

This specification is applied to ROHM custom type of thermal print head KD2003-ZSACF.

Production Place: Japan or China

1. Outlines

- | | | | | |
|------|--|---------------|-------------|-----------|
| (1) | Dimensional Outline | Fig.1 | | |
| (2) | Heat Element Structure | 2 | heaters/dot | |
| (3) | Number of Heat Elements | 576 | dots | |
| (4) | Heat Element Pitch | 0.125mm pitch | 8.0 | dots / mm |
| (5) | Print Width | 72.0mm | ± 0.2 | mm |
| (6) | Average Resistance Value (R_{ave})*1 | 800 Ω | ± 3 | % |
| (7) | Circuit Diagram | Fig.2 | | |
| (8) | Pinout Diagram | Table1 | | |
| (9) | Electrical Characteristics of Circuit | Table2, Fig.3 | | |
| (10) | Thermistor | Table3, Fig.4 | | |


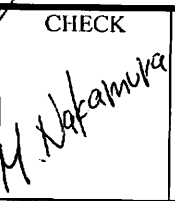
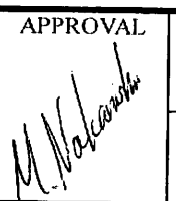
*1 Average resistance value is the one obtained as averaged resistance value of each heat element of the printhead. Tolerance $\pm 3\%$ shows the distribution of such averaged resistance value of the printhead.

2. Maximum Conditions at 25°C

| Item | Symbol | Maximum Conditions | Unit | Conditions |
|-----------------------|--------------|---------------------|--------|---------------------------------------|
| Supply Voltage | V_H | 26.4 | V | $V_p < 28$ V V_p : peak of V_H |
| Supply Energy | E_0 | 0.25 | mJ/dot | SLT=0.82ms |
| Substrate Temperature | T_{sub} | 65 | °C | Thermistor Temperature |
| Logic Supply Voltage | (V_{DD}) | 7 | V | Include Peak Voltage of V_{DD} |
| Logic Input Voltage | (V_{in}) | -0.5 ~ $V_{DD}+0.5$ | V | |

The product described in this specification is designed to be used with ordinary electronic equipment or devices.

Should you intend to use the product with equipment or devices that require an extremely high level of reliability and the malfunction of which would directly endanger human life, please be sure to consult with our sales representative in advance.

| | | | | |
|---|--|---|-----------------------------------|--|
| DESIGN  | CHECK  | APPROVAL  | DATE: 29 th Jun., 2008 | SPECIFICATION NO. 08RD2003-ZSACF |
| | | | REV. : A | <div style="border: 2px solid black; padding: 5px; text-align: center;"> PRINT ISSUE JUL 1 2008 ROHM CO., LTD. </div> |

3. Typical Printing Conditions at 25°C

(1) Mechanical Conditions (NOTE 1)

| Item | Mechanical Conditions | Unit or Conditions |
|---------------------|-----------------------|--------------------|
| Platen Pressure | 18.6 ± 1.96 | N / print width |
| Platen Hardness | 40 ± 5 | Shore A |
| Platen Diameter | 12.0 ~ 14.0 | mm |
| Scanning Resolution | 8.0 | line / mm |

(2) Thermal Paper use for Evaluation

OJI PD150R or equivalent (NOTE 2)

(3) Electrical Conditions (NOTE 3)

| Item | Symbol | Electrical Conditions | Unit | Conditions |
|---------------------------------|--------------------------------------|-----------------------|-----------------------------------|--------------------------|
| Power Consumption | P _o | 0.61 | W/dot | R _{ave} = 800 Ω |
| Supply Voltage | V _H | 24 | V | |
| Print Cycle | S.L.T | 0.82 | ms/line | Ambient Temp. |
| Energy Consumption (On Time) | E _o (T _{on}) | 0.21 | mJ/dot | 5°C |
| | | (0.34) | ms | |
| | | 0.19 | mJ/dot | 25°C |
| | | (0.31) | ms | |
| | | 0.17 | mJ/dot | 45°C |
| | | (0.28) | ms | |
| Supply Current | I _o | 7.9 | A | |
| Print Segment | | 2 | 288 dots ON at same time (NOTE 4) | |

4. Ambient Conditions

| Item | Symbol | Ambient Conditions | Unit on Conditions |
|----------------|------------------|--------------------|---------------------|
| Storage Temp | T _{sto} | -25 ~ 70 | °C |
| Operation Temp | T _{ope} | 5 ~ 45 | °C |
| Humidity | - | 10 ~ 90 | %RH No Condensation |

5. Print Quality (at standard conditions and Ambient Temperature of Printhead: 25°C)

(1) Optical Density: Min. 1.0*²

(2) Variation of Density (Difference in printing intensity of all back): max. 0.3*²

*2 with Macbeth Densitometer RD-914

6. Printhead Life on Standard Printing Conditions

End of Lifetime should be measured when the resistance value of each resistance element changes more than 15% compared with its initial value. Printing percentage at that time should be 12.5%.

(1) Pulse Life 5 × 10⁷ pulses

(1) (2) Abrasion Life 50km 【at continuous paper used】

(A condition of bad influential factors are not included in media)

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NOTE 1)

Platen diameter should not exceed $\phi 14.0\text{mm}$.

NOTE 2)

Please consult with Rohm in case of planning to use the thermal paper which is not Rohm recommendation.

NOTE 3)

Scanning Line Time (SLT) is the time to print one complete line using all strobes available.

The relation between the printhead supply voltage and "On Time" (T_{on}) is as follows;

$$P_0 = I_0^2 \times R_{ave} = \frac{V_H^2 \times R_{ave}}{(R_{com} \times N + R_{ave} + R_{ic})^2}$$

$$T_{on} = E_0 \div P_0$$

or

$$P_0 = E_0 \div T_{on}$$

$$V_H = \sqrt{(P_0 \div R_{ave}) \times (R_{com} \times N + R_{ave} + R_{ic})}$$

$R_{ave} = R_{res} + R_{lead}^{*3}$: Average resistance (Ex.) 800 (Ω)

N: Number of dots firing at same time (Ex.) 288 (dots)

R_{com} : Common resistance (Ex.) 0.075 (Ω)

R_{ic} : Driver saturated resistance (Ex.) 50 (Ω)

*3 R_{res} : Heater resistance, R_{lead} : Lead resistance

NOTE 4)

The number of dots firing at the same time is the value to achieve the printing quality stipulated in item 5 of page 2, and the electric current capacity of the head is 6.8A. However please note this value does not include the electric current capacity of cables.

Also, please be noted, the printing intensity variation becomes bigger when the number of dots firing at same time is more than 288.

NOTE 5)

In order to take a counter measure against ESD problem, conductive hard coat is applied as protective coat of the printhead(X-coat).

Changing the coating to electrically conductive, it minimizes the amount of electrostatic charge which occurs by friction of the thermal head and the media such as direct thermal paper, ribbon etc. Its effect is to reduce the possibility of heat element destruction by ESD.

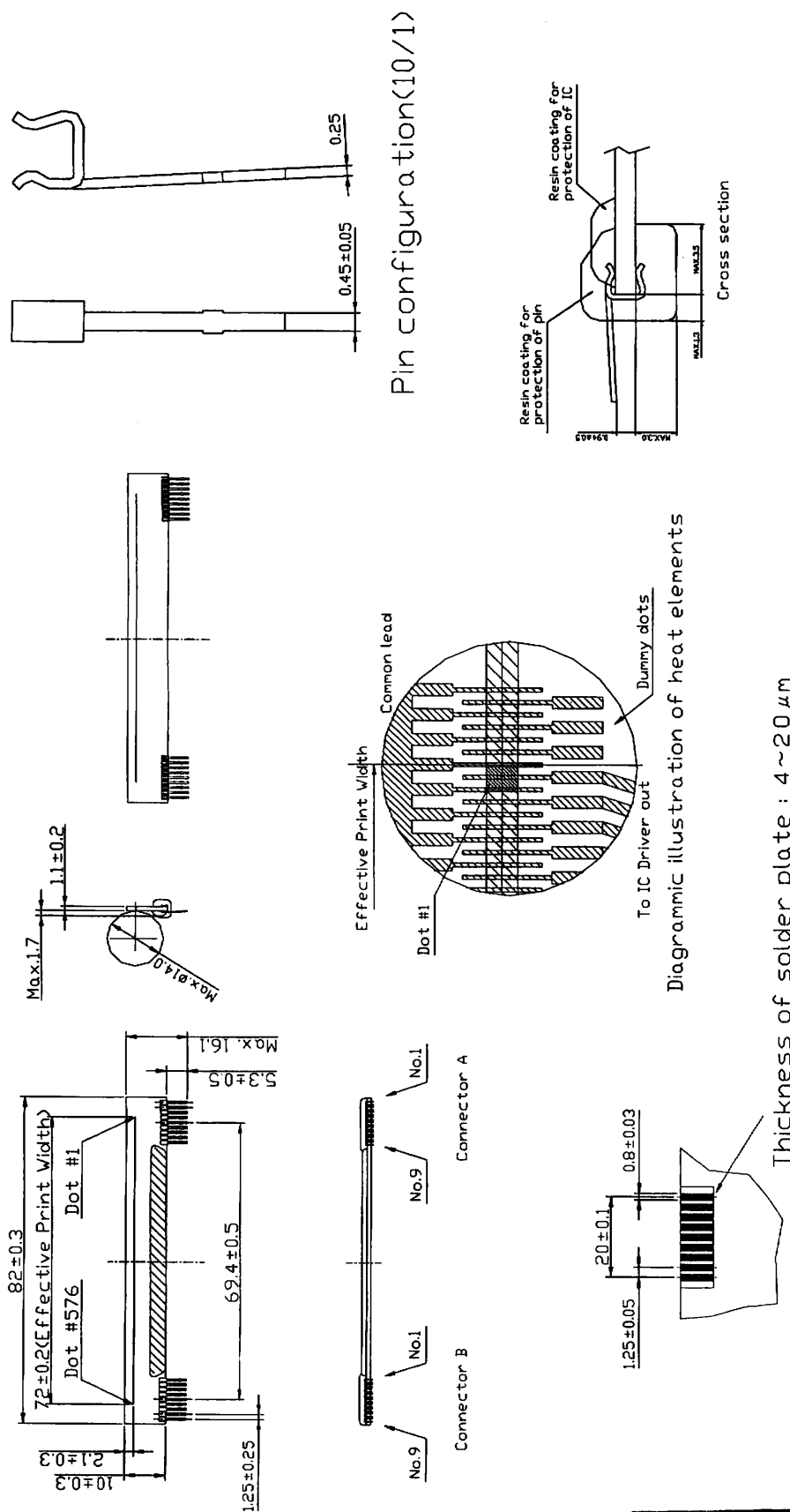
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7. Operation precautions

- (1) When continuous printing is performed, the supply energy should be reduced so that the substrate temperature monitored through the thermistor will remain below the maximum temperature show in Section 2. (Maximum Conditions at 25 degrees C)
- (2) Power on and off sequence must be in the following order to prevent the dot element damage;
Turn on - Apply the logic supply voltage (V_{DD}) first and the printhead supply voltage (V_H).
Turn off - Switch off the printhead supply voltage (V_H) first and turn the logic supply voltage (V_{DD}) off.
- (3) Interface each signal input (CLK, LAT, STB, DI) with CMOS level (ex. 74HC240). Please keep STB signal to "Disable" during ON/OFF and during no printing condition.
- (4) Heat elements and IC's shall be anti-electrostatic in order to prevent the electrostatic destruction. Do not touch the connector pins by naked hands.
- (5) The printhead substrate surface is coated with glass and mechanical stress or shock (including dust scratch damage) should be avoided to prevent damage.
- (6) When the printhead operation is finished, print supply voltage (including the charged voltage with capacitor) should be reduced to the ground level and remained until next printhead operation.
- (7) Platen roller should be composed of non-conductive materials.
- (8) Condensation should be avoided. If condensation occurred, do not switch on the printhead power until condensation disappeared.
- (9) The connectors installed are connected directly to the substrate. Please pay attention to the extra forces to get damages when the connector is plugged in or out. (Plug in-out cycle for this connector shall not be exceeded 20 times.)
- (10) Print quality would be degraded if paper or ink residue were stuck on the heat element area. For such a case, please use applicator with alcohol to clean up. Do not use any material or equipment, which destroy the heat elements.
- (11) If printing sound, for example sticking sound, occurred, please review and adjust the paper feed mechanism and the electrical pulse program to eliminate the sound.
- (12) Since this printhead is a type of ceramic substrate only, it is not durable against external stress. Please pay much attention on handling.
- (13) Please ensure that the paper used does not include bad element factor to affect the printhead life.
- (14) Printing without paper (Thermal paper etc.) should not be done. It may cause destruction on heat due to overload.
- (15) If printhead operation method is changed, Please inform us in advance to change.
- (16) When printhead is installed on the mechanical support, please use adhesive tape which we recommend. And air or foreign particles should not enter under the adhesive tape.
- (17) In order to avoid surge, V_H and GND cable length should be less than 100mm, and aluminum capacitor is required between V_H and GND at controller board side. Ceramic capacitor should be placed between V_{DD} and GND.
- (18) Please design the component in such a way that the printing media (while in printing) and the paper guide do not contact the IC protective coating and the pin protective coating, in order to keep the printing quality.
- (19) Please make designing in such a way to avoid the contact with conductive components like head support plate, because there is an area where the electrode are exposed on the surface and the side of thermal printhead.
- (20) Thermal printhead is heat-generating device, so that it may cause heat element damage or smoke / fire on its components by over heating if there occurs mechanical or electrical abnormalities. So please be sure to perform temperature control by thermistor and also to design the power (V_H , V_{DD}) shutdown system when abnormalities take place to protect the printhead.
- (21) If dusts/foreign particles stuck on the surface of thermal head substrate or printed circuit board, it may cause stained print, faded print and also damage of heat element, smoking and combustion. In this case, the head should be cleaned by ethyl-alcohol after power source for head is shut down and please check if the dusts/foreign articles are completely removed. Yet, make sure that ethyl alcohol is dried up before restarting the operation.
- (22) Please design power source for head (V_H , V_{DD}) to be shutdown when the thermal head surpasses the maximum rated wattage while STB is On, or the printing media does not move like paper jam. Otherwise, heated printing media bums and sticks to the head and may lead to combustion in the worst case.

Fig. 1 Dimension



2. Dimension of heat element's positioning
(2.1 ± 0.1) is guaranteed at Dot #1 and Dot #576.

1. Material of pin: MF202

Thickness of solder plate: $3 \mu m - 5 \mu m$

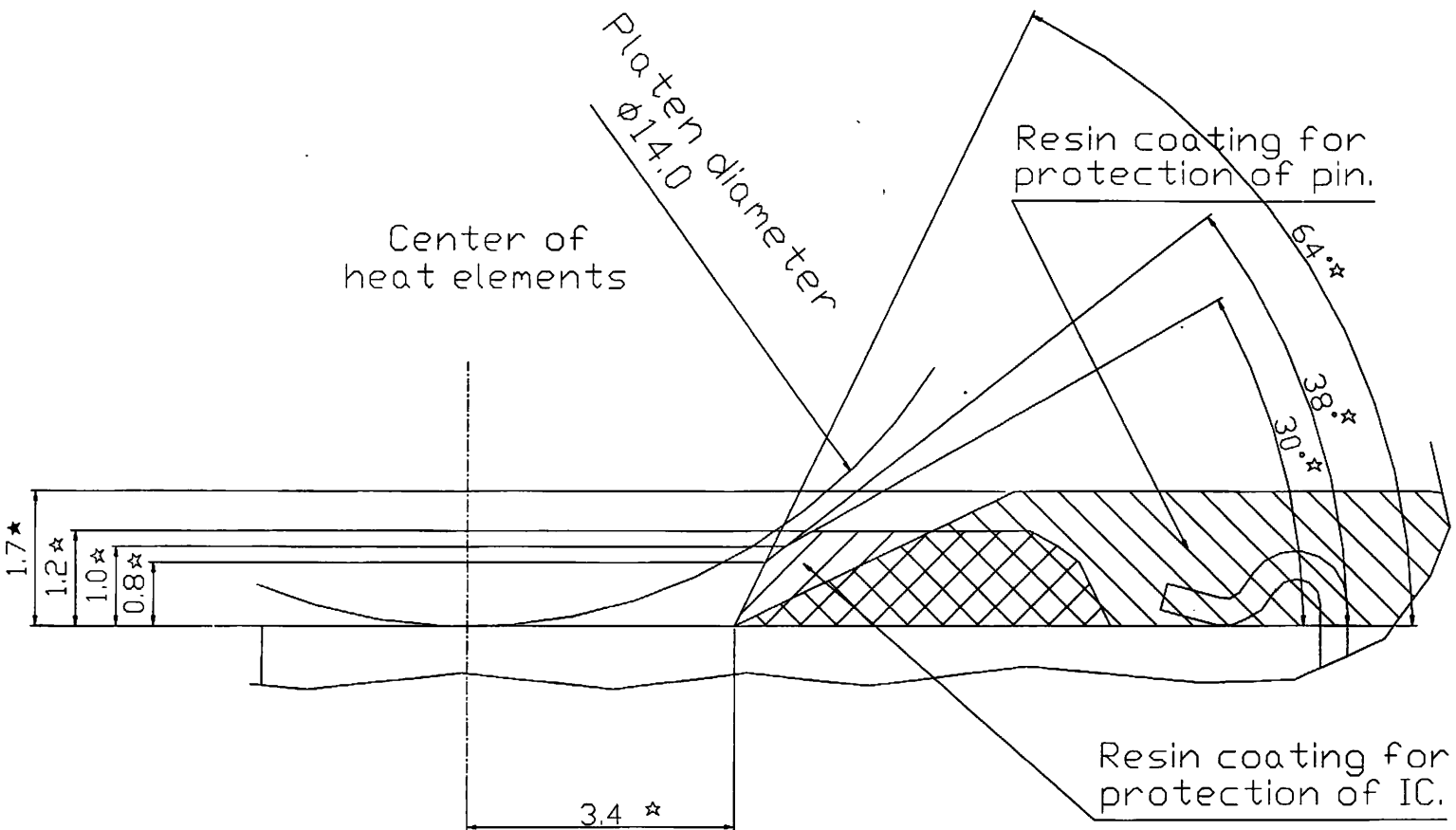
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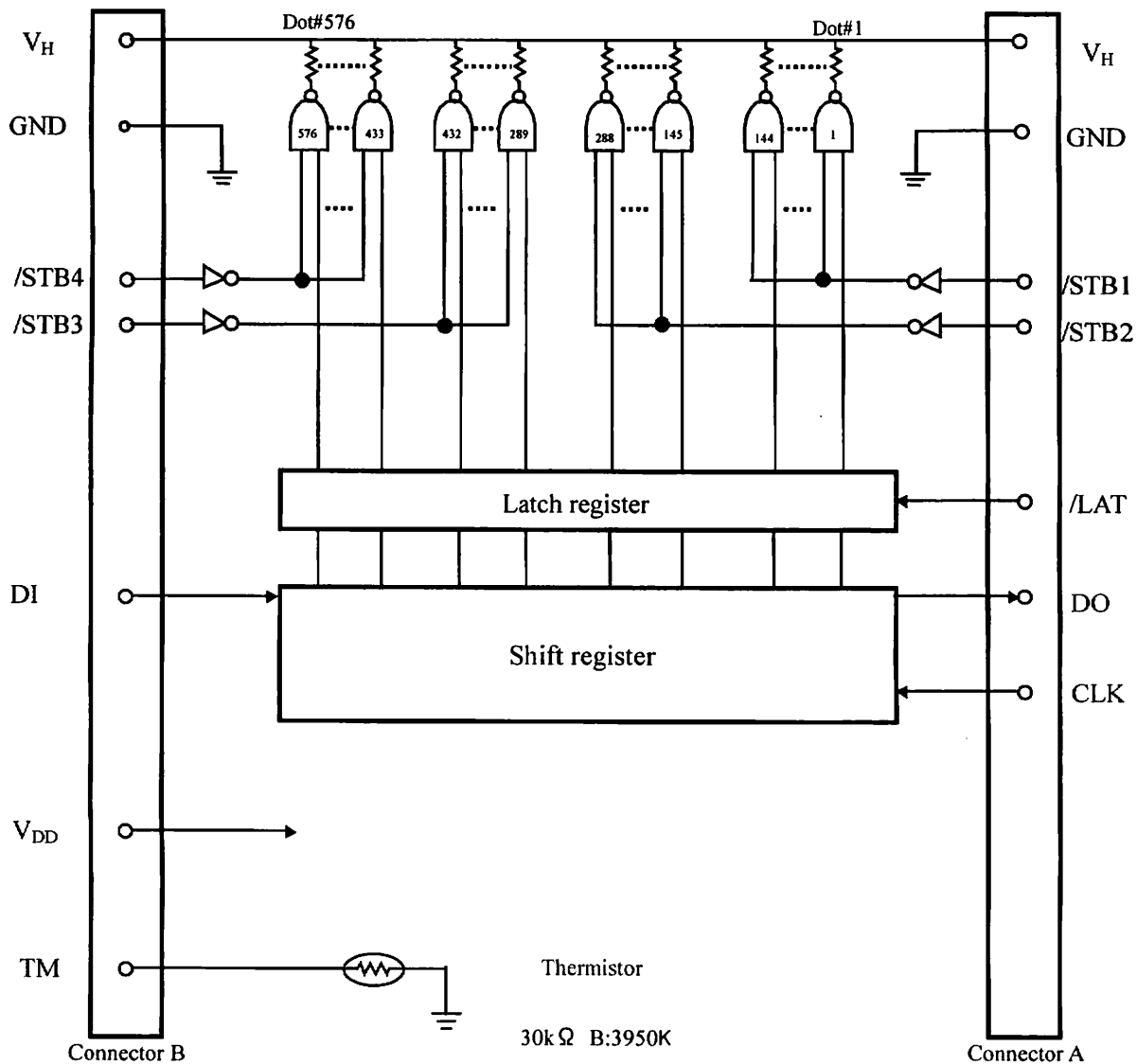
ROHM CO., LTD.

Cross section



- ☆: Dimension related to resin coating for protection of IC.
 - ★: Dimension related to resin coating for protection of pin.
- Protection coating should be the shape which can stay within the area with oblique lines.

Fig. 2 Circuit Diagram



/STB: Strobe(Low active)
 /LAT: Latch (Low active)
 CLK: Clock
 DI: Date in
 DO: Date out
 TM: Thermistor

| STB No. | Dot No. | Dots/STB |
|---------|-----------|----------|
| 1 | 1 ~ 144 | 144 |
| 2 | 145 ~ 288 | 144 |
| 3 | 289 ~ 432 | 144 |
| 4 | 433 ~ 576 | 144 |

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Table 1 Pinout Diagram

Connector A

| PIN No. | SIGNAL |
|---------|----------------|
| 1 | V _H |
| 2 | V _H |
| 3 | DO |
| 4 | CLK |
| 5 | /LAT |
| 6 | /STB2 |
| 7 | /STB1 |
| 8 | GND |
| 9 | GND |

Connector B

| PIN No. | SIGNAL |
|---------|-----------------|
| 1 | GND |
| 2 | GND |
| 3 | TM |
| 4 | V _{DD} |
| 5 | /STB4 |
| 6 | /STB3 |
| 7 | DI |
| 8 | V _H |
| 9 | V _H |

PIN No.: Refer to Fig.1

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Table 2-1 Electrical characteristics of Circuit ($V_{DD}=4.75\sim 5.25V$)
 $T_a=25\pm 10^{\circ}C$

| ITEM | | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITION |
|--------------------------------|---|-----------------|-------------|------|-------------|---------|----------------------------|
| PRINT VOLTAGE | | V_H | - | 24.0 | 26.4 | V | |
| LOGIC VOLTAGE | | V_{DD} | 4.75 | 5.00 | 5.25 | V | |
| LOGIC CURRENT | | I_{DD} | - | - | 48 | mA | $f_{DI}=f_{CLK}/2$ |
| INPUT VOLTAGE | H | V_{IH} | $0.8V_{DD}$ | - | V_{DD} | V | STB, DI, LAT, CLK |
| | L | V_{IL} | 0 | - | $0.2V_{DD}$ | V | |
| DATA INPUT CURRENT (DI) | H | $I_{IH DI}$ | - | - | 0.5 | μA | $V_{IH}=5V$ $V_{IL}=0V$ |
| | L | $I_{IL DI}$ | - | - | -0.5 | μA | |
| STB INPUT CURRENT (LOW ACTIVE) | H | $I_{IH STB}$ | - | - | 0.5 | μA | |
| | L | $I_{IL STB}$ | - | - | -16 | μA | |
| CLOCK INPUT CURRENT (CLK) | H | $I_{IH CLK}$ | - | - | 2.0 | μA | |
| | L | $I_{IL CLK}$ | - | - | -2.0 | μA | |
| LATCH INPUT CURRENT (LAT) | H | $I_{IH LAT}$ | - | - | 2.0 | μA | |
| | L | $I_{IL LAT}$ | - | - | -2.0 | μA | |
| DO VOLTAGE (DO) | H | V_{DOH} | 4.45 | | | V | $V_{DD}=4.5$ OPEN |
| | L | V_{DOL} | | | 0.05 | V | |
| CLOCK FREQUENCY | | f_{CLK} | - | - | 16 | MHz | See Fig. 3 |
| CLOCK WIDTH | | $t_w CLK$ | 28 | - | - | ns | |
| DATA SET-UP TIME | | $t_{setup DI}$ | 15 | - | - | ns | |
| DATA HOLD TIME | | $t_{hold DI}$ | 10 | - | - | ns | |
| DATA OUT DELAY TIME | | $t_d DO$ | - | - | 48 | ns | |
| LAT WIDTH | | $t_w LAT$ | 100 | - | - | ns | |
| LAT SET-UP TIME | | $t_{setup LAT}$ | 100 | - | - | ns | |
| LAT HOLD TIME | | $t_{hold LAT}$ | 50 | - | - | ns | |
| STB SET-UP TIME | | $t_{setup STB}$ | 300 | - | - | ns | |
| DRIVER OUT DELAY TIME | | t_{do} | - | - | 15 | μs | |

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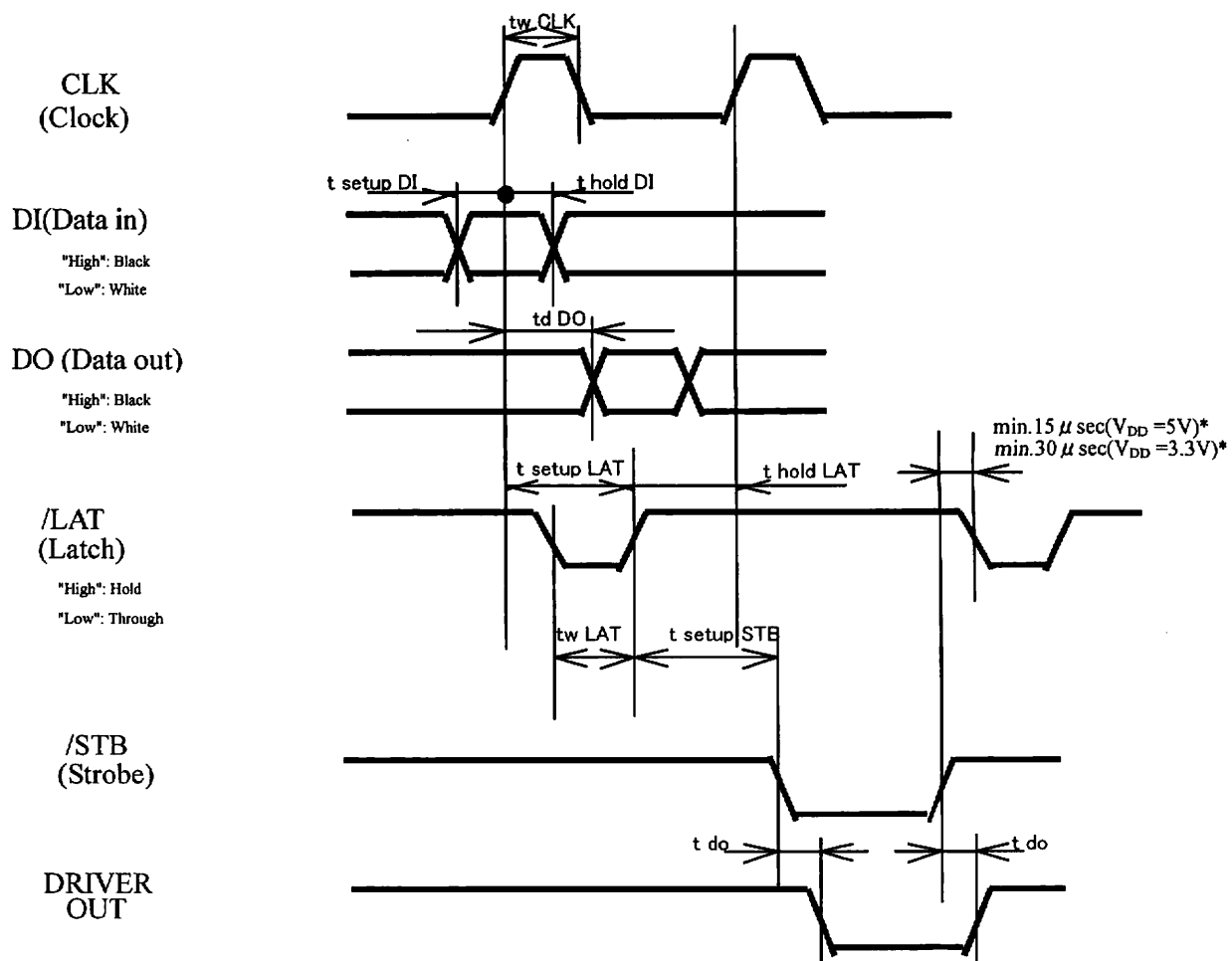
Table 2-2 Electrical characteristics of Circuit ($V_{DD}=3.13\sim3.47V$)
 $T_a=25\pm10^{\circ}C$

| ITEM | | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITION |
|--------------------------------|---|--------------|-------------|------|-------------|---------|------------------------------|
| PRINT VOLTAGE | | V_H | - | 24.0 | 26.4 | V | |
| LOGIC VOLTAGE | | V_{DD} | 3.13 | 3.30 | 3.47 | V | |
| LOGIC CURRENT | | I_{DD} | - | - | 28.8 | mA | $f_{DI}=f_{CLK}/2$ |
| INPUT VOLTAGE | H | V_{IH} | $0.8V_{DD}$ | - | V_{DD} | V | STB, DI, LAT, CLK |
| | L | V_{IL} | 0 | - | $0.2V_{DD}$ | V | |
| DATA INPUT CURRENT (DI) | H | $I_{IH DI}$ | - | - | 0.5 | μA | $V_{IH}=3.3V$ $V_{IL}=0V$ |
| | L | $I_{IL DI}$ | - | - | -0.5 | μA | |
| STB INPUT CURRENT (LOW ACTIVE) | H | $I_{IH STB}$ | - | - | 0.5 | μA | |
| | L | $I_{IL STB}$ | - | - | -16 | μA | |
| CLOCK INPUT CURRENT (CLK) | H | $I_{IH CLK}$ | - | - | 2.0 | μA | |
| | L | $I_{IL CLK}$ | - | - | -2.0 | μA | |
| LATCH INPUT CURRENT (LAT) | H | $I_{IH LAT}$ | - | - | 2.0 | μA | |
| | L | $I_{IL LAT}$ | - | - | -2.0 | μA | |
| DO VOLTAGE (DO) | H | VDOH | 2.95 | | | V | $V_{DD}=3.0V$ OPEN |
| | L | VDOL | | | 0.05 | V | |
| CLOCK FREQUENCY | | f CLK | - | - | 8 | MHz | See Fig. 3 |
| CLOCK WIDTH | | tw CLK | 56 | - | - | ns | |
| DATA SET-UP TIME | | tsetup DI | 30 | - | - | ns | |
| DATA HOLD TIME | | thold DI | 10 | - | - | ns | |
| DATA OUT DELAY TIME | | td DO | - | - | 95 | ns | |
| LAT WIDTH | | tw LAT | 100 | - | - | ns | |
| LAT SET-UP TIME | | tsetup LAT | 100 | - | - | ns | |
| LAT HOLD TIME | | thold LAT | 50 | - | - | ns | |
| STB SET-UP TIME | | tsetup STB | 300 | - | - | ns | |
| DRIVER OUT DELAY TIME | | t do | - | - | 30 | μs | |

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Fig. 3 Timing Chart



*If delay time for Driver Out can not be secured enough, there is a possibility that V_H would fluctuate greatly. Please design the circuit so that V_H does not exceed peak voltage (V_p).

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Table 3 Thermistor specification

Electrical requirements;

- 1) Resistance R_{25} : $30k\Omega \pm 5\%$ at 25°C
- 2) B value: $3950K \pm 2\%$
- 3) Resistance vs. Temperature: Fig.4

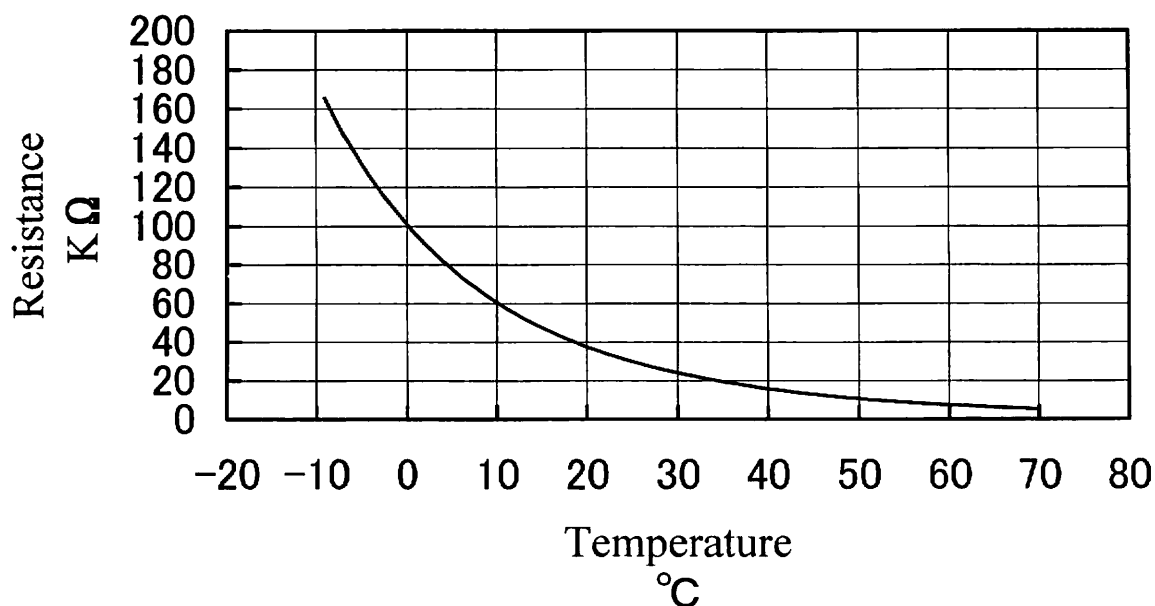
Rating;

- 1) Operating temperature: $-20 \sim +80^{\circ}\text{C}$
- 2) Time constant: Max. 30sec (in the air)

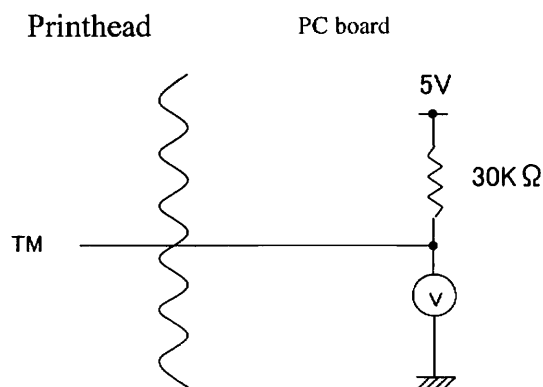
Fig.4 Temperature characteristic of Thermistor

$$R_x = R_{25} \cdot \text{EXP}\{B \cdot (1/T_x - 1/T_{25})\}$$

(T; Absolute temperature)



Recommended Circuit



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Limited Warranty

ROHM CO., LTD. ("ROHM") warrants this product against defects in material or workmanship, as follows;

1. For a period of twelve (12) months from the date of purchase, ROHM will repair or replace any products returned in fact, which ROHM shall determine to be defective in material or workmanship upon inspection.
2. The warranty shall be invalidated by any damage due to;
 - ①: Disasters such as fire, earthquake, flood, or robbery.
 - ②: repair, modification, misuse, abuse or negligence.

ROHM shall not be liable for any incidental or consequential damages (defects of main units, parts replacement, parts transportation) for breach of any express or implied warranty production over.

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ROHM CO., LTD.

REV.: A

SPECIFICATION No. 08KD2003 ZSACF

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< Specifications (Precautions and Prohibitions) >

• Safety Precautions

1) The products are designed and produced for application in ordinary electronic equipment (AV equipment, OA equipment, telecommunication equipment, home appliances, amusement equipment, etc.).
If the products are to be used in devices requiring extremely high reliability (medical equipment, transport equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or operational error may endanger human life and sufficient fail-safe measures, please consult with the Company's sales staff in advance. If product malfunctions may result in serious damage, including that to human life, sufficient fail-safe measures must be taken, including the following:

- [a] Installation of protection circuits or other protective devices to improve system safety
- [b] Installation of redundant circuits in the case of single-circuit failure

2) The products are designed for use in a standard environment and not in any special environments.
Application of the products in a special environment can deteriorate product performance. Accordingly, verification and confirmation of product performance, prior to use, is recommended if used under the following conditions:

- [a] Use in various types of liquid, including water, oils, chemicals, and organic solvents
- [b] Use outdoors where the products are exposed to direct sunlight, or in dusty places
- [c] Use in places where the products are exposed to sea winds or corrosive gases, including Cl_2 , H_2S , NH_3 , SO_2 , and NO_2
- [d] Use in places where the products are exposed to static electricity or electromagnetic waves
- [e] Use in proximity to heat-producing components, plastic cords, or other flammable items
- [f] Use involving sealing or coating the products with resin or other coating materials
- [g] Use involving unclean solder or use of water or water-soluble cleaning agents for cleaning after soldering
- [h] Use of the products in places subject to dew condensation

3) The products are not radiation resistant.

4) The Company is not responsible for any problems resulting from use of the products under conditions not recommended herein.

5) The Company should be notified of any product safety issues. Moreover, product safety issues should be periodically monitored by the customer.

• Precautions Regarding Application Examples and External Circuits

1) If change is made to the constant of an external circuit, allow a sufficient margin due to variations of the characteristics of the products and external components, including transient characteristics, as well as static characteristics.

2) The application examples, their constants, and other types of information contained herein are applicable only when the products are used in accordance with standard methods. Therefore, if mass production is intended, sufficient consideration to external conditions must be made.

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< Specifications (Precautions and Prohibitions) >

● **Precautions Regarding Foreign Exchange and Foreign Trade Control Law**

- 1) The Company has not determined whether or not the products are considered "a controlled product or technology" as specified in the Foreign Exchange and Foreign Trade Control Law. Accordingly, if exportation of the products, either separately or integrated in another company's products, is intended, or giving the products to persons who are not residents is planned, additional steps are required, based upon the appropriate regulations.

● **Prohibitions Regarding Industrial Property**

- 1) These Specifications contain information related to the Company's industrial property. Any use of them other than pertaining to the usage of appropriate products is not permitted. Duplication of these Specifications and its disclosure to a third party without the Company's permission is prohibited.
- 2) Information and data on products, including application examples, contained in these specifications are simply for reference; the Company does not guarantee any industrial property rights, intellectual property rights, or any other rights of a third party regarding this information or data. Accordingly, the Company does not bear any responsibility for:
 - [a] infringement of the intellectual property rights of a third party
 - [b] any problems incurred by the use of the products listed herein.
- 3) The Company prohibits the purchaser of its products to exercise or use the intellectual property rights, industrial property rights, or any other rights that either belong to or are controlled by the Company, other than the right to use, sell, or dispose of the products.

● **Precautions on Use of Products**

- 1) Verification and confirmation of performance characteristics of products, after on-board mounting, is advised.
- 2) In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse) is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- 3) When a highly active halogenous (chlorine, bromine, etc.) flux is used, the remainder of flux may negatively affect product performance and reliability.
- 4) In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the Company in advance

● **Precautions Regarding Product Storage**

- 1) Product performance and soldered connections may deteriorate if the products are stored in the following places:
 - [a] Where the products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [b] Where the temperature or humidity exceeds those recommended by the Company
- 2) The guaranteed period of solder connections and product performance is within one year from shipment by the Company, provided that the above-mentioned storage conditions have been satisfied.

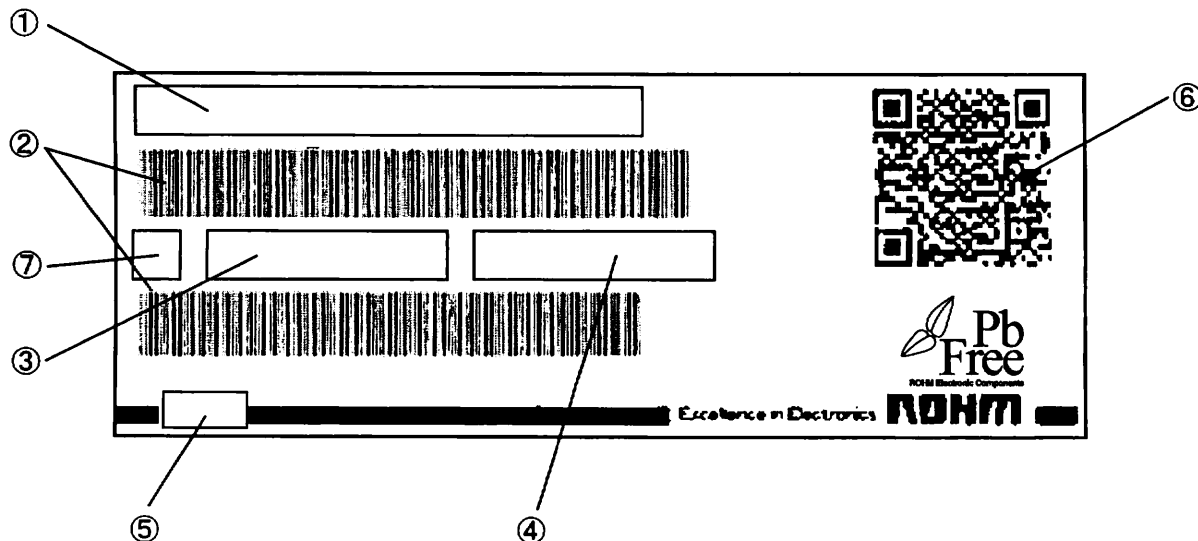
● **Other Matters**

- 1) Please sign these Specifications and return one copy to the Company.
If a copy is not returned within three months after the issued date specified on the front page of these Specifications, the Company will consider the Specifications accepted.
- 2) If any matter related to these Specifications needs to be clarified, discussions shall be held promptly between the two parties concerned to determine the issue.

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Description of lot no. and discrimination of a producing district

Discrimination of lot no. and a producing district shall be put into effect as follows.



- ① Type No.
- ② Bar code
- ③ Quantity
- ④ Lot No.

[ex.] 06 08 *****

- (1) Packaged year shall be indicated with last two number of A.D. [ex.] 2006
- (2) Packaged week shall be indicated with figure. [ex.] 8
- (3) This No. indicates the consecutive of packaged week by order.

- ⑤ The place of origin.
- ⑥ QR code
- ⑦ This mark is Pb-free.
[F]

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