IDP2040-40A Datasheet

1 Introduction

The IDP2040-40A is a smart display module featuring a 4" TFT LCD panel with a resolution of 480 x 480 and a projected capacitive multi-touch (PCAP) interface. It integrates Bridgetek's proprietary Embedded Video Engine (EVE) Graphic Controller, the BT815, to deliver rich, intuitive, and multi-touch graphic user interfaces. The module is powered by the cost-effective and high-performance Raspberry PI RP2040 microcontroller.

Unlike mobile devices that require regular recharging, this module is designed for installation in accessible locations, powered continuously via an RJ45-JST8 cable connection.

The IDP2040-40A module, featuring the Raspberry Pi MCU RP2040 and the advanced BT815 GPU, is specifically designed for GUI application development. Bridgetek offers extensive software and documentation support, including a Board Support Package (BSP) and tutorials, all accessible through the open-source repository. Additionally, the cutting-edge EVE Screen Designer (ESD) IDE provides a free, codeless, drag-and-drop interface for effortless GUI design.

1.1 Features

- Incorporates Raspberry Pi RP2040 Dual ARM Cortex-M0+ @ 133MHz
- Integrated with advanced BT815 Graphics Controller for enhanced performance
- Features a 4-inch LCD display with 480x480 resolution and Projected Capacitive Multi-Touch (PCAP) support
- Supports 5-point multi-touch for intuitive control with fingers
- RS485 interface for programming and data communication
- Equipped with a built-in buzzer for audio feedback
- Powered by a 24VDC source via an RJ45-JST8 cable.
- Sleek and modern design.

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2 Part Numbers/Ordering Information

Part No.	Description
IDP2040-40A	Intelligent Display Product 4.0 inch with Enclosure
IDA-WB-40A	IDP2040-40A Wall Box Mounting Bracket (Included in the package; optional for additional purchases)
IDA-RC-40A	IDP2040-40A Rear Cover Mounting Bracket (Included in the package; optional for additional purchases)

Table 1 - Part Numbers/Ordering Information

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3 Hardware Features

The IDA2040-40A module features a 4-inch TFT LCD and Capacitive Touch Panel, with dimensions of 89.1mm (L) X 89.1mm (W) X 12mm (T).

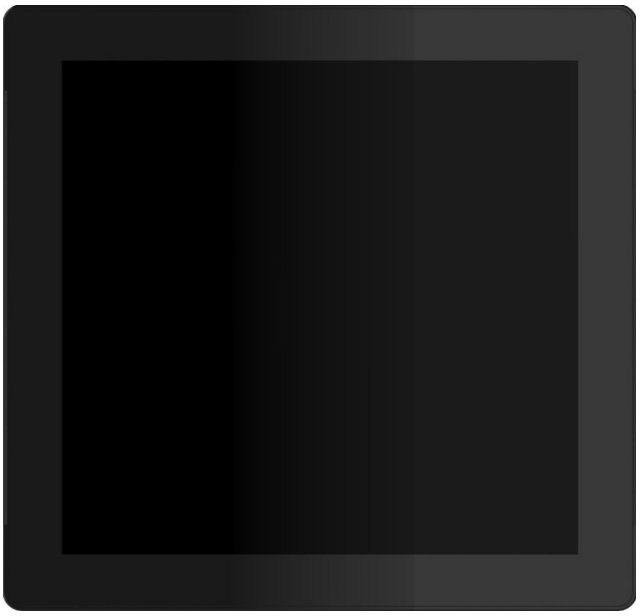

Figure 1 - IDP2040-40A Module Front View

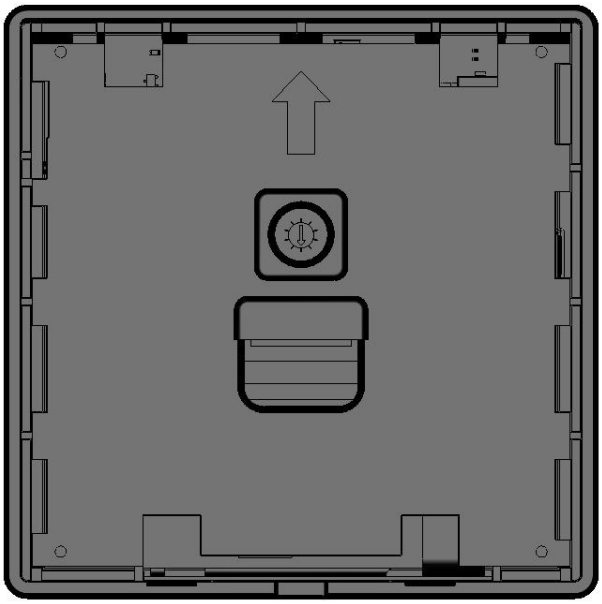

Figure 2 - IDP2040-40A Module Back View

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3.1 PCBA Profile

Dimensions of PCBA: 80mm (L) X 77mm (W) X 1mm (T) with maximum component height of approximately 4mm.

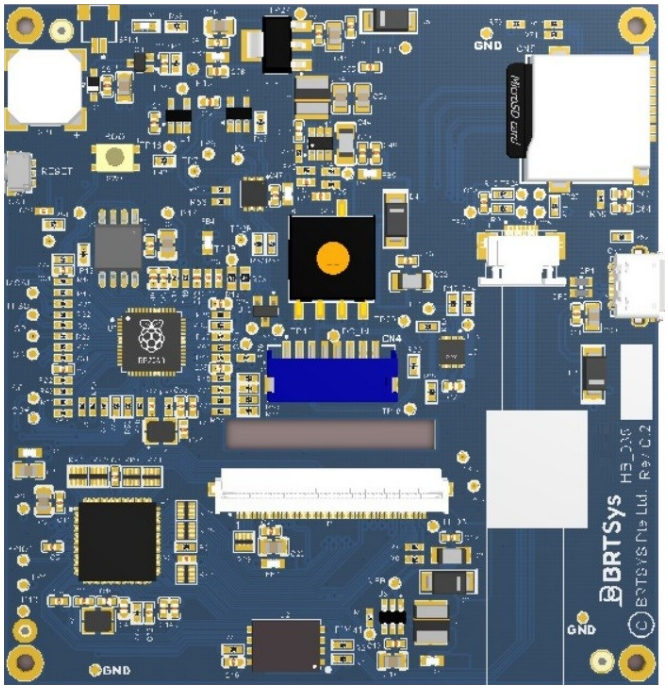

Figure 3 - IDP2040-40A PCBA Front View

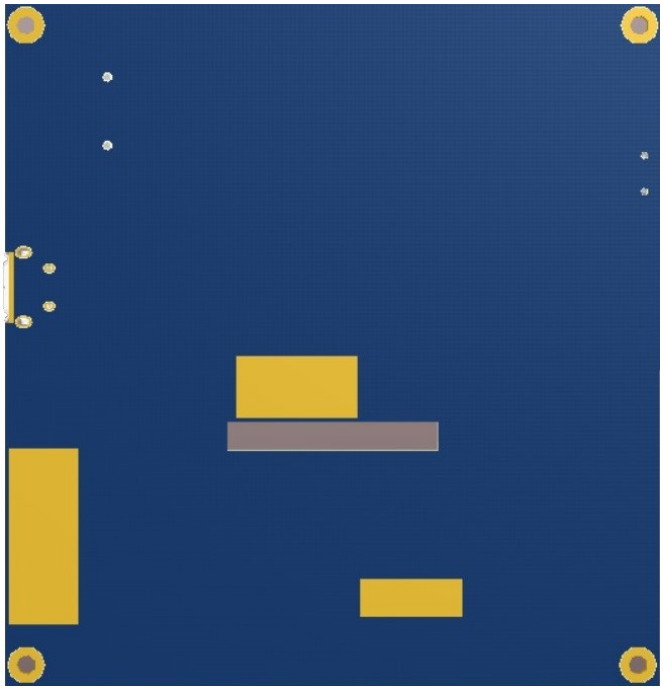

Figure 4 - IDP2040-40A PCBA Back View

3.1.1 IDP2040-40A Key Features

- 4-inch 480 x 480 TFT-LCD panel with capacitive touch panel
- Bridgetek's BT815 EVE chip for graphics, touch and audio control
- Raspberry Pi RP2040 microcontroller
- 8Mbyte NOR Flash with eXecute In Place (XIP) for RP2040 firmware
- 128Mbit NOR Flash connected with BT815 EVE for assets storage
- Micro USB port for communication to RP2040 MCU (and for reprogramming Flash)
- Built-in audio buzzer for sound notifications
- 45-pin 0.5mm pitch FPC connector for inter-connection to LCD panel
- 8-pin 0.5mm pitch FPC connector for inter-connection to capacitive touch panel
- 8-pin 1.5mm pitch JST FPC connector for connection to external host with RS485 interface and input power source
- Micro-SD card socket
- ID switch for assigning a unique ID for device management
- Bootsel button for entering USB device mode
- Hardware reset button

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3.2 PCB Profile

The printed circuit board is a four-layer design incorporating a 90-ohm impedance-controlled trace for USB differential signals, with the following layer stack:

1. Layer 1: Routing & Component placement (Top)
2. Layer 2: Ground Plane
3. Layer 3: Power Plane
4. Layer 4: Routing (Bottom)

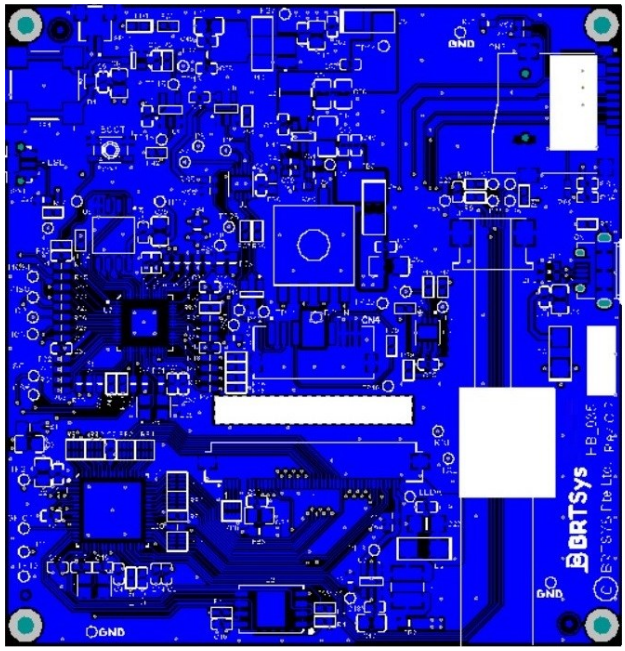

Figure 5 - IDP2040-40A PCB Top Layer

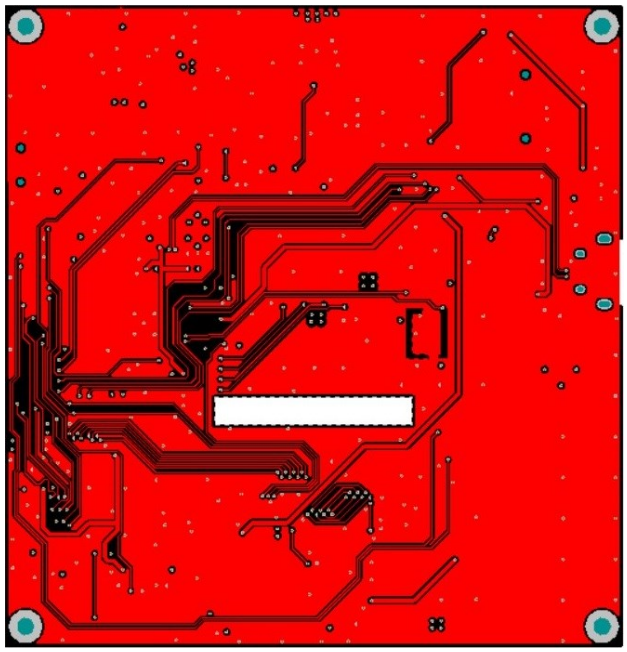

Figure 6 - IDP2040-40A PCB Bottom Layer

3.3 Connectors, Switches and Buttons

The following sections provide details about the connectors, their pin configurations, and the functions of the switches and buttons on the boards.

3.3.1 Mainboard

- **CN1 – Micro-USB Receptacle**

  The micro-USB receptacle enables PC communication with RP2040 MCU and device firmware debug and updates.

- **CN4 – Input Power with RS485 Interface**

  The 8-position, 1.5mm pitch right-angle JST connector provides RS485 interface to external devices and accepts 9V to 24V input power supply from external power source.

Pin No.	Name	Type	Description
1	B/Z	I/O	Negative receiver input, DE = 0; Negative driver output, DE=1
2	A/Y	I/O	Positive receiver input, DE = 0; Positive driver output, DE=1
3	NA	NA	Pin shorted to pin 6
4	DC_IN	P	Input power supply
5	DC_IN	P	Input power supply
6	NA	NA	Pin shorted to pin 3
7	GND	P	Ground
8	GND	P	Ground

Table 2 - CN4 Pinout

- **CN5 - Micro SD Card Connector**

  Supports SPI communication mode with auto card detection.

- **J1 – Capacitive Touch Panel Interface**

  The 8-position 0.5mm pitch top contact FPC connector provides support for LCD panels with capacitive touch function.

Pin No.	Name	Type	Description
1	GND	P	Ground
2	NC	NC	No connection
3	VDD	P	3.3V Output power supply
4	CTP_SCL	I	I2C serial bus, clock line
5	CTP_SDA	I/O	I2C serial bus, data line
6	CTP_INT#	I	Interrupt input from CTP
7	CTP_RST#	O	Reset output to CTP
8	GND	P	Ground

Table 3 - CN3 Pinout

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- **J2 – LCD Panel Interface**

This 45-position, 0.5mm pitch bottom-contact FPC connector from Molex is used for inter-connection to the 4” LCD panel. The manufacturer's part number for this connector is "5051104591."

Pin No.	Name	Type	Description
1	NC	NA	No Connection
2	NC	NA	No Connection
3	NC	NA	No Connection
4	NC	NA	No Connection
5	GND	P	Ground
6	GND	P	Ground
7	VDD_3V3	P	3.3V power supply
8	VDD_3V3	P	3.3V power supply
9	NC	NA	No Connection
10	S_MOSI	O	SPI master out slave in signal
11	S_SCK	O	SPI serial clock output
12	S_SSn1	O	SPI chip select signal
13	DISP	O	LCD display enable
14	LCD_R7	O	Bit 7 of red channel in the RGB signal
15	LCD_R6	O	Bit 6 of red channel in the RGB signal
16	LCD_R5	O	Bit 5 of red channel in the RGB signal
17	LCD_R4	O	Bit 4 of red channel in the RGB signal
18	LCD_R3	O	Bit 3 of red channel in the RGB signal
19	LCD_R2	O	Bit 2 of red channel in the RGB signal
20	LCD_R1	O	Bit 1 of red channel in the RGB signal
21	LCD_R0	O	Bit 0 of red channel in the RGB signal
22	LCD_G7	O	Bit 7 of green channel in the RGB signal
23	LCD_G6	O	Bit 6 of green channel in the RGB signal
24	LCD_G5	O	Bit 5 of green channel in the RGB signal
25	LCD_G4	O	Bit 4 of green channel in the RGB signal
26	LCD_G3	O	Bit 3 of green channel in the RGB signal
27	LCD_G2	O	Bit 2 of green channel in the RGB signal
28	LCD_G1	O	Bit 1 of green channel in the RGB signal
29	LCD_G0	O	Bit 0 of green channel in the RGB signal
30	LCD_B7	O	Bit 7 of blue channel in the RGB signal
31	LCD_B6	O	Bit 6 of blue channel in the RGB signal
32	LCD_B5	O	Bit 5 of blue channel in the RGB signal
33	LCD_B4	O	Bit 4 of blue channel in the RGB signal
34	LCD_B3	O	Bit 3 of blue channel in the RGB signal
35	LCD_B2	O	Bit 2 of blue channel in the RGB signal
36	LCD_B1	O	Bit 1 of blue channel in the RGB signal
37	LCD_B0	O	Bit 0 of blue channel in the RGB signal
38	DE	O	LCD data enable
39	LCD_PCLK	O	LCD pixel clock

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40	HSYNC	O	LCD horizontal sync
41	VSYNC	O	LCD vertical sync
42	NC	NA	No Connection
43	LEDK	P	LED Cathode
44	NC	NA	No Connection
45	LEDA	P	LED Anode

Table 4 - J2 Pinout

3.3.2 Switches and Buttons

- **SW1** is hardware reset button to reset RP2040 MCU.
- **SW2 i**s a 10-position rotary switch use for configuring a unique ID for the module.
- **SW3** is the BOOTSEL button to put RP2040 MCU into programming mode to program firmware into the 8MB flash memory connected to QSPI bus.

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4 Board Schematics

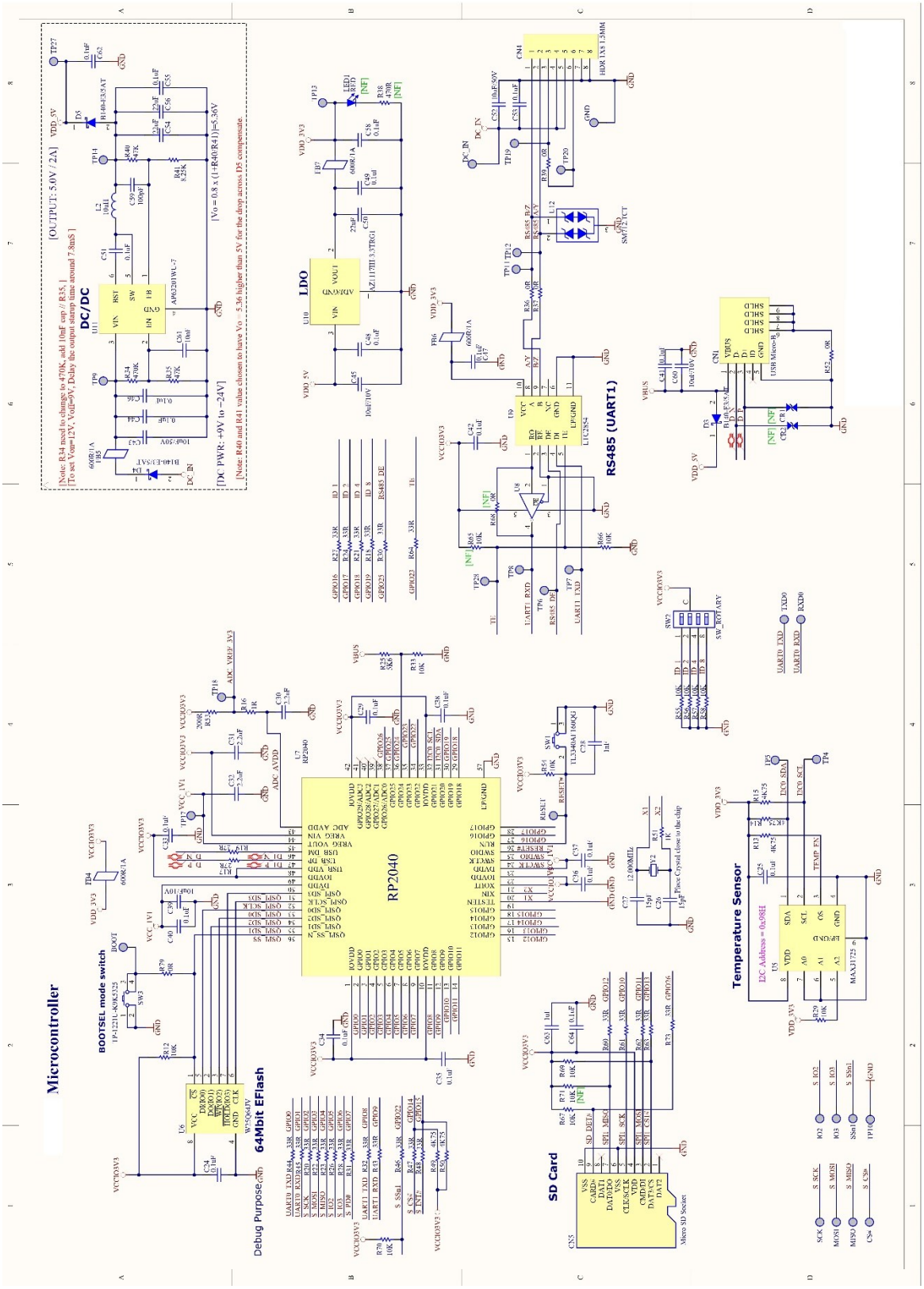

Figure 7 - Power Circuit & Microcontroller

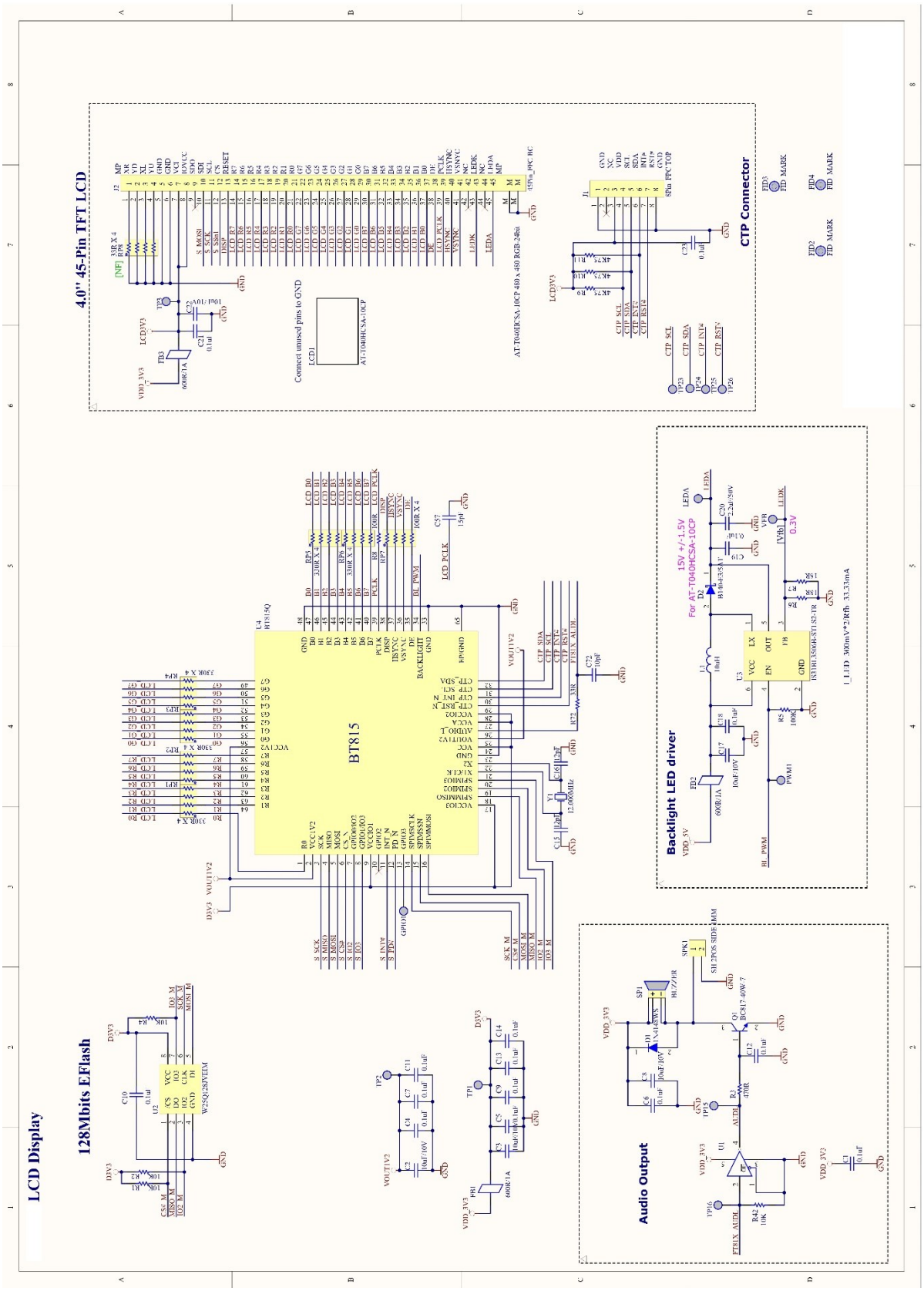

Figure 8 - BT815 EVE Graphic Controller

5 Device Description and Configuration

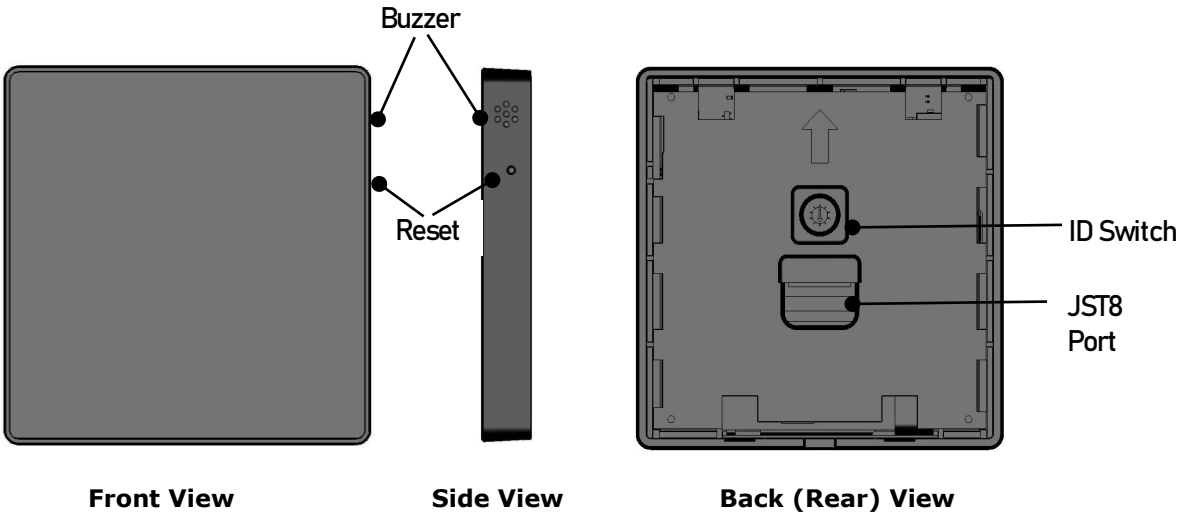

Figure 9 - IDP2040-40A Hardware Features

5.1 Power Supply

Power is delivered through the JST8 port located on the back of the IDP2040-40A display module. The supply voltage is 24V DC, with a nominal operating current of approximately 100mA. Users should use a power source with a minimum capacity of 3W.

5.2 Microcontroller

Raspberry Pi RP2040 microcontroller unit used in the module has the following key features:

- Dual ARM Cortex-M0+ @ 133MHz
- 264kB on-chip SRAM in six independent banks
- Support 8MB of on-board Flash memory via dedicated QSPI bus
- Micro-USB port supporting USB2.0 Full-speed device function; reprogramming the Flash can be achieved by simply dragging and dropping a file onto the RP2040 which appears as a mass storage device.
- 26 multi-function 3.3V General Purpose I/O (GPIO) with 23 GPIOs being digital-only and 3 ADC-capable GPIOs.
- 3-pin ARM Serial Wire Debug (SWD) port; the standard Serial Wire Debug (SWD) port can reset the system and load and run code without any button presses as well as for debugging purpose.

For full details of the Raspberry Pi RP2040 MCU, please refer to the RP2040 Datasheet.

5.3 Graphic Controller

The IDP2040-40A utilizes Bridgetek's third-generation Advanced Embedded Video Engine (EVE) BT815, offering high-resolution graphics and video playback to create high-quality Human Machine Interfaces (HMIs). In addition to graphics, it supports touch screen interface and features sigma delta audio out.

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5.4 JST8 Port

Power and data are provided through the 8-position JST connector located at the rear of the display module, which interfaces with an external host controller via RS485. The product package includes a JST8-RJ45 cable for connecting the display module to external devices.

Figure 10**Error! Reference source not found.** and Table 5 illustrates the pin orientation and functions of the 8-position JST connector.

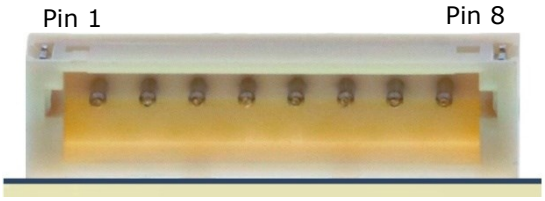

Figure 10 - JST8 Port Pin Orientation

Pin Number	1	2	3, 6	4, 5	7, 8
Function	RS485 B/Z	RS485 A/Y	Detection	DC24V IN	GND

Table 5 - JST8 Port Pin Function

5.5 Reset Button

The IDP2040-40A module includes a built-in device reset function. The reset button is located at the side of the display module, beneath the buzzer openings, and can be activated by pressing through the hole.

5.6 ID Switch

The ID switch on the back of the display can be configured with custom settings or left at the factory default value of zero.

5.7 Buzzer

The built-in buzzer is used to configure touch sounds, providing audible feedback so users can perceive and confirm their touch interactions with the display.

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5.8 JST8-RJ45 Cable

A 5-meter JST8-RJ45 cable, which functions as both the input supply source and RS485 interface to the external host, will be included in the package.

One end of the cable consists of a JST 1.5mm 8-position receptacle while the other end is fitted with a standard RJ45 plug.

Figure 11 and Table 6 illustrates the pin orientation and functions of the JST receptacle and RJ45 plug.

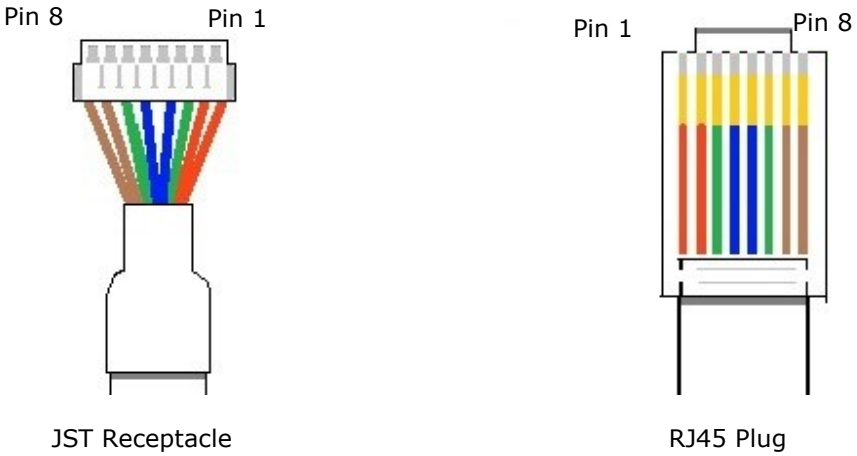

Figure 11 - JST8-RJ45 Cable Pin Orientation

Pin Number	1	2	3, 6	4, 5	7, 8
Function	RS485 B/Z	RS485 A/Y	Detection	DC24V IN	GND

Table 6 - JST8-RJ45 Cable Pin Function

The JST receptacle connects to the IDP2040-40A module, facilitating communication with an external host and receiving power from it. The RJ45 cable links to the external host, enabling both data transmission and power delivery. Other than incorporating an RJ45 socket with integrated power source in their design, developers can also achieve this by using a widely available Power-over-Ethernet (PoE) splitter. Below are some PoE splitters purchase link from global distributor/ online marketplace:

- PoE Splitter - Digikey
- PoE Splitter- AliExpress

Please refer to Figure 12 for connection while using the PoE splitter.

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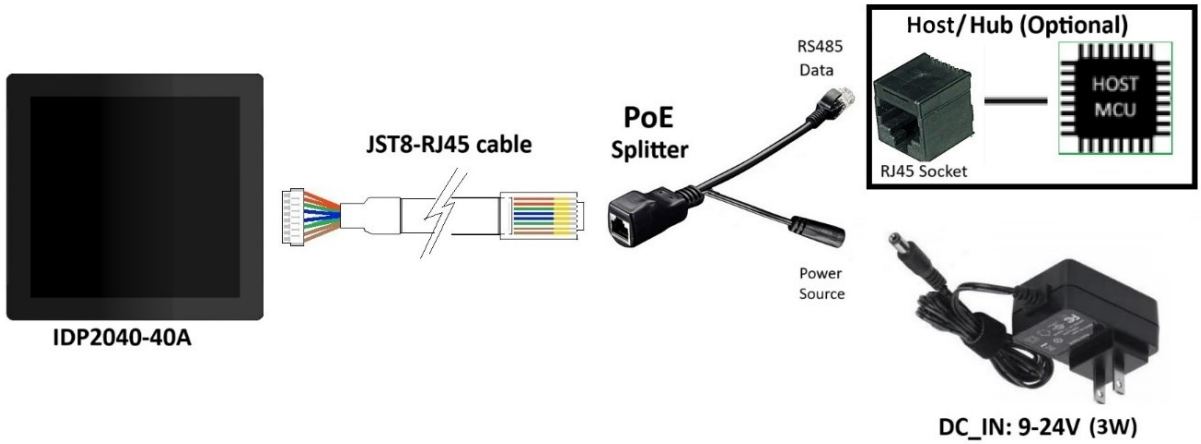

Figure 12 - IDP2040-40A Connection to Host with Use of PoE Splitter

Note: PoE splitter and DC power adapter not included in package.

6 Specifications

6.1 Electrical Specifications

Parameter		MIN	TYP	MAX	UNIT
DC_IN	Input voltage range	9	24.0	28	V
VCC3V3	Output voltage range	3.0	3.3	3.6	V
Icc_24V	Operating current, DC_IN=24V: Normal Operating current, DC_IN=24V: Screen Timeout	- -	70 50	- -	mA
V_{OD}	Differential Driver Output Voltage RL = ∞, V_{CC}=3V (Figure 13) RL = 27Ω, V_{CC}=3V (Figure 13) RL = 50Ω, V_{CC}=3.13V (Figure 13)	- 1.5 2	- - -	V_{CC} V_{CC} V_{CC}	V
ΔV_{OD}	Change in Magnitude of Driver Differential VOUT for Complementary Output States RL = 27Ω or R = 50Ω (Figure 13)	-	-	0.2	V
V_{OC}	Driver Common-Mode VOUT RL = 27Ω or R = 50Ω (Figure 13)	-	-	3	V
ΔV_{OC}	Change in Magnitude of Driver Common-Mode VOUT for Complementary Output States RL = 27Ω or R = 50Ω (Figure 13)	-	-	0.2	V
Temperature	Operating temperature Storage temperature	0 0	- -	55 60	℃

Table 7 - Operating Voltage and Current

TEST CIRCUITS

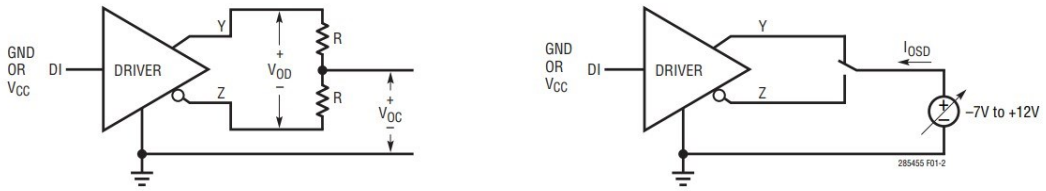

Figure 13 - DC Driver Test Circuits

6.2 Optical Specifications

Item	Symbol		Condition	Min.	Typ.	Max.	Unit
Brightness	Bp		θ=0° Φ=0°	-	800	-	Cd/m^2
Uniformity	⊿Bp			80	-	-	%
Viewing Angle	3:00		*Cr≥10*	-	80	-	Deg
	6:00			-	80	-	
	9:00			-	80	-	
	12:00			-	80	-	
Contrast Ratio	Cr		θ=0° Φ=0°	640	800	-	-
Response Time	Tr +Tf			-	30	40	ms
Color of CIE Coordinate	W	x	θ=0° Φ=0°	Typ -0.05	0.290	Typ +0.05	-
		y			0.344		-
	R	x			0.647		-
		y			0.317		-
	G	x			0.275		-
		y			0.582		-
	B	x			0.140		-
		y			0.088		-
NTSC Ratio	S			55	60	-	%

Table 8 - Optical Specifications

Note: The parameter is slightly changed by temperature, driving voltage and material.

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7 Mechanical Dimensions

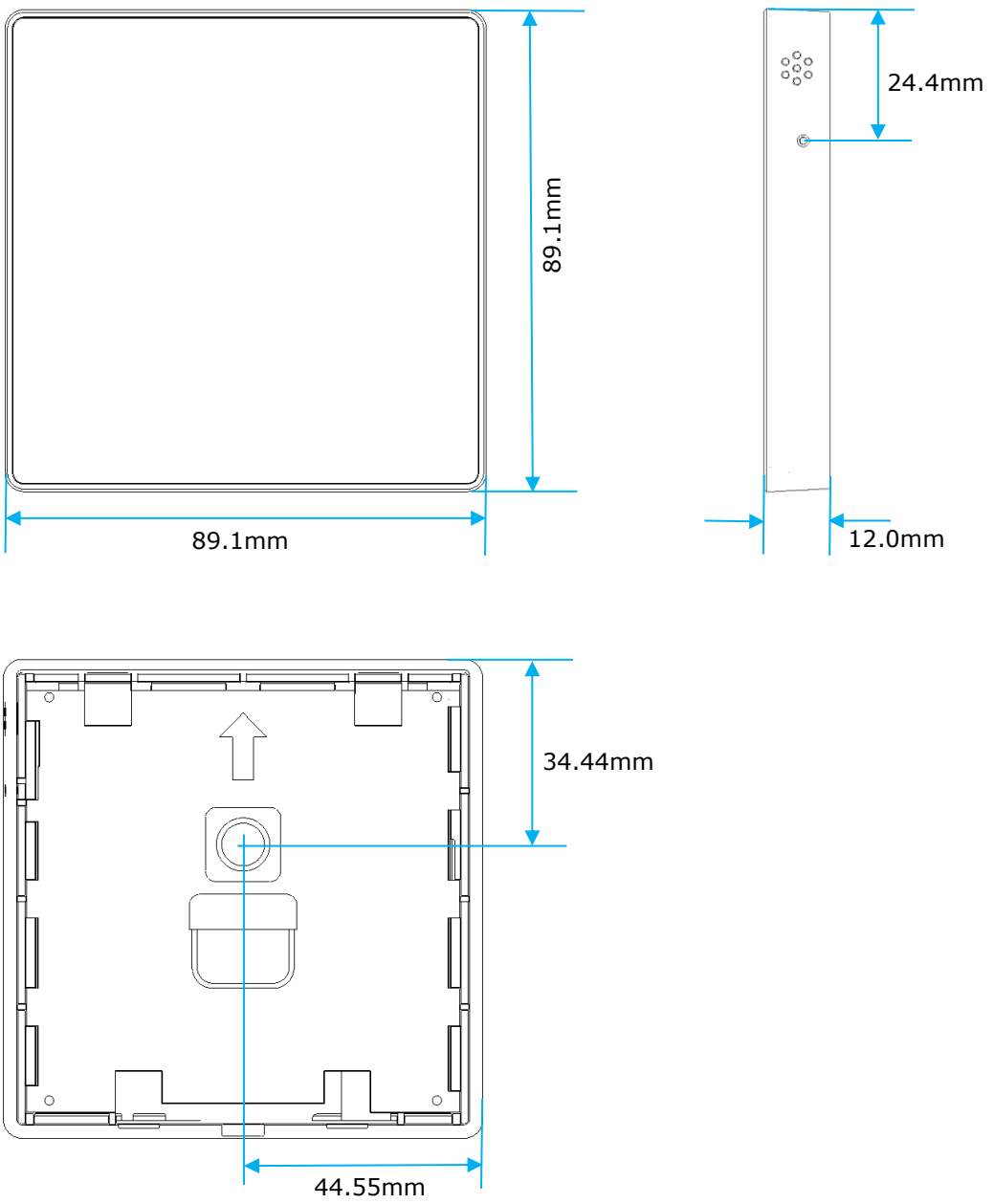

Figure 14 - IDP2040-40A Display Module Dimensions

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Figure 15 below shows:

a) dimensions of slots and screw holes on the rear cover relative to the center of the cover.

b) dimensions of device with rear cover attached.

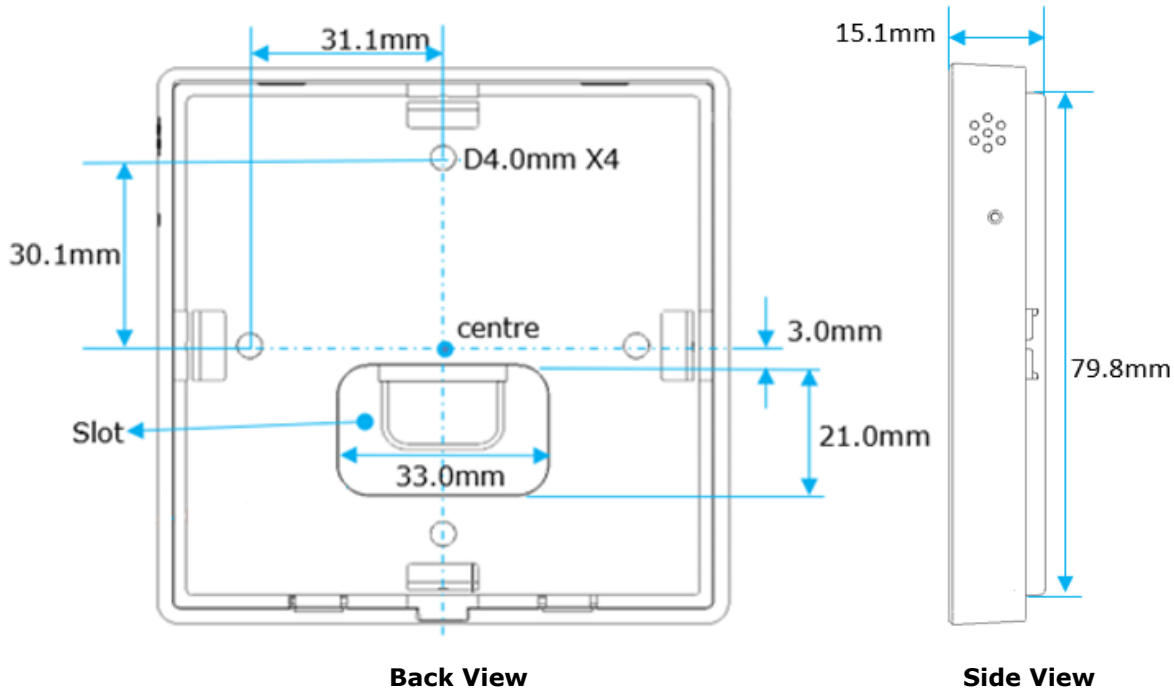

Figure 15 - Rear Cover's Slots and Screw Holes Dimensions

Figure 16 below shows:

a) dimensions of slots and screw holes of Wall-Box's Mounting Bracket relative to bracket's center

b) dimensions of module when fitted with Wall-Box's Mounting Bracket

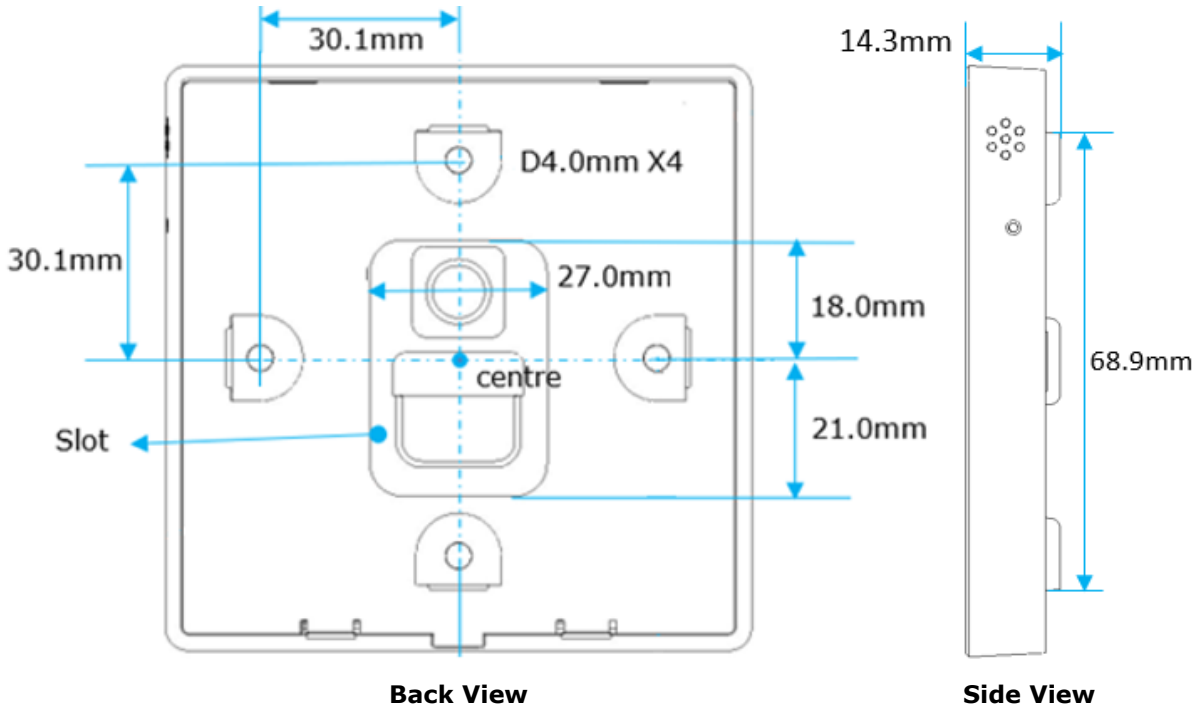

Figure 16 - Wall-Box's Mount Bracket Slots and Screw Holes Dimensions

8 Package Contents, Assembly and Mounting Guide

The following section details the contents of the IDP2040-40A package, the assembly of the display module, and the device mounting procedure.

8.1 Package content

Table 9 below lists the contents included in the IDP2040-40A package.

Sl.No.	Description	Quantity
IDP2040-40A Display Module		
1	Display Module including: LCD, CTP and PCBA *Note 1	1
2	Enclosure *Note 1	1
Mounting Accessories		
3	Wall Box Mounting Bracket *Note 2	1
4	Rear Cover Mounting Bracket *Note 2	1
5	Glass mount cover sheet	1
6	Double sided tape for Glass mount	2
Cable		
7	RJ45 to JST8 cable, 5-meter	1

Table 9 - Package Contents

Note:

1. Refer to Figure 17 for an image of the parts.
2. These brackets can be purchased separately as an optional add-on. See Table 1 for part numbers.

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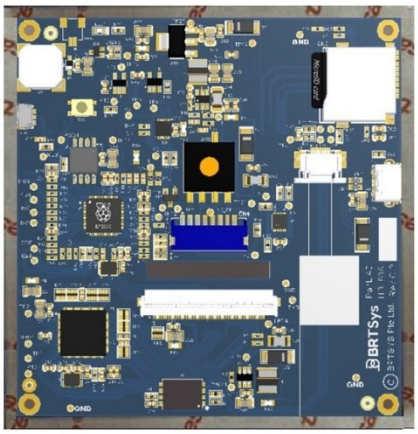
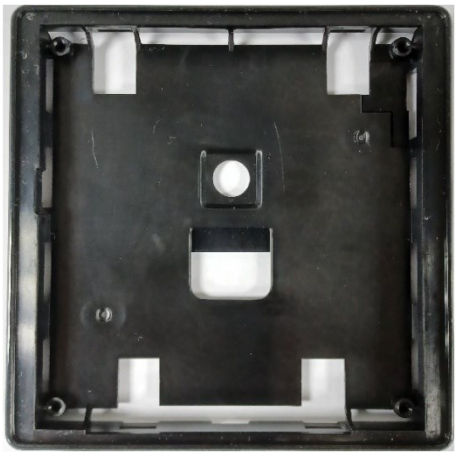
8.2 Module Assembly

Before assembly, ensure the firmware is correctly programmed, the unit is fully tested, and the SD card (if applicable) is inserted. Removing the casing will damage the double-sided tape use to secure the display module to enclosure.

Figure 17 shows IDP2040-40A display module parts and assembly structure, follow the steps below for module assembly.



Display Module



Enclosure

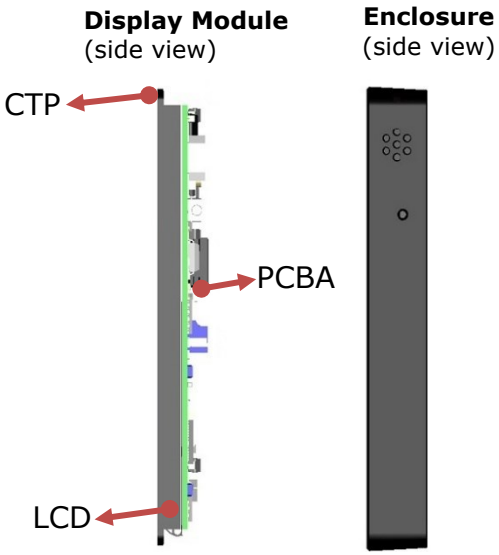


Figure 17 – Display Module and Assembly Structure

Place the display module face down on a clean, smooth surface to prevent scratching the LCD panel. Next, remove the double-sided tape around CTP by the pull-tapes indicated in Figure 18.

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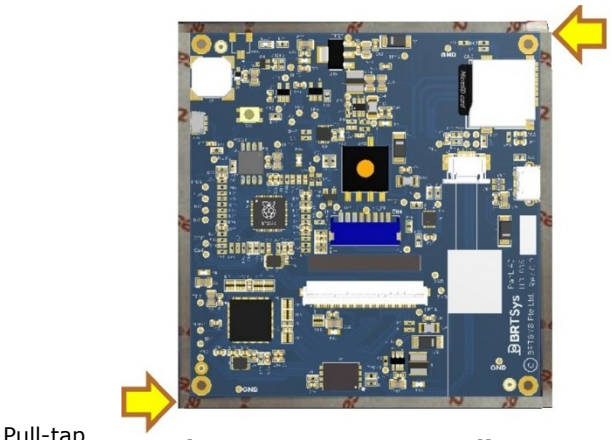

Figure 18 - Remove pull tape

Position the enclosure over the display module, making sure it's properly oriented as shown in Figure 19.

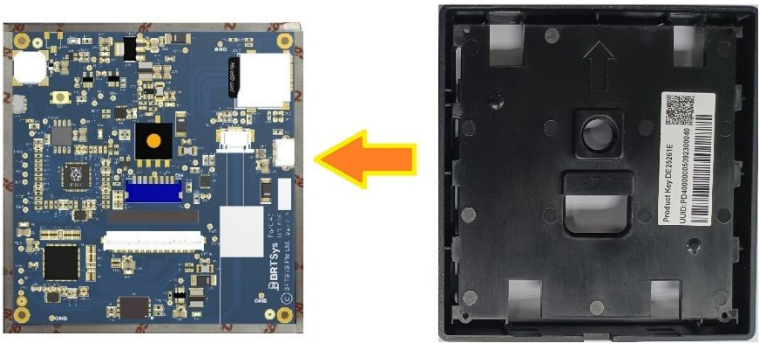

Figure 19 - Display Module and Enclosure Orientation

Press firmly on the areas shown in Figure 20 to secure enclosure to the CTP.

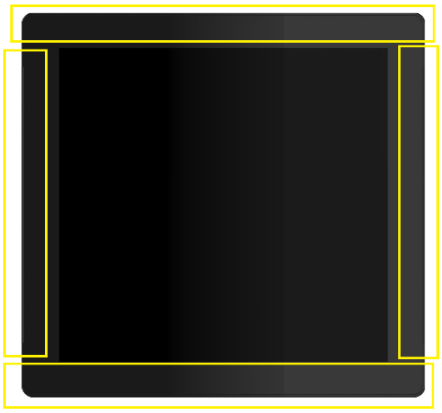

Figure 20 - Securing enclosure to CTP

8.3 Mounting Guide

The IDP2040-40A package includes accessories designed to facilitate the mounting of the display module and connecting it to external devices. It supports four mounting options:

1. Wall mount
2. Glass mount
3. Electrical Box mount
4. Wall Box mount

The following section demonstrates these mounting options.

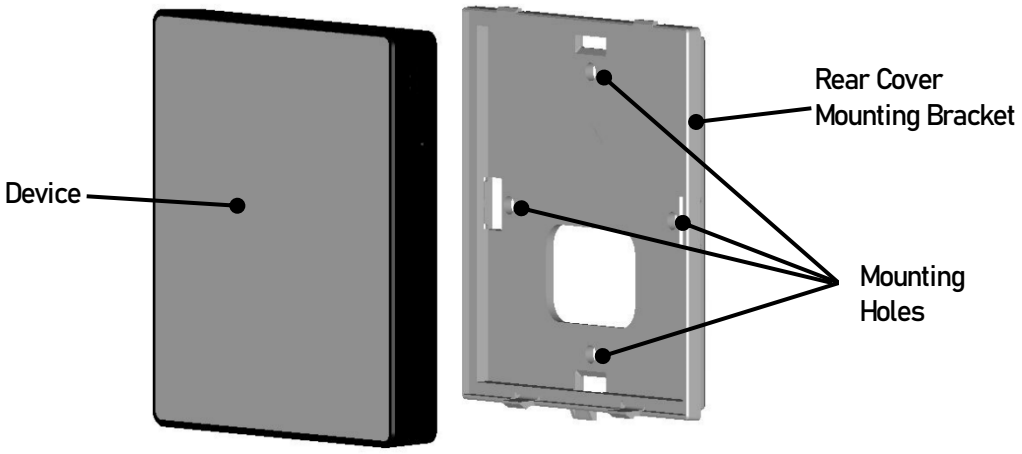

Figure 21 -Wall Mounting

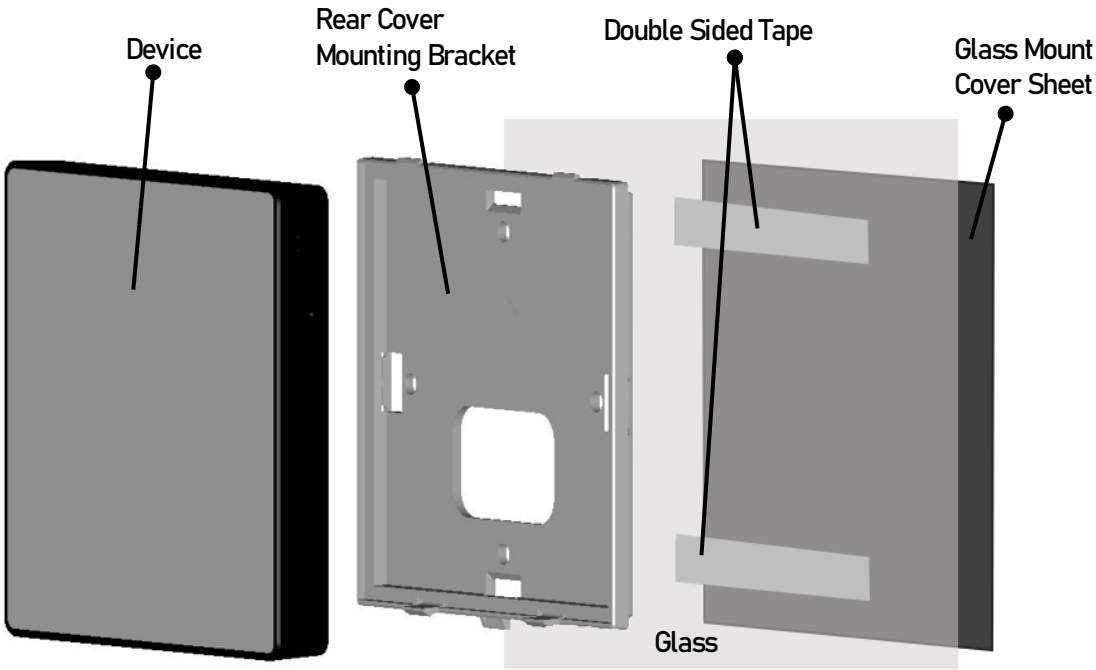

Figure 22 - Glass Mounting

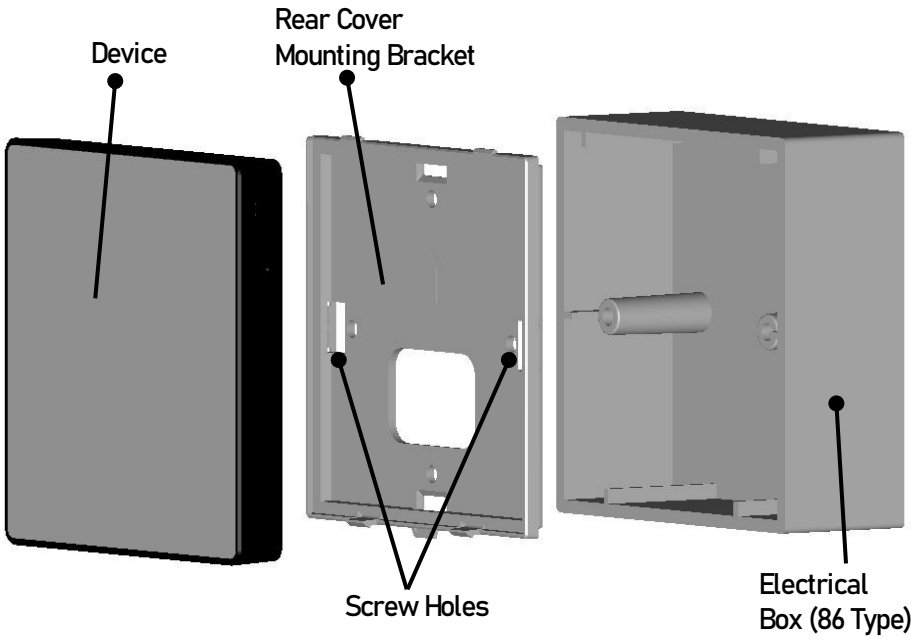

Figure 23 - Electrical Box (86 Type) Mounting

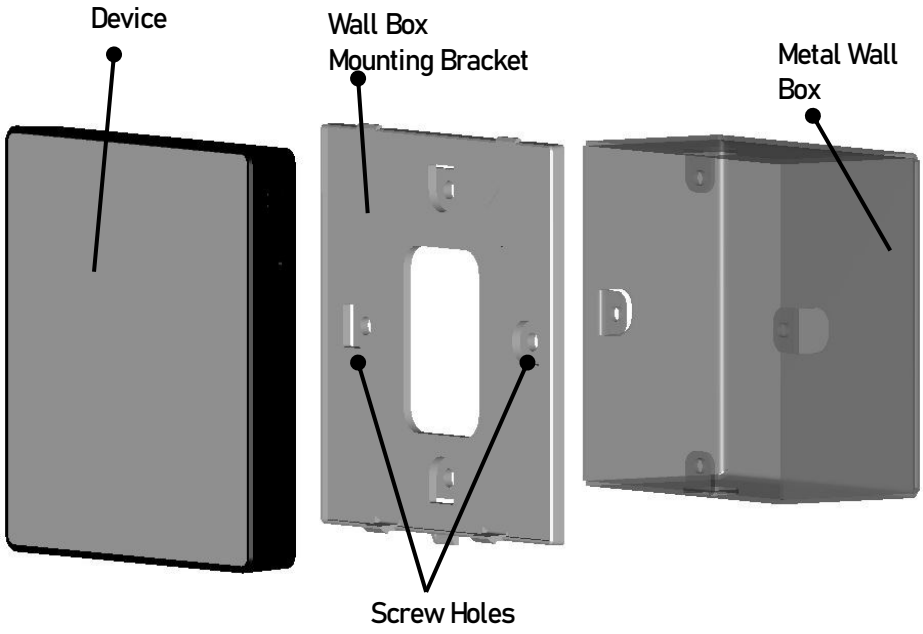

Figure 24 - Wall Box Mounting

Note: Wall mounting, glass mounting, and 86-type electrical box mounting can use the same Rear Cover Mounting Bracket, whereas wall box mounting requires the Wall Box Mounting Bracket.

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Figure 25 illustrates the cable wiring direction options for IDP2040-40A wall mounting (back view). The cable can be routed through one of the four rectangle slots on the rear cover or Wall-Box Mount Bracket for the electrical junction box or wall-box mount. (see Figure 15 for reference).

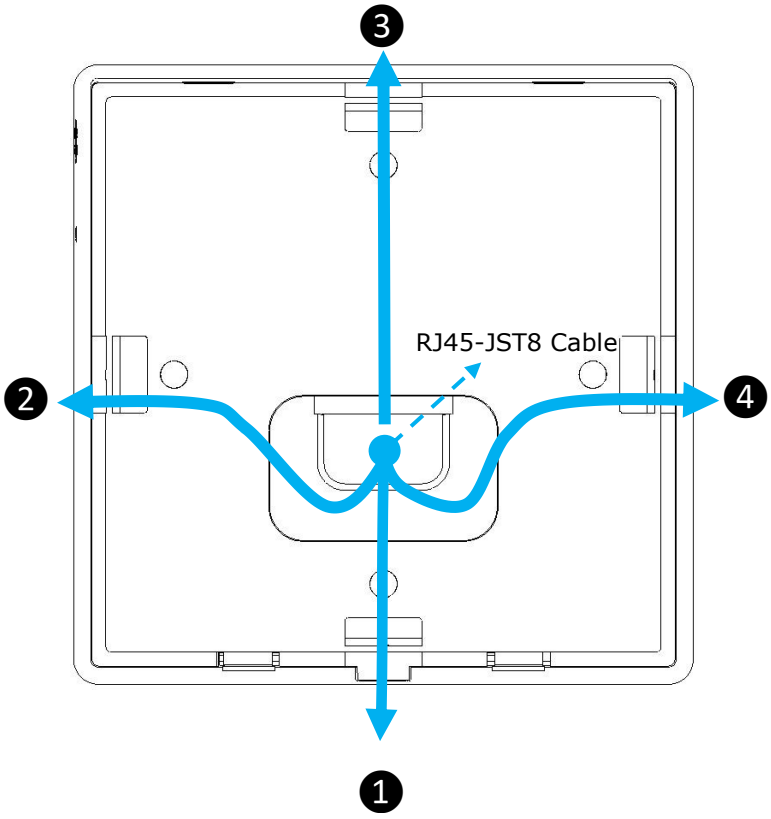

Figure 25 - RJ45-JST8 Cable Wiring Direction Options

Note:

A 5-meter RJ45-JST8 cable is included in the package with the following dimensions:

- Cable: 5m (L) x 9.1mm (W) x 3.0mm (T)
- RJ45 plug: 22mm (L) 11.5mm (W) x 13mm (T) .
- JST 8 plug: 14mm (L) x 4.5 (H) x 3.5 mm (T)

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9 Software Setup Information

9.1 Startup Test

The device comes preloaded with default firmware stored in the integrated XIP NOR-Flash. Follow these steps to perform an initial test to ensure the device is fully functional before flashing developers' own code.

Step 1: Powering Up the Device

Connect the device to power using the provided cable via the JST8 connector at DC_IN. For more information, refer to Section 5.1 and 5.8.

Step 2: Touch calibration

Once powered on, the display module's preloaded firmware will prompt the user to perform a touch calibration test, as shown in Figure 26. During calibration process, an audible beep tone will be activated. Complete the calibration as required for the application.

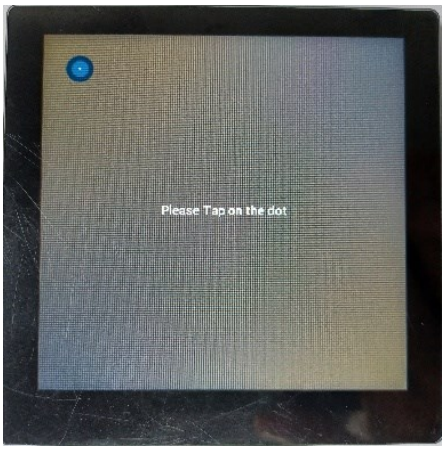

Figure 26 - Touch Calibration

Once the CTP is successfully calibrated, the application will load a **Graphic User Interface** (GUI) featuring a set of menus for simulating air conditioning, lighting, underfloor heating, and curtain control.

Figure 27 - Graphic User Interface

Figure 28 - Figure 31 illustrates the user interface displayed upon selecting the corresponding icons.

Air Conditioning Menu:

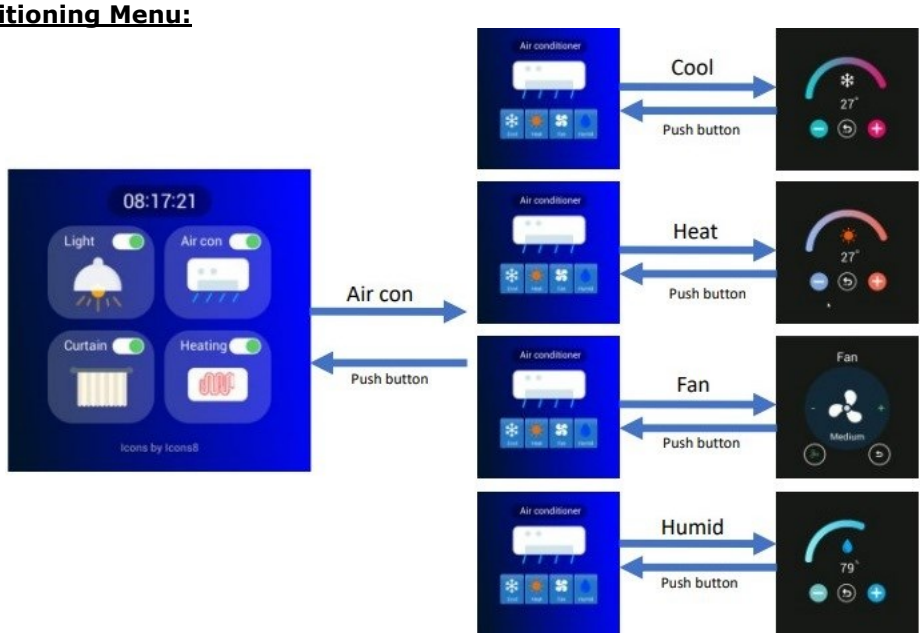

Figure 28 - Air Conditioning Menu

Light Conditioning Menu:

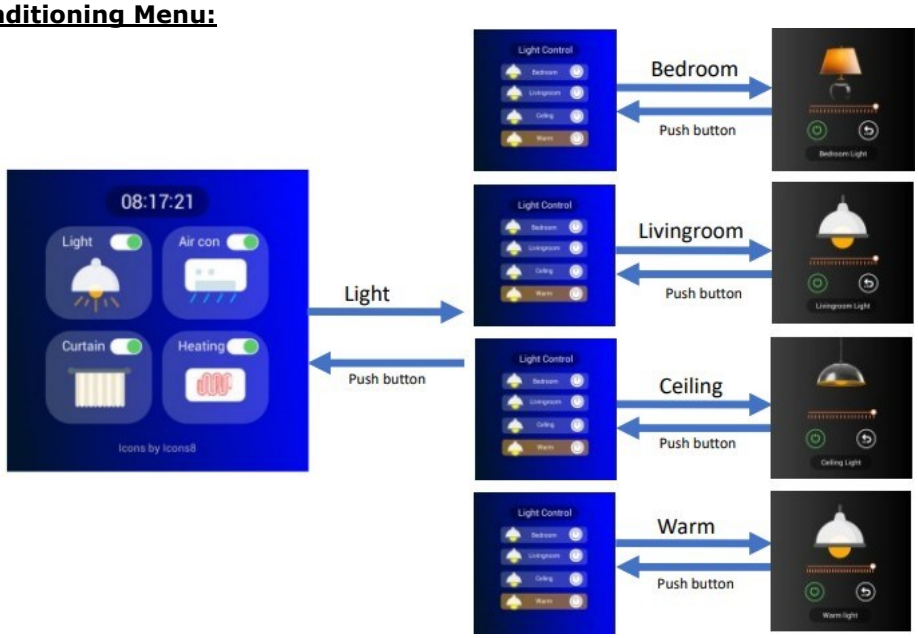

Figure 29 - Light Conditioning Menu

Underfloor Heating Menu:

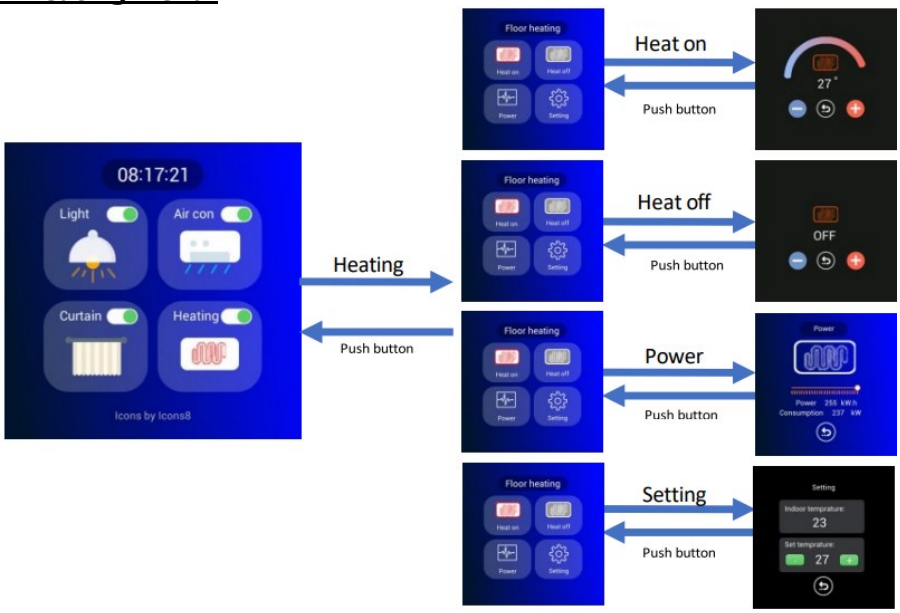

Figure 30 - Underfloor Heating Menu

Curtain Control Menu:

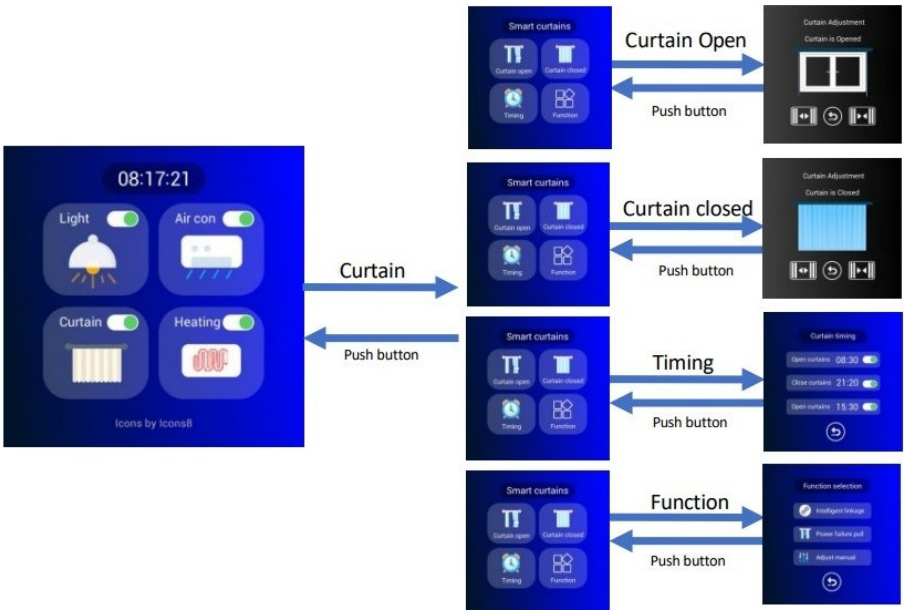

Figure 31 - Curtain Control Menu

9.2 Downloading Firmware

For firmware development, Bridgetek provides various development tools and sample codes to assist in the process. Refer to the next section for more details. The following section explains how to download the developer's firmware once it is ready.

The developer's firmware can be downloaded into the 64Mbit XIP NOR-Flash attached to the RP2040 Raspberry Pi MCU, as illustrated in Figure 32. Flashing can be performed via the USB Micro connector connected to the MCU.

There are two ways to enter **USB boot mode** for downloading the developer's firmware:

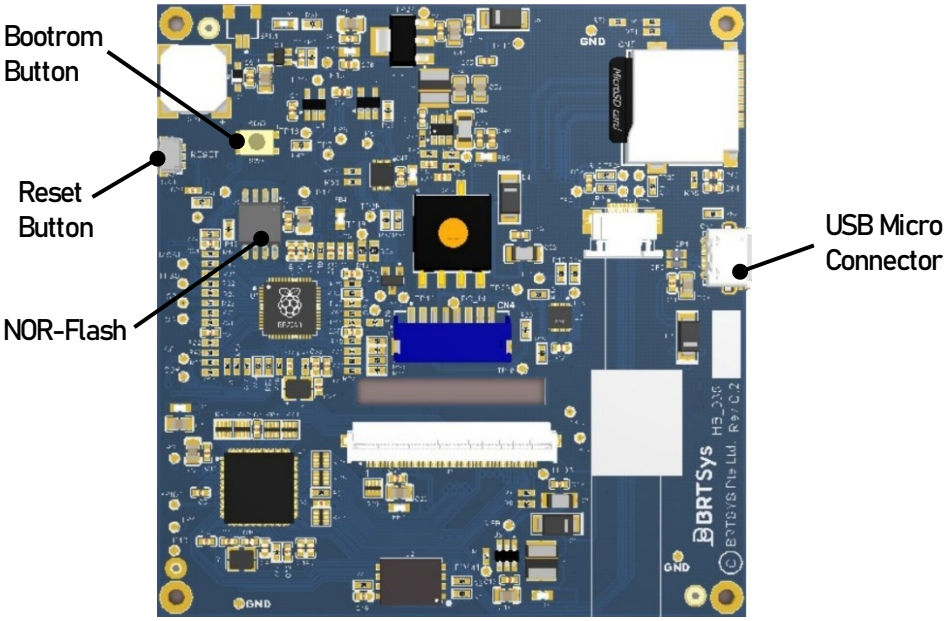

Figure 32 - Downloading Developer's Firmware

- **Method 1:** Press and hold the **Bootrom** button while powering up the display module.
- **Method 2:** While the unit is powered on, press and hold the **Bootrom** button, then press and release the **Reset** button before finally releasing the **Bootrom** button.

For detailed instructions on downloading the firmware, please refer to Section 9.3.

9.3 Software Development Tools and Support

Bridgetek provides free, comprehensive software to help users develop applications with ease. For more information, please visit the following web portal:

https://github.com/Bridgetek/IDP2040-40A

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Appendix A – References

Document References

BT815 Datasheet

RP2040 Datasheet

Acronyms and Abbreviations

Terms	Description
CTP	Capacitive Touch Panel
DC	Direct Current
EVE	Embedded Video Engine
FPC	Flexible Printed Circuit
GPIO	General Purpose Input Output
GUI	Graphic User Interface
HMIs	Human Machine Interfaces
IC	Integrated Circuit
I2C	Inter-Integrated Circuit
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LEDA	Light Emitting Diode Anode
LEDK	Light Emitting Diode Cathode
MCU	Micro Controller Unit
PC	Personal Computer
PCB	Printed Circuit Board
PCAP	Projected Capacitive
PCBA	Printed Circuit Board Assembled
PoE	Power-over-Ethernet
RS485	Recommended Standard #485
QSPI	Quad Serial Peripheral Interface

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SD Card	Secure Digital Card
SPI	Serial Peripheral Interface
TFT	Thin Film Transistor
USB	Universal Serial Bus
XIP	Execute In Place

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Appendix C – Revision History

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Clearance No.: BRT#220

Product Page: https://brtchip.com/ic-module/product-category/products/

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Revision	Changes	Date
Version 1.0	Initial Release	21-02-2025