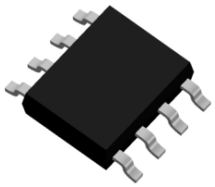
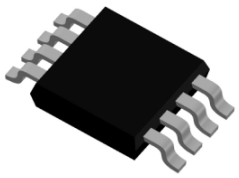
**WS72542**

## Low-Power Rail-to-Rail Input Output Operational Amplifiers

**Http//:www.willsemi.com**



**SOP-8L**

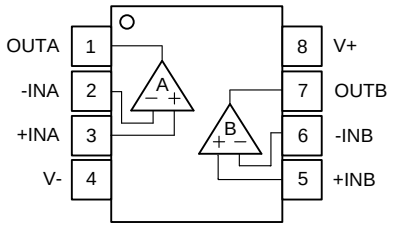


**MSOP-8L**

## Descriptions

The WS72542 series is a dual low-voltage operational amplifier with rail-to-rail input/output swing. Ultra low quiescent current makes this amplifier ideal for portable, battery operated equipment. The common mode input range includes ground making the device useful for low−side current−shunt measurements.

The WS72542 is available with MSL 3 Level in SOP-8L package and MSOP-8L package. Standard products are Pb-Free and halogen-Free.




**SOP-8L/MSOP-8L**

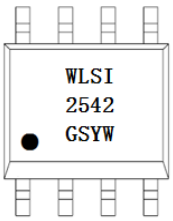
**Pin configuration (Top view)**

## Applications

- Active Filters
- Smoke/Gas Sensors
- Battery Powered Electronic Equipments
- Personal Medical Care

## Features

- Single Supply Voltage : 1.8~5.5V
- Quiescent Current per Amplifier : 42μA Typical
- GBWP : 2MHz
- Slew Rate : 1.4V/μs
- Offset Voltage : 2mV Maximum
- Offset Voltage Temp. Drift : 1.1μV / ℃
- THD+N :-102dB@1kHz, -86dB@10kHz
- CMRR/PSRR : 110dB/106dB
- Output Short-Circuit Curr. : 46mA
- -40℃ to 125℃ Operation Range
- Drives 2kΩ Resistive Loads
- No Output Crossover Distortion
- No Phase Reversal from Overdriven Input
- Rail-to-Rail Input/Output Swing




**SOP-8L**


**MSOP-8L**

**Marking**

**2542 = Device code**
**GS = Special code**
**GM = Special code**
**Y = Year code**
**W = Week code**

## Order Information

| Device | Package | Shipping |
|---|---|---|
| WS72542S-8/TR | SOP-8L | 4000/Reel &Tape |
| WS72542M-8/TR | MSOP-8L | 4000/Reel &Tape |

## Pin Descriptions

| Pin Number | Symbol | Descriptions |
|---|---|---|
| 1 | OUTA | Output |
| 2 | -INA | Inverting input |
| 3 | +INA | Non-inverting input |
| 4 | V- | Negative supply |
| 5 | +INB | Non-inverting input |
| 6 | -INB | Inverting input |
| 7 | OUTB | Output |
| 8 | V+ | Positive supply |

## Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Supply Voltage, ([V+] – [V-]) | $V_S$ (2) | 6 | V |
| Input Differential Voltage | $V_{IDR}$ (3) | ±6 | V |
| Input Common Mode Voltage Range | $V_{ICR}$ | $(V^-)$-0.2 to $(V^+)$+0.2 | V |
| Output Short-Circuit Duration | $t_{SO}$ | Unlimited | / |
| Operating Fee-Air Temperature Range | $T_A$ | -40 to 125 | °C |
| Storage Temperature Range | $T_{STG}$ | -65 to 150 | °C |
| Junction Temperature Range | $T_J$ | 150 | °C |
| Lead Temperature Range | $T_L$ | 260 | °C |

**Note:**

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are only stress ratings, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions are not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. All voltage values, except differential voltage are with respect to network terminal.
3. Differential voltages are at +IN with respect to -IN.

## ESD, Electrostatic Discharge Protection

| Symbol | Parameter | Condition | Minimum level | Unit |
|---|---|---|---|---|
| HBM | Human Body Model ESD | MIL-STD-883H Method 3015.8<br>JEDEC-EIA/JESD22-A114A | ±8000 | V |
| MM | Machine Model ESD | JEDEC-EIA/JESD22-A115 | ±350 | V |
| CDM | Charged Device Model ESD | JEDEC-EIA/JESD22-C101E | ±2000 | V |

## Electronics Characteristics

The ***** denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A$ = 25℃. $V_S$ = 5V, $V_{CM}$ = $V_{OUT}$ = $V_S$/2, $R_{load}$ = 100kΩ, $C_{load}$ =100pF.

| Symbol | Parameter | | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | | $V_{CM}$= $V_S$/2 | * | -2.0 | ±0.1 | 2.0 | mV |
| $\alpha_{VOS}$ | Input Offset Voltage Drift | | | | | 1.1 | | μV/℃ |
| $I_{IB}$ | Input Bias Current | | | | | 10 | | pA |
| $I_{OS}$ | Input Offset Current | | | | | 10 | | pA |
| $V_n$ | Input Voltage Noise | | f=0.1Hz to10Hz | | | 5.2 | | $\mu V_{P-P}$ |
| | | | f=10Hz to 20kHz | | | 4.6 | | $\mu V_{rms}$ |
| $e_n$ | Input Voltage Noise Density | | f=1kHz | | | 30 | | nV/√Hz |
| | | | f=10kHz | | | 23 | | |
| CMRR | Common Mode Rejection Ratio | | $V_{CM}$=0.1V to 4.9V | * | 85 | 110 | | dB |
| $V_{CM}$ | Common Mode Input Voltage Range | | | * | ($V^-$)-0.2 | | ($V^+$)+0.2 | V |
| PSRR | Power Supply Rejection Ratio | | | * | 90 | 106 | | dB |
| $A_{VOL}$ | Open Loop Large Signal Gain | | $V_{OUT}$=0.1V to 4.9V, $R_{load}$=10kΩ | * | 100 | 109 | | dB |
| $V_{OH}$ | High Level Output Voltage | | $R_{load}$=2kΩ | | | 50 | | mV |
| | | | $R_{load}$=10kΩ | | | 5 | | |
| $V_{OL}$ | Low Level Output Voltage | | $R_{load}$=2kΩ | | | 50 | | mV |
| | | | $R_{load}$=10kΩ | | | 5 | | |
| $I_{SC}$ | Output Short-Circuit Current | | Sink/Source Current | | | 46 | | mA |
| $I_Q$ | Quiescent Current per Amplifier | | | * | | 42 | 60 | μA |
| PM | Phase Margin | | $R_{load}$=100kΩ, $C_{load}$=100pF | | | 65 | | degrees |
| GM | Gain Margin | | $R_{load}$=100kΩ, $C_{load}$=100pF | | | -15 | | dB |
| GBWP | Gain-Bandwidth Product | | f=1kHz | | | 2 | | MHz |
| $t_S$ | Settling Time | 1.5 to 3.5V, Unity Gain | 0.1% | | | 1.9 | | μs |
| | | 2.45 to 2.55V, Unity Gain | 0.1% | | | 0.29 | | |
| SR | Slew Rate | | $A_V$=1, $V_{OUT}$=1.5V to 3.5V, $R_{load}$=100kΩ, $C_{load}$=100pF | | | 1.4 | | V/μs |
| FPBW | Full Power Bandwidth | | $2V_{P-P}$ | | | 240 | | kHz |
| THD+N | Total Harmonic Distortion and Noise | | f=1kHz, AV=1, $R_{load}$=100kΩ, $V_{OUT}$=$2V_{PP}$ | | | -102 | | dB |
| | | | f=10kHz, AV=1, $R_{load}$=100kΩ, $V_{OUT}$=$2V_{PP}$ | | | -86 | | |

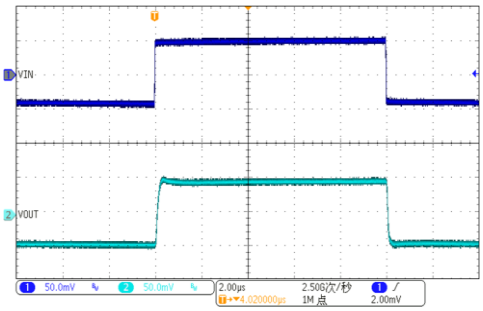
**Note:**

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.
2. A heat sink may be required to keep the junction temperature below the absolute maximum rating when the output is shorted indefinitely.
3. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.
4. Full power bandwidth is calculated from the slew rate FPBW = SR/($\pi \bullet V_{P-P}$).

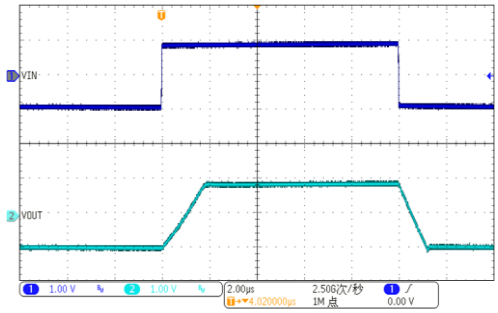
## Typical Characteristics

**$T_A$=25°C, $V_S$=±2.5V, $V_{CM}$=0V, unless otherwise noted**

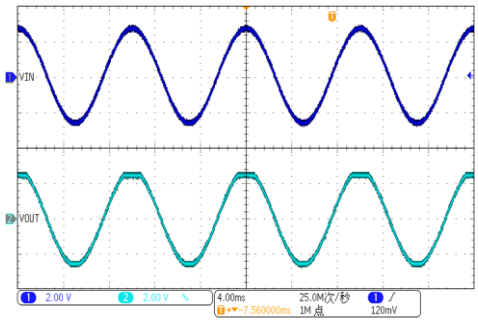
**Small-Siganl Step Response, 100mV Step**



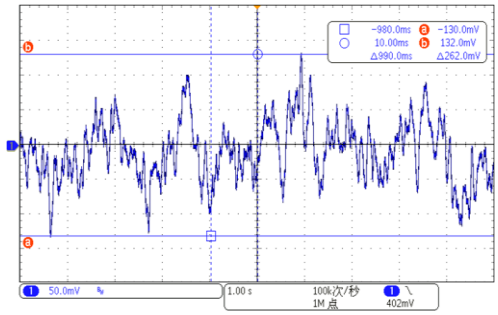

**Large-Siganl Step Response, 2V Step**



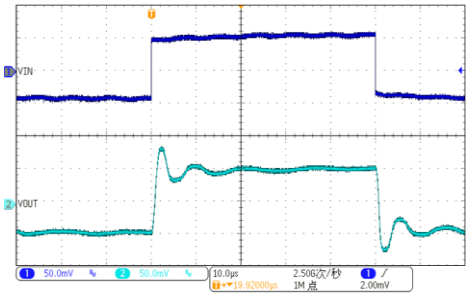

**VIN=-0.2V to 5.7V, No Phase Reversal**



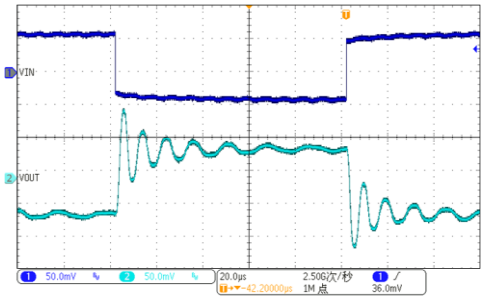

**0.1Hz to 10Hz Integrated Input Noise, Gain = 50000**



**Over Shoot Voltage, $C_{load}$=47nF, $R_{FB}$=10kΩ, Gain=+1**



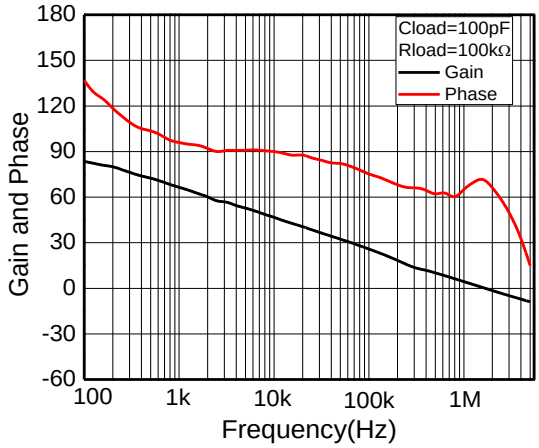

Over Shoot Voltage, $C_{load}$=47nF, $R_{load}$=40kΩ, Gain=-1



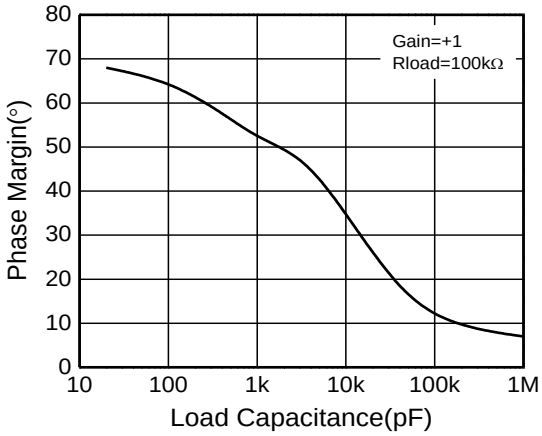
## Typical Characteristics (continued)

**$T_A$=25°C, $V_S$=±2.5V, $V_{CM}$=0V, unless otherwise noted**

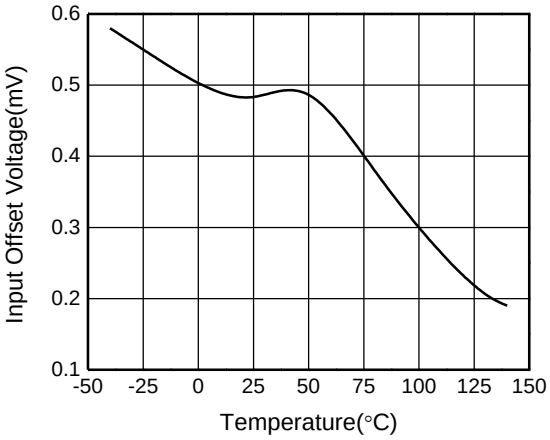
### Open-Loop Gain and Phase



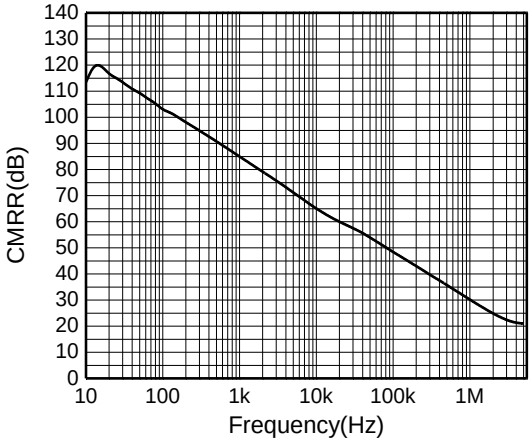

### Phase Margin vs. $C_{load}$ (Stable for Any $C_{load}$)



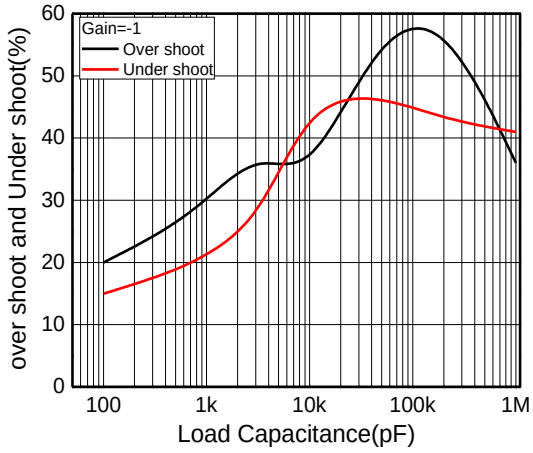

### Input Offset Voltage vs. Temperature



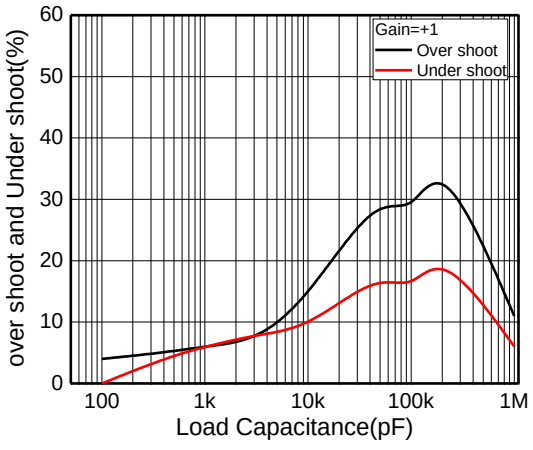

### CMRR vs. Frequency




### Over-Shoot % vs. $C_{load}$
### Gain=-1, $R_{FB}$=20kΩ



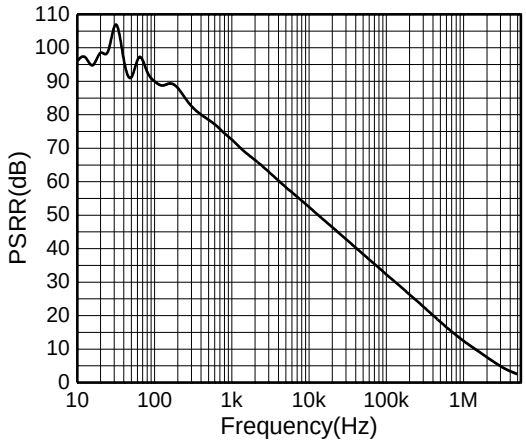

### Over-Shoot % vs. $C_{load}$
### Gain=+1



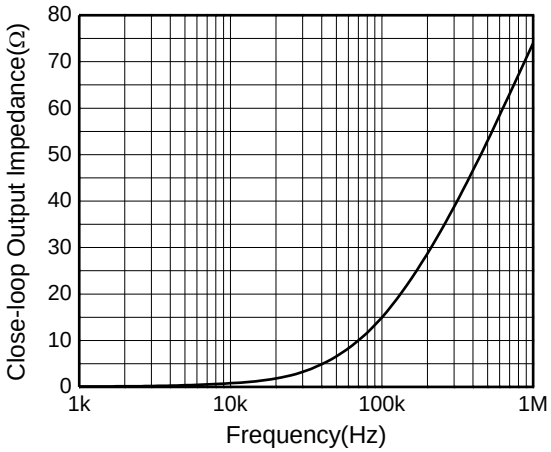
## Typical Characteristics (continued)

**$T_A$=25℃, $V_S$=±2.5V, $V_{CM}$=0V, unless otherwise noted**

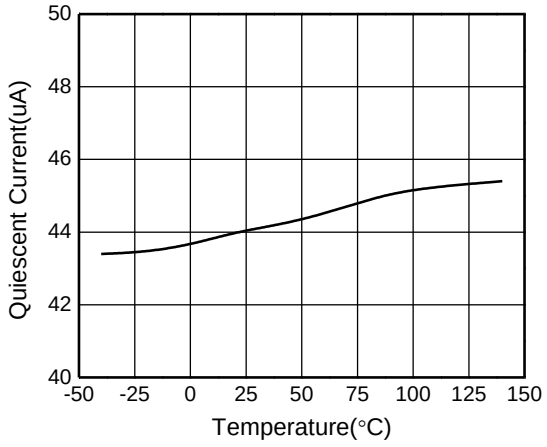
**PSRR vs. Frequency**



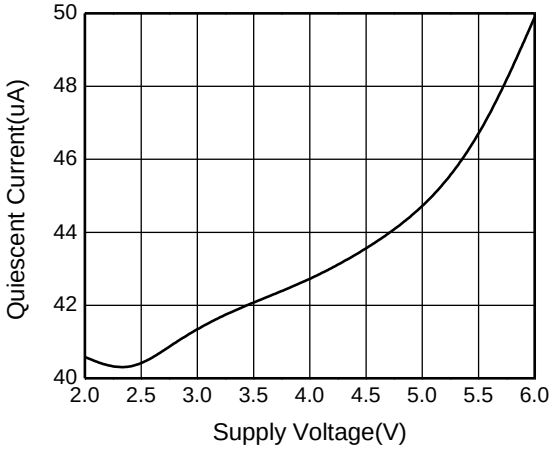

**Closed-Loop Output Impedance vs. Frequency**



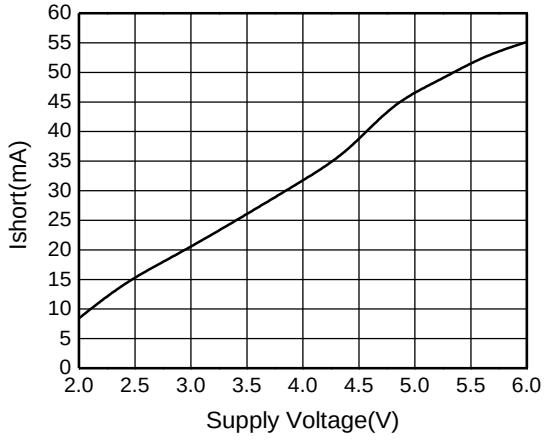

**Quiescent Supply Current vs. Temperature**



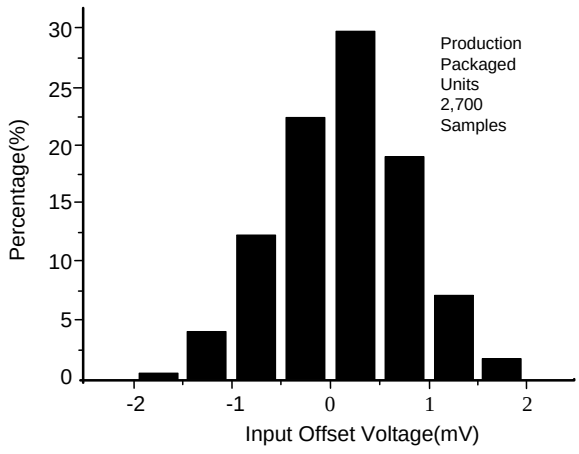

**Quiescent Supply Current vs. Supply Voltage**




**Short-Circuit Current vs. Supply Voltage**



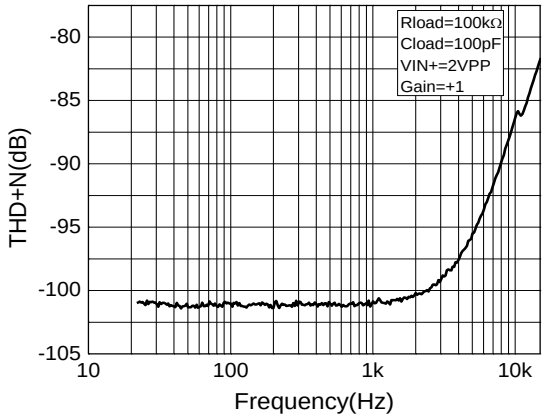

**Input Offset Voltage Distribution**



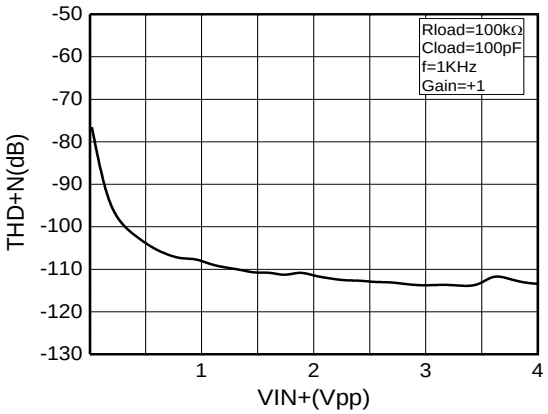
## Typical Characteristics (continued)

**$T_A$=25°C, $V_S$=±2.5V, $V_{CM}$=0V, unless otherwise noted**

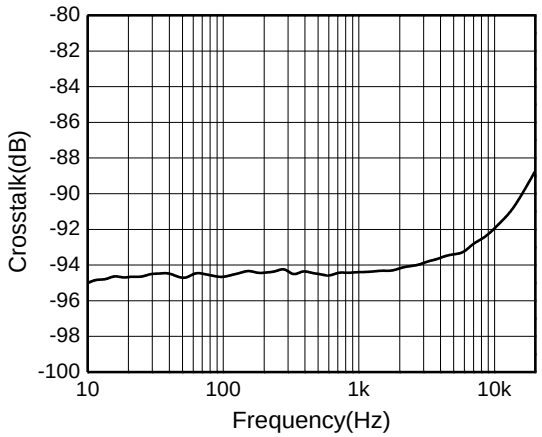
**THD+Noise vs. Frequency**




**THD+Noise vs. VIN+**

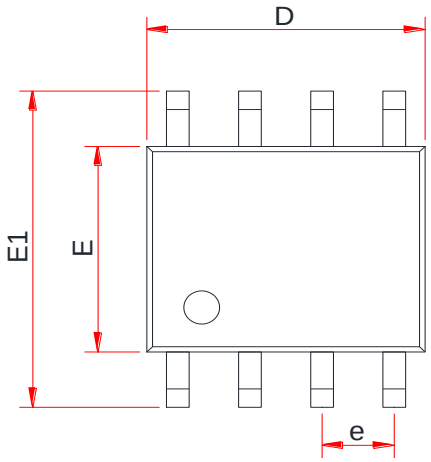



**Crosstalk**

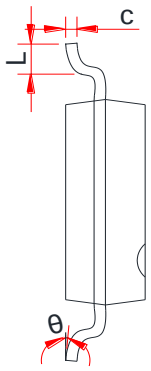


## PACKAGE OUTLINE DIMENSIONS

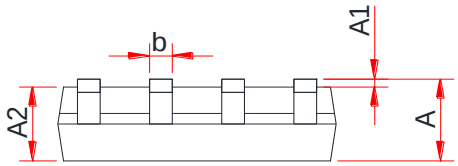
### SOP-8L




TOP VIEW




SIDE VIEW

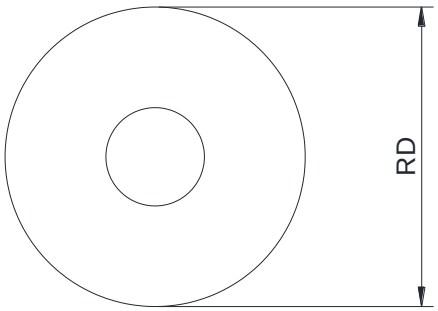



SIDE VIEW

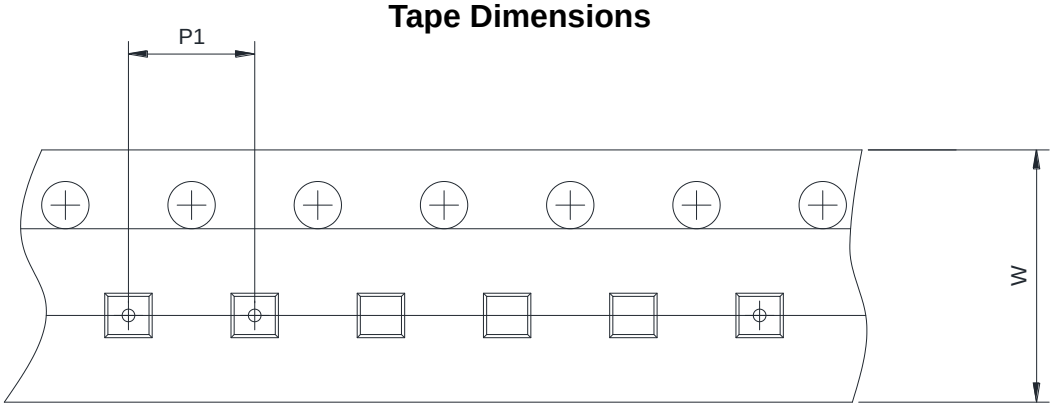
| Symbol | Dimensions In Millimeters (mm) | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 1.35 | 1.55 | 1.75 |
| A1 | 0.05 | 0.15 | 0.25 |
| A2 | 1.25 | 1.40 | 1.65 |
| b | 0.33 | - | 0.51 |
| c | 0.15 | - | 0.26 |
| D | 4.70 | 4.90 | 5.10 |
| E | 3.70 | 3.90 | 4.10 |
| E1 | 5.80 | 6.00 | 6.20 |
| e | 1.27BSC | | |
| L | 0.40 | - | 1.27 |
| θ | 0° | - | 8° |

## TAPE AND REEL INFORMATION

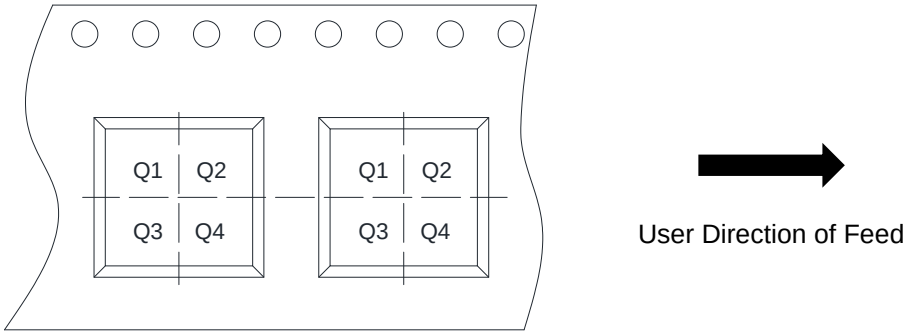
### Reel Dimensions




### Tape Dimensions



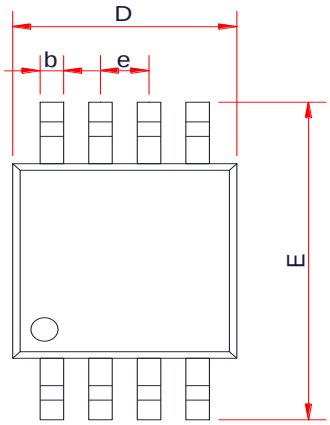

### Quadrant Assignments For PIN1 Orientation In Tape



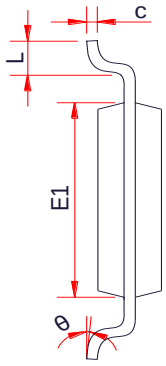

| | | |
|---|---|---|
| RD | Reel Dimension | ☐ 7inch ☑ 13inch |
| W | Overall width of the carrier tape | ☐ 8mm ☑ 12mm |
| P1 | Pitch between successive cavity centers | ☐ 2mm ☐ 4mm ☑ 8mm |
| Pin1 | Pin1 Quadrant | ☑ Q1 ☐ Q2 ☐ Q3 ☐ Q4 |

## PACKAGE OUTLINE DIMENSIONS

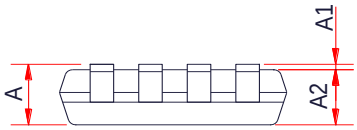
### MSOP-8L




TOP VIEW




SIDE VIEW

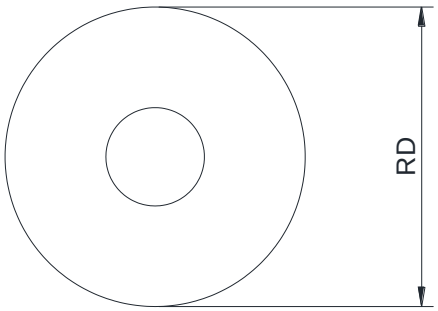



SIDE VIEW

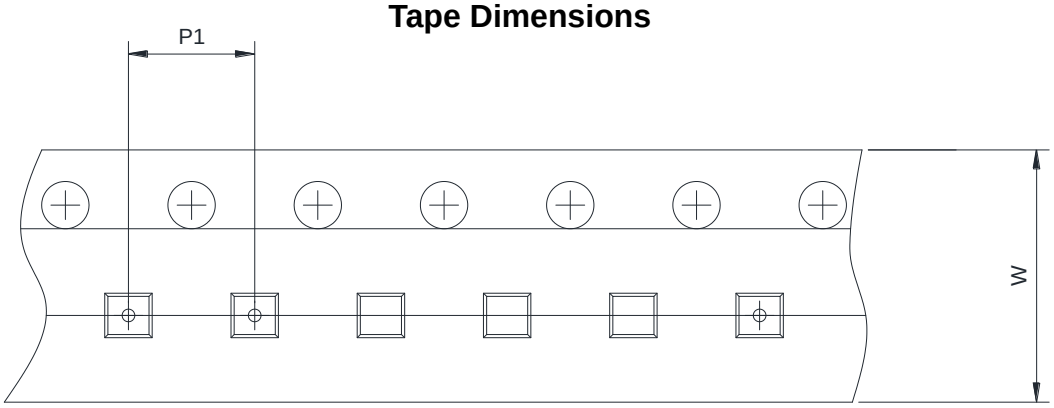
| Symbol | Dimensions In Millimeters (mm) | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | - | - | 1.10 |
| A1 | 0.02 | - | 0.15 |
| A2 | 0.75 | 0.80 | 0.95 |
| b | 0.25 | - | 0.38 |
| c | 0.09 | - | 0.23 |
| D | 2.90 | 3.00 | 3.10 |
| E | 4.75 | 4.90 | 5.05 |
| E1 | 2.90 | 3.00 | 3.10 |
| e | 0.65 BSC | | |
| L | 0.40 | - | 0.80 |
| θ | 0° | - | 6° |

## TAPE AND REEL INFORMATION

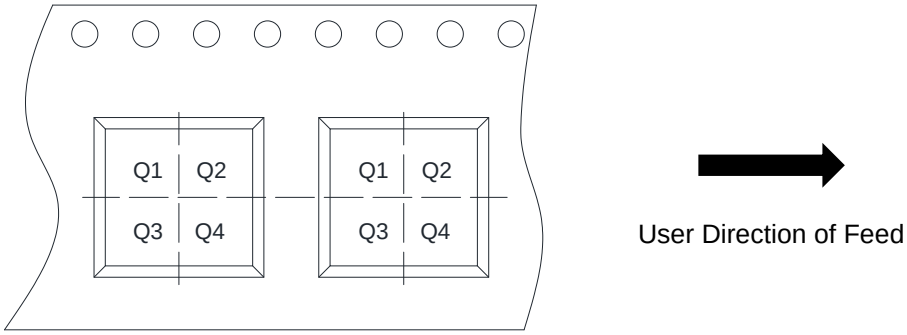
### Reel Dimensions




### Tape Dimensions




### Quadrant Assignments For PIN1 Orientation In Tape




| | | |
|---|---|---|
| RD | Reel Dimension | ☐ 7inch ☑ 13inch |
| W | Overall width of the carrier tape | ☐ 8mm ☑ 12mm |
| P1 | Pitch between successive cavity centers | ☐ 2mm ☐ 4mm ☑ 8mm |
| Pin1 | Pin1 Quadrant | ☑ Q1 ☐ Q2 ☐ Q3 ☐ Q4 |

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