High Voltage, Dual Differential Comparator with Open-Drain Output

Features

- Wide supply voltage range: 2.7 V to 36 V
- Open drain output
- Input offset voltage: ±4.5 mV (max.)
- Common mode input voltage range:
- V- to (V+) - 1.5 V
- Low supply current: 125 μA (typ.) per channel
- Low input bias current: 10 pA (typ.) at V_{CC} = 5 V and V_{CC} = 12 V
- Propagation delay time at V_{CC} = 5 V, overdrive = 5 mV:
  - 2 μs (high-to-low)
  - 2.3 μs (low-to-high)

Applications

- Photovoltaic inverters
- Charging piles
- Single phase UPS
- Server PSU
- Cordless power tool
- Wireless infrastructure
- Applicances
- Building automation
- Factory automation & control
- Motor drives
- Infotainment & cluster

Package Information

Part Number	Package	Body Size
DIO20903	SOIC-8	4.9 mm × 3.9 mm
	MSOP-8	3.0 mm × 3.0 mm
	DIP-8	9.20 mm × 6.35 mm
	TSSOP-8	2.93 mm × 4.40 mm
	TSOT23-8	2.92 mm × 1.65 mm
	DFN-8	2.0 mm × 2.0 mm

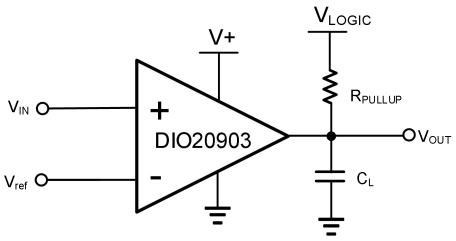
Description

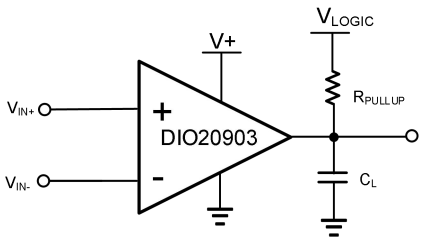
The DIO20903 is a dual ,high precision comparator with open-drain output. The device operate over a wide range of supply voltages from 2.7 V to 36 V, the current drain is independent of the supply voltage.

The DIO20903 holds a lower input offset voltage (V_{OS} = ±3.5 mV at T_A = 25°C), making it suitable for applications requiring precision. Featuring an open-drain output stage with an external pull-up resistor, the output can be connected to other open-drain outputs to achieve wired-AND logic relationships.

The DIO20903 is available in the Green SOIC-8, MSOP-8, DIP-8, TSSOP-8, TSOT23-8 and DFN2*2-8 packages. It is specified over ambient temperature range of -40°C to 125°C, which meets the requirements of industrial applications.

Simplified Schematic





Ordering Information

Ordering Part No.	Top Marking	MSL	RoHS	T_A	Package	
DIO20903CS8	DIOBV9C	3	Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500
DIO20903MP8	DIOBV9C	3	Green	-40 to 125°C	MSOP8	Tape & Reel, 3000
DIO20903DP8	DIOBV9C	3	Green	-40 to 125°C	DIP-8	Tube, 50
DIO20903TP8	DIOBV9C	3	Green	-40 to 125°C	TSSOP-8	Tape & Reel, 3000
DIO20903TST8	9CYW	3	Green	-40 to 125°C	TSOT23-8	Tape & Reel, 4000
DIO20903CN8	BV9C	3	Green	-40 to 125°C	DFN2*2-8	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.

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1. Pin Assignment and Functions

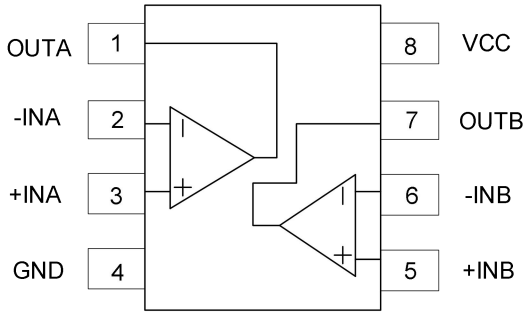


Figure 1. SOIC-8/ MSOP-8/ DIP-8/ TSSOP-8/ TSOT23-8 (Top view)

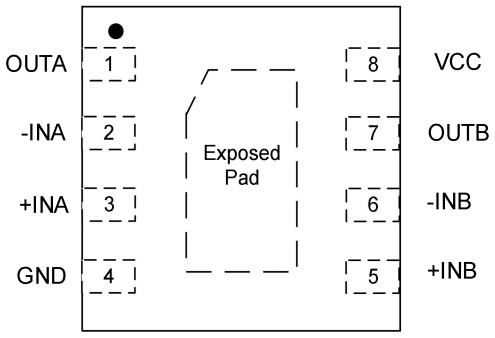


*Figure 2. DFN2*2-8 (Top view)*

Pin Name	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		25	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 V

V_{CM} = (V-), T_A = 25°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°C to 125°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°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 ≥ 15 kΩ to (V+)	100	400		V/mV
V_{OL}	Low level output voltage {swing from (V-)}	I_{SINK} ≤ 4 mA, V_{ID} = -1 V		165		mV
I_{OH-LKG}	High level output leakage current	V_{CC} = V_O = 5 V, V_{ID} = 1 V		0.3		nA
I_{OL}	Low level output current	V_{OL} = 1.5 V, V_{ID} = -1 V		33		mA
I_Q	Quiescent current (per channel)	No load, V_{CC} = 5 V		125		μA

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

V_{CM} = (V-), T_A = 25°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°C to 125°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°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 ≥ 15 kΩ to (V+)	100	400		V/mV
V_{OL}	Low level output voltage {swing from (V-)}	I_{SINK} ≤ 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°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°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°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 ≥ 15 kΩ to (V+)	100	400		V/mV
V_{OL}	Low level output voltage {swing from (V-)}	I_{SINK} ≤ 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 V

V_{O_PULLUP} = 5 V, V_{CM} = V_{CC}/2, C_L = 15 pF, R_L = 5.1 kΩ, T_A = 25°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_{ref} = 1.4 V		170		ns
$t_{response}$	Propagation delay time, high-to-low; Small scale input signal (1)	Input overdrive = 5 mV, Input step = 100 mV		2		µs
$t_{response}$	Propagation delay time, low-to-high; Small scale input signal (1)	Input overdrive = 5 mV, Input step = 100 mV		2.3		µs

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

V_{O_PULLUP} = 12 V, V_{CM} = V_{CC}/2, C_L = 15 pF, R_L = 5.1 kΩ, T_A = 25°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_{ref} = 1.4 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 V

V_{O_PULLUP} = 30 V, V_{CM} = V_{CC}/2, C_L = 15 pF, R_L = 5.1 kΩ, T_A = 25°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_{ref} = 1.4 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

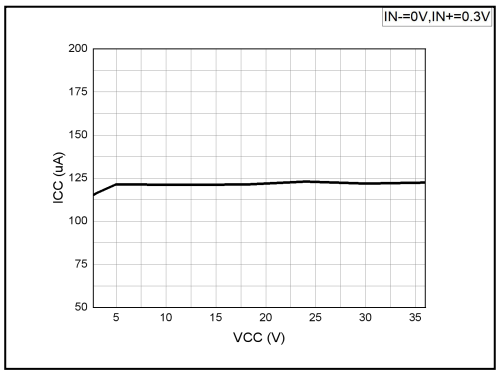


Figure 3. I_{CC} vs. V_{CC}

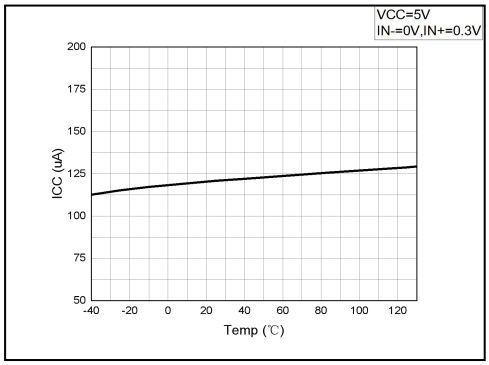


Figure 4. I_{CC} vs. Temperature

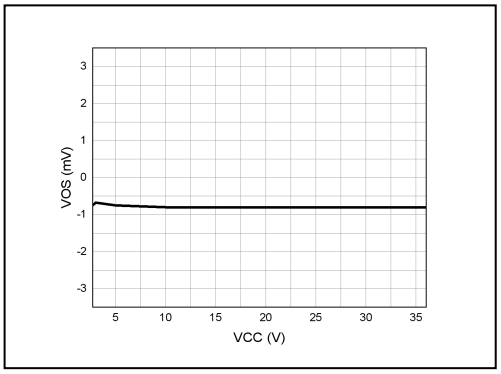


Figure 5. V_{OS} vs. V_{CC}

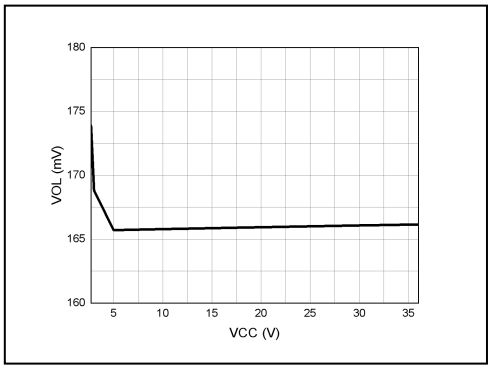


Figure 6. V_{OL} vs. V_{CC}

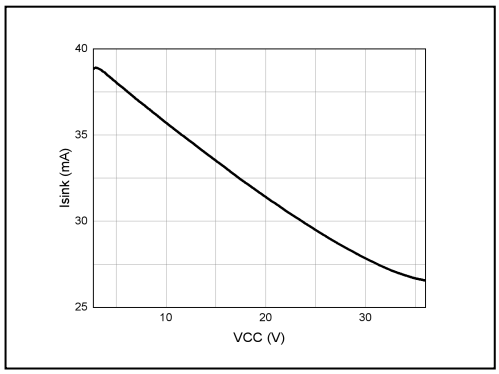


Figure 7. I_{SINK} vs. V_{CC}

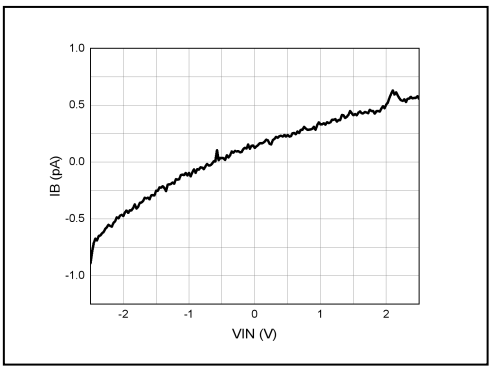


Figure 8. I_B vs. V_{IN}

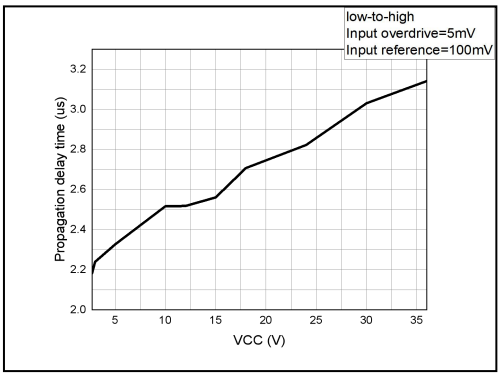


Figure 9. Propagation delay time vs. V_{CC} (low to high)

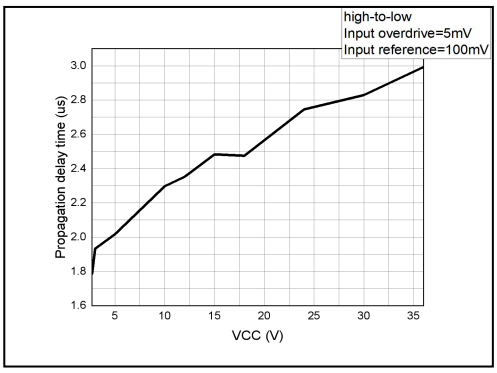


Figure 10. Propagation delay time vs. V_{CC} (high to low)

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 DIO20903 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.

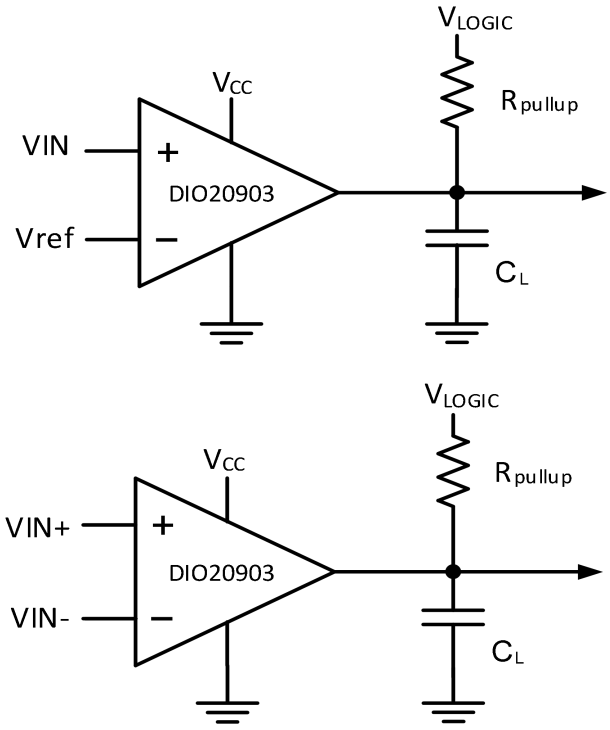


Figure 11. Single-ended and differential comparator configurations

9.1. Low input bias current

The DIO20903 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 DIO20903 is enable 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

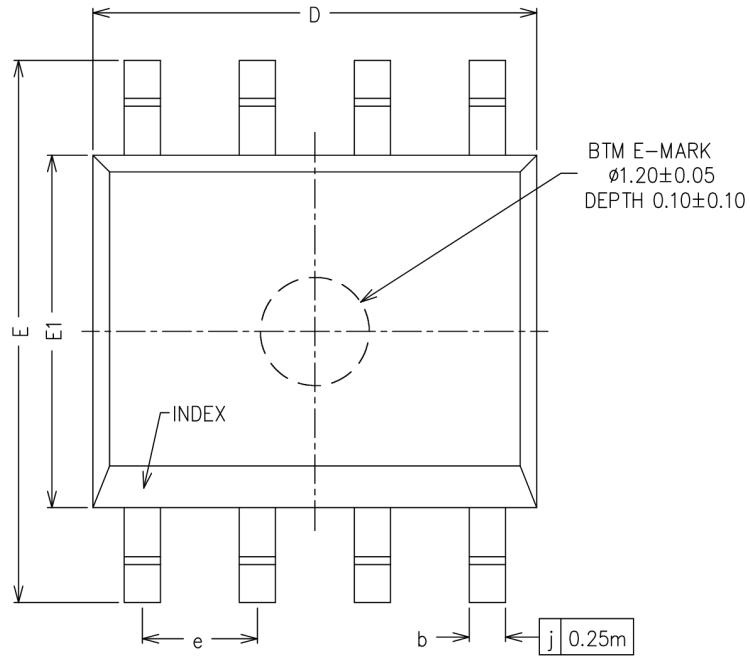
Output current is determined by the load/pull-up resistance and logic/pullup voltage. The output current generates a output low voltage (V_{OL}) from the comparator and V_{OL} is proportional to the output current.

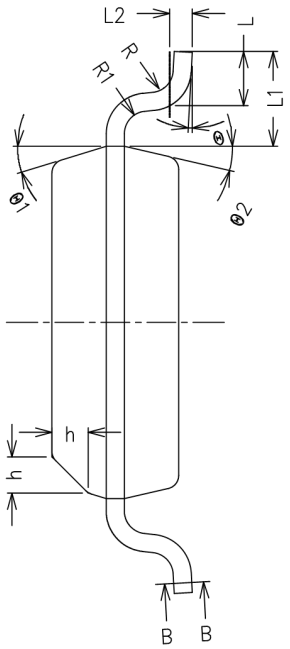
9.4. Response time

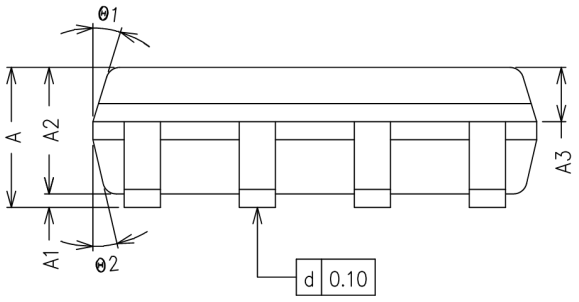
Response time is a function of overdriven input. The rising/falling time can be determined by the load capacitance (C_L), load/pullup resistance (R_{PULLUP}), and equivalent drain source resistance (R_{DS}).

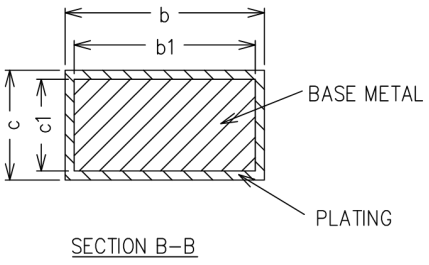
10. Physical Dimensions

10.1. SOIC-8





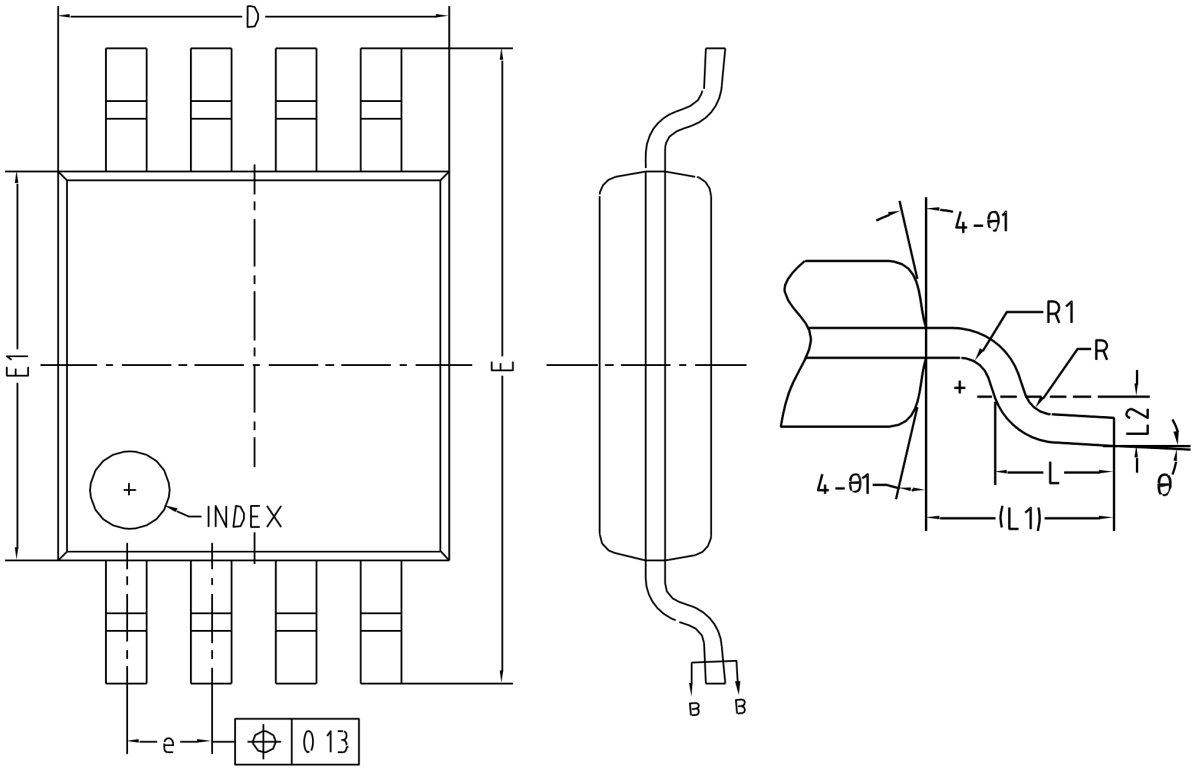


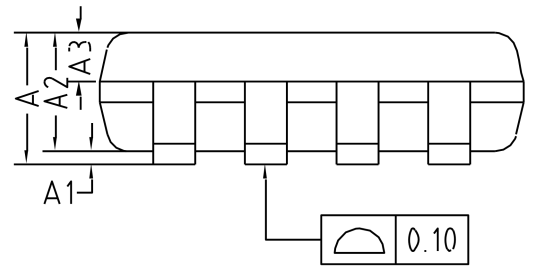


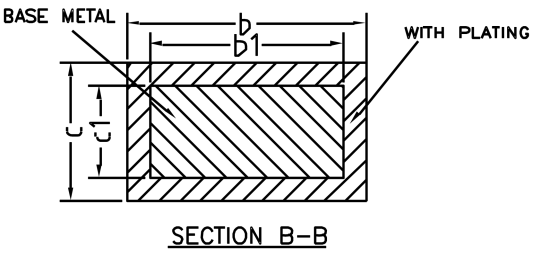
SECTION B–B

Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	1.35	1.55	1.75
A1	0.10	-	0.25
A2	1.30	1.40	1.50
A3	0.50	0.60	0.70
b	0.38	-	0.47
b1	0.37	0.40	0.43
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	1.17	1.27	1.37
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
h	0.30	0.40	0.50
θ	0°	-	8°
θ1	15°	17°	19°
θ2	11°	13°	15°

10.2. MSOP-8



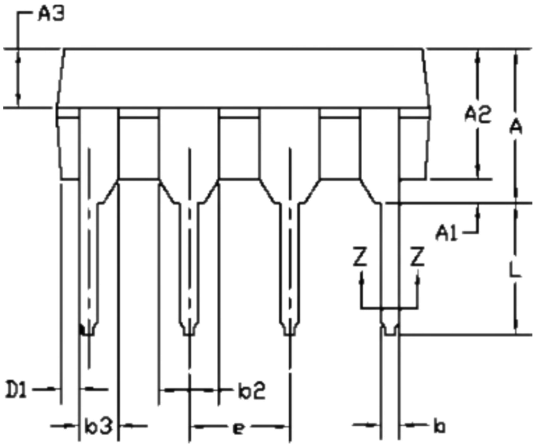


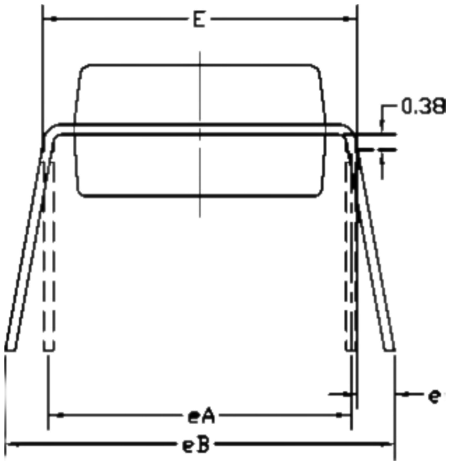


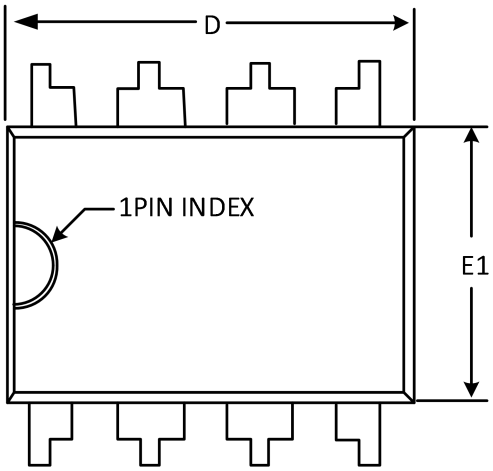
SECTION B–B

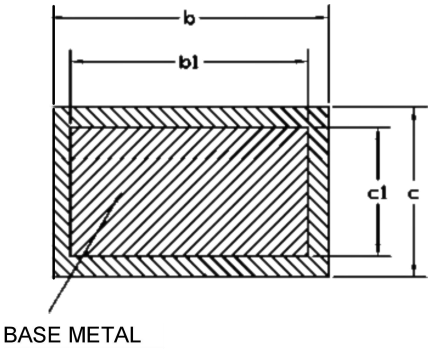
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.25	-	0.38
b1	0.24	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
e	0.55	0.65	0.75
L	0.40	0.55	0.70
L1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

10.3. DIP-8



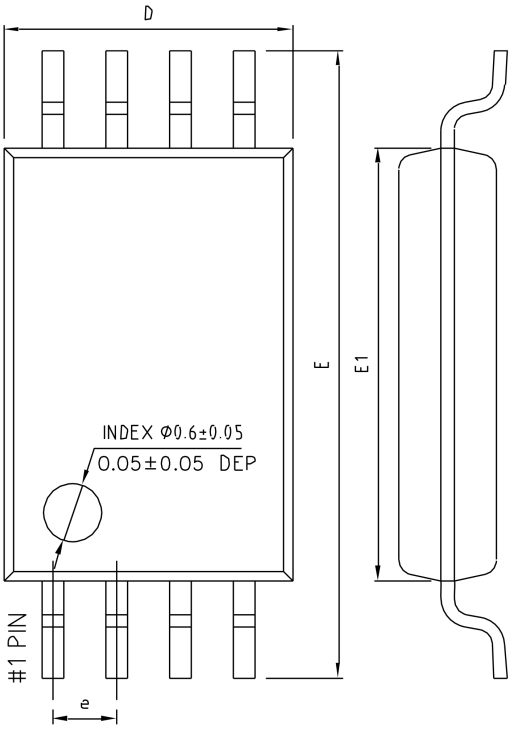


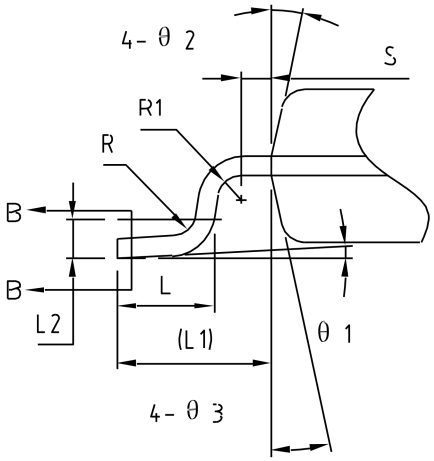


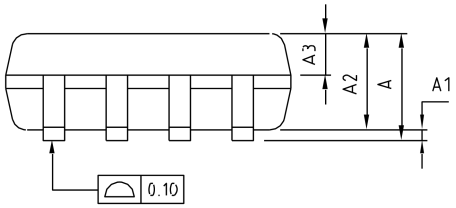


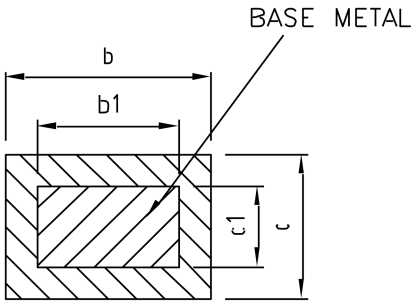
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	4.80
A1	0.5	-	-
A2	3.10	3.30	3.50
A3	1.40	1.50	1.60
b	0.38	-	0.55
b1	0.38	0.46	0.51
b2	1.47	1.52	1.57
b3	0.89	0.99	1.09
c	0.21	-	0.35
c1	0.20	0.25	0.30
D	9.10	9.20	9.30
D1	0.13	-	-
E	7.62	7.87	8.25
E1	6.25	6.35	6.45
e	2.54 BSC		
eA	7.62 BSC		
eB	7.62	8.8	10.9
ec	0	-	1.52
L	2.92	3.3	3.81

10.4. TSSOP-8



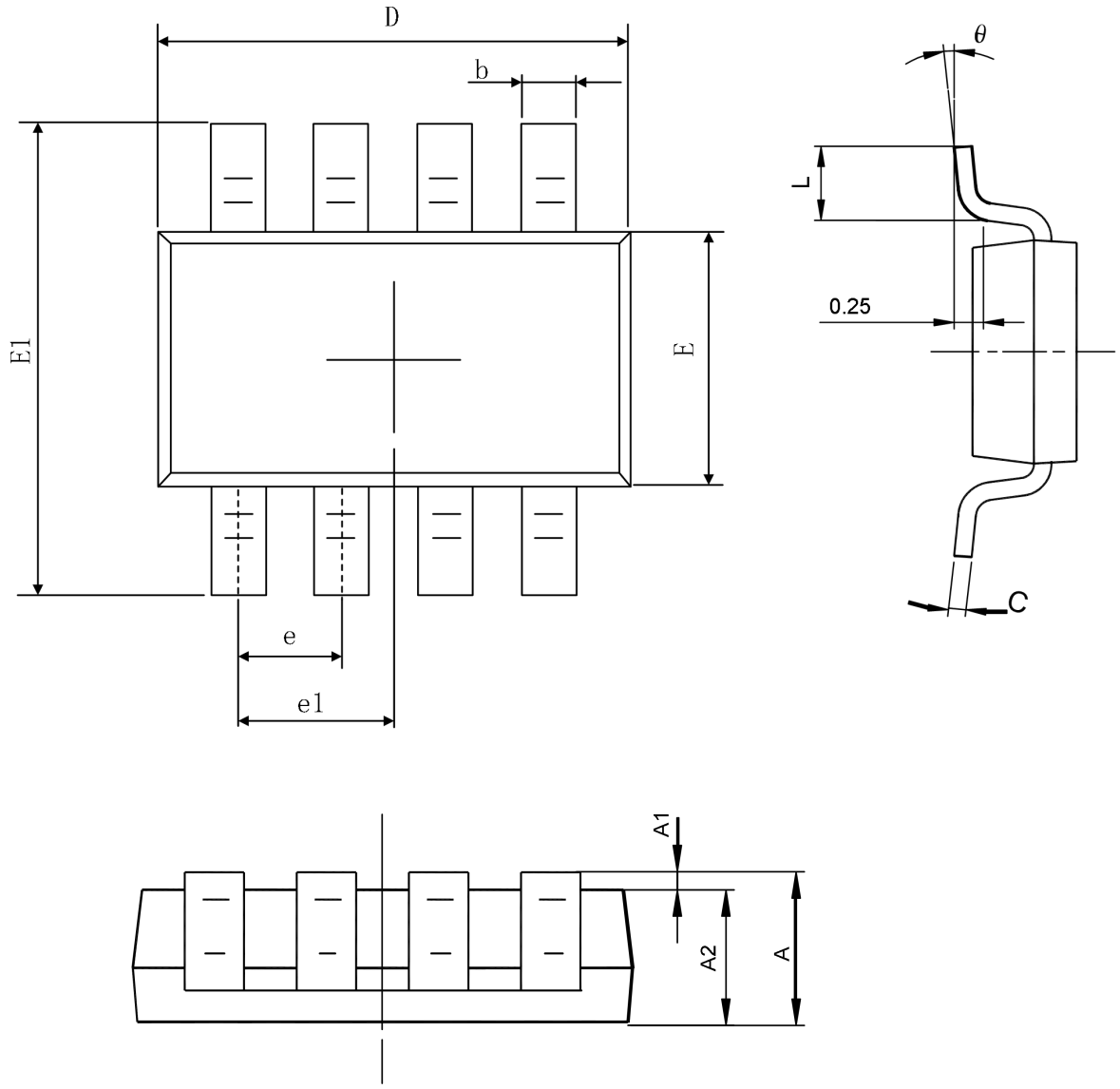






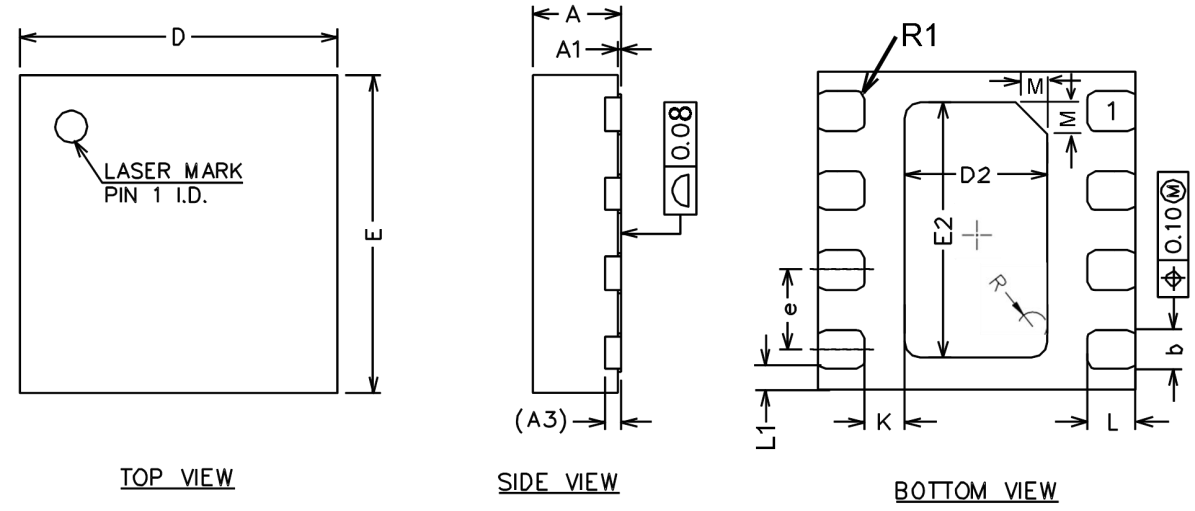
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.20
A1	0.05	-	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	-	0.28
b1	0.20	0.22	0.24
c	0.10	-	0.19
c1	0.10	0.13	0.15
D	2.83	2.93	3.03
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	-	-
R1	0.09	-	-
S	0.20	-	-
θ1	0°	-	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

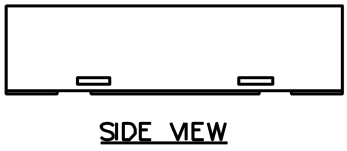
10.5. TSOT23-8



Common Dimensions (Units of measure = Millimeter)		
Symbol	**Min**	**Max**
A	0.700	0.900
A1	0.000	0.100
A2	0.700	0.800
b	0.300	0.500
C	0.080	0.200
D	2.820	3.020
E	1.600	1.700
E1	2.650	2.950
e	0.65 BSC	
e1	0.975 BSC	
L	0.300	0.600
θ	0°	8°

10.6. DFN2*2-8





Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
A3		0.127 REF	
b	0.15	0.20	0.25
D	1.95	2.00	2.05
E	1.95	2.00	2.05
D2	0.80	0.90	1.00
E2	1.50	1.60	1.70
e	0.45	0.50	0.55
K	0.15	0.25	0.35
L	0.25	0.30	0.35
L1	0.075	0.125	0.175
M		0.20 REF	
R		0.10 REF	
R1		0.05 REF	

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