ACS

320 x 240 LCD

Display Terminal

User's Manual

5/20/2010 3:54 PM

Ackerman Computer Sciences

On The Cutting Edge of Technological Evolution

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Overview

The **ACS 320 x 240 LCD Display Terminal** is designed to provide a cost effective RS-232/RS-485 operator interface. A high contrast 320 x 240 pixel LED backlight transflective LCD provides viewing in direct light, and well as indoors. It has a 12:00 to 6:00pm viewing angle, which means that it can be viewed from straight on to about 80 degrees downward. The backlight automatically turns on when characters are received or keypad inputs are activated, and shuts off after a programmable period of no use. You can use your choice of matrix or non-matrix keypads, providing 7 to 12 inputs. An on board tone generator and amplifier can be used to provide audible user feedback.

Features

- FLASH Based design for easy in-field software updates
- Transflective LCD Display with LED backlight and noon to 6:00PM viewing angle
- Single Power Supply
- Scan/Matrix & non-Matrix keypad inputs for 12 or 8 switch inputs
- On board 250mW audio amplifier for tone generator
- On board diagnostic LED that indicates Rx and Tx activity
- 6 User programmable graphics pages expandable to 12
- User Configurable non-Volatile Settings for:
    - Baud Rate
    - Display Communications Address for multi-drop operation
    - Keypad Type:
        - Debounce (8 N.O. switches)
        - Scan/Matrix (4 Column by 4 Row matrix of 16 N.O. switches)
        - Send Keypad Opens as well as Closes
    - Keypad polling for multi-drop operation
    - Backlight Timeout seconds
    - Optional Display Logo On power-up
    - Optional Display Settings On power-up
    - Optional Pop-up touchscreen QWERTY or NUMERIC keypad
    - Protocol Selection:
        - SOH / ETX commands for full graphics
        - ANSI subset for scrolling character data
- Small form-factor, mounts in standard dual-gang electrical switchbox with optional mounting plate and membrane keypad overlay
- Low Power
    - 80mA Typical with LED Backlight Off
    - 180mA Typical with LED Backlight On

Manual Conventions

In this manual the following assumptions, abbreviations and conventions are used:

ASCII

ASCII stands for the American Standard Code for Information Interchange. As ASCII code is the agreed upon numerical representation of a character. (see ASCII Table appendix)

ASCII Hex

The use of ASCII characters to represent one or more hexadecimal digits:

ASCII Character(s)	Represents Value
'0'	0
'1'	1
'2'	2
'3'	3
'4'	4
'5'	5
'6'	6
'7'	7
'8'	8
'9'	9
'A'	10
'B'	11
'C'	12
'D'	13
'E'	14
'F'	15
…	…
'10'	16
'28'	40
'7F'	127
'80'	128
'FF'	255
'13F'	319

<SOH>

Represents a single ASCII Start of Heading character; CTRL-A, 01 decimal, 01 hex. This character delineates the start of a command or response in SOH/ETX protocol mode.

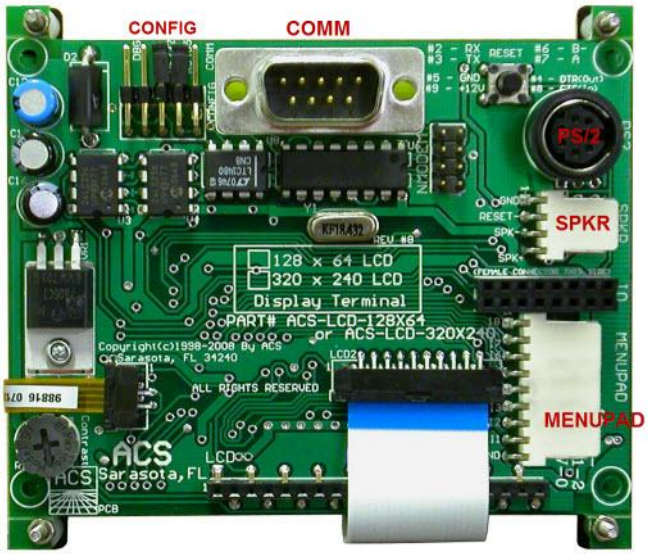
<ETX>

Represents a single ASCII End of Text character; CTRL-C, 03 decimal, 03 hex. This character delineates the end of a command or response in SOH/ETX protocol mode.

SOH/ETX Protocol

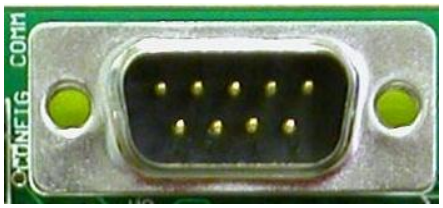
Represents the use of a command/response protocol where the messages are bracketed by the non-printing/displaying SOH and ETX characters and the bracketed message contents are expressed by a sequence of one or more printable/displayable characters.

Connections



COMM Connector

The following signals appear on the COMM DB-9P connector:



PIN	SIGNAL	Direction at display
2	RS-232 RxD	IN
3	RS-232 TxD	OUT
4	RS-232 DTR (optional)	OUT
5	GND	IN
6	RS-485 B-	I/O
7	RS-485 A+	I/O
8	RS-232 CTS (optional)	IN
9	+12-14VDC	IN

Mating Connector: DB-9 Female

RS-232 Connection to PC

COMM Pin #	PC DB9 Pin #	PC DB25 Pin #	Power Supply	LCD SIGNAL	DIR	PC SIGNAL
2	3	2		RxD	←	TxD
3	2	3		TxD	→	RxD
4 (optional)	8 (optional)	5 (optional)		DTR	→	CTS
5	5	7	GND	GND		GND
8	7 (optional)	4 (optional)		CTS	←	RTS
9	N/C	N/C	+12 → +14VDC	+12 → +14VDC		

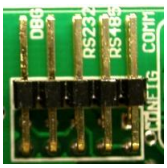
RS-485 Connection

COMM Pin #	Power Supply	SIGNAL
7	N/C	A+
6	N/C	B-
5	GND	GND
9	+12 → +14VDC	+12 → +14VDC

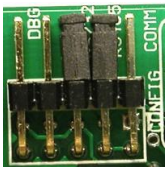
NOTE: Be sure to connect both the Ground of the PC or Host computer and the Ground of your +12 → +14VDC Power supply together!

The RS-485 A+ and B- signals are terminated with a 100 ohm resistor between them. In addition, there is a 10K pull-up resistor on the A+ signal to +3.3v and a 10K pull-down resistor on the B- signal to Ground, to put the received data line in an idle state when there is no connection.

Changing between RS-232 and RS-485 operation requires the movement of a pair of jumpers on the CONFIG header located next to the COMM connector:



CONFIG (no jumpers)



CONFIG for RS-232

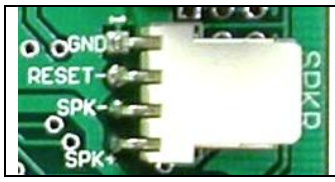
CONFIG for RS-485

The DTR connection is for optional flow control of the transmit data to the display to prevent over-flowing the display input buffer at higher baud rates. It requires disabling the RS-485 enable in the display configuration and implementation of flow control on the host device supplying the data to the display.

The LCD display functions as a RS-232 DTE (Data Terminal Equipment) device. There is an unpopulated jumper block site on the controller labeled NMODEM that can be used to reverse the signals pairs TxD, RxD and DTR, CTS on the COMM connector to make the device appear as DCE (Data communications Equipment). Installation of the NMODEM jumper block requires cutting the default traces on the bottom of the controller board underneath the jumper block, soldering in the 8 pin dual row 0.1" jumper header, and the installation of two pairs of shunt jumpers on the header oriented 90º from the original default trace connections.

Speaker / Reset (SPKR) Connector

The following signals appear on the six pin KK-100 SPKR connector:



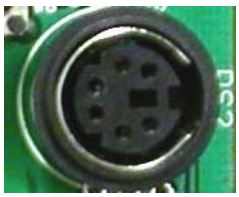
PIN	SIGNAL
1	GND
2	RESET-
3	Speaker -
4	Speaker +

Mating Connector: KK-100 0.1" 4 position

Pin #1 Identified by Square Pad, and signals are also identified by silkscreen legend on the board.

PS/2 Connector

The following signals appear on the six pin PS/2 connector:



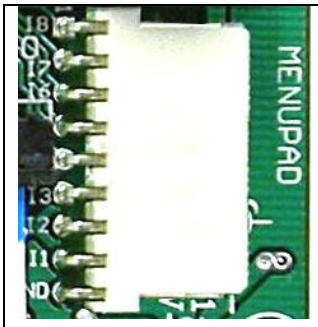
PIN	SIGNAL
1	DATA
2	(reserved)
3	GND
4	+5V
5	CLK
6	(reserved)

Mating Connector PS/2 circular DIN 6 position

The +5V is fused at 0.5A with a resettable fuse.

MENUPAD Connector

The following inputs are available on the "MENUPAD" connector:

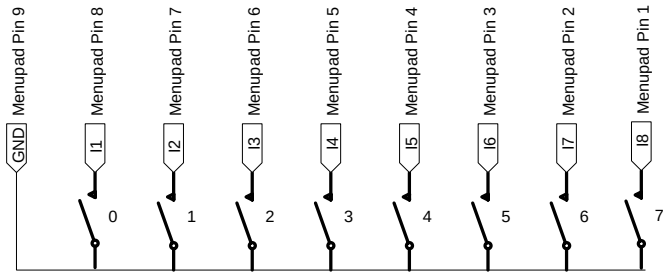


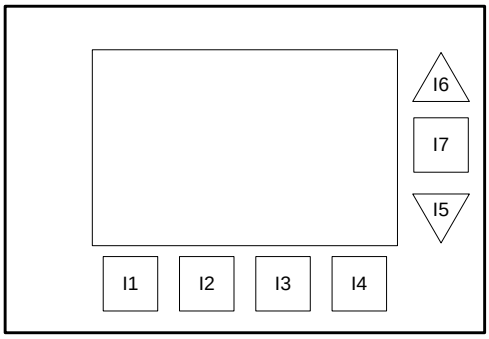
PIN	Label	Debounce	Scan/Matrix
1	I8	Input #8	Column #4
2	I7	Input #7	Column #3
3	I6	Input #6	Column #2
4	I5	Input #5	Column #1
5	I4	Input #4	Row #4
6	I3	Input #3	Row #3
7	I2	Input #2	Row #2
8	I1	Input #1	Row #1
9	GND	GND	GND

Mating Connector: Molex KK-100 0.1" 9 position

Pin #1 Identified by the board legend and the Square Pad. In Scan/Matrix mode, the Column signals are outputs and the Row signals are inputs.

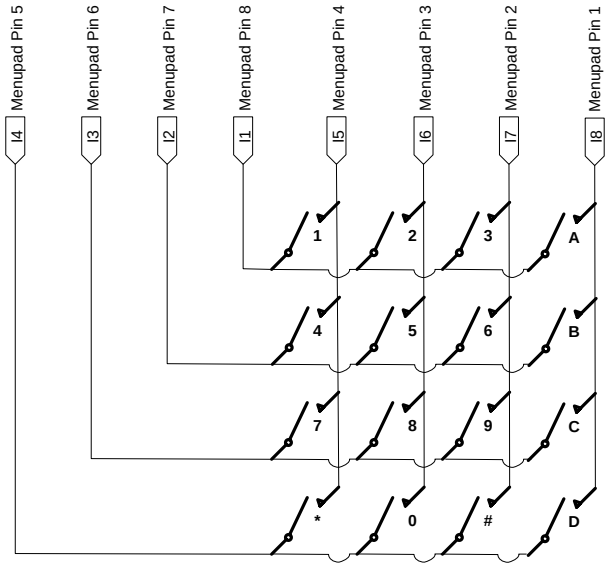
Debounce Wiring





Membrane Switch Overlay

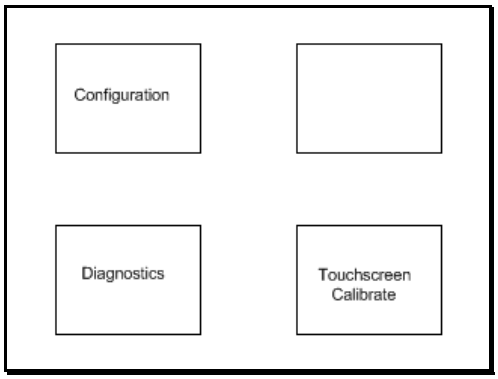
Scan/Matrix Wiring



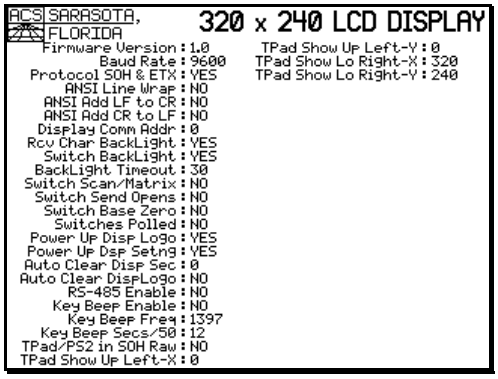
Startup

When power is applied or the ACS LCD 320x240 is reset, the controller initializes the display, turns on the backlight, then initializes the non-volatile memory, keypad, serial communications and touch screen.

If enabled by the **`Power Up Quad Detect`** configuration setting and if the touch screen reports that it has a continuous touch, the coordinate of the touch location is used to force the display into one of four startup modes:

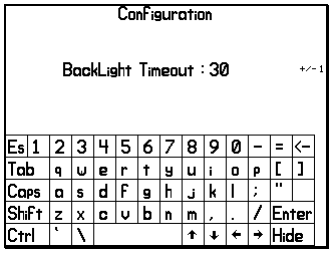


If there is no touch held in any quadrant, the display finishes powering up. If enabled by the **`Power Up Disp Logo`** configuration setting, the logo screen is restored from saved page zero. Then, if enabled by the **`Power Up Disp Setng`** configuration setting, the list of settings is displayed:

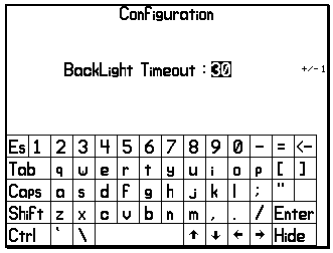


Configuration Mode

In Configuration Mode, the touch keypad is used to adjust or default User Configuration settings. In this mode, the touch keypad is displayed, and the ↑ and ↓ keys are used to scroll between configuration items, one at a time. When the desired setting is reached, the Enter key is used to edit the item's value which inverts:



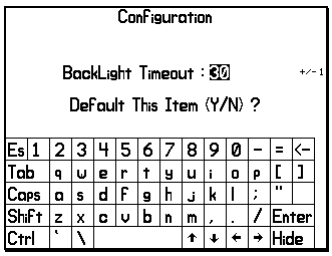
↑↓ keys scroll settings, Enter edits



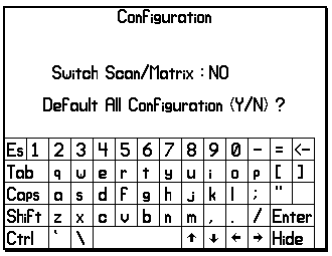
↑↓ keys scroll value, Enter saves

When editing, the ↑ and ↓ keys increment and decrement the value by the amount shown to the right of the item, and the ← and → keys change the increment amount. Pressing the Enter key again saves the setting into the non-volatile configuration memory.

When editing an item, the 'D' or 'd' key can restore an item to it's default value. When not editing an item, the 'D' or 'd' key can restore all of the configuration items to their default values.



When editing, 'D' key defaults item

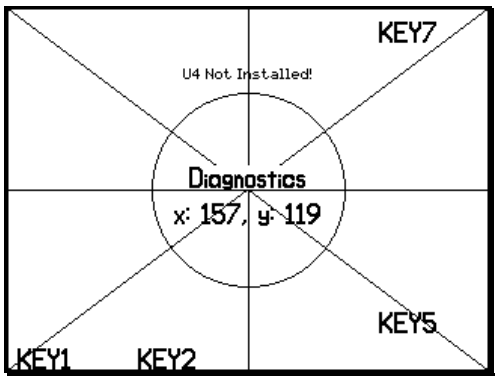


When not editing, 'D' key defaults all settings

Press the HIDE key or Reset the LCD display to exit Configuration Mode.

Diagnostics Mode

In Diagnostics Mode, the display draws some text and graphics, toggles the backlight on and off, produces an intermittent tone and shows the status of the MENUPAD key inputs as well as any touch screen touch coordinates:



Touch Screen Calibration Mode

When the screen is held touched in this quadrant during power-up, the LCD enters the Touch Screen calibration process. See the Touch Screen Calibration section below for the calibration sequence.

Incorrect entry of the touch screen coordinates during calibration can result in the inability of the touch screen to function properly and require that the touch screen calibration be manually erased and re-attempted. The touch screen calibration can only be force erased by invoking the User Configuration DEFAULT option via a sequence of input closures (or membrane switch closures) using the MENUPAD connector. See the User Configuration section below for entering User Configuration via the MENUPAD connector.

User Configuration

Entering User Configuration

User configuration can be entered in two ways:

1. Pressing on the upper left touch screen quadrant during power-up or Reset as outlined above in the Startup section.
2. Shorting two MENUPAD inputs to ground during power-up or Reset as outline below. This is easy to achieve by using the optional membrane switch ACS-LCD-128x64-MBSW and holding the two outermost keys closed while resetting the display.

To enter the User configuration menu using the second MENUPAD method:

1. Remove power, or hold the RESET button
2. On the MENUPAD connector ground inputs I1 and I4 by connecting pin #5 and pin #8 to pin #9 or use a connected membrane switch and hold down the two outermost buttons.
3. Power up the display, or release the RESET button if power was not removed.
4. A configuration menu should appear. Remove the above connection or release the two buttons.

A list of menu soft keys will appear across the bottom of the LCD. Push the corresponding membrane switch buttons (or momentarily ground the matching MENUPAD inputs) that are/would be below the menu items you wish to select.

To Default the entire user configuration to the factory defaults (and force erase the touch screen calibration) the sequence of input activations to press the Default soft key (I3) then the Yes soft key (I1) would be required.

Follow the on screen soft menus to edit, select, and edit the configuration values.

Be sure to press the save soft menu KEYPAD button after editing a value, to store/save it!

NOTE: Some configuration setting changes will not take effect until the display is Reset.

Configuration Settings

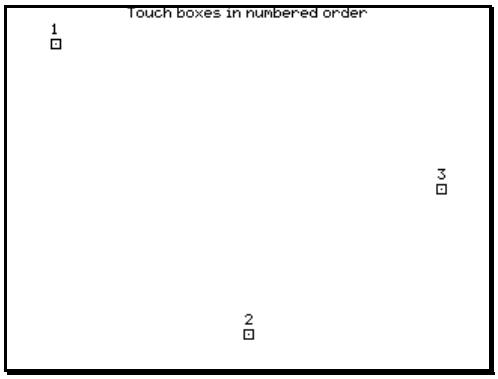
#	Setting	Description
00	Firmware Version	= version # of firmware
01	Baud Rate	1200, 2400, 4800, 9600 (default), 19200, 38400, 57600
02	Protocol SOH & ETX	0 = ANSI, 1=SOH/ETX(default)
03	ANSI Line Wrap	0 = no wrap (default), 1 = ANSI lines exceeding screen width wrap to next line
04	ANSI Add LF to CR	0 = CR (default), 1 = incoming CR replaced by CR/LF pair
05	ANSI Add CR to LF	0 = LF (default), 1 = incoming LF replaced by CR/LF pair
06	Display Comm Addr	0 = no address (default), xx = display's address for SOH/ETX protocol
07	Rcv Char Backlight	0 = disabled, 1 = backlight on for time when characters received
08	Switch Backlight	0 = disabled, 1 = backlight on for time when switch pressed
09	Backlight Timeout	= number of seconds backlight stays lit (default = 30)
0A	Switch Scan/Matrix	0 = debounce 7 keys (default), 1 = scan 3 x 4 matrix
0B	Switch Send Opens	0 = only switch closures sent (default), 1 = send switch opens too
0C	Switch Base Zero	0 = switch closures start at ASCII '0' (default), 1 = switch closures start at binary 0
0D	Switches Polled	0 = switch closures send autonomously (default), 1 = switch closures history sent when polled
0E	Power Up Disp Logo	0 = no logo upon reset, 1 = display graphic page 0 (logo) upon reset (default)
0F	Power Up Disp Setng	0 = no settings shown upon reset, 1 = display settings screen upon reset (default)
10	Auto Clear Disp Sec	= number of seconds before display clears (default = 0, off)
11	Auto Clear DispLogo	= number of seconds before logo clears (default = 0, off)
12	RS485 Enable	0 = disabled (default), 1= enabled
13	Key Beep Enable	0 = disabled (default), 1 = enabled
14	Key Beep Freq	262Hz, 440Hz, 880Hz, 1397Hz (default), 1760Hz, 2093Hz, 3520Hz
15	Key Beep Secs/50	= duration of key beep in fiftieths of a second (default = 12)
16	TPad/PS2 in SOH Raw	= Touch Keypad & PS2 characters sent outside of SOH/ETX protocol
17	TPad Show Up Left-X	= Touch Keypad Show upper left X coordinate (0 (default) – 319)
18	TPad Show Up Left-Y	= Touch Keypad Show upper left Y coordinate (0 (default) – 239)
19	TPad Show Lo Right-X	= Touch Keypad Show upper left x coordinate (0 – 319 (default))
1A	TPad Show Lo Right-Y	= Touch Keypad Show upper left x coordinate (0 – 239 (default))
1B	Power Up Quad Detect	= 0 no touchscreen quadrant detect upon reset, 1 = detect touchscreen quadrant held upon reset (default)
1C	TPad Style	= NONE, QWERTY, NUMERIC
1D	End of Config	= end of configuration items placeholder
1E	NV Status Byte	= NV status byte (default = 227)

Touch Screen

The ACS LCD320x240 display is equipped with a four wire resistive touch screen and controller. Touch event coordinates are reported to the host computer. An optional touch keypad may be displayed to allow interactive data entry. The calibration data to align the touch screen coordinates with the display is stored in non-volatile memory on the display.

Touch Screen Calibration

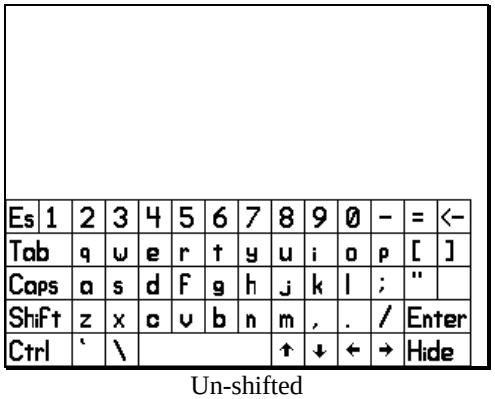
When a new display is first powered on, or at the request of the user, a touch screen calibration sequence can be performed with the resulting coefficients stored. The calibration screen looks like:



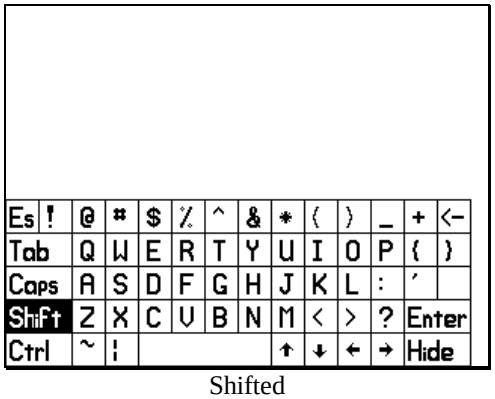
The protective plastic covering should be removed before attempting calibration. A soft pointed stylus should be used to touch each point in numerical sequence for improved accuracy. After each point has been touched, the display computes the alignment coefficients and saves them to non-volatile memory. Further touch screen activity is then compensated by the saved coefficients so that touch screen coordinates align with display pixel locations.

Touch Keypad

A touch keypad is also available. The touch pad transparently overlays graphics or text underneath. The touch pad appears on the bottom half of the display when a calibrated touch screen is tapped within a designated pop-up box. The location and size of this pop-up box is configurable and defaults to the entire screen. It may be disabled by configuring the designated pop-up box coordinates to all zeroes or by selecting a **`TPad Style`** of NONE. The touch pad can also be controlled by receipt of serial commands in SOH/ETX protocol mode. Here is the layout of the touch pad:



Un-shifted



Shifted

When the display is operating in SOH/ETX protocol mode, the keys that are touched are sent as Keypad Closed ('K') response messages (see Keypad Closed Response below). When in ANSI mode, the keys are sent as ASCII characters. The small key size may require the use of a stylus for correct entry.

Display Addressing

If you set the User Configuration Setting 'Display Comm Addr' item to a value greater than zero, you must take the following into consideration when using the SOH/ETX protocol:

Commands sent to the display must have a two-digit ASCII hex address sent between the leading <SOH>, and the following command letter. If the display's address does not match the address in the command, it will ignore the command. If a command is sent with an address of zero, it is considered a broadcast message, and all displays with an address set will display the command. This allows multiple displays to be updated via a single RS-232 interface.

Keystroke commands received from displays with their address greater than zero, will have the displays address in two digit ASCII hex between the <SOH> and the "K" or "k". Note that the return RS-232 RxD signals from multiple displays would have to be 'OR'ed using circuitry such as diodes that are external to the display. See the **'Multiple Display Wiring'** section below.

The display addressing feature is not supported when using the ANSI protocol.

Display Flow Control

Display firmware provides optional support for flow control of transmit data to the display to prevent overflowing the display input buffer at higher baud rates. The display will assert its DTR signal on power-up and whenever there is room in its input buffer. The display will de-assert its DTR signal whenever the input buffer is at 90% of its 1024 byte capacity or higher. The host device that the display is connected to should monitor the DTR signal, typically by connecting it to the CTS input, and only send transmit data to the display when the signal is asserted. Without flow control it is possible to overrun the display input buffer at baud rates above 9600 baud. Symptoms of input buffer overflow include missing or incorrectly displayed data or commands.

RS-485 Driver Enable

Display firmware provides configurable support for enabling the RS-485 transceiver to transmit via the DTR signal. The display will assert its DTR signal whenever it needs to transmit data, then de-assert its DTR signal after the data is fully transmitted. Enabling this option in the configuration menu overrides the Display Flow Control via DTR above.

Display SOH/ETX Protocol

The display supports two different communications protocols: SOH/ETX and ANSI subset. The choice of which protocol is supported is selectable via the User Configuration function 'Protocol SOH & ETX' outlined above.

The SOH/ETX protocol allows full control of the display features and functionality, but requires that the host computer properly format sequences of commands using the protocol to control the display.

The following SOH/ETX protocol commands are supported:

Print Command

<SOH>
"P"
{Starting Row 0-239 (00-EF) as Two Digit ASCII Hex}
{Starting Column 0-319(000-13F) as Three Digit ASCII Hex}
{Font 0-5 as Single Digit ASCII Hex}
{Style 1, 2 as Single Digit ASCII Hex}
{Justification 0, 1, 2, 3, 4, 5 as Single Digit ASCII Hex}
{Color 0=off, 1=on as Single Digit ASCII Hex}
{Characters of text to be displayed}
<ETX>

Example<SOH>P000000101TEST<ETX> would print "TEST" on row 0, column 0, with a 5x7 font, normal style

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

P

Value (ASCII 80 decimal / 50 hex). Starts Print command.

Starting Row

Range (0-239 (00-EF hex)). The upper left corner of the text, the topmost row is 0, and the bottommost row is 239 (EF).

Starting Column

Range (0-319 (000-13F hex)). The starting column of the text, the leftmost column in 0, and the rightmost column is 319 (13F).

Font

Range (0-5 (0-5 hex)). Font 0 is a single line proportional 5 x 7 font. Font 1 is a double row proportional 9 x 16 font. Font 2 is a single line proportional 4 x 5 font. Font 3 is a proportional giant font (30 x 56) for numbers 0 - 9 only. Font 4 is a fixed pitch 5 x 7 font. Font 5 is a bit doubled version of Font 1 (18 x 32). The specified W x H sizes are the maximum dimensions.

Style

Range (1, 2 (1-2 hex)). Style 1 is normal, that is non-inverted black characters on a white background. Style 2 is inverted, and generates white letters on a black background.

Justification

Range (0, 1, 2, 3, 4, 5 (0-5 hex)). Type 0 = Left Justified on display, 1 = Center Justified on display, 2 = Right Justified on display, 3 = absolute positioning to the specified column, 4 = Right Justified from absolute column, 5 = Center Justified on absolute column.

Text to be displayed

The characters of text to be displayed. Larger fonts display fewer characters on a line. The Giant font can only display numbers consisting of the digits 0 through 9. Text is truncated at the edges of the display.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Clear Rows Command

<SOH>
"C"
{Starting Row 0-239 (00-EF) as Two Digit ASCII Hex}
{Ending Row 0-239 (00-EF) as Two Digit ASCII Hex}
{Starting Column 0-319(000-13F) as Three Digit ASCII Hex}
{Ending Column 0-319(000-13F) as Three Digit ASCII Hex}
<ETX>

Example: <SOH>C00EF00013F<ETX> would clear the entire display

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

C

Value (ASCII 67 decimal / 43 hex). Starts Clear command.

Starting Row

Range (0-239 (00-EF hex)). The upper left corner of the rows to be cleared, the topmost row is 0, and the bottommost row is 239 (EF). Starting Row should be less than or equal to Ending Row.

Ending Row

Range (0-239 (00-EF hex)). The lower left corner of the rows to be cleared, the topmost row is 0, and the bottommost row is 239 (EF). Ending Row should be greater than or equal to Starting Row.

Starting Column

Range (0-319 (00-13F hex)). The left column of the rows to be cleared, the leftmost column is 0, and the rightmost row is 319 (13F). Starting Column should be less than or equal to Ending Column.

Ending Column

Range (0-127 (00-7F hex)). The right column of the rows to be cleared, the leftmost column is 0, and the rightmost row is 319 (13F). Ending Column should be greater than or equal to Starting Column.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Horizontal Load (Bitmap) Command

<SOH>
"H"
{Row 0-239(00-EF hex) as Two Digit ASCII Hex}
{Starting Column 0-319(000-13F hex) as Three Digit ASCII Hex}
{Length of data 0-320(000-140 hex) as Three Digit ASCII Hex}
{Data Bytes 0-255(00-FF hex) as Two Digit ASCII Hex characters per byte}
<ETX>

Example: <SOH>H000001FF<ETX> would draw a vertical line on row 0, 8 bits high

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

H

Value (ASCII 72 decimal / 48 hex). Starts the Horizontal Load command.

Row

Range (0-239 (00-EF hex)). The upper left corner of the data, the topmost row is 0, and the bottommost row is 239 (EF). The data bytes affect 8 rows down from and including this row.

Starting Column

Range (0-319 (00-13F hex)). The left column of the row that the data will be placed at, the leftmost column is 0, and the rightmost row is 319 (13F).

Length

Range (0-320 (000-140 hex)). This is the number of bytes of data that follows, each byte expressed using two digits of ASCII Hex.

Data Bytes

Range (0-255 (00-FF hex)). These are the binary patterns of dots you would like turned on/off at the specified location on the display. Each byte represents 8 pixels on the row, LSB is towards the top of the display, MSB is towards the bottom of the display. A '1' in a bit position turns on the corresponding pixel. Successive bytes are displayed from left to right on the same row. Bytes that would appear beyond the end of the row are not displayed.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

NOTE: Multiple Horizontal Load commands may be used to display a bitmap image on the display.

Line Command

<SOH>
"L"
{Starting X 0-319(000-13F) as Three Digit ASCII Hex}
{Starting Y 0-239(00-0EF) as Three Digit ASCII Hex}
{Ending X 0-319(000-13F) as Three Digit ASCII Hex}
{Ending Y 0-239(00-0EF) as Three Digit ASCII Hex}
{Color (0=off, 1=on, 2=complement) as Single Digit ASCII Hex}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

L

Value (ASCII 76 decimal). Starts Line command.

Starting X

Range (0-319 (000-13F hex)). This specifies the starting x coordinate of the line.

Starting Y

Range (0-239 (00-EF hex)). This specifies the starting y coordinate of the line.

Ending X

Range (0-319 (000-13F hex)). This specifies the ending x coordinate of the line.

Ending Y

Range (0-239 (00-EF hex)). This specifies the ending y coordinate of the line.

Color

Range (0-2). This specifies the color (0 = OFF, 1 = ON, 2 = COMPLEMENT) of the line.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Box Command

<SOH>
"B"
{1st Corner X 0-319(000-13F) as Three Digit ASCII Hex}
{1st Corner Y 0-239(00-0EF) as Three Digit ASCII Hex}
{2nd Corner X 0-319(000-13F) as Three Digit ASCII Hex}
{2nd Corner Y 0-239(00-0EF) as Three Digit ASCII Hex}
{Color (0=off, 1=on, 2=complement) as Single Digit ASCII Hex}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

B

Value (ASCII 66 decimal). Starts Box command.

1st Corner X

Range (0-319 (000-13F hex)). This specifies the starting x coordinate of the box.

1st Corner Y

Range (0-239 (00-EF hex)). This specifies the starting y coordinate of the box.

2nd Corner X

Range (0-319 (000-13F hex)). This specifies the ending x coordinate of the box.

2nd Corner Y

Range (0-239 (00-EF hex)). This specifies the ending y coordinate of the box.

Color

Range (0-2). This specifies the color (0 = OFF, 1 = ON, 2 = COMPLEMENT) of the box.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Filled Box Command

<SOH>
"F"
{1st Corner X 0-319(000-13F) as Three Digit ASCII Hex}
{1st Corner Y 0-239(00-0EF) as Three Digit ASCII Hex}
{2nd Corner X 0-319(000-13F) as Three Digit ASCII Hex}
{2nd Corner Y 0-239(00-0EF) as Three Digit ASCII Hex}
{Color (0=off, 1=on, 2=complement) as Single Digit ASCII Hex}
{Fill Color (0=off, 1=on, 2=complement) as Single Digit ASCII Hex}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

B

Value (ASCII 66 decimal). Starts Box command.

1st Corner X

Range (0-319 (000-13F hex)). This specifies the starting x coordinate of the box.

1st Corner Y

Range (0-239 (00-EF hex)). This specifies the starting y coordinate of the box.

2nd Corner X

Range (0-319 (000-13F hex)). This specifies the ending x coordinate of the box.

2nd Corner Y

Range (0-239 (00-EF hex)). This specifies the ending y coordinate of the box.

Color

Range (0-2). This specifies the color (0 = OFF, 1 = ON, 2 = COMPLEMENT) of the box.

Fill Color

Range (0-2). This specifies the fill color (0 = OFF, 1 = ON, 2 = COMPLEMENT) of the box.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Pixel Command

<SOH>
"X"
{X 0-319(000-13F) as Three Digit ASCII Hex}
{Y 0-239(00-0EF) as Three Digit ASCII Hex}
{Color (0=off, 1=on, 2=complement) as Single Digit ASCII Hex}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

X

Value (ASCII 88 decimal). Starts Pixel command.

X

Range (0-319 (000-13F hex)). This specifies the x coordinate of the pixel.

Y

Range (0-239 (00-EF hex)). This specifies the y coordinate of the pixel.

Color

Range (0-2). This specifies the color (0 = OFF, 1 = ON, 2 = COMPLEMENT) of the pixel.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Circle Command

<SOH>
"l"
{Center X 0-319(00-13F) as Three Digit ASCII Hex}
{Center Y 0-239(00-0EF) as Three Digit ASCII Hex}
{Radius X 0-319(00-13F) as Three Digit ASCII Hex}
{Color (0=off, 1=on, 2=complement) as Single Digit ASCII Hex}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

l

{lower case "L"}Value (ASCII 108 decimal). Starts Circle command.

Center X

Range (0-319 (000-13F hex)). This specifies the center x coordinate of the circle.

Center Y

Range (0-239 (00-EF hex)). This specifies the center y coordinate of the circle.

Radius

Range (0-319 (000-13F hex)). This specifies the radius of the circle. It must be greater than 0.

Color

Range (0-2). This specifies the color (0 = OFF, 1 = ON, 2 = COMPLEMENT) of the line.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Tone Command

<SOH>
"T"
{Frequency 26-4095Hz (01A-FFF) as Three Digit ASCII Hex}
{Duration 0-255 Fiftieths (00-FF) as Two Digit ASCII Hex}
<ETX>

Example: <SOH>T01A32<ETX> would play a tone of 26Hz, for 50 Fiftieths(1 Second)

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

T

Value (ASCII 84 decimal / 54 hex). Starts Tone command.

Frequency

Range (26-4095 (1A-FFF hex)). This specifies the frequency of the produced tone. A frequency of 0 turns off any current tone.

Duration

Range (0-255 (00-FF hex)). This specifies the duration of the tone in fiftieths of a second. A duration of 0 produces a constant tone.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Save Page Command

<SOH>
"S"
{Page number 0-255 (00-FF) as Two Digit ASCII Hex}
<ETX>

Example: <SOH>S01<ETX> would save the current display image in non-volatile memory Page 1

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

S

Value (ASCII 83 decimal / 53 hex). Starts Save page command.

Page number

Range (0-255 (00-FF hex)). This specifies the number of the page to save the current display image into. The base unit has a single non-volatile memory device that provides storage for the User Configuration settings and 6 pages. An additional 24LC512 memory device may be installed in U4 to provide up to 12 pages. Accessing a page number outside of the range of installed memory will result in an error message being shown on the display.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

NOTE: Page 0 is the logo page that is displayed on reset or power-up if enabled in the User Configuration settings. Defaulting the User Configuration overwrites page 0 with the factory logo.

NOTE: There is a delay of up to 3/8 of a second (375mSEC) for the display to write the image into the non-volatile memory. Commands may be sent to the display during this time, but will not be executed until after the delay has expired which may result in overrun of the input data buffer and loss or incorrect operation of the commands that were sent.

NOTE: Each page may be written up to 100,000 times before incorrect saving of the image may result.

Restore Page Command

<SOH>
"R"
{Page number 0-255 (00-FF) as Two Digit ASCII Hex}
<ETX>

Example: <SOH>R01<ETX> would restore the display image from non-volatile memory Page 1

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

R

Value (ASCII 82 decimal / 52 hex). Starts Restore page command.

Page number

Range (0-255 (00-FF hex)). This specifies the number of the page to restore the current display image from. The base unit has a single non-volatile memory device that provides storage for the User Configuration settings and 6 pages. An additional 24LC512 memory device may be installed in U4 to provide up to 12 pages. Accessing a page number outside of the range of installed memory will result in an error message being shown on the display.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

NOTE: Page 0 is the logo page that is displayed on reset or power-up if enabled in the User Configuration settings. Defaulting the User Configuration overwrites page 0 with the factory logo.

Backlight Command

<SOH>
"b"
{value = 0, 1 or 2 as single Digit ASCII Hex}
<ETX>

Example: <SOH>b0<ETX> would turn off the backlight, <SOH>b1<ETX> would turn on the backlight, <SOH>b2<ETX> would turn on the backlight for the configured time, after which it would go off.

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

b

Value (ASCII 98 decimal / 62 hex). Starts backlight command.

Value

Range (0, 1, 2 (0-2 hex)). This specifies the value to set the backlight to: 0 = off, 1 = on, 2 = on timed.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

NOTE: If the backlight is configured to turn on with received characters, it will not be possible to turn it off using this command.

Keypad Status Poll Command

<SOH>
"K"
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

K

Value (ASCII 75 decimal / 4B hex). Indicates start of Keypad Status Poll command.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

NOTE: When the display is configured for Switches Polled = 1, keypad / reset response messages are not sent when they occur. Instead, the messages are queued and are sent upon receipt of this poll command in the order that they were generated. If the queue is empty, a <SOH><NAK><ETX> response message is sent instead. The queue holds approximately 18 messages. If the queue is full, newer responses are discarded. Only complete response messages are queued / transmitted. In this mode, failure to poll frequently may result in lost keypad responses.

See the **MENUPAD key code Layout** section in this manual for key code responses.

Touch Keypad Display/Hide Command

<SOH>
"d"
{One Digit ASCII Hex Numeric value (0 → hide keypad, 1→ show QWERTY keypad, 2 → show NUMERIC keypad}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

d

Value (ASCII 100 decimal / 64 hex). Indicates start of Touch Keypad Display/Hide command.

Display/Hide Boolean Value

0 = Value (ASCII 48 decimal / 30 hex) This character is used to Hide the touch keypad.
1 = Value (ASCII 49 decimal / 31 hex) This character is used to Display the QWERTY touch keypad.
2 = Value (ASCII 50 decimal / 32 hex) This character is used to Display the NUMERIC touch keypad.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to terminate/execute the command received.

Keypad / PS/2 / Touch Keypad Close Response

<SOH>
"K"
{Two Digit ASCII Hex keycode}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

K

Value (ASCII 75 decimal / 4B hex). Indicates start of Keypad Close response, keycode to follow.

Keycode

Debounce Range (30 hex – 37 hex). This specifies which input was closed on the keypad attached to the MENUPAD connector.

Scan/Matrix Range (23 hex, 2A hex, 30 hex – 39 hex, 41 hex – 44 hex). This specifies which key that was pressed on the keypad attached to the MENUPAD connector.

Touch Keypad Range (00 hex – 7F hex). This specifies the key that was pressed on the touch keypad.

PS/2 Keyboard Range (00 hex – 7F hex). This specifies the PS/2 to ASCII translation of the key that was pressed on the attached PS/2 keyboard.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to delimit the response received.

See the **MENUPAD key code Layout** section in this manual for keycode responses.

Touch Keypad Display/Hide Response

<SOH>
"d"
{One Digit ASCII Hex Boolean value (0 → keypad hidden, 1→ QWERTY keypad displayed, 2 → NUMERIC keypad displayed}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

d

Value (ASCII 100 decimal / 64 hex). Indicates start of Touch Keypad Display/Hide command.

Display/Hide Boolean Value

0 = Value (ASCII 48 decimal / 30 hex) This character indicates the touch keypad is hidden.
1 = Value (ASCII 49 decimal / 31 hex) This character indicates the QWERTY touch keypad is displayed.
2 = Value (ASCII 50 decimal / 32 hex) This character indicates the NUMERIC touch keypad is displayed.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to delimit the response received.

Keypad Open Response

<SOH>
"k"
{Two Digit ASCII Hex keycode}
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

k

Value (ASCII 107 decimal / 6B hex). Indicates start of Keypad Open response.

Keycode

Debounce Range (30 hex – 37 hex). This specifies which key that was pressed then released on the keypad attached to the MENUPAD connector.

Scan/Matrix Range (23 hex, 2A hex, 30 hex – 39 hex, 41 hex – 44 hex). This specifies which key that was pressed then released on the keypad

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to delimit the response received.

See the **MENUPAD key code Layout** section in this manual for key code responses.

NOTE: User Configuration Setting 'Switch Send Opens' must be set for Keypad Opens to be sent!

Touch Screen Touched Response

<SOH>
"t"
{Four Digit ASCII Hex of touch X coordinated (0000 → 013F}
{Four Digit ASCII Hex of touch Y coordinate (0000 → 00EF }
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

t

Value (ASCII 116 decimal / 74 hex). Indicates start of Touch Screen touched response.

Touched Location Coordinates

Two sets of 4 digit ASCII Hex values representing the X & Y coordinates of the touched location.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to delimit the response received.

Touch Screen unTouched Response

<SOH>
"u"
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

u

Value (ASCII 117 decimal / 75 hex). Indicates Touch Screen touch point was released response.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to delimit the response received.

Power Up / Reset Response

<SOH>
"R"
<ETX>

<SOH>

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

R

Value (ASCII 82 decimal). Indicates the start of the Reset response.

<ETX>

Value (ASCII 3 decimal / 03 hex). This character is used to delimit the response received.

Display ANSI Protocol

The display supports two different communications protocols: SOH/ETX and ANSI subset. The choice of which protocol is supported is selectable via the User Configuration function outlined above.

The ANSI subset protocol allows the display to be used as a limited ANSI terminal with scrolling. The display consists of 30 lines of 40 characters shown using a fixed pitch 5 x 7 font in an 8 x 8 pixel matrix. The display supports the concept of a 'cursor', which is displayed, and represents the insertion point on the display where the next printable text will be placed.

The following ANSI protocol commands are supported:

BELL

Value (ASCII 7 decimal / 07 hex) Receipt of this character causes the display to produce a 1KHz tone for 0.2 seconds.

Backspace (BS)

Value (ASCII 8 decimal / 08 hex) Receipt of this character causes the display to move the cursor one position to the left.

Horizontal Tab (HT)

Value (ASCII 9 decimal / 09 hex) Receipt of this character causes the display to move the cursor right to the next tab stop. Moving past the rightmost tab stop causes the cursor to move to the beginning of the following line with display scrolling up if the cursor was on the last line. There are 9 tab stops per line at positions 4, 8, 12, 16, 20, 24, 28, 32 and 36.

Line Feed (LF)

Value (ASCII 10 decimal / 0A hex) Receipt of this character causes the display to move the cursor down to the next line in the same column. The display will scroll up if the cursor was on the last line.

Vertical Tab (VT)

Value (ASCII 11 decimal / 0B hex) Receipt of this character causes the display to move the cursor down to the next line in the same column. The display will scroll up if the cursor was on the last line.

Form Feed (FF)

Value (ASCII 12 decimal / 0C hex) Receipt of this character causes the display to move the cursor down to the next line in the same column. The display will scroll up if the cursor was on the last line.

Carriage Return (CR)

Value (ASCII 13 decimal / 0D hex) Receipt of this character causes the display to move the cursor left to the first column on the current line. There is a User Configuration setting that will automatically add receipt of a Line Feed (LF) character after a carriage return if required.

Cancel (CAN)

Value (ASCII 24 decimal / 18 hex) Receipt of this character causes the display to abort any escape sequence that may be in process. No other action is taken.

Escape (ESC)

Value (ASCII 33 decimal / 1B hex) Receipt of this character causes the display to attempt to decode one or more of the following characters as a control or escape sequence that will affect the display.

Displayed Characters

Values (ASCII 32 decimal / 20 hex through ASCII 127 decimal / 7F hex) Receipt of these characters cause the display to show the character on the screen at the current cursor location, and then move the cursor right to the next position. There is a User Configuration setting that will automatically wrap the cursor to the beginning of the next line, if required, scrolling up if the cursor was on the last line. The following characters are displayed:

	Upper Bits					
Lower Bits	0010	0011	0100	0101	0110	0111
0000	space	0	@	P	`	p
0001	!	1	A	Q	a	q
0010	"	2	B	R	b	r
0011	#	3	C	S	c	s
0100	$	4	D	T	d	t
0101	%	5	E	U	e	u
0110	&	6	F	V	f	v
0111	'	7	G	W	g	w
1000	(	8	H	X	h	x
1001	)	9	I	Y	i	y
1010	*	:	J	Z	j	z
1011	+	;	K	[	k	{
1100	,	<	L	\	l	|
1101	-	=	M	]	m	}
1110	.	>	N	^	n	→
1111	/	?	O	_	o	←

Reset Display (ESC c)

Values (ASCII 33, 99 decimal / 1B, 63 hex) Receipt of this character sequence causes the display to clear, the cursor position to move to the upper left corner and the backlight to turn off.

Cursor Down (ESC D)

Values (ASCII 33, 68 decimal / 1B, 44 hex) Receipt of this character sequence causes the display to move the cursor down to the next line in the same column. The cursor will not move and the display will not scroll up if the cursor was on the last line.

Cursor Down to column 1 (ESC E)

Values (ASCII 33, 69 decimal / 1B, 45 hex) Receipt of this character sequence causes the display to move the cursor down to the next line and the first column. The cursor will not move and the display will not scroll up if the cursor was on the last line.

Cursor Up (ESC M)

Values (ASCII 33, 77 decimal / 1B, 4D hex) Receipt of this character sequence causes the display to move the cursor up to the previous line in the same column. The cursor will not move if the cursor was on the first line.

ANSI Escape Sequences (ESC [ )

Values (ASCII 33, 91 decimal / 1B, 5B hex) Receipt of this character sequence causes the display to attempt to decode one or more of the following characters as an ANSI control sequence. These sequences can have 1 or 2 parameters that are expressed as decimal numbers separated by a semicolon. The absence of a parameter in a control sequence causes it to assume a default value of zero.

Cursor Up n lines (ESC [n A)

Values (ASCII 33, 91, 48-57, 65 decimal / 1B, 5B, 30-39, 41 hex) Receipt of this character sequence causes the display to move the cursor up 'n' lines in the same column. The cursor will not move up past the first line in the display.

Cursor Up n lines to column 1 (ESC [n F)

Values (ASCII 33, 91, 48-57, 70 decimal / 1B, 5B, 30-39, 46 hex) Receipt of this character sequence causes the display to move the cursor up 'n' lines and to the first column. The cursor will not move up past the first line in the display.

Cursor Down n lines (ESC [n B)

Values (ASCII 33, 91, 48-57, 66 decimal / 1B, 5B, 30-39, 42 hex) Receipt of this character sequence causes the display to move the cursor down 'n' lines in the same column. The cursor will not move past the bottom line in the display and the display will not scroll up.

Cursor Down n lines to column 1 (ESC [n E)

Values (ASCII 33, 91, 48-57, 69 decimal / 1B, 5B, 30-39, 45 hex) Receipt of this character sequence causes the display to move the cursor down 'n' lines and to the first column. The cursor will not move past the bottom line in the display and the display will not scroll up.

Cursor Right n characters (ESC [n C)

Values (ASCII 33, 91, 48-57, 67 decimal / 1B, 5B, 30-39, 43 hex) Receipt of this character sequence causes the display to move the cursor right 'n' characters on the same line. The cursor will not move past the end of the current line.

Cursor Left n characters (ESC [n D)

Values (ASCII 33, 91, 48-57, 68 decimal / 1B, 5B, 30-39, 44 hex) Receipt of this character sequence causes the display to move the cursor left 'n' characters on the same line. The cursor will not move past the beginning of the current line.

Move cursor to n (ESC [n G)

Values (ASCII 33, 91, 48-57, 71 decimal / 1B, 5B, 30-39, 47 hex) Receipt of this character sequence causes the display to move the cursor to column 'n' on the current line. The cursor will not move past the beginning or end of the current line.

Move cursor to r, c (ESC [r ; c H)

Values (ASCII 33, 91, [[48-57], 59, [48-57]], 72 decimal / 1B, 5B, [[30-39], 3B, [30-39]], 48 hex) Receipt of this character sequence causes the display to move the cursor to row 'r', column 'c'. The value for 'r' ranges from 0 – 7, the value for 'c' ranges from 0 – 20.

Erase all or part of display (ESC [n J)

Values (ASCII 33, 91, 48-50, 74 decimal / 1B, 5B, 30-32, 4A hex) Receipt of this character sequence causes part or all of the display to clear. If 'n' = 0, the display is cleared from the cursor position to the end. If 'n' = 1, the display is cleared from the beginning to the cursor position. If 'n' = 2 the entire display is cleared, and the cursor is moved to the upper left (0, 0).

Erase all or part of line (ESC [n K)

Values (ASCII 33, 91, 48-50, 75 decimal / 1B, 5B, 30-32, 4B hex) Receipt of this character sequence causes part or all of the line that the cursor is on to clear. If 'n' = 0, the line is cleared from the cursor position to the end of the line. If 'n' = 1, the line is cleared from the beginning to the cursor position. If 'n' = 2 the entire line is cleared. The position of the cursor is not affected by this command.

Save cursor position (ESC [n s)

Values (ASCII 33, 91, 114 decimal / 1B, 5B, 73 hex) Receipt of this character sequence causes the display to save the current cursor position.

Restore cursor position (ESC [n u)

Values (ASCII 33, 91, 116 decimal / 1B, 5B, 75 hex) Receipt of this character sequence causes the display to restore the previously saved cursor position.

Query Device Status (ESC [5 n)

Values (ASCII 33, 91, 53, 110 decimal / 1B, 5B, 35, 6E hex) Receipt of this character sequence causes the display to generate an <ESC> [0 n status message. The 'n' character is actually part of the command and is not replaced by a number. If the display was configured for Switches Polled = 1, then this status message will be followed by any queued keypad response messages.

Query (ESC [6 n)

Values (ASCII 33, 91, 54, 110 decimal / 1B, 5B, 36, 6E hex) Receipt of this character sequence causes the display to report the current cursor position as <ESC> [row ; column R. The 'n' character is actually part of the command and is not replaced by a number. The value for row is 0 – 7, the value for column is 0 – 20.

Keypad Close Response

If the User Configuration setting for the keypad is set to **Scan/Matrix**, then the keypad response is as follows:

<SOH>
"K"
{Two Digit ASCII Hex keycode}
<ETX>

SOH

Value (ASCII 1 decimal / 01 hex). This character is used to reset/start the command processing state machine. It must be at the beginning of every SOH/ETX protocol command sent to the display.

K

Value (ASCII 75 decimal / 4B hex). Indicates start of Keypad Close response.

Keycode

Scan/Matrix Range (23 hex, 2A hex, 30 hex – 39 hex). This specifies which key was pressed on the keypad attached to the MENUPAD connector.

ETX

Value (ASCII 3 decimal / 03 hex). This character is used to delimit the response received.

See the **MENUPAD key code Layout** section in this manual for key code responses.

Power Up / Reset Response

No power up / reset response is sent when the display is configured for ANSI protocol.

Firmware Revisions

Version	Date	Notes
1.0	7/30/08	First release for new 320x240 display hardware.
1.1	8/25/08	Corrected ANSI protocol mode so that it works without either NV_AnsiAddLfToCr or NV_AnsiAddCrToLf being set.
1.2	8/29/08	First compiled for ZNEO z16F to replace z8F.
1.3	9/25/08	Fixed touchscreen locking up diagnostics invoked from MENUPAD connector.
1.4	12/01/08	Fixed no touchscreen coordinate report when touchpad disabled. Speedup horizontal and vertical line draws, box fills.
1.5	9/02/09	Added display of held screen quadrant before function invoked. Increased number of touchscreen averaging reads from 4 to 8 to improve touchscreen reliability. Hard limited touchscreen coordsto screen dimensions. Added X display of screen coords where touched during calibration and diagnostics. Added PowerUpQuadDetect configuration option to bypass quadrant detection.
1.6	9/08/09	Added forced uncalibration of touchscreen if configuration default invoked from MENUPAD connector to allow restoring touchscreen operation after a bad calibration or calibration on a bad touchscreen.
1.7	9/21/09	Changed touchscreen algorithm to use median averaging filter: read the coordinates 16 times, sort the reads and average the middle 8.
1.8	9/24/09	Increased settling time of touchscreen A/D converter to improve conversion repeatability.
1.9	9/30/09	Fixed sporadic lockups during fast successive resets/power cycles caused by I2C bus lockup.
1.10	10/1/09	Added new numeric keypad style. Added ability to configure the pop-up keypad style. Fixed erroneous 'K'ey report for keypad HIDE keys. Fixed stranded QWERTY keypad keys after Quadrant invoked Default All Configuration.
1.11	10/12/09	Added a 2 second delay after the touch screen calibration to allow the pass/fail message to be seen.
1.12	12/23/09	Added an unTouch report that is sent following a touchscreen coordinate report when the touchscreen touch point is actually released. Fixed the popup QWERTY keypad CAPS, SHIFT and CTRL keys incorrectly sending a touch coordinate report.

Updating the LCD320x240 firmware

The following procedure has been tested on Windows 2000 and Windows XP. The use of a standard PC COM port is advised, problems with USB COM ports have been reported.

1. Extract the files from the downloaded firmware zip file somewhere on your hard drive. Open a command prompt window, and navigate to the folder where you extracted the files. In the following example, the folder path is: **D:\Data\z16\ACS\LCD\320x240HS**
2. Move the pair of Normal/DBG jumpers on the LCD320x240 to the DBG position.
3. Power the display, connected to your PC's COM port.
4. Type the following command (underlined text) in the command prompt window:

   D:\Data\z16\ACS\LCD\320x240HS> flashutil

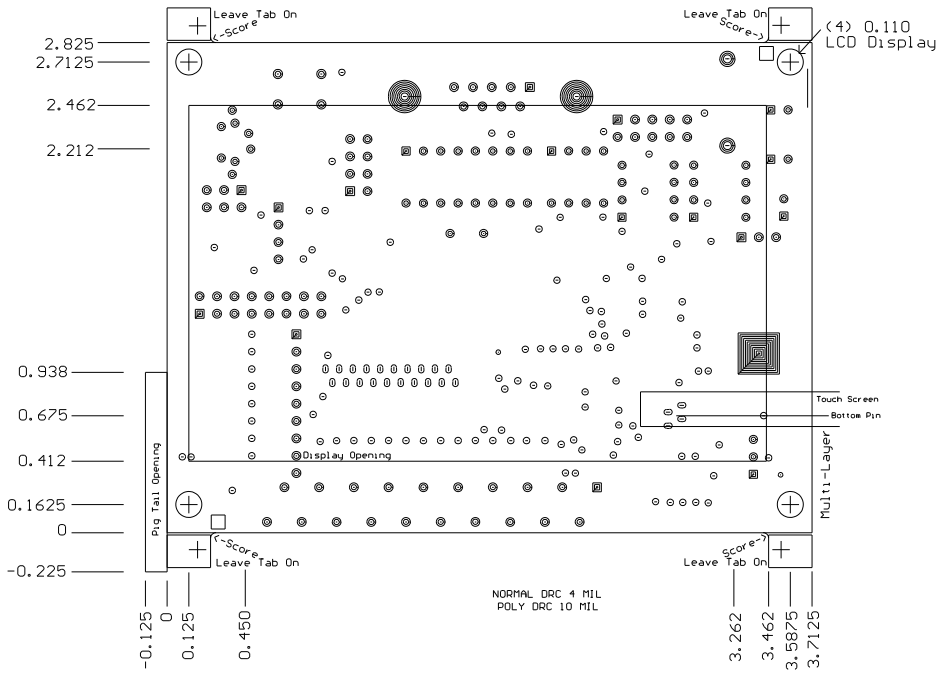
   The utility should examine the available Comm ports, find the display, and flash the firmware showing its progress on the command window:

   ```
   ----
   D:\Data\z16\ACS\LCD\320x240HS>zneo-tcl -t flashutil.tcl
   Loading lcd320x240.hex

   D:\Data\z16\ACS\LCD\320x240HS>
   ----
   ```

5. Restore the jumpers to the Normal position, and reset the display.
6. Because the firmware version was revised, the NVM configurations settings should default.
7. Verify the new firmware version # on the display.

Board Layout



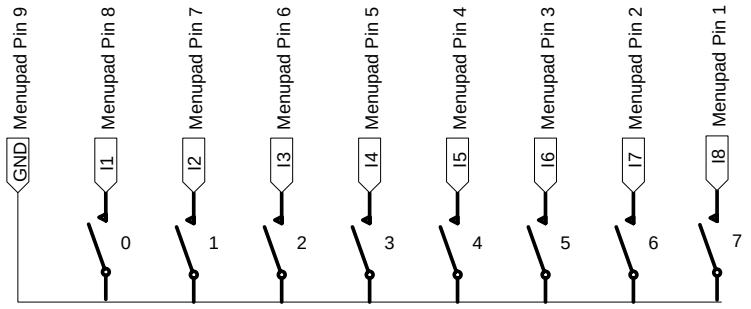
MENUPAD key code Layout

Debounce, SOH/ETX Protocol

0 (30 hex)	**1** (31 hex)	**2** (32 hex)	**3** (33 hex)	**4** (34 hex)	**5** (35 hex)	**6** (36 hex)	**7** (37 hex)
I1	I2	I3	I4	I5	I6	I7	I8

Debounce, ANSI Protocol

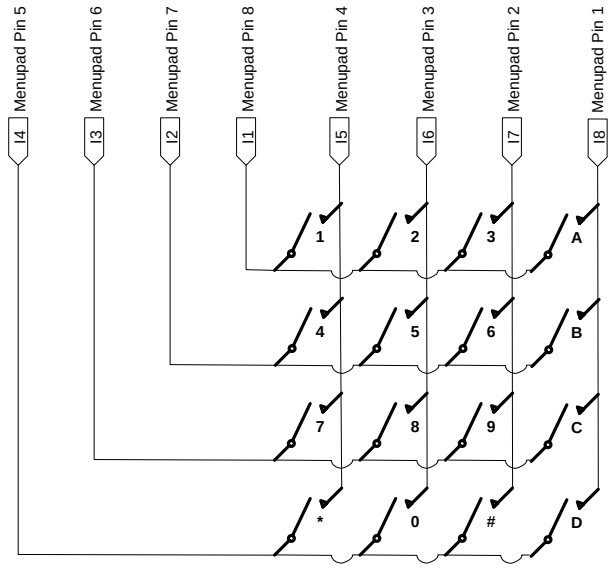
0 F1 (1B 5B 4F 50 00 00 00 hex)	**1 F2** (1B 5B 4F 51 00 00 00 hex)	**2 F3** (1B 5B 4F 52 00 00 00 hex)	**3 F4** (1B 5B 4F 53 00 00 00 hex)	**4 UP ARROW** (1B 5B 42 00 00 00 hex)	**5 DOWN ARROW** (1B 5B 41 00 00 00 hex)	**6 ENTER** (0D hex)	**7 F5** (1B 5B 4F 54 00 00 00 hex)



Scan/Matrix

4 Columns x 4 Rows

1 (31 hex)	**2** (32 hex)	**3** (33 hex)	**A** (41 hex)
4 (34 hex)	**5** (35 hex)	**6** (36 hex)	**B** (42 hex)
7 (37 hex)	**8** (38 hex)	**9** (39 hex)	**C** (43 hex)
***** (2A hex)	**0** (30 hex)	**#** (23 hex)	**D** (44 hex)



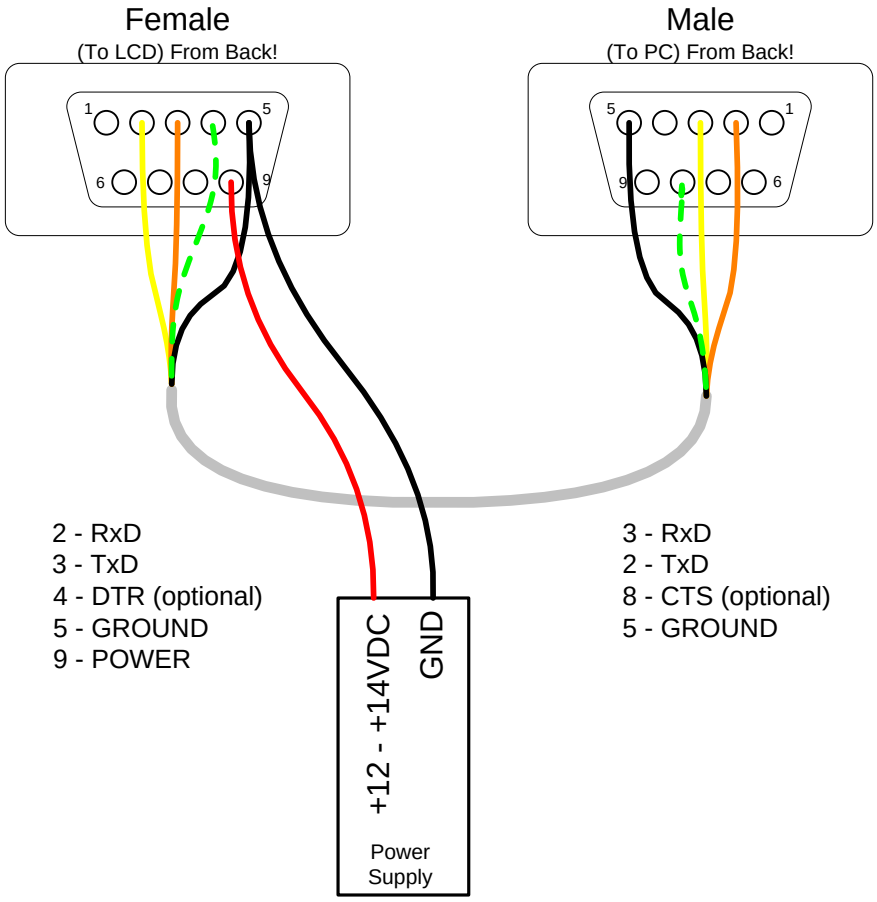
ASCII Table

Dec	Hex	Octal	Character
0	00	000	NUL (null)
1	01	001	SOH (start of heading)
2	02	002	STX (start of text)
3	03	003	ETX (end of text)
4	04	004	EOT (end of transmission)
5	05	005	ENQ (enquiry)
6	06	006	ACK (acknowledge)
7	07	007	BEL (bell)
8	08	010	BS (backspace)
9	09	011	TAB (horizontal tab)
10	0A	012	LF (line feed, new line)
11	0B	013	VT (vertical tab)
12	0C	014	FF (form feed, new page)
13	0D	015	CR (carriage return)
14	0E	016	SO (shift out)
15	0F	017	SI (shift in)
16	10	020	DLE (data link escape)
17	11	021	DC1 (device control 1)
18	12	022	DC2 (device control 2)
19	13	023	DC3 (device control 3)
20	14	024	DC4 (device control 4)
21	15	025	NAK (negative acknowledge)
22	16	026	SYN (synchronous idle)
23	17	027	ETB (end trans. block)
24	18	030	CAN (cancel)
25	19	031	EM (end of medium)
26	1A	032	SUB (substitute)
27	1B	033	ESC (escape)
28	1C	034	FS (file separator)
29	1D	035	GS (group separator)
30	1E	036	RS (record separator)
31	1F	037	US (unit separator)
32	20	040	Space
33	21	041	!
34	22	042	"
35	23	043	#
36	24	044	$
37	25	045	%
38	26	046	&
39	27	047	'
40	28	050	(
41	29	051	)
42	2A	052	*
43	2B	053	+
44	2C	054	,
45	2D	055	-
46	2E	056	.
47	2F	057	/
48	30	060	0
49	31	061	1
50	32	062	2
51	33	063	3
52	34	064	4
53	35	065	5
54	36	066	6
55	37	067	7
56	38	070	8

57	39	071	9
58	3A	072	:
59	3B	073	;
60	3C	074	<
61	3D	075	=
62	3E	076	>
63	3F	077	?
64	40	100	@
65	41	101	A
66	42	102	B
67	43	103	C
68	44	104	D
69	45	105	E
70	46	106	F
71	47	107	G
72	48	110	H
73	49	111	I
74	4A	112	J
75	4B	113	K
76	4C	114	L
77	4D	115	M
78	4E	116	N
79	4F	117	O
80	50	120	P
81	51	121	Q
82	52	122	R
83	53	123	S
84	54	124	T
85	55	125	U
86	56	126	V
87	57	127	W
88	58	130	X
89	59	131	Y
90	5A	132	Z
91	5B	133	[
92	5C	134	\
93	5D	135	]
94	5E	136	^
95	5F	137	_
96	60	140	`
97	61	141	a
98	62	142	b
99	63	143	c
100	64	144	d
101	65	145	e
102	66	146	f
103	67	147	g
104	68	150	h
105	69	151	i
106	6A	152	j
107	6B	153	k
108	6C	154	l
109	6D	155	m
110	6E	156	n
111	6F	157	o
112	70	160	p
113	71	161	q
114	72	162	r
115	73	163	s
116	74	164	t
117	75	165	u
118	76	166	v

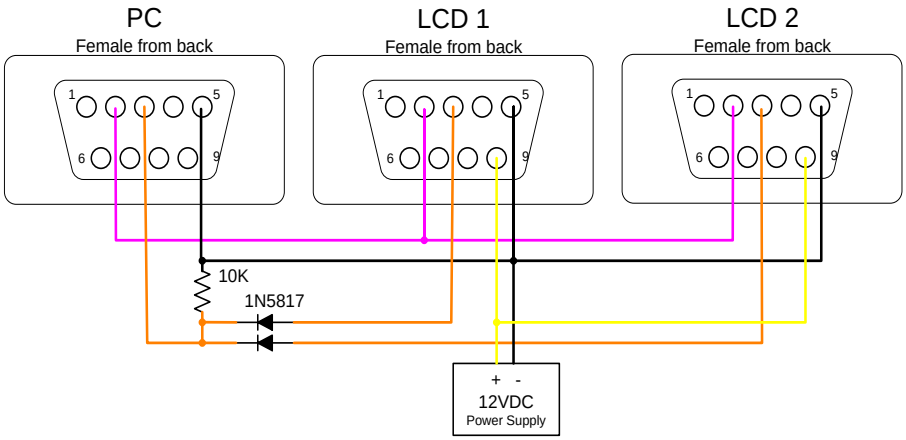
119	77	167	w
120	78	170	x
121	79	171	y
122	7A	172	z
123	7B	173	{
124	7C	174	|
125	7D	175	}
126	7E	176	→
127	7F	177	←

Wiring Harness Diagram



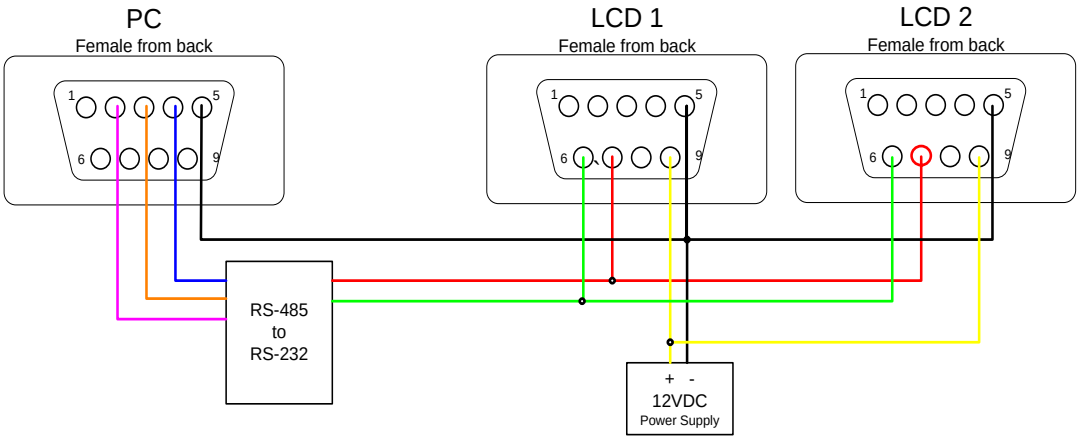
Multiple Display Wiring (RS-232)

Multiple displays can be connected via RS-232 by wiring the transmit data lines to the LCDs together, and 'OR'ing the receive data lines from the LCDs using low voltage drop Schottky diodes and a resistor to ground. Data to be displayed may be directed to the required display by configuring the display's **`Display Comm Addr`** and using the addressed communications outlined in the **Display Addressing** section above.



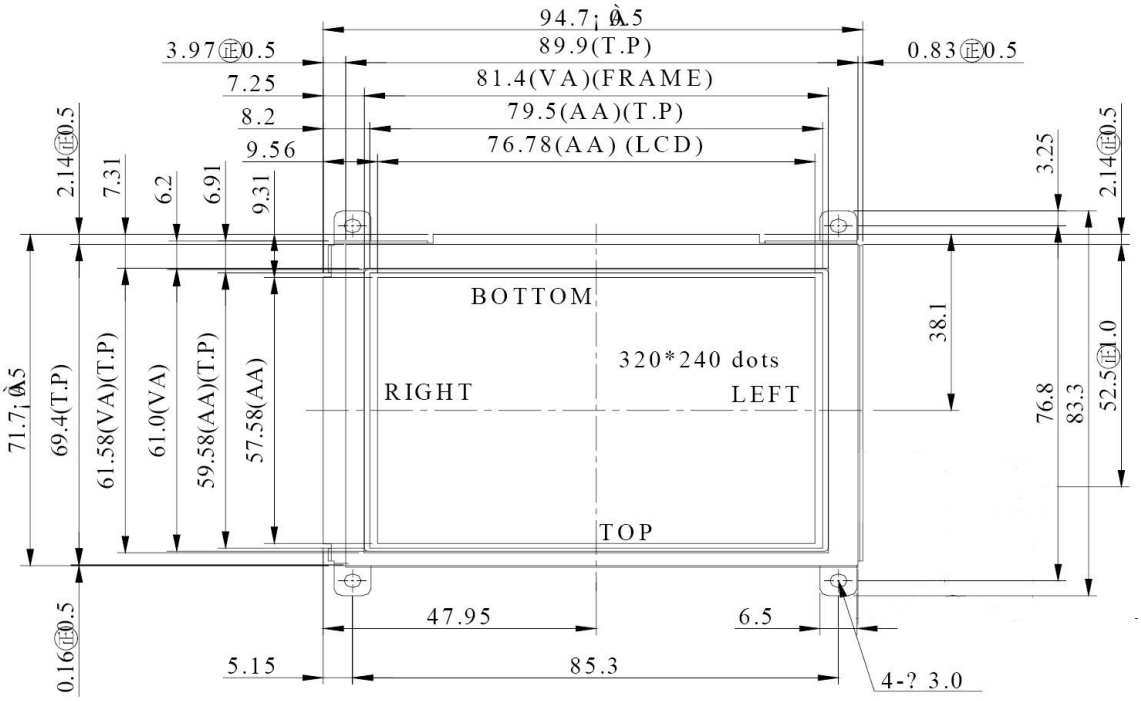
Multiple Display Wiring (RS-485)

Multiple displays can be connected via RS-485 by wiring the A+ and B- data lines to the LCDs together. RS-485 operation is enabled by configuring the RS-485 Enable in the settings. Received data may be polled by configuring the **`Switches Polled`** in the settings. Data to be displayed may be directed to the required display by configuring the display's **`Display Comm Addr`** and using the addressed communications outlined in the **Display Addressing** section above.



Mechanical Mounting Diagram

Dimensions in millimeters



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