1. DESCRIPTION

The XL285-2.5/XL385-2.5 are micropower 2-terminal band-gap voltage regulator diodes. Operating over a 20 μA to 20 mA current range, they feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to provide tight voltage tolerance.

2. FEATURES

- ±20 mV (±0.8%) max. Initial Tolerance (A Grade)
- Operating Current of 20 μA to 20 mA
- 0.6Ω Dynamic Impedance (A Grade)
- Low Temperature Coefficient
- Low Voltage Reference—2.5V

3. CONNECTION DIAGRAM

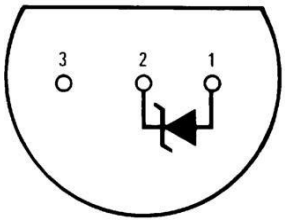


Figure 1.TO-92

(Bottom View)

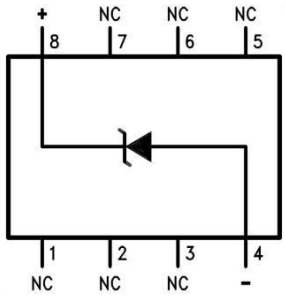
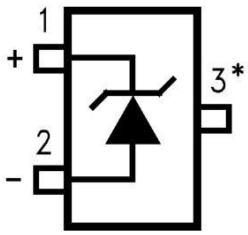


Figure 2. SOP



*Pin 3 is attached to the Die Attach Pad (DAP) and should be connected to Pin 2 or left floating

Figure 3. SOT23-3

4. ABSOLUTE MAXIMUM RATINGS(1)(2)

Reverse Current			30 mA
Forward Current			10 mA
Operating Temperature Range(3)	XL285-2.5		−40°C to + 85°C
	XL385-2.5		−40°C to + 85°C
ESD Susceptibility(4)			2kV
Storage Temperature			−55°C to + 150°C
Soldering Information	TO-92 Package (10 sec.)		260°C
	SOP and SOT-23 Package	Vapor Phase (60 sec.)	215°C
		Infrared (15 sec.)	220°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed.

(2) For elevated temperature operation, TJMAX is

: XL285: 125°C

XL385: 100°C

(3) The human body model is a 100 pF capacitor discharged through a 1.5 kΩ resistor into each pin

.

5. THERMAL CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted)

Thermal Resistance	**XL285**	**125°C**	**SOP-8**	**SOT-23**
	XL385	**100°C**		
	TO-92			
θ_{ja} (Junction to Ambient)	180°C/W (0.4" Leads)		165°C/W	283°C/W
	170°C/W (0.125" Leads)			
θ_{jc} (Junction to Case)	N/A		N/A	N/A

6. ELECTRICAL CHARACTERISTICS

Parameter	Conditions	Typ	XL385-2.5		Units (Limits)
			Tested Limit(2)	Design Limit(3)	
Reverse Breakdown Voltage	I_R = 100 µA	2.500 **2.500**	2.480 2.520	 **2.470** **2.530**	V(Min) V(Max) V(Min) V(Max)
Minimum Operating Current		12	18	**20**	µA (Max)
Reverse Breakdown Voltage Change with Current	$I_{MIN} \le I_R \le$ 1mA 1 mA ≤ I_R ≤ 20 mA		1 10	**1.5** **20**	mV (Max) mV (Max)
Reverse Dynamic Impedance	I_R = 100 µA, f = 20 Hz	0.2		0.6 **1.5**	Ω
Wideband Noise (rms)	I_R = 100 µA 10 Hz ≤ f ≤ 10 kHz	120			µV
Long Term Stability	I_R = 100 µA, T = 1000 Hr, T_A = 25°C ±0.1°C	20			ppm
Average Temperature Coefficient(4)	$I_{MIN} \le I_R \le$ 20 mA X Suffix Y Suffix All Others		 **30** **50**	 **150**	 ppm/°C (Max)

(1) Parameters identified with boldface type apply at temperature extremes. All other numbers apply at $T_A = T_J$ = 25°C.
(2) Specified and 100% production tested.
(3) Specified, but not 100% production tested. These limits are not used to calculate average outgoing quality levels.
(4) The average temperature coefficient is defined as the maximum deviation of reference voltage at all measured temperatures between the operating T_{MAX} and T_{MIN}, divided by T_{MAX}–T_{MIN}. The measured temperatures are −55°C, −40°C, 0°C, 25°C, 70°C, 85°C, 125°C.

ELECTRICAL CHARACTERISTICS

Parameter	Conditions	Typ	XL285-2.5		XL385-2.5		XL385-2.5		Units (Limit)
			Tested Limit(1)(2)	Design Limit(3)	Tested Limit(1)	Design Limit(3)	Tested Limit(1)	Design Limit(3)	
Reverse Breakdown Voltage	T_A = 25°C, 20 µA ≤ I_R ≤ 20 mA	2.5	2.462 2.538		2.462 2.538		2.425 2.575		V(Min) V(Max)
Minimum Operating Current	 XL385-2.5	13	20	**30**	20	**30**	20 15	**30** **20**	µA (Max)
Reverse Breakdown Voltage Change with Current	20 µA ≤ I_R ≤ 1 mA 1 mA ≤ I_R ≤ 20 mA		1 10	**1.5** **20**	2.0 20	**2.5** **25**	2.0 20	**2.5** **25**	mV (Max) mV (Max)
Reverse Dynamic Impedance	I_R = 100 µA, f = 20 Hz	1							Ω
Wideband Noise (rms)	I_R = 100 µA, 10 Hz ≤ f ≤ 10 kHz	120							µV
Long Term Stability	I_R = 100 µA, T = 1000 Hr, T_A = 25°C ±0.1°C	20							ppm
Average Temperature Coefficient(4)	I_R = 100 µA X Suffix Y Suffix All Others		 **30** **50**	 **150**	 **30** **50**	 **150**		 **150**	 ppm/°C ppm/°C ppm/°C (Max)

(1) Specified and 100% production tested.
(2) Specified, but not 100% production tested. These limits are not used to calculate average outgoing quality levels
(3) The average temperature coefficient is defined as the maximum deviation of reference voltage at all measured temperatures between the operating T_{MAX} and T_{MIN}, divided by T_{MAX}–T_{MIN}. The measured temperatures are −55°C, −40°C, 0°C, 25°C, 70°C, 85°C, 125°C.

7. TYPICAL PERFORMANCE CHARACTERISTICS

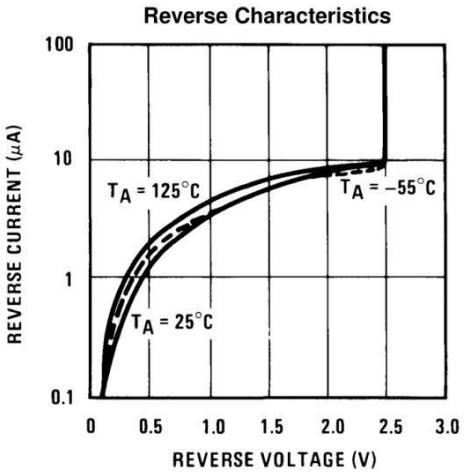


Figure 4.

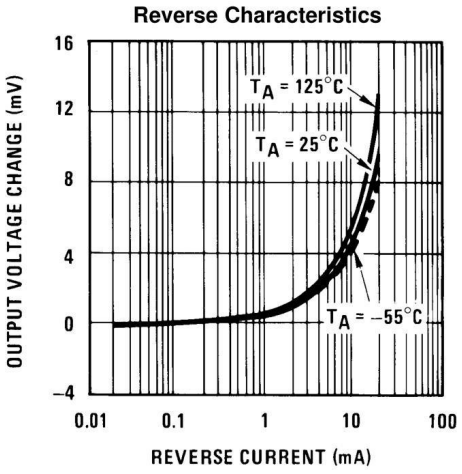


Figure 5.

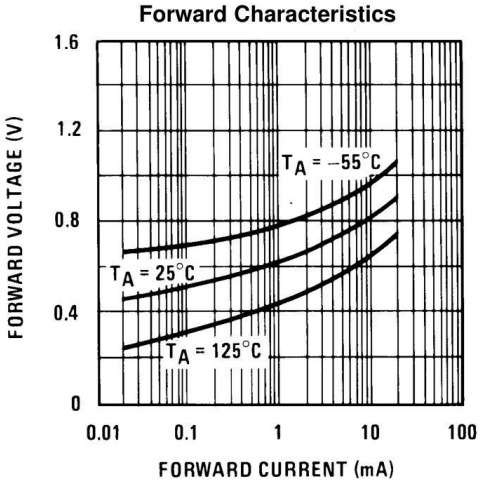


Figure 6.

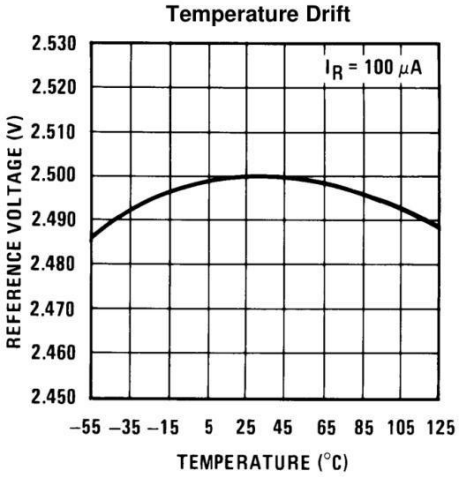


Figure 7.

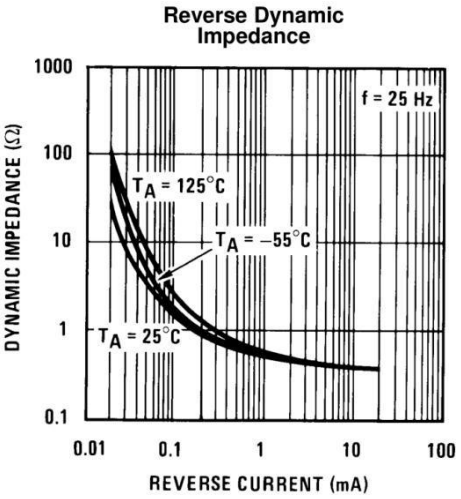


Figure 8.

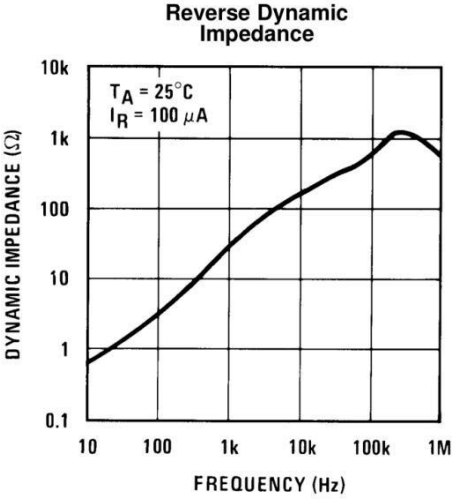


Figure 9.

TYPICAL PERFORMANCE CHARACTERISTICS(continued)

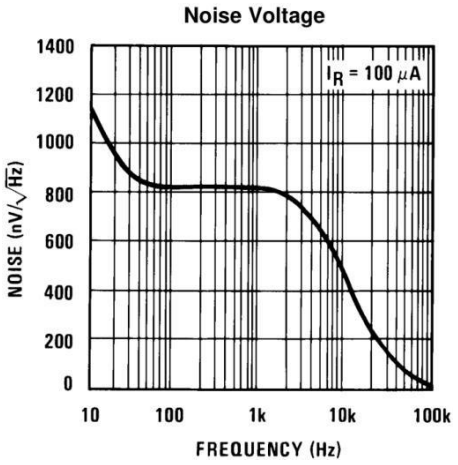


Figure 10.

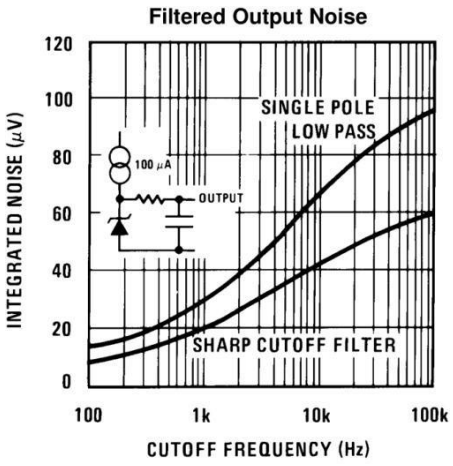


Figure 11.

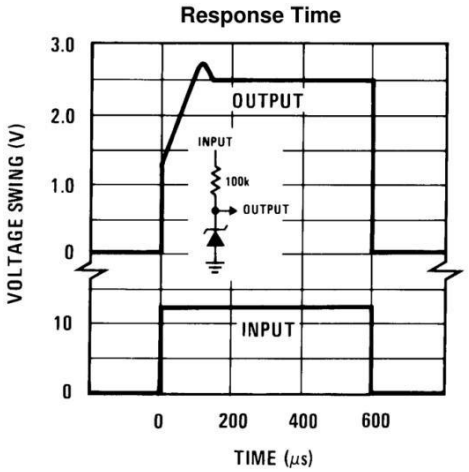


Figure 12.

8. TYPICAL PERFORMANCE CHARACTERISTICS

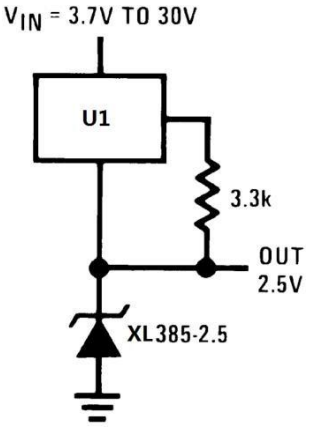


Figure 13.Wide Input Range Reference

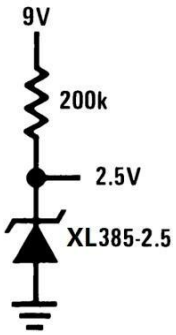
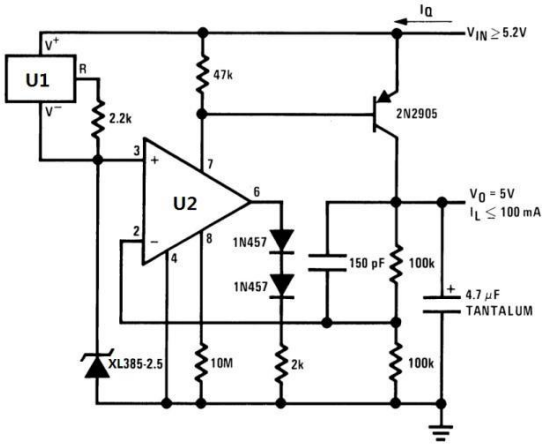


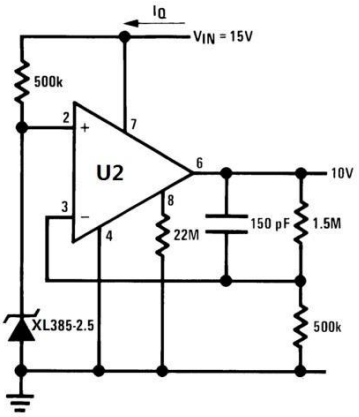
Figure 14.Micropower Reference from 9V Battery

Note 1: U1 uses a constant current source IC, such as an LM334 or equivalent.



$I_Q \approx 40$ μA

Figure 15.Micropower 5V Referencer

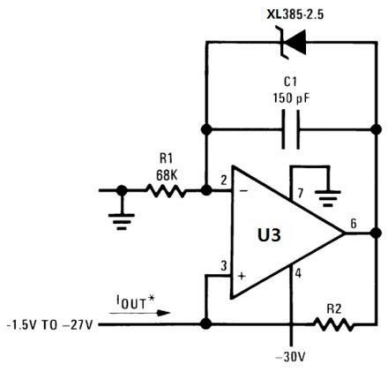


$I_Q \approx 30$ μA standby current

Figure 16.Micropower 10V Reference

Note 2: U2 uses a constant current source IC, such as an LM4250C or equivalent.

PRECISION 1 μA to 1 mA CURRENT SOURCES



$^*I_{OUT} = \frac{2.5V}{R2}$

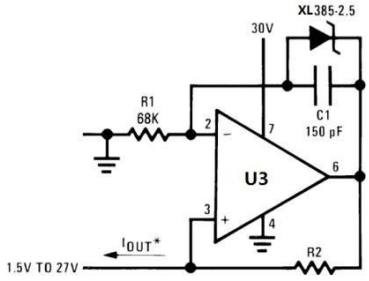
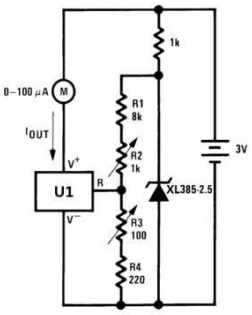


Figure 17.

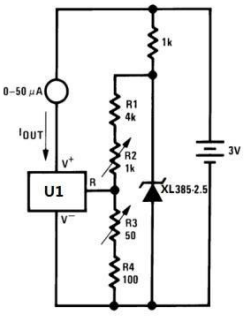
Note 3: U3 uses a constant current source IC, such as an LM312 or equivalent.



Calibration

1. Short XL385-2.5, adjust R3 for I_{OUT}=temp at 1μA/°K.
2. Remove short, adjust R2 for correct reading in centigrade

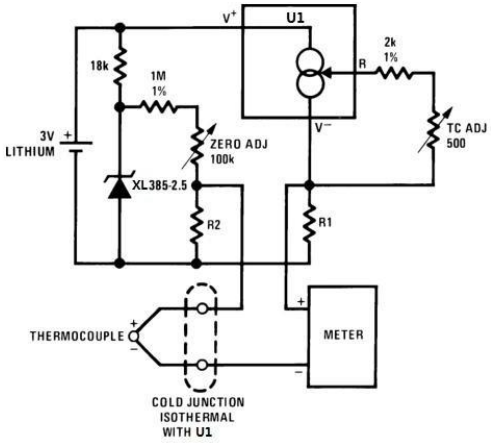
Figure 18.0° C – 100° C Thermomemter



Calibration

1. Short XL385-2.5, adjust R3 for I_{OUT}=temp at 1.8 μA/°K
2. Remove short, adjust R2 for correct reading in °F

Figure 19.0° F – 50° F Thermomemter



Adjustment Procedure

1. Adjust TC ADJ pot until voltage across R1 equals Kelvin temperature multiplied by the thermocouple Seebeck coefficient.
2. Adjust zero ADJ pot until voltage across R2 equals the thermocouple Seebeck coefficient multiplied by 273.2.

Figure 20.Micropower Thermocouple Cold Junction Compensator

Thermocouple Type(1)	Seebeck Coefficient (μV/°C)	R1 (Ω)	R2 (Ω)	Voltage Across R1 @25°C (mV)	Voltage Across R2 (mV)
J	52.3	523	1.24k	15.60	14.32
T	42.8	432	1k	12.77	11.78
K	40.8	412	953Ω	12.17	11.17
S	6.4	63.4	150Ω	1.908	1.766

(1) Typical supply current 50 μA

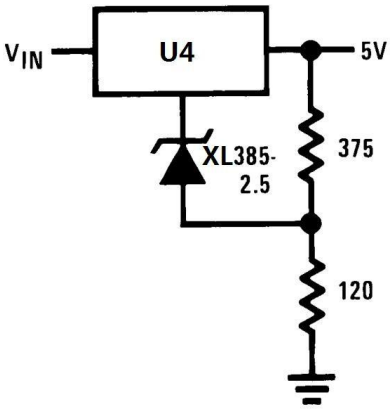
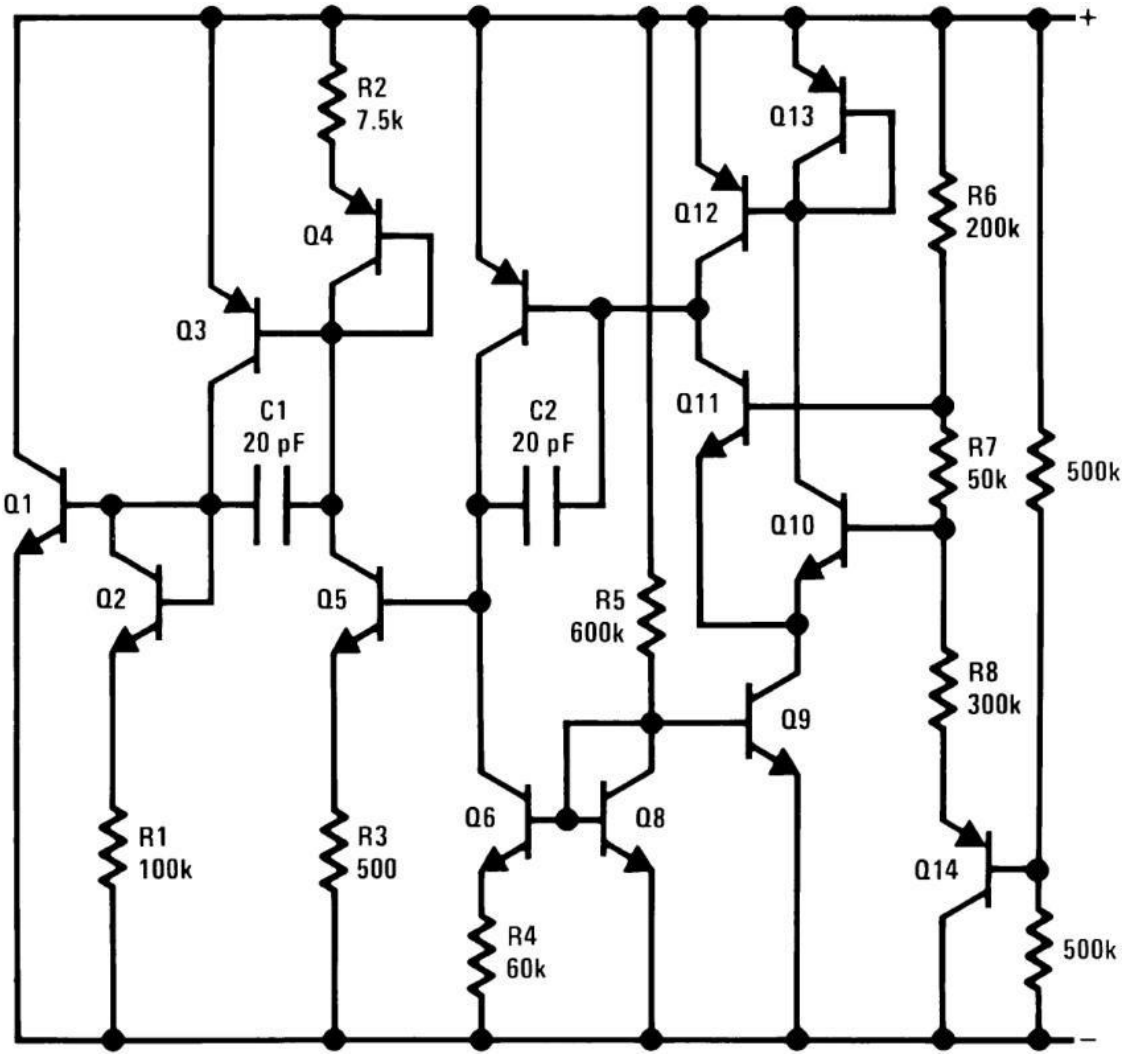


Figure 21. Improving Regulation of Adjstable Regulators

Note 4: U4 uses a constant current source IC, such as an LM338 or equivalent.

9. SCHEMATIC DIAGRAM



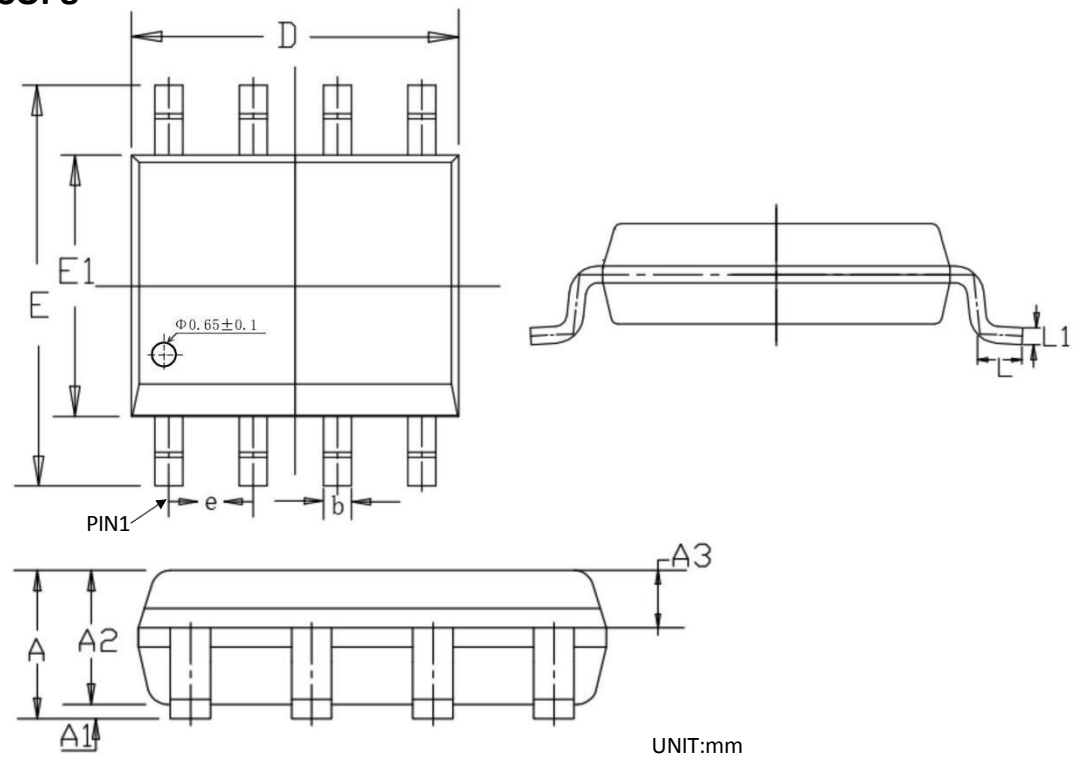
10. ORDERING INFORMATION

Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL285-2.5	XL285-2.5	SOP8	4.90 * 3.90	- 40 to 85	MSL3	T&R	2500
XT285-2.5	XT285-2.5	TO-92	4.58 * 4.58	- 40 to 85	MSL3	T&R	1000
XL385-2.5	XL385-2.5	SOP8	4.90 * 3.90	- 40 to 85	MSL3	T&R	2500
XT385-2.5	XT385-2.5	TO-92	4.58 * 4.58	- 40 to 85	MSL3	T&R	1000
XB385M3-2.5	XB385M3-2.5	SOT23-3	4.58 * 4.58	- 40 to 85	MSL3	T&R	3000

11. DIMENSIONAL DRAWINGS

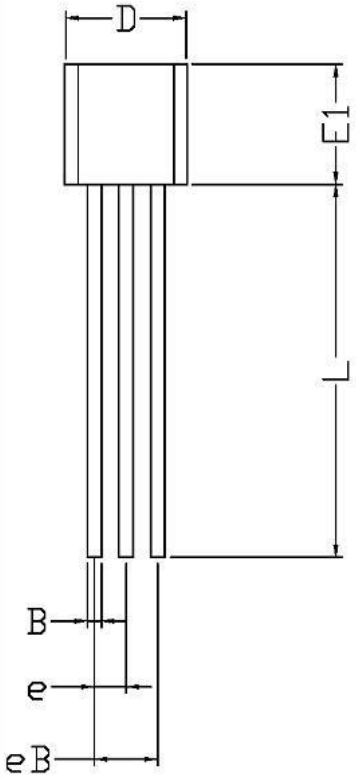
SOP8



UNIT:mm

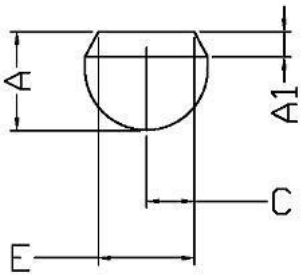
	MIN	NOM	MAX
A	1.450	1.550	1.650
A1	0.100	0.150	0.200
A2	1.300	1.400	1.500
A3	0.600	0.650	0.700
b	0.380	–	0.510
e	1.240	1.270	1.300
D	4.800	4.900	5.000
E	5.800	6.000	6.200
E1	3.800	3.900	4.000
L	0.450	0.600	0.750
L1	—	0.25BSC	—

TO-92



SYMBOL	MIN	MAX
A	3.46	3.96
A1	1.02 TYP	
B	0.36	0.56
C	1.80 TYP	
D	4.33	4.83
E1	4.33	4.83
E	3.35	3.85
eB	2.54 TYP	
e	1.27 TYP	
L	13.97	14.97

UNIT : mm



SOT23-3