ULN2003

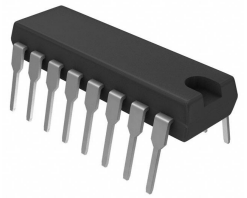
7ch High Voltage, High Current Darlington Transistor Arrays

General Description

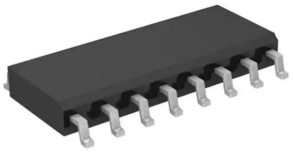
The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN Darlington pairs that features high-voltage outputs with common-cathode clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. The Darlington pairs may be paralleled for higher current capability.

Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers.

ULN2003 is available in SOP16 and DIP16 packages.



DIP16



SOP16

Features

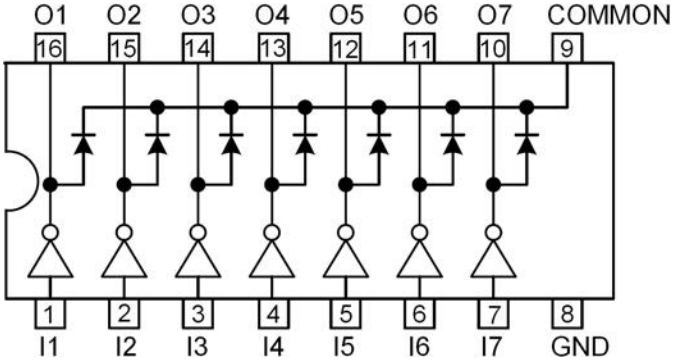
- 500mA Rated Collector Current(Single Output)
- High Voltage Outputs 50V
- Inputs Compatible with Various Types of Logic
- Output Clamp Diodes
- Relay Driver Application

Package Information

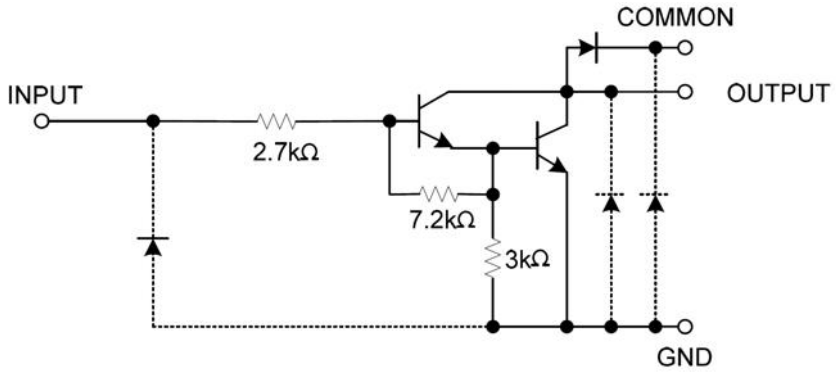
Part NO.	Order NO.	Package Description	Package Marking	Package Option
ULN2003	ULN2003	DIP16	CHMC SXXXX ULN2003	25/Tube
ULN2003	ULN2003F	SOP16	CHMC SXXXX ULN2003	50/Tube 4000/Reel

CHMC:Trademark ULN2003:Part NO. SXXXX:Lot NO.

Functional Block Diagram



Block Diagram



Note: The input and output parasitic diodes cannot be used as clamp diodes

Absolute Maximum Ratings

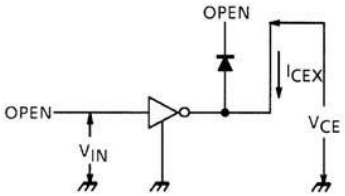
Parameter Name		Symbol	Value	Unit
Operating Voltage		V_{OUT}	-0.5～+50	V
Input Voltage		V_{IN}	-0.5～30	V
Continuous Output Current		I_C	500	mA/ch
Continuous Input Current		I_{IN}	25	mA
Power Dissipation	DIP16	P_D	1.47	W
	SOP16		1.25	W
Thermal Resistance Junction-Ambient, Max.	DIP16	θ_{JA}	70	°C/W
	SOP16		120	°C/W
Junction Temperature		T_J	+125	°C
Operating Temperature		Tamb	-40 ~ +85	°C
Storage Temperature		Tstg	-55 ~ +150	°C

Electrical Characteristics (unless otherwise specified Ta=25℃)

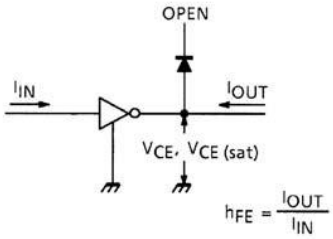
Parameter Name	Symbol	Conditions	Min	Typ	Max	Unit
Output Leakage Current	I_{CEX}	Vo=50V，Tamb= +70℃			100	μA
		Vo=50V，Tamb= +25℃			50	μA
Collector-Emitter Saturation Voltage	V_{CES}	Ic=350mA，I_B=500μA		1.1	1.6	V
		Ic=200mA，I_B=350μA		0.95	1.3	V
		Ic=100mA，I_B=250μA		0.85	1.1	V
Input Current	$I_{I（ON）}$	V_I=3.85V		0.93	1.35	mA
Input Voltage	$V_{（I ON）}$	V_{CE}=2.0V，Ic=200mA			2.4	V
		V_{CE}=2.0V，Ic=250mA			2.7	V
		V_{CE}=2.0V，Ic=300mA			3.0	V
Input Current	$I_{I（OFF）}$	V_{CE}=2.0V，Ic=350mA	50	100		μA
Input Capacitance	C_I			15	30	pF
Turn-On Delay	t_{ON}			0.25	1.0	μS
Turn-Off Delay	t_{OFF}			0.25	1.0	μS
Clamp Diode Leakage Current	I_R	V_R=50V, Tamb= +25℃			50	μA
		V_R=50V, Tamb= +70℃			100	μA
Clamp Diode Forward Voltage	V_F	I_F=350mA		1.5	2.0	V

Test Circuit

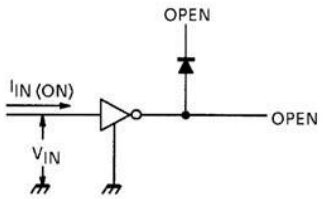
1. I_{CEX}



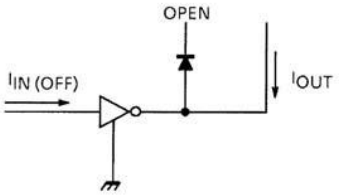
2. $V_{CE\ (sat)}$, h_{FE}



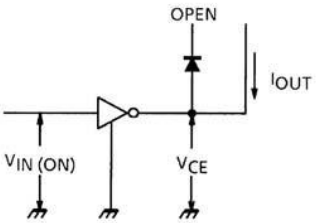
3. $I_{IN\ (ON)}$



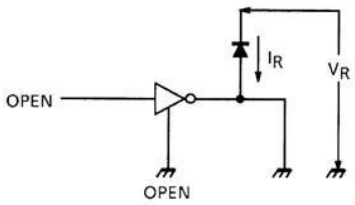
4. $I_{IN\ (OFF)}$



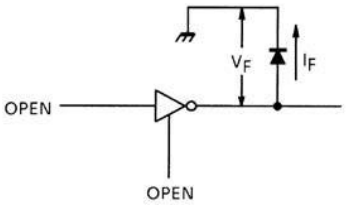
5. $V_{IN\ (ON)}$



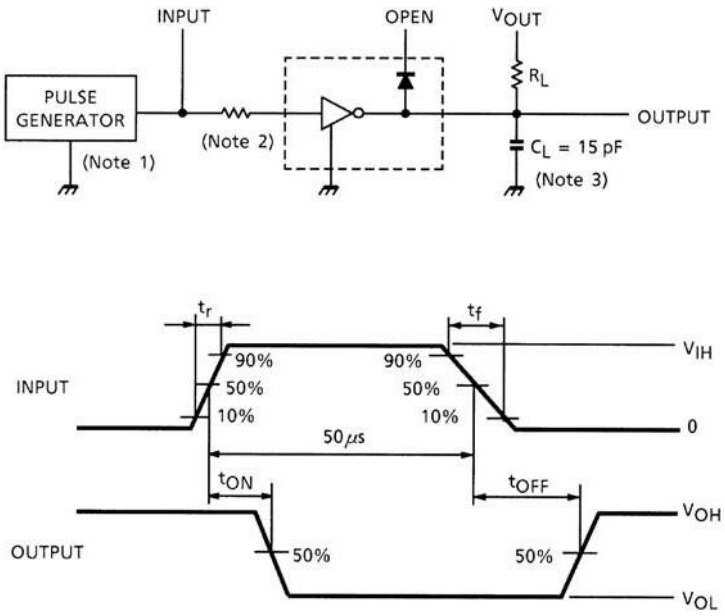
6. I_R



7. V_F



8. t_{ON}, t_{OFF}



Note1: Pulse width 50 μs, duty cycle 10%

Output impedance 50Ω ,tr≤5ns, tf≤10ns

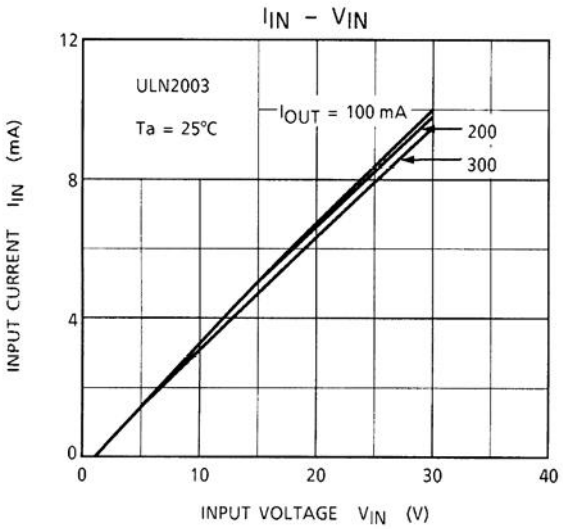
Note2: See below

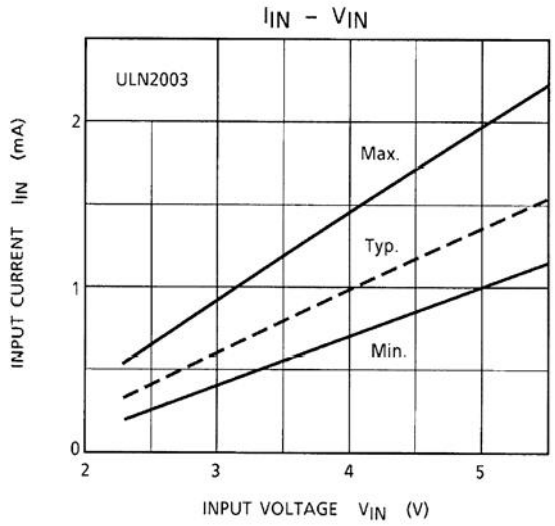
Input Condition

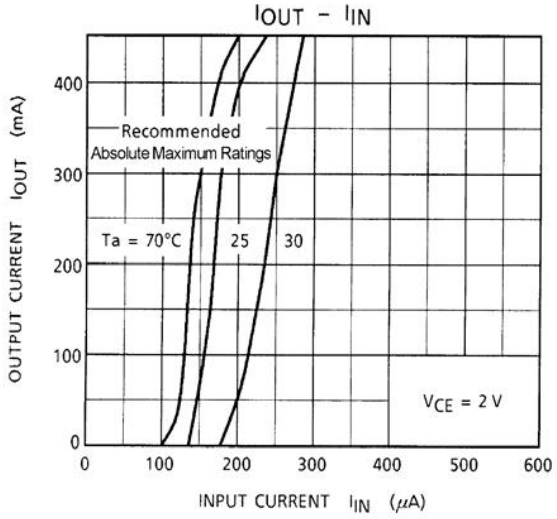
Type Number	R1	V_{IH}
ULN2003	0	3V

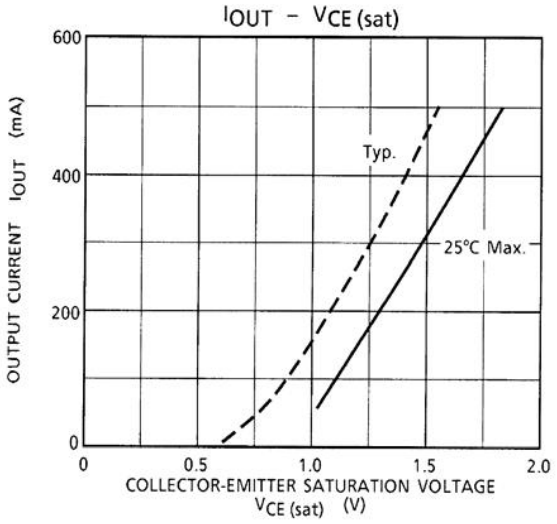
Note3: C_L includes probe and jig capacitance

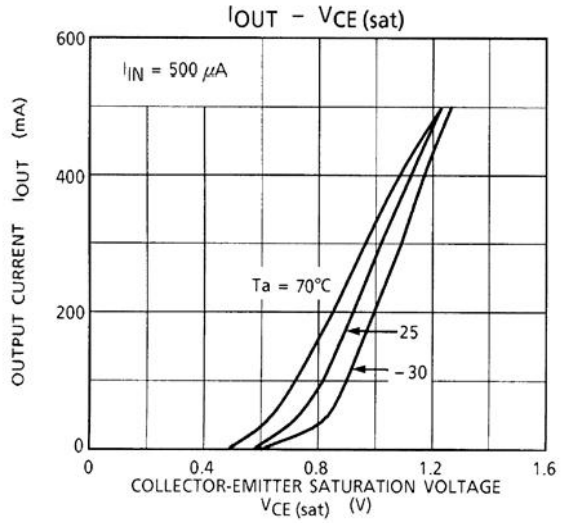
Typical Characteristics

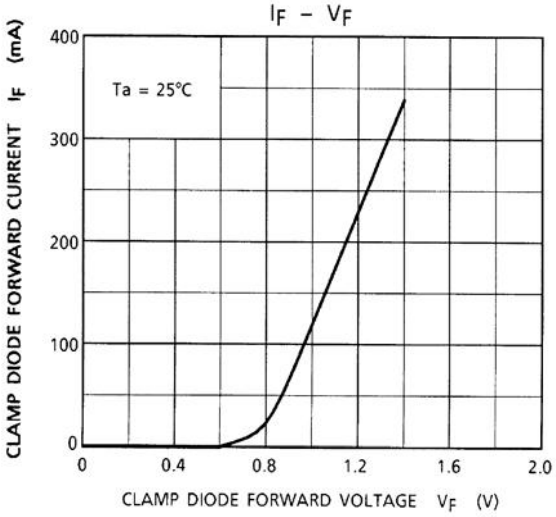


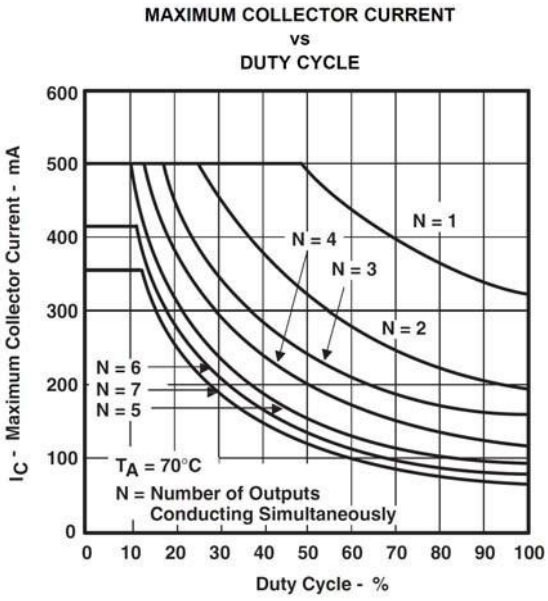




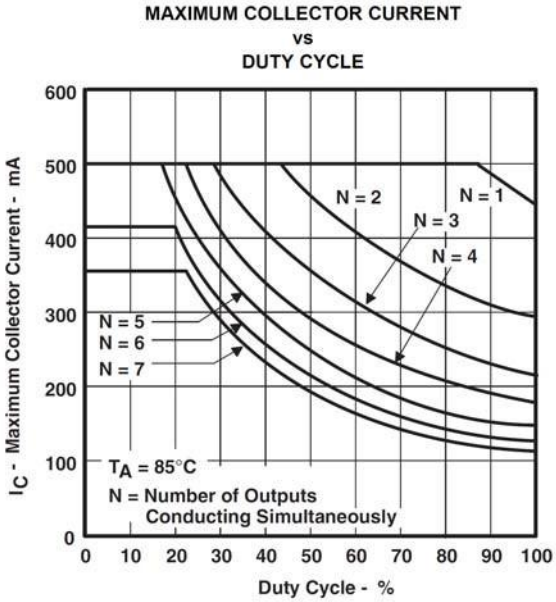



IOUT – VCE (sat)
IIN = 500 μA
Ta = 70°C
25
30
OUTPUT CURRENT IOUT (mA)
COLLECTOR-EMITTER SATURATION VOLTAGE
VCE (sat) (V)
0
200
400
600
0.4
0.8
1.2
1.6

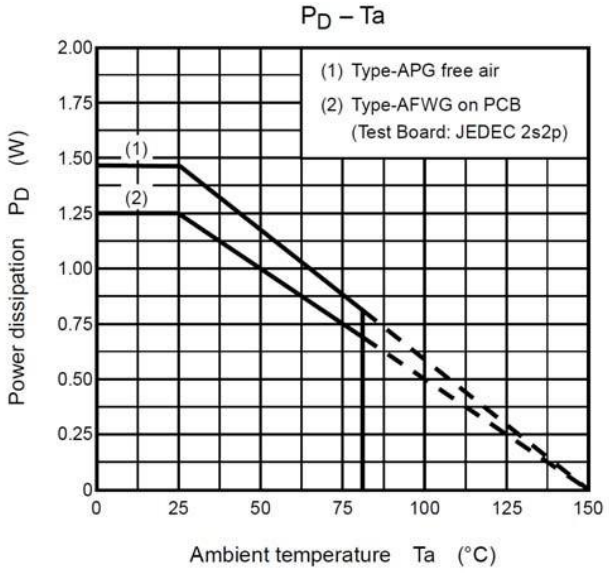

IF – VF
Ta = 25°C
CLAMP DIODE FORWARD CURRENT IF (mA)
CLAMP DIODE FORWARD VOLTAGE VF (V)
0
100
200
300
400
0.4
0.8
1.2
1.6
2.0


MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE
N = 1
N = 4
N = 3
N = 2
N = 6
N = 7
N = 5
TA = 70°C
N = Number of Outputs
Conducting Simultaneously
IC - Maximum Collector Current - mA
Duty Cycle - %
0
100
200
300
400
500
600
10
20
30
40
50
60
70
80
90
100

DIP16

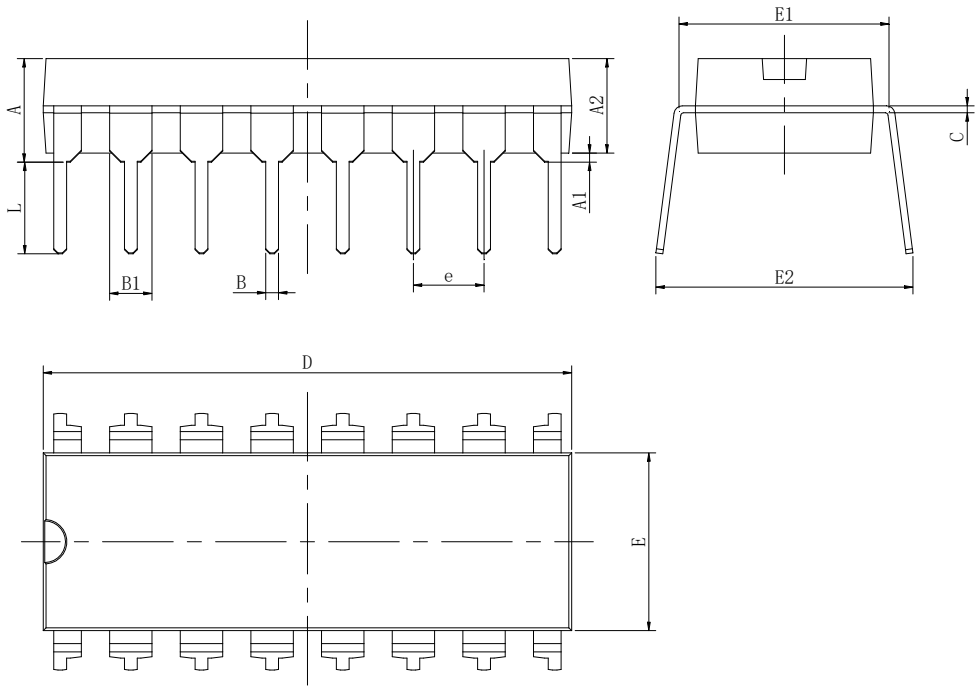

MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE
N = 2
N = 1
N = 3
N = 4
N = 5
N = 6
N = 7
TA = 85°C
N = Number of Outputs
Conducting Simultaneously
IC - Maximum Collector Current - mA
Duty Cycle - %
0
100
200
300
400
500
600
10
20
30
40
50
60
70
80
90
100

SOP16


P_D – Ta
(1) Type-APG free air
(2) Type-AFWG on PCB
(Test Board: JEDEC 2s2p)
(1)
(2)
Power dissipation P_D (W)
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0
0
25
50
75
100
125
150
Ambient temperature Ta (°C)

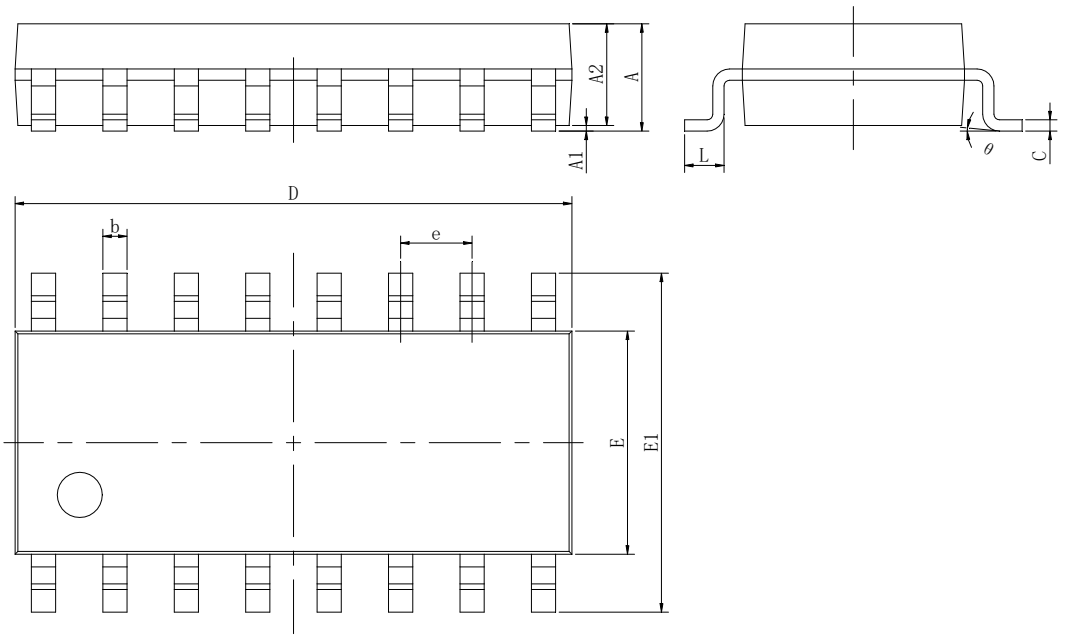
Outline Dimensions

DIP16 Unit：mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.380	0.570	0.015	0.022
B1	1.524(BSC)		0.060(BSC)	
C	0.204	0.360	0.008	0.014
D	18.800	19.200	0.740	0.756
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540(BSC)		0.100(BSC)	
L	3.000	3.600	0.118	0.142
E2	8.400	9.000	0.331	0.354

SOP16 Unit：mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	9.800	10.200	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Statements

- Silicore Technology reserves the right to make changes without further notice to any products or specifications herein. Before customers place an order, customers need to confirm whether datasheet obtained is the latest version, and to verify the integrity of the relevant information.

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- The product upgrades without end, Silicore Technology will wholeheartedly provide customers integrated circuits that have better performance and better quality.