

TOSHIBA BI-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

# TB62705CP, TB62705CF, TB62705CFN

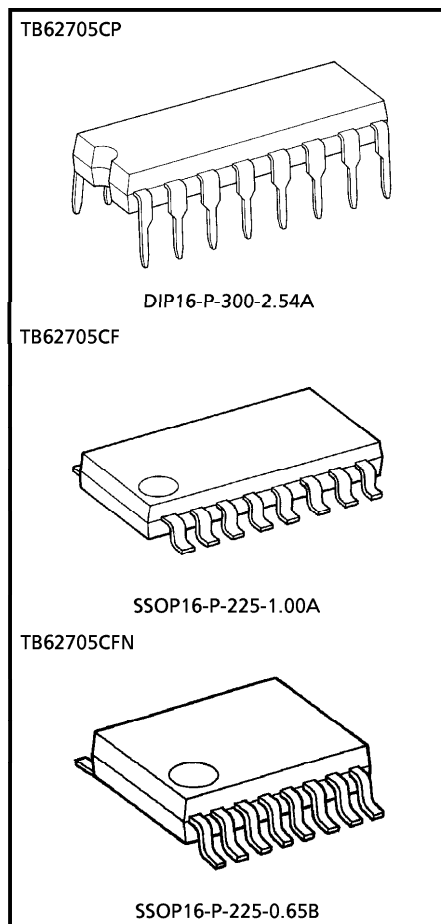
## 8BIT SHIFT REGISTER, LATCHES & CONSTANT CURRENT DRIVERS

The TB62705CP/CF/CFN are specifically designed for LED and LED DISPLAY constant current drivers. This constant current output circuits is able to set up external resistor ( $I_{OUT} = 5\sim 90\text{mA}$ ). This IC is monolithic integrated circuit designed to be used together with Bi-CMOS process. The devices consist of 8bit shift register, latch, AND-GATE & Constant Current Drivers.

### FEATURES

- Constant Current Output : current with one resistor for 5 to 90mA.
- Maximum Clock Frequency :  $f_{CLK} = 15$  (MHz)  
(Cascade Connecte Operate,  $T_{opr} = 25^{\circ}\text{C}$ )
- 5V C-MOS Compatible Input
- Package : DIP16-P-300-2.54A (TB62705CP)  
SSOP16-P-225-1.00A (TB62705CF)  
SSOP16-P-225-0.65B (TB62705CFN)
- Constant Output Current Matching :

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

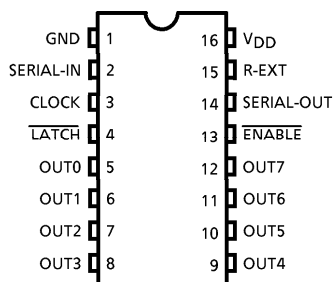


Weight  
 DIP16-P-300-2.54A : 1.11g (Typ.)  
 SSOP16-P-225-1.00A : 0.14g (Typ.)  
 SSOP16-P-225-0.65B : 0.07g (Typ.)

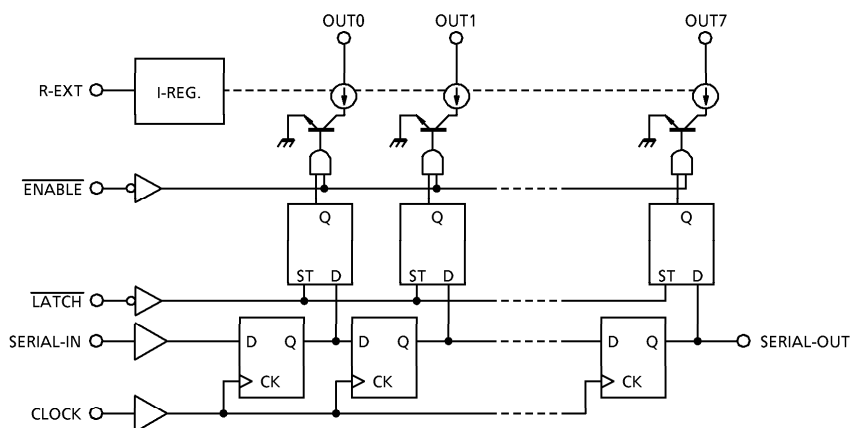
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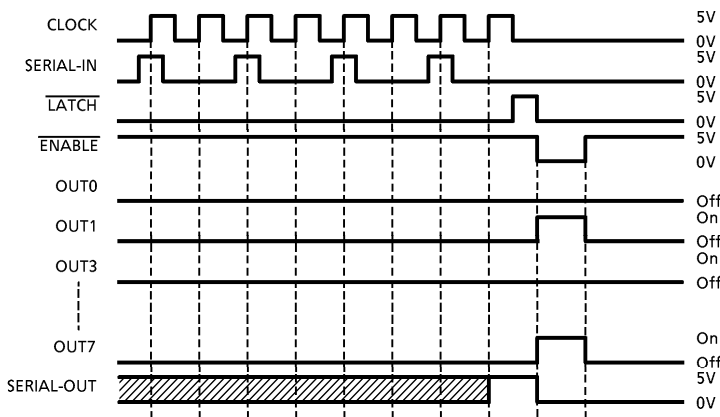
PIN CONNECTION (Top view)



BLOCK DIAGRAM



TIMING DIAGRAM



(Note) Latches are level sensitive, not rising edges sensitive and not synchronous CLOCK.  
 Input of LATCH-terminal to H Level, data passes latches, and input to L level, data hold latches.  
 Input of ENABLE-terminal to H level, all output (OUT0~7) do off.

**TERMINAL DISCIPTION**

PIN No.	PIN NAME	FUNCTION
1	GND	GND terminal for control logic.
2	SERIAL-IN	Input terminal of a serial-data for shift-register.
3	CLOCK	Input terminal of a clock for data shift to up-edge.
4	$\overline{\text{LATCH}}$	nput terminal of a data strobe. Latches passes data with "H" level input of $\overline{\text{LATCH}}$ -terminal, and hold data with "L" level input.
5~12	OUT0~7	Output terminals.
13	$\overline{\text{ENABLE}}$	Input terminal of output enable. All outputs (OUT0~7) do off with "H" level input of $\overline{\text{ENABLE}}$ -terminal, and do on with "L" level input.
14	SERIAL-OUT	Output terminal of serial-data for next SELIAL-IN terminal.
15	R-EXT	Input terminal of connects with a resistor for to set up all output current.
16	V <sub>DD</sub>	5V Supply voltage terminal

**TRUTH TABLE**

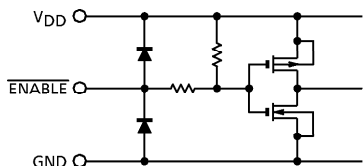
CLOCK	$\overline{\text{LATCH}}$	$\overline{\text{ENABLE}}$	SERIAL-IN	OUT0 ... OUT5 ... OUT7	SERIAL-OUT
UP	H	L	D <sub>n</sub>	D <sub>n</sub> ... D <sub>n-5</sub> ... D <sub>n-7</sub>	D <sub>n-7</sub>
UP	L	L	D <sub>n+1</sub>	No change	D <sub>n-6</sub>
UP	H	L	D <sub>n+2</sub>	D <sub>n+2</sub> ... D <sub>n-3</sub> ... D <sub>n-5</sub>	D <sub>n-5</sub>
DOWN	X	L	D <sub>n+3</sub>	D <sub>n+2</sub> ... D <sub>n-3</sub> ... D <sub>n-5</sub>	D <sub>n-5</sub>
DOWN	X	H	D <sub>n+3</sub>	Off	D <sub>n-5</sub>

(Note) OUT0~7 = on in case of D<sub>n</sub> = H level and OUT0~7 = off in case of D<sub>n</sub> = L level.

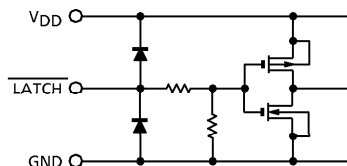
A resistor is connected with R-EXT and GND accompanied with outside, and it is necessary that a correct power supply voltage is supplied.

**EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS**

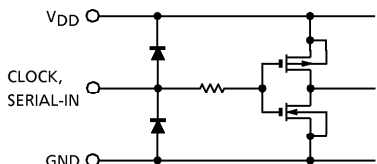
1.  $\overline{\text{ENABLE}}$  terminal



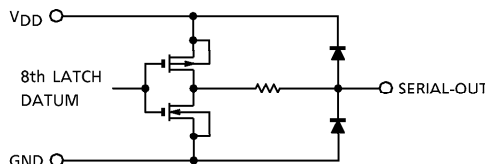
2.  $\overline{\text{LATCH}}$  terminal



3. CLOCK, SERIAL-IN terminal



4. SERIAL-OUT terminal



## MAXIMUM RATINGS (Ta = 25°C)

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

(Note) CP type : Ambient temperature delated above 25°C in the proportion of 11.8mW/°C

CF and CFN type : Ambient temperature delated above 25°C in the proportion of

6.3mW/°C

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

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

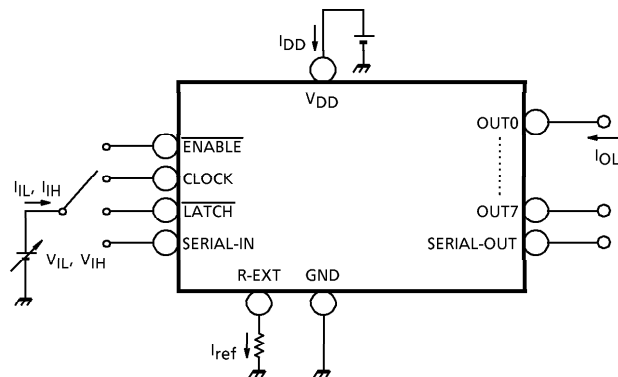
ELECTRICAL CHARACTERISTICS ( $V_{DD} = 5.0V$ ,  $T_a = 25^\circ C$  unless otherwise noted)

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		$I_{OH}$	—	$V_{OH} = 15.0V$	—	—	10	$\mu A$	
Output Voltage	S-OUT	$V_{OL}$	—	$I_{OL} = 1.0mA$	—	—	0.4	V	
		$V_{OH}$	—	$I_{OH} = -1.0mA$	4.6	—	—		
Output Current 1		$I_{OL1}$	—	$V_{CE} = 0.7V$	34.1	40.0	45.9	mA	
		$I_{OL2}$	—	$V_{CE} = 0.4V$					$R_{EXT} = 470\Omega$ (Include skew)
Current Skew		$\Delta I_{OL1}$	—	$I_O = 40mA$ , $V_{CE} = 0.4V$	$R_{EXT} = 470\Omega$	—	$\pm 1.5$	$\pm 6.0$	%
Output Current 2		$I_{OL3}$	—	$V_{CE} = 0.7V$	64.2	75.5	86.8	mA	
		$I_{OL4}$	—	$V_{CE} = 0.4V$					$R_{EXT} = 250\Omega$ (Include skew)
Current Skew		$\Delta I_{OL2}$	—	$I_O = 75mA$ , $V_{CE} = 0.7V$	$R_{EXT} = 250\Omega$	—	$\pm 1.5$	$\pm 6.0$	%
Supply Voltage Regulation		% / $V_{DD}$	—	$R_{EXT} = 470\Omega$ , $T_a = -40 \sim 85^\circ C$	—	1.5	5.0	% / V	
Pull-Up Resistor		$R_{IN (up)}$	—	—	150	300	600	$\Omega$	
Pull-Down Resistor		$R_{IN (down)}$	—	—	100	200	400	$\Omega$	
Supply Current	"OFF"	$I_{DD (off) 1}$	—	$R_{EXT} = OPEN$ , $OUT1 \sim 8 = off$	—	0.6	1.2	mA	
		$I_{DD (off) 2}$	—	$R_{EXT} = 470\Omega$ , $OUT1 \sim 8 = off$	3.5	5.8	8.0		
		$I_{DD (off) 3}$	—	$R_{EXT} = 250\Omega$ , $OUT1 \sim 8 = off$	6.5	10.7	15.0		
	"ON"	$I_{DD (on) 1}$	—	$R_{EXT} = 470\Omega$ , $OUT1 \sim 8 = on$	7.0	12.0	18.0		
		$I_{DD (on) 2}$	—	$R_{EXT} = 250\Omega$ , $OUT1 \sim 8 = on$	10.0	22.0	32.0		

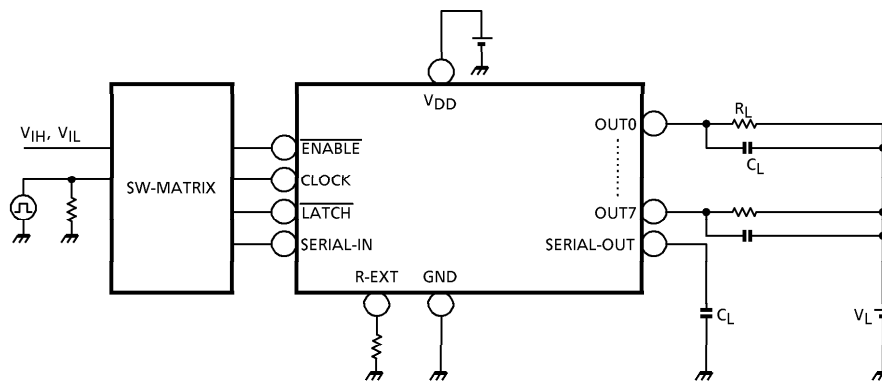
**SWITCHING CHARACTERISTICS** (Ta = 25°C unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time ("L" to "H")	SIN-OUTn	t <sub>pLH</sub>	—	V <sub>DD</sub> = 5.0V V <sub>CE</sub> = 0.4V V <sub>IH</sub> = V <sub>DD</sub> V <sub>IL</sub> = GND R <sub>EXT</sub> = 470Ω I <sub>OUT</sub> = 40mA V <sub>L</sub> = 3.0V R <sub>L</sub> = 65Ω C <sub>L</sub> = 10.5pF	—	1200	1500	ns
	LATCH-OUTn				—	1200	1500	
	ENABLE-OUTn				—	1200	1500	
	CLK-SOUT				—	30	70	
Propagation Delay Time ("H" to "L")	SIN-OUTn	t <sub>pHL</sub>	—		—	700	1000	ns
	LATCH-OUTn				—	700	1000	
	ENABLE-OUTn				—	700	1000	
	CLK-SOUT				—	30	70	
Pulse Width	CK	t <sub>w</sub> CLK	—		—	20	30	ns
	LATCH	t <sub>w</sub> LAT	—		—	10	25	
Set-Up Time for LATCH	L-H	t <sub>setup</sub>	—	—	25	50	ns	
	H-L			—	25	50		
Hold Time for LATCH	L-H	t <sub>hold</sub>	—	—	0	30	ns	
	H-L			—	0	30		
Maximum CLOCK Rise Time		t <sub>r</sub>	—	—	—	10	μs	
Maximum CLOCK Fall Time		t <sub>f</sub>	—	—	—	10	μs	
Output Rise Time		t <sub>or</sub>	—	—	300	600	1000	ns
Output Fall Time		t <sub>of</sub>	—	—	150	300	600	ns

**TEST CIRCUIT**  
DC characteristic



AC characteristic

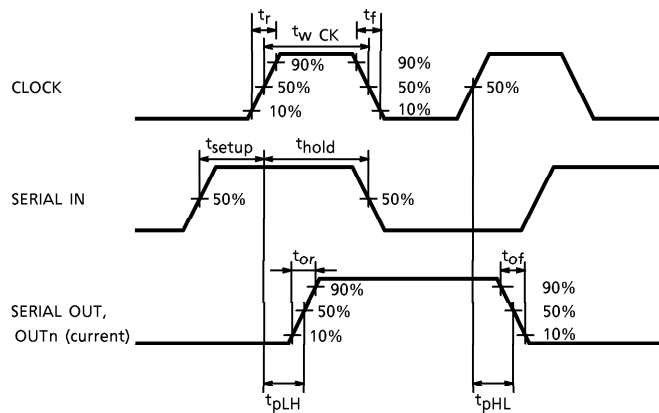


**PRECAUTIONS for USING**

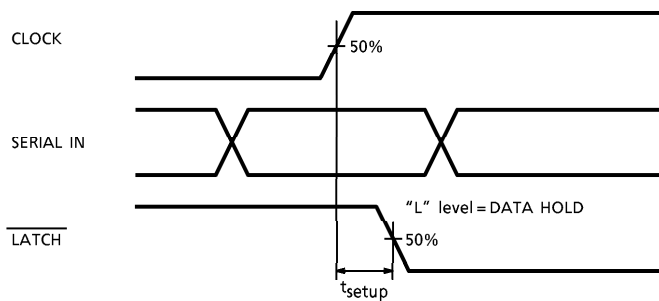
Utmost care is necessary in the design of the output line,  $V_{CC}$  ( $V_{DD}$ ) and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

TIMING WAVEFORM

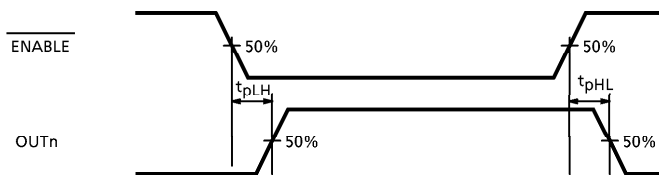
1. CLOCK-SERIAL OUT, OUTn



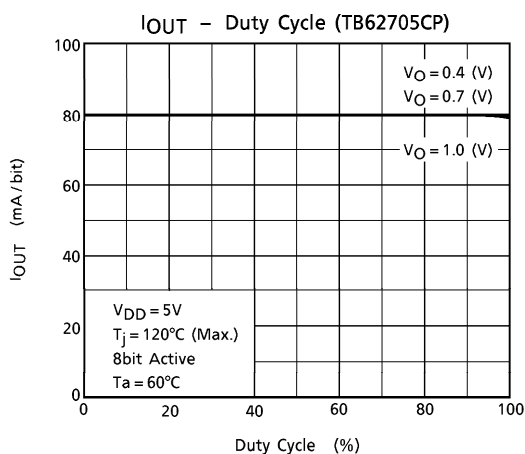
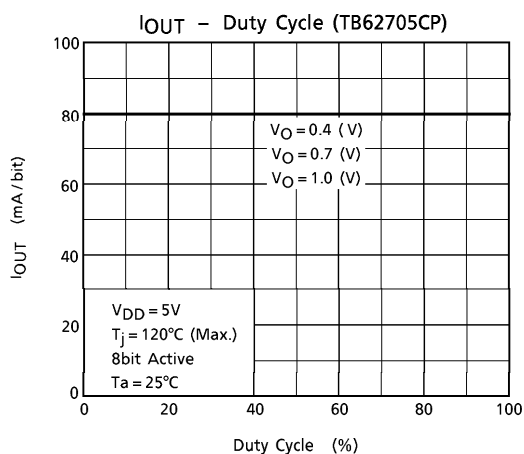
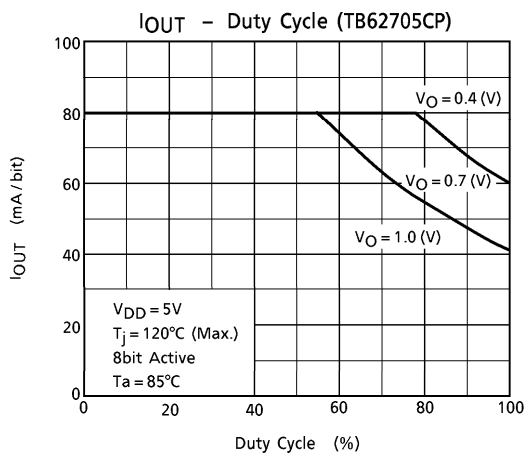
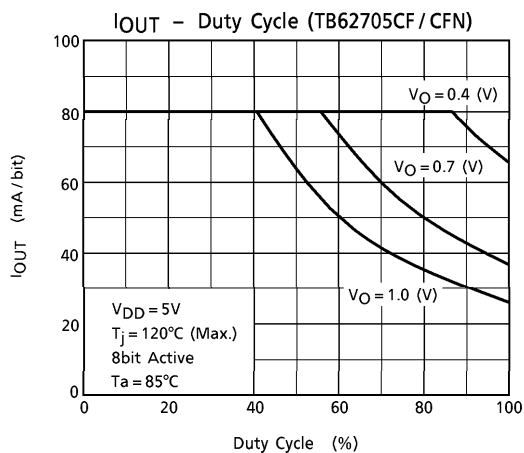
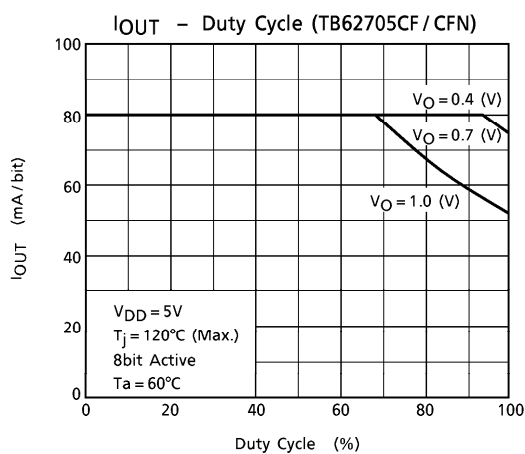
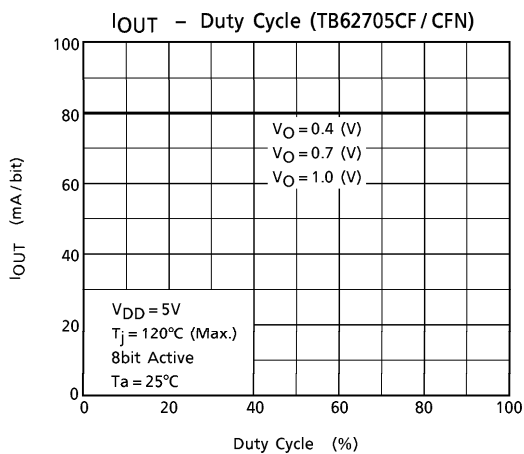
2. CLOCK-LATCH



3. ENABLE-OUTn







LED DRIVER TB6270X SERIES APPLICATION NOTE

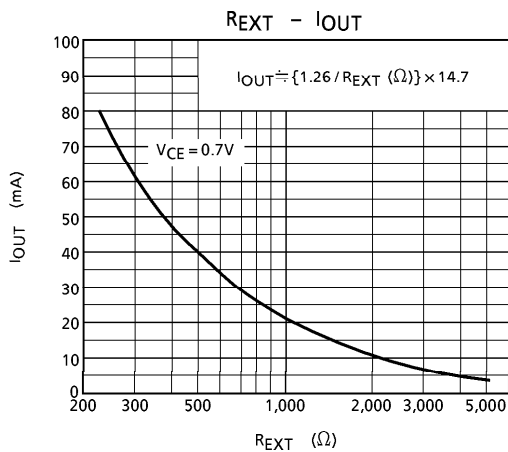
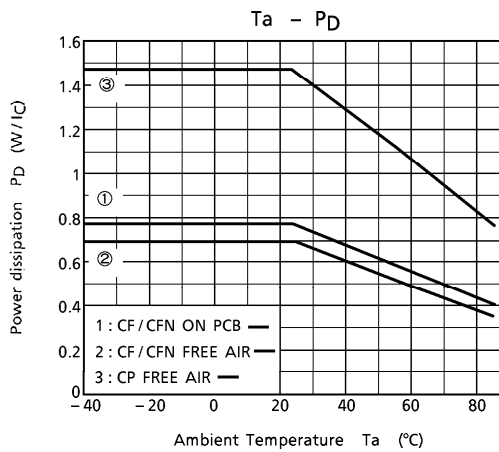


Fig. 1



[1] Output current ( $I_{OUT}$ )

$I_{OUT}$  is set by the external resistor (R-EXT) as shown in Fig1.

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

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

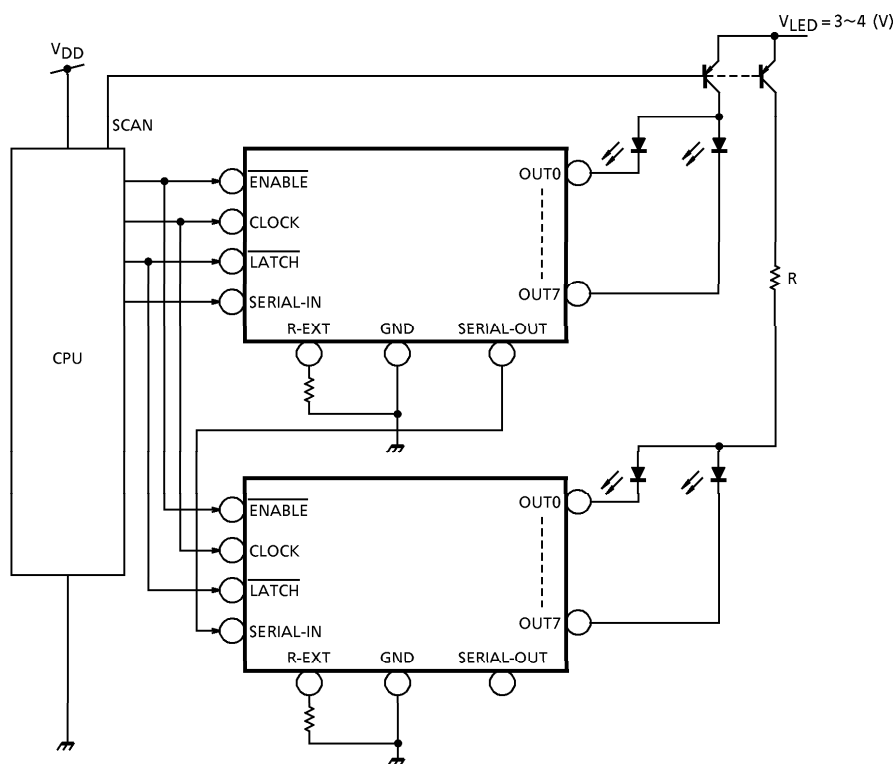
When a higher voltage is input to the device, the excess voltage is consumed inside the device, that leads to power dissipation.

In order to minimize power dissipation and loss, we would like to recommend to set the total supply voltage as shown below,

$$V_{LED} \text{ (total supply voltage)} = V_{CE} (T_r V_{sat}) + V_f \text{ (LED Forward voltage)} + V_O \text{ (I}_C \text{ supply voltage)}$$

When the total supply is too high considering the power dissipation of this device, an additional R can decrease the supply voltage ( $V_O$ ).

## PATTERN LAYOUT



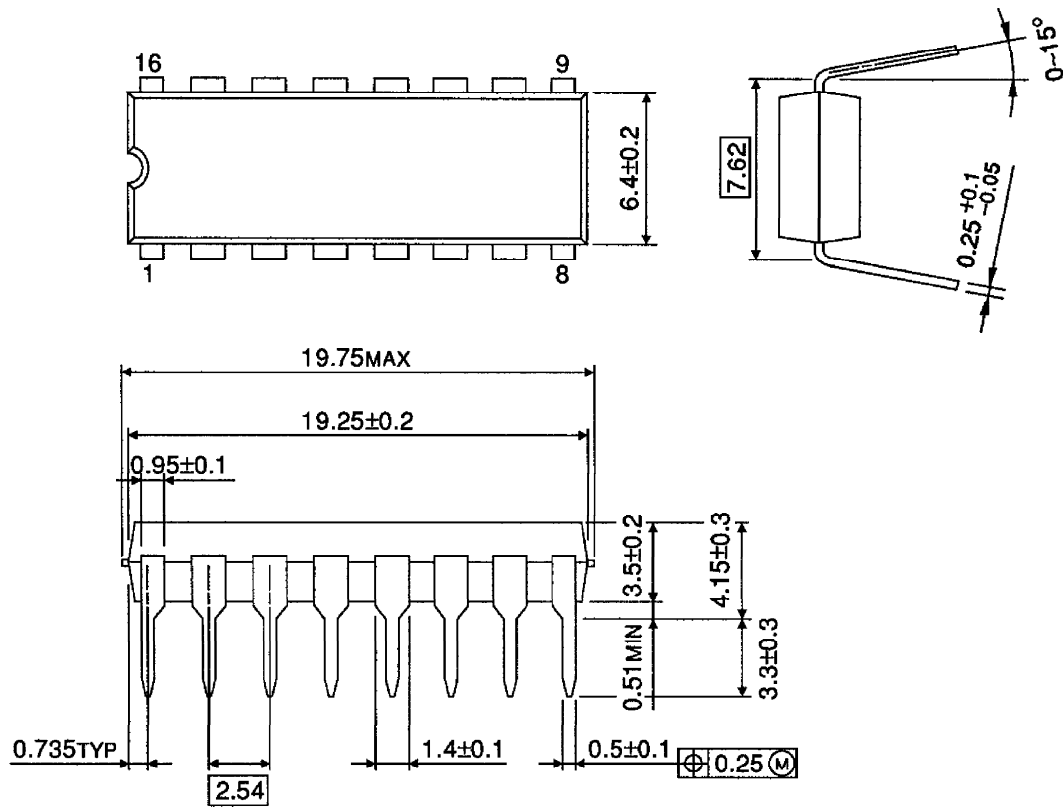
## [3] Pattern layout

This device owns only one ground pin that means signal ground pin and power ground pin are common.

If ground pattern layout contains large inductance and impedance, and the voltage between ground and LATCH, CLOCK terminals exceeds 2.5V by switching noise in operation, this device may miss-operate. So we would like you to pay attention to pattern layout to minimize inductance.

OUTLINE DRAWING  
DIP16-P-300-2.54A

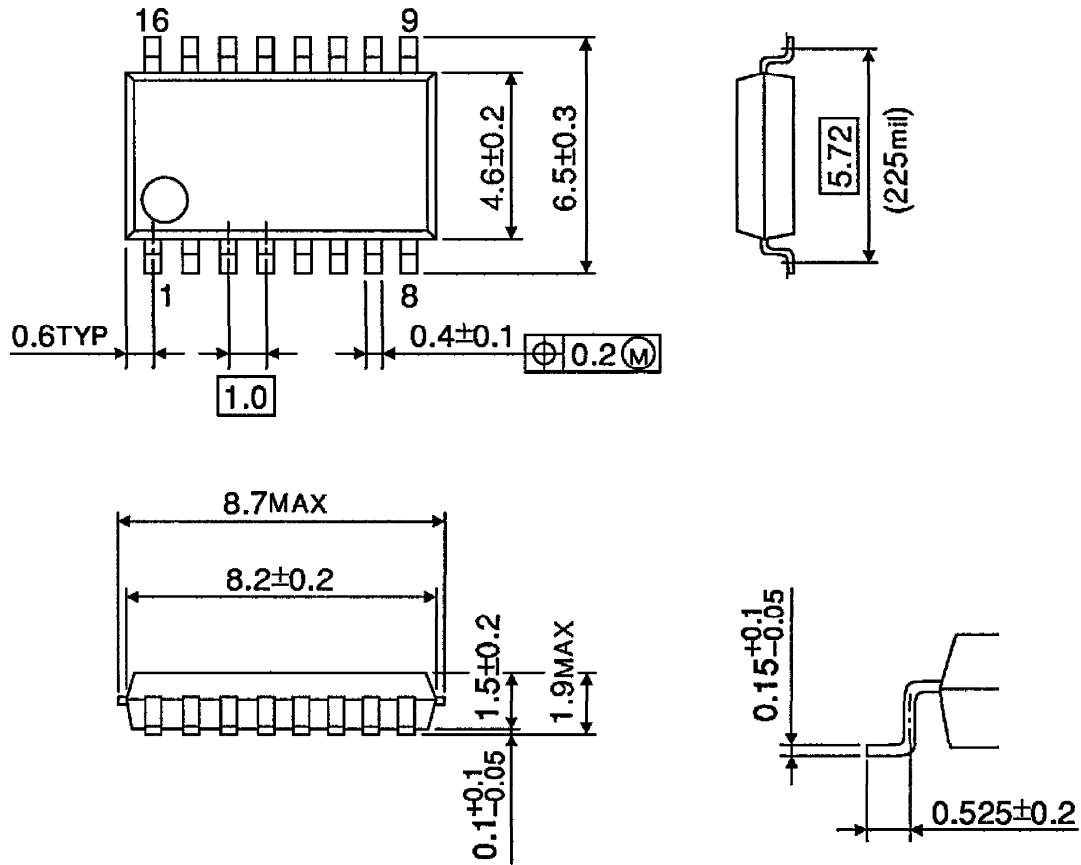
Unit : mm



Weight : 1.11g (Typ.)

**OUTLINE DRAWING**  
SSOP16-P-225-1.00A

Unit : mm

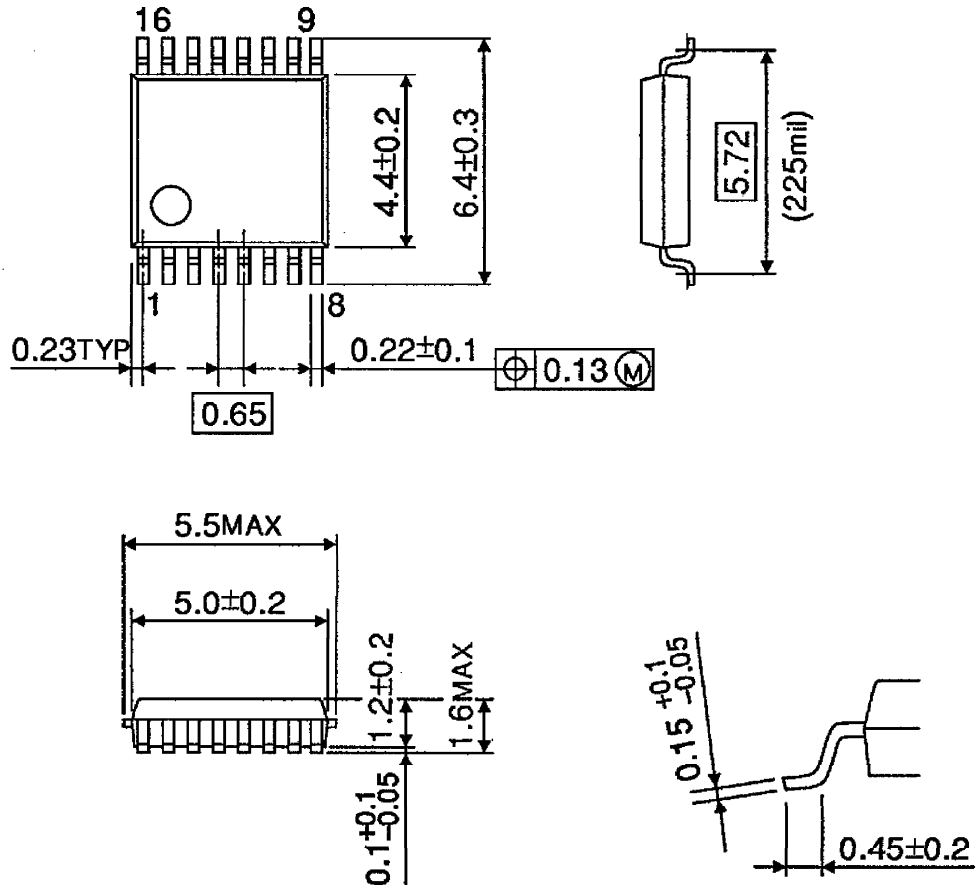


Weight : 0.14g (Typ.)

**OUTLINE DRAWING**

SSOP16-P-225-0.65B

Unit : mm



Weight : 0.07g (Typ.)