GLC24064
Technical Manual

Revision: 2.0

Contents

1 Getting Started

Figure 1: GLC24064-WB

The GLC24064 is an intelligent graphic LCD display designed to decrease development time by providing an instant solution to any project. With the ability to communicate via serial RS-232/TTL and I^2C protocols, the versitle GLC24064 can be used with virtually any controller. The ease of use is further enhanced by an intuitive command structure to allow display settings such as backlighting, contrast and baud rate to be software controlled. Additionally, text and fonts may be uploaded to the display and stored in the onboard memory.

1.1 Display Options Available

The GLC24064 comes in a variety of colors including the standard yellow/green, the popular blue/white and the crisp white/grey. Extended voltage, and temperature options are also available, to allow you to select the display which will best fit your project needs.

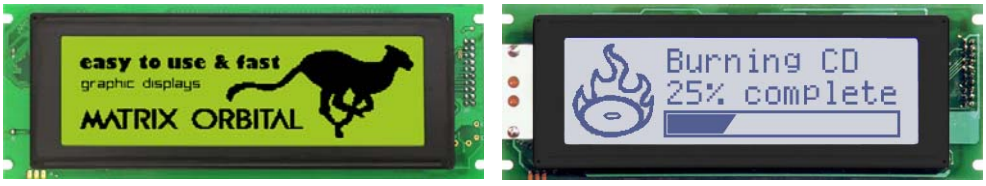


Figure 2: GLC24064 Options

1.2 Accessories

NOTE Matrix Orbital provides all the interface accessories needed to get your display up and running. You will find these accessories and others on our e-commerce website at http://www.matrixorbital.com. To speak with a sales associate see Section 15.5 on page 57 for contact information.

Figure 3: 5V Power Cable Adapter

Figure 4: 12V Power Cable Adapter (V/VPT Models)

Figure 5: Breadboard Cable

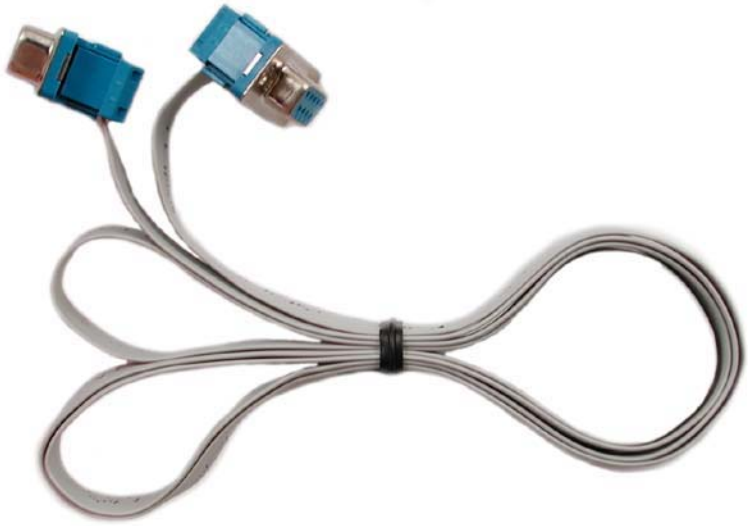


Figure 6: Serial Cable 4FT

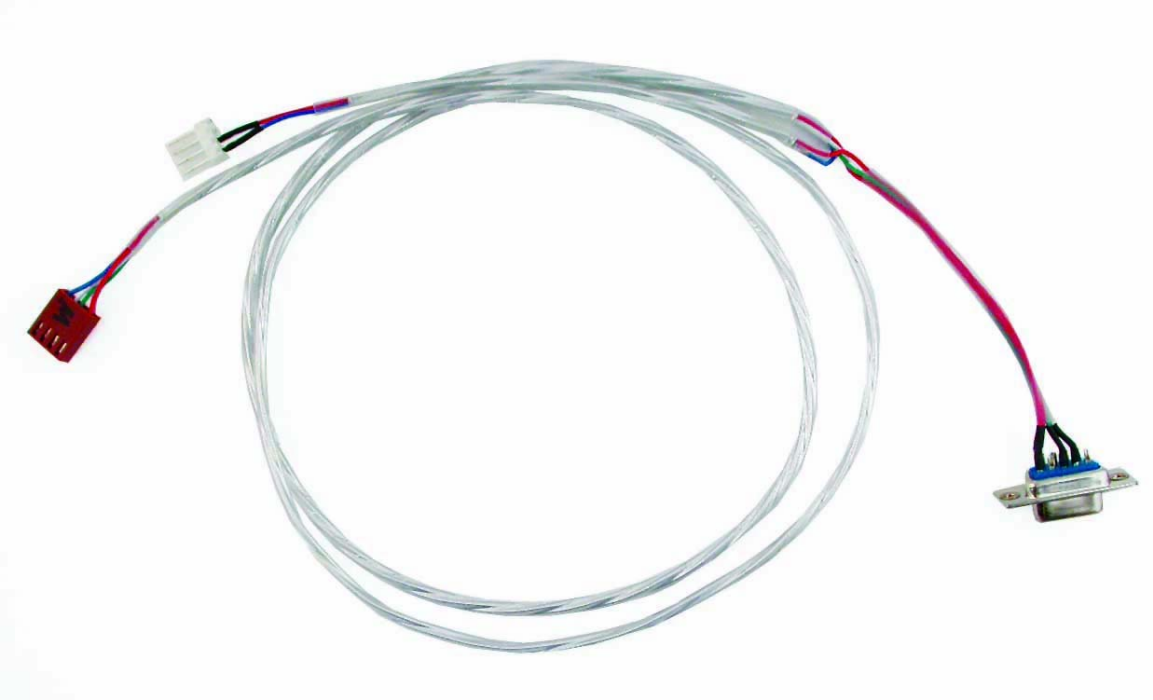


Figure 7: Communication and 5V Power Cable

1.3 Features

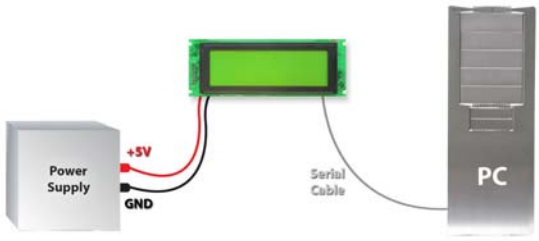
- 240 x 64 pixel graphics display
- Selectable communication protocol, RS-232/TTL/I^{2}C
- 128 byte buffered communication
- 5V - 20mA General Purpose Output
- 16 KB flash memory for fonts and bitmaps
- Communication speeds, up to 115 kbps for RS-232 and 100 kHz for I^{2}C
- Display text using built in or user supplied fonts
- Adjustable contrast
- Adjustable backlighting
- Default 19.2 kbps serial communication speed
- Extended temperature available for extreme environments of -20C to 70C
- Extended voltage and efficiant power supply available

1.4 Connecting to a PC

The GLC24064 connects seemlessly to a PC and it is an excellent means of testing the functionality and uploading new fonts and bitmaps. You will require a standard RS-232 9-pin serial cable such as the one pictured in ***figure 6 on page 3***, as well as a modified 5V power adapter such as the one pictured in ***figure 3 on page 2***.

In order to connect your display to a personal computer follow these easy instructions:

1. Plug the serial cable into the com port you wish to use.
2. Connect the modified 5V power adapter to a power lead from your PC power supply (you will have to open your computer case).
3. Connect the serial cable to the DB-9 connector on the back of the display.
4. Connect the 5V power adapter to the 4-pin connector on the back of the display.



WARNING DO NOT use the standard floppy drive power connector, as this will not provide you with the correct voltage and will damage the display module.

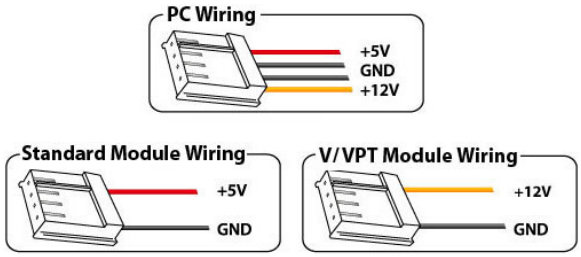


Figure 8: PC vs Matrix Orbital Display Module Wiring

1.5 Installing the Software

1.5.1 MOGD#

MOGD# is the latest updated version of MOGD and can be used to manage font and graphics downloads as well as exercise all of the features of our graphical displays. MOGD# provides a new user friendly

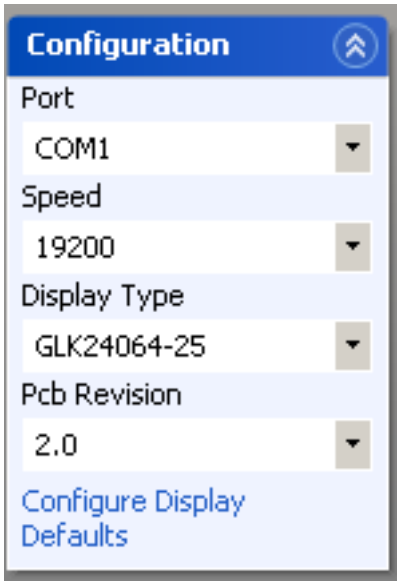
interface as well as many feature enhancements.

To install MOGD# from the Matrix Orbital CD, follow the following steps:

1. Insert the Matrix Orbital Cd-ROM into the Cd drive
2. Locate the file *MogdSharp.zip*, which should be in the “cd-drive:\Download” directory
3. Unzip *MogdSharp.zip* to a temporary directory using a program such as Winzip, Pkzip, etc.
4. Double click on "setup.exe"
5. Follow the instructions on the screen to complete the installation
6. MOGD# requires the .NET framework 2.0 and will download and install it automatically

After the installation is complete there will be a Matrix Orbital entry under “Start->Programs->Matrix Orbital” in the start menu. Click on the ’Mogd Sharp’ entry to run the program.

Be sure to check the information selected in the configuration panel the first time MOGD# is run. Once this information is entered correctly the program can be used to control all functions of the graphic display.



Port The serial port the display is plugged in to.

Speed The communication speed the display module is set to. (Default 19,200)

Display Type The type of display. (GLC24064)

Pcb Revision The revision of the display you are using. (Found on the back of the Pcb)

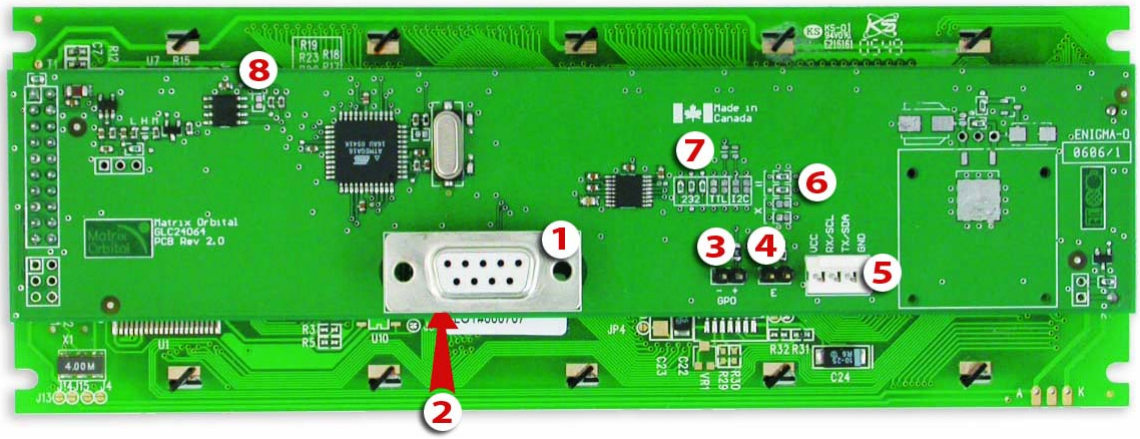
Figure 9: Mogd Sharp Settings

NOTES

- MOGD# may also be downloaded from Matrix Orbital’s support site at http://www.matrixorbital.ca/software/software_graphic/MogdSharp
- Winzip is available as a free download from http://www.winzip.com

2 Hardware Information

Refer to the following diagram for this chapter:

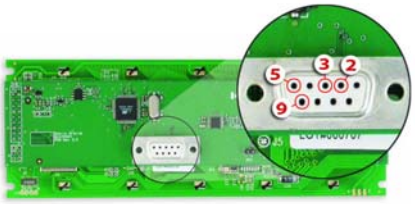


1 **DB-9 Connector**
2 **Power Through DB9 Jumper**
3 **GPO**
4 **Manual Override**
5 **Power / Data Connector**
6 **Legacy Connector Jumper**
7 **Protocol Select Jumpers**
8 **File System Lock Jumper**

Figure 10: GLC24064

2.1 DB-9 Connector

The GLC24064 provides a *DB-9 Connector* to readily interface with serial devices which use the EIA232 standard signal levels of ±12V to ±12V. It is also possible to communicate at TTL levels of 0 to +5V by setting the *Protocol Select Jumpers* to TTL. As an added feature it is also possible to apply power through pin 9 of the *DB-9 Connector* in order to reduce cable clutter. However, in order to accomplish this you must set the *Power Through DB-9 Jumper*.



Pin 2 Tx \ SCL (I^2C clock)
Pin 3 Rx \ SDA (I^2C data)
Pin 5 GND
Pin 9 PWR *(Must solder Power Through DB-9 Jumper. See table 1 on the next page for power requirements.)*

Figure 11: RS-232 Pinout

2.1.1 Power Through DB-9 Jumper

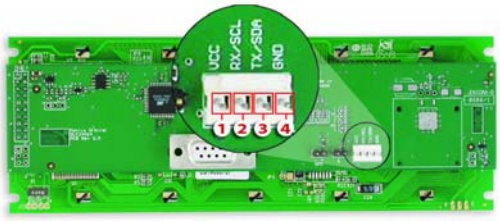
In order to provide power through pin 9 of the *DB-9 Connector* you must place a solder jumper on the *Power through DB-9 Jumper* pictured in ***figure 12*** below. The GLC24064 allows all voltage models to use the power through DB-9 option, see table 1 on the following page for display module voltage requirements.

Figure 12: Power Through DB-9 Jumper

WARNING Do not apply voltage through pin 9 of the DB-9 connector AND through the Power/Data Connector at the same time.

2.2 Power/Data Connector

The *Power/Data Connector* provides a standard connector for powering the display module. The GLC24064 requires five volts for the standard display module, between nine to fifteen for the wide voltage (V) and between nine to thirty-five volts for the wide voltage with efficiant power supply module (VPT). The voltage is applied through pins one and four of the four pin *Power/Data connector*. Pins two and three are reserved for serial transmition, using either the RS-232/TTL or the I^2C protocol, depending on what has been selected by the *Protocol Select Jumpers*. Pins two and three may be reversed by changing the *Legacy Connector Jumpers* in order to be compatible with previous Pcb revisions.



Pin 1 PWR *(See table 1)*
Pin 2 Rx \ SCL (I^2C clock)
Pin 3 Tx \ SDA (I^2C data)
Pin 4 GND

Figure 13: Power Connector and Pinout

Table 1: Power Requirements

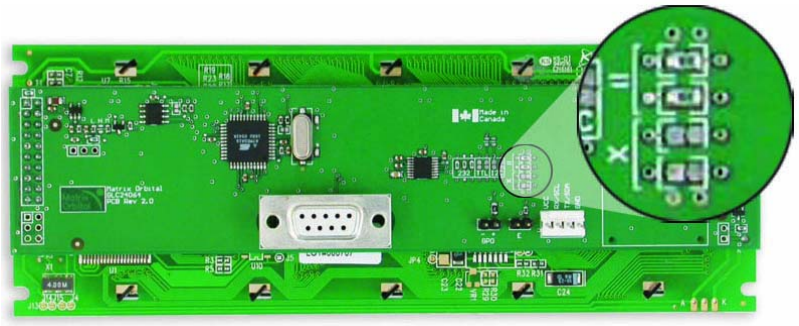
	Standard	-V	-VPT
Supply Voltage	+5Vdc ±0.25V	+9V to +15V	+9V to +35V
Supply Current	31 mA typical		
Supply Backlight Current	160 mA typical		

WARNINGS

- Do not apply any power with reversed polarization.
- Do not apply any voltage other than the specified voltage.

2.2.1 Legacy Data Connector Jumpers

To reverse pins two and three of the *Power/Data Connector* remove the zero ohm resistors from the *Legacy Data Connector Jumpers*, labeled with the = symbol and place them on the jumpers labeled with the **X** symbol. This will allow you to transmit on pin two, and receive data on pin three as pictured in ***figure 14*** below.



Power/Data Connector

=	Pin 2	Rx \ SCL (I^2C clock)
	Pin 3	Tx \ SDA (I^2C data)
X	Pin 2	Tx \ SDA (I^2C data)
	Pin 3	Rx \ SCL (I^2C clock)

Figure 14: Legacy Data Connector Jumpers

2.3 Protocol Select Jumpers

The *Protocol Select Jumpers*, pictured below in ***figure 15***, provide the means necessary to toggle the display module between RS-232, TTL and I^2C protocols. As a default, the jumpers are set to RS-232 mode with zero ohm resistors on the 232 jumpers. In order to place the display module in I^2C mode you must first remove the zero ohm resistors from the 232 jumpers and then solder the resistors on to the I2C jumpers. The display will now be in I^2C mode and have a default slave address of 0x50 unless it has been changed. Similarly, in order to change the display to TTL mode, simply remove the zero ohm resistors from the 232 or I^2C jumpers and solder them to the TTL jumpers.

Figure 15: Protocol Select Jumpers

2.4 General Purpose Output

A unique feature of the GLC24064 is the ability to control relays and other external devices using a *General Purpose Output (3)*, which can provide up to 20 mA of current and +5Vdc from the positive side of the GPO. This is limited by a 240 ohm resistor which is located directly above the positive pin as pictured below in ***figure 16***. If the device, which is being driven by a GPO, requires a relatively high current (such as a relay) and has an internal resistance of its own greater than 250 ohms, then the 240 ohm resistor may be removed and replaced with a Jumper.

Pin 1 - GND
Pin 2 + MAX: 20 mA, +5Vdc

Figure 16: General Purpose Output

WARNING If connecting a relay, be sure that it is fully clamped using a diode and capacitor in order to absorb any electro-motive force (EMF) which will be generated.

2.5 Manual Override

The *Manual Override* is provided to allow the GLC24064 to be reset to factory defaults. This can be particularly helpful if the display module has been set to an unknown baud rate or I ^{2}C Slave Address and you are no longer able to communicate with it. If you wish to return the module to its default settings you must:

1. Power off the display module.

2. Place a Jumper on the *Manual Override* pins.
3. Power up the display module.
4. The display module is now set to its default values listed below in ***table 2***.
5. Edit and save settings.

Figure 17: Manual Override Jumper

Table 2: Default Values

Contrast	128
Backlight	255
Baud Rate	19.2 kbps
I^2C Slave Address	0x50
Data Lock	False
RS232AutoTransmitData	True

NOTE The display module will revert back to the old settings once turned off, unless the settings are saved.

2.6 File System Lock Jumper

The *File System Lock Jumper* allows you to lock the file system on the GLC24064 so that no fonts or bitmaps can be either written or deleted from the onboard memory. This feature is useful in order to prpotect data integrity of production units, if protection of other settings is required see ***Chapter 12 Data Security***.

To lock the file system, solder a zero ohm resistor or use a solder jumper on the *File Sytem Lock Jumper* pictured in ***figure 18*** below.

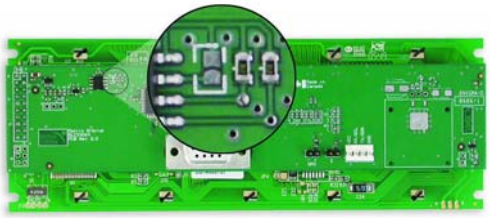


Figure 18: File System Lock Jumper

3 Troubleshooting

3.1 The display does not turn on when power is applied.

- First, you will want to make sure that you are using the correct power connector. Standard floppy drive power cables from your PC power supply may fit on the Power/Data Connector however they do not have the correct pinout as can be seen in ***figure 8 on page 5***. Matrix Orbital supplies power cable adapters for connecting to a PC, which can be found in the ***Accessories Section on page 2***.
- The next step is to check the power cable which you are using for continuity. If you don't have an ohm meter, try using a different power cable, if this does not help try using a different power supply.
- The last step will be to check the *Power / Data Connector* on the GLC24064. If the *Power / Data Connector* has become loose, or you are unable to resolve the issue, please contact Matrix Orbital see ***15.5 on page 57*** for contact information.

3.2 The display module is not communicandating.

- First, check the communication cable for continuity. If you don't have an ohm meter, try using a different communication cable. If you are using a PC try using a different Com port.
- Second, please ensure that the display module is set to communicate on the protocol that you are using, by checking the *Protocol Select Jumpers.* To change the protocol used by the display module see ***Section 2.3 on page 9***.
- Third, ensure that the host system and display module are both communicating on the same baud rate. The default baud rate for the display module is 19200 bps.
- If you are communicating to the display via I^2C please ensure that the data is being sent to the correct address. The default slave address for the display module is 0x50.

NOTE I^2C communication will always require pull up resistors.

- Finally, you may reset the display to it's default settings using the *Manual Override Jumper*, see ***Section 2.5 on page 10***.

3.3 The display module is communicating, however text cannot be displayed.

- The cause of this is often that no font has been loaded onto the display. To load a font onto the display see ***Section 4.2.1 on page 16.***
- Another common cause may be that the contrast settings have been set to low. The solution to this problem is to adjust the contrast settings, the default setting that will work in most environments is 128.

NOTE Optimal contrast settings may varry according to factors such as temerature, viewing angle and lighting conditions.

3.4 There is a problem uploading fonts or bitmaps.

- First, ensure that you can communicate to the display. A good test is to use a PC, with MOGD# installed, to connect to the display. See ***Section 1.4 on page 5*** for setting up a PC to test the GLC24064.
- Second, unsure that the *File System Lock Jumper* has not been set. See ***Section 2.6 on page 11***.
- Third, please ensure that the display module's memory is not full. The GLC24064 has 16 Kb of memory for fonts and bitmaps.

NOTE If you are unable to resolve any issue please contact Matrix Orbital. See *15.5 on page 57* for contact information.

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4 Communications

4.1 Introduction

The commands listed in this chapter describe how to configure data flow on the RS232/TTL and I^{2}C port. The display has built in flow control which may be useful when long strings of text are downloaded to the display. Flow control is enabled or disabled by two commands. If flow control is enabled, the display will return an "almost full" message (0xFE) to the controller when its internal buffer fills to a defined level, and an "almost empty" message (0xFF) when the buffer contents drop to a defined level.

4.1.1 I^{2}C Communication

The GLK24064-25 is capable of communicating at 100 kHz in I^{2}C mode, with 127 units addressable on a single I^{2}C communication line. However, in order to communicate via I^{2}C you must first set the Protocol Select Jumpers as can be seen in ***Section 2.3*** and ensure that pull up resistors, with a nominal value of 1K to 10K, are placed on the SCL SDA communication lines coming from pins two and three of the Data / Power Connector respectively. The GLC24064 uses 8-bit addressing, with the 8th bit designated as the read write

bit, a 0 designates a write address and a 1 designates a read address. The default read address of the display module will be 0x51, whereas the write address is 0x50 by default, to change the I^2C address see section 8.2.1.

When communicating in I^2C the GLC24064 will send an ACK on the 9th clock cycle when addressed. When writing to the display module, the display will respond with a ACK when the write has successfully been completed. However if the buffer has been filled, or the module is too busy processing data it will respond with a NAK. When performing a multiple byte read within one I^2C transaction, each byte read from the slave should be followed by an ACK to indicate that the master still needs data, and a NAK to indicate that the transmission is over.

4.1.2 Serial Communication

In addition to being able to communicate via I^2C the GLC24064 communicates natively through the RS-232 protocol at a default baud rate of 19,200 bps and is capable of standard baud rates from 9600 to 115200 bps. Furthmore the GLC24064 is also capable of reproducing any non-standard baud rate in between using values entered into our baud rate generation algorithm and set through command 164 (0xA4). The display module communicates at standard voltage levals of . at ±12V to ±12V or at TTL levels of 0 to +5V by setting the *Protocol Select Jumpers* to TTL.

4.2 Turn Flow Control On

Syntax

Hexadecimal	0xFE 0x3A [full] [empty]
Decimal	254 58 [full] [empty]
ASCII	254 ":" [full] [empty]

Parameters

Parameter	Length	Description
full	1	Bytes remaining before issuing a almost full message.
empty	1	Bytes available before issuing a almost empty message.

Description This command enables flow control. When the buffer fills so that only [full] bytes are available, the display will return an “almost full” message (0xFE) to the host controller. When the buffer empties so that only [empty] bytes remain, the display will return an “almost empty” message (0xFF) to the host controller.
The display will return the “almost full” message for every byte sent to the display until the used buffer space once more drops below the [full] level. Whether the user is in ‘flow control mode’ or not, the module will ignore display or command bytes which would overrun the buffer. While in ‘flow control mode’ the unit will return 0xFE when buffer is almost full even though it may have already thrown rejected data away. The buffer size for the display is 80 bytes.
When using this command in an application, selection of the value for the buffer [full] should be considered very carefully. This is a critical aspect to be able to use this feature to it’s full potential. When using a host system or PC which contains a FIFO, the user should set the value of [full] equal to or greater than the size of the FIFO. The reason for this is that the FIFO may be full when the host system receives 0xFE. In the case of 16550 UART the size at its maximum is 16, therefore the value of [full] should be set to 16 or greater.

Remembered Yes

Factory Default Off

4.3 Turn Flow Control Off

Syntax

Hexadecimal	0xFE 0x3B
Decimal	254 59
ASCII	254 “;”

Description This command turns off flow control. Bytes may overflow the buffer without warning.

Remembered Yes

4.4 Changing the I²C Slave Address

Syntax

Hexadecimal	0xFE 0x33 [adr]
Decimal	254 51 [adr]
ASCII	254 “3” [adr]

Parameters

Parameter	Length	Description
adr	1	The new I^2C write address (0x00 - 0xFF).

Description

This command sets the I^2C write address of the module between 0x00 and 0xFF. The I^2C write address must be an even number and the read address is automatically set to one higher. For example if the I^2C write address is set to 0x50, then the read address is 0x51.

NOTE The change in address is immediate.

Remembered

Always

Factory Default

0x50

4.5 Changing the Baud Rate

Syntax

Hexadecimal	0xFE 0x39 [speed]
Decimal	254 57 [speed]
ASCII	254 “9” [speed]

Parameters

Parameter	Length	Description
speed	1	Hex value corrisponding to a baud rate.

Description

This command sets the GLC's RS-232 port to the specified [speed]. The change takes place immediately. [speed] is a single byte specifying the desired port speed. Valid speeds are shown in the table below. The GLC can be manually reset to 19,200 baud in the event of an error during transmission, including transmitting a value not listed below, by setting themanual override jumper on the GLC controller board during power up. This command is ignored until this jumper is removed again.

Hex Value	Baud Rate
0xCF	9600
0x8A	14400
0x67	19200
0x44	28800
0x33	38400
0x22	57600
0x19	76800
0x10	115200

Remembered

Always

Factory Default

0x50

4.6 Setting a Non-Standard Baud Rate

Syntax

Hexadecimal	0xFE 0xA4 [speed]
Decimal	254 164 [speed]

Parameters

Parameter	Length	Description
speed	2	Inputed LSB MSB from baud rate formula (12-2047).

Description

This command sets the RS-232 port to a non-standard baud rate. The command accepts a two byte parameter that goes directly into the modules baud generator. Use the formula, $speed = \frac{CrystalSpeed}{8 \times DesiredBaud} - 1$ to calculate the [speed] for any baud rate setting. The speed can be anywhere from 12 to 2047 which corresponds to a baud range of 977 to 153,800 baud. Setting the baud rate out of this range could cause the display to stop working properly and require the Manual Override jumper to be set.

Remembered

Always

Examples

Display Type	Crystal Speed
Standard	16,000,000

$$speed = \frac{crystalspeed}{8 * DesiredBaud} - 1 \qquad speed = \frac{8,000,000}{8 * 13,500} - 1$$

$$speed = 74.07 - 1 \qquad speed = 73.07$$

- **LSB** = 0x4A (rounded)
- **MSB** = 0x00

NOTES

- Results from the formula are rounded down to the nearest whole number (73.07 = 73).
- This formula becomes less acurate as baud rates increase, due to rounding.
- Place the speed result backwards into the formula to receive the actual baud rate. ($Baud = \frac{CrystalSpeed}{8(speed+1)}$)
- The actual baud rate must be within 3% of the intended baud rate for the device to communicate.

5 Fonts

5.1 Introduction

The GLC24064 comes loaded with the 'Small Filled' and 'Futura Bk BT 16' fonts by default however, it is capable of displaying any font that is uploaded to it in the correct format. MOGD# provides a simple method of generating font files from your installed fonts. For instructions on how to install MOGD# see ***Section 1.5.1 on page 5***.

5.1.1 Font File Format

A font file consists of three parts, a header, a character table and bitmap data.

1. Header (4 bytes)
   (a) Nominal Width (1 byte)
   (b) Height (1 byte)
   (c) ASCII Start Value (1 byte)

(d) ASCII End Value (1 byte)

2. Character Table (3 bytes for every character between the ASCII Start and End values inclusive)

   (a) High Offset MSB (1 byte)
   (b) Low Offset LSB(1 byte)
   (c) Character Width (1 byte)

3. Bitmap Data

5.1.2 Creating a Font

The following is an example of how to create a font file for the letters *h*, *i* and *j*.

First you must create the bitmaps containing the character data in bitmap form. ***Figure 19*** below illustrates the bit pattern for the *h*, *i* and *j* bitmap data.

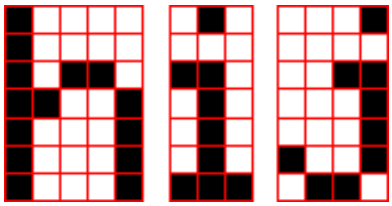


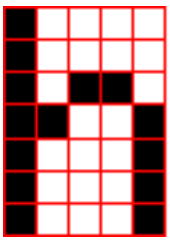
Figure 19: Bitmaps for h, i, and j

Second you may begin to create the font file starting with the header. The header will contain the nominal width, the height and the ASCII start and end values inclusive that you wish to create characters for.

Table 8: Font File Header

Nominal Width	Height	ASCII Start Val	ASCII End Val
0x05	0x07	0x49	0x4B

Next we will have to find out how many bytes each character will use up, in order to create the character table. The bitmaps are encoded horizontally and may have variable widths, *h* has a width of five, *i* a width of three and *j* a width of four, see the figure below for an example of encoding the first letter *h:*



Bitmap Data					Byte	Hex Value
1	0	0	0	0		
1	0	0	0	0	10000100	0x84
1	0	1	1	0	00101101	0x2D
1	1	0	0	1	10011000	0x98
1	0	0	0	1	11000110	0xC6
1	0	0	0	1	00100000	0x20
1	0	0	0	1		

Figure 20: Bitmap Encoding

As you can see the letter *h* will take up five bytes with the last five bits being zero padded to form a full byte. So if you continue the process you will get the character data as seen in ***table 5.1.2***.

Character Data

	Character Data					Byte Size (*For Reference*)
h	0x84	0x2D	0x98	0xC6	0x20	0x05
i	0x43	0x24	0x84			0x03
j	0x2D	0x98	0x19	0x60		0x04

The second part of the font file is the character table. The character table is comprised of three bytes for every glyph in the font file.

The first two bytes represents the position, in bytes, of the glyph stored MSB LSB referenced from the beginning of the file (including the header. The third byte is the width of the glyph in pixels. So because there will be 0x09 bytes in the character table (three bytes for each glyph) and four bytes in the header section, the first entry in the table will be 13, or 0x00 0x0D in hexadecimal, and 0x05 for the width.

To calculate the second entry in the character table, representing the position and width of the second glyph, take the offset of the first entry and add the size of the first bitmap in bytes. Since the first glyph occupies 0x05 bytes as seen in table 5.1.2 above, and the offset is 0x00 0x0D, the offset of the second entry will be 0x00 0x12 and the width of the glyph is 0x03.

Calculate the third entry the same way as the second to get ***table 9*** below.

Table 9: Character Table

	High Offset (MSB)	Low Offset (LSB)	Character Width
h	0x00	0x0D	0x05
i	0x00	0x12	0x03
j	0x00	0x15	0x04

Once completed, place the character table after the header and the character data aat the end, as seen in ***table 10***.

Table 10: Sample Font File

0x05	0x07	0x49	0x4B	0x00	0x0D	0x05	0x00
0x12	0x03	0x00	0x15	0x04	0x84	0x2D	0x98
0xC6	0x20	0x43	0x24	0x84	0x2D	0x98	0x19
0x60							

Red = **Header**
Blue = **Character Table**
Purple = **Character Data**

5.2 Uploading a Font File

Syntax

Hexadecimal	0xFE 0x24 [refID] [size] [data]
Decimal	254 36 [refID] [size] [data]
ASCII	254 “$” [refID] [size] [data]

Parameters

Parameter	Length	Description
refID	1	A unique font identification number.
size	2	Font file size (LSB to MSB).
data	x	Font file data.

Description

In order to upload a font to the GLC24064 you must first initiate the upload font file command (0xFE 0x24), you must then pass it a reference identification number, which must be unique for every font on the display module. You may then pass the display module the two byte file size, which needs to be transfered LSB, then MSB. The last part of uploading a font is transmitting the font file data.
For detailed instructions on uploading a file to the GLC24064 see ***Section 11.1 on page 39***.

Remembered

Always

5.3 Setting the Current Font

Syntax

Hexadecimal	0xFE 0x31 [refID]
Decimal	254 49 [refID]
ASCII	254 “1” [refID]

Parameters

Parameter	Length	Description
refID	1	A unique font identification number.

Description

In order to set the font on the GLK24064-25 you must know the font identification number of the font that you wish to use. The font ID is established when the font is saved to the display. The default installed fonts are “Small Filled” and “Futura Bk BT 16” and their font ID’s are 0x01 and 0x02 respectfully, with “Small Filled” being the default selected font. Once you are aware of the font ID for the font that you wish you use, simply send the command bytes (0xFE 0x31) and then send the font ID corresponding to the font. A directory listing of the contents of the entire filesystem may be obtained by using the “Get Filesystem Directory” command, see Section 11.5 on page 42 for more detailed information.

Remembered Yes

5.4 Font Metrics

Syntax

Hexadecimal	0xFE 0x32 [lm] [tm] [csp] [lsp] [srow]
Decimal	254 50 [lm] [tm] [csp] [lsp] [srow]
ASCII	254 “2” [lm] [tm] [csp] [lsp] [srow]

Parameters

Parameter	Length	Description
lm	1	Left margin: Location in pixels.
tm	1	Top margin: Location in pixels.
csp	1	Character Spacing: Amount of space in pixels between characters.
lsp	1	Line Spacing: Amount of space between lines in pixels.
srow	1	Scroll Row: The Y location of the last row in pixels.

Description

Font metrics define where the characters are positioned on the screen, by setting where the rows and columns begin based on the [lm][tm][csp][lsp][srow] parameters. [lm] defines the leftmost position and [tm] the topmost. [csp] controls the amount of pixels that are placed in between characters and [lsp] controls the amount of pixels that are placed in between lines. [srow] is the location of the top of the last row that will be displayed on the GLC24064. It defines the row that, when filled, will cause the display to auto scroll if auto scrolling is enabled. The font metrics will have to be reconfigured after changing to a different font.

Remembered Yes

5.5 Set Box Space Mode

Syntax

Hexadecimal	0xFE 0xAC [value]
Decimal	254 172 [value]

Parameters

Parameter	Length	Description
value	1	Value (0: Off, 1: On)

Description	This command will toggle the box space mode. Box space mode is when a box, the size of the character to be written, is printed to the display before a character is written.
Remembered	Yes
Factory Default	Off

6 Text

6.1 Introduction

The GLC24064 is an intelligent display module, designed to reduce the amount of code necessary to begin displaying data. This means that it is able to display all characters and strings that are sent to it, which are defined in the current font, without much, if any configuration. The display module will begin displaying text at the top left corner of the display area, known as home, and continue to print to the display as if it was a page on a typewriter. When the text reaches the bottom right, as defined in the font metrics, it will automatically scroll all of the lines up and continue to display text.

6.2 Move Cursor Home

Syntax	Hexadecimal	0xFE 0x48
	Decimal	254 72
	ASCII	254 “H”
Description	This command moves the text insertion point to the top left of the display area, based on the current font metrics see ***Section 5.4 on the previous page***.	
Remembered	No	

6.3 Setting the Cursor Position

Syntax	Hexadecimal	0xFE 0x47 [col] [row]
	Decimal	254 71 [col] [row]
	ASCII	254 “G” [col] [row]

Parameters

Parameter	Length	Description
col	1	Column
row	1	Row

Description

This command sets the text insertion point to the [col] and [row] specified. The insertion point is positioned using the base size of the current font (this command does not position the insertion point at a specific pixel). The column used is determined by multiplying the width of the widest character in the font by the [column]. The row used is determined by multiplying the height of the font by [row + Metrics: line spacing].

Remembered

No

6.4 Setting the Cursor Coordinate

Syntax

Hexadecimal	0xFE 0x79 [x] [y]
Decimal	254 121 [x] [y]
ASCII	254 “y” [x] [y]

Parameters

Parameter	Length	Description
x	1	The horizontal position in pixels.
y	1	The vertical position in pixels.

Description

This command positions the insertion point at a specific pixel (X,Y), which references the top left corner of the font insertion point.

Remembered

No

6.5 Auto Scroll On

Syntax

Hexadecimal	0xFE 0x51
Decimal	254 81
ASCII	254 “Q”

Description	When auto scrolling is on, it causes the display to shift the entire display's contents up to make room for a new line of text when the text reaches the end of the scroll row defined in the font metrics (the bottom right character position) see ***Section ?? on page ??***.
Remembered	Yes
Factory Default	On

6.6 Auto Scroll Off

Syntax	Hexadecimal	0xFE 0x52
	Decimal	254 82
	ASCII	254 "R"
Description	When auto scrolling is disabled, text will wrap to the top left corner of the display area when the text reaches the end of the scroll row defined in the font metrics (the bottom right character position) see ***Section ?? on page ??***. Existing text in the display area is not erased before new text is placed. A series of spaces followed by a "Cursor Home" command may be used to erase the top line of text.	
Remembered	Yes	

7 Bitmaps

7.1 Introduction

One of the main features of the GLC24064 is its ability to display bitmap images, that are either loaded onto its on board memory, or written directly to the screen. This chapter will cover creating a bitmap, uploading the bitmap, as well as drawing the bitmap from memory and directly.

7.2 Uploading a Bitmap File

Syntax

Hexadecimal	0xFE 0x5E [refID] [size] [data]
Decimal	254 94 [refID] [size] [data]
ASCII	254 “^” [refID] [size] [data]

Parameters

Parameter	Length	Description
refID	1	A unique bitmap identification number.
size	2	Bitmap file size (LSB to MSB).
data	x	Bitmap data.

Description

The GLC24064 is capable of storing up to sixty-four font and bitmap files combined, or 16 Kbytes which ever comes first. In order to upload a bitmap to the GLC24064 you must first initiate the upload font file command (0xFE 0x5E), you must then pass it a reference identification number, which must be unique for every font on the display module. You may then pass the display module the two byte file size, which needs to be transfered LSB, then MSB. The last part of uploading a bitmap is transmitting the bitmap file data.
For detailed instructions on uploading a file to the GLC24064 see ***Section 11.1 on page 39***.

Remembered

Always

7.3 Drawing a Bitmap from Memory

Syntax

Hexadecimal	0xFE 0x62 [refID] [X] [Y]
Decimal	254 98 [refID] [X] [Y]
ASCII	254 “b” [refID] [X] [Y]

Parameters

Parameter	Length	Description
refID	1	The bitmap identification number.
X	1	Left bounds.
Y	1	Top bounds.

Description

This command will draw a bitmap that is located in the on board memory. The bitmap is referenced by the bitmaps reference identification number, which is established when the bitmap is uploaded to the display module. The bitmap will be drawn beginning at the top left, from the specified X,Y coordinates. A directory listing of the contents of the entire filesystem may be obtained by using the “Get Filesystem Directory” command, see Section 11.5 on page 42 for more detailed information.

Remembered No

7.4 Drawing a Bitmap Directly

Syntax

Hexadecimal	0xFE 0x64 [X] [Y] [W] [H] [D]
Decimal	254 100 [X] [Y] [W] [H] [D]
ASCII	254 “d” [X] [Y] [W] [H] [D]

Parameters

Parameter	Length	Description
X	1	Left bounds.
Y	1	Top bounds.
W	1	Width
H	1	Height
D	1	Data

Description

Drawing a bitmap to the GLC24064, without first uploading the image to the memory can be a very useful feature for drawing images that are not used very often. In order to accomplish this, you must supply the display module with the X,Y coordinates, representing the top left corner of where you would like to draw the bitmap on the screen, as well as the width and the height of the bitmap. After you have supplied this data you may then upload the bitmap data to the GLC24064. The bitmap data is encoded into bytes horizontally and is transfered the same as if you were uploading a file, see ***Section 11.1 on page 39*** for more information about transferring data to the display module.

NOTE Drawing a bitmap directly to the display supports flow control.

Remembered No

8 Bar Graphs and Drawing

8.1 Introduction

Supplementary to the ability of the GLC24064 to display bitmaps and fonts, the GLC24064 also allows for a robust 2D drawing environment. With the ability to draw by pixel, line or rectangle, as well as the ability to continue a line to form a polygon, we are certain that you will spend less time, developing and creating better looking projects. With the addition of custom bar and strip graphs, you are sure to find the

right tools to make any graphical layout a success.

8.2 Set Drawing Color

Syntax

Hexadecimal	0xFE 0x63 [color]
Decimal	254 99 [color]
ASCII	254 “c” [color]

Parameters

Parameter	Length	Description
color	1	Drawing color (0: White, 1-255: Black).

Description

This command sets the drawing color for subsequent graphic commands that do not have the drawing color passed as a parameter. The parameter [color] is the value of the color where white is 0 and black is 1-255.

Remembered

No

8.3 Draw Pixel

Syntax

Hexadecimal	0xFE 0x70 [x] [y]
Decimal	254 112 [x] [y]
ASCII	254 “p” [x] [y]

Parameters

Parameter	Length	Description
x	1	X screen location.
y	1	Y screen location.

Description

This command will draw a pixel at (x,y) using the current drawing color. The unit processes these requests fast enough to keep up with a steady stream at 115 Kbps so flow control is not required.

Remembered

No

8.4 Drawing a Line

Syntax

Hexadecimal	0xFE 0x6C [x1] [y1] [x2] [y2]
Decimal	254 108 [x1] [y1] [x2] [y2]
ASCII	254 “l” [x1] [y1] [x2] [y2]

Parameters

Parameter	Length	Description
x1	1	Left bounds.
y1	1	Top Bounds.
x2	1	Right Bounds.
y2	1	Bottom Bounds.

Description

This command will draw a line from (x1,y1) to (x2,y2) using the current drawing color. Lines may be drawn from any part of the display to any other part. However, it may be important to note that the line may interpolate differently right to left, or left to right. This means that a line drawn in white from right to left may not fully erase the same line drawn in black from left to right.

Remembered

No

8.5 Continue a Line

Syntax

Hexadecimal	0xFE 0x65 [x] [y]
Decimal	254 101 [x] [y]
ASCII	254 “e” [x] [y]

Parameters

Parameter	Length	Description
x	1	Left bounds.
y	1	Top Bounds.

Description

This command will draw a line with the current drawing color from the last line end (x2,y2) to (x,y). This command uses the global drawing color.

Remembered

No

8.6 Draw a Rectangle

Syntax

Hexadecimal	0xFE 0x72 [color] [x1] [y1] [x2] [y2]
Decimal	254 114 [color] [x1] [y1] [x2] [y2]
ASCII	254 “r” [color] [x1] [y1] [x2] [y2]

Parameters

Parameter	Length	Description
color	1	Drawing color (0: White, 1-255: Black).
x1	1	Left bounds.
y1	1	Top Bounds.
x2	1	Right Bounds.
y2	1	Bottom Bounds.

Description

This command draws a rectangular box in the specified color (0: White, 1: Black). The top left corner is specified by (x1,y1) and the bottom right corner by (x2,y2).

Remembered

No

8.7 Drawing a Solid Rectangle

Syntax

Hexadecimal	0xFE 0x78 [color] [x1] [y1] [x2] [y2]
Decimal	254 120 [color] [x1] [y1] [x2] [y2]
ASCII	254 “x” [color] [x1] [y1] [x2] [y2]

Parameters

Parameter	Length	Description
color	1	Drawing color (0: White, 1-255: Black).
x1	1	Left bounds.
y1	1	Top Bounds.
x2	1	Right Bounds.
y2	1	Bottom Bounds.

Description

This command draws a solid rectangle in the specified color (0: White, 1: Black). The top left corner is specified by (x1,y1) and the bottom right corner by (x2,y2). Since this command involves considerable processing overhead, we strongly recommend the use of flow control, particularly if the command is to be repeated frequently.

Remembered

No

8.8 Initializing a Bar Graph

Syntax

Hexadecimal	0xFE 0x67 [refID] [type] [x1] [y1] [x2] [y2]
Decimal	254 103 [refID] [type] [x1] [y1] [x2] [y2]
ASCII	254 “g” [refID] [type] [x1] [y1] [x2] [y2]

Parameters

Parameter	Length	Description
refID	1	Reference number
type	1	Type of bar graph.
x1	1	Left bounds.
y1	1	Top Bounds.
x2	1	Right Bounds.
y2	1	Bottom Bounds.

Description

This command initializes a bar graph referred to by number [reference number] of type [type] with size from (x1,y1) (top left) to (x2,y2) (bottom right). A maximum of 16 bar graphs with reference numbers from 0 to 15 can be initialized as:

[type]	Direction	Bar Start Point
0	Vertical	Bottom
1	Horizontal	Left
2	Vertical	Top
3	Horizontal	Right

The bar graphs may be located anywhere on the display, but if they overlap, they will not display properly.

It is important that [x1] is less than [x2], and [y1] is less than [y2]. This command doesn’t actually draw the graph, it must be filled in using the Fill Bar Graph command. The unit saves time by only drawing that part of the bar graph which has changed from the last write, so the representation on the screen may not survive a screen clear or other corrupting action. A write of value zero, followed by new values will restore the proper look of the bar graph.

Remembered

No

8.9 Drawing a Bar Graph

Syntax

Hexadecimal	0xFE 0x69 [ref] [value]
Decimal	254 105 [ref] [value]
ASCII	254 “i” [ref] [value]

Parameters

Parameter	Length	Description
ref	1	Initialized bar graph reference number.
value	1	The number of pixels to fill.

Description

Once the bar graph has been initialized it can be filled in using this command. This command sets the bar graph specified by the [ref] number to fill in [value]. [value] is given in pixels and should not exceed the available height/width of the graph. (If it does the graph will simply be written to its maximum size.)

Remembered

No

8.10 Initializing a Strip Chart

Syntax

Hexadecimal	0xFE 0x6A [refID] [x1] [y1] [x2] [y2]
Decimal	254 106 [refID] [x1] [y1] [x2] [y2]
ASCII	254 “j” [refID] [x1] [y1] [x2] [y2]

Parameters

Parameter	Length	Description
refID	1	Reference number
x1	1	Left bounds.
y1	1	Top Bounds.
x2	1	Right Bounds.
y2	1	Bottom Bounds.

Description

A strip chart is an area of the screen reserved for horizontal scrolling. This is normally used as follows:

- Initialize the strip chart, which reserves the appropriate area of the screen.
- Draw a line segment at the right or left side of the strip chart.
- Shift the strip chart to the right or left.
- Draw the next line segment.
- Used this way the strip chart can produce a graph which scrolls smoothly horizontally in either direction. With text the strip chart can produce a marquis effect.

NOTE If the strip chart is used with text we recommend the use of a 6 or 7 pixel wide fixed width character set, with each character placed 8 pixels from the start of the previous one.

Up to 7 strip charts ([ref] = 0 - 6) may be defined. To initialize a strip chart the user must define an area on the display in which to place the strip chart.(x1,y1) is the top left corner of the area to be used, where [x1] is the placement of the column where the strip chart is to begin and [y1] is the row. The user must then define [x2] as the bottom right column of the area to be utilized and [y2] as the bottom right row.
The definition of x must lie on byte boundaries. That is, x must be defined as 0x00, 0x08, 0x10, etc. This restriction does not apply to y values.

Remembered

No

8.11 Shifting a Strip Chart

Syntax

Hexadecimal	0xFE 0x6B [ref]
Decimal	254 107 [ref]
ASCII	254 “k” [ref]

Parameters

Parameter	Length	Description
ref	1	Reference number of a strip chart that has already been created.

Description This command shifts the strip chart left or right. [ref] determines both which strip chart is used and which direction it will shift. The direction is selected by the most significant bit (MSB):

- MSB: 0 shifts left
- MSB: 1 shifts right

For example if [ref] is 1:

- 254 107 1 (hex FE 6B 01) shifts left
- 254 107 129 (hex FE 6B 81) shifts right

This command shifts the contents of the area defined in the Initialize Strip Chart command 8 pixels at a time.

Remembered No

9 General Purpose Output

9.1 Introduction

General purpose outputs allow you to connect devices, such as temperature probes, to the GLC24064 and supply them with up to 30mA of current at 5V. The GLC24064 has one GPO which is software controlled, with functions to turn it on or off and set the power state for the next startup.

9.2 General Purpose Output Off

Syntax

Hexadecimal	0xFE 0x56
Decimal	254 86
ASCII	254 “V”

Description This command turns OFF the general purpose outputs.

NOTE OFF means that the output is ground.

Remembered Yes

9.3 General Purpose Output On

Syntax

Hexadecimal	0xFE 0x57
Decimal	254 87
ASCII	254 “W”

Description

This command turns ON the general purpose output. The standard GPO’s on the GLC24064 output 20mA of current at 5V.

NOTE The output is pulled high.

Remembered

Yes

9.4 Set Startup GPO state

Syntax

Hexadecimal	0xFE 0xC3 [state]
Decimal	254 195 [state]

Parameters

Parameter	Length	Description
state	1	Startup state (0: Off, 1: On)

Description

This command will set the startup state for the GPO on the next power up. A value of one will cause the GPO to be off on the next startup while a value of one will cause the GPO to be on.

NOTE This command does not affect the current state of the GPO.

Remembered

Always

10 Display Functions

10.1 Introduction

The GLC24064 employs software controlled display settings, which allow for control over, clearing the screen, changing the brightness and contrast or setting timers for turning it on or off. The combination of these allow you complete software control over your display's appearance.

10.2 Clear Screen

Syntax	Hexadecimal	0xFE 0x58
	Decimal	254 88
	ASCII	254 "X"
Description	This command clears the display and resets the text insertion position to the top left position of the screen defined in the font metrics.	
Remembered	No	

10.3 Backlight On

Syntax	Hexadecimal	0xFE 0x42 [min]
	Decimal	254 66 [min]
	ASCII	254 "B" [min]

Parameters

Parameter	Length	Description
min	1	Minutes before turning the backlight on (0 to 100).

Description: This command turns the backlight on after the [minutes] timer has expired , with a one-hundred minute maximum timer. A time of 0 specifies that the display should turn on immediately and stay on. When this command is sent while the remember function is on, the timer will reset and begin after power up.

Remembered: Yes

Factory Default: 0

10.4 Backlight Off

Syntax	Hexadecimal	0xFE 0x46
	Decimal	254 70
	ASCII	254 “F”

Description: This command turns the backlight off immediately. The backlight will remain off until a ’Backlight On’ command has been received.

Remembered: Yes

10.5 Set Backlight Brightness

Syntax	Hexadecimal	0xFE 0x99 [brightness]
	Decimal	254 153 [brightness]

Parameters:

Parameter	Length	Description
brightness	1	Backlight setting (0 to 255).

Description: This command sets the backlight settings according to [backlight]. If the remember function is on, this command acts the same as ’Set and Save Backlight Brightness’.

Remembered: Yes

Factory Default: 255

10.6 Set and Save Backlight Brightness

Syntax	Hexadecimal	0xFE 0x98 [brightness]
	Decimal	254 152 [brightness]

Parameters:

Parameter	Length	Description
brightness	1	Backlight setting (0 to 255).

Description This command sets and saves the backlight [brightness] as default.

Remembered Always

10.7 Set Contrast

Syntax
Hexadecimal	0xFE 0x50 [contrast]
Decimal	254 80 [contrast]
ASCII	254 “P” [contrast]

Parameters

Parameter	Length	Description
contrast	1	Contrast value (0 to 255).

Description This command sets the display’s contrast to [contrast], where [contrast] is a value between 0x00 and 0xFF (between 0 to 255). Lower values cause ‘on’ elements in the display area to appear lighter, while higher values cause ‘on’ elements to appear darker. Lighting and temperature conditions will affect the actual value used for optimal viewing. Individual display modules will also differ slightly from each other in appearance. In addition, values for optimal viewing while the display backlight is on may differ from values used when backlight is off.
This command does not save the [contrast] value, and is lost after power down; but this command has the option of remembering the settings when issued with the Remember function ‘on’ . When this is the case, this command is the same as the Set and Save Contrast command.

Remembered Yes

Factory Default 128

10.8 Set and Save Contrast

Syntax
Hexadecimal	0xFE 0x91 [contrast]
Decimal	254 145 [contrast]

Parameters

Parameter	Length	Description
contrast	1	Contrast value (0 to 255).

Description — This command sets the display's contrast to [contrast], where [contrast] is a value between 0x00 and 0xFF (between 0 to 255). Lower values cause 'on' elements in the display area to appear lighter, while higher values cause 'on' elements to appear darker. Lighting conditions will affect the actual value used for optimal viewing. Individual display modules will also differ slightly from each other in appearance. In addition, values for optimal viewing while the display backlight is on may differ from values used when backlight is off.

NOTE This command saves the [contrast] value so that it is not lost after power down.

Remembered — Yes

Factory Default — 128

11 Filesystem

11.1 Introduction

The GLK24064-25 incorporates a 16 Kbyte on board flash memory in order to allow font and bitmap files to be transfered directly onto the display and recalled whenever necessary. The filesystem can address up to sixty-four font and bitmap files combined, or 16 Kbytes which ever comes first. This section covers uploading, downloading, deleting and moving files, as well as getting the remaining space or wiping the filesystem.

11.1.1 File Upload Protocol

In order to allow fonts and bitmaps to be uploaded to the on board flash memory Matrix Orbital has developed a simple protocol that supports RS-232/TTL or I^2C communications. In order to begin a file transmission the first step will be to provide the display module with the appropriate command bytes, meaning the command prefix, 0xFE, followed by the command number, 0x24 for a font file, or 0x5E for a bitmap file. This will begin the file transfer sequence. The next step will be to request a reference identification number (ref ID) which will allow you to identify the file for future use. Reference ID numbers can be any byte between 0x01 and 0xFF, however each ID must be unique. Once you have transmitted the refID, the display module will immediately echo the byte if the ID is not in use, however if the ID is in use it will decline the ID by sending a decline byte, 0x08, and terminate the session. Once you have received confirmation that the refID is not in use, you may then confirm the echo by sending a confirm byte, 0x01, or report a byte error by sending a decline byte, 0x08, this will will terminate the session.

The next part of uploading a font file is to provide the display module with the two byte file size of the

data that you wish to transfer, LSB to MSB. The LSB must be transmitted first and will be echoed by the module. You must confirm the echo with a 0x01, or report a byte error by sending a decline byte, 0x08. Second you may transfer the MSB, after receiving the MSB the display module will echo the byte and then send a confirm, 0x01, if the file fits, or decline byte, 0x08 and terminate the session.

Byte	Description
0x01	Confirm: Will continue the file transfer.
0x08	Decline: Terminate the session.

The last part of uploading a font file is to upload the file data. After transmitting each byte of the file the module will echo the byte and wait for a confirmation byte of 0x01 until the file has completed uploading. Below is an example of uploading the font file which we created in ***Section 5.1.2 on page 19***.

```
Host:    Transmit(0xFE); //Command Prefix
         Transmit(0x24); //Font file upload command
         Transmit(0x03); //Request file ID for font file

Module:  Echo(0x03);     //Accept request for file ID, by echoing the request

Host:    Receive();      //Receive the echo
         Confirm(0x01);  //Confirm File ID
         Transmit(0x19); //Transmit the file size LSB

Module:  Echo(0x19);     //Echo the LSB
         File Size = 0x19

Host:    Receive();      //Receive LSB echo
         Confirm(0x01);  //Confirm the LSB
         Transmit(0x00); //Transmit MSB

Module:  Echo(0x00);     //Echo MSB
         FileFits(0x01); //Send confirmation that the file fits

Host:    Receive();      //Receive confirmation
         Transmit(0x05); //Begin transmit of file data

Module:  Echo(0x05);     //Echo first byte from file

Host:    Receive();      //Receive echo
         Confirm(0x01);  //Confirm echo
         Transmit(0x07); //Transmit second byte of file data

etc...
```

NOTES

- The GLC24064 has watch dog timer, set to 2.1 seconds in between transmissions, in order prevent the display module from staying in a waiting state.
- Once the timeout has been reached the timer will reset the display and issue a 0xFE 0xD4 response to the host to signal that this has happened.

11.2 Wipe Filesystem

Syntax	Hexadecimal	0xFE 0x21 0x59 0x21
	Decimal	254 33 89 33
	ASCII	254 “!” “Y” “!”

Description: This command completely erases the display’s non-volatile memory. It removes all fonts, font metrics, bitmaps, and settings (current font, cursor position, communication speed, etc.). It is an “odd” command in that it is three bytes in length in order to prevent accidental execution.

Remembered: Yes

11.3 Deleting a File

Syntax	Hexadecimal	0xFE 0xAD [type] [refID]
	Decimal	254 173 [type] [refID]

Parameters:

Parameter	Length	Description
type	1	Type of file (0:Font, 1:Bitmap)
refID	1	Reference ID of the file to delete.

Description: This command erases a single file at a time within the GLC24064 memory when given two parameters: [type] and [ref]. The file type and reference number are defined when the file is saved to the GLC24064.

- [type] = 1: Bitmap
- [type] = 0: Font

Remembered: Yes

11.4 Get Filesystem Space

Syntax
Hexadecimal 0xFE 0xAF
Decimal 254 175

Description
This command will return 4 bytes, LSB to MSB for how many bytes are remaining in the 16 KB on board memory.

Remembered
No

11.5 Get Filesystem Directory

Syntax
Hexadecimal 0xFE 0xB3
Decimal 254 179

Description
This command will return a directory of the contents of the file system. The first byte returned will be a hex value representing the number of entries in the filesystem, followed by four bytes for each entry. See the following tables:

Filesystem Header	
Bytes	Description
1	Hex value representing the number of entries in the filesystem

File Entry	
Bytes	Description
1	Flag: Hex value of 0x00 indicates that this file entry has not been used.
1	FileID/Type: 1st bit is the file type (0: Font, 1: Bitmap). Next 7 bits are the file ID.
1	File Size: LSB
1	File Size: MSB

Remembered
No

11.6 Downloading a File

Syntax
Hexadecimal 0xFE 0xB2 [Type] [refID]
Decimal 254 178 [Type] [refID]

Parameters

Parameter	Length	Description
Type	1	File type (0:Font File, 1:Bitmap)
refID	1	Reference ID number

Description
To reverse pins two and three of the Power/Data Connector remove the zero ohm resistors from the Legacy Data Connector Jumpers, labeled with the = symbol and place them on the jumpers labeled with the X symbol. This will allow you to transmit on pin two, and receive data on pin three as pictured in figure [cap:Legacy-Data-Connector] below.

Remembered
No

11.7 Moving a File

Syntax
Hexadecimal 0xFE 0xB4 [oldT] [oldID] [newT] [newID]
Decimal 254 180 [oldT] [oldID] [newT] [newID]

Parameters

Parameter	Length	Description
oldT	1	Old file type
oldID	1	Old file ID
newT	1	New file type
newID	1	New file ID

Description
This command can be used to move a file to a new file ID, or correct the type of a file that was uploaded incorrectly. The command first checks to see if there is a file identified by [oldT] and [oldID]. If it does exist, and there is no file already with the desired type and ID, the ID and type of the old file will be changed to [newT] and [newID] respectively.

Remembered
Always

12 Data Security

12.1 Introduction

Ensuring that your GLC24064 display's exactly what you want it to can be the difference between a projects success and failure. This is why we incorporate features such as Data Lock into the GLC24064. With this new feature you now are in control over of how and when settings will be changed so there is no need to worry about the module acting exactly like you expected it to because all the settings may be locked and remembered for the next power up.

12.2 Set Remember

Syntax

Hexadecimal	0xFE 0x93 [switch]
Decimal	254 147 [switch]

Parameters

Parameter	Length	Description
switch	1	0: Do not remember, 1: Remember

Description

This command allows you to switch the remember function on and off. To use the remember function, set remember to on, then set all of the settings that you wish to save, settings that are listed as 'Remember: Yes' support being saved into the non-volatile memory. After you have set all of the commands that you wish to save, you may then cycle the power and check the display settings to ensure that all the settings have been saved. If you wish to use remember again after cycling the power, you must set it to on again.

NOTES

- Writing to non-volatile memory is time consuming and slows down the operation of the display.
- Non-volatile memory has a 'write limit' and may only be changed approximately 100,000 times.

Remembered

No

Factory Default

Do not remember

12.3 Data Lock

Syntax

Hexadecimal	0xFE 0xCA [level]
Decimal	254 202 [level]

Parameters

Parameter	Length	Description
level	1	Sets the data lock level

Description

Data lock, originally known as paranoia, allows you to lock the module from displaying information, as well as enables the protection of the filesystem and module settings. Each bit corresponds corresponds to a different lock level, while sending a zero will unlock your display as the following tables explains:

Bit	Binary	Data Lock Level	Description
0	0	Unlock	Sending a zero will cause the display to unlock.
1-4	1-1111	Reserved	
5	10000	Setting Lock	Locks the display settings such as backlight, contrast and GPO settings.
6	100000	Filesystem Lock	When locked no bitmap or font files may be added, deleted or modified.
7	1000000	Command Lock	Locks all commands but the the data lock command.
8	10000000		

NOTES

- Sending a new data lock level will override the previous data lock level.
- Data lock levels may be combined.

Remembered

Always

Factory Default

0

Examples

Hex	Dec	Binary	Description
0x00	0	0	Unlock
0xF0	240	11110000	Setting, Filesystem, Command and Display Lock
0x50	80	01010000	Setting and Command Lock

12.4 Set and Save Data Lock

Syntax
Hexadecimal 0xFE 0xCB [level]
Decimal 254 203 [level]

Parameters

Parameter	Length	Description
level	1	Sets the data lock level

Description
This command will set and save the data lock level. See the Data Lock section for more information.

Remembered
Always

Factory Default
0

13 Miscellaneous

13.1 Introduction

This chapter covers the 'Report Version Number' and 'Read Module Type' commands. These commands can be particularly useful to find out more information about the display module before contacting technical support.

13.2 Read Version Number

Syntax	Hexadecimal	0xFE 0x36
	Decimal	254 54
	ASCII	254 "6"

Description: This command will return a byte representing the version of the module, see the following table as an example:

Hex Value	Version Number
0x10	Version 1.0
0x20	Version 2.0
0x42	Version 4.2

Remembered: No

13.3 Read Module Type

Syntax	Hexadecimal	0xFE 0x37
	Decimal	254 55
	ASCII	254 "7"

Description This command will return a hex value corresponding to the the model number of the module see the following table:

Hex	Product ID	Hex	Product ID
1	LCD0821	**36**	LK202-24-USB
2	LCD2021	**37**	VK202-24-USB
5	LCD2041	**38**	LK204-24-USB
6	LCD4021	**39**	VK204-24-USB
7	LCD4041	**3A**	PK162-12
8	LK202-25	**3B**	VK162-12
9	LK204-25	**3C**	MOS-AP-162A
A	LK404-55	**3D**	PK202-25
B	VFD2021	**3E**	MOS-AL-162A
C	VFD2041	**40**	MOS-AV-202A
D	VFD4021	**41**	MOS-AP-202A
E	VK202-25	**42**	PK202-24-USB
F	VK204-25	**43**	MOS-AL-082
10	GLC12232	**44**	MOS-AL-204
13	GLC24064	**45**	MOS-AV-204
15	GLK24064-25	**46**	MOS-AL-402
22	GLK12232-25-WBL	**47**	MOS-AV-402
24	GLK12232-25-SM	**48**	LK082-12
31	LK404-AT	**49**	VK402-12
32	MOS-AV-162A	**4A**	VK404-55
33	LK402-12	**4B**	LK402-25
34	LK162-12	**4C**	VK402-25
35	LK204-25PC		

Remembered No

14 Command Summary

14.1 Communications

Description	Syntax		Page
Turn Flow Control On	Hexadecimal	0xFE 0x3A [full] [empty]	14
	Decimal	254 58 [full] [empty]	
	ASCII	254 ":" [full] [empty]	

Description	Syntax		Page
Turn Flow Control Off	Hexadecimal	0xFE 0x3B	15
	Decimal	254 59	
	ASCII	254 “;”	
Changing the I^2C Slave Address	Hexadecimal	0xFE 0x33 [adr]	16
	Decimal	254 51 [adr]	
	ASCII	254 “3” [adr]	
Changing the Baud Rate	Hexadecimal	0xFE 0x39 [speed]	16
	Decimal	254 57 [speed]	
	ASCII	254 “9” [speed]	
Setting a Non-Standard Baud Rate	Hexadecimal	0xFE 0xA4 [speed]	17
	Decimal	254 164 [speed]	

14.2 Fonts

Description	Syntax		Page
Uploading a Font File	Hexadecimal	0xFE 0x24 [refID] [size] [data]	20
	Decimal	254 36 [refID] [size] [data]	
	ASCII	254 “$” [refID] [size] [data]	
Setting the Current Font	Hexadecimal	0xFE 0x31 [refID]	21
	Decimal	254 49 [refID]	
	ASCII	254 “1” [refID]	
Font Metrics	Hexadecimal	0xFE 0x32 [lm] [tm] [csp] [lsp] [srow]	22
	Decimal	254 50 [lm] [tm] [csp] [lsp] [srow]	
	ASCII	254 “2” [lm] [tm] [csp] [lsp] [srow]	
Set Box Space Mode	Hexadecimal	0xFE 0xAC [value]	22
	Decimal	254 172 [value]	

14.3 Text

Description	Syntax		Page
Move Cursor Home	Hexadecimal	0xFE 0x48	23
	Decimal	254 72	
	ASCII	254 “H”	

Description	Syntax		Page
Setting the Cursor Position	Hexadecimal	0xFE 0x47 [col] [row]	23
	Decimal	254 71 [col] [row]	
	ASCII	254 “G” [col] [row]	
Setting the Cursor Coordinate	Hexadecimal	0xFE 0x79 [x] [y]	24
	Decimal	254 121 [x] [y]	
	ASCII	254 “y” [x] [y]	
Auto Scroll On	Hexadecimal	0xFE 0x51	24
	Decimal	254 81	
	ASCII	254 “Q”	
Auto Scroll Off	Hexadecimal	0xFE 0x52	25
	Decimal	254 82	
	ASCII	254 “R”	

14.4 Bitmaps

Description	Syntax		Page
Uploading a Bitmap File	Hexadecimal	0xFE 0x5E [refID] [size] [data]	25
	Decimal	254 94 [refID] [size] [data]	
	ASCII	254 “^” [refID] [size] [data]	
Drawing a Bitmap from Memory	Hexadecimal	0xFE 0x62 [refID] [X] [Y]	26
	Decimal	254 98 [refID] [X] [Y]	
	ASCII	254 “b” [refID] [X] [Y]	
Drawing a Bitmap Directly	Hexadecimal	0xFE 0x64 [X] [Y] [W] [H] [D]	27
	Decimal	254 100 [X] [Y] [W] [H] [D]	
	ASCII	254 “d” [X] [Y] [W] [H] [D]	

14.5 Bar Graphs and Drawing

Description	Syntax		Page
Set Drawing Color	Hexadecimal	0xFE 0x63 [color]	28
	Decimal	254 99 [color]	
	ASCII	254 “c” [color]	

Description	Syntax		Page
Draw Pixel	Hexadecimal	0xFE 0x70 [x] [y]	28
	Decimal	254 112 [x] [y]	
	ASCII	254 “p” [x] [y]	
Drawing a Line	Hexadecimal	0xFE 0x6C [x1] [y1] [x2] [y2]	28
	Decimal	254 108 [x1] [y1] [x2] [y2]	
	ASCII	254 “l” [x1] [y1] [x2] [y2]	
Continue a Line	Hexadecimal	0xFE 0x65 [x] [y]	29
	Decimal	254 101 [x] [y]	
	ASCII	254 “e” [x] [y]	
Draw a Rectangle	Hexadecimal	0xFE 0x72 [color] [x1] [y1] [x2] [y2]	29
	Decimal	254 114 [color] [x1] [y1] [x2] [y2]	
	ASCII	254 “r” [color] [x1] [y1] [x2] [y2]	
Drawing a Solid Rectangle	Hexadecimal	0xFE 0x78 [color] [x1] [y1] [x2] [y2]	30
	Decimal	254 120 [color] [x1] [y1] [x2] [y2]	
	ASCII	254 “x” [color] [x1] [y1] [x2] [y2]	
Initializing a Bar Graph	Hexadecimal	0xFE 0x67 [refID] [type] [x1] [y1] [x2] [y2]	31
	Decimal	254 103 [refID] [type] [x1] [y1] [x2] [y2]	
	ASCII	254 “g” [refID] [type] [x1] [y1] [x2] [y2]	
Drawing a Bar Graph	Hexadecimal	0xFE 0x69 [ref] [value]	32
	Decimal	254 105 [ref] [value]	
	ASCII	254 “i” [ref] [value]	
Initializing a Strip Chart	Hexadecimal	0xFE 0x6A [refID] [x1] [y1] [x2] [y2]	32
	Decimal	254 106 [refID] [x1] [y1] [x2] [y2]	
	ASCII	254 “j” [refID] [x1] [y1] [x2] [y2]	
Shifting a Strip Chart	Hexadecimal	0xFE 0x6B [ref]	33
	Decimal	254 107 [ref]	
	ASCII	254 “k” [ref]	

14.6 General Purpose Output

Description	Syntax		Page
General Purpose Output Off	Hexadecimal	0xFE 0x56	34
	Decimal	254 86	
	ASCII	254 “V”	

Description	Syntax		Page
General Purpose Output On	Hexadecimal	0xFE 0x57	35
	Decimal	254 87	
	ASCII	254 “W”	
Set Startup GPO state	Hexadecimal	0xFE 0xC3 [state]	35
	Decimal	254 195 [state]	

14.7 Display Functions

Description	Syntax		Page
Clear Screen	Hexadecimal	0xFE 0x58	36
	Decimal	254 88	
	ASCII	254 “X”	
Backlight On	Hexadecimal	0xFE 0x42 [min]	36
	Decimal	254 66 [min]	
	ASCII	254 “B” [min]	
Backlight Off	Hexadecimal	0xFE 0x46	37
	Decimal	254 70	
	ASCII	254 “F”	
Set Backlight Brightness	Hexadecimal	0xFE 0x99 [brightness]	37
	Decimal	254 153 [brightness]	
Set and Save Backlight Brightness	Hexadecimal	0xFE 0x98 [brightness]	37
	Decimal	254 152 [brightness]	
Set Contrast	Hexadecimal	0xFE 0x50 [contrast]	38
	Decimal	254 80 [contrast]	
	ASCII	254 “P” [contrast]	
Set and Save Contrast	Hexadecimal	0xFE 0x91 [contrast]	38
	Decimal	254 145 [contrast]	

14.8 Filesystem

Description	Syntax		Page
Wipe Filesystem	Hexadecimal	0xFE 0x21 0x59 0x21	41
	Decimal	254 33 89 33	
	ASCII	254 “!” “Y” “!”	
Deleting a File	Hexadecimal	0xFE 0xAD [type] [refID]	41
	Decimal	254 173 [type] [refID]	
Get Filesystem Space	Hexadecimal	0xFE 0xAF	42
	Decimal	254 175	
Get Filesystem Directory	Hexadecimal	0xFE 0xB3	42
	Decimal	254 179	
Downloading a File	Hexadecimal	0xFE 0xB2 [Type] [refID]	43
	Decimal	254 178 [Type] [refID]	
Moving a File	Hexadecimal	0xFE 0xB4 [oldT] [oldID] [newT] [newID]	43
	Decimal	254 180 [oldT] [oldID] [newT] [newID]	

14.9 Data Security

Description	Syntax		Page
Set Remember	Hexadecimal	0xFE 0x93 [switch]	44
	Decimal	254 147 [switch]	
Data Lock	Hexadecimal	0xFE 0xCA [level]	45
	Decimal	254 202 [level]	
Set and Save Data Lock	Hexadecimal	0xFE 0xCB [level]	46
	Decimal	254 203 [level]	

14.10 Miscellaneous

Description	Syntax		Page
Read Version Number	Hexadecimal	0xFE 0x36	47
	Decimal	254 54	
	ASCII	254 “6”	

Description	Syntax		Page
Read Module Type	Hexadecimal	0xFE 0x37	47
	Decimal	254 55	
	ASCII	254 “7”	

14.11 Command By Number

Command			Description	Page
Hex	Dec	ASCII		
0x21	33	“!”	Wipe Filesystem	41
0x24	36	“$”	Uploading a Font File	20
0x31	49	“1”	Setting the Current Font	21
0x32	50	“2”	Font Metrics	22
0x33	51	“3”	Changing the I^2C Slave Address	16
0x36	54	“6”	Read Version Number	47
0x37	55	“7”	Read Module Type	47
0x39	57	“9”	Changing the Baud Rate	16
0x3A	58	“:”	Turn Flow Control On	14
0x3B	59	“;”	Turn Flow Control Off	15
0x42	66	“B”	Backlight On	36
0x46	70	“F”	Backlight Off	37
0x47	71	“G”	Setting the Cursor Position	23
0x48	72	“H”	Move Cursor Home	23
0x50	80	“P”	Set Contrast	38
0x51	81	“Q”	Auto Scroll On	24
0x52	82	“R”	Auto Scroll Off	25
0x56	86	“V”	General Purpose Output Off	34
0x57	87	“W”	General Purpose Output On	35
0x58	88	“X”	Clear Screen	36
0x5E	94	“^”	Uploading a Bitmap File	25
0x62	98	“b”	Drawing a Bitmap from Memory	26
0x63	99	“c”	Set Drawing Color	28
0x64	100	“d”	Drawing a Bitmap Directly	27
0x65	101	“e”	Continue a Line	29
0x67	103	“g”	Initializing a Bar Graph	31
0x69	105	“i”	Drawing a Bar Graph	32
0x6A	106	“j”	Initializing a Strip Chart	32
0x6B	107	“k”	Shifting a Strip Chart	33
0x6C	108	“l”	Drawing a Line	28
0x70	112	“p”	Draw Pixel	28
0x72	114	“r”	Draw a Rectangle	29
0x78	120	“x”	Drawing a Solid Rectangle	30
0x79	121	“y”	Setting the Cursor Coordinate	24
0x91	145		Set and Save Contrast	38

Command Hex	Dec	ASCII	Description	Page
0x93	147		Set Remember	44
0x98	152		Set and Save Backlight Brightness	37
0x99	153		Set Backlight Brightness	37
0xA4	164		Setting a Non-Standard Baud Rate	17
0xAC	172		Set Box Space Mode	22
0xAD	173		Deleting a File	41
0xAF	175		Get Filesystem Space	42
0xB2	178		Downloading a File	43
0xB3	179		Get Filesystem Directory	42
0xB4	180		Moving a File	43
0xC3	195		Set Startup GPO state	35

15 Appendix

15.1 Specifications

15.1.1 Environmental

Table 65: Environmental Specifications

	Standard Temperature	**Extended Temperature**
Operating Temperature	0°C to +50°C	-20°C to +70°C
Storage Temperature	-20°C to +70°C	-30°C to +80°C
Operating Relative Humidity	90% max non-condensing	
Vibration (Operating)	4.9 m/s^2 XYZ directions	
Vibration (Non-Operating)	19.6 m/s^2 XYZ directions	
Shock (Operating)	29.4 m/s^2 XYZ directions	
Shock (Non-Operating)	490 m/s^2 XYZ directions	

15.1.2 Electrical

Table 66: Electrical Specifications

	Standard	**Wide Voltage (V)**	**Wide Voltage with Efficiant Switching Power Supply (VPT)**
Supply Voltage	+5Vdc $\pm$0.25V	+9V to +15V	+9V to +35V
Backlight On	110 mA typical		
Backlight Off Supply	40 mA		
Power Conservation	35 mA		

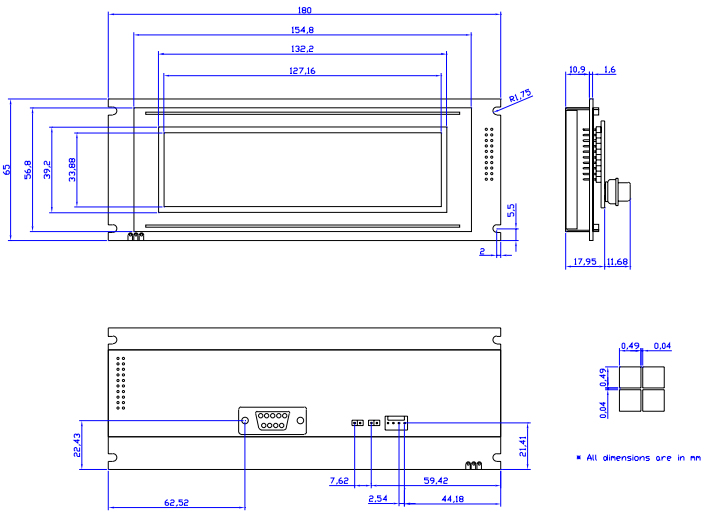
15.2 Optical Characteristics

Table 67: Optical Characteristics

Pixel Layout	240 x 64 pixels XxY
Number of Characters	320 (maximum 40 characters x 8 Lines with 5x7 font)
Display Area	127.16 x 33.88mm XxY
Dot Size	0.49 x 0.49mm (XxY)
Dot Pitch	0.53 x 0.53mm (XxY)
LED Backlight Life	100, 000 hours yellow/green backlight 20, 000 hours white backlight
Backlight	Yellow/Green LED White LED

15.3 Physical Layout

Figure 21: Physical Diagram



15.4 Definitions

E Extended Temperature (-20C to 70C)

VPT Wide Voltage with Efficient Switching Power Supply (+9 to +35Vdc)

V Wide Voltage (+9 to +15Vdc)

GW Grey Text / White Background

WB White Text / Blue Background

MSB Most Significant Byte

LSB Least Significant Byte

15.5 Contacting Matrix Orbital

Telephone

Sales and Support: 1(403)229-2737

On The Web

Sales: http://www.MatrixOrbital.com

Support: http://www.MatrixOrbital.ca

Forums: http://www.lcdforums.com