MIC910

135MHz, Low-Power SOT-23-5 Op Amp

General Description

The MIC910 is a high-speed, unity-gain stable operational amplifier. It provides a gain-bandwidth product of 135MHz with a very low, 2.4mA supply current, and features the tiny SOT-23-5 package.

Supply voltage range is from ±2.5V to ±9V, allowing the MIC910 to be used in low-voltage circuits or applications requiring large dynamic range.

The MIC910 is stable driving any capacitive load and achieves excellent PSRR, making it much easier to use than most conventional high-speed devices. Low supply voltage, low power consumption, and small packing make the MIC910 ideal for portable equipment. The ability to drive capacitive loads also makes it possible to drive long coaxial cables.

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

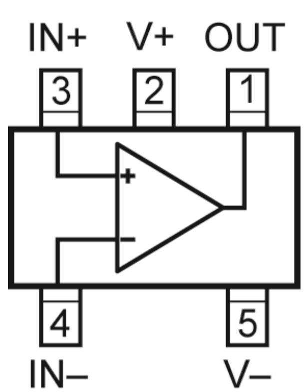
Features

- 135MHz gain bandwidth product
- 2.4mA supply current
- Unconditionally unity-gain stable
- SOT-23-5 package
- 270V/µs slew rate
- Drives any capacitive load

Applications

- Video
- Imaging
- Ultrasound
- Portable equipment
- Line drivers

Functional Pinout



SOT-23-5

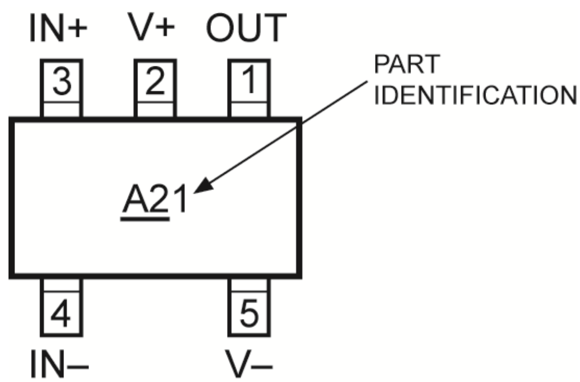
Ordering Information

Part Number[1]	Marking	Junction Temperature Range	Package
MIC910YM5	A21	–40°C to +85°C	SOT-23-5

Note:

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

Pin Configuration



SOT-23-5 (M5)
(Top View)

Pin Description

Pin Number	Pin Name	Pin Function
1	OUT	Output: Amplifier output.
2	V+	Positive Supply (Input): Connect a 10µF capacitor in parallel with a 0.1µF capacitor to ground.
3	IN+	Noninverting Input.
4	IN–	Inverting Input.
5	V–	Negative Supply (Input): Connect a 10µF capacitor in parallel with a 0.1µF capacitor to ground.

Absolute Maximum Ratings[2]

Supply Voltage ($V_{V+} - V_{V-}$) .... +20V
Differential Input Voltage ($|V_{IN+} - V_{IN-}|$). .... 8V[4]
Input Common-Mode Range (V_{IN+}, V_{IN-}) .... V_{V+} to V_{V-}
Lead Temperature (soldering, 5s) .... +260°C
Storage Temperature (T_S) .... +150°C
ESD Rating[5] 1.5kV

Operating Ratings[3]

Supply Voltage (V_S) .... ±2.5V to ±9V
Junction Temperature (T_J) .... –40°C to +85°C
Package Thermal Resistance
SOT-23-5 (θ_{JA}) .... +260°C/W

Electrical Characteristics (±5V)

V_{V+} = +5V; V_{V-} = –5V, V_{CM} = 0V, V_{OUT} = 0V; R_L = 10MΩ; T_J = +25°C, **bold** values indicate –40°C ≤ T_J ≤ +85°C, unless noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{OS}	Input Offset Voltage			1	**15**	mV
	Input Offset Voltage Temperature Coefficient			4		µV/°C
I_B	Input Bias Current			3.5	5.5	µA
					9	
I_{OS}	Input Offset Current			0.05	**3**	µA
V_{CM}	Input Common-Mode Range	CMRR > 60dB	–3.25		+3.25	V
CMRR	Common-Mode Rejection Ratio	$-2.5V < V_{CM} < +2.5V$	70	90		dB
			60			
PSRR	Power Supply Rejection Ratio	$\pm5V < V_S < \pm9V$	74	81		dB
			70			
A_{VOL}	Large-Signal Voltage Gain	R_L = 2kΩ, V_{OUT} = ±2V	**60**	71		dB
		R_L = 200Ω, V_{OUT} = ±2V	**60**	71		
V_{OUT}	Maximum Output Voltage Swing	Positive, R_L = 2kΩ	+3.3	3.5		V
			+3.0			
		Negative, R_L = 2kΩ		–3.5	–3.3	
					–3.0	
		Positive, R_L = 200Ω	+3.0	3.2		
			+2.75			
		Negative, R_L = 200Ω		–2.8	–2.45	
					–2.2	
GBW	Gain Bandwidth Product	R_L = 1kΩ		125		MHz
BW	–3dB Bandwidth	A_V = 1, R_L = 100Ω		192		MHz
SR	Slew Rate			230		V/µs
I_{GND}	Short-Circuit Output Current	Source		72		mA
		Sink		25		
	Supply Current			2.4	3.5	
					4.1	

Notes:

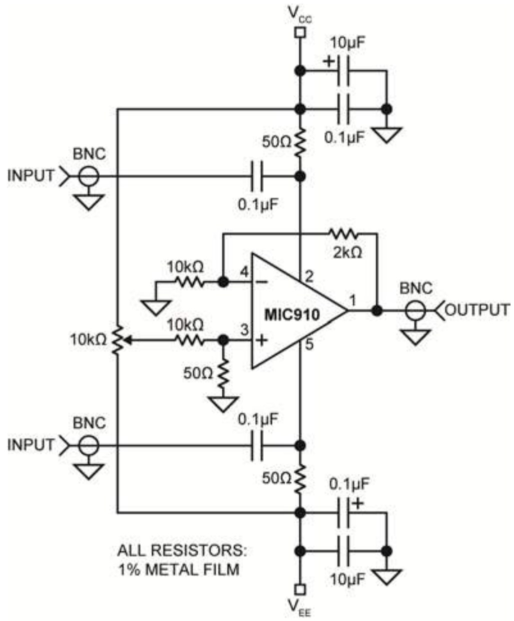
2. Exceeding the absolute maximum ratings may damage the device.
3. The device is not guaranteed to function outside its operating ratings.
4. Exceeding the maximum differential input voltage will damage the input stage and degrade performance as input bias current is likely to increase.
5. Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5kΩ in series with 100pF.

Electrical Characteristics (±9V)

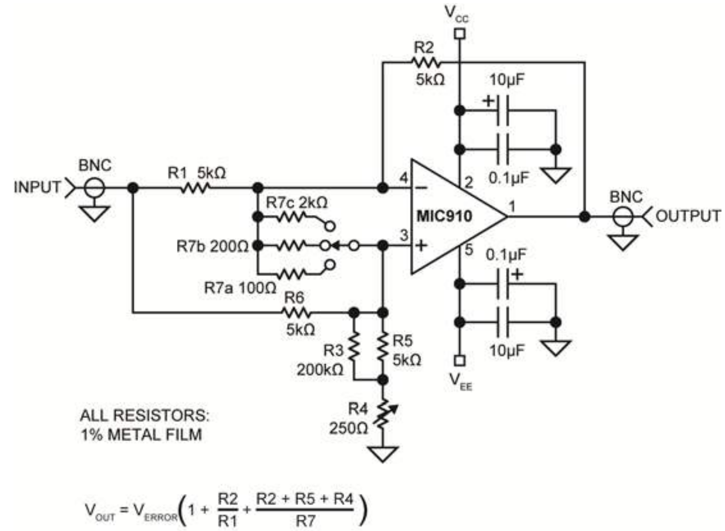
V_{V+} = +9V; V_{V-} = –9V, V_{CM} = 0V, V_{OUT} = 0V; R_L = 10MΩ; T_J = +25°C, **bold** values indicate –40°C ≤ T_J ≤ +85°C, unless noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{OS}	Input Offset Voltage			1	**15**	mV
	Input Offset Voltage Temperature Coefficient			4		µV/°C
I_B	Input Bias Current			3.5	5.5	µA
					9	
I_{OS}	Input Offset Current			0.05	**3**	µA
V_{CM}	Input Common-Mode Range	CMRR > 60dB	–7.25		+7.25	V
CMRR	Common-Mode Rejection Ratio	–6.5V < V_{CM} < +6.5V	70	98		dB
			60			
A_{VOL}	Large-Signal Voltage Gain	R_L = 2kΩ, V_{OUT} = ±6V	**60**	73		dB
V_{OUT}	Maximum Output Voltage Swing	Positive, R_L = 2kΩ	+7.2	7.4		V
			+6.8			
		Negative, R_L = 2kΩ		–7.4	–7.2	
					–6.8	
GBW	Gain Bandwidth Product	R_L = 1kΩ		135		MHz
SR	Slew Rate			270		V/µs
I_{GND}	Short-Circuit Output Current	Source		90		mA
		Sink		32		
	Supply Current			2.5	3.7	
					4.3	

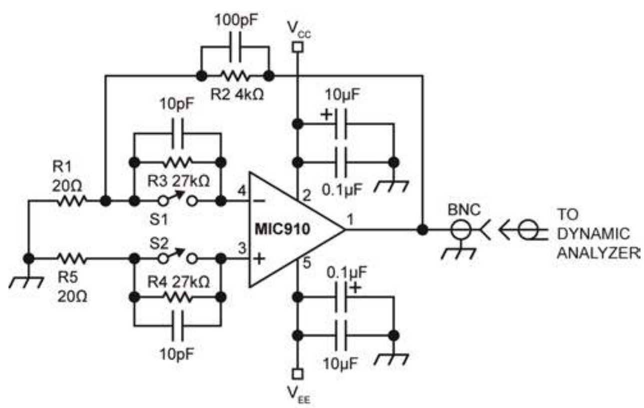
Test Circuit



PSRR vs. Frequency



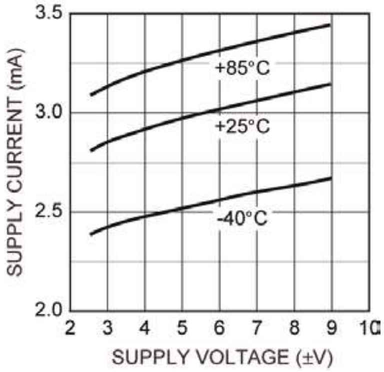
CMRR vs. Frequency



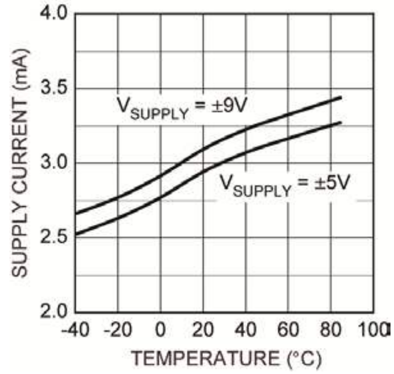
Noise Measurement

Typical Characteristics

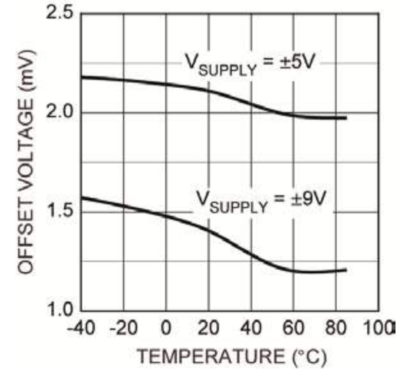
Supply Current vs. Supply Voltage



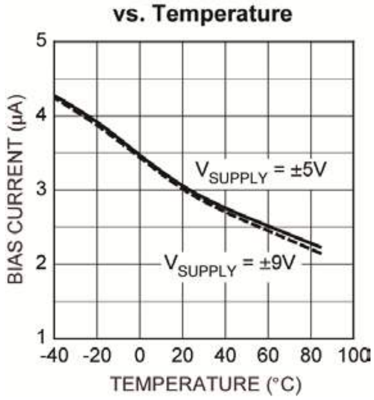
Supply Current vs. Temperature



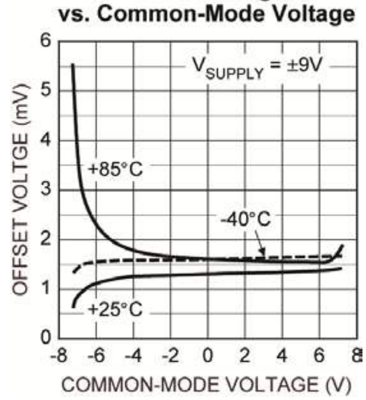
Offset Voltage vs. Temperature



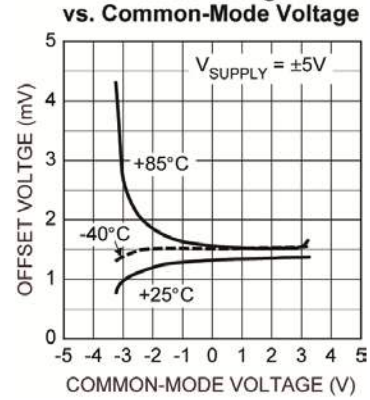
Bias Current vs. Temperature



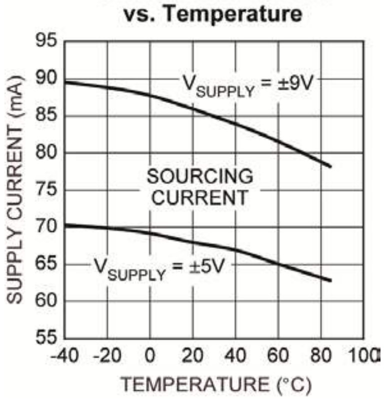
Offset Voltage vs. Common-Mode Voltage



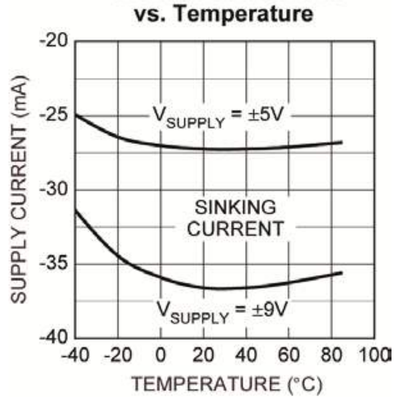
Offset Voltage vs. Common-Mode Voltage



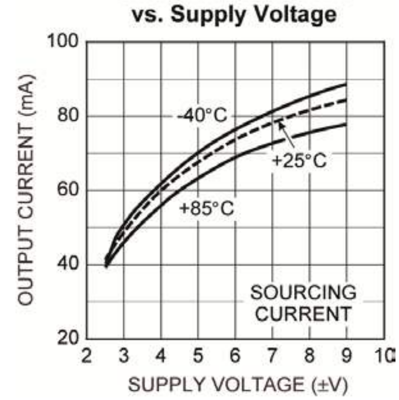
Short-Circuit Current vs. Temperature



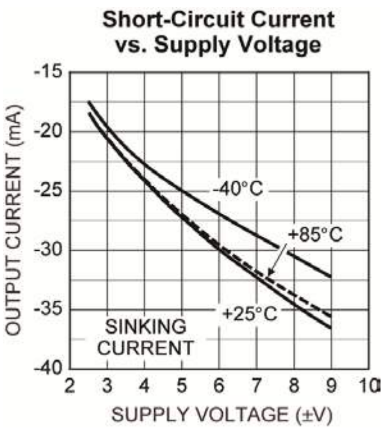
Short-Circuit Current vs. Temperature

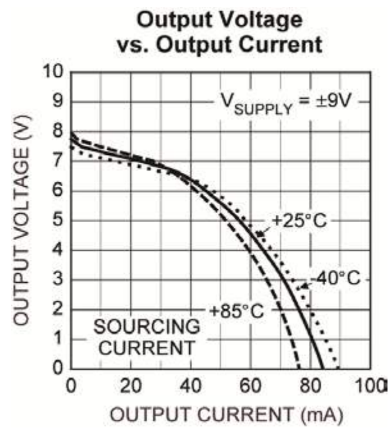


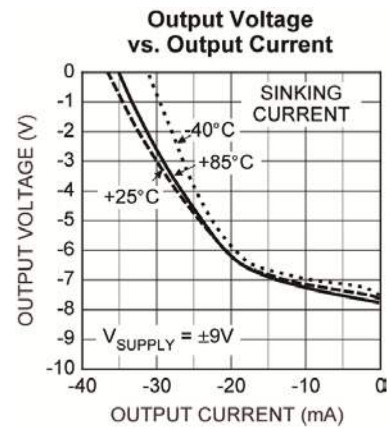
Short-Circuit Current vs. Supply Voltage

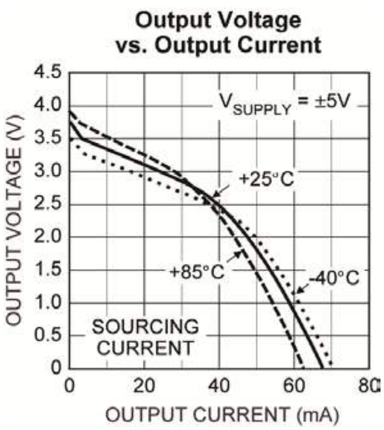


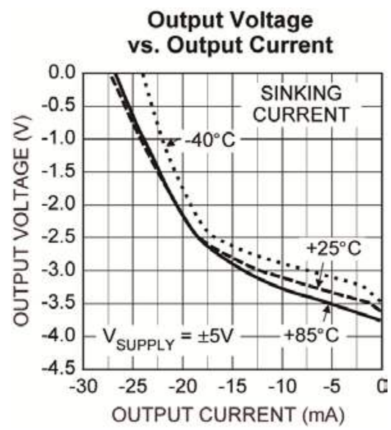
Typical Characteristics (Continued)

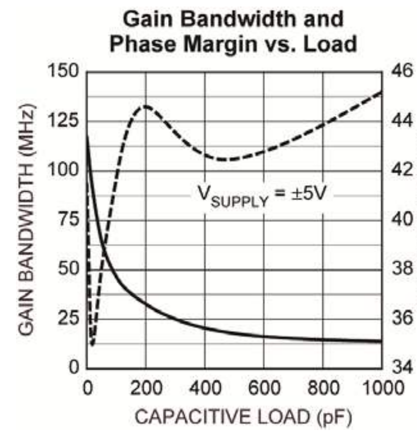


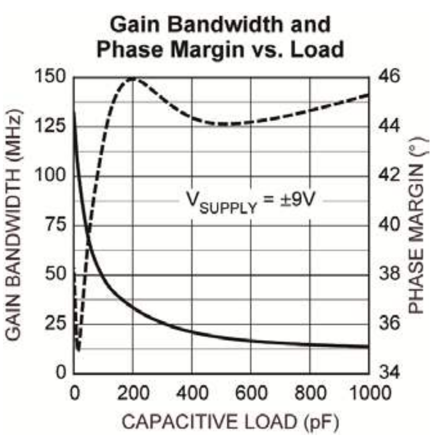


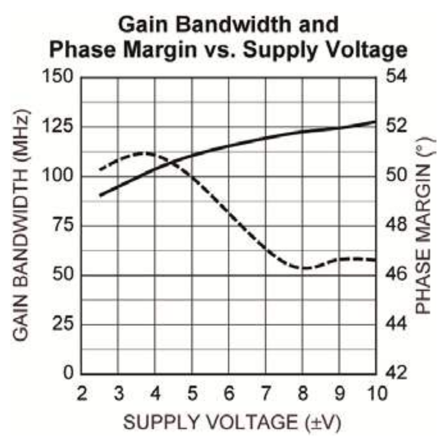


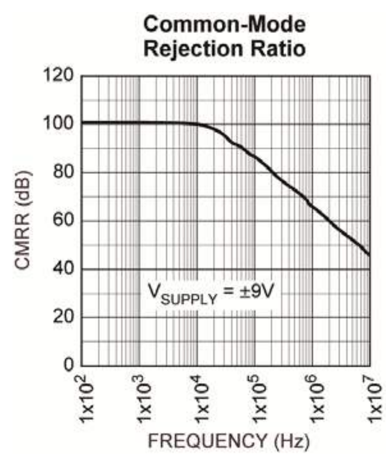






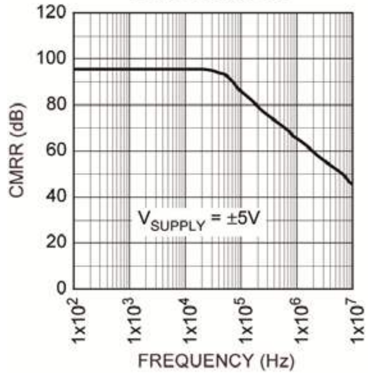




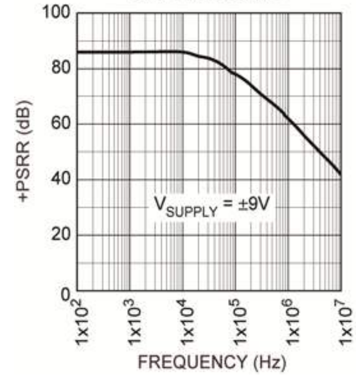


Typical Characteristics (Continued)

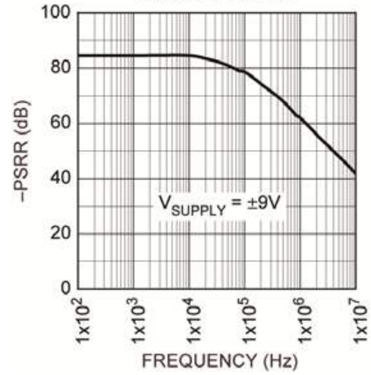
Common-Mode Rejection Ratio



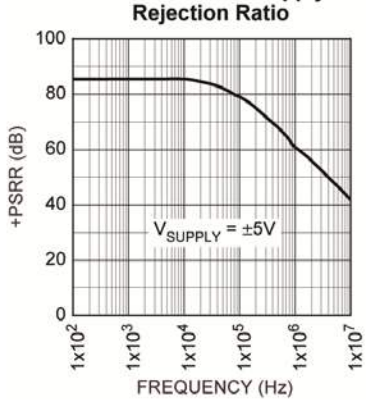
Positive Power Supply Rejection Ratio



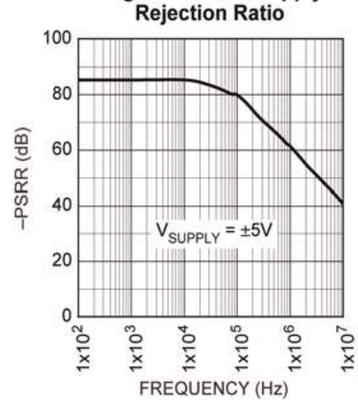
Negative Power Supply Rejection Ratio



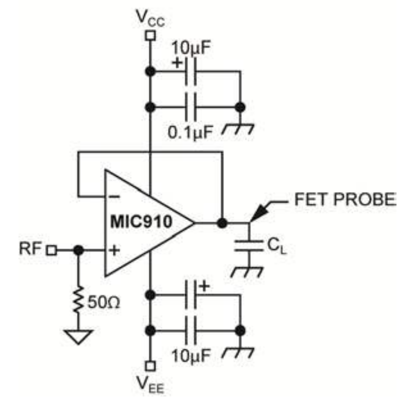
Positive Power Supply Rejection Ratio



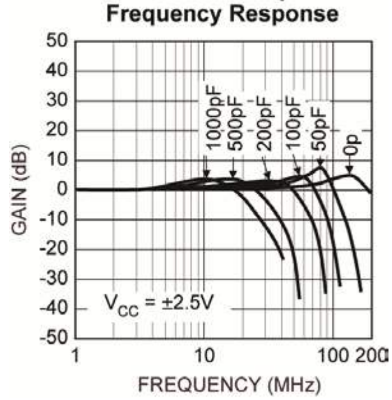
Negative Power Supply Rejection Ratio



Closed-Loop Frequency Response Test Circuit



Closed-Loop Frequency Response



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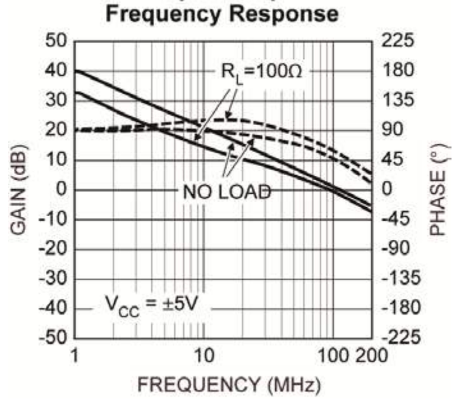
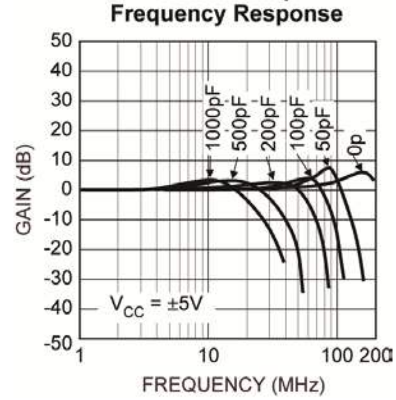
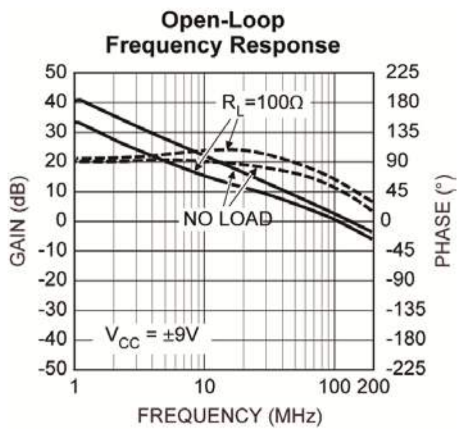
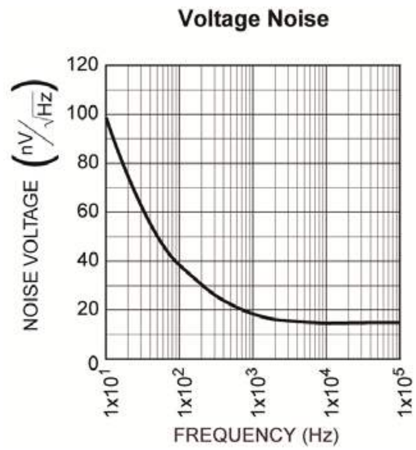


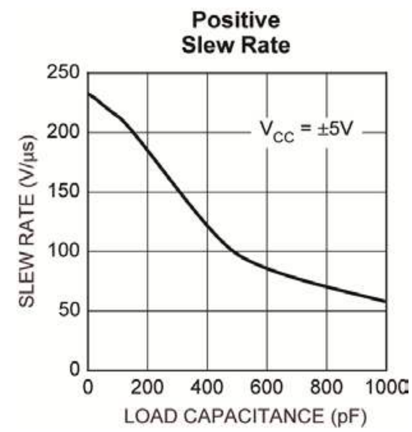
Closed-Loop Frequency Response

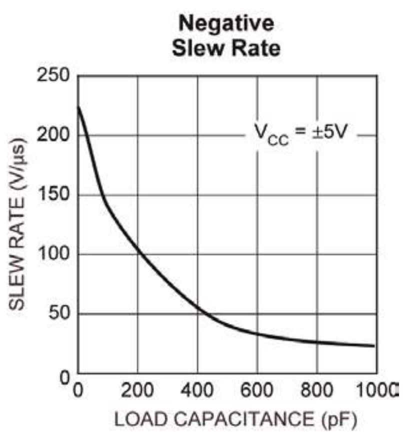


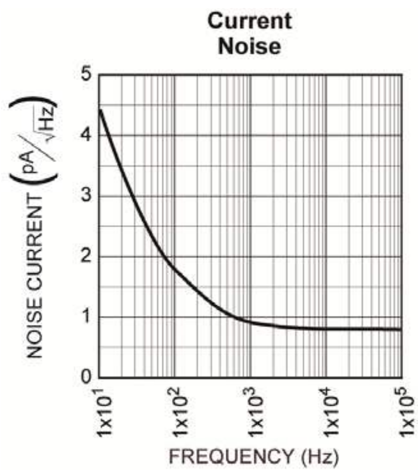
Typical Characteristics (Continued)

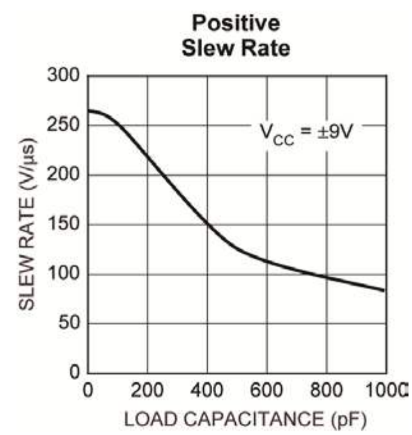


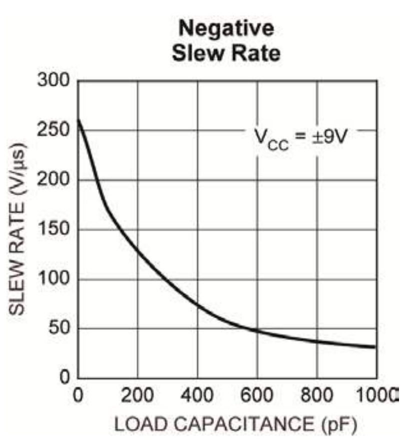




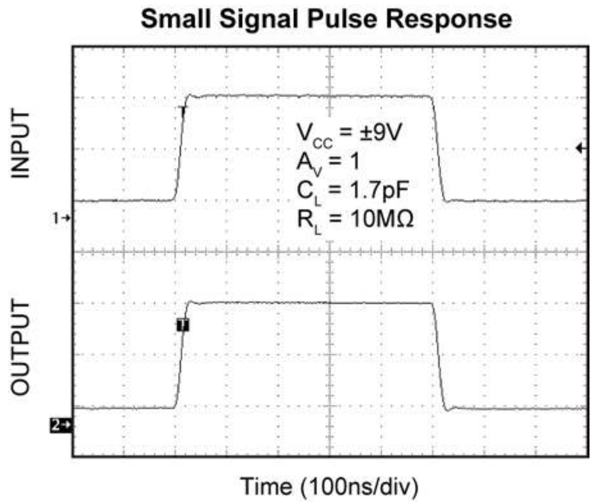


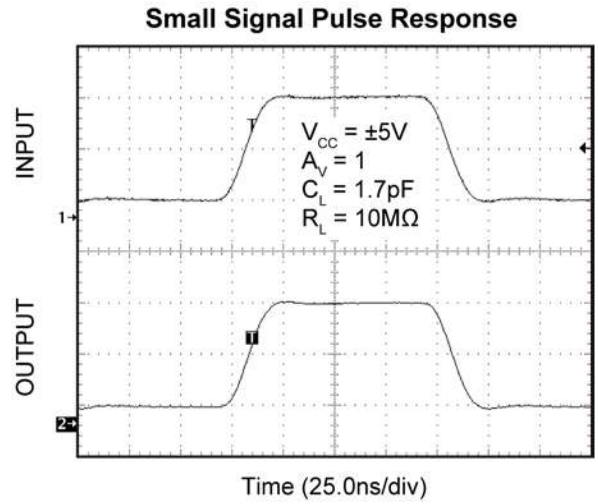


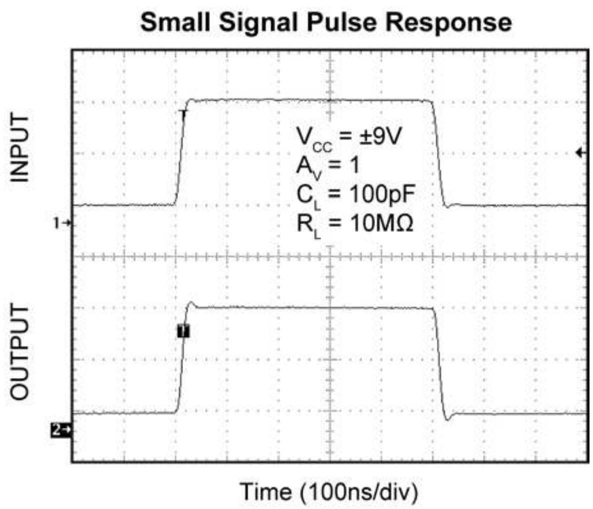


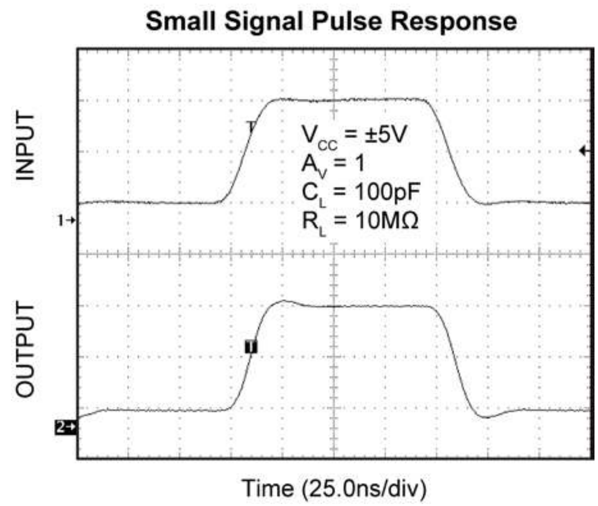


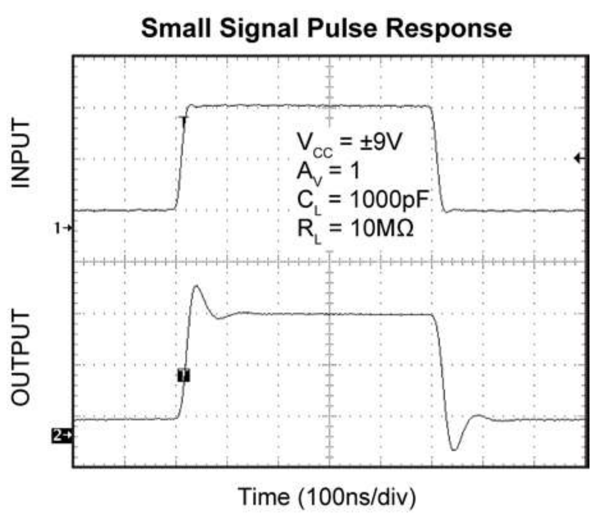
Functional Characteristics

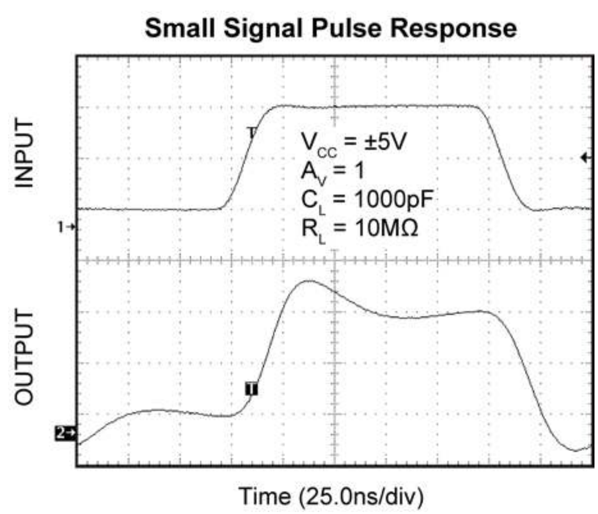






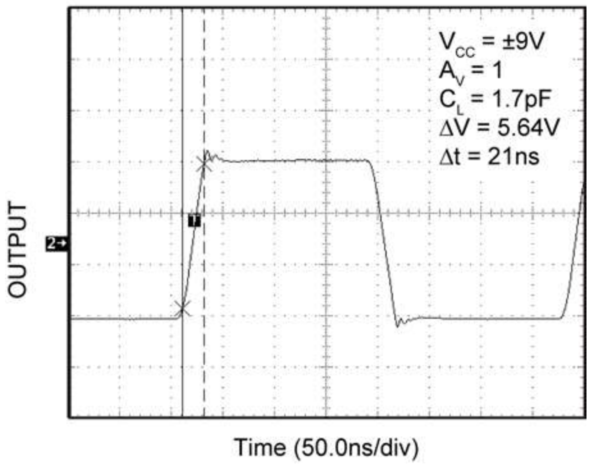




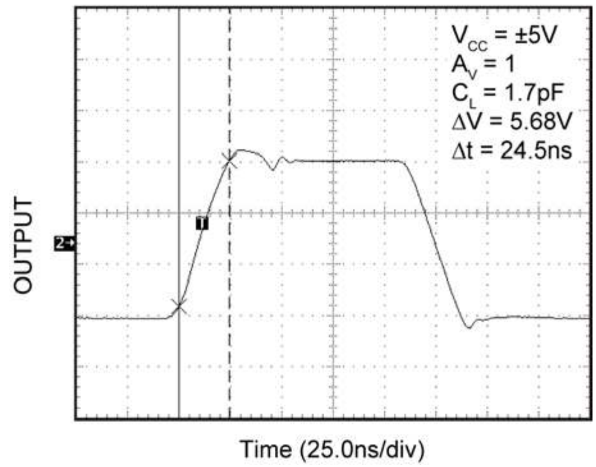


Functional Characteristics (Continued)

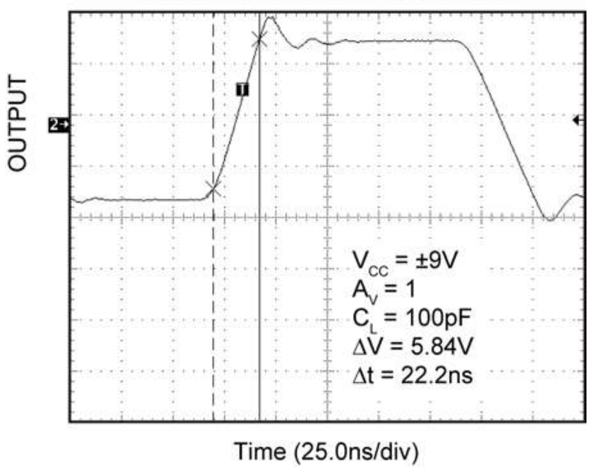
Large Signal Pulse Response



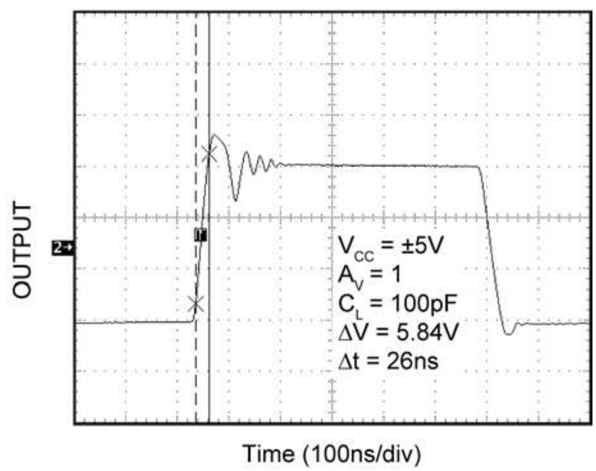
Large Signal Pulse Response



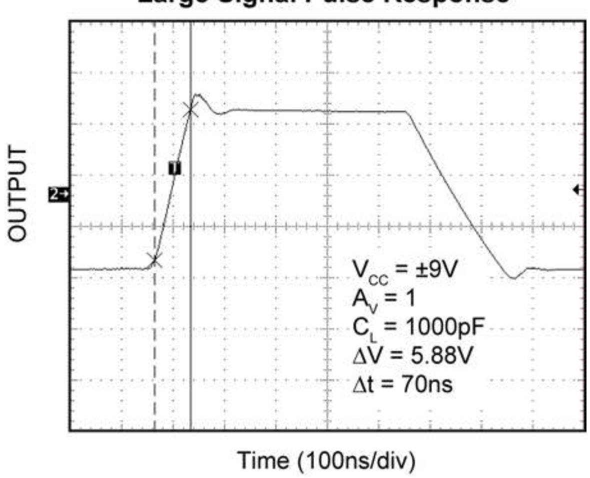
Large Signal Pulse Response



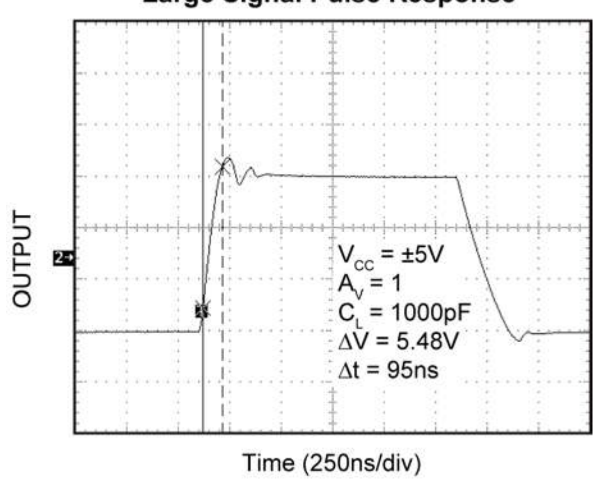
Large Signal Pulse Response



Large Signal Pulse Response



Large Signal Pulse Response



Application Information

The MIC910 is a high-speed, voltage-feedback operational amplifier featuring very low supply current and excellent stability. This device is unity gain stable and capable of driving high capacitance loads.

Driving High Capacitance

The MIC910 is stable when driving any capacitance (see the “Gain Bandwidth and Phase Margin vs. Load Capacitance” graph in the *Typical Characteristics* section) making it ideal for driving long coaxial cables or other high-capacitance loads.

Phase margin remains constant as load capacitance is increased. Most high-speed op amps are only able to drive limited capacitance.

Note: increasing load capacitance does reduce the speed of the device (see the “Gain Bandwidth and Phase Margin vs. Load” in the *Typical Characteristics* section). In applications where the load capacitance reduces the speed of the op amp to an unacceptable level, the effect of the load capacitance can be reduced by adding a small resistor (<100Ω) in series with the output.

Feedback Resistor Selection

Conventional op amp gain configurations and resistor selection apply; the MIC910 is not a current feedback device. Resistor values in the range of 1kΩ to 10kΩ are recommended.

Layout Considerations

All high-speed devices require careful PCB layout. The high stability and high PSRR of the MIC910 make it easier to use than most other op amps, but the following guidelines should be observed:

- Capacitance, particularly on the two inputs pins will degrade performance.
- Avoid large copper traces to the inputs.
- Keep the output signal away from the inputs and use a ground plane.

It is important to ensure adequate supply bypassing capacitors are located close to the device

Power Supply Bypassing

Regular supply bypassing techniques are recommended. A 10µF capacitor in parallel with a 0.1µF capacitor on both the positive and negative supplies is 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) and equivalent series resistance (ESR). Surface-mount ceramic capacitors are ideal.

Thermal Considerations

The SOT-23-5 package, like all small packages, has a high thermal resistance. It is important to ensure the IC does not exceed the maximum operating junction (die) temperature of 85°C. The part can be operated up to the absolute maximum temperature rating of 125°C, but between 85°C and 125°C performance will degrade, in particular CMRR will reduce.

A MIC910 with no load, dissipates power equal to the quiescent supply current × the supply voltage (Equation 1):

$$P_{D(NO\ LOAD)} = (V_{V+} - V_{V-})I_S \qquad \text{Eq. 1}$$

When a load is added, the additional power is dissipated in the output stage of the op amp. The power dissipated in the device is a function of supply voltage, output voltage and output current (Equation 2).

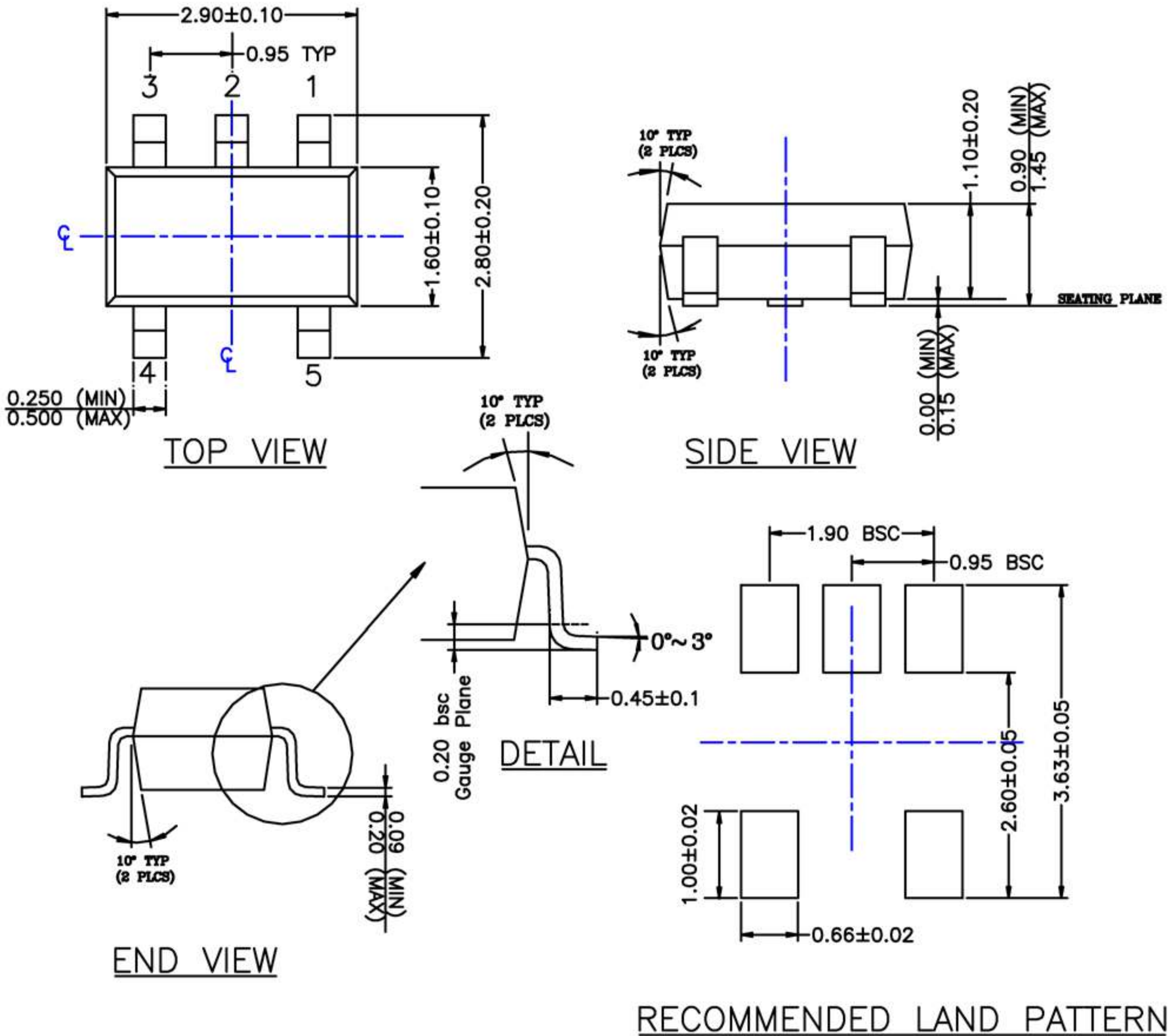
$$P_{D(OUTPUT\ STAGE)} = (V_{V+} - V_{OUT})I_{OUT} \qquad \text{Eq. 2}$$

Total Power Dissipation = $P_{D(NO\ LOAD)} + P_{D(OUTPUT\ STAGE)}$

Ensure the total power dissipated in the device is no greater than the thermal capacity of the package. The SOT23-5 package has a thermal resistance of 260°C/W (Equation 3).

$$\text{Maximum Allowable Power Dissipation} = \frac{T_{J(MAX)} - T_{A(MAX)}}{260°C/W} \qquad \text{Eq. 3}$$

Package Information and Recommended Landing Pattern[6]



NOTE:
1. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & BURR.
2. PACKAGE OUTLINE INCLUSIVE OF SOLER PLATING.
3. DIMENSION AND TOLERANCE PER ANSI Y14.5M, 1982.
4. FOOT LENGTH MEASUREMENT BASED ON GAUGE PLANE METHOD.
5. DIE FACES UP FOR MOLD, AND FACES DOWN FOR TRIM/FORM.
6. ALL DIMENSIONS ARE IN MILLIMETERS.

SOT-23-5 (M5)

Note:

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

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