Instruction Manual

μRS1000
μRS1800

Models 4365□□
4375□□
μRS1000/μRS1800 Recorder
/C3 RS-422-A

IM 4D6B1-10E

YOKOGAWA ◆
Yokogawa Electric Corporation

IM 4D6B1-10E
2nd Edition

INTRODUCTION

This Instruction Manual describes the option RS-422-A for the μRS1000/μRS1800 pen and dot printing recorder.
For details concerning the operation of the μRS1000, refer to IM 4D6B1-01E; for details concerning the operation of the μRS1800, refer to IM 4H4B1-01E.

NOTES

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- This manual is the second edition, June 1994.

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- August '94 first edition

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CONTENTS

1 INSTALLATION OF RS-422-A INTERFACE

The option /C3 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: μRS1000/μRS1800 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 a μRS1000/μRS1800 recorder)

1.2 Interface Terminal

1.2.1 Terminal Arrangement

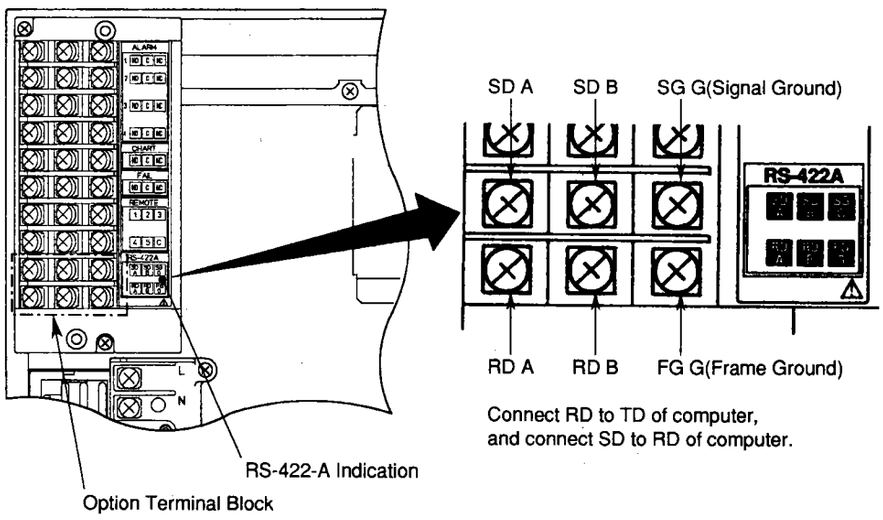


Figure 1.1 Terminal Arrangement

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

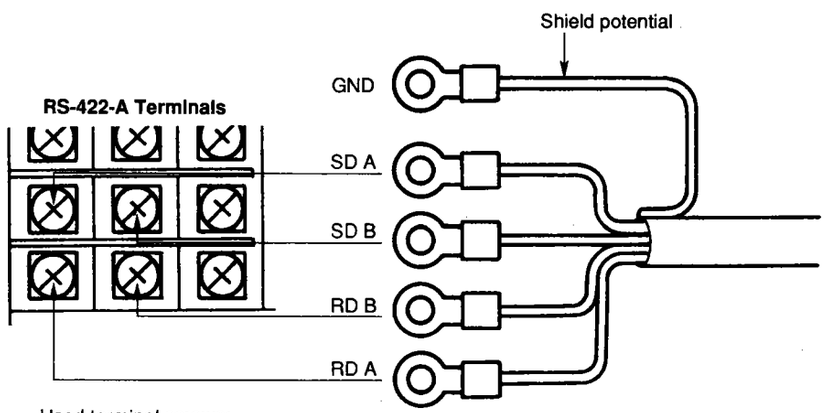


Figure 1.2 Cable Termination

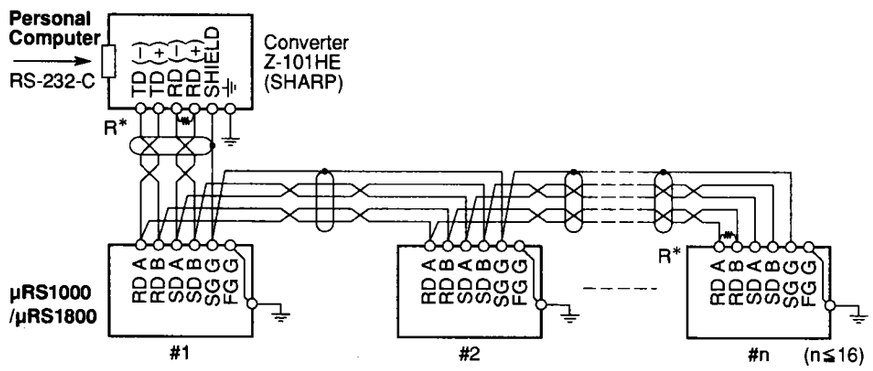
WARNING There is the power supply terminal near the interface terminal.
To prevent an electric shock, ensure the main power supply is turned OFF.

1.3 Communication Wiring

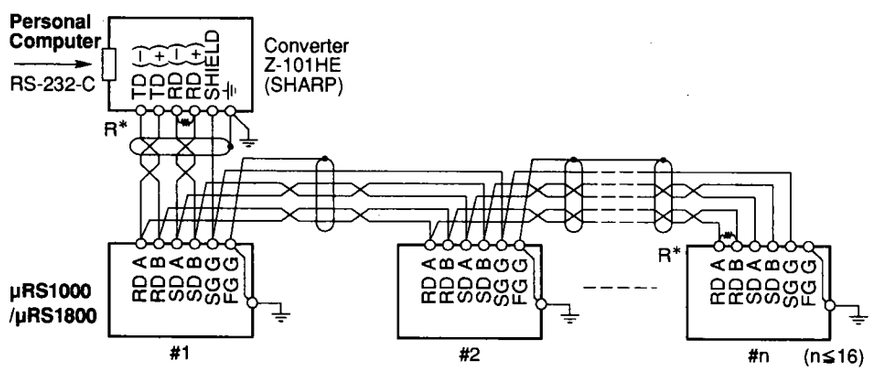
If the host (PC) is equipped with a RS-422-A interface, the μRS1000/μRS1800 can be connected directly.
If the host (PC) is equipped with a RS-232-C interface, the μRS1000/μRS1800 can be connected using a converter which has fail safe function (SHARP Z-101HE or equivalent).

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=100Ω, 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: 100Ω, capacitance 50pF/m)

Keep the terminated unshielded section to a minimum and clear of the μRS1000/ μRS1800 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). Refer to 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.

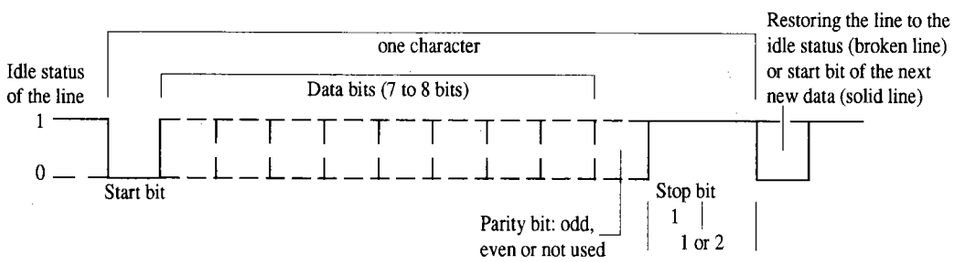


Figure 1.4 Start-Stop System for One Character

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.

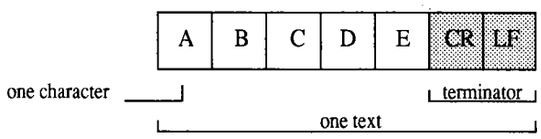


Figure 1.5 Structure of Text

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.

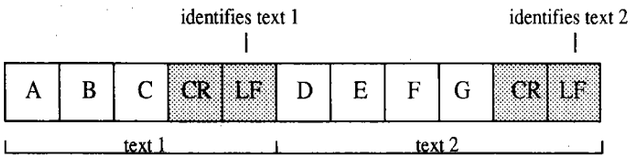


Figure 1.6 Example of Two Texts, Where the Terminator is CR-LF

NOTE The μRS1000/μRS1800 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 the μRS1000/μRS1800). 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 μRS1000/μRS1800 using the ESC S command just after commands have been sent (from the PC). Refer to 2.4.2.
Note that you cannot send an ESC S command after having sent an LF or FMcommand.
After the μRS1000/μRS1800 receives the ESC S command, it will output its status to the PC. Actually, the μRS1000/μRS1800 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 μRS1000/μRS1800 has been receiveid, the input buffer will not be empty (the ESC S command will be still in there), which means the μRS1000/μRS1800 cannot receive other commands yet.

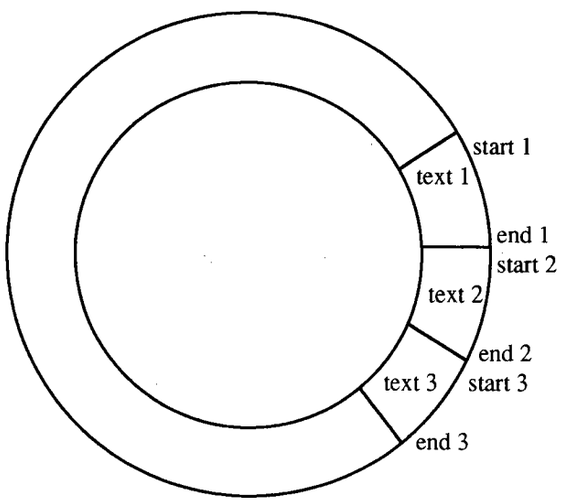


Figure 1.7 Rotary Buffer

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

SETTING PROCEDURE:

1 Remove the recorder packing material as described 1.2.2 in the Instruction Manual of the μRS1000/μRS1800 and remove the lock screw.

2 Enter the SET UP Mode by turning ON the power while pressing the ENT-key.

3 Use the UP/DOWN-keys to select the display '[n' and press the ENT-key.

4 Set the RS-422-A address (possibilities are from 01 to 16) using the UP/DOWN-keys. The initial value is '01'. Press the ENT-key.

5 Select the transmission speed (baud rate). The speed is selectable from 75 (75), 150 (15), 300 (30), 600 (60), 1200 (12), 2400 (24), 4800 (48) and 9600 (96) bits/second using the UP/DOWN keys (The numbers within parentheses are actually displayed on the μRS1000/μRS1800). After selection, press the ENT-key. The initial value is 1200 bps.

6 Select the data length. The length is selectable from '7b' (7 bits) or '8b' (8bits) using the UP/DOWN keys. After selection, press the ENT-key. The initial value is '8b'.

7 Select the parity bit. This bit is selectable from 'od' (ODD), 'EV' (EVEN) or 'nE' (NONE) using the UP/DOWN-keys. After selection, press the ENT-key. The initial value is 'EV'.

8 Select the number of stop bits. This is selectable from 1 or 2, using the UP/DOWN-keys. After selection, press the ENT-key. The initial value is 1 bits.

9 The display '[n' will appear. Use the UP/DOWN-keys to select the display 'E n' and press the ENT-key. The settings for the communication are completed, but have not been stored yet.

Use the UP/DOWN-keys to select 'St' (STORE) to keep your new settings or 'Ab' (ABORT) and press the ENT-key. After a few seconds, the SET UP Mode is completed and the Operation Mode will appear.

Set the RS-422-A interface communication as follows if your recorder equiped with /H8 option.

1 Remove the recorder packing material as described 1.2.2 in the Instruction Manual of the μRS1000/μRS1800 and remove the lock screw.

2 Enter the SET UP Mode by turning 'ON' the power while pressing the ENT-key.

3 Use the UP/DOWN-keys to select the display '[oMM'. Press the ENT-key.

4 Set the RS-422-A address (possibilities are from 01 to 16) using the UP/DOWN-keys. 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 UP/DOWN-keys. 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 UP/DOWN-keys. After selection, press the ENT-key. The initial value is 8 bits.

7 Select the parity bit. This bit is selectable from odd, EVEn ot nonE using the UP/DOWN-keys. After selection, press the ENT-key. The initial value is EVEn.

8 Select the number of stop bits. This is selectable from 1 or 2 usig the UP/DOWN-keys. 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 UP/DOWN-keys.

Before leaving the SET-UP Mode, you have to store your new settings. Press the UP/DOWN-keys 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.

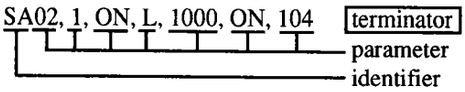
2 RECEIVING FUNCTIONS

This chapter describes program set commands and program control commands. Remember first to open a device by the ESC 0 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, 104 [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 (8 characters)
    HH:MM:SS (8 characters)
  - Channel: CC (2 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	SA	alarm setting
	SC	chart speed setting
	SD	clock setting
	SE	chart speed 2 setting

NOTE For restrictions concerning settings, refer to main μRS1000/μRS1800 Instruction Manual.
When setting the above commands, the set mode will appear. When returning to the operation mode, use the UD command (refer to 2.3.6).

2.1.2 Alarm Setting

(see 5.3 of main μRS1000/μRS1800 IM)

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
p4: the alarm set point. Enter within 5 digits, regardless of the decimal point and + or –. Refer to the following table.

Input Type		Basic Specification Code	Decimal Point Position
DC Voltage	–20.00 to 20.00 mV	–00/–30/–40	□□□.□□
	–200.0 to 200.0 mV	–01/–31/–41	□□□□.□
	–2.000 to 2.000 V	–02/–32/–42	□□.□□□
	–6.000 to 6.000 V	–03/–33/–43	□□.□□□
	–20.00 to 20.00 V	–04/–34/–44	□□□.□□
TC/RTD		–10 to –21	□□□□.□

p5: activating of the alarm output relay ON/OFF
p6: the alarm output relay number. Selectable from I01 to I12, 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.

2.1.3 Chart Speed Setting

(see 5.4 of main μRS1000/μRS1800 IM)

format: **SCp1**

p1: the chart speed (in mm/h)
(5 to 12000 mm/h for the pen model [fixed increments : refer to the following table],

5	6	8	9	10	12	15	16	18	20
24	25	30	32	36	40	45	48	50	54
60	64	72	75	80	90	96	100	120	125
135	150	160	180	200	225	240	250	270	300
320	360	375	400	450	480	500	540	600	675
720	750	800	900	960	1000	1080	1200	1350	1440
1500	1600	1800	2000	2160	2250	2400	2700	2880	3000
3600	4000	4320	4500	4800	5400	6000	7200	8000	9000
10800	12000								

1 to 1500 mm/h for the dot printing model

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

2.1.4 Clock Setting

(see 5.5 of main μRS1000/μRS1800 IM)

format: **SDp1, p2**

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

example: **SD92/07/13, 15:02:00**

2.1.5 Chart Speed 2 Setting

(see 5.4 of main μRS1000/μRS1800 IM)

format: **SEp1**

p1: the second chart speed (in mm/h)
(5 to 12000 mm/h for the pen model [40 increments : refer to 2.2.3], 1 to 1500 mm/h for the dot printing model [28 increments : refer to 2.2.3])

example: **SE100**

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

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	SETUP list printout start/stop
	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

(see 5.6 of main μRS1000/μRS1800 IM)

Command	Function
PS0	starts the recording
PS1	stops the recording

2.2.3 Manual Printout Start/Stop

(see 4.6.1 of main μRS1000/μRS1800 IM)

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

2.2.4 List Printout Start/Stop

(see 4.6.2 of main μRS1000/μRS1800 IM)

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

2.2.5 SET UP List Printout Start/Stop

(see 4.6.3 of main μRS1000/μRS1800 IM)

Command	Function
SU0	starts the SET UP list printout
SU1	stops the SET UP list printout

2.2.6 Returning Display to Operation Mode

Command	Function
UD0	selects AUTO display

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
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 'output data format' (3.2).
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 ER23. For the respective contents, refer to the next figure and table.

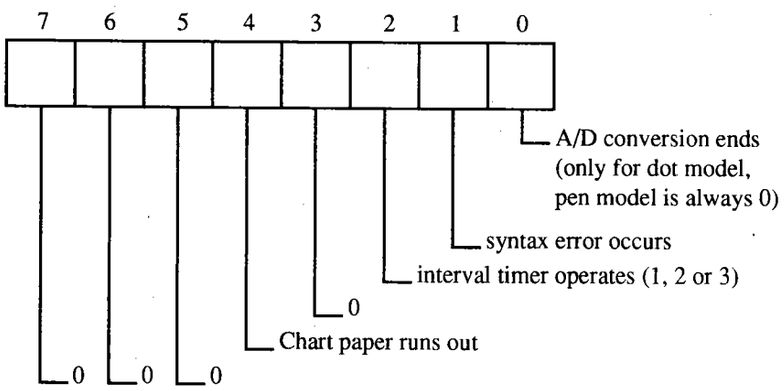


Figure 2.1 Output Format after ESC S Command Has Been Sent

NOTE The error 'chart paper runs out' will be only reset by entering new chart paper (level). In the case of all other errors: status will be reset (0) after the error message has been output.

Example:

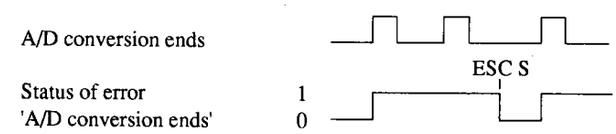


Table 2.1 Status Output Table

Status Output	Status			
	A/D END	Syntax Error	Interval Timer Operation	Chart Paper Runs out
ER00C_RL_F				
ER01C_RL_F	●			
ER02C_RL_F		●		
ER03C_RL_F	●	●		
ER04C_RL_F			●	
ER05C_RL_F	●		●	
ER06C_RL_F		●	●	
ER07C_RL_F	●	●	●	
ER16C_RL_F				●
ER17C_RL_F	●			●
ER18C_RL_F		●		●
ER19C_RL_F	●	●		●
ER20C_RL_F			●	●
ER21C_RL_F	●		●	●
ER22C_RL_F		●	●	●
ER23C_RL_F	●	●	●	●

● : Status

If an error message is output, all error statuses will be reset, except for the error 'chart paper runs out'. 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 0)_□□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 15) μRS1000/μRS1800 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 0) 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 2.2.9):
- TS0
- 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 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 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 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 three 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)
- TS2 + ESC T + LF (outputs information on unit and decimal point)

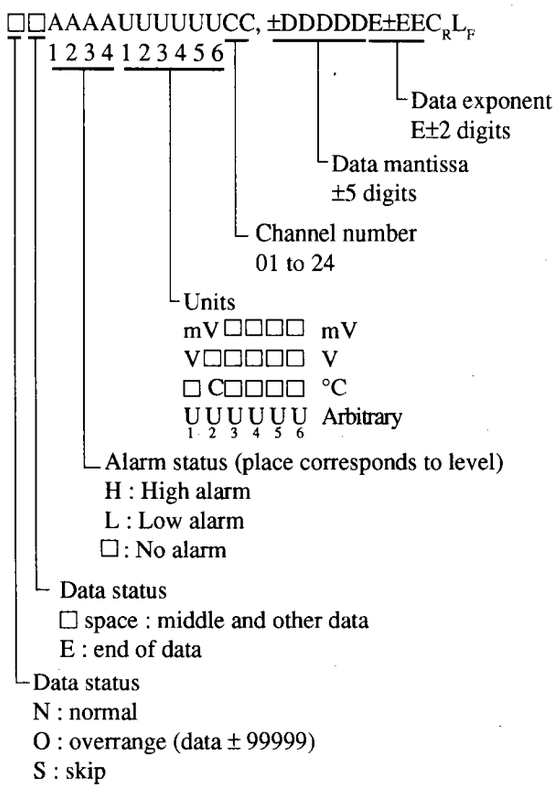
3.2.1 Output Format of Measured Values in the ASCII Mode

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$_R$L$_F$ (year, month, day)

TIMEHHMMSSC$_R$L$_F$ (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

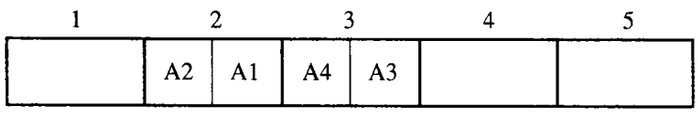
output byte number= 5 x n+6 (order of output byte can be selected)
The output byte number is output from the most significant byte (MSB) or least significant byte (LSB) according to the output sequence (BO command). Note that in the mentioned formula the above mentioned 2 bytes are not included.

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.

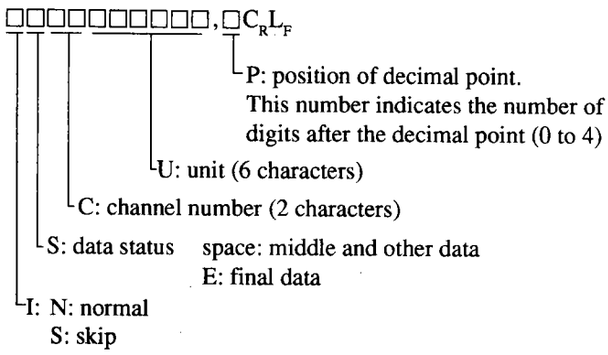
Measured data:



- 1: channel number (1 to 24)
- 2, 3: Alarm status
  An=1: H
  An=2: L
  An=0: No alarm or set to OFF
  Outputs for each level:
  A1 = level 1
  |
  A4 = level 4
- 4, 5: 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

3.2.3 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

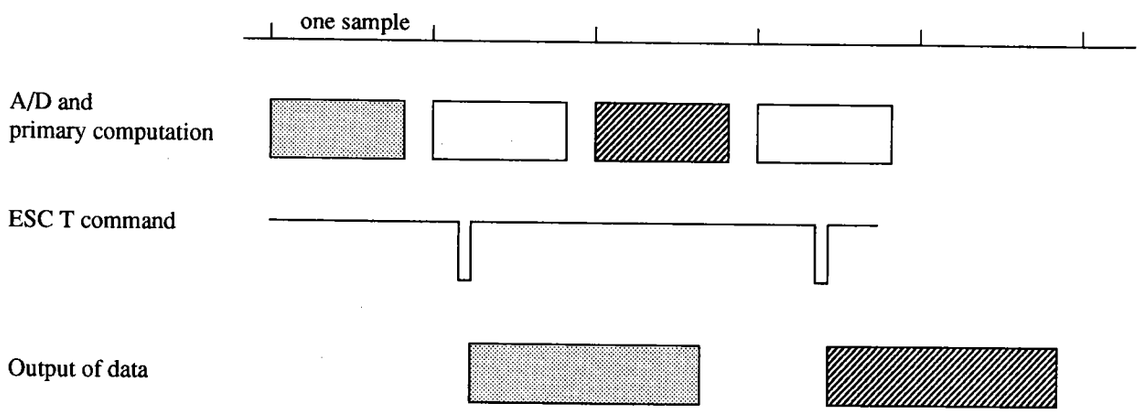
When an ESC S command is received, status is output in the following format:

ER□□C_RL_F

Status Output	Status			
	A/D END	Syntax Error	Interval Timer Operation	Chart Paper Runs out
ER00C_RL_F				
ER01C_RL_F	●			
ER02C_RL_F		●		
ER03C_RL_F	●	●		
ER04C_RL_F			●	
ER05C_RL_F	●		●	
ER06C_RL_F		●	●	
ER07C_RL_F	●	●	●	
ER16C_RL_F				●
ER17C_RL_F	●			●
ER18C_RL_F		●		●
ER19C_RL_F	●	●		●
ER20C_RL_F			●	●
ER21C_RL_F	●		●	●
ER22C_RL_F		●	●	●
ER23C_RL_F	●	●	●	●

●: Status

4 TIME CHART



The sample period is 125ms for the pen model and 2.5s 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, 24*	output format is designated to be measured values in ASCII mode output start channel: 01 output end channel: 24
LF 01, 24*	units and decimal point position to be output start channel: 01 end channel: 24
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

Second digit \ First 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							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							Ü	
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 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 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 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 an set point data can be output on a channel-by-channel.
If an ESC T command has already been sent, the data 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:
The μRS 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:

```
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$(&H1B)+"S";  (sending ESC S)  } to prevent buffer overflow
140   LINE INPUT #1,STS$        (reading status) }
150   RETURN
```

Command length of input buffer of the μRS 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:

```
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 μRS1000/μRS1800 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 μRS1000/μRS1800 when ESC S is received.
Output format: ERxx (CR) (LF) (xx = 00 to 23. 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 μRS1000/μRS1800 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 μRS1000/μRS1800, it is possible to monitor the errors during communication through the ESC S command.

6.3 Timing of Resetting Error Status

When the μRS1000/μRS1800 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.

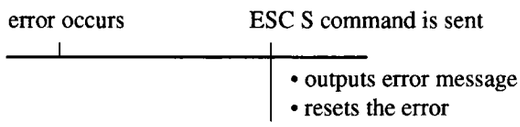


Figure 6.1 Timing

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 μRS, Display on Screen and Write to Disc

```
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 μRS and Write to Disc

```
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 μRS and Write to Disc

```
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 μRS and Display on Screen

```
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 μRS and Display on Screen

```
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 μRS and Display on Screen

```
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;"B01"+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 μRS, Display on Screen and Write to Disc

```
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 μRS and Write to Disc

```
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 μRS and Write to Disc

```
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
```

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