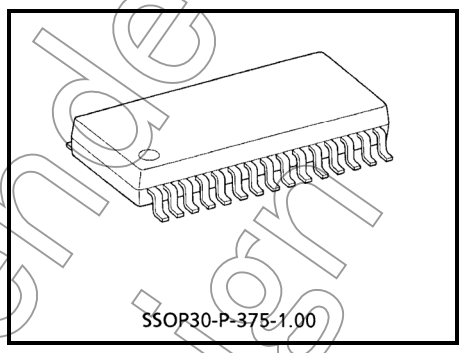
TOSHIBA BIPOLAR DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TD62650FG,TD62651FG,TD62652FG

5V POWER SUPPLY & SUPPLY MONITORING + COMMUNICATIONS IC

The TD62650FG series covers products developed for use in microcomputer systems applicable to automatic vending machines. They produce an output voltage of 5 V ± 0.5 V without need for adjustment, through their accurate reference voltage and amplifier circuit.
The 5V section can reset the system by outputting reset signals at power−on, and also output a reset signal when the 5 V output voltage drops below the specified 92% (TD62650FG / 652FG) or 85% (TD62651FG) because of external disturbances or other problem.
It also incorporates a watchdog timer for self−diagnosing the system. When the system malfunctions, the IC generates reset pulses intermittently to prevent the system from running away.
The interface section incorporates three serial ports corresponding to the typical 24−V 4800 bps system in microcomputers.
The suffix (G) appended to the part number represents a Lead (Pb)-Free product.



Weight: 0.63 g (typ.)

FEATURES

- Accurate output : 5V ± 0.25 V
- Output PNP Tr incorporated : Current capacity ; 300 mA (max)
- Power−on Reset timer incorporated
- Watchdog timer incorporated
- Small flat package sealing : SSOP30 pin (1 mm pitch)

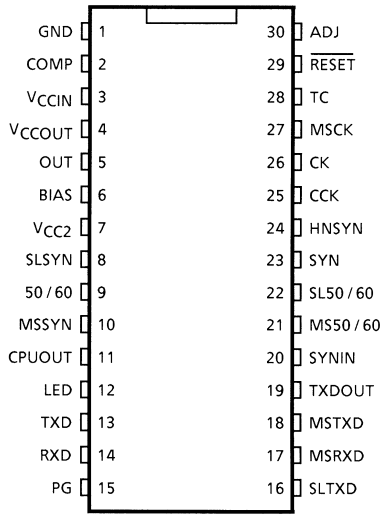
- Difference 1

CHARACTERISTIC	TD62650 / 652FG	TD62651FG
Reset Detecting Voltage	5V / 92%	5V / 85%

- Difference 2
  Time setting resistance 22 kΩ for power−on reset / watchdog timer, and PULL resistance of 4.7 kΩ for $\overline{\text{RESET}}$ pin.

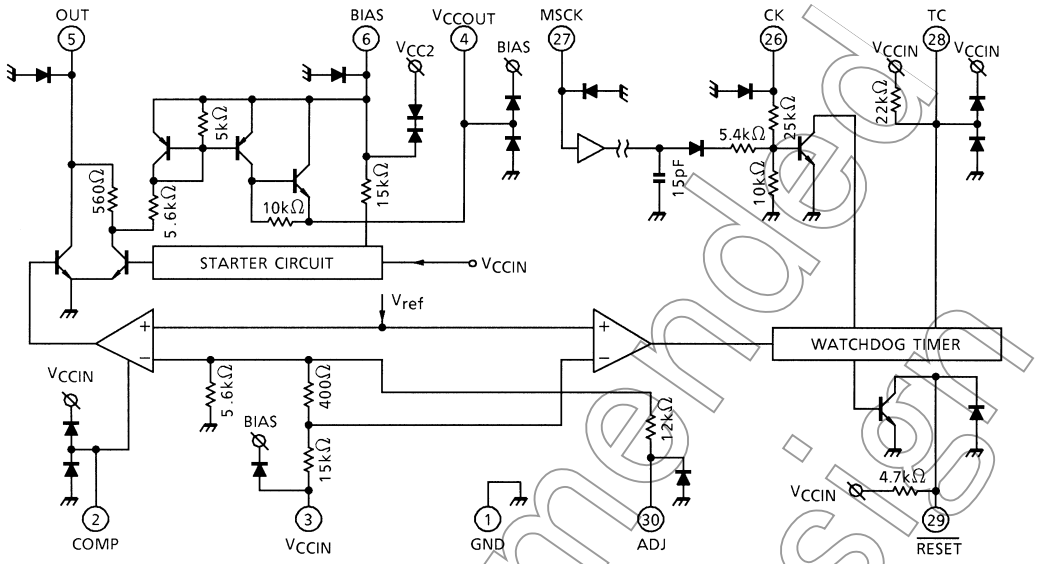
TD62650FG	TD62651FG	TD62652FG
Built−in	None	None

PIN CONNECTION

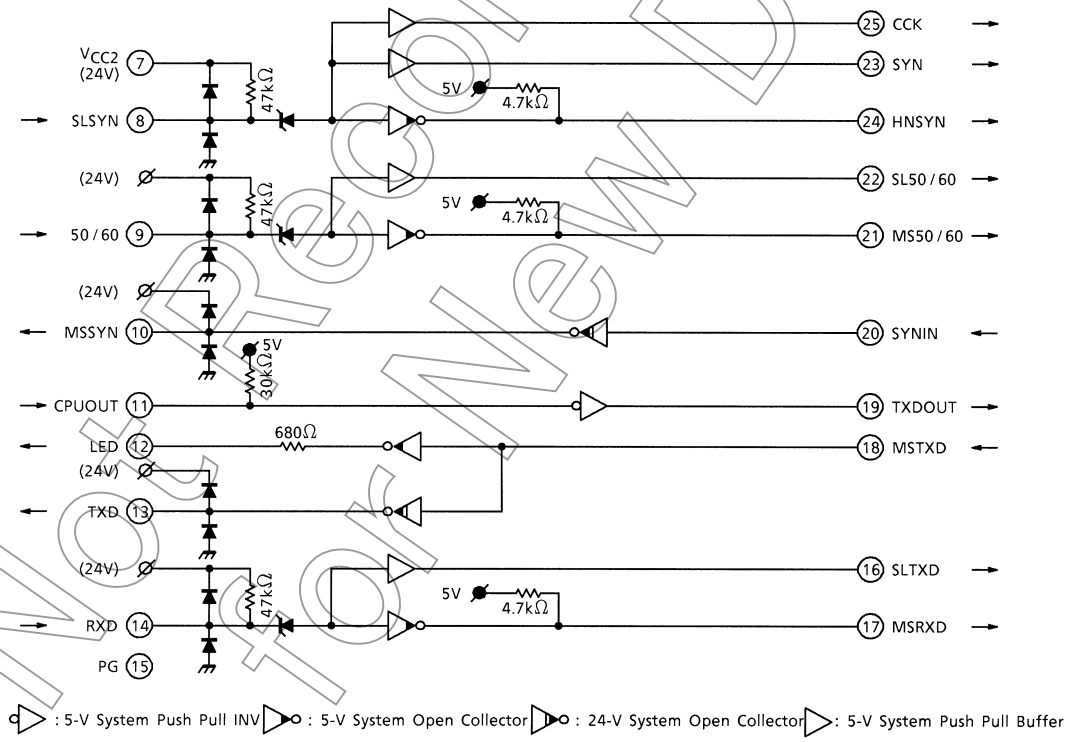


TD62650FG BLOCK DIAGRAM

5V POWER SUPPLY + SUPPLY MONITORING

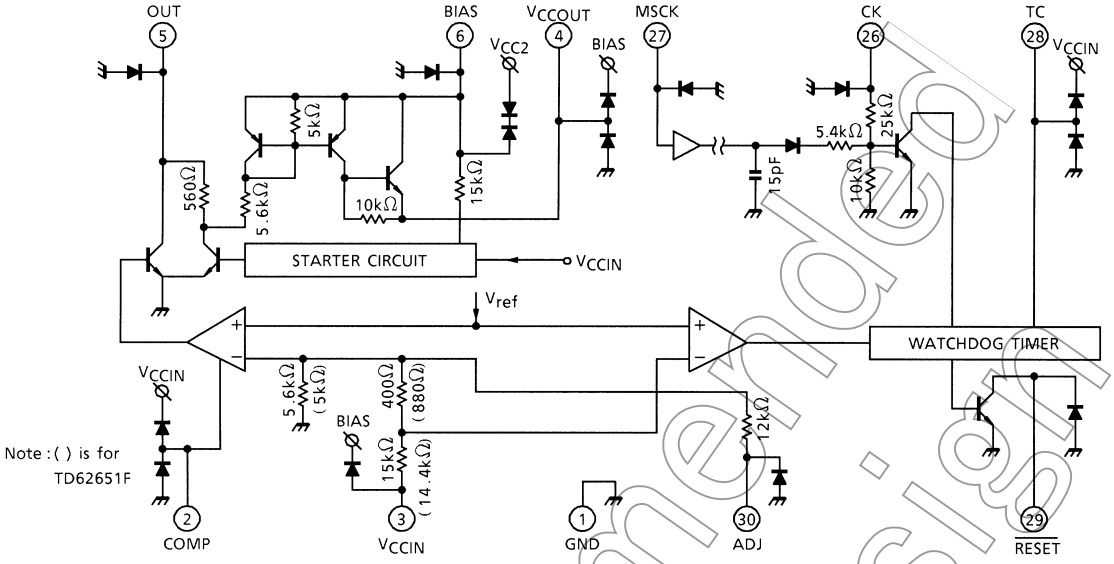


INTERFACE

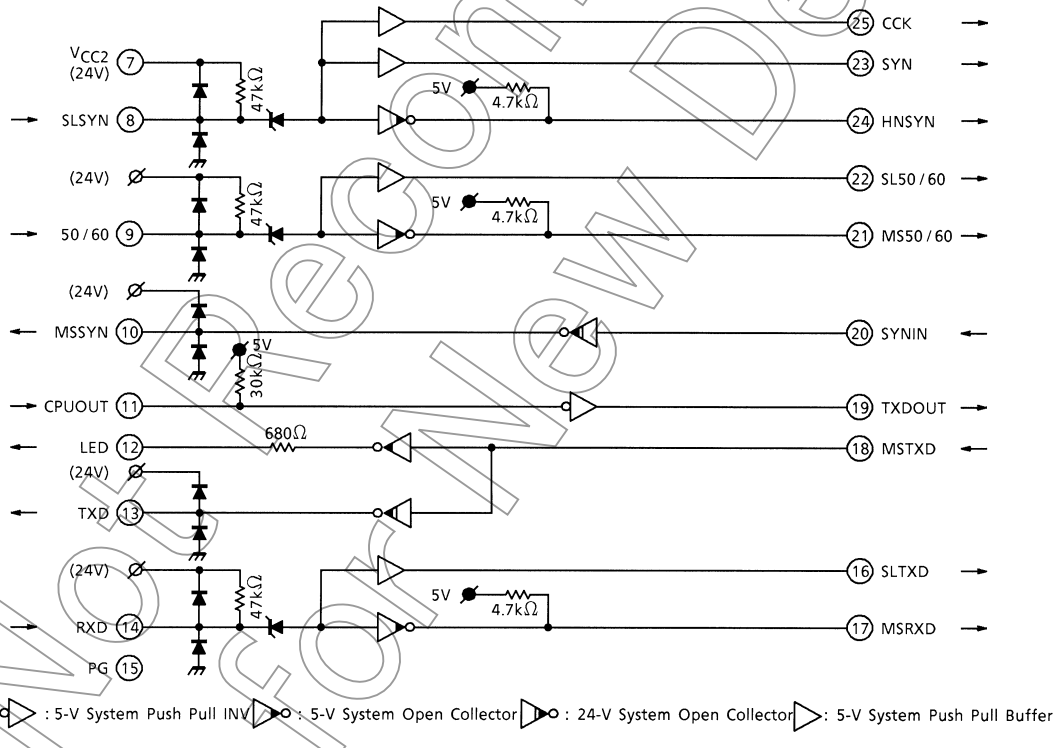


TD62651FG / TD62652FG BLOCK DIAGRAM

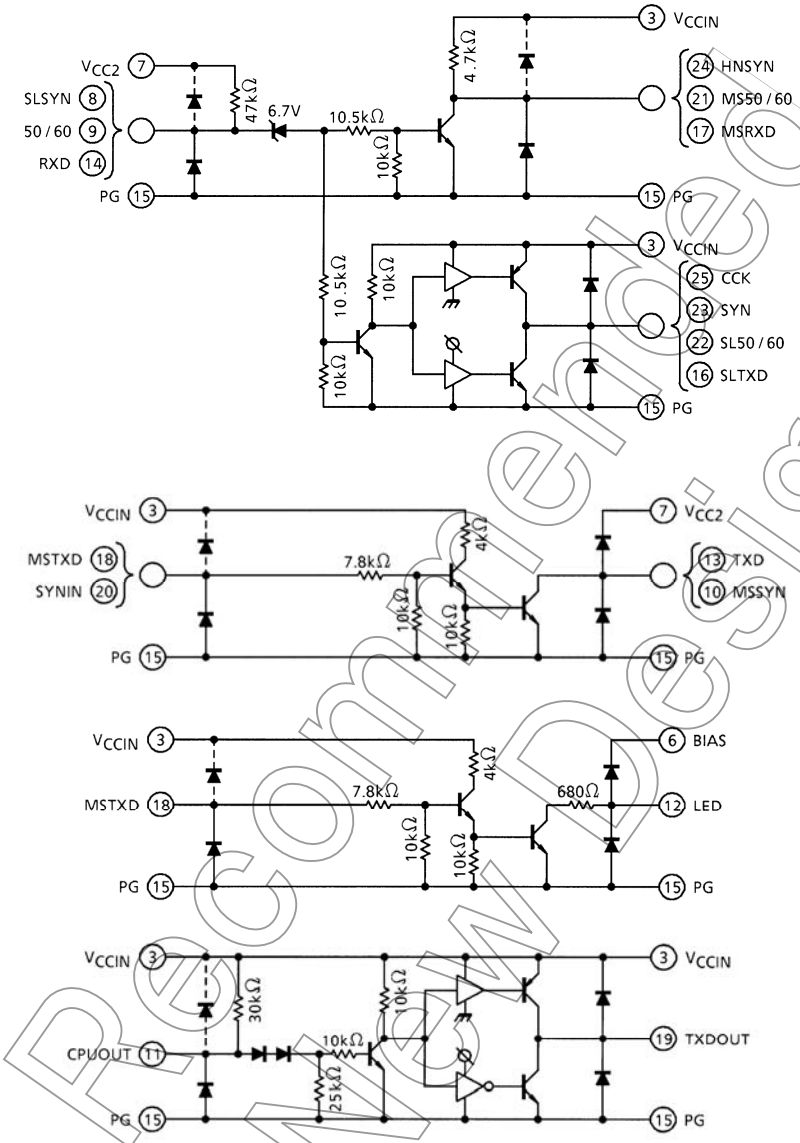
5V POWER SUPPLY + SUPPLY MONITORING



INTERFACE



INTERFACE INPUT / OUTPUT CIRCUITS

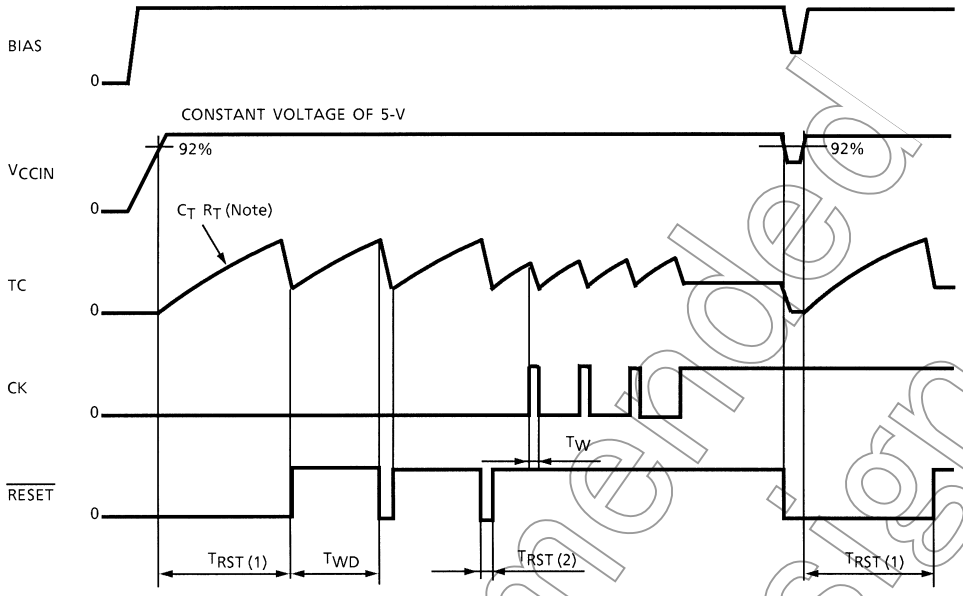


PIN FUNCTION

PIN No.	PIN NAME	PIN FUNCTION
1	GND	GND pin for 5 V power supply and supply monitoring.
2	COMP	Phase compensation pin for output stabilization.
3	V_{CCIN}	Power supply pin for internal circuit. The output voltage can also be detected at this pin.
4	V_{CCOUT}	Output pin for built−in Power Tr, having a current capacitance of 300 mA (max). It is also used as an output pin for 5 V constant power supply through shorting with V_{CCIN} pin.
5	OUT	Connected to the base of an external PNP transistor so that the output voltage is stabilized. Current design suitable for load capacities is thus possible. Since the recommended I_{OUT} current is 5 mA, an output current of 300 mA is assured if the external transistor has an hFE of 60. When the internal transistor is used, it can be opened.
6	BIAS	Power supply starting pin. The starting current is supplied through a resistor to which the input voltage is applied. When V_{CCIN} rises above 3.0 V, the starting current is absorbed in the internal circuit ; instead, I_{OUT} is supplied via V_{CCIN}.
7	V_{CC2}	Power supply pin for the 24−V system.
8	SLSYN	Input pin for the 24−V system interface. Pull−up resistor 47 kΩ is incorporated at V_{CC2} pin.
9	50 / 60	Input pin for 24−V system interface. Pull−up resistor 47 kΩ is incorporated at V_{CC2} pin.
10	MSSYN	Output pin for the 24−V system open collector.
11	CPUOUT	Input pin for the 5−V system Push / Pull inverter. Pull−up resistor 30 kΩ is incorporated at V_{CCIN} pin.
12	LED	LED lighting pin for the 8 system open collector. 680 Ω limiting resistor is incorporated.
13	TXD	Output pin for the 24−V system open collector.
14	RXD	Input pin for the 24−V system interface. Pull−up resistor 47 kΩ is incorporated at the V_{CC2} pin.
15	PG	GND pin for the 5−V / 24−V system interfaces.
16	SLTXD	Output pin for the 5−V system open collector. Pull−up resistor 4.7 kΩ is incorporated at the V_{CCIN} pin.
17	MSRXD	Output pin for the 5−V system Push−Pull buffer.
18	MSTXD	Input pin for the 5−V system interface, for input at LED (12 pin) and TXD (13 pin) pins.
19	TXDOUT	Output pin for the 5−V system Push / Pull inverter (CPUOUT : 11 pin).
20	SYNIN	Input pin for the 5−V system interface.
21	MS50 / 60	Output pin for the 5−V system open collector. Pull−up resistor 4.7 kΩ is incorporated at V_{CCIN} pin.
22	SL50 / 60	Output pin for the 5−V system Push / Pull buffer.
23	SYN	Output pin for the 5−V system Push−Pull buffer.
24	HNSYN	Output pin for the 5−V system open collector. Pull−up resistor 4.7 kΩ incorporated at V_{CCIN} pin.
25	CCK	Output pin for the 5−V system Push−Pull buffer.

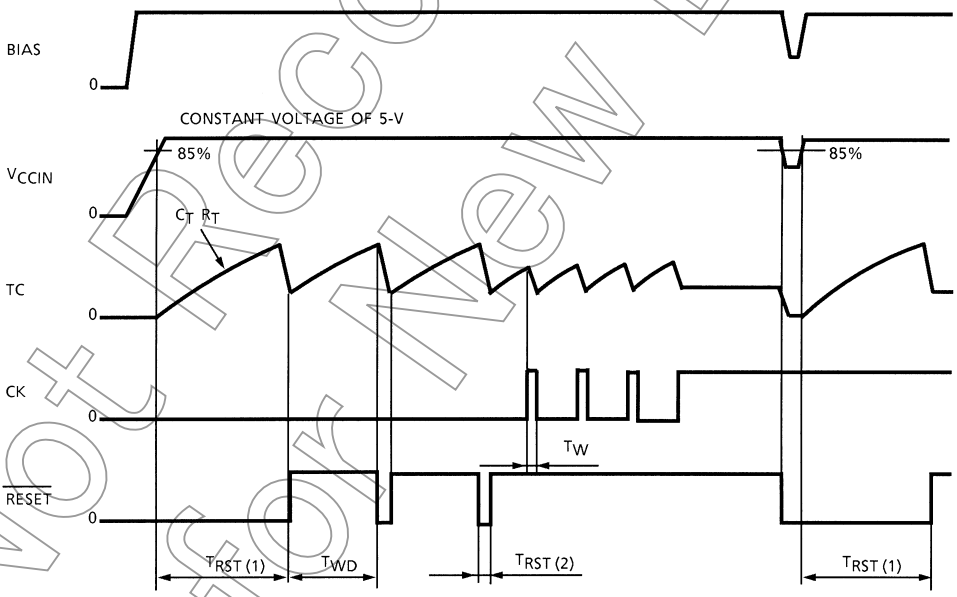
PIN No.	PIN NAME	PIN FUNCTION
26	CK	Input pin for watchdog timer. The pin is pulled up to V_{CCIN} if the IC is used only as a power−on reset timer.
27	MSCK	To input clock pulses, one−shot pulses can be generated for CK (26 pin) inputs at the rise edge. When the pin is not used, short it with GND.
28	TC	Time setting pin for the reset and watchdog timers.
29	$\overline{\text{RESET}}$	NPN transistor open−collector output. (1) The signal goes low when the output voltage drops below the specified 92% (TD62650 / 652) or 85% (651) level. (2) The pin generates a reset signal that is determined by the external condenser connected to the TC pin. (3) The pin generates reset pulses intermittently if no clock is attached to the CK pin. This function can be used as a watchdog timer for microcomputers.
30	ADJ	Output voltage adjusting pin. The voltage will increase when a resistor is connected between ADJ and GND (1 pin). It can reduce the voltage when the resistor is inserted between ADJ and V_{CCIN} (3 pin). The voltage can be changed by a maximum of ± 1V.

TIMING CHART (TD62650FG, TD62652FG)



Note: TD6250FG incorporates RT (22kΩ (Typ.) only for C_T.)

TIMING CHART (TD62651FG)



ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT	PIN
Input Voltage	VV_{CC24}	−0.4~35	V	V_{CC2}, BIAS
	VV_{CCIN}	−0.4~7	V	V_{CCIN}
	V_{IN24} (Condition 1) (Condition 2)	−0.4~VV_{CC2} + 0.4−0.4~30	V	SLSYN, 50 / 60, RXD
	V_{IN5}	−0.4~VV_{CCIN} + 0.4	V	CPUOUT, MSCK, ADJ, COMP, CK, TC, SYNIN, MSTXD
Output Voltage	V_{OUT24}	−0.4~VV_{CC2} + 0.4	V	MSSYN, TXD
	VV_{CCOUT}	−0.4~V_{BIAS} + 0.4	V	V_{CCOUT}, OUT
	V_{LED} (Condition 3) (Condition 4)	−0.4~V_{BIAS} + 0.4−0.4~10	V	LED
	V_{OUT5}	−0.4~VV_{CCIN} + 0.4	V	$\overline{\text{RESET}}$, CCK, HNSYN, SYN, SL50 / 60, MS50 / 60, TXDOUT, MSRXD, SLTXD
Output Current	I_{OUT}	10	mA	OUT
	I_{RESET}	4	mA	$\overline{\text{RESET}}$
	I_{OUT} Push / Pull	±4	mA / ch	CCK, SYN, SL50 / 60, TXDOUT, SLTXD
	I_{OUT5}	10	m / ch	HNSYN, MS50 / 60, LED, MSRXD
	I_{OUT24}	24	mA / ch	MSSYN, TXD
	IV_{CCOUT}	300	mA	V_{CCOUT}
Power Dissipation	P_D (Note 5)	1.47	W	
Operating Temperature	T_{opr}	−40~85	°C	
Storage Temperature	T_{stg}	−55~150	°C	

Condition 1: $VV_{CC2} \leq 29.6$ V
Condition 2: $VV_{CC2} > 29.6$ V
Condition 3: $V_{BIAS} \leq 9.6$ V
Condition 4: $V_{BIAS} > 9.6$ V
Note 5: Board mounting time (50 × 50 × 1.6 mm, Cu = 30%)

DC ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{CCIN} = 5 V)

Interface Section

CHARACTERISTIC	SYMBOL	PIN	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Input Voltage	V_{IH5}	(Note 1)	—		V_{CCIN} × 70%	—	—	V
	V_{IL5}				—	—	V_{CCIN} × 30%	
	V_{IH24}	(Note 1)			13	—	V_{CC2} + 0.4	
	V_{IL24}				−0.4	—	7	
Input Current	I_{IH5-1}	(Note 3)	—	V_{IN} = 5 V	320	462	600	μA / ch
	I_{IL5-1}			V_{IN} = 0 V	—	0	10	μA
	I_{IH5-2}	(Note 7)		V_{IN} = 5 V	480	690	940	
	I_{IL5-2}			V_{IN} = 0 V	115	170	240	
	I_{IH24}	(Note 2)		V_{IN} = 24 V	1.1	1.6	2.1	mA / ch
	I_{IL24}			V_{IN} = 0 V	350	510	690	μA
Output Voltage	V_{OH5-1}	(Note 4)	—	I_{OH} = −20 μA	V_{CC} − 0.1	—	—	V
	V_{OH5-2}			I_{OH} = −4 mA	V_{CCIN} × 70%	—	—	
	V_{OL5-1}			I_{OL} = 20 μA	—	—	0.1	
	V_{OL5-2}			I_{OL} = 4 mA	—	—	V_{CCIN} × 30%	
	V_{OL5-3}	(Note 5)		I_{IN} = 500 μA I_{OL} = 10 mA	—	—	0.5	
	V_{OL} LED	LED		I_{IN} = 200 μA I_{OL} = 1 mA	—	—	1.4	
	V_{OL24}	(Note 6)		I_{IN} = 200 μA I_{OL} = 24 mA	—	—	0.5	
Output Impedance	R_{OL} LED	LED	—	(Note 8)	540	680	1000	Ω
	R_{OH5}	(Note 5)		(Note 9)	3.2	4.7	6.2	kΩ
Current Consumption 24	IV_{CC2}		—	VV_{CC2} = 24 V	—	1.6	2.1	mA
Leakage Current	I_{LEAK24}	(Note 6)	—	V_{OH} = 24.0 V	—	—	10	μA
	I_{LEAK5}	(Note 4)		V_{OH} = 5 V	—	—	10	
Output Shorting Current	I_{OS} (Note)	(Note 4)	—	V_{CCIN} = 5.25 V V_{OH} = 0 V	—	17.5	—	mA

Note: Two outputs or more must not be shorted at the same time.
Shorting duration must be limited to less than 1 second.

Note 1: CPUOUT, SYNIN, MSTXD
Note 2: SLSYN, 50 / 60, RXD
Note 3: SYNIN, MSTXD
Note 4: CCK, SYN, SL50 / 60, TXDOUT, SLTXD
Note 5: HNSYN, MS50 / 60, MSRXD
Note 6: MSSYN, TXD
Note 7: CPUOUT
Note 8: (V_{OL} (@I_{OL} = 5 mA) − V_{OL} (@I_{OL} = 1 mA)) ÷ 4 mA
Note 9: 4 V ÷ (@I_{OH} (V_{OH} = 0 V) − @I_{OH} (VOH = 4 V))

DC ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{BIAS} = 7 to 17 V, Ta = −40 to 85°C)
5V power supply, supply monitoring section

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Output Voltage	V_{CCOUT}	—	IV_{CCOUT} = 0.1 A	4.75	5.0	5.25	V
Input Stability	V_{CCOUT} LINE	—	V_{BIAS} = 7~35 V	—	0.1	0.5	%
Load Stability	V_{CCOUT} LOAD	—	IV_{CCOUT} = 1~150 mA	—	0.1	0.5	%
Temperature Coefficient	V_{CCOUT} t	—		—	0.01	—	% / °C
Output Voltage	V_{OL} $\overline{RESET}$	—	I_{OL} = 2 mA	—	—	0.5	V
Output Leakage Current	$\frac{I_{LEAK}}{RESET}$	—	V_{RESET} = 7 V	—	—	5	μA
Input Current	I_{TC}	—	V_{TC} = 0 to 3.5 V (Note 8)	−3	—	3	μA
Threshold Voltage	V_{TC} H	—	$\overline{RESET}$ "High" to "Low"	—	80% × V_{CCIN}	—	V
	V_{TC} L		$\overline{RESET}$ "Low" to "High"	—	40% × V_{CCIN}	—	
Input Current	I_{CK}	—	V_{IN} = 5 V (Note 8)	—	0.3	0.7	mA
Input Voltage	V_{IH}	—	(Note 4)	V_{CCIN} × 70%	—	—	V
	V_{IL}			—	—	V_{CCIN} × 30%	
Reset Detecting Voltage	V_{CC} $\overline{RESET}$	—	TD62650 / 652FG	89% × V_{CCIN}	92% × V_{CCIN}	95% × V_{CCIN}	V
			TD62651FG	82% × V_{CCIN}	85% × V_{CCIN}	88% × V_{CCIN}	
Output Impedance	$\frac{R_{OH}}{RESET}$	—	TD62650FG (Note 1)	3.2	4.7	6.2	kΩ
	R_{OH} TC		TD62650FG (Note 1)	15	22	29	
Current Consumption 5	IV_{CCIN}	—	(Note 2)	—	5	6.5	mA
			(Note 5)	—	11.5	15.0	
Bias Current Consumption	I_{BIAS}	—	V_{BIAS} = 8V (Note 7)	—	1.73	2.25	mA
Watchdog Timer	T_{WD}	—	TD62650FG (Note 6)	15.4 × CT	24.2 × CT	33.0 × CT	ms
			TD62651 /652FG	0.9 × CTRT	1.1 × CTRT	1.3 × CTRT	s
Reset Timer (1) (Note 3)	T_{RST} (1)	—	TD62650FG (Note 6)	24.2 × CT	35.2 × CT	48.4 × CT	ms
			TD62651 / 652FG	1.3 × CTRT	1.6 × CTRT	1.9 × CTRT	s
Reset Timer (Note 3)	T_{RST} (2)	—	(Note 6)	300 × CT	600 × CT	900 × CT	ms

CHARACTERISTIC	SYMBOL	TEST CIR−CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Clock Input Pulse width	TW CK	—		3	—	—	μs
Maximum Response Frequency 1	f_{MAX} MSCK	—		2	—	—	kHz
Maximum Response Frequency 2	f_{MAX} CK	—		10	—	—	kHz
Msck Pin Input Signal Rise Time	tr MSCK	—	(Note 9)	—	—	500	ns
Minimum Input / Output Voltage Difference	V_{OH} V_{CCOUT}	—	IV_{CCOUT} = 0.1 A	—	—	1.5	V

Note 1: 4 V ÷ (@I_{OH} (V_{OH} = 0 V) − @I_{OH} (V_{OH} = 4 V)
Note 2: V_{BIAS} = 8 V, V_{CCIN} − V_{CCOUT} Short
Open Collector I / O : Open
Push−Pull I / O : Open
MSCK Input : Open
Note 3: Reset Timer (1) : Power On Reset Time
Reset Timer (2) : Watchdog Reset Time
Note 4: MSCK, CK Pins
Note 5: HNSYN, MS50 / 60, MSRXD Pull / UP Resistance + CCK, SYN, SL50 / 60, TXDOUT, SLTXD Driving Current
Note 6: CT Unit (μF)
Note 7: V_{CCIN}, V_{CCOUT} Open
Note 8: Only TD62651FG, TD62652FG
Note 9: Input Condition 5 V : 0 to 100%

AC ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	CHARACTERISTIC / INPUT CONDITION	SYMBOL	TEST CIR-CUIT	OUTPUT CONDITION	MIN	TYP.	MAX	UNIT
Propagation Delay Time (tpLH: 50%−50%, tpHL: 50%−50%)	SLSYN−CCK (Note 1)	tpLH	—	(Note 4)	—	0.6	—	µs
		tpHL			—	1.5	—	
	SLSYN−SYN (Note 1)	tpLH		(Note 4)	—	0.6	—	
		tpHL			—	1.5	—	
	SLSYN−HNSYN (Note 1)	tpLH		(Note 5)	—	0.5	—	
		tpHL			—	0.1	—	
	50 / 60−MS50 / 60 (Note 1)	tpLH		(Note 5)	—	0.5	—	
		tpHL			—	0.1	—	
	50 / 60−SL50 / 60 (Note 1)	tpLH		(Note 4)	—	0.6	—	
		tpHL			—	1.5	—	
	SYNIN−MSSYN (Note 2)	tpLH		(Note 3)	—	1.0	—	
		tpHL			—	0.1	—	
	CPUOUT−TXDOUT (Note 2)	tpLH		(Note 4)	—	1.0	—	
		tpHL			—	1.2	—	
	MSTXD−LED (Note 2)	tpLH		(Note 5)	—	0.5	—	
		tpHL			—	0.1	—	
	MSTXD−TXD (Note 2)	tpLH		(Note 3)	—	1.0	—	
		tpHL			—	0.1	—	
	RXD−SLTXD (Note 1)	tpLH		(Note 4)	—	0.6	—	
		tpHL			—	1.5	—	
	RXD−MSRXD (Note 1)	tpLH		(Note 5)	—	0.5	—	
		tpHL			—	0.1	—	
Rise Time (tr: 10%−90%)	MS50 / 60	tr	—		—	0.3	—	µs
	SL50 / 60				—	0.2	—	
	LED				—	0.2	—	
	MSSYN				—	1.1	—	
	TXDOUT				—	0.2	—	
	TXD				—	1.1	—	
	SYN				—	0.2	—	
	CCK				—	0.2	—	
	HNSYN				—	0.3	—	
	SLTXD				—	0.2	—	
	MSRXD				—	0.3	—	

CHARACTERISTIC	CHARACTERISTIC / INPUT CONDITION	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Fall Time (tr: 90%−10%)	MS50 / 60	tf	—		—	0.1	—	µs
	SL50 / 60				—	0.5	—	
	LED				—	0.1	—	
	MSSYN				—	0.1	—	
	TXDOUT				—	0.5	—	
	TXD				—	0.1	—	
	SYN				—	0.5	—	
	CCK				—	0.5	—	
	HNSYN				—	0.1	—	
	SLTXD				—	0.5	—	
	MSRXD				—	0.1	—	

Input / Output Conditions

- Input Condition

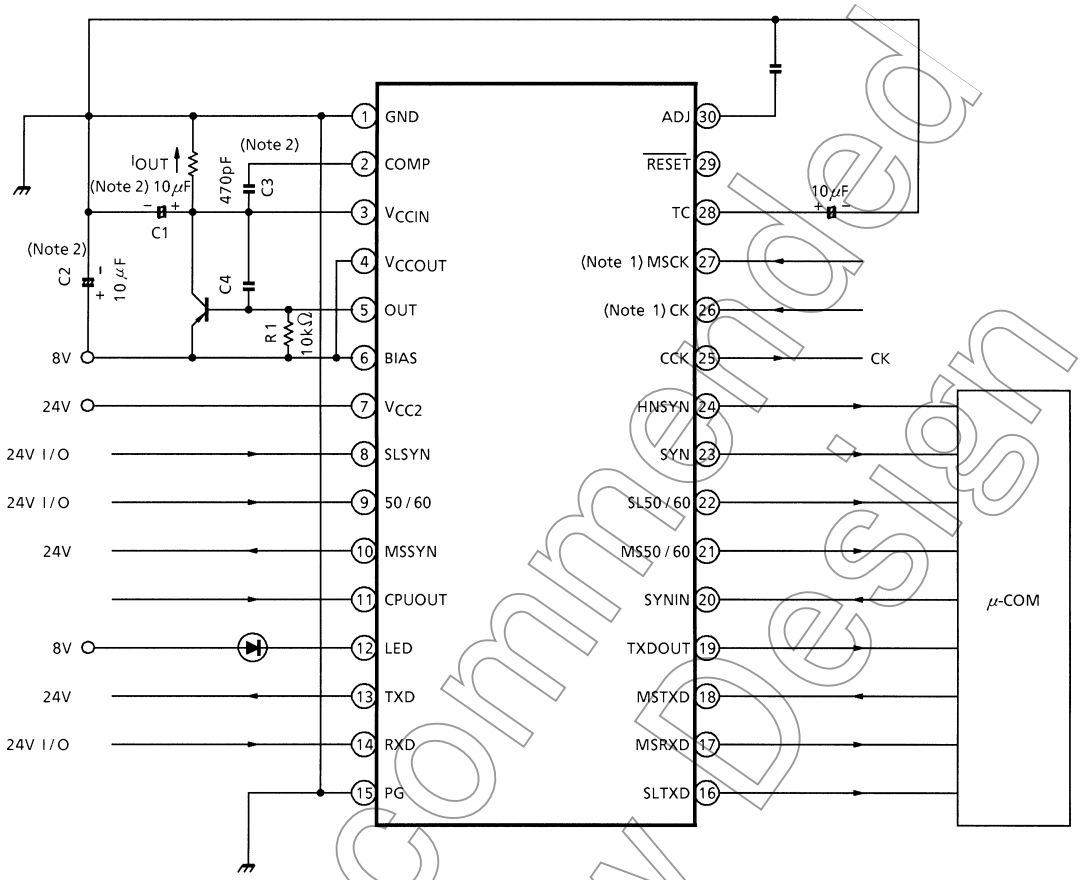
  Note 1: 24−V System : 0.2µs at 2 to 22−V
  Note 2: 5−V System : 0.1µs at 30 to 70%

- Output Conditions

  Note 3: 24−V System : C_L = 50 pF
  Note 4: 5−V System : C_L = 50 pF, R_L = 5 kΩ
  Note 5: 5−V System : C_L = 50 pF

APPLICATION CIRCUIT

When using an external PNP transistor :



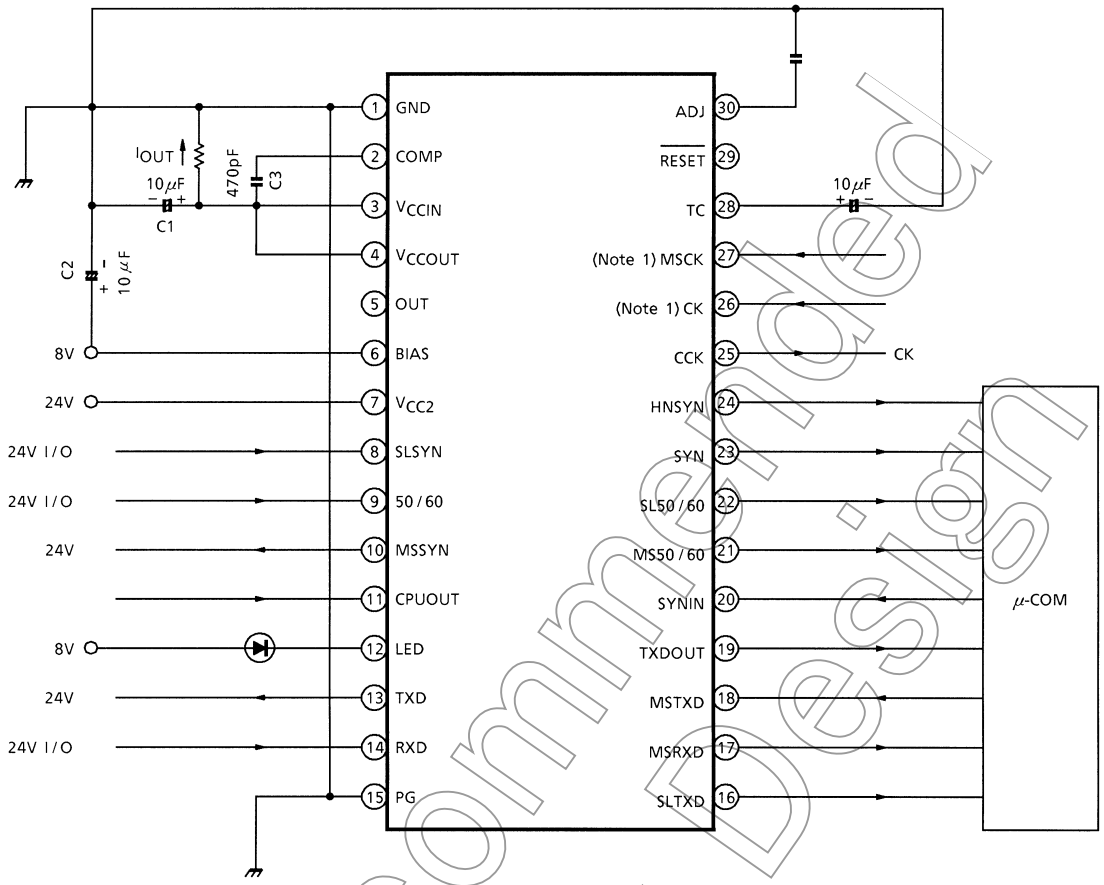
Note 1: When using the MSCK pin, short circuit the CK pin with GND.
When using the CK pin, short circuit the MSCK pin with GND.

Note 2: C1 and C2 are necessary to absorb external noise, etc. Connect them as close to the IC as possible.
C3 is used for phase correction, but this also must be connected as close to the IC as possible.
We recommend that C4 be connected between OUT and V_{CCIN}.

PRECAUTIONS for USING

This IC does not integrate protection circuits such as overcurrent and overvoltage protectors.
Thus, if excess current or voltage is applied to the IC, the IC may be damaged. Please design the IC so that excess current or voltage will not be applied to the IC.
Utmost care is necessary in the design of the output line, V_{CC} (V_{CCIN}, V_{CCOUT}, BIAS, V_{CC2}) and GND line since IC may be destroyed due to short−circuit between outputs, air contamination fault, or fault by improper grounding.

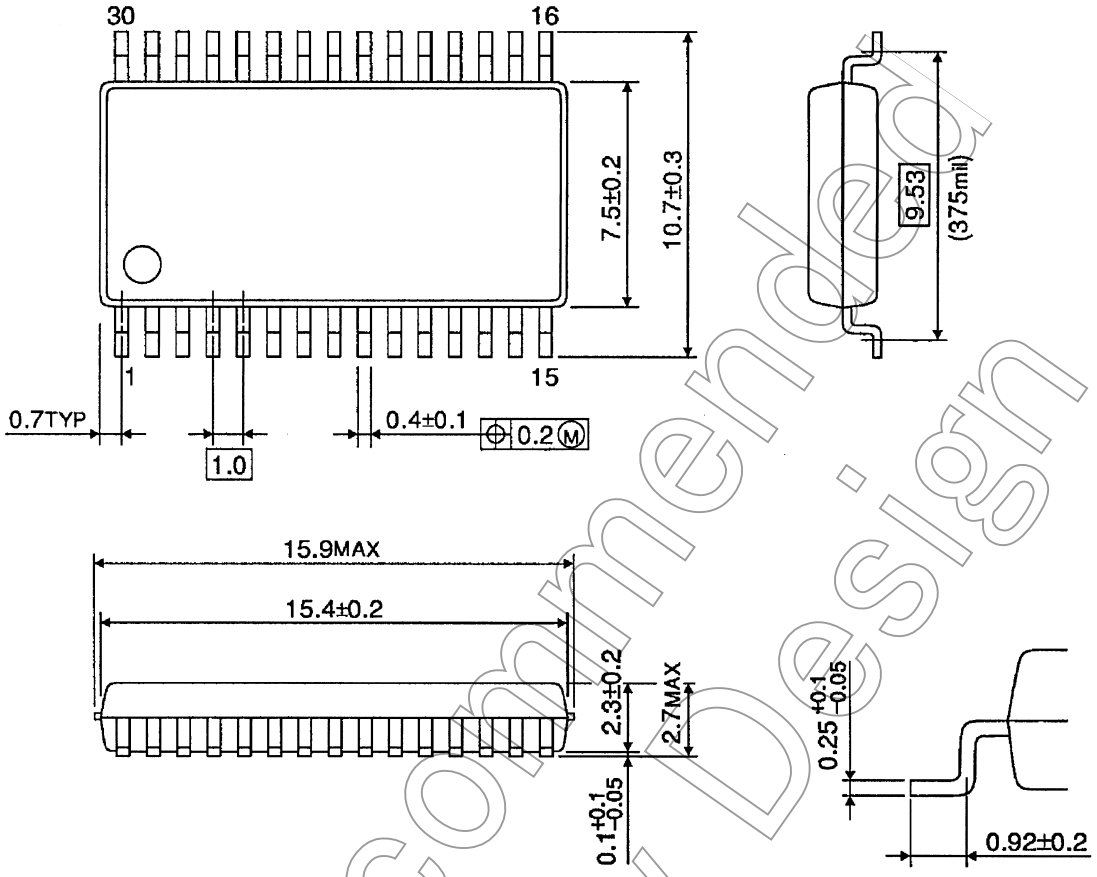
When using a built−in PNP transistor :



Note 1: When using the MSCK pin, short the CK pin with GND.
When using the CK pin, short the MSCK pin with GND.
Note 2: C1 and C2 are necessary to absorb external noise, etc.
Connect them as close to the IC as possible.
C3 is used for phase correction, but this also must be connected as close to the IC as possible.

PACKAGE DIMENSIONS

SSOP30−P−375−1.00 Unit: mm



Weight: 0.63 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.

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 absolute maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

About solderability, following conditions were confirmed

- Solderability

  (1) Use of Sn-37Pb 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

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