MIC862

Dual Ultra-Low Power Op Amp in SOT-23-8

Features

- 8-Pin SOT-23 Package
- 3 MHz Gain-Bandwidth Product
- 5 MHz, –3 dB Bandwidth
- 31 µA Supply Current
- Rail-to-Rail Output
- Ground Sensing at Input (Common-Mode-to-GND)
- Drives Large Capacitive Loads
- Unity Gain Stable

Applications

- Portable Equipment
- Medical Instruments
- PDAs
- Pagers
- Cordless Phones
- Consumer Electronics

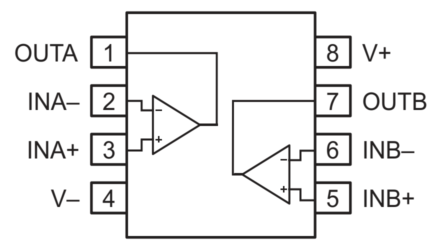
General Description

The MIC862 is a dual low-power operational amplifier in an SOT23-8 package. It is designed to operate in the 2V to 5V range, rail-to-rail output, with input common-mode to ground. The MIC862 provides 3 MHz gain-bandwidth product while consuming only 31 µA supply current per channel.

With low supply voltage and 8-lead SOT-23 packaging, MIC862 provides two channels as general-purpose amplifiers for portable and battery-powered applications. Its package provides the maximum performance available while maintaining an extremely slim form factor. The minimal power consumption of this IC maximizes the battery life potential.

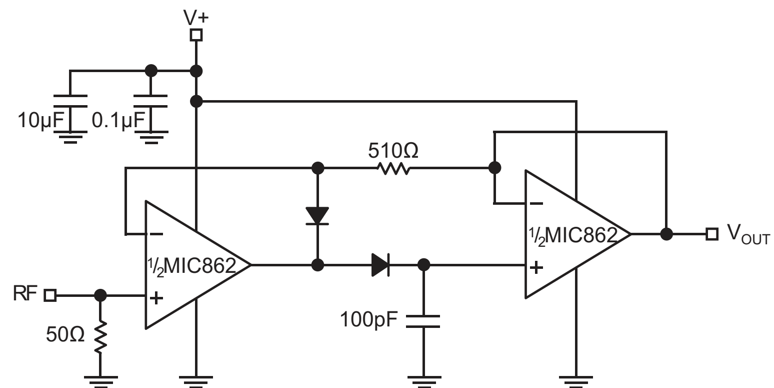
Package Type

MIC862
8-Pin SOT-23 (M8)



Typical Application Schematic

PEAK DETECTOR CIRCUIT FOR AM RADIO



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{V+} to V_{V-})........+6.0V
Differential Input Voltage (V_{IN+} to V_{IN-}) (Note 1)........+6.0V
Input Voltage (V_{IN+} to V_{IN-})........V_{V+} + 0.3V, V_{V-} – 0.3V
Output Short-Circuit Current Duration........Indefinite
ESD Rating (Note 2)........ESD Sensitive

Operating Ratings ‡

Supply Voltage (V+ to V-)........+2.0V to +5.25V

† Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ Notice: The device is not guaranteed to function outside the operating ratings.

Note 1: Exceeding the maximum differential input voltage will damage the input stage and degrade performance (in particular, input bias current is likely to increase).

2: Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5 kΩ in series with 100 pF.

TABLE 1-1: ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V+ = +2V, V– = 0V, V_{CM} = V+/2; R_L = 500 kΩ to V+/2; –40°C ≤ T_A ≤ +85°C unless otherwise noted.						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
Input Offset Voltage	V_{OS}	–6	0.1	6	mV	—
		–5	0.1	5		T_A = +25°C
Differential Offset Voltage		—	0.5	—	mV	—
Input Offset Voltage Temperature Coefficient		—	6	—	µV/°C	—
Input Bias Current	I_B	—	10	—	pA	—
Input Offset Current	I_{OS}	—	5	—	pA	—
Input Voltage Range (from V–)	V_{CM}	0.5	1	—	V	CMRR > 50 dB
Common-Mode Rejection Ratio	CMRR	45	75	—	dB	0V < V_{CM} < 1V
Power Supply Rejection Ratio	PSRR	50	78	—	dB	Supply voltage change of 2V to 2.7V.
Large-Signal Voltage Gain	A_{VOL}	66	74	—	dB	R_L = 5 kΩ, V_{OUT} = 1.4 V_{PP}
		75	89	—		R_L = 100 kΩ, V_{OUT} = 1.4 V_{PP}
		85	100	—		R_L = 500 kΩ, V_{OUT} = 1.4 V_{PP}
Maximum Output Voltage Swing	V_{OUT}	V+ – 80 mV	V+ – 55 mV	—	V	R_L = 5 kΩ
		V+ – 3 mV	V+ – 1.4 mV	—		R_L = 500 kΩ
Minimum Output Voltage Swing		—	V– + 14 mV	V– + 20 mV	V	R_L = 5 kΩ
		—	V– + 0.85 mV	V– + 3 mV		R_L = 500 kΩ
Gain-Bandwidth Product	GBW	—	2.1	—	MHz	R_L = 20 kΩ, C_L = 2 pF, A_V = 11
Phase Margin	PM	—	57	—	°	R_L = 20 kΩ, C_L = 2 pF, A_V = 11
–3 dB Bandwidth	BW	—	4.2	—	MHz	R_L = 1 MΩ, C_L = 2 pF, A_V = 1
Slew Rate	SR	—	2	—	V/µs	R_L = 1 MΩ, C_L = 2 pF, A_V = 1, Positive Slew Rate = 1.5 V/µs
Short-Circuit Output Current	I_{SC}	1.8	2.6	—	mA	Source
		1.5	2.2	—		Sink
Supply Current (per Op Amp)	I_S	—	27	43	µA	No Load
Channel-to-Channel Crosstalk	—	—	–100	—	dB	Note 1

Note 1: DC signal referenced to input. Refer to the Typical Performance Curves section's AC performance graphs.

TABLE 1-2: ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V+ = +2.7V, V– = 0V, V_{CM} = V+/2; R_L = 500 kΩ to V+/2; –40°C ≤ T_A ≤ +85°C unless otherwise noted.

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Input Offset Voltage	V_{OS}	–6	0.1	6	mV	—
		–5	0.1	5		T_A = +25°C
Differential Offset Voltage		—	0.5	—	mV	—
Input Offset Voltage Temperature Coefficient		—	6	—	µV/°C	—
Input Bias Current	I_B	—	10	—	pA	—
Input Offset Current	I_{OS}	—	5	—	pA	—
Input Voltage Range (from V–)	V_{CM}	1	1.8	—	V	CMRR > 60 dB
Common-Mode Rejection Ratio	CMRR	65	83	—	dB	0V < V_{CM} < 1.35V
Power Supply Rejection Ratio	PSRR	60	85	—	dB	Supply voltage change of 2.7V to 3V
Large-Signal Voltage Gain	A_{VOL}	65	77	—	dB	R_L = 5 kΩ, V_{OUT} = 2 V_{PP}
		80	90	—		R_L = 100 kΩ, V_{OUT} = 2 V_{PP}
		90	101	—		R_L = 500 kΩ, V_{OUT} = 2 V_{PP}
Gain-Bandwidth Product	GBW	—	2.3	—	MHz	R_L = 20 kΩ, C_L = 2 pF, A_V = 11
Phase Margin	PM	—	50	—	°	R_L = 20 kΩ, C_L = 2 pF, A_V = 11
–3 dB Bandwidth	BW	—	4.2	—	MHz	R_L = 1 MΩ, C_L = 2 pF, A_V = 1
Slew Rate	SR	—	3	—	V/µs	R_L = 1 MΩ, C_L = 2 pF, A_V = 1, Positive Slew Rate = 1.5 V/µs
Short-Circuit Output Current	I_{SC}	4.5	6.3	—	mA	Source
		4.5	6.2	—		Sink
Supply Current (per Op Amp)	I_S	—	28	45	µA	No Load
Channel-to-Channel Crosstalk	—	—	–120	—	dB	Note 1

Note 1: DC signal referenced to input. Refer to the Typical Performance Curves section's AC performance graphs.

TABLE 1-3: ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V+ = +5V, V– = 0V, V_{CM} = V+/2; R_L = 500 kΩ to V+/2; –40°C ≤ T_A ≤ +85°C unless otherwise noted.

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Input Offset Voltage	V_{OS}	–6	0.1	6	mV	—
		–5	0.1	5		T_A = +25°C
Differential Offset Voltage		—	0.5	—	mV	—
Input Offset Voltage Temperature Coefficient		—	6	—	µV/°C	—
Input Bias Current	I_B	—	10	—	pA	—
Input Offset Current	I_{OS}	—	5	—	pA	—
Input Voltage Range (from V–)	V_{CM}	3.5	4.1	—	V	CMRR > 60 dB
Common-Mode Rejection Ratio	CMRR	60	87	—	dB	0V < V_{CM} < 3.5V
Power Supply Rejection Ratio	PSRR	60	92	—	dB	Supply voltage change of 3V to 5V
Large-Signal Voltage Range	A_{VOL}	65	73	—	dB	R_L = 5 kΩ, V_{OUT} = 4.8 V_{PP}
		80	86	—		R_L = 100 kΩ, V_{OUT} = 4.8 V_{PP}
		89	96	—		R_L = 500 kΩ, V_{OUT} = 4.8 V_{PP}
Maximum Output Voltage Swing	V_{OUT}	V+ – 50 mV	V+ – 37 mV	—	V	R_L = 5 kΩ
		V+ – 3 mV	V+ – 1.3 mV	—		R_L = 500 kΩ
Minimum Output Voltage Swing		—	V– + 24 mV	V– + 40 mV		R_L = 5 kΩ
		—	V– + 0.7 mV	V– + 3 mV		R_L = 500 kΩ
Gain-Bandwidth Product	GBW	—	3	—	MHz	R_L = 20 kΩ, C_L = 2 pF, A_V = 11
Phase Margin	PM	—	45	—	°	—
–3 dB Bandwidth	BW	—	5	—	MHz	R_L = 1 MΩ, C_L = 2 pF, A_V = 1
Slew Rate	SR	—	4	—	V/µs	R_L = 1 MΩ, C_L = 2 pF, A_V = 1, Positive Slew Rate = 1.5 V/µs
Short-Circuit Output Current	I_{SC}	17	23	—	mA	Source
		18	27	—		Sink
Supply Current (per Op Amp)	I_S	—	31	47	µA	No Load
Channel-to-Channel Crosstalk	—	—	–120	—	dB	Note 1

Note 1: DC signal referenced to input. Refer to the Typical Performance Curves section's AC performance graphs.

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Operating Temperature Range	—	–40	—	+125	°C	—
Storage Temperature Range	T_S	—	—	+150	°C	—
Ambient Temperature Range	T_A	–40	—	+85	°C	—
Package Thermal Resistance						
Thermal Resistance SOT-23-8	θ_{JA}	—	100	—	°C/W	Using 4-Layer PCB
	θ_{JC}	—	70	—	°C/W	Using 4-Layer PCB

Note 1: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +125°C rating. Sustained junction temperatures above +125°C can impact the device reliability.

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

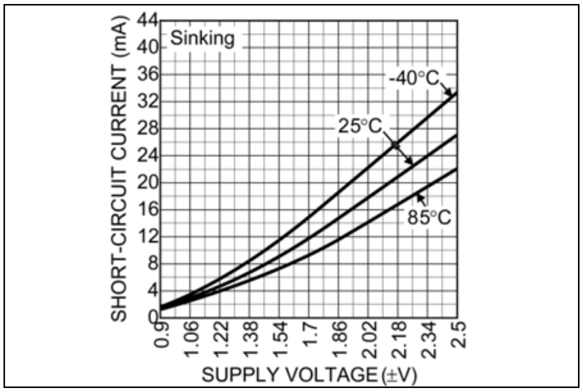


FIGURE 2-1: *Short-Circuit Current vs. Supply Voltage.*

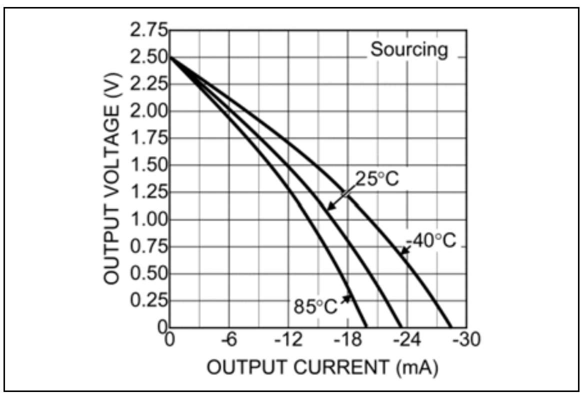


FIGURE 2-2: *Output Voltage vs. Output Current.*

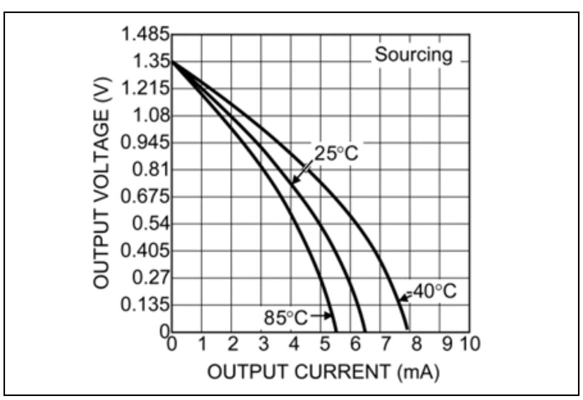


FIGURE 2-3: *Output Voltage vs. Output Current.*

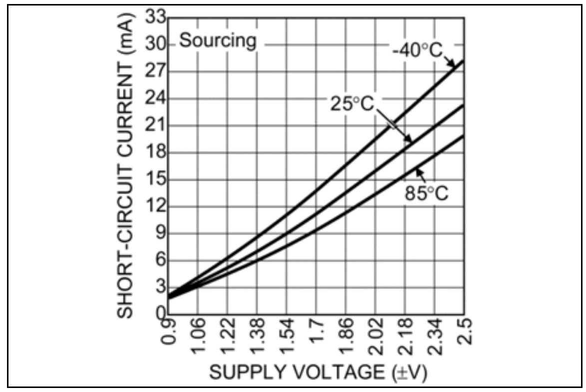


FIGURE 2-4: *Short-Circuit Current vs. Supply Voltage.*

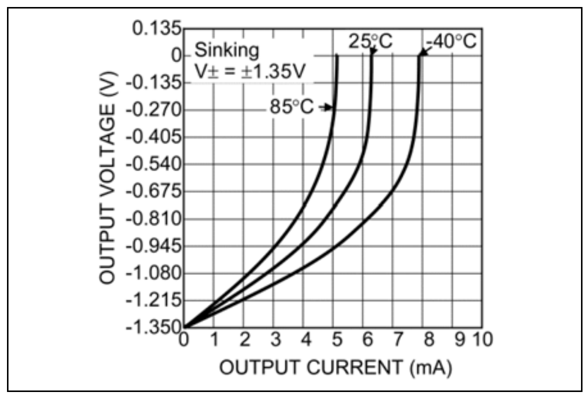


FIGURE 2-5: *Output Voltage vs. Output Current.*

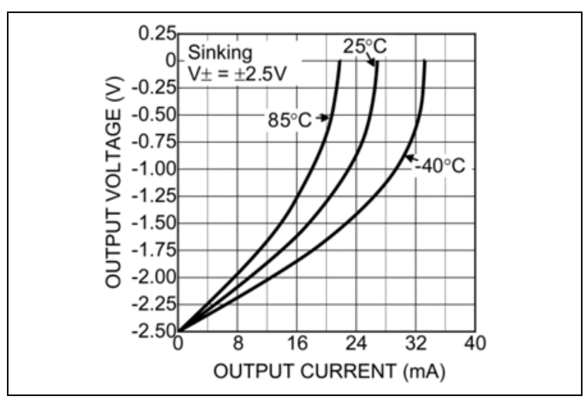


FIGURE 2-6: *Output Voltage vs. Output Current.*

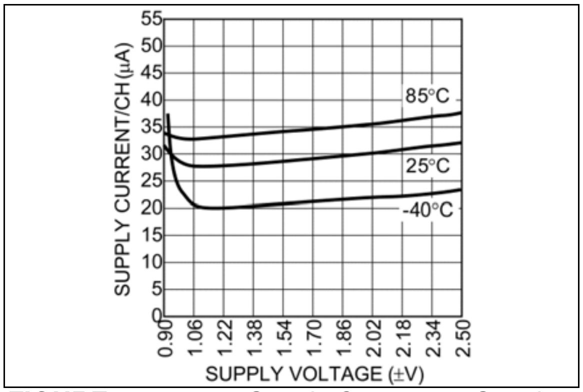


FIGURE 2-7: *Supply Current vs. Supply Voltage.*

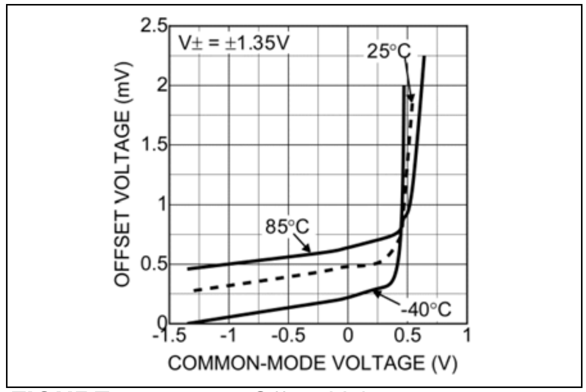


FIGURE 2-10: *Offset Voltage vs. Common-Mode Voltage.*

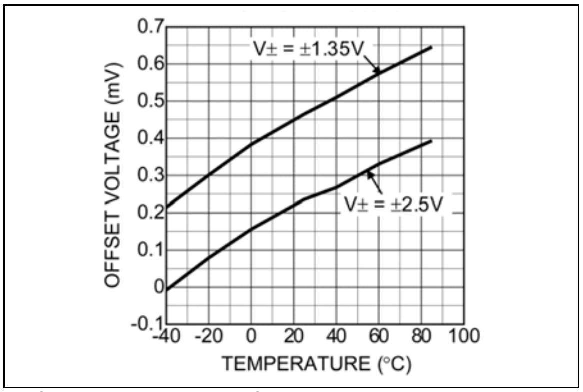


FIGURE 2-8: *Offset Voltage vs. Temperature.*

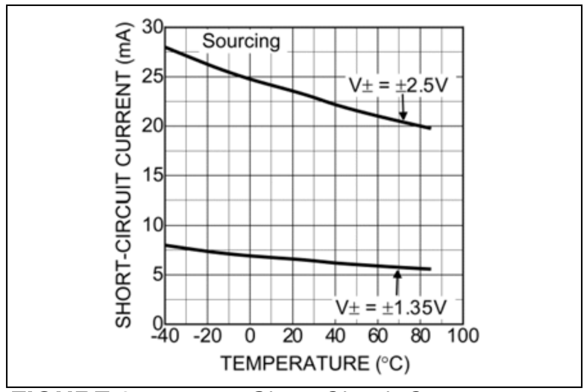


FIGURE 2-11: *Short-Circuit Current vs. Temperature.*

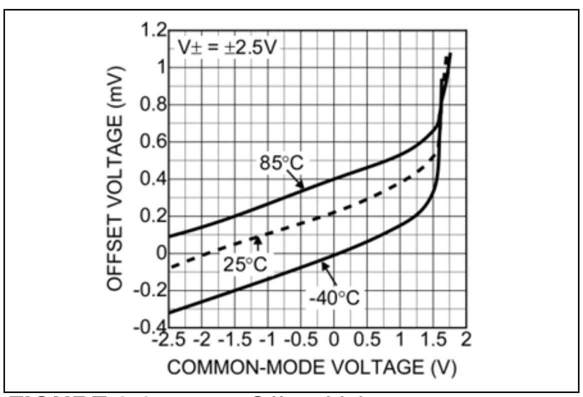


FIGURE 2-9: *Offset Voltage vs. Common-Mode Voltage.*

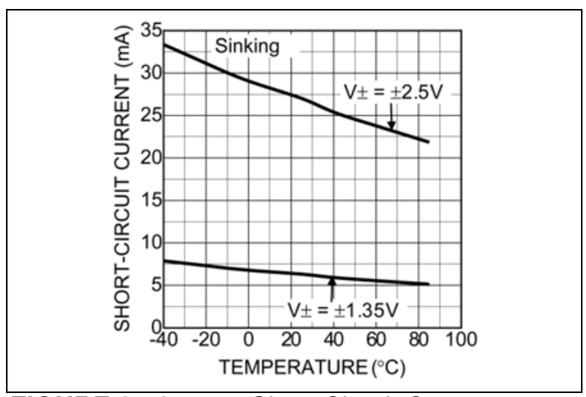


FIGURE 2-12: *Short-Circuit Current. vs. Temperature.*

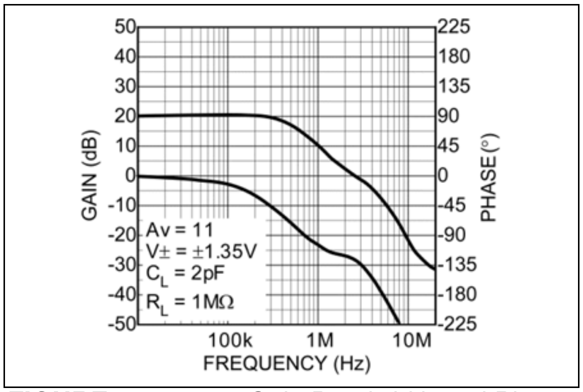


FIGURE 2-13: *Gain Bandwidth and Phase Margin.*

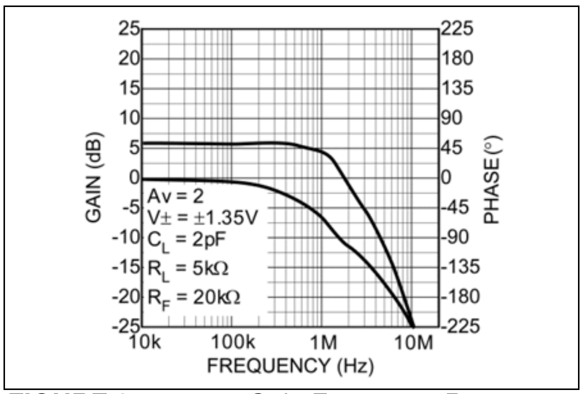


FIGURE 2-14: *Gain Frequency Response.*

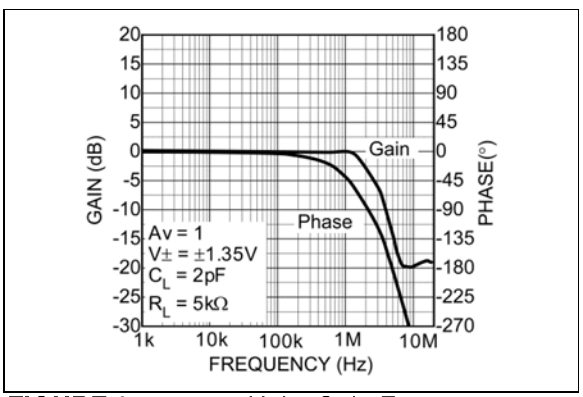


FIGURE 2-15: *Unity Gain Frequency Response.*

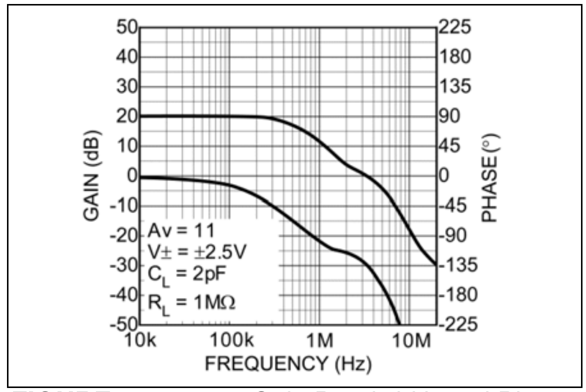


FIGURE 2-16: *Gain Bandwidth and Phase Margin.*

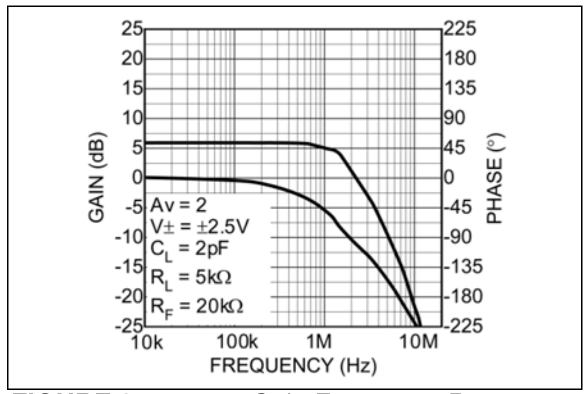


FIGURE 2-17: *Gain Frequency Response.*

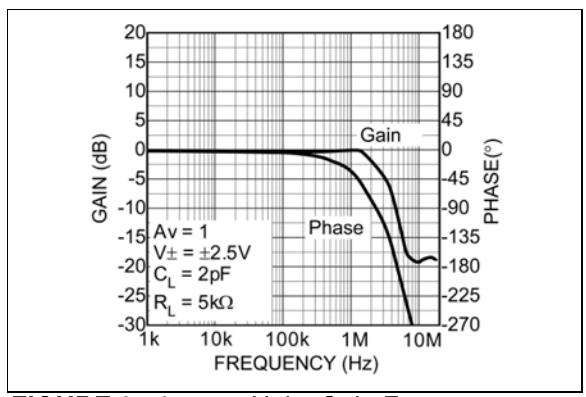


FIGURE 2-18: *Unity Gain Frequency Response.*

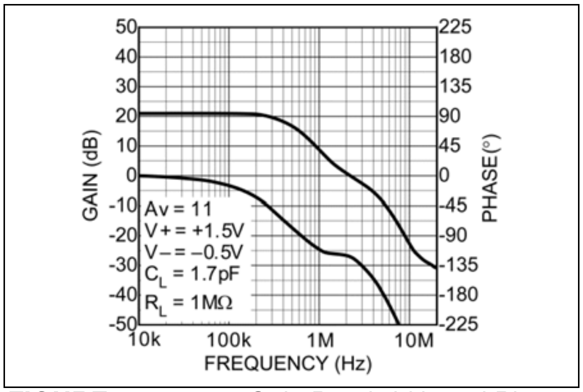


FIGURE 2-19: *Gain Bandwidth and Phase Margin.*

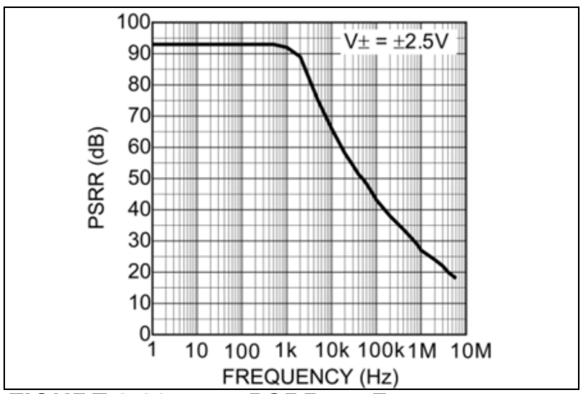


FIGURE 2-20: *PSRR vs. Frequency.*

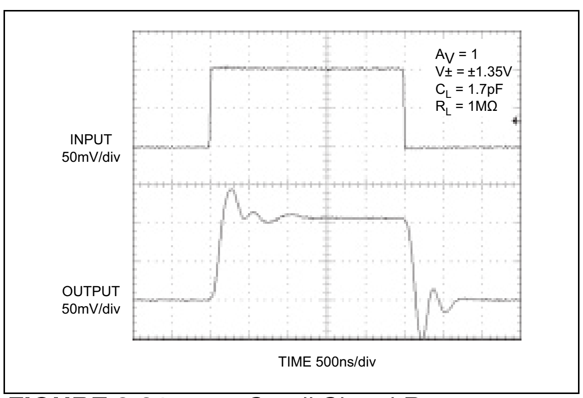


FIGURE 2-21: *Small Signal Response.*

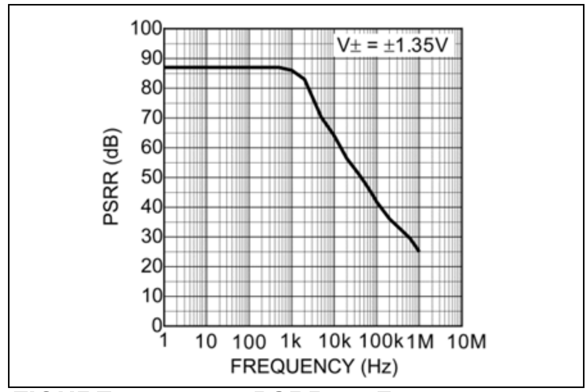


FIGURE 2-22: *PSRR vs. Frequency.*

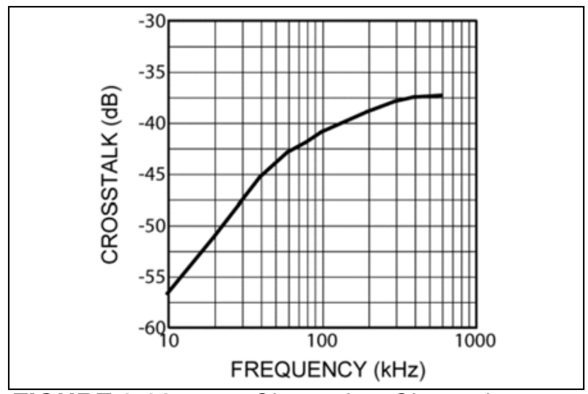


FIGURE 2-23: *Channel-to-Channel Crosstalk.*

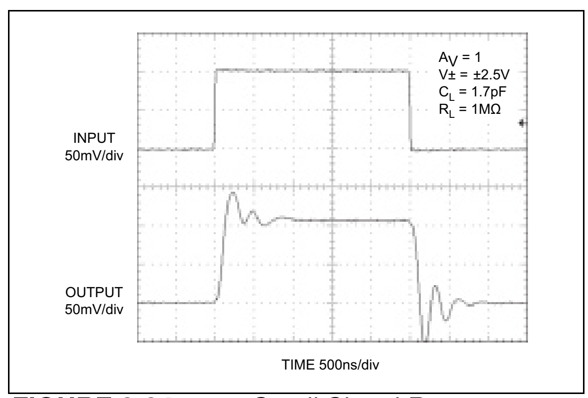


FIGURE 2-24: *Small Signal Response.*

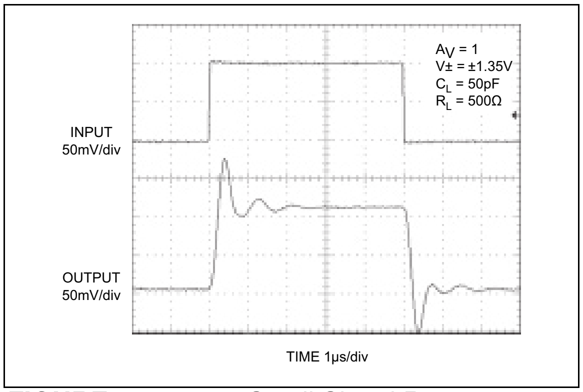


FIGURE 2-25: *Small Signal Response.*

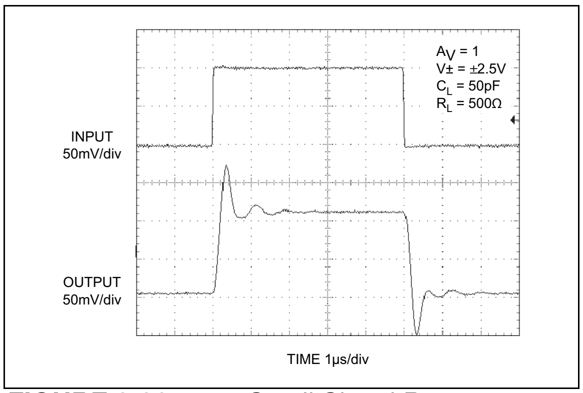


FIGURE 2-26: *Small Signal Response.*

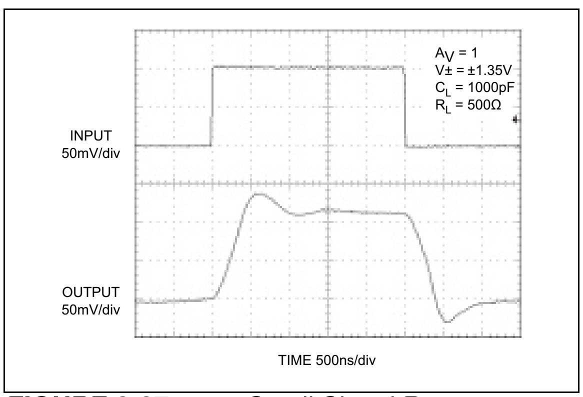


FIGURE 2-27: *Small Signal Response.*

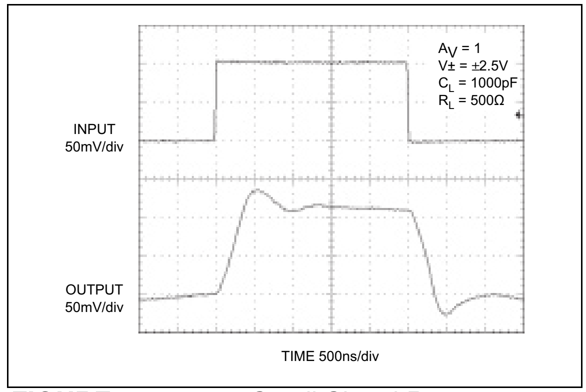


FIGURE 2-28: *Small Signal Response.*

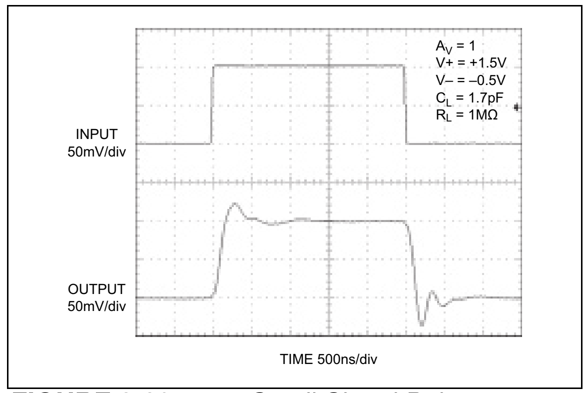


FIGURE 2-29: *Small Signal Pulse Response.*

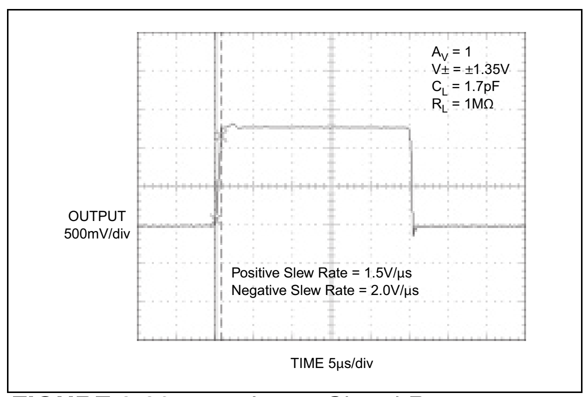


FIGURE 2-30: *Large Signal Response.*

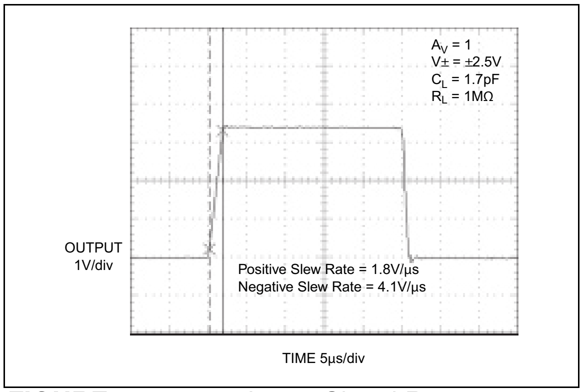


FIGURE 2-31: *Large Signal Response.*

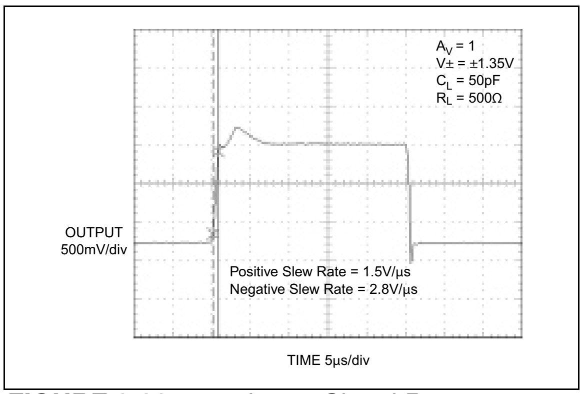


FIGURE 2-32: *Large Signal Response.*

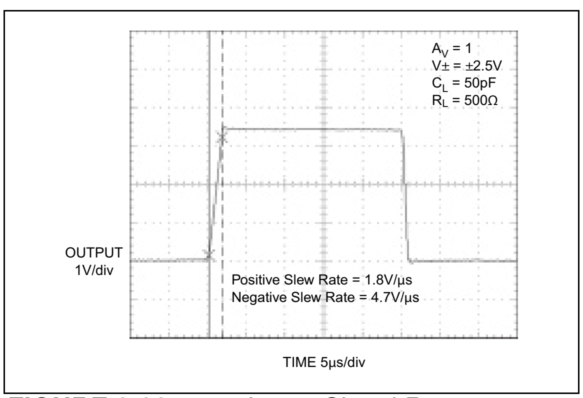


FIGURE 2-33: *Large Signal Response.*

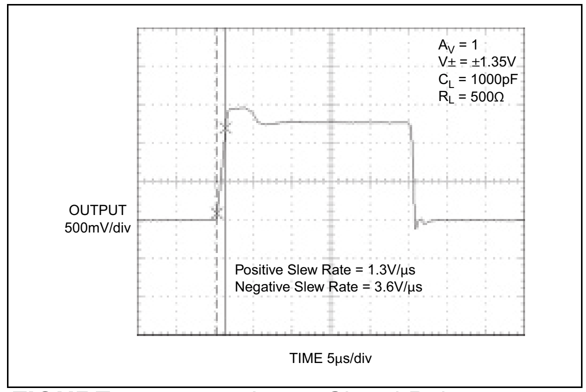


FIGURE 2-34: *Large Signal Pulse Response.*

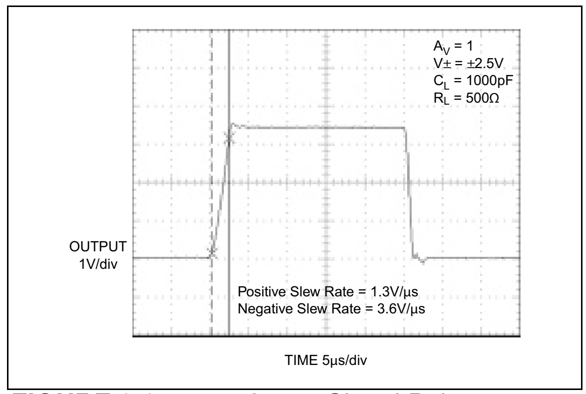


FIGURE 2-35: *Large Signal Pulse Response.*

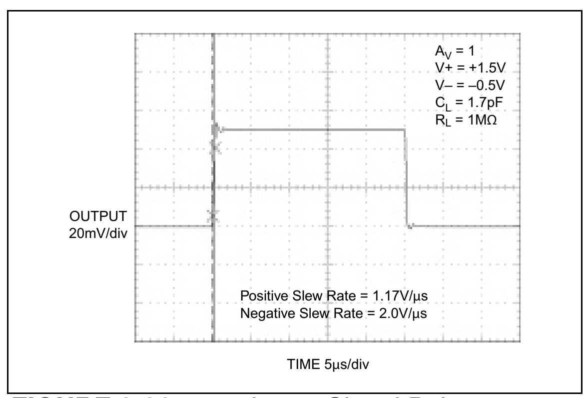


FIGURE 2-36: *Large Signal Pulse Response.*

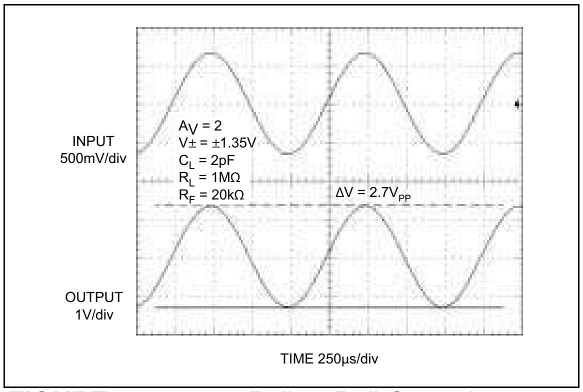


FIGURE 2-37: *Rail-to-Rail Operation.*

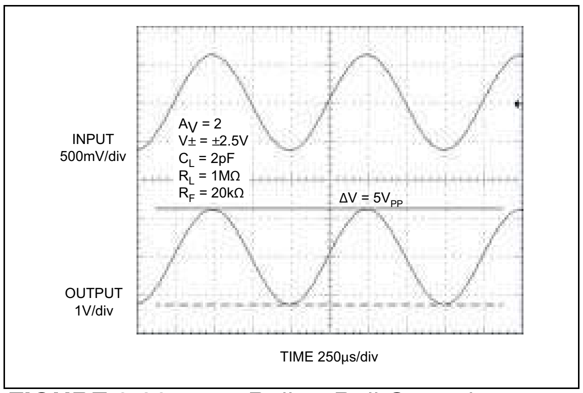


FIGURE 2-38: *Rail-to-Rail Operation.*

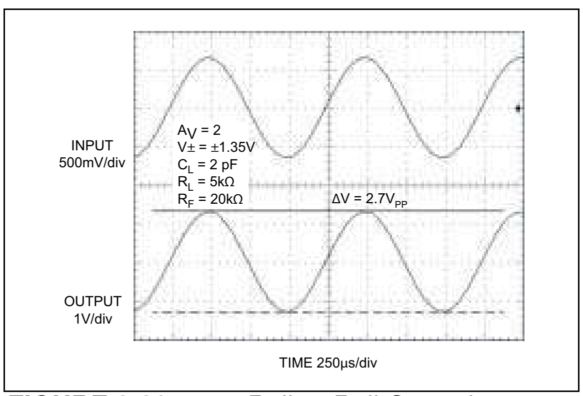


FIGURE 2-39: *Rail-to-Rail Operation.*

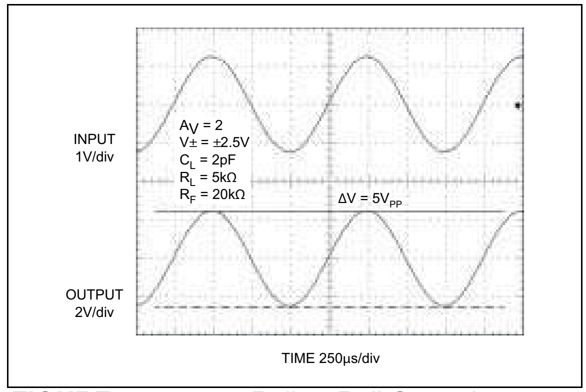


FIGURE 2-40: *Rail-to-Rail Operation.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Symbol	Description
1	OUTA	Amplifier A Output.
2	INA–	Amplifier A Inverting Input.
3	INA+	Amplifier A Non-Inverting Input
4	V–	Negative Supply.
5	INB+	Amplifier B Non-Inverting Input.
6	INB–	Amplifier B Inverting Input.
7	OUTB	Amplifier B Output.
8	V+	Positive Supply.

4.0 APPLICATION INFORMATION

4.1 Power Supply Bypassing

Regular supply bypassing techniques are recommended. A 10 µF capacitor in parallel with a 0.1 µF capacitor on both the positive and negative supplies are ideal. For best performance all bypassing capacitors should be located as close to the op amp as possible and all capacitors should be low ESL (equivalent series inductance), ESR (equivalent series resistance). Surface-mount ceramic capacitors are ideal.

4.2 Supply and Loading Resistive Considerations

The MIC862 is intended for single-supply applications configured with a grounded load. It is not advisable to operate the MIC862 under either of the following conditions:

- A grounded load and split supplies (±V)
- A single supply where the load is terminated above ground.

Under the above conditions, if the load is less than 20 kΩ and the output swing is greater than 1V (peak), there may be some instability when the output is sinking current.

4.3 Capacitive Load

When driving a large capacitive load, a resistor of 500Ω is recommended to be connected between the op amp output and the capacitive load to avoid oscillation.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

8-Pin SOT-23*	Example
● XXX NNN	● A34 943

Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).

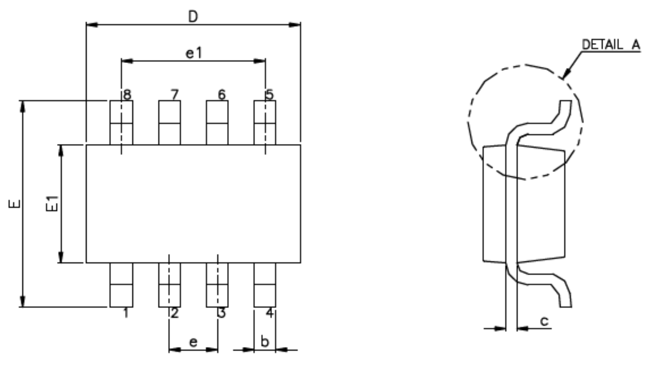
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

Underbar (_) and/or Overbar (‾) symbol may not be to scale.

8-Lead SOT-23 Package Outline and Recommended Land Pattern

TITLE
8 LEAD SOT23 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SOT23-8LD-PL-1	**UNIT**	MM
Lead Frame	Copper Alloy	**Lead Finish**	Matte Tin

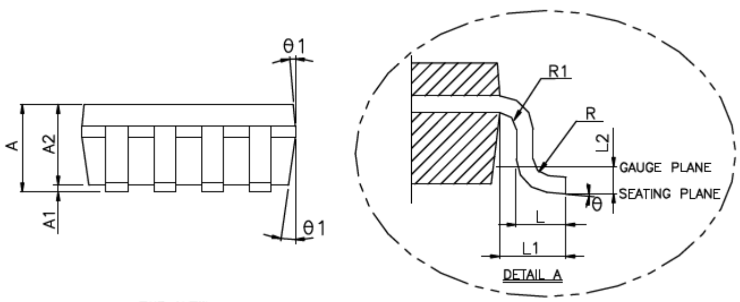


TOP VIEW SIDE VIEW

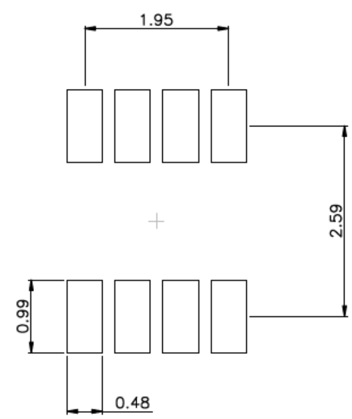
VARIATION(ALL DIMENSIONS SHOWN IN MM)

SYMBOL	MIN.	NOM.	MAX.
A	–	–	1.45
A1	0.00	–	0.15
A2	0.90	1.15	1.30
b	0.22	–	0.38
c	0.08	–	0.22
D	2.90 BSC.		
E	2.80 BSC.		
E1	1.60 BSC.		
e	0.65 BSC.		
e1	1.95 BSC.		
L	0.30	0.45	0.60
L1	0.60 REF.		
L2	0.25 BSC.		
R	0.10	–	–
R1	0.10	–	0.25
θ	0°	4°	8°
θ1	5°	10°	15°

NOTE :
1. JEDEC OUTLINE : MO-178 BA.



END VIEW DETAIL A



RECOMMENDED LAND PATTERN

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

APPENDIX A: REVISION HISTORY

Revision A (August 2017)

- Converted Micrel document MIC862 to Microchip data sheet template DS20005836A.
- Minor text changes throughout.
- Corrected the Product Identification System section by removing an errorneous letter T from the part number.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	X	XX	-XX
Device	Temperature	Package	Media Type

Device:	MIC862:		Dual Ultra-Low Power Op Amp
Temperature:	Y	=	–40°C to +85°C
Package:	M8	=	8-Lead SOT-23
Media Type:	TR	=	3,000/Reel

Examples:

a) MIC862YM8-TR: Dual Ultra-Low Power Op Amp, –40°C to +85°C Junction Temperature Range, 8-Lead SOT-23 Package, 3,000/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
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