



Designer or ViSi How to Draw Pixels and Lines

DOCUMENT DATE: **15th JANUARY 2019**
DOCUMENT REVISION: **1.1**



Description

This application note shows how to program a 4D display module in the Designer environment to make it draw points and lines on the screen. The 4DGL code of the Designer project can be copied and pasted to an empty ViSi project and it will compile normally. The code can also be integrated to that of an existing ViSi project.

Before getting started, the following are required:

- Any Picaso, Diablo16, or Goldelox display module. Visit www.4dsystems.com.au to see the latest products using any of these graphics processors.
- [4D Programming Cable / \$\mu\$ USB-PA5/uUSBPA5-II](#) for non-gen4 displays (uLCD-xxx / uOLED-xxx)
- [4D Programming Cable & gen4-IB / 4D-UPA / gen4-PA](#) for gen4 displays (gen4-uLCD-xxx)
- [micro-SD \(\$\mu\$ SD\)](#) memory card
- [Workshop 4 IDE](#) (installed according to the installation document)
- When downloading an application note, a list of recommended application notes is shown. It is assumed that the user has read or has a working knowledge of the topics presented in these recommended application notes.

Note: The attached Designer project and the discussions in this application note make use of a uLCD-32PTU, which is a 320-pixel-by-240-pixel display.

Goldelox displays, however, are usually smaller. The uOLED-96-G2, for instance, is a 96-pixel-by-64-pixel display. For Goldelox display users, the discussions are still relevant and there should be no difficulty in editing the simple project.

Content

Description	2
Content	3
Application Overview	3
Setup Procedure	4
Create a New Project	4
Design the Project	5
<i>Display Resolution and Coordinate System</i>	5
<i>Start Drawing</i>	6
<i>Draw a Pixel</i>	6
gfx_PutPixel(x, y, colour)	6
<i>Draw a Line</i>	7
gfx_Line(x1, y1, x2, y2, colour)	7
<i>More Graphics Functions</i>	7
<i>Clearing the Screen</i>	8
<i>Using the Repeat...Until/Forever Loop</i>	9
Run the Program	11
Proprietary Information	12
Disclaimer of Warranties & Limitation of Liability	12

Application Overview

The Designer environment enables the user to write 4DGL code in its natural form to program the display module. 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.

The purpose of this application note is, besides showing the user how to draw pixels and lines, to introduce the basics of 4DGL through examples.

Setup Procedure

For instructions on how to launch Workshop 4, how to open a **Designer** project, and how to change the target display, kindly refer to the section “**Setup Procedure**” of the application note

[Designer Getting Started - First Project](#)

For instructions on how to launch Workshop 4, how to open a **ViSi** project, and how to change the target display, kindly refer to the section “**Setup Procedure**” of the application note

[ViSi Getting Started - First Project for Goldelox](#)

or

[ViSi Getting Started - First Project for Picaso and Diablo16](#)

Create a New Project

For instructions on how to create a new **Designer** project, please refer to the section “**Create a New Project**” of the application note

[Designer Getting Started - First Project](#)

For instructions on how to create a new **ViSi** project, please refer to the section “**Create a New Project**” of the application note

[ViSi Getting Started - First Project for Goldelox](#)

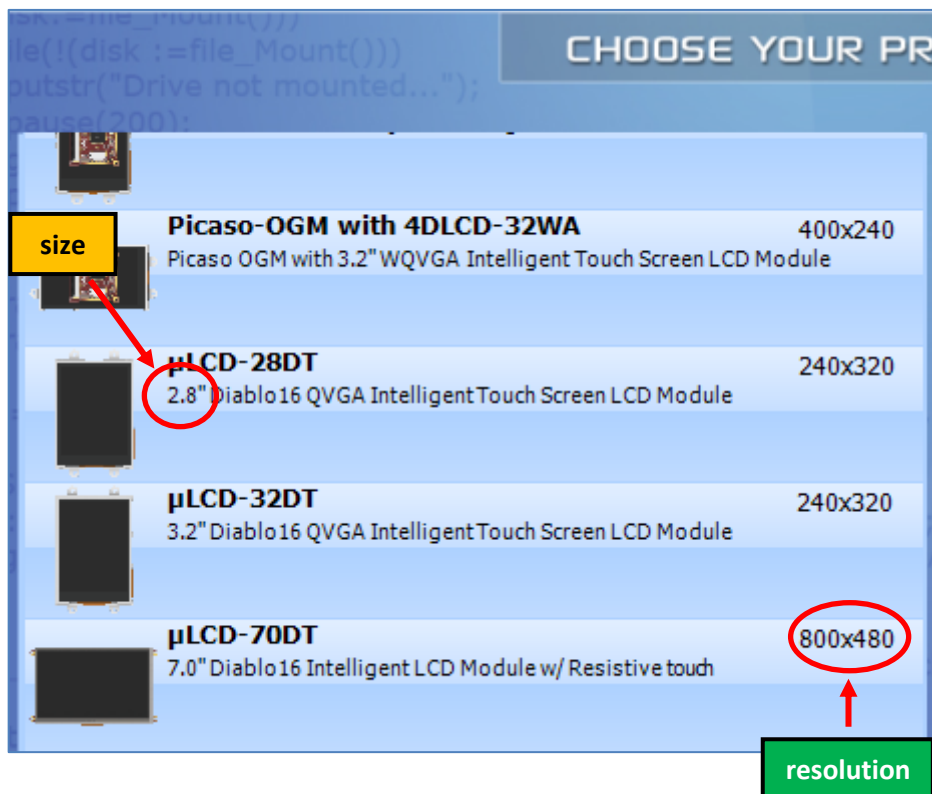
or

[ViSi Getting Started - First Project for Picaso and Diablo16](#)

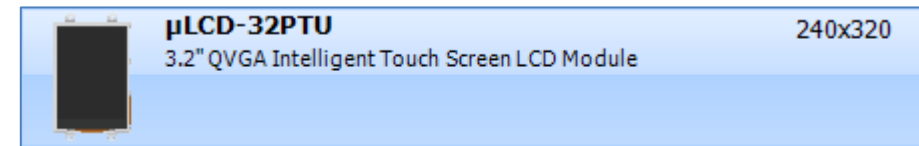
Design the Project

Display Resolution and Coordinate System

Before starting to draw, it is necessary to know how positions of points on the display screen are determined. 4D Systems offers display screens of various resolutions and sizes. When the user opens a new project, the Choose Your Product window shows the screen resolutions and sizes of different display modules.

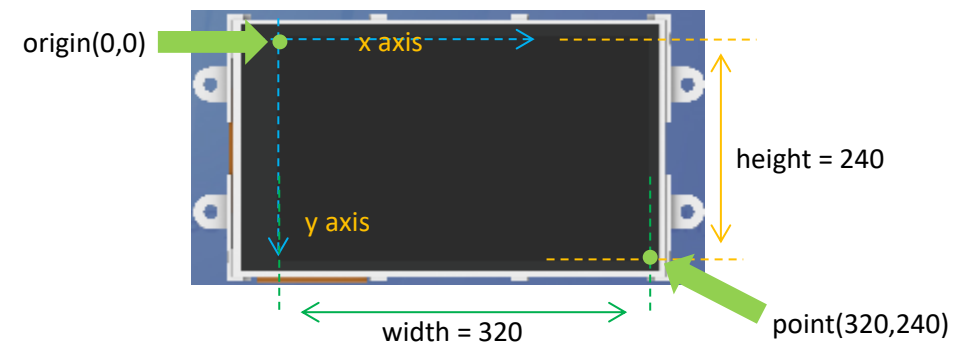


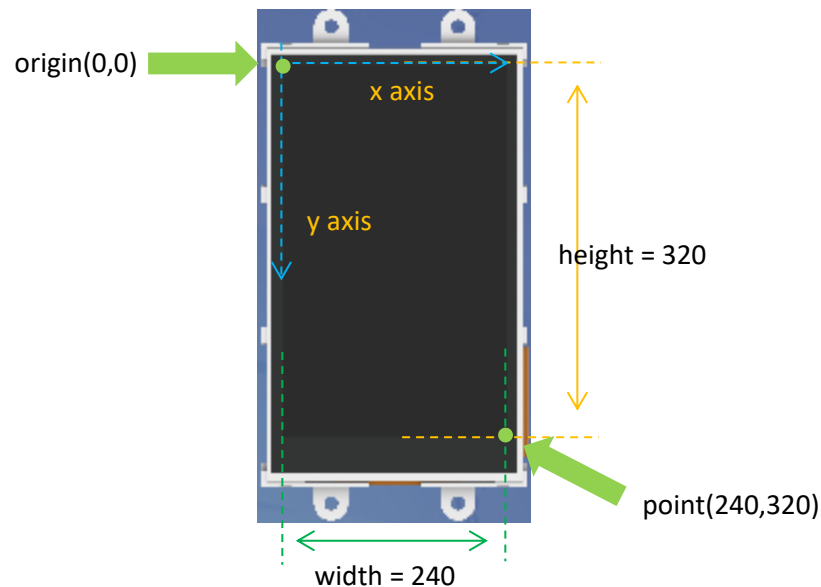
For the μ LCD-32PTU screen:



For all modules, positions of points are determined starting from the origin, which is always located at the top-left corner. The location of this reference point is common to all orientations – the portrait, landscape, portrait rotated, and landscape rotated. Two most commonly used orientations are portrait and landscape.

Landscape orientation:



Portrait orientation:

Observe the similarity of the above to the Cartesian coordinate system. The y axis points downward here, however. This system applies to all display modules and all orientations.

Start Drawing

From this point onwards, graphics functions and their use will be discussed. The user is advised to use the Designer program skeleton provided by Workshop as a starting code. Just insert additional codes between lines 11 and 12.

```

1  #inherit "4DGL_16bitColours.fnc"
2
3  #inherit "4DGL_16bitColours.fnc"
4
5  func main()
6
7      gfx_ScreenMode(PORTRAIT) ; // change manually if orientation
8
9      print("Hello World") ; // replace with your code
10
11     repeat // maybe replace
12     forever // this as well
13
14     endfunc

```

Insert additional codes here

Draw a Pixel**gfx_PutPixel(x, y, colour)**

This function draws a pixel at position x, y using the specified colour.

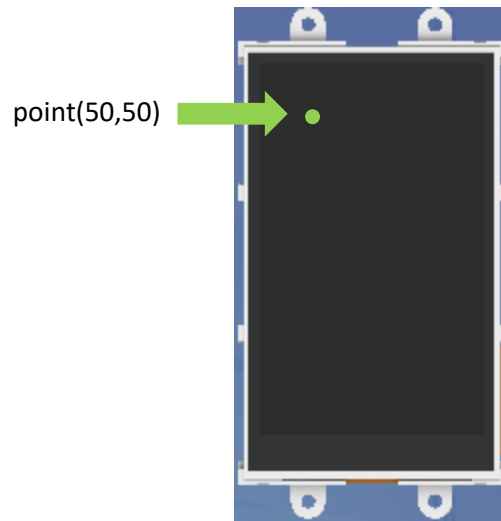
Example:

```

12  gfx_PutPixel( 50, 50, GREEN);

```

The screen (uLCD-32PTU, portrait orientation in this example) will look like as shown below.

Portrait orientation:

The size of the pixel is exaggerated here since it is actually very small.

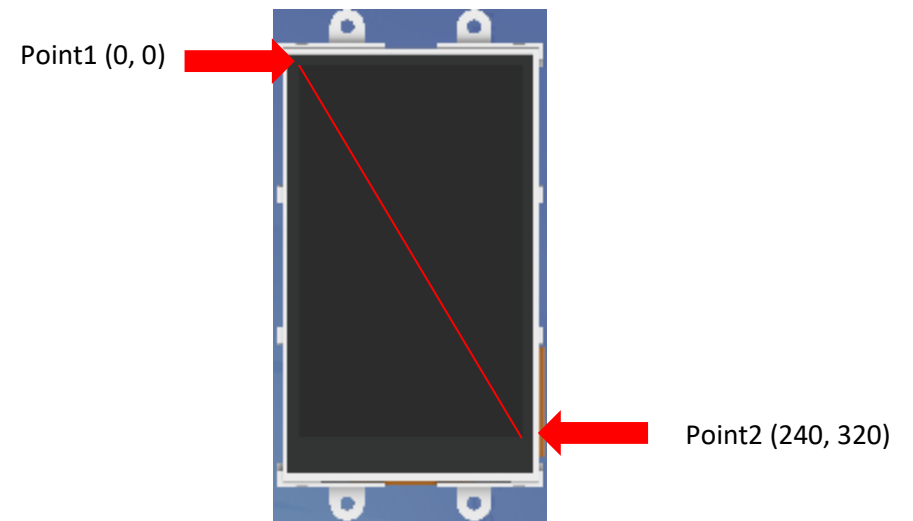
Draw a Line**`gfx_Line(x1, y1, x2, y2, colour)`**

This function draws a line from point (x1, y1) to point (x2, y2) using the specified colour.

Example:

```
13 | gfx_Line(0, 0, 240, 320, RED);
```

The screen (uLCD-32PTU, portrait orientation in this example) will look like as shown below.

**More Graphics Functions**

There are other functions related to the those for drawing pixels and lines - the `gfx_GetPixel(x, y)`, `gfx_Hline(y, x1, x2, colour)`, `gfx_Vline(x, y1, y2, colour)`, `gfx_LineTo(xpos, ypos)`, etc. Learning how to use these functions is relatively easy after having been acquainted with how points are addressed in 4D display screens and how pixels and lines are drawn. Users who want to experiment with these functions may refer to **section 2.6 Graphics Functions** of any of the following documents:

[Goldelox Internal Functions Manual](#)

[Picaso Internal Functions Manual](#)

[Diablo16 Internal Functions Manual](#)

The following sections of this application note discuss how to clear the screen, how to add a delay, and how to further use the repeat...until/forever loop.

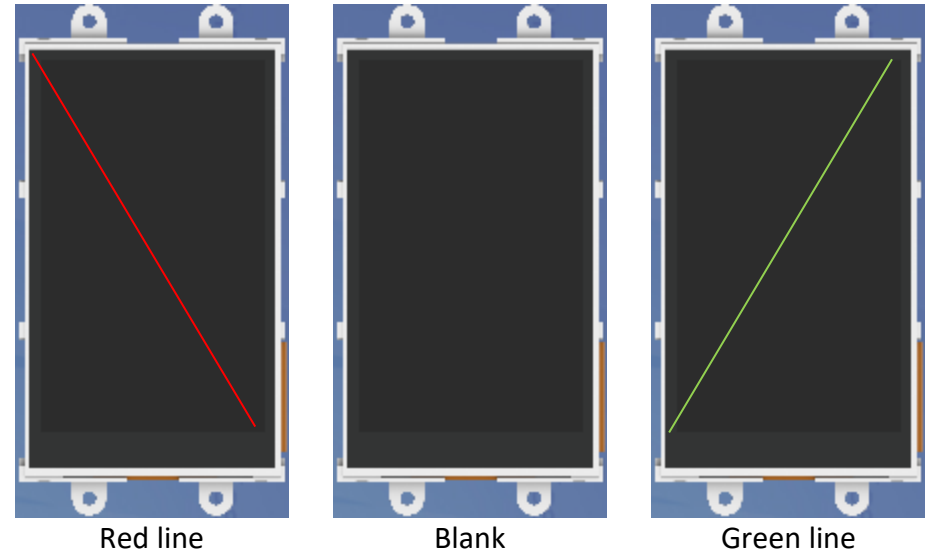
Clearing the Screen

Often times it is necessary to clear the screen to remove unwanted graphics or create a flashing effect.

Clear the screen using the function `gfx_Cls()`. To illustrate:

```
18   repeat
19       gfx_Line(0, 0, 240, 320, RED);
20       pause(500); //add a 500-millisecond delay
21       gfx_Cls(); //clear the screen
22       gfx_Line(240, 0, 0, 320, GREEN);
23       pause(1000); //add a one-second delay
24       gfx_Cls(); //clear the screen
25   forever
```

The code above repetitively draws a red line, clears the screen, and draws a green line. To illustrate:



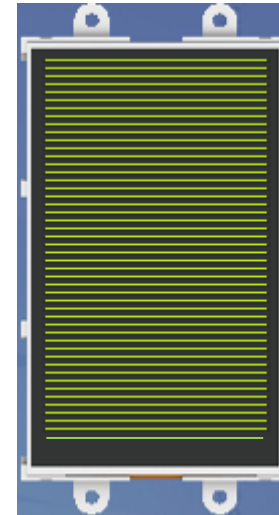
Note that in the code a new function is introduced – **pause(duration)**. This function adds a time delay, the unit of which is in milliseconds. Adding a delay is necessary for the observer to see the lines drawn since the instructions are executed so fast. Try, for example, removing line 24 of the code.

Using the Repeat...Until/Forever Loop

Using loops is one way to shorten a code. Again, a **loop** is a part of the program used to perform repetitive operations. For example, the programmer can use a loop to draw multiple lines. To illustrate:

```
3  #inherit "4DGL_16bitColours.fnc"
4
5  func main()
6
7      gfx_ScreenMode(PORTRAIT) ; // change manually if
8
9      var y;
10     y := 0;
11
12     repeat
13         gfx_Line(0, y, 240, y, GREEN);
14         pause(100); //add a 100-millisecond delay
15         y := y + 5; //can also be y += 5 (shorthand)
16     until(y == 320);
17
18     pause(3000);
19 endfunc
```

The figure above shows a code for drawing horizontal lines from top to bottom of the screen. The figure below shows the outcome.



A line-by-line discussion of the code now follows. Lines previously discussed are bypassed.

In line 9, **y** is declared as a **variable**.

```
9  | | var y;
```

Values of **variables**, as opposed to constants, may **change** during the course of program execution. Here the incrementing value of **y** is used in drawing the horizontal lines. Also, the programmer must declare **y** as a variable first before using it. To learn more about variables in 4DGL, consult the [4DGL Programmers Reference Manual](#).

In line 10, the value of **y** is initially set to zero.

```
10 | | y := 0;
```

The statements from lines 12 to 16 make up the **repeat...until** loop. The instructions inside the loop are executed repetitively until a condition is met. Below is the syntax or format for declaring a repeat...until loop.

Syntax:

```
repeat
    [statements]
until (condition);
```

The condition, in this case, is when the increasing value of the variable **y**, which was initially set to zero, is equal to 320.

```
16 | until (y == 320);
```

Replacing **until(condition)** with **forever** will make the loop execute indefinitely. There are other kinds of loops besides the **repeat...until/forever** loop. These are discussed in the [4DGL Programmers Reference Manual](#).

The statement in line 13 now makes use of the value of the variable **y** to draw a green horizontal line.

```
13 | gfx_Line(0, y, 240, y, GREEN);
```

After a line is drawn, the value of **y** is increased by five.

```
15 | y := y + 5; //can also be y += 5 (shorthand)
```

Note that the expression **y := y + 5** can also be written as **y += 5**. When the next iteration of the loop occurs, the new horizontal line will be drawn five pixels below the previous line. This repeats until the value of **y** reaches 320. The program then pauses for 3 seconds then exits.

Run the Program

For instructions on how to save a **Designer** project, how to connect the target display to the PC, how to select the program destination, and how to compile and download a program, please refer to the section “**Run the Program**” of the application note

[Designer Getting Started - First Project](#)

For instructions on how to save a **ViSi** project, how to connect the target display to the PC, how to select the program destination, and how to compile and download a program, please refer to the section “**Run the Program**” of the application note

[ViSi Getting Started - First Project for Goldelox](#)

or

[ViSi Getting Started - First Project for Picaso and Diablo16](#)

The uLCD-32PTU, uLCD-35DT, uOLED-96-G2, and/or uOLED-160-G2 display modules are commonly used as examples, but the procedure is the same for other displays.

Proprietary Information

The information contained in this document is the property of 4D Systems Pty. Ltd. and may be the subject of patents pending or granted, and must not be copied or disclosed without prior written permission.

4D Systems endeavours to ensure that the information in this document is correct and fairly stated but does not accept liability for any error or omission. The development of 4D Systems products and services is continuous and published information may not be up to date. It is important to check the current position with 4D Systems.

All trademarks belong to their respective owners and are recognised and acknowledged.

Disclaimer of Warranties & Limitation of Liability

4D Systems makes no warranty, either expresses or implied with respect to any product, and specifically disclaims all other warranties, including, without limitation, warranties for merchantability, non-infringement and fitness for any particular purpose.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

In no event shall 4D Systems be liable to the buyer or to any third party for any indirect, incidental, special, consequential, punitive or exemplary damages (including without limitation lost profits, lost savings, or loss of business opportunity) arising out of or relating to any product or service provided or to be provided by 4D Systems, or the use or inability to use the same, even if 4D Systems has been advised of the possibility of such damages.

4D Systems products are not fault tolerant nor designed, manufactured or intended for use or resale as on line control equipment in hazardous environments requiring fail – safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines or weapons systems in which the failure of the product could lead directly to death, personal injury or severe physical or environmental damage ('High Risk Activities'). 4D Systems and its suppliers specifically disclaim any expressed or implied warranty of fitness for High Risk Activities.

Use of 4D Systems' products and devices in 'High Risk Activities' and in any other application is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless 4D Systems from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any 4D Systems intellectual property rights.