# μPC4558MF-DAA

## High Performance Dual Operational Amplifier
## $V_n$ = 1 $\mu V_{r.m.s.}$, SR = 1 V/$\mu$s, GBW = 2 MHz, $V_{IO}$ = ±0.5 mV

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Rev.1.00
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## Description

The μPC4558MF-DAA is a dual type operational amplifier having internal phase compensating circuits, its electrical characteristics features higher speed, broader bandwidth, and lower noise compared with such conventional general purpose operational amplifier as μPC741.

Therefore, application to active filters, audio amplifiers, VCO, etc. can be realized with simple circuit composition.

## Features

- Input offset voltage : ±0.5 mV (TYP.)
- Input offset current : ±5 nA (TYP.)
- Input Bias Current : 60 nA (TYP.)
- Slew Rate : 1.0 V/μs
- Input equivalent noise voltage (RIAA): 1.0 $\mu V_{r.m.s.}$ (TYP.)
- Internal frequency compensation
- Low noise
- Output short circuit protection

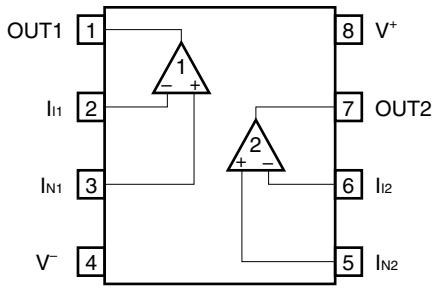
## Ordering Information

| Part Number | Package | Package Code (Previous Package Code) | Package Abbreviation | Supplying Form |
|---|---|---|---|---|
| μPC4558MF-DAA-E1-AT *1 | 8-pin plastic SOP (3.9 × 4.9) | PRSP0008DM-A ( – ) | MF | • 12 mm wide embossed taping<br>• Pin 1 on draw-out side<br>• 2500 p/reel |

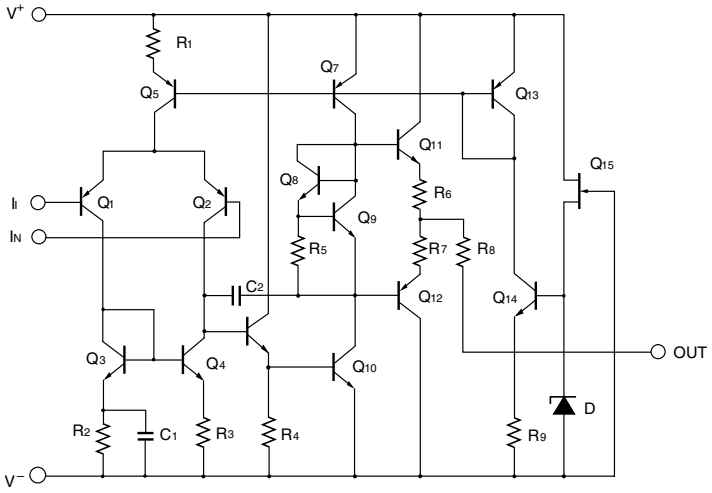
Note: *1. Pb-free (This product does not contain Pb in the external electrode and other parts.)

**Caution** Do not use the products in applications such as the transportation equipment (a car, a train, a ship, etc.) where “Special quality grade” is required, because the products are placed in a quality grade “standard” to be required at general devices.

## Pin Configuration (Top View)




## Equivalent Circuit (for Each Circuit)




## Absolute Maximum Ratings ($T_A$ = 25°C)

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| Voltage between $V^+$ and $V^-$ *1 | $V^+ - V^-$ | −0.3 to +36 | V |
| Differential Input Voltage | $V_{ID}$ | ±30 | V |
| Input Voltage *2 | $V_I$ | $V^-$ − 0.3 to $V^+$ + 0.3 | V |
| Output Applied Voltage *3 | $V_O$ | $V^-$ − 0.3 to $V^+$ + 0.3 | V |
| Total Power Dissipation *4 | $P_T$ | 440 | mW |
| Output Short Circuit Duration (vs. GND) *5 | $t_S$ | Indefinite | s |
| Operating Ambient Temperature | $T_A$ | −40 to +85 | °C |
| Storage Temperature | $T_{stg}$ | −55 to +125 | °C |

Notes: *1. Note that reverse connections of the power supply may damage ICs.

*2. The input voltage is allowed to input without damage or destruction independent of the magnitude of $V^+$. Either input signal is not allowed to go negative by more than 0.3 V. In addition, the input voltage that operates normally as an operational amplifier is within the Common Mode Input Voltage range of an electrical characteristic.

*3. A range where input voltage can be applied to an output pin externally with no deterioration or damage to the feature (characteristic). The input voltage can be applied regardless of the electric supply voltage. This specification which includes the transition state such as electric power ON/OFF must be kept.

*4. This is the value in $T_A \leq 56$°C of when the glass epoxy substrate (size: 100 mm x 100 mm, thickness: 1 mm, 15% of the substrate area where only one side is copper foiled is filling wired) is mounted. Derate at −6.4 mW/°C when $T_A > 56$°C. In the condition same as the above, Junction − ambient thermal resistance $R_{th(J-A)}$ =156°C/W.

*5. Only as for $V^+ \leq 15$V and any 1 channel. Please use the product within the derating condition or Total Power Dissipation, which are showed in Note 4.

## Recommended Operating Conditions

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| Power Supply Voltage (Split) | $V^{\pm}$ | ±4 | | ±16 | V |

## Electrical Characteristics ($T_A$ = 25°C, $V^{\pm}$ = ±15 V)

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | | ±0.5 | ±6.0 | mV | $R_S$ ≤ 10 kΩ |
| Input Offset Current | $I_{IO}$ | | ±5 | ±200 | nA | |
| Input Bias Current *1 | $I_B$ | | 60 | 500 | nA | |
| Large Signal Voltage Gain | $A_V$ | 20000 | 100000 | | | $R_L$ ≥ 2 kΩ, $V_O$ = ±10 V |
| Power Consumption | $P_d$ | | 90 | 170 | mW | $I_O$ = 0 A |
| Common Mode Rejection Ratio | CMR | 70 | 90 | | dB | $R_S$ ≤ 10 kΩ |
| Supply Voltage Rejection Ratio | SVR | | 30 | 150 | μV/V | $R_S$ ≤ 10 kΩ |
| Output Voltage Swing | $V_{om}$ | ±12 | ±14 | | V | $R_L$ ≥ 10 kΩ |
| | | ±10 | ±13 | | V | $R_L$ ≥ 2 kΩ |
| Common Model Input Voltage Range | $V_{ICM}$ | ±12 | ±14 | | V | |
| Slew Rate | SR | | 1.0 | | V/μs | $A_V$ = +1 |
| Input Equivalent Noise Voltage | $V_n$ | | 6 | | $\mu V_{p-p}$ | $R_S$ = 1 kΩ,<br>f = 1 Hz to 1 kHz (Fig.1) |
| Channel Separation | | | 105 | | dB | f = 1 kHz (Fig.2) |

Note: *1. Input bias currents flow out from IC, because each current is base current of PNP-transistor on input stage.

## MEASUREMENT CIRCUIT

**Figure1 Noise Measurement Circuit**

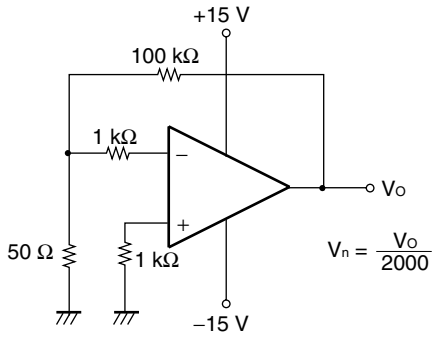
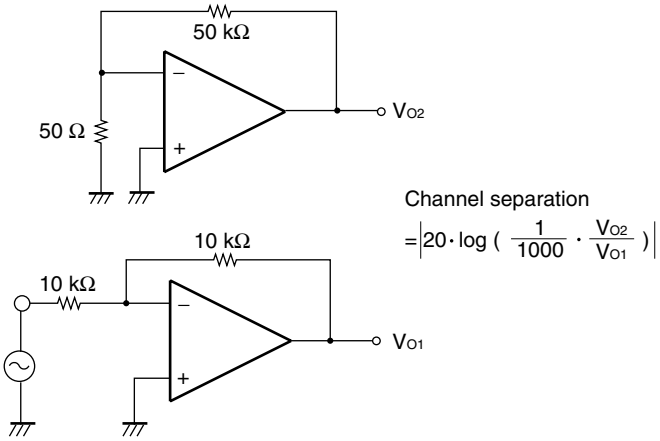
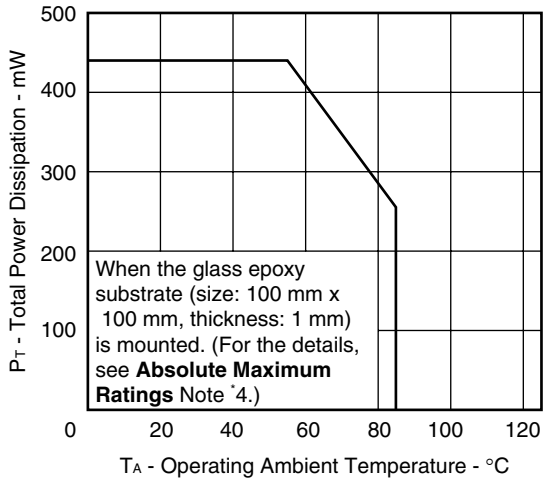



**Figure2 Channel Separation Measurement Circuit**

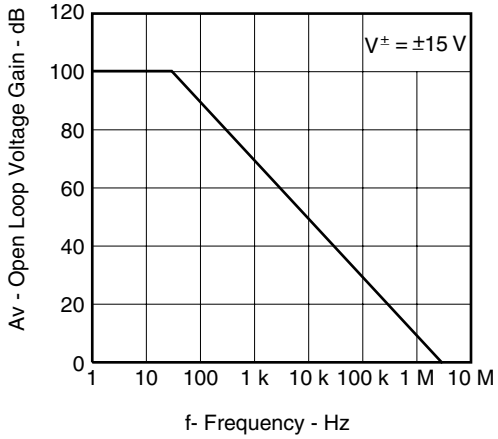


## Typical Characteristics ($T_A$ = 25°C, TYP.) (Reference value)

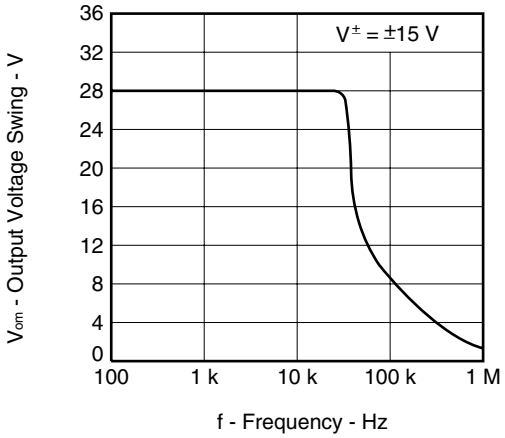
$P_T$ vs. $T_A$



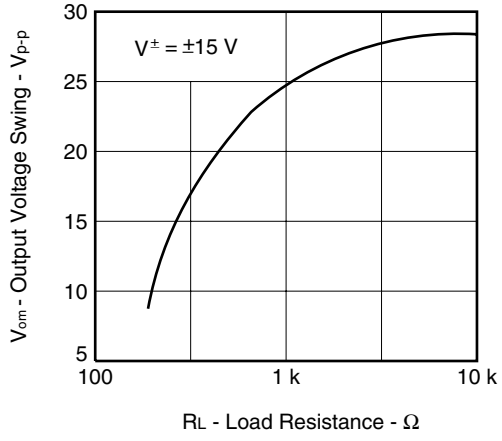

OPEN LOOP FREQUENCY RESPONSE



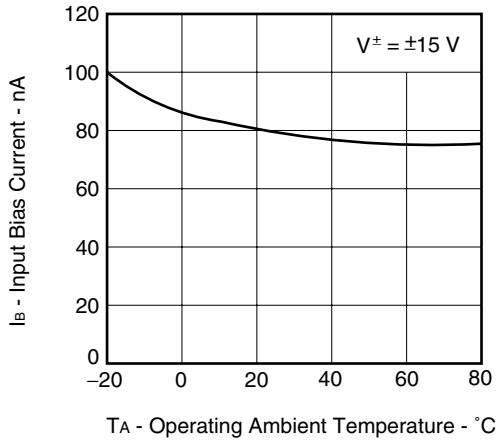

LARGE SIGNAL FREQUENCY RESPONSE



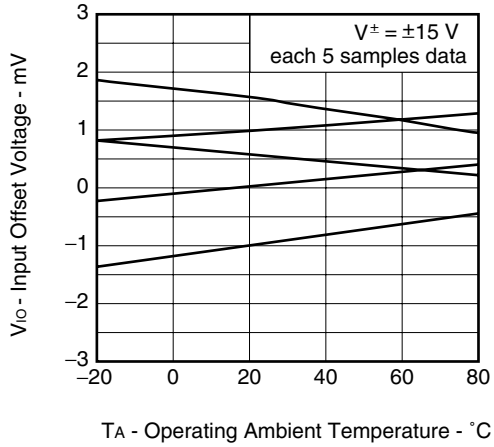

OUTPUT VOLTAGE SWING



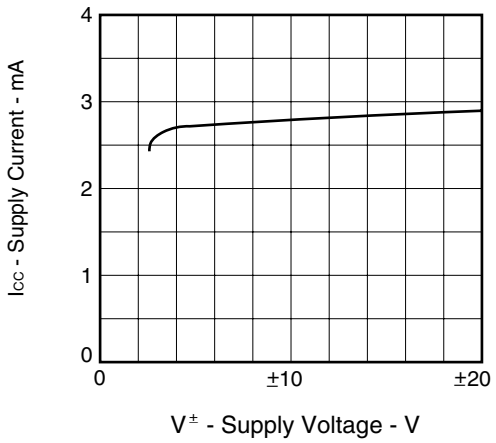

INPUT BIAS CURRENT



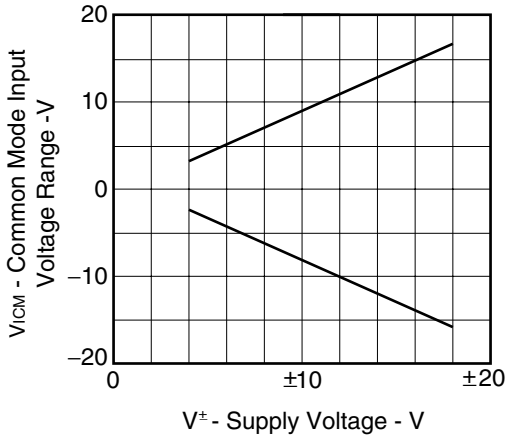

INPUT OFFSET VOLTAGE



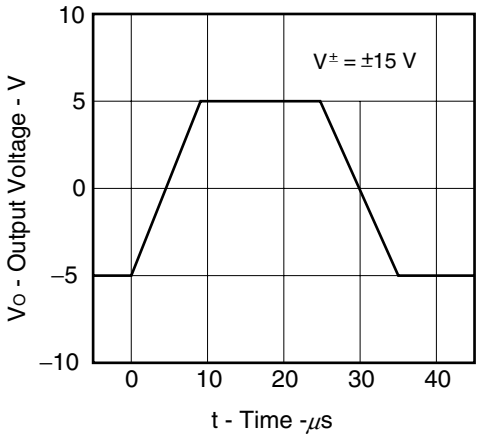
SUPPLY CURRENT vs. SUPPLY VOLTAGE



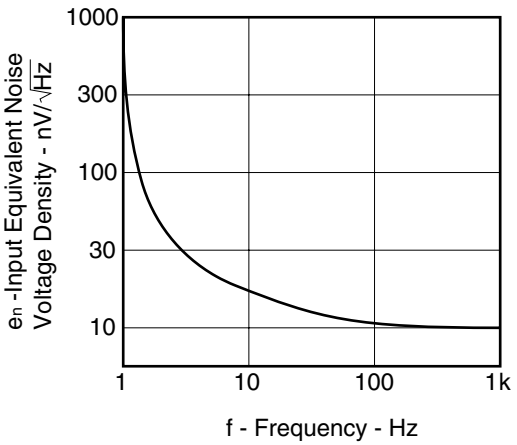

COMMON MODE INPUT VOLTAGE RANGE




VOLTAGE FOLLOWER PULSE RESPONSE




INPUT EQUIVALENT NOISE VOLTAGE DENSITY

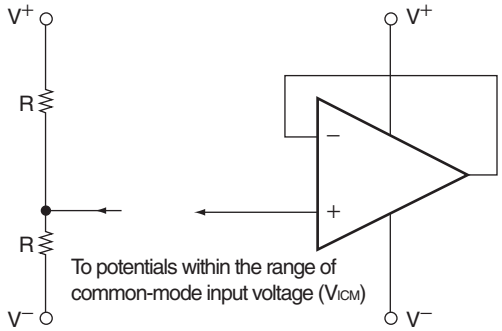


## PRECAUTIONS FOR USE

- **The process of unused circuits**

  If there is an unused circuit, the following connection is recommended.

Process example of unused circuits




**Remark** A midpoint potential of $V^+$ and $V^-$ is applied to this example.

- **Power supply used (Split/Single)**

  The input voltage should be allowed to input without damage or destruction. Even during the transition period of supply voltage, power on/off etc., this specification should be kept. The normal operation will establish when the both inputs are within the Common Mode Input Voltage Range of electrical characteristics.

- **Ratings of input/output pin voltage**

  When the voltage of input/output pin exceeds the absolute maximum rating, it may cause degradation of characteristics or damages, by a conduction of a parasitic diode within an IC. In addition, when the input pin may be lower than $V^-$, or the output pin may exceed the power supply voltage, it is recommended to make a clump circuit by a diode whose forward voltage is low (e.g.: Schottky diode) for protection.

- **Range of common-mode input voltage**

  When the supply voltage does not meet the condition of electrical characteristics, the range of common-mode input voltage is as follows.
  $V_{ICM}$ (TYP.): $V^-$ +1 to $V^+$ −1 (V) ($T_A$ = 25°C)
  During designing, temperature characteristics for use with allowance.

- **The maximum output voltage**

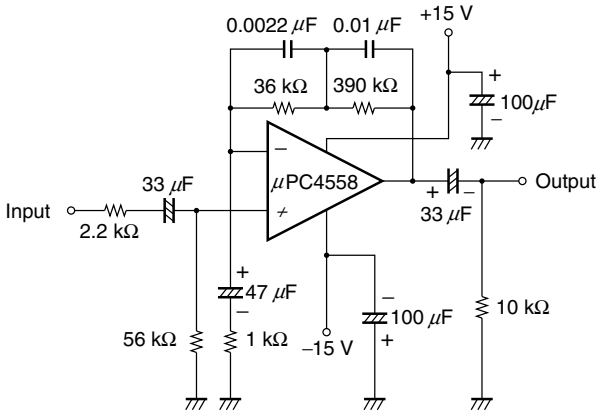
  The range of the TYP. value of the maximum output voltage when the supply voltage does not meet the condition of electrical characteristics is as follows:
  $V_{om}^+$ (TYP.):$V^+$ −1 (V) ($T_A$ = 25°C), $V_{om}^-$ (TYP.): $V^-$+1 (V) ($T_A$ = 25°C)
  During designing, consider variations in characteristics and temperature characteristics for use with allowance.
  In addition, also note that the output voltage range ($V_{om}^+ - V_{om}^-$) becomes narrow when an output current increases.

- **Handling of ICs**

  When stress is added to ICs due to warpage or bending of a board, the characteristic fluctuates due to piezoelectric effect. Therefore, pay attention to warpage or bending of a board.

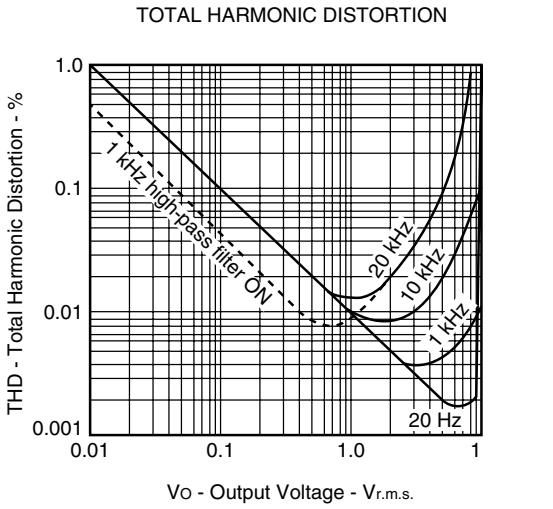
## Application Circuit

RIAA PREAMP ($A_V$ = 32.5 dB)




TYPICAL CHARACTERISTIC
Distortion 0.03% ($V_O$ = 1$V_{r.m.s.}$, f = 1 kHz)

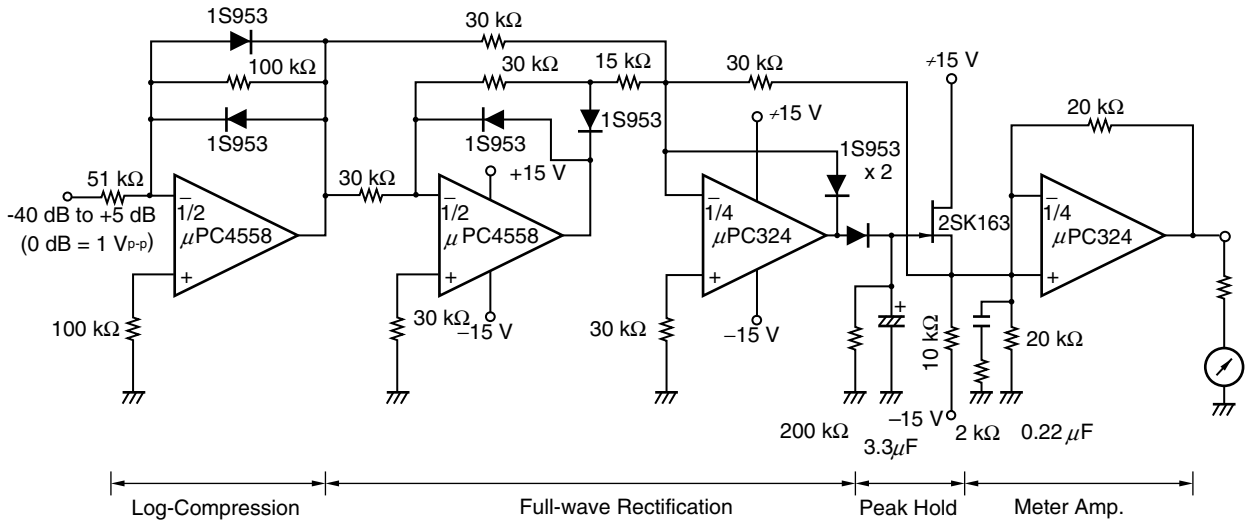
Noise 1.0 μ$V_{r.m.s.}$ (Input Equiv., Input Short
Peak DEt., Average Indication)




## Peak Level Meter

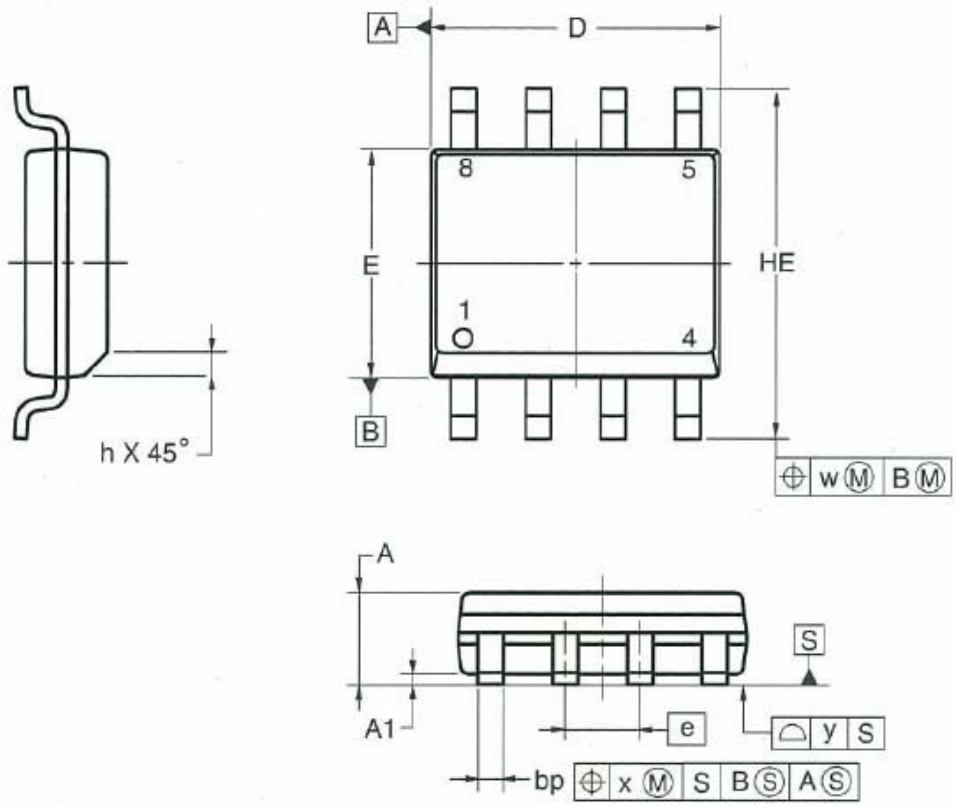
This circuit converts the peak voltage (about ±10 mV to ±10 V) of the input signal to a DC voltage (about 0.2 V to 1.3 V) and drives the meter.

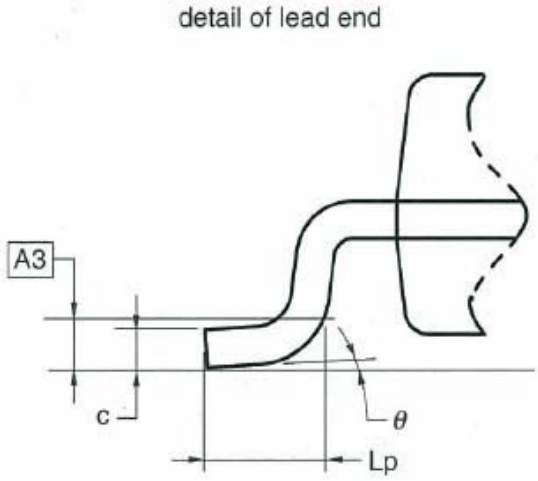
Since the output voltage is proportional to the logarithmic value of the peak voltage of the input signal, indication of a much wider dynamic range can be obtained compared to conventional linear indicating methods.



## Package Drawings

### 8-pin Plastic SOP (3.9 × 4.9)




(UNIT:mm)

| ITEM | DIMENSIONS |
|---|---|
| D | 4.80 to 5.00 |
| E | 3.80 to 4.00 |
| HE | 5.80 to 6.20 |
| e | 1.27 |
| bp | 0.35 to 0.49 |
| A | 1.35 to 1.75 |
| A1 | 0.10 to 0.25 |
| A3 | 0.25 |
| c | 0.19 to 0.25 |
| Lp | 0.40 to 1.25 |
| h | 0.25 to 0.50 |
| w | 0.25 |
| x | 0.25 |
| y | 0.10 |
| θ | 0° to 7° |

| Revision History | μPC4558MF-DAA Data Sheet |
|---|---|

| Rev. | Date | Description | |
|---|---|---|---|
| | | Page | Summary |
| 1.00 | Jul 25, 2012 | – | First Edition Issued |

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