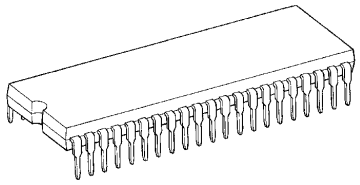
TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB62717N, TB62717F

24 BIT CONSTANT CURRENT DRIVERS
(3 × 8 BIT SHIFT REGISTER & LATCH)

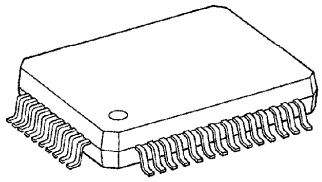
The TB62717N/F are specifically designed constant current driver for LED & LED DISPLAY.
This constant-current output-circuits is able to set up at an external resistor.
This IC is monolithic integrated circuit designed to be used together with Bi-CMOS process.
The devices builds in three block composed by the shift register circuit of eight bits, the latch-circuit of eight bits, the AND gate circuit of eight bits and the constant-current output circuits of eight bits.
This device has a SERIAL-IN terminal and a SERIAL-OUT terminal three blocks to each, and has a CLOCK terminal and a LATCH terminal three blocks to the commonness.

T62717N



SDIP42-P-600-1.78

T62717F



QFP48-P-1014-0.80

Weight
SDIP42-P-600-1.78 : 4.13 g (Typ.)
QFP48-P-1014-0.80 : g (Typ.)

FEATURES

- Constant Current Output : Able to set up at an external resistor for all output 2 current.
- Schmitt Triggered Input
- Recommended Operating Condition
  - Maximum Clock Frequency : f_{CLK} = 10.0 MHz (Cascade connected)
  - IC Supply Voltage : V_{DD} = 4.5~5.5 V
  - Output Voltage : V_{OUT} = 0.4~17 V
  - Output Current : I_{OUT} = 5~30 mA / bit
  - Operating Temperature : T_{opr} = −40~85°C

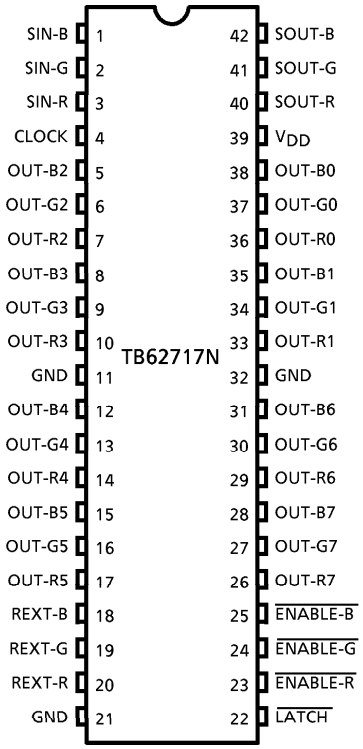
CONSTANT OUTPUT CURRENT MATCHING

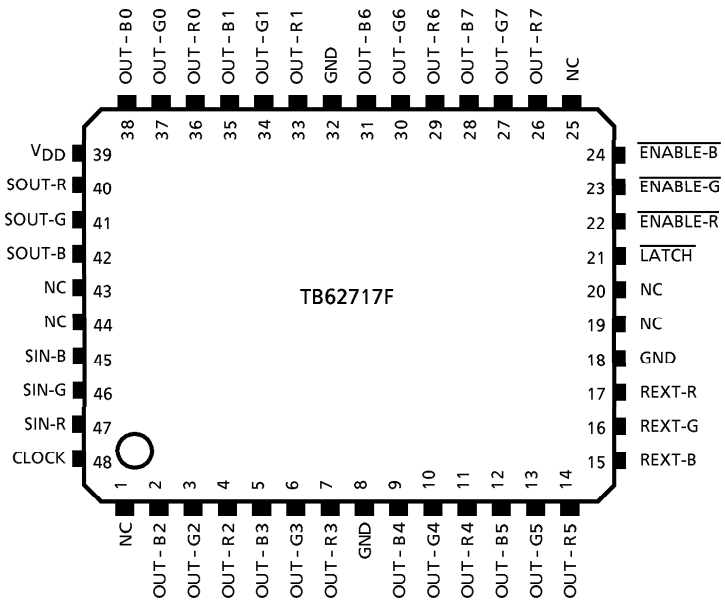
OUTPUT-GND VOLTAGE	CURRENT MATCHING	OUTPUT CURRENT
≧0.4 V	±6.0%	5~50 mA

- 5 V CMOS Compatible Input
- Package : N Type SDIP42-P-600-1.78
  F Type QFP48-P-1014-0.80

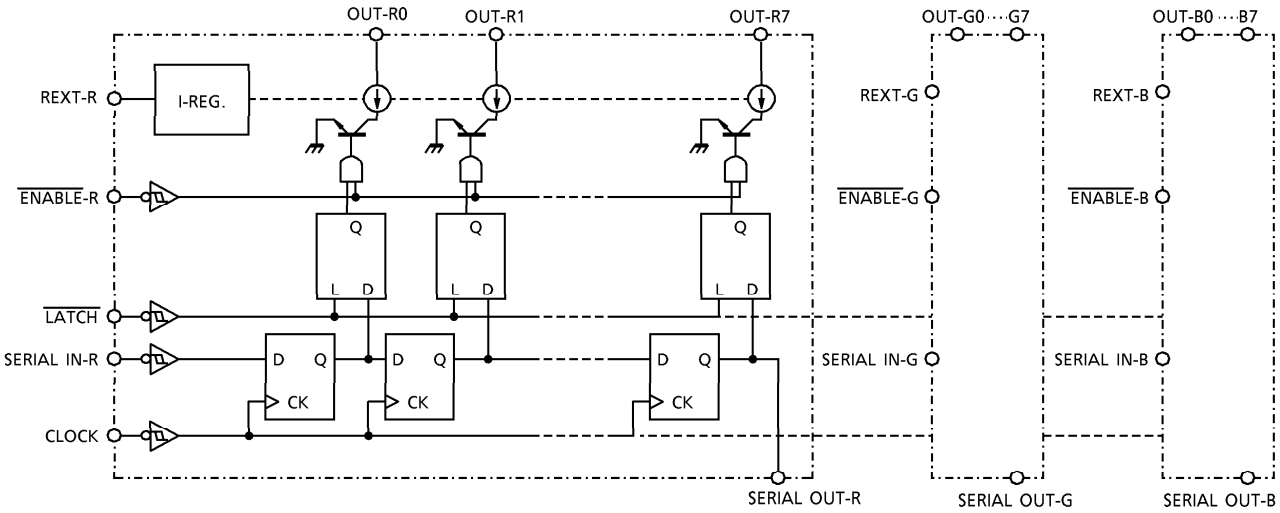
980910EBA1

PIN CONNECTION (TOP VIEW)





BLOCK DIAGRAM



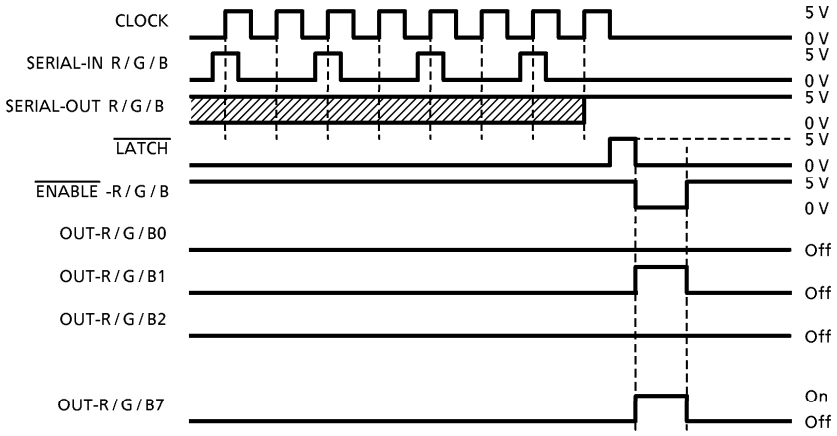
(Note) I_{OUT} = 30 mA / bit (max) in 24 bit output activate

TRUTH TABLE

CLOCK	$\overline{\text{LATCH}}$	$\overline{\text{ENABLE}}$ R / G / B	SERIAL-IN R / G / B	OUT- R / G / B0 ··· OUT- R / G / B3 ··· OUT- R / G / B7	SERIAL-OUT R / G / B
UP	H	L	D_n	D_n ··· D_{n-3} ··· D_{n-7}	D_{n-7}
UP	L	L	D_{n+1}	No Change	D_{n-6}
DOWN	H	L	D_{n+1}	D_{n+1} ··· D_{n-2} ··· D_{n-6}	D_{n-6}
—	X	L	D_{n+2}	No Change	D_{n-6}
—	X	H	D_{n+3}	All Off	D_{n-6}

(Nete) OUT-R / G / B0~7 = on in case of Dn = H level and OUT-R / G / B0~7 = off in case of Dn = 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.

TIMING DIAGRAM



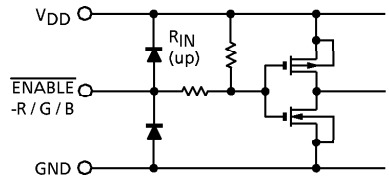
(Note) Latch are level sensitive, not rising edges sensitive and not synchronous CLOCK.
Input of LATCH-terminal to "H" level, data passes latches, and input to "L" level, data hold latches.
Input of ENABLE-terminal to "H" level, all output do off.

TERMINAL EXPLANATION

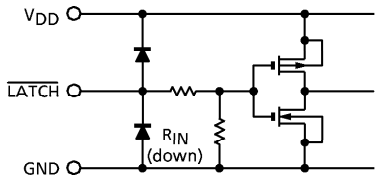
NUMBERS		NAME	EXPLANATION
N	F		
36~38	36~38	OUT-R / G / B0	This terminal is the constant-current output of the 0th bit of each block. An output terminal is high-active in the input data.
33~35	33~35	OUT-R / G / B1	This terminal is the constant-current output of the 1st bit of each block. An output terminal is high-active in the input data.
5~7	2~4	OUT-R / G / B2	This terminal is the constant-current output of the 2nd bit of each block. An output terminal is high-active in the input data.
8~10	5~7	OUT-R / G / B3	This terminal is the constant-current output of the 3rd bit of each block. An output terminal is high-active in the input data.
12~14	9~11	OUT-R / G / B4	This terminal is the constant-current output of the 4th bit of each block. An output terminal is high-active in the input data.
15~17	12~14	OUT-R / G / B5	This terminal is the constant-current output of the 5th bit of each block. An output terminal is high-active in the input data.
29~31	29~31	OUT-R / G / B6	This terminal is the constant-current output of the 6th bit of each block. An output terminal is high-active in the input data.
26~28	26~28	OUT-R / G / B7	This terminal is the constant-current output of the 7th bit of each block. An output terminal is high-active in the input data.
11, 21, 32	8, 18, 32	GND	These three terminals are GND terminals. We recommend that it is grounded (this terminal all).
1~3	45~47	SERIAL-IN -R / G / B	This terminal is a serial-data input of each block.
4	48	CLOCK	This terminal is the clock signal input which is common to each block.
22	21	$\overline{\text{LATCH}}$	This terminal is latch signal input. This terminal is a level latch. Therefore, input data are held while input of a level is being maintained. It only passes through the data on the output side in the case of the H level.
23~25	22~24	$\overline{\text{ENABLE}}$ -R / G / B	This terminal is output control signal input. When input of a L level is maintained, an output terminal drives this terminal corresponding to the input data. Output is made a non-drive independently with the input data in the case of the H level.
18~20	15~17	REXT-B / G / R	This terminal is for the resistance connection which the output electric current value of each block is set up to. Resistance with the outside is connected between this terminal and GND. Output electric current is set up in the value corresponding to the re
39	39	V_{DD}	This terminal is input of a power supply voltage 5 V.
40~42	40~42	SERIAL OUT -B / G / R	This terminal is a serial-data output of each block.

EQUIVALENT CIRCUIT ABOUT THE INPUT AND OUTPUT TERMINAL

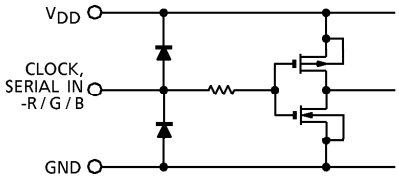
1. The terminal of the $\overline{\text{ENABLE}}$ -R / G / B



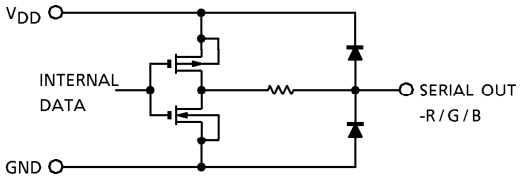
2. The terminal of the $\overline{\text{LATCH}}$



3. The terminal of the CLOCK and SERIAL IN R / G / B



4. The terminal of the SERIAL OUT R / G / B



MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Supply Voltage		V_{DD}	+ 7.0	V
Input Voltage		V_{IN}	− 0.4~V_{DD} + 0.4	V
Output Current		I_{OUT}	+ 50	mA
Output Voltage		V_{OUT}	− 0.5~ + 17.0	V
Clock Frequency		f_{CK}	15	MHz
GND Terminal Current (Note 1)		I_{GND}	2200	mA
Power Dissipation (Note 2)	TB62717N	P_D	1.78 (ON PCB) / 1.56 (FREE AIR)	°C / W
	TB62717F		1.38 (ON PCB) / 0.86 (FREE AIR)	
Thermal Resistance (Note 2)	TB62717N	$R_{th\ (j-a)}$	70 (ON PCB) / 80 (FREE AIR)	°C / W
	TB62717F		90 (On PCB) / 145 (FREE AIR)	
Operating Temperature		T_{opr}	− 40~ + 85	°C
Storage Temperature		T_{stg}	− 55~ + 150	°C

(Note 1) Use all GND-terminals.

(Note 2) Ambient temperature delayed the above 25°C with the type N with 14.2 mW / °C and the type F with 11.1 mW / °C in on PCB (Glass Epoxy PCB 50 × 50 × 1.6 mm Cu 36%).

RECOMMENDED OPERATING CONDITION (Ta = 25°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}	—	0.4	—	15.0	V
Output Current	I_{OUT}	DC 1 circuit	—	—	35	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	MHz
Power Dissipation	P_D	Ta = 85°C (SDIP42 on PCB)	—	—	0.92	W
		Ta = 85°C (QFP48 on PCB)	—	—	0.71	

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

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	CONDITION		MIN.	TYP.	MAX.	UNIT
Input Voltage	"H" Level	V_{IH}	1	Ta = −40~85°C		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	SOUT-R / G / B	V_{OL}		I_{OL} = 1.0 mA		—	—	0.4	V
		V_{OH}		I_{OL} = −1.0 mA		4.6	—	—	
Output Current		I_{OL}		V_{CE} = 0.4 V	R_{EXT} = 660 Ω	25.5	30.0	34.5	mA
	Current Skew	ΔI_{OL}		I_{OL} = 30 mA, V_{CE} = 0.4 V	R_{EXT} = 660 Ω	—	±1.5	±6.0	%
Supply Voltage Regulation		% / V_{DD}		R_{EXT} = 660 Ω	Ta = −40~85°C	—	1.5	5.0	% / V
Pull-Up Resistor		$R_{IN\ (up)}$		—		150	300	600	Ω
Pull-Down Resistor		$R_{IN\ (down)}$		—		150	300	600	Ω
Supply Current	"OFF"	$I_{DD\ (off)\ 1}$		R_{EXT} = OPEN	All output off	—	1.2	2.4	mA
		$I_{DD\ (off)\ 2}$		R_{EXT} = 660 Ω		7.0	12.0	16.0	
	"ON"	$I_{DD\ (on)\ 1}$			All output on	15.0	28.0	40.0	

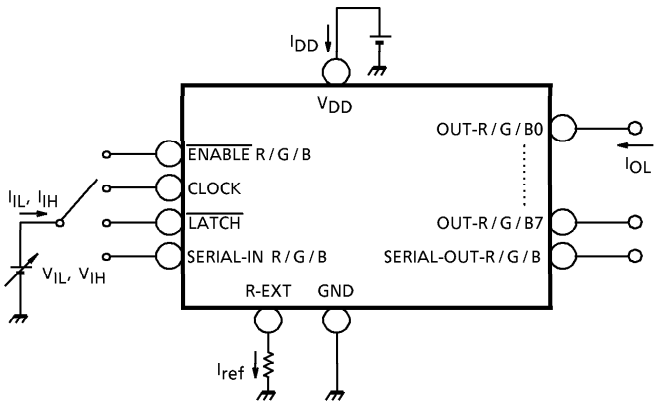
(Note) Current-skew items are specifications about the electric current value of eight output which each block has.
Therefore, as for the output electric current value which a different block sticks to, its become the specifications which are equal to the "I_{OL}" item.

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

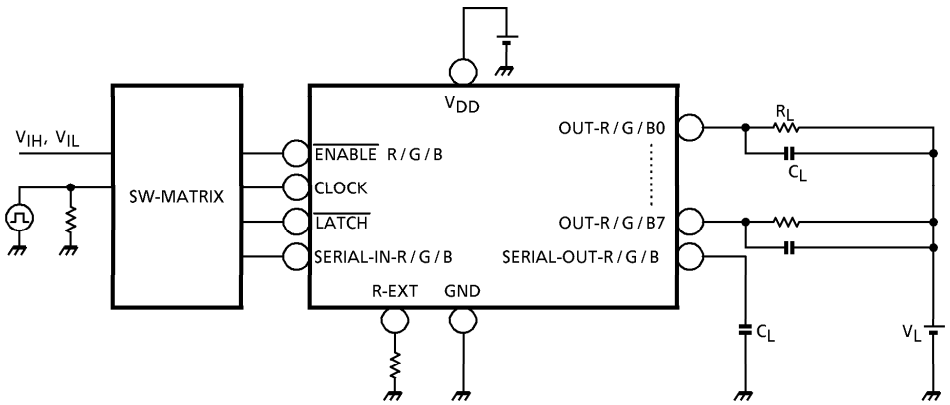
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time ("L" to "H")	CLK-OUTn	t_{pLH}	2	V_{DD} = 5.0 V V_{CE} = 0.4 V V_{IH} = V_{DD} V_{IL} = GND R_{EXT} = 660 Ω V_L = 3.0 V C_L = 10.5 pF	—	1200	1500	ns
	/ LATCH-OUTn				—	1200	1500	
	/ EN-OUTn				—	1200	1500	
	CLK-SOUT				—	30	70	
Propagation Delay Time ("H" to "L")	CLK-OUTn	t_{pHL}			—	700	1000	
	/ LATCH-OUTn				—	700	1000	
	/ EN-OUTn				—	700	1000	
	CLK-SOUT				—	30	70	
Pulse Width	CLK	t_w CLK, / CLK			—	20	30	
	LATCH	t_w LAT, / LAT			—	10	25	
Set-Up Time for / LATCH and SIN	L-H	t_{setup} / LAT			—	25	50	
	H-L				—	25	50	
Hold Time for / LATCH and SIN	L-H	t_{hold} / LAT			—	0	15	
	H-L				—	0	15	
Maximum CLOCK Rise Time		t_r			—	—	10	μs
Maximum CLOCK Fall Time		t_f			—	—	10	
Output Rise Time		t_{or}			300	600	1000	ns
Output Fall Time		t_{of}			150	300	600	

TEST CIRCUIT

DC characteristic

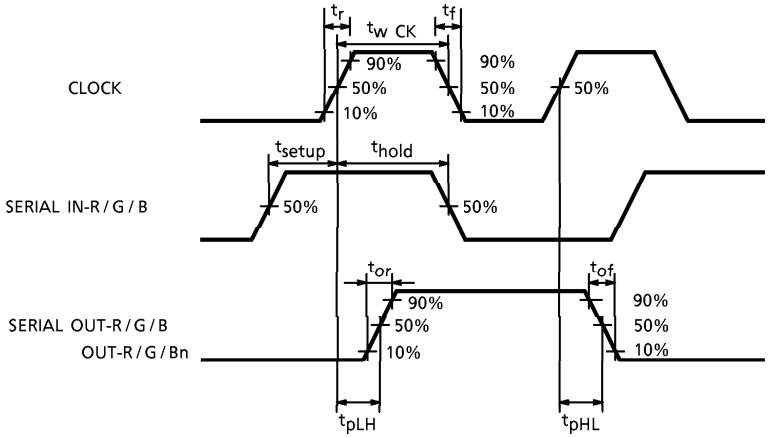


AC characteristic

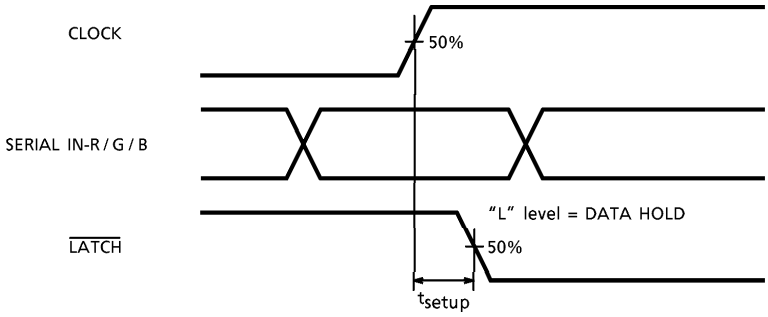


TIMING WAVEFORM

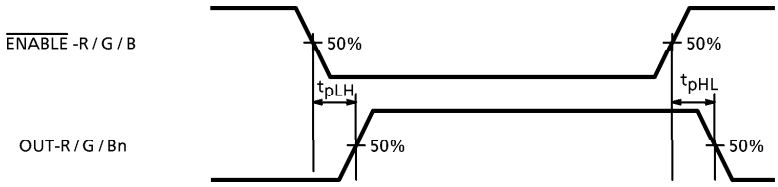
1. CLOCK-SERIAL OUT-R / G / B, SERIAL OUT-R / G / B, OUT-R / G / B0~7



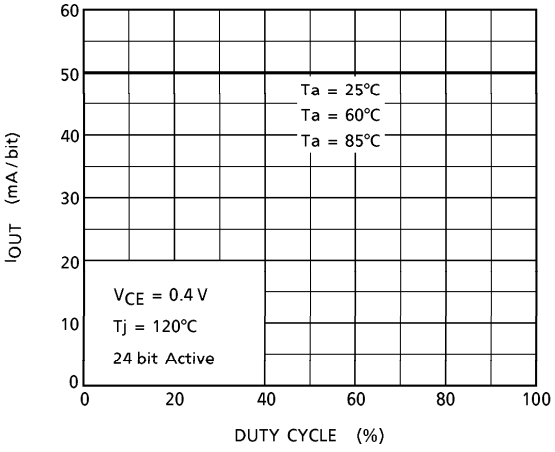
2. CLOCK-$\overline{\text{LATCH}}$



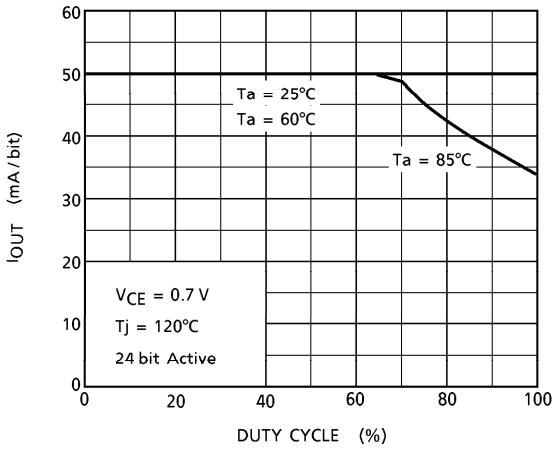
3. $\overline{\text{ENABLE}}$-R / G / B, OUT-R / G / B n



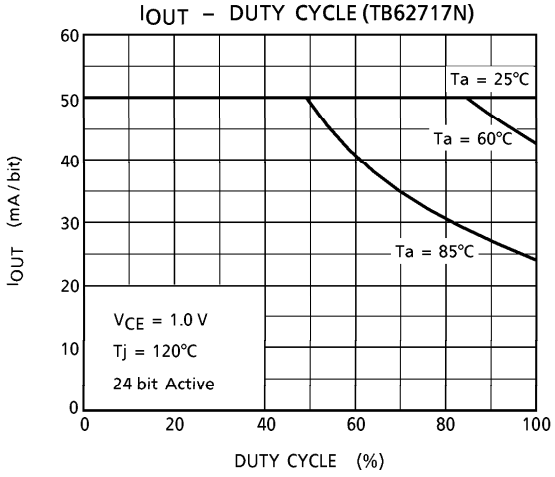
I_{OUT} – DUTY CYCLE (TB62717N)



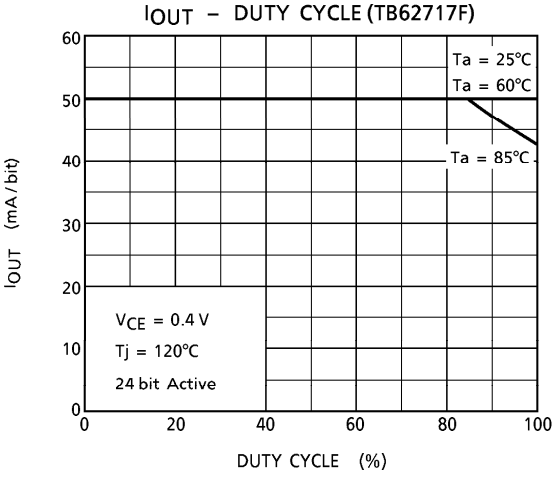
I_{OUT} – DUTY CYCLE (TB62717N)



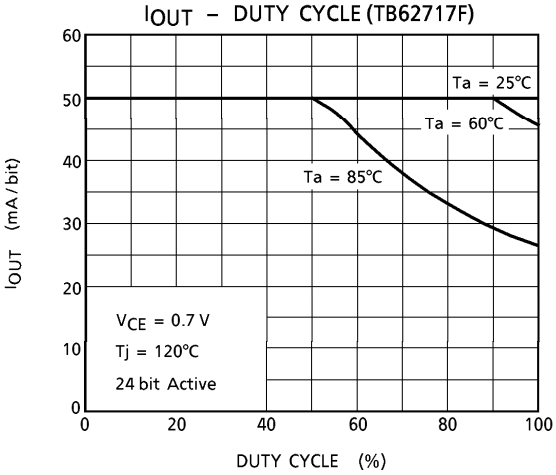
I_{OUT} – DUTY CYCLE (TB62717N)



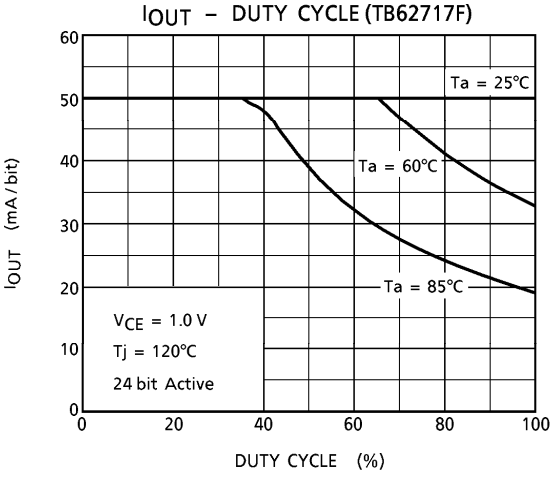
I_{OUT} – DUTY CYCLE (TB62717F)



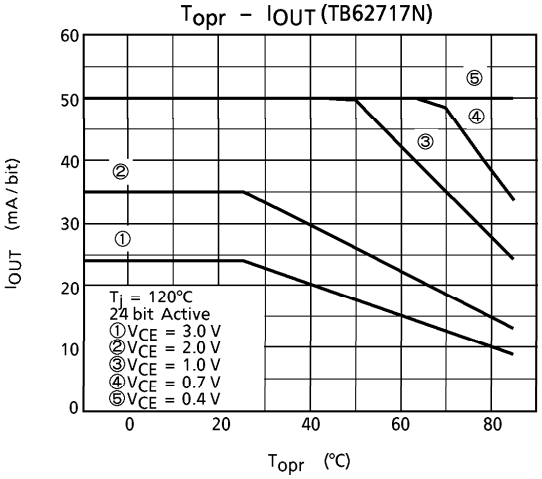
I_{OUT} – DUTY CYCLE (TB62717F)



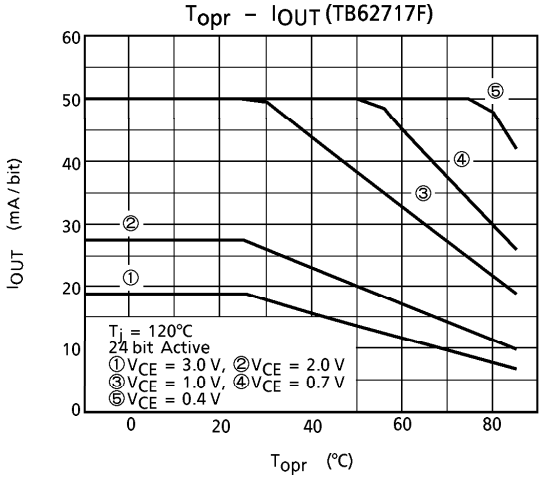
I_{OUT} – DUTY CYCLE (TB62717F)



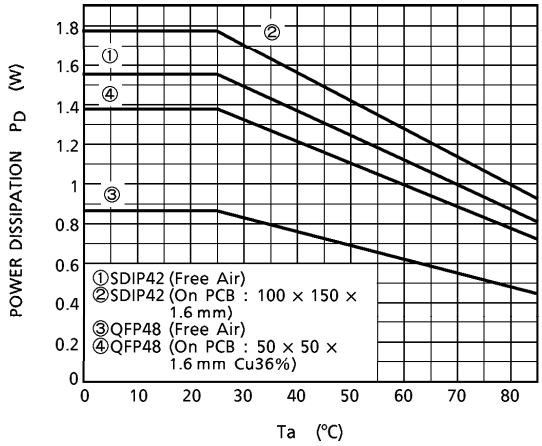
T_{opr} – I_{OUT} (TB62717N)



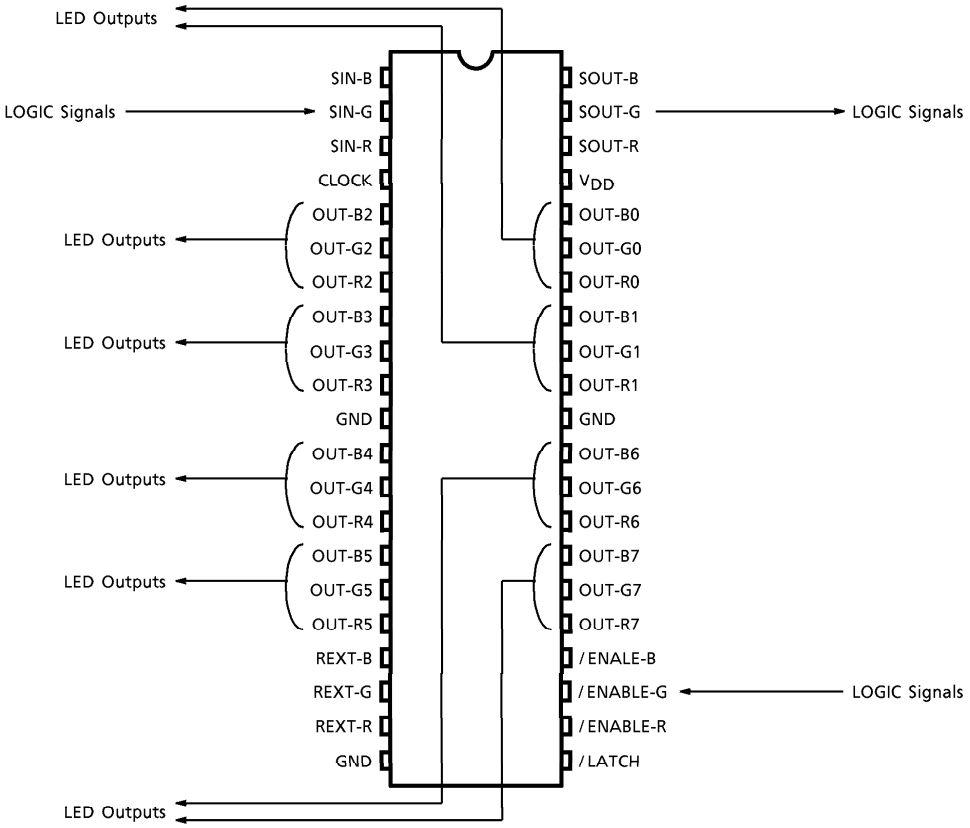
T_{opr} – I_{OUT} (TB62717F)

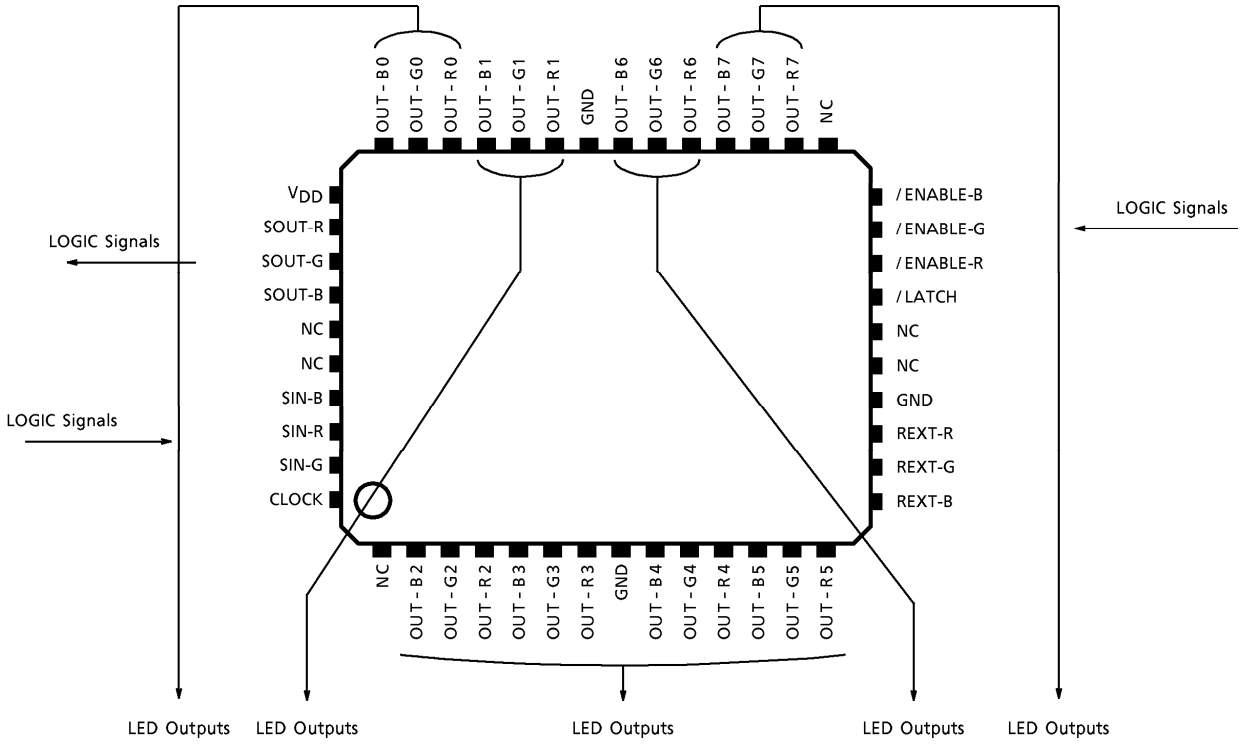


P_D – Ta (TB62717N / F)



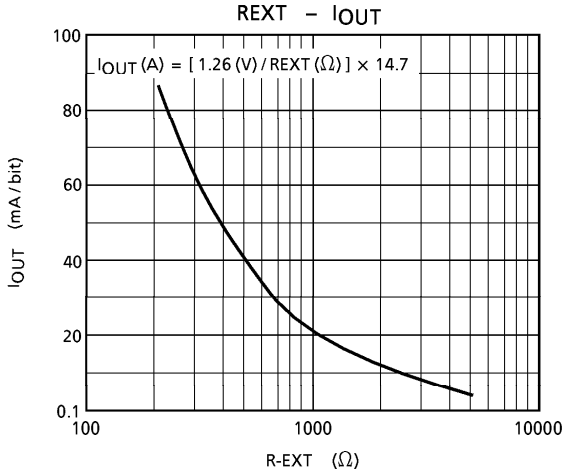
I/O LAYOUT IMAGE





LED DRIVER TB6270X SERIES APLICATION 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 0.4~0.7 V (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,

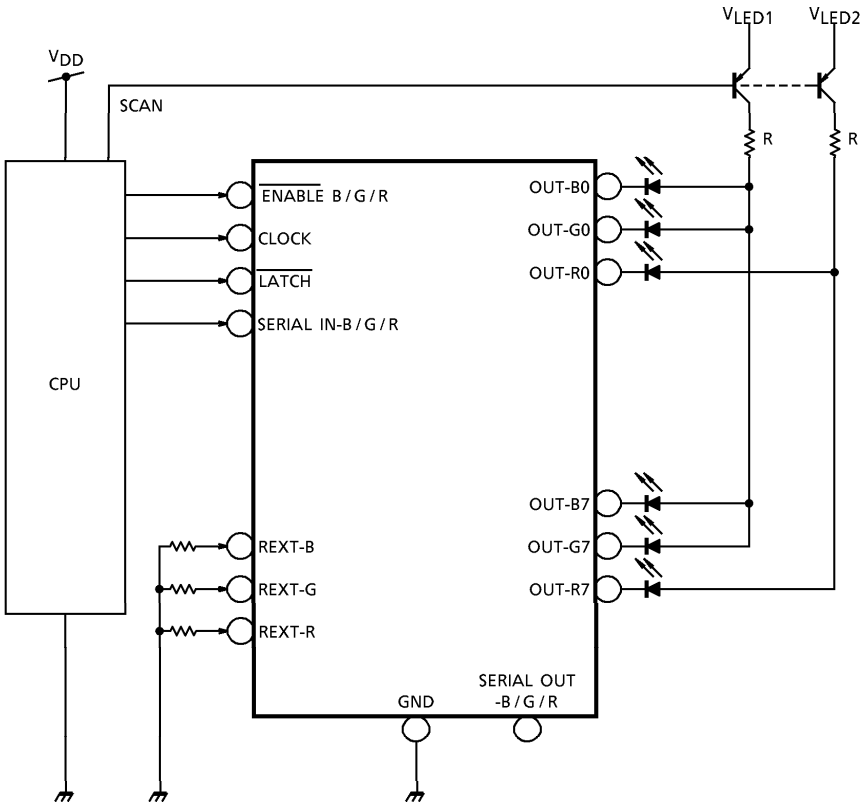
V_{LED} (total supply voltage) = V_{CE} (T_r V_{sat}) + V_f (LED Forward voltage) + V_O (IC supply voltage)

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

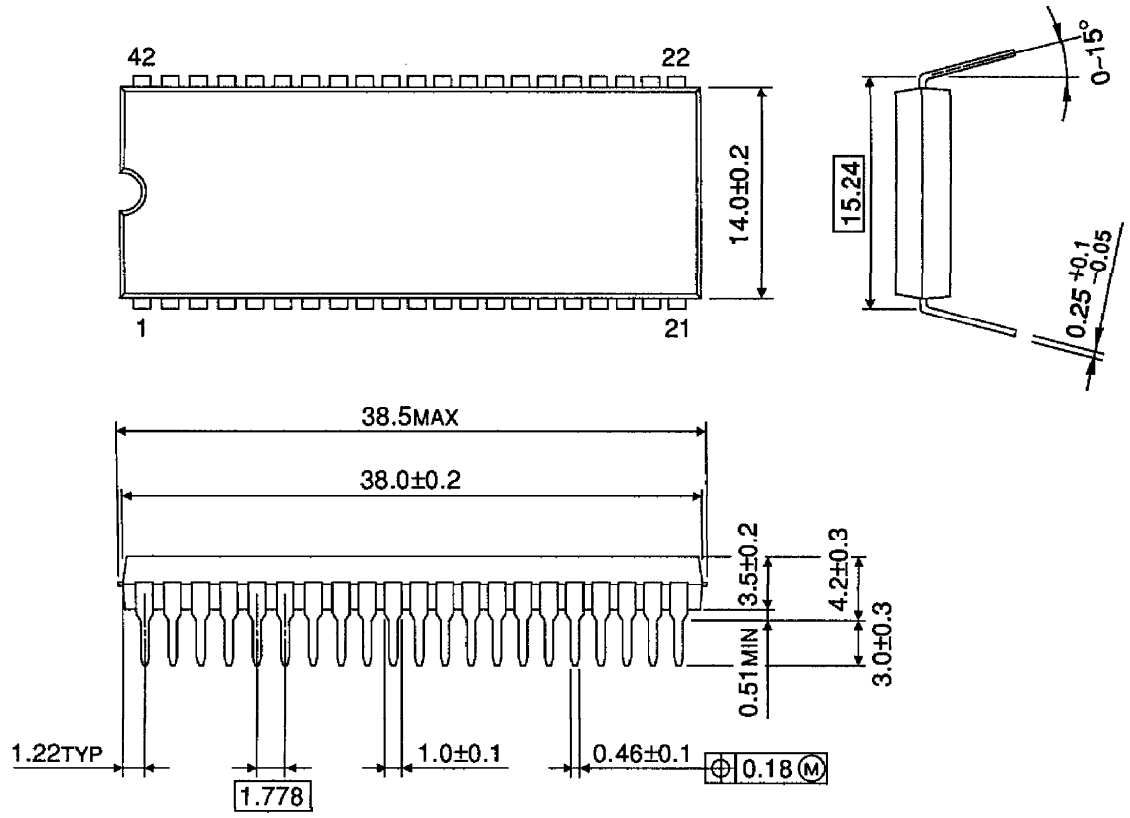
This device owns only one ground pin that means signal ground pin and power ground pin are common.
If ground pattern layout contains large inductance and impedance, and the voltage between ground and LATCH, CLOCK terminals exceeds 2.5 V by switching noise in operation, this device may miss-operate. So we would like you to pay attention to pattern layout to minimize inductance.

PATTERN LAYOUT



OUTLINE DRAWING

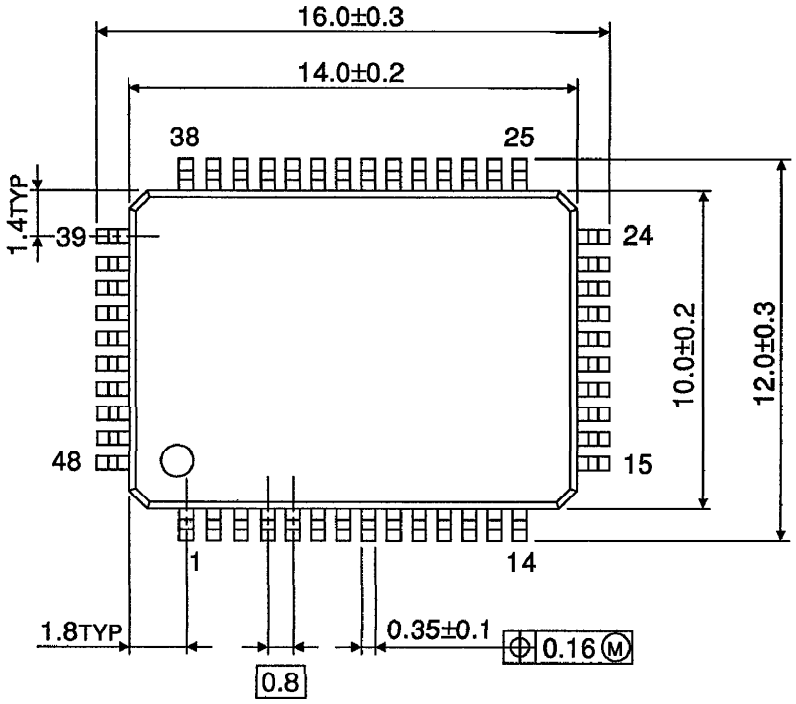
SDIP42-P-600-1.78 Unit : mm

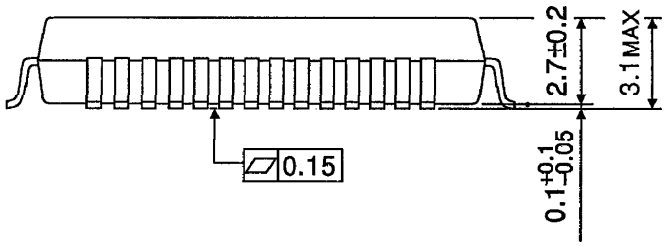


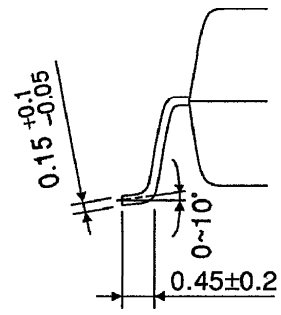
Weight : 4.13 g (Typ.)

OUTLINE DRAWING

QFP48-P-1014-0.80 Unit : mm







Weight : g (Typ.)