KA258/KA258A, KA358/KA358A, KA2904

Dual Operational Amplifier

Features

- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100dB
- Wide Power Supply Range:
  KA258/KA258A, KA358/KA358A: 3V ~ 32V (or ±1.5V~ 16V)
  KA2904 : 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 KA258 series 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.
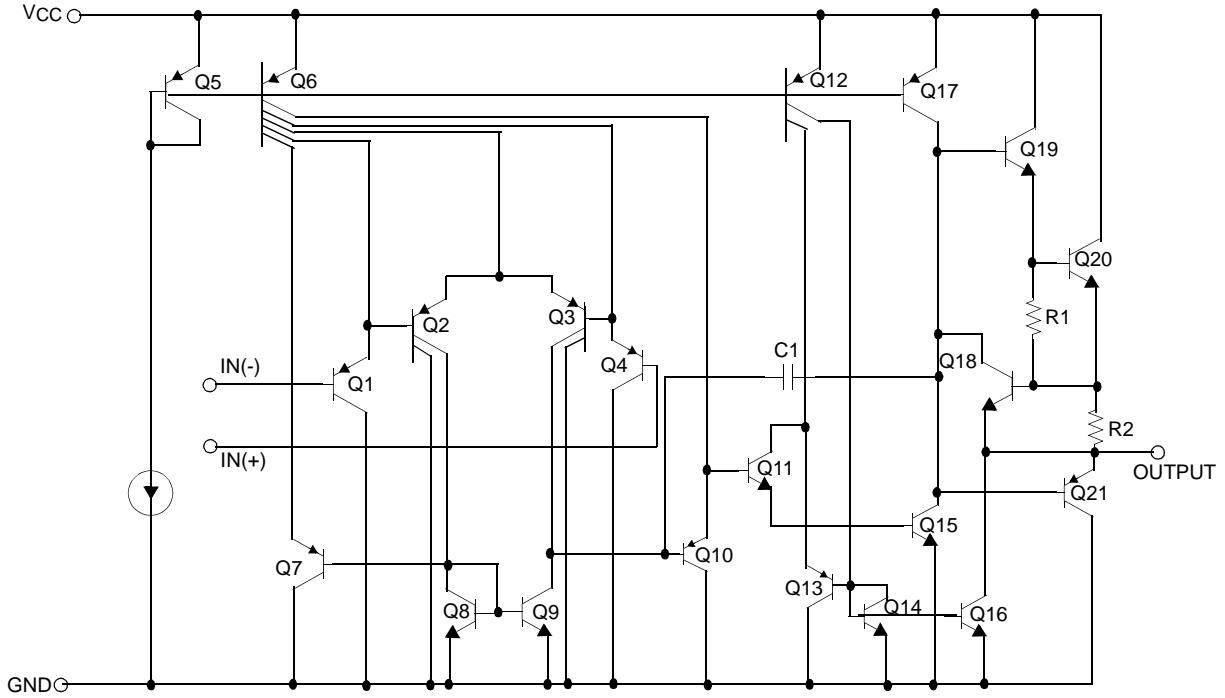
8-DIP

8-SOP

9-SIP
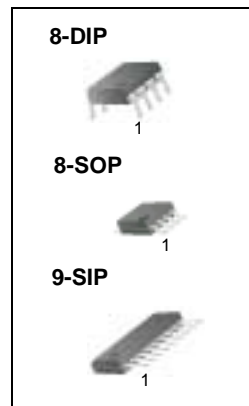
Internal Block Diagram
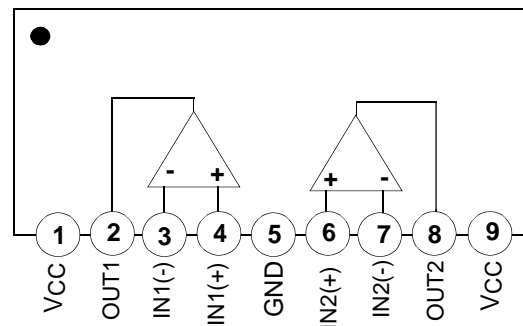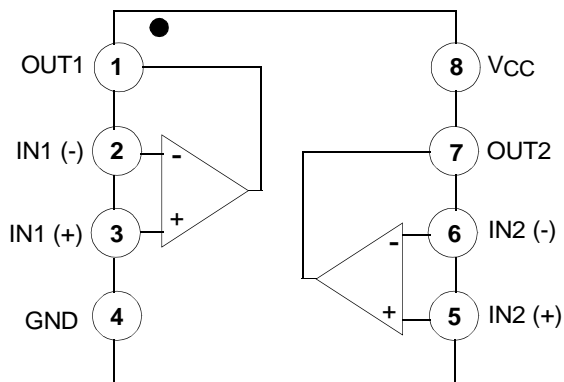
Schematic Diagram

(One section only)

Absolute Maximum Ratings

Parameter	Symbol	KA258/KA258A	KA358/KA358A	KA2904	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
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		KA258			KA358			KA2904			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 (KA2904, 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 (KA2904, 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 KA2904)	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 ≤ T$_A$ ≤ +85°C for the KA258; and the 0 °C ≤ T$_A$ ≤ +70°C for the KA358; and the -40°C ≤ T$_A$ ≤ +85°C for the KA2904

Parameter	Symbol	Conditions		KA258			KA358			KA2904			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 (KA2904,V$_{CC}$ = 26V)		0	-	Vcc -2.0	0	-	Vcc -2.0	0	-	Vcc -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 KA2904)	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$_{I(DIFF)}$	-		-	-	Vcc	-	-	Vcc	-	-	Vcc	V

Electrical Characteristics (Continued)

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

Parameter	Symbol	Conditions		KA258A			KA358A			Unit
				Min.	Typ.	Max.	Mln.	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 ≤ T$_A$ ≤ +85°C for the KA258A; and the 0°C ≤ T$_A$ ≤ +70°C for the KA358A

Parameter	Symbol	Conditions		KA258A			KA358A			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$_{I(DIFF)}$	-		-	-	V$_{CC}$	-	-	V$_{CC}$	V

Typical Performance Characteristics
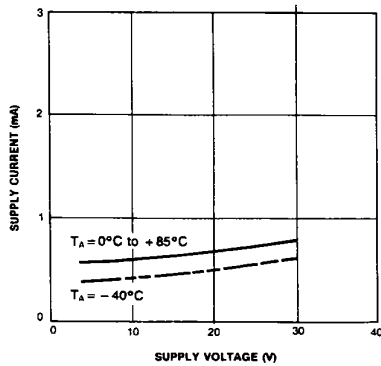
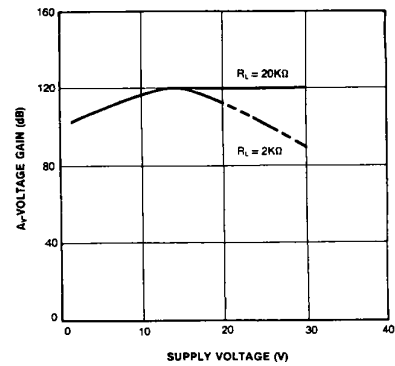Figure 1. Supply Current vs Supply Voltage

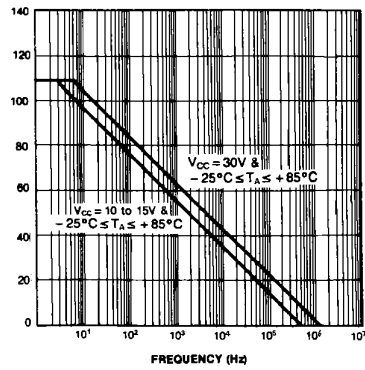Figure 2. Voltage Gain vs Supply Voltage

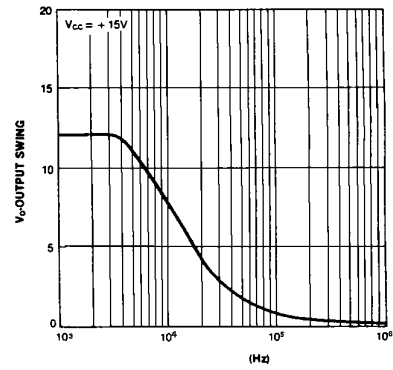Figure 3. Open Loop Frequency Response

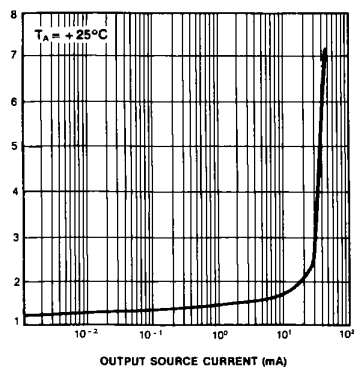Figure 4. Large Signal Output Swing vs Frequency

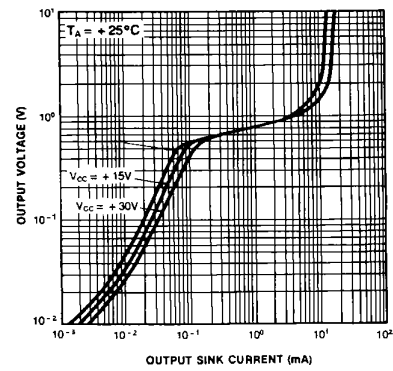Figure 5. Output Characteristics vs Current Sourcing

Figure 6. Output Characteristics vs Current Sinking

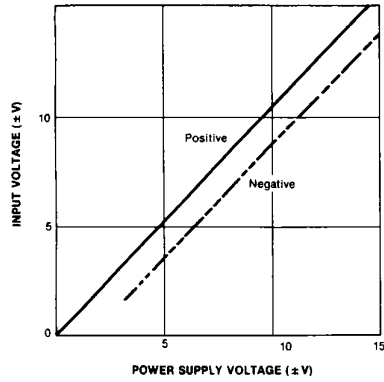# Typical Performance Characteristics (Continued)

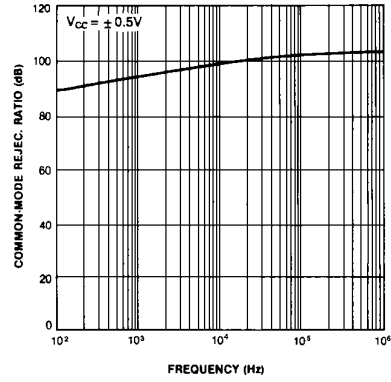Figure 7. Input Voltage Range vs Supply Voltage
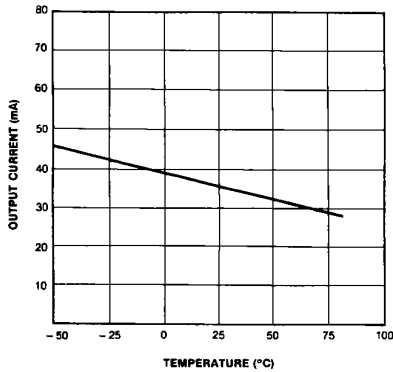

Figure 8. Common-Mode Rejection Ratio

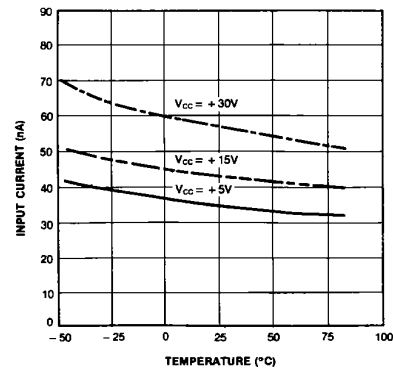Figure 9. Output Current vs Temperature (Current Limiting)
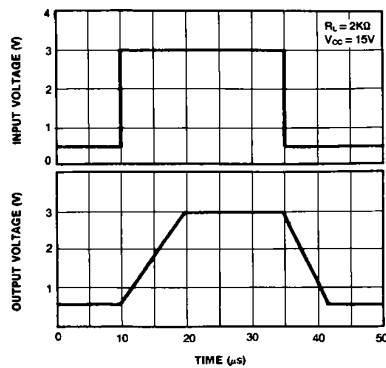

Figure 10. Input Current vs Temperature

Figure 11. Voltage Follower Pulse Response
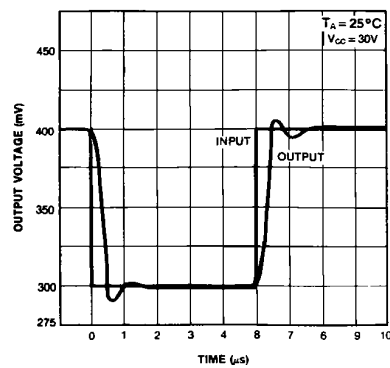

Figure 12. Voltage Follower Pulse Response
(Small Signal)

Mechanical Dimensions
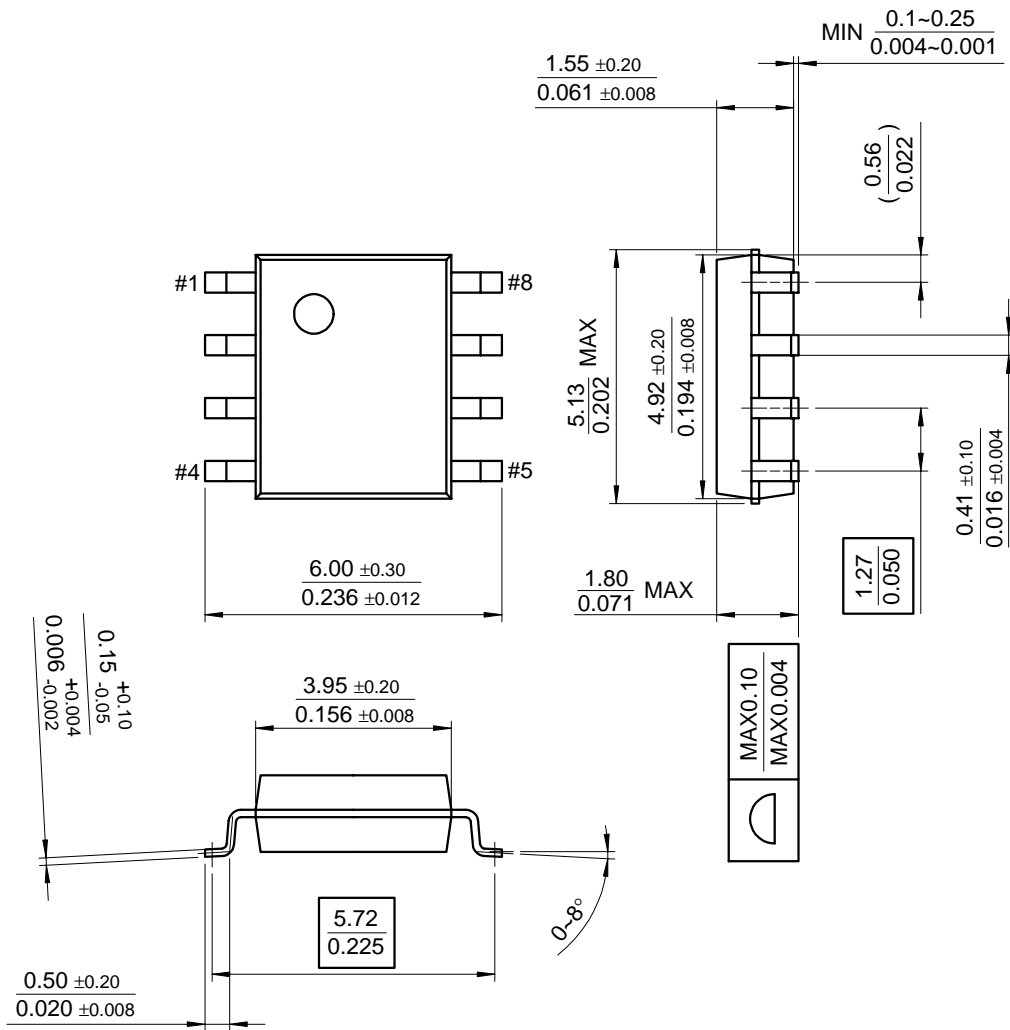
Package

Dimensions in millimeters

8-DIP

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

#1

#8

#4

#5

$\dfrac{0.79}{0.031}$

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

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

$\dfrac{9.60}{0.378}$ MAX

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

$\dfrac{2.54}{0.100}$

$\dfrac{5.08}{0.200}$ MAX

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

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

$\dfrac{0.33}{0.013}$ MIN

$\dfrac{7.62}{0.300}$

$\dfrac{0.25 \, ^{+0.10}_{-0.05}}{0.010 \, ^{+0.004}_{-0.002}}$

0~15°

Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

8-SOP

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

$\dfrac{1.55\ \pm0.20}{0.061\ \pm0.008}$

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

$\dfrac{5.13}{0.202}$ MAX

$\dfrac{4.92\ \pm0.20}{0.194\ \pm0.008}$

$\dfrac{0.41\ \pm0.10}{0.016\ \pm0.004}$

#1 #8

#4 #5

$\dfrac{6.00\ \pm0.30}{0.236\ \pm0.012}$

$\dfrac{1.80}{0.071}$ MAX

$\dfrac{1.27}{0.050}$

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

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

$\dfrac{3.95\ \pm0.20}{0.156\ \pm0.008}$

$\dfrac{5.72}{0.225}$

0~8°

$\dfrac{0.50\ \pm0.20}{0.020\ \pm0.008}$

Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

9-SIP

#1

#9

$\frac{21.84 \pm 0.20}{0.860 \pm 0.008}$

$\frac{22.24}{0.876}$ MAX

$\frac{0.76}{0.030}$

$\frac{1.20 \pm 0.10}{0.047 \pm 0.004}$

$\frac{0.60 \pm 0.10}{0.024 \pm 0.004}$

$\frac{2.54}{0.100}$

$\frac{1.15 \pm 0.20}{0.045 \pm 0.008}$

$\frac{5.80 \pm 0.20}{0.228 \pm 0.008}$

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

$\frac{7.30}{0.287}$ MAX

$\frac{1.25 \pm 0.10}{0.049 \pm 0.004}$

$\frac{0.25 \pm 0.10}{0.010 \pm 0.004}$

$\frac{6.00}{0.236}$ MAX

$\frac{3.00 \pm 0.20}{0.118 \pm 0.008}$

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Ordering Information

Product Number	Package	Operating Temperature
KA358	8-DIP	0 ~ +70°C
KA358A		
KA358D	8-SOP	
KA358AD		
KA358S	9-SIP	
KA358AS		
KA258	8-DIP	-25 ~ +85°C
KA258A		
KA258D	8-SOP	
KA258AD		
KA2904	8-DIP	-40 ~ +85°C
KA2904D	8-SOP	