MIC863

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

General Description

The MIC863 is a dual low-power operational amplifier in a 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 MIC863 provides 450kHz gain-bandwidth product while consuming only a 4.2µA supply current

With low supply voltage and 8-pin SOT-23 packaging, MIC863 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.

Datasheets and support documentation are available on Micrel's web site at: www.micrel.com.

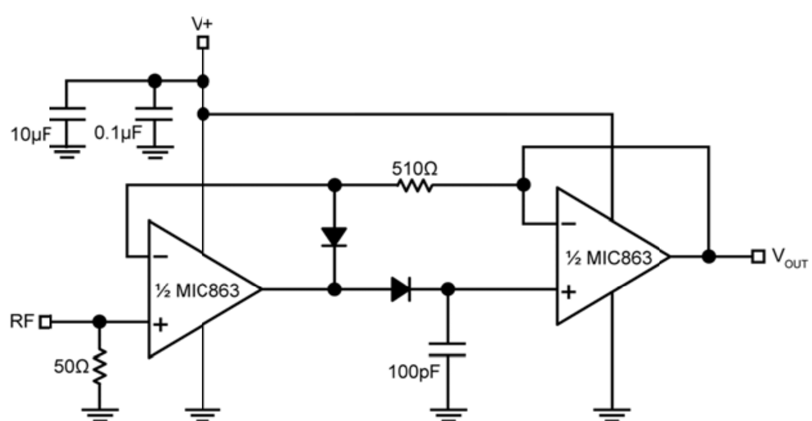
Features

- 8-Pin SOT-23 package
- 450kHz gain-bandwidth product
- 800kHz, –3dB bandwidth
- 4.2µA supply current/channel
- Rail-to-rail output
- Ground sensing at input (common mode-to-GND)
- Drives large capacitive loads (0.02µF)
- Unity gain stable

Applications

- Portable equipment
- Medical instrument
- PDAs
- Pagers
- Cordless phones
- Consumer electronics

Typical Application



Peak Detector Circuit for AM Radio

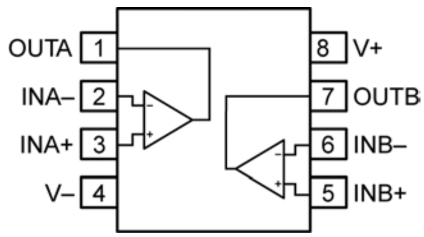
Ordering Information

Part Number	Marking[(1)]	Junction Temperature Range	Lead Finish	Package
MIC863YM8	A35	–40°C to +85°C	Pb-Free	8-Pin SOT-23

Note:

1. Underbar (_) may not be to scale.

Pin Configuration



8-Pin SOT-23 (M8)
(Top View)

Pin Description

Pin Number	Pin Name	Pin Function
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

Absolute Maximum Ratings[2]

Supply Voltage (V_{V+} – V_{V-}) ....+6.0V
Differential Input Voltage ($|V_{IN+} – V_{IN-}|$[4]. ....+6.0V
Input Voltage (V_{IN+} – V_{IN-}) ....V_{V+} + 0.3V, V_{V-} – 0.3V
Lead Temperature (soldering, 10s)........................... 260°C
Output Short-Circuit Current Duration....................Indefinite
Storage Temperature (Ts)... 150°C
ESD Rating[5].. ESD Sensitive

Operating Ratings[3]

Supply Voltage (V_{V+} – V_{V-})......................... +2.0V to +5.25V
Ambient Temperature (T_A) .... –40°C to +85°C
Package Thermal Resistance
θ_{JA} (Using 4-Layer PCB).................................100°C/W
θ_{CA} (Using 4-Layer PCB) ....70°C/W

Electrical Characteristics

V+ = +2V, V– = 0V, V_{CM} = V+/2; R_L = 500kΩ to V+/2; T_A = 25°C, unless otherwise noted. **Bold** values indicate –40°C ≤ T_A ≤ +85°C.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{OS}	Input Offset Voltage		**–6**	0.1	**+6**	mV
			–5		+5	
	Differential Offset Voltage			0.5		mV
	Input Offset Voltage Temperature Coefficient			6		µV/°C
I_B	Input Bias Current			10		pA
I_{OS}	Input Offset Current			5		pA
V_{CM}	Input Voltage Range	CMRR > 50dB	**0.5**	1		V
CMRR	Common-Mode Rejection Ratio	0 < V_{CM} < 1V	**45**	75		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change of 2V to 2.7V	**50**	85		dB
A_{VOL}	Large-Signal Voltage Gain	R_L = 100kΩ, V_{OUT} = 1.4V_{PP}	**66**	81		dB
		R_L = 500kΩ, V_{OUT} = 1.4V_{PP}	**73**	90		
V_{OUT}	Maximum Output Voltage Swing	R_L = 500kΩ	**V+ – 3mV**	V+ – 1.4mV		V
	Minimum Output Voltage Swing	R_L = 500kΩ		V– + 0.5mV	**V– + 3mV**	
GBW	Gain-Bandwidth Product	R_L = 200kΩ, C_L = 2pF, A_V = 11		320		kHz
PM	Phase Margin	R_L = 200kΩ, C_L = 2pF, A_V = 11		69		°
BW	–3dB Bandwidth	A_V = 1, C_L = 2pF, R_L = 1MΩ		600		kHz
SR	Slew Rate	A_V = 1, C_L = 2pF, R_L = 1MΩ, Positive Slew Rate = 0.17V/µs		0.33		V/µs
I_{SC}	Short-Circuit Output Current	Source	**1.8**	2.6		mA
		Sink	**1.5**	2.2		
I_S	Supply Current (per Op Amp)	No Load		3.5	**7**	µA
	Channel-to-Channel Crosstalk	Note 6		–100		dB

Notes:

2. Exceeding the absolute maximum ratings may damage the device.
3. The device is not guaranteed to function outside its operating ratings.
4. Exceeding the maximum differential input voltage will damage the input stage and degrade performance (in particular, input bias current is likely to increase).
5. Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5kΩ in series with 100pF.
6. DC signal referenced to input. Refer to the *Typical Characteristics* section for “AC Performance Characteristics”.

Electrical Characteristics

V+ = +2.7V, V– = 0V, V_{CM} = V+/2; R_L = 500kΩ to V+/2; T_A = 25°C, unless otherwise noted. **Bold** values indicate –40°C ≤ T_A ≤ +85°C.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{OS}	Input Offset Voltage		**–6**	0.1	**+6**	mV
			–5		+5	
	Differential Offset Voltage			0.5		mV
	Input Offset Voltage Temperature Coefficient			6		µV/°C
I_B	Input Bias Current			10		pA
I_{OS}	Input Offset Current			5		pA
V_{CM}	Input Voltage Range	CMRR > 60dB	**1**	1.8		V
CMRR	Common-Mode Rejection Ratio	0 < V_{CM} < 1.35V	**60**	83		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change of 2.7V to 3V	**55**	85		dB
A_{VOL}	Large-Signal Voltage Gain	R_L = 100kΩ, V_{OUT} = $2V_{PP}$	**70**	83		dB
		R_L = 500kΩ, V_{OUT} = $2V_{PP}$	**78**	91		
GBW	Gain-Bandwidth Product	R_L = 200kΩ, C_L = 2pF, A_V = 11		350		kHz
PM	Phase Margin	R_L = 200kΩ, C_L = 2pF, A_V = 11		65		°
BW	–3dB Bandwidth	A_V = 1, C_L = 2pF, R_L = 1MΩ		600		kHz
SR	Slew Rate	A_V = 1, C_L = 2pF, R_L = 1MΩ, Positive Slew Rate = 0.17V/µs		0.35		V/µs
I_{SC}	Short-Circuit Output Current	Source	**4.5**	6.3		mA
		Sink	**4.5**	6.2		
I_S	Supply Current (per Op Amp)	No Load		3.6	**7**	µA
	Channel-to-Channel Crosstalk	Note 6		–120		dB

Electrical Characteristics

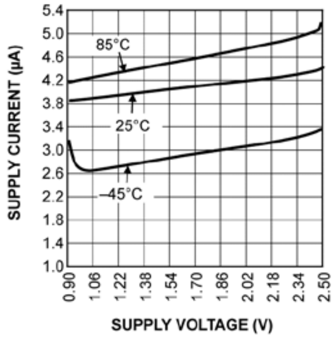
V+ = +5V, V– = 0V, V_{CM} = V+/2; R_L = 500kΩ to V+/2; T_A = 25°C, unless otherwise noted. **Bold** values indicate –40°C ≤ T_A ≤ +85°C.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{OS}	Input Offset Voltage		**–6**	0.1	**+6**	mV
			–5		+5	
	Differential Offset Voltage			0.5		mV
	Input Offset Voltage Temperature Coefficient			6		µV/°C
I_B	Input Bias Current			10		pA
I_{OS}	Input Offset Current			5		pA
V_{CM}	Input Voltage Range	CMRR > 60dB	**3.5**	4.1		V
CMRR	Common-Mode Rejection Ratio	0 < V_{CM} < 3.5V	**60**	85		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change of 3V to 5V	**60**	86		dB
A_{VOL}	Large-Signal Voltage Gain	R_L = 100kΩ, V_{OUT} = 4.0V_{PP}	**73**	81		dB
		R_L = 500kΩ, V_{OUT} = 4.0V_{PP}	**78**	88		
V_{OUT}	Maximum Output Voltage Swing	R_L = 500kΩ	**V+ – 3mV**	V+ – 1.3mV		V
	Minimum Output Voltage Swing	R_L = 500kΩ		V– + 0.7mV	**V– + 3mV**	
GBW	Gain-Bandwidth Product	R_L = 200kΩ, C_L = 2pF, A_V = 11		450		kHz
PM	Phase Margin			63		°
BW	–3dB Bandwidth	A_V = 1, C_L = 2pF, R_L = 1MΩ		800		kHz
SR	Slew Rate	A_V = 1, C_L = 2pF, R_L = 1MΩ, Positive Slew Rate = 0.2V/µs		0.35		V/µs
I_{SC}	Short-Circuit Output Current	Source	**17**	23		mA
		Sink	**18**	27		
I_S	Supply Current (per Op Amp)	No Load		4.2	**8**	µA
	Channel-to-Channel Crosstalk	Note 6		–120		dB

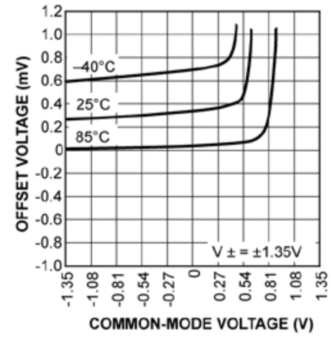
Typical Characteristics

DC Performance Characteristics

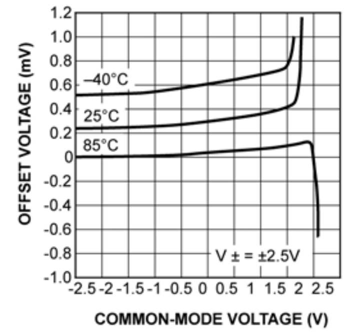
Supply Current vs. Supply Voltage



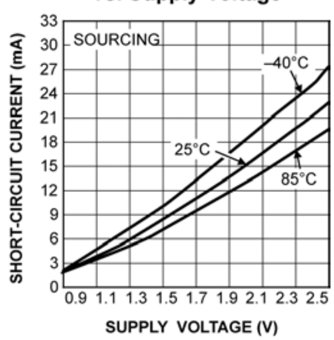
Offset Voltage vs. Common-Mode Voltage



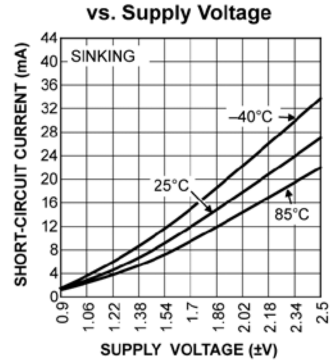
Offset Voltage vs. Common-Mode Voltage



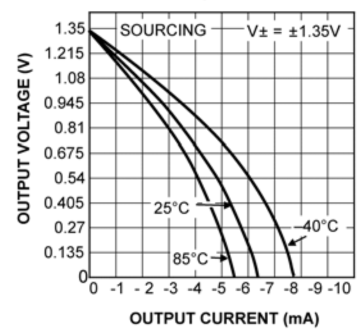
Short-Ciruit Current vs. Supply Voltage



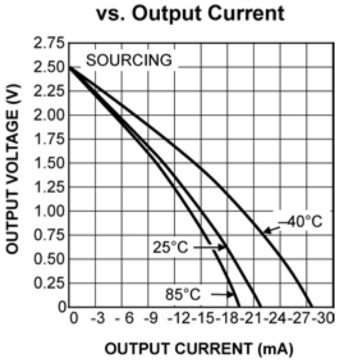
Short-Ciruit Current vs. Supply Voltage



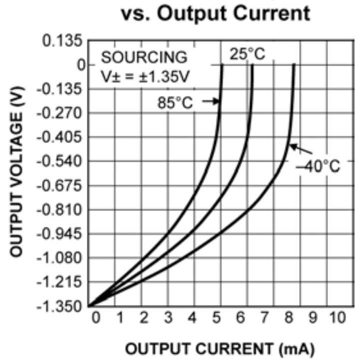
Output Voltage vs. Output Current



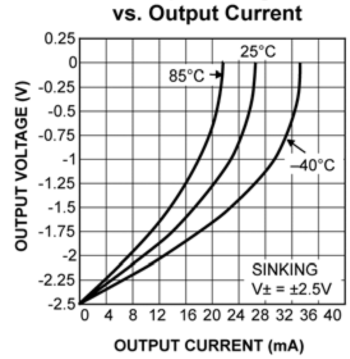
Output Voltage vs. Output Current



Output Voltage vs. Output Current

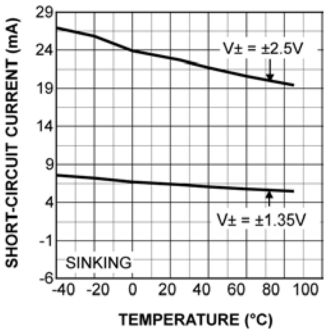


Output Voltage vs. Output Current

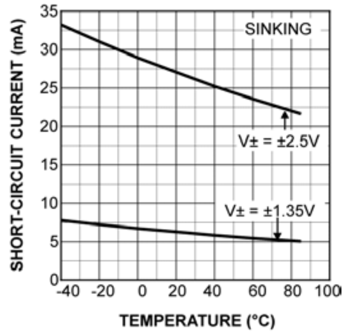


Typical Characteristics (Continued)

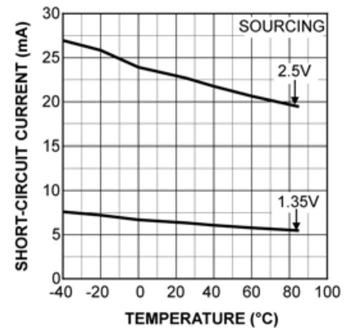
DC Performance Characteristics (Continued)



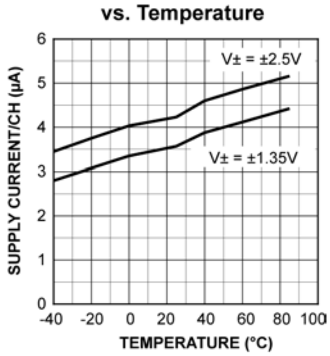
Short-Circuit Current vs. Temperature



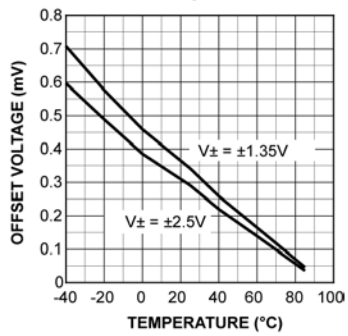
Short-Circuit Current vs. Temperature



Short-Circuit Current vs. Temperature



Supply Current per Channel vs. Temperature

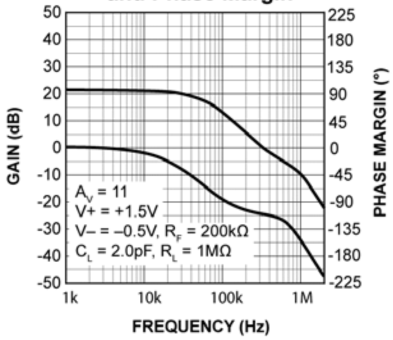


Offset Voltage vs. Temperature

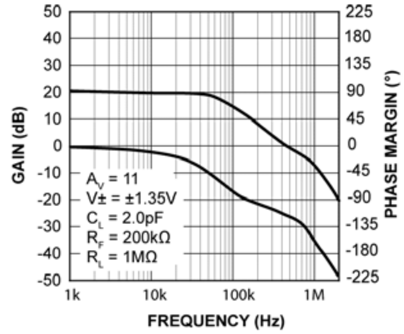
Typical Characteristics (Continued)

AC Performance Characteristics

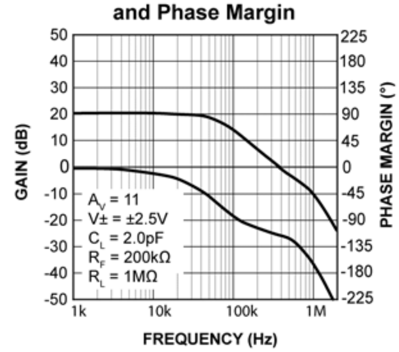
Gain Bandwidth and Phase Margin



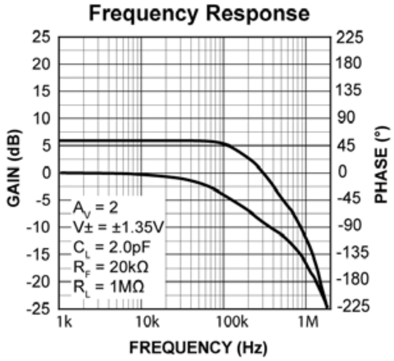
Gain Bandwidth and Phase Margin



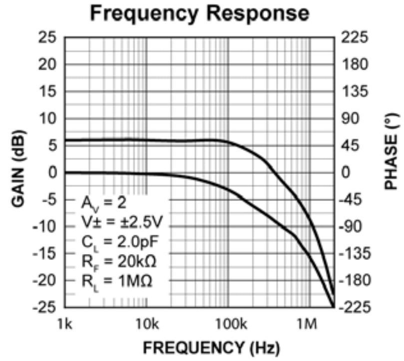
Gain Bandwidth and Phase Margin



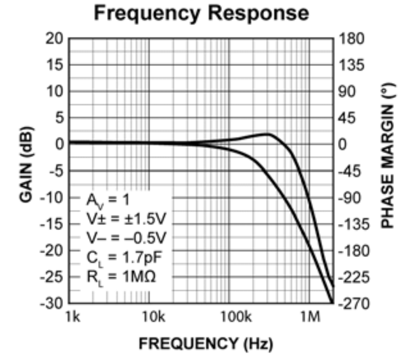
Gain Bandwidth Frequency Response



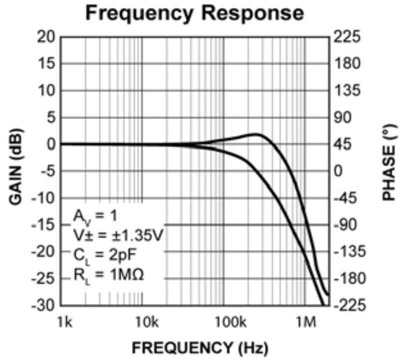
Gain Bandwidth Frequency Response



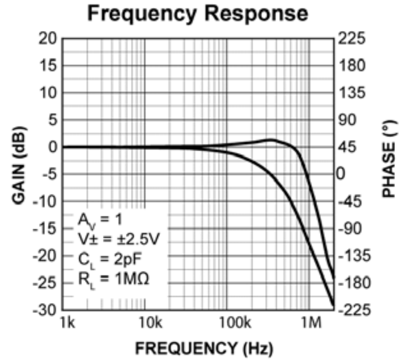
Unity Gain Frequency Response

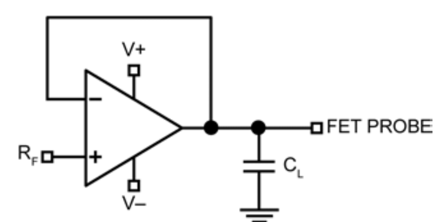


Unity Gain Frequency Response



Unity Gain Frequency Response

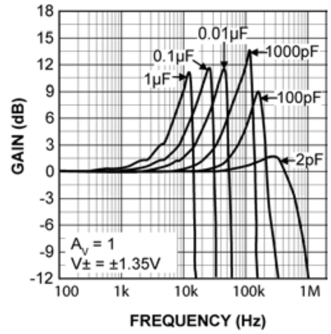




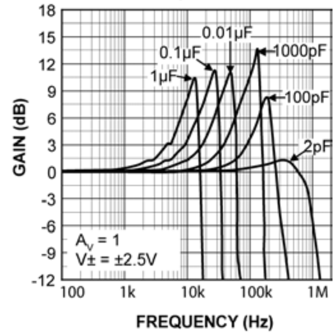
Typical Characteristics (Continued)

AC Performance Characteristics (Continued)

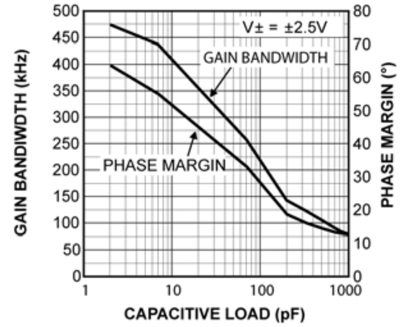
Close Loop Unity Gain Frequency Response



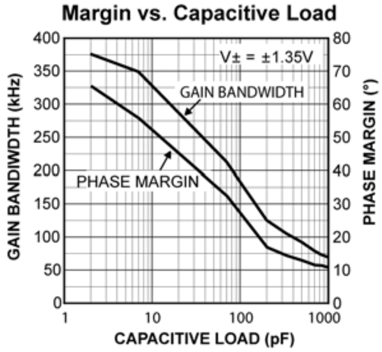
Close Loop Unity Gain Frequency Response

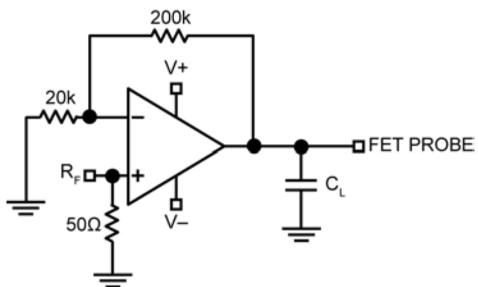


Gain Bandwidth and Phase Margin vs. Capacitive Load

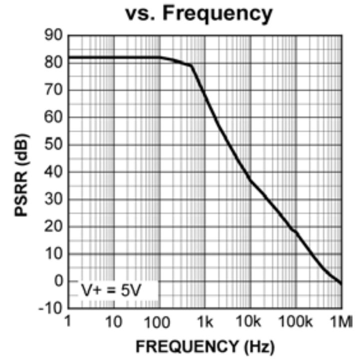


Gain Bandwidth and Phase Margin vs. Capacitive Load

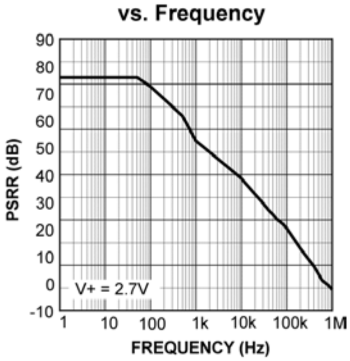




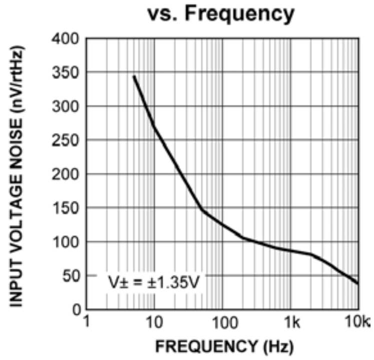
PSRR vs. Frequency



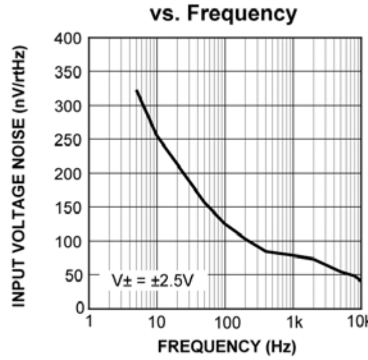
PSRR vs. Frequency



MIC863 Input Voltage Noise vs. Frequency

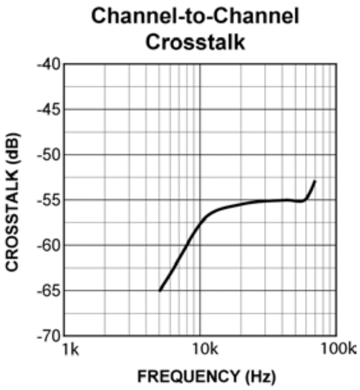


MIC863 Input Voltage Noise vs. Frequency



Typical Characteristics (Continued)

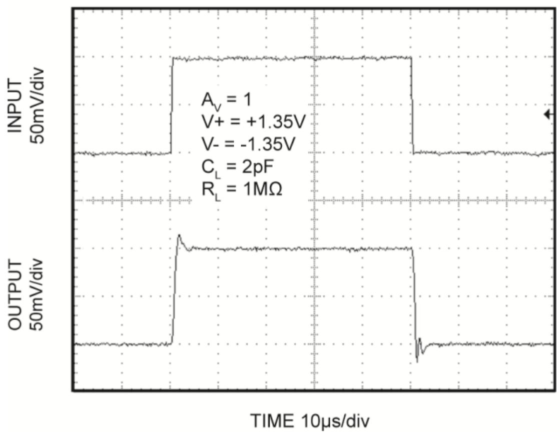
AC Performance Characteristics (Continued)



Functional Characteristics

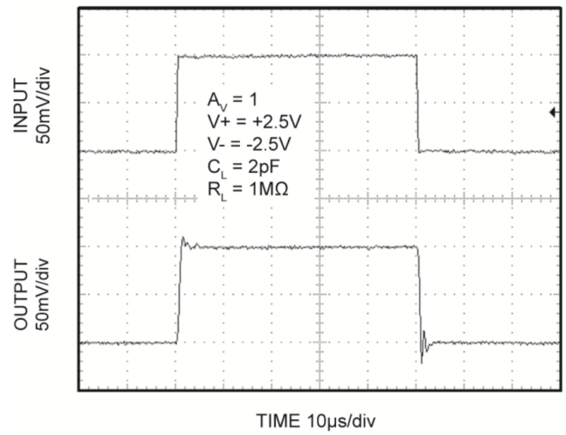
Small Signal Pulse Response

Test Circuit 3: A_V = 1



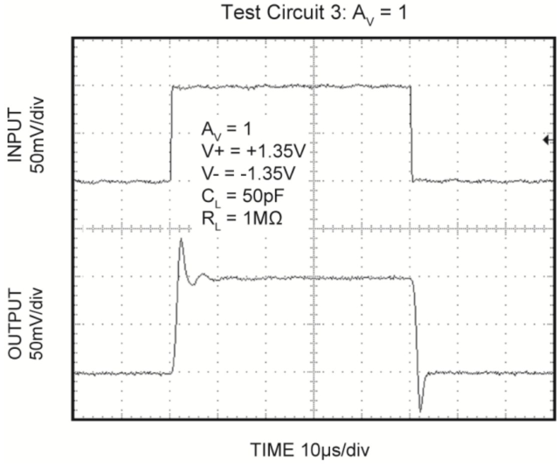
Small Signal Pulse Response

Test Circuit 3: A_V = 1



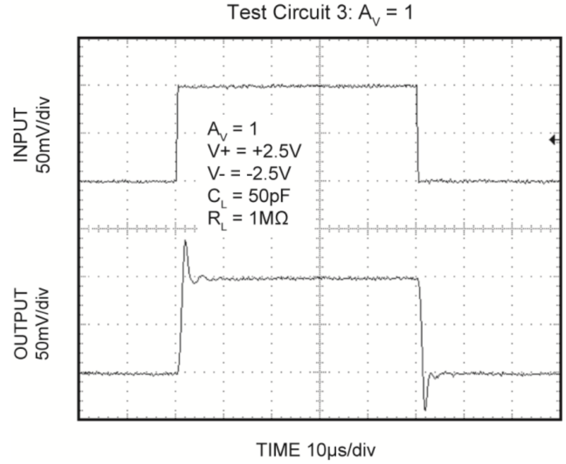
Small Signal Pulse Response

Test Circuit 3: A_V = 1



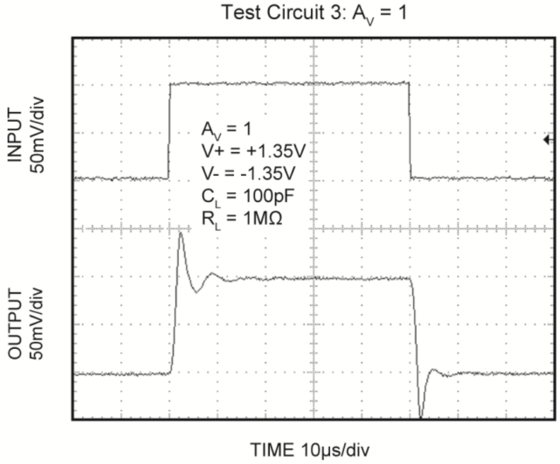
Small Signal Pulse Response

Test Circuit 3: A_V = 1



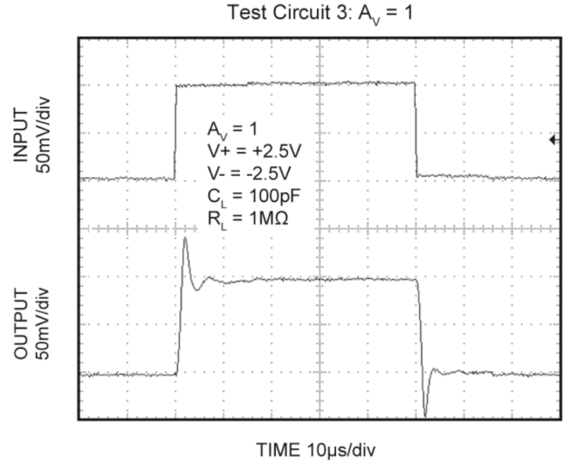
Small Signal Pulse Response

Test Circuit 3: A_V = 1



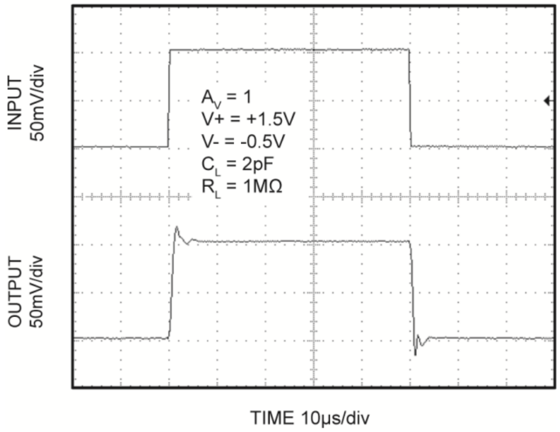
Small Signal Pulse Response

Test Circuit 3: A_V = 1

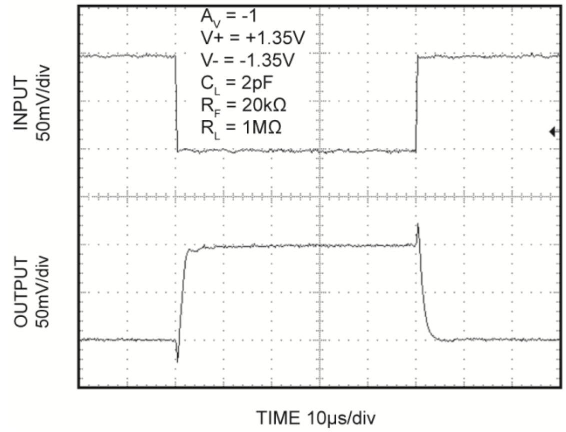


Functional Characteristics (Continued)

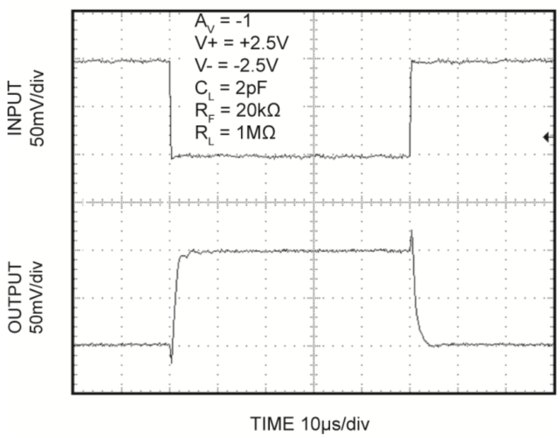
Small Signal Pulse Response
Test Circuit 3: $A_V = 1$



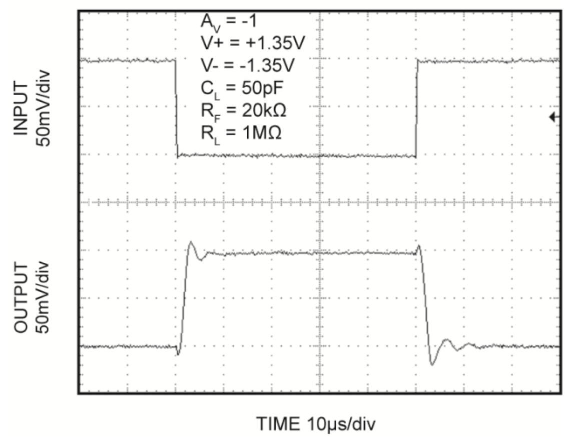
Small Signal Pulse Response
Test Circuit 4: $A_V = -1$



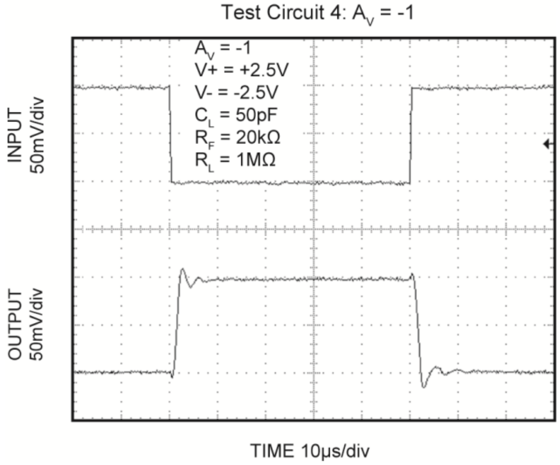
Small Signal Pulse Response
Test Circuit 4: $A_V = -1$



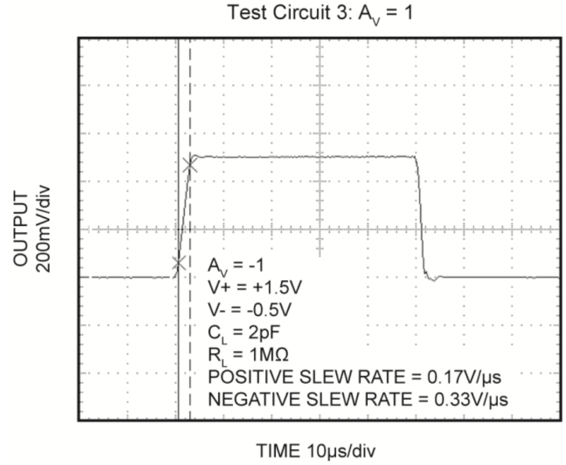
Small Signal Pulse Response
Test Circuit 4: $A_V = -1$



Small Signal Pulse Response
Test Circuit 4: $A_V = -1$

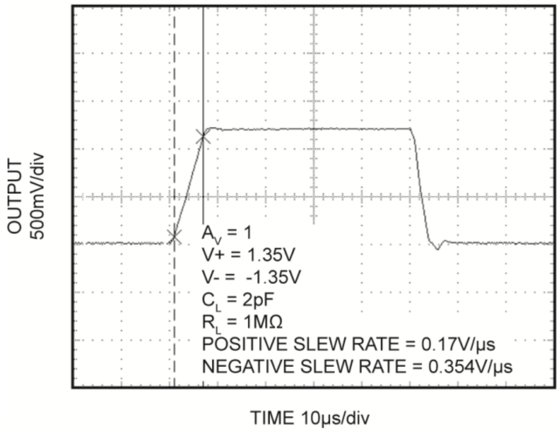


Large Signal Pulse Response
Test Circuit 3: $A_V = 1$

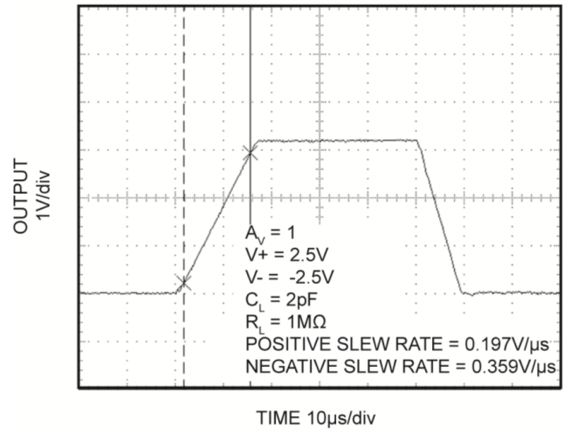


Functional Characteristics (Continued)

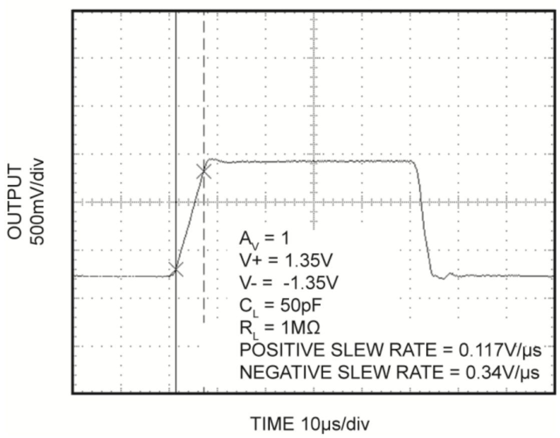
Large Signal Pulse Response
Test Circuit 3: $A_V = 1$



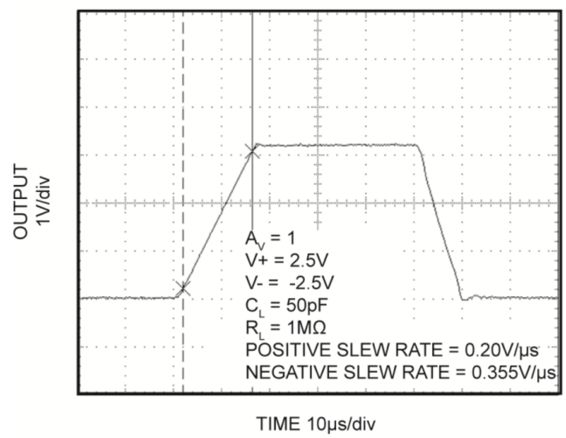
Large Signal Pulse Response
Test Circuit 3: $A_V = 1$



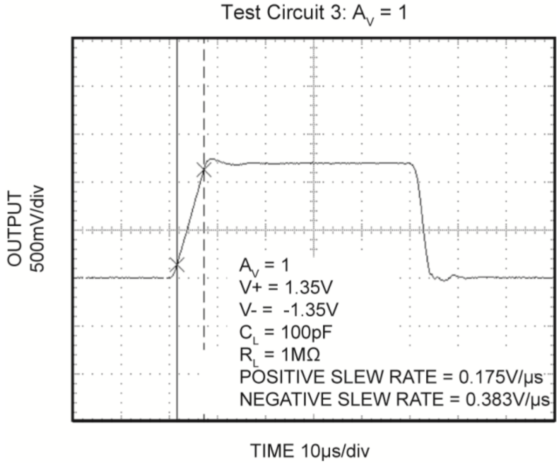
Large Signal Pulse Response
Test Circuit 3: $A_V = 1$



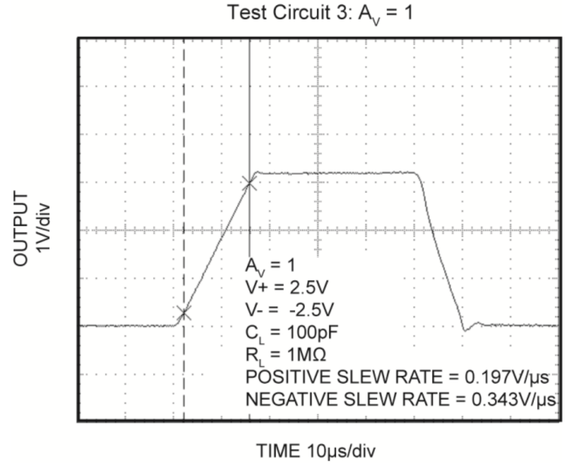
Large Signal Pulse Response
Test Circuit 3: $A_V = 1$



Large Signal Pulse Response
Test Circuit 3: $A_V = 1$

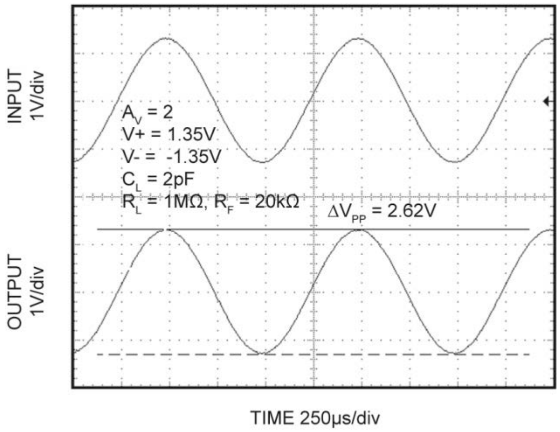


Large Signal Pulse Response
Test Circuit 3: $A_V = 1$

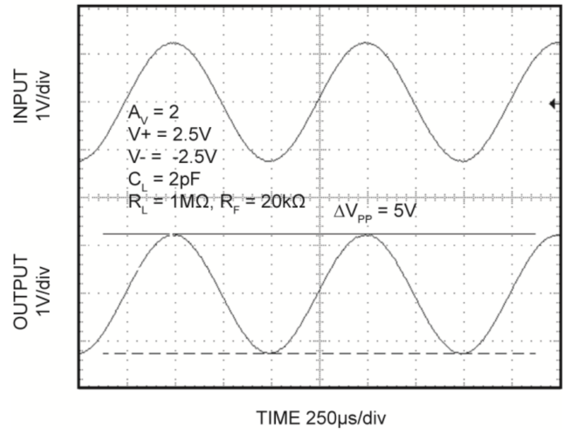


Functional Characteristics (Continued)

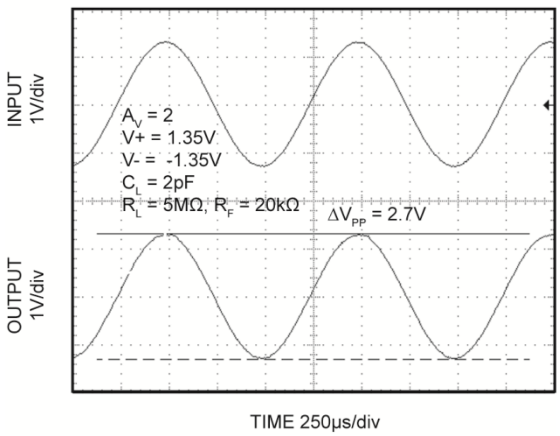
Rail-to-Rail Output Operation



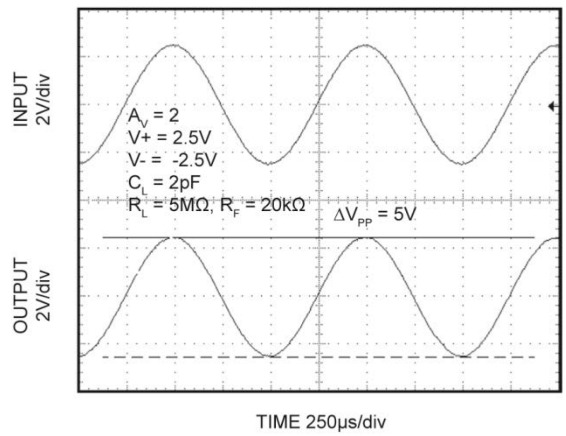
Rail-to-Rail Output Operation



Rail-to-Rail Output Operation



Rail-to-Rail Output Operation



Application Information

Regular supply bypassing techniques are recommended. A 10µF capacitor in parallel with a 0.1µF 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 equivalent series inductance (ESL), equivalent series resistance (ESR). Surface-mount ceramic capacitors are ideal.

The MIC863 is intended for single-supply applications configured with a grounded load. It is not advisable to operate the MIC863 under either of the following conditions when the load is less than 20kΩ and the output swing is greater than 1V (peak-to-peak):

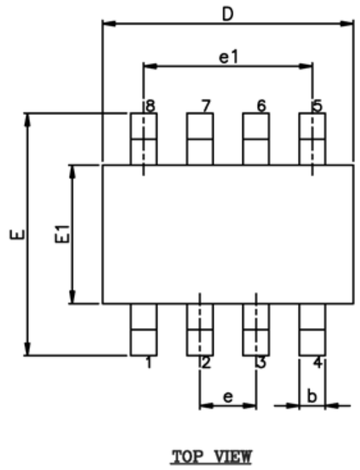
1. A grounded load and split supplies (±V)

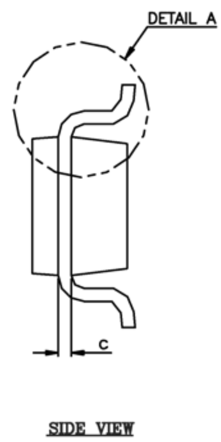
or

2. A single supply where the load is terminated above ground.

Under the above listed conditions, there may be some instability when the output is sinking current.

Package Information[7]

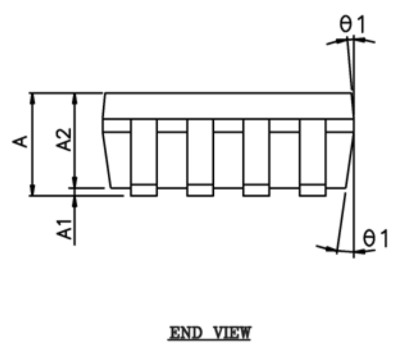


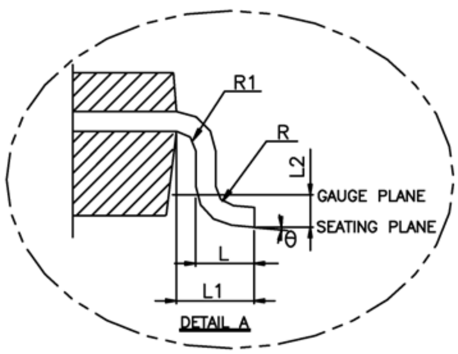


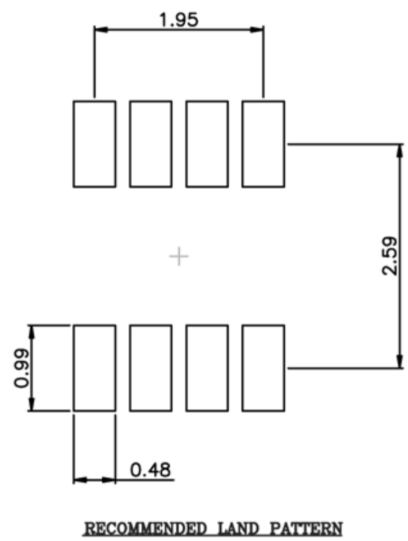
VARIATION(ALL DIMENSIONS SHOWN IN MM)

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.







8-Pin SOT-23 (M8)

Note:

7. Package information is correct as of the publication date. For updates and most current information, go to www.micrel.com.

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