GTT480272A

Hardware Manual

Revision 1.5

PCB Revision: 1.4 or Higher

Firmware Revision: 1.0 or Higher

Revision History

Revision	Date	Description	Author
1.5	August 21st, 2012	Updated I2C Section	Clark
1.4	March 10th, 2011	Restricted Temperature Rating	Clark
1.3	August 24th, 2010	Additional Heading Numbers and Additional Formatting	Clark
1.2	July 28th, 2010	Added Defect Criteria	Clark
1.1	July 22nd, 2010	Added GTT Support Tools to Software Section	Clark
1.0	June 23rd, 2010	Initial Release	Clark

Contents

1   Introduction

Figure 1: GTT480272A Display

The Matrix Orbital GTT480272A is a full colour TFT display with an integrated touch screen crafted to become a crisp, controllable canvas for creativity. Utilizing an extended version of our widely used command protocol and industry standard communication protocols, the customizable GTT480272A will quickly become the gorgeous face of your application.

Seamless incorporation of a touch screen provides sleek user input while a small piezo speaker can offer audio feedback for a completely interactive experience. Storage of fonts and bitmaps within the swappable onboard SD memory card allow for a co-ordinated appearance in any design.

The elegant simplicity of the familiar Matrix Orbital command structure now provides updates to the user and flow control for full two-way communication. Also new are animations, moving at an amazing 25 frames per second, automated display initialization, and field upgradeability.

Available flow controlled RS232 and TTL interfaces, as well as an I2C protocol provide versatile communication schemes for the standard model, while USB and RS422 versions ensure that any controller can have a beautiful user interface. Scorching fast communication speeds, up to 115kbps in serial modes and 100kbps in I2C, ensure important information is relayed on time.

The innovativeGTT480272A, with all of the features mentioned above, is available in various voltage and communication options to provide a sleek touch of creativity to any project.

1

2 Quick Connect Guide

2.1 Available Headers
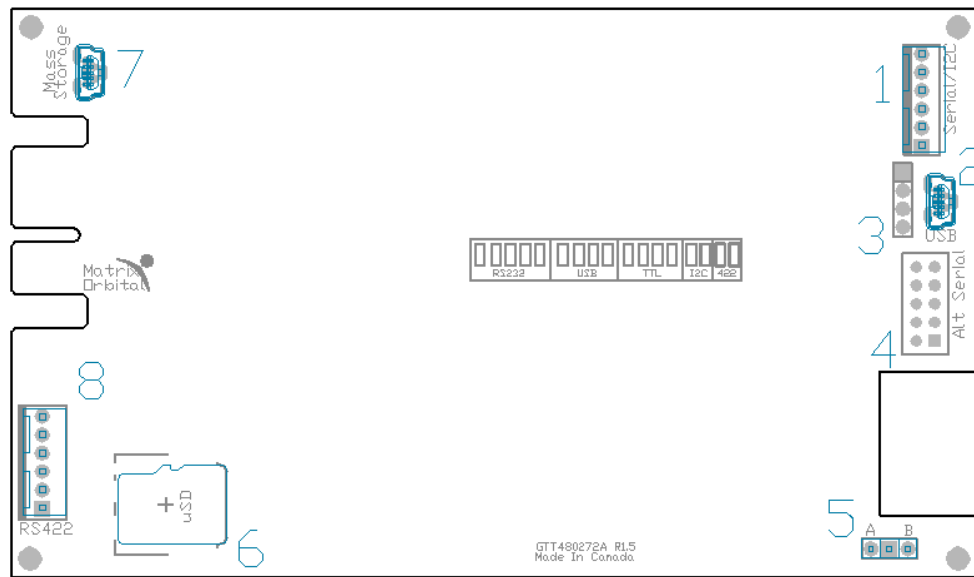
Figure 2: GTT480272A Header Locations

Table 1: List of Available Headers

#	Header	Mate	Population
1	Extended Communication/Power	ESCCPC5V	Standard Model Only
1	Standard Communication/Power	BBC	I2C Model Only
2	USB Communications	EXTMUSB3FT/ INTMUSB3FT	USB Model Only
3	Alternate USB	None Offered	Contact Sales to Request
4	Alternate Serial	None Offered	Contact Sales to Request
5	Mass Storage Configuration Jumper	JMPR	All Models
6	SD Card	Micro SD Card	All Models
7	USB Mass Storage	EXTMUSB3FT/ INTMUSB3FT	All Models
8	RS422 Terminal Block	16-30 AWG Wire	RS422 Model Only

2.2 Standard Module

The standard version of the GTT480272A allows for user configuration of two common communication protocols. The unit can communicate using flow controlled serial protocol at either RS323 or TTL voltage levels. Connections for each are accessed through the communication/power header as in Table 2.

2.2.1 Recommended Parts

Figure 3: Extended Communication/Power Cable (ESCCPC5V)

The most common cable choice for the GTT480272A display, the Extended Communication/ Power Cable, offers a simple connection to the unit with familiar interfaces. A DB9 and floppy power header provide all necessary input to drive your display.

Figure 4: Internal Communication/Power Cable (ISCCPC5V)

For an internal PC interface to the GTT480272A, an Internal Serial Communication/Power Cable can be used. In this case, internal serial and floppy power headers provide the input to drive your display.

2.2.2 Serial Connections

The serial interface provides a classic connection to the GTT480272A. The Extended Communication/Power Cable is most commonly used for this set up as it provides connections for DB9 serial and floppy power cables. To place your board in Serial mode, adhere to the steps below.

1. Set the Protocol Select jumpers.
   - RS232: Connect the five jumpers in the 232* protocol box with the zero ohm jumper resistors provided or an alternate wire or solder solution.
   - TTL: Connect the four jumpers in the TTL* protocol box.

   *Note: Jumpers must be removed from all protocol boxes save for the one in use.

2. Make the connections.
   a. Connect the six pin female header of the Extended Communication/Power Cable to the communication/power header of your GTT480272A.
   b. Insert the male end of your serial cable to the corresponding DB9 header of the Extended Communication/Power Cable and the mate the female connector with the desired communication port of your computer.
   c. Select an unmodified floppy cable from a PC power supply and connect it to the power header of the Extended Communication/Power Cable.

3. Create.
   - GTT Tools will serve to get you started, and then allow you to move on with your own development. Instructions for this program can be found below and a variety of application notes are linked in the Application Notes Section of this manual.

2.3 I2C Module

The I2C version of the GTT480272A offers both a standard 4 pin I2C connection as well as a USB header for debugging purposes without the need to muck about with hardware changes. A simple I2C.cfg file in the SYSTEM folder will tell the unit to respond on the I2C bus, with it missing it will respond via USB. Connections for each protocol can be found in the I2C Model hardware section.

2.3.1 Recommended Parts

Figure 5: Extended Breadboard Cable (BBC)

For a more flexible interface to the GTT480272A-I2C, a Breadboard Cable may be used. This provides a simple four wire connection that is popular among developers for its ease of use in a breadboard environment.

Figure 6: Communication/Power Cable (SCCPC5V)

The Communication/ Power Cable offers a simple connection to the GTT480272A-I2C with familiar interfaces. DB9 and floppy power headers provide all necessary input to drive your display.

2.3.2 I^{2}C Connections

A more advanced connection to the GTT480272A is provided by the I^{2}C setting. This requires a connection directly to your project which is best accomplished using a breadboard and the Breadboard Cable. Power must be supplied from your breadboard or another external source. To dive right into your application and use the GTT480272A in I^{2}C mode, get started with the guidelines below.

1. Set the Protocol Select switches.
   - I^{2}C: Ensure that the two I^{2}C jumpers in the corresponding protocol box are connected while all others, save USB, are open.
2. Make the connections.
   a. Connect the Breadboard Cable to the Standard Communication/Power header on your GTT480272A and plug the four leads described below into your breadboard. The red lead will require power, while the black should be connected to ground, and the green and yellow should be connected to your controller clock and data lines respectively.
   b. Pull up the clock and data lines to five volts using a resistance between one and ten kilohms on your breadboard.
3. Create.
   - This time you're on your own. While there are many examples linked within the Application Notes Section of this manual, too many controllers and languages exist to cover them all. If you get stuck in development, it is possible to switch over to another protocol on the standard board, and fellow developers are always on our forums for additional support.

2.4   USB Module

The GTT480272A-USB offers a single USB interface for easy connection to a host computer. This simple but common protocol can be accessed using the on board mini B style USB connector as outlined below.

2.4.1   Recommended Parts

The External Mini USB Cable is recommended for the GTT480272A-USB display. It will connect to the miniB style header on the unit and provide a connection to a regular A style USB connector, commonly found on a PC.

Figure 7: Mini-B USB Cable (EXTMUSB3FT)

2.4.2   USB Connections

The USB connection is the quickest, easiest solution for PC development. After driver installation, the GTT480272A-USB will be accessible through a virtual serial port, providing the same result as a serial setup without the cable hassle. To connect to your GTT480272A-USB please read below.

1. Set the Protocol Select jumpers.
   - USB: The GTT480272A-USB offers USB protocol only. Model specific hardware prevents this unit from operating in any other protocol, and does not allow other models to operate in the USB protocol. Protocol Select jumpers on the USB model cannot be moved.
2. Make the connections.
   - Plug the mini-B header of your external mini USB cable into your GTT480272A-USB and the regular USB header into your computer USB jack.
3. Install the drivers.
   a. Download the latest drivers at www.matrixorbital.ca/drivers, and save them to a known location.
   b. When prompted, install the USB bus controller driver automatically
   c. If asked, continue anyway, even though the driver is not signed
   d. When the driver install is complete, your display will turn on, but communication will not yet be possible.
   e. At the second driver prompt, install the serial port driver automatically
   f. Again, if asked, continue anyway
4. Create.
   - Use uProject or hyperterminal to get started, and then move on with your own development. Instructions for these programs can be found below and a number of application notes are linked in the Application Notes Section of this manual.

2.5 RS422 Module

The GTT480272A-422 provides an industrial alternative to the standard RS232 communication protocol. Rather than single receive and transmit lines, the RS422 model uses a differential pair for each receive and transmit signals to reduce degradation and increase transmission lengths. The RS422 signals are available in a six pin connector as seen in Table 6.

2.5.1 RS422 Connections

To interface to the robust GTT480272A-422, a series of six wires are usually screwed into the RS422 terminal block provided. This setup will supply power to your display and provide a simple communication scheme. To connect in RS422 mode, adhere to the steps below.

1. Set the Protocol Select jumpers.
    - RS422: The GTT480272A-422 offers only RS422 protocol and does not require any jumper changes. Model specific hardware prevents this unit from operating in any other protocol, and does not allow other models to operate in the RS422 protocol.
2. Make the connections.
    a. Screw one wire; sized 16 to 30 on the American Wire Gauge, into each of the six terminal block positions.
    b. Connect the Vcc wire to the positive terminal of your power supply and the GND terminal to the negative or ground lead to provide appropriate power as in Table 11.
    c. Secure the A and B wires to your non-inverting and inverting output signals respectively, while attaching the Z and Y wires to your inverting and non-inverting inputs.
3. Create.
    - In a PC environment, GTT Tools will serve to get you started. In addition, a variety of application notes are available online in a number of different languages to aid in the development of a display controller. Instructions for the program can be found below and the examples linked in the Application Notes are great code references.

3   Software

The multiple communication protocols available and simple command structure of the GTT480272A means that a variety of applications can be used to communicate with the display. Text is sent to the display as a character string, for example, sending the decimal value 41 will result in an 'A' appearing on the screen. A number of control characters are also activated. Advanced commands are merely values prefixed with a special command byte, 254 in decimal. While many software programs are available to communicate with the GTT480272A, a number of more common samples are detailed in depth below.

Table 21: Reserved Control Characters

Control Characters					
7	Bell / Beep	10	Line feed / New line	13	Carriage return

3.1   GTT Support Tools

Downloaded from http://www.matrixorbital.ca/software/, the GTT Project support tool provides a simple graphic interface with the full library of GTT series commands. This program allows users to drag and drop commands into a list that can be transmitted to the GTT, saved, and even loaded for later use.
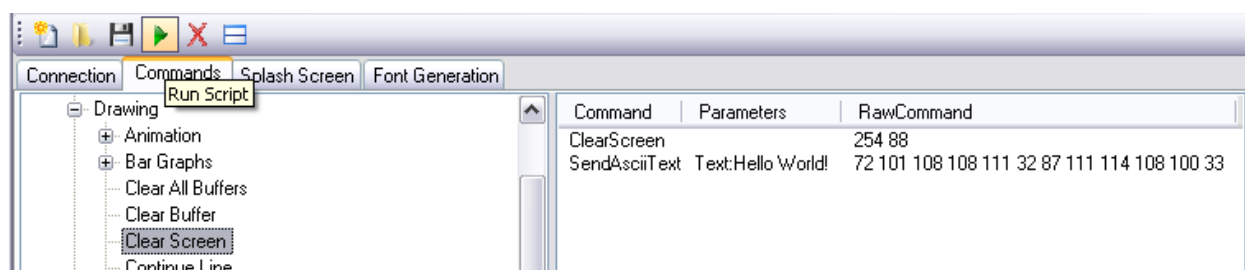

Figure 8: GTT Support Tools

As you can see, each command added is displayed its name, any applicable parameters, and finally, a byte by byte account of the information that will be sent in decimal notation. While this list of commands can be saved and recalled later, it can also be converted into a binary file using the save as feature. This will allow easy creation of AUTOEXEC startup files, and integration into application specific code. Finally, the support tool provides a debug window that will display the information flow to and from your GTT to ensure your command list executes exactly as it was envisioned.

3.2   Application Notes

Full demonstration programs and code are available for Matrix Orbital displays from Matrix Orbital Application Note section at www.matrixorbital.ca/appnotes. These programs are meant to showcase the capability of the display and are not intended to be integrated into a final design. For additional information regarding code, please read the "On Code" document also found on the support site.

4 Hardware

4.1 Standard Model

4.1.1 Extended Communication/Power Header
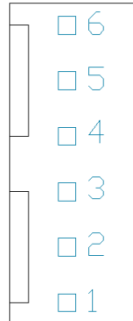

Figure 9: Extended Communication/Power Header

Table 2: Extended Communication/Power Pinout

Pin	Function
6	RTS
5	CTS
4	Gnd
3	Tx (SDA)
2	Rx (SCL)
1	Vcc

The Extended Communication/Power Header provides a standard connector for interfacing to the GTT480272A. Voltage is applied through pins one and four of the header. Please ensure the correct voltage input for your display by referencing the electrical specifications in Table 11 before applying power. Pins two and three are reserved for serial transmission using either RS-232/TTL levels, depending on what has been selected by the Protocol Select Jumpers. Pins five and six are used for serial transmission hardware flow control. Please note that unlike older Matrix Orbital displays, hardware flow control is mandatory for serial communications in RS232 or TTL modes. The Serial Molex 22-04-1061 style header used can be mated to a number of connectors.

4.1.2 Alternate Serial Header

Advanced applications may prefer the straight two by five pin connection offered through the optional Alternate Serial Header. The Alternate Serial Header may be added to the GTT480272A for an added charge as part of a custom order. Please use the Contact section to reach Sales for additional details.

4.1.3 Protocol Select Jumpers

The Protocol Select Jumpers provide the means necessary to alter the standard GTT480272A communication setting between RS-232 and TTL. As a default, the jumpers are set to RS-232 mode with solder jumps on the RS232 jumpers. In order to change the display to TTL mode, simply remove the zero ohm resistors from the RS232 jumpers and solder them to the TTL jumpers.

4.2 I2C Model

4.2.1 Standard Communication/Power Header

Figure 10: Extended Communication/Power Header

Table 3: Standard Communication/Power Pinout

Pin	Function
1	Vcc
2	Rx (SCL)
3	Tx (SDA)
4	Gnd

The Standard Communication/Power Header provides a more simplistic connection to the GTT480272A-I2C. Voltage is applied through pins one and four of the header. Again, please ensure the correct voltage input for your display by referencing the electrical specifications in Table 11 before applying power. Pins two and three are reserved for clocking data through the I²C protocol. Pins five and six are used for serial transmission hardware flow control, and ignored for I²C communications. The Tyco 640456-4-LF style headers used can be mated to a number of connectors.

4.2.2 Mini USB Communication Connector
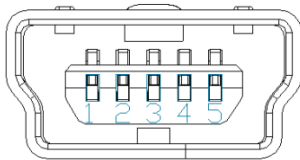
Figure 11: Mini USB Connector

Table 4: Mini USB Pinout

Pin	Function
1	Vcc
2	D-
3	D+
5	Gnd

The GTT480272A-I2C also comes with a Mini-B USB connector for development and debugging purposes. By removing the I2C.cfg file from the SYSTEM directory, the GTT480272A-I2C can be interfaced to a PC through a standard USB cable. This connection creates a virtual com port that offers a proven communication scheme while developing in I2C.

4.3 USB Model

4.3.1 Mini USB Communication Connector

Figure 12: Mini USB Connector

Table 5: Mini USB Pinout

Pin	Function
1	Vcc
2	D-
3	D+
5	Gnd

The GTT480272A-USB comes with a familiar Mini-B USB connector to fulfill both communication and power needs. The GTT4802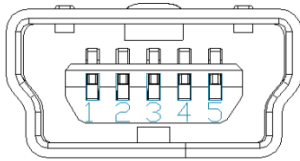72A-USB can be connected to virtually any other USB host using the appropriate cable. Most commonly used with a PC, this connection creates a virtual com port that offers a simple power solution with a familiar communication scheme.

4.3.2 Alternate USB Communication Header

Some advanced applications may prefer the straight four pin connection offered through the optional Alternate USB Header. The Alternate USB Header may be added to the GTT480272A-USB for an added charge as part of a custom order. Please use the Contact section to reach Sales for additional details.

4.4 RS422 Model

4.4.1 RS422 Header
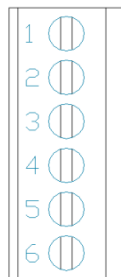
Figure 13: RS422 Header

Table 6: RS422 Pinout

Pin	Function
1	Gnd
2	Rx (Y)
3	Inv Rx (Z)
4	Inv Tx (B)
5	Tx (A)
6	Vcc

The six pin RS422 Header of the GTT480272A-422 offers power and ground connections as well as two differential pair communication lines. Both a regular and an inverted line are provided for both receive and transmit signals. The Tyco 282834-6 style header is best suited to a wire connection.

4.5 Common Features

4.5.1 Mass Storage Mini USB Connector

Figure 14: Mass Storage USB Connector

Pin	Function
1	Vcc
2	D-
3	D+
5	Gnd

The GTT480272A comes with a secondary Mini USB connector to access the SD memory card as a mass storage device for easier access to the files contained on the card. The mass storage jumper must be placed to use this function, please refer to the Mass Storage Mode section for further information.
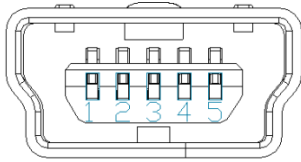
4.5.2 SD Memory Card

The SD Memory Card is used to store all user fonts, bitmaps, 9-slices, animations and start-up settings. The start-up settings are stored in a binary file called AUTOEXEC. This file contains a simple stream of characters stored just as they would be if they were sent to the display at runtime, this will store all the commands to change the initial settings for your application. Start-up settings are stored in this location alone; therefore, simply removing the AUTOEXEC file will restore the display to factory defaults.

Please refer to the Protocol Manual at http://www.matrixorbital.ca/manuals/GTT Series/ for a complete list of available commands executable not only at start up but runtime as well.

4.5.3 Mass Storage Mode

With a jumper placed on the mass storage side of the mode selector, the unit will power up in mass storage mode. Placing a jumper on the USB mass storage header labelled "A", the unit will appear to any PC as a mass storage device, giving you access to the contents of the SD memory card directly.

Please note, the speed of data transfers in mass storage mode is limited, and is only intended to be used in situations where an external SD memory card reader is not available.

4.5.4 Field Upgrade

After release, Matrix Orbital may publish updates to the GTT code base or functionality that can be easily applied to the unit in the field. While in Mass Storage Mode replace all of the files in the GTT upgrade folder with the latest package available from www.matrixorbital.ca/software/GTT/. Then, cycle power to the unit, wait for the upgrade to complete, and allow the screen to reboot. Finally, replace the GTT in your application and enjoy the new additions to the display you've come to know and love.

5   Troubleshooting

5.1   Power

In order for your Matrix Orbital display to function correctly, it must be supplied with the appropriate power. If the power LED near the top right corner of the board is not illuminated, power is not applied correctly. Try the tips below.

- First, 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 a different power supply.
- If changes have been made to the protocol select block, ensure all the appropriate protocol select jumpers are connected and all unused protocol jumpers are disconnected.
- The last step will be to check the power connector in use on your display. If the connector has become loose or you are unable to resolve the issue, please use the Contact section to reach a friendly Matrix Orbital support representative.

5.2   Display

If your display is powered successfully without an AUTOEXEC file present, the Matrix Orbital logo, or user created screen should display on start up. If this is not the case, check out these tips.

- If any start-up issues are encountered, it is recommended that you remove the AUTOEXEC file from the SD card to allow the unit to start with factory defaults.

5.3   Communication

When communication of either text or commands is interrupted, try the steps below.

- 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.
- In USB protocol, ensure that a connection is made to the header labelled USB, not Mass Storage and check that the mode selection jumper is placed on the "B" side.
- Next, please ensure that the display module is set to communicate on the protocol that you are using, by checking the Protocol Select Jumpers.
- In serial protocol, 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 115,200 bps.
- Match Rx from the display to the transmit pin from your host and the Tx pin to receive.
- If you are communicating to the display via I²C***** please ensure that the data is being sent to the address defined in your I2C.cfg file. The default slave address is decimal 80 (0x50 hex).
- In I²C mode, connect SDA to the data line of your controller and SCL to the clock output.
- Unlock the display. See the Set and Save Data Lock command for more info.

*Note: I²C communication will always require pull up resistors on SCL and SDA of one to ten kilohms.

5.4 Factory Defaults

If the settings of your display become altered in a way that dramatically impacts usability, the default settings can be temporarily restored simply by removing the AUTOEXEC file in the memory card's root directory. This will reset the baud rate to 115,200.

6 Appendix

6.1 Optical Characteristics

Table 8: Optical Characteristics

Module Size	133.00 x 78.0 x 21.7	mm
Viewing Area	97.60 x 56.40	mm
Pixel Arrangement	RGB vertical Stripe	
Pixel Size	0.066 x 0.198	mm
Pixel Pitch	0.198 x 0.198	mm
Luminance	500	cd/m²
Viewing Angle	80° Left 80° Right 60° Up 80° Down	
Contrast Ratio	500:1	

6.2 Environmental Characteristics

Table 9: Environmental Specifications

Operating Temperature	0°C to +50°C
Storage Temperature	-20°C to +70°C
Operating Relative Humidity*	95% (T < 40°C) 85% (40°C < T < 50°C)

*Note: No condensation at any temperature

6.3 Touch Specifications

Table 10: Touch Screen Attributes

Screen Hardness	3.0	H
Required Operating Force	1.177	N

6.4 Power Consumption

Table 11: Required Supply Voltage

Parameter	Min	Typ	Max	Unit	Remarks
Supply Voltage	4.75	5.0	5.25	V	Standard Voltage
	9.0	12.0	35.0	V	Extended Wide Voltage (-VPT)

Table 12: Operating Current Draw

Parameter	Min	Typ	Max	Unit	Remarks
Logic	-	190	-	mA	Backlight Off
Backlight	-	265	-	mA	Full Brightness

6.5 ESD Performance

Table 13: ESD Resistance Data

Component	Value	Unit	Remarks
Serial Translator (RS232, RS422)	±15	kV	Human Body Model
	±15	kV	Air Gap (IEC 1000-4-2)
	±8	kV	Contact (IEC 1000-4-2)
Controller (I²C, TTL)	±2	kV	Human Body Model

6.6 Electrical Characteristics

6.6.1 Absolute Maximum Ratings

Table 14: GTT480272A Limiting Values

Parameter	Min	Max	Unit	Remarks
Supply Voltage	-0.5	6	V	Standard Voltage Option
	-0.5	35	V	Extended Wide Voltage (-VPT) Option
RS232 Pins	-25	25	V	Input Signals
	-13.2	13.2	V	Output Signals
RS422 Pins	-13	13	V	Inverting and Non, Input and Output Signals
I2C/TTL pins	-0.5	6.0	V	SCL, SDA, Input and Output Signals
USB Pins	-0.5	3.8	V	Input and Output Signals

6.6.2 Communication Characteristics

Table 15: RS232 Interface Characteristics

Parameter	Min	Typ	Max	Unit
Input Threshold Low	0.6	1.2	-	V
Input Threshold High	-	1.5	2.4	V
Output Voltage Swing	±5.0	±5.4	-	V
Input Resistance	3	5	7	kΩ
Output Resistance	300	10M	-	Ω
Output Short Circuit Current	-	±35	±60	mA

Table 16: USB Interface Characteristics

Parameter	Min	Typ	Max	Unit
Static Out ut High	2.8	-	3.6	V
Static Output Low	-	-	0.3	V
Input Differential Thre hold	0.2	-	-	V
Common Mode Output Voltage	0.8	-	2.5	V
Driver Output Impedance	26	29	44	Ω

Table 17: TTL Interface Characteristics

Parameter	Min	Typ	Max	nit
Input Threshold Low	-	0	0.8	V
Input Threshold High	2.0	3	5.5	V
Out ut Voltage Low	-	0	0.4	V
Output Voltage High	2.9	3	3.3	V
Output Short Circuit Current	-	-	±50	mA

Table 18: I²C Interface Characteristics

Parameter	Min	Typ	Max	Unit
Input Threshold Low	-	0	0.3	V
Input Threshold High	0.7	5	-	V
Output Voltage Low	-	0	0.4	V
Output Short Circuit Current	-	-	±50	mA

Table 19: RS422 Interface Characteristics

Parameter	Min	Typ	Max	Unit	Remarks
Input Voltage (A and B)	-7.0	-	12.0	V	
Input Differential Threshold	-200	-125	-50	mV	-7V < Vin < +12V
Differential Driver Output	2	-	3.3	V	RL = 100Ω
Common Mode Output Voltage	-	1.65	3	V	
Input Resistance	96	-	-	kΩ	-7V < Vin < +12V
Driver Short Circuit Current Limit	-	-	250	mA	
Receiver Output Short Circuit Current	-	-	95	mA	

6.7 Defect Criteria

6.7.1 Display Specifications

Table 20: Display Defect Criteria

Defect	Condition	Criteria
Line	Not Allowed	N/A
Bright Dots	Red + Green + Blue	≤ 3 Dots
	Green	≤ 1 Dots
	Within φ10mm Circle	≤ 1 Dots
	Dots within Adjaent Pixels	0 Sets
Dark Dots	Red + Green + Blue	≤ 3 Dots
	Dots within 2 Adjacent Pixels	0 Sets
Total	Bright Dots + Dark Dots	≤ 4 Dots

6.7.2 Appearance Specifications

Table 21: Screen and Touch Defect Criteria

Defect*	Condition	Critera
Circular Objects (Stains, Dust, Dent, Bubble, Dark/White spot, Foreign matter)	d < 0.2mm	Allowed
	0.2mm ≤ d < 0.4mm	≤4points
	d ≥ 0.4mm	0points
Rectangular Objects (Stains, Dust)	W≤0.1mm + L<0.5mm	Allowed
	W≤0.1mm + 0.5mm≤L<2.5mm	≤4points
	W>0.1mm, L≥2.5mm	0points
Scratches	W≤0.05mm + L≤2.0mm	Allowed
	W>0.05mm, L>2.0mm	0points

*Note: Defects must occur in Active Area
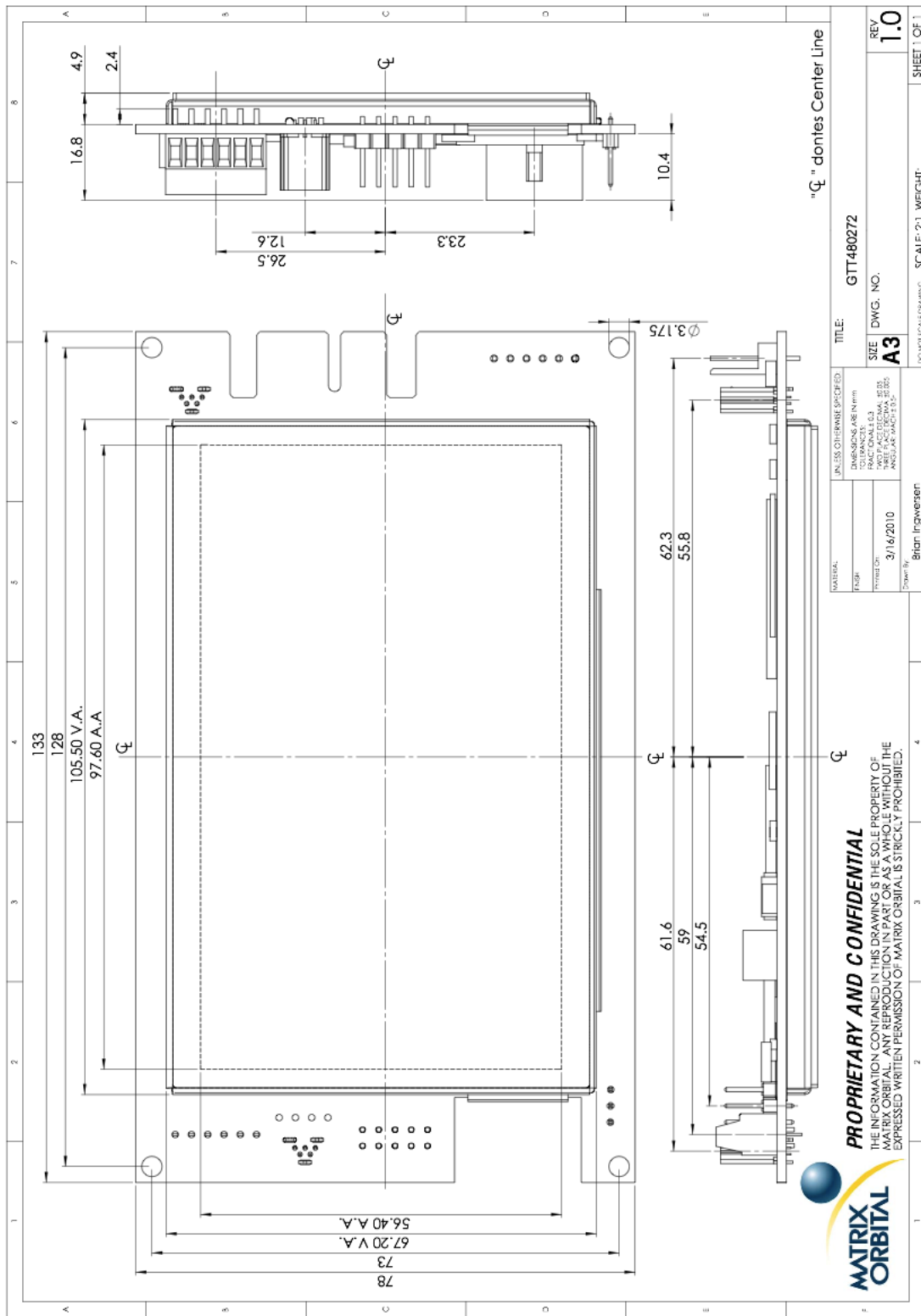
6.8 Dimensional Drawing

Figure 15: GTT480272A Dimensional Drawing

7 Ordering

7.1 Part Numbering Scheme

Table 22: Part Numbering Scheme

GTT	480272	A		-USB
1	2	3	4	5

7.2 Options

Table 23: Display Options

#	Designator	Options
1	Product Type	GTT: TFT Display with Touchscreen Input
2	Display Size	480272: 480 pixel columns by 272 rows
3	Display Form Factor	A: A form factor
4	Voltage	NP: Standard Voltage -VPT: Wide Voltage with Efficient Switching Power Supply
5	Protocol	NP: Standard Model -USB: USB Only Model -I2C: I2C Model with USB Support -422: RS422 Only Model

7.3 Accessories

Table 24: Communication Accessories

EXTMUSB3FT	External Mini-USB Cable	
INTMUSB3FT	Internal Mini-USB Cable	
ESCCPC5V	Extended Serial Communication/5V Power Cable	
BBC	Breadboard Cable	

8 Definitions

9-Slice: Graphic format used to scale bitmaps, usually rectangular, without distorting their geometry. Nine regions define the object center, four corners, and four sides for accurate up or down scaling.

ASCII: American standard code for information interchange used to give standardized numeric codes to alphanumeric characters.

BPS: Bits per second, a measure of transmission speed.

GUI: Graphical user interface.

Hexadecimal: A base 16 number system utilizing symbols 0 through F to represent the values 0-15.

I^2C: Inter-integrated circuit protocol uses clock and data lines to communicate short distances at slow speeds from a master to up to 128 addressable slave devices. A display is a slave device.

LSB: Least significant bit or byte in a transmission, the rightmost when read.

MSB: Most significant bit or byte in a transmission, the leftmost when read.

RS232: Recommended standard 232, a common serial protocol. Logic levels can be as high as +/-30V, a high level is negative, a low is positive.

RS422: Recommended standard 422, a more robust differential pair serial protocol.

SDA: Serial data line used to transfer data in I^2C protocol. This open drain line should be pulled high through a resistor. Nominal values are between 1K and 10K Ω.

SCL: Serial clock line used to designate data bits in I^2C protocol. This open drain line should be pulled high through a resistor. Nominal values are between 1K and 10K Ω.

TTL: Transistor-transistor logic applied to serial protocol. Low level is 0V while high logic is 5V.

USB: Universal Serial Bus protocol widely used in PCs.

9 Contact

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