## DESCRIPTION

The AO2170 offers high voltage (36V), cost-optimized operation amplifier. AO2170 also offers strong general-purpose DC and AC specifications, including rail-to-rail output, low offset, low offset drift and 1.2MHz bandwidth.

Convenient features such as wide differential input voltage range, high output current, and high slew rate of 0.67V/us make the AO2170 a robust operational amplifier for high-voltage, cost-effective applications. as well as excellent speed/power consumption ratio, providing an excellent bandwidth (1.2MHz) and slew rate of 0.67V/us. The op-amps are unity gain stable and feature an ultra- low input bias current.

The AO2170 is stable at capacitance up to 100pF (Typ) and operation under single power supplies of 3V to 36V or dual power supplies of ±1.5V to ±18V.

The AO2170 is available in SOP8 and MSOP8 packages.

## ORDERING INFORMATION

| Package Type | Part Number | |
|---|---|---|
| SOP8<br>SPQ: 4,000pcs/Reel | M8 | AO2170M8R |
| | | AO2170M8VR |
| MSOP8<br>SPQ: 4,000pcs/Reel | MS8 | AO2170MS8R |
| | | AO2170MS8VR |
| Note | V: Halogen free Package<br>R: Tape & Reel | |
| AiT provides all RoHS products | | |

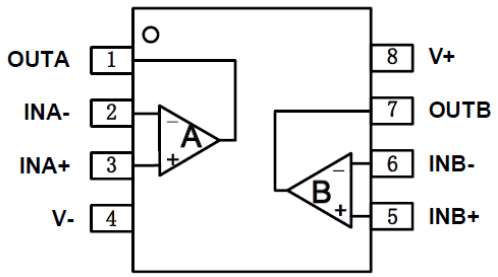
## FEATURES

- Low Offset Voltage: ±0.8mV (Typical)
- Low Offset Voltage Drift: ±3uV/°C
- Low Noise: 45nV/√Hz at 1kHz
- High Common-Mode Rejection Ratio: 110dB
- Low Bias Current: ±10pA
- Rail-to-Rail Output
- Wide Bandwidth:1.2MHz GBW
- High Slew Rate: 0.67V/us
- Low Quiescent Current:150uA per Amplifier
- Supply Range: +3V to +36V
- Available in SOP8 and MSOP8 packages

## APPLICATION

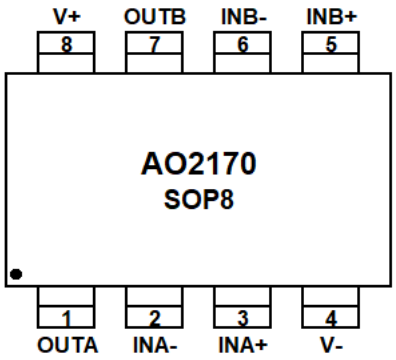
- Merchant Network and Server PSU
- Industrial AC-DC & Merchant DC/DC
- Motor Drives: AC and Servo Drive Power Supplies
- Building Automation
- Sensors
- Photodiode Amplification
- Active Filters
- Test Equipment

## TYPICAL APPLICATION

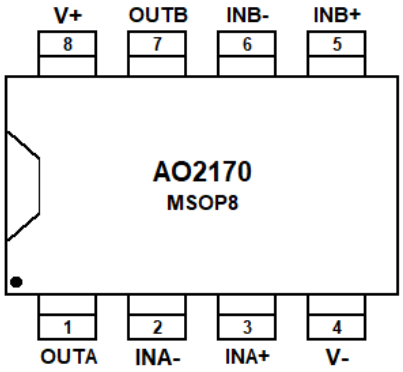



SOP8/MSO8

## PIN DESCRIPTION




Top View




Top View

| Pin # | | Symbol | I/O | Function |
|---|---|---|---|---|
| SOP8 | PSOP8 | | | |
| 1 | 1 | OUTA | O | Output, channel A |
| 2 | 2 | INA- | I | Inverting input, channel A |
| 3 | 3 | INA+ | I | Noninverting input, channel A |
| 4 | 4 | V- | - | Negative (lowest) power supply or ground (for single supply operation) |
| 5 | 5 | INB+ | I | Noninverting input, channel B |
| 6 | 6 | INB- | I | Inverting input, channel B |
| 7 | 7 | OUTB | O | Output, channel B |
| 8 | 8 | V+ | - | Positive (highest) power supply |

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range, unless otherwise noted

| | | |
|---|---|---|
| Supply Voltage, Vs=(V+) - (V-) | | -0.7V ~ 36V |
| Signal Input Voltage Pin[NOTE1] | | (V-)-0.2V ~ (V+)0.2V |
| Signal Output Voltage Pin[NOTE2] | | (V-)-0.2V ~ (V+)0.2V |
| Signal Input Current Pin[NOTE1] | | -10mA ~ 10mA |
| Signal Output Current Pin[NOTE2] | | -100mA ~ 100mA |
| Output Short-Circuit Current[NOTE3] | | Continuous |
| $T_A$, Operating Range Temperature | | -40℃ ~ 125℃ |
| $T_J$, Junction Temperature | | 150℃ |
| $T_{STG}$, Storage Temperature | | -55℃ ~ 150℃ |
| **ESD Ratings[NOTE4]** | | |
| $V_{(ESD)}$, Electrostatic discharge | Human-body model (HBM) | ±5000V |
| | Machine Model (MM) | ±200V |

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

NOTE1: Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.

NOTE2: Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.5V beyond the supply rails should be current-limited to ±100mA or less.

NOTE3: Short-circuit to ground, one amplifier per package.

NOTE4: JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

## RECOMMENDED OPERATING CONDITIONS

over operating free-air temperature range, unless otherwise noted

| Parameter | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Supply voltage Vs= (V+) - (V-) | Single-Supply | 3 | - | 36 | V |
| | Dual-Supply | ±1.5 | - | ±18 | |

## ELECTRICAL CHARACTERISTICS

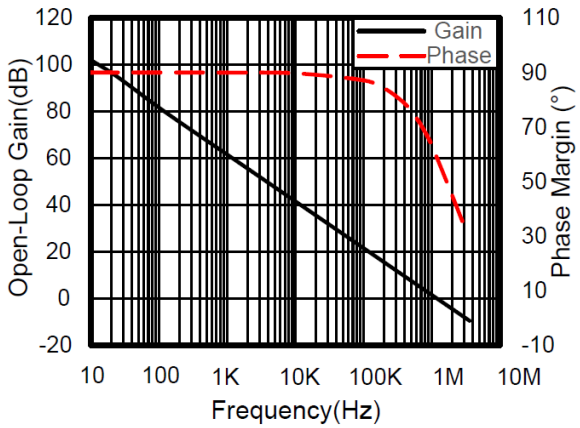
at $T_A$ = +25°C, Vs=3V to 36V, $R_L$ = 10kΩ connected to $V_S$/2, and $V_{OUT}$ = $V_S$/2, unless otherwise noted.

| Parameter | Symbol | Conditions | $T_J$ | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **POWER SUPPLY** | | | | | | | |
| Operating Voltage Range | Vs | | +25°C | 3 | - | 36 | V |
| Quiescent Current/Amplifier | $I_Q$ | Vs=±2.5V, Io=0mA | +25°C | - | 150 | 250 | uA |
| | | Vs=±18V, Io=0mA | | - | 200 | 350 | |
| Power-Supply Rejection Ratio | PSRR | Vs=5V to 36V | +25°C | 98 | 120 | - | dB |
| **INPUT** | | | | | | | |
| Input Offset Voltage | Vos | $V_{CM}$=$V_S$/2 | +25°C | -4 | ±0.8 | 4 | mV |
| | | | -40°C to 125°C | - | ±1.1 | | |
| Input Offset Voltage Average Drift | Vos Tc | | -40°C to 125°C | - | 3 | - | uV/°C |
| Input Bias Current | $I_B$ | $V_{CM}$=0V | +25°C | - | 10 | 60 | pA |
| | | | -40°C to 125°C | - | 600 | - | |
| Input Offset Current | $I_{OS}$ | $V_{CM}$=0V | +25°C | - | 10 | 60 | pA |
| | | | -40°C to 125°C | - | 600 | - | |
| Common-Mode Voltage Range | $V_{CM}$ | Vs= ±18V | +25°C | (V-)-0.1 | - | (V+)-2 | V |
| Common-Mode Rejection Ratio | CMRR | Vs=±2.5V, $V_{CM}$=(V-)-0.1V to (V+)-2V | +25°C | 70 | 110 | - | dB |
| | | Vs=±18V, $V_{CM}$=(V-)-0.1V to (V+)-2V | +25°C | 70 | - | - | |
| **OUTPUT** | | | | | | | |
| Open-Loop Voltage Gain | $A_{OL}$ | $R_L$=10KΩ, Vo=(V-)-0.6V to (V+)-0.6V | +25°C | 93 | 115 | - | dB |
| Output Swing | $V_{OH}$ | $V_S$=±18V, $R_L$=10KΩ | +25°C | 17.85 | - | - | V |
| | $V_{OL}$ | | | - | - | -17.85 | V |
| Short-Circuit Current | $I_{SC}$ | $V_S$=36V, Vo=0V | +25°C | - | 70 | - | mA |
| Capacitive Load Drive | $C_{LOAD}$ | | +25°C | - | 100 | - | pF |
| **FREQUENCY RESPONSE** | | | | | | | |
| Slew Rate | SR | G=+1, $C_L$=100pF | +25°C | - | 0.67 | - | V/us |
| Gain-Bandwidth Product | GBW | | +25°C | - | 1.2 | - | MHz |
| Setting Time,0.01% | ts | $V_S$=±2.5V, G=+1, $C_L$=100pF, Step=2V | +25°C | - | 5 | - | us |
| Overload Recovery Time | $t_{OR}$ | $V_{IN}$·Gain≥$V_S$, G=11 | +25°C | - | 5 | - | us |
| Turn On Time | $t_{ON}$ | | +25°C | - | 10 | - | us |
| **NOISE** | | | | | | | |
| Input Voltage Noise | En | f=0.1Hz to 10Hz, Vs=±2.5V | +25°C | - | 16 | - | uVpp |
| Input Voltage Noise Density | en | f=1KHz | +25°C | - | 45 | - | nV/√Hz |

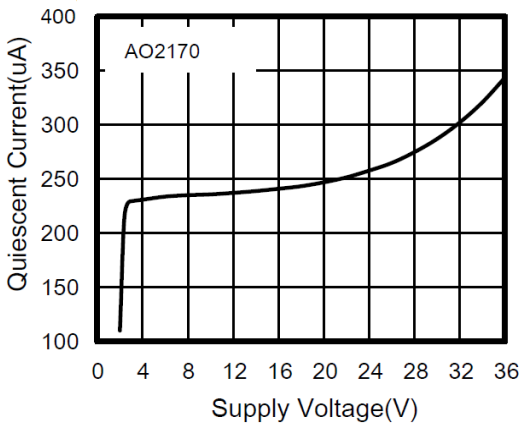
## TYPICAL PERFORMANCE CHARACTERISTICS

at $T_A$ = +25°C, $V_S$=±18V, $R_L$ = 10kΩ connected to $V_S$/2, $V_{OUT}$ = $V_S$/2, unless otherwise noted.

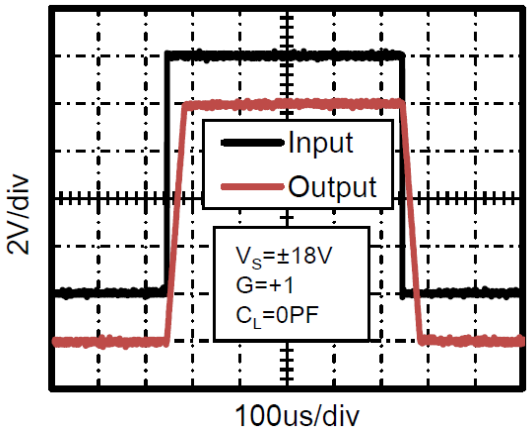
1. Open-Loop Gain and Phase vs. Frequency



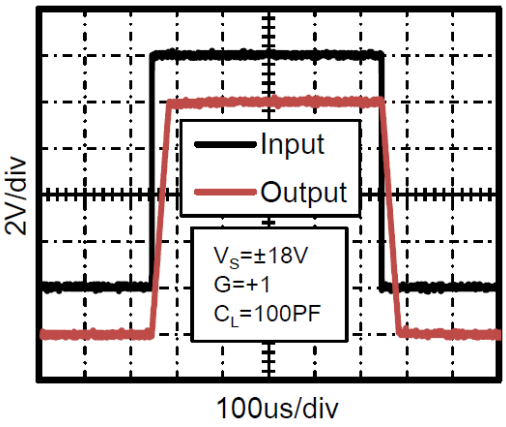

2. Supply Voltage vs. Quiescent Current



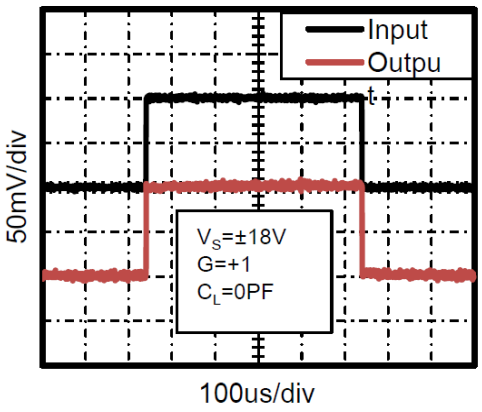

3. Large Signal Step Response



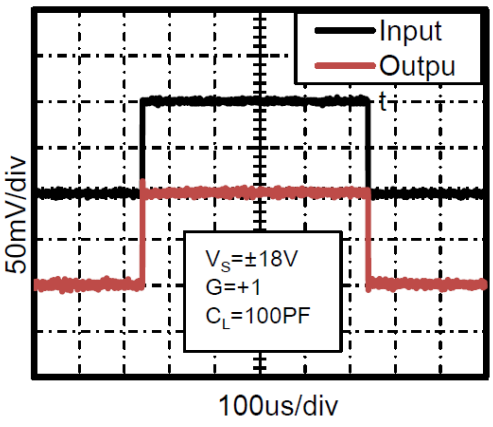

4. Large Signal Step Response



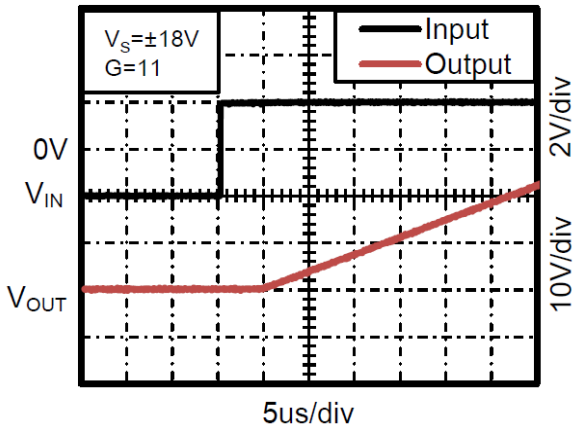

5. Small Signal Step Response



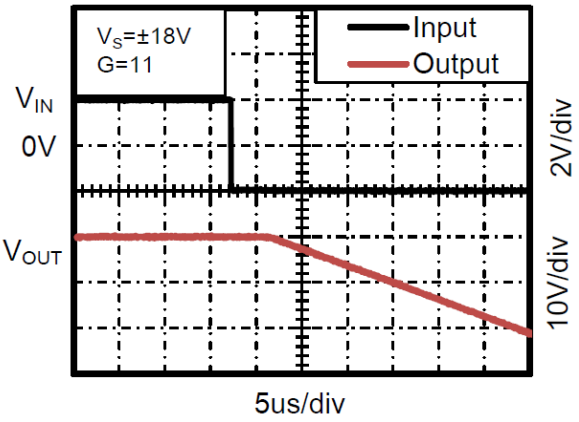

6. Small Signal Step Response



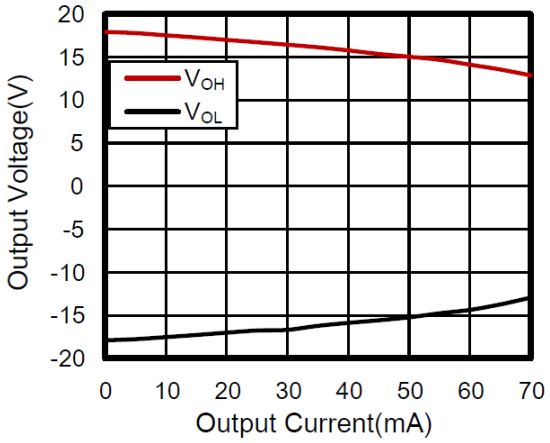
7. Positive Overvoltage Recovery



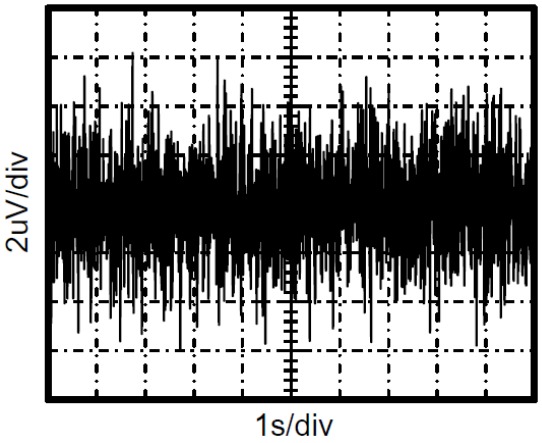

8. Negative Overvoltage Recovery




9. Output Voltage Swing vs Output Current

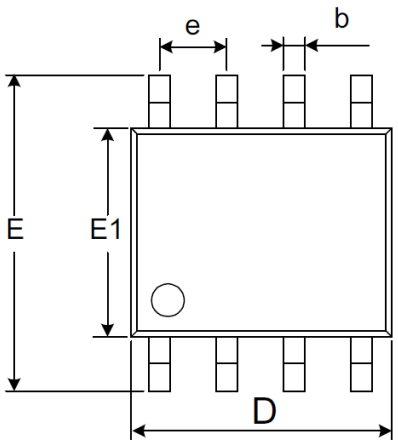


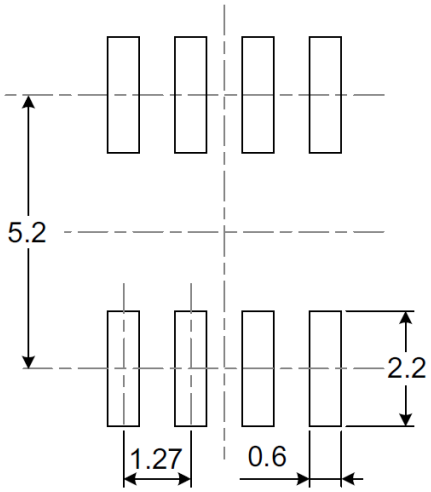

10. 0.1Hz to 10Hz Noise at $V_S$=5V



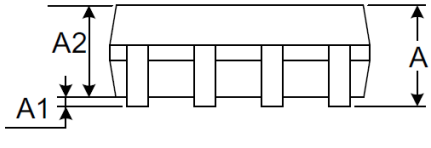
## PACKAGE INFORMATION

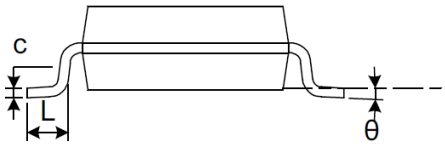
Dimension in SOP8 (Unit: mm)



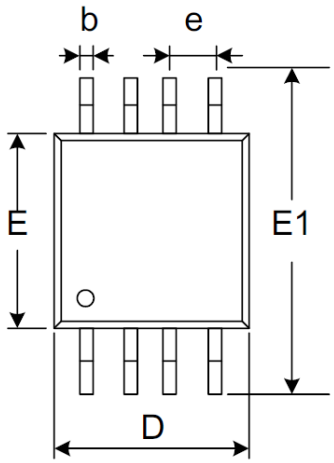

RECOMMENDED LAND PATTERN (Unit: mm)

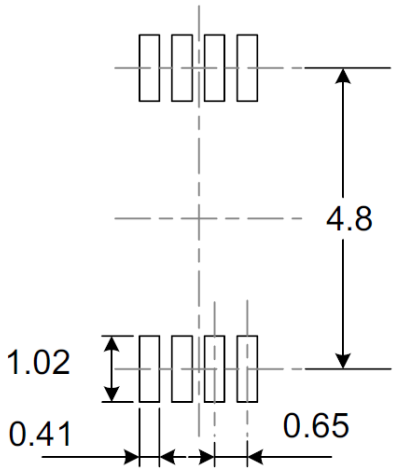


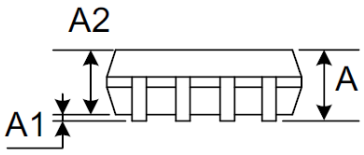

| Symbol | Millimeters | | Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.007 | 0.010 |
| D | 4.800 | 5.000 | 0.187 | 0.197 |
| e | 1.270 BSC | | 0.050 BSC | |
| E | 5.800 | 6.200 | 0.228 | 0.244 |
| E1 | 3.800 | 4.000 | 0.150 | 0.157 |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

Dimension in MSOP8 (Unit: mm)




RECOMMENDED LAND PATTERN (Unit: mm)





| Symbol | Millimeters | | Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.820 | 1.100 | 0.032 | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 0.380 | 0.010 | 0.015 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| e | 0.650 BSC | | 0.026 BSC | |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 4.750 | 5.050 | 0.187 | 0.199 |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0° | 6° | 0° | 6° |

# IMPORTANT NOTICE

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