



# Dual Operational Amplifier – LM358

Low power, Dual Operational Amplifier in bare die form

Rev 1.1  
21/01/18

## Description

The LM358 consists of x2 independent, high gain, internally frequency compensated operational amplifiers operating from a single power supply as low as 3V or as high as 32V. The device is useful in interface circuits with digital systems and can be operated from the single common 5V power supply. The device also finds use in transducer amplifiers, DC gain blocks & many other conventional op-amp circuits which benefit from the single power supply capability.  $I_Q$  per amplifier is about 1/5 of the industry 741. Split-supply operation is also possible with supply current drain independent of voltage supplied for low power. The die size is one of the smallest in the industry.

## Features:

- Temperature compensated bandwidth (unity gain)
- Temperature compensated  $I_B$ : 45nA
- Wide power supply range, single supply: 3V-32V or dual supplies:  $\pm 1.5V$  to  $\pm 16V$
- Low  $V_{OS}$ : 2mV, and  $I_{OS}$  : 5nA
- Differential input voltage range equal to the power supply voltage
- Large output voltage: 0V to  $V_{CC} - 1.5V$  swing
- Input Common-Mode Voltage range includes GND

## Ordering Information

The following part suffixes apply:

- No suffix - MIL-STD-883 /2010B Visual Inspection

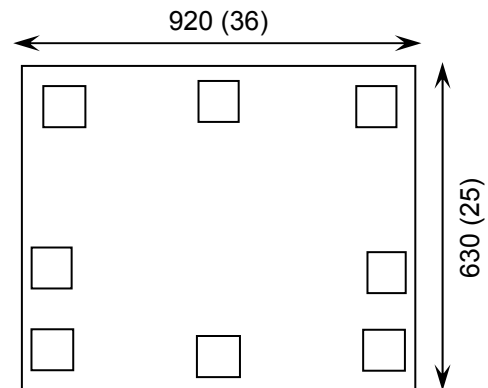
For a higher electrical grade version of this product please see

[LM358A](#)

For High Reliability versions of this product please see

[LM158](#) and [LM158A](#)

## Die Dimensions in $\mu m$ (mils)



## Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness  $\leftrightarrow$  350 $\mu m$ (15 Mils) – On request
- Assembled into Ceramic Package – On request

## Mechanical Specification

Die Size (Unsawn)	920 x 630 36 x 25	$\mu m$ mils
Minimum Bond Pad Size	85 x 85 3.35 x 3.35	$\mu m$ mils
Die Thickness	350 ( $\pm 20$ ) 13.78 ( $\pm 0.79$ )	$\mu m$ mils
Top Metal Composition	Al 1%Si 1.1 $\mu m$	
Back Metal Composition	N/A – Bare Si	

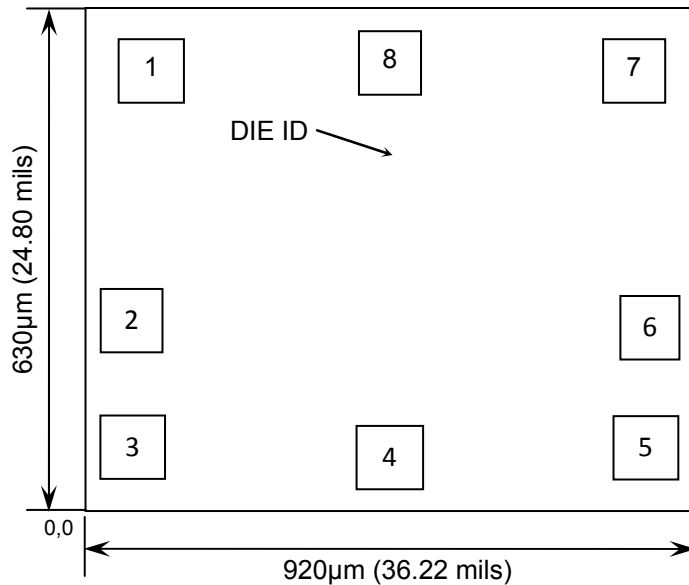




# Dual Operational Amplifier – LM358

Rev 1.1  
21/01/18

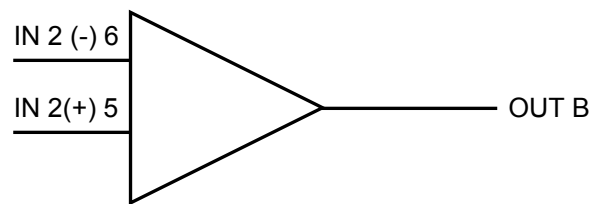
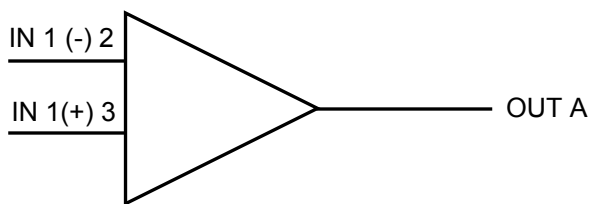
## Pad Layout and Functions



PAD	FUNCTION	COORDINATES (mm)	
		X	Y
1	OUTPUT A	0.1285	0.5015
2	- INPUT A	0.1125	0.2425
3	+ INPUT A	0.1125	0.1125
4	GND	0.4600	0.1075
5	+ INPUT B	0.8075	0.1125
6	- INPUT B	0.8075	0.2425
7	OUTPUT B	0.7915	0.5015
8	V <sub>CC</sub>	0.4600	0.5175

CHIP BACK POTENTIAL IS FLOAT

## Logic Diagram



PAD 8 = V<sub>CC</sub>

PAD 4 = GND





# Dual Operational Amplifier – LM358

Rev 1.1  
21/01/18

## Absolute Maximum Ratings<sup>1</sup>

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage – Single Supply	$V_{CC}$	32	V
Supply Voltage – Split Supply		±16	V
Input Differential Voltage Range	$V_{IDR}$	32	V
Input Common Mode Voltage Range	$V_{ICR}$	-0.3 to 32	V
Output Short Circuit to Ground	-	Continuous	-
Junction Temperature	$T_J$	150	°C
Input Current (per pin) <sup>2</sup>	$I_{IN}$	50	mA

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.
2.  $V_{IN} < -0.3V$ . This input current exists when voltage is driven negative at any of the input leads

## Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	MAX	UNITS
DC Supply Voltage	$V_{CC}$	±2.5 or 5	±15 or 30	V
Operating Temperature	$T_A$	0	+70	°C

## DC Electrical Characteristics ( $T_A = 0$ to $70^\circ\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Input Offset Voltage	$V_{IO}$	$V_O = 1.4V$ , $V_{CC} = 5V - 30V$ ; $R_S = 0\Omega$ , $V_{ICM} = 0V$ to $V_{CC} - 1.7V$	25°C	-	2	7	mV
			70°C	-	-	9	
Input Offset Voltage Drift	$\Delta V_{IO} / \Delta T$	$V_{CC} = 30V$ ; $R_S = 0\Omega$	-	7	-	$\mu V / ^\circ\text{C}$	
Input Offset Current	$I_{IO}$	$V_{CC} = 5V$	25°C	-	5	50	nA
			70°C	-	-	150	
Input Offset Current Drift	$\Delta I_{IO} / \Delta T$	$V_{CC} = 30V$ ; $R_S = 0\Omega$	-	10	-	$pA / ^\circ\text{C}$	
Input Bias Current	$I_{IB}$	$V_{CC} = 5V$	25°C	-	45	250	nA
			70°C	-	40	500	
Supply Current	$I_{CC}$	$R_L = \infty, V_{CC} = 5V, V_O = 0V$	-	0.5	1.2	mA	
		$R_L = \infty, V_{CC} = 30V, V_O = 0V$	-	1	2		
Common Mode Input Voltage range	$V_{ICR}$	$V_{CC} = 30V$	25°C	0	-	$V_{CC} - 1.5$	V
			70°C	0	-	$V_{CC} - 2$	
Differential Input Voltage range	$V_{IDR}$	All $V_{IN} \geq \text{GND}$ or $V_{CC}^-$ (if used)	-	-	$V_{CC}$	V	





# Dual Operational Amplifier – LM358

Rev 1.1  
21/01/18

## DC Electrical Characteristics continued ( $T_A = 0$ to $70^\circ\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Large-Signal Open-Loop Voltage Gain	$A_{VOL}$	$V_{CC} = 15\text{V}$ $R_L \geq 2\text{K}\Omega$	$25^\circ\text{C}$	25	100	-	V/mV
			$70^\circ\text{C}$	15	-	-	
Output High-Level Voltage swing	$V_{OH}$	$V_{CC} = 30\text{V}, R_L = 2\text{K}\Omega$	26	-	-	V	
		$V_{CC} = 30\text{V}, R_L = 10\text{K}\Omega$	27	28	-		
Output Low-Level Voltage swing	$V_{OL}$	$V_{CC} = 5\text{V}, R_L = 10\text{K}\Omega$	-	5	20	mV	
Common-Mode Rejection Ratio	CMRR	$V_{CC} = 30\text{V}, R_S = 10\text{K}\Omega,$ $T_A = 25^\circ\text{C}$	65	85	-	dB	
Power Supply Rejection Ratio	PSSR	$V_{CC} = 30\text{V},$ $T_A = 25^\circ\text{C}$	65	100	-	dB	
Crosstalk Attenuation	$V_{O1}/V_{O2}$	$f = 1\text{KHz to } 20\text{KHz}, V_{CC} = 30\text{V},$ $T_A = 25^\circ\text{C}$	-	-120	-	dB	
Output Short-Circuit current to GND	$I_{SC}$	$V_{CC} = 5\text{V}, V_O = 0\text{V}$ $T_A = 25^\circ\text{C}$	-	40	60	mA	
Output Source Current	$I_{SOURCE}$	$V_{IN+} = 1\text{V}, V_{IN-} = 0\text{V},$ $V_{CC} = 15\text{V}, V_O = 2\text{V}$	$25^\circ\text{C}$	20	40	-	mA
			$70^\circ\text{C}$	10	20	-	
Output Sink Current	$I_{SINK}$	$V_{IN+} = 0\text{V}, V_{IN-} = 1\text{V},$ $V_{CC} = 15\text{V}, V_O = 2\text{V},$	$25^\circ\text{C}$	10	20	-	mA
			$70^\circ\text{C}$	5	8	-	
		$V_{IN+} = 0\text{V}, V_{IN-} = 1\text{V},$ $V_{CC} = 15\text{V}, V_O = 0.2\text{V},$ $T_A = 25^\circ\text{C}$	12	50	-	$\mu\text{A}$	

## Typical Characteristics

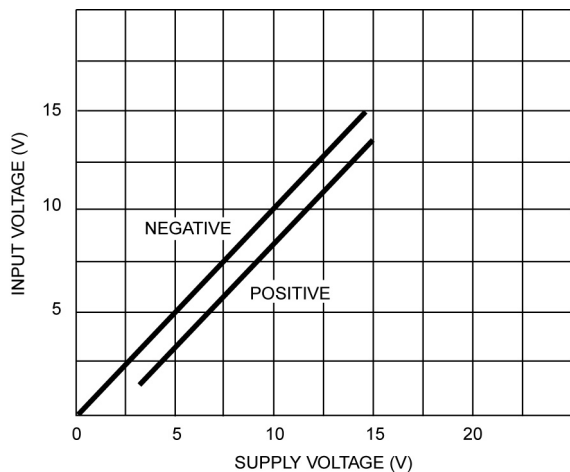


FIGURE 1. Input Voltage Range versus Supply Voltage

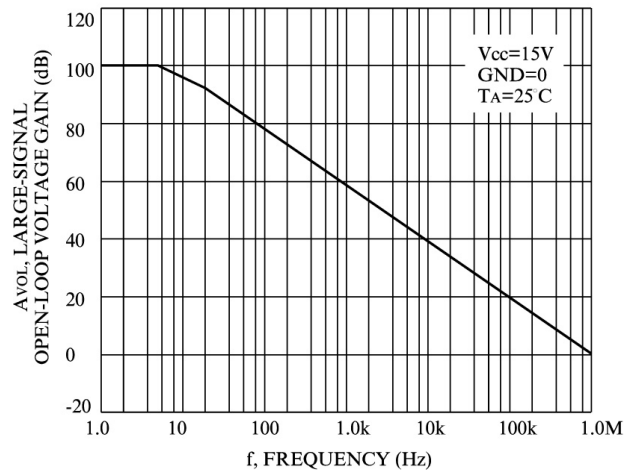


FIGURE 2. Open-Loop Frequency





# Dual Operational Amplifier – LM358

Rev 1.1  
21/01/18

## Typical Characteristics continued

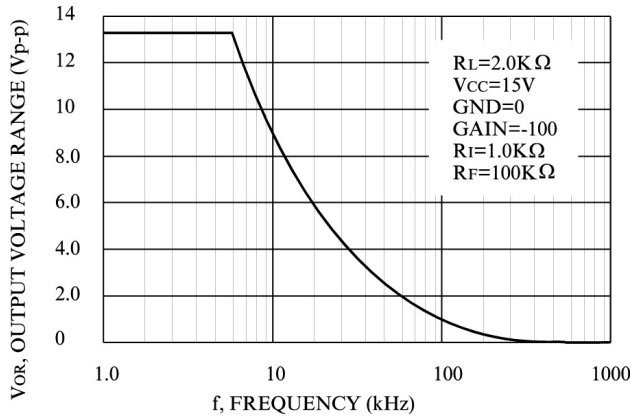


FIGURE 3. Large-Signal Frequency response

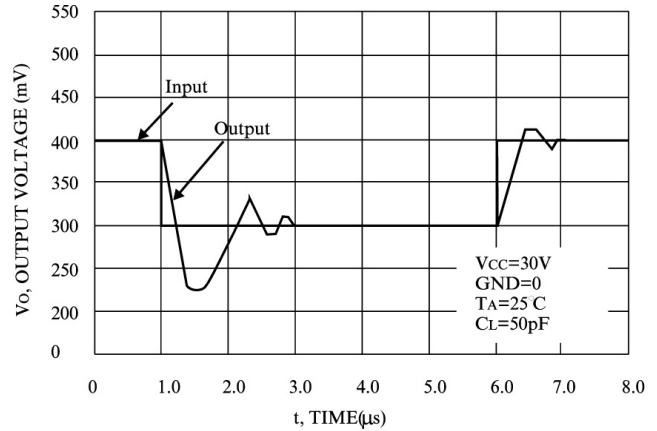


FIGURE 4. Small-Signal Voltage Follower Pulse Response (Non-inverting)

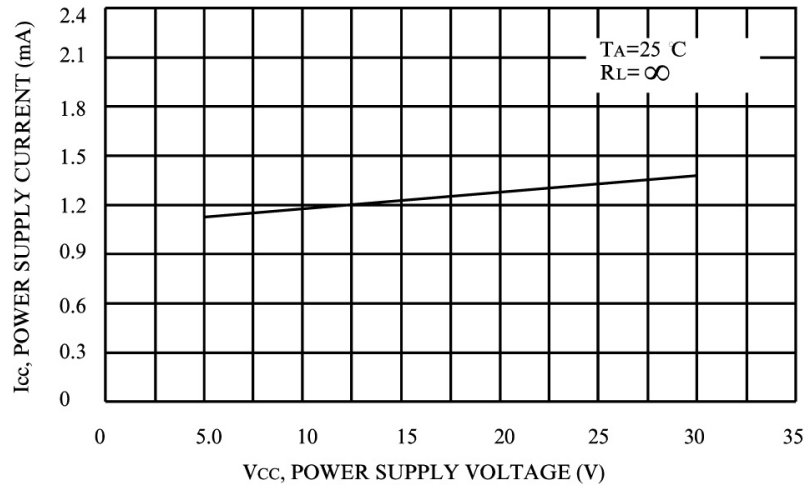


FIGURE 5. Power Supply Current versus Power Supply Voltage





# Dual Operational Amplifier – LM358

Rev 1.1  
21/01/18

## Typical Characteristics continued

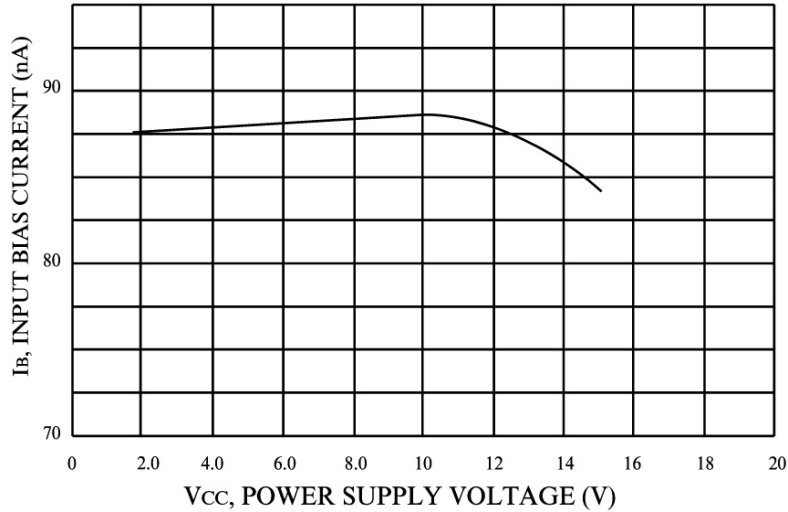


FIGURE 6. Low frequency Op-Amp with Offset adjust

**DISCLAIMER:** The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Silicon Supplies Ltd hereby disclaims any and all warranties and liabilities of any kind.

**LIFE SUPPORT POLICY:** Silicon Supplies Ltd components may be used in life support devices or systems only with the express written approval of Silicon Supplies Ltd, if a failure of such components can reasonably be expected to cause the failure of that life support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

