LT1881/LT1882

Dual and Quad Rail-to-Rail Output, Picoamp Input Precision Op Amps

FEATURES

- **Offset Voltage: 50μV Maximum (LT1881A)**
- **Input Bias Current: 200pA Maximum (LT1881A)**
- **Offset Voltage Drift: 0.8μV/°C Maximum**
- **Rail-to-Rail Output Swing**
- **Supply Range: 2.7V to 36V**
- Operates with Single or Split Supplies
- Open-Loop Voltage Gain: 1 Million Minimum
- 1mA Maximum Supply Current Per Amplifier
- Stable at A_V = 1, C_L = 1000pF
- Standard Pinouts
- Wide Operating Temperature Range: –55°C to 125°C (LT1882)

APPLICATIONS

- Thermocouple Amplifiers
- Bridge Transducer Conditioners
- Instrumentation Amplifiers
- Battery-Powered Systems
- Photo Current Amplifiers

DESCRIPTION

The LT®1881 and LT1882 op amps bring high accuracy input performance to amplifiers with rail-to-rail output swing. Input bias currents and capacitive load driving capabilities are superior to the similar LT1884 and LT1885 amplifiers, at the cost of a slight loss in speed. Input offset voltage is trimmed to less than 50μV and the low drift maintains this accuracy over the operating temperature range. Input bias currents are an ultralow 200pA maximum.

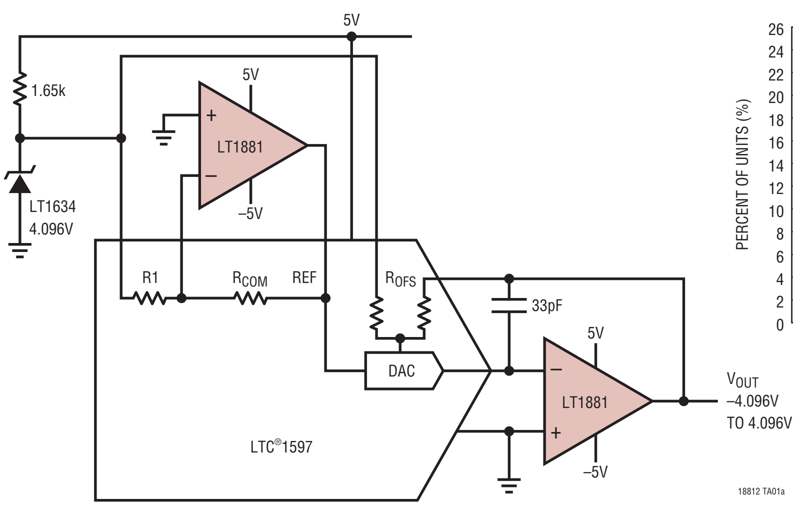
The amplifiers work on any total power supply voltage between 2.7V and 36V (fully specified from 5V to ±15V). Output voltage swings to within 40mV of the negative supply and 220mV of the positive supply make these amplifiers good choices for low voltage single supply operation.

Capacitive loads up to 1000pF can be driven directly in unity-gain follower applications.

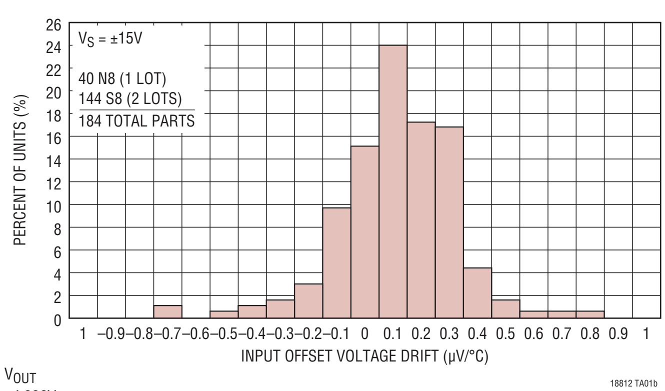
The dual LT1881 and LT1881A are available with standard pinouts in S8 and PDIP packages. The quad LT1882 is in a 14-pin SO package. For a higher speed device with similar DC specifications, see the LT1884/LT1885.

TYPICAL APPLICATION

16-Bit Voltage Output DAC on ±5V Supply



TC V_{OS} Distribution, Industrial Grade



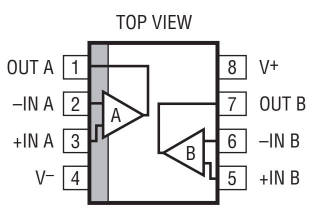
ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage (V^+ to V^-)..40V
Differential Input Voltage (Note 2)...........................±10V
Input Voltage.. V^+ to V^-
Input Current (Note 2).......................................±10mA
Output Short-Circuit Duration (Note 3) .... Indefinite
Operating Temperature Range (Note 4)
- LT1881C/LT1882C...............................–40°C to 85°C
- LT1881I/LT1882I ....–40°C to 85°C
- LT1882H ....–40°C to 125°C
- LT1882MP..–55°C to 125°C

Specified Temperature Range (Note 5)
- LT1881C/LT1882C...............................–40°C to 85°C
- LT1881I/LT1882I ....–40°C to 85°C
- LT1882H ....–40°C to 125°C
- LT1882MP..–55°C to 125°C

Maximum Junction Temperature.......................... 150°C
Storage Temperature Range...................–65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

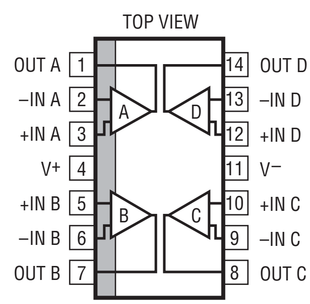
PIN CONFIGURATION



N8 PACKAGE
8-LEAD PDIP

S8 PACKAGE
8-LEAD PLASTIC SO

T_{JMAX} = 150°C, θ_{JA} = 130°C/W (N8)
T_{JMAX} = 150°C, θ_{JA} = 190°C/W (S8)



S PACKAGE
14-LEAD PLASTIC SO

T_{JMAX} = 150°C, θ_{JA} = 160°C/W

ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE
LT1881CN8#PBF	LT1881CN8#TRPBF	LT1881CN8	8-Lead PDIP	0°C to 70°C
LT1881IN8#PBF	LT1881IN8#TRPBF	LT1881IN8	8-Lead PDIP	–40°C to 85°C
LT1881CS8#PBF	LT1881CS8#TRPBF	1881	8-Lead Plastic SO	0°C to 70°C
LT1881IS8#PBF	LT1881IS8#TRPBF	1881I	8-Lead Plastic SO	–40°C to 85°C
LT1881ACN8#PBF	LT1881ACN8#TRPBF	LT1881ACN8	8-Lead PDIP	0°C to 70°C
LT1881AIN8#PBF	LT1881AIN8#TRPBF	LT1881AIN8	8-Lead PDIP	–40°C to 85°C
LT1881ACS8#PBF	LT1881ACS8#TRPBF	1881A	8-Lead Plastic SO	0°C to 70°C
LT1881AIS8#PBF	LT1881AIS8#TRPBF	1881AI	8-Lead Plastic SO	–40°C to 85°C
LT1882CS#PBF	LT1882CS#TRPBF	LT1882CS	14-Lead Plastic SO	0°C to 70°C
LT1882IS#PBF	LT1882IS#TRPBF	LT1882IS	14-Lead Plastic SO	–40°C to 85°C
LT1882HS#PBF	LT1882HS#TRPBF	LT1882HS	14-Lead Plastic SO	–40°C to 125°C
LT1882MPS#PBF	LT1882MPS#TRPBF	LT1882MPS	14-Lead Plastic SO	–55°C to 125°C

Consult LTC Marketing for parts specified with wider operating temperature ranges.

For more information on lead free part marking, go to: http://www.linear.com/leadfree/
For more information on tape and reel specifications, go to: http://www.linear.com/tapeandreel/

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Single supply operation V_S = 5V, 0V; V_{CM} = V_S/2 unless otherwise noted. (Note 5)

SYMBOL	PARAMETER	CONDITIONS		C/I Grades MIN	C/I Grades TYP	C/I Grades MAX	H/MP Grades MIN	H/MP Grades TYP	H/MP Grades MAX	UNITS
V_{OS}	Input Offset Voltage (LT1881A)				25	50				µV
		0°C < T_A < 70°C	●			85				µV
		–40°C < T_A < 85°C	●			110				µV
	Input Offset Voltage (LT1881/LT1882)				30	80		30	80	µV
		0°C < T_A < 70°C	●			125				µV
		–40°C < T_A < 85°C	●			150				µV
		–40°C < T_A < 125°C	●						300	µV
		–55°C < T_A < 125°C	●						300	µV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift (Note 6)	0°C < T_A < 70°C	●		0.3	0.8				µV/°C
		–40°C < T_A < 85°C	●		0.3	0.8				µV/°C
		–40°C < T_A < 125°C	●					0.3	0.8	µV/°C
		–55°C < T_A < 125°C	●					0.3	0.8	µV/°C
$\Delta V_{OS}/\Delta TIME$	Long-Term Input Offset Voltage Stability				0.3			0.3		µV/month
I_{OS}	Input Offset Current (LT1881A)				100	200				pA
		0°C < T_A < 70°C	●			250				pA
		–40°C < T_A < 85°C	●			300				pA
	Input Offset Current (LT1881/LT1882)				150	500		150	500	pA
		0°C < T_A < 70°C	●			600				pA
		–40°C < T_A < 85°C	●			700				pA
		–40°C < T_A < 125°C	●						2000	pA
		–55°C < T_A < 125°C	●						2000	pA
I_B	Input Bias Current (LT1881A)				100	200				pA
		0°C < T_A < 70°C	●			250				pA
		–40°C < T_A < 85°C	●			300				pA
	Input Bias Current (LT1881/LT1882)				150	500		150	500	pA
		0°C < T_A < 70°C	●			600				pA
		–40°C < T_A < 85°C	●			700				pA
		–40°C < T_A < 125°C	●						3000	pA
		–55°C < T_A < 125°C	●						3000	pA
	Input Noise Voltage	0.1Hz to 10Hz			0.5			0.5		μV_{P-P}
e_n	Input Noise Voltage Density	f = 1kHz			14			14		$nV/\sqrt{Hz}$
i_n	Input Noise Current Density	f = 1kHz			0.03			0.03		$pA/\sqrt{Hz}$
R_{IN}	Input Resistance	Differential Mode	●		20			20		MΩ
		Common Mode	●		100			100		GΩ
C_{IN}	Input Capacitance		●		2			2		pF
V_{CM}	Input Voltage Range			V^- + 1.0		V^+ – 1.0	V^- + 1.0		V^+ – 1.0	V
			●	V^- + 1.2		V^+ – 1.2	V^- + 1.2		V^+ – 1.2	V
CMRR	Common Mode Rejection Ratio	1V < V_{CM} < 4V		106	128		106	128		dB
		1.2V < V_{CM} < 3.8V	●	104			102			dB
PSRR	Power Supply Rejection Ratio	V^- = 0V, V_{CM} = 1.5V								
		0°C < T_A < 85°C, 2.7V < V^+ < 32V	●	106						dB
		0°C < T_A < 125°C, 2.7V < V^+ < 32V	●				106			dB
		T_A = –40°C, 3V < V^+ < 32V		106						dB
		T_A = –55°C, 3V < V^+ < 32V					106			dB
	Minimum Operating Supply Voltage		●		2.4	2.7		2.4	2.7	V

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Single supply operation V_S = 5V, 0V; V_{CM} = V_S/2 unless otherwise noted. (Note 5)

SYMBOL	PARAMETER	CONDITIONS		C/I Grades MIN	C/I Grades TYP	C/I Grades MAX	H/MP Grades MIN	H/MP Grades TYP	H/MP Grades MAX	UNITS
A_{VOL}	Large-Signal Voltage Gain	R_L = 10k; 1V < V_{OUT} < 4V		500	1600		500	1600		V/mV
			●	350			300			V/mV
		R_L = 2k; 1V < V_{OUT} < 4V		300	800		300	800		V/mV
			●	250			200			V/mV
		R_L = 1k; 1V < V_{OUT} < 4V		250	400		250	400		V/mV
			●	200			150			V/mV
V_{OL}	Output Voltage Swing Low	No Load	●		20	40		20	50	mV
		I_{SINK} = 100µA	●		25	50		25	60	mV
		I_{SINK} = 1mA	●		70	150		70	200	mV
		I_{SINK} = 5mA	●		270	600		270	750	mV
V_{OH}	Output Voltage Swing High	No Load	●		120	220		120	300	mV
	(Referred to V^+)	I_{SINK} = 100µA	●		130	230		130	325	mV
		I_{SINK} = 1mA	●		180	300		180	450	mV
		I_{SINK} = 5mA	●		360	600		360	800	mV
I_S	Supply Current Per Amplifier	V_S = 3V, 0V		0.45	0.65	0.85	0.45	0.65	0.85	mA
			●			1.2			1.5	mA
		V_S = 5V, 0V		0.5	0.65	0.9	0.5	0.65	0.9	mA
			●			1.4			1.7	mA
		V_S = 12V, 0V		0.5	0.70	1.0	0.5	0.70	1.0	mA
			●			1.5			1.8	mA
I_{SC}	Short-Circuit Current	V_{OUT} Short to GND	●	15	30		10	30		mA
		V_{OUT} Short to V^+	●	15	30		10	30		mA
GBW	Gain Bandwidth Product	f = 20kHz		0.35	1.0		0.35	1.0		MHz
	Channel Separation	f = 1kHz			120			120		dB
t_S	Settling Time	0.01%, V_{OUT} = 1.5V to 3.5V, A_V = –1, R_L = 2k			30			30		µs
SR^+	Slew Rate Positive	A_V = –1		0.15	0.35		0.15	0.35		V/µs
			●	0.12			0.1			V/µs
SR^-	Slew Rate Negative	A_V = –1		0.11	0.18		0.11	0.18		V/µs
			●	0.08			0.06			V/µs
FPBW	Full-Power Bandwidth	V_{OUT} = $4V_{P-P}$		8.75	14		8.75	14		kHz
		(Note 10)	●	6.35			4.75			kHz
ΔV_{OS}	Offset Voltage Match (LT1881A)	(Note 7)			30	70				µV
		0°C < T_A < 70°C	●			125				µV
		–40°C < T_A < 85°C	●			160				µV
	Offset Voltage Match (LT1881/LT1882)	(Note 7)			35	125		35	125	µV
		0°C < T_A < 70°C	●			175				µV
		–40°C < T_A < 85°C	●			235				µV
		–40°C < T_A < 125°C	●						385	µV
		–55°C < T_A < 125°C	●						385	µV
	Offset Voltage Match Drift	(Notes 6, 7)	●		0.4	1.2		0.4	1.2	µV/°C
ΔI_{B+}	Noninverting Bias Current Match (LT1881A)	(Note 7)			200	300				pA
		0°C < T_A < 70°C	●			400				pA
		–40°C < T_A < 85°C	●			500				pA

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Single supply operation V_S = 5V, 0V; V_{CM} = V_S/2 unless otherwise noted. (Note 5)

SYMBOL	PARAMETER	CONDITIONS		C/I Grades MIN	C/I Grades TYP	C/I Grades MAX	H/MP Grades MIN	H/MP Grades TYP	H/MP Grades MAX	UNITS
ΔI_B+	Noninverting Bias Current Match (LT1881/LT1882)	(Note 7)			250	700		250	700	pA
		0°C < T_A < 70°C	●			900				pA
		−40°C < T_A < 85°C	●			1000				pA
		−40°C < T_A < 125°C	●						2000	pA
		−55°C < T_A < 125°C	●						2000	pA
ΔCMRR	Common Mode Rejection Ratio Match	(Notes 7, 9)	●	102	125		100	125		dB
ΔPSRR	Power Supply Rejection Match (Notes 7, 9)	V^- = 0V, V_{CM} = 1.5V								
		0°C < T_A < 85°C, 2.7V < V^+ < 32V	●	104	126					dB
		0°C < T_A < 125°C, 2.7V < V^+ < 32V	●				102	126		dB
		T_A = −40°C, 3V < V^+ < 32V		104	126					dB
		T_A = −55°C, 3V < V^+ < 32V					102	126		dB

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Split supply operation V_S = ±15V, V_{CM} = 0V unless otherwise noted. (Note 5)

SYMBOL	PARAMETER	CONDITIONS		C/I Grades MIN	C/I Grades TYP	C/I Grades MAX	H/MP Grades MIN	H/MP Grades TYP	H/MP Grades MAX	UNITS
V_{OS}	Input Offset Voltage (LT1881A)				25	50				µV
		0°C < T_A < 70°C	●			85				µV
		−40°C < T_A < 85°C	●			110				µV
	Input Offset Voltage (LT1881/LT1882)				30	80		30	80	µV
		0°C < T_A < 70°C	●			125				µV
		−40°C < T_A < 85°C	●			150				µV
		−40°C < T_A < 125°C	●						300	µV
		−55°C < T_A < 125°C	●						300	µV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift (Note 6)	0°C < T_A < 70°C	●		0.3	0.8				µV/°C
		−40°C < T_A < 85°C	●		0.3	0.8				µV/°C
		−40°C < T_A < 125°C	●					0.3	0.8	µV/°C
		−55°C < T_A < 125°C	●					0.3	0.8	µV/°C
ΔV_{OS}/ ΔTIME	Long-Term Input Offset Voltage Stability				0.3			0.3		µV/month
I_{OS}	Input Offset Current (LT1881A)				100	200				pA
		0°C < T_A < 70°C	●			250				pA
		−40°C < T_A < 85°C	●			300				pA
	Input Offset Current (LT1881/LT1882)				150	500		150	500	pA
		0°C < T_A < 70°C	●			600				pA
		−40°C < T_A < 85°C	●			700				pA
		−40°C < T_A < 125°C	●						2000	pA
		−55°C < T_A < 125°C	●						2000	pA
I_B	Input Bias Current (LT1881A)				100	200				pA
		0°C < T_A < 70°C	●			250				pA
		−40°C < T_A < 85°C	●			300				pA
	Input Bias Current (LT1881/LT1882)				150	500		150	500	pA
		0°C < T_A < 70°C	●			600				pA
		−40°C < T_A < 85°C	●			700				pA
		−40°C < T_A < 125°C	●						3000	pA
		−55°C < T_A < 125°C	●						3000	pA

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Split supply operation V_S = ±15V, V_{CM} = 0V unless otherwise noted. (Note 5)

SYMBOL	PARAMETER	CONDITIONS		C/I Grades MIN	C/I Grades TYP	C/I Grades MAX	H/MP Grades MIN	H/MP Grades TYP	H/MP Grades MAX	UNITS
	Input Noise Voltage	0.1Hz to 10Hz			0.5			0.5		μV_{P-P}
e_n	Input Noise Voltage Density	f = 1kHz			14			14		$nV/\sqrt{Hz}$
i_n	Input Noise Current Density	f = 1kHz			0.03			0.03		$pA/\sqrt{Hz}$
R_{IN}	Input Resistance	Differential Mode Common Mode	● ●		20 100			20 100		MΩ GΩ
C_{IN}	Input Capacitance		●		2			2		pF
V_{CM}	Input Voltage Range		 ●	V^- + 1.0 V^- + 1.2		V^+ – 1.0 V^+ – 1.2	V^- + 1.0 V^- + 1.2		V^+ – 1.0 V^+ – 1.2	V V
CMRR	Common Mode Rejection Ratio	–13.5V < V_{CM} < 13.5V	●	114	130		110	130		dB
+PSRR	Positive Power Supply Rejection Ratio	V^- = –15V, V_{CM} = 0V; 1.5V < V^+ < 18V	●	110	132		108	132		dB
–PSRR	Negative Power Supply Rejection Ratio	V^+ = 15V, V_{CM} = 0V; –1.5V < V^- < –18V	●	106	132		104	132		dB
	Minimum Operating Supply Voltage		●		±1.2	±1.35		±1.2	±1.35	V
A_{VOL}	Large-Signal Voltage Gain	R_L = 10k; –13.5V < V_{OUT} < 13.5V	 ●	1000 700	1600		1000 500	1600		V/mV V/mV
		R_L = 2k; –13.5V < V_{OUT} < 4V	 ●	175 125	420		175 110	420		V/mV V/mV
		R_L = 1k; 1V < V_{OUT} < 4V	 ●	90 65	230		90 7	230		V/mV V/mV
V_{OL}	Output Voltage Swing Low (Referred to V_{EE})	No Load I_{SINK} = 100µA I_{SINK} = 1mA I_{SINK} = 5mA	● ● ● ●		20 25 70 270	40 50 150 600		20 25 70 270	50 60 200 750	mV mV mV mV
V_{OH}	Output Voltage Swing High (Referred to V_{CC})	No Load I_{SOURCE} = 100µA I_{SOURCE} = 1mA I_{SOURCE} = 5mA	● ● ● ●		120 130 180 360	220 230 300 600		120 130 180 360	300 325 450 800	mV mV mV mV
I_S	Supply Current Per Amplifier	V_S = ±15V	 ●	0.5	0.85	1.1 1.6	0.5	0.85	1.1 2.0	mA mA
I_{SC}	Short-Circuit Current	V_{OUT} Short to V^-	 ●	20 15	40 40		20 10	40 40		mA mA
		V_{OUT} Short to V^+	 ●	20 15	30 30		20 10	30 30		mA mA
GBW	Gain Bandwidth Product	f = 20kHz		0.4	0.85		0.4	0.85		MHz
	Channel Separation	f = 1kHz			120			120		dB
t_S	Settling Time	0.01%, V_{OUT} = –5V to 5V, A_V = –1, R_L = 2k			30			30		µs
SR^+	Slew Rate Positive	A_V = –1	 ●	0.21 0.18	0.4		0.21 0.15	0.4		V/µs V/µs
SR^-	Slew Rate Negative	A_V = –1	 ●	0.13 0.1	0.20		0.11 0.07	0.20		V/µs V/µs

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Split supply operation V_S = ±15V, V_{CM} = 0V unless otherwise noted. (Note 5)

SYMBOL	PARAMETER	CONDITIONS		C/I Grades MIN	C/I Grades TYP	C/I Grades MAX	H/MP Grades MIN	H/MP Grades TYP	H/MP Grades MAX	UNITS
FPBW	Full-Power Bandwidth	V_{OUT} = 28V_{P-P}		1.47	2.25		1.47	2.25		kHz
		(Note 10)	●	1.13			0.79			kHz
ΔV_{OS}	Offset Voltage Match	(Note 7)			35	70				µV
	(LT1881A)	0°C < T_A < 70°C	●			125				µV
		–40°C < T_A < 85°C	●			160				µV
	Offset Voltage Match	(Note 7)			42	125		42	125	µV
	(LT1881/LT1882)	0°C < T_A < 70°C	●			175				µV
		–40°C < T_A < 85°C	●			235				µV
		–40°C < T_A < 125°C	●						435	µV
		–55°C < T_A < 125°C	●						435	µV
	Offset Voltage Match Drift	(Notes 6, 7)	●		0.4	1.1		0.4	1.1	µV/°C
ΔI_B+	Noninverting Bias Current Match	(Note 7)			200	300				pA
	(LT1881A)	0°C < T_A < 70°C	●			400				pA
		–40°C < T_A < 85°C	●			500				pA
ΔI_B+	Noninverting Bias Current Match	(Note 7)			250	700		250	700	pA
	(LT1881/LT1882)	0°C < T_A < 70°C	●			900				pA
		–40°C < T_A < 85°C	●			1000				pA
		–40°C < T_A < 125°C	●						2000	pA
		–55°C < T_A < 125°C	●						2000	pA
ΔCMRR	Common Mode Rejection Match	(Notes 7, 9)	●	110	125		106	125		dB
Δ+PSRR	Positive Power Supply Rejection Ratio Match	V^- = –15V, V_{CM} = 0V, 1.5V < V^+ < 18V, (Notes 7, 9)	●	108	130		108	130		dB
Δ–PSRR	Negative Power Supply Rejection Ratio Match	V^+ = 15V, V_{CM} = 0V, –1.5V < V^- < –18V, (Notes 7, 9)	●	104	130		104	130		dB

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The inputs are protected by internal resistors and back-to-back diodes. If the differential input voltage exceeds ±0.7V, the input current should be limited externally to less than 10mA.

Note 3: A heat sink may be required to keep the junction temperature below absolute maximum.

Note 4: The LT1881C/LT1882C and LT1881I/LT1882I are guaranteed functional over the operating temperature range of –40°C to 85°C. The LT1882H is guaranteed functional over the operating temperature range –40°C to 125°C. The LT1882MP is guaranteed functional over the operating temperature range –55°C to 125°C.

Note 5: The LT1881C/LT1882C are guaranteed to meet specified performance from 0°C to 70°C. The LT1881C/LT1882C are designed, characterized and expected to meet specified performance from –40°C to 85°C but are not tested or QA sampled at these temperatures. The LT1881I/LT1882I are guaranteed to meet specified performance from –40°C to 85°C. The LT1882H is guaranteed to meet specified performance from –40°C to 125°C. The LT1882MP is guaranteed to meet specified performance from –55°C to 125°C.

Note 6: This parameter is not 100% tested.

Note 7: Matching parameters are the difference between amplifiers A and B in the LT1881; and between amplifiers A and D and B and C in the LT1882.

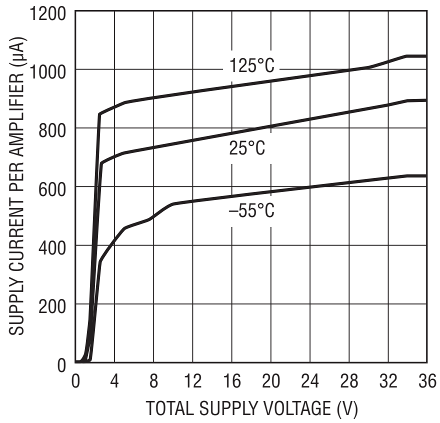
Note 8: This parameter is the difference between the two noninverting input bias currents.

Note 9: ΔCMRR and ΔPSRR are defined as follows: CMRR and PSRR are measured in µV/V on each amplifier. The difference is calculated in µV/V and then converted to dB.

Note 10: Full power bandwidth is calculated from the slew rate: FPBW = $SR/2\pi V_P$.

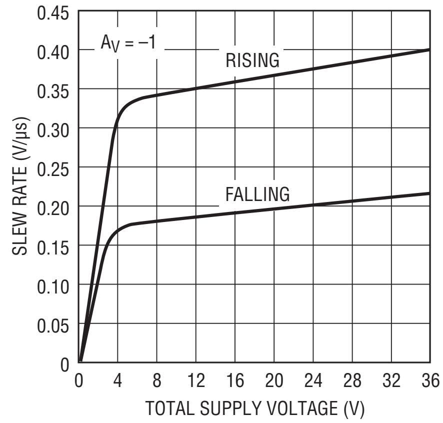
TYPICAL PERFORMANCE CHARACTERISTICS

Supply Current per Amplifier vs Supply Voltage



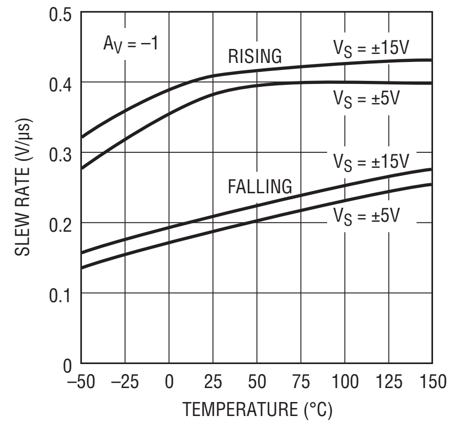
18812 G01

Slew Rate vs Supply Voltage



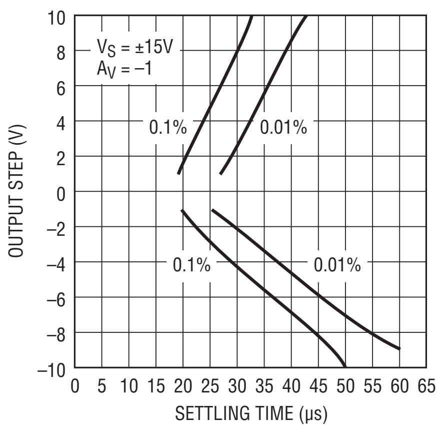
18812 G02

Slew Rate vs Temperature



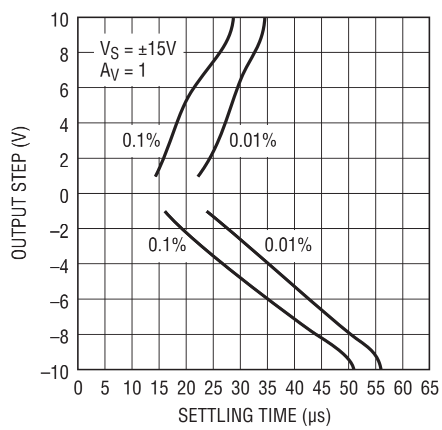
18812 G03

Settling Time vs Output Step



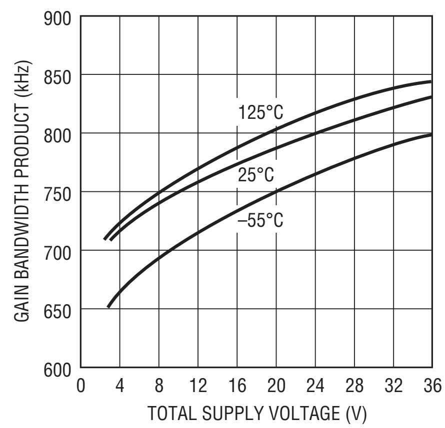
18812 G04

Settling Time vs Output Step



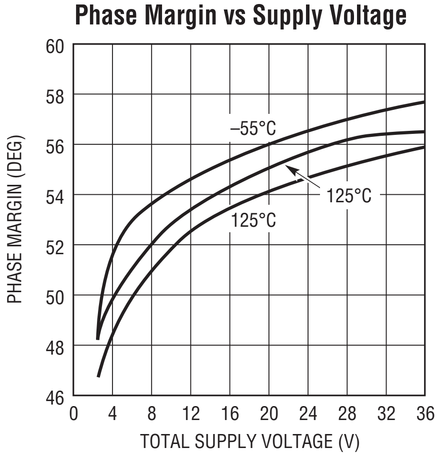
18812 G05

Gain Bandwidth Product vs Supply Voltage



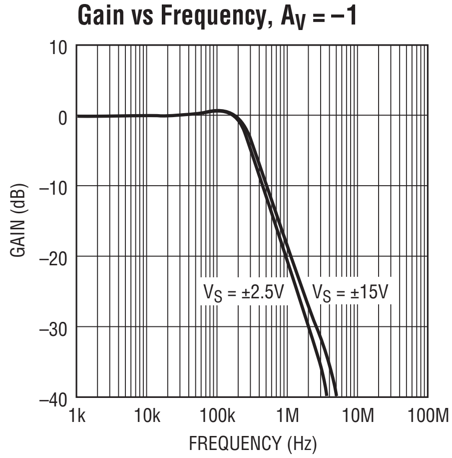
18812 G06

Phase Margin vs Supply Voltage



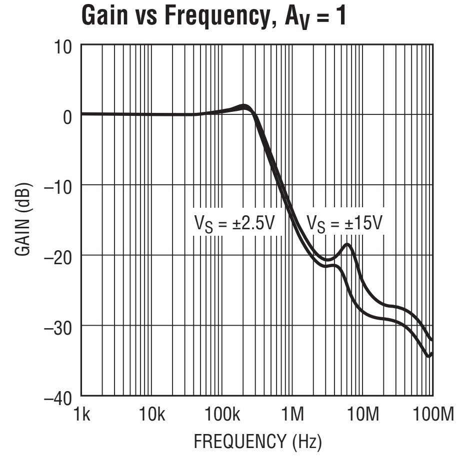
18812 G07

Gain vs Frequency, A_V = –1



18812 G08

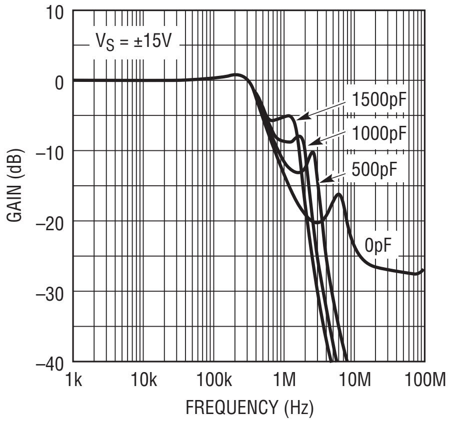
Gain vs Frequency, A_V = 1



18812 G09

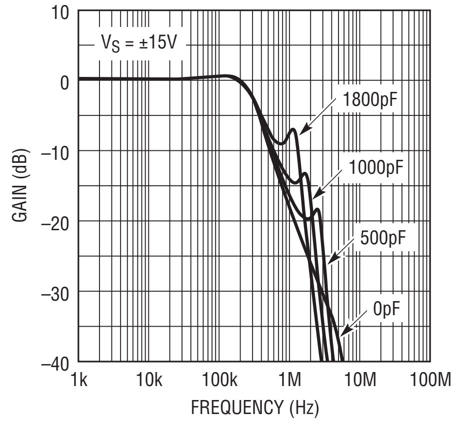
TYPICAL PERFORMANCE CHARACTERISTICS

Gain vs Frequency with C_{LOAD}, $A_V = 1$



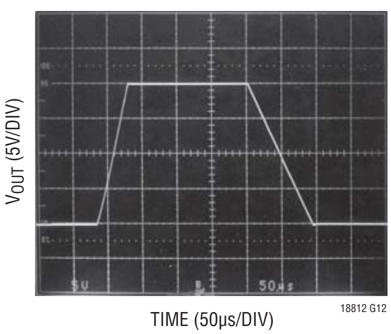
18812 G10

Gain vs Frequency with C_{LOAD}, $A_V = -1$



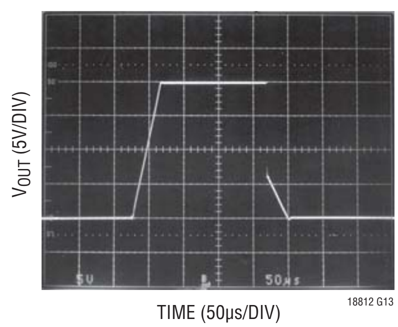
18812 G11

Large Signal Response, $A_V = -1$



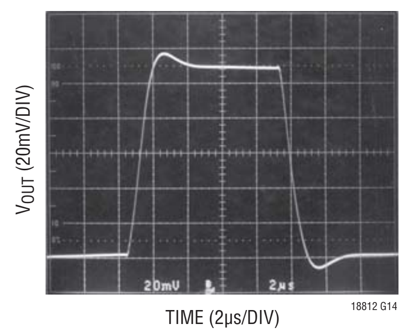
18812 G12

Large Signal Response, $A_V = 1$



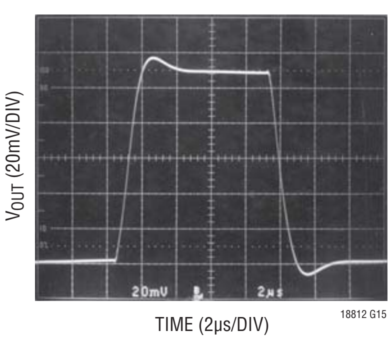
18812 G13

Small Signal Response, $A_V = -1$, No Load



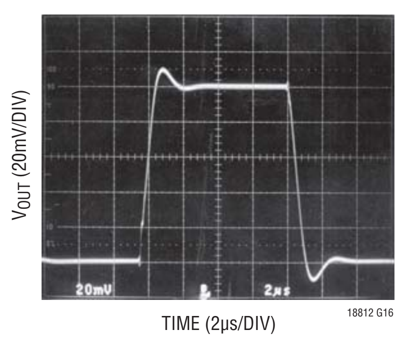
18812 G14

Small Signal Response, $A_V = -1$, $C_L = 1000pF$



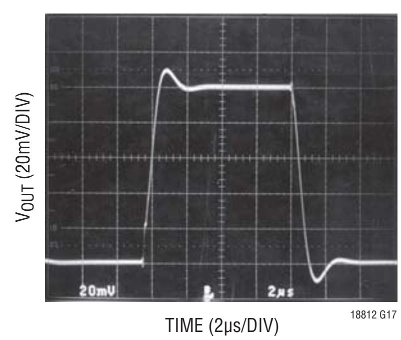
18812 G15

Small Signal Response, $A_V = 1$, $R_L = 2k$



18812 G16

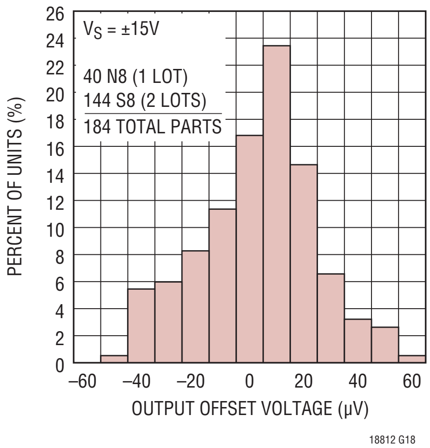
Small Signal Response, $A_V = 1$, $C_L = 500pF$



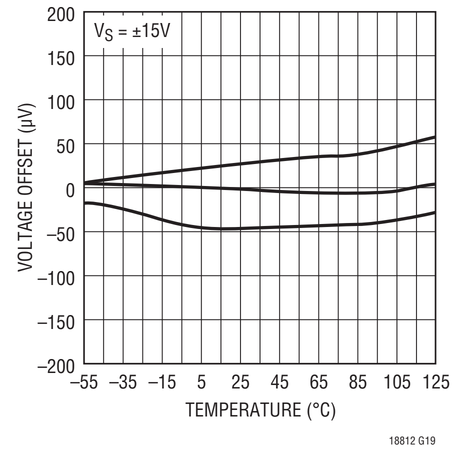
18812 G17

TYPICAL PERFORMANCE CHARACTERISTICS

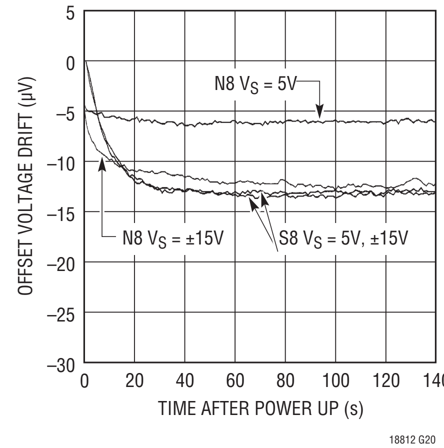
V_{OS} Distribution, T_A = 25°C



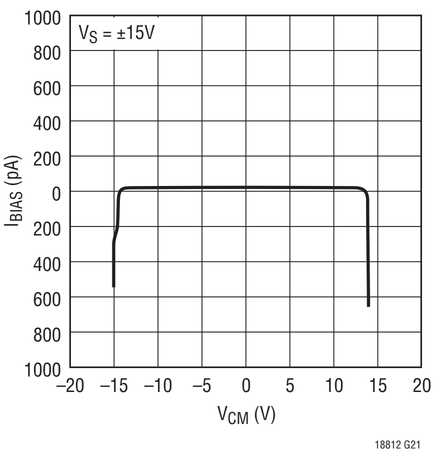
Voltage Offset vs Temperature



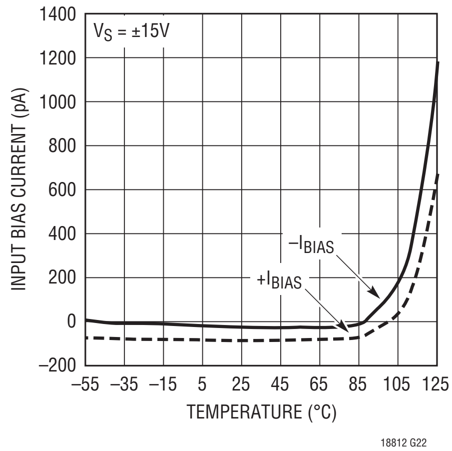
Warm-Up Drift vs Time



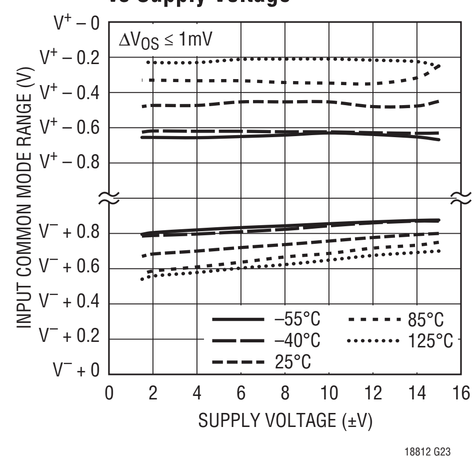
Input Bias Current vs Common Mode Voltage



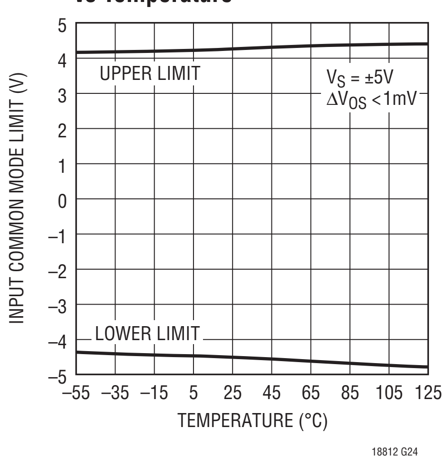
Input Bias Current vs Temperature



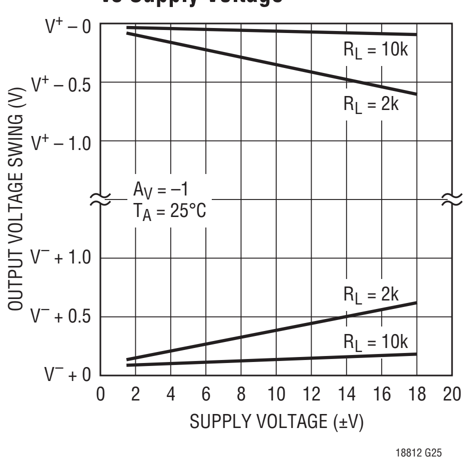
Input Common Mode Range vs Supply Voltage



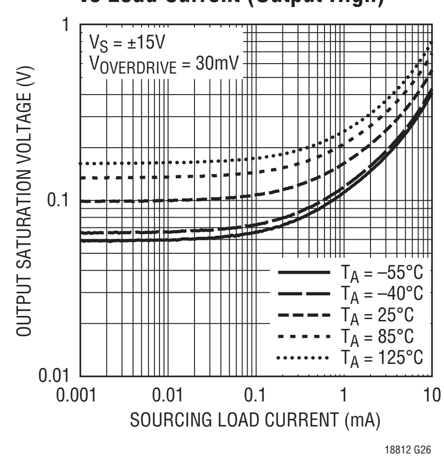
Input Common Mode Range vs Temperature



Output Voltage Swing vs Supply Voltage

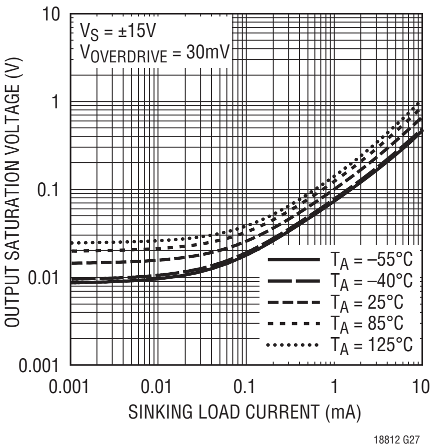


Output Saturation Voltage vs Load Current (Output High)

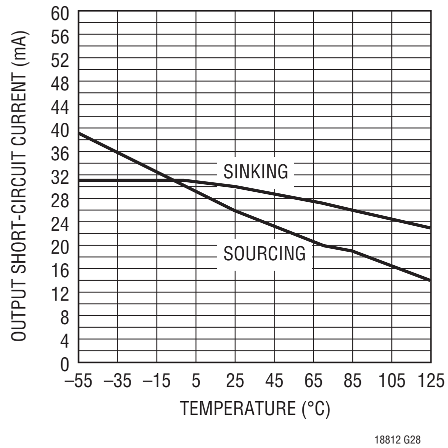


TYPICAL PERFORMANCE CHARACTERISTICS

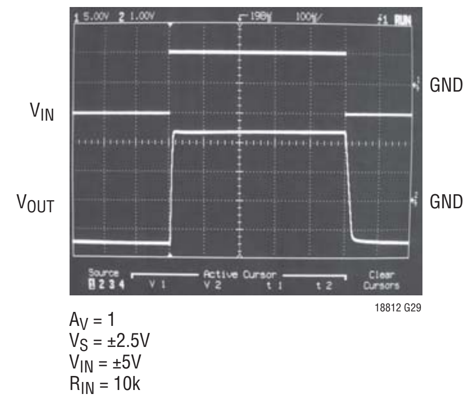
Output Saturation Voltage vs Load Current (Output Low)



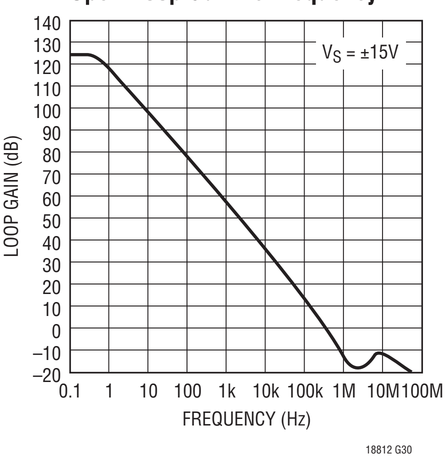
Output Short-Circuit Current vs Temperature



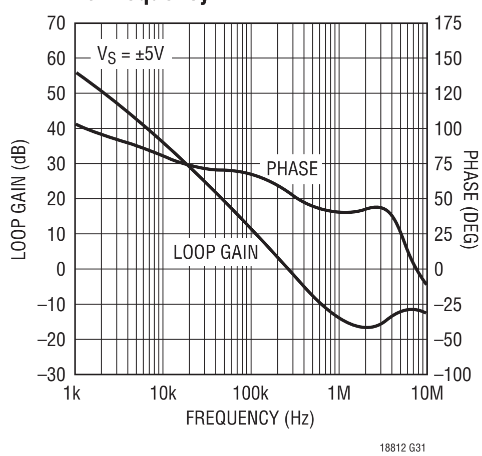
Output Voltage vs Large Input Voltage



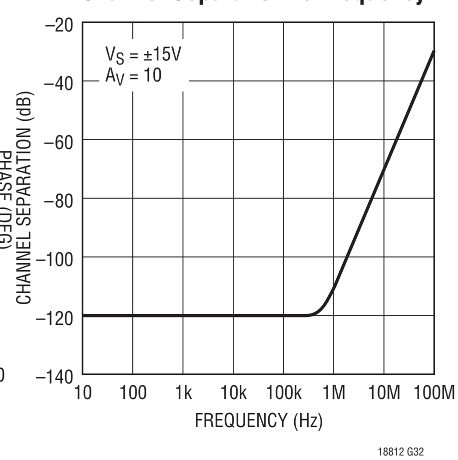
Open-Loop Gain vs Frequency



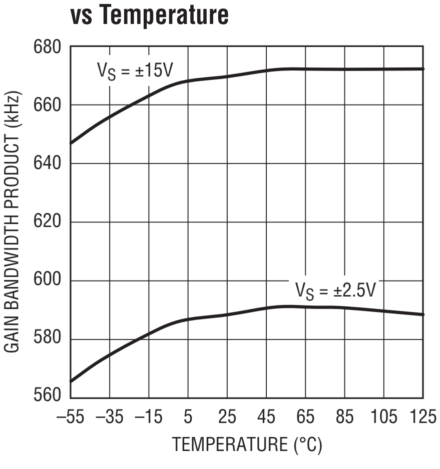
Open-Loop Gain and Phase vs Frequency



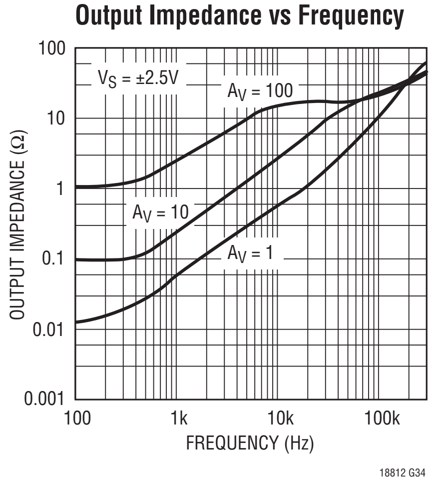
Channel Separation vs Frequency



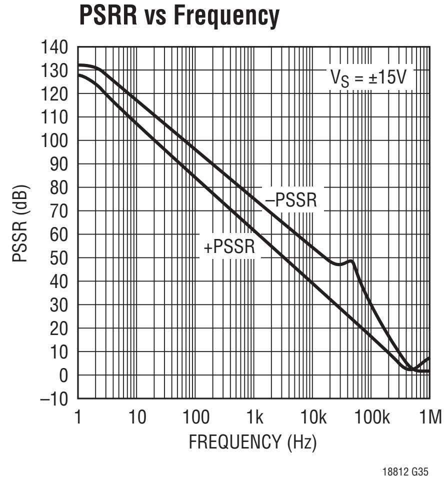
Gain Bandwidth Product vs Temperature



Output Impedance vs Frequency

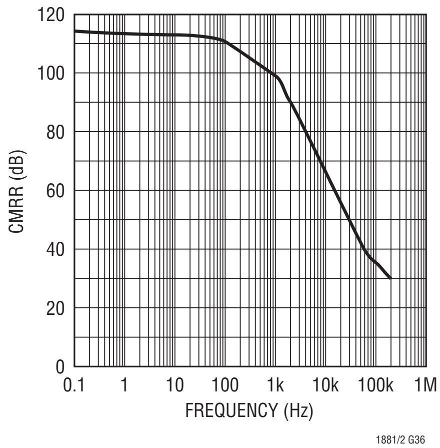


PSRR vs Frequency

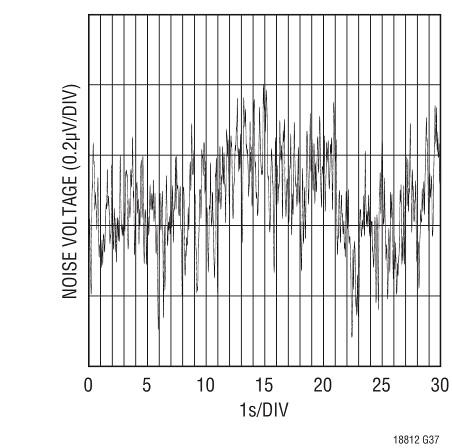


TYPICAL PERFORMANCE CHARACTERISTICS

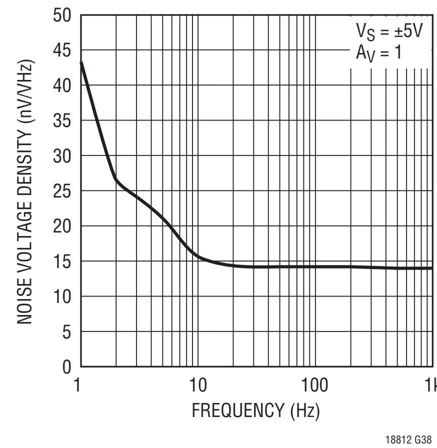
Common Mode Rejection Ratio vs Frequency



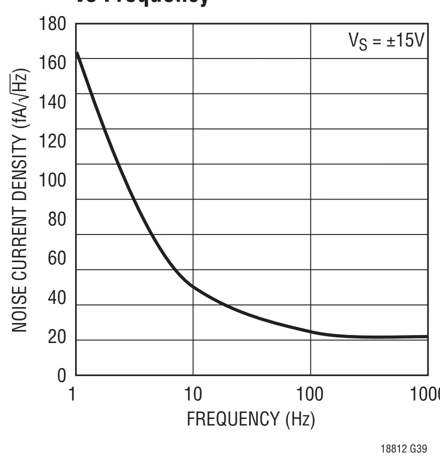
0.1Hz to 10Hz Noise



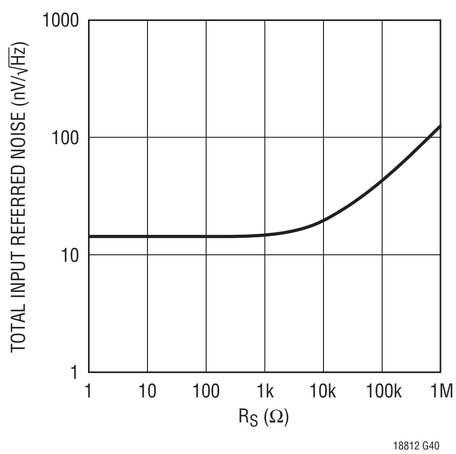
Noise Voltage vs Frequency



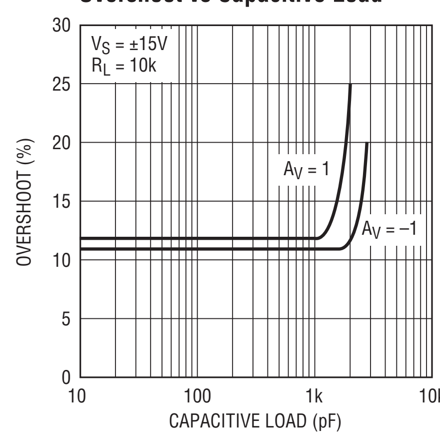
Noise Current Density vs Frequency



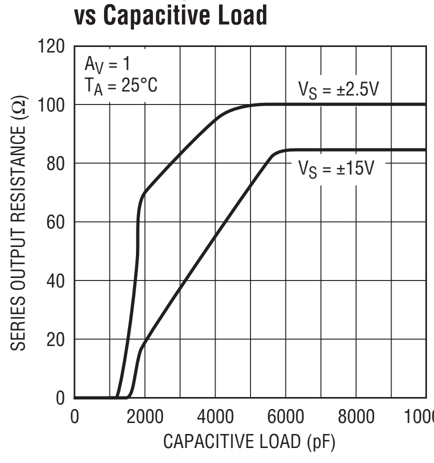
Total Noise vs Source Resistance



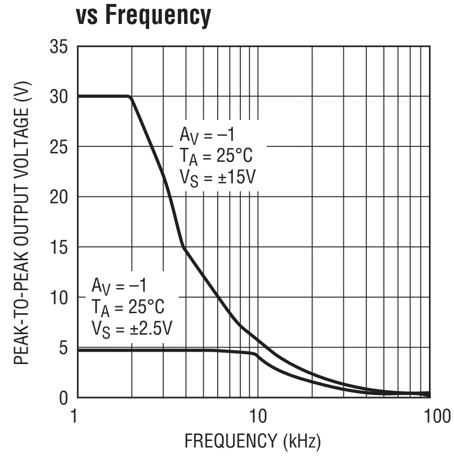
Overshoot vs Capacitive Load



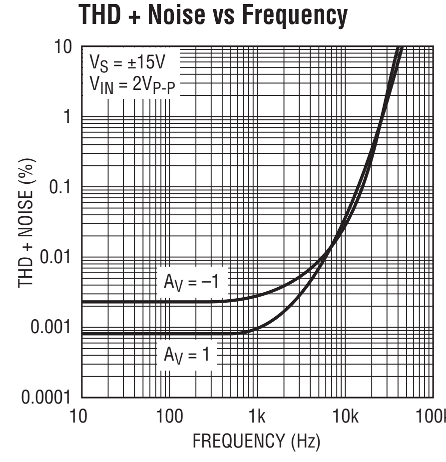
Series Output Resistance vs Capacitive Load



Undistorted Output Swing vs Frequency

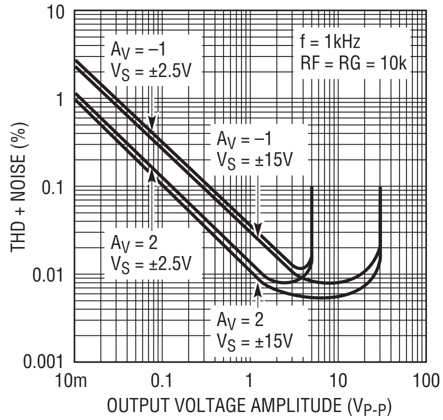


THD + Noise vs Frequency

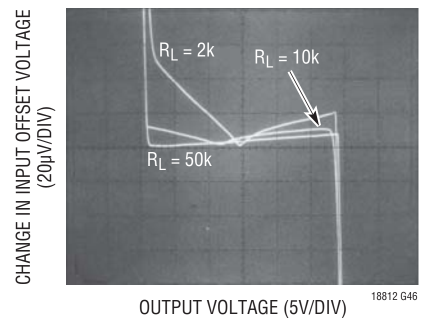


TYPICAL PERFORMANCE CHARACTERISTICS

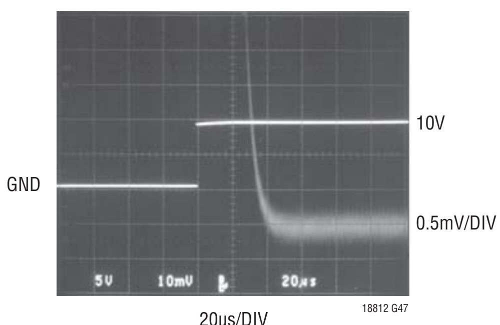
Total Harmonic Distortion + Noise vs Output Voltage Amplitude



Open-Loop Gain

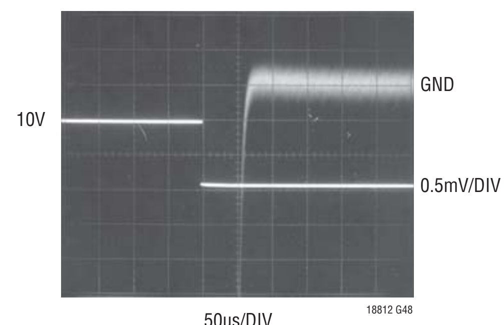


Settling Time/Output Step 0.01%



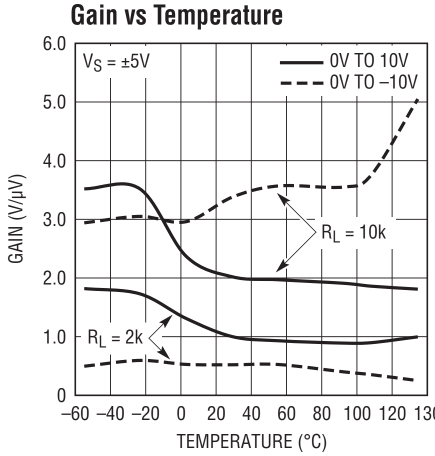
$A_V = 1$
$V_S = \pm15V$

Settling Time/Output Step 0.01%

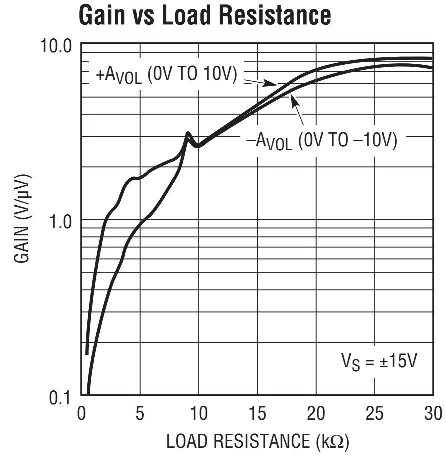


$A_V = 1$
$V_S = \pm15V$

Gain vs Temperature



Gain vs Load Resistance



APPLICATIONS INFORMATION

The LT1881 dual and LT1882 quad op amps feature exceptional input precision with rail-to-rail output swing. The amplifiers are similar to the LT1884 and LT1885 devices. The LT1881 and LT1882 offer superior capacitive load driving capabilities over the LT1884 and LT1885 in low voltage gain configurations. Offset voltages are trimmed to less than 50µV and input bias currents are less than 200pA on the "A" grade devices. Obtaining beneficial advantage of these precision input characteristics depends upon proper applications circuit design and board layout.

Preserving Input Precision

Preserving the input voltage accuracy of the LT1881/LT1882 requires that the applications circuit and PC board layout do not introduce errors comparable to or greater than the 30µV offset. Temperature differentials across the input connections can generate thermocouple voltages of 10's of microvolts. PC board layouts should keep connections to the amplifier's input pins close together and away from heat dissipating components. Air currents across the board can also generate temperature differentials.

The extremely low input bias currents, 150pA, allow high accuracy to be maintained with high impedance sources and feedback networks. The LT1881/LT1882's low input bias currents are obtained by using a cancellation circuit on-chip. This causes the resulting $I_{BIAS}+$ and $I_{BIAS}-$ to be uncorrelated, as implied by the I_{OS} specification being greater than the I_{BIAS}. The user should not try to balance the input resistances in each input lead, as is commonly recommended with most amplifiers. The impedance at either input should be kept as small as possible to minimize total circuit error.

PC board layout is important to insure that leakage currents do not corrupt the low I_{BIAS} of the amplifier. In high precision, high impedance circuits, the input pins should be surrounded by a guard ring of PC board interconnect, with the guard driven to the same common mode voltage as the amplifier inputs.

Input Common Mode Range

The LT1881 and LT1882 outputs are able to swing nearly to each power supply rail, but the input stage is limited to operating between V^- +1V and V^+ –1V. Exceeding this common mode range will cause the gain to drop to zero; however, no phase reversal will occur.

Input Protection

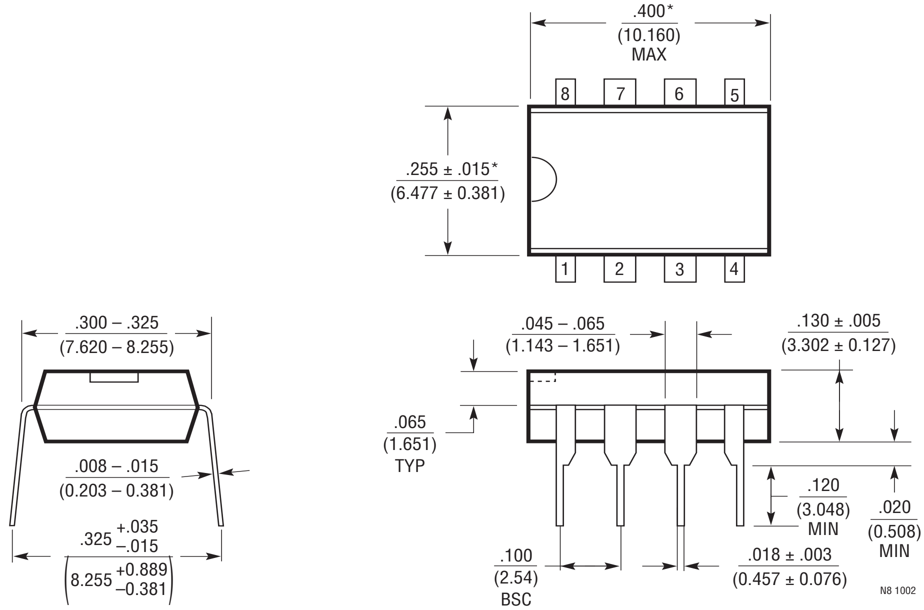
The inverting and noninverting input pins of the LT1881 and LT1882 have limited on-chip protection. ESD protection is provided to prevent damage during handling. The input transistors have voltage clamping and limiting resistors to protect against input differentials up to 10V. Short transients above this level will also be tolerated. If the input pins can see a sustained differential voltage above 10V, external limiting resistors should be used to prevent damage to the amplifier. A 1k resistor in each input lead will provide protection against a 30V differential voltage.

Capacitive Loads

The LT1881 and LT1882 can drive capacitive loads up to 1000pF in unity-gain. The capacitive load driving increases as the amplifier is used in higher gain configurations. Capacitive load driving may be increased by decoupling the capacitance from the output with a small resistance.

PACKAGE DESCRIPTION

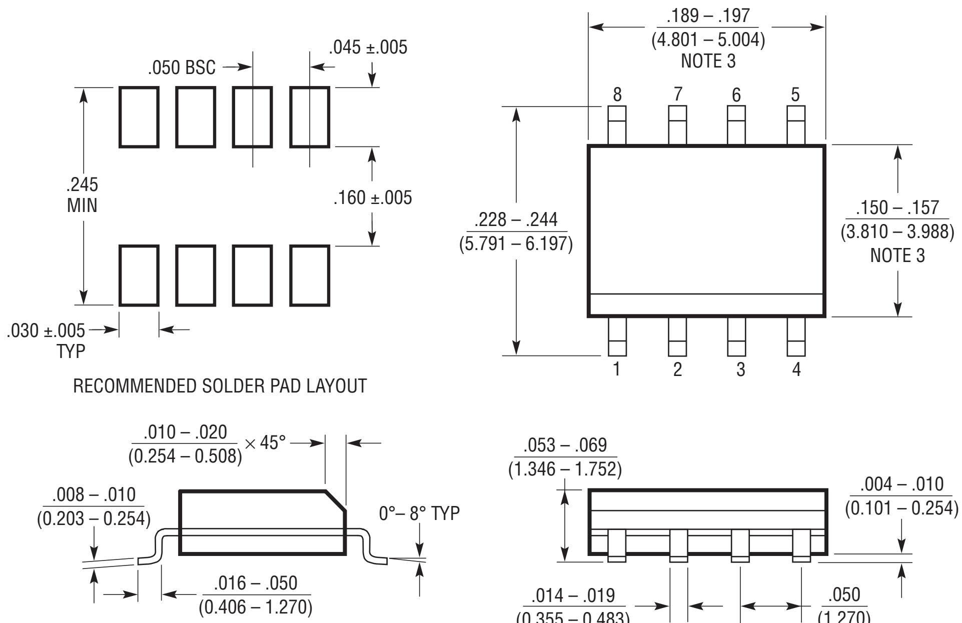
N8 Package
8-Lead PDIP (Narrow 0.300)
(LTC DWG # 05-08-1510)



NOTE:
1. DIMENSIONS ARE $\frac{\text{INCHES}}{\text{MILLIMETERS}}$
*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

PACKAGE DESCRIPTION

S8 Package
8-Lead Plastic Small Outline (Narrow 0.150)
(LTC DWG # 05-08-1610)

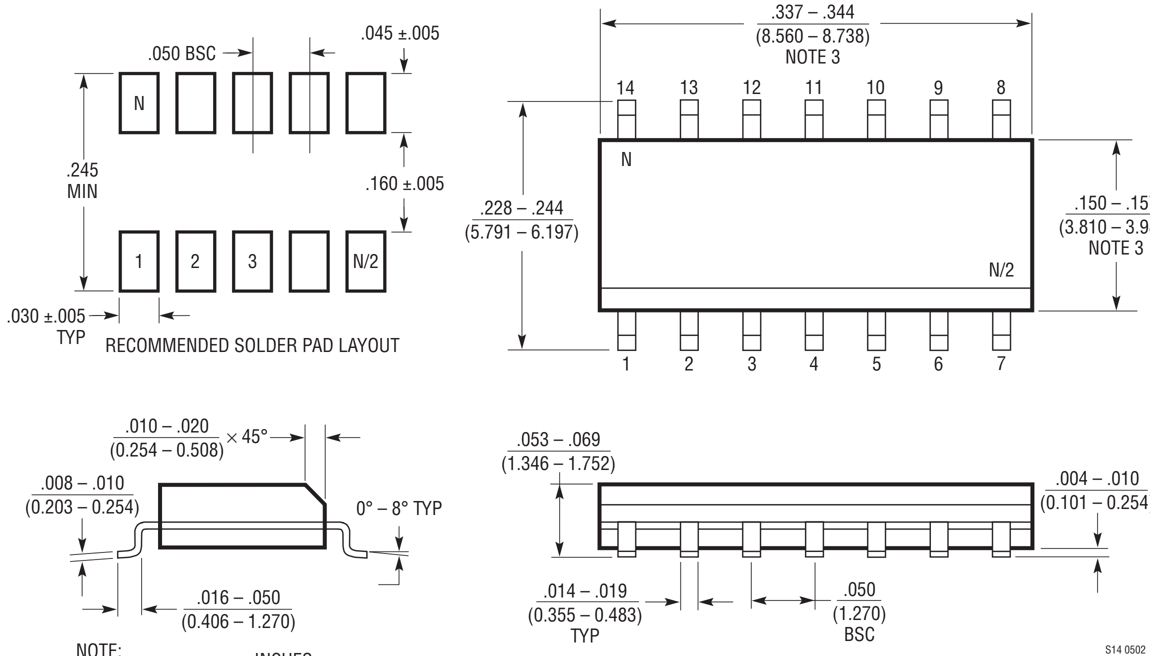


NOTE:
1. DIMENSIONS IN INCHES / (MILLIMETERS)
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

SO8 0303

PACKAGE DESCRIPTION

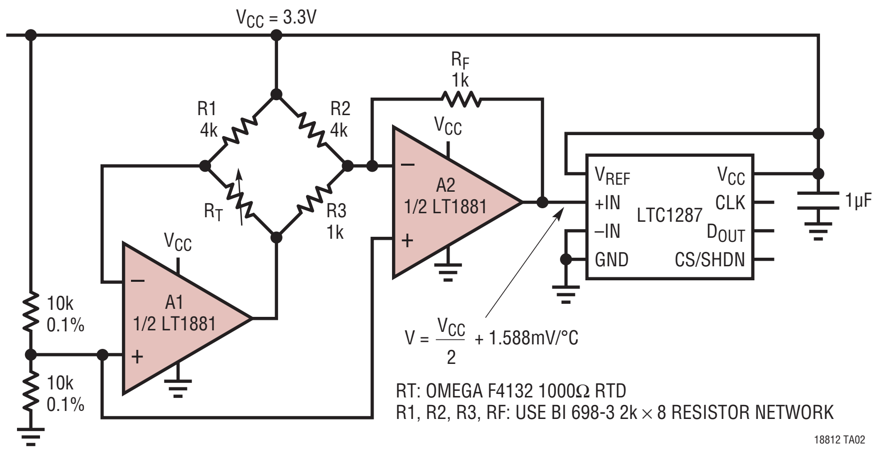
S Package
14-Lead Plastic Small Outline (Narrow 0.150)
(LTC DWG # 05-08-1610)



NOTE:
1. DIMENSIONS IN $\frac{\text{INCHES}}{\text{(MILLIMETERS)}}$
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

TYPICAL APPLICATION

–50°C to 600°C Digital Thermometer Operates on 3.3V



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1112/LT1114	Dual/Quad Picoamp Input Op Amps	V_{OS} = 60μV Max
LT1167	Gain Programmable Instrumentation Amp	Gain Error = 0.08% Max
LT1677	Low Noise, Rail-to-Rail Precision Op Amp	e_n = 3.2nV/$\sqrt{Hz}$
LT1793	Low Noise JFET Op Amp	I_B = 10pA Max
LT1880	SOT-23 Picoamp Input Precision Op Amp	150μV Max V_{OS}, –40°C to 85°C Operation Guaranteed, SOT-23 Package
LT1884/LT1885	Dual/Quad Picoamp Input Op Amps	3 Times Faster than LT1881/LT1882
LTC2050	Zero Drift Op Amp in SOT-23	V_{OS} = 3μV Max, Rail-to-Rail Output
LTC6011/LTC6012	Dual/Quad 135μA Rail-to-Rail Output Precision Op Amps	Lower Power, Available in DFN Package
LTC6081/LTC6082	Dual/Quad Precision CMOS Op Amps	I_B = 1pA Max, V_{OS} = 70μV Max

Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7417
(408) 432-1900 ● FAX: (408) 434-0507 ● www.linear.com

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