

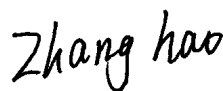


# THERMAL PRINT HEAD

## EM48N

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|          |             |          |            |          |  |
|          |             |          |            |          |   |

**1. Description**

This specification is applied to EM48N hermal print head.

**2. Scope**

The EM48N is a thermal print head which has heat elements which produce 384 dots with 8 dots/mm by means of a high density thick film process. It also includes C-MOS ICs; Which operate as 384 bits shift-registers, latches and switching transistors to drive heat elements.

**3. Outline**

| Item                          | Specification                                | Note     |
|-------------------------------|--|----------|
| Dimension                     | Fig.5  |          |
| Schematic diagram             | Fig.3  |          |
| Pin assignment                | Table.3                                      |          |
| Print width                   | 48 mm  |          |
| Number of heaters             | 384 dots                                     |          |
| Heater resolution             | 8 dots/mm                                    |          |
| Heater pitch                  | 0.125 mm                                     |          |
| Printed dot dimension         | 0.11mm×0.10 mm                               |          |
| Heater resistance             | $\bar{R} = 176 \Omega \pm 4\%$               |          |
| Specifications for driver ICs | Table.2                                      |          |
| Number of driver ICs          | 64bits × 6                                   |          |
| Number of data inputs         | 1 serial input                               |          |
| Number of strobos             | 6  |          |
| Logic power supply            | 5.0 V × 60 mA                                | at 8 MHz |
| Specification for Thermistor  | $R_{25}=30K\Omega \pm 5\%, B=3,950K \pm 3\%$ | Table. 1 |

**4. Maximum ratings**

| Parameter                     | Symbol | Specification                | Note  |
|-------------------------------|--------|------------------------------|---|
| Heater energy consumption     | Eomax  | 0.26 mJ/dot                  | 2.5 ms/line   |
|                               |        | 0.20 mJ/dot                  | 1.25 ms/line  |
| Head voltage                  | VH     | 10V                          | Between Connectors  |
| Logic voltage                 | Vdd    | 5.25V                        |   |
| Environment temperature       | Ta     | -30 ° C ~ +50 ° C            | Operating(The printed optical density is not guaranteed between -30 ° C ~ +5 ° C) |
|                               |        | - 40 ° C ~ +80 ° C           | Non-operating   |
| Environment humidity          |        | 10 ~ 90%RH                   | Non-condensing  |
| Maximum operating temperature | Ts     | Continuous:65° C 30min. MAX. | Thermistor temp.  |
|                               |        | Peak:80° C Thermistor temp.  | When 80° C was detected, Printing must be stopped, and wait until 60° C           |

**5. Standard printing conditions**

| Parameter                 |      | Symbol  | Recommended operating conditions          |                      | Note                               |
|---------------------------|------|---------|---|----------------------|------------------------------------|
| Speed                     |      |         | 2.5 ms/line                               | 1.25 ms/line         |                                    |
| Heater power consumption  |      | Po      | 0.124 W/dot                               | 0.258 W/dot          | $\bar{R} = 176 \Omega$             |
| Heat voltage              |      | VH      | 5.0 V                                     | 7.2 V                | Between Connectors                 |
| Heater energy consumption | 5°C  | Eo (ts) | 0.20 mJ/dot(1.6ms)                        | 0.17 mJ/dot(0.65 ms) | 64 dots simultaneously ON (Note 1) |
|                           | 25°C |         | 0.18 mJ/dot(1.4ms)                        | 0.14 mJ/dot(0.54 ms) |                                    |
|                           | 40°C |         | 0.16mJ/dot(1.28ms)                        | 0.13mJ/dot(0.50 ms)  |                                    |
| Supply current            |      | Io      | 26.6 mA/dot                               | 38.3 mA/dot          | $\bar{R} = 176 \Omega$             |
| Timing chart              |      |         | Fig. 2                                    |                      |                                    |
| Platen pressure           |      |         | 7.2 ~ 9.5 N / TPH                         |                      |                                    |
| Platen hardness           |      |         | 40~50deg                                  |                      |                                    |
| Platen diameter           |      |         | Φ8 Max.                                   |                      |                                    |
| Scanning resolution       |      |         | 16 line/mm                                |                      |                                    |
| Thermal paper             |      |         | F230AA<br>MITSUBISHI PAPER MILL CO., LTD. |                      |                                    |
| Optical density           |      |         | 1.1 OD Min.                               |                      | (Note 2)                           |

(Note 1) Supply energy is defined by the following formula.

$$E_o = I_o^2 \bar{R} t_s = \frac{(VH - V_{com})^2 \cdot \bar{R} \cdot t_s}{(R + R_{ic})^2}$$

$R_{ic} = 11.7 \Omega$  : Driver IC “ON” resistance

$t_s$  : Strobe pulse width

$VH$  : Head voltage

$\bar{R}$  : Heater average resistance

$V_{com} = 0.3 V$

(Note 2) Printed optical density is measured at 10mm intervals after the starting point. Printed optical density is measured by RD-914 reflector optical density meter or equivalent .

**6. Life expectancy**

The life expectancy under 12.5% printing duty of less at 25° C is defined by the following whichever earlier comes.

| Item             | Specification          | Note |
|------------------|------------------------|------|
| Number of pulses | $1 \times 10^8$ pulses |      |
| Run length       | 50 Km                  |      |

## 7. Warning during use

### 7.1 Strobe signal

During head power supply ON/OFF sequence ,strokes should be kept "disable".

### 7.2 Stability of IC operation

Care should be taken for stable operation of driver ICs as indicated bellow. (Fig.1)

(1) If the voltage including surge exceeds maximum rating of driver IC, the TPH may burn out by latch-up. Care should be taken especially when head current changes by strobes or at the ON/OFF sequence. The voltage shall be kept within the following voltage.

|               |                        |
|---------------|------------------------|
| VH            | : 0V ~ +10V            |
| Vdd           | : 0V ~ +7V             |
| Other signals | : GND -0.5V ~ Vdd+0.5V |

**7.3** The heater and driver ICs are electrostatically sensitive. Care should be taken not to touch connectors with hands or an electrostatically charged object. It is recommended that brushes near the head be provided to discharge electrostatic build up.

**7.4** On the surface near the heater, do not apply any hard material. The abrasion resistant layer is fragile to mechanical impact.

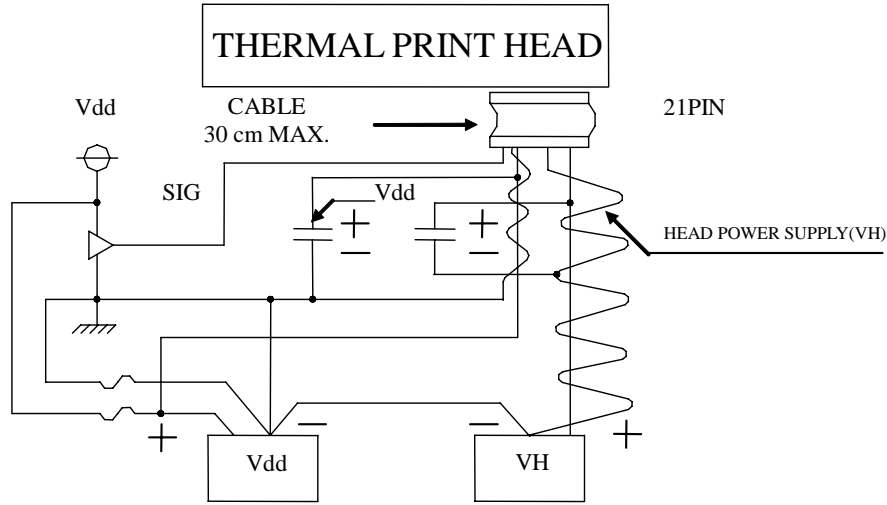
**7.5** Ink dregs adhered to the heater should be wiped off softly with a soft cloth dipped alcohol or detergent. Do not use sandpaper or equivalent.

**7.6** Keep hard particles out of the heater surface. Hard particles may scratch the abrasion resistant layer.

**7.7** Maximum number of heaters for simultaneous is 192.

**7.8** When the printer is on standby, the thermal head (VH) must be switched off.

**Fig. 1 Recommend Connection**



**Table. 1 Thermistor**

$$R_{25} = 30K\Omega \pm 5\%, B_{CONST} = 3950\text{kelvin} \pm 3\%, R = R_{25}e^{B(1/T - 1/T_{25})}$$

| Temperature ( ° C ) | Thermistor Resistance (R) |           |           |
|---------------------|---------------------------|-----------|-----------|
|                     | Min. (KΩ)                 | Typ. (KΩ) | Max. (KΩ) |
| -40.0               | 717                       | 843       | 989       |
| -35.0               | 535                       | 623       | 723       |
| -30.0               | 405                       | 466       | 535       |
| -25.0               | 308                       | 352       | 400       |
| -20.0               | 238                       | 269       | 303       |
| -15.0               | 185                       | 208       | 232       |
| -10.0               | 145                       | 161       | 178       |
| -5.0                | 113                       | 124       | 137       |
| 0.0                 | 88.7                      | 96.8      | 105       |
| 5.0                 | 69.9                      | 75.7      | 81.7      |
| 10.0                | 55.4                      | 59.5      | 63.8      |
| 15.0                | 44.1                      | 47.1      | 50.1      |
| 20.0                | 35.4                      | 37.5      | 39.6      |
| 25.0                | 28.5                      | 30.0      | 31.5      |
| 30.0                | 22.8                      | 24.2      | 25.5      |
| 35.0                | 18.3                      | 19.6      | 20.8      |
| 40.0                | 14.9                      | 15.9      | 17.1      |
| 45.0                | 12.1                      | 13.1      | 14.1      |
| 50.0                | 9.92                      | 10.8      | 11.7      |
| 55.0                | 8.16                      | 8.91      | 9.7       |
| 60.0                | 6.76                      | 7.41      | 8.12      |
| 65.0                | 5.62                      | 6.2       | 6.83      |
| 70.0                | 4.7                       | 5.21      | 5.77      |
| 75.0                | 3.95                      | 4.4       | 4.9       |
| 80.0                | 3.34                      | 3.74      | 4.18      |

**Table. 2 C-MOS Driver IC**

**Table 2.1** Electrical characteristics for driver IC

Absolute maximum ratings for driver ICs.

| Parameter               | Symbol   | Test conditions | Ratings            | Unit |
|-------------------------|----------|-----------------|--------------------|------|
| Supply voltage          | $V_{dd}$ | Surge           | 0 ~ 7              | V    |
|                         | VH       | Surge           | 0 ~ 10             | V    |
| Input voltage for logic | $V_{IN}$ |                 | 0 ~ $V_{dd} + 0.5$ | V    |

Recommended operating conditions

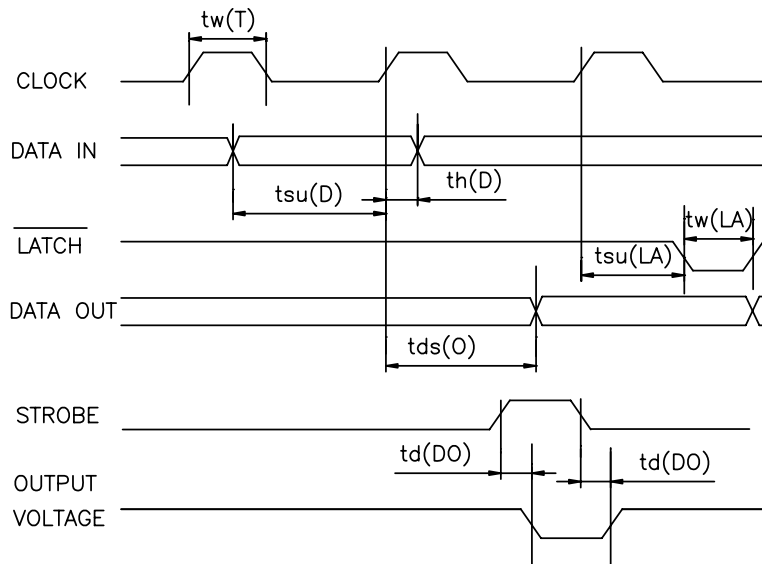
| Parameter               | Symbol    | Test conditions       | Recommendations     |      |                     | Unit |
|-------------------------|-----------|-----------------------|---------------------|------|---------------------|------|
|                         |           |                       | Min.                | Typ. | Max.                |      |
| Supply voltage          | $V_{dd}$  |                       | 3.0                 | 5.0  | 5.25                | V    |
|                         | VH        | Supply voltage for VH |                     |      | 8.0                 | V    |
| Input voltage for logic | $V_{IH}$  |                       | $0.8 \times V_{dd}$ |      | $V_{dd}$            | V    |
|                         | $V_{IL}$  |                       | 0                   |      | $0.2 \times V_{dd}$ | V    |
| Clock frequency         | $f_{CLK}$ | duty 50%              |                     |      | 8                   | MHz  |

**Table 2.2** Electrical characteristics for driver IC.

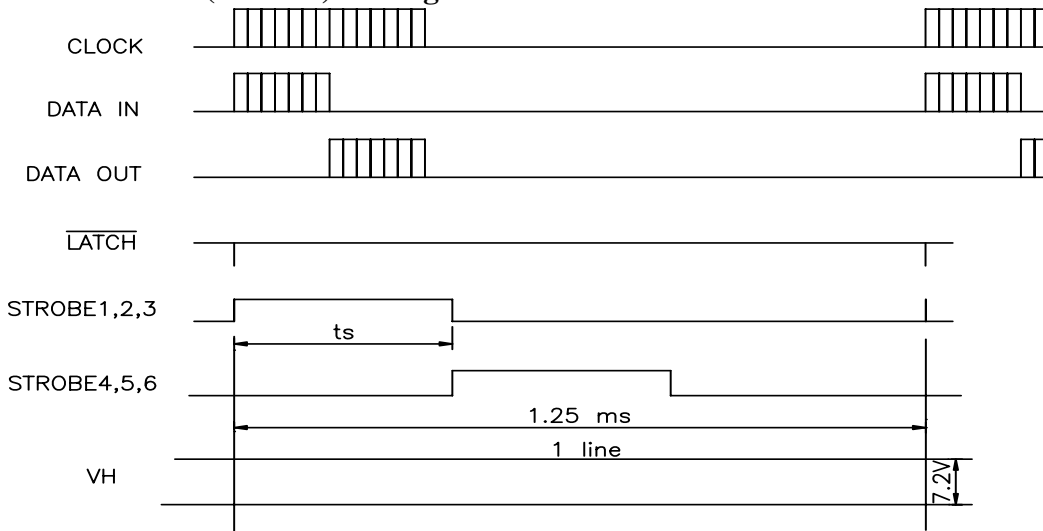
| Parameter                     | Symbol             | Test conditions                        | Ratings           |      |      | Unit        |         |
|-------------------------------|--------------------|--|-------------------|------|------|-------------|---------|
|                               |                    |  | Min.              | Typ. | Max. |             |         |
| Input current                 | $\overline{LATCH}$ | $I_{IH}$                               | $V_{IH} = V_{dd}$ |      |      | 3.0         | $\mu A$ |
|                               | STROBE             |  |                   |      |      | 55          | $\mu A$ |
|                               | CLOCK              |  |                   |      |      | 3.0         | $\mu A$ |
|                               | DATA IN            |  |                   |      |      | 0.5         | $\mu A$ |
|                               | $\overline{LATCH}$ | $I_{IL}$                               | $V_{IL} = GND$    | -330 |      |             | $\mu A$ |
|                               | STROBE             |  |                   | -0.5 |      |             | $\mu A$ |
|                               | CLOCK              |  |                   | -3.0 |      |             | $\mu A$ |
|                               | DATA IN            |  |                   | -0.5 |      |             | $\mu A$ |
| “L” Output voltage of drivers | $V_{DOL}$          | $V_{dd} = 3V$ $I_{DOL} = 60mA$         |                   | 0.7  | 0.9  | V           |         |
| Leak current of drivers       | $I_{LEAK}$         | $V_{OH} = 8V$                          |                   |      | 1.0  | $\mu A/dot$ |         |
| Logic supply current          | $I_{dd}$           | $f_{CLK} = 8MHz$<br>$SI = 1/2 f_{CLK}$ |                   | 21   | 60   | mA          |         |
| “H”Level output voltage       | $V_{OH}$           | $I_{OH} = -0.5mA$                      | 2.6               |      |      | V           |         |
| “L”Level output voltage       | $V_{OL}$           | $I_{OH} = 0.5mA$                       |                   |      | 0.4  | V           |         |

**Table 2.3** Switching characteristics for driver ICs.

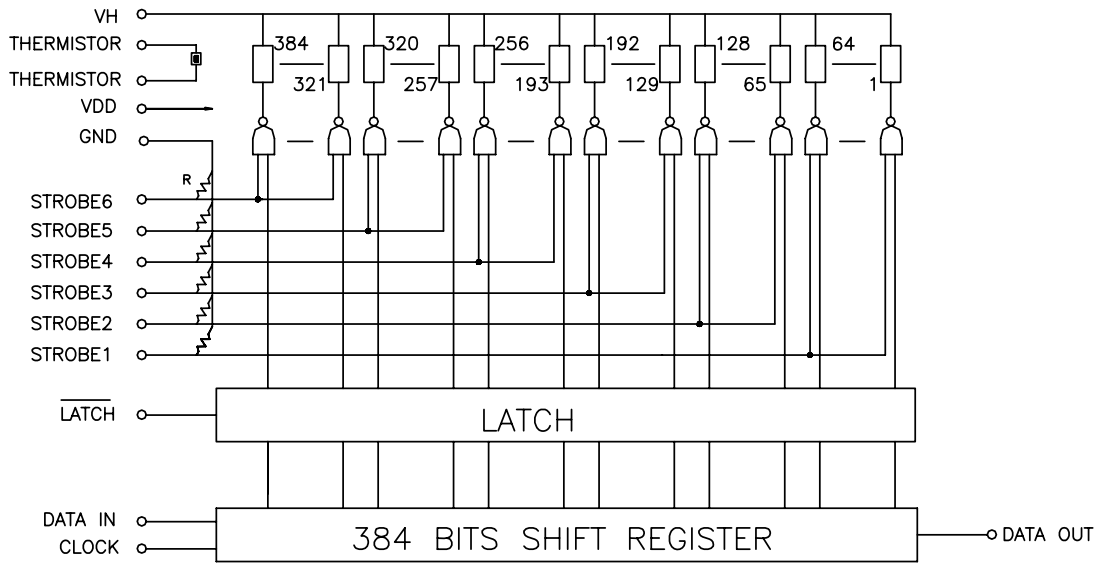
| Parameter                          | Symbol    | Test conditions | Ratings |      |      | Unit    |
|------------------------------------|-----------|-----------------|---------|------|------|---------|
|                                    |           |                 | Min.    | Typ. | Max. |         |
| Clock frequency                    | $f_{MAX}$ | cascade         |         |      | 8.0  | MHz     |
| Clock pulse width                  | $tw(T)$   |                 | 50      |      |      | ns      |
| Data setup time                    | $tsu(D)$  |                 | 40      |      |      | ns      |
| Data hold time                     | $th(D)$   |                 | 40      |      |      | ns      |
| Latch setup time                   | $tsu(LA)$ |                 | 100     |      |      | ns      |
| Latch pulse width                  | $tw(LA)$  |                 | 100     |      |      | ns      |
| Clock to So delay time             | $td(SO)$  |                 |         |      | 130  | ns      |
| Strobe to driver Output delay time | $td(DO)$  |                 |         |      | 26.0 | $\mu s$ |



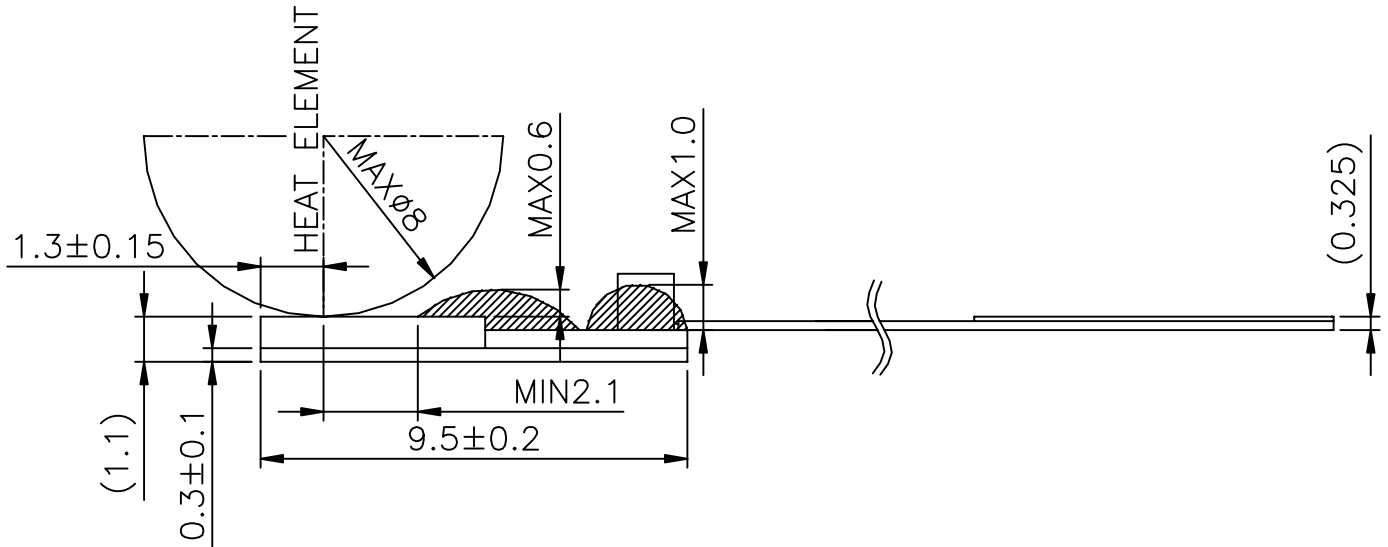
**Fig. 2 Thermal Print Head (EM48N) Timing Chart**



**Fig. 3 Schematic Diagram**



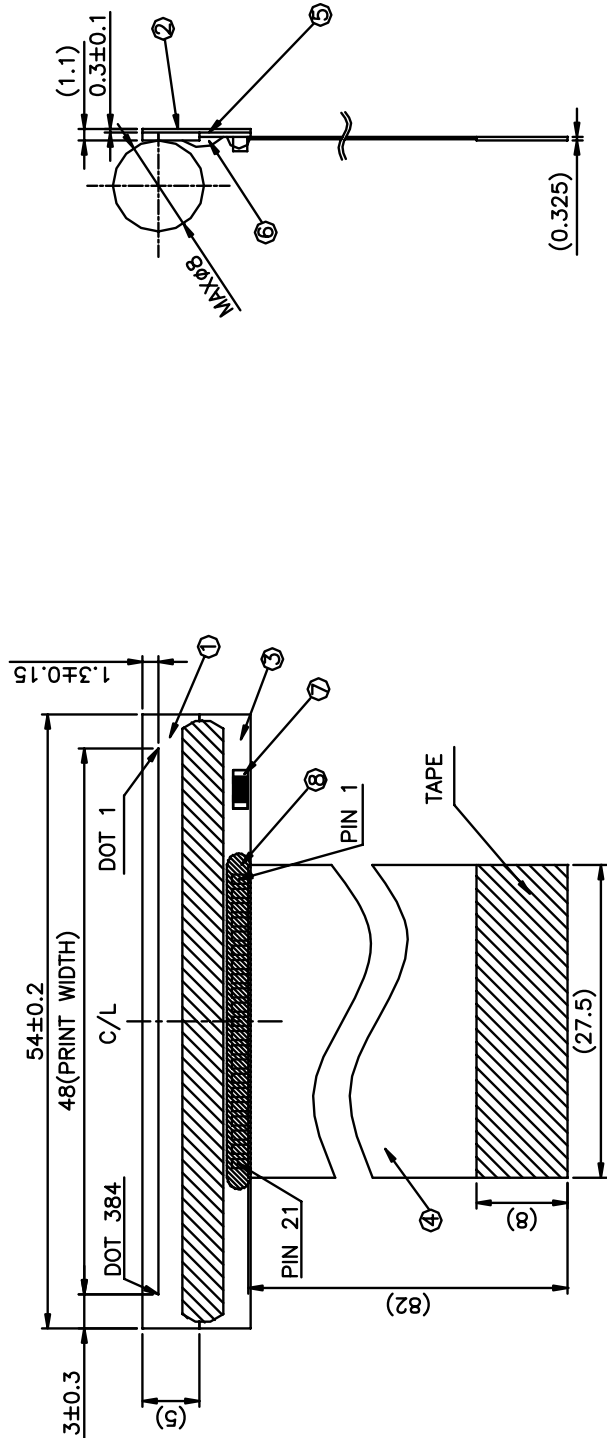
**Fig. 4 Cross Section**



**Table. 3 Pin assignment**

| PIN | NAME               | PIN | NAME       | PIN | NAME    |
|-----|--------------------|-----|------------|-----|---------|
| 1   | VH                 | 8   | STROBE2    | 15  | STROBE6 |
| 2   | VH                 | 9   | STROBE3    | 16  | GND     |
| 3   | DATA OUT           | 10  | THERMISTOR | 17  | GND     |
| 4   | $\overline{LATCH}$ | 11  | THERMISTOR | 18  | CLOCK   |
| 5   | GND                | 12  | Vdd        | 19  | DATA IN |
| 6   | GND                | 13  | STROBE4    | 20  | VH      |
| 7   | STROBE1            | 14  | STROBE5    | 21  | VH      |

**Fig. 5 Dimension**



| ITEM DESCRIPTION | MATERIAL | DEF | SUMMARYS |
|------------------|----------|-----|----------|
| 1 SUBSTRATE      | CERAMIC  | 1   |          |
| 2 HEAT SINK      |          | 1   |          |
| 3 CIRCUIT BOARD  | FR4      | 1   |          |
| 4 FFC            |          | 1   |          |
| 5 ADHESIVE       |          | 1   |          |
| 6 EPOXY MOLD     |          | ○   |          |
| 7 THERMISTOR     |          | 1   |          |
| 8 U/V ADHESIVE   |          | ○   |          |

- NOTE:
1. COMPOSITION OF LOT No. 9 02 010001 (2009) (Feb) (Lot No.)
  2. THIS MODEL COMPLIES WITH THE RoHS DIRECTIVE

