VK202-25-USB
Technical Manual

Revision: 1.0

Contents

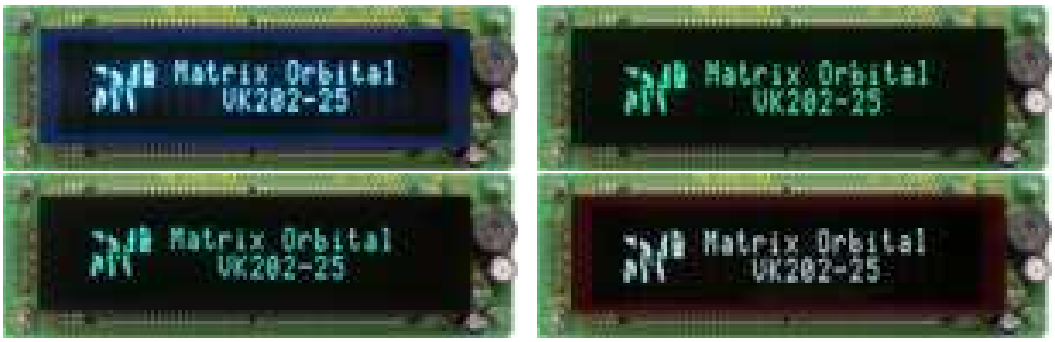


Figure 1: VK202-25-USB Filter Options

1 Getting Started

The VK202-25-USB is an intelligent VFD display designed to decrease development time by providing an instant solution to any project. With the ability to communicate via USB protocol, the versatile VK202-25-USB 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 brightness, and baud rate to be software controlled. Additionally, up to thirty-two custom charaters, such as character sets for bar graphs, medium, and large numbers, may be stored in the non-volitile memory to be easily recalled and displayed at any time.

1.1 Display Options Available

The VK202-25 is complimented with a wide selection of filters including blue, green, grey and red. If the VFD will be in direct sunlight, the grey filter will prevent the displayed text from 'washing out'. Extended voltage, and temperature options are also available, to allow you to select the display which will best fit your project needs.

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 14.5 on page 53 for contact information.

Figure 2: 3ft mini-B USB

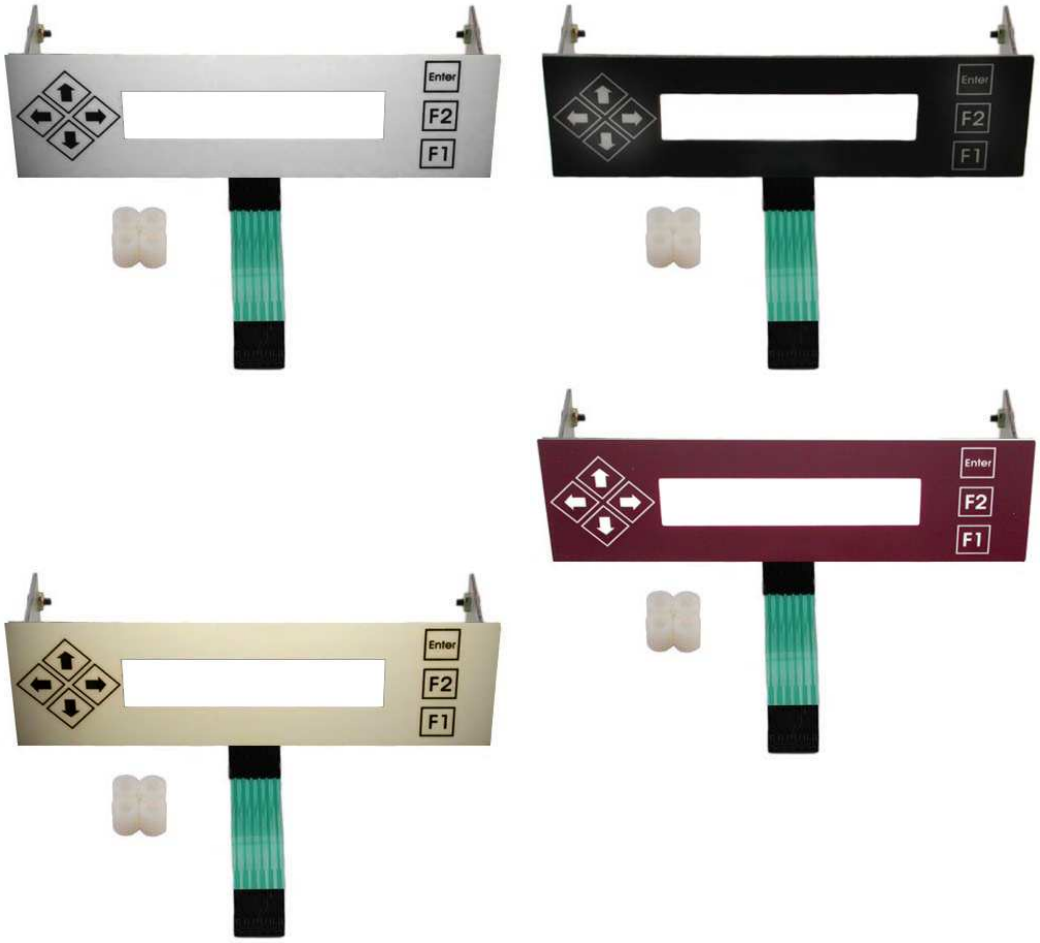


Figure 3: Keypad Mountings

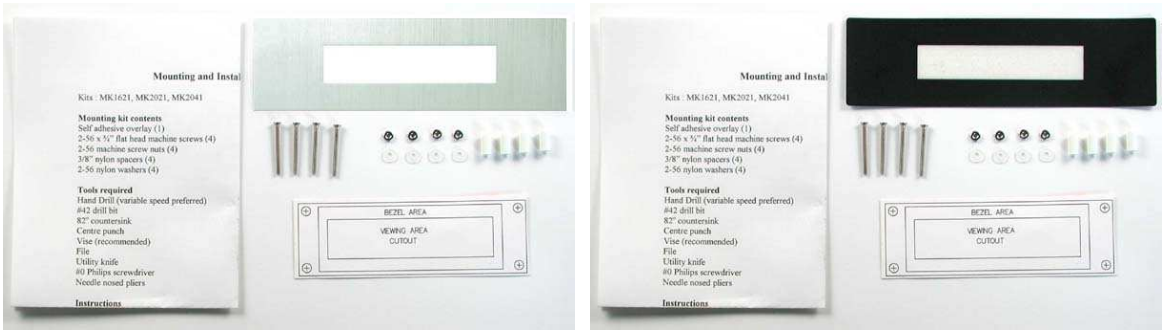


Figure 4: Mounting Kits

Figure 5: 4X4 Keypad

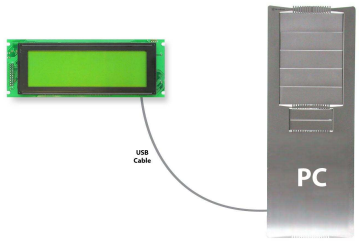
1.3 Features

- 20 column by 2 line text vacuum fluorescent display
- USB communication protocol
- Six, 5V -20mA, general purpose outputs for a variety of applications
- Lightning fast communication speeds, up to 115.2 kbps
- Extended temperature available for extreme environments of -40C to 85C
- Built in font with provision for up to 8 user defined characters
- Optional 1-wire bus that is capable of communicating with up to 32 devices over a single bus
- Ability to add a customized splash / startup screen
- Software controlled brightness with configurable time-out setting up to 90 minutes and software controlled speed
- Use of up to a 25 key keypad with a 10 key buffer
- Horizontal or vertical bar graphs
- Fits Matrix Orbital's mountings without any modifications

1.4 Connecting to a PC

The VK202-25-USB connects seamlessly to a PC and it is an excellent means of testing the functionality. To connect your display to a PC, you will require a USB cable such as the one pictured in ***figure 2 on page 2***.

1. In order to connect your USB display to a personal computer simply plug the mini-B USB cable from the PC to the USB connector on the display.



NOTE The VK202-25-USB unit can also be powered via a standard PC power cable, shown in figure 6.

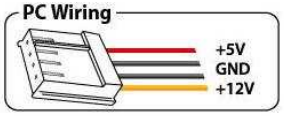


Figure 6: Alternate Display Power Cable

1.5 Installing the Software

1.5.1 Drivers

In order to communicate with any Matrix Orbital USB display, the proper drivers for the unit must first be correctly installed on the controlling PC or device. To preform this operation, follow the steps listed below:

1. Go to the website location: http://www.matrixorbital.ca/drivers/
2. Download or copy the appropriate USB drivers into a directory.
3. Uncompress the files. They will be a self extracting ZIP file.
4. Connect the USB cable to the display and the computer.
5. Windows will give a prompt for drivers for a USB , Serial Device.
6. Select 'Specify location', and navigate to the directory the file was uncompressed to.
7. Test the display using a software tool such as uProject.

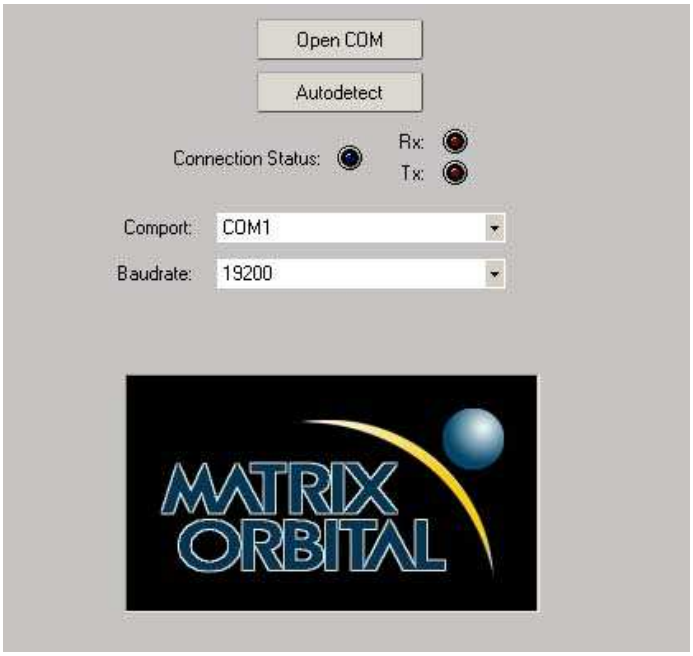
1.5.2 uProject

uProject was designed by Matrix Orbital to provide a simple and easy to use interface that will allow you to test all of the features of our alpha numeric displays.

To install uProject from the Matrix Orbital website, follow the following steps:

1. Go to the website location: http://www.matrixorbital.ca/software/software_alpha/uproject/
2. Click on “Download Here”
3. Locate the file uProject.exe on your desktop
4. Double click on “uProject.exe”

Be sure to check the information selected in the COM Setup the first time uProject is run. Although the display is connected via a USB Cable, it will create its own, virtual, Comport which will be displayed in the uProject environment. Once this information is entered correctly the program can be used to control all functions of the graphic display.



Comprt The serial port the display is plugged into.

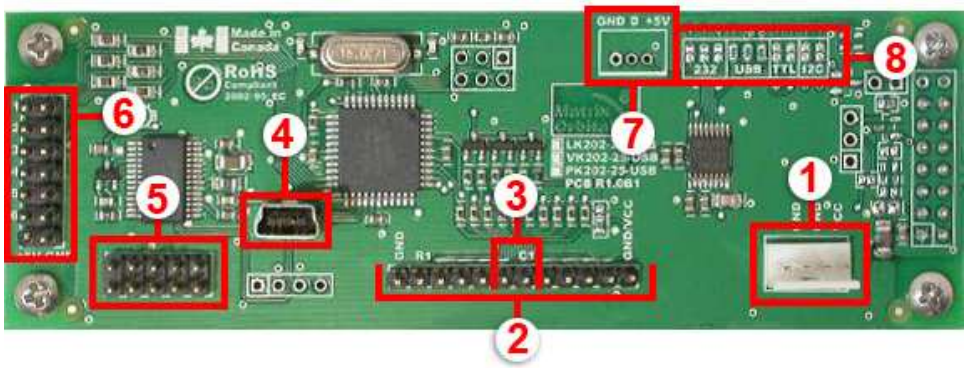
Baudrate The communication speed the display module is set to. (Default 19,200)

Figure 7: uProject Settings

NOTE uProject and other alphanumeric software may also be downloaded from Matrix Orbital’s support site at http://www.matrixorbital.ca/software/software_alpha/

2 Hardware Information

Refer to the following diagram for this chapter:

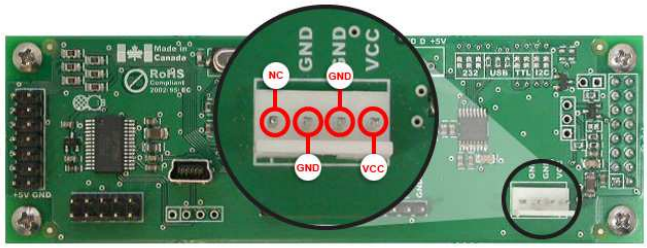


1 Power Connector
2 Keypad Header
3 Manual Override
4 USB Header
5 Optional Serial Header
6 GPOs
7 Optional Dallas 1-Wire Bridge
8 Protocol Select Jumpers

Figure 8: VK202-25-USB

2.1 Power Connector

The VK202-25-USB provides a *Power Connector* to allow the device to be powered externally. In order to power the device externally, you must remove one of the USB protocol select jumpers. The jumper to remove is the rightmost USB jumper as seen if ***figure*** 16



Pin 1 NC
Pin 2 GND
Pin 3 GND
Pin 4 +5V

Figure 9: Alternate Power Connector

2.2 Keypad Interface Connector

The VK202-25-USB provides a *Keypad Interface Connector* which allows for up to a five by five matrix style keypad to be directly connected to the display module. Key presses are generated when a short is detected between a row and a column. When a key press is generated a character, which is associated with the particular key press, is automatically sent on the Tx communication line. The character that is associated with each key press may be altered using the "Assign Key Codes" command, for more detailed information see the ***Keypad Section, on page 33***.

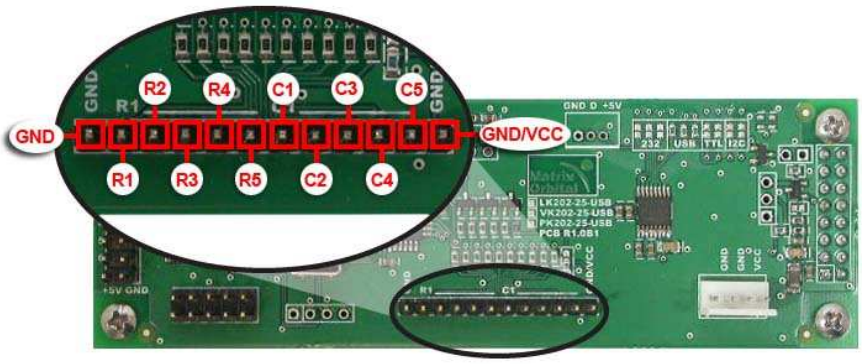


Figure 10: Keypad Interface Connector

2.3 Manual Override

The *Manual Override* is provided to allow the VK202-25-USB to be reset to factory defaults. This can be particularly helpful if the display module has been set to an unknown baud rate 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 1***.
5. Edit and save settings.

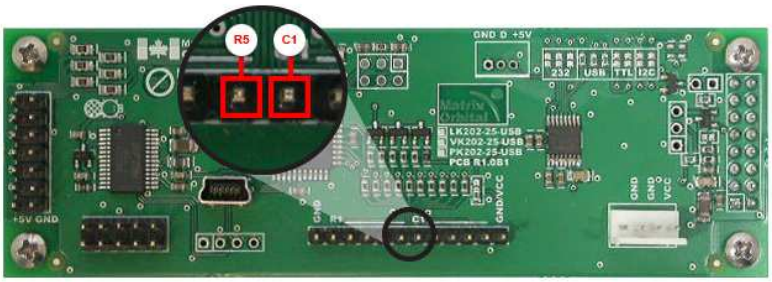


Figure 11: Manual Override Jumper

Table 1: Default Values

Brightness	255
Contrast	128
Baud Rate	19.2 kbps

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

2.4 USB Header

The *USB Header* provides USB connector for communication and power of the display. An alternate power option for the display can be seen in ***figure*** 9

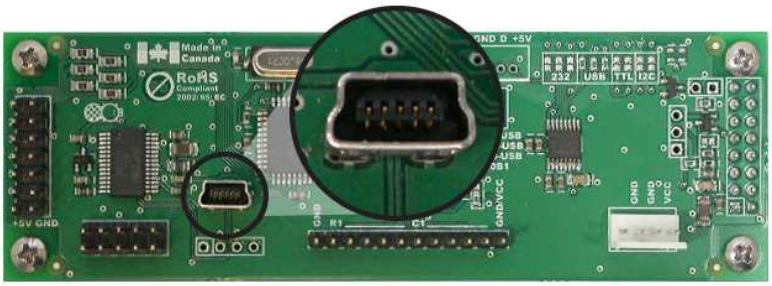


Figure 12: USB Header

Table 2: Power Requirements

	Standard
Supply Voltage	+5Vdc ±0.25V
Supply Current	50mA (Backlight Off)
Backlight Current	185mA (Backlight On)

WARNINGS

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

2.5 Serial Header

The VK202-25-USB also offers an alternative, *Serial Header* option to permit serial communication with the device. Please note the the display normally does not come with the *Serial Header*, it will have to be ordered as a custom. Please talk to your sales representative if you would like this option.

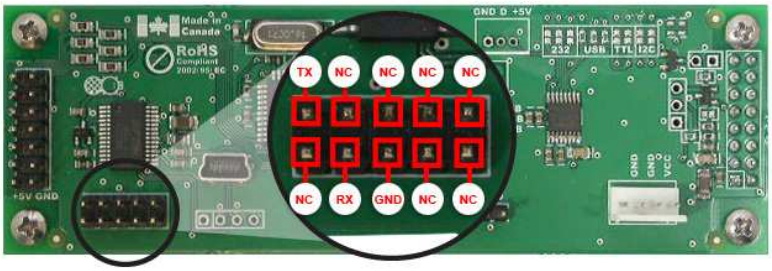
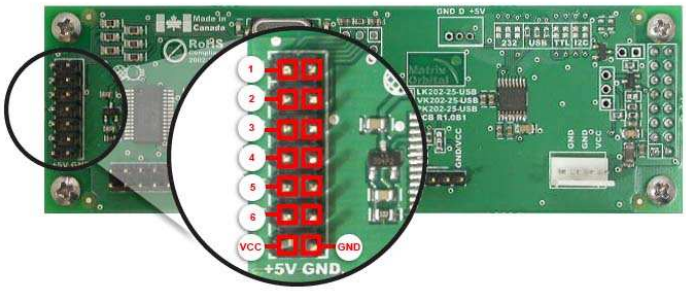


Figure 13: Serial Header

NOTE This component is optional and must be custom ordered

2.6 General Purpose Outputs

A unique feature of the VK202-25-USB is the ability to control relays and other external devices using a *General Purpose Output*, 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 to the above right of the GPOs as pictured below in ***figure 14***. 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.



GND Ground (0VDC)
GPO +5VDC at 20 mA

Figure 14: 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.

2.7 Dallas 1-Wire Bridge

In addition to the six general purpose outputs the VK202-25-USB offers an optional Dallas 1-wire bridge, to allow for an aditional thirty two 1-wire devices to be connected to the display. Please note the the display normally does not come with the Dallas 1-wire bridge, it will have to be ordered as a custom. Please talk to your sales representative if you would like this option. See ***Section 8 on page 31***.

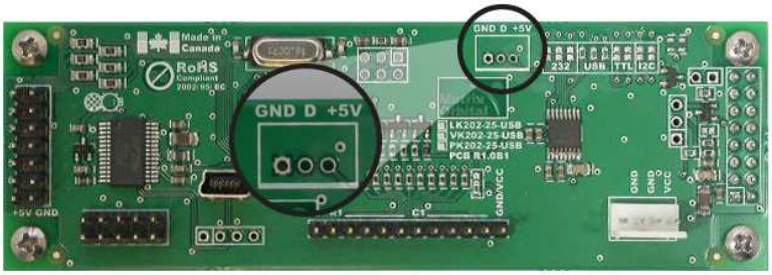


Figure 15: Dallas 1-Wire Bridge

NOTE This component is optional and must be custom ordered

2.8 Protocol Select Jumpers

The *Protocol Select Jumpers*, pictured below in ***figure 16***, provide the means necessary to toggle the display module between USB power and external power. As a default, the jumpers are set to USB mode with solder jumps on the USB jumpers. In order to place the display module in external power mode you must first remove the rightmost solder jump from the USB jumpers, as shown in ***figure 16***. The display cannot be used in RS232, TTL, or I2C mode.

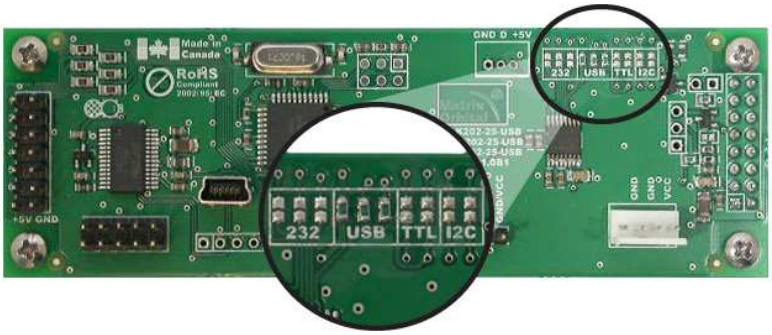


Figure 16: Protocol Select Jumpers

3 Troubleshooting

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

- First, check the USB cable which you are using for continuity. If you don't have an ohm meter, try using a different USB cable, if this does not help try using a different power supply.
- Second, ensure that the correct drivers are properly installed. For the latest drivers, visit the Matrix Orbital website at http://www.matrixorbital.ca/drivers/. If you require additional support to resolve this matter, please contact Matrix Orbital using one of the mehods described in section 14.5.
- The last step will be to check the USB Cable on the VK202-25-USB. If the USB Cable has become loose, or you are unable to resolve the issue, please contact Matrix Orbital, see section 14.5 for contact information.

3.2 The display module is not communicating.

- First, 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.
- Finally, you may reset the display to it's default settings using the *Manual Override Jumper*, see ***Section 2.3 on page 8***.

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

- A 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.
If you are unable to resolve any issue please contact Matrix Orbital. See *14.5 on page 53* for contact information.

4 Communications

4.1 Introduction

The commands listed in this chapter describe how to configure data flow on the VK202-25-USB.

4.1.1 I²C Communication Summary

The VK202-25-USB is capable of communicating at 100 KHz in I^2C mode, with 127 units addressable on a single I^2C communication line. However, in order to communicate via I^2C 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^2C. 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^2C data lines operate at 5V normally or 3.3V for -1U style units. The VK202-25-USB 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 VK202-25-USB 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 VK202-25-USB, 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 VK202-25-USB 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 VK202-25-USB 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 VK202-25-USB 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 3.

Table 3: 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 VK202-25-USB 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 VK202-25-USB 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 VK202-25-USB 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 VK202-25-USB 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 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

Default: 0x50

4.3 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
53	1200
29	2400
CF	4800
67	9600
33	19200
22	28800
19	38400
10	57600
8	115200

Remembered: Always

Default: 19,200 bps

4.4 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

Crystal Speed 16 Mhz

Desired BAUD 13,500

$$speed = \frac{crystalspeed}{8 * DesiredBaud} - 1 \qquad speed = \frac{16,000,000}{8 * 13,500} - 1$$

$$speed = 148.15 - 1 \qquad speed = 147.15$$

- **LSB** = 0x93 (rounded)
- **MSB** = 0x00
- Intended Baud Rate: 13,500 baud Actual Baud Rate: $\frac{16,000,000}{8(147+1)}$ =13,514 Percent Difference: 0.1%

NOTES

- Results from the formula are rounded down to the nearest whole number (i.e 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 Text

5.1 Introduction

The VK202-25-USB 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 ASCII formated characters and strings that are sent to it, which are defined in the current character set. 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 row, it is able to automatically scroll all of the lines up and continue to display text, with the auto scroll option set to on.

5.1.1 Character Set

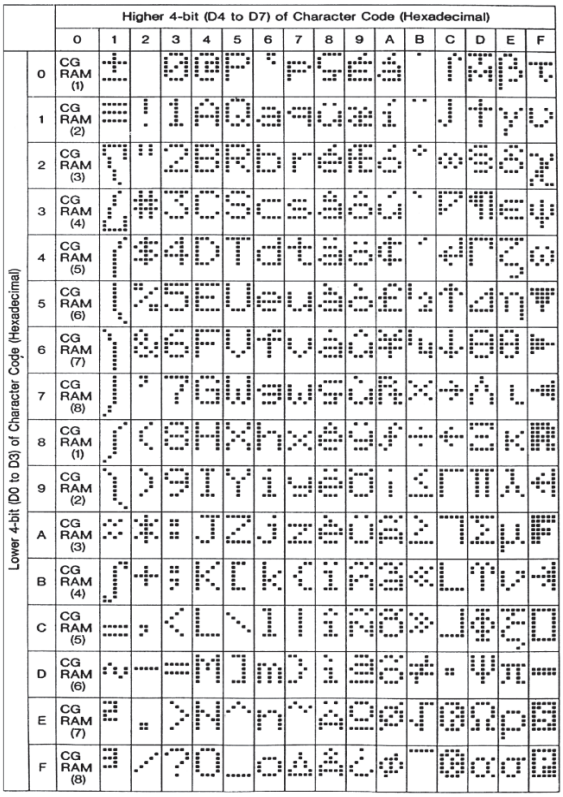


Figure 17: Character Set

5.1.2 Control Characters

In addition to a full text set, the VK202-25-USB display supports the following ASCII Control characters:

0x08 Backspace

0x0C Clear screen / New page

0x0D Carriage return

0x0A Line feed / New line

5.2 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 last row.	
Remembered	Yes	
Default	On	

5.3 Auto Scroll Off

Syntax	Hexadecimal	0xFE 0x52
	Decimal	254 82
	ASCII	254 “R”
Description	When auto scrolling is disabled the text will wrap to the top left corner of the display area when the text reaches the end of last row.	
Remembered	Yes	

5.4 Clear Screen

Syntax	Hexadecimal	0xFE 0x58
	Decimal	254 88
	ASCII	254 “X”
Description	This command will immediately clear all of the contents of the display.	
Remembered	No	

5.5 Changing the Startup Screen

Syntax	Hexadecimal	0xFE 0x40
	Decimal	254 64
	ASCII	254 “@”
Description	In order to change the text that is displayed by the VK202-25-USB when it starts up simply send the command bytes 254 64 followed by the characters that you wish to display, starting from the top left. This command will automatically line wrap the characters that are sent to it.	
Remembered	Yes	

5.6 Set Auto Line Wrap On

Syntax	Hexadecimal	0xFE 0x43
	Decimal	254 67
	ASCII	254 “C”
Description	Enabling Auto Line Wrap will allow the cursor to automatically wrap over to the next line when the current line is full.	

NOTE Line wraps may occur in the middle of a word.

Remembered Yes

5.7 Set Auto Line Wrap Off

Syntax	Hexadecimal	0xFE 0x44
	Decimal	254 68
	ASCII	254 “D”
Description	Disabling Auto Line Wrap will allow you to change the line configuration. The normally sequentional progression becomes an alternating pattern. Rather than moving from line 1 to 2 to 3, the display will write from line 1 to 3 to 2. For a two line display, this means that a row’s worth of characters written between the first and second lines or after the second will not be displayed on the screen or wrapped. The four line models will see only an alteration in line flow.	

Remembered Yes

5.8 Set 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 will allow you to manually set the cursor position, which controls the text insertion point, by specifying the [col] and [row] of the new proposed cursor position.

NOTE If the cursor position is set past the end of a line it will wrap to the beginning of the next line.

Remembered No

5.9 Go Home

Syntax
Hexadecimal	0xFE 0x48
Decimal	254 72
ASCII	254 “H”

Description This command will return the cursor to the top left corner of the display area, identified as row one, column one.

Remembered No

5.10 Move Cursor Back

Syntax
Hexadecimal	0xFE 0x4C
Decimal	254 76
ASCII	254 “L”

Description This command will move the cursor back one space. If this command is sent when the cursor is at the home position the cursor will wrap to the last row / column position if line wrap is on. Sending this command will not effect the text displayed on the module, however any characters that are sent will over write the current characters that are being displayed.

Remembered No

5.11 Move Cursor Forward

Syntax
Hexadecimal	0xFE 0x4D
Decimal	254 77
ASCII	254 “M”

Description This command will move the cursor forward one space. If this command is sent when the cursor is at the bottom right position the cursor will wrap back to the home position if line wrap is on. Sending this command will not effect the text displayed on the module, however any characters that are sent will over write the current characters that are being displayed.

Remembered No

5.12 Underline Cursor On

Syntax
Hexadecimal	0xFE 0x4A
Decimal	254 74
ASCII	254 “J”

Description This command will cause the VK202-25-USB to display an underline cursor at the current text insertion point.

Remembered Yes

5.13 Underline Cursor Off

Syntax
Hexadecimal	0xFE 0x4B
Decimal	254 75
ASCII	254 “K”

Description This command will turn the the underline cursor off.

Remembered Yes

5.14 Blinking Block Cursor On

Syntax
Hexadecimal	0xFE 0x53
Decimal	254 83
ASCII	254 “S”

Description This command will cause the VK202-25-USB to display a block cursor at the current text insertion point.

Remembered Yes

5.15 Blinking Block Cursor Off

Syntax	Hexadecimal	0xFE 0x54
	Decimal	254 84
	ASCII	254 “T”
Description	This command will turn the block cursor off.	
Remembered	Yes	

6 Special Characters

6.1 Introduction

The VK202-25-USB has the ability to create four different sets of eight custom characters and save them to internal banks of memory. Each set of eight can be recalled from memory at any time, and selected characters can be written to the display screen. Characters and sets can be created at any time, saved for later use, and displayed to the screen through the intuitive command structure described below.

6.2 Creating a Custom Character

Syntax	Hexadecimal	0xFE 0x4E [refID] [data]	
	Decimal	254 78 [refID] [data]	
	ASCII	254 “N” [refID] [data]	
Parameters	Parameter	Length	Description
	refID	1	Character reference ID (0-7).
	data	8	Character data.

Description

The VK202-25-USB allows for upta to eight custom defined characters to be added onto the the character set. A custom character is a five by eight pixel matrix with each row represented by a byte value. For example:

Custom Character 'h'					Decimal	Hex
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	*0*	*0*	*0*	16	0x10
1	*0*	**1**	**1**	*0*	22	0x16
1	**1**	*0*	*0*	**1**	25	0x19
1	*0*	*0*	*0*	**1**	17	0x11
1	*0*	*0*	*0*	**1**	17	0x11

Each bit value of one, in the table, represents an on pixel, whereas a value of zero represents a pixel that is turned off. Therefore in order to define custom character 'h' you would send the command byte prefix 254 followed by the command 78. Next, you will have to select the memory location in which you wish to save the character in. The available memory locations for this command are zero through to seven. After sending the memory location, or [refID], you may then send the eight byte custom character data in sequence from the top to the bottom.

Once you have defined a custom character you may display it by sending the display module the [refID]. For example if a custom character was saved in position one, the command to display the custom character, at the current cursor position, would be simply to send the number one to the display module without quotes.

Remembered

No

6.3 Saving Custom Characters

Syntax

Hexadecimal	0xFE 0xC1 [Bank] [ID] [Data]
Decimal	254 193 [Bank] [ID] [Data]

Parameters

Parameter	Length	Description
Bank	1	Memory bank to save to (0-4).
ID	1	Character ID (0-7)
Data	8	Character Definition

Description

New to the VK202-25-USB has added five non-volatile memory banks for custom character storage. This is intended to allow you to create your own custom bar graphs, medium/large numbers and startup screen. However, each memory bank may be used to store a set of any eight custom characters; with the only provision being that memory bank zero contains the characters that will be used in the startup screen. By default the memory banks will be loaded as follows:

[Bank]	Description
0	Startup screen characters.
1	Horizontal bars
2	Vertical bars
3	Medium numbers

In order to save new custom characters into a memory bank, follow the same process as you would for creating a custom character, see Section 6.2 on page 24, only use 254 193 [Bank Number] before sending the [ID] and character [Data].

Remembered

Yes

6.4 Loading Custom Characters

Syntax

Hexadecimal	0xFE 0xC0 [Bank]
Decimal	254 192 [Bank]

Parameters

Parameter	Length	Description
Bank	1	Memory bank to save to (0-4).

Description

This command is used to load the custom characters into the volatile memory so that they may be used. If custom bar graph or number characters are stored in the memory banks, this command may be used instead of initializing the bar graph / number. To use this command send the command bytes followed by the [Bank] that contains the custom character data that you want to retrieve.

Remembered

No

6.5 Save Startup Screen Custom Characters

Syntax

Hexadecimal	0xFE 0xC2 [refID] [data]
Decimal	254 194 [refID] [data]

Parameters

Parameter	Length	Description
refID	1	Character reference ID (0-7).
data	8	Character data.

Description

Using this command you may create the custom characters. that will be stored in memory bank zero, which will be used in the startup screen. For more information about creating custom characters see ***Section 6.2 on page 24***.

NOTES

- Changes only take place once the power has been cycled.
- This command is the same as sending CMD 254 / 193 / 0 / [ID] / [DATA]

Remembered

Yes

6.6 Initialize Medium Number

Syntax

Hexadecimal	0xFE 0x6D
Decimal	254 109
ASCII	254 “m”

Description

This command will load the default medium number characters into the volatile memory. If you have stored your own custom medium numbers, use the ’Load Custom Characters’ command to load your custom character data into the volatile memory. This command will allow you to use the ’Place Medium Numbers’ command.

Remembered

No

6.7 Place Medium Numbers

Syntax

Hexadecimal	0xFE 0x6F [Row] [Col] [Digit]
Decimal	254 111 [Row] [Col] [Digit]
ASCII	254 “o” [Row] [Col] [Digit]

Parameters

Parameter	Length	Description
Row	1	The row number.
Col	1	The column number.
Digit	1	Medium number to place (0-9).

Description

This command will place a medium number (two columns high) at the [row] and [col] specified.

NOTE Medium Numbers must be initialized before this command is executed.

Remembered

No

6.8 Initialize Horizontal Bar

Syntax	Hexadecimal	0xFE 0x68
	Decimal	254 104
	ASCII	254 “h”

Description: This command will load the default horizontal bar characters into the volatile memory. If you have stored your own custom horizontal bar data, use the ’Load Custom Characters’ command instead to load your custom bar data into the volatile memory. This command will allow you to use the ’Place Horizontal Bar’ command.

Remembered: No

6.9 Place Horizontal Bar Graph

Syntax	Hexadecimal	0xFE 0x7C [Col] [Row] [Dir] [Length]
	Decimal	254 124 [Col] [Row] [Dir] [Length]
	ASCII	254 “|” [Col] [Row] [Dir] [Length]

Parameters:

Parameter	Length	Description
Col	1	The column number.
Row	1	The row number.
Dir	1	The direction of the bar data (0 or 1).
Length	1	The length of the bar data.

Description: This command will place a bar graph at [row], [column]. A [Dir] value of zero will cause the bar to go right, and one will cause the bar to go left. The [Length] is the size in pixels of the bar graph.

NOTES

- Horizontal Bars must be initialized before this command is executed.
- Bar graphs may be one directional only.

Remembered: No

6.10 Initialize Narrow Vertical Bar

Syntax	Hexadecimal	0xFE 0x73
	Decimal	254 115
	ASCII	254 “s”

Description This command will load the narrow vertical bar characters into the volatile memory. If you have stored your own custom vertical bar data, use the 'Load Custom Characters' command instead to load your custom bar data into the volatile memory. This command will allow you to use the 'Place Vertical Bar' command.

NOTE Narrow bars have a width of two pixels.

Remembered No

6.11 Initialize Wide Vertical Bar

Syntax

Hexadecimal	0xFE 0x76
Decimal	254 118
ASCII	254 "v"

Description This command will load the wide vertical bar characters into the volatile memory. If you have stored your own custom vertical bar data, use the 'Load Custom Characters' command instead to load your custom bar data into the volatile memory. This command will allow you to use the 'Place Vertical Bar' command.

NOTE Wide bars have a width of five pixels.

Remembered No

6.12 Place Vertical Bar

Syntax

Hexadecimal	0xFE 0x3D [Column] [Length]
Decimal	254 61 [Column] [Length]
ASCII	254 "=" [Column] [Length]

Parameters

Parameter	Length	Description
Column	1	The column number.
Length	1	The length of the bar data.

Description This command will place a bar graph at the specified [Column] with the specified [Length]. The [Length] is the size in pixels of the bar graph.

NOTES

- A Vertical Bar style must be initialized before this command is executed.
- Bar graphs may be one directional only.

Remembered No

7 General Purpose Output

7.1 Introduction

General purpose outputs allow you to connect devices, such as LEDs, to the VK202-25-USB and supply them with up to 20mA of current at 5V. The VK202-25-USB has 6 GPOs which are software controlled, with functions to turn them on/off and set the power state for the next startup.

7.2 General Purpose Output Off

Syntax

Hexadecimal	0xFE 0x56 [Num]
Decimal	254 86 [Num]
ASCII	254 “V” [Num]

Parameters

Parameter	Length	Description
Num	1	GPO number.

Description This command turns OFF general purpose output [num].

NOTE OFF means that the output is pulled LOW.

Remembered Yes

7.3 General Purpose Output On

Syntax

Hexadecimal	0xFE 0x57 [Num]
Decimal	254 87 [Num]
ASCII	254 “W” [Num]

Parameters

Parameter	Length	Description
Num	1	GPO number.

Description: This command turns ON general purpose output [num]. The standard GPO's on the VK202-25-USB output 20mA of current at 5V.

NOTE ON means the output is pulled HIGH.

Remembered: Yes

7.4 Set Startup GPO state

Syntax:

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

Parameters:

Parameter	Length	Description
Num	1	GPO number.
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

8 Dallas 1-Wire

8.1 Introduction

Another convenient feature of the VK202-25-USB is that it provides a Dallas 1-wire interface in order to readily communicate with up to thirty two 1-wire devices on a single bus. 1-wire communication is begun by discovering the address of the device that you wish to communicate with. To do this you must send the "Search for a 1-Wire Device' command. After you have established the address of the device that you wish to communicate with, you may begin a transaction with the device

8.2 Search for a 1-Wire Device

Syntax:

Hexadecimal	0xFE 0xC8 0x2
Decimal	254 200 2

Description

This command will allow you to begin communicating with the devices on the 1-wire bus by returning a packet containing device information for each 1-wire device on the bus in the form of:

Search Return Packet

Offset (Bytes)	**Offset** (Bytes)	**Description**
0	2	**0x232A** Preamble
2	1	**0x8A** Packet is 10 bytes long, another address will follow **0x0A** Packet is 10 bytes long, this is the last address
3	1	0x31 - 1-Wire Packet Type
4	1	Error Code (0x00 for success)
5	8	1-Wire Address
13	1	**CRC8** 0x00 means the last address was valid

Remembered

No

8.3 Dallas 1-Wire Transaction

Syntax

Hexadecimal	0xFE 0xC8 0x1 [flags] [SndBits] [RcvBits] [Data]
Decimal	254 200 1 [flags] [SndBits] [RcvBits] [Data]

Parameters

Parameter	Length	Description
flags	1	Flags to control optional components of the transaction.
SndBits	1	The number of bits you will be transmitting on the bus.
RcvBits	1	The number of bits you will be reading on the bus.
Data	variable	Data to be transmitted, LSB to MSB.

Description

This command will perform a single transaction on the 1-wire bus in this order:

1. Bus Reset.
2. Transmit data onto the bus.
3. Receive data from the bus.

The number of bits to be transmitted and read must be specified for this command to be successful.

NOTE To determine what functions the device will respond to, consult the devices' data sheet.

1-Wire Flags

Bit	Description
7	
6	Unused
5	(0 for future compatibility)
4	
3	Add a CRC8 to the end of the transmitted data
2	(0 for future compatibility)
1	Assume last received byte is a CRC8 and validate it
0	Reset bus before transaction

1-Wire Error Codes

Code	Description
0x00	Success
0x01	Unknown 1-Wire Command
0x02	No devices on the bus
0x03	Fatal search error

Remembered

No

9 Keypad

9.1 Introduction

The VK202-25-USB supports up to a 25 key, matrix style, keypad and may be configured to allow key presses to be automatically transmitted via USB. The VK202-25-USB also allows for auto-repeating key presses, and remapping of all keypad character codes.

The connector is not keyed so the keypad will probably plug in either of two ways. The display will not be damaged by reversing the connector. However, the keypad will generate a different ASCII character mapping for each position. If the connector has fewer than 10 pins it should be centered on the display

connector. The keypad is scanned whenever a key is pressed;there is no continuous key scan. This means that key presses are dealt with immediately without any appreciable latency. This also prevents electrical noise which is often caused by continuous key scans.

9.2 Auto Transmit Key Presses On

Syntax	Hexadecimal	0xFE 0x41
	Decimal	254 65
	ASCII	254 “A”
Description	In this mode, all key presses are sent immediately to the host system without the use of the poll keypad command. This is the default mode on power up.	
Remembered	Yes	
Default	On	

9.3 Auto Transmit Key Presses Off

Syntax	Hexadecimal	0xFE 0x4F
	Decimal	254 79
	ASCII	254 “O”
Description	In this mode, up to 10 key presses are buffered until the unit is polled by the host system, via the poll keypad command 254 38. Issuing this command places the unit in polled mode.	
Remembered	Yes	

9.4 Poll Key Press

Syntax	Hexadecimal	0xFE 0x26
	Decimal	254 38
	ASCII	254 “&”

Description: This command returns any buffered key presses via the serial interface. The host system must be set up to receive key codes. When the display receives this command, it will immediately return any buffered key presses which may have not been read already. If there is more than one key press buffered, then the high order bit (MSB) of the returned key code will be set (1). If this is the only buffered key press, then the MSB will be cleared (0). If there are no buffered key presses, then the returned code will be 0x00. Please note that to make use of this command, the "Auto Transmit Key Presses" mode should be off.

Remembered: No

9.5 Clear Key Buffer

Syntax:

Hexadecimal	0xFE 0x45
Decimal	254 69
ASCII	254 "E"

Description: This command clears any unread key presses. In a menu application, if the user presses a key which changes the menu context, any following key presses may be inaccurate and can be cleared out of the buffer between menu changes to prevent jumping around the menu tree. It may also be used, in effect, to reset the keypad in case the host application resets for whatever reason.

Remembered: No

9.6 Set Debounce Time

Syntax:

Hexadecimal	0xFE 0x55 [time]
Decimal	254 85 [time]
ASCII	254 "U" [time]

Parameters:

Parameter	Length	Description
time	1	Debounce time in increments of 6.554ms (0 - 255).

Description: This command sets the time between key press and key read. All key types with the exception of latched piezo switches will 'bounce' for a varying time, depending on their physical characteristics. The [time] value is in increments of 6.554ms. The default debounce time for the module is 8 (about 52ms), which is adequate for most membrane keypads.

Remembered: Yes
Default: 8

9.7 Set Auto Repeat Mode

Syntax

Hexadecimal	0xFE 0x7E [mode]
Decimal	254 126 [mode]
ASCII	254 “~” [mode]

Parameters

Parameter	Length	Description
mode	1	Auto Repeat Mode (0: Resend Key , 1: Key Up/Down)

Description

Two auto repeat modes are available and are set via the same command:

- **Resend Key Mode:** 0x00
- **Key Up/Down Mode:** 0x01

Resend Key Mode This mode is similar to the action of a keyboard on a PC. In this mode, when a key is held down, the key code is transmitted immediately followed by a 1/2 second delay. After this delay, key codes will be sent via the RS-232 interface at a rate of about 5 codes per second. This mode has no effect if polling or if using the I^2C interface.

Key Up/Down Mode This mode may be used when the typematic parameters of the “Resend Key Code” mode are unacceptable or if the unit is being operated in polled mode. The host system detects the press of a key and simulates an auto repeat inside the host system until the key release is detected. In this mode, when a key is held down, the key code is transmitted immediately and no other codes will be sent until the key is released. On the release of the key, the key release code transmitted will be a value equal to the key down code plus 20 hex.

Remembered

Yes

Examples

When the key code associated with key ’P’ (0x50) is pressed, the release code is ’p’ (0x70). In RS-232 polled mode or via the I^2C, the “Key Down / Key Up” codes are used; however, the user should be careful of timing details. If the poll rate is slower than the simulated auto-repeat it is possible that polling for a key up code will be delayed long enough for an unwanted key repeat to be generated.

9.8 Auto Repeat Mode Off

Syntax

Hexadecimal	0xFE 0x60
Decimal	254 96
ASCII	254 “‘”

Description This command turns auto repeat mode off. See Set Auto Repeat Mode.

Remembered No

9.9 Assign Keypad Codes

Syntax

Hexadecimal	0xFE 0xD5 [KDown] [KUp]
Decimal	254 213 [KDown] [KUp]

Parameters

Parameter	Length	Description
KDown	25	Key down codes
KUp	25	Key up codes

Description This command will allow you to reassign the key codes that correspond to the key presses on the matrix style key pad. The first 25 bytes that are transmitted will be used for the key down codes and the next 25 bytes that are transmitted will be used for the key up codes.

Key Down					
	1	**2**	**3**	**4**	**5**
1	A	B	C	D	E
2	F	G	H	I	J
3	K	L	M	N	O
4	P	Q	R	S	T
5	U	V	W	X	Y

Key Up					
	1	**2**	**3**	**4**	**5**
1	a	b	c	d	e
2	f	g	h	i	j
3	k	l	m	n	o
4	p	q	r	s	t
5	u	v	w	x	y

Remembered Always

10 Display Functions

10.1 Introduction

The VK202-25-USB 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 Display On

Syntax

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

Parameters

Parameter	Length	Description
min	1	Minutes before turning the display on (0 to 90).

Description: This command turns the backlight on after the [minutes] timer has expired, with a ninety minute maximum timer. A time of 0 specifies that the backlight 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
Default: 0

10.3 Display 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 ’Display On’ command has been received.

Remembered: Yes

10.4 Set VFD Brightness

Syntax:

Hexadecimal	0xFE 0x59 [brightness]
Decimal	254 89 [brightness]
ASCII	254 “Y” [brightness]

Parameters:

Parameter	Length	Description
brightness	1	Brightness setting (0 to 3).

Description: This command sets and saves the display’s brightness to [brightness], where [brightness] is a value between 0x00 and 0x03 (between 0 and 3) according to the table below:

Value	Brightness
0x03	25%
0x02	50%
0x01	75%
0x00	100%

If the remember function is on, this command acts the same as ’Set and Save VFD Brightness’.

Remembered: Yes
Default: 255

10.5 Set and Save VFD Brightness

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

Parameters

Parameter	Length	Description
brightness	1	Brightness setting (0 to 3).

Description: This command sets and saves the display's brightness to [brightness], where [brightness] is a value between 0x00 and 0x03 (between 0 and 3) according to the table below:

Value	Brightness
0x03	25%
0x02	50%
0x01	75%
0x00	100%

Remembered: Always

11 Data Security

11.1 Introduction

Ensuring that your VK202-25-USB 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 VK202-25-USB 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.

11.2 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

Default: Do not remember

11.3 Data Lock

Syntax

Hexadecimal	0xFE 0xCA 0xF5 0xA0 [level]
Decimal	254 202 245 160 [level]

Parameters

Parameter	Length	Description
level	1	Sets the data lock level

Description

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	Data Lock Level	Description
0-2	Reserved	Should be left 0
3	Communication Speed Lock	When this bit is set (1) the Baud Rate and I^2C Slave address are locked
4	Setting Lock	When this bit is set (1) the display settings such as backlight, contrast and GPO settings are locked. (Internal EEPROM)
5	Reserved	Should be left 0
6	Command Lock	When this bit is set (1) all commands but commands 202/203 are locked. (cmd lock)
7	Display Lock	When this bit is set (1) the module is locked from displaying any new information. (text lock)

NOTES

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

Remembered Always
Default 0
Examples

Hex	Dec	Binary	Description
0x00	0	0	Unlock
0x50	80	01010000	Setting and Command Lock

11.4 Set and Save Data Lock

Syntax
Hexadecimal 0xFE 0xCB 0xF5 0xA0 [level]
Decimal 254 203 245 160 [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
Default: 0

11.5 Write Customer Data

Syntax	Hexadecimal	0xFE 0x34 [data]
	Decimal	254 52 [data]
	ASCII	254 “4” [data]

Parameters	Parameter	Length	Description
	data	16	Writes the customer data

Description: Writes the customer Data. 16 Bytes of data can be saved in non-volatile memory.

Remembered: No

11.6 Read Customer Data

Syntax	Hexadecimal	0xFE 0x35
	Decimal	254 53
	ASCII	254 “5”

Description: Reads whatever was written by Write Customer Data.

Remembered: No

12 Miscellaneous

12.1 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.

12.2 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
0x19	Version 1.9
0x57	Version 5.7

Remembered No

12.3 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	**2**	LCD2021
5	LCD2041	**6**	LCD4021
7	LCD4041	**8**	LK202-25
9	LK204-25	**A**	LK404-55
B	VFD2021	**C**	VFD2041
D	VFD4021	**E**	VK202-25
F	VK204-25	**10**	GLC12232
13	GLC24064	**14**	Unused
15	GLK24064-25	**16**	Unused
21	Unused	**22**	GLK12232-25
23	Unused	**24**	GLK12232-25-SM
25	GLK24064-16-1U-USB	**26**	GLK24064-16-1U
27	GLK19264-7T-1U-USB	**28**	GLK12232-16
29	GLK12232-16-SM	**2A**	GLK19264-7T-1U
2B	LK204-7T-1U	**2C**	LK204-7T-1U-USB
31	LK404-AT	**32**	MOS-AV-162A
33	LK402-12	**34**	LK162-12
35	LK204-25PC	**36**	LK202-24-USB
37	VK202-24-USB	**38**	LK204-24-USB
39	VK204-24-USB	**3A**	PK162-12
3B	VK162-12	**3C**	MOS-AP-162A
3D	PK202-25	**3E**	MOS-AL-162A
3F	MOS-AL-202A	**40**	MOS-AV-202A
41	MOS-AP-202A	**42**	PK202-24-USB
43	MOS-AL-082	**44**	MOS-AL-204
45	MOS-AV-204	**46**	MOS-AL-402
47	MOS-AV-402	**48**	LK082-12
49	VK402-12	**4A**	VK404-55
4B	LK402-25	**4C**	VK402-25
4D	PK204-25	**4E**	Unused
4F	MOS	**50**	MOI
51	XBoard-S	**52**	XBoard-I
53	MOU	**54**	XBoard-U
55	LK202-25-USB	**56**	VK202-25-USB
57	LK204-25-USB	**58**	VK204-25-USB
5B	LK162-12-TC	**5C**	Unused
71	Unused	**72**	GLK240128-25
73	LK404-25	**74**	VK404-25
77	Unused	**78**	GLT320240
79	GLT480282	**7A**	GLT240128

Remembered

No

13 Command Summary

13.1 Communications

Description	Syntax		Page
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]	

13.2 Text

Description	Syntax		Page
Auto Scroll On	Hexadecimal	0xFE 0x51	19
	Decimal	254 81	
	ASCII	254 “Q”	
Auto Scroll Off	Hexadecimal	0xFE 0x52	20
	Decimal	254 82	
	ASCII	254 “R”	
Clear Screen	Hexadecimal	0xFE 0x58	20
	Decimal	254 88	
	ASCII	254 “X”	
Changing the Startup Screen	Hexadecimal	0xFE 0x40	20
	Decimal	254 64	
	ASCII	254 “@”	
Set Auto Line Wrap On	Hexadecimal	0xFE 0x43	21
	Decimal	254 67	
	ASCII	254 “C”	
Set Auto Line Wrap Off	Hexadecimal	0xFE 0x44	21
	Decimal	254 68	
	ASCII	254 “D”	
Set Cursor Position	Hexadecimal	0xFE 0x47 [col] [row]	21
	Decimal	254 71 [col] [row]	
	ASCII	254 “G” [col] [row]	
Go Home	Hexadecimal	0xFE 0x48	22
	Decimal	254 72	
	ASCII	254 “H”	

Description	Syntax		Page
Move Cursor Back	Hexadecimal	0xFE 0x4C	22
	Decimal	254 76	
	ASCII	254 “L”	
Move Cursor Forward	Hexadecimal	0xFE 0x4D	22
	Decimal	254 77	
	ASCII	254 “M”	
Underline Cursor On	Hexadecimal	0xFE 0x4A	23
	Decimal	254 74	
	ASCII	254 “J”	
Underline Cursor Off	Hexadecimal	0xFE 0x4B	23
	Decimal	254 75	
	ASCII	254 “K”	
Blinking Block Cursor On	Hexadecimal	0xFE 0x53	23
	Decimal	254 83	
	ASCII	254 “S”	
Blinking Block Cursor Off	Hexadecimal	0xFE 0x54	23
	Decimal	254 84	
	ASCII	254 “T”	

13.3 Special Characters

Description	Syntax		Page
Creating a Custom Character	Hexadecimal	0xFE 0x4E [refID] [data]	24
	Decimal	254 78 [refID] [data]	
	ASCII	254 “N” [refID] [data]	
Saving Custom Characters	Hexadecimal	0xFE 0xC1 [Bank] [ID] [Data]	25
	Decimal	254 193 [Bank] [ID] [Data]	
Loading Custom Characters	Hexadecimal	0xFE 0xC0 [Bank]	26
	Decimal	254 192 [Bank]	
Save Startup Screen Custom Characters	Hexadecimal	0xFE 0xC2 [refID] [data]	26
	Decimal	254 194 [refID] [data]	
Initialize Medium Number	Hexadecimal	0xFE 0x6D	27
	Decimal	254 109	
	ASCII	254 “m”	
Place Medium Numbers	Hexadecimal	0xFE 0x6F [Row] [Col] [Digit]	27
	Decimal	254 111 [Row] [Col] [Digit]	
	ASCII	254 “o” [Row] [Col] [Digit]	
Initialize Horizontal Bar	Hexadecimal	0xFE 0x68	28
	Decimal	254 104	
	ASCII	254 “h”	
Place Horizontal Bar Graph	Hexadecimal	0xFE 0x7C [Col] [Row] [Dir] [Length]	28
	Decimal	254 124 [Col] [Row] [Dir] [Length]	
	ASCII	254 “|” [Col] [Row] [Dir] [Length]	

Description	Syntax		Page
Initialize Narrow Vertical Bar	Hexadecimal	0xFE 0x73	28
	Decimal	254 115	
	ASCII	254 “s”	
Initialize Wide Vertical Bar	Hexadecimal	0xFE 0x76	29
	Decimal	254 118	
	ASCII	254 “v”	
Place Vertical Bar	Hexadecimal	0xFE 0x3D [Column] [Length]	29
	Decimal	254 61 [Column] [Length]	
	ASCII	254 “=” [Column] [Length]	

13.4 General Purpose Output

Description	Syntax		Page
General Purpose Output Off	Hexadecimal	0xFE 0x56 [Num]	30
	Decimal	254 86 [Num]	
	ASCII	254 “V” [Num]	
General Purpose Output On	Hexadecimal	0xFE 0x57 [Num]	30
	Decimal	254 87 [Num]	
	ASCII	254 “W” [Num]	
Set Startup GPO state	Hexadecimal	0xFE 0xC3 [Num] [state]	31
	Decimal	254 195 [Num] [state]	

13.5 Dallas 1-Wire

Description	Syntax		Page
Search for a 1-Wire Device	Hexadecimal	0xFE 0xC8 0x2	31
	Decimal	254 200 2	
Dallas 1-Wire Transaction	Hexadecimal	0xFE 0xC8 0x1 [flags] [SndBits] [RcvBits] [Data]	32
	Decimal	254 200 1 [flags] [SndBits] [RcvBits] [Data]	

13.6 Keypad

Description	Syntax		Page
Auto Transmit Key Presses On	Hexadecimal	0xFE 0x41	34
	Decimal	254 65	
	ASCII	254 “A”	
Auto Transmit Key Presses Off	Hexadecimal	0xFE 0x4F	34
	Decimal	254 79	
	ASCII	254 “O”	

Description	Syntax		Page
Poll Key Press	Hexadecimal	0xFE 0x26	34
	Decimal	254 38	
	ASCII	254 “&”	
Clear Key Buffer	Hexadecimal	0xFE 0x45	35
	Decimal	254 69	
	ASCII	254 “E”	
Set Debounce Time	Hexadecimal	0xFE 0x55 [time]	35
	Decimal	254 85 [time]	
	ASCII	254 “U” [time]	
Set Auto Repeat Mode	Hexadecimal	0xFE 0x7E [mode]	36
	Decimal	254 126 [mode]	
	ASCII	254 “~” [mode]	
Auto Repeat Mode Off	Hexadecimal	0xFE 0x60	36
	Decimal	254 96	
	ASCII	254 “‘”	
Assign Keypad Codes	Hexadecimal	0xFE 0xD5 [KDown] [KUp]	37
	Decimal	254 213 [KDown] [KUp]	

13.7 Display Functions

Description	Syntax		Page
Display On	Hexadecimal	0xFE 0x42 [min]	37
	Decimal	254 66 [min]	
	ASCII	254 “B” [min]	
Display Off	Hexadecimal	0xFE 0x46	38
	Decimal	254 70	
	ASCII	254 “F”	
Set VFD Brightness	Hexadecimal	0xFE 0x59 [brightness]	38
	Decimal	254 89 [brightness]	
	ASCII	254 “Y” [brightness]	
Set and Save VFD Brightness	Hexadecimal	0xFE 0x91 [brightness]	38
	Decimal	254 145 [brightness]	

13.8 Data Security

Description	Syntax		Page
Set Remember	Hexadecimal	0xFE 0x93 [switch]	39
	Decimal	254 147 [switch]	
Data Lock	Hexadecimal	0xFE 0xCA 0xF5 0xA0 [level]	40
	Decimal	254 202 245 160 [level]	
Set and Save Data Lock	Hexadecimal	0xFE 0xCB 0xF5 0xA0 [level]	41
	Decimal	254 203 245 160 [level]	

Description	Syntax		Page
Write Customer Data	Hexadecimal	0xFE 0x34 [data]	42
	Decimal	254 52 [data]	
	ASCII	254 “4” [data]	
Read Customer Data	Hexadecimal	0xFE 0x35	42
	Decimal	254 53	
	ASCII	254 “5”	

13.9 Miscellaneous

Description	Syntax		Page
Read Version Number	Hexadecimal	0xFE 0x36	42
	Decimal	254 54	
	ASCII	254 “6”	
Read Module Type	Hexadecimal	0xFE 0x37	43
	Decimal	254 55	
	ASCII	254 “7”	

13.10 Command By Number

Command Hex	Description Dec	Page ASCII		
0x26	38	“&”	Poll Key Press	34
0x33	51	“3”	Changing the I^2C Slave Address	16
0x34	52	“4”	Write Customer Data	42
0x35	53	“5”	Read Customer Data	42
0x36	54	“6”	Read Version Number	42
0x37	55	“7”	Read Module Type	43
0x39	57	“9”	Changing the Baud Rate	16
0x3D	61	“=”	Place Vertical Bar	29
0x40	64	“@”	Changing the Startup Screen	20
0x41	65	“A”	Auto Transmit Key Presses On	34
0x42	66	“B”	Display On	37
0x43	67	“C”	Set Auto Line Wrap On	21
0x44	68	“D”	Set Auto Line Wrap Off	21
0x45	69	“E”	Clear Key Buffer	35
0x46	70	“F”	Display Off	38
0x47	71	“G”	Set Cursor Position	21
0x48	72	“H”	Go Home	22
0x4A	74	“J”	Underline Cursor On	23
0x4B	75	“K”	Underline Cursor Off	23
0x4C	76	“L”	Move Cursor Back	22
0x4D	77	“M”	Move Cursor Forward	22

Command Hex	Description Dec	Page ASCII		
0x4E	78	“N”	Creating a Custom Character	24
0x4F	79	“O”	Auto Transmit Key Presses Off	34
0x51	81	“Q”	Auto Scroll On	19
0x52	82	“R”	Auto Scroll Off	20
0x53	83	“S”	Blinking Block Cursor On	23
0x54	84	“T”	Blinking Block Cursor Off	23
0x55	85	“U”	Set Debounce Time	35
0x56	86	“V”	General Purpose Output Off	30
0x57	87	“W”	General Purpose Output On	30
0x58	88	“X”	Clear Screen	20
0x59	89	“Y”	Set VFD Brightness	38
0x60	96	“‘”	Auto Repeat Mode Off	36
0x68	104	“h”	Initialize Horizontal Bar	28
0x6D	109	“m”	Initialize Medium Number	27
0x6F	111	“o”	Place Medium Numbers	27
0x73	115	“s”	Initialize Narrow Vertical Bar	28
0x76	118	“v”	Initialize Wide Vertical Bar	29
0x7C	124	“|”	Place Horizontal Bar Graph	28
0x7E	126	“~”	Set Auto Repeat Mode	36
0x91	145		Set and Save VFD Brightness	38
0x93	147		Set Remember	39
0xA4	164		Setting a Non-Standard Baud Rate	17
0xC0	192		Loading Custom Characters	26
0xC1	193		Saving Custom Characters	25
0xC2	194		Save Startup Screen Custom Characters	26
0xC3	195		Set Startup GPO state	31
0xC8	200		Dallas 1-Wire Transaction	32
0xCA	202		Data Lock	40

14 Appendix

14.1 Specifications

14.1.1 Environmental

Table 66: 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	

14.1.2 Electrical

Table 67: Electrical Specifications

Supply Voltage	+5Vdc ±0.25V
Backlight On	185 mA typical
Backlight Off Supply	50 mA

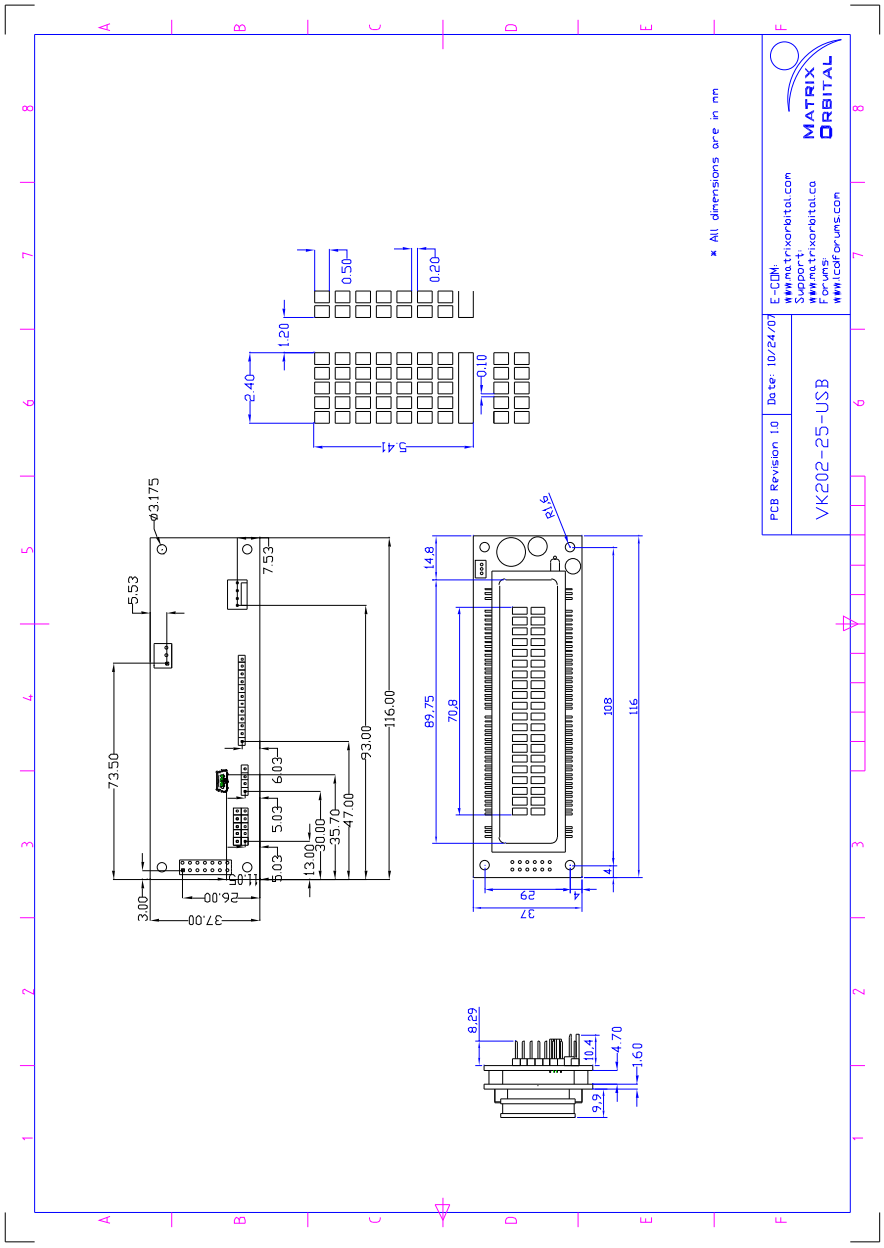
14.2 Optical Characteristics

Table 68: Optical Characteristics

Character x Lines	20 columns x 2 rows
Module Size	116.00 mm x 37.00 mm x 27.7 mm
Character Size	3.20 mm x 5.55 mm
Active Area	75.50 mm x 11.50 mm
LED Backlight Life	100,000 hours typical

14.3 Physical Layout

Figure 18: Physical Diagram



14.4 Definitions

E Extended Temperature (-20C to 70C)

MSB Most Significant Byte

LSB Least Significant Byte

14.5 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