

## Description

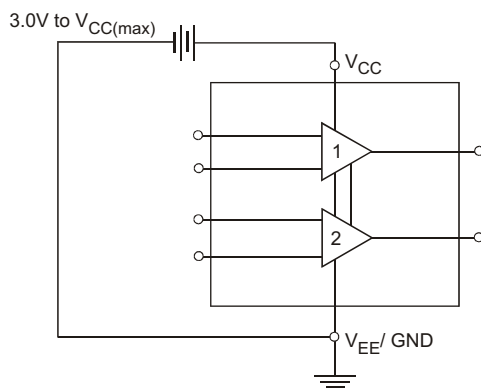
Utilizing the circuit designs perfected for two operational amplifiers, these dual operational amplifiers feature low power drain, a common mode input voltage range extending to  $GND/V_{EE}$  and single supply or split supply operation. The GM358 is equivalent to one-half of an GM324.

These amplifiers have several distinct advantages over standard operational amplifier types in single supply applications. They can operate at supply voltages as low as 3.0 V or as high as 32 V, with quiescent currents about one-fifth of those associated with the MC1741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

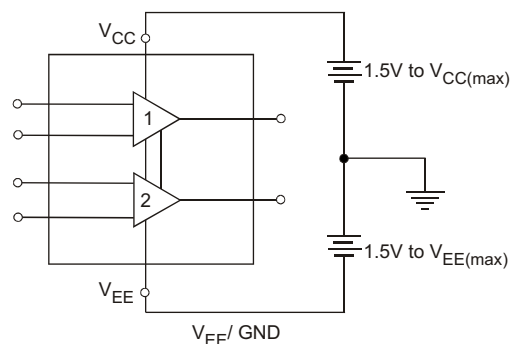
## Features

- ◆ Short Circuit Protected Outputs
- ◆ True Differential Input Stage
- ◆ Single Supply Operation: 3.0 V to 32 V
- ◆ Low Input Bias Currents
- ◆ Internally Compensated
- ◆ Common Mode Range Extends to Negative Supply
- ◆ Single and Split Supply Operation
- ◆ ESD Clamps on the Inputs Increase Ruggedness of the Device without Affecting Operation

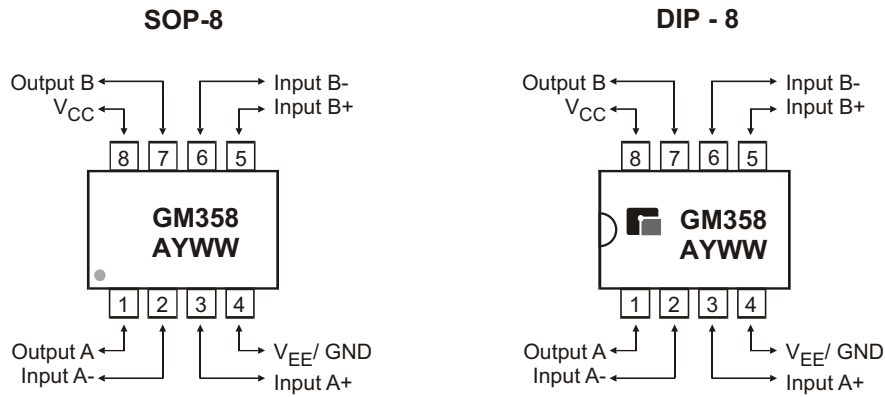
## SINGLE SUPPLY



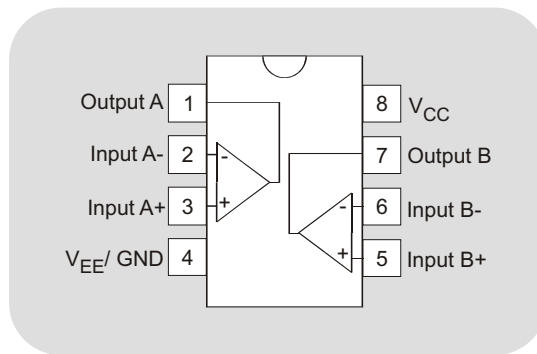
## SPLIT SUPPLIES



### ◆ MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)



A : Assembly Location  
Y : Year  
W W : Weekly



### ◆ ORDERING INFORMATION

Ordering Number	Package	Shipping
GM358D8T	DIP-8	60 Units / Tube
GM358S8T	SOP-8	100 Units / Tube
GM358S8R	SOP-8	2,500 Units/Tape & Reel

\* For detail Ordering Number identification, please see last page.

## ◆ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Power Supply Voltage Single Supply Split Supplies	$V_{CC}$ $V_{CC}, V_{EE}$	32 $\pm 16$	Vdc
Input Differential Voltage Range (Note 1 )	$V_{IDR}$	$\pm 32$	Vdc
Input Common Mode Voltage Range(Note 2)	$V_{ICR}$	-0.3 to 32	Vdc
Output Short Circuit Duration	$t_{SC}$	Continuous	-
Junction Temperature	$T_J$	150	$^{\circ}C$
Thermal Resistance, Junction - to - Air (Note 3)	$R_{JA}$	238	$^{\circ}C/W$
Operating Ambient Temperature Range	$T_A$	0 to +70	$^{\circ}C$
Storage Temperature Range	$T_{STG}$	-55 to +125	$^{\circ}C$
ESD Tolerance - Human Body Model (Note 4)	-	2000	V

**Note 1:** Split Power Supplies.

**Note 2:** For Supply Voltages less 32V the absolute maximum input voltage is equal to the supply voltage.

**Note 3:**  $R_{JA}$  for Case 846A

**Note 4:** ESD data available upon request.

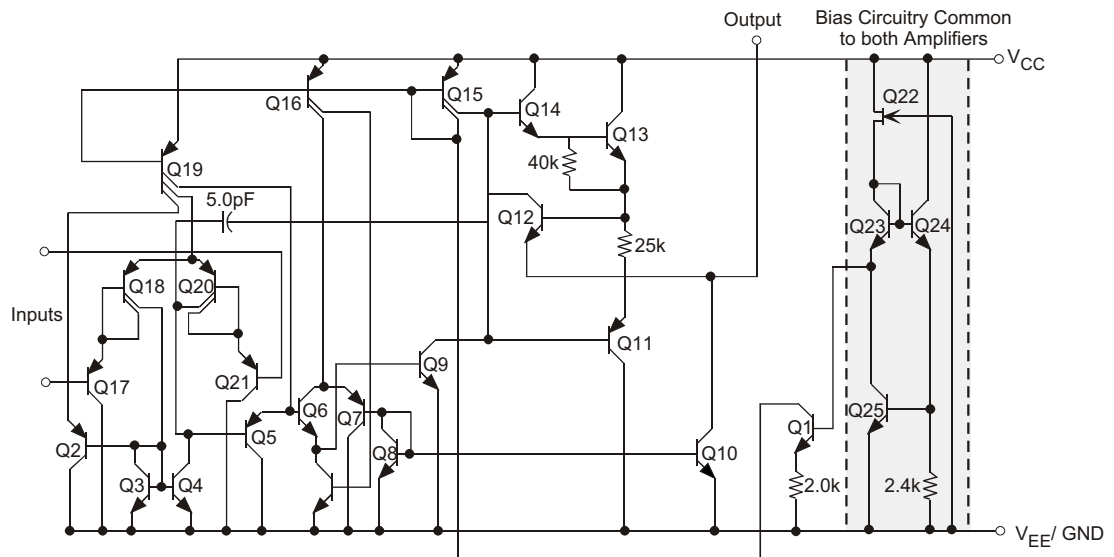
### ◆ ELECTRICAL CHARACTERISTICS

( $V_{CC} = 5V$ , at specified free - air temperature, unless otherwise specified)

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	$V_{CC} = 5V$ to MAX $V_{CC} = V_{ICRmin}$ $V_O = 1.4V$	25°C	3	7	mV
			Full range		9	
Average Temperature Coefficient of Input Offset Voltage	$V_{IO}$		Full range	7		$\mu V/^\circ C$
Input Offset Current	$I_{IO}$	$V_O = 1.4V$	25°C	2	50	nA
			Full range		150	
Average Temperature Coefficient of Input Offset Voltage	$I_{IO}$		Full range	10		$pA/^\circ C$
Input Bias Current	$I_{IB}$	$V_O = 1.4V$	25°C	-20	-250	nA
			Full range		-500	
Common-Mode Input Voltage Range	$V_{ICR}$	$V_{CC} = 5V$ to MAX	25°C	0 to $V_{CC}-1.5$		V
			Full range	0 to $V_{CC}-2$		
High - Level Output Voltage	$V_{OH}$	$R_L \geq 2k$	25°C	$V_{CC}-1.5$		V
		$V_{CC}=MAX, R_L=2k$	Full range	26		
		$V_{CC}=MAX, R_L \geq 10k$	Full range	27	28	
Low - Level Output Voltage	$V_{OL}$	$R_L \geq 10k$	Full range	5	20	mV
Large - Signal Differential Voltage Amplification	$A_{VD}$	$V_{CC}=15V, V_O=1V$ to 11V, $R_L \geq 2k$	25°C	25	100	V/ mV
			Full range	15		
Common Mode Rejection Ration	CMRR	$V_{CC} = 5V$ to MAX, $V_{IC} = V_{ICRmin}$	25°C	65	80	dB
Supply Voltage Rejection Ration	$k_{SVR}$	$V_{CC} = 5V$ to MAX	25°C	65	100	dB
Crosstalk Attenuation	$V_{O1}/V_{O2}$	$f = 1kHz$ to 20kHz	25°C	120		dB
Output Current	$I_O$	$V_{CC} = 15V, V_O = 0,$ $V_{ID} = 1V$	25°C	-20	-30	mA
			Full range	-10		
		$V_{CC} = 15V, V_O = 15V,$ $V_{ID} = -1V$	25°C	10	20	
			Full range	5		
$V_O = 200mV, V_{ID} = -1$	25°C	12	30	$\mu A$		
Short - Circuit Output Current	$I_{OS}$	$V_{CC}$ at 5V, $V_O = 0,$ GND at -5V	25°C	$\pm 40$	$\pm 60$	mA
Supply current (two amplifiers)	$I_{CC}$	$V_O = 2.5V$ , no load	Full range	0.7	1.2	mA
		$V_{CC} = MAX, V_O = 0.5V_{CC}$ no load	Full range	1	2	

\* All characteristics are measured under open loop conditions with zero common-mode input voltage unless otherwise specified.  
\*MAX\*  $V_{CC}$  for testing purposes is 30V. Full range is 0°C to 70°C.

#### ◆ SCHEMATIC BLOCK DIAGRAM



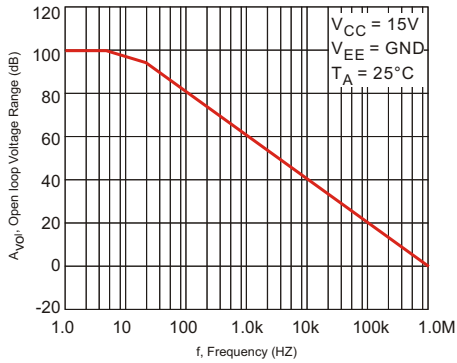
#### ◆ CIRCUIT DESCRIPTION

The GM358 series is made by using two internally compensated, and two - stage operational amplifiers. The first stage of each consists of differential input devices Q20 and Q18, with input buffer transistors Q21 and Q17, and the differential to single ended converter Q3 and Q4. The first stage performs not only the first stage gain function, but also performs the level shifting and transconductance reduction functions. By reducing the transconductance, a smaller compensation capacitor (only 5.0 pF) can be employed, thus saving chip area. The transconductance reduction is accomplished by splitting the collectors of Q20 and Q18.

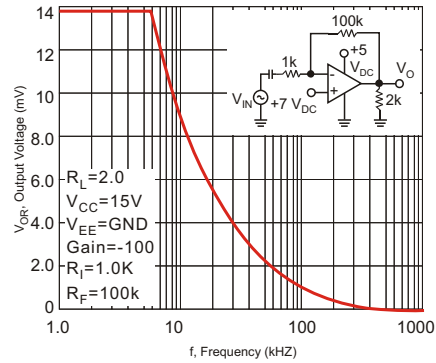
Another feature of this input stage is that the input common mode range can include the negative supply or ground, in single supply operation, without saturating either the input devices or the differential to single - ended converter. The second stage consists a standard current source load amplifier stage.

Each amplifier is biased from an internal voltage regulator, which has a low temperature coefficient thus giving each amplifier good temperature characteristics as well as excellent power supply rejection.

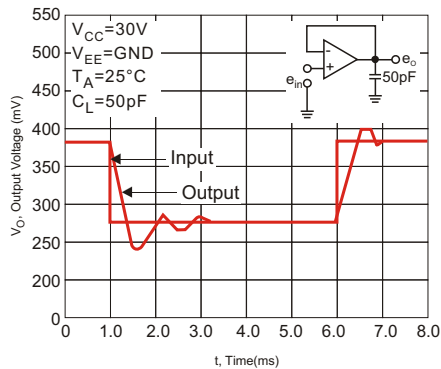
### ◆ Typical Performance Characteristics



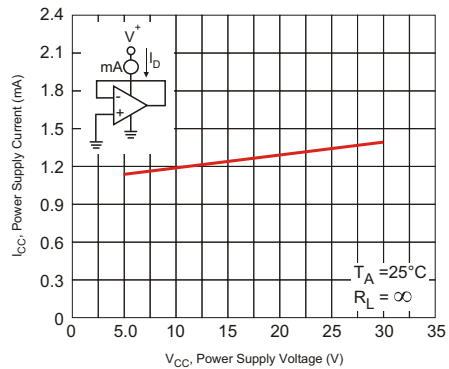
**Figure 1. Large-Signal Open Loop Voltage Gain**



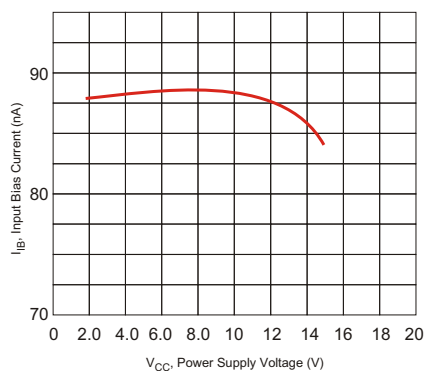
**Figure 2. Large - Signal Frequency Response**



**Figure 3. Small Signal Voltage Follower Pulse Response (Noninverting)**



**Figure 4. Power Supply Current versus Power Supply Voltage**



**Figure 5. Input Bias Current versus Supply Voltage**

### ◆ TYPICAL APPLICATIONS

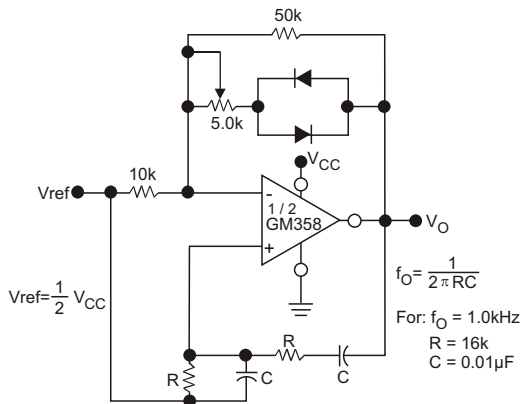


Figure 6. Wien Bridge Oscillator

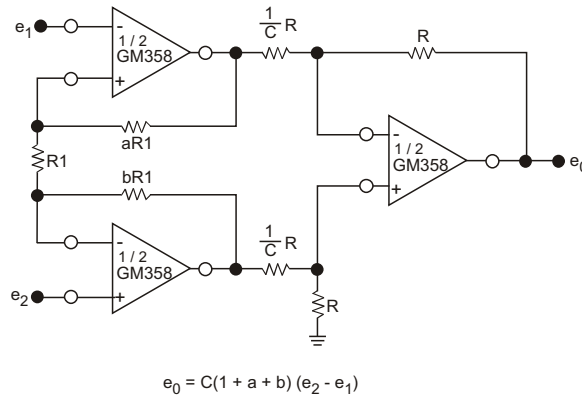


Figure 7. High Impedance Differential Amplifier

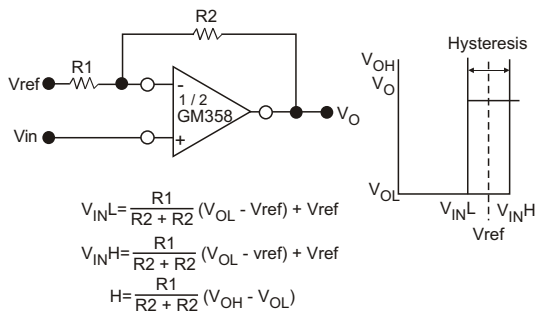
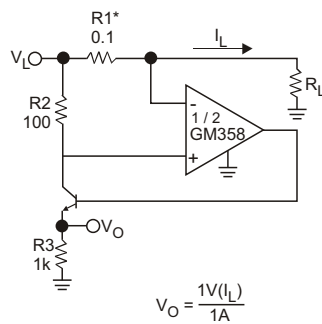


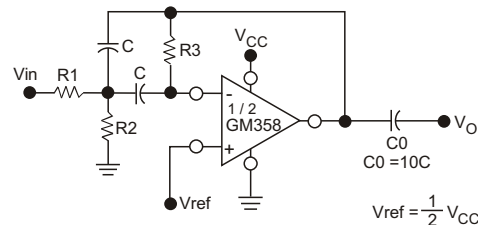
Figure 8. Comparator with Hysteresis



$$V_O = \frac{1V(I_L)}{1A}$$

\*(Increase R1 for IL small)  
 $V_L \geq V^* - 2$

Figure 10. Current Monitor



Given:  $f_0$  = center frequency  
 $A(f_0)$  = gain center frequency

Choose value  $f_0, C$

$$\text{Then: } R3 = \frac{Q}{f_0 C}$$

$$R1 = \frac{R3}{2A(f_0)}$$

$$R2 = \frac{R1 R3}{4Q^2 R1 - R2}$$

For less than 10% error from operational amplifier.  $\frac{Q_0 f_0}{BW} < 0.1$   
 Where  $f_0$  and BW are expressed in Hz.

If source impedance varies, filter may be preceded with voltage follower buffer to stabilize filter parameter.

Figure 9. Multiple Feedback Bandpass Filter

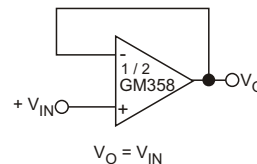
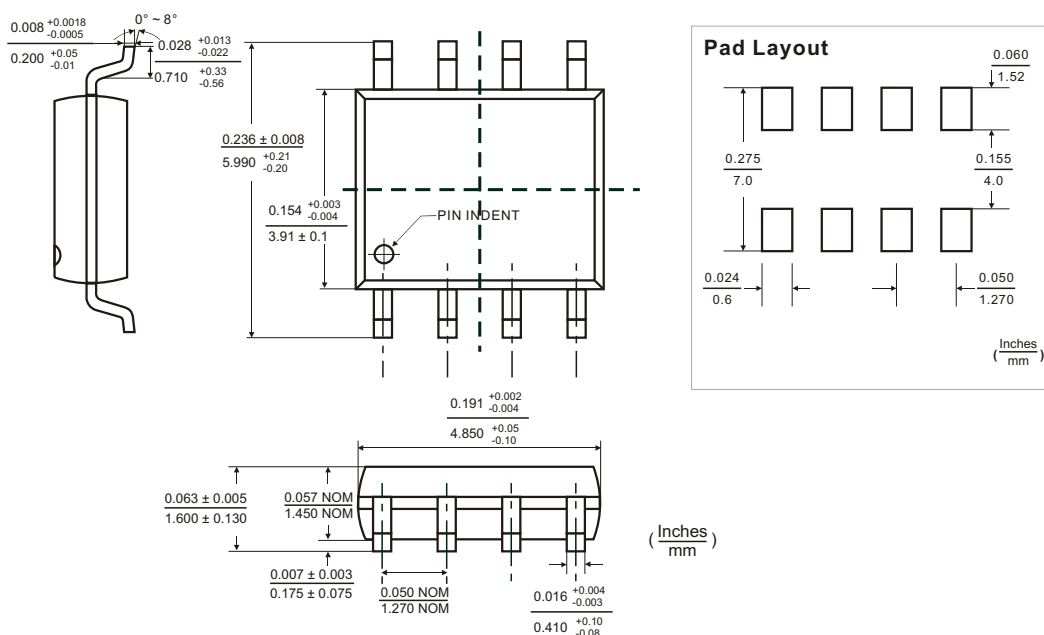
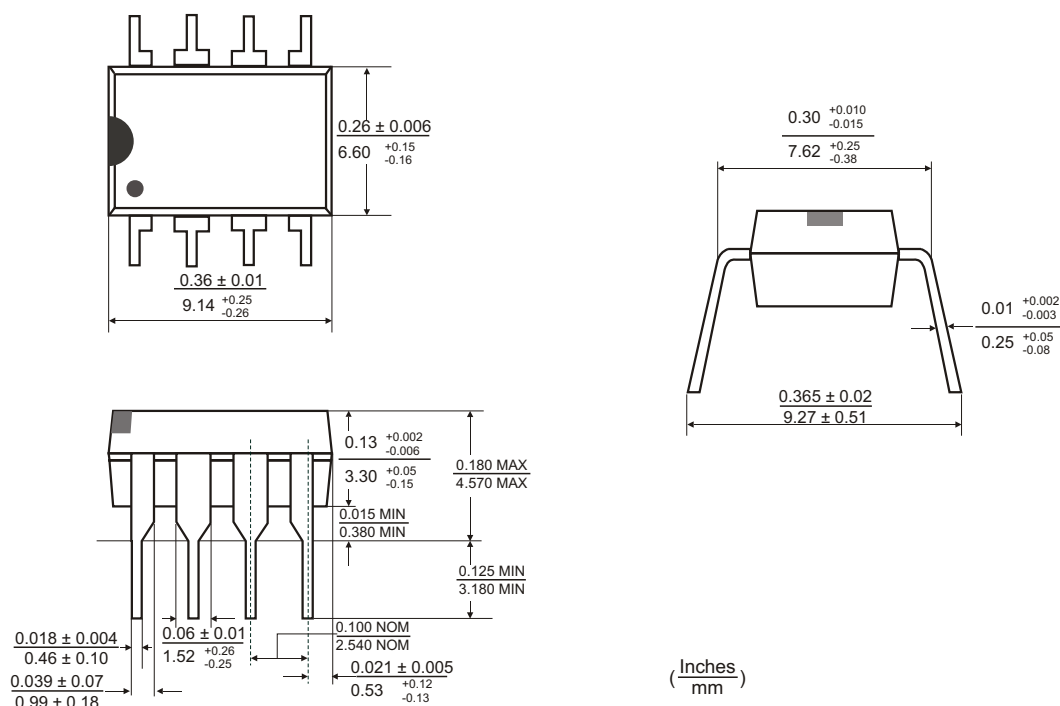


Figure 11. Voltage Follower

### ◆ SOP-8 PACKAGE OUTLINE DIMENSIONS

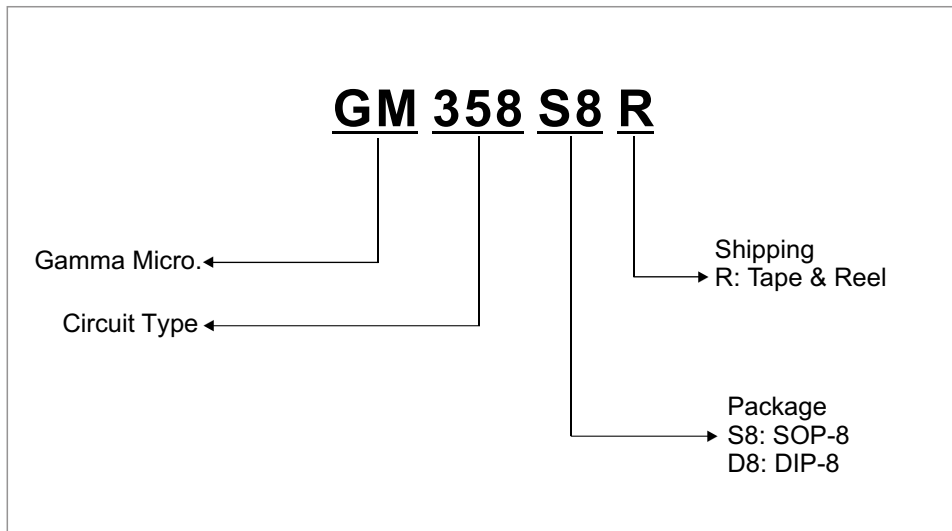


### ◆ DIP-8 PACKAGE OUTLINE DIMENSIONS







#### ◆ ORDERING NUMBER



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