This manual contains instructions for communication functions of the LMD-100.

To prevent accidents arising from the misuse of this instrument, please ensure the operator receives this manual.

⚠ Warning

Turn the power supply to the instrument off before wiring or checking.

Working or touching the terminal with the power switched on may result in severe injury or death due to Electric Shock.

---

1. System configuration

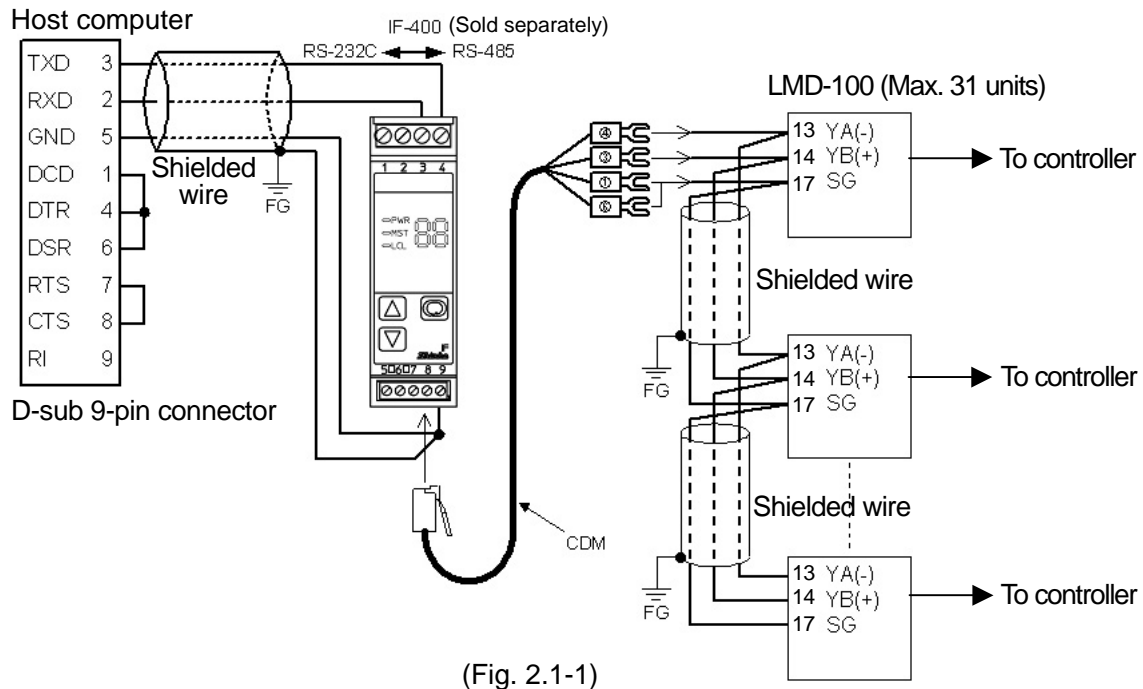The communication converter IF-400 (sold separately) is used for the following system configuration.
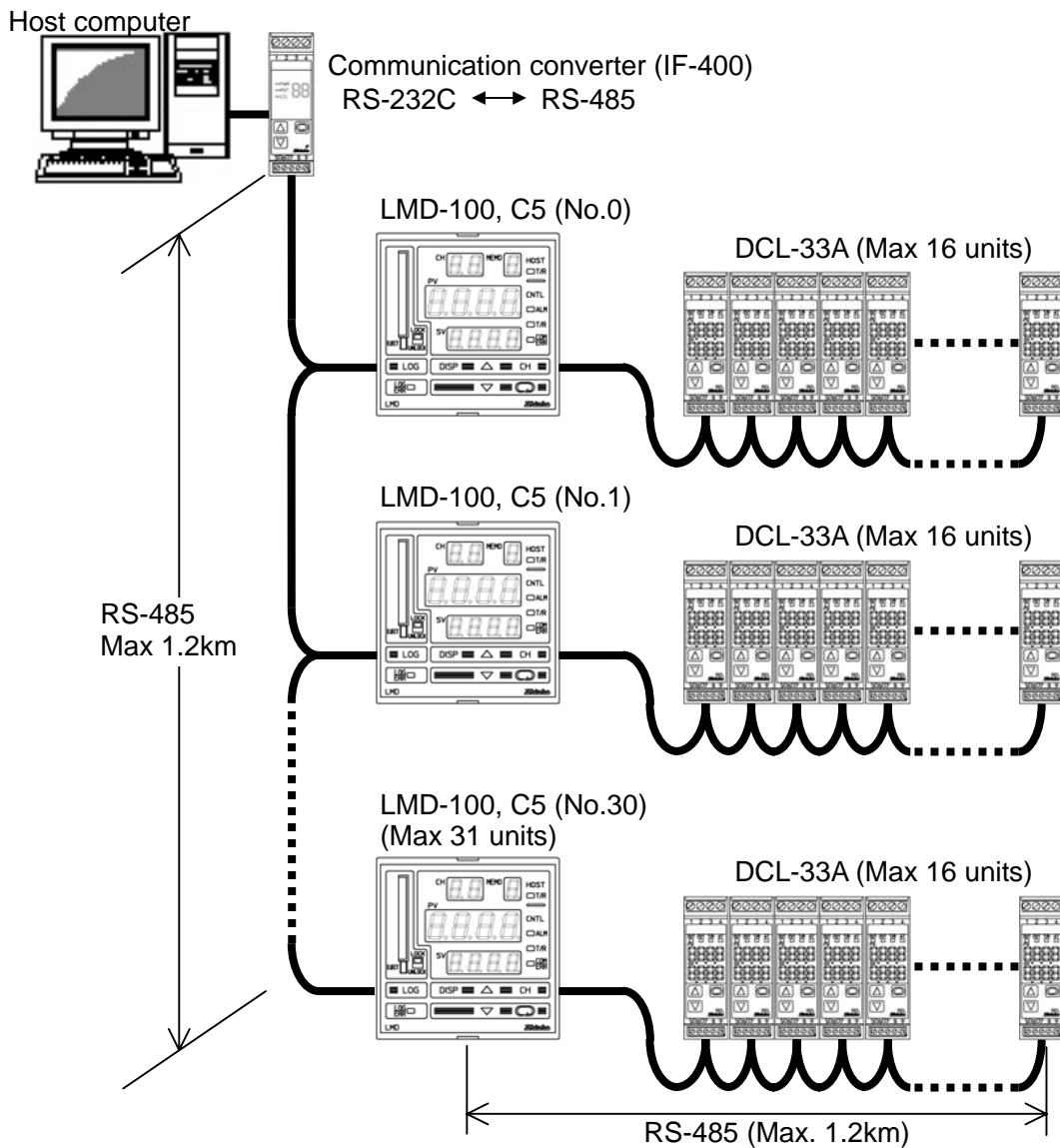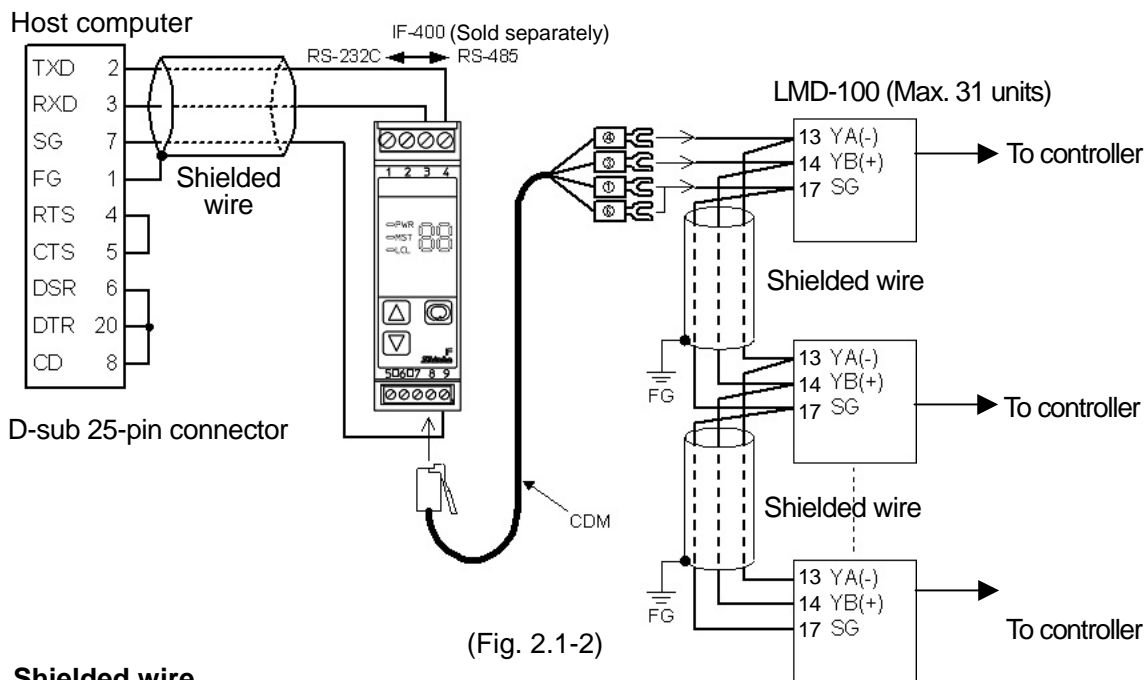

(Fig. 1-1)

2. Wiring

2.1 Wiring example between the LMD-100 and host computer
When using communication converter IF-400 (sold separately)

[D-sub 9-pin connector]

(Fig. 2.1-1)

[D-sub 25-pin connector]

(Fig. 2.1-2)

Shielded wire

Connect only one side of the shielded wire to the FG terminal so that current cannot flow to the shielded wire.

If both sides of the shielded wire are connected to the FG terminal, the circuit will be closed between the shielded wire and the ground. As a result, current will run through the shielded wire, and this may cause noise.

Be sure to ground FG terminal.

Recommended cable: OTSC-VB 2PX0.5SQ (made by Onamba Co., Ltd.) or equivalent
(Use a twisted pair cable.)

Terminator (Terminal resistor)
The terminator is mounted at the end of the wire when connecting a personal computer with multiple peripheral devices. The terminator prevents signal reflection and disturbance.
Do not connect terminator with the communication line because each LMD-100 has built-in pull-up and pull-down resistors instead of a terminator.

2.2 Wiring example between LMD-100 and controllers

(1) DCL-33A (Fig. 2.2-1)

Connection between LMD-100 and DCL-33A

Use CDM communication cable (sold separately).

Connect CDM modular plug to DCL-33A modular jack.

For CDM "Y" terminal connection, refer to the following.

CDM "Y" terminal number	LMD-100 terminal number
4	15 YA (-)
3	16 YB (+)
1, 6	17 SG

CDM cable length: 3000mm (Can be extended in units of 1000mm fixed length)

Connection between DCL-33A units
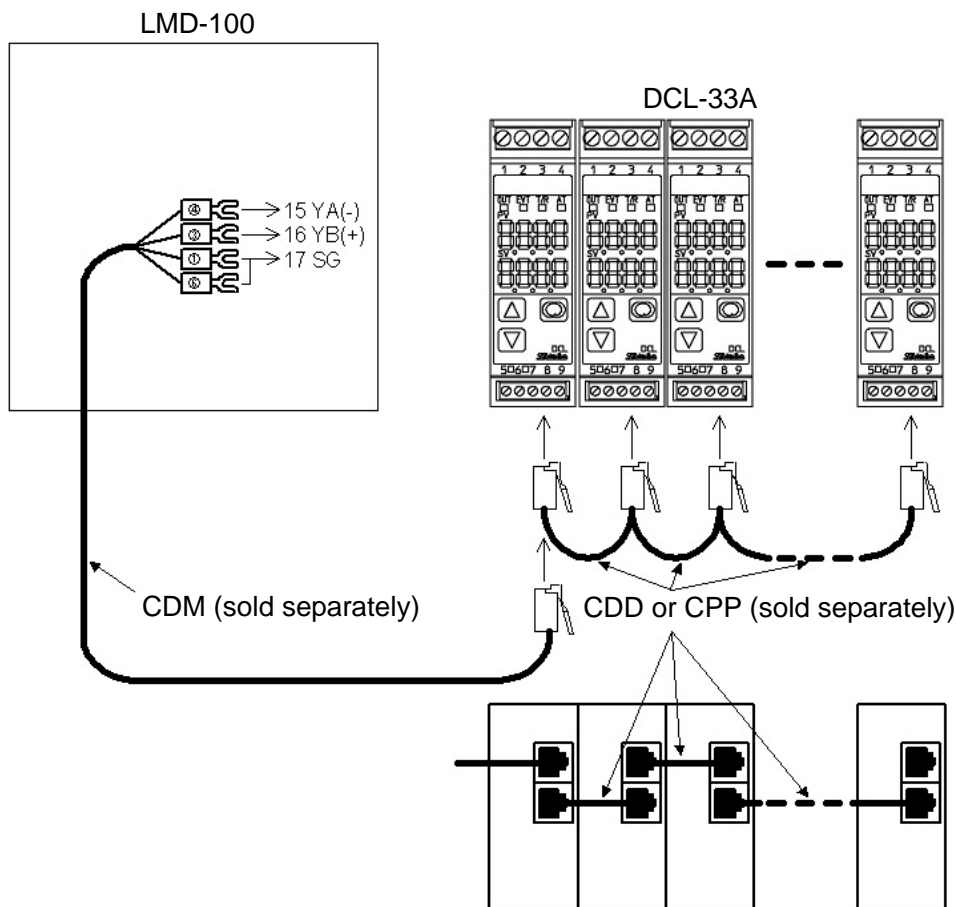
Use communication cable CDD or CPP (sold separately), and plug into modular jack.

Cable length of CDD: 60mm. For distances larger than 60mm, use the CPP cable.
Cable length of CPP: 500mm.
(For distances larger than 500mm, the CPP can be extended in units of 500mm fixed length.
For distances less than 500mm, the CPP can be cut down in units of 100mm fixed length.)

(Fig. 2.2-1)

(2) ACS-13A, JCL-33A, JCS-33A, JCM-33A, JCR-33A, JCD-33A (Fig. 2.2-2)
   Connection between LMD-100 and controllers (ACS-13A/JCL-33A/JCS-33A/JCM-33A/JCR-33A/JCD-33A)
   Connection between controllers (ACS-13A/JCL-33A/JCS-33A/JCM-33A/JCR-33A/JCD-33A)

   Connect YA (-) to YA (-), YB (+) to YB (+) and SG to SG respectively, using a shielded wire.

   Connect only one side of the shielded wire to the FG terminal so that current cannot flow to the shielded wire.

   If both sides of the shielded wire are connected to the FG terminal, the circuit will be closed between the shielded wire and the ground. As a result, current will run through the shielded wire, and this may cause noise.

   Be sure to ground FG terminal.

   Recommended cable: OTSC-VB 2PX0.5SQ (made by Onamba Co., Ltd.) or equivalent
                     (Use a twisted pair cable.)

Wiring example between LMD-100 and ACS-13A (Fig. 2.2-2)
   Terminal numbers for connection differ depending on a controller model as follows.

LMD-100	JCL-33A	JCS-33A	JCM-33A	JCR-33A	JCD-33A
15 YA (-)	10 YA (-)	13 YA (-)	10 YA (-)	11 YA (-)	11 YA (-)
16 YB (+)	11 YB (+)	14 YB (+)	13 YB (+)	14 YB (+)	14 YB (+)
17 SG	12 SG	15 SG	14 SG	17 SG	17 SG
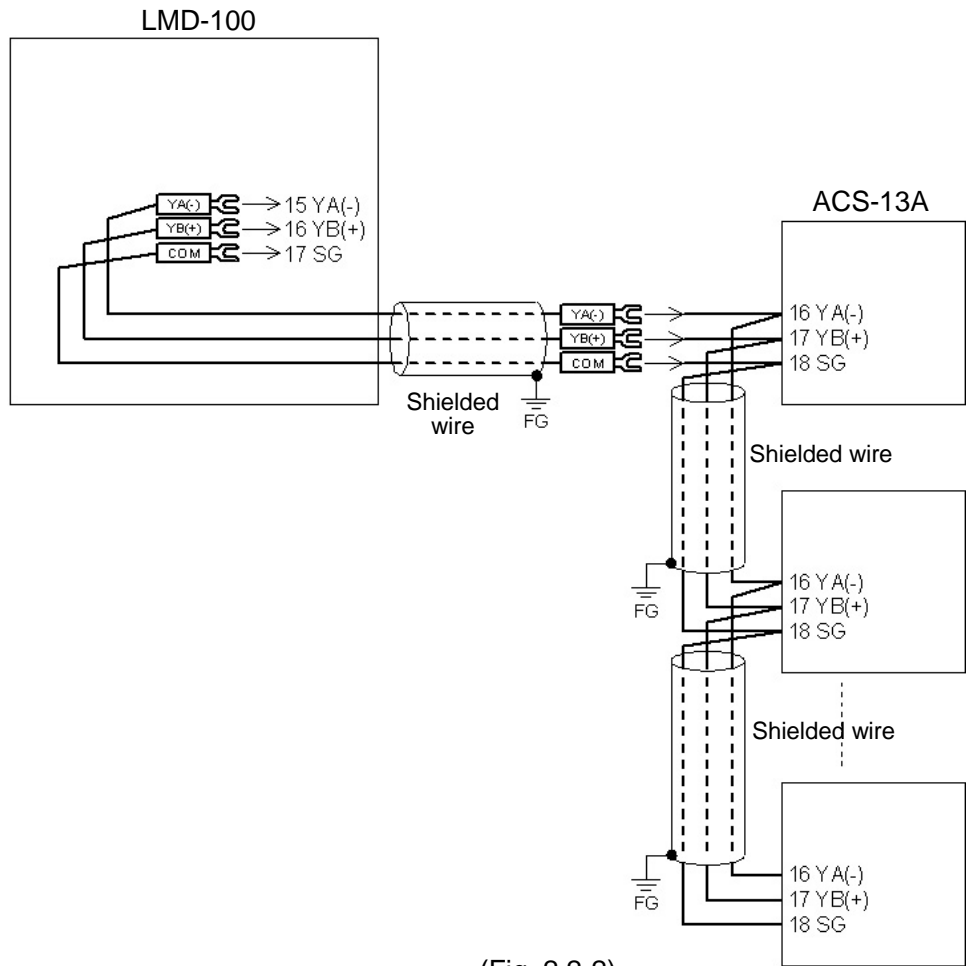
(Fig. 2.2-2)

(3) NCL-13A (Fig. 2.2-3)

   Connection between LMD-100 and NCL-13A

   Connect YA (-) to YA (-), YB (+) to YB (+) and SG to SG respectively, using the communication cable CFP-C5 (sold separately).

   Connection between NCL-13A units

   Connect bus plug to bus plug.

LMD-100

15 YA(-)
16 YB(+)
17 SG

NCL-13A

CFP-C5 (sold separately)

Screw type plug for lines
Model: Terminal block ATB-001-1
(sold separately)

Bus plug   Bus plug
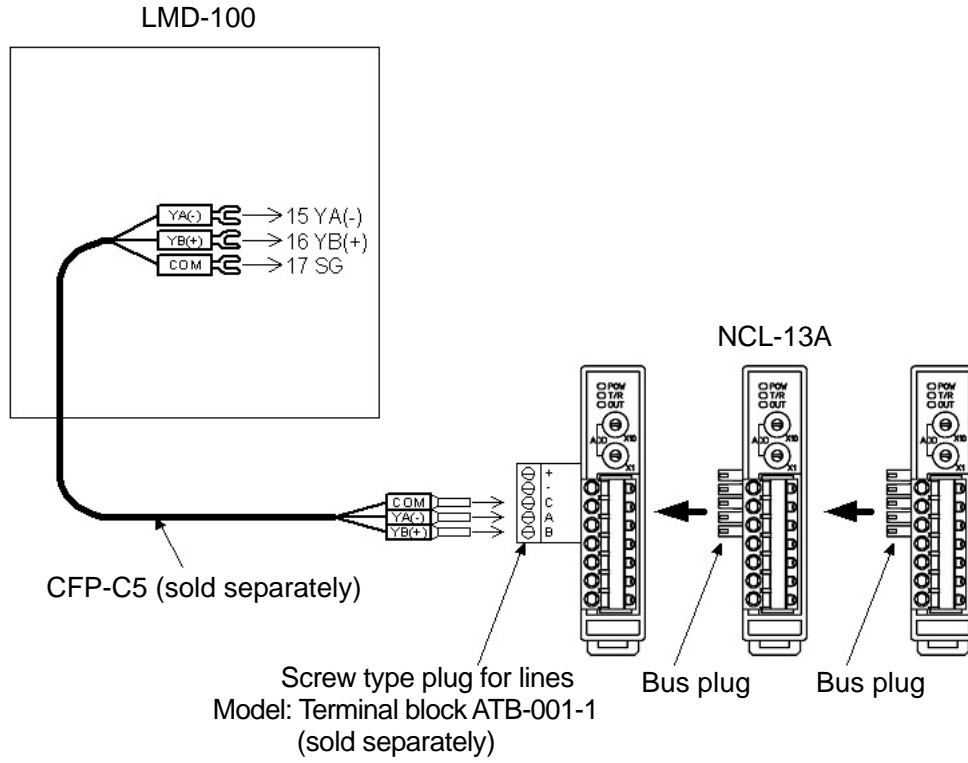
(Fig. 2.2-3)

3. Communication parameters setting

Set controllers and LMD-100 following the procedures below.

3.1 Controllers setting

Set communication parameters of the controller, using front keypad of the controller.
(Refer to the Instruction manual for each controller.)

(1) Communication protocol selection: **Shinko protocol**
(2) Instrument number setting: Set the number **from 1 (one)** in numerical order.
  (e.g.) When 5 units of controllers are connected, set instrument numbers from 1 to 5.
(3) Communication speed selection: **19200bps**
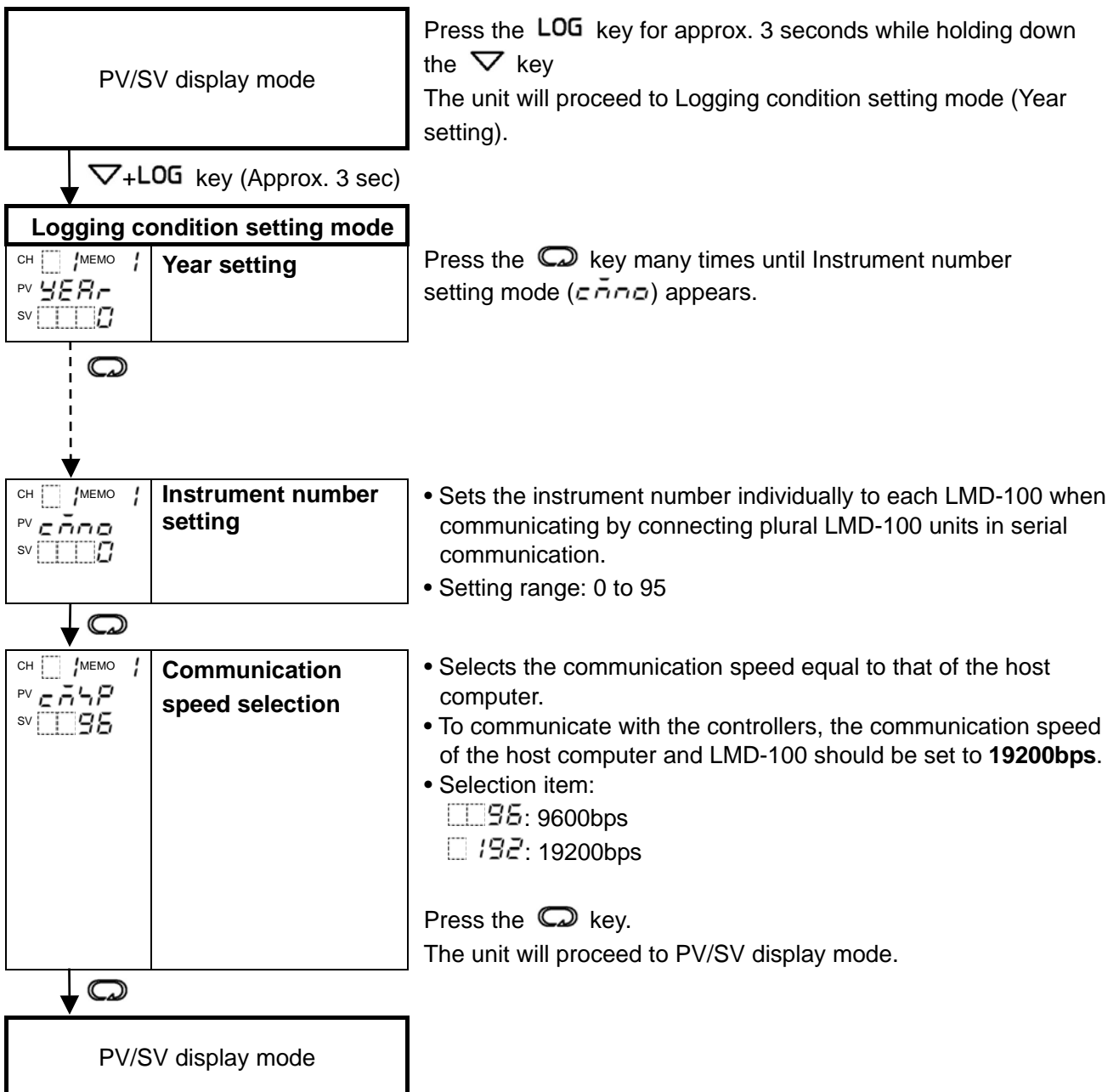
3.2 LMD-100 setting

Set communication parameters (**instrument number, communication speed**) in the **Logging condition setting mode,** using front keypad of the LMD-100.
During data logging, communication parameters cannot be set.
To set communication parameters, stop data logging by pressing the LOG key for approx. 1 second.

To enter Logging condition setting mode, press the LOG key for approx. 3 seconds while holding down the ▽ key in the PV/SV display mode.

To set (or select) each setting item, use the △ or ▽ key, then register the value with the ⊂⊃ key. The setting item will be switched.

PV/SV display mode	Press the LOG key for approx. 3 seconds while holding down the ▽ key The unit will proceed to Logging condition setting mode (Year setting).

▽+LOG key (Approx. 3 sec)

Logging condition setting mode	
CH ☐ /MEMO / PV **YEAr** SV ☐☐☐*0* **Year setting**	Press the ⊂⊃ key many times until Instrument number setting mode (*cⁿno*) appears.

⊂⊃

CH ☐ /MEMO / PV **cⁿno** SV ☐☐☐*0* **Instrument number setting**	• Sets the instrument number individually to each LMD-100 when communicating by connecting plural LMD-100 units in serial communication. • Setting range: 0 to 95

⊂⊃

CH ☐ /MEMO /
PV **cⁿSP**
SV ☐*96* **Communication speed selection**
	• Selects the communication speed equal to that of the host computer.
	• To communicate with the controllers, the communication speed of the host computer and LMD-100 should be set to **19200bps**.
	• Selection item:
	  ☐☐*96*: 9600bps
	  ☐*192*: 19200bps
	
	Press the ⊂⊃ key.
	The unit will proceed to PV/SV display mode.

⊂⊃

PV/SV display mode

4. Communication procedure

Communication starts with command transmission from the host computer and ends with the response of the LMD-100 or controller.

Host computer   LMD-100/Controller
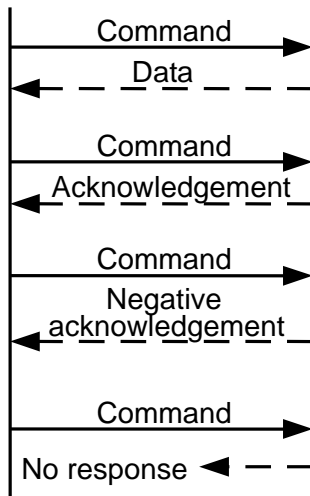
(Fig.4-1)

- **Response with data**
  When the host computer sends the reading command, the LMD-100 or controller responds with the corresponding set value or current status.
- **Acknowledgement**
  When the host computer sends the setting command, the LMD-100 or controller responds by sending the acknowledgement after the processing is terminated.
- **Negative acknowledgement**
  When the host computer sends a non-existent command or value out of the setting range, the LMD-100 or controller returns a negative acknowledgement.
- **No response**
  The LMD-100 or controller will not respond to the host computer in the following cases:
  - Global address is set.
  - Communication error (framing error, parity error)
  - Checksum error

Communication timing between the host computer and LMD-100/controller
  Host computer side (Notice on programming)
  Set the program so that the host computer can disconnect the transmitter from the communication line within a 1 character transmission period after sending the command in preparation for reception of the response from the LMD-100 or controller.
  To avoid the collision of transmissions between the host computer and the LMD-100/controller, send the next command after carefully checking that the host computer received the response.

  LMD-100/controller side
  When the LMD-100 or controller starts transmission through a communication line, the LMD-100 or controller is arranged so as to provide an idle status (mark status) transmission period of 1 or more characters before sending the response to ensure synchronization on the receiving side.
  The LMD-100 or controller is arranged so as to disconnect the transmitter from the communication line within a 1 character transmission period after sending the response.

5. Shinko protocol

5.1 Transmission mode
Shinko protocol is composed of ASCII codes.
Hexadecimal (0 to 9, A to F), which is divided into high order (4-bit) and low order (4-bit) out of 8-bit binary data in command is transmitted as ASCII characters.
Data format   Start bit: 1 bit
                 Data bit: 7 bits
                 Parity   : Even
                 Stop bit : 1 bit
Error detection: Checksum

5.2 Command configuration
All commands are composed of ASCII.
The data (set value, decimal number) is represented with a hexadecimal number.
The negative numbers are represented with 2's complement.
Numerals (1, 2, 4) written below the command represent number of characters.

(1) Setting command

Header (02H)	Address	Sub address	Command type (50H)	Data item	Data	Checksum	Delimiter (03H)
1	1	1	1	4	4	2	1

(2) Reading command

Header (02H)	Address	Sub address	Command type (20H)	Data item	Checksum	Delimiter (03H)
1	1	1	1	4	2	1

(3) Response with data

Header (06H)	Address	Sub address	Command type (20H)	Data item	Data	Checksum	Delimiter (03H)
1	1	1	1	4	4	2	1

(4) Acknowledgement

Header (06H)	Address	Checksum	Delimiter (03H)
1	1	2	1

(5) Negative acknowledgement

Header (15H)	Address	Error code	Checksum	Delimiter (03H)
1	1	1	2	1

Header   : Control code to represent the beginning of the command or the response.
ASCII codes are used.
Setting command, Reading command : STX (02H) fixed
Response with data, Acknowledgement: ACK (06H) fixed
Negative acknowledgement   : NAK (15H) fixed

Instrument number (Address): Numbers by which the host computer discerns each LMD-100.
Instrument number 0 to 95.
ASCII codes (20H to 7FH) are used by adding 20H to instrument numbers 0 to 95 (00H to 5FH).
95 (7FH) is called Global address, which is used when the same command is sent to all the LMD-100 units connected. However, the response is not returned.

Sub address   : LMD-100: 20H fixed
Connected controllers: ASCII codes (21H to 30H, 7FH) are used by adding 20H to channel numbers 1 to 16 (01H to 10H) and 95 (5FH).
95 (7FH) is called Global address, which is used when the same command is sent to all controllers connected to one LMD-100 unit. However, the response is not returned.

Command type : Code to discern Setting command (50H) and Reading command (20H)

Data item   : Data classification of the command object.
Composed of hexadecimal 4 digits (Refer to "6. Communication command table".)

Data   : The contents of data (set value) differ depending on the setting command.
Composed of hexadecimal 4 digits (Refer to "6. Communication command table".)

Checksum   : 2-character data to detect communication errors. (Refer to "5.3 Checksum calculation".)

Delimiter   : Control code to represent the end of command
03H fixed

Error code   : Represents an error type. Composed of hexadecimal 1 digit
1 (31H)-----Non-existent command
2 (32H)-----Not used
3 (33H)-----Setting out of the setting range
4 (34H)-----Unsettable status [e.g. During data logging **(*)**, while AT is performing, or when sending the logging start command without inserting the CF card]
5 (35H)-----During setting mode by key operation

(*) Setting commands such as Logging cycle setting (0008H), External operation input (LOG) priority (0009H) and Logging Start/Stop (000AH) can be set during data logging as the key operation.

5.3 Checksum calculation

Checksum is used to detect receiving errors in the command or data.
Set the program for the host computer side as well to calculate the checksum of the response data from the LMD-100 or controller so that communication errors can be checked.

The ASCII code (hexadecimal) corresponding to the characters which range from the address to that before the checksum are converted to binary notation, and the total value is calculated.
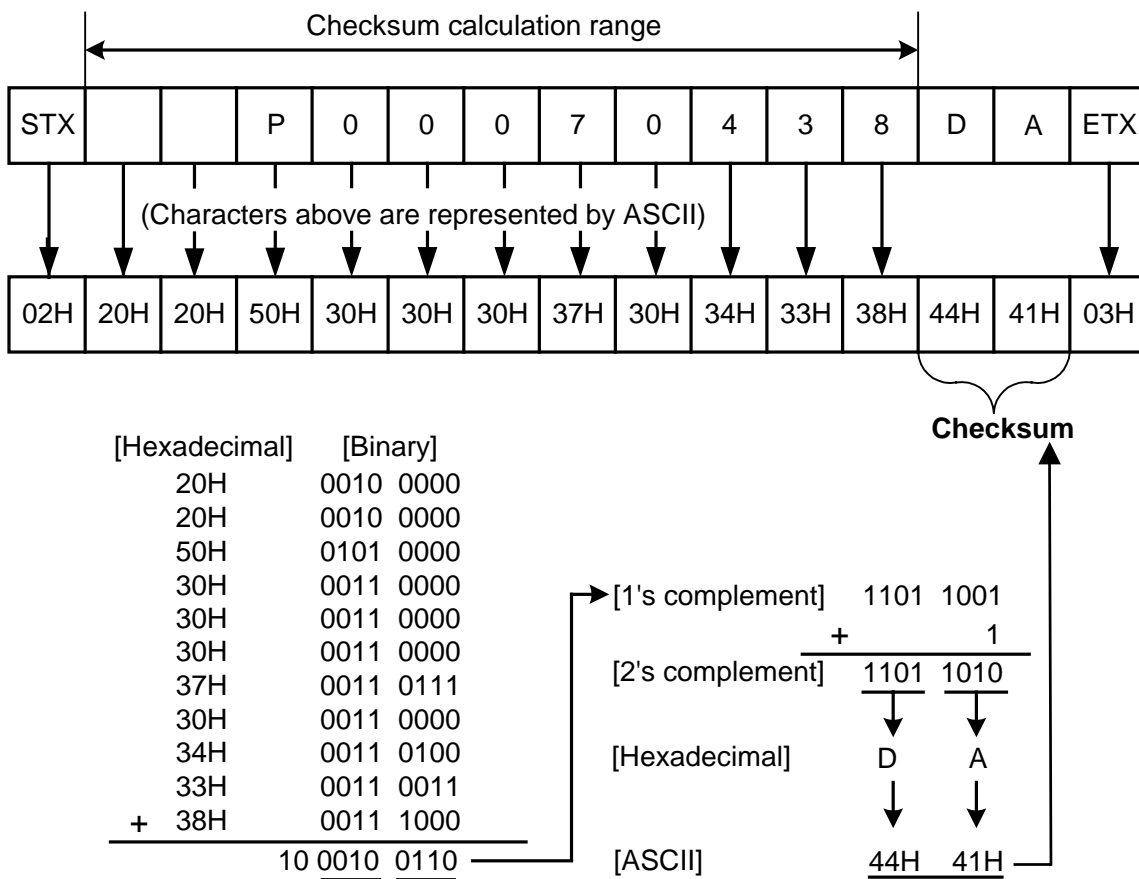The lower 2-digits of the total value are converted to 2's complements, and then to hexadecimal figures, that is, ASCII code for the checksum.

Checksum calculation example

Logging auto-start end time: 18:00 (0438H)
Address (instrument number): 0 (20H)

• 1's complement: Reverse each binary bit. 0 will become 1 and vice versa.
• 2's complement: Add 1 to 1's complements.

Checksum calculation range

STX			P	0	0	0	7	0	4	3	8	D	A	ETX

(Characters above are represented by ASCII)

02H	20H	20H	50H	30H	30H	30H	37H	30H	34H	33H	38H	44H	41H	03H

Checksum

[Hexadecimal]	[Binary]
20H	0010 0000
20H	0010 0000
50H	0101 0000
30H	0011 0000
30H	0011 0000
30H	0011 0000
37H	0011 0111
30H	0011 0000
34H	0011 0100
33H	0011 0011
+ 38H	0011 1000
	10 0010 0110

[1's complement]   1101 1001
                +   1
[2's complement]   1101 1010

[Hexadecimal]   D   A

[ASCII]   44H   41H

9

6. Communication command table

6.1 Communication commands of the LMD-100

Shinko Command type	Sub address	Data item		Data
20H/50H	0	0001H	PV logging	0000H: Not effective 0001H: Effective
20H/50H	0	0002H	SV logging	0000H: Not effective 0001H: Effective
20H/50H	0	0003H	OUT1 MV logging	0000H: Not effective 0001H: Effective
20H/50H	0	0004H	Status logging	0000H: Not effective 0001H: Effective
20H/50H	0	0005H	Logging auto-start	0000H: Not effective 0001H: Effective

20H/50H	0	0006H	Logging auto-start start time	Set value (0 to 1439 minutes)
				(e.g.) 8:30
				    8 x 60min+30min=510min
				    Hexadecimal of 510: 01FEH
				    Set to "01FEH".

20H/50H	0	0007H	Logging auto-start end time	Set value (0 to 1439 minutes)
				(e.g.) 17:30
				    17 x 60min+30min=1050min
				    Hexadecimal of 1050: 041AH
				    Set to "041AH".

20H/50H	0	0008H	Logging cycle	0000H: 1 second 0001H: 2 seconds 0002H: 5 seconds 0003H: 10 seconds 0004H: 15 seconds 0005H: 20 seconds 0006H: 30 seconds 0007H: 1 minute 0008H: 2 minutes 0009H: 5 minutes 000AH: 10 minutes 000BH: 15 minutes 000CH: 20 minutes 000DH: 30 minutes 000EH: 60 minutes
20H/50H	0	0009H	External operation input (LOG) priority	0000H: External operation input (LOG) has priority 0001H: LOG key has priority
20H/50H	0	000AH	Logging Start/Stop	0000H: Logging Stop 0001H: Logging start
20H/50H	0	000BH	OUT2 MV logging	0000H: Not effective 0001H: Effective
20H	0	0080H	CF card used memory reading	Used memory capacity (Decimal point ignored)

6.2 Communication command of the controller

For the Communication command of the connected controllers, refer to the Communication instruction manual for each controller.

To communicate with the connected controllers, set the controller channel number to the Sub address, then send it.

6.3 Command example when sending commands from the host computer to the LMD-100

(1) Address 0, CF card used memory reading

• Reading command from the host computer

Header	Address	Sub address	Command type	Data item [0080H]	Checksum	Delimiter
(02H)	(20H)	(20H)	(20H)	(30H 30H 38H 30H)	(44H 38H)	(03H)

• Response from the LMD-100 in normal status [CF card used memory: 7.4% (004AH)]

Header	Address	Sub address	Command type	Data item [0080H]	Data [004AH]	Checksum	Delimiter
(06H)	(20H)	(20H)	(20H)	(30H 30H 38H 30H)	(30H 30H 34H 41H)	(30H 33H)	(03H)

(2) Address 0, Logging auto-start end time reading

• Reading command from the host computer

Header	Address	Sub address	Command type	Data item [0007H]	Checksum	Delimiter
(02H)	(20H)	(20H)	(20H)	(30H 30H 30H 37H)	(44H 39H)	(03H)

• Response from the LMD-100 in normal status [Logging auto-start end time: 18:00 (0438H)]

Header	Address	Sub address	Command type	Data item [0007H]	Data [0438H]	Checksum	Delimiter
(06H)	(20H)	(20H)	(20H)	(30H 30H 30H 37H)	(30H 34H 33H 38H)	(30H 41H)	(03H)

(3) Address 0, Logging auto-start end time setting

• Setting command from the host computer [Logging auto-start end time: 17:30 (041AH)]

Header	Address	Sub address	Command type	Data item [0007H]	Data [041AH]	Checksum	Delimiter
(02H)	(20H)	(20H)	(50H)	(30H 30H 30H 37H)	(30H 34H 31H 41H)	(44H 33H)	(03H)

• Response from the LMD-100 in normal status

Header	Address	Checksum	Delimiter
(06H)	(20H)	(45H 30H)	(03H)

6.4 Command example when sending commands from the host computer to the controller

(1) LMD-100 address 0, Controller address 1, PV reading

• Reading command from the host computer

Header	Address	Sub address	Command type	Data item [0080H]	Checksum	Delimiter
(02H)	(20H)	(21H)	(20H)	(30H 30H 38H 30H)	(44H 37H)	(03H)

・Response from the controller in normal status [PV: 127℃ (007FH)]

Header	Address	Sub address	Command type	Data item [0080H]	Data [007FH]	Checksum	Delimiter
(06H)	(20H)	(21H)	(20H)	(30H 30H 38H 30H)	(30H 30H 37H 46H)	(46H 41H)	(03H)

(2) LMD-100 address 0, Controller address 2, PV reading

• Reading command from the host computer

Header	Address	Sub address	Command type	Data item [0080H]	Checksum	Delimiter
(02H)	(20H)	(22H)	(20H)	(30H 30H 38H 30H)	(44H 36H)	(03H)

• Response from the controller in normal status [PV: 99.9 (03E7H)]

Header	Address	Sub address	Command type	Data item [0080H]	Data [03E7H]	Checksum	Delimiter
(06H)	(20H)	(22H)	(20H)	(30H 30H 38H 30H)	(30H 33H 45H 37H)	(46H 37H)	(03H)

● **Data**

Note on setting, reading command
• The data (set value, decimal) is converted to hexadecimal figures.
  A negative number is represented by 2's complement.
• When connecting plural LMD-100 units, the address (instrument number) must not be duplicated.

Setting command
• Setting range of each item is the same as that of key operation.
• When the data (set value) has a decimal point, a whole number (hexadecimal) without a decimal point is used.
• The memory can store up to 1,000,000 (one million) entries. If the number of settings exceeds the limit, the data will not be saved. So frequent transmission via communication is not recommended.

Reading command
• When the data (set value) has a decimal point, a whole number (hexadecimal) without a decimal point is used for a response.

7. Specifications

Cable length : Max. communication distance 1.2km
Cable resistance: Within 50Ω (Terminator is not necessary or 120Ω or more on one side.)
Communication interface: EIA RS-485
Communication method : Half-duplex communication
Communication speed : 9600/19200bps (Selectable by keypad) (Default: 9600bps)
Synchronization : Start-stop synchronization
Code form : ASCII, binary
Error detection : Parity check, checksum
Error correction : Command request repeat system
Data format Start bit : 1
Data bit : 7
Parity : Even parity
Stop bit : 1

Start bit	b1	b2	b3	b4	b5	b6	b7	Parity	Stop bit

8. Troubleshooting

If any malfunctions occur, refer to the following items after checking the power supply to the host computer, the LMD-100 and connected controllers.

• **Problem: Communication failure**

Check the following
Make sure that the communication connector is securely connected.
Check that wiring of the communication connector is correct. Refer to "2. Wiring".
Burnout or imperfect contact on the communication cable and the connector.
Communication speed of the LMD-100 does not coincide with that of the host computer. Refer to "3. Communication parameter setting".
The data bit, parity and stop bit of the host computer do not accord with those of LMD-100 protocol.
The instrument number (address) of the LMD-100 or controller does not coincide with that of the command. Refer to "5. Shinko protocol".
The instrument numbers (addresses) are duplicated in multiple LMD-100 units. Refer to "3. Communication parameter setting".
Make sure that the program is appropriate for the transmission timing. Refer to "4. Communication procedure".

• **Problem: Although communication is occurring, the response is 'NAK'.**

Check the following
Check that a non-existent command code has not been sent.
The setting command data exceeds the setting range of the LMD-100 or controllers.
Unsettable status (During data logging, while AT is performing, etc.)
The LMD-100 or controller is in the front key operation setting mode.

For all other malfunctions, please contact our main office or dealers.