TC51553 CONTROLLER

USER MANUAL

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TOUCH SCREEN LCD MODULE HANDLING PRECAUTIONS

The following precautions will guide you in handling of our product correctly:

1. Liquid crystal display devices:
   1.1. The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock on LCD and touch screen. Should the glass break, handle it with care.
   1.2. The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.
   1.3. Wash your hands or clothes if you touch liquid crystal!

2. Avoid Static electricity!
   2.1. When working with the module, use your naked or gloved hand and wear non-conductive work suit to prevent generating static electricity by friction. ESD ground straps should be utilized.
   2.2. Be sure to ground any electrical appliances you may be using, such as soldering iron, cutting pliers, tweezers, etc.
   2.3. Floors, doors, and work tables must be grounded to discharge electricity.

3. When the LCD module alone must be stored for long periods of time:
   3.1. Protect the modules from high temperature and humidity.
   3.2. Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
   3.3. Protect the modules from excessive external forces.

4. Use the module with a power supply that is equipped with an over current protector circuit, since the module is not provided with this protective feature.

5. Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.

6. Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used.

7. Do not stack up modules since they can be damaged by components on neighboring modules.

8. Do not place heavy objects on top of the product. This could cause glass breakage.

9. Do not scratch LCD or touch screen!

10. In order to maintain module reliability, do not touch or hold by the connector area.

11. Avoid any bending, pulling, or other excessive force on flexible cables, which can result in broken connections.

12. ATTENTION!!! AVOID DISCONNECTING TOUCH SCREEN FROM THE J8 CONNECTOR!

PREFACE

About This Manual

This user's manual describes the function and operation of the TC51553 controller Firmware v2.0 and higher. This manual will help you quickly set up the touch screen controller evaluation board and its accompanying software, so that you can rapidly test and evaluate their usefulness for your application.

If You Need an Assistance

If you have any questions about this evaluation board, feel free to e−mail TVI Electronics Support Team at support@tvielectronics.com. Include the product name in the subject heading.

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1. FUNCTIONS AND STRUCTURE

1.1. GENERAL

The TC51553 is an intelligent LCD controller with an integrated touch screen control that supports Optrex F-51553 128x64 COG Monochrome STN Graphic LCD. This controller allows user to individually control each display pixel. This independent pixel control allows user displaying both text and pictures simultaneously. The TC51553 uses an ATMEGA16 microcontroller and external AT24C512 serial EEPROM. The microcontroller can be reprogrammed at any time by using AVRISP device.

1.2. FEATURES

1.2.1. RS-232 communication interface with nine programmable baud rates

The TC51553 controller has RS-232 protocol interface. Communication parameters are: 8 Bit, No Parity and 1 Stop Bit. The TC51553 controller is shipped set at 9600 baud rate. The baud rate can be changed by a command and stored. A regular DB9 connector on board allows communication with PC through the standard serial cable. TVI Electronics offers this cable as part number DB9MF. A serial TTL interface is supplied at J4. For TTL interface, remove the jumpers on J4 header, see jumpers configuration.

1.2.2. 512k bites external EEPROM

512kb of external EEPROM are divided into 64 pages of 1024 bytes each. The lower four pages of this memory hold a default text font used to display text. The remaining memory can be used to store up to 60 full-screen images. A utility program allows user to convert and download 128x64 pixels bmp or jpg patterns to display.

1.2.3. Touch screen controller

The touch screen controller can respond by sending X and Y coordinates of touch screen contact location or by sending digits (if used as a keypad) to main microprocessor or computer. In Keypad Mode, controller sends ASCII code of each number. "Esc" button sends char 27 (ASCII for Esc), "Ent" button sends char 13 (ASCII for Enter). The TC51553 controller is calibrated for touch screen. Any command sent from main computer or microprocessor will disable touch screen. The touch screen can be enabled by a command.

1.2.4. AVRISP interface

AVRISP (In-System Programmer) interface allows user to program own code into microcontroller, AVRISP device is required.

1.2.5. Draw/Clear Line/Rectangle/Circle

The TC51553 controller simplifies drawing and clearing of horizontal, vertical and skew lines and shapes, such as rectangle and circle.

1.2.6. Voltage regulator

The TC51553 has a built-in voltage regulator with input 7 - 15 VDC (connector J11) and output 5 VDC (connector J5). The voltage regulator is capable to provide up to 1A current for external applications. 5V power may be applied to J5 eliminating the need for J11.

1.2.7. Software control

Software allows controlling LCD contrast, backlight ON/OFF and display ON/OFF.

1.2.8. Horizontal scrolling bar

The TC51553 controller provides a horizontal scrolling bar feature. Up to 25 characters may be stored in the external EEPROM. Scrolling bar delay and font type can be specified by a command. See Commands List.

1.2.9. Fonts

The TC51553 controller supports 3 built in font sizes: 5x7, 8x14, and 8 x 14 Bold. The bmp font files are stored as screens 1-4 in controller's memory. The font files can be created in Windows Paint or other compatible program. Different font sizes can be freely mixed on the screen.

1.2.10. Spare pins on Atmega16

8 port pins of ATmega16 microcontroller (PA6, PA7, PC2, PC3, PD4, PD5, PD6, PD7) are available for your personal use.

1.3. POWER REQUIREMENTS

Power to the TC51553 is derived from the external power supply through either J11 or J5 connectors. Voltages of 7 VDC to 15 VDC must be supplied through J11 connector. Since it is regulated on the TC51553, this input voltage does not need to be regulated as long as it falls within this range. Voltage of 5 VDC must be supplied through the J5 and should be regulated.

* Make sure the polarity is correct! Reversed power will damage the device and/or power supply!

2. GETTING STARTED

This chapter guides you through the hardware connection, powering up the TC51553 controller and setting up the software for initial testing.

2.1. HARDWARE CONNECTION

Carefully open the LCD connector latch J1 by pulling the brown latch outwards. Insert the flat data cable contacts side down into the connector being sure the cable is fully seated, push the latch back in being sure the cable is pushed all the way in. To connect the backlight, pass straight wires through the holes of the J3 connector and solder on the F-51553 LED pads (+ and -) with the corresponding holes on the J3 connector.

If you have a touch screen carefully pull the latch on connector J8 out. Insert the touch screen cable into J8 being sure it is seated, push the latch back in.

2.2. POWER UP

Connect a power supply to J11 power jack; make sure the polarity is correct. Screen #5 is the power up screen which will be displayed each time the unit is powered up. The power up screen can be customized through Control Panel software. The factory default will show TVI Electronics logo and current controller firmware revision as shown on Default Power Up Screen below.

Example 2-1 Default Power Up Screen

2.3. QUICK START

Download and install Control Panel software on your PC. Follow instructions that the installer gives you. When installation is complete, connect a serial cable from your PC to the TC51553 controller. Once this connection is made, launch the Control Panel software on your PC. Select an appropriate COM Port, Baud Rate (default 9600), and click Connect. Now you may begin using the software to evaluate the TC51553 controller board.

Figure 2-1 Default Software Screen
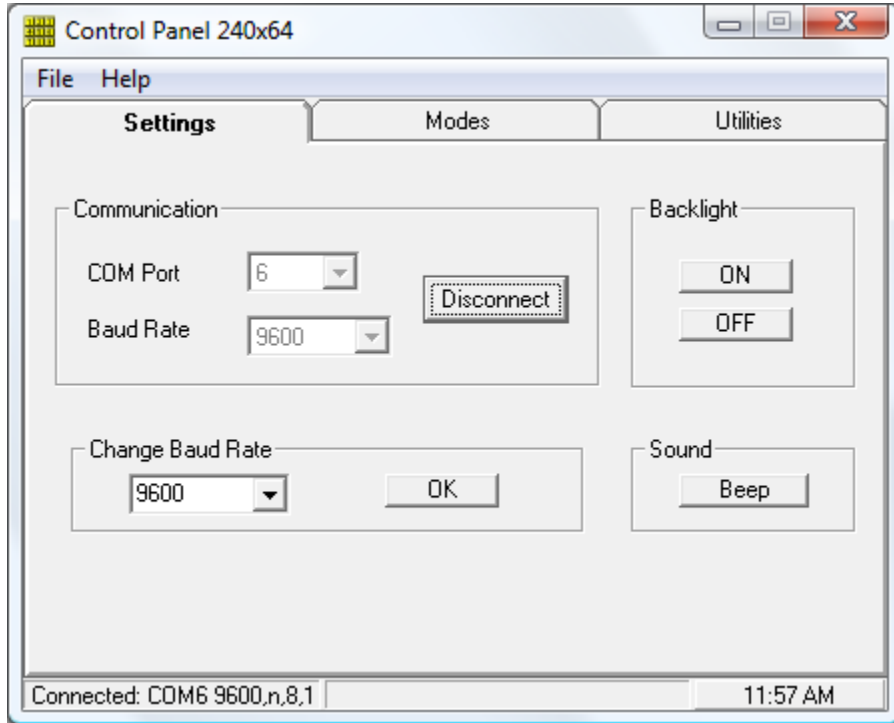
3. OPERATION

This chapter describes each function of TC51553 controller.

3.1. TC51553 CONTROLLER JUMPERS AND SWITCHES

Figure 3-1 TC51553 Controller Board Layout
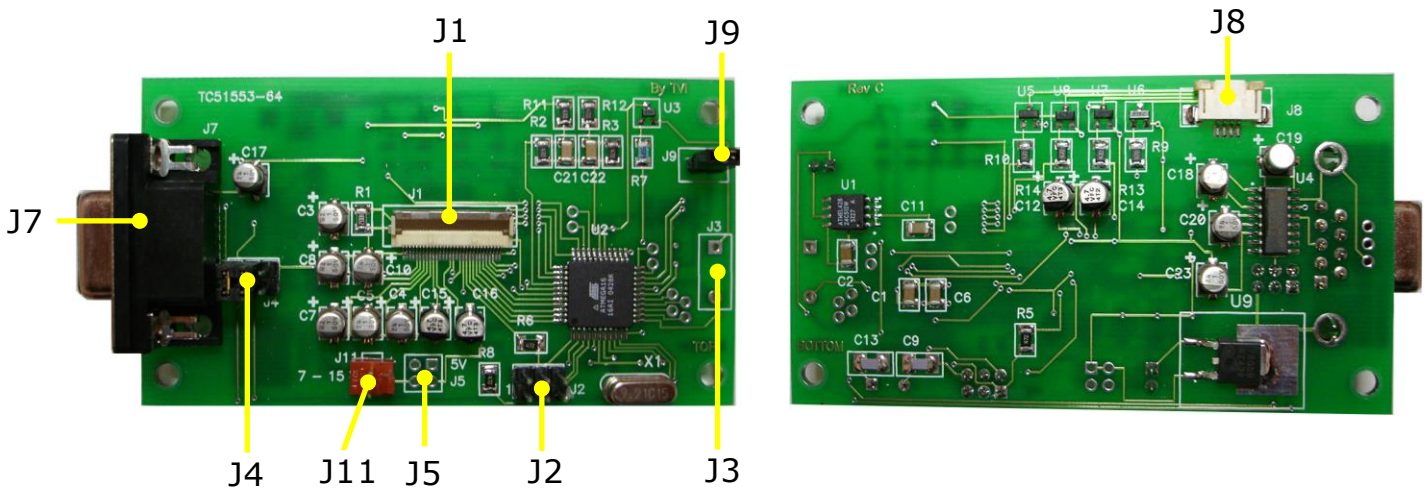
Table 3-1 Jumpers & Headers

Reference Designator	Function	Setting	Subsection
J2	AVRISP Interface		
J4	Serial communication through RS232	ON	3.1.1
	Serial communication through Atmega16 UART	OFF	
J9	Baud Rate 9600	ON	3.1.2
	User defined Baud Rate	OFF	

Table 3-2 Connectors

Reference Designator	Function
J1	F-51553 LCD Interface
J3	F-51553 LCD Backlight Connector
J5	Optional 5VDC Input/Output
J7	RS232 Connector
J8	Touch Screen Connector
J11	7 – 15 VDC Input

3.1.1. Serial Communication

Communication with Touch Screen LCD Module through RS232 requires installation of jumpers on J4 (Factory Default).

Communication with Touch Screen LCD Module through Atmega16 UART requires removal of two jumpers on J4. Use J4 as a header to connect TXD, RXD, and GND from external application.

3.1.2. Baud Rate Settings

The TC51553 controller has nine programmable baud rates. The TC51553 controller is shipped set at 9600 baud rate. A baud rate is set by a command and stored. The baud rate can be changed at any time by removing a jumper from J9.

3.2. TC51553 COMMANDS LIST

- Text Mode

Print a single character:

Address								Data (ASCII)							
0	0	0	0	0	0	1	0	x	x	x	x	x	x	x	x

Address 0x02, Data - ASCII for a character

Print a string:

Address								Data (ASCII) or String Terminator							
0	0	1	0	0	1	1	0	x	x	x	x	x	x	x	x

The string starts with Address 0x26 followed by ASCII Data for every character. The max string size is 25 ASCII characters. For a string less than 25 characters, use a string terminator 0x0D.

- Graphic Mode

To operate in Graphic Mode, the controller requires two characters per command.

Address								Data							
0	0	0	0	0	0	1	1	x	x	x	x	x	x	x	x

Address 0x03, Data - 8 bit for a desired graphic pattern

- XY Mode allows control of a single pixel as well as drawing shapes, such as rectangle and circle and horizontal, vertical or skew lines according to the entered coordinates.
In a Pixel mode the controller will rewrite the contents of the display data RAM for a given pixel.
    (0,0) - coordinate at the top left corner of the screen.
    (127,63) - coordinate at the lower right corner of the screen.

Pixel ON/OFF:

Address								Data							
0	0	0	0	1	0	1	0	x	x	x	x	x	x	x	x

X Coordinate								Y Coordinate							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Step 1. Address 0x0A, Data - number of coordinates in the string
Step 2. X (from 0 to 127), Y (from 0 to 63) coordinates

If the specified number of coordinates > 1, repeat Step 2.
For more than 128 (X and Y) coordinates, repeat Steps 1 & 2.

Overwriting the same coordinate will reverse a pixel on the screen (ON/OFF).

To draw a line:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E, Data 0x00, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - Start coordinate   (X2,Y2) - End coordinate

To clear a line:

Address								Data							
0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1F, Data 0x00, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - Start coordinate   (X2,Y2) - End coordinate

To draw a rectangle:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E, Data 0x01, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner   (X2,Y2) - lower right corner

To clear a rectangle:

Address								Data							
0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1F, Data 0x01, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner   (X2,Y2) - lower right corner

To draw a filled rectangle:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E, Data 0x02, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner   (X2,Y2) - lower right corner

To clear a filled rectangle or a specified area:

Address								Data							
0	0	0	1	1	1	1	1	0	0	0	0	0	0	1	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1F, Data 0x02, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner   (X2,Y2) - lower right corner

To reverse pixels of the specified rectangle:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E,   Data 0x03,   Data X1,   Data Y1,   Data X2,   Data Y2
(X1,Y1) - upper left corner   (X2,Y2) - lower right corner

To draw a circle:

Address								Radius							
0	0	1	0	0	0	0	0	x	x	x	x	x	x	x	x

X Coordinate								Y Coordinate							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x20,   Data R,   Data X,   Data Y
R - circle radius   X,Y - circle center point

To clear a circle:

Address								Radius							
0	0	1	0	0	0	0	1	x	x	x	x	x	x	x	x

X Coordinate								Y Coordinate							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x21,   Data R,   Data X,   Data Y
R - circle radius   X,Y - circle center point

- Specify Start page and column

Start page:

Address								Data							
0	0	0	0	0	1	1	0	0	0	0	0	0	x	x	x

Address 0x06,   Data x
x - page address from 0 to 7

Start column:

Address								Data							
0	0	0	1	0	0	1	0	0	x	x	x	x	x	x	x

Address 0x12,   Data x
x - column address from 0 to 127

- Select Screen font:

Address								Data							
0	0	0	1	0	1	0	1	0	0	0	0	0	0	x	x

Address 0x15,   Data x
font 5x7 (default): x = 1, font 8x14: x = 2, font 8x14 Bold: x = 3

- Backlight:

Address								Data							
0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	x

Address 0x09,   Data x
ON: x = 1, OFF: x = 2

- The touch screen controller can respond by sending X and Y coordinates of a touch screen contact location or by sending digits (if used as a keypad) to main microprocessor or computer. The controller will respond by sending "$" character to main microprocessor after the touch screen release.

  Touch screen in XY Coordinates Mode (allow 2% inaccuracy):

Address								Data							
0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	x

Address 0x05,   Data x
ON: x = 1, OFF: x = 2

Controller response:

X Coordinate								Comma							
x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0

Y Coordinate								String Terminator							
y	y	y	y	y	y	y	y	0	0	1	0	0	0	0	0

Example: x 0x2C y 0x20

Keypad Mode:

Address								Data							
0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	x

Address 0x13,   Data x
ON: x = 1, OFF: x = 2

- Touch Screen Calibration:

Address								Data							
0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1

Address 0x19,   Data 1

The calibration routine is provided to compensate for the normal touch screen variation. You will be asked to touch all four corners of the touch screen. A "Dot" along with comments will appear on the screen indicating where to make a touch. If inaccurate data is received, you will be asked to repeat the touch screen calibration. After successful calibration the controller will print "Done!" on the screen.

- Display power save mode:

Address								Data							
0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	x

Address 0x0D,   Data x
ON: x = 1, OFF: x = 2

- Display background color:

Address								Data							
0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	x

Address 0x0B,   Data x
NORMAL: x = 1, REVERSE: x = 2

- Clear screen:

Address								Data							
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1

Address 0x01,   Data 0x01

- Optrex F-51553 series LCD modules have two LCD BIAS Sets. Changing LCD Bias Set (1/7, 1/9) will affect the display contrast.

Address								Data							
0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	x

Address 0x0E,   Data x
1/7: x = 1, 1/9: x = 2

- Optrex F-51553 series LCD modules provide 9-bits of software contrast adjustment. This is subdivided into 3-bit rough adjustment called "V5 Voltage Regulator Internal Resistor Ratio Set" and 6-bit fine adjustment called "Electronic Volume".

V5 Voltage Regulator Internal Resistor Ratio Set:

Address								Data							
0	0	0	0	1	1	0	0	0	0	0	0	0	x	x	x

Address 0x0C,   Data x (from 0 to 7)

Electronic Volume:

Address								Data							
0	0	0	1	0	0	0	0	0	0	x	x	x	x	x	x

Address 0x10,   Data x (from 0 to 63)

- The TC51553 controller supports Horizontal Scrolling Bar feature. Scrolling text location can be selected by Start page command. User can specify a scrolling delay and select font. Max number of scrolling characters is 25. Run scrolling text command will activate a touch screen. By pressing the touch screen, controller will stop the scrolling text, clear its page, and send ASCII char 7 ("Bell") to main computer or microprocessor. To restart scrolling text feature, the appropriate command is required.

To Run a scrolling text:

1. Save scrolling text to the external EEPROM.

Address								Data					
0	0	0	1	1	0	0	0	0	0	0	x	x	x	x	x

Address 0x18,   Data x (ASCII Code, max 25)

2. Select scrolling delay.

Address								Data (Delay Time)							
0	0	0	1	0	1	1	1	x	x	x	x	x	x	x	x

Address 0x17,   Data x
To calculate delay time, multiply x by 1/10 of second.

3. Run scrolling text with selected font.

Address								Data (Font Selector)							
0	0	0	1	0	1	1	0	0	0	0	0	0	0	x	x

Address 0x16,   Data x
font 5x7 (default): x = 1, font 8x14: x = 2, font 8x14 Bold: x = 3

If scrolling text was previously saved in the external EEPROM and the delay was specified, use Run scrolling text command to restart a scrolling feature.

- Set baud rate:

Address								Data							
0	0	0	0	1	1	1	1	0	0	0	0	x	x	x	x

Address 0x0F,   Data x
2400bps: x= 0, 4800bps: x = 1, 9600bps: x = 2, 14400bps: x = 3,
19200bps: x = 4, 28800bps: x = 5, 38400bps: x = 6, 57600bps: x = 7,
76800bps: x = 8, 115200bps: x = 9

The baud rate is stored and will default to the stored value.

- 512kb of external EEPROM is divided into 64 pages, 1024 bytes each. The lower four pages of this memory hold default text font used to display text. The remaining memory can be used to store up to 60 full-screen images. A utility program allows user to convert and download 128x64 pixels bmp or jpg graphics to display.

Load screen from EEPROM:

Address								Data							
0	0	0	0	1	0	0	0	0	x	x	x	x	x	x	x

Address 0x08,   Data x (from 1 to 64)

Save current screen:

Address								Data							
0	0	0	1	0	0	0	1	0	x	x	x	x	x	x	x

Address 0x11,   Data x (from 1 to 64)

* The controller will respond with exclamation mark (!) 0x21 when ready for the next command.

4. PHYSICAL DESCRIPTION

This chapter contains the Touch Screen LCD Module physical dimensions.

4.1. TOUCH SCREEN LCD MODULE PHYSICAL DIMENSIONS
- Dimensions for Modules with F-51553GNBJ-LW-AEN LCD
  97.0mm (W) x 50.0mm (H) x 25.0mm (D)

- Dimensions for Modules with F-51553GNYJ-LY-AA LCD
  97.0mm (W) x 50.0mm (H) x 32.0mm (D)