Lucas Control Systems
Deeco™ Systems

M5 Touch Module
USER MANUAL

Manual P/N: 8864
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Baud Rate:	up to 14400 Baud
Data Bits:	8
Parity:	None
Stop Bits:	1
Flow Control:	XON/OFF or hardware
Emulation:	ANSI

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For Returns - Contact Deeco Systems' customer service for a Return Authorization (RA) number prior to shipping product to the factory. Freight to the factory is prepaid by the customer. Freight return to the customer is paid by Deeco Systems. Ship product in its original packaging or equivalent to prevent transit damage.

Printed in the U.S.A.

WARNING!

These warnings must be observed. Damage to the display and/or controller card could result if these warnings are not heeded.

1. THE LUCAS DEECO CONTROLLER IS STATIC SENSITIVE. IF THE ENCLOSURE IS OPENED, USE CMOS HANDLING PROCEDURES TO AVOID STATIC DAMAGE. ALWAYS EXERCISE STATIC PRECAUTIONS WHEN HANDLING THE OPEN FRAME EMBEDDED MODULE.
2. DO NOT ATTEMPT TO ALTER THE VOLTAGE POTENTIOMETER SETTING ON THE POWER SUPPLY BOARD. IT IS SET PROPERLY AT THE FACTORY AND SEALED. IF THE SEAL IS BROKEN AND THE SETTING ALTERED, DAMAGE TO THE DISPLAY MAY RESULTS AND ALL WARRANTIES WOULD BE VOIDED.
3. IF IT IS NECESSARY TO DISCONNECT THE DISPLAY PANEL FROM THE CONTROLLER BOARD, WAIT A *MINIMUM* OF TEN SECONDS AFTER POWER DOWN TO AVOID POSSIBLE DAMAGE TO THE DISPLAY PANEL.
4. READ THE INSTALLATION AND SET-UP SECTION OF THIS MANUAL *CAREFULLY BEFORE* ATTEMPTING TO APPLY POWER TO THE DISPLAY.

Table of Contents

1.0 Overview

Lucas Control Systems, Deeco™ Systems offers a complete line of rugged computers, VGA monitors, and terminals. These products are available in sealed standalone enclosures, with panel mount brackets and as embedded modules. All Deeco Systems products are available with touch systems for a complete user interface. Deeco Systems has manufactured quality flat panel display based products for harsh and industrial applications for more than a decade.

The M5 family of electroluminescent flat panel touch modules can be configured for either 512 x 256 or 640 x 400 pixel displays. These modules include the IR touch screen, EL display, power conversion circuitry and an intelligent C5 controller. The C5 controller provides pixel graphics, ANSI 3.64 standard encoding as well as the IR touch control circuitry. An industry standard RS-232 serial communications port with selectable baud rates provides host interfacing.

Using simple ASCII handler commands, the M5 executes high level graphics and terminal text applications, drawing lines, circles, arcs, vectors, polygons, and area fills.

The IR touch screen provides 63 x 31 (512 x 256) and 80 x 50 (640 x 400) touch points for convenient screen button location and fast user host interaction. Three modes of touch operation are provided in insure application design flexibility.

1.1 PRODUCT SUMMARY

- Fully integrated module
- Intelligent Deeco C5 Controller
- Single Board Design Contains Text, Graphic, and Touch Controller Circuitry
- Product Display Development Time Minimized
- Draw Graphic Images Within Minutes of Unpacking
- IR Touch Screen option (Entry, Exit, Tracking, X-Y Reporting)
- Power Conversion Circuitry
- Decreased Design Costs
- Minimum Front Panel Footprint
- Bright Electroluminescent display
- Complete Graphics and Text Firmware: 17 Graphic Commands, 40 Text Commands and 11 Touch Commands
- Simple ASCII Handler Formats
- Onboard Self-Test and Diagnostics

1.2 ORDERING INFORMATION

M5-1 (P/N 8845)
VT100 Subset Text
512 x 256 EL Display and Deeco Pixel Graphics. Includes pigtail for +5VDC and +12VDC.

M5T-1 (P/N 8816)
VT100 Subset Text
Same as M5-1 and includes SealTouch infrared touch system.

M5-3 (P/N 8846)
VT100 Subset Text
640 x 400 EL Display with Deeco Pixel Graphics. Includes pigtail for +5VDC and +12VDC.

M5T-3 (P/N 8817)
VT100 Subset Text
Same as M5-3 and includes SealTouch infrared touch system.

1.3 SPECIFICATIONS

Host Communications	RS232C, Baud rate 300 to 38.4K jumper selectable.	
Keyboard port:	IBM AT compatible	
Display:	80 x 25 characters	
Viewing Angle:	>120 degrees, horizontal	
Humidity:	5-95% RH Non-condensing	
Temperature:		
Operating	0^{o}C to $+55^{o}$C	
Non-operating	-40^{o}C to $+75^{o}$C	
	512 x 256	**640 x 400**
IR Touch Resolution	63 x 31 points	80 x 50 points
Dimensions:	10.5" (W) x 5.7" (H) x 2.6" (D) (267 mm x 145 mm x 66 mm)	10.6" (W) x 6.9" (H) x 2.3" (D) (269 mm x 175 mm x 58 mm)
Viewing and Touch Area:	7.68" (W) x 3.83" (H)	7.68" (W) x 4.84" (H)
Weight:	40 oz	44 oz
Power Requirements (typical)	+5V @ 0.75A +12V @ 1.0A	+5V @ 0.75A +12V @ 1.3A

2.0 Installation

2.1 SETUP

This section covers unpacking, and applying power to the M5ST. Following these steps will ensure successful operation.

2.2 UNPACKING

Visually inspect the control card and the display for damage when unpacking the module. Contact shipper if any damage is found.

The display module consists of two circuit boards. The display/driver board contains the glass display, mounting frame and the drive circuits. The controller board contains the refresh memory, the drawing processor, the command interpreter, and the DC/DC converter.

Observe ESD Precautions When Unpacking and Handling the M5ST Module,

Remove the module from the protective wrapping, and inspect the unit. Contact the shipper if any damage is noted.

2.3 POWER CONNECTION

Voltage requirements are +5VDC for the controller logic and +12VDC for the display voltage converter, IR touch and RS232 port. The display voltage must never exceed +15VDC or it will damage the serial interface on the controller. It is very important to have clean power at the correct levels. Failure to have correct power can result in irregular operation or even complete failure. A cable assembly is provided by Deeco, consisting of the mating connector and 1 foot of wire.

Connect the power cable to the voltage sources indicated in Figure 1.

Table 1 gives maximum power requirements for the M5 regardless of which display is used.

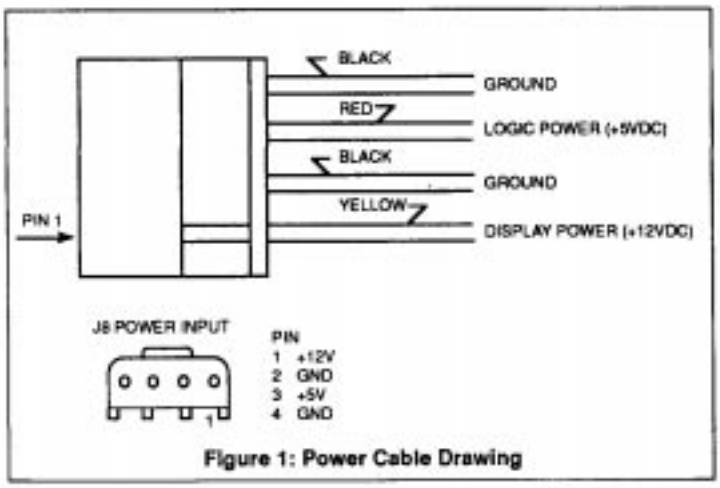


Figure 1: Power Cable Drawing

Description	Min.	Typ.	Max.	Units
Logic supply (VCC)	4.9	5.0	5.25	V
Logic supply current	-	0.75	1.00	A
Display supply (VD)	11.5	12.0	12.6	V
VD supply current (OP)	-	-	2.5	A
VD surge current	-	-	2.5	A
Max. P.P Ripple	-	-	5%	-

Table 1 - M5 Power Requirements

Note: When checking for proper voltage levels, always check the voltages at the Deeco controller card -- NOT at the source. This is the only way to ensure an accurate reading of power levels.

2.4 SELF TEST

The C5 controller has a built-in self-test, so it is possible to determine if the unit is operating correctly.

To enable "self-test" mode, simply install a jumper at E8 on the C5 controller. The display alternates from all pixels on to all pixels off with a left to right sweep fill.

During the time the display is dark, an IR beam test is performed. A permanent vertical or horizontal line displayed during self-test indicates an IR beam failure.

3.0 Command Descriptions

3.1 ANSI 3.64 DESCRIPTION

The ANSI 3.64 standard describes a method of encoding information and commands for computer peripherals and other devices. The encoding is based on the 7-bit ASCII encoding defined by the ANSI standard 3.4 and the 8-bit extension to that encoding which defined the ANSI 3.41 standard.

A typical ANSI 3.64 command uses a "sequence introducer", "parameters" and a "final character" or "terminator", all encoded in ASCII. The sequence introducer signals the receiving device that a command follows.

The parameters are ASCII encoded decimal numbers. Multiple parameters are separated by semi-colons. If a parameter is a negative number (as in graphic relative commands) the parameter must have a colon instead of a semi-colon separating it from the next parameter. The colon must be used even if it is the last parameter.

The final character determines which command the receiving device is to perform. A terminator is used when device specific commands are used.

The C5 controller uses the ESC, CSI and DCS sequence introducers and ST as a terminator. These ANSI-defined symbols are encoded as one or two characters (depending if 8-bit or 7-bit data is being sent, the C5 will accept either). The symbols are encoded as follows:

ANSI Symbol	8-bit Encoding	7-bit Encoding	ASCII Equiv.
ESC	1BH	1BH	ESC
CSI	9BH	1BH 5BH	ESC [
DCS	90H	1BH 50H	ESC P
ST	9CH	1BH 5CH	ESC \

Note: Spaces are used in commands descriptions for illustration only. They are not part of the command. If an ASCII space character is part of a command, it will be shown as <space>.

3.2 TEXT COMMANDS

ASCII Control Code	Action	ASCII Control Code	Action
07	Bell	84	Index
08	Backspace	85	Next Line
09	Horizontal Tab	8D	Reverse Index
0A	Line Feed	90	DCS
0B	Line Feed	98	CSI<
0C	Line Feed	99	CSI>
0D	Carriage Return	9B	CSI
1B	Escape	9C	ST

3.3 SCROLLING

SCROLL REGION: **CSI Pt; Pb r**

Function: Select the top and bottom of the scrolling region (that area of the screen that can scroll as new characters are received). The scroll region must consist of at least two lines. Lines are counted from "1". If no value is specified, or after power-up or reset, the default values are the top and bottom of the screen.
Pt: Line number of top of scroll region.
Pb: Line number of bottom of scroll region.

3.4 CURSOR POSITIONING

CURSOR UP: **CSI Pn A**

Function: Move the cursor up. The cursor will stop at the top of the scroll region.
Pn: Number of lines to move up.

CURSOR DOWN: **CSI Pn B**

Function: Move the cursor down. The cursor will stop at the bottom of the scroll region.
Pn: Number of lines to move down.

CURSOR RIGHT: **CSI Pn C**

Function: Move the cursor right. The cursor will stop at the right margin.
Pn: Number of character positions to move.

CURSOR LEFT: **CSI Pn D**

Function: Move the cursor left. The cursor will stop at the left margin.
Pn: Number of character positions to move.

CURSOR POSITION: **CSI Pr; Pc H**

Function: Move the cursor to the specified character line and column. Rows are numbered 1 to 24, columns from 1 to 80. Row or column "0" is interpreted as a row or column "1". Default for a missing parameter is "1". If the row or column specified is greater than the actual number (24 rows, 80 columns) then the largest number possible is used.
Pr: Row number
Pc: Column number

3.5 CHARACTER ATTRIBUTES

REVERSE VIDEO ON: **CSI 7 m**
REVERSE VIDEO OFF: **CSI 27 m**
Function: Select the specified attribute for all NEW characters received. If the characters are subsequently moved, the attribute moves with them.

3.6 EDITING

ERASE LINE, CURSOR TO END: **CSI K**
Function: Erase from the cursor (inclusive) to the end of the line. No line attributes are affected.

ERASE LINE, START TO CURSOR: **CSI 1 K**
Function: Erase from the beginning of the line to the cursor (inclusive). No line attributes are affected.

ERASE LINE: **CSI 2 K**
Function: Erase the entire line.

ERASE SCREEN: **CSI 2 J or ESC <formfeed>**
Function: Erase the entire screen. The cursor maintains its original position.

3.7 TABS

HORIZONTAL TABS SET: **ESC H**
Function: Set a tab stop at the current cursor position.

HORIZONTAL TAB CLEAR: **CSI g**
Function: Clear a tab stop at current cursor position.

CLEAR ALL TABS: **CSI 3 g**
Function: Clear all tab stops.

3.8 AUTO-WRAP ON/OFF

AUTO-WRAP ON: **CSI ? 7 h**
Function: If the cursor is at the right margin when a new character is received, precede the character with a carriage return and linefeed. If the cursor is at the bottom of the scroll region, cause a scroll up.

AUTO-WRAP OFF: **CSI ? 7 l**
Function: Disable Auto-wrap

3.9 TEXT CURSOR

TEXT CURSOR ON: **CSI ? 25 h**
Function: Turn on the text cursor.

TEXT CURSOR OFF: **CSI ? 25 l**
Function: Turn the text cursor off.

ALPHA CURSOR BLOCK: **CSI < 2 h**
Function: Selects the "box" style of blinking alphanumeric cursor.

ALPHA CURSOR UNDERLINE: **CSI < 2 l**
Function: Selects the "underline" style of blinking alphanumeric cursor.

3.10 SEVEN/EIGHT BIT CONTROL CODES

TRANSMIT 7-BIT EQUIVALENT:
ESC <space> F
<space>:ASCII space character

TRANSMIT 8-BIT CONTROL CODE:
ESC <space> G
<space>:ASCII space character

3.11 ALPHA CONTROLS

CHARACTER SIZE: **CSI < Ps s**
Function: Select the character size used for terminal characters. There are seven sizes available, the basic size and 6 additional sizes. The basic size corresponds to a 6x10 character cell (on 512 x 256 matrix displays) or a 8 x 16 character cell (on 640 x 400 matrix displays). The additional sizes multiply the basic size by 2, 4, 8, etc.
Ps: Character size selection (1, 2, 3, 4, . . . 7)

WRITE MODE: **CSI < Ps M**
Function: Selects the raster write mode for terminal alphanumerics. The write mode may be JAM, COMPLEMENT, SET, or CLEAR.
Pm: Write Mode (0=JAM, 1=COMPLEMENT, 2=CLEAR, 3=SET)

3.12 HARD CHARACTER SETS IN THE C5: CSI < PCS H

A hard character set refers to a set whose image resides in the program memory of the C5. All C5 character sets are hard sets.

There are two hard character sets in the C5, one for each supported display dimension: 640 x 400 and 512 x 256. At power-up, the C5 determines the display dimension and selects the appropriate character set for use. This power-up default can be over-ridden by command.

The command **`CSI < Pcs H`** will select one of the two hard characters sets for use, regardless of the display dimensions. The sets are numbered 0, and 2 for display dimensions 640 x 400, and 512 x 256 respectively, and it is this number which is used as the Pcs parameter in the hard character set selection command.

The character cell corresponding to a character set is invoked with the set. The number of rows and columns resulting will be different for different display dimensions. The following chart describes the character sets and the resulting row/column counts for the various displays.

			Column x Row	
Character Set	**Cell Size**	**Nominal Display**	**640 x 400**	**512 x 256**
0	8 x 16	640 x 400	80 x 25	64 x 16
2	6 x 10	512 x 256	106 x 40	85 x 25

3.13 GRAPHIC COMMANDS

GRAPHIC CURSOR ON: **`CSI < 9 h`**
Function: Enables the display of the graphic cursor symbol.

GRAPHIC CURSOR OFF: **`CSI < 9 l`**
Function: Disables the display of the graphic cursor symbol.

3.14 GRAPHIC CURSOR STYLE

GRAPHIC CURSOR BOX: **CSI 10 h**
Function: Selects the graphic cursor style as a box.

GRAPHIC CURSOR CROSS: **CSI 10 l**
Function: Selects graphics cursor style as a cross.

SET GRAPHIC CURSOR: **DCS 1 G Py; Px ST**
Function: Set graphic cursor to a specific location.
Py: "Y" co-ordinate of cursor
Px: "X" co-ordinate of cursor

3.15 GRAPHIC OBJECTS

VECTOR, ABSOLUTE: **DCS 2 G Py1; Px1; Py2; Px2 ST**
Function: Draw a vector from (Y1, X1) to (Y2, X2). The new graphics cursor position becomes (Y2, X2). The vector appearance is controlled by the line style attribute.
Py1: Y of start of vector
Px1: X of start of vector
Py2: Y of end of vector
Px2: X of end of vector

VECTOR, RELATIVE: **DCS 3 G Py2; Px2 ST**
Function: Draw a vector from the current graphics cursor position to the graphics cursor position plus (Y2, X2). This becomes the new graphics cursor position.
Py2: Y of end of vector
Px2: X of end of vector

CIRCLE, ABSOLUTE: **DCS 4 G Pr; Pyc; Pxc ST**
Function: Draw a circle, centered at (Yc, Xc) with radius Pr. The graphics cursor becomes the circle center upon completion.
Pr: Radius of circle
Pyc: Y of circle center position
Pxc: X of circle center position

CIRCLE, RELATIVE: **DCS 5 G Pr ST**

Function: Draw a circle, centered at the current graphic cursor position, with radius Pr. The graphic cursor remains unchanged.

Pr: Radius of circle

ARC, ABSOLUTE: **DCS 6 G Pa1; Pa2; Pr Pyc; Pxc ST**

Function: Draw a circular arc, centered at (Yc, Xc) with radius Pr. The arc start and stop are specified as angles from the horizontal (0 degrees at the right). The graphics cursor becomes the circle center upon completion.

Pr: Radius of the circle
Pa1: Angle, in degrees, of start of arc
Pa2: Angle, in degrees, of arc stop
Pyc: Y of circle center position
Pxc: X of circle center position

ARC, RELATIVE: **DCS 7 G Pa1; Pa2; Pr ST**

Function: Draw a circular arc, centered at the current graphics cursor position, with radius, Pr. The arc start and stop are specified as angles from the horizontal (0 degrees at the right). The arc is drawn counterclockwise. The graphics cursor remains unchanged.

Pa1: Angle in degrees of arc start
Pa2: Angle in degrees of arc stop
Pr: Radius of circle

BLOCK FILL, ABSOLUTE: **DCS 8 G Pyl; Pxl; Pyu; Pxr ST**

Function: Fill a rectangular area. The fill pattern is controlled by the fill style attribute. The rectangular area is defined by the lower left and upper right corner positions. The graphics cursor becomes the upper right corner position upon completion.

Pyl: Y coordinate lower left corner
Pxl: X coordinate lower right corner
Pyu: Y coordinate upper right corner
Pxr: X coordinate upper right corner

BLOCK FILL, RELATIVE: **DCS 9 G Pyu; Pxr ST**

Function: Fill a rectangular area. The fill pattern is controlled by the fill style attribute. The rectangular region is defined by the current graphics cursor position (at the lower left corner) and the offset (from the graphics cursor yu, xr). The graphics cursor becomes the upper right corner upon completion.

Pyu: Y coordinate, upper right corner
Pxr: X coordinate, upper right corner

CONCAVE FILL, ABSOLUTE: **DCS 10 G Pys: Pxs ST**

Function: Fill a concave polygonal area. The fill pattern is always a solid color, white or black. The region is defines by a solid border surrounding the specified seed position. If the pixel at the seed position is white, then the border is assumed to be black. If the pixel is black, the border is assumed to be white. The region is filled with the border color. The graphics cursor becomes the seed position upon completion.

Pys: Y coordinate seed position

Pxs: X coordinate seed position

CONCAVE FILL, RELATIVE: **DCS 11 G ST**

Function: Fill a concave polygonal area. The fill pattern is always a solid color, white or black. If the pixel at the seed position is white, then the border is assumed to be black. If the seed pixel is black, then the border is assumed to be white. The region is filled with the border color. The graphics cursor is used as the seed position and remains unchanged upon completion.

3.16 GRAPHICS TEXT COMMANDS

GRAPHICS STRING DRAW ABSOLUTE: **DCS 14 G Py; Px A <a...a> ST**

Function: Draw a text string. The current character attributes control the character size, and video mode, (reverse or normal). The graphics cursor becomes the last character position plus 1 upon completion of the command.

Py: Y coordinate start of string position

Px: X coordinate start of string position

<a...a>: ASCII code of characters. Control codes are assumed to be displayable except for Escape (code 1BH) and String Terminator (code 9CH) which terminate the command.

GRAPHIC STRING DRAW RELATIVE: **DCS 15 G A <a...> ST**

Function: Draw a character string beginning at the current graphics cursor position. The current character attributes control the size and video mode (reverse or normal). The graphics cursor becomes the last character position plus 1 upon completion of the command. Control codes are assumed to be displayable except for Escape (code 1 BH) and String Terminator (code 9CH) which terminate the command.

3.17 GRAPHIC ATTRIBUTES

LINE STYLE: **DCS 18 G Ps ST**

Function: Select the line style for vectors and object borders.
Ps: Style
0 = solid white
1 = long dash
2 = short dash
3 = dot
4 = dot dash
5 = sparse dot

FILL STYLE: **DCS 19 G Ps ST**

Function: Select the fill style for block fills
Ps: Style
0 = solid black
1 = solid white
2 = vertical hatch
3 = horizontal hatch
4 = slant left hatch
5 = slant right hatch
6 = sparse dot

WRITE MODE: **DCS 20 G Pm ST**

Function: Select the raster write mode. The write mode refers to how new raster data (objects being drawn) and existing raster data are combined. The simplest mode is to "replace" where new data completely replaces the old. There are three other methods, each described by a Boolean logical expression: 1) complement; RASTER=NEW XOR OLD; 2) clear; RASTER=(NOT NEW) AND OLD; and 3) set; RASTER=NEW OR OLD.
Pm: Write Mode; 0-3 for Replace, Complement, Clear, Set.

3.18 RASTER OPERATIONS

RASTER WRITE, ABSOLUTE: **DCS 21 G Py; Px; pyd; Pxd H <h...h> ST**
RASTER WRITE, RELATIVE: **DCS 22 G Pyr, Pxr, Pyd, Pxd H <h...h> ST**

Function: The area to be written is a rectangular portion of raster memory. Raster data, supplied in HEX/ASCII, is written directly to the raster starting point (Px, Py). Writing continues at the same Y value until the pixel corresponding to (Px+xd-1, Py) is written. Writing resumes at the point (Px, Py+1) and the cycle repeats thus writing data into a rectangular raster region. In practice, the Pyd parameter is not used and writing will continue n the Y direction until the command is terminated. Data bits are displayed in the raster, with the least significant bit at the left.

- Px, Py: Specify the start position (pixel), absolute.
- Pxr, Pyr: Start position, relative to graphics cursor.
- Pxd; Pyd: Specify the dimensions of the rectangular region to be written
- <h...h>: HEX/ASCII data

Note: Because the smallest unit of data is 8 bits, the number of data units (HEX/ASCII byte) needed to specify Pxd number of pixels may result in excess pixels. For example: To write 18 pixels in the X directions, you need at least three bytes, which yield 6 extra pixels for each step in the Y direction. The 6 extra pixels are masked off and discarded.

3.19 RASTER PAGES

The standard C5 raster memory consists of two 32Kx8 (32768) blocks. Each one of these blocks is one raster page. They are numbered page 0 and page 1. The width is pixels, called hereafter Xmas, is equal to the display width in pixels. The size of the raster page Y dimension, called hereafter Ymax, is equal to the formula below:

Ymax=32768/(Xmax/8)
Example: Ymax for a 512 x 256 display is: 32768/(512/8) = 512.

See Figure 2 for raster page map for all display sizes.

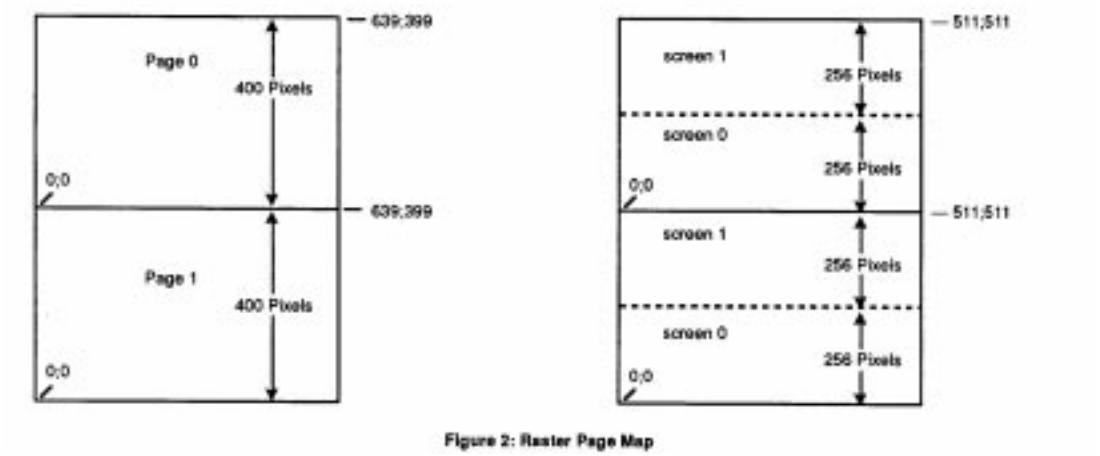


Figure 2: Raster Page Map

As you will note from Figure 2, a 640 x 400 configuration has only enough lines for a single screen (Ymax equals Y dimension of the display) per page. However, in a 512 x 256 configuration Ymax equals twice the Y dimension of the display, giving each raster page two screens, 0 and 1.

Note: The raster pages can be thought of as being circular. Repeated full screen scrolls will eventually display all of a page.

The command to select the raster page that will be written to is:

ACTIVE PAGE SELECT: **`CSI < Pp A`**

Function: Select the active page.
Pp is the active raster page 0 or 1.

The command to select the raster page to be displayed is:

DISPLAY PAGE SELECT: **`CSI < Pp; Po P`**

Function: Select the display page. Pp is displayed raster page 0 or 1. Po is an offset specifying the display start coordinate in pixels.

Example: In 512 x 256 configuration, at default the portion of raster memory displayed is 256 pixels high (Y dimension) and starts at location 0;0. As shown in Figure 2, screen 0 will be displayed. To display screen 1, make Po 256.

3.20 TOUCH COMMANDS

ENTRY TOUCH REPORTS ON: **CSI > 16 h**
Function: Sends a report of the coordinates where the IR beams are first broken. If this is the only active mode, a user could touch the screen and drag across it, but the only report sent would be the point of first contact.

TOUCH ENTRY REPORT MODE OFF: **CSI > 16 l**
Function: Disables Touch Entry Reporting.

TOUCH EXIT REPORT ON: **CSI > 17 h**
Function: Sends a report of the coordinates where the IR beams are last broken. If this is the only active mode, a user could touch the screen and drag across it, but the only report sent would be made after the finger is lifted from the screen.

TOUCH EXIT REPORT MODE OFF: **CSI > 17 l**
Function: Disables Touch Exit Reporting.

TOUCH TRACK REPORT ON: **CSI > 18 h**
Function: Sends a report of the coordinates of a "drag" across the screen at each change of position. If Entry Mode is not on, it will also report the position of the first touch. This mode has no fixed reporting period, instead it will report only when the "broken" beam moves.

TOUCH TRACK REPORT OFF: **CSI > 18 l**
Function: Disables Touch Track Reporting Mode.

MULTI TOUCH REPORT ON: **CSI > 19 h**
Function: Sends an error report whenever the user touches the screen in more than one place at a time.

MULTI TOUCH REPORT OFF: **CSI > 19 l**
Function: Disables multi touch reporting.

BEEP ON TOUCH REPORT ON: **CSI > 21 h**
Function: Causes an audible signal to be generated when a button's response is sent.

BEEP ON TOUCH REPORT OFF: **CSI > 21 l**
Function: Disables Beep on Touch Report.

RETURN SEQUENCE FROM TOUCH SCREEN: **CSI > Py; Px (code)**
The Coordinates are ASCII encoded decimal values
Px = X Coordinate
Py = Y Coordinate
Codes: T=Track, E=Entry, X=Exit

3.21 SELF CHECK FUNCTIONS

The touch sensor contains a microcomputer that will perform a beam failure self check. During this period, the device will not respond to touches or computer commands (and none should be attempted or they will be lost). The screen should not be touched during the test as erroneous results for the IR beam will occur.

IR BEAM TEST SELF CHECK: **CSI > 4 n**
Function: The sensor will check the operation of the IR beams, and report the IR beam status.

IR BEAM STATUS REPORT: **CSI>Pf c**
Function: Response to IR beam test self check command. If beams are operating correctly, Pf=0.

BEAM FAILURE REQUEST: **CSI > 3 n**
Function: When the sensor indicates that an IR beam has failed, this command will request a report as to which component failed.

BEAM FAILURE RESPONSE: **CSI > Pf; Pf; Pf...a**
Function: Identifies which component has failed (in response to Beam Failure Request Command above). Any number of failure codes may be sent. Component identification codes begin with 00 for the left most LED on the X axis. EVEN numbers identify the LEDs, ODD numbers identify the PHOTOTRANSISTORS. Numbers count upward to the right on the X axis and upward in the Y axis.
Pf: A decimal ASCII integer that identifies which component has failed.

C5 SYSTEM STATUS REQUEST: **CSI 5 n**
Function: Request for the C5 system status report.

C5 SYSTEM STATUS OK: **CSI 0 n**
Function: Response to C5 system status request, indicating no malfunction.

C5 SYSTEM STATUS NOT OK: **CSI 3 n**
Function: Response to C5 system status request, indicating a malfunction has occurred.

C5 SYSTEM CONFIGURATION REQUEST: **CSI < 3 n**
Function: Request for system configuration (Version and Revision numbers etc.).

C5 SYSTEM CONFIGURATION REPORT: **CSI < 3 Pv; Pr; Pi n**
Function: Reports firmware version and revision numbers and IR option (if installed).
Pv: Firmware version number.
Pr: Firmware revision number.
Pi: IR option 20=no IR detected.
21=IR detected.

XON/XOFF PROTOCOL/ENABLED: **CSI < 12 h**
Function: (Default) Sends software handshaking characters to the host.

XON/XOFF PROTOCOL DISABLED: **CSI < 12 l**
Function: Disables software handshaking.

SCREEN SAVER ON: **CSI < 1 h**
Function: Enable the screen saver time-out feature. This feature blanks the screen after a specified time of no input (host, touch, or keyboard).

SCREEN SAVER OFF: **CSI < 1 l**
Function: Disables the screen saver time-out feature.

KEYBOARD MAPPING ON: **CSI < 14 h**
Function: (Default) When enabled, keyboard input is automatically interpreted.

KEYBOARD MAPPING OFF: **CSI < 14 l**
Function: If this mode is enabled, direct scan codes are sent by the keyboard to the display.

3.22 RESET

HARD RESET: **ESC c**
Function: Cause a hard terminal reset. Resets all parameters to default values.

4.0 Communications and Interfaces

4.1 SERIAL INTERFACE OPERATIONS

For the RS232 serial port, internally generated baud rates from 300 to 38.4 KB are available.

4.2 DATA FORMAT

The data format is jumper selectable. It consists of:

1 Start Bit
7 or 8 Data Bits
1 Stop Bit
No parity or Odd parity
No parity check is made!

5.0 Handshaking Techniques

The connection described herein is the RS232 serial type and is relatively simple.

5.1 SOFTWARE HANDSHAKING

The C5 defaults to XON/XOFF software handshaking protocol, thus making this the simplest method of controlling data flow. This method utilizes a 256 byte input buffer on the C5, and the XON/XOFF (11H, 13H) signals to indicate when the display controller is "busy". When the input buffer reaches 80% of capacity (205 bytes) the C5 sends an XOFF, thus "telling" the host system to suspend any further data transmission unit an XON is received. When the input buffer (C5) reaches 20% of capacity, (51 bytes) the XON is sent "telling" the host system to resume data transmission.

Just three communications signals are employed:

1. TxD Transmits serial data. (This is an output signal from the C5 serial port).
2. RxD Receives serial data. (Input to the C5 serial port).
3. GND Ground reference for RS232C signals.

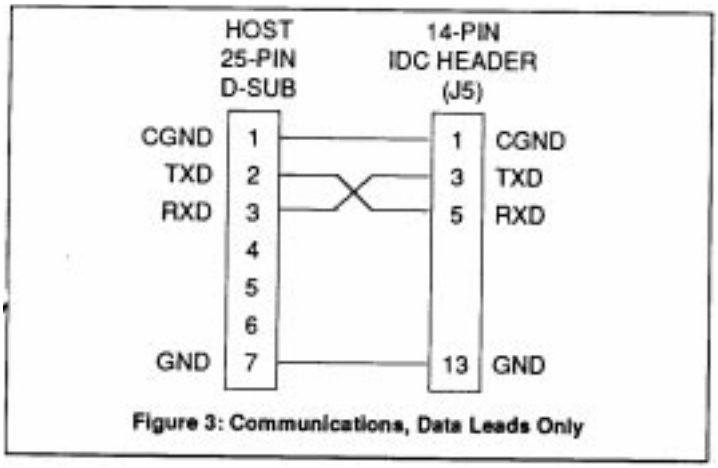


Figure 3: Communications, Data Leads Only

There is, however a limitation to this scheme. It is less effective than hardware handshaking because of the 'lag' time involved in processing the command. This is especially important with baud rates of 19.2 KB or higher.

If your particular requirements are not shown here, refer to Hardware Handshaking Signals.

5.2 HARDWARE HANDSHAKING PROTOCOL

When using baud rates of 19.2 KB or higher, or when software handshaking is not available, a hardware handshaking scheme is recommended.

Hardware protocol can be implemented using RTS/CTS convention. Data flow from the C5 is enabled only when CTS is asserted. Similarly, the C5 will assert RTS when it is able to receive data.

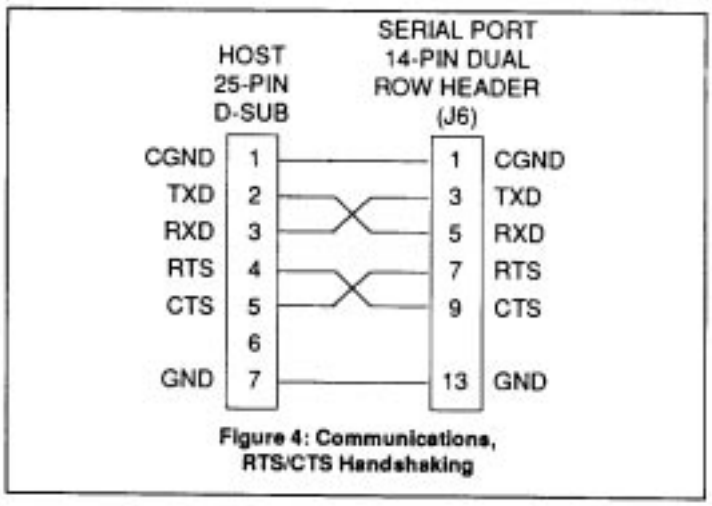


Figure 4: Communications, RTS/CTS Handshaking

6.0 Serial Connector Description

A brief description of the pin numbers and their signal function follows:

Pin #	Function
3	TXD: Data from the Display to the Host.
5	RXD: Data from the Host to the Display.
7	RTS: Handshake signal asserted by the display to indicate that it is not busy, and will accept data from the host.
9	CTS: Handshake signal asserted by the host to indicate that it is not busy, and will accept data from the M5 display module.
13	GND: Signal ground, connected to the signal ground of the display module.
1	CHASSIS: Chassis ground. This is connected only to a terminal next to the header.

Note: These pin numbers refer to the 14 pin header on the C5 controller.

Note: When using an IBM-PC or compatible as the host device, software handshaking (XON/XOFF) is required. When using this configuration, make sure pins 4 and 5 are shorted and pins 6 and 20 are shorted (see Figure 5). To use hardware handshaking with the PC as shown in Figure 4, special software drivers are required.

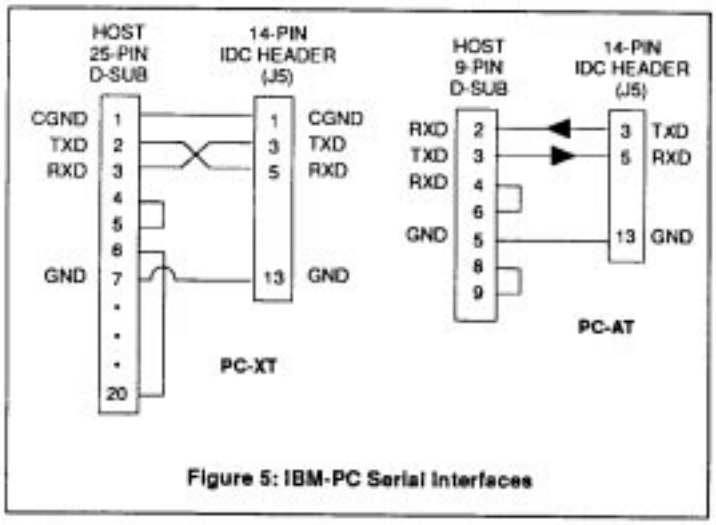


Figure 5: IBM-PC Serial Interfaces

7.0 Keyboard Interface Operation

The keyboard interface is designed to work with the IBM PC AT keyboard or any functional equivalent. Data is transferred serially with its own clock, and comes not in an ASCII format but rather in a special IBM scan code. To assist the user, the display controller can be set to convert the IBM scan codes to the ASCII format before sending data to the host. IBM PC AT compatible keyboards are widely available from manufacturers such as Hi-Tech, Oak, Keytronics etc.

7.1 SIGNAL CONNECTOR

IBM PC AT compatible keyboards normally come supplied with a round DIN style 5-pin AT180 degree connector at the end of a cable. Since it is assumed that our customers would be more likely to plug the keyboard into a chassis mounted connector rather that directly into the display controller card, the connector used on the card is different from that used on the keyboard. However, an adapter cable (Deeco #6700) is available to provide the connection between the two.

The controller card connector is a 5-pin single line, 0.100" spaced device (AMP #640456-5). The mating part is AMP#640440-5 or equivalent.

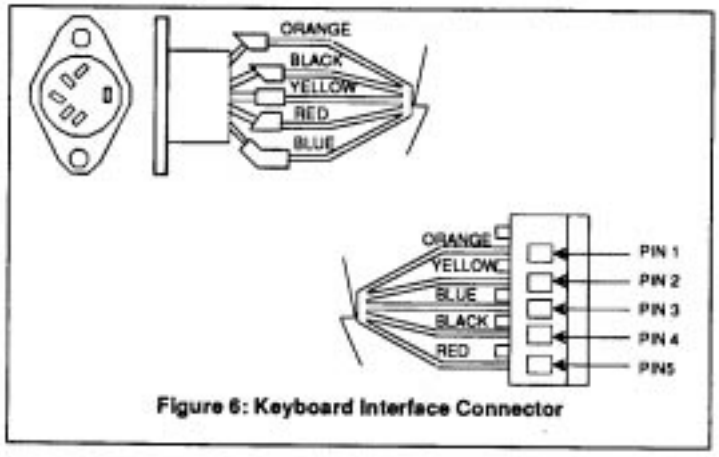


Figure 6: Keyboard Interface Connector

Functional Description of Each Pin		
Pin 1	Clock	Used to latch incoming data.
Pin 2	Data	Serial signal that defines the scan code.
Pin 3	No Connect	
Pin 4	Ground	Signal ground for the keyboard.
Pin 5	+5V	Supplies power to the keyboard.

The adapter cable sold by Deeco (P/N 6700) for evaluation units, consists of two connectors, the AMP #640440-5 and a chassis mount, round 5-pin DIN connector (Switchcraft #57GB5F) or equivalent.

8.0 Jumper Settings

Jumpers E1-E11 control the C5 operating modes such as baud rate, data bits and display select. The first jumper configuration listed is the default '0' denotes no jumper, '1' denotes jumper in place.

E3	E2	E1	Function Baud Rate Selection
0	0	0	9600
0	0	1	19200
0	1	0	38400
0	1	1	300
1	0	0	600
1	0	1	1200
1	1	0	2400
1	1	1	4800

E4	Data Bit Selection
0	8 data bits
1	7 data bits

E5	Parity Selection
0	No parity
1	Odd parity

E8-E11 are factory set. Information on these jumpers is provided for reference only.

E8	Power-up Mode
0	Normal Operation
1	Run burn-in self test

E11	E10	E9	Display Selection
0	0	0	M5 - 640 x 400
0	0	1	M5 - 512 x 256
1	0	0	
1	0	1	
1	1	0	512 x 256 Touch Only
1	1	1	640 x 400 Touch Only

9.0 Maintenance

The M5 is a ruggedized system, so no special maintenance procedures are required. Periodic cleaning of the IR Touch Bezel and display filter are recommended for proper operation of the SealTouch system as well as for clear viewing of the display.

9.1 EFFECTS OF CHEMICALS ON THE SEALTOUCH BEZEL

The bezel and filter are made of an acrylic material, so strong solvents should not be used for cleaning purposes. A soft, lint-free cloth, along with a non-abrasive, non-acidic cleaner can be used to clean the touch screen. Refer to the following section for details regarding suitable cleaning compounds.

The following table provides a list of chemicals and their effect on acrylic plastic after 7 days immersion at 77° F (25° C).

Class	Name	% Solution	Effect
Acids	Acetic Acid	100	Dissolves
	Chromic Acid	40	Discolors
	Citric Acid	10	Negligible
	Hydrochloric Acid	38	Attacks
	Hydrochloric Acid	10	Negligible
	Nitric Acid	40	Attacks
	Nitric Acid	10	Negligible
	Oleic Acid	Any	Negligible
	Sulfuric Acid	98	Dissolves
	Sulfuric Acid	30	Negligible
Bases	Ammonium Hydroxide	28	Negligible
	Sodium Carbonate	20	Negligible
	Sodium Hydroxide	60	Negligible
Commercial	Cottonseed Oil	Any	Negligible
	Detergent Solution	Any	Negligible
	Kerosene No. 2 D396	Any	Negligible
	Lacquer Thinner	Any	Dissolves
	Mineral Oil	Any	Negligible
	Soap Solution	Any	Negligible
	Transformer Oil D1040	Any	Negligible
	Turpentine D13	Any	Attacks

Class	Name	% Solution	Effect
Inorganic Compounds	Distilled Water	Any	Negligible
	Hydrogen Peroxide	28	Negligible
	Sodium Chloride	10	Negligible
Organic Compounds	Sodium Hypochlorite	5	Negligible
	Carbon Tetrachloride	Any	Attacks
	Dibutyl Sebacate	Any	Negligible
	Diethyl Formimide	Any	Swells
	Acetone	Any	Dissolves
	Aniline	Any	Dissolves
	Benzene	Any	Dissolves
	Ethyl Acetate	Any	Dissolves
	Ethyl Alcohol	95	Dissolves
	Ethyl Dichloride	50	Absorbs 2%
	2-Ethylhexyl Sebacate	Any	Dissolves
	Heptane	Any	Negligible
	Isooctane	Any	Negligible
	Methyl Alcohol	Any	Attacks
	Phenol (Aqueous)	5	Attacks
	Toluene	Any	Dissolves

10.0 IR Touch System

10.1 SEALTOUCH SYSTEM HARDWARE

The SealTouch hardware consists of the touch bezel and the touch controller. The touch bezel reads all touch inputs. The IR touch controller processes this information, then communicates with the host over a RS-232 link.

10.1.1 Infrared Bezel/Touch Controller

The IR bezel consists of a Touch Frame that houses an array of IR diodes and transistors. Once these beams are broken by a finger or a stylus, data is sent to the IR Touch Controller. The IR Touch Controller processes the touch data from the IR bezel, and reports which IR row beam and which IR column beam are interrupted by the touch.

10.1.2 Touch System Serial Interface

The IR Touch Controller communicates with the host system via a standard RS-232C serial port on the IR Touch Controller. A 9" (228.6 mm), 10-pin to 9-pin cable is included to adapt the 10-pin serial port to a standard 9-Pin male DSUB serial port. Refer to the following table for the serial interface pin-outs:

Touch Serial Interface Connector	
Pin 2	Receive Data (Host System to Monitor)
Pin 3	Send Data (Monitor to Host System)
Pin 5	Ground

10.2 OPERATION OF THE TOUCH MOUSE

The touch mouse drivers emulate a two button mouse. They simulate mouse button actuations and motions. The left mouse button is the default button state. To make the right mouse button the active button, simply touch the upper right corner of the display. The left button is re-activated by touching the upper left corner of the display. The cursor will not move from the current position when changing the active mouse button. Be sure to touch in the corner of the display, and not just the general area.

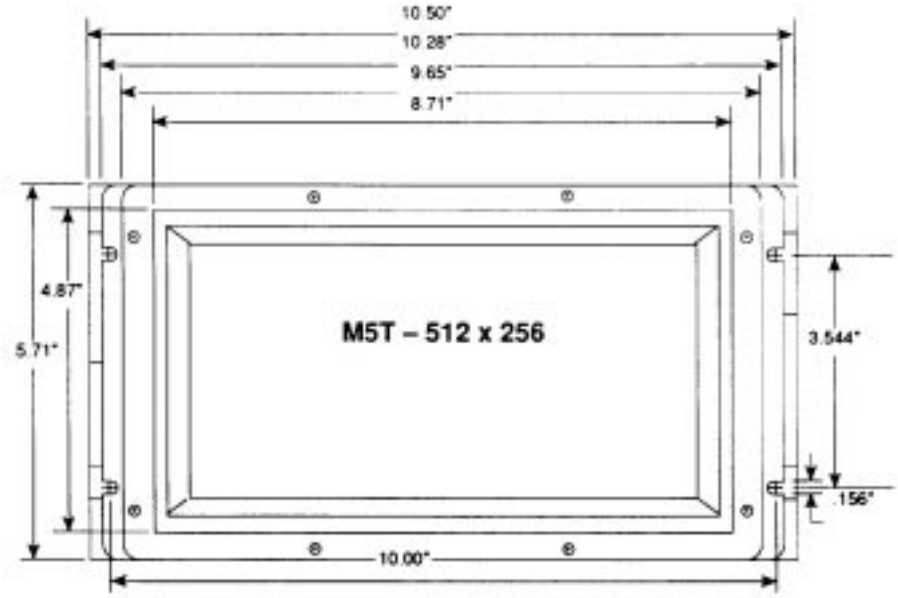
There are three significant touch “events” used to emulate a mouse. The first event is the “entry” event. An entry event is the first touch by a finger detected by the system. The second event is a “track” event. Track events are changes in the finger position after the entry event. The last event is the “exit” event. An exit event is the removal of the finger from the touch system. When the touch system detects an entry touch event, the mouse position is updated to be identical with the touch position. This is signified by the visible cursor moving to a position beneath the finger.

There are two tracking modes, absolute and relative, with which an application can interface with the mouse. Absolute mode is the recommended mode to use with the mouse. Absolute mode refers to the mouse position being referenced to the screen’s absolute pixel position. When the application references the mouse position, it is only interested in the current position of the mouse. This mode works best with a touch mouse, since the application’s mouse position is dependent on the mouse driver’s position.

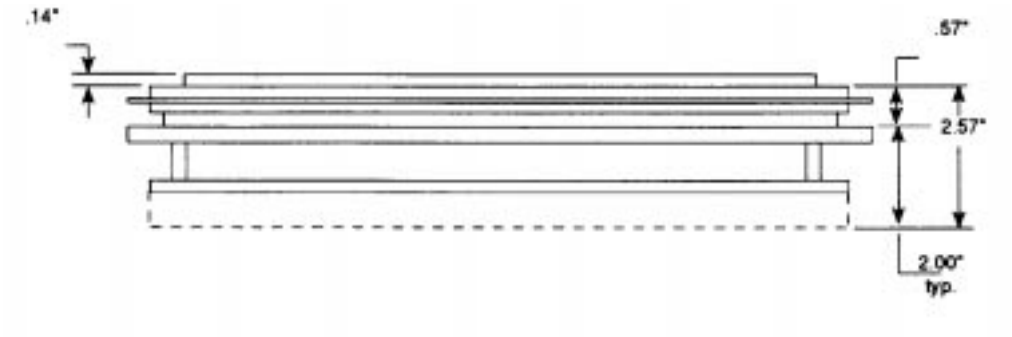
Relative mode refers to the mouse positioning being referenced to the last known position during tracking events. When the application references the mouse position, it wants to know the position changes from the last known position. This mode only works well with a touch mouse when the application uses the mouse driver to update and position the actual mouse cursor, or arrow on the screen. This mode does not work well when the application is maintaining the mouse position, and drawing the mouse cursor on the screen, rather than relying on the mouse driver. This mode causes problems because the application’s mouse position is independent of the mouse driver’s mouse position. This difference in mouse pointer positioning may cause an offset between the stylus and the mouse pointer. Typically, the user may “home” the mouse pointer by tracking the pointer into a corner that will allow the mouse pointer to arrive first. This allows the user to coordinate the X and Y coordinates of the applications mouse pointer with those of the touch mouse driver.

A special “double-click” algorithm has been developed to insure that double-click operations, a rapid entry-exit-entry-exit, are cleanly detected and reported.

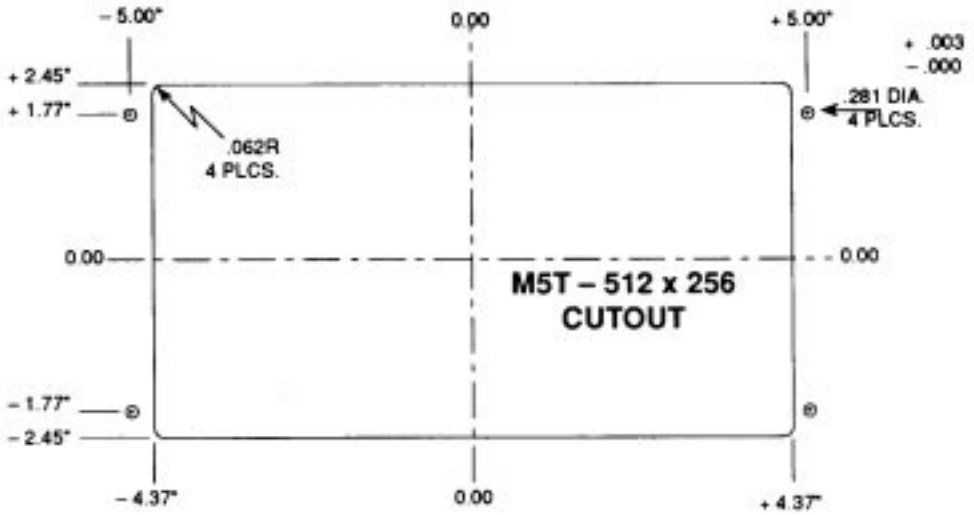
APPENDIX A: MECHANICAL DRAWINGS
M5 - 512 x 258



FRONT VIEW



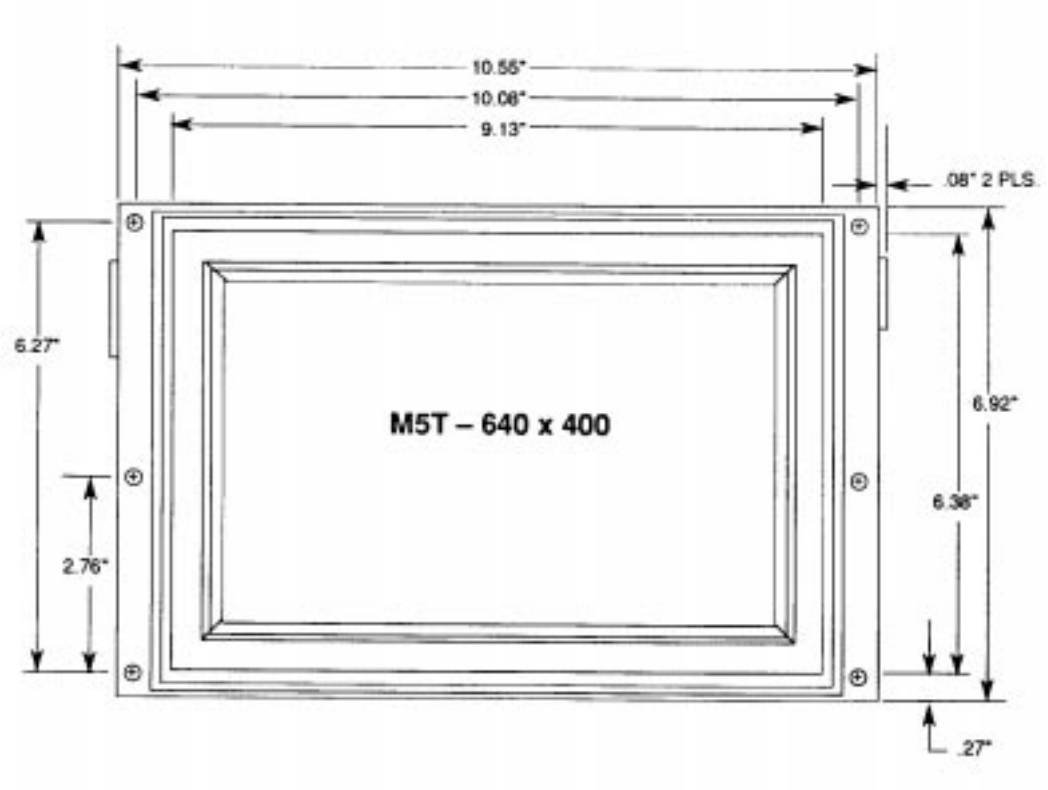
SIDE VIEW



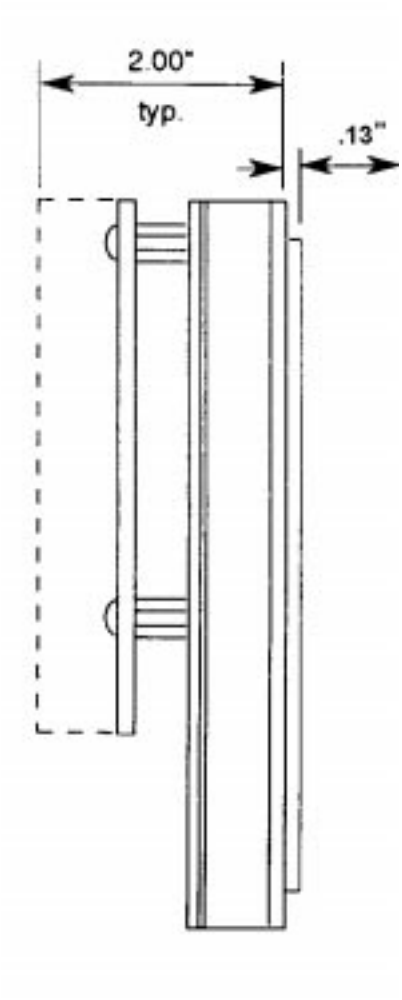
SUGGESTED CUT-OUT FOR M5 - 512 x 256

APPENDIX B: MECHANICAL DRAWINGS

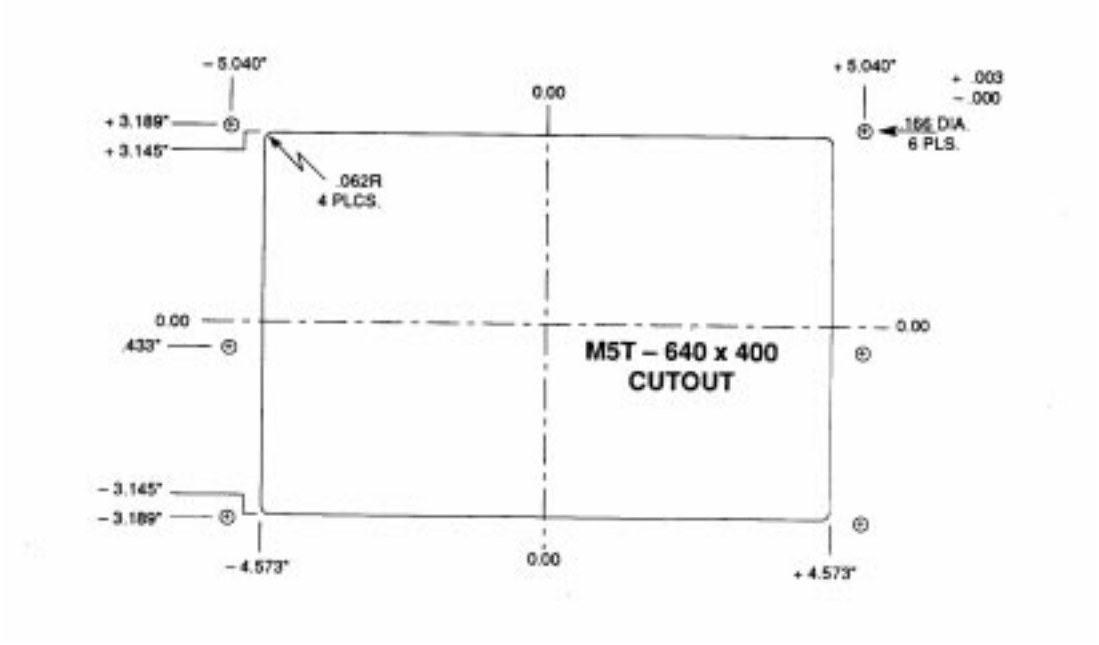
M5 - 640 x 400



FRONT VIEW



SIDE VIEW



SUGGESTED CUT-OUT FOR M5 - 640 x 400

Limited Warranty

Lucas Control Systems, Deeco Systems warrants this product against defects in materials and workmanship for a period of one year from the date of original shipment from the factory.

During this warranty period, Lucas Control Systems will, at no cost to the buyer, promptly repair or replace defective equipment returned to the factory, or other authorized warranty repair center, transportation charges pre-paid by the buyer, and will return such equipment, transportation charges prepaid. Lucas Control Systems 's sole obligation shall be, at its option, to repair or replace any goods which have been determined to be defective by Lucas Control System.

Equipment returned to the factory must be accompanied by the following information:

- Returned Material Authorization (RMA) number, obtained from Lucas Control Systems;
- Reason for return, with a comprehensive description of the malfunction;
- The name and telephone number of the person to contact in the event of questions or problems; and,
- Shipping instructions

This warranty shall not apply to damage resulting from improper handling, accident, negligence, loss or damage in transit, or abuse (such as applying the wrong polarity or voltage power). This warranty shall be voided should the buyer attempt any repairs or alterations without prior written permission of Lucas Control Systems.

Lucas Control Systems makes no other warranty, either expressed or implied, and disclaims any warranty or merchantability or fitness for a particular purpose. Any action by buyer for any alleged breach of this warranty shall be brought to the attention of Lucas Control Systems by the buyer within the warranty period.

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