

High Voltage, Dual Differential Comparator with Open-Drain Output

■ Features

- AEC-Q100 qualified:
 - Device ambient temperature: $-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$
 - Device junction temperature: $-40^{\circ}\text{C} \leq T_J \leq 150^{\circ}\text{C}$
- Wide supply voltage range: 2.7 V to 36 V
- Open drain output
- Input offset voltage: $\pm 4.5\text{ mV}$ (max.)
- Common mode input voltage range: V_- to $(V_+) - 1.5\text{ V}$
- Low supply current: 125 μA (typ.) per channel
- Low input bias current: 10 pA (typ.) at $V_{CC} = 5\text{ V}$ and $V_{CC} = 12\text{ V}$
- Propagation delay time at $V_{CC} = 5\text{ V}$, overdrive = 5 mV:
 - 2 μs (high-to-low)
 - 2.3 μs (low-to-high)

■ Applications

- Automotive
 - HEV/EV and power train
 - Infotainment and cluster
- Body control module
- Industrial appliance

■ Package Information

Part Number	Package	Body Size
DIA20903	SOIC-8	4.9 mm × 3.9 mm
	MSOP-8	3.0 mm × 3.0 mm

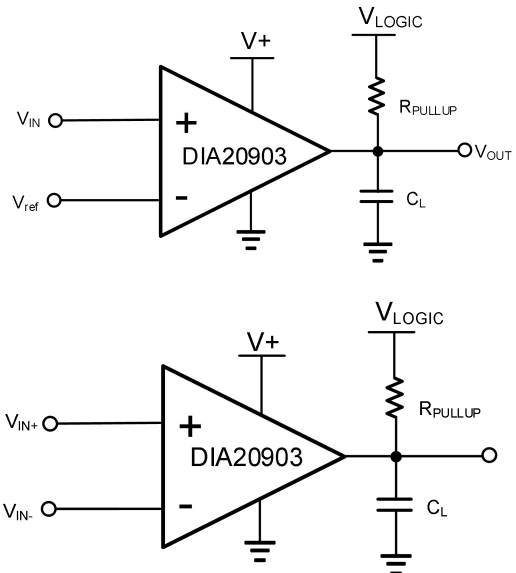
■ Description

The DIA20903 is a dual ,high precision comparator with open-drain output. The device operates over a wide range of supply voltages from 2.7 V to 36 V, the current drain is independent of the supply voltage.

The DIA20903 holds a lower input offset voltage ($V_{OS} = \pm 3.5\text{ mV}$ at $T_A = 25^{\circ}\text{C}$), making it suitable for applications requiring precision. Featuring an open-drain output stage with an external pull-up resistor, its output can be connected to other open-drain outputs to achieve wired-AND logic relationships.

The DIA20903 is available in the Green SOIC-8 and MSOP-8 packages. It is specified over ambient temperature range of -40°C to 125°C , which meets the requirements of automotive applications.

■ Simplified Schematic



■ Ordering Information

Ordering Part No.	Top Marking	MSL	RoHS	T _A	Package	
DIA20903CS8	DIABV9C	1	Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500
DIA20903MP8	DIABV9C	1	Green	-40 to 125°C	MSOP8	Tape & Reel, 3000

If you encounter any issue in the process of using the device, please contact our customer service at marketing@dioo.com or phone us at (+86)-21-62116882. If you have any improvement suggestions regarding the datasheet, we encourage you to contact our technical writing team at docs@dioo.com. Your feedback is invaluable for us to provide a better user experience.

Table of Contents

1. Pin Assignment and Functions	1
2. Absolute Maximum Ratings	2
3. Recommended Operating Conditions	2
4. ESD Ratings	2
5. Thermal Considerations	3
6. Electrical Characteristics	3
6.1. Electrical Characteristics: $V_{CC} = 5\text{ V}$	3
6.2. Electrical Characteristics: $V_{CC} = 12\text{ V}$	3
6.3. Electrical Characteristics: $V_{CC} = 30\text{ V}$	4
7. Switching Characteristics	5
7.1. Switching Characteristics: $V_{CC} = 5\text{ V}$	5
7.2. Switching Characteristics: $V_{CC} = 12\text{ V}$	5
7.3. Switching Characteristics: $V_{CC} = 30\text{ V}$	5
8. Typical Characteristics	6
9. Application Information	7
9.1. Low input bias current	7
9.2. Wide range of supply voltage	7
9.3. Output and drive current	7
9.4. Response time	7
10. Physical Dimensions	8
10.1. SOIC-8	8
10.2. MSOP-8	9

Table of Figures

Figure 1. SOIC-8 / MSOP-8 (Top view)	1
Figure 2. I_{CC} vs. V_{CC}	6
Figure 3. I_{CC} vs. Temperature	6
Figure 4. V_{OS} vs. V_{CC}	6
Figure 5. V_{OL} vs. V_{CC}	6
Figure 6. I_{SINK} vs. V_{CC}	6
Figure 7. I_B vs. V_{IN}	6
Figure 8. Propagation delay time vs. V_{CC} (low to high)	6
Figure 9. Propagation delay time vs. V_{CC} (high to low)	6
Figure 10. Single-ended and differential comparator configurations	7

1. Pin Assignment and Functions

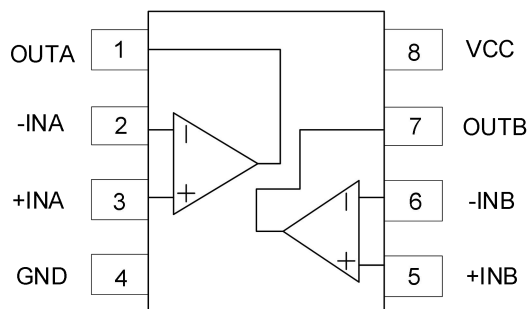


Figure 1. SOIC-8 / MSOP-8 (Top view)

Pin Name ⁽¹⁾	Description
OUTX	Output
+INX	Positive input
-INX	Negative input
VCC	Positive supply
GND	Ground

Note:

(1) X = A, B.

2. Absolute Maximum Ratings

Exceeding the maximum ratings listed under Absolute Maximum Ratings when designing is likely to damage the device permanently. Do not design to the maximum limits because long-time exposure to them might impact the device's reliability. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply voltage	-0.3	42	V
V_{ID}	Differential input voltage	-36	42	V
V_I	Input voltage (either input)	-0.3	42	V
I_{IK}	Input current		-50	mA
V_O	Output voltage	-0.3	42	V
I_O	Output current		35	mA
T_J	Operating virtual-junction temperature		150	°C
T_{STG}	Storage temperature	-65	150	°C

3. Recommended Operating Conditions

Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply voltage	2.7	36	V
V_{IN}	Input voltage range	-0.1	$V_{CC} - 1.5$	V
T_A	Ambient temperature	-40	125	°C

4. ESD Ratings

When a statically-charged person or object touches an electrostatic discharge sensitive device, the electrostatic charge might be drained through sensitive circuitry in the device. If the electrostatic discharge possesses sufficient energy, damage might occur to the device due to localized overheating.

Model	Condition	Rating	Unit
HBM	ESDA/JEDEC JS-001	±3000	V
CDM	ESDA/JEDEC JS-002	±2000	V

5. Thermal Considerations

The thermal resistance determines the heat insulation property of a material. The higher the thermal resistance is, the lower the heat loss. Accumulation of heat energy degrades the performance of semiconductor components.

Symbol	Metric	SOIC-8	MSOP-8	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	131.8	199.4	°C/W

6. Electrical Characteristics

6.1. Electrical Characteristics: $V_{CC} = 5\text{ V}$

$V_{CM} = (V_-)$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{OS}	Input offset voltage	$V_{CC} = 2.7\text{ to }36\text{ V}$	-3.5		3.5	mV
		$V_{CC} = 2.7\text{ to }36\text{ V}$, $T_A = -40^\circ\text{C to }125^\circ\text{C}$	-4.5		4.5	
I_B	Input bias current			10		pA
I_{OS}	Input offset current			5		pA
V_{CM}	Common mode range	$V_{CC} = 2.7\text{ to }36\text{ V}$	V_-		$(V_+) - 1.5$	V
		$V_{CC} = 2.7\text{ to }36\text{ V}$, $T_A = -40^\circ\text{C to }125^\circ\text{C}$	V_-		$(V_+) - 1.5$	
$A_{VD}^{(1)}$	Large signal differential voltage amplification	$V_O = 1.4\text{ V to }11.4\text{ V}$, $R_L \geq 15\text{ k}\Omega\text{ to } (V_+)$	100	400		V/mV
V_{OL}	Low level output voltage {swing from (V_-) }	$I_{SINK} \leq 4\text{ mA}$, $V_{ID} = -1\text{ V}$		165		mV
I_{OH-LKG}	High level output leakage current	$V_{CC} = V_O = 5\text{ V}$, $V_{ID} = 1\text{ V}$		0.3		nA
I_{OL}	Low level output current	$V_{OL} = 1.5\text{ V}$, $V_{ID} = -1\text{ V}$		33		mA
I_Q	Quiescent current (per channel)	No load, $V_{CC} = 5\text{ V}$		125		μA

6.2. Electrical Characteristics: $V_{CC} = 12\text{ V}$

$V_{CM} = (V_-)$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{OS}	Input offset voltage	$V_{CC} = 2.7\text{ to }36\text{ V}$	-3.5		3.5	mV
		$V_{CC} = 2.7\text{ to }36\text{ V}$, $T_A = -40^\circ\text{C to }125^\circ\text{C}$	-4.5		4.5	
I_B	Input bias current			10		pA
I_{OS}	Input offset current			5		pA

V_{CM}	Common mode range	$V_{CC} = 2.7$ to 36 V	V-		$(V+) - 1.5$	V
		$V_{CC} = 2.7$ to 36 V, $T_A = -40^{\circ}\text{C}$ to 125°C	V-		$(V+) - 1.5$	
$A_{VD}^{(1)}$	Large signal differential voltage amplification	$V_O = 1.4$ V to 11.4 V; $R_L \geq 15$ k Ω to (V+)	100	400		V/mV
V_{OL}	Low level output voltage {swing from (V-)}	$I_{SINK} \leq 4$ mA, $V_{ID} = -1$ V		165		mV
I_{OH-LKG}	High level output leakage current	$V_{CC} = V_O = 12$ V, $V_{ID} = 1$ V		0.3		nA
I_{OL}	Low level output current	$V_{OL} = 1.5$ V, $V_{ID} = -1$ V		30		mA
I_Q	Quiescent current (per channel)	No load, $V_{CC} = 12$ V		125		μA

6.3. Electrical Characteristics: $V_{CC} = 30$ V

$V_{CM} = (V-)$, $T_A = 25^{\circ}\text{C}$, unless otherwise noted.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{OS}	Input offset voltage	$V_{CC} = 2.7$ to 36 V	-3.5		3.5	mV
		$V_{CC} = 2.7$ to 36 V, $T_A = -40^{\circ}\text{C}$ to 125°C	-4.5		4.5	
I_B	Input bias current			20		pA
I_{OS}	Input offset current			5		pA
V_{CM}	Common mode range	$V_{CC} = 2.7$ to 36 V	V-		$(V+) - 1.5$	V
		$V_{CC} = 2.7$ to 36 V, $T_A = -40^{\circ}\text{C}$ to 125°C	V-		$(V+) - 1.5$	
$A_{VD}^{(1)}$	Large signal differential voltage amplification	$V_O = 1.4$ V to 11.4 V, $R_L \geq 15$ k Ω to (V+)	100	400		V/mV
V_{OL}	Low level output voltage {swing from (V-)}	$I_{SINK} \leq 4$ mA, $V_{ID} = -1$ V		165		mV
I_{OH-LKG}	High level output leakage current	$V_{CC} = V_O = 30$ V, $V_{ID} = 1$ V		0.3		nA
I_{OL}	Low level output current	$V_{OL} = 1.5$ V, $V_{ID} = -1$ V		30		mA
I_Q	Quiescent current (per channel)	No load, $V_{CC} = 30$ V		125		μA

Note:

- (1) Guaranteed by design.
- (2) Specifications subject to change without notice.

7. Switching Characteristics

7.1. Switching Characteristics: $V_{CC} = 5\text{ V}$

$V_{O_PULLUP} = 5\text{ V}$, $V_{CM} = V_{CC}/2$, $C_L = 15\text{ pF}$, $R_L = 5.1\text{ k}\Omega$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{response}	Propagation delay time, high-to-low; TTL input signal ⁽¹⁾	TTL input with $V_{\text{ref}} = 1.4\text{ V}$		170		ns
t_{response}	Propagation delay time, high-to-low; Small scale input signal ⁽¹⁾	Input overdrive = 5 mV, Input reference = 100 mV		2		μs
t_{response}	Propagation delay time, low-to-high; Small scale input signal ⁽¹⁾	Input overdrive = 5 mV, Input reference = 100 mV		2.3		μs

7.2. Switching Characteristics: $V_{CC} = 12\text{ V}$

$V_{O_PULLUP} = 12\text{ V}$, $V_{CM} = V_{CC}/2$, $C_L = 15\text{ pF}$, $R_L = 5.1\text{ k}\Omega$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{response}	Propagation delay time, high-to-low; TTL input signal ⁽¹⁾	TTL input with $V_{\text{ref}} = 1.4\text{ V}$		200		ns
t_{response}	Propagation delay time, high-to-low; Small scale input signal ⁽¹⁾	Input overdrive = 5 mV, Input step = 100 mV		2.3		μs
t_{response}	Propagation delay time, low-to-high; Small scale input signal ⁽¹⁾	Input overdrive = 5 mV, Input step = 100 mV		2.5		μs

7.3. Switching Characteristics: $V_{CC} = 30\text{ V}$

$V_{O_PULLUP} = 30\text{ V}$, $V_{CM} = V_{CC}/2$, $C_L = 15\text{ pF}$, $R_L = 5.1\text{ k}\Omega$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{response}	Propagation delay time, high-to-low; TTL input signal ⁽¹⁾	TTL input with $V_{\text{ref}} = 1.4\text{ V}$		300		ns
t_{response}	Propagation delay time, high-to-low; Small scale input signal ⁽¹⁾	Input overdrive = 5 mV, Input step = 100 mV		2.7		μs
t_{response}	Propagation delay time, low-to-high; Small scale input signal ⁽¹⁾	Input overdrive = 5 mV, Input step = 100 mV		3		μs

Note:

(1) High-to-low and low-to-high refer to the transition at the input.

(2) Specifications subject to change without notice.

8. Typical Characteristics

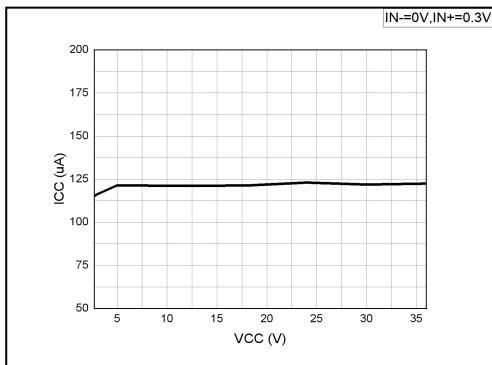


Figure 2. I_{CC} vs. V_{CC}

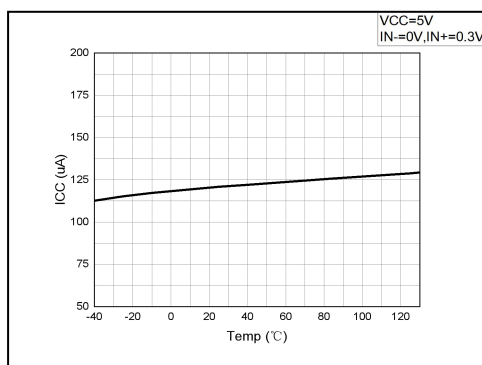


Figure 3. I_{CC} vs. Temperature

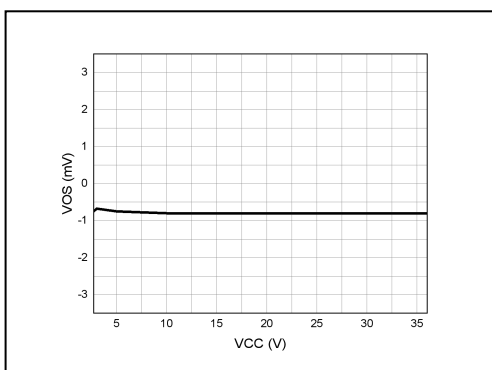


Figure 4. V_{OS} vs. V_{CC}

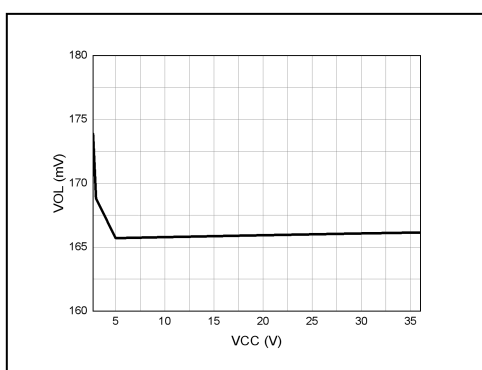


Figure 5. V_{OL} vs. V_{CC}

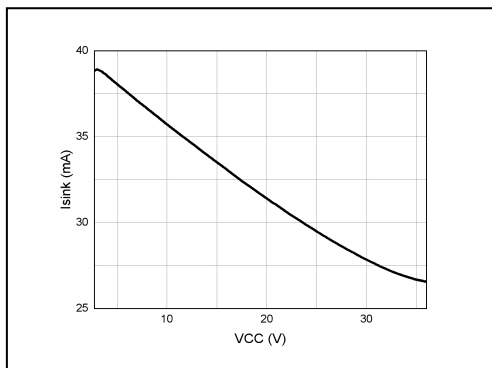


Figure 6. I_{SINK} vs. V_{CC}

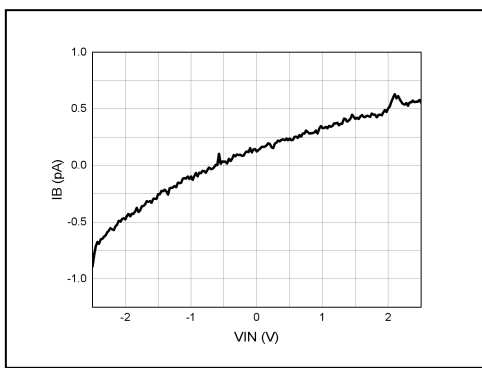


Figure 7. I_B vs. V_{IN}

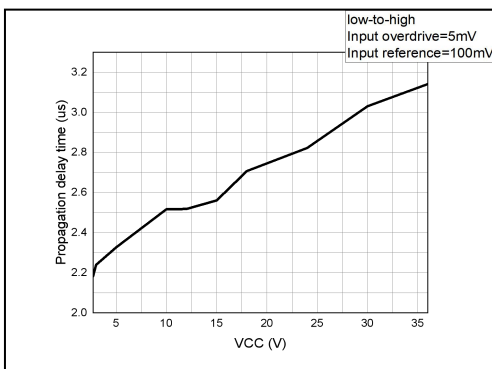


Figure 8. Propagation delay time vs. V_{CC} (low to high)

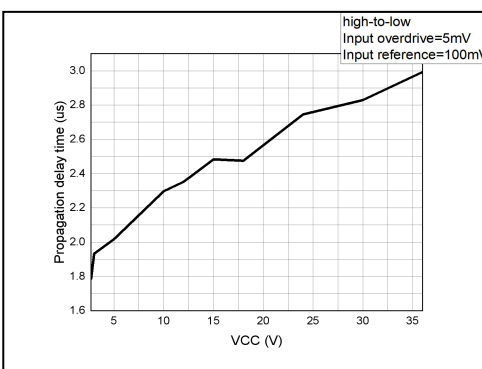


Figure 9. Propagation delay time vs. V_{CC} (high to low)

9. Application Information

Important notice: Validation and testing are the most reliable ways to confirm system functionality. The application information is not part of the specification and is for reference purposes only.

The DIA20903 is the dual differential comparator featuring high speed and low power. The device is typically used to compare a single signal to a reference or two signals against each other. Many users utilize the open drain output to drive the comparison logic output to a logic voltage level to an MCU or logic device. The wide supply range and high voltage capability enable the level of this comparator to shift to higher or lower voltages.

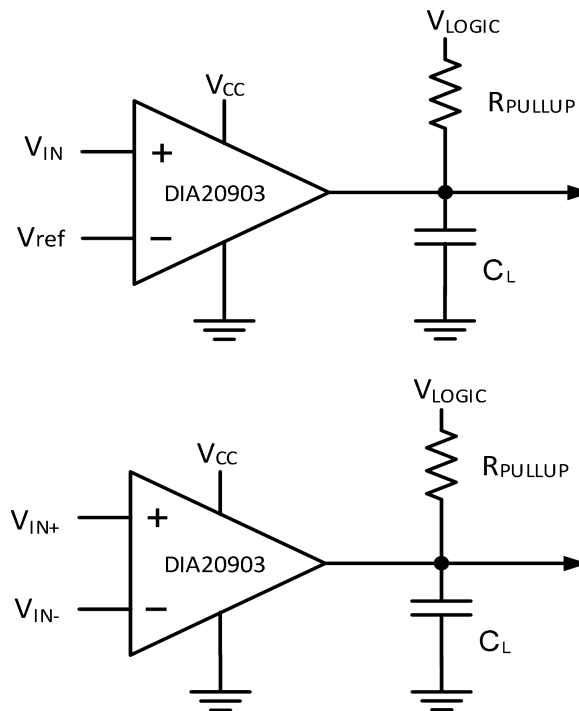


Figure 10. Single-ended and differential comparator configurations

9.1. Low input bias current

The DIA20903 comparator has an ultra-low input bias current at about 10 pA, which allows the comparator to be used in applications with high resistance sources.

9.2. Wide range of supply voltage

The DIA20903 is enabled to operate with the supply voltage up to 42 V. The open-drain output allows the user to configure the output's logic high voltage (V_{OH}) and enables the comparator to be used in AND functionality.

9.3. Output and drive current

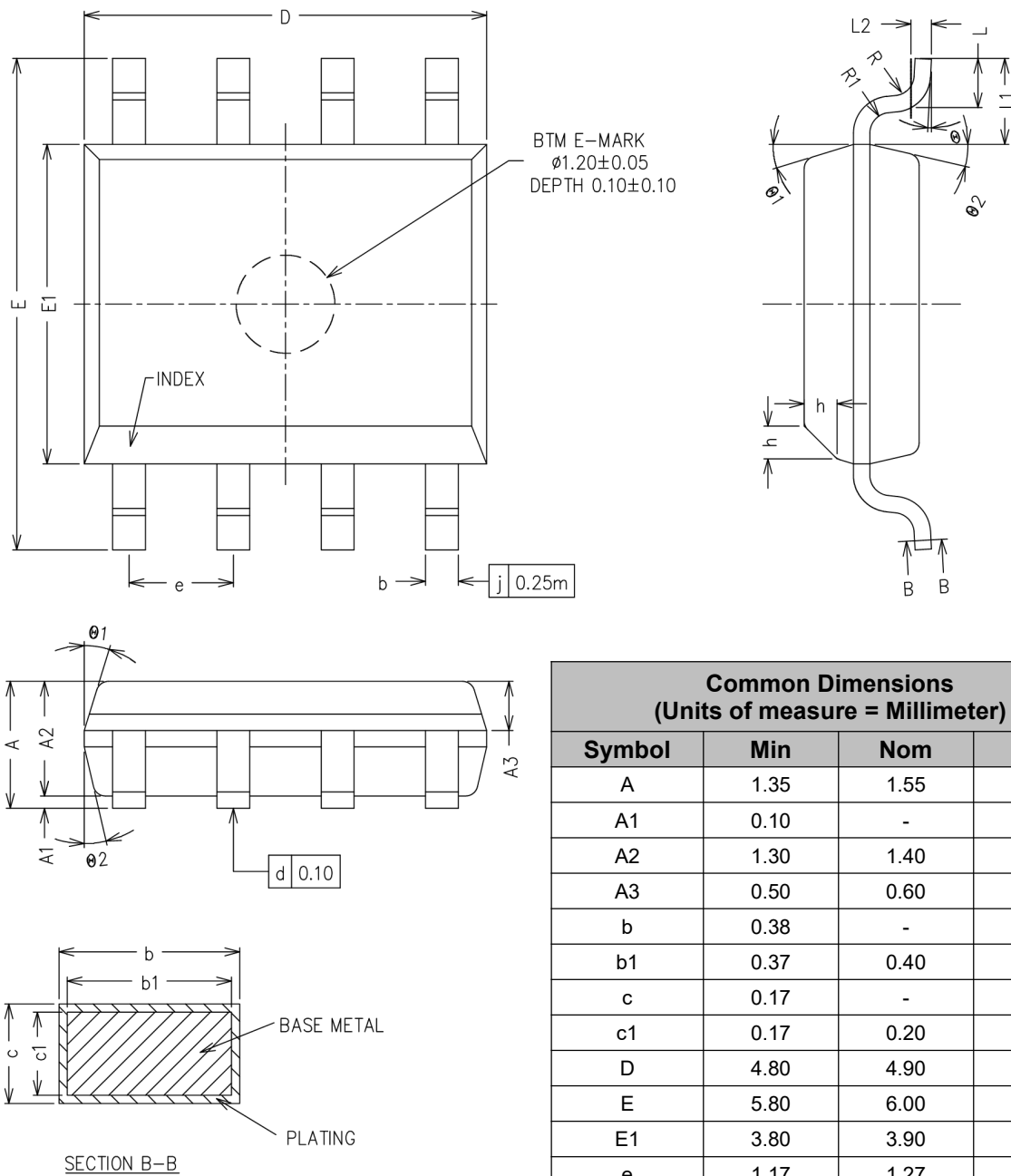
Output current is determined by the load/pull-up resistance and logic/pullup voltage. The output current generates a output low voltage (V_{OL}) from the comparator and V_{OL} is proportional to the output current.

9.4. Response time

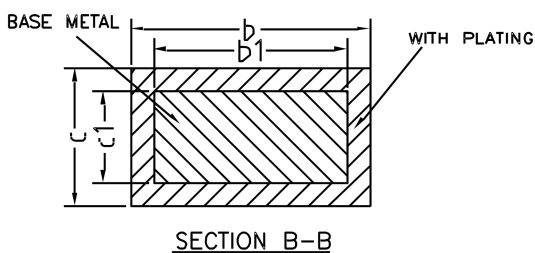
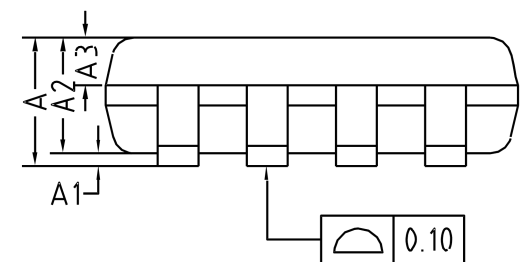
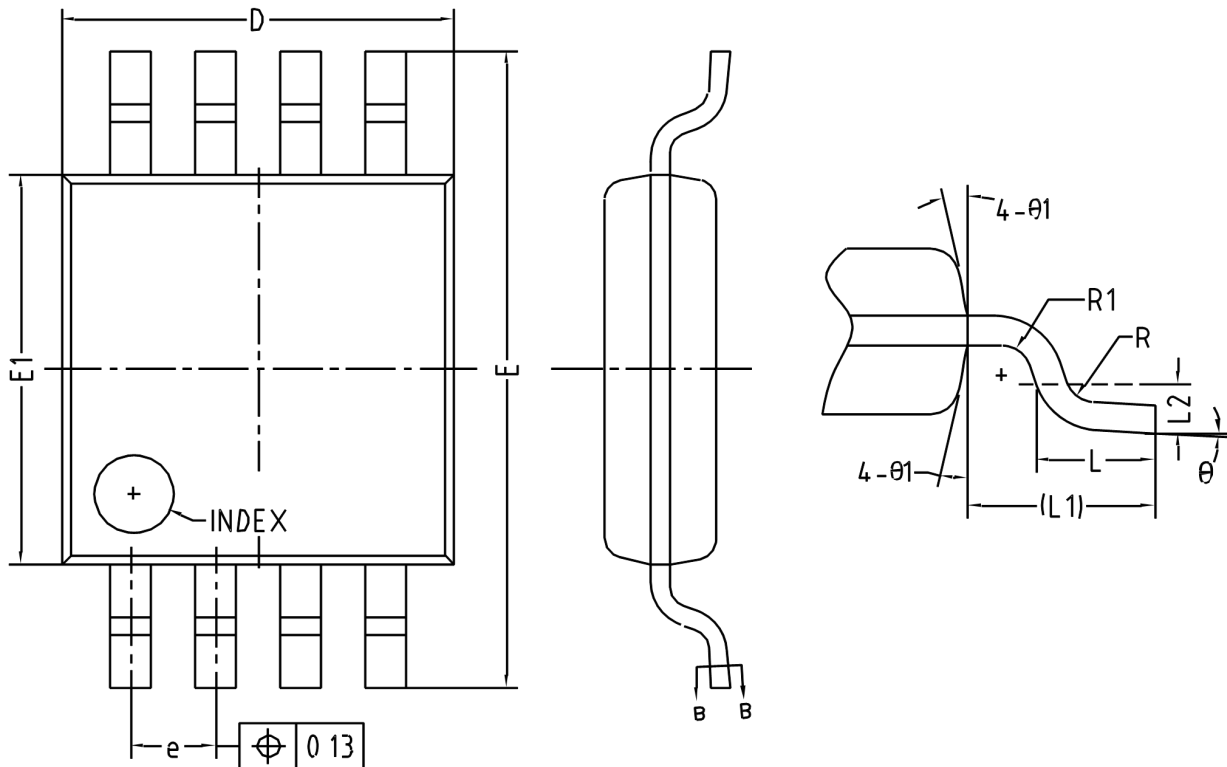
Response time is a function of overdriven input. The rising/falling time can be determined by the load capacitance (C_L), load/pullup resistance (R_{PULLUP}), and equivalent drain source resistance (R_{DS}).

10. Physical Dimensions

10.1. SOIC-8



10.2. MSOP-8



Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Nom	Max
A	-	-	1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.25	-	0.38
b1	0.24	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
e	0.55	0.65	0.75
L	0.40	0.55	0.70
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
θ	0°	-	8°
θ1	9°	12°	15°

Disclaimer

This specification and information contained herein are provided on an “AS IS” basis and WITH ALL FAULTS. All product specifications, statements, information, and data (collectively, the “Information”) in this datasheet or made available on the website of www.dioo.com are subject to change without notice. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to his/her application. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, express or implied.