.7	2.6	mA
IDD	Supply Guilett	VO = 2.3 V, NO 10au	Full range			2.6	111/4

^{*}On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

TLC2202M operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	PARAMETER	TEST CONDITIONS	T. †	TL	C2202N	1	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	UNIT
CD	Class note at waits and	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.6	2.5		\//··•
SR	Slew rate at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	Full range	0.9			V/μs
.,	Facility land in mode a cine walter	f = 10 Hz	25°C		18		2) //s/ -
Vn	Equivalent input noise voltage	f = 1 kHz	25°C	8			nV/√Hz
.,	Dool, to made assistation to reincusting	f = 0.1 to 1 Hz	25°C		0.5		\/
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz	25°C		0.7		μV
In	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product		25°C		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	25°C		47°	·	

[†]Full range is -55°C to 125°C.



[†] Full range is -55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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TLC2202M electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

	DADAMETED	TEST CONDITIONS	- +	TL	C2202A	M	TL	.C2202E	вМ	
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
\/	Innut effect voltage		25°C		80	500		80	500	\/
VIO	Input offset voltage		Full range			750			750	μV
αΛΙΟ	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	25°C		0.001	0.005*		0.001	0.005*	μV/mo
	Input offset current		25°C		0.5	60		0.5	60	~ A
lio	input oilset current		Full range			500			500	pA
l.s	Input biog ourront		25°C		1	60		1	60	20
IB	Input bias current		Full range			500			500	pA
VICR	Common-mode input voltage range	R _S = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
.,	Maximum high-level output	D 4010	25°C	4.7	4.8		4.7	4.8		.,
VOH	voltage	$R_L = 10 \text{ k}\Omega$	Full range	4.7			4.7			V
1/01	Maximum low-level output	lo - 0	25°C		0	50		0	50	mV
VOL	voltage	IO = 0	Full range			50			50	IIIV
		$V_{O} = 1 V \text{ to } 4 V,$	25°C	150	315		150	315		
Δ. /5	Large-signal differential	$R_L = 500 \text{ k}\Omega$	Full range	75			75			V/mV
AVD	voltage amplification	$V_{O} = 1 V \text{ to } 4 V,$	25°C	25	55		25	55		V/IIIV
		R _L = 10 kΩ	Full range	10			10			
CMRR	Common-mode rejection	$V_O = 0$, $V_{IC} = V_{ICR}min$,	25°C	75	110		75	110		dB
CIVIKK	ratio	$R_S = 50 \Omega$	Full range	75			75			UD .
kovr	Supply-voltage rejection	V _{DD} = 4.6 V to 16 V	25°C	80	110		80	110		dB
ksvr	ratio (ΔV _{DD±} /ΔV _{IO})	VDD = 4.0 V to 10 V	Full range	80			80			uБ
Inn	Supply current	V _O = 2.5 V, No load	25°C		1.7	2.6		1.7	2.6	mA
IDD	очрыў синені	VO = 2.5 V, 140 load	Full range			2.6			2.6	ША

^{*}On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150$ °C extrapolated to $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



[†]Full range is -55°C to 125°C

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TLC2202M operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

	DADAMETED	TEST CONDITIONS	- +	TL	C2202A	M	TL	C2202B	М	LINUT
	PARAMETER	TEST CONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
CD.	Class make at smaller make	$V_O = 0.5 \text{ V to } 2.5 \text{ V},$	25°C	1.6	2.5		1.6	2.5		Mha
SR Slew rate at unity gain		$R_L = 10 kΩ$, $C_L = 100 pF$	Full range	0.9			1.1			V/μs
,	Equivalent input noise voltage	f = 10 Hz	25°C		18	35*		18	30*	->4/\(\frac{11-}{11-}\)
Vn (see Note 5)		f = 1 kHz	25°C		8	15*		8	12*	nV/√Hz
,,	Peak-to-peak equivalent input	f = 0.1 to 1 Hz	25°C		0.5			0.5		.,
VN(PP)	noise voltage	f = 0.1 to 10 Hz	25°C		0.7			0.7		μV
In	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$	25°C		1.9			1.9		MHz
фm	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		47°			47°		

^{*}On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

NOTE 5: This parameter is tested on a sample basis for the TLC2202A and on all devices for the TLC2202B. For other test requirements, please contact the factory. This statement has no bearing or nontesting of other parameters.



[†]Full range is -55°C to 125°C

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TLC2201Y electrical characteristics at $V_{DD\pm}$ = ± 5 V, T_A = 25°C (unless otherwise noted)

	DADAMETER	TEST SOME	NITIONIO	ΤL	C2201Y	1	
	PARAMETER	TEST COND	DITIONS	MIN	TYP	MAX	UNIT
VIO	Input offset voltage				100		μV
	Input offset voltage long-term drift (see Note 4)],, ,	D 500		0.001		μV/mo
I _{IO}	Input offset current	$V_{IC} = 0$,	$R_S = 50 \Omega$		0.5		pA
I _{IB}	Input bias current				1		pA
Vон	Maximum high-level output voltage	$R_L = 10 \text{ k}\Omega$			4.8		V
VOL	Maximum low-level output voltage	I _O = 0			0		mV
		$V_0 = 1 V \text{ to } 4 V,$	$R_L = 500 \Omega$		55		.,, .,
AVD	Large-signal differential voltage amplification	$V_0 = 1 V \text{ to } 4 V,$	$R_L = 10 \Omega$		55		V/mV
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}$ min, R _S = 50 Ω	V _O = 0,		110		dB
ksvr	Supply voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	$V_{DD} = 4.6 \text{ to } 16^{\circ}$	V		110		dB
I _{DD}	Supply current per amplifier	$V_0 = 2.5 V$,	No load		1	·	mA

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2201Y operating characteristics at V_{DD \pm} = \pm 5 V, T_A = 25°C

	PARAMETER	TEC	r conditions		TL	C2201	1	
	PARAMETER	IES	CONDITIONS		MIN	TYP	MAX	UNIT
SR	Positive slew rate at unity gain	$V_0 = \pm 0.5 \text{ to } 2.5 \text{ V},$	$R_L = 10 \text{ k}\Omega$,	$C_L = 100 pF$		2.5		V/µs
.,		f = 10 Hz				18		->//\ -
Vn	Equivalent input noise voltage	f = 1 kHz	8			nV/√Hz		
.,	Peak-to-peak equivalent input noise	f = 0.1 to 1 Hz				0.5		.,
V _{N(PP)}	voltage	f = 0.1 to 10 Hz				0.7		μV
In	Equivalent input noise current					0.6		pA/√Hz
	Gain-bandwidth product	f = 10 kHz,	$R_L = 10 \text{ k}\Omega$,	C _L = 100 pF		1.8		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$,	C _L = 100 pF			48°		

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TLC2202Y electrical characteristics, V_{DD} = 5 V, T_A = 25°C (unless otherwise noted)

	DADAMETED	TEOT COME	NITIONIO.	Τl	C2202Y	′	
	PARAMETER	TEST CONE	DITIONS	MIN	TYP	MAX	UNIT
VIO	Input offset voltage				100		μV
	Input offset voltage long-term drift (see Note 4)	, ,	D 500		0.001		μV/mo
I _{IO}	Input offset current	$V_{IC} = 0,$	$R_S = 50 \Omega$		0.5		рА
I _{IB}	Input bias current				1		pА
Vон	Maximum high-level output voltage	$R_L = 10 \text{ k}\Omega$			4.8		V
VOL	Maximum low-level output voltage	I _O = 0			0		mV
		$V_0 = 1 V \text{ to } 4 V,$	$R_L = 500 \Omega$		315		.,, .,
AVD	Large-signal differential voltage amplification	$V_0 = 1 V to 4 V,$	$R_L = 10 \Omega$		55		V/mV
CMRR	Common-mode rejection ratio	$V_O = 0$, V_{ICR} min,	$R_S = 50 \Omega$		110		dB
ksvr	Supply-voltage rejection ratio (ΔV _{DCC} /ΔV _{IO})	$V_{DD} = 4.6 \text{ to } 16 \text{ V}$			110		dB
lDD	Supply current	V _O = 2.5 V,	No load		1.7		mA

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at $T_A = 150^{\circ}C$ extrapolated to $T_A = 25^{\circ}C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2202Y operating characteristics at V_{DD} = 5 V, T_A = 25°C

	PARAMETER	TEST CO	NDITIONS	TL	C2202Y	′	
	PARAMETER	TEST CO	MIN	TYP	MAX	UNIT	
SR	Positive slew rate at unity gain	$V_O = 0.5 \text{ V to } 2.5 \text{ V}$ $C_L = 100 \text{ pF}$	V, $R_L = 10 kΩ$,		2.5		V/μs
.,		f = 10 Hz			18		->4/15
Vn	Equivalent input noise voltage	f = 10 kHz				nV/√Hz	
.,	.	f = 0.1 to 1 Hz			0.5		.,
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 10 Hz			0.7		μV
In	Equivalent input noise current				0.6		pA/√Hz
B ₁	Gain-bandwidth product	f = 10 kHz, C _L = 100 pF	$R_L = 10 \text{ k}\Omega$,		1.9		MHz
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$,	C _L = 100 pF		47°		

PARAMETER MEASUREMENT INFORMATION

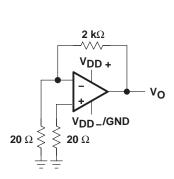
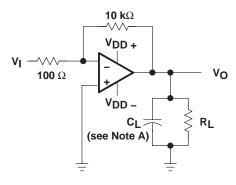
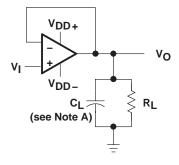


Figure 1. Noise-Voltage Test Circuit



NOTE A: C_L includes fixture capacitance.

Figure 2. Phase-Margin Test Circuit



NOTE A: C_I includes fixture capacitance.

Figure 3. Slew-Rate Test Circuit

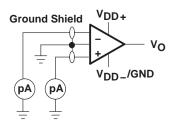


Figure 4. Input-Bias and Offset-Current Test Circuit

typical values

Typical values presented in this data sheet represent the median (50% point) of device parametric performance.

input bias and offset current

At the picoamp bias current level of the TLC220x, TLC220xA, and TLC220xB, accurate measurement of the bias current becomes difficult. Not only does this measurement require a picoammeter, but test socket leakages can easily exceed the actual device bias currents. To measure these small currents, Texas Instruments uses a two-step process. The socket leakage is measured using picoammeters with bias voltages applied but with no device in the socket. The device is then inserted in the socket, and a second test measuring both the socket leakage and the device input bias current is performed. The two measurements are then subtracted algebraically to determine the bias current of the device.

noise

Texas Instruments offers automated production noise testing to meet individual application requirements. Noise voltage at f = 10 Hz and f = 1 kHz is 100% tested on every TLC2201B device, while lot sample testing is performed on the TLC220xA. For other noise requirements, please contact the factory.



Table of Graphs

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I _{IB}	Input bias current	vs Common-mode input voltage vs Free-air temperature	7 8
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VO(PP)	Maximum peak-to-peak output voltage	vs Frequency	11
VOH	High-level output voltage	vs Frequency vs High-level output current vs Free-air temperature	12 13 14
V _{OL}	Low-level output voltage	vs Low-level output current vs Free-air temperature	15 16
A _{VD}	Large-signal differential voltage amplification	vs Frequency vs Free-air temperature	17 18
los	Short-circuit output current	vs Supply voltage vs Free-air temperature	19 20
CMRR	Common-mode rejection ratio	vs Frequency	21
I _{DD}	Supply current	vs Supply voltage vs Free-air temperature	22 23, 24
	Pulse response	Small signal Large signal	25, 26 27, 28
SR	Slew rate	vs Supply voltage vs Free-air temperature	29 30
	Noise voltage (referred to input)	0.1 to 1 Hz 0.1 to 10 Hz	31 32
	Gain-bandwidth product	vs Supply voltage vs Free-air temperature	33, 34 35
φm	Phase margin	vs Supply voltage vs Free-air temperature	36, 37 38, 39
	Phase shift	vs Frequency	17



-1000

-600

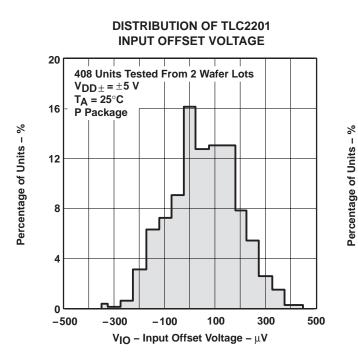
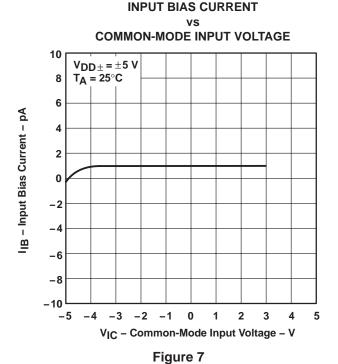


Figure 5



DISTRIBUTION OF INPUT OFFSET VOLTAGE 16 1726 Amplifiers Tested From 1 Wafer Lot $V_{DD\pm} = \pm 15 V$ 14 $T_A = 25^{\circ}C$ P Package 12 10 8 6

TLC2202

Figure 6

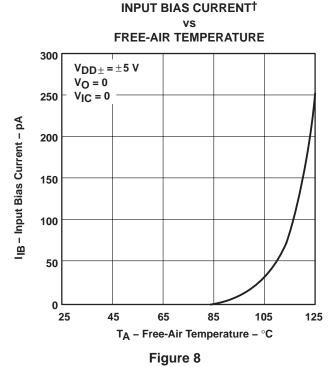
V_{IO} – Input Offset Voltage – μV

-200

200

600

1000



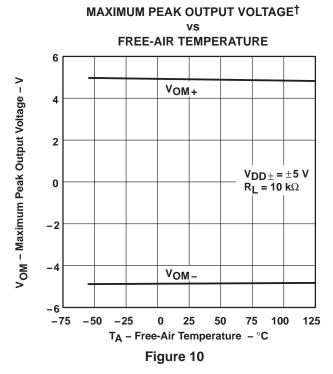
†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

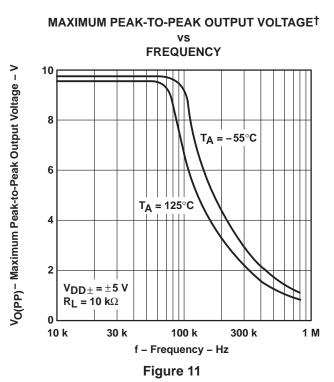


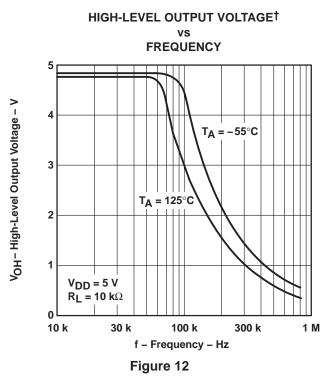
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TYPICAL CHARACTERISTICS

MAXIMUM PEAK OUTPUT VOLTAGE VS OUTPUT CURRENT VOM+ VOM Figure 9

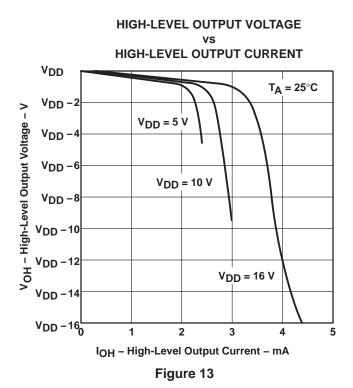


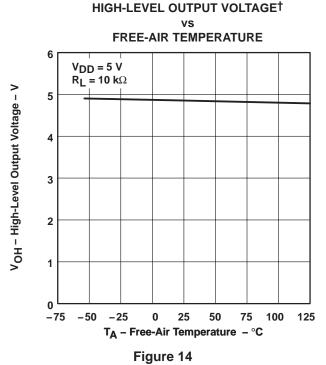




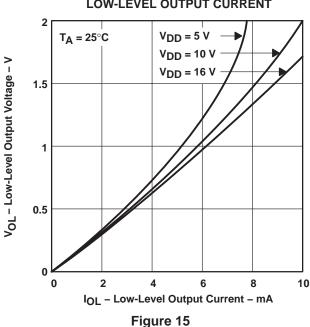
[†]Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.











LOW-LEVEL OUTPUT VOLTAGE[†]

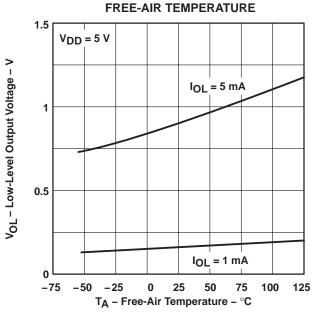


Figure 16

[†]Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

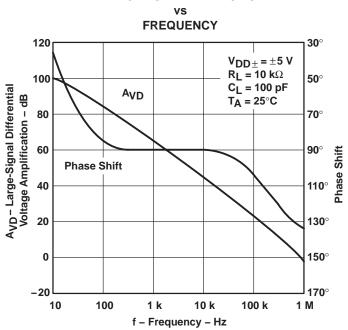


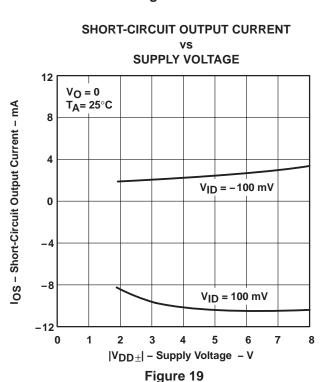
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TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE **AMPLIFICATION AND PHASE SHIFT** vs **FREQUENCY** 120 **30**° $V_{DD\pm} = \pm 5 V$ $R_L = 10 \text{ k}\Omega$ 100 50° $C_{L}^{-} = 100 \text{ pF}$ A_{VD} T_A = 25°C 80 70° 60 90° Phase Shift **Phase Shift** 40 20 130° 150° 0 170°

Figure 17





LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION†

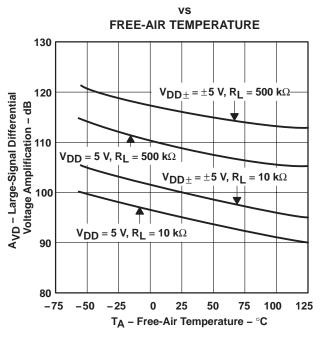
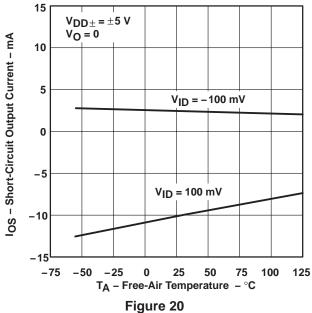


Figure 18

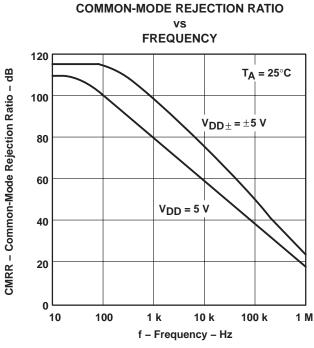
SHORT-CIRCUIT OUTPUT CURRENT†

FREE-AIR TEMPERATURE

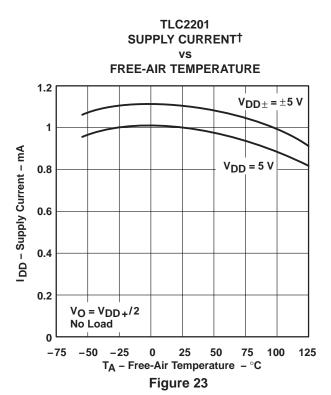


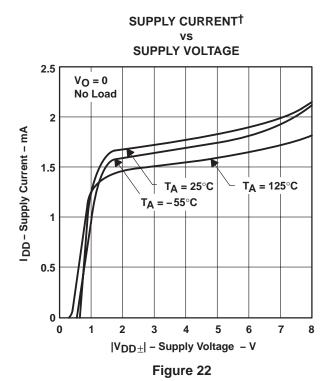
[†] Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



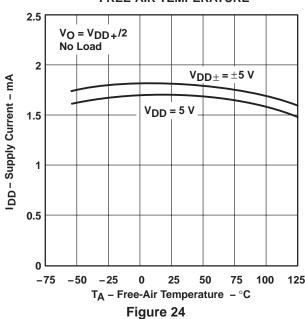








TLC2202 SUPPLY CURRENT[†] FREE-AIR TEMPERATURE



[†] Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



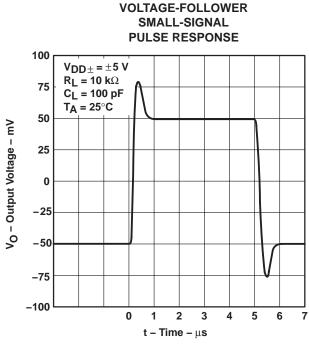
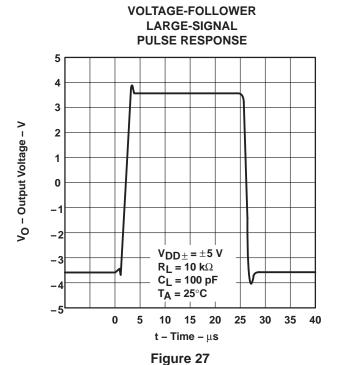


Figure 25



VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE

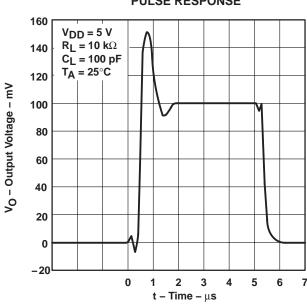


Figure 26

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

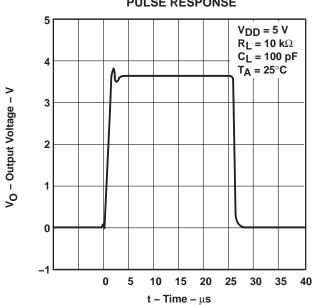
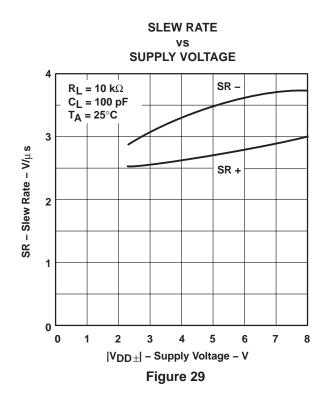
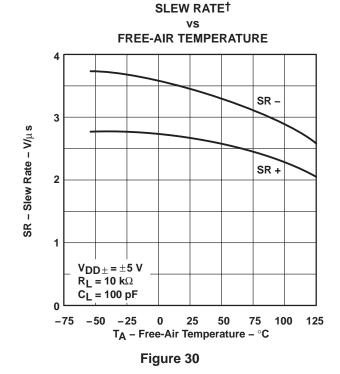
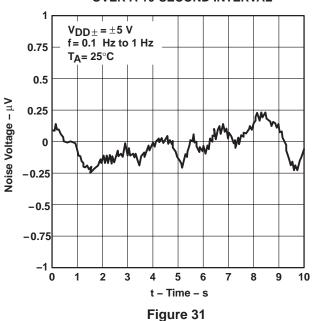


Figure 28

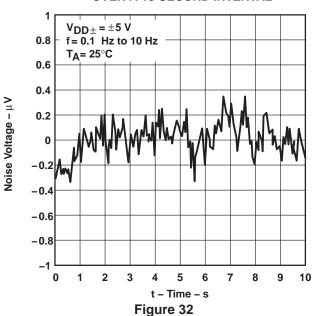




NOISE VOLTAGE (REFERRED TO INPUT) **OVER A 10-SECOND INTERVAL**



NOISE VOLTAGE (REFERRED TO INPUT) **OVER A 10-SECOND INTERVAL**

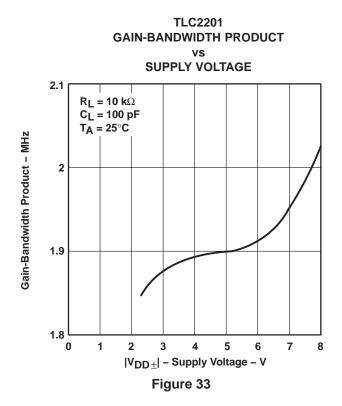


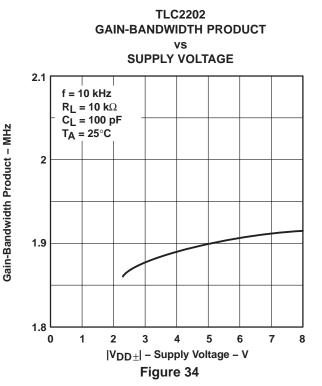
[†]Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

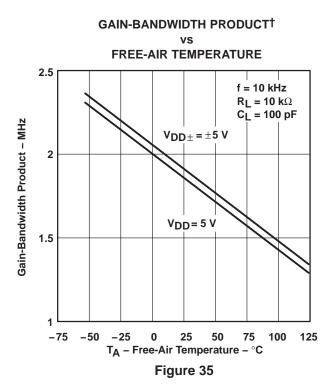


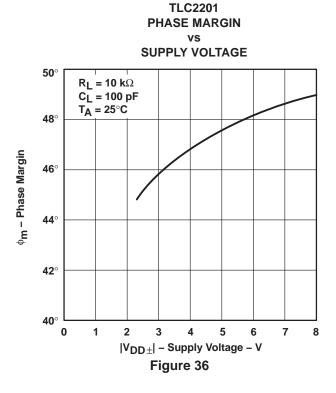
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TYPICAL CHARACTERISTICS



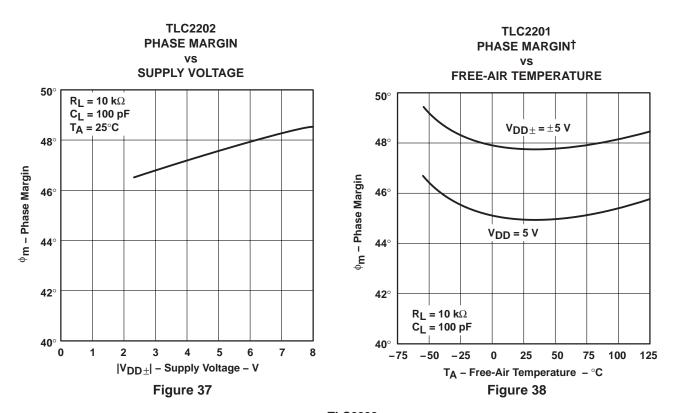




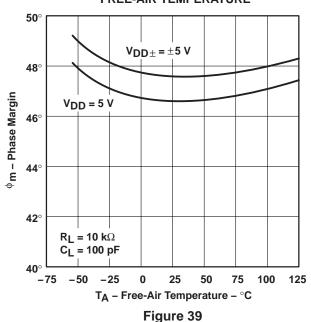


[†] Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.









[†] Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



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APPLICATION INFORMATION

latch-up avoidance

Because CMOS devices are susceptible to latch-up due to their inherent parasitic thyristors, the TLC220x, TLC220xA, and TLC220xB inputs and outputs are designed to withstand -100-mA surge currents without sustaining latch-up; however, techniques reducing the chance of latch-up should be used whenever possible. Internal protection diodes should not be forward biased in normal operation. Applied input and output voltages should not exceed the supply voltage by more than 300 mV. Care should be exercised when using capacitive coupling on pulse generators. Supply transients should be shunted by the use of decoupling capacitors (0.1 μ F typical) located across the supply rails as close to the device as possible.

electrostatic discharge protection

These devices use internal ESD-protection circuits that prevent functional failures at voltages at or below 2000 V. Care should be exercised in handling these devices as exposure to ESD may result in degradation of the device parametric performance.

macromodel information

Macromodel information provided was derived using Microsim *Parts*™, the model generation software used with Microsim *PSpice*™. The Boyle macromodel (see Note 5) and subcircuit in Figure 40 were generated using the TLC220x typical electrical and operating characteristics at 25°C. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

- Maximum positive output voltage swing
- Maximum negative output voltage swing
- Slew rate
- Quiescent power dissipation
- Input bias current
- Open-loop voltage amplification

- Unity-gain frequency
- Common-mode rejection ratio
- Phase margin
- DC output resistance
- AC output resistance
- Short-circuit output current limit

NOTE 5: G. R. Boyle, B. M. Cohn, D. O. Pederson, and J. E. Solomon, "Macromodeling of Integrated Circuit Operational Amplifiers", *IEEE Journal of Solid-State Circuits*, SC-9, 353 (1974).

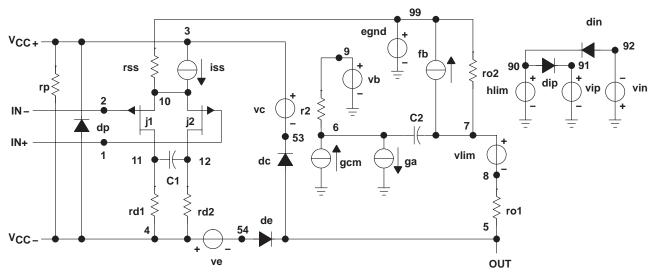
PSpice and Parts are trademarks of MicroSim Corporation.



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APPLICATION INFORMATION

macromodel information (continued)



```
.subckt TLC220x 1 2 3 4 5
                                                                10 dc 135.0E-6
                                                            2
                                                       iio
                                                                0
                                                                  .5E-12
      11 12 8.51E-12
                                                            88
                                                               0 1E-21
 c1
                                                       i1
 с2
            50.00E-12
                                                            11
                                                                89 10 jx
                                                       j1
 cpsr 85 86 79.6E-9
                                                       j2
                                                            12
                                                               80 10 jx
 dcm+ 81
         82 dx
                                                       r2
                                                            6
                                                                9
                                                                  100.0E3
 dcm- 83
         81 dx
                                                            84
                                                                81
                                                       rcm
                                                                  1k
 dc
     5
         53 dx
                                                            88
                                                               Ω
                                                                   1500
                                                       rn1
 de
     54 5
            dx
                                                       ro1
                                                            8
                                                                  188
 dlp 90
         91
                                                                99 187
            dx
                                                       ro2
                                                               99 1.481E6
 dln 92
         90 dx
                                                       rss
                                                            10
     4
         3
             dx
                                                       vad
                                                            60
                                                               4 -.3v
 ecmr 84 99 (2,99) 1
                                                       vcm+ 82
                                                                99 2.2
            poly(2) (3,0) (4,0) 0 .5 .5
 egnd 99
         0
                                                       vcm- 83
                                                               99 -4.5
 epsr 85
            poly(1) (3,4) -200E-6 20E-6
                                                       vb
                                                            9
                                                                0 dc 0
 ense 89
         2.
            poly(1) (88,0) 100E-6 1
                                                       VC
                                                            3
                                                                53 dc .9
 fb
      7
         99
            poly(6) vb vc ve vlp vln
                                                       ve
                                                            54
                                                               4
                                                                   dc .8
              895.9E3 -90E3 90E3 90E3 -90E3 895E3
                                                       vlim 7
 vpsr 0 +
                                                                8
                                                                  dc 0
         0
            11 12 314.2E-6
                                                       vlp 91 0 dc 2.8
 qa
      6
      0
         6
             10 99 1.295E-9
                                                       vln 0
                                                               92 dc 2.8
 gpsr 85 86 (85,86) 100E-6
                                                       vpsr 0 86 dc 0
 grd1 60 11 (60,11) 3.141E-4
                                                      .model dx d(is=800.0E-18)
 grd2 60
         12 (60,12) 3.141E-4
                                                      .model jx pjf(is=500.0E-15 beta=1.462E-3
 hlim 90 0 vlim 1k
                                                     + vto=-.155 kf=1E-17)
 hcmr 80 1 poly(2) vcm+ vcm- 0 1E2 1E2
 irp 3
         4
            965E-6
```

Figure 40. Boyle Macromodel and Subcircuit





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PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish (6)	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9088201M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088201M2A TLC2201MFKB	Samples
5962-9088201MPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088201MPA TLC2201M	Samples
5962-9088202M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088202M2A TLC2202MFKB	Samples
5962-9088202MPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088202MPA TLC2202M	Samples
5962-9088203Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088203Q2A TLC2201 AMFKB	Samples
5962-9088203QPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088203QPA TLC2201AM	Samples
5962-9088204Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088204Q2A TLC2202 AMFKB	Samples
5962-9088204QPA	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088204QPA TLC2202AM	Samples
TLC2201AMD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	2201AM	Samples
TLC2201AMDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		2201AM	Samples
TLC2201AMFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088203Q2A TLC2201 AMFKB	Samples
TLC2201AMJG	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	TLC2201 AMJG	Samples
TLC2201AMJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088203QPA TLC2201AM	Samples
TLC2201AMP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI	-55 to 125		





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Orderable Device	Status	Package Type	_	Pins	_	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
	(1)		Drawing		Qty	(2)	(6)	(3)		(4/5)	
TLC2201CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	2201C	Samples
TLC2201CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	2201C	Samples
TLC2201CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	2201C	Samples
TLC2201CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	2201C	Samples
TLC2201CP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	TLC2201CP	Samples
TLC2201CPE4	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	TLC2201CP	Samples
TLC2201CPSR	OBSOLETE	so so	PS	8		TBD	Call TI	Call TI	0 to 70		
TLC2201ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		22011	Samples
TLC2201IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		22011	Samples
TLC2201IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		22011	Samples
TLC2201IP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type		TLC2201IP	Samples
TLC2201IPE4	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type		TLC2201IP	Samples
TLC2201MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088201M2A TLC2201MFKB	Samples
TLC2201MJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088201MPA TLC2201M	Samples
TLC2202AMFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088204Q2A TLC2202 AMFKB	Samples
TLC2202AMJG	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	TLC2202 AMJG	Samples
TLC2202AMJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088204QPA TLC2202AM	Samples



10-Jun-2014



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Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish (6)	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
TLC2202CD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		2202C	Sample
TLC2202CDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		2202C	Samples
TLC2202CDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		2202C	Samples
TLC2202CDRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		2202C	Samples
TLC2202CP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type		TLC2202CP	Samples
TLC2202CPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		P2202	Samples
TLC2202ID	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		TLC2202I	Samples
TLC2202IDG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		TLC2202I	Samples
TLC2202IP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type		TLC2202IP	Samples
TLC2202IPE4	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type		TLC2202IP	Samples
TLC2202MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9088202M2A TLC2202MFKB	Samples
TLC2202MJG	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	TLC2202MJG	Samples
TLC2202MJGB	ACTIVE	CDIP	JG	8	1	TBD	A42	N / A for Pkg Type	-55 to 125	9088202MPA TLC2202M	Samples

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

TBD: The Pb-Free/Green conversion plan has not been defined.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

PACKAGE OPTION ADDENDUM



10-Jun-2014

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes. **Pb-Free** (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

- (3) MSL, Peak Temp. The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead/Ball Finish Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF TLC2201, TLC2201AM, TLC2201M, TLC2202, TLC2202AM, TLC2202M:

Catalog: TLC2201A, TLC2201, TLC2202A, TLC2202

Military: TLC2201M, TLC2202M

Space: TLC2201-SP, TLC2201-SP

NOTE: Qualified Version Definitions:

- Catalog TI's standard catalog product
- Military QML certified for Military and Defense Applications



PACKAGE OPTION ADDENDUM

10-Jun-2014

• Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION





Α0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

All differsions are norminal												
Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLC2201CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLC2201IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLC2202CDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

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*All dimensions are nominal

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Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)			
TLC2201CDR	SOIC	D	8	2500	340.5	338.1	20.6			
TLC2201IDR	SOIC	D	8	2500	340.5	338.1	20.6			
TLC2202CDR	SOIC	D	14	2500	367.0	367.0	38.0			

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



NOTES: A. All linear dimensions are in inches (millimeters).

- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification.
- E. Falls within MIL STD 1835 GDIP1-T8

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a metal lid.
- D. Falls within JEDEC MS-004



P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Falls within JEDEC MS-001 variation BA.



D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AB.



D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AA.



D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.





NOTES: A. All linear dimensions are in millimeters.

B. This drawing is subject to change without notice.

C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.



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