

1. DESCRIPTION

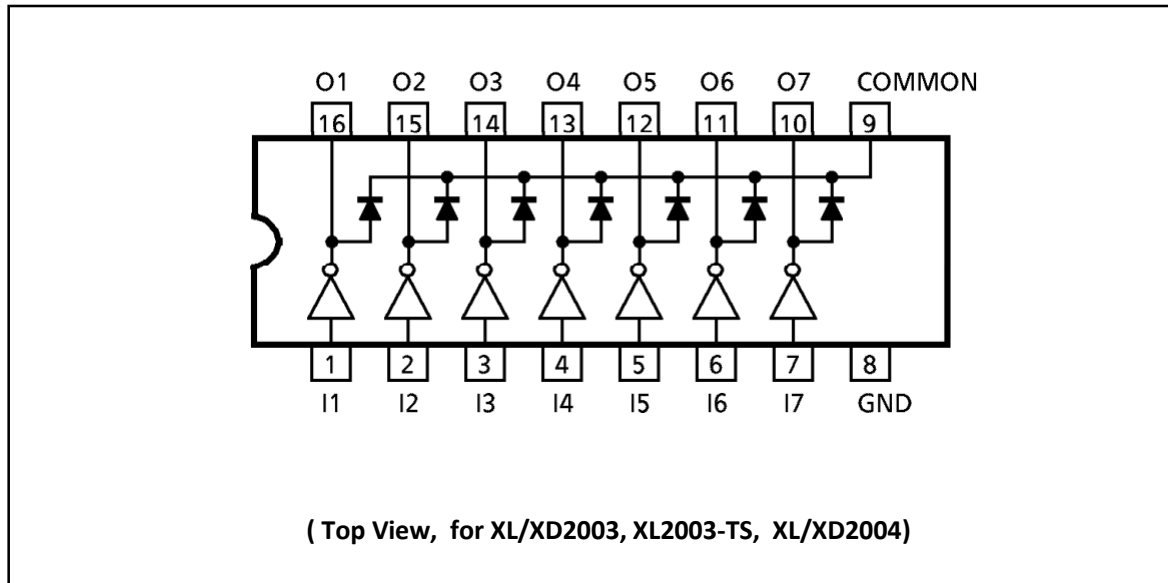
The 2003/2004 Series are high-voltage, high-current Darlington arrays each containing seven open collector Darlington pairs with common emitters. Each channel is rated at 500 mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout.

The versions interface to all common logic families: XL/XD2003 (5 V TTL, CMOS), XL/XD2004 (6~15 V CMOS, PMOS). These versatile devices are useful for driving a wide range of loads including solenoids, relay DC motors, LED display filament lamps, thermal printheads etc.

2. FEATURES

- Rated Collector Output current (single output) up to 500 mA
- High- voltage outputs: 50V
- Integrated suppression diodes for inductive
- loads Inputs compatible with various types of logic
- Input pins placed opposite to output pins to simplify layout
- Package type include: SOP16、TSSOP16、DIP16

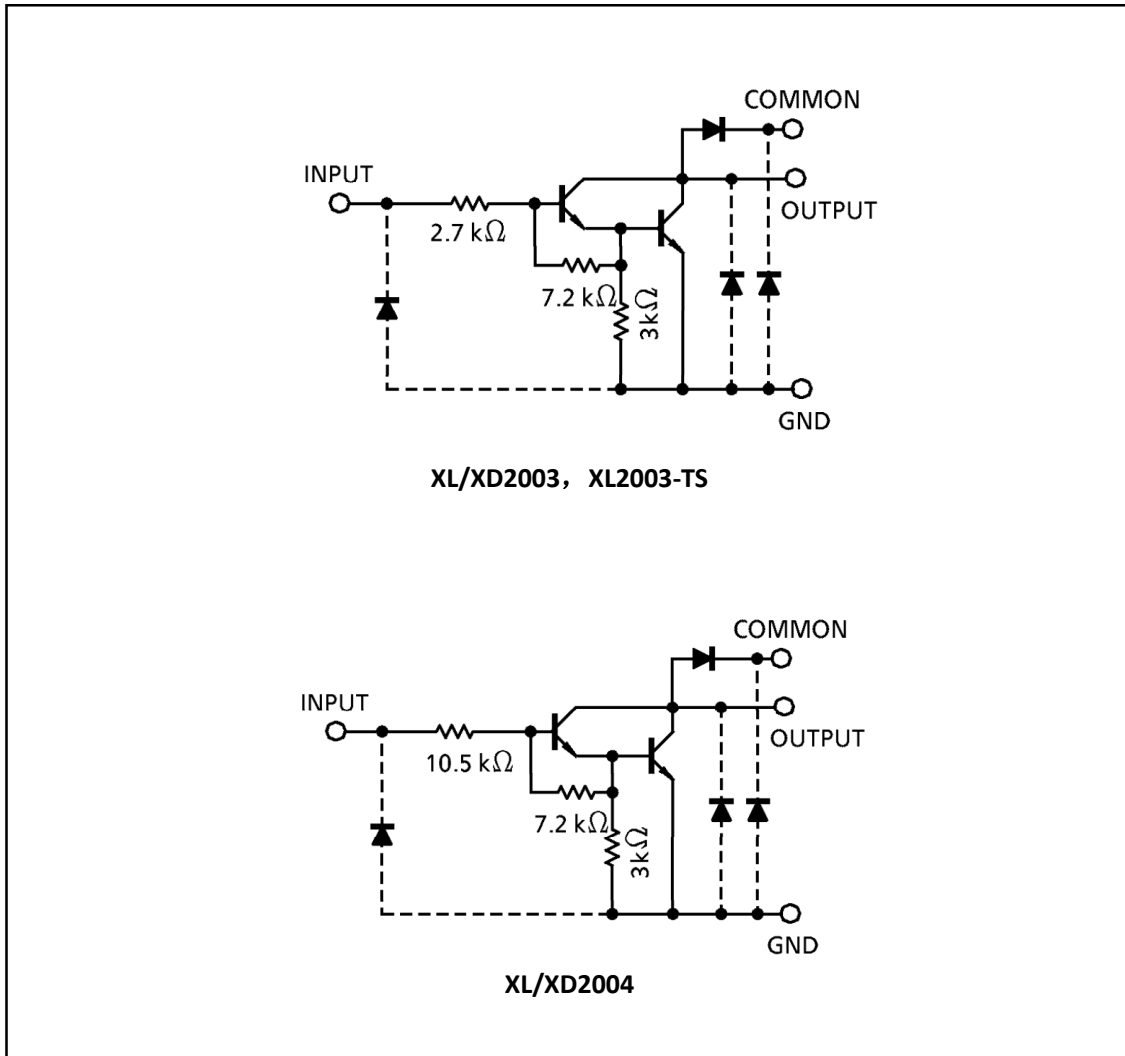
3. PIN CONFIGURATIONS AND FUNCTIONS



PIN		I/O	FUNCTION DESCRIPTIONS
NAME	NO.		
I1	1	I	Channel 1 through 7 Darlington base input
I2	2		
I3	3		
I4	4		
I5	5		
I6	6		
I7	7		
O1	16	O	Channel 1 through 7 Darlington collector output
O2	15		
O3	14		
O4	13		
O5	12		
O6	11		
O7	10		
COMMON	9	—	Common cathode node for flyback diodes (required for inductive loads)
GND	8	—	Common emitter shared by all channels (typically tied to ground)

(Note: I = Input, O = Output)

4. SCHEMATICS (EACH DRIVER)



(Note: The input and output parasitic diodes can not be used as clamp diodes.)

TYPE	INPUT BASE RESISTOR	DESIGNATION
XL/XD2003, XL2003-TS	2.7 kΩ	TTL, 5 V CMOS
XL/XD2004	10.5 kΩ	6~15V PMOS, CMOS

5. SPECIFICATIONS

5.1. Absolute Maximum Ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_O	Collector-emitter output voltage	50	V
V_I	Input voltage	30	V
I_C	Continuous collector current	500	mA
I_B	Continuous base current	25	mA
I_F	Clamping diode continuous current	350	mA
V_R	Clamping diode reverse voltage	50	V
T_A	Operating ambient temperature range	-20 to 85	°C
T_{STG}	Storage temperature range	-40 to 125	°C
T_J	Junction temperature	150	°C
ESD	Electrostatic discharge rating - HBM	0.8	kV

Table 2. Thermal data

Symbol	Parameter	DIP-16	SO-16	TSSOP16	Unit
R_{thJA}	Thermal resistance junction-ambient, Max.	78	69.3	105.7	°C/W
R_{thJC}	Thermal resistance junction-case (top), Max.		29	36.9	°C/W
R_{thJB}	Thermal resistance junction-board, Max.		37.5	72.8	°C/W

Note: Maximum power dissipation is a function of $T_{J(max)}$, R_{thJA} and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A) / R_{thJA}$. Operating at the absolute maximum T_J of +150°C can affect reliability.

5.2 Electrical characteristic (TA = 25 °C unless otherwise specified)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{CEX}	Output leakage current	$V_{CE} = 50 \text{ V}$, (Figure 3)			60	μA
		$T_A = -20^\circ\text{C}$, $V_{CE} = 50 \text{ V}$ (Figure 3)			95	
		$T_A = 85^\circ\text{C}$, $V_{CE} = 50 \text{ V}$, $V_I = 5 \text{ V}$ (Figure 4)			600	
		$T_A = -20^\circ\text{C}$, $V_{CE} = 50 \text{ V}$, $V_I = 5 \text{ V}$ (Figure 4)			500	
$V_{CE(SAT)}$	Collector-emitter saturation voltage (Figure 5)	$I_C = 100 \text{ mA}$, $I_B = 250 \mu\text{A}$		0.8	1.2	V
		$I_C = 200 \text{ mA}$, $I_B = 350 \mu\text{A}$		1.2	1.4	
		$I_C = 350 \text{ mA}$, $I_B = 500 \mu\text{A}$		1.4	1.8	
		for XL/XD2003, $V_I = 3.85 \text{ V}$		0.95	1.5	
		for XL/XD2004, $V_I = 5 \text{ V}$ $V_I = 12 \text{ V}$		0.35 1.1	0.7 1.6	
$I_{I(OFF)}$	Input current (Figure 7)	$T_A = 85^\circ\text{C}$, $I_C = 500 \mu\text{A}$		70		μA
$V_{I(ON)}$	Input voltage (Figure 8)	for XL/XD2003, XL2003-TS $I_C = 200 \text{ mA}$			2.7	V
		$I_C = 250 \text{ mA}$			2.9	V
		$I_C = 300 \text{ mA}$			3.2	V
		for XL/XD2004 $I_C = 125 \text{ mA}$			5	V
		$I_C = 200 \text{ mA}$			6	V
		$I_C = 275 \text{ mA}$			7	V
		$I_C = 350 \text{ mA}$			8	V
h_{FE}	DC Forward current gain (Figure 5)	$V_{CE} = 2 \text{ V}$, $I_C = 350 \text{ mA}$	1000			
C_I	Input capacitance			15	30	pF
t_{PLH}	Turn-on delay time	$0.5 V_I$ to $0.5 V_O$		0.25	1.2	μs
t_{PHL}	Turn-off delay time	$0.5 V_I$ to $0.5 V_O$		0.25	1.2	μs
I_R	Clamp diode leakage current (Figure 9)	$V_R = 50 \text{ V}$			70	μA
		$T_A = 85^\circ\text{C}$, $V_R = 50 \text{ V}$			120	
V_F	Clamp diode forward voltage (Figure 10)	$I_F = 350 \text{ mA}$		1.8	2.3	V

5.3 Measurement circuits

Figure 3. Output leakage current

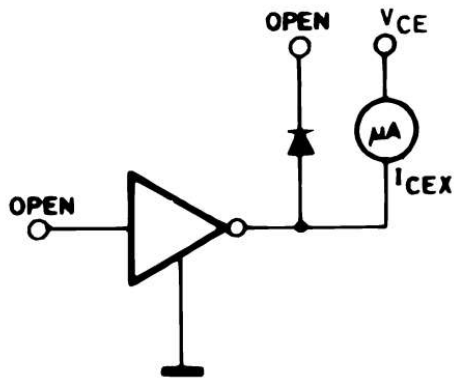


Figure 4. Output leakage current

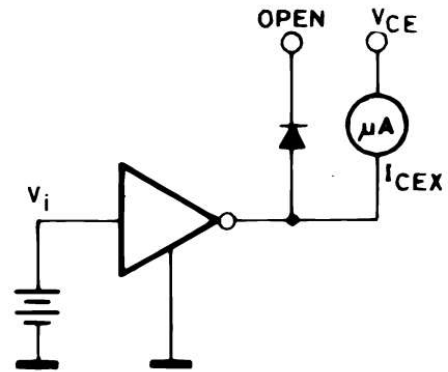


Figure 5. Collector-emitter saturation voltage

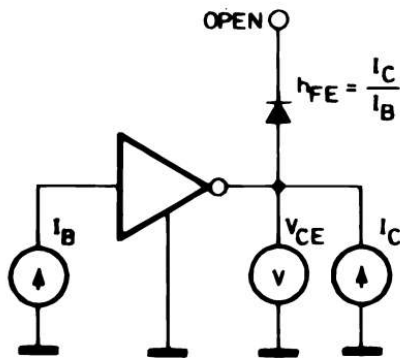


Figure 6. Input current (ON)

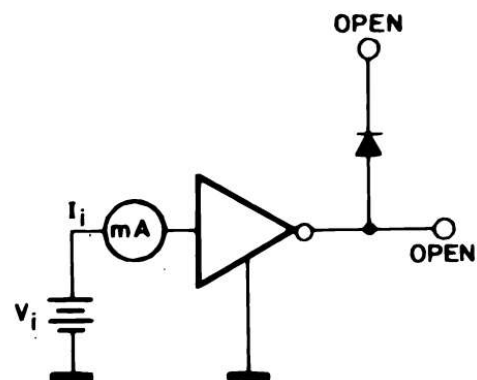


Figure 7. Input current (OFF)

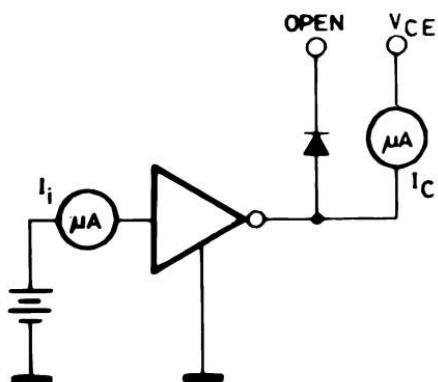


Figure 8. Input voltage

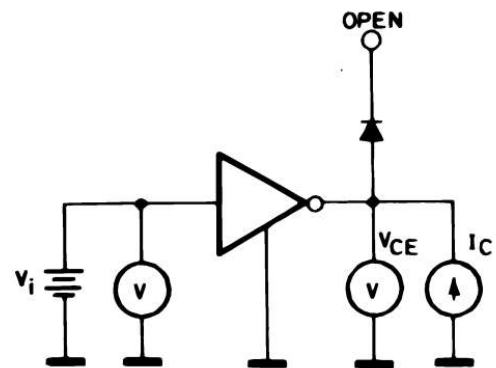


Figure 9. Clamp diode leakage current

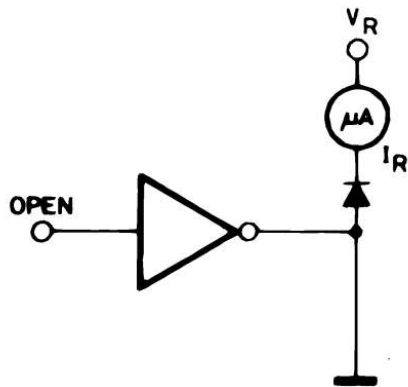
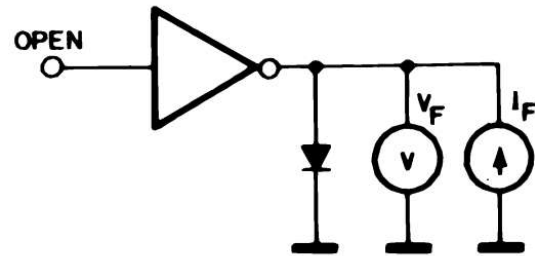


Figure 10. Clamp diode forward voltage



6. TYPICAL PERFORMANCE CHARACTERISTICS

Figure 11. Collector current vs. saturation voltage ($T_J = 25^\circ\text{C}$)

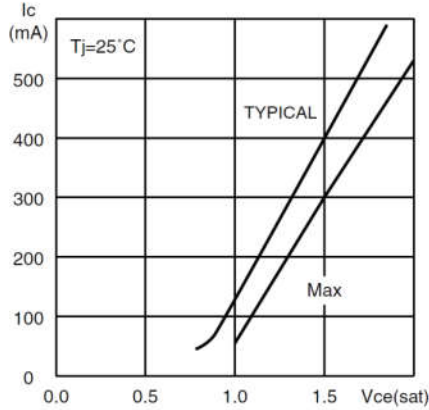


Figure 12. Collector current vs. saturation voltage

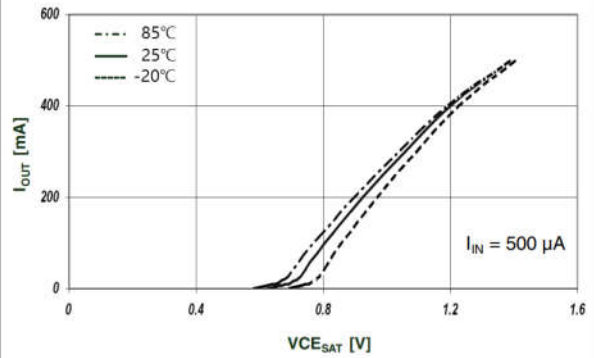


Figure 13. Input current vs. input voltage

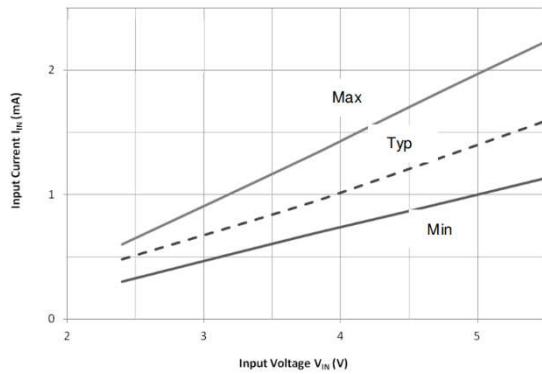


Figure 14. Input current vs. input voltage ($T_a = 25^\circ\text{C}$)

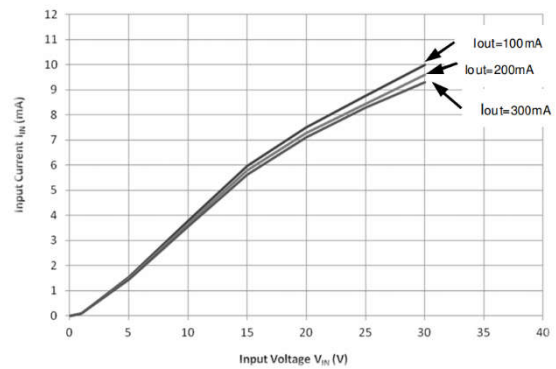


Figure 15. Collector current vs. input current

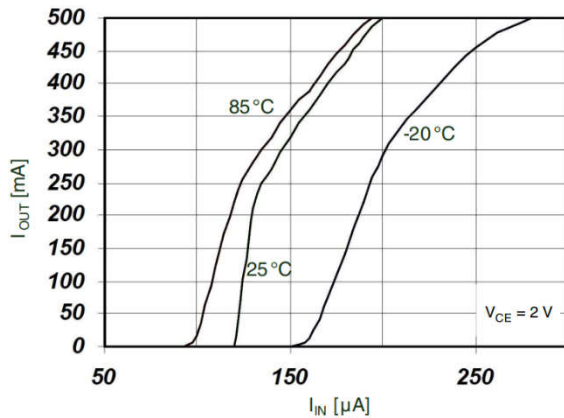


Figure 16. h_{FE} vs. output current

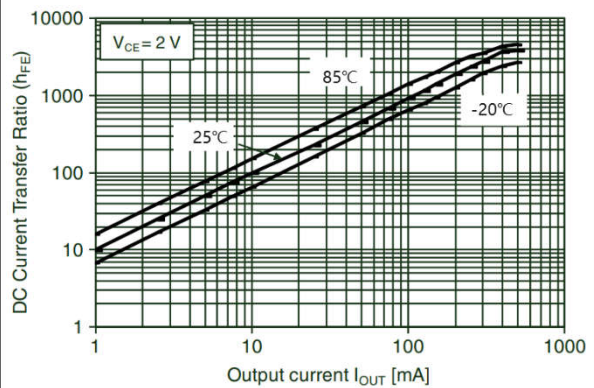


Figure 17. Peak collector current vs. duty cycle (DIP16)

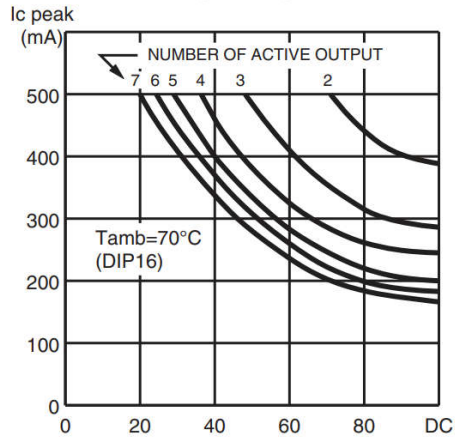
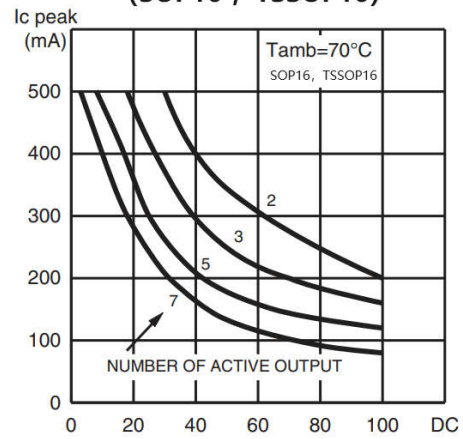


Figure 18. Peak collector current vs. duty cycle (SOP16 , TSSOP16)



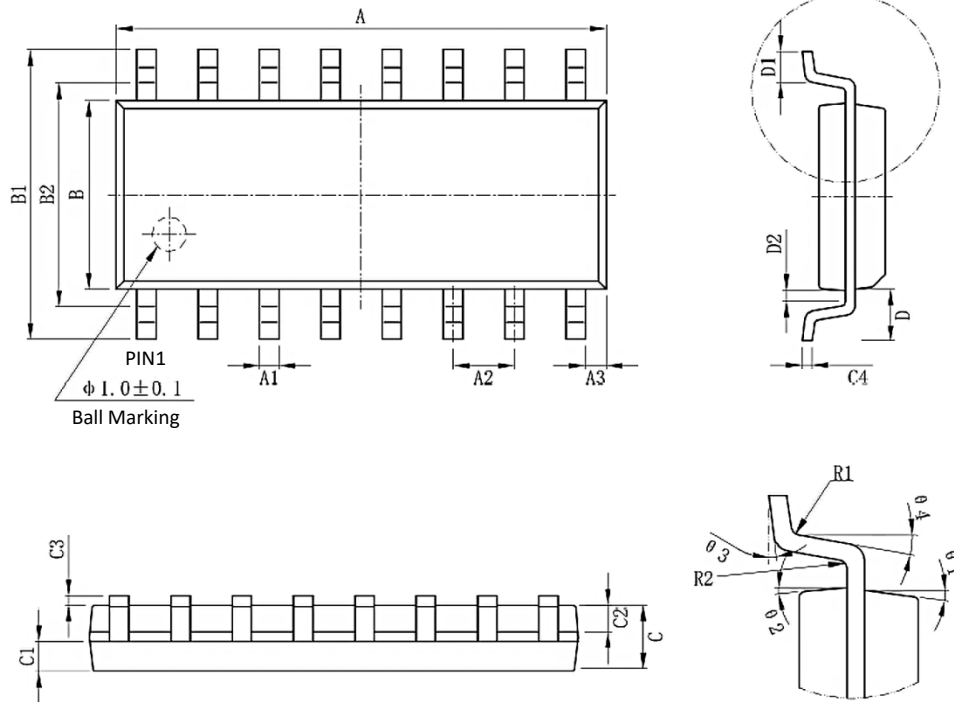
7. ORDERING INFORMATION

Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL2003-TS	XL2003-TS	TSSOP16	5.00 * 4.40	- 20 to 85	MSL3	T&R	2500
XL2003	XL2003	SOP16	10.00 * 3.95	- 20 to 85	MSL3	T&R	2500
XD2003	XD2003	DIP16	19.05 * 6.35	- 20 to 85	MSL3	Tube 25	1000
XL2004	XL2004	SOP16	10.00 * 3.95	- 20 to 85	MSL3	T&R	2500
XD2004	XD2004	DIP16	19.05 * 6.35	- 20 to 85	MSL3	Tube 25	1000

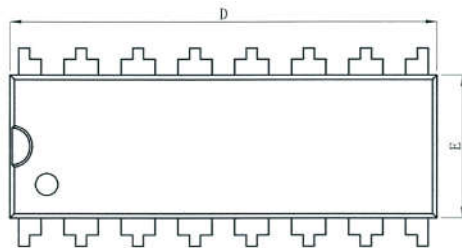
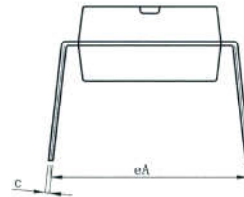
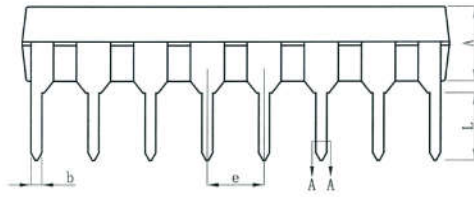
8. DIMENSIONAL DRAWINGS

SOP16

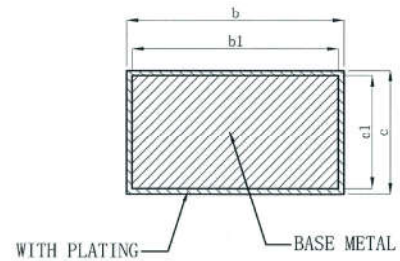


Mark	Size	Min (mm)	Max (mm)	Mark	Size	Min (mm)	Max (mm)
A		9.80	10.00	C4		0.203	0.233
A1		0.356	0.456	D		1.05TYP	
A2		1.27TYP		D1		0.40	0.70
A3		0.302TYP		D2		0.15	0.25
B		3.85	3.95	R1		0.20TYP	
B1		5.84	6.24	R2		0.20TYP	
B2		5.00TYP		$\theta 1$		$8^{\circ} \sim 12^{\circ}$ TYP4	
C		1.40	1.60	$\theta 2$		$8^{\circ} \sim 12^{\circ}$ TYP4	
C1		0.61	0.71	$\theta 3$		$0^{\circ} \sim 8^{\circ}$	
C2		0.54	0.64	$\theta 4$		$4^{\circ} \sim 12^{\circ}$	
C3		0.05	0.25				

DIP16



PIN1

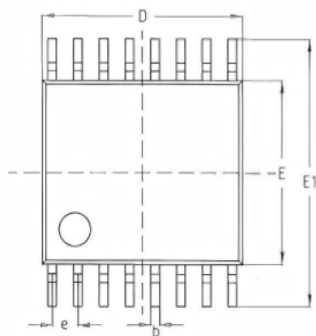


symbol	millimeter		
	Min	Nom	Max
A	3.20	3.30	3.40
b	0.44	---	0.53
b1	0.43	0.46	0.49
c	0.25	---	0.30
c1	0.24	0.25	0.26
D	18.95	19.05	19.15
E	6.25	6.35	6.45
e	2.54BSC		
eA	8.30	8.80	9.30
L	3.00	---	---

TSSOP16

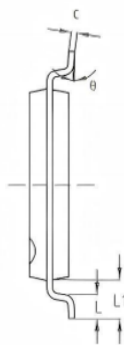
TOP VIEW

正视图



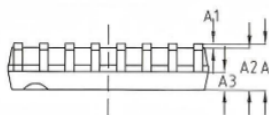
SIDE VIEW

侧视图



SIDE VIEW

侧视图



机械尺寸/mm Dimensions			
字符 SYMBOL	最小值 MIN	典型值 NOMINAL	最大值 MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
c	0.13	—	0.17
D	4.90	5.00	5.10
E	4.30	4.40	4.50
E1	6.20	6.40	6.60
e	0.65 BSC		
L1	1.00REF		
L	0.45	0.60	0.75
θ	0°	—	8°