

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.

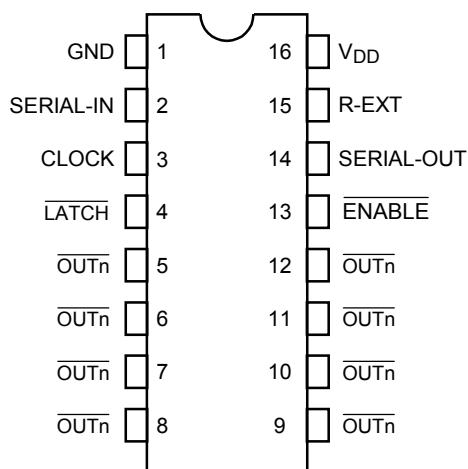
The devices consist of 8bit shift register, latch, AND-GATE & Constant Current Drivers.

FEATURES

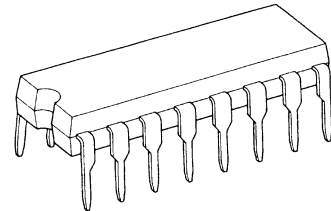
- Constant Current Output : current with one resistor for 5 to 90mA.
- Maximum Clock Frequency : $f_{CLK} = 15 \text{ (MHz)}$
(Cascade Connecte Operate, $T_{opr} = 25^\circ\text{C}$)
- 5V C-MOS Compatible Input
- Package : DIP16-P-300-2.54A (TB62705CP)
SSOP16-P-225-1.00A (TB62705CF)
SSOP16-P-225-0.65B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

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

PIN CONNECTION (Top view)

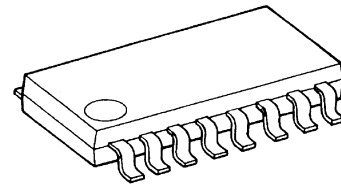


TB62705CP



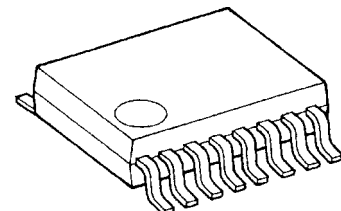
DIP16-P-300-2.54A

TB62705CF



SSOP16-P-225-1.00A

TB62705CFN

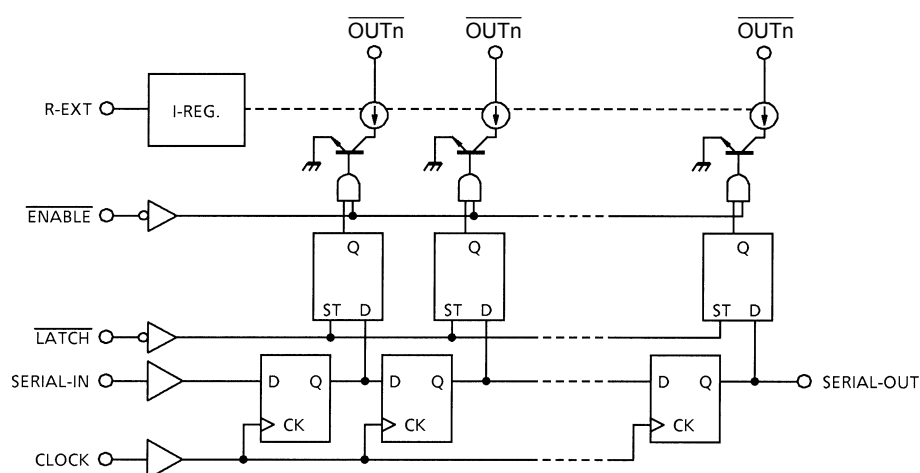


SSOP16-P-225-0.65B

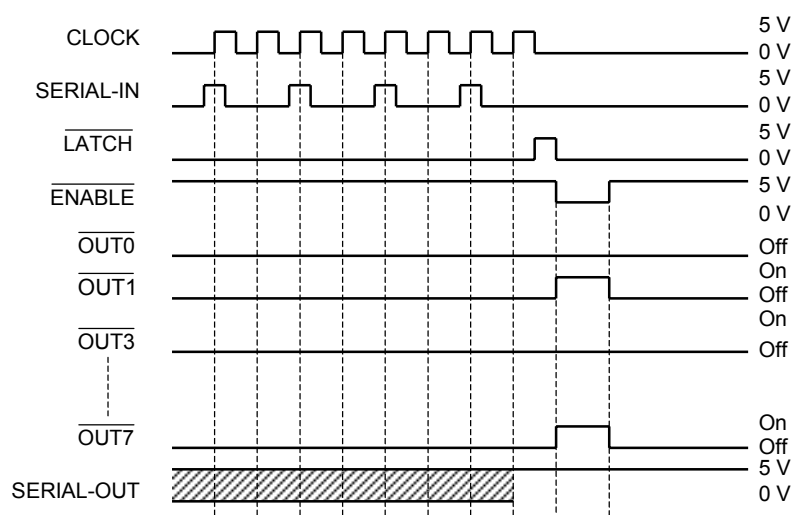
Weight

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.)

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 ($\overline{\text{OUTn}}$) do off.

TERMINAL DISCRIPTION

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	$\overline{\text{LATCH}}$	Input 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	$\overline{\text{OUTn}}$	Output terminals.
13	$\overline{\text{ENABLE}}$	Input terminal of output enable. All outputs ($\overline{\text{OUTn}}$) 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 SERIAL-IN terminal.
15	R-EXT	Input terminal of connects with a resister for to set up all output current.
16	V _{DD}	5V Supply voltage terminal

TRUTH TABLE

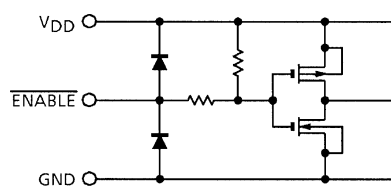
CLOCK	$\overline{\text{LATCH}}$	$\overline{\text{ENABLE}}$	SERIAL-IN	$\overline{\text{OUTn}}$	SERIAL-OUT
UP	H	L	D _n	D _n ... D _{n-5} ... D _{n-7}	D _{n-7}
UP	L	L	D _{n+1}	No change	D _{n-6}
UP	H	L	D _{n+2}	D _{n+2} ... D _{n-3} ... D _{n-5}	D _{n-5}
DOWN	X	L	D _{n+3}	D _{n+2} ... D _{n-3} ... D _{n-5}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

Note: $\overline{\text{OUTn}}$ = on in case of D_n = H level and $\overline{\text{OUTn}}$ = off in case of D_n = L level.

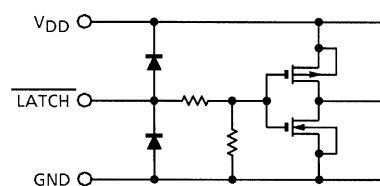
A resistor is connected with R-EXT and GND accompanied with outside, and it is necessary that a correct power supply voltage is supplied.

EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS

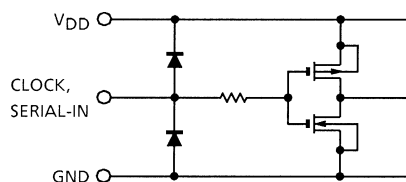
1. $\overline{\text{ENABLE}}$ terminal



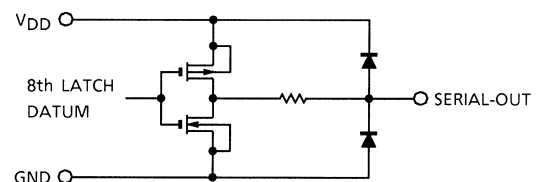
2. $\overline{\text{LATCH}}$ terminal



3. CLOCK, SERIAL-IN terminal



4. SERIAL-OUT terminal



MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V _{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 _{CE}	-0.5~17.0	V
Clock Frequency	f _{CK}	15	MHz
GND Terminal Current	I _{GND}	720	mA
Power Dissipation	P _D	1.47 (CP-type : FREE AIR, Ta = 25°C)	W
		0.78 (CF / CFN-type : ON PCB, Ta = 25°C)	
Thermal Resistance	R _{th(j-a)}	85 (CP-type : FREE AIR, Ta = 25°C)	°C / W
		160 (CF / CFN-type : ON PCB, Ta = 25°C)	
Operating Temperature	T _{opr}	-40~85	°C
Storage Temperature	T _{stg}	-55~150	°C

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

CF and CFN type : Ambient temperature delated above 25°C in the proportion of 6.3 mW / °C

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

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	$\overline{\text{OUTn}}$, 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 (CP-type FREE AIR)	—	—	0.82	W
		Ta = 85°C (CF / CFN-type ON PCB)	—	—	0.40	

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

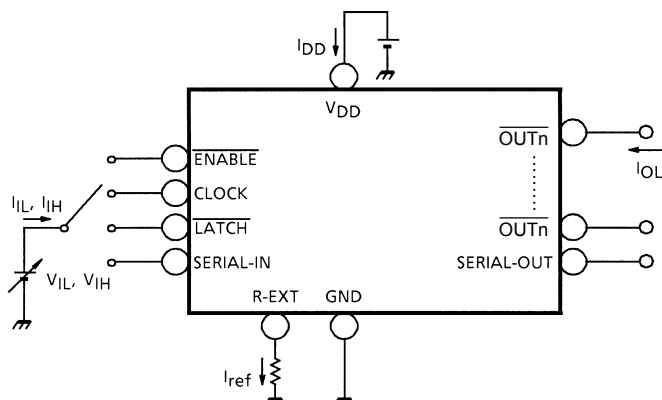
CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	CONDITION		MIN	TYP.	MAX	UNIT
Input Voltage	"H" Level	V _{IH}	—	—		0.7 V _{DD}	—	V _{DD}	V
	"L" Level	V _{IL}	—	—		GND	—	0.3 V _{DD}	
Output Leakage Current		I _{OH}	—	V _{OH} = 15.0 V		—	—	10	μA
Output Voltage	S-OUT	V _{OL}	—	I _{OL} = 1.0 mA		—	—	0.4	V
		V _{OH}	—	I _{OH} = -1.0 mA		4.6	—	—	
Output Current 1		I _{OL1}	—	V _{CE} = 0.7 V	R _{EXT} = 470 Ω (Include skew)	34.1	40.0	45.9	mA
		I _{OL2}	—	V _{CE} = 0.4 V		33.7	39.5	45.3	
	Current Skew	ΔI _{OL1}	—	I _O = 40 mA, V _{CE} = 0.4 V	R _{EXT} = 470 Ω	—	±1.5	±6.0	%
Output Current 2		I _{OL3}	—	V _{CE} = 1.0 V	R _{EXT} = 250 Ω (Include skew)	64.2	75.5	86.8	mA
		I _{OL4}	—	V _{CE} = 0.7 V		63.8	75.0	86.2	
	Current Skew	ΔI _{OL2}	—	I _O = 75 mA, V _{CE} = 0.7 V	R _{EXT} = 250 Ω	—	±1.5	±6.0	%
Supply Voltage Regulation		% / V _{DD}	—	R _{EXT} = 470 Ω, Ta = -40~85°C		—	1.5	5.0	% / V
Pull-Up Resistor		R _{IN} (up)	—	—		150	300	600	Ω
Pull-Down Resistor		R _{IN} (down)	—	—		100	200	400	Ω
Supply Current	"OFF"	I _{DD} (off) 1	—	R _{EXT} = OPEN, $\overline{\text{OUT0}} \sim \overline{7}$ = off		—	0.6	1.2	mA
		I _{DD} (off) 2	—	R _{EXT} = 470 Ω, $\overline{\text{OUT0}} \sim \overline{7}$ = off		3.5	5.8	8.0	
		I _{DD} (off) 3	—	R _{EXT} = 250 Ω, $\overline{\text{OUT0}} \sim \overline{7}$ = off		6.5	10.7	15.0	
	"ON"	I _{DD} (on) 1	—	R _{EXT} = 470 Ω, $\overline{\text{OUT0}} \sim \overline{7}$ = on		7.0	12.0	18.0	
		I _{DD} (on) 2	—	R _{EXT} = 250 Ω, $\overline{\text{OUT0}} \sim \overline{7}$ = on		10.0	22.0	32.0	

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

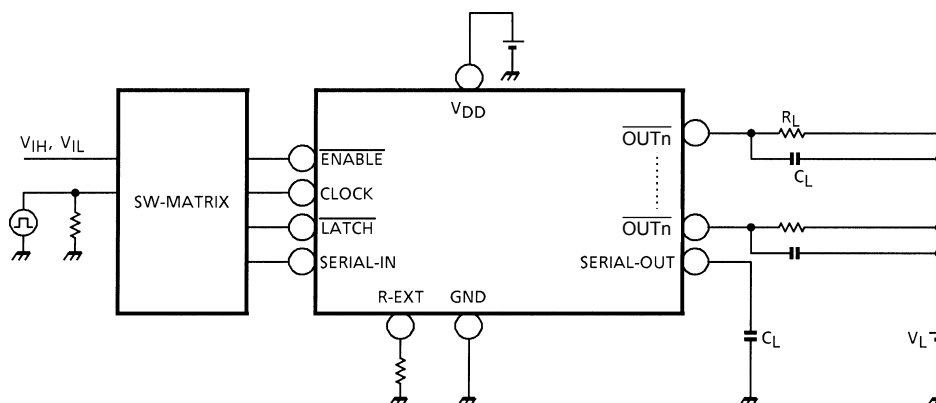
CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	CONDITION	MIN	TYP.	MAX	UNIT
Propagation Delay Time ("L" to "H")	SIN- $\overline{\text{OUTn}}$	t_{pLH}	—	$V_{\text{DD}} = 5.0 \text{ V}$ $V_{\text{CE}} = 0.4 \text{ V}$ $V_{\text{IH}} = V_{\text{DD}}$ $V_{\text{IL}} = \text{GND}$ $R_{\text{EXT}} = 470 \text{ }\Omega$ $I_{\text{OUT}} = 40 \text{ mA}$ $V_{\text{L}} = 3.0 \text{ V}$ $R_{\text{L}} = 65 \text{ }\Omega$ $C_{\text{L}} = 10.5 \text{ pF}$	—	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	$t_{\text{w CLK}}$	—		—	20	30	ns
	LATCH	$t_{\text{w LAT}}$	—		—	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 characteristic



AC characteristic

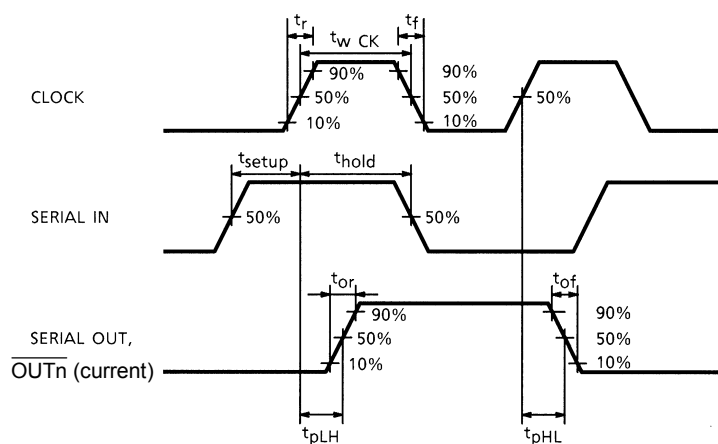


PRECAUTIONS for USING

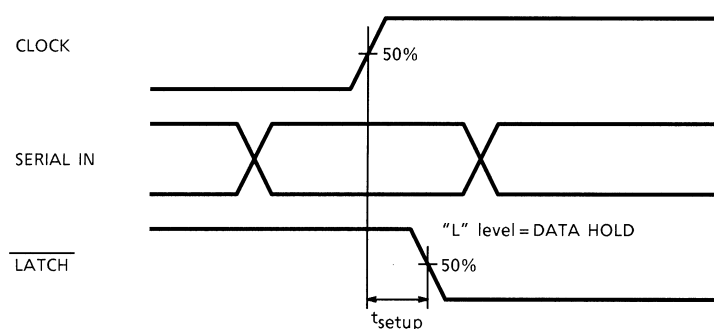
Utmost care is necessary in the design of the output line, VCC (VDD) and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

TIMING WAVEFORM

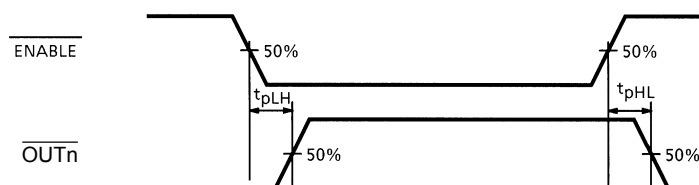
1. CLOCK-SERIAL OUT, $\overline{\text{OUTn}}$

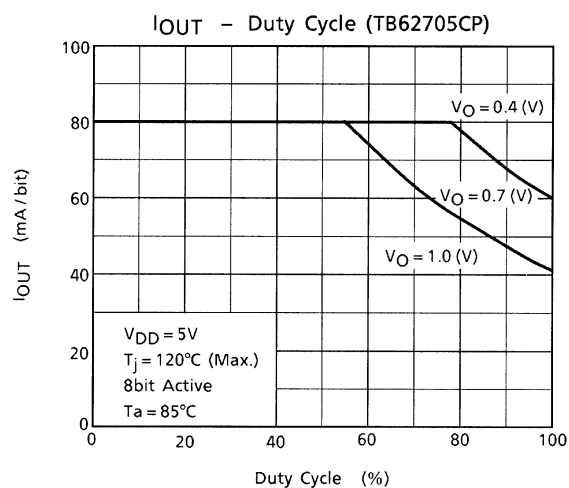
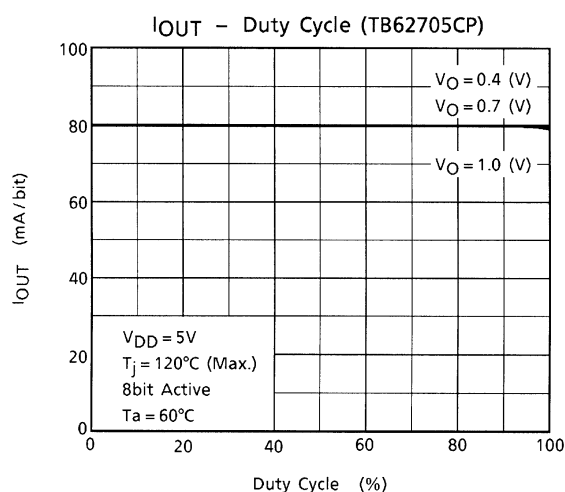
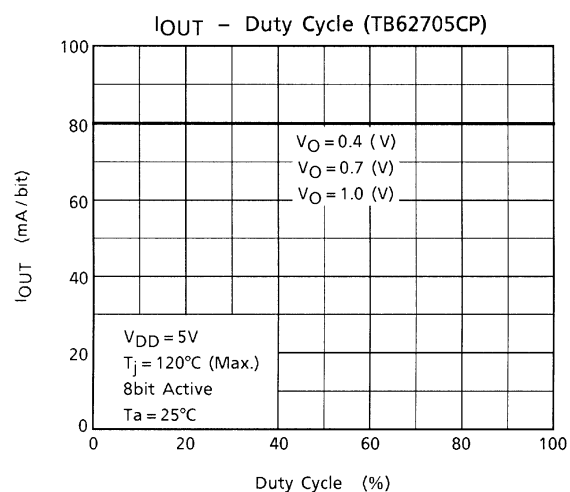
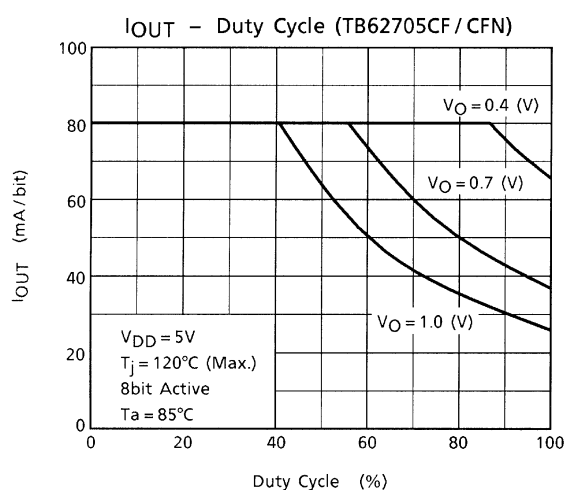
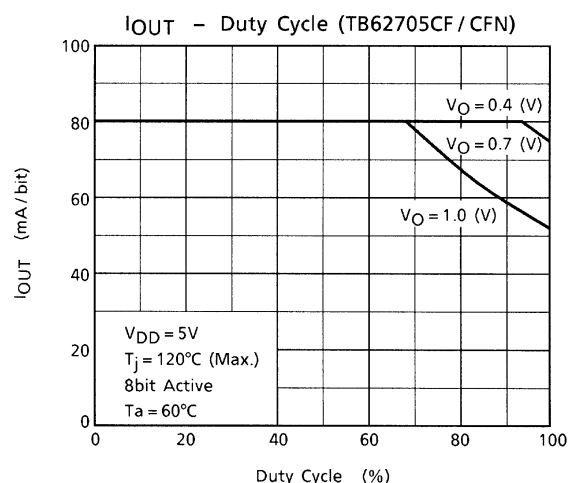
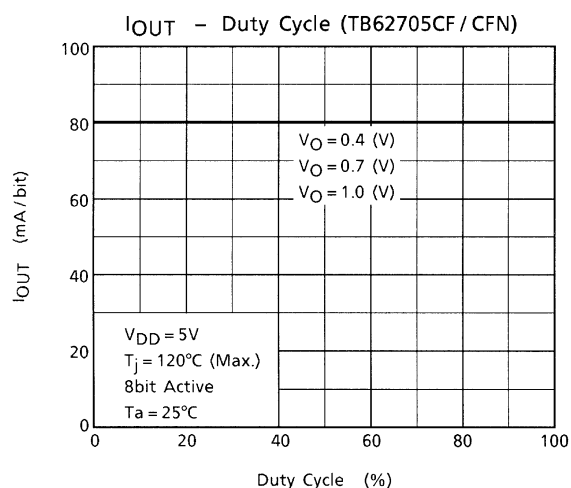


2. CLOCK-LATCH



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





LED DRIVER TB6270X SERIES APPLICATION NOTE

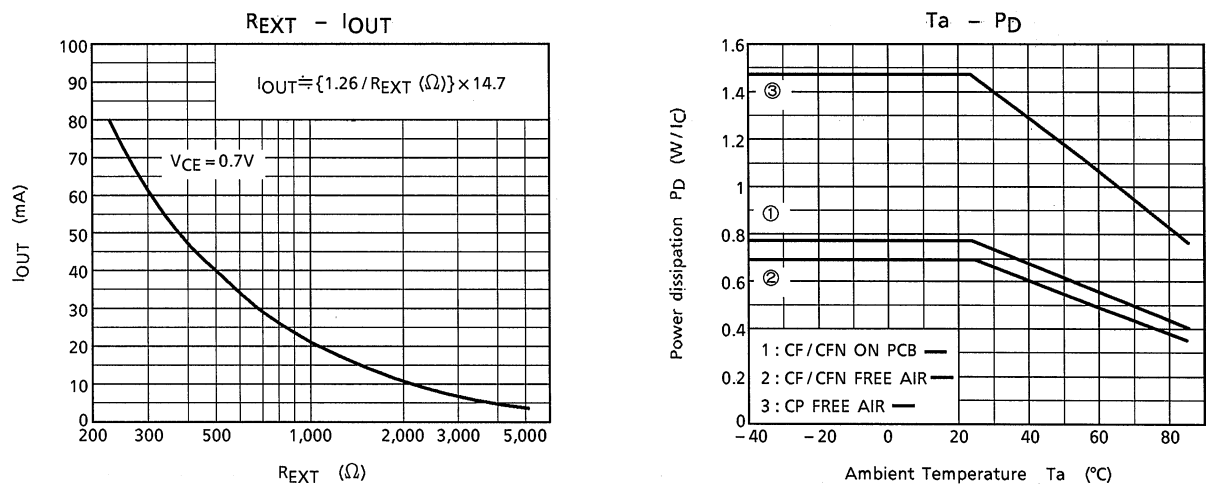


Fig. 1

[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).

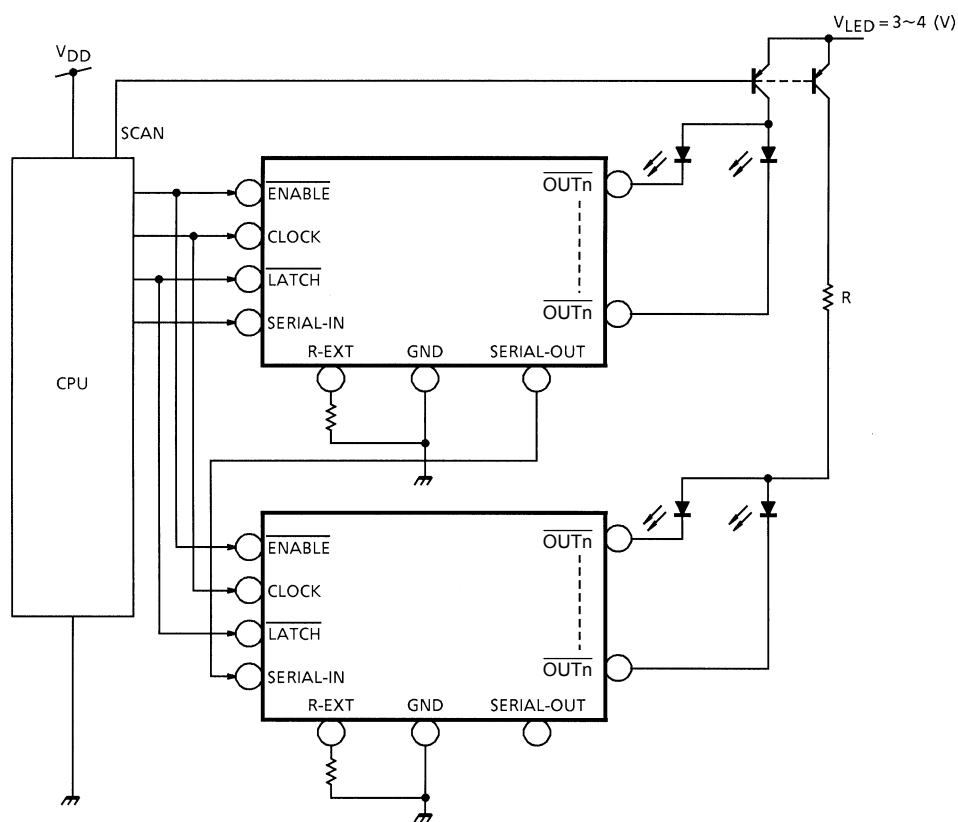
When a higher voltage is input to the device, the excess voltage is consumed inside the device, that leads to power dissipation.

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

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

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

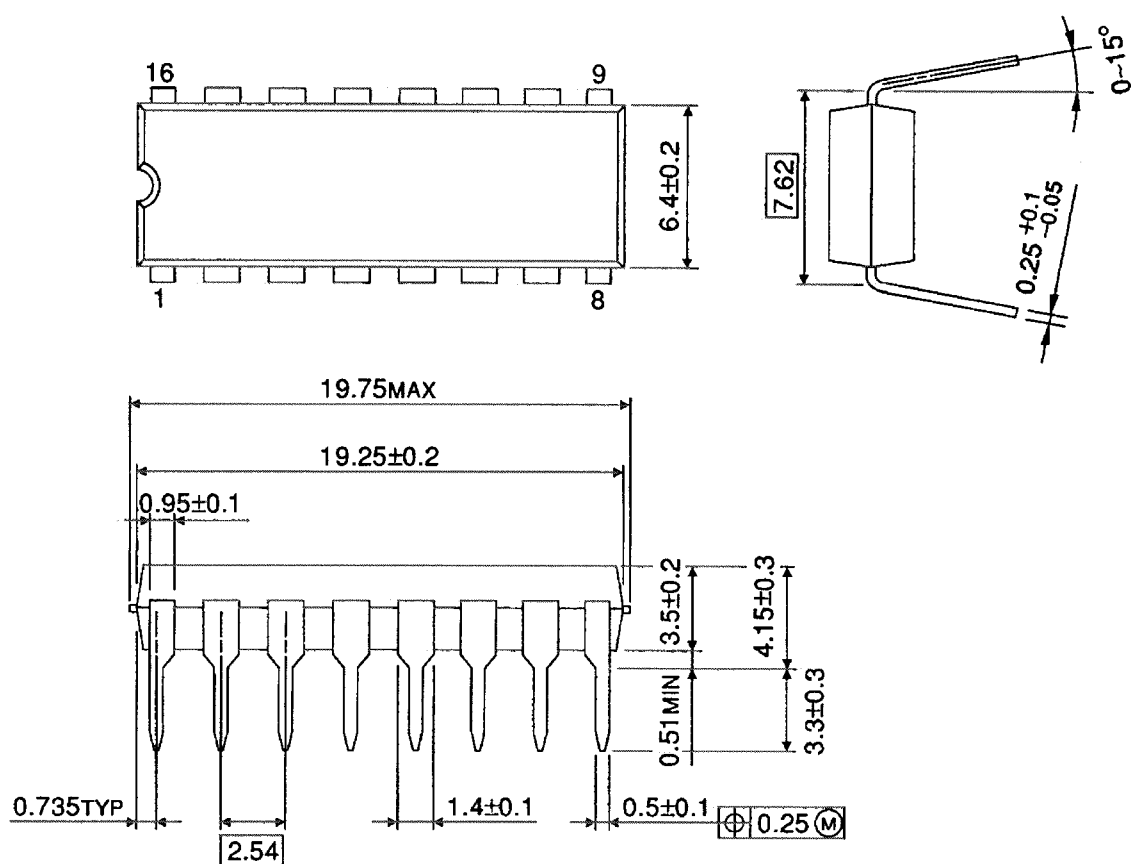
This device owns only one ground pin that means signal ground pin and power ground pin are common.

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

PACKAGE DIMENSIONS

DIP16-P-300-2.54A

Unit : mm

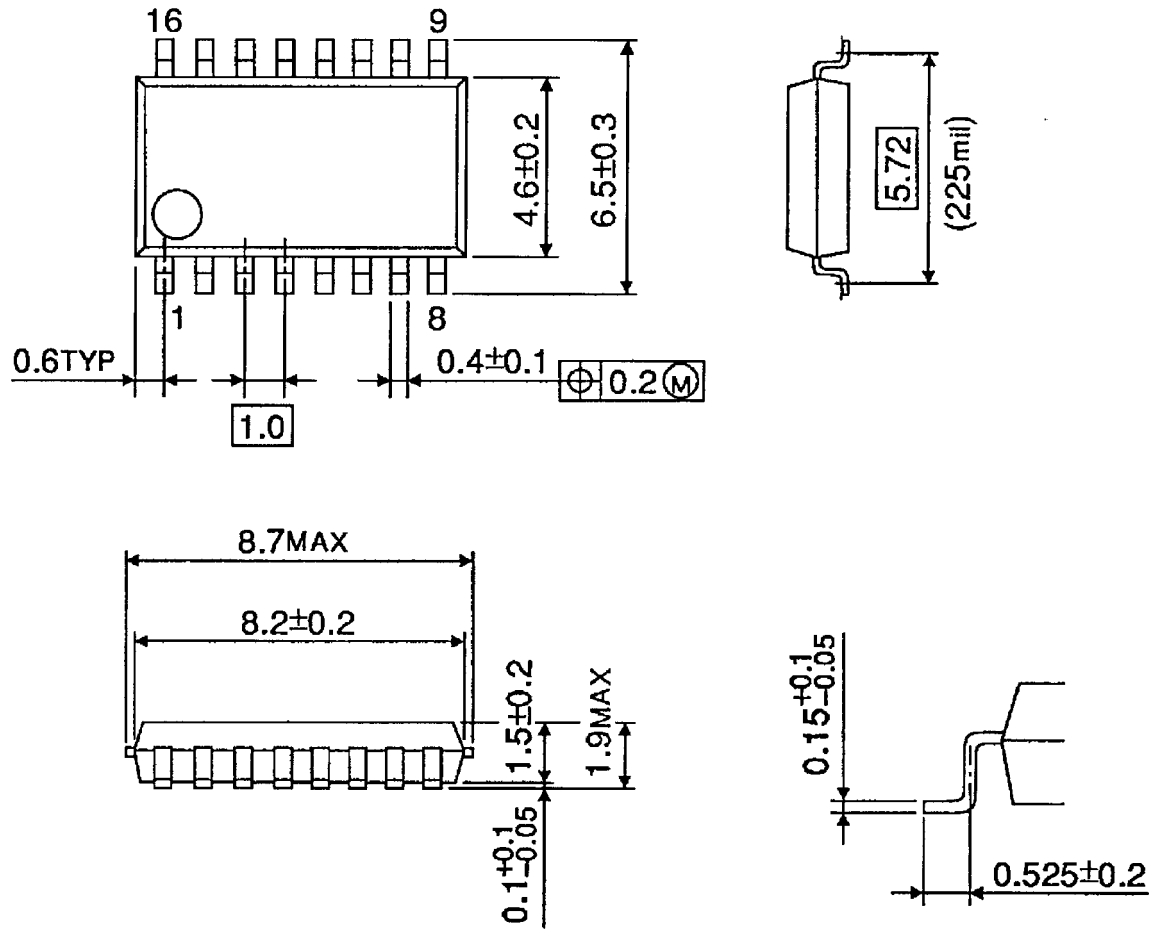


Weight: 1.11 g (Typ.)

PACKAGE DIMENSIONS

SSOP16-P-225-1.00A

Unit : mm

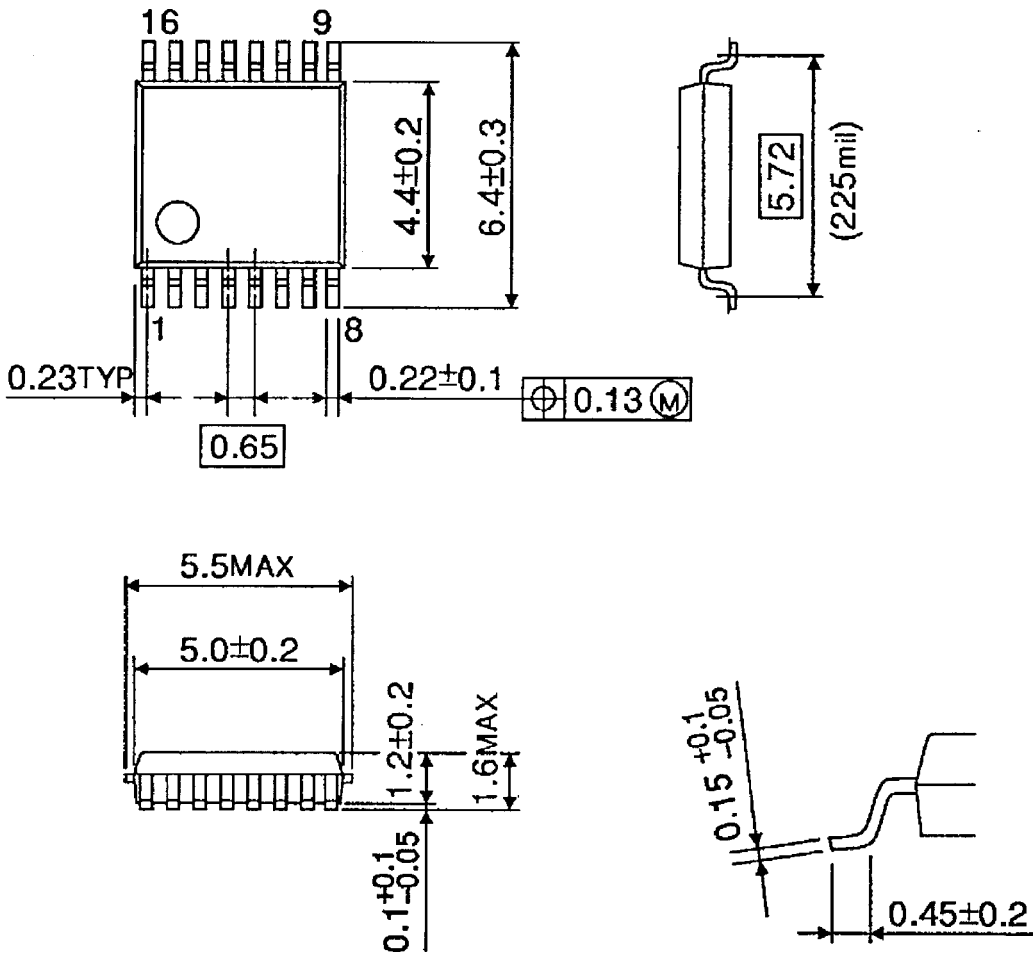


Weight: 0.14 g (Typ.)

PACKAGE DIMENSIONS

SSOP16-P-225-0.65B

Unit : mm



Weight: 0.07 g (Typ.)

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.