GOLDELOX Serial (SPE) Command Set

Manual

Revision 2.3

Contents

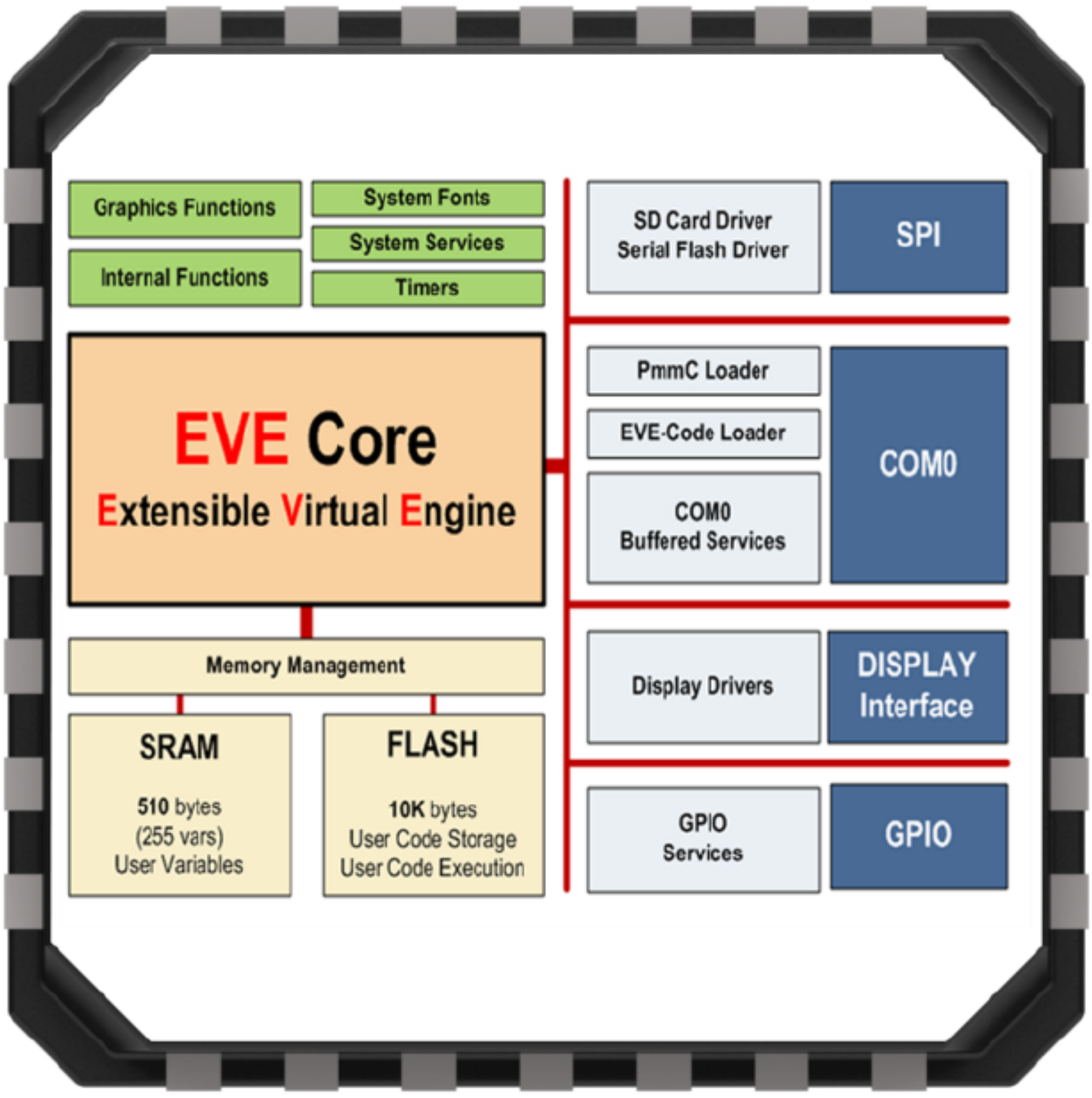
1. GOLDELOX Processor

The Goldelox Processor by 4D Labs is in a family of embedded graphics processors powered by a highly optimised soft core virtual engine, E.V.E. (Extensible Virtual Engine)

There are many 4D Products powered with the Goldelox processor, including:

- uOLED-96-G1
- uOLED-96-G2
- uOLED-128-G1
- uOLED-128-G2
- uOLED-160-G1
- uOLED-160-G2
- uLCD-144-G1
- uLCD-144-G1
- uTOLED-20-G2

EVE is a proprietary, high performance virtual processor 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



GOLDELOX Internal Block Diagram

The Goldelox processor used in the above products can be configured in a number of ways, depending on the needs of the user. Using 4D Labs' Workshop4 IDE, the user has the choice of 3 programming environments, Designer, ViSi and the Serial Environment.

This document targets the Serial Environment, how to configure a Display Module to be 'Serial Ready', and all the commands available in the Serial Environment to send the display from your Host Controller of choice.

For more information on the Workshop4 Software in General or the other Environments available in Workshop4, please refer to the Workshop4 User Guide, available from the 4D Labs website.

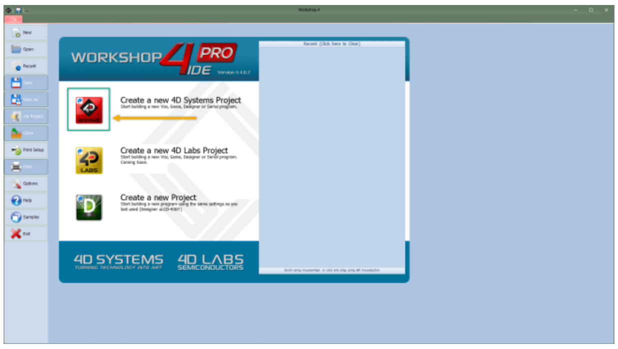
2. Introduction to Workshop4 - Serial Environment

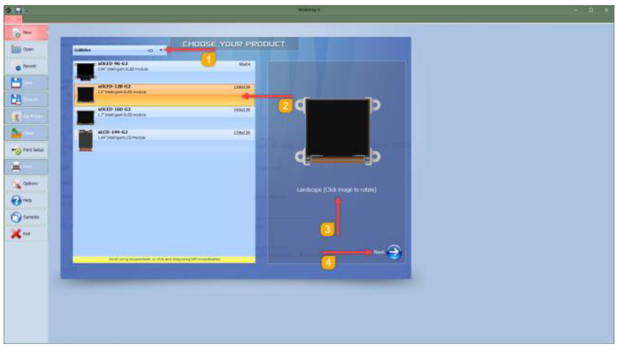
The GOLDELOX Processor can be programmed to act as a 'SERIAL SLAVE' device, responding to the Serial commands sent from virtually any Host Controller.

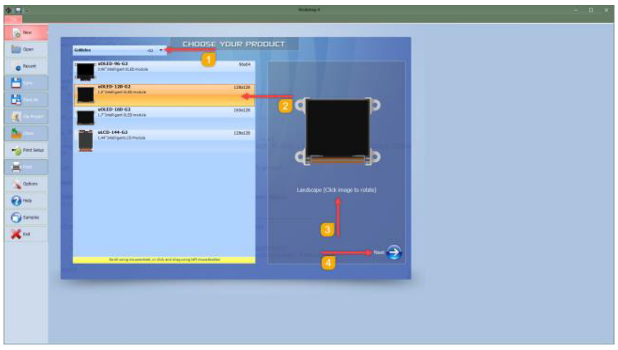
2.1. How to Configure GOLDELOX as a Serial Slave

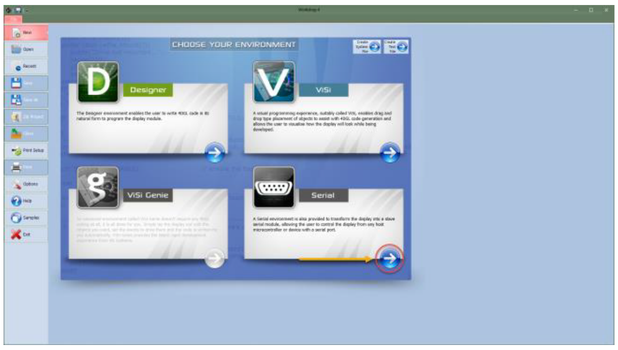
To set up your processor to be a Serial Display is a very simple process.

When a user starts the Workshop4 IDE, starts a new project, selects their module of choice, and then selects the Serial Environment, the user is presented with a basic environment to get them started using their chosen product as a Serial Slave.









In the 'Tools' menu of the Serial Environment, is a button called 'SPE Load'. SPE stands for "Serial Platform Environment". If your display module is connected to the PC via the 4D Systems Programming Cable, clicking this button will load a special 4DGL application onto your module. This application is known as the SPE Application, and will enable your chosen module to run as a Serial Slave.

Note

The Display Modules are **SPE READY** by default, meaning the SPE Application has been loaded to each of the modules at the 4D Systems Factory. The user can reload the **SPE** Application if required, to update the SPE Application on board OR to move over to the **Serial Environment** from another Workshop4 Environment such as Designer or ViSi.

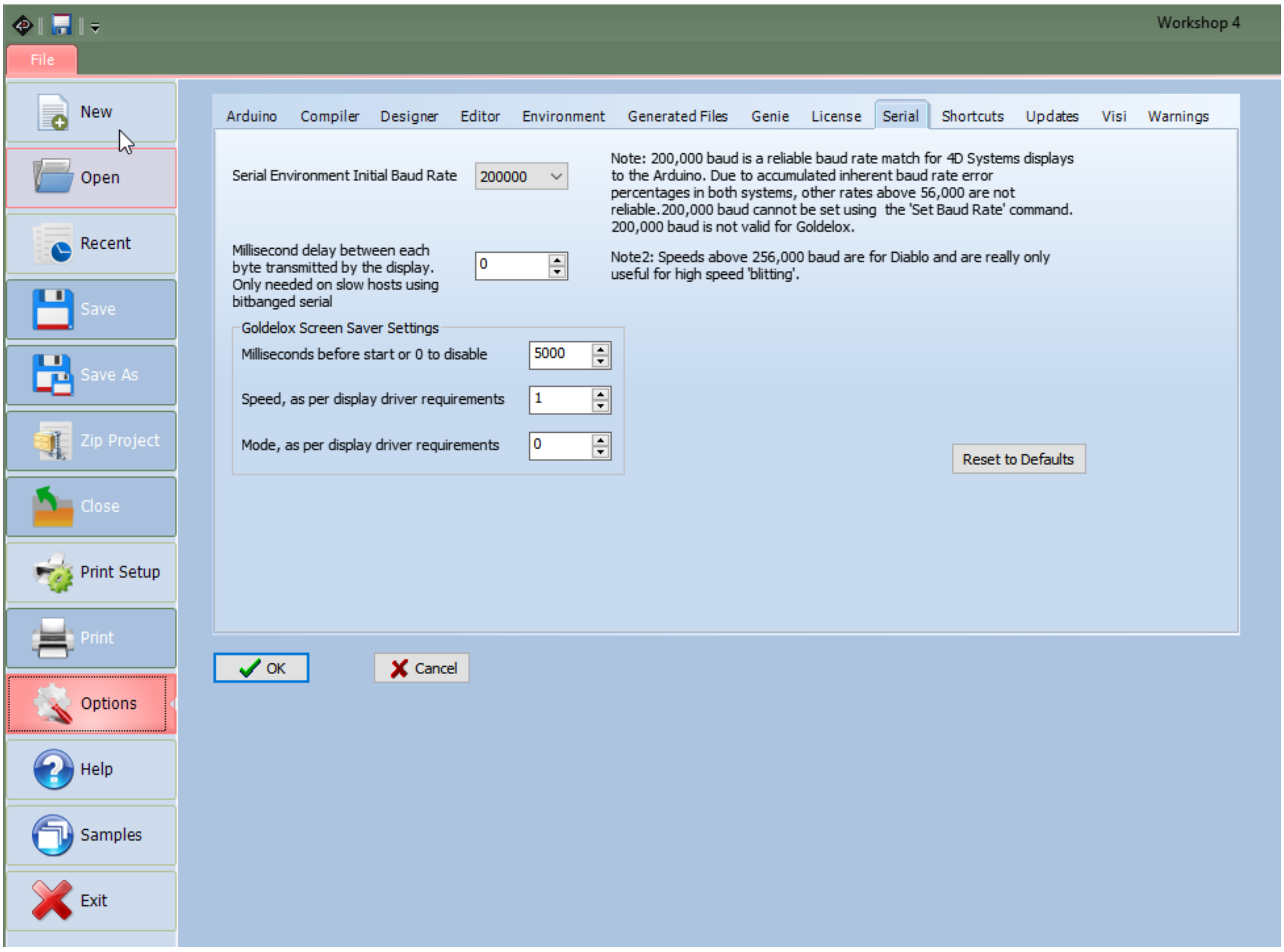
Once the Goldelox-powered display is 'SPE READY', either brand new out of the box, or programmed to have the SPE Application via the above instructions, the user can begin programming their Host of choice to communicate to the 4D Labs processor.

2.2. Additional Configuration Parameters for Serial Communication

When the SPE Application is loaded to the processor, the Baud Rate is set to the initial default of 9600. This initial Baud Rate can be modified, so when the Display Module starts up, it is at the desired Baud Rate without having to send commands to change it from the Host.

Similarly, Screen Saver default settings such as Screen Saver Mode, Speed and Delay could be adjusted. Screen saver settings depend on the Display Driver IC. Not all the displays/drivers offer this feature.

To change the default Baud Rate and Screen Saver default settings click on the Option button on the buttons down the left hand side of the Workshop4 IDE, click on the Serial tab, and change the 'Serial Environment Initial Baud Rate' and default Screen Saver settings to be whatever is suitable for your application.



Serial Environment Initial Baud Rate: 200000

Note: 200,000 baud is a reliable baud rate match for 4D Systems displays to the Arduino. Due to accumulated inherent baud rate error percentages in both systems, other rates above 56,000 are not reliable. 200,000 baud cannot be set using the 'Set Baud Rate' command. 200,000 baud is not valid for Goldelox.

Millisecond delay between each byte transmitted by the display. Only needed on slow hosts using bitbanged serial: 0

Note2: Speeds above 256,000 baud are for Diablo and are really only useful for high speed 'blitting'.

Goldelox Screen Saver Settings

Milliseconds before start or 0 to disable: 5000

Speed, as per display driver requirements: 1

Mode, as per display driver requirements: 0

Note

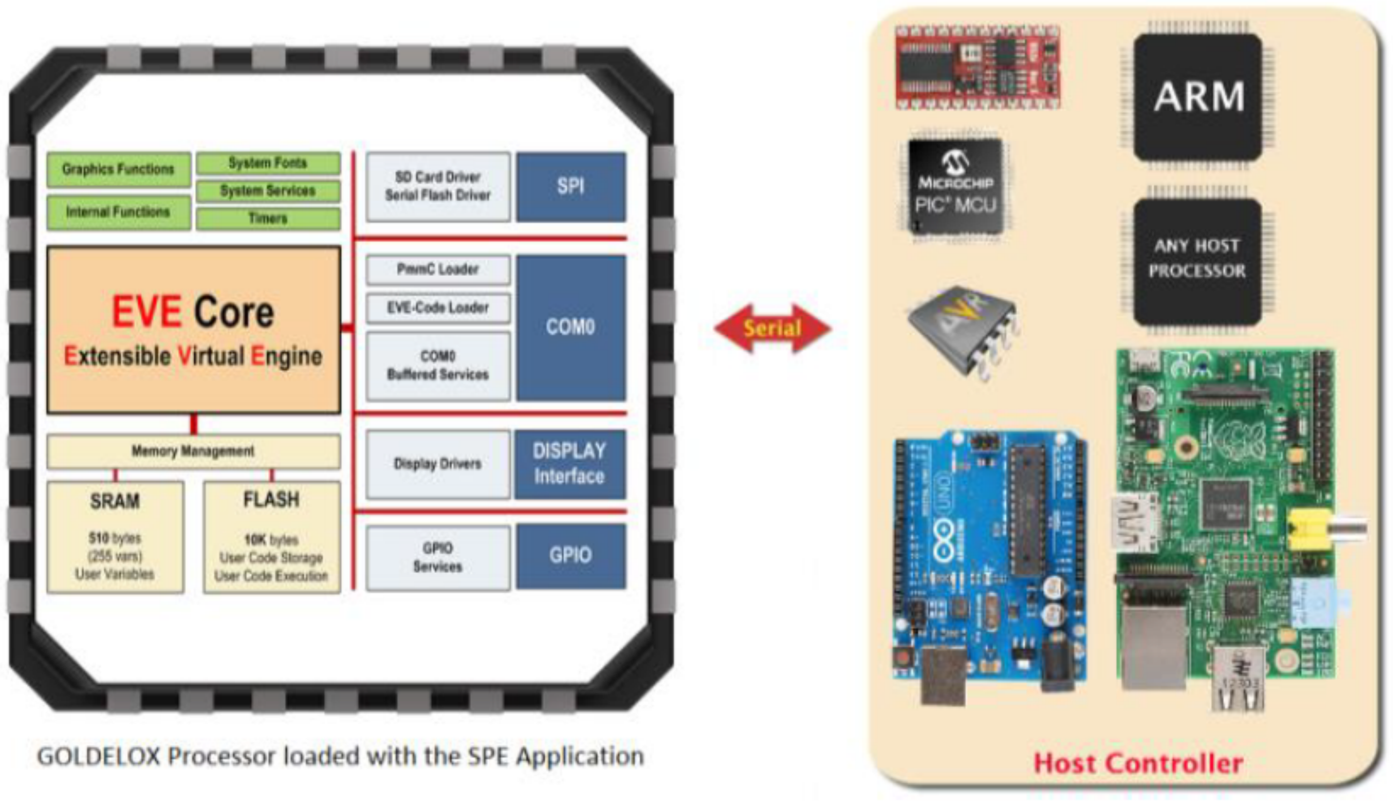
The initial Baud rate and 'slowdown' settings for slow systems can be set under 'options', 'serial' before loading SPE.

Once the desired Baud Rate has been set, along with any 'Slowdown' delay (where required), the Display Module needs to have the SPE Application loaded once again, so these settings can take effect.

Simply follow the instructions in How to Configure GOLDELOX as a Serial Slave, to load the updated SPE Application onto the Display Module.

2.3. Host Interface

When a processor is loaded with the SPE Application, it enables communication to a Serial Host over a bidirectional serial interface via its Serial UART. All communications between the host and the device occur over this serial interface. The protocol is simple and easy to implement.



Serial Data Format: 8 Bits, No Parity, 1 Stop Bit. Serial data is true and not inverted

2.4. Introduction and Guidelines to the Serial Protocol

The Serial Protocol used with the SPE Application is a set of commands with associated parameters, to enable the Host Controller to display primitives, text, images, play audio, video or data log to micro-SD card, receive touch events etc on the 4D Systems Display Module, in the simplest manner available.

The Serial Protocol is made up of commands and parameters, sent over the Serial Port in byte format to the Display Module. Each command is unique, and has a specific set of parameters associated with it. Each command that is sent to the Display Module is replied to with a response. Some commands do not specifically require a response, so for these commands the Display will reply with an Acknowledge once successfully executed.

Commands that require a specific response may send back a varying number of bytes, depending on the command and what the response is.

Each Command sent to the display will require a certain amount of time before the response is sent, again dependent on the command and the operation that has to be performed.

Commands should only be sent and their response received, before another command is sent. If two commands are sent before the first response is received, incorrect operation may follow.

2.5. Power-Up and Reset

When the Goldelox processor comes out of a power-up or external reset, a sequence of events is executed internally. The user should wait about 3 seconds for the start-up to take place before attempting to communicate with the module.

2.6. Splash Screen

The splash screen appears on the screen 5 seconds after the start-up routines have been executed, provided there has been no serial activity. Therefore as per Power-Up and Reset, the splash screen should appear after approximately 8 seconds from power up or reset. Communications doesn’t have to wait for the Splash screen to appear.

3. The Serial Command Set - Explained

The Serial Protocol and associated Commands enable the user to send bytes serially from the chosen Host Controller, to the 4D Display module loaded with the SPE Application, and control or receive information from, the Display Module.

In the Goldelox Serial Protocol Command Set, there are currently 71 Commands available to the user. Each command send to the Display Module will incur a response of some description from the Display Module. This may be in the form of data, or a simple ACK that the command has been received.

Here is an example to better illustrate a few commands.

3.1. Example 1 – Moving the Cursor

Aim: Moving the Cursor to a specific location on the display, so text can originate from that point.

MoveCursor Command: HEX 0xFFE4 (2 bytes) – (Library Function txt_MoveCursor)

MoveCursor Parameters: Line Number (2 bytes), Row Number (2 bytes)

MoveCursor Returns: Acknowledge HEX 0x06

To Move the Cursor to Line Number=7, Row Number=12, firstly the 7 and 12 need to be converted into bytes. 7 is 0x7 and 12 is 0x0C. Because the command requires 2 bytes for each of these parameters to be sent, the first byte in this example will be 0x00 for both the Line and the Row.

The Bytes that will need to be sent will be: **0xFF, 0xE4, 0x00, 0x07, 0x00, 0x0C**

The Bytes that will be received back from the display will be: **0x06**

Note

Separation commas ',' between bytes that are shown in the Bytes to Send, and the Bytes Received syntax are purely for legibility purposes in this document and must not be considered as part of any transmitted/received data unless specifically stated.

3.2. Example 2 – Drawing a Hollow Rectangle

Aim: Draw a Hollow Rectangle at a specific location on the display, with a specific outline colour

Rectangle Command: HEX 0xFFCF (2 bytes) – (Library Function gfx_Rectangle)

Rectangle Parameters: X1 Position (2 bytes), Y1 Position (2 bytes), X2 Position (2 bytes), Y2 Position (2 bytes), Colour (2 bytes)

Rectangle Returns: Acknowledge HEX 0x06

To draw a Blue rectangle starting with the top left corner at X=10, Y=20 and the bottom right corner at X=80, Y= 80, firstly the 10, 20 and 80 numbers need to be converted into bytes.

10 is 0x0A, 20 is 0x14 and 80 is 0x050. Because the command requires 2 bytes for each of these parameters to be sent, the first byte in this example will be 0x00 for X1, Y1, and X2. Y2 utilises 2 bytes.

Finally, the colour needs to be sent as 2 bytes. The colour Blue is 0x001F.

The Bytes to be sent will be: **0xFF, 0xCF, 0x00, 0x0A, 0x00, 0x14, 0x00, 0x50, 0x00, 0x50, 0x00, 0x1F**

The Bytes that will be received back from the display will be: **0x06**

Note

Separation commas ',' between bytes that are shown in the Bytes to Send, and the Bytes Received syntax are purely for legibility purposes in this document and must not be considered as part of any transmitted/received data unless specifically stated.

4. Using Serial with a Library

4.1. Available Libraries

4D Labs has created a set of libraries suitable for a range of microcontrollers on the market to use and communicate with 4D Systems' range of display modules, when configured to be Serial Slaves using the SPE application and the Serial Environment in Workshop4.

The following libraries have been created and are **available from the Samples menu inside the Workshop4 IDE Software**, where the Workshop4 software is available from the 4D Labs website.

- Arduino Library
- C Library
- Pascal Library
- PicAxe Library

These libraries enable the programmer to have access to all of the Serial Commands, but in a format that is more suited for High Level Programming, such as the Arduino IDE.

4.2. Benefits to using a Library

The libraries created by 4D Labs enable the user to simply include the library file in the code of their chosen Host Controller, and call high level functions (very similar and often equivalent to the 4DGL set of functions) instead of having to deal with the low level serial data bytes.

Please refer to the individual application notes on each of the libraries (as they become available), for a better understanding of what they include and how they are used in a Host controller. Refer to the Workshop4 product page on the 4D Labs website for more information, along with the modules product page.

4.3. Basic Example of using a library

If using the Arduino as the host controller of choice, by simply copying the library into the appropriate libraries folder for the Arduino IDE, and including the library in your sketch, the Arduino user will then have access to high level functions which provide many benefits over using the low level byte commands.

For example, to clear the display, and draw a rectangle from X1=0, Y1=10 to X2=50, Y2=70 in Red on the display, the following byte commands are required:

> **Send to the display:** 0xFF, 0xCF
> **Receive from the display:** 0x06
> **Send to the display:** 0xFF, 0xCF, 0x00, 0x00, 0x00, 0x0A, 0x00, 0x32, 0x00, 0x46, 0xF8, 0x00
> **Receive from the display:** 0x06

Sending these commands from the Arduino would require each byte to be sent over the serial port to the display. 4D Labs has created a library to do this for you.

Using the Arduino library for example, the following functions would be required.

```
Display.gfx_Cls();
Display.gfx_Rectangle(0, 10, 50, 70, RED);
```

4.4. Library References

While this document is specifically for the Serial Command bytes, at the bottom of each command table is a reference to the relevant function that would be called if using the 4D Labs Serial Library.

5. Goldelox Serial Commands

The following sections detail each of the commands available in the 4D Labs Serial Environment, when communicating to a 4D Systems Display Module loaded with the SPE Application. Please refer to How to Configure GOLDELOX as a Serial Slave for more information on how to do this.

5.1. Text and String Commands

The following is a summary of the commands available to be used for Text and Strings:

- Move Cursor
- Put Character
- Put String
- Character Width
- Character Height
- Text Foreground Colour
- Text Background Colour
- Set Fonts
- Text Width
- Text Height
- Text X-Gap
- Text Y-Gap
- Text Bold
- Text Inverse
- Text Italic
- Text Opacity
- Text Underline
- Text Attribute
- Set Text Parameters

5.1.1. Move Cursor

The **Move Cursor** command moves the text cursor to a screen position set by line and column parameters. The line and column position is calculated, based on the size and scaling factor for the currently selected font. When text is outputted to screen it will be displayed from this position. The text position could also be set with "Move Origin" command if required to set the text position to an exact pixel location. Note that lines and columns start from 0, so line 0, column 0 is the top left corner of the display.

Library Function: `txt_MoveCursor`

Syntax: `cmd(word)`, `line(word)`, `column(word)`

Commands	Description
cmd	0xFFE4
line	Holds a positive value for the required line position.
column	Holds a positive value for the required column position.

Returns: (0x06) ACK byte if successful, anything else implies mismatch between command and response.

Example

```
// Byte Stream:
// cmd(MSB), cmd(LSB), line(MSB), line(LSB), column(MSB), column(LSB)

0xFF, 0xE4, 0x00, 0x05, 0x00, 0x03

// This will move the cursor to Line=5, Column=3
// Where 5 as 2 byes is 0x00 and 0x05, and 3 as 2 bytes is 0x00 and 0x03
// The Response will be 0x06 if the command is successfully executed
```

5.1.2. Put Character

The **Put Character** command prints a single character to the display.

Library Function: `putCH`

Syntax: `cmd(word)`, `character(word)`

Commands	Description
cmd	0xFFFE
character	Holds a positive value for the required character.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), character(MSB), character(LSB)

0xFF, 0xFE, 0x00, 0x39

// This will send the character '9' (0x00, 0x39) to the display
// The response will be 0x06 assuming the command was successful executed
```

5.1.3. Put String

The **Put String** command prints a string to the display and returns the pointer to the string.

A string needs to be terminated with a NULL.

Library Function: `putstr`

Syntax: `cmd(word)`, `string(string)`

Commands	Description
cmd	0x0006
string	Holds a Null terminated string. char0, char1, char2, ..., charN, NULL **NOTE:** Maximum characters in the string is 255 + NULL

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), char0, char1, char2, …, charN, NULL

0x00, 0x06, 0x48, 0x65, 0x6C, 0x6C, 0x6F, 0x00

// This will send the string “Hello” to the display, as H = 0x48, e = 0x65, l = 0x6C and o =
0x6F, followed by a NULL = 0x00.
// The response will be 0x06 indicating ACK if the command was successful.
```

5.1.4. Character Width

The **Character Width** command is used to calculate the width in pixel units for a character, based on the currently selected font. The font can be proportional or mono-spaced. If the total width of the character exceeds 255 pixel units, the function will return the 'wrapped' (modulo 8) value.

Library Function: `charwidth`

Syntax: `cmd (word)`, `char(byte)`

Commands	Description
cmd	0x0002
char	The ASCII character for the width calculation.

Returns: `acknowledge(byte)`, `width(word)`

- *acknowledge*: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *width*: Width of a single character in pixel units.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), char

0x00, 0x02, 0x48

// This is requesting the width in pixels of the character ‘H’, as ASCII ‘H’ is Hex 0x48
// Assuming for example the selected font is System Fonts or FONT0
// The response will be 0x06, 0x00, 0x07 where 0x00, 0x07 is Decimal 7 (FONT 0 is a 7x8
font)
```

5.1.5. Character Height

The **Character Height** command is used to calculate the height in pixel units for a character, based on the currently selected font. The font can be proportional or mono-spaced. If the total height of the character exceeds 255 pixel units, the function will return the 'wrapped' (modulo 8) value.

Library Function: `charheight`

Syntax: `cmd(word)`, `char(byte)`

Commands	Description
cmd	0x0001
height	The ascii character for the height calculation.

Returns: `acknowledge(byte)`, `height(word)`

- *acknowledge*: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *height*: Height of a single character in pixel units.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), char

0x00, 0x01, 0x48

// This is requesting the height in pixels of the character ‘H’, as ASCII ‘H’ is Hex 0x48
// Assuming for example the selected font is System Fonts or FONT0
// The response will be 0x06, 0x00, 0x08 where 0x00, 0x08 is Decimal 8 (FONT 0 is a 7x8
font)
```

5.1.6. Text Foreground Colour

The **Text Foreground Colour** command sets the text foreground colour.

Library Function: `txt_FGcolour`

Syntax: `cmd(word)`, `colour(word)`

Commands	Description
cmd	0xFF7F
colour	Specifies the colour to be set.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), colour(MSB), colour(LSB)

0xFF, 0x7F, 0x00, 0x10

// This is setting the Foreground colour to Navy, which is Hex 0x00, 0x10
// The Response will be 0x06 if the command is successfully executed
```

5.1.7. Text Background Colour

The **Text Background Colour** command sets the text background colour.

Library Function: `txt_BGcolour`

Syntax: `cmd(word)`, `colour(word)`

Commands	Description
cmd	0xFF7E
colour	Specifies the colour to be set.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), colour(MSB), colour(LSB)

0xFF, 0x7E, 0xF8, 0x00

// This is setting the Background colour to Red, which is Hex 0xF8, 0x00
// The Response will be 0x06 if the command is successfully executed.
```

5.1.8. Set Font

The **Set Font** command sets the required font using its ID.

To set the external fonts (media fonts), "Set Sector Address" should be used to set the sector address of the font data saved on the uSD card. The Sector address could be found from the include file generated by the 4D Workshop4 IDE when a string object is dropped on to the screen and the file is compiled to write the Fonts data to the uSD card. Check the Application Note Serial: Displaying Third Party Fonts with GOLDELOX for further details.

Library Function: `txt_FontID`

Syntax: `cmd(word)`, `id(word)`

Commands	Description
cmd	0xFF7D
id	0 for System font (Default Fonts) 7 for Media fonts.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), id(MSB), id(LSB)

0xFF, 0x7D, 0x00, 0x07

// This will set the font to be media fonts which is 0x00, 0x07
// The response will be 0x06 if the command is successfully executed.
```

5.1.9. Text Width

The **Text Width** command sets the text width multiplier between 1 and 16.

Library Function: `txt_Width`

Syntax: `cmd(word)`, `multiplier(word)`

Commands	Description
cmd	0xFF7C
multiplier	Width multiplier 1 to 16 (Default =1)

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), multiplier(MSB), multiplier (LSB)

0xFF, 0x7C, 0x00, 0x05

// This will set the Text Width to be 5x that of the default.
// The Response will be 0x06 if the command is successfully executed
```

5.1.10. Text Height

The **Text Height** command sets the text height multiplier between 1 and 16.

Library Function: `txt_Height`

Syntax: `cmd(word)`, `multiplier(word)`

Commands	Description
cmd	0xFF7B
multiplier	Height multiplier. 1 to 16 (Default =1)

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), multiplier(MSB), multiplier (LSB)

0xFF, 0x7B, 0x00, 0x02

// This will set the Text Height to be 2x that of the default.
// The Response will be 0x06 if the command is successfully executed.
```

5.1.11. Text X-gap

The **Text X-gap** command sets the pixel gap between characters (x-axis), where the gap is in pixel units.

Library Function: `txt_Xgap`

Syntax: `cmd(word)`, `pixelcount(word)`

Commands	Description
cmd	0xFF7A
pixelcount	0 to 32(Default =0)

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), pixelcount(MSB), pixelcount(LSB)

0xFF, 0x7A, 0x00, 0x02

// This will set the text X-Gap to be 2 pixels, where 2 pixels is 0x00, 0x02
// The Response will be 0x06 if the command is successfully executed.
```

5.1.12. Text Y-gap

The **Text Y-gap** command sets the pixel gap between characters (y-axis), where the gap is in pixel units.

Library Function: `txt_Ygap`

Syntax: `cmd(word)`, `pixelcount(word)`

Commands	Description
cmd	0xFF79
pixelcount	0 to 32(Default =0)

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), pixelcount(MSB), pixelcount(LSB)

0xFF, 0x79, 0x00, 0x05

// This will set the text Y-Gap to be 5 pixels, where 5 pixels is 0x00, 0x05
// The Response will be 0x06 if the command is successfully executed.
```

5.1.13. Text Bold

The **Text Bold** command sets the Bold attribute for the text.

The 'Text Bold' attribute is cleared internally once the text (character or string) is displayed.

Library Function: `txt_Bold`

Syntax: `cmd(word)`, `mode(word)`

Commands	Description
cmd	0xFF76
mode	1 for ON. 0 for OFF.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0xFF, 0x76, 0x00, 0x01

// This will set the text to be bold, Bold = ON
// The Response will be 0x06 if the command is successfully executed.
```

5.1.14. Text Inverse

The **Text Inverse** command inverts the text Foreground and Background colour.

The 'Text Inverse' attribute is cleared internally once the text (character or string) is displayed.

Library Function: `txt_Inverse`

Syntax: `cmd(word)`, `mode(word)`

Commands	Description
cmd	0xFF74
mode	1 for ON. 0 for OFF.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0xFF, 0x74, 0x00, 0x01

// This will set the text Background and foreground colour to be inverse, where inverse = ON
= 0x00, 0x01
// The Response will be 0x06 if the command is successfully executed.
```

5.1.15. Text Italic

The **Text Italic** command sets the text to italic.

The 'Text Italic' attribute is cleared internally once the text (character or string) is displayed.

Library Function: `txt_Italic`

Syntax: `cmd(word)`, `mode(word)`

Commands	Description
cmd	0xFF75
mode	1 for ON. 0 for OFF.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0xFF, 0x75, 0x00, 0x01

// This will set the text to be italic, where italic = ON = 0x00, 0x01
// The Response will be 0x06 if the command is successfully executed.
```

5.1.16. Text Opacity

The **Text Opacity** command selects whether or not the 'background' pixels are drawn. (Default mode is OPAQUE with BLACK background.)

Library Function: `txt_Opacity`

Syntax: `cmd(word)`, `mode(word)`

Commands	Description
cmd	0xFF77
mode	1 for ON. (Opaque). 0 for OFF. (Transparent)

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0xFF, 0x77, 0x00, 0x00

// This will set the text to be transparent, where Opacity = OFF = 0x00, 0x00
// The Response will be 0x06 if the command is successfully executed.
```

5.1.17. Text Underline

The **Text Underline** command sets the text to underlined.

The 'Text Underline' attribute is cleared internally once the text (character or string) is displayed.

Library Function: `txt_Underline`

Syntax: `cmd(word)`, `mode(word)`

Commands	Description
cmd	0xFF73
mode	1 for ON. 0 for OFF.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0xFF, 0x73, 0x00, 0x01

// This will set the text to be underlined, where Underline = ON = 0x00, 0x01
// The Response will be 0x06 if the command is successfully executed.
```

5.1.18. Text Attributes

The **Text Attributes** command controls the following functions grouped,

- Text Bold
- Text Italic
- Text Inverse
- Text Underlined

The Attributes are set to normal internally once the text (character or string) is displayed.

Library Function: `txt_Attributes`

Syntax: `cmd(word)`, `value(word)`

Commands	Description
cmd	0xFF72
value	(bit 5 or) DEC 16 for BOLD (bit 6 or) DEC 32 for ITALIC (bit 7 or) DEC 64 for INVERSE (bit 8 or) DEC 128 for UNDERLINED Set or Clear the relevant bits to set the attributes for the text to be written. (bits can be combined by using logical 'OR' of bits) **NOTE:** bits 0-3 and 8-15 are reserved.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), value(MSB), value(LSB)

0xFF, 0x72, 0x00, 0x90

// This will set the Text Attributes to be Bold and Underlined. Where Bold has the value 16
and Underlined has the value 128, so 16+128=144 which is 0x90 in Hex.
// The Response will be 0x06 if the command is successfully executed.
```

5.1.19. Set Text Parameters

Sets various parameters for the Text commands.

Library Function: `txt_Set`

Syntax: `cmd(word)`, `function(word)`, `value(word)`

Commands	Description
cmd	0xFFE3
function	Function = 7 Text Print Delay Sets the Delay between the characters being printed through Put Character or Put String functions.
value	0 or 255 msec Default is 0 msec

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), function(MSB), function(LSB), value(MSB), value(LSB)

0xFF, 0xE3, 0x00, 0x07, 0x00, 0x96

// This will set the Text Print Delay to be 150 (0x00, 0x96)
// The response will be 0x06 if successful
```

5.2. Graphics Commands

The following is a summary of the commands available to be used for Graphics:

- Clear Screen
- Change Colour
- Draw Circle
- Draw Filled Circle
- Draw Line
- Draw Rectangle
- Draw Filled Rectangle
- Draw Polyline
- Draw Polygon
- Draw Triangle
- Calculate Orbit
- Put Pixel
- Read Pixel
- Move Origin
- Draw Line and Move Origin
- Clipping
- Set Clip Window
- Extend Clip Region
- Background Colour
- Outline Colour
- Contrast
- Frame Delay
- Line Pattern
- Screen Mode
- Transparency
- Transparent Colour
- Set Graphics Parameters

5.2.1. Clear Screen

The Clear Screen command clears the screen using the current background colour. This command brings some of the settings back to default; such as, - Outline colour set to BLACK - Pen set to OUTLINE - Text magnifications set to 1 - All origins set to 0:0

The alternative to maintain settings and clear screen is to draw a filled rectangle with the required background colour.

Library Function: `gfx_Cls`

Syntax: `cmd(word)`

Commands	Description
cmd	0xFFD7

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0xFF, 0xD7

// The following will clear the display and restore the settings back to their defaults.
// The response will be 0x06 if the command is successful
```

5.2.2. Change Colour

The **Change Colour** command changes all oldColour pixels to newColour within the clipping window area.

Library Function: `gfx_ChangeColour`

Syntax: `cmd(word)`,

Commands	Description
cmd	0xFFBE
oldColour	Specifies the sample colour to be changed within the clipping window
newColour	Specifies the new colour to change all occurrences of old colour within the clipping window

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), oldColour(MSB), oldColour (LSB), newColour(MSB), newColour (LSB)

0xFF, 0xBE, 0x00, 0x00, 0x00, 0x1F

// This will change all pixels coloured Black (0x00, 0x00) to be coloured
// Blue (0x00,0x1F) within the clipping area.
// (Refer to the Clip Window command for more information on this.)
// The Response will be 0x06 if the command is successful
```

5.2.3. Draw Circle

The **Draw Circle** command draws a circle with centre point x, y with radius r using the specified colour.

Library Function: `gfx_Circle`

Syntax: `cmd(word)`, `x(word)`, `y(word)`, `rad(word)`, `colour(word)`

Commands	Description
cmd	0xFFCD
x, y	Specifies the centre of the circle.
rad	Specifies the radius of the circle.
colour	Specifies the colour of the circle.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB), rad(MSB), rad(LSB), colour(MSB),
colour(LSB)

0xFF, 0xCD, 0x00, 0x1E, 0x00, 0x1E, 0x00, 0x14, 0x80, 0x10

// This will draw a Circle at X=30 (Hex 0x00, 0x64), Y=30 (Hex 0x00, 0x1E), of Radius=20
(0x00, 0x14), and of Colour=Purple (0x80, 0x10).
// The response will be 0x06 if the command is successful
```

5.2.4. Draw Filled Circle

The **Draw Circle** command draws a solid circle with centre point x1, y1 with radius using the specified colour.

The outline colour can be specified with the Outline Colour command. If Outline Colour is set to 0, no outline is drawn.

Library Function: `gfx_CircleFilled`

Syntax: `cmd(word)`, `x(word)`, `y(word)`, `rad(word)`, `colour(word)`

Commands	Description
cmd	0xFFCC
x, y	Specifies the centre of the circle.
rad	Specifies the radius of the circle.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB), rad(MSB), rad(LSB), colour(MSB),
colour(LSB)

0xFF, 0xCC, 0x00, 0x2D, 0x00, 0x28, 0x00, 0x23, 0x84, 0x10

// This will draw a Solid Filled Circle at X=45 (Hex 0x00, 0x2D), Y=40 (Hex 0x00, 0x28), of
Radius=35 (0x00, 0x23), and of Colour=Grey (0x84, 0x10).
// The response will be 0x06 if the command is successful
```

5.2.5. Draw Line

The **Draw Line** command draws a line from x1,y1 to x2,y2 using the specified colour. The line is drawn using the current object colour. The current origin is not altered. The line may be tessellated with the Line Pattern command.

Library Function: `gfx_Line`

Syntax: `cmd(word)`, `x1(word)`, `y1(word)`, `x2(word)`, `y2(word)`, `colour(word)`

Commands	Description
cmd	0xFFD2
x1, y1	Specifies the starting coordinates of the line.
x2, y2	Specifies the ending coordinates of the line.
colour	Specifies the colour of the line.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x1(MSB), x1(LSB), y1(MSB), y1(LSB), x2(MSB), x2(LSB), y2(MSB),
y2(LSB), colour(MSB), colour(LSB)

0xFF, 0xD2, 0x00, 0x0A, 0x00, 0x0F, 0x00, 0x28, 0x00, 0x3C, 0x04, 0x10

// This will Line from X1=10 (Hex 0x00, 0x0A), Y1=15 (Hex 0x00, 0x0F), to X2=40 (0x00,
0x28), Y2=60 (0x00, 0x3C) of Colour=Teal (0x04, 0x10).
// The response will be 0x06 if the command is successful
```

5.2.6. Draw Rectangle

The **Draw Rectangle** command draws a rectangle from x1, y1 to x2, y2 using the specified colour. The line may be tessellated with the Line Pattern command.

Library Function: `gfx_Rectangle`

Syntax: `cmd(word)`, `x1(word)`, `y1(word)`, `x2(word)`, `y2(word)`, `colour(word)`

Commands	Description
cmd	0xFFCF
x1, y1	Specifies the top left corner of the rectangle.
x2, y2,	Specifies the bottom right corner of the rectangle.
colour	Specifies the colour of the rectangle.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x1(MSB), x1(LSB), y1(MSB), y1(LSB), x2(MSB), x2(LSB), y2(MSB),
y2(LSB), colour(MSB), colour(LSB)

0xFF, 0xCF, 0x00, 0x0A, 0x00, 0x14, 0x00, 0x5A, 0x00, 0x3C, 0xF8, 0x00

// The will draw a Rectangle from X1=10 (0x00, 0x0A), Y1=20 (0x00, 0x14), to X2=90 (0x00,
0x5A), Y2=60 (0x00, 0x3C), of colour=Red (0xF8, 0x00).
// The response will be 0x06 if the command is successful
```

5.2.7. Draw Filled Rectangle

The **Draw Filled Rectangle** command draws a solid rectangle from x1, y1 to x2, y2 using the specified colour. The line may be tessellated with the Line Pattern command. The outline colour can be specified with the Outline Colour command. If Outline Colour is set to 0, no outline is drawn.

Library Function: `gfx_RectangleFilled`

Syntax: `cmd(word)`, `x1(word)`, `y1(word)`, `x2(word)`, `y2(word)`, `colour(word)`

Commands	Description
cmd	0xFFCE
x1, y1	Specifies the top left corner of the rectangle.
x2, y2	Specifies the bottom right corner of the rectangle.
colour	Specifies the colour of the rectangle.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x1(MSB), x1(LSB), y1(MSB), y1(LSB), x2(MSB), x2(LSB), y2(MSB),
y2(LSB), colour(MSB), colour(LSB)

0xFF, 0xCE, 0x00, 0x0A, 0x00, 0x14, 0x00, 0x5A, 0x00, 0x3C, 0x07, 0xE0

// The will draw a Solid Filled Rectangle from X1=10 (0x00, 0x0A), Y1=20 (0x00, 0x14), to
X2=90 (0x00, 0x5A), Y2=60 (0x00, 0x3C), of colour=Lime (0x07, 0xE0).
// The response will be 0x06 if the command is successful
```

5.2.8. Draw Polyline

The **Draw Polyline** command plots lines between points specified by a pair of arrays using the specified colour. The lines may be tessellated with the Line Pattern command. The **"Draw Polyline"** command can be used to create complex raster graphics by loading the arrays from serial input or from MEDIA with very little code requirement.

Library Function: `gfx_Polyline`

Syntax: `cmd(word)`, `n(word)`, `vx1(word)` … `vxN(word)`, `vy1(word)` … `vyN(word)`, `colour(word)`

Commands	Description
cmd	0x0005
n	Specifies the number of elements in the x and y arrays specifying the vertices for the polyline.
vx, vy	Specifies the array of elements for the x/y coordinates of the vertices. Vx1, vx2, …, vxN, vy1, vy2, …, vyN
colour	Specifies the colour of the polyline.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), n(MSB), n(LSB), vx1(MSB), vx1(LSB), vx2(MSB), vx2(LSB), vx3(MSB),
vx3(LSB), vy1(MSB),
// vy1(LSB), vy2(MSB), vy2(LSB), vy3(MSB), vy3(LSB), colour(MSB), colour(LSB)

0x00, 0x05, 0x00, 0x03, 0x00, 0x0A, 0x00, 0x3C, 0x00, 0x78, 0x00, 0x05, 0x00, 0x50, 0x00,
0x5A, 0x80, 0x00

// The following will draw a 3 point Polyline from X1=10 (0x00, 0x0A), Y1=5 (0x00, 0x05), to
X2=60 (0x00, 0x3C),
// Y2=80 (0x00, 0x50), and finally to X3=120 (0x00, 0x78), Y3=90 (0x00, 0x5A) of
Colour=Maroon (0x80, 0x00)
// The response will be 0x06 if the command is successful
```

5.2.9. Draw Polygon

The **Draw Polygon** command plots lines between points specified by a pair of arrays using the specified colour. The last point is drawn back to the first point, completing the polygon. The lines may be tessellated with Line Pattern command. The **Draw Polygon** command can be used to create complex raster graphics by loading the arrays from serial input or from MEDIA with very little code requirement.

Library Function: `gfx_Polygon`

Syntax: `cmd(word)`, `n(word)`, `vx1(word)` … `vxN(word)`, `vy1(word)` … `vyN(word)`, `colour(word)`

Commands	Description
cmd	0x0004
n	Specifies the number of elements in the x and y arrays specifying the vertices for the polygon.
vx, vy	Specifies the array of elements for the x/y coordinates of the vertices. Vx1, vx2, …, vxN, vy1, vy2, …, vyN
colour	Specifies the colour of the polygon.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), n(MSB), n(LSB), vx1(MSB), vx1(LSB), vx2(MSB), vx2(LSB), vx3(MSB),
vx3(LSB), vy1(MSB),
// vy1(LSB), vy2(MSB), vy2(LSB), vy3(MSB), vy3(LSB), vy4(MSB),colour(MSB), colour(LSB)

0x00, 0x04, 0x00, 0x03, 0x00, 0x0A, 0x00, 0x3C, 0x00, 0x78, 0x00, 0x05, 0x00, 0x50, 0x00,
0x5A, 0xFF, 0xE0

// The following will draw a 3 point Polygon from X1=10 (0x00, 0x0A), Y1=5 (0x00, 0x05), to
X2=60 (0x00, 0x3C),
// Y2=80 (0x00, 0x50), and finally to X3=120 (0x00, 0x78), Y3=90 (0x00, 0x5A) of
Colour=Yellow (0xFF, 0xE0)
// The response will be 0x06 if the command is successful
```

5.2.10. Draw Triangle

The **Draw Triangle** command draws a triangle outline between vertices x1,y1 , x2,y2 and x3,y3 using the specified colour. The line may be tessellated with the Line Pattern command.

Library Function: `gfx_Triangle`

Syntax: `cmd(word)`, `x1(word)`, `y1(word)`, `x2(word)`, `y2(word)`, `x3(word)`, `y3(word)`, `colour(word)`

Commands	Description
cmd	0xFFC9
x1, y1	Specifies the first vertice of the triangle.
x2, y2	Specifies the second vertice of the triangle.
x3, y3	Specifies the third vertice of the triangle.
colour	Specifies the colour of the triangle.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x1(MSB), x1(LSB), y1(MSB), y1(LSB), x2(MSB), x2(LSB), y2(MSB),
y2(LSB),
// x3(MSB), x3(LSB), y3(MSB), y3(LSB), colour(MSB), colour(LSB)

0xFF, 0xC9, 0x00, 0x00, 0x00, 0x00, 0x00, 0x28, 0x00, 0x28, 0x00, 0x00, 0x00, 0x28, 0x07,
0xFF

// This will draw a Triangle from X1=00 (0x00, 0x00), Y1=00 (0x00, 0x00), to X2=40 (0x00,
0x28),
// Y2=40 (0x00, 0x28), to X3=00 (0x00, 0x00), Y3=40 (0x00, 0x28) of colour=Aqua (0x07, 0xFF)
// The response will be 0x06 if the command is successful
```

5.2.11. Calculate Orbit

The **Calculate Orbit** command calculates the x, y coordinates of a distant point relative to the current origin, where the only known parameters are the **angle** and the **distance** from the current origin.

Library Function: ``

Syntax: `cmd(word)`, `angle(word)`, `distance(word)`

Commands	Description
cmd	0x0003
angle	Specifies the angle from the origin to the remote point. The angle is specified in degrees.
distance	Specifies the distance from the origin to the remote point in pixel units.

Returns: acknowledge(byte), Xdist(word), Ydist(word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *Xdist* : X coordinate from the current origin.
- *Ydist* : Y coordinate from the current origin.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), angle(MSB), angle(LSB), distance(MSB), distance(LSB)

0x00, 0x03, 0x00, 0x2D, 0x00, 0x3C

// This will calculate the x and y coordinates based on the Angle=45 degrees (0x00, 0x2D)
// and the Distance=60 pixels (0x00, 0x3C) from the current origin.

// The response will be 0x06, 0x00, 0x29, 0x00, 0x29 assuming the origin is at X=0, Y=0.
// The coordinates are X=41 (0x00, 0x29) and Y=41 (0x00, 0x29)
```

5.2.12. Put pixel

The **Put Pixel** command draws a pixel at position x, y using the specified colour.

Library Function: `gfx_PutPixel`

Syntax: `cmd(word)`, `x(word)`, `y(word)`, `colour(word)`

Commands	Description
cmd	0xFFCB
x, y	Specifies the pixel x, y coordinates.
colour	Specifies the colour of the pixel.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB), colour(MSB), colour(LSB)

0xFF, 0xCB, 0x00, 0x28, 0x00, 0x32, 0xFF, 0xE0

// This will put a pixel at X=40 (0x00, 0x28), Y=50 (0x00, 0x32), and colour the pixel
Yellow (0xFF, 0xE0).
// The response will be 0x06 if the command is successful
```

5.2.13. Read Pixel

The **Read Pixel** command reads the colour value of the pixel at position x,y.

Library Function: `gfx_GetPixel`

Syntax: `cmd(word)`, `x(word)`, `y(word)`

Commands	Description
cmd	0xFFCA
x, y	Specifies the pixel x, y coordinates.

Returns: acknowledge(byte), colour(word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *colour* : 16bit colour of the pixel.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB)

0xFF, 0xCA, 0x00, 0x28, 0x00, 0x32

// This will read the colour of a pixel at X=40 (0x00, 0x28), Y=50 (0x00, 0x32)
// The response will be 0x06, 0xFF, 0xE0 if the command is successful,
// assuming the pixel being read is coloured Yellow (0xFF, 0xE0)
```

5.2.14. Move Origin

The **Move Origin** command moves the origin to a new position.

Library Function: `gfx_MoveTo`

Syntax: `cmd(word)`, `xpos(word)`, `ypos(word)`

Commands	Description
cmd	0xFFD6
xpos, ypos	Specifies the horizontal and vertical position of the new origin.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), xpos(MSB), xpos(LSB), ypos(MSB), ypos(LSB)

0xFF, 0xD6, 0x00, 0x32, 0x00, 0x5A

// This will move the Origin to be X=50 (0x00, 0x32), Y=90 (0x00, 0x5A)
// The response will be 0x06 if the command is successful
```

5.2.15. Draw Line & Move Origin

The **Draw Line & Move Origin** command draws a line from the current origin to a new position. The Origin is then set to the new position. The line is drawn using the current object colour, using the **"Set Graphics Parameters" – "Object Colour"** command. The line may be tessellated with the Line Pattern command.

Note: this command is mostly useful with the Calculate Orbit command, and usually the Draw Line command would be used

Library Function: `gfx_LineTo`

Syntax: `cmd(word)`, `xpos(word)`, `ypos(word)`

Commands	Description
cmd	0xFFD4
xpos, ypos	Specifies the horizontal and vertical position of the line end as well as the new origin.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), xpos(MSB), xpos(LSB), ypos(MSB), ypos(LSB)

0xFF, 0xD4, 0x00, 0x32, 0x00, 0x46

//This will draw a line from the current origin (assuming this is X=0, Y=0 for this
example)
// to X=50 (0x00, 0x32), Y=70 (0x00, 0x46) and set the origin to be this point (X=50, Y=70).

// The response will be 0x06 if the command is successful
```

5.2.16. Clipping

The **Clipping** command Enables or Disables the ability for Clipping to be used.

Library Function: `gfx_Clipping`

Syntax: `cmd(word)`, `value(word)`

Commands	Description
cmd	0xFF6C
value	0 = Clipping Disabled, 1 = Clipping Enabled

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), value(MSB), value(LSB)

0xFF, 0x6C, 0x00, 0x01

// This will Enable Clipping

// The response will be 0x06 if the command is successful
```

5.2.17. Set Clip Window

The **Set Clip Window** command specifies a clipping window region on the screen such that any objects and text placed onto the screen will be clipped and displayed only within that region. For the clipping window to take effect, the clipping setting must be enabled separately using the Clipping command.

Library Function: `gfx_ClipWindow`

Syntax: `cmd (word)`, `x1 (word)`, `y1 (word)`, `x2 (word)`, `y2 (word)`

Commands	Description
cmd	0xFFBF
x1, y1	Specifies the horizontal and vertical position of the top left corner of the clipping window.
x2, y2	Specifies the horizontal and vertical position of the bottom right corner of the clipping window.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x1(MSB), x1(LSB), y1(MSB), y1(LSB), x2(MSB), x2(LSB), y2(MSB),
y2(LSB)

0xFF, 0xBF, 0x00, 0x00, 0x00, 0x00, 0x00, 0x28, 0x00, 0x28

// This will set the top left of the Clipping Window Region to be X1=0 (0x00, 0x00),
// Y1=0 (0x00, 0x00), and bottom right to be X2=40 (0x00, 0x28), Y2=40 (0x00, 0x28)

// The response will be 0x06 if the command is successful
```

5.2.18. Extend Clip Region

The **Extend Clip Region** command forces the clip region to the extent of the last text that was printed, or the last image that was shown.

Library Function: `gfx_SetClipRegion`

Syntax: `cmd(word)`

Commands	Description
cmd	0xFFBC

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0xFF, 0xBC

// This will extend the clip region to the extent of the last text or image that was shown.

// The response will be 0x06 if the command is successful.
```

5.2.19. Background Colour

The **Background Colour** command sets the screen background colour.

Library Function: `gfx_BGcolour`

Syntax: `cmd (word)`, `colour (word)`

Commands	Description
cmd	0xFF6E
colour	Specifies the colour to be set (0-65535 or HEX 0x0000-0xFFFF)

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), colour(MSB), colour(LSB)

0xFF, 0x6E, 0x00, 0x10

// This will set the Background Colour to be Navy (0x00, 0x10)

// The response will be 0x06 if the command is successful.
```

5.2.20. Outline Colour

The **Outline Colour** command sets the outline colour for rectangles and circles.

Library Function: `gfx_OutlineColour`

Syntax: `cmd (word)`, `colour (word)`

Commands	Description
cmd	0xFF67
colour	Specifies the colour to be set (0-65535 or HEX 0x0000-0xFFFF), set to 0 for no effect.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), colour(MSB), colour(LSB)

0xFF, 0x67, 0xF8, 0x1F

// This will set the Outline Colour to be Fuchsia (0xF8, 0x1F)
```

5.2.21. Contrast

The **Contrast** Command sets the contrast of the display, or turns it On/Off depending on display model.

Library Function: `gfx_Contrast`

Syntax: `cmd(word)`, `contrast (word)`

Commands	Description
cmd	0xFF66
contrast	Contrast 0 = Display OFF Contrast 1 - 15 = Contrast Level **EXCEPTION:** uLCD-144-G2 does not support Contrast 'levels', values from 1-15 could be set to turn the display 'On' and 0 to turn the Display 'Off'.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), contrast(MSB), contrast(LSB)

0xFF, 0x66, 0x00, 0x09

// This will set the Contrast of the display (example is a uOLED-128-G2) to be 9.
```

5.2.22. Frame Delay

The **Frame Delay** command sets the inter frame delay for the "Media Video" command

Library Function: `gfx_FrameDelay`

Syntax: `cmd(word)`, `Msec (word)`

Commands	Description
cmd	0xFF69
Msec	0-255 milliseconds

Returns: acknowledge (byte), value (word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *value* : Previous Frame Delay value.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), Msec(MSB), Msec(LSB)

0xFF, 0x69, 0x00, 0x05

// This will set the frame delay to 5 milliseconds

// The response will be 0x06 if the command is successful.
```

5.2.23. Line Pattern

The **Line Pattern** command sets the line draw pattern for line drawing. If set to zero, lines are solid, else each '1' bit represents a pixel that is turned off.

Library Function: `gfx_LinePattern`

Syntax: `cmd (word)`, `pattern (word)`

Commands	Description
cmd	0xFF65
pattern	0 = all line pixels are on (Default) 0-65535 (or HEX 0x0000-0xFFFF) = number of bits in the line are turned off to form a pattern

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), pattern(MSB), pattern(LSB)

0xFF, 0x65, 0x00, 0x08

// This will set the Line Pattern of the line to be drawn to have 8 bits out of the 65535
turned off.
```

5.2.24. Screen Mode

The **Screen Mode** command alters the graphics orientation LANDSCAPE, LANDSCAPE_R, PORTRAIT, PORTRAIT_R.

Library Function: `gfx_ScreenMode`

Syntax: `cmd(word)`, `mode (word)`

Commands	Description
cmd	0xFF68
mode	0 = LANDSCAPE 1 = LANDSCAPE REVERSE 2 = PORTRAIT 3 = PORTRAIT REVERSE

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0xFF, 0x68, 0x00, 0x01

// This will set the Screen Mode of the display to be Landscape Reverse.
```

5.2.25. Set Graphics Parameters

Sets various parameters for the Graphics Commands.

Library Function: `gfx_Set`

Syntax: `cmd (word)`, `function (word)`, `value (word)`

Commands	Description
cmd	0xFFD8
function	See the list below.
value	See the list below.

Function	Value
Function = 0 Pen Size Sets the Draw mode to Outline or Solid.	0 or SOLID 1 or OUTLINE
Function = 2 Object Colour Generic colour for gfx_LineTo(...)	0 – 65535 or 0 - 0xFFFF
Function = 4 Transparent Colour Not Implemented on Goldelox.	n/a
Function = 5 Transparency Not Implemented on Goldelox.	n/a

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), function(MSB), function(LSB), value(MSB), value(LSB)

0xFF, 0xD8, 0x00, 0x12, 0x04, 0x00

// This will call the Object Colour command and set the object colour to be Green (0x04,
0x00)

// The response will be 0x06 if successful
```

5.3. Media Commands (SD/SDHC Memory Cards)

The following is a summary of the commands available to be used for Media:

- Media Init
- Set Byte Address
- Set Sector Address
- Read Byte
- Read Word
- Write Byte
- Write Word
- Flush Media
- Display Image (RAW)
- Display Video (RAW)
- Display Video Frame (RAW)

5.3.1. Media Init

The **Media Init** command initialises a uSD/SD/SDHC memory card for further operations. The SD card is connected to the SPI (serial peripheral interface) of the Goldelox chip.

Library Function: `media_Init`

Syntax: `cmd(word)`

Commands	Description
cmd	0xFFB1

Returns: acknowledge (byte), value(word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *value* : **Non-Zero** if the card is present and successfully initialised. **0** if no card is present or not able to initialise.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0xFF, 0xB1

// This command will initialize a uSD/SD/SDHC memory card so it can be used for further
operations.
// The response could be 0x06 0x00 0x04 if the memory card is successfully initialized
(assuming a 2gb uSD card).
```

5.3.2. Set Byte Address

The **Sey Byte Address** command sets the media memory internal Address pointer for access at a non-sector aligned byte address.

Library Function: `media_SetAdd`

Syntax: `cmd (word)`, `HIword (word)`, `LOword (word)`

Commands	Description
cmd	0xFFB9
Hiword	Specifies the high word (upper 2 bytes) of a 4 byte media memory byte address location.
LOword	Specifies the low word (lower 2 bytes) of a 4 byte media memory byte address location.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), HIword(MSB), HIword(LSB), LOword(MSB), LOword(LSB)

0xFF, 0xB9, 0x00, 0x00, 0x02, 0x01

// This will set the media address to byte 513 (0x00, 0x00, 0x02, 0x01)
// (which is sector #1, 2nd byte in sector) for subsequent operations.
// The response will be 0x06 if the command is successful
```

5.3.3. Set Sector Address

The **Set Sector Address** command sets the media memory internal Address pointer for sector access.

Library Function: `media_SetSector`

Syntax: `cmd (word)`, `HIword (word)`, `LOword (word)`

Commands	Description
cmd	0xFFB8
Hiword	Specifies the high word (upper 2 bytes) of a 4 byte media memory sector address location.
LOword	Specifies the low word (lower 2 bytes) of a 4 byte media memory sector address location.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), HIword(MSB), HIword(LSB), LOword(MSB), LOword(LSB)

0xFF, 0xB8, 0x00, 0x00, 0x00, 0x0A

// This will set the media address to the 11th (0x00, 0x00, 0x00, 0x0A)
// sector (which is also byte address 5120) for subsequent operations
// The response will be 0x06 if the command is successful
```

5.3.4. Read Byte

The **Read Byte** command returns the byte value from the current media address, set by the Set Byte Address command. The internal byte address will then be internally incremented by one.

Library Function: `media_ReadByte`

Syntax: `cmd (word)`

Commands	Description
cmd	0xFFB7

Returns: acknowledge (byte) , value (word)

- *acknowledge* :(0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *value* : Byte value in the LSB.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0xFF, 0xB7

// This will read and return the byte value from the media address set by the Set Byte
Address command.
// The response will be 0x06, 0x00, 0xFF assuming the value being read was 255 (0x00, 0xFF).
```

See also

The Media Init command to enable the media to be ready for access, and Set Byte Address command to define where reading is to occur.

5.3.5. Read Word

The **Read Word** command returns the word value (2 bytes) from the current media address, set by the Set Byte Address command. The internal byte address will then be internally incremented by two. If the address is not aligned, the word will still be read correctly.

Library Function: `media_ReadWord`

Syntax: `cmd (word)`

Commands	Description
cmd	0xFFB6

Returns: acknowledge (byte) , value (word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *value* : Word value.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0xFF, 0xB6

// This will read and return the word value from the media address set by the Set Byte
Address command.
// The response will be 0x06, 0x3B, 0xAF assuming the value being read was 15279 (0x3B,
0xAF).
```

See also

The Media Init command to enable the media to be ready for access, and Set Byte Address command to define where reading is to occur.

5.3.6. Write Byte

Writes a byte to the current media address that was initially set with the Set Sector Address command.

Note

Writing bytes or words to a media sector must start from the beginning of the sector. All writes will be incremental until the Flush Media command is executed, or the sector address rolls over to the next sector. When the Flush Media command is called, any remaining bytes in the sector will be padded with **0xFF**, destroying the previous contents. An attempt to use the Set Byte Address command will result in the lower 9 bits being interpreted as zero. If the writing rolls over to the next sector, the Flush Media command is issued automatically internally.

Library Function: `media_WriteByte`

Syntax: `cmd (word)`, `value (word)`

Commands	Description
cmd	0xFFB5
value	Byte value, in the LSB, to be written at the current byte address location.

Returns: acknowledge (byte) , status (word)

- *acknowledge* :(0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *status* : **Non-Zero** for successful media response. **0** for attempt failed.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), value(MSB), value(LSB)

0xFF, 0xB5, 0x00, 0x61

// This will write the ASCII character ‘a’ (0x00, 0x61) as a byte to the media address set
by Set Sector Address.
// The response will be 0x06, 0x00, 0x01 assuming the value being written was successful.
```

See also

The Media Init command to enable the media to be ready for access, and Set Sector Address command to define where writing is to occur.

5.3.7. Write Word

Writes a word to the current media address that was initially set with the Set Sector Address command.

Note

Writing bytes or words to a media sector must start from the beginning of the sector. All writes will be incremental until the Flush Media command is executed, or the sector address rolls over to the next sector. When Flush Media command is called, any remaining bytes in the sector will be padded with **0xFF**, destroying the previous contents. An attempt to use the Set Byte Address command will result in the lower 9 bits being interpreted as zero. If the writing rolls over to the next sector, the Flush Media command is issued automatically internally.

Library Function: `media_WriteWord`

Syntax: `cmd (word)`, `value (word)`

Commands	Description
cmd	0xFFB4
value	The 16 bit word to be written at the current media address location.

Returns: acknowledge (byte) , status (word)

- *acknowledge* :(0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *status* : **Non-Zero** for successful media response. **0** for attempt failed.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), value(MSB), value(LSB)

0xFF, 0xB4, 0x00, 0x41

// This will write the ASCII character ‘A’ (0x00, 0x41) as a word to the media address set
by Set Sector Address.
// The response will be 0x06, 0x00, 0x01 assuming the value being written was successful.
```

See also

The Media Init command to enable the media to be ready for access, and Set Sector Address command to define where writing is to occur.

5.3.8. Flush Media

After writing any data to a sector, the **Flush Media** command should be called to ensure that the current sector that is being written is correctly stored back to the media else write operations may be unpredictable.

Library Function: `media_Flush`

Syntax: `cmd(word)`

Commands	Description
cmd	0xFFB2

Returns: acknowledge (byte) , status (word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *status* : **Non-Zero** for successful media response. **0** for attempt failed.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0xFF, 0xB2

// This command will ensure data written to the current sector is correctly stored to the
media.
// The response will be 0x06, 0xFF, 0xFF if the command is successful (see Status above)
```

5.3.9. Display Image (RAW)

Displays an image from the media storage at the specified co-ordinates. The image address is previously specified with the Set Byte Address command or Set Sector Address command. If the image is shown partially off screen, it may not be displayed correctly.

Library Function: `media_Image`

Syntax: `cmd (word)`, `x (word)`, `y (word)`

Commands	Description
cmd	0xFFB3
x, y	Specifies the top left position where the image will be displayed.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB)

0xFF, 0xB3, 0x00, 0x0A, 0x00, 0x14

// This will display an image at X=10 (0x00, 0x0A), Y=20 (0x00, 0x14) from the media storage
location specified.
// The response will be 0x06 if the command is successful
```

See also

The Media Init command to enable the media to be ready for access, and Set Byte Address or Set Sector Address commands to define where reading is to occur.

5.3.10. Display Video (RAW)

Displays a video clip from the media storage device at the specified co-ordinates. The video address location in the media is previously specified with the Set Byte Address or Set Sector Address commands. If the video is shown partially off screen, it may not be displayed correctly. Note that showing a video blocks all other processes until the video has finished showing. See the Display Video Frame command for alternatives.

Library Function: `media_Video`

Syntax: `cmd(word)`, `x (word)`, `y (word)`

Commands	Description
cmd	0xFFBB
x, y	Specifies the top left position where the video clip will be displayed.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB)

0xFF, 0xBB, 0x00, 0x0A, 0x00, 0x0A

// This will display a video clip at X=10 (0x00, 0x0A), Y=10 (0x00, 0x0A) from the media
storage device location specified.
// The response will be 0x06 if the command is successful
```

See also

The Media Init command to enable the media to be ready for access, and Set Byte Address or Set Sector Address commands to define where reading is to occur. See the Display Video Frames command for an alternative.

5.3.11. Display Video Frame (RAW)

Displays a video from the media storage device at the specified co-ordinates. The video address is previously specified with the Set Byte Address command or Set Sector Address command. If the video is shown partially off it may not be displayed correctly. The frames can be shown in any order. This function gives you great flexibility for showing various icons from an image strip, as well as showing videos while doing other tasks

Library Function: `media_VideoFrame`

Syntax: `cmd (word)`, `x (word)`, `y (word)`, `frameNumber (word)`

Commands	Description
cmd	0xFFBA
x, y	Specifies the top left position of the video frame to be displayed.
frameNumber	Specifies the required frame number to be displayed.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB), frameNumber(MSB), frameNumber(LSB)

0xFF, 0xBA, 0x00, 0x23, 0x00, 0x05, 0x00, 0x2D

// This will display frame number 45 (0x00, 0x2D) of the video clip stored at the address
specified,
// and display it at location X=35 (0x00, 0x23), Y=5 (0x00, 0x05).
// The response will be 0x06 if the command is successful
```

See also

See also the Media Init command to enable the media to be ready for access, and Set Byte Address or Set Sector Address commands to define where reading is to occur.

5.4. Memory Access Commands

The following is a summary of the commands available to be used for Memory Access:

- Byte Peek
- Byte Poke
- Word Peek
- Word Poke

5.4.1. Byte Peek

This command returns the EVE System Byte Register value in the lower byte.

Library Function: `peekB`

Syntax: `cmd (word)`, `byteRegister (word)`

Commands	Description
cmd	0xFFF6
byteRegister	Byte register address. GOLDELOX EVE System Registers Memory Map for Byte registers is listed at the end of this document.

Returns: acknowledge (byte), value (word) - *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response. - *value* : Register value in the LSB.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), byteRegister(MSB), byteRegister(LSB)

0xFF, 0xF6, 0x00, 0xA1

//This will read and return the byte value from the Byte register address 161 (0x00 0xA1)
// that represents Current Screen Mode.

// The response will be 0x06, 0x00, 0x01 assuming the Screen Mode being set to Landscape
Reverse.
```

5.4.2. Byte Poke

This command sets the EVE System Byte Register value in the lower byte.

Library Function: `pokeB`

Syntax: `cmd (word)`, `byteRegister (word)`, `value (word)`

Commands	Description
cmd	0xFFF4
byteRegister	Byte register address. GOLDELOX EVE System Registers Memory Map for Byte registers is listed at the end of this document.
value	Register value in LSB.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), byteRegister(MSB), byteRegister(LSB), value(MSB), value(LSB)

0xFF, 0xF4, 0x00, 0xA1, 0x00, 0x02

// This command will set the LSB of the ‘value’ (0x00 0x02) in the Byte register address 161
(0x00 0xA1)
// that represents Current Screen Mode. The Screen Mode would change to Portrait mode.

// The response will be 0x06 assuming the command was successful
```

5.4.3. Word Peek

This command returns the EVE System Word Register value.

Library Function: `peekW`

Syntax: `cmd (word)`, `wordRegister (word)`

Commands	Description
cmd	0xFFF5
wordRegister	Word register address. GOLDELOX EVE System Registers Memory Map for Word registers is listed at the end of this document.

Returns: acknowledge (byte), value (word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *value* : Register value.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), wordRegister(MSB), wordRegister(LSB)

0xFF, 0xF5, 0x00, 0x68

//This will read and return the word value from the word register address 104 (0x00 0x68)
that represents Current X Origin.

//The response will be 0x06, 0x00, 0x00 assuming the current X Origin is set to 0.
```

5.4.4. Word Poke

This command sets the EVE System Word Register value.

Library Function: `pokeW`

Syntax: `cmd (word)`, `wordRegister (word)`, `value (word)`

Commands	Description
cmd	0xFFF3
wordRegister	Word register address. GOLDELOX EVE System Registers Memory Map for Word registers is listed at the end of this document.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), WordRegister(MSB), WordRegister(LSB), value(MSB), value(LSB)

0xFF, 0xF3, 0x00, 0x68, 0x00, 0x0A

// This command will set the ‘value’ (0x00 0x0A) in the Word register address 104 (0x00
0x68)
// that represents Current X Origin. The Current X origin would change to 10 (0x00 0x0A).

// The response will be 0x06 assuming the command was successful
```

5.5. GPIO Commands

The following is a summary of the commands available to be used for GPIO:

- Joystick

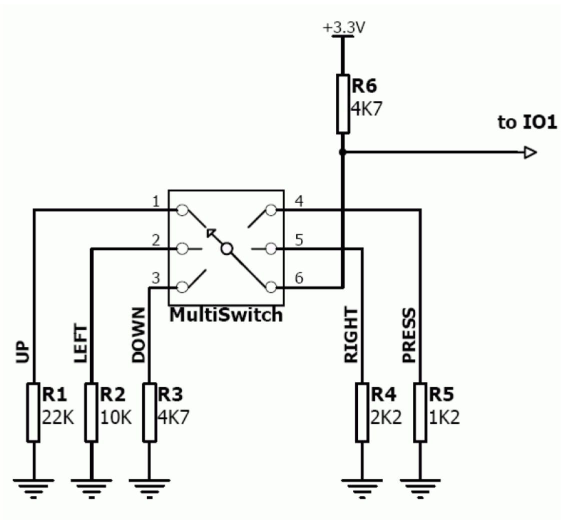
5.5.1. Joystick

This command will return the value of the joystick position.

- 0: RELEASED
- 1: UP
- 2:LEFT
- 3:DOWN
- 4:RIGHT
- 5:PRESS

Note

The joystick input uses IO1 utilizing the A/D converter. Each switch is connected to junction of 2 resistors that form a unique voltage divider circuit. Refer to the Goldelox data sheet example schematics for the required resistor values.



Library Function: `joystick`

Syntax: `cmd (word)`

Commands	Description
cmd	0xFFD9

Returns: acknowledge (byte), value (word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *value* : Returns the value of the Joystick position from 0 - 5(5 position switch implementation).

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0xFF, 0xD9

// If the IO1 is connected to the Joystick as shown in the above figure,
// the response will be 0x06 0x00 0x04 assuming the ‘RIGHT’ being activated through the
joystick/switch.
```

5.6. Sound and Tune Commands

The following is a summary of the commands available to be used for Sound and Tune:

- Beep

5.6.1. function

This command will produce a single musical note for the required duration through IO2.

Library Function: `BeeP`

Syntax: `cmd(word)`, `note (word)`, `duration (word)`

Commands	Description
cmd	0xFFDA
note	A value specifying the frequency of the note. Note could be between 0-64.
duration	Specifies the time in milliseconds that the note will be played for.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), note(MSB), note(LSB), duration(MSB), duration(LSB)

0xFF, 0xDA, 0x00, 0x2D, 0x03, 0xE8

// This will play note 45 for 1 second.

//The response will be 0x06 assuming the command was successful
```

5.7. Serial (UART) Communications Commands

The following is a summary of the commands available to be used for Serial (UART) Communications:

- Set Baud Rate

5.7.1. Set Baud Rate

The **Set Baud Rate** command is used to set the required baud rate. To set the default baud rate, please refer to the instructions in Additional Configuration Parameters for Serial Communication.

Library Function: `setbaudWait`

Syntax: `cmd (word)`, `index (word)`

Commands	Description
cmd	0x000B
index	Specifies the baud rate index value.

Index Value

Index	Required Baud Rate	% Error	Actual Baud Rate
27271	110	0.00 %	110
9999	300	0.00 %	300
4999	600	0.00 %	600
2499	1200	0.00 %	1200
1249	2400	0.00 %	2400
624	4800	0.00 %	4800
312	9600	-0.16 %	9585
207	14400	0.16 %	14423
155	19200	0.00 %	19231
95	31250	0.00 %	31250
77	38400	0.16 %	38462
53	56000	-.79 %	55556
51	57600	0.16 %	57692
25	115200	0.16 %	115385
22	128000	1.90 %	130435
11	256000	-2.34 %	250000
10	300000	-0.09 %	272727
8	375000	-11.11 %	333333
6	500000	-14.29 %	428571
4	600000	0.00 %	600000

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), index(MSB), index(LSB)

0x00, 0x0B, 0x00, 0x0A

// This will set the baud rate to be 300000, which is Index 10 (0x00, 0x0A)
// The response will be 0x06 at the new baud rate set, 100ms after the command is sent
```

5.8. Image Control Commands

The following is a summary of the commands available to be used for Image Control:

- Blit Com to Display

5.8.1. Blit Com to Display

This command will BLIT (Block Image Transfer) 16 bit pixel data from the Com port on to the screen.

Library Function: `blitComtoDisplay`

Syntax: `cmd (word)`, `x (word)`, `y (word)`, `width (word)`, `height (word)`, `data (data)`

Commands	Description
cmd	0x000A
x, y	Specifies the horizontal and vertical position of the top-left corner of the image to be displayed.
width	width of the image to be displayed.
height	height of the image to be displayed.
data	pixel1...pixeln 16 bit pixel data to be plotted on the Display screen. 16 bit = 5bit Red, 6bit Green, 5bit Blue

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), x(MSB), x(LSB), y(MSB), y(LSB), width(MSB), width(LSB), height(MSB),
height(LSB), pixel1, pixel2, …, pixelN

0x00, 0x0A, 0x00, 0x00, 0x00, 0x00, 0x00, 0x80, 0x00, 0x80, 0x31, 0x81, 0x63 ... etc

// This will displaying an image at X=0 (0x00, 0x00), Y=0 (0x00, 0x00) with Width = 128
(0x00, 0x80) and height = 128 (0x00, 0x80)

// The response will be 0x06 assuming the command was successful
```

5.9. System Commands

The following is a summary of the commands available to be used for System:

- Get Display Model
- Get SPE Version
- Get PmmC Version
- Screen Saver Timeout
- Screen Saver Speed
- Screen Saver Mode

5.9.1. Get Display Model

Returns the Display Model in the form of a string without Null terminator.

Library Function: `sys_GetModel`

Syntax: `cmd(word)`

Commands	Description
cmd	0x0007

Returns: acknowledge (byte), count (word), model (string)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *count* : Number of characters in the model name to return.
- *model* : Display Module's model name. Without NULL terminator.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0x00, 0x07

// This will request the display to return its model name as a string of characters without
the NULL.

// The response will be 0x06, 0x00, 0x0C, 0x75 0x4F 0x4C 0x45 0x44 0x2D 0x31 0x36 0x30 0x2D
0x47 0x32
// assuming the command was successful and the display returned 12 characters (0x00, 0x0C)
and
// the display model was “uOLED-160-G2” (0x75 0x4F 0x4C 0x45 0x44 0x2D 0x31 0x36 0x30 0x2D
0x47 0x32)
```

5.9.2. Get SPE Version

Returns the SPE Version installed on the module.

Library Function: `sys_GetVersion`

Syntax: `cmd (word)`

Commands	Description
cmd	0x0008

Returns: acknowledge (byte), version (word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *version* : SPE Version installed on the module.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0x00, 0x08

// This will return the version of the SPE Application loaded into the display

// The response will be 0x06, 0x01, 0x00 assuming the command was successful and the version
of the
// SPE Application was 256 (0x01, 0x00)
```

5.9.3. Get PmmC Version

Returns the PmmC Version installed on the module.

Library Function: `sys_GetPmmC`

Syntax: `cmd (word)`

Commands	Description
cmd	0x0009

Returns: acknowledge (byte), version (word)

- *acknowledge* : (0x06) ACK byte if successful. Anything else implies mismatch between command and response.
- *version* : PmmC Version installed on the module.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB)

0x00, 0x09

// This will return the version of the PmmC loaded into the display

// The response will be 0x06, 0x02, 0x03 assuming the command was successful
// and the PmmC loaded was version 515 (0x02, 0x03) which represents Rev23
```

5.9.4. Screen Saver Timeout

This command will set the screen saver Timeout. 0 is set to disable the screen saver.

Default screen saver timeout settings could be adjusted as shown in Additional Configuration Parameters for Serial Communication.

Note

This feature is display dependent. Not all the display screens offer Screen Saver feature. Such as, uLCD-144-G2 does not support Screen Saver.

Library Function: `SSTimeout`

Syntax: `cmd (word)`, `timeout (word)`

Commands	Description
cmd	0x000C
timeout	Specifies the screen saver timeout in milliseconds. Timeout value could be 1-65535. 0 disables the screen saver.

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), timeout(MSB), timeout(LSB)

0x00, 0x0C, 0x03, 0xE8

// This will set the screen saver timeout to 1 second. Where (0x03 0xE8) is 1000msec.

// The response will be 0x06 assuming the command was successful
```

5.9.5. Screen Saver Speed

This command will set the screen saver Speed.

Default screen saver speed settings could be adjusted as shown in Additional Configuration Parameters for Serial Communication.

Note

This feature is display dependent. Not all the display screens offer Screen Saver feature.

Library Function: `SSSpeed`

Syntax: `cmd (word)`, `speed (word)`

Commands	Description
cmd	0x000D
speed	Specifies the screen saver speed. Speed values are different for different Display Modules. uLCD-144-G2: N/A uOLED-96-G2: 0 - 3 (Fastest - Slowest) uOLED-128-G2: 0 - 3 (Fastest - Slowest) uOLED-160-G2: 0-255 (Fastest - Slowest)

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

```
// Byte Stream:
// cmd(MSB), cmd(LSB), speed(MSB), speed(LSB)

0x00, 0x0D, 0x00, 0x00

// This will set the screen saver speed to maximum.

//The response will be 0x06 assuming the command was successful
```

5.9.6. Screen Saver Mode

This command will set the screen saver scroll direction. There could be no screen saver supported in which case the screen wouldn't have any effect from this command. Or, there could be 2 directional or 4 directional scroll features available on a particular display screen.

Default screen saver speed settings could be adjusted as shown in Additional Configuration Parameters for Serial Communication.

Note

This feature is display dependent. Not all the display screens offer Screen Saver feature.

Library Function: `SSMode`

Syntax: `cmd (word)`, `mode (word)`

Commands	Description
cmd	0x000E
mode	Specifies the screen saver scroll direction. **mode** values are different for different display modules. uLCD-144-G2: N/A - Scrolling is not supported uOLED-96-G2: N/A - Always scrolls up, cannot be changed uOLED-128-G2: 0 - Up, 1 - Down, 2 - Left, 3 - Right uOLED-160-G2: 0 - Left, 1 - Right

Returns: (0x06) ACK byte if successful. Anything else implies mismatch between command and response.

Examples

Example 1

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0x00, 0x0E, 0x00, 0x00

// This will set the screen saver scroll direction to ‘UP’ on a uOLED-128-G2 module.
// The response will be 0x06 assuming the command was successful
```

Example 2

```
// Byte Stream:
// cmd(MSB), cmd(LSB), mode(MSB), mode(LSB)

0x00, 0x0E, 0x00, 0x00

// This will set the screen saver scroll direction to ‘RIGHT’ on a uOLED-160-G2 module.
// The response will be 0x06 assuming the command was successful
```

6. GOLDELOX EVE System Registers Memory Map

The following tables outline in detail the Goldelox system registers and flags.

BYTE-Size Registers Memory Map

LABEL	ADDRESS DEC	ADDRESS HEX	USAGE	NOTES
VX1	128	0x80	display hardware GRAM x1 pos	SYSTEM (R/O)
VY1	129	0X81	display hardware GRAM y1 pos	SYSTEM (R/O)
VX2	130	0x82	display hardware GRAM x2 pos	SYSTEM (R/O)
VY2	131	0x83	display hardware GRAM y2 pos	SYSTEM (R/O)
SYS_X_MAX	132	0x84	display hardware X res-1	SYSTEM (R/O)
SYS_Y_MAX	133	0x85	display hardware Y res-1	SYSTEM (R/O)
WRITE_GRAM_REG	134	0x86	display GRAM write address	SYSTEM (R/O)
READ_GRAM_REG	135	0x87	display GRAM read address	SYSTEM (R/O)
IMAGE_WIDTH	136	0x88	loaded image/animation width	SYSTEM (R/O)
IMAGE_HEIGHT	137	0x89	loaded image/animation height	SYSTEM (R/O)
IMAGE_DELAY	138	0x8A	frame delay (if animation)	USER
IMAGE_MODE	139	0x8B	image/animation colour mode	SYSTEM (R/O)
CLIP_LEFT_POS	140	0x8C	left clipping point setting	USER
CLIP_TOP_POS	141	0x8D	top clipping point setting	USER
CLIP_RIGHT_POS	142	0x8E	right clipping point setting	USER
CLIP_BOTTOM_POS	143	0x8F	bottom clipping point setting	USER
CLIP_LEFT	144	0x90	left clipping point active	USER
CLIP_TOP	145	0x91	top clipping point active	USER
CLIP_RIGHT	146	0x92	right clipping point active	USER
CLIP_BOTTOM	147	0x93	bottom clipping point actiVe	USER
FONT_TYPE	148	0x94	0 = fixed, 1 = proportional	SYSTEM (R/O)
FONT_MAX	149	0x95	number of chars in font set	SYSTEM (R/O)
FONT_OFFSET	150	0x96	ASCII offset (usually 0x20)	SYSTEM (R/O)
FONT_WIDTH	151	0x97	width of font (pixel units)	SYSTEM (R/O)
FONT_HEIGHT	152	0x98	height of font (pixel units)	SYSTEM (R/O)
TEXT_XMAG	153	0x99	text width magnification	USER
TEXT_YMAG	154	0x9A	text height magnification	USER
TEXT_MARGIN	155	0x9B	text place holder for CR	SYSTEM (R/O)
TEXT_DELAY	156	0x9C	text delay effect (0-255msec)	USER
TEXT_X_GAP	157	0x9D	X pixel gap between chars	USER
TEXT_Y_GAP	158	0x9E	Y pixel gap between chars	USER
GFX_XMAX	159	0x9F	width of current orientation	SYSTEM (R/O)
GFX_YMAX	160	0xA0	height of current orientation	SYSTEM (R/O)
GFX_SCREENMODE	161	0xA1	Current screen mode (0-3)	SYSTEM (R/O)
reserved	162 - 165	0xA2 -0xA5	reserved	SYSTEM (R/O)

NOTES

SYSTEM	SYSTEM registers are maintained by internal system functions and should not be written to. They should only ever be read. DO NOT WRITE to these registers.
USER	USER registers are read/write (R/W) registers used to alter the system behaviour. Refer to the individual functions for information on the interaction with these registers.

These registers are accessible with peekB and pokeB functions.

WORD-Size Registers Memory Map

LABEL	ADDRESS DEC	ADDRESS HEX	USAGE	NOTES
SYS_OVERFLOW	83	0x53	16bit overflow register	USER
SYS_COLOUR	84	0x54	internal variable for colour	SYSTEM
SYS_RETVAL	85	0x55	return value of last function	SYSTEM
GFX_BACK_COLOUR	86	0x56	screen background colour	USER
GFX_OBJECT_COLOUR	87	0x57	graphics object colour	USER
GFX_TEXT_COLOUR	88	0x58	text foreground colour	USER
GFX_TEXT_BGCOLOUR	89	0x59	text background colour	USER
GFX_OUTLINE_COLOUR	90	0x5A	circle/rectangle outline	USER
GFX_LINE_PATTERN	91	0x5B	line draw tessellation	USER
IMG_PIXEL_COUNT	92	0x5C	count of pixels in image	SYSTEM
IMG_FRAME_COUNT	93	0x5D	count of frames in animation	SYSTEM
MEDIA_HEAD	94	0x5E	media sector head position	SYSTEM
SYS_OUTSTREAM	95	0x5F	Output stream handle	SYSTEM
GFX_LEFT	96	0x60	image left real point	SYSTEM
GFX_TOP	97	0x61	image top real point	SYSTEM
GFX_RIGHT	98	0x62	image right real point	SYSTEM
GFX_BOTTOM	99	0x63	image bottom real point	SYSTEM
GFX_X1	100	0x64	image left clipped point	SYSTEM
GFX_Y1	101	0x65	image top clipped point	SYSTEM
GFX_X2	102	0x66	image right clipped point	SYSTEM
GFX_Y2	103	0x67	image bottom clipped point	SYSTEM
GFX_X_ORG	104	0x68	current X origin	USER
GFX_Y_ORG	105	0x69	current Y origin	USER
RANDOM_LO	106	0x6A	random generator LO word	SYSTEM
RANDOM_HI	107	0x6B	random generator HI word	SYSTEM
MEDIA_ADDR_LO	108	0x6C	media byte address LO	SYSTEM
MEDIA_ADDR_HI	109	0x6D	media byte address HI	SYSTEM
SECTOR_ADDR_LO	110	0x6E	media sector address LO	SYSTEM
SECTOR_ADDR_HI	111	0x6F	media sector address HI	SYSTEM
SYSTEM_TIMER_LO	112	0x70	1msec system timer LO word	USER
SYSTEM_TIMER_HI	113	0x71	1msec system timer HI word	USER
TIMER0	114	0x72	1msec user timer 0	USER
TIMER1	115	0x73	1msec user timer 1	USER
TIMER2	116	0x74	1msec user timer 2	USER
TIMER3	117	0x75	1msec user timer 3	USER
INCVAL	118	0x76	predec/preinc/postdec/postinc addend	USER
TEMP_MEDIA_ADDRLO	119	0x77	temporary media address LO	SYSTEM
TEMP_MEDIA_ADDRHI	120	0x78	temporary media address HI	SYSTEM

LABEL	ADDRESS DEC	ADDRESS HEX	USAGE	NOTES
GFX_TRANSPARENTCOLOUR	121	0x79	Image transparency colour	USER
GFX_STRINGMETRIX	122	0x7A	Low byte = string width High byte = string height	SYSTEM
GFX_TEMPSTORE1	123	0x7B	Low byte = last character printed High byte = video frame timer over-ride	SYSTEM
reserved	124	0x7C	reserved	SYSTEM
reserved	125	0x7D	reserved	SYSTEM
SYS_FLAGS1	126	0x7E	system control flags word 0	FLAGS
SYS_FLAGS2	127	0x7F	system control flags word 1	FLAGS
USR_SP	128	0x80	User defined stack pointer	USERSTACK
USR_MEM	129	0x81	255 user variables / array(s)	MEMORY
SYS_STACK	384	0x180	128 level EVE machine stack	SYSTEMSTACK

NOTES

SYSTEM	SYSTEM registers are maintained by internal system functions and should not be written to. They should only ever be read.
DO NOT WRITE to these registers.	
USER	USER registers are read/write (R/W) registers used to alter the system behaviour. Refer to the individual functions for information on the interaction with these registers.
USERSTACK	Used by the debugging and system extension utilities.
MEMORY	255 word size variables for users program.
STACK	128 word EVE system stack (STACK grows upwards).
FLAGS	FLAGS are a mixture of bits that are maintained by either internal system functions or set / cleared by various system functions. Refer to the FLAGS Register Bit Map table, and individual functions for further details.

These registers are accessible with peekW and pokeW functions.

FLAG Registers Bit Map

REGISTER	ADDRESS DEC	ADDRESS HEX	NAME	USAGE	NOTES	VALUES
SYS_FLAGS1	**126**	**0x7E**	***denotes auto reset**			
	Bit 0		_STREAMLOCK	Used internally	SYSTEM	0x0001
	Bit 1		_PENSIZE	Object, 0 = solid, 1 = outline	SYSTEM	0x0002
	Bit 2		_OPACITY	Text, 0 = transparent, 1 = opaque	SYSTEM	0x0004
	Bit 3		_OUTLINED	box/circle outline 0 = off, 1 = on	SYSTEM	0x0008
	Bit 4		_BOLD	* Text, 0 = normal, 1 = bold	SYSTEM	0x0010
	Bit 5		_ITALIC	* Text, 0 = normal, 1 = italic	SYSTEM	0x0020
	Bit 6		_INVERSE	* Text, 0 = normal, 1 = inverse	SYSTEM	0x0040
	Bit 7		_UNDERLINED	* Text, 0 = normal, 1 = underlined	SYSTEM	0x0080
	Bit 8		_CLIPPING	0 = clipping off, 1 = clipping on	SYSTEM	0x0100
	Bit 9		_STRMODE	Used internally	SYSTEM	0x0200
	Bit 10		_SERMODE	Used internally	SYSTEM	0x0400
	Bit 11		_TXTMODE	Used internally	SYSTEM	0x0800
	Bit 12		_MEDIAMODE	Used internally	SYSTEM	0x1000
	Bit 13		_PATTERNED	Used internally	SYSTEM	0x2000
	Bit 14		_COLOUR8	Display mode, 0 = 16bit, 1 = 8bit	SYSTEM	0x4000
	Bit 15		_MEDIAFONT	0 = internal font, 1 = media font	SYSTEM	0x8000
SYS_FLAGS2	**127**	**0x7F**				
	Bit 0		_MEDIA_INSTALLED	SD or FLASH device is detected/ active	SYSTEM	0x0001
	Bit 1		_MEDIA_TYPE	0 = SD, 1 = FLASH chip	SYSTEM	0x0002
	Bit 2		_MEDIA_READ	1 = MEDIA read in progress	SYSTEM	0x0004
	Bit 3		_MEDIA_WRITE	1 = MEDIA write in progress	SYSTEM	0x0008
	Bit 4		_OW_PIN	0 = IO1, 1 = IO2 (Dallas OW Pin)	SYSTEM	0x0010
	Bit 5		_PTR_TYPE	Used internally	SYSTEM	0x0020
	Bit 6		_TEMP1	Used internally	SYSTEM	0x0040
	Bit 7		_TEMP2	Used internally	SYSTEM	0x0080
	Bit 8		_RUNMODE	1 = running pcode from media	SYSTEM	0x0100
	Bit 9		_SIGNED	0 = number printed '-' prepend	SYSTEM	0x0200
	Bit 10		_RUNFLAG	1 = EVE processor is running	SYSTEM	0x0400
	Bit 11		_SINGLESTEP	1 = set breakpoint for debugger	SYSTEM	0x0800
	Bit 12		_COMMINT	1 = buffered coms active	SYSTEM	0x1000
	Bit 13		_DUMMY16	1 = display needs 16bit dummy	SYSTEM	0x2000
	Bit 14		_DISP16	1 = display is 16bit interface	SYSTEM	0x4000
	Bit 15		_PROPFONT	1 = current font is proportional	SYSTEM	0x8000

7. Revision History

Document Revision

Revision Number	Date	Description
1.0	01/02/2013	First Release
1.1	22/02/2013	Added character limit information to the Put String command.
1.2	21/03/2013	Fixed Set Font command, which was incorrect.
1.3	22/03/2013	Fixed Set Baud Rate index values, which were incorrect.
1.4	07/11/2013	Fixed incorrect Return on Screen Mode command.
1.5	07/05/2014	Updated image in section 2.2.
1.6	15/09/2014	Updated the information for Startup/Reset and Splash Screen.
1.7	01/10/2014	Fixed typo in putstr function name (was previously putStr incorrectly), incorrect use of gfx_Set instead of txt_Set on page 30, and incorrect use of SSTimeout instead of SSSpeed.
2.0	26/04/2017	Updated Formatting and Contents.
2.1	22/03/2019	Updated Formatting, updated Screen Saver Mode.
2.2	30/05/2024	Converted for resource centre.
2.3	03/06/2024	Fix missing library functions - `txt_Ygap` and media_Video syntax - `x (word)` and `y (word)`. Also, Added Revision History.

8. Legal Notice

8.1. Proprietary Information

8.2. Disclaimer of Warranties & Limitations of Liabilities