

300mA Bi-Direction Relay Driver

DESCRIPTION

BL8023C is a bi-direction relay driver circuit, used to control the magnetic latching relay, with large output capability, ultra-low power consumption. It can be widely used in smart meters and other pulses, level control applications.

BL8023C can provide 300mA typical driving current, which will different according to the relay coil resistance. The input High Level Threshold of BL8023C is 3V; it can compatible with most single chip microcontroller.

BL8023C is available in SOP-8 and DIP-8 packages.

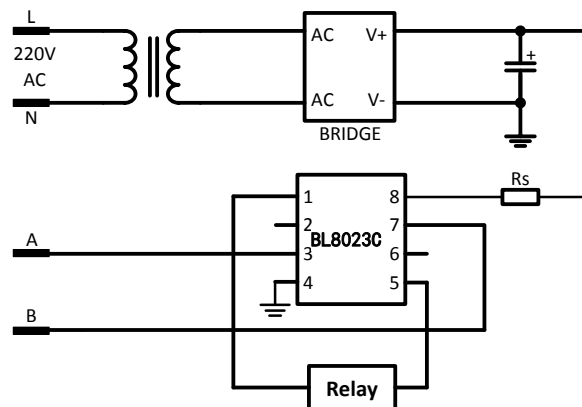
FEATURES

- 5 to 36V input voltage range
- Low Power Consumption ($I_Q < 1\mu A$)
- Input High Level Threshold: 3V, compatible with most single chip microcontroller
- Typical Driving Current: 300mA
 $R_{ds(on)} = 12\Omega$ ($V_{in} = 12V$, PMOSFET+NMOSFET)
 $R_{ds(on)} = 10\Omega$ ($V_{in} = 30V$, PMOSFET+NMOSFET)
- Peak Driving Current: 500mA@ $V_{in} = 24V$
- Environment Temperature: $-40^{\circ}C \sim 85^{\circ}C$
- SOP-8 and DIP-8 packages

APPLICATIONS

- Smart Meter

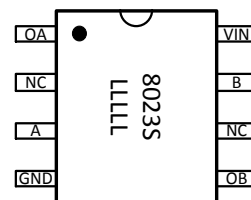
TYPICAL APPLICATION



ORDERING INFORMATION

| Part No. | Package | Tape & Reel |
|----------|---------|-------------|
| BL8023C | SOP-8 | 2500/Reel |

PIN OUT & MARKING



SOP-8/DIP8

8023S: Product Code
 LL: Lot No.
 L: Fab code
 LL: Date code

ABSOLUTE MAXIMUM RATING

| Parameter | | | Value |
|--|-------|---------------|---------------|
| Max Input Voltage | | | 40V |
| Max Operating Junction Temperature(Tj) | | | 150°C |
| Ambient Temperature(Ta) | | | -40°C – 125°C |
| Package Thermal Resistance | SOP-8 | θ_{ja} | 128°C / W |
| | | θ_{jc} | 45°C / W |
| Storage Temperature(Ts) | | | -40°C - 150°C |
| Lead Temperature & Time | | | 260°C, 10S |

Note: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

RECOMMENDED WORK CONDITIONS

| Parameter | Value |
|------------------------------------|--------------|
| Input Voltage Range | Max.36V |
| Operating Junction Temperature(Tj) | -40°C – 85°C |

ELECTRICAL CHARACTERISTICS

(VIN=5V, TA=25°C)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------|---------------------------------|--------------------------------|-----|-----|-----|------|
| VIN | Input Voltage Range | | 5 | | 36 | V |
| Iq | Quiescent Current | | | | 1 | uA |
| Rdson | Switch Rdson | Vin=12V, RL=75ohm | | 12 | 18 | ohm |
| | | Vin=30V, RL=75ohm | | 10 | 16 | ohm |
| | | Vin=12V, RL=40ohm | | 12 | 20 | ohm |
| | | Vin=30V, RL=40ohm ¹ | | 10 | 16 | ohm |
| VTH | ON Input High Voltage | Vin=12V | | 3 | | V |
| RIN | Equivalent Input Resistor | | | 500 | | Kohm |
| VSD | Fly-Wheel Diode Forward Voltage | Is=1A | | 1.2 | 2 | V |
| TR | Rise Time | VIN=12V, RL=75ohm | | 40 | | ns |
| TD(ON) | Turn ON Delay Time | VIN=12V, RL=75ohm | | 60 | | ns |
| TF | Fall Time | VIN=12V, RL=75ohm | | 30 | | ns |
| TD(OFF) | Turn OFF Delay Time | VIN=12V, RL=75ohm | | 70 | | ns |

Note: 1) This condition is not suitable for SOT23-6 package.

2) Input rise/fall time must less than 1ms, otherwise maybe destroy the chip.

LOGIC FUNCTION TABLE

| Input A | Input B | Output OA | Output OB | RELAY RESPONSE |
|---------|---------|----------------|----------------|----------------|
| 1 | 0 | 1 | 0 | ON |
| 0 | 1 | 0 | 1 | OFF |
| 0 | 0 | High-impedance | High-impedance | Hold |
| 1 | 1 | High-impedance | High-impedance | Hold |

PIN DESCRIPTION

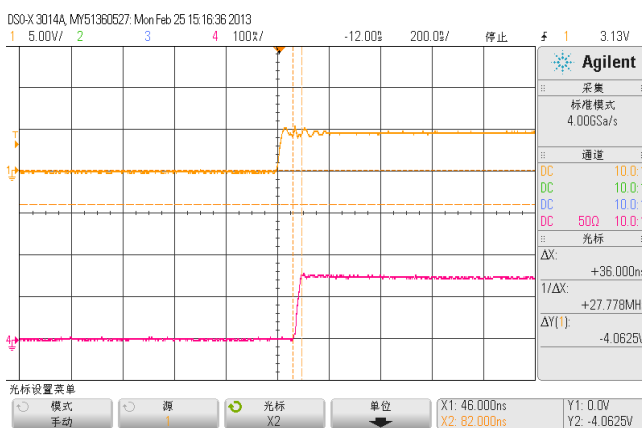
| PIN # | NAME | DESCRIPTION |
|-------|------|----------------------|
| 1 | OA | Output A |
| 2, 6 | NC | Not connected. |
| 3 | A | Input A |
| 4 | GND | Ground. |
| 5 | OB | Output B |
| 7 | B | Input B |
| 8 | VIN | Supply input voltage |

ELECTRICAL PERFORMANCE

Tested under $T_A=25^{\circ}\text{C}$, unless otherwise specified

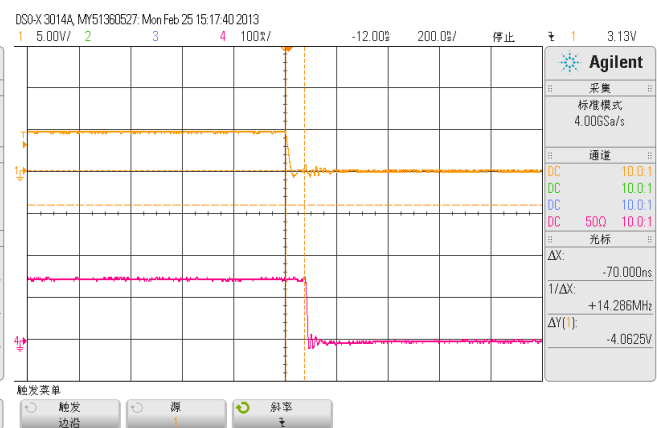
Turn on delay and rise time

Ch1---Input Ch2---Output

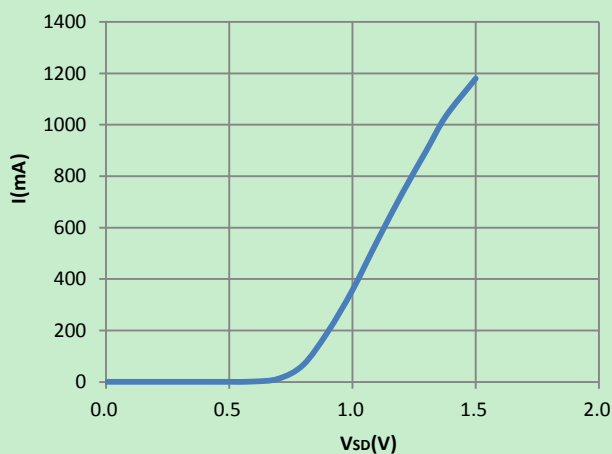


Turn off delay and fall time

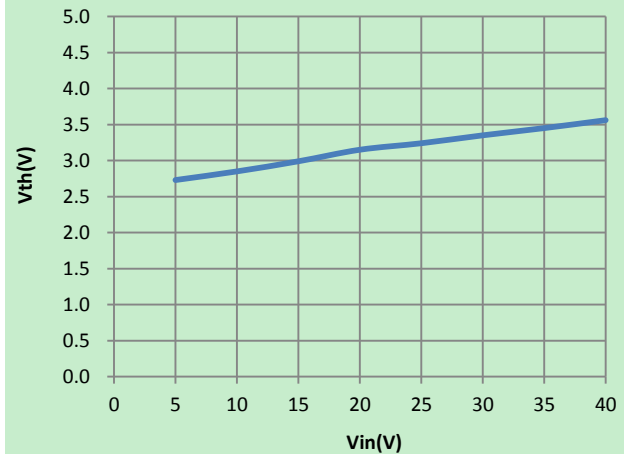
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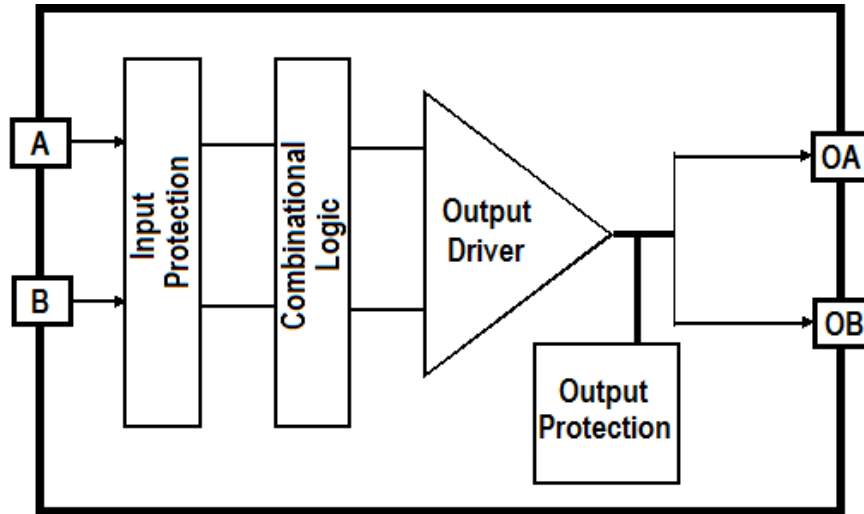
Forward Voltage



Vth VS. Vin



BLOCK DIAGRAM

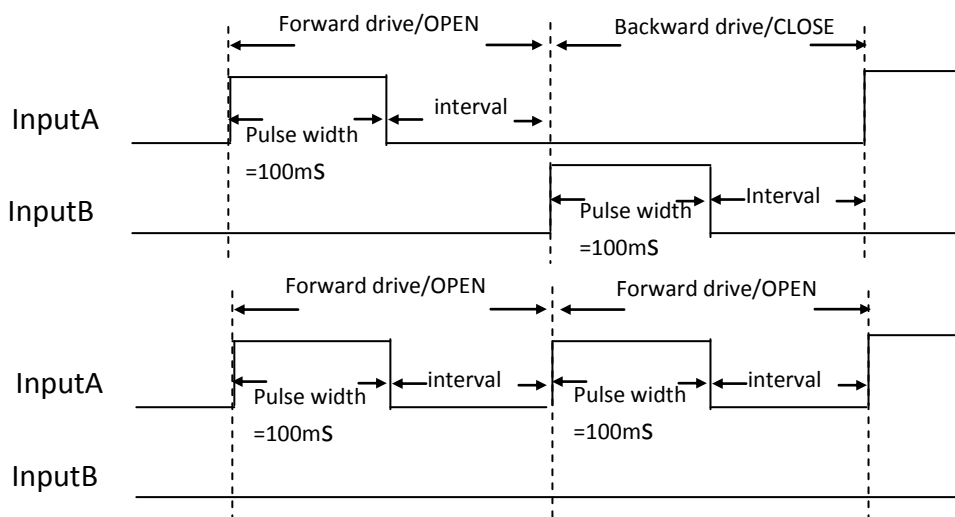


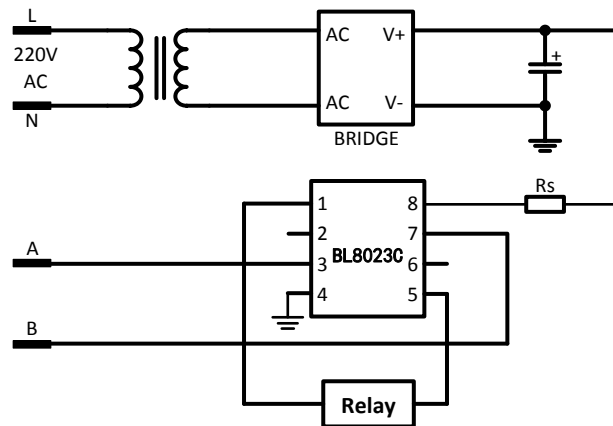
DETAILED DESCRIPTION

Pulse Triggering

If input is driven by square pulse, connect the inputs to the pulse source directly. Relay will operate as logic table stated (V_{in} should be less than the power supply voltage, R_s is current-limiting resistor, it can be ignored in the voltage is below 20V, i.e. $R_s=0$).

The recommended pulse width=100ms. The length of the intervals should be longer than 100ms. These intervals include: intervals between forward drive pulse and next backward drive pulse, intervals between forward drive pulse and next forward drive pulse, intervals between backward drive pulse and next forward drive pulse, intervals between backward drive pulse and next backward drive pulse.





Pulse triggering application diagram

Relay free-wheel

Relay from ON to OFF, the energy stored in the relay inductor released by the chip's internal body diode and the relay inductor. Until the end of the release of this energy, relay proceeding to the next operation.

PACKAGE OUTLINE

| Package | SOP-8 | Devices per reel | 2500 | Unit | mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------|---------|------------------|------|--|----|--------|-----|-----|-----|---|------|------|------|----|------|------|------|----|------|------|------|----|------|------|------|---|------|---|------|----|------|------|------|---|------|---|------|----|------|------|------|---|------|------|------|---|------|------|------|----|------|------|------|---|---------|--|--|---|------|------|------|----|---------|--|--|----|---------|--|--|---|------|---|---|----|------|---|---|---|------|------|------|-------|----|---|----|---------|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|
| Package specification: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | <p>COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)</p> <table border="1"> <thead> <tr> <th>SYMBOL</th> <th>MIN</th> <th>NOM</th> <th>MAX</th> </tr> </thead> <tbody> <tr><td>A</td><td>1.35</td><td>1.55</td><td>1.75</td></tr> <tr><td>A1</td><td>0.10</td><td>0.15</td><td>0.25</td></tr> <tr><td>A2</td><td>1.25</td><td>1.40</td><td>1.65</td></tr> <tr><td>A3</td><td>0.50</td><td>0.60</td><td>0.70</td></tr> <tr><td>b</td><td>0.38</td><td>—</td><td>0.51</td></tr> <tr><td>b1</td><td>0.37</td><td>0.42</td><td>0.47</td></tr> <tr><td>c</td><td>0.17</td><td>—</td><td>0.25</td></tr> <tr><td>c1</td><td>0.17</td><td>0.20</td><td>0.23</td></tr> <tr><td>D</td><td>4.80</td><td>4.90</td><td>5.00</td></tr> <tr><td>E</td><td>5.80</td><td>6.00</td><td>6.20</td></tr> <tr><td>E1</td><td>3.80</td><td>3.90</td><td>4.00</td></tr> <tr><td>e</td><td colspan="3">1.27BSC</td></tr> <tr><td>L</td><td>0.45</td><td>0.60</td><td>0.80</td></tr> <tr><td>L1</td><td colspan="3">1.04REF</td></tr> <tr><td>L2</td><td colspan="3">0.25BSC</td></tr> <tr><td>R</td><td>0.07</td><td>—</td><td>—</td></tr> <tr><td>R1</td><td>0.07</td><td>—</td><td>—</td></tr> <tr><td>h</td><td>0.30</td><td>0.40</td><td>0.50</td></tr> <tr><td>theta</td><td>8°</td><td>—</td><td>8°</td></tr> <tr><td>theta 1</td><td>15°</td><td>17°</td><td>19°</td></tr> <tr><td>theta 2</td><td>11°</td><td>13°</td><td>15°</td></tr> <tr><td>theta 3</td><td>15°</td><td>17°</td><td>19°</td></tr> <tr><td>theta 4</td><td>11°</td><td>13°</td><td>15°</td></tr> </tbody> </table> | | SYMBOL | MIN | NOM | MAX | A | 1.35 | 1.55 | 1.75 | A1 | 0.10 | 0.15 | 0.25 | A2 | 1.25 | 1.40 | 1.65 | A3 | 0.50 | 0.60 | 0.70 | b | 0.38 | — | 0.51 | b1 | 0.37 | 0.42 | 0.47 | c | 0.17 | — | 0.25 | c1 | 0.17 | 0.20 | 0.23 | D | 4.80 | 4.90 | 5.00 | E | 5.80 | 6.00 | 6.20 | E1 | 3.80 | 3.90 | 4.00 | e | 1.27BSC | | | L | 0.45 | 0.60 | 0.80 | L1 | 1.04REF | | | L2 | 0.25BSC | | | R | 0.07 | — | — | R1 | 0.07 | — | — | h | 0.30 | 0.40 | 0.50 | theta | 8° | — | 8° | theta 1 | 15° | 17° | 19° | theta 2 | 11° | 13° | 15° | theta 3 | 15° | 17° | 19° | theta 4 | 11° | 13° | 15° |
| SYMBOL | MIN | NOM | MAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 1.35 | 1.55 | 1.75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A1 | 0.10 | 0.15 | 0.25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A2 | 1.25 | 1.40 | 1.65 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A3 | 0.50 | 0.60 | 0.70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b | 0.38 | — | 0.51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b1 | 0.37 | 0.42 | 0.47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| c | 0.17 | — | 0.25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| c1 | 0.17 | 0.20 | 0.23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 4.80 | 4.90 | 5.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 5.80 | 6.00 | 6.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E1 | 3.80 | 3.90 | 4.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| e | 1.27BSC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L | 0.45 | 0.60 | 0.80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L1 | 1.04REF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L2 | 0.25BSC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R | 0.07 | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R1 | 0.07 | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| h | 0.30 | 0.40 | 0.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| theta | 8° | — | 8° | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| theta 1 | 15° | 17° | 19° | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| theta 2 | 11° | 13° | 15° | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| theta 3 | 15° | 17° | 19° | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| theta 4 | 11° | 13° | 15° | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Package | DIP-8 | Devices per reel | | Unit | mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------|---------|------------------|-------|--|----|--------|-----|-----|-----|---|---|---|------|----|------|---|---|----|------|------|------|----|------|------|------|---|------|---|------|----|------|------|------|----|------|------|------|----|------|------|------|---|------|---|------|----|------|------|------|---|------|------|------|----|------|---|---|---|------|------|------|----|------|------|------|---|---------|--|--|----|---------|--|--|----|------|------|-------|----|---|---|------|---|------|------|------|
| Package specification: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | <p>COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)</p> <table border="1"> <thead> <tr> <th>SYMBOL</th> <th>MIN</th> <th>NOM</th> <th>MAX</th> </tr> </thead> <tbody> <tr><td>A</td><td>—</td><td>—</td><td>4.80</td></tr> <tr><td>A1</td><td>0.50</td><td>—</td><td>—</td></tr> <tr><td>A2</td><td>3.10</td><td>3.30</td><td>3.50</td></tr> <tr><td>A3</td><td>1.40</td><td>1.50</td><td>1.60</td></tr> <tr><td>b</td><td>0.38</td><td>—</td><td>0.55</td></tr> <tr><td>b1</td><td>0.38</td><td>0.46</td><td>0.51</td></tr> <tr><td>b2</td><td>1.47</td><td>1.52</td><td>1.57</td></tr> <tr><td>b3</td><td>0.89</td><td>0.99</td><td>1.09</td></tr> <tr><td>c</td><td>0.21</td><td>—</td><td>0.35</td></tr> <tr><td>c1</td><td>0.20</td><td>0.25</td><td>0.30</td></tr> <tr><td>D</td><td>9.10</td><td>9.20</td><td>9.30</td></tr> <tr><td>D1</td><td>0.13</td><td>—</td><td>—</td></tr> <tr><td>E</td><td>7.62</td><td>7.87</td><td>8.25</td></tr> <tr><td>E1</td><td>6.25</td><td>6.35</td><td>6.45</td></tr> <tr><td>e</td><td colspan="3">2.54BSC</td></tr> <tr><td>eA</td><td colspan="3">7.62BSC</td></tr> <tr><td>eB</td><td>7.62</td><td>8.80</td><td>10.90</td></tr> <tr><td>ec</td><td>0</td><td>—</td><td>1.52</td></tr> <tr><td>L</td><td>2.92</td><td>3.30</td><td>3.81</td></tr> </tbody> </table> | | SYMBOL | MIN | NOM | MAX | A | — | — | 4.80 | A1 | 0.50 | — | — | A2 | 3.10 | 3.30 | 3.50 | A3 | 1.40 | 1.50 | 1.60 | b | 0.38 | — | 0.55 | b1 | 0.38 | 0.46 | 0.51 | b2 | 1.47 | 1.52 | 1.57 | b3 | 0.89 | 0.99 | 1.09 | c | 0.21 | — | 0.35 | c1 | 0.20 | 0.25 | 0.30 | D | 9.10 | 9.20 | 9.30 | D1 | 0.13 | — | — | E | 7.62 | 7.87 | 8.25 | E1 | 6.25 | 6.35 | 6.45 | e | 2.54BSC | | | eA | 7.62BSC | | | eB | 7.62 | 8.80 | 10.90 | ec | 0 | — | 1.52 | L | 2.92 | 3.30 | 3.81 |
| SYMBOL | MIN | NOM | MAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | — | — | 4.80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A1 | 0.50 | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A2 | 3.10 | 3.30 | 3.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A3 | 1.40 | 1.50 | 1.60 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b | 0.38 | — | 0.55 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b1 | 0.38 | 0.46 | 0.51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b2 | 1.47 | 1.52 | 1.57 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b3 | 0.89 | 0.99 | 1.09 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| c | 0.21 | — | 0.35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| c1 | 0.20 | 0.25 | 0.30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | 9.10 | 9.20 | 9.30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D1 | 0.13 | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | 7.62 | 7.87 | 8.25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E1 | 6.25 | 6.35 | 6.45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| e | 2.54BSC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| eA | 7.62BSC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| eB | 7.62 | 8.80 | 10.90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ec | 0 | — | 1.52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L | 2.92 | 3.30 | 3.81 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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