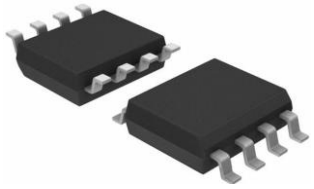
Low-power Operational Amplifier

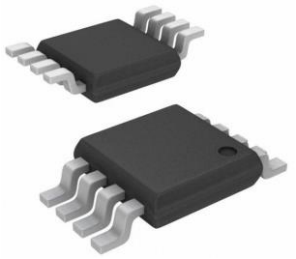
PRODUCT DESCRIPTION

The MS8059/MS8059M is a dual-channel operational amplifier, it has high unit gain bandwidth, and its slew rate can reach 0.4V/μs under specific circumstance. The quiescent current(5V) of each amplifier is only 430μA. The input common-mode range includes ground and the device can operate at single power supply or dual power supply. It can also drive large capacitive load easily.

The MS8059/MS8059M is available in SOP8 and MSOP8 packages. In general, the MS8059/MS8059M is a operational amplifier with low power and wide power supply range. And it has economical price which makes it can be supplied in wide applications.



SOP8



MSOP8

FEATURES

- Gain-bandwidth Product 1MHz@25°C
- Low Supply Current 430μA
- Low Input Bias Current 30nA
- Wide Supply Voltage 2.5V to 36V
- Stable with High Capacitive Loads

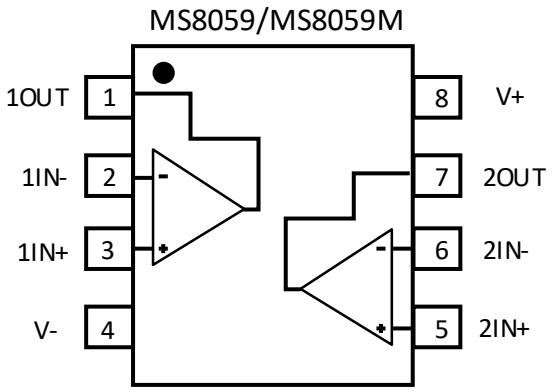
APPLICATIONS

- Chargers
- Power Supplies
- Industrial: Control Tools
- Desktops
- Communications

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS8059	SOP8	MS8059
MS8059M	MSOP8	MS8059M

PIN CONFIGUREATION



PIN DESCRIPTION

Pin	Name	Type	Description
MS8059/MS8059M			
1	1OUT	O	Channel 1 Output
2	1IN-	I	Channel 1 Negative Input
3	1IN+	I	Channel 1 Positive Input
4	V-	-	Negative Power Supply
5	2IN+	I	Channel 2 Positive Input
6	2IN-	I	Channel 2 Negative Input
7	2OUT	O	Channel 2 Output
8	V+	-	Positive Power Supply

ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Range	Unit
Differential Input Voltage	± Power Supply	V
Input Current(VIN < -0.3V)	50	mA
Power Supply(V+ - V-)	40	V
Input Voltage	-0.3 ~ 40	V
Junction Temperature	150	°C
Operating Temperature	-40 ~ 125	°C
Soldering Temperature (10s)	260	°C
Storage Temperature, Tstg	-65 ~ 150	°C

ELECTRICAL CHARACTERISTICS

Unless otherwise noted, TA=25°C, V+=5V, V-=0V, VO=1.4V

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Characteristics						
Input Offset Voltage	Vos	TA=25°C		3	7	mV
		–40°C ≤ TA ≤125°C			10	
Input Bias Current	IB	TA=25°C		30	250	nA
		–40°C ≤ TA ≤125°C			500	
Input Offset Current	IOS	TA=25°C		5	50	nA
		–40°C ≤ TA ≤ 125°C			150	
Input Common-mode Voltage Range	VCM	V+=30V, CMRR>=50dB	0		(V+)-1.5	V
		V+=30V, CMRR>=50dB			(V+)- 2	
Common-mode Rejection Ratio	CMRR	RS≤10kΩ	65	85		dB
Large Signal Gain	Avo	V+=15V,RL=2kΩ,VO=1.4V~11.4V	88	100		dB
		V+=15V,RL=2kΩ,VO=1.4V ~11.4V –40°C ≤ TJ ≤ 125°C	83			
Output Characteristics						
Output Swing	VOH	V+=30V,RL=2kΩ, –40°C ≤ TJ ≤ 125°C	26			V
		V+=30V,RL=10kΩ –40°C ≤ TJ ≤ 125°C	27	28		
	VOL	V+=5V,RL=10kΩ –40°C ≤ TJ ≤ 125°C		5	20	mV
Output Current Source	Isource	VID=+1V,V+=15V,VO=2V	20	30		mA
		VID=+1V,V+=15V,VO=2V –40°C ≤ TJ ≤ 125°C	10	20		
Output Current Sink	Isink	VID=-1V,V+=15V,VO=2V	5	8		mA
		VID=-1V,V+=15V,VO=2V –40°C ≤ TJ ≤ 125°C	3	6		
		VID=-1V,V+=15V,VO=0.2V	12	100		μA
Output Short Circuit to Ground	Io	V+=15V		30	85	mA

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power Consumption						
Power Supply Rejection Ratio	PSRR	RS ≤10kΩ, V+ ≤5V~30V	65	100		dB
Quiescent Current/Amplifier	Iq	V+=5V		0.430	1.15	mA
		V+=5V, –40°C ≤ TJ ≤ 125°C		0.7	1.2	
		V+=30V		0.660	2.85	
		V+=30V, –40°C ≤ TJ ≤ 125°C		1.5	3	
Dynamic Characteristics						
Gain Bandwidth Product	GBW	Temperature 25°C, V+=30V, f=100kHz VIN=10mV, RL=2kΩ,CL=100pF		1		MHz
		Temperature 125°C, V+=30V, f=100kHz VIN=10mV, RL=2kΩ, CL=100pF		0.7		
Slew Rate	SR	V+=15V, RL=2kΩ, VIN=0.5V~3V CL=100pF, Unit Gain		0.4		V/μs
Phase Margin	Z			60		Degrees
Others						
Voltage Noise Density	en	f=1kHz, Rs=100Ω, V+=30V		60		$nV/\sqrt{Hz}$
Harmonic Distortion	THD	f=1kHz, AV=20dB, RL=2kΩ VO=2VPP, CL=100pF, V+=30V		0.015		%

TYPICAL APPLICATION

Non-inverting DC Gain (0V Input = 0V Output)

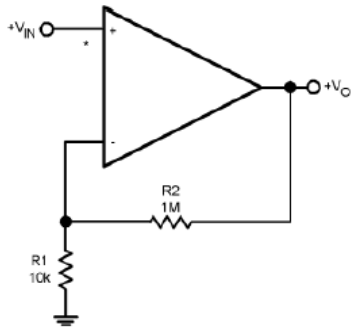


Figure 1. Non-inverting DC Gain Circuit (0V Input = 0V Output)

Design Requirements

Power Supply (up to 36V)

Phase Margin: 60°

Detailed Design Procedure

Connecting the 1MΩ feedback resistor between the output terminal and the inverting input terminal.

Connecting the 10kΩ resistor between the inverting input terminal and ground. Place the resistor as close to the inverting input pin as possible.

Connecting the power supply and the input voltage.

Application Curve

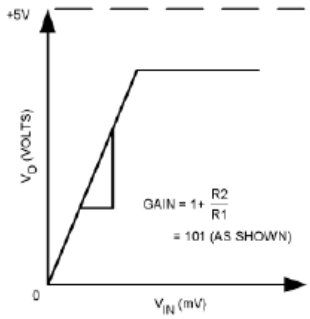
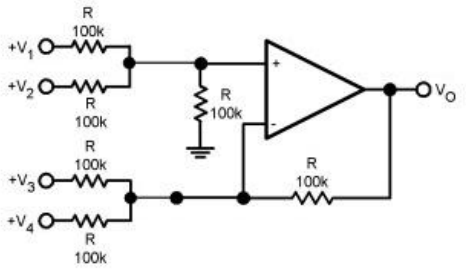


Figure 2. Non-inverting Amplifier Gain

DC Summing Amplifier (VIN's≥0V,VO≥0V)

The summing amplifier is a special inverting amplifier. As shown in Figure 3, the circuit gives an inverted output of weighted algebraic sum of 4 inputs. The gain of each input is equal to the ratio of the feedback resistor to the input resistor. The advantage of this circuit is that there is no interaction between inputs and summing operations and weighted averaging are easily implemented.



VO=V1+V2-V3-V4, (V1+V2)≥(V3+V4) Keeping VO>0V

Figure 3. DC Summing Amplifier Circuit VIN's≥0V,VO≥0V

Amplitude Modulator Circuit

The modulator circuit is shown in Figure 4, PWM signal is used to switch the MOSFET. When the MOSFET is on, the circuit performs as an inverting amplifier with gain 1. When the MOSFET is off, the inverting and non-inverting signals cancel each other out. So the output transitions from -VIN to GND at the carrier frequency and amplitude.

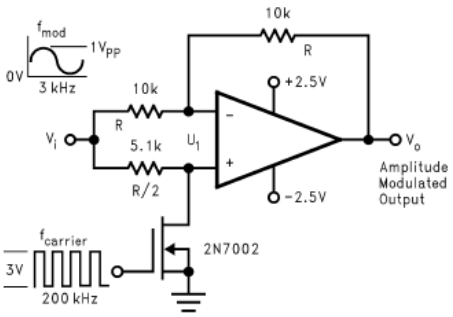
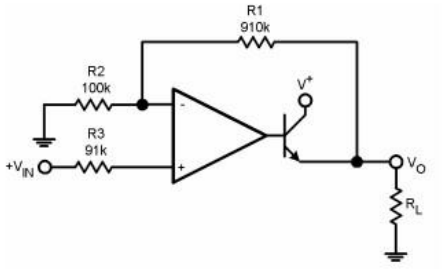


Figure 4. Amplitude Modulator Circuit

Power Amplifier

The power amplifier circuit is shown in Figure 5. The voltage gain is set by R1 and R2. The amplifier output is connected to the base of BJT to amplify the current. The current gain is the BJT gain, set to β. The result is that the output provides high power to the load. Differential power supply is necessary here.



VO=0V for VIN=0V, AV=10

Figure 5. Power Amplifier Circuit

LED Driver

As shown in Figure 6, the MS8059/MS8059M is used as an LED driver. The output current of amplifier passes through the diode. The LED voltage is assumed to be fixed.

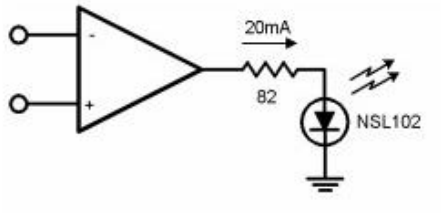


Figure 6. LED Driver Circuit

Fixed Current Sources

The operational amplifier can provide fixed current source for multiple loads. The amplifier output is connected to the base of bipolar transistors. The feedback is placed in the BJT drain and the inverting input terminal of the amplifier. The current ratio in two BJTs is set by R1 and R2.

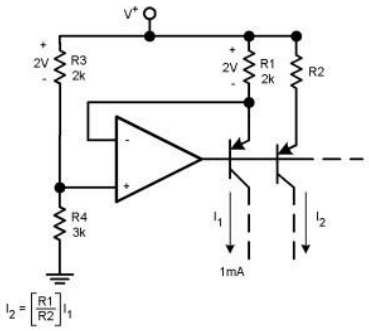


Figure 7. Fixed Current Source Circuit

Lamp Driver

Similar to the LED driver, the MS8059/MS8059M can be used to drive lamps. The amplifier output is connected to the base of a bipolar transistor which will drive β times the output current through the lamp.

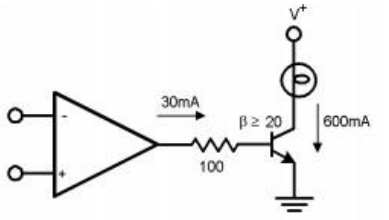
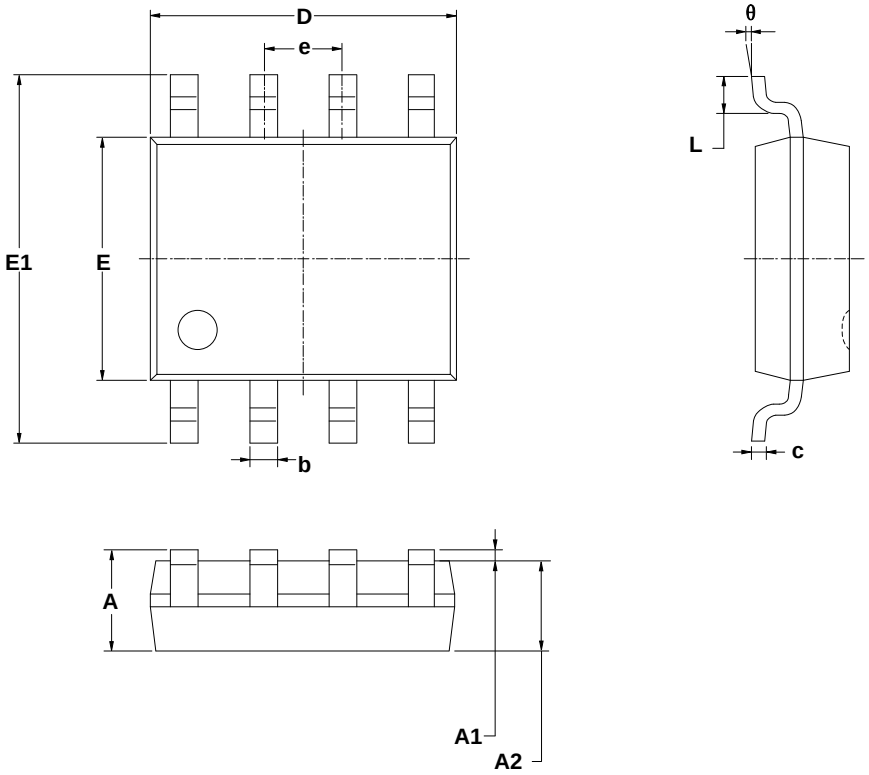


Figure 8. Lamp Driver Circuit

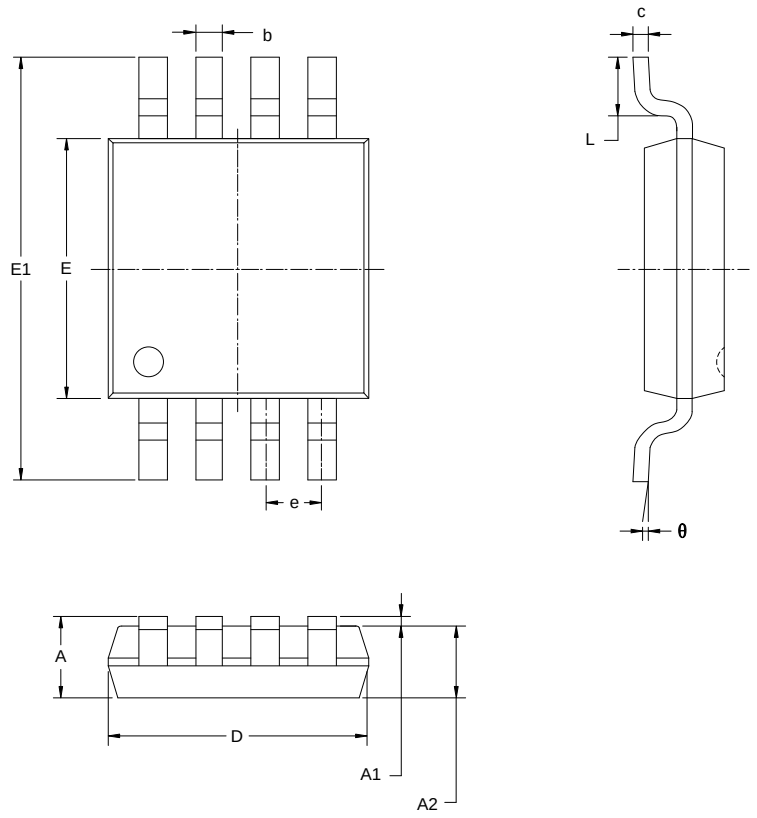
PACKAGE OUTLINE DIMENSIONS

SOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0 º	8 º	0 º	8 º

MSOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650BSC		0.026BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

MARKING and PACKAGING SPECIFICATION

1. Marking Drawing Description

Product Name: MS8059, MS8059M

Product Code: XXXXXX, XXXXXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging Specification

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS8059	SOP8	2500	1	2500	8	20000
MS8059M	MSOP8	3000	1	3000	8	24000

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MOS CIRCUIT OPERATION PRECAUTIONS

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1、The operator shall ground through the anti-static wristband.

2、The equipment shell must be grounded.

3、The tools used in the assembly process must be grounded.

4、Must use conductor packaging or anti-static materials packaging or transportation.

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