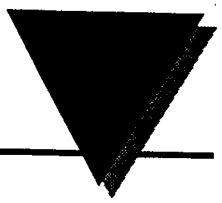
DP20 Series

Communication Interface
RS-232C, RS-422A, RS-485

OMEGA®

An OMEGA Technologies Company

Operator's Manual



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DP20 Series Communication Interface (1)
Operator's Manual (1)

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Contents

1. Summary

This manual describes the Communication Interface option for the DP20 Series meter.

For basic functions and other details, please refer to the operator's manual for the DP20 Series meter.

The DP20 Series has three types of communication interface: RS-232C, RS-422A, and RS-485, which are EIA (Electronic Industries Association of the U.S.) standards. Each allows a personal computer, etc. to set (write) and monitor (read) parameters of the DP20 Series meter.

RS-232C, RS-422A, and RS-485 are data communication standards established by EIA. The standards cover electrical and mechanical aspects, that is, hardware, but not data transmission procedure of software. Therefore it is not possible to communicate unconditionally with an instrument which has the same interface. It is necessary to have a sufficient knowledge of specifications and transmission procedure.

When RS-422A or RS-485 is used, several DP20 Series meters can be connected parallel to one another. When a line converter for RS-232C to RS-422A and RS-232C to RS-485 conversion is used, connection with a personal computer of a different communication system is possible.

2. General Specifications

Signal level:	To conform with EIA's RS-232C, RS-422A, and RS-485		
Communication system:	RS-232C	2-line half duplex system	
	RS-422A	4-line half duplex multidrop system	
	RS-485	2-line half duplex multidrop (bus) system	
Synchronization system:	Start-stop synchronization system		
Communication distance:	RS-232C	Maximum 15m	
	RS-422A	Maximum total of 1200m	(differs depending on conditions)
	RS-485	Maximum total of 500m	(differs depending on conditions)
Communication speed:	1200, 2400, 4800, and 9600 bps		
Transmission procedure:	No procedure		
Data format:	7 bits, even parity, stop bit 1		
	8 bits, no parity, stop bit 1		
Communication code:	ASCII codes		
Control signal:	Not used		
Error detection:	Vertical parity (even parity) check		
	BCC (block check character) check		

Number of indicators to be connected:

RS-232C:	1
RS-422A:	Maximum 10 (32, depending on conditions)
RS-485:	Maximum 32 (depending on conditions; host included)

3. Connecting Indicator with Host Computer

3-1. Control Signal

The DP20 Series indicator is provided with input and output for data transmission, data reception and grounding for signals, but not for any other signal line. Therefore, control signals should be dealt with by the host side.

As various systems use different methods for dealing with them, refer to the specifications of the host computer for details.

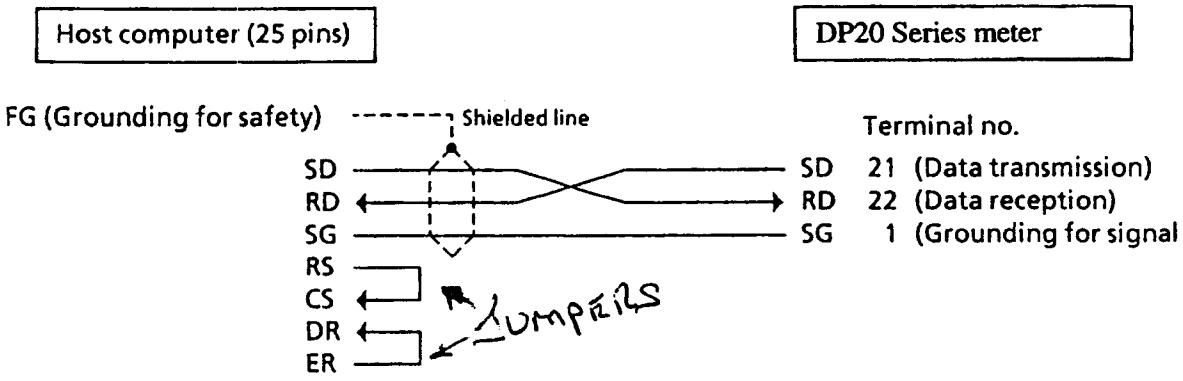
Following is an explanation, with examples, of how to connect the indicator with a host computer.

3-2. Connection of RS-232C

(1) Connection signals of RS-232C (in case of 25-pin interface)

Name of Signal	Abbreviation		Direction of Signal	Connector Pin No.
	EIA Standard	JIS Standard		
Grounding for safety or shielding	- - -	- - -	- -	1
Data transmission	BA	SD	Output	2
Data reception	BB	RD	Input	3
Request for transmission	CA	RS	Output	4
Transmission OK	CB	CS	Input	5
Data setting ready	CC	DR	Input	6
Grounding for signals or common return	AB	SG	- -	7
Data terminal ready	CD	ER	Output	20

(2) Example of RS-232C connection



3-3. Connection of RS-422A

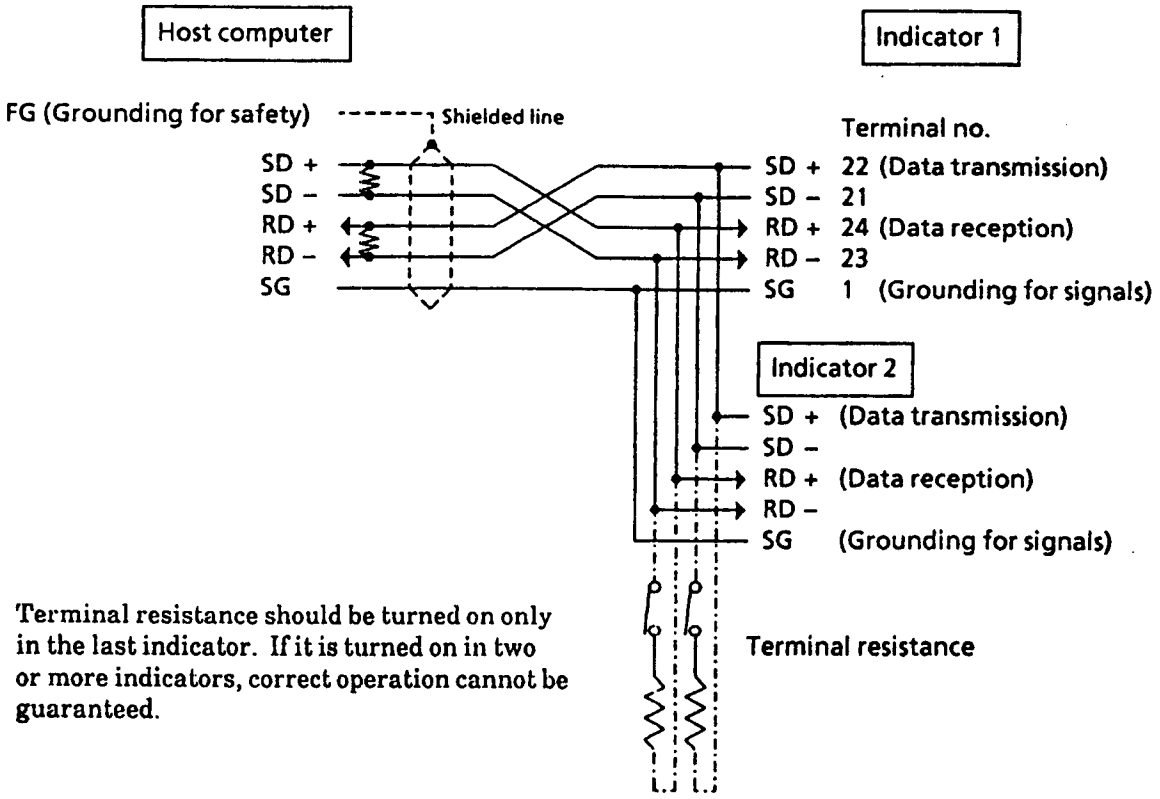
(1) The control signal line should be taken care of in the same manner as in the case of RS-232C.

(2) The input/output logical levels of the DP20 Series are as follows.

In the mark state (including the state in which communication is not carried out)	**− < **+ (E.g., RD− < RD+)
In the space state	**− > **+ (E.g., RD− > RD+)

Until immediately before transmission, however, SD+ and SD− of the indicator have high impedance and outputs of the above levels are produced immediately before transmission is begun.

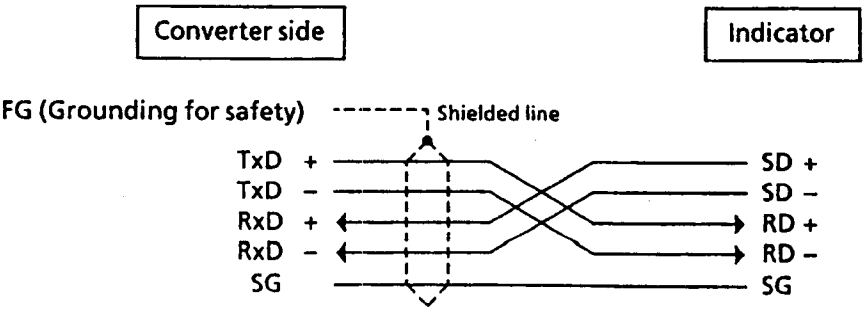
(3) Example of RS-422A connection



- Terminal resistance should be turned on only in the last indicator. If it is turned on in two or more indicators, correct operation cannot be guaranteed.

Note: The terminal (connector) outputs of some RS-232C ↔ RS-422A converters have the following specifications. You should confirm the respective logical levels before connecting them.

E.g.: In the mark state TxD+ > TxD−, In the space state TxD+ < TxD−



3-4. Connection of RS-485

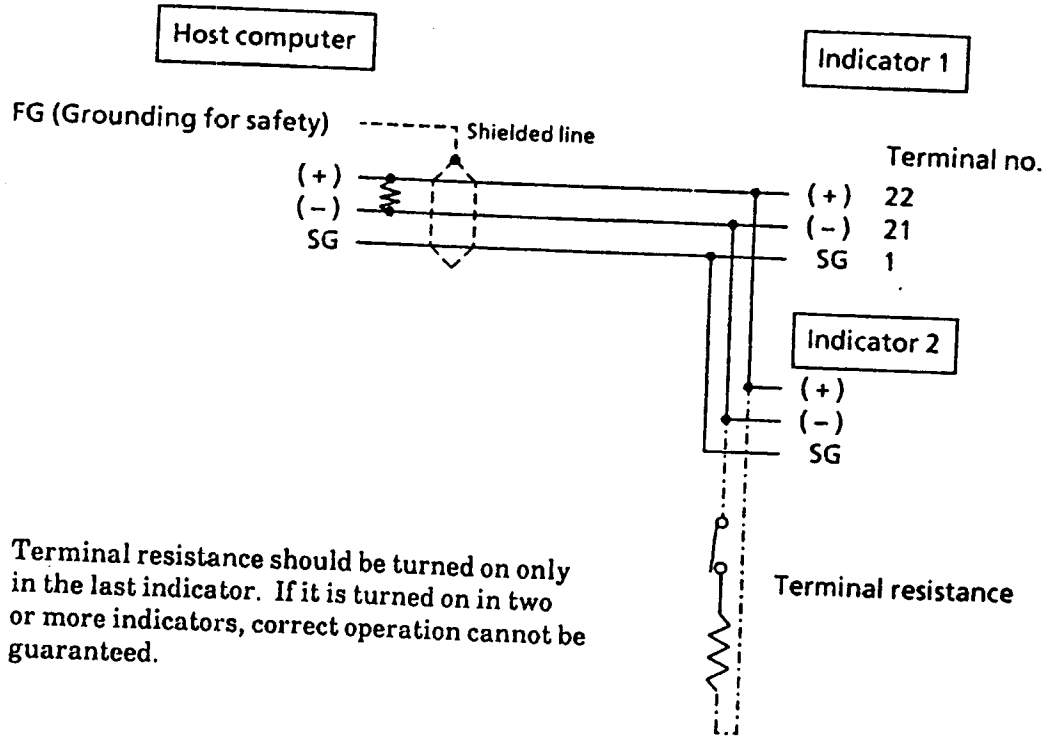
(1) The control signal line should be taken care of in the same manner as in the case of RS-232C.

(2) The input/output logical levels of the DP20 Series are as follows.

In the mark state (including the state in which communication is not carried out)	−terminal < +terminal
In the space state	−terminal > +terminal

Until immediately before transmission, however, the +terminal and −terminal of the controller have high impedance and outputs at the above levels are produced immediately before transmission is begun.

(3) Example of RS-485 connection



- Terminal resistance should be turned on only in the last indicator. If it is turned on in two or more indicators, correct operation cannot be guaranteed.

3-5. Control of 3-State Output

(1) Since RS-422A and RS-485 have the multidrop system, to prevent transmission signals from colliding transmission output should always have high impedance while communication is not being carried out or a signal is being received.

(2) Output should be controlled such that it changes from high impedance to normal immediately before transmission and returns to high impedance simultaneously when transmission ends. Nevertheless, 3-state control is delayed by a maximum of about 6msec. after the completion of transmission of the end bit of an end character. Therefore, if the host side starts transmission immediately after its receipt, a delay of about 10msec. should be provided.

4. Setting of Parameters Related to Communication

4-1. Following are the 5 parameters related to communication. They are set via the front keyboard of the indicator.

[mode] Switching between communication mode and local mode
[Add-] Selecting communication address (machine number)
[dAtA] Selecting data format
[bPS] Selecting communication speed
[dEL y] Selecting delay time

(1) [mode] Mode

The DP20 Series indicator with the communication function option has two modes allowing communication, i.e. the local mode and the communication mode.

[LoCL] Local mode

- O It is possible to switch from the communication mode to the local mode both by a communication command from the host computer and via the front keyboard of the indicator.
- O In the local mode, the communication monitor lamp on the front panel of the indicator remains unlit.
- O In communication, only read commands are effective; parameters can be read but not written (set/changed).
- O Parameters can be set and changed by front key operation.

[Comm] Communication mode

- O It is possible to switch from the local mode to the communication mode by a communication command from the host computer. Switching via the front keyboard is not possible.
- O When the communication mode is switched to, the communication monitor lamp on the front panel of the indicator lights.
- O Read commands and write commands via communication become effective to make it possible to read (monitor) and write (set/change) parameters.
- O It is not possible to set or change parameters via the front keyboard of the indicator.

(2) [Add-] Communication address

- O Since RS-422A and RS-485 allow parallel connection, connected apparatuses are identified by assigned addresses (machine numbers) so that a specific apparatus can respond.
- O An address is selected from 0 to 31 via the front keyboard of the indicator.
- O Addresses are not set or changed via communication.

(3) [DATA] Data format

- Communication data formats is selected via the front keyboard of the indicator either of the following.

Character	Length of Data	Parity	Stop Bit
8n1	8 bits	No	1
7E1	7 bits	Even	1

- A data format cannot be set or changed via communication.

(4) [bPS] Communication speed

- Any of the following four communication speeds can be selected via the front keyboard of the indicator.
- Communication speed cannot be set or changed via communication.

Communication speeds: 1200, 2400, 4800, and 9600 [bps]

(5) [dEL Y] Delay time

- This is the screen for setting a minimum delay time between the receipt of a communication command and transmission.
- A time is selected from the range of 0 to 99 via the front keyboard of the indicator.
- It is not possible to set/change and read via communication.

Delay time = (2msec. × Set value) + Command processing time (msec.)

E.g.: Set value 0 0 × 2msec. = 0 + Command processing time (msec.)
Set value 20 20 × 2msec. = 40 + Command processing time (msec.)
Set value 99 99 × 2msec. = 198 + Command processing time (msec.)

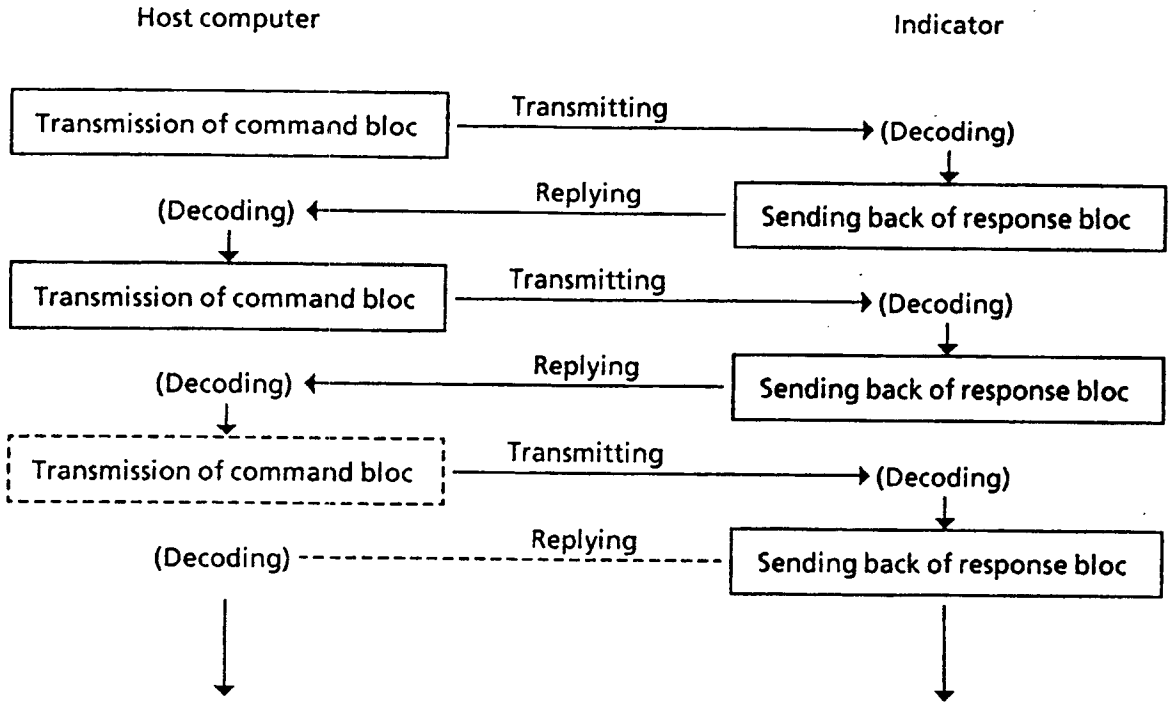
Nevertheless, the actual time between the receipt of a communication command and transmission is a total of the delay time shown above and command processing time by software.

Write commands take longer to be processed.

5. Protocol

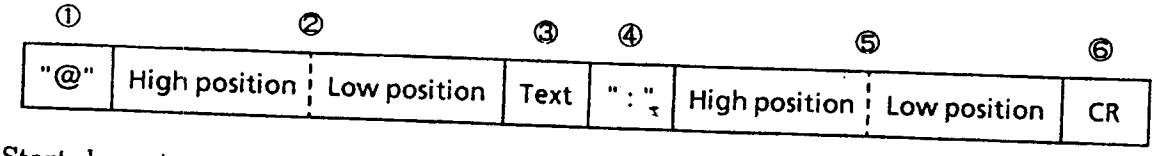
5-1. Communication Procedure

The communication procedure is carried out bloc by bloc, and the right of transmission is switched for each bloc between the host side and the indicator side.



5-2. Bloc

Following is the bloc format of both command and response.



①: Start character "@" (40H)
Indicates the start of a bloc.

②: Address (machine number) ..... 2 digits
The 2-digit address data (0~31) set by the indicator is split into the high position (tens digit) and low position (units digit), and each is expressed by ASCII data.

③: Text ..... Aggregate of a command and data
Text is expressed according to the format of each command.

④: End character ":" (3AH)
Indicates the end of a text.

⑤: BCC check ..... BCC check data are expressed in 2-digit figures.
Data from after "@" (high position date of address) to ":" are computed by means of exclusive OR (XOR), and the value obtained is converted into two ASCII characters, which are expressed in 2-digit figures in the high position and low position.

E.g.: BCC operation of a read command of the basic screen group

"@" + "01" + "D1" + ":" + BCC + CR
(40H) (30H)(31H) (44H)(31H) (3AH) (34H)(45H) (0DH)

30H ⊕ 31H ⊕ 44H ⊕ 31H ⊕ 3AH = 4EH ⟶ ∴ BCC = (34H), (45H) → 4 E

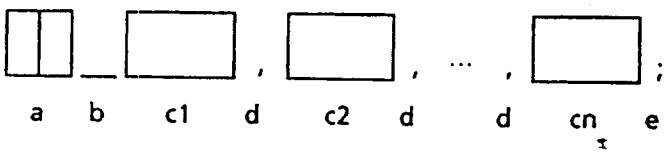
In the above, ⊕ = XOR (exclusive OR)

⑥: Terminator ..... "CR" (0DH)
Indicates the termination of a bloc.

- Since address data are inserted in each bloc to be transmitted and sent back, it is not necessary to establish and dispose of a data link.
- Only the apparatus with a number corresponding to the address in a command bloc transmitted decodes a command, data, etc., and inserts the same address in a response bloc to send back. Apparatuses whose numbers do not correspond to the address in the command bloc do nothing but wait for the next command.
- If bloc data and the terminator "CR" are not completely received within 3 seconds after receiving the start character "@", it is time-out and the apparatus is automatically put into the state of waiting for the next command bloc (i.e., a new start character "@").

5-3. Text Format

The text format is as follows:



a: Command (2 alphanumeric characters)
For purposes of distinction, a command is expressed in two alphanumeric characters.

b: Space (20H)
Used to mark off data from a command.

c1~cn: Data (4 or 6 characters of roman letter(s), numeral(s), and code(s))
Indicates data of predetermined numbers according to the formats set for the respective commands.

d: Comma (2CH)
Used to mark off each data.

e: Semicolon (3BH)
Used to mark the omission of data when subsequent data are omitted in accordance with a set format.

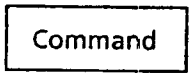
5-4. Characters Usable in Text

Following are the characters that can be used in text.

Character	ASCII	Reading	Range and Meaning of Code
Roman letters	41H~5AH		A~Z (capitals only)
Numerals	30H~39H		0~9
+	2BH	Plus sign	Code of numerical data
−	2DH	Minus sign	Code of numerical data
.	2EH	Period	Decimal point of numerical data
	20H	Space	Code to mark off command from data
,	2CH	Comma	Code to mark off each data
;	3BH	Semicolon	Data omission code (in write command)
_	5FH	Underscore	Used to make character data into matching number, etc.

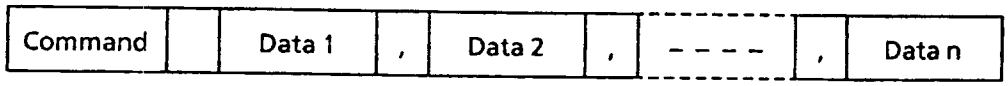
5-5. Differences in Text Format According to Command Type

(1) Read command



When a read command is sent from the host computer, the text format comprises the command (2 characters) only. If anything else is used, it is regarded as a text format error.

(2) Write command

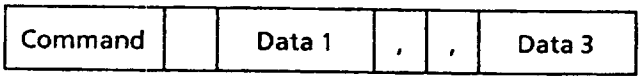


When a write command is sent from the host computer the text format is as shown above, but data can be omitted as shown below.

E.g. : When there are three data:

- Data (data 2 and 3) after data 1 can be omitted by " ; ".

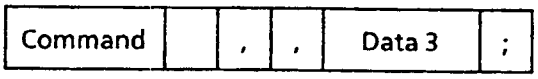
- Data 2 is omitted by " , ".



- Data 1 and data 3 are omitted by " , " and " ; " respectively.

○ In write commands, the following are regarded as text format errors:

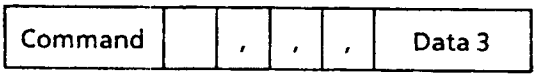
- Characters such as " , " and " ; " are added to the data predetermined to be last (data 3 in the example)



- There is no data after a space " ".

- The command ends with a comma " , " and the number of data is insufficient

- The number of commas is larger than the predetermined number of data



- Any other cases that differ from the basic format

(3) Response data

Command		Data 1	,	Data 2	,	- - - -	,	Data n

Above is the text format of responses (response blocs) sent back from the indicator to the host. In responses, data are not omitted in either the read or write command.

5-6. Numerical Data Format

(1) Numerical data in texts have a fixed length of 6 characters including a decimal point.

(2) A code is attached to the head of a numerical data.

(3) If the figures including the code do not reach 6 characters, "0" should be inserted on the code side make up 6 characters.

(4) Five characters excluding the code must be numerals and a decimal point.

(5) The place of a code should be occupied by a code or any of the special characters listed below. No other roman letters or numerals may occupy it.

(6) If the numeral is 0, both +0 and −0 are acceptable, but only +0 is allowed in response data.

(7) Example

	1	2	3	4	5	6
1	+	0	0	0	0	1
0.001	+	0	.	0	0	1
1234	+	0	1	2	3	4
12.34	+	1	2	.	3	4
0	+	0	0	0	0	0

	1	2	3	4	5	6
-1	-	0	0	0	0	1
-0.001	-	0	.	0	0	1
-1234	-	0	1	2	3	4
-12.34	-	1	2	.	3	4
-0.000	-	0	.	0	0	0

(8) Special data

In the following cases, specific roman letters are put in place of a code.

a. Numerical data are between +10000 and +19999

+ 12345	U	0	2	3	4	5
+ 10.001	U	0	.	0	0	1

+ 123.45	U	2	3	.	4	5

U (55H) represents + 10000.

b. Numerical data are between −10000 and −19999

− 12345	D	0	2	3	4	5
− 10.001	D	0	.	0	0	1

− 123.45	D	2	3	.	4	5

D (44H) represents − 10000.

c. Scale-over of numerical data onto + side

H (48H)	H	0	0	0	0	0

d. Scale-over of numerical data onto − side

L (4CH)	L	0	0	0	0	0

5-7. Character Data Format

(1) Character data in texts have a fixed length of 4 letters.

(2) If the number of letters in character data is less than 4, "_" (underscore) is placed before the data to make up 4.

E.g.:

_	_	H	I

(3) If there is a space " " in character data, it should be replaced by an underscore.

E.g.:

A	_	H	I

(4) Example of character data

E.g.:

_	_	H	I	,	A	_	L	O

5-8. Bit Data Format

Bit data means such parameters as On-Off, which have only two values and are expressed by one bit in order to increase transmission efficiency.

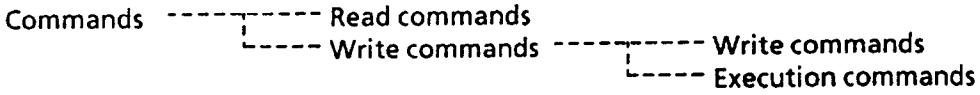
In the DP20 Series indicator, only 0 (30H) and 1 (31H) are used as responses to read commands.

[E.g.] 0: SW off Output off Lamp goes out.
1: SW on Output on Lamp lights.

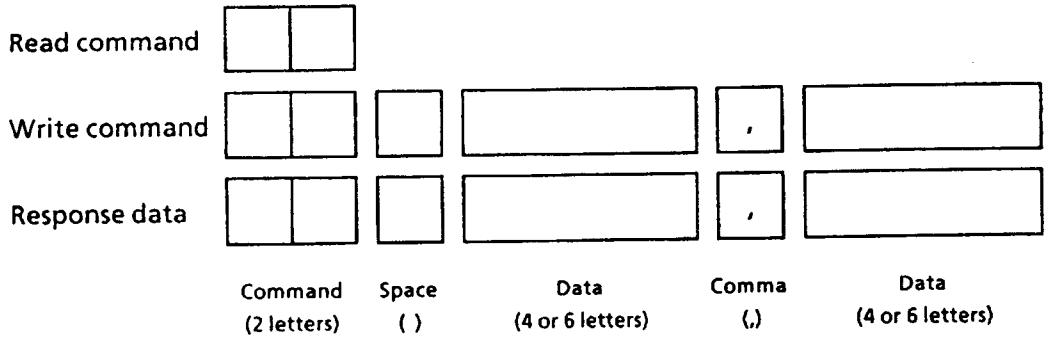
6. Commands

6-1. Outline of Commands

(1) Commands sent out from the host computer are broadly divided into the following 3 types.



(2) Read commands and write commands are represented identically by 2 alphanumeric characters. In a read command, only the command is the text while in a write command, the command is followed by a space followed by data.
The text format of response blocs (data to be sent back) is identical to that of write commands, and both read and write commands are responded to with the same data.



◎ Although data can be omitted in write commands, no omission is possible in response data.

6-2. Read Commands

(1) Read commands are used by the host computer to read various data in the indicator.

(2) Read commands can be used when the communication mode is local (LOC) as well as communication (COM).

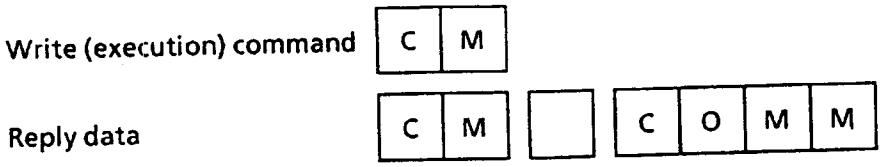
6-3. Write Commands

(1) Write commands are used by the host computer to set and change various data of the indicator.

(2) Write commands (including execution commands) can be used only when the communication mode is communication, not when it is local.

(3) Even when the communication mode is local, data to change the setting of the communication mode can be transmitted by a write (execution) command.

* The text of a changing command (CL, CM) of the communication mode comprises the command only and is not added with data even when it is a write (execution) command.
In the response bloc (reply data), however, a command and data are sent back.



7. Detailed Explanation of Commands

7-1. List of Commands

There are 18 communication commands in the communication interface.
Following is a table of commands, the numbers of parameters in write/read commands, and formats. For details of each communication command, see 7-2. Detailed Explanation of Commands.

List of Commands		
(1) Commands related to DIP switch and status		
D1	Reading of setting status of DIP switch 1	D1 ①, ②, ③, ④
D2	Reading of setting status of DIP switch 2	D2 ①, ②, ③, ④
M1	Reading of alarm output status and standby flag	M1 ①, ②, ③, ④
M2	Reading of lighting status of monitor lamp	M2 ①, ②, ③, ④, ⑤, ⑥, ⑦
M3	Reading of voltage or current input type	M3 ①
(2) Commands related to PV value		
MP	Reading of PV value (current value)	MP ①
MX	Reading of peak hold value	MX ①
MN	Reading of bottom hold value	MN ①
MC	Control of PV cycle reading	MC ①, ②
SH	Control of restarting peak/bottom hold action	SH ①
(3) Commands related to alarm		
AS	Reading of set value of alarm	AS ①, ②
AH	Reading and writing of alarm action hysteresis	AH ①, ②
AM	Reading and writing of alarm mode	AM ①, ②
(4) Commands related to display scaling		
SC	Reading/writing of display scaling	SC ①, ②
SD	Reading/writing of decimal point position	SD ①
SF	Reading/writing of compensation value and unit for sensor	SF ①, ②
(5) Commands related to communication		
CL	Switching to local mode	CL ①
CM	Switching to communication mode	CM ①

(6) Error response		
ER	Error message	ER ①

* Error responses are not commands; when communication is found to be abnormal for some reason, a response is sent back in the same format as the command. For details, see 8. Handling of Errors.

7-2. Detailed Explanation of Commands and Data

[Legend]

Command	Title	Section	Type of Command
Contents/meaning of command Remarks			Type of data
R: Format of read command W: Format of write command Res: Format of reply data (response)			
Meaning, selectable range, etc., of parameter (①, ② ··· represent the order of parameters.)			

D1	Dip status 1	(1)	Read Command
Reading of status of rotary switch 1 (SW1) setting 0~F is expressed by 4 bits of ①~④.			Bit data
R: D1 W: None Res: D1 ①, ②, ③, ④			

Switch Nos. ⟶

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
①	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
②	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
③	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
④	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

For the types and measuring ranges of applicable sensors, see the operator's manual for the DP20 Series meter.

D2	Dip status 2	(1)	Read Command
Reading of status of DIP switch (SW2) setting			Bit data
R: D2 W: None Res: D2 ①, ②, ③, ④, ⑤			
① SW2-1	Display updating cycle	[0] Off (0.25 sec.)	[1] On (2 sec.)
② SW2-2	RTD input standard	[0] Off (JPt)	[1] On (Pt)
③ SW2-3	Alarm	[0] Off (no standby action)	[1] On (standby action)
④ SW2-4	Keylock	[0] Off (lock release)	[1] On (lock set)
⑤ SW2-5	Unit	[0] Off (°C)	[1] On (°F)

M1	Monitor 1	(1)	Read Command
Reading of output condition and standby status when alarm option is added			Bit data
R: M1 W: None Res: M1 ①, ②, ③, ④			
① Standby status of alarm 1		[0] Off	[1] On
② Standby status of alarm 2		[0] Off	[1] On
③ Output of alarm 1		[0] Off	[1] On
④ Output of alarm 2		[0] Off	[1] On

M2	Monitor 2	(1)	Read Command
Reading of lighting statuses of monitor lamps on front panel of indicator			Bit data
R: M2 W: None Res: M2 ①, ②, ③, ④, ⑤, ⑥, ⑦			
① Maximum value lamp		[0] Unlit	[1] Lit
② Minimum value lamp		[0] Unlit	[1] Lit
③ Hold lamp		[0] Unlit	[1] Lit
④ Communication lamp		[0] Unlit	[1] Lit
⑤ Alarm 1 lamp		[0] Unlit	[1] Lit
⑥ Alarm 2 lamp		[0] Unlit	[1] Lit
⑦ Range lamp		[0] Unlit	[1] Lit

M3	Monitor 3	(1)	Read Command
Reading of input type in case of voltage or current input			Character data
R: M3 W: None Res: M3 ①			
① Types of input	[MILI] Voltage (mV) input [VOLT] Voltage (V) input [CURR] Current (mA) input		

MP	Monitor Process value	(2)	Read Command
Reading of current PV value			Numerical data
R: MP W: None Res: MP ①			
① Current PV value The PV value just taken in is sent back. * Even when a display is being held, what is sent back is not the value held but current PV value.			

MX	Monitor maXimum value	(2)	Read Command
Reading of peak hold (maximum) value			Numerical data
R: MX W: None Res: MX ①			
① Peak hold (maximum) value The highest value held is sent back.			

MN	Monitor miNimum value	(2)	Read Command
Reading of bottom hold (minimum) value			Numerical data
R: MN W: None Res: MN ①			
① Bottom hold value (minimum) The lowest value held is sent back.			

MC	Monitor Cycle	(2)	Write Command
To start/stop reading cycle of current PV value and set cycle time			① Character data ② Numerical data
R: None W: MC ①, ② Res: MC ①, ②			
① [STRT] To start reading cycle [STOP] To stop reading cycle ② Cycle + 1~ + 2000 [seconds] * Even when a display is being held, what is sent back is not the value held but current PV value.			

SH	Sample & Hold	(2)	Write Command
To control restart of peak hold and bottom hold			Character data
R: None W: SH ① Res: SH ①			
① [STRT]			

AS	Alarm Set value	(3)	Read/Write Commands
Reading and writing of alarm set value			Numerical data
R: AS W: AS ①, ② Res: AS ①, ②			
① Set value of alarm 1 – 1999~ + 9999 ② Set value of alarm 2 – 1999~ + 9999 When alarm 2 is in deviation higher/lower limit mode, selectable range of ② is + 1~ + 9999. * Decimal point is in same position as that of measuring range.			

AH	Alarm Hysteresis	(3)	Read/Write Commands
Reading and writing of alarm action hysteresis			Numerical data
R: AH W: AH ①, ② Res: AH ①, ②			
① Alarm 1 action hysteresis + 2~ + 99 ② Alarm 2 action hysteresis + 2~ + 99 * Decimal point is in same position as that of measuring range.			

AM	Alarm Mode	(3)	Read/Write Commands
Reading and writing of alarm mode			Character data
R: AM W: AM ①, ② Res: AM ①, ②			

① Alarm 1 mode	[__HI]	Higher limit alarm	[__LO]	Lower limit alarm
② Alarm 2 mode	[A_HI]	Absolute value higher limit alarm	[A_LO]	Absolute value lower limit alarm
	[D_HI]	Deviation higher limit alarm	[D_LO]	Deviation lower limit alarm
	[D_HL]	Deviation higher/lower limit alarm		

SC	SCaling	(4)	Read/Write Commands
Reading and writing of display scaling value			Numerical data
R: SC W: SC ①, ② Res: SC ①, ②			
① Lower limit of display scaling ② Higher limit of display scaling Selectable range: – 1999~ + 9999 (span: 100~10000 counts) * Decimal point is in same position as 'Decimal point' (dP).			

SD	Set Decimal point	(4)	Read/Write Commands
Reading and writing of decimal point position			Character data
R: SD W: SD ① Res: SD ①			
① Decimal point positions [_ _ _ _] No decimal point [_ _ . _] E.g.: 99.9 [_ . _ _] E.g.: 9.99 [. _ _ _] E.g.: .999			

SF	Set shiFt value	(4)	Read/Write Commands
Reading and writing of compensation value and unit for sensor			① Numerical data ② Character data
R: SF W: SF ①, ② Res: SF ①, ②			
① Sensor compensation value – 999~ + 999 [unit] ② Unit [DEGC] Celsius (°C) [DEGF] Fahrenheit (°F) * Decimal point is in same position as that of measuring range.			

CL	Comm. Local	(5)	Execution Command
Switching to local mode			Character data
R: None W: CL Res: CL ①			
① [LCAL] Local mode			

CM	Communication Mode	(5)	Execution Command
Switching to communication mode			Character data
R: None W: CM Res: CM ①			
① [COMM] Communication mode			

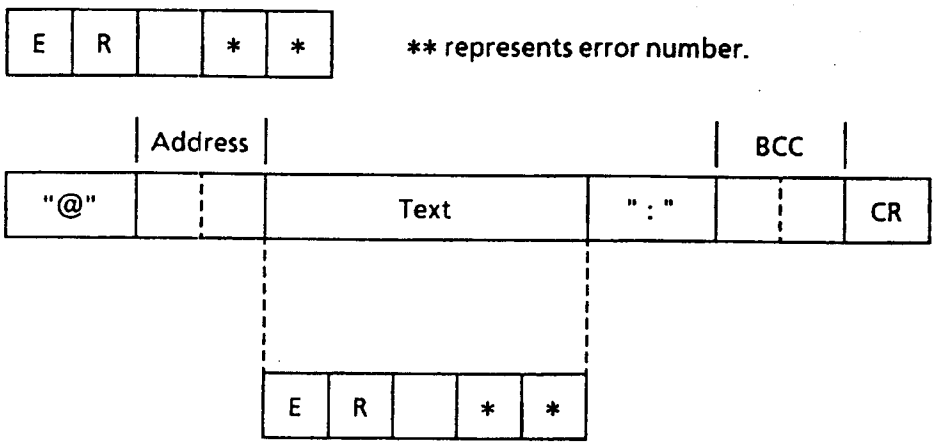
8. Handling of Errors

8-1. How to Deal with Errors

If an error is found in a text format, command, data, etc., in a text upon the receipt of a command (transmission data), an error message depending on the type of error should be sent back. If an error is found anywhere other than in a text, that is, in the start character (@), address (machine number end character (:), BCC, terminator (CR), or command bloc format, a response bloc (reply data) is not sent back from the DP20 but the next correct bloc is awaited. Therefore, in this case the host computer should transmit a command bloc again.

8-2. Error Message Format

Error messages have the following format. Basically, this format is the same as the command format for response.



8-3. Types of Error and Error Numbers

The following table shows the types of error and error numbers.

Error Type	Error No.	Contents
Framing error	ER 01	Stop bit impossible to detect or incompatible.
Overrun error	ER 02	Next data transferred to register before received buffer is read.
Parity error	ER 03	Number of "1" in received data differs from previously set parity even or odd.
BCC error	ER 05	BCC (all exclusive ORs of machine no., text, and text end code) incompatible.
Command error	ER 06	Undefined or unanalyzable command received.
Text format error	ER 07	Text format differs from set format (no. of data, use of code, etc.).
Data format error	ER 08	Data format differs from set format (e.g., unusable character is used).
Data error	ER 09	Data exceeds limit of selectable nos. or includes unselectable character.
Execution command error	ER 10	Execution command received when impossible to accept execution command.
Write command error	ER 11	Write command received in local mode or when that data cannot be rewritten.
Specifications/option error	ER 12	Command received is for specifications or option not added to instrument.

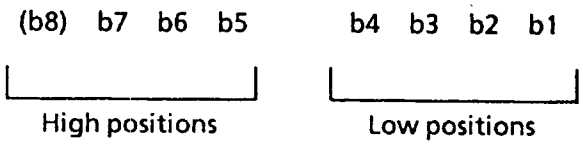
8-4. Order of Priorities of Errors

The lower the error number, the higher the priority. If two or more errors arise simultaneously, the indicator responds to the error with higher priority (with the lower number).

9. ASCII Codes

b7b6b5	000	001	010	011	100	101	110	111
b4~b1	0	1	2	3	4	5	6	7
0000	NUL	TC7 (DLE)	SP *	0	@	P	`	p
0001	TC1 (SOH)	DC1	!	1	A	Q	a	q
0010	TC2 (STX)	DC2	"	2	B	R	b	r
0011	TC3 (ETX)	DC3	#	3	C	S	c	s
0100	TC4 (EOT)	DC4	$	4	D	T	d	t
0101	TC5 (ENQ)	TC8 (NAK)	%	5	E	U	e	u
0110	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v
0111	BEL	TC10 (ETB)	'	7	G	W	g	w
1000	FEO (BS)	CAN	(	8	H	X	h	x
1001	FE1 (HT)	EM	)	9	I	Y	i	y
1010	FE2 (LF)	SUB	*	:	J	Z	j	z
1011	FE3 (VT)	ESC	+	;	K	[	k	{
1100	FE4 (FF)	IS4 (FS)	,	<	L	\	l	¦
1101	FE5 (CR)	IS3 (GS)	-	=	M	]	m	}
1110	SO	IS2 (RS)	.	>	N	^	n	~
1111	SI	IS1 (US)	/	?	O	_	o	DEL

◎ Note: 20H (SP) represents OR. (This state is the same as the original.)



MADE IN USA

WARRANTY/DISCLAIMER

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID, if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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

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

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

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

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

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