



# HLM358P / HLM358S

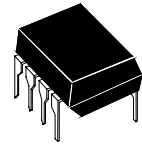
LOW POWER DUAL OPERATIONAL AMPLIFIERS

## Description

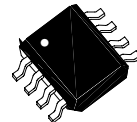
These devices consist of two independent, high gain, internally frequency-compensated operational amplifiers designed to operate from a single supply over a wide range of voltages. Operation from split supplies also is possible if the difference between the two supplies is 3V to 32V, and  $V_{CC}$  is at least 1.5V more positive than the input common-mode voltage. The low supply-current drain is independent of the magnitude of the power supply voltage.

## Features

- Two internally compensated OP amps
- Internally frequency compensated for unity gain
- Short Circuit Protected Outputs
- Wide power supply range:  $3V_{DC}$  to  $32V_{DC}$  (Single supply)
- Input common-mode voltage range includes ground
- Large output voltage swing:  $0V_{DC}$  to  $V_{CC}-1.5V_{DC}$

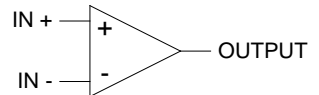


8-Lead Plastic **DIP-8**  
 Package Code: P



8-Lead Plastic **SO-8**  
 Package Code: S

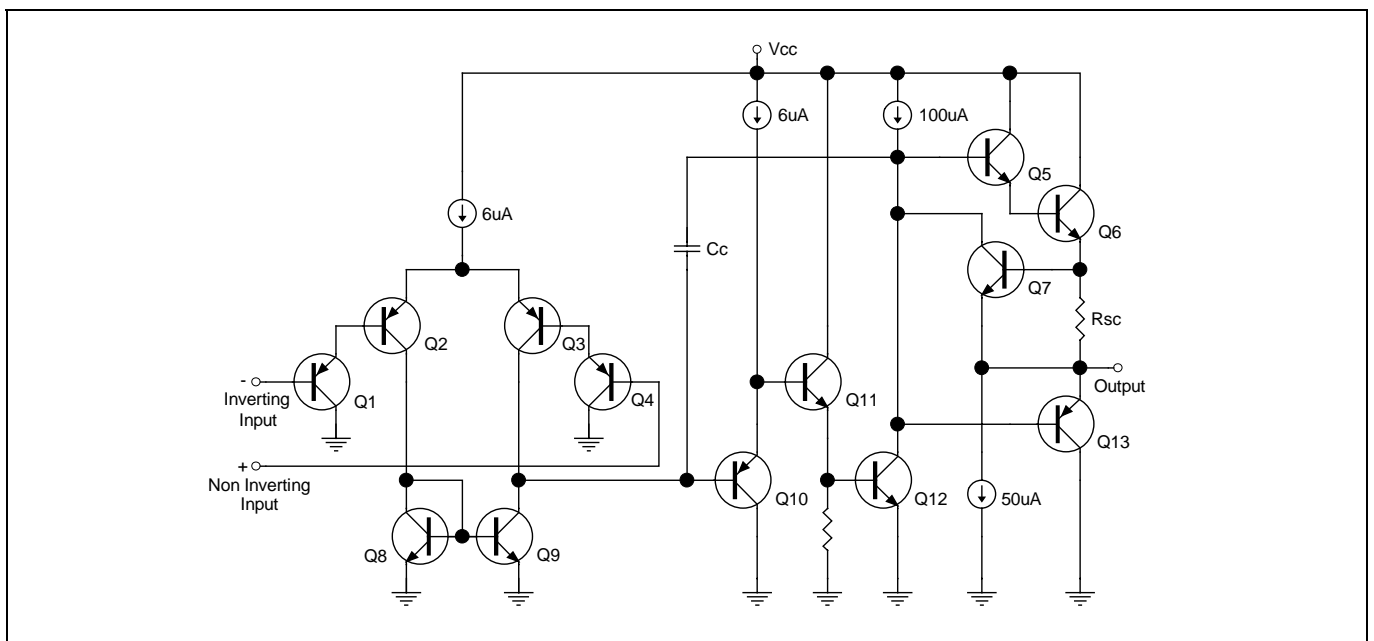
Logic Diagram (each amplifier)



## Pin Configurations

	Pin 1: Output 1	Pin 5: Non Inverting Input 2
	Pin 2: Inverting Input 1	Pin 6: Inverting Input 2
	Pin 3: Non Inverting Input 1	Pin 7: Output 2
	Pin 4: $V_{EE}$	Pin 8: $V_{CC}$

## Schematic Diagram





### Absolute Maximum Ratings (Ta=25°C, unless otherwise specified)

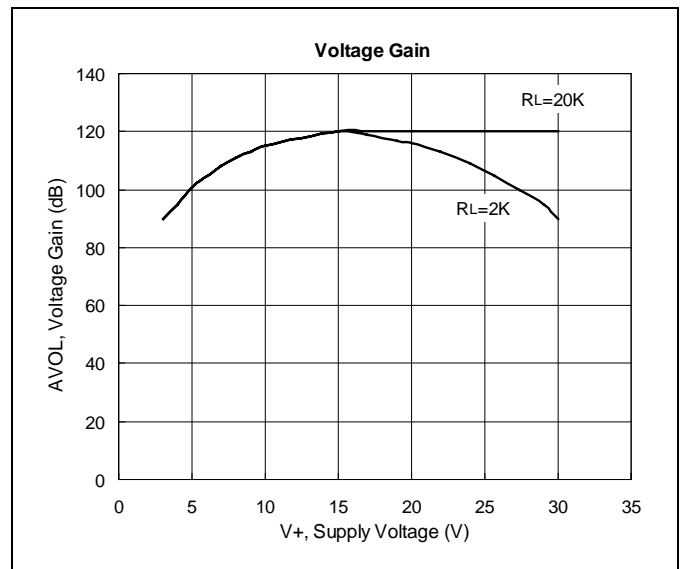
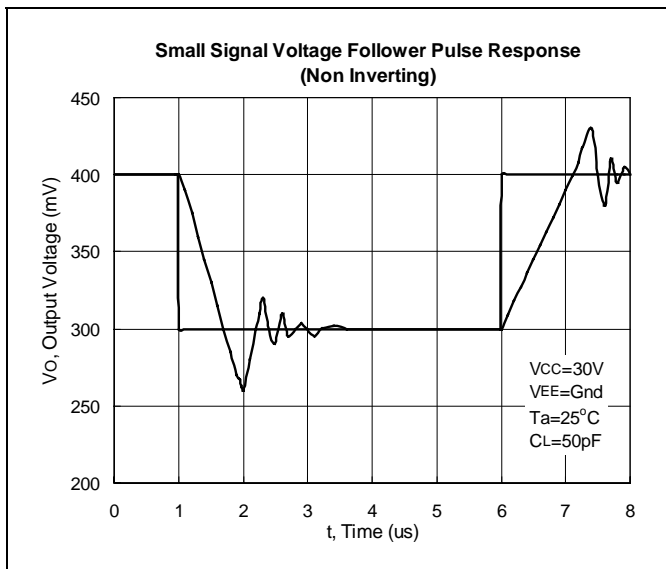
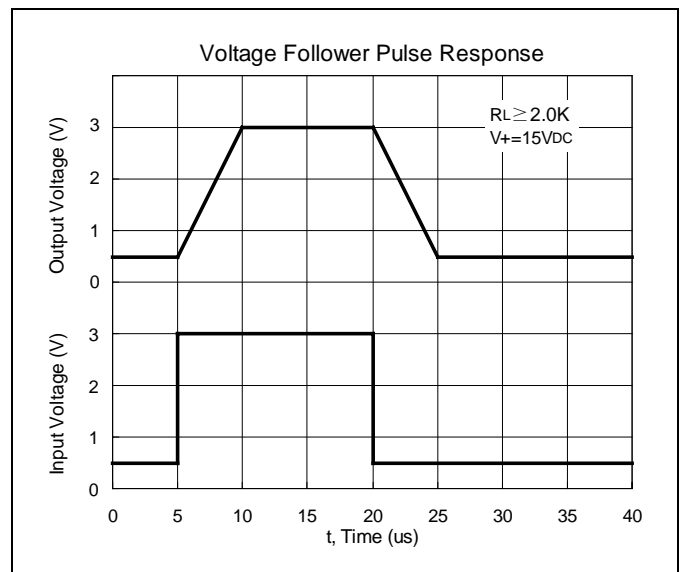
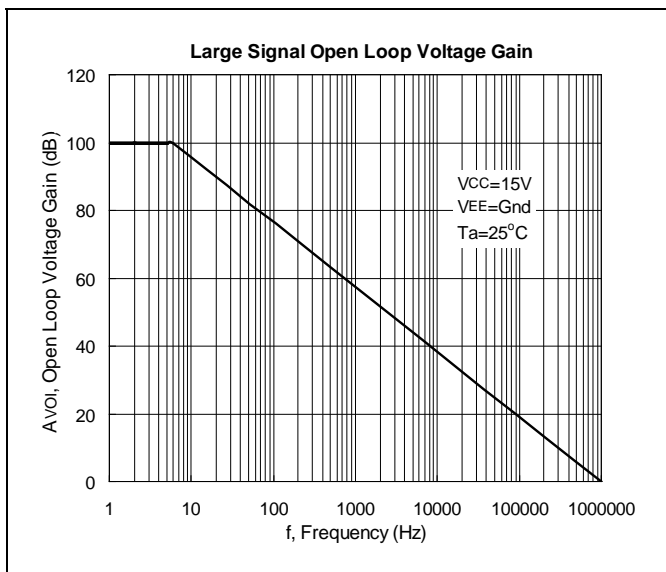
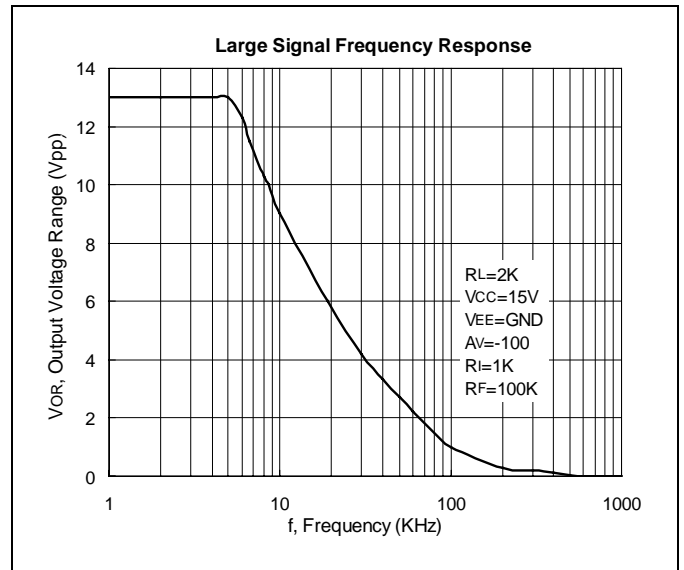
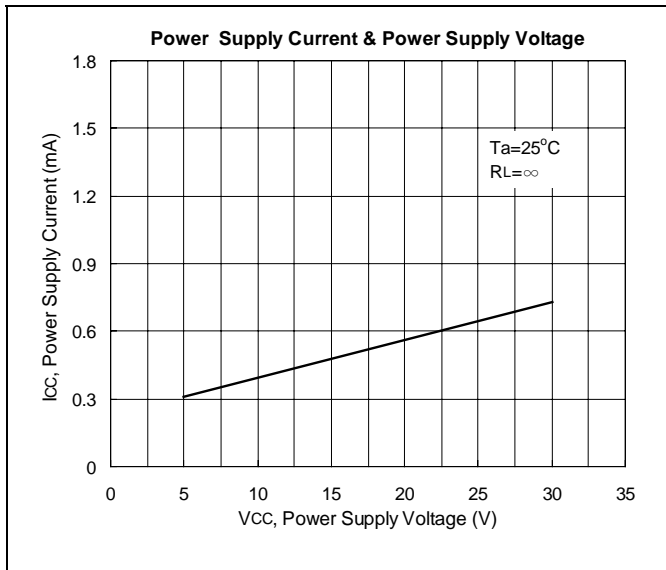
Symbol	Parameter	Range	Units
V <sub>CC</sub>	Power Supply Voltage (Single Supply)	32	V <sub>DC</sub>
V <sub>CC</sub> , V <sub>EE</sub>	Power Supply Voltage (Split Supplies)	±16	V <sub>DC</sub>
V <sub>IDR</sub>	Input Differential Voltage Range	±32	V <sub>DC</sub>
V <sub>ICR</sub>	Input Common Mode Voltage Range	-0.3 to +32	V <sub>DC</sub>
t <sub>SC</sub>	Output Short Circuit Duration	Continuous	
T <sub>J</sub>	Junction Temperature	150	°C
T <sub>stg</sub>	Storage Temperature Range	-55 to +125	°C
T <sub>A</sub>	Operating Ambient Temperature Range	0 to +70	°C
P <sub>D</sub>	Maximum Power Dissipation (DIP-8)	800	mW
	Maximum Power Dissipation (SO-8)	500	

### Electrical Characteristics (V<sub>CC</sub>=5V, V<sub>EE</sub>=Ground, Ta=25°C, unless otherwise specified)

Symbol	Parameter	Test Conditions	HLM358P/S			Unit
			Min	Typ	Max	
V <sub>IO</sub>	Input Offset Voltage	V <sub>CC</sub> =5V~30V, V <sub>ICR</sub> =0V~V <sub>CC</sub> -1.5V, V <sub>O</sub> =1.4V, R <sub>S</sub> =0Ω	-	2	7	mV
I <sub>IO</sub>	Input Offset Current	I <sub>IN(+)</sub> -I <sub>IN(-)</sub>	-	-	30	nA
I <sub>IB</sub>	Input Bias Current	I <sub>IN(+)</sub> or I <sub>IN(-)</sub>	-	35	200	nA
A <sub>VOL</sub>	Large Signal Voltage Gain	V <sub>CC</sub> =15V, R <sub>L</sub> =2KΩ	25	100	-	V/mV
CMR	Common-Mode Rejection Ratio	V <sub>CM</sub> =0V~V <sub>CC</sub> -1.5V	65	85	-	dB
CS	Channel Separation	1KHz≤f≤20KHz	-	-120	-	dB
PSR	Power Supply Rejection	V <sub>CC</sub> =5V~30V	65	100	-	dB
ΔV <sub>IO</sub> /ΔT	Average Temperature Coefficient of Input Offset Voltage	R <sub>S</sub> =0Ω	-	7	-	uV/°C
ΔI <sub>IO</sub> /ΔT	Average Temperature Coefficient of Input Offset Current	R <sub>S</sub> =0Ω	-	10	-	pA/°C
V <sub>ICR</sub>	Input Common Mode Voltage Range	V <sub>CC</sub> =30V			V <sub>CC</sub> -2V	V
V <sub>OH</sub>	Output Voltage (High Limit)	V <sub>CC</sub> =30V, R <sub>L</sub> =2KΩ	26	27	-	V
		V <sub>CC</sub> =30V, R <sub>L</sub> =10KΩ	27	28	-	
V <sub>OL</sub>	Output Voltage (Low Limit)	R <sub>L</sub> =10KΩ	-	5	20	mV
I <sub>CC</sub>	Supply current	R <sub>L</sub> =∞, V <sub>CC</sub> =30V	-	1	2	mA
I <sub>Source</sub>	Output Source Current	V <sub>CC</sub> =15V, V <sub>IN+</sub> =1V, V <sub>IN-</sub> =0V, V <sub>O</sub> =2V	20	40	-	mA
I <sub>Sink</sub>	Output Sink Current	V <sub>CC</sub> =15V, V <sub>IN+</sub> =0V, V <sub>IN-</sub> =1V, V <sub>O</sub> =2V	10	20	-	mA
I <sub>CC</sub>	Power Supply Current	V <sub>CC</sub> =30V, Ta=T <sub>high</sub> to T <sub>low</sub>	-	1	2	mA
		V <sub>CC</sub> =5V, Ta=T <sub>high</sub> to T <sub>low</sub>	-	0.6	1.2	mA
I <sub>SC</sub>	Output Short Circuit to Ground	V <sub>CC</sub> =5V, GND at -5V, V <sub>O</sub> =0V	-	40	60	mA

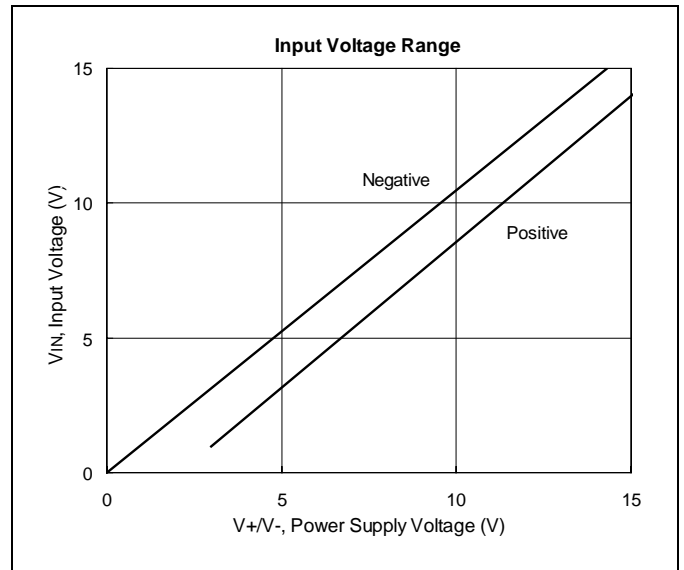
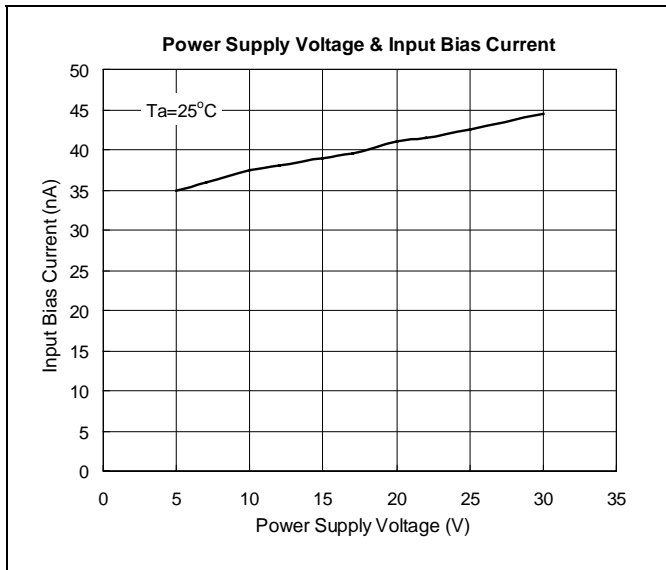


### Characteristics Curve

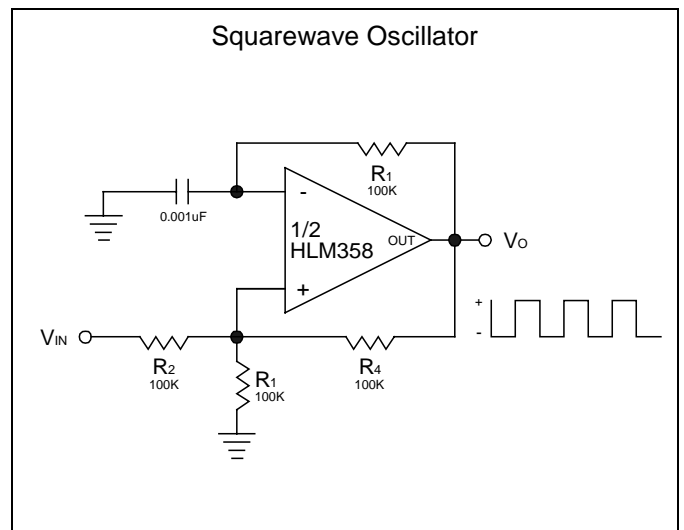
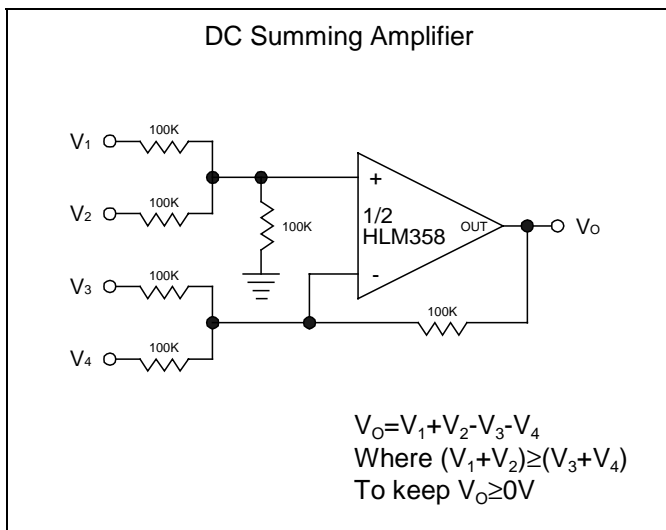
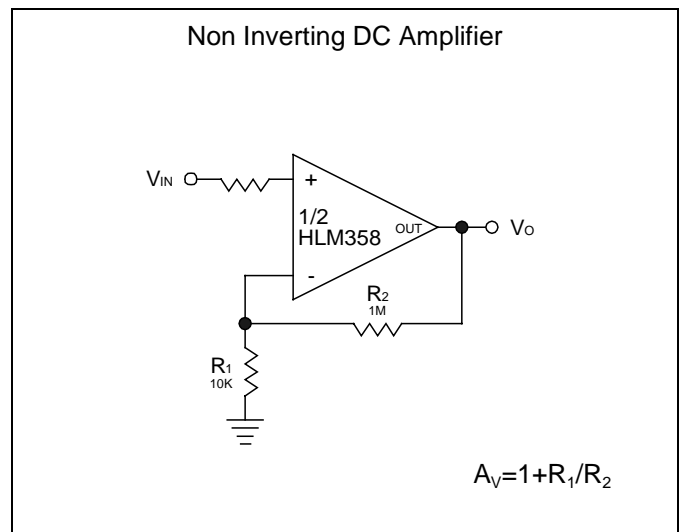
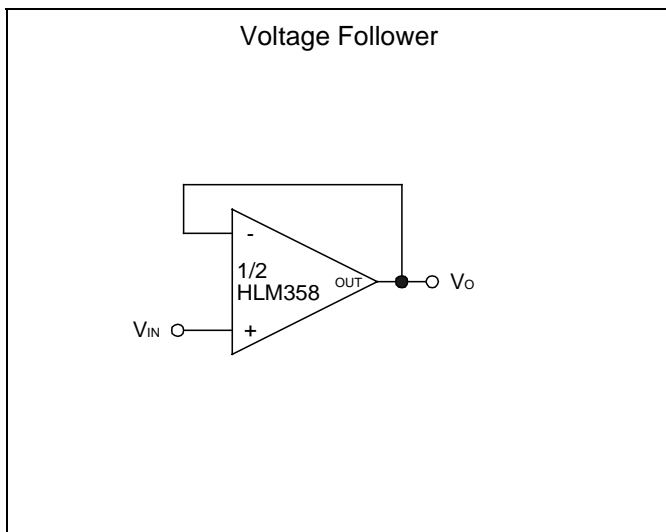




### Characteristics Curve

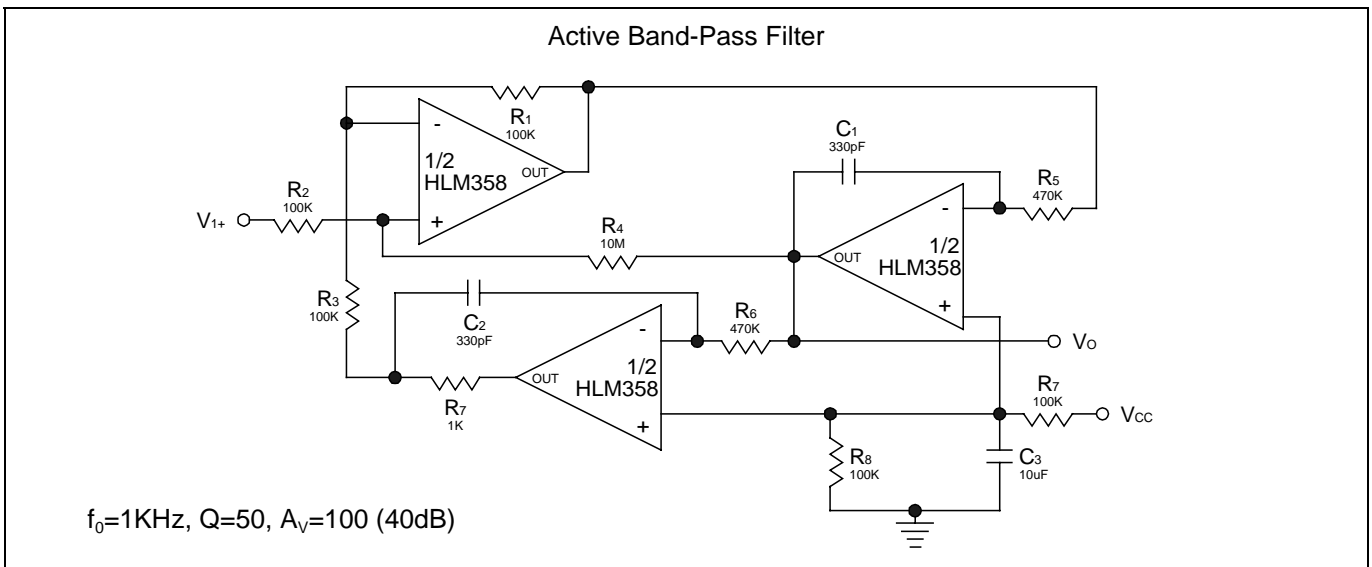
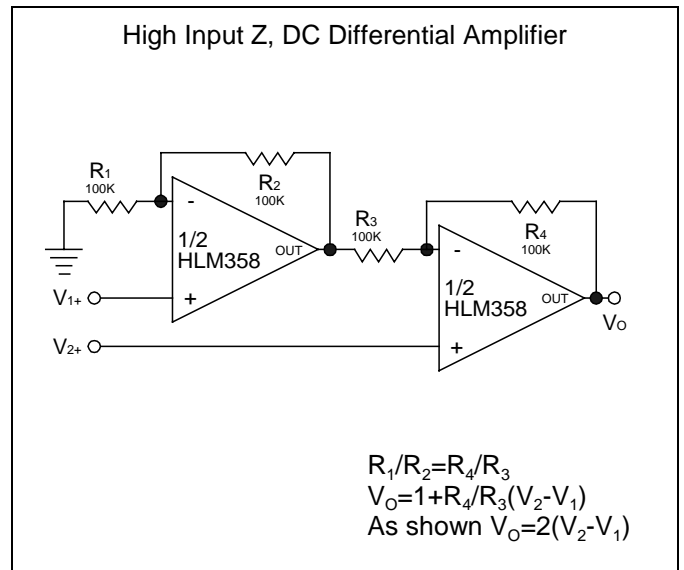
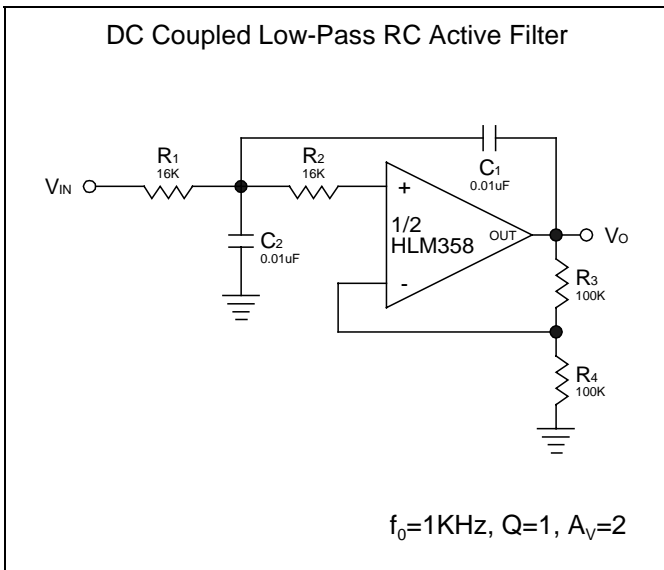
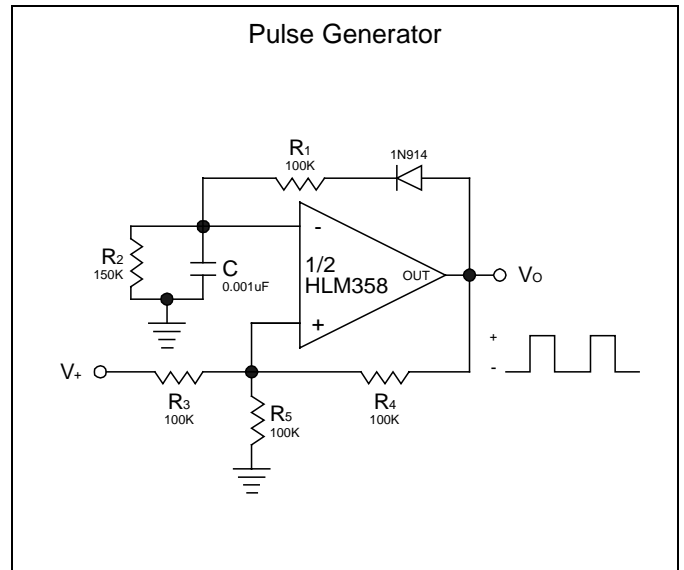
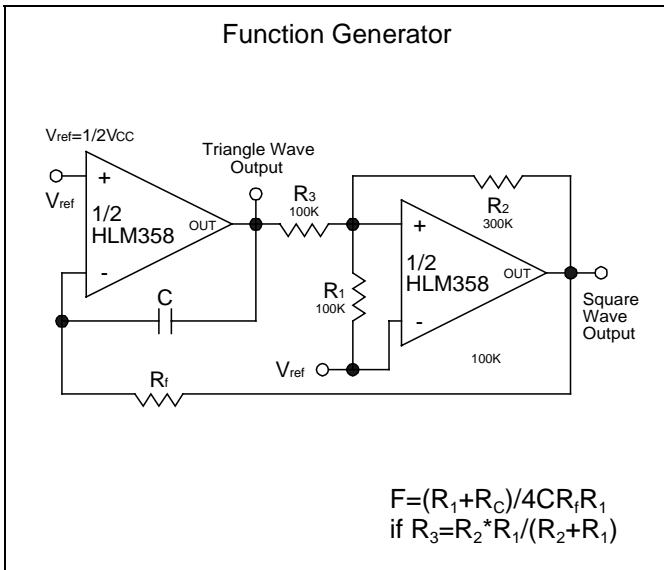


### Typical Application Circuit





### Typical Application Circuit





### DIP-8 Dimension

8-Lead DIP-8  
Plastic Package  
HSMC Package Code: P

**Marking:**

Pb Free Mark  
 Pb-Free: " " (Note)  
 Normal: None

Date Code      Control Code

Note: Green label is used for pb-free packing

Pin Style: 1. Output 1 2. Inverting input 1  
 3. Non inverting input 1 4. V<sub>EE</sub>  
 5. Non inverting input 2  
 6. Inverting input 2 7. Output 2 8. V<sub>CC</sub>

Material:  
 • Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)  
 • Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	6.29	6.40
B	9.22	9.32
C	-	*1.52
D	-	*1.27
E	-	*0.99
F	3.25	3.35
G	3.17	3.55
H	0.38	0.53
I	2.28	2.79
J	7.49	7.74
K	-	*3.00
L	8.56	8.81
M	0.229	0.381
α1	94°	97°

\*: Typical, Unit: mm

### SO-8 Dimension

8-Lead SO-8 Plastic  
Surface Mounted Package  
HSMC Package Code: S

**Marking:**

Pb Free Mark  
 Pb-Free: "●" (Note)  
 Normal: None

Pin 1 Index  
 Date Code      Control Code

Note: Green label is used for pb-free packing

Pin Style: 1. Output 1 2. Inverting input 1  
 3. Non inverting input 1 4. V<sub>EE</sub>  
 5. Non inverting input 2  
 6. Inverting input 2 7. Output 2 8. V<sub>CC</sub>

Material:  
 • Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)  
 • Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	4.85	5.10
B	3.85	3.95
C	5.80	6.20
D	1.22	1.32
E	0.37	0.47
F	3.74	3.88
G	1.45	1.65
H	4.80	5.10
I	0.05	0.20
J	0.30	0.70
K	0.19	0.25
L	0.37	0.52
M	0.23	0.28
N	0.08	0.13
O	0.00	0.15

\*: Typical, Unit: mm

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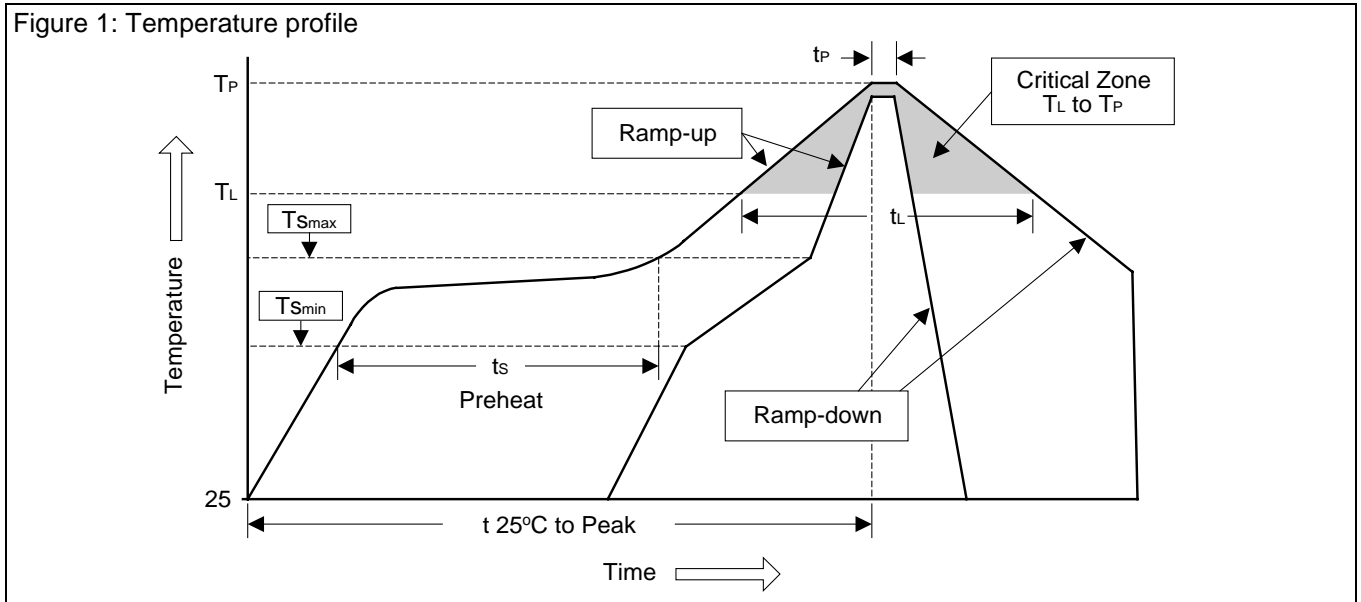
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## Soldering Methods for HSMC's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate ( $T_L$ to $T_P$ )	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min ( $T_{smin}$ )	100°C	150°C
- Temperature Max ( $T_{smax}$ )	150°C	200°C
- Time (min to max) ( $t_s$ )	60~120 sec	60~180 sec
$T_{smax}$ to $T_L$		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature ( $T_L$ )	183°C	217°C
- Time ( $t_L$ )	60~150 sec	60~150 sec
Peak Temperature ( $T_P$ )	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature ( $t_p$ )	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

### 3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec