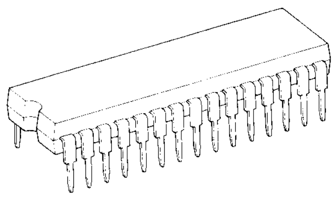
TOSHIBA Bi−CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB62708N

16BIT SHIFT REGISTER, LATCHES & CONSTANT CURRENT SOURCE DRIVERS

The TB62708N is specifically designed for LED and LED DISPLAY (Cathode Common) constant current drivers.
This constant current output circuits is able to set up external resistor (I_{OUT} = 5~90 mA).
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.


SDIP30-P-400-1.78

Weight: 1.99 g (typ.)

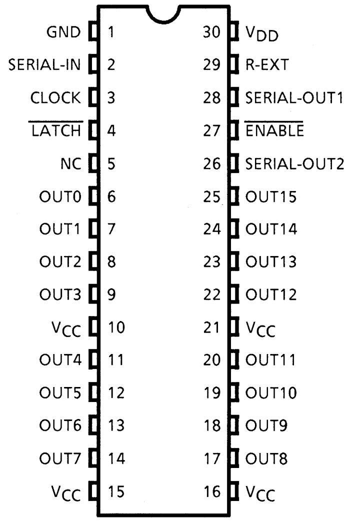
FEATURES

- Constant Current Output:
  Can set up all output current with one resistor for 5 to 90 mA.
- Constant Output Current Matching:

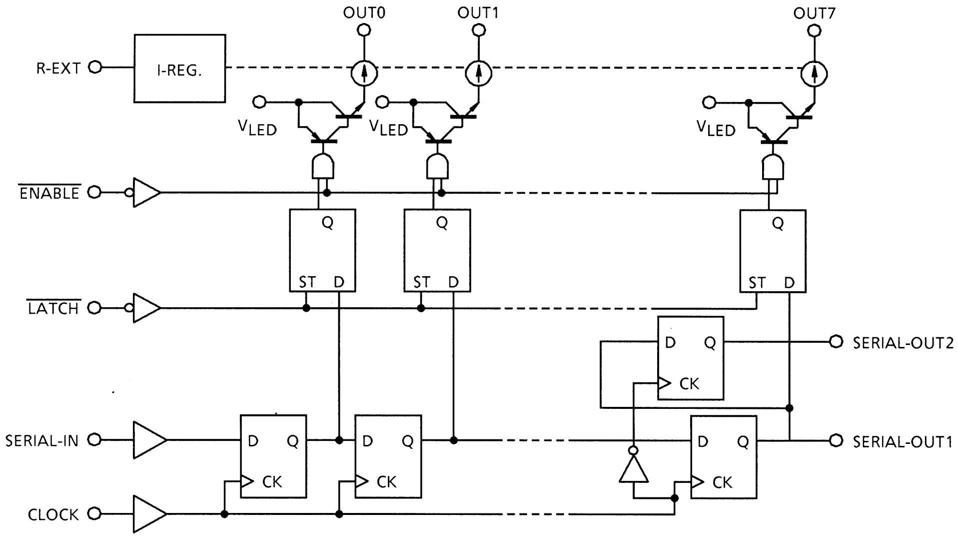
OUTPUT−GND VOLTAGE	CURRENT MATCHING	OUTPUT CURRENT
≥2.0 [V]	±6.0 [%]	−90 [mA]

- Maximum Clock Frequency : f_{CLK} = 15 [MHz] (Cascade Connected Operate, T_{opr} = 25°C)
- 5 V CMOS Compatible Input
- Package : SDIP30−P−400−1.78 (TB62708N)

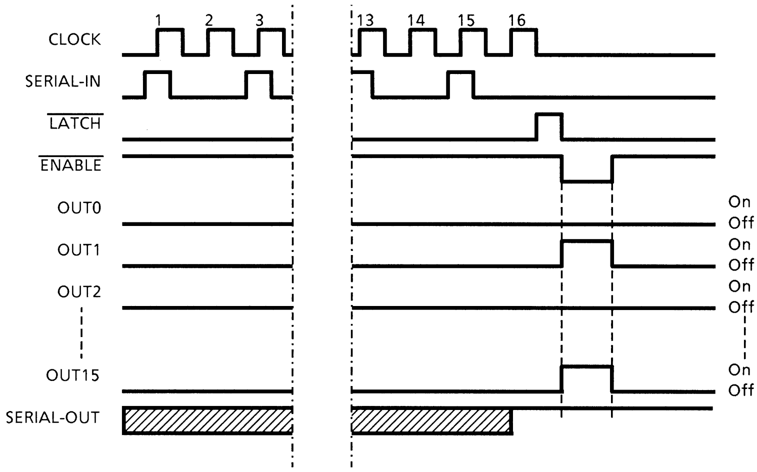
PIN CONNECTION (Top view)



BLOCK DIAGRAM



TIMING DIAGRAM



Note: Latches are level sensitive, not rising edge sensitive and not synchronous CLOCK.
Input of $\overline{\text{LATCH}}$ −terminal to "H" level, data passes latches, and input to "L" level, data hold latches.
Input of $\overline{\text{ENABLE}}$ −terminal to "H" level, all output (OUT0~15) do off.

TERMINAL DESCRIPTION

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.
6~9, 11~14, 17~20, 22~25	OUT0~15	Output terminals.
27	$\overline{\text{ENABLE}}$	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.
26	SERIAL−OUT2	Output terminal of a serial−data for next SERIAL−IN terminal.
28	SERIAL−OUT1	Output terminal of a serial−data for next SERIAL−IN terminal.
29	R−EXT	Input terminal of connects with a resister for to set up all output current.
30	V_{DD}	5 V Supply voltage terminal
10, 15, 16, 20	V_{CC}	0~17 V Supply voltage terminal for LED

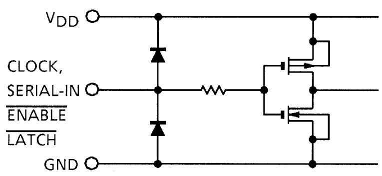
TRUTH TABLE

CLOCK	$\overline{\text{LATCH}}$	$\overline{\text{ENABLE}}$	SERIAL−IN	OUT0 ··· OUT7 ··· OUT15	SERIAL−OUT1	SERIAL−OUT2
UP	H	L	D_n	D_n ··· D_{n-7} ··· D_{n-15}	D_{n-15}	D_{n-16}
DOWN	H	L	D_n	D_n ··· D_{n-7} ··· D_{n-15}	No change	D_{n-15}
UP	L	L	D_{n+1}	No change (data hold)	D_{n-14}	No change
DOWN	L	L	D_{n+1}	No change (data hold)	No change	D_{n-14}
No Edge	H	L	D_{n+1}	D_{n+1} ··· D_{n-6} ··· D_{n-14}	No change	No change
No Edge	X	H	D_{n+1}	Off	D_{n-14}	No change

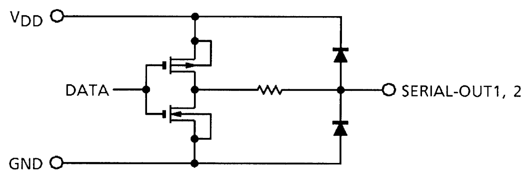
Note: OUT0~15 = on in case of D_n = "H" level and OUT0~15 = off in case of D_n = "L" level.
A resistor is connected with R−EXT and GND accompanied with outside, and it is necessary that a correct power supply voltage is supplied.

EQUIVALENT CIRCUIT OF INPUTS AND OUTPUTS

1. $\overline{\text{ENABLE}}$, $\overline{\text{LATCH}}$, CLOCK & SERIAL−IN terminal



2. SERIAL−OUT terminal



ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	0~7.0	V
Supply Voltage for LED	V_{CC}	0~17	V
Input Voltage	V_{IN}	−0.4~V_{DD} + 0.4	V
Output Current	I_{OUT}	−90	mA
Output Voltage	V_{CE}	−0.4~17.0	V
Clock Frequency	f_{CK}	15	MHz
GND Terminal Current	I_{VCC}	1440	mA
Power Dissipation	P_D	2.08 (ON PCB, Ta = 25°C)	W
		1.56 (FREE AIR, Ta = 25°C)	
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~150	°C

Note: Ambient temperature delated above 25°C in the proportion of 16.64 mW / °C on PCB.
On PCB (100 × 150 ×1.6 mm.Universal PCB).

RECOMMENDED OPERATING CONDITION
(V_{DD} = 5 V, Ta = −40~85°C unless otherwise noted)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP.	MAX	UNIT
Supply Voltage	V_{DD}	—	4.5	5.0	5.5	V
Supply Voltage for LED	V_{CC}	GND Standard	0	—	17	V
Output Voltage	V_{OUT}	V_{CC} Standard	0	—	−17	V
Output Current	I_{OUT}	OUTn, DC 1 circuit	−5	—	−78	mA
	I_{OH}	SERIAL−OUT 1, 2	—	—	1.0	
	I_{OL}	SERIAL−OUT 1, 2	—	—	−1.0	
Input Voltage	V_{IH}	V_{DD} = 4.5~5.5V	0.7 V_{DD}	—	V_{DD} +0.3	V
	V_{IL}		−0.3	—	0.3 V_{DD}	
$\overline{\text{LATCH}}$ Pulse Width	$t_{w\,\overline{LAT}}$		100	—	—	ns
CLOCK Pulse Width	$t_{w\,CLK}$		50	—	—	ns
$\overline{\text{ENABLE}}$ Pulse Width	$t_{w\,\overline{EN}}$		1000	—	—	ns
Set−Up Time	t_{setup}		50	—	—	ns
Hold Time	t_{hold}		30	—	—	ns
Clock Frequency	f_{CLK}	Cascade operation	—	—	10.0	MHz
Power Dissipation	P_D	ON PCB, Ta = 85°C	—	—	1.08	W

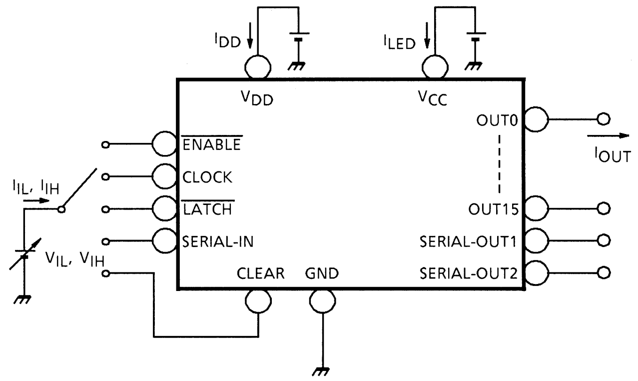
ELECTRICAL CHARACTERISTICS
(V_{CC} = 17 V, V_{DD} = 5 V, Ta = 25°C unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR−CUIT	TEST 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_{LEAK}	—	V_{CC} = 17.0 V		—	—	−10	μA
Output Voltage	S−OUT	V_{OL}	—	I_{OL} = 1.0 mA		—	—	0.4	V
		V_{OH}	—	I_{OL} = −1.0 mA		4.6	—	—	
Output Current 1		I_{OL1}	—	V_{OUT} = V_{CC} −2.0 V	R_{EXT} = 360 Ω (Include skew)	−66.3	−78	−89.7	mA
	Current Skew	ΔI_{OL1}	—	V_{OUT} = V_{CC} −2.0 V	R_{EXT} = 360 Ω	—	±1.5	±6.0	%
Supply Voltage Regulation		% / V_{DD}	—	R_{EXT} = 360 Ω, Ta = −40~85°C		—	1.5	5.0	% / V
Supply Current 1	“OFF”	$I_{DD\ (off)}$	—	R_{EXT} = OPEN, OUT0~15 = off		—	0.6	1.2	mA
	“ON”	$I_{DD\ (on)}$	—	R_{EXT} = 360 Ω, DATA = “H” OUT0~15 = on		—	10.0	15.0	
Supply Current 1	“OFF”	$I_{CC\ (off)}$	—	R_{EXT} = 360 Ω, ALL DATA = “H” OUT0~15 = off		—	1.0	2.0	mA
	“ON”	$I_{CC\ (on)}$	—	R_{EXT} = 360 Ω, ALL DATA = “H” OUT0~15 = on		—	1260	—	

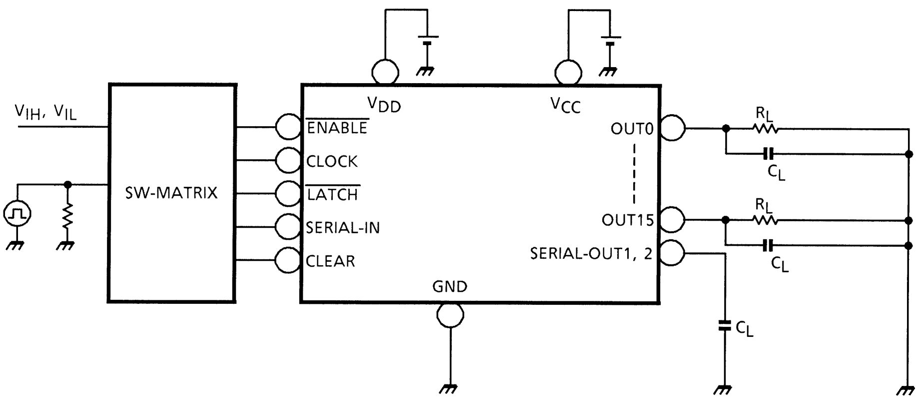
SWITCHING CHARACTERISTICS (Ta = 25°C, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Propagation Delay Time ("L" to "H")	CLK−OUTn	t_{pLH}	—	{CLK, $\overline{LATCH}$ & $\overline{ENABLE}$ to t_{pLH} & t_{pHL}: 50% to 50%} V_{DD} = 5.0 V, V_{CC} = 17.0 V V_{OUT} = V_{CC} − 2.0 V V_{IH} = V_{DD} V_{IL} = GND R_{EXT} = 360 Ω R_L = 300 Ω	—	200	500	ns
	$\overline{LATCH}$ −OUTn				—	200	500	
	$\overline{ENABLE}$ −OUTn				—	200	500	
	CLK−SOUT					30	70	
Propagation Delay Time ("H" to "L")	CLK−OUTn	t_{pHL}	—		—	200	500	ns
	$\overline{LATCH}$ −OUTn				—	200	500	
	$\overline{ENABLE}$ −OUTn				—	200	500	
	CLK−SOUT				—	30	70	
Pulse Width	CLK	$t_{w\ CLK}$	—		—	20	30	ns
	$\overline{LATCH}$	$t_{w\ \overline{LAT}}$	—		—	10	25	
Set−up Time for $\overline{LATCH}$ & CLOCK		t_{setup}	—		—	25	50	ns
Hold Time for $\overline{LATCH}$ & CLOCK		t_{hold}	—		—	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

DC CHARACTERISTICS TEST CIRCUIT



AC CHARACTERISTICS TEST CIRCUIT

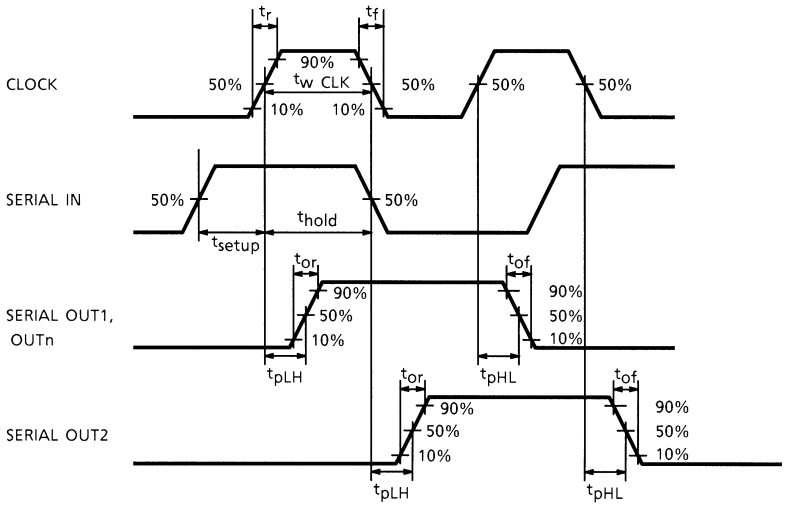


PRECAUTIONS for USING

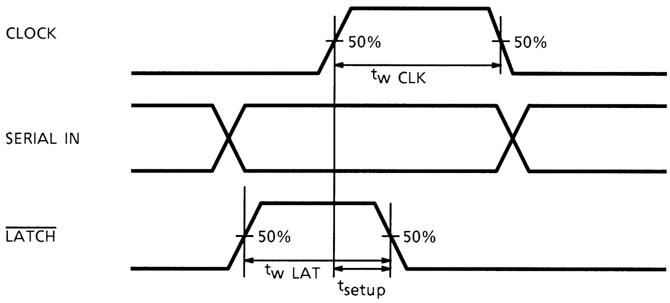
Utmost care is necessary in the design of the output line, V_{CC} (V_{DD}) and GND line since IC may be destroyed due to short−circuit between outputs, air contamination fault, or fault by improper grounding.

TIMING WAVEFORM

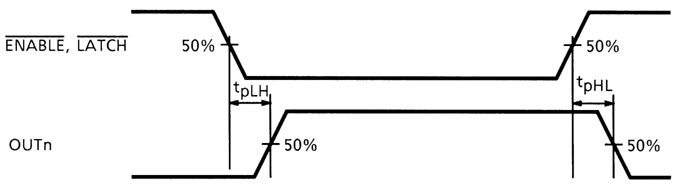
1. CLOCK−SERIAL OUT, OUTn

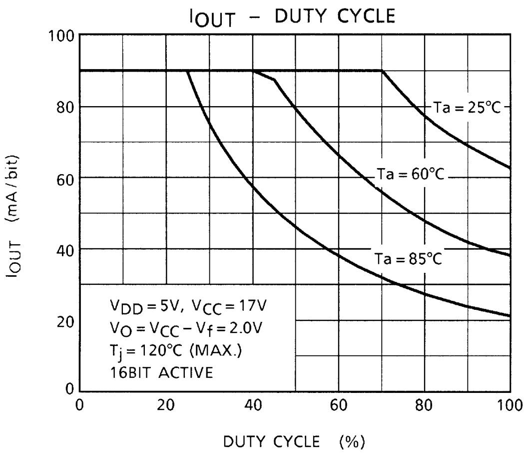


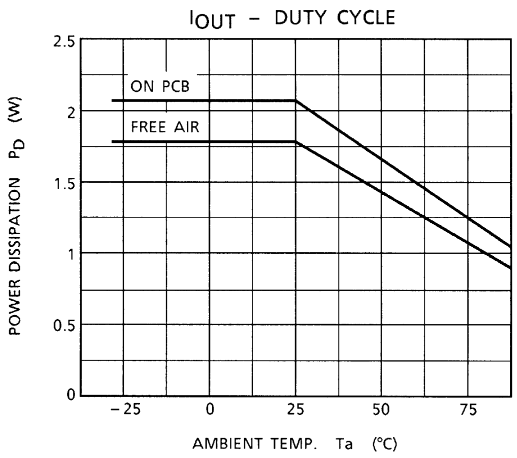
2. CLOCK−$\overline{\text{LATCH}}$



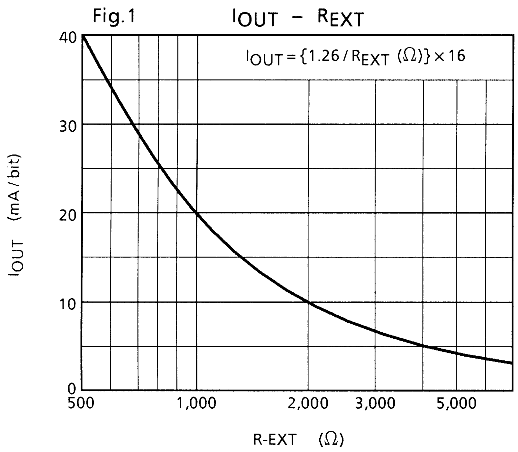
3. $\overline{\text{ENABLE}}$, $\overline{\text{LATCH}}$−OUTn







LED DRIVER TB6270X SERIES APPLICATION NOTE



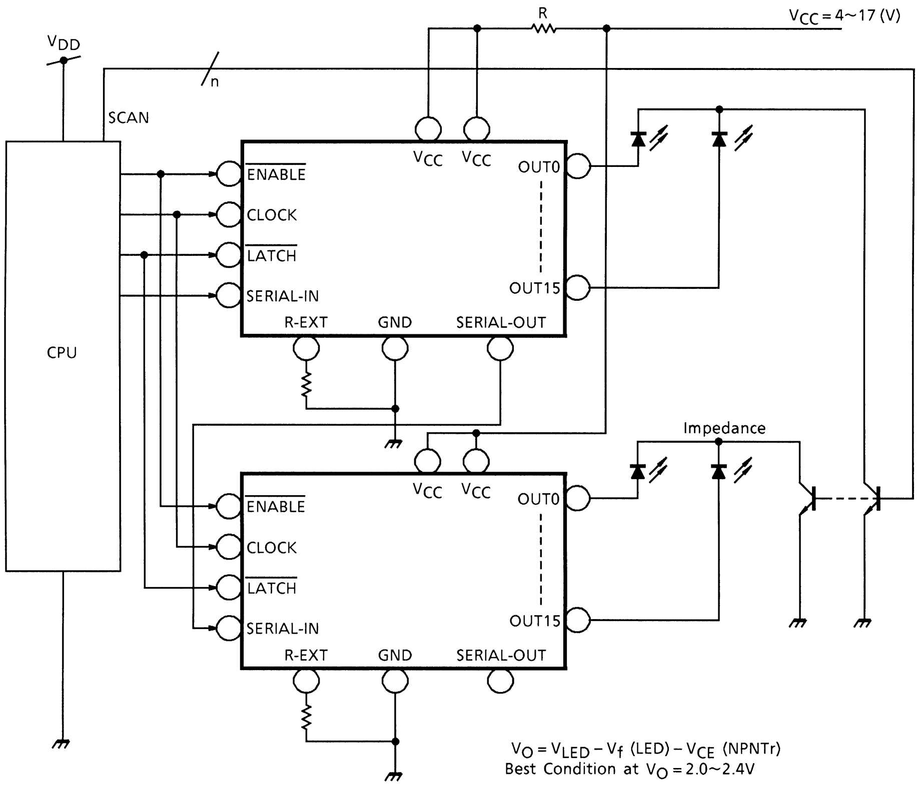
[1] Output current (I_{OUT})
I_{OUT} is set by the enternal resistor (R−EXT) as shown in Fig.1.

[2] Total supply voltage (V_{LED})
This device can operate 2.0~2.3V (V_O).
When a higher voltage is input to the devide, 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 recommended to set the total supply voltage as shown below.

V_{LED} (Total supply voltage)
= V_{CE} (Tr 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 devide, an additional R can decrease the supply voltage (V_O).

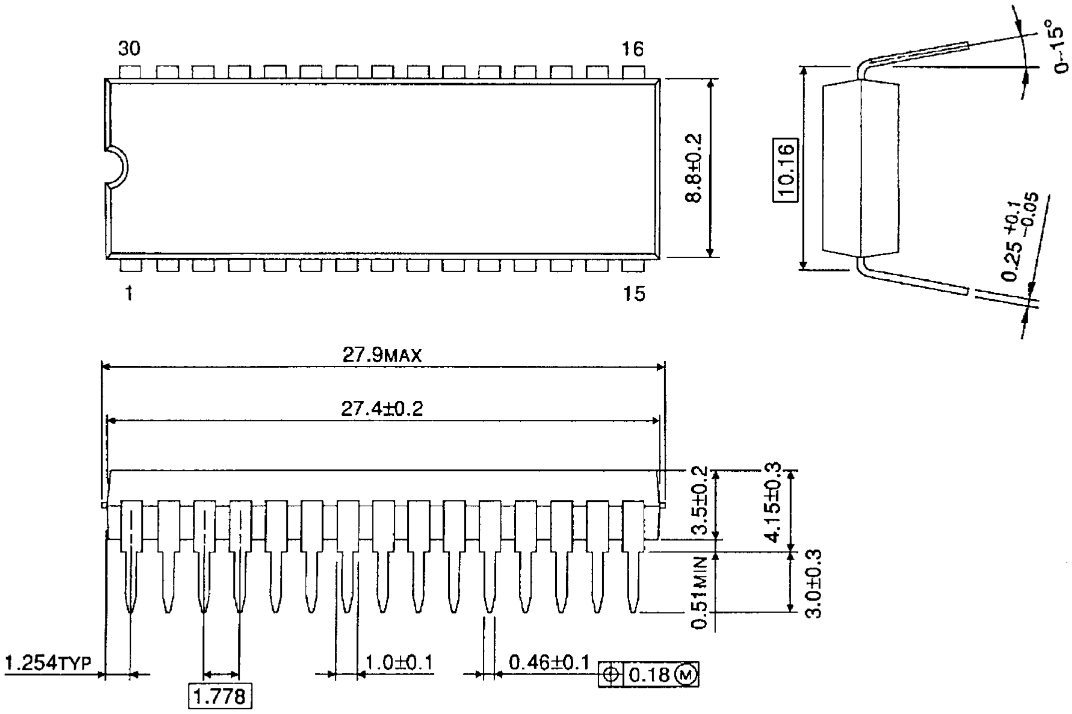
APPLICATION



[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 life you to pay attention to pattern layout to minimize inductance.

Package Dimensions

SDIP30-P-400-1.78 Unit : mm



Weight: 1.99 g (typ.)

Notes on Contents

1. Block Diagrams

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

2. Equivalent Circuits

The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Timing Charts

Timing charts may be simplified for explanatory purposes.

4. Application Circuits

The application circuits shown in this document are provided for reference purposes only.
Thorough evaluation is required, especially at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

5. Test Circuits

Components in the test circuits are used only to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

IC Usage Considerations

Notes on Handling of ICs

(1) The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

(2) Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

(3) If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

(4) Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

(5) Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.
If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

Points to Remember on Handling of ICs

(1) Heat Radiation Design
In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (Tj) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

(2) Back-EMF
When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor's power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device's motor power supply and output pins might be exposed to conditions beyond maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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