

SPECIFICATIONS

PWB_UNIT_M972A

Japan Display Inc.

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1) BASIC SPECIFICATIONS

1.1 Outline

This product is a drive board for LumiFree sold by Japan Display Inc.

Light distribution control, which is the basic performance of LC panel, can be controlled via I2C.

1.2 Basic information

No	PARAMETER	SPECIFICATIONS
1	Product name	PWB_UNIT_M972A
2	Applicable product	LumiFree

1.3 Structures

No	PARAMETER	SPECIFICATIONS	Unit
1	Size	45.0 x 45.0 x 6.7 (Typ.)	mm
2	Weight	7 ± 0.7	g

*1) For external dimensions including tolerances, please refer to 8. PWB DRAWING.

1.4 Operating/Storage condition

No	PARAMETER	SPECIFICATIONS
1	Operating temperature	-20°C to +70°C *1
2	Storage temperature	-20°C to +80°C *1

*1) No dew condensation and freezing

1.5 Conformance Information

1) Environmental Compatibility Information

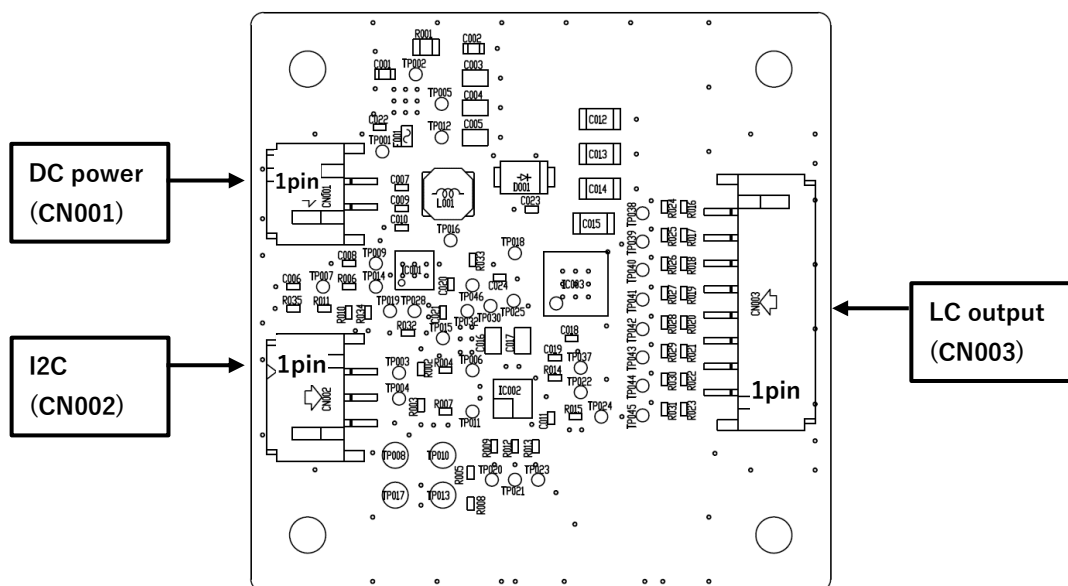
Environmental Compatibility Information
RoHS compliant (10 substances)

2) Compatibility information for each component

UL Certifications		
PWB	Component No.	E88441
	Type No	MV-0
	material	UL94V-0
connector S2B-PH-SM4-TB(LF)(SN)	Component No.	E60389
	material	UL94V-0
connector S3B-PH-SM4-TB(LF)(SN)	Component No.	E60389
	material	UL94V-0
connector S8B-PH-SM4-TB(LF)(SN)	Component No.	E60389
	material	UL94V-0

2) I/O TERMINALS

2.1 Hardware structure and pin assignment of connector



2.2 Connector pin description

CN001: S2B-PH-SM4-TB(LF)(SN) (J.S.T.MFG.CO.,LTD.)

PIN	SYMBOL	FUNCTION	I/O/P	REMARKS
1	VCC	Power supply	P	
2	GND	Ground	P	

P: power supply, I: input, O: output

CN002: S3B-PH-SM4-TB(LF)(SN) (J.S.T.MFG.CO.,LTD.)

I2C Version *2)

PIN	SYMBOL	FUNCTION	I/O/P	REMARKS
1	SCL	Serial clock	I	Pulled VCC internally 4.7kohm
2	SDA	Serial data	I, O	Pulled VCC internally 4.7kohm
3	GND	Ground	P	

P: power supply, I: input, O: output

CN003: S8B-PH-SM4-TB(LF)(SN) (J.S.T.MFG.CO.,LTD.)

PIN	SYMBOL	FUNCTION	I/O/P	REMARKS
1	AMPOUT1	LC Ch1	O	
2	AMPOUT2	LC Ch2	O	
3	AMPOUT3	LC Ch3	O	
4	AMPOUT4	LC Ch4	O	
5	AMPOUT5	LC Ch1	O	
6	AMPOUT6	LC Ch2	O	
7	AMPOUT7	LC Ch3	O	
8	AMPOUT8	LC Ch4	O	

P: power supply, I: input, O: output

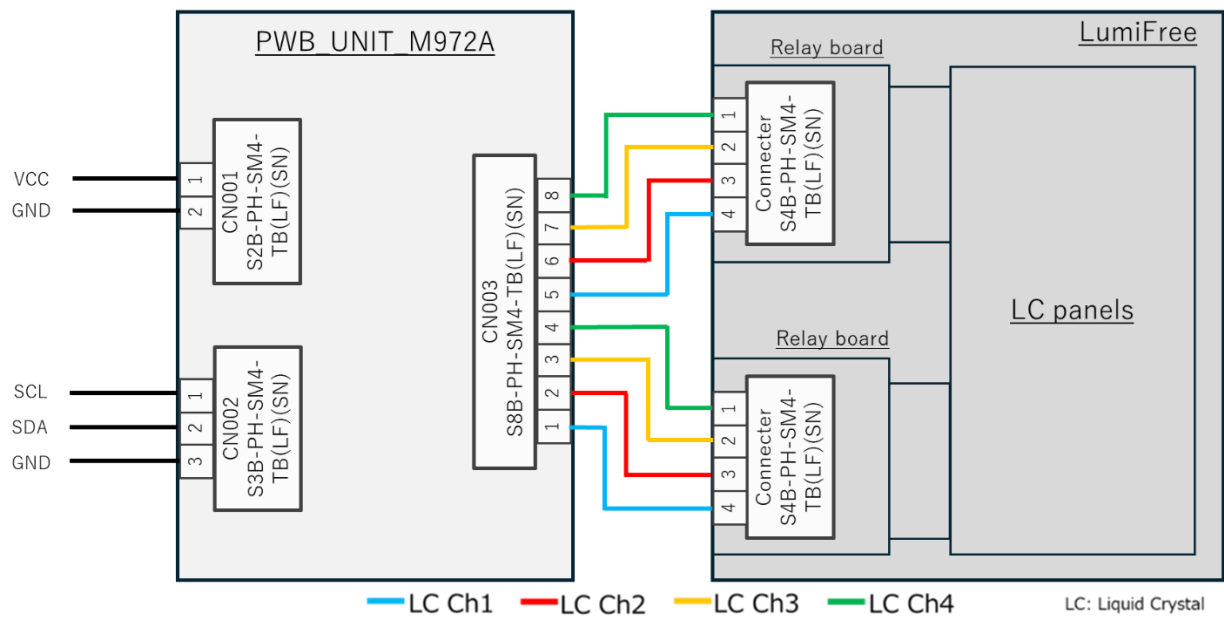
*1) Please prepare cables designed for each input/output connector.

*2) If an additional pull-up resistor is installed in the customer's system, it should be pulled up against the same line as VCC of this product.

2.3 Connection specification with LumiFree

1) Connector connection specification

For connection to LumiFree, please connect as shown below.



Please connect the two LumiFree relay boards to CN003 using the diagram shown above as a reference. (NC pin is not allowed)

The two relay boards are of the same design and can be interchanged but be sure to connect both to CN003.

3) ELECTRICAL CHARACTERISTICS

3.1 Absolute maximum ratings

Stress beyond those listed under "ABSOLUTE MAXIMUM RATINGS" may cause permanent damage to the device.

GND = 0V

ITEM	SYMBOL	CONDITION	RATING		UNIT	REMARKS
			Min.	Max.		
Power supply voltage	VCC	-	-0.3	6.0	V	-
Input voltage	VI	-	-0.3	VCC+0.3	V	*1
Output voltage	VO	-	-0.3	VCC+0.3	V	*2

*1) Applied pin: CN002 SCL(I2C), SDA(I2C),

*2) Applied pin: CN002 SDA(I2C)

3.2 DC characteristics

GND = 0V

ITEM	SYMBOL	CONDITION	RATING			UNIT	REMARKS
			Min.	Typ.	Max.		
Power supply voltage	VCC	-	2.97	-	5.50	V	*1)
Allowable power supply ripple	Vp-p	Connected with LumiFree-	-	-	200	mVp-p	-
Power supply current	I _{VCC}	2.97V ≤ VCC ≤ 5.5V -20°C ≤ Ta ≤ 70°C LumiFree up to Dia. 105mm assumed	-	-	350	mA	*2)
Power supply Inrush current	I _{PEAK}	2.97V ≤ VCC ≤ 5.5V Rising speed 2V/100us	-	-	1200	mA	*3)
Input voltage	VIH	-	0.8 VCC	-	VCC	V	*4)
	VIL	-	0	-	0.2 VCC	V	*4)
Output voltage	VOH	-	-	-	VCC	V	*5) *6)
	VOL	2.97V ≤ VCC ≤ 5.5V IOL = 1.5mA	-	-	0.4	V	*5)
Pull-up resistor value	RI	Ta = 25°C	4.465	4.700	4.935	kΩ	*4)*7)

*1) Rated values indicate the operating range of electrical functions. The influence on optical characteristics should be fully verified before setting.

*2) To ensure product safety, the current supply capacity of the customer's power supply to the product should be 2A or more (to allow the internal fuse of the product to blow in the event of an abnormality), or 350mA to 450mA or less.

*3) The larger of the inrush current at VCC power-on or the inrush current at startup of the DCDC circuit in the product.

*4) Applied pin: CN002 SCL(I2C), SDA(I2C)

*5) Applied pin: CN002 SDA(I2C)

*6) Open drain output (4.7kohm pull-up)

*7) Characteristics of mounted resistor at Ta=25°C (5% tolerance on resistance value)

3.3 AC characteristics (I2C)

Follow the Fast mode specifications in NXP's "UM10204 I2C-bus specifications and user manual".

*1) Please note that clock stretch function has to be used.

4) FUNCTION

4.1 Overview

This product can control the light distribution characteristics of light passing through the liquid crystal panel (LumiFree) for lighting fixtures.

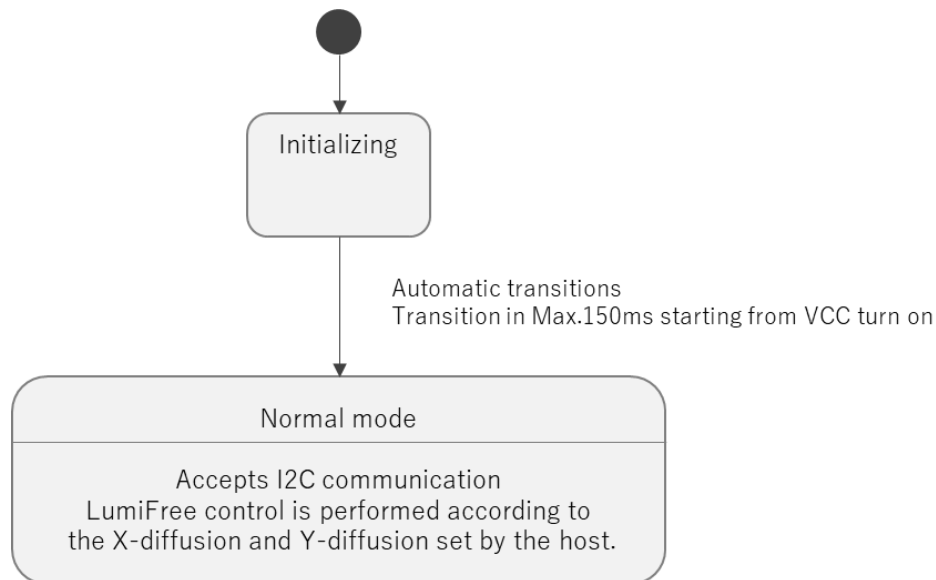
For details on each connection and use, please refer to "3 Input/Output Terminal Specifications" in this specification.

4.2 Functional sequence

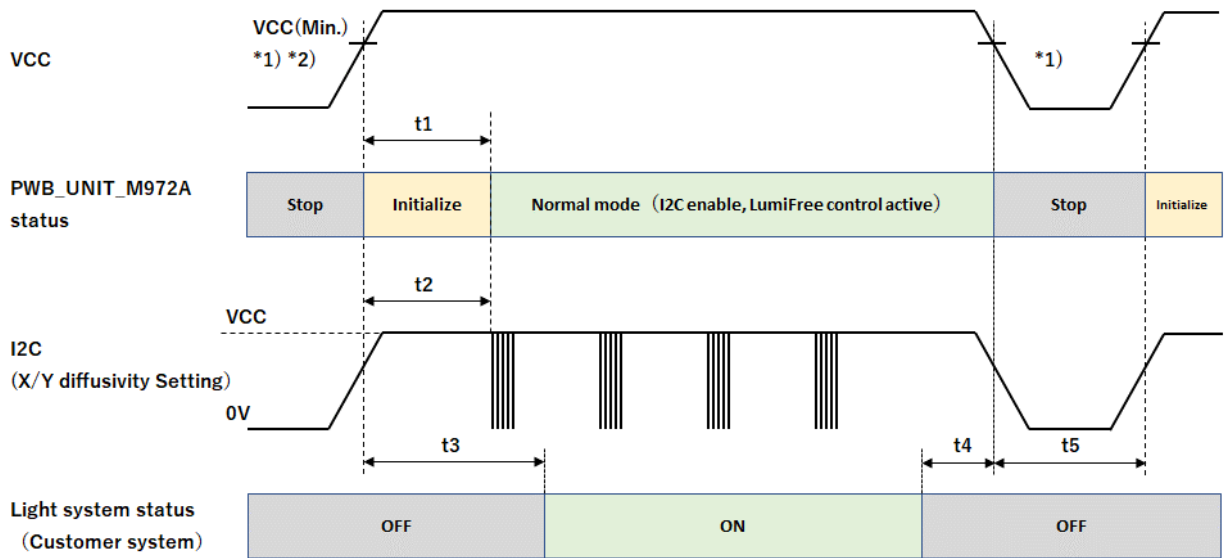
1) State definition

State	Descriptions
Initializing	Initialization process is being executed after power-on startup. I2C communication from the host is not accepted.
Normal mode	Accepts I2C communication from host. LumiFree control is performed according to the X-diffusion and Y-diffusion set by the host. Until the X and Y diffusivities are set, LumiFree control is performed with the initial values (0x00 for both X and Y diffusivities) of this product.

2) State transition diagram



3) ON/OFF sequence



PARAMETER	SYMBOL	RATING		UNIT	REMARKS
		Min.	Max.		
VCC turn on ~ Initialization complete	t1	-	150	ms	
VCC turn on ~ I2C access enable	t2	150	-	ms	*3)
VCC turn on ~ Light source on	t3	150	-	ms	*4)
Light source off ~ VCC turn off	t4	0	-	ms	*4)
VCC turn off ~ VCC turn on	t5	500	-	ms	

*1) The rising and falling speed of VCC should be slower than 2V/100us and faster than 2V/10ms.

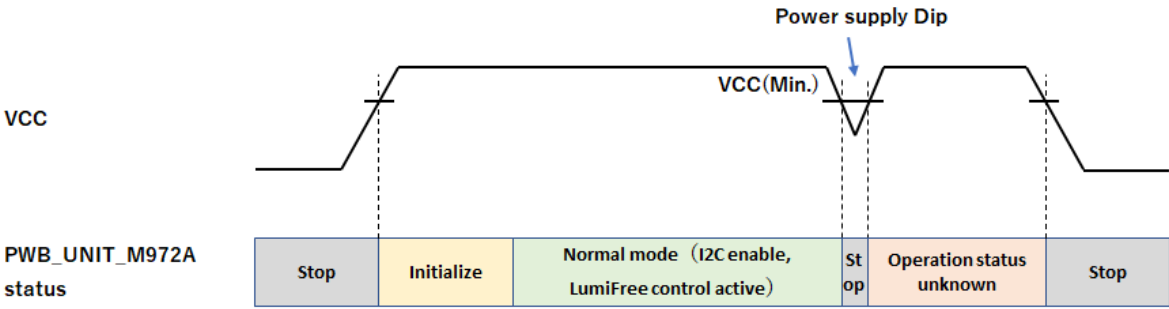
*2) VCC (min.) is minimum voltage of VCC. Please refer to 4.2 DC characteristics.

*3) The X-diffusivity/Y-diffusivity settings via I2C should be made after the initialization is completed.

*4) Please set this value after confirming the behavior at startup and shutdown by the customer.

Since LumiFree control cannot be performed during state transitions at startup and shutdown, the diffusion state may be unintended by the customer.

4) Power supply dip



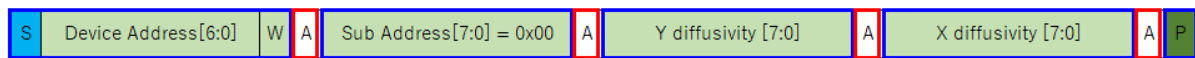
Normal operation cannot be guaranteed when the power supply dips below VCC(Min.) for a short period of time, as in a momentary power failure, and then returns to VCC normal voltage ("Operating status unknown" in the above figure).

If there is any abnormality in operation, restart according to 3) ON/OFF sequence in 5.2 Functional Sequence.

4.3 Diffusivity setting Write/Read method (I2C)

*Please note that clock stretch function has to be used.

1) Write method



 : Host process Client process

S: Start P: Stop A: ACK

Device Address: 0x71(7bit)

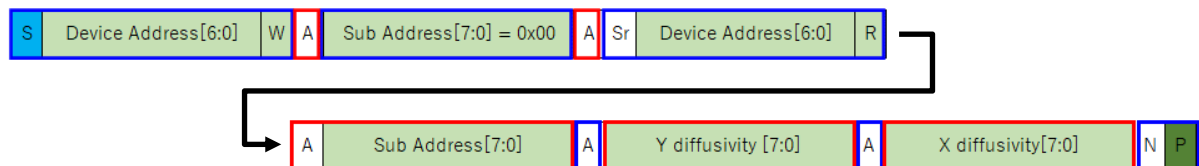
Sub address: 0x00

Y diffusivity: 0x00~0xFF

X diffusivity: 0x00~0xFF

- *1) Applies when all the data shown above are available. If the number of data is insufficient, or if there is too much data, the received data will be discarded.
- *2) Settings are retained during Normal mode. When the power is turned off, the setting is lost and the next startup value becomes the initial value.
- *3) After transitioning to Normal mode, the product's default values (0x00 for both X and Y diffusivities) are applied until the X and Y diffusivities are set.

2) Read method



 : Host process Client process

S: Start Sr: Repeated Start P: Stop A: ACK N: NACK

Device Address: 0x71(7bit)

- *1) Even if Sub Address other than 0x00, ACK is returned and 0xFF is sent for data requests.
- *2) If ACK is returned from Host even after the final data (X diffusivity) is sent, 0xFF data is sent.

5) PWB USAGE AND PRECAUTIONS

5.1 Precautions for handling

- 1) Be aware of the static electricity when handling the products because they have semiconductors inside. Avoid static electricity with conductive mats, wrist straps, antistatic shoes, and ionizers if necessary. Please be careful not to work on unclean work desks and clean them regularly to avoid foreign objects.
- 2) Be sure to turn off the power on the set side when connecting. Plugging or unplugging the connector of this product while the power of the set is on may damage the electrical circuit of the machine. When energizing power during testing and inspection processes, use the power supply and input signal of the drive device that satisfies the power ON/OFF sequence.
- 3) When inserting the socket housing of the harness into the connector, hold the socket housing firmly and insert it straight into the connector terminal. Do not force the socket housing into the connector after insertion.
- 4) Please inform us in advance if you use this product in your equipment or your device that requires high reliability because its failure or malfunction may result in damage to human lives or bodies or other serious damage (e.g., professional-use medical equipment, transportation equipment, aerospace equipment, nuclear equipment, combustion or explosion control equipment, in-car devices, various safety devices).
- 5) Do not use this product in any equipment or device for which the manufacture, use or sale is prohibited by laws, regulations, and rules both inside and outside your country.
- 6) The circuitry, software, and accompanying information described in this product specification document are intended to provide examples of operation for explanatory purposes only. If you apply such items or information to your own equipment, the design of such equipment is undertaken at your own risk. We shall not be liable for any damage caused to you or any third party using such items or information.
- 7) Use within the range of the rated, guaranteed operating conditions (e.g., operating voltage, operating environment). In cases where the product is operated outside the range of guaranteed values, we shall not be liable for any subsequent equipment failure or defects.
- 8) This product is designed and manufactured for standard use in general electronic equipment. Use in the following specific environments may affect its performance. Give due consideration to the environment under which the product is used.
 1. Use in liquids such as water, oil, chemicals, and organic solvents.
 2. Use in places where condensation forms on the product.
 3. Use in direct sunlight/outdoors, or in dusty conditions.
 4. Use in places where salt air or corrosive gas is present.
 5. Use in environments containing strong static electricity, electromagnetic waves, or radiation exist.
 6. Installation near heat-generating components.

- 9) Do not touch this product with your bare hands, and do not touch mounted parts or metal parts. Doing so may result in poor solder joints and corrosion. Also, do not apply excessive stress to the installation of this product, such as when fixing it.
- 10) The contents of this product specification document may be changed for technical or regulatory reasons.
- 11) Do not disassemble, analyze, reverse-engineer, remodel, modify, or reproduce this product. Please note that we shall not be liable for any damage that may arise from such acts.
- 12) A fuse (type name: KAMAYA "FCC16102ABTP") is attached to the power supply line in the drive board. For this fuse to operate effectively, the current supply capability of the customer power supply must be at least 2A. If you are using a power supply with a current supply capacity of 2A or less, the fuse may not work. Also, it does not work for circuits before the fuse. For example, if the power supply is short-circuited at the I/F connector, some parts such as the I/F connector may be damaged by fire or smoke. In order to prevent accidents, please provide an appropriate protection circuit on the set side as well. When installing a fuse on the set side, select a fuse with appropriate specifications so that the fuse does not blow due to the inrush current at the start of operation.
- 13) Applying Input Signals
The input signal should be applied at the same time as the power supply of the product or after the power is turned on. When turning off the power supply, turn off the power supply after turning off the input signal or at the same time as the input signal. For details, please follow the power and signal voltage supply sequence described in this specification. Input under conditions other than those recommended may cause malfunctions or display degradation. In addition, unused terminals should be treated as specified in this specification.
- 14) Prevention of Noise Malfunction
To prevent noise malfunction, pay particular attention to the specified values of VIL and VIH. In addition, please consider shortening the cables used for signal transmission.
- 15) EMI Caution
Include measures in your set to avoid EMI.
- 16) Static Electricity Precautions
This product may malfunction due to static electricity as well as general electronic components. Please include measures on the set side to prevent malfunctions.
- 17) If this product has a defect or malfunction attributable to our company within one year after delivery, we will repair or replace it without charge after mutual consultation with the customer regarding the action to be taken. Please note, however, that we shall not be responsible for any malfunctions or mechanical defects that may occur when this product is stored or used under conditions beyond those specified in this product specification document.
- 18) Raw materials used in the products listed in this product specification document may be subject to regulations on chemical substances and environmentally hazardous substances in the relevant countries. Please confirm the requirements specified by the respective regulations, which differ depending on the destination and purpose.

19) The design of this product, parts, circuits, software, etc. may be changed for improvement. If it is determined that the design change will affect the specifications of this product, we will notify you in advance of the change.

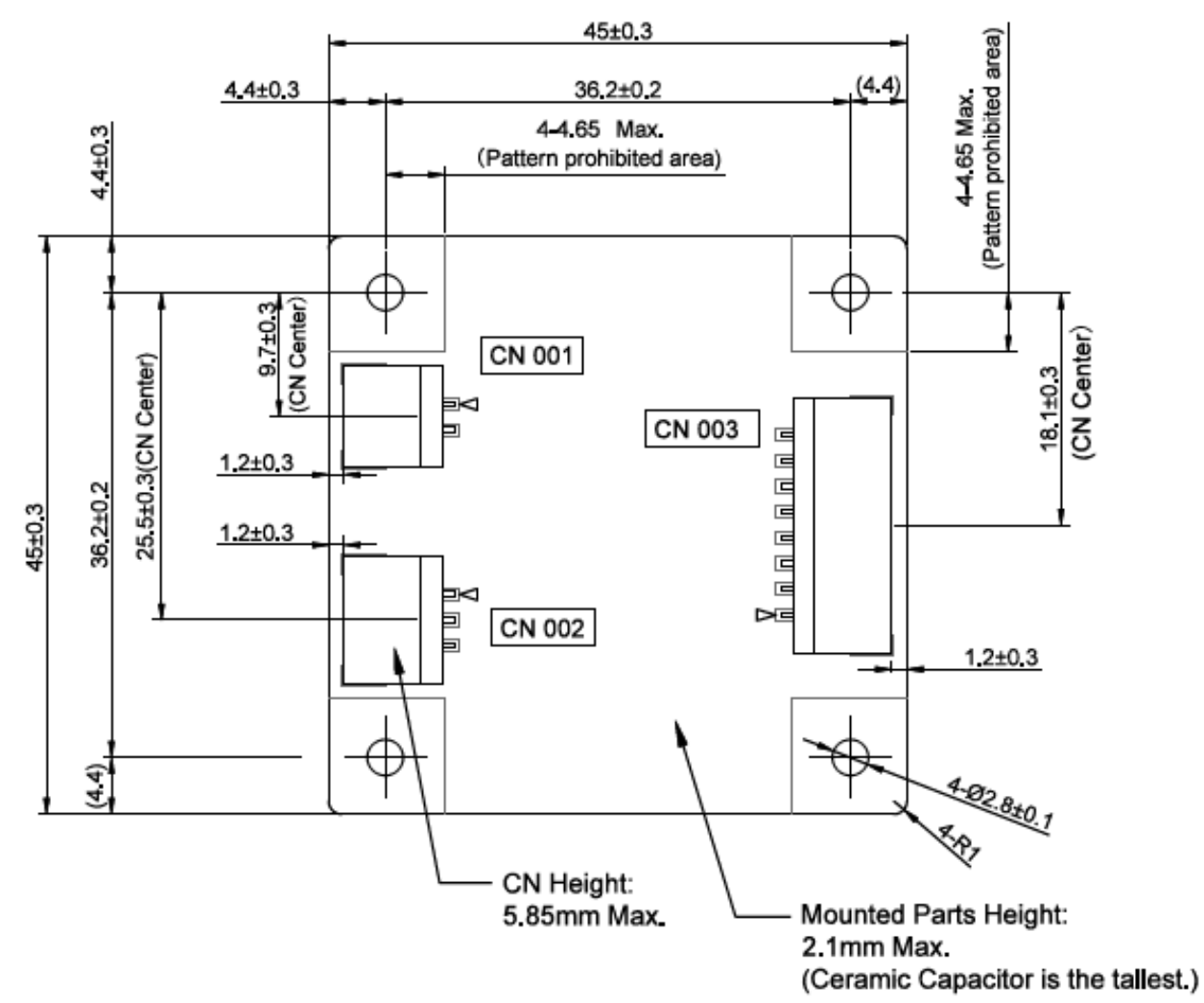
20) This product should be stored in its original packaging in a dark place out of direct sunlight at a temperature of 10~35°C^{*1} and humidity of 40~70% to avoid condensation. Since condensation may also occur due to sudden temperature changes, store and transport the products in an environment with minimal temperature fluctuation. Dew condensation may cause operational errors or malfunctions.

*1 The storage temperature range of the product is the temperature compensation range for non-operation and operating after the product is incorporated into the customer's system.

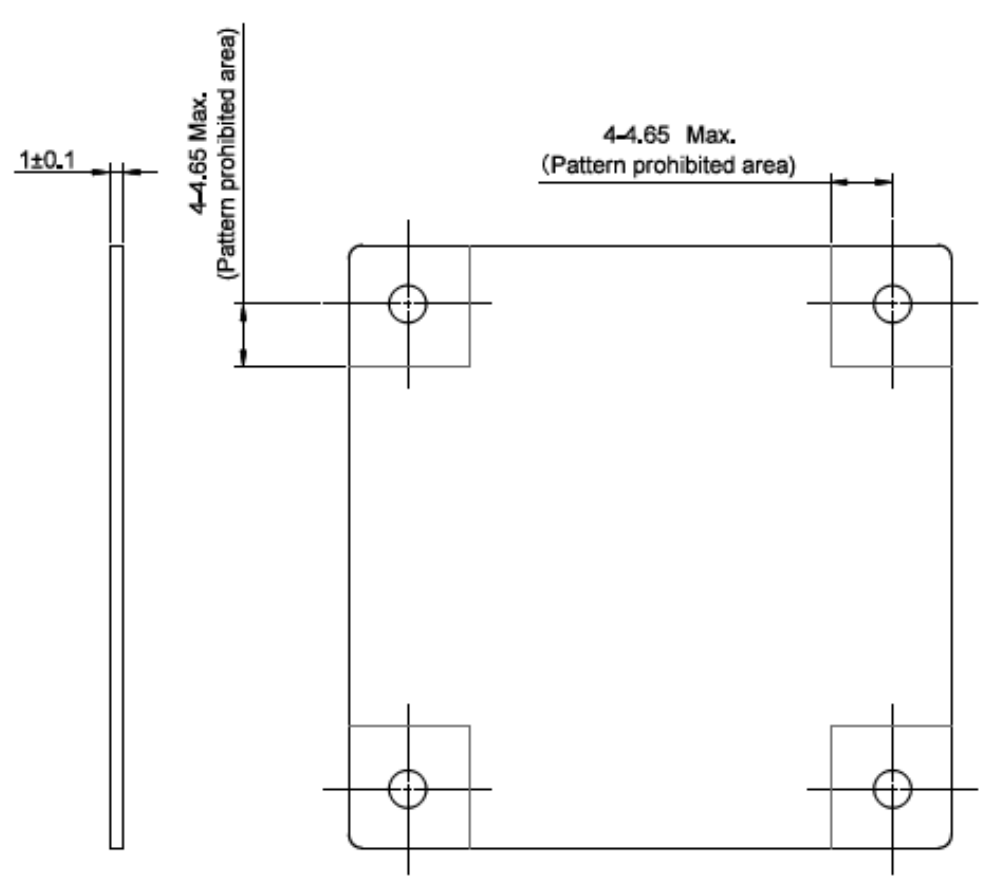
The temperature range for storage is the temperature range that should be observed during storage before incorporating the product, taking into account the packaging materials and protective agents.

21) Items not listed in the specifications shall be discussed by both parties after evaluation and confirmation using actual equipment.

7) PWB DRAWING



【Parts Surface】



【Reverse Side】

NOTE:
1. Dimensional tolerances not listed are ±0.5mm.
2. () means reference dimensions.
3. Δ means No.1 assigned pin.
4. Ni+Au Plating.
5. Pattern prohibited area (4 location) have no wiring pattern including GND.
6. For other details, please refer to the delivery specifications.

△x	/ /			UNIT mm	TOLERANCE ±0.5	MODEL M972A
△x	/ /			PROJECTION		DOCUMENT NO
△x	/ /			SCALE		MODEL M972A
△x	/ /			DOCUMENT TEXT		
△x	/ /			PWB_UNIT_M972A		
HISTORY & COUNT	SHEET /	DATE	REVISION	SIGN.	DOCUMENT NO	SHEET
DRAWN BY J.KUBO	PLANNED BY J.KUBO	CHECKED BY N.HASHINO	APPROVED BY S.KOURA	AM-M972A-OPD		1/1