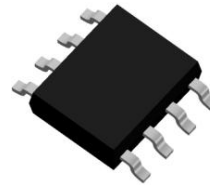
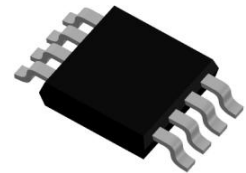
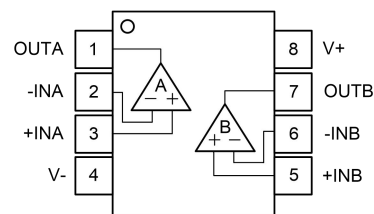


WS72142
300nA Nano-Power Rail-to-Rail Input Output Operational Amplifiers
[Http://www.willsemi.com](http://www.willsemi.com)
Descriptions

The WS72142 is a dual low-voltage operational amplifier with rail-to-rail input/output swing. Ultra low power makes this amplifier ideal for battery-powered and portable applications. The WS72142 has a gain-bandwidth product of 13kHz (TYP) and is unity gain stable. These specifications make this operational amplifier appropriate for low frequency applications, such as battery current monitoring and sensor conditioning.

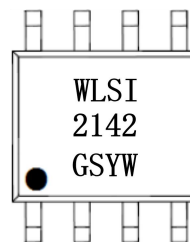
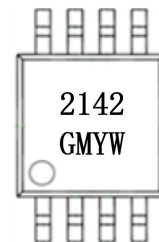
WS72142 is available with MSL 3 Level in SOP-8L package and MSOP-8L package. Standard products are Pb-Free and halogen-Free.


SOP-8L

MSOP-8L

SOP-8L/MSOP-8L
Pin configuration (Top view)
Applications

- Handsets and Mobile Accessories
- Current Sensing
- Wireless Remote Sensors, Active RFID Readers
- Environment/Gas/Oxygen Sensors
- Threshold Detectors/Discriminators
- Low Power Filters
- Battery or Solar Powered Devices
- Sensor Network Powered by Energy Scavenging

Features

- Wide Supply Voltage : 1.6~5.5V
- Quiescent Current per Amplifier : 300nA Typical
- GBWP : 13kHz
- Rail-to-Rail Input/Output Swing
- Unity Gain Stable
- -40°C to 125°C Operation Temperature Range
- Available in Green SOP-8L and MSOP-8L Packages


SOP-8L

MSOP-8L
Marking

- 2142** = Device code
- GS** = Special code
- GM** = Special code
- Y** = Year code
- W** = Week code

Order Information

| Device | Package | Shipping |
|---------------|---------|------------------|
| WS72142S-8/TR | SOP-8L | 4000/Reel & Tape |
| WS72142M-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⁽¹⁾

| Parameter | Symbol | Value | Unit |
|--------------------------------------|----------------|--|------|
| Supply Voltage, ([V+] - [V-]) | $V_S^{(2)}$ | 6 | V |
| Input Common Mode Voltage Range | V_{ICR} | (V ⁻)-0.3 to (V ⁺)+0.3 | V |
| Output Short-Circuit Duration | $t_{SO}^{(3)}$ | Unlimited | / |
| Operating Free-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:

- 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.
- All voltage values, except differential voltage are with respect to network terminal.
- A heat sink may be required to keep the junction temperature below the absolute maximum, depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies the amount of PC board metal connected to the package. The specified values are for short traces connected to leads.

ESD, Electrostatic Discharge Protection

| Symbol | Parameter | Condition | Minimum level | Unit |
|--------|--------------------------|--|---------------|------|
| HBM | Human Body Model ESD | MIL-STD-883H Method 3015.8 JEDEC-EIA/JESD22-A114A | ±8000 | V |
| CDM | Charged Device Model ESD | JEDEC-EIA/JESD22-C101E | ±2000 | V |
| MM | Machine Model ESD | JEDEC-EIA/JESD22-A115 | ±400 | V |

Electronics Characteristics

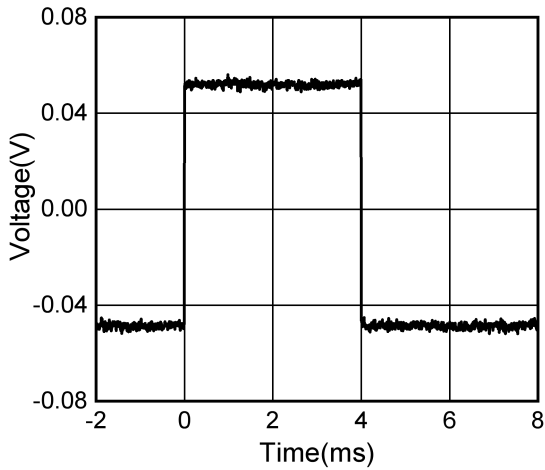
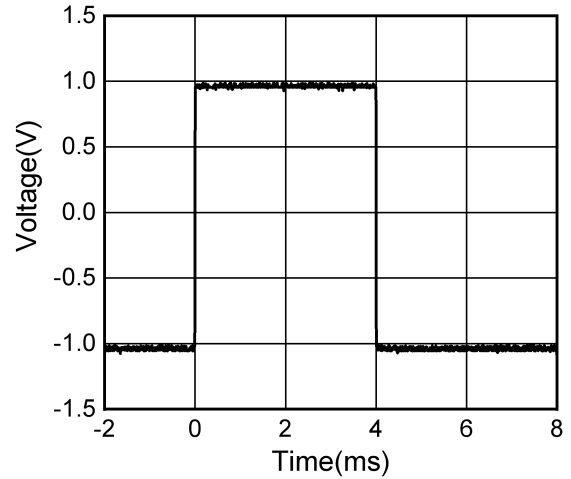
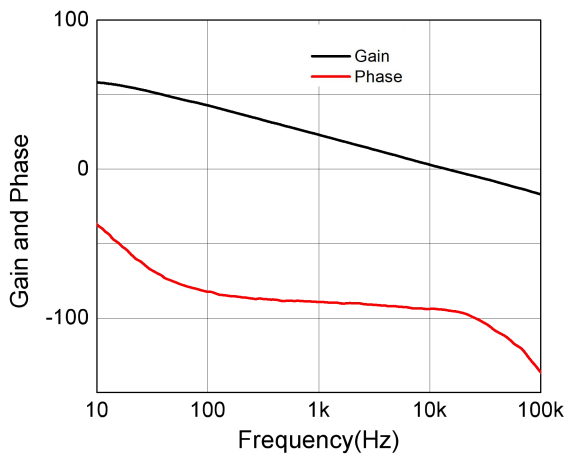
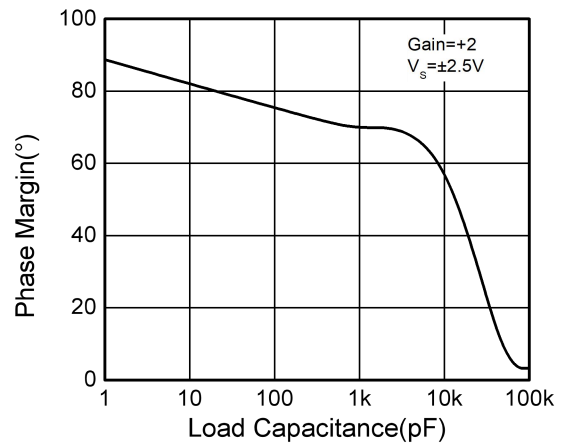
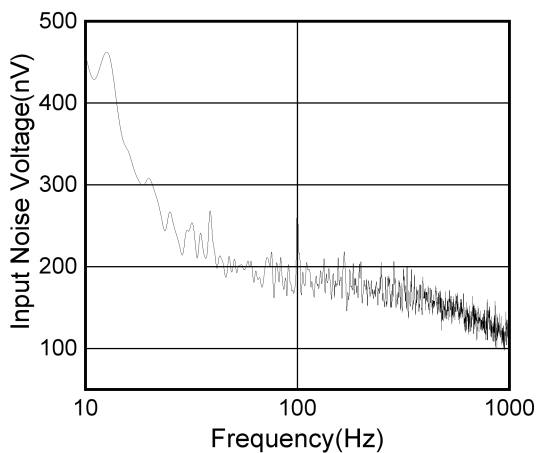
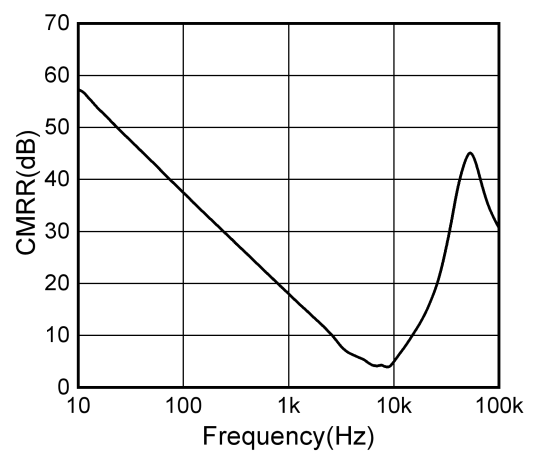
The *denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 27^\circ\text{C}$. $V_S = 5\text{V}$, $V_{\text{CM}} = V_{\text{OUT}} = V_S/2$, $R_{\text{load}} = 100\text{k}\Omega$, $C_{\text{load}} = 60\text{pF}$.

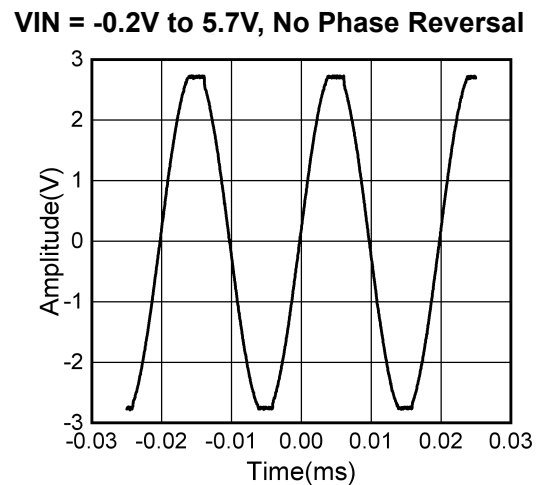
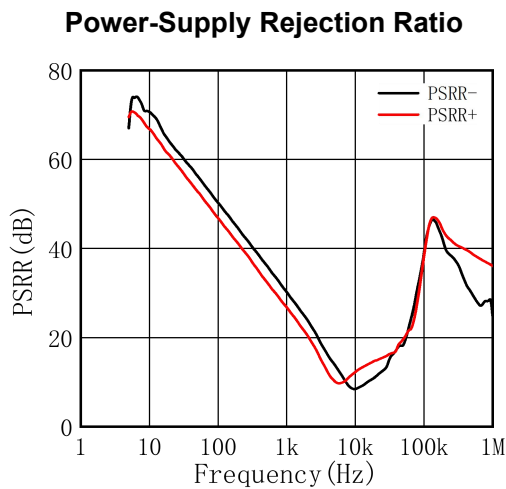
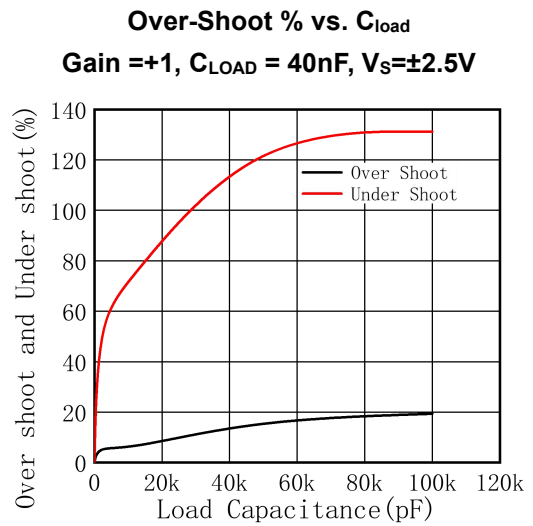
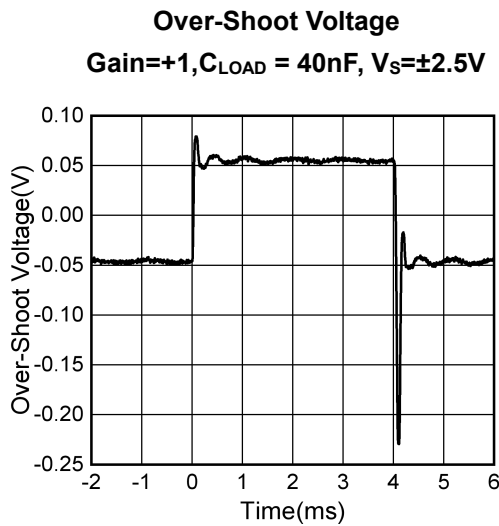
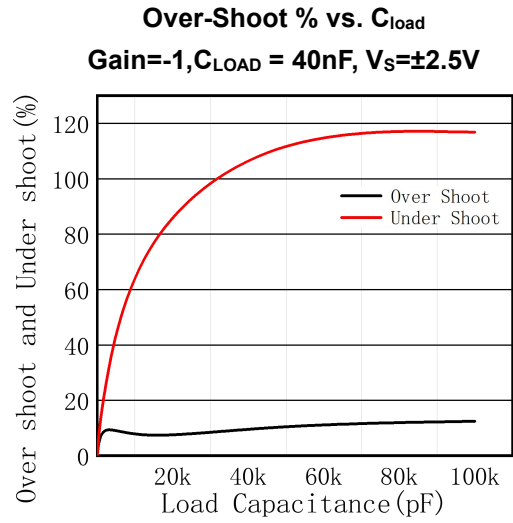
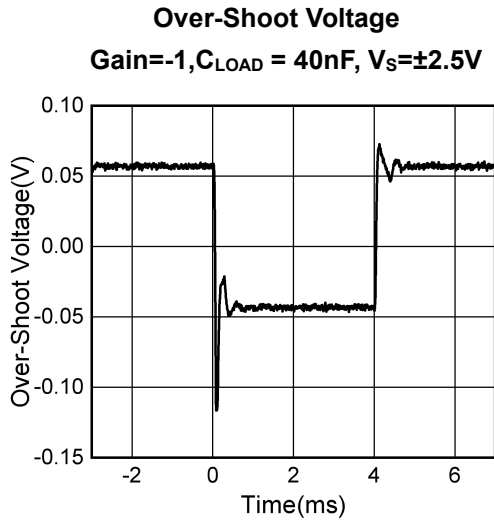
| Symbol | Parameter | | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------------|---------------------------------------|---------------------------|---|---------------|-----------|---------------|------------------------------|
| V_{OS} | Input Offset Voltage | | $V_{\text{CM}} = V_S/2$ and $V_{\text{CM}} = \text{GND}$ * | -3.5 | ± 0.1 | 3.5 | mV |
| α_{VOS} | Input Offset Voltage Drift | | | | 1.6 | | $\mu\text{V}/^\circ\text{C}$ |
| I_{IB} | Input Bias Current | | | | <10 | | pA |
| I_{OS} | Input Offset Current | | | | <10 | | pA |
| V_n | Input Voltage Noise | | $f = 0.1\text{Hz to } 10\text{Hz}$ | | 8 | | $\mu\text{V}_{\text{P-P}}$ |
| e_n | Input Voltage Noise Density | | $f = 1\text{kHz}$ | | 80 | | $\text{nV}/\sqrt{\text{Hz}}$ |
| R_{IN} | Input Resistance | | | | >1 | | $\text{T}\Omega$ |
| CMRR | Common Mode Rejection Ratio | | $V_{\text{CM}} = 0.1\text{V to } 4.9\text{V}$ * | 55 | 75 | | dB |
| V_{CM} | Common Mode Input Voltage Range | | | $(V^-) - 0.3$ | | $(V^+) + 0.3$ | V |
| PSRR | Power Supply Rejection Ratio | | | 65 | 91 | | dB |
| A_{VOL} | Open Loop Large Signal Gain | | $V_{\text{OUT}} = 2.5\text{V}, R_{\text{load}} = 100\text{k}\Omega$ | | 118 | | dB |
| | | | $V_{\text{OUT}} = 0.1\text{V to } 4.9\text{V}, R_{\text{load}} = 100\text{k}\Omega$ * | 85 | 118 | | dB |
| $V_{\text{OL}}, V_{\text{OH}}$ | Output Swing from Supply Rail | | $R_{\text{load}} = 100\text{k}\Omega$ | | 5 | | mV |
| R_{OUT} | Closed-Loop Output Impedance | | $G = 1, f = 1\text{kHz}, I_{\text{OUT}} = 0$ | | 4.3 | | Ω |
| I_{SC} | Output Short-Circuit Current | | Sink or Source Current | 12 | 15 | | mA |
| V_{DD} | Supply Voltage | | | 1.6 | | 5.5 | V |
| I_{Q} | Quiescent Current per Amplifier | | | | 300 | 450 | nA |
| PM | Phase Margin | | $R_{\text{load}} = 100\text{k}\Omega, C_{\text{load}} = 60\text{pF}$ | | 80 | | degrees |
| GM | Gain Margin | | $R_{\text{load}} = 100\text{k}\Omega, C_{\text{load}} = 60\text{pF}$ | | 18 | | dB |
| GBWP | Gain-Bandwidth Product | | $f = 1\text{kHz}$ | | 13 | | kHz |
| t_s | Settling Time | 1.5 to 3.5V, Unity Gain | 0.1% | | 0.4 | | ms |
| | | 2.45 to 2.55V, Unity Gain | 0.1% | | 0.04 | | |
| SR | Slew Rate | | $A_V = 1, V_{\text{OUT}} = 1.5\text{V to } 3.5\text{V}, R_{\text{load}} = 100\text{k}\Omega, C_{\text{load}} = 60\text{pF}$ | | 7 | | $\text{mV}/\mu\text{s}$ |
| FPBW | Full Power Bandwidth ^{Note1} | | $2V_{\text{P-P}}$ | | 300 | | Hz |

Note:

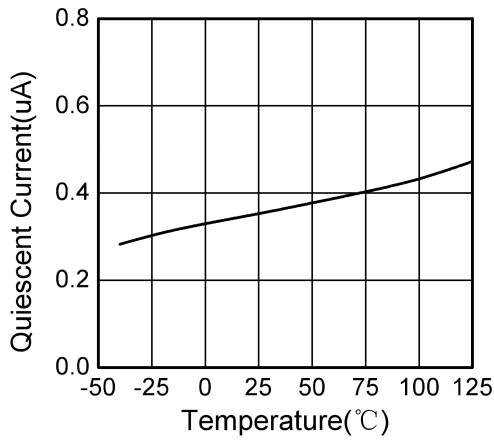
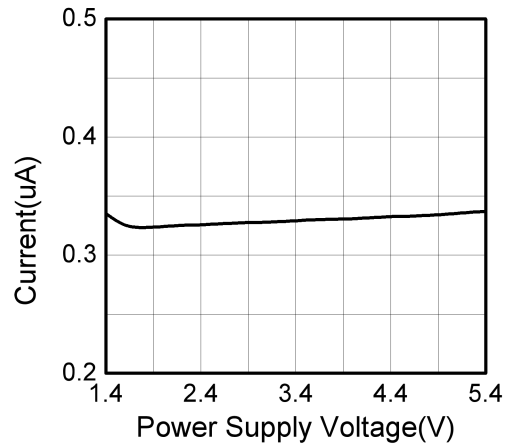
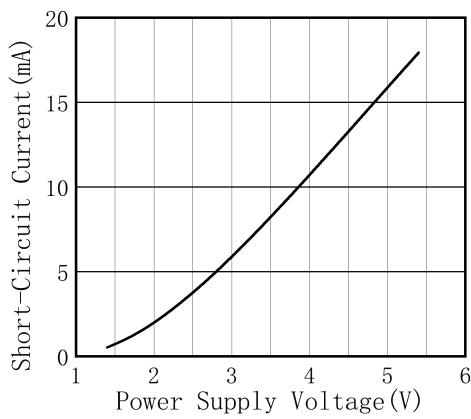
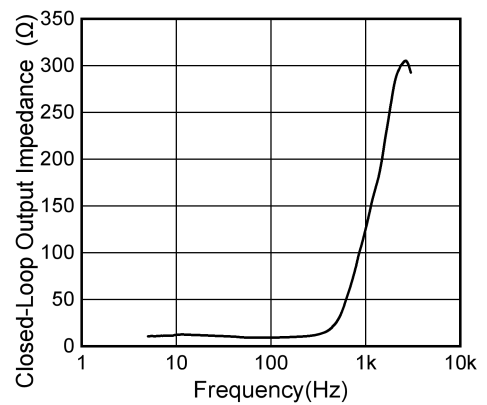
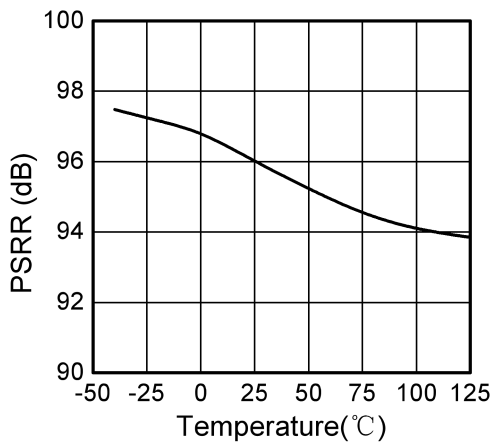
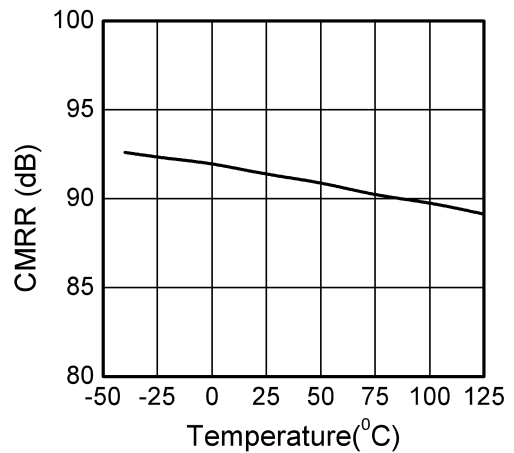
1. Full power bandwidth is calculated from the slew rate $\text{FPBW} = \text{SR}/(\pi \cdot V_{\text{P-P}})$.

Typical Characteristics
 $T_A=25^\circ\text{C}$, $V_S=5\text{V}$, $V_{CM}=V_S/2$, unless otherwise noted

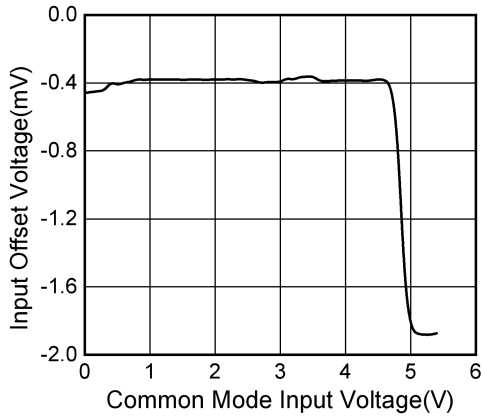
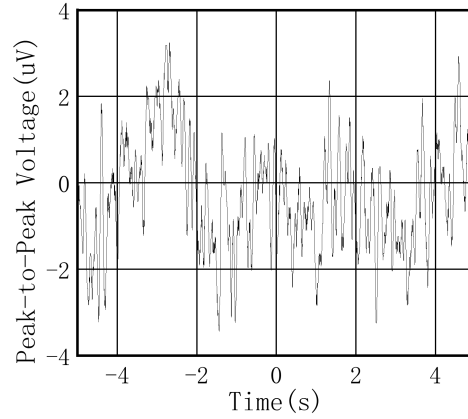
Small-Signal Step Response, 100mV Step

Large-Signal Step Response, 2V Step

Open-Loop Gain and Phase

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

Input Voltage Noise Spectral Density

CMRR vs. Frequency


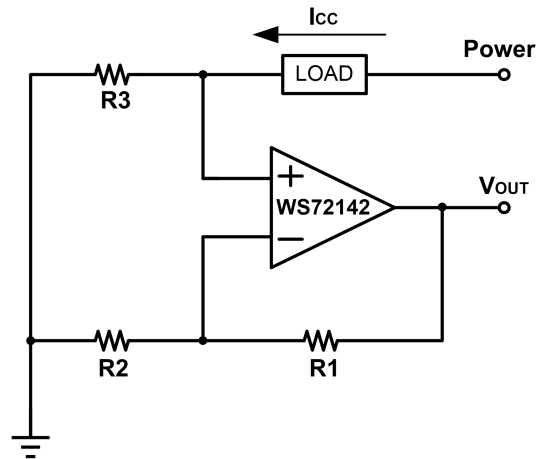
Typical Characteristics (continued)
 $T_A=25^{\circ}\text{C}$, $V_S=5\text{V}$, $V_{\text{CM}}=V_S/2$, unless otherwise noted


Typical Characteristics (continued)
 $T_A=25^{\circ}\text{C}$, $V_S=5\text{V}$, $V_{CM}=V_S/2$, unless otherwise noted

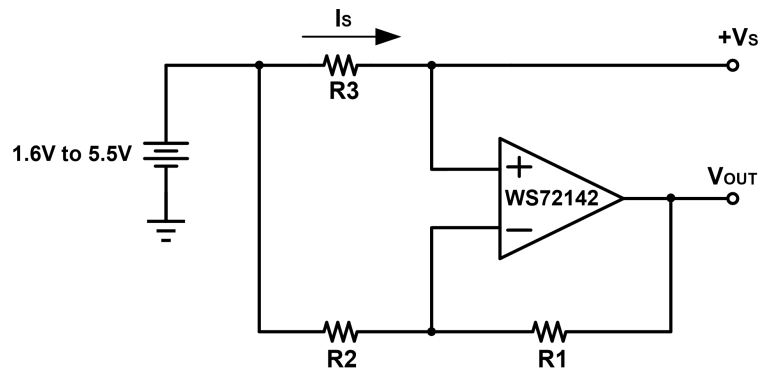
Quiescent Supply Current vs. Temperature

Quiescent Supply Current vs. Supply Voltage

Short-Circuit Current vs. Supply Voltage

Closed-Loop Output Impedance vs. Frequency

PSRR vs. Temperature

CMRR vs. Temperature


Typical Characteristics (continued)
 $T_A=25^{\circ}\text{C}$, $V_S=5\text{V}$, $V_{CM}=V_S/2$, unless otherwise noted

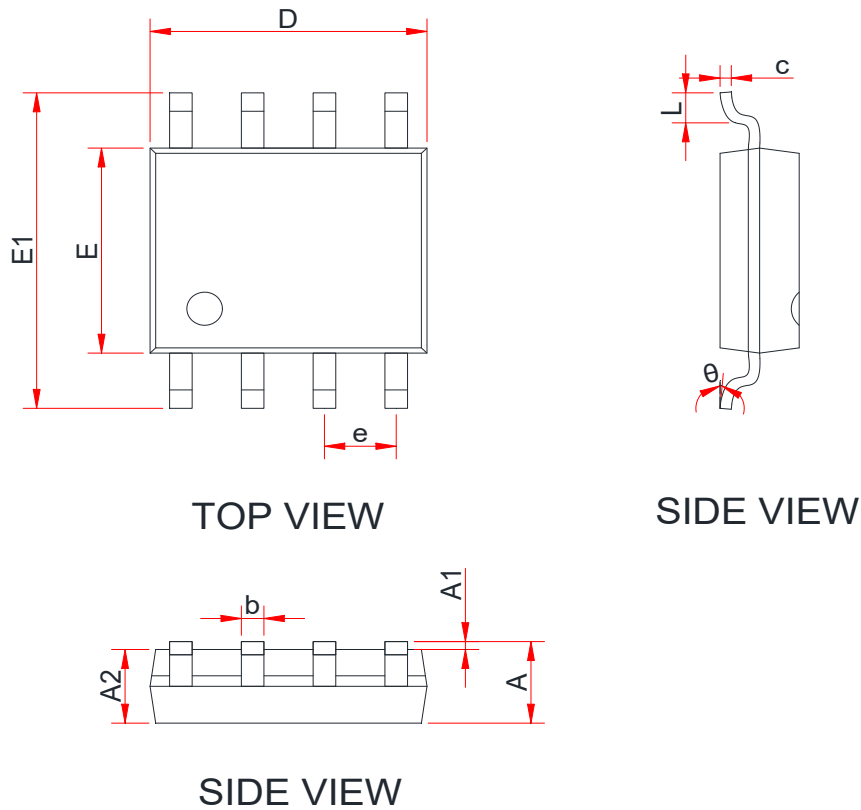
Input Offset Voltage vs. Common Mode Input Voltage

0.1Hz to 10Hz Time Domain Output Voltage Noise


Application Circuit
(1) WS72142 in Low Side Battery Current Sensor

Application Circuit for Low Side Battery Current Sensor

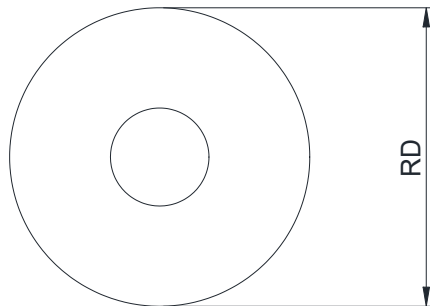
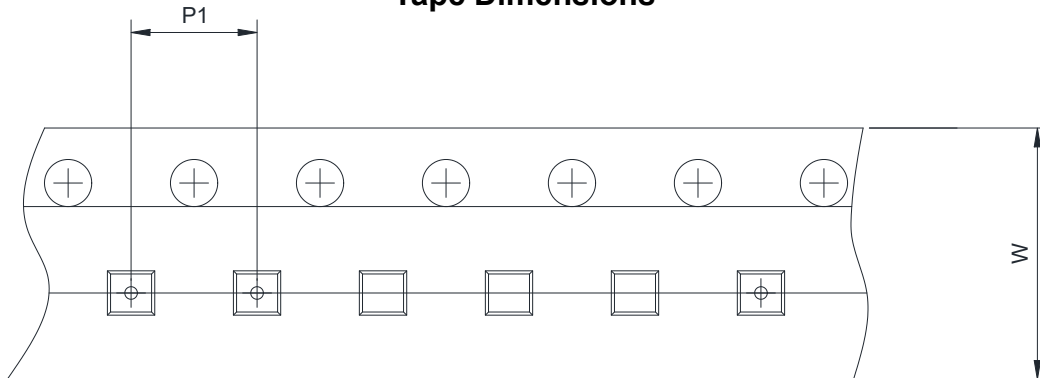
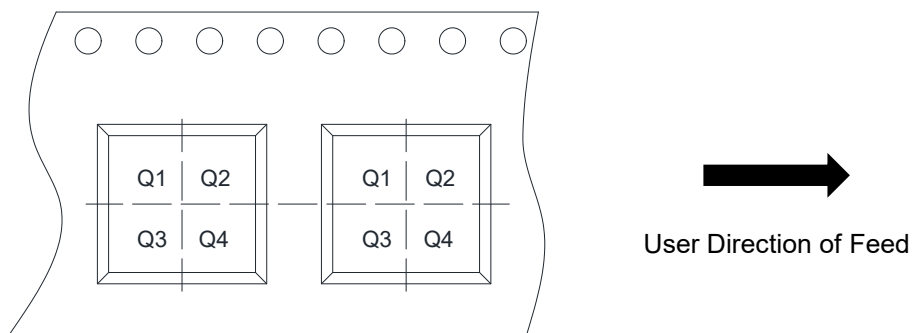
$$V_{OUT} = I_{CC} \times R_3 \times \left(\frac{R_1}{R_2} + 1 \right)$$

(2) WS72142 in High Side Battery Current Sensor

Application Circuit for High Side Battery Current Sensor

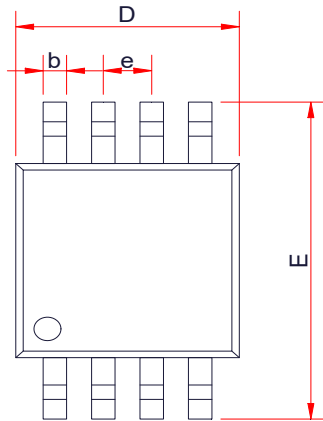
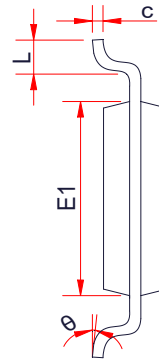
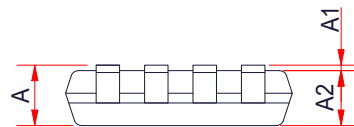
$$I_S = \frac{+V_S - V_{OUT}}{R_1 \times R_3 \div R_2}$$

PACKAGE OUTLINE DIMENSIONS
SOP-8L


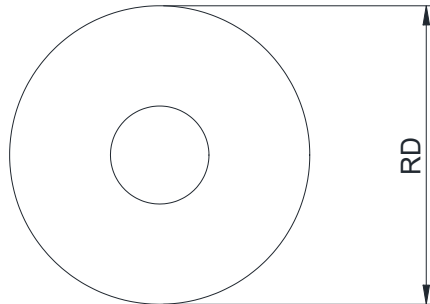
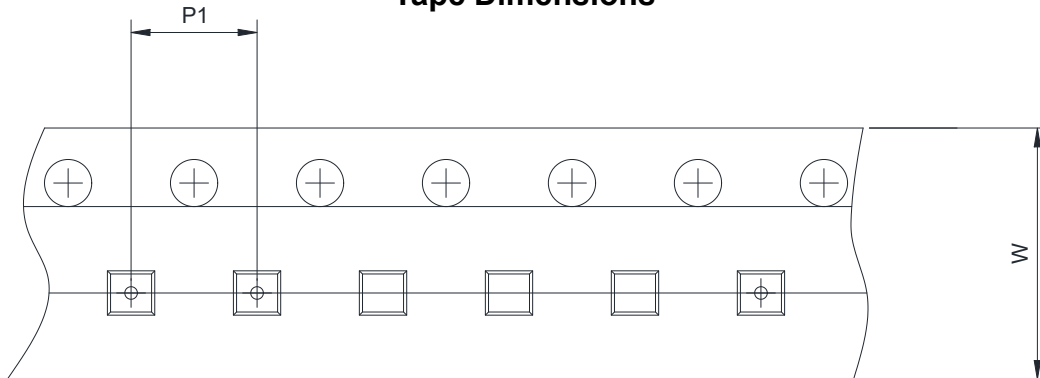
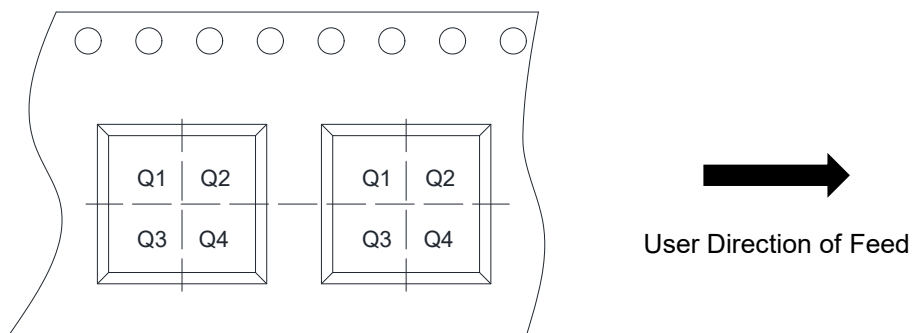
| Symbol | Dimensions In Millimeters (mm) | | |
|----------|--------------------------------|------|------|
| | Min. | Typ. | Max. |
| A | 1.35 | 1.55 | 1.75 |
| A1 | 0.05 | 0.15 | 0.25 |
| A2 | 1.25 | 1.40 | 1.65 |
| b | 0.33 | - | 0.51 |
| c | 0.15 | - | 0.26 |
| D | 4.70 | 4.90 | 5.10 |
| E | 3.70 | 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
SOP-8L
Reel Dimensions

Tape Dimensions

Quadrant Assignments For PIN1 Orientation In Tape


| | | | | | |
|------|---|--|--|---|-----------------------------|
| RD | Reel Dimension | <input type="checkbox"/> 7inch | <input checked="" type="checkbox"/> 13inch | | |
| W | Overall width of the carrier tape | <input type="checkbox"/> 8mm | <input checked="" type="checkbox"/> 12mm | | |
| P1 | Pitch between successive cavity centers | <input type="checkbox"/> 2mm | <input type="checkbox"/> 4mm | <input checked="" type="checkbox"/> 8mm | |
| Pin1 | Pin1 Quadrant | <input checked="" type="checkbox"/> Q1 | <input type="checkbox"/> Q2 | <input type="checkbox"/> Q3 | <input type="checkbox"/> 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
MSOP-8L
Reel Dimensions

Tape Dimensions

Quadrant Assignments For PIN1 Orientation In Tape


| | | | | | |
|------|---|--|--|---|-----------------------------|
| RD | Reel Dimension | <input type="checkbox"/> 7inch | <input checked="" type="checkbox"/> 13inch | | |
| W | Overall width of the carrier tape | <input type="checkbox"/> 8mm | <input checked="" type="checkbox"/> 12mm | | |
| P1 | Pitch between successive cavity centers | <input type="checkbox"/> 2mm | <input type="checkbox"/> 4mm | <input checked="" type="checkbox"/> 8mm | |
| Pin1 | Pin1 Quadrant | <input checked="" type="checkbox"/> Q1 | <input type="checkbox"/> Q2 | <input type="checkbox"/> Q3 | <input type="checkbox"/> Q4 |

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[NJM358CG-TE2](#) [HA1630S01LPEL-E](#) [LM324AWPT](#) [HA1630Q06TELL-E](#)