

TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB62705CPG, TB62705CFG, TB62705CFNG

8-BIT SHIFT REGISTER, LATCHES & CONSTANT-CURRENT DRIVERS

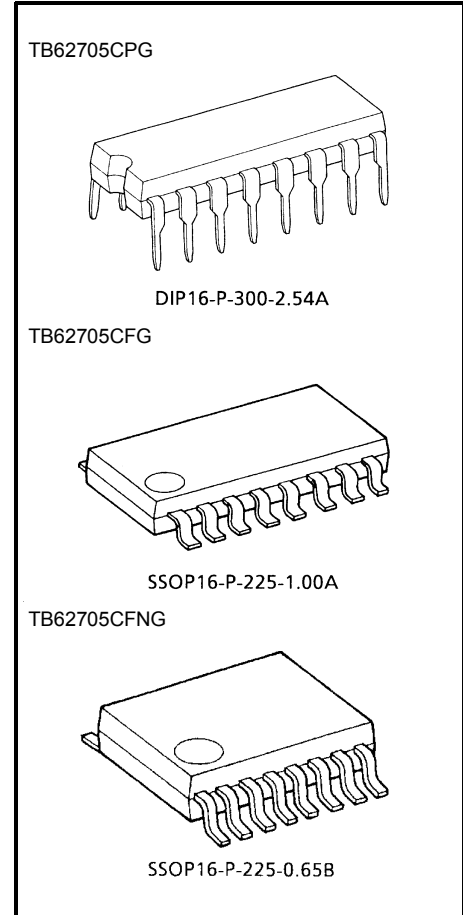
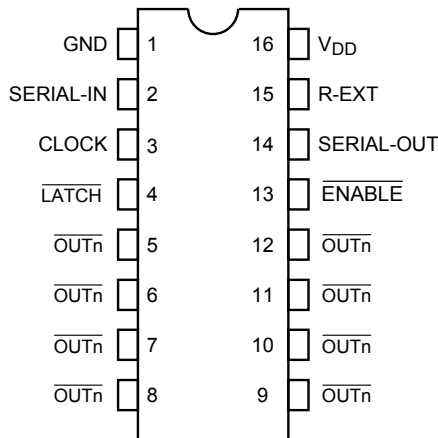
The TB62705CPG / CFG / CFNG are specifically designed for LED and LED DISPLAY constant-current drivers. These constant-current output circuits can support the set-up of an external resistor ($I_{OUT} = 5\sim 90\text{mA}$). This IC is a monolithic integrated circuit designed to be used together with Bi-CMOS process. The devices consist of an 8-bit shift register, latch, AND-GATE and constant-current drivers. This devices are a product for the Pb free(Sn-Ag).

FEATURES

- Constant-current Output : current with one resistor for 5 to 90mA.
- Maximum Clock Frequency : $f_{CLK} = 15$ (MHz)
(Cascade Connects Operate, $T_{opr} = 25^{\circ}\text{C}$)
- 5V C-MOS Compatible Input
- Package : DIP16-P-300-2.54A (TB62705CPG)
SSOP16-P-225-1.00A (TB62705CFG)
SSOP16-P-225-0.65B (TB62705CFNG)
- Constant Output Current Matching:

OUTPUT-GND VOLTAGE	CURRENT MATCHING	OUTPUT CURRENT
$\geq 0.4\text{ V}$	$\pm 6.0\%$	5~40 mA
$\geq 0.7\text{ V}$	$\pm 6.0\%$	5~90 mA

PIN CONNECTION (Top view)



Weight
 DIP16-P-300-2.54A : 1.11 g (typ.)
 SSOP16-P-225-1.00A : 0.14 g (typ.)
 SSOP16-P-225-0.65B : 0.07 g (typ.)

PIN DESCRIPTION

PIN No.	PIN NAME	FUNCTION
1	GND	GND terminal for control logic
2	SERIAL-IN	Input pin for shift register serial data
3	CLOCK	Clock input terminal for data shift to up-edge.
4	$\overline{\text{LATCH}}$	Data strobe input terminal. Latches pass $\overline{\text{LATCH}}$ data with "H" level input and retain data with "L" level input.
5~12	$\overline{\text{OUTn}}$	Output terminals
13	$\overline{\text{ENABLE}}$	Input terminal for output enable. All outputs ($\overline{\text{OUTn}}$) go off with $\overline{\text{ENABLE}}$ data input at "H" level and go on with data input at "L" level.
14	SERIAL-OUT	Output terminal for serial data for the next SERIAL-IN terminal.
15	R-EXT	Input terminal for connecting a resistor to regulate all output currents.
16	V_{DD}	5-V supply pin of the IC

TRUTH TABLE

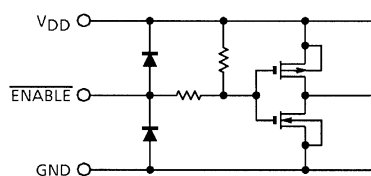
CLOCK	$\overline{\text{LATCH}}$	$\overline{\text{ENABLE}}$	SERIAL-IN	$\overline{\text{OUTn}}$	SERIAL-OUT
UP	H	L	D_n	$D_n \cdots D_{n-5} \cdots D_{n-7}$	D_{n-7}
UP	L	L	D_{n+1}	No change	D_{n-6}
UP	H	L	D_{n+2}	$D_{n+2} \cdots D_{n-3} \cdots D_{n-5}$	D_{n-5}
DOWN	X	L	D_{n+3}	$D_{n+2} \cdots D_{n-3} \cdots D_{n-5}$	D_{n-5}
DOWN	X	H	D_{n+3}	Off	D_{n-5}

Note: $\overline{\text{OUTn}}$ = on if $D_n = \text{H}$ level, and $\overline{\text{OUTn}}$ = off if $D_n = \text{L}$ level.

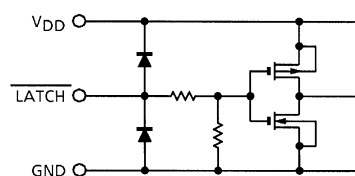
An external resistor is connected with R-EXT and GND. Be sure to administer the correct power supply voltage.

INPUT/OUTPUT EQUIVALENT CIRCUITS

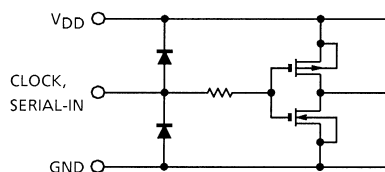
1. $\overline{\text{ENABLE}}$ terminal



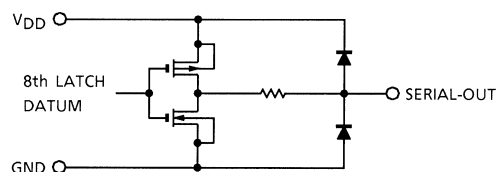
2. $\overline{\text{LATCH}}$ terminal



3. CLOCK, SERIAL-IN terminal



4. SERIAL-OUT terminal



MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	0~7.0	V
Input Voltage	V _{IN}	-0.4~V _{DD} + 0.4	V
Output Current	I _{OUT}	90	mA
Output Voltage	V _{CCE}	-0.5~17.0	V
Clock Frequency	f _{CK}	15	MHz
GND Terminal Current	I _{GND}	720	mA
Power Dissipation	P _D	1.47 (CPG-type : FREE AIR, Ta = 25°C)	W
		0.78 (CFG / CFNG-type : ON PCB, Ta = 25°C)	
Thermal Resistance	R _{th(j-a)}	85 (CPG-type : FREE AIR, Ta = 25°C)	°C / W
		160 (CFG / CFNG-type : ON PCB, Ta = 25°C)	
Operating Temperature	T _{opr}	-40~85	°C
Storage Temperature	T _{stg}	-55~150	°C

Note: CPG type: For an ambient temperature above 25°C, the derating is 11.8 mW/°C.

CFG and CFNG type: For an ambient temperature above 25°C, the derating is 6.3 mW/°C.

RECOMMENDED OPERATING CONDITION (Ta = -40~85°C unless otherwise stated)

CHARACTERISTIC	SYMBOL	CONDITION	MIN	TYP.	MAX	UNIT
Supply Voltage	V _{DD}	—	4.5	5.0	5.5	V
Output Voltage	V _{OUT}	—	—	—	15.0	V
Output Current	I _O	OUT _n , DC 1 circuit	5	—	88	mA
	I _{OH}	SERIAL-OUT	—	—	1.0	
	I _{OL}	SERIAL-OUT	—	—	-1.0	
Input Voltage	V _{IH}	—	0.7 V _{DD}	—	V _{DD} +0.3	V
	V _{IL}	—	-0.3	—	0.3 V _{DD}	
LATCH Pulse Width	t _w LAT	V _{DD} = 4.5~5.5 V	100	—	—	ns
CLOCK Pulse Width	t _w CLK		50	—	—	ns
ENABLE Pulse Width	t _w EN		4500	—	—	ns
Set-up Time for DATA	t _{setup} (D)		60	—	—	ns
Hold Time for DATA	t _{hold} (D)		20	—	—	ns
Set-up Time for LATCH	t _{setup} (L)		100	—	—	ns
Hold Time for LATCH	t _{hold} (L)		60	—	—	ns
Clock Frequency	f _{CK}	Cascade operation	10.0	—	—	MHz
Power Dissipation	P _D	Ta = 85°C (CPG-type FREE AIR)	—	—	0.82	W
		Ta = 85°C (CFG / CFNG-type ON PCB)	—	—	0.40	

ELECTRICAL CHARACTERISTICS ($V_{DD} = 5.0\text{ V}$, $T_a = 25^\circ\text{C}$ unless otherwise stated)

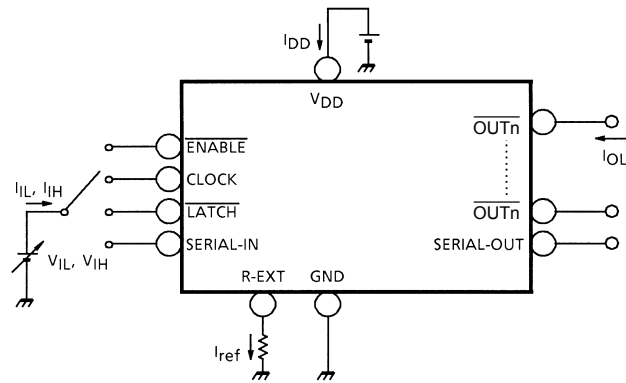
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	CONDITION	MIN	TYP.	MAX	UNIT
Input Voltage	"H" Level	V_{IH}	—	—	$0.7 V_{DD}$	—	V_{DD}	V
	"L" Level	V_{IL}	—	—	GND	—	$0.3 V_{DD}$	
Output Leakage Current		I_{OH}	—	$V_{OH} = 15.0\text{ V}$	—	—	10	μA
Output Voltage	S-OUT	V_{OL}	—	$I_{OL} = 1.0\text{ mA}$	—	—	0.4	V
		V_{OH}	—	$I_{OH} = -1.0\text{ mA}$	4.6	—	—	
Output Current 1		I_{OL1}	—	$V_{CE} = 0.7\text{ V}$	34.1	40.0	45.9	mA
		I_{OL2}	—	$V_{CE} = 0.4\text{ V}$				
	Current Skew	ΔI_{OL1}	—	$I_O = 40\text{ mA}$, $V_{CE} = 0.4\text{ V}$	$R_{EXT} = 470\ \Omega$	—	± 1.5	± 6.0
Output Current 2		I_{OL3}	—	$V_{CE} = 1.0\text{ V}$	64.2	75.5	86.8	mA
		I_{OL4}	—	$V_{CE} = 0.7\text{ V}$				
	Current Skew	ΔI_{OL2}	—	$I_O = 75\text{ mA}$, $V_{CE} = 0.7\text{ V}$	$R_{EXT} = 250\ \Omega$	—	± 1.5	± 6.0
Supply Voltage Regulation		% / V_{DD}	—	$R_{EXT} = 470\ \Omega$, $T_a = -40\sim 85^\circ\text{C}$	—	1.5	5.0	% / V
Pull-Up Resistor		$R_{IN (up)}$	—	—	150	300	600	k Ω
Pull-Down Resistor		$R_{IN (down)}$	—	—	100	200	400	k Ω
Supply Current	"OFF"	$I_{DD (off) 1}$	—	$R_{EXT} = \text{OPEN}$, $\overline{\text{OUT0}} \sim \overline{7} = \text{off}$	—	0.6	1.2	mA
		$I_{DD (off) 2}$	—	$R_{EXT} = 470\ \Omega$, $\overline{\text{OUT0}} \sim \overline{7} = \text{off}$	3.5	5.8	8.0	
		$I_{DD (off) 3}$	—	$R_{EXT} = 250\ \Omega$, $\overline{\text{OUT0}} \sim \overline{7} = \text{off}$	6.5	10.7	15.0	
	"ON"	$I_{DD (on) 1}$	—	$R_{EXT} = 470\ \Omega$, $\overline{\text{OUT0}} \sim \overline{7} = \text{on}$	7.0	12.0	18.0	
		$I_{DD (on) 2}$	—	$R_{EXT} = 250\ \Omega$, $\overline{\text{OUT0}} \sim \overline{7} = \text{on}$	10.0	22.0	32.0	

SWITCHING CHARACTERISTICS (Ta = 25°C unless otherwise stated)

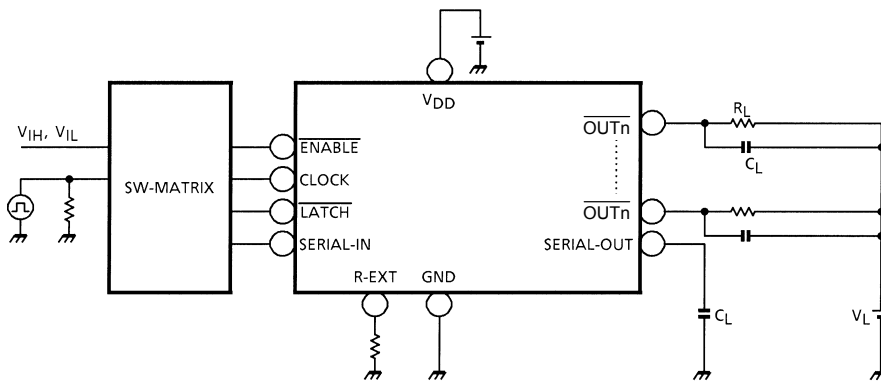
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	CONDITION	MIN	TYP.	MAX	UNIT
Propagation Delay Time ("L" to "H")	SIN - $\overline{\text{OUTn}}$	t_{pLH}	—	$V_{DD} = 5.0 \text{ V}$ $V_{CE} = 0.4 \text{ V}$ $V_{IH} = V_{DD}$ $V_{IL} = \text{GND}$ $R_{EXT} = 470 \Omega$ $I_{OUT} = 40 \text{ mA}$ $V_L = 3.0 \text{ V}$ $R_L = 65 \Omega$ $C_L = 10.5 \text{ pF}$	—	1200	1500	ns
	$\overline{\text{LATCH}} - \overline{\text{OUTn}}$				—	1200	1500	
	$\overline{\text{ENABLE}} - \overline{\text{OUTn}}$				—	1200	1500	
	CLK-SOUT				—	30	70	
Propagation Delay Time ("H" to "L")	SIN - $\overline{\text{OUTn}}$	t_{pHL}	—		—	700	1000	ns
	$\overline{\text{LATCH}} - \overline{\text{OUTn}}$				—	700	1000	
	$\overline{\text{ENABLE}} - \overline{\text{OUTn}}$				—	700	1000	
	CLK-SOUT				—	30	70	
Pulse Width	CK	$t_w \text{ CLK}$	—		—	20	30	ns
	LATCH	$t_w \text{ LAT}$	—		—	10	25	
Set-up Time for LATCH	L-H	t_{setup}	—	—	25	50	ns	
	H-L			—	25	50		
Hold Time for LATCH	L-H	t_{hold}	—	—	0	30	ns	
	H-L			—	0	30		
Maximum CLOCK Rise Time		t_r	—	—	—	10	μs	
Maximum CLOCK Fall Time		t_f	—	—	—	10	μs	
Output Rise Time		t_{or}	—	—	300	600	1000	ns
Output Fall Time		t_{of}	—	—	150	300	600	ns

TEST CIRCUIT

DC characteristics



AC characteristics

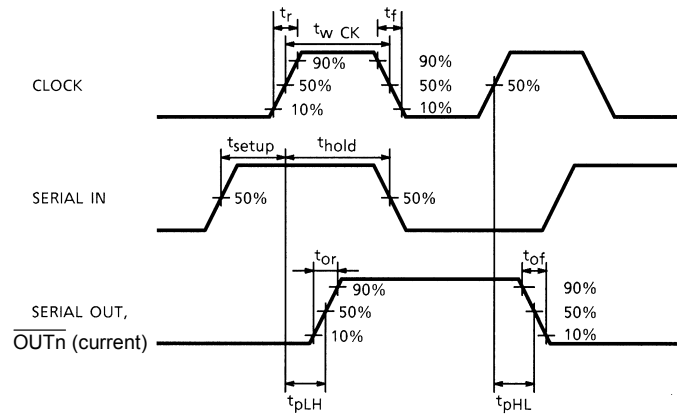


Precaution on Use

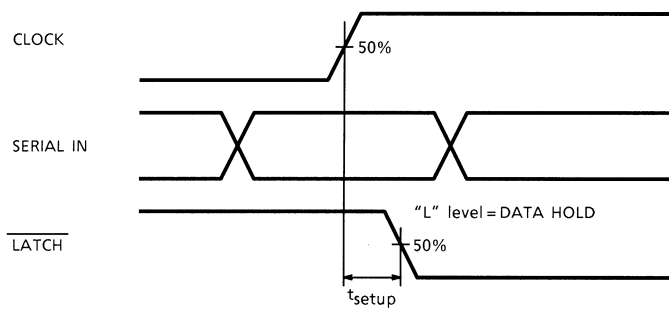
Utmost care is necessary in the design of the output line, VCC (VDD) and GND line since the IC may be damaged due to short-circuits between outputs, air contamination faults, or faults caused by improper grounding.

TIMING WAVEFORM

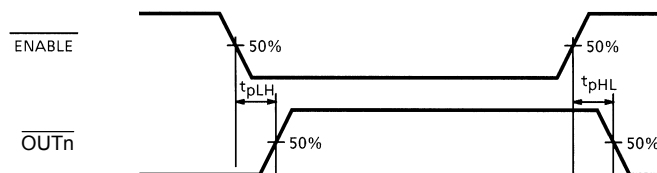
1. CLOCK-SERIAL OUT, $\overline{\text{OUTn}}$

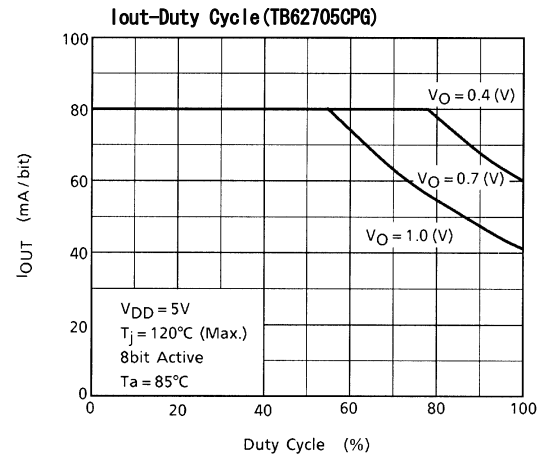
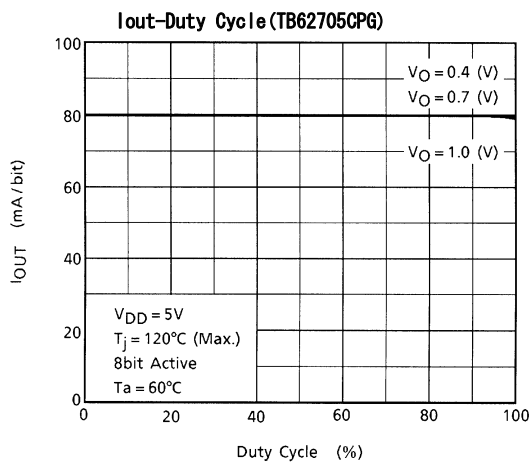
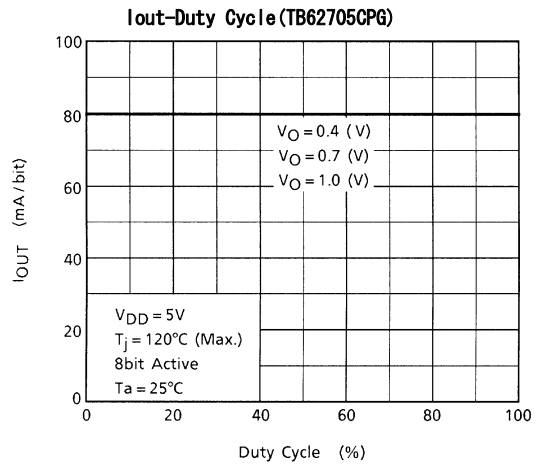
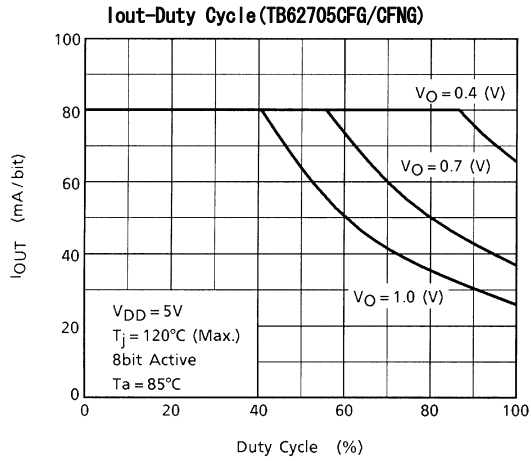
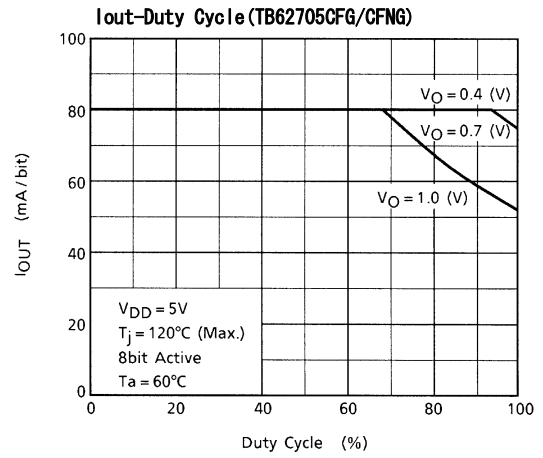
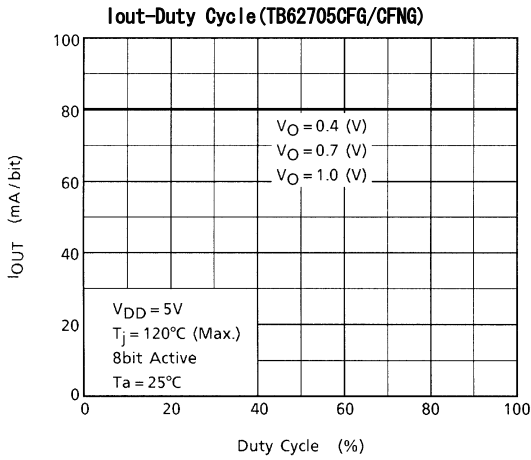


2. CLOCK-LATCH

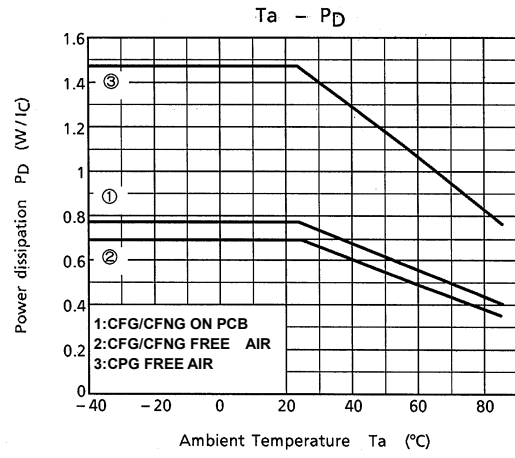
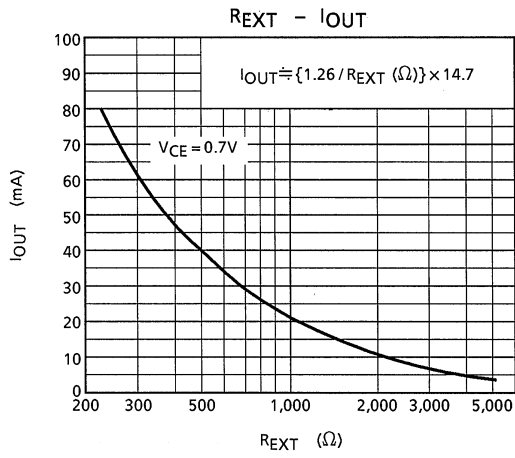


3. ENABLE- $\overline{\text{OUTn}}$





LED DRIVER TB6270X SERIES APPLICATION NOTE



[1] Output current (I_{OUT})

I_{OUT} is set by the external resistor (R-EXT), as shown in Fig. 1.

[2] Total supply voltage (V_{LED})

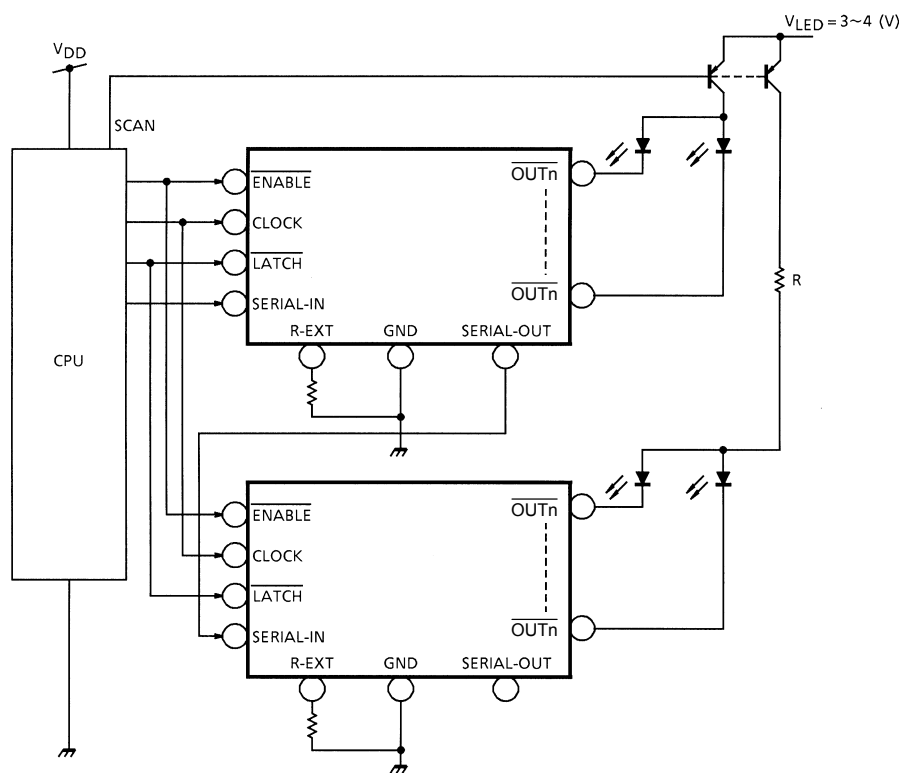
This device can operate on 0.4~0.7 V (V_O).

When a higher voltage is input to the device, the excess voltage is consumed inside the device, which leads to power dissipation. To minimize power dissipation and loss, we recommend that the total supply voltage be set as follows:

$$V_{LED} \text{ (total supply voltage)} = V_{CE} (T_r V_{sat}) + V_f \text{ (LED forward voltage)} + V_O \text{ (IC supply voltage).}$$

When the total supply is too high in the light of the power dissipation of this device, an additional resistor (R) can be used to decrease the supply voltage (V_O).

PATTERN LAYOUT



[3] Pattern layout

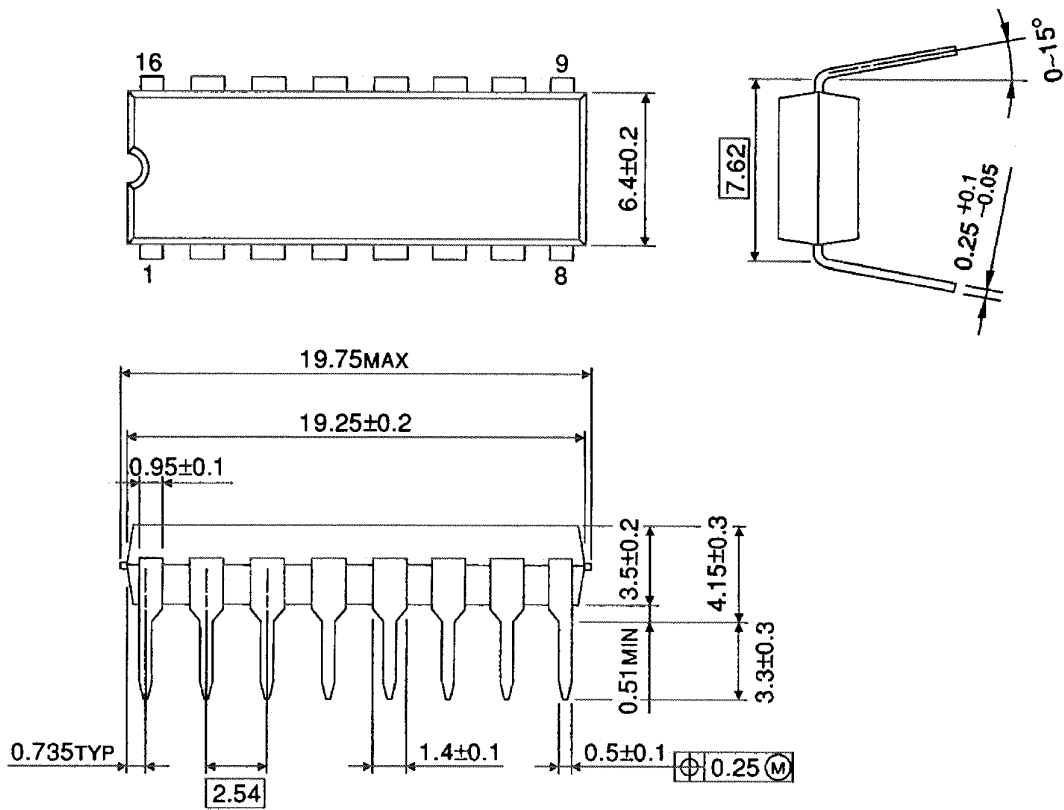
This device has only one ground pin, i.e., the combined signal ground pin and power ground pin.

If the ground pattern layout contains a large amount of inductance and impedance, and the voltage between the ground and LATCH or CLOCK terminals exceeds 2.5 V due to switching noise, the device may not operate correctly. Be sure to pay attention to pattern layout to minimize inductance.

PACKAGE DIMENSIONS

DIP16-P-300-2.54A

Unit : mm

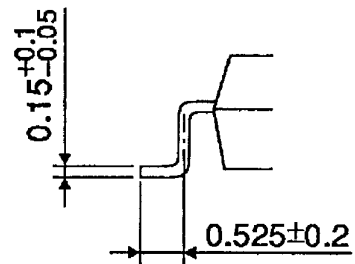
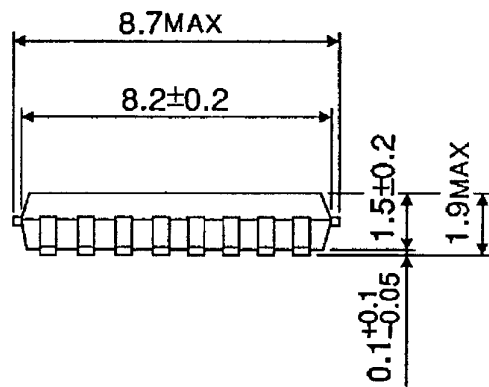
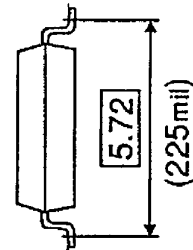
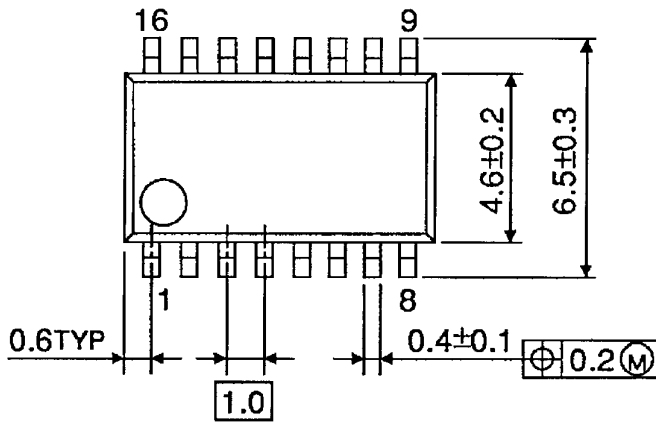


Weight: 1.11 g (Typ.)

PACKAGE DIMENSIONS

SSOP16-P-225-1.00A

Unit : mm

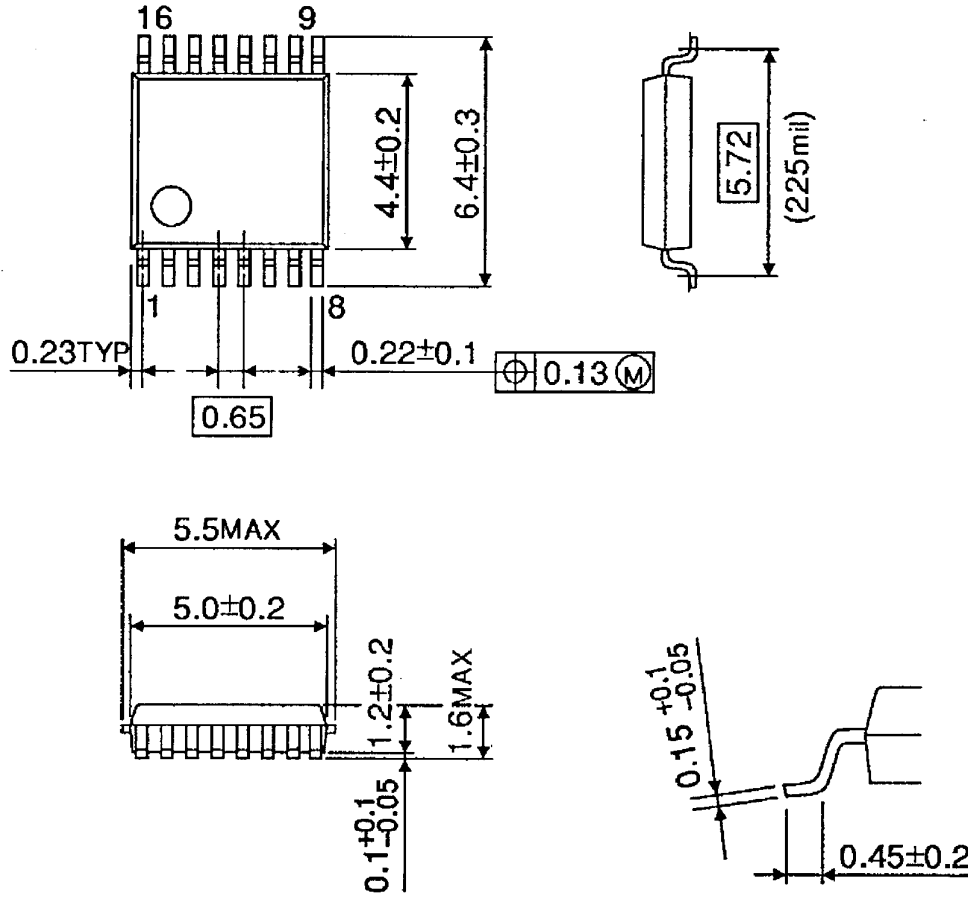


Weight: 0.14 g (Typ.)

PACKAGE DIMENSIONS

SSOP16-P-225-0.65B

Unit : mm



Weight: 0.07 g (Typ.)

About solderability, following conditions were confirmed

- Solderability
 - (1) Use of Sn-63Pb solder Bath
 - solder bath temperature = 230°C
 - dipping time = 5 seconds
 - the number of times = once
 - use of R-type flux
 - (2) Use of Sn-3.0Ag-0.5Cu solder Bath
 - solder bath temperature = 245°C
 - dipping time = 5 seconds
 - the number of times = once
 - use of R-type flux

RESTRICTIONS ON PRODUCT USE

030619EBA

- The information contained herein is subject to change without notice.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
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..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.