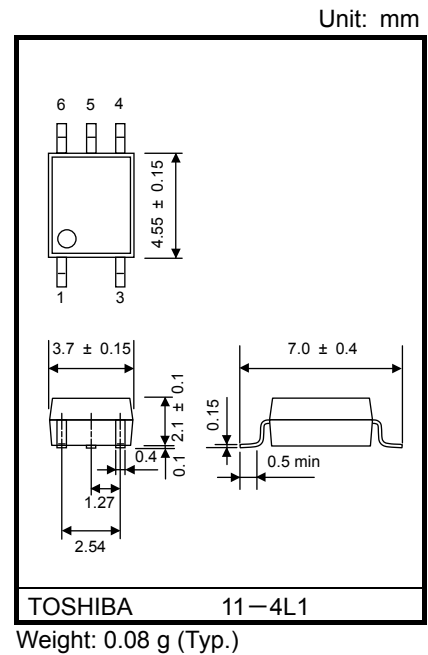


# TLP116A

Plasma Display Panels (PDPs)  
 High-Speed Interface  
 Factory Automation (FA)

The Toshiba TLP116A mini-flat coupler is a small-outline coupler suitable for surface-mount assembly. The TLP116A consists of a GaAlAs light-emitting diode and an integrated high-gain, high-speed photodetector. This unit is housed in the 6-pin SO package and guarantees a creepage distance of  $\geq 5.0\text{mm}$ , a clearance of  $\geq 5.0\text{mm}$  and an insulation thickness of  $\geq 0.4\text{mm}$ . Therefore, the TLP116A meets the reinforced insulation class requirements of international safety standards.

- Inverter logic (totem-pole output)
- SO6 package
- Guaranteed performance over:  $-40$  to  $100^\circ\text{C}$
- Power supply voltage:  $4.5$  to  $5.5\text{V}$
- Input thresholds current:  $I_{FHL} = 5\text{ mA}$  (max)
- Propagation delay time ( $t_{pHL} / t_{pLH}$ ):  $60\text{ ns}$  (max)
- Switching speed:  $20\text{ MBd}$  (typ.)
- Common-mode transient immunity:  $\pm 10\text{ kV/us}$
- Isolation voltage:  $3750\text{ Vrms}$
- UL approval: UL1577, File No.E67349 Under application



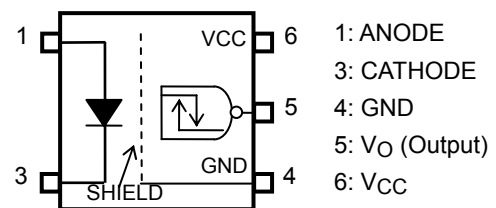
**Truth Table**

Input	LED	Tr1	Tr2	Output
H	ON	OFF	ON	L
L	OFF	ON	OFF	H

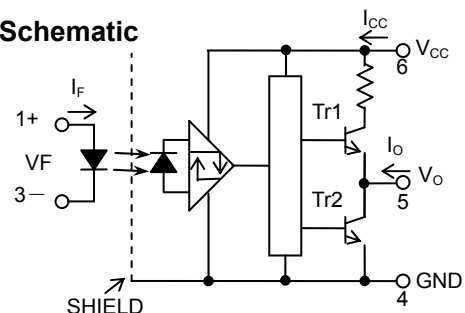
**Construction Mechanical Rating**

Creepage Distance:  $5.0\text{mm}$  (min)  
 Clearance:  $5.0\text{mm}$  (min)  
 Insulation Thickness:  $0.4\text{mm}$  (min)

**Pin Configuration (Top View)**



**Schematic**



A bypass capacitor of  $0.1\mu\text{F}$  must be connected between pins 6 and 4.

**Absolute Maximum Ratings (Ta=25°C)**

Characteristic		Symbol	Rating	Unit
LED	Forward current	I <sub>F</sub>	20	mA
	Forward current derating (Ta ≥ 85°C)	ΔI <sub>F</sub> / ΔTa	-0.5	mA/°C
	Peak transient forward current (Note 1)	I <sub>FPT</sub>	1	A
	Reverse voltage	V <sub>R</sub>	5	V
DETECTOR	Output current	I <sub>O</sub>	10	mA
	Output voltage	V <sub>O</sub>	6	V
	Supply voltage	V <sub>CC</sub>	6	V
	Output power dissipation	P <sub>O</sub>	40	mW
Operating temperature range		Topr	-40 to 100	°C
Storage temperature range		Tstg	-55 to 125	°C
Lead solder temperature(10 s)		Tsol	260	°C
Isolation voltage (AC, 1 min., R.H. ≤ 60%, Ta=25°C) (Note 2)		BVs	3750	Vrms

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

**Recommended Operating Conditions**

Characteristic	Symbol	Min	Typ.	Max	Unit
Input current , ON	I <sub>F(ON)</sub>	8	—	18	mA
Input voltage , OFF	V <sub>F(OFF)</sub>	0	—	0.8	V
Supply voltage (Note 3)	V <sub>CC</sub>	4.5	5.0	5.5	V
Operating temperature	Topr	-40	—	100	°C

Note: Recommended operating conditions are given as a design guideline to obtain expected performance of the device. Additionally, each item is an independent guideline respectively. In developing designs using this product, please confirm specified characteristics shown in this document.

**Correlation between Input current, switching speed and drive circuit (reference information).**

Input current (IF)	Test Circuit	Typical switching speed
12mA	1 (Page 4)	21 – 23 MBd
8mA	1 (Page 4)	18 – 20 MBd
8mA	2 (Page 4, With Speed up capacitor)	23 – 27 MBd

Note 1 : Pulse width PW ≤ 1μs, 300 pps.

Note 2 : This device is regarded as a two terminal device : pins 1 and 3 are shorted together, as are pins 4,5 and 6.

Note 3 : The detector of this product requires a power supply voltage (V<sub>CC</sub>) of 4.5 V or higher for stable operation. If the V<sub>CC</sub> is lower than this value, an I<sub>CC</sub> may increase, or an output may be unstable. Be sure to use the product after checking the supply current, and the operation of a power-on/-off.

## Electrical Characteristics

(Unless otherwise specified, Ta=-40 to 100°C, V<sub>CC</sub>=4.5 to 5.5 V)

Characteristic	Symbol	Test Circuit	Conditions	Min	Typ.	Max	Unit
Input forward voltage	V <sub>F</sub>	—	I <sub>F</sub> = 10 mA, Ta = 25°C	1.45	1.58	1.85	V
Temperature coefficient of forward voltage	ΔV <sub>F</sub> / ΔTa	—	I <sub>F</sub> = 10 mA	—	-2.0	—	mV/°C
Input reverse current	I <sub>R</sub>	—	V <sub>R</sub> =5 V, Ta = 25°C	—	—	10	μA
Input capacitance	C <sub>T</sub>	—	V = 0, f = 1 MHz, Ta = 25°C	—	60	—	pF
Logic low output voltage	V <sub>OL</sub>	1	I <sub>OL</sub> = 1.6 mA, I <sub>F</sub> = 12 mA, V <sub>CC</sub> = 5 V	—	—	0.4	V
Logic high output voltage	V <sub>OH</sub>	2	I <sub>OH</sub> = -0.02 mA, V <sub>F</sub> = 1.05 V, V <sub>CC</sub> = 5 V	4.0	—	—	V
Logic low supply current	I <sub>CCL</sub>	3	I <sub>F</sub> = 12 mA	—	—	5.0	mA
Logic high supply current	I <sub>CCH</sub>	4	V <sub>F</sub> = 0 V	—	—	5.0	mA
Input current logic low output	I <sub>FHL</sub>	—	I <sub>O</sub> = 1.6 mA, V <sub>O</sub> < 0.4 V	—	—	5	mA
Input voltage logic high output	V <sub>FLH</sub>	—	I <sub>O</sub> = -0.02 mA, V <sub>O</sub> > 4.0 V	0.8	—	—	V

\*All typical values are at Ta=25°C, V<sub>CC</sub>=5 V, I<sub>F</sub>(ON)=12 mA unless otherwise specified

## Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Conditions	Min	Typ.	Max	Unit
Capacitance input to output	C <sub>S</sub>	V <sub>s</sub> = 0, f = 1 MHz (Note 2)	—	0.8	—	pF
Isolation resistance	R <sub>S</sub>	R.H. ≤ 60%, V <sub>S</sub> = 500 V (Note 2)	1×10 <sup>12</sup>	10 <sup>14</sup>	—	Ω
Isolation voltage	BV <sub>S</sub>	AC, 1 minute	3750	—	—	V <sub>rms</sub>
		AC, 1 second, in oil	—	10000	—	
		DC, 1 minute, in oil	—	10000	—	V <sub>dc</sub>

Note 4: A ceramic capacitor (0.1 μF) should be connected from pin 6 to pin 4 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypass may impair the switching property.  
The total lead length between capacitor and coupler should not exceed 1 cm.

## Switching Characteristics

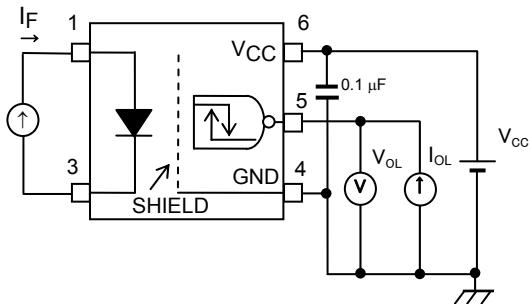
(Unless otherwise specified,  $T_a = -40$  to  $100^\circ\text{C}$ ,  $V_{CC} = 4.5$  to  $5.5$  V)

Characteristic	Symbol	Test Circuit	Conditions	Min.	Typ.	Max.	Unit	
Propagation delay time to logic high output	$t_{pHL}$	5	$I_F = 0 \rightarrow 12$ mA	$R_{IN} = 100 \Omega$ $C_L = 15$ pF (Note 5)	—	—	60	ns
Propagation delay time to logic low output	$t_{pLH}$		$I_F = 12 \rightarrow 0$ mA		—	—	60	ns
Propagation delay time to logic high output	$t_{pHL}$	6	$V_{IN} = 0 \rightarrow 5$ V ( $I_F = 0 \rightarrow 8$ mA)	$R_{IN} = 470 \Omega$ $C_{IN} = 27$ pF $C_L = 15$ pF (Note 5)	—	—	60	ns
Propagation delay time to logic low output	$t_{pLH}$		$V_{IN} = 5 \rightarrow 0$ V ( $I_F = 8 \rightarrow 0$ mA)		—	—	60	ns
Switching time dispersion between ON and OFF	$ t_{pHL} - t_{pLH} $	5	$I_F = 12$ mA, $R_{IN} = 100 \Omega$ , $C_L = 15$ pF (Note 5)	—	—	30	ns	
Output fall time(90-10%)	$t_f$		$I_F = 0 \rightarrow 12$ mA	$R_{IN} = 100 \Omega$ $C_L = 15$ pF (Note 5)	—	15	—	ns
Output rise time(10-90%)	$t_r$		$I_F = 12 \rightarrow 0$ mA		—	15	—	ns
Common mode transient immunity at high Level output	$CM_H$	7	$V_{CM} = 1000$ Vp-p, $I_F = 0$ mA, $V_o(\text{Min}) = 4$ V, $T_a = 25^\circ\text{C}$	10000	—	—	V/ $\mu\text{s}$	
Common mode transient immunity at low level output	$CM_L$		$V_{CM} = 1000$ Vp-p, $I_F = 12$ mA, $V_o(\text{Max}) = 0.4$ V, $T_a = 25^\circ\text{C}$	-10000	—	—	V/ $\mu\text{s}$	

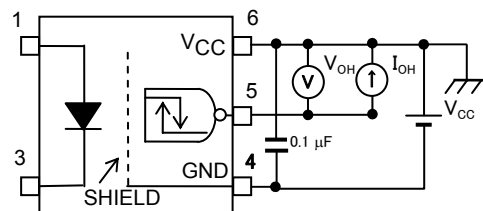
\*All typical values are at  $T_a = 25^\circ\text{C}$

Note 5:  $C_L$  is approximately 15 pF which includes probe and Jig/stray wiring capacitance.

TEST CIRCUIT 1:  $V_{OL}$



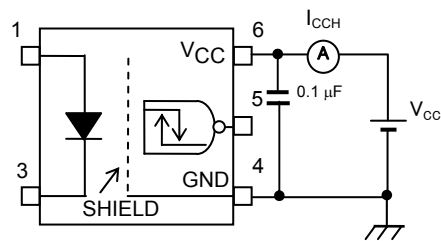
TEST CIRCUIT 2:  $V_{OH}$



TEST CIRCUIT 3:  $I_{CCL}$

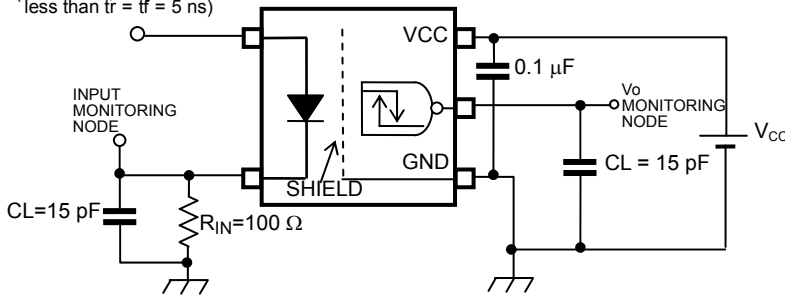


TEST CIRCUIT 4:  $I_{CCH}$

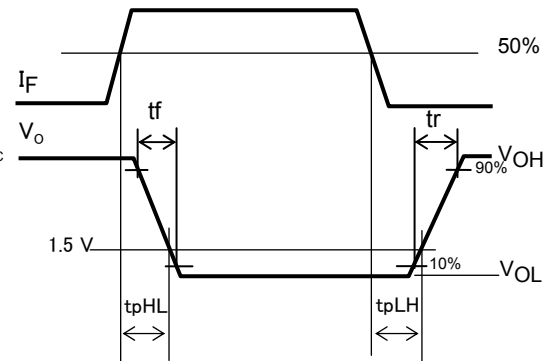


## TEST CIRCUIT 5: tpHL, tpLH

$I_F = 12 \text{ mA (P.G)}$   
 ( $f = 5 \text{ MHz}$ , duty = 50%  
 less than  $t_r = t_f = 5 \text{ ns}$ )

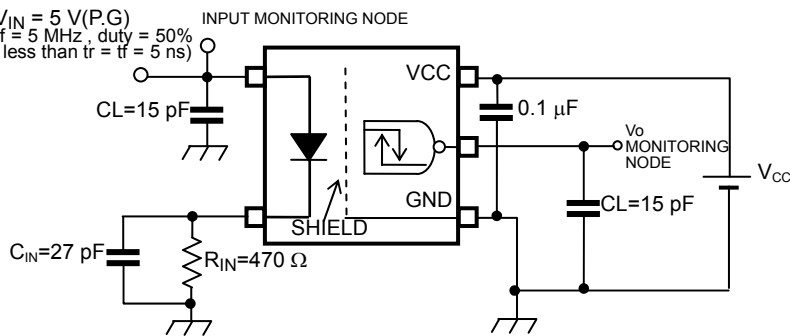


CL is capacitance of the probe and JIG.  
 (P.G): Pulse Generator

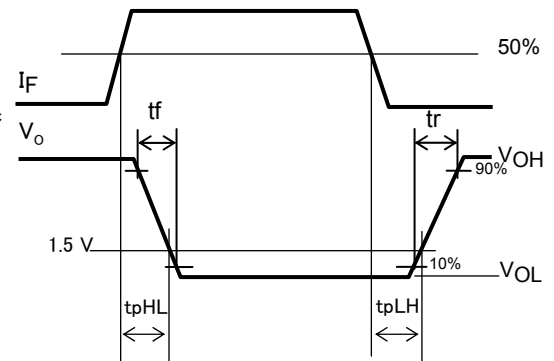


## TEST CIRCUIT 6: tpHL, tpLH

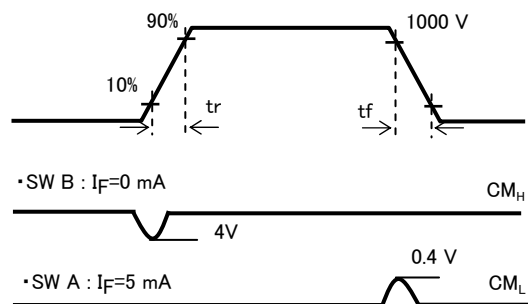
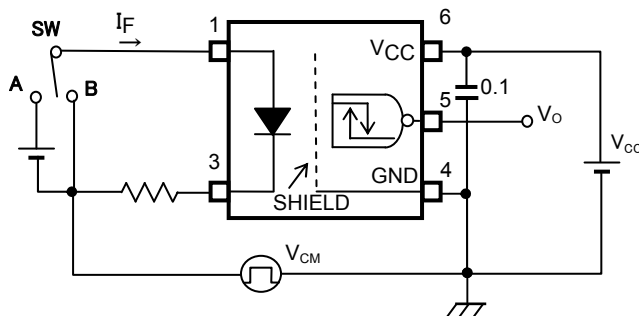
$V_{IN} = 5 \text{ V (P.G)}$   
 ( $f = 5 \text{ MHz}$ , duty = 50%  
 less than  $t_r = t_f = 5 \text{ ns}$ )



CL is capacitance of the probe and JIG.  
 (P.G): Pulse Generator



## TEST CIRCUIT 7: Common-Mode Transient Immunity Test Circuit



$$CM_H = \frac{800(V)}{t_r(\mu s)} \quad CM_L = \frac{800(V)}{t_f(\mu s)}$$

**Specification for Embossed-Tape Packing (TPL)(TPR) for SO6 Coupler**

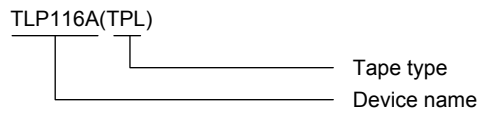
**1. Applicable Package**

Package	Product Type
SO6	Mini-flat coupler

**2. Product Naming System**

Type of package used for shipment is denoted by a symbol suffix after a product number. The method of classification is as below.

(Example)



**3. Tape Dimensions**

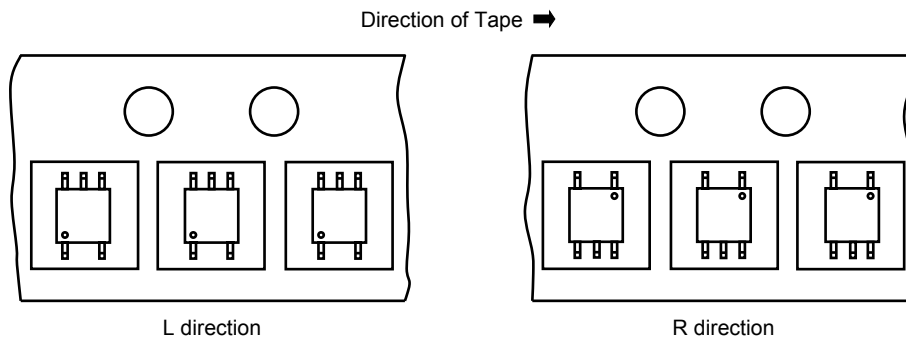
**3.1 Specification Classification Are as Shown in Table 1**

**Table 1 Tape Type Classification**

Tape type	Classification	Quantity (pcs/reel)
TPL	L direction	3000
TPR	R direction	3000

**3.2 Orientation of Device in Relation to Direction of Tape Movement**

Device orientation in the recesses is as shown in Figure 1.



**Figure 1 Device Orientation**

**3.3 Empty Device Recesses Are as Shown in Table 2.**

**Table 2 Empty Device Recesses**

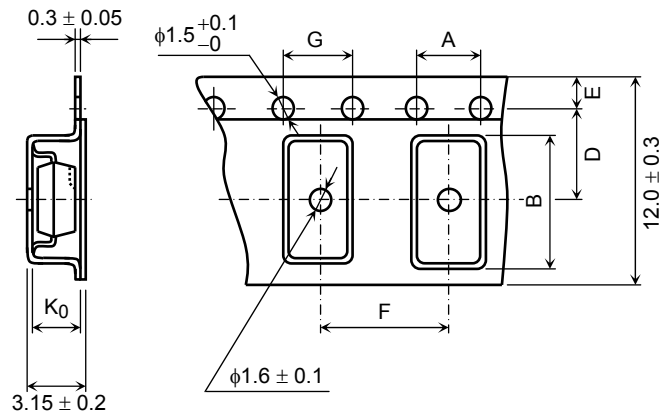
	Standard	Remarks
Occurrences of 2 or more successive empty device recesses	0	Within any given 40-mm section of tape, not including leader and trailer
Single empty device recesses	6 devices (max.) per reel	Not including leader and trailer

**3.4 Start and End of Tape**

The start of the tape has 50 or more empty holes. The end of tape has 50 or more empty holes and two empty turns only for a cover tape.

**3.5 Tape Specification**

- (1) Tape material: Plastic (protection against electrostatics)
- (2) Dimensions: The tape dimensions are as shown in Figure 2 and Table 3.



**Figure 2 Tape Forms**

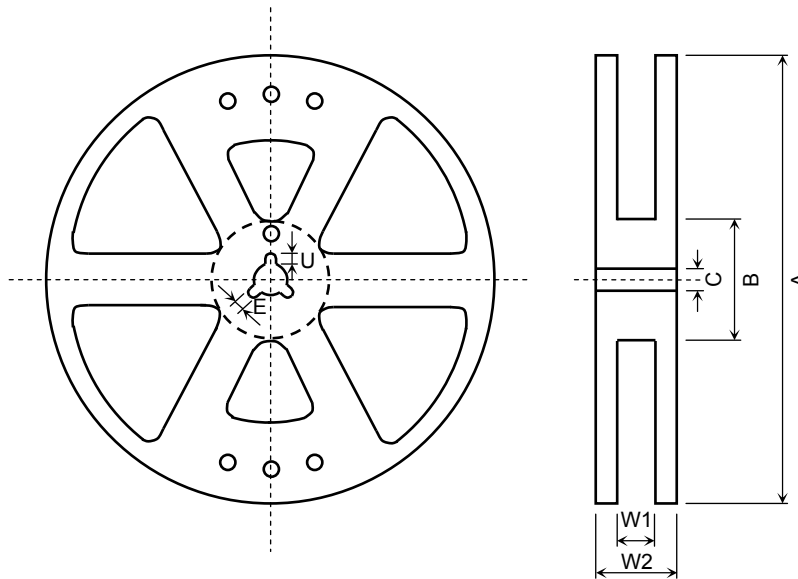
**Table 3 Tape Dimensions**

Unit: mm  
Unless otherwise specified: ±0.1

Symbol	Dimension	Remark
A	4.2	—
B	7.6	—
D	5.5	Center line of indented square hole and sprocket hole
E	1.75	Distance between tape edge and hole center
F	8.0	Cumulative error $\begin{matrix} +0.1 \\ -0.3 \end{matrix}$ (max) per 10 feed holes
G	4.0	Cumulative error $\begin{matrix} +0.1 \\ -0.3 \end{matrix}$ (max) per 10 feed holes
K <sub>0</sub>	2.8	Internal space

**3.6 Reel**

- (1) Material: Plastic
- (2) Dimensions: The reel dimensions are as shown in Figure 3 and Table 4.



**Figure 3 Reel Form**

**Table 4 Reel Dimensions**

Unit: mm

Symbol	Dimension
A	$\Phi 380 \pm 2$
B	$\Phi 80 \pm 1$
C	$\Phi 13 \pm 0.5$
E	$2.0 \pm 0.5$
U	$4.0 \pm 0.5$
W1	$13.5 \pm 0.5$
W2	$17.5 \pm 1.0$

**4. Packing**

Either one reel or five reels of photocoupler are packed in a shipping carton.

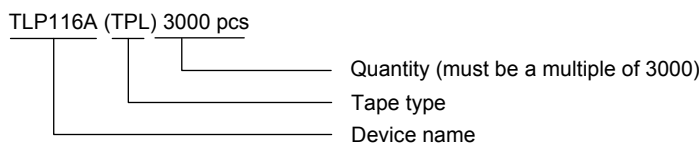
**5. Label Indication**

The carton bears a label indicating the product number, the symbol representing classification of standard, the quantity, the lot number and the Toshiba company name.

**6. Ordering Method**

When placing an order, please specify the product number, the tape type and the quantity as shown in the following example.

(Example)



**RESTRICTIONS ON PRODUCT USE**

20070701-EN GENERAL

- The information contained herein is subject to change without notice.
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In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc.
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