

# LED Driver Board

## 104PW02F

**DATA SHEET**   
DOD-PP-1033 (2nd edition)

**This DATA SHEET is updated document from  
DOD-PP-1026(1).**

**All information is subject to change without notice.  
Please confirm the sales representative before  
starting to design your system.**

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## INTRODUCTION

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Some electronic parts/components would fail or malfunction at a certain rate. In spite of every effort to enhance reliability of products by NEC, the possibility of failures and malfunction might not be avoided entirely. To prevent the risks of damage to death, human bodily injury or other property arising out thereof or in connection therewith, each customer is required to take sufficient measures in its safety designs and plans including, but not limited to, redundant system, fire-containment and anti-failure.

The products are classified into three quality grades: "**Standard**", "**Special**", and "**Specific**" of the highest grade of a quality assurance program at the choice of a customer. Each quality grade is designed for applications described below. Any customer who intends to use a product for application other than that of Standard quality grade is required to contact an NEC sales representative in advance.

The **Standard** quality grade applies to the products developed, designed and manufactured in accordance with the NEC standard quality assurance program, which are designed for such application as any failure or malfunction of the products (sets) or parts/components incorporated therein a customer uses are, directly or indirectly, free of any damage to death, human bodily injury or other property, like general electronic devices.

Examples: Computers, office automation equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment, industrial robots, etc.

The **Special** quality grade applies to the products developed, designed and manufactured in accordance with an NEC quality assurance program stricter than the standard one, which are designed for such application as any failure or malfunction of the products (sets) or parts/components incorporated therein a customer uses might directly cause any damage to death, human bodily injury or other property, or such application under more severe condition than that defined in the Standard quality grade without such direct damage.

Examples: Control systems for transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, medical equipment not specifically designed for life support, safety equipment, etc.

The **Specific** quality grade applies to the products developed, designed and manufactured in accordance with the standards or quality assurance program designated by a customer who requires an extremely higher level of reliability and quality for such products.

Examples: Military systems, aircraft control equipment, aerospace equipment, nuclear reactor control systems, medical equipment/devices/systems for life support, etc.

The quality grade of this product is the "**Standard**" unless otherwise specified in this document.

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**1. OUTLINE**

This 104PW02F LED Driver Board is for an LCD module. Adaptable LCD modules are as follows. In addition, this 104PW02F is compliant with the European RoHS directive (2002/95/EC).

Adaptable LCD modules
NL10276BC20-18D
NL10276BC20-18 (Rev.B or after)



**2. SPECIFICATIONS**

**2.1 GENERAL SPECIFICATIONS**

Item	Specification	Unit
Size	See "5.OUTLINE DRAWINGS".	mm
Weight	7.0 (typ.)	g
Delivery unit	10 (min.)	set

**2.2 ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Rating	Unit	Remarks	
Power supply voltage	VDDDB	-0.3 to +15.0	V	Ta= 25°C	
Input voltage	BRTC signal	VBC			-1.0 to VDDDB+1.0
	BRTI signal	VBI			-0.3 to +5.5
	PWM signal	PWM			-0.3 to +5.5
	PWMSEL	PWMSEL			-0.1 to +4.0
Storage temperature	Tst	-30 to +80	°C	-	
Operating temperature	Top	-30 to +80		-	
Relative humidity Note1	RH	≤ 95	%	Ta ≤ 40°C	
		≤ 85		40 < Ta ≤ 50°C	
		≤ 55		50 < Ta ≤ 60°C	
		≤ 36		60 < Ta ≤ 70°C	
		≤ 24		70 < Ta ≤ 80°C	
Absolute humidity Note1	AH	≤ 70 Note2	g/m <sup>3</sup>	-	



Note1: No condensation

Note2: Water amount at Ta= 80°C and RH= 24%

2.3 ELECTRICAL CHARACTERISTICS

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDDB	10.8	12.0	13.2	V	Note1
Power supply current		IDDB	-	-	1,000 Note2	mA	At the maximum luminance control. Note3
Input voltage	BRTC / PWM signal	High	VBCH	2.0	-	5.3	-
		Low	VBCL	0	-	0.8	
	BRTI signal		VBI	0	-	5.0	
Output voltage	Forward voltage (per circuit)	VL	This value is in accordance with the value for the adaptable LCD module.			V	Ta= +25°C at IL= 60mA/One circuit
Output current	Forward current (per circuit)	IL	-	60	-	mA	At maximum luminance control. Note 3
External PWM frequency (BRTH= Open, PWMSEL= GNDB)		f <sub>PWM</sub>	100	-	500	Hz	Note 4
External PWM pulse width		tPWH	200	-	-	μs	-
Internal PWM frequency (PWMSEL= Open)		Ft	-	251	-	Hz	-

Note1: When designing of the power supply, take the measures for the prevention of surge voltage.

Note2: This value excludes peak current such as overshoot current.

Note3: The power supply lines (VDDB and GNDB) may have ripple voltage during luminance control of LED. There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on. Put a capacitor between the power supply lines (VDDB and GNDB) to reduce the noise if necessary.

Note 4: See 2.6 LUMINANCE CONTROL for the definition of f<sub>PWM</sub>. A recommended f<sub>PWM</sub> value is as follows

$$f_{PWM} = \frac{2n-1}{4} \times fv$$

(n = integer, fv = frame frequency of LCD module)

2.4 FUSE

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDDB	FMC16252AB	Kamaya Electric Co.,Ltd.	2.5A	5.0A 5s max	Note1
			32V		

Note1: The power supply's rated current must be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

2.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

CN1 socket (Driver Board side): 53261-0871 (MOLEX Inc.)  
 Adaptable plug: 51021-0800 (MOLEX Inc.)

Pin No.	Symbol	Function	Remarks
1	VDDB	Power supply	Note1
2	VDDB	Power supply	
3	GNDB	Ground	
4	GNDB	Ground	
5	BRTC	Backlight ON/OFF signal	High or Open: Backlight ON Low: Backlight OFF
6	BRTI/PWM	Luminance control terminal	Note2
7	BRTH	Luminance control terminal	Note2
8	PWMSEL	Luminance control selector terminal	GNDB: External PWM control Note3 Open: Resistor control or Voltage control Note2

Note1: All GNDB and VDDB terminals must be connected to appropriate terminals.

Note2: See "**2.6 LUMINANCE CONTROL**".

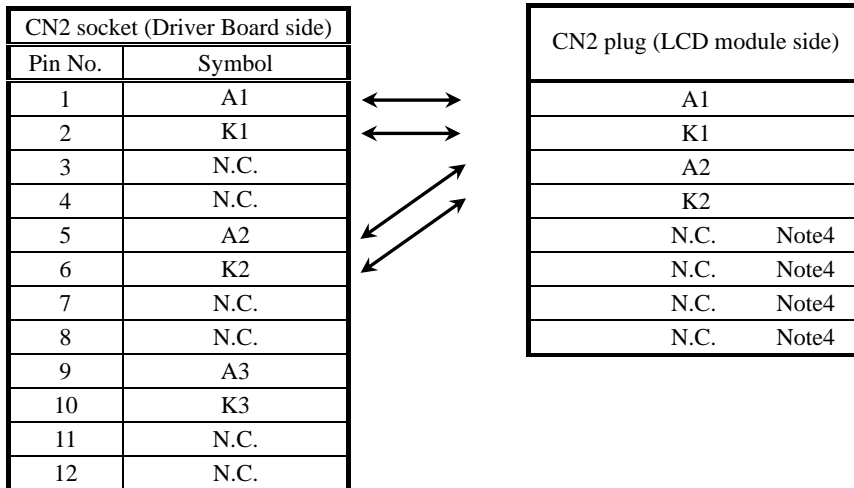
Note3: To enable external PWM control, PWMSEL (pin 8) must be connected to GNDB of the circuit board.

CN2 socket (Driver Board side): SM12B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)  
 Adaptable plug (Backlight side): SHR-12V-S, SHR-12V-S-B (J.S.T. Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	A1	Anode 1	-
2	K1	Cathode 1	-
3	N.C.	-	-
4	N.C.	-	-
5	A2	Anode 2	-
6	K2	Cathode 2	-
7	N.C.	-	-
8	N.C.	-	-
9	A3	Anode 3	-
10	K3	Cathode 3	-
11	N.C.	-	-
12	N.C.	-	-

Reference (Connection to the CN2 plug of the LCD module side)

NL10276BC20-18D, after NL10276BC20-18 (Rev. B)

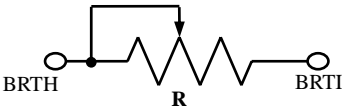


Note4: Either way whether this pin is connected or not, there is no problem in operation.

2.6 LUMINANCE CONTROL

Method	Adjustment and luminance ratio															
External PWM	<p>• Adjustment</p> <p>Backlight luminance can be controlled by duty ratio of the external PWM signal. To enable external PWM control, keep CN1 7pin Open or GNDB, and CN1 8pin connect to GNDB of the circuit board. The PWM signal must follow specification noted in the section <b>2.3 ELECTRICAL CHARACTERISTICS</b>.</p>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Pin No</th> <th style="width: 20%;">Symbol</th> <th style="width: 65%;">Remark</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">BRTC</td> <td>High or Open: Backlight ON (Note1) Low: Backlight OFF</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">BRTI/PWM</td> <td style="text-align: center;">See below</td> </tr> <tr> <td style="text-align: center;">7</td> <td style="text-align: center;">BRTH</td> <td style="text-align: center;">Open or GNDB</td> </tr> <tr> <td style="text-align: center;">8</td> <td style="text-align: center;">PWMSEL</td> <td style="text-align: center;">GNDB</td> </tr> </tbody> </table>	Pin No	Symbol	Remark	5	BRTC	High or Open: Backlight ON (Note1) Low: Backlight OFF	6	BRTI/PWM	See below	7	BRTH	Open or GNDB	8	PWMSEL	GNDB
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	6	BRTI/PWM	See below													
	7	BRTH	Open or GNDB													
	8	PWMSEL	GNDB													
	<p>Note1: Voltage level of pin No.5 will be pulled up to high level internally when left Open.</p>															
	<p><u>Schematic diagram of external PWM settings</u></p>															
<p>Note2: tPWH: Set to equal to greater than 200μs.</p>																



Method	Adjustment and luminance ratio																					
External PWM	<p>Definitions of parameters are as follows.</p> $f_{\text{PWM}} = \frac{1}{t_{\text{PW}}}, \text{DL} = \frac{t_{\text{PWH}}}{t_{\text{PW}}}$ <p>Interference noise may appear when the external PWM frequency and the vertical frame frequency of LCD module are close enough. To avoid interference noise, it is recommended choose the external PWM frequency <math>f_{\text{PWM}}</math> as follows.</p> $f_{\text{PWM}} = \frac{2n-1}{4} \times f_v$ <p>(n = integer, <math>f_v</math> = frame frequency of LCD module)</p> <ul style="list-style-type: none"> <li>Relative Luminance</li> </ul> <table border="1" data-bbox="486 817 1295 1003"> <thead> <tr> <th>Duty ratio (DL) Note3</th> <th>Luminance ratio</th> </tr> </thead> <tbody> <tr> <td>0.1</td> <td>Less than or equal to 10% (Min. Luminance)</td> </tr> <tr> <td>1.0</td> <td>100% (Max. Luminance)</td> </tr> </tbody> </table> <p>Note3: See "Schematic diagram of external PWM settings".</p>	Duty ratio (DL) Note3	Luminance ratio	0.1	Less than or equal to 10% (Min. Luminance)	1.0	100% (Max. Luminance)															
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0.1	Less than or equal to 10% (Min. Luminance)																					
1.0	100% (Max. Luminance)																					
Resistor control	<ul style="list-style-type: none"> <li>Adjustment</li> </ul> <p>The variable resistor (<b>R</b>) for luminance control should be 10kΩ ±5%, 1/10W. Minimum point of the resistor is the minimum luminance. Also maximum point of the resistor is the maximum luminance.</p> <p>The resistor (<b>R</b>) must be connected between BRTH-BRTI terminals.</p> <table border="1" data-bbox="486 1305 1295 1603"> <thead> <tr> <th>Pin No</th> <th>Symbol</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>BRTC</td> <td>High or Open: Backlight ON Low: Backlight OFF</td> </tr> <tr> <td>6</td> <td>BRTI/PWM</td> <td>See below</td> </tr> <tr> <td>7</td> <td>BRTH</td> <td>See below</td> </tr> <tr> <td>8</td> <td>PWMSEL</td> <td>Open</td> </tr> </tbody> </table> <p style="text-align: center;"><u>Schematic diagram of resistor control settings</u></p>  <ul style="list-style-type: none"> <li>Relative Luminance</li> </ul> <table border="1" data-bbox="491 1865 1291 2013"> <thead> <tr> <th>Resistance</th> <th>Luminance ratio</th> </tr> </thead> <tbody> <tr> <td>0Ω</td> <td>10% (Typ., Luminance ratio)</td> </tr> <tr> <td>10kΩ</td> <td>100% (Max. Luminance)</td> </tr> </tbody> </table>	Pin No	Symbol	Remark	5	BRTC	High or Open: Backlight ON Low: Backlight OFF	6	BRTI/PWM	See below	7	BRTH	See below	8	PWMSEL	Open	Resistance	Luminance ratio	0Ω	10% (Typ., Luminance ratio)	10kΩ	100% (Max. Luminance)
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10kΩ	100% (Max. Luminance)																					

Method	Adjustment and luminance ratio																					
Voltage control	<ul style="list-style-type: none"> <li>• Adjustment</li> </ul> <p>Voltage control method works, when BRTH terminal is 0V and VBI voltage is applied between BRTI and BRTH terminal. This control method can carry out continuation adjustment of luminance.</p> <p>Luminance is the maximum when BRTI terminal is Open.</p> <table border="1" data-bbox="488 600 1294 891"> <thead> <tr> <th>Pin No</th> <th>Symbol</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>BRTC</td> <td>High or Open: Backlight ON Low: Backlight OFF</td> </tr> <tr> <td>6</td> <td>BRTI/PWM</td> <td>Input voltage</td> </tr> <tr> <td>7</td> <td>BRTH</td> <td>0V</td> </tr> <tr> <td>8</td> <td>PWMSEL</td> <td>Open</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>• Relative Luminance</li> </ul> <table border="1" data-bbox="485 994 1297 1167"> <thead> <tr> <th>BRTI signal (VBI)</th> <th>Luminance ratio</th> </tr> </thead> <tbody> <tr> <td>0V</td> <td>10% (Typ., Luminance ratio)</td> </tr> <tr> <td>2.5 to 5.0V</td> <td>100% (Max. Luminance)</td> </tr> </tbody> </table>	Pin No	Symbol	Remark	5	BRTC	High or Open: Backlight ON Low: Backlight OFF	6	BRTI/PWM	Input voltage	7	BRTH	0V	8	PWMSEL	Open	BRTI signal (VBI)	Luminance ratio	0V	10% (Typ., Luminance ratio)	2.5 to 5.0V	100% (Max. Luminance)
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### 3. RELIABILITY TEST


This test is in accordance with the Reliability Test of the adaptable LCD module. Refer to Reliability Test of the adaptable LCD module.

4. PRECAUTIONS


4.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "4.2 CAUTIONS" and "4.3 ATTENTIONS"!**

	This sign has the meaning that a customer will be injured or the product will sustain damage if the customer practices wrong operations.
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	This sign has the meaning that a customer will be injured if the customer practices wrong operations.
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4.2 CAUTIONS

	<p><b>* Be sure to wait for a while after turning the power OFF before replacing. LED driver is still hot soon after shutting down.</b></p> <p><b>* Do not apply mechanical shock. It may damage products.</b></p>
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4.3 ATTENTIONS



4.3.1 Handling of the product

- ① Do not touch or apply stress to exposed electronic parts. Doing so may cause damage or malfunctioning of products. Only hold the edge of the circuit board when unpacking.
- ② When handling the product, take measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
- ③ Do not plug or unplug the interface connectors while the product is operating.
- ④ Do not hook or pull cables such as lamp cable, and so on, in order to avoid any damage.

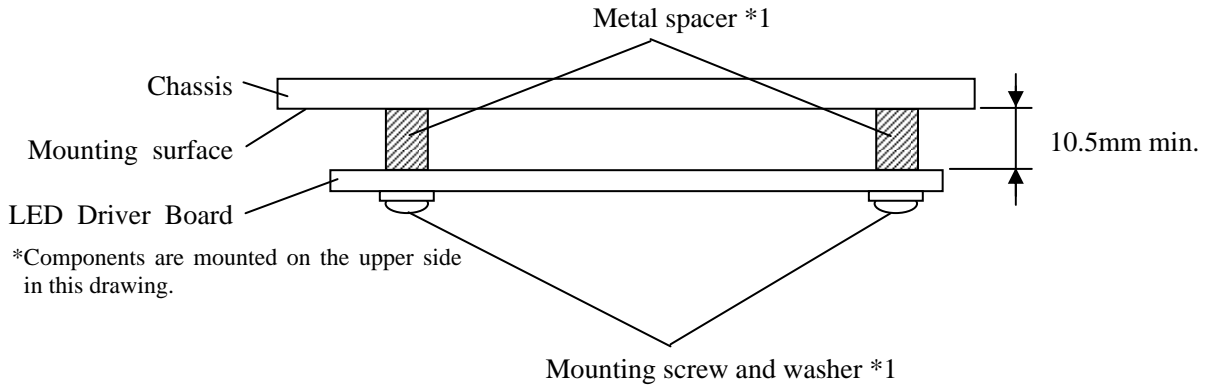
4.3.2 Environment

- ① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
- ② In order to prevent dew condensation occurred by temperature difference, the product packing box must be opened after enough time being left under the environment of an unpacking room. Evaluate the storage time sufficiently because dew condensation is affected by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with the original packing state after a customer receives the package)
- ③ Do not operate in high magnetic field. If not, circuit boards may be broken.
- ④ This product is not designed as radiation hardened.

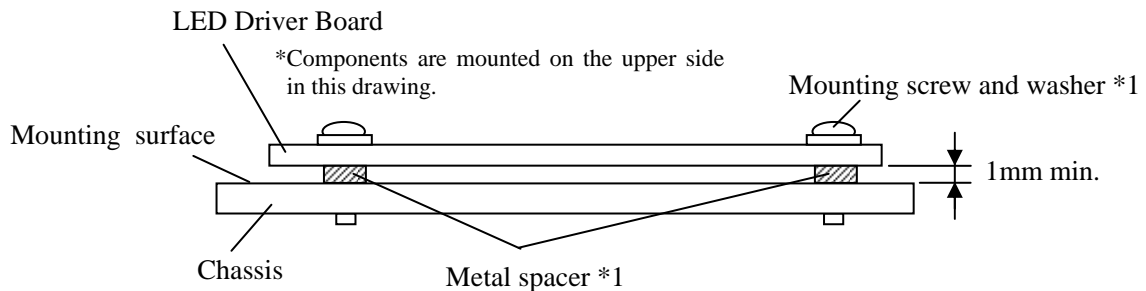
4.3.3 Others

- ① All GNDB and VDDB terminals should be used without any non-connected lines.
- ② Do not disassemble a product.
- ③ Pack the product with the original shipping package, in order to avoid any damages during transportation, when returning the product to NEC.
- ④ Insert spacers between the LED Driver board and the chassis to secure spatial distance.

Mounting method example 1.



Mounting method example 2.



\*1: The conductive material (mounting screw, washer, metal spacer and so on) is allowed to mount within the limits of 2.5mm radius from the center of mounting hole.

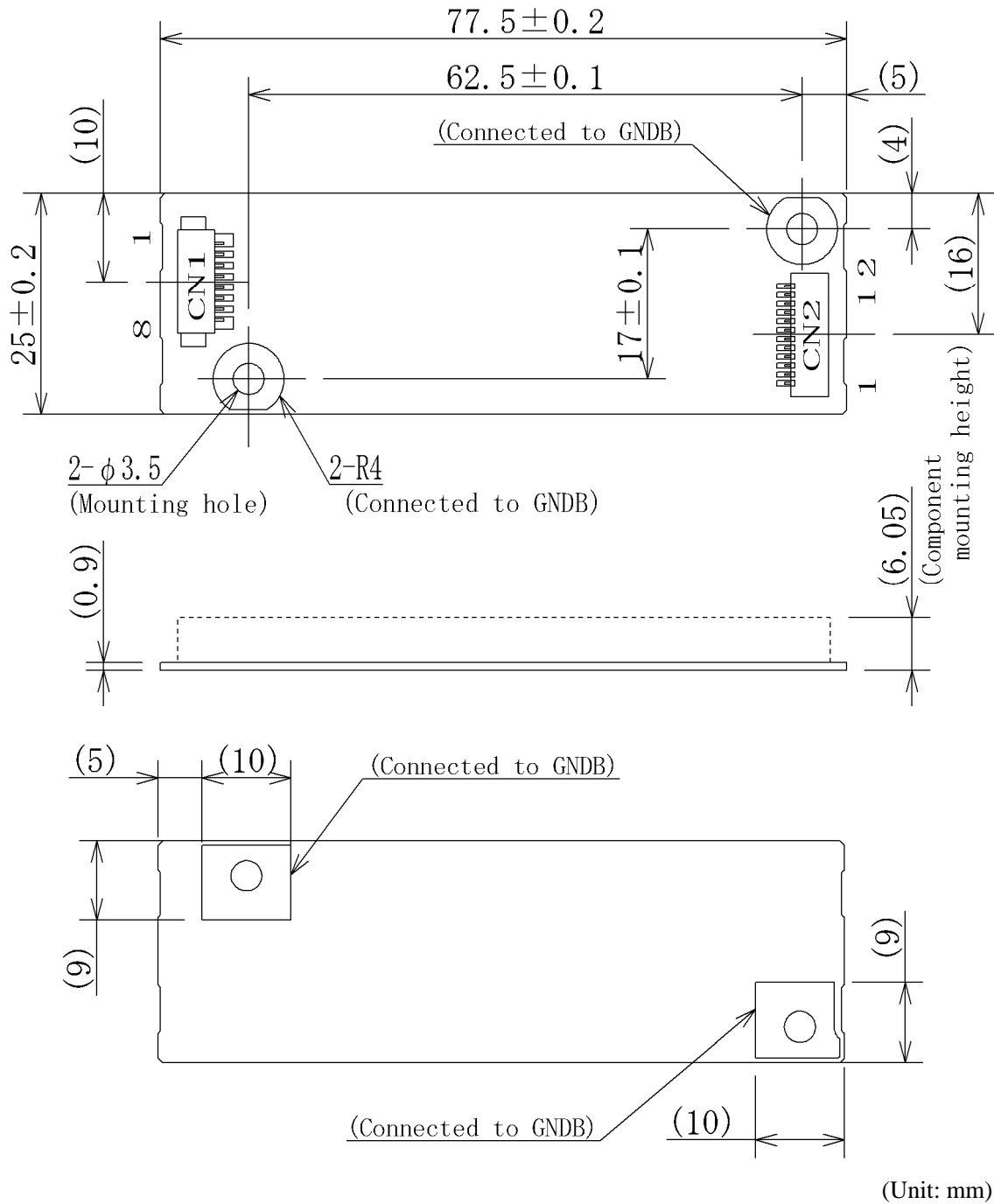
- ⑤ The information of China RoHS directive six hazardous substances or elements in this product is as follows.

China RoHS directive six hazardous substances or elements					
Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr VI)	Polybrominated Biphenyls (PBB)	Polybrominated Biphenyl Ethers (PBDE)
×	○	○	○	○	○

Notel: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of SJ/T11363-2006 standard regulation.

×: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of SJ/T11363-2006 standard regulation.

5. OUTLINE DRAWINGS



Note1: The values in parentheses are for reference.