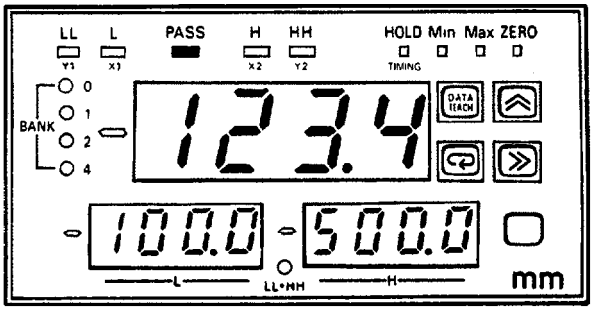
K3TS Communication Output-type Intelligent Signal Processor

Operation Manual

Revised June 1995



Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

⚠ DANGER! Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

⚠ WARNING Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

⚠ Caution Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

OMRON Product References

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PC” means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

1, 2, 3... 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

TABLE OF CONTENTS

About this Manual:

Section 1 introduces the basic features of the K3TS Intelligent Signal Processor.

Section 2 gives a general description of the K3TS rear panel communications connector/terminals.

Section 3 provides the interface specifications and basic operational elements required in order to use the RS-422/RS-485 models.

Section 4 provides the basic operational elements required in order to use the BCD output model and gives two programming examples.

Appendix A provides an ASCII list.

Appendix B provides a list of optional accessories.

⚠WARNING Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

SECTION 1
Front Panel: Nomenclature and Functions

This section gives a general description of the K3TS Intelligent Signal Processor's front panel.

1-1 Introduction

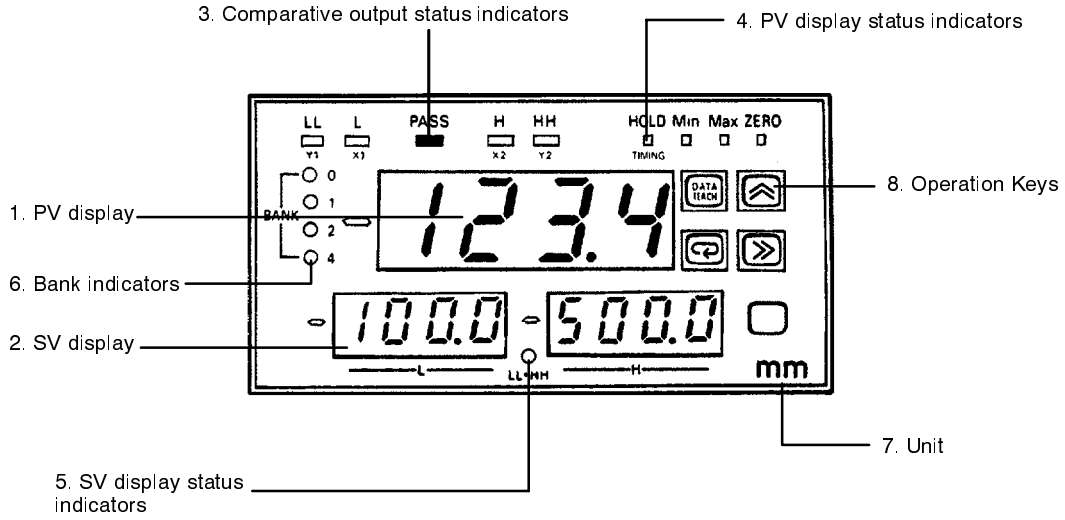
This manual provides the basic operational elements required in order to operate the Communication Output-type K3TS Intelligent Signal Processors. Depending upon the requirements, one of several connector/terminal models can be selected for use with the Intelligent Signal Processor.

Following the front panel model descriptions, the RS-422/RS-485 model specifications and operation are provided in detail. Included is a communication program example written in N88 BASIC.

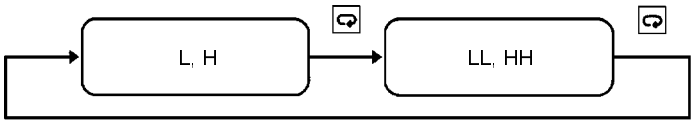
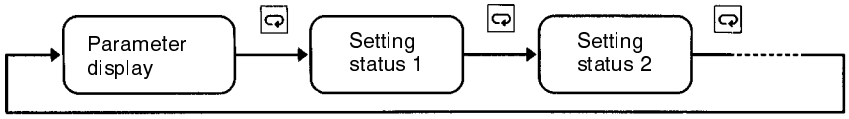
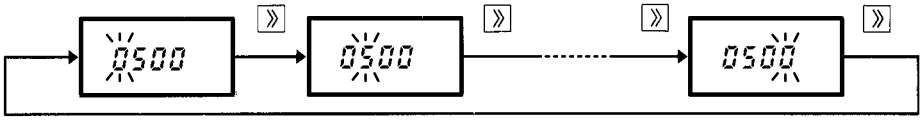
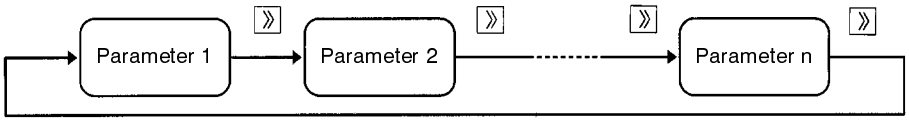
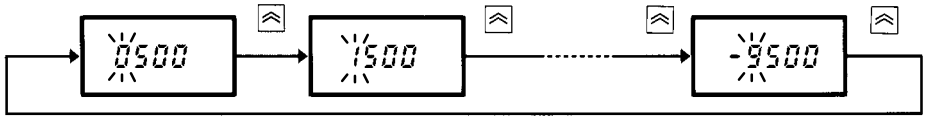
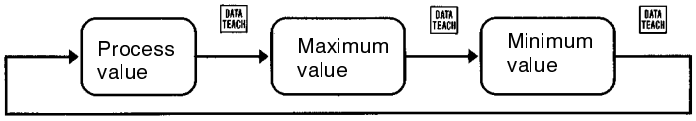
Finally, the BCD Output Model is ideal when connecting directly with a PC or a personal computer. Operational details and two program examples involving connection with a PC are provided.

1-2 K3TS-SD1_B-__ (with Set Value LED Display)

The following diagram identifies the major features found on the K3TS with Set Value LED Display front panel. The table gives a brief description of the function of each front panel feature.



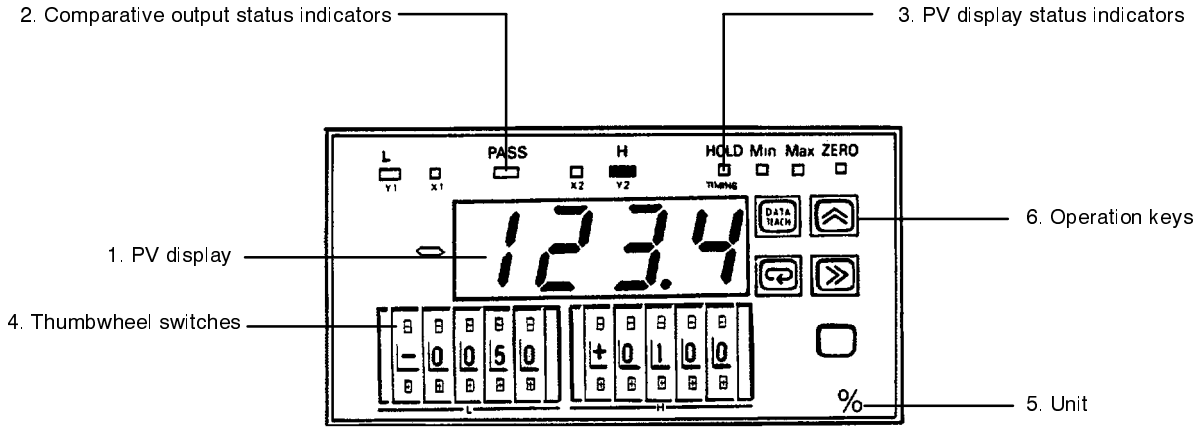
No.	Name		Functions
1	PV (process value) display		Displays the process, maximum, and minimum values. Displays characters indicating the set mode and set values. Displays an error message when an error occurs.
2	SV (set value) display		Displays the set value of a comparative output. In setting mode, displays the set parameter.
3	Comparative output status indicators	HH	Is lit when HH comparative output status is ON. HH comparative output status turns ON when the measured value exceeds the HH set value.
		H	Is lit when H comparative output status is ON. H comparative output status turns ON when the measured value exceeds the H set value.
		L	Is lit when L comparative output status is ON. L comparative output status turns ON when the measured value falls below the L set value.
		LL	Is lit when LL comparative output status is ON. LL comparative output status turns ON when the measured value falls below the LL set value.
		PASS	Is lit when PASS comparative output status is ON. PASS comparative output status turns ON when all HH, H, L, and LL comparative output status are OFF.
4	PV display status indicators	HOLD	Is lit when HOLD input is ON. By turning ON the HOLD terminal on the rear panel, the hold function can be effected.
		TIMING	Is lit when the TIMING input is ON. By turning ON the TIMING terminal on the rear panel, the TIMING hold function can be effected.
		Min	Indicates that the value displayed on the PV display is the minimum value. To display the minimum value, use the DATA TEACH Key.
		Max	Indicates that the value displayed on the PV display is the maximum value. To display the maximum value, use the DATA TEACH Key.
		ZERO	Is lit when ZERO shift status is ON. By turning ON the ZERO terminal on the rear panel, the ZERO shift function can be effected. The ZERO indicator is lit when the display value is shifted if the model has a display shift function.
5	SV display status indicators		Indicates whether the displayed set value on the SV display is HH and LL or H and L. The SV display is lit when the set values are HH and LL and not lit when the set values are H and L.
6	Bank indicators		To alter the set value without key operation, select another bank when making a level change. The K3TS has eight banks; each bank can output HH, H, L, and LL set values. The selected bank is displayed in the binary system.
7	Unit		Attach the appropriate label (use the labels supplied as accessories).

No.	Name		Functions
8	Operation Keys	Level Key	Selects the setting mode, in which the setting levels can be changed.
		Display Key	Displays a set value on the SV display.  In the setting mode, after a parameter is selected with the Shift Key, the selected setting is enabled or disabled or the set value is written to memory with this key. 
		Shift Key	Shifts the digit where the set value is to be changed.  Selects a parameter at each setting level. 
		Up Key	Increases the value of the current digit in the set value by one. 
		DATA TEACH Key	Selects the process value, possible display shift status (*1), maximum value (*2), or minimum value (*2). *1: Available only if the model incorporates a shift function. *2: Available only when operating parameter 3 is in the normal setting.  In the setting mode, effects the teaching function. With this function, the set values and linear output range are set by means of actual input.

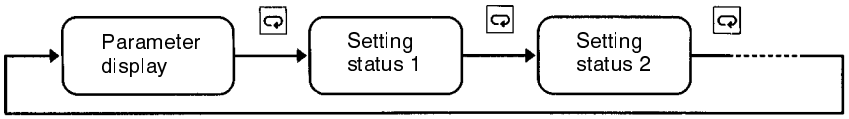
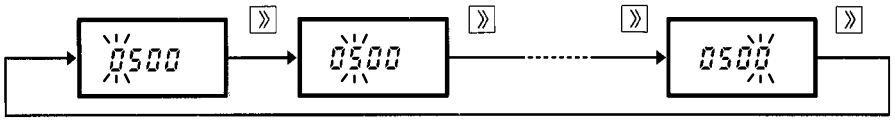
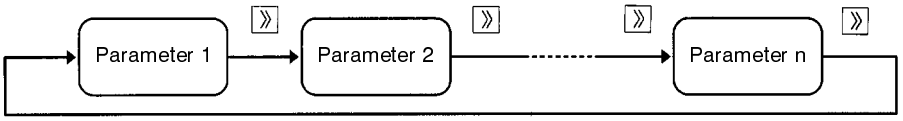
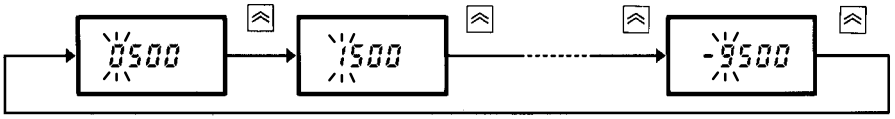
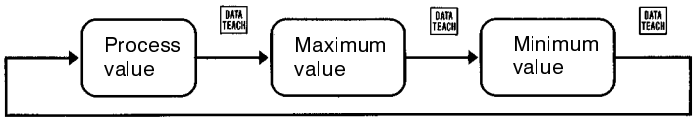
Note Apart from details concerning communications, refer to the *K3TS Operation Manual* for details on parameter settings and operations.

1-3 K3TS-SD1□D-B4 (with Thumbwheel Switches)

The following diagram identifies the major features found on the K3TS with Thumbwheel Switches front panel. The table gives a brief description of the function of each front panel feature.



No.	Name		Functions
1	PV (process value) display		Displays the process, maximum, and minimum values. Displays characters indicating the set mode and set values. Displays an error message when an error occurs.
2	Comparative output status indicators	H	Is lit when H comparative output status is ON. H comparative output status turns ON when the measured value exceeds the H set value.
		L	Is lit when L comparative output status is ON. L comparative output status turns ON when the measured value falls below the L set value.
		PASS	Is lit when PASS comparative output status is ON. PASS comparative output status turns ON when all HH, H, L, and LL comparative output status are OFF.
3	PV display status indicators	HOLD	Is lit when HOLD input is ON. By turning ON the HOLD terminal on the rear panel, the hold function can be effected.
		TIMING	Is lit when the TIMING input is ON. By turning ON the TIMING terminal on the rear panel, the TIMING hold function can be effected.
		Min	Indicates that the value displayed on the PV display is the minimum value. To display the minimum value, use the DATA TEACH Key.
		Max	Indicates that the value displayed on the PV display is the maximum value. To display the maximum value, use the DATA TEACH Key.
		ZERO	Is lit when ZERO shift status is ON. By turning ON the ZERO terminal on the rear panel, the ZERO shift function can be effected.
4	Thumbwheel switches		Set H and L set values. The set values can be changed at any time regardless of the RUN or setting mode.
5	Unit		Attach the appropriate label (use the labels supplied as accessories).

No.	Name		Functions
6	Operation Keys	□ Level Key	Selects the setting mode, in which the set levels can be changed.
		Display Key	This key has no function in RUN mode. In the setting mode, after a parameter is selected with the Shift Key, the selected setting is enabled or disabled or the set value is written to memory with this key. 
		Shift Key	Shifts the digit where the set value is to be changed.  Selects a parameter at each setting level. 
		Up Key	Increases the value of the current digit in the set value by one. 
		DATA TEACH Key	Displays the process, maximum, or minimum value. (Operating parameter 3: Only in the normal setting.)  In the setting mode, effects the teaching function. With this function, the set values, prescale values and linear output range are set by means of actual input.

Note Apart from details concerning communications, refer to the *K3TS Operation Manual* for details on parameter settings and operations.

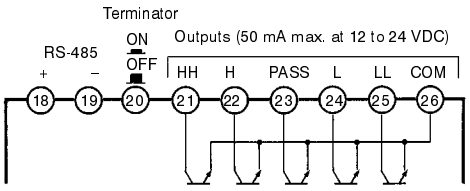
SECTION 2
Rear Panel Communications Connector/Terminals

This section gives a general description of the K3TS rear panel communications connector/terminals. Depending upon the requirements, one of several connector/terminal types can be selected for use with the Intelligent Signal Processor.

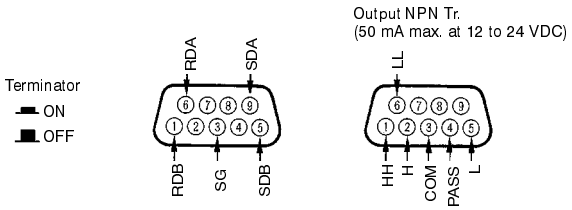
2-1 Connector/Terminal Allocations

Depending upon the requirements of the host system or peripheral device, the Intelligent Signal Processor can use one of the following outputs:

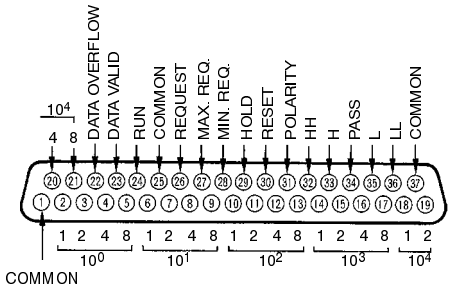
K31-S5: RS-485 + Transistor



K31-S6: RS-422 + Transistor



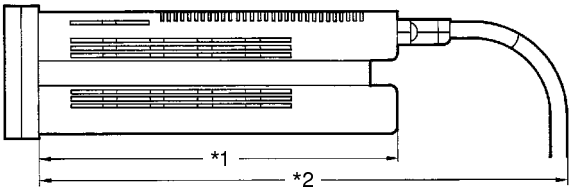
K31-B4: BCD + Transistor (NPN Open Collector)



2-2 Connecting Communications Connectors

Connect a host system or peripheral device to the appropriate communication connector; confirm that the system or device conforms to that connector's communication specifications. Before mounting this device, be sure to consider the added depth required by connected cables.

The BCD output type is supplied with a connector.
Plug: XM2A-3701
Hood: XM2S-3711



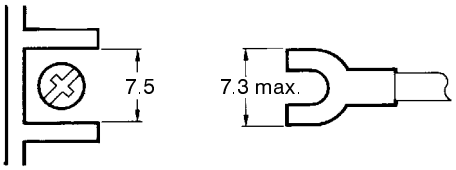
*1: Depth of main body from panel (when mounted): 130 mm
*2: Depth of main body plus D-sub connector (OMRON XM2 or XM4) from panel (when mounted): 200 mm minimum (37-pin connector);
190 mm minimum (9-pin connector)

The following OMRON D-SUB connectors are recommended:

9 pin: XM2A-0901 (plug) + XM2S-0911 (hood)
XM4A-0921 (plug) + XM2S-0911 (hood)

If using an equivalent connector, make sure that the connector fastening screw is the following metric size: M2.6 x 0.45.

When connecting to the terminal-block-type unit, use crimp-style terminals of the appropriate size for M3.5 screws. Securely insert the communication connector from the external system into the communication connector on the body of the Unit. After connection, tighten the screws on either side of the communication connector with a screwdriver. For the appropriate cable length, refer to the respective communication specifications.



SECTION 3
RS-422/RS-485 Models

This section provides the interface specifications and basic elements required in order to use the RS-422/RS-485 models. Included in this section is a communication program example written in N88 BASIC.

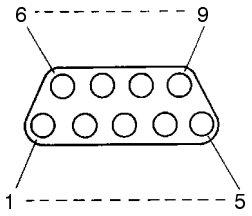
3-1 Interface Specifications

3-1-1 RS-422

Electrical characteristics conform to EIA RS-422.

Communications Signals

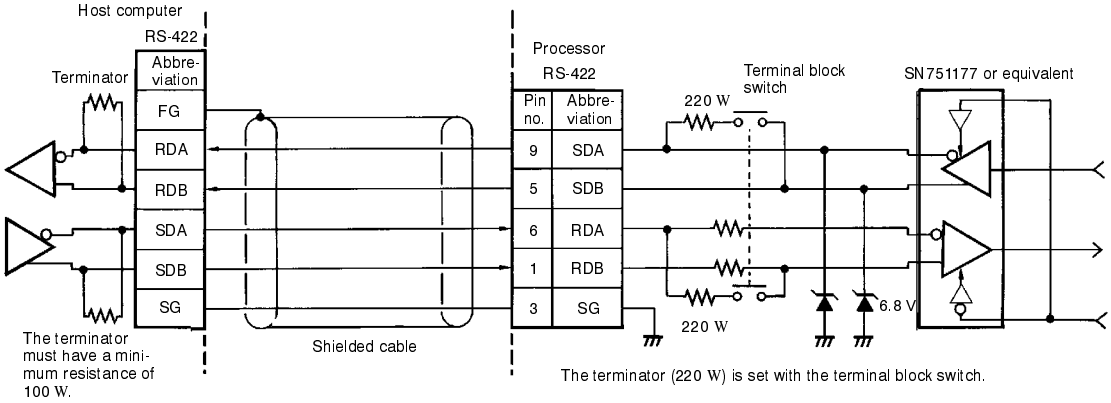
The following information identifies the key input/output signals of the interface.



Signal	Abbreviation	Signal direction	Pin No.
Send Data A	SDA	Output	9
Send Data B	SDB	Output	5
Receive Data A	RDA	Input	6
Receive Data B	RDB	Input	1
Signal Ground	SG	---	3
Frame Ground (safety ground)	FG	---	7

Connection Diagram

The following example provides information on how the RS-422 Intelligent Signal Processor is to be connected to the host computer.



Synchronization clock: Internal clock

Total line length: 500 m maximum

Recommended cable: CO-HC-ESV-3P x 7/0.2 (Hirakawa Densen)

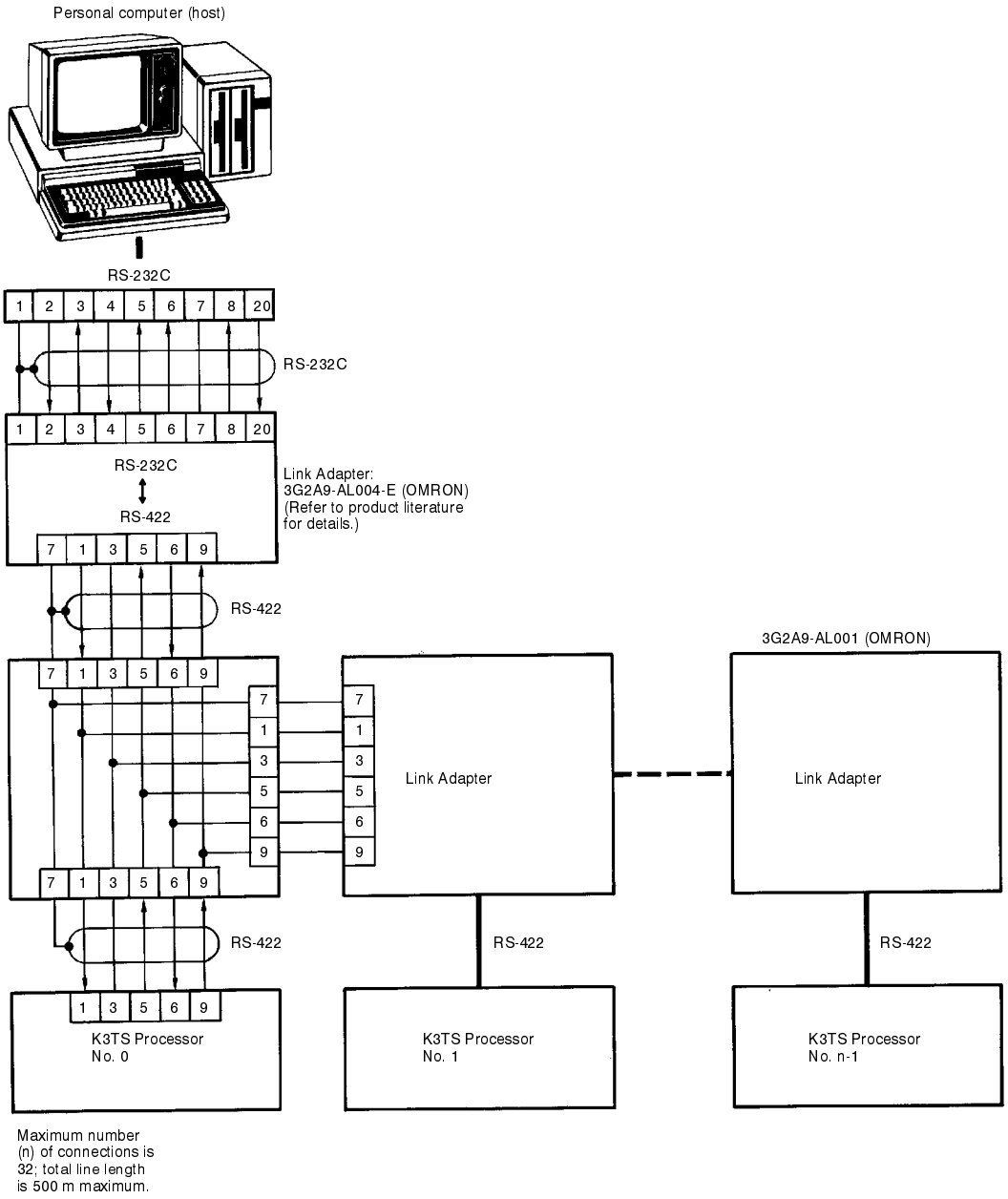
Applicable connectors: Plug: XM2A-0901 (OMRON) or equivalent
XM4A-0921 (OMRON) or equivalent
Hood: XM2S-0911 (OMRON) or equivalent

Connection method (RS-422 connection): Maximum 1:32 connection

When using this connection:
Turn ON the terminal block switch at the end station.
Turn OFF all other terminal block switches.

RS-422 System Example

The following example shows several Intelligent Signal Processors connected to a personal computer using the RS-422 connection method.

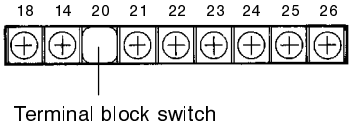


3-1-2 RS-485

Electrical characteristics conform to EIA RS-485.

Communications Signals

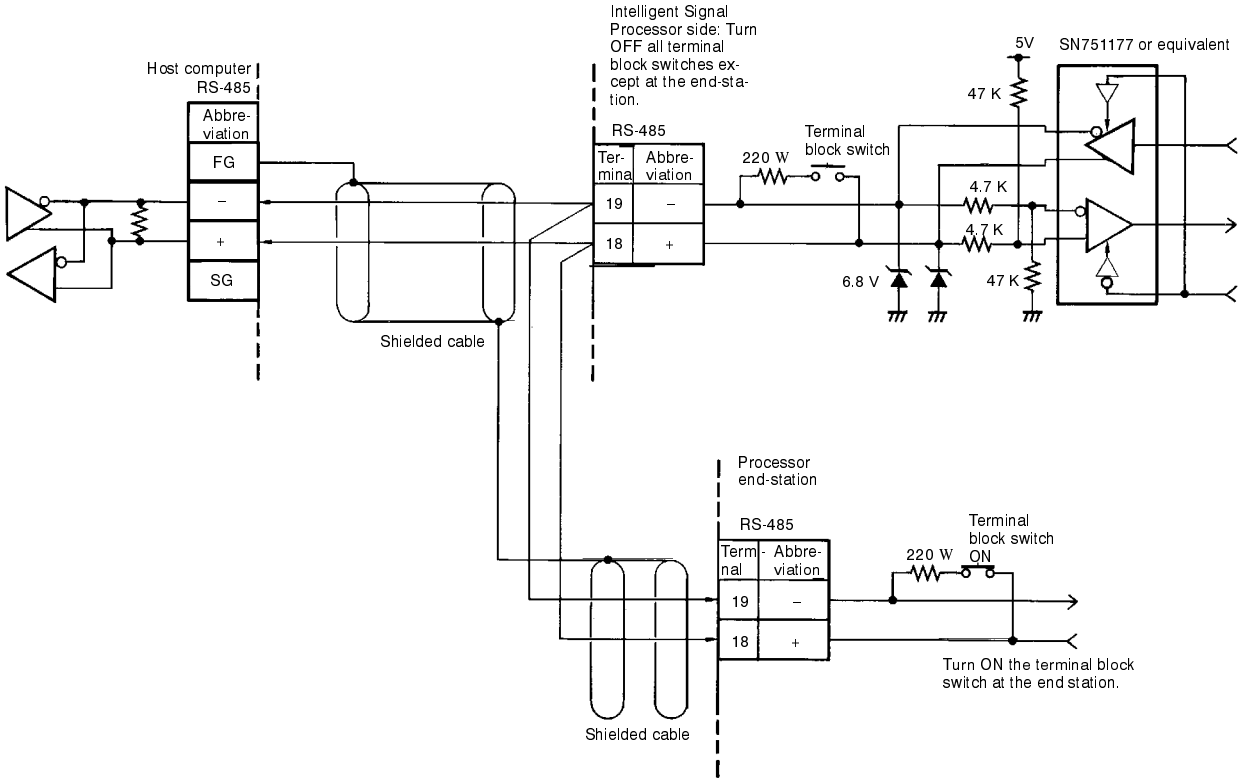
The following information identifies the key input/output signals of the interface.



Signal	Abbreviation	Signal direction	Terminal No.
Inverted output	Negative (–) side	Input/output	19
Non-inverted output	Positive (+) side	Input/output	18

Connection Diagram

The following example provides information on how the RS-485 Intelligent Signal Processor is to be connected to the host computer.



Synchronization clock: Internal clock

Total line length: 500 m maximum

Recommended cable: CO-HC-ESV-3P x 7/0.2 (Hirakawa Densen)

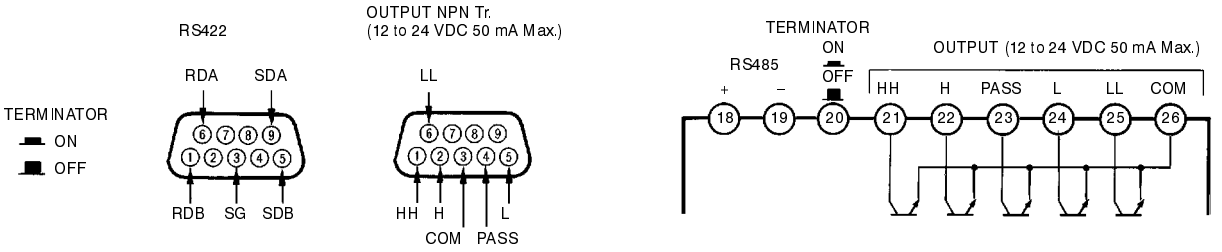
Connection method (RS-485 connection): Maximum 1:32 connection

In this case, the SYSMAC SYSBUS wire type cannot be connected.

3-2 Before Applying Power

Terminator Designation

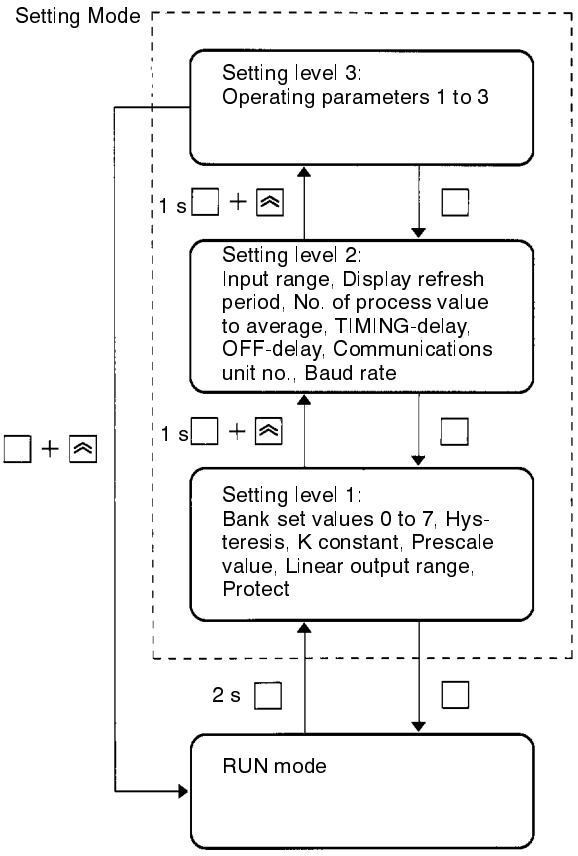
For the RS-422 and RS-485 models, designate the Intelligent Signal Processor (Processor) located at the right end of the transmission line as an end station by setting the terminator switch of that unit to ON.



3-3 Key Operation

Before attempting communication when using the RS-422 and RS-485 Models, set the baud rate (communication speed) and unit number according to the following procedures; use the keys on the front of the Unit to make the settings. For operation procedures other than the following, refer to the operation manual or instruction manual supplied with the Unit.

This device has two modes: RUN mode, for normal operation; and Setting mode, for initial setting. The Setting mode is further categorized in three levels according to the frequency of use. Set the baud rate and unit number with Setting level 2.



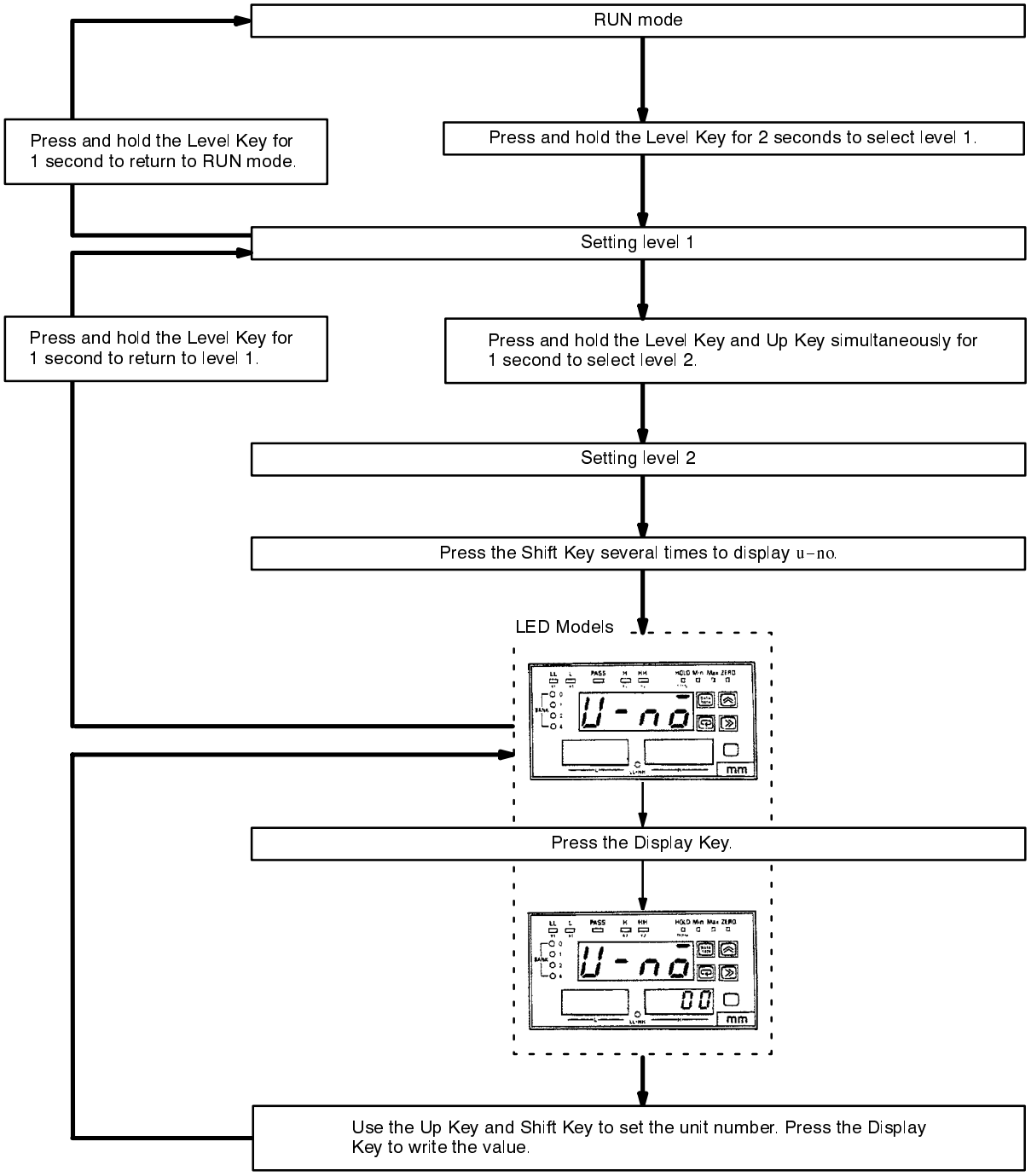
K3TS Setting Level

3-3-1 Communications Unit Number

The communications unit number is an identification number by which the host computer to which the Intelligent Signal Processor is connected identifies the Intelligent Signal Processor. The Thumbwheel Switches Models are not provided with the communication output function.

In order to set the communications unit number, follow the instructions outlined on the flow diagram (after the table) and set within the following range:

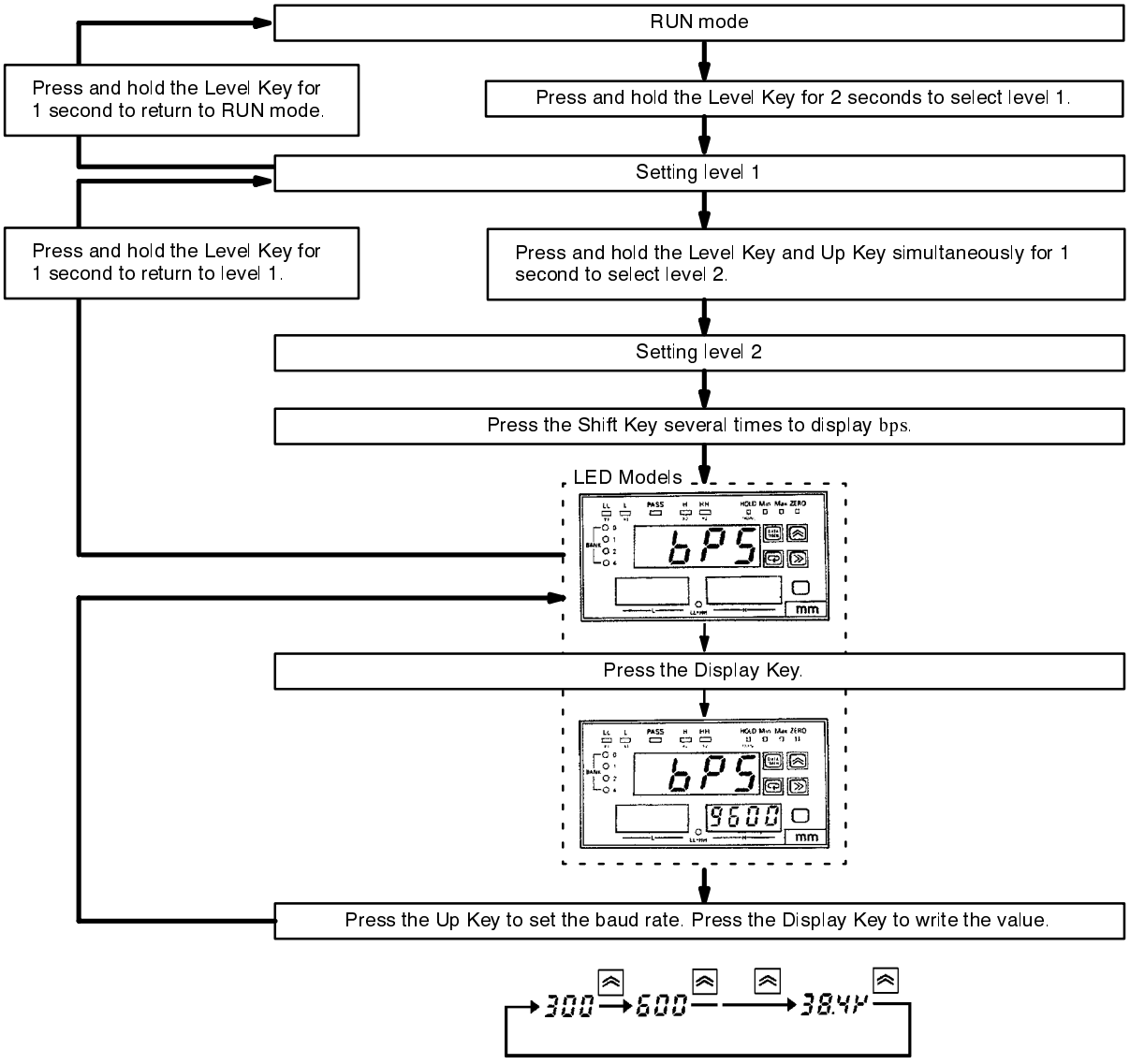
Setting range
00 to 99



3-3-2 Baud Rate

The Thumbwheel Switches Models are not provided with the communication output function. In order to set the baud rate, follow the instructions outlined in the flow diagram (after the table) and set within the following range:

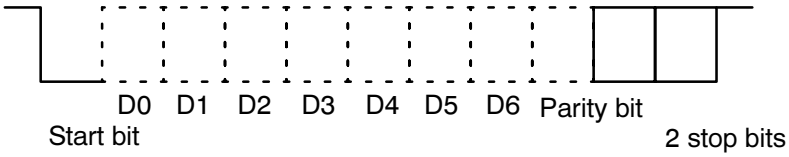
Setting range	
Display	**Meaning**
300	300 bps
600	600 bps
1200	1,200 bps
2400	2,400 bps
4800	4,800 bps
9600	9,600 bps
19.2k	19.2k bps
38.4k	38.4k bps



3-4 General RS-422/RS-485 Specifications

Transmission line connection:	Multiple point
Communication system:	RS-422 (4-wire, half-duplex), RS-485 (2-wire, half-duplex)
Synchronization system:	Start-stop synchronization (2 stop bits)
Communication speed:	300/1,200/2,400/4,800/9,600/19,200/38,400 bps (key-selectable)
Communication code:	ASCII (7 bits)
Error detection:	Vertical parity (even) and FCS (frame check sequence)
Interface:	RS-422/RS-485

Start-stop synchronization data configuration:

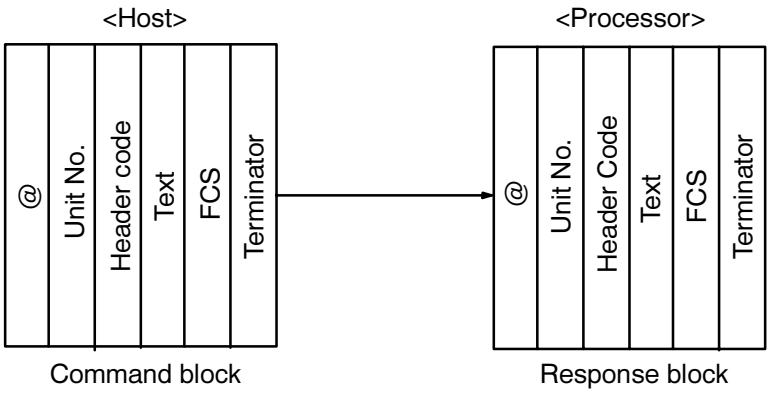


When a personal computer is used as the host system, do not select either 19,200 bps or 38,400 bps as the communication speed.

3-5 Communications and Error Control

3-5-1 Communications Control Procedures

The host link procedure for the Intelligent Signal Processor series is conversational, based on PC host link procedures. The prior data transmission right belongs to the host computer, and the data transmission right is shifted with every one block of data transmitted. When a command block is transmitted, a response block is always returned.

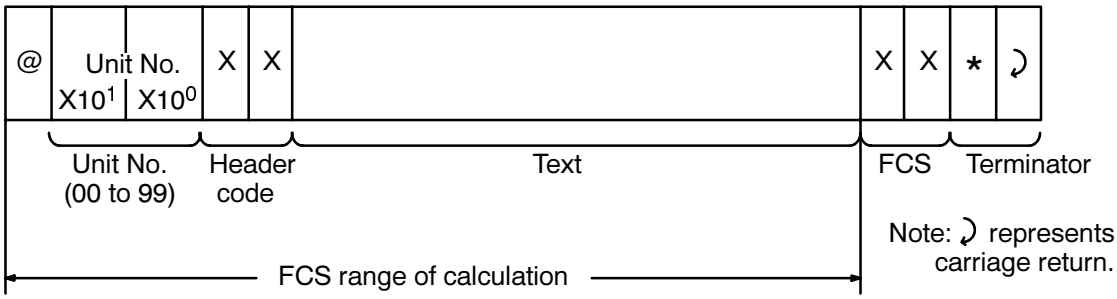


Unit numbers correspond to device numbers in a PC system. When assigning unit numbers for several units, be sure to avoid duplication of the settings.

3-5-2 Block Format

The block transmitted from the host computer is referred to as a command block. The block transmitted from the Processor is referred to as a response block.

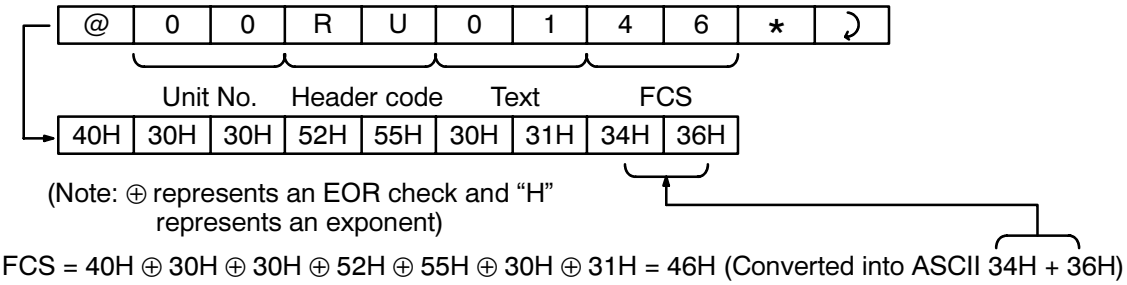
One block begins with the start character ”@” and communication address, and ends with the FCS and terminator.



Data characters are in ASCII.

The FCS (frame check sequence) is formed by converting the 8-bit data obtained by converting the exclusive logical sum of @ to the last text character into two ASCII characters. Be sure to attach the FCS to the end of the text.

FCS calculation example: (The following command is provided only as an example in calculating the FCS and is not actually a legal command.)



FCS = 40H ⊕ 30H ⊕ 30H ⊕ 52H ⊕ 55H ⊕ 30H ⊕ 31H = 46H (Converted into ASCII 34H + 36H)

3-5-3 Error Control

K3TS errors must be corrected at the host computer. The host computer controls the following error recovery procedures:

The following error detection is performed at the Processor:

1, 2, 3... 1. Character check (check of every character)

- Vertical parity check (even parity). Exclusive logical sum (EOR) check for each character.
- Frame check. If a “0” is detected at the stop bit position, it is assumed that an error has occurred during communication.
- Overrun check. Overrun occurs when the next character is received while the current character is being processed.

2. Block check (check of each block)

- Format check. Command format construction is checked.
- Registration data check. Check of numerical range of numbers such as unit number and bank number.
- FCS check. Exclusive logical sumcheck of @ to the last text character.

If the above checks detect that an error has occurred during communication, error recovery control is requested at the host computer by the response

block end code. Note, however, that when it is determined that the communication address is different through the registration data check, no response block is transmitted.

3-6 Commands and Responses

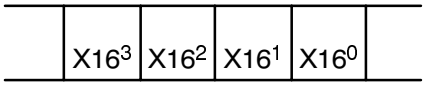
3-6-1 Command/Response Format Data

The hexadecimal data and decimal data relevant to command format and response format must be converted into ASCII.

(Example)
Hexadecimal data: $F –> $46
Decimal data: 8 –> $38

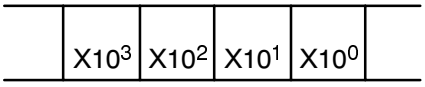
Hereafter, hexadecimal data and decimal data in command/response format are expressed as follows:

Hexadecimal Data



$X16^3$ through $X16^0$ mean hexadecimal data. Therefore, the numbers to be processed are $0(0000) through $F(1111).

Decimal Data



$X10^3$ through $X10^0$ mean decimal data. Therefore, the numbers to be processed are $0(0000) through $9(1001).

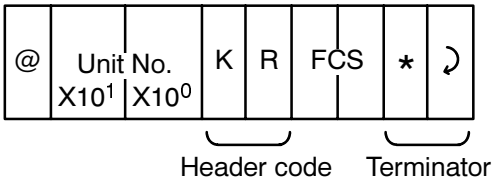
3-6-2 Command List

Header code	RUN mode		Test mode	Setting mode (See Note)	Name
	RUN	During change of setting			
KR	Yes	Yes	Yes	---	Reset control (maximum/minimum value and TIMING-hold resetting)
W%	Yes	Yes	Yes	---	Set value write
W#	Yes	Yes	Yes	---	Set value write (only with bank)
R%	Yes	Yes	Yes	---	Set value read
R#	Yes	Yes	Yes	---	Set value read (only with bank)
RH	Yes	Yes	Yes	---	Hold data read
RX	Yes	Yes	Yes	---	Display value (PV) read
RU	Yes	Yes	Yes	---	Model data read
TS	Yes	Yes	Yes	---	Test
ME	Yes	Yes	Yes	---	Backup mode
MA	Yes	Yes	Yes	---	RAM write mode selection
MW	Yes	Yes	Yes	---	RAM data all save

Note Communications are not possible in setting mode.

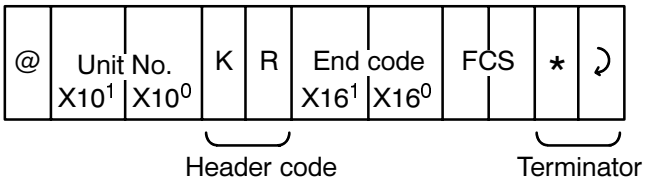
3-7 Reset Control (Maximum/Minimum Value Reset TIMING-hold Reset)

Command Format



Response Format

Response at normal end. End code: ”00”



When this command ends normally, a reset is performed.

3-8 Selection of Write Modes

The set value data sent from the computer or the sequencer is internally stored by the K3TS, which has a non-volatile memory and a RAM. The set value is stored by the non-volatile memory even when power is off. The RAM, however, should be used instead of the non-volatile memory if the set value must be changed frequently while operating the K3TS.

The K3TS has two kinds of write modes (backup mode and RAM write mode), either of which can be chosen for data storage.

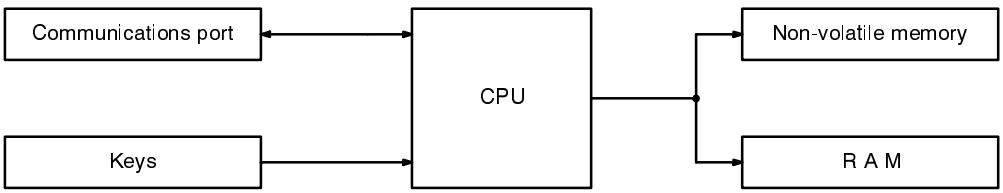
When power is on, the K3TS is in its backup mode automatically. Changing the mode is possible with communications commands only. The selection of write modes are explained as follows:

Backup Mode

In the backup mode, all set values are stored by the non-volatile memory and the RAM. This mode should not be selected if the value you set must be changed frequently (more than ten times a day in single value control operation, for example) while operating the K3TS.

The K3TS is automatically in its backup mode each time power is ON.

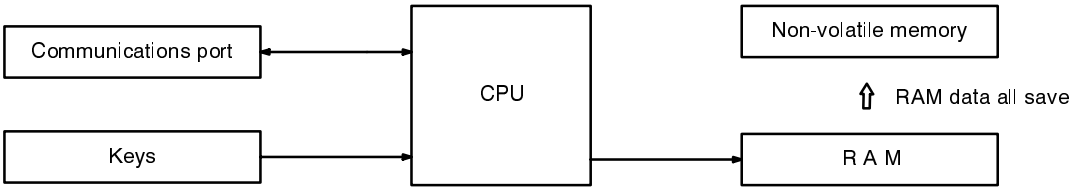
The following block diagram shows the condition of data storage the backup mode:



RAM Write Mode

In the RAM write mode, all set values are kept by the RAM while power is on. This mode should be selected if the value you set must be changed frequently (in program control operation, for example).

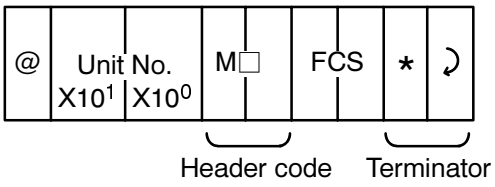
The following block diagram shows data storage in the RAM write mode.



3-8-1 Write Mode

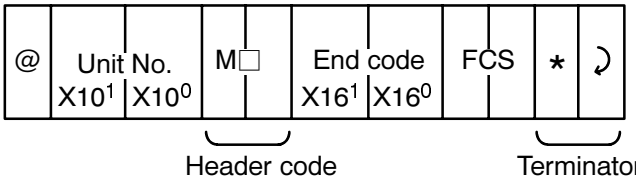
Command Format

ME: Backup mode
MA: RAM write mode



Response Format

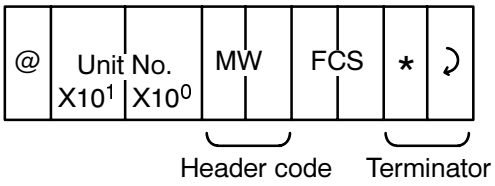
Response at normal end. End code: ”00”



3-8-2 RAM Data All Save

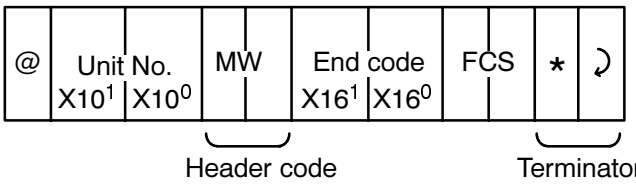
If the RAM data all save is executed, the contents of the RAM is transferred to the non-volatile memory. Any set value written in the RAM write mode is lost when power is switched off. To avoid this, execute the RAM data all save.

Command Format



Response Format

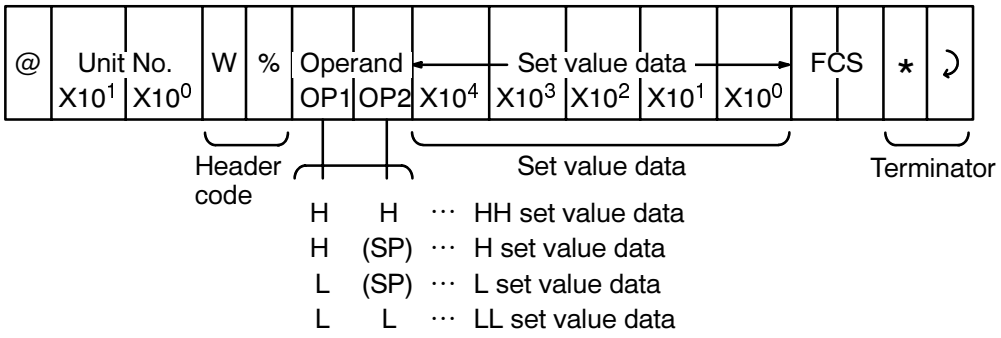
Response at normal end. End code: ”00”



3-9 Set Value Write

The set values (HH, H, L, and LL) are written individually.

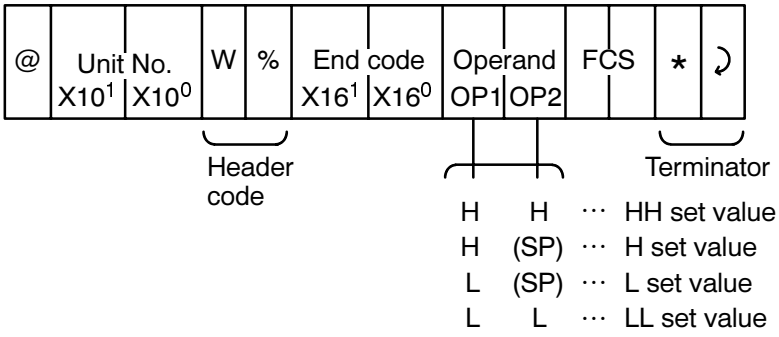
Command Format



Set value is expressed in five figures of ASCII. Set the x10^4 digit to “F” for negative values (e.g., F2050 = −2050).

Response Format

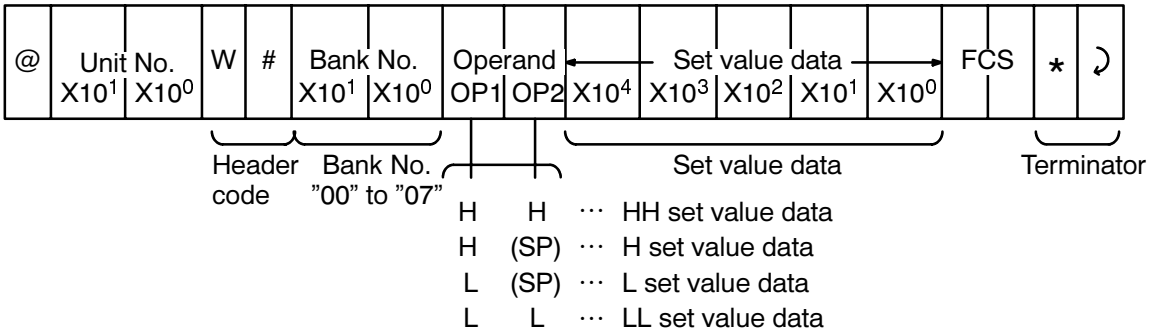
Response at normal end. End code: ”00”



3-10 Set Value Write (Unused Bank)

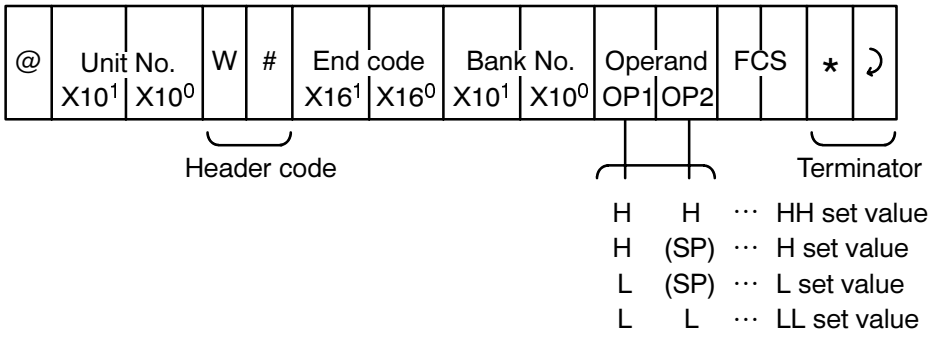
The set values (HH, H, L, and LL) of the banks not in use are written individually. Other set values (HH, H, L, and LL) are written individually.

Command Format



Set value is expressed in five figures of ASCII. Set the x10^4 digit to “F” for negative values (e.g., F2050 = −2050).

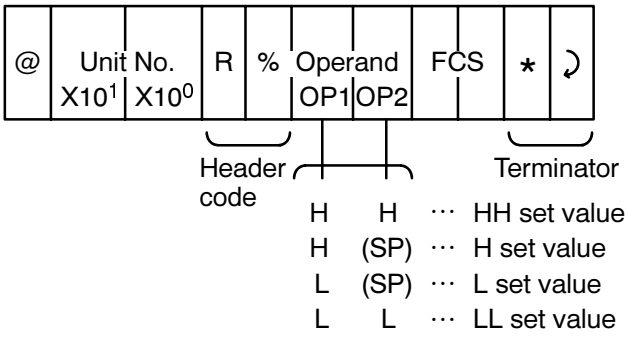
Response Format Response at normal end. End code: ”00”



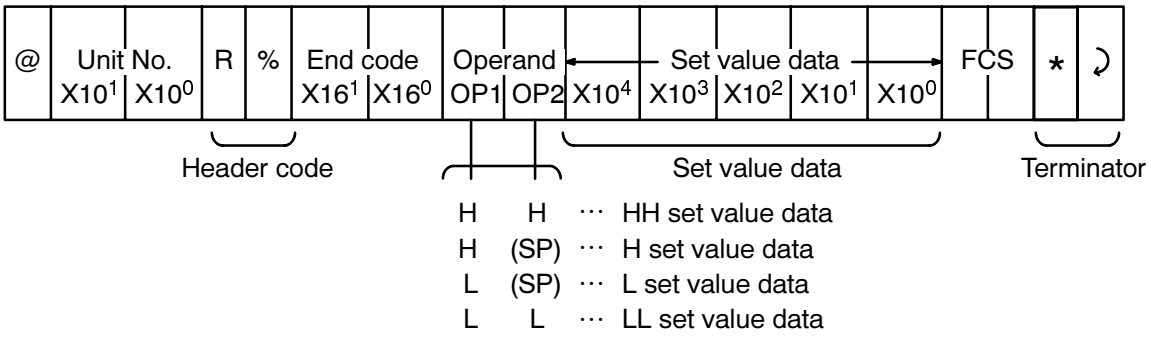
3-11 Set Value Read

The set values (HH, H, L, and LL) are read individually.

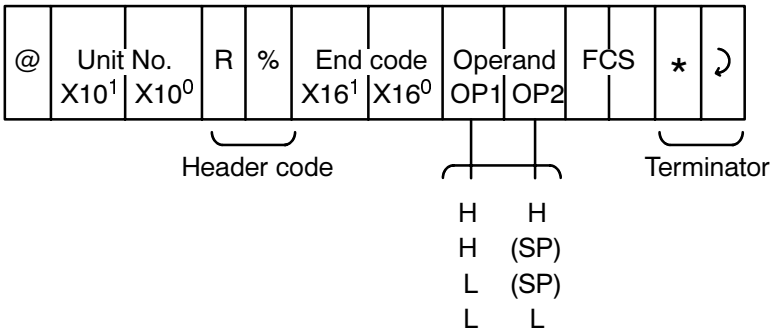
Command Format



Response Format Response at normal end. End code: ”00”



Response format when an error occurs ((SP) indicates a space):

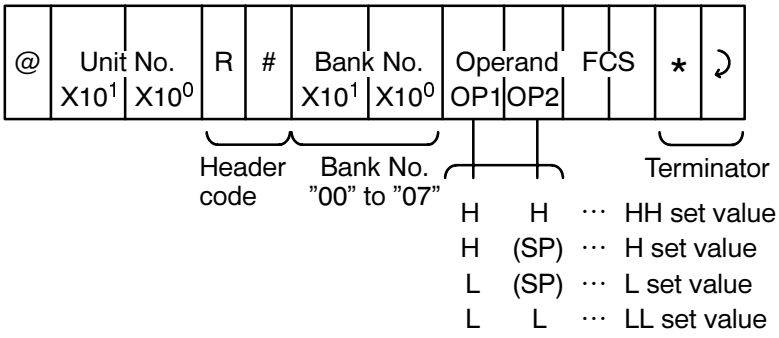


Set value is expressed in five figures of ASCII. Negative sign is represented by ”F” at the position of the $X10^4$ digit.

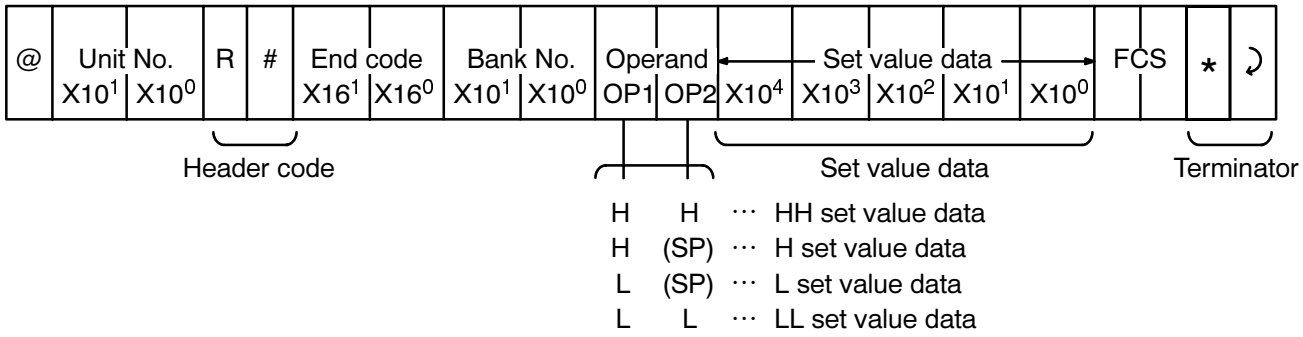
3-12 Set Value Read (Unused Bank)

This set value read is effective only in models with RS-422/485 capability and bank function, and special models with K3TS communication and comparative output. The set values (HH, H, L, and LL) of the banks not in use are read individually.

Command Format



Response Format Response at normal end. End code: ”00”

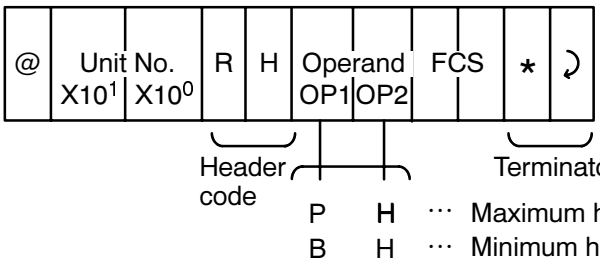


Set value is expressed in five figures of ASCII. Set the $x10^4$ digit to “F” for negative values (e.g., F2050 = −2050).

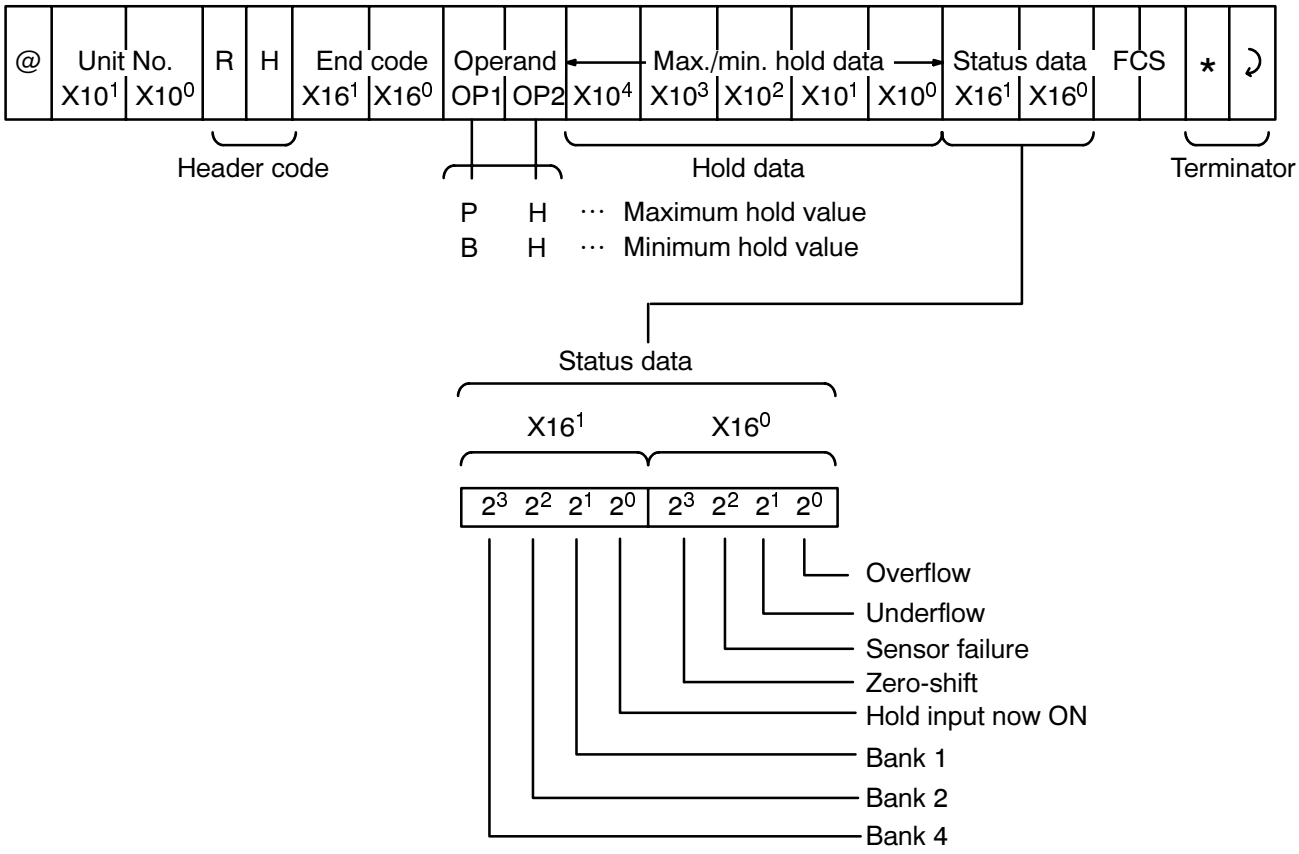
3-13 Maximum/Minimum Value Read

Reads maximum/minimum hold data (maximum/minimum value).

Command Format



Response Format Response at normal end. End code: ”00”

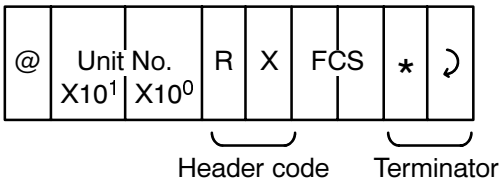


Hold data is expressed in five figures of ASCII. Set the x10^4 digit to “F” for negative values (e.g., F2050 = −2050). Do not attempt to read maximum/minimum hold data while TIMING-hold (operating parameter 3 is not set to normal) is ON or in the test mode. If attempted, incomplete data will be output.

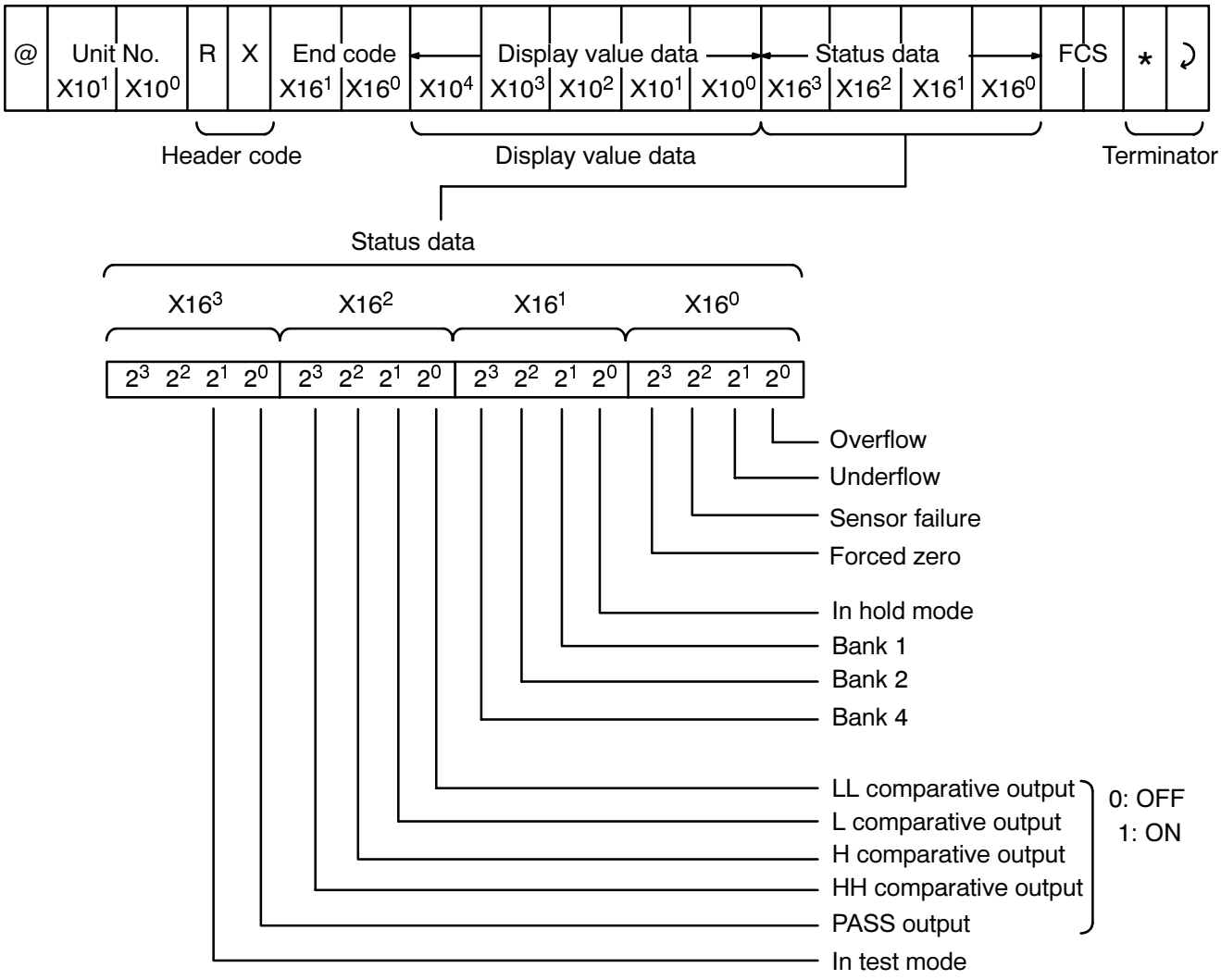
3-14 Display Value (PV Value) Read

Reads display value (PV value).

Command Format



Response Format Response at normal end. End code: ”00”

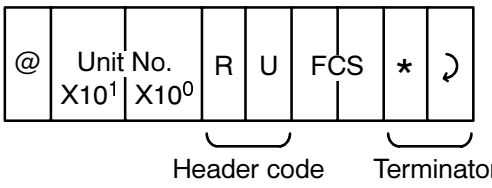


Display value is expressed in five figures of ASCII. Set the x10^4 digit to “F” for negative values (e.g., F2050 = −2050).

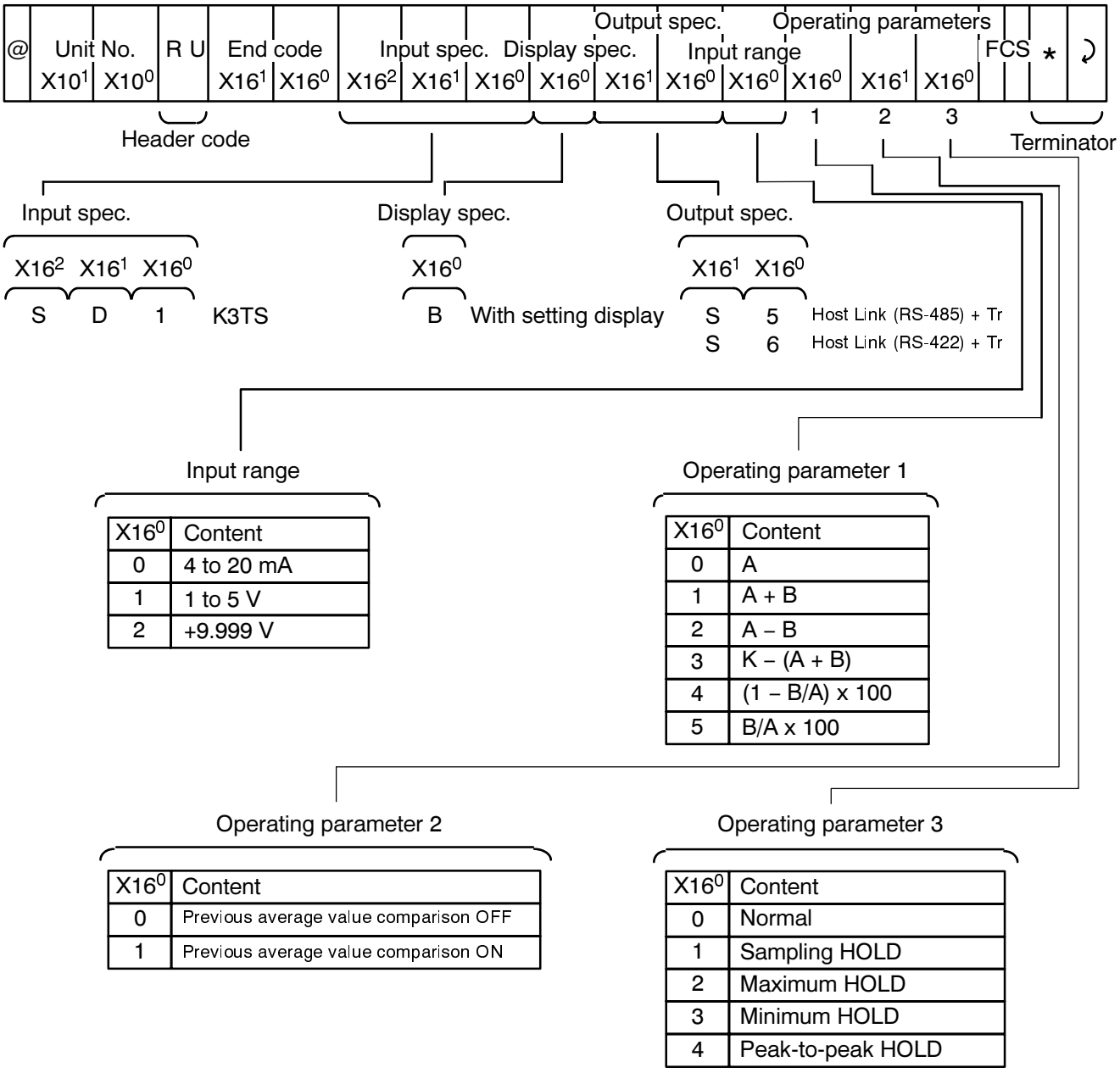
3-15 Model Data Read

Reads model data.

Command Format



Response Format Response at normal end. End code: ”00”



Input range

$X16^0$	Content
0	4 to 20 mA
1	1 to 5 V
2	+9.999 V

Operating parameter 1

$X16^0$	Content
0	A
1	A + B
2	A – B
3	K – (A + B)
4	(1 – B/A) x 100
5	B/A x 100

Operating parameter 2

$X16^0$	Content
0	Previous average value comparison OFF
1	Previous average value comparison ON

Operating parameter 3

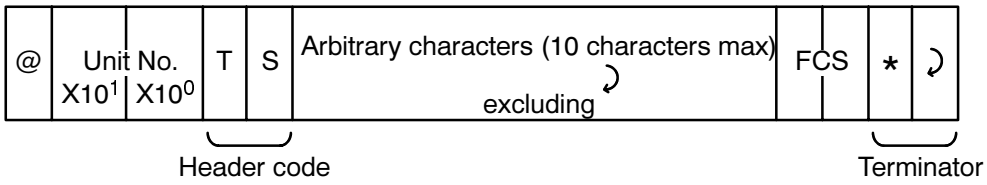
$X16^0$	Content
0	Normal
1	Sampling HOLD
2	Maximum HOLD
3	Minimum HOLD
4	Peak-to-peak HOLD

The command content is expressed in ASCII.

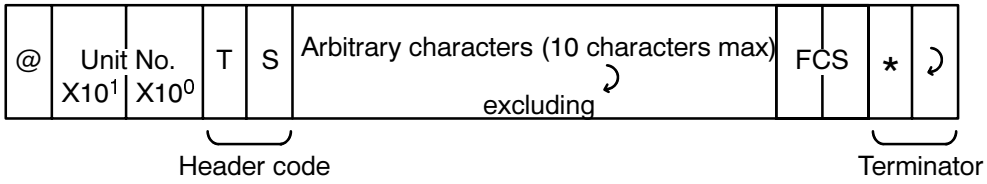
3-16 Test

One block of data with FCS sent from the host computer is returned without altering anything.

Command Format



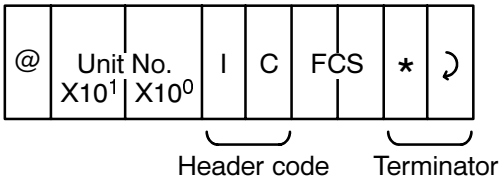
Response Format Response at normal end.



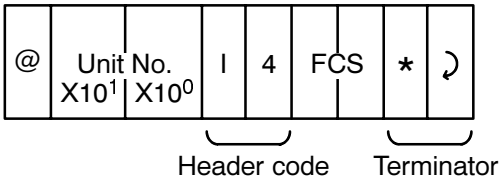
3-17 Undefined Command Error

The following response is returned when a command header code cannot be decoded.

Response Format



3-18 Error Response Format



3-19 End Code List

End code		Contents
x 16^1	x 16^0	
0	0	Normal end
1	4	FCS error
1	4	Format error (parameter length error, parameter error, data code error, data length error)

3-20 Communication Program Example

3-20-1 Program Example of RS-422/RS-485 Communication

In this program, when inputting transmission data in command format from a computer keyboard, data returned from the Processor that conforms to the response format is displayed on the computer screen. Input the data to be transmitted from the start character "@" to the last piece of text data. After data input, FCS is calculated and transmitted with a terminator. If this program is not executed correctly, there will be an error in the transmission section; check the connection of communication cables, etc.

(This program is written in N88 BASIC. An NEC PC-9801 personal computer is used as the host system.)

```
1000 '*********************************************
1010 '*   PROGRAM    : Processor  TUSHIN for PC-9801 *
1020 '*   VERSION    : 1.12     '91.1.24             *
1030 '*   Copyright (C) 1991 OMRON Corporation       *
1040 '*********************************************
1050 '*********************************************
1060 '*   <Main processing>                          *
1070 '*********************************************
1080 *MAIN
1090 GOSUB *INIT                    <Initial setting>
1100 GOSUB *MDAT                    <Transmission data formation>
1110 GOSUB *COMM                    <Communication execution>
1120 GOSUB *DISP                    <Display processing>
1130 GOSUB *QUIT                    <End processing>
1140 IF FRG=0 THEN GOTO 1170        End judgment
1150 CLS                            Clear screen
1160 GOTO 1100                      Repeat jump
1170 END                            End
1180 '*********************************************
1190 '*   <Initial setting>                          *
1200 '*********************************************
1210 *INIT
1220 CLS                            Clear screen
1230 TIM=1000                       Data reception wait time setting
1240 LMT=10                         Retry frequency setting
1250 DIM NGM$(LMT-1)                NG data storage in memory
1260 PRE$="@00RU"                   Default command
1270 TRM$="*"+CHR$(13)              Terminator definition
1280 NG1$="NO RESPONSE"             NG data definition
1290 NG2$="END CODE:"               '
1300 NG3$="FCS ERROR "              '
```

```
1310 RETURN
1320 '***********************************************
1330 '*  <Transmission data formation>               *
1340 '***********************************************
1350 *MDAT
1360 SEND$=""                       Default transmission data
1370 LOCATE 0,0                     Display allocation
1380 PRINT "SEND DATA : ";          Transmission data input display
1390 IN$=INKEY$                     Transmission command input
1400 PRINT IN$;                     Transmission command display
1410 IF IN$=CHR$(13) GOTO 1440      Transmission command determination
1420 SEND$=SEND$+IN$                Transmission command formation
1430 GOTO 1390                      '
1440 IF SEND$="" THEN SEND$=PRE$    Transmission data determination
1450 DUMY$=SEND$                    '
1460 GOSUB *FCS                     FCS calculation
1470 SEND$=SEND$+FCS$+TRM$          <Transmission data formation>
1480 LOCATE 0,0                     Display allocation
1490 PRINT "SEND DATA : ";SEND$"    Transmission data display
1500 RETURN
1510 '***********************************************
1520 '*  <Communication execution>                  *
1530 '***********************************************
1540 *COMM
1550 NG=0                           Clear retry counter
1560 *RETRY                         '
1570 CNT=0                          Clear reception wait time
1580 REC=0                          Clear reception end flag
1590 RESP$=""                       Clear reception data
1600 OPEN "COM:E73"AS #1            Transmission port setting
1610 PRINT #1,SEND$;                Data transmission
1620 WHILE (CNT<TIM AND REC=0)      (Waiting for reception)
1630 IF LOC(1)=0 THEN *SKIP         Received data presence/absence judgment
1640 DUMY$=INPUT$(LOC(1),#1)        Received data acceptance
1650 RESP$=RESP$+DUMY$              '
1660 CHK$=RIGHT$(RESP$,2)           Terminator check
1670 IF CHK$=TRM$ THEN REC=1        '
1680 *SKIP                          '
1690 CNT=CNT+1                      Reception wait time progression
1700 WEND                           '
1710 CLOSE #1                       Close transmission port
```

```
1720 GOSUB *RESP.CHK                Response check
1730 IF CHK<>0 THEN RETRY           Retry execution
1740 RETURN
1750 '*********************************************
1760 '*  <Display processing>                      *
1770 '*********************************************
1780 *DISP
1790 LOCATE 0,1                     Display allocation
1800 PRINT "RESPONSE  : ";RESP$     Received data display
1810 IF NG=0 THEN *DISP.END         NG data display
1820 FOR I=1 TO NG                  '
1830 PRINT "TRY";I;"=> ";NGM$(I-1)  '
1840 NEXT                           '
1850 *DISP.END                      '
1860 RETURN
1870 '*********************************************
1880 '*  <End processing>                          *
1890 '*********************************************
1900 *QUIT
1910 FRG=0                          Flag clearing
1920 LOCATE 25,3                    Display allocation
1930 PRINT "To repeat, press RETURN."
1940 CHNG$=INKEY$                   RETURN key input
1950 IF CHNG$=CHR$(13) THEN FRG=1   Return judgment
1960 IF CHNG$="" THEN GOTO 1940     '
1970 RETURN
1980 '*********************************************
1990 '*  <FSC calculation>                         *
2000 '*********************************************
2010 *FCS
2020 FCS=0                          FCS clearing
2030 FOR I=1 TO LEN(DUMY$)          '
2040 FCS=FCS XOR ASC(MID$(DUMY$,I,1) '
2050 NEXT                           '
2060 FCS$=RIGHT$("0"+HEX$(FCS),2)   FCS HEX conversion
2070 RETURN
2080 '*********************************************
2090 '*  Response check                            *
2100 '*********************************************
2110 *RESP.CHK
2120 CHK=1                          When no response occurs
```

```
2130 IF REC=0 THEN *RESP.ER         CHK = 1
2140 CDE$=MID$(RESP$,6,2)           '
2150 CHK=2                          When no normal end occurs
2160 CDF$=MID$(RESP$,4,2)           CHK = 2
2170 IF CDF$="TS" THEN GOTO 2190    Test command check
2180 IF CDE$<>"00" THEN *RESP.ER    '
2190 CHK=0                          '
2200 GOSUB *FCS.CHK                 FCS check
2210 IF CHK=0 THEN *CHK.END         Normal end
2220 *RESP.ER                       '
2230 IF CHK=1 THEN NGM$(NG)=NG1$    NG data storage
2240 IF CHK=2 THEN NGM$(NG)=NG2$+CDE$ '
2250 IF CHK=3 THEN NGM$(NG)=NG3$    '
2260 NG=NG+1                        NG frequency progression
2270 IF NG=LMT THEN CHK=0           Retry end
2280 *CHK.END                       '
2290 RETURN
2300 '***********************************************
2310 '*  <FCS check>                                 *
2320 '***********************************************
2330 *FCS.CHK
2340 LENGTH=LEN(RESP$)-4            Obtain range of calculation
2350 DUMY$=LEFT$(RESP$,LENGTH)      '
2360 GOSUB *FCS                     FCS calculation
2370 RECFCS$=MID$(RESP$,LENGTH+1,2) When FCS error occurs
2380 IF FCS$<>RECFCS$ THEN CHK=3    CHK = 3
2390 RETURN
```

3-20-2 Operation Example

The following is an execution example of the previous program:

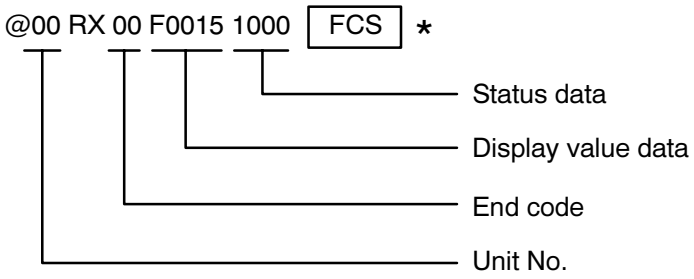
Bold characters represents operation and the carriage return symbol represents the RETURN key. This program cannot execute transmission normally unless the initial transmission settings of the personal computer are: even parity, 7 bits, 2 stop bits, and the same baud rate as the Processor. If the connectors are not properly connected, the program may stop halfway. The host computer is a PC-9801.

RUN ↵
SEND DATA : ↵
RESPONSE : @00RU00TA1BS10500 FCS *
(If only the RETURN key is pressed when inputting data,

the RU command is transmitted for unit no. 00.)

RUN ↵
SEND DATA : @**00RX** ↵
RESPONSE : @00RX00F00151000 FCS *
(Unit no. 00 display value is read.)

Response is as follows:

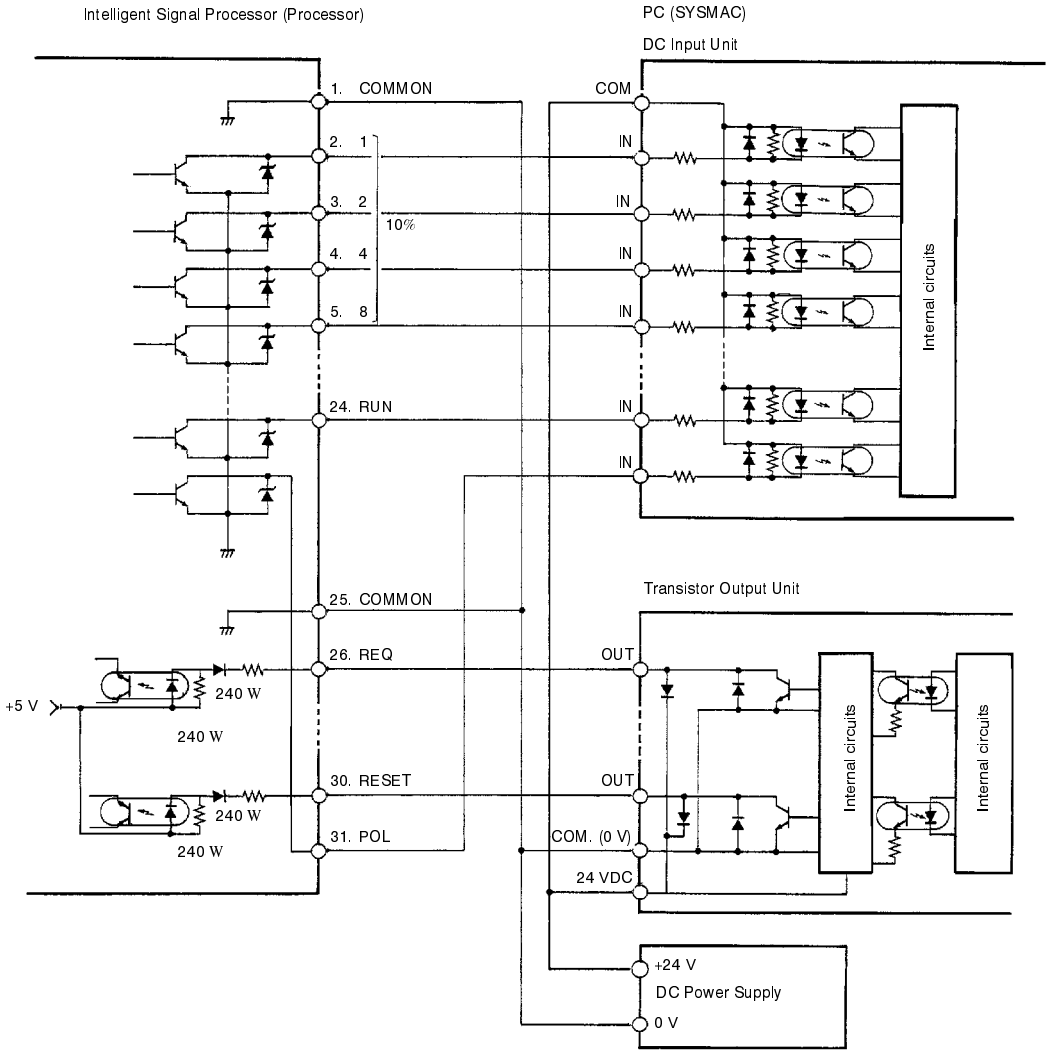


SECTION 4
BCD Output Model

This section provides the basic operational elements required in order to use the BCD output model. Included in this section is a PC connection example. Two program examples are also given.

4-1 Connecting BCD Outputs

The K3TS with BCD communications can be directly connected to a PC (Programmable Controller) or a personal computer. Refer to the following connection example.



Operation

When a REQ signal is input to the Processor from a PC, the data is confirmed after an interval of 30 ms, and a DATA VALID (D.V.) signal is output from the Processor. Read the data when the DATA VALID signal is ON.

Connection between PC and Processor should be performed with a rear panel transmission connector.

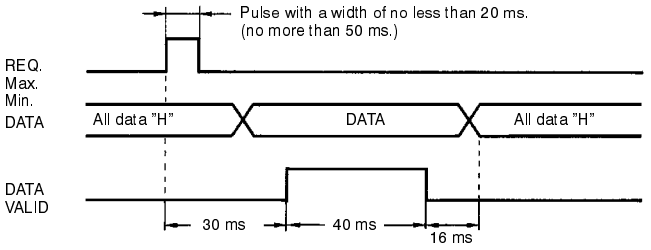
When one PC Unit is connected with several Processor Units, it is possible to achieve a wired OR connection between the DATA (including POL, OVER) and DATA VALID signals.

Data cannot be written from a PC to a Processor.

Timing Charts

Sampling Data Output (at Each Sample)

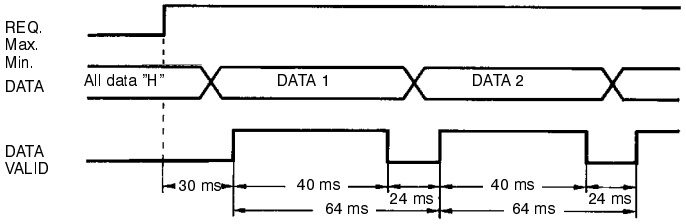
Data is confirmed after 30 ms from the REQ signal rising time, and DATA VALID signal is output. Read data while DATA VALID signal ON. The DATA VALID signal is turned OFF after an interval of 40 ms, then data is turned OFF after an interval of 16 ms.



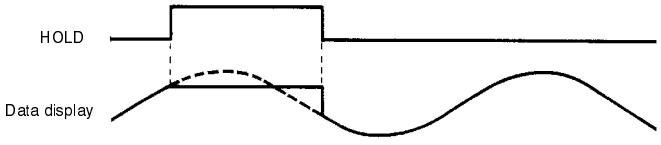
Continuous Data Output

When the REQ signal remains ON, measurement data is output at intervals of 64 ms. When a hold operation or another operation is performed during the change from DATA 1 to DATA 2, the BCD data output is either DATA 1 or DATA 2 at the hold signal timing. Read maximum or minimum data when DATA VALID signal turns ON, after a 30 ms interval from maximum or minimum signal ON time to confirm measurement data.

The RUN signal is ON during RUN mode or TEST mode. (Note that the RUN signal is turned OFF when an error other than overflow or underflow occurs.)

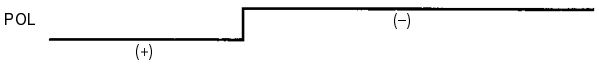


When a HOLD signal is input, the Processor stops accepting input and the data received just before the HOLD signal is retained and displayed. The same function is available in (5)-(7) terminal ON.

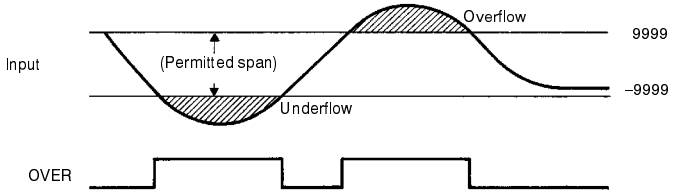


When RESET signal is input (ON), the maximum and minimum values are cleared and ----is displayed.

POL output becomes L at positive (+) pole or H at negative (–) pole.



OVER output is formed when BCD output data becomes overflow or underflow data.

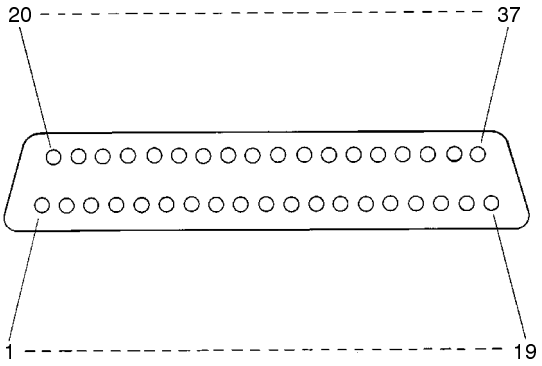


In comparative mode or scaling mode, no BCD output is formed (All outputs become ”H”.). In TEST mode, the test PV value currently input is output in both REQ maximum and REQ minimum signals. When two or more input signals are input simultaneously, or when a signal is input during another input, all the output data is turned OFF. Do not turn ON two or more input signals at the same time (except for the HOLD signal).

I/O Ratings

Input/output signal name		Item		Rating
Input	REQ HOLD Max. Min. RESET	Input voltage		Non-voltage contact input
		Input current		10 mA
		Signal level voltage	High (When OFF)	3 V min.
			Low (When ON)	1.5 V max.
Output	DATA POL OVER DATA VALID RUN	Rated load voltage		12 to 24 VDC$^{+10}/_{-15}$%
		Maximum load current		10 mA
		Leakage current		100 μA max.

Terminal Numbers



Terminal no.	Signal name	Signal direction	Description
1	COM	---	GND (See Note 1)
2	DATA	Output	1 Read data: 10^0 digit

Terminal no.	Signal name	Signal direction	Description
3	DATA	Output	2 Read data: 10^0 digit
4		Output	4 Read data: 10^0 digit
5		Output	8 Read data: 10^0 digit
6		Output	1 Read data: 10^1 digit
7		Output	2 Read data: 10^1 digit
8		Output	4 Read data: 10^1 digit
9		Output	8 Read data: 10^1 digit
10		Output	1 Read data: 10^2 digit
11		Output	2 Read data: 10^2 digit
12		Output	4 Read data: 10^2 digit
13		Output	8 Read data: 10^2 digit
14		Output	1 Read data: 10^3 digit
15		Output	2 Read data: 10^3 digit
16		Output	4 Read data: 10^3 digit
17		Output	8 Read data: 10^3 digit
18		Output	1 Read data: 10^4 digit
19		Output	2 Read data: 10^4 digit
20		Output	4 Read data: 10^4 digit
21		Output	8 Read data: 10^4 digit
22	OVER	Output	Output when input value exceeds display range
23	DATA VALID	Output	Data confirmation signal
24	RUN	Output	Operation signal
25	COM	–––	GND (See Note)
26	REQ	Input	PV output request
27	Max.	Input	Maximum value output request
28	Min.	Input	Minimum value output request
29	HOLD	Input	Hold input
30	RESET	Input	Reset input
31	POL	Output	Positive/negative polarity signal
32	HH	Output	HH comparative output
33	H	Output	H comparative output
34	PASS	Output	PASS comparative output
35	L	Output	L comparative output
36	LL	Output	LL comparative output
37	COM	Output	GND (See Note)

Note Terminals No. 1, 25, and, 37 have the same COM.

Applicable Connectors

Plug: XM2A-3701 (OMRON) or equivalent
Hood: XM2S-3711 (OMRON) or equivalent

4-2 Operations: Front Key Section

No setting with front keys is required for the BCD output type.

4-3 BCD Programs

With the BCD output type, only the PV value (display value), maximum value, and minimum value can be read. The K3TS provides read data in four figures. The marks (+) and (–) correspond respectively to L polarity and H polarity. Read the read data after the DATA VALID signal rises.

Data cannot be written from the PC to the Processor.

4-4 Program Example 1: Connection to a PC

The following program example 1 shows a single Processor unit connected to the SYSMAC C-500 (OMRON).

4-4-1 Explanation of Operation

In this program, by turning ON PC 0013, the PV (process value) of the Processor is read into the PC to be stored in data memory. Without regard to 0013 ON time, only one data sample is read.

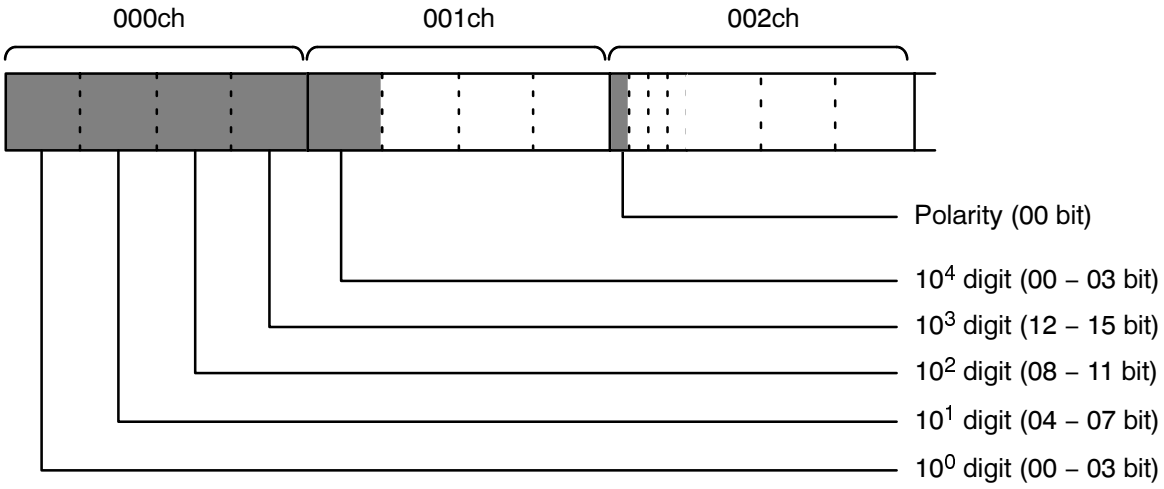
4-4-2 I/O Allocation in Use

Terminal no.	Signal name	Signal direction	Description	I/O allocation
1	COM	–––	GND	–––
2	RD1-0	Output	1 Read data: 10^0 digit	Input unit 0000
3	RD1-1	Output	2 Read data: 10^0 digit	Input unit 0001
4	RD1-2	Output	4 Read data: 10^0 digit	Input unit 0002
5	RD1-3	Output	8 Read data: 10^0 digit	Input unit 0003
6	RD2-0	Output	1 Read data: 10^1 digit	Input unit 0004
7	RD2-1	Output	2 Read data: 10^1 digit	Input unit 0005
8	RD2-2	Output	4 Read data: 10^1 digit	Input unit 0006
9	RD2-3	Output	8 Read data: 10^1 digit	Input unit 0007
10	RD3-0	Output	1 Read data: 10^2 digit	Input unit 0008
11	RD3-1	Output	2 Read data: 10^2 digit	Input unit 0009
12	RD3-2	Output	4 Read data: 10^2 digit	Input unit 0010
13	RD3-3	Output	8 Read data: 10^2 digit	Input unit 0011
14	RD4-0	Output	1 Read data: 10^3 digit	Input unit 0012
15	RD4-1	Output	2 Read data: 10^3 digit	Input unit 0013
16	RD4-2	Output	4 Read data: 10^3 digit	Input unit 0014
17	RD4-3	Output	8 Read data: 10^3 digit	Input unit 0015
18	RD5-0	Output	1 Read data: 10^4 digit	Input unit 0100
19	RD5-1	Output	2 Read data: 10^4 digit	Input unit 0101
20	RD5-2	Output	4 Read data: 10^4 digit	Input unit 0102
21	RD5-3	Output	8 Read data: 10^4 digit	Input unit 0103
22	OVER	Output	Output when input value exceeds display range	Input unit 0104* (See Note)
23	DATA VALID	Output	Data confirmation signal	Input unit 0105
24	RUN	Output	Operation signal	Input unit 0106
25	COM	–––	GND	–––
26	REQ	Input	PV output request	Output unit 0200
27	Max.	Input	Maximum value output request	Output unit 0201* (See Note)
28	Min.	Input	Minimum value output request	Output unit 0202* (See Note)
29	HOLD	Input	Hold input	Output unit 0203* (See Note)
30	RESET	Input	Reset input	Output unit 0204* (See Note)
31	POL	Output	Positive/negative polarity signal	Input unit 0107

Note: I/O marked with an asterisk is not used in this program.

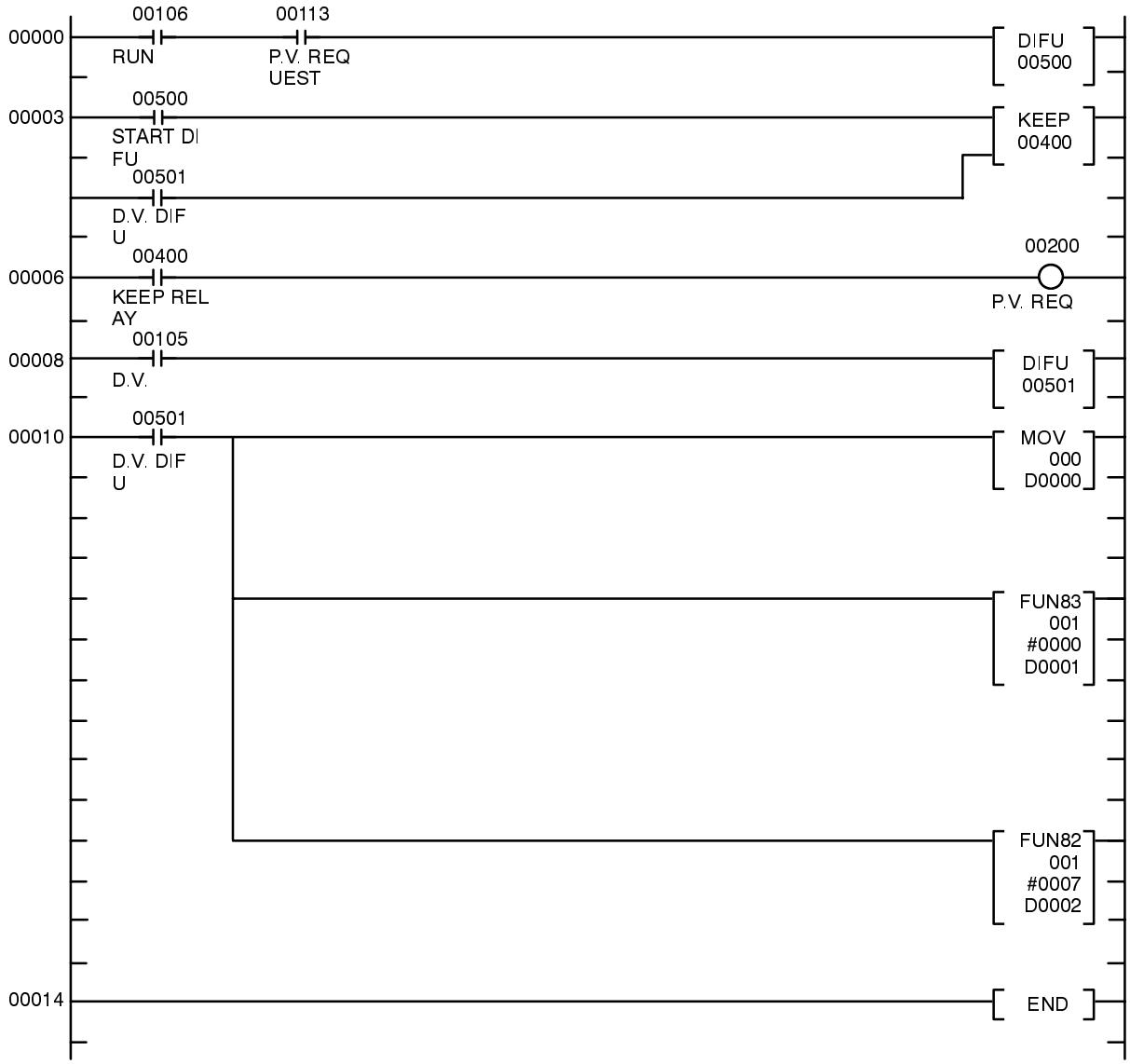
4-4-3 DM (Data Memory) Area

Read data is stored in the memory below.



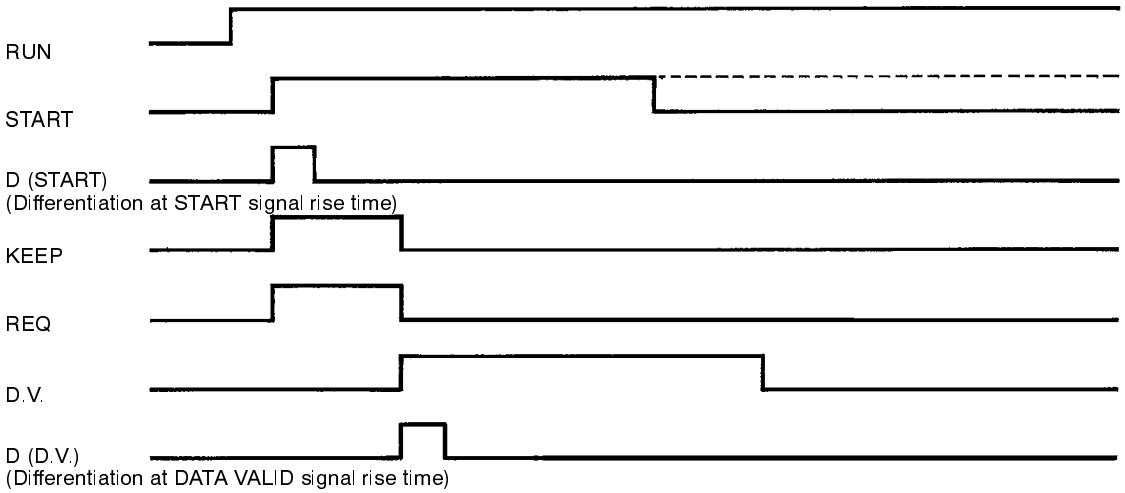
4-4-4 Ladder Program

The following diagram illustrates the flow and order of signals.



4-4-5 Timing Chart

The following example illustrates the relative timing and duration of each input/output signal.



4-5 Program Example 2: Connection to a PC

The following program example 2 shows 3 Processors (designated as ISP-A, ISP-B, and ISP-C units) connected to the SYSMAC C-500 (OMRON).

4-5-1 Explanation of Operation

In this program, by turning ON PC 0013, PV (process values) of three Processor units (A, B, and C) are successively read into the PC, to be stored into data memory. Without regard to 0013 ON time, only one data sample is read from each Processor.

4-5-2 I/O Allocation in Use

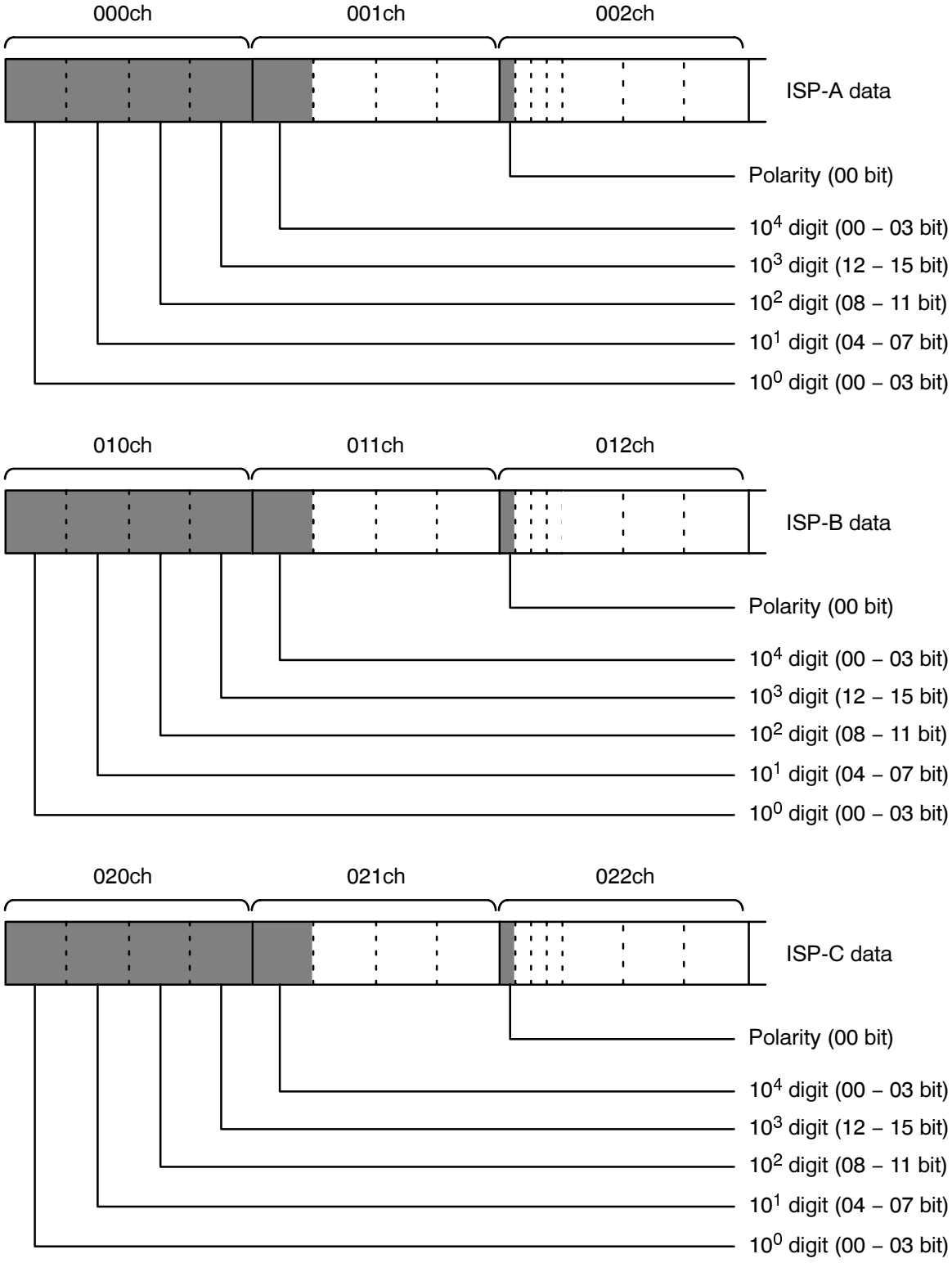
Terminal no.			Signal name	Signal direction	Description	I/O allocation
ISP-A	ISP-B	ISP-C				
1	1	1	COM	–––	GND	–––
2	2	2	RD1-0	Output	1 Read data: 10^0 digit	Input unit 0000
3	3	3	RD1-1	Output	2 Read data: 10^0 digit	Input unit 0001
4	4	4	RD1-2	Output	4 Read data: 10^0 digit	Input unit 0002
5	5	5	RD1-3	Output	8 Read data: 10^0 digit	Input unit 0003
6	6	6	RD2-0	Output	1 Read data: 10^1 digit	Input unit 0004
7	7	7	RD2-1	Output	2 Read data: 10^1 digit	Input unit 0005
8	8	8	RD2-2	Output	4 Read data: 10^1 digit	Input unit 0006
9	9	9	RD2-3	Output	8 Read data: 10^1 digit	Input unit 0007
10	10	10	RD3-0	Output	1 Read data: 10^2 digit	Input unit 0008
11	11	11	RD3-1	Output	2 Read data: 10^2 digit	Input unit 0009
12	12	12	RD3-2	Output	4 Read data: 10^2 digit	Input unit 0010
13	13	13	RD3-3	Output	8 Read data: 10^2 digit	Input unit 0011
14	14	14	RD4-0	Output	1 Read data: 10^3 digit	Input unit 0012
15	15	15	RD4-1	Output	2 Read data: 10^3 digit	Input unit 0013
16	16	16	RD4-2	Output	4 Read data: 10^3 digit	Input unit 0014
17	17	17	RD4-3	Output	8 Read data: 10^3 digit	Input unit 0015
18	18	18	RD5-0	Output	1 Read data: 10^4 digit	Input unit 0100
19	19	19	RD5-1	Output	2 Read data: 10^4 digit	Input unit 0101
20	20	20	RD5-2	Output	4 Read data: 10^4 digit	Input unit 0102
21	21	21	RD5-3	Output	8 Read data: 10^4 digit	Input unit 0103
22	22	22	OVER	Output	Output when input value exceeds display range	Input unit 0104* (See Note)
23	–––	–––	DATA VALID	Output	Data confirmation signal-A	Input unit 0105
24	–––	–––	RUN	Output	Operation signal-A	Input unit 0106
–––	23	–––	DATA VALID	Output	Data confirmation signal-B	Input unit 0109
–––	24	–––	RUN	Output	Operation signal-B	Input unit 0110
–––	–––	23	DATA VALID	Output	Data confirmation signal-C	Input unit 0111
–––	–––	24	RUN	Output	Operation signal-C	Input unit 0112
25	25	25	COM	–––	GND	–––
26	–––	–––	REQ	Input	PV output request-A	Output unit 0200
–––	26	–––	REQ	Input	PV output request-B	Output unit 0201
–––	–––	26	REQ	Input	PV output request-C	Output unit 0202
27	–––	–––	Max.	Input	Maximum value output request-A	Output unit 0203* (See Note)

ISP-A	ISP-B	ISP-C				
---	27	---	Max.	Input	Maximum value output request-B	Output unit 0204* (See Note)
---	---	27	Max.	Input	Maximum value output request-C	Output unit 0205* (See Note)
28	---	---	Min.	Input	Minimum value output request-A	Output unit 0206* (See Note)
---	28	---	Min.	Input	Minimum value output request-B	Output unit 0207* (See Note)
---	---	28	Min.	Input	Minimum value output request-C	Output unit 0208* (See Note)
29	---	---	HOLD	Input	Hold input-A	Output unit 0209* (See Note)
---	29	---	HOLD	Input	Hold input-B	Output unit 0210* (See Note)
---	---	29	HOLD	Input	Hold input-C	Output unit 0211* (See Note)
30	---	---	RESET	Input	Reset input-A	Output unit 0212* (See Note)
---	30	---	RESET	Input	Reset input-B	Output unit 0213* (See Note)
---	---	30	RESET	Input	Reset input-C	Output unit 0214* (See Note)
31	31	31	POL	Output	Positive/negative polarity signal	Input unit 0107

Note 1. I/O marked with an asterisk is not used in this program.
2. ISP = Intelligent Signal Processor

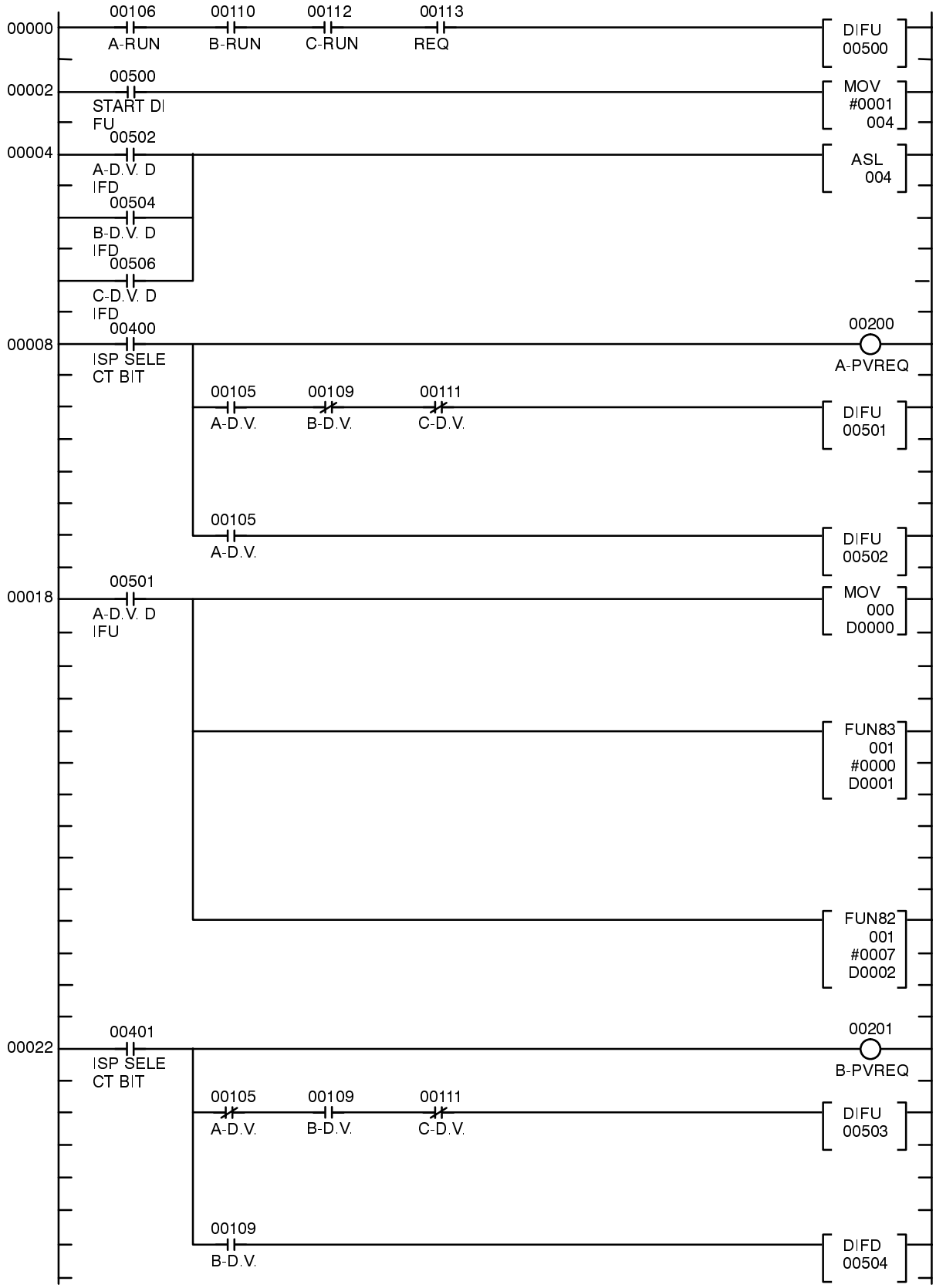
4-5-3 DM (Data Memory) Area

Read data is stored in the memory below.

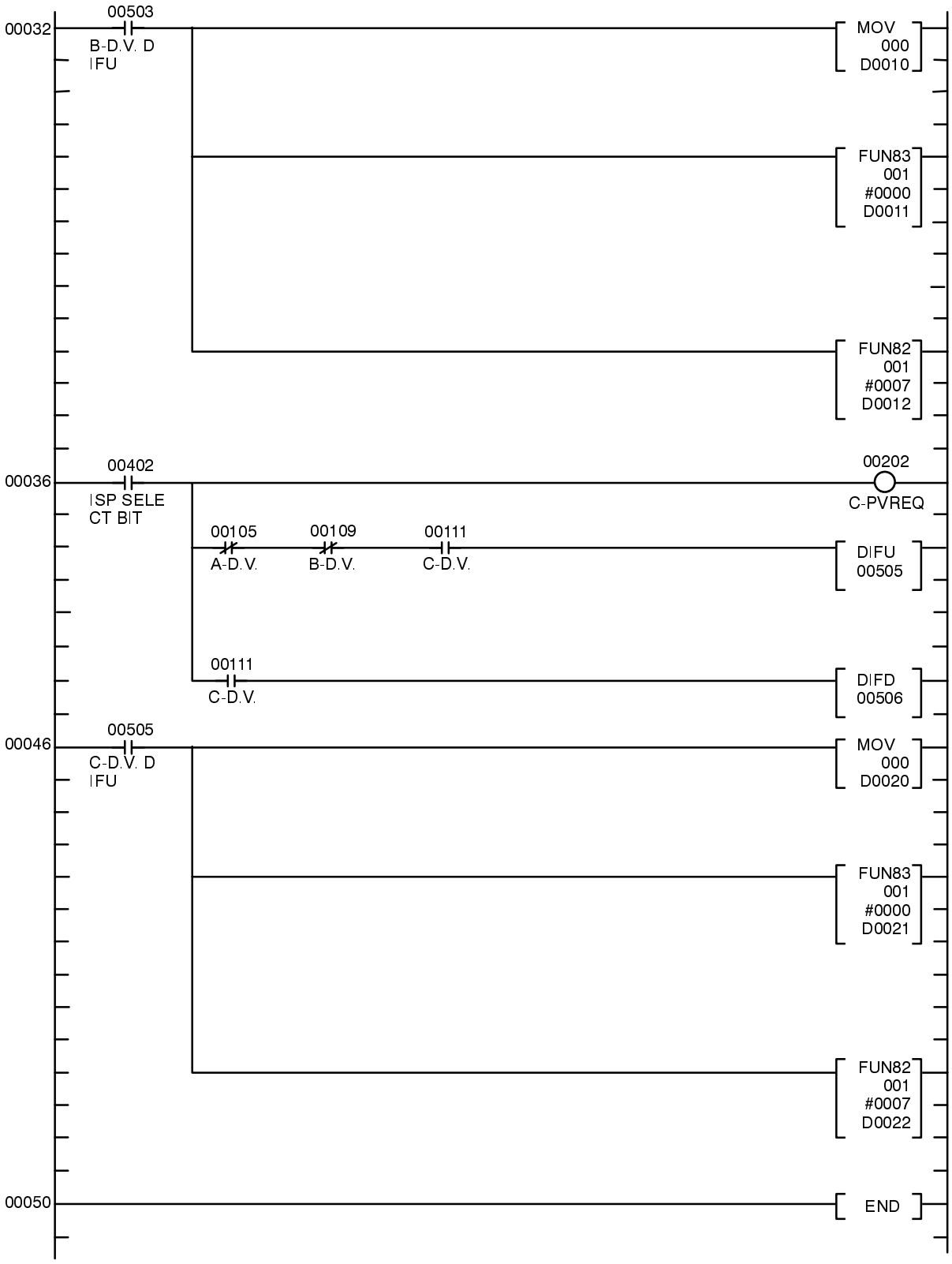


4-5-4 Ladder Program

The following diagram illustrates the flow and order of signals.

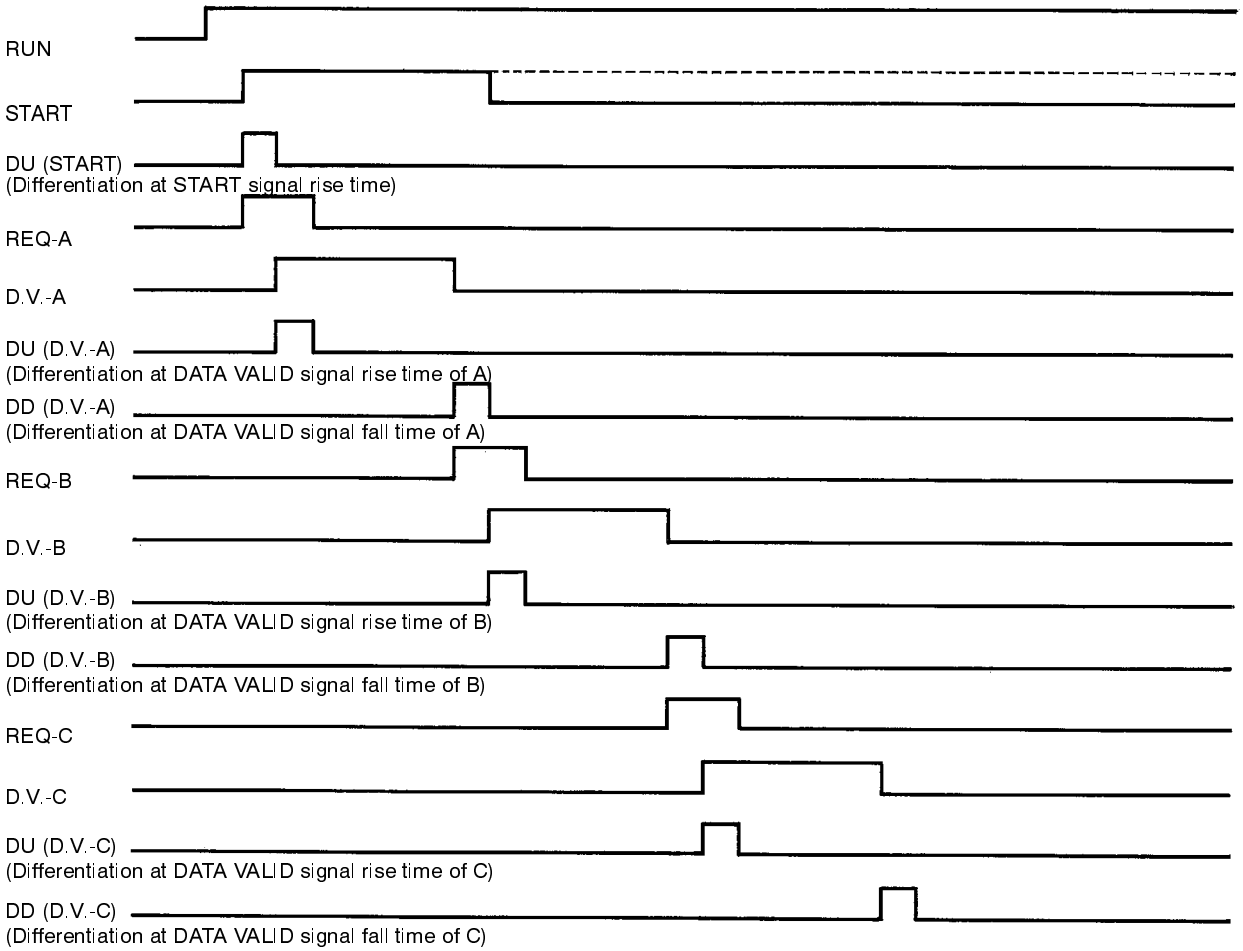


(This diagram is a continuation from the previous page)



4-5-5 Timing Chart

The following example illustrates the relative timing and duration of each input/output signal.



Appendix A
ASCII List

b_8								
b_7	0	0	0	0	1	1	1	1
b_6	0	0	1	1	0	0	1	1
b_5	0	1	0	1	0	1	0	1

b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
				0	0	0	0
				0	0	0	1
				0	0	1	0
				0	0	1	1
				0	1	0	0
				0	1	0	1
				0	1	1	0
				0	1	1	1
				1	0	0	0
				1	0	0	1
				1	0	1	0
				1	0	1	1
				1	1	0	0
				1	1	0	1
				1	1	1	0
				1	1	1	1

Even parity

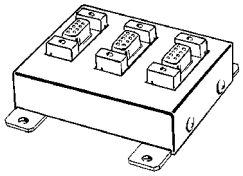
R \ C	0	1	2	3	4	5	6	7
0	NUL	DLE	SPACE	0	@	P	’	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	”	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	,	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	/	l	|
D	CR	GS	–	=	M	]	m	}
E	SO	RS	·	>	N	^	n	~
F	SI	US	/	?	O	–	o	DEL

Appendix B
List of Optional Accessories

Link Adapters

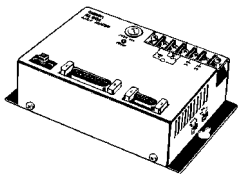
3G2A9-AL001

Three RS-422 adapters for RS-422 line distribution.



3G2A9-AL004

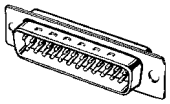
One RS-232C adapter and two RS-422 adapters for RS-232C and RS-422.



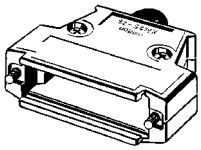
Connectors

XM2A-0901, XM4A-0921, XM2A-2501, XM4A-2521, XM2A-3701 (Plug)

D-SUB connector. Use in combination with XM2S.



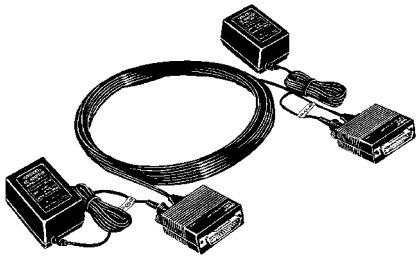
XM2S-0911, XM2S-2511, XM2S-3711 (Hood)



Optical Link Adapter

Z3RN

To extend RS-232C line.



Index

O

P

R

S

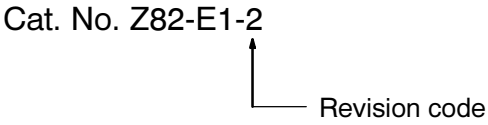
T

U

W

Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	October 1991	Original production
2	June 1995	The manual was extensively corrected and changed. The Thumbwheel Switches Models added.