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LM2904,LM358/LM358A,LM258/ LM258A

Dual Operational Amplifier

Features

- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100dB
- Wide Power Supply Range:
  LM258/LM258A, LM358/LM358A: 3V~32V (or ±1.5V ~ 16V)
  LM2904 : 3V~26V (or ±1.5V ~ 13V)
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V DC to Vcc -1.5V DC
- Power Drain Suitable for Battery Operation.

Description

The LM2904,LM358/LM358A, LM258/LM258A consist of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltage. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. Application areas include transducer amplifier, DC gain blocks and all the conventional OP-AMP circuits which now can be easily implemented in single power supply systems.

8-DIP

1

8-SOP

1
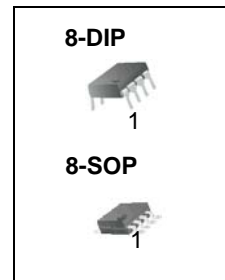
Internal Block Diagram

Rev. 1.0.3
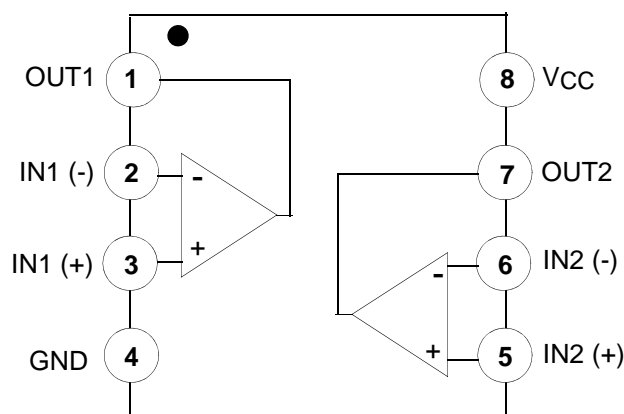
Schematic Diagram

(One section only)
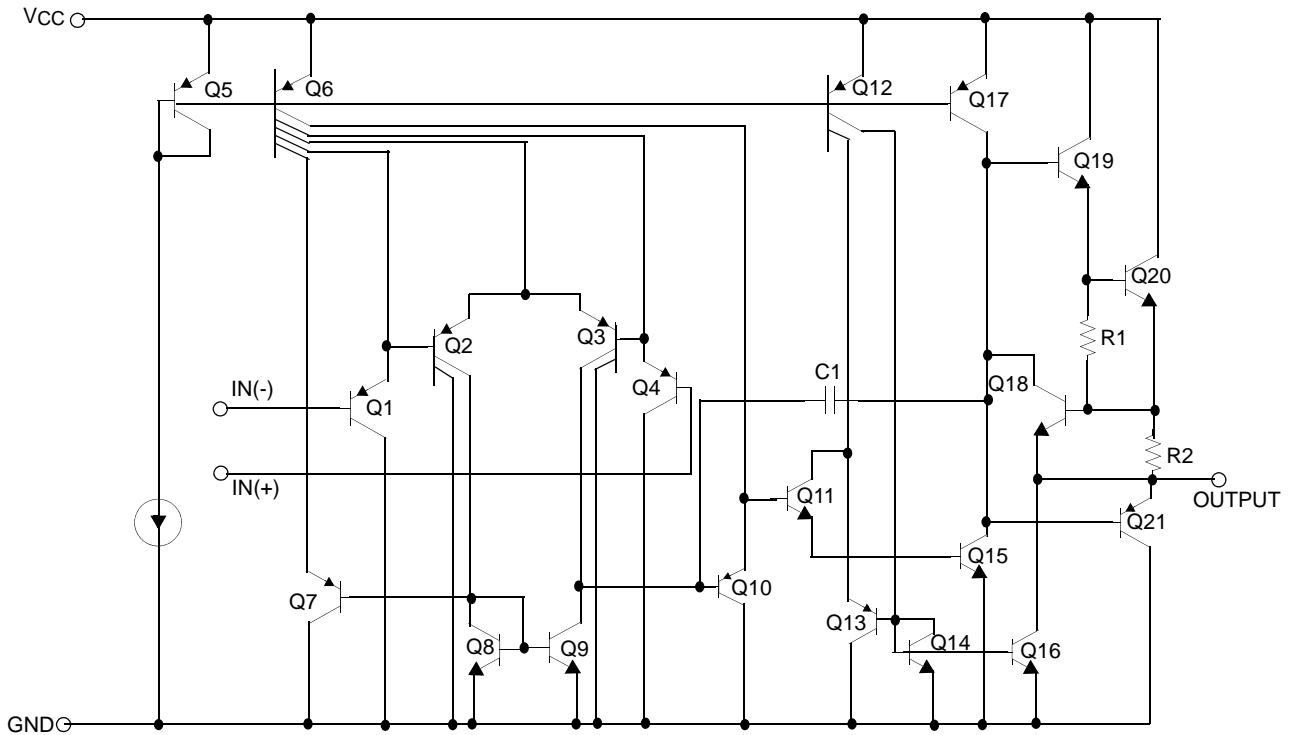
Absolute Maximum Ratings

Parameter	Symbol	LM258/LM258A	LM358/LM358A	LM2904	Unit
Supply Voltage	V_{CC}	±16 or 32	±16 or 32	±13 or 26	V
Differential Input Voltage	$V_{I(DIFF)}$	32	32	26	V
Input Voltage	V_I	-0.3 to +32	-0.3 to +32	-0.3 to +26	V
Output Short Circuit to GND $V_{CC} \leq 15V$, $T_A = 25°C$(One Amp)	-	Continuous	Continuous	Continuous	-
Operating Temperature Range	T_{OPR}	-25 ~ +85	0 ~ +70	-40 ~ +85	°C
Maximun Junction Temperature	$T_{J(MAX)}$	+150	+150	+150	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	-65 ~ +150	-65 ~ +150	°C

Electrical Characteristics

(V$_{CC}$ = 5.0V, V$_{EE}$ = GND, T$_A$ = 25°C, unless otherwise specified)

Parameter	Symbol	Conditions		LM258			LM358			LM2904			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	V$_{IO}$	V$_{CM}$ = 0V to V$_{CC}$ -1.5V V$_{O(P)}$ = 1.4V, R$_S$ = 0Ω		-	2.9	5.0	-	2.9	7.0	-	2.9	7.0	mV
Input Offset Current	I$_{IO}$	-		-	3	30	-	5	50	-	5	50	nA
Input Bias Current	I$_{BIAS}$	-		-	45	150	-	45	250	-	45	250	nA
Input Voltage Range	V$_{I(R)}$	V$_{CC}$ = 30V (LM2904, V$_{CC}$=26V)		0	-	V$_{CC}$ -1.5	0	-	V$_{CC}$ -1.5	0	-	V$_{CC}$ -1.5	V
Supply Current	I$_{CC}$	R$_L$ = ∞, V$_{CC}$ = 30V (LM2904, V$_{CC}$=26V)		-	0.8	2.0	-	0.8	2.0	-	0.8	2.0	mA
		R$_L$ = ∞, V$_{CC}$ = 5V		-	0.5	1.2	-	0.5	1.2	-	0.5	1.2	mA
Large Signal Voltage Gain	G$_V$	V$_{CC}$ = 15V, R$_L$= 2kΩ V$_{O(P)}$ = 1V to 11V		50	100	-	25	100	-	25	100	-	V/mV
Output Voltage Swing	V$_{O(H)}$	V$_{CC}$=30V (V$_{CC}$ =26V for LM2904)	R$_L$ = 2kΩ	26	-	-	26	-	-	22	-	-	V
			R$_L$= 10kΩ	27	28	-	27	28	-	23	24	-	V
	V$_{O(L)}$	V$_{CC}$ = 5V, R$_L$= 10kΩ		-	5	20	-	5	20		5	20	mV
Common-Mode Rejection Ratio	CMRR	-		70	85	-	65	80	-	50	80	-	dB
Power Supply Rejection Ratio	PSRR	-		65	100	-	65	100	-	50	100	-	dB
Channel Separation	CS	f = 1kHz to 20kHz (Note1)		-	120	-	-	120	-	-	120	-	dB
Short Circuit to GND	I$_{SC}$	-		-	40	60	-	40	60	-	40	60	mA
Output Current	I$_{SOURCE}$	V$_{I(+)}$ = 1V, V$_{I(-)}$ = 0V, V$_{CC}$ = 15V, V$_{O(P)}$ = 2V		20	30	-	20	30	-	20	30	-	mA
	I$_{SINK}$	V$_{I(+)}$ = 0V, V$_{I(-)}$ = 1V, V$_{CC}$ = 15V, V$_{O(P)}$ = 2V		10	15	-	10	15	-	10	15	-	mA
		V$_{I(+)}$ = 0V,V$_{I(-)}$ =1V , V$_{CC}$ = 15V, V$_{O(P)}$ = 200mV		12	100	-	12	100	-	-	-	-	μA
Differential Input Voltage	V$_{I(DIFF)}$	-		-	-	V$_{CC}$	-	-	V$_{CC}$	-	-	V$_{CC}$	V

Note:

1. This parameter, although guaranteed, is not 100% tested in production.

Electrical Characteristics (Continued)

(V$_{CC}$= 5.0V, V$_{EE}$ = GND, unless otherwise specified)
The following specification apply over the range of -25°C $\leq$ T$_A$ $\leq$ +85°C for the LM258; and the 0°C $\leq$ T$_A$ $\leq$ +70°C for the LM358; and the -40°C $\leq$ T$_A$ $\leq$ +85°C for the LM2904

Parameter	Symbol	Conditions		LM258			LM358			LM2904			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	V$_{IO}$	V$_{CM}$ = 0V to V$_{CC}$ -1.5V V$_{O(P)}$ = 1.4V, R$_S$ = 0Ω		-	-	7.0	-	-	9.0	-	-	10.0	mV
Input Offset Voltage Drift	ΔV$_{IO}$/ΔT	R$_S$ = 0Ω		-	7.0	-	-	7.0	-	-	7.0	-	μV/°C
Input Offset Current	I$_{IO}$	-		-	-	100	-	-	150	-	45	200	nA
Input Offset Current Drift	ΔI$_{IO}$/ΔT	-		-	10	-	-	10	-	-	10	-	pA/°C
Input Bias Current	I$_{BIAS}$	-		-	40	300	-	40	500	-	40	500	nA
Input Voltage Range	V$_{I(R)}$	V$_{CC}$ = 30V (LM2904 , V$_{CC}$ = 26V)		0	-	V$_{CC}$ -2.0	0	-	V$_{CC}$ -2.0	0	-	V$_{CC}$ -2.0	V
Large Signal Voltage Gain	G$_V$	V$_{CC}$ = 15V, R$_L$ =2.0kΩ V$_{O(P)}$ = 1V to 11V		25	-	-	15	-	-	15	-	-	V/mV
Output Voltage Swing	V$_{O(H)}$	V$_{CC}$=30V (V$_{CC}$ = 26V for LM2904)	R$_L$ = 2kΩ	26	-	-	26	-	-	22	-	-	V
			R$_L$=10kΩ	27	28	-	27	28	-	23	24	-	V
	V$_{O(L)}$	V$_{CC}$ = 5V, R$_L$=10kΩ		-	5	20	-	5	20	-	5	20	mV
Output Current	I$_{SOURCE}$	V$_{I(+)}$ = 1V, V$_{I(-)}$ = 0V, V$_{CC}$ = 15V, V$_{O(P)}$ = 2V		10	30	-	10	30	-	10	30	-	mA
	I$_{SINK}$	V$_{I(+)}$ = 0V, V$_{I(-)}$ = 1V, V$_{CC}$ = 15V, V$_{O(P)}$ = 2V		5	8	-	5	9	-	5	9	-	mA
Differential Input Voltage	V$_{I(DIFF)}$	-		-	-	V$_{CC}$	-	-	V$_{CC}$	-	-	V$_{CC}$	V

Electrical Characteristics (Continued)

(V_{CC} = 5.0V, V_{EE} = GND, T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Conditions		LM258A			LM358A			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	V_{IO}	V_{CM} = 0V to V_{CC} -1.5V $V_{O(P)}$ = 1.4V, R_S = 0Ω		-	1.0	3.0	-	2.0	3.0	mV
Input Offset Current	I_{IO}	-		-	2	15	-	5	30	nA
Input Bias Current	I_{BIAS}	-		-	40	80	-	45	100	nA
Input Voltage Range	$V_{I(R)}$	V_{CC} = 30V		0	-	V_{CC} -1.5	0	-	V_{CC} -1.5	V
Supply Current	I_{CC}	R_L = ∞, V_{CC} = 30V		-	0.8	2.0	-	0.8	2.0	mA
		R_L = ∞, V_{CC} = 5V		-	0.5	1.2	-	0.5	1.2	mA
Large Signal Voltage Gain	G_V	V_{CC} = 15V, R_L = 2kΩ V_O = 1V to 11V		50	100	-	25	100	-	V/mV
Output Voltage Swing	V_{OH}	V_{CC} = 30V	R_L = 2kΩ	26	-	-	26		-	V
			R_L = 10kΩ	27	28	-	27	28	-	V
	$V_{O(L)}$	V_{CC} = 5V, R_L = 10kΩ		-	5	20	-	5	20	mV
Common-Mode Rejection Ratio	CMRR	-		70	85	-	65	85	-	dB
Power Supply Rejection Ratio	PSRR	-		65	100	-	65	100	-	dB
Channel Separation	CS	f = 1kHz to 20kHz (Note1)		-	120	-	-	120	-	dB
Short Circuit to GND	I_{SC}	-		-	40	60	-	40	60	mA
Output Current	I_{SOURCE}	$V_{I(+)}$ = 1V, $V_{I(-)}$ = 0V V_{CC} = 15V, $V_{O(P)}$ = 2V		20	30	-	20	30	-	mA
	I_{SINK}	$V_{I(+)}$ = 1V, $V_{I(-)}$ = 0V V_{CC} = 15V, $V_{O(P)}$ = 2V		10	15	-	10	15	-	mA
		$V_{in +}$ = 0V, $V_{in (-)}$ = 1V $V_{O(P)}$ = 200mV		12	100	-	12	100	-	μA
Differential Input Voltage	$V_{I(DIFF)}$	-		-	-	V_{CC}	-	-	V_{CC}	V

Note:

1. This parameter, although guaranteed, is not 100% tested in production.

Electrical Characteristics (Continued)

(V$_{CC}$ = 5.0V, V$_{EE}$ = GND, unless otherwise specified)

The following specification apply over the range of -25°C $\leq$ T$_A$ $\leq$ +85°C for the LM258A; and the 0°C $\leq$ T$_A$ $\leq$ +70°C for the LM358A

Parameter	Symbol	Conditions		LM258A			LM358A			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	V$_{IO}$	V$_{CM}$ = 0V to V$_{CC}$ -1.5V V$_{O(P)}$ = 1.4V, R$_S$ = 0Ω		-	-	4.0	-	-	5.0	mV
Input Offset Voltage Drift	ΔV$_{IO}$/ΔT	-		-	7.0	15	-	7.0	20	μV/°C
Input Offset Current	I$_{IO}$	-		-	-	30	-	-	75	nA
Input Offset Current Drift	ΔI$_{IO}$/ΔT	-		-	10	200	-	10	300	pA/°C
Input Bias Current	I$_{BIAS}$	-		-	40	100	-	40	200	nA
Input Common-Mode Voltage Range	V$_{I(R)}$	V$_{CC}$ = 30V		0	-	Vcc -2.0	0	-	Vcc -2.0	V
Output Voltage Swing	V$_{O(H)}$	V$_{CC}$ = 30V	R$_L$ = 2kΩ	26	-	-	26	-	-	V
			R$_L$ = 10kΩ	27	28	-	27	28	-	V
	V$_{O(L)}$	V$_{CC}$ = 5V, R$_L$=10kΩ		-	5	20	-	5	20	mV
Large Signal Voltage Gain	G$_V$	V$_{CC}$ = 15V, R$_L$=2.0kΩ V$_{O(P)}$ = 1V to 11V		25	-	-	15	-	-	V/mV
Output Current	I$_{SOURCE}$	V$_{I(+)}$ = 1V, V$_{I(-)}$ = 0V V$_{CC}$ = 15V, V$_{O(P)}$ = 2V		10	30	-	10	30	-	mA
	I$_{SINK}$	V$_{I(+)}$ = 1V, V$_{I(-)}$ = 0V V$_{CC}$ = 15V, V$_{O(P)}$ = 2V		5	9	-	5	9	-	mA
Differential Input Voltage	V$_{I(DIFF)}$	-		-	-	Vcc	-	-	Vcc	V

Typical Performance Characteristics
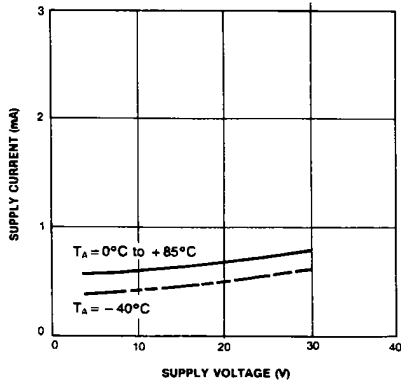
Figure 1. Supply Current vs Supply Voltage
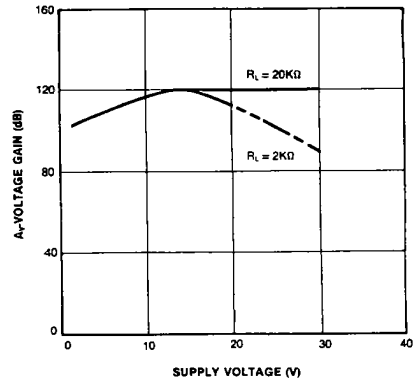
Figure 2. Voltage Gain vs Supply Voltage
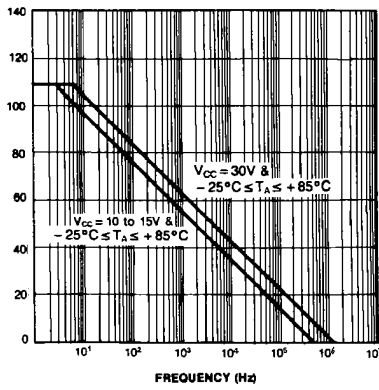
Figure 3. Open Loop Frequency Response
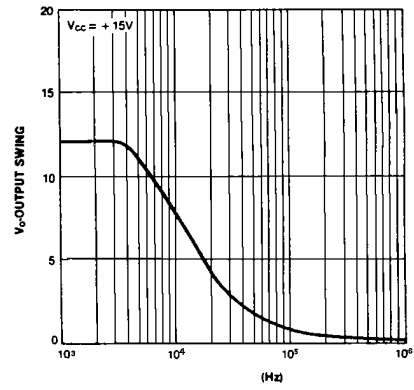
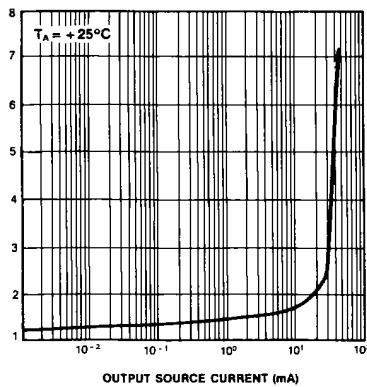Figure 4. Large Signal Output Swing vs Frequency

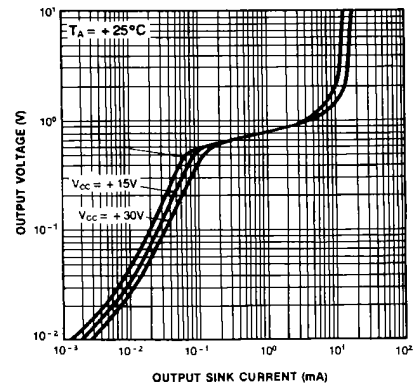Figure 5. Output Characteristics vs Current Sourcing

Figure 6. Output Characteristics vs Current Sinking
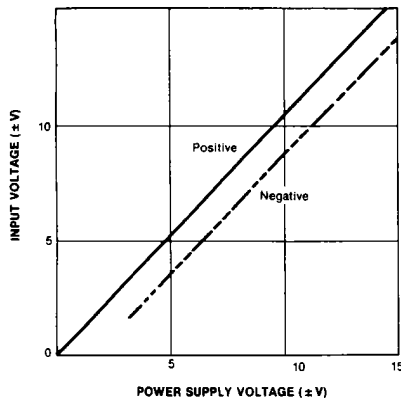
Typical Performance Characteristics (Continued)

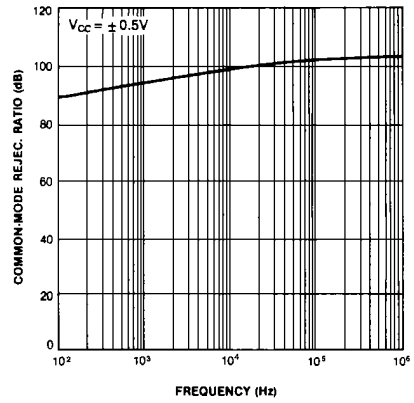**Figure 7. Input Voltage Range vs Supply Voltage**
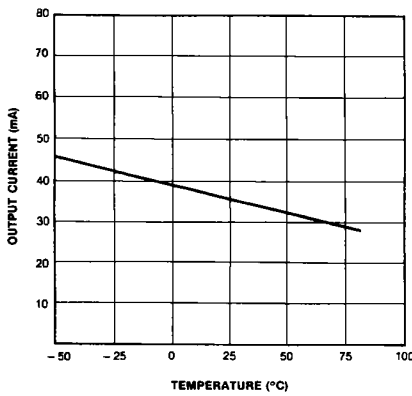

Figure 8. Common-Mode Rejection Ratio

Figure 9. Output Current vs Temperature (Current Limiting)
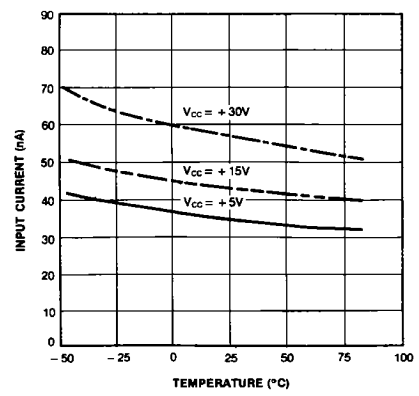
Figure 10. Input Current vs Temperature
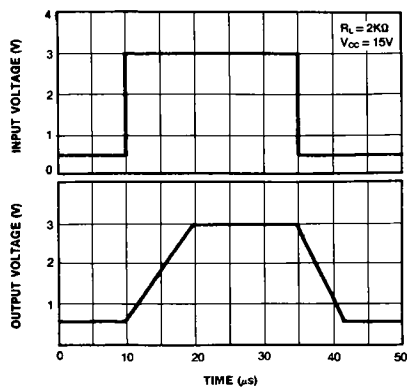
Figure 11. Voltage Follower Pulse Response
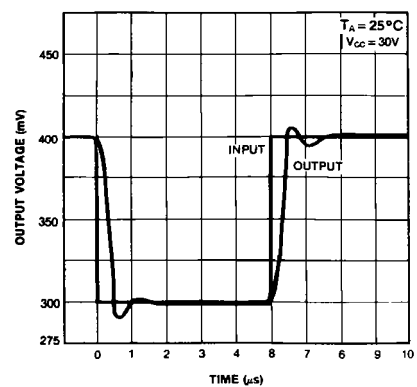
Figure 12. Voltage Follower Pulse Response (Small Signal)

Mechanical Dimensions

Package

Dimensions in millimeters

8-DIP

$\dfrac{6.40 \pm 0.20}{0.252 \pm 0.008}$

#1   #8

#4   #5

$\dfrac{9.60}{0.378}$ MAX

$\dfrac{9.20 \pm 0.20}{0.362 \pm 0.008}$

$\left(\dfrac{0.79}{0.031}\right)$

$\dfrac{0.46 \pm 0.10}{0.018 \pm 0.004}$

$\dfrac{1.524 \pm 0.10}{0.060 \pm 0.004}$

$\boxed{\dfrac{2.54}{0.100}}$

$\dfrac{3.30 \pm 0.30}{0.130 \pm 0.012}$

$\dfrac{5.08}{0.200}$ MAX

$\dfrac{3.40 \pm 0.20}{0.134 \pm 0.008}$

$\dfrac{0.33}{0.013}$ MIN

$\boxed{\dfrac{7.62}{0.300}}$

$0.25 \begin{smallmatrix} +0.10 \\ -0.05 \end{smallmatrix}$

$0.010 \begin{smallmatrix} +0.004 \\ -0.002 \end{smallmatrix}$

0~15°
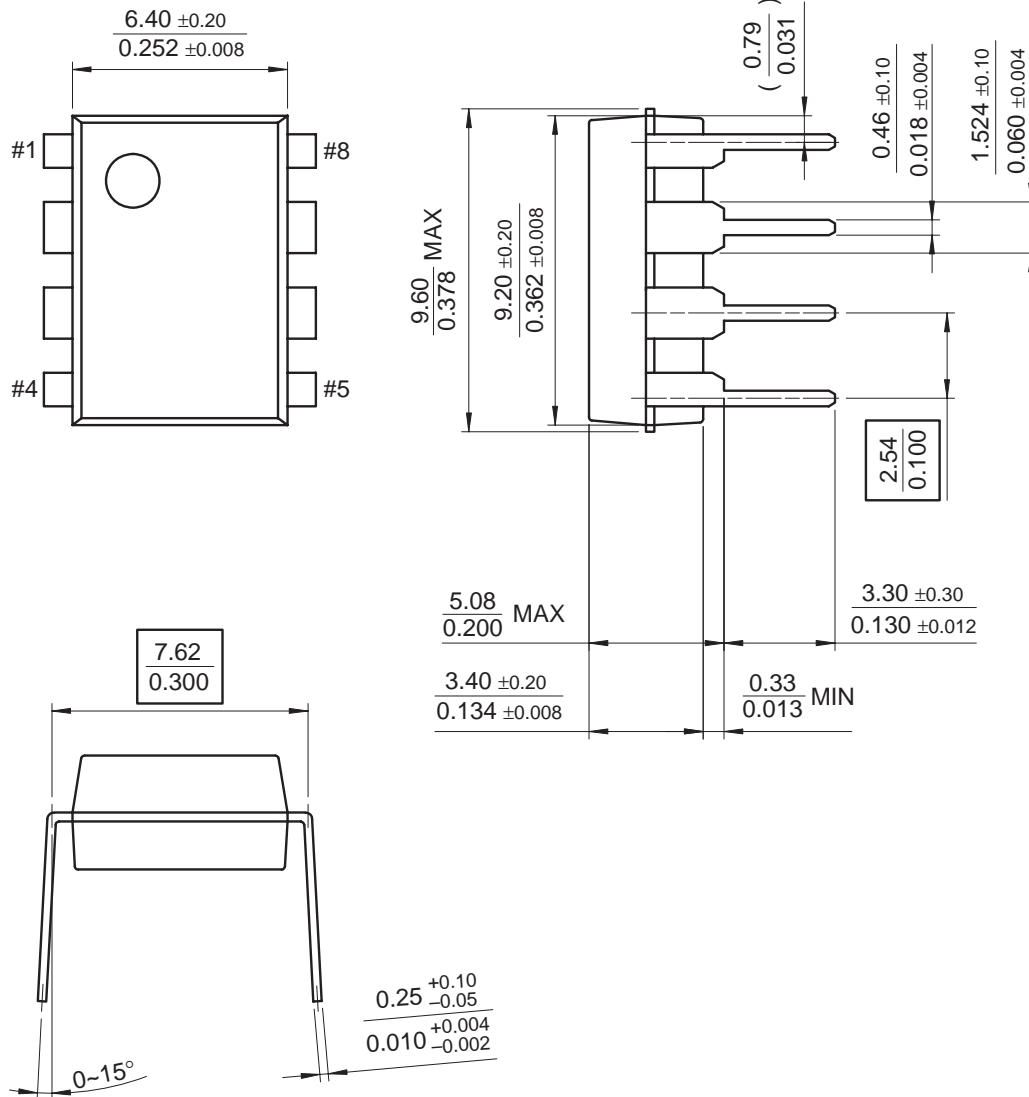
Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

8-SOP

MIN $\dfrac{0.1\sim0.25}{0.004\sim0.001}$

$\dfrac{1.55 \pm 0.20}{0.061 \pm 0.008}$

$\left(\dfrac{0.56}{0.022}\right)$

#1 #8

#4 #5

$\dfrac{5.13}{0.202}$ MAX

$\dfrac{4.92 \pm 0.20}{0.194 \pm 0.008}$

$\dfrac{0.41 \pm 0.10}{0.016 \pm 0.004}$

$\dfrac{6.00 \pm 0.30}{0.236 \pm 0.012}$

$\dfrac{1.80}{0.071}$ MAX

$\dfrac{1.27}{0.050}$

$\dfrac{MAX0.10}{MAX0.004}$

$\dfrac{0.15 \ {}^{+0.10}_{-0.05}}{0.006 \ {}^{+0.004}_{-0.002}}$

$\dfrac{3.95 \pm 0.20}{0.156 \pm 0.008}$

$\dfrac{5.72}{0.225}$

0~8°

$\dfrac{0.50 \pm 0.20}{0.020 \pm 0.008}$
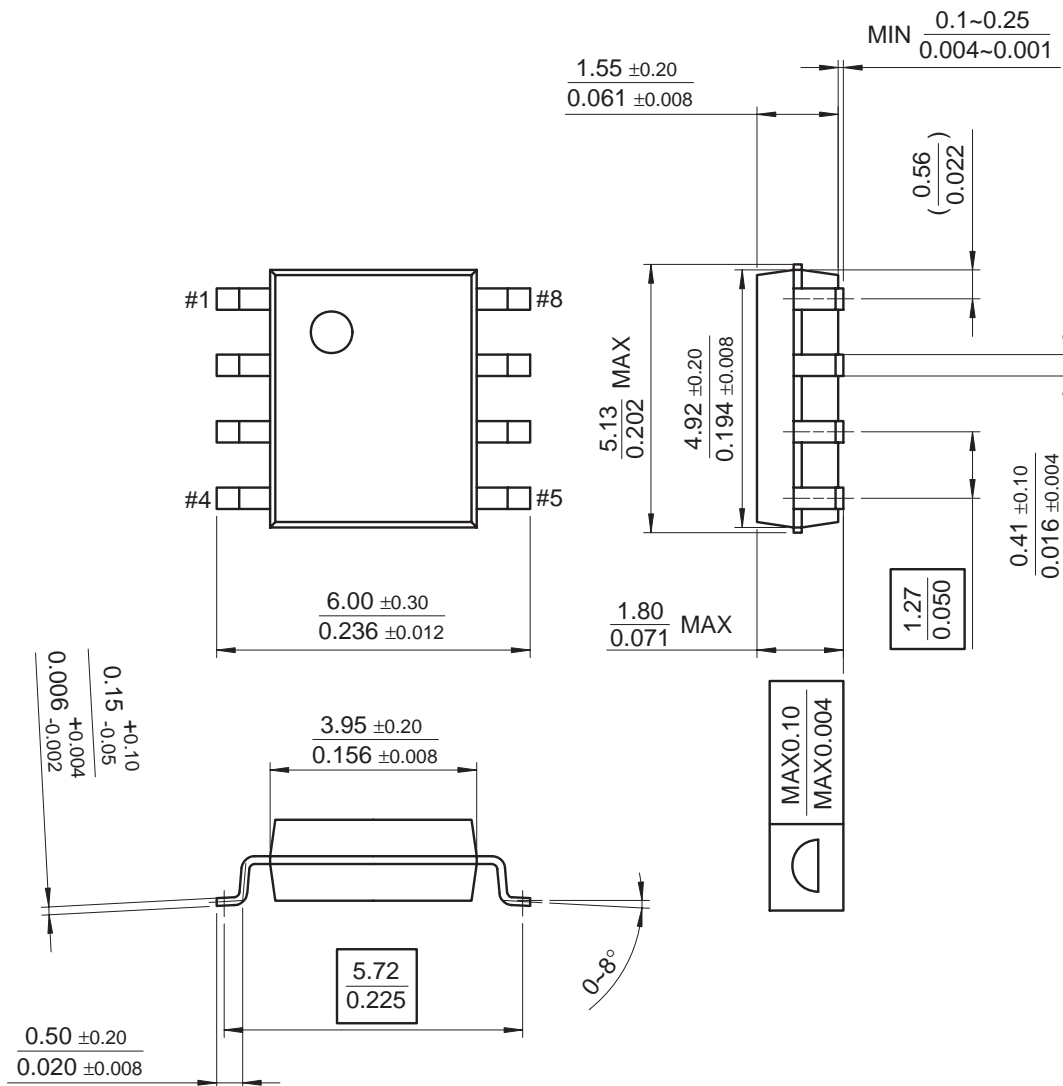
Ordering Information

Product Number	Package	Operating Temperature
LM358N	8-DIP	0 ~ +70°C
LM358AN		
LM358M	8-SOP	
LM358AM		
LM2904N	8-DIP	-40 ~ +85°C
LM2904M	8-SOP	
LM258N	8-DIP	-25 ~ +85°C
LM258AN		
LM258M	8-SOP	
LM258AM		

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