



Is Now Part of



**ON Semiconductor®**

To learn more about ON Semiconductor, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (\_), the underscore (\_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (\_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at [www.onsemi.com](http://www.onsemi.com). Please email any questions regarding the system integration to [Fairchild\\_questions@onsemi.com](mailto:Fairchild_questions@onsemi.com).

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

# KA258/KA258A, KA358/KA358A, KA2904

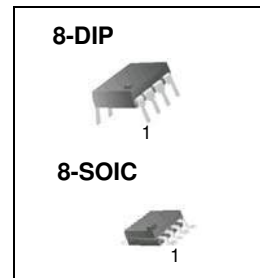
## Dual Operational Amplifier

### Features

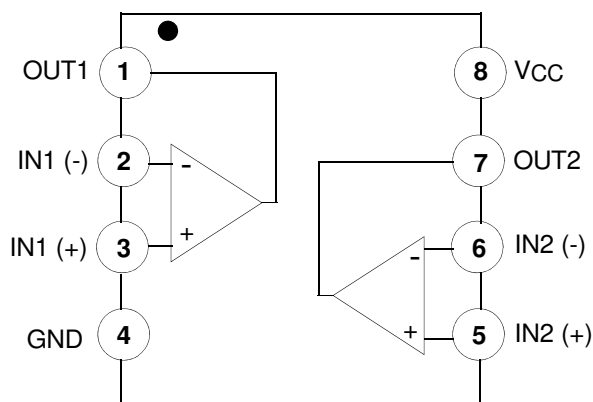
- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100dB
- Wide Power Supply Range:  
KA258/KA258A, KA358/KA358A: 3V ~ 32V (or  $\pm 1.5V \sim 16V$ )  
KA2904 : 3V~26V (or  $\pm 1.5V \sim 13V$ )
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V DC to  $V_{CC} - 1.5V$  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.

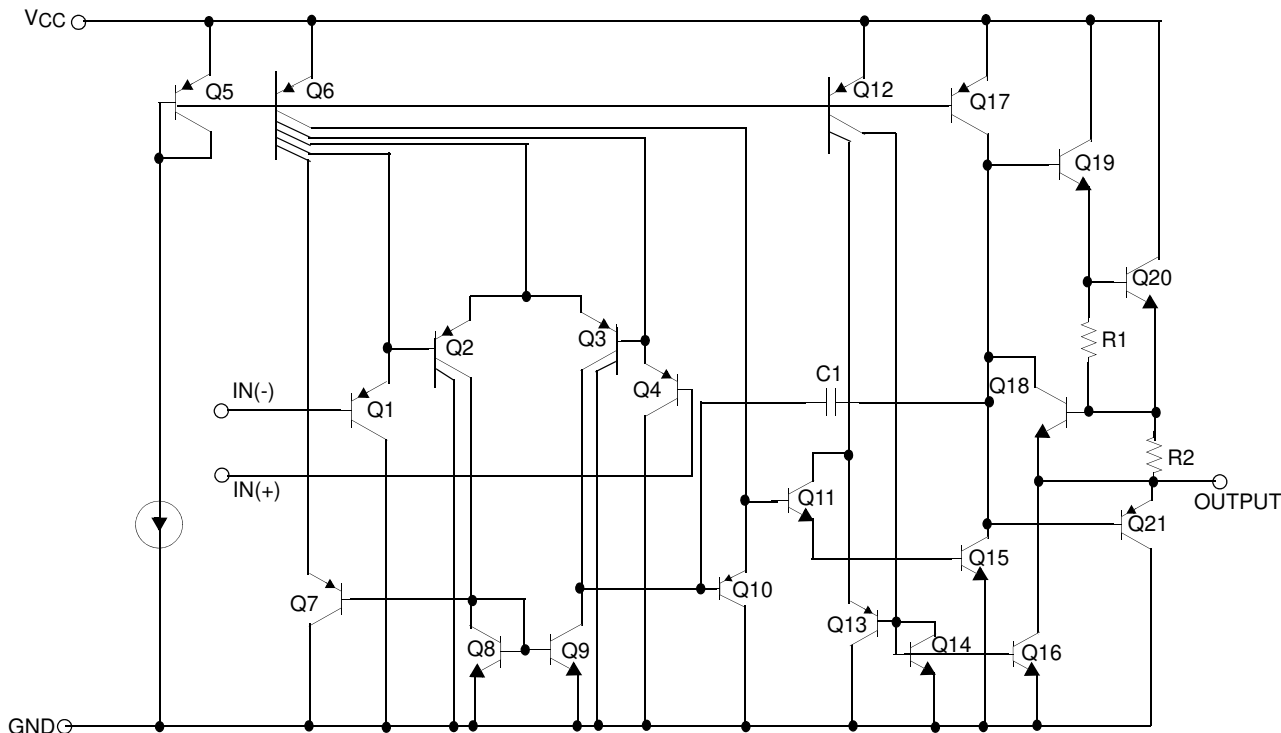


### Internal Block Diagram



## Schematic Diagram

(One section only)



## Absolute Maximum Ratings

| Parameter   | Symbol   | KA258/KA258A | KA358/KA358A | KA2904      | Unit |
|---|----------|--------------|--------------|-------------|------|
| Supply Voltage  | VCC      | ±16 or 32    | ±16 or 32    | ±13 or 26   | V    |
| Differential Input Voltage                                    | VI(DIFF) | 32           | 32           | 26          | V    |
| Input Voltage   | VI       | -0.3 to +32  | -0.3 to +32  | -0.3 to +26 | V    |
| Output Short Circuit to GND<br>VCC ≤ 15V, TA = 25°C (One Amp) | -        | Continuous   | Continuous   | Continuous  | -    |
| Operating Temperature Range                                   | TOPR     | -25 ~ +85    | 0 ~ +70      | -40 ~ +85   | °C   |
| Maximum Junction Temperature                                  | TJ(MAX)  | +150         | +150         | +150        | °C   |
| Storage Temperature Range                                     | TSTG     | -65 ~ +150   | -65 ~ +150   | -65 ~ +150  | °C   |

## Electrical Characteristics

( $V_{CC} = 5.0V$ ,  $V_{EE} = GND$ ,  $T_A = 25^\circ C$ , 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 $V_{CC} - 1.5V$<br>$V_{O(P)} = 1.4V$ , $R_S = 0\Omega$     | -                 | 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          | $V_{I(R)}$    | $V_{CC} = 30V$<br>(KA2904, $V_{CC} = 26V$ )                                 | 0                 | -        | $V_{CC} - 1.5$ | 0     | -        | $V_{CC} - 1.5$ | 0      | -        | $V_{CC} - 1.5$ | V       |
| Supply Current               | $I_{CC}$      | $R_L = \infty$ , $V_{CC} = 30V$<br>(KA2904, $V_{CC} = 26V$ )                | -                 | 0.8      | 2.0            | -     | 0.8      | 2.0            | -      | 0.8      | 2.0            | mA      |
|                              |               | $R_L = \infty$ , $V_{CC} = 5V$  | -                 | 0.5      | 1.2            | -     | 0.5      | 1.2            | -      | 0.5      | 1.2            | mA      |
| Large Signal Voltage Gain    | $G_V$         | $V_{CC} = 15V$ , $R_L = 2k\Omega$<br>$V_{O(P)} = 1V$ to $11V$               | 50                | 100      | -              | 25    | 100      | -              | 25     | 100      | -              | V/mV    |
| Output Voltage Swing         | $V_{O(H)}$    | $V_{CC} = 30V$ , $R_L = 2k\Omega$   | 26                | -        | -              | 26    | -        | -              | 22     | -        | -              | V       |
|                              |               | $V_{CC} = 26V$<br>for KA2904)   | $R_L = 10k\Omega$ | 27       | 28             | -     | 27       | 28             | -      | 23       | 24             | -       |
|                              | $V_{O(L)}$    | $V_{CC} = 5V$ , $R_L = 10k\Omega$   | -                 | 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 $20kHz$<br>(Note1)  | -                 | 120      | -              | -     | 120      | -              | -      | 120      | -              | dB      |
| Short Circuit to GND         | $I_{SC}$      | -   | -                 | 40       | 60             | -     | 40       | 60             | -      | 40       | 60             | mA      |
| Output Current               | ISOURCE       | $V_{I(+)} = 1V$ , $V_{I(-)} = 0V$<br>$V_{CC} = 15V$ , $V_{O(P)} = 2V$       | 20                | 30       | -              | 20    | 30       | -              | 20     | 30       | -              | mA      |
|                              | ISINK         | $V_{I(+)} = 0V$ , $V_{I(-)} = 1V$<br>$V_{CC} = 15V$ , $V_{O(P)} = 2V$       | 10                | 15       | -              | 10    | 15       | -              | 10     | 15       | -              | mA      |
|                              |               | $V_{I(+)} = 0V$ , $V_{I(-)} = 1V$<br>$V_{CC} = 15V$ ,<br>$V_{O(P)} = 200mV$ | 12                | 100      | -              | 12    | 100      | -              | -      | -        | -              | $\mu A$ |
| 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<sub>CC</sub> = 5.0V, V<sub>EE</sub> = GND, unless otherwise specified)The following specifications apply over the range of -25°C ≤ T<sub>A</sub> ≤ +85°C for the KA258; and the 0°C ≤ T<sub>A</sub> ≤ +70°C for the KA358; and the -40°C ≤ T<sub>A</sub> ≤ +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 <sub>IO</sub>      | V <sub>CM</sub> = 0V to V <sub>CC</sub> -1.5V<br>V <sub>O(P)</sub> = 1.4V, R <sub>S</sub> = 0Ω  | -                     | -    | 7.0                     | -     | -    | 9.0                     | -      | -    | 10.0                    | mV    |   |
| Input Offset Voltage Drift | ΔV <sub>IO</sub> /ΔT | R <sub>S</sub> = 0Ω   | -                     | 7.0  | -                       | -     | 7.0  | -                       | -      | 7.0  | -                       | μV/°C |   |
| Input Offset Current       | I <sub>IO</sub>      | -   | -                     | -    | 100                     | -     | -    | 150                     | -      | 45   | 200                     | nA    |   |
| Input Offset Current Drift | ΔI <sub>IO</sub> /ΔT | -   | -                     | 10   | -                       | -     | 10   | -                       | -      | 10   | -                       | pA/°C |   |
| Input Bias Current         | I <sub>BIAS</sub>    | -   | -                     | 40   | 300                     | -     | 40   | 500                     | -      | 40   | 500                     | nA    |   |
| Input Voltage Range        | V <sub>I(R)</sub>    | V <sub>CC</sub> = 30V<br>(KA2904, V <sub>CC</sub> = 26V)  | 0                     | -    | V <sub>CC</sub><br>-2.0 | 0     | -    | V <sub>CC</sub><br>-2.0 | 0      | -    | V <sub>CC</sub><br>-2.0 | V     |   |
| Large Signal Voltage Gain  | G <sub>V</sub>       | V <sub>CC</sub> = 15V, R <sub>L</sub> = 2.0kΩ<br>V <sub>O(P)</sub> = 1V to 11V                  | 25                    | -    | -                       | 15    | -    | -                       | 15     | -    | -                       | V/mV  |   |
| Output Voltage Swing       | V <sub>O(H)</sub>    | V <sub>CC</sub> = 30V<br>(V <sub>CC</sub> = 26V for KA2904)                                     | R <sub>L</sub> = 2kΩ  | 26   | -                       | -     | 26   | -                       | -      | 22   | -                       | -     | V |
|                            |                      |   | R <sub>L</sub> = 10kΩ | 27   | 28                      | -     | 27   | 28                      | -      | 23   | 24                      | -     | V |
|                            | V <sub>O(L)</sub>    | V <sub>CC</sub> = 5V, R <sub>L</sub> = 10kΩ   | -                     | 5    | 20                      | -     | 5    | 20                      | -      | 5    | 20                      | mV    |   |
| Output Current             | I <sub>SOURCE</sub>  | V <sub>I(+)</sub> = 1V, V <sub>I(-)</sub> = 0V<br>V <sub>CC</sub> = 15V, V <sub>O(P)</sub> = 2V | 10                    | 30   | -                       | 10    | 30   | -                       | 10     | 30   | -                       | mA    |   |
|                            | I <sub>SINK</sub>    | V <sub>I(+)</sub> = 0V, V <sub>I(-)</sub> = 1V<br>V <sub>CC</sub> = 15V, V <sub>O(P)</sub> = 2V | 5                     | 8    | -                       | 5     | 9    | -                       | 5      | 9    | -                       | mA    |   |
| Differential Input Voltage | V <sub>I(DIFF)</sub> | -   | -                     | -    | V <sub>CC</sub>         | -     | -    | V <sub>CC</sub>         | -      | -    | V <sub>CC</sub>         | V     |   |

**Electrical Characteristics** (Continued)(V<sub>CC</sub> = 5.0V, V<sub>EE</sub> = GND, T<sub>A</sub> = 25°C, unless otherwise specified)

| Parameter                    | Symbol               | Conditions  | KA258A                |      |                         | KA358A |      |                         | Unit |
|------------------------------|----------------------|---|-----------------------|------|-------------------------|--------|------|-------------------------|------|
|                              |                      |   | Min.                  | Typ. | Max.                    | Min.   | Typ. | Max.                    |      |
| Input Offset Voltage         | V <sub>IO</sub>      | V <sub>CM</sub> = 0V to V <sub>CC</sub> -1.5V<br>V <sub>O(P)</sub> = 1.4V, R <sub>S</sub> = 0Ω  | -                     | 1.0  | 3.0                     | -      | 2.0  | 3.0                     | mV   |
| Input Offset Current         | I <sub>IO</sub>      | -   | -                     | 2    | 15                      | -      | 5    | 30                      | nA   |
| Input Bias Current           | I <sub>BIAS</sub>    | -   | -                     | 40   | 80                      | -      | 45   | 100                     | nA   |
| Input Voltage Range          | V <sub>I(R)</sub>    | V <sub>CC</sub> = 30V   | 0                     | -    | V <sub>CC</sub><br>-1.5 | 0      | -    | V <sub>CC</sub><br>-1.5 | V    |
| Supply Current               | I <sub>CC</sub>      | R <sub>L</sub> = ∞, V <sub>CC</sub> = 30V   | -                     | 0.8  | 2.0                     | -      | 0.8  | 2.0                     | mA   |
|                              |                      | R <sub>L</sub> = ∞, V <sub>CC</sub> = 5V  | -                     | 0.5  | 1.2                     | -      | 0.5  | 1.2                     | mA   |
| Large Signal Voltage Gain    | G <sub>V</sub>       | V <sub>CC</sub> = 15V, R <sub>L</sub> = 2kΩ<br>V <sub>O</sub> = 1V to 11V                       | 50                    | 100  | -                       | 25     | 100  | -                       | V/mV |
| Output Voltage Swing         | V <sub>OH</sub>      | V <sub>CC</sub> = 30V   | R <sub>L</sub> = 2kΩ  | 26   | -                       | -      | 26   | -                       | V    |
|                              |                      |   | R <sub>L</sub> = 10kΩ | 27   | 28                      | -      | 27   | 28                      | -    |
|                              | V <sub>OL</sub>      | V <sub>CC</sub> = 5V, R <sub>L</sub> = 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         | ISC                  | -   | -                     | 40   | 60                      | -      | 40   | 60                      | mA   |
| Output Current               | I <sub>SOURCE</sub>  | V <sub>I(+)</sub> = 1V, V <sub>I(-)</sub> = 0V<br>V <sub>CC</sub> = 15V, V <sub>O(P)</sub> = 2V | 20                    | 30   | -                       | 20     | 30   | -                       | mA   |
|                              |                      |   | 10                    | 15   | -                       | 10     | 15   | -                       | mA   |
|                              | I <sub>SINK</sub>    | V <sub>in(+)</sub> = 0V, V <sub>in(-)</sub> = 1V<br>V <sub>O(P)</sub> = 200mV                   | 12                    | 100  | -                       | 12     | 100  | -                       | μA   |
| Differential Input Voltage   | V <sub>I(DIFF)</sub> | -   | -                     | -    | V <sub>CC</sub>         | -      | -    | V <sub>CC</sub>         | V    |

**Note:**

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

**Electrical Characteristics** (Continued)(V<sub>CC</sub> = 5.0V, V<sub>EE</sub> = GND, unless otherwise specified)The following specification apply over the range of -25°C ≤ T<sub>A</sub> ≤ +85°C for the KA258A; and the 0°C ≤ T<sub>A</sub> ≤ +70°C for the KA358A

| Parameter                       | Symbol               | Conditions  | KA258A                |      |                         | KA358A |      |                         | Unit  |   |
|---------------------------------|----------------------|---|-----------------------|------|-------------------------|--------|------|-------------------------|-------|---|
|                                 |                      |   | Min.                  | Typ. | Max.                    | Min.   | Typ. | Max.                    |       |   |
| Input Offset Voltage            | V <sub>IO</sub>      | V <sub>CM</sub> = 0V to V <sub>CC</sub> - 1.5V<br>V <sub>O(P)</sub> = 1.4V, R <sub>S</sub> = 0Ω | -                     | -    | 4.0                     | -      | -    | 5.0                     | mV    |   |
| Input Offset Voltage Drift      | ΔV <sub>IO</sub> /ΔT | -   | -                     | 7.0  | 15                      | -      | 7.0  | 20                      | μV/°C |   |
| Input Offset Current            | I <sub>IO</sub>      | -   | -                     | -    | 30                      | -      | -    | 75                      | nA    |   |
| Input Offset Current Drift      | ΔI <sub>IO</sub> /ΔT | -   | -                     | 10   | 200                     | -      | 10   | 300                     | pA/°C |   |
| Input Bias Current              | I <sub>BIAS</sub>    | -   | -                     | 40   | 100                     | -      | 40   | 200                     | nA    |   |
| Input Common-Mode Voltage Range | V <sub>I(R)</sub>    | V <sub>CC</sub> = 30V   | 0                     | -    | V <sub>CC</sub><br>-2.0 | 0      | -    | V <sub>CC</sub><br>-2.0 | V     |   |
| Output Voltage Swing            | V <sub>O(H)</sub>    | V <sub>CC</sub> = 30V   | R <sub>L</sub> = 2kΩ  | 26   | -                       | -      | 26   | -                       | -     | V |
|                                 |                      |   | R <sub>L</sub> = 10kΩ | 27   | 28                      | -      | 27   | 28                      | -     | V |
|                                 | V <sub>O(L)</sub>    | V <sub>CC</sub> = 5V, R <sub>L</sub> = 10kΩ   | -                     | 5    | 20                      | -      | 5    | 20                      | mV    |   |
| Large Signal Voltage Gain       | G <sub>V</sub>       | V <sub>CC</sub> = 15V, R <sub>L</sub> = 2.0kΩ<br>V <sub>O(P)</sub> = 1V to 11V                  | 25                    | -    | -                       | 15     | -    | -                       | V/mV  |   |
| Output Current                  | I <sub>SOURCE</sub>  | V <sub>I(+)</sub> = 1V, V <sub>I(-)</sub> = 0V<br>V <sub>CC</sub> = 15V, V <sub>O(P)</sub> = 2V | 10                    | 30   | -                       | 10     | 30   | -                       | mA    |   |
|                                 | I <sub>SINK</sub>    | V <sub>I(+)</sub> = 1V, V <sub>I(-)</sub> = 0V<br>V <sub>CC</sub> = 15V, V <sub>O(P)</sub> = 2V | 5                     | 9    | -                       | 5      | 9    | -                       | mA    |   |
| Differential Input Voltage      | V <sub>I(DIFF)</sub> | -   | -                     | -    | V <sub>CC</sub>         | -      | -    | V <sub>CC</sub>         | V     |   |

# Typical Performance Characteristics

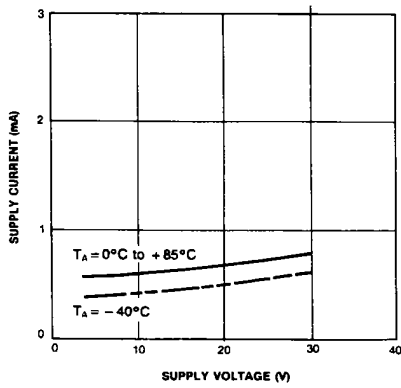


Figure 1. Supply Current vs Supply Voltage

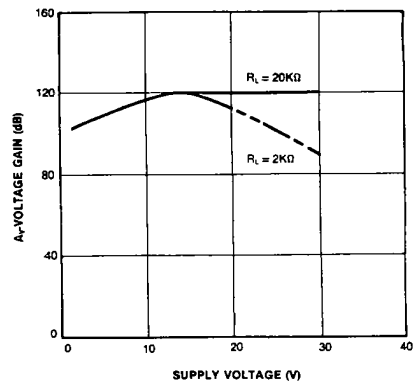


Figure 2. Voltage Gain vs Supply Voltage

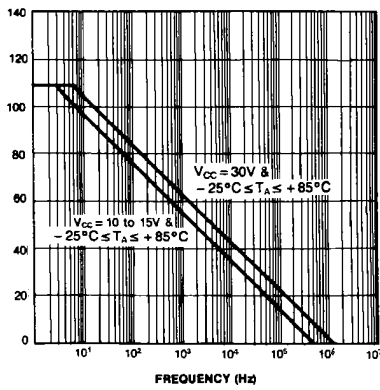


Figure 3. Open Loop Frequency Response

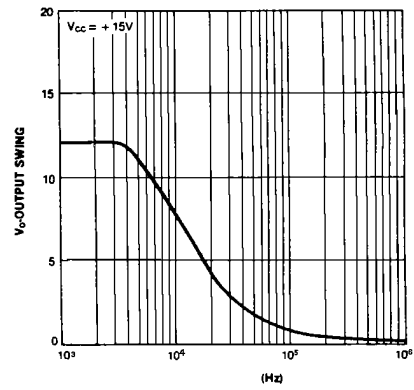


Figure 4. Large Signal Output Swing vs Frequency

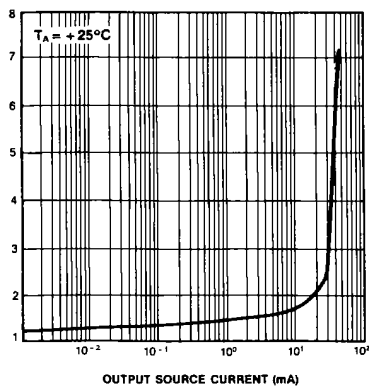


Figure 5. Output Characteristics vs Current Sourcing

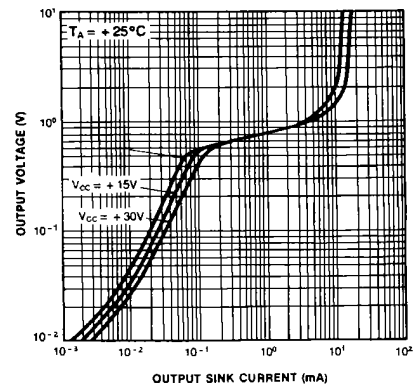


Figure 6. Output Characteristics vs Current Sinking



Typical Performance Characteristics (Continued)

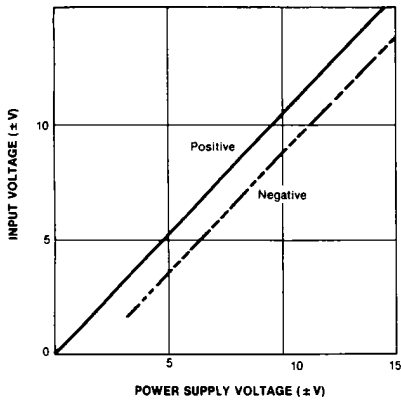


Figure 7. Input Voltage Range vs Supply Voltage

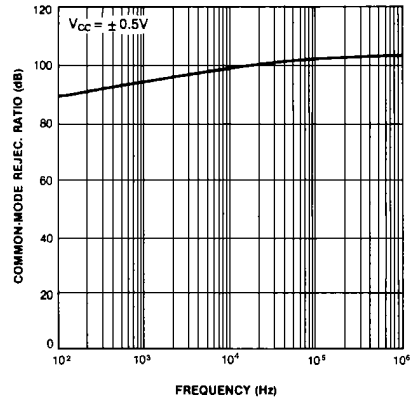


Figure 8. Common-Mode Rejection Ratio

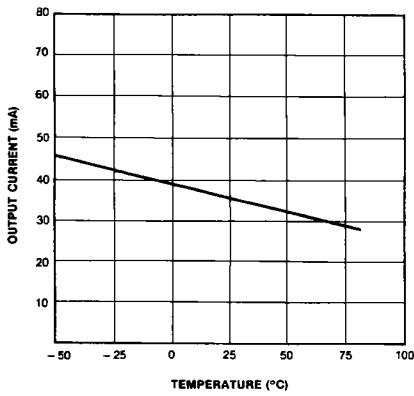


Figure 9. Output Current vs Temperature (Current Limiting)

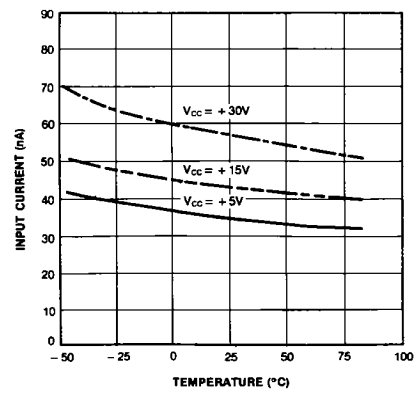


Figure 10. Input Current vs Temperature



Figure 11. Voltage Follower Pulse Response

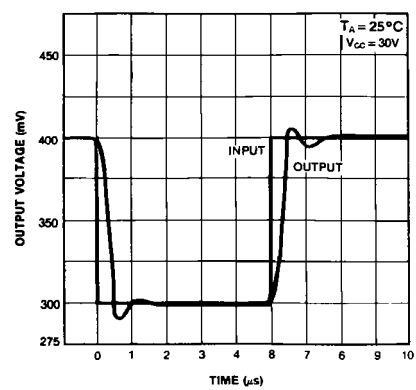


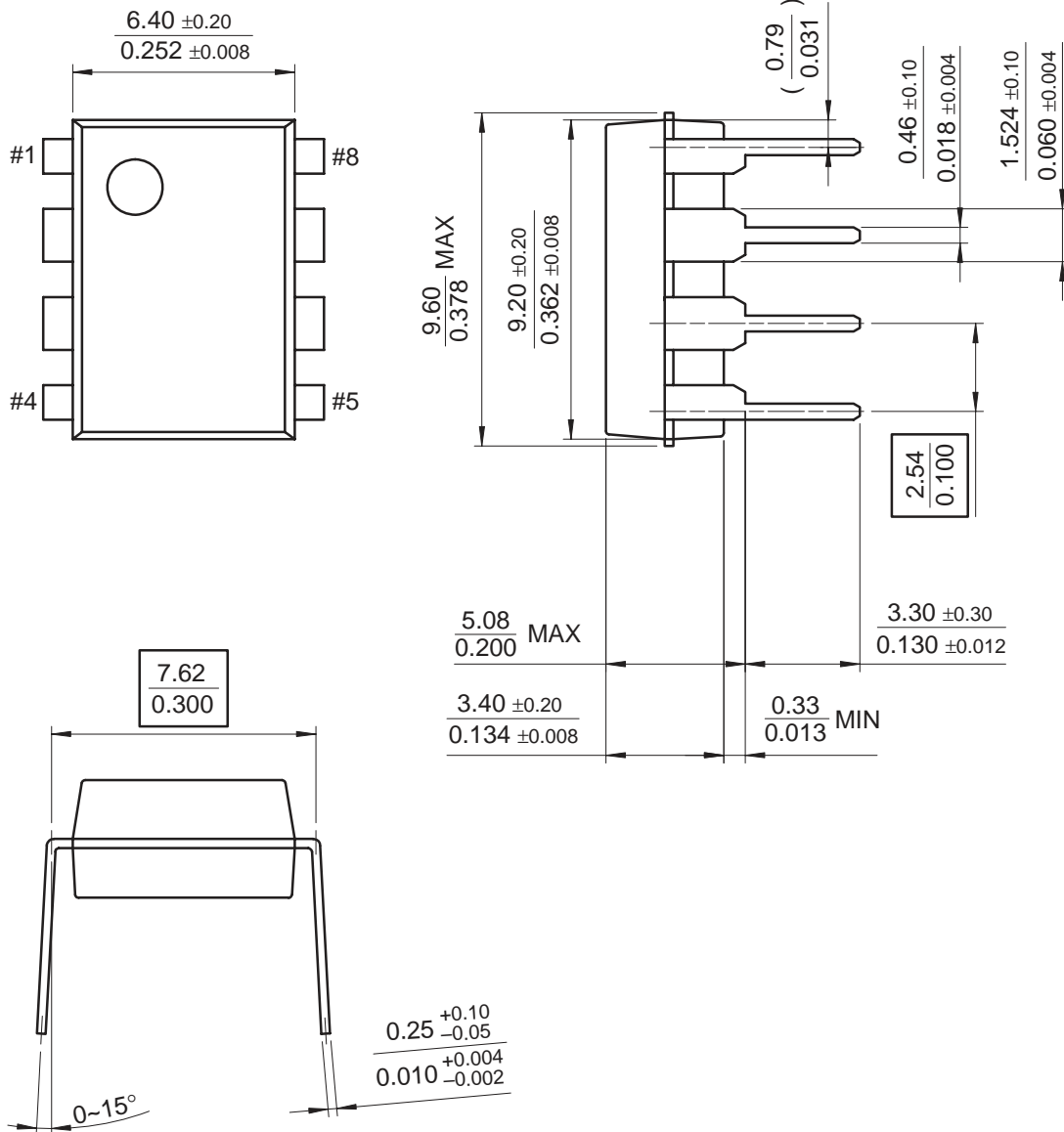
Figure 12. Voltage Follower Pulse Response (Small Signal)

# Mechanical Dimensions

## Package

Dimensions in millimeters

### 8-DIP

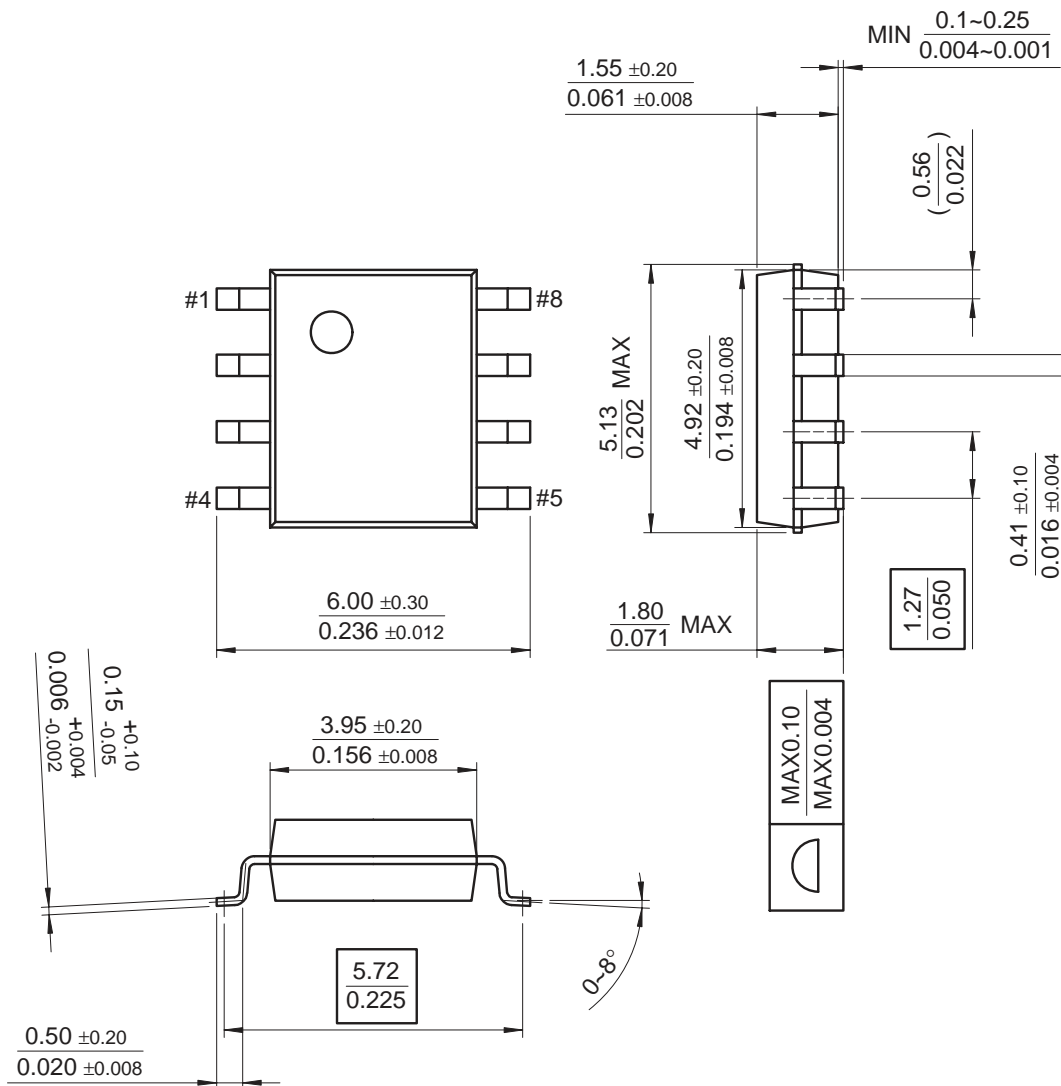


**Mechanical Dimensions** (Continued)

**Package**

**Dimensions in millimeters**

**8-SOIC**



## Ordering Information

| Product Number | Package | Operating Temperature |
|----------------|---------|-----------------------|
| KA358          | 8-DIP   | 0 ~ +70°C             |
| KA358A         |         |                       |
| KA358D         | 8-SOIC  |                       |
| KA358AD        |         |                       |
| KA258D         | 8-SOIC  | -25 ~ +85°C           |
| KA258AD        |         |                       |
| KA2904         | 8-DIP   | -40 ~ +85°C           |
| KA2904D        | 8-SOIC  |                       |

### DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

### LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local  
Sales Representative