4D SYSTEMS
TURNING TECHNOLOGY INTO ART

3.2" *micro*LCD PICASO Display
µLCD-32PTU

Document Date: 15th January 2013
**Document Revision: 1.5**

Overview

The **μLCD-32PTU** is a compact and cost effective Intelligent Display Module packed with plenty of features, ready to become the GUI for your target application. It is the perfect choice for many applications that require a front end smart graphics interface.

Embedded at the heart of the design is the **PICASO** processor, which is driven by a highly optimised virtual core engine called **EVE** (Extensible Virtual Engine). An extensive range of hardware and software peripherals have been integrated into the design, to give the user freedom to adapt the module to suit almost any application.

The display module is an elegant combination of a 3.2" (240x320) LCD Screen, audio amplifier and speaker, micro-SD card connector, Lithium Ion and Polymer battery support, along with a group of general purpose input/output pins (GPIO's), including I^{2}C and serial communications.

This display module serves as a perfect solution to be deployed at the forefront of any product design, requiring a brilliance of colour, animation or images on any application. This **PICASO** driven Intelligent Display Module is a perfect example of where art meets technology.
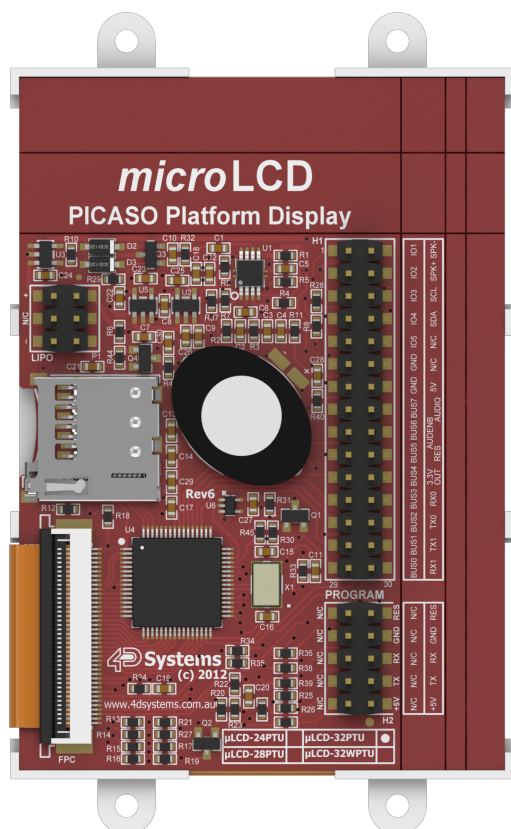
The **μLCD-32PTU** has a **3.2"** TFT LCD display at the forefront of the design that showcases the power and capabilities of the PICASO processor. Combining a resolution of **240x320** pixels with **65K** True to Life colours, this module is perfect for animations, slideshows and other multimedia presentations.

Audio support provided on the display module is supplied by the **PICASO** processor, an on-board audio amplifier and 8Ω speaker. A simple instruction enables the user to play audio files while continuing the execution of the users code, such as display updates, touch recognition, communications and much more.

The **micro-SD** card slot provides the user with expandable memory space suitable for multimedia file retrieval, including images, animations and movie clips, as well as data logging applications.

The module can be programmed in its native 4DGL language (similar to C), using the Workshop4 IDE software tool suite, or it can be configured as a serial slave device to use with your favourite host controller. The freedom is at your fingertips with this 3.2" intelligent microLCD module.

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1. Description

The µLCD-32PTU module demonstrates class and finesse in the microLCD range, featuring a 3.2" 240x320 screen resolution that is the ideal size for displaying detailed graphics for many interactive touch applications.

Driving the display and peripherals is the PICASO processor, a very capable and powerful chip which enables stand-alone functionality, programmed using the 4D Systems Workshop 4 IDE Software. The Workshop IDE enables graphic solutions to be constructed rapidly and with ease due to its design being solely for 4D's graphics processors.
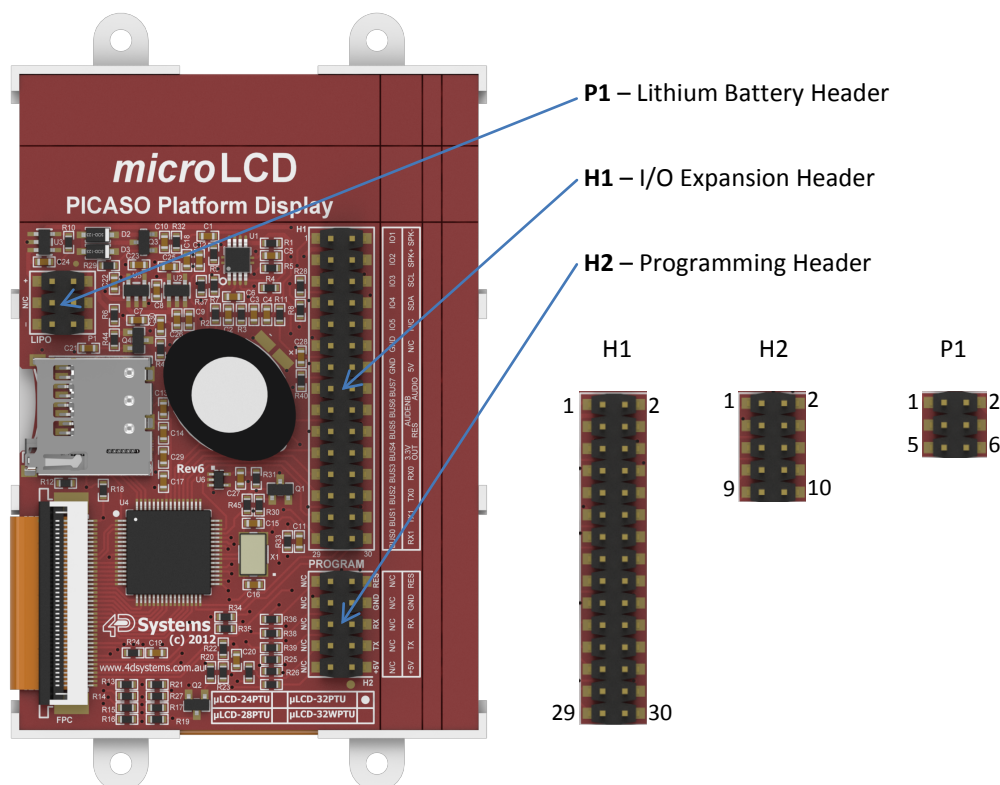
The module has an array of features including PWM for Sound, Touch Detection, micro-SD memory storage, Lithium battery support, general purpose I/O, serial communications, an I2C interface and multiple millisecond resolution timers, amongst many more features.

2. Features

- Low-cost 3.2" LCD-TFT display graphics user interface solution.

- 240 x 320 VGA resolution, RGB 65K true to life colours, TFT screen with Integrated 4-Wire Resistive Touch Panel.

- Easy 5 pin interface to any host device: VCC, TX, RX, GND, RESET

- Powered by the 4D-Labs PICASO processor (also available as separate OEM IC)

- 14KB of flash memory for user code storage and 14KB of SRAM for user variables, or 14KB shared user code and program variables.

- 2 x Asynchronous hardware serial ports (COM0, COM1), TTL interface, with 300 to 600K baud.

- 1 x I^2C interface (Master).

- 8 x 16 bit timers with 1 millisecond resolution.

- 13 x General Purpose I/O pins. Supports fast 8-bit parallel data transfer through Upper 8 bits.

- On-board micro-SD memory card adaptor for multimedia storage and data logging purposes. HC memory card support is also available for cards larger than 4GB.

- DOS compatible file access (FAT16 format) as well as low level access to card memory.

- Lithium battery support, with built in battery charger and automatic change-over.

- Dedicated PWM Audio pin driven by WAV files from micro-SD card.

- On-board audio amplifier with a tiny 8Ω speaker for sound generation and WAV file playback.

- Built in extensive 4DGL graphics and system library functions.

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

- Supports all available Windows fonts.

- A 30 pin header for I/O expansion and future plug-in daughter boards.

- 4.0V to 5.5V range operation (single supply).

- Module dimensions: 56.32 x 79.69 x 15.9mm (including corner plates). Weighing ~ 50g.

- Display Viewing Area: 48.60 x 64.80mm

- 4 x corner plates with 2.7mm holes for mechanical mounting.

- RoHS Compliant.

3. Pin Configuration and Summary

P1 – Lithium Battery Header

H1 – I/O Expansion Header

H2 – Programming Header

H2 Pin Outs (Programming Header)			
Pin	**Symbol**	**I/O**	**Description**
1	N/C	-	Not connected
2	RES	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.
3	N/C	-	Not connected
4	GND	P	Supply Ground
5	N/C	-	Not connected
6	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 microLCD. This pin is tolerant up to 5.0V levels.
7	N/C	-	Not connected
8	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 microLCD. This pin is tolerant up to 5.0V levels.
9	N/C	-	Not connected
10	+5V	P	Main Voltage Supply +ve input pin. Reverse polarity protected. Range is 4.0V to 5.5V, nominal 5.0V.

I = Input, O = Output, P = Power

H1 Pin Outs (I/O Expansion Header)			
Pin	Symbol	I/O	Description
1	IO1	I/O	General Purpose Input Output 1 Pin
2	SPK-	O	Speaker Output –ve, for external Speaker
3	IO2	I/O	General Purpose Input Output 2 Pin
4	SPK+	O	Speaker Output +ve, for external Speaker
5	IO3	I/O	General Purpose Input Output 3 Pin
6	SCL	O	I^2C Clock Output
7	IO4	I/O	General Purpose Input Output 4 Pin
8	SDA	I/O	I^2C Bidirectional Data
9	IO5	I/O	General Purpose Input Output 5 Pin
10	N/C	-	Not connected
11	GND	P	Supply Ground
12	N/C	-	Not connected
13	GND	P	Supply Ground
14	+5V	P	Supply Input +ve, 4.0V to 5.5V, 5.0V Nominal
15	BUS7	I/O	IO Bus (BUS0..7) bit 7
16	AUDIO	I/O	Audio Input or Output, TTL Line level
17	BUS6	I/O	IO Bus (BUS0..7) bit 6
18	AUDENB	I	Audio Amplified Enable, Active High (5V)
19	BUS5	I/O	IO Bus (BUS0..7) bit 5
20	RES	I	Master Reset, Active Low (GND) (Refer H2 Pinout)
21	BUS4	I/O	IO Bus (BUS0..7) bit 4
22	3.3V OUT	P	3.3V Output, 20mA Max supply
23	BUS3	I/O	IO Bus (BUS0..7) bit 3
24	RX0	I	Asynchronous serial port 0 receive pin. COM0 (same as the RX pin on the H2 Programming Header)
25	BUS2	I/O	IO Bus (BUS0..7) bit 2
26	TX0	O	Asynchronous serial port 0 transmit pin. COM0 (same as the TX pin on the H2 Programming Header)
27	BUS1	I/O	IO Bus (BUS0..7) bit 1
28	TX1	O	Asynchronous serial port 1 transmit pin. COM1
29	BUS0	I/O	IO Bus (BUS0..7) bit 0
30	RX1	I	Asynchronous serial port 1 receive pin. COM1

I = Input, O = Output, P = Power

P1 Pin Outs (Lithium Battery Header)			
Pin	Symbol	I/O	Description
1	+	P	Lithium Ion or Polymer 3.7V Battery +ve Terminal
2	+	P	Lithium Ion or Polymer 3.7V Battery +ve Terminal
3	N/C	-	Not connected
4	N/C	-	Not connected
5	-	P	Lithium Ion or Polymer 3.7V Battery -ve Terminal
6	-	P	Lithium Ion or Polymer 3.7V Battery -ve Terminal

I = Input, O = Output, P = Power

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4. Hardware Interface - Pins

The μLCD-32PTU provides both a hardware and software interface. This section describes in detail the hardware interface pins of the device.

4.1. Serial Ports - COM0, COM1 UARTS

The μLCD-32PTU has two dedicated hardware Asynchronous Serial ports that can communicate with external serial devices. These are referred to as the COM0 and the COM1 serial ports.
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 600K baud.
- Single byte transmits and receives or 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.
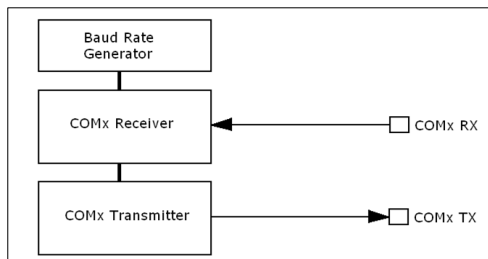
A single byte serial transmission consists of the start bit, 8-bits of data followed by the stop bit. The start bit is always 0, while a stop bit is always 1. The LSB (Least Significant Bit, Bit 0) is sent out first following the start bit. Figure below shows a single byte transmission timing diagram.
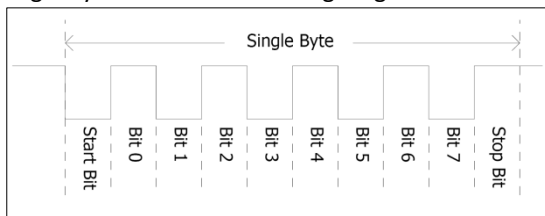
COM0 is also the primary interface for 4DGL user program downloads and chip configuration (PmmC programming). Once the compiled 4DGL application program (EVE byte-code) is downloaded and the user code starts executing, the serial port is then available to the user application. Refer to Section 5. 'Firmware / PmmC Programming' for more details on this subject.

TX0 pin (Serial Transmit COM0):
Asynchronous Serial port COM0 transmit pin, TX0. Connect this pin to external serial device receive (Rx) signal. This pin is 5.0V tolerant.

RX0 pin (Serial Receive COM0):
Asynchronous Serial port COM0 receive pin, RX0. Connect this pin to external serial device transmit (Tx) signal. This pin is 5.0V tolerant.

TX1 pin (Serial Transmit COM1):
Asynchronous Serial port COM1 transmit pin, TX1. Connect this pin to external serial device receive (Rx) signal. This pin is 5.0V tolerant.

RX1 pin (Serial Receive COM1):
Asynchronous Serial port COM1 receive pin, RX1. Connect this pin to external serial device transmit (Tx) signal. This pin is 5.0V tolerant.

4.2. General Purpose I/O

There are 13 general purpose Input/Output (GPIO) pins available to the user. These are grouped as IO1..IO5 (Note for IO1, IO2 and IO3 below) and BUS0..BUS7. Power-Up Reset default is all INPUTS.

The 5 I/O pins (IO1..IO5), provide flexibility of individual bit operations while the 8 pins (BUS0..BUS7), known as GPIO BUS, serve collectively for byte wise operations. The IO4 and IO5 also act as strobing signals to control the GPIO Bus. GPIO Bus can be read or written by strobing a low pulse (50ns duration or greater) the IO4/BUS_RD or IO5/BUS_WR for read or write respectively. For detailed usage refer to the separate document titled:
"***PICASO-4DGL-Internal-Functions.pdf***"

IO1-IO5 pins (excluding IO3) (2 x GPIO pins):
General purpose I/O pins. Each pin can be individually set for INPUT or an OUTPUT.

IO1 pin (Frame Mark pin):
The IO1 pin has 2 functions. It can be used as a GPIO pin but can also be used to detect the start of a Frame. When used as a GPIO pin, simply connect an Input/Output to the IO1 pin on the H1 header. When using IO1 for Frame Mark, simply leave the IO1 pin on the H1 header disconnected, and read the status of IO1 as an Input.

IO2 pin (Lithium Battery Status pin):
The IO2 pin has 2 functions. It can be used as a GPIO pin but can also be used to tell when the Lithium battery has reached a low level (3.7V) and needs to be charged. When used as a GPIO pin,

simply connect an Input/Output to the IO2 pin on the H1 header. When using IO2 for Battery Status, simply leave the IO2 pin on the H1 header disconnected, and read the status of IO2 as an Input. (See 6.4. 'Lithium Batteries' for more information).

IO3 pins (Peripheral Supply pin):
IO3 is controllable via the processor, or via the H2 Interface pin driven by an external circuit. If IO3 is set as OUTPUT and driven HIGH the µSD and Display are enabled, and disabled when driven LO. Set as INPUT to use an external circuit to drive this pin.

IO4/BUS_RD pin (GPIO IO4 or BUS_RD pin):
General Purpose IO4 pin. Also used for BUS_RD signal to read and latch the data in to the parallel GPIO BUS0..BUS7.

IO5/BUS_WR pin (GPIO IO5 or BUS_WR pin):
General Purpose IO5 pin. Also used for BUS_WR signal to write and latch the data to the parallel GPIO BUS0..BUS7.

BUS0-BUS7 pins (GPIO 8-Bit Bus):
8-bit parallel General purpose I/O Bus.

Note: All GPIO pins are 5.0V tolerant.

4.3. System Pins

+5V (Module Voltage Input)
H1 pin 14, H2 pin 10:
Module supply voltage input pin. This pin must be connected to a regulated supply voltage in the range of 4.0 Volts to 5.5 Volts DC. Nominal operating voltage is 5.0 Volts.

3.3V Out (3.3V Regulated Output)
H1 pin 22:
External circuitry that requires a regulated 3.3V supply can be powered up via this pin. Maximum available current is 20mA.

GND (Module Ground)
H1 pin 11/13, H2 pin 4:
Device ground pins. These pins must be connected to ground.

RESET (Module Master Reset)
H1 pin 20, H2 pin 2:
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.

SPK-/SPK+ (External Speaker Outputs)
H1 pin 2/4 Respectively:
External Speaker Outputs, designed to drive an 8Ω speaker to a maximum of 1.2W. These are connected in Parallel with the on board speaker.

AUDENB (Audio Enable Input)
H1 pin 18:
Input dedicated to enable or disable the on-board amplifier.

AUDIO (Audio Line Level Input/Output)
H1 pin 16:
Universal Input or Output specifically for Audio. This pin connects directly into the on-board amplifier. When used in conjunction with AUDENB this pin can be used to input a signal into the on-board amplifier (AUDENB disabled) to play audio from an external device using the on-board amplifier, or as a line-level output (AUDENB enabled) to drive an external amplifier.

+/- (Lithium Battery Terminals)
P1 pins 1/2(+ve), 5/6(-ve):
These are the terminals of the Lithium Battery connector. These are to be connected **only** to a Lithium Ion or Polymer 3.7V Battery else the µLCD-32PTU may be damaged. See Section 6.4

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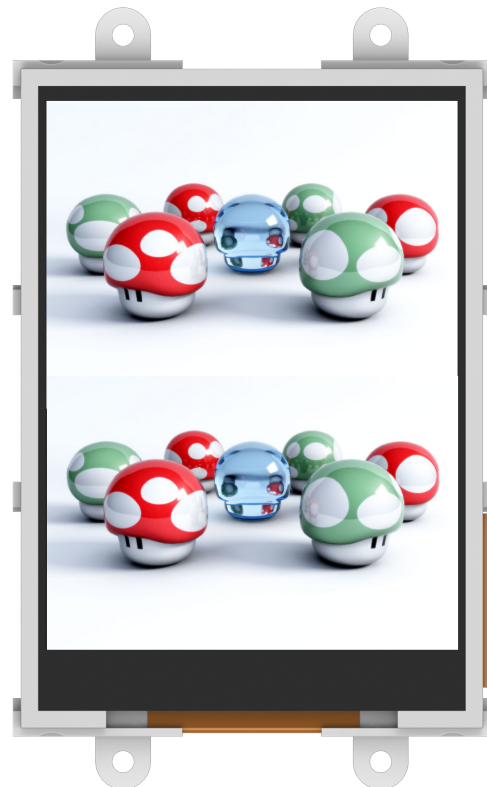
## 5. PmmC/Firmware Programming

The PICASO processor used in the μLCD-32PTU module is a custom graphics processor. All functionality including the high level commands are built into the chip. This chip level configuration is available as a Firmware/PmmC (Personality-module-micro-Code) file.

A PmmC file contains all of the low level micro-code information (analogy of that of a soft silicon) which define the characteristics and functionality of the device. The ability of programming the device with a PmmC file provides an extremely flexible method of customising as well as upgrading it with future enhancements.

A PmmC file can only be programmed into the device via its COM0 serial port. Figure below provides a typical implementation for the PmmC programming interface.

The PmmC file is programmed into the device with the aid of Workshop 4, the 4D Systems IDE software (See Section 11). To provide a link between the PC and the ICSP interface, a specific 4D Programming Cable is required and is available from 4D Systems.

Using a non-4D programming interface could damage your display, and **void your Warranty.**

4D Programming Cable
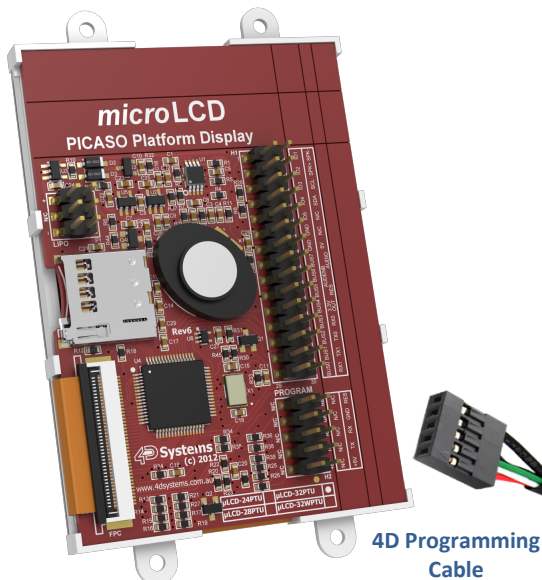
6. Module Features

The μLCD-32PTU module is designed to accommodate most applications. Some of the main features of the module are listed below.

### 6.1. Display – 3.2" TFT Touch Screen

The μLCD-32PTU module is equipped with a 3.2" TFT display. Details of the display are listed below:

• Screen Size: 3.2" diagonal
• Resolution: 240 x 320
• Integrated 4-Wire Resistive Touch Screen
• Screen Dimensions: 54.34 x 77.70 x 3.70mm
• Viewing Area: 48.60 x 64.80mm
• Pixel Pitch: 0.2025 x 0.2025mm
• Brightness: 200cd/m2
• Contrast Ratio: 350:1
• Viewing Angle Above Centre: 60 degrees
• Viewing Angle Below Centre: 60 degrees
• Viewing Angle Left of Centre: 70 degrees
• Viewing Angle Right of Centre: 70 degrees
• Viewing Direction: 12 O'clock
• 6 Parallel LEDs for Backlighting

Note: The Displays used are the highest rated 'Grade A' Displays, which allow for 0-4 defective pixels. A defective pixel could be solid Black (Dead), White, Red, Green or Blue.

6.2. PICASO Processor

The module is designed around the PICASO Graphics Controller from 4D-Labs.
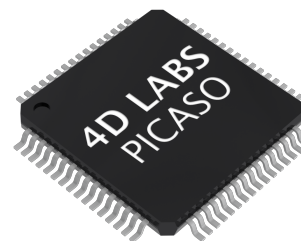
The PICASO is a smart Controller and the interface to the TFT- LCD displays is almost plug-n-play.

All of the data and control signals are provided by the chip to interface directly to the display.

Powerful graphics, text, image, animation and countless more features are built right inside the chip.

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The data sheet for the processor is available from the http://www.4dsystems.com.au website: *"PICASO-Processor-Datasheet-REVx.pdf"*

6.3. Audio

Audio playback support in the PICASO Processor enables the μLCD-32PTU module to play audio WAV files stored in the micro-SD memory card. PWM and an on-board audio amplifier with 8Ω speaker ensure ample audio output capability. A simple instruction enables the user to play/pause/stop audio files while continuing the execution of the user application code, such as display updates, touch recognition, communications, etc. The audio system also allows real time pitch change of audio samples.

For a complete list of audio commands please refer to the separate document titled: *"PICASO-4DGL-Internal-Functions.pdf"*

Note: The on-board speaker is a small device designed to project into an audio cavity. It is not very loud by itself. To enable louder audio, it is recommended to use a larger external 8Ω speaker. See the 'Hardware Interface Pins' – 'System Pins' section for more information.

6.4. Lithium Batteries

The μLCD-32PTU module includes a battery charging circuit suitable for Lithium Ion (LiIon) and Lithium Polymer (LiPo) batteries, which is designed to work **only** with 3.7V batteries. If anything other than a LiIon or LiPo 3.7V battery is connected the module could be damaged. Features current sensing and reverse discharge protection using an on board Lithium charge management controller.

When the Lithium battery is connected and an external 5V source is connected to either of the +5V pins, the Lithium battery will be charged automatically. If the 5V source is disconnected, the Lithium battery will be switched in circuit and continue to power the module automatically.

When running from the Lithium battery, when the battery level drops down to 3.7V, the Status input (connected to IO2) into the Picaso will be triggered indicating the battery is discharged. The display should then be connected to an external 5V source for charging.
When the battery is at this cut off voltage, μSD card read and write operations should be avoided,

as they may fail due to low voltage.

WARNING: There is a large range of Lithium batteries available on the market. Some include safety circuits built in, while others do not. Lithium batteries can explode if short circuited, overcharged, if they get too hot, and can leak if they sit fully discharged for a prolonged period of time.
4D Systems recommends whenever Lithium batteries are used that caution and due diligence should be exercised to ensure the safety of the user and nearby people. While the chances of explosion or leakage may be minimal, 4D Systems recommends safe practices at all times when dealing with these batteries.

6.5. SD/SDHC Memory Cards

The module supports micro-SD memory cards via the on-board micro-SD connector. The memory card is used for all multimedia file retrieval such as images, animations and movie clips. The memory card can also be used as general purpose storage for data logging applications. Support is available for off the shelf micro-SD and high capacity HC memory cards (4GB and above).

6.6. FAT16

The μLCD-32PTU uses off the shelf standard SDHC/SD/micro-SD memory cards with up to 2GB capacity usable with FAT16 formatting. For any FAT file related operations, before the memory card can be used it must first be formatted with FAT16 option. The formatting of the card can be done on any PC system with a card reader. Select the appropriate drive and choose the FAT16 (or just FAT in some systems) option when formatting. The card is now ready to be used in the PICASO based application.

The μLCD-32PTU also supports high capacity HC memory cards (4GB and above). The available capacity of SD-HC cards varies according to the way the card is partitioned and the commands used to access it.

The FAT partition is always first (if it exists) and can be up to the maximum size permitted by FAT16. Windows 7 will format FAT16 up to 4GB. Windows XP will format FAT16 up to 2GB and the Windows XP command prompt will format FAT16 up to 4GB.

7. Display Precautions

• Avoid having to display the same image/object on the screen for lengthy periods of time. This will cause a burn-in which is a common problem with all types of display technologies. Blank the screen after a while or dim it very low by adjusting the contrast. Better still; implement a screen saver feature.

• Moisture and water can damage the display. Moisture on the surface of a powered display will cause the electrodes to corrode. Wipe off any moisture gently or let the display dry before usage.

• 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 high temperature and humidity. Avoid such conditions when storing.

• Do not tamper with the display flex cable that is connected to the control board. This may affect the connection between the display and the driving circuitry and cause failure.

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

• Always use the mounting holes on the module's corner plates to mount the display.

8. Hardware Tools

The following hardware tools are required for full control of the μLCD-32PTU module.

8.1. 4D Programming Cable

The 4D Programming Cable is an essential hardware tool to program, customise and test the μLCD-32PTU module.

The 4D Programming Cable is used to program a new Firmware/PmmC and downloading compiled 4DGL code into the module. It even serves as an interface for communicating serial data to the PC.

The 4D Programming Cable is available from 4D Systems, www.4dsystems.com.au

4D Programming Cable

8.2. Development Hardware

4D Systems has designed a development board compatible with the μLCD-32PTU, enabling easy prototyping to take place and to experiment with the μLCD-32PTU display module.
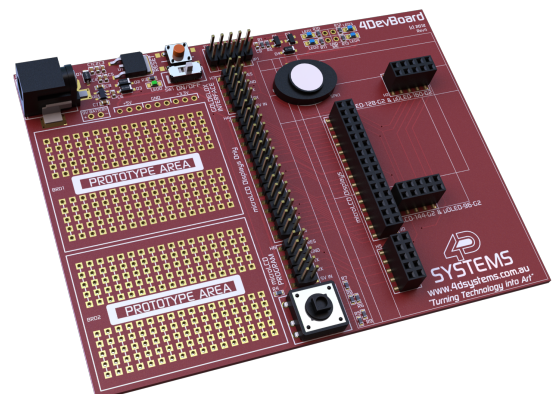
This development board is called the 4DevBoard, and is available from the 4D Systems website store, or from 4D Systems distributors.

9. 4DGL - Software Language

The μLCD-32PTU utilises the PICASO processor, which belongs to a family of processors powered by a highly optimised soft core virtual engine, EVE (Extensible Virtual Engine).

EVE is a proprietary, high performance virtual-machine with an extensive byte-code instruction set optimised to execute compiled 4DGL programs. 4DGL (4D Graphics Language) was specifically developed from ground up for the EVE engine core. It is a high level language which is easy to learn and simple to understand yet powerful enough to tackle many embedded graphics applications.

4DGL is a graphics oriented language allowing rapid application development, and the syntax structure was designed using elements of popular languages such as C, Basic, Pascal and others.

Programmers familiar with these languages will feel right at home with 4DGL. It includes many familiar instructions such as IF..ELSE..ENDIF, WHILE..WEND, REPEAT..UNTIL, GOSUB..ENDSUB, GOTO, PRINT as well as some specialised instructions SERIN, SEROUT, GFX_LINE, GFX_CIRCLE and many more.

For detailed information pertaining to the 4DGL language, please refer to the following documents:
"4DGL-Programmers-Reference-Manual.pdf"
"PICASO-4DGL-Internal-Functions.pdf"

To assist with the development of 4DGL applications, the Workshop 4 IDE combines a full-featured editor, a compiler, a linker and a down-loader into a single PC-based application. It's all you need to code, test and run your applications.

4DGL is available to be written in two of the four environments offered by the Workshop 4 IDE, Designer and ViSi.

10. 4D Systems - Workshop 4 IDE

Workshop 4 is a comprehensive software IDE that provides an integrated software development platform for all of the 4D family of processors and modules. The IDE combines the Editor, Compiler, Linker and Down- Loader to develop complete 4DGL application code. All user application code is developed within the Workshop 4 IDE.

The Workshop 4 IDE supports multiple development environments for the user, to cater for different user requirements and skill level.

- The **Designer** environment enables the user to write 4DGL code in its natural form to program the μLCD-32PTU.
- A visual programming experience, suitably called **ViSi**, enables drag-and-drop type placement of objects to assist with 4DGL code generation and allows the user to visualise how the display will look while being developed.
- An advanced environment called **ViSi-Genie** doesn't require any 4DGL coding at all, it is all done automatically for you. Simply lay the display out with the objects you want, set the events to drive them and the code is written for you automatically. ViSi-Genie provides the latest rapid development experience from 4D Systems.
- A **Serial** environment is also provided to transform the μLCD-32PTU into a slave serial module, allowing the user to control the display from any host microcontroller or device with a serial port.

The Workshop 4 IDE is available from the 4D Systems website. www.4dsystems.com.au

For a comprehensive manual on the Workshop 4 IDE Software along with other documents, refer to the documentation from the 4D Systems website, on the Workshop 4 product page.

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10.1. Workshop 4 – Designer Environment

Choose the Designer environment to write 4DGL code in its raw form.
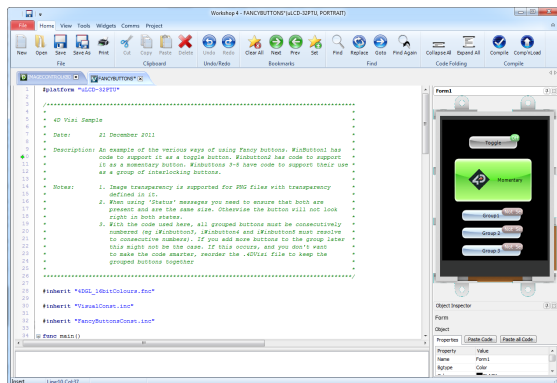
The Designer environment provides the user with a simple yet effective programming environment where pure 4DGL code can be written, compiled and downloaded to the μLCD-32PTU.
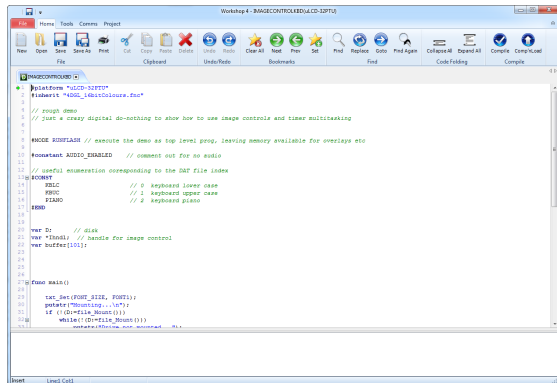
10.2. Workshop 4 – ViSi Environment

ViSi was designed to make the creation of graphical displays a more visual experience.

ViSi is a great software tool that allows the user to see the instant results of their desired graphical layout. Additionally, there is a selection of inbuilt dials, gauges and meters that can simply be placed onto the simulated module display. From here each object can have its properties edited, and at the click of a button all relevant 4DGL code associated with that object is produced in the user program. The user can then write 4DGL code around these objects to utilise them in the way they choose.

10.3. Workshop 4 – ViSi Genie Environment

ViSi Genie is a breakthrough in the way 4D Systems' graphic display modules are programmed. It is an environment like no other, a code-less programming environment that provides the user with a rapid visual experience, enabling a simple GUI application to be 'written' from scratch in literally seconds.

ViSi Genie does all the background coding, no 4DGL to learn, it does it all for you.

Pick and choose the relevant objects to place on the display, much like the ViSi Environment (See Section 11.2), yet without having to write a single line of code. Each object has parameters which can be set, and configurable events to animate and drive other objects or communicate with external devices.

Simply place an object on the screen, position and size it to suit, set the parameters such as colour, range, text, and finally select the event you wish the object to be associated with, it is that simple.

In seconds you can transform a blank display into a fully animated GUI with moving sliders, animated press and release buttons, and much more. All without writing a single line of code!

ViSi Genie provides the user with a feature rich rapid development environment, second to none.
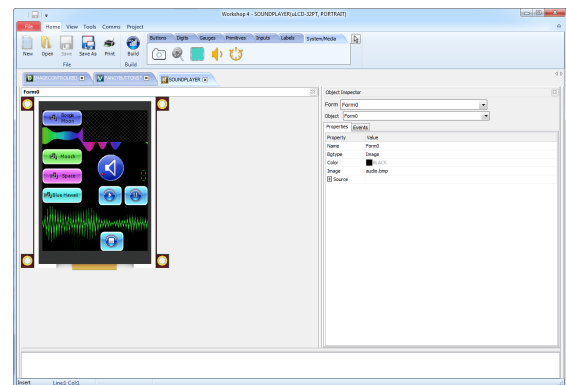
10.4. Workshop 4 – Serial Environment

The Serial environment in the Workshop 4 IDE provides the user the ability to transform the μLCD-32PTU into a slave serial graphics controller.

This enables the user to use their favourite microcontroller or serial device as the Host, without having to learn 4DGL or program in a separate IDE. Once the μLCD-32PTU is configured

microLCD PICASO DISPLAY

and downloaded to from the Serial Environment, simple graphic commands can be sent from the users host microcontroller to display primitives, images, sound or even video.

Refer to the "**Serial Command Set Reference Manual**" from the Workshop 4 product page on the 4D Systems website for a complete listing of all the supported serial commands

By default, each module shipped from the 4D Systems factory will come pre-programmed ready for use in the Serial mode.

11. 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 by purchasing the display solution in a Starter Kit, it ensures that if you want to take full advantage of the 4D Systems display solution and try out each of the 4D Workshop4 Environments, upgrade PmmC/firmware, you can.

The **Designer** environment can utilise every feature of the display, however depending on the user requirements, a micro-SD (µSD) card may not be required. The µSD card is used when displaying images/video/sound, along with datalogging to µSD, and a programming cable is definitely required for downloading compiled code and PmmC/Firmware updates.

The **ViSi** environment is the same as Designer in terms of feature utilisation, but is image based so requires a µSD card, along with a programming cable.

The **ViSi-Genie** environment is also image based, and therefore requires a µSD card and programming cable also.

The **Serial** environment does not require either a µSD or Programming cable to be used, however can utilise both depending on the user requirements. The µSD card can be used for such things as storage of multimedia files and datalogging, and the Programming cable for PmmC/Firmware updates, or changing to one of the other three programming environments.

The Starter Kit includes:
- 4D Programming Adaptor or Cable
- 2Gb micro-SD Card
- 5 way cable for easy connection to a breadboard or host
- Display Module
- Quick Start Guide

Simply select the Starter Kit option when purchasing the chosen display module on the 4D Systems shopping cart, or from your local distributor.

12. Mechanical Details

microLCD PICASO DISPLAY

microLCD
PICASO Platform Display

5.6mm
30.48mm (12x 2.54mm)
23.6mm
7.3mm

56.5mm
30.5mm
3.72mm
2.87mm

92.4mm
79.9mm
64.80mm
48.60mm
77.7mm
85.9mm

54.3mm

5.08mm

µLCD-24PTU | µLCD-32PTU
µLCD-28PTU | µLCD-32WPTU

13mm
1mm

3mm
2.54mm
30.48mm (12 x 2.54mm)
6mm
17mm
4.6mm

	NAME	DATE	
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: 0.2mm ANGULAR:		TITLE: **Picaso microLCD Display - uLCD-32PTU**	A3
DRAWN	JB	15/01/2013	
CHK'D			
APPV'D			

DO NOT SCALE DRAWING   REVISION **6**   SCALE: 2:1   SHEET 1 OF 1

4D SYSTEMS

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13. Schematic Diagram

AUDIO

PROCESSOR

BACKLIGHTS

EXPANSION HEADER

PROGRAMMING HEADER

uSD CARD

MOLEX 473340001 microSD Connector

FPC TO I2D DISPLAY

POWER (5V to 3.3V)

LiPo BATTERY + CHARGER

Title:	*Picaso - microLCD Display PCB*	4D Systems Ltd
Size: A3	Number:	Revision: 10	Unit 3, 51 York Rd, Penrith NSW Australia
Date: 14/01/2013	Time: 2:38:15 p.m.	Sheet 1 of 1
File: Picaso-MultiPCB-REV10.SchDoc

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14. Specifications and Ratings

ABSOLUTE MAXIMUM RATINGS
Operating ambient temperature .... -15°C to +65°C
Storage temperature .... -30°C +70°C
Voltage on any digital input pin with respect to GND .... -0.3V to 6.0V
Voltage on SWITCH pin with respect to GND .... -0.3V to 6.0V
Voltage on VCC with respect to GND .... -0.3V to 6.0V

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**	**Units**
Supply Voltage (VCC)		4.0	5.0	5.5	V
Operating Temperature		-10	--	+60	°C
Input Low Voltage (VIL)	VCC = 3.3V, all pins	VGND	--	0.2VCC	V
Input High Voltage (VIH)	VCC = 3.3V, non 5V tolerant pins	0.8VCC	--	VCC	V
Input High Voltage (VIH)	All GPIO pins, RX0 and TX0 pins	0.8VCC	--	5.5	V
Reset Pulse	External Open Collector	2.0	--	--	µs
Operational Delay	Power-Up or External Reset	500	--	3000	ms

GLOBAL CHARACTERISTICS BASED ON OPERATING CONDITIONS					
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Units**
Supply Current (ICC)	VCC = 5.0V, heavily depends on screen usage conditions, sleep mode	--	155	--	mA
Output Low Voltage (VOL)	VCC = 5.0V, IOL = 3.4mA	--	--	0.4	V
Output High Voltage (VOH)	VCC = 5.0V, IOL = -2.0mA	3.2	--	--	V
Capacitive Loading	All pins	--	--	50	pF
Flash Memory Endurance	PICASO PmmC Programming	--	10000	--	E/W

TOUCH SCREEN CHARACTERISTICS					
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Units**
Linearity		--	--	<1.5	%
Terminal Resistance X	X film side	300	400	800	Ohm
Terminal Resistance Y	Y film side	300	600	800	Ohm
Durability – Scratch Test	Stylus Pen or Finger Sliding	100	--	--	K
Durability – Tap Test	Stylus Pen or Finger Press	1	--	--	Million
Transparency	Non Glare	80	--	--	%

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OPTICAL CHARACTERISTICS						
Parameter		**Condition**	**Min**	**Typ**	**Max**	**Units**
Contrast ratio (Centre point)			300	350	--	--
Luminance of white (Centre point)			200	220	260	Cd/m^2
White Uniformity			80	--	--	%
Response Time	Rising + Falling (Tr + Tf)		--	25	--	ms
Colour Chromaticity (CIE 1931)	White, Wx	Back-light On	0.273	0.313	0.353	
	White, Wy		0.289	0.329	0.369	
	Red, Rx		0.574	0.624	0.674	
	Red, Ry		0.318	0.368	0.418	
	Green, Gx		0.300	0.350	0.400	
	Green, Gy		0.500	0.550	0.600	
	Blue, Bx		0.093	0.143	0.193	
	Blue, By		0.069	0.119	0.169	
Viewing Angle	Vertical above Centre	Contrast Ratio ≥ 10	60			Degrees
	Vertical below Centre		60			
	Horizontal Left of Centre		70			
	Horizontal Right of Centre		70			

ORDERING INFORMATION
Order Code: µLCD-32PTU
Package: 105mm x 65mm x 30mm
Packaging: Module sealed in antistatic foam padded 4D Systems Box

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15. Legal Notice

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  [uLCD-32PTU](#)