

TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB62706BN, TB62706BF

16BIT SHIFT REGISTER, LATCHES & CONSTANT CURRENT DRIVERS

The TB62706BN, TB62706BF is specifically designed for LED and LED DISPLAY constant current drivers.

This constant current output circuits is able to set up external resistor ($I_{OUT} = 5 \sim 90 \text{ mA}$). (Note)

This IC is monolithic integrated circuit designed to be used together with Bi-CMOS process.

The devices consist of 16bit shift register, latch, AND-GATE and Constant Current Drivers.

FEATURES

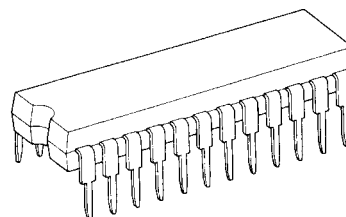
- Constant Current Output : Can set up all output current with one resistor for 5 to 90 mA.
- Maximum Clock Frequency : $f_{CLK} = 15 \text{ (MHz)}$ (Cascade Connected Operate, $T_{opr} = 25^\circ\text{C}$)
- 5 V C-MOS Compatible Input
- Package : SDIP24-P-300-1.78~1.778mmPitch~ (TB62706BN)
SSOP24-P-300-1.00B~1.0mmPitch~ (TB62706BF)
- Constant Output Current Matchong:

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

(Note)

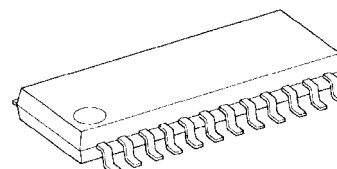
Note: TB62706BF can be used under limited P_D
($P_D \leq 1.04 \text{ W}$, with PCB)

TB62706BN



SDIP24-P-300-1.78

TB62706BF



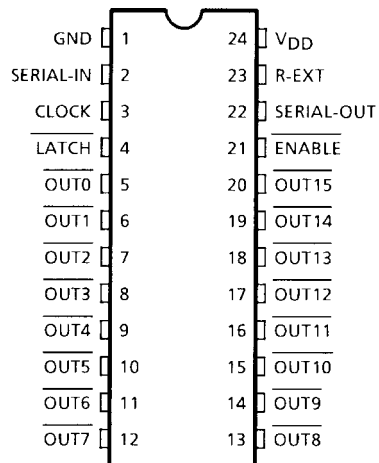
SSOP24-P-300-1.00B

Weight

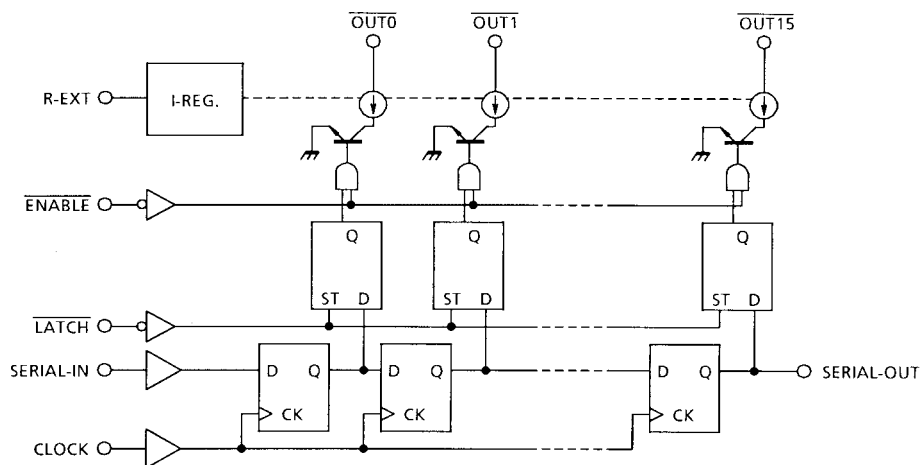
SDIP24-P-300-1.78 : 1.22 g (typ.)

SSOP24-P-300-1.00B : 0.32 g (typ.)

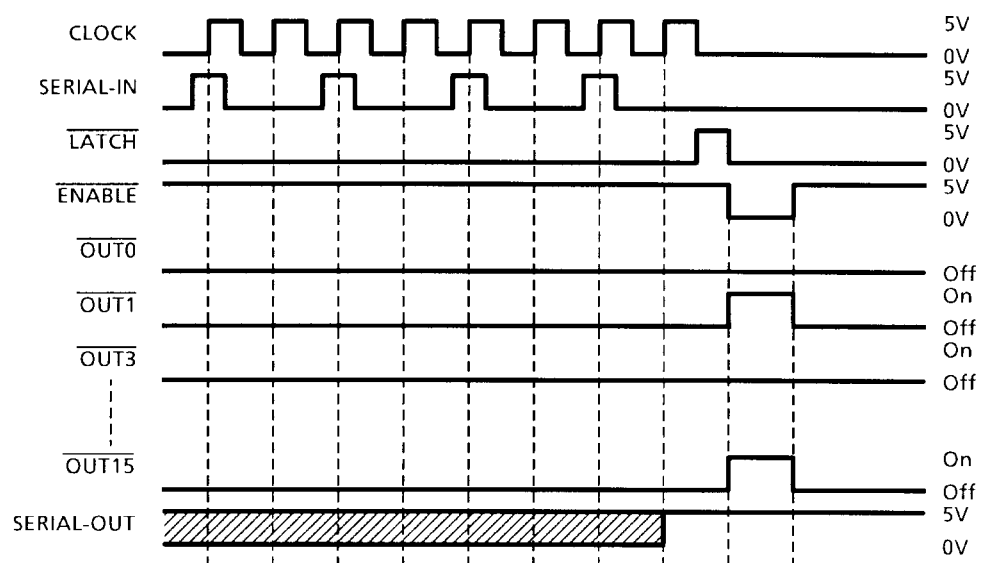
PIN CONNECTION (Top view)



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 (OUT0~15) 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.
5~20	$\overline{\text{OUT0}} \sim \overline{\text{OUT15}}$	Output terminals.
21	$\overline{\text{ENABLE}}$	Input terminal of output enable. All outputs ($\overline{\text{OUT0}} \sim \overline{\text{OUT15}}$) do off with "H" level input of $\overline{\text{ENABLE}}$ -terminal, and do on with "L" level input.
22	SERIAL-OUT	Output terminal of a serial-data for next SERIAL-IN terminal.
23	R-EXT	Input terminal of connects with a resistor for to set up all output current.
24	V_{DD}	5 V Supply voltage terminal.

TRUTH TABLE

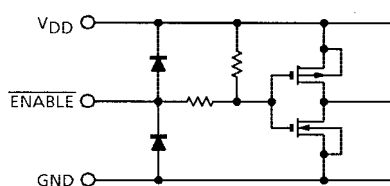
CLOCK	$\overline{\text{LATCH}}$	$\overline{\text{ENABLE}}$	SERIAL-IN	$\overline{\text{OUT0}} \dots \overline{\text{OUT7}} \dots \overline{\text{OUT15}}$	SERIAL-OUT
UP	H	L	D_n	$D_n \dots D_{n-7} \dots D_{n-15}$	D_{n-15}
UP	L	L	D_{n+1}	No change	D_{n-14}
UP	H	L	D_{n+2}	$D_{n+2} \dots D_{n-5} \dots D_{n-13}$	D_{n-13}
DOWN	X	L	D_{n+3}	$D_{n+2} \dots D_{n-5} \dots D_{n-13}$	D_{n-13}
DOWN	X	H	D_{n+3}	Off	D_{n-13}

Note: $\overline{\text{OUT0}} \sim \overline{\text{OUT15}}$ = on in case of $D_n = \text{H level}$ and $\overline{\text{OUT0}} \sim \overline{\text{OUT15}}$ = off in case of $D_n = \text{L level}$.

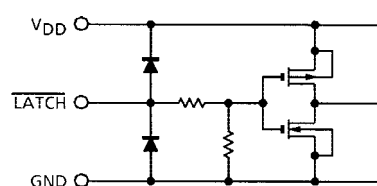
A resistor is connected with R-EXT and GND accompanied with outside, and it is necessary that a correct power supply voltage is supplied.

EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS

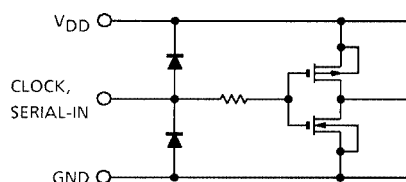
1. $\overline{\text{ENABLE}}$ terminal



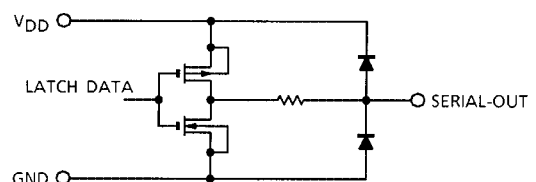
2. $\overline{\text{LATCH}}$ terminal



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 _{OUT}	-0.5~17.0	V
Clock Frequency	f _{CK}	15	MHz
GND Terminal Current	I _{GND}	1440	mA
Power Dissipation	P _D	1.78 (BN-type : ON PCB, Ta = 25°C)	W
		1.00 (BF-type : ON PCB, Ta = 25°C)	
Thermal Resistance	R _{th (j-a)}	BN : 70 (BN-type : ON PCB)	°C / W
		BF : 120 (BF-type : ON PCB)	
Operating Temperature	T _{opr}	-40~85	°C
Storage Temperature	T _{stg}	-55~150	°C

Note: BN-type : Ambient temperature delated above 25°C in the proportion of 14.2 mW / °C

BF-type : Ambient temperature delated above 25°C in the proportion of 8.3 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	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}	
$\overline{\text{LATCH}}$ Pulse Width	t _w $\overline{\text{LAT}}$	V _{DD} = 4.5~5.5 V	100	—	—	ns
CLOCK Pulse Width	t _w CLK		50	—	—	ns
$\overline{\text{ENABLE}}$ Pulse Width	t _w $\overline{\text{EN}}$		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 $\overline{\text{LATCH}}$	t _{setup} (L)		100	—	—	ns
Hold Time for $\overline{\text{LATCH}}$	t _{hold} (L)		60	—	—	ns
Clock Frequency	f _{CLK}	Cascade operation	—	—	10.0	MHz
Power Dissipation	P _D	Ta = 85°C (BN-type)	—	—	0.92	W
		Ta = 85°C (BF-type)	—	—	0.50	

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

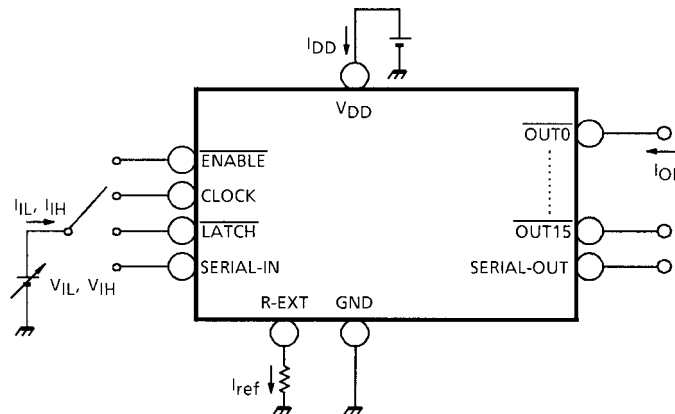
CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	CONDITION		MIN	TYP.	MAX	UNIT
Input Voltage	"H" Level	V _{IH}	—	Ta = -40~85°C		0.7 V _{DD}	—	V _{DD}	V
	"L" Level	V _{IL}	—	Ta = -40~85°C		GND	—	0.3 V _{DD}	
Output Leakage Current		I _{OH}	—	V _{OH} = 15.0 V		—	—	10	μA
Output Voltage	SERIAL-OUT	V _{OL}	—	I _{OL} = 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 current matching)	34.1	40.0	45.9	mA
		I _{OL2}	—	V _{CE} = 0.4 V		33.7	39.5	45.3	
	Current Skew	Δ I _{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 current matching)	64.2	75.5	86.8	mA
		I _{OL4}	—	V _{CE} = 0.7 V		63.8	75.0	86.2	
	Current Skew	Δ I _{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, OUT0 ~ 15 = off		—	0.6	1.2	mA
		I _{DD} (off) 2	—	R _{EXT} = 470 Ω, $\overline{\text{OUT0}} \sim \overline{15}$ = off		3.5	5.8	8.0	
		I _{DD} (off) 3	—	R _{EXT} = 250 Ω, $\overline{\text{OUT0}} \sim \overline{15}$ = off		6.5	10.7	15.0	
	"ON"	I _{DD} (on) 1	—	R _{EXT} = 470 Ω, $\overline{\text{OUT0}} \sim \overline{15}$ = on		10.0	16.0	22.0	
		I _{DD} (on) 2	—	R _{EXT} = 250 Ω, $\overline{\text{OUT0}} \sim \overline{15}$ = on		18.0	28.3	38.5	

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

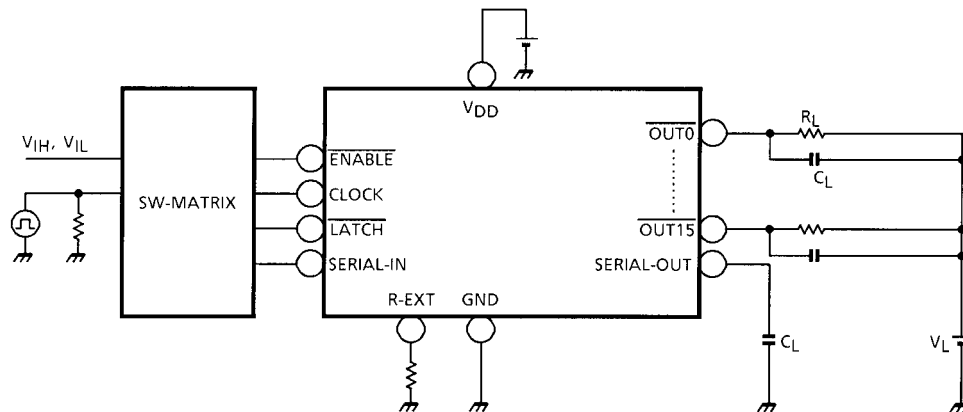
CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	CONDITION	MIN	TYP.	MAX	UNIT
Propagation Delay Time ("L" to "H")	CLK- $\overline{\text{OUTn}}$	t_{pLH}	—	$V_{\text{DD}} = 5.0 \text{ V}$ $V_{\text{CE}} = 0.4 \text{ V}$ $V_{\text{IH}} = V_{\text{DD}}$ $V_{\text{IL}} = \text{GND}$ $R_{\text{EXT}} = 470 \text{ }\Omega$ $V_{\text{L}} = 3.0 \text{ V}$ $R_{\text{L}} = 65 \text{ }\Omega$ $C_{\text{L}} = 10.5 \text{ pF}$	—	1200	1500	ns
	$\overline{\text{LATCH}} - \overline{\text{OUTn}}$				—	1200	1500	
	$\overline{\text{ENABLE}} - \overline{\text{OUTn}}$				—	1200	1500	
	CLK-SOUT				15	30	70	
Propagation Delay Time ("H" to "L")	CLK- $\overline{\text{OUTn}}$	t_{pHL}	—		—	700	1000	ns
	$\overline{\text{LATCH}} - \overline{\text{OUTn}}$				—	700	1000	
	$\overline{\text{ENABLE}} - \overline{\text{OUTn}}$				—	700	1000	
	CLK-SOUT				15	30	70	
Pulse Width	CLK	$t_{\text{w CLK}}$	—		—	20	30	ns
	$\overline{\text{LATCH}}$	$t_{\text{w LAT}}$	—		—	10	25	ns
Set-up Time	L-H	$t_{\text{setup (L)}}$	—		—	25	50	ns
	H-L	$t_{\text{setup (C)}}$			—	25	50	ns
Hold Time	L-H	$t_{\text{hold (L)}}$	—		—	0	15	ns
	H-L	$t_{\text{hold (C)}}$			—	0	15	ns
Maximum CLOCK Rise Time		t_{r}	—		—	—	10	μs
Maximum CLOCK Fall Time		t_{f}	—		—	—	10	μs
Output Rise Time		t_{or}	—	150	300	600	ns	
Output Fall Time		t_{of}	—	150	300	600	ns	

TEST CIRCUIT

DC characteristic



AC characteristic

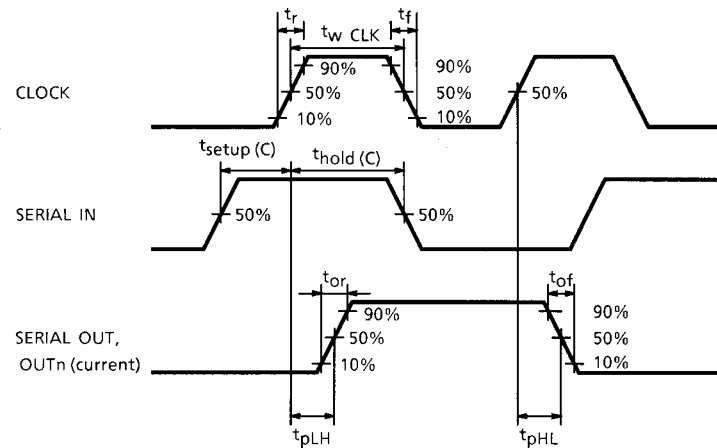


PRECAUTIONS for USING

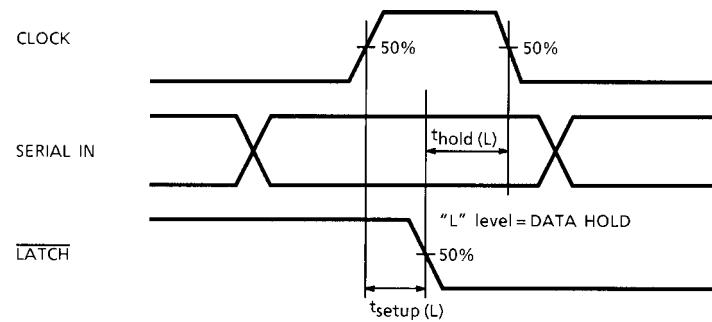
Utmost care is necessary in the design of the output line, VCC (V_{DD}) and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

TIMING WAVEFORM

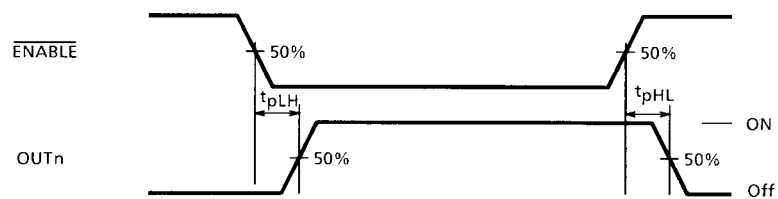
1. CLOCK-SERIAL OUT, OUTn

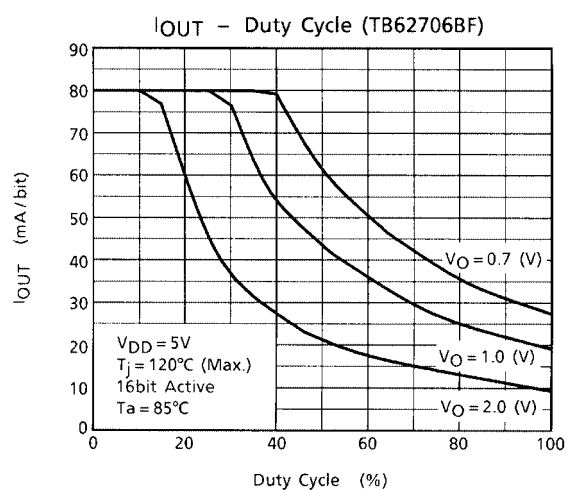
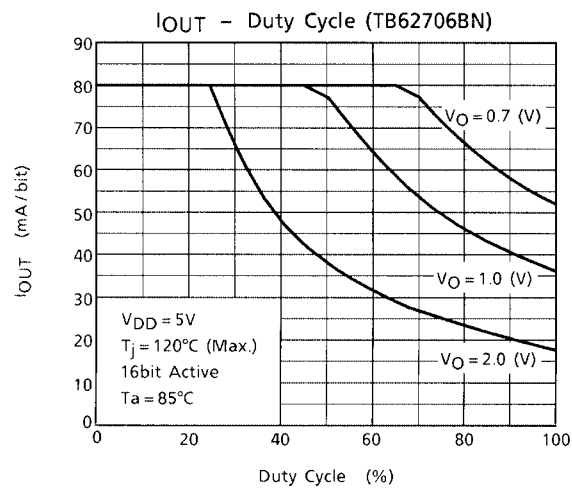
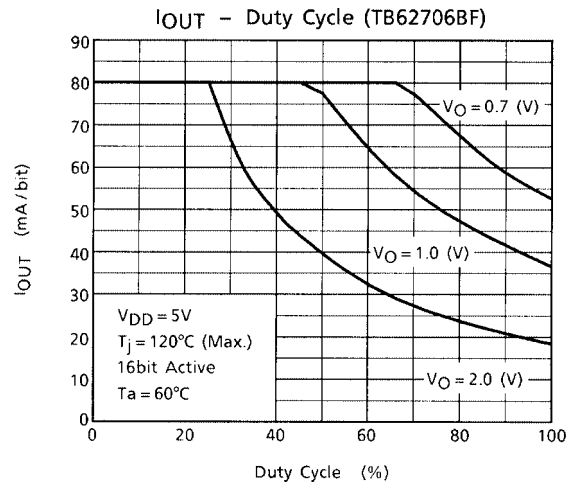
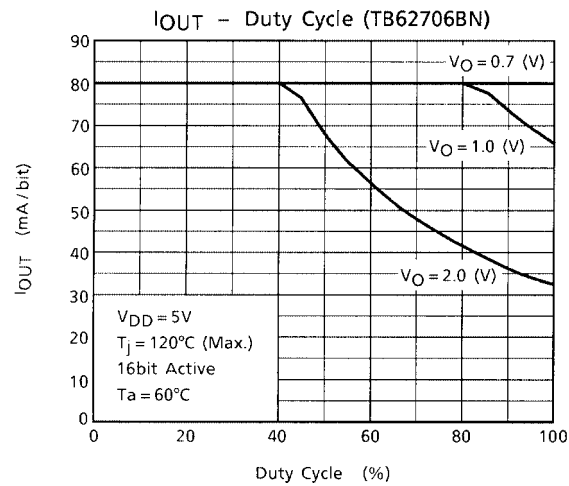
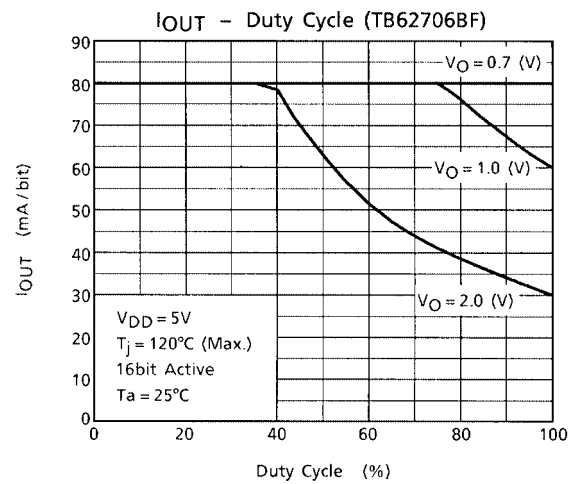
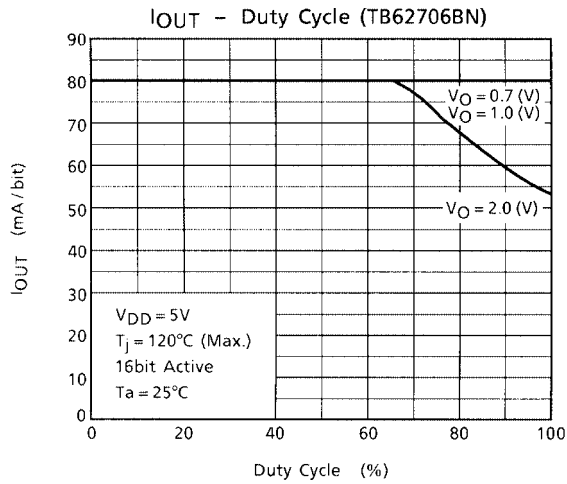


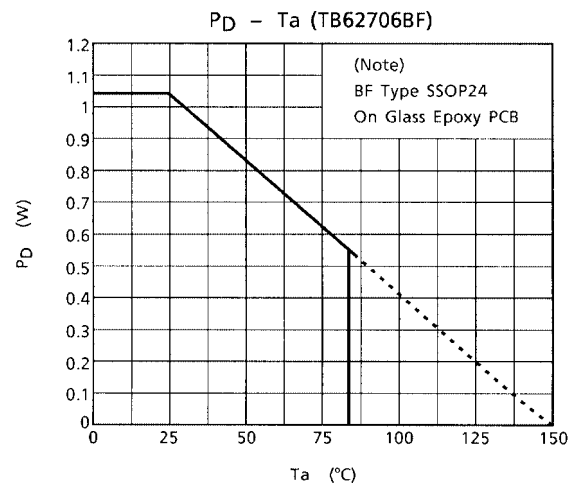
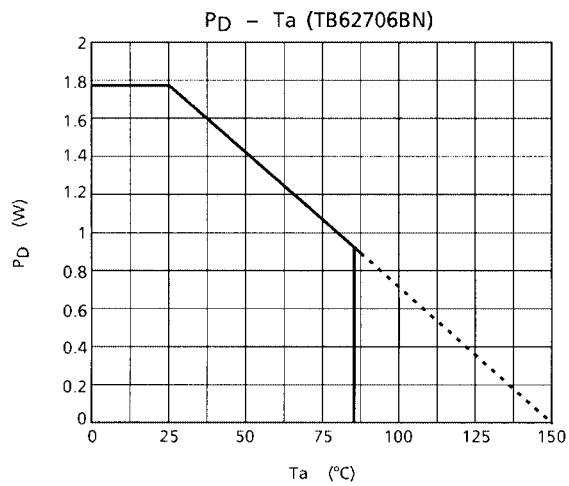
2. CLOCK-LATCH



3. ENABLE-OUTn







LED DRIVER TB6270X SERIES APPLICATION NOTE

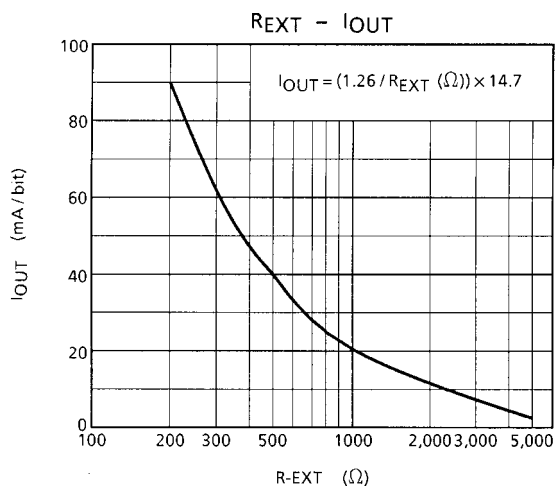


Fig.1

[1] Output current (I_{OUT})

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

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

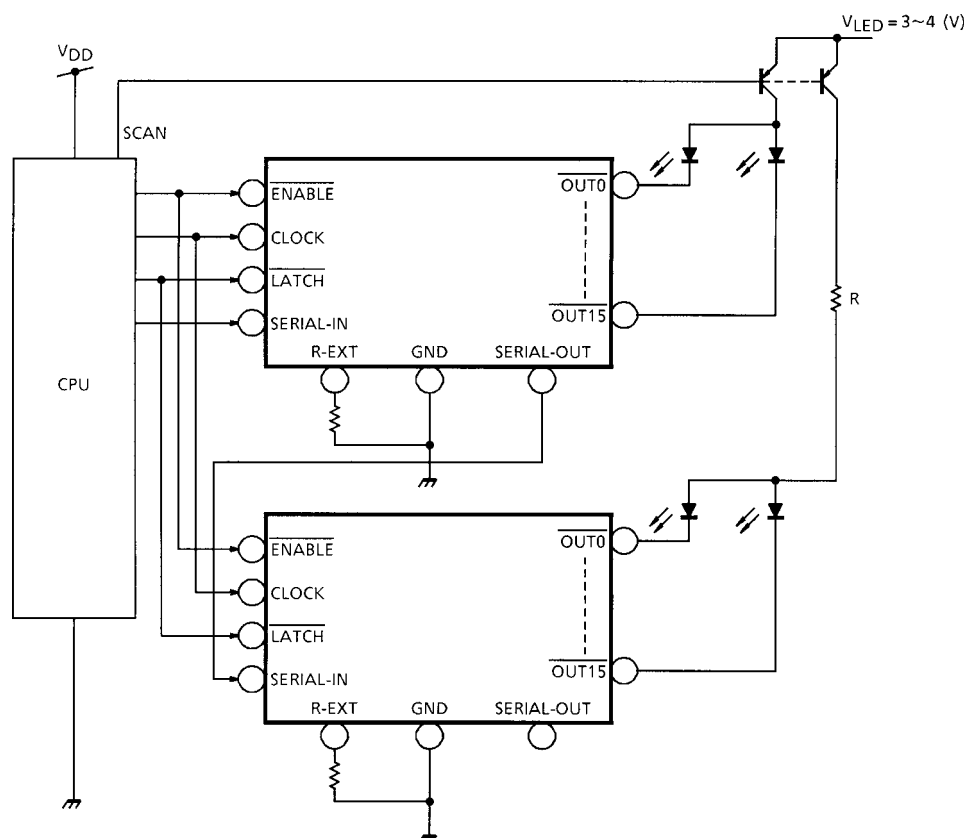
This device can operate 0.4~0.7V (V_O).

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,

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

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



[3] Pattern layout

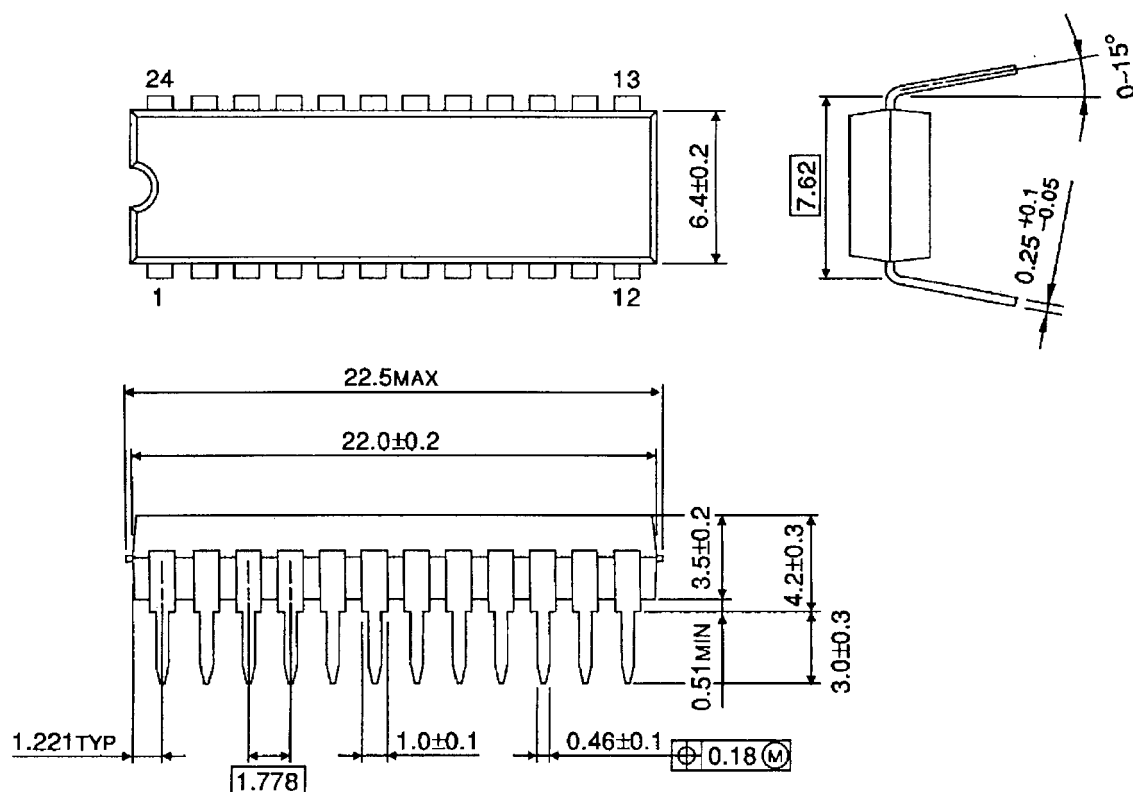
This device owns only one ground pin that means signal ground pin and power ground pin are common.

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

SDIP24-P-300-1.78

Unit : mm

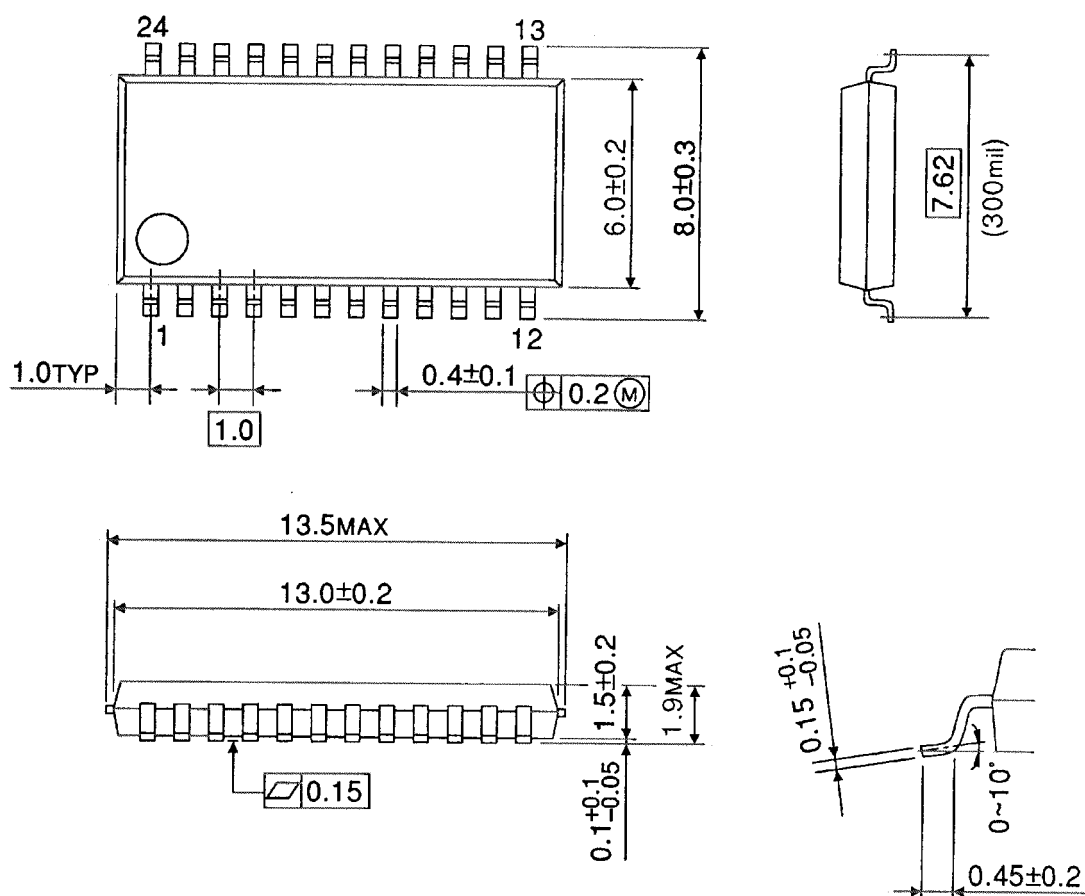


Weight: 1.22 g (typ.)

Package Dimensions

SSOP24-P-300-1.00B

Unit : mm



Weight: 0.32 g (typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

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