/RS232C and /GP-IB for LR4100E, LR4200E Series Recorders

IM 3710 - 10E

IM 3710 - 10E
4th Edition

Product Registration

Thank you for purchasing YOKOGAWA products.

YOKOGAWA provides registered users with a variety of information and services. Please allow us to serve you best by completing the product registration form accessible from our homepage.

http://www.yokogawa.com/ns/reg/

CONTENTS

FD No. 10023-N

1. OUTLINE

1.1 GP-IB Outline

This GP-IB interface of this instrument is used internationally as a standard instrument interface bus, and conforms to IEEE Standard 488-1978.

- **Measured and calculated data output**
- **Digital data entry**
- **Set data input / output**
- **Control command input**

Note that power switch operation and SET UP mode setting (communication parameter settings) cannot be controlled via a GP-IB interface.

1.2 GP-IB Interface Functions

The GP-IB interface functions are as shown in the Table 1.1.

Table 1.1 Interface Functions

Function	Description
SH1	Send handshake
AH1	Acknowledge handshake
T6	Basic talker function Serial poll Talker cancel by listener designation
L4	Basic listener function Listener cancel by talker designation
SR1	Service request function
RL1	Remote / local function
PP0	No parallel port function
DC1	Device clear function
CT1	Device trigger function
C0	No controller function

1.3 Bus Driver System

This GP-IB interface bus driver uses both open connector and tristate circuits.

1.4 GP-IB Address Setting

When GP-IB communications are performed, it is necessary to determine the addresses to be used in the programs. Set the address for this instrument according to the following procedure.

* Move the SET UP (DIP) switch on the rear panel to ON position.
* While holding the [ENTRY] key pressed, turn on the power switch; the instrument will go into SET UP mode.
  (Continue to press the [ENTRY] key until the SET UP mode message appears on the display panel.)

Function labels will be as in the table below.

F1	F2	F3	F4
UNIT	PRN	RCD	RMT

Press the [NEXT] key once; labels will change to:

F1	F2	F3	F4
COM	PJC	OTHR	RAM

Press the (F1) function key to set COM (communications) mode.

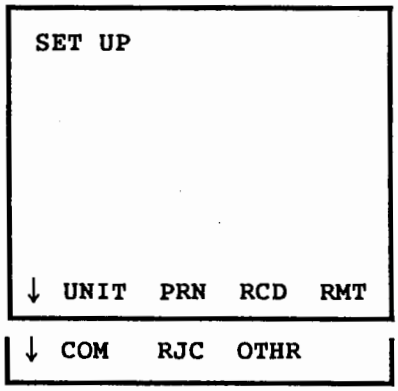
* LR4120E and LR4220E have a different function key panel.

[Display Selection]

- Turn the SET UP (DIP) switch on the rear panel to ON position.
- [ENTER] key + power ON; display below will appear.

[Key Operations]

[Setting Display]



[Description]

- Press (F1) key to set COM (communications) mode.

The following displays will appear on the display panel. Note that parameters 2 through 6 are not required for a GP-IB interface.

[Display] **[Function Key Assignments]**

1 | GP-IB ADDRESS : 1 |

GP-IB address setting

	(F1)	(F2)	(F3)	(F4)
↓	0	1	2	3
↓	4	5	6	7
↓	8	9	10	11
	12	13	14	15

* Function key assignments can be changed by pressing the [NEXT] key.

2 | RS BAUD RATES : 1200 |

RS-232C baud rate

	(F1)	(F2)	(F3)	(F4)
↓	75	150	300	600
	1200	2400	4800	9600

* Function key assignments can be changed by pressing the [NEXT] key.

3 | RS STOP BIT : 2 |

RS-232C stop bit

(F1)	(F2)	(F3)	(F4)
1	1.5	2	

4 | RS PARITY : EVEN |

Parity error check

(F1)	(F2)	(F3)	(F4)
EVEN	ODD	NONE	

5 | RS DATA BITS : 8 |

Word length

(F1)	(F2)	(F3)	(F4)
7	8		

6 | RS HANDSHAKE : OFF : OFF |

Handshake setting

	(F1)	(F2)	(F3)	(F4)
↓	OFF: C:R	X:E	X:R	C:E

After completing parameter setting, press [ENTRY] key twice. Self test is performed and the recorder will return to the power ON state (released from SET UP mode). (If ENTRY key is pressed only once, the recorder will return to the initial display in SET UP mode.)

1.5 RS-232C Outline

The RS-232C interface is a communications interface conforming to the *EIA standard, and enables the following (at the time of duplex communications).

- **Measured and calculated value outputs**
- **Data (in digital form) input**
- **Setting value input / output**
- **Control command input**

Note that power switch operational setup mode settings (communication parameter settings) cannot be controlled via an RS-232C interface.

* EIA : Electronic Industries Association (U.S.)

1.6 RS-232C Interface Function

[Transmission System]

Transmission System :	Start-stop system (asynchronous) Full duplex
Transmission Speed :	75, 150, 300, 600, 1200, 2400, 4800, 9600 bit / sec.
Start Bits :	1 bit
Stop Bits :	1, 1.5 or 2 bits
Parity :	Even, odd or none
Word Length :	7 or 8 bits
Electrical Characteristics :	Conforms to EIA RS-232C.
Connector :	Recorder : DBSP-JB25S (JAE)
	Cable : DB-25P equivalent

1.7 RS-232C Communication Data Setting

Enter RS-232C communications parameters from the front panel.

* While holding the [ENTRY] key pressed, turn on the power switch; the instrument will go into SET UP mode.
  (Continue to hold the [ENTRY] key pressed until the SET UP mode message appears on the display panel.)

Function labels will be as in the table below.

F1	F2	F3	F4
UNIT	PRN	RCD	RMT

Press the [NEXT] key once; labels will change to:

F1	F2	F3	F4
COM	RJC	OTHR	RAM

Press the (F1) function key to set COM (communications) mode.

LR4120E and LR4220E have a different function key panel.

For RS-232C communications, set parameters 2 through 6 to match those of the computer connected.

The following displays appear on the display panel.

[Display] **[Function Key Assignments]**

1 | GP-IB ADDRESS : 1 |

GP-IB address setting

(F1)	(F2)	(F3)	(F4)
0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15

* Function key assignments can be changed by pressing the [NEXT] key.

2 | RS BAUD RATES : 1200 |

RS-232C baud rate

(F1)	(F2)	(F3)	(F4)
75	150	300	600
1200	2400	4800	9600

* Function key assignments can be changed by pressing the [NEXT] key.

3 | RS STOP BIT : 2 |

RS-232C stop bit

(F1)	(F2)	(F3)	(F4)
1	1.5	2	

4 | RS PARITY : EVEN |

Parity error check

(F1)	(F2)	(F3)	(F4)
EVEN	ODD	NONE	

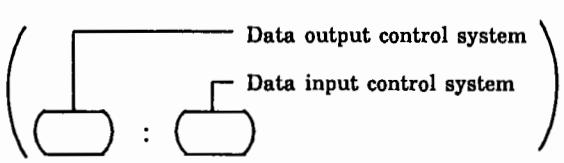
5 | RS DATA BITS : 8 |

Word length

(F1)	(F2)	(F3)	(F4)
7	8		

6 | RS HANDSHAKE : OFF : OFF |

Handshake setting



(F1)	(F2)	(F3)	(F4)
OFF : C : R	X : E	X : R	C : E

* Function key assignments can be changed by pressing the [NEXT] key.

OFF : No input/output control by ER, RS, or CS signals or Xon.
X : Data output controlled by Xon reception.
CS : Data output controlled by CS signal reception.
RS : RS signal ON when input possible, OFF when input not possible.
ER : ER signal ON when input possible, OFF when input not possible.

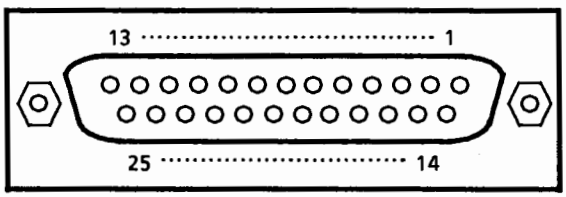
After setting all items, press ▽ key to advance to the next step.

After setting parameters, depress [ENTRY] key twice.

Self test is performed and the recorder will return to the power on state (it is released from SET UP mode). (If ENTRY is pressed only once, the recorder will return to the initial display in SET UP mode.)

1.8 RS-232C Interface Connectors

[Connector Pin Positions and Signal Function Description]



Pin No.	EIA Code	Direction	Signal Name (English)	JIS Code	CCITT
1	AA	–	Frame Ground	FG	101
2	BA	Output	Transmitted Data	SD	103
3	BB	Input	Received Data	RD	104
4	CA	Output	Request to Send	RS	105
5	CB	Input	Clear to Send	CS	106
6	CC	Input	Data Set Ready	DR	107
7	AB	–	Signal Ground	SG	102
8	CF	Input	Data Carrier Detect	CD	109
9 to 19			NC		
20	CD	Output	Data Terminal Ready	ER	
21 to 25			NC		

Figure 1.1 Connector Pin Positions and Signal Function Description

[Signals Used by LR]

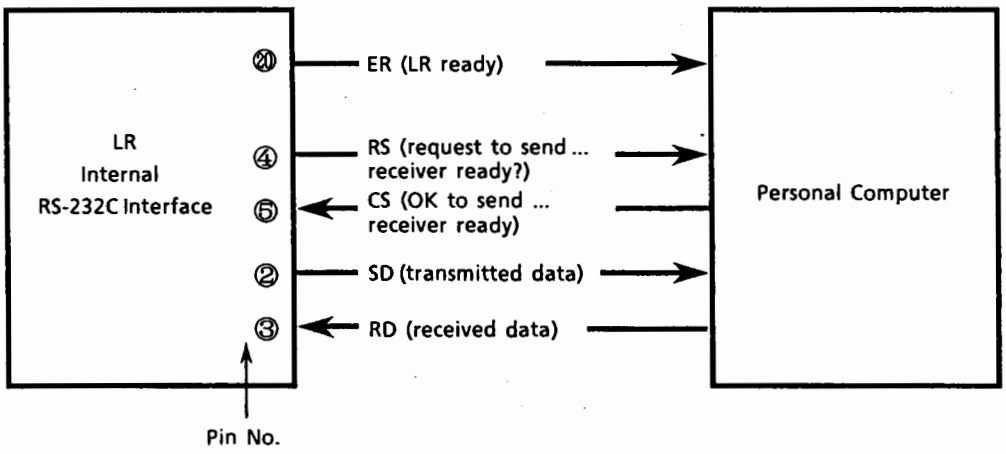


Figure 1.2

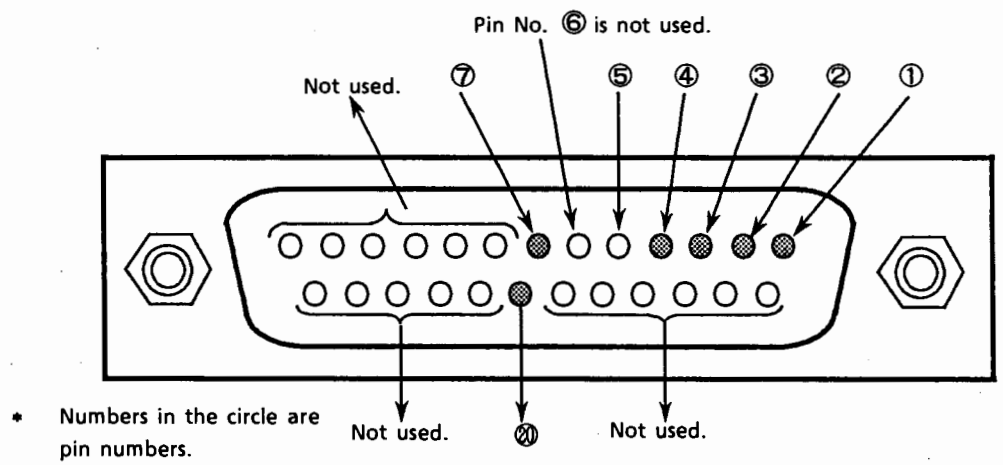


Figure 1.3

Table 1.2

Pin No.	Abbreviation			Input / Output	Signal Name	Signal Monitoring	Remarks
	JIS	CCITT	EIA				
①	FG	101	AA	–	Frame Ground	–	Protective ground
②	SD	103	BA	Output	Transmitted Data	–	Data transmission
③	RD	104	BB	Input	Received Data	–	Receives data
④	RS	105	CA	Output	Request to Send	○	Used to send data to data communication equipment.
⑤	CS	105	CB	Input	Clear to Send	○	Used to receive data from data communication equipment.
⑥	This pin not used in LR RS-232C interface.						
⑦	SG	102	AB	–	Signal Ground	–	Signal ground
⑧ to ⑬	These pins not used in LR RS-232C interface.						
⑳	ER	108/2	CD	Output	Equipment Ready	–	Turns ON (positive voltage) when data terminal is in power on state and able to send/ receive data.
㉑ to ㉕	These pins not used in LR RS-232C interface.						

1.9 RS-232C Data Communications

(1) Start-Stop Communication System

The built-in RS-232C interface performs communications in the start-stop system. In start-stop transmission, each time a character is sent it is preceded by a start bit at its head, which is then followed by the data bits (7 or 8 bits), parity bit, and stop bit (see Figure 1.4). The user must specify the communication speed, data length, parity bit, and stop bit (s) in the SET UP mode.

Note that since the single start bit is added automatically, there is no need to specify it.

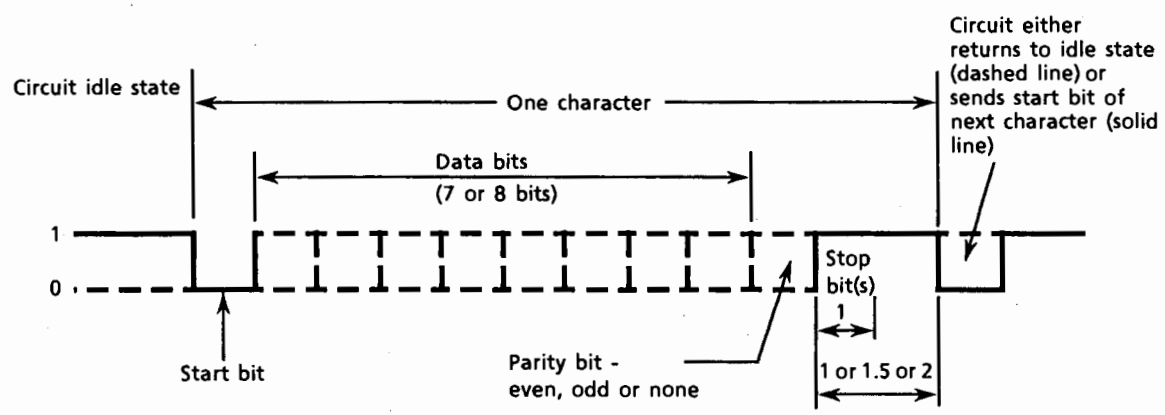


Figure 1.4 Data Format for One Character in Start - Stop System

(2) Text

Communications data is usually sent as a multi-character string followed by a terminator.

This is referred to as a "text". The user should recognize and interpret data in such units (see Figure 1.5).

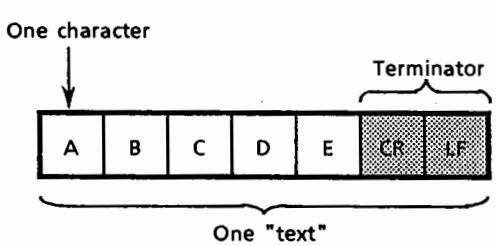


Figure 1.5 "Text" Example

(3) Text Interpretation

When a terminator is received via an RS-232C interface, it interprets it as the end of a received text and recognizes that text unit (see Figure 1.6).

Example : When terminator is CR-LF pair

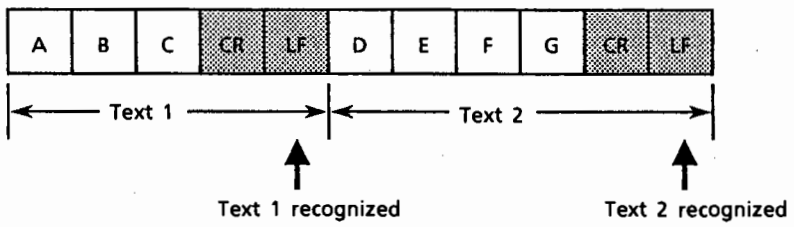


Figure 1.6

[About Terminators]

"L_F" or ";" are used as a terminator when data is received. (C_R and L_F are used as terminators when data is sent.)

When C_R and L_F are used as a terminator as shown in the diagram above, the C_R is ignored.

(Note that when communicating with personal computers, as in some personal computer software there are PRINT statement modes which output only C_R as a terminator, without any L_F.)

(4) Input Buffering

The input buffer is implemented as a rotary buffer of 256 bytes. As texts are received they are stored in sequence in the rotary buffer and transferred out in oldest-first order in response to read requests from BASIC. There is no need to deal with this explicitly at the user program level.

Rotary Buffering

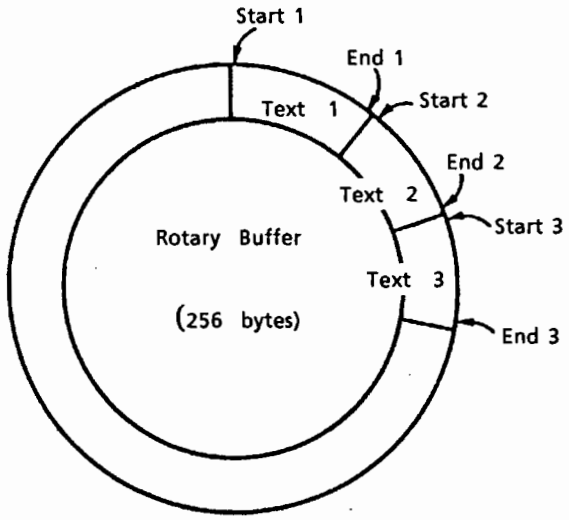


Figure 1.7

(5) Buffer Full Control

As stated above, input and output buffers are required for data communications. However, the capacities of those buffers are limited (in this device, 256 bytes).

Therefore, especially on the receiving side, if a large amount of data is transmitted in a short time, the buffer capacity may be exceeded.

Since there are many cases in which it is not possible to retransmit the same data after it has been sent from the transmitting side if the excess data overflows the buffer, this will cause a data communication failure.

For this reason, the receive side must monitor buffer status so as to prevent buffer capacity from being exceeded, detecting any incipient buffer full condition and signaling the transmitting device to request a temporary halt in data transmission.

During the halt in data transmission, the received data in the buffer is processed, and when space is again available in the buffer, a request is sent to the transmitting device to restart transmission.

[X-ON / X-OFF]

The RS-232C interface uses the [X-ON / X-OFF] method of buffer full control.

- When the personal computer with which data communications are being performed sends an X-OFF upon reaching a buffer full condition, this recorder will temporarily halt data transmission.
- When the personal computer sends an X-ON as a result of clearing the buffer full condition, this recorder will resume data transmission.

Note : For buffer full control by means of [X-ON / X-OFF], it must be possible to send and receive the X-ON / X-OFF characters even while data transmission is in progress. Therefore a full duplex communication system is required.

1.10 GP-IB / RS-232C Interface Location

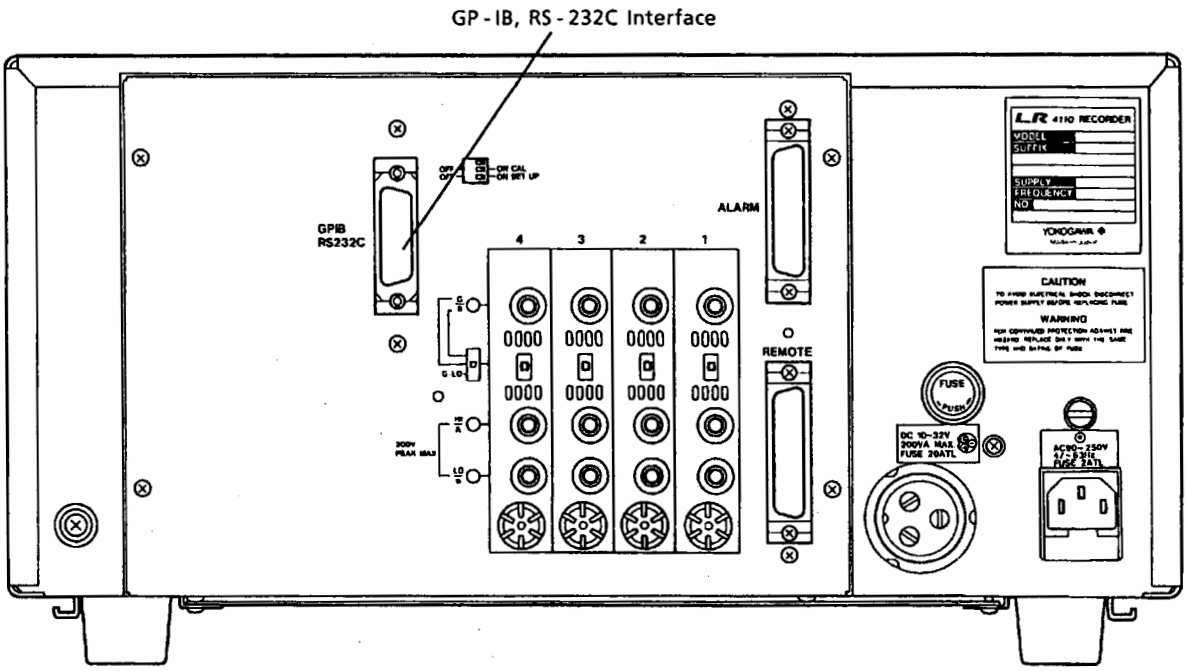


Figure 1.8 LR4100E GP-IB / RS-232C Interface Location

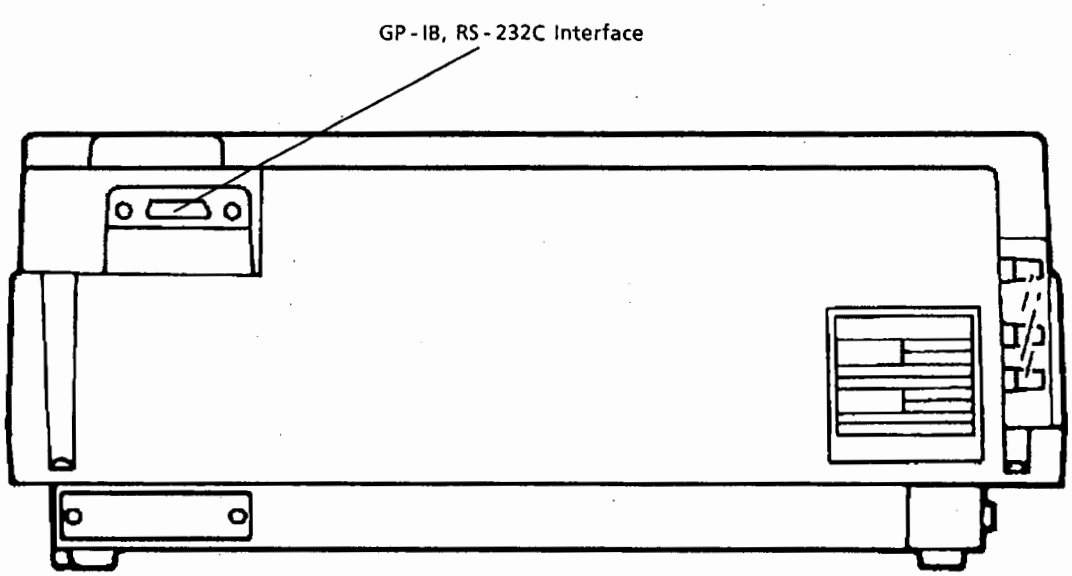


Figure 1.9 LR4200E GP-IB / RS-232C Interface Location

2. COMMANDS FOR DATA ENTRY, CONTROL, DATA OUTPUT AND INPUT

2.1 Command Summary List

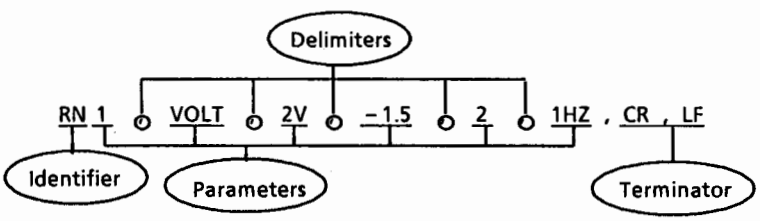
Table 2.1 Command Summary List

Type	Command	Function
Entry	RN	Range setting
	CO	MATH constant setting
	AL	Alarm setting
	(TG)	Tag setting
	PA	Record format setting for partial compression/expansion
	AS	Record format setting for AUTO SHIFT
	(MS)	Message entry
	SC	Date/time setting
	SP	Chart speed setting
	RA	Recording area adjustment
	DA	Data sampling (write to memory card or internal RAM disk)
	DU	Data recovery (read from memory card or internal RAM disk)
	LO	Load settings from memory card or floppy disk (read)
	SA	Save settings to memory card or floppy disk
	FS	Data copying to floppy disk (for optional /FDD code)
	FO	Data copying from floppy disk (for optional /FDD code)
	FA	Making ASCII-conversion and copying data from internal RAM disk to floppy disk (for optional /FDD code)
	FW	Automatic data copying to floppy disk (for optional /FDD code)
	FR	Automatic reproduction from floppy disk (for optional /FDD code)
Control	DS	Display mode selection
	CS	Chart start-stop control
	(PL)	Pen up/down control
	(LS)	List print command
	(PM)	Message print command
	<PO>	Phase sync ON/OFF
	RC	Recording start-stop control
	(MP)	Manual print command
Output	TS	Output data selection
	BO	MSB, LSB output order selection
	IM	SRQ status mask command
	FM	ASCII/binary output selection
	MF	ASCII/binary output selection for IC card data
Input	CV	Communication input data command
RAM Initialization	CL	Initializes RAM to state at time of shipment

*: LR4120E LR4220E does not have commands inside the ( ).
*: One-pen models do not have a PO command, inside the < >.

2.2 General Considerations Relating to Commands

Commands are composed of ASCII codes and can be separated into identifiers, parameters, delimiters, and terminators.



Identifiers : Defined by two upper-case characters.

Parameters :
- Parameters are separated by delimiters (commas).
- Numeric parameters may be preceded by a leading sign. If unsigned, they are treated as positive.
  (Examples) −.00001 +100 123.45
- For numeric parameters, the effective set range differs depending on commands.
- Spaces preceding and following a parameter or spaces in the middle of a parametaer are ignored, except in those parameters specified with ASCII character strings, such as units and messages, in which spaces are recognized.
- Parameters that need not be changed can be omitted, but the delimiters must not be omitted. However, it is permissible to omit contiguous trailing delimiters (,,,) resulting from omissions at the end of a command.
  (Example) RN1, VOLT, 2V
- The parameters below are fixed-length. An error will result if the length is incorrect.
  - Date YY/MO/DD (8 characters)
  - Time HH : MN : SS (8 characters)

Terminators :
(1) CR/LF
(2) LF
(3) ; (semicolon)
(4) EOI = True (GP-IB only)

[ASCII Code]

Upper 4 bits →

Lower 4 bits ↓

	0	1	2	3	4	5	6	7
0			SPC	0		P		p
1			!	1	A	Q	a	q
2				2	B	R	b	r
3			#	3	C	S	c	s
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			*	:	J	Z	j	z
B			+		K		k	
C					L	μ*	l	
D			–		M		m	
E			.		N	Ω*	n	
F			/	* °	O		o	

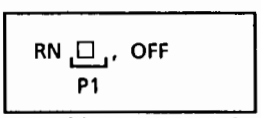
* Character definitions unique to the LR

,3. DATA ENTRY COMMANDS

3.1 Range Setting

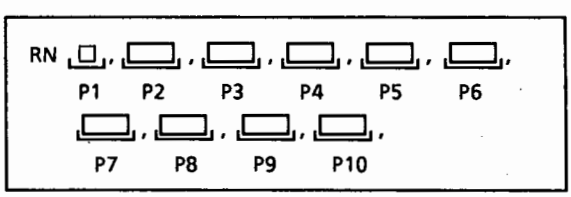
3.1.1 VOLT, TC and RTD Range Setting

(1) To set range to OFF :



PI : Channel number (1 to 4) * For a one-pen model, channel number=1.

(2) For DC voltage, thermocouple, or resistance temperature detector input



P1 : Channel number (1 to 4) * For a one-pen model, channel number=1.

P2 : Enter (SCALE) when scaling is desired.
Omit when scaling is not desired.

P3 : Input type specification
DC voltage ··· P3 : (VOLT)
Thermocouple ···P3 : (TC)
RTD ··· P3 : (RTD)

P4 : Range specification ··· see lists below.

For VOLT P4 : { 100¥V, 200¥V, 500¥V, (or 100¥V, 200¥V, 500¥V if using non-Japanese personal computer) (¥V means μV)
1mV, 2mV, 5mV, 10mV, 20mV, 50mV, 100mV,
200mV, 500mV, 1V, 2V, 5V, 10V, 20V, 50V,
100V, 200V } any one

For TC P4 : { R, S, B, K, E, J, T, N, W, L, U, KpvsAv7Fe } any one

For RTD P4 : { Pt100 : 1 / DIN, Pt100 : 2 / DIN, Pt100 : 3 / DIN,
Pt50 : 1 / DIN, Pt50 : 2 / DIN, Pt100 : 1 / JIS,
Pt100 : 2 / JIS, Pt100 : 3 / JIS, Pt50 : 1 / JIS,
Pt50 : 2 / JIS, Ni100 : 1 / DIN, Ni100 : 1 / SAMA
J263*B } any one

P5 : Span left
- Decimal point location adjusted according to range.
- 5 significant digits.

P6 : Span right
- Decimal point location adjusted according to range.
- 5 significant digits.

P7 : Scale left
P8 : Scale right
} Scale range is − 20000 to + 20000.

- Scale left and scale right values are adjusted according to whichever has the fewest digits below the decimal point.
- 5 significant digits.
- Omitted if scaling not desired.

P9 : Scale units
- Enable to enter any desired character string up to 6 characters.
- Omitted if scaling not desired.

P10: Filter (0.1 Hz, 1 Hz, OFF)

Program examples in cases where scaling is not desired:

DC voltage ··· RN2, VOLT, 2V, −1.5, 1.5, OFF
Thermocouple ··· RN3, TC, T, 10.5, 100, 0.1Hz
RTD ··· RN4, RTD, Pt100 : 1 / JIS, 50, 100, 1Hz

Program examples in cases where scaling is desired:

DC voltage ··· RN2, SCALE, VOLT, 5V, 1, 5, 0.00, 100.00, %, OFF
Thermocouple ··· RN3, SCALE, TC, T, 10, 100, 0, 100, %, 1Hz
RTD ··· RN4, SCALE, RTD, Pt100 : 1 / JIS, 10, 100, 0, 100, %, 0. 1Hz

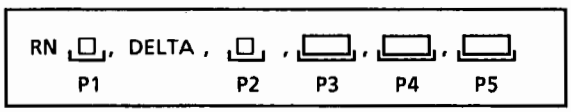
Table 3.1 (1/2)

Range / Type Name	°C			°F		
	Measurement Range (normal)	Measurement Range (DELTA)	Simple Setting Value	Measurement Range (normal)	Measurement Range (DELTA)	Simple Setting Value
100μV	−110.00 to 110.00	←	0.00 to 100.00			
200μV	−220.00 to 220.00	←	0.00 to 200.00			
500μV	−550.00 to 550.00	←	0.0 to 500.0			
1mV	−1.1000 to 1.1000	←	0.0000 to 1.0000			
2mV	−2.2000 to 2.2000	←	0.0000 to 2.0000			
5mV	−5.500 to 5.500	←	0.0005 to .0000			
10mV	−11.000 to 11.000	←	0.000 to 10.000			
20mV	−22.000 to 22.000	←	0.000 to 20.000			
50mV	−55.00 to 55.00	←	0.00 to 50.00			
100mV	−110.00 to 110.00	←	0.00 to 100.00			
200mV	−220.00 to 220.00	←	0.00 to 220.00			
500mV	−550.0 to 550.0	←	0.0 to 500.0			
1V	−1.1000 to 1.1000	←	0.0000 to 1.0000			
2V	−2.2000 to 2.2000	←	0.0000 to 2.0000			
5V	−5.500 to 5.500	←	0.000 to 5.000			
10V	−11.000 to 11.000	←	0.000 to 10.000			
20V	−22.000 to 22.000	←	0.0002 to 0.000			
50V	−55.00 to 55.00	←	0.00 to 100.00			
100V	−110.00 to 110.00	←	0.00 to 100.00			
200V	−220.00 to 220.00	←	0.00 to 200.00			
R	0.0 to 1760.0	±1760.0	0.0 to 1700.0	32 to 3200	±3200	100 to 3200
S	0.01 to 760.0	±1760.0	0.0 to 1700.0	32 to 3200	±3200	100 to 3200
B	0.0 to 1820.0	±1820.0	0.0 to 1800.0	32 to 3308	±3295	100 to 3300
K	−200.0 to 1370.0	±1370.0	−200.0 to 1300.0	−328.0 to 2498.0	±2498.0	−300.0 to 2400.0
E	−200.0 to 800.0	±800.0	−200.0 to 800.0	−328.0 to 1472.0	±1472.0	−300.0 to 1400.0
J	−200.0 to 1100.0	±1100.0	−200.0 to 1100.0	−328.0 to 2012.0	±2012.0	−300.0 to 2000.0
T	−200.0 to 400.0	±400.0	−200.0 to 400.0	−328.0 to 752.0	±752.0	−300.0 to 700.0
N	0.0 to 1300.0	±1300.0	0.0 to 1300.0	32.0 to 2372.0	±2372.0	100.0 to 2300.0
W	0.0 to 2315.0	±2315.0	0.0 to 2300.0	32 to 4199.0	±4199	100 to 4100
L	−200.0 to 400.0	±900.0	−200.0 to 900.0	−328.0 to 1652.0	±1652.0	−300.0 to 1600.0
U	−200.0 to 400.0	±400.0	−200.0 to 400.0	−328.0 to 752.0	±752.0	−300.0 to 700.0
KpvsAu7Fe	0.0 to 300.0K	±300.0K	0.0 to 300.0K	0.0 to 300.0K	±300.0k	0.0 to 300.0K

Table 3.1 (2/2)

Range/Type Name	℃			℉		
	Measurement Range (normal)	Measurement Range (DELTA)	Simple Setting Value	Measurement Range (normal)	Measurement Range (DELTA)	Simple Setting Value
Pt100:1	−200.0 to 850.0	±850.0	−200.0 to 800.0	−328.0 to 800.0	±1562.0	−300.0 to 1500.0
Pt100:2	−200.0 to 400.0	±400.0	−200.0 to 400.0	−328.0 to 752.0	±752.0	−300.0 to 700.0
Pt100:3	−150.0 to 150.0	±150.0	−100.0 to 100.0	−238.0 to 302.0	±302.0	−200.0 to 300.0
Pt50:1	−200.0 to 640.0	±640.0	−200.0 to 600.0	−328.0 to 1184.0	±1184.0	−300.0 to 1100.0
Pt50:2	−50.0 to 600.0	±600.0	0.0 to 600.0	−58.0 to 1112.0	±1112.0	0.0 to 1100.0
Pt100:1/JPt	−200.0 to 640.0	±640.0	−200.0 to 600.0	−328.0 to 1184.0	±1184.0	−300.0 to 1100.0
Pt100:2/JPt	−200.0 to 400.0	±400.0	−200.0 to 400.0	−328.0 to 752.0	±752.0	−300.0 to 700.0
Pt100:3/JPt	−150.0 to 150.0	±150.0	−100.0 to 100.0	−238.0 to 302.0	±302.0	−200.0 to 300.0
Pt50:1/JPt	−200.0 to 640.0	±640.0	−200.0 to 600.0	−328.0 to 1184.0	±1184.0	−300.0 to 1100.0
Pt50:2/JPt	−50.0 to 600.0	±600.0	0.0 to 600.0	58.0 to 1112.0	±1112.0	0.0 to 1100.0
Ni100:1/DIN	−60.0 to 180.0	±180.0	0.0 to 100.0	76.0 to 356.0	±356.0	0.0 to 300.0
Ni100:1/SAMA	−200.0 to 250.0	±250.0	−200.0 to 200.0	−328.0 to 482.0	±482.0	−300.0 to 400.0
J263*B	0.0 to 300.0K	±300.0K	0.0 to 300.0K	0.0 to 300K	±300.0K	0.0 to 300.0K

3.1.2 DELTA (Difference Calculation) Setting



P1 : Channel number (2 to 4)
P2 : Reference channel for difference calculation (1 to 3)
* Set number less than P1.
* Enter VOLT, TC, or RTD input.
P3 : Span left
- Decimal point location adjusted according to reference channel range.
- 5 significant digits

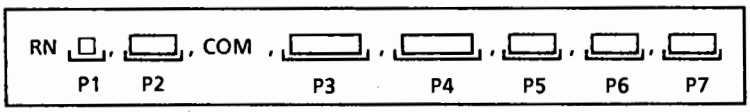
P4 : Span right
- Decimal point location adjusted according to reference channel range.
- 5 significant digits.

P5 : Filter (0.1 Hz, 1 Hz, OFF)

(Program Examples)

RN5, DELTA, 2, −2, 2, 1 Hz

3.1.3 COM (Digital Input Communication) Setting



P1 : Channel number (1 to 4)
P2 : Enter (SCALE) when scaling is desired.
Omit when scaling is not desired.
P3 : Span left
P4 : Span right
- 5 significant digits. effective range −22000 to 22000.
- Decimal point positions for span left and span right are adjusted to whichever has the fewest digits below the decimal point.

P5 : Scale left
P6 : Scale right
- Decimal point positions for scale left and scale right are adjusted to whichever has the fewest digits below the decimal point.
- Effective range; −22000 to 22000.
- Omitted if scaling not desired.

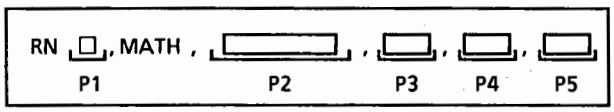
P7 : Span / scale units (6 characters max)

(Program Examples)

When scaling is desired:
RN3, COM, 1.00, 5.00, UNIT
When scaling is not desired:
RN1, SCALE, COM, 1.000, 5,000, 0.00, 100.00 %

* "Digital input communication" refers to the input of digital numeric values from the computer to the LR (main unit). The drawing of waveforms, and such.

3.1.4 MATH Setting (Requires */MATH Option)



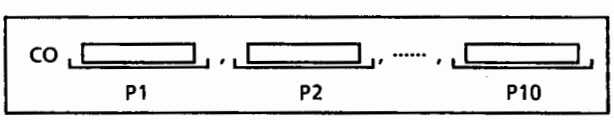
P1 : Channel number (1 to 4)
P2 : Calculation expression (18 characters maximum)
P3 : Span left
P4 : Span right
- Span left and span right set values are adjusted according to whichever has the fewest digits below the decimal point.
- 5 significant digits. Effective range ; −22000 to 22000.

P5 : Calculation units (6 characters max)

(Program Example)

RN7, /MATH, (1*A + 3*B) / 4, −100.00, 100.00, UNIT07

[MATH Constants]

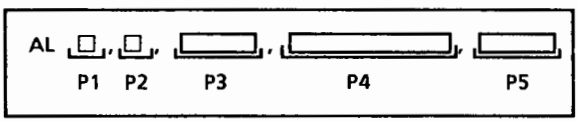


P1 through P10 : MATH constant values (10 values maximum)

· MATH constant length must not exceed 12 characters.

· Constant range { +9.9999E+29 to 1.0000E−30 / 0 / −1.0000E−30 to 9.9999E+29 }

3.2 Alarm Setting

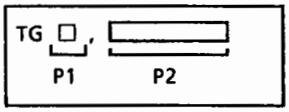


P1 : Alarm setting channel (1 to 4)
P2 : Alarm No. (1, 2)
(There are two alarm levels for each alarm channel.)
P3 : Alarm mode (H, L, OFF)
H ··· High-limit alarm
L ··· Low - limit alarm
P4 : Alarm setpoint
Alarm setpoint ranges are as follows :
(1) For VOLT, TC, RTD or DELTA measurement, the corresponding ranges are as shown in the table provided in Section 3.1.1.
(2) For SCALE setting, SCALE values shown in Section 3.1.1 are used.
(3) COM or MATH setting can range COM ±22000.
P5 : Relay output (1 to 4, OFF)

(Example)
AL2, 1, H, 5.000, 1

* The alarm setpoint must be within the measuring ranges shown in the table provided in Section 3.1.1.
For scale mode, the alarm setpoint must be within the scale set range.

3.3 Tag Setting (Used only for LR4110)



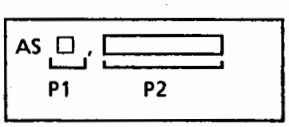
P1 : Tag set channel (1 to 4)
P2 : Tag name (7 characters maximum)

(Program Example)

TG1, LR4100
* Used only for LR4110 and LR4210.

3.4 Record Format Setting

(1) When ASS (AUTO record SPAN SHIFT mode) is selected via SET UP RCD:
(Refer to Section 6.4.9, "AUTO Span Shift Mode" of main unit instruction manual.)



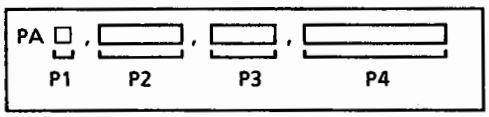
P1 : Record format set channel (1 to 4)
P2 : AUTO record SPAN SHIFT mode (ON, OFF)

- An error will result if an attempt is made to enter "ON" for a channel for which the RANGE mode is OFF, DELTA, SCALE, or MATH.
- An error will result if an attempt is made to enter "ON" if anything other than "ATSS" was entered for RCD in SET UP mode.

(Program Example)

AS1, ON

(2) When PART (partial compression / expansion) is selected via SET UP RCD:
(See Section 6.4.8, "Partial Compression / Expansion Recording" of main unit instruction manual.)



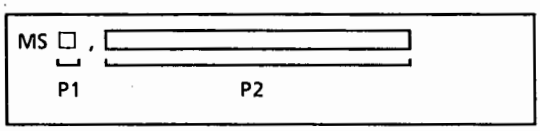
P1 : Entry channel (1 to 4)
P2 : partial compression / expansion mode (ON, OFF)
Note : For "OFF" the following entries are unnecessary.
P3 : Partial compression / expansion ratio (1 to 99)
P4 : partial compression / expansion point
* Must be within SPAN LEFT / RIGHT, or SCALE LEFT / RIGHT range.

- An error will occur if an attempt is made to enter "ON" for a channel whose RANGE mode is OFF.
- An error will result if an attempt is made to enter "ON" if anything other than "PART" was entered or RCD in SET UP mode.

(Program Example)

PA1, ON, 50, 1.000

3.5 Message Setting (Used only for LR4110E)



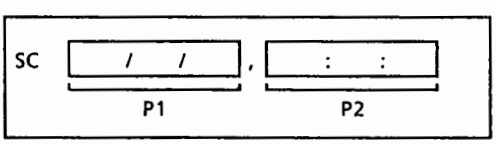
P1 : Message channel (0 to 4)
P2 : Message (70 characters maximum)

(Program Example)

MS1, YOKOGAWA

* Used only for LR4110E and LR4200E.

3.6 Date and Time Setting



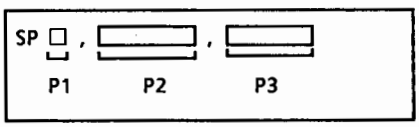
P1 : YY/MO/DD
- YY =year, MO = month, DD = day
- P1 must be 8 characters or error will result.

P2 : HH:MN:SS
- HH = hour, MN = minute, SS = second
- P2 must be 8 characters or error will result.

(Program Example)

SC88/04/01, 01: 23: 45

3.7 Chart Speed Setting



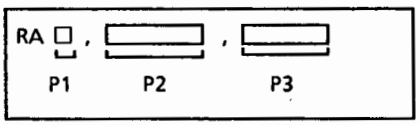
P1 : Chart speed channel (1, 2)
* "2" cannot be used unless CHART SPD2 is set to "ON" with SET UP RMT.
(Refer to Instruction Manual (IM 3711-01E or IM 3721 - 01E), Section 6.4.14 "Set Up Mode.")

P2 : Chart speed
When units are mm (10 to 1200)
When units are inches (0.5 to 45)
* The CHART SPEED UNIT selected in SET UP UNIT determines which can be used. (Units are mm when shipped from factory.)
(Refer to Instruction Manual (IM 3711-01E or IM 3721 - 01E), Section 6.4.14 "Set Up Mode")

P3 : Chart speed units
When units are mm (mm / H or mm / M)
When units are inches (in / H or in / M)
* The CHART SPEED UNIT selected in SET UP UNIT determines which can be used. An error will result if an attempt is made to specify mm / H when inch has been selected in SET UP.

(Program Example)
SP1, 1200, mm / H

3.8 Recording Area Adjustment Setting



P1 : Channel to be entered for recording area adjust (1 to 4)

P2 : Recording area adjust left value (0 to 99)

* Specified in %.

P3 : Recording area adjust right value (1 to 100)

* Specified in %.
* Recording area adjust right value and must be greater than left value.
* Left value and right value absolutely must be integers.

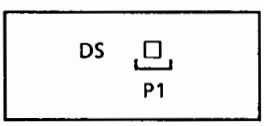
(Program Example)

RA1, 10, 90

Note : When a recording area adjustment is performed via a communications interface, the position may be slightly shifted because the data is entered in %.

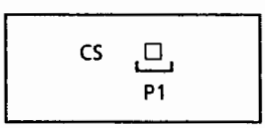
4. CONTROL COMMANDS

4.1 Display Mode Commands



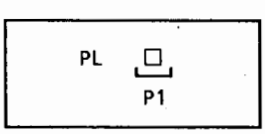
P1 : 0 ··· Display range (RANGE)
1 ··· Display measurement value (DIGITAL)
2 ··· Display bar graph (ANALOG)

4.2 Chart Start / Stop Commands



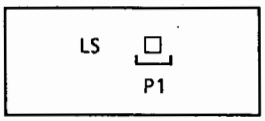
P1 : 0 ··· Chart start
1 ··· Chart stop

4.3 Pen Up / Down Commands (Used only for LR4110E)



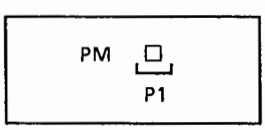
P1 : 0 ··· Pen down
1 ··· Pen up
* Used only for LR4110E, LR4210E.

4.4 List Print Commands (Used only for LR4110E)



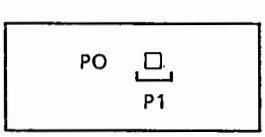
P1 : 0 ··· Execute list print
1 ··· Stop list print
* Used only for LR4110E, LR4210E.

4.5 Message Print Commands (Used only for LR4110E)



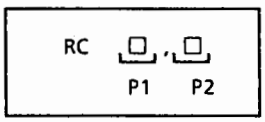
P1 : 0 ··· Print message entered for MESSAGE0.
1 ··· Print message entered for MESSAGE1.
2 ··· Print message entered for MESSAGE2.
3 ··· Print message entered for MESSAGE3.
4 ··· Print message entered for MESSAGE4.
* Used only for LR4110E, LR4210E.

4.6 Pen-offset Compensation ON / OFF



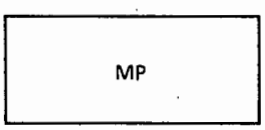
P1 : 0 ··· Turn ON pen-offset compensation.
1 ··· Turn OFF pen-offset compensation.
* One-pen models do not include this funciton.

4.7 Recording Start / Stop Control



P1 : Recording start / stop channel (1 to 4)
P2 : 0 ··· Start recording.
1 ··· Stop recording. (Measurement unaffected.)

4.8 Manual Print Command (Used only for LR4110)



Execute manual print.
* Used only for LR4110E, LR4210E.

5. COMMUNICATION OUTPUT SPECIFICATION ENTRY COMMANDS

5.1 Output Data Selection

TS ··· Output data selection

TS0	:	Specifies measured value output mode
TS1	:	Specifies parameter entry data output mode
TS2	:	Specifies units, decimal point information output mode
TS3	:	Specifies IC memory data or internal RAM disk data output mode

5.1.1 Measured Value Output (TS0)

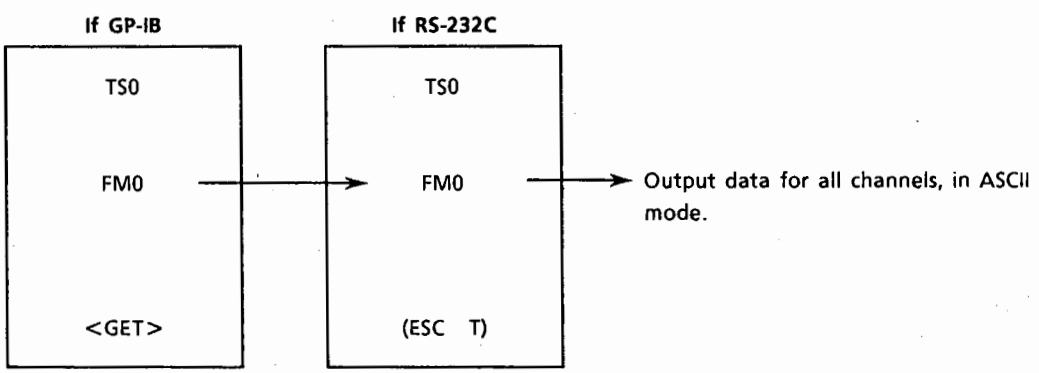
(1) Output measured value in ASCII mode (TS0 + FM0)

(2) Output measured value in binary mode (TS0 + FM1)

TS0 (measured value output mode)

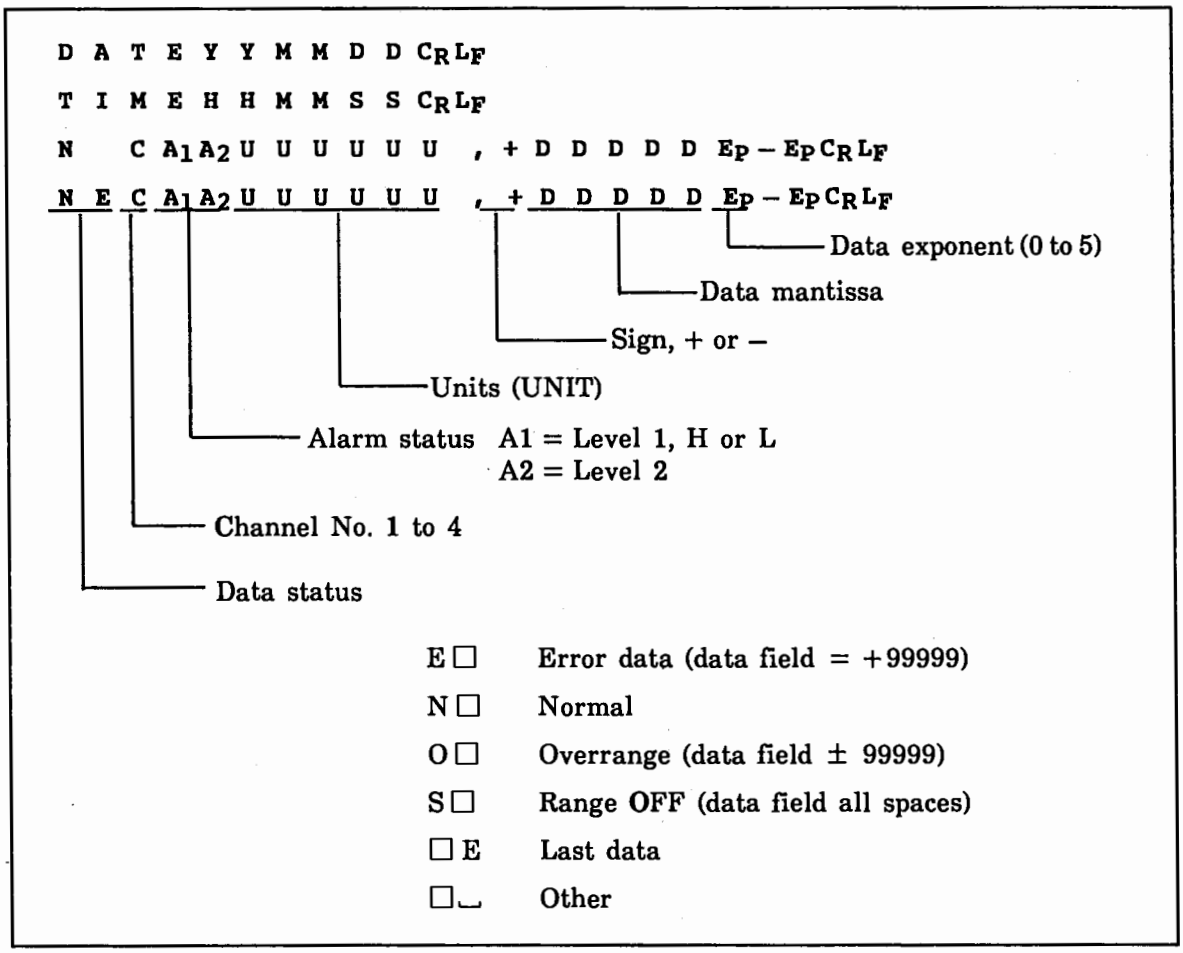
The measured value data is output when the unit receives, in the following sequence, the TS, FM□, BO commands (not required for ASCII mode), and "GET" or (ESC T). The output data format is specified with the FM command (for ASCII formatted data), or with the FM command plus the BO command (for binary data).

* Basic execution command sequence



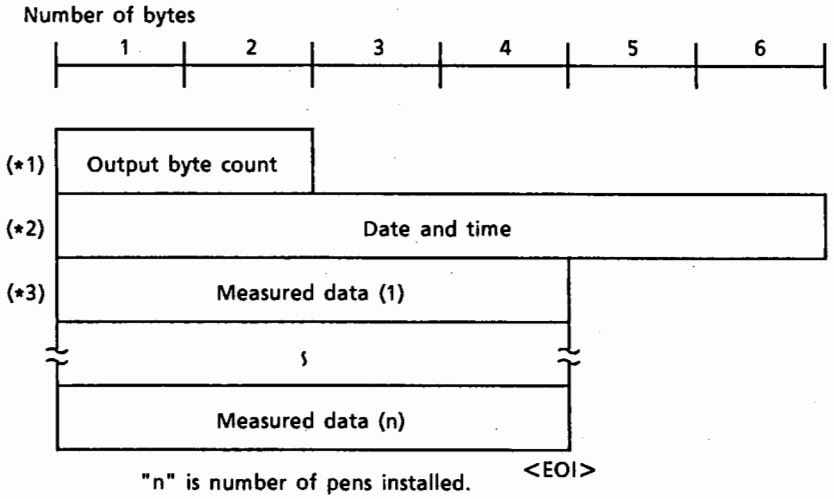
Note : ESC is hexadecimal (1B).

(1) Measured Value Output Format (ASCII)



- Output the measured (computed) date when a <GET> or ESC T is received. Output data corresponding to the number of pens.
- Output EOI when the last byte is output.

(2) Measured Value Output Format (Binary)



(*1) Output byte count

In this example the output byte count = 6 + n*4. The data can be output either MSB-first or LSB-first according to the byte output sequence specified with the BO command.

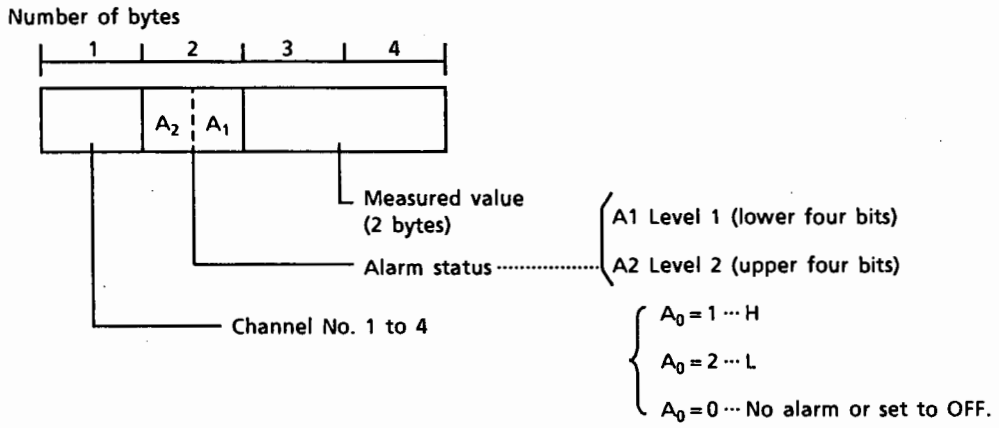
(*2) Date and time

1	2	3	4	5	6
Year	Month	Day	Hour	Minute	Second

Year 0 to 99 (0 to 63H)
Month 1 to 12 (1 to 0CH)
Day 1 to 31 (1 to 1FH)
Hour 0 to 23 (0 to 17H)
Minute 0 to 59 (0 to 3BH)
Second 0 to 59 (0 to 3BH)

Output sequence is fixed.

(*3) Measured data



The measured values (bytes 3 and 4) can be output either MSB-first or LSB-first according to the byte output sequence specified with the BO command.

- **Illegal Data:**

  + overrange $7C7C_H$
  − overrange 8080H
  Range OFF $7F7F_H$
  Error data $7E7E_H$ or $7EEE_H$

- **Relationship Between Binary Data and Decimal value:**

(Output binary data)	(Corresponding decimal value)
(MIN) AA10 (H)	−22000
⋮	⋮
FFFE	−2
FFFF	−1
0000	0
0001	1
0002	2
⋮	⋮
(MAX) 55F0	22000

- When measured data is output the channel count is automatically determined by the effective number of channels.
- The error data ($7E7E_H$ and $7EEE_H$) are output in the following situations:
  ① When a measured data request is executed while a main unit range change is in progress.
  ② When an error occurs in the A/D card or related circuitry.

- **Upper Byte (MSB) Output Example:**
  (When data value = 1)

Byte 1	Byte 2	Byte 3	Byte 4
		00	01

- **Lower Byte (LSB) Output Example:**
  (When data value = 1)

Byte 1	Byte 2	Byte 3	Byte 4
		01	00

5.1.2 Parameter Setting Information Output (TS1)

When the commands TS1, <GET> or <ESC T> are received in that order, the unit

GP-IB RS-232C

outputs its parameter settings in the order shown below.

(* Parameters are output in the same order as in the command input.)
(1) RN ··· Range setting
(2) CO ··· Constant Setting (not output if MATH board not present)
(3) AL ··· Alarm setting
(4) RA ··· Record area adjust setting
(5) PA ··· Recording format (partial compression / expansion mode)
(6) AS ··· Recording format (AUTO SPAN SHIFT mode)
(7) TG ··· Tag setting
(8) MS ··· Message setting
(9) SP ··· Chart speed setting
(10) EN ··· End of parameter settings output

* LR4120 and LR4220 recorders do not include TG and MS outputs.
Refer to Sample Program 1 (for an RS-232C communications interface), page 9-1 and Sample Program 1 (for a GP-IB communications interface), page 9-6 provided in this manual.

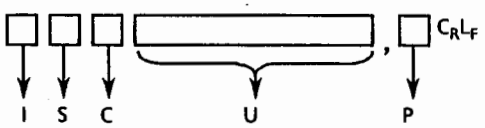
5.1.3 Units and Decimal Point Information Output

When the commands TS2, <GET> or <ESC T> are received in that order, the unit

GP-IB : RS-232C

outputs its units and decimal point information in the order shown below.

(Output Format)



I ··· { N : VOLT, TC, RTD, DELT, SCALE, *COM, *MATH
S : OFF

S ··· { S ··· Space ··· intermediate other data
E ··· Last data

C ··· Channel number (1 to 4)

U ··· UNIT (6 characters)

P ··· Decimal point position

{ 0 means 00000
1 means 000.00
2 means 000.00
3 means 00.000
4 means 0.0000
5 means .00000

* Output only when options are installed.
Refer to Sample Program 1 (for an RS-232C communications interface), page 9-3 and Sample Program 1 (for a GP-IB communications interface), page 9-7 provided in this manual.

5.1.4 IC Memory Data Output (TS3)

TS3 + MF0 ··· Output file directory information from IC card or internal RAM disk
TS3 + MF1 ··· ASCII data output from IC card or internal RAM disk
TS3 + MF2 ··· Binary data output from IC card or internal RAM disk
TS3 + MF4 ··· Output file directory information from floppy disk

(1) When the sequences TS3, MF0, and "GET" or (ESC T) is received, the unit outputs the file directory information from the IC card or internal RAM disk.

```
␣␣V O L U M E CR LF
⑥    ①
␣␣A B C D 0 0 0 0 , 1 2 – 4 5 – 7 8 , 3 2 0 0 0 CR LF
⑥    ②              ③              ④
␣␣A B C D 0 1 , 1 – – 4 5 – – 8 , 8 0 0 0   CR LF
⑥
E N D CR LF
   ⑤
< E O I >
```

① Volume name (always MEMORY in the case of an internal RAM disk)
② File name (always INMEM in the case of an internal RAM disk)
③ Sample channel information (Number ; channel acquiring data, – ; channel not acquiring data)
④ Sampled data point count (Actual number of sampled data points)
⑤ Directory information output terminator
⑥ Space

- If an error occurs in IC memory or internal RAM disk:
  #ERROR ON DATA MEMORY C_RL_F <EOI>

(2) When the sequence TS3, MF1, a1, a2, a3, a4 (GET) or (ESC T) is received,

GP-IB RS-232C

(a1 – File name (8 characters maximum)
a2 – Channel number (1 to 4)
a3 – First data number
a4 – Last data number)

* When a program for LR8100E is used, a channel number 5 to 8 can be specified.

the recorder outputs the data from the IC memory or internal RAM disk in ASCII format in the sequence below.

Header information
Data information

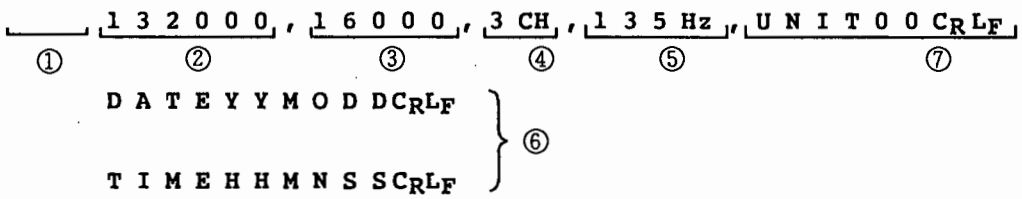
<Header Information> (ASCII mode)

(1) If an error occurs in IC memory or internal RAM disk:

- If specified file does not exist
- If memory is not installed
- If data sampling is in progress

#ERROR ON DATA MEMORY C_RL_F <EOI> is displayed.

(2) When correct data exists:



① : Space (four spaces)

② : Sample data output range (if sample data length is not correct, it is handled as the last data point.)

③ : Trigger point

④ : Input channel at time of sampling (use CH number even in TAG mode.)

⑤ : Sampling frequency: 135 Hz
(5 characters) 9 Hz
0.2 Hz (etc.)

⑥ : Time of day at trigger point
Sampling start time in free mode.

⑦ : UNITS

(3) If data (including sample data) does not exist, #NO SAMPLE is displayed.

<Data Information> (ASCII mode)

```
N     C C C C C , + D D D D D E - EpCRLF
NETCCCCC,+DDDDDE-EpCRLF< E O I >
```

- Data exponent (0 to 5)
- Data mantissa
- Sign, + or –
- Data sample number (1 to 32000)
- Data status

E□□ Error data
N□□ Normal
O□□ Overrange
□E□ Last data point
□□ Other
□□T Trigger point (in free mode the first data point is the trigger point.)
□□ Others
␣ Space

The unit outputs the sampled data in memory from the range specified with the MF command.

(3) When the sequence TS3, MF2, a1 a2, a3, a4, BOa1 <GET> or (ESC T) is received,

GP–IB RS–232C

a1–File name (8 characters maximum)
a2–Channel number (1 to 4)
a3–Beginning data number
a4–Last data number

* Supports LR8100E memory data. In this case, a channel number (5 to 8) can be specified.

the recorder outputs the data from the IC memory or internal RAM disk in binary in the sequence below.

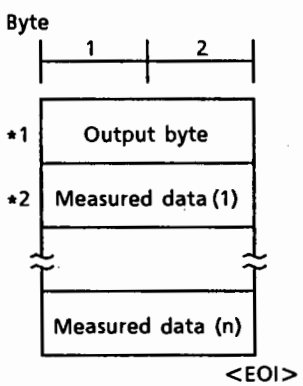
Header information	··· same as for ASCII case
Channel information	··· 52-byte binary + <EOI>
Data	··· binary + <EOI>

<Channel Information> (52 byte, fixed)

OFFSET	TYPE	Description
0	1BYTE×12	Measurement range (character string)
12	1BYTE×12	Measurement mode (character string): OFF, VOLT, SCALE/TC, etc.
24	2BYTE	Left span
26	2BYTE	Right span
28	2BYTE	Scale left
30	2BYTE	Scale right
32	1BYTE	Measured value decimal point
33	1BYTE	Scale value decimal point
34	1BYTE×6	Measurement units (character string)
40	1BYTE×6	Scale units (character string)
46	2BYTE×3	Conversion information

* Two-byte data are output in the sequence of byte output with a BO command.

<Data Information> (Binary Mode)



"n" is number of data points output

*1 <Output byte count>

Output byte count would be n*2 in this example. Either MSB or LSB can be output first, according to the byte output sequence specified with the BO command.

*2 <Measured data>

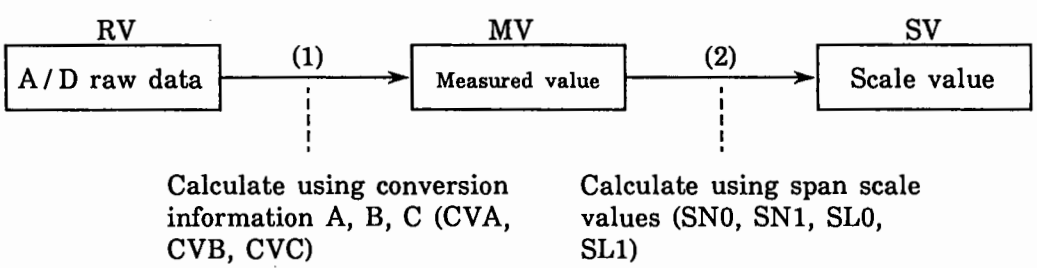
Raw A/D data is output. Use channel information for measured value, scale value conversion.

<Supplement>

1. Memory Binary Data (Channel Information)

Measurement range ··· ··· ··· ···	Measurement range at time of measurement (5V, 50 mV, K, etc.)
Measurement mode ··· ··· ··· ···	Measurement mode (VOLT, SCALE/TC, etc.)
Left span ··· ··· ··· ··· ··· ··· ··· ···	Span left side value (SN0)
Right span ··· ··· ··· ··· ··· ··· ··· ···	Span right side value (SN1)
Scale left ··· ··· ··· ··· ··· ··· ··· ···	Scale left side value (SL0)
Scale right ··· ··· ··· ··· ··· ··· ··· ···	Scale right side value (SL1)
Measurement decimal point ···	Span value (and measured value) decimal point position (DPM)
Scale decimal point ··· ···	Scale value decimal point (DPS)
Conversion information 1 ··· ···	Conversion constant A for conversion from raw data to measured value (CVA)
Conversion information 2 ··· ···	Conversion constant B for conversion from raw data to measured value (CVB)
Conversion information 3 ··· ···	Conversion constant C for conversion from raw data to measured value (CVC)

2. When IC memory data or internal RAM disk data (binary formatted) is Output, measured data that is A / D converted is output. The output data is difficult to recognize, so it is converted using channel data (see below).



(1) A/D data →Measured value

$$\begin{cases} M = (RV \times CVA / CVB) + CVC \\ \text{Note that CVC is not added for DELTA (difference calculation).} \\ MV = M \times 10^{-(DPM)} \end{cases}$$

Measured value can be obtained by using these expressions in the program.

(2) Measured value → Scale value

$$\begin{cases} S = (M - SN0) \times (SL1 - SL0) / (SN1 - SN0) \\ SV = S \times 10^{-(DPM)} \end{cases}$$

Scale value can be obtained by using these expressions in the program.

3. Three types of date can be output in binary mode:
   - Raw VOLT, TC, RTD A/D data (possible also when SCALE is selected)
   - Data input using a communication (COM) function
   - Data calculated using MATH option

(3) When the sequence TS3, MF4 and "GET" or (ESC T) is received, the unit outputs the file directory information from floppy disk.

The output format is the same as that of the output file directory information from an IC card or internal RAM disk.

5.2 MSB, LSB Output Order Selection

Ths command specifies whether measured data will be output MSB-first or LSB-first during binary output.

BO0 ··· Output MSB-first

BO1 ··· Output LSB-first

(When the power turns ON, binary output format is initialized to BO0.)

5.3 SRQ Status Mask Command

Enables masking of the occurrence of certain status byte interrupt sources.

IM (n) ··· Interrupt mask specification

n is the numeral at the head of the following items or a sum of the numerals of their relevant items.

0 ··· Turn off all interrupt sources.

1 ··· Interrupt at the end of IC memory data or internal RAM disk data recording/retrieving.

2 ··· Interrupt on syntax error.

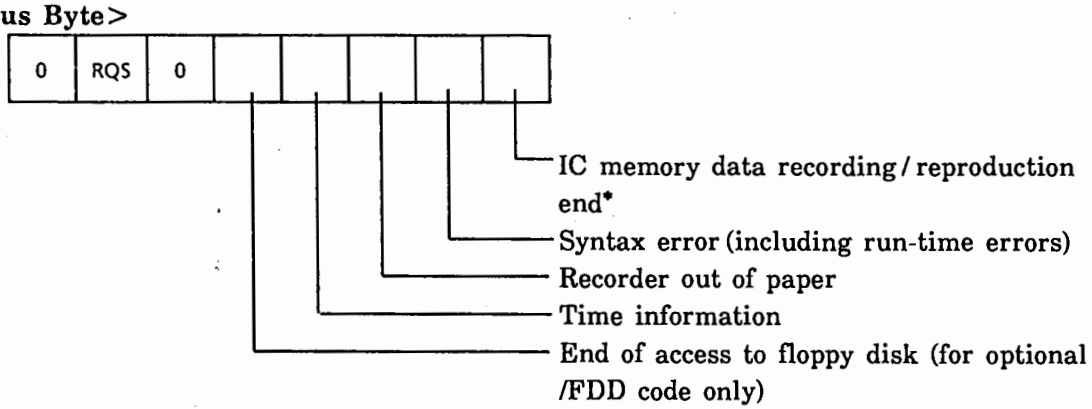
4 ··· Interrupt when recorder is out of paper.

8 ··· Interrupt at time information.

16 ··· Interrupt at the end of access to floppy disk.

For example, an interrupt occurs when a syntax error is generated and the recorder is out of paper; IM6 is displayed.

<Status Byte>



* When IC memory data or internal RAM disk recording / reproduction function is used.

※ No interruption occurs in RS-232 communications.

5.4 Setting of Time Information Period

The time information depends on the set period.

IT (n) ··· Setting of time information period

IT0 ··· time information every second
IT1 ··· time information every ten seconds
IT2 ··· time information every minute

This setting specifies the interval of bit 3 (08H) of the status byte.
The timing for bit 3 is according to the internal clock.

- In case the setting has been set to 10 seconds, timing will occur when the seconds of the internal clock become 00, 10, 20, 30, 40 or 50.
- In case the setting has been set to one minute, timing will occur each time the minute digits change.

5.5 Device Clear

(This command is effective in GP-IB communications only.)
This command may differ depending on computers.
When the device clear is received, the unit will go into the following state:

(1) All pens set to standby position.
(2) All pens lifted (pen up) (only for LR4110E, LR4210E).
(3) Chart feed stopped.
(4) Display in measured value display mode (digital).
(5) Recording print information erased (only for LR4110E, LR4210E).
(Data below completely erased.)
- Alarm printout information
- Message printout information
- Time printout information

(6) List printout stopped (only for LR4110E, LR4210E).

5.6 Notes Concerning Displays

When the LR and a personal computer are connected via a GP-IB or RS-232C interface, some of the LR characters will not appear on the computer keyboard. Use the substitutions below for these characters.

ASCII Code (Hexadecimal)	This Unit	PC Keyboard
$3F_H$	(Used for deg ℃, °F deg)	?
$5C_H$	μ	¥ *1
$5E_H$ *2	Ω	^

(Example) To enter RN1, 100μ V, −1, 1, OFF via communications enter RN1, 100¥V, −1, 1, OFF from the computer keyboard.

In BASIC, the CHR$ function may be used. You may input either,
PRINT@1 ; "RN1, 100¥ V, −1, 1, OFF" or
PRINT@1 ; "RN1, 100" + CHR$ (&H5C) + "V, −1, 1, OFF" (for GP-IB).

*1 On computers lacking the "¥" symbol, use the backslash " / ". The same applies for RS-232C interface.

*2 As this may differ depending on the computer, be sure to select the character matching the ASCII code.

6. DIGITAL INPUT DATA COMMUNICATIONS

6.1 Digital Input Data Entry

This function enables the input of digital values using communications functions.

* Before starting this operation, set the recorder to communication mode.

Set Items

1. CH
2. Mode
3. Span left
4. Span right
5. Units

```
 CH
MODE : COM
SPAN L :
SPAN R :
UNIT :
```

Follow the sequence below.

[Key Operations]	[Setting Display]	[Description]
SHIFT + ENTRY (START) CHART RUN/STOP (START) F4	1CH MODE : VOLT RANGE : 5V SPAN L : 0.000V SPAN R : 5.000V FILTER : OFF ↓ 1CH 2CH 3CH 4CH ↓ 5CH 6CH 7CH 8CH	Press SHIFT key followed by RANGE key to display the set panel. The panel will show the entry display for the current 1CH. Select the channel for data input.
CHART RUN/STOP (START)	4CH MODE : OFF ↓ OFF VOLT TC RTD ↓ DELT SCAL COPY COM ↓ MATH	When the channel is selected, the cursor will automatically move to MODE :. If [NEXT] [F4] (COM) are pressed, the screen will change to the COM (communication) entry display. * The function key assignments may change depending on the model. Before entering data, make sure that "COM" is selected.

* One-pen models do not include CH input or DELT COPY for mode selection.

[Key Operations]	[Setting Display]	[Description]
1 Y 0 . / N 0 # ▽	4CH MODE : COM SPAN L : -2.0 SPAN R : 2.0 UNIT : ← → del	• Enter span left setting value from the program keypad. After completing the entry, press the ▽ key to move to the next item. (Range is ± 22,000.)
F 5 V 0 . / N 0 # ▽	4CH MODE : COM SPAN L : 1.0 SPAN R : 2.0 UNIT : ← → del	• Enter span right setting in the same way as shown above.
ENTRY SHIFT ENTRY SHIFT F 5 V ENTRY	4CH MODE : COM SPAN L : 1.0 SPAN R : 5.0 UNIT : ↓ ← → del ↓ Ω μ % &	• Enter the units for the span value from the program keypad. • Ω, μ, %, & can be entered using the function keys. • Up to 8 characters can be entered, but only 5 characters can be displayed on the scale left / right displays. • In data display mode, only the leading two characters of the units are displayed. If the units are changed the scale units will change, too.
ENTRY	4CH MODE : COM SPAN L : 1.0V SPAN R : 5.0V UNIT : V	This completes the COM (communications) setting. If data entry continues, set the channel again. When completing the setting, press [ENTRY] again.

Note: About SPAN for COM

If the decimal point position is different for left and right, it is aligned with whichever has the fewer fractional digits. The user must keep in mind that in COM the handling of external input values differs depending on the number of fractional digits.

(Example)

External input value		Fractional digits	Span value
20000	⇒	0 digit	20000
		1 digit	2000.0
		2 digits	200.00
		3 digits	20.000
		4 digits	2.0000
		5 digits	.20000

In COM input, even if a decimal point is present in the input value, the fractional part will be automatically cut off. Since there is therefore a loss of significant digits in values with fractional parts, compensation is required in those cases where there are few digits above the decimal point.

(Example) When entering SINE result in digital form;

```
10 K=10000
20 PI=3.1415/180
30 FOR I=0 TO 360
40 A=K*SIN (PI*I)
50 PRINT @ 1:  "CV1,"+STR$(A)
                    60 NEXT I
```

- Since the result A takes values in the ± 10,000 range, the span is set at −1.0000 to 1.0000.

6.2 Digital Input Data

The term "digital input data" refers to data sent from personal computers as numeric values via a GP-IB or RS-232C communications interface and used for purposes such as servo recording, rather than data obtained through measurement by means of A / D conversion of input voltages.

Use of the digital input function of the communications functions enables personal computer data to be servo recorded, scaled, and displayed.

Digital input data numbers (1 to 4) absolutely must be specified when sending digital input data to this recorder.

* When using digital input data with COM:
  For example, if recording is done with the range mode of channel 2 set to COM, the data of digital input data number 2 is used as the recorded value. Thus the digital input data used is that with the same number as the channel number entered.

Relationships between COM entry channel and digital input data number:

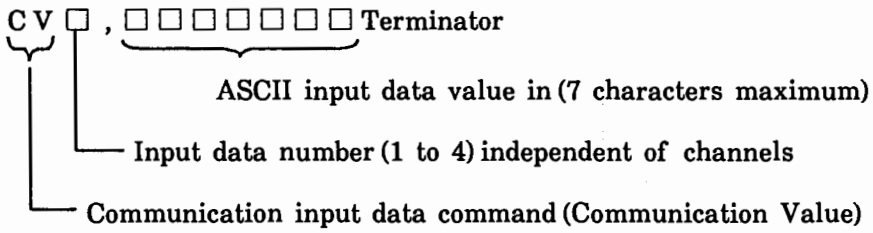
COM Entry Channel	Digital Input Data Number
1	1
2	2
⋮	⋮
4	4

Up to 8 digital input data number can be used. Data number exceeding 5 to 8 and number of pens, (data numbers 3 and 4 in two channel models, for example), cannot be used in COM mode.

/MATH option allows the above data number to be used.

6.3 Digital Input Command

Digital data is entered using the following command.



(1) Input Data Number

When COM is selected in range mode, specify which channel's COM input value is used.

For /MATH option, the input data number corresponds to one of the COM input values C1 through C8.

* Even if any of CV5 to CV8 ... is specified, this value cannot be input in COM mode. Or even if one- to three-pen models use data numbers exceeding their number of pens, these data numbers cannot be input either.
* COM input values C5 through C8 or COM input values exceeding a maximum channel number in up to channel 3 can be used in computational expressions in conjunction with the /MATH option.

(2) Input Data: ASCII Input Data

a) Effective input data ranges from −30000 to 30000. However, in COM or SCALE / COM mode, SPAN L and R ranges from −22000 to 22000. A range outside −30000 to 30000 is handled as a syntax error.

b) Input data character strings:
The effective character string, up to the terminator, is used as an input data character string. Thus, if any spaces directly precede the terminator, they are omitted. Input data character strings are processed as follows:
1) The maximum number of effective digits is five. An error will occur if a character string exceeds five digits.
2) 「−」,「+」,「0」through「9」, and「.」are used for setting characters. An error occurs if any other characters are used. Thus an E-conversion (measured value output) format character string will result in an error.
3) If the character string contains a decimal point, digits after the decimal point are discarded.
4) An error will occur if the character string exceeds ± 30000.

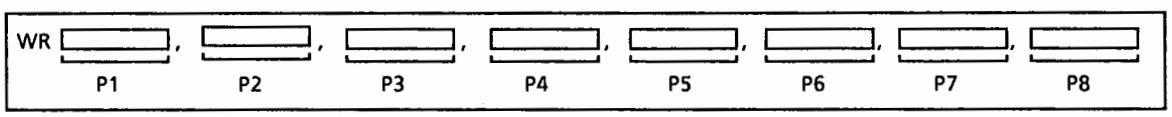
c) When no digital data is entered :
0 is used when no digital data is entered. All data is initialized to 0 when power is on.

7. COMMANDS FOR DATA INPUT TO IC MEMORY CARD

7.1 Measured Value

7.1.1 Data Filing

Data filing commands file the measured data in the IC memory card or internal RAM disk.



P1 : File name (8 characters maximum)
* If all spaces are used an error will occur.
* Always INMEM in the case of an internal RAM disk.

P2 : Sampling cycles per channel
(1000, 2000, 4000, 8000, 16000, 32000)

P3 : In free mode : (OFF)
In trigger mode : (ON)

P4 : Sample rate
In free mode :
(0.01 Hz, 0.02 Hz, 0.05 Hz, 0.1 Hz, 0.2 Hz, 0.5 Hz, 1 Hz, 3 Hz, 5 Hz, 9 Hz, 135 Hz)
In trigger mode :
(0.01 Hz, 0.02 Hz, 0.05 Hz, 0.1 Hz, 0.2 Hz, 0.5 Hz, 1 Hz, 3 Hz, 5 Hz, 9 Hz, 135 Hz)

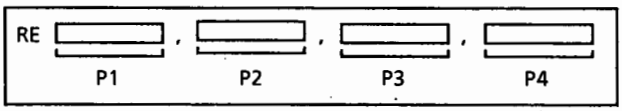
P5 : Pretrigger range
* Only in trigger mode.
(0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100)
• Specified in 10% units.

P6 : Trigger alarm (in trigger mode)
In trigger alarm OFF : OFF
In trigger alarm ON : ON

P7 : Trigger chart (in trigger mode)
In trigger chart OFF : OFF
In trigger chart ON : ON

P8 : Trigger remote (in trigger mode)
In trigger remote OFF : OFF
In trigger remote ON : ON
* Valid only for /REM option.

7.1.2 Data Reproduction



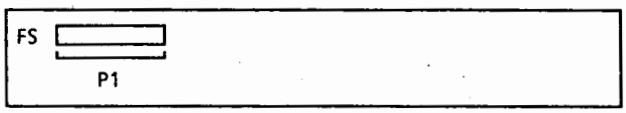
P1 : File name (8 characters maximum)
- * If all spaces are used an error will occur.
- * Always INMEM in the case of an internal RAM disk.

P2 : Reproduction rate
(0.01 Hz, 0.02 Hz, 0.05 Hz, 0.1 Hz, 0.2 Hz, 0.5 Hz, 1 Hz, 3 Hz, 5 Hz, 9 Hz, 135 Hz)

P3 : Reproduction starting point (1 to 32000)

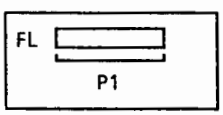
P4 : With / without range, constant LOAD (ON, OFF)
- * When ON is entered, range and constants used when the data was filed are set.
- * The parameters cannot be omitted.

7.1.3 Copying Data File from Internal RAM Disk to Floppy Disk



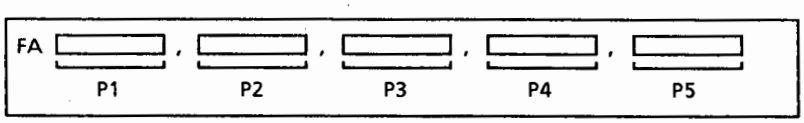
P1 : File name when copying to floppy disk

7.1.4 Copying Data File from Floppy Disk to Internal RAM Disk



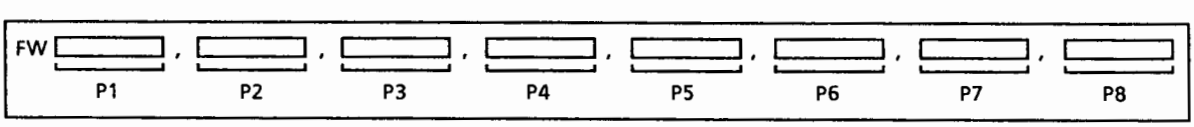
P1 : File name to be copied to internal memory

7.1.5 Making ASCII-conversion and Copying Data File from Internal RAM Disk to Floppy Disk



P1 : File name when copying to floppy disk
P2 : First channel number for ASCII conversion (1 to 4)
P3 : Last channel number for ASCII conversion (1 to 4)
* Set channel number at P2 or greater.
P4 : First data item number for ASCII conversion (1 to 32,000)
P5 : Last data item number for ASCII conversion (1 to 32,000)
* Set data item number at P4 or greater.

7.1.6 Automatic Data File Copying to Floppy Disk



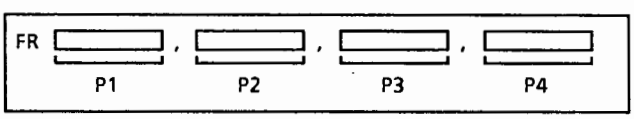
P1 : File name when copying to floppy disk
P2 : Number of samplings per channel
(1000, 2000, 4000, 8000, 16,000, or 32,000)
P3 : When setting to free mode: (off)
When setting to trigger mode: (on)
P4 : Sampling rate
* Effective only when in trigger mode
(0.01 Hz, 0.02 Hz, 0.05 Hz, 0.1 Hz, 0.2 Hz, 0.5 Hz, 1 Hz, 3 Hz, 5 Hz, 9 Hz, or 135 Hz)
P5 : Pre-trigger range
(0, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100)

P6 : Trigger alarm
* Effective only when in trigger mode
When setting to trigger alarm off: (off)
When setting to trigger alarm on: (on)

P7 : Trigger chart
* Effective only when in trigger mode
When setting to trigger chart off: (off)
When setting to trigger chart on: (on)

P8 : Trigger remote
* Effective only when in trigger mode
When setting to trigger remote off: (off)
When setting to trigger remote on: (on)
Note: Trigger remote is effective only in models with the optional remote function (/REM).

7.1.7 Automatic Data Reproduction from Floppy Disk



P1 : File name to be reproduced (up to eight characters).
* Entering all as blank causes an error.

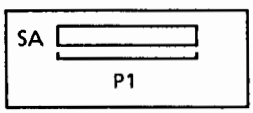
P2 : Reproduction rate
(0.01 Hz, 0.02 Hz, 0.05 Hz, 0.1 Hz, 0.2 Hz, 0.5 Hz, 1 Hz, 3 Hz, 5 Hz, 9 Hz, or 135 Hz)

P3 : First data item number to be reproduced (1 to 32,000)

P4 : Presence or absence of loads for range and constant (on, off)
* When set to on, the range and constant are set when the data item is fetched.
* Parameters cannot be omitted.

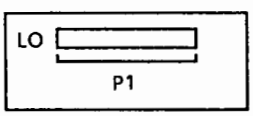
7.2 Set Values

(1) To save recorder settings on the IC memory card or the floppy disk:



P1 : File name (8 characters maximum)
* Do not use all spaces as an error will occur.

(2) To load data from an IC card memory or a floppy disk to the recorder:



P1 : Data filed file name (8 characters maximum)
* Do not use all spaces as an error will occur.

* Data is saved in the order shown below:
  Range setting
  Constant entries (only when MATH option)
  Alarm setting
  RECORD AREA ADJUST setting (in % units)
  Record format entries (for AUTO SPAN SHIFT mode)
  Record format entries (for partial compression /expansion)
  Tag setting (only for LR4110E)
  Message entries (only for LR4110E, LR4210E)
  Chart speed setting

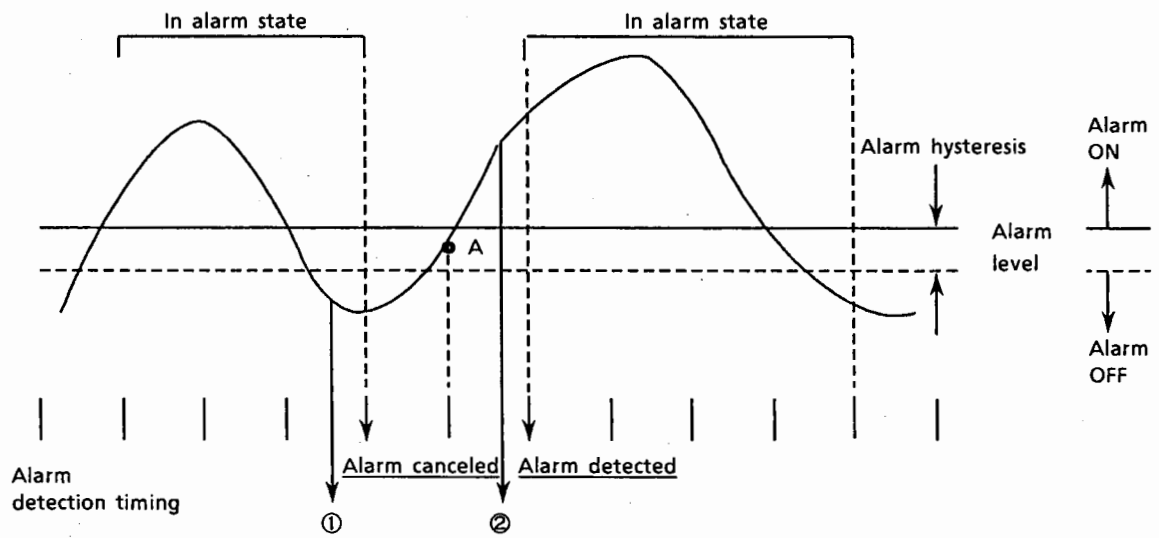
7.3 IC Memory Card Data Communications Output Precautions

<Relationship Between Memory Data and Alarm Trigger>

This recorder monitors alarms at 125 ms intervals. Therefore, even though the measured value reaches the alarm limit during the 125 ms interval, the alarm condition is not detected until the next alarm monitoring period. Similarly, when the measured value returns from the alarm level it will not be detected until the next alarm monitoring period. The above also applies when acquiring data from the IC memory card or internal RAM disk.

The recorder samples alarm detection data using a trigger signal. Therefore, during this period of time, trigger signal detection is delayed.

(Example)



At time ①, the alarm state is still in effect even though the measurement is below the alarm level. The alarm is not canceled until the alarm detection period (125 ms period) commences.

At time ②, even though the measurement is above the alarm level, the alarm will not be detected until the next alarm detection period (125 ms interval) commences.

8. INPORTANT NOTICE

8.1 Escape Sequences (for RS-232C Interface Communications)

The escape-sequence based control commands described below are provided for the control of communication functions via an RS-232C communications interface.

(1) Trigger Execution

• (ESC T) ··· Execute trigger

- When this command is received, the measured data obtained by the latest scan operation is entered into the buffer and then output.

* Send (ESC T) followed by a one byte data (hexadecimal) then a single "T" character (see example below).

(Example)

To output (ESC T) from a PC9801 series computer:

PRINT#1, CHR$ (&H1B) + "T";

The RS-232C interface must have been previously opened as file number 1.

(2) Status Output Request

- (ESC S) ··· Instructs status output

- When this command is received, any one of the following statuses are output.
- Output status is one of the following.

E R □ □ C_R L_F

The numerals in parentheses at the end of each of the following items or the sum of some relevant item numerals is output in hexadecimal notation. For example, when both a syntax error and a recorder out-of-paper error occur, ER06C_RL_F is output. However, items not specified with IM commands are ineffective.

End of data writing to IC memory card or internal memory or data reproduction (1)
··· When data writing to the IC memory card or the internal memory or data reproduction ends, "1" is output.

Syntax error (2)
··· If a syntax error occurs, "2" is output.

Recorder out of paper (4)
··· If the recorder runs out of paper, "4" is output.

Time information (8)
··· When the time is indicated, "8" is output.

End of access to floppy disk (10: hexadecimal notation)
··· When access to a floppy disk ends, "16" is output.

- If any of the above statuses is output, all error statuses are cleared. Error status developed when power is turned ON or a new status is output. If no error status has occurred, ER00 C_RL_F is output.
- If the LR4100E LR4200E cannot perform command reception control during data entry, due to the hardware handshake settings, it transmits each command (ESC S) and then reverts to read status. Thus it can control the timing of the commands that are to be sent from the computer.
- When ESC T is sent, data output starts, while ESC S cannot be executed (output data format is not assured). After sending all output data, execute ESC S.

* Send (ESC S) followed by a one byte data (hexadecimal) and an "S" character (see the example below).

(Example)

To output (ESC S) from a PC9801 series computer:

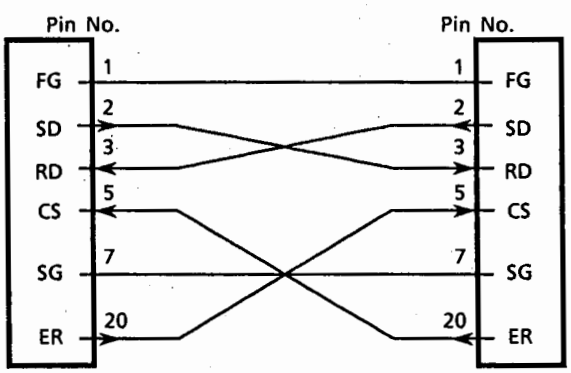
```
PRINT#1, CHRA$ (&H1B) + "S";
LINE INPUT#1, D$
PRINT D$
```

The RS-232C interface must have been previously opened as file number 1.

9. SAMPLE PROGRAMS (for RS-232C and GP-IB INTERFACES)

[RS-232C Sample Programs] (PC-9801)

- LR communications mode ··· OFF : OFF
- Communication mode ··· 8 bits
  Non parity
  1 stop bit
- Cable connections



1. Set Data Output

(1) Read LR set data and display it on a CRT. Then store it on a floppy disk.

```
10 'TS1 <ESC T>
20 OPEN "COM1:N81N" AS #1
30 OPEN "TEST.DAT" FOR OUTPUT AS #2
40 PRINT #1,"TS1"
50 PRINT #1,CHR$(&H1B)+"T";
60 LINE INPUT #1,D$:PRINT D$:PRINT #2,D$
70 IF LEFT$(D$,2)<>"EN" THEN 60
80 CLOSE
90 END
```

(2) Read the set data from a floppy disk and display it on a CRT. Then set it to LR.

```
10 'SETTEI
20 OPEN "COM1:N81N" AS #1
30 OPEN "TEST.DAT" FOR INPUT AS #2
40 PRINT #1,"IM2"
50 PRINT #1,CHR$(&H1B)+"S";
60 LINE INPUT #1,D$:PRINT D$
70 PRINT #1,CHR$(&H1B)+"S";
80 LINE INPUT #1,D$:PRINT D$
90 LINE INPUT #2,D$:PRINT D$
100 IF LEFT$(D$,2)="EN" THEN 150
110 PRINT #1,D$
120 PRINT #1,CHR$(&H1B)+"S";
130 LINE INPUT #1,D$:PRINT D$
140 GOTO 90
150 CLOSE
160 END
```

2. Output of Units and Decimal Point Information

```
10 'TS2 <ESC T>
20 OPEN "COM1:N81N" AS #1
30 OPEN "TEST.DAT" FOR OUTPUT AS #2
40 PRINT #1,"TS2"
50 PRINT #1,CHR$(&H1B)+"T";
60 LINE INPUT #1,D$:PRINT D$:PRINT #2,D$
70 IF MID$(D$,2,1)<>"E" THEN 60
80 CLOSE
90 END
```

[Output Results]

```
N 1V      ,2
N 2mV     ,3
N 3¥V     ,2
NE4?F     ,1
```

3. Measured Value Output

(1) ASCII Formatted Data Output

Read the measured data from LR in ASCII mode and display it on a CRT. Then store it on a floppy disk.

```
10 'TS0 <ESC T>
20 OPEN "COM1:N81N" AS #1
30 OPEN "TEST.DAT" FOR OUTPUT AS #2
40 PRINT #1,"TS0"
50 PRINT #1,"FM0"
60 PRINT #1,CHR$(&H1B)+"T";
70 LINE INPUT #1,D$:PRINT D$:PRINT #2,D$
80 IF MID$(D$,2,1)<>"E" THEN 70
90 CLOSE
100 END
```

[Output Results]

```
DATE880401
TIME021322
N 1  V      ,-    1E-2
N 2  mV     ,- 1149E-3
N 3HL¥V     ,+    0E-2
NE4  ?F     ,+  159E-1
```

(2) Binary Data Output

Read the measured data from LR in binary mode and display it on a CRT. Then store it on a floppy disk.

```
10 'TS0 FM1 BO1 <ESC T>
20 OPEN "COM1:N81N" AS #1
30 OPEN "TEST.DAT" FOR OUTPUT AS #2
40 PRINT #1,"TS0"
50 PRINT #1,"FM1"
60 PRINT #1,"BO1"
70 PRINT #1,CHR$(&H1B)+"T";
80 D$=INPUT$(2,#1):PRINT #2,D$
90 A=CVI(MID$(D$,1,2)):PRINT A
100 D$=INPUT$(A,#1):PRINT #2,D$
120 PRINT ASC(MID$(D$,1,1));:PRINT "/";
130 PRINT ASC(MID$(D$,2,1));:PRINT "/";
140 PRINT ASC(MID$(D$,3,1));:PRINT
150 PRINT ASC(MID$(D$,4,1));:PRINT ":";
160 PRINT ASC(MID$(D$,5,1));:PRINT ":";
170 PRINT ASC(MID$(D$,6,1))
180 L=0
190 FOR I=4 TO A-3
200  PRINT RIGHT$("0"+HEX$(ASC(MID$(D$,I+3,1))),2)+" ";
210  L=L+1
220  IF L=4 THEN L=0 : PRINT
230 NEXT
240 CLOSE
250 END
```

[Output Results]

```
 22
 88 / 4 / 1
 2 : 14 : 52
01 00 FF FF
02 00 83 FB
03 21 00 00
04 00 A0 00
```

[GP-IB Sample Programs] (PC-9801)

LR4100E GP-IB Address : 1

1. Set Data Output

(1) Read LR4100E, LR4200E set data and display it on a CRT. Then write it to a floppy disk.

```
10 'TS1 <GET>
20 OPEN "TEST.DAT" FOR OUTPUT AS #1
30 ISET IFC
40 CMD DELIM=0
50 PRINT @1;"TS1"
60 WBYTE &H3F,&H21,&H8,&H3F;
70 LINE INPUT @1;D$:PRINT D$:PRINT #1,D$
80 LINE INPUT @;D$:PRINT D$:PRINT #1,D$
90 IF LEFT$(D$,2)<>"EN" THEN 80
100 CLOSE:STOP
110 END
```

(2) Read data from the floppy disk and display it on a CRT. Then enter it into LR4100E, LR4200E.

```
10 'SETTEI
20 ISET IFC
30 ON SRQ GOSUB *SSS
40 POLL 1,B
50 SRQ ON
60 OPEN "TEST.DAT" FOR INPUT AS #1
70 ISET IFC
80 CMD DELIM=0
90 PRINT @1;"IM2"
100 LINE INPUT #1,D$:PRINT D$
110 IF LEFT$(D$,2)="EN" THEN 140
120 PRINT @1;D$
130 GOTO 100
140 CLOSE:STOP
150 END
160 *SSS
170 POLL 1,B
180 IF (B AND &H42)=&H42 THEN PRINT "SYNTAX ERROR"
190 RETURN
```

2. Output of Units and Decimal Point Information

```
10 'TS2 <GET>
20 OPEN "TEST.DAT" FOR OUTPUT AS #1
30 ISET IFC
40 CMD DELIM=0
50 PRINT @1;"TS2"
60 WBYTE &H3F,&H21,&H8,&H3F;
70 LINE INPUT @1;D$:PRINT D$:PRINT #1,D$
80 GOTO 100
90 LINE INPUT @;D$:PRINT D$:PRINT #1,D$
100 IF MID$(D$,2,1)<>"E" THEN 90
110 CLOSE:STOP
120 END
```

[Output Results]

```
N 1V      ,2
N 2mV     ,3
N 3¥V     ,2
NE4?F     ,1
```

3. Measured Value Output

(1) ASCII Formatted Data Output

Read the measured data from LR4100E in ASCII mode and display it on a CRT. Store it on a floppy disk.

```
10 'TS0 FM0 <GET>
20 OPEN "TEST.DAT" FOR OUTPUT AS #1
30 ISET IFC
40 CMD DELIM=0
50 PRINT @1;"TS0"
60 PRINT @1;"FM0"
70 WBYTE &H3F,&H21,&H8,&H3F;
80 LINE INPUT @1;D$:PRINT D$:PRINT #1,D$
90 LINE INPUT @;D$:PRINT D$:PRINT #1,D$
100 IF MID$(D$,2,1)<>"E" THEN 90
110 CLOSE:STOP
120 END
```

[Output Results]

```
DATE880401
TIME020257
N 1   V      ,+     0E-2
N 2   mV     ,- 1155E-3
N 3HL¥V      ,+     0E-2
NE4   ?F     ,+   156E-1
```

(2) Binary Data Output

Read the measured data from LR4100E in binary mode and display it on a CRT. Then store it on a floppy disk.

```
10 'TS0 FM1 BO1 <GET>
20 OPEN "TEST.DAT" FOR OUTPUT AS #1
30 ISET IFC
40 CMD DELIM=0
50 PRINT @1;"TS0"
60 PRINT @1;"FM1"
70 PRINT @1;"BO1"
80 WBYTE &H3F,&H21,&H8,&H3F;
90 CMD DELIM=3
100 LINE INPUT @1;D$:PRINT #1,D$
110 A=CVI(MID$(D$,1,2)):PRINT A
130 PRINT ASC(MID$(D$,3,1));:PRINT "/";
140 PRINT ASC(MID$(D$,4,1));:PRINT "/";
150 PRINT ASC(MID$(D$,5,1));:PRINT
160 PRINT ASC(MID$(D$,6,1));:PRINT ":";
170 PRINT ASC(MID$(D$,7,1));:PRINT ":";
180 PRINT ASC(MID$(D$,8,1))
190 L=0
200 FOR I=6 TO A-1
210  PRINT RIGHT$("0"+HEX$(ASC(MID$(D$,I+3,1))),2)+" ";
220  L=L+1
230  IF L=4 THEN L=0 : PRINT
240 NEXT
250 CLOSE:STOP
260 END
```

[Output Results]

```
 22
 88 / 4 / 1
 2 : 4 : 34
01 00 00 00
02 00 7B FB
03 21 00 00
04 00 9B 00
```