User's Guide

VR200/RS-422A
Communications
Instruction Manual

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PREFACE

This instruction manual describes the optional RS-422-A communication function for the VR200 view recorder. For details concerning the operations of the recorder, refer to the instruction manual for the VR200.

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Chapter 1 INSTALLING THE RS-422-A INTERFACE

The option /C3 provides the VR200 view recorder with the EIA (Electronic Industries Association) RS-422-A communication interface to allow a host computer to do the following:

- read measured values,
- read parameters, and
- set parameters.

However, this interface does not allow the host computer to operate the power switch of the VR100VR200 nor control the parameters which can only be set in the SETUP mode on the VR100VR200.

1.1 Interface Specifications

Communication System:	4-wire, half-duplex, multi-drop connection
	1:n (1 = host computer and n = VR200 view recorders, n = 1 to 16)
	Start-stop (asynchronous) system
Transmission speed:	1200, 2400, 4800, or 9600 bits/s
Start bit:	1 bit
Stop bit:	1 or 2 bits
Parity:	Even, odd, or none
Word length:	7 or 8 bits
Electrical signal characteristics:	EIA standard electrical characteristics for the interchange signals and associated circuitry. Functional isolation.
Communication distance:	Up to 500 meters (between an isolated line converter or an isolated-output computer and a VR200 recorder)

1.2 Interface Terminal

1.2.1 Terminal Assignment

SD A   SD B   SG G (signal ground)

RD A   RD B   FG G (frame ground)

RS-422A

Connect RD to TD of the host computer.
Connect SD to RD of the host computer.

Option terminal   Indication of RS-422-A terminals
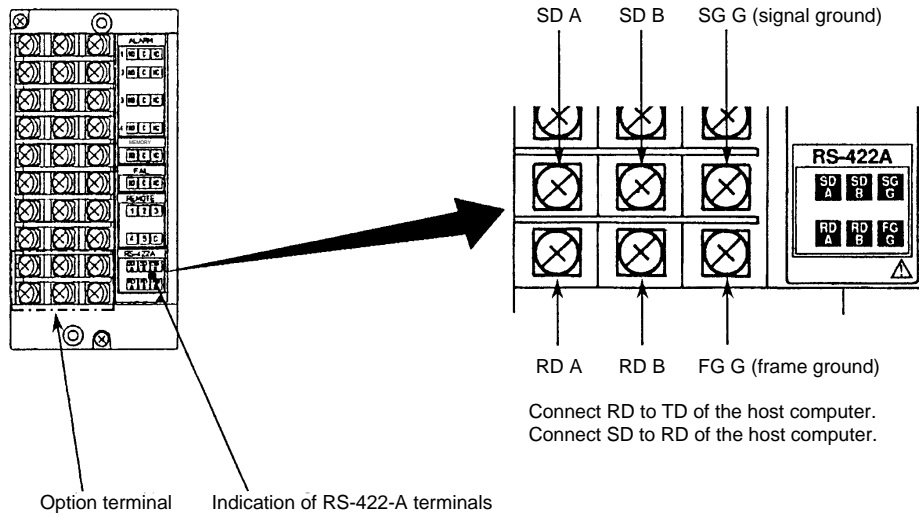
Figure 1.1 Terminal Assignment

1.2.2 Cable Termination

Shield potential

RS-422-A terminals

GND
SD A
SD B
RD B
RD A

Terminal screws: ISO M4, 6 mm long

Use crimp-on lugs (for 4 mm screws) with insulation sleeves for the leadwire ends.
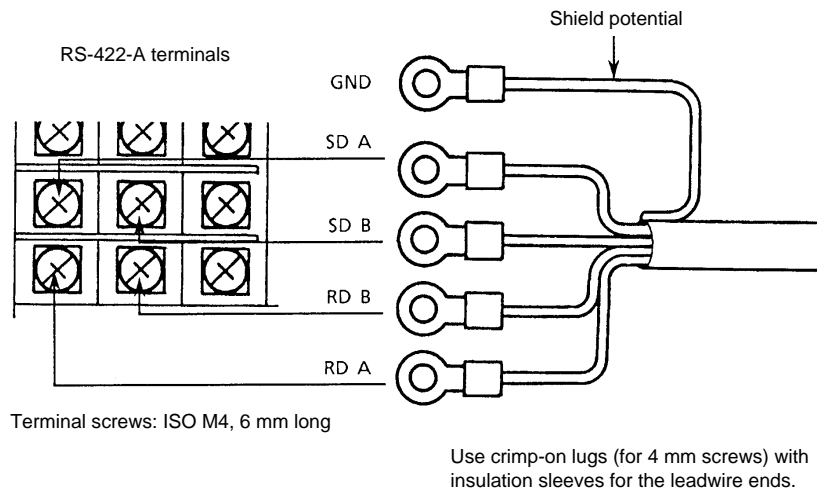
Figure 1.2 Cable Termination

WARNING

To prevent an electric shock, ensure that the main power supply is turned off.

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1.3 Communication Wiring

If the host PC is equipped with an RS-422-A interface, the VR200 can be connected directly. If the host PC is equipped with only an RS-232-C interface, the VR200 can be connected using a converter (SHARP model Z-101HE or equivalent).

Shown below are two wiring examples, which are the same except for the case shielding. If there will be a connection between different panels, wiring method **b** should be used.
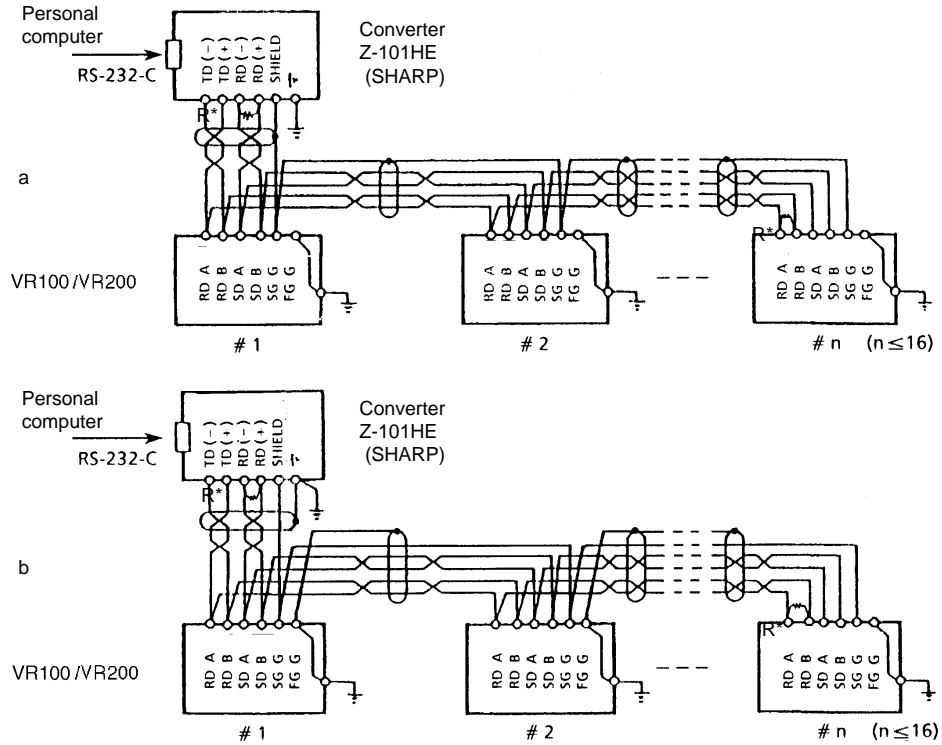
* R in the figure denotes the terminal resistance.
R: 100W, 1/2 W or greater (adjust according to the impedance. The converter shown above is the inverter type. The + and - polarity depends on the type of converter.)

Figure 1.3 Communication Wiring

In case **a**, use two pairs of 24 AWG (minimum) twisted shielded cables or the equivalent. In case **b**, use three pairs of 24 AWG (minimum) twisted shielded cables or the equivalent. The extra pair is used for SG in case **b**. (Characteristic impedance: 100 Ω, capacitance: 50 pF/m)
Keep the terminated unshielded section to a minimum and clear of the VR200 recorder ground line.

WARNING

To prevent an electric shock, ensure that the main power supply is turned off.

1.4 Data Configuration

The signal is determined by the potentials of RS-422-A terminals A and B, as follows:

1 INSTALLING THE RS-422-A INTERFACE

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$$\text{If } A < B, \text{ then signal} = 1$$
$$\text{If } A > B, \text{ then signal} = 0$$

1.4.1 Start-stop (Asynchronous) Communication

The built-in RS-422-A interface communicates based on the start-stop (asynchronous) system. The start-stop system first adds the start bit to the head and then in turn adds the data bits (7 or 8 bits), parity bit, and stop bit(s) to every transmission of each character (see Figure 1.4). Define the address of the RS-422-A interface built in the VR200 recorder, baud rate, data length, parity bit, and stop bit(s) in the SETUP mode on the VR200 recorder.
The start bit is automatically added and thus need not be set.
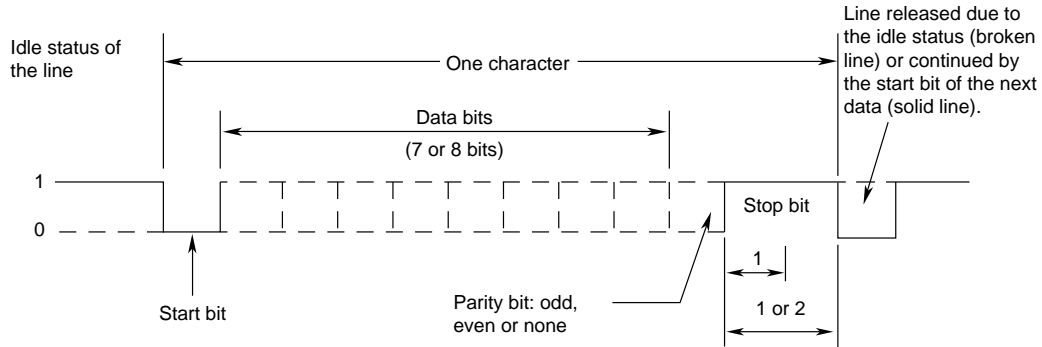
Figure 1.4 Configuration of Each Character in Start-stop System

1.4.2 Text

Each communication data usually contains more than one character, to which a terminator character is appended. This is referred to as a text. See also Figure 1.5.
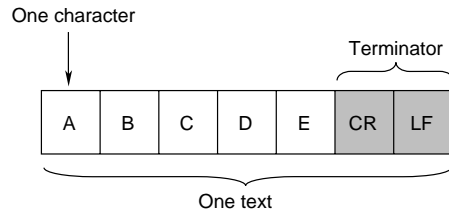
Figure 1.5 Structure of Text

The built-in RS-422-A interface identifies each text by regarding the reception of a terminator as the end of the text. See also Figure 1.6.
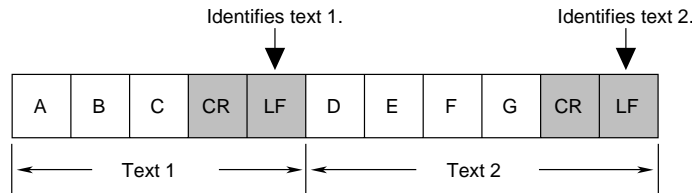
Figure 1.6 Example of Two Texts Where Terminator Is CR/LF

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Note ———
The VR200 identifies an LF as the end of a text when receiving data (and sends a CR and LF as the terminator when sending data). As shown in the example in Figure 1.6, when a CR and LF are used as the terminator, the CR is ignored. Take care when communicating with a PC, since some PCs may not send the LF character depending on the mode when the PRINT command, etc. is invoked.

1.4.3 Input Buffer

The input buffer of the VR200 recorder is a rotary buffer. The rotary buffer outputs a text on a first-in, first-out basis while storing the data in turn. The user must be aware of this when programming, and take care to prevent the buffer from overflowing. One merit of the rotary buffer is that it can flexibly cope with more than one text being sent contiguously because of the low loss in case of variable text length.
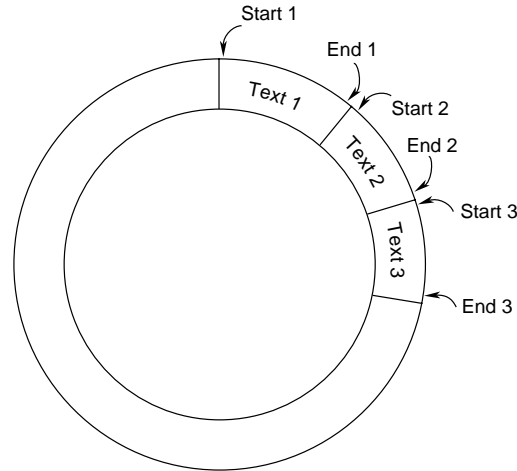
Figure 1.7 Rotary Buffer

1.4.4 Buffer Overflow

As described already, the input buffer is necessary for data communication. The capacity, however, is limited (256 bytes for a 4-channel model). Thus, in the receiver, the buffer capacity may not be sufficient if a lot of data is sent in a short time, causing some data to be dropped and adversely affecting the data communications (buffer overflow).

To prevent buffer overflow, confirm the status of the VR200 using the ESC S command immediately after a command has been sent (from the PC).

Note ———
A PC may not be able to send the ESC S command after having sent the LF or FM command.

After receiving the ESC S command, the VR200 outputs its status to the PC. This is done in the following sequence. The VR200 first stores the ESC S command in the input buffer, then this command is read from the buffer. Consequently, the VR200 outputs its status to the PC. If the PC does not send the next command until it receives the VR200 status, the next command will be always received without fail, since there must be a space in the input buffer of the VR200.

1.5 Setting up the RS-422-A Communication Interface

SETUP PROCEDURE:

1 Unpack the VR200 recorder.

2 While pressing the [↵] key, turn on the power to enter the SETUP mode.

3 Use the **[▲]**/**[▼]** keys to select the display 'SETUP=OPT,' then press the [↵] key.

4 Use the **[▲]**/**[▼]** keys to select the display 'OPT=COMM,' then press the [↵] key.

5 Use the **[▲]**/**[▼]** keys to select the address of the RS-422-A interface of the recorder from 01 to 16, then press the [↵] key. The default is '01.' Note that '00' cannot be selected.

6 Use the **[▲]**/**[▼]** keys to select the baud rate from '1200,' '2400,' '4800,' and '9600' bps, then press the [↵] key. The default is 9600 bps.

7 Use the **[▲]**/**[▼]** keys to select the data length between '7' and '8' bits, then press the [↵] key. The default is 8 bits.

8 Use the **[▲]**/**[▼]** keys to select the parity specification from 'ODD,' 'EVEN,' and 'NONE,' then press the [↵] key. The default is 'EVEN.'

9 Use the **[▲]**/**[▼]** keys to select the stop bit specification between '1' and '2' bits, then press the [↵] key. The default is 1 bit.

10 The display '*COMM SET*' appears, which shows that the communication setup is completed.
   To proceed to another setting in the SETUP mode if necessary, press the **ESC** key.

   Before leaving the SETUP mode, you must store the new setting in the internal memory. Press the **ESC** key to return to the 'SETUP=OPT' display, then select the 'SETUP=END' display using the **[▲]**/**[▼]** keys, then press the [↵] key.
   Finally,
   • to store and make the new settings take effect, select the 'END&INIT.DATA=STORE' display using the **[▲]**/**[▼]** keys, then press the [↵] key; or
   • to discard the new settings, select the 'END&INIT.DATA=ABORT' display using the **[▲]**/**[▼]** keys, then press the [↵] key.
   The mode is then released from SETUP to operation in several seconds.

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Chapter 2 RECEIVING FUNCTIONS

This chapter describes the program set commands and program control commands. Remember first to open a device by invoking the ESC O command before the set or control commands can be sent.

2.1 General Rules for Commands

A command is represented by ASCII codes and consists of an identifier, parameters, delimiters and a terminator.

Example: SR01, VOLT, 20 mV, 0, 10000 [terminator]
— Parameters
— Identifier

Identifier

• Defined by two alphabetical, capital letters.

Parameters

• Parameters must be separated by a delimiter (comma).
• Numeric data are displayed as integers (e.g., +20, -240).
• When parameters are numeric, the effective setting ranges depend on these parameters.
• Spaces preceding and following a parameter and spaces within a parameter are ignored. Spaces within a parameter specified by ASCII characters (engineering units, tags, and messages) are valid.
• Parameters which do not need to be changed do not need to be specified. (E.g., the command "SR01,, 20mV" leaves the mode unchanged.)
• A string of delimiters at the end of the command/parameter string may be omitted (see the example below).
  Example: The last four commas of
         SR01, VOLT,,,,
       can be omitted.
• The lengths of the following parameters are fixed. If the length differs, a syntax error occurs.
  - Date and time: YY/MM/DD (8 characters)
                     HH:MM:SS (8 characters)
  - Channel: CC (2 characters). For example, channel 1 must be entered as "01."

Terminator

A command must end with either of the following terminators:
  CR + LF
or,
  LF
For the open (ESC O) and close (ESC C) commands, only CR+LF can be used.

2.2 Program Set Commands

2.2.1 List of Program Set Commands

Command Type	Command	Function
Set	SR	Sets the input range and display scale.
	SA	Sets the alarms.
	SN	Sets the engineering unit.
	SW	Sets the waveform span rate.
	SD	Sets the date and time.
	SY	Copies the channel settings.
	SZ	Sets the discrete (zone) display.
	SP	Sets the partial expanded display.
	SK	Sets whether to display the scale values.
	ST	Sets the tag number.
	SL	Sets the trip level.
	SF	Sets the floppy disk format.
	SG	Sets the data file names.
	SC	Sets the LCD brightness and saver function.
	SM	Sets the messages.
	SH	Sets the number of division of the bar graph scale.
	SX	Sets wether to display the span rate and message menu.
	MD	Sets the waveform display and scale display.

Note _____

For restrictions concerning settings, refer to the instruction manual for the VR200.

2.2.2 Setting the Range and Scale

(See Section 4.1 of the instruction manual for the VR200.)

SKIP

Skips scanning the specified channel, i.e., prevents that channel from being measured, recorded and displayed.

Format: SRp1,mode

> p1:   Channel number (CC)
> mode: SKIP

Example: SR01,SKIP

VOLT, TC, RTD, and DELT

Format: SRp1,mode, p2, p3, p4

> p1:   Channel number (CC)
> mode: VOLT, TC, RTD, or DELT (difference computation between the specified channel and the reference channel)
> p2:   Specification of the range
> For mode VOLT: 20mV, 60mV, 200mV, 2V, 6V, or 20V
> For mode TC: R, S, B, K, E, J, T, N, W, L, or U
> For mode RTD: JPT or PT (or, optionally CU1, CU2, CU3, CU4, CU5, CU6, or CU25)
> For mode DELT: the reference channel number. Note that the reference channel number must be lower than the channel number specified in p1.
> p3:   Enter the low limit value of the display span within 5 digits excluding the decimal point and the + or - sign.
> p4:   Enter the high limit value of the display span within 5 digits excluding the decimal point and the + or - sign.

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Input range table

Input type	Range	Input	Measurement range	Unit
DC Voltage	20 mV	20 mV	-20.00 to 20.00 mV	mV
	60 mV	60 mV	-60.00 to 60.00 mV	mV
	200 mV	200 mV	-200.0 to 200.0 mV	mV
	2 V	2 V	-2.000 to 2.000 V	V
	6 V	6 V	-6.000 to 6.000 V	V
	20 V	20 V	-20.00 to 20.00 V	V

Input type	Range	Measurement range ˙C	Measurement range ˙F
T C	R	0.0 to 1760.0 ˚C	32 to 3200°F
	S	0.0 to 1760.0˚C	32 to 3200°F
	B	0.0 to 1820.0˚C	32 to 3308°F
	K	-200.0 to 1370.0˚C	–328.0 to 2498.0°F
	E	-200.0 to 800.0˚C	–328.0 to 1472.0°F
	J	-200.0 to 1100.0˚C	–328.0 to 2012.0°F
	T	-200.0 to 400.0˚C	–328.0 to 752.0°F
	L	-200.0 to 900.0˚C	–328.0 to 1652.0°F
	U	-200.0 to 400.0˚C	–328.0 to 752.0°F
	N	0.0 to 1300.0˚C	32 to 2372°F
	W	0.0 to 2315.0˚C	–328.0 to 752.0°F
R T D	JPT	-200.0 to 550.0˚C	–328.0 to 1112.0°F
	PT	-200.0 to 600.0˚C	–328.0 to 1022.0°F
	CU1 to CU6*	-200.0 to 300.0˚C	–328.0 to 1112.0°F
	CU25*	-200.0 to 300.0˚C	–328.0 to 1022.0°F

* Allowed when the /N1 option (Cu10, Cu25) is equipped.

DI (Digital Input)

Format: SRp1, mode, p2

p1:   Channel number (CC)
mode: DI (digital input)
p2:   Select the signal type from LEVL (level) or CONT (contact).

Example: SR01, DI, CONT

SCL (Scaling)

Format: SRp1, mode, p2, p3, p4, p5, p6, p7, p8

p1:   Channel number (CC)
mode: SCL
p2:   Input type. VOLT, TC or RTD
p3:   Range
p4:   Low limit value of the display span (LOWER SPAN). Enter 5 digits, excluding the decimal point and the + or – sign.
p5:   High limit value of the display span (UPPER SPAN). Enter 5 digits, excluding the decimal point and the + or – sign.
p6:   Lower scale limit (SCL LOWER). Enter 6 digits, excluding the decimal point and the + or – sign.
p7:   Upper scale limit (SCL UPPER). Enter 6 digits, excluding the decimal point and the + or – sign.
p8:   Decimal point position of scaling value (0 to 4, which stands for the number of digits after the decimal point)

Example: SR01, SCL, VOLT, 20mV, 0, 1000, –1000, 1000, 1

This example performs 0 to 10 mV input in channel 01 and is scaled from –100.0 to 100.0.

SQRT (Square Root)

Format: SRp1, mode, p2, p3, p4, p5, p6, p7

p1:	Channel number (CC)
mode:	SQRT
p2:	Range designation
	Selectable from 20mV, 60mV, 200mV, 2V, 6V, and 20V.
p3:	Low limit value of the display span (LOWER SPAN). Enter 5 digits, excluding the decimal point and the + or – sign.
p4:	High limit value of the display span (UPPER SPAN). Enter 5 digits, excluding the decimal point and the + or – sign.
p5:	Lower scale limit (SCL LOWER). Enter 6 digits, excluding the decimal point and the + or – sign.
p6:	Upper scale limit (SCL UPPER). Enter 6 digits, excluding the decimal point and the + or – sign.
p7:	Decimal point position of the scaling value (0 to 4, which stands for the number of digits after the decimal point)

Example: SR01, SQRT, 20mV, 0, 1000, –1000, 1000, 1

This example performs 0 to 10 mV input in channel 01. From this value the square root is taken and the value is scaled from –100.0 to 100.0.

2.2.3 Setting Alarms

(See Section 4.2 of the instruction manual for the VR200.)

Format: SAp1, p2, ON/OFF, p3, p4, p5, p6

p1:	Channel number (CC)
p2:	Alarm level number (1 to 4)
ON/OFF:	Set alarm ON or OFF.
p3:	Type of alarm, selectable from:
	H: High limit alarm
	L: Low limit alarm
	R: Rate-of-change limit on increasing signal
	r: Rate-of-change limit on decreasing signal
	h: Difference high limit alarm
	l: Difference low limit alarm
p4:	Alarm set point. Enter within 5 digits, excluding the decimal point and the + or – sign. The decimal point position depends on the range (or scaling) setting. See also the input range table on Page 2-3.
p5:	Enter ON or OFF to specify whether to activate the alarm output relay.
p6:	Alarm output relay number. Selectable from I01 to I06, depending on your option installed.

Example: SA02, 1, ON, L, 1000, ON, I04

This example defines the low limit alarm in alarm level 1 of channel 2, sets the alarm setpoint to 1.000 V, and specifies output relay No. 4 to be activated by this alarm.

2.2.4 Setting the Unit

(See Section 4.3 of the instruction manual for the VR200.)

Format: **SNp1, p2**

        p1:   Channel number (CC)

        p2:   Engineering unit (up to six characters)

Example: **SN02, kg**

This example assigns the unit "kg" to channel 2. Note that a unit can only be assigned to channels of the SCL or SQRT input.

2.2.5 Setting the Waveform Span Rate (TIME/DIV)

(See Section 4.4 of the instruction manual for the VR200.)

Format: **SWp1**

        p1:   Select the waveform span rate from 1, 5, 10, 20, 30, and 60 (minutes).

Example: **SW1**

This example sets the waveform span rate to 1 minute.

2.2.6 Setting the Clock

(See Section 4.5 of the instruction manual for the VR200.)

Format: **SDp1, p2**

        p1:   Date (YY/MM/DD)

                       YY: The last two digits of the Western year

                       MM: 01 to 12

                       DD: 01 to 31

        p2:   Time (HH:MM:SS)

                       HH: 00 to 23

                       MM: 00 to 59

                       SS: 00 to 59

Example: **SD96/03/13, 15:02:00**

2.2.7 Copying the Channel Settings

(See Section 4.6 of the instruction manual for the VR200.)

Format: **SYp1, p2**

        p1:   Channel number (CC) from which you want to copy the settings (origin)

        p2:   Channel number (CC) to which you want to copy the settings (destination)

Example: **SY01, 03**

This example copies all settings from channel 1 to channel 3.

Note

You can only copy from a lower channel number to a higher channel number.

2 RECEIVING FUNCTIONS

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2.2.8 Setting the Discrete (ZONE) Display

(See Section 4.7.1 of the instruction manual for the VR200.)

Format: **SZp1, p2, p3**

p1:   Channel number (CC)
p2:   Lower display boundary value (0 to 95)
p3:   Upper display boundary value (5 to 100)

Example: SZ02, 30,50

This example results in the display for 0 to 100% of channel 2 in the band from 30 to 50% of the scale.

Note

• The display bandwidth cannot be set to 5% or less.
• The lower display boundary must be less than the upper boundary.

2.2.9 Setting the Partial Expanded Display

(See Section 4.7.2 of the instruction manual for the VR200.)

Format: **SPp1, p2, p3, p4**

p1:   Channel number (CC)
p2:   Partial expanded display ON/OFF
p3:   Percentage of the full display span which will be compressed (1 to 99%)
p4:   Boundary value (lower display span + 1 to upper display span – 1). Enter a numeric value excluding the decimal point.

Note

The decimal point position depends on the range (or scaling) setting. See also the input range table on Page 2-3.

Example: SP01, ON, 25, 0000

This example results in partial expanded display for channel 1 where the value at 25% of the display scale corresponds with 0.000V.

2.2.10 Setting the Scale Value Indication On/Off (DISP_SCALE, only for VR200 with style number 1 or lower)

(See Section 4.7.3 of the instruction manual for the VR200.)

Format: **SKp1, p2**

p1:   Channel number (CC)
p2:   Whether to display the scale values.
        Enter "ON" or "OFF".

2.2.11 Setting the Tag

(See Section 4.7.4 of the instruction manual for the VR200.)

Format: **STp1, p2**

p1:   Channel number (CC) for which you want to set a tag number
p2:   Tag number (up to 7 characters)

Example: ST01, TAG1

This example sets the tag of channel 1 to "TAG1."

2.2.12 Setting the Trip Level

(See Section 4.7.5 of the instruction manual for the VR200.)

Format: SLp1, p2, p3

p1:	Trip level number
	VR100 and VR200 with style number 1 or lower
	1 for level 1 (red line)
	2 for level 2 (yellow line)
	VR200 with style number 2 higher
	1 to 6
p2:	Whether to display. Enter "ON" or "OFF."
p3:	Level. 0 to 100 (%).
p4:	Color (RED, GRN, BLU, BRN, PRP, L.BLU, ORG, GRY, W.RED, only for VR200 with style number 2 or higher)

Example: SL1, ON, 70, RED

This example sets the red trip-level line to be displayed at 70%.

2.2.13 Setting the Floppy Disk Format Type (FD, only for VR104/VR202/VR204)

(See Section 5.1 of the instruction manual for the VR200.)

Format: SFp1

p1:	"1.44M" for 1.44 MB 2HD
	(or "1.2M" for 1.2 MB 2HD only if you use the Japanese version software with an NEC PC-9801 series PC)

Example: SF1.44M

This example defines that floppy disks will be formatted as 1.44 MB (2HD). If your model has -3M optioin, the format type of the flopyy disk must be fixed to 1.44MB.

2.2.14 Setting the Data File Name (FILE)

(See Section 5.2 of the instruction manual for the VR200.)

Format: SGp1, p2, p3, p4

p1:	Enter the file comment (in up to 32 characters).
p2:	Specify the method of setting the file names:
	"DATE" for using the names set automatically
	"SET" for using the user-defined names
	"AUTO" for automatically incrementing the file number.
p3:	Name of the event file(s) (up to seven characters). The entry is invalid when p2 is set to "DATE."
	When p2 is set to "AUTO," enter the desired three characters for the second to fourth characters of each file name.
p4:	Name of the display data file(s) (up to seven characters). The entry is invalid when p2 is set to "DATE."
	When p2 is set to "AUTO," enter the three-digit serial number, which will be set to the fifth to seventh characters of each file name.

Example: SG, SET, TANK01, TWAVE01

This example defines "TANK01" and "TWAVE01" as the names of the event file and display data file, respectively.

For the rules when specifying file names, see Appendix 2.

2.2.15 Setting the LCD Brightness and LCD Saver (LCD)

(See Section 4.8 of the instruction manual for the VR200.)

Format: SCp1, p2, p3

    p1:   LCD brightness level. 0 to 15
    p2:   Sets the LCD saver function "ON" or "OFF."
    p3:   Timer setting to activate the LCD saver. Select from 1, 2, 5, 10, 30, and 60 (minutes).

Example: SC8, ON, 10

This example sets the brightness level to 8 and the LCD saver to be activated in 10 minutes after the last key operation.

2.2.16 Setting the Summer/ Winter Time (DST)

(See Section 5.6 of the instruction manual for the VR200.)

Format: SSp1, p2

    p1:   "SUMMER" or "WINTER"
    p2:   Date and time (YY/MM/DD HH)

Example: SSWINTER, 96/10/10 01

2.2.17 Message setting (MESSAGE, only for the VR 200 with style number 2 or higher)

(See Section 4.8 of the instruction manual for the VR200.)

Format: SMp1, p2

    p1:   Message number (1 to 5)
    p2:   Message string (16 characters or less)

Example: SM3, MOTOR ON

Assign the message "MOTOR ON" to message 3.

2.2.18 Setting of the Number of Divisions of the Bar Graph Scale (BAR_SCALE_DIV, for the VR 200 with style number 2 or higher)

(See Section 4.9 of the instruction manual for the VR200.)

Format: SHp1, p2

    p1:   Channel number (CC)
    p2:   Number of divisions (4 to 12)

Example: SH03, 7

2.2.19 ON/OFF Setting of the Waveform Span Rate Display, ON/OFF Setting of the Message Menu (SPECIAL, for the VR 200 with style number 2 or higher)

(for VR200 only, see section 4.10 in the instruction manual)

Format: SXp1, p2

    p1:   Turn ON/OFF the waveform span rate display on the trend display screen
    p2:   Turn ON/OFF the message writing menu in the operation mode

Example: SXON, OFF

If your model has -3M option, add the parameter p3.

p3:   Select the methods when saving measurement data to the floppy disk:

    ALL (default) save all measurement data from the VR200 internal memory.

    UNSAVED: Save only the meansurement data newly loaded to the VR200
      internal memory, after the last time you saved to the floppy disk.

2.20 Waveform Display and Scale Display Setting (DISP_WAVE, for the VR 200 with style number 2 or higher)

(see section 4.7.3 in the instruction manual)

Format: **MDp1, p2, p3**

   p1: Channel number (CC)

   p2: Turn ON/OFF the waveform display

   p3: Turn ON/OFF the scale display

Example: **MD02, ON, ON**

2.3 Program Control Commands

2.3.1 List of Program Control Commands

Command Type	Command	Function
Control	UD	Returns the screen to the standard screen.
	AK	Acknowledges the alarm(s).
	MI	Initializes the data memory.
	EV	Writes a time-axis mark or raises a manual trigger.
	BO	Specifies the bit sequence in bytes (for binary output).
	TS	Specifies which data value is to be output.
	FM	Specifies the data format of the measured value to be output.
	LF	Specifies the channel for the request for the set value (TS1 command) or the unit and decimal point (TS2 command).
	LO	Loads the specified SET configuration file.
	LI	Saves the settings (made in SET mode) with the specified file name.
	ME	Write the messages.
	UM	Switch the display

2.3.2 Standard Screen Call

(For the standard screen, see Section 1.6.1 of the instruction manual for the VR100 or the VR200.)

Command	Function
UD0	Returns the screen to the standard screen.
UD1	Returns the digital values for channels 1 to 3.
UD2	Returns the digital values for channels 4 to 6.
UD3	Returns the digital values for channels 1 to 6.

2.3.3 Alarm Acknowledge

(See Section 3.3 of the instruction manual for the VR100 or the VR200.)

Command	Function
AK0	Starts the alarm acknowledge function.

2.3.4 Initializing the Data Memory

(See Section 5.3 of the instruction manual for the VR100 or the VR200.)

Command	Function
MIYES	Initializes the data memory.

2.3.5 Writing a Time-axis Mark and Raising an Event Trigger

(See Sections 3.5 and 3.7 of the instruction manual for the VR100 or the VR200.)

Command	Function
EV0	VR100 and VR200 with style number 1 or lower: Writes a time-axis mark.
	VR200 with style number 2 or higher: Writes a message 1.
EV1	Raises a manual trigger.
	The manual trigger is effective only when the sample mode is set to trigger-on or trigger-rotation and the key trigger is set to ON.

2.3.6 Designating the Sequence of Byte Output (for Binary Output)

Command	Function
BO0	Designates that the measured values are to be output from the most significant byte (see Page 3-4).
BO1	Designates that the measured values are to be output from the least significant byte (see Page 3-4).

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2.3.7 Selecting the Output Data

Command	Function
TS0	Requests the measured values.
TS1	Requests the parameter set values.
TS2	Requests unit and decimal point information.

2.3.8 Selecting the Output Format for Measured Data

Command	Function
FM0, p1, p2	Selects the channels for which measured values are to be output in ASCII format.
FM1, p1, p2	Selects the channels for which measured values are to be output in binary format.

Where p1 is the channel number (CC) from which the output should start, and p2 is the channel number (CC) at which the output should end

Note _____

If you designate the output to be measured values (invoking the TS0 command), specify the data format by this FM command.

2.3.9 Selecting Channels for Request for Setting Parameters, Unit/Decimal Point Information

Command	Function
LF, p1, p2	Selects channels for which parameter set values (after the invoking the TS1 command) or for which engineering unit and decimal point information is to be output (after invoking the TS2 command).

Where p1 is the channel number (CC) from which the output should start, and p2 is the channel number (CC) at which the output should end

Note _____

If you designate the output data type by the TS1 or TS2 command, specify the format by this LF command.

2.3.10 Loading the SET Configuration File

(See Section 5.5.2 of the instruction manual for the VR200.)

Command	Function
LOp1	Loads the SET configuration file (suffix .PNL) specified by p1 into the internal memory.

Where p1 is the name of the file to be loaded (maximum of eight characters)

2.3.11 Saving the SET Configuration File

(See Section 5.5.1 of the instruction manual for the VR200.)

Command	Function
LIp1	Saves the settings (made in SET mode) as a SET configuration file with the specified name.

Where p1 is the name of the save file (maximum of eight characters)

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2.3.12 Message Writing(for the VR 200 with style number 2 or higher)

Command	Function
MEp1	Selects message number for which parameter set values to be displayed and the information file is saved.

2.3.13 Display Switching(for the VR 200 with style number 2 or higher)

Command	Function
UM0	Trend display
UM1	Bar graph display
UM2	Digital value display
UM3	Information display
UM4	List display

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2.4 Escape Sequence

The following escape sequence commands are used to control the communications.

2.4.1 Execution of Trigger

ESC T C$_R$L$_F$ Requests for the data to be prepared in the buffer.

If an ESC T (CR LF) command is received, then
• measured data (when TS0 is specified) sampled at the most recent scan,
• parameter settings (when TS1 is specified), or
• units and decimal point information (when TS2 is specified)
are stored in the buffer.
Data output will start only after the output format has been designated (using the FM or LF command).
For details on actual use and the command output sequence, see Section 3.1, "Introduction to Output Data Formats" and Section 3.2, "Output Data Formats."

To invoke the ESC T command, send the character "T" following 1B (1-byte hexadecimal).

The trigger is effective for a device which has not yet been opened.

Make sure to send the terminator (CR and LF) following "ESC T."

2.4.2 Status Output

ESC S C$_R$L$_F$ Outputs status.

If the ESC S command is received, the statuses of the commands which have been sent so far are output.
Output statuses range from ER00 to ER10. The respective contents are shown in the figure and table below.

7	6	5	4	3	2	1	0
0	0	0	0		0		0

Syntax error
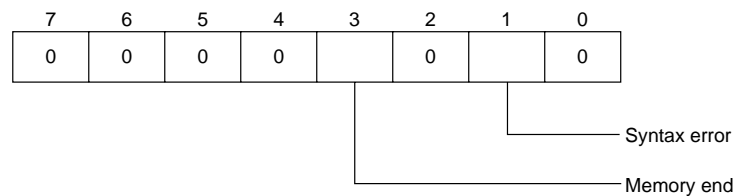
Memory end

Status Output	Cause of the ENABLE status	
	Syntax Error	**Memory End**
ER 00 C$_R$L$_F$		
ER 02 C$_R$L$_F$	●	
ER 08 C$_R$L$_F$		●
ER 10 C$_R$L$_F$	●	●

Transmission of any of the following commands while saving the data to a floppy disk causes a syntax error:
• Set commands (SR, SA, SN, SD, SY, SW, SZ, SP, ST, SF, SL, SG, and SC)
• Some control commands (MI, LO, and LI)

2 RECEIVING FUNCTIONS

Example:

ESC S

Status of the
syntax error

1

0

Syntax error status
in output buffer

For instance, sending "ER02" resets the syntax error status even though the error still exists.

The ESC S command may not be returned correctly if it is sent immediately after sending the FM or LF command. After receiving the FM or LF command, the VR100 /VR200 recorder starts sending the data and thus cannot respond to the ESC S command. The ESC S command can be returned correctly if it is sent after reading all the data sent from the VR100/VR200 recorder.

To invoke the ESC S command, send the character "S" following 1B (1-byte hexadecimal).

Make sure to send the terminator (CR and LF) following "ESC S."

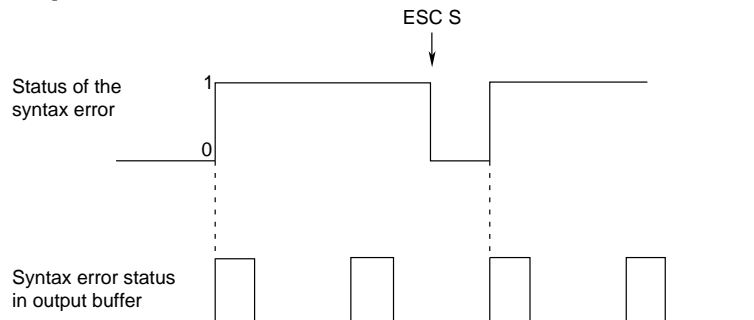## 2.4.3 Open Command

$(\text{ESC O})\smile\ \square\ \square\ C_RL_F$
where $\square\ \square$ is the address (ASCII code "01" to "16")

The open command addresses a communication destination when a host (PC) is connected to more than one (up to 15) VR200 recorders.
This command always controls non-addressed devices.
Before issuing an open command, make sure that the previous address device is closed by a close command.
All commands except for the execution of the trigger are valid for the addressed (after ESC O) device (VR200) only.
The terminator must be CR + LF.

2.4.4 Close Command

$(\text{ESC C})\smile\ \square\ \square\ C_RL_F$
where $\square\ \square$ is the address (ASCII code "01" to "16")

The close command closes the addressed state of a device. Only the addressed device will respond to this command.
The terminator must be CR + LF.

Chapter 3 TRANSMITTING FUNCTIONS

This chapter describes the different output formats.

3.1 Introduction to Output Data Formats

The type of data to be sent from the VR200 recorder is specified by the TS command (TS0, TS1, or TS2: see Section 2.3.7), and the output data format is specified by the FM command (see Section 2.3.8).

Note
The specification of the data type by the TS command is effective only when the ESC T command is sent afterwards. Hence, changing the specification of the data type by the TS command after the ESC T command is sent will not take effect until the ESC T command is sent again.

3.1.1 TS0

After sending the TS0 and the ESC T command, you must specify the output format using the FM command. Data cannot be output if the FM command is omitted. However, after the FM command has been sent and the data has been read, the data within the same sample can be read again by specifying the output format once more using the FM command.

If the next FM command is sent before the specified data have been output completely, the newly requested data will be output.

Sequence (see also Sections 2.3.7 and 2.3.8)

TS0
ESC T
FMx, xx, xx
(Read all data specified, until the end.)
FMx, xx, xx
(Read all data specified, until the end.)

Note
• Do not send the LF command until the reply data have been read completely after sending the FM command.
• After sending the ESC T command, data will be stored in a buffer and the system will wait for FM or LF commands (regardless of whether the ESC T command is sent without executing an FM or LF command after the last invocation of the ESC T command, or whether data have not yet been sent completely.)
• The ASCII code for "ESC" is 1B in hexadecimal notation.

3.1.2 TS1 and TS2

After sending the TS1 (or TS2) and the ESC T command, to read the data you must specify the output channel using the LF command. It is possible after reading the data completely to read data for other channels by sending another LF command.

Sequence (see also Sections 2.3.7 and 2.3.9)

TS1
ESC T
LFxx, xx
(Read all data specified, until the end.)
LFxx, xx
(Read all data specified, until the end.)

Note
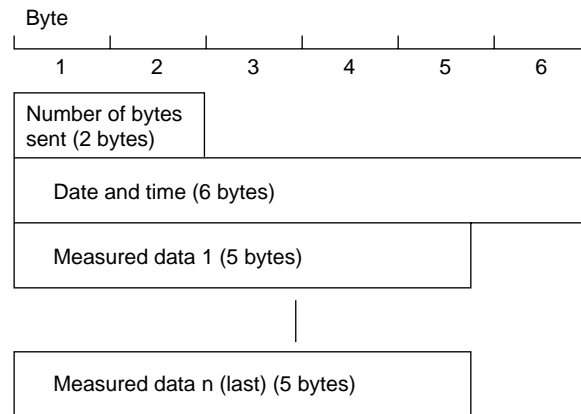• Do not send the LF command until the reply data have been read completely after sending the FM command.
• After sending the ESC T command, data will be stored in the buffer and the system will wait for FM or LF commands (regardless of whether the ESC T command is sent without executing an FM or LF command after the last invocation of the ESC T command, or whether data have not yet been sent completely.)

3.2 Output Data Formats

There are four formats in which data can be output.

- TS0 + ESC T + FM0 (outputs measured values in ASCII mode)
- TS0 + ESC T + FM1 (outputs measured values in Binary mode)
- TS1 + ESC T + LF (outputs parameter setting values)
- TS2 + ESC T + LF (outputs information on engineering unit and decimal point)

3.2.1 Output Format of Measured Values in ASCII Mode

When the TS0, ESC T, and FM0 commands are received, the measured values and computed results are output as ASCII codes. When the ESC T command is received immediately after the TS0 command, the recorder transfers the internal data to the RS-422-A transmission buffer.

Output format:

DATE YY MM DD C$_R$L$_F$ (Year, month, day)

TIME HH MM SS C$_R$L$_F$ (Hour, minute, second)

□□ AAAA UUUUUU CC,±DDDDD E±EE C$_R$L$_F$

Exponent of the data
± sign and 2 digits following "E"

Mantissa of the data
± sign and 5 digits
(Zeros are filled when less than 5 digits.)

Channel number 01 to 04 (for VR104) or 01 to 06 (for VR106)

Engineering unit
mV□□□□ : mV
V□□□□□ : V
□C□□□□ : °C
□F□□□□ : °F
UUU U U U : Arbitrary unit (up to 6 characters)

Alarm status (the order corresponds to the level numbers.)
H: High limit alarm
L: Low limit alarm
h: Difference high limit alarm
l: Difference low limit alarm
R: Rate-of-change alarm on increase
r: Rate-of-change alarm on decrease
Space: No alarm

Data status
Space: Not the end of data
E: End of data

Data status
N : Normal
D : Difference data (DELT)
O : Overrange (data value is ±99999.)
S : Skipped (data value is all spaces.)

3.2.2 Output Format of Measured Values in Binary Mode

When the TS0, ESC T and FM1 commands are received, the measured values and computed results are output in binary.

Output format:

(1) Sequence of transfer

Byte

| 1 | 2 | 3 | 4 | 5 | 6 |

Number of bytes sent (2 bytes)

Date and time (6 bytes)

Measured data 1 (5 bytes)

Measured data n (last) (5 bytes)

(2) Number of bytes sent

Number of bytes sent $= 5 \times n + 6$

This parameter can be sent either from the most significant byte or from the least significant byte, as specified by the BO command.

Note that the 2 bytes of the "number of bytes sent" itself are not included.

(3) Date and time

Byte

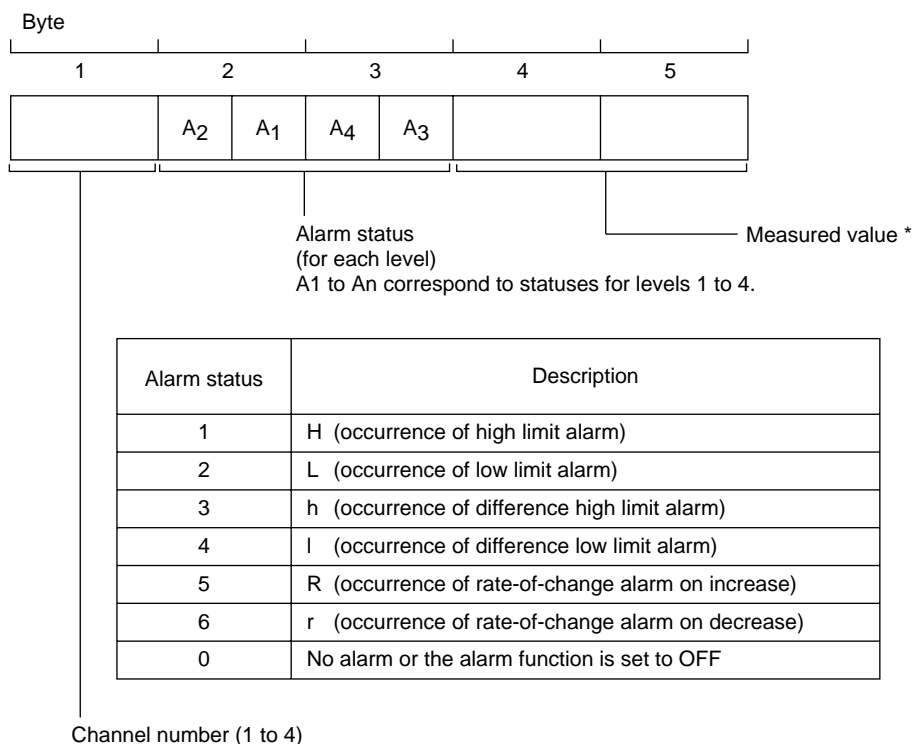| 1	2	3	4	5	6
Year	Month	Day	Hour	Minute	Second
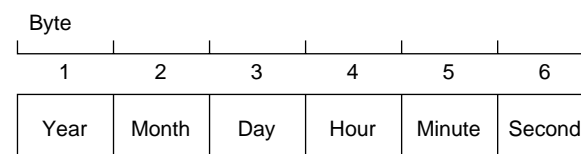
Year :   0 to 99 (00H to 63H)

Month :   1 to 12 (01H to 0CH)

Day :   1 to 31 (01H to 1FH)

Hour :   0 to 23 (00H to 17H)

Minute : 0 to 59 (00H to 3BH)

Second : 0 to 59 (00H to 3BH)

3 TRANSMITTING FUNCTIONS

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(4) Measured data

Byte

1	2		3		4	5
	A$_2$	A$_1$	A$_4$	A$_3$		

Alarm status
(for each level)
A1 to An correspond to statuses for levels 1 to 4.

Measured value *

Alarm status	Description
1	H (occurrence of high limit alarm)
2	L (occurrence of low limit alarm)
3	h (occurrence of difference high limit alarm)
4	l (occurrence of difference low limit alarm)
5	R (occurrence of rate-of-change alarm on increase)
6	r (occurrence of rate-of-change alarm on decrease)
0	No alarm or the alarm function is set to OFF

Channel number (1 to 4)

*Measured value

The order of the byte arrangement, whether to begin with the most significant byte (MSB) or least significant byte (LSB), can be specified by the BO command.
Abnormal data:
7E7E is the data value output for + overrange.
8181 is the data value output for – overrange.
8080 is the data value output when the channel is skipped.
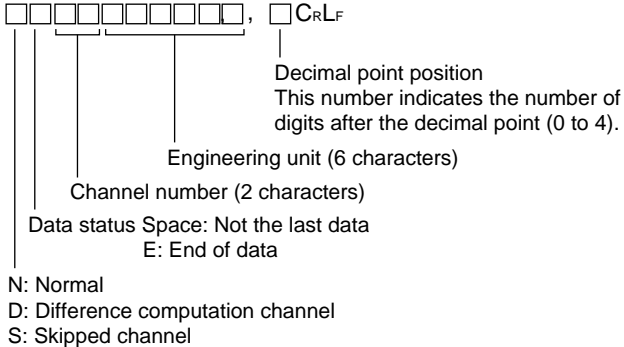
3.2.3 Output Format of Parameter Settings

When receiving the TS1, ESC T, and LF commands, the VR200 recorder sends the set values of parameters in the following order (each set value is output in the same format as the set command):

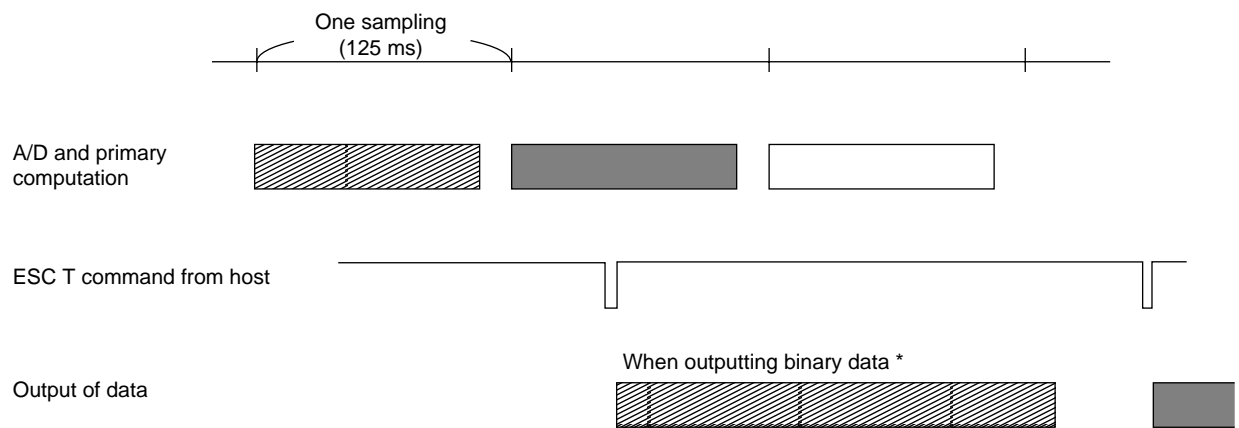| Communication	Set Value(s) to Be Output
SR	Range
SN	Engineering unit
SA	Alarms
SZ	Discrete (zone) display
SP	Partial expanded display
SK	Scale value indication
SW	Waveform span rate
ST	Tag numbers
SF	Floppy disk format type
SL	Trip levels
SG	Data file names
SM	Messages
SH	Number of division of bar graph display
SX	Waveform span rate and message menu display
SC	LCD brightness and saver function
SS	Summer/Winter setting
EN	End of parameter settings output

3.2.4 Output Format of Unit and Decimal Point Information

When receiving the TS2, ESC T, and LF commands, the VR200 recorder sends the information on the unit and decimal point in the following format. The channel numbers can be specified with the LF command.

☐☐☐☐☐☐☐☐ , ☐C$_R$L$_F$

Decimal point position
This number indicates the number of
digits after the decimal point (0 to 4).

Engineering unit (6 characters)

Channel number (2 characters)

Data status Space: Not the last data
E: End of data

N: Normal
D: Difference computation channel
S: Skipped channel

3 TRANSMITTING FUNCTIONS

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Chapter 4 TIME CHART

One sampling
(125 ms)

A/D and primary
computation

ESC T command from host

Output of data

When outputting binary data *

* If the ESC T command is received to output data before the data is updated, the previous
sample data will be output.

Chapter 5 INITIAL STATUS

The initial status after power on is as follows.

TS0   Output data type is the measured values.

FM0, 01, 04   Measured values are output as ASCII codes.
      From channel 01
      To channel 04
(All channels are specified.)

LF 01, 04   The channels for which the set values are output are:
      From channel 01
      To channel 04
(All channels are specified.)

BO1   Beginning with the least significant byte (LSB).

Chapter 6   ERRORS DURING RS-422-A OUTPUT

6.1 Preventing Errors

Do not send an FM or LF command from the host PC until the measured data or set point data in all the channels specified by the last command have been output. If an FM or LF command is sent while the VR200 recorder is outputting data, a communication error may occur.

An LF command sent after the TS0 command, or an FM command sent after the TS1 or TS2 command may also cause a communication error.

If an ESC T command was already sent after the last time TS0 was set, data (even in other formats) in any channel at any time interval can be read by the host PC using FM commands as many times as required. At this time (when the FM command is repeatedly sent), the VR200 recorder also sends the data acquired last time ESC T was received.

Also, if an ESC T command was already sent after the last time TS1 or TS2 was set, the settings (even in other formats) in any channel at any time interval can be read by the host PC using LF commands as many times as required.

Thus, once the ESC T command has been sent, the measured values and set values can be read any number of times, which is a very useful function.

Note

When sending data from the host PC to a recorder, use the ESC S command to avoid buffer overflow:
When the VR200 recorder receives an ESC S request, it saves it in the buffer memory. This request is retrieved from the buffer memory and, after acknowledging the command, the recorder sends the status to the PC. Make sure not to send any other commands between sending the ESC S command to the recorder and reading the status from the recorder. This ensures that commands can be received by the recorder since its input buffer is empty.

Example:

```
10   OPEN "COM1:N81N" AS #1
20   `
30   PRINT #1,CHR$(&H1B)+"O 01"
40   PRINT #1,"SR01,VOLT,20mV,-2000,2000"
50   GOSUB *HANDSHAKE
60   PRINT #1,"PS0"
70   GOSUB *HANDSHAKE
80   PRINT #1,"UD0"
90   PRINT #1,CHR$(&H1B)+"C 01"
100  CLOSE
110  END
120  *HANDSHAKE
130  PRINT #1,CHR$(&H1B)+"S";  (sending ESC S)
140  LINE INPUT #1,STS$       (reading status)
150  RETURN
```

The command length of the input buffer of the VR200 is 256 bytes for a 4-channel model.

6.2 How to Request Error Message Output

If an error occurs when the host sends a setting or control command to a VR200 recorder via the RS-422-A communication interface, the host can request the VR200 to output an error message.

(1) Error message (error number) request command

ESC S (C_R) (L_F)
(1B)H (53)H

(2) Error message sent from VR200 in reply to ESC S command

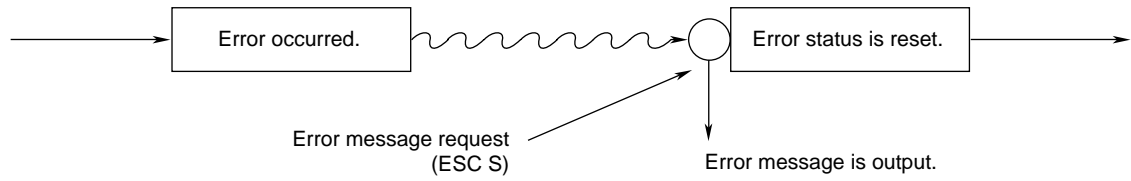Output format: **ERxx (C_R) (L_F)** (xx = 00 to 10. See Section 2.4.2 for details.)

Note

An error message is output only when the ESC S command is sent.

If the ESC S command (request for error message) is sent to a VR200 while data is being output due to the receipt of a TS0, TS1 or TS2 command, a communication error may occur.

When data is exchanged between the host and a VR200 via RS-422-A communication, it is possible to monitor the errors during each transmission and reception by assembling the ESC S commands in the communication program in the host computer.

6.3 Timing of Resetting the Error Status

When the VR200 receives an ESC S command after an error occurred, the recorder outputs the corresponding error message and the error status is reset at the same time.

```
┌─────────────────┐  ∿∿∿∿∿∿∿∿  ○  ┌─────────────────┐
│ Error occurred. │ ─────────────  │ Error status is reset. │ ───►
└─────────────────┘                └─────────────────┘

        Error message request ──────►
              (ESC S)
                                    Error message is output.
```

6 ERRORS DURING RS-422-A OUTPUT

Chapter 7 PROGRAM EXAMPLES

Examples of application programs for an IBM PC are shown below.

Environment

Computer used: IBM PC
Mode: Character length = 8 bits, parity = none, stop bit = 1, baud rate = 1200 bps
Handshake: None
The file name used for writing to and reading from the floppy disk is **TEST.DAT**.

7.1 Program to Read Parameter Settings from VR200, Display Them on Screen and Write Them to Disk

```
100  '*************************************************************
110  '**   RS422A Example Program for IBM PC                   **
120  '**                                                       **
130  '**      To input and save parameter settings             **
140  '**                                                       **
150  '*************************************************************
160  '**
170  '**     Baud rate: 1200       Stop bit: 1 bit
180  '**     Parity: none          Control: OFF/OFF
190  '**     Data length: 8 bits   Others: LF is sent automatically.
200  '**
210  '
220  OPEN "COM1:1200,N,8,1,LF" AS #1
230  OPEN "TEST.DAT" FOR OUTPUT AS #2
240  '
250  LF$=CHR$(&HA)                    :' Line feed = 0AH
260  PRINT #1,CHR$(27)+"O 01"
270  PRINT #1,"TS1"
280  PRINT #1,CHR$(27)+"T";
290  PRINT #1,"LF01,04"
300  LINE INPUT #1,D$
310  IF LEFT$(D$,1)=LF$ THEN D$=MID$(D$,2) :' Remove "LF" of head string
320  PRINT D$
330  PRINT #2,D$
340  IF LEFT$(D$,2)<>"EN" THEN GOTO  300
350  '
360  PRINT #1,CHR$(27)+"C 01"
370  CLOSE
380  END
```

7.2 Program to Read Parameter Settings from Disk, Display Them on Screen, and Set up VR200

```
100  '**********************************************************
110  '**   RS422A Example Program for IBM PC                 **
120  '**                                                     **
130  '**          To read setting information                **
140  '**                                                     **
150  '**********************************************************
160  '**
170  '**      Baud rate: 1200          Stop bit: 1 bit
180  '**      Parity: none                 Control: OFF/OFF
190  '**      Data length: 8 bits      Others: LF is sent automatically.
200  '**
210  '
220  OPEN "COM1:1200,N,8,1,LF" AS #1
230  OPEN "TEST.DAT" FOR INPUT AS #2
240  '
250  PRINT #1,CHR$(27)+"O 01"
260  LINE INPUT #2,D$: PRINT D$
270  IF LEFT$(D$,2)="EN" THEN GOTO 340   :' Watch data end
280  PRINT #1,D$
290  PRINT #1,CHR$(27)+"S";  :' For protect receive buffer overflow
300  LINE INPUT #1,D$
310  PRINT D$
320  GOTO 260
330  '
340  PRINT #1,CHR$(27)+"C 01"
350  CLOSE
360  END
```

7.3 Program to Read Unit and Decimal Point Information from VR200, Display It on Screen, and Write It to Disk

```
100   '*********************************************************
110   '**   RS422A Example Program for IBM PC                **
120   '**                                                   **
130   '**         To input and save point and unit information  **
140   '**                                                   **
150   '*********************************************************
160   '**
170   '**   Baud rate: 1200          Stop bit: 1 bit
180   '**   Parity: none             Control: OFF/OFF
190   '**   Data length: 8 bits      Others: LF is sent automatically.
200   '**
210   '
220   OPEN "COM1:1200,N,8,1,LF" AS #1
230   OPEN "TEST.DAT" FOR OUTPUT AS #2
240   '
250   LF$=CHR$(&HA)                          :' Line feed = 0AH
260   PRINT #1,CHR$(27)+"O 01"
270   PRINT #1,"TS2"
280   PRINT #1,CHR$(27)+"T";
290   PRINT #1,"LF01,04"
300   LINE INPUT #1,D$
310   IF LEFT$(D$,1)=LF$ THEN D$=MID$(D$,2) :' Remove "LF" of head string
320   PRINT D$
330   PRINT #2,D$
340   IF MID$(D$,2,1)<>"E" THEN GOTO 300
350   '
360   PRINT #1,CHR$(27)+"C 01"
370   CLOSE
380   END
```

7.4 Program to Output Measured Data (in ASCII Code) from VR200 and Write to Disk

```
100  '*******************************************************
110  '**   RS422A Example Program for IBM PC                **
120  '**                                                    **
130  '**          To input and save measured data           **
140  '**                   (ASCII code)                     **
150  '**                                                    **
160  '*******************************************************
170  '**
180  '**  Baud rate: 1200         Stop bit: 1 bit
190  '**  Parity: none            Control: OFF/OFF
200  '**  Data length: 8 bits     Others: LF is sent automatically.
210  '**
220  '
230  OPEN "COM1:1200,N,8,1,LF" AS #1
240  OPEN "TEST.DAT" FOR OUTPUT AS #2
250  '
260  LF$=CHR$(&HA)                        :' Line feed = 0AH
270  PRINT #1,CHR$(27)+"O 01"
280  PRINT #1,"TS0"
290  PRINT #1,CHR$(27)+"T";
300  PRINT #1,"FM0,01,04"
310  LINE INPUT #1,D$
320  IF LEFT$(D$,1)=LF$ THEN D$=MID$(D$,2) :' Remove "LF" of head string
330  PRINT D$
340  PRINT #2,D$
350  IF MID$(D$,2,1)<>"E" THEN GOTO 310
360  '
370  PRINT #1,CHR$(27)+"C 01"
380  CLOSE
390  END
```

7.5 Program to Output Measured Data (in Binary Code) from VR200 and Write to Disk

```
100  '*********************************************************
110  '**   RS422A Example Program for IBM PC                 **
120  '**                                                     **
130  '**         To input and save measured data             **
140  '**                  (ASCII code)                       **
150  '**                                                     **
160  '*********************************************************
170  '**
180  '**  Baud rate: 1200        Stop bit: 1 bit
190  '**  Parity: none           Control: OFF/OFF
200  '**  Data length: 8 bits    Others: LF is sent automatically.
210  '**
220  '
230  OPEN "COM1:1200,N,8,1,LF" AS #1
240  OPEN "TEST.DAT" FOR OUTPUT AS #2
250  '
260  PRINT #1,CHR$(27)+"O 01"
270  PRINT #1,"TS0"
280  PRINT #1,"BO1"
290  '
300  PRINT #1,CHR$(27)+"T";
310  PRINT #1,"FM1,01,04"
320  D$=INPUT$(2,#1)
330  PRINT #2,D$
340  A=CVI(MID$(D$,1,2))
350  PRINT A
360  D$=INPUT$(A,#1)
370  PRINT #2,D$
380  PRINT ASC(MID$(D$,1,1));:PRINT "/";
390  PRINT ASC(MID$(D$,2,1));:PRINT "/";
400  PRINT ASC(MID$(D$,3,1));:PRINT
410  PRINT ASC(MID$(D$,4,1));:PRINT ":";
420  PRINT ASC(MID$(D$,5,1));:PRINT ":";
430  PRINT ASC(MID$(D$,6,1))
440  '
450  L=0
460  FOR I=7 TO A
470    PRINT RIGHT$("0"+HEX$(ASC(MID$(D$,I,1))),2)+" ";
480    L=L+1
490    IF L=5 THEN L=0 : PRINT
500  NEXT I
510  '
520  PRINT #1,CHR$(27)+"C 01"
530  CLOSE
540  END
```

7 PROGRAM EXAMPLES

APPENDIX

Appendix 1 ASCII Code Table

——— Upper byte ———

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0			S/P	0		P		p								
1				1	A	Q	a	q							°	
2				2	B	R	b	r							Ω	
3			#	3	C	S	c	s							μ	
4				4	D	T	d	t								
5			%	5	E	U	e	u								
6				6	F	V	f	v							℧	
7				7	G	W	g	w								
8			(	8	H	X	h	x								
9			)	9	I	Y	i	y								
A	L/F		*	:	J	Z	j	z								
B		ESC	+		K		k									
C			,		L		l									
D	C/R		—		M		m									
E			.		N		n									
F			/		O		o									

Lower byte

Note

- Select the degree symbol (°) of °C or °F as follows:
  - (a) In case of measured values output (TS0), and unit and decimal point output (TS2):
    - ° = space (20H)
  - (b) In case of setting parameter output (TS1):
    - ° = E1H
  - (c) In case of recorder setting:
    - ° = E1H
- Do not use any code whose corresponding character is not shown in the table (blanks). Use 20H for a space.

Appendix 2 File Naming Rules

File Name Length

Data file:	Up to seven alphanumeric characters
Configuration (parameter settings) file:	Up to eight alphanumeric characters

Lowercase/Uppercase Letters

All lowercase letters are processed as uppercase letters for file names, based on the rules of MS-DOS.

System-reserved File Names

The following system-reserved file names cannot be used for a user-defined file name:
CON, PRN, AUX, AUX1, AUX2, NUL, CLOCK.

Prohibited Characters

The following characters cannot be used:
- Any character not included in the 7-bit ASCII codes
- \ (back slash), ? (question mark), * (asterisk), . (period), <, > (inequality signs), " (quotation mark), = (equals sign), [,] (bracket), : (colon), ; (semicolon), + (plus sign), / (slash), | (vertical bar), ¥ (yen mark), space

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