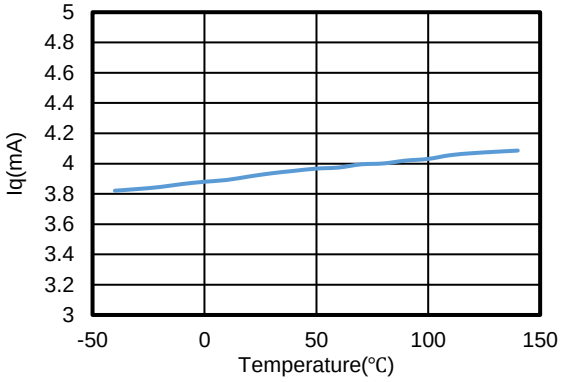
Features

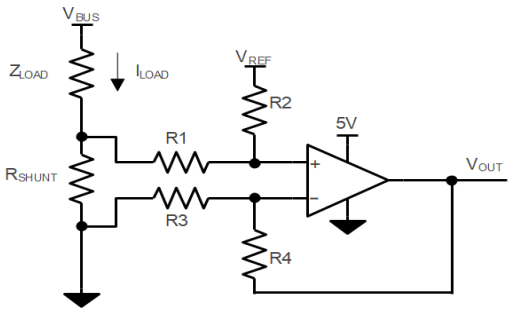
- Supply Voltage: 4.5 V to 40 V or ±2.25 V to ±20 V
- Offset Voltage: ±15 μV Maximum
- Differential Input Voltage Range to Supply Rail, can Work as Comparator
- Input Rail to $-V_S$, Rail to Rail Output
- Bandwidth: 12 MHz
- Slew Rate: 12 V/μs
- Over-Temperature Protection
- Low Noise: 6 nV/√Hz at 1 kHz
- 2 kV HBM, 1 kV CDM
- –40°C to 125°C Operation Temperature Range

Applications

- Instrumentation
- Active Filters, ASIC Input or Output Amplifier
- Sensor Interface
- Motor Control
- Industrial Control
- Low noise power supply



Typical Application Circuit

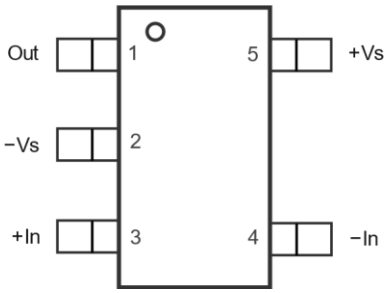


$V_{OUT} = (I_{LOAD} \times R_{SHUNT}) \times (R2 / R1) + V_{REF}$

When R3 = R1, R2 = R4, $R_{SHUNT} << R1$

Pin Configuration and Functions

CI823A
SOT23-5 Package
Top View



CI823B
SOP8 Package
Top View

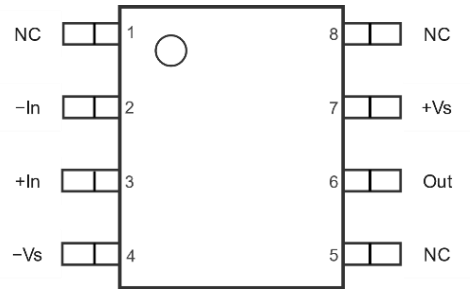
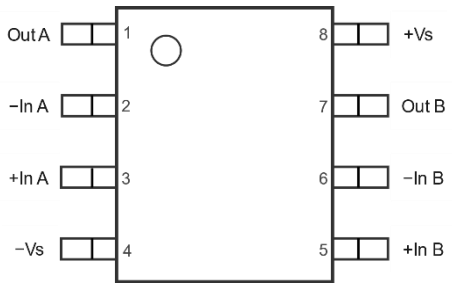


Table 1. Pin Functions:CI823

Pin		Name	I/O	Description
SOT23-5	SOP8			
1	6	Out	Output	Output
2	4	$-V_S$		Negative power supply
3	3	+In	Input	Noninverting input
4	2	−In	Input	Inverting input
5	7	$+V_S$		Positive power supply
	1	NC		Not connected
	5	NC		Not connected
	8	NC		Not connected

CI823C
SOP8 Package
Top View



CI823D
MSOP8 Package
Top View

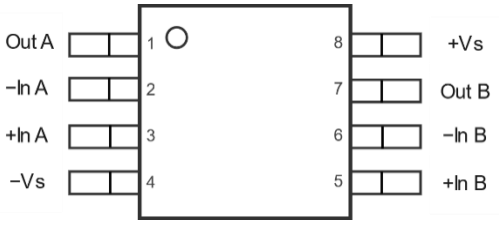


Table 2. Pin Functions:CI823

Pin	Name	I/O	Description
1	Out A	Output	Output
2	−In A	Input	Inverting input
3	+In A	Input	Noninverting input
4	$-V_S$		Negative power supply
5	+In B	Input	Noninverting input
6	−In B	Input	Inverting input
7	Out B	Output	Output
8	$+V_S$		Positive power supply

Specifications

Absolute Maximum Ratings

Over operating ambient temperature (unless otherwise noted) (1)

Parameter	Min	Max	Unit
Supply Voltage, (+V_S) – (–V_S)		42 V	V
Input Voltage	(−V_S) – 0.3	42 V	V
Differential Input Voltage	(−V_S) − (+V_S)	(+V_S) − (−V_S)	V
Input Current: +IN, –IN (2)	−10	10	mA
Output Voltage	(−V_S) − 0.3	(+V_S) + 0.3	V
Output Short-Circuit Duration (3)		Infinite	
Maximum Operating Junction Temperature		150	°C
Operating Temperature Range	−40	125	°C
Storage Temperature Range	−65	150	°C
Lead Temperature (Soldering, 10 sec)		260	°C

(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.
(2) The inputs are protected by ESD protection diodes to the negative power supply. If the input extends more than 300 mV beyond the negative power supply, the input current should be limited to less than 10 mA.
(3) A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM(1)	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001	2	kV
CDM(2)	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002	1	kV
LU	Latch Up	JESD 78, 25°C	500	mA
		JESD 78, 125°C	200	mA

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
V_S	Supply Voltage, (+V_S) – (–V_S)	4.5(±2.25)		40(±20)	V
T_A	Operating Temperature Range	–40		125	°C

Electrical Characteristics

All test condition is V_S = 30 V, T_A = 25°C, R_L = 10 kΩ, unless otherwise noted.

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
Power Supply							
V_S	Supply Voltage Range			4.5		40	V
I_Q	Quiescent Current per Amplifier	V_S = 40 V			2.4	3	mA
		V_S = 30 V			2	2.5	mA
PSRR	Power Supply Rejection Ratio	V_S = 30 V	-40°C to 125°C			2.7	mA
		V_S = 5 V			1.9	2.4	mA
		V_S = 5 V	-40°C to 125°C			2.6	mA
		V_S = 4.5 V to 36 V		135	155		dB
PSRR	Power Supply Rejection Ratio	V_S = 4.5 V to 36 V	-40°C to 125°C	130			dB
V_S	Supply Voltage Range			4.5		36	V
Input Characteristics							
V_{OS}	Input Offset Voltage	V_S = 40 V, V_{CM} = 20 V		-15		15	µV
		V_S = 30 V, V_{CM} = 15 V		-15		15	µV
			-40°C to 125°C	-25		25	µV
		V_S = 5 V, V_{CM} = 2.5 V		-15		15	µV
			-40°C to 125°C	-25		25	µV
V_{OS} TC	Input Offset Voltage Drift		-40°C to 125°C		0.05	0.15	µ V/°C
I_B	Input Bias Current				10		pA
			-40°C to 125°C		100		pA
I_{OS}	Input Offset Current				100		pA
I_{IN}	Different Input Current	V_S = 36 V, V_{ID} = 36 V				100	µA
			-40°C to 125°C			120	µA
C_{IN}	Input Capacitance	Differential Mode			5		pF
		Common Mode			2.5		pF
Av	Open-loop Voltage Gain	R_{LOAD} = 10 kΩ, VOUT = 0.5 V to 29.5 V		135	155		dB
			-40°C to 125°C	130			dB
V_{CMR}	Common-mode Input Voltage Range			(V-)		(V+) – 1.5	V
CMRR	Common Mode Rejection Ratio	V_{CM} = 0 V to 28.5 V		135	155		dB
			-40°C to 125°C	130			dB

Electrical Characteristics (Continued)

All test condition is V_S = 30 V, T_A = 25°C, R_L = 10 kΩ, unless otherwise noted.

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
Output Characteristics							
	Output Swing from Positive Rail	R_{LOAD} = 100 kΩ to V_S/2			12	25	mV
			-40°C to 85°C			35	mV
			-40°C to 125°C			40	mV
		R_{LOAD} = 10 kΩ to V_S/2			80	120	mV
			-40°C to 85°C			170	mV
			-40°C to 125°C			200	mV
		R_{LOAD} = 2 kΩ to V_S/2			370	500	mV
			-40°C to 85°C			700	mV
			-40°C to 125°C			750	mV
	Output Swing from Negative Rail	R_{LOAD} = 100 kΩ to V_S/2			5	25	mV
			-40°C to 85°C			30	mV
			-40°C to 125°C			30	mV
		R_{LOAD} = 10 kΩ to V_S/2			30	80	mV
			-40°C to 85°C			95	mV
			-40°C to 125°C			105	mV
		R_{LOAD} = 2 kΩ to V_S/2			140	300	mV
			-40°C to 85°C			450	mV
			-40°C to 125°C			500	mV
I_{SC}	Output Short-Circuit Current	Source		70	95		mA
			-40°C to 85°C	55			mA
			-40°C to 125°C	50			mA
		Sink		130	150		mA
			-40°C to 85°C	100			mA
			-40°C to 125°C	85			mA

Electrical Characteristics (Continued)

All test condition is V_S = 30 V, T_A = 25°C, R_L = 10 kΩ, unless otherwise noted.

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
AC Specifications							
GBW	Gain-Bandwidth Product				12		MHz
SR	Slew Rate	G = 1, 10 V step		8	12		V/μs
			-40°C to 125°C	7			V/μs
t_{OR}	Overload Recovery				500		ns
t_S	Settling Time, 0.1%	G = 1, 10 V step			5		μs
	Settling Time, 0.01%				7		μs
PM	Phase Margin	R_L=10 K, C_L= 50 pF			60		°
GM	Gain Margin	R_L=10 K, C_L= 50 pF			10		dB
Noise Performance							
E_N	Input Voltage Noise	f = 0.1 Hz to 10 Hz			0.1		μV_{PP}
e_N	Input Voltage Noise Density	f = 0.1 kHz			6		nV/√Hz
		f = 1 kHz			6		nV/√Hz
		f = 10 kHz			7		nV/√Hz
i_N	Input Current Noise	f = 10 kHz			200		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1 kHz, G =1, R_L = 10 kΩ, V_{OUT} = 6 V_{RMS}			0.0002		%

Typical Performance Characteristics

Test condition: V_S = ±15 V, V_{CM} = 0 V, R_L = 10 kΩ, unless otherwise specified.

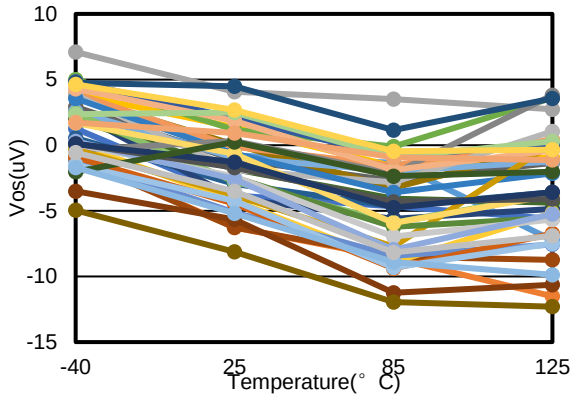


Figure 1. V_{OS} at 30 V V_S, 15 V V_{CM} vs. Temperature, 40pcs

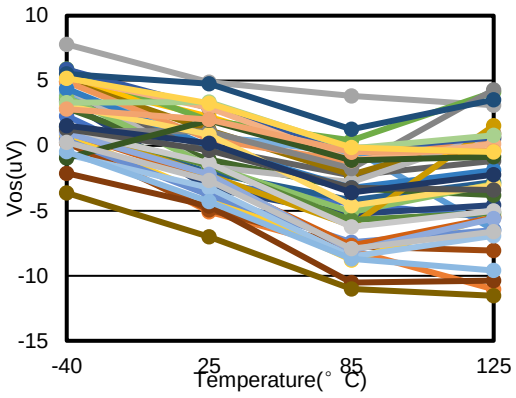


Figure 2. V_{OS} at 5 V V_S, 2.5 V V_{CM} vs. Temperature, 40pcs

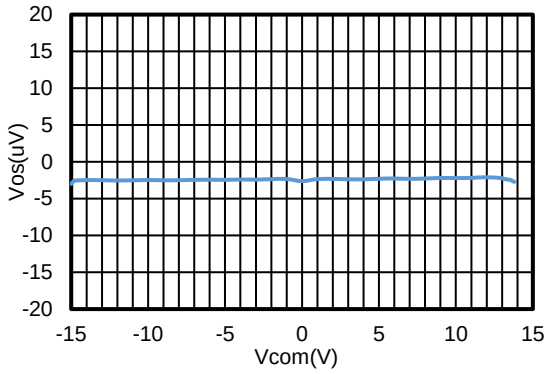


Figure 3. Offset Voltage vs. Common-Mode Voltage

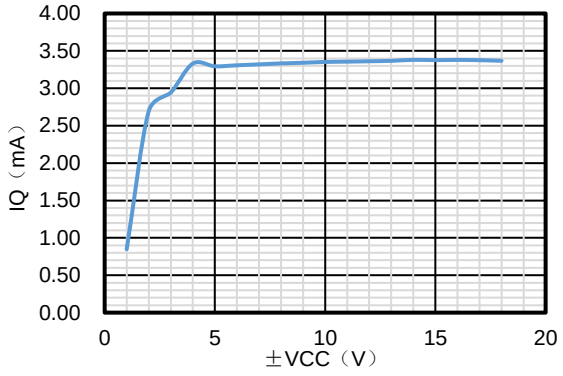


Figure 4. Iq vs. Supply Voltage

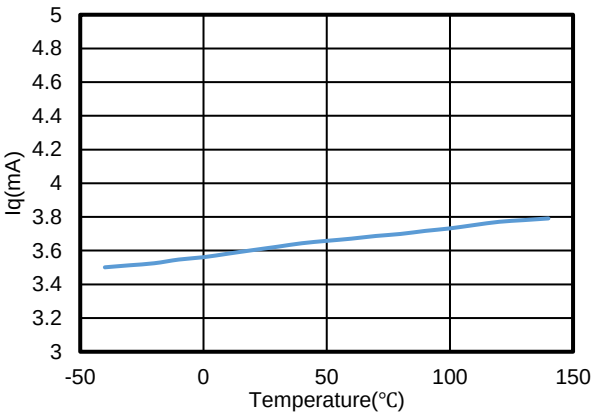


Figure 5. Iq vs. Temperature, +-2.5 V Supply, CI823

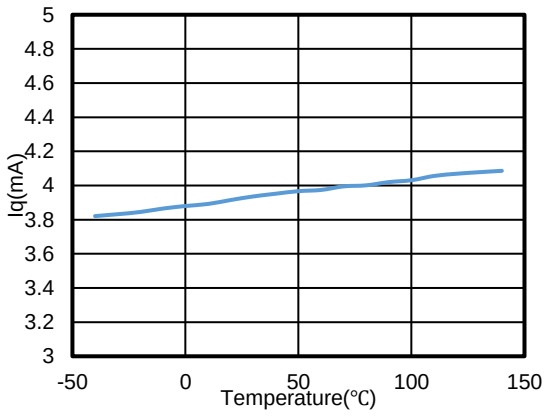


Figure 6. Iq vs. Temperature, +-15 V Supply, CI823

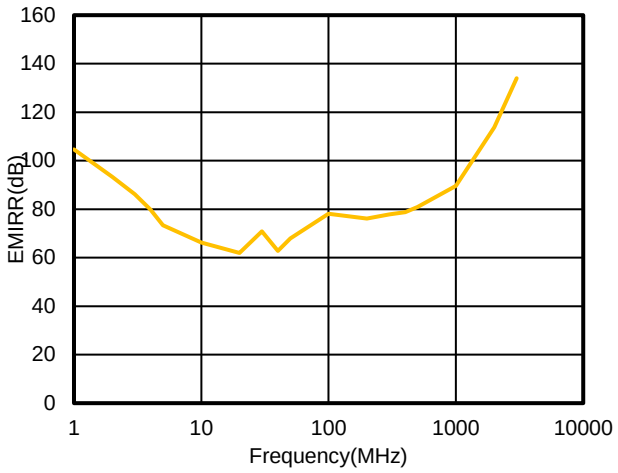


Figure 7. EMIRR vs. Frequency

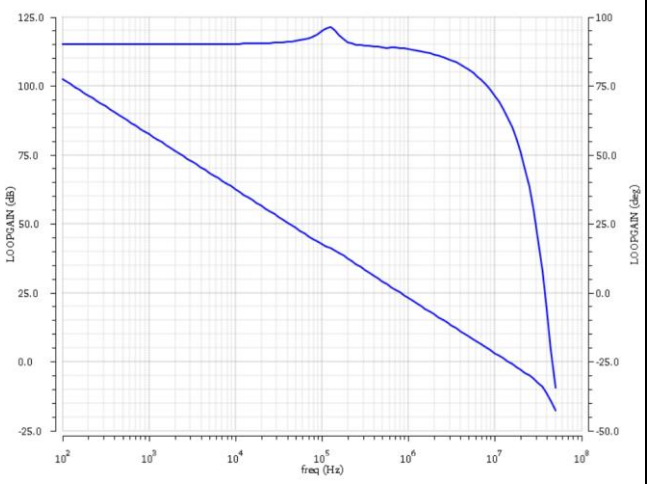


Figure 8. Open Loop Gain and Phase vs. Frequency

R_L = 10 kΩ, C_L = 50 pF

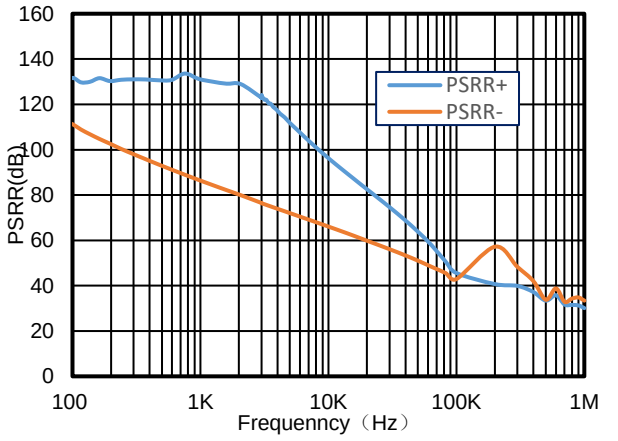


Figure 9. PSRR vs. Frequency

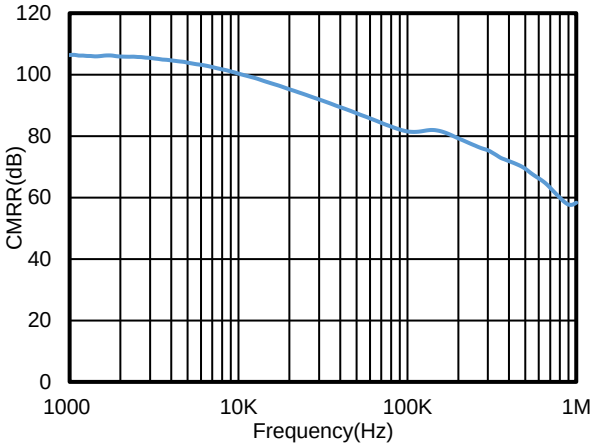
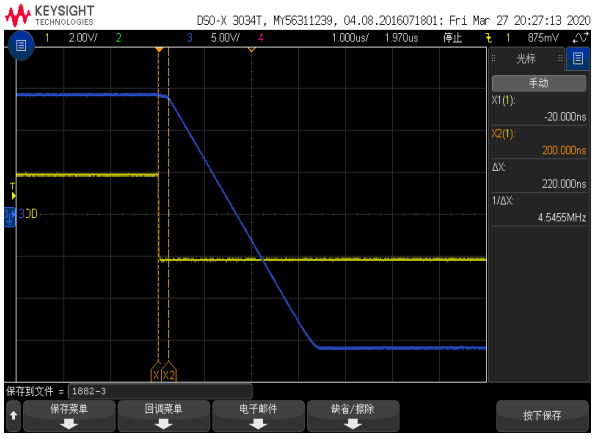


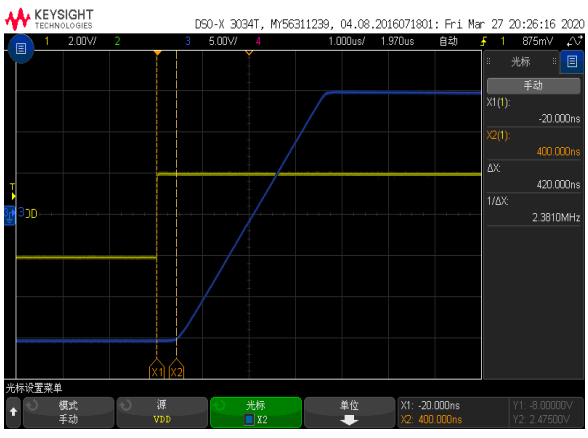
Figure 10. Negative Overload Recovery



Time: 2 us/div, Measure Time: 220 ns

R_L=2 K, C_L=100 pF, G=10

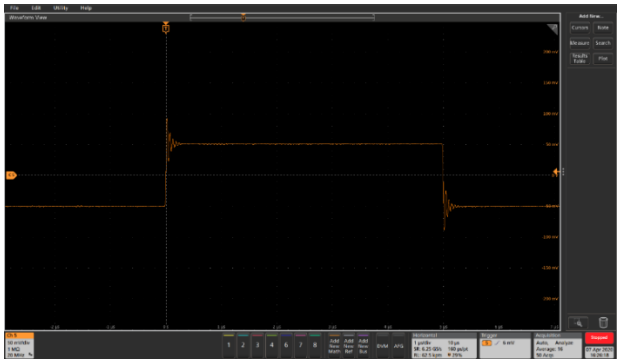
Figure 11. Positive Overload Recovery



Time: 2 us/div, Measure Time: 420 ns

R_L=2 K, C_L=100 pF, G=10

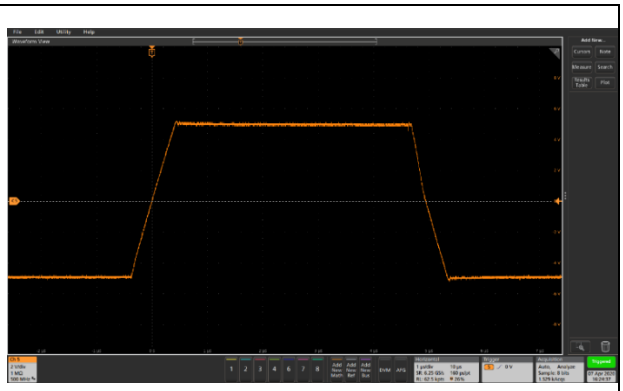
Figure 12. Negative Overload Recovery



Voltage: 50 mV/div, Time: 2 us/div

R_L=2 K, C_L=100 pF, G=1

Figure 13. 100 mV Signal Step Response



Voltage: 2 V/div, Time: 2 µs/div

R_L=2 K, C_L=100 pF, G=1

Figure 14. 10 V Signal Step Response

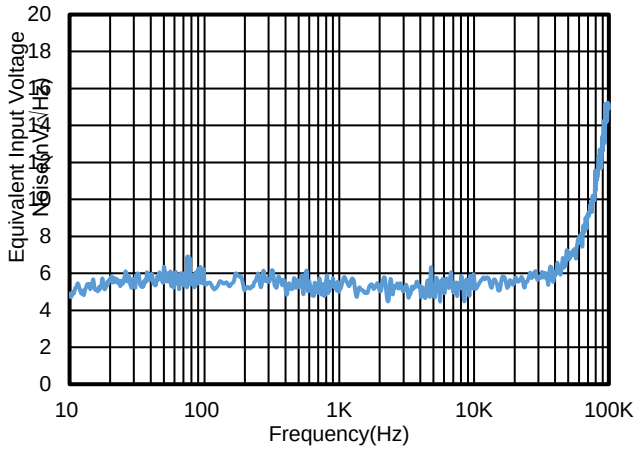


Figure 15. Voltage Noise Spectral Density vs. Frequency

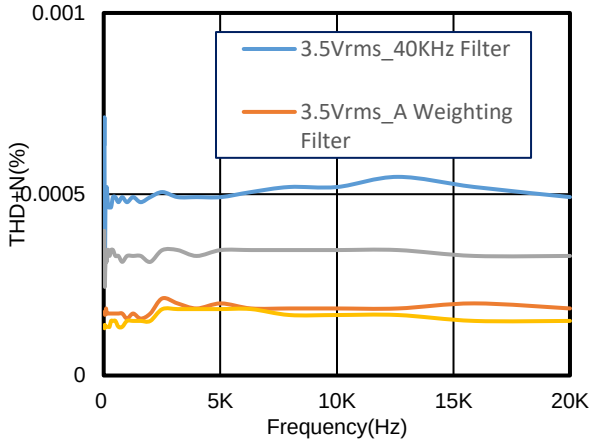


Figure 16. V_{OUT} vs. I_{OUT}, Sink

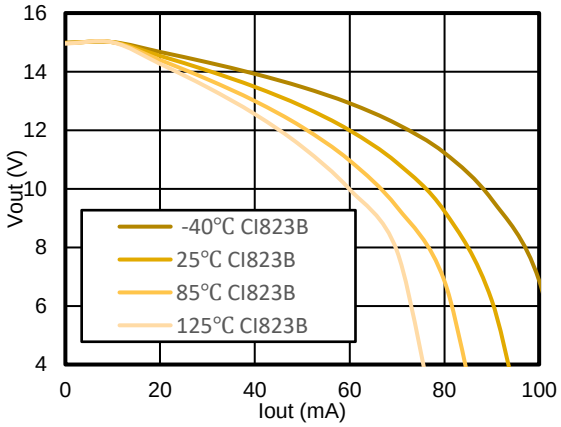


Figure 17. V_{OUT} vs. I_{OUT}, Source

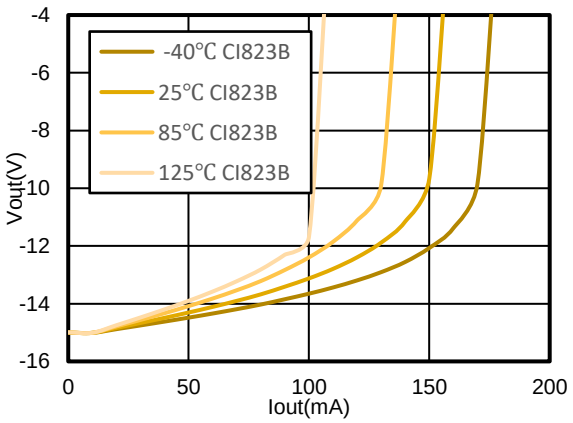


Figure 18. V_{OUT} vs. I_{OUT}, Sink

CI823B

Detailed Description

Overview

The CI823X series op amps can operate on a single-supply voltage (4.5 V to 40 V), or a split-supply voltage (±2.25 V to ±20 V), making them highly versatile and easy to use. The power-supply pins should have local bypass ceramic capacitors (typically 0.01 µF to 0.1 µF). Parameters that can exhibit variance with regard to operating voltage or temperature are presented in the Typical Characteristics.

Functional Block Diagram

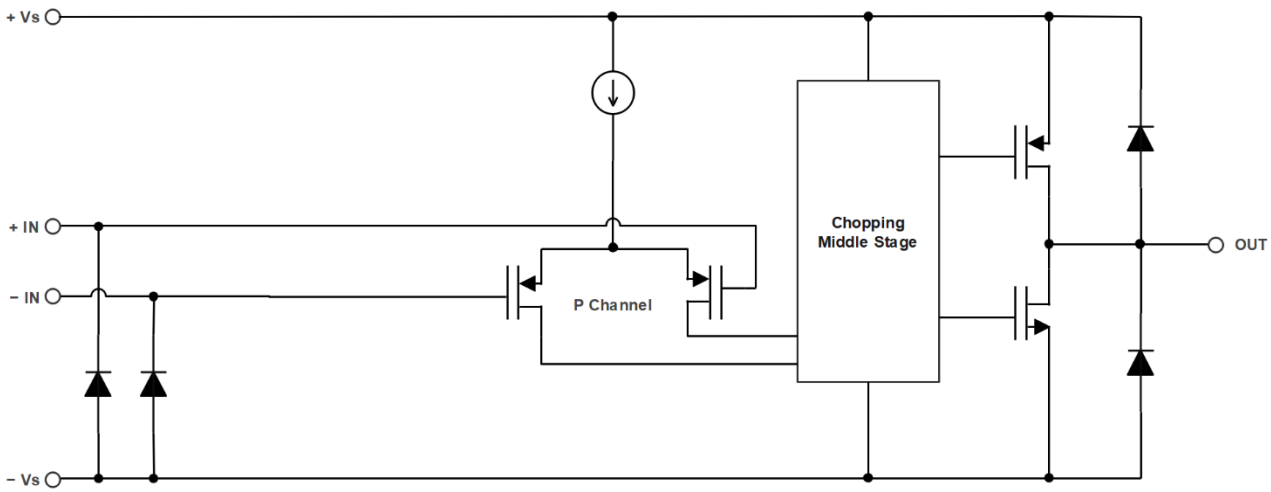
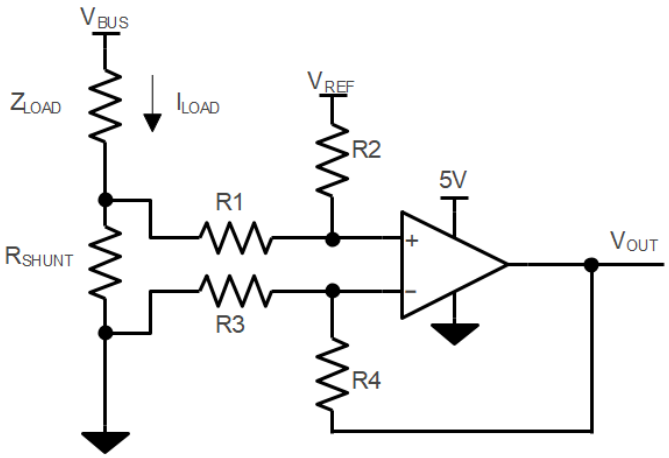


Figure 19. Functional Block Diagram

Low Side Current Sensing Application

Figure 20 shows the CI823X configured in a low -side current sensing application. The low-side current sensing method consists of placing a sense resistor between the load and the circuit ground. The voltage dropping across the resistor is amplified by different amplifier circuits with CI823X. The V_{REF} can be used to add bias voltage to output voltage. Particular attention must be paid to the matching and precision of R1, R2, R3, and R4, to maximize the accuracy of the measurement.



$$V_{OUT} = (I_{LOAD} \times R_{SHUNT}) \times (R2 / R1) + V_{REF}$$

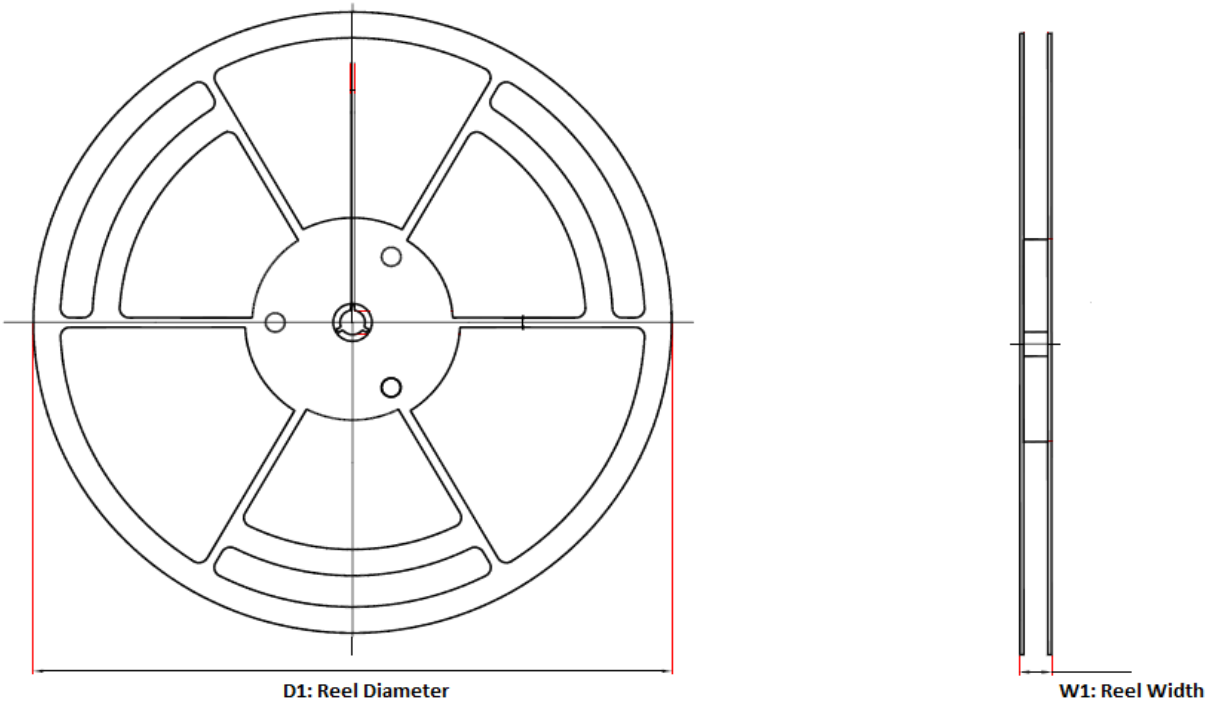
When R3 = R1, R2 = R4, R_{SHUNT} << R1

Figure 20. Dual Supply Operation Connections

Power Supply Recommendations

Place 0.1-µF bypass capacitors close to the power supply pins for reducing coupling errors from the noisy or high impedance power supplies.

Tape and Reel Information

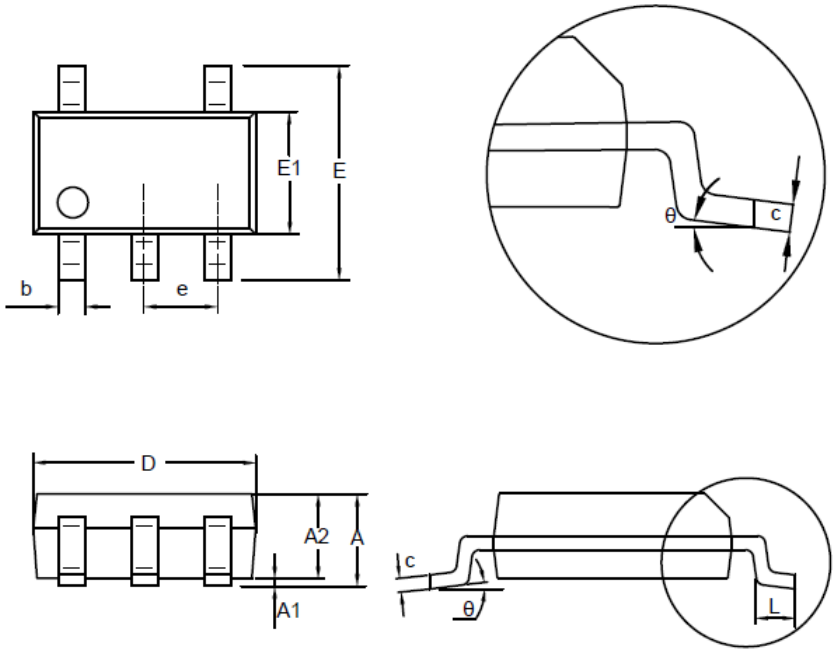


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
CI823A	SOT23-5	180.0	13.1	3.2	3.2	1.4	4.0	8.0	Q3
CI823B	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
CI823C	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
CI823D	MSOP8	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1

Package Outline Dimensions

SOT23-5

Package Outline Dimensions S5T(SOT23-5-A)



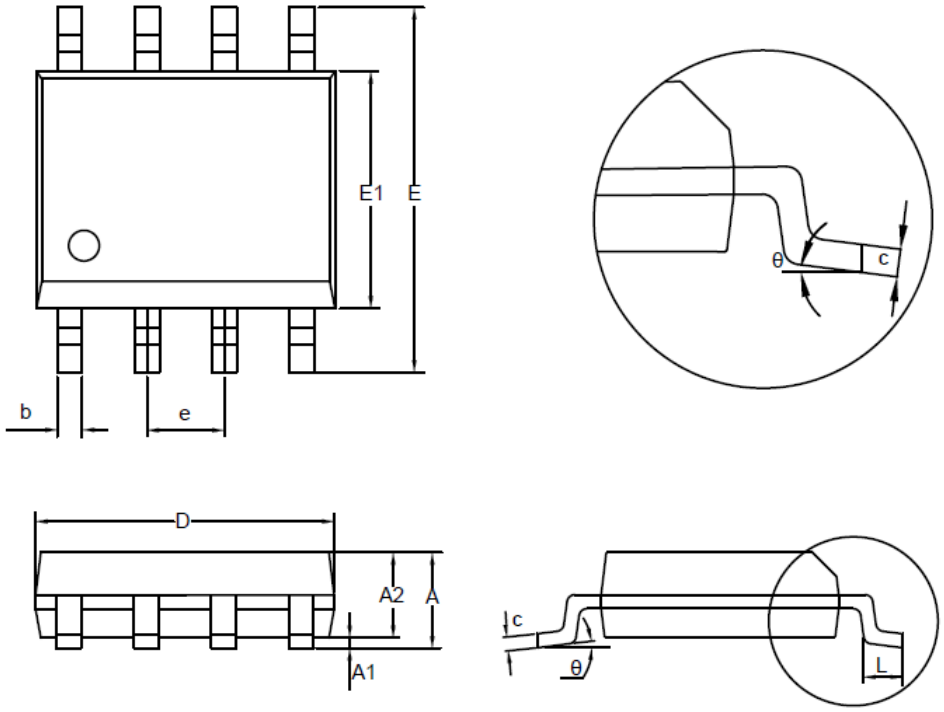
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

SOIC8

Package Outline Dimensions SO1(SOP-8-A)



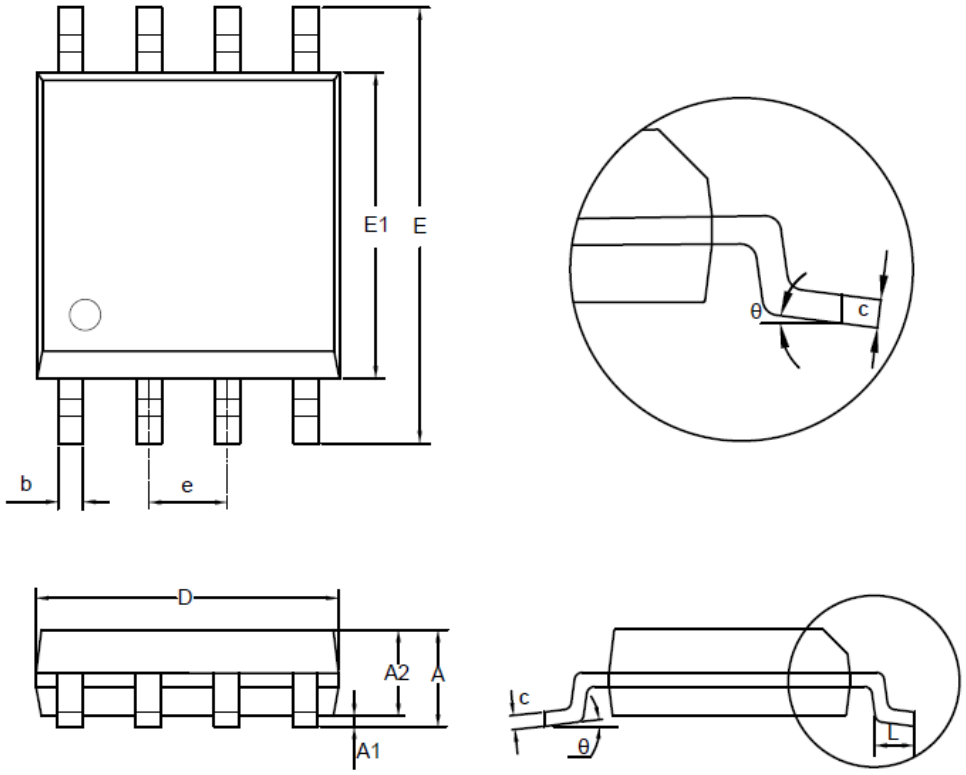
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

MSOP8

Package Outline Dimensions VS1(MSOP-8-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.