Vorne Industries

2000C Series
Canned Message Display
User's Manual

2000C SERIES CANNED MESSAGE DISPLAY

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1. INTRODUCTION TO THE 2000C DISPLAY

1.1 A Quick Start

If this is your first time working with the Vorne 2000C display and you would like a quick way to see what the lit display looks like , this section is for you. The quickest way to see a display is to put the unit in the PROGRAM mode. To accomplish this connect DC ground (terminal one) to the PROGRAM terminal (terminal four), and apply power to the display (see section 4.1 Powering The Display). The display will light up with the message:

"EDITING MESSAGE 001".

1.2 Features Of The Display

The model 2000C canned message display can store up to 250 messages of 20 characters each in an EEPROM non-volatile memory. Each message can be programmed to be fixed, flashed or scrolled, and to time out automatically or persist until the next message is called up. In addition messages can be chained together to allow up to 180 characters (9 messages) to be displayed from a single message address either by scrolling the entire message or by alternately displaying lines of text. Up to 8 characters of real time variable data can be inserted per fixed or flashed message and can be inserted anywhere within the 20 available characters. A FIFO (first in - first out) message queue allows up to 8 messages to be queued in internal memory at any time. Message callup and variable data loading are handled through the same port minimizing the number of I/O points needed to interface to the display.

1.3 Programming The Display

The 2000C display is field programmable through its RS232 PROGRAM port. Any keyboard or computer capable of transmitting the required protocol (RS232 at 300 baud, 8 data bits, no parity and 1 or 2 stop bits) can be used to program the display. The Vorne Display-Pro software package for IBM personal computers and compatibles (available at no charge from the factory) makes it very easy to program displays from the PC. The software also provides hard copies of message files, long term message file storage and easy programming of additional displays.

On displays powered from 120 VAC or 10-30 VDC, the display sources an auxiliary regulated +5 VDC output (200 mA maximum) useful for powering keyboards.

1.4 Notes On Vacuum Fluorescent Displays

Vacuum Fluorescent display technology was chosen for this product because of its superior brightness, viewing angle, and spectral qualities. The natural color emitted by the display tube is a green blue, peaking at a wavelength of 505 nanometers. The display is filterable to blue, red or yellow by using different labels. If one of these colors is desirable for your application please consult the factory. The VFD tube has a rated life of 50,000 hours (almost six years of continuous operation). Rated life is said to be reached when the display tube reaches half brightness. To maximize the life of the display, it is important to avoid keeping the same message fixed on the display for extended periods (hours). Thus if you wish to have a default message on the display such as "ALL SYSTEMS GO", "MACHINE RUNNING" etc, it is suggested that you scroll the message to prevent imprinting the message on the display phosphors.

2. FEATURES OF THE 2000C DISPLAY

2.1 Fixed, Flashed And Scrolled Messages

Each message when edited can be assigned one of three basic display formats - fixed, flashed or scrolled. Also assigned is how long (or many times) the message will be displayed. Oftentimes it is convenient to program a message to display until the next message number is loaded.

Fixed Message - Fixed messages display for a period of time, assignable in two second intervals from 2 to 198 seconds, or alternately until the next message is called up through the parallel input port.

Flashed Message - Flashed messages flash at a fixed rate of approximately 3 times per second for a period of time assignable in two second intervals from 2 to 198 seconds, or alternately until the next message is called up through the parallel input port.

Scrolled Message - Scrolled messages scroll across the display (from right to left) at a fixed rate, for a number of times assignable between 1 and 99 times, or continually scroll until the next message is called up through the parallel input port. Scrolling is especially useful in combination with chaining messages together, to create continuous messages of up to 180 characters in length.

2.2 Chaining Messages Together

Any message can be the start of a chain that links together up to 8 additional messages. Chaining is especially useful to create messages longer than 20 characters (up to 180 character messages are possible with chaining). These longer messages can be displayed either by scrolling the entire message or by alternately displaying lines. Chaining is also useful in applications where a common message segment is defined in one message location and then repeatedly linked to other messages, the overall effect being to reduce the amount of message memory used. Each message can have its own independent chaining sequence defined, thus 250 independent chains are possible (one for each message). For example, messages 1, 2 and 9 can have the following chained sequences defined all at the same time.

```
MESSAGE 001:  001 -> 002 -> 003 -> 004 -> 005 -> 006 -> 007 -> 008 -> 009
MESSAGE 002:  002 -> 004 -> 006 -> 008 -> 001 -> 003 -> 005 -> 007 -> 009
MESSAGE 003:  009 -> 008 -> 007 -> 006 -> 005 -> 004 -> 003 -> 002 -> 001
```

The first message in any chain determines the attributes of the entire chain; message type (fixed, flashed or scrolled), message timing and which other messages will be links in the chain. All linked messages just add more text — they do not change the operation. For example, if the first message in a chain is of the scrolled type, the entire chain will be scrolled, regardless of how the other messages are formatted. If the first message in a chain is fixed or flashed, each message in the chain will display fixed or flashed for a duration determined solely by the first message.

2.3 Displaying Real Time Variable Data Within A Message

Up to 8 real time hexadecimal (0-9 and A-F) variable data characters can be displayed in each and every one of the 250 messages. The variable data can be loaded whenever the message is displayed, and can be updated repeatedly as long as the message continues to be displayed. There are some important limitations of variable data to be noted. Variable data can only be loaded into fixed or flashed messages that are not chained. In other words variable data cannot be loaded into scrolled messages or chained messages. Also, variable data cannot be queued, it must be loaded following the message selection, while the message is actually being displayed.

When programming messages, space is reserved for a variable data character by embedding the character "^" (5E Hex) in the message wherever a variable data character is desired. As an example, if one of the messages displays production count and rate, with 5 digits of count and 3 digits of rate, the message text would be entered in the PROGRAM mode as:

" COUNT ^^^^^ RATE ^^^"

The required loading and timing sequences for variable data are discussed in section 4.8 ("Loading Real Time Variable Data Into A Message").

2.4 Queueing Multiple Message Selections

If multiple messages are called up within a short period of time, the display will automatically queue up to eight message numbers in internal memory for subsequent display in a FIFO (first in - first out) basis. Fixed and flashed messages will be displayed for several seconds and scrolled messages will be displayed once regardless of what was originally programmed. Thus all queued messages will be processed through, displaying for a minimum of several seconds until the message queue is empty.

For some applications queueing may not be desirable (for example when the programmable controller is internally prioritizing or queueing messages, or when it is desired to have the message display always reflect whichever message number is currently on the parallel input port). A special version of the 2000C operating software is available with queueing disabled for fixed messages, thus providing immediate display of the most recently called up message. In this special software scrolled and flashed messages are still subject to queueing. If this is desirable for your application please consult the factory.

2.5 Powerup Memory Test

Every time a message is edited, the 2000C calculates a checksum of the entire message memory which it stores in nonvolatile memory. If this stored checksum does not match a newly calculated checksum on powerup the display will show the message:

"ERROR MEMORY CHECK"

This is an indication that the message memory contents have been corrupted and the unit may need servicing. The message will automatically disappear after several seconds and the display will allow operation. It is suggested, however, that the display be reprogrammed and, if the error message persists, returned to the factory for evaluation.

3. PROGRAMMING THE 2000C DISPLAY

3.1 Placing The Display In The Program Mode

To put the display in the PROGRAM mode connect DC ground (terminal one) to the PROGRAM terminal (terminal four), and apply power to the display (see section 4.1 Powering The Display). The display will light up with the prompt

<div align="center">"EDITING MESSAGE 001"</div>

From this prompt, the display is ready to allow editing of the internally stored messages through the RS232 PROGRAM port.

3.2 The RS232 Programming Port

The 2000C display is field programmable through its RS232 PROGRAM port. Any keyboard or computer capable of transmitting the required protocol (RS232 at 300 baud, 8 data bits, no parity and 1 or 2 stop bits) can be used to program the display. Since no communication handshaking is required or provided by the display, just two wires are needed for serial communication. These are the signal ground and transmit data (TXD) from your keyboard or computer. Most computers and many serial keyboards use either a DB9 or DB25 connector for their serial port. A DB9 usually has signal ground on pin 5 and transmit data on pin 3. A DB25 usually has signal ground on pin 7 and transmit data on pin 2. Terminals 1 and 2 on displays powered from 120 VAC or 10-30 VDC source an auxiliary regulated +5 VDC output (200 mA maximum) which is useful for powering keyboards.

Wire your keyboard or computer to the display as follows:
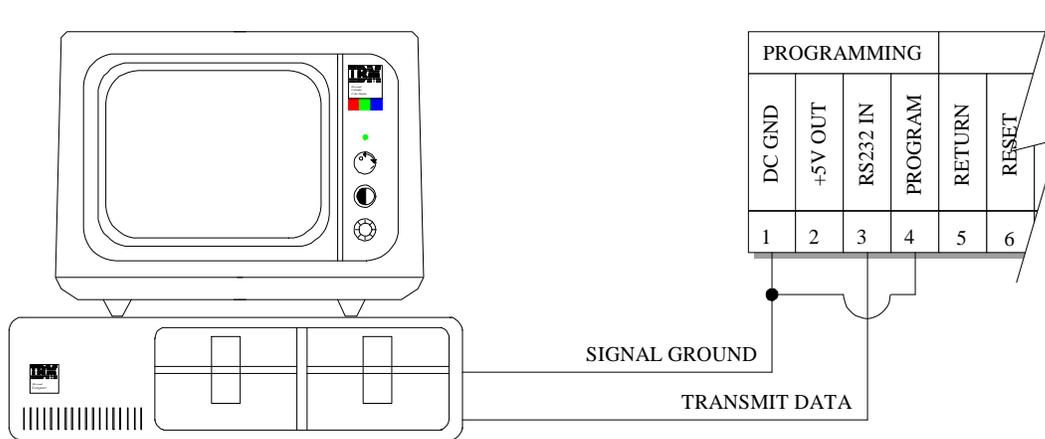
3.3 Programming The Display From An IBM PC Or Compatible

If an IBM personal computer or compatible is available for programming the display, we highly recommend using the Vorne Display-Pro software package (available at no charge from Vorne). The Vorne Display-Pro utility provides a complete development environment designed to decrease the time it takes to program and reprogram the Vorne 2000C series alphanumeric canned message displays.

With the VDP utility the user can create new message files, edit previously saved message files, and simulate how messages will appear once programmed in the Vorne 2000C display. The program will also print out hard copies of message files for documentation purposes, provide long term message file storage and provide easy dumping of message files to one or more displays.

The VDP program is menu driven with pull down menus and extensive online help. Available in both 5 1/4" and 3 1/2" disk formats it requires the following hardware:

• a personal computer running MS-DOS or PC-DOS version 2.00 or later;
• one floppy disk drive (hard disk optional);
• 256K RAM available memory;
• one Asynchronous Communications Adapter (serial port).

Note: The remainder of section 3 pertains to programming the 2000C display from a keyboard or a dumb terminal, and can be ignored if you are using the Vorne Display-Pro software to program the display. In the latter case follow the instructions provided with the VDP software.

3.4 Programming The Display From A Keyboard Or Dumb Terminal

Note: This section pertains to programming the 2000C display from a keyboard or a dumb terminal, and should be skipped if you are using the Vorne Display-Pro software to program the display.

When working through the menus (described below and flowcharted in Figure 1), several keys have special uses that are documented below. Experiment - you will soon get an intuitive feel for the editing process.

KEY	NAME	FUNCTION
"CR"	Carriage Return	Accepts the current menu choice.
"SP"	Space Bar	Increments choices within a menu; increments message number whenever that is a selection.
"ESC"	Escape Key	Return to "EDITING MESSAGE ###" prompt with no action taken. Also used to bypass message chaining menu, and to return to "DISPLAY TIL NEXT MSG" prompt in message timing menu.
"0"-"9"	Numeric Keys	Overwrites number at blinking cursor. Valid numbers are in the range from "0" through "9".

###	is any number between 1 and 250
X	is any number between 1 and 9

A) Message Selection

Prompt   "EDITING MESSAGE ###"

Description   The initial message when entering the PROGRAM mode allows selection of any of the 250 messages for editing. Any attempt to enter a message number greater than 250 will default to 001.

Keys   "SP"   • Increments the message number.

          "0"-"9"   • Overwrite message number at blinking cursor location.

          "CR"   • Accepts the message number and goes to next menu (B1).

          "R"   • Goes to message review menu (F).

B1) Message Type - Fixed

Prompt   "MESSAGE ### FIXED"

Description   Selects the message type to be fixed.

Keys   "CR"   • Accepts the message type as fixed. Go to (C1).

          "SP"   • Increments menu choice to (B2).

B2) Message Type - Flashed

Prompt   "MESSAGE ### FLASHED"

Description   Selects the message type to be flashed.

Keys   "CR"   • Accepts the message type as flashed. Go to (C1).

          "SP"   • Increments menu choice to (B3).

B3) Message Type - Scrolled

Prompt   "MESSAGE ### SCROLLED"

Description   Selects the message type to be scrolled.

Keys   "CR"   • Accepts the message type as scrolled. Go to (C1).

          "SP"   • Wraps the menu choice back to (B1).

C1) Message Timing - Til Next Message

Prompt   *"DISPLAY TIL NEXT MSG"*

Description   Instead of allowing the message to time out, when this menu option is selected the message remains on the display until another message is called up.

Keys   "SP"   • Increments the menu choice to (C2).

          "CR"   • Accepts the current choice and goes to next menu (D).

C2) Message Timing - Fixed Time

Prompt   *"DISPLAY MSG XX TIMES"*
Description   Selects the number of times a message is to be displayed. Is selectable in single number increments from 01 to 99 times. For fixed or flashed messages each time increment represents approximately two seconds. Thus the message can be timed between 2 and 198 seconds. For a scrolled message the times designation represents how many times the message will scroll across the display.
Keys   "SP"   • Increments the message time.
               "ESC" • Returns the prompt to (C1).
               "CR"   • Accepts the selected message time. Go to (D).
               "0"-"9" • Overwrites message time at blinking cursor location.

D) Message Chaining

Prompt   "CHAINLINK X MSG ###" where X represents current chain link and can range from 1 to 8.
Description   Allows linking up to eight additional messages to currently edited message.
Keys   "ESC" • Skips chaining and goes directly to message text (E).
               "SP"   • Increments message number.
               "0"-"9" • Overwrites message number at blinking cursor location.
               "CR"   • If ### is 000 (no message number entered), or if X is 8 (last chain link available) go to message text (E), otherwise, accepts current chain link message data and increments chain link number.

E) Message Text

Prompt   When unit is factory shipped, each message location has preset text "MESSAGE XXX BUFFER !". Otherwise what appears is the currently stored message text.
Description   Loads current message text from nonvolatile memory and allows editing.
Keys   The following edit keys are valid. All other keys are literal in nature, both upper and lower case. Note that position 1 refers to the leftmost character position and position 20 refers to the rightmost character position when viewing the display.
               "BS"   • Backspace key moves cursor back one character without deletion. If at position 1, the cursor will wrap to position 20.
               "LF"   • Linefeed key moves cursor forward one character without deletion. If at position 20, the cursor will wrap to position 1.
               "DEL" • Delete key deletes current character and moves cursor back one character. If at position 1, the cursor will wrap to position 20.
               "SP"   • Space bar deletes current character and moves cursor forward one character. If at position 20 the cursor will wrap to position 1.
               "^"   • Up-Arrow (also called Carat sign) is used to reserve a variable data position. While in the PROGRAM mode a "^" will be displayed once it has been entered into a message. When in the RUN mode blanks will be displayed until variable data is loaded.
               "ESC" • Saves message text and all attributes, recalculates a memory checksum and goes to
               "CR"   message selection prompt (A) for next message (message number is automatically incremented). *It is important to note that no message attributes are stored in nonvolatile memory until the "ESC" or "CR" key is entered in the message text menu.*

F) Message Review

Prompt   "REVIEW MESSAGE ###"
Description Selects message for review, as if it were called up in RUN mode.
Keys   "SP"   • Increments message number.
                 "0"-"9" • Overwrites message number at blinking cursor location.
                 "CR"   • Will display message selected as if it were called up in the RUN mode.
                 ANY KEY • While the message is reviewing, any key will terminate the message review and go back to message selection prompt (A) with the reviewed message selected for editing.

Note: See Figure 1 below for a graphic flowchart of the entire editing process.

Figure 1 - Graphic Flowchart Of Editing Process
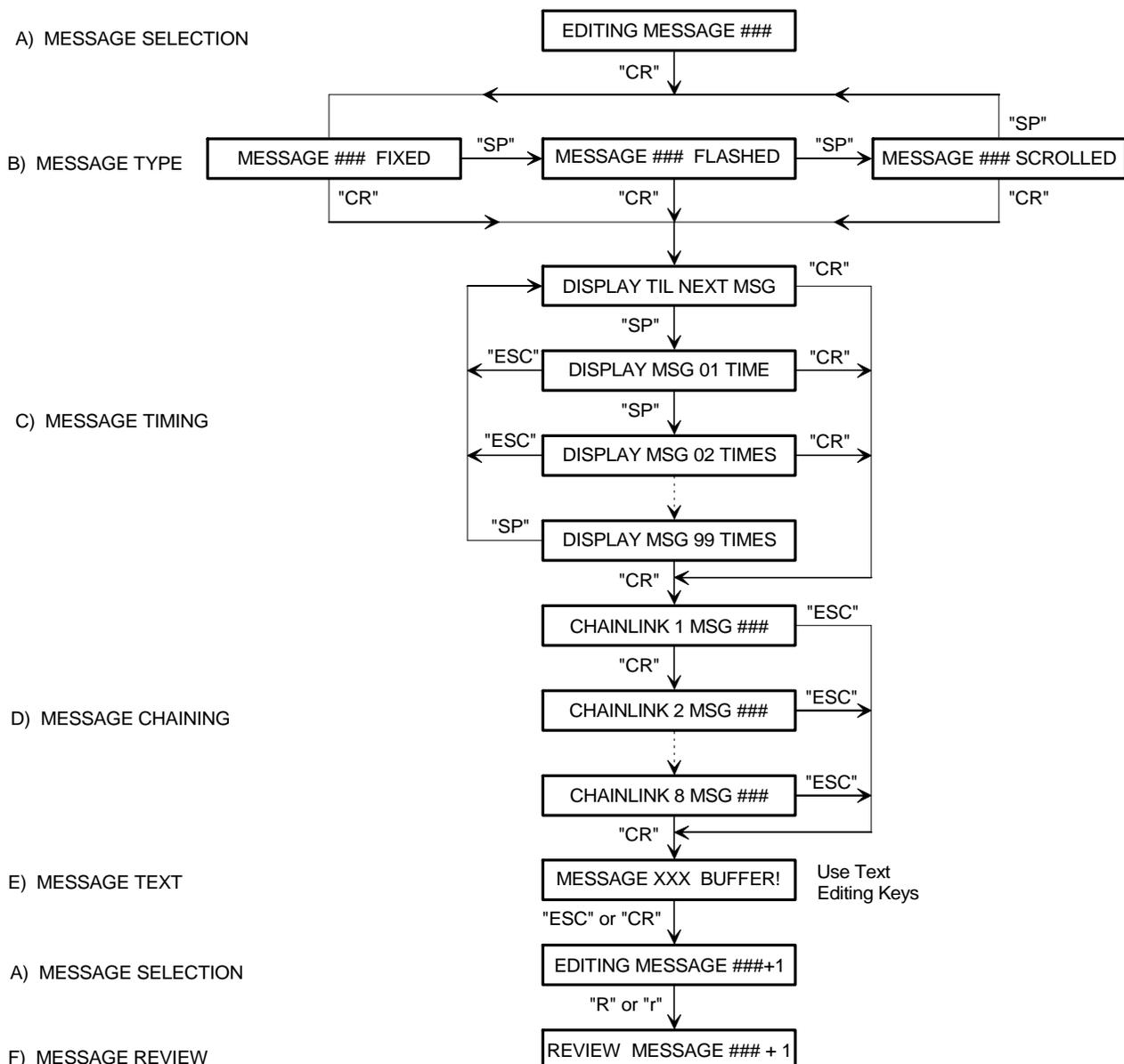
4. INTERFACING THE 2000C DISPLAY TO CONTROLLERS

4.1 Powering The Display

The chart below outlines the operating and inrush power requirements of the three different size models of the 2000C display.

MODEL	SIZE	OPERATING POWER	INRUSH POWER
2005C	5 mm (.2")	2.3 VA	X.X VA
2009C	9 mm (.35")	3.6 VA	X.X VA
2015C	15 mm (.59")	6.8 VA	X.X VA

Power Connections For Displays With Housing Option C (Panel Mount Case) - Power connections are made to a separate three terminal power connector (marked A, B, and C). Power is wired into terminals A and B as shown below. Terminal C is used to provide earth ground to the enclosure. It is highly recommended that earth ground be wired to terminal C as this will provide a safety ground to the enclosure as well as a return path for external electrical noise disturbances.

OPERATING VOLTAGE OPTION 120
120 Volt AC ± 15%

POWER IN		
120 VAC	120 VAC	EARTH GND
A	B	C

OPERATING VOLTAGE OPTION 24
10 - 30 Volt DC

POWER IN		
DC GND IN	10-30 VDC IN	EARTH GND
A	B	C

OPERATING VOLTAGE OPTION 5
5 Volt DC ± 5% (Regulated)

POWER IN		
DC GND IN	5V DC IN	EARTH GND
A	B	C

Power Connections For Displays With Housing Option B (Bezel Mount) Or O (No Housing) - Power connections are made to the first two terminals of the top eight terminal connector. The power supplied must be a very clean, well regulated 5 Volts DC (± 5%).

1 DC GND IN	2 5V DC IN	
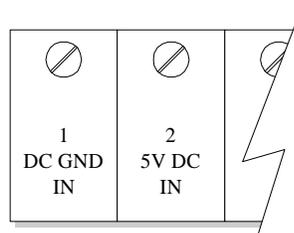
4.2 Selecting A PLC Output Card To Use With The Display

The RETURN, RESET, VAR DATA, STROBE and D0-D7 inputs are designed to interface with programmable controllers. For displays ordered with housing option C (panel mount case) input options L and H are available; for displays ordered with housing options B (bezel mount) or O (no housing) the input goes directly into a CMOS gate with characteristics outlined below under CMOS.

L Input Specifications - For displays in panel mount case only.
Use input option L with TTL, contact or open collector output cards.

Input Voltage Range	• 3.5 to 9 Volt DC Sink or Source
Input Loading	• 680 ohm
Leakage Accepted	• Up to 2mA
Logic 0	• 1.5 Volts maximum
Logic 1	• 3.5 Volts minimum

H Input Specifications - For displays in panel mount case only.
Use input option H with 12, 15 or 24 volt DC output cards.

Input Voltage Range	• 9 to 30 Volt DC Sink or Source
Input Loading	• 3.3K ohm
Leakage Accepted	• Up to 2mA
Logic 0	• 6.6 Volts maximum
Logic 1	• 9.0 Volts minimum

CMOS Input Specifications - For displays with bezel mount or no housing only.
Use CMOS input option with TTL, contact or open collector output cards.

Input Voltage Range	• 5 Volt DC Sink only
Input Loading	• 12K Ohm pullup to 5 Volts
Leakage Accepted	•
Logic 0	• 1.5 Volts maximum
Logic 1	• 3.5 Volts minimum

4.3 Wiring The Display To Your Controller

This section provides an overview of the inputs designed to interface with programmable controllers (terminals 5 to 16). These are graphically shown and described below.

Panel Mount Units

PROGRAMMABLE CONTROL											
RETURN	RESET	VAR. DATA	STROBE	D0	D1	D2	D3	D4	D5	D6	D7
5	6	7	8	9	10	11	12	13	14	15	16

Bezel or No Housing Units

Top

PROG. CONTROL			
N.C.	RESET	VAR. DATA	STROBE
5	6	7	8

Bottom

PROGRAMMABLE CONTROL							
D0	D1	D2	D3	D4	D5	D6	D7
9	10	11	12	13	14	15	16

Return (Terminal 5) - Units supplied in a panel mount case can be used with both sink and source output cards, depending on how the return line is wired. The sink I/O is also known as active low since its on state is ground, whereas the source I/O is known as active high since its on state is positive DC.

For sink I/O wire the 2000C return line to the plus side of your output card supply. This provides a passive pullup for all inputs listed in this section. For source I/O wire the 2000C return line to the ground side of your output card supply. This provides a passive pulldown for all inputs listed in this section. In all cases make sure to wire the DC ground of the 2000C to the DC ground of your output card supply.

Units supplied with a bezel mount or no housing do not have a return line connection. These displays can only be used in the sink (active low) configuration. All the inputs are passively pulled up through a 12K Ohm resistor to 5 Volts DC. Wiring examples are shown in section 4.4.

Reset (Terminal 6) - When brought active this terminal will reset the unit to a condition similar to powerup (display blank, scanning input port, message queue empty). The reset can be used to clear messages from the display as well as empty the message queues - however no data can be loaded into the display for 100 milliseconds after a reset.

Var. Data (Terminal 7) - Since the same 8 bit RUN port (D0-D7) is used to both call up messages and to load real time variable data, the VAR DATA terminal is used to differentiate between the two operations. If the terminal is held active, any data entered through the RUN port is interpreted as variable data. When not active (or left floating) any data entered through the RUN port is interpreted as a call for a message. If variable data will not be used this terminal should be left unconnected.

Strobe / D0-D7 (Terminal 8 to 16) - D0 through D7 and the strobe line make up the RUN port used to both call up messages and to load real time variable data. Messages are called up using simple binary coding to represent message numbers. Variable data is loaded one character at a time, using the D0 - D6 port lines to simultaneously load the binary representation of the character and the position of the variable data character within the message.

When the strobe line is brought active the information on the RUN port (D0-D7) is loaded into the display, and the corresponding message or variable data is displayed. For applications where variable data is not used the strobe is optional (see Section 4.6 Selecting Strobe Or No Strobe Operation). For timing requirements and loading sequences, see Section 4.7 Calling Up Messages and Section 4.8 Loading Real Time Variable Data Into A Message.

4.4 Wiring Examples

On the next two pages are a variety of examples designed to show proper wiring between the PLC and the 2000C display. Please note that the output card power supply must be compatible with the 2000C input option ordered (input option L requires 3.5-9 Volt I/O, input option H 9-30 Volt I/O, input option CMOS requires 5 Volt I/O).

Housing Option "C" (Panel Mount Case)
Wiring Examples

5-30 VOLT DC SOURCE OUTPUT CARD

5-30 VOLT DC
USERS
SUPPLY

+ −

PROGRAMMABLE CONTROLLER	VORNE DISPLAY
+V	1) DC GND
GND	2) +5V OUT
	3) SERIAL IN
	4) PROG
	5) RETURN
OUT 11	6) RESET
OUT 10	7) VAR DATA
OUT 9	8) STROBE
OUT 1	9) D0
OUT 2	10) D1
OUT 3	11) D2
OUT 4	12) D3
OUT 5	13) D4
OUT 6	14) D5
OUT 7	15) D6
OUT 8	16) D7

1) Tie external supply DC ground to Vorne DC ground.

2) Tie external supply DC ground to Vorne Return terminal.

3) Connect source outputs to Vorne inputs.

5-30 VOLT DC SINK OUTPUT CARD

5-30 VOLT DC
USERS
SUPPLY

+ −

PROGRAMMABLE CONTROLLER	VORNE DISPLAY
+V	1) DC GND
GND	2) +5V OUT
	3) SERIAL IN
	4) PROG
	5) RETURN
OUT 11	6) RESET
OUT 10	7) VAR DATA
OUT 9	8) STROBE
OUT 1	9) D0
OUT 2	10) D1
OUT 3	11) D2
OUT 4	12) D3
OUT 5	13) D4
OUT 6	14) D5
OUT 7	15) D6
OUT 8	16) D7

1) Tie external supply DC ground to Vorne DC ground.

2) Tie external supply +V to Vorne Return terminal.

3) Connect sink outputs to Vorne inputs.

CONTACT OUTPUT CARD

5-30 VOLT DC
USERS
SUPPLY

+ −

CONTACT OUTPUTS	VORNE DISPLAY
	1) DC GND
	2) +5V OUT
	3) SERIAL IN
	4) PROG
	5) RETURN
	6) RESET
	7) VAR DATA
	8) STROBE
	9) D0
	10) D1
	11) D2
	12) D3
	13) D4
	14) D5
	15) D6
	16) D7

1) Tie external supply DC ground to Vorne DC ground and to common of switches.

2) Tie external supply +V to Vorne Return terminal.

3) Connect contact outputs to Vorne inputs.

Housing Option "B" (Bezel Mount) Or "O" (No Housing)
Wiring Examples

TTL OUTPUT CARD

5 VOLT DC USERS SUPPLY

+   -

+V		1) DC GND
GND		2) +5V IN
		3) SERIAL IN
		4) PROG
		5) N.C.
OUT 11		6) RESET
OUT 10		7) VAR DATA
OUT 9		8) STROBE
OUT 1		1) D0
OUT 2		2) D1
OUT 3		3) D2
OUT 4		4) D3
OUT 5		5) D4
OUT 6		6) D5
OUT 7		7) D6
OUT 8		8) D7

TOP TERMINAL STRIP

BOTTOM TERMINAL STRIP

PROGRAMMABLE CONTROLLER   VORNE DISPLAY

1) Tie external supply DC ground to Vorne DC ground.

2) Connect TTL outputs to Vorne inputs.

CONTACT OUTPUT CARD

	1) DC GND
	2) +5V IN
	3) SERIAL IN
	4) PROG
	5) N.C.
	6) RESET
	7) VAR DATA
	8) STROBE
	1) D0
	2) D1
	3) D2
	4) D3
	5) D4
	6) D5
	7) D6
	8) D7

TOP TERMINAL STRIP

BOTTOM TERMINAL STRIP

CONTACT OUTPUTS   VORNE DISPLAY

1) Tie Vorne DC ground to common of switches.

2) Connect contact outputs to Vorne inputs.

4.5 Placing The Display In The Run Mode

When the PROGRAM terminal (terminal 4) is left unconnected the canned message display goes automatically into the RUN mode. Upon first entering the RUN mode the display will blank and begin scanning the RUN input port for data. This data can include calling up messages or loading real time variable data into a displayed message.

4.6 Selecting Strobe Or No Strobe Operation

Although a strobe input is provided as part of the RUN port, for some applications it is not necessary to use the strobe when calling up messages from the PLC. These are applications where variable data will _not_ be used and where the PLC outputs are guaranteed to stably change states within the display input debounce time of 5 milliseconds. In such applications it is possible to permanently tie the strobe to the active position so in effect the display will be in a constant strobe mode and will take in whatever message number is present at the RUN port for at least 10 milliseconds. The advantages of not using the strobe are easier programming of the PLC and requiring one less output to operate the display.

4.7 Calling Up Messages

Messages are called up through the RUN input port by simply loading the address in binary, where input D7 is the MSB (most significant bit) and input D0 is the LSB (least significant bit). Some examples of message callups are listed in the table below.

INPUT	D7	D6	D5	D4	D3	D2	D1	D0
BINARY VALUE	128	64	32	16	8	4	2	1
NO MESSAGE (0)	0	0	0	0	0	0	0	0
MESSAGE 1	0	0	0	0	0	0	0	1
MESSAGE 2	0	0	0	0	0	0	1	0
MESSAGE 3	0	0	0	0	0	0	1	1
MESSAGE 27	0	0	0	1	1	0	1	1
MESSAGE 250	1	1	1	1	1	0	1	0
NO MESSAGE (251)	1	1	1	1	1	0	1	1
NO MESSAGE (255)	1	1	1	1	1	1	1	1

Note: In the above chart 1 refers to the active or on I/O state. For source I/O this is positive DC, for sink I/O this is ground. 0 refers to the inactive or off I/O state.

To confirm the message apply a strobe pulse of at least 10 millisecond duration to the STROBE input (terminal 8). The data must be valid for the complete duration of the strobe pulse. After a 10 ms strobe pulse is received the canned message display will display the message as it was entered and formatted in the PROGRAM mode. For no strobe operation strap the strobe terminal to the active position (see section 4.6 Selecting Strobe Or No Strobe Operation). Message numbers must still be present on the D0-D7 port for at least 10 mS duration to be valid. Below is a timing diagram which shows proper timing requirements for calling up messages when using the strobe.

$T_{ON} \geq$ 10ms
$T_{SETUP} \geq$ 0ms
$T_{HOLD} \geq$ 0ms
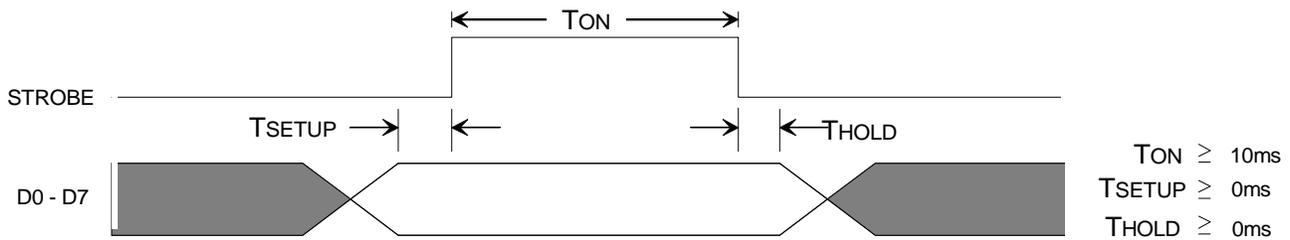
4.8 Loading Real Time Variable Data Into A Message

If a message has been programmed for variable data in the PROGRAM mode, the canned message display will initially display the variable data positions as blanks when the message is called up in the RUN mode. This section explains how to properly load variable data into the blank positions. Recall that variable data can only be loaded into fixed or flashed messages that are not chained. Also variable data cannot be queued, in other words it must be loaded following the message callup, while the message is actually being displayed. Variable data can be updated repeatedly as long as the message continues to be displayed.

Since the same input port is used to both call up messages and load real time variable data, the VAR DATA terminal (terminal 7) is used to differentiate between the two operations. Whenever variable data is being loaded this terminal must be held active. Once the variable data terminal is released (not held active), any new data strobed in will be interpreted as a message callup.

Variable data is loaded one character at a time, using the D0-D6 port lines to simultaneously load the binary representation of the character and the position (address) of the variable data character within the message. Each variable data character must be individually strobed into the unit while a valid character and address are applied to the data port. The table below lists the input port assignment used when loading variable data.

Below is an example of loading variable data into the message:

Variable Data Port Assignments

INPUT	DATA TYPE	BIT	BINARY VALUE
D7	-	-	-
D6	ADDRESS	MSB	4
D5	ADDRESS	B2	2
D4	ADDRESS	LSB	1
D3	CHARACTER	MSB	8
D2	CHARACTER	B3	4
D1	CHARACTER	B2	2
D0	CHARACTER	LSB	1

"COUNT 89023 RATE 264"

The eight address positions are assigned from right to left. Assigning addresses to the above message:

```
"COUNT 89023 RATE 264"          ADDRESS

                                           0
                                           1
                                           2
                                           3
                                           4
                                           5
                                           6
                                           7
```
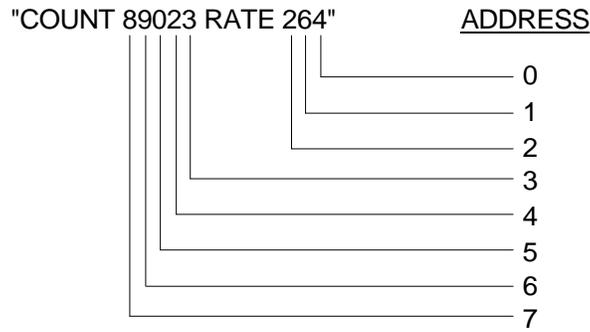
The order in which the characters are loaded is optional. Each character loaded will immediately be displayed. In the above example:

ADDRESS	DATA	CHARACTER ADDRESS			CHARACTER DATA			
		D6	D5	D4	D3	D2	D1	D0
0	"4"	0	0	0	0	1	0	0
1	"6"	0	0	1	0	1	1	0
2	"2"	0	1	0	0	0	1	0
3	"3"	0	1	1	0	0	1	1
4	"2"	1	0	0	0	0	1	0
5	"0"	1	0	1	0	0	0	0
6	"9"	1	1	0	1	0	0	1
7	"8"	1	1	1	1	0	0	0

Note: In the above chart 1 refers to the active or on I/O state. For source I/O this is positive DC, for sink I/O this is ground. 0 refers to the inactive or off I/O state.

Timing Diagram - Loading 2 Characters Of Variable Data

$T_{ON} \geq 10ms$
$T_{SETUP} \geq 0ms$
$T_{HOLD} \geq 0ms$
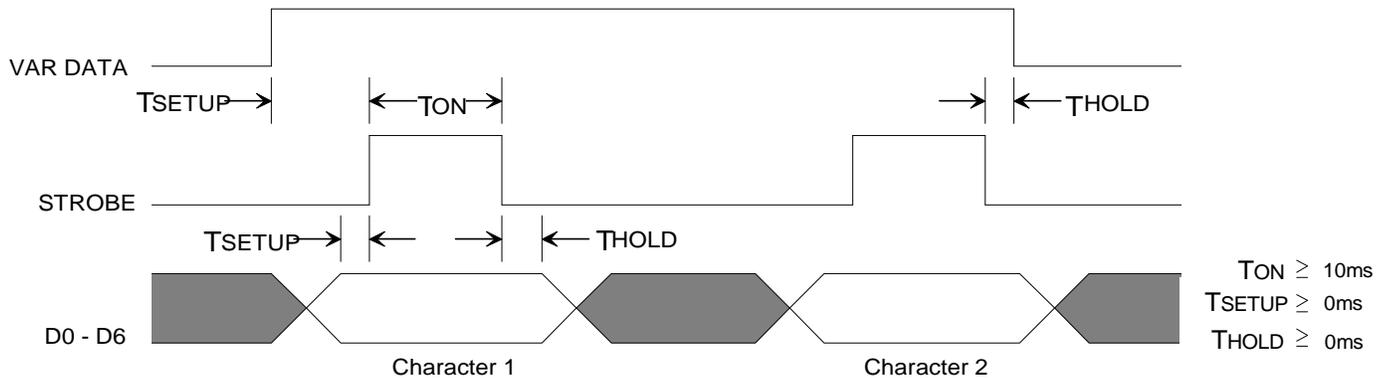
Appendix A - Mounting Information

Housing Option "C" (Panel Mount Case)

The fully enclosed panel mount unit can be mounted through the front of a panel cutout and fastened to the panel with two side clips (provided). An optional gasket provides front panel Nema 12 sealing.
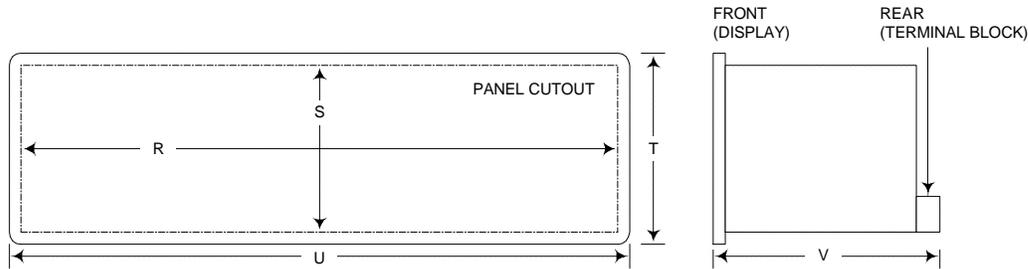
Housing Option "B" (Bezel Mount)

The bezel with attached display and logic boards can be mounted through the front of a panel and fastened to the panel with four integral studs.

(4) 6-32 studs centered and 0.15 from bezel edge.
Mounting studs of bezel fit through clearance holes drilled in panel.
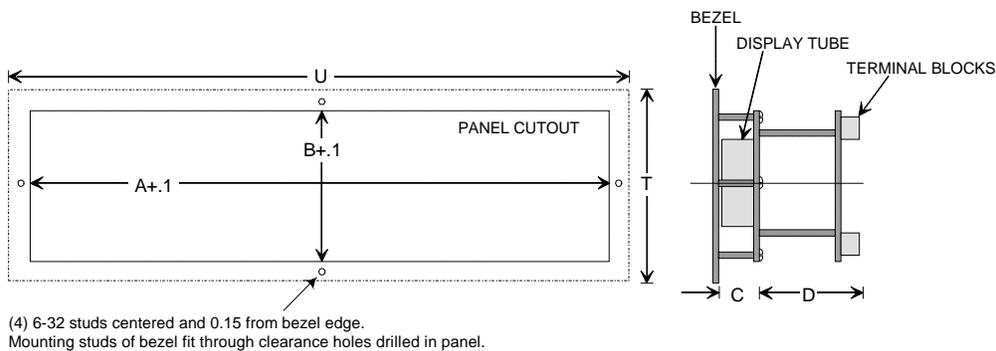
Housing Option "O" (No Housing)

The display and logic board can be mounted to the rear of a panel by using the circuit board mounting holes (6-32 clearance holes) provided on each side of the display tube.
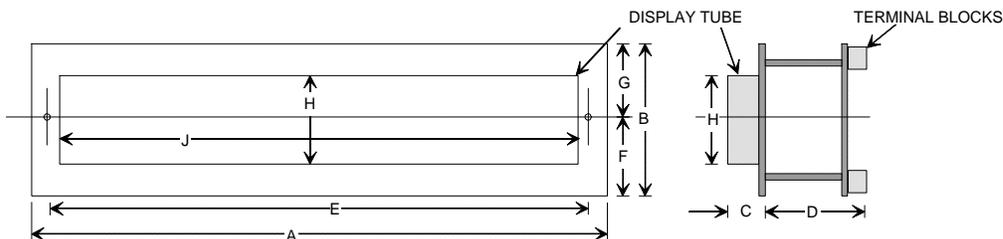
Model	Character Height	A	B	C	D	E	F	G	H	J	R	S	T	U	V
MODEL 2005	.20	6.3	2.1	0.5	1.6	6.0	1.3	0.9	1.1	5.4	6.9	2.5	2.8	7.2	4.0
MODEL 2009	.35	9.1	2.4	0.6	1.6	8.7	1.3	1.1	1.4	8.2	9.7	2.8	3.1	10.0	4.6
MODEL 2015	.59	12.7	2.5	0.7	1.6	12.3	1.3	1.3	1.5	11.7	13.3	2.9	3.2	13.6	4.6

Note: All mounting dimensions are in inches.

Appendix B - 2000C Character Set

00h	01h	02h	03h	04h	05h	06h	07h
08h	09h	0Ah	0Bh	0Ch	0Dh	0Eh	0Fh
10h	11h	12h	13h	14h	15h	16h	17h
18h	19h	1Ah	1Bh	1Ch	1Dh	1Eh	1Fh
20h	21h	22h	23h	24h	25h	26h	27h
28h	29h	2Ah	2Bh	2Ch	2Dh	2Eh	2Fh
30h	31h	32h	33h	34h	35h	36h	37h
38h	39h	3Ah	3Bh	3Ch	3Dh	3Eh	3Fh
40h	41h	42h	43h	44h	45h	46h	47h
48h	49h	4Ah	4Bh	4Ch	4Dh	4Eh	4Fh
50h	51h	52h	53h	54h	55h	56h	57h
58h	59h	5Ah	5Bh	5Ch	5Dh	5Eh	5Fh
60h	61h	62h	63h	64h	65h	66h	67h
68h	69h	6Ah	6Bh	6Ch	6Dh	6Eh	6Fh
70h	71h	72h	73h	74h	75h	76h	77h
78h	79h	7Ah	7Bh	7Ch	7Dh	7Eh	7Fh

Appendix C - Message Definition Template

Use the chart below to help format your messages. Photocopy as desired.

MSG. # (1-250)	MESSAGE TEXT																				FIXED FLASHED SCROLLED	TIME 0-99	CHAINING SEQUENCE							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			1	2	3	4	5	6	7	8