

Contents in this document may change without prior notice.
Please obtain the delivery specification for the final design.



15.6" Wide (FHD)

Projected capacitive Touchscreen Module with LCD

Simple Set Plus

TK-S Series

Model: TK-SPA156FH-11A3

Product Specification

DMC Co., Ltd.

<https://www.dush.co.jp/english/>

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Appendix

- Outline Drawing
- Glass/Glass Structure Projected Capacitive Touch Screen, Mounting Guidance
- Touch Screen Controller Specification: DUS3200 Product Specification
- Appearance inspection standard
(LCD Modules with Capacitive Glass Sensor Touchscreen)

1 Summary

This is a “TK series Simple Set Plus” with 15.6" Wide projected capacitive touchscreen sensor, controller, and LCD(Liquid Crystal Display) plus HDMI Board.

2 Product Model

Model	Specification		
	LCD size (Resolution)	Touchscreen Type	Set Type
TK-SPA156FH-11A3	15.6" Wide (FHD)	Projected capacitive	Simple Set Plus

3 Components

Components	Name	Specification	Manufacturer	Model
TS+LCD	Touchscreen (TS)	Projected capacitive	DMC	DUS-N156WA060A
	LCD	15.6" Wide	Data Image	FG150690DSSWPG01
Accessories	Touchscreen controller	-	DMC	DUS3200
	HDMI board	HDMI input	DMC	SWAD-A3
	Image cable (L: 320mm)	-	DMC	22E3E4-00031
	Board-to-Board USB cable(L: 240mm)	-	DMC	22E3E4-00032

4 Packaging Specification

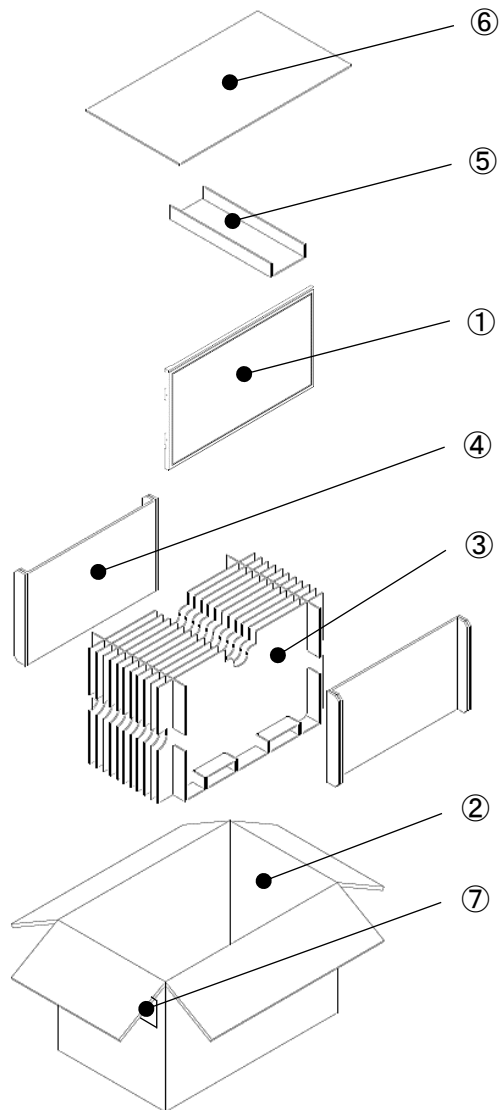
Depending on the number of shipments, individual packaging may be used instead of grouped packaging.

4-1 Grouped Packaging

Box	Contents	Specification	Size (W x D x H)
A	TS+LCD	Grouped packaging (10units/box)**	External dimension: 482×302×317
B	Accessories	Grouped packaging (10pcs/box)**	External dimension: 457×295×151

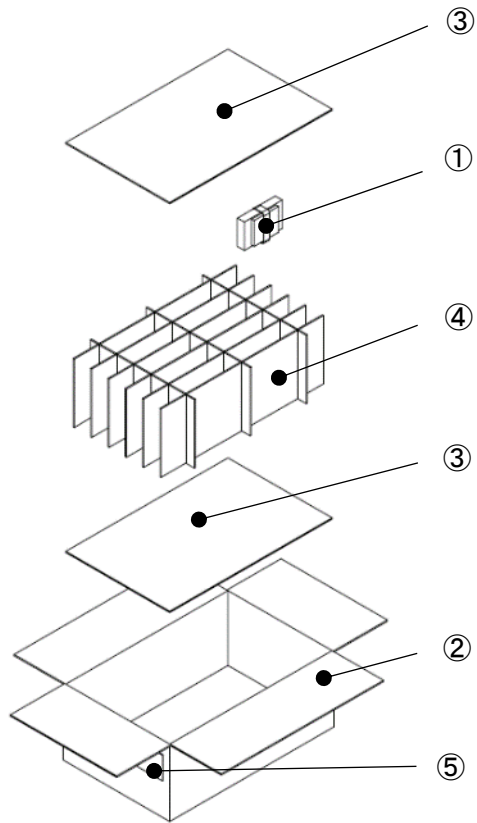
**May not be as specified according to the quantity shipped.

• Grouped Packaging Configuration (A)



No.	Name	Qty
①	TS+LCD (placed inside antistatic bag)	10
②	Outer Box	1
③	Partition Set	
	Partition 1	11
	Partition 2	2
	Bottom Supporter	2
	Frame Divider	1
④	Pad between products	2
⑤	Top Supporter	1
⑥	Top Pad	1
⑦	Grouped packaging label	1

• Grouped Packaging Configuration (B)



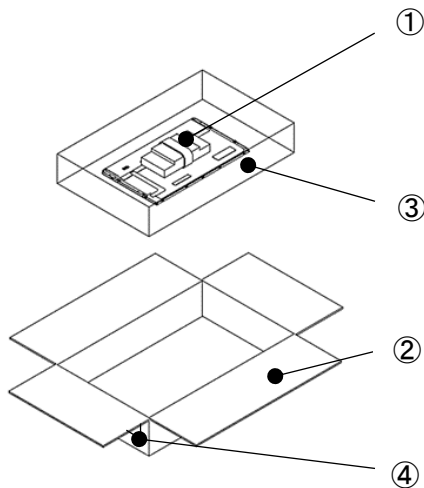
No.	Name	Qty	
①	SWAD-A3 (placed inside air-cushion bag)	10	
	DUS3200 (placed inside antistatic bag)		
	22E3E4-00031 (placed inside antistatic bag)		
	22E3E4-00032 (placed inside antistatic bag)		
②	Outer box	1	
③	Top/Bottom pad	2	
④	Partition Set	Partition A	3
		Partition B	6
⑤	Grouped packaging label	1	

4-2 Individual Packaging

Box	Contents	Specification	Size (W x D x H)
C	TS+LCD, Accessories	Individual packaging (1units/box)	External dimension 589×379×136

※One box includes TS+LCD and accessories.

• Individual Packaging Configuration (C)



No.	Name	Qty
①	TS+LCD (placed inside antistatic bag)	1
	SWAD-A3 (placed inside air-cushion bag)	
	DUS3200 (placed inside antistatic bag)	
	22E3E4-00031 (placed inside antistatic bag)	
	22E3E4-00032 (placed inside antistatic bag)	
②	Outer box	1
③	air cushion	-
④	packaging label	1

5 Module Specification

5-1 Function

Item		Specification	units	
LCD	Display device	15.6" Wide TFT LCD	-	
	Display area (Active area)	344.16(W) ×193.59(H)	mm	
	Pixels	1920(W) ×1080(H)	-	
	Pixel pitch	0.179(W) ×0.179(H)	mm	
	Color	16.7M	colors	
	Brightness (Typ.)	400	cd/m ²	
	View angle (Typ.)	Vertical (Upper/Lower)	85 / 85	deg.
		Horizontal (Left/Right)	85 / 85	
	Interface	LVDS	-	
	Backlight method	LED, with backlight driver	-	
	Backlight life ^{※1}	Typ. 50,000	hours	
Touchscreen	Touchscreen type	Projected Capacitive	-	
	Input method	Finger	-	
	Maximum simultaneous input point	5 point ^{※2}	-	
	Operating life(Continuous Typing)	50 million times(finger input)	-	
	Communication Method	USB 2.0	-	
	Supporting OS ^{※3}	Microsoft® Windows® 10/11 (32bit/64bit)	-	
HDMI board	Input image port	HDMI (does not support HDCP)	-	
	Input Signal	Digital	HDMI 1.3b	-
		Horizontal scan cycle	30K - 80K	Hz
		Vertical scan cycle	50 - 60	Hz
Module	Bonding method	Air-bonding (Bonding of LCD and touchscreen with double-sided tape.)	-	
	Input power voltage ^{※4}	12±5%	V	
	Energy consumption(Max.)	22.4	W	

※1 Time until brightness declines by 50% from the initial value at maximum brightness in ambient temperature of 25°C.

※2 The standard Windows touchscreen driver can be used, but operation may become unstable depending on the environment installed. Please perform calibration according to the instructions in "[Section 10. Touchscreen Calibration](#)".

※3 Please contact us for information regarding OS other than Windows.

※4 If the capacity of the power supply used is large, the drop in voltage when it is turned off will be gradual. When restarting, please turn on the power again after the power supply voltage becomes 0V.

5-2 Environment

Item	Specification
Ambient operating temperature (Inside cabinet and display side)	0°C to 55°C
Ambient storage temperature	-20°C to 70°C
Ambient operating humidity	10%RH to 85%RH (Non-condensing. Wet-bulb temperature is 39 °C or less)
Ambient storage humidity	10%RH to 85%RH (Non-condensing. Wet-bulb temperature is 39 °C or less)
Dust	0.1mg/m ³ or under (Conductive dust is prohibited)
Corrosive Gas	Corrosive gas is prohibited
Pollution Degree	Pollution Degree 2, for indoor use

5-3 Mechanical Specification

Item	Specification	
Mass	TS (Touchscreen) + LCD	Approx. 1540 g
	Touchscreen controller	Approx. 15 g
	HDMI board	Approx. 50 g
	Cables	Approx. 10 g
External Measurements (TS (Touchscreen)) + LCD, excluding protruding parts)	363.8(W) × 215.9(H) × (12.77)(D) mm	

5-4 Touchscreen Controller

Please refer to the attached touchscreen specification for details.

5-5 Touchscreen Driver

In order to use the touchscreen, you will need to install a touchscreen driver (DMT-DD).

To obtain the driver, please download it from the following site.

URL: <https://www.dush.co.jp/english/download/>

Download > Driver-App > Touchscreen Related > Touchscreen Driver.

For DMT-DD installing directions, please refer to the User's Guide included in the downloaded files.

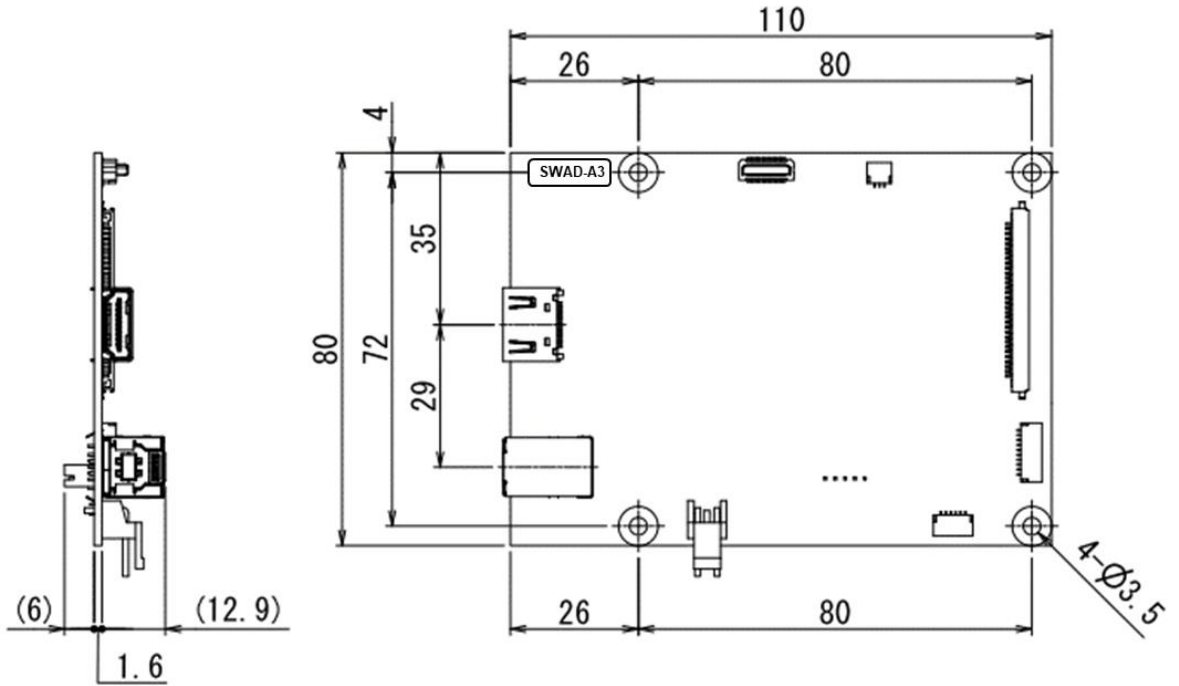
5-6 HDMI Board

5-6-1 Model

Model	Image Input Port
SWAD-A3	HDMI ×1

5-6-2 External Dimension

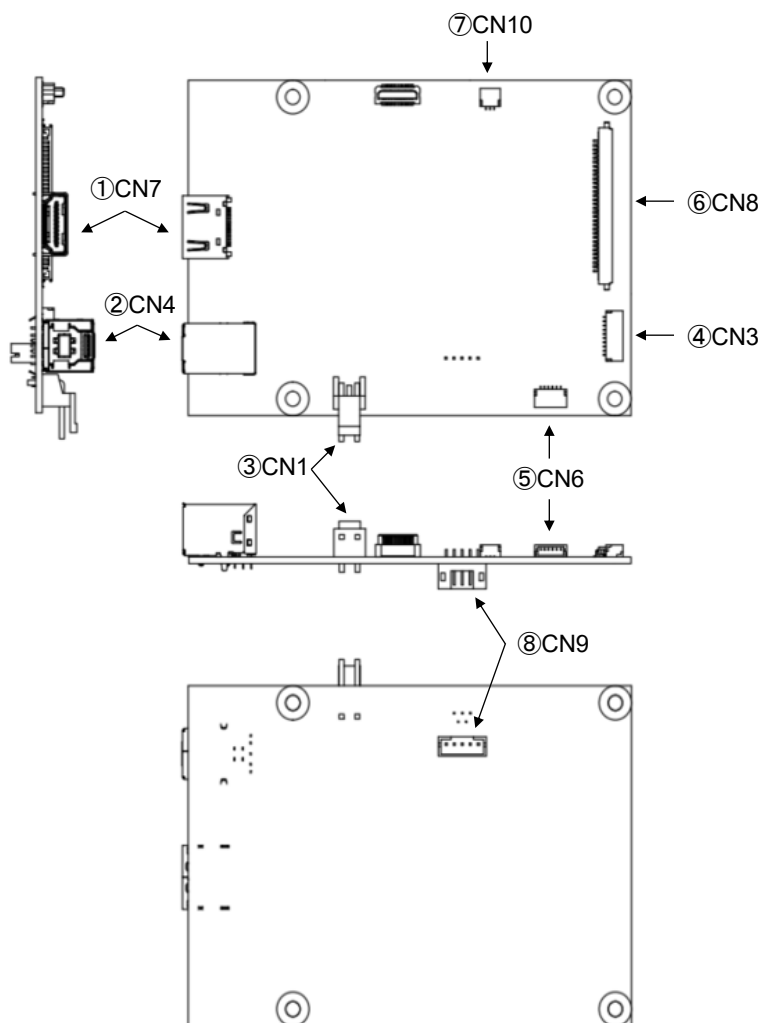
Item	Measurement
PCB outline (excluding connector)	110mm x 80 mm



5-6-3 Support Timing

No	Resolution	Aspect Ratio	Refresh Rate
1	640×480p	4: 3	60Hz
2	720×480p	4: 3	60Hz
3	800×600p	4: 3	56Hz
4	800×600p	4: 3	60Hz
5	1024×768p	4: 3	60Hz
6	1280×720p	16: 9	60Hz
7	1280×960p	4: 3	60Hz
8	1280×1024p	5: 4	60Hz
9	1600×900p	16: 9	60Hz
10	1600×1200p	4: 3	60Hz
11	1680×1050p	16: 10	60Hz
12	1920×1080p	16: 9	60Hz

5-6-4 Part Names (HDMI Board)



No.	Interface Name
①	Image input (HDMI)
②	Touchscreen control USB (USB 3.0 Type-B)
③	12VDC Power input (Nylon connector)
④	LCD Backlight control
⑤	Touchscreen controller connecting I/F ^{※1} (USB 2.0, Nylon connector)
⑥	LCD Image output (LVDS)
⑦	Pilot lamp LED control
⑧	OSD control I/F(Nylon connector)

※1 Connector for connecting the HDMI board and touchscreen controller.

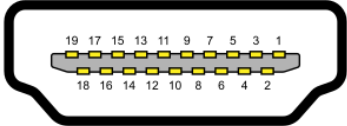
※2 Use of other connectors not listed is prohibited. They are for internal adjustments only and may be excluded without prior notice.

5-6-5 Image Input (HDMI) I/F

Connector No.: CN7

Interface: HDMI Type A

※HDMI standard compliant

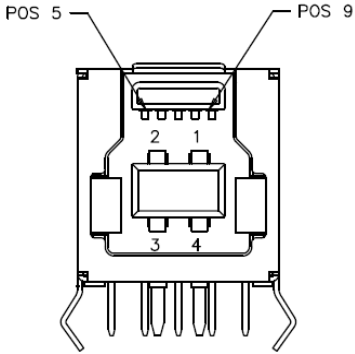
PIN No	Signal Name	PIN No	Signal Name	Schematic Diagram
1	TMDS Data2+	11	TMDS Clock Shield	
2	TMDS Data2 Shield	12	TMDS Clock-	
3	TMDS Data2-	13	CEC (NC)	
4	TMDS Data1+	14	Reserved	
5	TMDS Data1 Shield	15	DDC Clock	
6	TMDS Data1-	16	DDC Data	
7	TMDS Data0+	17	DDC GND	
8	TMDS Data0 Shield	18	+5V Power	
9	TMDS Data0-	19	Hot Plug Detect	
10	TMDS Clock+	-	-	

5-6-6 Touchscreen Control USB I/F

Connector No.: CN4

Interface: USB3.0

Connector: USB3.0 Type-B

PIN No.	Signal Name	Description	Schematic Diagram
1	VBUS (5V)	Power	 <p>View from connector inserting side</p>
2	D-	USB 2.0	
3	D+		
4	GND	GND for power return	
5	StdB_SSTX-	SuperSpeed transmitter	
6	StdB_SSTX+		
7	GND_DRAIN	GND for signal return	
8	StdB_SSRX-	SuperSpeed receiver	
9	StdB_SSRX+		
10	Shield		

* USB port for touchscreen control (can be connected to USB2.0 Type-B).

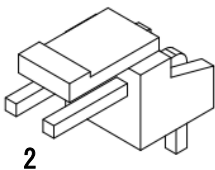
5-6-7 12VDC Power Input I/F

Connector No.: CN1

Interface: +12VDC Input

Connector: A3963WR2-2P(JWT)

※Equivalent to S2P-VH(JST)

PIN No.	Signal Name	Schematic Diagram
1	+12V	
2	GND	

5-6-8 LCD Backlight Control I/F

Connector No.: CN3

Connector: 1010-SMTR-10P(JWT)

※Equivalent to SM10B-SRSS-TBT (JST)

PIN No.	Signal Name	Description
1	12V	Backlight power
2	12V	
3	12V	
4	12V	
5	GND	Ground
6	GND	
7	GND	
8	GND	
9	BL_EN	Backlight ON/OFF High level: Backlight ON. Low level: Backlight OFF.
10	BL_PWM	Backlight dimming input

※Specification (signal used) vary according to the connected LCD.

5-6-9 Touchscreen Controller Connection I/F

Connector No.: CN6

Interface: USB 2.0

Connector: 1010-SMTR-06P(JWT)

※Equivalent to SM06B-SRSS-TBT (JST)

PIN No.	Signal Name
1	VBUS
2	D-
3	D+
4	GND
5	RESETn
6	GND

※Specification (signal used) vary according to the connected touchscreen controller.

※Connector for connecting the HDMI board and the touchscreen controller.

5-6-10 LCD(LVDS) Output I/F

Connector No.: CN8

Interface: LVDS

Connector: 1058-HL-SMTR-30P(Well-in)

※Equivalent to FI-X30SSLA-HF (JAE)

PIN No.	Signal Name	PIN No.	Signal Name
1	O-Link0-	16	E-Link1+
2	O-Link0+	17	GND
3	O-Link1-	18	E-Link2-
4	O-Link1+	19	E-Link2+
5	O-Link2-	20	E-CLK-
6	O-Link2+	21	E-CLK+
7	GND	22	E-Link3-
8	O-CLK-	23	E-Link3+
9	O-CLK+	24	GND
10	O-Link3-	25	Panel VCC 3.3V
11	O-Link3+	26	Panel VCC 3.3V
12	E-Link0-	27	Panel VCC 3.3V
13	E-Link0+	28	Panel VCC 5V
14	GND	29	Panel VCC 5V
15	E-Link1-	30	Panel VCC 5V

※Specification (Signal used) vary according to the connected LCD.

5-6-11 Pilot Lamp LED Control I/F

Connector No.: CN10

Connector: 1010-SMTR-03P(JWT)

※Equivalent to SM03B-SRSS-TBT (JST)

PIN No.	Signal Name
1	LED_G
2	GND
3	LED_R

※Power supply 3.3V, limiting resistance 220Ω (board built-in)

5-6-12 Pilot Lamp LED

By preparing a LED board (refer to following circuit board diagram), the power of the HDMI board and the status of the image input signal can be indicated by LED.

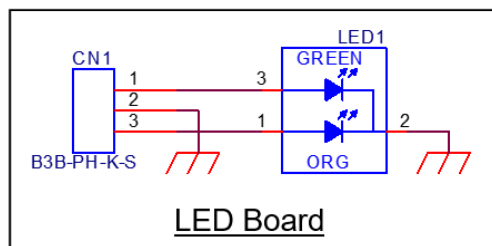
▪ Status Indicating LED (Example)

Green lit: Power ON, with image input signal

Orange lit: Power ON, without image input signal.

LED off: Power OFF

▪ Circuit diagram (Example)



5-6-13 OSD Operation I/F

Connector No : CN9

Connector : 2000-WS-05P (JWT)

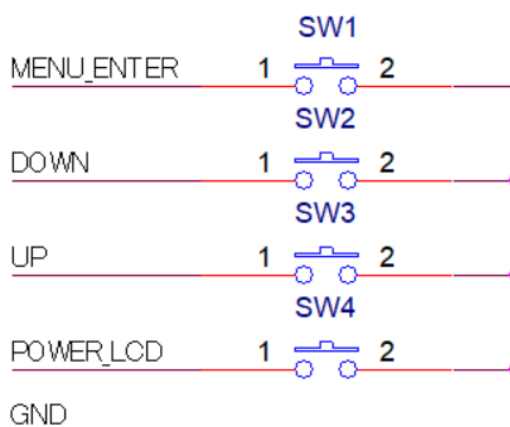
※Equivalent to B5B-PH-K-S (JST)

PIN No.	Signal Name	Description
1	MENU_ENTER	By connecting to GND, the OSD menu can be displayed, and the set status can be fixed (ENTER function).
2	DOWN	By connecting to GND, shift leftward in the selection of icons on the top menu, shift upward in the selection of items on the submenu, change parameter of each item, and decrease the value of bar meter of each item.
3	UP	By connecting to GND, shift rightward in the selection of icons on the top menu, shift downward in the selection of items on the submenus, change parameter of each item, and increase the value of bar meter of each item.
4	GND	Ground
5	POWER_LCD ※1 ※2	By connecting to GND, turned ON/OFF the power of LCD.

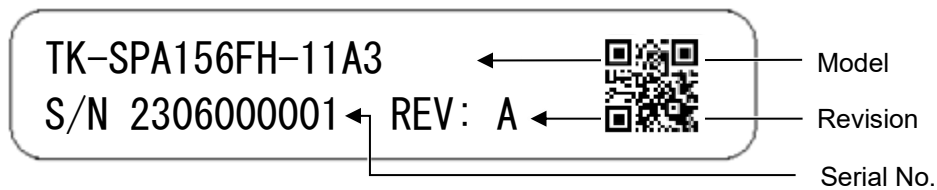
※1 For continuous ON/OFF operation, please allow an interval of at least 5 seconds.

※2 The status is maintained even when the power to the HDMI board is turned on and off.

5-6-14 OSD Operation Switch Reference Circuit



6 Product Label



Above is an image example of the product label.

Below information will be indicated on the actual product.

- Model: Product Model
- Serial No.: 10 digit control number
- Revision: Alphabets (A to Z) according to the product revision

7 Compliant Standards

7-1 RoHS

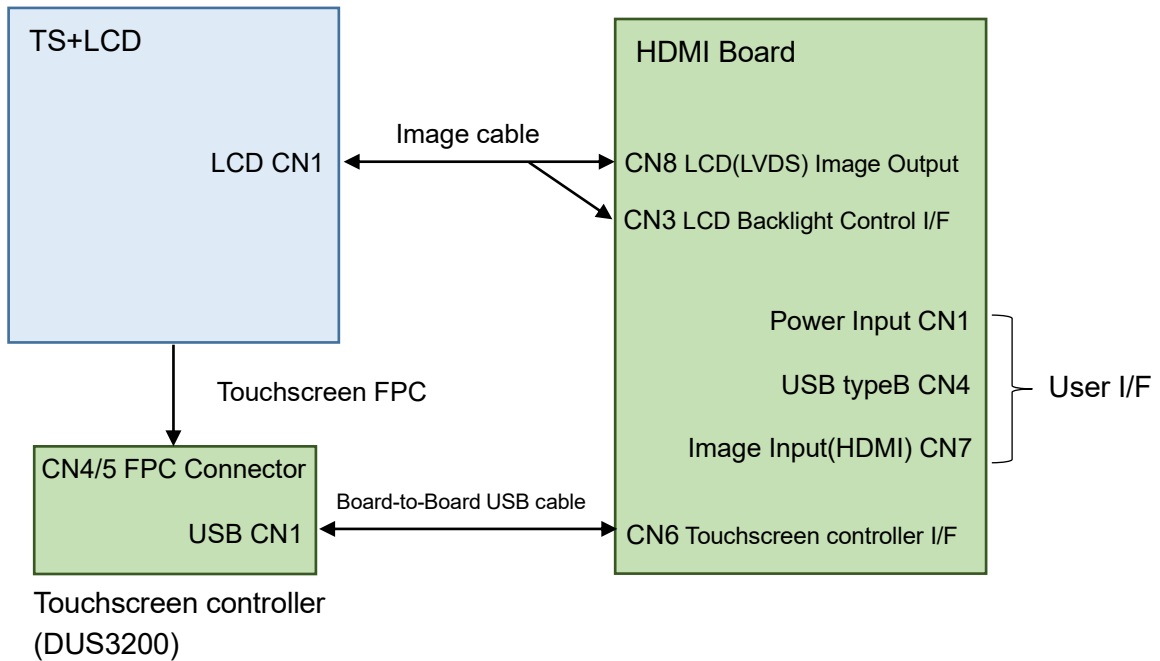
Compliant to EU RoHS directives.

8 Appearance inspection standard

Please refer to “Appearance inspection standard(LCD Modules with Capacitive Glass Sensor Touchscreen)” (22G4GX-00002E) for standards.

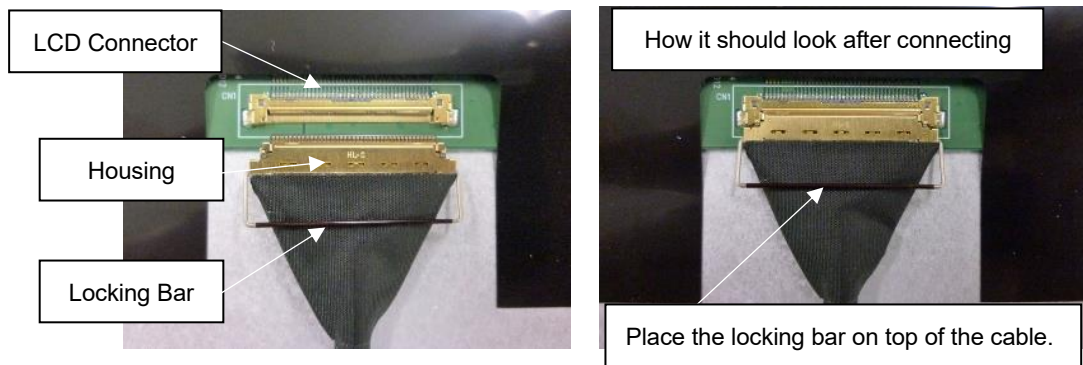
9 Connecting Method

9-1 Connecting Diagram

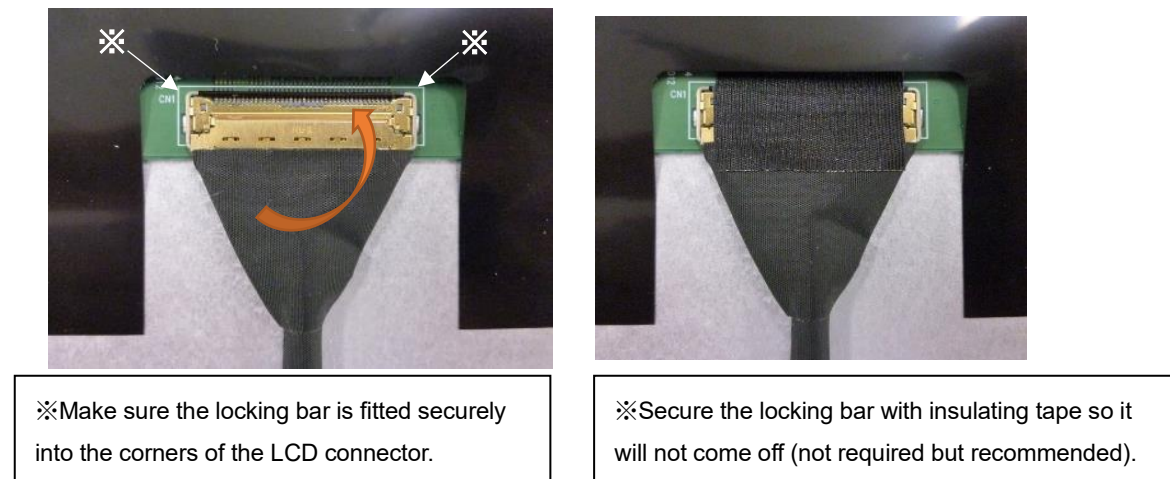


9-2 Connecting Image Cable to LCD

- (1) Slide the housing of the image cable into the connector on the backside of the LCD in the direction shown below.

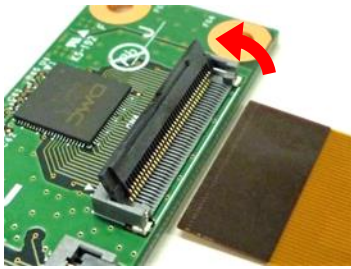
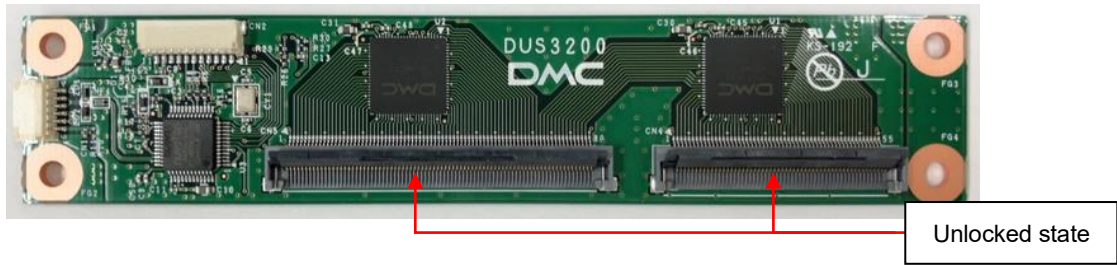


- (2) Fit the Locking bar into the LCD Connector (Locked)



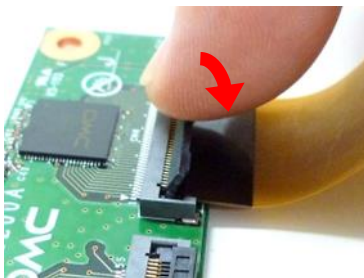
9-3 Connecting Touchscreen FPC to Touchscreen Controller

- (1) Slowly push up the lock lever with a fingernail or the like to unlock state it.



Unlocked state

- (2) Insert the touchscreen FPC securely into the two connectors on the touchscreen controller and lock state it.



Locked state

9-4 Connecting Image Cable to HDMI Board

- (1) Insert the image cable securely into the connector in the two locations of the HDMI board.

Insert with the connecting point facing up and visible.



How it should look after connecting



Insert with the connecting point facing up not visible.

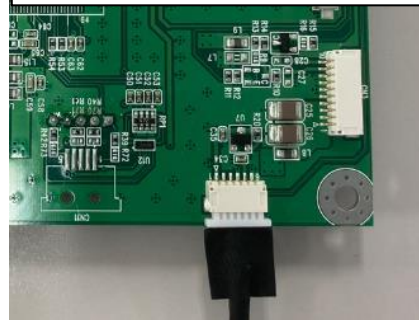
9-5 Connecting Board-to-Board USB Cable to HDMI Board

- (1) Insert the board-to-board USB cable securely into the connector of the HDMI board as shown in below diagram.



Insert so the connecting point is not visible.

How it should look after connecting

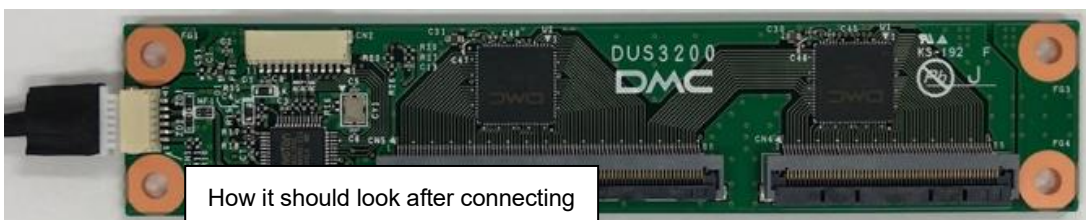


9-6 Connecting Board-to-Board USB Cable to Touchscreen Controller

- (1) Insert the board-to-board USB cable securely into the connector of the touchscreen controller as shown in below diagram.



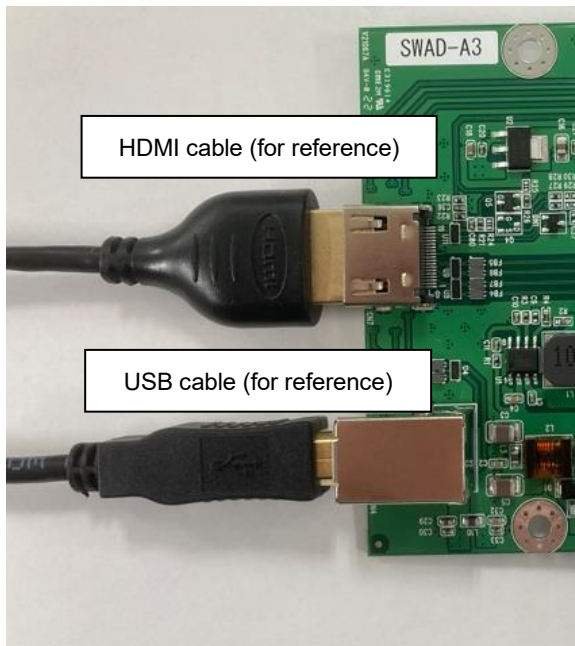
Insert so the connecting point is not visible.



How it should look after connecting

9-7 Connecting Each Cable to User I/F of HDMI Board

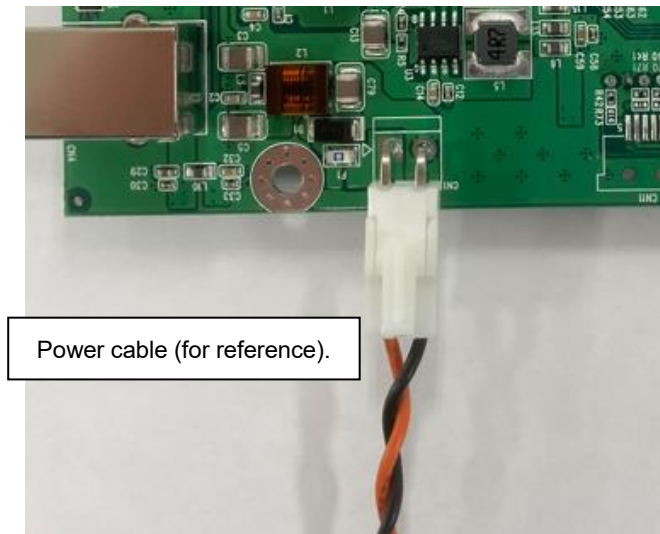
(1) Connecting the HDMI cable and the USB cable.



※Please insert securely.

※HDMI cable/ USB cable not included.

(2) Connecting the Power cable.



※Please insert securely.

※Power cable not included.

10 Touchscreen Calibration

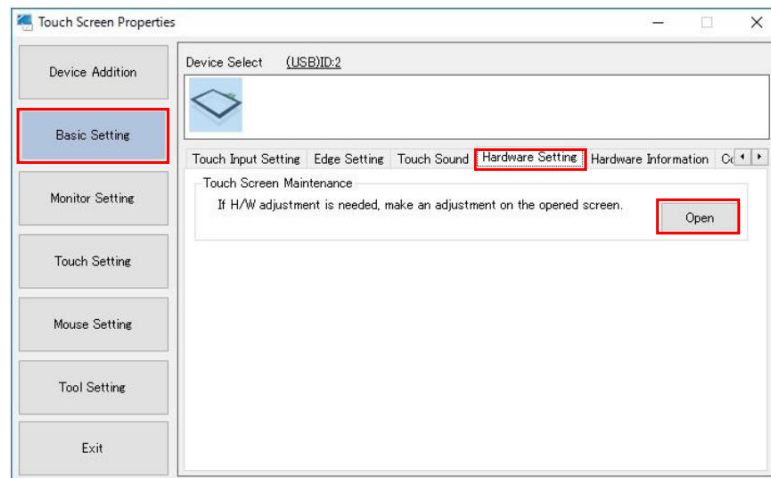
Touchscreen operations may become unstable depending on the installation environment due to its characteristics. To use it correctly, please perform calibration when building into a device.

Install DMT-DD from "[5-5. Touchscreen Driver](#)" when calibrating.

10-1 Projected Capacitive Touchscreen

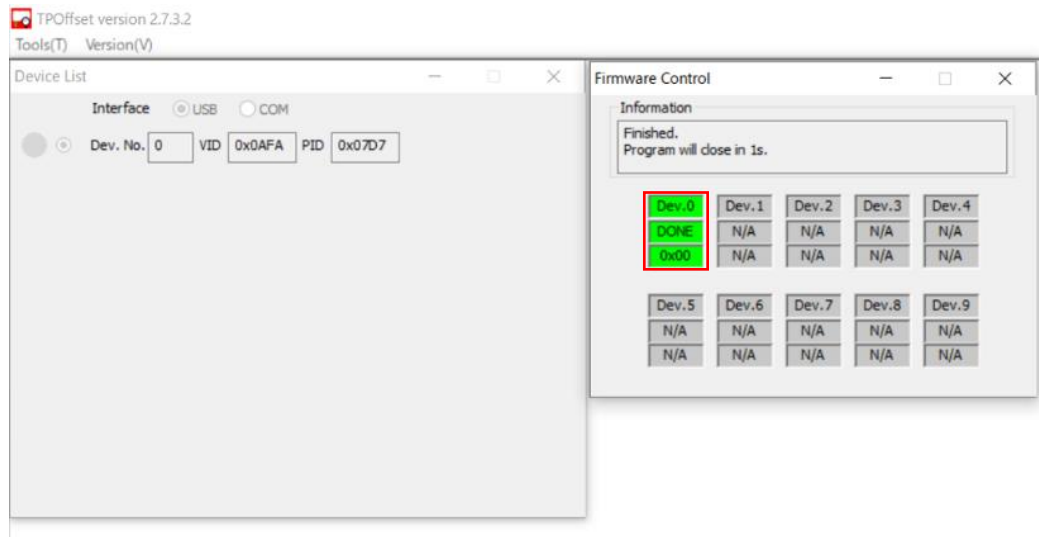
[TPOffset] ...Sensitivity calibration.

- (1) Start DMT-DD.
- (2) Open [Touchscreen Maintenance] via [Basic Setting] > [Hardware Setting] and click [Open].



- (3) Hardware calibration is complete when [Dev.0] [DONE] [0x00] turns green.

Maintenance Tool Screen (Example)



*[Setup Tool] cannot be operated while the [Maintenance Tool] is running.

*Please do not touch the touchscreen when calibration is being performed.

*This tool will automatically terminate.

11 OSD Function

Various configurations and adjustments can be made with the OSD (On Screen Display).




The OSD can be operated using the “MENU_ENTER” control and “UP” / “DOWN” control described in section “[5-6-13 OSD Operation I/F \(CN9\)](#)”.






The value set once will be retained and will not be deleted when power is shut down.

11-1 OSD Menu

Top menu icons



Main Menu	Submenu	Adjustment range	Initial Value	Description
PICTURE 	Brightness	0 ~ 100	100	Adjust brightness of display
	Contrast	0 ~ 100	50	Adjust contrast of display
	Sharpness	0 ~ 4	2	Adjust sharpness of display
	Exit	-	-	Go back to main menu
DISPLAY 	Auto Adjustment	N/A (Analog RGB input operation is possible)		
	H Position	0 ~ 100	50	Adjust horizontal position of display.
	V Position	0 ~ 100	-	Adjust vertical position of display
	Pixel Clock	N/A (Analog RGB input operation is possible)		
	Phase	N/A (Analog RGB input operation is possible)		
	Exit	-	-	Go back to main menu
COLOR 	Gamma	OFF 1.8 2.2 2.4	OFF	Adjust Gamma value
	Color Temp	5800K 6500K 7500K 9300K sRGB	6500K	Adjust color temperature ※Depending on the LCD you prepared, it may not be possible to set the color temperature correctly.
		User		
	Color Effect	Standard Dynamic Movie Photo Vivid	Standard	Adjust color effect
		User		
	Auto Color	N/A (Analog RGB input operation is possible)		
	Exit	-	-	Go back to main menu

ADVANCE 	Aspect Ratio	Full 16:9 4:3 5:4 Original	Full	Adjust aspect ratio
	Exit	-	-	Go back to main menu
INPUT 	N/A (Only HDMI)			
AUDIO 	N/A			
OTHER 	Reset	-	-	Reset to initial value
	Menu Time	0 ~ 30	10	Set time display of OSD menu
	OSD H Position	0 ~ 100	50	Adjust horizontal position of OSD menu
	OSD V Position	0 ~ 100	50	Adjust vertical position of OSD menu
	Transparency	0 ~ 7	0	Adjust transparency of OSD menu
	Exit	-	-	Go back to main menu
INFOMATION (EXIT) 	-	-	-	Exit OSD

11-2 OSD Menu Operation

11-2-1 System Configuration

Displaying the OSD

- (1) Press "MENU_ENTER" switch to display the main menu of the OSD.

Selecting with the OSD

- (1) Choose the icon on the OSD main menu by pressing "UP" / "DOWN" switch while OSD is displayed.

The icon in yellow is the icon in the selected state.

- (2) Press "MENU_ENTER" switch to choose icon.

- (3) Choose the item on the OSD sub menu by pressing "UP" / "DOWN" switch while OSD is displayed.

The item in white is the item in the selected state.

- (4) Press "UP" / "DOWN" switch to change the value of "Bar Meter" and "Parameter", and press "MENU_ENTER" switch to set.

- ※ The set value will be retained in the Scaler Board. It will not change even after the power is turned OFF.

Exiting the OSD

- (1) After making the adjustments, select [EXIT] of the sub menu to go back to the main menu.
- (2) Select [INFORMATION] of the main menu to end the OSD.

- ※ If an operation is aborted, the OSD will automatically close at the auto close Time (Menu Time).

Refer to "[11-2-4 Setting Auto close Time \(Menu Time\) of OSD Menu](#)" for details on how to set the OSD Timer.

11-2-2 Adjusting Brightness

- (1) Open the OSD menu.
- (2) Select [PICTURE] (main menu icon) > [Brightness] (submenu item).
- (3) Adjust the bar meter of [Brightness], brightness of the LCD can be changed in real time.
- (4) Set your preferable brightness.
- (5) End the OSD menu.

11-2-3 Changing Color Temperature

- (1) Open the OSD menu.
 - (2) Select [COLOR] (main menu icon) > [Color Temp] (submenu item).
 - (3) Set your preferable color temperature.
 - (4) Select [User] ,individual colors "R"(Red),"G"(Green),"B"(Blue) can be adjusted.
 - (5) End the OSD menu.
- ※Depending on the LCD you prepared, it may not be possible to set the color temperature correctly.

11-2-4 Setting Auto Close Time (Menu Time) of OSD Menu

Set the auto close time (Menu Time) to automatically close the OSD menu.

The Auto close time of the OSD menu can be set 0 ~ 30 seconds.

Set the value "0", the OSD menu will not be closed.

Please note that even if the value is not set ("MENU_ENTER" switch is not pressed), the value you lastly adjusted will be set when the timing of the OSD menu close.

- (1) Open the OSD menu.
- (2) Select [OTHER] (main menu icon) > [Menu Time] (submenu item).
- (3) Press "UP" / "DOWN" switch, change the value (0 ~ 30s) of the "Bar Meter".
- (4) Set your preferable auto close time.
- (5) End the OSD menu.

11-2-5 Return to Initial Values

Return the values of the OSD to the initial state.

- (1) Open the OSD menu.
- (2) Select [OTHER] (main menu icon) > [Reset] (submenu item).

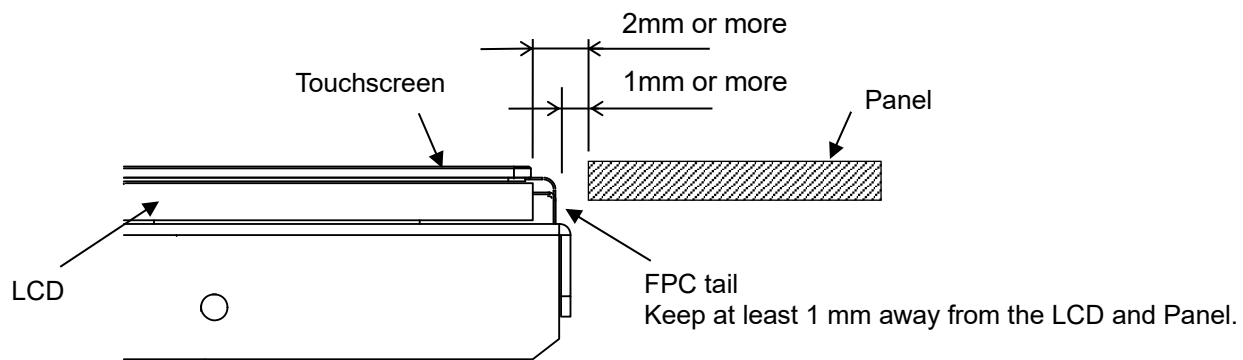
12 Terms of Use

12-1 Installing Projected Capacitive Touchscreen

- ❶ If surrounding environment changes or materials to alter the electrical field (a large capacitor, power-supply unit, LCD panel, or materials with high dielectric constant) is near, these external factors will adversely affect the function of the touch screen to detect the correct input positions.
- ❷ At structure design, please refer to the mounting guidance below and ensure enough gap distances among each component in order to avoid the external factors described above.

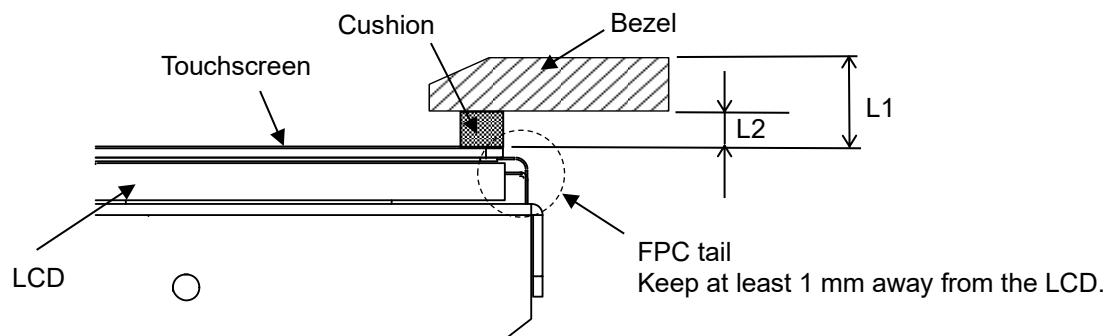
(1) When placing the panel and touchscreen on same surface

- Place keep a distance of at least 2mm or more between panel and touchscreen and 1mm or more from the FPC tail.



(2) When bezel comes on top of touchscreen surface

- It is recommended that the bezel placed on the top of the touchscreen is made of insulating resin. Please make sure to keep a distance (L1) between the touchscreen and the bezel as seen in below diagram.
- When sheet metal bezel is used, capacitive coupling with the sheet metal may occur at the outer periphery of the active area. When designing the bezel with metal materials such as sheet metal, ensure that the gap L2 between the touchscreen and the bezel is about 2 mm.
- Please keep the FPC tail of the touchscreen as far as possible from the metal.



Please make sure the below dimensions are kept to prevent the touchscreen from malfunctioning.

$L1 \geq 2\text{mm}$: Distance between bezel surface/ touchscreen.

$L2 \geq 2\text{mm}$: When using a sheet metal bezel, it is recommended that a distance of more than 2mm is secured between the touchscreen and the back side of the bezel.

12-2 Installing Module

- (1) For stable brightness and display, connect the GND via the mounting hole on the LCD.
- (2) Mount the LSI so that no external pressure is applied to the LSI mounting area.
- (3) Make sure there are no warping and twisting when installing.
- (4) Make sure the specified temperature and humidity between the module and structure or parts is taken into consideration to secure ventilation.
- (5) Take anti-static measures such as wearing grounding arm bands during assembly.
- (6) To prevent malfunction or damage, please insert each cable and touchscreen FPCs completely and securely to the connector.

12-3 Precautions for Use of LCD

- (1) The LCD contains irritants inside. If by any chance the liquid should flow out due to damages and come in contact with the skin, wash immediately under running water for more than 15 minutes and consult a physician.
- (2) LCD may have uneven brightness depending on the contents displayed. Please note that this is not a malfunction.
- (3) LCD elements may have spots (black spots/ bright spots). This is a characteristic of the LCD and not a malfunction.
- (4) When screen is viewed outside the viewing angle, the color displayed may appear to change. This is a basic characteristic of the LCD and not a malfunction.
- (5) When the same screen is displayed for a certain long period of time, the image may remain as an afterimage. This is a basic characteristic of the LCD.
In order to avoid afterimages, use a screensaver or other similar functions to periodically change the display and avoid displaying the same image for a long period of time.

12-4 Precautions for Projected Capacitive Touchscreen

- (1) If elements that change ambient environments or electric fields (capacitors with large capacity, power units, and materials with high permittivity such as metals) are set close to the product, it might have impact to the coordinate detection. Make sure to keep a good distance from the above unstable elements as much as possible when designing.
- (2) Due to the characteristics of the touchscreen, its functions might become unstable according to the environment it is installed. For correct operations, perform sensitivity sensor calibration when building into a device. Also if at any time the touchscreen operation become unstable due to changes in environment or installation conditions, perform sensitivity sensor calibration.
- (3) The touchscreen surface is made of glass. Glass becomes easy to break if scratched. Please handle with care and avoid glass from coming in contact with other glass and hard objects.
- (4) Touchscreen may not operate correctly when there is moisture on the surface. When moisture is detected on the touchscreen surface, please wipe it dry before use.
- (5) Handle When designing applications, consider the fact that area slightly outside the display might be read as a coordinate due to the characteristics of the touchscreen when touched.
- (6) Be careful when handling the end face of the glass as it is easily injured.

12-5 Precautions for Static Electricity

- (1) Static Electricity may cause damages. Please take sufficient measurements when handling.
- (2) Any personal handling the product should take measurements. Wearing grounding bands is recommended.

12-6 Operating Precautions

- (1) When used outside the specification standards, it may significantly affect product quality and service life, such as degradation of display quality and generation of air bubbles. Please be sure to use within the specifications.

12-7 Storing Precautions

- (1) When storing the module, please avoid areas of high temperature and humidity. Especially when storing for a long period of time, make sure to store in a place that is not be exposed to direct sunlight and/or fluorescent lighting.
- (2) Please store the module in a condition where it is not subject to excessive load.

12-8 Handling Precautions

- (1) Do not leave the product in an environment with high temperature for a prolong period. Make sure to avoid high humidity especially when the temperature is above 40°C. Failing to do so may cause polarizing plate deterioration, peeling, and/or bubbles to form.
- (2) If the surface of the polarizing plate becomes dirty, wipe it lightly with a soft material such as cotton cloth moistened with a small amount of ethyl alcohol.
- (3) Make sure to wipe off immediately any form of liquids to avoid deformation, discoloration or fading of the polarizing plate.
- (4) Condensation on the polarizing plate during testing is prohibited to prevent staining, discoloration, or spots to form on the plate.
- (5) Disassembling and/or changing the volume of the module is prohibited. Doing so may cause malfunction and failure to perform correctly.
- (6) This product is intended for use in general electronic equipment and is not intended for use in special environments such as corrosive gas atmosphere. If use in a special environment is anticipated, please evaluate the product thoroughly or take precautions not to expose the LCD to corrosive gases, etc.
- (7) This product is intended for use in standard applications (office equipment, industrial, communication, and household equipment, etc.). Do not use the products for special applications that require extremely high reliability (e.g., aerospace, nuclear power control, medical applications for life support, etc.) or where malfunctions or failures may directly cause injuries to the human body.
- (8) Do not rub or press the product with hard or sharp objects.
- (9) Keep away from flames/fire.
- (10) Avoid wiping the product with excessive pressure.
- (11) Avoid locally rubbing the product with strong pressure. It may cause damage to the function of the touchscreen.
- (12) When operating the product, please avoid striking it with a hard object.
- (13) Do not forcibly fold or bend the product.

- (14) When storing the product, use the packing box and keep the product within the specified storage temperature and humidity and in an environment where it is free of excessive pressure and loads.
- (15) Avoid using and storing the product where it can be exposed to or can come in contact with liquids, organic solvents, and acidic atmosphere.
- (16) Avoid using the product in direct sunlight.
- (17) Do not pull off or disassemble the product.
- (18) When handling the product, hold the main unit and not the touchscreen FPC (tail).
- (19) EMC (EMS, EMI) evaluation is not conducted at shipment. Please conduct overall evaluation and confirmation after the product has been installed in your equipment.

13 Warranty

The warranty period is limited to 12 months (1 year) from the date of shipment. Any defects that occur upon normal use under conditions specified herein will be repaired (factory repair) free of charge. (Warranty for any repair needed to the same repaired part of the same product is three months.)

You will be liable for all repair fees even within the warranty period for any conditions listed below.

- (1) Any malfunctions, defects, and/or damages that occurred during transport, transfer, or mishandling by the user after delivery.
- (2) Any malfunctions, defects, and/or damages caused by natural or man-made disaster.
- (3) If the product is used under any condition, environment, or method other than those specified in the specifications, catalogs, manuals, notes, and/or other documents.
- (4) Any malfunctions, defects, and/or damages caused by connected equipment and/or usage of inappropriate consumables and media.
- (5) If the product is repaired, remodeled, modified, or disassembled by a party other than DMC Co., Ltd, or if a serial number label cannot be verified.
- (6) Any failure, damage, or malfunction is deemed to be caused on your behalf.

This warranty covers only the product itself. Any damages, on-site repairs and replacement driven by the failure of the product will be decided upon discussion by both parties as necessary. This product is structurally not repairable. All damaged parts are subject for replacement and freight will be charged.

14 Production Discontinuance

In the event of production discontinuance, an announcement will be made six months prior to the last possible order reception date.

15 Other

For comments or queries, feel free to contact us.

North South America area

technical-global@dush.co.jp

Asia Pacific area

technical-global-asia@dush.co.jp

Europe, Middle East, Africa area

technical-global-eu@dush.co.jp

FAQ

<https://www.dush.co.jp/english/support/faq/>

3rd Edition, December 2023

DMC Co., Ltd.

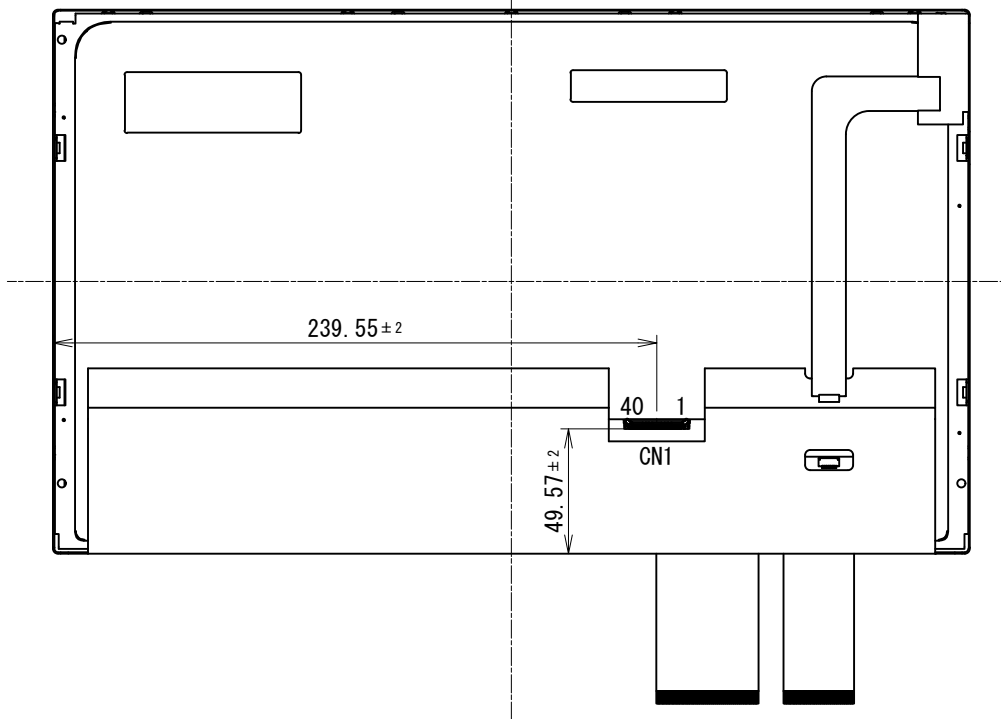
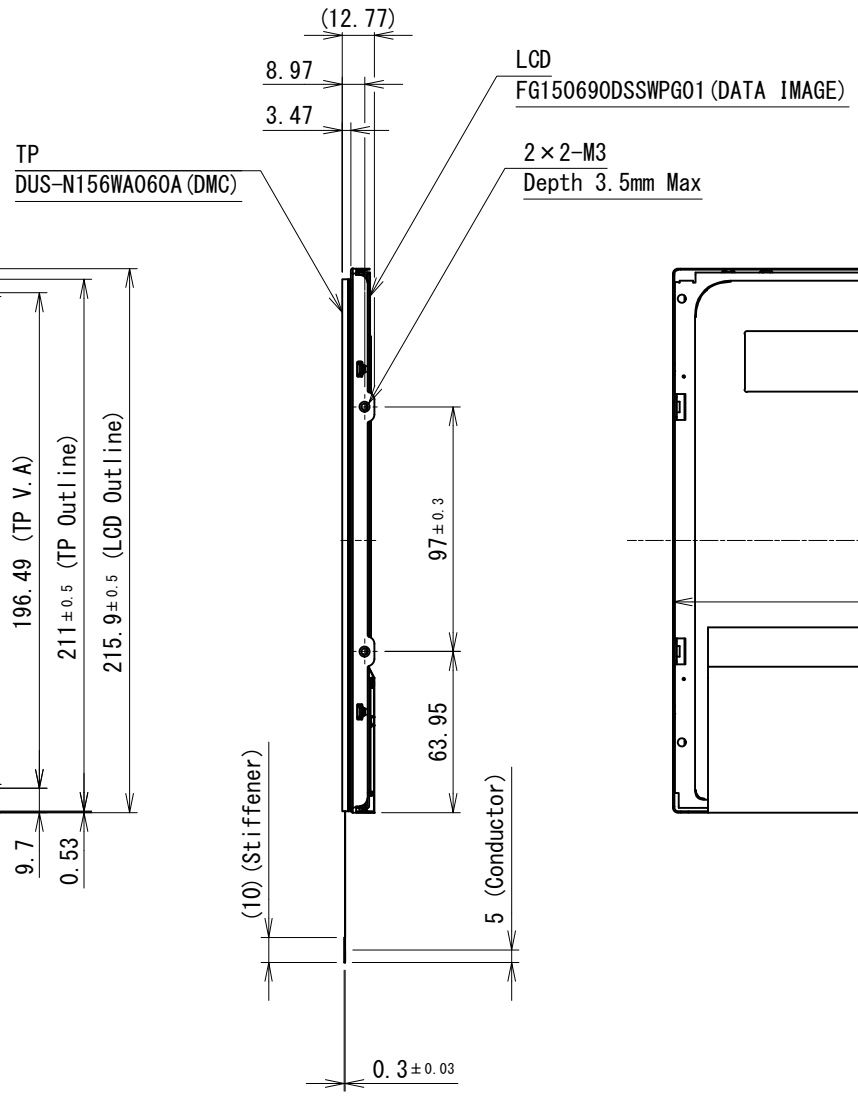
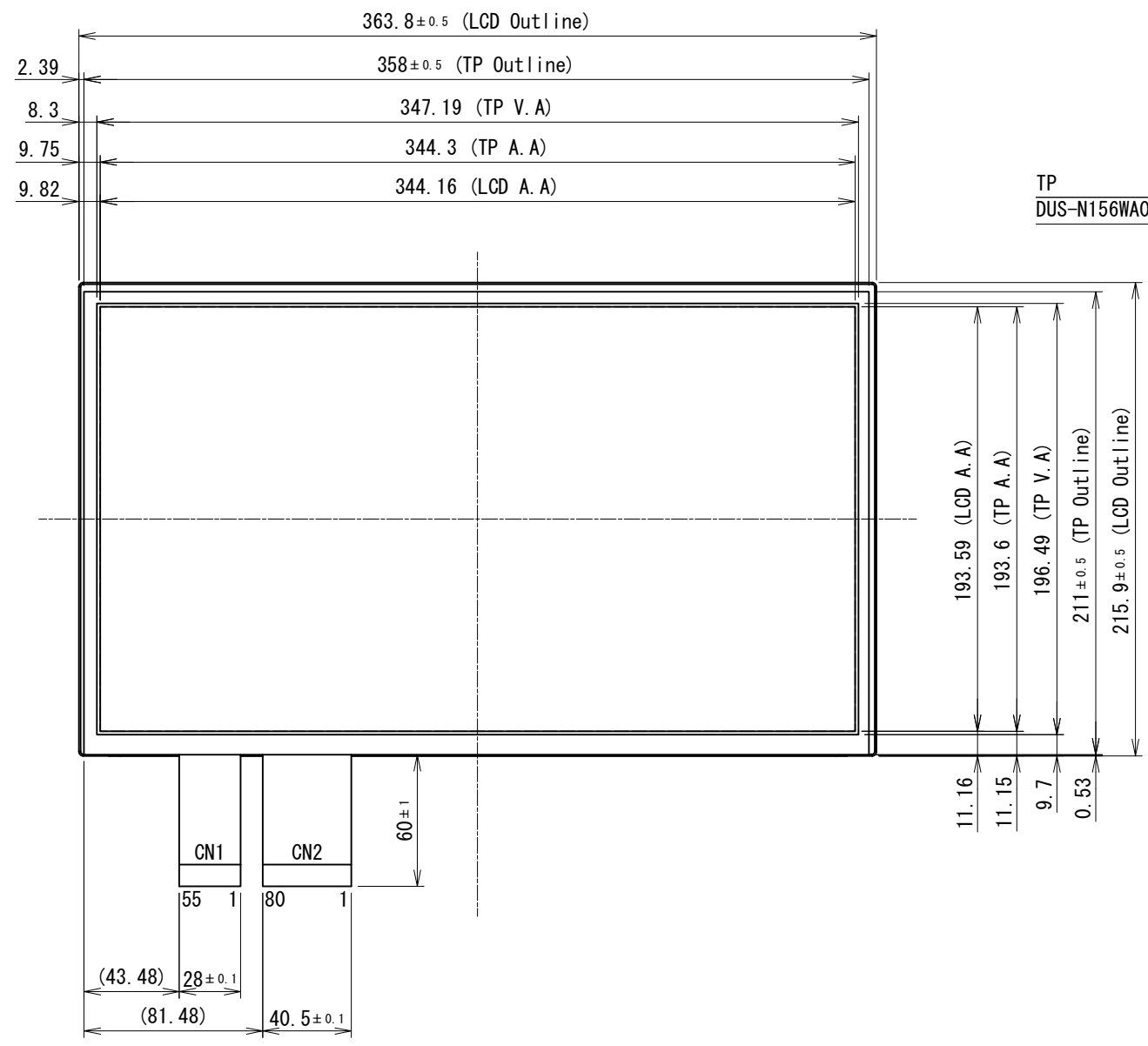
Business hours: 9:00a.m. ~5:00p.m. (Central Time)

URL: <https://www.dush.co.jp/english/>

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SYM	改訂日 DATE	改訂内容 DESCRIPTION	ページ PAGE	担当 DESIGNED
	2023.05.22	新規図面登録	-	S. Takada



- NOTES
- タッチ方式：投影型静電容量方式
Type: Projected Capacitive Touchscreen
 - ITOガラス：厚さ2.35mm
ITO Glass: thickness 2.35mm
 - LCD Connector CN1: 20455-040E-76(I-PEX) or equivalent
 - 指示無き寸法公差は、±0.5mmとする。
Tolerance shall be of ±0.5mm Unless specified otherwise.

製図日 ISSUED	2023.05.22	部署 SECTION	Technical Dept.	尺度 SCALE	CAD登録名 CAD FILE NAME	OUTLINE_TK-SPA156FH-11A3	RoHS対応品 RoHS compliant
承認 APPROVED		検図 CHECKED		1:3	製品名 MODEL	TK-SPA156FH-11A3	
T. Okada		S. Yoshimoto		単位 UNIT	図名 TITLE	OUTLINE	ページ PAGE
		S. Takada		mm	図番 DWG No.	SM3-002372-10	1 / 1
DMC Co., Ltd.			A3				

Glass/Glass Structure Projected Capacitive Touch Screen, Mounting Guidance

Projected capacitive touch screen detects the touched locations by measuring the increased amount of the capacitance value between its electrodes. Once it is built into a system, capacitance couplings are continually yielded among the touchscreen, FPC tail, controller board and metal Chassis.

If surrounding environment changes or materials to alter the electrical field (a large capacitor, power-supply unit, LCD panel, or materials with high dielectric constant) is near, these external factors will adversely affect the function of the touch screen to detect the correct input positions.

At structure design, please refer to the mounting guidance below and ensure enough gap distances among each component in order to avoid the external factors described above.

- Refer to the drawing of the touch screen, and take into account the tolerances at structure design.
- Fix the touchscreen firmly so that the gap distances between the touchscreen and other components will not be affected by touching or will not change with the passage of time. An unexpected input may be caused if the gap is too narrow.
- In case of using capacitive sensor outside, the moisture may cause the trouble.
- In order to avoid the gap distance L1 from being changed with the passage of time, it is recommended to apply the adhesive tape onto all the 4 sides with no space (fully sealed) when gluing the touch screen.

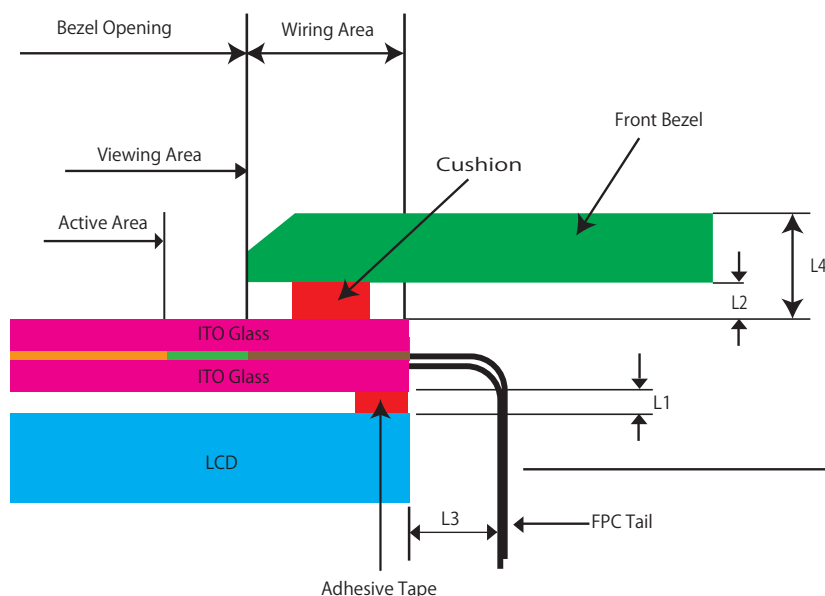
The distance values indicated in this sheet are for reference only.

The appropriate distance values depend on touch screen size, LCD, chassis design and other factors.

Please confirm the appropriate distances with the actual products prior to fixing the chassis design.

Structure with Bezel

- It is recommended to use an insulating resin material for the bezel. Ensure the gap between the touch screen and front bezel (L4)
- If a metal material is used for the bezel, unintended capacitance couplings may occur on the periphery of the active area.
If a metal material is used for bezel, ensure the gap of approximately 2mm between touch screen and bezel (L2).
- In order to avoid the gap distance L1 from being changed with the passage of time, it is recommended to apply the adhesive tape onto all the 4 sides with no space (fully sealed) when gluing the touch screen.



$L4 \geq 2\text{mm}$: Distance between touch screen and bezel surface

$L2 \geq 2\text{mm}$: If the bezel is metal, at least 2mm would be needed between the touch screen and bottom of the bezel.

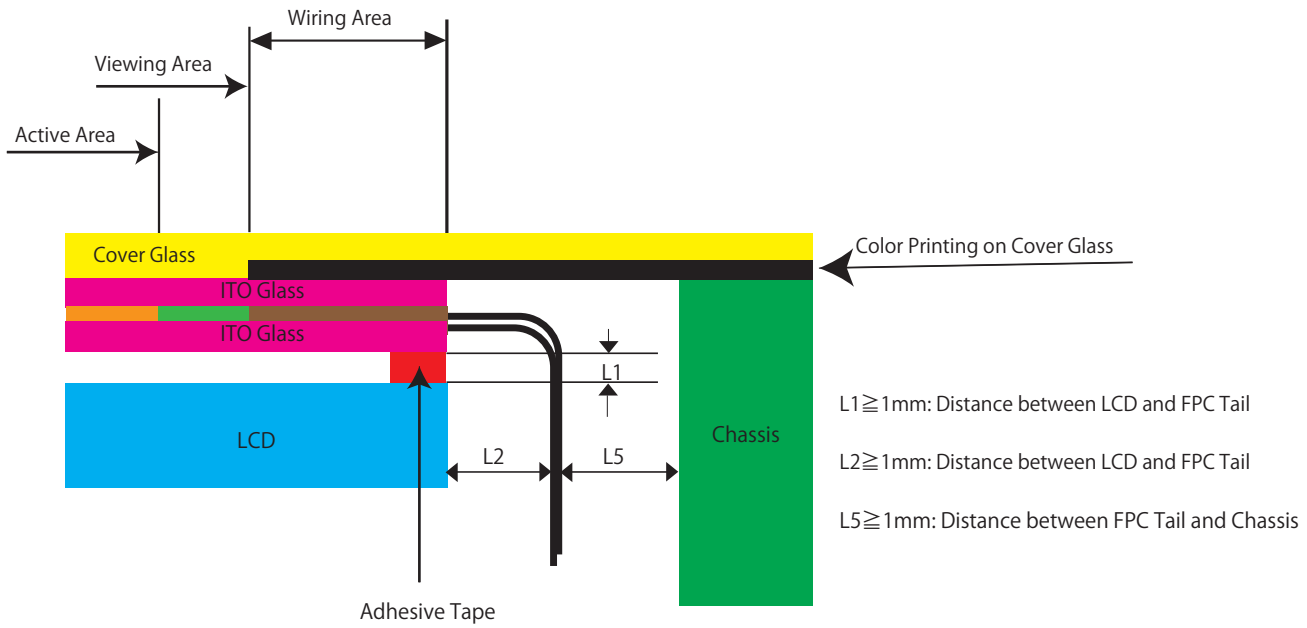
$L1 \geq 1\text{mm}$: Distance between touch screen and LCD bezel

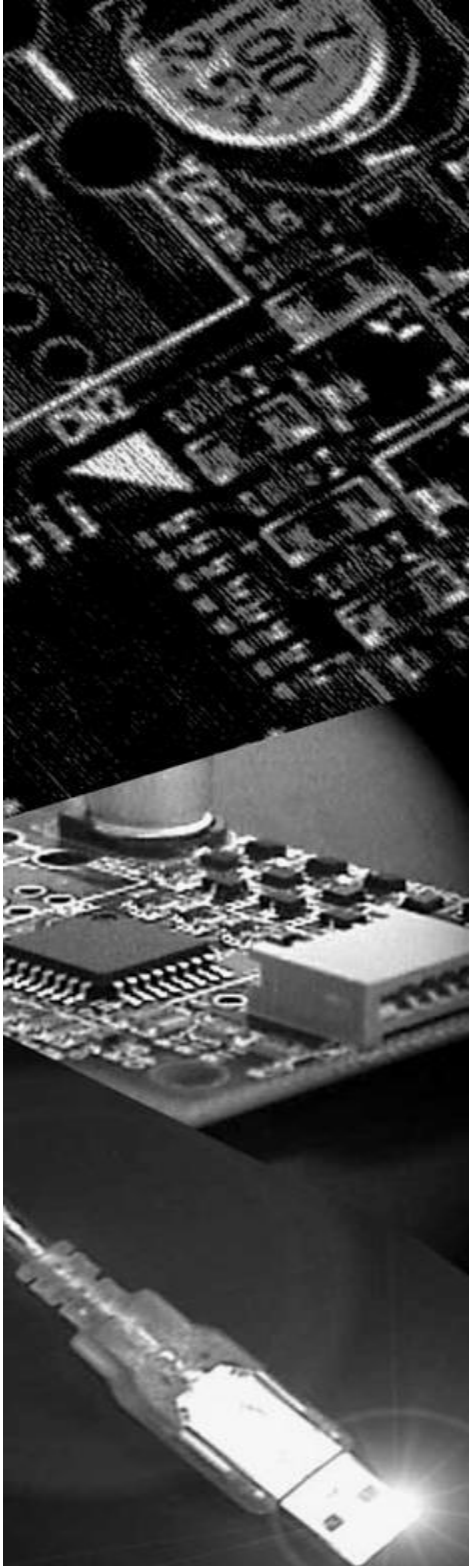
$L3 \geq 1\text{mm}$: Distance between LCD and FPC Tail

The FPC tail must not be forcibly stressed or bent too hard. The conduction in the insulated area and/or wire breaking may be caused. For the specifications of FPC bending, refer to the product specifications of the touch screen.

Flat-surface Structure (Covering glass is needed)

- In order to avoid the gap distance L1 from being changed with the passage of time, it is recommended to apply the adhesive tape onto all the 4 sides with no space (fully sealed) when gluing the touch screen.





DMC Co., Ltd.

**Controller Board for Projected Capacitive Touch Screen
DUS3200 Product Specifications**

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Outline Dimensional Drawing

1. Applicable Product

This specification sheet is applied to DUS3200 touch screen controller board.

2. Product Specification

2.1. Touch Screen Board Specification

Item		Specification	Remark
Touch Detection Principle		Projected Capacitive	
Host Interface		USB Full Speed UART I2C	Compatibility with UART or I2C depends on firmware. Please check with our sales for compatibility.
Input Power-supply Voltage		4.75~5.25[V]	
Driving Voltage		18V	
Operating Temp		-40 [°C] to 85 [°C]	No dew condensation
Storing Temp		-40 [°C] to 85 [°C]	No dew condensation
Main IC		MCU 1 [pc]	
		Sensor IC 2 [pc]	
Number of Electrodes	Electrode (X)	78 (Max)	
	Electrode (Y)	52 (Max)	
Coordinate Performance	Normal Coordinate Number to Output	5 [Finger]	Maximum 20
	Report rate (1 finger)	100 [Hz]	*2
	Report rate (2 finger)	100 [Hz]	*2
	Report rate (2 finger at same axis)	100 [Hz]	*2
	Electrode resolution	256 [1/Electrode]	
	2 finger minimum distance (X)	3.5 [Electrode]	21[mm] @ 6[mm]◇
	2 finger minimum distance (Y)	3.5 [Electrode]	21[mm] @ 6[mm]◇
	Coordinate Accuracy (high accuracy area)	Max ±3.0mm	21.5inches or smaller*1
	Coordinate Accuracy (low accuracy area)	Max ±6.0mm	
	Coordinate Accuracy (high accuracy area)	Max ±5.0mm	21.6inches or larger *1
	Coordinate Accuracy (low accuracy area)	Max ±8.0mm	
	Low accuracy area	3 [Electrode]	Specify 3 areas from the edge
Low Power Mode		USB Suspend mode	
Calibration	Calibration function	Support	
	Calibration Time	Max 10 [sec]	*3

- *1.Touch contact size: $\phi 10$. The indicated coordinate accuracies are performances under a noise-free environment. The accuracy may significantly drop due to extrinsic noises and surrounding environment.
- *2.The indicated values depend on software noise filter and CR values of the sensor glass. This specification is of the operation by normal clock scan.
- *3.Calibration Time varies according to size of the touch screen.

2.2. Host Interface

2.2.1. USB Interface

Item	Specification	Remark
Host Interface	USB 2.0 Full speed 12[Mbps]	
Power supply	Bus-powered	
Power type	High power device	
VendorID/ProductID	0x0AFA / 0x07D7 (At firmware update: 0x0AFA / 0x07D6)	
Power save mode	USB Suspend mode (compliant to USB specification)	Except current.

2.2.2. Serial Interface

Item	Specification	Remark
Host Interface	UART Baud Rate 57.6[Kbps]	
Data bits	8	
Stop bit	1	
Parity check	None	

2.2.3. I2C Interface

Item	Specification	Remark
Slave adress	0x5C	
Transfer speed	400 kbps	Fast mode
Transfer data length	Maximum 255 bits + Length 1 bits	
Slave mode	Single master IC only. Multi-master IC is not supported	

2.3. Electrical Specification

2.3.1. Maximum Absolute Rating

Item	Specification			Unit	Remark
	Min.	Typ.	Max.		
Touch Panel Power Supply	-0.3		6.0	V	

2.3.2. DC Characteristics

Board Consumption Current

Test Condition: TA = 25°C, VCC = 5V

Item	Specification			Unit	Remark
	Min.	Typ.	Max.		
Touch Panel Power Supply	4.75	5.0	5.25	V	
Normal operation mode		95.0		mA	Report rate:100Hz 10 Finger, 23inch USB Vbus
Suspend mode		30.0		mA	

2.3.3. USB Signal (D+, D-) DC Characteristics

Item	Specification			Unit	Remark
	Min.	Typ.	Max.		
Input High Voltage	2.0	-	3.6	V	
Input Low Voltage	-	-	0.8	V	
Output High Voltage	2.8	-	3.6	V	
Output Low Voltage	0	-	0.3	V	

2.3.4. UART Signal (Rx, Tx) DC Characteristics

Item	Specification			Unit	Remark
	Min.	Typ.	Max.		
Input High Voltage (Rx)	2.0	-	3.6	V	
Input Low Voltage (Rx)	-	-	0.6	V	
Output High Voltage (Tx)	2.4	-	3.6	V	
Output Low Voltage (Tx)	-	-	0.4	V	

2.3.5. I2C (SCL, SDA, I2C_INT) DC Characteristics

Item	Specification			Unit	Remark
	Min.	Typ.	Max.		
Input High Voltage	2.0	—	3.6	V	
Input Low Voltage	—	—	0.6	V	
Output Low Voltage	—	—	0.4	V	

SCL, SDA, I2C_INT is output by Open drain.

SCL, SDA, I2C_INT is Pullup on DUS3200. (SCL, SDA=3.3V_4.7kΩ, I2C_INT =3.3V_10kΩ)

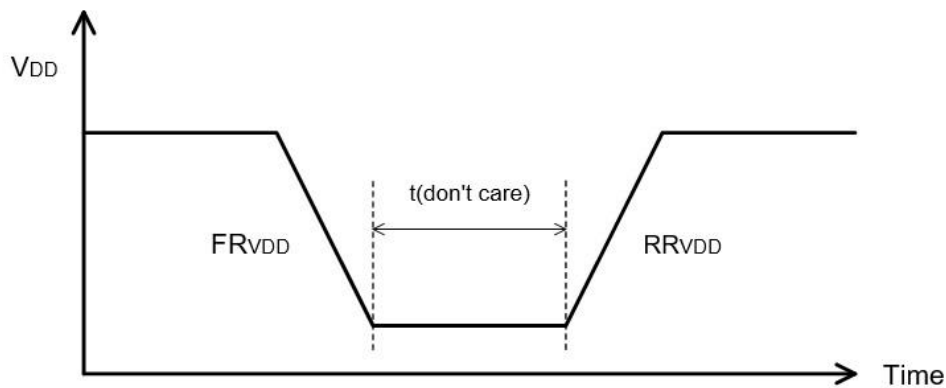
2.3.6. RESETn Signal DC Characteristics

Item	Specification			Unit	Remark
	Min.	Typ.	Max.		
Input High Voltage	2.3	—	3.6	V	
Input Low Voltage	—	—	0.9	V	
Minimum pulse width	1	—	—	ms	

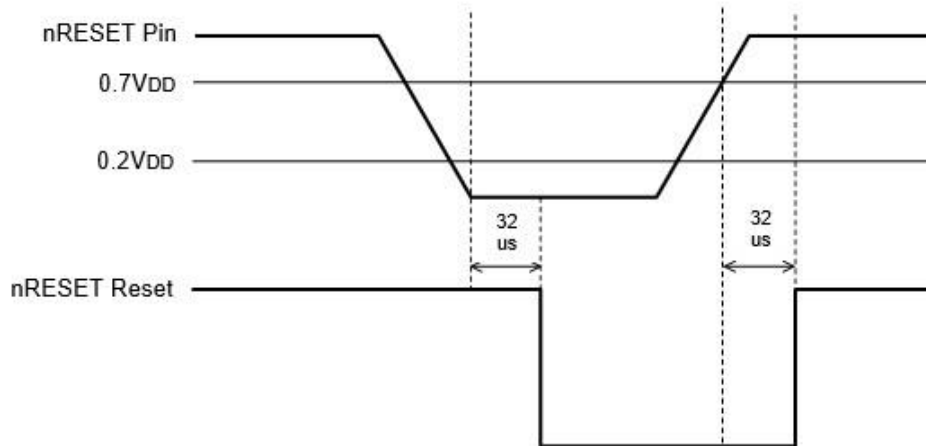
2.4. Timing Requirements

2.4.1. Power-on Reset

Item	Symbol	Specification			Unit	Remark
		Min.	Typ.	Max.		
Temperature	Ta	-40	-	85	°C	
Reset Voltage	VPOR		1.47		V	
VDD Start Voltage	VPOR			100	mV	VDD Start Voltage to Ensure Power-on Reset
VDD Rising Rate	RRVDD	10			us/V	VDD Rising Rate to Ensure Power-on Reset
VDD Falling Rate	RDVDD	320			us/V	VDD Falling Rate to Ensure Power-on Reset

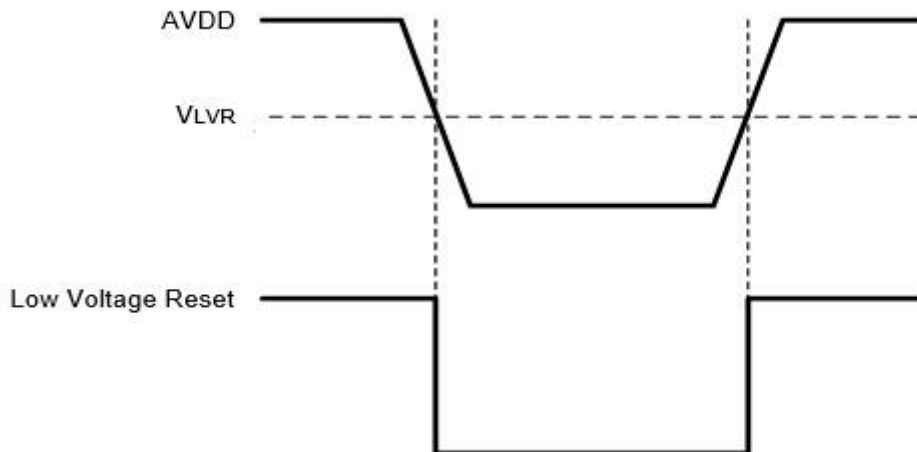


2.4.2. nRESET Reset (External Reset)



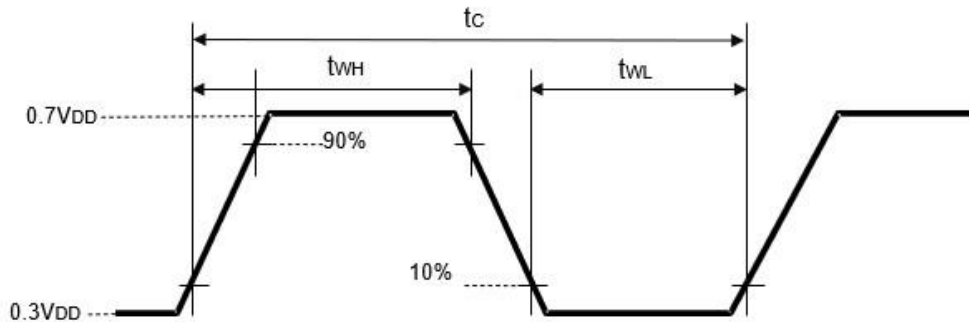
2.4.3. Low Voltage Reset

Item	Symbol	Specification			Unit	Remark
		Min.	Typ.	Max.		
Temperature	T _a	-40		85	°C	
Power-supply Voltage	A _V DD	0	-	3.6	V	
Operating Current	I _{LVR}		0.5		uA	A _V DD = 3.6 V
Threshold Voltage	V _{LVR}	1.40	1.48	1.56	V	T _A = 25 °C



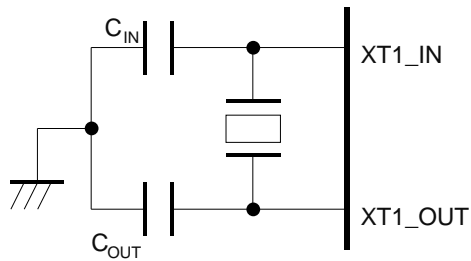
2.4.4. External Clock Timing

Item	Symbol	Specification			Unit	Remark
		Min.	Typ.	Max.		
Input Cycle	t_c		62.5		ns	16MHz
Clock Pulse Width	t_{WH}, t_{WL}	10			ns	

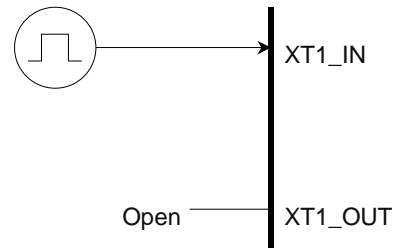


2.4.5. Clock Input Circuit

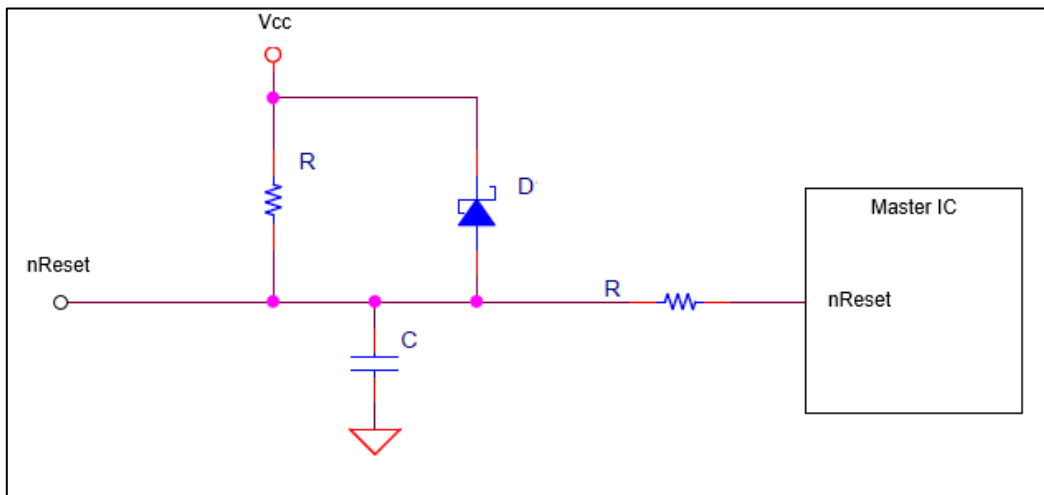
When using a ceramic resonator



External clock input circuit



2.4.6. Input Equivalent Circuit of Reset Signal



2.5. Connector Pin Assignment

2.5.1. Connector Information

Connector Number	Model Number	Maker
CN1	SM06B-SRSS-TB	JST
CN2	SM11B-SRSS-TB	JST
CN4	FH28H-55S-0.5SH	Hirose
CN5	FH28H-80S-0.5SH	Hirose

2.5.2. Connector Terminal

Connector Number	Terminal Number	Terminal Name	Description
CN1	1	VBUS	USB power input
	2	D-	USB D-
	3	D+	USB D+
	4	GND	USB GND
	5	RESETn	Reset Terminal Active Low Minimum Pulse Width 1ms (Connection is unnecessary. It is pulled up within the board.)
	6	GND	Reset GND
CN2	1	ICE_CK	Unused
	2	ICE_DAT	Unused
	3	RESETn	Reset Terminal Active Low Minimum Pulse Width 1ms (Connection is unnecessary. It is pulled up within the board.)
	4	Tx	UART Communication DUS Board → Host Computer
	5	Rx	UART Communication Host Computer → DUS Board
	6	SCL	I2C
	7	SDA	I2C
	8	I2C_INT / GPIO	For Interrupt signal when using I2C
	9	VCC_IN	DC Power Input
	10	ICE_VCC	Unused
	11	GND	Power GND
CN4			Connector for touch sensor, 55 pins
CN5			Connector for touch sensor, 80 pins

3. Precautions

Do not boot the controller while a hand or metal is on the touch panel. It may not work properly after booted.

Operation may become unstable depending on the surrounding environment.

Do not use the controller under environments that affect capacitive values (Possible affecting factor is power supply noise.).

The application tool, TPOffset must be executed in advance of the use of touch screens.

TPOffset, the application software, which can be downloaded from the DMC's website shown in below. It is executable on Windows OS.

DMC's website: TPOffset download page

<https://www.dush.co.jp/english/download/driver-app/>

4. Warranty

4.1. Warranty Period

- § The warranty period is limited to 1 year from the date of shipping. The warranty for the initial deflection such as appearance deflection is limited to 1 month.
- § Any defected parts under proper use will be examined by the supplier and replaced by the new parts if the deflection is considered to be caused by the supplier.
- § The replacement is subject to be included in the next lot.

4.2. Warranty Target

- § The warranty only covers the product itself and does not cover any damage to others caused by using this product. Onsite repair or replacement is not supported.
- § We will do our best for delivery problem and product deflections, but the warranty for the production line is not covered.

4.3. Warranty Exceptions

Following conditions are not covered with the warranty and subject to charge.

- § Any malfunctions and damages during transportation and transfer by the user.
- § Any malfunctions and damages caused by a natural disaster or a fire.
- § Any malfunctions and damages caused by static electricity
- § Any malfunctions and damages caused by the failure of the associated equipment.
- § If the product is remodeled, disassembled or repaired by the user.
- § If the product is glued onto the equipment and uninstalled.
- § Any malfunctions and damages caused by an improper usage and handling against the specifications and notes.

5. Precautions for Use

5.1. General Handling

- § Keep the product away from any conductive objects while in use.
- § Do not touch the conductive part of the product to avoid being damaged by the electrostatic discharge. Follow the proper procedure for handling.
- § Keep the product in the proper storing environment and avoid any load to the product.
- § Do not use or store the product in the severe condition like following:
 - Wet environment or a condition where the product is likely to get wet. Where dew condensation is likely to occur. Near solvent or acid.
- § Do not take apart or alter the product.

5.2. Others

- § The contents of this document are subject to change without notice.
- § The manufacturer or sales representatives will not be liable for any damages or loss arising from use of this product.
- § This product is intended for use in standard applications (computers, office automation, and other office equipment, industrial, communications, and measurement equipment, personal and household devices, etc.) Please avoid using this product for special applications where failure or abnormal operation may directly affect human lives, or cause physical injury or property damage, or where extremely high levels of reliability are required (such as aerospace systems, vehicle operating control, atomic energy controls, medical devices for life support, etc.).
- § Any semiconductor devices have inherently a certain rate of failure. The user must protect against injury, damage, or loss from such failures by incorporating safety design measures into the user's facility and equipment.

6. Version History

Ver1.0 (June 21, 2018)

First release

Ver2.0 (May 28, 2020)

UART interface specifications have been added along with firmware support.

2.1. Touch panel board specifications Changed to standard output coordinates from 10 to 5 (for matching with other models)

2.3.2 The description of DC characteristics, current consumption and maximum current value has been deleted, and the notation has been changed to Typ.

Review the dimensional drawing and layout(There is no change in dimensions)

Ver3.0 (April 16, 2021)

2.1 Touch Screen Board Specification Added note on Host Interface

Revised operating temperature and storage temperature ranges

Revised coordinate accuracy specification values

2.3.2. DC Characteristics Added max values.

2.5.2. Connector Terminal

CN1: RESETn Added "(Connection is unnecessary. It is pulled up within the board)."

CN2: RESETn Added "(Connection is unnecessary. It is pulled up within the board)."

Tx/Rx Deleted "(5V TTL Level)".

3. Precautions Added a sentence

Dimensional Drawing Added components on backside of the board.

Ver4.0 (January 12, 2022)

Specification for I2C interface is added.

Ver5.0 (March 20, 2023)

Added [2.4. Timing Requirements]

DUS3200 Product Specifications
Ver5.0 issued on March 20, 2023
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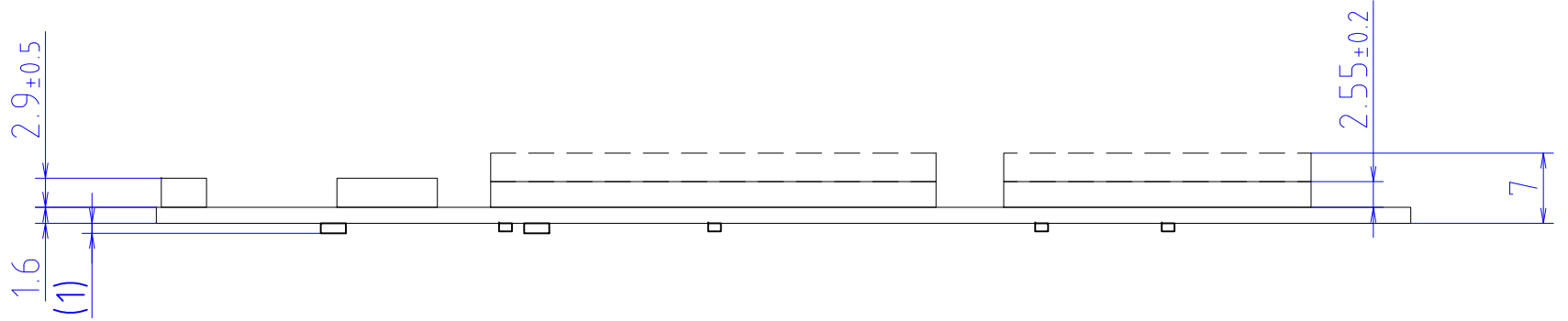
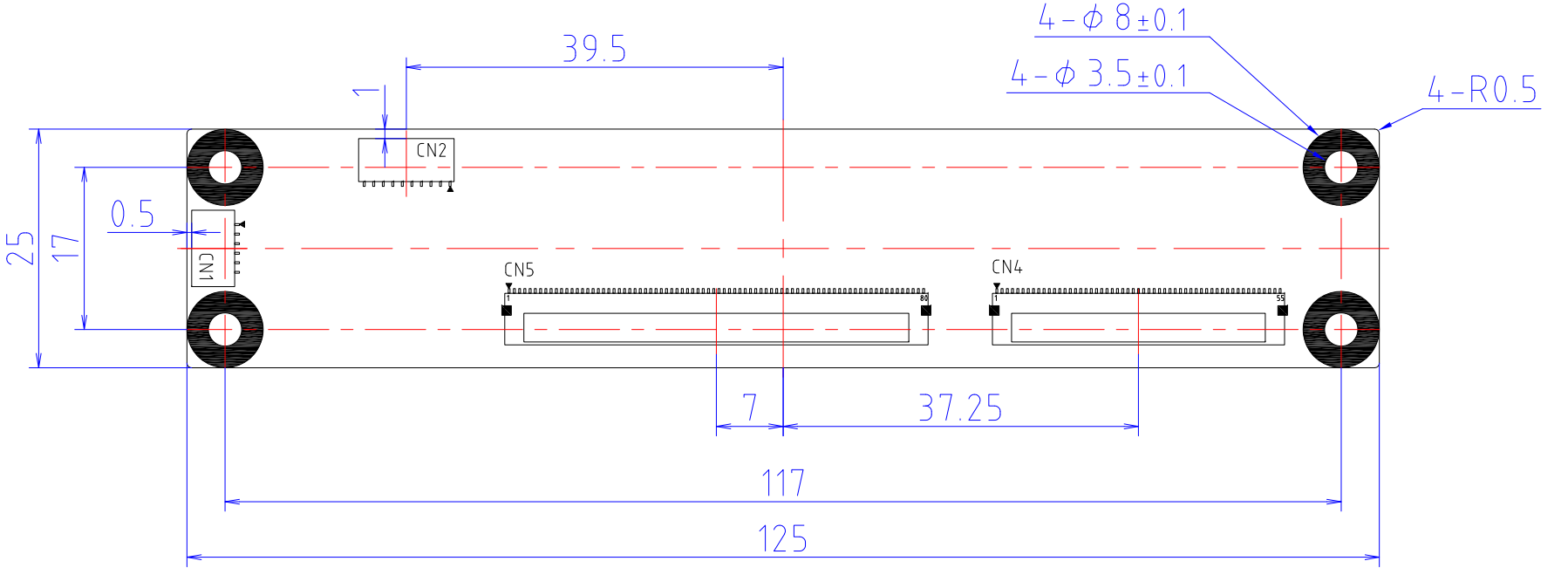


DMC Co., Ltd.

<https://www.dush.co.jp/english/>

11F Takanawa Sengakuji Ekimae Bldg., 2-18-10 Takanawa, Minato-ku, Tokyo 108-0074, Japan

Phone: +81-3-6721-6731 (Japanese), 6736 (English) Fax: +81-3-6721-6732



※ Tolerance: ± 0.3 except for hole diameter
 ※ Material: FR-4
 ※ Mass: Typ. 15g
 ※ Unit: mm

Date	P/N	
January 6, 2021	DUS3200	
Dimensional Drawing		Rev.
DMC Co., Ltd.		2

Appearance inspection standard

LCD Modules with Capacitive Glass Sensor Touchscreen

Document No.	22G4GX-00002E	Page (Cover Excluded)	2
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Revision history

Revision	Date	Person in charge	Page	Description
0	2023/3/10	Imada	—	Initial Preliminary

Appearance inspection standard (1)

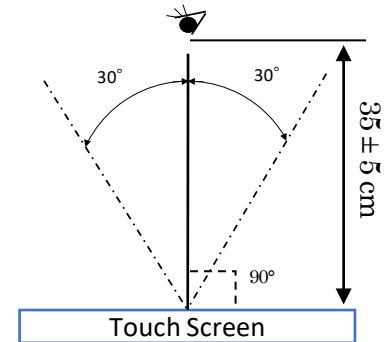
1.1 Inspection condition

Inspection Distance : 35 ± 5 cm

View Angle : Inspection under non-operating condition : $\pm 30^\circ$

Ambient Illumination : 500~2000 lux

Inspection time : 3~5 seconds



1.2 Scratch, dust (W = width, L = length, D = average diameter = (longest + shortest) / 2))

Total defects on each panel.

【 14 inches < Size ≤ 22 inches 】 Within 10 pcs / panel

【 < Size ≤ 14 inches 】 Within 7 pcs / panel

Item	Width(mm)	Length(mm)	Acceptable Numbers
Linear (Foreign substance/scratch/ transparent defects) *1 Defects over 0.2mm in diameter will be judged in circular.	$0.15 < W \leq 0.2$	$L \leq 10$	Up to 4pc per product
	$0.1 < W \leq 0.15$	$L \leq 20$	Up to 6pc per product
	$W \leq 0.1$	Acceptable	Acceptable
Circular (Foreign substance/scratch/ transparent defects) *1	$0.5 < D \leq 0.7$		Up to 1pc per product
	$0.3 < D \leq 0.5$		Up to 6pc per product
	$D \leq 0.3$		Acceptable

*1 Transparent defects mean, e.g. bubble , lint etc...

(Lint is the defect that is different transparent from other part due to the elevating surface by printing over foreign substance.)

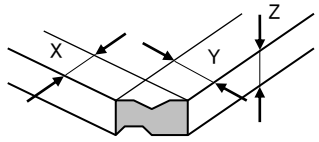
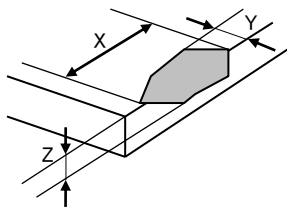
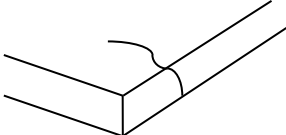
- Stains are acceptable as long as they are not clearly outlined and are not noticeable.
- Applied only in the Viewing Area.

Scratches or dusts in the outside of the Viewing Area are acceptable unless the electrical characteristics are affected.

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Appearance inspection standard (2)

1.3 Chip(cover glass , touch panel) (t = Glass thickness)

Item	Size(mm)		Acceptable Numbers
Corner		X	$1.0 \leq X \leq 2.0$
		Y	$1.0 \leq Y \leq 2.0$
		Z	$\leq t$
Other than at corners		X	≤ 5.0
		Y	$1.0 \leq Y \leq 2.0$
		Z	$\leq t/2$
Progressive Crack			Not acceptable

1.4 Appearance criteria for color-printed area of covering glass (judged from surface view)

Item	Defect contents	Acceptable range	
Color Peeling	Color print coming off	Unacceptable	
Color Lacking	Color print partly missing	Unacceptable	
Color Running	Ink bleed	The defect should not be over edge face	
Scratch	Scratch on color-printed part	Base glass should not be exposed	
Color Unevenness	Color thickness is uneven	Should be no color unevenness that can be easily detected. (should not be detectable by gaze for 4 - 6 seconds)	
Pinhole through to the base glass, Adhering foreign substance which is different color from the printing	a : $0.2 \text{ mm} < D \leq 0.3 \text{ mm}$ b : $D \leq 0.2 \text{ mm}$	Acceptable quantity	Total acceptable quantity
		a : 2pcs in $\phi 30 \text{ mm}$ b : Acceptable	Up to 5pc per product
Tilt/Misalignment	—	Should be within tolerances indicated by the drawing	

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