MIC920

80 MHz Low-Power SC70 Op Amp

Features

- 80 MHz Gain Bandwidth Product
- 115 MHz –3dB Bandwidth
- 550 µA Supply Current (Typical)
- 5-Lead SC70 Package
- 3000V/µs Slew Rate (Typical)
- Drives Any Capacitive Load
- Unity Gain Stable

Applications

- Video
- Imaging
- Ultrasound
- Portable Equipment
- Line Drivers

General Description

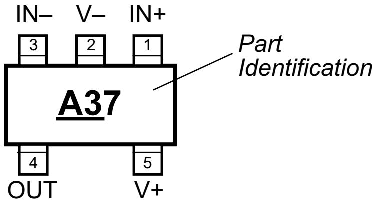
The MIC920 is a high-speed operational amplifier with a gain-bandwidth product of 80 MHz. The part is unity gain stable. It has a very low 550 µA supply current, and features the 5-Lead SC70 package.

Supply voltage range is from ±2.5V to ±9V, allowing the MIC920 to be used in low voltage circuits or applications requiring large dynamic range.

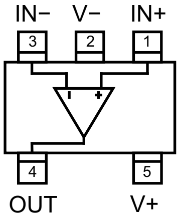
The MIC920 is stable driving any capacitative load and achieves excellent PSRR and CMRR, making it much easier to use than most conventional high-speed devices. Low supply voltage, low power consumption, and small packing make the MIC920 ideal for portable equipment. The ability to drive capacitative loads also makes it possible to drive long coaxial cables.

Package Type

Pin Configuration



Functional Pinout



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{V+} to V_{V-}) 20V
Differential Input Voltage (V_{IN+} to V_{IN-}) (Note 1) 4V
Input Common Mode Range (V_{IN+} to V_{IN-}) .... V_{V+} to V_{V-}
ESD Rating (Note 2) .... 1.5 kV

Operating Ratings ‡

Supply Voltage (V_S) .... ±2.5V to ±9V

† 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 change).

2: Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5 kΩ in series with 100 pF. Pin 4 is ESD sensitive.

ELECTRICAL CHARACTERISTICS (±5V)

Electrical Characteristics: V+ = +5V, V– = –5V, V_{CM} = 0V, R_L = 10 MΩ; T_A = 25°C, unless otherwise noted.

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Input Offset Voltage	V_{OS}	—	0.43	5	mV	$-40°C \le T_J \le +85°C$
Input Offset Voltage Temperature Coefficient	$\Delta V_{OS}/\Delta T_A$	—	1	—	µV/°C	$-40°C \le T_J \le +85°C$
Input Bias Current	I_B	—	0.26	0.6	µA	$-40°C \le T_J \le +85°C$
Input Offset Current	I_{OS}	—	0.04	0.3	µA	$-40°C \le T_J \le +85°C$
Input Common-Mode Range	V_{CM}	–3.25	—	+3.25	V	CMRR > 72 dB, $-40°C \le T_J \le +85°C$
Common-Mode Rejection Ratio	CMRR	75	85	—	dB	$-2.5V < V_{CM} < +2.5V$
Power Supply Rejection Ratio	PSRR	95	104	—	dB	$\pm 3.5V < V_S < \pm 9V$
Large-Signal Voltage Gain	A_{VOL}	65	82	—	dB	R_L = 2k, V_{OUT} = ±2V
		—	85	—	dB	R_L = 100Ω, V_{OUT} = ±1V
Maximum Output Voltage Swing	V_{OUT}	+3.0	3.6	—	V	Positive, R_L = 2 kΩ $-40°C \le T_J \le +85°C$
		—	–3.6	–3.0	V	Negative, R_L = 2 kΩ $-40°C \le T_J \le +85°C$
Unity Gain-Bandwidth Product	G_{BW}	—	67	—	MHz	C_L = 1.7 pF
Phase Margin	P_M	—	32	—	°	—
–3 dB Bandwidth	B_W	—	100	—	MHz	A_V = 1, C_L = 1.7 pF, R_L = 1 kΩ
Slew Rate	S_R	—	1350	—	V/µs	C = 1.7 pF, Gain = 1, V_{OUT} = 5V, Peak to Peak, Positive SR = 1190V/µs
Short-Circuit Output Current	I_{SC}	45	63	—	mA	Source
		20	45	—		Sink
Supply Current	I_S	—	0.55	0.80	mA	No load, $-40°C \le T_J \le +85°C$
Input Voltage Noise	—	—	11	—	nV/√Hz	f = 10 kHz
Input Current Noise	—	—	0.7	—	pA/√Hz	f = 10 kHz

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V+ = +9V, V– = –9V, V_{CM} = 0V R_L = 10 MΩ; T_J = 25°C, unless otherwise noted.

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Input Offset Voltage	V_{OS}	—	0.3	5	mV	–40°C ≤ T_J ≤ +85°C
Input Offset Voltage Temperature Coefficient	$\Delta V_{OS}/\Delta_{TA}$	—	1	—	µV/°C	–40°C ≤ T_J ≤ +85°C
Input Bias Current	I_B	—	0.23	0.60	µA	–40°C ≤ T_J ≤ +85°C
Input Offset Current	I_{OS}	—	0.04	0.3	µA	–40°C ≤ T_J ≤ +85°C
Input Common-Mode Range	V_{CM}	–7.25	—	+7.25	V	CMRR > 75 dB, –40°C ≤ T_J ≤ +85°C
Common-Mode Rejection Ratio	CMRR	60	91	—	dB	–6.5V < V_{CM} < +6.5V
Power Supply Rejection Ratio	PSRR	95	104	—	dB	±3.5V < V_S < ±9V
Large-Signal Voltage Gain	A_{VOL}	75	84	—	dB	R_L = 2k, V_{OUT} = ±2V
		—	93	—	dB	R_L = 100Ω, V_{OUT} = ±1V
Maximum Output Voltage Swing	V_{OUT}	6.5	7.5	—	V	Positive, R_L = 2 kΩ, –40°C ≤ T_J ≤ +85°C
		—	–7.5	–6.2	V	Negative, R_L = 2 kΩ –40°C ≤ T_J ≤ +85°C
Unity Gain-Bandwidth Product	G_{BW}	—	80	—	MHz	C_L = 1.7 pF
Phase Margin	P_M	—	30	—	°	—
–3 dB Bandwidth	B_W	—	115	—	MHz	A_V = 1, C_L = 1.7 pF, R_L = 1 kΩ
Slew Rate	S_R	—	3000	—	V/µs	C = 1.7 pF, Gain = 1, V_{OUT} = 5V, Peak to Peak, Positive SR = 2500V/µs
Short-Circuit Output Current	I_{SC}	50	65	—	mA	Source
		30	50	—		Sink
Supply Current	I_S	—	0.55	0.8	mA	No load, –40°C ≤ T_J ≤ +85°C
Input Voltage Noise	—	—	10	—	nV/√Hz	f = 10 kHz
Input Current Noise	—	—	0.8	—	pA/√Hz	f = 10 kHz

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Storage Temperature	T_S	—	—	150	°C	—
Operating Junction Temperature Range	T_J	–40	—	+85	°C	—
Lead Temperature	—	—	—	260	°C	Soldering, 5 sec.
Package Thermal Resistance						
Thermal Resistance SC70	—	—	450	—	°C/W	—

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 +85°C rating. Sustained junction temperatures above +85°C can impact the device reliability.

2.0 TYPICAL PERFORMANCE CURVES

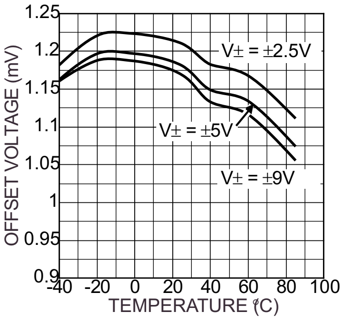


FIGURE 2-1: Offset Voltage vs. Temperature.

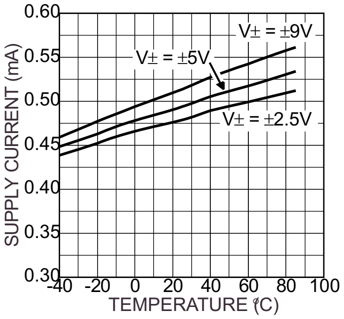


FIGURE 2-2: Supply Current vs. Temperature.

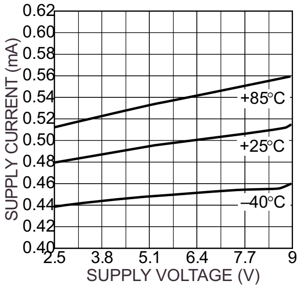


FIGURE 2-3: Supply Current vs. Supply Voltage.

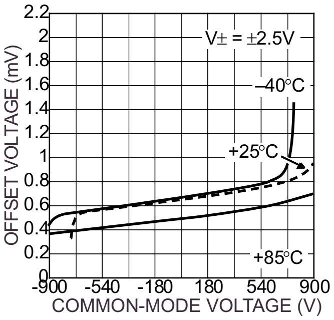


FIGURE 2-4: Offset Voltage vs. Common-Mode Voltage.

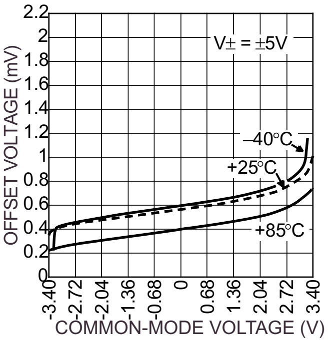


FIGURE 2-5: Offset Voltage vs. Common-Mode Voltage.

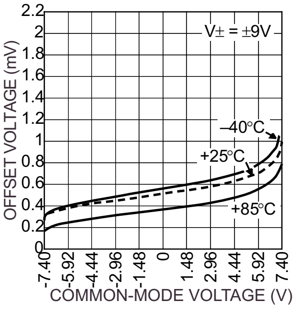


FIGURE 2-6: Offset Voltage vs. Common-Mode Voltage.

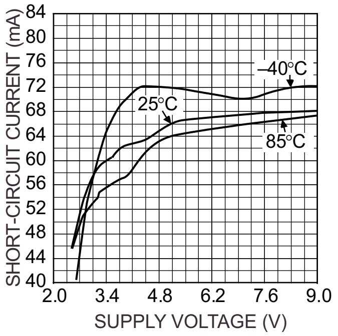


FIGURE 2-7: *Short Circuit Current vs. Supply Voltage (Sourcing).*

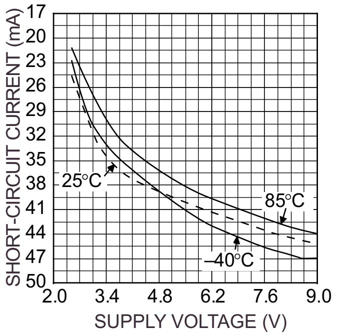


FIGURE 2-8: *Short Circuit Current vs. Supply Voltage (Sinking).*

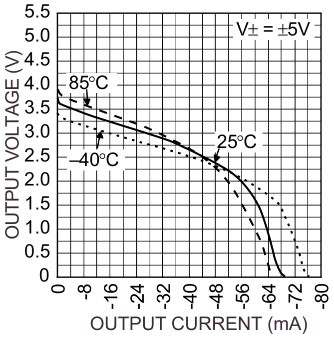


FIGURE 2-9: *Output Voltage vs. Output Current (Sourcing).*

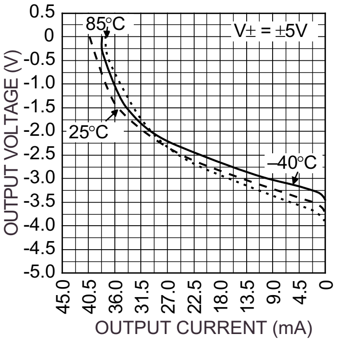


FIGURE 2-10: *Output Voltage vs. Output Current (Sinking).*

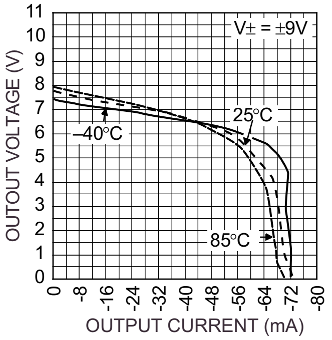


FIGURE 2-11: *Output Voltage vs. Output Current (Sourcing).*

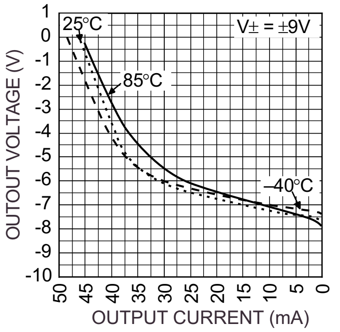


FIGURE 2-12: *Output Voltage vs. Output Current (Sinking).*

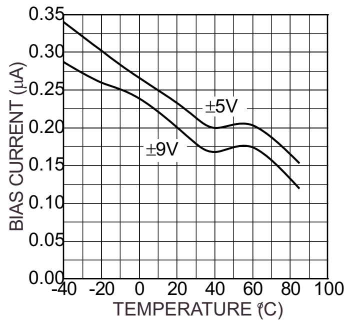


FIGURE 2-13: *Bias Current vs. Temperature.*

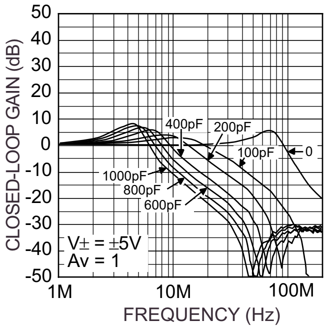


FIGURE 2-16: *Closed-Loop Gain vs. Frequency.*

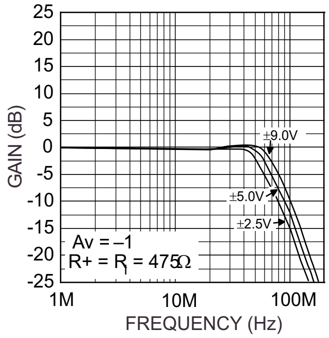


FIGURE 2-14: *Closed-Loop Frequency Response.*

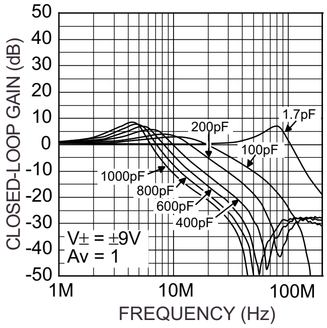


FIGURE 2-17: *Closed-Loop Frequency Response.*

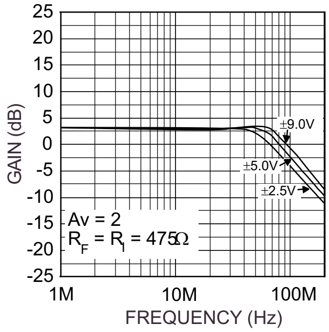


FIGURE 2-15: *Closed-Loop Frequency Response.*

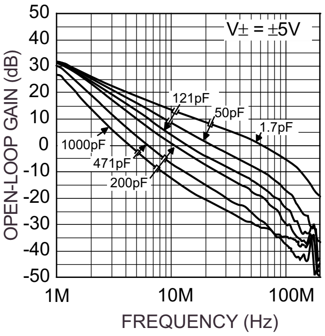


FIGURE 2-18: *Open-Loop Gain vs. Frequency.*

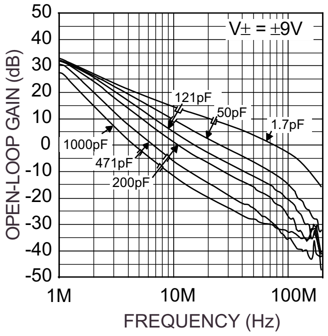


FIGURE 2-19: *Open-Loop Gain vs. Frequency.*

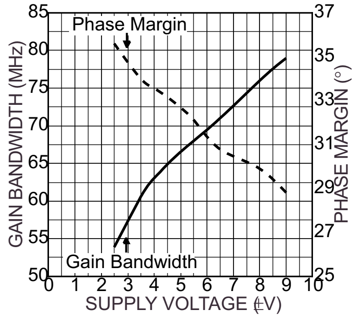


FIGURE 2-20: *Gain Bandwidth and Phase Margin vs. Supply Voltage.*

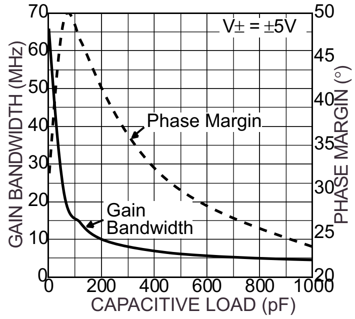


FIGURE 2-21: *Gain Bandwidth and Phase Margin vs. Load.*

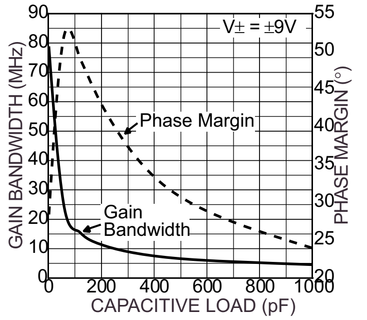


FIGURE 2-22: *Gain Bandwidth and Phase Margin vs. Load.*

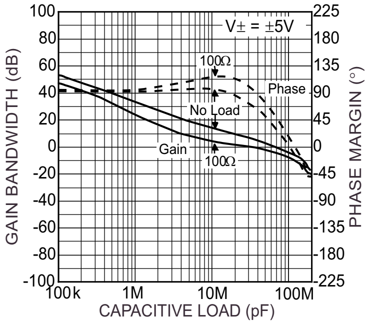


FIGURE 2-23: *Open-Loop Frequency Response.*

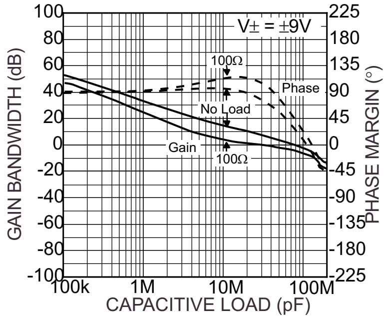


FIGURE 2-24: *Open-Loop Frequency Response.*

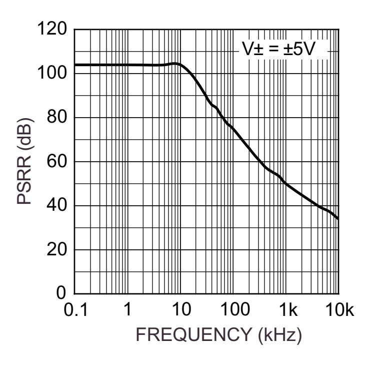


FIGURE 2-25: Positive PSRR vs. Frequency.

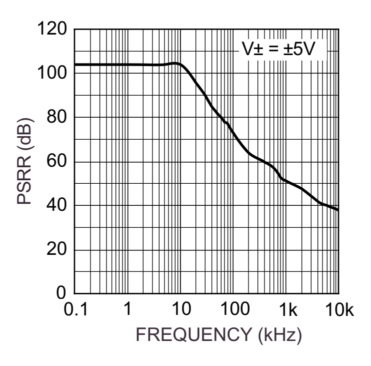


FIGURE 2-26: Negative PSRR vs. Frequency.

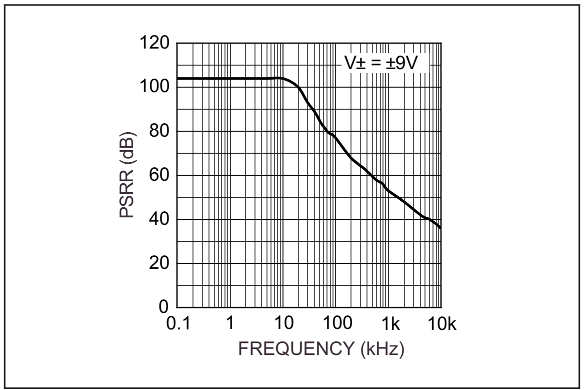


FIGURE 2-27: Positive PSRR vs. Frequency

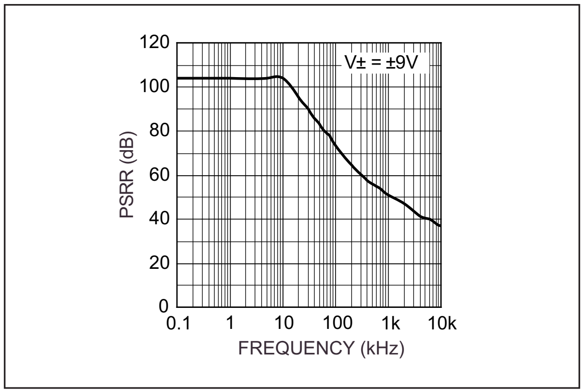


FIGURE 2-28: Negative PSRR vs. Frequency

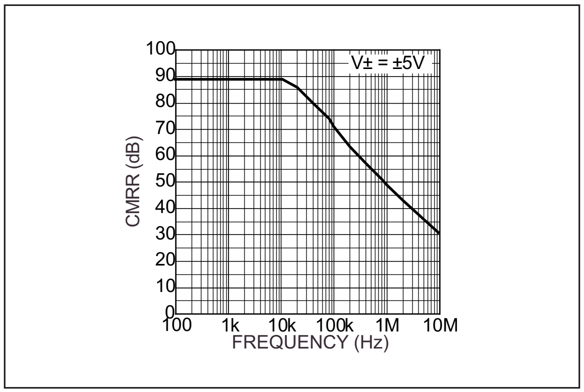


FIGURE 2-29: Common-Mode Rejection Ratio.

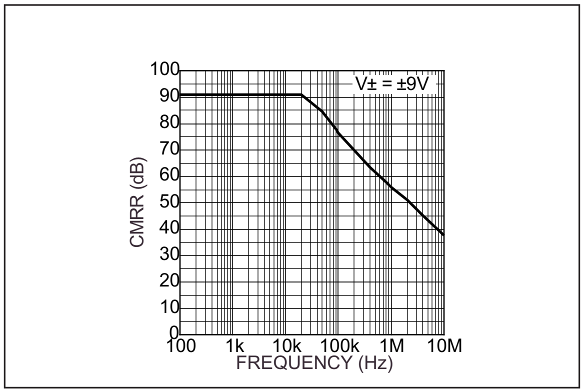


FIGURE 2-30: Common-Mode Rejection Ratio.

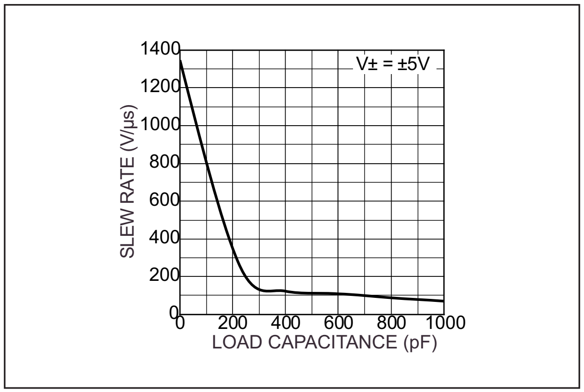


FIGURE 2-31: *Positive Slew Rate.*

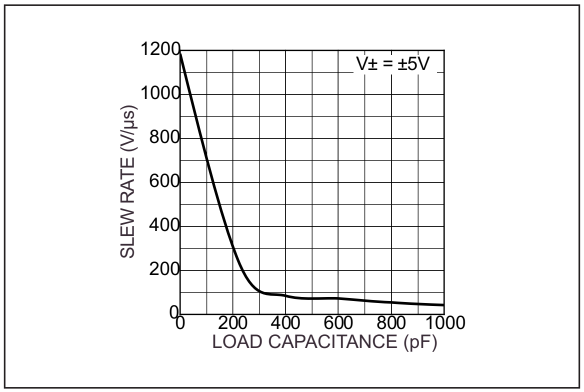


FIGURE 2-32: *Negative Slew Rate.*

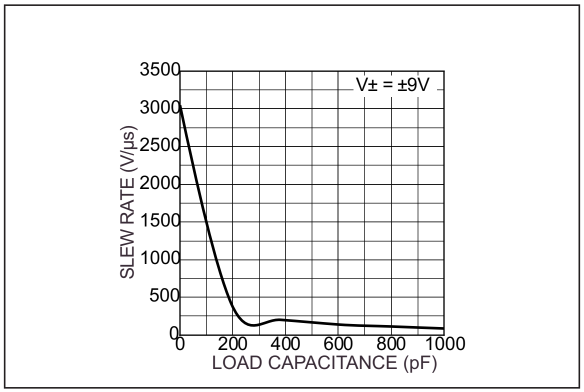


FIGURE 2-33: *Positive Slew Rate.*

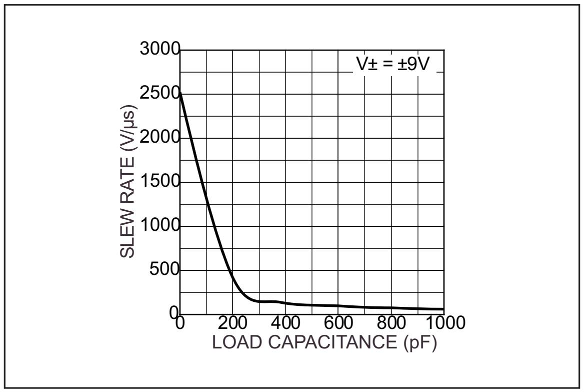


FIGURE 2-34: *Negative Slew Rate.*

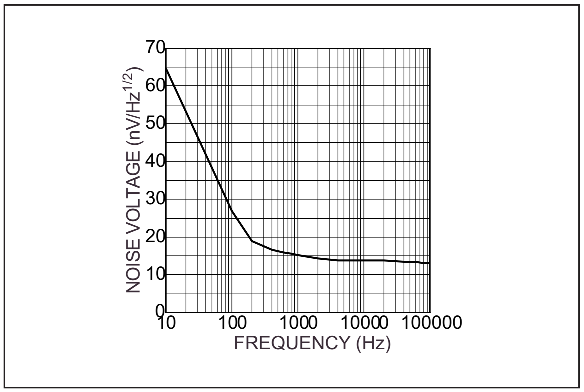


FIGURE 2-35: *Voltage Noise Density vs. Frequency.*

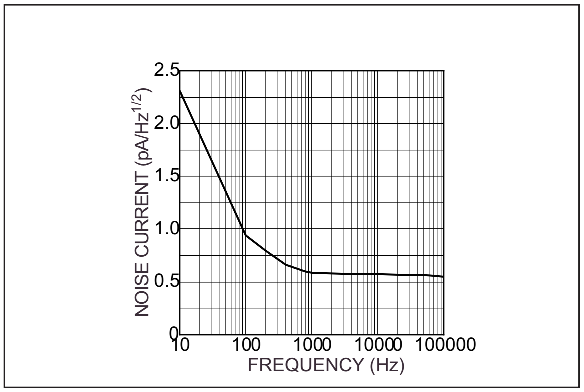


FIGURE 2-36: *Current Noise Density vs. Frequency.*

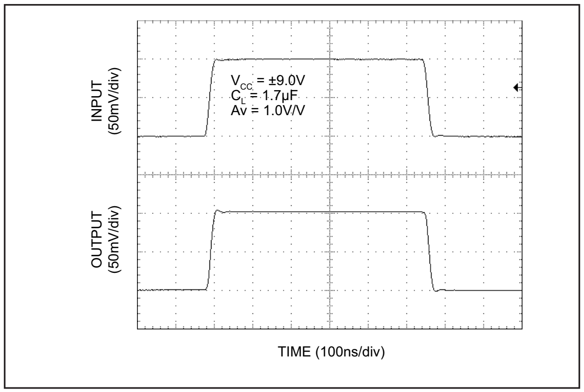


FIGURE 2-37: *Small Signal Pulse Response.*

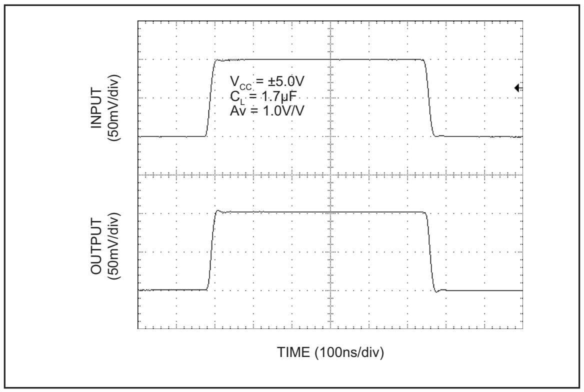


FIGURE 2-38: *Small Signal Pulse Response.*

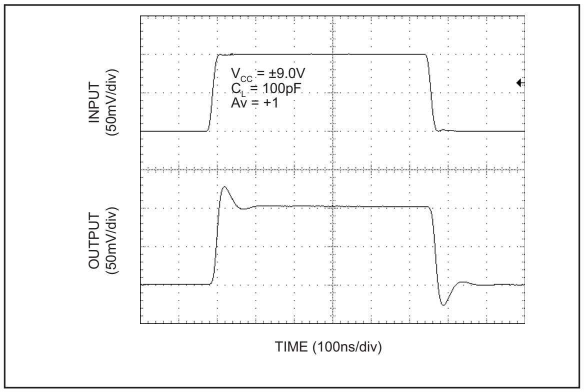


FIGURE 2-39: *Small Signal Pulse Response.*

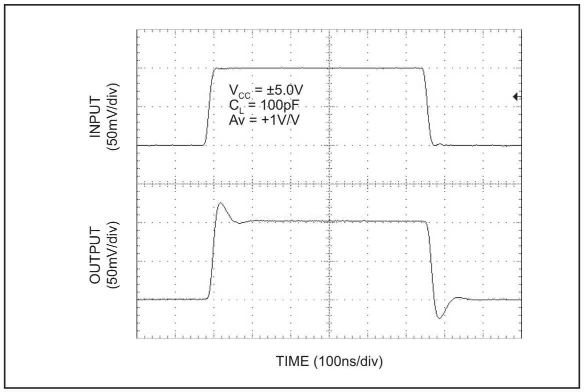


FIGURE 2-40: *Small Signal Pulse Response.*

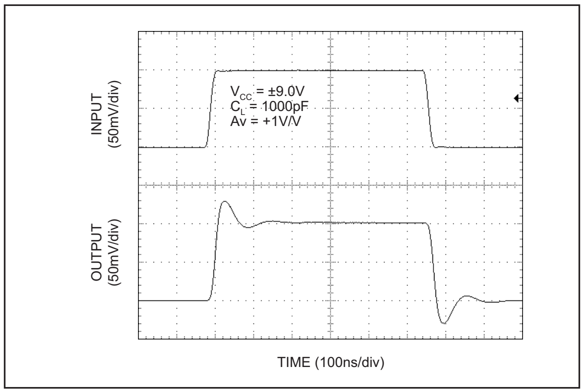


FIGURE 2-41: *Small Signal Pulse Response.*

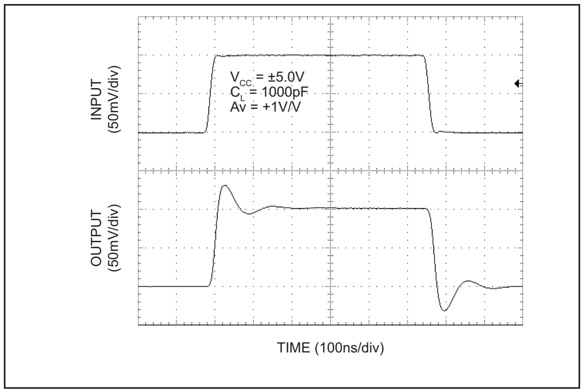


FIGURE 2-42: *Small Signal Pulse Response.*

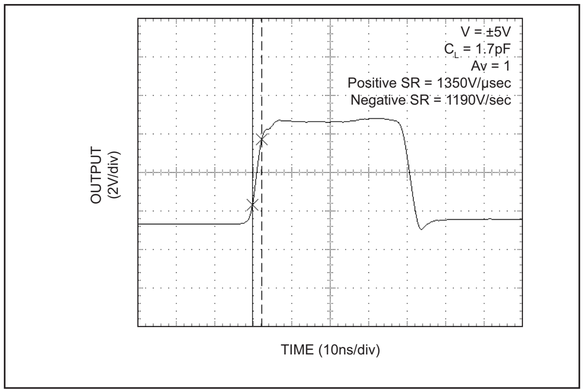


FIGURE 2-43: *Large Signal Response.*

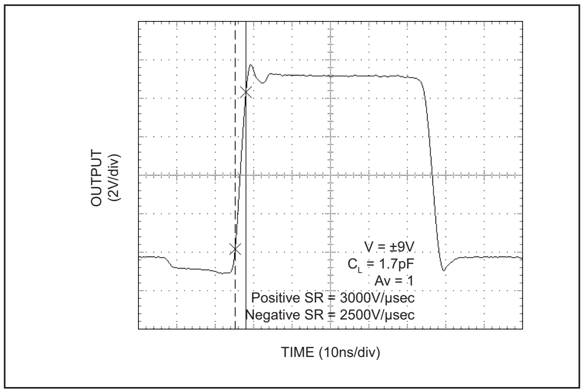


FIGURE 2-44: *Large Signal Response.*

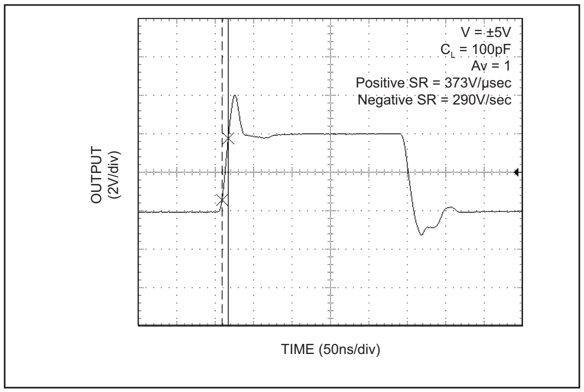


FIGURE 2-45: *Large Signal Response.*

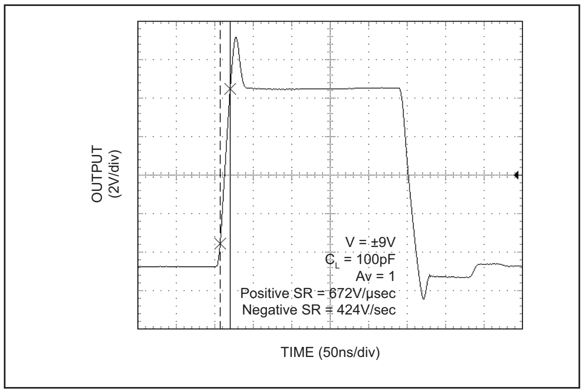


FIGURE 2-46: *Large Signal Response.*

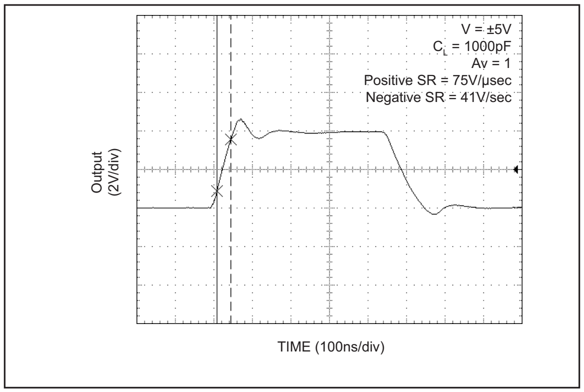


FIGURE 2-47: *Large Signal Response.*

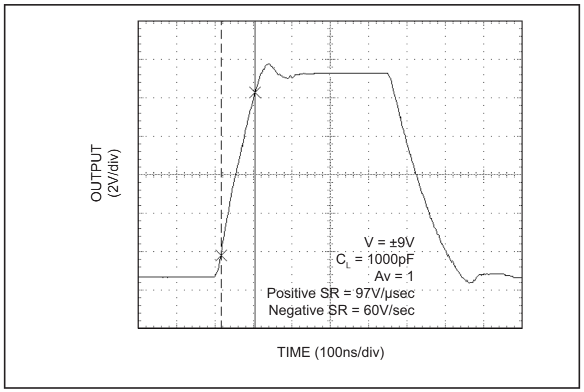


FIGURE 2-48: *Large Signal Response.*

3.0 TEST CIRCUITS

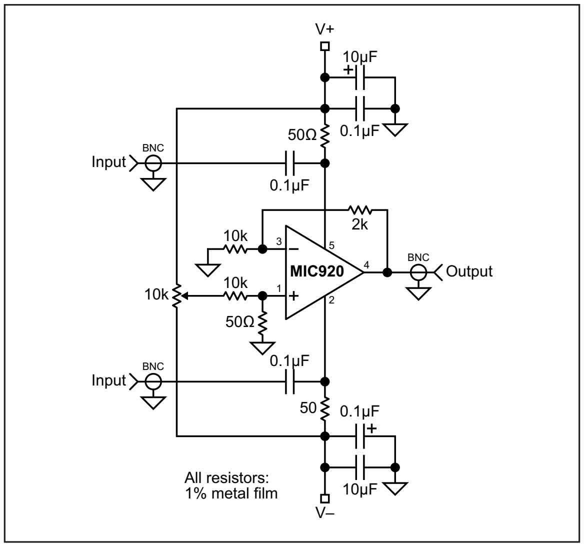


FIGURE 3-1: *PSRR vs. Frequency.*

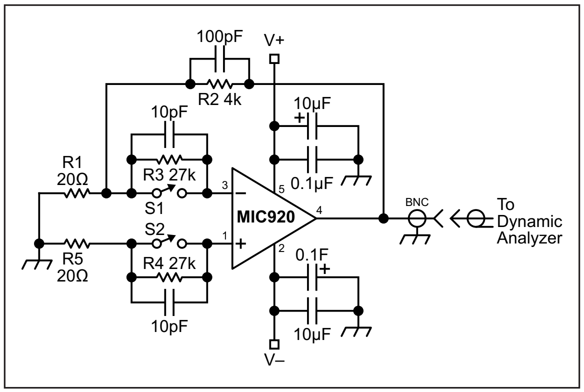


FIGURE 3-2: *Noise Measurement.*

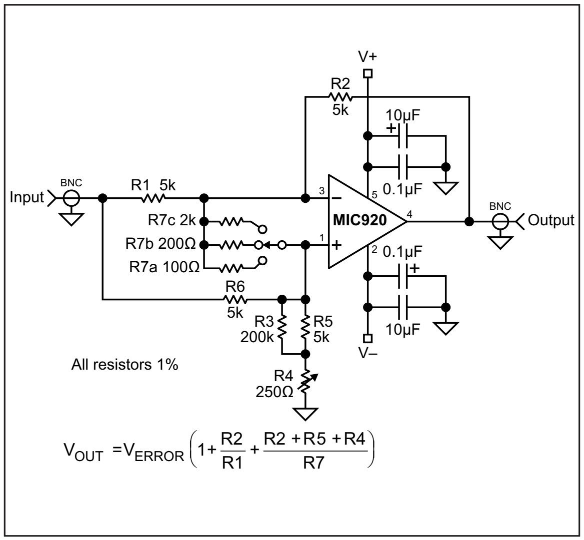


FIGURE 3-3: *CMRR vs. Frequency.*

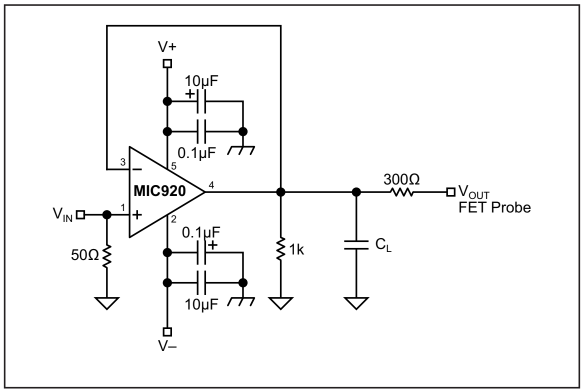


FIGURE 3-4: *Closed Loop Frequency Response Measurement.*

4.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 4-1.

TABLE 4-1: PIN FUNCTION TABLE

Pin Number	Symbol	Description
1	IN+	Non-inverting input.
2	V–	Negative Supply (Input).
3	IN–	Inverting Input.
4	OUT	Output: Amplifier Output
5	V+	Positive Supply (Input).

5.0 APPLICATION INFORMATION

The MIC920 is a high-speed, voltage-feedback operational amplifier featuring very low supply current and excellent stability. This device is unity gain stable, capable of driving high capacitance loads.

5.1 Driving High Capacitance

The MIC920 is stable when driving high capacitance, making it ideal for driving long coaxial cables or other high-capacitance loads. Most high-speed op amps are only able to drive limited capacitance.

Note: Increasing load capacitance does reduce the speed of the device. 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.

5.2 Feedback Resistor Selection

Conventional op amp gain configurations and resistor selection apply, the MIC920 is NOT a current feedback device.

Also, for minimum peaking, the feedback resistor should have low parasitic capacitance, usually 470Ω is ideal. To use the part as a follower, the output should be connected to input via a short wire.

5.3 Layout Considerations

All high speed devices require careful PCB layout. 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.

5.4 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.

5.5 Thermal Considerations

The SC70-5 package, like all small packages, have 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.

An MIC920 with no load, dissipates power equal to the quiescent supply current x supply voltage.

EQUATION 5-1:

$$P_{D(no\ load)} = (V_{V+} - V_{V-})I_S$$

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 5-2:

$$P_{D(output\ stage)} = (V_{V+} - V_{OUT})$$

$$P_{D(Total)} = P_{D(no\ load)} + P_{D(output\ stage)}$$

Ensure the total power dissipated in the device is no greater than the thermal capacity of the package. The SC70-5 package has a thermal resistance of 450°C/W.

EQUATION 5-3:

$$P_{D(max)} = \frac{T_{J(max)} - T_{A(max)}}{450°C/W}$$

6.0 PACKAGING INFORMATION

6.1 Package Marking Information

5-Lead SC70*	Example
XXX NNN	A37 508

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
	ⓔ3	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (ⓔ3) 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).

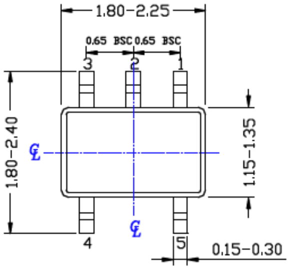
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

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

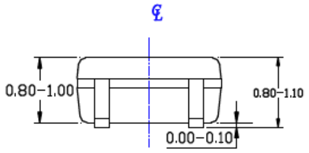
5-Lead SC70 (C5) Package Outline and Recommended Land Pattern

TITLE
5 LEAD SC70 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

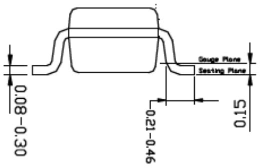
DRAWING #	SC70-5LD-PL-2	**UNIT**	MM



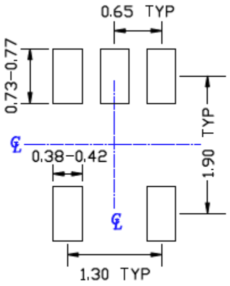
TOP VIEW



SIDE VIEW



END VIEW



RECOMMENDED LAND PATTERN

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR.

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 (October 2019)

- Converted Micrel document MIC920 to Microchip data sheet template DS20006268A.
- Minor text changes throughout.

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:	MIC920:		80 MHz Low-Power SC70 Op Amp
Temperature:	Y	=	–40°C to +85°C
Package:	C5	=	5-Lead SC70
Media Type:	TR	=	3,000/Reel

Examples:

a)	MIC920YC5-TR:	80 MHz Low-Power SC-70 Op Amp, –40°C to +85°C Ambient Temperature Range, 5-Lead SC70 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:

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

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