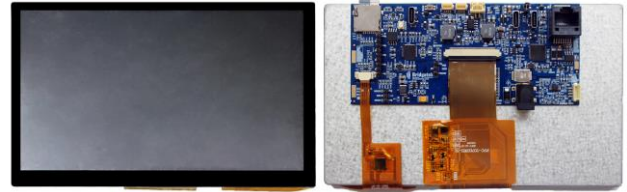


# Bridgetek Pte Ltd

## IDM2040-7A

### Datasheet



## 1 Introduction

The IDM2040-7A is an intelligent display module featuring a 7" 800x480 capacitive touch panel. The module carries the latest generation EVE4 controller BT817 supported by a low-cost high performance RP2040 microcontroller. The on-board RS485 transceiver allows communication with Long Distance Sensor Bus (LDSBus) devices or DMX512 devices through Cat 5/6 cables over an RJ45 connector. The input power supply can be either a Type-C PD charger or a PSU via the DC-jack. The Type-C PD port is controlled by FTDI's latest PD controller FT232HP, with PD sink profile programmable through the FTDI utility FT\_PROG.

With the use of a Raspberry Pi MCU RP2040, the IDM2040-7A module allows easy programming with various circuitpython or micropython libraries.

## 1.1 Features

- BT817 latest generation EVE controller.
- FT232HP: high speed USB connectivity with embedded USB PD support.
- RP2040 MCU with 8 MB on-board flash memory programmable with Circuit Python (libraries provided).
- BRT LDSBus connectivity to a wide range of long distance sensors and actuators (libraries provided).
- USB type C connectivity throughout for connection reliability.
- DMX512 supported for lighting control displays.
- Supports 7" 800x480 LCD with capacitive touch screen.
- On board 16MB NOR Flash for EVE assets.
- On board audio power amplifier and audio connector for external speaker and audio line in.
- RJ45 connector for controlling LDSBus or DMX512 devices.
- Type-C port for RP2040 USB DFU or debug.
- Type-C port for FT232HP USB serial converter.
- Type-C port for USB PD charger up to 20V.
- DC-jack for up to 24V PSU.
- Micro-SD card socket.
- 2x Stemma QT (QWIIC) I2C peripheral sockets.
- SPI pin headers for Adafruit Wi-Fi module or other peripherals.
- Hardware RESET button.
- RP2040 DFU button.

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## 2 Ordering Information

<b>Part No.</b>	<b>Description</b>
IDM2040-7A	Intelligent Display Module 7 inch for LDSBus/DMX controller

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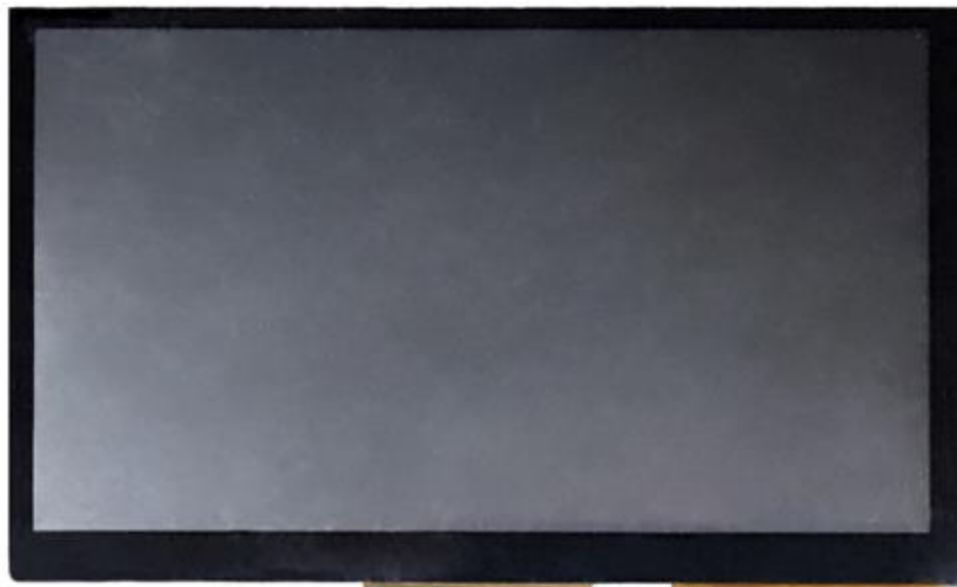
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## 3 Hardware Description

### 3.1 IDM2040-7A Module

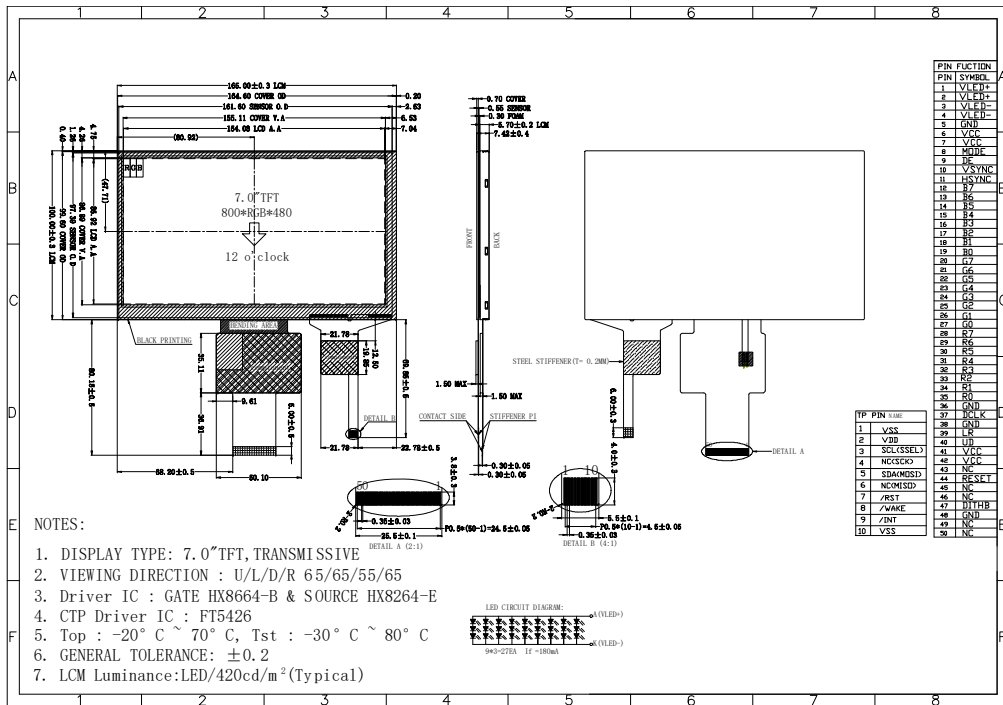
The IDM2040-7A module consists of a 7" 800x480 capacitive touch LCD with HB\_026 PCBA mounted to the LCD back frame. The size of the module is 165mm X 100mm X 21mm.



**Figure 1 - IDM2040-7A Module - Top View**



**Figure 2 - IDM2040-7A Module - Bottom View**

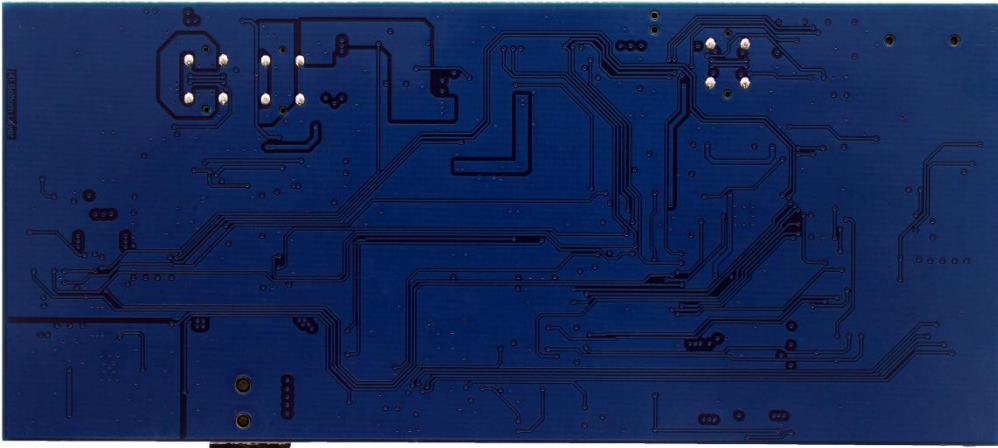


**Figure 3 – 7 inch LCD Dimension**



**Figure 4 - IDM2040-7A Board - Top View**



**Figure 5 - IDM2040-7A Board – Bottom View****Key Features:**

- ❖ Micro-SD card socket
- ❖ Raspberry Pi RP2040 MCU
- ❖ Type-C USB connector
- ❖ Hardware Reset Button
- ❖ Two 4-position 1mm pitch JST male connectors (Stemma QT/ QWIIC) for I2C peripheral interface
- ❖ One 2-position 2mm pitch JST male connector for PD Load
- ❖ One 2-position 2.54mm pitch male Harwin header for BUS snooping
- ❖ One USB Type-C connector for 20.0V PD charger
- ❖ One USB Type-C connector for PC Debugging (Python Input/Output)
- ❖ One RJ45 connector for LDSBus and DMX512 application
- ❖ One 4-position 1.50mm JST male connector for audio filter and amplifier
- ❖ FT232HPQ chip for PD controller and USB serial communication
- ❖ One DC jack connector for DC input from PSU
- ❖ One 50-pin 0.50mm pitch FPC connector for LCD interface
- ❖ BT817Q chip for graphics, touch and audio controller
- ❖ One 3-position 2.54mm Harwin male header for ADC peripheral interface
- ❖ One 3-position 2.54mm Harwin male header for SWD interface
- ❖ One 9-position 2.54mm Harwin male header for SPI peripheral interface
- ❖ One 10-pin 0.50mm pitch FPC connector for capacitive touch screen

## 3.2 Power supply

There are various options for easily powering the IDM2040-7A board as listed below –

- 24V DC input coming from PSU – CN18
- 20V from USB Type-C PD charger – CN12
- 5V USB Type-C PC debug connector - CN13A
- 5V USB Type-C serial converter connector - CN13.

All of these input options will go to the DC-DC Buck switching regulator to output 3.3V for the entire system.

For applications where an LDSBus device or DMX512 device is connected, either 20V PD power or 24V DC power is required.

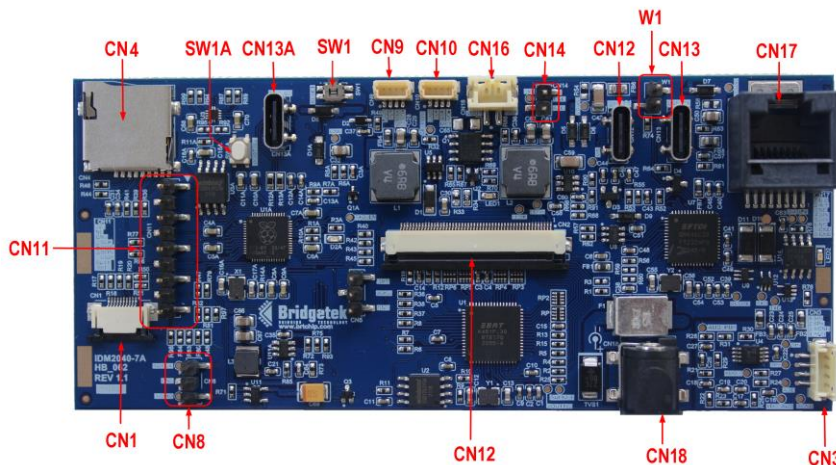
### 3.3 Raspberry Pi RP2040 MCU

Raspberry Pi RP2040 micro-controller unit (MCU) with 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
- Type-C 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](#).

### 3.4 The Connectors & Hardware Reset Button



**Figure 6 – Connectors of IDM2040-7A**

The connectors and the hardware reset button are described in the following sections.

**Note:** All GP(IO)s stated as below can also be configured as PIO or PWM.

- **CN1** is a 10-pin FPC connector for capacitive touch panel.
- **CN3** is a 4-position connector header for audio output to a speaker and external audio line-in input.

Pin No.	Name	Type	Description
1	SP-	O	Audio output for speaker
2	SP+	O	Audio output for speaker
3	GND	P	Ground
4	AUD	I	Audio line-in input

**Table 1 - CN3 Pinout**

- **CN4** is a Micro SD card socket which is supporting SPI-single mode. The physical interface supports the card detection.
- **CN5** is a 3-position vertical pin header connector for power (3.3V) and ADC input or it could also be configured as GPIO port.



Pin No.	Name	Type	Description	Pin Configurable Function
1	VCC3V3	P	DC power supply (3.3V)	-
2	GP26/ADC0	I	by default, it is ADC0 input	GP26/ADC0/I2C1_SDA
3	GND	P	Ground	-

**Table 2 - CN5 Pinout**

- **W1** is a 2-position vertical pin header connector for choosing CN12 Power delivery or CN13 for communication with PC.

W1 status	Application
Short	CN13 is plugged to a USB host, CN12 is left open
Open	CN12 is plugged to a Type-C PD charger

**Table 3 - W1 Function**

- **CN8** is a 3-position vertical pin header connector for SWD interface.

Pin No.	Name	Type	Description	Pin Configurable Function
1	SWCLK	I	Serial Wire Debug, Clock	SWCLK
2	GND	P	Ground	-
3	SWDIO	I	Serial Wire Debug, I/O	SWDIO

**Table 4 - CN8 Pinout**

- **CN9 & CN10** are the Stemma QT/ QWIIC connectors for power (3.3V) and I2C interface.

Pin No.	Name	Type	Description	Pin Configurable Function
1	GND	P	Ground	-
2	VCC3V3	P	DC power supply (3.3V)	-
3	CN9: I2C0_SDA CN10: I2C1_SDA	I/O	I2C Serial Bus, Data Line	CN9: GP20/I2C0_SDA CN10: GP18/SPI0_SCK/I2C1_SDA
4	CN9: I2C0_SCL CN10: I2C1_SCL	O	I2C Serial Bus, Clock Line	CN9: GP21/I2C0_SCL CN10: GP19/SPI0_TX/I2C1_SCL

**Table 5 - CN9 7 & CN10 Pinout**

- **CN11** is the 9-position vertical pin header connector for power (3.3V) and SPI interface. The SPI bus signals are shared with Micro-SD card except for the chip select signal.

Pin No.	Name	Type	Description	Pin Configurable Function
1	VCC3V3	P	DC power supply (3.3V)	-
2	-	-	NC	-
3	GND	P	Ground	-
4	SPI1_SCK	O	SPI1 clock output	GP10/SPI1_SCK/I2C1_SDA

5	SPI1_MISO	I	SPI master input, slave output.	GP12/SPI1_RX/I2C0_SDA/UART0_TX
6	SPI1_MOSI	O	SPI master output, slave input.	GP11/SPI1_TX/I2C1_SCL
7	SPI1_CS2#	O	SPI Chip Select output for external SPI peripheral device, active low. On board 10kΩ pull-up to 3.3V.	GP22
8	BUSY	I	Reserve for AdafruitAirLift Breakout Wi-Fi module	GP14
9	RESET#	O	Reserve for AdafruitAirLift Breakout Wi-Fi module	GP15

**Table 6 – CN11 Pinout**

- **CN12** is a USB type C receptacle connector used for FT232HPQ (U7) to negotiate with USB PD power source to deliver the power as programmed in external EEPROM sink PDO profile (default 20V/3A). It is also as a power supply option for the board.
- **CN13** is a USB type C receptacle connector used for communication with PC. Use this port to program the EEPROM (U8) if needed. It can also be used for communication via USB to UART converter as a virtual com port, between RP2040 UART0 and PC host. Note that when CN12 is not connected to a Type-C PD charger, W1 jumper needs to be closed so that FT232HPQ can be detected as a USB device by PC host.
- **CN13A** is a USB type C receptacle connector used for RP2040 programming and debugging.
- **CN14** is used for monitoring the UART0 communication.

Pin No.	Name	Type	Description
1	GND	P	Ground
2	TTL_RXD	O	RP2040 UART0 communication (= UART0_TXD AND UART0_RXD)

**Table 7 – CN14 Pinout**

- **CN16** is Power delivery output from CN12 via load switch Q1. Maximum 20V @ 3A load can be connected.

Pin No.	Name	Type	Description
1	VOUT	P	Voltage output from CN12 USB type C VBUS
2	GND	-	Ground

**Table 8 – CN16 Pinout**

- **CN17** is RJ45 port for RS-485 communication, LDSBus sensor control, DMX512 device control. The polarity of RS-485 A/B signal can be controlled by RP2040 GP16. Set GP16 to logic Low for normal A/B operation (for LDSBus), set GP16 to logic High to switch A/B operation (for DMX512).

Pin No.	Name	Type	Description
1	B/Z	I/O	RS-485 inverting Drive Output/Receiver Input
2	A/Y	I/O	RS-485 Noninverting Drive Output/Receiver Input
3	NC	-	Not Connect
4	+24V	P	24V from CN18 or 20V from CN12 VBUS
5	+24V	P	24V from CN18 or 20V from CN12 VBUS
6	NC	-	Not Connect
7	GND	P	Ground
8	GND	P	Ground

**Table 9 – CN17 Pinout**

- **CN18** is used for external DC power supply input.

Pin No.	Name	Type	Description
Plug Inner	DC+	P	DC input, Inner diameter 2.5mm
Plug Outer	GND	P	Ground, Outer diameter 5.5mm

**Table 10 – CN18 Pinout**

- **SW1** is the hardware reset button. Push to reset MCU RP2040.
- **SW1A** is the BOOTSEL button to put the RP2040 MCU into programming mode to program the FLASH connected to RP2040 QSPI bus.

## 4 Specifications

### 4.1 Electrical Specifications

Parameter	Description	Minimum	Typical	Maximum	Units	Notes
VCC_24V	24V supply voltage	18	24	28	V	CN18
VBUS	supply voltage	4.5	20	22	V	CN12
VBUS	supply voltage	4.5	5.0	5.5	V	CN13
VBUS	supply voltage	4.5	5.0	5.5	V	CN13A
Icc1_3.3V	VCC=3.3V operating current	-	280	-	mA	With LCD and Backlight LED on
Icc2_3.3V	VCC=3.3V operating current	-	490	-	mA	Add 1W speaker
Voh	Output Voltage High	2.4	-	-	V	
Vol	Output Voltage Low	-	-	0.4	V	
Vih	Input High Voltage	2.0	-	-	V	
Vil	Input Low Voltage	-	-	0.8	V	
T	Operating temperature	-20	-	+70	°C	

**Table 11 – Operating Voltage and Current**

### 4.2 Display Specifications

Item	Spec	Units	Notes
LCD Type	TFT active matrix	-	
Display Colours	16.7M	-	
Display active area	154.0(H) * 85.92(V)	mm	7.0 inch diagonal
Number of Pixels	800(RGB)*480	dots	
Pixel pitch	0.135(H) * 0.135(V)	mm	
Backlight	3X9 white LEDs	-	
Touch screen	5-finger capacitive touch	-	

**Table 12 – LCD and Touch Information**

### 4.3 Optical Specifications

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Brightness	Bp	$\theta=0^\circ$ $\square=0^\circ$	-	420	-	Cd/m <sup>2</sup>	1	
Uniformity	$\Delta Bp$		75	-	-	%	1,2	
Viewing Angle	3:00	$Cr \geq 10$	-	65	-	Deg	3	
	6:00		-	55	-			
	9:00		-	65	-			
	12:00		-	65	-			
Contrast Ratio	Cr	$\theta=0^\circ$ $\square=0^\circ$	300	500		-	4	
Response Time	Tr		-	10	-	ms	5	
	Tf		-	10	-	ms		
Color of CIE Coordinate	W	x		0.28		-	1,6	
		y		0.33		-		
	R	x		0.51		-		
		y		0.34		-		
	G	x	$\theta=0^\circ$ $\square=0^\circ$		0.31			-
		y			0.56			-
	B	x			0.15			-
		y			0.14			-
NTSC Ratio	S			50	60	-	%	

**Table 13 – Optical Specifications**

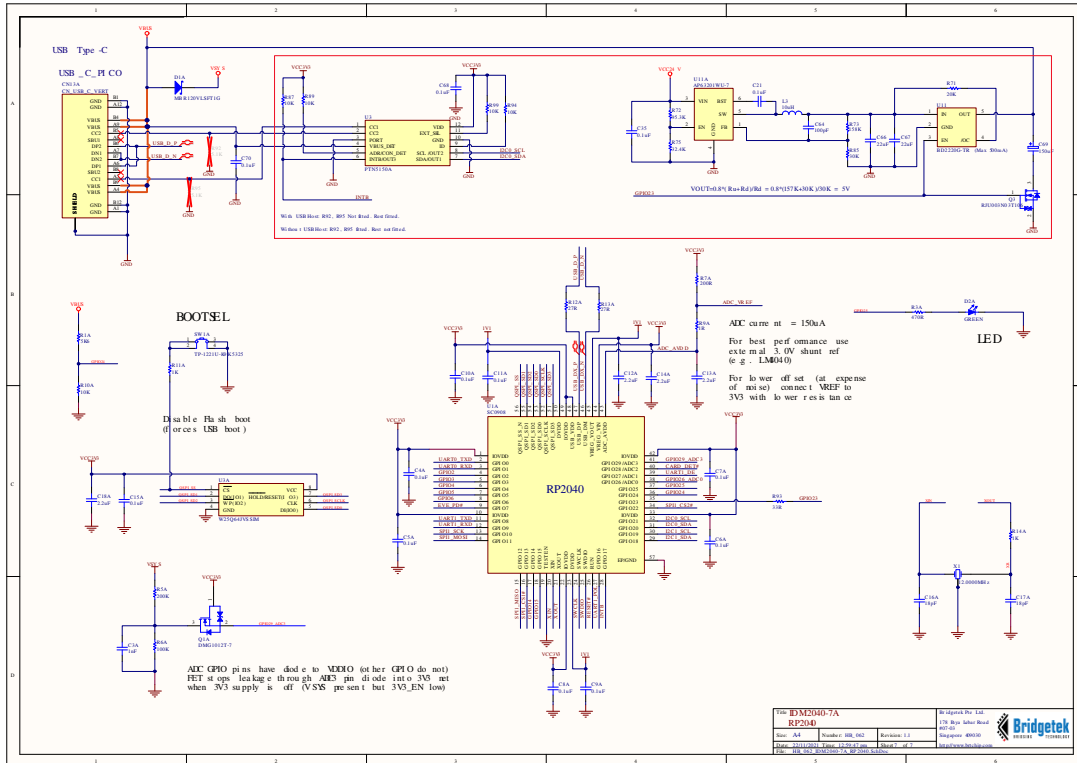
**Note 1:** The parameter is slightly changed by temperature, driving voltage and material

**Note 2:** The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm) Measuring condition:

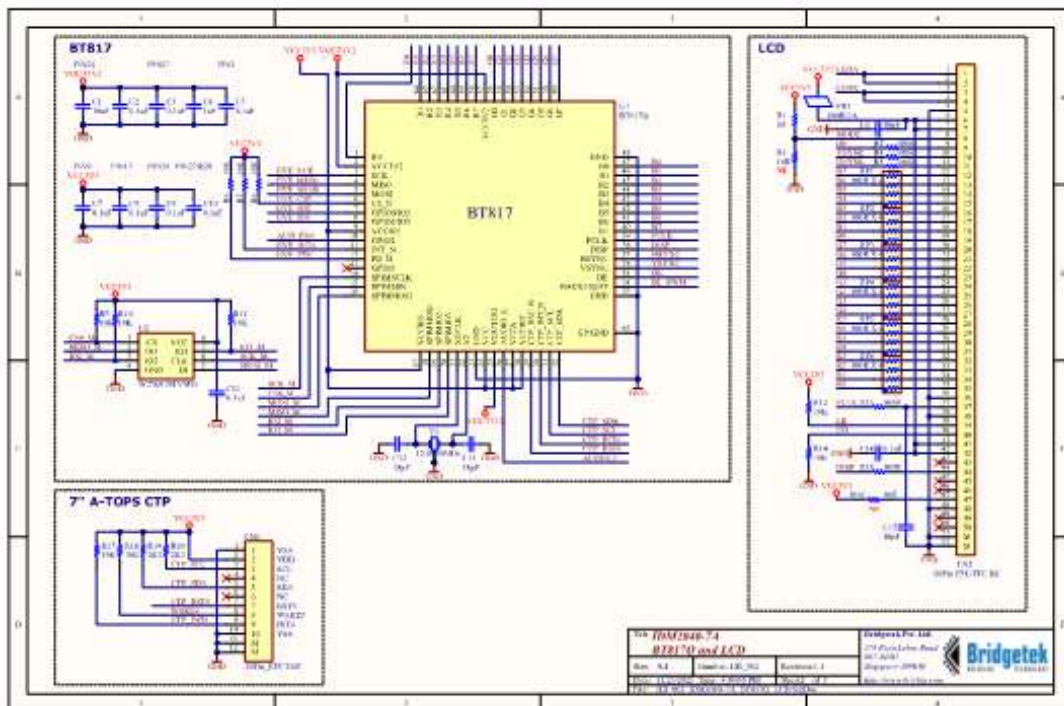
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25°C.

Adjust operating voltage to get optimum contrast at the center of the display. Measured value at the center point of LCD panel after more than 5 minutes while backlight turned on.

## 5 Board Schematics

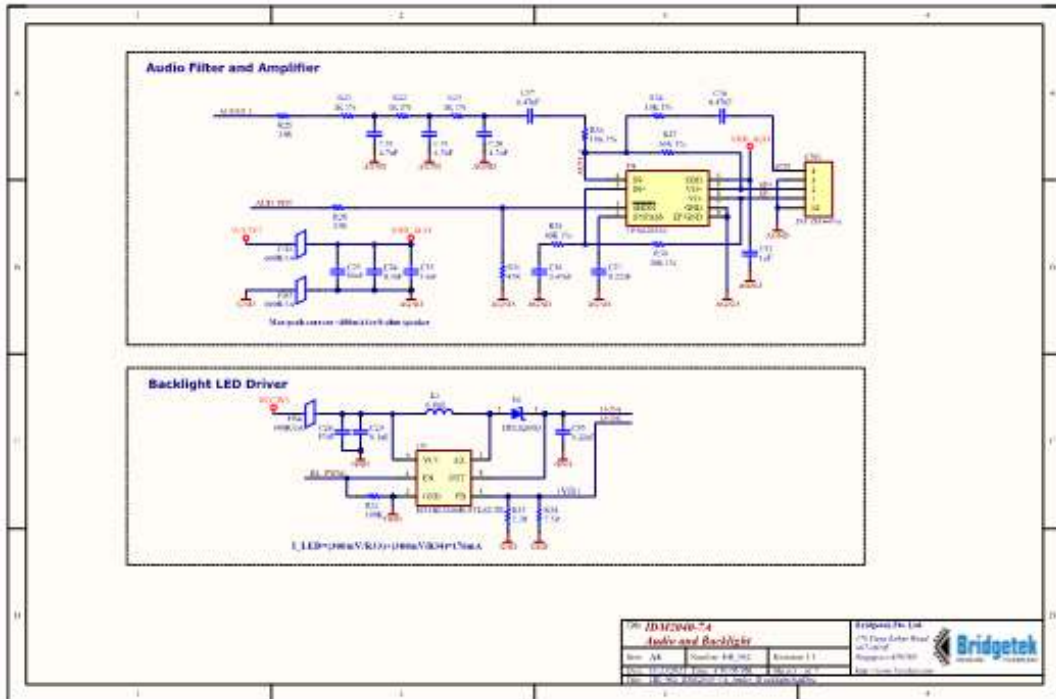


**Figure 7 - RP2040 MCU Schematic**

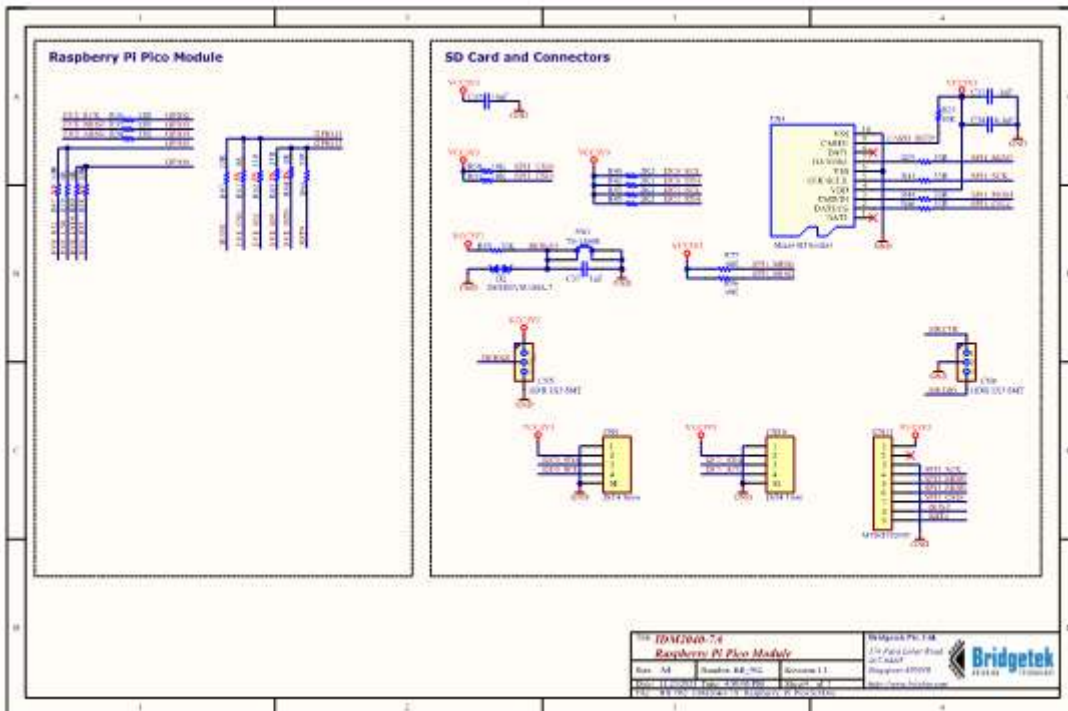


**Figure 8 - BT817Q and LCD Schematic**

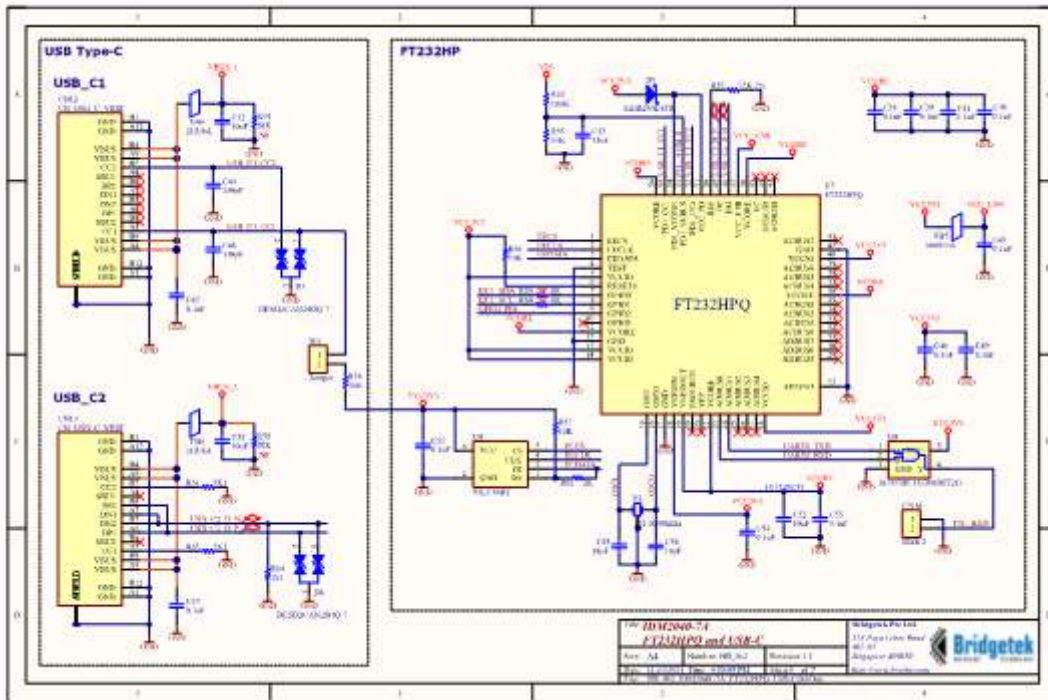




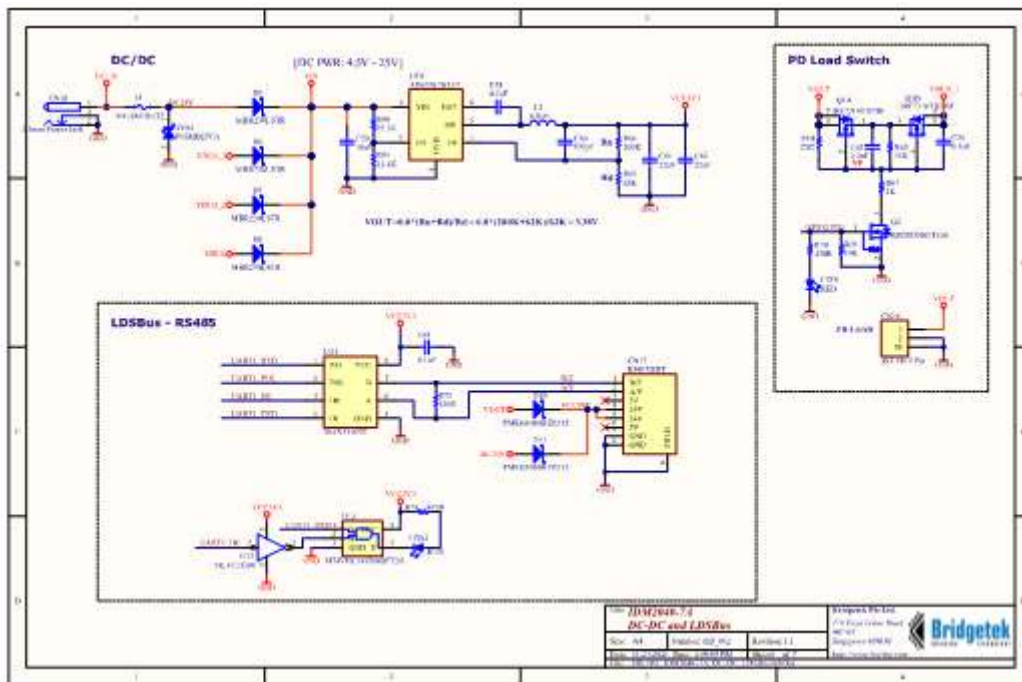
**Figure 9 – Audio and Backlight Schematic**



**Figure 10 - RP2040 Peripheral Connectors Schematic**



**Figure 11 – FT232HP and USB-C Schematic**

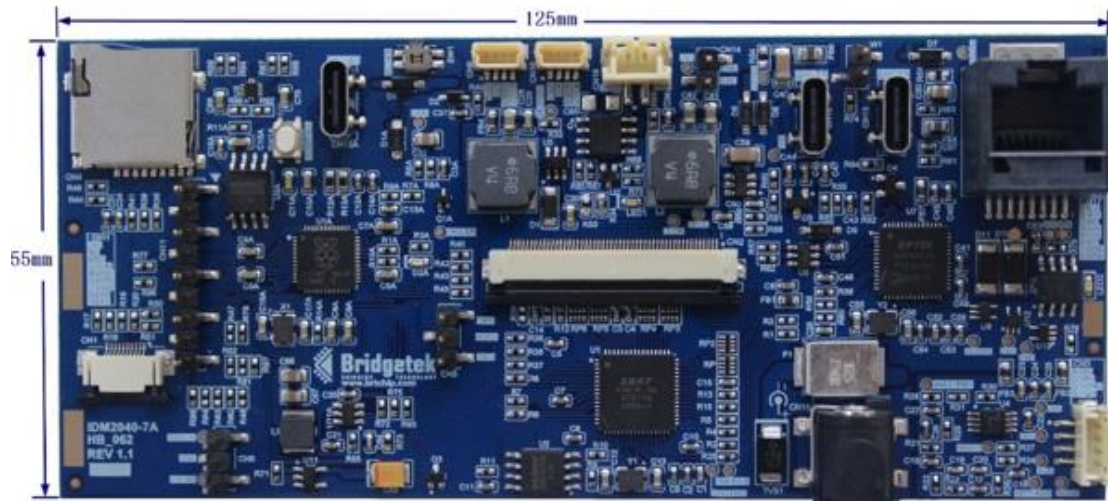


**Figure 12 – DC-DC and LDSBus Schematic**

## 6 Mechanical Dimensions

### 6.1 IDM2040-7A Board PCB Dimensions

All units are in millimeters (mm).

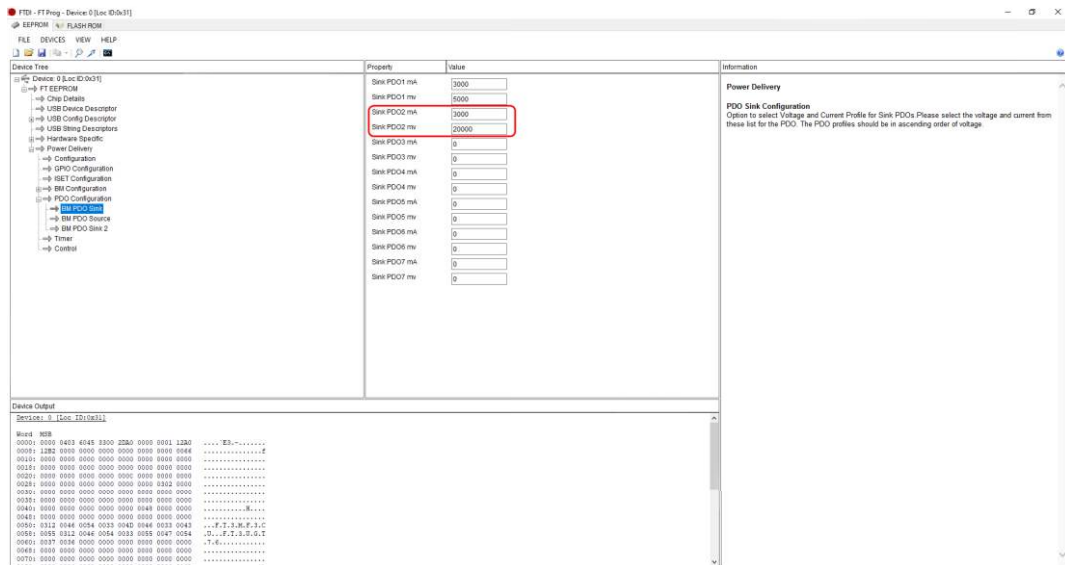


**Figure 13 – IDM2040-7A Board PCB Dimensions (Top View)**

## 7 Hardware Setup Information

### 7.1 Power Delivery Setup

- Download EEPROM Programming Utility FT\_PROG from <https://ftdichip.com/utilities/>, then install FT\_PROG on the PC.
- Make sure jumper W1 is shorted on the board.
- Use a USB cable connect CN13 type C port to PC.
- Run FT\_PROG, click Scan and Parse button to find the device.
- Click PDO Configuration and fill in the power deliver voltage and current in BM PDO Sink table.
- The last setting will effect output, for Figure 14, the power delivery will be 20V/3A.



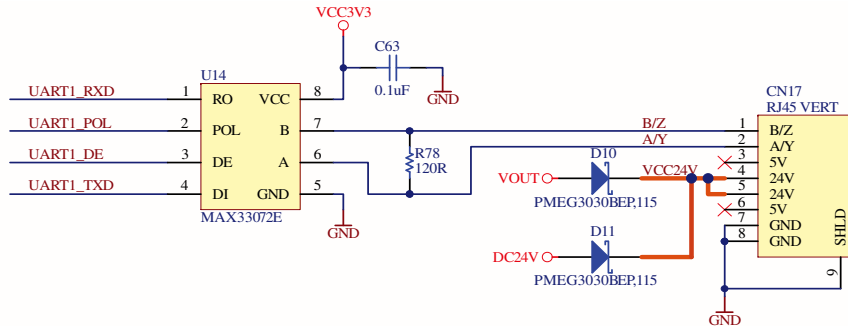
**Figure 14 – Power Delivery Setting**

- Use a type C to type C USB cable connect the power charger USB port to CN12 type C port on the board, U7, FT232HPQ will negotiate with the power charger and request to deliver 20/3A as configured in the above setting.
- PIN 1 of CN16 and PIN4, PIN5 of CN17 will output 20V, current output maximum 3A.
- Recommend power charger:

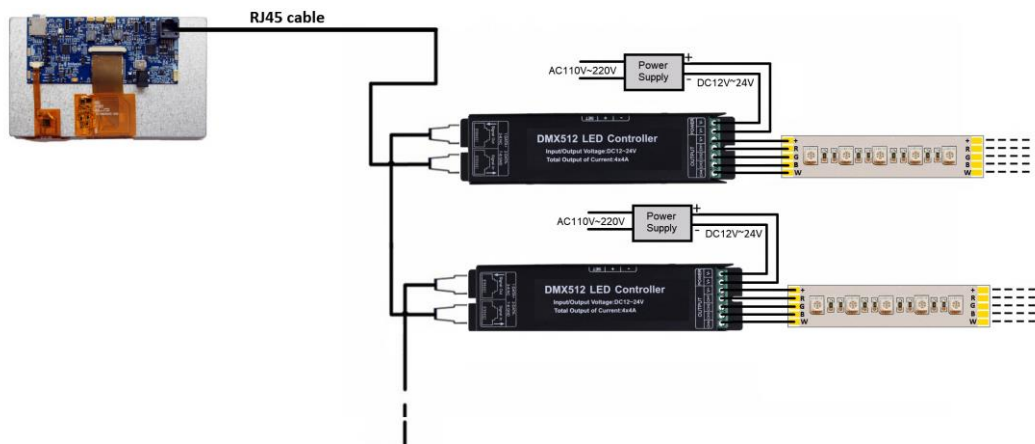
Brand: UG Green	Model: CD224
Brand: Wiredix	Model: WD-PD65AC

## 7.2 Control DMX512 Device Network

- Use a standard RJ45 cable connect CN17 to the RJ45 port of DMX512 device.
- UART1 baud rate set at 250000 bits/s.
- When sending a command to a DMX512 device, set UART1\_POL(GP16) to logic high to switch the output polarity to match with the polarity of RJ45 port of DMX512 device.



**Figure 15 – RS-485 Transceiver with Polarity Control**

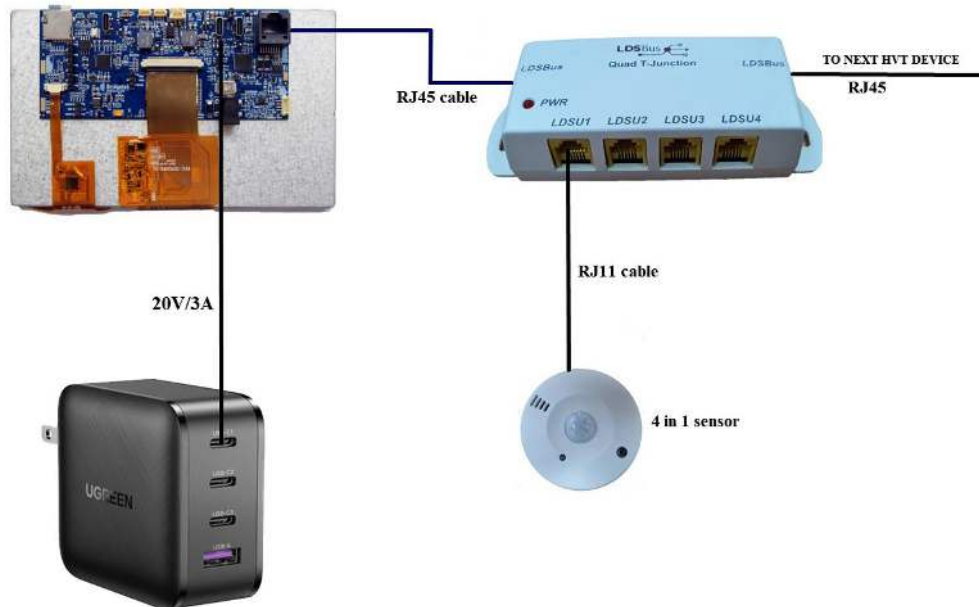


**Figure 16 – IDM2040-7A Module Connection to DMX512 Device**



### 7.3 Control LDSBus Sensor Network

- Using a standard RJ45 cable, connect CN17 to the RJ45 port of the Bridgetek HVT and connect an LDSBus sensor such as the 4 in 1 sensor etc.
- UART1 baud rate set at 230400 bits/s.



**Figure 17 – IDM2040-7A Module Connection to LDSBus Sensor**

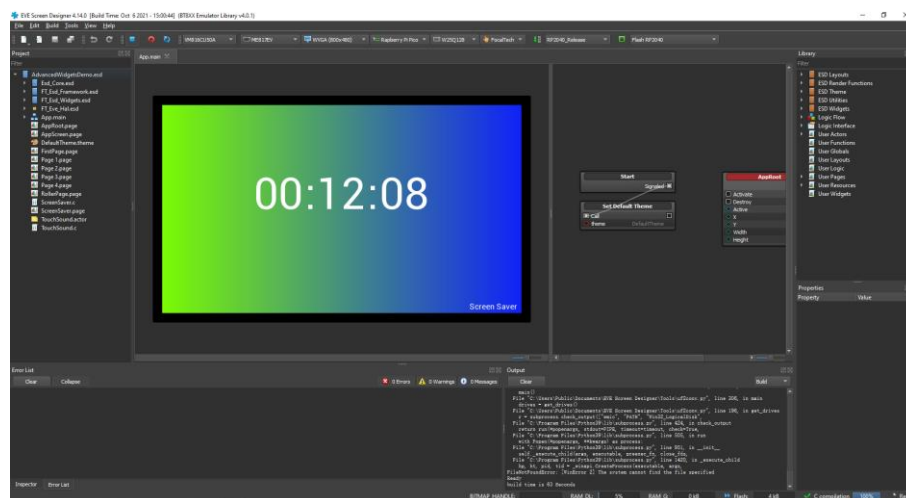
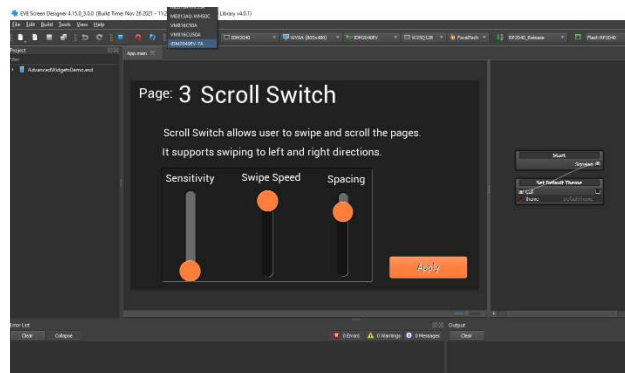


## 8 Software Setup Information

- The RP2040 microcontroller can be programmed using C/C++, MicroPython or CircuitPython.

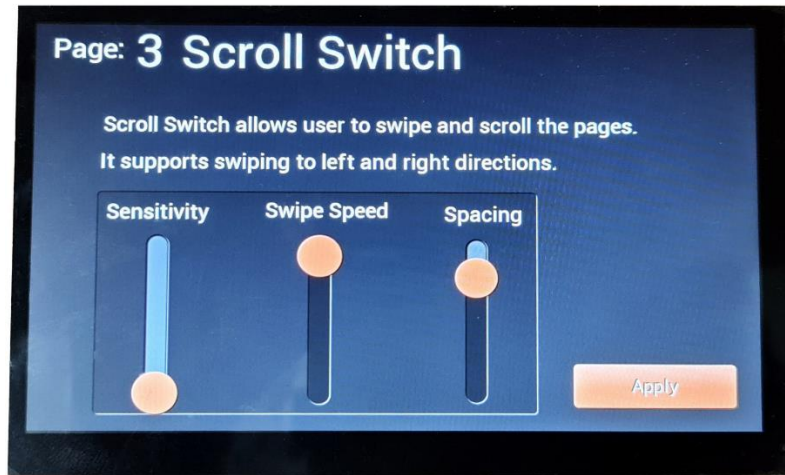
### 8.1 C/C++ SDK Setup

- For C/C++ development, it is need to install the following programs.
  - [Python 3.x](#)
  - [ARM GCC compiler](#)
  - [CMake](#)
  - [Build Tools for Visual Studio 2019](#) (C++ build tools only)
  - [Visual Studio Code](#)
  - [pico-sdk tools](#)
- It is recommended to download one package of all the above tools from [here](#) to install them.
- Raspberry Pi PICO/RP2040 C/C++ SDK document can be downloaded [here](#).
- Raspberry Pi PICO/RP2040 C/C++ examples can be downloaded [here](#).
- Raspberry Pi PICO/RP2040 C/C++ API Document is [here](#).
- Download and install EVE Screen Designer (ESD) version 4.14.0 or above from <https://brtchip.com/ic-module/toolchains/>.
- Open ESD tools and Run one example from C:\Users\Public\Documents\EVE Screen Designer\Examples\Advanced\AdvancedWidgetsDemo\AdvancedWidgetsDemo.esd, with the settings as shown below.
- Users need to change the build target to IDM2040EV-7A via the toolbar button:



**Figure 18 – Run AdvancedWidgetsDemo ESD Example Code**

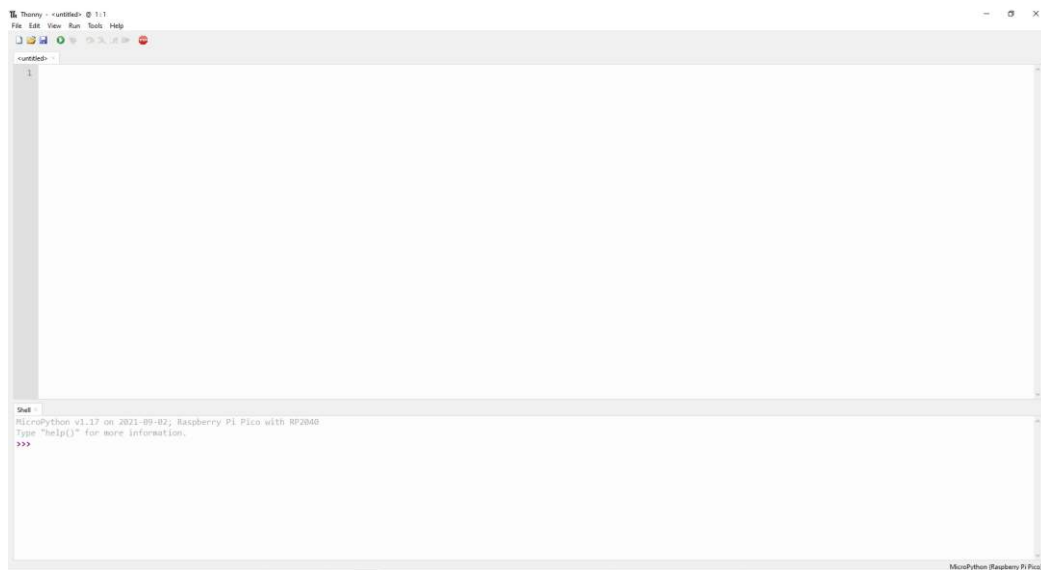
- Click Build->Build and Upgrade Hardware, it will compile the code and generate the AdvancedWidgetsDemo.UF2 file.
- Push and hold SW1A BOOTSEL button on the board, then connect CN13A to your computer using a USB cable. Release BOOTSEL once the drive RTPI-RP2 appears on your computer, Drag and drop the UF2 file on the RPI-RP2 drive. After reset, just press the 3 calibration dots and the following display will appear on the LCD.



**Figure 19 – Run AdvancedWidgetsDemo Example Code**

## 8.2 MicroPython SDK Setup

- Download the MicroPython UF2 file from [MicroPython](#).
- Push and hold SW1A BOOTSEL button on the board, then connect your computer using a type C USB cable. Release BOOTSEL once the drive RTPI-RP2 appears on your computer
- Drag and drop the UF2 file on the RPI-RP2 drive. The RP2040 will reboot and will now run MicroPython.
- Download and install [Thonny](#) for your computer.
- Connect the board to your computer and in Thonny go to Tools>Options and click on the interpreter tab. From the interpreter dropdown list select MicroPython (Raspberry Pi PICO). Choose port "USB Serial Device (COMX)". Figure 7-1 shows the MicroPython and Thonny in ready status.



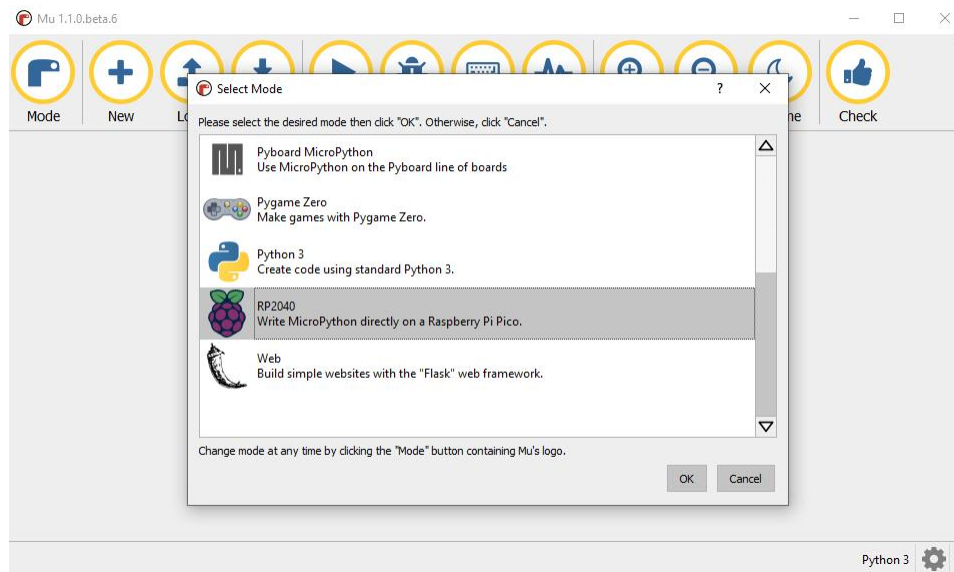
**Figure 20 – MicroPython with Thonny in READY status**

- Raspberry Pi PICO/RP2040 MicroPython SDK document can be downloaded from [here](#).
- Raspberry Pi PICO MicroPython examples can be downloaded from [here](#).
- Blink D2A example code is

```
from machine import Pin
import utime
led = Pin(25,Pin.OUT)
while True:
    led.value(1)
    utime.sleep(1)
    led.value(0)
    utime.sleep(1)
```

### 8.3 Circuitpython SDK Setup

- Download the CircuitPython UF2 file from [CircuitPython](#).
- Push and hold SW1A BOOTSEL button on the board, then connect your computer using a type C USB cable. Release BootSEL once the drive RTPI-RP2 appears on your computer
- Drag and drop the UF2 file on the RPI-RP2 drive. The RP2040 will reboot and the drive CIRCUITPY appears on your computer.
- Download and install [Thonny](#) or [Mu](#) for your computer, recommend to install Mu editor for CircuitPython application.
- Connect the board to your computer and Run Mu, select RP2040, the MU with CircuitPython is ready to use.



**Figure 21 – Install Mu Editor**

- Blink D2A example code is

```
import time
import board
import digitalio
led = digitalio.DigitalInOut(board.GP25)
led.direction = digitalio.Direction.OUTPUT
while True:
    led.value = True
    time.sleep(1)
    led.value = False
    time.sleep(1)
```

## 8.4 Bridgetek CircuitPython SDK Setup

- Below is the link which provides the sample code & libraries to run the EVE module in CircuitPython.
  - [pico-bteve github link](#)
- Visit BRT’s website at <https://brtchip.com/eve/> for more information regarding the EVE module & its toolchain.

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## Appendix A – References

### Document References

[BT817 Datasheet](#)

[FT232HP Datasheet](#)

[RP2040 Datasheet](#)

### Acronyms and Abbreviations

Terms	Description
DC	Direct Current
EVE	Embedded Video Engine
IC	Integrated Circuit
I2C	Inter-Integrated Circuit
LDSBus	Long Distance Sensor Bus
MCU	Micro Controller Unit
PD	Power Delivery
PWM	Pulse Width Modulation
SPI	Serial Peripheral Interface
SWD	Serial Wire Debug
TTL	Transistor-transistor Logic
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver-Transmitter

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## Appendix C – Revision History

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