

RRIO 1.8 V High-Speed Push-Pull Output Comparator

Features

- Propagation Delay: 35 ns
- Low Current Consumption: 58 μ A
- Rail-to-Rail Inputs and Output
- Push-Pull Output
- Supply Operation From 1.8 V to 5 V
- Wide Temperature Range: -40 $^{\circ}$ C to 125 $^{\circ}$ C
- High ESD Tolerance: 6 kV HBM, 1.5 kV CDM
- Latch-Up Immunity: \pm 200 mA
- SOT 23 - 5L Package

Applications

- Telecom
- Instrumentation
- Testing Equipment
- Testing and Measurement
- Signal Conditioning
- High-Speed Sampling Systems
- Portable Communication Systems

General Description

The AWS79101 single comparator features high-speed response time with rail-to-rail inputs. With a supply voltage specified from 1.8 V to 5 V, this comparator can operate over a wide temperature range: -40 $^{\circ}$ C to 125 $^{\circ}$ C.

The AWS79101 comparator offers micropower consumption as low as a few tens of microamperes thus providing an excellent ratio of power consumption current versus response time.

The AWS79101 includes push-pull outputs and is available in small packages (SOT 23 – 5L).

Typical Application Circuit

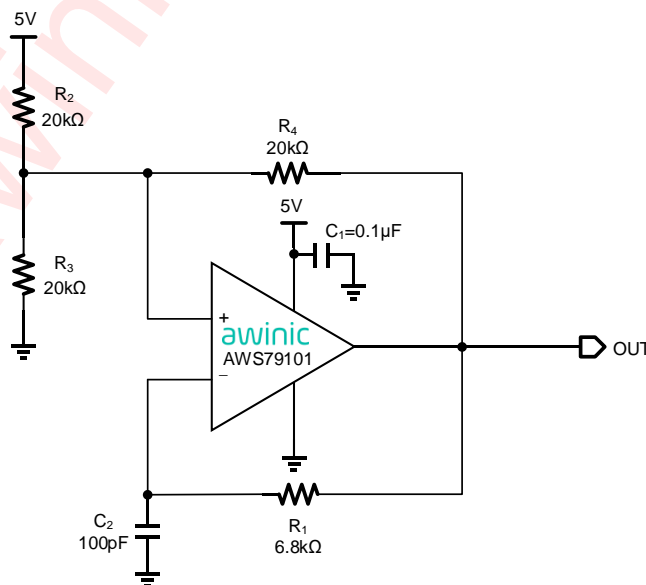


Figure 1 Typical Application of AWS79101

Pin Configuration And Top Mark

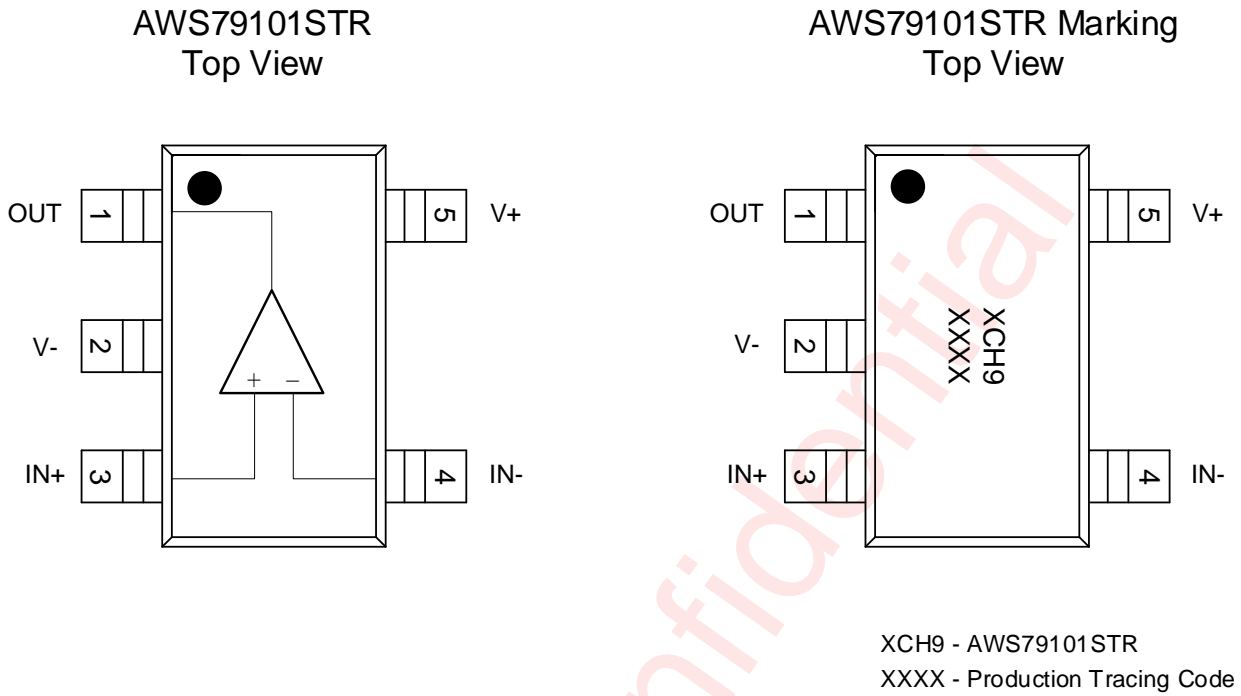


Figure 2 Pin Configuration

Pin Definition

| No. | NAME | DESCRIPTION |
|-----|------|---|
| 1 | OUT | Output |
| 2 | V- | Negative (low) supply or ground (for single-supply operation) |
| 3 | IN+ | Noninverting input |
| 4 | IN- | Inverting input |
| 5 | V+ | Positive (high) supply |

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Functional Block Diagram

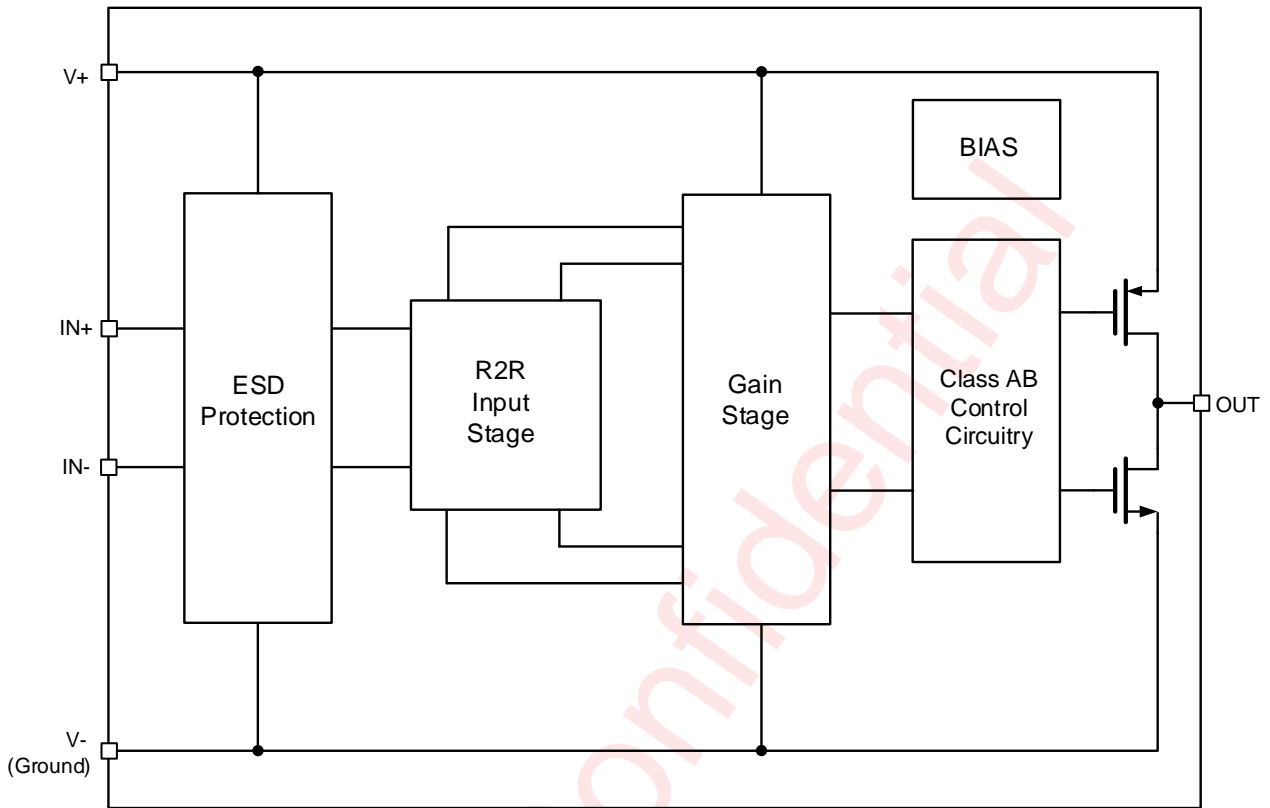


Figure 3 Functional Block Diagram

Typical Application Circuits

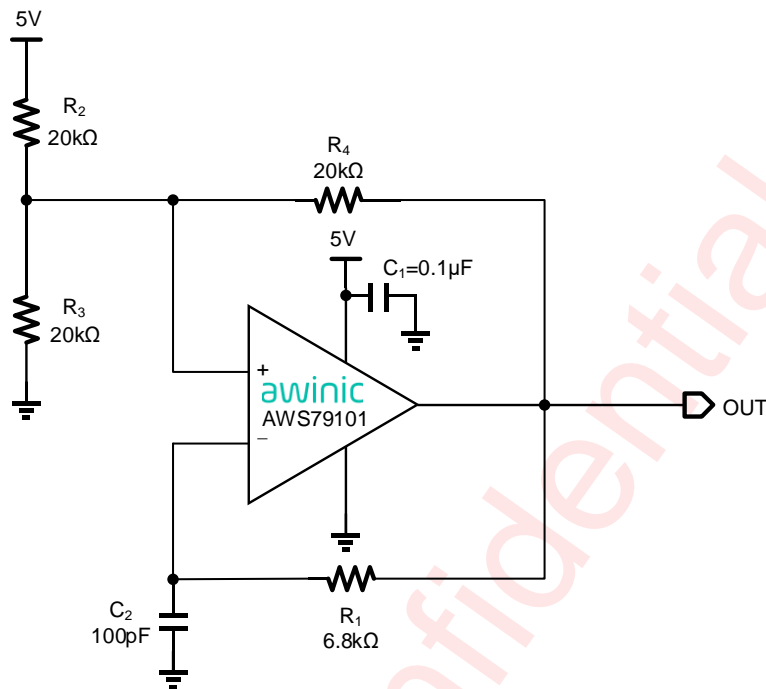


Figure 4 AWS79101 Application Circuit

- **Notice for typical application circuits:**

1. Bypass capacitors C_1 is used to reduce the coupled noise by providing a low-impedance path to ground. So low-ESR, 0.1 μF ceramic bypass capacitors are necessary between each supply pin and ground, placed close to the device, but far away from input traces.

Ordering Information

| Part Number | Temperature | Package | Marking | Moisture Sensitivity Level | Environmental Information | Delivery Form |
|-------------|-----------------|-------------|---------|----------------------------|---------------------------|------------------------------|
| AWS79101STR | -40 °C ~ 125 °C | SOT 23 - 5L | XCH9 | MSL1 | RoHS+HF | 3000 units/ Tape and Reel |

Absolute Maximum Ratings (NOTE1)

| PARAMETERS | RANGE |
|--|----------------------------------|
| Supply voltage, $V_S = (V+) - (V-)$ (NOTE 1) | 5.5 V |
| Differential input voltage (NOTE 2) | ± 5 V |
| Input voltage range | $(V-) - 0.3$ V to $(V+) + 0.3$ V |
| Operating temperature range | -40 °C to 125 °C |
| Storage temperature T_{STG} | -65 °C to 150 °C |
| Junction temperature T_{JMAX} | 150 °C |
| Lead temperature (soldering 10 seconds) | 260 °C |

NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE2: Input pins are diode-clamped to each power supply. Input signals that may extend more than 0.5 V beyond the supply rails must be current limited to 10 mA or less.

ESD Rating and Latch Up

| PARAMETERS | VALUE | UNIT |
|---------------------------------|-----------------------|------|
| HBM (Human Body Model) (NOTE 3) | ± 6 | kV |
| CDM (NOTE 4) | ± 1.5 | kV |
| Latch-Up (NOTE 5) | +IT: 200 -IT: -200 | mA |

NOTE3: The human body model is a 100 pF capacitor discharged through a 1.5 k Ω resistor into each pin. Test method: ESDA/JEDEC JS-001-2017

NOTE4: Test method: ESDA/JEDEC JS-002-2018

NOTE5: Test method: JEDEC78E

Thermal Information

| THERMAL METRICS | | | |
|-----------------|--|-------|------|
| SYMBOL | PARAMETER | VALUE | UNIT |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 280 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 124 | °C/W |
| $R_{\theta JC}$ | Junction-to-case (top) thermal resistance | 149 | °C/W |
| Ψ_{JT} | Junction-to-top characterization parameter | 142 | °C/W |
| Ψ_{JB} | Junction-to-board characterization parameter | 211 | °C/W |

Electrical Characteristics

Electrical characteristics at $V_{CC} = 2\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, and full V_{CM} range(unless otherwise specified)

| SYMBOL | PARAMETER | TEST CONDITION ⁽¹⁾ | T_A | MIN | TYP | MAX | UNIT |
|--------------------------|--|---|----------------|------|---------|-----|------------------------------|
| V_{IO} | Input offset voltage | | 25 °C | | 0.5 | 6 | mV |
| | | | -40 °C ~125 °C | | | 7 | |
| $\Delta V_{IO}/\Delta T$ | Input offset voltage drift | | -40 °C ~125 °C | | 3 | 20 | $\mu\text{V}/^\circ\text{C}$ |
| I_{IO} | Input offset current ⁽²⁾ | | 25 °C | | ± 1 | | pA |
| I_{IB} | Input bias current ⁽²⁾ | | 25 °C | | ± 1 | | pA |
| I_{CC} | Supply current | No load, output high, $V_{CM} = 0\text{ V}$ | 25 °C | | 50 | | μA |
| | | | -40 °C ~125 °C | | | 105 | |
| | | No load, output low, $V_{CM} = 0\text{ V}$ | 25 °C | | 55 | | |
| | | | -40 °C ~125 °C | | | 110 | |
| I_{SC} | Short-circuit current | Source | 25 °C | | 14 | | mA |
| | | Sink | 25 °C | | 12 | | mA |
| V_{OH} | Output voltage high | $I_{SOURCE} = 1\text{ mA}$ | 25 °C | | 1.95 | | V |
| | | | -40 °C ~125 °C | 1.80 | | | |
| V_{OL} | Output voltage low | $I_{SINK} = 1\text{ mA}$ | 25 °C | | 40 | | mV |
| | | | -40 °C ~125 °C | | | 120 | |
| CMRR | Common mode rejection ratio | $0 < V_{CM} < 2\text{ V}$ | 25 °C | | 70 | | dB |
| SVR | Supply voltage rejection | $\Delta V_{CC} = 2\text{ V to } 5\text{ V}$ | 25 °C | | 80 | | |
| T_{PLH} | Propagation delay, low to high output level ⁽³⁾ | $V_{CM} = 0\text{ V}$, $f = 10\text{ kHz}$, $C_L = 50\text{ pF}$, overdrive = 100 mV | 25 °C | | 38 | | ns |
| | | | 25 °C | | 48 | | |
| T_{PHL} | Propagation delay, high to low output level ⁽⁴⁾ | $V_{CM} = 0\text{ V}$, $f = 10\text{ kHz}$, $C_L = 50\text{ pF}$, overdrive = 100 mV | 25 °C | | 38 | | |
| | | | 25 °C | | 50 | | |

| SYMBOL | PARAMETER | TEST CONDITION ⁽¹⁾ | T _A | MIN | TYP | MAX | UNIT |
|----------------|-----------|---|----------------|-----|-----|-----|------|
| T _F | Fall time | f = 10 kHz, C _L = 50 pF, R _L = 10 kΩ, overdrive = 100 mV | 25 °C | | 8 | | ns |
| T _R | Rise time | f = 10 kHz, C _L = 50 pF, R _L = 10 kΩ, overdrive = 100 mV | 25 °C | | 9 | | |

NOTES:

- (1) All values over the temperature range are guaranteed through correlation and simulation. No production test is performed at the temperature range limits.
- (2) Maximum values include unavoidable inaccuracies of the industrial tests.
- (3) Response time is measured 10%/90% of the final output value with the following conditions: inverting input voltage (IN-) = V_{CM} and non-inverting input voltage (IN+) moving from V_{CM} - 100 mV to V_{CM} + overdrive.
- (4) Response time is measured 10%/90% of the final output value with the following conditions: inverting input voltage (IN-) = V_{CM} and non-inverting input voltage (IN+) moving from V_{CM} + 100 mV to V_{CM} - overdrive.

Electrical characteristics at $V_{CC} = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, and full V_{CM} range(unless otherwise specified)

| SYMBOL | PARAMETER | TEST CONDITION ⁽¹⁾ | T_A | MIN | TYP | MAX | UNIT |
|--------------------------|--|---|----------------|------|---------|-----|------------------------------|
| V_{IO} | Input offset voltage | | 25 °C | | 0.5 | 6 | mV |
| | | | -40 °C ~125 °C | | | 7 | |
| $\Delta V_{IO}/\Delta T$ | Input offset voltage drift | | -40 °C ~125 °C | | 3 | 20 | $\mu\text{V}/^\circ\text{C}$ |
| I_{IO} | Input offset current ⁽²⁾ | | 25 °C | | ± 1 | | μA |
| I_{IB} | Input bias current ⁽²⁾ | | 25 °C | | ± 1 | | μA |
| I_{CC} | Supply current | No load, output high, $V_{CM} = 0\text{ V}$ | 25 °C | | 52 | | μA |
| | | | -40 °C ~125 °C | | | 85 | |
| | | No load, output low, $V_{CM} = 0\text{ V}$ | 25 °C | | 57 | | |
| | | | -40 °C ~125 °C | | | 90 | |
| I_{SC} | Short-circuit current | Source | 25 °C | | 39 | | mA |
| | | Sink | 25 °C | | 28 | | mA |
| V_{OH} | Output voltage high | $I_{SOURCE} = 1\text{ mA}$ | 25 °C | | 3.27 | | V |
| | | | -40 °C ~125 °C | 3.10 | | | |
| V_{OL} | Output voltage low | $I_{SINK} = 1\text{ mA}$ | 25 °C | | 25 | | mV |
| | | | -40 °C ~125 °C | | | 100 | |
| CMRR | Common mode rejection ratio | $0 < V_{CM} < 3.3\text{ V}$ | 25 °C | | 75 | | dB |
| SVR | Supply voltage rejection | $\Delta V_{CC} = 2\text{ V to }5\text{ V}$ | 25 °C | | 80 | | |
| T_{PLH} | Propagation delay, low to high output level ⁽³⁾ | $V_{CM} = 0\text{ V}$, $f = 10\text{ kHz}$, $C_L = 50\text{ pF}$, overdrive = 100 mV | 25 °C | | 40 | | ns |
| | | | 25 °C | | 50 | | |
| T_{PHL} | Propagation delay, high to low output level ⁽⁴⁾ | $V_{CM} = 0\text{ V}$, $f = 10\text{ kHz}$, $C_L = 50\text{ pF}$, overdrive = 100 mV | 25 °C | | 40 | | |
| | | | 25 °C | | 55 | | |

| SYMBOL | PARAMETER | TEST CONDITION ⁽¹⁾ | T _A | MIN | TYP | MAX | UNIT |
|----------------|-----------|---|----------------|-----|-----|-----|------|
| T _F | Fall time | f = 10 kHz, C _L = 50 pF, R _L = 10 kΩ, overdrive = 100 mV | 25 °C | | 5 | | ns |
| T _R | Rise time | f = 10 kHz, C _L = 50 pF, R _L = 10 kΩ, overdrive = 100 mV | 25 °C | | 7 | | |

NOTES:

- (1) All values over the temperature range are guaranteed through correlation and simulation. No production test is performed at the temperature range limits.
- (2) Maximum values include unavoidable inaccuracies of the industrial tests.
- (3) Response time is measured 10%/90% of the final output value with the following conditions: inverting input voltage (IN-) = V_{CM} and non-inverting input voltage (IN+) moving from V_{CM} - 100 mV to V_{CM} + overdrive.
- (4) Response time is measured 10%/90% of the final output value with the following conditions: inverting input voltage (IN-) = V_{CM} and non-inverting input voltage (IN+) moving from V_{CM} + 100 mV to V_{CM} - overdrive.

Electrical characteristics at $V_{CC} = 5\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, and full V_{CM} range(unless otherwise specified)

| SYMBOL | PARAMETER | TEST CONDITION ⁽¹⁾ | T_A | MIN | TYP | MAX | UNIT |
|--------------------------|--|---|----------------|------|---------|-----|------------------------------|
| V_{IO} | Input offset voltage | | 25 °C | | 0.5 | 6 | mV |
| | | | -40 °C ~125 °C | | | 7 | |
| $\Delta V_{IO}/\Delta T$ | Input offset voltage drift | | -40 °C ~125 °C | | 3 | 20 | $\mu\text{V}/^\circ\text{C}$ |
| I_{IO} | Input offset current ⁽²⁾ | | 25 °C | | ± 1 | | pA |
| I_{IB} | Input bias current ⁽²⁾ | | 25 °C | | ± 1 | | pA |
| I_{CC} | Supply current | No load, output high, $V_{CM} = 0\text{ V}$ | 25 °C | | 55 | | μA |
| | | | -40 °C ~125 °C | | | 90 | |
| | | No load, output low, $V_{CM} = 0\text{ V}$ | 25 °C | | 62 | | |
| | | | -40 °C ~125 °C | | | 95 | |
| I_{SC} | Short-circuit current | Source | 25 °C | | 72 | | mA |
| | | Sink | 25 °C | | 46 | | mA |
| V_{OH} | Output voltage high | $I_{SOURCE} = 4\text{ mA}$ | 25 °C | | 4.92 | | V |
| | | | -40 °C ~125 °C | 4.70 | | | |
| V_{OL} | Output voltage low | $I_{SINK} = 4\text{ mA}$ | 25 °C | | 80 | | mV |
| | | | -40 °C ~125 °C | | | 200 | |
| CMRR | Common mode rejection ratio | $0 < V_{CM} < 5\text{ V}$ | 25 °C | | 80 | | dB |
| SVR | Supply voltage rejection | $\Delta V_{CC} = 2\text{ V to }5\text{ V}$ | 25 °C | | 80 | | |
| T_{PLH} | Propagation delay, low to high output level ⁽³⁾ | $V_{CM} = 0\text{ V}$, $f = 10\text{ kHz}$, $C_L = 50\text{ pF}$, overdrive = 100 mV | 25 °C | | 40 | | ns |
| | | | 25 °C | | 52 | | |
| T_{PHL} | Propagation delay, high to low output level ⁽⁴⁾ | $V_{CM} = 0\text{ V}$, $f = 10\text{ kHz}$, $C_L = 50\text{ pF}$, overdrive = 100 mV | 25 °C | | 40 | | |
| | | | 25 °C | | 60 | | |

| SYMBOL | PARAMETER | TEST CONDITION ⁽¹⁾ | T _A | MIN | TYP | MAX | UNIT |
|----------------|-----------|---|----------------|-----|-----|-----|------|
| T _F | Fall time | f = 10 kHz, C _L = 50 pF, R _L = 10 kΩ, overdrive = 100 mV | 25 °C | | 4 | | ns |
| T _R | Rise time | f = 10 kHz, C _L = 50 pF, R _L = 10 kΩ, overdrive = 100 mV | 25 °C | | 4 | | |

NOTES:

- (1) All values over the temperature range are guaranteed through correlation and simulation. No production test is performed at the temperature range limits.
- (2) Maximum values include unavoidable inaccuracies of the industrial tests.
- (3) Response time is measured 10%/90% of the final output value with the following conditions: inverting input voltage (IN-) = V_{CM} and non-inverting input voltage (IN+) moving from V_{CM} - 100 mV to V_{CM} + overdrive.
- (4) Response time is measured 10%/90% of the final output value with the following conditions: inverting input voltage (IN-) = V_{CM} and non-inverting input voltage (IN+) moving from V_{CM} + 100 mV to V_{CM} - overdrive.

Typical Characteristics

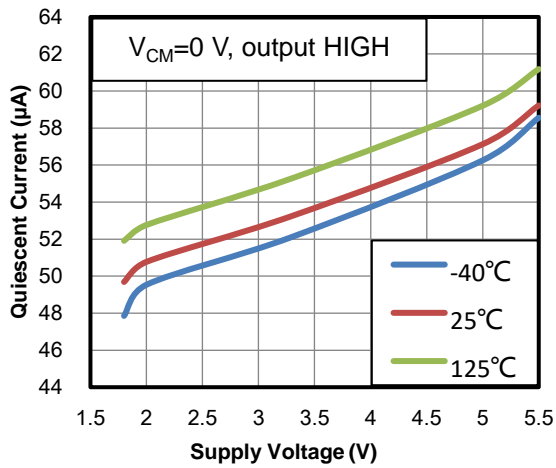


Figure 5 I_Q vs. V_{CC} ($V_{CM}=0$ V, output HIGH)

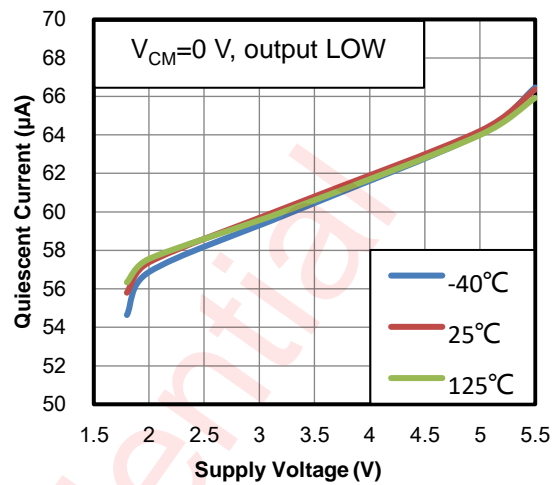


Figure 6 I_Q vs. V_{CC} ($V_{CM}=0$ V, output LOW)

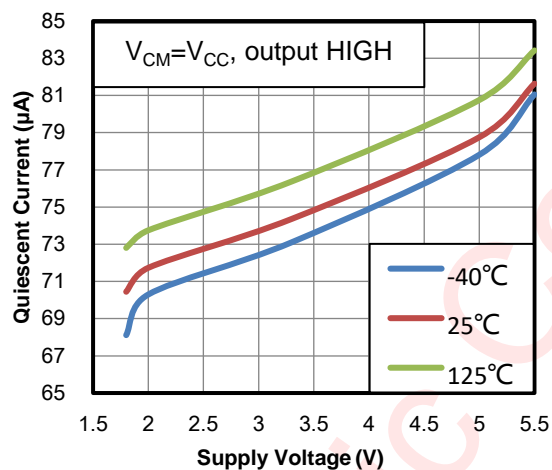


Figure 7 I_Q vs. V_{CC} ($V_{CM}=V_{CC}$, output HIGH)

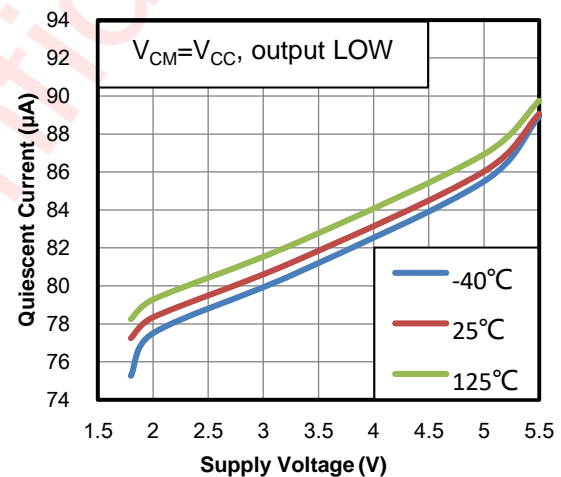


Figure 8 I_Q vs. V_{CC} ($V_{CM}=V_{CC}$, output LOW)

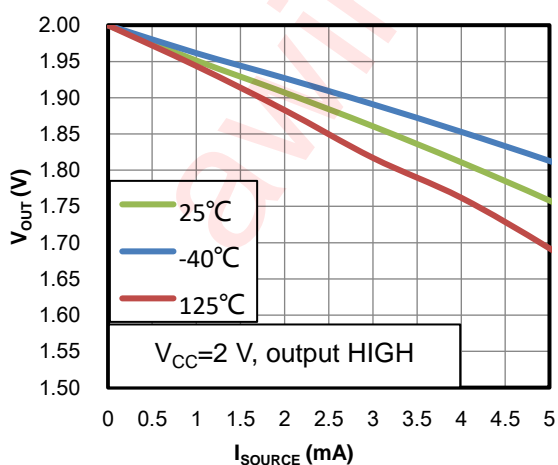


Figure 9 V_{OUT} vs. I_{SOURCE} ($V_{CC}=2$ V)

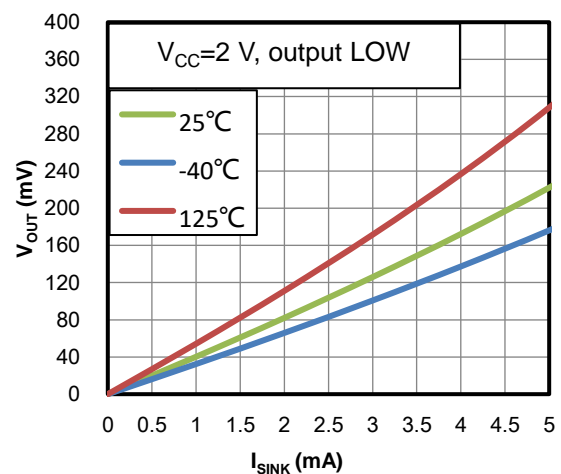


Figure 10 V_{OUT} vs. I_{SINK} ($V_{CC}=2$ V)

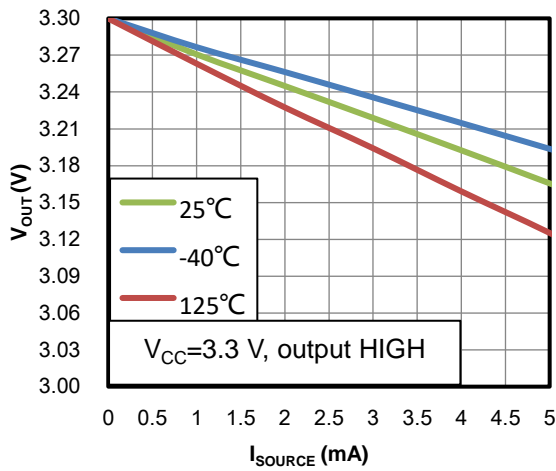


Figure 11 V_{OUT} vs. I_{SOURCE} ($V_{CC}=3.3$ V)

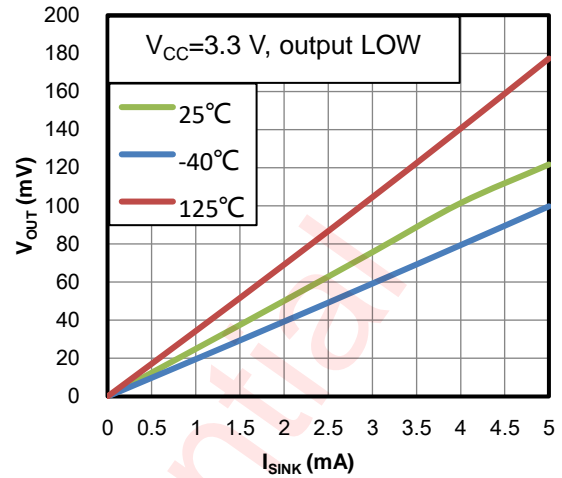


Figure 12 V_{OUT} vs. I_{SINK} ($V_{CC}=3.3$ V)

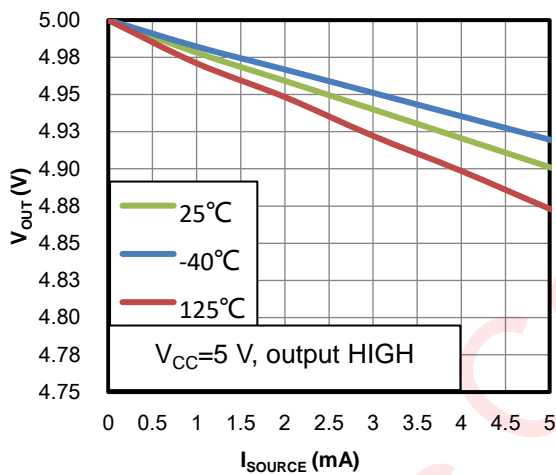


Figure 13 V_{OUT} vs. I_{SOURCE} ($V_{CC}=5$ V)

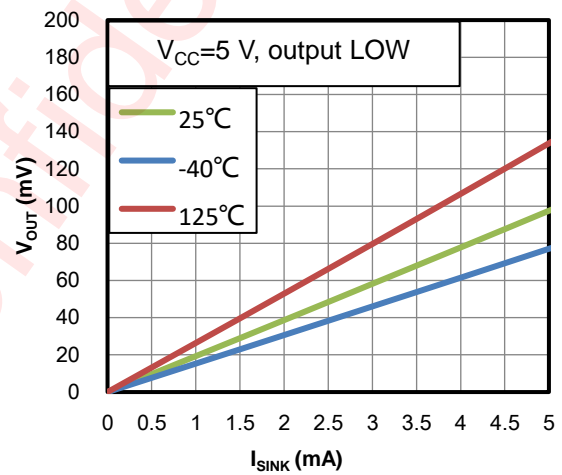


Figure 14 V_{OUT} vs. I_{SINK} ($V_{CC}=5$ V)

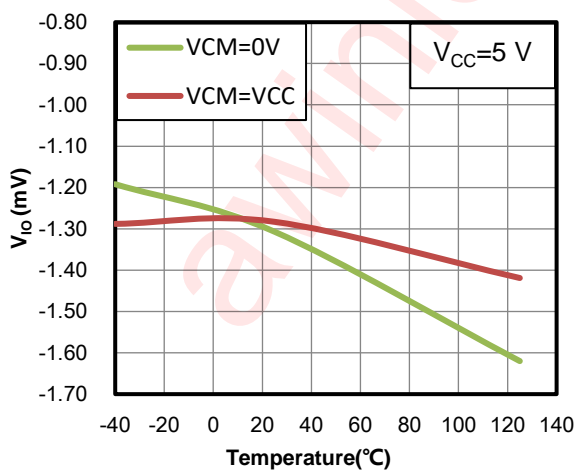


Figure 15 V_{IO} vs. Temperature and V_{CM}

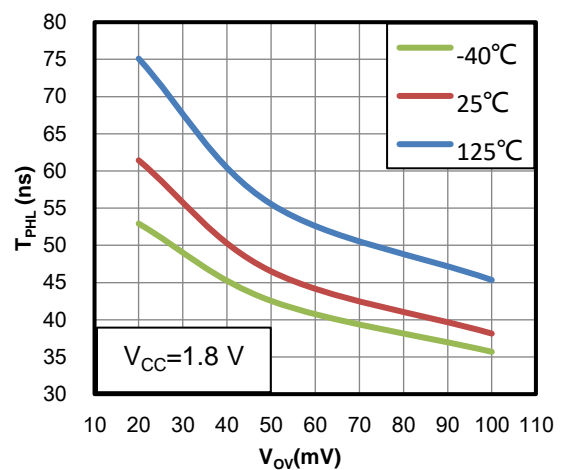


Figure 16 T_{PHL} vs. V_{OV} ($V_{CC}=1.8$ V, $V_{CM}=0$ V)

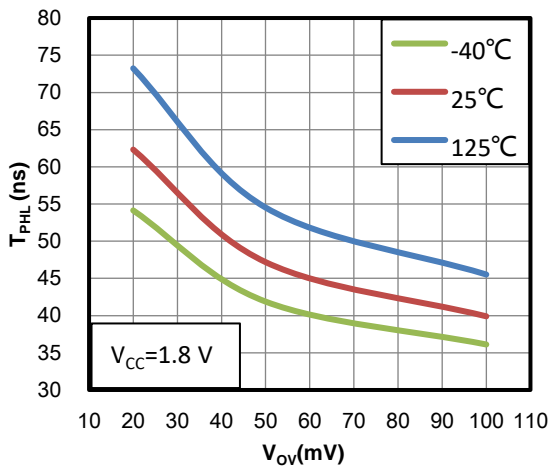


Figure 17 T_{PHL} vs. V_{OV}(V_{CC}=1.8 V, V_{CM}=1.8 V)

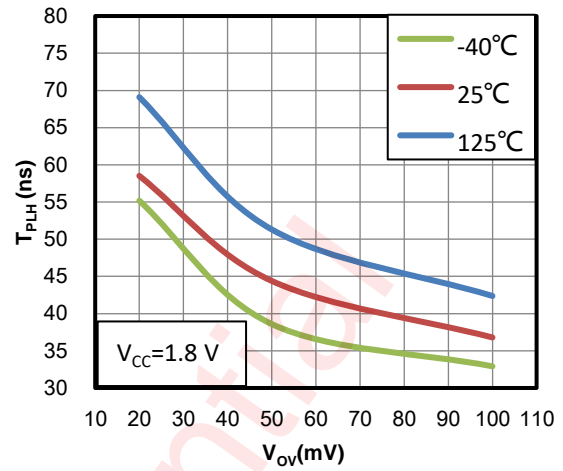


Figure 18 T_{PLH} vs. V_{OV}(V_{CC}=1.8 V, V_{CM}=0 V)

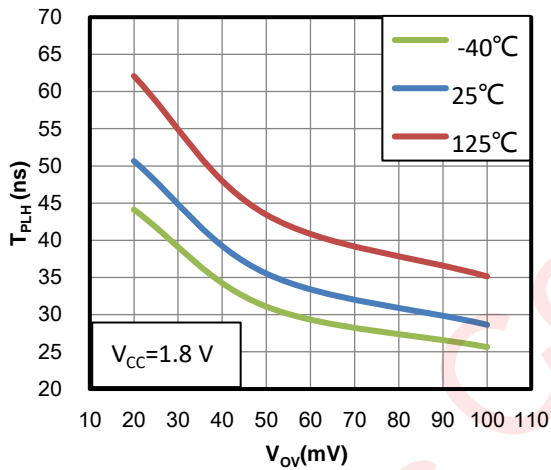


Figure 19 T_{PLH} vs. V_{OV}(V_{CC}=1.8 V, V_{CM}=1.8 V)

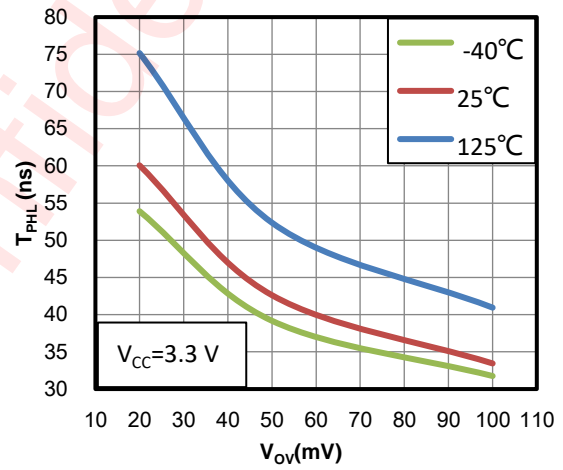


Figure 20 T_{PHL} vs. V_{OV}(V_{CC}=3.3 V, V_{CM}=0 V)

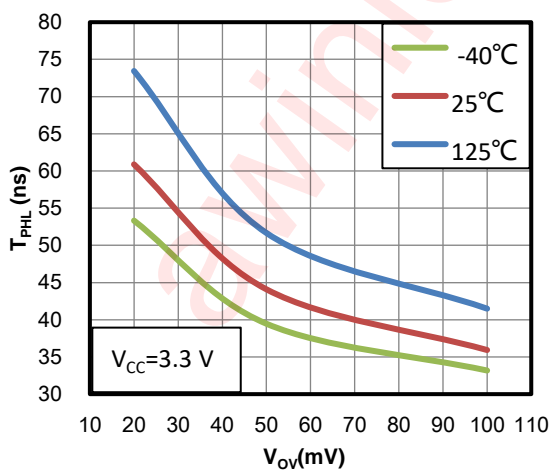


Figure 21 T_{PHL} vs. V_{OV}(V_{CC}=3.3 V, V_{CM}=3.3 V)

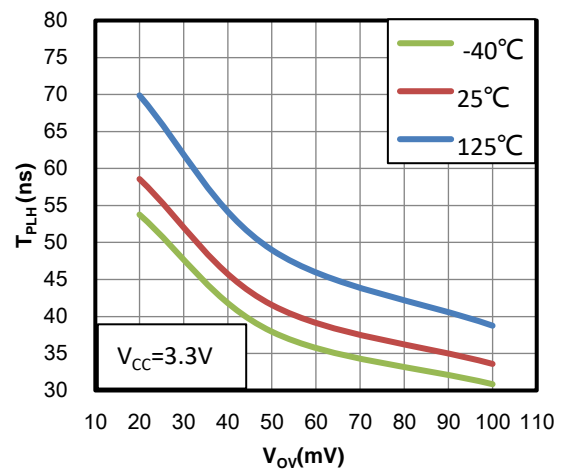


Figure 22 T_{PLH} vs. V_{OV}(V_{CC}=3.3 V, V_{CM}=0 V)

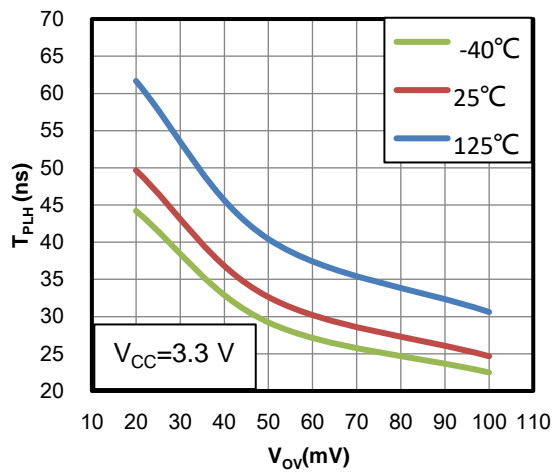


Figure 23 T_{PLH} vs. V_{OV} ($V_{CC}=3.3\text{ V}, V_{CM}=3.3\text{ V}$)

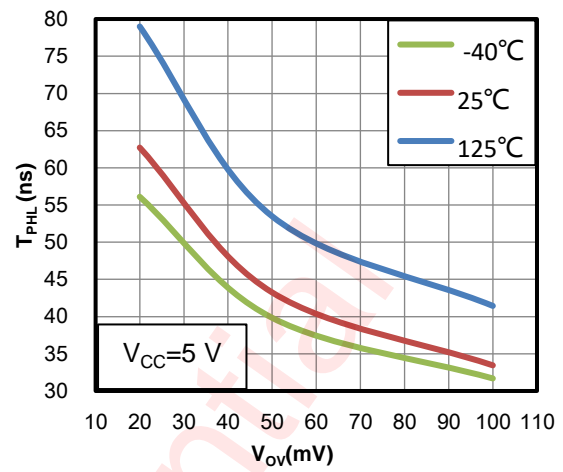


Figure 24 T_{PHL} vs. V_{OV} ($V_{CC}=5\text{ V}, V_{CM}=0\text{ V}$)

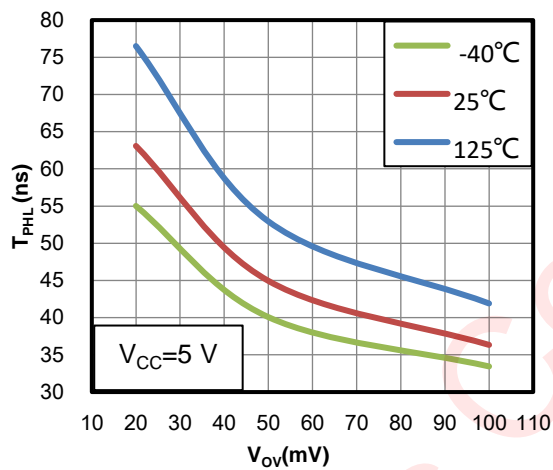


Figure 25 T_{PHL} vs. V_{OV} ($V_{CC}=5\text{ V}, V_{CM}=5\text{ V}$)

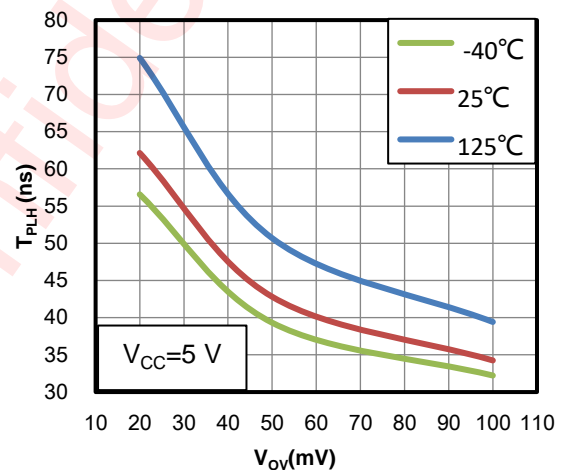


Figure 26 T_{PLH} vs. V_{OV} ($V_{CC}=5\text{ V}, V_{CM}=0\text{ V}$)

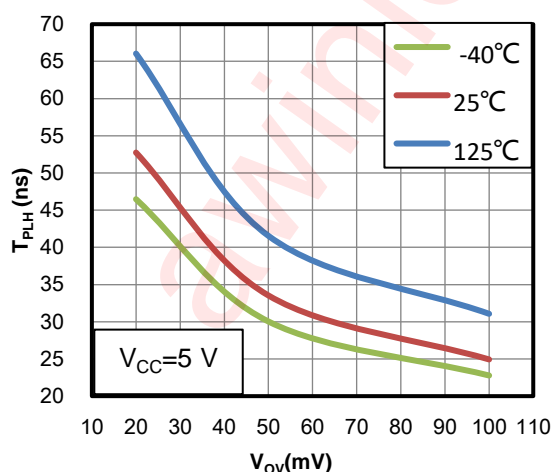


Figure 27 T_{PLH} vs. V_{OV} ($V_{CC}=5\text{ V}, V_{CM}=5\text{ V}$)

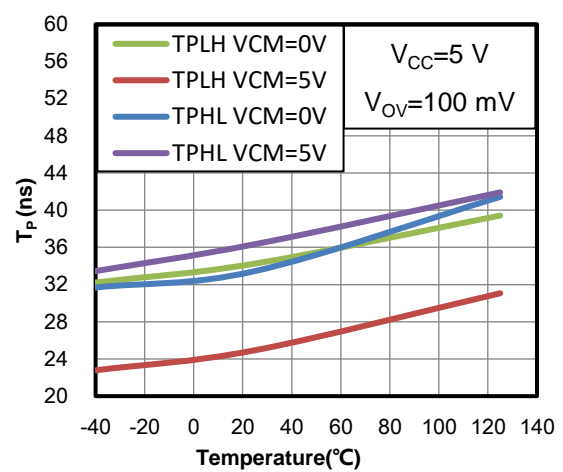


Figure 28 T_P vs. Temperature ($V_{CC}=5\text{ V}$)

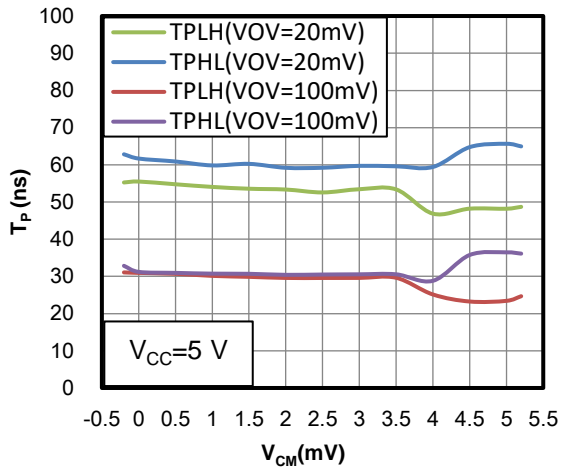


Figure 29 T_{PLH} and T_{PHL} vs. V_{CM}(V_{CC}=5 V)

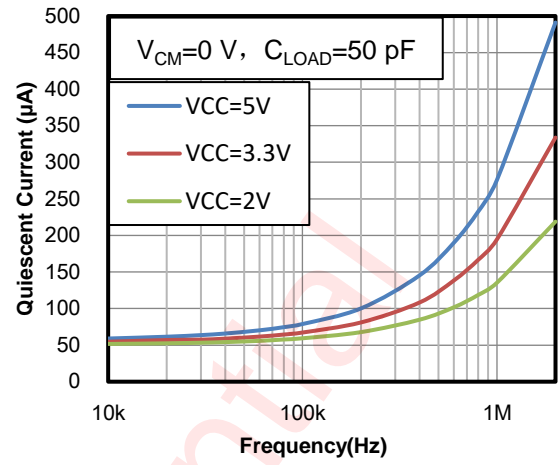


Figure 30 I_q vs. Freq(V_{CM}=0 V,output HIGH)

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PCB Layout Consideration

For the optimal performance of the device, good PCB layout practices are needed, here are some guidelines:

1. Use a printed circuit board (PCB) with a good, unbroken low-inductance ground plane.
2. Place a decoupling capacitor (0.1 μF ceramic, surface-mount capacitor) as close as possible to V_{CC} .
3. On the inputs and the output, keep lead lengths as short as possible to avoid unwanted parasitic feedback around the comparator. Keep inputs away from the output.
4. Solder the device directly to the PCB rather than using a socket.
5. For slow-moving input signals, take care to prevent parasitic feedback. A small capacitor (1000 pF or less) placed between the inputs can help eliminate oscillations in the transition region. This capacitor causes some degradation to propagation delay when the impedance is low. The topside ground plane runs between the output and inputs.
6. The ground pin ground trace runs under the device up to the bypass capacitor, shielding the inputs from the outputs.

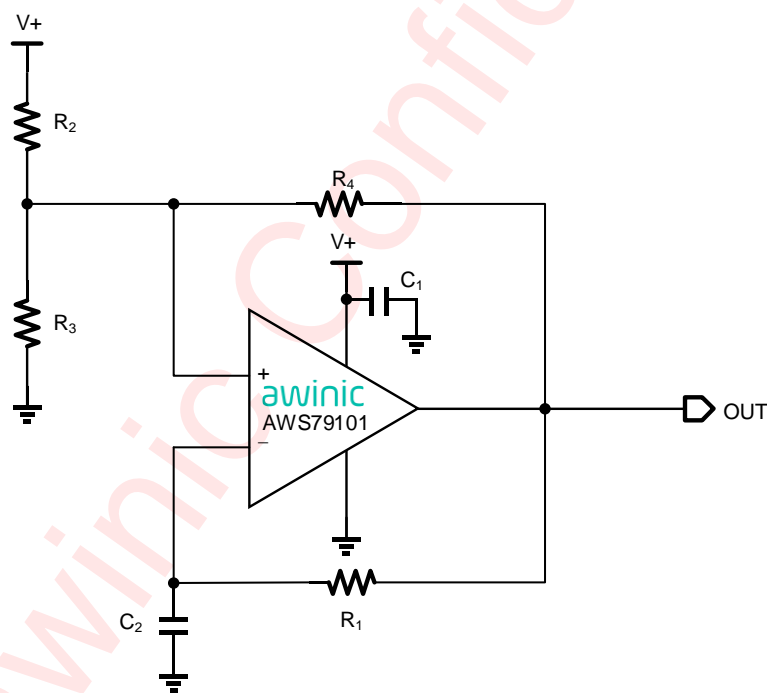


Figure 31 AWS79101 Schematic Example

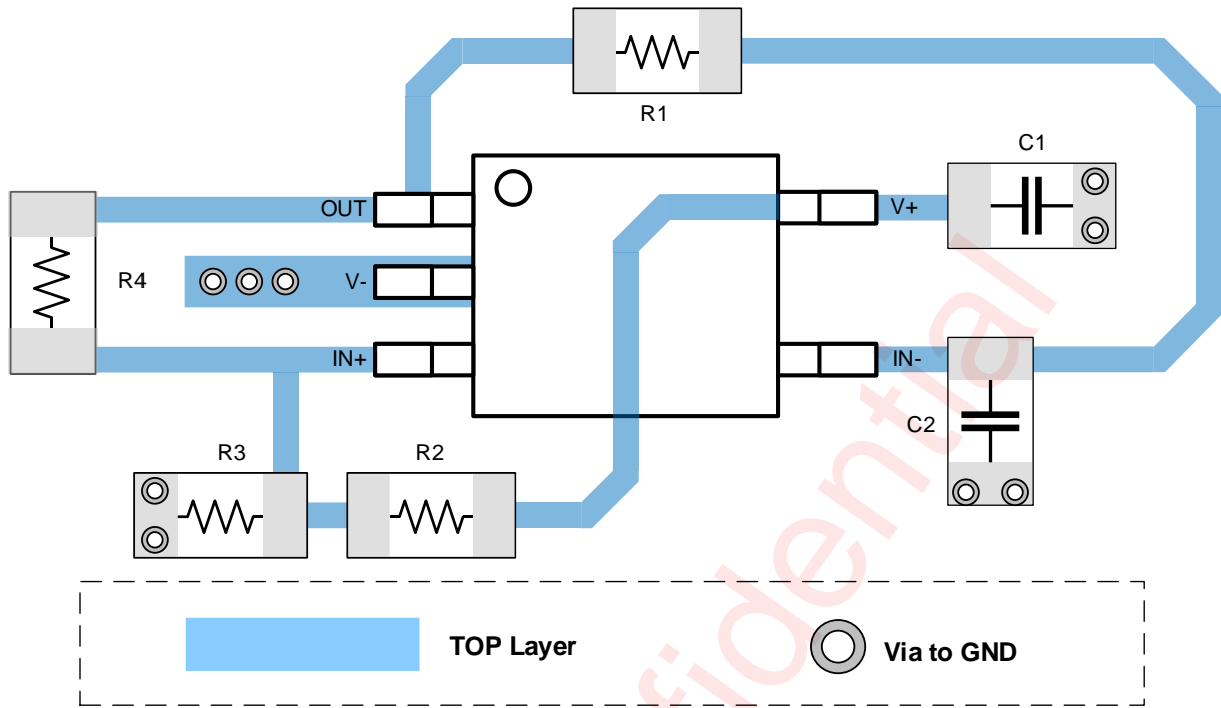
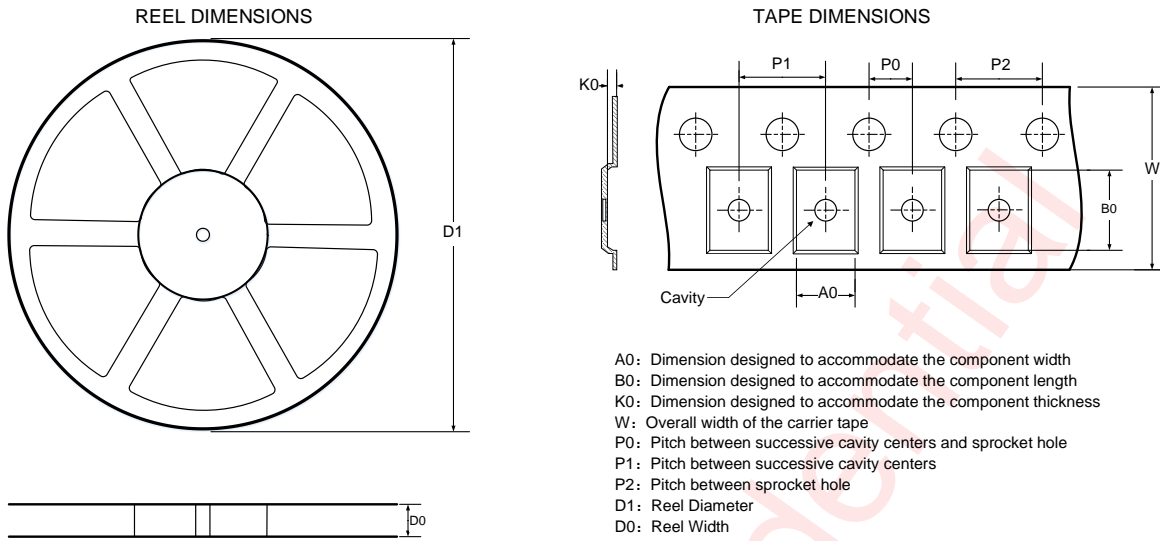


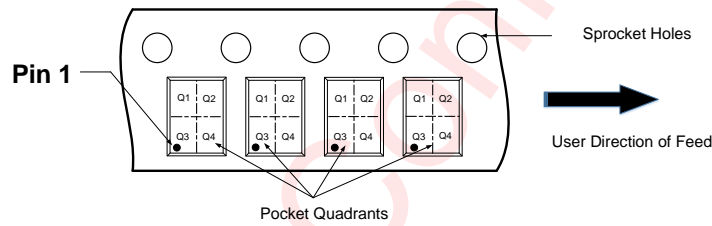
Figure 32 AWS79101 Layout Example

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Tape And Reel Information



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



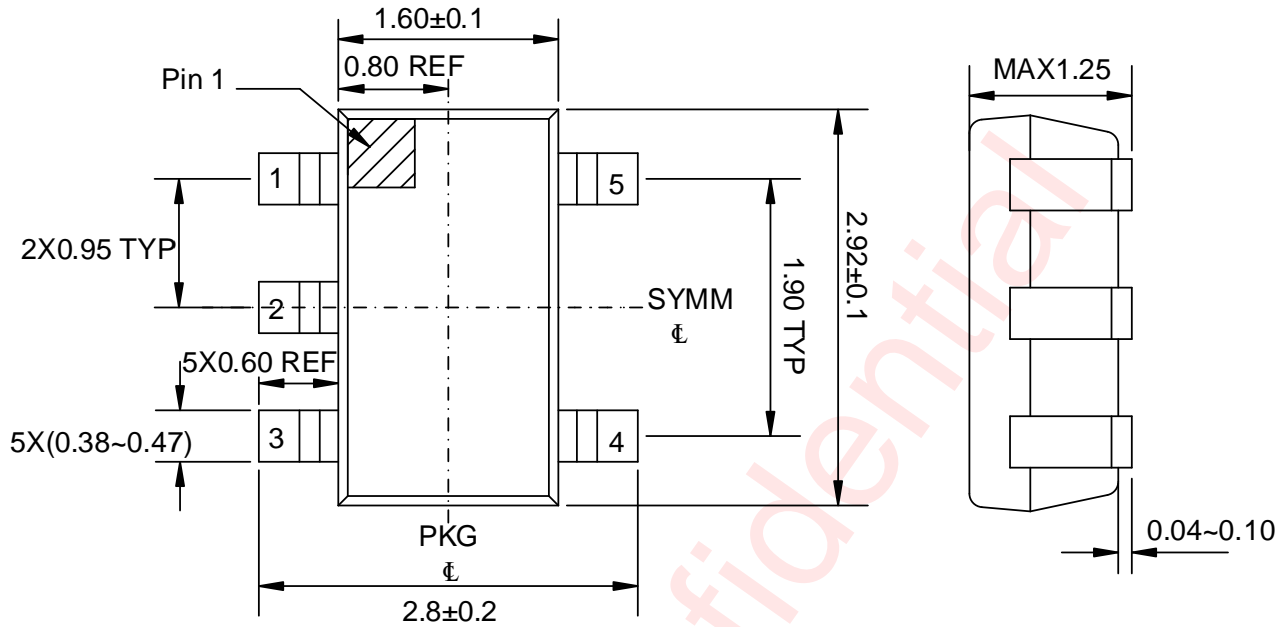
Note: The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

| D1 (mm) | D0 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|---------|---------|---------|---------|---------|---------|---------|---------|--------|---------------|
| 180 | 8.6 | 3.26 | 3.3 | 1.4 | 2 | 4 | 4 | 8 | Q3 |

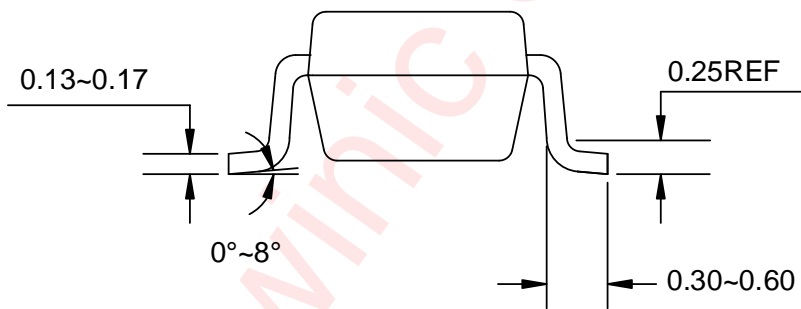
All dimensions are nominal

Package Description



Top View

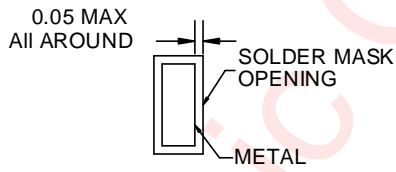
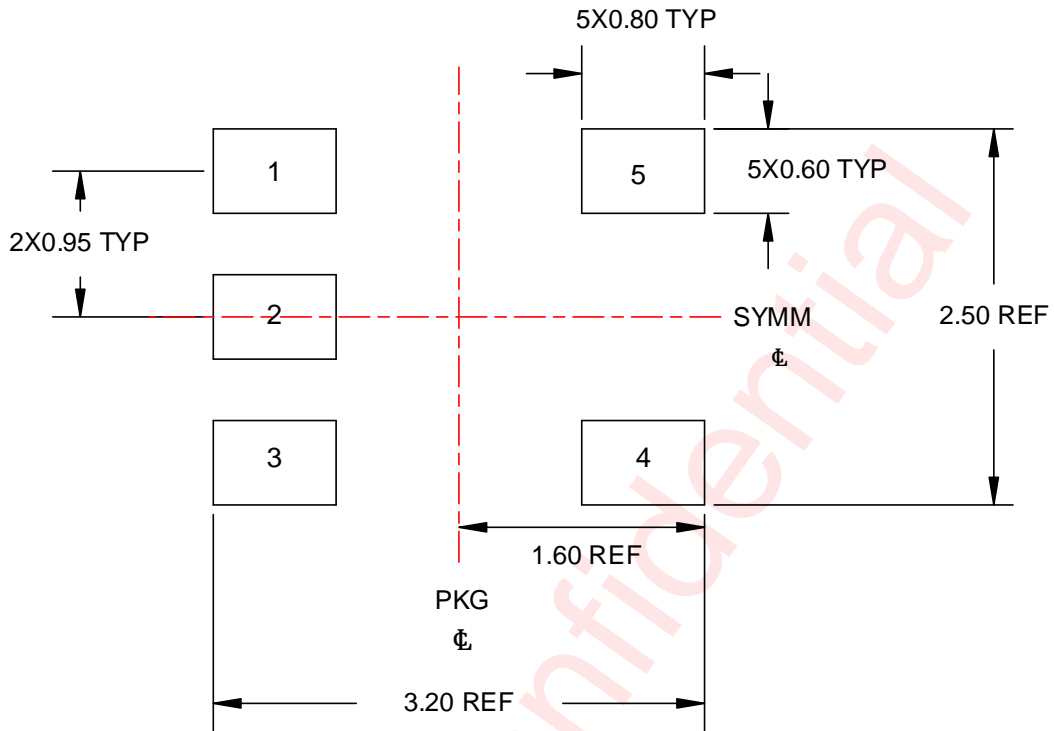
Side View



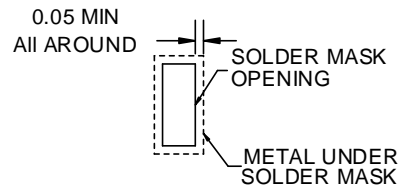
Side View

Unit: mm

Land Pattern Data



NON SOLDER MASK DEFINED



SOLDER MASK DEFINED

Unit: mm

Revision History

| Version | Date | Change Record |
|---------|-----------|-------------------|
| V1.0 | Jul. 2023 | Official released |

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