High Speed, Video Difference Amplifier

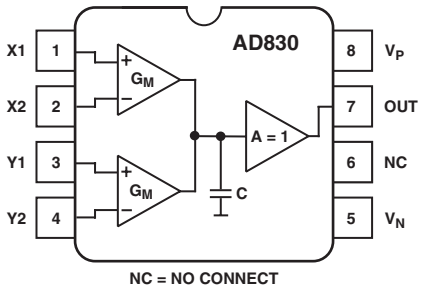
AD830

FEATURES
Differential Amplification
Wide Common-Mode Voltage Range: +12.8 V, –12 V
Differential Voltage Range: ±2 V
High CMRR: 60 dB @ 4 MHz
Built-In Differential Clipping Level: ±2.3 V
Fast Dynamic Performance
85 MHz Unity Gain Bandwidth
35 ns Settling Time to 0.1%
360 V/μs Slew Rate
Symmetrical Dynamic Response
Excellent Video Specifications
Differential Gain Error: 0.06%
Differential Phase Error: 0.08°
15 MHz (0.1 dB) Bandwidth
Flexible Operation
High Output Drive of ±50 mA Min
Specified with Both ±5 V and ±15 V Supplies
Low Distortion: THD = –72 dB @ 4 MHz
Excellent DC Performance: 3 mV Max Input Offset Voltage

APPLICATIONS
Differential Line Receiver
High Speed Level Shifter
High Speed In-Amp
Differential to Single-Ended Conversion
Resistorless Summation and Subtraction
High Speed A/D Driver

CONNECTION DIAGRAM

8-Lead Plastic PDIP (N), CERDIP (Q) and SOIC (RN) Packages



GENERAL DESCRIPTION

The AD830 is a wideband, differencing amplifier designed for use at video frequencies but also useful in many other applications. It accurately amplifies a fully differential signal at the input and produces an output voltage referred to a user-chosen level. The undesired common-mode signal is rejected, even at high frequencies. High impedance inputs ease interfacing to finite source impedances and thus preserve the excellent common-mode rejection. In many respects, it offers significant improvements over discrete difference amplifier approaches, in particular in high frequency common-mode rejection.

The wide common-mode and differential voltage range of the AD830 make it particularly useful and flexible in level shifting applications, but at lower power dissipation than discrete solutions. Low distortion is preserved over the many possible differential and common-mode voltages at the input and output.

Good gain flatness and excellent differential gain of 0.06% and phase of 0.08° make the AD830 suitable for many video system applications. Furthermore, the AD830 is suited for general-purpose signal processing from dc to 10 MHz.

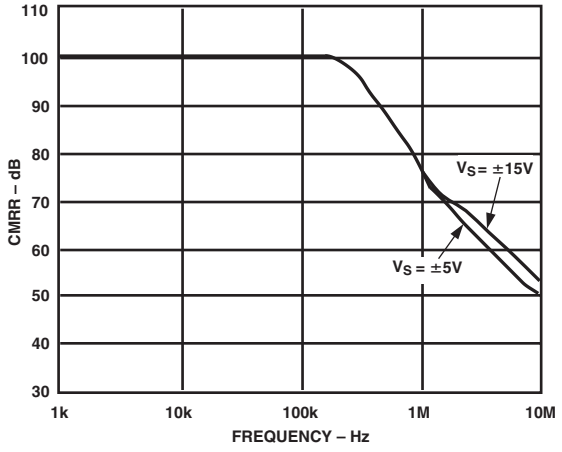


Figure 1. Common-Mode Rejection Ratio vs. Frequency

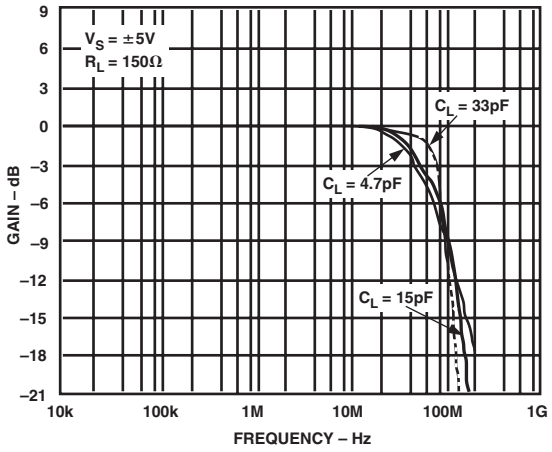


Figure 2. Closed-Loop Gain vs. Frequency, Gain = +1

AD830–SPECIFICATIONS (V_S = ±15 V, R_{LOAD} = 150 Ω, C_{LOAD} = 5 pF, T_A = 25°C, unless otherwise noted.)

Parameter	Conditions	AD830J/AD830A Min	AD830J/AD830A Typ	AD830J/AD830A Max	AD830S[1] Min	AD830S[1] Typ	AD830S[1] Max	Unit
DYNAMIC CHARACTERISTICS								
3 dB Small Signal Bandwidth	Gain = +1, V_{OUT} = 100 mV rms	75	85		75	85		MHz
0.1 dB Gain Flatness Frequency	Gain = +1, V_{OUT} = 100 mV rms	11	15		11	15		MHz
Differential Gain Error	0 V to 0.7 V, Frequency = 4.5 MHz		0.06	0.09		0.06	0.09	%
Differential Phase Error	0 V to 0.7 V, Frequency = 4.5 MHz		0.08	0.12		0.08	0.12	Degrees
Slew Rate	2 V Step, R_L = 500 Ω		360			360		V/µs
	4 V Step, R_L = 500 Ω		350			350		V/µs
3 dB Large Signal Bandwidth	Gain = +1, V_{OUT} = 1 V rms	38	45		38	45		MHz
Settling Time, Gain = +1	V_{OUT} = 2 V Step, to 0.1%		25			25		ns
	V_{OUT} = 4 V Step, to 0.1%		35			35		ns
Harmonic Distortion	2 V p-p, Frequency = 1 MHz		–82			–82		dBc
	2 V p-p, Frequency = 4 MHz		–72			–72		dBc
Input Voltage Noise	Frequency = 10 kHz		27			27		nV/√Hz
Input Current Noise			1.4			1.4		pA/√Hz
DC PERFORMANCE								
Offset Voltage	Gain = +1		±1.5	±3		±1.5	±3	mV
	Gain = +1, T_{MIN} – T_{MAX}			±5			±7	mV
Open-Loop Gain	DC	64	69		64	69		dB
Gain Error	R_L = 1 kΩ, G = ±1		±0.1	±0.6		±0.1	±0.6	%
Peak Nonlinearity, R_L= 1 kΩ,	–1 V ≤ X ≤ +1 V		0.01	0.03		0.01	0.03	% FS
Gain = +1	–1.5 V ≤ X ≤ +1.5 V		0.035	0.07		0.035	0.07	% FS
	–2 V ≤ X ≤ +2 V		0.15	0.4		0.15	0.4	% FS
Input Bias Current	V_{IN} = 0 V, 25°C to T_{MAX}		5	10		5	10	µA
	V_{IN} = 0 V, T_{MIN}		7	13		8	17	µA
Input Offset Current	V_{IN} = 0 V, T_{MIN} – T_{MAX}		0.1	1		0.1	1	µA
INPUT CHARACTERISTICS								
Differential Voltage Range	V_{CM} = 0		±2.0			±2.0		V
Differential Clipping Level[2]	Pins 1 and 2 Inputs Only	±2.1	±2.3		±2.1	±2.3		V
Common-Mode Voltage Range	V_{DM} = ±1 V	–12.0		+12.8	–12.0		+12.8	V
CMRR	DC, Pins 1, 2, ±10 V	90	100		90	100		dB
	DC, Pins 1, 2, ±10 V, T_{MIN} – T_{MAX}	88			86			dB
	Frequency = 4 MHz	55	60		55	60		dB
Input Resistance			370			370		kΩ
Input Capacitance			2			2		pF
OUTPUT CHARACTERISTICS								
Output Voltage Swing	R_L ≥ 1 kΩ	±12	+13.8, –13.8		±12	+13.8, –13.8		V
	R_L ≥ 1 kΩ, ±16.5 V_S	±13	+15.3, –14.7		±13	+15.3, –14.7		V
Short-Circuit Current	Short to Ground		±80			±80		mA
Output Current	R_L = 150 Ω	±50			±50			mA
POWER SUPPLIES								
Operating Range		±4		±16.5	±4		±16.5	V
Quiescent Current	T_{MIN} – T_{MAX}		14.5	17		14.5	17	mA
+ PSRR (to V_P)	DC, G = +1		86			86		dB
– PSRR (to V_N)	DC, G = +1		68			68		dB
PSRR	DC, G = +1, ±5 to ±15 V_S	66	71		66	71		dB
PSRR	DC, G = +1, ±5 to ±15 V_S, T_{MIN} – T_{MAX}	62	68		60	68		dB

NOTES
[1]See Standard Military Drawing 5962-9313001MPA for specifications.
[2]Clipping level function on X channel only.

Specifications subject to change without notice.

SPECIFICATIONS (V_S = ±5 V, R_{LOAD} = 150 Ω, C_{LOAD} = 5 pF, T_A = +25°C, unless otherwise noted.)

Parameter	Conditions	AD830J/AD830A Min	AD830J/AD830A Typ	AD830J/AD830A Max	AD830S[1] Min	AD830S[1] Typ	AD830S[1] Max	Unit
DYNAMIC CHARACTERISTICS								
3 dB Small Signal Bandwidth	Gain = +1, V_{OUT} = 100 mV rms	35	40		35	40		MHz
0.1 dB Gain Flatness Frequency	Gain = +1, V_{OUT} = 100 mV rms	5	6.5		5	6.5		MHz
Differential Gain Error	0 V to 0.7 V, Frequency = 4.5 MHz, Gain = +2		0.14	0.18		0.14	0.18	%
Differential Phase Error	0 V to 0.7 V, Frequency = 4.5 MHz, Gain = +2		0.32	0.4		0.32	0.4	Degrees
Slew Rate, Gain = +1	2 V Step, R_L = 500 Ω		210			210		V/µs
	4 V Step, R_L = 500 Ω		240			240		V/µs
3 dB Large Signal Bandwidth	Gain = +1, V_{OUT} = 1 V rms	30	36		30	36		MHz
Settling Time	V_{OUT} = 2 V Step, to 0.1%		35			35		ns
	V_{OUT} = 4 V Step, to 0.1%		48			48		ns
Harmonic Distortion	2 V p-p, Frequency = 1 MHz		–69			–69		dBc
	2 V p-p, Frequency = 4 MHz		–56			–56		dBc
Input Voltage Noise	Frequency = 10 kHz		27			27		nV/√Hz
Input Current Noise			1.4			1.4		pA/√Hz
DC PERFORMANCE								
Offset Voltage	Gain = +1		±1.5	±3		±1.5	±3	mV
	Gain = +1, T_{MIN} – T_{MAX}			±4			±5	mV
Open-Loop Gain	DC	60	65		60	65		dB
Unity Gain Accuracy	R_L = 1 kΩ		±0.1	±0.6		±0.1	±0.6	%
Peak Nonlinearity, R_L = 1 kΩ	–1 V ≤ X ≤ +1 V		0.01	0.03		0.01	0.03	% FS
	–1.5 V ≤ X ≤ +1.5 V		0.045	0.07		0.045	0.07	% FS
	–2 V ≤ X ≤ +2 V		0.23	0.4		0.23	0.4	% FS
Input Bias Current	V_{IN} = 0 V, 25°C to T_{MAX}		5	10		5	10	µA
	V_{IN} = 0 V, T_{MIN}		7	13		8	17	µA
Input Offset Current	V_{IN} = 0 V, T_{MIN} – T_{MAX}		0.1	1		0.1	1	µA
INPUT CHARACTERISTICS								
Differential Voltage Range	V_{CM} = 0		±2.0			±2.0		V
Differential Clipping Level[2]	Pins 1 and 2 Inputs Only	±2.0	±2.2		±2.0	±2.2		V
Common-Mode Voltage Range	V_{DM} = ±1 V	–2.0		+2.9	–2.0		+2.9	V
CMRR	DC, Pins 1, 2, +4 V to –2 V	90	100		90	100		dB
	DC, Pins 1, 2, +4 V to –2 V, T_{MIN} – T_{MAX}	88			86			dB
	Frequency = 4 MHz	55	60		55	60		dB
Input Resistance			370			370		kΩ
Input Capacitance			2			2		pF
OUTPUT CHARACTERISTICS								
Output Voltage Swing	R_L ≥ 150 Ω	±3.2	±3.5		±3.2	±3.5		V
	R_L ≥ 150 Ω, ±4 V_S	±2.2	–2.4, +2.7		±2.2	–2.4, +2.7		V
Short-Circuit Current	Short to Ground		–55, +70			–55, +70		mA
Output Current		±40			±40			mA
POWER SUPPLIES								
Operating Range		±4		±16.5	±4		±16.5	V
Quiescent Current	T_{MIN} – T_{MAX}		13.5	16		13.5	16	mA
+ PSRR (to V_P)	DC, G = +1, Offset		86			86		dB
– PSRR (to V_N)	DC, G = +1, Offset		68			68		dB
PSRR (Dual-Supply)	DC, G = +1, ±5 to ±15 V_S	66	71		66	71		dB
PSRR (Dual-Supply)	DC, G = +1, ±5 to ±15 V_S, T_{MIN} – T_{MAX}	62	68		60	68		dB

NOTES

[1]See Standard Military Drawing 5962-9313001MPA for specifications.

[2]Clipping level function on X channel only.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage . . . . . ±18 V
Internal Power Dissipation[2] . . . . . Observe Derating Curves
Output Short-Circuit Duration . . . . . Observe Derating Curves
Common-Mode Input Voltage . . . . . $\pm V_S$
Differential Input Voltage . . . . . $\pm V_S$
Storage Temperature Range (Q) . . . . . –65°C to +150°C
Storage Temperature Range (N) . . . . . –65°C to +125°C
Storage Temperature Range (RN) . . . . . –65°C to +125°C
Operating Temperature Range
AD830J . . . . . 0°C to +70°C
AD830A . . . . . –40°C to +85°C
AD830S . . . . . –55°C to +125°C
Lead Temperature Range (Soldering 60 sec) . . . . . 300°C

NOTES
[1]Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
[2]8-Lead PDIP Package: θ_{JA} = 90°C/W.
8-Lead SOIC Package: θ_{JA} = 155°C/W.
8-Lead CERDIP Package: θ_{JA} = 110°C/W.

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by the AD830 is limited by the associated rise in junction temperature. For the plastic packages, the maximum safe junction temperature is 145°C. For the CERDIP, the maximum junction temperature is 175°C. If these maximums are exceeded momentarily, proper circuit operation will be restored as soon as the die temperature is reduced. Leaving the AD830 in the overheated condition for an extended period can result in permanent damage to the device. To ensure proper operation, it is important to observe the recommended derating curves.

While the AD830 output is internally short-circuit protected, this may not be sufficient to guarantee that the maximum junction temperature is not exceeded under all conditions. If the output is shorted to a supply rail for an extended period, then the amplifier may be permanently destroyed.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD830AN	–40°C to +85°C	8-Lead PDIP	N-8
AD830JR	0°C to +70°C	8-Lead SOIC	RN-8
5962-9313001MPA*	–55°C to +125°C	8-Lead CERDIP	Q-8
AD830AR	–40°C to +85°C	8-Lead SOIC	RN-8
AD830AR-REEL	–40°C to +85°C	8-Lead SOIC	RN-8
AD830AR-REEL7	–40°C to +85°C	8-Lead SOIC	RN-8
AD830JR-REEL	0°C to 70°C	8-Lead SOIC	RN-8
AD830JR-REEL7	0°C to 70°C	8-Lead SOIC	RN-8

*See Standard Military Drawing 5962-9313001 MPA for specifications.

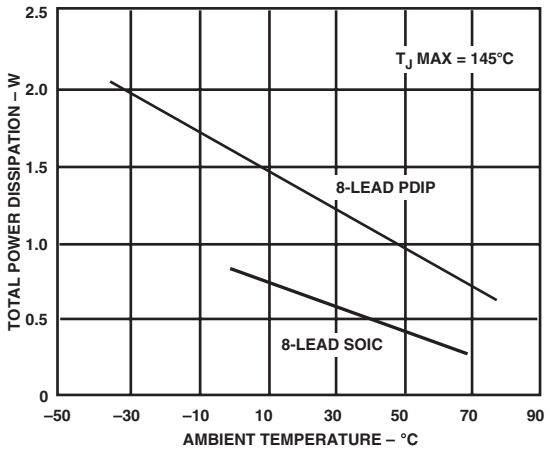


Figure 3. Maximum Power Dissipation vs. Temperature, PDIP and SOIC Packages

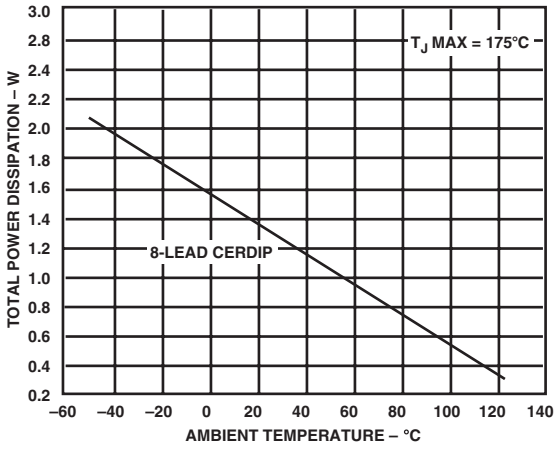


Figure 4. Maximum Power Dissipation vs. Temperature, CERDIP Package

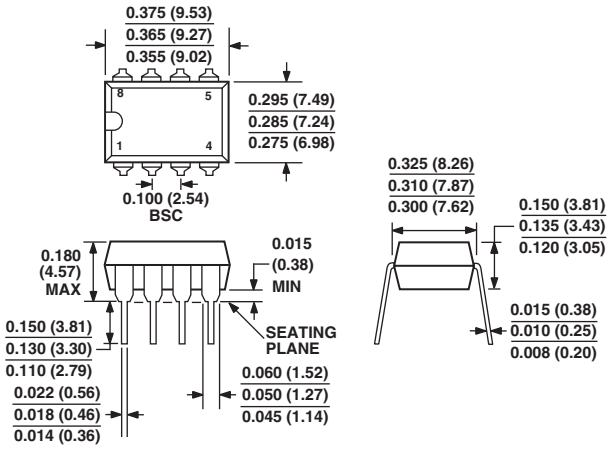
CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD830 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

OUTLINE DIMENSIONS

8-Lead Plastic Dual-in-Line Package [PDIP]
(N-8)

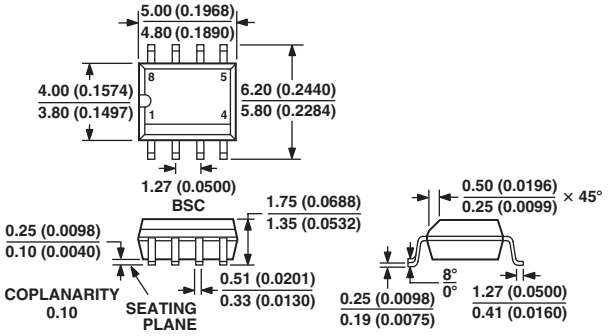
Dimensions shown in inches and (millimeters)



COMPLIANT TO JEDEC STANDARDS MO-095AA
CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS
(IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

8-Lead Standard Small Outline Package [SOIC]
(R-8)

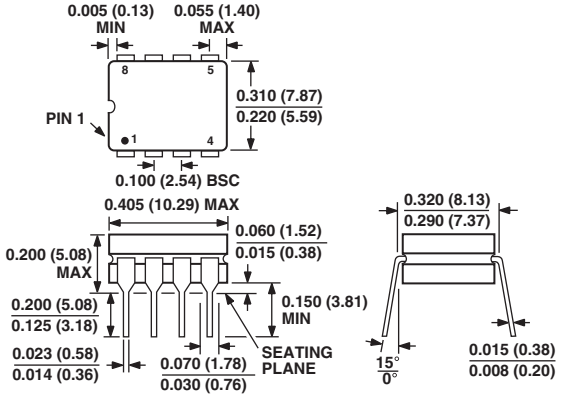
Dimensions shown in millimeters and (inches)



COMPLIANT TO JEDEC STANDARDS MS-012AA
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS
(IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

8-Lead Ceramic DIP - Glass Hermetic Seal [CERDIP]
(Q-8)

Dimensions shown in inches and (millimeters)



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