User's Guide

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RD260A-S4
RS422A Communications
Instruction Manual

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WARNING: These products are not designed for use in, and should not be used for, patient-connected applications.

INTRODUCTION

This Instruction Manual describes the option RS-422-A for the RD260A pen and dot printing recorder.
For details concerning the operation of this recorder, see the instruction manual.

NOTES

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CONTENTS

1 INSTALLATION OF RS-422-A INTERFACE

The -S4 option includes EIA (Electronic Industries Association) RS-422-A communications interface to output measured values and change settting parameters. However, this interface does not include operations of the power switch and chart feed. Setting of SET UP mode can not be controlled.

1.1 Interface Functions

Communication system:	4 wire half-duplex multi-drop connection 1:n (host computer: this recorder) n=1 to 16 Start-stop system
Transmission speeds:	75, 150, 300, 600, 1200, 2400, 4800 and 9600 bits/second
Start bit:	1 bit
Stop bit:	1 or 2 bits
Parity:	Even, odd or no parity
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 meter (between an isolated line converter or an isolated computer and this recorder)

1.2 Interface Terminal

1.2.1 Terminal Arrangement

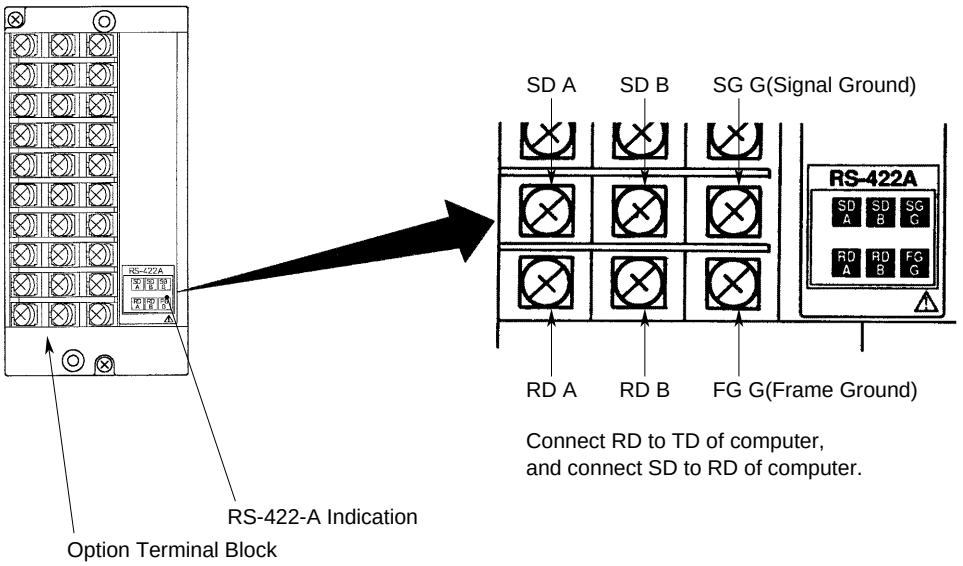


Figure 1.1 Terminal Arrangement

WARNING There is the power supply terminal near the interface terminal.
To prevent an electric shock, ensure the main power supply is turned OFF.

1.2.2 Cable Termination

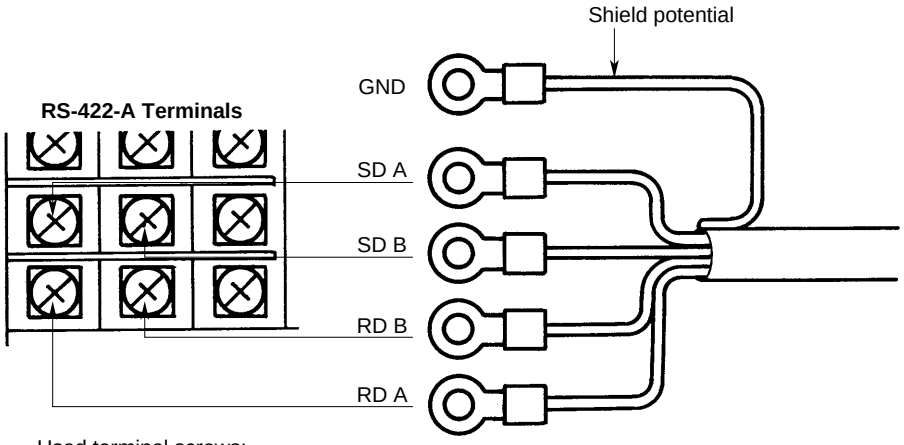


Figure 1.2 Cable Termination

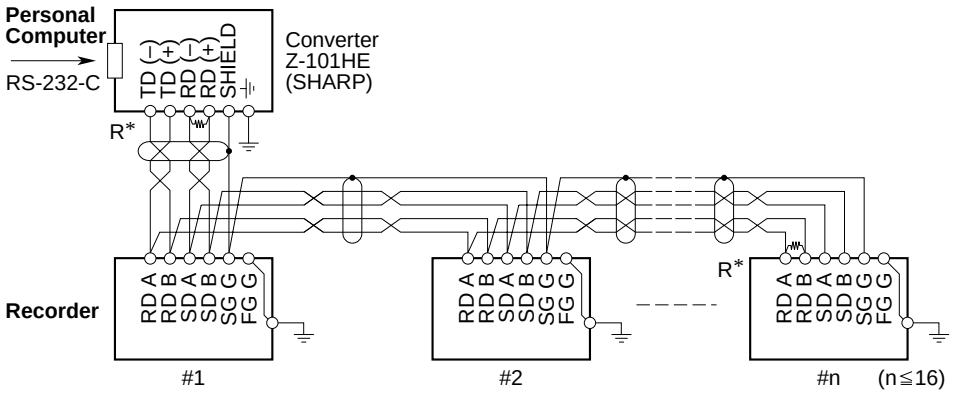
WARNING There is the power supply terminal near the interface terminal.
To prevent an electric shock, ensure the main power supply is turned OFF.

1.3 Communication Wiring

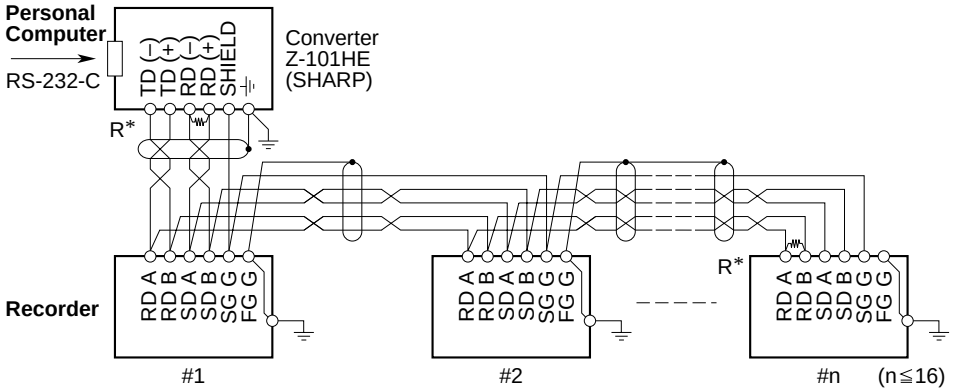
If the host (PC) is equipped with a RS-422-A interface, this recorder can be connected directly.
If the host (PC) is equipped with a RS-232-C interface, this recorder can be connected using a converter which has fail safe function (SHARP Z-101HE or equivalent).

Shown below are two wiring examples, which are same except for the case-shielding. If there will be a connection between other panels, wiring should be done as shown in figure b.

a



b



*: R in figure 1.3 indicates a terminal resistance. R=100 , 1/2W min (adjust according to the impedance).
The converter is of the inverter type. The + and – polarity depends on the type of converter.

Figure 1.3 Communication Wiring

In case of wiring as shown in figure a, use two pairs of 24AWG (minimum) twisted shielded cables or equivalent.
In case of wiring as shown in figure b, use three pairs of 24AWG (minimum) twisted shielded cables or equivalent. One pair is used for SG in case of figure b.
(Characteristic impedance: 100 , capacitance 50pF/m)

Keep the terminated unshielded section to a minimum and clear of this recorder ground line.

WARNING

There is the power supply terminal near the interface terminal.
To prevent an electric shock, ensure the main power supply is turned OFF.

1.4 Data Configuration

The relation between the signal and the potential of the RS-422-A terminals is as follows: A<B :1
A>B :0

1.4.1 Start-Stop Communication

The RS-422-A interface communicates with the start-stop system. The start-stop system first adds the start bit to the head and then in turn adds the data bits (7 to 8 bits), parity bit and stop bit(s) in every transmission of one character (see figure 1.4). See section 1.5 for the address, communication (baud) rate, data length, parity bit, and stop bit(s) settings.
The start bit is automatically added and no setting is necessary.

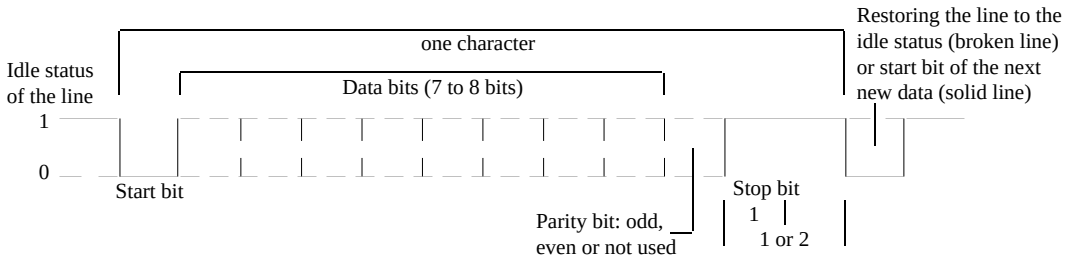


Figure 1.4 Start-Stop System for One Character

1.4.2 Text

Communication data usually takes the form of more than one character to which a terminator is added. This is called ‘text’. See also figure 1.5.

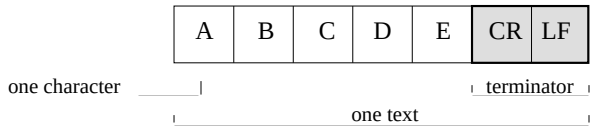


Figure 1.5 Structure of Text

The RS-422-A interface identifies a text by regarding the reception of a terminator as the end of text. See also figure 1.6.

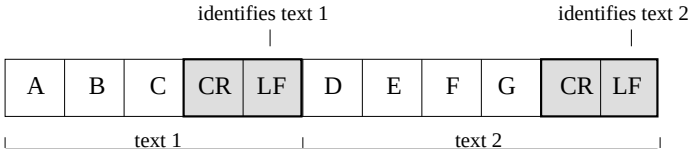


Figure 1.6 Example of Two Texts, Where the Terminator is CR-LF

NOTE This recorder identifies text by regarding ‘LF’ or ‘;’ as the terminator when receiving the data (and will send CR and LF as the terminator).
However, only CR + LF is usable as the terminator for open command (ESC O) and close command (ESC C).
As in the example shown in figure 1.6, when CR and LF are used as the terminator, CR is ignored. Therefore, when communication is performed with a PC, the terminator LF might not be sent. Exercise care.

1.4.3 Input Buffer

The input buffer takes the form of rotary buffer (capacity: 256bytes). The rotary buffer outputs a text on the first-in first-out basis while storing data in turn. It is not necessary for the user to be aware of in the program, however take care to prevent buffer overflow. A merit of the rotary buffer is that it can flexibly cope with more than one text being sent contiguously because of low loss against variable text length.

1.4.4 Buffer Overflow

As described before, the input buffer is necessary for data communication. The capacity, however, is limited (256 bytes for this recorder). Thus, in the receiver,
the buffer capacity may become shorted if vast data is sent in a short time.
These impair data communications (buffer overflow).
To prevent buffer overflow, it is recommended to confirm the status of the recorder using the ESC S command just after commands have been sent (from the PC). See subsection 2.4.2.
Note that you cannot send an ESC S command after having sent an LF or FM command.
After the recorder receives the ESC S command, it will output its status to the PC.
Actually, the recorder will store the ESC S command in the input buffer and this command will be read from this buffer. Then the status will be output to the PC.
If the computer sends other commands before the status of the recorder has been receiveid, the input buffer will not be empty (the ESC S command will be still in there), which means the recorder cannot receive other commands yet.

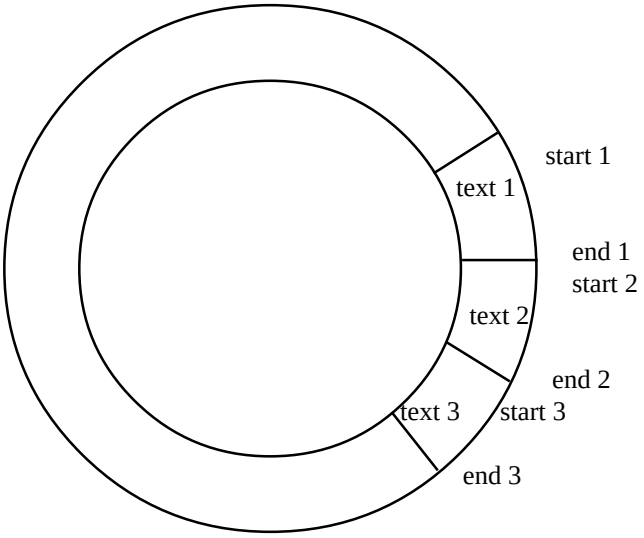


Figure 1.7 Rotary Buffer

1.5 How to Set the RS-422-A Interface Communications

1 Remove the recorder packing material as described 1.2.2 in the Instruction Manual of this recorder and remove the lock screw.

2 Enter the SET UP mode by turning 'ON' the power while pressing the [**CH UP**] (↵ [**ENT**] key.

3 Use the [△] key to select the display '[oMM'. Press the [**ENT**] key.

4 Set the RS-422-A address (possibilities are from 01 to 16) using the [△] key. The initial value is '01'. Press the [**ENT**] key.

5 Select the transmission speed (baud rate). The speed is selcetable from 75, 150, 300, 600, 1200, 2400, 4800 and 9600 bits/second using the [△] key. After selection, press the [**ENT**] key. The initial value is 9600 bps.

6 Select the data length. The length is selectable from 7bit (7 bits) or 8bit (8 bits) using the [△] key. After selection, press the [**ENT**] key. The initial value is 8 bits.

7 Select the parity bit. This bit is selectable from odd, EVEn or nonE using the [△] key. After selection, press the [**ENT**] key. The initial value is EVEn.

8 Select the number of stop bits. This is selectable from 1bit (1 bits) or 2bit (2 bits) usig the [△] key. After selection, press the [**ENT**] key. The initial value is 1 bit.

The display '[oMM' will appear. You can now adjust other settings in the SET UP mode, by using the [△] key.

Before leaving the SET UP mode, you have to store your new settings. Press the [△] key until the display 'End' appears.

Press the [**ENT**] key. Select 'StorE' to keep your new settings or 'AborT' and press the [**ENT**] key. After a few seconds, the OPERATION mode will appear.

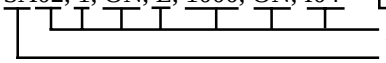
2 RECEIVING FUNCTIONS

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

2.1 Program Set Commands

Commands are represented by ASCII codes and divided into an identifier, parameters, delimiters and a terminator.

Example: SA02, 1, ON, L, 1000, ON, I04 [terminator]



identifier

- Defined by two alphabetical, capital characters

parameter

- Parameters are separated by a delimiter (comma)
- Numeric data are displayed by integers (e.g. +20, –240)
- When parameters are numeric, the effective setting ranges depend on these parameters
- Spaces preceding and following a parameter, or a space within a parameter are ignored.
- Parameters which do not need to be changed can be omitted. Delimiters, however, can not be omitted. (e.g. SA02, , ON: level number of alarm is unchanged)
- A string of delimiters at the end of a command/parameter string may be omitted (see example below).
  E.g. SA02, 1, ON, L, , can be omitted
- The length of the following parameters is fixed. If the length differs, syntax errors will occur.
  - Date and time: YY/MM/DD (eight characters) HH:MM:SS (eight characters)
  - Channel: CC (two characters, e.g. channel 1 must be entered as 01)

terminator

A command ends with one of the following terminators:
CR + LF
LF
; (semicolon)

When using the ESC O or ESC C command, only the CR + LF terminator is valid.

2.1.1 List of Program Set Commands

Type	Command	Function
Set	SR	range setting
	SM	offsets setting
	SA	alarm setting
	SN	unit setting
	SC	chart speed setting
	SD	clock setting
	SS	trend recording format setting (Dot-printing model only)
	SZ	zone setting
	SP	partial expanded setting
	ST	tag setting
	SG	message setting
	SE	chart speed 2 setting
	SL	Key lock setting

NOTE For restrictions concerning settings, see main Instruction Manual.
When setting the above commands, the set mode will appear. When returning to the OPERATION mode, use the UD command (see subsection 2.2.6).

2.1.2 Range Setting

SKIP Prevents the specified channel from being measured, recorded and displayed.

format: **SRp1, mode designation**

p1: channel number (CC)

mode designation: SKIP

example: **SR01, SKIP**

VOLT, TC, RTD and DELT

format: **SRp1, mode designation, p2, p3, p4**

p1: channel number (CC)

mode designation: VOLT, TC, RTD
DELT (difference computation of measured values between set channel and reference channel)

p2: range designation
in case of VOLT: 20mV, 60mV, 200mV, 2V, 6V, 20V
in case of TC: R, S, B, K, E, J, T, N, W, L, U
in case of RTD: PT, JPT
in case of DELT: the reference channel number. Note that the reference channel number must be lower than the set channel.

p3: minimum value of the recording span. Enter within five digits, regardless of the decimal point and + or –

p4: maximum value of the recording span. Enter within five digits, regardless of the decimal point and + or –

Input range table

Input type	Range	Measurement range	Unit
DC Voltage	20mV	–20.00mV to 20.00mV	mV
	60mV	–60.00mV to 60.00mV	mV
	200mV	–200.0mV to 200.0mV	mV
	2V	–2.000V to 2.000V	V
	6V	–6.000V to 6.000V	V
	20V	–20.00V to 20.00V	V
Input type	Range	Measurement range	Measurement range
TC	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
	N	0.0 to 1300.0°C	32 to 2372°F
	W	0.0 to 2315.0°C	32 to 4199°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
Input type	Range	Measurement range	Measurement range
RTD	PT	–200.0 to 600.0°C	–328.0 to 1112.0°F
	JPT	–200.0 to 550.0°C	–328.0 to 1022.0°F

DI (Digital Input)

format: **SRp1, mode designation, p2**

p1: channel number (CC)
mode designation: DI (digital input)
p2: type designation
selectable from LEVL (level) or CONT (contact)

example: **SR01, DI, CONT**

SCL (Scaling)

format: **SRp1, mode designation, p2, p3, p4, p5, p6, p7**

p1: channel number (CC)
mode designation: SCL
p2: mode designation
selectable from VOLT, TC or RTD
p3: range designation
p4: the minimum value of the recording span (SPAN L). Enter 5 digits, regardless of the decimal point and + or –
p5: the maximum value of the recording span (SPAN R). Enter 5 digits, regardless of the decimal point and + or –
p6: the minimum value of the scale (SCL l). Enter 6 digits, regardless of the decimal point and + or –
p7: the maximum value of the scale (SCL r). Enter 6 digits, regardless of the decimal point and + or –
p8: decimal point position of scaling value (0 to 4, which stands for the number of digits after the decimal point)

example: **SR01, SCL, 20mV, 0, 1000, –1000, 1000, 1**
This example performs 0 to 10mV input in channel 1 and is scaled from –100.0 to 100.0.

NOTE An error will occur if one of p5, p6 or p7 is omitted. However, it is possible to omit all three values in case you do not want to change them.

SQRT (Square Root)

format: **SRp1, mode designation, p2, p3, p4, p5, p6, p7**

p1: channel number (CC)
mode designation: SQRT
p2: range designation
selectable from 20mV, 60mV, 200mV, 2V, 6V, 20V
p3: minimum value of the recording span (SPAN L). Enter within five digits, regardless of the decimal point and + or –
p4: maximum value of the recording span (SPAN R). Enter within five digits, regardless of the decimal point and + or –
p5: minimum value of the scale (SCL l). Enter within six digits, regardless of the decimal point and + or –
p6: maximum value of the scale (SCL r). Enter within six digits, regardless of the decimal point and + or –
p7: decimal point position of scaling value (0 to 3, 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 10mV input in channel 1. From this value the square root is taken and the value is scaled from –100.0 to 100.0.

NOTE An error will occur if one of p5, p6 or p7 is omitted. However, it is possible to omit all three values in case you do not want to change them.

2.1.3 Offsets Setting

format: **SMp1, p2**

p1: channel number (CC)
p2: offset level (regardless of the decimal point)

2.1.4 Alarm Setting

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: the type of alarm, selectable from
H: high limit alarm
L: low limit alarm
h: difference high limit alarm
l: difference low limit alarm
p4: alarm set point. Enter within five digits, regardless of the decimal point and + or –. See the following table.

Input Type		Decimal Point Position
DC Voltage	–20.00 to 20.00 mV	□□□.□□
	–60.00 to 60.00 mV	□□□.□□
	–200.0 to 200.0 mV	□□□□.□
	–2.000 to 2.000 V	□□.□□□
	–6.000 to 6.000 V	□□.□□□
	–20.00 to 20.00 V	□□□.□□
TC/RTD		□□□□.□

p5: activating of the alarm output relay ON/OFF
p6: alarm output relay number. Selectable from I01 to I06, depending on your option

example: **SA02, 1, ON, L, 1000, ON, I04**
This example sets an level 1, low limit, alarm to channel 2. The alarm set point is 10.00mV and if an alarm occurs, output relay number 4 will be activated.

2.1.5 Unit Setting

format: **SNp1, p2**

p1: channel number (CC)
p2: unit characters (up to six)

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.

2.1.6 Chart Speed Setting

format: **SCp1**

p1: chart speed (in mm/h)
(10 to 12000 mm/h for the Pen model [40 increments : see the following table], 10 to 1500mm/h for the Dot-printing model [28increments]

10	15	20	25	30	40	50	60	75	80
90	100	120	150	160	180	200	240	300	360
375	450	600	720	750	900	1200	1500	1800	2400
3000	3600	4500	4800	5400	6000	7200	9000	10800	12000

example: **SC40**
This example changes the chart speed to 40 mm/h.

2.1.7 Clock Setting

format: **SDp1, p2**

p1: date (YY/MM/DD)
p2: time (HH:MM:SS)

example: **SD97/07/13, 15:02:00**

2.1.8 Trend Recording Format Setting

format: **SSp1**

p1: selection of trend recording mode
selectable from AUTO or FIX

NOTE This setting applies only to the Dot-printing model.

2.1.9 Zone Recording Setting

format: **SZp1, p2, p3**

p1: channel number (CC)
p2: left boundary value (0 to 95)
p3: right boundary value (5 to 100)

example: **SZ02, 30,50**
This example results in zone recording for channel 2 in the band from 30 to 50mm.

2.1.10 Partial Expanded Recording Setting

format: **SPp1, p2, p3, p4**

p1: channel number (CC)
p2: partial expanded recording ON/OFF
p3: percentage of the full recording span which will be compressed. (1 to 99%)
p4: boundary value (recording span + 1 to recording span – 1)

example: **SP01, ON, 25, 0000**
This example results in partial expanded recording for channel 1 where the value at 25% of the chart corresponds with 0.000V.

NOTE The decimal point position will be according to the range (or scaling) setting. See also the input range table on page 2-3.

2.1.11 Tag Setting

format: **STp1, p2**

p1: channel number (CC)
p2: tag characters (up to seven characters)

example: **ST01, TAG 1**

2.1.12 Message Setting

format: **SGp1, p2**

p1: message number (selectable from MSG1, MSG2, MSG3, MSG4, MSG5)
p2: message characters (up to 16 characters)

example: **SGMSG2, TEST1**
This example sets the message 'TEST1' as message number 2.

2.1.13 Chart Speed 2 Setting

format: **SEp1**

p1: second chart speed (in mm/h)
(10 to 12000 mm/h for the Pen model [40 increments],
10 to 1500 mm/h for the Dot-printing model [28 increments])

example: **SE100**
This example sets the second chart speed to 100 mm/h.

2.1.14 Key Lock Setting

format: **SLp1, p2, p3**

p1: RCD key
LOCK
FREE
p2: PRINT key
LOCK
FREE
p3: FEED key
LOCK
FREE

example: **SL LOCK, FREE, LOCK**
This example releases the Key Lock of the [**PRINT**] key.

2.2 Program Control Commands

2.2.1 List of Program Control Commands

Type	Command	Function
Control	PS	start/stop recording
	MP	manual printout start/stop
	LS	list printout start/stop
	SU	SET UP list printout start/stop
	MS	message printout start
	UD	returning display OPERATION mode
	BO	designation sequence of byte output (Binary output)
	TS	selection of output data
	FM	selection of output format of measured data
	LF	selection of output format for unit/decimal point

2.2.2 Start/Stop the Recording

Command	Function
PS0	starts the recording
PS1	stops the recording

2.2.3 Manual Printout Start/Stop

Command	Function
MP0	starts the manual printout
MP1	stops the manual printout

2.2.4 List Printout Start/Stop

Command	Function
LS0	starts the list printout
LS1	stops the list printout

2.2.5 Message Printout Start

Command	Function
MSp1	starts the message printout

Where p1 is the message number
selectable from 1 (MSG1), 2 (MSG2), 3 (MSG3), 4 (MSG4), 5 (MSG5)

2.2.6 Returning Display to OPERATION Mode

Command	Function
UD0	selects AUTO display
UD1, p1	selects MANUAL display
UD2	selects DATE display
UD3	selects CLOCK display
UD4	selects OFF

Where p1 is the channel number (CC)

2.2.7 Designation Sequence of Byte Output (Binary output)

Command	Function
BO0	outputs from MSB (upper byte)
BO1	outputs from LSB (lower byte)

2.2.8 Selection of Output Data

Command	Function
TS0	outputs measured values
TS1	outputs values of setting parameters
TS2	outputs unit and decimal point information

2.2.9 Selection of Output Format for Measured Data

Command	Function
FM0, p1, p2	selects channels from which measured values are output in ASCII mode
FM1, p1, p2	selects channels from which measured values are output in Binary mode

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

NOTE After you designated the output to be measured values (TS0 command), specify the format by this FM command.

2.2.10 Selection of Output Format for Unit/Decimal Point Information

Command	Function
LF, p1, p2	selects channels from which unit/decimal point information is output (TS2)

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

NOTE After you designated the output by a TS2 command, specify the format by this LF command.

2.3 Escape Sequence

Communications can be controlled by using the following escape commands.

2.3.1 Execution of Trigger

ESC T executes triggering

If an ESC T command is received,
• measured data (when TS0 is specified), or
• units & decimal point information (when TS2 is specified)
are stored in a buffer.
Data output will start only after the output format has been designated (using the FM or LF command).
For actual use and output sequence, see section 3.2, ‘‘output data format’’.
ESC T sends a character ‘T’ following data of 1 byte (1B) H.

Example: If (ESC T) is output using PC 9801 Series:
PRINT #1,CHR$ (&1HB) +’T’;
(In case of NEC PC 9801, the interface file number should be 1 and should be opened.)

2.3.2 Status Output

ESC S outputs status

If the ESC S command is received, statuses of the commands which have been sent so far are output.
Output statuses range from ER00 to ER07. For the respective contents, see the next figure and table.

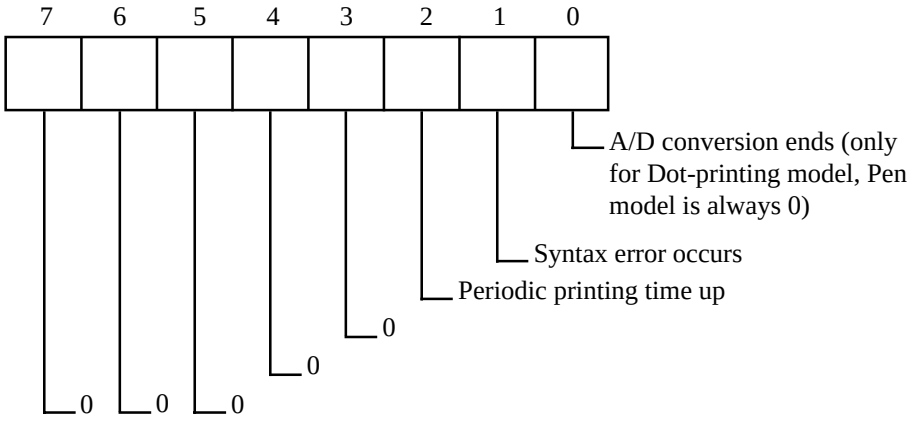


Figure 2.1 Output Format after ESC S Command Has Been Sent

NOTE Status will be reset (0) after the error message has been output.

Example:

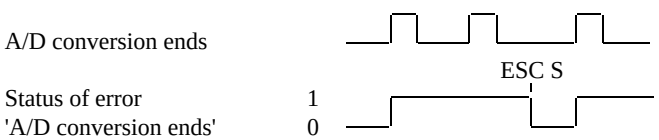


Table 2.1 Status Output Table

Status Output	Status		
	A/D END	Syntax Error	periodic printing time up
ER00C_RL_F			
ER01C_RL_F	●		
ER02C_RL_F		●	
ER03C_RL_F	●	●	
ER04C_RL_F			●
ER05C_RL_F	●		●
ER06C_RL_F		●	●
ER07C_RL_F	●	●	●

● : Status

If an error message is output, all error statuses will be reset. This error will not be reset.
If there are no statuses to be output when the ESC S command is received, ER00 will be output.
Data from the recorder is output using an FM or LF command. To allow time to output these data, do not send an ESC S command immediately after sending the FM or LF command.
ESC S sends a character 'S' following data of 1 byte (1B) H.

Example: If (ESC S) is output using PC 9801 Series:
PRINT #1,CHR$ (&1HB) +'S';
LINE INPUT #1, D$
PRINT D$
(In case of NEC PC 9801, the interface file number should be 1 and should be opened.)

2.3.3 Open Command

(ESC O)_□□ C_RL_F
where □□ is the address (ASCII code '01' to '16')

The open command is to address a communication destination when a HOST (PC) is connected to more than one (up to 16) 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 (incl. ESC T) are valid for the addressed (after ESC O) device only.

Only CR + LR can be used as the terminator.

2.3.4 Close Command

(ESC C)_ □□ C_RL_F
where □□ is the address (ASCII code '01' to '16')

The close command is to close the addressed state of a device. Only the addressed device will respond to this command.

Only CR + LR can be used as the terminator.

3 TRANSMITTING FUNCTIONS

This chapter describes different output formats.

3.1 Introduction to Output Data Formats

The format to output data can be specified by the following commands (see subsection 2.2.9):
• TS0
• TS1, TS2

NOTE When you specify a TS command and send an ESC T command, the TS command will be reset. However, if you send an ESC T command again, the TS command will be set to the previous value.

3.1.1 TS0

After sending the TS0 and the ESC T command, you must specify the output format using an FM command. Data cannot be output when an FM command is omitted. However, after the FM command has been sent, data within the same sample can be output again by specifying the output format once more using an 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 subsection 2.2.9, 2.2.10)
TS0
ESC T
FMx, xx, xx
(read data completely)
FMx, xx, xx
(read data completely)

NOTE Do not send any FM or LF commands until the data have been sent completely.
After sending an ESC T command, data will be stored in a buffer and the system will wait for FM or LF commands. (Regardless whether the ESC T command is sent without executing FM or LF command, or whether data have been sent completely.)
The ASCII code for ESC is (1B)H.

3.1.2 TS1, TS2

After sending the TS1 (or TS2) and the ESC T command, you must specify the output channel using an LF command. It is possible, after data have been output completely, to output data from another channel by specifying an LF command again.

Sequence (see also subsection 2.2.9, 2.2.10)
TS2
ESC T
LFxx, xx
(read data (end data))
LFxx, xx
(read data (end data))

NOTE Do not send any FM or LF commands until the data have been sent completely.
After sending an ESC T command, data will be stored in a buffer and the system will wait for FM or LF commands.

3.2 Output Data Formats

There are four formats which can be used to output data.

- 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 values of setting parameters)
- TS2 + ESC T + LF (outputs information on unit and decimal point)

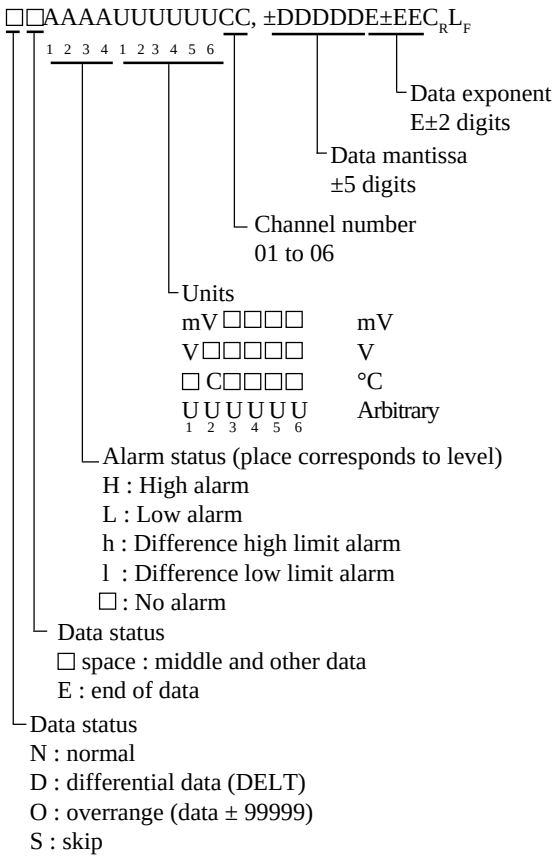
3.2.1 Output Format of Measured Values in the ASCII Mode

When the TS0, ESC T and FM0 commands are received, the measured value and computed result are output in ASCII mode. When the ESC T command is received immediately after the TS0 command, the recorder data will be transferred to a buffer.

Output format:

DATEYYMMDDC_RL_F (year, month, day)

TIMEHHMMSSC_RL_F (hour, minute, second)



3.2.2 Output Format of Measured Values in the Binary Mode

When the TS0, ESC T and FM1 commands are received, the measured value and computed result are output in the Binary mode.

Output format

Transfer order

output byte number	2 byte
date and time	6 byte
measured data (1)	5 byte
|	
measured data (n)	5byte

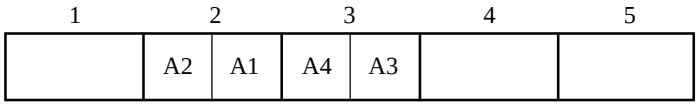
Output byte number

output byte number= 5 x n+6 (order of output byte can be selected)
The output byte number is output from the most significant byte (MSB) or least significant byte (LSB) according to the output sequence (BO command). Note that in the mentioned formula the above mentioned 2 bytes are not included.

Date and time

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)*
* Output is hexadecimal, therefore numeric output needs to be converted.



Channel number (1 to 24)

Alarm status
An=1: H
An=2: L
An=3: h
An=4: l
An=0: No alarm or set to OFF
Outputs for each level:
A1 = level 1
|
A4 = level 4

Measured value (order of output byte can be selected, using BO command)
data + over: 7E7E is output
data – over: 8181 is output
skip: 8080 is output

Measured data:

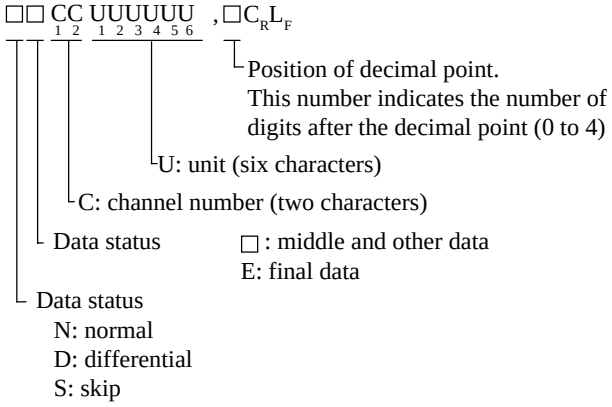
3.2.3 Output Format of Setting Parameters

When the TS1, ESC T and LF commands are received, setting parameters are output in the following order (the set values are output in the same format as input):

Communication	Set value output
PS	start/stop recording
SR	range setting
SM	offsets setting
SN	unit setting
SA	alarm setting
SC	chart speed setting
SS	trend recording format setting
SZ	zone setting
SP	partial expanded setting
ST	tag setting
SG	message setting
SE	chart speed 2 setting
SL	key lock setting
UD	selection of display
EN	the end of setting parameter output

3.2.4 Output Format of Information on Unit and Decimal Point

When the TS2, ESC T and LF commands are received, information on units and decimal points are output in the following format. Channel numbers can be specified with the LF command.



3.3 Status Byte Format

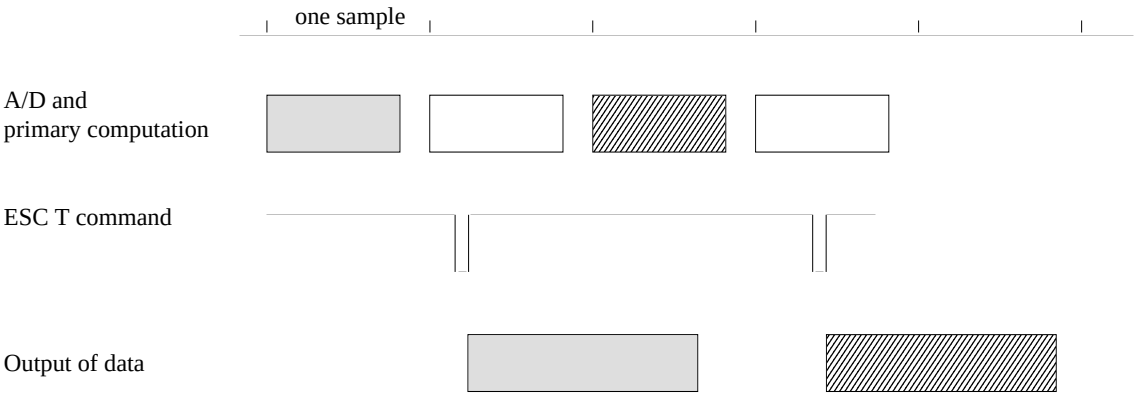
When an ESC S command is received, status is output in the following format:

ER□□C_RL_F

Status Output	Status		
	A/D END	Syntax Error	periodic printing time up
ER00C_RL_F			
ER01C_RL_F	●		
ER02C_RL_F		●	
ER03C_RL_F	●	●	
ER04C_RL_F			●
ER05C_RL_F	●		●
ER06C_RL_F		●	●
ER07C_RL_F	●	●	●

●: Status

4 TIME CHART



The sample period is 125ms for the Pen model and 5s for the Dot-printing model. When the ESC T command is received to output data before data is updated, the previous sample data will be output.

5 INITIAL STATUS

The initial status after turning the power ON is shown below.

TS0	output format is designated to be measured values
FM0, 01, 06*	output format is designated to be measured values in ASCII mode output start channel: 01 output end channel: 06
LF 01, 06*	units and decimal point position to be output start channel: 01 end channel: 06
BO0	From most significant byte (MSB)

* Depending on the recorder model, the highest channel number will be the initial status.

NOTE The contents of RS-422-A cannot be backed up by a battery.

ASCII Code Table

First digit

Second digit

	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							¶	
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									

NOTE The degree symbol (°) of °C should be selected as follows:

- In case of Measured values output (TS0) and Unit, Decimal point output (TS2):
  ° = space (20H)
- In case of setting parameter output (TS1):
  ° = E1H
- In case of recorder setting:
  ° = E1H

6 ERRORS DURING RS-422-A OUTPUT

6.1 Preventing Errors

Do not send an FM or LF command until the measured data or set point data in the specified channel is output. If an FM or LF command is sent during data output, the communication will be interrupted.

If an LF command (to set TS0) or an FM command (to set TS1 or TS2) is sent, the communication will be interrupted.

If an ESC T command was already sent when TS0 is set, data (even in other formats) in any channel can be output with an FM command. Data received with the last ESC T is output.

If an ESC T command was already sent when TS1 or TS2 is set, data set in any channel can be output with an LF command. If an ESC T command was already sent, the measured data and set point data can be output on a channel-by-channel.
If an ESC T command has already been sent, the measured value and set value can be output over more than one time.

NOTE When data is sent from the PC to the recorder, use the ESC S command to avoid buffer overflow:
This recorder receives an ESC S request, and saves it in the buffer memory. This request is retrieved from the buffer memory and, after command acknowledgement, the status is sent 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. Commands can be only received by the recorder when its input buffer is empty.

Example (Dot-printing model):

```
10    OPEN "COM1:N81N" AS #1
20    '
30    PRINT #1,CHR$(&H1B)+"O 01"
40    PRINT #1,"SA02,1,ON,L,1000,ON,I04"
50    GOSUB *HANDSHAKE
60    PRINT #1,"PS0"
70    GOSUB *HANDSHAKE
80    PRINT #1,"UD0"
90    PRINT #1,CHR$(&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)   } to prevent buffer overflow
150   RETURN
```

Command length of input buffer of this recorder is 256 bytes.

NOTE When the PC9801 receives binary data from the recorder, set the memory switches so that the PC9801 can use a DEL mode as a BS(08) code. For memory setting, see the PC9801 Instruction Manual.

NOTE Binary data cannot use a LINE INPUT statement. To read binary data, use an INPUT$ statement.

Example (Dot-printing model):

```
10      OPEN "COM1:N81N" AS #1
20      '
30      PRINT #1,CHR$(&H1B)+"O  01"
40      PRINT #1,"BO1"
50      PRINT #1,"TS0"
60      PRINT #1,CHR$(&H1B)+"T";
70      PRINT #1,"FM1,01,04"
80      D$=INPUT$(2,#1)          (to designate data length of read data)
90      CNT=CVI(D$)
100     D$=INPUT$(CNT,#1)
110     CLOSE
120     END
```

Execution of the above program may result in the following:
After line 100 has been executed, binary data will be stored in D$.
It the output data length "CNT" in line 90 exceeds 255, the read-data is separated into several parts.
When binary data is handled in an integer array on a 2-byte basis, the least significant byte is followed by the most significant byte, so an FM command should specify an output byts from the LSB (least significant byte) (line 40).

6.2 How to Request for Error Message Output

If an error occurs when a supervisory computer sends a setting or control command to the recorder via the RS-422-A communication interface, an error message can be output from the recorder upon receipt of a command from the computer.

1 request to output error message number
command: ESC S
(1B) H (53) H

2 error message output from the recorder when ESC S is received.
Output format: ERxx (CR) (LF) (xx = 00 to 07. Refer to 3.3 for details)

NOTE An error message is only output when an ESC S command is sent.
If an ESC S command (request to send error message) is sent to the recorder while data is being output due to the receipt of a TS0 or TS2 command, communication will be interrupted.
When data is transmitted between a supervisory computer and the recorder, it is possible to monitor the errors during communication through the ESC S command.

6.3 Timing of Resetting Error Status

When the recorder receives an ESC S command following the occurrence of an error, the recorder outputs the corresponding error message and the error status is simultaneously reset.

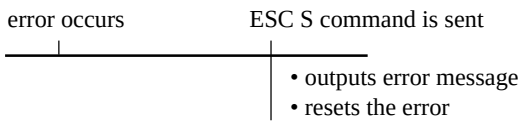


Figure 6.1 Timing

7 SAMPLE PROGRAMS

7.1 Sample Programs for NEC PC 9801

Used computer: NEC PC 9801
Mode: 8 bit, NONE parity, stop bit 1, baud rate 9600 bps
Handshake: NONE
The file name used for writing to and reading from the disc is TEST.DAT.

7.1.1 Program to Read Information on Unit and Decimal Point from the recorder, Display on Screen and Write to Disc (Dot-printing model)

```
10    OPEN “COM1:N81N” AS #1
20    OPEN “TEST.DAT” FOR OUTPUT AS #2
30    ‘
40    PRINT #1,CHR$(&H1B)+”O 01"
50    PRINT #1,”TS2"
60    PRINT #1,CHR$(&H1B)+”T”;
70    PRINT #1,”LF01,04"
80    LINE INPUT  #1,D$
90    PRINT D$
100   PRINT #2,D$
110   IF MID$(D$,2,1)<>”E” THEN GOTO 80
120   ‘
130   PRINT #1,CHR$(&H1B)+”C 01"
140   CLOSE
150   END
```

7.1.2 Program to Output Measured Data (ASCII code) from the recorder and Write to Disc (Dot-printing model)

```
10    OPEN “COM1:N81N” AS #1
20    OPEN “TEST.DAT” FOR OUTPUT AS #2
30    ‘
40    PRINT #1,CHR$(&H1B)+”O 01"
50    PRINT #1,”TS0"
60    PRINT #1,CHR$(&H1B)+”T”;
70    PRINT #1,”FM0,01,04"
80    LINE INPUT #1,D$
90    PRINT D$
100   PRINT #2,D$
110   IF MID$(D$,2,1)<>”E” THEN GOTO 80
120   ‘
130   PRINT #1,CHR$(&H1B)+”C 01"
140   CLOSE
150   END
```

7.1.3 Program to Output Measured Data (Binary code) from the recorder and Write to Disc (Dot-printing model)

```
10    OPEN “COM1:N81N” AS #1
20    OPEN “TEST.DAT” FOR OUTPUT AS #2
30    ‘
40    PRINT #1,CHR$(&H1B)+”O 01"
50    PRINT #1,”TS0"
60    PRINT #1,”BO1"
70    ‘
80    PRINT #1,CHR$(&H1B)+”T”;
90    PRINT #1,”FM1,01,04"
100   D$=INPUT$(2,#1)
110   PRINT #2,D$
120   A=CVI(MID$(D$,1,2))
130   PRINT A
140   D$=INPUT$(A,#1)
150   PRINT #2,D$
160   PRINT ASC(MID$(D$,1,1));     :PRINT “/”;
170   PRINT ASC(MID$(D$,2,1));     :PRINT “/”;
180   PRINT ASC(MID$(D$,3,1));    :PRINT
190   PRINT ASC(MID$(D$,4,1));     :PRINT “:”;
200   PRINT ASC(MID$(D$,5,1));     :PRINT “:”;
210   PRINT ASC(MID$(D$,6,1))
220   ‘
230   L=0
240   FOR I=7 TO A
250     PRINT RIGHT$(“0”+HEX$(ASC(MID$(D$,I,1))),2)+” “;
260     L=L+1
270     IF L=5 THEN L=0 : PRINT
280   NEXT I
290   ‘
300   PRINT #1,CHR$(&H1B)+”C 01"
310   CLOSE
320   END
```

7.2 Sample Programs for YEWMAC

Used computer: YEWMAC with RS 3 card installed (serial interface card) to line controller slot 3 and using port 1
Mode: 8 bit, NONE parity, stop bit 1, baud rate 9600 bps
Handshake: NONE

7.2.1 Program to Read Information on Unit and Decimal Point from the recorder and Display on Screen (Dot-printing model)

```
10    ASSIGN RS3=3
20    RESET 3
30    CONTROL 3,105;1          :! DATA LENGTH 8 bit
40    CONTROL      3,106;0      :! STOP BIT 1
50    CONTROL     3,107;0       :! PARITY NONE
60    CONTROL     3,108;13      :! 9600 BAUD
70    !
80    DIM D$128
90    OUTPUT 3,1;CHR$(27)+"O 01"
100   OUTPUT 3,1;"TS2"
110   OUTPUT 3,1;CHR$(27)+"T";
120   OUTPUT 3,1;"LF01,04"
130   ENTER  3,1;D$
140   PRINT D$
150   IF MID$(D$,2,1)<>"E" THEN GOTO 130
160   OUTPUT 3,1;CHR$(27)+"C 01"
170   END
```

7.2.2 Program to Output Measured Data (ASCII code) from the recorder and Display on Screen (Dot-printing model)

```
10    ASSIGN RS3=3
20    RESET 3
30    CONTROL 3,105;1          :! DATA LENGTH 8 bit
40    CONTROL 3,106;0          :! STOP BIT 1
50    CONTROL 3,107;0          :! PARITY NONE
60    CONTROL 3,108;13         :! 9600 BAUD
70    !
80    DIM D$128
90    OUTPUT 3,1;CHR$(27)+"O 01"
100   OUTPUT 3,1;"TS0"
110   OUTPUT 3,1;CHR$(27)+"T";
120   OUTPUT 3,1;"FM0,01,04"
130   ENTER  3,1;D$
140   PRINT D$
150   IF MID$(D$,2,1)<>"E" THEN GOTO 130
160   OUTPUT 3,1;CHR$(27)+"C 01"
170   END
```

7.2.3 Program to Output Measured Data (Binary code) from the recorder and Display on Screen (Dot-printing model)

```
10    ASSIGN RS3=3
20    RESET 3
30    CONTROL 3,105;1          :! DATA LENGTH 8 bit
40    CONTROL 3,106;0          :! STOP BIT 1
50    CONTROL 3,107;0          :! PARITY NONE
60    CONTROL 3,108;13         :! 9600 BAUD
70    CONTROL 3,118;0          :! NO TERMINATOR
80    CONTROL 3,119;1          :! RECEIVE 1 BYTE
90    !
100   DIM D$1(128)
110   CR$=CHR$(13)
120   LF$=CHR$(10)
130   !
140   OUTPUT 3,1;CHR$(27)+"O 01"+CR$+LF$
150   OUTPUT 3,1;"TS0"+CR$+LF$
160   OUTPUT 3,1;"BO1"+CR$+LF$
170   OUTPUT 3,1;CHR$(27)+"T"
180   OUTPUT 3,1;"FM1,01,04"+CR$+LF$
190   !
200   ENTER 3,1 NOFORMAT ; D$(*)        :! DATA BYTE QTY
210   A=ASC(D$(0))
220   ENTER 3,1 NOFORMAT ; D$(*)
230   A=A + ASC(D$(0))*256
240   PRINT A
250   !
260   ENTER 3,1 NOFORMAT ; D$(*)        :! YEAR
270   PRINT ASC(D$(0)); :PRINT    "/";
280   ENTER 3,1 NOFORMAT ; D$(*)        :! MONTH
290   PRINT ASC(D$(0)); :PRINT    "/";
300   ENTER 3,1 NOFORMAT ; D$(*)        :! DAY
310   PRINT ASC(D$(0)); :PRINT
320   ENTER 3,1 NOFORMAT ; D$(*)        :! HOUR
330   PRINT ASC(D$(0)); :PRINT    ":";
340   ENTER 3,1 NOFORMAT ; D$(*)        :! MINUTE
350   PRINT ASC(D$(0)); :PRINT    ":";
360   ENTER 3,1 NOFORMAT ; D$(*)        :! SECOND
370   PRINT ASC(D$(0))
380   !
390   L=0
400   FOR I=7 TO A
410     ENTER 3,1 NOFORMAT ; D$(*)
420     PRINT RIGHT$("0"+HEX$(ASC(D$(0))),2); : PRINT " ";
430     L=L+1
440     IF L=5 THEN L=0 : PRINT : ENDIF
450   NEXT I
460   !
470   OUTPUT 3,1;CHR$(27)+"C 01"
480   END
```

7.3 Sample Programs for IBM PC

Used computer: IBM PC
Mode: 8 bit, NONE parity, stop bit 1, baud rate 1200 bps
Handshake: NONE
The file name used for writing to and reading from the disc is TEST.DAT.

7.3.1 Program to Read Information on Unit and Decimal Point from the recorder, Display on Screen and Write to Disc (Dot-printing model)

```
10    OPEN "COM1:1200,N,8,1,LF" AS #1
20    OPEN "TEST.DAT" FOR OUTPUT AS #2
30    '
40    LF$=CHR$(&HA)                    :' Line feed = 0AH
50    PRINT #1,CHR$(27)+"O 01"
60    PRINT #1,"TS2"
70    PRINT #1,CHR$(27)+"T";
80    PRINT #1,"LF01,04"
90    LINE INPUT #1,D$
100   IF LEFT$(D$,1)=LF$ THEN D$=MID$(D$,2) :' Remove "LF" of head string
110   PRINT D$
120   PRINT #2,D$
130   IF MID$(D$,2,1)<>"E" THEN GOTO 90
140   '
150   PRINT #1,CHR$(27)+"C 01"
160   CLOSE
170   END
```

7.3.2 Program to Output Measured Data (ASCII code) from the recorder and Write to Disc (Dot-printing model)

```
10    OPEN "COM1:1200,N,8,1,LF" AS #1
20    OPEN "TEST.DAT" FOR OUTPUT AS #2
30    '
40    LF$=CHR$(&HA)                    :' Line feed = 0AH
50    PRINT #1,CHR$(27)+"O 01"
60    PRINT #1,"TS0"
70    PRINT #1,CHR$(27)+"T";
80    PRINT #1,"FM0,01,04"
90    LINE INPUT #1,D$
100   IF LEFT$(D$,1)=LF$ THEN D$=MID$(D$,2) :' Remove "LF" of head string
110   PRINT D$
120   PRINT #2,D$
130   IF MID$(D$,2,1)<>"E" THEN GOTO 90
140   '
150   PRINT #1,CHR$(27)+"C 01"
160   CLOSE
170   END
```

7.3.3 Program to Output Measured Data (Binary code) from the recorder and Write to Disc (Dot-printing model)

```
10    OPEN “COM1:1200,N,8,1,LF” AS #1
20    OPEN “TEST.DAT” FOR OUTPUT AS #2
30    ‘
40    PRINT #1,CHR$(27)+”O 01"
50    PRINT #1,”TS0"
60    PRINT #1,”BO1"
70    ‘
80    PRINT #1,CHR$(27)+”T”;
90    PRINT #1,”FM1,01,04"
100   D$=INPUT$(2,#1)
110   PRINT #2,D$
120   A=CVI(MID$(D$,1,2))
130   PRINT A
140   D$=INPUT$(A,#1)
150   PRINT #2,D$
160   PRINT ASC(MID$(D$,1,1));:PRINT “/”;
170   PRINT ASC(MID$(D$,2,1));:PRINT “/”;
180   PRINT ASC(MID$(D$,3,1));:PRINT
190   PRINT ASC(MID$(D$,4,1));:PRINT “:”;
200   PRINT ASC(MID$(D$,5,1));:PRINT “:”;
210   PRINT ASC(MID$(D$,6,1))
220   ‘
230   L=0
240   FOR I=7 TO A
250     PRINT RIGHT$(“0”+HEX$(ASC(MID$(D$,I,1))),2)+” “;
260     L=L+1
270     IF L=5 THEN L=0 : PRINT
280   NEXT I
290   ‘
300   PRINT #1,CHR$(27)+”C 01"
310   CLOSE
320   END
```

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 25 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal two (2) year product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR WARRANTY RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR NON-WARRANTY REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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