Vorne Industries

2100SB V2 Series
Multi-Line Message Display
User's Manual

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Printed in the U.S.A.

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1 Introduction

1.1 General

Vorne 2100SB Series Displays are panel mountable, vacuum fluorescentmessage displays designed to interface with most PLC's and industrial computers. Three sealed front panel buttons and an on-screen menu allow easy application set up, while a locking setup feature prevents inadvertent change or loss of setup selections. Units are available with a choice of display sizes and power suppliesto meet the requirements of a wide variety of applications.

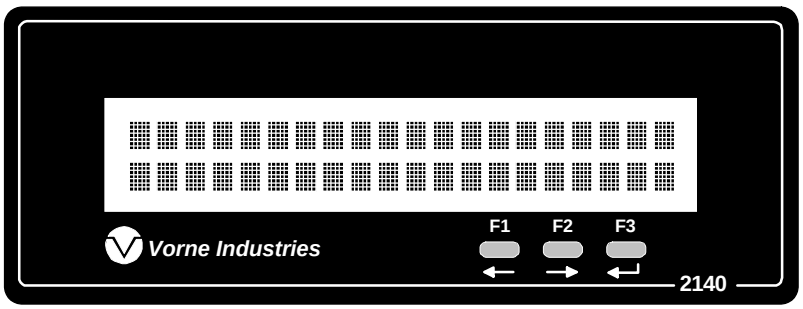
1.2 2100SB Serial Buffered Display

The 2100SB Display is available with two or four lines of 5x7 dot matrix characters.

2140 Two Line Display

The 2140 configuration, shown in Figure 1, displays 40 characters in two lines of 20 characters. The characters of a 2140 are each 11mm in height.

Figure 1
2140 Front Panel



2180 Four Line Display

The 2180 configuration, shown in Figure 2, displays 80 characters in four lines of 20 characters. The characters of a 2180 are each 9mm in height.

Figure 2
2180 Front Panel

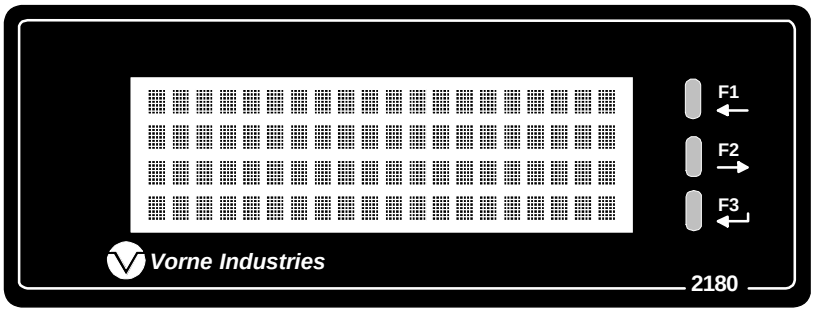


Table A Model Summary Table

Model 2140SB	2 Lines of 11 mm Characters
Model 2180SB	4 Lines of 9 mm Characters

2 Features

2.1 Vacuum Fluorescent Display (VFD)

VFD technology provides superior brightness, viewing angle, and spectral qualities. The natural color emitted by the VFD is a blue-green peaking at a wavelength of 505 nanometers. The VFD tube has a rated life of 50,000 hours (almost six years of continuous operation). Rated life is defined as the length of time before the average dot brightness will reach one-half of its original brightness due to fatigue of the display phosphors.

Note: To maximize the life of the display, it is important to avoid keeping the same message fixed on the display for extended periods (hours). If default messages like "ALL SYSTEMS GO" or "MACHINE RUNNING" are used, it is suggested that they scroll to prevent imprinting the message on the display phosphors.

2.2 E^2PROM Memory

This memory is used to store the information entered during setup. Setup data needs to be entered only once. Individual setup items may be modified at any time by entering the setup mode and making the desired changes, and then choosing the **Save Changes** option upon exit. This memory is retained in the absence of power with no need for a battery.

2.3 Scripts

The 2100 Series displays interpret scripts received from a host device with a serial port such as a PLC or a DOS based computer. Scripts are used to define the text to be displayed, to specify how the text is to be presented, to control the relay, and to define the operation of the front panel function keys. Scripts may contain literal text, control characters, and command strings. Scripts can be transmitted serially in a Simple Packet Protocol. A detailed discussion of scripts and the Simple Packet Protocol is contained in Chapter 4.

2.4 Tasks

The 2100 Series displays have the ability to perform up to four different functions or tasks at the same time; each script is assigned a task number 0 - 3. An example of the usefulness of multitasking is the ability to separately control operation of the relay output, scroll a message on the display, and send serial text to an external device - all at the same time. Further information on tasks is contained in Chapter 4.

2.5 Power Supply Options

Displays are available with either a 24 volt DC power supply or a 120 volt AC (± 15%) 50-60 Hz power supply. Both supplies are fused and have a typical operating power of 20VA.

2.6 Relay Output

A software controllable SPDT relay output is available for annunciator purposes. Relay connections are wired to pins D, E, and F on the terminal strip located on the rear of the 2100 Display (this terminal strip is marked A - F). Refer to the back panel diagrams at the end of this chapter (Figures 3 & 4). The relay is rated for 120 VAC at 1 Amp.

Table B Relay Terminal Connections

Terminal	Connections
D	Relay Output (Normally Closed)
E	Relay Output (Common)
F	Relay Output (Normally Open)

Warning: Use the relay for annunciation only. Do not use the relay for control applications!

2.7 Serial Ports

All serial communications to a 2100 Display are through opto-isolated serial ports. The RS232 port is accessible via the DB9 connector on the back of the unit. RS422 connections are wired to the 6 pin terminal strip labeled "RS422" located on the back of the unit.

Communications Setup Selections

Communication parameters for each 2100 Display must be selected during setup. Choices include data bits, baud rate, unit address, and group address. Refer to Section 3.3 and 5.2 for specific details.

Configurations

2100 Displays can be configured for a serial network, permitting centralized control using a single computer or PLC. Messages and commands can be sent to individual units, a group of units, or to all units.

2.8 Back Panel

Figure 3
2100SB-120 VAC Back Panel

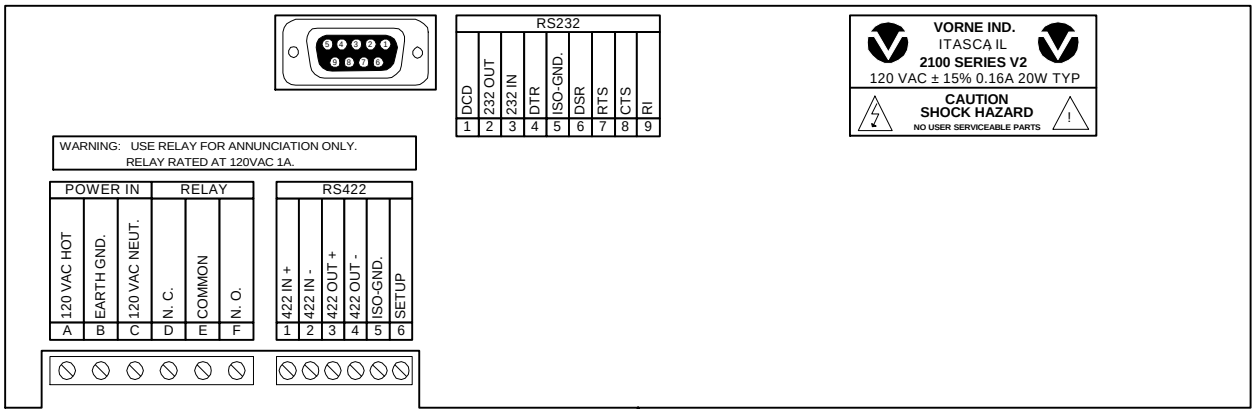
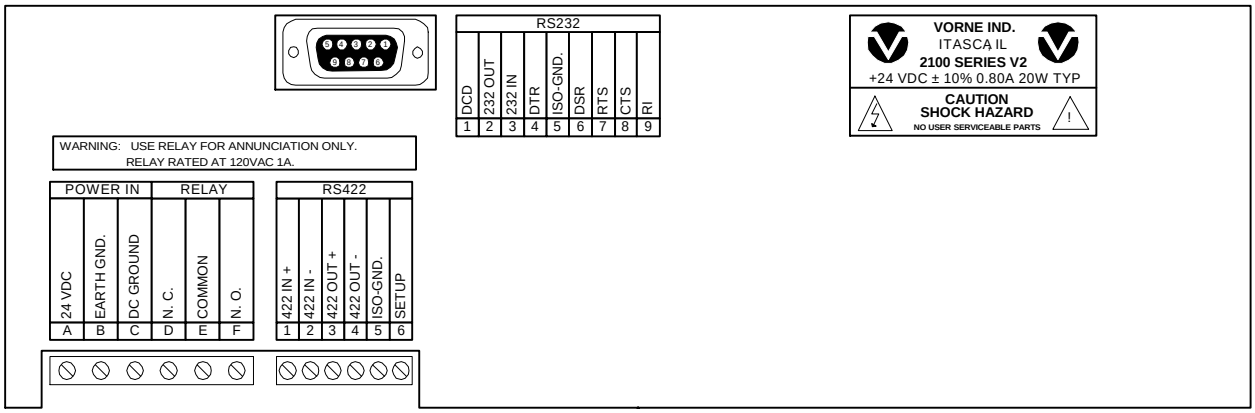


Figure 4
2100SB-24 VDC Back Panel



3 Setup

3.1 Powering The Display

Power connections are made to three pins of a 6 pin terminal strip on the rear of the 2100 Display. This terminal stripis marked A - F. Refer to the back panel drawings at the end of Chapter 2.

Power connections are wired to terminals A and C. Terminal B is used to provide earth ground to the unit. Earth ground must be wired to terminal B in order to provide a safety ground to the enclosure as well as a return path for external electrical noise disturbances.

Table C Power Connections

Terminal	120 VAC Connections	24 VDC Connections
A	120 VAC (Hot)	+24 VDC
B	Earth Ground	Earth Ground
C	120 VAC (Neutral)	DC Ground

3.2 Setup Mode

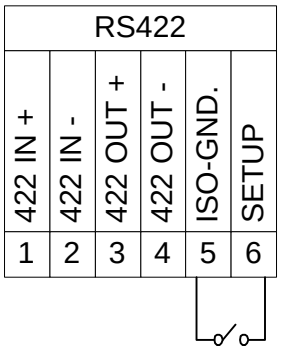
The 2100 Display setup selections are made using the front panel keys F1, F2, and F3. These keys are used to step through the setup menu and select the 2100SB Display's operating parameters. Once saved, these choices are stored in nonvolatile memoryand need not be entered again.

Entering Setup Mode (SETUP Feature)

To enter the Setup Mode, the SETUP input terminal must be connected to the ISO-GND terminal. The SETUP feature also protects the unit's setup values from accidental or inadvertent change. If no changes were made and the SETUP input terminal is disconnected from the ISO-GND terminal, the unit reboots. However, if changes were made, an exit menu is displayed.

It is suggested that a switch be installed across the SETUP and ISO-GND terminals. This provides an easy way of entering the setup mode. The diagram on the following page shows the wiring required for the SETUP circuit.

Figure 5
SETUP Circuit Wiring Diagram



Using the Front Panel Menu Keys

As long as the unit is in the Setup mode, the title of the active setup menu will be displayed on the first line of the display. The second line will display the menu choicefor the current setup parameter. When in the Setup mode, the **F1** key is used to move to the previous menu choice and the **F2** key is used to move to the next menu choice.

The **F3** key is used to select the currently displayed choice. If the current setup selection is a numeric value, the **F1** key will decrement the current value each time it is pressed and the **F2** key will increment the current value when it is pressed. If the current selection is not a numeric value, **F1** and **F2** will index through the available choices.

Note: Holding down a key will cause it to repeat.

The unit is shipped from the factory with default settings loaded into memory. If the values have been changed, the default settings can be reloaded by entering the setup mode and selecting **Load Default Setup.**

3.3 2100SB Setup Options

When the 2100SB is placed in the Setup mode, the **Choose an Option** menu will be displayed. The options are: General Setup, Serial Port Setup, *Parallel Port Setup*, Load Default Setup, Test Mode, and *Enter Program Mode*. *Parallel Port Setup* and *Enter Program Mode* are not used on the 2100SB Displays.

General Setup

Alternate Escape: /ESC, FS, GS, RS, US, ENQ, ACK, BEL, DC2, DC4, NAK, SYN, CAN, EM, SUB/ Default = ESC

The **ESC** character is the default command identifier. This selection permits an additional character to be selected as a valid command identifier. This is required if the host does not permit literal ESC characters to be used. Regardless of this selection, the ESC character will always be recognized as a valid command identifier

Vertical Scroll: /Yes, No/ Default = Yes
The vertical scroll feature allows messages that are received to be displayed without the need to use cursor control. On a 2140, the first 20 characters received are displayed on line one. The following 20 characters are displayed on line two. Any additional characters received will force the data on line one to be replaced by the data on line two. Any subsequent characters will be displayed on line two. On 2180 units, vertical scrolling occurs when the 81st character is received. This is typically most useful in Terminal mode, particularly when the host device is not programmable. Refer to Section 5.3, Terminal Emulation, for details.

If the vertical scroll is not used, any fixed message with more characters than the display is capable of showing will be truncated. To display additional text, the unit must receive a **Cursor** command or Form Feed.

Boot Message: /Boot, None/ Default = Boot
This parameter is used to determine the boot message that will be displayed when the unit is powered up.

If *None* is selected, the display will power-up, briefly display one diagnostic screen, and then go blank.

If *Boot* is selected, the display will power-up, display one diagnostic screen, and then display informational screens for approximately 8 seconds. During this time the unit will accept input data, but will not display the data until all of the informational screens have been displayed

Terminal Mode: /Disabled, VT-102 Compatible, 2100 Series Slave/ Default = Disabled
This selection is available to place the 2100 Display into one of the two Terminal Emulation modes. Refer to Section 5.3 for details.

Data Stream Port: Not used on the 2100SB.

Stream Data Type: Not used on the 2100SB.

Exit
This selection will return to the **Choose an Option** menu.

Serial Port Setup

Unit Address: /000 - 255/ Default = 000
Each 2100 Display can be assigned a unique address. This permits the host to communicate with individual units in a network. Addresses can be assigned from 000 to 255.

Group Address: /0 - 8/ Default = 0
Each 2100 Display can be assigned a group address. Refer to Section 5.2, Communicating To Multiple Units, for details.

Baud Rate: /300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K, 76.8K/ Default = 19.2K
The baud rate between the host and the 2100 Display must be specified. The same baud rate will also be used for serial output functions.

Number of Data Bits: /7, 8/ Default = 8
The number of serial data bits must be selected. Parity bits are ignored.

Line Terminator: /CR, LF/ Default = CR
The line terminator selection option is for use with the Simple Packet Protocol format of serial communication. Refer to Section 4.1, Building Scripts, for details.

Exit
This selection will return to the **Choose an Option** menu.

Parallel Port Setup: Not used on the 2100SB.

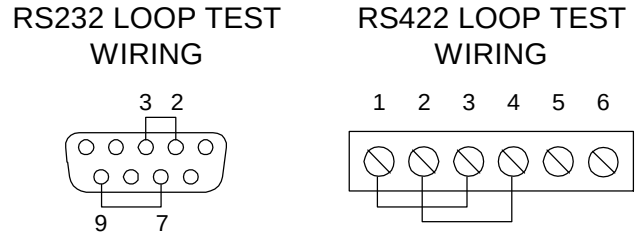
Load Default Setup
This selection will load the default setup settings. Remember, no change is saved unless "Save Changes" is also selected. This allows you to load and view the default settings without losing your old settings. Just choose "Ignore Changes" when you exit the setup mode and your old settings will be unchanged.

Test Mode

Show Configuration
This test will display the boot informational screens. These information screens display the Checksum Test Result, Electronic ID, Memory Size, Model, Firmware Version, Alternate Escape Character, Baud Rate, Data Bits, and Unit Address for the unit.

Serial Port Test
This selection will perform a loop test on the serial ports. A loop test will be performed using the port that has a loop-back connector installed. Only one loop-back connector should be installed at any given time. Refer to the diagrams below. Make the appropriate connections for the desired test, then run the test. The test will be performed and the results displayed. If no loop-back connector is installed, the test will fail. Pressing any key will exit the test. Figure 6 shows the correct connections for either the RS232 loop test or the RS422 loop test.

Figure 6
Loop Test Wiring Diagram



Relay Test
Pressing F1 will turn the relay ON. Pressing F2 will turn it OFF. Pressing the F3 key will exit the test.

Display Test
This test will automatically cycle test characters on the display. Pressing F1 will pause on the current set of characters. Pressing the F2 key will jump to the next set of characters. Pressing the F3 key will exit the test.

***Parallel Port Test*: *Not used on the 2100SB*.**

Exit
This selection will return to the **Choose an Option** menu.

***Enter Program Mode: Not used on the 2100SB*.**

Exiting Setup Mode

To exit the setup mode, disconnect the setup terminal from the ISO-GND terminal. If no changes were made while in the setup mode, the unit will reboot. Otherwise, this will result in a "Setup Has Changed!" prompt screen and menu.

Exit: Save Changes
Pressing the F3 key will save the current settings, exit setup, and reboot. Pressing either the F1 or F2 key will cycle to the "Ignore Changes" option.

Quit: Ignore Changes
Pressing the F3 key will exit setup without saving the changes and reboot. Pressing either the F1 or F2 key will cycle to the "Save Changes" option.

4 Scripts

4.1 Building Scripts

The 2100 series displays are controlled using an ASCII-text command language. The language supports not only standard functions like text display, cursor control, blinking, and scrolling, but also a wide variety of advanced functions which are controlled through various command sequences. When a sequence of text and commands are collected together to be run as a unit, the collection is called a "script." When a script is transmitted serially, it is referred to as a *serial buffer script*.

Tasks

Some operations, such as displaying static text, are simple and when executed require no further attention. However, some operations require constant attention from the 2100SB's microprocessor. One example of such an operation, is scrolling a message. It would be very limiting if, while scrolling text on line 1 of the display, nothing else could be done with the display without terminating the text on line 1. To prevent this type of limiting operation, the 2100SB is capable of executing up to four tasks at the same time. The four tasks can display text or perform any and all escape sequences that are available to a single task. Each script must be designated with a task number from zero to three.

Simple Packet Protocol

Simple Packet Protocol is the serial communication format which is used to send a Serial Buffer Script to a 2100SB unit for execution.

Format: **<SOH>***TypeAddress***;***Task***:***script***<TERM>**

<SOH> The ASCII Start of Header character (decimal value 1) must begin every transmission.

Type This element specifies whether the Serial Buffer Script is for an individual unit address or for a group address.

S	For individual unit address.
s	For group address.

Address This element specifies the actual unit or group address. If none is specified, the default is Address 0.

0 - 255	Valid unit address.
0 - 255	Valid group address (Refer to Section 5.2, Group Addressing).

; The ASCII Semicolon character (decimal value 59).

Task This element specifies the Task number to which the script should be assigned. If none is specified, the default is Task 0.

0 - 3	Valid task numbers.

: The ASCII Colon character (decimal value 58).

script This element is the actual message script which can contain literal text, control characters, and command strings. The control characters <SOH>,<CR> and <LF> cannot be used in this part of the packet.

<TERM> This element specifies the terminating character that marks the end of the packet. This character must match the Line Terminator selected in the setup menu. Refer to Section 3.3 for setup details. Valid Line Terminator choices are:

<CR>	ASCII Carriage Return character (decimal value 13).
<LF>	ASCII Line Feed character (decimal value 10).

Example Serial Buffer Script

<SOH>S24;1:<FF><ESC>S Test Message<CR>

The example packet would send the script:

<FF><ESC>S Test Message

to a 2100 display set to address 24 and the script would be assigned to Task 1. The script instructs the 2100 display to clear the screen and scroll the text " Test Message" on the first line.

In many cases the header (the part of the packet before the script) of the Simple Packet Protocol can have the form:

<SOH>S:

This form simply defaults to an individual address of zero and task zero.

Displaying Literal Text

The most basic script for a 2100 series display involves the printing of literal texton the VFD display. The script for this function is formed exactly as it is to be displayed. For example, to display the phrase "Hello, world!", the script would be composed of the text within the double quotes. The cursor will be left in the character position immediately following the displayed text.

Script #1:
Hello, world!

If a second script "Bad results." immediately follows the first script, it would start at the position immediately after the first phrase where the cursor was left.

Script #1:
Hello, world!
Script #2:
Bad results.

The 2100 display treats incoming scripts much like a terminal. Characters will be placed one after the other on the screen until the end of the display is reached. When the end of the display is reached, one of two possible results can occur. If the display has been configured through a setup menu option to scroll vertically, then all characters on the screen will move up one line when the next character is received. The bottom line of the display will be erased and additional characters will be placed on the display starting at the leftmost position of the bottom line. If the setup option for vertical scrolling is not active, any characters received past the end of the screen are simply not displayed.

Using Control Characters

Control characters can be used to control how scripts appear on the display. These control characters are treated as special functions by the display. They allow a script to clear the screen and move the cursor around the screen simply by including them as part of the script text. Figure 7 gives a list of available control characters. Since control characters are not displayable on most terminals or computers, a control character in this manual will always be depicted as a code name abbreviation enclosed between angle brackets. For example, the ASCII Form Feed character, decimal value 12, will be shown as **<FF>** for reference purposes only. The real script must contain the actual ASCII code (see **Literal Control Characters** later in this section).

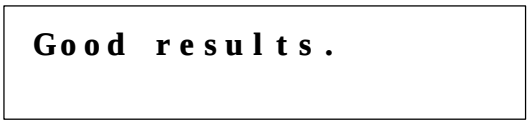
Figure 7
Control Characters

Code Name	Abbr.	Function
Backspace	<BS>	Move the cursor back (left) one position.
Horizontal Tab	<HT>	Move the cursor to the next tab stop. Stops are set at character columns 8 and 16.
Vertical Tab	<VT>	Move the cursor to the leftmost position of the next line.
Form Feed	<FF>	Clear the display and move the cursor to the leftmost position of the top line.
Line Feed	<LF>	Move the cursor down one line. This character can only be used if <CR> is the selected line terminator.
Carriage Return	<CR>	Move the cursor to the leftmost position of the current line. This character can only be used if <LF> is the selected line terminator.
End of Transmission	<EOT>	Marks the end of a scrolled portion of text.

Control characters can be used to modify the previous example. Inserting the Form Feed character at the beginning of the scripts clears any previous message and starts the new text at line one, character one.

Script #1:
<FF>Hello, world!

Script #2:
<FF>Good results.



Command Strings

The combination of literal text and the control characters shown in Figure 7 illustrate how a great variety of text can be displayed on the 2100. Additional features such as blinking and different fonts require an additional control character, <**ESC**>. The <**ESC**> character, decimal value 27, is used by the 2100 to mark the beginning of a special display command. All extended functions are built using escape command sequences.

All escape command strings must begin with the <**ESC**> character and end with an upper or lower case letter. The letter is the part of the sequence which describes its function. Since there are 26 letters in the alphabet and both upper and lower case letters are used, there are 52 possible commands available. The 2100 uses far less than 52, making it possible to let the letter have meaning to the user. For example, the letter '**B**' is used to end the **Blink** command and '**C**' refers to the **Cursor** command.

Between the <**ESC**> character and the command letter is the argument list for the command. It is the argument list which allows the cursor command to move to a specific location or choose whether blink should be on or off. An individual argument is a number in the range -32768 to +32767. A semicolon is placed between adjacent arguments to separate them. The arguments are arranged in a reverse ordered list called a stack. As the display reads the escape sequence, it must separate the arguments.

The display considers an argument to begin when it finds a digit, '**0**' through '**9**', or a '**+**', or a '**-**'. The end of the argument is assumed to be the first non-digit found. If the sequence is correctly formatted, all arguments will end with a semicolon or the actual command letter for the function.

Once the display has found an entire argument, it is placed on the stack, as shown in Figure 8. The arguments wait on the stack until the display finds a command letter. When the command letter is found, the display begins removing arguments from the top of the stack to use in the command. The very first argument removed from the stack will always be the argument immediately preceding the command letter. If an argument list is shorter than the number required for a command, then attempting to get an argument from the stack will result in a zero value argument. Please note the shortcut arguments used in Figure 8. They are used to conserve script space. Extra spaces preceding an argument are ignored. This accommodates serial systems which insert a leading space for any positive number printed.

Figure 8
Stack Handling

Sequence	Stack After Sequence Has Been Read		
<ESC>C	Top:	0	Note: No argument Defaults to zero
<ESC>2;3C	Top: Bottom:	+3 +2	
<ESC>2;-3;5C	Top: Next: Bottom:	+5 -3 +2	
<ESC>-;;+C	Top: Next: Bottom:	+1 0 -1	'+' is a shortcut for +1 No argument = 0 '-' is a shortcut for -1
<ESC>536;-;3;0;+;C	Top: Next: Next: Next: Next: Bottom:	0 +1 0 +3 -1 +536	No argument = 0 '+' is a shortcut for +1 '-' is a shortcut for -1

Each command letter determines the number of arguments required and the valid values that can be assigned. For example, the **Cursor** command (command letter **C**) expects to find two arguments on the stack. The top of the stack is always considered to be the column position and the next argument is always the line position.

For the first sequence in Figure 8, **<ESC>C**, the column to move to is zero. The **Cursor** command expects two arguments to be present in the script. The missing argument will be given the value of zero. In this case, the result should be to move the cursor to column zero, line zero. Since zero is not a valid value, the value "zero" will be replaced with the value "one". The actual result of this script would be to move the cursor to column one, line one.

In the third sequence, the column value is five. The line value "-3" is negative. For negative line values, the result will be no line cursor movement. Therefore, the result of this sequence would be to move the cursor to column five of the current line. The **Cursor** command only expects two arguments and the third sequence has more than two arguments. When more arguments are present than expected, the extra arguments will be discarded.

Virtually every feature of the 2100 display can be accessed with some kind of escape sequence, allowing scripts to have complete control of the 2100 display unit. Escape sequences fall into two broad categories: Display Attribute Control and Script Flow Control. Display Attribute controls are used to determine the appearance of the displayed text. Script Flow controls are used to control the order in which it is processed. Figure 9 summarizes the standard 2100 series escape sequences.

Figure 9
Standard 2100 Display Escape Sequences

Command	Command Letter	Type	Description
Blink	B	Display	Control blinking of characters.
Cursor	C	Display	Set the next display write position.
Erase	E	Display	Erase the specified line.
Erase2eol	e	Display	Erase from the specified position to the end of the line. Cursor remains at the specified location.
Font	F	Display	Choose a character set.
Goto	G	Flow	Loop back to a script marker.
Keypress	s	Flow	Send key press value out the serial port.
Lock	l	Flow	Make a task ignore new scripts, or undo the same.
Marker	X	Flow	Mark the return place for the Goto command.
Output	O	Display	Set display or serial port as output.
Relay	r	Display	Turn the relay output on or off.
Repeat	R	Display	Print the next character x times.
Scroll	S	Flow/Display	Set scrolling for the current line.
Wait	W	Flow	Stop script execution for a while.

Simple Examples To Try

This example assumes that Line Terminator is set to <CR> in setup and the unit address is set to 0. Refer to Sections 4.2, 4.3, and 4.14 for more information on the Scroll, Cursor, and Blink commands used below.

- Let's display message "Status OK!" on line 1 of the display.
  <SOH>S0;0: Status OK! <CR>

- Now let's clear the display and leave the cursor on column 1 of line 1.
  <SOH>S0;0:<FF><CR>

- Now, let's scroll the message "Status OK!" on line 1 of the display.
  <SOH>S0;0:<ESC>28;SStatus OK! <CR>

- Scrolling requires a task of its own. What happens if we end the task?
  To find out, let's send a dummy message to task 0. This will end the old task 0.
  <SOH>S0;0:<CR>
  The previous command will end the scrolling task, but leave the text on the display wherever it was at the moment the new script was executed.

- Clear the display again.
  <SOH>S0;0:<FF><CR>

- Now, let's blink the text "WARNING!" on line 2 of display starting at column 6.
  <SOH>S0;0:<ESC>2;6C<ESC>128;+BWARNING!<CR>

- Clear the display again.
  <SOH>S0;0:<FF><CR>

We're done!

Advanced Example Application Preface

The commands in Figure 9 with the addition of display text and control characters are the basic building blocks of all scripts. Consider an example application where a PLC is monitoring the status of a machine and a number of its hoppers. The hoppers require manual filling on an irregular basis. When the PLC detects a low level on a hopper, we would like to alert the operator, inform him or her of the hopper number that needs filling, and receive a response indicating that the message was received. Otherwise, after a delay, we will alert the supervisor at another location.

To accomplish this we can use two Vorne 2100SB series displays. We decide to use 2180SB displays since they will give us the ability to simultaneously display up to four lines of text. This will give us the most flexibility for future needs. One display is mounted near the operator station and set to address 1. The other display is located near the supervisor and set to address 2. The displays and the PLC are wired in a multidrop configuration (see section 5.2 for more information on multidrop configuration).

The PLC will control the displays by sending scripts over the serial communication lines. The relay outputs on the 2100SB displays are connected to large annunciator lights. For our example, the PLC will send commands to the operator's 2100SB to display a message (inform the operator), turn on the strobed relay output (flashing annunciator light), and start the keypress script (check for a response). When a key is pressed, the 2100 display will transmit the keypress back to the PLC. Upon receiving the keypress acknowledgment from the 2100 display, the PLC will send new commands to that 2100SB, which display a new message, turn off the relay, and stop the keypress script. After a set time, if there is no response, the PLC will alert the supervisor by sending a message to the supervisor's 2100SB, and turning on his or her annunciator light. In this case, when a key is finally pressed on the operator's 2100SB, we will remove the alert status at the supervisor's 2100SB.

Take a minute to review the **Serial Buffer Scripts** information earlier in this section. Then as you review the scripts in this example, refer to the complete explanations of the commands in sections 4.2 to 4.14. The 'references' lines give a brief description of the action and a list of commands used. The line following each 'references' line displays the actual commands and syntax. The example assumes that the terminator selected in setup is CR.

Let's get started!

Advanced Example Application

Step 1 - We send commands to initialize display 1.

- Terminate any task 0 previously running on display 1.
  <SOH>S1;0

- Terminate any task 1 previously running on display 1.
  <SOH>S1;1

- Terminate any task 2 previously running on display 1.
  <SOH>S1;2

- Terminate any task 3 previously running on display 1.
  <SOH>S1;3

- Make sure the relay of display 1 is off (using Relay command).
  <SOH>S1;0:<ESC>-r<CR>

- Clear display 1
  <SOH>S1;0:<FF><CR>

- Scroll text "Status OK" on line 2 of display 1 using task 0 (using Cursor, and Scroll commands).
  <SOH>S1;0:<ESC>2;20C<ESC>28;SStatus OK <CR>

Step 2 - We send commands to initialize display 2.

- Terminate any task 0 previously running on display 2.
  <SOH>S2;0

- Terminate any task 1 previously running on display 2.
  <SOH>S2;1

- Terminate any task 2 previously running on display 2.
  <SOH>S2;2

- Terminate any task 3 previously running on display 2.
  <SOH>S2;3

- Make sure the relay of display 2 is off (using Relay command).
  <SOH>S2;2:<ESC>-r<CR>

- Clear display 2
  <SOH>S2;0:<FF><CR>

- Scroll text "Status OK" on line 2 of display 2 using task 0 (using Cursor, and Scroll commands).
  <SOH>S2;0:<ESC>2;20C<ESC>28;SStatus OK <CR>

Step 3 - The PLC detects a low level in hopper #9, and sends a warning notice to the operator.

- Erase line 2 of display 1 using task 0 (using Erase command). Note that this script will also end scrolling for task 0, and leave the cursor on line 2 of the display.
  <SOH>S1;0:<ESC>2E<CR>

- Blink text "WARNING!" starting at column 6 on line 1 of display 1 using task 0 (using Cursor and Blink commands).
  <SOH>S1;0:<ESC>1;6C<ESC>128;+BWARNING!<ESC>-B<CR>

- Display text "Hopper #9 LOW!" on line 3 and "Press F1 to confirm" on line 4 of display 1 using task 0 (using Cursor command).
  <SOH>S1;0:<ESC>3;4CHopper #9 LOW!<ESC>4;1CPress F1 to confirm<CR>

- Cycle relay on display 1 using task 1 (using Relay, Wait, and Goto commands).
  <SOH>S1;1:<ESC>+r<ESC>0;10W<ESC>-r<ESC>0;10W<ESC>G<CR>

- Start the Keypress Script on display 1 to check for a keypress (using Keypress script). Note that this script always uses task 3.
  <SOH>S1;3:<ESC>-1s<CR>

Step 4 - The PLC starts a timer.

Scenario A - The Operator Responds.

Scenario A (Step 5) - If the operator responds by pressing the F1 key before the timeout, the PLC will receive the ASCII character "1" from the keypress script, and will send a new message to the operator.

- Erase line 4 of display 1 using task 0 (using Erase command).
  <SOH>S1;0:<ESC>4E<CR>
- Display text "Thank You" on line 4 of display 1 using task 0 (using Cursor command).
  <SOH>S1;0:<ESC>4;5CThank You<CR>
- Stop the Keypress Script on display 1. Note that running anything in task 3 will halt the script.
  <SOH>S1;3:<CR>

Scenario A (Step 6) -The operator fills hopper #9 and the PLC no longer detects a low level on hopper #9. The PLC removes the warning status to the operator.

- Turn relay of display 1 off using task 1 (using Relay command).
  <SOH>S1;1:<ESC>-r<CR>
- Clear display 1.
  <SOH>S1;0:<FF><CR>
- Scroll message "Status OK" on line 2 of display 1 using task 0 (using Cursor and Scroll commands).
  <SOH>S1;0:<ESC>2;20C<ESC>28;SStatus OK <CR>

Scenario B - The Operator Does Not Respond.

Scenario B (Step 5) - If the operator does <u>not</u> respond by pressing the F1 key before the timeout, the PLC will <u>not</u> receive the ASCII character "1" from the keypress script, and will send a warning status to the supervisor.

- Erase line 2 of display 2 using task 0 (using Erase command). Note that this script will also end scrolling for task 0, and leave the cursor on line 2 of the display.
  <SOH>S2;0:<ESC>2E<CR>

- Blink text "WARNING!" starting at column 6 on line 1 of display 2 using task 0 (using Cursor and Blink commands).
  <SOH>S2;0:<ESC>1;6C<ESC>128;+BWARNING!<ESC>-B<CR>

- Display text "Hopper #9 LOW!" on line 3 of display 2 using task 0 (using Cursor command).
  <SOH>S2;0:<ESC>3;4CHopper #9 LOW!

- Cycle relay on display 2 using task 1 (using Relay, Wait, and Goto commands).
  <SOH>S2;1:<ESC>+r<ESC>0;10W<ESC>-r<ESC>0;10W<ESC>G<CR>

  We're all done!

The scripts in the previous example were presented in a straightforward and elementary manner. In many instances the scripts can be combined and simplified to reduce the overall program length and number of transmissions required, but care must be taken to account for all tasks that are running.

For example the following script:

<SOH>S1;0:<ESC>2E<ESC>1;6C<ESC>128;+BWARNING!<ESC>-B<ESC>3;4C
Hopper #9 LOW!<ESC>4;1CPress F1 to confirm<CR>

would end scrolling, erase line 2, blink message "WARNING!" starting at column 6 on line 1, display message "Hopper #9 LOW! on line 3, and display message "Press F1 to confirm" on line 4 of display 1 - all using task 0. This results in a smaller program and fewer required transmissions than the following scripts that were used:

<SOH>S1;0:<ESC>2E<CR>
<SOH>S1;0:<ESC>1;6C<ESC>128;+BWARNING!<ESC>-B<CR>
<SOH>S1;0:<ESC>3;4CHopper #9 LOW!<ESC>4;1CPress F1 to confirm<CR>

When writing scripts keep in mind:

- Running a script in a task will terminate the previous script running in that task.

- A task that writes static data to the display (including blinked characters) terminates as soon as the data is written. None the less, the information will be displayed until it is erased or overwritten.

- Scrolling text requires a separate task as long as the scrolling continues. Erasing a display using <SOH>S2;0:<FF><CR> which is executed using task 0 would not stop any scrolling text using tasks 1, 2, or 3.

- Also, remember multiple scripts can often be combined into one.

Literal Control Characters

Literal Control Representation format is used if you want to display the character associated with the ASCII control characters or if you want to transmit the control characters to a peripheral device, using the **Output** command. The following table shows the control characters, their literal control representations, and the associated displayable characters. Only the combinations listed in Table D on the following page will be converted; all other combinations will be displayed unchanged.

For example, if you wanted to display: **C** I love my 2100 **C**

You would type: #C I love my 2100 #C

Table D Literal Control Characters

Control Character	Hex/ASCII Value	Decimal Value	Literal Control Representation	Character
<NUL>	0	0	#@	**@**
<SOH>	1	1	#A	**A**
<STX>	2	2	#B	**B**
<ETX>	3	3	#C	**C**
<EOT>	4	4	#D	**D**
<ENQ>	5	5	#E	**E**
<ACK>	6	6	#F	**F**
<BEL>	7	7	#G	**G**
<BS>	8	8	#H	**H**
<HT>	9	9	#I	**I**
<LF>	0A	10	#J	**J**
<VT>	0B	11	#K	**K**
<FF>	0C	12	#L	**L**
<CR>	0D	13	#M	**M**
<SO>	0E	14	#N	**N**
<SI>	0F	15	#O	**O**
<DLE>	10	16	#P	**P**
<DC1>	11	17	#Q	**Q**
<DC2>	12	18	#R	**R**
<DC3>	13	19	#S	**S**
<DC4>	14	20	#T	**T**
<NAK>	15	21	#U	**U**
<SYN>	16	22	#V	**V**
<ETB>	17	23	#W	**W**
<CAN>	18	24	#X	**X**
<EM>	19	25	#Y	**Y**
<SUB>	1A	26	#Z	**Z**
<ESC>	1B	27	#[	**[**
<FS>	1C	28	#\	****
<GS>	1D	29	#]	**]**
<RS>	1E	30	#^	**^**
<US>	1F	31	#_	**_**
a # character	23	35	##	**#**
<DEL>	7F	127	#?	**`**

4.2 Blink

The **Blink** command is used to make displayed characters blink at a specified rate. The text to be blinked must be bracketed on each side by a **Blink** command string.

Format: **<ESC>***rate***;***switch***B**

rate This argument is used to specify the blinking rate. The range of values is 1 through 255. The fastest rate is 1 and 255 is the slowest rate. If zero is entered, the rate that was used in the last **Blink** command will be chosen. The 2100 Display is initialized with a default blink rate of 20. The blink rate is a global setting. Therefore, display characters with the blinking attribute will blink at whatever rate was most recently selected.

<ESC>128;+B is a midrange blink rate
<ESC>1;+B is the fastest blink rate
<ESC>255;+B is the slowest blink rate

switch This argument is used to turn blinking on, off, or to toggle the current setting. Toggle is useful for terminating **Blink** in a script.

+ Blink on (+ is a shortcut for +1).

- Blink off (- is a shortcut for -1).

0 Toggle from previous state. If the first **Blink** command starts text blinking, the second **Blink** command can have zero entered for this argument which would toggle the **Blink** command from start blinking to stop blinking. The default value is 0.

B The upper-case letter **B** is used to invoke the **Blink** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>+B Blinking<ESC>B Not<CR>

In this example, two **Blink** command strings are included. The first command string turns on the blink effect and the second command string terminates the blink effect. The word "Blinking" will blink at the previously selected or default blink rate. The word "Not" will not blink.

4.3 Cursor

The **Cursor** command is used to explicitly specify the position where the next character will be displayed. Two arguments are associated with this command.

Format: **<ESC>***line***;***column***C**

line This argument is used to specify the line on which the next character will be placed. The range of values for this argument is 1 or 2 for the 2140 or 1 thru 4 for the 2180. Zero, no number, or a number greater than the maximum number of lines on the display, default to 1. Negative values will result in no line cursor movement.

column This argument is used to specify the column position where the next character will be placed. The range of values for this argument is 1 thru 20. One is the left most column and 20 is the right most column. Zero, no number, or numbers greater than 20 default to one. Negative values will result in no column cursor movement.

C The upper-case letter **C** is used to invoke the **Cursor** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>CM<CR>

In this example, the letter "M" will be placed in the first column of the first line.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>2;15CT<CR>

In this example, the letter "T" will be placed in the fifteenth column of the second line.

4.4 Erase

The **Erase** command clears the specified line and leaves the cursor at the first column of the line. One argument is required for this command.

Format: **<ESC>***line***E**

line This argument specifies the line to erase. Line numbers are 1 or 2 for 2140 units, and 1 thru 4 for 2180 units. The default is the current line if no line is specified.

E The upper-case letter **E** is used to invoke the **Erase** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>2E<CR>

In this example, the contents of the second line would be erased and the cursor would be placed in the first column of the second line.

4.5 Erase2eol

The **erase2eol** command clears the line from the specified location to the end of that line. This command is useful when writing over existing text that might be longer than the new text. The format allows the user to define the line and column position from which to erase, but it is possible, and frequently more useful, to simply erase from the current position with no cursor movement. After an **erase2eol** command has been executed, the cursor is left at the position from which the **erase2eol** command took effect.

Format: **<ESC>***line***;***column***e**

line This argument specifies the line on which to erase. Valid arguments are 1 or 2 for 2140 units and 1 through 4 for 2180 units. Zero, no number, or a number greater than the maximum number of lines on the display, default to 1. Negative values will result in no line cursor movement.

column This argument specifies the column position from which to erase, inclusive. The range of values for this argument is 1 thru 20. Out of range values or negative numbers will result in no column cursor movement.

e The lower-case letter **e** is used to invoke the **erase2eol** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>2;1CNew Text<ESC>-;-e<CR>

In this example, the **Cursor** command is used to move to line 2, column 1, where "New Text" is written. The **erase2eol** command will clear the line from the character position following "New Text" (the current cursor position) to the end of the line. The cursor will remain at the position following "New Text". Note that the example makes use of the fact that using negative values for the arguments result in no cursor movement. Also, note that a shortcut is used in this example where "-" is substituted for "-1" in the **erase2eol** command.

4.6 Font

The **Font** command is used to select the character set that will be displayed on the 2100 Display. Available fontsinclude the full 256 character IBM® set, the JIS8 (Katakana) character set and the Slavic (Latin II) character set. One argument is required for this command. The IBM® character set is the default character set. Note that the bottom "page" of 128 characters is the same for all three fonts. It is the upper "page" of 128 characters that varies between fonts. Refer to Appendix C - Character Sets.

The **Font** command is specific to a task. When a font selection is made, it remains in effect for subsequent messages (of the same task) unless explicitly changed.

Format: **<ESC>***font***F**

font This argument specifies the character set to be used following the **Font** command. Available values for this argumentare 1, 2 and 3. The default is **1**.

1 Selects the full 256 character IBM® set.

2 Selects the JIS8 (Katakana) character set.

3 Selects the Slavic (Latin II) character set. Consult the factory for details on the Slavic character set, or refer to DOS code page 852.

F The upper-case letter **F** is used to invoke the **Font** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>2F<CR>

In this example, the Katakana character set will be used for the text following the **Font** command entry.

4.7 Goto

The **Goto** command is used to repeat the preceding text and commands the number of times specified by the arguments. The repeated portion of the script would be from the specified **Marker** command. Refer to the description of the **Marker** command, Section 4.10. Two arguments are required for this command.

Note: Nested **Goto** commands referenced to the same marker are not recommended because it results in an infinite loop.

Note: If a marker command is not included in a script containing a **Goto** command, the **Goto** command will loop to the beginning of the script.

Format: **<ESC>***marker***;***repeat***G**

marker The **Marker** command has a matching argument so that the loop is from the marker location to the **Goto** command. Valid values for this argument are 0 and 1. The default value is zero.

repeat This argument specifies the number of times to repeat the preceding part of the script before the display will move on to process the rest of the script. The range of values for this argument is 0 through 255. Zero will cause repeating until a new script of the same task is received (also called an infinite goto). The default value is zero.

G The upper-case letter **G** is used to invoke the **Goto** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<FF>Repeat again<ESC>X<VT>and again<ESC>3G!!!!<CR>

This script executed on a 2180 display will clear the display, write "Repeat again" on the first line and then repeat three times the process of moving to the next line and writing "and again". Finally, the unit will write "!!!!" following the last repeated text. Note that the **Marker** for the **Goto** in the example script is the <ESC>X. The resulting message would appear as:

```
Repeat again
and again
and again
and again!!!!
```

4.8 Keypress Script

The **Keypress script** is not actually a command, but rather a predefined script included in permanent 2100SB memory. The script simplifies the use of the front panel keys. The **Keypress script** always uses task 3. Therefore, running any other script in task 3 will terminate the **Keypress script**.

Format: **<ESC>**-1**s**

-1 This argument specifies the predefined **Keypress script**.

s The lower-case letter **s** is used to invoke the **Keypress script**.

Example (assumes the line terminator is set to <CR>):

<SOH>S1:<ESC>-1s<CR>

This script will cause any keys pressed on the 2100 series display with address 1 to be transmitted back to the host. The following chart describes the relationship between keys pressed and characters transmitted.

F1 Transmits the character "1" (ASCII 31) decimal value = 49
F2 Transmits the character "2" (ASCII 32) decimal value = 50
F3 Transmits the character "3" (ASCII 33) decimal value = 51

Note: Since there is no active serial communication handshaking, care should be taken when executing the **Keypress script** on a networked display. Anytime this script is executing, the 2100SB will immediately transmit a character every time a key is pressed.

4.9 Lock

The **lock** command is used to control message display. When the lock mode is enabled, the current script must complete before another script using the same task can be executed. If the lock mode is disabled, the current script will be terminated upon receiving a new script. The **lock** command is specific to a task. One argument is required for this command.

Note: Scripts with infinite **Scroll**, or infinite **Goto** commands should not be used in the lock mode. The script will never be completed and the subsequent scripts will not be executed.

If the current script is locked and executing when a new script is sent, up to 8 new scripts of 256 characters can be queued.

Format: **<ESC>***switch***l**

switch This argument is used to enable or disable the lock mode. The default value is zero.

+	Enable lock mode (+ is a shortcut for +1).
-	Disable lock mode (- is a shortcut for -1).
0	Toggle from previous state.

l The lower-case letter **l** is used to invoke the **lock** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<FF><ESC>+lPriority Message<ESC>200W<ESC>-l<CR>

This script clears the screen and displays "Priority Message", then waits for 20 seconds before unlocking the script. The script cannot be interrupted until it is unlocked. Refer to Section 4.15 for details on using the **Wait** command.

4.10 Marker

The **Marker** command is used to specify the beginning point of a **Goto** loop. One argument is required for this command.

Format: **<ESC>***marker***X**

marker This is the matching argument to the marker value in the **Goto** command so that the loop is from the **Marker** location to the **Goto** command location. Valid values for this argument are 0 and 1. If no value is entered or if the value is greater than 1, the value will default to zero.

X The upper-case letter **X** is used to invoke the **Marker** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:I feel <ESC>1XGREAT! <ESC>1;2G<CR>

This example would display as:

4.11 Output

The **Output** command is used to direct characters to the serial port or to the display screen. This command requires one argument. The **Output** command is specific to a task, and therefore only affects routing of text for the task referenced in the script.

Format: **<ESC>***route***O**

route This argument specifies the desired routing of the text. The value for this parameter must be 0 thru 5.

- **0** Direct the text following the command string to the screen of the 2100 Display. This is the default setting.
- **1** Direct the text following the command string to the serial port. The text will be directed to the RS232 port output (pin 2) and the RS422 port output (pins 3 and 4). The baud rate and data bits for the output are the same as the input settings which are selected during setup.
- **2** Dual output (0 and 1 simultaneously).
- **3** Reserved for system use.
- **4** Reserved for system use.
- **5** Reserved for system use.

O The upper-case letter **O** is used to invoke the **Output** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<FF>Done<ESC>1O#M#JBatch #24 Done#M#J<ESC>0O<CR>

This script clears the screen and writes "Done" on the display screen and transmits out of the serial port:

<CR><LF>Batch #24 Done<CR><LF>

to a peripheral device, perhaps a line printer, computer or another Vorne display. Finally, a closing **Output** command is used so that subsequent scripts (of the same task number) are directed to the display screen. Otherwise, subsequent scripts (of the same task) would also be directed to the serial port. Note that the transmitted <CR> and <LF> characters are entered via their Literal Control Representation formats.

Note: Any commands embedded in the text that are intended for the peripheral must be in the Literal Control Representation format. Refer to the Literal Control Characters - Table D.

4.12 Relay

The **relay** command is used to control the SPDT relay on the 2100 Display. This relay is rated for 120 VAC 1A. The **relay** command combined with the **Wait** command can control the relay with delay and duration timing as shown in the example below. One argument is required for this command.

Format: **<ESC>***switch***r**

switch

+ Turns the relay on (+ is a shortcut for +1).

- Turns the relay off (- is a shortcut for -1).

0 Toggles the relay from its previous state. Zero is the default value.

r The lower-case letter **r** is used to invoke the **relay** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>+r<ESC>10W<ESC>-r<ESC>20W<ESC>+r<ESC>10W<ESC>-r<CR>

This example would turn on the relay for one second, then turn off the relay for two seconds, turn it back on for one second and then off again. Remember, in order for the relay script to continue cycling the relay, it must be running in its own uninterrupted task. Refer to the description of the **Wait**
command for further explanation of its operation.

Warning: Use the relay for annunciation only! Do not use the relay for control applications.

4.13 Repeat

The **Repeat** command allows the character following the command string to be repeated a specified number of times. This can be used to insert multiple blank characters when scrolling or reduce the size of scripts with many repeating characters. One argument is required for this command.

Format: **<ESC>***count***R**

count This argument specifies the number of times the character following the command string is to be repeated. The range of values is 1 to 255. Zero and one produce one character. The default value is zero.

R The upper-case letter **R** is used to invoke the **Repeat** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>8R-Vorne<ESC>7R-<CR>

In this example, eight dashes would be displayed, then the word "Vorne" followed by seven more dashes.

4.14 Scroll

The **Scroll** command is used to scroll characters, from right to left, on the current line. The text to be scrolled must be preceded by the **Scroll** command and terminated by either an **<EOT>** character (decimal value 04) or the end of the script. Regardless of the column position of the cursor, scrolling text will always begin at the rightmost character of the current line and scroll to the left, pushing any existing text off the line ahead of it. The two possible arguments for the **Scroll** command allow the user to specify the speed of the scrolled message and how many times the text should scroll.

Format: **<ESC>***rate***;***repeat***S**

rate This argument specifies the scroll rate. The number represents the time in 0.2 second increments required for a character to scroll across the 20 character line. The range of acceptable values is 1 through 255. Thus a character can take from 0.2 to 51 seconds to travel across the line. A value of zero or no number selects the previous rate, or, if no previous rate is available, selects the default rate of 20.

repeat This argument specifies the number of times the scrolling text should repeat. Acceptable values are from 1 through 255, and represent the actual number of repeats. A value of zero or no number will cause the text to scroll continuously until it is explicitly cleared or a new script of the same task is received by the display (also called an infinite scroll).

S The upper-case letter **S** is used to invoke the **Scroll** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<ESC>50;0S_ _ _ _ scrolling text<EOT><CR>

('_' indicates a space character)

This example script would cause the text

s c r o l l i n g t e x t

to continuously scroll across the current line. The four spaces provide a break between consecutive scrolls. The scroll speed would be such that it would take ten seconds for a character to move completely across the line. The scrolling would continue until the line is explicitly cleared or another script takes control of the line.

The user should note that, when scrolling repetitively, consecutive scrolls will immediately follow the previous one. For this reason, space characters should be inserted preceding or following the scrolled text to provide a break between repetitions, as shown in the preceding example. It should also be noted that the scrolling will come to a halt on the last repetition

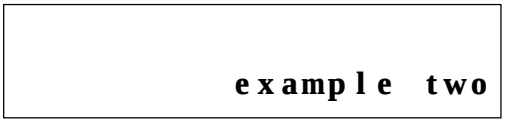
once the last character of the scrolled text (including any spaces) has appeared at the far right of the line. If it is desired to have the visible text scroll all the way off the line on the last repetition, the user should either pad the text with 20 trailing spaces, or use another **Scroll** command that simply scrolls 20 spaces onto the line. The first method will insert 20 spaces between each consecutive scroll. The second technique will allow the user to use fewer spaces between the repeated text and still scroll off the last repetition.

Example (assumes the line terminator is set to <CR>):

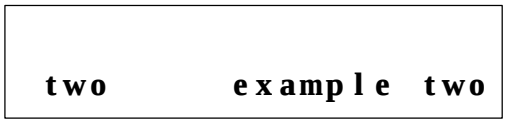
<SOH>s:<ESC>2;1C<ESC>7S_ _ _ _ _example two<EOT><ESC>1S<ESC>20R_<CR>

('_' indicates a space character)

This example script would cursor to line 2 and scroll the text



seven times at the previously specified or default rate. After the text has scrolled on to the line for the seventh time, the unit is finished processing the first **Scroll** command. If the script ended here, the display would end up showing:



However, there is another **Scroll** command which will scroll on twenty space characters. This will have the effect of scrolling off the existing text left over from the first **Scroll** command. The second **Scroll** command specifies the same rate as the first **Scroll** command and since there is no delay, the leftover text from the first scroll will simply keep moving to the left as it is scrolled off by the twenty spaces. Note the use of the **Repeat** command as a shortcut to typing twenty space characters.

4.15 Wait

The **Wait** command is used to pause the processing of a script for a specified length of time. The **Wait** command allows timing control and with the **Goto** command, allows control over alternating several lines of text or repeating some text or function, without having to retransmit any data. This command has two possible arguments.

Format: **<ESC>***function***;***time***W**

function This argument defines how the **Wait** command is used. Valid arguments are:

0 Wait for the period specified in the time argument multiplied by 0.1 seconds. The wait range possible using this function is 0.1 to 6553.5 seconds. A short cut for 0 is to omit this argument.

1 Wait for the period specified in the time argument multiplied by .01 seconds. The wait range with this function is .01 to 655.35 seconds.

time This is the multiplier used to define the wait period specified with the function argument. For example, if the delay is to be 10 seconds and the function argument is zero, the time value must be 100. Valid values for the time parameter are 0 thru 65535. A value of zero will generate no time delay.

W The upper-case letter **W** is used to invoke the **Wait** command.

Example (assumes the line terminator is set to <CR>):

<SOH>s:<FF><ESC>1XWARNING<ESC>20W<FF><ESC>5W
Low Pressure<ESC>30W<FF><ESC>5W<ESC>1;0G<CR>

This script uses the **Wait** command in combination with the **Goto** and **Marker** commands to control the timing of a repetitive looping message. The script clears the display of any existing text, drops a **Marker** reference, and then writes the text "WARNING" on the first line. Next, the unit waits for 2 seconds, clears the display, waits 0.5 seconds, and then writes the text "Low Pressure." Following a 3 second wait, the unit again clears the display, waits 0.5 seconds, and then loops back to the **Marker** location. The **Goto** command specifies continued repetitions, so the script will continue alternating between "WARNING" and "Low Pressure" until it is terminated by a different script.

5 Serial Port Operation

5.1 Communicating To A Single Display

Communications from the host can be sent to a single 2100 Display in either RS232 or RS422.

Wiring to a Single Display

Connections to the serial port are made to either the RS232 connector or the RS422 connector on the rear of the unit. The serial port is comprised of an RS422 communications port and a built-in RS232 to RS422 converter. The host must communicate with the 2100SB either via the RS232 converter port or the RS422 port. Only one port can be used at any given time. The following tables identify all of the serial port connections for the 2100 Display.

Table E RS422 Serial Port Terminal Strip

Terminal #	Lead Designation
1	RS422 IN+
2	RS422 IN-
3	RS422 OUT+
4	RS422 OUT-
5	ISO-GND
6	SETUP

Table F RS232 Serial Port Female DB9 Connector

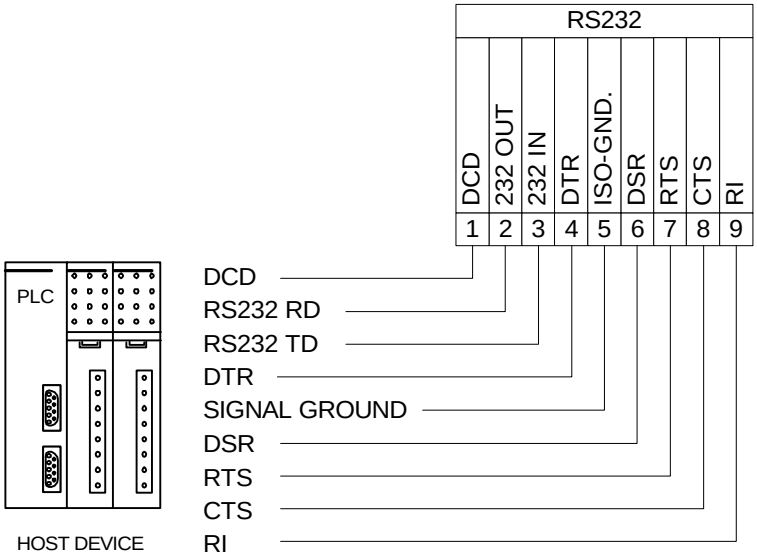
Terminal #	Lead Designation
1	(DCD) Data Carrier Detect
2	(TD) RS232 OUT
3	(RD) RS232 IN
4	(DTR) Data Terminal Ready
5	(GND) ISO-GND
6	(DSR) Data Set Ready
7	(RTS) Request To Send
8	(CTS) Clear To Send
9	(RI) Ring Indicator

Note: RTS and CTS are internally connected.
DSR, DTR, and DCD are internally connected.
RI is driven active.

Note: All ISO-GND terminals are internally connected.

The following diagrams show wiring examplesfor connecting the host to a single 2100 Display using RS232 or RS422 data types. For RS232 communications, the only connections absolutely necessary are the ones shown for pin 2 (232 OUT), pin 3 (232 IN), pin 5 (SIGNAL GROUND), and pin 7 (RTS). All other RS232 connections are only necessary for programs or equipment that require the use of handshaking signals.

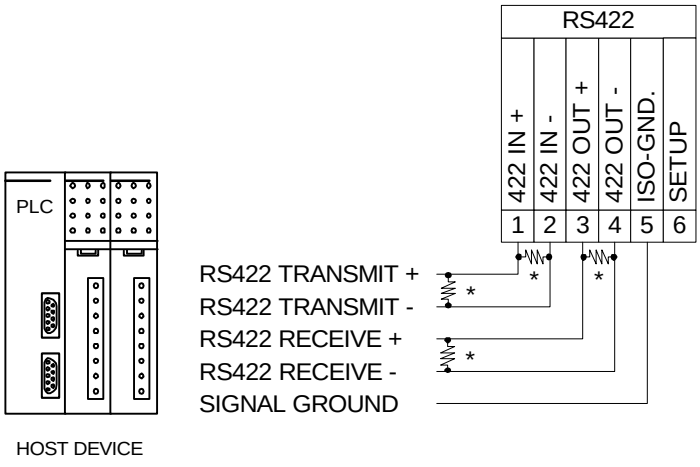
Figure 10
Single Unit - RS232 Diagram



Note: A standard straight through PC modem cable can be wired from the host to the 2100SB.

Note: The maximum recommended cable length forRS232 communications is 50 feet.

Figure 11
Single Unit - RS422 Diagram



* Terminator resistor (typically 120 ohm, 1/4 W). Refer to Section 5.2 Communicating to Multiple Units, Wiring an RS422 Network, for details.

Note: The maximum recommended cable length forRS422 communications is 4000 feet.

5.2 Communicating To Multiple Units

Understanding An RS422 Network

Units may be configured in a multidrop network where the host RS422 signal is connected directly to multiple 2100 display units. A maximum of 32 display units or 4000 feet of cable may be connected to a single host output in a multidrop configuration.

- RS422 Multidrop
  This configuration is used when the host output is RS422. The RS422 output from the host is wired in parallel to all of the 2100 Display units in the network

Wiring An RS422 Network

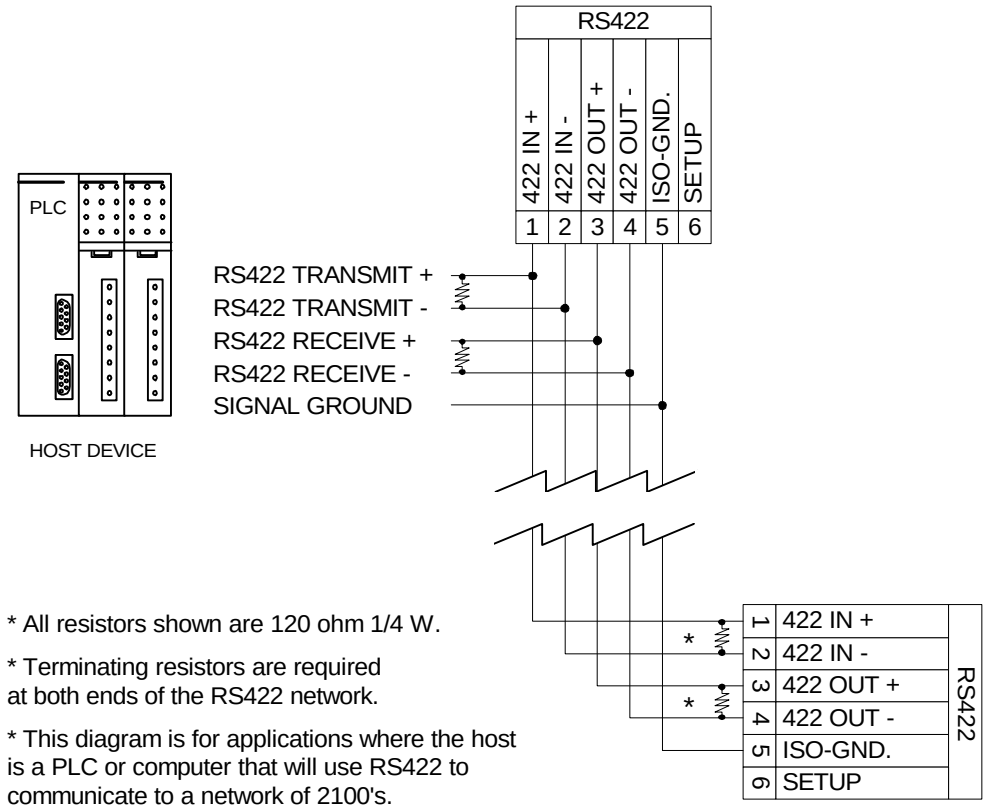
Terminating

The network wiring must be terminated correctly at both the beginning (the host in the drawing below) and at the last 2100 ending the network. In reality, the host can be connected anywhere on the network. The terminating resistors must still be installed at both ends of the network. If the host is connected at the center of the network, terminating resistors would be required on the two end 2100's. In this case, no terminating resistors would be required at the host. The purpose of the terminating resistors is to prevent reflection problems. The resistance value of the terminating resistors should match the characteristic impedance of the cable. A typical value for this is 120 ohm.

RS422 Multidrop

The diagram below shows the required 120 ohm resistors (assuming that the host is at one end of the network) and illustrates the proper wiring for an RS422 multidrop network. RS422 multidrop is the basic network configuration for 2100 display units.

Figure 12
RS422 Multidrop Wiring

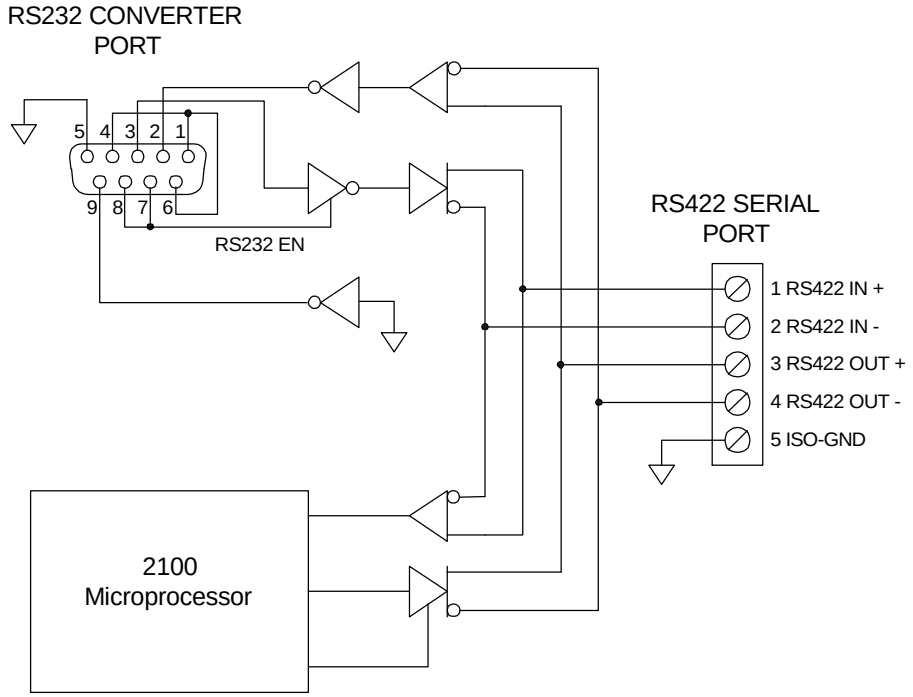


RS232 Converter

All 2100 Display units have a built-in dataconverter that can be used to convert the host RS232 data to RS422. This allows the host to communicate via RS232. The converter unit then retransmits the data out its RS422 port to all other units on the network.

- RS232 to RS422 Conversion
  This configuration is used when a host RS232 output is converted to RS422 by one of the 2100 units for use in a multiple display network. The host is wired to a 2100 Display's RS232 converter port. Then, the RS422 output from that 2100 Display unit is wired in parallel to all of the other 2100 Display units in the network. The RS422 portion of the wiring in the network is the same for all network configurations. The following diagram shows the internal RS232 to RS422 converter of a 2100 Display.

Figure 13
RS232 Converter



Note: Note that the maximum recommended cable length for RS232 communications is 50 feet. For best results, the shortest cable possible should be used.

Terminating

As discussed earlier, RS422 multidrop network wiring must be terminated correctly at both ends of the network. When the RS232 to RS422 converter is used, the host communicates to a 2100SB using RS232. No terminating resistors are required on the RS232 communication lines. However, terminating resistors are still required on the RS422 portion of the network. Again, the purpose of the terminating resistors is to prevent reflection problems. The resistance value of the terminating resistors should match the characteristic impedance of the cable. A typical value for this is 120 ohm.

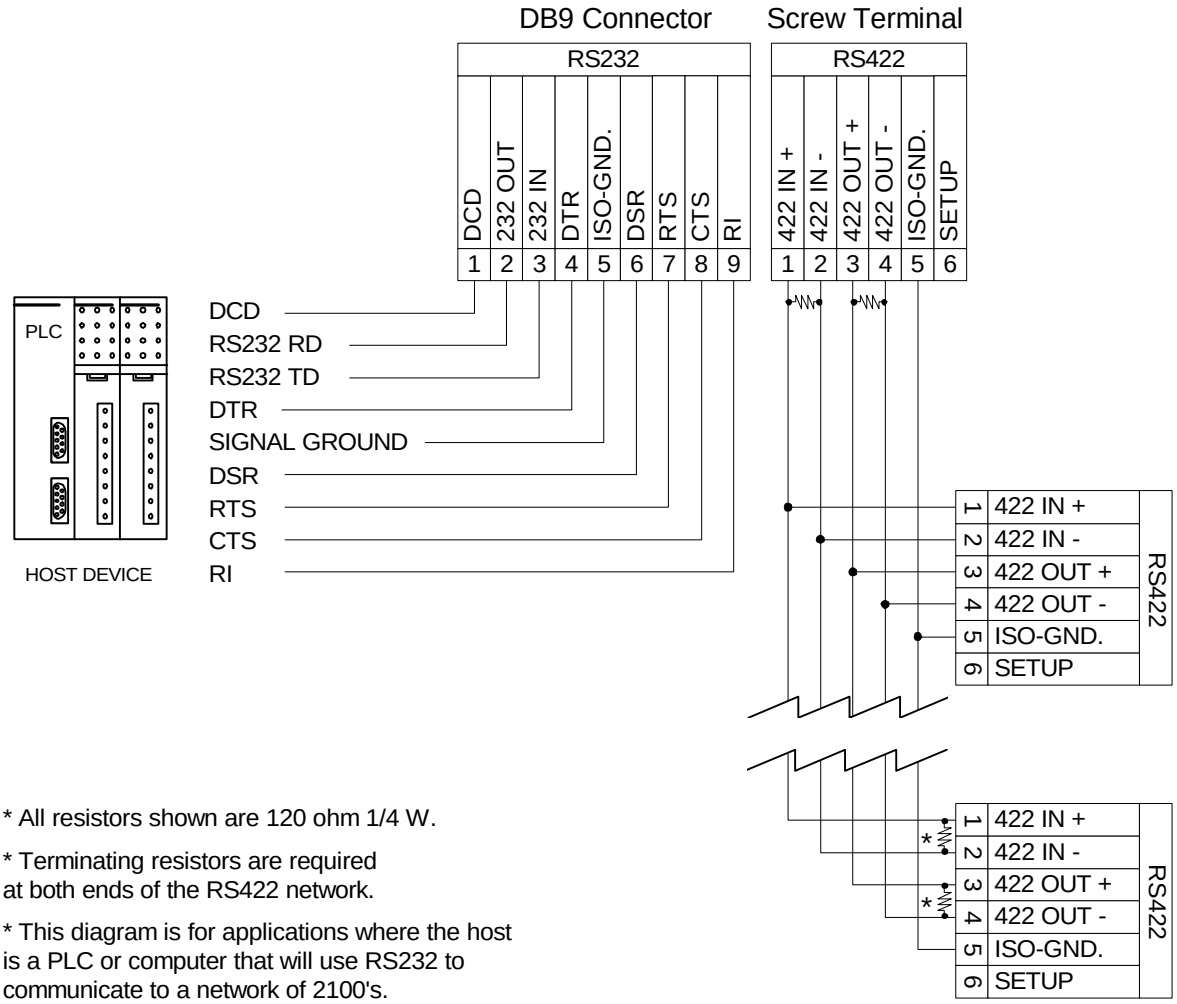
The diagram below shows the required 120 ohm resistors and illustrates the proper wiring for a network configuration where the host RS232 output is converted to RS422 (the first unit in the drawing below). Note that after the conversion, the subsequent units are wired in the standard RS422 multidrop configuration. As in the straight RS422 multidrop network, the host can use any 2100 on the network as a converter unit. The terminating resistors must still be installed at both ends of the RS422 network. If the host is connected to a unit at the center of the network, terminating resistors would still be required on the two end 2100's. In this case, no terminating resistors would be required at the converter unit. Remember, the RS422 portion of the wiring in the network is the same for all network configurations.

Just a reminder, for RS232 communications, the only connections absolutely necessary are the ones shown for pin 2 (232 OUT), pin 3 (232 IN), pin 5 (SIGNAL GROUND), and pin 7 (RTS). RTS is the enable line for the converter. All other RS232 connections are only necessary for programs or equipment that require the use of handshaking signals.

Note: RTS and CTS are internally connected.
DSR, DTR, and DCD are internally connected.
RI is driven active.

Note: All ISO-GND terminals are internally connected.

Figure 14
RS232 Converter Wiring



Recommended RS422 Cables

Since the impedance of the cable and terminator resistance need to match, a cable with a characteristic impedance of 120 ohms should be used. One recommended cable for interconnecting units is Belden® #89730 for plenum installationsor #9730 for conduit installations (or equivalent). Both types have three twisted pairs of 24 AWG stranded tinned copper wire with each pair individually shielded. The characteristic impedanceof the cable is 100 ohms. This type of cable provides good overall performance for a relatively low cost.

Two of the twisted pairs are used for data transmission, one pair is used for data coming from the host and one pair is used for data going to the host. In each of the two pairs, one wire is used for the non-inverting data line and the other wire is used for the inverting data line. Both wires on the third pair are used to connect ISO-GND from 2100 to 2100 and to the host. The shield wires are used to protect the data lines from noise and should be connected ***on only one end of each cable*** to earth ground.

Recommended RS232 Cable

A standard male-to-female DB9 straight through modem cable is all that is required to connect a Vorne 2100 style RS232 connector to an IBM/AT style RS232 connector. Again, note that the maximum recommended cable length forRS232 communications is 50 feet. For best results, the shortest cable possible should be used.

Addressing Multiple Units

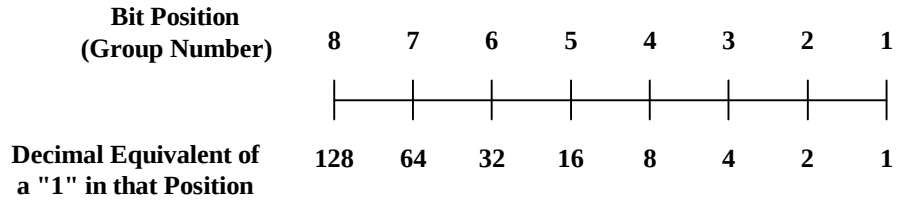
The RS422 network uses addressing to allow the host to communicate with specific individual displays or groups of displays in the network. Each unit in a network may be assigned a unit address and a group address. The unit address and group address are selected during setup. (Refer to Section 3.3 for details on setup.)

Unit Addressing

Unit addresses can have a value in the range of 000 to 255. If a serial transmission is directed to a specific unit address, only the 2100 units set to that address will display the message. More than one display may use the same unit address, but the best way to send a transmission to multiple units is to use group addressing.

Group Addressing

Group addresses can have a value from 0 to 8. The group address represents a bit position in an 8 bit binary number, as shown:



Referring to the above relationship, to communicate with only group 7 the host would transmit 64 as a group address. To communicate with only group 4, the host would transmit 8 as a group address. This arrangement allows the host to direct a message to any combination of groups. For example, to transmit to groups 6, 4 and 3, add together 32 + 8 + 4 and transmit 44 as the group address. Each display will interpret the transmitted group address and determine if it is being addressed. A transmitted group address of 0 is a broadcast to all units.

5.3 Terminal Emulation

VT102 Compatible

Enabling the setup function "*Terminal Mode - VT102 Compatible*" will cause the 2100 series display to operate in Terminal Emulation mode (refer to Section 3.3 for details on setup). When in Terminal Emulationmode, the 2100 series display emulates an ANSI / VT102 terminal. Refer to the ANSI terminal document for complete information. The following commands are supported:

BS	Backspace
CAN	Cancel
CR	Carriage Return
CUB	Cursor Backward
CUD	Cursor Down
CUF	Cursor Forward
CUP	Cursor Position
CUU	Cursor Up
DCH	Delete Character
DECLL	LED Control (Used for Relay Control)
DL	Delete Line
ED	Erase in Display
EL	Erase in Line
ESC	Introducer Control Character
FF	Form Feed
HT	Horizontal Tabulation
HVP	Horizontal and Vertical Positioning
ICH	Insert Character
IL	Insert Line
LF	Line Feed
MC	Media Copy
NUL	NUL
RCP	Restore Cursor Position
RM	Reset Mode
SCP	Store Cursor Position
SGR	Select Graphic Rendition
SM	Set Mode
VT	Vertical Tabulation

Note: All other commands will be ignored.

2100 Series Slave

Enabling the setup function "*Terminal Mode - 2100 Series Slave*" will cause the 2100 series display to operate in Slave mode (refer to Section 3.3 for details on setup). When in Slave mode, the 2100 series display mirrors the operation of a Vorne 2100PC display. Vorne 2100PC displays have all the functionality of 2100SB displays plus canned message capability. In a multidrop network, when a canned message, using the HOST MODE option of the OUTPUT_DEVICE command, is called up on a 2100PC, the same tasks, commands, etc. will be executed on 2100 displays set to slave mode.

Note: When setting up a 2100PC for slave operation care must be taken in writing scripts. It is possible in complex scripting applications to "overrun" the slave display since there is a limited communication "bandwidth".

Appendix A - Glossary

Address	A unique identification number assigned to a 2100 Display.
Alternate Escape	An alternative command identifier. This can be the first character in a command string sent to the 2100 Display, if it was selected during setup. It should be noted that <ESC> is always recognized as the command identifier. Selecting an Alternate Escape allows the user to use an alternate character to identify a command, but <ESC> is still recognized as well.
ANSI	American National Standards Institute.
Argument	Parameter for a function.
ASCII	American Standard Code for Information Interchange.
Backspace	Backspace control character (decimal value 8), used in scripts or in Terminal Emulation mode to move the cursor left one position.
Baud Rate	The data transfer rate between the host unit and the units in the serial network.
Blink	The **Blink** command is used to make displayed characters turn off and on at a specified rate. The **Blink** command code character is **B**.
<BS>	Represents the Backspace control character. See Backspace.
Carriage Return	Carriage Return control character (decimal value 13), used in Terminal Emulation mode to move the cursor to the beginning of the current line. Carriage Return is one of the two choices for the terminator of the Simple Packet Protocol and should not be used in serial buffer scripts.
Command Character	A single alphabetical character used to invoke a command. A command character must be part of a command string. See Command String.

Command String	The basic structure for issuing commands to the 2100 Display. A command string must have an Escape or Alternate Escape control character, arguments (when required), and a single alphabetical command character.
Conduit	A tube or trough in which insulated wires and cables are passed.
Control Character	Any one of several ASCII control characters, typically not displayed, which has a special meaning to the 2100 unit. Various control characters can be used in serial scripts or Terminal Emulation mode to move the cursor, clear the display, terminate an effect, identify a command string, and begin or end the Simple Packet Protocol format.
<CR>	Represents the Carriage Return control character. See Carriage Return.
Cursor	The **Cursor** command is used to specify the position where the next character will be displayed. The **Cursor** command character is **C**.
E^2PROM or EEPROM	Electrically Erasable Programmable Read Only Memory. The memory in the 2100 Display that is used to store setup information.
End of Transmission	End of Transmission control character (decimal value 4), used in scripts to terminate the **Scroll** command (mark the end of a string of characters that are to be scrolled.)
<EOT>	Represents the End of Transmission control character. See End of Transmission.
Erase	The **Erase** command is used to clear a specified line and place the cursor at the first column of the line. The **Erase** command character is **E**.
Erase2eol	The **erase2eol** command is used to clear a display line from the specified location to the end of the line. The **erase2eol** command character is **e**.
<ESC>	Represents the Escape control character. See Escape.
Escape	The Escape control character (decimal value 27), used as the first character in all command strings, unless an Alternate Escape character is selected in setup. In that case, the 2100 unit will recognize either the Escape or the chosen Alternate Escape character as the command identifier.

<FF>	Represents the Form Feed control character. See Form Feed.
Font	The **Font** command is used to specify the character set to be shown on the 2100 Display. The **Font** command character is **F**.
Form Feed	Form Feed control character (decimal value 12), used in serial scripts to clear the display and move the cursor to the beginning of the first line.
Goto	The **Goto** command is used to repeat the preceding text and commands a specified number of times. The **Goto** command character is **G**.
Horizontal Tab	Horizontal Tab control character (decimal value 9), used in serial scripts or in Terminal Emulation mode to move the cursor to the next tab stop.
Host	Any device that initiates serial communication with a 2100 Series Display Unit.
<HT>	Represents the Horizontal Tab control character. See Horizontal Tab.
Keypress Script	The **Keypress script** is a predefined script included in permanent 2100SB memory. The script simplifies the use of the front panel keys.
<LF>	Represents the Line Feed control character. See Line feed.
Line Feed	Line Feed control character (decimal value 10), used in Terminal Emulation mode to move the cursor down one line in the same column. Line Feed is one of the two choices for the terminator of the Simple Packet Protocol and should not be used in serial buffer scripts.
Lock	The **lock** command is used to determine if a new message will be displayed before the current message has completed its run. The **lock** command character is **l**. The **lock** command is specific to a task.
Marker	The **Marker** command is used to specify the location to where a **Goto** command can loop. The **Marker** command character is **X**.
Multidrop	A serial network configuration where the communications from the host are transmitted to more than one 2100 Display without being repeated. The 2100 Displays are wired in parallel.

Multitasking	The ability of the 2100 display unit to separately perform up to four different functions at the same time.
Output	The **Output** command is used to direct data to the serial port. The **Output** command character is **O**.
PLC	Programmable Logic Controller.
RAM	Random Access Memory. Memory used during run time to store data.
Relay	The **relay** command is used to control the SPDT relay in the 2100 Display. The **relay** command character is **r**.
Repeat	The **Repeat** command allows the character following the command string to be repeated a specified number of times. The **Repeat** command character is **R**.
Script	A sequentially ordered string of commands, literal text, and control characters which instructs a 2100 unit to perform a function.
Scroll	The **Scroll** command is used to scroll characters horizontally from right to left. The **Scroll** command character is **S**.
Setup	An electrical mechanism to prevent accidental change of setup data in the 2100 Display. Setup data may be viewed or changed when the SETUP terminal is connected to ISO-GND. Setup data may not be changed when the SETUP terminal is not connected to ISO-GND.
Simple Packet Protocol	The standard serial communication format which is used to send a Serial Buffer Script to a 2100SB unit.
<SOH>	Represents the Start of Header control character. See Start of Header.
SPDT	Single Pole Double Throw.
Start of Header	Start of Header control character (decimal value 1), is used as the first character of the Simple Packet Protocol format of serial communication.
Task	A task is a function performed by the 2100 display. Up to four tasks can be performed at the same time. A function can include but is not limited to scrolling text, controlling the relay, displaying text, internal timing, etc.

Vertical Tab	Vertical Tab control character (decimal value 11), used in serial scripts to move the cursor to the beginning of the next line.
VFD	Vacuum Fluorescent Display. The 2100 Display uses VFD technology to create visible characters.
<VT>	Represents the Vertical Tab control character. See Vertical Tab.
Wait	The **Wait** command is used to pause during the processing of a script for a specified length of time. The **Wait** command character is **W**.

Appendix B - Specifications

Communication Interface

- RS232 Serial Port - DB9 Connector
- RS422 Serial Port - Screw Terminal

Vacuum Fluorescent Display

- Wavelength - Peak at 505 nanometers
- Rated Life - 50,000 hours (when average dot brightness reaches ½ of original brightness)
- Character Height
  Model 2140 - 11 mm
  Model 2180 - 9 mm

Physical and Electrical

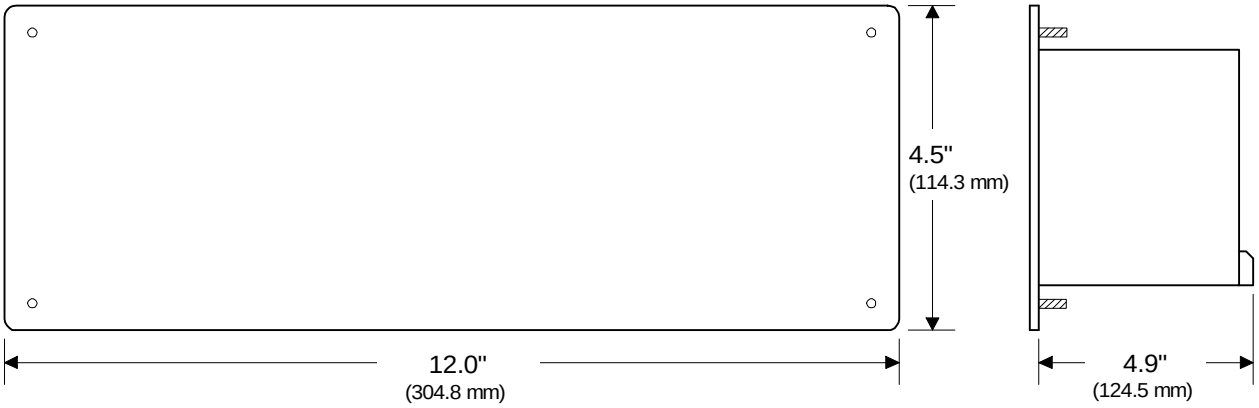
Power Supply Options	120 VAC ±15% (50 - 60 Hz), 0.16A, 20 Watts 24 VDC ±10%, 0.8A, 20 Watts
Operating Temperature Range	0° - 50° C
Storage Temperature Range	-20° to +70° C
Relative Humidity	0 - 95% Relative Humidity, Non-condensing
Weight	Approx. 6.5 lbs.

Annunciator Relay

Type	Single Pole Double Throw
Rating	120 VAC @1A

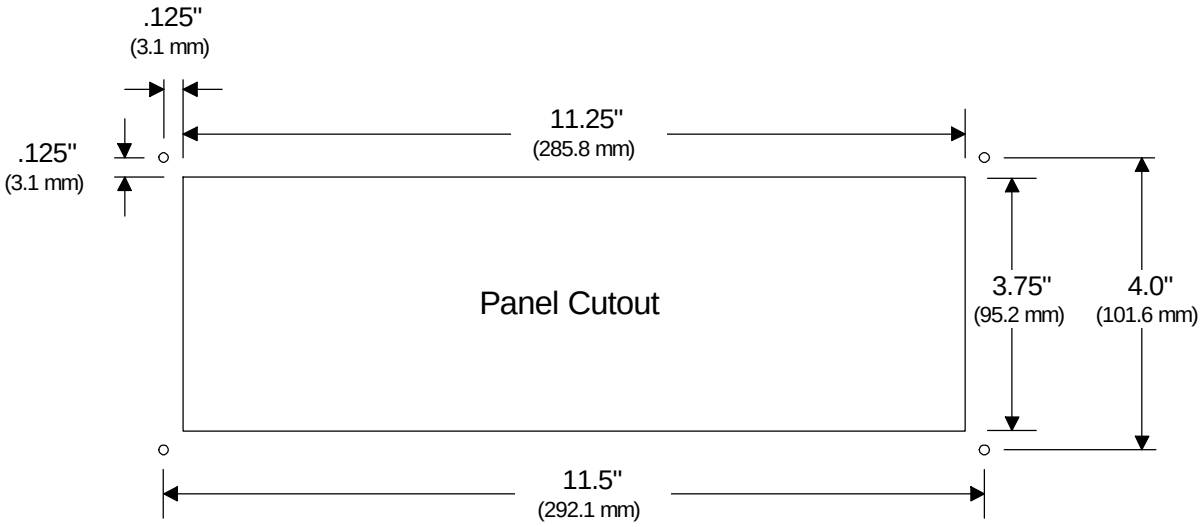
Dimensions

Front Panel and Depth



Mounting Information

The 2100 Display mounts in the user's panel through a rectangular cutout and is secured with four 10/32 hex nuts to threaded studs located at the corners of the bezel.



Mounting holes require clearance for 10-32 threaded standoffs, 7/32nds (5.6mm) diameter.

Appendix C - Character Sets

The full IBM®, J1S8 (Katakana), Slavic (Latin II) and Cyrillic character sets are available on the 2100 Display. All fonts share the first 128 characters (00h to 7Fh).

Common Character Set

Font 1 IBM® Character Set

128 80h		144 90h		160 A0h		176 B0h		192 C0h		208 D0h		224 E0h		240 F0h	
129 81h		145 91h		161 A1h		177 B1h		193 C1h		209 D1h		225 E1h		241 F1h	
130 82h		146 92h		162 A2h		178 B2h		194 C2h		210 D2h		226 E2h		242 F2h	
131 83h		147 93h		163 A3h		179 B3h		195 C3h		211 D3h		227 E3h		243 F3h	
132 84h		148 94h		164 A4h		180 B4h		196 C4h		212 D4h		228 E4h		244 F4h	
133 85h		149 95h		165 A5h		181 B5h		197 C5h		213 D5h		229 E5h		245 F5h	
134 86h		150 96h		166 A6h		182 B6h		198 C6h		214 D6h		230 E6h		246 F6h	
135 87h		151 97h		167 A7h		183 B7h		199 C7h		215 D7h		231 E7h		247 F7h	
136 88h		152 98h		168 A8h		184 B8h		200 C8h		216 D8h		232 E8h		248 F8h	
137 89h		153 99h		169 A9h		185 B9h		201 C9h		217 D9h		233 E9h		249 F9h	
138 8Ah		154 9Ah		170 AAh		186 BAh		202 CAh		218 DAh		234 EAh		250 FAh	
139 8Bh		155 9Bh		171 ABh		187 BBh		203 CBh		219 DBh		235 EBh		251 FBh	
140 8Ch		156 9Ch		172 ACh		188 BCh		204 CCh		220 DCh		236 ECh		252 FCh	
141 8Dh		157 9Dh		173 ADh		189 BDh		205 CDh		221 DDh		237 EDh		253 FDh	
142 8Eh		158 9Eh		174 AEh		190 BEh		206 CEh		222 DEh		238 EEh		254 FEh	
143 8Fh		159 9Fh		175 AFh		191 BFh		207 CFh		223 DFh		239 EFh		255 FFh	

Font 2 JIS8 (Katakana) Character Set

128 80h		144 90h		160 A0h		176 B0h		192 C0h		208 D0h		224 E0h		240 F0h	
129 81h		145 91h		161 A1h		177 B1h		193 C1h		209 D1h		225 E1h		241 F1h	
130 82h		146 92h		162 A2h		178 B2h		194 C2h		210 D2h		226 E2h		242 F2h	
131 83h		147 93h		163 A3h		179 B3h		195 C3h		211 D3h		227 E3h		243 F3h	
132 84h		148 94h		164 A4h		180 B4h		196 C4h		212 D4h		228 E4h		244 F4h	
133 85h		149 95h		165 A5h		181 B5h		197 C5h		213 D5h		229 E5h		245 F5h	
134 86h		150 96h		166 A6h		182 B6h		198 C6h		214 D6h		230 E6h		246 F6h	
135 87h		151 97h		167 A7h		183 B7h		199 C7h		215 D7h		231 E7h		247 F7h	
136 88h		152 98h		168 A8h		184 B8h		200 C8h		216 D8h		232 E8h		248 F8h	
137 89h		153 99h		169 A9h		185 B9h		201 C9h		217 D9h		233 E9h		249 F9h	
138 8Ah		154 9Ah		170 AAh		186 BAh		202 CAh		218 DAh		234 EAh		250 FAh	
139 8Bh		155 9Bh		171 ABh		187 BBh		203 CBh		219 DBh		235 EBh		251 FBh	
140 8Ch		156 9Ch		172 ACh		188 BCh		204 CCh		220 DCh		236 ECh		252 FCh	
141 8Dh		157 9Dh		173 ADh		189 BDh		205 CDh		221 DDh		237 EDh		253 FDh	
142 8Eh		158 9Eh		174 AEh		190 BEh		206 CEh		222 DEh		238 EEh		254 FEh	
143 8Fh		159 9Fh		175 AFh		191 BFh		207 CFh		223 DFh		239 EFh		255 FFh	

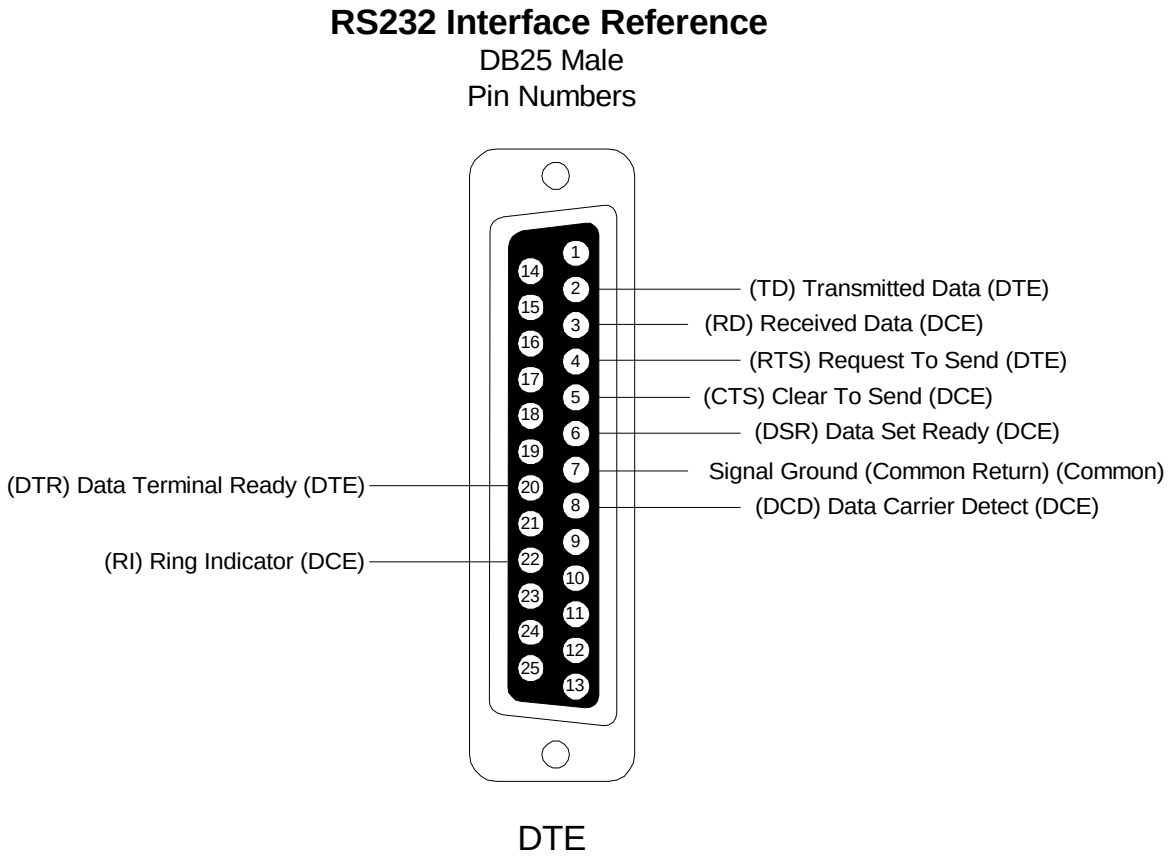
Font 3 Slavic (Latin II) Character Set

128 80h		144 90h		160 A0h		176 B0h		192 C0h		208 D0h		224 E0h		240 F0h	
129 81h		145 91h		161 A1h		177 B1h		193 C1h		209 D1h		225 E1h		241 F1h	
130 82h		146 92h		162 A2h		178 B2h		194 C2h		210 D2h		226 E2h		242 F2h	
131 83h		147 93h		163 A3h		179 B3h		195 C3h		211 D3h		227 E3h		243 F3h	
132 84h		148 94h		164 A4h		180 B4h		196 C4h		212 D4h		228 E4h		244 F4h	
133 85h		149 95h		165 A5h		181 B5h		197 C5h		213 D5h		229 E5h		245 F5h	
134 86h		150 96h		166 A6h		182 B6h		198 C6h		214 D6h		230 E6h		246 F6h	
135 87h		151 97h		167 A7h		183 B7h		199 C7h		215 D7h		231 E7h		247 F7h	
136 88h		152 98h		168 A8h		184 B8h		200 C8h		216 D8h		232 E8h		248 F8h	
137 89h		153 99h		169 A9h		185 B9h		201 C9h		217 D9h		233 E9h		249 F9h	
138 8Ah		154 9Ah		170 AAh		186 BAh		202 CAh		218 DAh		234 EAh		250 FAh	
139 8Bh		155 9Bh		171 ABh		187 BBh		203 CBh		219 DBh		235 EBh		251 FBh	
140 8Ch		156 9Ch		172 ACh		188 BCh		204 CCh		220 DCh		236 ECh		252 FCh	
141 8Dh		157 9Dh		173 ADh		189 BDh		205 CDh		221 DDh		237 EDh		253 FDh	
142 8Eh		158 9Eh		174 AEh		190 BEh		206 CEh		222 DEh		238 EEh		254 FEh	
143 8Fh		159 9Fh		175 AFh		191 BFh		207 CFh		223 DFh		239 EFh		255 FFh	

Font 4 Cyrillic Character Set

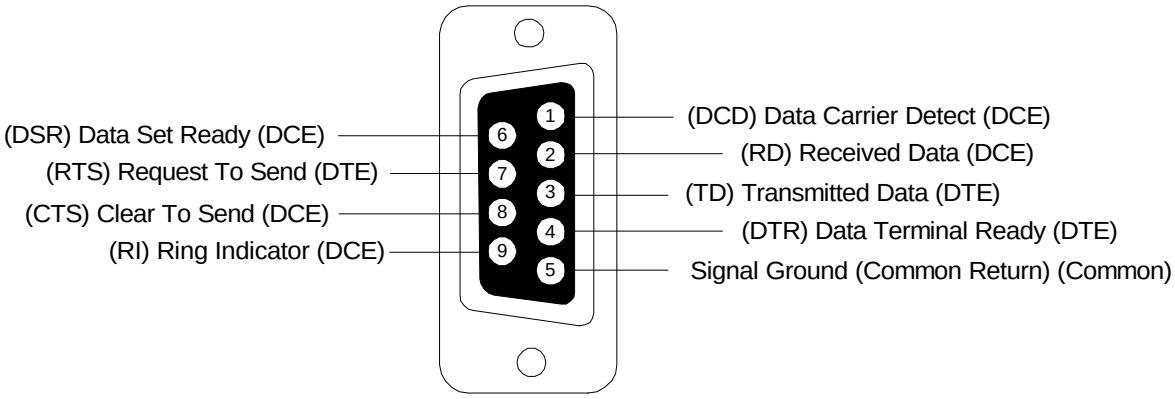
128 80h	144 90h	160 A0h	176 B0h	192 C0h	208 D0h	224 E0h	240 F0h
129 81h	145 91h	161 A1h	177 B1h	193 C1h	209 D1h	225 E1h	241 F1h
130 82h	146 92h	162 A2h	178 B2h	194 C2h	210 D2h	226 E2h	242 F2h
131 83h	147 93h	163 A3h	179 B3h	195 C3h	211 D3h	227 E3h	243 F3h
132 84h	148 94h	164 A4h	180 B4h	196 C4h	212 D4h	228 E4h	244 F4h
133 85h	149 95h	165 A5h	181 B5h	197 C5h	213 D5h	229 E5h	245 F5h
134 86h	150 96h	166 A6h	182 B6h	198 C6h	214 D6h	230 E6h	246 F6h
135 87h	151 97h	167 A7h	183 B7h	199 C7h	215 D7h	231 E7h	247 F7h
136 88h	152 98h	168 A8h	184 B8h	200 C8h	216 D8h	232 E8h	248 F8h
137 89h	153 99h	169 A9h	185 B9h	201 C9h	217 D9h	233 E9h	249 F9h
138 8Ah	154 9Ah	170 AAh	186 BAh	202 CAh	218 DAh	234 EAh	250 FAh
139 8Bh	155 9Bh	171 ABh	187 BBh	203 CBh	219 DBh	235 EBh	251 FBh
140 8Ch	156 9Ch	172 ACh	188 BCh	204 CCh	220 DCh	236 ECh	252 FCh
141 8Dh	157 9Dh	173 ADh	189 BDh	205 CDh	221 DDh	237 EDh	253 FDh
142 8Eh	158 9Eh	174 AEh	190 BEh	206 CEh	222 DEh	238 EEh	254 FEh
143 8Fh	159 9Fh	175 AFh	191 BFh	207 CFh	223 DFh	239 EFh	255 FFh

Appendix D - Typical RS232 Pinouts



IBM/AT® Style RS232 Interface

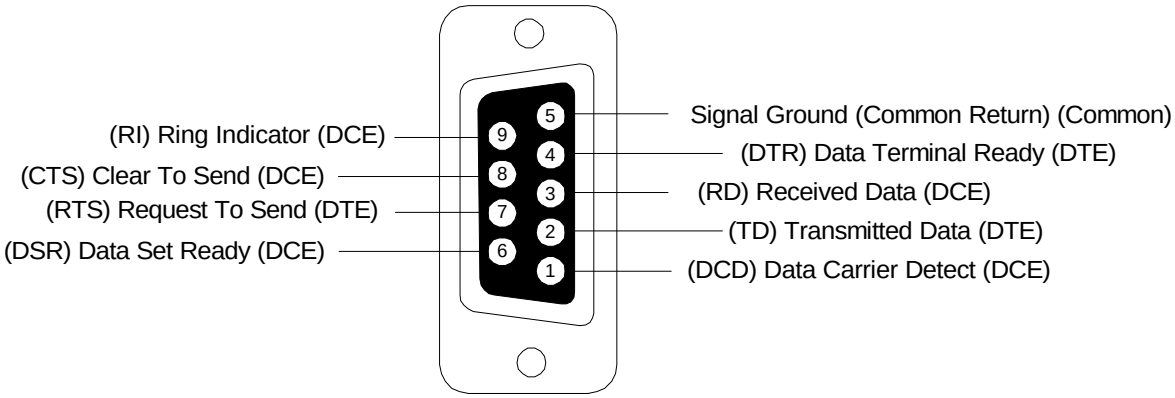
DB9 Male
Pin Numbers



DTE

Vorne 2100 Style RS232 Interface

DB9 Female
Pin Numbers



DCE

Note: A standard straight through PC modem cable is all that is required to connect a Vorne 2100 style connector to an IBM/AT® style connector.

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S

T

U

V

W

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