OP27A, OP27C, OP27E, OP27G OP37A, OP37C, OP37E, OP37G

LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS

SLOS100B - FEBRUARY 1989 - REVISED AUGUST 1994

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

Supply voltage, V _{CC+} (see Note 1)
Supply voltage, V _{CC} (see Note 1) – 22 V
Input voltage, V _I V _{CC±}
Duration of output short circuit unlimited
Differential input current (see Note 2) ±25 mA
Continuous power dissipation
Operating free-air temperature range: OP27A, OP27C, OP37A, OP37C – 55°C to 125°C
OP27E, OP27G, OP37E, OP37G – 25°C to 85°C
Storage temperature range – 65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG or FK package
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds : P package

NOTES: 1. All voltage values are with respect to the midpoint between V_{CC+} and V_{CC-} unless otherwise noted.

The inputs are protected by back-to-back diodes. Current-limiting resistors are not used in order to achieve low noise. Excessive
input current will flow if a differential input voltage in excess of approximately ± 0.7 V is applied between the inputs unless some
limiting resistance is used.

DISSIPATION RATING TABLE

PACKAGE	$T_{\mbox{A}} \le 25^{\circ}\mbox{C}$ POWER RATING	DERATING FACTOR ABOVE T _A = 25°C	T _A = 85°C POWER RATING	T _A = 125°C POWER RATING
JG	1050 mW	8.4 mW/°C	546 mW	210 mW
FK	1375 mW	11.0 mW/°C	715 mW	275 mW
Р	1000 mW	8.0 mW/°C	520 mW	N/A

LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS

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recommended operating conditions

		OP27A, OP37A			OP2	UNIT		
		MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Supply voltage, V _{CC+}		4	15	22	4	15	22	V
Supply voltage, V _{CC} _		-4	-15	-22	-4	-15	-22	V
Common mode input voltage V	$V_{CC\pm} = \pm 15 \text{ V}, T_A = 25^{\circ}\text{C}$	± 11			±11			V
Common-mode input voltage, V _{IC}	$V_{CC\pm} = \pm 15 \text{ V}, T_A = -55^{\circ}\text{C to } 125^{\circ}\text{C}$	±10.3			±10.2			V
Operating free-air temperature, TA	_	-55		125	-55		125	°C

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ± 15 V (unless otherwise noted)

DADAMETED		TEST CONDITIONS		_ +	OP:	27A, OP3	37A	OP	27C, OP3	7C	
	PARAMETER		SNOTHONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V _{IO}	Input offset voltage	$V_{O} = 0,$	V _{IC} = 0	25°C		10	25		30	100	μV
VIO	input onset voltage	$R_S = 50 \Omega$,	See Note 3	Full range			60			300	μν
αVIO	Average temperature coefficient of input offset voltage			Full range		0.2	0.6		0.4	1.8	μV/°C
	Long-term drift of input offset voltage	See Note 4				0.2	1		0.4	2	μV/mo
lio	Input offset current	Vo = 0	$V_O = 0$, $V_{IC} = 0$	25°C		7	35		12	75	nA
ΙΟ	input onset current	V() = 0, V() = 0 Fu	Full range			50			135	ПА	
I _{IB}	Input bias current	$V_O = 0$, $V_{IC} = 0$	25°C		±10	±40		±15	±80	nA	
чв	input bias current	VO = 0,	VIC - 0	Full range			±60			±150	ПА
VICR	Common-mode input			25°C	11 to –11			11 to –11			V
TICK	voltage range			Full range	10.3 to -10.3			10.5 to -10.5			V
		$R_L \ge 2 k\Omega$			±12	±13.8		±11.5	±13.5		
VOM	Peak output voltage swing	$R_L \ge 0.6 \text{ k}\Omega$			±10	±11.5		±10	±11.5		V
		$R_L \ge 2 k\Omega$		Full range	±11.5			10.5			
			$V_0 = \pm 10 \text{ V}$		1000	1800		700	1500		
	Large-signal differential		$V_0 = \pm 10 \text{ V}$		800	1500			1500		
AVD	voltage amplification	$R_L \ge 0.6 \text{ k}\Omega$ $V_{CC\pm} = \pm 4$	$V_{O} = \pm 1 \text{ V},$		250	700		200	500		V/mV
		$R_L \ge 2 k\Omega$,	$V_0 = \pm 10 \text{ V}$	Full range	600			300			
ri(CM)	Common-mode input resistance					3			2		GΩ
r _O	Output resistance	$V_{O} = 0$,	IO = 0	25°C		70			70		Ω
CMRR	Common-mode rejection	V _{IC} = ±11 V		25°C	114	126		100	120		dB
Sivilar	ratio	V _{IC} = ±10 \		Full range	110			94			UB
kSVR	Supply voltage rejection	tage rejection $V_{CC\pm} = \pm 4 V$		25°C	100	120		94	118		dB
JVK	ratio	$V_{CC\pm} = \pm 4$	5 V to ±18 V	Full range	96			86			

[†] Full range is – 55°C to 125°C.

NOTES: 3. Input offset voltage measurements are performed by automatic test equipment approximately 0.5 seconds after applying power.

^{4.} Long-term drift of input offset voltage refers to the average trend line of offset voltage versus time over extended periods after the first 30 days of operation. Excluding the initial hour of operation, changes in V_{IO} during the first 30 days are typically 2.5 μ V (see Figure 3).



LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS

recommended operating conditions

			MIN	NOM	MAX	UNIT
Supply voltage, V _{CC+}			4	15	22	V
Supply voltage, V _{CC} _			-4	-15	-22	V
Common mode input voltage V. a	$V_{CC\pm} = \pm 15 \text{ V},$	T _A = 25°C	±11			V
Common-mode input voltage, V _{IC}	$V_{CC\pm} = \pm 15 \text{ V},$	$T_A = -55^{\circ}C \text{ to } 125^{\circ}C$	±10.5			V
Operating free-air temperature, TA	•		-25		85	°C

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ± 15 V (unless otherwise noted)

DADAMETER		TEST CONDITIONS			OP	27E, OP3	7E	OP	27G, OP3	37G	UNIT
	PARAMETER	IESI CO	SNOTTIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNII
VIO	Input offset voltage	$V_0 = 0,$		25°C		10	25		30	100	μV
VIO	input onset voltage	$R_S = 50 \Omega$,	See Note 3	Full range			60			220	μν
α۷ιΟ	Average temperature coefficient of input offset voltage			Full range		0.2	0.6		0.4	1.8	μV/°C
	Long-term drift of input offset voltage	See Note 4				0.2	1		0.4	2	μV/mo
lio	Input offset current	$V_{O} = 0$,	VIC = 0	25°C		7	35		12	75	nA
110	input onset current	VO = 0,	VIC = 0	Full range			50			135	ПА
I _{IB}	Input bias current	$V_{O} = 0$,	V10 = 0	25°C		±10	±40		±15	±80	nA
I IB	input blue eurient	VO = 0,	VIC = 0	Full range		-	±60			±150	117 (
VICR	Common-mode input			25°C	11 to –11			11 to –11			V
TION	voltage range			Full range	10.3 to -10.3			10.5 to -10.5			,
		$R_L \ge 2 k\Omega$			±12	±13.8		±11.5	±13.5		
Vом	Peak output voltage swing	$R_L \ge 0.6 \text{ k}\Omega$!		±10	±11.5		±10	±11.5		V
		$R_L \ge 2 k\Omega$		Full range	±11.5			10.5			
			$V_0 = \pm 10 \text{ V}$		1000	1800		700	1500		
	Large-signal differential		$V_0 = \pm 10 \text{ V}$		800	1500			1500		
AVD	voltage amplification	$R_L \ge 0.6 \text{ k}\Omega$ $V_{CC\pm} = \pm 4$	$V_0 = \pm 1 \text{ V},$		250	700		200	500		V/mV
		$R_L \ge 2 k\Omega$,	$V_0 = \pm 10 \text{ V}$	Full range	600			450			
ri(CM)	Common-mode input resistance					3			2		GΩ
r _O	Output resistance	$V_0 = 0$,	IO = 0	25°C		70			70		Ω
CMRR	Common-mode rejection	V _{IC} = ±11 V	1	25°C	114	126		100	120		dB
CIVILLY	ratio	V _{IC} = ±10 \	/	Full range	110			96			an an
ksvr	Supply voltage rejection	$V_{CC\pm} = \pm 4$		25°C	100	120		94	118		dB
"21K	ratio	$V_{CC\pm} = \pm 4$.5 V to ±18 V	Full range	96			90			ub_

[†]Full range is – 25°C to 85°C.

NOTES: 3. Input offset voltage measurements are performed by automatic test equipment approximately 0.5 seconds after applying power.

^{4.} Long-term drift of input offset voltage refers to the average trend line of offset voltage versus time over extended periods after the first 30 days of operation. Excluding the initial hour of operation, changes in V_{IO} during the first 30 days are typically 2.5 μV (see Figure 3).



OP27 operating characteristics over operating free-air temperature range, $V_{CC\pm}$ = $\pm 15~V$

	PARAMETER	TEST CONI	TEST CONDITIONS		7A, OP2	27E	OP2	7C, OP2	7G	UNIT
	PARAIVIETER	TEST CONDITIONS		MIN	TYP	MAX	MIN	TYP	MAX	UNIT
SR	Slew rate	$A_{VD} \ge 1$,	$R_L \ge 2 \ k\Omega$	1.7	2.8		1.7	2.8		V/μs
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 10 Hz, See Figure 34	$R_S = 20 \Omega$,		0.08	0.18		0.09	0.25	μV
		f = 10 Hz,	R _S = 20 Ω		3.5	5.5		3.8	8	
٧n	Equivalent input noise voltage	f = 30 Hz,	$R_S = 20 \Omega$		3.1	4.5		3.3	5.6	nV/√ Hz
		f = 1 kHz,	$R_S = 20 \Omega$		3	3.8		3.2	4.5	
		f = 10 Hz,	See Figure 35		1.5	4		1.5		
In	Equivalent input noise current	f = 30 Hz,	See Figure 35		1	2.3		1		pA/√ Hz
		f = 1 kHz,	See Figure 35		0.4	0.6		0.4	0.6	
	Gain-bandwidth product	f = 100 kHz		5	8	·	5	8		MHz

OP37 operating characteristics over operating free-air temperature range, $V_{CC\pm}$ = $\pm 15~V$

PARAMETER		TEST CON	TEST CONDITIONS		OP37A, OP37E			37C, OP	37G	UNIT
		TEST CONDITIONS		MIN	TYP	MAX	MIN	TYP	MAX	I UNII
SR	Slew rate	$A_{VD} \ge 5$,	$R_L \ge 2 k\Omega$	11	17		11	17		V/μs
V _{N(PP)}	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 10 Hz, See Figure 34	$R_S = 20 \Omega$,		0.08	0.18		0.09	0.25	μV
		f = 10 Hz,	R _S = 20 Ω		3.5	5.5		3.8	8	
٧n	Equivalent input noise voltage	f = 30 Hz,	R _S = 20 Ω		3.1	4.5		3.3	5.6	nV/√ Hz
	voltage	f = 1 kHz,	R _S = 20 Ω		3	3.8		3.2	4.5	1
		f = 10 Hz,	See Figure 35		1.5	4		1.5		
In	Equivalent input noise current	f = 30 Hz,	See Figure 35		1	2.3		1		pA/√ Hz
		f = 1 kHz,	See Figure 35		0.4	0.6		0.4	0.6	1
	Coin bandwidth product	f = 10 kHz		45	63		45	63		MHz
	Gain-bandwidth product	$A_V \ge 5$,	f = 1 MHz		40			40		I IVITZ

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
VIO	Input offset voltage	vs Temperature	1
ΔVΙΟ	Change in input offset voltage	vs Time after power on vs Time (long-term drift)	2 3
I _{IO}	Input offset current	vs Temperature	4
I _{IB}	Input bias current	vs Temperature	5
VICR	Common-mode input voltage range	vs Supply voltage	6
Vом	Maximum peak output voltage	vs Load resistance	7
V _{O(PP)}	Maximum peak-to-peak output voltage	vs Frequency	8, 9
AVD	Differential voltage amplification	vs Supply voltage vs Load resistance vs Frequency	10 11 12, 13, 14
CMRR	Common-mode rejection ratio	vs Frequency	15
ksvr	Supply voltage rejection ratio	vs Frequency	16
SR	Slew rate	vs Temperature vs Supply voltage vs Load resistance	17 18 19
φm	Phase margin	vs Temperature	20, 21
ф	Phase shift	vs Frequency	12, 13
V _n	Equivalent input noise voltage	vs Bandwidth vs Source resistance vs Supply voltage vs Temperature vs Frequency	22 23 24 25 26
In	Equivalent input noise current	vs Frequency	27
	Gain-bandwidth product	vs Temperature	20, 21
los	Short-circuit output current	vs Time	28
Icc	Supply current	vs Supply voltage	29
	Pulse response	Small signal Large signal	30, 32 31, 33

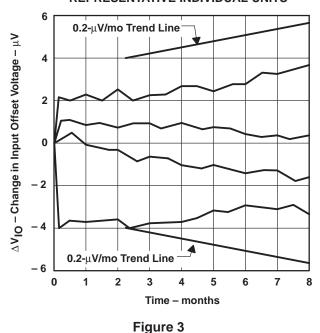
Figure 1

TYPICAL CHARACTERISTICS[†]

WARM-UP CHANGE IN INPUT OFFSET VOLTAGE OF REPRESENTATIVE INDIVIDUAL UNITS **INPUT OFFSET VOLTAGE** FREE-AIR TEMPERATURE **ELAPSED TIME** 100 $V_{CC\pm} = \pm 15 V$ $V_{CC\pm} = \pm 15 V$ 80 T_A = 25°C $\Delta V_{\mbox{\scriptsize IO}} - \mbox{\scriptsize Change}$ in Input Offset Voltage – $\mu \mbox{\scriptsize V}$ OP27C/37C 60 10 V_{IO} – Input Offset Voltage – μV OP27CP/GP OP27A/37A 40 OP27A/37A OP37CP/GP 20 0 OP27E/37E - 20 5 - 40 OP27G/37G OP27AP/EP OP27C/37C OP37AP/EP - 60 - 80 - 100 - 50 - 25 50 75 100 125 5 T_A - Free-Air Temperature - °C Time After Power On - minutes

LONG-TERM DRIFT OF INPUT OFFSET VOLTAGE OF REPRESENTATIVE INDIVIDUAL UNITS

Figure 2





LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS

-75 -50 -25

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INPUT BIAS CURRENT

FREE-AIR TEMPERATURE

TYPICAL CHARACTERISTICS[†]

 $\pm\,$ 50

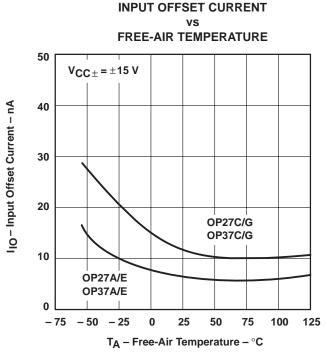
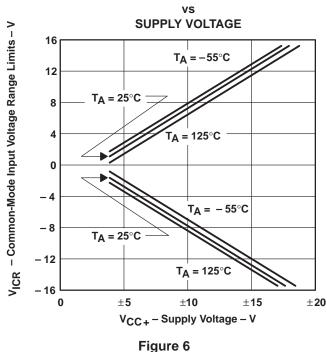


Figure 4

Figure 5

0





MAXIMUM PEAK OUTPUT VOLTAGE

25

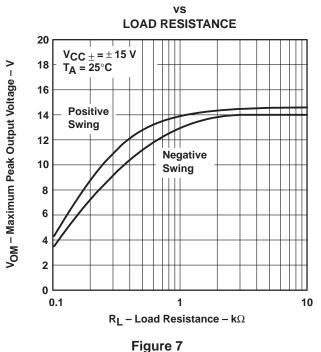
T_A - Free-Air Temperature - °C

50

75

100

125





TYPICAL CHARACTERISTICS

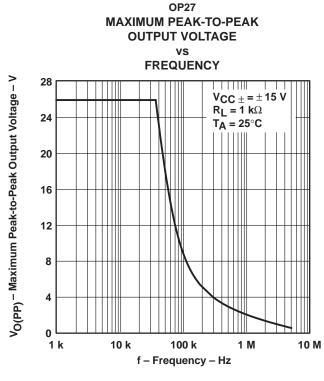


Figure 8

OP27A, OP27E, OP37A, OP37E LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION VS TOTAL SUPPLY VOLTAGE

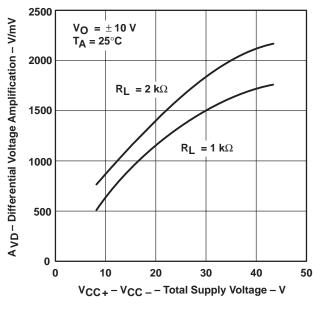


Figure 10

OP37 MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs FREQUENCY

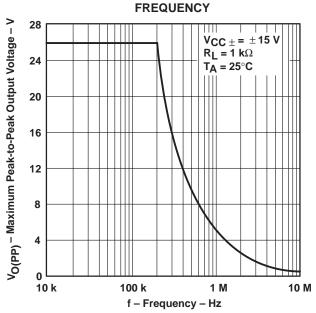


Figure 9

OP27A, OP27E, OP37A, OP37E LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION VS

LOAD RESISTANCE

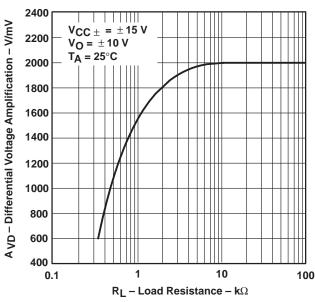
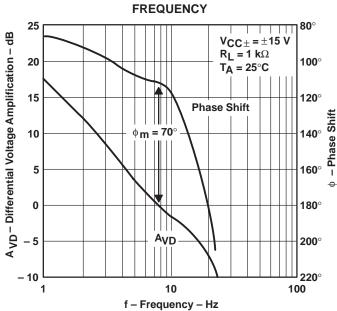


Figure 11



TYPICAL CHARACTERISTICS

OP27 LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT



OP37 LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT

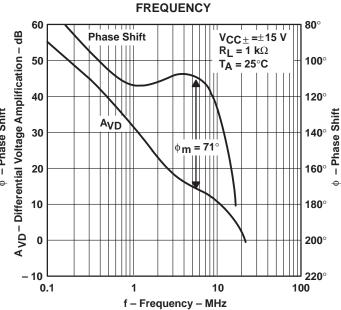


Figure 12

OP27A, OP27E, OP37A, OP37E LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION

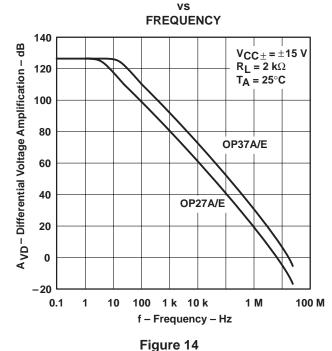


Figure 13

OP27A, OP27E, OP37A, OP37E COMMON-MODE REJECTION RATIO VS FREQUENCY V_{CC±} = ±15 V_{IC} = ±10 V

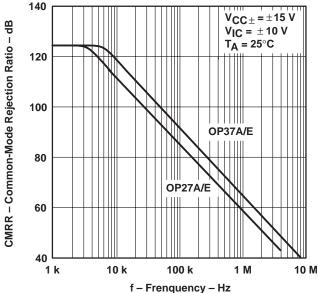
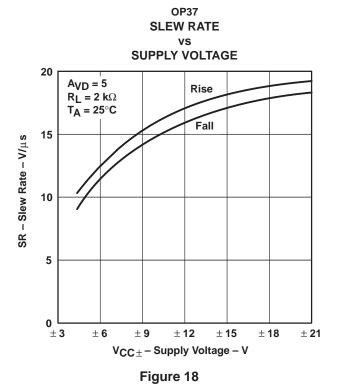


Figure 15

TYPICAL CHARACTERISTICS[†]

SUPPLY VOLTAGE REJECTION RATIO **FREQUENCY** 160 $V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V}$ kSVR-Supply Voltage Rejection Ratio-dB T_A = 25°C 140 120 100 Negative Supply 80 60 40 **Positive** Supply 20 0 10 100 1k 10k 100k 1M 10M 100M f - Frequency - Hz

Figure 16



SLEW RATE vs FREE-AIR TEMPERATURE

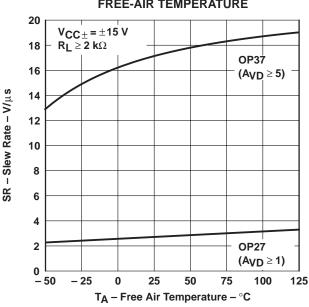
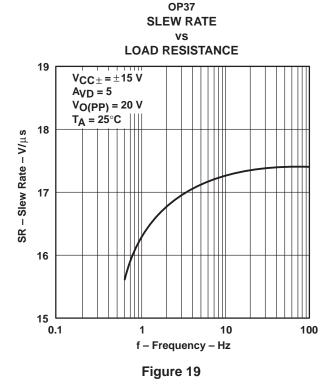


Figure 17

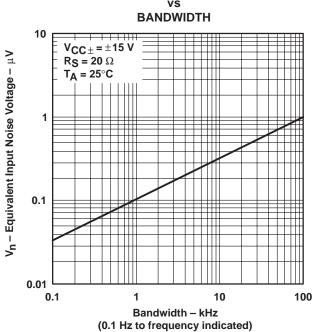




TYPICAL CHARACTERISTICS[†]

OP27 OP37 PHASE MARGIN AND PHASE MARGIN AND GAIN-BANDWIDTH PRODUCT GAIN-BANDWIDTH PRODUCT FREE-AIR TEMPERATURE FREE-AIR TEMPERATURE 809 85° 11 $V_{CC\pm} = \pm 15 V$ $V_{CC\pm} = \pm 15 \text{ V}$ 75 80 10.6 85 φm 10.2 보 70° 80 75° Gain-Bandwidth Product – MHz φm Gain-Bandwidth Product - M **70**° 65° 9.8 om-Phase Margin om-Phase Margin 60° 65° 9.4 GBW (f = 10 kHz) 60° 9 55° 50° 55° 8.6 50° 45 8.2 GBW (f = 100 kHz) 50 45 40° 40 35° 45 7.4 30° 40 359 - 75 - 50 - 25 25 50 75 100 - 50 - 25 50 75 100 125 125 T_A – Free-Air Temperature – °C T_A - Free-Air Temperature - °C Figure 20 Figure 21

EQUIVALENT INPUT NOISE VOLTAGE vs



TOTAL EQUIVALENT INPUT NOISE VOLTAGE

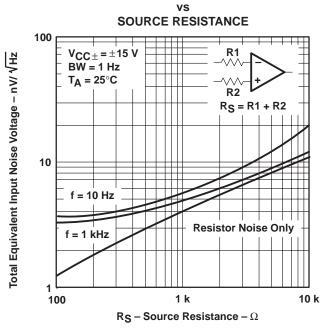


Figure 22 Figure 23

 † Data for temperatures below -25°C and above 85°C are applicable to the OP27A, OP27C, OP37A, and OP37C only.



TYPICAL CHARACTERISTICS[†]

OP27A, OP27E, OP37A, OP37E **EQUIVALENT INPUT NOISE VOLTAGE**

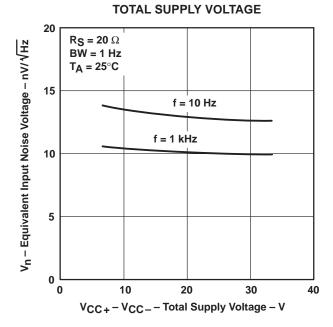


Figure 24

OP27A, OP27E, OP37A, OP37E **EQUIVALENT INPUT NOISE VOLTAGE** FREE-AIR TEMPERATURE

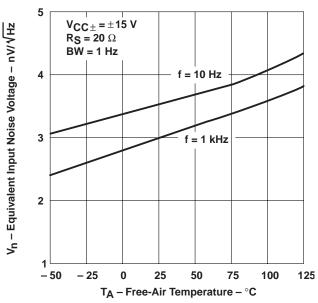


Figure 25

OP27A, OP27E, OP37A, OP37E **EQUIVALENT INPUT NOISE VOLTAGE**

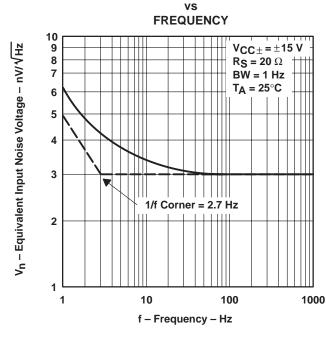


Figure 26

EQUIVALENT INPUT NOISE CURRENT vs

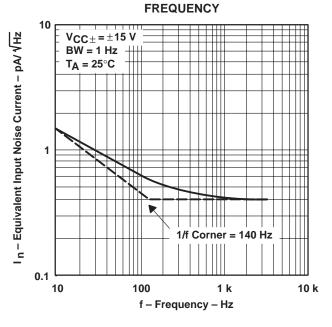


Figure 27