IoD-09 Series

IoD-09TH (0.9" Through Hole Version)
IoD-09SM (0.9" Surface Mount Version)

Datasheet

Contents

1. Description

The IoD-09 (Internet of Displays) series is a range of miniature display modules Designed and Manufactured by 4D Systems.

The IoD-09 modules feature a full-colour 0.9" TFT LCD. They are powered by the WiFi-enabled ESP8266, which offers an array of functionality and options for any Designer / Integrator / User.

The IoD-09 modules can be easily programmed using 4D Systems Workshop4 or the Arduino IDE installed with the ESP8266 core.

The feature-rich 4D Systems GFX4dIoD09 library enables speedy development of applications by providing extensive primitive graphics functions, enhanced graphics via Workshop4, SD card access, and much more, all integrated into a single library.

The onboard SD card socket enables the use of FAT16 or FAT32 formatted cards for extensive storage capabilities.

The IoD-09 modules feature 12 pads, 6 on each end, for easy and simple connection to an application or mother board, or for connecting to accessory boards for a range of functionality advancements. The IoD-09TH features Through Hole (TH) pads with male pin headers mounted, and the IoD-09SM features Surface Mount (SM) pads.

This range of modules has been designed to minimise the impact of display-related circuitry and provide a platform suitable for integration into a product.

The IoD-09 modules can act as master or slave devices, they can be effortlessly connected to the internet, can display a raft of information and graphics, along with the capability to communicate to SPI, I2C, and/or 1-wire devices, as well as having general GPIO for digital control/input.

More information on the Espressif ESP8266 SoC can be found on the Espressif website and the ESP8266EX SoC datasheet.

> ✏️ **Note**
>
> The IoD-09TH module is recommended for all applications, whereas the IoD-09SM module is designed for integrators, due to the nature of its Surface Mount pads. The IoD-09TH is easily programmed with the 4D-UPA and should be the module of choice for most applications.
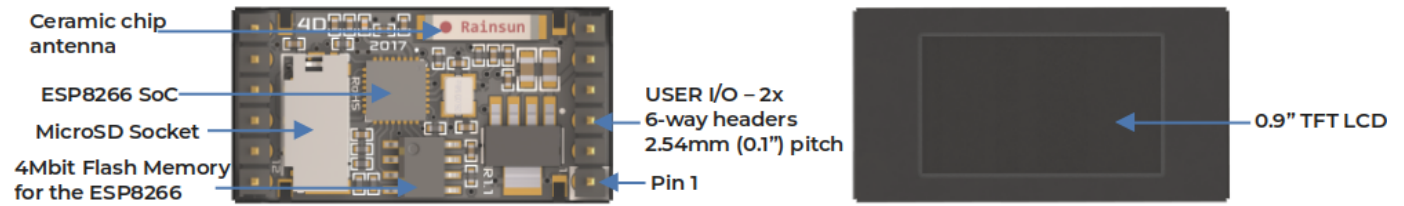
2. Features

- Powerful Intelligent LCD-TFT display module powered by the Espressif ESP8266 SoC.

- 80 x 160 Resolution, full colour TFT Screen

- Built-in WiFi is suitable for 'Internet of Things' applications.

- 802.11 b/g/n/e/i support

- Integrated TCP/IP protocol stack

- WiFi 2.4 GHz, supporting WPA/WPA2 and WEP/TKIP/AES, along with STA/AP/STA+AP/P2P operation modes

- 4Mbit (512kb) of Flash memory for User Application Code and Data.

- 128Kb of SRAM of which 80kb is available for the User.

- 12pin/pad connection, for all signals, power, communications and programming.

- On-board push/pull type microSD memory card connector for multimedia storage and data logging purposes.

- DOS-compatible file access (FAT16 or FAT32 format).

- Display full-colour images, animations, and icons.

- 4.0V to 5.5V range operation (single supply). A 1Amp+ supply is highly recommended for stability.

- Module dimensions:

    - (TH version) - 31.8 x 16.4 x 11.7mm

    - (SM version)- 37.0 x 16.4 x 5.9mm

- Weighing:

    - (TH version) - ~ 5g

    - (SM version) - ~ 5g

- RoHS, REACH and CE compliant.

> ✏️ **Note**
>
> - Arduino is a trademark of Arduino Team, and all references to the word "Arduino" or the use of its logo/marks are strictly about the Arduino product, and how this product is compatible with the aspect of the product but is not associated with the Arduino Team in anyway.
> - ESP8266 / ESP8266EX are products made by Espressif. 4D Systems is not associated with Espressif in anyway, other than using their product.

3. Hardware Overview (IoD-09TH)

Ceramic chip antenna

ESP8266 SoC

MicroSD Socket

4Mbit Flash Memory for the ESP8266

USER I/O – 2x 6-way headers 2.54mm (0.1") pitch

Pin 1

0.9" TFT LCD

🗔 Recommended Operating Conditions

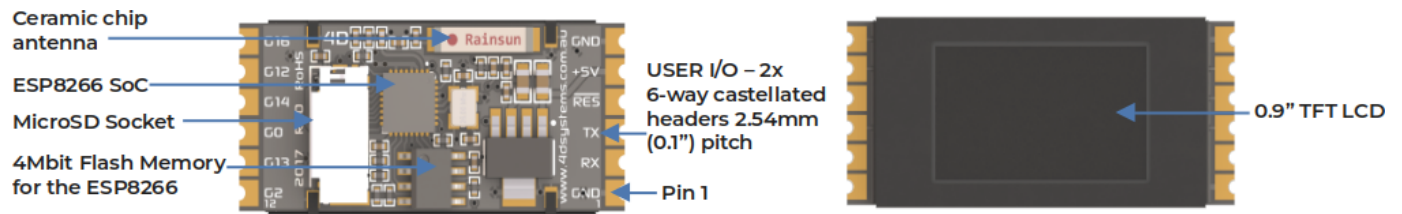| Pin	Symbol	I/O	Description
1	GND	P	Supply Ground.
2	RX	I	Asynchronous Serial Receive pin, TTL level. Connect this pin to the Transmit (Tx) signal of other serial devices. Used in conjunction with the TX pin for programming this module. This pin is tolerant up to 3.3V levels.
3	TX	O	Asynchronous Serial Transmit pin, TTL level. Connect this pin to the Receive (Rx) signal of other serial devices. Used in conjunction with the RX pin for programming this module. This pin outputs 3.3V levels.
4	RESET	I	Master Reset signal. Internally pulled up to 3.3V via a 10K resistor. An active Low pulse greater than 2 micro-seconds will reset the module. If the module needs to be reset externally, only use open collector-type circuits. This pin is not driven low by any internal conditions. The host should control this pin via one of its port pins using an open collector/drain arrangement.
5	5V	P	Main Voltage Supply +ve input pin. The range is 4.0V to 5.5V, nominal 5.0V.
6	GND	P	Supply Ground.
7	GPIO16	I/O	I/O pin. Can be used as digital input or output. Can also be used for PWM and 1-wire device interfacing. This pin is available to the user. This pin is tolerant up to 3.3v levels.
8	GPIO12	I/O	This pin is the MISO pin used on the SPI Bus. This pin is tolerant up to 3.3v levels.
9	GPIO14	I/O	This pin is the SCK pin used on the SPI Bus. This pin is tolerant up to 3.3v levels.
10	GPIO0	I/O	I/O pin. This pin is also used for flash programming. This pin is tolerant up to 3.3v levels. This pin can be used for I2C communications. **NOTE**: Special Pin
11	GPIO13	I/O	This pin is the MOSI pin used on the SPI Bus. This pin is tolerant up to 3.3v levels.
12	GPIO2	I/O	I/O pin. This pin is also used for boot selection. This pin is tolerant up to 3.3v levels. This pin can be used for I2C communications. **NOTE**: Special Pin.

✏️ Note

I = Input, **O** = Output, **P** = Power

4. Hardware Overview (IoD-09SM)

Ceramic chip antenna

ESP8266 SoC

MicroSD Socket

4Mbit Flash Memory for the ESP8266

USER I/O – 2x 6-way castellated headers 2.54mm (0.1") pitch

Pin 1

0.9" TFT LCD

🗔 Recommended Operating Conditions

Pin	Symbol	I/O	Description
1	GND	P	Supply Ground.
2	RX	I	Asynchronous Serial Receive pin, TTL level. Connect this pin to the Transmit (Tx) signal of other serial devices. Used in conjunction with the TX pin for programming this module. This pin is tolerant up to 3.3V levels.
3	TX	O	Asynchronous Serial Transmit pin, TTL level. Connect this pin to the Receive (Rx) signal of other serial devices. Used in conjunction with the RX pin for programming this module. This pin outputs 3.3V levels.
4	RESET	I	Master Reset signal. Internally pulled up to 3.3V via a 10K resistor. An active Low pulse greater than 2 micro-seconds will reset the module. If the module needs to be reset externally, only use open collector-type circuits. This pin is not driven low by any internal conditions. The host should control this pin via one of its port pins using an open collector/drain arrangement.
5	5V	P	Main Voltage Supply +ve input pin. The range is 4.0V to 5.5V, nominal 5.0V.
6	GND	P	Supply Ground.
7	GPIO16	I/O	I/O pin. Can be used as digital input or output. Can also be used for PWM and 1-wire device interfacing. This pin is available to the user. This pin is tolerant up to 3.3v levels.
8	GPIO12	I/O	This pin is the MISO pin used on the SPI Bus. This pin is tolerant up to 3.3v levels.
9	GPIO14	I/O	This pin is the SCK pin used on the SPI Bus. This pin is tolerant up to 3.3v levels.
10	GPIO0	I/O	I/O pin. This pin is also used for flash programming. This pin is tolerant up to 3.3v levels. This pin can be used for I2C communications. **NOTE**: Special Pin
11	GPIO13	I/O	This pin is the MOSI pin used on the SPI Bus. This pin is tolerant up to 3.3v levels
12	GPIO2	I/O	I/O pin. This pin is also used for boot selection. This pin is tolerant up to 3.3v levels. This pin can be used for I2C communications. **NOTE**: Special Pin.

✏️ Note

I = Input, **O** = Output, **P** = Power

5. Hardware Description

The IoD-09TH is a Through Hole design that features DIP style male pin headers, designed to plug into female connectors, onto jumper wires/harnesses, into a breadboard for testing, or directly into PCB holes and soldered in place.

The IoD-09SM is a Surface Mount design, which features castellated pads, which can be soldered to wires or male pins, but are designed to be directly connected to a host PCB, and soldered in place.

The IoD-09TH is designed to be programmed with the 4D-UPA programming adaptor and simply plugs on and off easily. The IoD-09SM cannot easily connect to the 4D-UPA, as it has no pins. Wires can be soldered to the IoD-09SM and then connected to the 4D-UPA programmer, but the intent of the IoD-09SM is for integration into a product and programming in place.

5.1. Mounting the Hardware

The IoD-09TH features male pins, which are at a regular 0.1" (2.54mm) pitch spacing, and are designed to plug into another PCB (headers or directly into pads) for easy plug 'n play style mounting. The metal casing features shaped 'feet', allowing the module to sit down on a surface, giving the rear electronics space. A hole can be formed in the host PCB, to give access to the electronics, if direct mounting to PCB pads is selected.
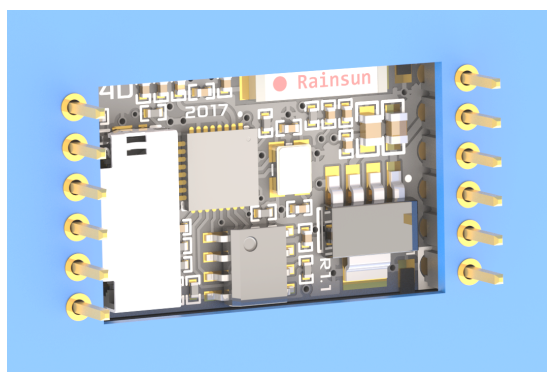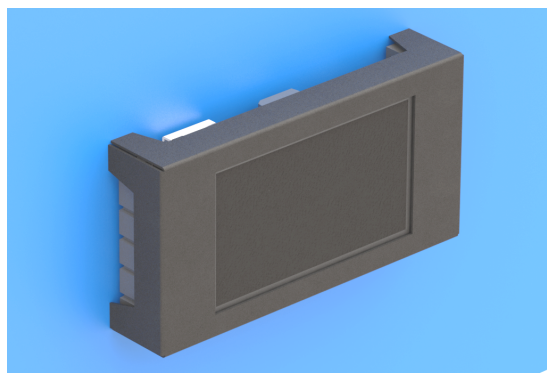

The IoD-09SM features surface-mount castellated pads and is designed to be soldered in place onto a host PCB. This module can be mounted on a PCB in 2 main ways.

A hole the size of the front of the metal frame could be formed in the product, the IoD-09SM placed through the hole, and the surface mount pads being soldered to the back. Illustrated below.
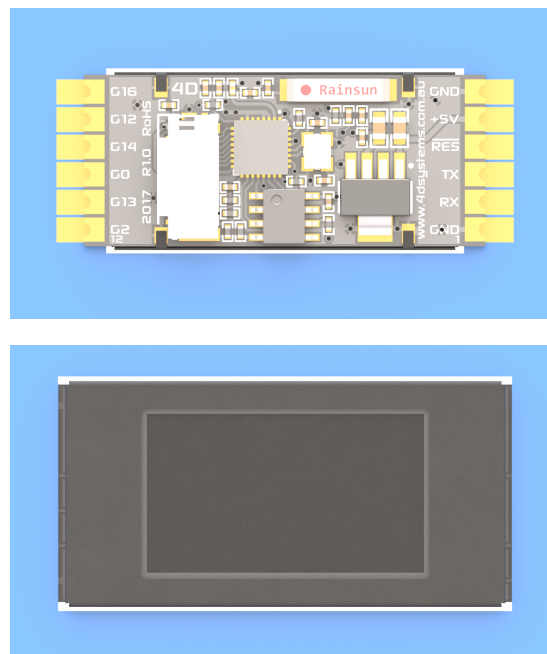
A hole the size of the rear of the module, with enough clearance for the electronics, is formed in the product, and the IoD-SM sits in the hole with the surface mount pads being soldered from the front, and its electronics accessed through the hole.
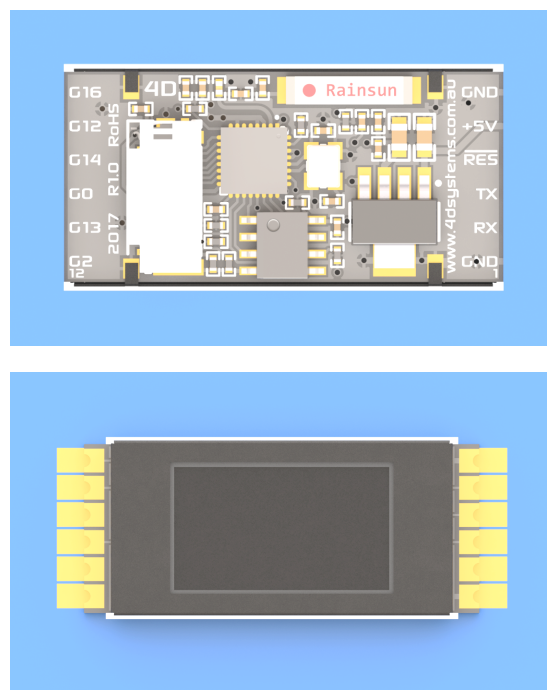
6. Hardware Interface - Pins

This section describes in detail the hardware interface pins of the device.

6.1. Serial Port - TTL Level

The ESP8266 Processor has hardware asynchronous serial ports that can be accessed via the headers on the IoD-09 module. You can use the serial port to communicate with external serial devices.

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 921600 baud.
- Single byte transmits and receives a fully buffered service. The buffered service feature runs in the background capturing and buffering serial data without the user application having to constantly poll any of the serial ports. This frees up the application to service other tasks.

A single-byte serial transmission consists of the start bit, 8 bits of data followed by the stop bit. The start bit is always 0, while a stop bit is always 1. The LSB (Least Significant Bit, Bit 0) is sent out first following the start bit. The Figure below shows a single-byte transmission timing diagram.
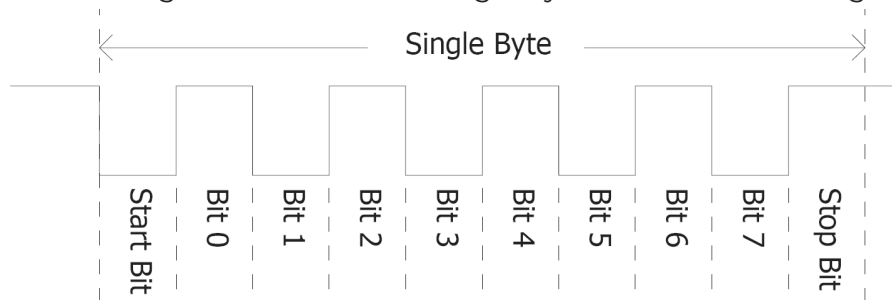
The serial port is also the primary interface for User program downloads, and configuration via the IDE.

6.2. System Pins

+5V (Module Voltage Input):

Module supply voltage input pins. This pin should be connected to a stable supply voltage in the range of 4.0 Volts to 5.5 Volts DC. The nominal operating voltage is 5.0 Volts. Note that backlight brightness will be dimmer for voltages under 5.0V.

GND (Module Ground):

Device ground pins. Both pins should be connected to the ground.

RESET (Module Master Reset):

Module Master Reset pin. An active low pulse of greater than 2µs will reset the module. Internally pulled up to 3.3V via a 10K resistor. Only use open collector-type circuits to reset the device if an external reset is required.

GPIO0 (Flash Programming):

This pin is primarily used for the Flashing of the ESP8266's Flash Memory via the programming software. This pin must be left floating at power-up to enable the ESP8266 to boot correctly. Once the module has been booted, you can use this pin for I2C or GPIO operations.

GPIO2 (Flash Mode):

This pin is primarily used to tell the ESP8266 which mode it needs to be in and to load from Flash Memory. This pin must be left floating at power-up to enable the ESP8266 to boot correctly. you can use this pin for I2C or GPIO operations.

GPIO12 (MISO):

This pin is the MISO SPI pin, which is used for the Display, and the microSD card, and is also available for the User to connect additional SPI devices to the bus. You can use it with the other SPI pins and requires GPIO0, GPIO2 or GPIO16 for the Chip Select of any additional devices.

GPIO13 (MOSI):

This pin is the MOSI SPI pin, which is used for the Display, and the microSD card, and is also available for the User to connect additional SPI devices to the bus. You can use it with the other SPI pins and requires GPIO0, GPIO2 or GPIO16 for the Chip Select of any additional devices.

GPIO14 (SCK):

This pin is the SCK SPI pin, which is used for the Display, and the microSD card, and is also available for the User to connect additional SPI devices to the bus. You can use it with the other SPI pins and requires GPIO0, GPIO2 or GPIO16 for the Chip Select of any additional devices.

GPIO16 (User GPIO):

Input/Output available to the user. You can use this pin as a digital input/output to connect with sensors, relays etc. You can also use this pin for '1-wire' protocol devices and as a PWM output, or it can be used as the Chip Select for the SPI bus.

6.3. SPI

There is 1 hardware SPI channel (HWSPI) which is used to drive the screen and the SD card. The SPI channel can communicate at speeds up to 80 MHz. The SPI channel is Master only and you can use it with additional SPI devices, however, is shared with the Display and the SD Card. An additional GPIO is required for each additional SPI device to be added to the bus, to act as Chip Select.

When communications to the Display are taking place, the SPI bus must not exceed 39 MHz, which is the maximum stable speed it can operate.

When communications to the SD card are taking place, the SPI bus must not exceed 30 MHz, which is the maximum stable speed it can operate. You may need to reduce further depending on the capabilities of the SD card. This is configurable in the GFX4dIoD09 library.

> ✏️ **Note**
>
> The SPI channel (HWSPI) is dedicated to the memory card, and screen. You cannot reconfigure the HWSPI channel for alternate uses, as the Display and SD card would then be inoperable.

6.4. I2C

I2C is available on the IoD-09, using GPIO0 and GPIO2. However, these pins must be left to be pulled high during startup, for the ESP8266 to boot correctly. Pull-up resistors are present on the IoD-09 so it boots correctly, which is also required for I2C. The IoD-09 is compatible with 100kbit/s and 400kbit/s bus speeds, (higher may be possible, refer to ESP8266 documentation).

The TX and RX serial UART pins on the IoD-09 (ESP8266) are also compatible with I2C if these are desired to be used instead. No pull-up resistors are built into the IoD-09 for these pins.

6.5. 1-Wire

1-Wire communications are available on GPIO0, GPIO2 or GPIO16, to communicate with Delas 1-wire compatible devices. A library for IoD-09 has been created to use this communication bus type.

7. ESP8266 SoC

The module is designed around the ESP8266 SoC from Espressif.

The ESP8266 is a 32-bit RISC Microcontroller with a built-in WiFi controller, and GPIO capability, however, some GPIO is used for onboard features, such as the TFT LCD and MicroSD card.

The TFT-LCD interfaces to the ESP8266 using SPI, along with the microSD card. This enables high-speed transfers for these peripherals, providing fast graphics and fast SD card access.

Powerful graphics, text, images, animation, internet access and countless more features are available to the user via the 4D Systems GFX4dIoD09 library and 4D Systems Workshop4 IDE. Alternatively, you can use the Arduino IDE to write drivers/software for the module as required.

8. SD/SDHC Memory Cards

The IoD-09 module supports microSD cards via the onboard micro-SD connector.

The memory card is used for all multimedia file retrieval such as images, animations and data files. Also, you can use the card as general-purpose storage for data logging applications.

Support is available for off-the-shelf high-capacity HC memory cards (4GB and above). Memory cards up to 32GB in size can be used, such as FAT16 or FAT32, however, it must be noted that only a portion of this can be used by the FAT16 file system.

9. Display/Module Precautions

- Avoid having to display the same image/object on the screen for lengthy periods. This can cause a burn-in which is a common problem with all types of display technologies. Implement a screen saver feature if possible, to prevent this from occurring, or considerably slow the process. LCDs suffer considerably less than OLED displays, however, it is still recommended to implement a screen saver if possible.

- Moisture and water can damage the display. If water is to enter the display either from the front or from the rear, or comes in contact with the PCB, it will damage. Wipe off any moisture gently or let the display dry before usage. If using this display module in an environment where it can get wet, ensure an appropriate enclosure is used.

- Dirt from fingerprint oil and fat can easily stain the surface of the display. Gently wipe off any stains with a soft lint-free cloth.

- The performance of the display will degrade under elevated temperature and humidity. Avoid such conditions when storing.

- Displays are susceptible to mechanical shock and any force exerted on the module may result in deformed zebra stripes, a cracked display cell and a broken backlight

- Display modules have a finite life, which is typically dictated by the display itself, more specifically the backlight. The backlight contains LEDs, which fade over time. In the Specifications section is a figure for the typical life of the display, and the criteria are listed.

10. Hardware Tools

The following hardware tools are required for full control of the IoD-09 Display Modules.

10.1. 4D-UPA Universal Programmer

The 4D Systems 4D-UPA is an essential hardware tool to program, customise and test the IoD-09TH Display Module. It is not plug-and-play compatible with the IoD-09SM Display Module due to the nature of how the Surface Mount version attaches, however it could be wired up to program the IoD-09SM if required.

The 4D-UPA is used to program the IoD-09TH via Workshop4 and/or the Arduino IDE. It even serves as an interface for communicating serial data to the PC.
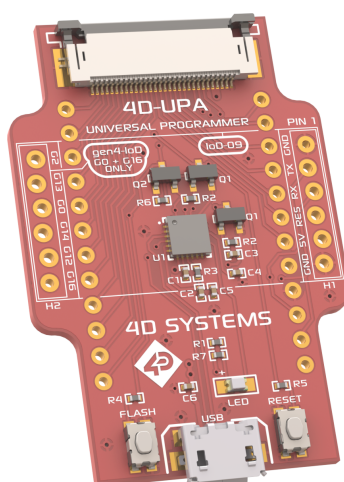
The 4D-UPA is available from the 4D Systems website.

Please note, the 4D-UPA can be used as a simple interface to power the IoD-09 or to connect to other devices.

The 4D-UPA programmer features an Auto-Reset circuit (*credit-NodeMCU*), but also features Reset and Flash buttons, for flexibility.

Alternatively, other programming devices could be used, including programming from a host controller. Please refer to the ESP8266 datasheet for more programming options for this SoC.

11. Programming the IoD

There are two IDEs available to program the IoD-09. Using the Arduino IDE, or using the 4D Systems Workshop4 IDE.

Using the Workshop4 IDE provides additional graphical benefits over using the Arduino IDE, however, the Worskhop4 IDE is only Windows-based (unless via a Virtual Machine).

If using the Workshop4 IDE, Workshop4 installation will call the Arduino IDE in the background for programming the board (handled automatically and invisibly). Some minor setup is required to install the board into the Arduino IDE, using the Board Manager and installing the JSON file. See the Arduino IDE section.

If the Workshop4 IDE is not going to be used at all, then the IoD board needs to be added to the Arduino IDE in the same way, using the Arduino Board Manager. More details are in the Arduino IDE section.

11.1. Arduino IDE

The IoD-09 is Arduino IDE compatible. The IoD can be directly programmed via Arduino IDE like any other ESP8266/Arduino module.

The IoD-09 must be added to the Arduino IDE. This is typically done using the Boards Manager.

Advanced users who wish to use the GitHub main repository are welcome to, which also supports the IoD-09, however, is not classed as Stable by the ESP8266 community so should be used with caution.

The easiest way to install the IoD-09 into the Arduino IDE is by installing the Stable release JSON file provided by the ESP8266 community. This is done by starting up the Arduino IDE, going to File, Preferences, and entering the following line into the 'Additional Boards Manager URLs' field. If you already have a listing in there, simply add a comma after the last one, and paste this new URL in at the end: https://arduino.esp8266.com/stable/package_esp8266com_index.json

Click OK on the preferences window to close it.

Go up to Tools, Board, and click on Board Manager.
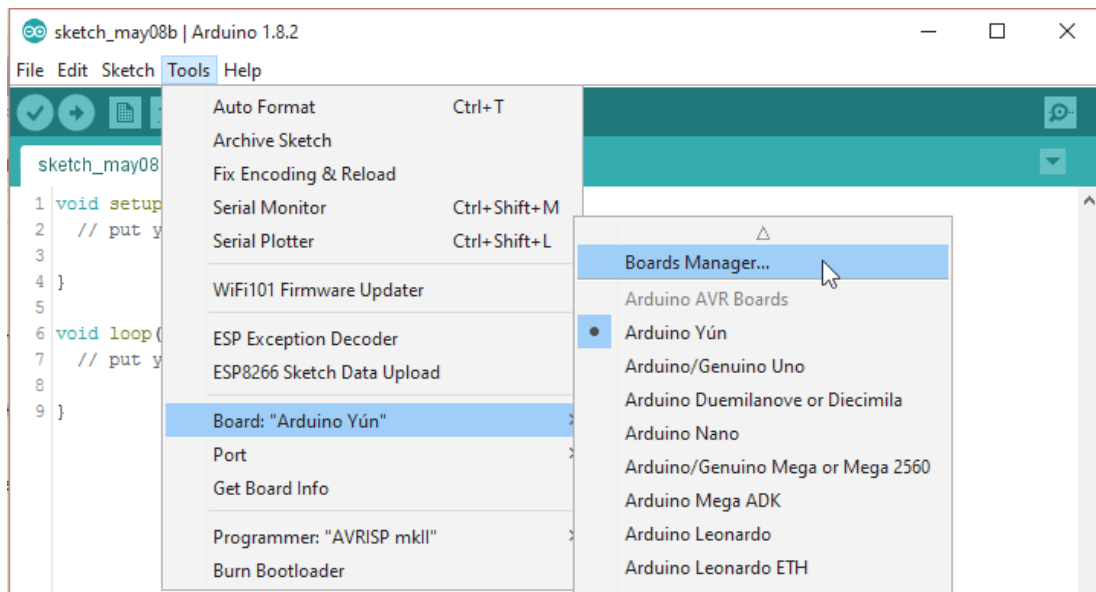
Once it loads, scroll down to the bottom, and you should see a listing for esp8266. Click on it, then on install, and install the latest version.

Once this has been completed, click Close, and then shut down the Arduino IDE.

The Arduino IDE should then be set up to start using the IoD-09.

> ✏️ **Note**
>
> For advanced users, the GitHub repository for the Arduino esp8266 core (non-stable version), is not classed as being stable by Espressif. Use at your own risk. Follow the instructions on their GitHub readme.
>
> The ESP8266 Core is not maintained or created by 4D Systems. It belongs to esp8266.com.

11.2. Additional Libraries

Check out the GFX4d library from the 4D Systems GitHub page. The page contains the library specifically for the IoD-09 and some demo applications.

This library can be downloaded and added to the Arduino IDE, like any normal library.

Navigate to https://github.com/4dsystems/GFX4dIoD9 and download the repository, using the download/clone button. Save the zip file to your PC.

Open the Arduino IDE, and go to Sketch - Include Library - Add Zip Library
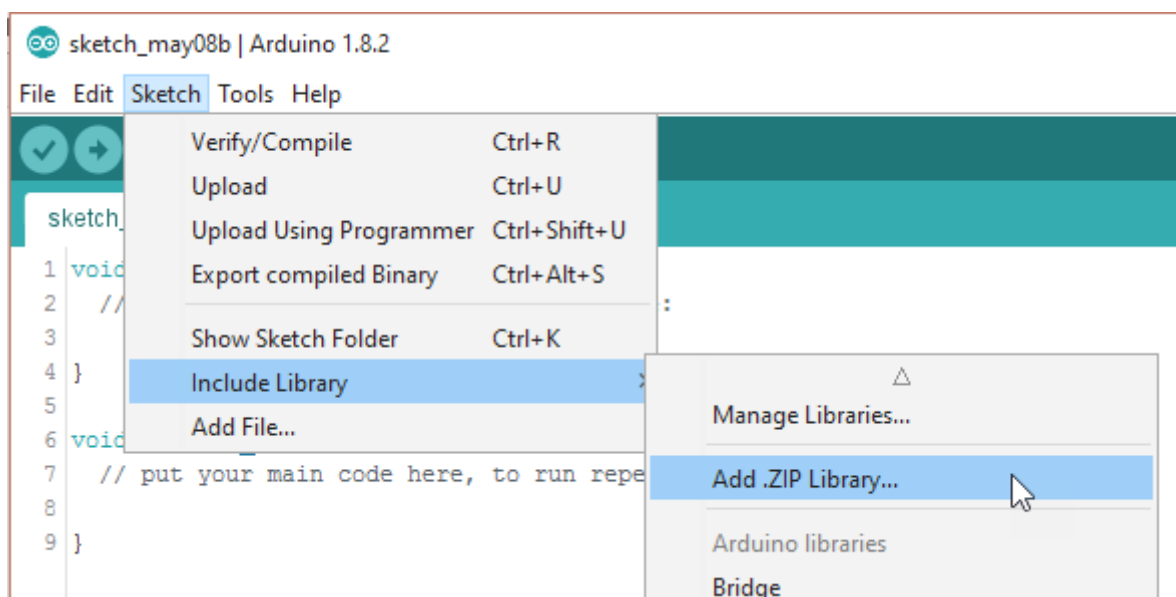
The library will then be installed and will be available for you to use. There are examples of applications available in the examples folder.

11.3. Workshop4 IDE

The Workshop4 IDE is a comprehensive software IDE that provides an integrated software development platform for all 4D Systems Intelligent Display Modules, including the IoD.

Workshop4 IDE allows rapid development of applications, and the IoD can take full advantage of the available extended graphics functions.

The Workshop4 IDE can create/edit Arduino code and verify/compile and then load the code into the IoD's ESP8266 processor, without having to use the Arduino IDE directly. It makes it possible to create both simple and complex graphical user interfaces.

When the Workshop4 IDE is started, it presents the User with a screen to start a new project or to load a project. Upon selecting to start a new project, another screen is displayed, presenting the wide range of 4D Systems products available to be programmed or configured by the Workshop4 IDE.

The Workshop4 IDE can be used to program the IoD-09, just as the Arduino IDE does. This is possible due to the integration of the Arduino compiler via the Arduino IDE, which allows Arduino sketches to be written and compiled from within the Workshop4 IDE, which then provides WS4 the benefit of adding graphical widgets and features to the IoD, which would otherwise not be available when using the Arduino IDE.

If you use the Workshop4 IDE, you can program the IoD module and have the opportunity to create graphics which you can call using Arduino code via the GFX4dIoD09 library. Many options are possible.

> ✏️ **Note**
>
> The Workshop4 IDE requires the Arduino IDE to be installed as Workshop4 IDE calls the Arduino IDE for compiling the Arduino sketches. The Arduino IDE however is not required to be opened or modified to program the IoD, once it has been set up. Please follow the steps found in the previous section to install and add the IoD to the Arduino IDE, before installing the Workshop4 IDE.

12. Display Module Part Numbers

The following is a breakdown of the part numbers and what they mean.

Example:

- IoD-09TH
- IoD-09SM

  IoD - IoD (Internet of Displays) Family

  09 - Display size (0.9")

  TH - Through Hole version

  SM - Surface Mount version

13. Starter Kit

4D Systems highly recommends all first-time buyers of 4D Systems' displays, to purchase the Starter Kit when purchasing their first 4D Systems display solution.

The Starter Kit provides all the hardware that is required to get the User up and running.
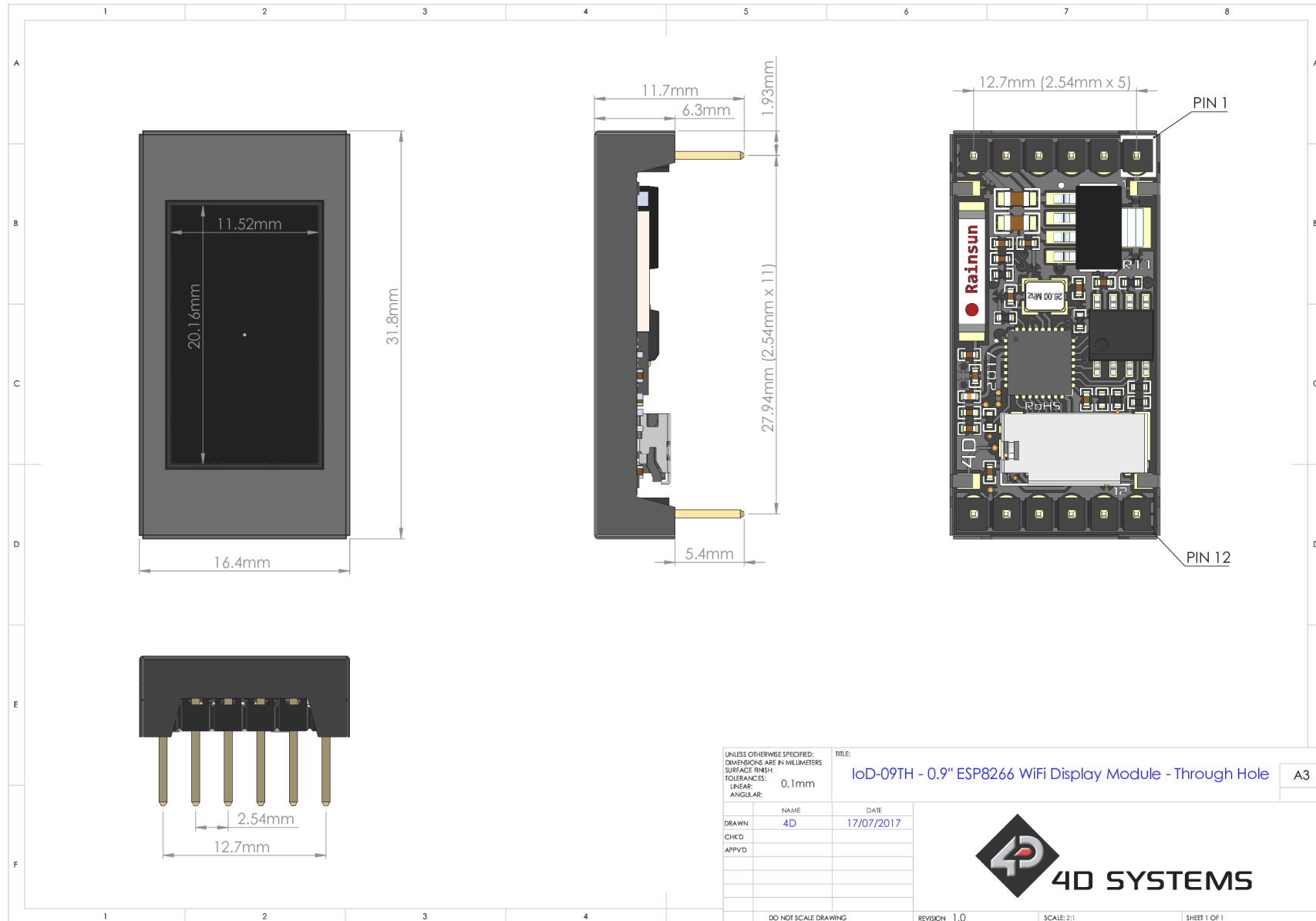
Not all development environments and features will be needed by every User. However, purchasing the display solution in a Starter Kit allows you to take full advantage of all of the features of the 4D Systems Display Solution and try out each of the 4D Woskshop4 Environments before settling with the preferred feature set.

Starter Kits typically include:

- IoD Display Module
- 4D-UPA Programmer
- 4GB micro-SD Card

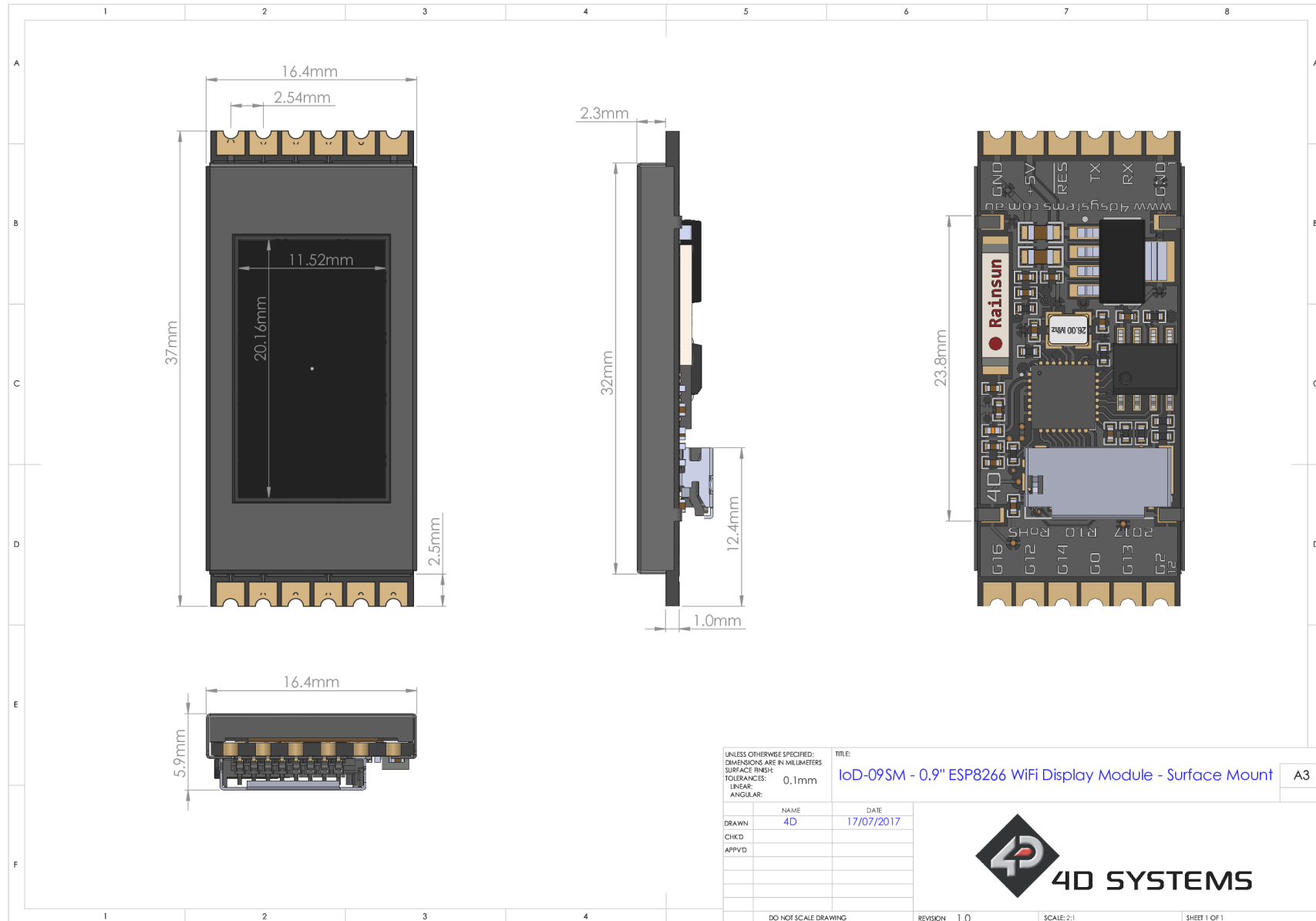Please refer to the 4D Systems website for current components included in the Starter Kit, if available. Simply select the Starter Kit option when purchasing the chosen display module on the 4D Systems shopping cart, or from your local distributor.

14. Mechanical Details - IoD-09-TH

11.7mm
6.3mm
1.93mm

11.52mm

20.16mm
31.8mm

27.94mm (2.54mm x 11)

16.4mm

5.4mm

12.7mm (2.54mm x 5)

PIN 1

PIN 12

2.54mm

12.7mm

	NAME	DATE
DRAWN	4D	17/07/2017
CHK'D		
APPV'D		

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR: 0.1mm
ANGULAR:

TITLE:
IoD-09TH - 0.9" ESP8266 WiFi Display Module - Through Hole

A3

4D SYSTEMS

DO NOT SCALE DRAWING   REVISION 1.0   SCALE: 2:1   SHEET 1 OF 1

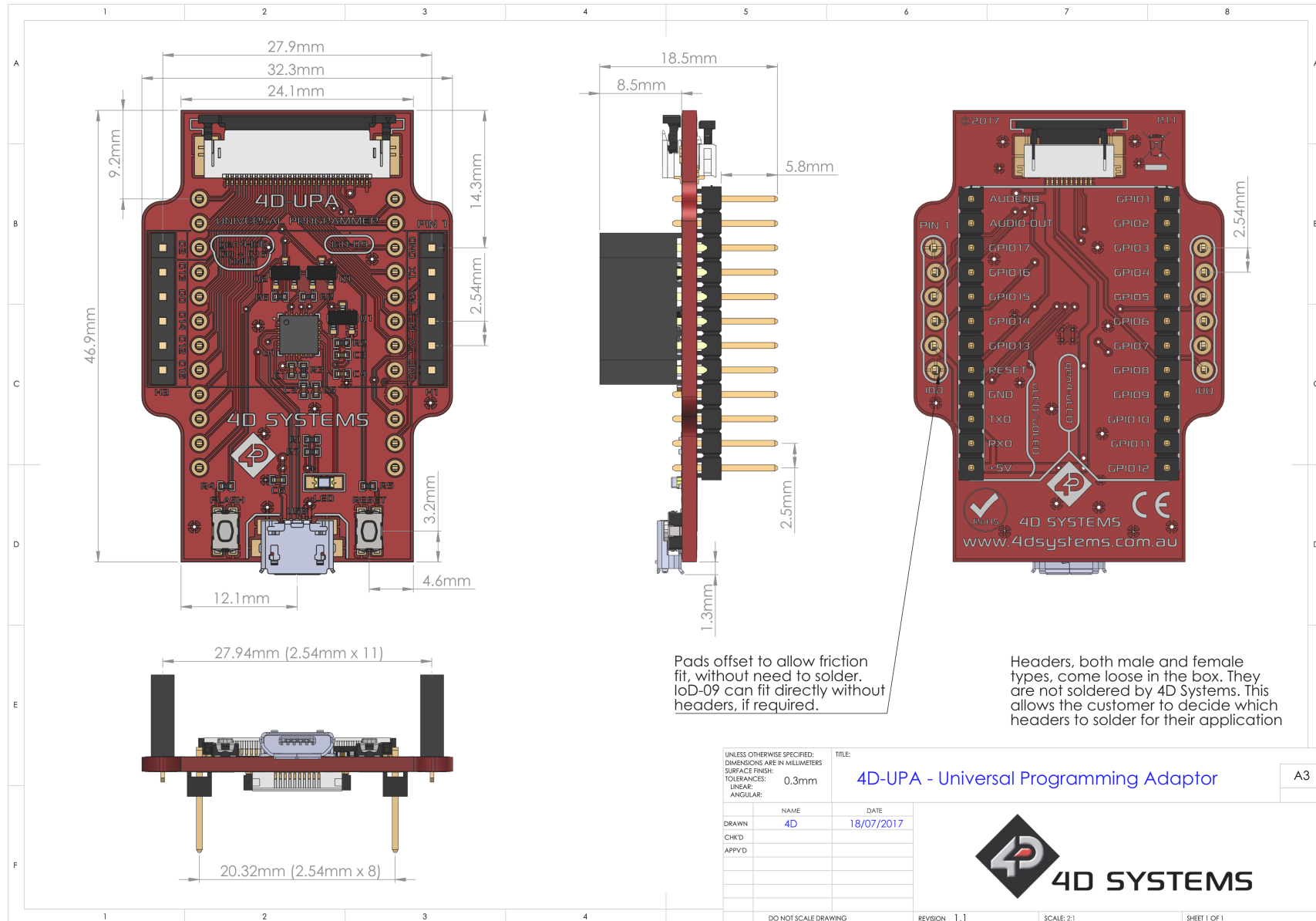## 15. Mechanical Details - IoD-09-SM

TITLE:

IoD-09SM - 0.9" ESP8266 WiFi Display Module - Surface Mount

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES: 0.1mm
  LINEAR:
  ANGULAR:

	NAME	DATE
DRAWN	4D	17/07/2017
CHK'D		
APPV'D		

A3

4D SYSTEMS

DO NOT SCALE DRAWING   REVISION 1.0   SCALE: 2:1   SHEET 1 OF 1

16. Mechanical Details - 4D-UPA Programmer

Pads offset to allow friction fit, without need to solder. IoD-09 can fit directly without headers, if required.

Headers, both male and female types, come loose in the box. They are not soldered by 4D Systems. This allows the customer to decide which headers to solder for their application

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	0.3mm	TITLE:	4D-UPA - Universal Programming Adaptor		A3
	NAME	DATE			
DRAWN	4D	18/07/2017			
CHK'D				4D SYSTEMS	
APPV'D					
DO NOT SCALE DRAWING		REVISION 1.1	SCALE: 2:1	SHEET 1 OF 1	

17. Schematic Details - IoD-09 Display Module
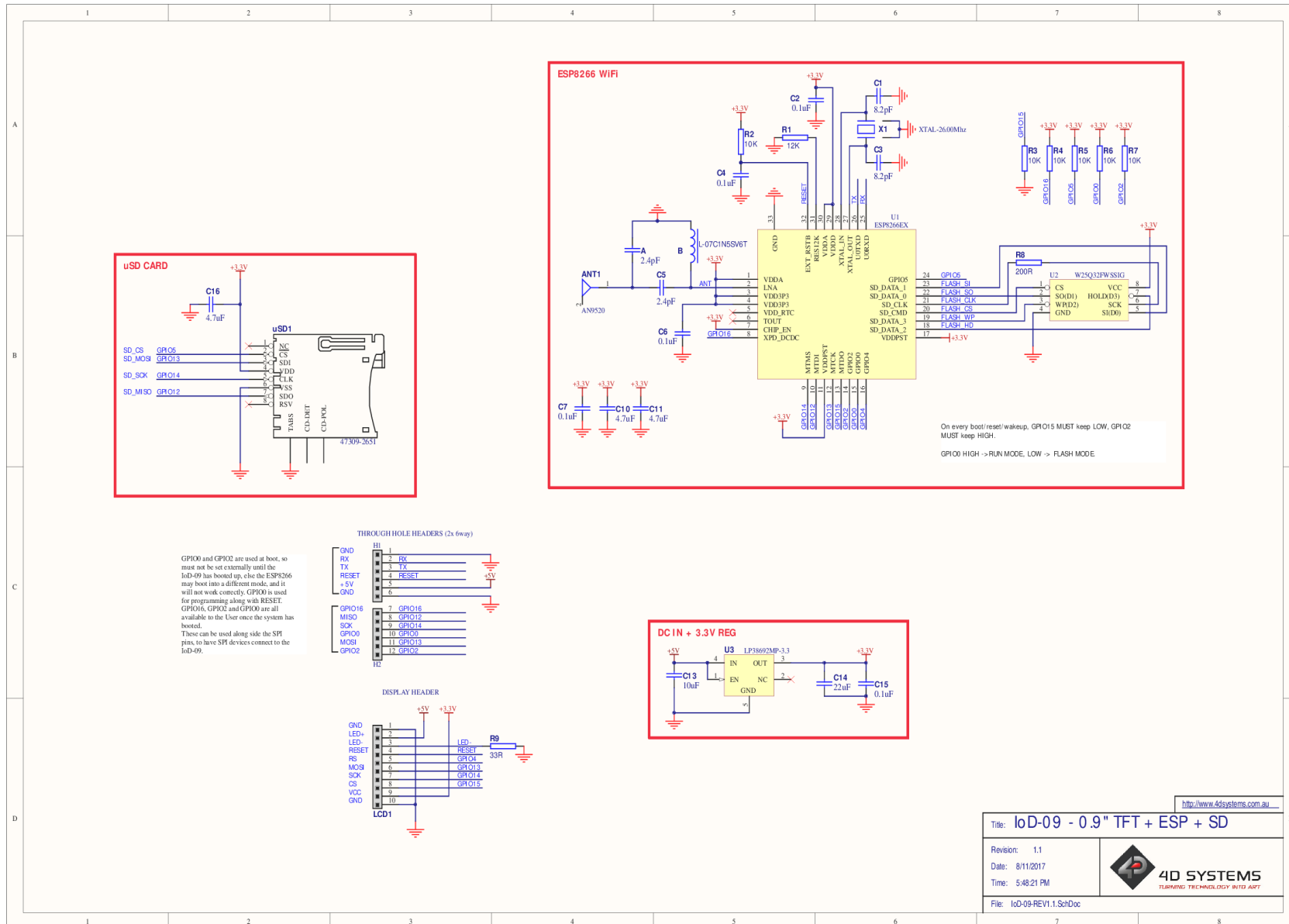
18. Schematic Details - 4D-UPA Programming Module
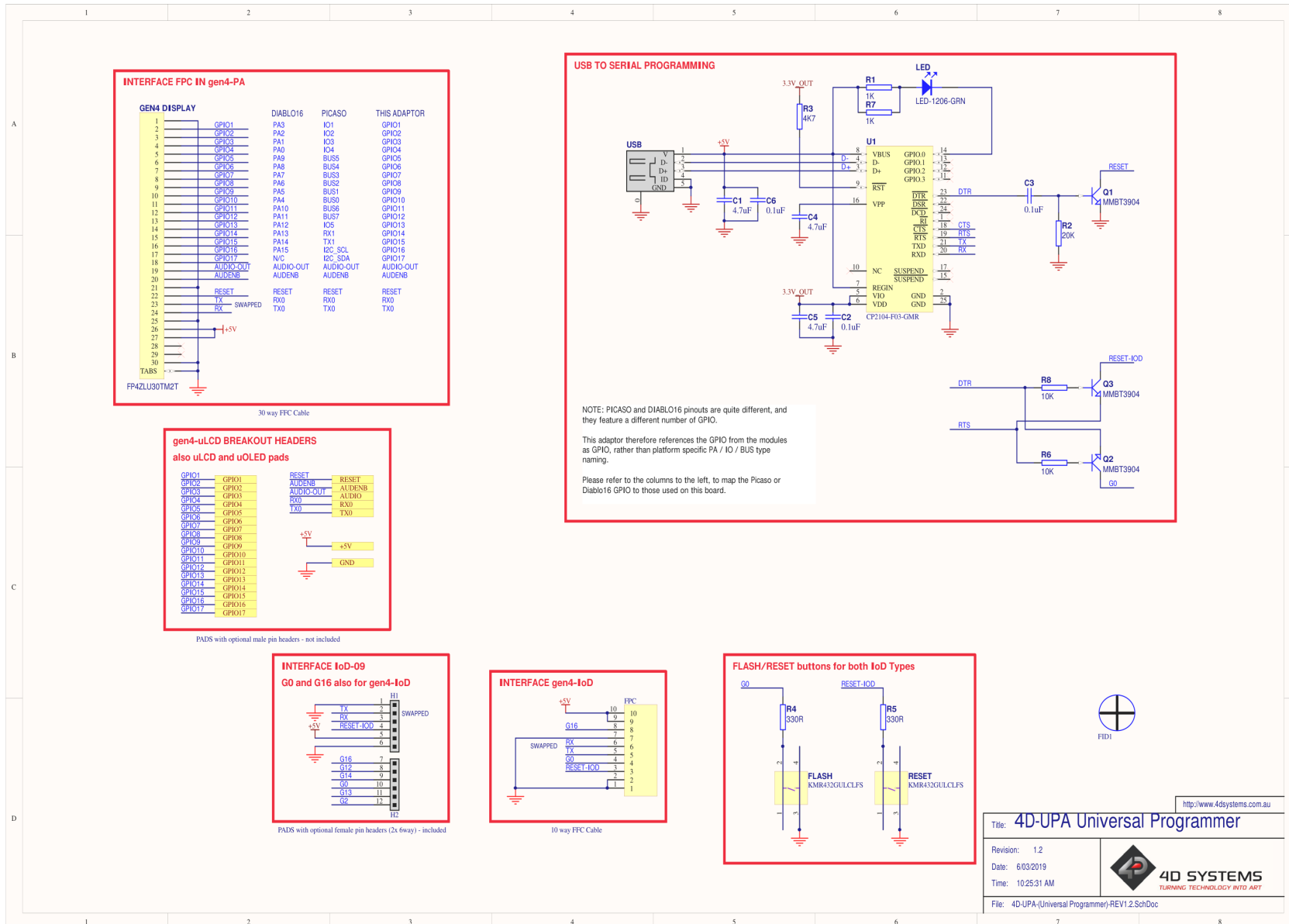
19. Specifications

Absolute Maximum Ratings

Operating ambient temperature	-20°C to +70°C
Storage temperature	-30°C to +80°C
Voltage on any digital input pin with respect to GND	-0.3V to 6.0V
Voltage on VCC with respect to GND	-0.3V to 6.0V
Maximum current sunk/sourced by any pin	12.0mA

✏️ Note

Stresses above those listed here may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the recommended operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Conditions	Min	Typ	Max
Supply Voltage (VCC)	Stable external supply required	4.0	5.0	5.5
OperatingTemperature		-10	--	+60
Input Low Voltage	3.3, all pins	-0.3	--	0.25VCC
Input High Voltage	GPIO0, GPIO16, and RX Pins	0.7VCC	--	3.3
Output Low Voltage		--	--	0.1VCC
Output High Voltage		0.8VCC	--	--

▦ Global Characteristics Based on Operating Conditions

Parameter	Conditions	Min	Typ	Max	Un
Supply Current (ICC)	IoD-09TH – Average, not Peak	--	140	--	m
	IoD-09SM – Average, not Peak	--	140	--	m
Display Endurance	Hours of operation, measured to when the display is 50% original brightness	30000	--	--	H

▦ LCD DISPLAY INFORMATION

Parameter	Conditions	Specifications
Display Type		TFT Transmissive LCD
Display Size	IoD-09TH/SM	0.9" Diagonal
Display Resolution		80 x 160 (Portrait Viewing)
Display Brightness	IoD-09TH/SM	180 cd/m2
Display Contrast Ratio	IoD-09TH/SM	500:1
Display Viewing Angles	Above Centre (Portrait Mode)	55 Degrees
	Below Centre (Portrait Mode)	65 Degrees
	Left of Centre (Portrait Mode)	65 Degrees
	Right of Centre(Portrait Mode)	65 Degrees
Display Viewing Direction		6 O'clock Display (Optimal viewing is from below when in Portrait mode. The end closest to the microSD connector, is the bottom.)
Display Backlighting	IoD-09TH/SM	1 LED
Pixel Pitch	IoD-09TH/SM	0.144mm (80 pixels) x 0.126mm (160 pixels) (Non-Square pixels)
Pixel Density	Number of pixels in 1 row in 25.4mm	176 DPI/PPI (80 Pixels) 201 DPI/PPI (160 Pixels)