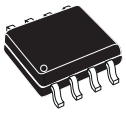
LM2903B

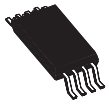
Datasheet

Low-power dual voltage comparator



SO8

MiniSO8



TSSOP8

DFN8 2 x 2
wettable flanks

Maturity status link
LM2903B

Features

- Wide single supply voltage range or dual supplies +2 V to +36 V or ±1 V to ±18 V
- Very low supply current 0.5 mA typ., essentially independent of supply voltage
- Low input bias current: 20 nA typ.
- Low input offset current: ±5 nA typ.
- Input common-mode voltage range includes negative rail
- Low output saturation voltage: 250 mV typ. (I_{out} = 4 mA)
- TTL, DTL, ECL, MOS, CMOS compatible outputs
- Automotive qualification

Applications

- Level shifters
- Sampling circuits
- Peak & zero crossing detectors
- Threshold detectors
- Automotive

Description

The LM2903B consists of two independent low-power voltage comparators designed specifically to operate from a single supply over a wide range of voltages. It is fully specified at 5 V and 36 V supply voltage operation, however operation from dual power supplies is also possible.

The B-grade version of the LM2903 comparators offers an increased maximum operating voltage of 40 V and improved electrical characteristics.

1 Diagram and pin configuration

Figure 1. **Diagram**

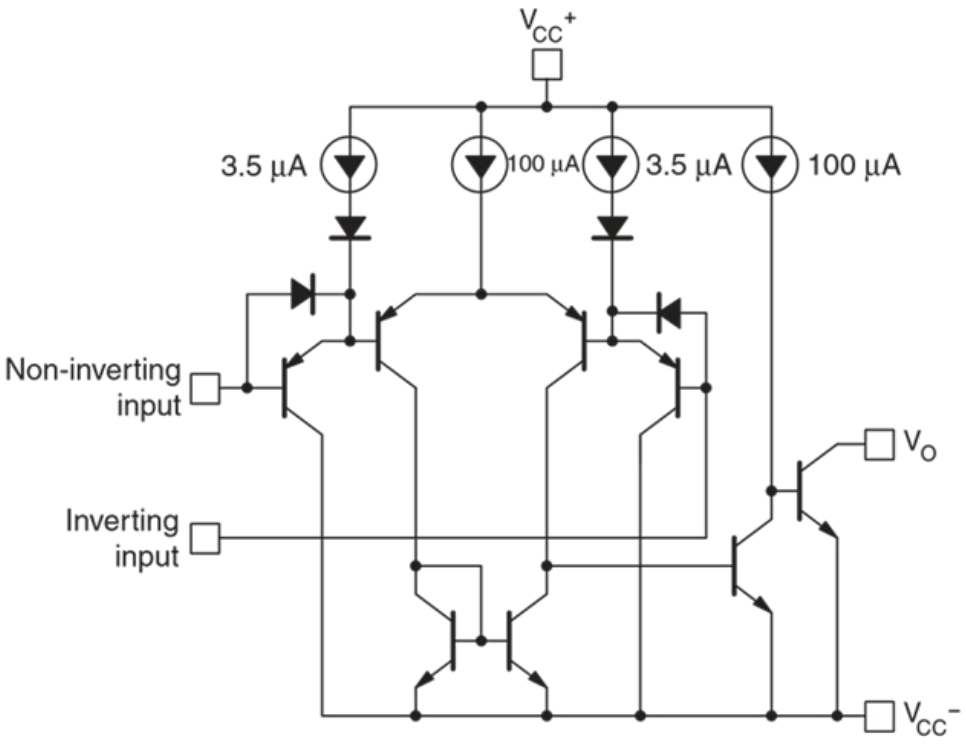
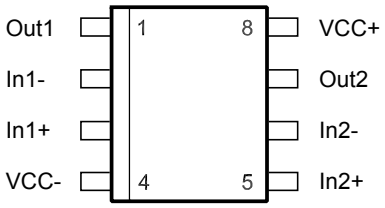
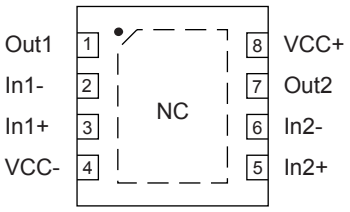


Figure 2. **Pin connections (top view)**



SO8 / MiniSO8 / TSSOP8



DFN8 (2 x 2) and DFN8 (2 x 2) wettable flanks [a]

2 Maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{cc}	Supply voltage (1)	±20 or 40	V
V_{id}	Differential input voltage (2)	±40	
V_{in}	Input voltage	-0.3 to 40	
I_{in}	Input current (3)	10	mA
	Output short-circuit current (4)	30	mA
	Output short-circuit duration (4)	Infinite	s
T_{stg}	Storage temperature range	-65 to 150	°C
T_j	Maximum junction temperature	150	
R_{thja}	Thermal resistance junction to ambient (5)		°C/W
	SO-8	125	
	MiniSO-8	190	
	TSSOP	120	
	DFN8	57	
R_{thjc}	Thermal resistance junction to case (5)		
	SO-8	40	
	MiniSO-8	39	
	TSSOP	37	
	DFN8	26	
ESD	HBM: human body model (6)	800	V
	MM: machine model (7)	200	
	CDM: charged device model (8)		
	SO-8	1500	
	MiniSO-8	1300	
	TSSOP	1500	
	DFN8	1500	

1. *All voltage values, except differential voltage, are with respect to network ground terminal.*
2. *Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.*
3. *Input current must be limited by a resistor in series with the inputs to keep V_{in} in the range of the specified AMR.*
4. *Short-circuits from the output to Vcc+ can cause excessive heating and eventual destruction. The maximum output current is approximately 30 mA.*
5. *Short-circuits can cause excessive heating and destructive dissipation. Values are typical.*
6. *Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.*
7. *Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.*
8. *Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.*

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{cc}	Supply voltage	2 to 36	V
V_{icm}	Common-mode input voltage range Tamb = 25 °C Common-mode input voltage range Tmin ≤ Tamb ≤ Tmax	V_{cc-} to V_{cc+} - 1.5 V_{cc-} to V_{cc+} - 2	
T	Operating free-air temperature range	-40 to 125	°C

3 Electrical characteristics

V_{cc}+ = 5 V and 36 V, V_{cc}- = 0 V, V_o = 1.4 V, RI connected to ground, T = 25 °C (unless otherwise specified).

Table 3. Electrical characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage (1) Tmin < T < Tmax			4 5	mV
I_{ib}	Input bias current (2) Tmin < T < Tmax		20	150 200	nA
I_{io}	Input offset current Tmin < T < Tmax		5	30 40	nA
A_{vd}	V_{cc} = 15 V, R_L = 15 kΩ, Vo = 1 to 11 V (3)		200		V / mV
I_{cc}	Supply current, all comparators, no load V_{cc} = 5 V Tmin < T < Tmax V_{cc} = 36 V Tmin < T < Tmax		 0.4 0.6	 1 1 2.5 2.5	mA
V_{id}	Differential input voltage			V_{cc}	V
V_{ol}	Low-level output voltage V_{cc} = 5 V, V_{id} = -1 V, I_{sink} = 4 mA T_{min} < T < T_{max} V_{cc} = 36 V, V_{id} = -1 V, I_{sink} = 4 mA T_{min} < T < T_{max}		 250 250	 350 600 350 600	mV
I_{oh}	High-level output current V_{cc} = V_o = 36 V, V_{id} = 1 V T_{min} < T < T_{max}		0.1	 1	nA µA
I_{sink}	Output sink current V_{id} = -1 V, V_o = 1.5 V V_{cc} = 5 V T_{min} < T < T_{max} V_{cc} = 36 V T_{min} < T < T_{max}	 8 7 11 10	 17 10 22 13		mA
t_{res}	Small signal response time R_L = 5.1 kΩ to V_{cc} (4) V_{cc} = 5 V V_{cc} = 36 V		 1.0 0.9		µs
t_{rel}	Large signal response time (5) TTL input (V_{ref} = +1.4 V, R_L = 5.1 kΩ to V_{cc}) Output signal at 50% of final value Output signal at 95% of final value			 500 1	 ns µs

1. *At output switch point, V_O ≈ 1.4 V, R_S = 0 Ω with V_{cc} from 5 V to 36 V, and over the full input common-mode range (0 V to V_{cc} –1.5 V).*
2. *The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference of input lines.*

3. *Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator provides a proper output state. The low input voltage state must not be less than –0.3 V (or 0.3 V below the negative power supply, if used).*
4. *The response time specified is for a 100 mV input step with 5 mV overdrive.*
5. *Maximum values are guaranteed by design and evaluation.*

4 Typical performance characteristics

Figure 3. Supply current vs. supply voltage

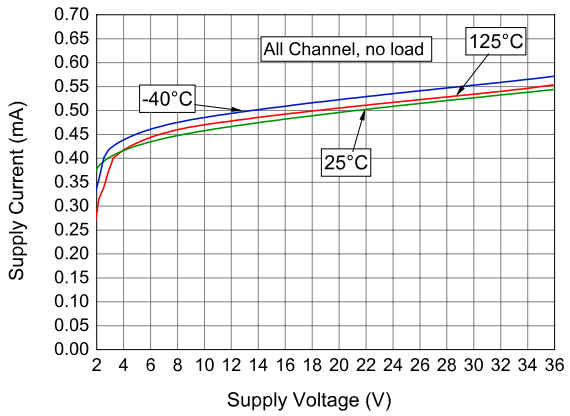


Figure 4. Input offset voltage vs. supply voltage

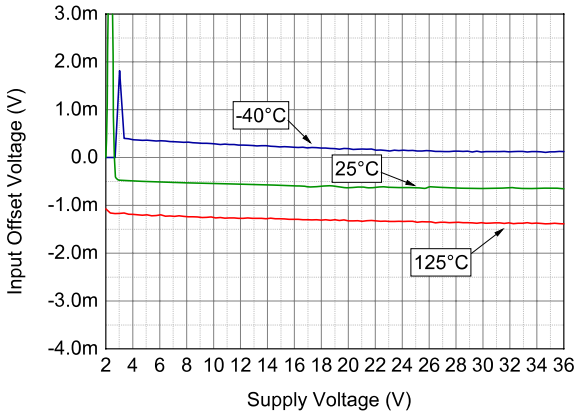


Figure 5. Input offset voltage vs. common-mode voltage at Vcc = 36 V

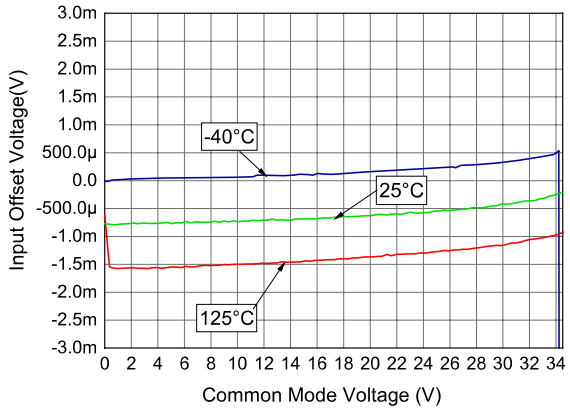


Figure 6. Input bias current vs. supply voltage at Vcm = Vcc/2

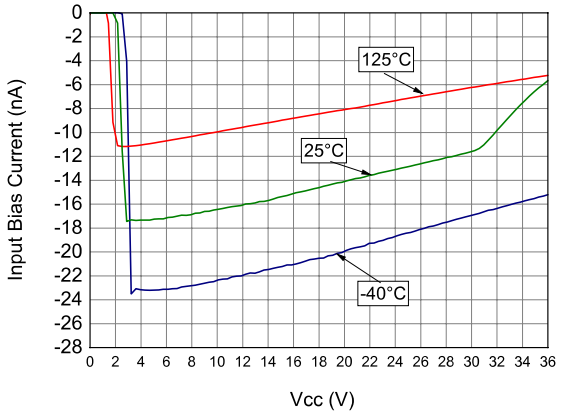


Figure 7. Input bias current vs. common-mode voltage at Vcc = 36 V

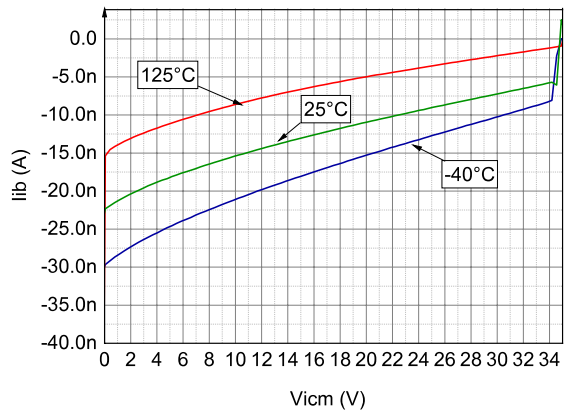


Figure 8. Output saturation voltage vs. output current

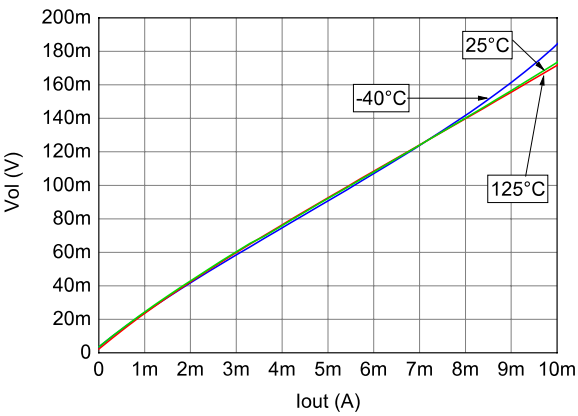


Figure 9. Output saturation current vs. output voltage at Vcc = 36 V

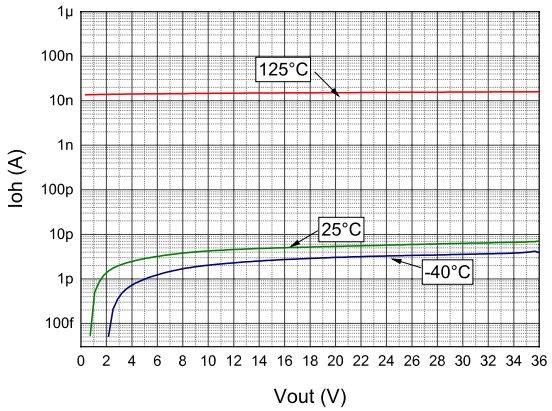


Figure 10. Positive step response

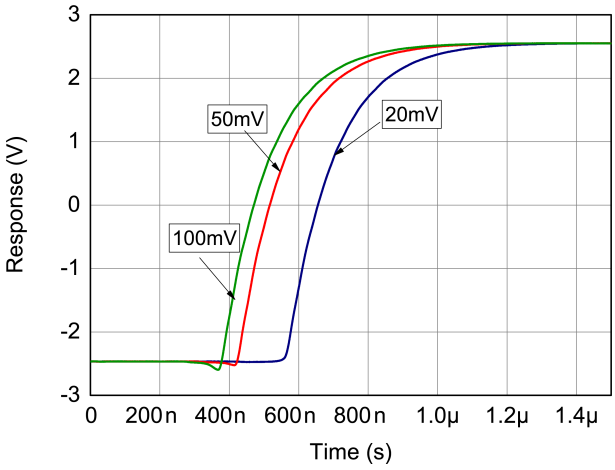


Figure 11. Negative step response

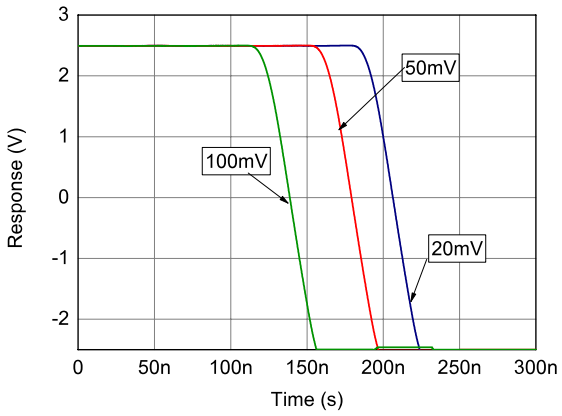


Figure 12. Propagation delay vs. overdrive for positive steps at Vcc = 36 V

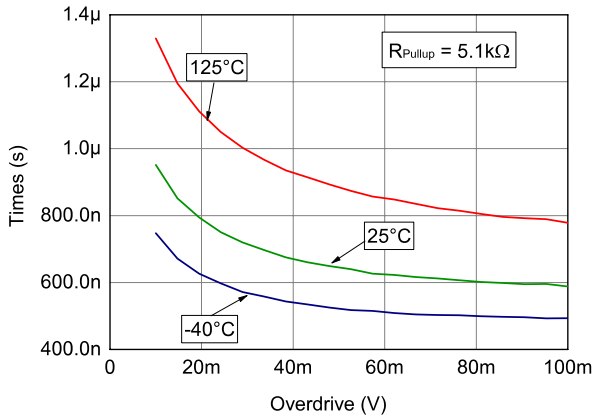
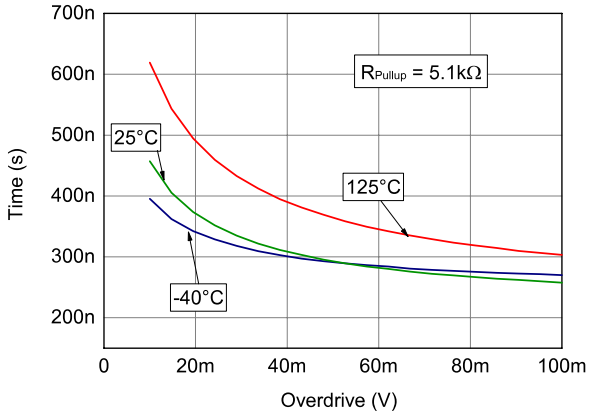


Figure 13. Propagation delay vs. overdrive for negative steps at Vcc = 36 V



5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

5.1 SO8 package information

Figure 14. SO8 package outline

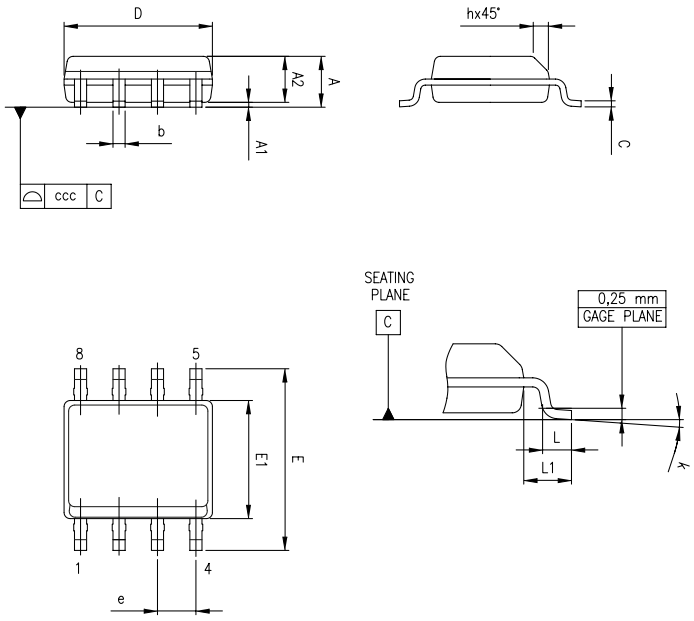
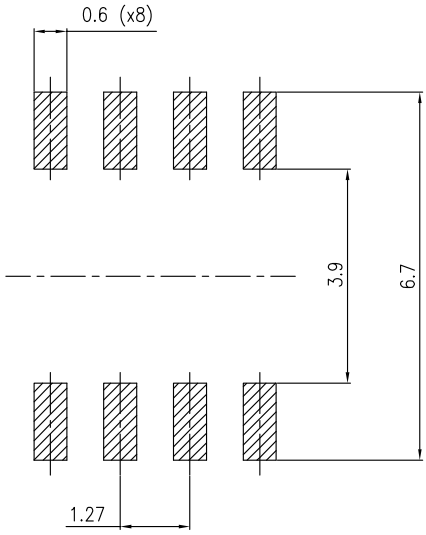


Table 4. SO8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.04		0.010
A2	1.25			0.049		
b	0.28	0.40	0.48	0.011	0.016	0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40	0.635	1.27	0.016		0.050
L1		1.04			0.040	
k	1°		8°	1°		8°
ccc			0.10			0.004

Figure 15. **SO8 recommended footprint**



5.2 MiniSO8 package information

Figure 16. **MiniSO8 package outline**

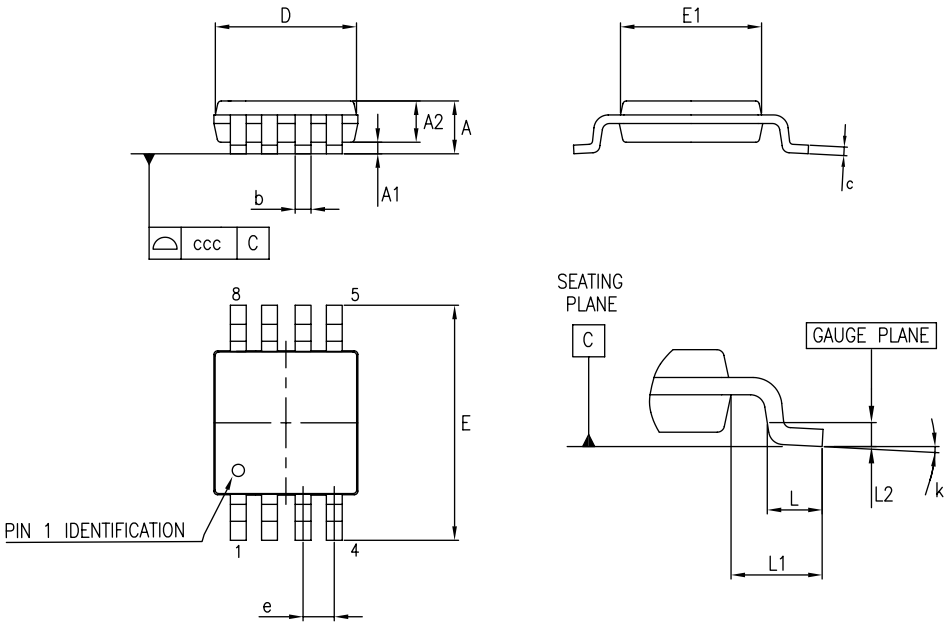
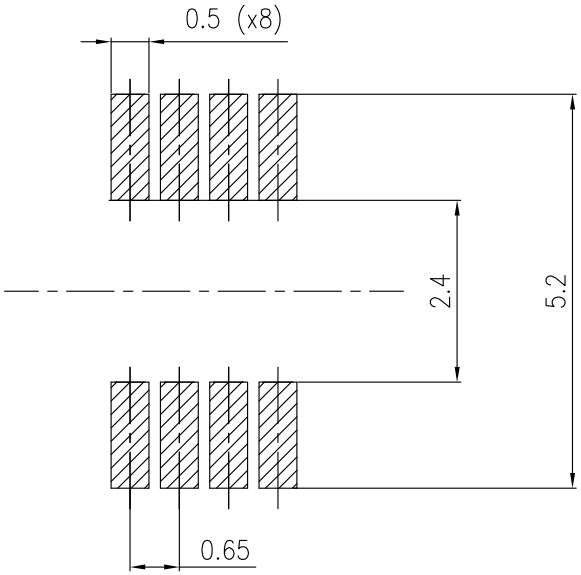


Table 5. **MiniSO8 mechanical data**

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.1			0.043
A1	0		0.15	0		0.006
A2	0.75	0.85	0.95	0.03	0.033	0.037
b	0.22		0.4	0.009		0.016
c	0.08		0.23	0.003		0.009
D	2.8	3	3.2	0.11	0.118	0.126
E	4.65	4.9	5.15	0.183	0.193	0.203
E1	2.8	3	3.1	0.11	0.118	0.122
e		0.65			0.026	
L	0.4	0.6	0.8	0.016	0.024	0.031
L1		0.95			0.037	
L2		0.25			0.01	
k	0°		8°	0°		8°
ccc			0.1			0.004

Figure 17. **MiniSO8 recommended footprint**



5.3 TSSOP8 package information

Figure 18. **TSSOP8 package outline**

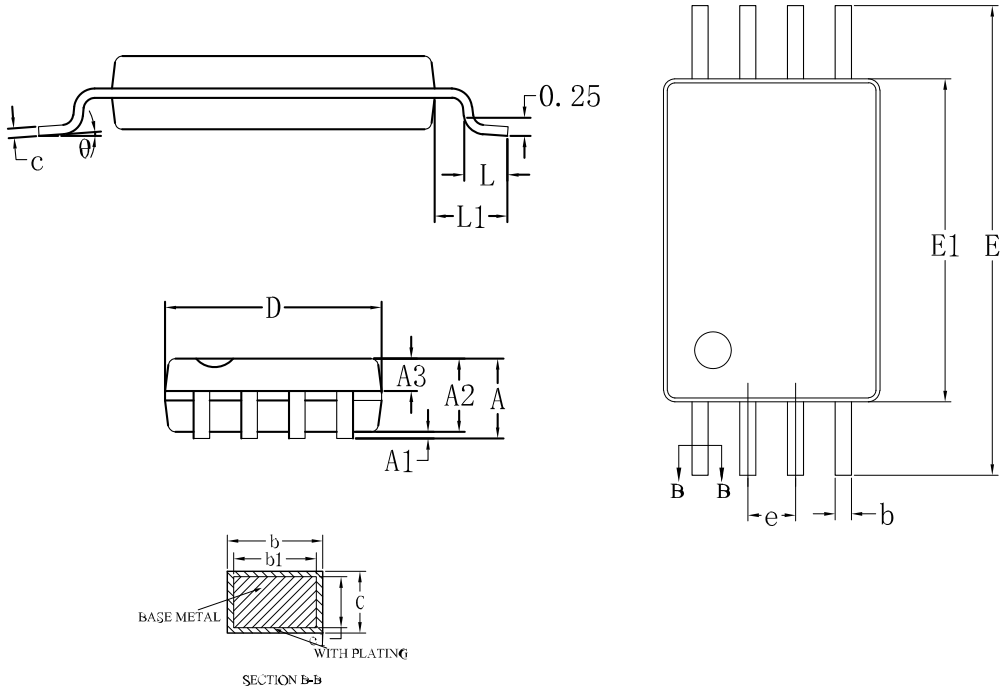
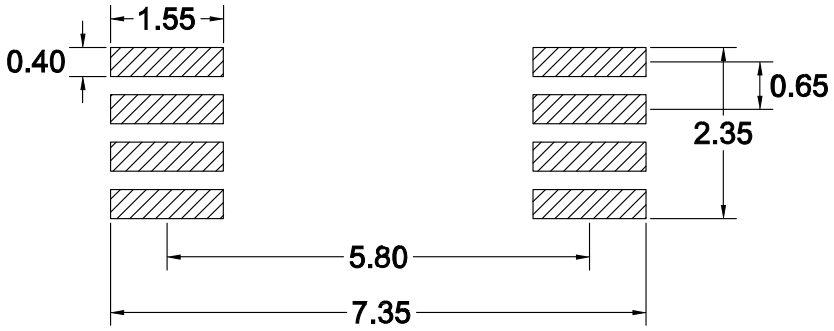


Table 6. **TSSOP8 mechanical data**

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	-	-	1.20			0.047
A1	0.05	-	0.15	0.002		0.006
A2	0.90	1.00	1.05	0.035	0.039	0.041
A3	0.39	0.44	0.49	0.015	0.017	0.019
b	0.20	-	0.28	0.008	-	0.011
b1	0.19	0.22	0.25	0.007	0.008	0.010
D2	3.55	3.65	3.75	0.140	0.144	0.148
c	0.13	-	0.17	0.005	-	0.007
c1	0.12	0.13	0.14	0.005	0.005	0.006
D	2.90	3.00	3.10	0.114	0.118	0.122
E1	4.30	4.40	4.50	0.169	0.173	0.177
E	6.20	6.40	6.60	0.244	0.252	0.260
e	0.65 BSC			0.025 BSC		
L	0.45	-	0.75	0.018	-	0.030
L1	1.00 REF			0.039 REF		
θ	0°	-	8°	0°	-	8°

Figure 19. **TSSOP8 recommended footprint**



5.4 DFN8 2 x 2 wettable flank package information

Figure 20. **DFN8 2 x 2 wettable flank package outline**

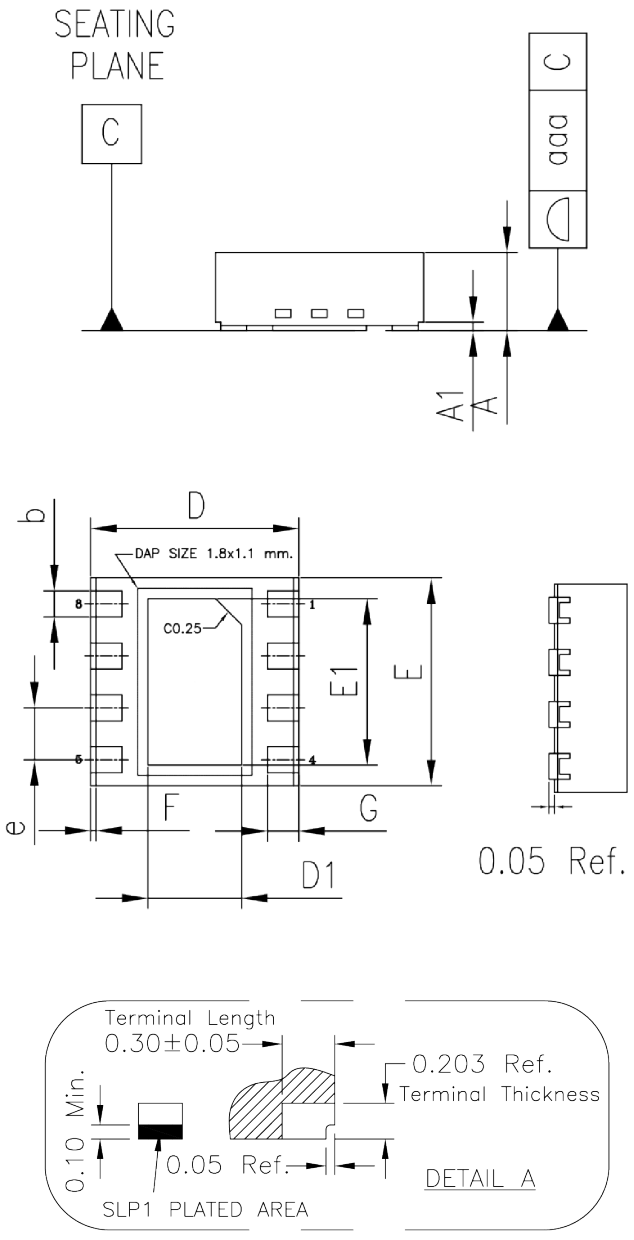
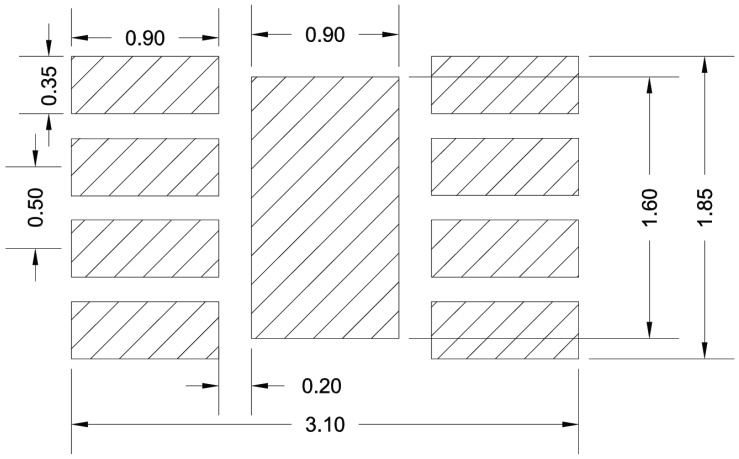


Table 7. **DFN8 2 x 2 wettable flank package mechanical data**

Ref.	Dimensions					
	Millimiters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.70	0.75	0.80	0.028	0.030	0.031
A1	0.10			0.004		
b	0.20	0.25	0.30	0.008	0.010	0.012
D	1.95	2.00	2.05	0.077	0.079	0.081
D1	0.80	0.90	1.00	0.031	0.035	0.039
E	1.95	2.00	2.05	0.077	0.079	0.081
E1	1.50	1.60	1.70	0.059	0.063	0.067
e		0.50			0.020	
F		0.05			0.002	
G	0.25	0.30	0.35	0.010	0.012	0.014
aaa		0.10			0.004	

Figure 21. **DFN8 2 x 2 wettable flank recommended footprint**



6 Ordering information

Table 8. Order code

Order code	Temperature range	Package	Packaging	Marking
LM2903BYDT (1)	-40 to +125 °C	SO-8	Tape & reel	2903BY
LM2903BYST (1)		MiniSO-8		K432
LM2903BYPT (1)		TSSOP8		2903B
LM2903BYQ3T (1)		DFN8 (2 x 2 mm) wettable flank		K2T

1. *Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent.*

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
27-Sep-2022	1	Initial release.
13-Dec-2022	2	Updated figure and description on the cover page, Table 1, Figure 10, Figure 11, Figure 12 and Figure 13. Added new TSSOP8 package on the cover, new Section 5.3 TSSOP8 package information, LM2903BYPT order code in Table 7. Order code, Figure 15. SO8 recommended footprint and Figure 17. MiniSO8 recommended footprint.
28-Jun-2023	3	Updated figure on the cover page, Figure 2. Added new package DFN8 2 x 2 wettable flank Section 5.4 and new LM2903BYQ3T order code in Table 8.
12-Jun-2024	4	Added new ESD parameter for DFN8 in Table 1.

Contents

List of tables

List of figures