LED Driver Board

121PW02F

DATA SHEET

DOD-PP-3215 (4th edition)

This DATA SHEET is updated document from DOD-PP-2627(3).

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

INTRODUCTION

TMJ does and will not assume any liability for infringement of patents, copyrights or other intellectual property rights of any third party arising out of or in connection with application of the products described herein except for that directly attributable to mechanisms and workmanship thereof. No license, express or implied, is granted under any patent, copyright or other intellectual property right of TMJ.

Some electronic products would fail or malfunction at a certain rate. In spite of every effort to enhance reliability of products by TMJ, 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 grades: **"Standard"**, **"Special"**, and **"Specific"**.
Each quality grade is designed for applications described below. Any customer who intends to use a product for application other than that of Standard is required to contact TMJ sales representative in advance.

The **Standard:** Applications as any failure, malfunction or error of the products are free from any damage to death, human bodily injury or other property (Products Safety Issue) and not related the safety of the public (Social Issues), like general electric devices.
Examples: Office equipment, audio and visual equipment, communication equipment, test and measurement equipment, personal electronic equipment, home electronic appliances, car navigation system (with no vehicle control functions), seat entertainment monitor for vehicles and airplanes, fish finder (except marine radar integrated type), PDA, etc.

The **Special:** Applications as any failure, malfunction or error of the products might directly cause any damage to death, human bodily injury or other property (Products Safety Issue) and the safety of the public (Social Issues) and required high level reliability by conventional wisdom.
Examples: Vehicle/train/ship control system, traffic signals system, traffic information control system, air traffic control system, surgery/operation equipment monitor, disaster/crime prevention system, etc.

The **Specific:** Applications as any failure, malfunction or error of the products might severe cause any damage to death, human bodily injury or other property (Products Safety Issue) and the safety of the public (Social Issues) and developed, designed and manufactured in accordance with the standards or quality assurance program designated by the customer who requires extremely high level reliability and quality.
Examples: Aerospace system (except seat entertainment monitor), nuclear control system, life support system, etc.

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

CONTENTS

1. OUTLINE

This 121PW02F LED Driver Board is for TMJ LCD module. In addition, this 121PW02F is compliant with the European RoHS directive (2011/65/EU) and Delegated Directive (2015/863/EU, Amending Annex II of 2011/65/EU). ☆

2. SPECIFICATIONS

2.1 GENERAL SPECIFICATIONS

Item	Specification	Unit
Size	See "**5.OUTLINE DRAWINGS**".	mm
Weight	6.0 (max.)	g
Delivery unit	10 (min.)	set

2.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply voltage		VDDB	-0.3 to +15.0	V	Ta= 25°C
Input voltage	BRTC signal	VBC	-1.0 to VDDB+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^3	Ta= 80°C

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	-	380	800 Note2	mA	At the maximum luminance control. Note3
Input voltage	BRTC signal	High	VBCH	2.0	-	VDDB	V	-
		Low	VBCL	0	-	0.8		
	PWM signal	High	VPWMH	2.0	-	5.3		
		Low	VPWML	0	-	0.8		
	BRTI signal		VBI	0	-	5.0		
Input current	BRTC signal	High	IBCH	-	-	500	μA	-
		Low	IBCL	-130	-	-		
	PWM signal	High	IPWMH	-	-	210		
		Low	IPWML	-840	-	-		
	BRTI signal		IBI	-840	-	210		
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= 50mA/One circuit
Output current	Forward current (per circuit)		IL	-	50	-	mA	At maximum luminance control. Note3
External PWM frequency (BRTH= Open, PWMSEL= GNDB)			f_{PWM}	100	-	500	Hz	Note4
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.

Note4: See 2.7 LUMINANCE CONTROL for the definition of f_{PWM}. A recommended f_{PWM} value is as follows

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

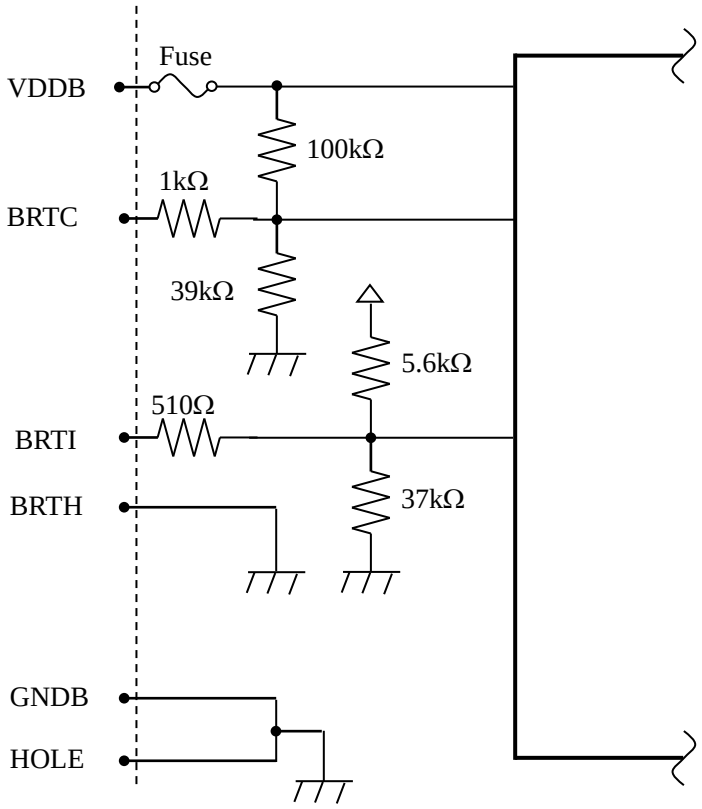
(n = integer, fv = frame frequency of LCD module)

2.4 FUSE

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

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 EQUIVALENT CIRCUIT AT INPUT PART



LED driver board

2.6 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 "**2.7 LUMINANCE CONTROL**".
Note3: To enable external PWM control, PWMSEL (pin 8) must be connected to GNDB of the circuit board.

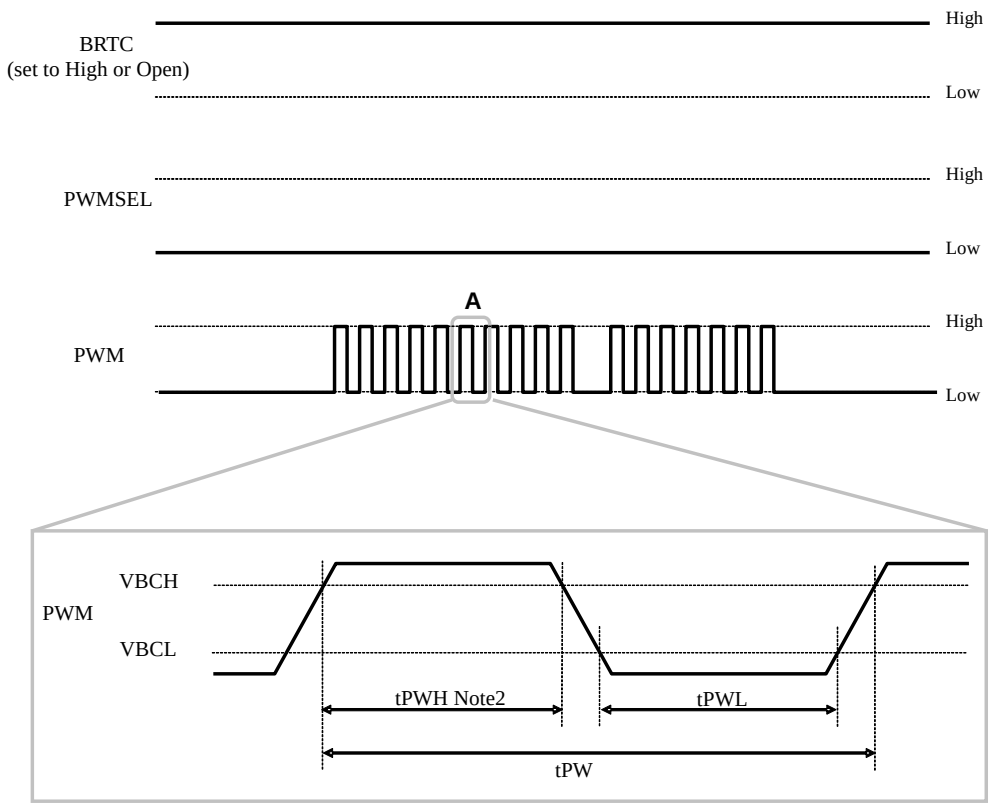
CN2 socket (Driver Board side): SM12B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)
Adaptable plug (Backlight side): SHR-12V-S, SHR-12V-S-B (J.S.T. Mfg. Co., Ltd.)

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

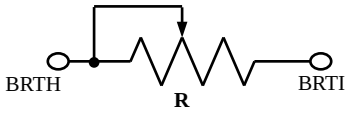
2.7 LUMINANCE CONTROL

<table>
<tr><th>Method</th><th>Adjustment and luminance ratio</th></tr>
<tr><td>External PWM</td><td>
• Adjustment
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 2.3 ELECTRICAL CHARACTERISTICS.

<table>
<tr><th>Pin No</th><th>Symbol</th><th>Remark</th></tr>
<tr><td>5</td><td>BRTC</td><td>High or Open: Backlight ON (Note1)
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>Open or GNDB</td></tr>
<tr><td>8</td><td>PWMSEL</td><td>GNDB</td></tr>
</table>
Note1: Voltage level of pin No5 will be pulled up to high level internally when left Open.

Schematic diagram of external PWM settings


Note2: tPWH: Set to equal to greater than 200μs.
</td></tr>
</table>

<table>
<tr><th>Method</th><th>Adjustment and luminance ratio</th></tr>
<tr><td>External PWM</td><td>
Definitions of parameters are as follows.
$$f_{PWM} = \frac{1}{tPW}, DL = \frac{tPWH}{tPW}$$
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 f_{PWM} as follows.
$$f_{PWM} = \frac{2n-1}{4} \times fv$$
$$(n = \text{integer}, fv = \text{frame frequency of LCD module})$$
• Relative Luminance
<table>
<tr><th>Duty ratio (DL) Note3</th><th>Luminance ratio</th></tr>
<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>
</table>
Note3: See "Schematic diagram of external PWM settings".
</td></tr>
<tr><td>Resistor control</td><td>
• Adjustment
The variable resistor (R) for luminance control should be 10kΩ ±5%. Minimum point of the resistor is the minimum luminance. Also maximum point of the resistor is the maximum luminance.
The resistor (R) must be connected between BRTH-BRTI terminals.
<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Remark</th></tr>
<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>
</table>
Schematic diagram of resistor control settings


• Relative Luminance
<table>
<tr><th>Resistance</th><th>Luminance ratio</th></tr>
<tr><td>0Ω</td><td>10% (typ., Luminance ratio)</td></tr>
<tr><td>10kΩ</td><td>100% (Max. Luminance)</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Method</th><th>Adjustment and luminance ratio</th></tr>
<tr><td>Voltage control</td><td>
• Adjustment

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.
Luminance is the maximum when BRTI terminal is Open.

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Remark</th></tr>
<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>
</table>

• Relative Luminance

<table>
<tr><th>BRTI signal (VBI)</th><th>Luminance ratio</th></tr>
<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>
</table>
</td></tr>
</table>

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.

This sign has the meaning that a customer will be injured if the customer practices wrong operations.

4.2 CAUTIONS

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

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.

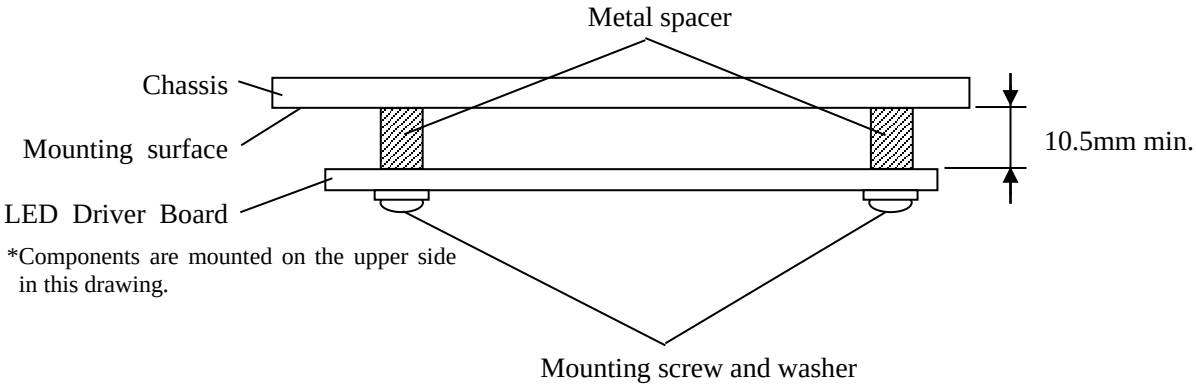
4.3.2 Environment

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.

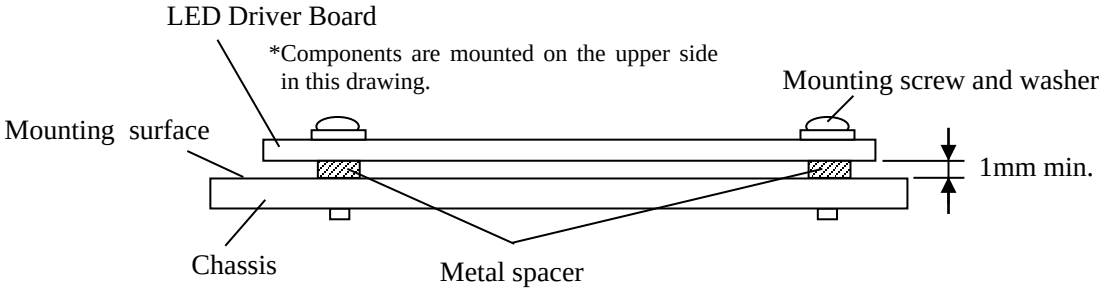
4.3.3 Others

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 TMJ.
④ Insert spacers between the LED Driver board and the chassis to secure spatial distance.

Mounting method example 1.



Mounting method example 2.

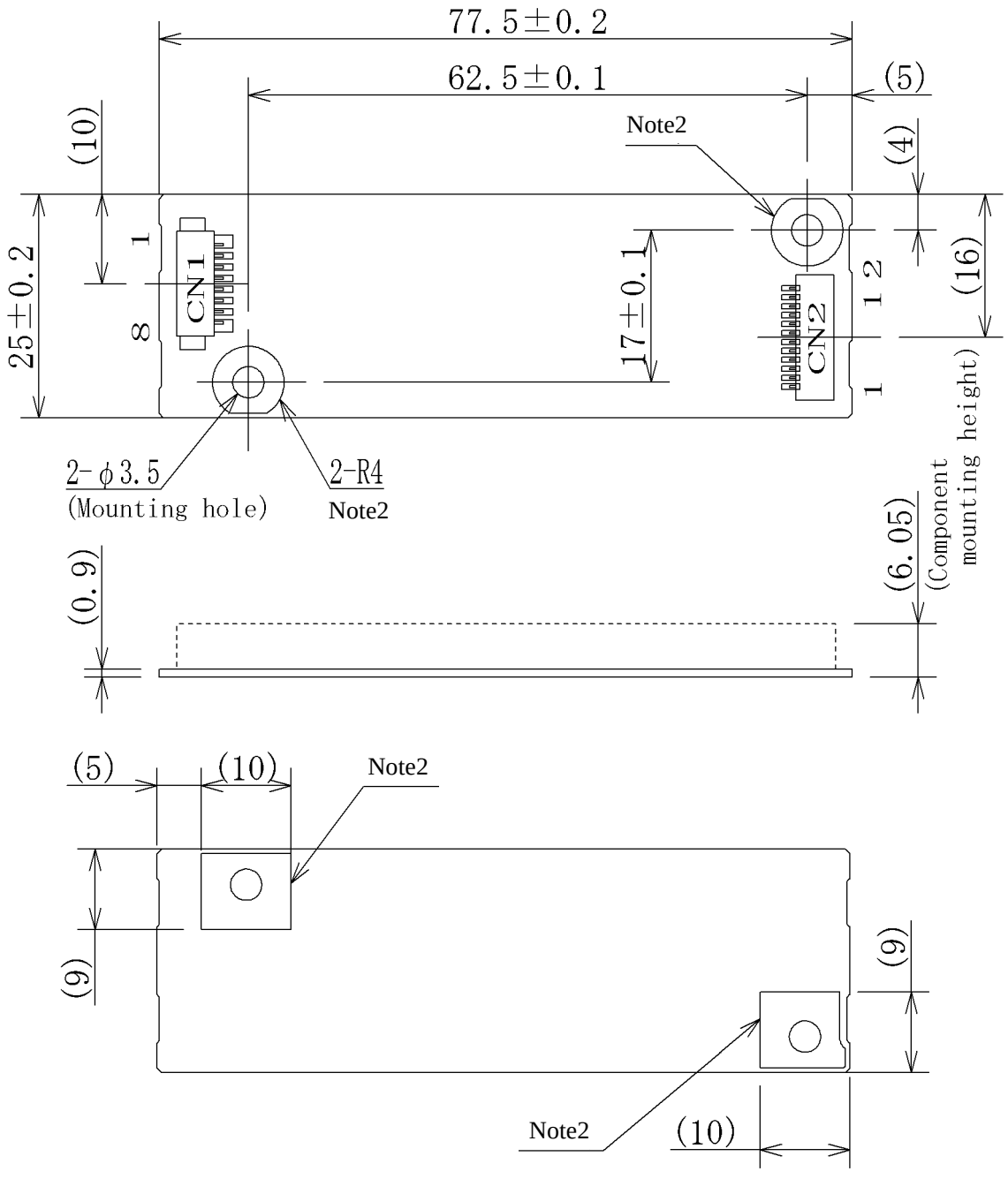


⑤ The information of China RoHS (Ⅱ) six hazardous substances or elements in this product is as follows.

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

Note1: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of GB/T26572-2011 standard regulation.
×: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of GB/T26572-2011 standard regulation.

5. OUTLINE DRAWINGS



(Unit: mm)

Note1: The values in parentheses are for reference.
Note2: Two mounting holes are connected to GNDB in the product.