

1 Introduction

NPN Plastic-Encapsulate Darlington Transistors

ULN2003A is a high voltage, high current Darlington transistor array. Each device consists of seven NPN Darlington pairs that can be output independently. These Darlington pairs have common emitter poles that support high voltage output with a common cathode clamp diode for switching inductive loads. The input and output of the clamp diode are relatively fixed to simplify the layout of the printed circuit board. The collector current of a single Darlington pair is rated at 500mA, and parallel Darlington pairs provide a higher current.

Each Darlington pair of ULN2003A devices has a 2.7kΩ series base resistance that works directly with TTL or CMOS devices. This device is often used to drive a variety of loads, such as DC engine, LED display light, high power cache and general logic circuits such as TTL, 5V CMOS, etc.

2 Available Package

PART NUMBER	PACKAGE
ULN2003A	SOP16

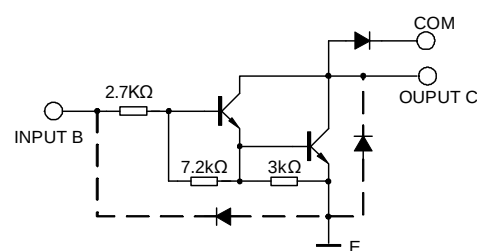


Figure 2-1. Functional Block Diagram

3 Feature

- 500mA rated collector current (single output)
- High voltage output: 50V
- Output clamp diode
- Compatible with all kinds of logic input
- Relay driver application

4 Applications

- Relay Drivers
- Hammer Drivers
- Lamp Drivers
- Line Drivers
- Logic Buffers
- Stepper Motors
- IP Camera
- HVAC Valve and LED Dot Matrix

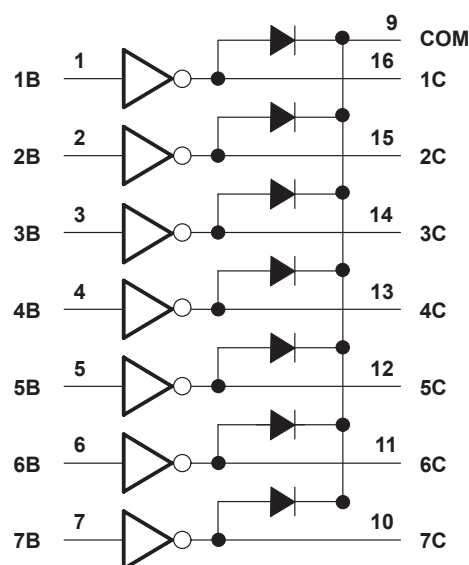


Figure 2-2. Simplified Block Diagram

5 Orderable Information

DEVICE	PACKAGE	OP TEMP	ECO PLAN	MSL	PACKING OPTION	SORT
ULN2003A	SOP16	-40 ~ 85°C	RoHS & Green	Level 3 168 HR	Tape and Reel 2500 Units / Reel	Active

Note:

ECO PLAN: For the RoHS and Green certification standards of this product, please refer to the official report provided by TN.

MSL: Moisture Sensitivity Level. Determined according to TN industry standard classification.

SORT: Specifically defined as follows:

Active: Recommended for new products;

Customized: Products manufactured to meet the specific needs of customers;

Preview: The device has been released and has not been fully mass produced. The sample may or may not be available;

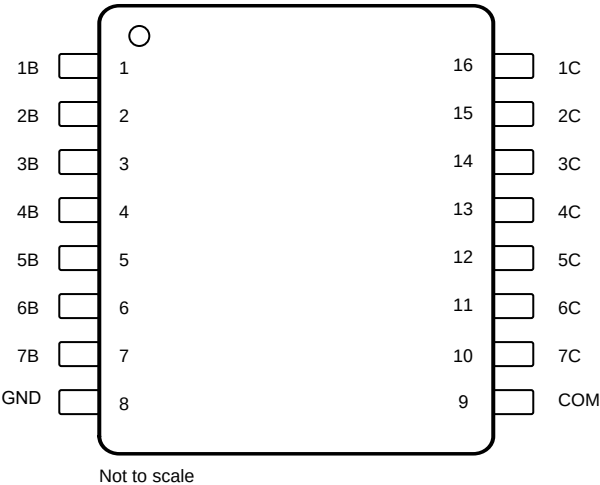
NoRD: It is not recommended to use the device for new design. The device is only produced for the needs of existing customers;

Obsolete: The device has been discontinued.

6 Pin Configuration and Marking Information

6.1 Pin Configuration and Function

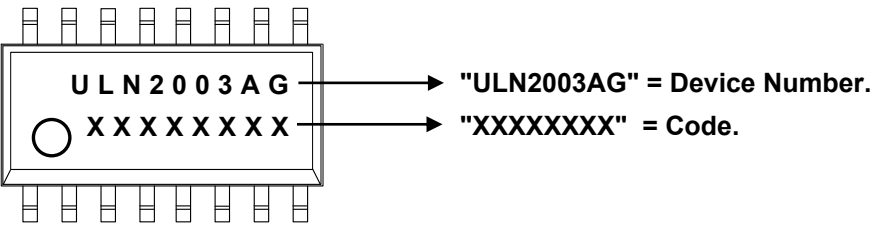
Figure 6-1. SOP16 Package Top View



Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
1B	1	I	Channel 1 through 7 Darlington base input
2B	2		
3B	3		
4B	4		
5B	5		
6B	6		
7B	7		
1C	16	O	Channel 1 through 7 Darlington collector output
2C	15		
3C	14		
4C	13		
5C	12		
6C	11		
7C	10		
GND	8	—	Common emitter shared by all channels (typically tied to ground)
COM	9	I/O	Common cathode node for flyback diodes (required for inductive loads)

6.2 Marking Information



7 Specifications

7.1 Absolute Maximum Ratings⁽¹⁾

at 25°C free-air temperature (unless otherwise noted)

CHARACTERISTIC		SYMBOL	VALUE	UNIT
Output voltage ⁽²⁾		V _{OUT}	50	V
Input voltage ⁽²⁾		V _{IN}	30	V
Collector current (peak)		I _C	500	mA
Base-terminal current		I _B	25	mA
Maximum power dissipation	SOP-18	P _{D MAX}	Internally Limited ⁽³⁾	W
Maximum junction temperature		T _{J MAX}	150	°C
Storage Temperature		T _{stg}	-55 ~ 150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to network ground terminal.

(3) Refer to *Thermal Information* for details.

7.2 Recommended Operating Conditions

PARAMETER	SYMBOL	MIN.	NOM.	MAX.	UNIT
Operating junction temperature	T _J	-	-	125	°C
Operating ambient temperature	T _A	-40	-	85	°C

7.3 Thermal Information⁽⁴⁾

THERMAL METRIC	SYMBOL	ULN2003A SOP16 Package	UNIT
Junction-to-ambient thermal resistance	R _{ΘJA}	75.2	°C/W
Reference maximum power dissipation for continuous operation	P _{D Ref}	1.33	W

(4) Test in T_A = 25°C, see *Notes* for more details.

7 Specifications

7.4 Electrical Characteristics

at 25°C free-air temperature (unless otherwise specified)

参数		测试图	测试条件		最小	典型	最大	单位
V _{I(ON)}	导通状态输入电压	图 14	V _{CE} =2V	I _C =200mA			2.4	V
				I _C =250mA			2.7	
				I _C =300mA			3	
V _{OH}	开关后输出高电平	图 17	V _S =50V, I _O =300mA	50V 版本	VS-50			mV
				40V 版本	VS-40			
V _{CE(SAT)}	集电极-发射极饱和压降	图 13	I _I =250μA, I _C =100mA			0.9	1.1	V
			I _I =350μA, I _C =200mA			1.0	1.3	
			I _I =500μA, I _C =350mA			1.4	1.6	
I _{CEX}	集电极关断漏电流	图 10	V _{CE} =50V, I _I =0				50	μA
V _F	钳位二极管正向压降	图 16	I _F =350mA			1.7	2	V
I _{I(off)}	关断输入电流	图 11	V _{CE} =50V, I _C =500μA		50	65		uA
I _I	输入电流	图 12	V _I =3.85V			0.93	1.35	mA
h _{FE}	直流正向电流增益	图 13	V _{CE} =2V, I _C =350mA		1000			
I _R	钳位二极管反向电流	图 15	V _R =50V				50	μA
C _I	输入电容		V _I =0, f=1MHz			15	25	pF
t _{PLH}	传输延迟 低-高	图 17				0.25	1	μs
t _{PHL}	传输延迟 高-低	图 17				0.25	1	μs

T_A=-40°C~+105°C

参数		测试图	测试条件		最小	典型	最大	单位
V _{I(ON)}	导通状态输入电压	图 14	V _{CE} =2V	I _C =200mA			2.7	V
				I _C =250mA			2.9	
				I _C =300mA			3	
V _{OH}	开关后输出高电平	图 17	V _S =50V I _O =300mA	50V版本	VS50			mV
				40V版本	VS40			
V _{CE(SAT)}	集电极-发射极饱和压降	图 13	I _I =250 .A, I _C =100mA			0.9	1.2	V
			I _I =350 .A, I _C =200mA			1	1.4	
			I _I =500 .A, I _C =350mA			1.2	1.7	
I _{CEX}	集电极关断漏电流	图 10	V _{CE} =50V, I _I =0				100	.A
V _F	钳位二极管正向压降	图 16	I _F =350mA			1.7	2.2	V
I _{I(off)}	关断输入电流	图 11	V _{CE} =50V, I _C =500 .A		30	65		uA
I _I	输入电流	图 12	V _I =3.85V			0.93	1.35	mA
I _R	钳位二极管反向电流	图 15	V _R =50V				100	.A
C _I	输入电容		V _I =0, f=1MHz			15	25	pF
t _{PLH}	传输延迟 低-高	图 17				1	10	.s
t _{PHL}	传输延迟 高-低	图 17				1	10	.s

7.5 Typical Characteristics

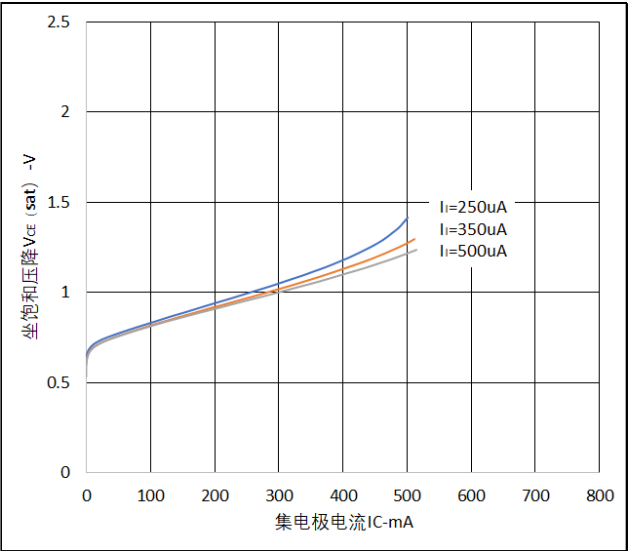


图 3、饱和压降 VS 集电极电流

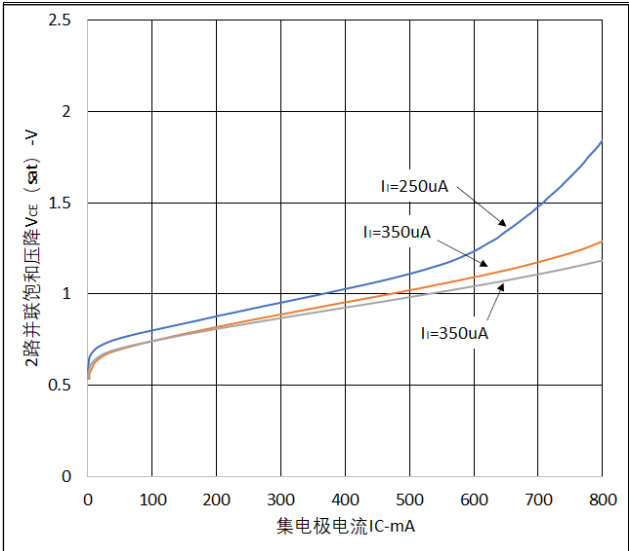


图 4、2 路并联饱和压降 VS 集电极电流

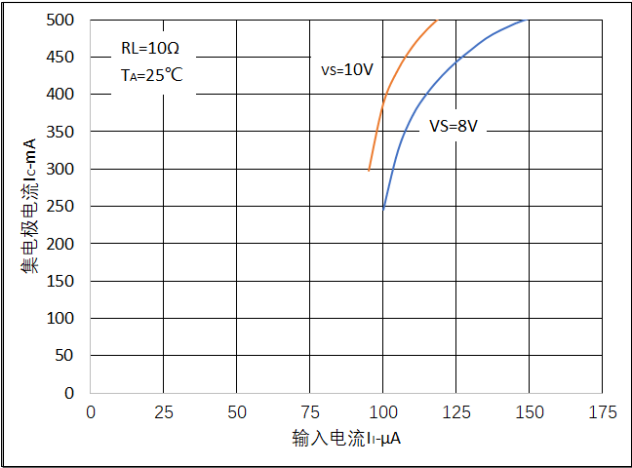


图 5、集电极电流 VS 输入电流

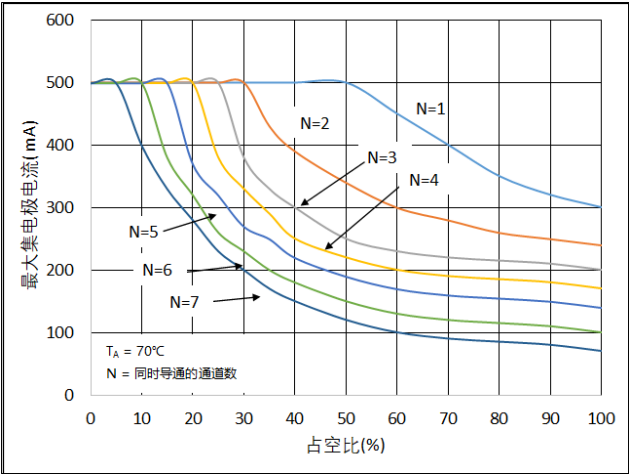


图 6、最大集电极电流 VS 占空比

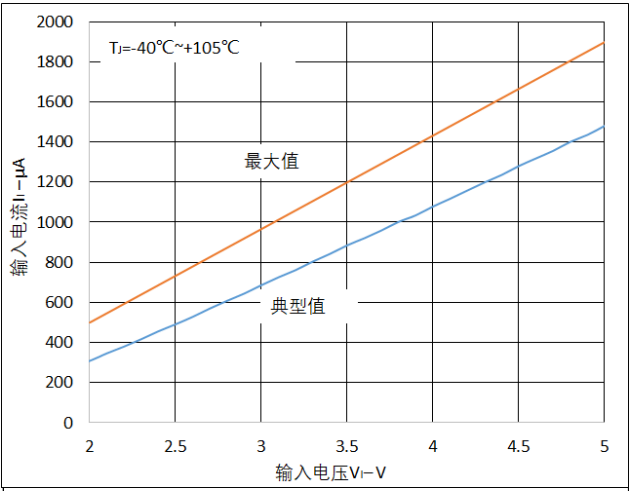


图 7、输入电流 VS 输入电压

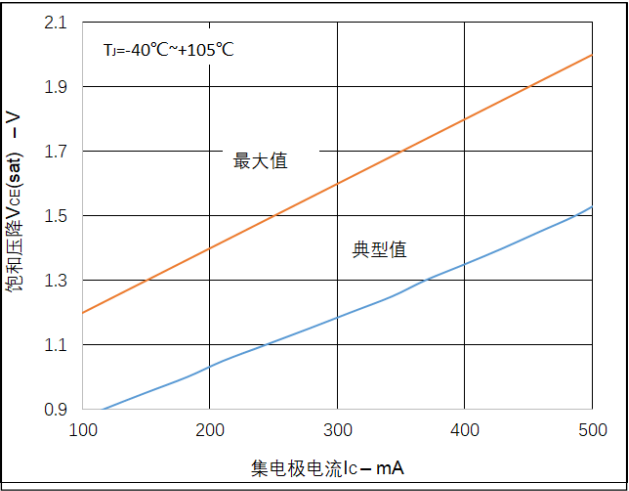


图 8、饱和压降 VS 集电极电流

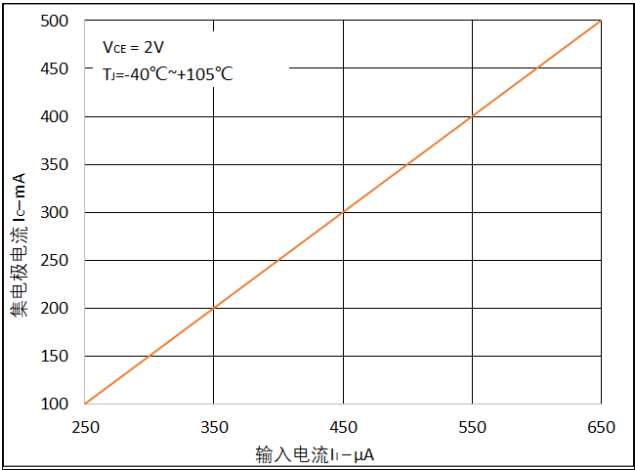


图 9、集电极电流 VS 输入电流

8 Parameter Measurement Information

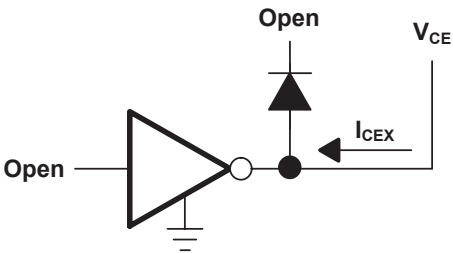


Figure 1a. I_{CEX} Test Circuit

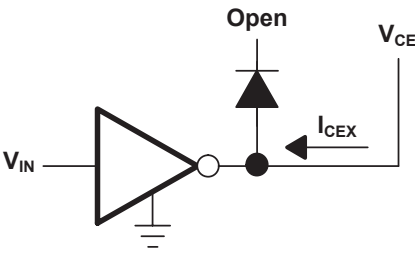


Figure 1b. I_{CEX} Test Circuit

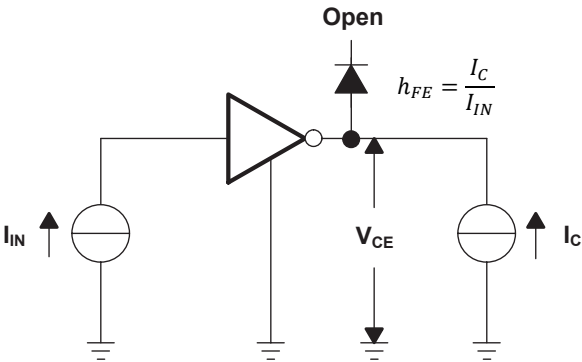


Figure 2. h_{FE} , $V_{CE(SAT)}$ Test Circuit

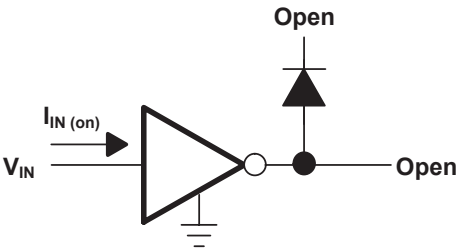


Figure 3. I_{IN} Test Circuit

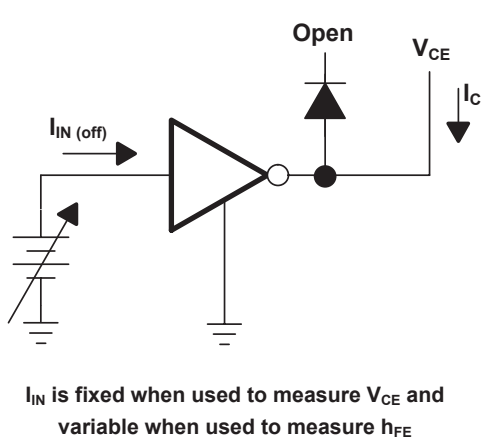


Figure 4. I_{IN} (off) Test Circuit

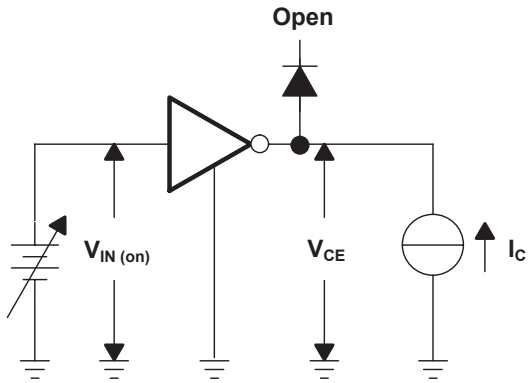


Figure 5. V_{IN} (on) Test Circuit

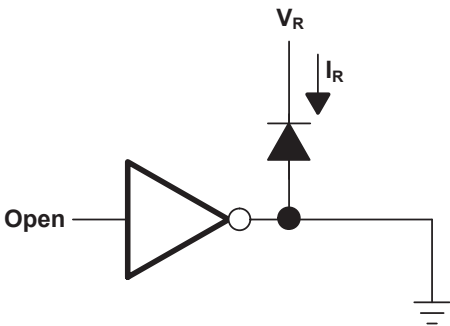


Figure 6. I_R Test Circuit

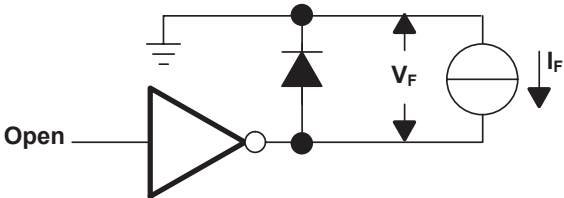


Figure 7. V_F Test Circuit

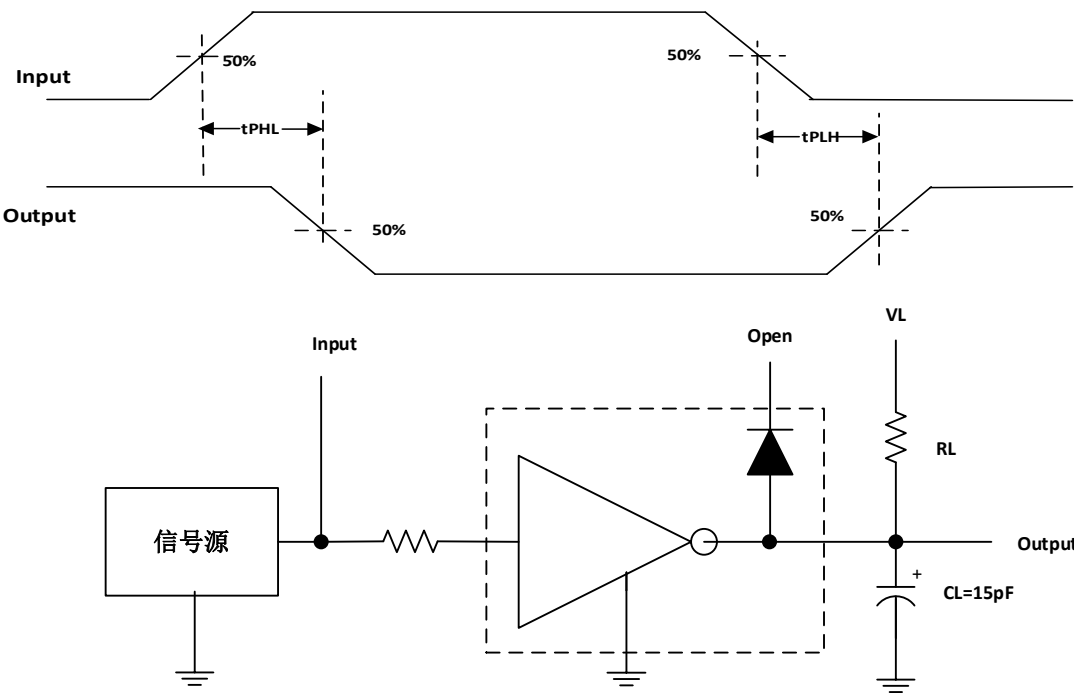
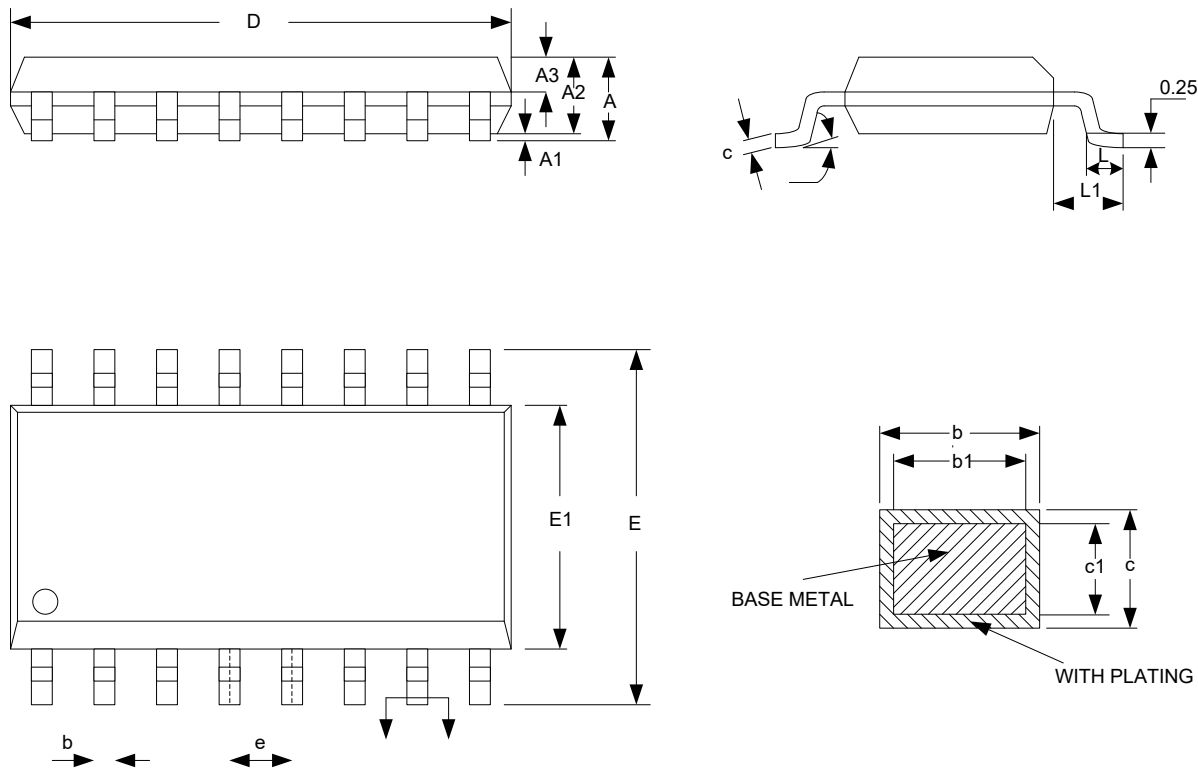


图 17、传输延时波形图

备注：图 17 中电容负载为示波器探头寄生电容

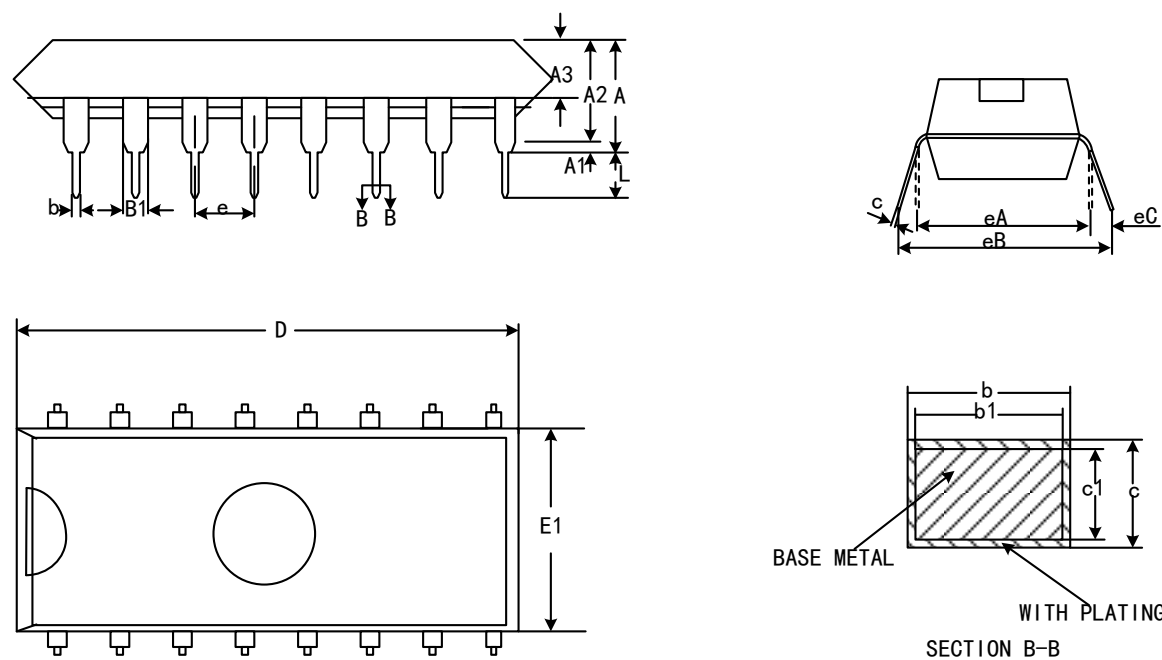
9 Mechanical Information

SOP16 Package



SYMBOL	MILLMETER		
	MIN	NOM	MAX
A	-	-	1.77
A1	0.08	0.18	0.28
A2	1.20	1.40	1.60
A3	0.55	0.65	0.75
b	0.39	-	0.48
b1	0.38	0.41	0.43
c	0.21	-	0.26
c1	0.19	0.20	0.21
D	9.70	9.90	10.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
L	0.5	0.65	0.80
L1	1.05BSC		
θ	0°	-	8°

DIP16:



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	3.60	3.80	4.00
A1	0.51	—	—
A2	3.10	3.30	3.50
A3	1.42	1.52	1.62
b	0.44	—	0.53
b1	0.43	0.46	0.48
B1	1.52BSC		
c	0.25	—	0.31
c1	0.24	0.25	0.26
D	18.90	19.10	19.30
E1	6.15	6.35	6.55
e	2.54BSC		
eA	7.62BSC		
eB	7.62	—	9.50
eC	0	—	0.94
L	3.00	—	—

Contact Information

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For additional information, please contact your local Sales Representative.



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