User's Manual

Model UT150L
Communication Functions

IM 05C01E22-10E

YOKOGAWA
Yokogawa Electric Corporation

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3rd Edition

Introduction

This instruction manual describes the communication functions of the UT150L controller and contains information on how to create communication programs.

Read the manual carefully to understand the communication functions of the UT150L.

The UT150L controller has the following communication protocols.

1) PC link communication protocol
2) MODBUS communication protocol

Note that the UT150L controller cannot communicate with a host device with a communication protocol other than these.

■ Intended Readers

This manual is intended for people familiar with the functions of the UT150L Controller and control engineers and personnel in charge of maintaining instrumentation and control equipment.

You are required to understand as a background knowledge the communication specifications of higher-level devices, in regard to their communication hardware, language used for creating communication programs, and so on.

■ Related Documents

The following instruction manuals all relate to the communication functions.

Read them as necessary. The codes enclosed in parentheses are the document numbers.

- *Model UT150L Limit Controller* (IM 05C01E22-01E)
  Explains the basic operation of the UT150L controller.
  Supplied with the UT150L Limit Controller.

FD No. IM 05C01E22-10E
3rd Edition: Jun. 2004 (YK)

Documentation Conventions

■ Symbols

The following symbols are used in this manual.

●Symbols Used in the Main Text

CAUTION

Draws attention to information that is essential for understanding the operation and/or features of the product.

NOTE

Gives additional information to complement the present topic and/or describe terms specific to this document.

See Also

Gives reference locations for further information on the topic.

■ Description of Displays

(1) Some of the representations of product displays shown in this manual may be exaggerated, simplified, or partially omitted for reasons of convenience when explaining them.

(2) Figures and illustrations representing the controller's displays may differ from the real displays in regard to the position and/or indicated characters (upper-case or lower-case, for example), to the extent that they do not impair a correct understanding of the functions and the proper operation and monitoring of the system.

Notices

■ Regarding This Instruction Manual

(1) This manual should be passed on to the end user. Keep at least one extra copy of the manual in a safe place.
(2) Read this manual carefully to gain a thorough understanding of how to operate this product before you start using it.
(3) This manual is intended to describe the functions of this product. Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa) does not guarantee that these functions are suited to the particular purpose of the user.
(4) Under absolutely no circumstance may the contents of this manual, in part or in whole, be transcribed or copied without permission.
(5) The contents of this manual are subject to change without prior notice.
(6) Every effort has been made to ensure accuracy in the preparation of this manual. Should any errors or omissions come to your attention however, please contact your nearest Yokogawa representative or our sales office.

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(1) In order to protect the product and the system controlled by it against damage and ensure its safe use, make certain that all of the instructions and precautions relating to safety contained in this document are strictly adhered to. Yokogawa does not guarantee safety if products are not handled according to these instructions.
(2) The following safety symbols are used on the product and/or in this manual.

●Symbols Used on the Product and in This Manual

CAUTION

This symbol on the product indicates that the operator must refer to an explanation in the instruction manual in order to avoid the risk of injury or death of personnel or damage to the instrument. The manual describes how the operator should exercise special care to avoid electrical shock or other dangers that may result in injury or loss of life.

Protective Grounding Terminal

This symbol indicates that the terminal must be connected to ground prior to operating the equipment.

Functional Grounding Terminal

This symbol indicates that the terminal must be connected to ground prior to operating the equipment.

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(6) Copying this software for purposes other than backup is strictly prohibited.
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(9) No portion of the software supplied by Yokogawa may be transferred, exchanged, leased or sublet for use by any third party without the prior permission of Yokogawa.

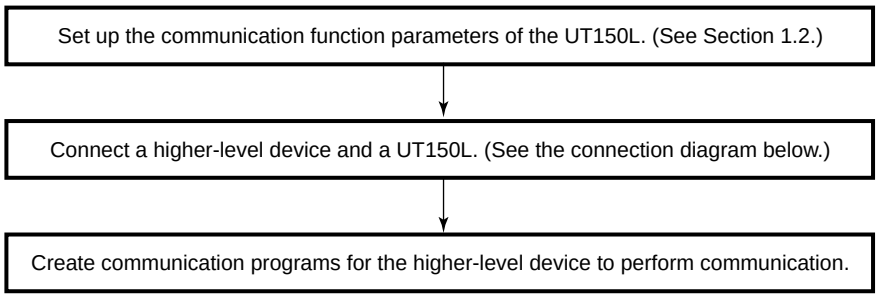
Contents

1. Setup

This chapter describes the setup procedure required to be able to use the communication functions (PC link, and MODBUS) and the communication parameters of the UT150L.

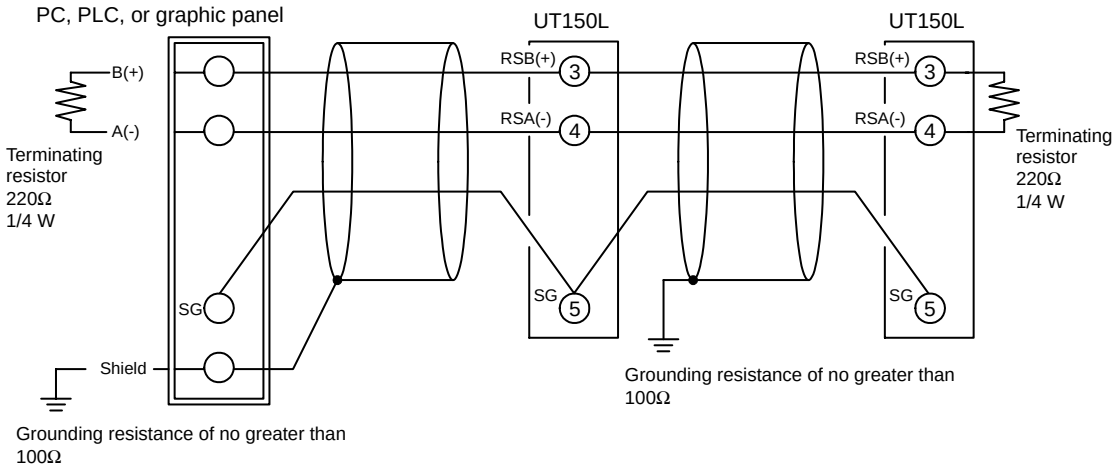
1.1 Setup Procedure

Set up the communication functions on the UT150L as follows:



∗ Communication programs should be created referring to the documentation of each higher-level device.

● **For UT150L connection**



1.2 Notes on Setting Parameters

This section describes the setting parameters for using the communication functions and their setting ranges.

NOTE

The details of UT150L communication functions need to be the same as those of the communication functions of the host devices to be connected. Check the communication parameters of the host device first, then set up those of the UT150L.

Table 1-1 Parameters to be Set for Communication Functions

Parameter Name	Symbol	Setting Range		Default
Protocol selection	PSL	PC link communication	0: without sum check 1: with sum check	0
		MODBUS communication	3: ASCII mode 4: RTU mode	
Address	ADR	1 to 99		1
Baud rate	BPS	0: 2400, 1: 4800, 2: 9600		2: 9600
Parity	PRI	0: none, 1: even, 2: odd		1: EVN
Stop bit	STP	1, 2		1
Data length	DLN	7, 8 (Note 1)		8

Note 1: When “3: ASCII mode” is selected for MODBUS communication in protocol selection, the data length is fixed to “7.”
When “4: RTU mode” is selected, it is fixed to “8.”

● Protocol-by-Protocol Default Parameter Settings

Communication Protocol \ Parameter	PSL	BPS	PRI	STP	DLN
PC-link communication without sum check	0	9600	EVN	1	8
PC-link communication with sum check	1	9600	EVN	1	⑧
MODBUS communication (ASCII mode)	3	9600	EVN	1	⑦
MODBUS communication (RTU mode)	4	9600	EVN	1	⑧

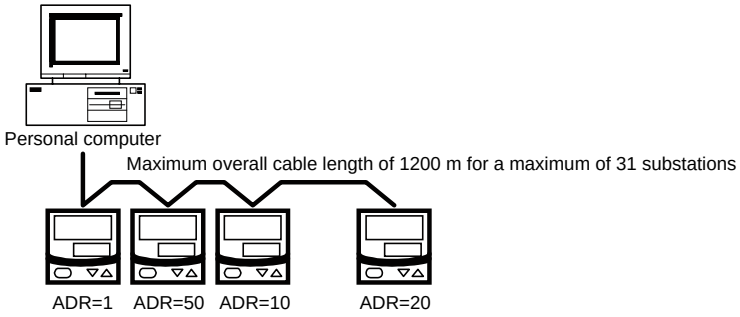
Note: Circled numbers denote fixed values.

● Protocol selection (PSL)

Set the same communication protocol as that of the host device to be connected. The UT150L has PC link communication, and MODBUS communication functions.

● **Address number (ADR)**
Set the address number of the UT150L itself. An address number of 1 to 99 may be assigned in any order. There is however one limitation — the number of UT150L to be connected to a single communication port is limited to 31.

Example of connecting four UT150L to a host device by setting address numbers of 1, 50, 10, and 20



● **Baud rate (BPS)**
Set the same communication rate as that of the host device to be connected. (Otherwise, proper communication cannot be achieved.) The unit of the communication rate is bps (bits per second).

● **Parity (PRI)**
Set the handling of parity to be carried out when data is sent or received. Set the same parity state as that of the host device to be connected.

● **Stop bit (STP)**
Set the same stop bit as that of the host device to be connected.

● **Data length (DLN)**
Set the same data length as that of the host device to be connected. (When MODBUS communication (PSL: 3 or 4) is chosen in protocol selection, the data length is fixed.)

2. Communication Specifications

The RS-485 communication interface has the PC link communication, and the MODBUS communication.

Table 2-1 UT150L Communication Protocol

Communication Hardware	2-wire RS-485 communication system
Terminal	Terminal numbers: 3-5
Communication Protocol Specifications	PC link communication without sum check PC link communication with sum check MODBUS communication (ASCII mode) MODBUS communication (RTU mode)
Maximum Baud Rate	9600 bps

Table 2-2 Types of Devices to be Connected

Device to be Connected	Communication Protocol	Example of Connected Devices
PC	PC link communication	General-purpose PCs
	MODBUS communication	General-purpose PCs

2.1 RS-485 Communication Specifications

Table 2-3 RS-485 Communication Interface

Item	Specifications
Standard	EIA RS-485 compliant
Maximum number of devices to be connected	31
Communication system	2-wire, half duplex
Synchronization	Asynchronous (start-stop)
Communication protocol	No-protocol
Maximum communication distance	1200 m
Baud rate	2400, 4800, 9600

3. PC Link Communication

3.1 Overview

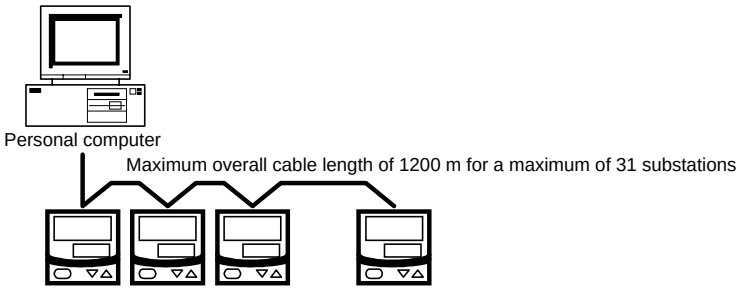


Figure 3-1 Connection of Slaves in PC Link Communication

The use of PC link communication enables UT150L to communicate with a device such as a PC, easily. In this communication, you can use such device to read/write data from/into D registers or read data from I relays, both of which are internal registers of the UT150L.

Hereafter, PCs, are generally called “host devices.”

See Also

Chapters 5 and 6 for information on the D registers and I relays.

In the PC link communication, a host device identifies each UT150L with a communication address of 1 to 99. Some of commands to use let you to specify broadcast that requires no address numbers. For more information on broadcast specification, see subsection 3.2.2.

3.1.1 Configuration of Command

Commands sent from a host device to UT150L, consist of the following elements.

Number of Bytes	1	2	2	1	3	Variable length	2	1	1
Element	STX	Address number (ADR)	CPU number 01	Time to wait for response 0	Command	Data corresponding to command	Checksum	ETX	CR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1) STX (Start of Text)
This control code indicates the start of a command. The character code is CHR$(2).

(2) Address Number (01 to 99)
Address numbers are used by the host device to identify UT150L at the communication destination. (They are identification numbers specific to the UT150L.)

(3) CPU Number
This number is fixed to 01.

(4) Time to Wait for Response
This is fixed to 0.

(5) Command (See subsection 3.2.1, List of Commands)
Specify a command to be issued from the host device.

(6) Data Corresponding to Command
Specify an internal register (D register or I relay), number of data pieces, UT150L parameter value, and others.

(7) Checksum
This converts the ASCII codes of texts between the character next to STX and the character immediately before the checksum into hexadecimal values and adds them byte by byte. It then fetches the single lowermost byte of the added results as the checksum.

This column is only required for PC link communication with checksum. PC link communication without checksum does not require this 2-byte space of ASCII code.

(8) ETX (End of Text)
This control code indicates the end of a command string. The character code is CHR$(3).

(9) CR (Carriage Return)
This control code indicates the end of a command. The character code is CHR$(13).

NOTE

The control codes STX, ETX, and CR are essential for commands when you create a communication program for PC link communication. Omission of any of them or incorrect order of them results in communication failure.

● **Data Form of Commands**

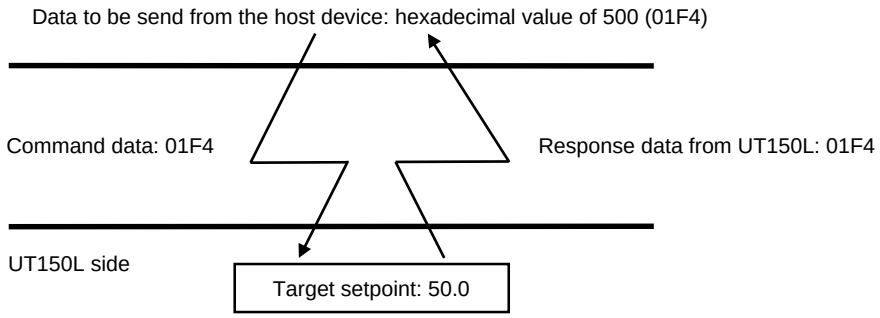
The table below shows the data forms of commands for D registers and I relays.

Table 3-1 Data Forms of Commands for D Registers and I Relays

Type of Data	Contents of Data	Specified Form
PV high and low limits, target setpoints, and others	Measuring range (EU) data	Numeric data not including the decimal point
Bias, deviation alarms, and other	Measuring range width (EUS) data	Numeric data not including the decimal point
Proportional bands, upper and lower limits of output, and others	% data (0.0 to 100.0%)	0 to 1000
Various modes, alarm types, and others	Seconds, absolute values, and data without unit	Absolute values not including the decimal point

● **Command Format for Communication**

Example: When setting a target setpoint “50.0” to a UT150L, the host device sends the value “500” as command data without the decimal point (this is true for both setting 5.00 or 500).



* The position of the decimal point for “500” is determined by the DP (position of decimal point) parameter of the UT150L.

3.1.2 Configuration of Response

Responses from UT150L with respect to a command sent from the host device consists of the elements shown below, which differ depending on the condition of communication; normal or failure.

1) Normal Communication

When communication is complete normally, UT150L return a character string “OK” and when the read commands, return read-out data.

Number of Bytes	1	2	2	2	Variable length	2	1	1
Element	STX	Address number (ADR)	CPU number 01	OK	Parameter data	Checksum	ETX	CR

2) In the Event of Failure

If communication is complete abnormally, UT150L return a character string “ER” and error code (EC1 and EC2). (See subsection 3.2.4, Response Error Codes.)

- No response is made in case of an error in address number specification or CPU number specification.
- If a UT150L cannot receive ETX in a command, response may not be made.

* As a measure against those, provide a timeout process in the communication functions of the host device or in communication programs.

Number of Bytes	1	2	2	2	2	2	3	2	1	1
Element	STX	Address number (ADR)	CPU number 01	ER	EC1	EC2	Command	Checksum	ETX	CR

3.2 Communication with Host Device

In PC link communication, when specifying D registers or I relays, the internal registers of UT150L, you can use their numbers as is. The specifications of the number of each internal register are:

- D registers: D**** (****: numeric value)
- I relays: I**** (****: numeric value)

Host devices to be connected to UT150L are those capable of handling the PC link communication protocol.

As an example of communication program, Section 3.3 shows an example of BASIC program created using Microsoft Quick BASIC.

3.2.1 List of Commands

The following shows the lists of commands available in PC link communication. The details of them are explained in the description of each command.

(1) Bit-basis Access Commands Dedicated to I Relays

Command	Description	Number of Bits to be Handled
BRD	Bit-basis read	1 to 48 bits
BWR	Bit-basis write	1 to 32 bits
BRR	Bit-basis, random read	1 to 16 bits
BRW	Bit-basis, random write	1 to 16 bits
BRS	Specifies I relays to be monitored on a bit-by-bit basis.	1 to 16 bits
BRM	Bit-basis monitoring	—

(2) Word-basis Access Commands

Command	Description	Number of Bits to be Handled
WRD	Word-basis read	1 to 32 words
WWR	Word-basis write	1 to 32 words
WRR	Word-basis, random read	1 to 16 words
WRW	Word-basis, random write	1 to 16 words
WRS	Specified internal registers to be monitored on a word basis	1 to 16 words
WRM	Word-basis monitoring	—

(3) Information Command

Command	Description	Number of Devices to be Handled
INF	Reads model, presence/absence of option, and revision.	1

3.2.2 Specifying Broadcast

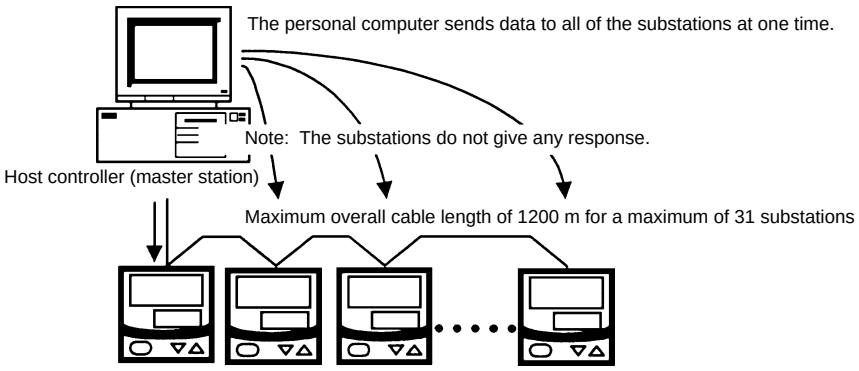


Figure 3-2 Specifying Broadcast

The broadcast function enables all of the connected UT150L or other devices to receive a command. Specifying an address number in Table 3-3 for the address number column in a command enables the host device to write data from/into the internal registers of all UT150L or other devices.

For UT150L, internal registers (D registers and I relays) are assigned with numbers for management. (See chapters 5 and 6 for details.) For the internal registers of other models, see the documentation of the relevant model.

Table 3-2 Address Numbers

ADR	Applicable Devices
BG	UT150L and UT100 Series

3.2.3 Commands

BRD Reads I relays on a bit-by-bit basis.

● **Function**

Reads a sequence of contiguous ON/OFF statuses by the specified number of bits starting at a specified I relay number.

- The number of bits to be read at a time is 1 to 48.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum command element in the command.

● **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	5	1	3	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRD	I relay number	Comma or space	Number of bits (n)	Checksum	ETX	CR

Number of Bytes	1	2	2	2	1	1	1	…	1	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	d1	d2	d3	…	dn	Checksum	ETX	CR

The response is “0” when the status is OFF or “1” when ON.

dn: read data to the extent of the specified number of bits (n = 1 to 48)
dn = 0 (OFF)
dn = 1 (ON)

● **Example: Reading the status of alarm 1 of the UT150L with address number 01**

The following command reads the status of alarm 1 (I0001) at address number 01.

[Command] STX$+ “01010BRDI0001, 00191” +ETX$+CR$

The following response is returned with respect to the above command. (Alarm 1 is ON.)

[Response] STX$+ “0101OK18D” +ETX$+CR$

Alarm has been ON since 1 was returned.

BWR Writes data into I relays on a bit-by-bit basis.

● Function

Writes ON/OFF data into a sequence of contiguous I relays at intervals of the specified number of bits and starting at a specified I relay number.

- The number of bits to be written at a time is 1 to 32.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes a checksum function. When performing communication without checksum, do not include the 2-byte checksum command element in the command.

● Command/Response (for normal operation)

Number of Bytes	1	2	2	1	3	5	1	3	1	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	BWR	I relay number	Comma or space	Number of bits (n)	Comma or space	d1	d2

Command (continued)

…	1	2	1	1
…	dn	Checksum	ETX	CR

Write information is “0” when it is OFF or “1” when it is ON.

dn: write data to the extent of the specified number of bits (n = 1 to 32)
dn = 0 (OFF)
dn = 1 (ON)

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

● **Example:** Setting the user-defined flag of UT150L with address number 01 to ON.
The following command writes ON into the user-defined flag (I0018) at address number 01.

[Command] STX$+ “01010BWRI0018, 001, 1AC” +ETX$+CR$

Note: The user-defined flag is a flag the user can read/write without restraint. For areas available to the user, see Chapter 6, Functions and Applications of I Relays.

“OK” is returned as the response to the above command.

[Response] STX$+ “0101OK5C” +ETX$+CR$

BRR Reads I relays on a bit-by-bit basis in a random order.

● Function

Reads the ON/OFF statuses of I relays at intervals of the specified number of bits in a random order.

- The number of bits to be read at a time is 1 to 16.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes a checksum function. When performing communication without a checksum, do not include the 2-byte checksum command element in the command.

● Command/Response (for normal operation)

Number of Bytes	1	2	2	1	3	2	5	1	5	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRR	Number of bits (n)	I relay number 1	Comma or space	I relay number 2	Comma or space

Command (continued)

…	5	2	1	1
…	I relay number n	Checksum	ETX	CR

Number of Bytes	1	2	2	2	1	1	…	1	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	d1	d2	…	dn	Checksum	ETX	CR

The response is “0” when the status is OFF or “1” when ON.

dn: read data to the extent of the specified number of bits (n = 1 to 16)
dn = 0 (OFF)
dn = 1 (ON)

● **Example:** Reading the statuses of alarms 1 and 2 of the UT150L with address number 05

The following command reads the statuses of alarm 1 (I0001) and alarm 2 (I0002) at address number 05.

[Command] STX$+ “05010BRR04I0001, I00027F” +ETX$+CR$

With respect to the above command, the ON and OFF responses are returned for alarms 1 and 2 respectively.

[Response] STX$+ “0501OK10C1” +ETX$+CR$

Alarm 1 has been ON.

BRW Writes data into I relays on a bit-by-bit basis in a random order.

● **Function**

Writes ON/OFF statuses into I relays at intervals of the specified number of bits on a per-I relay basis and in random order.

- The number of bits to be written at a time is 1 to 16.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without a checksum, do not include the 2-byte checksum command element in the command.

● **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	1	1	5
Command element	STX	Address number (ADR)	CPU number 01	0	BRW	Number of bits (n)	I relay number 1	Comma or space	d1	Comma or space	I relay number 2

Command (continued)

1	1	1	…	5	1	1	2	1	1
Comma or space	d2	Comma or space	…	I relay number n	Comma or space	dn	Checksum	ETX	CR

Write information is “0” when it is OFF or “1” when it is ON.

dn: write data to the extent of the specified number of bits (n = 1 to 16)
dn = 0 (OFF)
dn = 1 (ON)

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

● **Example:** Setting four user-defined flags of the UT150L with address number 05 to ON, OFF, OFF, and ON.

The following command sets the four user-defined flags (I0025, I0026, I0027, and I0028) at address number 05 to ON, OFF, OFF, and ON respectively.

[Command] STX$+ “05010BRW04I0025, 1, I0026, 0, I0027, 0, I0028, 181” +ETX$+CR$

Note: The user-defined flags (I relays) are flags that the user can freely read/write. For areas available to the user, see Chapter 6, Functions and Applications of I Relays.

“OK” is returned as the response to the above command.

[Response] STX$+ “0501OK60” +ETX$+CR$

BRS Specifies I relays to be monitored on a bit-by-bit basis.

● **Function**

Specifies the numbers of I relays to be monitored on a bit-by-bit basis. Note that this command simply specifies I relays. Actual monitoring is performed by the BRM command after the I relay numbers are specified.

When the volume of data is large and you wish to increase the communication rate, it is effective to use a combination of the BRS and BRM commands rather than the BRD command.

- The number of registers to be specified at a time is 1 to 16.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without a checksum, do not include the 2-byte checksum command element in the command.

● **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	3	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRS	Number of bits (n)	I relay number 1	Comma or space	I relay number 2	Comma or space

Command (continued)

…	5	2	1	1
…	I relay number n	Checksum	ETX	CR

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

● **Example:** Monitoring the PV burnout status of the UT150L with address number 05

The following command monitors the PV burnout status (I0007) at address number 05.

(This command is used for simply specifying registers.)

[Command] STX$+ “05010BRS01I00074D” +ETX$+CR$

“OK” is returned as the response to the above command.

[Response] STX$+ “0501OK60” +ETX$+CR$

BRM Monitors I relays on a bit-by-bit basis.

● **Function**

Reads the ON/OFF statuses of I relays that have been specified in advance by the BRS command.

- Before executing this command, the BRS command must always be executed to specify which I relays are to be monitored. If no relay has been specified, error code 06 is generated. This error also occurs if the power supply is turned off.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without the checksum, do not include the 2-byte checksum command element in the command.

● **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRM	Checksum	ETX	CR

Number of Bytes	1	2	2	2	1	1	1	…	1	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	d1	d2	d3	…	dn	Checksum	ETX	CR

The response is “0” when the status is OFF or “1” when ON.

dn: read data to the extent of the number of bits specified by the BRS command (n = 1 to 16)
dn = 0 (OFF)
dn = 1 (ON)

● **Example:** Monitoring the PV burnout status of the UT150L with address number 05

The following command monitors the PV burnout status (I0007) at address number 05. (This command reads the statuses of the I relays specified by the BRS command.)

[Command] STX$+ “05010BRMD7” +ETX$+CR$

The ON/OFF status of the I relay is returned as the response to the above command.

[Response] STX$+ “0501OK191” +ETX$+CR$

I relay has been ON.

WRD Reads D registers and I relays on a word-by-word basis.

● Function

Reads a sequence of contiguous register information on a word-by-word basis, by the specified number of words, and starting at the specified register number.

- The number of words to be read at a time is 1 to 32.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without the checksum, do not include the 2-byte checksum command element in the command.

● Command/Response (for normal operation)

Number of Bytes	1	2	2	1	3	5	1	2	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRD	Register number	Comma or space	Number of words (n)	Checksum	ETX	CR

Number of Bytes	1	2	2	2	4	4	…	4	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	dddd1	dddd2	…	ddddn	Checksum	ETX	CR

The response is returned in a 4-digit character string (0000 to FFFF) in a hexadecimal pattern.

Read data of the specified number of words
ddddn = character string in a hexadecimal pattern
n = 1 to 32

● **Example:** Reading a measured input value of the UT150L with address number 03

The following command reads the measured input value (D0002) at address number 03.

[Command] STX$+ “03010WRDD0002, 0174” +ETX$+CR$

The measured input value 200 (00C8 (HEX)) is returned as the response to the above command.

[Response] STX$+ “0301OK00C839” +ETX$+CR$

WWR Writes data into D registers and I relays on a word-by-word basis.

● **Function**

Writes information into a sequence of contiguous registers on a word-by-word basis, by the specified number of words, and starting at the specified register number.

- The number of words to be written at a time is 1 to 32.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without the checksum, do not include the 2-byte checksum command element in the command.

● **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	5	1	2	1	4
Command element	STX	Address number (ADR)	CPU number 01	0	WWR	Register number	Comma or space	Number of words (n)	Comma or space	dddd1

Command (continued)

4	…	4	2	1	1
dddd2	…	ddddn	Checksum	ETX	CR

Write information is specified in a 4-digit character string (0000 to FFFF) in a hexadecimal pattern.

(Write data of the specified number of words
ddddn = character string in a hexadecimal pattern
n = 1 to 32)

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

● **Example:** Writing “200” into target setpoint of UT150L with address number 03.

The following command writes data 200 (00C8 (HEX)) into the target setpoint 1 (D0120) at address number 03.

[Command] STX$+ “03010WWRD0120, 01, 00C88F” +ETX$+CR$

“OK**”** is returned as the response to the above command.

[Response] STX$+ “0301OK5E” +ETX$+CR$

WRR Reads D registers and I relays on a word-by-word basis in random order.

● **Function**

Reads the statuses of registers on a word-by-word basis, by the specified number of words and in a random order.

- The number of words to be read at a time is 1 to 16.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without the checksum, do not include the 2-byte checksum command element in the command.

● **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	5	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRR	Number of words (n)	Register number 1	Comma or space	Register number 2	Comma or space

Command (continued)

…	5	2	1	1
…	Register number (n)	Checksum	ETX	CR

Number of Bytes	1	2	2	2	4	4	…	4	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	dddd1	dddd2	…	ddddn	Checksum	ETX	CR

The response is returned in a 4-digit character string (0000 to FFFF) in a hexadecimal pattern.

(ddddn = character string in a hexadecimal pattern (n = 1 to 16))

● **Example:** Reading the measured input and output values of the UT150L with address number 10. The following command reads the measured input value (D0002) and the target setpoint (D0003) at address number 10.

[Command] STX$+ “10010WRR02D0002, D000388” +ETX$+CR$

The measured input value 200 (00C8 (HEX)) and output value 50 (0032 (HEX)) are returned as the response to the above command.

[Response] STX$+ “1001OK00C80032FC” +ETX$+CR$

WRW Writes data into D registers and I relays on a word-by-word basis in random order.

● Function

Writes register information specified for each register into registers of the specified number of words in a random order.

- The number of words to be written at a time is 1 to 16.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without the checksum, do not include the 2-byte checksum command element in the command.

● Command/Response (for normal operation)

Number of Bytes	1	2	2	1	3	2	5	1	4	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRW	Number of words (n)	Register number 1	Comma or space	dddd1	Comma or space

Command (continued)

5	1	4	…	5	1	4	2	1	1
Register number 2	Comma or space	dddd2	…	Register number n	Comma or space	ddddn	Checksum	ETX	CR

Write information is specified in a 4-digit character string (0000 to FFFF) in a hexadecimal pattern.

(Repetition of register numbers and write information by the specified number of words
ddddn = character string in a hexadecimal pattern
n = 1 to 16)

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

● **Example:** Writing “20.0” into target setpoint 1 of UT150L with address number 10 and “15.0” into the alarm-1 setpoint.

The following command writes
“20.0” into target setpoint 1 (D0120) and “15.0” into the alarm-1 setpoint (D0101) at address number 10.

[Command] **STX$+ “10010WRW02D0120, 00C8, D0101, 009694” +ETX$+CR$**

Target setpoint: 200 — Alarm setpoint: 150

“OK” is returned as the response to the above command.

[Response] **STX$+ “1001OK5C” +ETX$+CR$**

WRS Specifies the D registers and I relays to be monitored on a word-by-word basis.

● Function

Specifies the numbers of the registers to be monitored on a word-by-word basis. Note that this command simply specifies the registers. Actual monitoring is performed by the WRM command after the register numbers are specified by this command.

If the volume of data is large and you wish to increase the communication rate, it is useful to use a combination of the WRS and WRM commands rather than the WRD command. If the power supply is turned off, the register numbers specified will be erased.

- The number of words to be specified at a time is 1 to 16.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without the checksum, do not include the 2-byte checksum command element in the command.

● Command/Response (for normal operation)

Number of Bytes	1	2	2	1	3	2	5	1	5	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRS	Number of words (n)	Register number 1	Comma or space	Register number 2	Comma or space

Command (continued)

…	5	2	1	1
…	Register number n	Checksum	ETX	CR

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

● **Example:** Monitoring the measured input value of UT150L with address number 01
The following command monitors the measured input value (D0002) at address number 01.
(This command simply specifies the registers.)

[Command] STX$+ “01010WRS01D000255” +ETX$+CR$

CPU number: 01 — D register number: D0002

“OK” is returned as the response to the above command.

[Response] STX$+ “0101OK5C” +ETX$+CR$

WRM Monitors the D register and I relays on a word-by-word basis.

● Function

Reads register information that has been specified in advance by the WRS command.

- Before executing this command, the WRS command must always be executed to specify which registers are to be monitored. If no register has been specified, error code 06 is generated. This error also occurs if the power supply is turned off.
- For the format of response in the event of failure, see subsection 3.1.2.
- The command shown below includes the checksum function. When performing communication without the checksum, do not include the 2-byte checksum command element in the command.

● Command/Response (for normal operation)

Number of Bytes	1	2	2	1	3	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRM	Checksum	ETX	CR

Number of Bytes	1	2	2	2	4	4	…	4	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	dddd1	dddd2	…	ddddn	Checksum	ETX	CR

The response is returned in a 4-digit character string (0000 to FFFF) in a hexadecimal pattern.

Read data of the number of words specified by the WRS command
ddddn = character string in a hexadecimal pattern
n = 1 to 16

● Example: Monitoring the measured input value of UT150L with address number 01

The following command monitors the measured input value (D0002) at address number 01.

(This command reads the statuses of the registers specified by the WRS command.)

[Command] **STX$+ “01010WRME8” +ETX$+CR$**

CPU number: 01

The measured input value 200 (00C8 (HEX)) is returned as the response to the above command.

[Response] **STX$+ “0101OK00C837” +ETX$+CR$**

Measured input value: 200

INF Reads the model, presence or absence of options, and revisions.

● Function

Returns the model number of UT150L, whether any options are included, and the version number and revision number are read.

- For the format of response in the event of failure, see subsection 3.1.2.

● Command/Response (for normal operation)

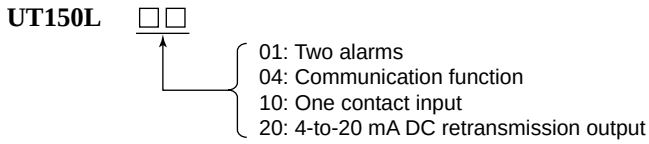
Number of Bytes	1	2	2	1	3	1	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	INF	6	Checksum	ETX	CR

Number of Bytes	1	2	2	2	8	7	1	4	4
Response element	STX	Address number (ADR)	CPU number 01	OK	UT150L□□ (Note 1)	Version Revision (Note 2)	Space	Readout start register for special device	Number of readout registers for special device

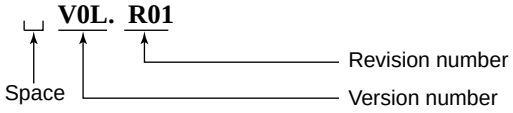
Response (continued)

4	4	2	1	1
Write start register for special device	Number of write registers for special device	Checksum	ETX	CR

Note: Model and option of UT150L



Note: Version number and revision number



3.2.4 Response Error Codes

See Also

Subsection 3.1.2, Configuration of Response, for the structure of the response in the event of error.

The error codes (EC1) and detailed error codes (EC2) of response are as follows.

Table 3-3 List of Error Codes EC1

Error Code	Meaning	Causes
02	Command error	• No command exists. • Command not executable
03	Internal register specification error	• No register number exists. • If a bit register (I relay) is used on a word-by-word basis, its specification is not correct.
04	Out of setpoint range	• A character other than 0 or 1 has been used for the bit setting. • A value other than 0000 to FFFF has been specified in the word specification. • The position of a start for a data load, save, or other command, is out of the address range.
05	Out of data number range	• The specification of the number of bits or words is out of the range of use. • The number of data specified and the number of parameters for registers, etc. are not consistent.
06	Monitor error	• An attempt was made to execute monitoring without specifying the monitor (BRS or WRS).
08	Parameter error	• An illegal parameter is set.
42	Sum error	• The sum does not match the expected value.
43	Internal buffer overflow	• A data value greater than specified is received.
44	Character reception time-out	• The end-of-data or end-of-text character is not received.

Table 3-4 List of Detailed Error Codes EC2

Error Code (EC1)	Meaning	Detailed Error Code (EC2)
03	Device specification error	Parameter number where error occurred (HEX) This is the number of a parameter in sequence that first resulted in error when counted from the leading parameter. **Example:** Error in device name specification ↓ **STX 01010BRW 05 I0017, 1, I0018, 0, A00502** Parameter numbers 1 2 3 4 5 6 In this case, EC1 = 03 and EC2 = 06
04	Out of setpoint range	
05	Out of data number range	
08	Parameter error	An illegal paraeter is set.

For error codes other than those noted as EC1, there is no EC2 meaning.

3.3 Example of BASIC Program for Send and Receive

This section shows an example of a command sending and response receiving program created with Microsoft Quick BASIC*2 for PC/AT*1 (or compatible machines).

The communication conditions of the UT150L and those of the PC (e.g., communication rate) must agree with each other. Set the communication rate (baud rate) of the PC using the SWITCH command of MS-DOS*3. For how to use the SWITCH command, refer to the User's Reference Manual of MS-DOS. Moreover, set the parity, character bit length, stop bit length, and so on using the OPEN statement.

*1 PC/AT is a product of IBM Corporation.
*2 Microsoft Quick BASIC is a registered trademark of Microsoft Corporation.
*3 MS-DOS is a registered trademark of Microsoft Corporation.

Example of the Program Created Using Microsoft Quick BASIC Version 7.1
(Reads the values in three D registers from register 0002.)

```
1000  '  === Main routine ===
1010  STX$=CHR$(2)                                  ' Define
1020  ETX$=CHR$(3)                                  ' Define
1030  CR$=CHR$(13)                                  ' Define
1040  RCVCHR$= ""                                   ' Initialize receive character string
1050  fRCVEND=0                                     ' Initialize flag
1060  fTIMEOUT=0                                    ' Initialize flag
1070  '
1080  SEND$=STX$+"01010WRDD0002,03"+ETX$            ' Create character string for send
1090  '
1100  OPEN "COM1:9600,N,8,1,ASC"  FOR RANDOM AS #1  ' Open a port
1110     ON COM(1) GOSUB receivechr                 ' Specify interruption processing during
                                                      receiving
1120     ON TIME(5) GOSUB timeout                   ' Specify interruption processing at timeout
1130  '
1140     PRINT #1,SEND$                             ' Send
1150     COM(1) ON                                  ' Permit interruption during receive
1160     TIMER ON                                   ' Start timer
1170  '
1180     DO                                         ' Wait for receive end or timeout
1190     LOOP WHILE fRCVEND=0 AND fTIMEOUT=0        '
1200  '
1210     TIMER OFF                                  ' Stop timer
1220     COM(1) OFF                                 ' Prohibit interruption during receiving
1230     CLOSE #1                                   ' Close the port
1240  '
1250     PRINT ">"+SEND$                            ' Display sent character string on screen
1260     PRINT "<"+RCVCHR$                          ' Display received character string on
                                                      screen
1270     END                                        ' END
1280  '
1290  '  === Subroutine ===
1300  receivechr:                                   ' Interruption processing during receiving
1310     CHR1$=INPUT\(1,#1)                         ' Fetch characters from receive buffer
                                                      one by one
1320     IF CHR1$=CR$   THEN                        ' If received character string is "CR,"
1330     IF RCVCHR$=SEND$ THEN                      ' If received character string is the same
                                                      served command,
1340     RCVCHR$= ""                                ' Initialize receive character string. (Echo
                                                      Back Processing)
1350        fRCVEND=0                               ' receiving flag remains initialized at 0.
1360     ELSE                                       ' If received character string is different
                                                      from served command,
1370        fRCVEND=1                               ' receiving end flag is set.
1380     END IF                                     '
1390     ELSE                                       ' If it is a character other than CR,
1400        fRCVEND=0                               ' receiving end flag remains initialized at 0.
1410     RCVCHR$=RCVCHR$+CHR1$                      ' Create received character string
1420     END IF                                     '
1430  RETURN
1440  '
```

```
1450   timeout:                                    ‘ Timeout processing
1460      fTIMEOUT=1                               ‘ Set timeout flag
1470      RCVCHR$=″Time out !  (5 sec)″+CR$        ‘ Character string for display on screen
                                                     “Time out! (5 sec)”
1480   RETURN
  ↑
```

* The line numbers are not required. (They are simply provided for checking the number of program steps.)

4. MODBUS Communication

4.1 Overview

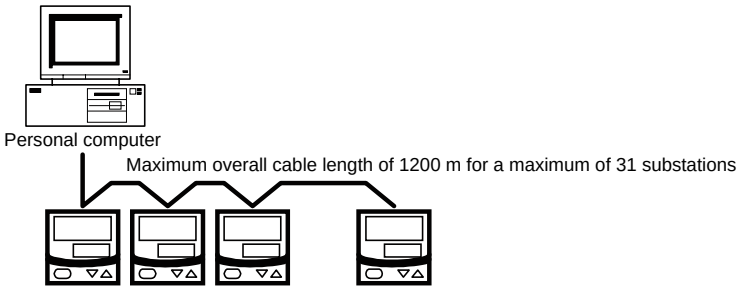


Figure 4-1 Connection of Slaves in MODBUS Communication

Use of the MODBUS communication enables UT150L to communicate with a wide variety of devices such as PCs. In this communication, you use such device to read/write data from/into D registers, (internal registers) of the UT150L.

Hereafter, PCs are generally called “host devices.”

See Also
Chapter 5 for information on the D registers.

For the MODBUS communication of the UT150L, we provide the ASCII mode (ASCII system) and RTU mode (binary system) for the communication mode.

Table 4-1 ASCII and RTU Modes

Item	ASCII Mode	RTU Mode
Number of data bits	7 bits (ASCII)	8 bits (binary)
Message start mark	: (colon)	Not necessary
Message end mark	CR + LF	Not necessary
Length of message (Note 1)	2N + 1	N
Data time intervals	1 second or less	24 bit time or less (Note 2)
Error detection	Longitudinal redundancy check: LRC	Cyclic redundancy check: CRC-16

Note 1: When the length of a message in the RTU mode, it is assumed to be “N.”
Note 2: When the communication rate is 9600 bps, 1 ÷ 9600 × 24 sec or less.

In the MODBUS communication, a higher-level device identifies each UT150L with a communication address of 1 to 99. Some of the commands used let you specify broadcast that requires no address numbers. For more information on broadcast specifications, see subsection 4.2.2.

4.1.1 Configuration of Message

Messages sent from a higher-level device to UT150L, consists of the following elements.

Element	Start of Message Mark	Address Number (ADR)	Function Code	Data	Error Check	End of Message Mark
Number of bytes in RTU mode	None	1	1	2n	2	None
Number of bytes in ASCII mode	1	2	2	4n	2	2
	(1)	(2)	(3)	(4)	(5)	(6)

(1) Start of Message Mark
This mark indicates the start of a message. Note that only ASCII mode requires the colon.

(2) Address Number (1 to 99)
Address numbers are used by host devices to identify the UT150L at the communication destination. (These numbers are identification numbers specific to individual UT150L.)

(3) Function Code (See subsection 3.2.1, List of Function Codes)
The function code specifies a command (function code) from the higher-level device.

(4) Data
This element specifies D register numbers, the number of D registers, parameter values, and so on in accordance with the function code.

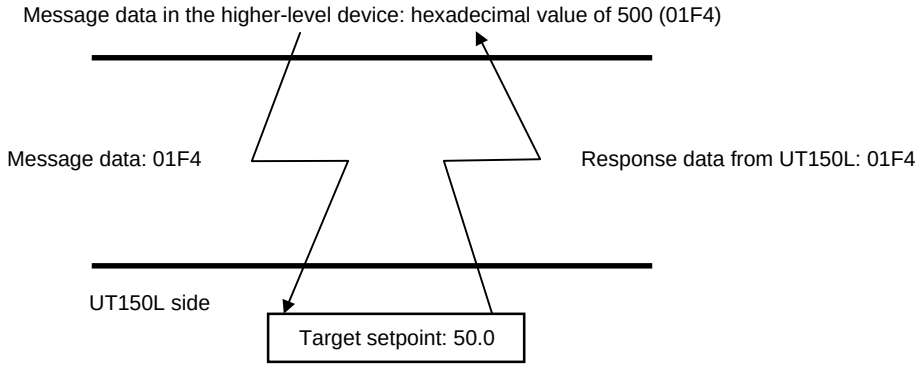
(5) Error Check
In RTU mode Carried out by the cyclic redundancy check (CRC-16) system.

In ASCII mode Carried out by the longitudinal redundancy check (LRC) system.

(6) End of Message Mark
This mark indicates the end of a message.

Note that only ASCII mode requires CR + LF

● **Message format for communication**
Example: When setting the target setpoint “50.0” to a UT150L, the higher-level device sends message data (01F4) into a value of “500” converted into hexadecimals not including the decimal point (thus, this is true for sending both 5.00 or 500).



∗ The position of the decimal point for “500” is determined by the DP (position of decimal point) parameter of the UT150L.

4.2 Communication with Host Device

The specification of D registers for a message using commercially available SCADA or the like and specification of D registers for a message in customer-created communication programs are different from simple specification of D register numbers. Thus, care should be taken.

(1) When using commercially available SCADA or the like, specify the D register numbers by changing them into reference numbers. D register numbers whose “D” leading character is replaced with “4,” are treated as reference numbers. (When using a DDE server or others, specify these reference numbers.)
(2) For communication programs created by the customer, specify registers using the hexadecimal numbers of values that are obtained by subtracting “40001” from the reference numbers. (Thus, hexadecimal numbers are those to be specified.)

Example: To specify target setpoint “D0120”:

(1) For a message using commercially available SCADA or the like, specify reference number “40120.”
(2) For a message in a customer-created communication program, specify the hexadecimal number, or 0077, of a value (0119) obtained by subtracting 40001 from the reference number.

4.2.1 List of Function Codes

Function codes are command words used by the higher-level device to obtain the D register information of UT150L.

Table 4-2 List of Function Codes

Code Number	Function	Description
03	Reads data from multiple D registers.	Capable of reading data from a maximum of 32 successive D registers between D0001 and D0421.
06	Writes data into D register.	Capable of writing data to one D register between D0101 and D0421.
08	Performs loop back test.	See subsection 4.2.3, “Function Codes.
16	Writes data into multiple D registers.	Capable of writing data into a maximum of 32 successive D registers between D0101 and D0421.

- A write using the function code is not possible for read-only or disabled D registers.
- Broadcast can be specified for function codes 06 and 16 only.

4.2.2 Specifying Broadcast

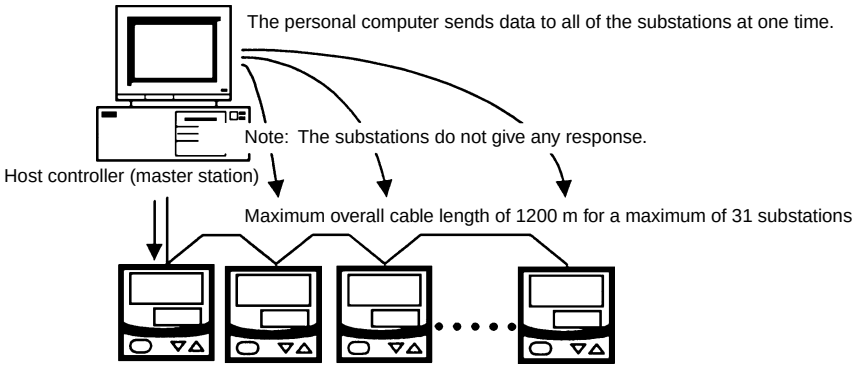


Figure 4-2 Specifying Broadcast

Broadcast is a feature in which all connected UT150L can receive the command concerned. Specifying the number in Table 4-3 at the location of the address number in a message enables the higher-level device to write data into the D registers of all UT150L.

Table 4-3 Broadcast Specification Number

Number to be Specified in ADR	Applicable Devices
00	UT150L

4.2.3 Function Codes

03 Reads data from multiple D registers.

● **Function**

This function code reads the contents of successive D registers by the specified number of them starting at a specified D register number.

• The maximum number of D registers to be read at a time is 32.

• For the format of responses in the event of failure, see subsection 4.2.4.

● **Message (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (03)	D-Register Start Number (Upper Digit)	D-Register Start Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Message (continued)

Number of D Registers (Upper Digit)	Number of D Registers (Lower Digit)	Error Check	End of Message Mark (CR + LF)
1	1	2	None
2	2	2	2

● **Response (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (03)	Byte Count	Contents of D-Register (Upper Digit)	Contents of D-Register (Lower Digit)	…
Number of bytes in RTU mode	None	1	1	1	1	1	…
Number of bytes in ASCII mode	1	2	2	2	2	2	…

Response (continued)

Contents of D Registers (Upper Digit)	Contents of D Registers (Lower Digit)	Error Check	End of Message Mark (CR + LF)
1	1	2	None
2	2	2	2

● **Example:** Reading the statuses of alarms 1 and 2 from the UT150L with address number 17. The following message reads four successive D registers starting at alarm 1 (D0101) and address number 17 in the ASCII mode.

[Message] **[:]11030064000286[CR][LF]**

Start of message mark

"11": address number 17, "03": function code 03, "0064": D register address 0101, "0002": number of D registers 2, and "86": error check

* Numbers in quotation marks are hexadecimal.

The following response is returned with respect to the above message.

[Response] **[:]11030405A000A84[CR][LF]**

Setting of alarm1, alarm2

"04": byte count, "005A": alarm 1 setpoint 90, "000A": alarm 2 setting 10

16 Writes data into D registers.

● **Function**

This function code writes data into successive D registers by the number of specified D registers from a specified D register number.

- The maximum number of D registers into which data is written at a time is 32.
- For the format of response in the event of failure, see subsection 4.2.4.
- Lets you specify broadcast (by setting “00” to the address number).

● **Message (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (10)	D-Register Start Number (Upper Digit)	D-Register Start Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Massage (continued)

Number of D Registers (Upper Digit)	Number of D Registers (Lower Digit)	Byte Count	Data (Upper Digit)	Data (Lower Digit)	…	Error Check	End of Message Mark (CR + LF)
1	1	1	1	1	…	2	None
2	2	2	2	2	…	2	2

● **Response (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (10)	D-Register Start Number (Upper Digit)	D-Register Start Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Response (continued)

Number of D Registers (Upper Digit)	Number of D Registers (Lower Digit)	Error Check	End of Message Mark (CR + LF)
1	1	2	None
2	2	2	2

● **Example:** Setting a alarm-1 setpoint of 80, and a alarm-2 setpoint of 70 to UT150L with address number 02.

The following message writes values 80, and 70 in this order in the ASCII mode, starting at the proportional band (D0101) of address number 02.

[Message] **[:]02100064000204005000 46EE[CR][LF]**

Start of message mark

“02”: address number 02, “10”: function code 16, “0064”: starts register address 0101, “0002”: number of D registers 2, “04”: byte count, “0050”: alarm-1 setpoint 80, “0046”: alarm-2 setpoint 70, and “EE”: error check

* Numbers in quotation marks are hexadecimal.

The following response is returned with respect to the above message.

[Response] **[:]0210006400028 8[CR][LF]**

Number of D registers: 2

06 Writes data into D register.

● Function

This function code writes data into a specified D register number.

- The maximum number of D registers into which data is written at a time is 1.
- For the format of response in the event of failure, see subsection 4.2.4.
- Lets you specify broadcast (by setting "00" to the address number).

● Message (for normal operation)

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (06)	D-Register Number (Upper Digit)	D-Register Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Message (continued)

Write Data (Upper Digit)	Write Data (Lower Digit)	Error Check	End of Message Mark (CR + LF)
1	1	2	None
2	2	2	2

● Response (for normal operation)

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (06)	D-Register Number (Upper Digit)	D-Register Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Response (continued)

Write Data (Upper Digit)	Write Data (Lower Digit)	Error Check	End of Message Mark (CR + LF)
1	1	2	None
2	2	2	2

● **Example:** Setting 70.0 to the target setpoint of UT150L with address number 01.
The following message writes "700" to the target setpoint (D0120) at address number 01 in the ASCII mode.

[Message] **[:]0106007702BCC4[CR][LF]**

Start of message mark

"01": address number 01, "06": function code 06, "0077": D-register address 0120, "02BC": target setpoint 70.0, and "C4": error check
* Numbers in quotation marks are hexadecimal.

The response of the same contents is returned with respect to the above message.

[Response] **[:]0106007702BCC4[CR][LF]**

Target setpoint: 70.0

08 Performs a loop back test.

● **Function**

This function code is used to check connection for communication.

- For the format of response in the event of failure, see subsection 4.2.4.
- The specification of a D register number (marked with an asterisk below) for a loop back test is "00" (fixed).
- Any value can be selected for send data.

● **Message (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (08)	∗00 (Upper Digit)	∗00 (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Message (continued)

Send Data (Upper Digit)	Send Data (Lower Digit)	Error Check	End of Message Mark (CR + LF)
1	1	2	None
2	2	2	2

● **Response (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (08)	00 (Upper Digit)	00 (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Response (continued)

Send Data (Upper Digit)	Send Data (Lower Digit)	Error Check	End of Message Mark (CR + LF)
1	1	2	None
2	2	2	2

● **Example:** Sending data 1234h to UT150L with address number 05 to check connection for communication.

The following message sends "1234" (hexadecimal) to address number 05 in the ASCII mode.

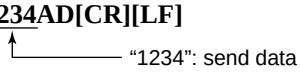
[Message] **[:]050800001234AD[CR][LF]**

"05": address number 05, "08": function code 08, "0000": fixed, "1234": send data, and "AD": error check

* Numbers in quotation marks are hexadecimal.

When connection for communication is normal, the following response is returned with respect to the above message.

[Response] **[:]050800001234AD[CR][LF]**



4.2.4 Response Error Codes

● **Message Format in the Event of Error**

If there is any inconsistency other then communication errors in a message, UT150L does nothing, but returns the following message.

Element	Address Number (ADR)	Function Code*	Error Code	Error Check
Number of bytes in RTU mode	1	1	1	2
Number of bytes in ASCII mode	2	2	2	2

∗ The function code contains a function code (hexadecimal number) + 80 (hexadecimal number).

● **Error Codes in Response**

Table 4-4 List of Error Codes

Error Code	Meaning	Description
01	Function code error	No function code exists.
02	D-register address error	Address out of the range has been specified.
03	D-register count error	Number of D registers has been specified, being out of the range.

● **Even when a message is sent, no response returns if:**

- Retransmission error (overrun, framing, parity, LRC, or CRC-16 error) was detected.
- Address in an instructed message is incorrect.
- Interval between data composing a message was 1 second or more.
- Broadcast is specified (address number: 00).

* As a measure against those, provide a timeout process in the communication functions of a higher-level device or in communication programs.

5. Functions and Usage of D Registers

5.1 Overview of D Registers

This section explains the functions and usage of D registers.

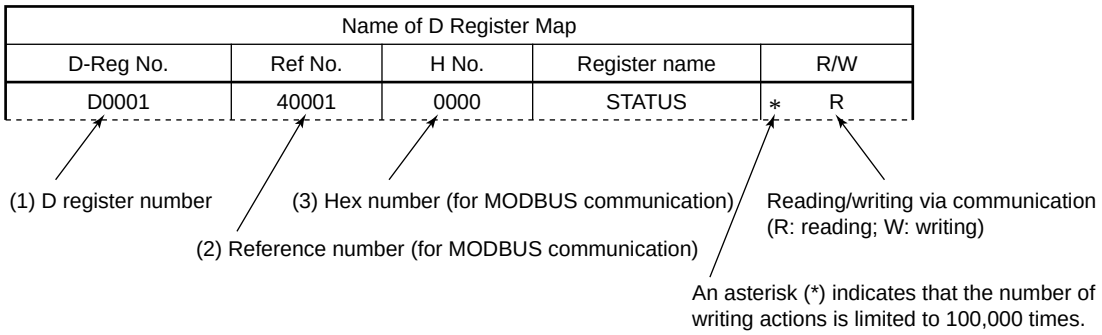
The D registers store the parameter data, flag data and process data that are handled by UT150L controller. By connecting UT150L controller to host devices capable of PC link communication, or MODBUS communication, you can readily use these internal data items by reading from or writing to the D registers.

Using the D registers, you can perform:

- Centralized control using host devices
- Data exchange by reading/writing using host devices

5.2 Interpretation of Lists of D Registers (D Register Map Tables)

This section explains how to read the “D Register Map” tables in this chapter. In the example shown below, the number in the leftmost column denotes (1) D-register number. The five-digit number in the column on the immediate right of the leftmost column represents (2) Reference number for MODBUS communication. The number in the column third from left is (3) Register number (hexadecimal) for the MODBUS communication program. Each register code name in the D Register Map tables represents register name of specific process data item, operating parameter, setup parameter or other data items. For details on the operating and setup parameters, see *Model UT150L Limit Controller* instruction manual (IM 05C01E22-01E).



5.3 Classification of D Registers

■ Classification of D Register Map Tables

The table below outlines how the D registers are classified by their numbers in the D Register Map tables.

Table 5-1 Classification of D Registers

Register No.	Area and Data Categories		Description	Reference
D0001 to 0010	Process data area (Note 1)	Operating data	PV, CSP and other values	Section 5.4
D0401 to 0420	User area (Note 2), represented by shaded section in the table ( )	—	Used for communication with the Host devices.	Section 5.4
D0011 to 0100 D0121 to 0200 D0216 to 0300 D0307 to 0400	Must not be used.			
D0101 to 0120	Operating parameters area *1	Operating parameter	FL, BS etc.	Section 5.4
D0201 to 0215	Setup parameters area *1	Setup parameter	AL, HY etc.	Section 5.4
D0301 to 0306				

Note 1: Data for process values, operating parameters and setup parameters are stored as the types (EU, EUS, % and ABS without the decimal point) indicated in the "Operating Parameters" and the "Setup Parameters" of the *UT150L Limit Controller* instruction manual. The OFF and ON states are represented by 0 and 1, respectively. The D registers D0401 to 0420 are read-only.

Note 2: The user area (register numbers D0401 to 0420) is reserved for 16-bit register data used in other software programs. When working with host devices, do not write to or read from this area as usually done.

NOTE

No data may be written to or read from data storage areas with blank fields in the tables that follow. If you attempt to do so, UT150L controller may fail to operate correctly.

5.4 Register Map Table

Area for Process Data									
D-Reg No.	Ref No.	H No.	Register Name	R/W	D-Reg No.	Ref No.	H No.	Register Name	R/W
D0001	40001	0000	STATUS	R	D0216 to 0300				
D0002	40002	0001	PV	R	D0301	40301	012C	IN	*R/W
D0003	40003	0002	CSP	R	D0302	40302	012B	DP	*R/W
D0004					D0303	40303	012E	RH	*R/W
D0005					D0304	40304	012F	RL	*R/W
D0006					D0305	40305	0130	SPH	*R/W
D0007					D0306	40306	0131	SPL	*R/W
D0008					D0313 to 0400				
D0009	40009	0008	TIM	R	D0401	40401	0037		R/W
D0010	40010	0009	MOD	R	D0402	40402	0038		R/W
D0011 to 0100					D0403	40403	0039		R/W
D0101	40101	0064	A1	*R/W	D0404	40404	003A		R/W
D0102	40102	0065	A2	*R/W	D0405	40405	003B		R/W
D0103					D0406	40406	003C		R/W
D0104					D0407	40407	003D		R/W
D0105					D0408	40408	003E		R/W
D0106					D0409	40409	003F		R/W
D0107					D0410	40410	0040		R/W
D0108					D0411	40411	0041		R/W
D0109					D0412	40412	0042		R/W
D0110					D0413	40413	0043		R/W
D0111	40111	006E	HYS	*R/W	D0414	40414	0044		R/W
D0112					D0415	40415	0045		R/W
D0113					D0416	40416	0046		R/W
D0114	40114	0071	SP1	*R/W	D0417	40417	0047		R/W
D0115					D0418	40418	0048		R/W
D0116	40116	0073	FL	*R/W	D0419	40419	0049		R/W
D0117	40117	0074	BS	*R/W	D0420	40420	004A		R/W
D0118	40118	0075	LOC	*R/W					
D0119									
D0120	40120	0077	CSP1	R/W					
D0121 to 0200									
D0201									
D0202									
D0203	40203	00CA	AL1	*R/W					
D0204	40204	00CB	AL2	*R/W					
D0205	40205	00CC	HY1	*R/W					
D0206	40206	00CD	HY2	*R/W					
D0207	40207	00CE	DIS	*R/W					
D0208	40208	00CF	HILO	*R/W					
D0209	40209	00D0	OPSL	*R/W					
D0210	40210	00D1	PSL	*R/W					
D0211	40211	00D2	ADR	*R/W					
D0212	40212	00D3	BPS	*R/W					
D0213	40213	00D4	PRI	*R/W					
D0214	40214	00D5	STP	*R/W					
D0215	40215	00D6	DLN	*R/W					

Shaded areas ▭ indicate a user area (D-register numbers D0401 to D0420). These registers are not available if the host devices.

An asterisk (*) indicates that the number of writing actions is limited to 100,000 times

5.4.1 D Register Contents

D registers are designed to indicate two or more events, such as errors and parameter data, using combinations of bits within them. If any of the events shown in the following tables occurs, the corresponding bit is set to 1. The bit remains set to 0 if the event has not occurred yet. Note that bits in blank fields are not in use.

- **D0001 Register - Bit Configuration of STATUS (Input Error)**

Bit	Code	Event
0	ALM1.st	'1' if alarm 1 is on, or '0' if off
1	ALM2.st	'1' if alarm 2 is on, or '0' if off
2	0	
3	0	
4	PV+over.st	PV above the upper limit of scale
5	PV-over.st	PV below the lower limit of scale
6	BO.st	Burn-out error
7	0	
8	SYSTEM.E.st	Error in system data
9	CALB.E.st	Error in calibrated values
10	PARA.E.st	Error in operating parameters
11	0	Error in automatical calibration of valve position
12	ADERR.st	Error in A/D Converter
13	RJCERR.st	RJC error in PV
14	EEP.E.st	Error in EEPROM
15	0	

- **D0002 Register - PV (Measured Input Value)**

- **D0003 Register - CSP (Currently used Target Setpoint)**

- **D0009 Register - TIM (Duration Time)**

  Example: The reading for one hours, 38 minutes and 57 seconds is given as 5.937 seconds.

- **D0010 Register - MOD (Limit Control Status)**

Bit	Code	Event
0	0	
1	EXD. st	0:Not extend, 1:Extend
2	OUT. st	0:Relay off/Lamp on, 1:Relay on/Lamp off
3 to 15	0	

- **D0101 and D0102 Registers - A1 and A2 (Alarm or Timer Setpoints)**

  If either "23" or "24" is set in the AL1 and AL2 registers, the value is used as the setpoint for the timer in units of seconds. If a value other than "23" and "24" is set, it is used as the alarm setpoint.

- **D120 Register-CSP1 (Target Setpoint for writing via Communication Only)**

  The CSP1 parameter is a target setpoint for use via communication only and is effective only if the SP1 parameter is selected. Use this register when you want to change the target setpoint by means of communication. Once you write a value into this register, the D0114 (SP1) register contains the same value. Note that data in the D0120 register is not recorded when the power is turned off. When the power is turned back on, the D0120 register contains the value previously written into the D0114 (SP1) register.

6. Functions and Usage of I Relays

This chapter explains the functions and usage of the I relays.

The I relays contain information on errors in UT150L controller, as well as the controller's alarm statuses. By connecting the UT150L controller to host devices (via PC communication link), you can read these internal data items from the I relays to use for your own particular purpose. (Note that most of the I relays have the same functions as the D registers.)

6.1 Status I Relays

The following table summarizes how the on-off status I relays are classified.

I Relay No.	Data Category	Description	Remarks
1 to 16, 50, 51	On-off statuses	Error information (same as data in the D0001 register)	Information stored in each group of these I relays is represented by the four sets of binary codes, from 0000 (0 in the decimal system) to 1000 (8 in the decimal system), which are formed by each combination of four I relays. The lowest-numbered I relay in each set signifies the LSB of the four bits.
17 to 48	Read/Write	User area (Data can be written to or read from the range of I relays)	

NOTE

The on-off status I relays numbered 1 to 16 store on-off status information. In normal operation, this area can be accessed to read the on-off status.
When specifying an I relay number via communication, begin the number with an upper-case letter I. For example, type I0014 to specify the RJCERR.st relay (I relay numbered 14).

No data may be written to or read from data storage areas with blank fields in the tables that follow. If you attempt to do so, UT150L controller may fail to operate correctly.

Area of I Relays											
No.	I Relay Name Code	No.	I Relay Name Code	No.	I Relay Name Code	No.	I Relay Name Code	No.	I Relay Name Code	No.	I Relay Name Code
1	ALM1.st	11	PARA.E.st	21	UR5	31	UR15	41	UR25	51	OUT
2	ALM2.st	12		22	UR6	32	UR16	42	UR26	52	
3		13	ADERR.st	23	UR7	33	UR17	43	UR27	53	
4		14	RJCERR.st	24	UR8	34	UR18	44	UR28	54	
5	PV+over.st	15	EEP.E.st	25	UR9	35	UR19	45	UR29	55	
6	PV-over.st	16		26	UR10	36	UR20	46	UR30	56	
7	BO.st	17	UR1	27	UR11	37	UR21	47	UR31		
8		18	UR2	28	UR12	38	UR22	48	UR32		
9	SYSTEM.E.st	19	UR3	29	UR13	39	UR23	49			
10	CALB.E.st	20	UR4	30	UR14	40	UR24	50	EXD		

Appendix
Table of ASCII Codes (Alphanumeric Codes)

In order to implement PC link communication, create a transmission/receiving program by referring to the following table of ASCII codes.

b8	b7	b6	b5	b4	b3	b2	b1		0 (000)	1 (001)	2 (010)	3 (011)	4 (100)	5 (101)	6 (110)	7 (111)
				0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
				0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
				0	0	1	0	2	STX	DC2	“	2	B	R	b	r
				0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
				0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
				0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
				0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
				0	1	1	1	7	BEL	ETB	‘	7	G	W	g	w
				1	0	0	0	8	BS	CAN	(	8	H	X	h	x
				1	0	0	1	9	HT	EM	)	9	I	Y	i	y
				1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
				1	0	1	1	B	VT	ESC	+	;	K	[	k	{
				1	1	0	0	C	FF	FS	,	<	L	¥	l	|
				1	1	0	1	D	CR	GS	–	=	M	]	m	}
				1	1	1	0	E	SO	RS	.	>	N	•	n	¯
				1	1	1	1	F	SI	US	/	?	O	_	o	DEL

Control codes — Character codes

Note:
SP ($20): space
DEL ($7F): control code

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