Development Target Specification

Products	Type
Thermal Print Head	KD2003-DAFW00A
Specification No. :	Rev.
20KD2003-DAFW00A	REV. : B

Creation date

19 Nov. 2020

・Division

Printhead div.

・Person in charge

J. Fujino

・Responsible person

S. Daicho

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No.	Date	Page	Revision Item	Spec. No.	Design
	3/Jun./'15	-	First issue	A	M.Nakamura
	19/Nov./'20	-	Apply latest format	B	J. Fujino

< Limited Warranty >

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

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.

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.

< Specifications (Precautions and Prohibitions) >

● Precaution on using ROHM Products

1) Our Products are designed and manufactured for application in ordinary electronic equipment (such as AV equipment, OA equipment, telecommunication equipment, home electronics appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment, transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Special Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

2) ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures.
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3) Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4) The Products are not subject to radiation-proof design.

5) Please verify and confirm characteristics of the final or mounted products in using the Products.

6) 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.

7) De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8) Confirm that operation temperature is within the specified range described in the product specification.

9) ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

● Precaution for Mounting / Circuit board design

1) When a highly active halogen nous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2) In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM in advance.

● Precautions Regarding Application Examples and External Circuits

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

2) You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise you own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for damages, expenses or losses incurred by you or third parties arising from the use of such information.

● Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

● Precaution for Storage / Transportation

1) Product performance and soldered connections may deteriorate if the Products are stored in the places where:
[a] the Products are exposed to sea winds or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
[b] the temperature or humidity exceeds those recommended by ROHM
[c] the Products are exposed to direct sunshine or condensation
[d] the Products are exposed to high Electrostatic

2) Even under ROHM recommended storage condition, solder ability of products out of recommended storage time period may be degraded.
It is strongly recommended to confirm solder ability before using Products of which storage time is exceeding the recommended storage time period.
3) Store / transport cartons in the correct direction, which is indicated on a carton as a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4) Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

● Precaution for product label
QR code printed on ROHM product label is for ROHM's internal use only, and please do not use at customer site.

● Precaution for disposition
When disposing Products please dispose them properly using an authorized industry waste company.

● Precaution Regarding Intellectual Property Rights
1) All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data.

2) ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software)

3) No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the Products or the information contained in this document. Provided, however, that ROHM will not assert its intellectual property rights or other rights against you or your customers to the extent necessary to manufacture or sell products containing the Products, subject to the terms and conditions herein.

● Other Matters
1) This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2) The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3) In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4) The proper names of companies or products described in this document are trademarks of registered trademarks of ROHM, its affiliated companies or third parties.

< Operation precautions >

1) For continuous printing, adjust the head control so that the thermistor temperature does not exceed the maximum specified value.
2) Control the following sequence (at power ON / OFF) so as not to damage the heating element.
   - When power is turned on: VDD → (VSF) → VH. However, VSF and VH can be applied simultaneously.
   - When power is turned off: VH → (VSF) → VDD. However, VSF and VH can be shut off simultaneously.
3) During non-printing operation, turn off the VH power supply of the head (including the charge charged in the capacitor).
4) Interface each signal (CLK, LAT, STB, DI) input at C-MOS level (74HC240 equivalent). Also, keep the STB signal in the "DISABLE" state when the power is turned ON / OFF and when not printing.
5) Check the following for resistance measurement.
   - VSF terminal organic species: When measuring the resistance value of the heating element, separate VSF and VH and apply the voltage shown in the electrical characteristics section to VSF before measuring.
6) Regarding the interface, check and note the following.
   - Solder terminal specifications: To secure and maintain the bonding strength, connect an FPC, etc., to the terminals (soldering, etc.) and then reinforce the bonding from both sides of the board using resin.
   - Specification with connector: The connector is directly connected to the board. Do not apply excessive force to the connector attachment / detachment part. (Use up to 20 times of attachment and detachment.)
7) Check and pay attention to the following when assembling the head.
   - Head board unit specification: To improve the positional accuracy between the platen and the head heating element, assemble it to the heat sink or other parts based on the center of the heating element or affixed marks.
   - Specification with heat sink: Warping due to temperature change is suppressed as much as possible with the head alone. Be careful not to increase the warpage due to the mounting hardware.
8) When fixing the head to the support plate, use an adhesive tape recommended by our company and attach it so that there are no bubbles or foreign matter.
9) The exposed terminals may be discolored due to sulfurization, oxidation, etc. Since this discoloration has an adverse effect on solder wettability and solder strength, please immediately (within 24 hours) soldering or preliminary soldering after opening the package.
10) Solder bonding conditions vary depending on the equipment, etc., so please evaluate and decide. Depending on the joining conditions, the head may fail.
11) To prevent surges, keep the length of VH and GND cables within 100 mm, and install an aluminum electrolytic capacitor between VH and GND as close as possible to the head and a multilayer ceramic capacitor between VDD and GND.
12) To ensure print quality, design the IC protective coat and the pin protective coat so that the recording medium (during actual running) and the paper guide do not contact.
13) To prevent static electricity damage to the heating element and IC, provide antistatic protection. Do not directly touch the electrodes such as connector pins.
14) Use a non-conductive platen roller.
15) Since there are parts of this head where electrodes are exposed on the board surface and the end face, design the head support plate and other conductive parts so that they do not come into contact.
16) The head substrate is made of ceramic and is vulnerable to external impact. Handle with care. Also, do not apply a mechanical impact (including foreign matter inclusion or foreign matter entrapment by the platen) to the head substrate surface.
17) Do not use print media that has factors that adversely affect the life of the head.
18) Be careful not to print (blank print) without a print medium (such as thermal paper).
19) Sound may be generated during printing depending on the mechanism of the printing machine or the printing program. In that case, please adjust with a mechanism or a program.

20) The thermal printhead is a heat-generating component. If an electrical or mechanical failure occurs, it may overheat and cause damage to the heat-generating element, or smoke or ignition of components. Therefore, in order to ensure the safety of the system, perform temperature control with a thermistor and shut off the head power supply (VH, VDD) in the event of an abnormality.
21) Print quality may be degraded if paper waste or ink waste accumulates on the heating element. Soak the cotton swab with ethyl alcohol etc. and wipe gently. If polishing is required, do not use anything that may destroy the heating element.
22) If dirt or foreign matter adheres to the head substrate or the wiring surface of the printed circuit board, there is a risk of print smearing, print smearing, destruction of heating elements, smoke and ignition. After turning off the power to the head, clean it with ethyl alcohol and check that it has been completely removed. The next time you turn on the power, make sure that the ethyl alcohol is sufficiently dry.
23) Make sure that the head does not condense. If condensed, keep all power OFF until the condensation disappears.
24) When the STB of the thermal print head exceeds the maximum rating in the ABLE state or when the print medium does not move due to paper jam (paper jam), shut off the head power supply (VH, VDD). Please The print media becomes hot and burns to the head, and in the worst case, may cause smoke.
25) Please contact us in advance when changing the usage of the thermal print head.

This specification is applied to ROHM standard type of thermal printhead KD2003-DAFW00A.
Production Place: China

1. Outlines

(1)	Dimensional Outline	Fig.1-1, Fig.1-2		
(2)	Heat Element Structure	2 heaters/dot		
(3)	Number of Heat Elements	640dots		
(4)	Heat Element Pitch	0.125mm		(8.0 dots/mm)
(5)	Print Width	80mm	± 0.2	mm
(6)	Average Resistance Value (R_{ave})*1	650Ω	± 3	%
(7)	Circuit Diagram	Fig.2		
(8)	Pin out Diagram	Table1		
(9)	Electrical Characteristics of Circuit	Table2-1, Table2-2, Fig.3		
(10)	Thermistor	Table3, Fig.4		
(11)	Package diagram	Fig.5		

*1 Average resistance value is the one obtained as averaged resistance value of each heat element of the printhead, and its tolerance shows the distribution of such averaged resistance value of the printhead.

2. Maximum Conditions (Ambient Temperature of Printhead: 25°C)

Item	Symbol	Maximum Conditions	Unit	Conditions
Supply Voltage	V_H	26.4	V	V_P < 28V V_P : Peak of V_H
Supply Energy	E_0	0.18	mJ/dot	S.L.T.=0.5msec
		0.24		S.L.T.=0.82msec
Substrate Temperature	T_{sub}	65	ºC	Thermistor Temperature
Logic Supply Voltage	V_{DD}	7	V	Include Peak Voltage
Logic Input Voltage	V_{in}	-0.25 ~ V_{DD}+0.25	V	Max.7.0V

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.

3. Typical Printing Conditions (Ambient Temperature of Printhead: 25°C)

(1) Mechanical Conditions

Item	Mechanical Conditions	Unit or Conditions
Platen Pressure	19.6 ± 1.96	N / print width
Platen Hardness	40 ± 5	Shore A
Platen Diameter	15.0 ~ 20.0	mm
Scanning Resolution	8.0	line / mm

The Platen diameter may not exceed the maximum dimension shown.

(2) Thermal Paper use for Evaluation

OJI PD150R or equivalent

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

(3) Electrical Conditions

Item	Symbol	Electrical Conditions		Unit	Conditions
Power Consumption	P_0	0.75		W/dot	R_{ave}=650Ω
Supply Voltage	V_H	24.0		V	
Print Cycle	S.L.T.	0.5	0.82	ms/line	Ambient Temp.
Energy Consumption (On Time)	E_0 (T_{on})	0.16	0.19	mJ/dot	5°C
		(0.21)	(0.25)	ms	
		0.15	0.18	mJ/dot	25°C
		(0.20)	(0.24)	ms	
		0.14	0.17	mJ/dot	45°C
		(0.19)	(0.23)	ms	
Supply Current *2	I_0	21.7		A	
Print Segment		1		640dots ON at same time *3	

*2: This value is the peak of current. The mean of current can't be controlled to exceed the current capacity of the head is 13.6 A. However please note this value does not include the electric current capacity of cables.

*3: The number of dots applied simultaneously is value for achieving the print quality specified in item 5, and the greater the number of dots applied simultaneously, the greater the variation in print density.

NOTE)
Scanning Line Time (SLT) is the time to print one complete line using all strobes available.
The relation between the printhead "Supply Voltage" (V_H) and "On Time" (Ton) 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} :	Average resistance	(Ex.)	650	(Ω)
(R_{res}:	Heater resistance)			
(R_{lead}:	Lead resistance)			
N :	Number of dots firing at same time	(Ex.)	640	(dots)
R_{com} :	Common resistance	(Ex.)	0.075	(Ω)
R_{ic} :	Driver saturated resistance	(Ex.)	9	(Ω)

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)

Optical density is measured in a full black pattern area according to ISO 5-4:2009.
A black pattern means a 100% black printed area under typical printing conditions.

(1) Optical Density: Min.1.0
(2) Variation of Density (Difference in printing intensity of all black): Max.0.3

6. Printhead Life (at standard conditions and Ambient Temperature of Printhead: 25°C)

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: 1×10^8 pulses
(2) Abrasion Life: 150 km

In order to take a counter measure against ESD problem, conductive hard coat is applied as protective coat of the print head(W-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.

Fig.1-1 Dimension

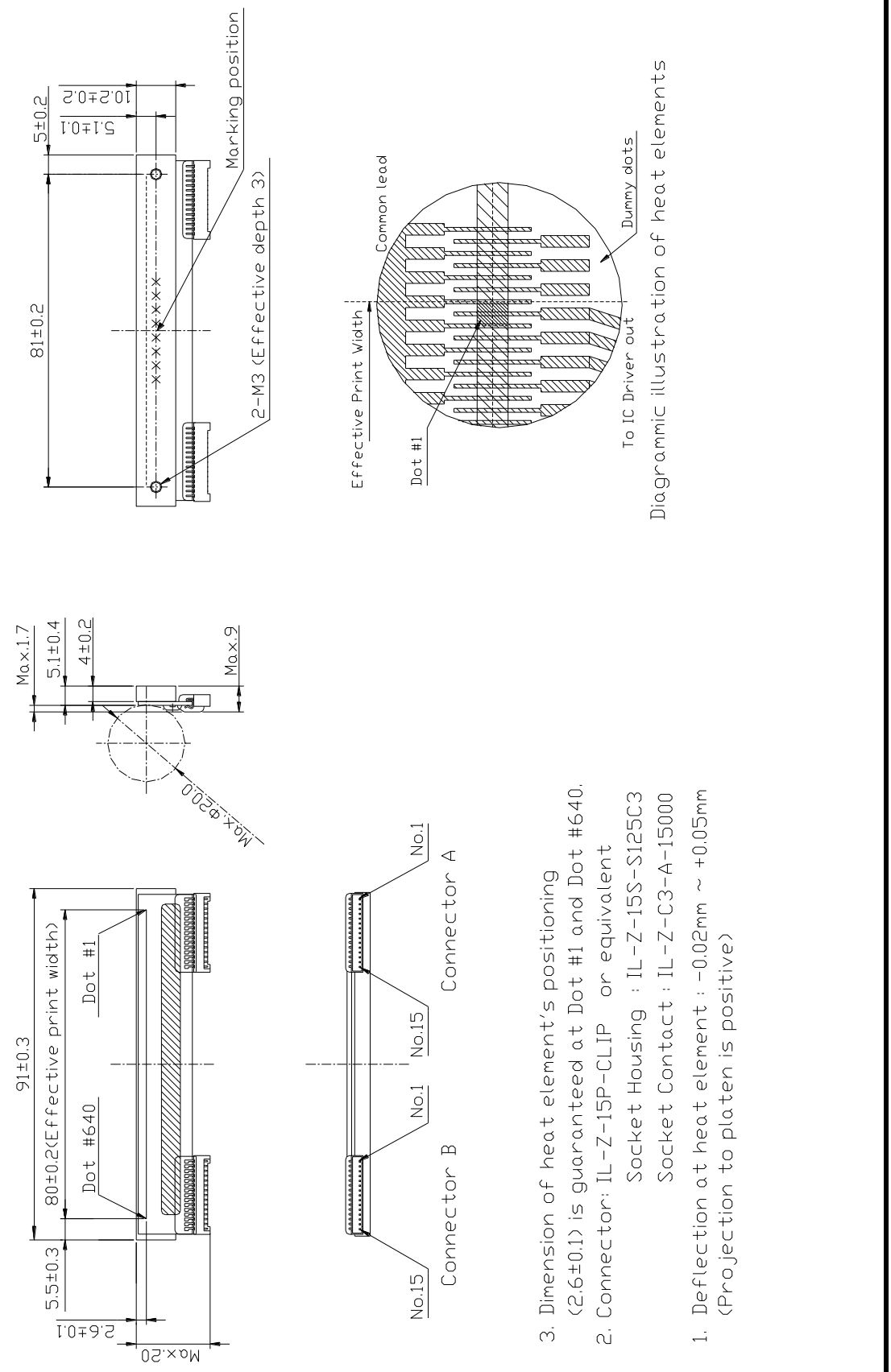


Fig.1-2 Cross Section

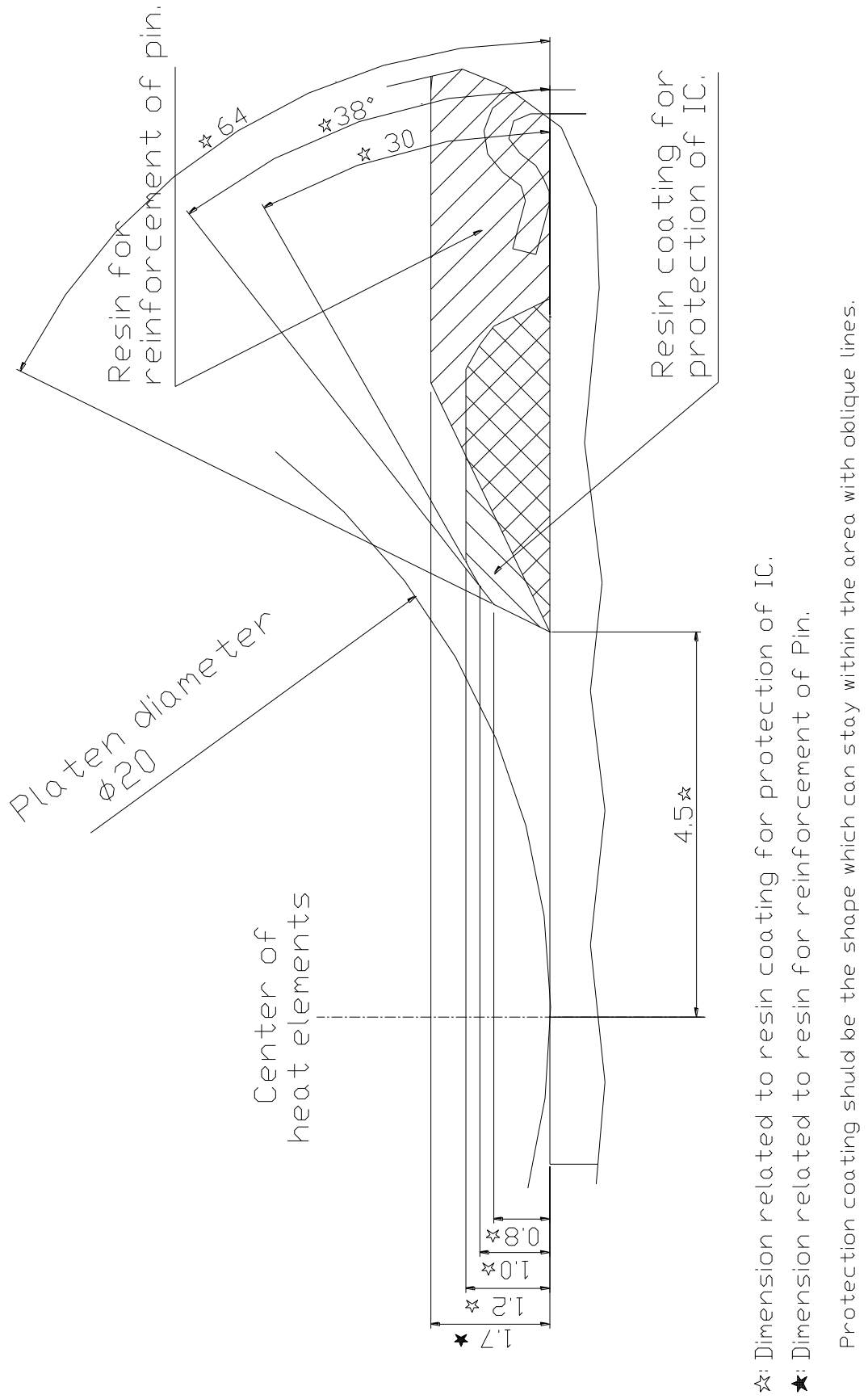
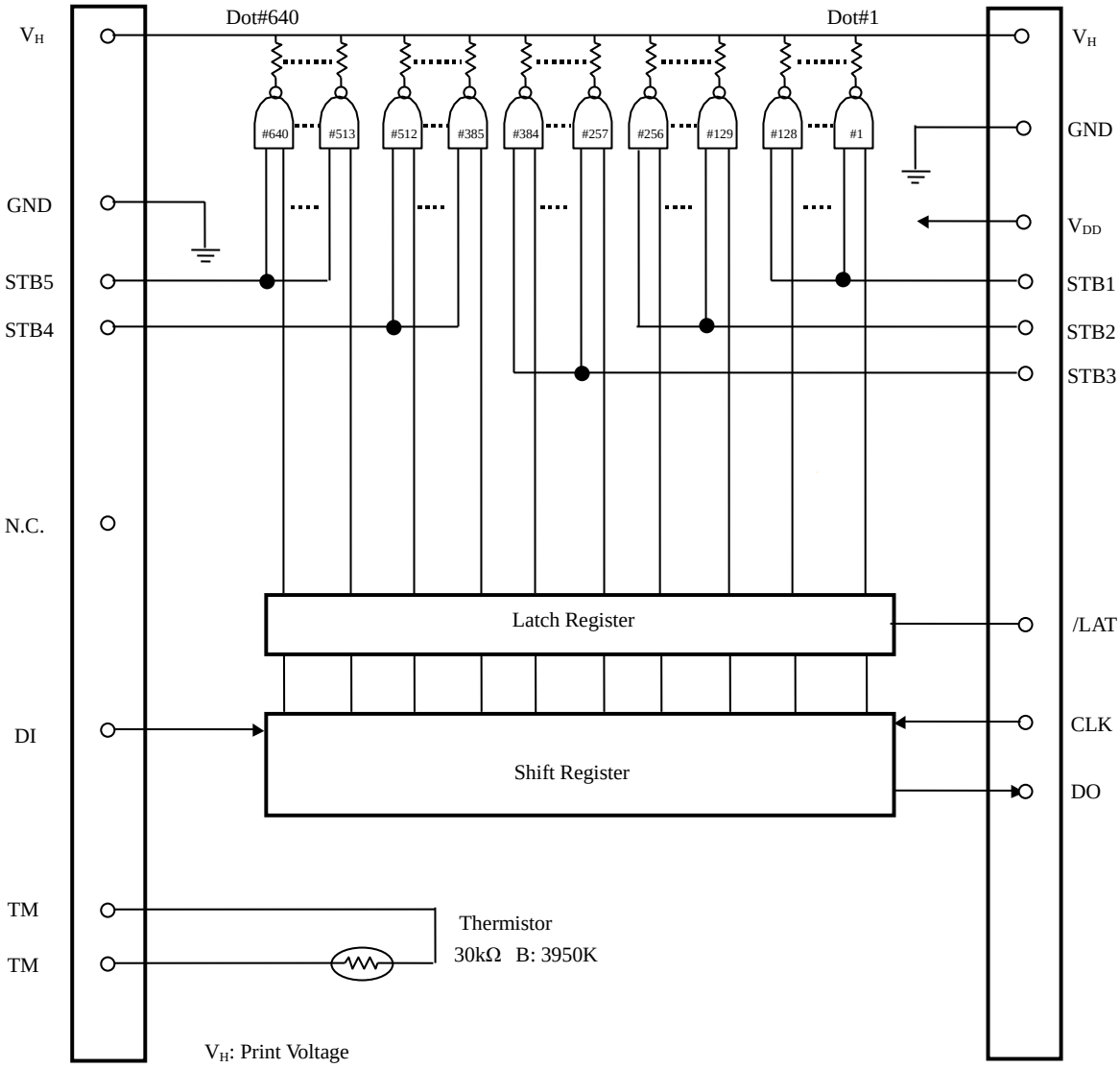


Fig.2 Circuit Diagram



V_H: Print Voltage
STB: Strobe (High active)
/LAT: Latch
CLK: Clock
DI: Data in
DO: Data out
GND: Ground
TM: Thermistor
N.C.: No connection

STB No.	Dot No.	Dots/STB
1	1 ~ 128	128
2	129 ~ 256	128
3	257 ~ 384	128
4	385 ~ 512	128
5	513 ~ 640	128

Table1 Pinout Diagram

Connector A: IL-Z-15P-CLIP or equivalent

PIN No.	SIGNAL
1	V_H
2	V_H
3	V_H
4	V_H
5	DO
6	/LAT
7	CLK
8	V_{DD}
9	STB1
10	STB2
11	STB3
12	GND
13	GND
14	GND
15	GND

Connector B: IL-Z-15P-CLIP or equivalent

PIN No.	SIGNAL
1	GND
2	GND
3	GND
4	GND
5	GND
6	TM
7	TM
8	STB4
9	STB5
10	N.C.
11	DI
12	V_H
13	V_H
14	V_H
15	V_H

PIN No.: Refer to Fig.1-1

Table2-1 Electrical Characteristics of Circuit (VDD = 4.75 ~ 5.25V)

Ta=25±10°C

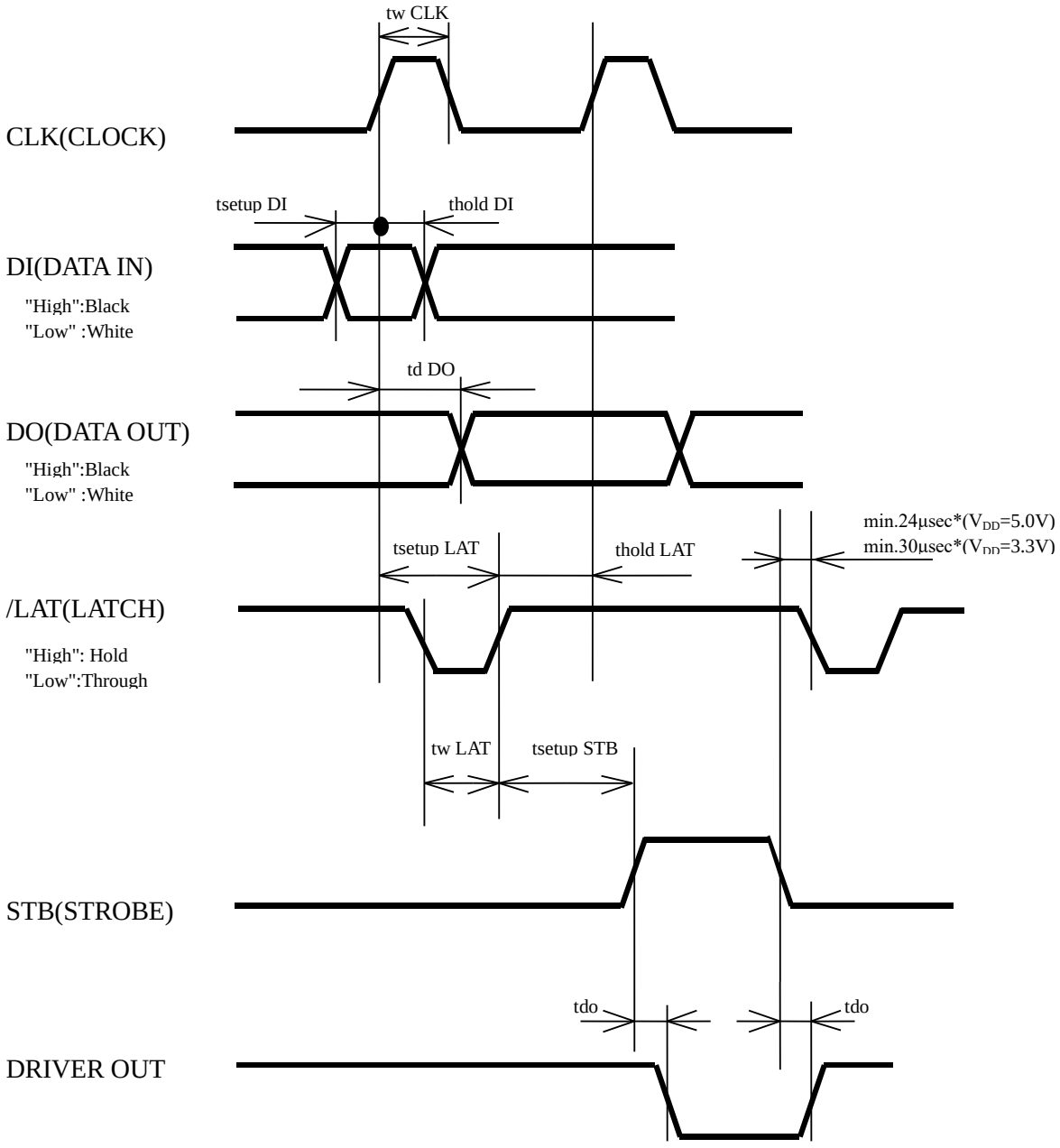
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	SIGNAL
PRINT VOLTAGE		V_H	-	24.0	26.4	V	
LOGIC VOLTAGE		V_{DD}	4.75	5.00	5.25	V	
LOGIC CURRENT		I_{DD}	-	-	80	mA	fDI= fCLK/2 fCLK=8MHz
INPUT VOLTAGE	H	V_{IH}	$0.8V_{DD}$	-	V_{DD}	V	STB, DI, LAT, CLK
	L	V_{IL}	0	-	$0.2V_{DD}$	V	
DATA INPUT CURRENT (DI)	H	I_{IH} DI	-	-	0.5	µA	V_{IH}=5V V_{IL}=0V
	L	I_{IL} DI	-	-	-0.5	µA	
STB INPUT CURRENT (HIGH ACTIVE)	H	I_{IH} STB	-	-	90	µA	
	L	I_{IL} STB	-	-	-1.0	µA	
CLOCK INPUT CURRENT (CLK)	H	I_{IH} CLK	-	-	5.0	µA	
	L	I_{IL} CLK	-	-	-5.0	µA	
LATCH INPUT CURRENT (LAT)	H	I_{IH} LAT	-	-	5.0	µA	
	L	I_{IL} LAT	-	-	-5.0	µA	
DO VOLTAGE (DO)	H	V_{DOH}	V_{DD}-0.4	-	-	V	I_{OH}= -0.4mA
	L	V_{DOL}	-	-	0.4	V	I_{OL}= 0.4mA
CLOCK FREQUENCY		f CLK	-	-	16	MHz	See Fig. 3
CLOCK WIDTH		tw CLK	20	-	-	ns	
DATA SET-UP TIME		tsetup DI	15	-	-	ns	
DATA HOLD TIME		thold DI	15	-	-	ns	
DATA OUT DELAY TIME		td DO	-	-	25	ns	
LAT WIDTH		tw LAT	40	-	-	ns	
LAT SET-UP TIME		tsetup LAT	60	-	-	ns	
LAT HOLD TIME		thold LAT	20	-	-	ns	
STB SET-UP TIME		tsetup STB	300	-	-	ns	
DRIVER OUT DELAY TIME		tdo	-	-	24	µ s	

Table2-2 Electrical characteristics of Circuit (VDD = 3.13 ~ 3.47V)

Ta=25±10°C

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	SIGNAL
PRINT VOLTAGE		V_H	-	24.0	26.4	V	
LOGIC VOLTAGE		V_{DD}	3.13	3.3	3.47	V	
LOGIC CURRENT		I_{DD}	-	-	36	mA	fDI=fCLK/2 fCLK=6MHz
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 (HIGH ACTIVE)	H	I_{IH} STB	-	-	30	µA	
	L	I_{IL} STB	-	-	-1.0	µA	
CLOCK INPUT CURRENT (CLK)	H	I_{IH} CLK	-	-	5.0	µA	
	L	I_{IL} CLK	-	-	-5.0	µA	
LATCH INPUT CURRENT (LAT)	H	I_{IH} LAT	-	-	5.0	µA	
	L	I_{IL} LAT	-	-	-5.0	µA	
DO VOLTAGE (DO)	H	V_{DOH}	V_{DD}-0.4	-	-	V	I_{OH}= -0.4mA
	L	V_{DOL}	-	-	0.4	V	I_{OL}= 0.4mA
CLOCK FREQUENCY		f CLK	-	-	10	MHz	See Fig. 3
CLOCK WIDTH		tw CLK	32	-	-	ns	
DATA SET-UP TIME		tsetup DI	25	-	-	ns	
DATA HOLD TIME		thold DI	25	-	-	ns	
DATA OUT DELAY TIME		td DO	-	-	35	ns	
LAT WIDTH		tw LAT	100	-	-	ns	
LAT SET-UP TIME		tsetup LAT	100	-	-	ns	
LAT HOLD TIME		thold LAT	40	-	-	ns	
STB SET-UP TIME		tsetup STB	300	-	-	ns	
DRIVER OUT DELAY TIME		tdo	-	-	30	µ s	

Fig.3 Timing Chart



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

Table 3 Thermistor Specification

Electrical requirements;

1) Resistance R_{25}: 30kΩ ± 5% at 25°C
2) B value: 3950K ± 2%
3) Resistance vs. Temperature: Fig.4

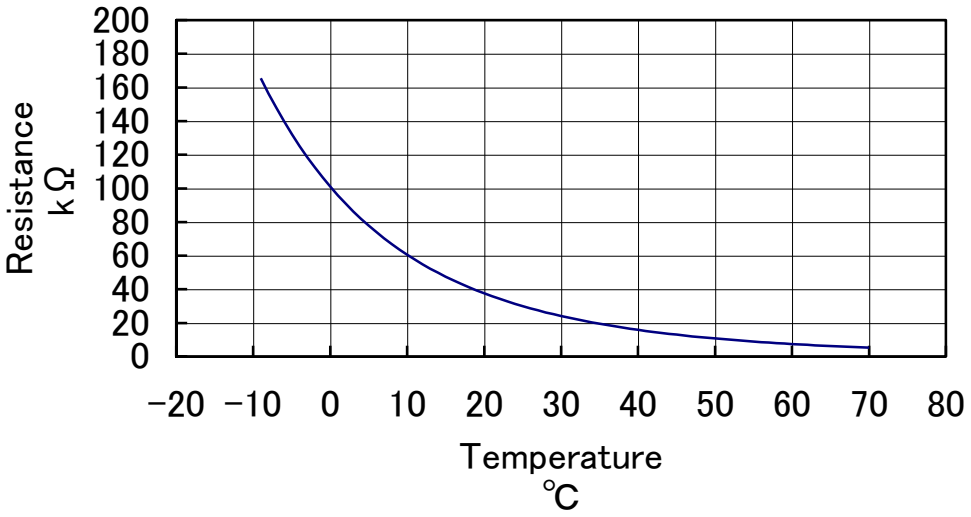
Rating;

1) Operating temperature: -20 ~ +80°C
2) Time constant: Max. 30sec (in the air)

Fig.4 Temperature characteristic of Thermistor

$$R_X=R_{25}*EXP\{B*(1/T_X-1/T_{25})\}$$

(T; Absolute temperature)



Recommended Circuit

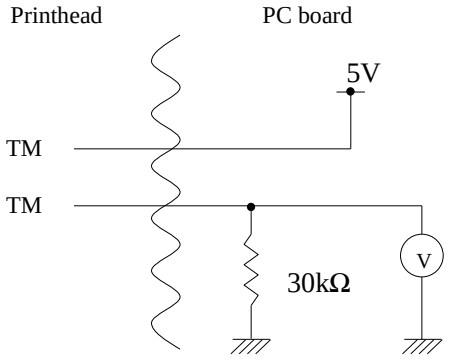


Fig.5 Package diagram