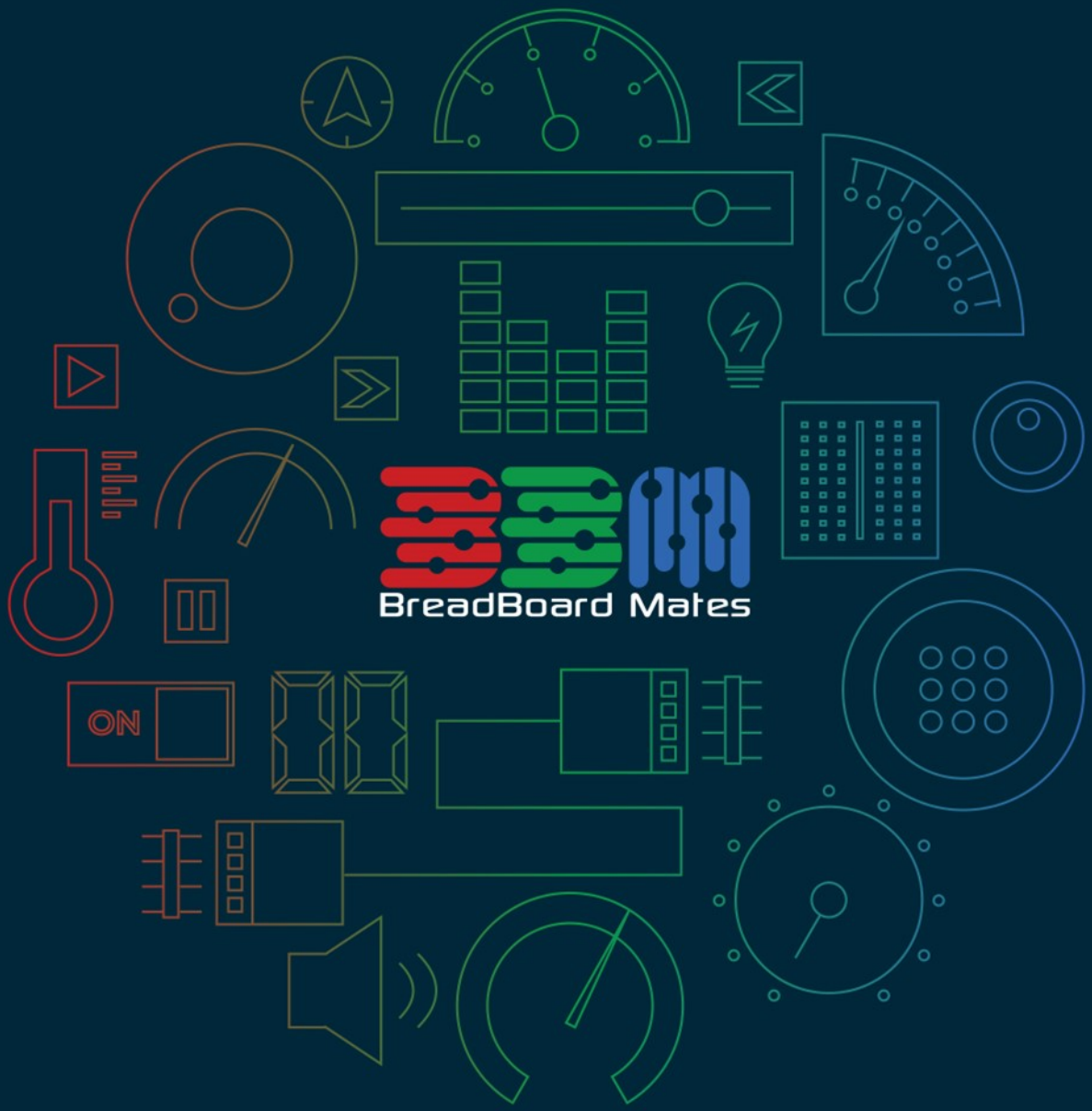
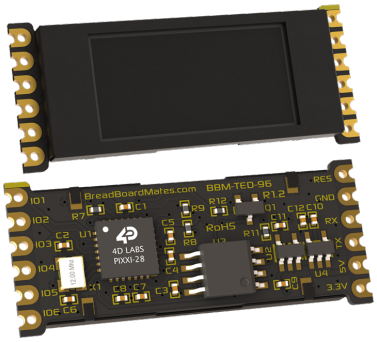


TED-96

DATASHEET

Contents

Introduction



TED-96 is the OEM version of the unique TIMI-96 module and is aimed for product integration where TIMI-96 form-factor may not be suited.

TED-96 is a 0.96” TFT IPS LCD display module that is driven directly by a PIXXI28 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-96 was created to be used in products or projects after development has been done on the TIMI-96 module, where a permanent installation is required. TIMI-96 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-96 then steps in after this development has been done, for integration into a product.

Product Features

TED-96’s main interface is a 3.3V level Asynchronous Serial UART and features 6 GPIO (3 more than TIMI-96) which can be used as Digital or Analog inputs, Digital Outputs, Master I2C Communication or PWM Audio output. These interfaces arm TED-96 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 Pixxi28 Graphics Processor
- 160(W)x80(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
- 6 GPIO (3.3V level), 2 capable of Analog or I2C, 1 capable of PWM Audio
- 16MB of External SPI Flash Memory
- 32KB of Processor Flash Memory
- 14KB 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. 5.0 grams

Hardware Detail

TED-96 headers are made up of a row of 6 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-96 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-96 header pads have 12 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 Left-end doubles as a programming interface and features Power-In, Power-Out and Serial UART, while the Right-end is completely GPIO.

Pin 1 is denoted by a silkscreen marking, top right when viewing from the front of the module. It wraps around in a sort of DIP naming fashion, back up to the top left, which is pin 12.

User I/O - Dual 6 row pads (H1 + H2)

Side/Pad	Symbol	I/O Type	Description
Right-1	IO1	I/O/A	GPIO capable of Digital, Analog, I2C SCL (3.3V Level)
Right-2	IO2	I/O/A	GPIO capable of Digital, Analog, I2C SDA (3.3V Level)
Right-3	IO3	I/O	GPIO capable of Digital, PWM Audio Out (3.3V Level)
Right-4	IO4	I/O	Digital GPIO (3.3V Level)
Right-5	IO5	I/O	Digital GPIO (3.3V Level)
Right-6	IO6	I/O	Digital GPIO (3.3V Level)
Left-7	3V3 OUT	Power	3.3V 500mA Power Output for User
Left-8	5V	Power	Module 5V Input, Main Power
Left-9	TX	O	Asynchronous Serial UART Transmit Pin (3.3V Level)
Left-10	RX	I	Asynchronous Serial UART Receive Pin (3.3V, 5V Tolerant)
Left-11	GND	Power	Module / System GND
Left-12	RESET	I	System Reset, Active Low

Hardware Interfaces

The TED-96 has hardware peripherals configured for interfacing with other external devices – general purpose digital input/output, analog input, UART, PWM and I2C.

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-96 module itself. The pins primary use is for programming TED-96 and is required by the Mates Programmer for loading Firmware/PmmC and applications.

General Purpose I/O

The TED-96 has six general purpose input/output (GPIO) pins available.

GPIO pins **IO1** to **IO6** 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, the pins are 3.3V tolerant. These are not 5V tolerant 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** and **IO2** 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 PIXXI28 Processor has a single hardware asynchronous serial port with fixed pins TX/RX. The PIXXI28's serial port can be used to communicate with external serial devices and is also used for programming the PIXXI28 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 (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 (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 (**IO1**). 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 (**IO2**). 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-96, 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-96 can only function as a Master in an I2C bus, therefore it cannot be an I2C Slave to a Host at this time.

PWM Audio Output

TED-96 is capable of PWM Audio output using GPIO **IO3**, for connecting to a buzzer, piezo or amplifier/speaker via a filter, and is capable of audio RTTTL tones, frequencies and PWM Audio.

Hardware Requirements

Hardware Overview

TED-96 is designed to be used in several ways, but the most basic configurations can be achieved with a TED-96 module and a Mates Programmer, connected to your PC in a tethered configuration (See Programming Hardware section).

> **Note**
>
> TED-96 was designed to be integrated into a product, so connections between TED-96 and the programmer need to be allowed for in your design. The simplest approach will be mentioned here, utilising 6-way male pin headers 2.54mm pitch.

What You Will Need

- TED-96 Module
- 6-way male pin header 2.54mm (0.1") pitch, soldered to the Left side of TED-96 (only 5 of the pins are utilised for programming however)
- Mates 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 Mates Programmer does not come with the microUSB cable, this can be purchased from virtually any hardware/computer store.

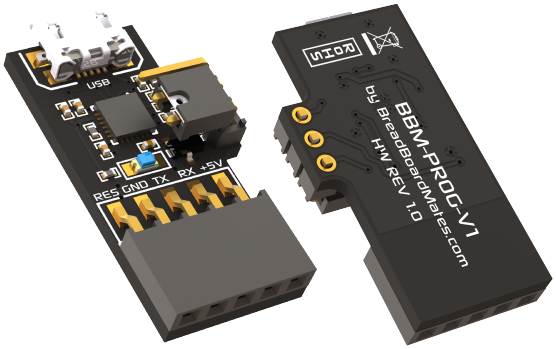
Currently, Microsoft Windows is the only supported Operating System for Mates Studio. Announcements will be made when other OS's will become supported.

Programming Hardware

TED-96 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 Mates Programmer and can also be used for testing and debugging of TED-96 applications using the Mates Studio IDE.

The Mates Programmer utilizes the Silicon Labs CP2104 USB to UART bridge, and uses the TED'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-96 and other devices.

TED-96 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 Pixxi28 processor.

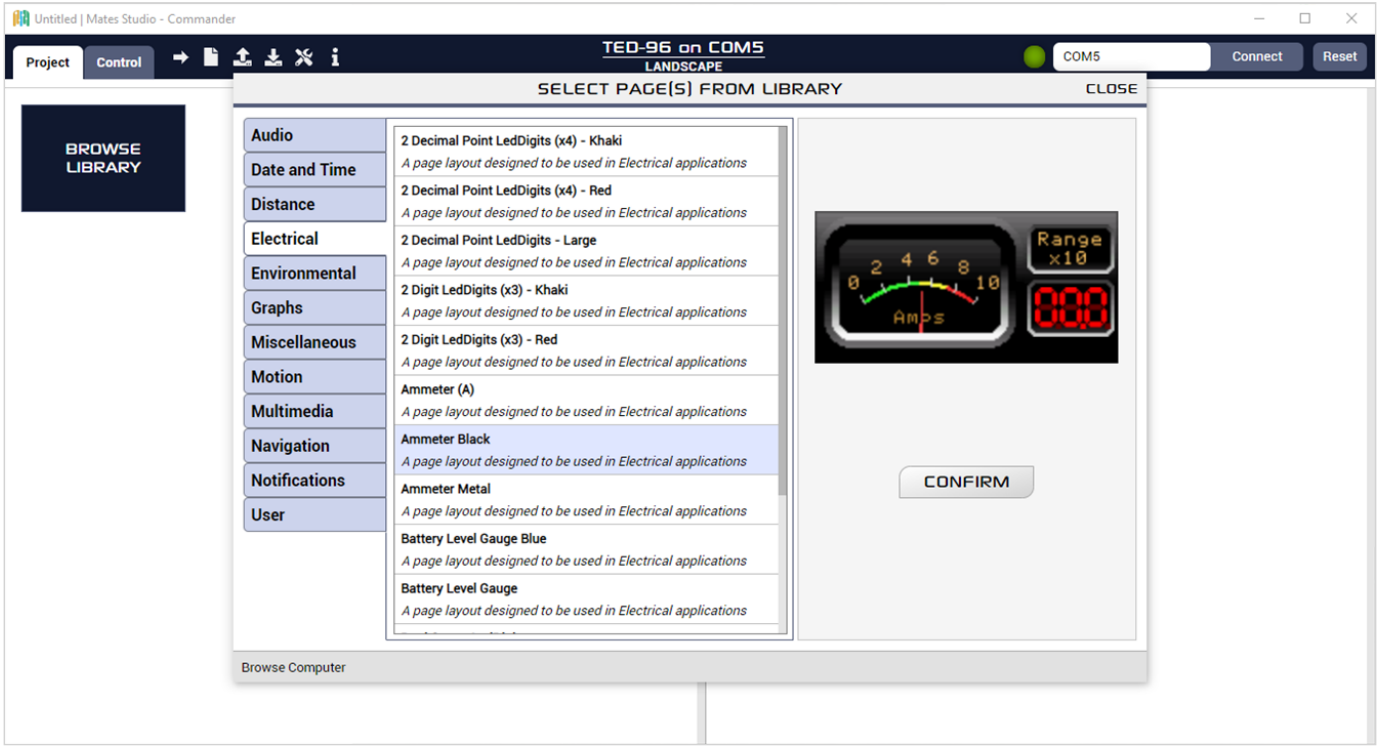
If the jumper is placed on the 2 pins closest to the USB connector, this will make the programmer compatible with programming Atmel chips, such is used on many of the Arduino boards, or barebone chips. This may also be compatible with other microcontrollers too.

Software Requirements

All software development for the TED-96 module utilizes the Mates Studio IDE.

The latest version of Mates Studio can be downloaded from the 4D Systems website or directly from this link here.

Details specific about the Mates Studio IDE can be found in the Mates Studio IDE documentation.



Typical Connections

Direct Interface with Programmer

One of the simplest interfaces for TED-96 is connecting a male pin header to the Left side of TED-96 and attaching the Mates Programmer to the header directly. This is more a development type approach, however headers could be utilised on TED-96 to plug into the main PCB in the product, or into a cable.

At minimum, a 5-way header is required for programming TED-96, however using a 6-way header may make more sense if this is going to be a more permanent solution, so all pins can be utilised. Adding a second header onto the Right side of TED-96 will give access to all pins as required.

Interface to a Host

TED-96 can interface to virtually any microcontroller or Host, using a Serial UART interface. Simple wire connections can be achieved directly to TED-96, either soldered directly or via a soldered header. If the microcontroller or Host utilises 3.3V or 5.0V UART, then TED-96 can be easily connected.

Interface Notes

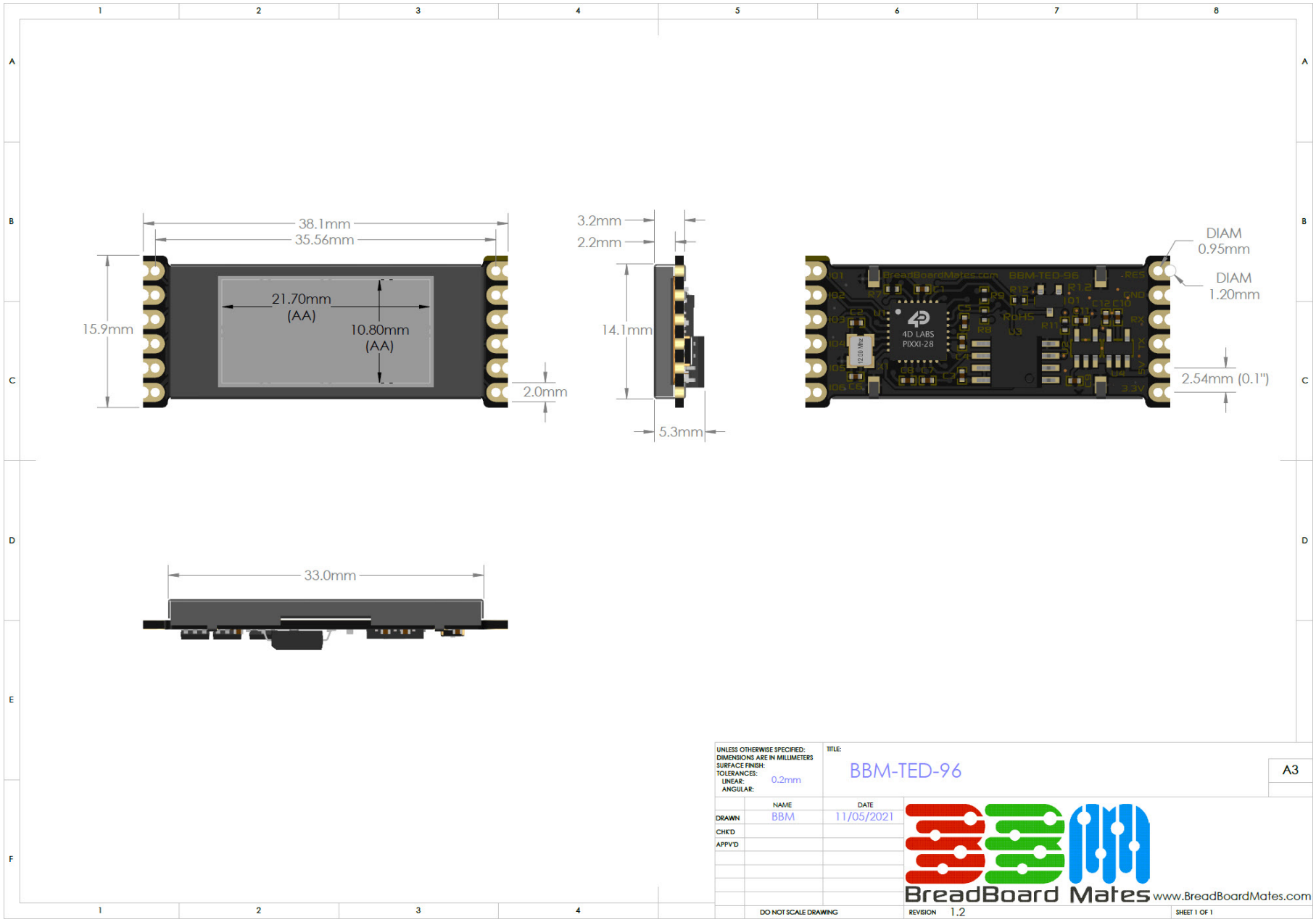
TED-96 has a single Serial UART, which is shared for the programming from the Mates Studio IDE, but it can also be used to interface to a Host or other device.

When programming the TED-96, 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-96 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.

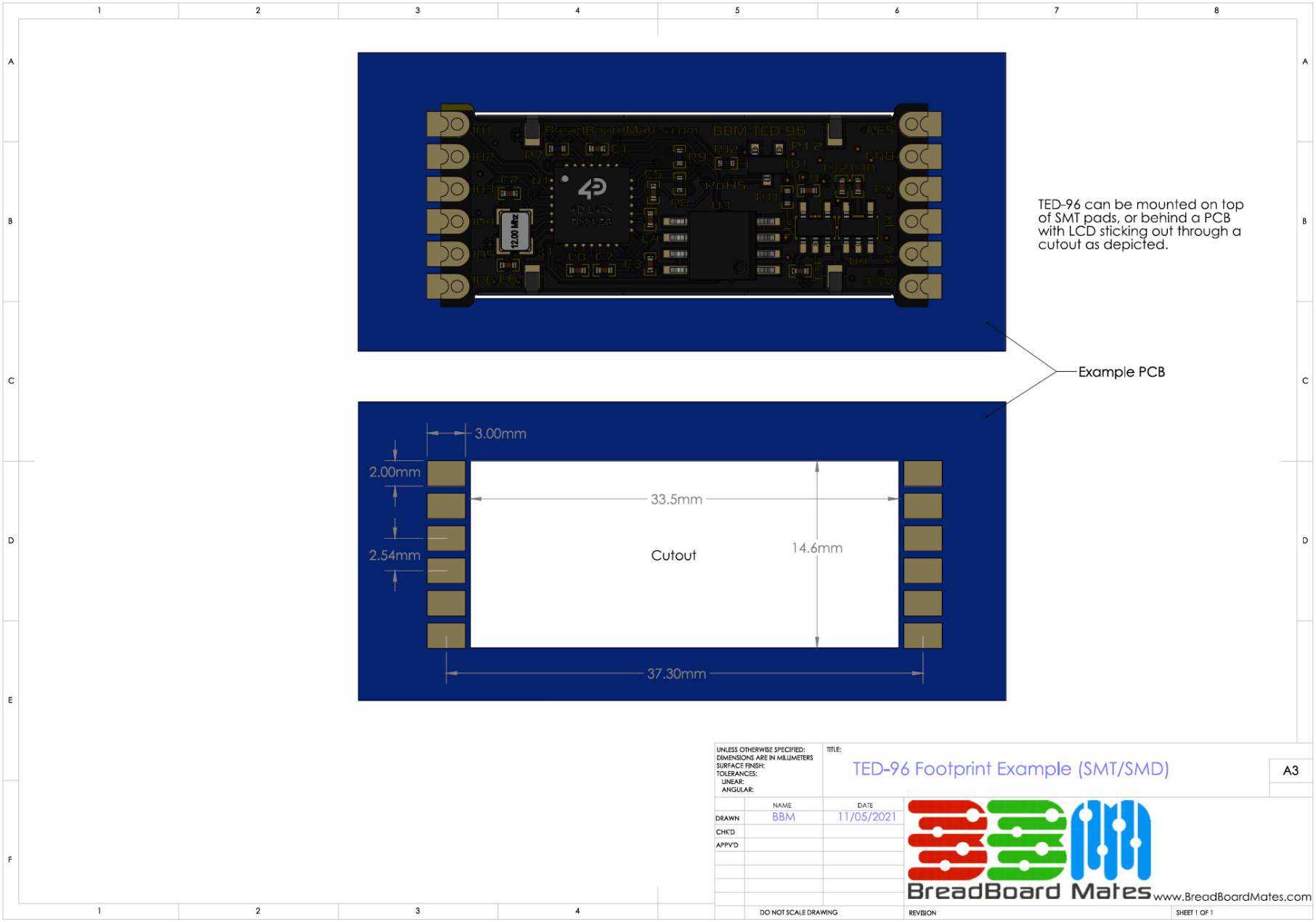
When designing a final product, a switch or jumper may be utilised to isolate the RX pin, allowing only Programming TX signals to reach the TED-96's RX pin, until the switch is changed. This is useful as it means unplugging or unwiring the UART is no longer required when programming TED-96.

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-96 to program them.

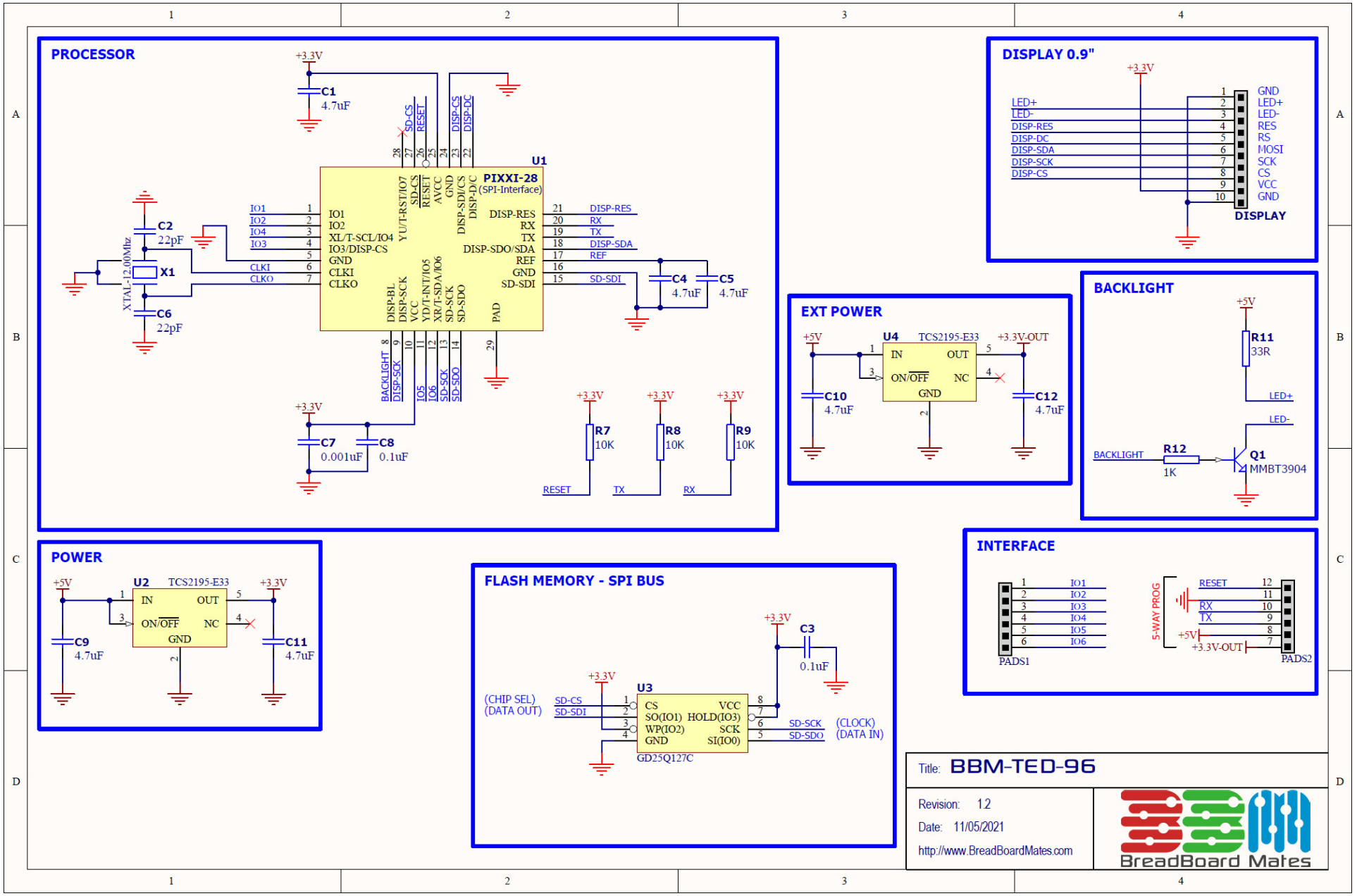
Hardware Drawing



Hardware SMD/SMT Footprint



Hardware Schematic



Specifications & Ratings

Recommended Operating Conditions

Parameter	Conditions / Information	Min	Typ	Max	Un
Operating Temperature		-20	—	+70	°(
Storage Temperature		-30	—	+80	°(
Humidity (RH)	Max 60°C	—	—	90%	R
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	—	—	µ
Operational Delay	Power-Up or External Reset	500	—	3000	m
Output Voltage (3V3)	Output Voltage for User	—	3.3	—	V
Output Current	Output Current capability for User	—	500	—	m
GPIO Current	Source / Sink	—	—	15	m

Operating Characteristics

Parameter	Conditions / Information	Min	Typ	Max	Ur
Supply Current (ICC)	5V Supply – Normal Operation	—	90	—	m
Supply Current (ICC)	5V Supply – Sleep Mode	—	3	—	m
Supply Current (ICC)	5V Supply – Deep Sleep Mode	—	2	—	m
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		0.96” Diagonal
Display Resolution		160×80 pixels
Display Brightness	5V Supply	120 cd/m2 (typical)
Display Contrast Ratio		800:1 (typical)
Display Viewing Angles	Above, Below, Left and Right of Center	80 Degrees
Display Viewing Direction		ALL (IPS Display)
Display Backlighting	White LED Backlighting	1 LED
Pixel Pitch		0.135 x 0.135mm (Square pixels)
Pixel Density	Number of pixels in 1 row in 25.4mm	187 DPI/PPI