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GLT240128
Technical Manual

Revision: 1.2

Contents

Contents ii

1 Getting Started 1
- 1.1 Display Options Available . . . 1
- 1.2 Accessories . . . 2
- 1.3 Features . . . 3
- 1.4 Connecting to a PC . . . 4
  - 1.4.1 Connection for Non-USB Modules . . . 4
  - 1.4.2 Connection for USB Modules . . . 5
- 1.5 Installing the Software . . . 5
  - 1.5.1 MOGD# . . . 5

2 Hardware Information 6
- 2.1 Communication Connectors . . . 8
  - 2.1.1 Power/Data Connector for Non-USB modules only . . . 8
  - 2.1.2 USB Connector for USB modules only . . . 9
- 2.2 Touchpad Interface Connector . . . 10
- 2.3 DB-9 Connector for Non-USB modules only . . . 10
- 2.4 Power Through DB-9 Jumper . . . 11
- 2.5 Optional USB Header for USB modules only . . . 12
- 2.6 Protocol Select Jumpers . . . 12
- 2.7 Filesystem Lock Jumper . . . 13
- 2.8 Manual Override . . . 14

3 Troubleshooting 15
- 3.1 The display does not turn on when power is applied. . . . 15
- 3.2 The display module is not communicating. . . . 15
- 3.3 The display module is communicating, however text cannot be displayed. . . . 16
- 3.4 There is a problem uploading fonts or bitmaps. . . . 16

4 Communications 16
- 4.1 Introduction . . . 16
  - 4.1.1 I^2C Communication Summary . . . 16
  - 4.1.2 I^2C Transaction Example . . . 17
  - 4.1.3 Serial Communication . . . 18
  - 4.1.4 USB Communication . . . 18
- 4.2 Turn Flow Control On . . . 18
- 4.3 Turn Flow Control Off . . . 19
- 4.4 Changing the I^2C Slave Address . . . 19
- 4.5 Changing the Baud Rate . . . 20
- 4.6 Setting a Non-Standard Baud Rate . . . 21

5 Fonts **22**
5.1 Introduction . . . 22
5.1.1 Font File Format . . . 22
5.1.2 Creating a Font . . . 22
5.2 Uploading a Font File . . . 24
5.3 Setting the Current Font . . . 24
5.4 Font Metrics . . . 25
5.5 Set Box Space Mode . . . 26

6 Text **26**
6.1 Introduction . . . 26
6.1.1 Character Set . . . 26
6.1.2 Control Characters . . . 26
6.2 Move Cursor Home . . . 26
6.3 Setting the Cursor Position . . . 27
6.4 Setting the Cursor Coordinate . . . 27
6.5 Auto Scroll On . . . 27
6.6 Auto Scroll Off . . . 28

7 Bitmaps **28**
7.1 Introduction . . . 28
7.2 Uploading a Bitmap File . . . 28
7.3 Drawing a Bitmap from Memory . . . 29
7.4 Drawing a Bitmap Directly . . . 30

8 Bar Graphs and Drawing **30**
8.1 Introduction . . . 30
8.2 Set Drawing Color . . . 30
8.3 Draw Pixel . . . 31
8.4 Drawing a Line . . . 31
8.5 Continue a Line . . . 32
8.6 Draw a Rectangle . . . 32
8.7 Drawing a Solid Rectangle . . . 32
8.8 Initializing a Bar Graph . . . 33
8.9 Drawing a Bar Graph . . . 34
8.10 Initializing a Strip Chart . . . 34
8.11 Shifting a Strip Chart . . . 35

9 Touchpad **36**
9.1 Introduction . . . 36
9.1.1 Region Mode . . . 36
9.1.2 Co-ordinate Mode . . . 36
9.2 Set Touch Region . . . 37
9.3 Delete Touch Region . . . 37
9.4 Delete All Touch Regions . . . 37
9.5 Set Touch Mode . . . 38
9.6 Set Region Reporting Mode . . . 38

9.7 Set Dragging Threshold . . . 39
9.8 Set Pressure Threshold . . . 39
9.9 Run Touchpad Calibration . . . 39

10 Display Functions **40**
10.1 Introduction . . . 40
10.2 Clear Screen . . . 40
10.3 Display On . . . 40
10.4 Display Off . . . 41
10.5 Set Brightness . . . 41
10.6 Set and Save Brightness . . . 41
10.7 Set Contrast . . . 42
10.8 Set and Save Contrast . . . 42

11 Filesystem **43**
11.1 Introduction . . . 43
11.1.1 File Upload Protocol . . . 43
11.1.2 XModem Upload Protocol . . . 45
11.2 Wipe Filesystem . . . 45
11.3 Deleting a File . . . 46
11.4 Get Filesystem Space . . . 46
11.5 Get Filesystem Directory . . . 48
11.6 Filesystem Upload . . . 48
11.7 Downloading a File . . . 48
11.8 Moving a File . . . 49

12 Data Security **49**
12.1 Introduction . . . 49
12.2 Set Remember . . . 50
12.3 Data Lock . . . 50
12.4 Set and Save Data Lock . . . 52
12.5 Dump the Filesystem . . . 52
12.6 Write Customer Data . . . 52
12.7 Read Customer Data . . . 52

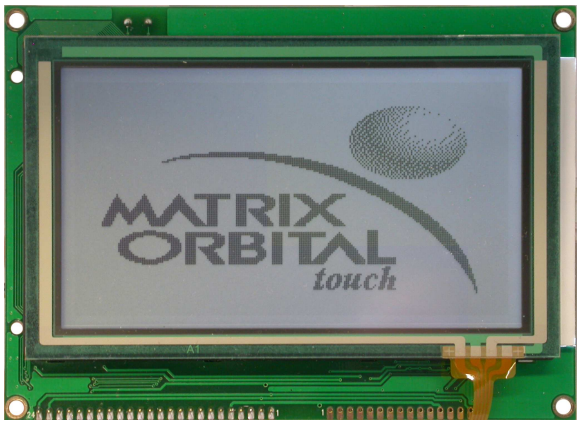
13 Miscellaneous **53**
13.1 Introduction . . . 53
13.2 Read Version Number . . . 53
13.3 Read Module Type . . . 53

14 Command Summary **55**
14.1 Communications . . . 55
14.2 Fonts . . . 55
14.3 Text . . . 55
14.4 Bitmaps . . . 56
14.5 Bar Graphs and Drawing . . . 56
14.6 Touchpad . . . 57

14.7 Display Functions 57
14.8 Filesystem 58
14.9 Data Security 58
14.10Miscellaneous 59
14.11Command By Number 59

15 Appendix **61**
15.1 Optical Characteristics 61
15.2 Specifications 61
15.2.1 Environmental 61
15.2.2 Electrical 62
15.2.3 Touch 62
15.3 Physical Layout 62
15.4 Ordering Information 64
15.5 Definitions 64
15.6 Contacting Matrix Orbital 64
15.7 Revision History 65

1 Getting Started



The GLT240128 is an intelligent graphic LCD display designed to decrease development time by providing an instant touch screen solution to any project. With the ability to communicate via serial RS-232 protocol at regular and TTL levels as well as USB and I^2C, the versatile GLT240128 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 backlight brightness, contrast and baud rate to be software controlled. Additionally, text and fonts may be uploaded to the display and stored in the on board memory. Finally, simple touch commands allow for the seemless integration of user control into the display environment.

1.1 Display Options Available

The GLT240128 comes in three backlight options, grey text on a white backlight, white text with a blue backlight, and standard grey text on a yellow-green backlight . Extended voltage options are also available to allow you to select the display which will best fit your project needs. Please see table 81 for ordering information.

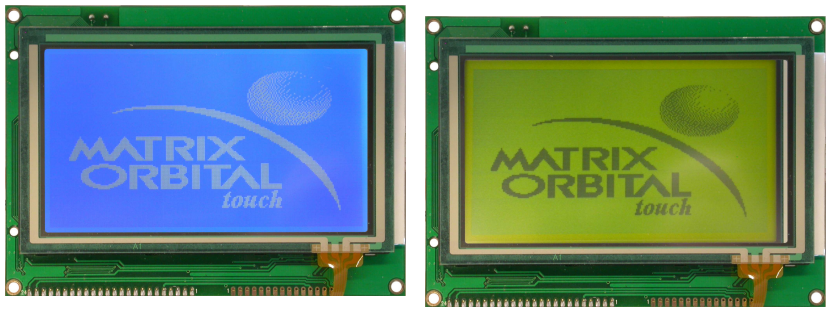


Figure 1: GLT240128 Options

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 contact a sales associate see Section 15.6 for contact information.

Figure 2: 5V Power Adapter

Figure 3: 12V Power Adaptor (-V/-VPT)

Figure 4: 3ft Mini-B USB Cable

Figure 5: Breadboard Cable

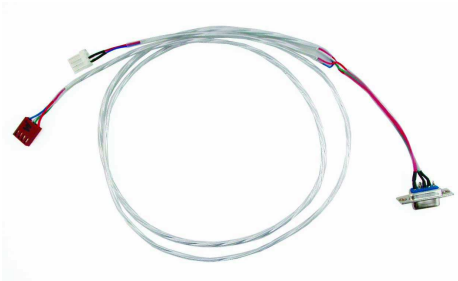


Figure 6: Communication & Power Cable

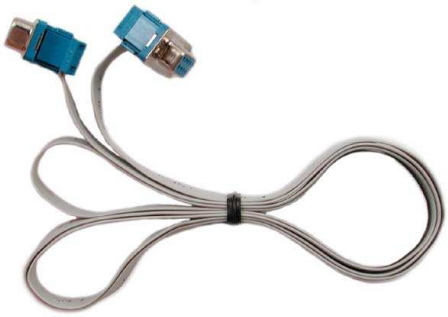


Figure 7: Serial Cable

1.3 Features

- 240 x 128 pixel graphics display
- Integrated Touchpad Overlay
- Selectable communication protocol, RS-232, TTL, and I^2C for Non-USB models; USB only for USB models

- 128 byte buffered communication
- 16 KB flash memory for fonts and bitmaps
- Lightning fast communication speeds, up to 115 kbps for Serial and 100 kbps for I^2Cprotocol
- * Use of up to 127 modules on the same 2 wire I^2C interface
- Display text using built in or user supplied fonts
- Software adjustable contrast and backlight brightness
- Default 19.2 kbps serial communication speed
- Extended voltage, and efficient power supply available

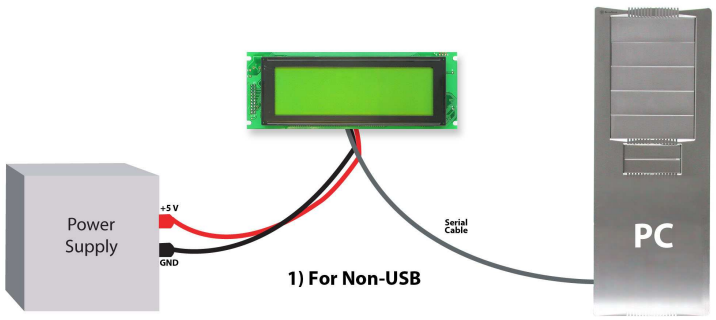
1.4 Connecting to a PC

The GLT240128 connects seamlessly to a PC and it is an excellent means of testing the functionality and uploading new fonts and bitmaps. For the Non-USB version, you will require a standard RS-232 9-pin serial cable such as the one pictured in Figure 7, as well as a modified 5V or 12V power adapter, depending on the voltage model, such as the ones pictured in Figures 2 and 3. For the USB model, of course, all you will need is a USB to mini USB cable such as the one in Figure 4.

1.4.1 Connection for Non-USB Modules

In order to connect your Non-USB 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 appropraite modified 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 appropriate power adapter to the 4-pin connector on the back of the display.



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

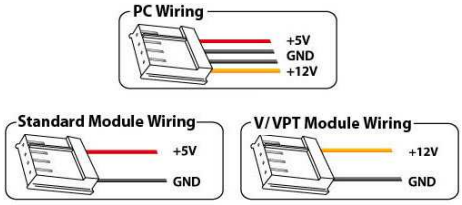
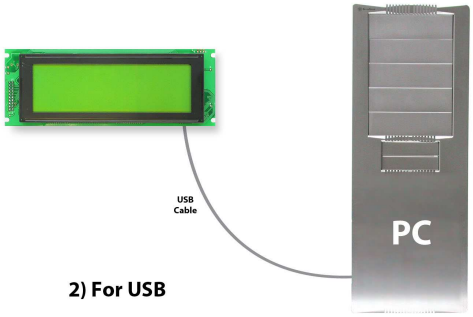


Figure 8: PC vs Matrix Orbital Display Module Wiring

1.4.2 Connection for USB Modules

In order to connect your USB display to a personal computer simply plug the mini-B USB cable, such as that shown in Figure 4 from the PC to the USB connector on the display.



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 website, follow the following steps:

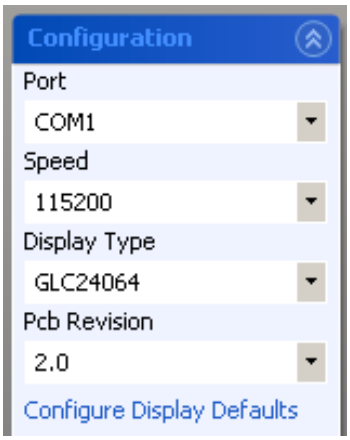
1. Go to the website location: http://www.matrixorbital.ca/software/software_graphic/MOGDsharp/
2. Click on "Download Here"
3. Locate the file MogdSharp.zip on your desktop
4. Unzip MogdSharp.zip to a temporary directory using a program such as Winzip
5. Double click on "setup.exe"

6. Follow the instructions on the screen to complete the installation

7. 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 (GLT240128)

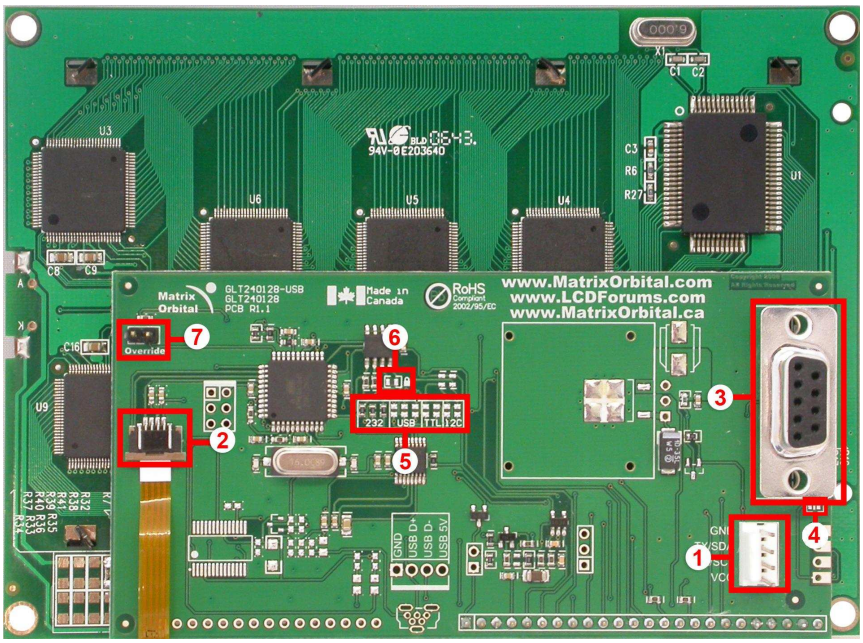
PCB Revision The revision of the display you are using. (Found on the back of the PCB).

Figure 9: Mogd Sharp Settings

- Winzip is available as a free download from http://www.winzip.com

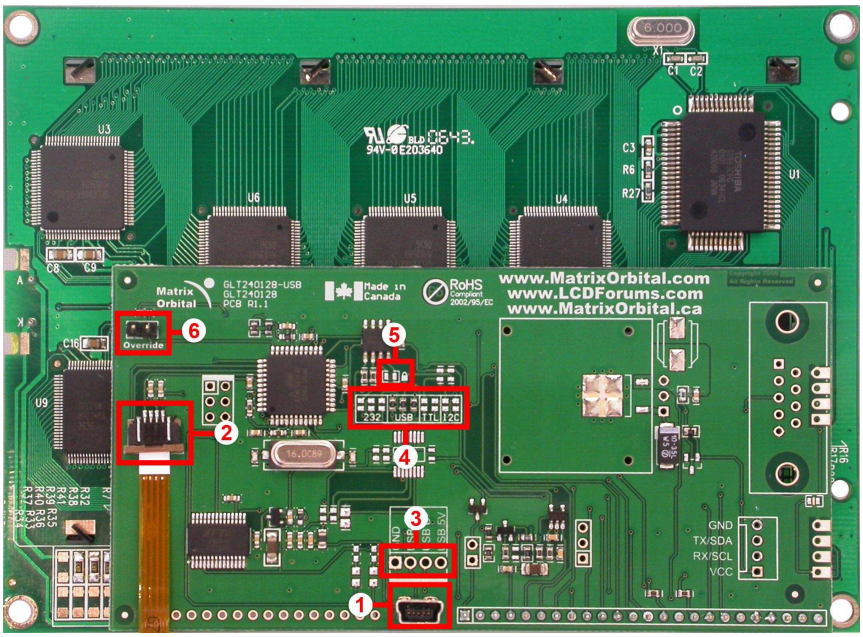
2 Hardware Information

Refer to the following diagram for this chapter:



1 **Power/Data Connector**
2 **Touchpad Header**
3 **DB9 Connector**
4 **Power Through DB9 Jumper**
5 **Protocol Select Jumpers**
6 **Filesystem Lock Jumper**
7 **Manual Override Jumper**

Figure 10: GLT240128 Non-USB



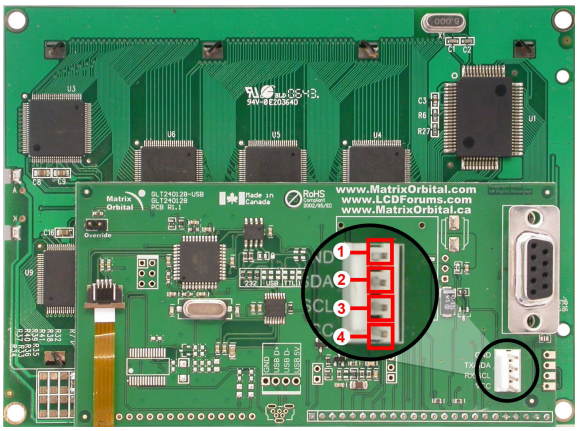
1 USB Connector
2 Touchpad Header
3 Optional USB Header
4 Protocol Select Jumpers
5 Filesystem Lock Jumper
6 Manual Override Jumper

Figure 11: GLT240128 USB

2.1 Communication Connectors

2.1.1 Power/Data Connector for Non-USB modules only

The P*ower/Data Connector* provides a standard connector for powering the display module. The GLT240128 requires five volts for the standard display module, between nine to fifteen for the wide voltage (V) model, and between nine to thirty-five volts for the wide voltage with efficient 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 transmission, using either the RS-232 or TTL protocol levels, depending on what has been selected by the *Protocol Select Jumpers.*



Pin 1	GND
Pin 2	Tx/SDA (I^2C data)
Pin 3	Rx/SCL (I^2C clock)
Pin 4	Vcc *(see table 78 on page 62)*

Figure 12: Power Connector and Pin-out

2.1.2 USB Connector for USB modules only

The *USB Connector* provides a standard connector for powering and communicating to the USB display module. As with the non-USB version, the GLT240128-USB requires five volts for the standard display module as per table 78.

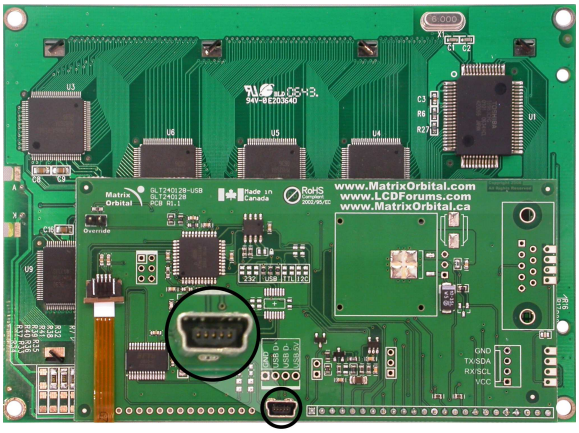


Figure 13: USB Connector for GLT240128

2.2 Touchpad Interface Connector

The GLT240128 provides a *Touchpad Interface Connector* which allows for the touchpad to be interfaced to the display. This connector should remain plugged in while the unit is in operation and should not be tampered with in any way.

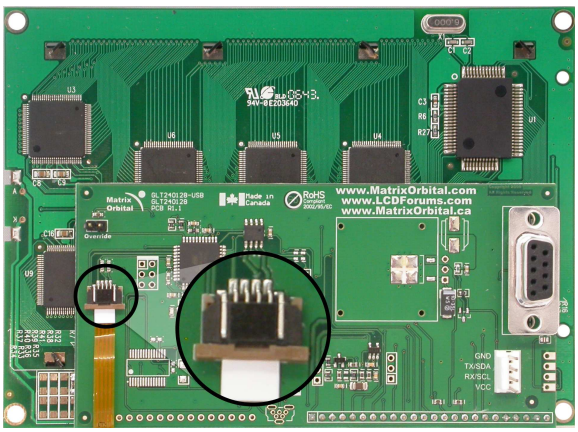
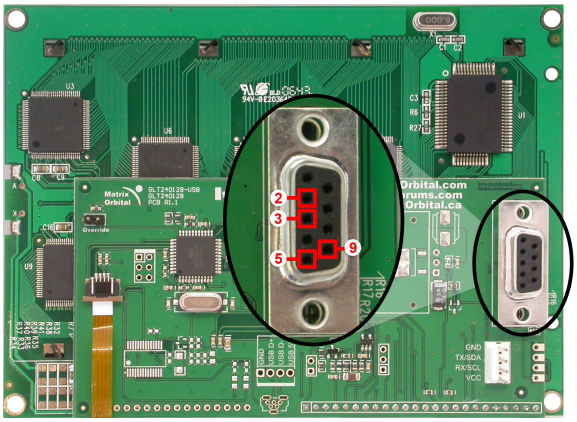


Figure 14: Touchpad Interface Connector

2.3 DB-9 Connector for Non-USB modules only

The GLT240128 provides a *DB-9 Connector* to readily interface with serial devices which use the EIA232 standard signal levels of ±9V. 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 RX/SCL (I^2C clock)
Pin 3 TX/SDA (I^2C data)
Pin 5 GND
Pin 9 PWR *(Must solder power through DB-9 jumper. See table 7*

Figure 15: RS-232 Pin-out

2.4 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 16 below. The GLT240128 allows all voltage models to use the power through DB-9 option, see table 78 for display module voltage requirements.

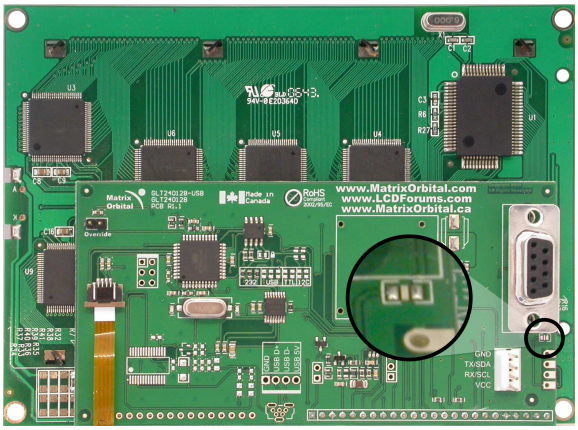


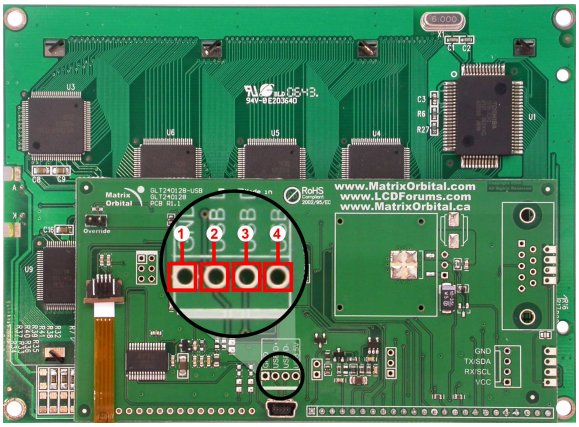
Figure 16: Power Through DB-9 Jumper

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

NOTE We do not recommend that you use pin 9 (Ring Indicator) of the PC to power the display module. You will have to make a special DB9 cable.

2.5 Optional USB Header for USB modules only

The GLT240128 USB version has an optional four pin header for internal USB communications with host units. This provides the same communication lines as the regular header, albeit in a different form factor for greater customization. Again, please 78 see for power requirements.



Pin 1 GND
Pin 2 D+
Pin 3 D-
Pin 4 Vcc *(see table 78 on page 62)*

Figure 17: Optional Internal USB Header

2.6 Protocol Select Jumpers

The *Protocol Select Jumpers*, pictured below in Figure 18, provide the means necessary to toggle the display module between RS-232 and TTL protocol levels. As a default for Non-USB modules, 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 I^2C jumpers, or bridge solder across the pads. The display will now be in I^2C mode and have a default slave address of 0x50 unless the I^2C address 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. Although RS-232, USB, TTL and I^2C are present, only 232/TTL/I^2C are for use in the Non-USB module. For the USB module operation the USB jumpers must be in place. There are three, one is for power. If you wish to power it up from a non-USB source, you must remove one of the jumpers. The jumper to remove is the rightmost USB jumper as seen if Figure 19.

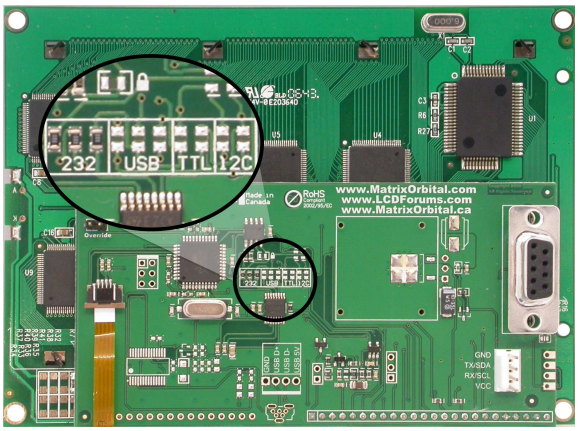


Figure 18: Protocol Select Jumpers for Serial and I^{2}C modules

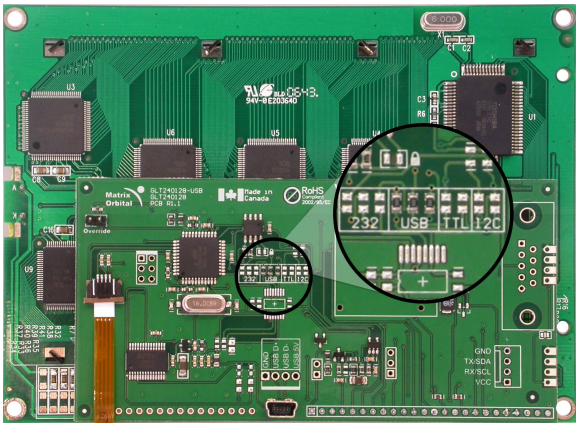


Figure 19: Protocol Jumpers for USB modules

2.7 Filesystem Lock Jumper

The Filesystem Lock Jumper allows you to lock the filesystem on the GLT240128 so that no fonts or bitmaps can be either written or deleted from the on board memory. This feature is useful in order to protect data integrity of production units, if protection of other settings is required see Section 12

To lock the filesystem, solder a zero ohm resistor or use a solder jumper pictured in Figure 20 below.

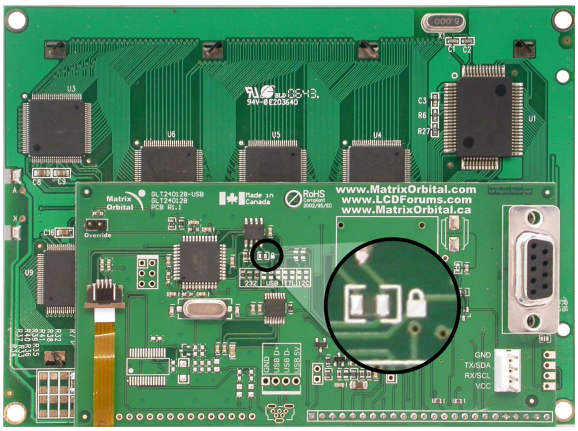


Figure 20: Filesystem Lock Jumper

2.8 Manual Override

The *Manual Override* is provided to allow the GLT240128 to be reset to some of the factory defaults. This can be particularly helpful if the display module has been set to an unknown baud rate or I^2C 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, as pictured below.
3. Power up the display module.
4. The display module is now set to its default values listed below in table 1.
5. Edit and save settings.

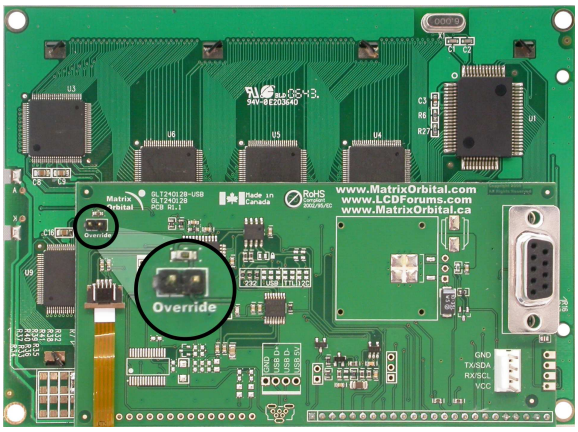


Figure 21: Manual Override Jumper

Table 1: Default Values

Contrast	128
Backlight	255
Baud Rate	19.2 kbps
Data Lock	False

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

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 **??**. 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 GLT240128. If the *Power / Data Connector* has become loose, or you are unable to resolve the issue, please contact Matrix Orbital see 15.6 on page 64 for contact information.

3.2 The display module is not communicating.

- 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 2.6 on page 12.
- 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 2.8 on the preceding page.

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 vary according to factors such as temperature, 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 4for setting up a PC to test the GLT240128.
- Second, ensure that the Filesystem Lock Jumper has not been set. See Section 2.7 on page 13.
- Third, please ensure that the display module's memory is not full. The GLT240128 has 16 Kb of memory for fonts and bitmaps.

NOTE If you are unable to resolve any issue please contact Matrix Orbital. See 15.6 on page 64 for contact information.

4 Communications

4.1 Introduction

The commands listed in this chapter describe how to configure data flow on the GLT24064.

4.1.1 I²C Communication Summary

The GLT24064 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 ensure that pull up resistors, with a nominal value of 1K to 10K, are placed on the SCL and SDA communication lines coming from pins two and three of the Data / Power Connector respectively. Data responses by the module are automatically output via RS232, in case the host will be querying the module, it is necessary for the host to inform the module that its responses are to be output via I^{2}C. This can be done by sending command 254 /160 / 0 to turn off auto transmission of data in RS232. This will keep the data in the buffer until the master clocks a read of the slave. The I^{2}C data lines operate at 5V normally or 3.3V for -1U style units. The GLT24064 uses 8-bit addressing, with the 8th or Least Significant Bit (LSB) 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. This address may be changed by using cmd 254 / 51 / <address>. The GLT24064 should only be sent addresses that are even (LSB is 0). When the I^2C master wishes to write to the display, the effective address is $50 (0101 0000) , since the LSB has to be 0 for an I^2C master write. When the I^2C master wishes to read the GLT24064, the effective address is $51 (0101 0001), since the LSB has to be 1 for an I^2C master read.

If we take a standard Phillips 7 bit address of $45 (100 0101), Matrix Orbital's GLT24064 would describe this Phillips I^2C address as $8A (1000 1010). The read address would be $8B (1000 1011).

The unit does not respond to general call address ($00).

When communicating in I^2C the GLT24064 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.

The GLT24064 has some speed limitations, especially when run in I^2C mode. Here are some considerations when writing I^2C code:

* to be able to read the replies of query commands (eg. cmds 54, 55) the following command must be sent (only needs to be sent once, so this can be done somewhere in init): 254 / 160 / 0 this command puts the reply data in the I^2C output buffer instead of the RS232 output buffer. Please note that due to a 16 byte output buffer, query commands that reply with more than 16 bytes cannot be read (eg cmd Get FileSystem Directory)

* 3ms delay between the read commands

* 625us delay in between data bytes within a transaction is necessary

* 375us between transactions is necessary

NOTE These delays are consrevative, and may be decreased based on performance

4.1.2 I^2C Transaction Example

The typical I^2C transaction contains four parts: the start sequence, addressing, information, and stop sequence. To begin a transaction the data line, SDA, must toggle from high to low while the clock line, SCL, is high. Next, the display must be addressed using a one byte hexadecimal value, the default to write to the unit is 0x50, while read is 0x51. Then information can be sent to the unit; even when reading, a command must first be sent to let the unit know what type of information it is required to return. After each bit is sent, the display will issue an ACK or NACK as described above. Finally, when communication is complete, the transaction is ended by toggling the data line from low to high while the clock line is high. An example of the use of this algorithm to write a simple "HELLO" message can be seen in 2.

Table 2: I^2C Transaction Algorithm

START	Toggle SDA high to low
Address	0x50
Information	0x48 0x45 0x4C 0x4C 0x4F
STOP	Toggle SDA low to high

4.1.3 Serial Communication

In addition to being able to communicate via I^2C the GLT24064 communicates natively through the RS-232 protocol at at a default baud rate of 19,200 bps and is capable of standard baud rates from 9600 to 115,200 bps. Furthermore the GLT24064 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 levels of -30V to +30V or at TTL levels of 0 to +5V by setting the *Protocol Select Jumpers* to TTL.

4.1.4 USB Communication

The GLT24064 is a USB device that offers identical communication protocol as the serial comport. capable of communicating via a USB interface. The USB communications are identical to the serial communications. Communication is via a virtual com port, which is created in the operating system by the drivers necessary to install the USB display. The GLT24064 communicating via USB is capable of baud rates of 19,200 bps to 115,200 bps. Other baud rates are subject to the limitation of the virtual com port driver. For further information regarding supported operating systems, and driver limitations please contact technical support.

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. (Full is 0)
empty	1	Bytes available before issuing a almost empty message. (Empty is 128)

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 128 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. It is suggested that the “almost full” parameter be equal to the largest chunk of data the host will be sending the display (should be less than 127).

NOTE This command is not available in I^2C mode.

Remembered Yes
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.

NOTE This command is not available in I^2C mode.

Remembered Yes

4.4 Changing the I^2C 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

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 corresponding to a baud rate.

Description

This command sets the 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 display module 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 the manual override jumper during power up. However, it should be noted that this command will be ignored until the manual override 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

Default 19,200 bps