

TOUCH PANEL INTERFACE BOARD

Delivery Specifications

Model Name : AHL-120N8-BL

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 **WARNING**

- Avoid using this product for applications that may affect people's lives, such as medical equipment, space equipment, aircraft, submarine repeater and other equipment for which extremely high reliability is required.
- If you are planning to use this product for control or security system in transport equipment (train, automobile and vessel or the like), always contact our sales service center in advance.
- The quality level of this product is limited to general applications. (Computer, OA equipment, FA equipment, communication equipment, measuring equipment, AV equipment, etc.)
- Do not ever remodel or recompose our products. It may cause problems and breakdown.

 **CAUTION**

- Hold the connecter part of cable for plug-in and plug-out.
- Do not approach any instruments or parts that could generate heat.
- Please handle cables with special care.
- Avoid remodeling or decomposing AHL-120N8-BL.
- Take care not to drop it off or give any impact or shock to it. It could cause breakdown.
- In handling AHL-120N8-BL, pay special attention to static electricity, and provide worker and work site grounding.
- Handle the equipment following the regulation in this specifications such as described "operating power" and "operating temperature" or breakdown way happen.
- Do not fix the controller when it is touched with something else. Give care to ventilation in point of the design.
- Install AHL-120N8-BL not to contact with anything. Give care to aeration and ventilation in point of design.
- Avoid placing it next to the parts that may generate heat and provide coating on wiring. The above handling may cause breaking lines, short-circuit and fire.
- Avoid locating cables next to the things may cause a bad influence to Power lines, Oscillators and Signals.
- Avoid the direct rays of the sun in use.
- Do not use in the oily smoke or powdered dust environment. It may cause a malfunction.
- Use it in the environment that doesn't exceed Operational and storage condition standard.
- Do not use or store in conditions that has condensation.
- Use or Store in the environment free from the corrosion gas and sorts.
- Use in the places where have less vibrations and shocks.

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Date	Revised Contents	Edition	Prepared by
Mar. 21, 2008		1.0	Y. Saoyama
July. 1st, 2008	<p>“2 Features”</p> <ul style="list-style-type: none"> · “2.2 Temperature condition” <ul style="list-style-type: none"> -Added operating humidity and storage humidity. · “2.4 Electrical resolution” <ul style="list-style-type: none"> -Changed the title to “2.4 Output data resolution”. -Corrected the explanation about the 12bit output. <p>“3 Connection”</p> <ul style="list-style-type: none"> · Corrected the specifications of CN03. -AHL operation mode setting: Moved it as "4 Setting Operation mode " to page-9. <p>“4 Setting specification”</p> <ul style="list-style-type: none"> · Changed the title to “4 Setting operation mode”. · Added the setting method by JP01 and No.1 pin of CN03 in detail. <p>“8 Outline Drawing”</p> <ul style="list-style-type: none"> · Added a height dimensions. <p>“9 Warranty Period and Warranty Range”</p> <ul style="list-style-type: none"> · Added the detailed contents. 	2.0	Y. Saoyama

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1 Introduction

The AHL-120N8-BL is an interface board used to detect the resistive membrane-type analog touch panel pushing pressure position. Even if an unstable data (voltage value) generated when the touch panel was lightly depressed and noise arising due to operating environment are input to the AHL-120N8-BL, internal filtering (touch panel controller:AHL-120N8) is carried out; it is, therefore, possible to detect the pushing pressure position with high precision.

This board supports 4-wire and 8-wire resistive touch panel which manufactured by GUNZE Ltd.

The communication system contains serial (Asynchronous mode) and USB. Where the serial interface is used, it is possible to connect the COM port of a personal computer directly. In the case of USB interface, it is possible to connect the USB port. The GUNZE original format (AHL original) and the WHQL format are available by each connection.

Also the device driver software is available as following.

Name of driver software	Support OS	Support mode
GZTP PACK	Windows [®] XP, Windows [®] Vista [™]	WHQL mode
TPDD Series	Windows [®] Me, Windows [®] 2000, Windows [®] XP, Windows [®] Vista [™]	AHL original mode

Contact our sales section if you use another operating system.

3 Connection

CN01: Touch panel connection
 Type No.: IMSA-9616S-08A-GF1 (IRISO)
 Connect the GUNZE 8wire analog touch panel with terminal pitch 1.0mm to CN02.

Pin No.	Function	Pin No.	Function
1	yL	5	xR
2	yLref	6	xL
3	yUref	7	xLref
4	yU	8	xRref

CN02: Touch panel connection
 Type No.: 53261-0871 (MOLEX)
 Matching socket: 51021-0800 (MOLEX)
 It is possible to connect extended touch panel connecting cable CA-TTP8100-GIT.

Pin No.	Function	Pin No.	Function
1	xRref	5	yU
2	xLref	6	yUref
3	xL	7	yLref
4	xR	8	yL

CN03: Power Supply, EIA-232E(RS-232C) interface , USB interface
 Type No.: DF13-15P-1.25H(HIROSE ELECTRIC CO.)
 (Matching Socket DF13-15S-1.25C (HIROSE ELECTRIC CO.))

Pin No.	Function	Pin No.	Function
1	AHL operation mode	9	GND
2	Resolution Setting	10	GND
3	N.C.	11	GND
4	D+	12	CTS
5	D-	13	RTS
6	5V	14	RxD
7	5V	15	TxD
8	GND		

Please refer to "4 Setting Operation Mode" for more detail.

4 Setting Operation Mode

The operation mode is selectable by JP01 or the input signal of No.1 pin of CN03.

4.1 Setting by JP01

	WHQL mode	AHL original mode
JP01	Short*	Open
No.1 pin of CN03	Open	

* : initial setting

The operation mode is selectable by JP01 setting. In this case, always use No.1 pin of CN03 as "Open".

4.2 Setting by No.1 pin of CN03

	WHQL mode	AHL original mode
No.1 pin of CN03	Low	Open
JP01	Open	

The operation mode is selectable by the input signal of No.1 pin of CN03. In this case, always use JP01 as "Open."

4.3 Other

JP02 is reserved for internal use.

Always use it as "Short" without the change of initial setting.

5 USB Interface

5.1 Outline

The AHL-120N8-BL has the built-in USB (Universal Serial Bus) interface, by which the touch position data can be obtained via the USB port of a personal computer. This board complies with the two kinds of modes (the AHL original mode / WHQL mode) as the USB communication. Also, the device driver is prepared for the mouse emulation referring to '7.3 Mouse emulation'.

5.2 Basic specifications

Transfer speed : 1.5 Mbps
 Transfer format : Interrupt transfer
 Transfer interval : 10 ms

5.3 Data format (Response to IN token)

1) At touch or release:

- AHL original mode

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1st byte	1	0	T/R_(*1)	X11	X10	X9	X8	X7
2nd byte	0	0	0	Y11	Y10	Y9	Y8	Y7
3rd byte	0	X6	X5	X4	X3	X2	X1	X0
4th byte	0	Y6	Y5	Y4	Y3	Y2	Y1	Y0

(*1) 1 at touch and 0 at release.

-WHQL mode, based on HID

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1st byte	0	0	0	0	0	0	0	T/R_
2nd byte	X7	X6	X5	X4	X3	X2	X1	X0
3rd byte	0	0	0	0	0	0	X9	X8
4th byte	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
5th byte	0	0	0	0	0	0	Y9	Y8

First data after "touched" is "0", after second data is "1", when released then return to "0"

2) At non touch:

NAK handshaking is returned.

- The X0-X11 is the coordinate data of X axis and the Y0-11 is the Y axis. Both of them are the binary value.
- When 10bits resolution is selected, X11, X10, Y11, Y10 are always 0.

5.4 Descriptor

1) Device Descriptor

-For AHL original mode

Field	Value	Description
bLength	12H	
bDescriptorType	01H	Device
bcdUSB	0200H	USB2.0
bDeviceClass	FFH	Vendor Specific
bDeviceSubClass	FFH	
bDeviceProtocol	FFH	Vendor Specific
bMaxPacketSize0	08H	
idVendor	0637H	
idProduct	0001H	
bcdDevice	nnnnH	BCD notation of firmware version
iManufacturer	01H	
iProduct	02H	
iSerialNumber	00H	No String Descriptor
bNumConfigurations	01H	

-For WHQL mode based on HID

Field	Value	Description
bLength	12H	
bDescriptorType	01H	Device
bcdUSB	0200H	USB2.0
bDeviceClass	00H	
bDeviceSubClass	00H	
bDeviceProtocol	00H	
bMaxPacketSize0	08H	
idVendor	0637H	
idProduct	0004H	
bcdDevice	nnnnH	BCD notation of firmware version
iManufacturer	01H	
iProduct	02H	
iSerialNumber	00H	No String Descriptor
bNumConfigurations	01H	

2) Configuration Descriptor

-For AHL original mode

Field	Value	Description
bLength	09H	
bDescriptorType	02H	Configuration
wTotalLength	0019H	
bNumInterfaces	01H	
bConfigurationValue	01H	
iConfiguration	00H	No String Descriptor
bmAttributes	10100000B	Bus-Powered, Remote WakeUp
MaxPower	32H	100mA

-For WHQL mode based on HID

Field	Value	Description
bLength	09H	
bDescriptorType	02H	Configuration
wTotalLength	0022H	
bNumInterfaces	01H	
bConfigurationValue	01H	
iConfiguration	00H	No String Descriptor
bmAttributes	10100000B	Bus-Powered, Remote WakeUp
MaxPower	32H	100mA

3) Interface Descriptor

-For AHL original mode

Field	Value	Description
bLength	09H	
bDescriptorType	04H	Interface
bInterfaceNumber	00H	
bAlternateSetting	00H	
bNumEndpoints	01H	
bInterfaceClass	FFH	Vendor Specific
bInterfaceSubClass	FFH	
bInterfaceProtocol	FFH	Vendor Specific
iInterface	00H	No String Descriptor

-For WHQL mode based on HID

Field	Value	Description
bLength	09H	
bDescriptorType	04H	Interface
bInterfaceNumber	00H	
bAlternateSetting	00H	
bNumEndpoints	01H	
bInterfaceClass	03H	HID
bInterfaceSubClass	01H	Boot
bInterfaceProtocol	02H	Mouse
iInterface	00H	No String Descriptor

4) HID Descriptor

- For WHQL mode based on HID only

Field	Value	Description
bLength	09H	
bDescriptorType	21H	Interface
BcdHID	0110H	HID 1.1
bCountryCode	00H	Not Localized
bNumDescriptors	01H	
bDescriptorType	22H	Report
wDescriptorLength	003AH	

5) Endpoint Descriptor

-For both AHL original mode and WHQL mode based on HID

Field	Value	Description
bLength	07H	
bDescriptorType	05H	Endpoint
bEndpointAddress	81H	Endpoint1, IN
bmAttributes	00000011B	Interrupt Transaction
wMaxPacketSize	0008H	
bInterval	0AH	10msec

6) String Descriptor

-For both AHL original mode and WHQL mode based on HID

Field	Value	Description
bLength	04H	
bDescriptorType	03H	String
wLangID	0409H	English
[Index1]		
Field	Value	Description
BLength	0CH	
BDescriptorType	03H	String
BString	"GUNZE" (Unicode)	
[Index2]		
Field	Value	Description
BLength	38H	
BDescriptorType	03H	String
BString	"GUNZE Touch Panel(4/8 Wire)" (Unicode)	

7) Report Descriptor

-For WHQL mode based on HID only

Value	Description
05H, 01H	USAGE_PAGE (Generic Desktop)
09H, 02H	USAGE (Mouse)
A1H, 01H	COLLECTION (Application)
09H, 01H	USAGE (Pointer)
A1H, 00H	COLLECTION (PHysical)
05H, 09H	USAGE_PAGE (Button)
19H, 01H	USAGE_MINIMUM (Button 1)
29H, 03H	USAGE_MAXIMUM (Button 3)
15H, 00H	LOGICAL_MINIMUM (0)
25H, 01H	LOGICAL_MAXIMUM (1)
95H, 03H	REPORT_COUNT (3)
75H, 01H	REPORT_SIZE (1)
81H, 02H	INPUT (Data,Var,Abs)
95H, 01H	REPORT_COUNT (1)
75H, 05H	REPORT_SIZE (5)
81H, 01H	INPUT (Cnst,Ary,Abs)
05H, 01H	USAGE_PAGE (Generic Desktop)
09H, 30H	USAGE (X)
09H, 31H	USAGE (Y)
16H, 00H, 00H	LOGICAL_MINIMUM (0)
26H, FFH, 0FH	LOGICAL_MAXIMUM (4095)
36H, 00H, 00H	PHYSICAL_MINIMUM (0)
46H, FFH, 0FH	PHYSICAL_MAXIMUM (4095)
95H, 02H	REPORT_COUNT (2)
75H, 10H	REPORT_SIZE (16)
81H, 02H	INPUT (Data,Var,Abs)
C0H	END_COLLECTION
C0H	END_COLLECTION

6 Serial Interface

6.1 Outline

Using start-stop serial, touch position data and command communication can be carried out.

By connecting EIA-232D (RS-323C) transceiver, direct connection to the COM port of a personal computer, etc. is possible.

When the WHQL mode is selected, Windows can find AHL-120N8-BL by 'Control panel – Add hardware' or 'Device manager – Scan for hardware changes'.

Also available is the device driver for mouse emulation which is shown in '7.3 Mouse emulation' in detail. By using this unit, the touch panel can be used in place of the mouse.

6.2 Output mode

AHL-120N8-BL has three modes of the way to output coordinate value.

- Continuous mode*

It keeps outputting position data while it is touching a touch panel.

When a finger or a pen is released from the touch panel, only one position data of a position of a release are outputted.

Nothing is outputted when it isn't touching it.

- Make mode

When it touches a touch panel, only the first one position data are outputted. Position data aren't outputted even if it keeps touching a touch panel after that. (The next position data aren't outputted unless a finger or a pen is released from the touch panel and it touches it again.) .

Even if a finger or a pen is released from the touch panel, the position data of a position of a release aren't outputted.

Nothing is outputted when it isn't touching it.

- Make&Break mode

When it touches a touch panel, only the first one position data are outputted. Position data aren't outputted even if it keeps touching a touch panel after that.

When a finger or a pen is released from the touch panel, only one position data of a position of a release are outputted.

Nothing is outputted when it isn't touching it.

Note: The '*' shows the default settings. The change of the mode can be changed by the following command. The changed mode is kept in EEPROM on the circuit board.

6.3 Communication format

- Communication speed : 1200 / 2400 / 4800 / **9600*** / 19200 / 38400 bps
- Data length : 7bits / **8 bits***
- Parity : **None*** / Even / Odd
- Stop bit : **1 bit*** / 2 bits
- Flow control : Software (Xon / Xoff)

NOTE) The '*' is the default setting.

6.4 Text format

- According to 8-bit ASCII format, one data is transmitted at 11 or 12 bytes.

HEADER ('T'/'R')	X Coordinate (4 bytes)	';' (2Ch)	Y Coordinate (4 bytes)	CR (0Dh)	LF (0Ah)*
-----------------------	-----------------------------	-----------	-----------------------------	----------	-----------

* Where "CR" + "LF" was set as a delimiter:

NOTE) The delimiter default is only "CR".

* Example in Continuous Mode:

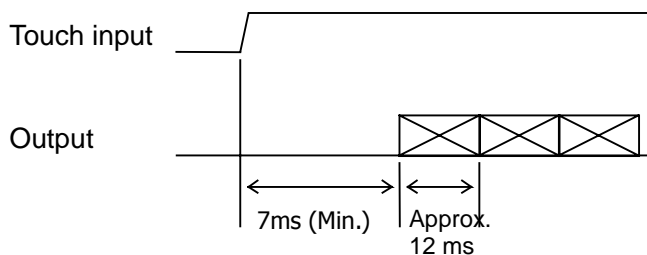
```

T0273 , 0581    <--      When the touch panel was depressed
T0273 , 0582
T0272 , 0581
.
.
.
.
.
.
T0273 , 0582
R0273 , 0581    <--      The touch panel was released.
    
```

- * The data while the touch panel is being depressed is transmitted with "T" prefixed as a header, and when the touch panel was released, only one data is transmitted with "R" prefixed as a header.
- * The data is the numeral of 0 to 4,096 (decimal) for both X and Y.
- * Where the AHL-120N8-BL and touch panel were connected as specified, the touch panel left lower part becomes the origin.

NOTE) The data(0,0) will not be output when the lower left part of the touch panel is pressed.
 Also, the data(4095,4095) will not be output when upper right part of the touch panel. The actual output is the data between 0 and 4,095. Ex.) 20 to 4,000. Because of the resistance included in the circuit wiring of the touch panel and the circuit board.

6.5 Response speed



NOTE) The communication conditions are as follows for the data.

```

Communication speed    :    9,600 bps
Parity                  :    None
Data length            :    8 bits
Stop bit                :    1 bit
    
```

6.6 Output rate

- Approx. 87 cps (cps: Co-ordinate Per Second)

NOTE) The communication conditions are as follows for the data.

Communication speed	:	9,600 bps
Parity	:	None
Data length	:	8 bits
Stop bit	:	1 bit

6.7 Command System

Command	Operation
RE	Resets the AHL-120N8-BL. However, if this command is received during data transmission, the data being transmitted may be in disorder.
DI	Diagnosis of the AHL-120N8-BL. In the normal condition, "Pass ____" is returned. * " _ " means the space.
SR	Transmission stops. The command is accepted, however. During data transmission, the transmission is stopped from the next data.
BR	Transmission re-starts.
XOFF	Same as "SR" command
XON	Same as "BR" command
VE	Returns software version "Vn.nn_". Ex. "V1.00 " * " _ " means the space.
LF	The data delimiter should be "CR(0Dh)" + "LF (0Ah)".
CR	The data delimiter should be "CR (0Dh)".
XL	Returns the reference data on the X-coordinate low voltage side. Ex. "0012" The reference data refers to the data in the touch panel electrode part.
XH	Returns the reference data on X-coordinate high-voltage side.
YL	Returns the reference data on Y-coordinate low-voltage side.
YH	Returns the reference data on Y-coordinate high-voltage side.
SM (MM)	Set to the Make mode.
MB	Set to the Make & Break mode.
CM	Set to the Continuous mode.
T "bb" "p" "d" "s"	Changes the communication format. bb : Communication speed "38" (38400) / "19" (19200) / "96" (9600) / "48" (4800) / "24" (2400) / "12" (1200) p : Parity "N" (none) / "E" (even) / "O" (odd) d : Data length "8" (8 bits) / "7" (7 bits) s : Stop bit length "1" (1 bit) / "2" (2 bits)
EA	Clear the content of EEPROM and reset. Set the content of EEPROM default values after resetting.

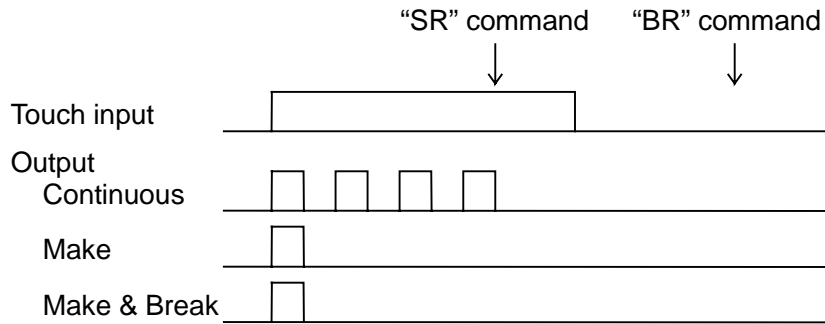
- NOTES) 1) Transmit the command in the ASCII format.
 2) When transmitting the command, send "CR" (0Dh) lastly (as a delimiter).
 3) Any letter, capital or small, is effective for the command.
 4) The command is executed immediately upon receipt thereof. The command is accepted even when the AHL-120N8-BL is being transmitted, and for the command with response data, such

as "DI" and "VE" commands, the response data is outputted in the course of position data, and then, the position data is outputted again. And Transmission stops from the next data with the case of "SR".

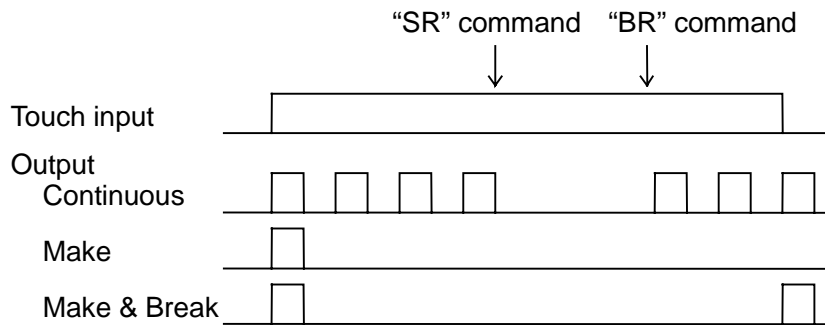
- 5) For the response data to the command, normally, transmit "CR" (0Dh) lastly (as a delimiter).
- 6) Where the command could not be received normally or the command that is not present in the list was sent, it is disregarded. (No data is outputted.)
- 7) When the setting is changed by "SR" command, the changed setting is cancelled if the AHL-120N8-BL is reset.
- 8) The changed setting is stored by the EEPROM when the setting is changed by "LF", "CR", "SM (MM)", "MB", "CM", "Tbbpds" commands.
- 9) The interval between commands should be 15 ms or more. However "RE" command takes more time to initialize internal settings.

6.8 Output pattern when the transmission stop "SR" and transmission restart "BR" commands are received.

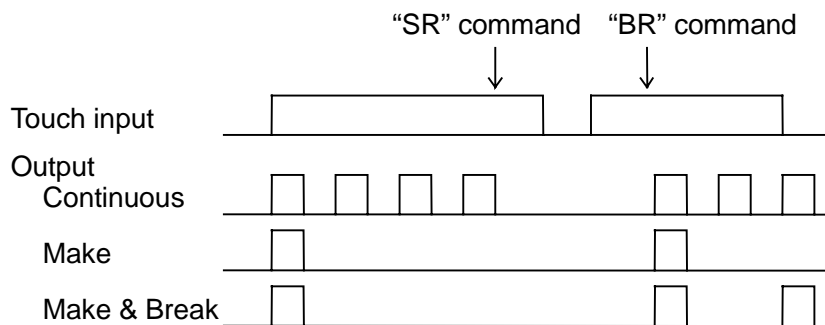
<Pattern 1>



<Pattern 2>



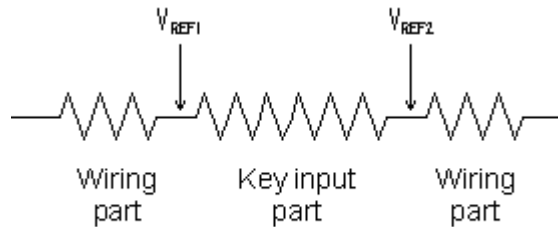
<Pattern 3>



* Each pulse of output is one-point data.

7 Calibration

7.1 Auto calibration



Touch Panel Equivalent Circuit

Since the touch panel forms the equivalent circuit as shown in the figure above, if direct current voltage is applied to both ends of the touch panel, some dc voltage will be applied to the key input part, and the remaining one will be applied to the wiring part. Consequently, if the resistance value of only key input part and only wiring part changes, the voltage applied thereto also changes. In other words, if the resistance value in each part of the touch panel changes, the output voltage when the same point on the touch panel was depressed differs, thereby giving rise to a phenomenon of positional deviation.

On the other hand, in combinations of (AHL-120N8-BL) + (8-wire touch panel), the AHL-120N8 checks double-end voltage (reference voltage: V_{REF1} , V_{REF2}) in the key input part of the touch panel in order to make internal correction so that the data on the low voltage side becomes zero and the high-voltage side data becomes "1023" or "4095" which is referred to as auto calibration; therefore, there is virtually no positional deviation caused by changes in resistance value in each part of the touch panel.

The reference voltage is saved inside the AHL-120N8-BL.

The AHL-120N8 checks the reference voltage when; 1. the power is turned ON; and 2. the unit is reset.

- * Normally, the touch panel reference data does not change significantly as shown in the example above. Accordingly, the reference data is not rewritten substantially, either.
- * In our touch panel, the resistance value in each part is hard to change, but it may vary, depending on operating conditions (environment) or when it has been used over a long period of time.

7.2 User calibration

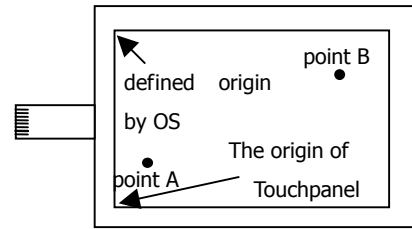
In the touch panel module in which the touch panel and display were laminated, the touch panel pressing position and display position must be aligned with each other. This is called "user calibration".

This user calibration should be carried out when the touch panel module is used for the first time, and the touch panel pressing position and display position shifted, for example.

(NOTE) There is no correlation between the touch panel pressing position and display position with the touch panel module assembled. It is, therefore, necessary to always carry out user calibration the first time the touch panel module is used. Even when the touch panel module is of the same configuration, the position data in the same point of the touch panel differs among the modules for reasons of dispersion in touch panel resistance value, etc. Also, there is a need to carry out user calibration for each module even if the touch panel module is of the same configuration since there is an error in touch panel and display lamination as well, for example.

As one example of user calibration method, a description is given of the method used by pressing 2 points on the touch panel.

- * Position data of touch panel at point A: (X_A, Y_A)
 - * Position data of touch panel at point B: (X_B, Y_B)
- However, X_A < X_B and Y_A < Y_B.



- * Dot position on the display at point A: (DX_A, DY_A)
 - * Dot position on the display at point B: (DX_B, DY_B)
- However, DX_A < DX_B and DY_A > DY_B.

The number of dots (DX1) per data in the X direction is:

$$DX1 = (DX_B - DX_A) / (X_B - X_A) \text{-----A)}$$

The number of dots (DY1) per data in the Y direction is:

$$DY1 = (DY_A - DY_B) / (Y_B - Y_A) \text{-----B)}$$

Therefore, the relationship between the optional positions (X_D, Y_D) on the touch panel and dot positions

(DX_D, DY_D) on the display is:

$$DX_D = DX_A + DX1 \times (X_D - X_A) \text{-----C)}$$

$$DY_D = DY_A - DY1 \times (Y_D - Y_A) \text{-----D)}$$

Attention! Screen the left top usually becomes the origin by the OS such as Windows, but touch panel defines the left bottom as the origin. Therefore calculation type of DY_D is different from DX_D.

Explanation is given below of the above calibration method.

- 1) Press 2 points on the display to obtain the data of X_A, Y_A, X_B & Y_B. Save these data in the host computer.
- 2) From eq. A) and eq. B) above, find DX1 and DY1. Save this data and DX_A & DY_A as well in the host computer.

This completes the user calibration. During normal operation, find the touch positions DX_D, DY_D on the display unit from these data and position data X_D, Y_D when the touch panel was depressed, using eq. C) and eq. D) above. This calculation should be made each time the touch panel position data is inputted.

Thus, the touch positions DX_D, DY_D on the display are found according to the touch panel position data X_D, Y_D.

7.3 Mouse emulation

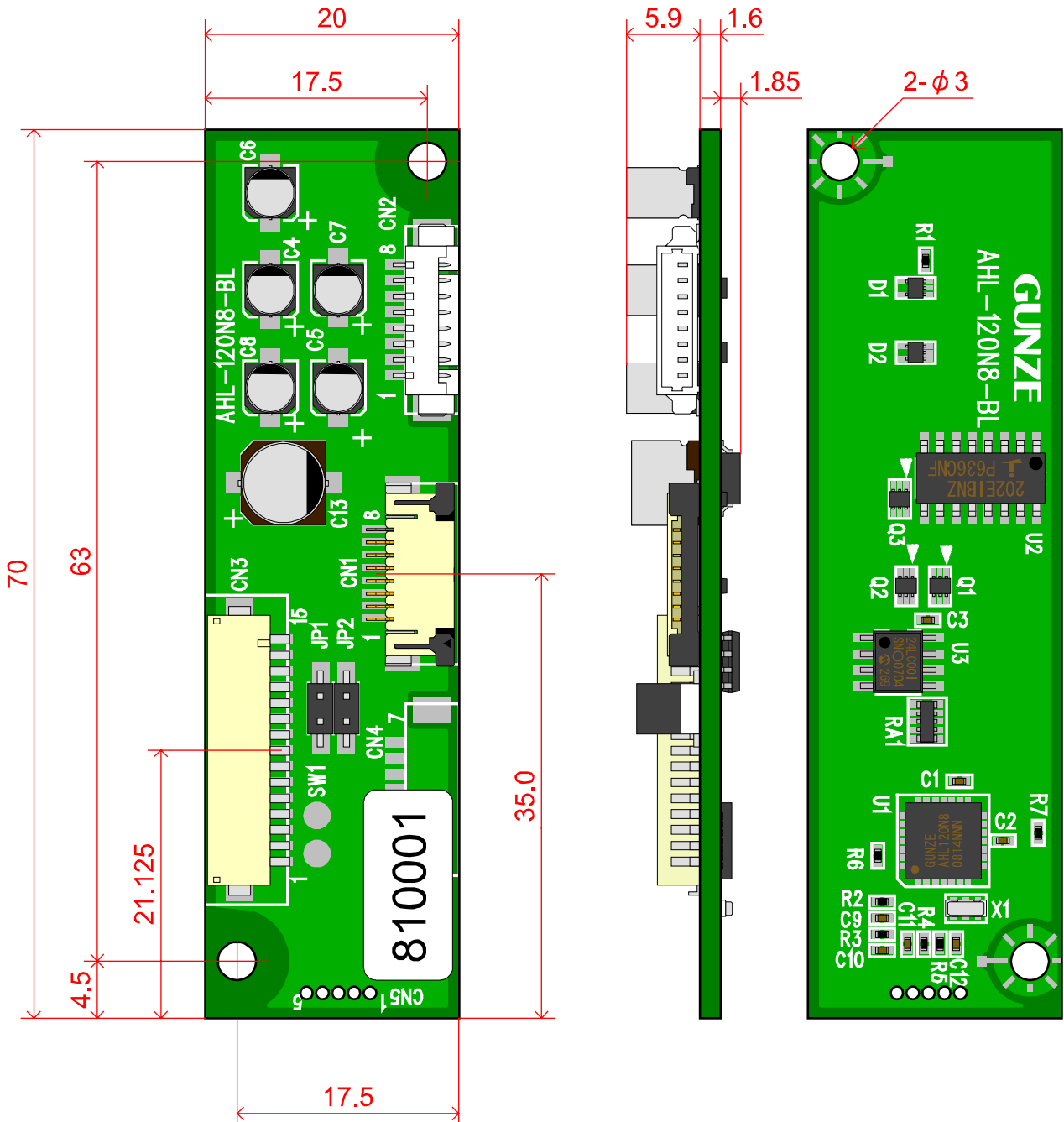
The device driver for mouse emulation is available. By using this unit, the touch panel can be used in place of the mouse.

Name of driver software	Support OS	Support mode
GZTP PACK	Windows XP, Windows Vista™	WHQL mode
TPDD series	Windows Me, Windows 2000, Windows XP, Windows Vista™	AHL original mode

Contact our sales section if you use another operation system.

8 Outline Drawing

Unit : mm



9 Warranty Period and Warranty Range

9.1 Warranty Period and Range

Warranty Period	The warranty period is one year from the date of the delivery. After the warranty period, we will repair product with repair cost charged from customer.
Warranty Range	<p>Warranty is valid to only the products that GUNZE has delivered. Any failure or malfunction lead or caused by our product is out of our warranty range, and we do not accept any claims for damage from customer. If your product should fail or break down due to our nonconformity during warranty period, we will repair defectives free of charge. However, in the following cases, the repair costs are charged to you or your company:</p> <ul style="list-style-type: none"> ● Failure and damage arising from shocks by drop or the like during transportation (movement) after delivery. ● Failure and damage caused by handling against the method of use and precautions described in this Specifications ● Failure and damage caused by disasters, such as thunderbolt, fire, and accidents ● Repair or remodeling at other company besides GUNZE.

9.2 Repairs during Warranty Period

GUNZE will handle all repairs by SEND BACK SERVICE*. We do not repair our products at customer's.

*SEND BACK SERVICE is maintenance service that customer sends back product to GUNZE for repairs and will return product back to customer after we have repaired it.

Route of Repairs during Warranty Period

Postage is asked to be covered by customer.

```

graph LR
    Customer[Customer] -- "Defective product" --> SCW[Sales contact window]
    SCW -- "Defective product" --> GUNZE[GUNZE]
    GUNZE -- "Repair" --> SCW
    SCW -- "Repair" --> Customer
            
```

- Please send back defected product to our Sales Office.
- To avoid any damage during send back, please return defected product using same package and shipping supply when it was delivered from GUNZE.
- To avoid any kind of trouble during send back, please use transfer company which will issue delivery certificate or delivery ticket.

9.3 Repairs after Warranty Period

GUNZE will handle all repairs by SEND BACK SERVICE*1. We do not repair our products at customer's. GUNZE will assure customer minimum of 3-year warranty on Repair-Performance Component*2 after discontinuation of manufacturing.

However, there will be occasion which we are unable to assure when the component became unavailable.

*1 SEND BACK SERVICE is maintenance service that customer sends back product to GUNZE for repairs and will return product back to customer after we have repaired it.

*2 Repair-Performance Component is a component that maintains function of a product.

