

TOSHIBA Bi- CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB62706BNG, TB62706BFG

16BIT SHIFT REGISTER, LATCHES & CONSTANT CURRENT DRIVERS

The TB62706BNG, TB62706BFG are specifically designed for LED and LED DISPLAY constant current drivers.

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

These devices are monolithic integrated circuit designed to be used together with Bi- CMOS process.

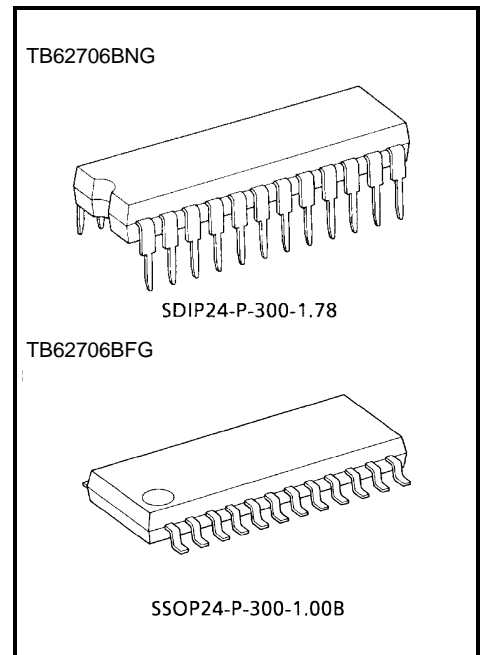
The devices consist of 16bit shift register, latch, AND- GATE and Constant Current Drivers.

These products are Pb free.

FEATURES

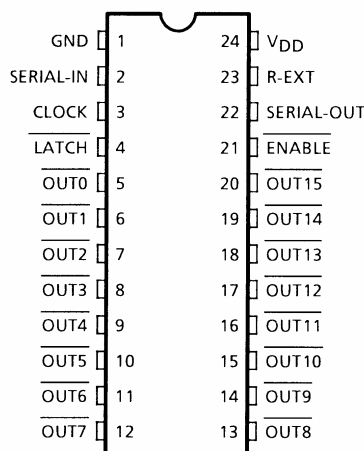
- Constant Current Output : Can set up all output current with one resistor for 5 to 90 mA.
- Maximum Clock Frequency : $f_{CLK} = 15\text{ (MHz)}$ (Cascade Connected Operate, $T_{opr} = 25^{\circ}\text{C}$)
- 5 V C- MOS Compatible Input
- Package: SDIP24- P- 300- 1.78 (TB62706BNG)
SSOP24- P- 300- 1.00B (TB62706BFG)
- Constant Output Current Matching:

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

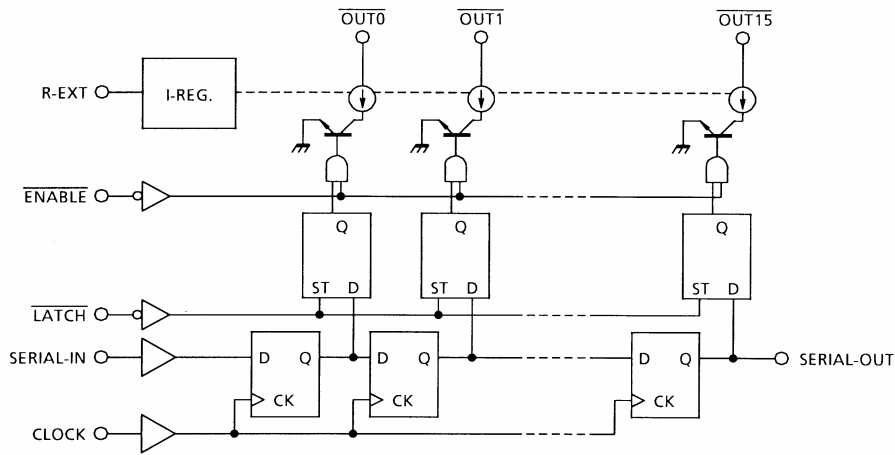


Weight
 SDIP24-P-300-1.78 : 1.22 g (typ.)
 SSOP24-P-300-1.00B : 0.32 g (typ.)

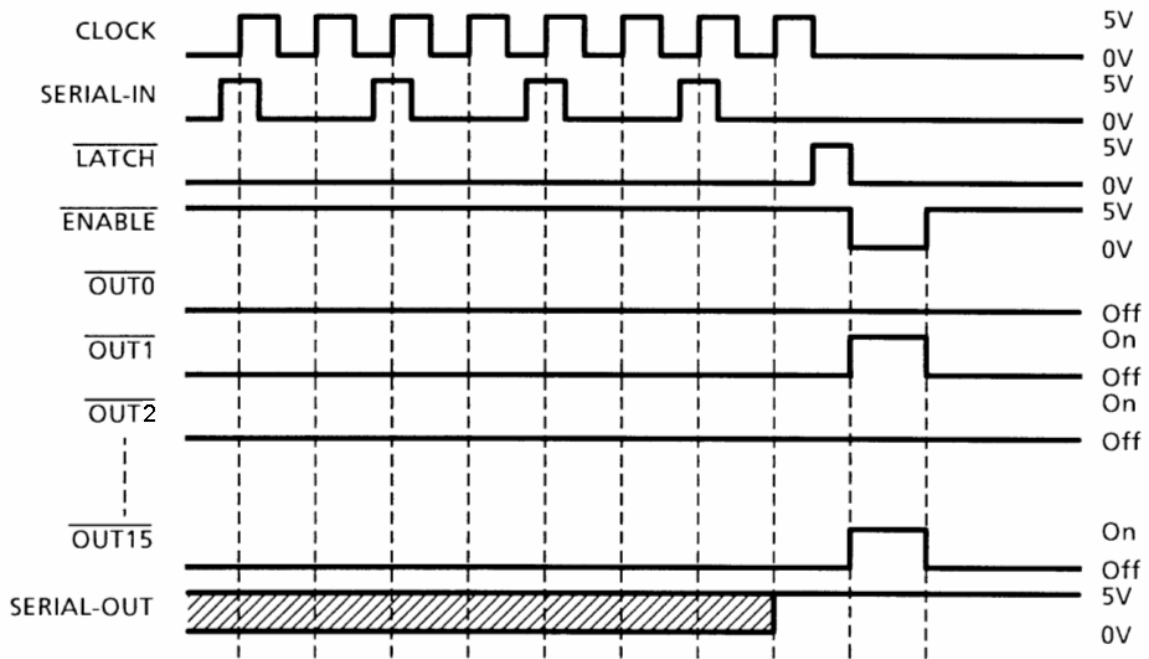
PIN CONNECTION (Top view)



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 DISCRPTION

| 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 LATCH - terminal, and hold data with "L" level input. |
| 5~20 | $\overline{\text{OUT0}} \sim \overline{\text{15}}$ | Output terminals. |
| 21 | $\overline{\text{ENABLE}}$ | Input terminal of output enable. All outputs ($\overline{\text{OUT0}} \sim \overline{\text{15}}$) do off with "H" level input of 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

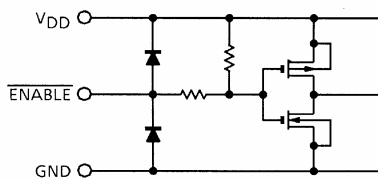
| CLOCK | $\overline{\text{LATCH}}$ | $\overline{\text{ENABLE}}$ | SERIAL- IN | $\overline{\text{OUT0}} \dots \overline{\text{OUT7}} \dots \overline{\text{OUT15}}$ | SERIAL- OUT |
|-------|---------------------------|----------------------------|------------------|---|-------------------|
| UP | H | L | D _n | D _n ... D _{n-7} ... 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} ... D _{n-5} ... D _{n-13} | D _{n-13} |
| DOWN | X | L | D _{n+3} | D _{n+2} ... D _{n-5} ... D _{n-13} | D _{n-13} |
| DOWN | X | H | D _{n+3} | Off | D _{n-13} |

Note: $\overline{\text{OUT0}} \sim \overline{\text{15}}$ = on in case of D_n = H level and $\overline{\text{OUT0}} \sim \overline{\text{15}}$ = off in case of D_n = L level.

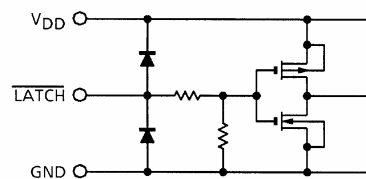
A resistor is connected with R- EXT and GND accompanied with outside, and it is necessary that a correct power supply voltage is supplied.

EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS

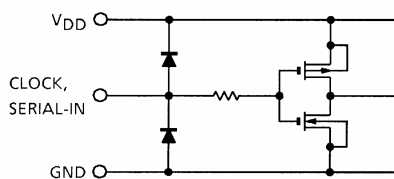
1. $\overline{\text{ENABLE}}$ terminal



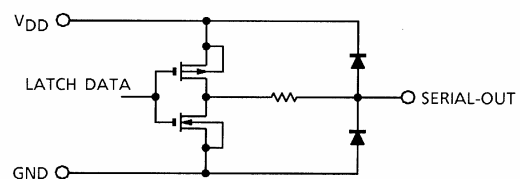
2. $\overline{\text{LATCH}}$ terminal



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 _{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 (BNG- type : ON PCB, Ta = 25°C) | W |
| | | 1.00 (BFG- type : ON PCB, Ta = 25°C) | |
| Thermal Resistance | R _{th (j- a)} | BNG : 70 (BN- type : ON PCB) | °C / W |
| | | BFG : 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} | |
| LATCH Pulse Width | t _w LATCH | 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 _{CLK} | | Cascade operation | - | - | 10.0 |
| Power Dissipation | P _D | Ta = 85°C (BNG- type) | - | - | 0.92 | W |
| | | Ta = 85°C (BFG- type) | - | - | 0.50 | |

ELECTRICAL CHARACTERISTICS (V_{DD} = 5.0 V, Ta = 25°C unless otherwise noted)

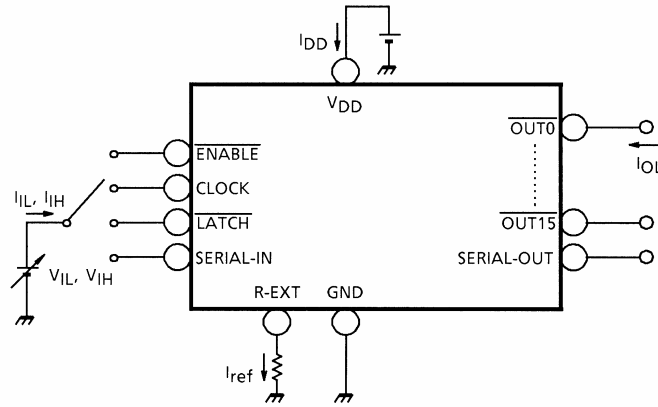
| CHARACTERISTIC | | SYMBOL | TEST CIRCUIT | CONDITION | MIN | TYP. | MAX | UNIT | |
|---------------------------|--------------|-------------------------|--------------|---|--|------|---------------------|-------|----|
| Input Voltage | "H" Level | V _{IH} | — | Ta = - 40~85°C | 0.7 V _{DD} | — | V _{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 | D 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 | D 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, $\overline{\text{OUT0}} \sim \overline{\text{15}} = \text{off}$ | 3.5 | 5.8 | 8.0 | | |
| | | I _{DD} (off) 3 | — | R _{EXT} = 250 Ω, $\overline{\text{OUT0}} \sim \overline{\text{15}} = \text{off}$ | 6.5 | 10.7 | 15.0 | | |
| | "ON" | I _{DD} (on) 1 | — | R _{EXT} = 470 Ω, $\overline{\text{OUT0}} \sim \overline{\text{15}} = \text{on}$ | 10.0 | 16.0 | 22.0 | | |
| | | I _{DD} (on) 2 | — | R _{EXT} = 250 Ω, $\overline{\text{OUT0}} \sim \overline{\text{15}} = \text{on}$ | 18.0 | 28.3 | 38.5 | | |

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

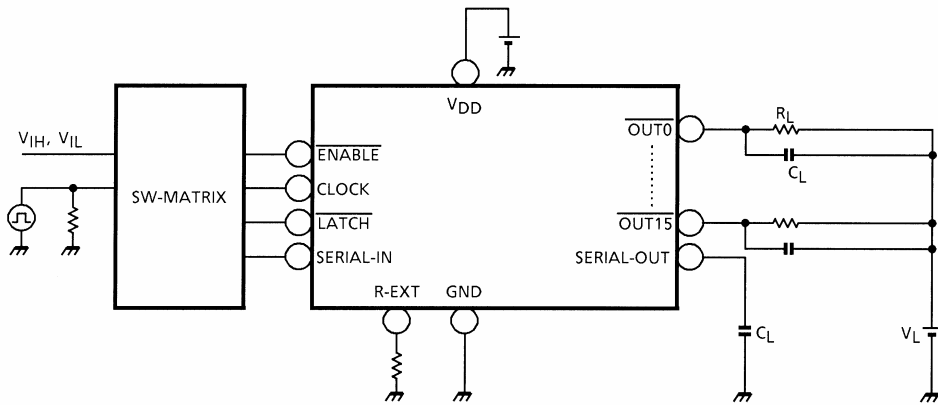
| CHARACTERISTIC | | SYMBOL | TEST CIRCUIT | CONDITION | MIN | TYP | MAX | UNIT |
|-------------------------------------|---|-------------------------------|--------------|---|-----|------|---------------|------|
| Propagation Delay Time ("L" to "H") | CLK- $\overline{\text{OUTn}}$ | t_{pLH} | - | $V_{DD} = 5.0\text{ V}$ $V_{CE} = 0.4\text{ V}$ $V_{IH} = V_{DD}$ $V_{IL} = \text{GND}$ $R_{EXT} = 470\ \Omega$ $V_L = 3.0\text{ V}$ $R_L = 65\ \Omega$ $C_L = 10.5\text{ pF}$ | - | 1200 | 1500 | ns |
| | $\overline{\text{LATCH}} - \overline{\text{OUTn}}$ | | | | - | 1200 | 1500 | |
| | $\overline{\text{ENABLE}} - \overline{\text{OUTn}}$ | | | | - | 1200 | 1500 | |
| | CLK- SOUT | | | | 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 | $t_w\text{ CLK}$ | - | | - | 20 | 30 | ns |
| | $\overline{\text{LATCH}}$ | $t_w\text{ LAT}$ | - | | - | 10 | 25 | ns |
| Set-up Time | L- H | $t_{\text{setup}}\text{ (L)}$ | - | - | 25 | 50 | ns | |
| | H- L | $t_{\text{setup}}\text{ (C)}$ | - | - | 25 | 50 | ns | |
| Hold Time | L- H | $t_{\text{hold}}\text{ (L)}$ | - | - | 0 | 15 | ns | |
| | H- L | $t_{\text{hold}}\text{ (C)}$ | - | - | 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

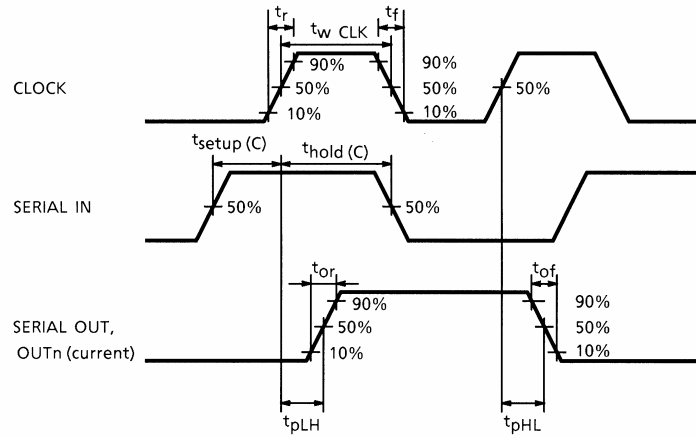


PRECAUTIONS for USING

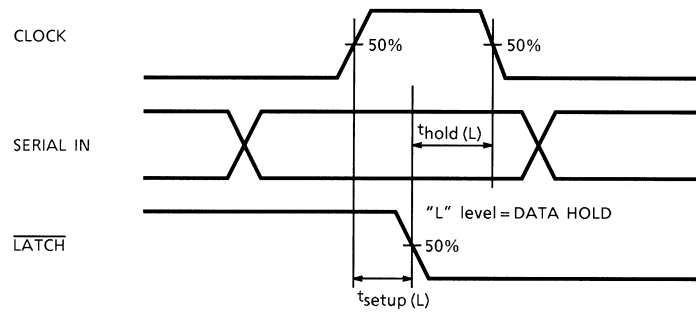
Utmost care is necessary in the design of the output line, V_{CC} (V_{DD}) and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

TIMING WAVEFORM

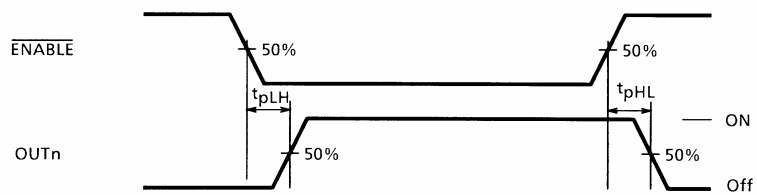
1. CLOCK- SERIAL OUT, OUTn

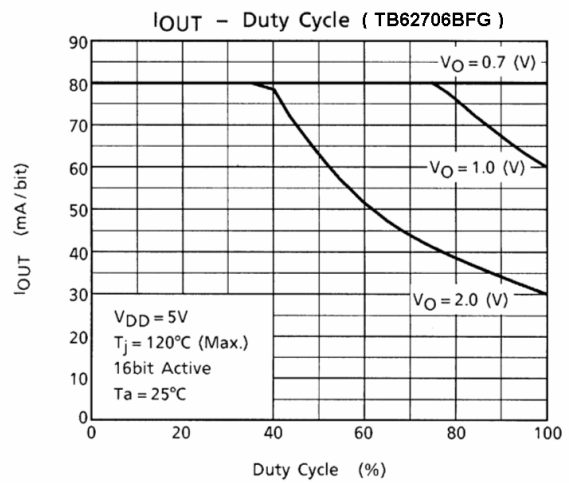
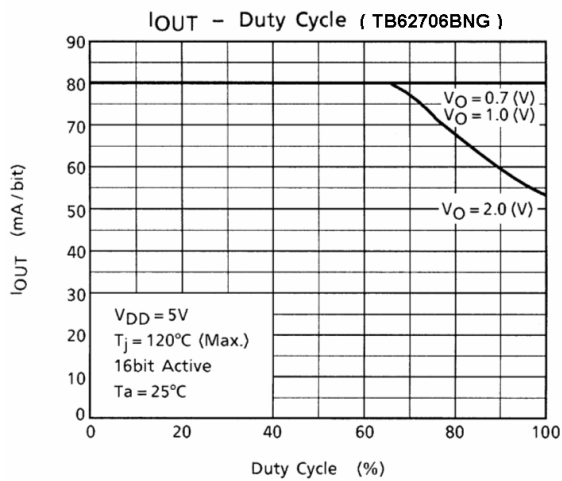
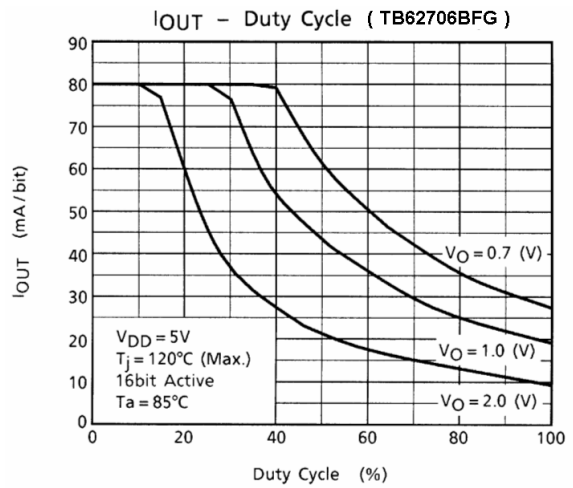
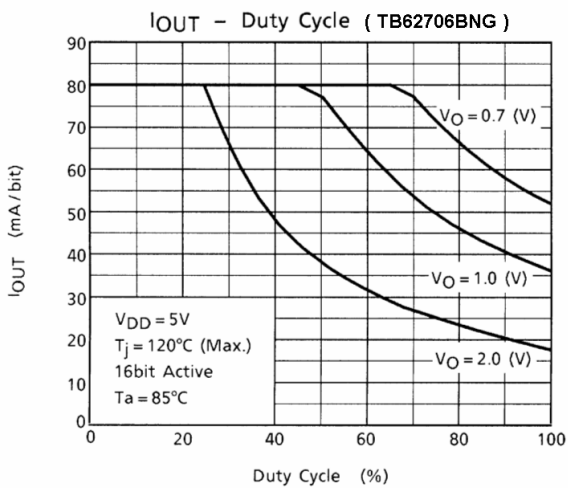
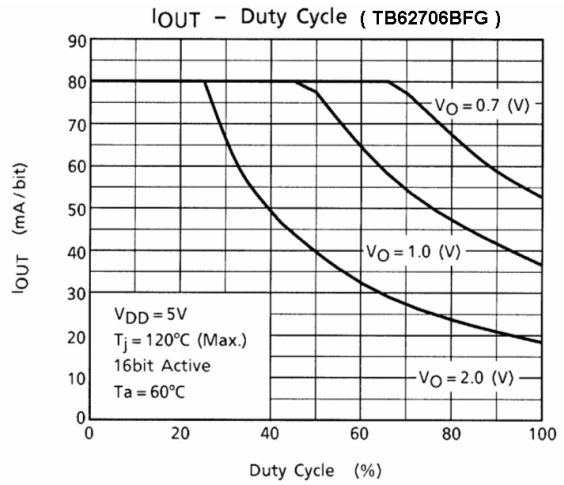
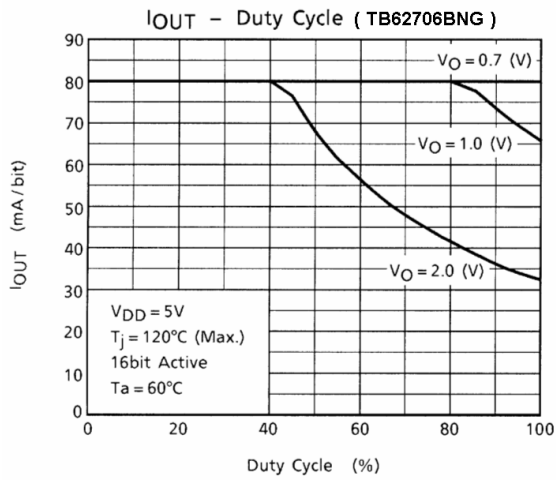


2. CLOCK- LATCH



3. ENABLE - OUTn





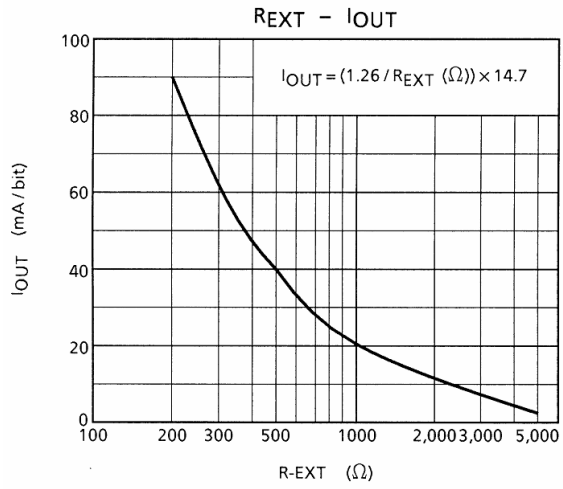
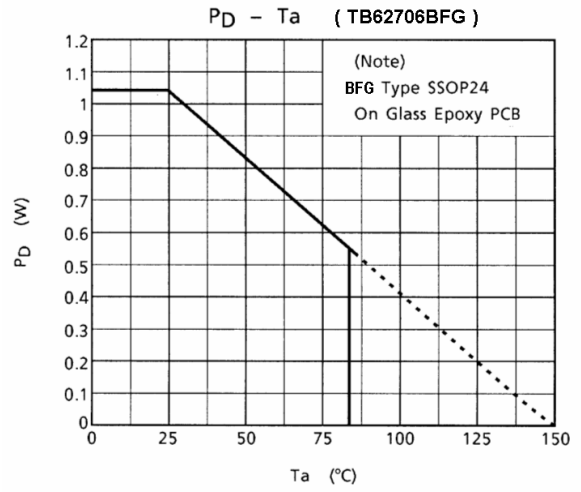
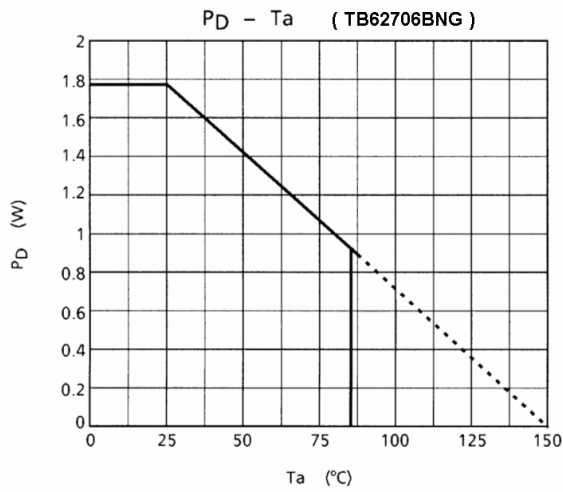


Fig.1



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 (VLED)

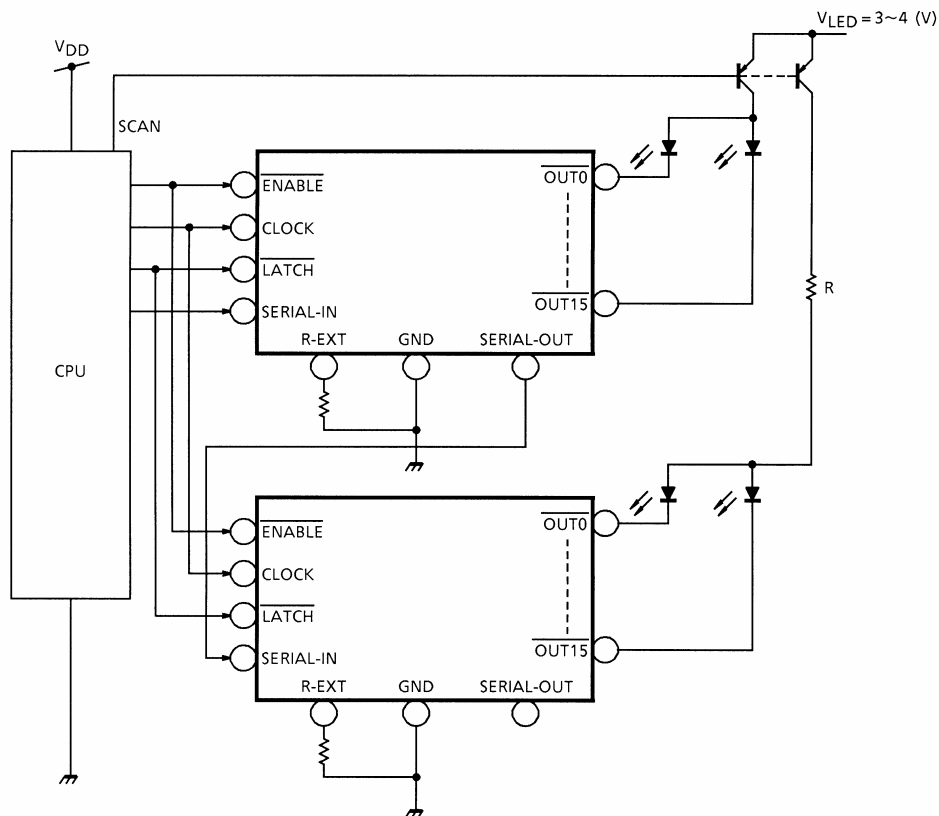
This device can operate 0.4~0.7V (V_O).

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).



[3] Pattern layout

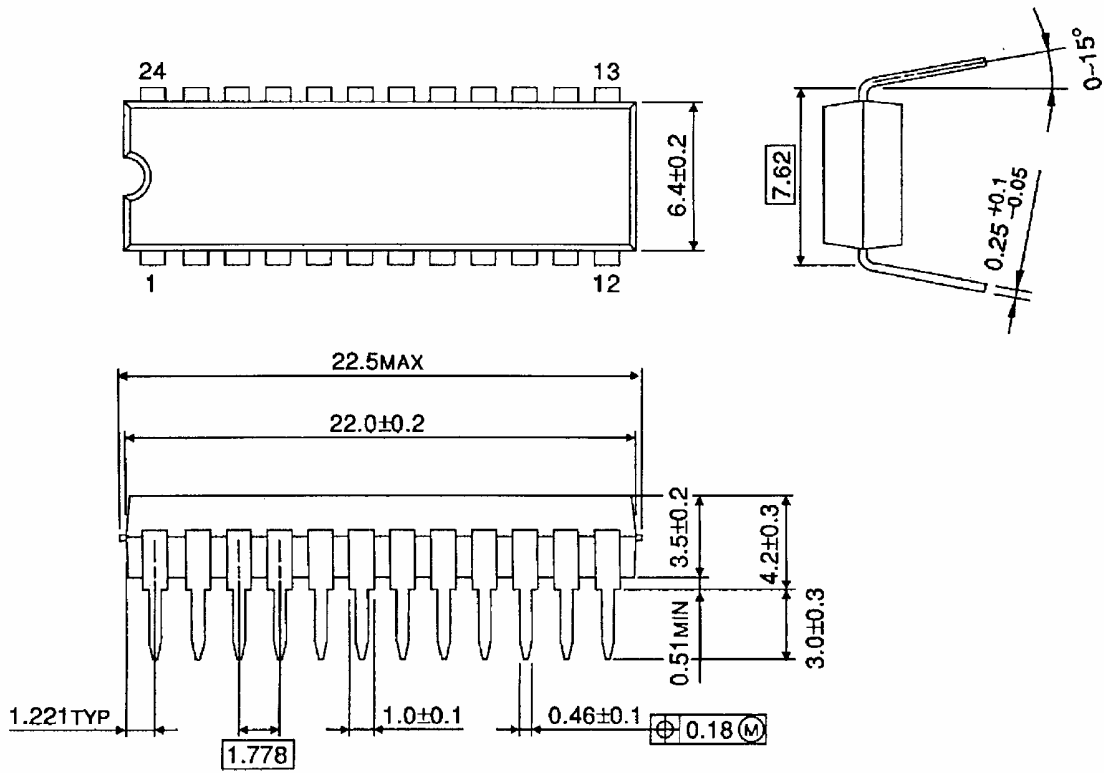
This device owns only one ground pin that means signal ground pin and power ground pin are common.

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

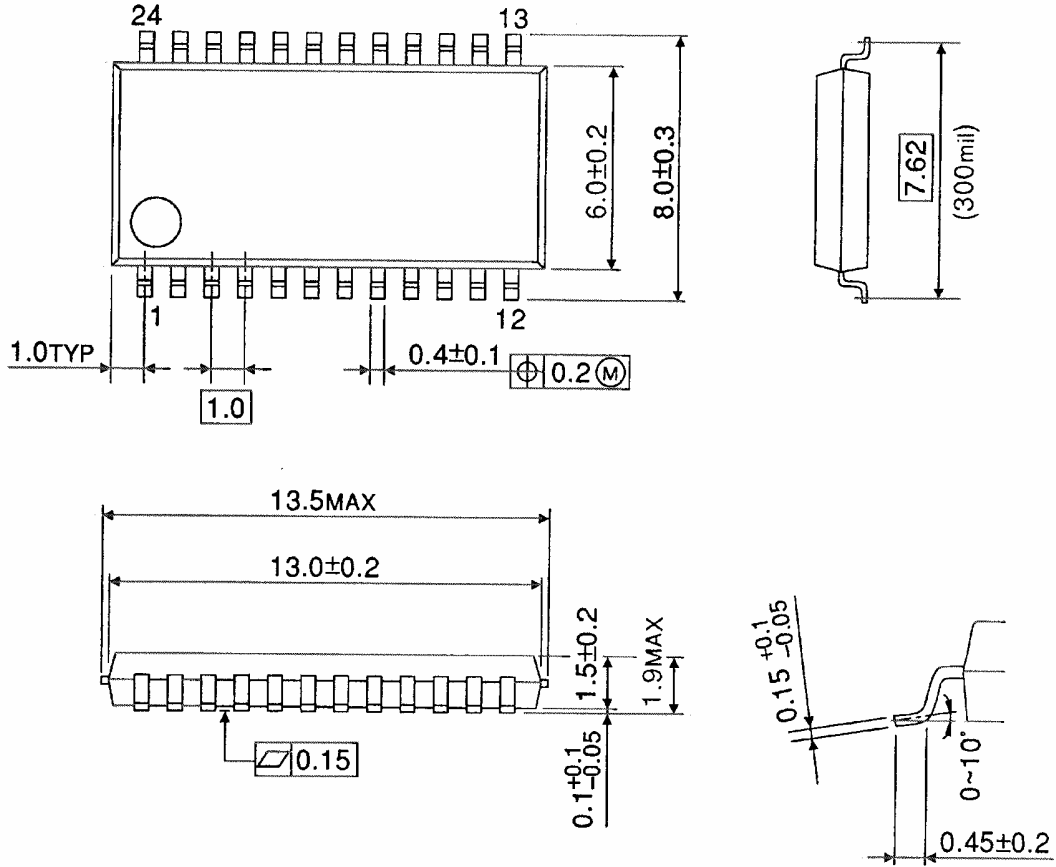


Weight: 1.22 g (typ.)

Package Dimensions

SSOP24-P-300-1.00B

Unit : mm



Weight: 0.32 g (typ.)

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

000707EBA

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