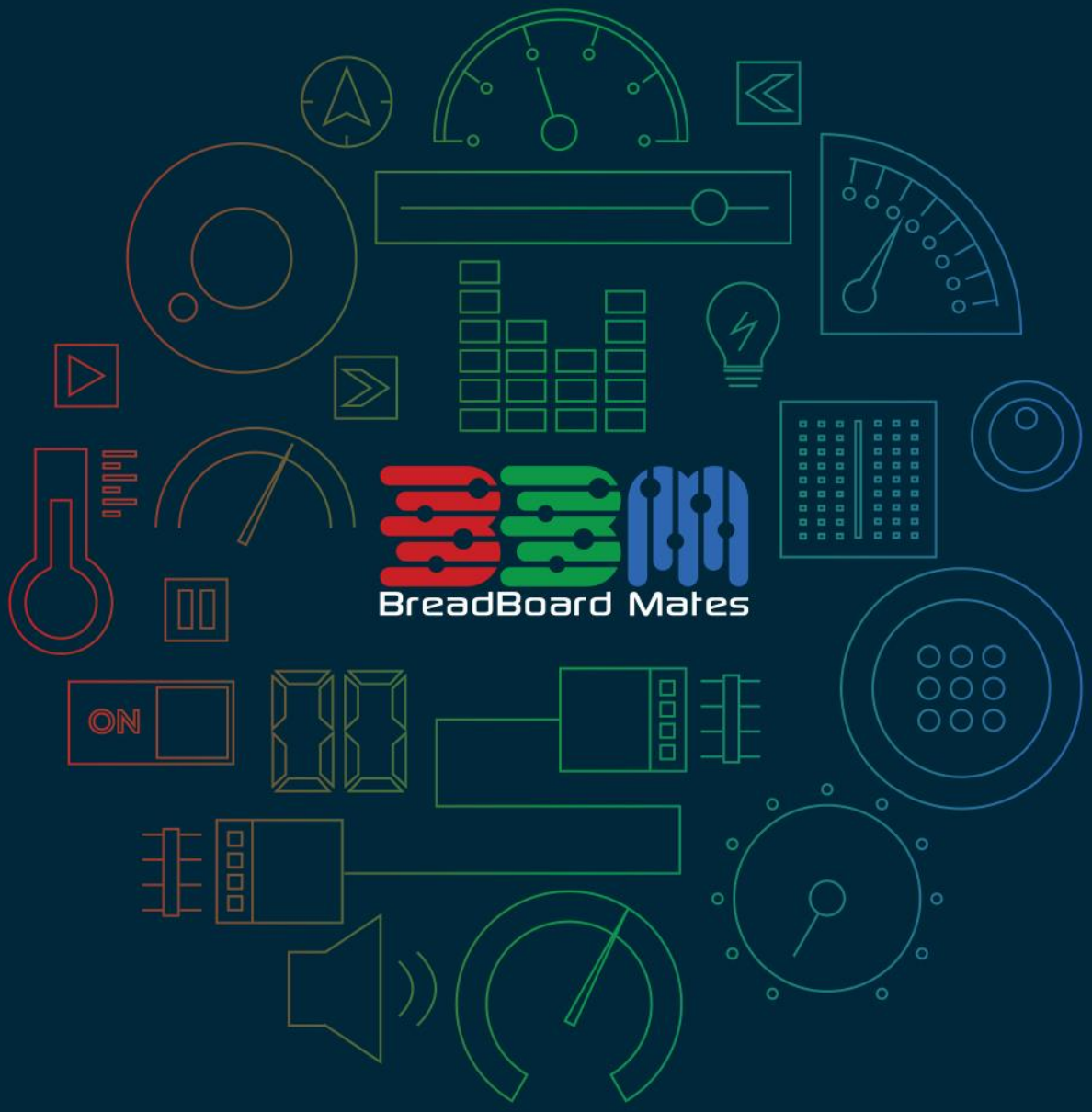

TED-130X
DATASHEET

Document Revision: 0.2
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Content subject to change at any time, please refer to www.breadboardmates.com for the latest revision.

Table of Contents

Document Revision History

Revision Number	Date	Description
0.1	15/08/2022	Initial Draft
0.2	12/09/2022	Initial Public Pre-Release
1.0	xx/xx/2022	Initial Public Release

Hardware Revision History

Revision Number	Date	Description
1.0	08/06/2022	Initial Internal Release
1.1	12/09/2022	Initial Public Release

About Breadboard Mates

Breadboard Mates (aka BBM) is an Australian start-up company and was established in 2020 with the aim to bring breadboard friendly display products to the market, cutting down the time and components required to develop or experiment with electronics.

Hobbyist to Professional, BBM products can be utilised for development or education or anything in between. Development of projects / applications is made incredibly easy with the help of the revolutionary Mates Studio IDE.

The Mates Studio IDE is unlike any other, it offers 4 different programming methods with interchangeable pages and widgets, and helps speed up development for stand alone, host driven or PC tethered applications.

Breadboard Mates is constantly working on new product ideas, so keep a watch on the breadboardmates.com website for new product releases.

Product Description

TED-130X is the OEM version of the unique TIMI-130X module and is aimed for product integration where TIMI-130X form-factor may not be suited.

TED-130X is a 1.3" TFT IPS LCD display module that is driven directly by a PIXXI-44 graphics processor from 4D Labs. It features both castellated and through-hole pads at each end of the module, allowing for different mounting options.

TED-130X was created to be used in products or projects after development has been done on the TIMI-130X module, where a permanent installation is required. TIMI-130X was designed as a flexible design aid, primarily to simulate components readouts and meters, which would otherwise be cumbersome or demanding on hardware resources for breadboard or electronic development. Simulating component readouts allows accelerated development and retains the often-limited GPIO hardware associated with many developments. TED-130X then steps in after this development has been done, for integration into a product.

Product Features

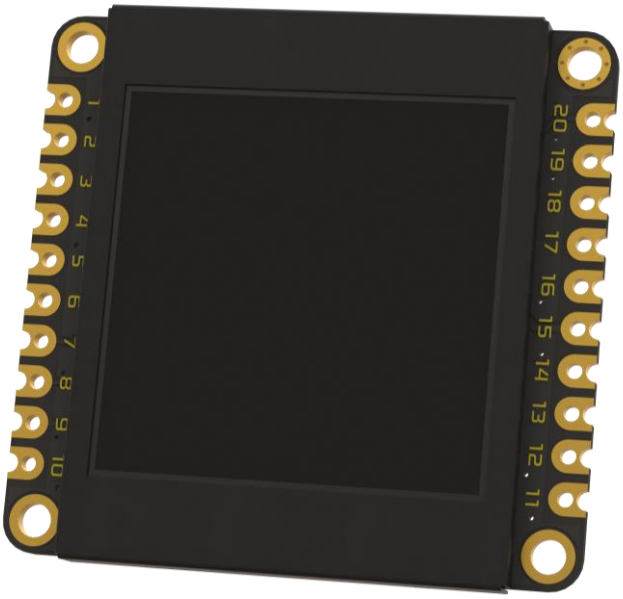
TED-130X's main interface is a 3.3V level Asynchronous Serial UART and features 14 GPIO (11 more than TIMI-130X) which can be used as Digital or Analog inputs, Digital Outputs, Master I2C Communication, or PWM Audio output. These interfaces arm TEDX-130 with resources to be either a stand-alone controller, a Host driven slave, or a tethered test instrument, while being capable of interfacing and powering external devices itself.

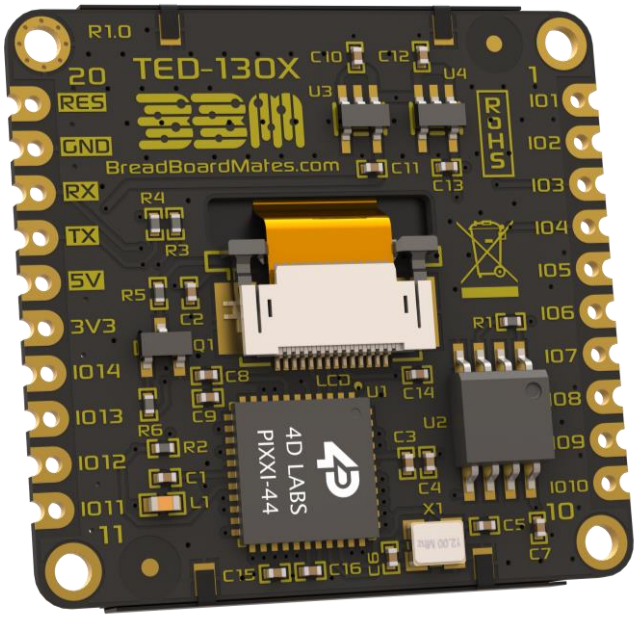
- Powered by 4D Labs Pixxi-44 Graphics Processor
- 240(W)x240(H) resolution TFT IPS LCD, non-touch
- 3.3V (5V tolerant) Serial UART interface, capable 300 to 2187500 Baud
- Master I2C (3.3V level) interface bus
- 14 GPIO (3.3V level), 4 capable of Analog, and 1 pair as I2C
- 32MB of External SPI Flash Memory
- 32KB of Processor Flash Memory
- 30KB of Processor SRAM for User Variables
- Single supply 5V power input (*3.3V possible - See 'System Pins' Section)
- Dedicated 3.3V 500mA power output for User
- Standard 0.1" (2.54mm) pitch castellated and through hole pads
- RoHS and REACH compliant
- PCB is UL 94V-0 Flammability Rated
- Weight approx. 7.0 grams

Hardware Detail

TED-130X headers are made up of a row of 10 pads on each end of the module. They are 0.1” (2.54mm) pitch, can be mounted directly to another PCB utilising the Castellated Pads, or they can be mounted with 0.1” (2.54mm) pitch male or female headers, for plugging into another board or cable, or soldered directly to wires/cable.

TED-130X can be orientated in any of its 4 positions, Portrait, Landscape, Portrait Reversed and Landscape Reversed, enabling the display to be positioned to suit the product it is being mounted in.





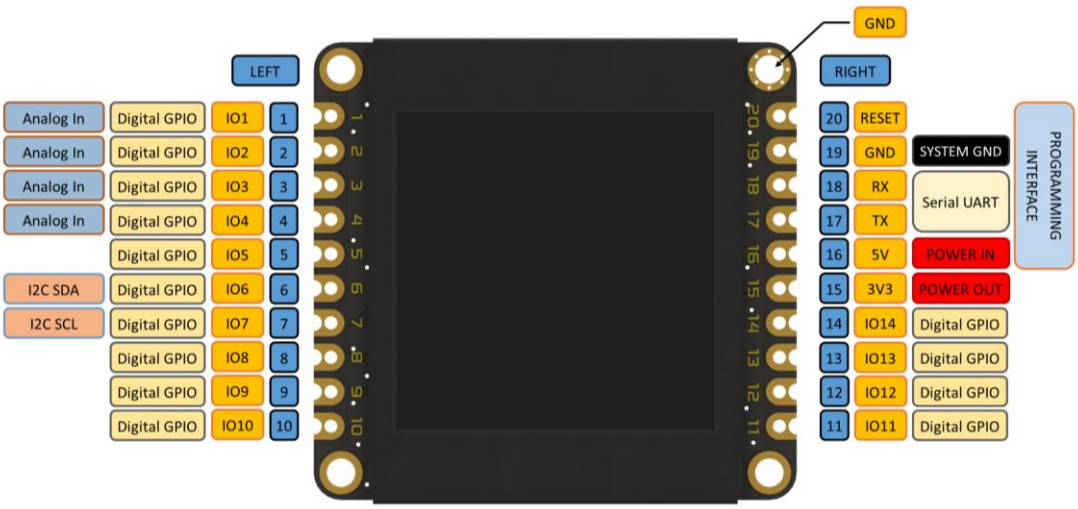
Pin Configuration

The TED-130X header pads have 20 physical pads which are dual purpose. Each pad is both castellated on the edge of the board, and a through-hole pad for mounting wires or headers. It can be directly mounted onto another PCB, on to headers, or mounted directly with wires.

When looking from the front of the module, the Top-Right side doubles as a programming interface and features Power-In, Power-Out and Serial UART, while the Left-side and Bottom-Right is GPIO.

The pads show silkscreen markings, top left is pin-1 when viewing from the front of the module, wrapping around in a sort of DIP naming fashion, up to pin-20 on the top right.

User I/O - Dual 10 row pads			
Side / Pad	**Symbol**	**I/O Type**	**Description**
Left - 1	IO1	I/O/A	GPIO capable of Digital, Analog (3.3V Level)
Left - 2	IO2	I/O/A	GPIO capable of Digital, Analog (3.3V Level)
Left - 3	IO3	I/O/A	GPIO capable of Digital, Analog (3.3V Level)
Left - 4	IO4	I/O/A	GPIO capable of Digital, Analog (3.3V Level)
Left - 5	IO5	I/O	Digital GPIO (**5V Tolerant**, 3.3V Level)
Left - 6	IO6	I/O	Digital GPIO, I2C SDA (3.3V Level)
Left - 7	IO7	I/O	Digital GPIO, I2C SCL (3.3V Level)
Left – 8	IO8	I/O	Digital GPIO (3.3V Level)
Left – 9	IO9	I/O	Digital GPIO (3.3V Level)
Left – 10	IO10	I/O	Digital GPIO (3.3V Level)
Right – 11	IO11	I/O	Digital GPIO (3.3V Level)
Right – 12	IO12	I/O	Digital GPIO (**5V Tolerant**, 3.3V Level)
Right – 13	IO13	I/O	Digital GPIO (**5V Tolerant**, 3.3V Level)
Right – 14	IO14	I/O	Digital GPIO (**5V Tolerant**, 3.3V Level)
Right – 15	3V3 OUT	Power	3.3V 500mA Power Output for User
Right – 16	5V	Power	Module 5V Input, Main Power
Right – 17	TX	O	Asynchronous Serial UART Transmit Pin (3.3V Level)
Right – 18	RX	I	Asynchronous Serial UART Receive Pin (3.3V, **5V Tolerant**)
Right – 19	GND	Power	Module / System GND
Right – 20	RESET	I	System Reset, Active Low



Hardware Interfaces

The TED-130X has hardware peripherals configured for interfacing with other external devices – general purpose digital input/output, analog input, UART, I2C and Audio.

System Pins

+5V (Device Supply Voltage)
Display supply voltage pin. This pin should be connected to a stable supply voltage in the range of 4.0 Volts to 5.5 Volts DC. Nominal operating voltage is 5.0 Volts for optimal display performance.

Note: If absolutely required, 3.3V can be applied to the +5V input, and the module will operate correctly, but with a lower backlight brightness. For this reason, it is not a recommended configuration, but for systems without 5V it enables compatibility. Note the 3.3V regulators will be passing the input voltage and not regulating themselves, so ensure you are using a clean power supply input.

3V3 (Device Output Voltage)
3.3V Output of the user dedicated voltage regulator. Capable of approximately 500mA, for external use by the User to power circuits/devices. This is an OUTPUT only, and is not the same regulator as the main system.

GND (Module Ground)
Device ground pin. This pin must be connected to system ground.

RESET (Module Master Reset)
Device Master Reset pin. An active low pulse of greater than 2 microseconds will reset the device. Ideally use an open collector type circuit to reset the device if an external reset is required. Alternatively connect it to a GPIO from a host and drive the pin Low to reset and set the pin High (3.3V) to return to run. This pin is not driven low by any internal conditions but is pulled high with a pull up resistor on the TED-130X module itself. The pins primary use is for programming TED-130X and is required by the BBM Programmer for loading Firmware/PmmC and applications.

General Purpose I/O

The TED-130X has six general purpose input/output (GPIO) pins available.

GPIO pins **IO1** to **IO14** can be individually set as a digital input or output. The pin mode of all the pins at power-up or reset is input by default.

When set as digital inputs, all pins are 3.3V tolerant except for specifically **IO5**, **IO12**, **IO13** and **IO14** – which are 5V tolerant. All other pins are 3.3V tolerant only and must not be connected directly to 5V devices outputs or 5V sources. When set as digital outputs, the pins output at 3.3V levels. Digital GPIO pins can source/sink 15 mA.

GPIO pins **IO1**, **IO2, IO3** and **IO4** can also serve as analog input pins. The pin mode of all the pins at power-up or reset is input by default. The analog input pins have a range of 0 to 3.3V, each having a maximum 12-bit resolution. Do not exceed the maximal permissible input voltage on these GPIO.

Serial Ports – TTL Level Serial

The PIXXI-44 Processor has a single hardware asynchronous serial port on this TED-130X module, with fixed pins TX/RX. The PIXXI-44's serial port can be used to communicate with external serial devices and is also used for programming the PIXXI-44 itself.

The primary features are:

Full-Duplex 8-bit data transmission and reception.

Data format: 8-bits, No Parity, 1 Stop bit.

Independent Baud rates from 300 baud up to 2187500 baud.

This serial UART is also the programming interface for User program downloads. Once the compiled application is downloaded and the user code starts executing, the serial port is then available to the user application.

TX pin (Serial Transmit):

Dedicated Asynchronous Serial port transmit pin, TX. Connect this pin to external serial device receive (RX) signal. This pin outputs at 3.3V levels.

RX pin (Serial Receive):

Dedicated Asynchronous Serial port receive pin, RX. Connect this pin to external serial device transmit (TX) signal. This pin is 5.0V tolerant.

Note: The serial UART output at the level of TTL 3.3V, however is 5V tolerant on the RX pin, so can accept communications from 5V devices.

I2C Interface

The I2C peripheral operates up to 1 MHz, supporting standard mode, full speed, and fast mode.

I2C clock output pin, SCL (**IO7**). Connect this pin to the SCL pin of an external I2C device. This is 3.3V tolerant only and must not be connected to 5V I2C buses.

I2C data input/output pin, SDA (**IO6**). Connect this pin to the SDA pin of an external I2C device. This is 3.3V tolerant only and must not be connected to 5V I2C buses.

No pull-up resistors are provided on TED-130X, therefore external pull up resistors are required to be added by the User on the Bus. Typical pull up resistors to 3.3V are in the region of 4.7Kohm.

Note: The TED-130 can only function as a Master in an I2C bus, therefore it cannot be an I2C Slave to a Host at this time.

Audio Output

TED-130X is capable of basic audio output using any of its GPIO, for connecting to a buzzer or piezo, and is capable of audio RTTTL tones, and frequencies.

Hardware Requirements

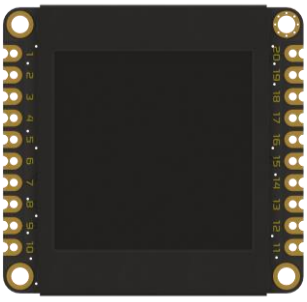
Hardware Overview

TED-130X is designed to be used in several ways, but the most basic configurations can be achieved with a TED-130X module and a BBM-Programmer, connected to your PC in a tethered configuration (See Programming Hardware section).

Note: TED-130X was designed to be integrated into a product, so connections between TED-130X and the programmer need to be allowed for in your design. The simplest approach will be mentioned here, utilising 5-way male pin headers 2.54mm pitch.

What you will need

- TED-130X Module
- 5-way male pin header 2.54mm (0.1") pitch, soldered to the Right of TED-130X
- BBM-Programmer
- MicroUSB Cable (Standard Type A USB to microUSB – Not included)
- Windows PC/Laptop running Windows 7 or higher, x86 or x64. ARM is currently not supported at this time.




The BBM-Programmer does not come with the microUSB cable, this can be purchased from virtually any hardware/computer store.

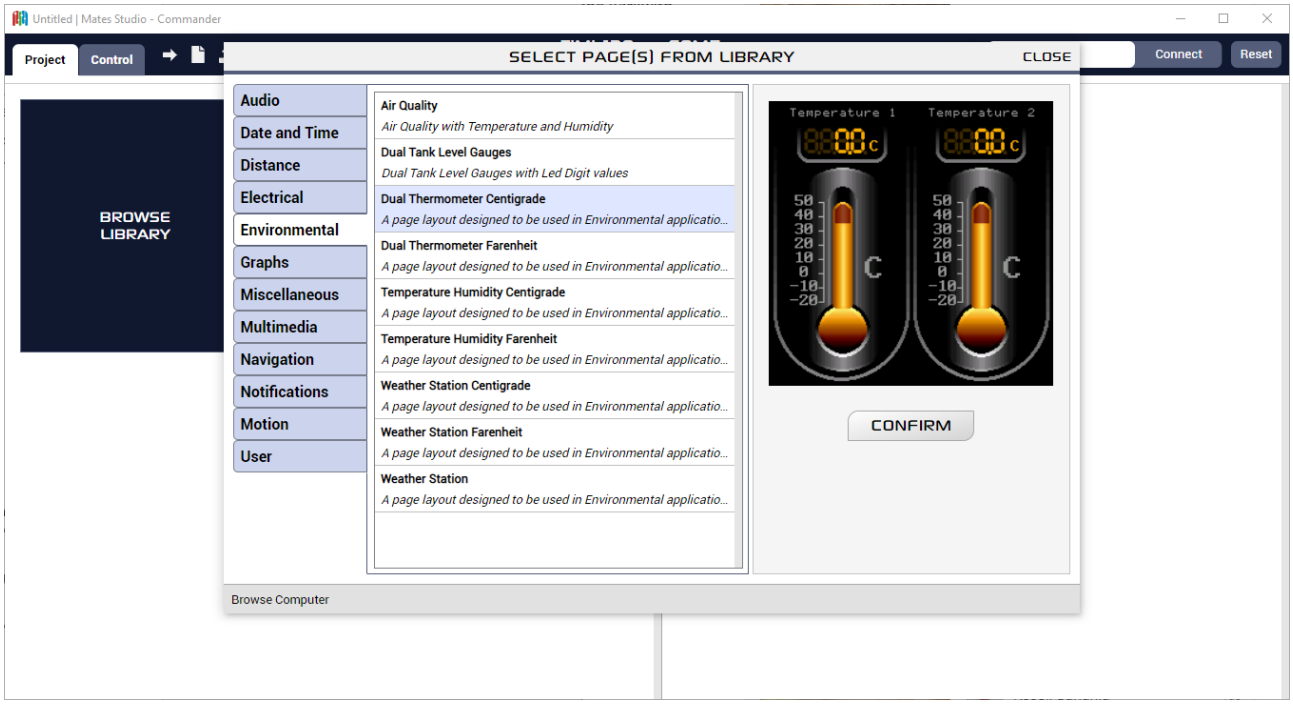
Currently Microsoft Windows is the only supported Operating System for Mates Studio. Announcements will be made when other OS's will become supported.

Required Software

All software development for the TED-130X module utilises the Mates Studio IDE.

Please download the latest version of Mates Studio from the breadboardmates.com website.

Details specific about the Mates Studio IDE can be found in the Mates Studio IDE documentation, available from our website.



Programming Hardware

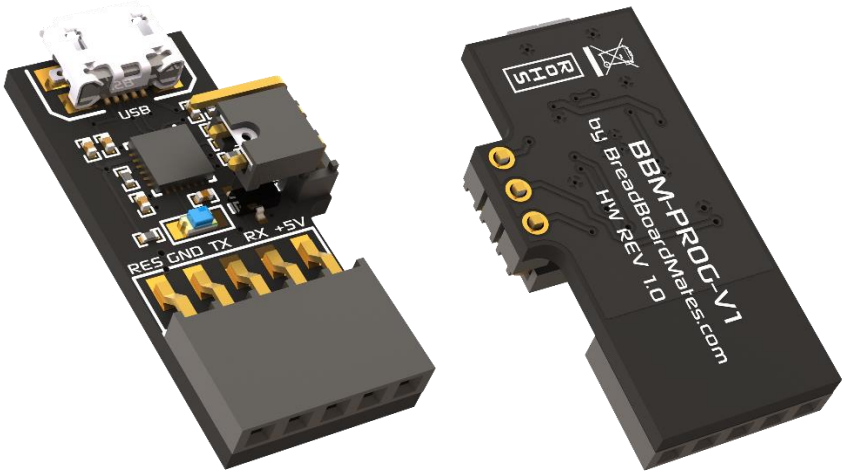
Programming Hardware - Overview

TED-130X utilises a USB to Serial programmer for application and firmware updates, which programs both the Processor Flash memory, along with the on-board SPI Flash memory.

The Programmer, dubbed BBM-Prog, is the official BBM Programmer and can also be used for testing and debugging of TED-130X applications using the Mates Studio IDE.

Programming Hardware – Detail

The BBM-PROG utilises the Silicon Labs CP2104 USB to UART bridge, and uses the TED-130X's Serial UART to load applications, firmware/PmmC and media content.



The BBM-PROG features a 3-pin jumper with shunt, which is present to change the way the programmer handles the Reset line, utilised by TED-130X and other devices.

TED-130X requires the jumper to be positioned like the image above, closest to the 5-way female header. This makes the programmer compatible with programming the 4D Labs Pixxi-28 processor.

If the jumper is placed on the 2 pins closest to the USB connector, this will make the programmer compatible with programming Atmel chips, such is used on many of the Arduino boards, or barebone chips. This may also be compatible with other microcontrollers too.

Typical Connections

Direct Interface with Programmer

One of the simplest interfaces for TED-130X is connecting a male pin header to the Right side of TED-130X and attaching the BBM-Programmer to the header directly. This is more a development type approach, however headers could be utilised on TED-130X to plug into the main PCB in the product, or into a cable.

At minimum, a 5-way header is required for programming TED-130X. Adding a 10-way header however may make more sense, or even adding a second header onto the Left side of TED-130 will give access to all pins as required.

Interface to a Host

TED-130X can interface to virtually any microcontroller or Host, using a Serial UART interface. Simple wire connections can be achieved directly to TED-130X, either soldered directly or via a soldered header. If the microcontroller or Host utilises 3.3V or 5.0V UART, then TED-130X can be easily connected.

Interface Notes

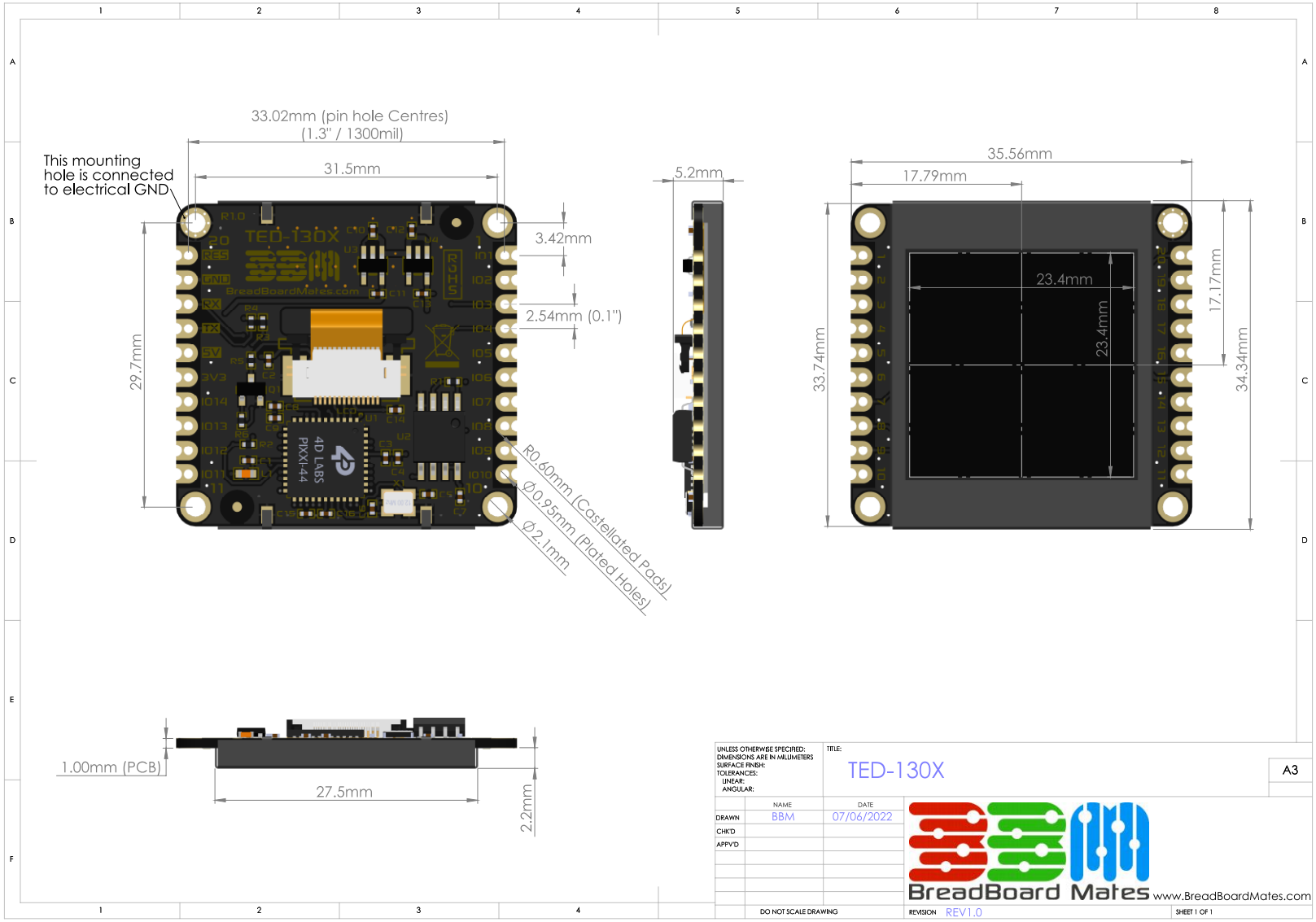
TED-130X has a single Serial UART, which is shared for the programming from the Mates Studio IDE, but it can also be used to interface to a Host or other device.

When programming the TED-130X, it needs to be isolated from any other circuit that might be connected to the UART. Unplug any UART connections from the RX and TX, and program the TED-130X module directly with the Programmer. When programming is complete, connect the UART RX/TX back up to allow communication to the host/device to resume.

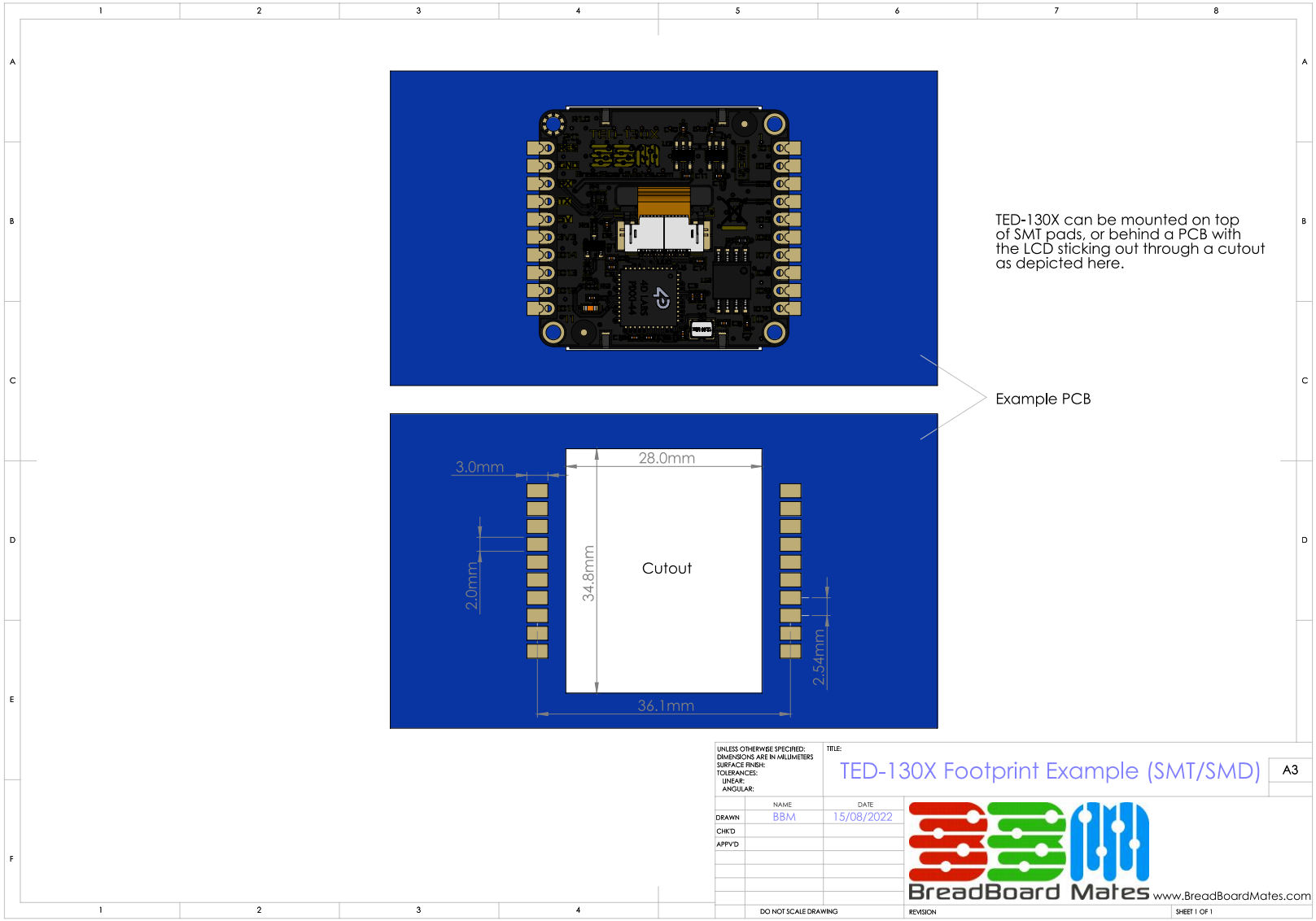
When designing a final product, a switch or jumper may be utilised to isolate the RX pin, allowing only Programming TX signals to reach the TED-130X's RX pin, until the switch is changed. This is useful as it means unplugging or unwiring the UART is no longer required when programming TED-130X.

The same situation applies for Host MCU's which also only have a single UART, as programming them often uses the UART too so they would need to be disconnected from TED-130X to program them.

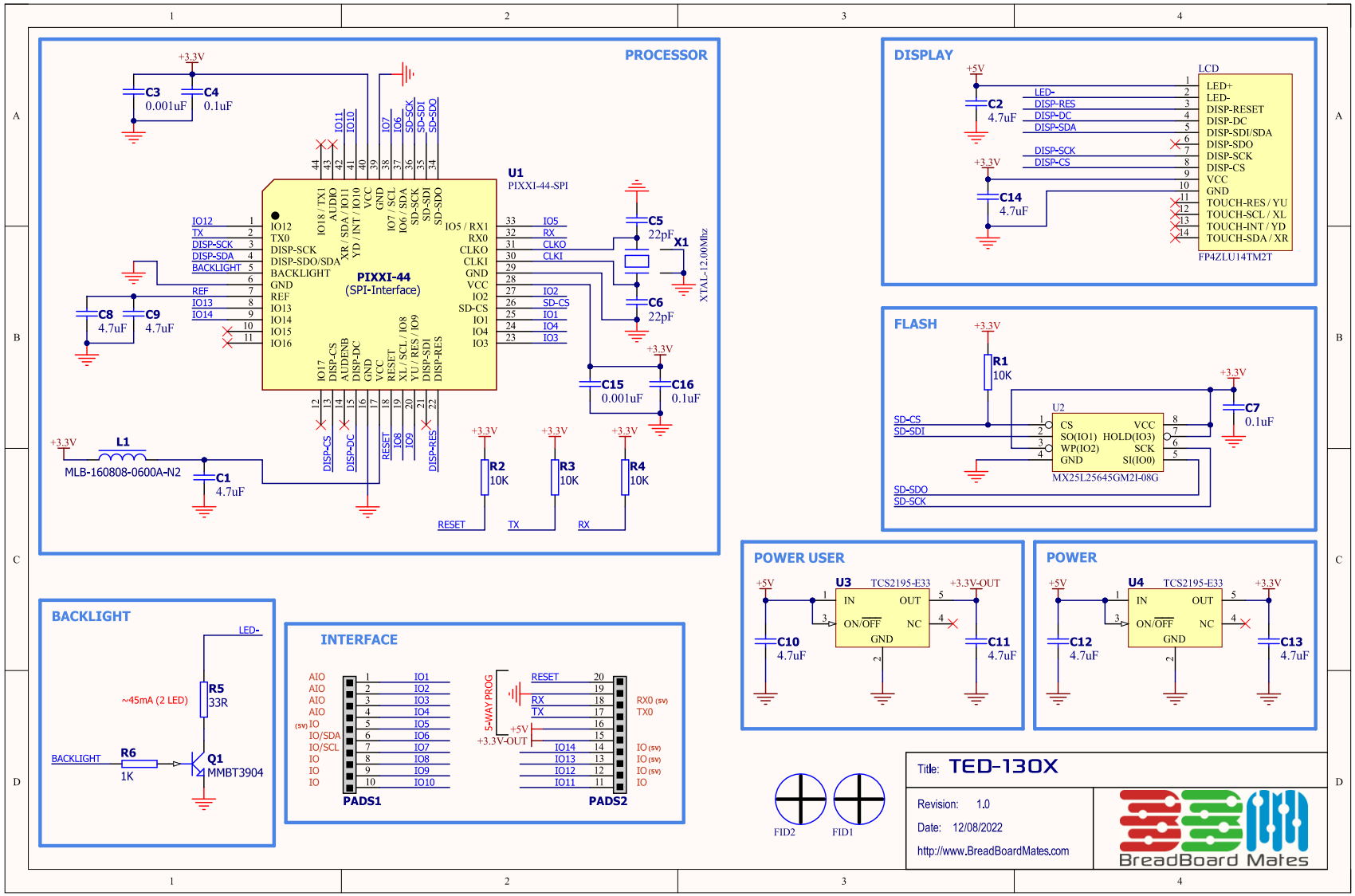
Hardware Drawing



Hardware SMD/SMT Footprint



Hardware Schematic



Specifications & Ratings

RECOMMENDED OPERATING CONDITIONS					
Parameter	Conditions / Information	Min	Typ	Max	Units
Operating Temperature		-20	--	+70	°C
Storage Temperature		-30	--	+80	°C
Humidity (RH)	Max 60°C	--	--	90%	RH
Supply Voltage (VCC)	Stable external supply required	4.0	5.0	5.5	V
Processor voltage (VP)		--	3.3	--	V
Input Low Voltage (VIL)	all pins	GND	--	0.2VP	V
Input High Voltage (VIH)	non 5V tolerant pins	0.8VP	--	3.3	V
Input High Voltage (VIH)	5V Tolerant Pins, (RX pin)	0.8VP	--	VCC	V
Reset Pulse	External Open Collector (RESET pin)	1.3	--	--	µs
Operational Delay	Power-Up or External Reset	500	--	3000	Ms
Output Voltage (3V3)	Output Voltage for User	--	3.3	--	V
Output Current	Output Current capability for User	--	500	--	mA
GPIO Current	Source/Sink	--	--	15	mA

OPERATING CHARACTERISTICS					
Parameter	Conditions / Information	Min	Typ	Max	Units
Supply Current (ICC)	5V Supply – Normal Operation	--	100	--	mA
	5V Supply – Sleep Mode	--	8	--	mA
	5V Supply – Deep Sleep Mode	--	3	--	mA
Display Endurance	Hours of operation, measured to when display is 50% original brightness	30000	--	--	H

LCD DISPLAY INFORMATION		
Parameter	Conditions / Information	Specification
Display Type		TFT IPS LCD
Display Size		1.3” Diagonal
Display Resolution		240x240 pixels
Display Brightness	5V Supply	400 cd/m2 (typical)
Display Contrast Ratio		800:1 (typical)
Display Viewing Angles	Above Centre	80 Degrees
	Below Centre	80 Degrees
	Left of Centre	80 Degrees
	Right of Centre	80 Degrees
Display Viewing Direction		ALL (IPS Display)
Display Backlighting	White LED Backlighting	2 LED
Pixel Pitch		0.0975 x 0.0975mm (Square pixels)
Pixel Density	Number of pixels in 1 row in 25.4mm	260 DPI/PPI

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