



GTT29A

Hardware Manual

Revision 1.1

PCB Revision: 1.0 or Higher

Firmware Revision: 2.0 or Higher

Revision History

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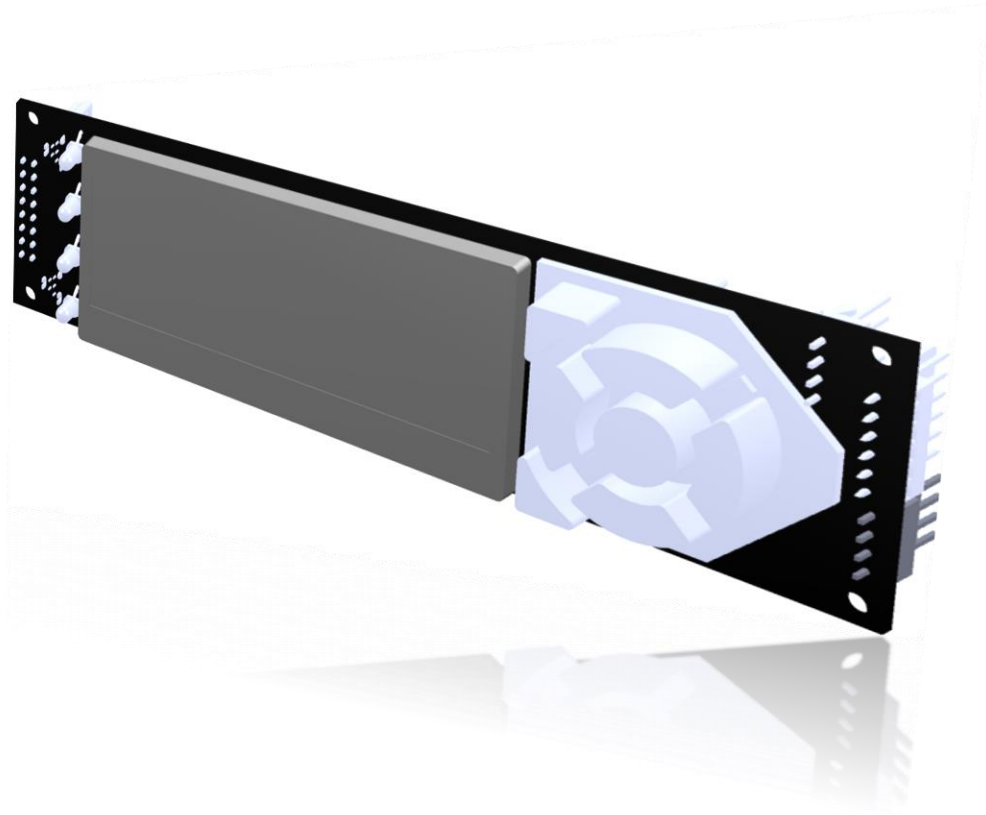


Figure 1: The GTT29A Display

1 Introduction

The Matrix Orbital GTT29A is a full colour TFT display with an integrated keypad, crafted to become a crisp, controllable canvas for creativity. Utilizing an extended version of our widely used command library and industry standard communication protocols, the customizable GTT29A series contains an intelligent display that will quickly become the gorgeous face of your application.



2 Features

In addition to a beautiful full-colour TFT screen, seamless incorporation of a keypad provides sleek user input while a small piezo speaker and vibratory motor can offer audio and tactile feedback for a completely interactive experience. Four bi-colour LEDs provide visual outputs. Storage of fonts and bitmaps within the swappable onboard SD memory card allows 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 optional flow control for full two-way communication. Animations, full-colour graphs, automated display initialization, and field upgradeability are also available on the display.

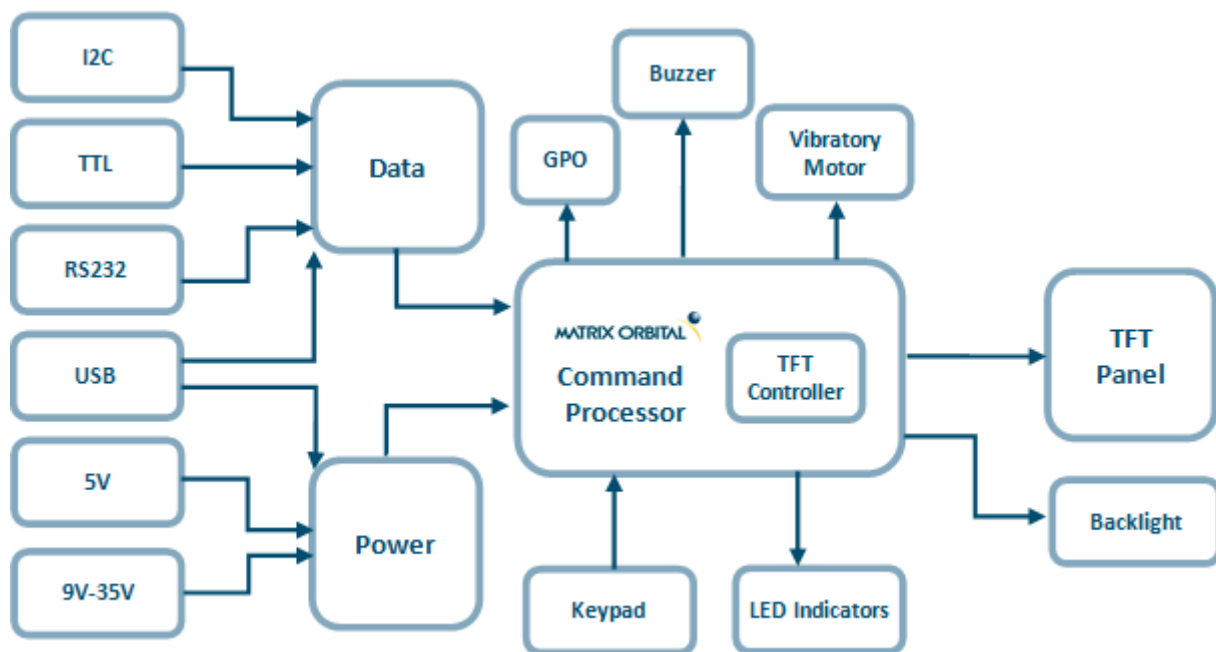


Figure 2: Functional Diagram

Available flow controlled RS232 and TTL interfaces, as well as an I²C protocol provide versatile communication schemes, while the USB versions ensure that any controller can have a beautiful user interface. Scorching fast communication speeds, up to 256kbps in serial modes and 400kHz in I2C, ensure important information is relayed on time.

3 Ordering

The innovative GTT29A, 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.

3.1 Ordering Part Numbering Scheme

Table 1: Part Numbering Scheme

GTT	29	A	-TPN	-BLM	-B0	-H1	-CU	-V5
1	2	3	4	5	6	7	8	9

3.2 Options

Table 2: Display Options

#	Designator	Options
1	Product Type	GTT: Graphic TFT Display
2	Display Size	29: 2.9"
3	Screen Type	A: A Type
4	Touch	-TPN: No touch panel
5	Backlight	-BLM: 300 Nit < Brightness < 600 Nit
6	Bezel	-B0: None
7	Headers	-H0: No Connectors -H1: Standard Connectors -H2: Locking Connectors -H3: Right Angle, Locking Connectors -H4: Terminal Blocks
8	Protocol	-CS: RS232 Model -CT: TTL Model -CU: USB Model
9	Voltage	-V5: 5.0V Input Voltage -VPT: Regulated 9V-35V Input Voltage

***Note:** All options may not be available, please consult www.matrixorbital.com for a list of purchasable products.



3.3 Recommended Parts

Serial Communication



Figure 3: ESCCPC5V

The most common cable choice for the any GTT 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 communicate to and power your display.

I2C Communication



Figure 4: BBC

For a more flexible interface to the GTT, especially with the I²C protocol, 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.

USB Communication



Figure 5: EXTMUSB3FT

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

Power



Figure 6: PCS

The standard power cable can be used to apply power to the GTT, either in conjunction with the ESCCPC5V cable, or via a direct connection to the Alternate Power Header. It connects to a standard PC power supply.

Mass Storage



Figure 7: EXTMUSB3FT

An External Mini-B USB Cable may also be used to access data within the onboard SD card when removing the card itself is not possible. This connection also provides power to the GTT and can be more convenient than moving the SD card from one location to another.

4 Hardware

4.1 Available Headers

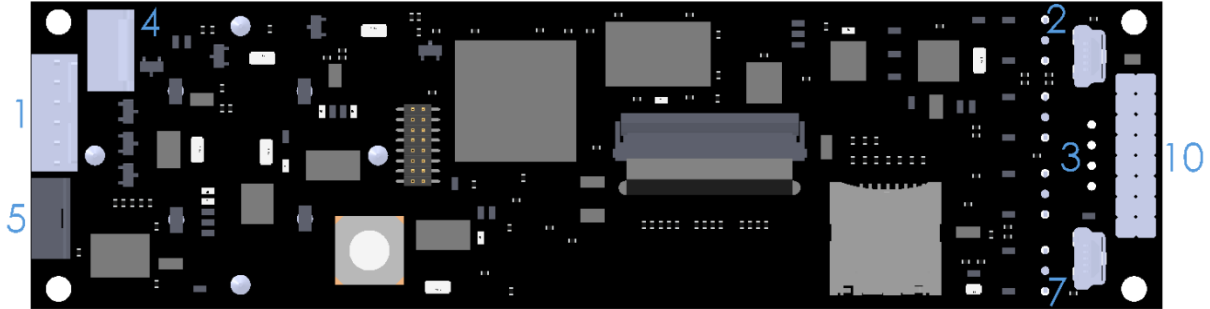


Figure 8: GTT29A Header Locations

Table 3: List of Available Headers

#	Header	Standard Mate	Population
1	Extended Serial Communication & Power	ESCCPC5V, ISCCPC5V	RS232/TTL Models Only
2	USB Communication & Power	EXTPUSB6FT	USB Model Only
3	Alternate USB	None Offered	Custom Only
4	I2C Communication & Power	BBC	All Models
5	Alternate Power	PCS	USB Model Only
7	Mass Storage	EXTPUSB6FT	All Models
10	GPO	None Offered	All Models



4.2 Extended Serial Communication/Power Header

The communication/power header provides an interface for the two most common GTT29A protocols: RS232 and TTL. With the ability to connect to a PC serial port or microcontroller and optional hardware flow control, this is the most versatile header available on the GTT29A.



Figure 9: Extended Communication/Power Header

Table 4: Extended Communication/Power Pinout

Pin	Function
6	RTS
5	CTS
4	Gnd
3	Tx
2	Rx
1	Vcc

Voltage is applied through pins one and four of the header, please reference electrical specifications before applying power. Pins two and three are reserved for serial transmission using either RS-232/TTL levels, depending on what model has been ordered. Finally, pins five and six are used for optional hardware flow control. The Serial Molex 22-04-1061 style header used can be mated to a number of connectors, including a 22-01-1062.

4.3 Mini-B USB Communication Connector

USB protocol offers an easy connection to any host computer. The simple and widely available protocol can be accessed using the familiar Mini-B USB connector to fulfill communication needs.

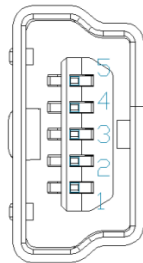


Figure 10: Mini USB Connector

Table 5: Mini USB Pinout

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

The USB model can be connected to virtually any USB host using the appropriate cable; however, additional power must be supplied through the alternate power header. Most commonly used with a PC, this connection creates a virtual com port that offers a simple power solution with a familiar communication scheme.

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 USB model for an added charge as part of a custom order. Please use the Contact section to reach Sales for additional details.

Drivers

The latest drivers are available for download in a zipped file format at www.matrixorbital.ca/drivers. To install or update the drivers installed on your PC, locate the GTT29A in your device manager, right click its' icon, select Update Driver Software, and manually point to the unzipped driver file.

4.4 I²C Communication/Power Header

A dedicated I²C header is available on RS232 and TTL GTT29A models and provides the most basic protocol connection to the unit.

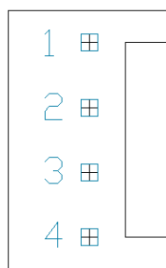


Figure 11: I²C Communication/Power Header

Table 6: I²C Communication/Power Pinout

Pin	Function
1	Vcc
2	SCL
3	SDA
4	Gnd

Voltage is applied through pins one and four of the header, please reference the electrical specifications before applying power. Pins two and three are reserved for I²C clock and data signals respectively, both of which should be pulled up to five volts using a resistance between one and ten kilohms. The Tyco 640456-4-LF style header used can be mated to a number of connectors, including Molex 22-01-3047.



4.5 Alternate Power Connector

The Alternate Power Connector provides the ability to power the GTT29A using a second cable. This connection is required for USB protocol due to the power requirements of the GTT29A.



Figure 12: Alternate Power Connector

Table 7: Alternate Power Pinout

Pin	Function
1	Vcc
2	Gnd
3	Gnd
4	NC*

The standard Tyco 171825-4 style header is particularly useful for connecting to an unmodified floppy power cable, a 171822-4 for example, from a PC power supply for a simple bench power solution.

***Note:** When using a -VPT model, it may be desirable to input power to the GTT using the floppy power cable 12V connection. Please Contact a friendly Matrix Orbital support representative for modification details.

4.6 Mass Storage Mini-B USB Header

The GTT29A comes with a secondary Mini-B USB connector to access the SD memory card as a mass storage device for easier access to the files contained on the card.

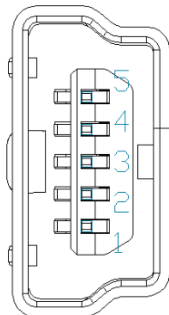


Figure 13: Mass Storage USB Connector

Table 8: Mass Storage USB Pinout

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

The user must hold the lower left dot key, or send an Enter Mass Storage command to use this function, please refer to the Mass Storage Mode section for further information.

Mass Storage Mode

In situations where an external SD memory card reader is not available, the GTT can be booted up in Mass storage mode, granting direct access to the contents stored on the memory card. Mass storage mode can be initiated by disconnecting power from the display, pressing and holding down the bottom left dot button, applying power to the display, and waiting for the start screen before releasing the key. When in mass storage mode, the unit appears as a mass storage device on the PC it is connected to, allowing the user to transfer or alter any files on the SD card.

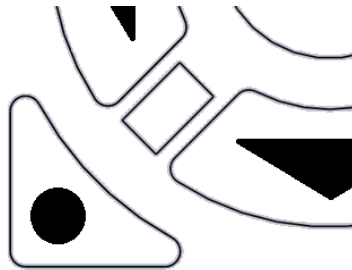


Figure 14:Bottom Left keypad key

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.

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.



4.7 General Purpose Outputs

A unique feature of the GTT29A is the ability to control relays* and other external devices using either one of six General Purpose Outputs.

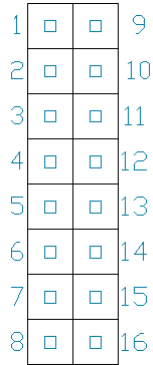


Figure 15: GPO Header

Table 9: GPO Pinout

Pin	Function	Pin	Function
1	Gnd	9	Vcc
2	Gnd	10	GPO 6
3	Gnd	11	GPO 5
4	Gnd	12	GPO 4
5	Gnd	13	GPO 3
6	Gnd	14	GPO 2
7	Gnd	15	GPO 1
8	Gnd	16	GND

Each can source up to 15mA of current at five volts when on, or sink 15mA at zero volts when off. The two row, fourteen pin header can be interfaced to a number of female connectors to provide control to any peripheral devices required.

4.8 LED Indicators

The GTT29A has 4 bi-colour LED Indicators. Red, green, and orange-yellow colours can be created using the Set Indicator State Command.

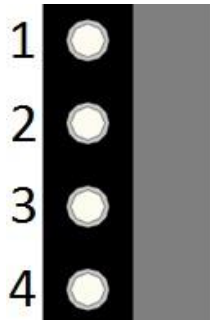


Figure 16: LED Location

Table 10: LED Output

Colour	Value
Off	0
Green	1
Red	2
Yellow	3

4.9 Keypad

To facilitate user input, the GTT29A provides a 7-Key keypad. When a key press is generated, a character specific to that key press is automatically sent on the Tx communication line. If the display module is running in I²C mode, the key press will remain in the buffer until it is accessed using the display read address.

		Key Down		
		Columns		
		1	2	3
R o w s	1	A	B	N/A*
	2	D	E	C
	3	G	H	N/A*

Figure 17: Default Tactile Key Down Values

		Key Up		
		Columns		
		1	2	3
R o w s	1	a	b	N/A*
	2	d	e	c
	3	g	h	N/A*

Figure 18: Default Tactile Key Up Values

***Note:** Values are not mapped to a physical key.

The character that is associated with each key press may be altered using the “Assign Key Codes” command. Scripted keys can also be created using the Create a Scripted Key command, where a script is linked to a key value, and will be executed when said key value is pressed.

5 Troubleshooting

5.1 Power

To function correctly, the GTT29A 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.

- GTT devices have specific power requirements. Ensure the correct voltage and sufficient current are available to your device by consulting the Power Consumption table.
- 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.
- 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 with an AUTOEXEC file present, the Matrix Orbital logo or user specified screen should display briefly 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.
- 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 correct address. 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.

5.4 Factory Defaults

If the settings of your display become altered in a way that dramatically impacts usability, the default settings can be restored simply by removing the AUTOEXEC file in the memory card's root directory. This will remove the start screen and reset the baud rate to 115,200. If the Matrix Orbital start screen is desired, default files are available at www.matrixorbital.ca/manuals/GTT_Series/GTT_Example_Files.

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



6 Appendix

6.1 Dimensional Drawing

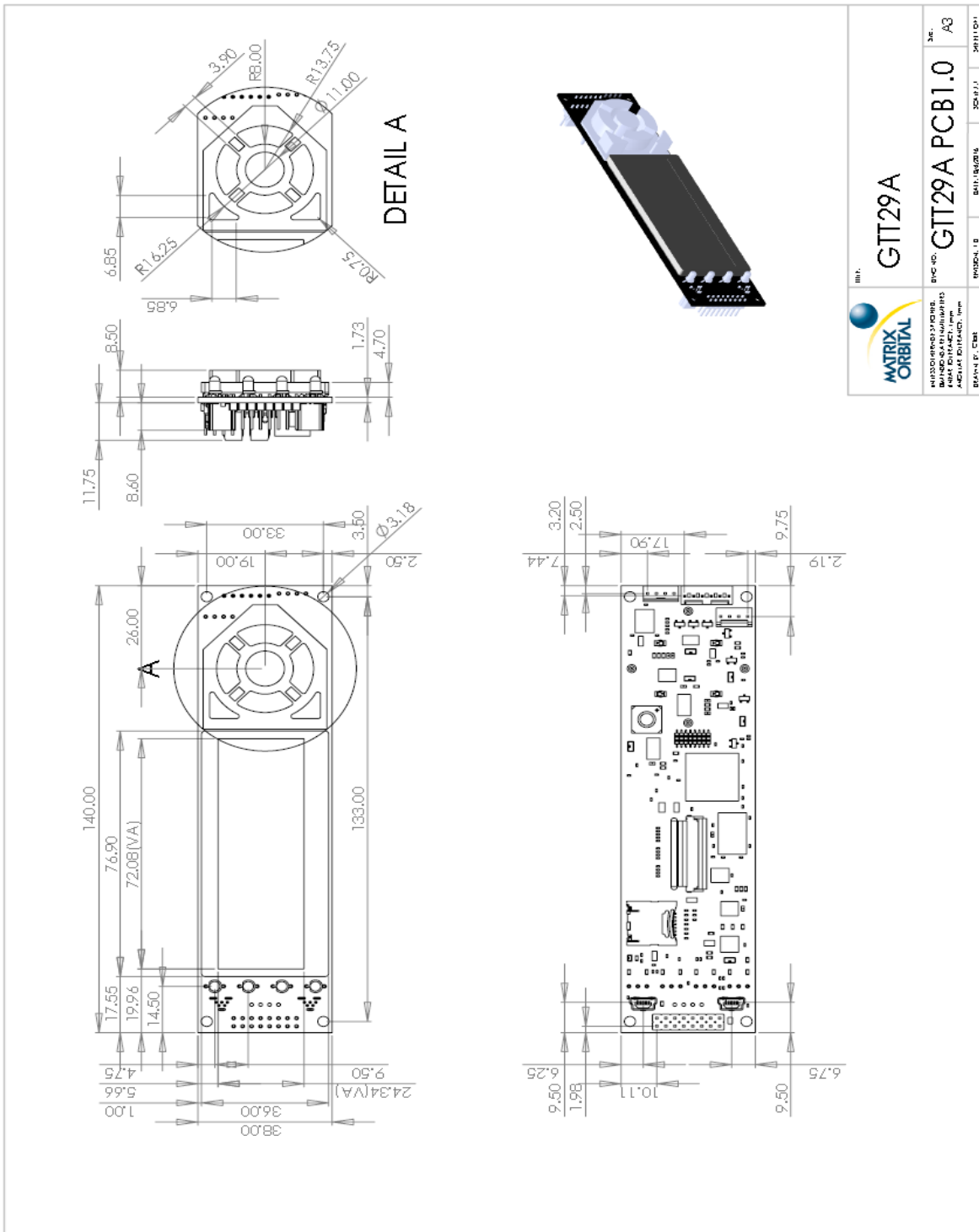


Figure 19: GTT29A Drawing



6.2 Power Consumption

Table 11: Required Supply Voltage

Parameter	Min	Typ	Max	Unit	Remarks
Supply Voltage	4.75	5.0	5.25	V	Standard Voltage (V5)
	9.0	12.0	35.0	V	Wide Voltage (VPT)

Table 12: Operating Current Draw

Parameter	Min	Typ	Max	Unit	Remarks
Logic	-	270	-	mA	Backlight Off
Backlight	0	60	120	mA	Off, Mid, Max
Keypad Backlight	0	20	40	mA	Off, Mid, Max
Piezo	-	70	-	mA	Burst
Motor	-	150	-	mA	Burst
GPO	-	-	15	mA	Each
LED Indicators	-	15	-	mA	Red\Green

6.4 Optical Characteristics

Table 14: Optical Characteristics

Module Size	140.0 x 38.0 x 21.95	mm
Viewing Area	72.08 x 24.34	mm
Active Area	70.08x 22.34	mm
Pixel Pattern	320x RGB x 102	
Dot Pitch	0.219 x 0.219	mm
Luminance	400	cd/m ²
Viewing Angle	75° Left, Right, Down,Up	
Contrast Ratio	500:1	

6.3 Environmental

Table 13: Environmental Specifications

Operating Temperature	-20°C to +70°C
Storage Temperature	-30°C to +80°C
Operating Relative Humidity*	90% (T < 50°C) 60% (50°C < T)

*Note: No condensation at any temperature

6.5 ESD Performance

Table 15: ESD Resistance Data

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

6.6 Electrical Characteristics

Absolute Maximum Ratings

Table 16: GTT29A Limiting Values

Parameter	Min	Max	Unit	Remarks
Supply Voltage	-0.5	6	V	Standard Voltage (V5) Option
	-0.5	35	V	Extended Wide Voltage (VPT) Option
RS232 Pins	-25	25	V	Input Signals
	-13.2	13.2	V	Output Signals
I2C/TTL pins	-0.5	3.6	V	SCL, SDA, Input and Output Signals
USB Pins	-0.5	3.8	V	Input and Output Signals



Communication Characteristics

Table 17: 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 19: I²C Interface Characteristics

Parameter	Min	Typ	Max	Unit
Input Threshold Low	-	0	1.0	V
Input Threshold High	2.3	3.3	3.6	V
Output Voltage Low	-	0	0.4	V
Output Short Circuit Current	-	-	±50	mA

Table 18: USB Interface Characteristics

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

Table 20: TTL Interface Characteristics

Parameter	Min	Typ	Max	Unit
Input Threshold Low	-	0	1.0	V
Input Threshold High	2.3	3.3	3.6	V
Output Voltage Low	-	0	0.4	V
Output Voltage High	2.9	3	3.3	V
Output Short Circuit Current	-	-	±50	mA

6.7 Defect Criteria

Display Specifications

Table 21: Display Defect Criteria

Defect	Condition	Criteria
Line	Not Allowed	N/A
Bright Dots	Red + Green + Blue Within φ10mm Circle	0 Dots 0 Sets
Dark Dots	Red + Green + Blue Within φ10mm Circle	≤ 2 Dots 0 Sets
Total	Bright Dots + Dark Dots	≤ 2 Dots

Appearance Specifications

Table 22: Screen and Touch Defect Criteria

Defect*	Condition	Criteria
Circular Objects <small>(Stains, Dust, Scratch, Bubble, Dark/White spot, Foreign matter)</small>	d < 0.10mm	Allowed
	0.10mm ≤ d < 0.15mm	≤2points
	0.15mm ≤ d < 0.25mm	≤1points
	0.25mm ≤ d	0points
Linear Objects	W ≤ 0.03mm	Allowed
	0.05mm ≤ W ≤ 0.05mm, L ≤ 2.5mm	≤3points
	0.05mm ≤ W ≤ 0.10mm, L ≤ 2.5mm	≤2points
	0.1mm ≤ W, L ≥ 1.0mm	≤0points

*Note: Defects must occur in Active Area



7 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.

I²C: 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.

SDA: Serial data line used to transfer data in I²C 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 I²C 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.

8 Contact

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